aws

User Guide

Amazon CloudWatch Logs

Amazon CloudWatch Logs: User Guide

Table of Contents

What is Amazon CloudWatch Logs?

You can use Amazon CloudWatch Logs to monitor, store, and access your log files from Amazon Elastic Compute Cloud (Amazon EC2) instances, AWS CloudTrail, Route 53, and other sources.

CloudWatch Logs enables you to centralize the logs from all of your systems, applications, and AWS services that you use, in a single, highly scalable service. You can then easily view them, search them for specific error codes or patterns, filter them based on specific fields, or archive them securely for future analysis. CloudWatch Logs enables you to see all of your logs, regardless of their source, as a single and consistent flow of events ordered by time.

CloudWatch Logs also supports querying your logs with a powerful query language, auditing and masking sensitive data in logs, and generating metrics from logs using filters or an embedded log format.

CloudWatch Logs supports two *log classes*. Log groups in the *CloudWatch Logs Standard log class* support all CloudWatch Logs features. Log groups in the *CloudWatch Logs Infrequent Access log class* incur lower ingestion charges and support a subset of the Standard class capabilities. For more information, see Log classes.

Features

- **Two log classes for flexibility** – CloudWatch Logs offers two log classes so that you can have a cost-effective option for logs that you access infrequently. You also have a full-featured option for logs that require real-time monitoring or other features. For more information, see Log classes.
- **Query your log data** – You can use CloudWatch Logs Insights to interactively search and analyze your log data. You can perform queries to help you more efficiently and effectively respond to operational issues. CloudWatch Logs Insights includes a purpose-built query language with a few simple but powerful commands. We provide sample queries, command descriptions, query autocompletion, and log field discovery to help you get started. Sample queries are included for several types of AWS service logs. To get started, see Analyzing log data with CloudWatch Logs Insights.
- **Create field indexes to make queries more efficient** – You can create *field indexes* of fields in your log events. When you then use a field index in a CloudWatch Logs Insights query, the query attempts to skip processing log events that are known to not include the indexed field. This

query reduces the scan volume of your queries, making it possible to return results faster. To get started, see Create field indexes to improve query performance and reduce scan volume.

- **Detect and debug using Live Tail** – You can use Live Tail to quickly troubleshoot incidents by viewing a streaming list of new log events as they are ingested. You can view, filter, and highlight ingested logs in near real time, helping you to detect and resolve issues quickly. You can filter the logs based on terms you specify, and also highlight logs that contain specified terms to help you quickly find what you are looking for. For more information, see Troubleshoot with CloudWatch Logs Live Tail.
- **Monitor logs from Amazon EC2 instances** – You can use CloudWatch Logs to monitor applications and systems using log data. For example, CloudWatch Logs can track the number of errors that occur in your application logs and send you a notification whenever the rate of errors exceeds a threshold you specify. CloudWatch Logs uses your log data for monitoring; so, no code changes are required. For example, you can monitor application logs for specific literal terms (such as "NullReferenceException") or count the number of occurrences of a literal term at a particular position in log data (such as "404" status codes in an Apache access log). When the term you are searching for is found, CloudWatch Logs reports the data to a CloudWatch metric that you specify. Log data is encrypted while in transit and while it is at rest. To get started, see Getting started with CloudWatch Logs.
- **Monitor AWS CloudTrail logged events** – You can create alarms in CloudWatch and receive notifications of particular API activity as captured by CloudTrail and use the notification to perform troubleshooting. To get started, see Sending CloudTrail Events to CloudWatch Logs in the *AWS CloudTrail User Guide*.
- **Audit and mask sensitive data** – If you have sensitive data in your logs, you can help safeguard it with *data protection policies*. These policies let you audit and mask the sensitive data. If you enable data protection, then by default, sensitive data that matches the data identifiers you select is masked. For more information, see Help protect sensitive log data with masking.
- **Log retention** – By default, logs are kept indefinitely and never expire. You can adjust the retention policy for each log group, keeping the indefinite retention, or choosing a retention period between 10 years and one day.
- **Deletion protection** – A safeguard that prevents accidental deletion of log groups and their log streams. When enabled on a log group, deletion protection blocks all deletion operations until it is explicitly disabled. By default, deletion protection is not enabled. This optional feature helps protect critical operational and compliance data from unintended removal, such as log groups that contain audit data, and production application logs for troubleshooting and analysis.

- **Archive log data** – You can use CloudWatch Logs to store your log data in highly durable storage. The CloudWatch Logs agent makes it easy to quickly send both rotated and non-rotated log data off of a host and into the log service. You can then access the raw log data when you need it.
- **Log Route 53 DNS queries** – You can use CloudWatch Logs to log information about the DNS queries that Route 53 receives. For more information, see Logging DNS Queries in the *Amazon Route 53 Developer Guide*.
- **Centralize logs across accounts and regions** – You can use CloudWatch Logs Centralization to define cross-account and cross-region centralization rules that replicate log data ingested across multi-account and region environments into a central region and account. You can configure a backup region within the central account for increased resiliency, define encryption settings for newly created log groups in the central account, and create metric and subscription filters on log events from specific source accounts and regions with enhanced filtering capabilities.

Related AWS services

The following services are used in conjunction with CloudWatch Logs:

- **AWS CloudTrail** is a web service that enables you to monitor the calls made to the CloudWatch Logs API for your account, including calls made by the AWS Management Console, AWS Command Line Interface (AWS CLI), and other services. When CloudTrail logging is turned on, CloudTrail captures API calls in your account and delivers the log files to the Amazon S3 bucket that you specify. Each log file can contain one or more records, depending on how many actions must be performed to satisfy a request. For more information about AWS CloudTrail, see What Is AWS CloudTrail? in the *AWS CloudTrail User Guide*. For an example of the type of data that CloudWatch writes into CloudTrail log files, see Logging CloudWatch Logs API and console operations in AWS CloudTrail.
- **AWS Identity and Access Management (IAM)** is a web service that helps you securely control access to AWS resources for your users. Use IAM to control who can use your AWS resources (authentication) and what resources they can use in which ways (authorization). For more information, see What Is IAM? in the *IAM User Guide*.
- **Amazon Kinesis Data Streams** is a web service you can use for rapid and continuous data intake and aggregation. The type of data used includes IT infrastructure log data, application logs, social media, market data feeds, and web clickstream data. Because the response time for the data intake and processing is in real time, processing is typically lightweight. For more

information, see What is Amazon Kinesis Data Streams? in the *Amazon Kinesis Data Streams Developer Guide*.

- **AWS Lambda** is a web service you can use to build applications that respond quickly to new information. Upload your application code as Lambda functions and Lambda runs your code on high-availability compute infrastructure and performs all the administration of the compute resources, including server and operating system maintenance, capacity provisioning and automatic scaling, code and security patch deployment, and code monitoring and logging. All you need to do is supply your code in one of the languages that Lambda supports. For more information, see What is AWS Lambda? in the *AWS Lambda Developer Guide*.

Pricing

When you sign up for AWS, you can get started with CloudWatch Logs for free using the AWS Free Tier.

Standard rates apply for logs stored by other services using CloudWatch Logs (for example, Amazon VPC flow logs and Lambda logs).

For more information about pricing, see Amazon CloudWatch Pricing.

For more information about how to analyze your costs and usage for CloudWatch Logs and CloudWatch, and for best practices about how to reduce your costs, see CloudWatch billing and cost.

Amazon CloudWatch Logs concepts

The terminology and concepts that are central to your understanding and use of CloudWatch Logs are described below.

Log class

CloudWatch Logs offers two classes of log groups. The Standard log class is a full-featured option for logs that require real-time monitoring or logs that you access frequently. The Infrequent Access log class is a lower-cost option for logs that you access less frequently. It supports a subset of the Standard log class capabilities.

Log events

A log event is a record of some activity recorded by the application or resource being monitored. The log event record that CloudWatch Logs understands contains two properties:

the timestamp of when the event occurred, and the raw event message. Event messages must be UTF-8 encoded.

Log streams

A log stream is a sequence of log events that share the same source. More specifically, a log stream is generally intended to represent the sequence of events coming from the application instance or resource being monitored. For example, a log stream may be associated with an Apache access log on a specific host. When you no longer need a log stream, you can delete it using the aws logs delete-log-stream command.

Log groups

Log groups define groups of log streams that share the same retention, monitoring, and access control settings. Each log stream has to belong to one log group. For example, if you have a separate log stream for the Apache access logs from each host, you could group those log streams into a single log group called `MyWebsite.com/Apache/access_log`.

There is no limit on the number of log streams that can belong to one log group.

Metric filters

You can use metric filters to extract metric observations from ingested events and transform them to data points in a CloudWatch metric. Metric filters are assigned to log groups, and all of the filters assigned to a log group are applied to their log streams.

Retention settings

Retention settings can be used to specify how long log events are kept in CloudWatch Logs. Expired log events get deleted automatically. Just like metric filters, retention settings are also assigned to log groups, and the retention assigned to a log group is applied to their log streams.

Deletion protection

Deletion protection is a safeguard that prevents accidental deletion of log groups and their log streams. When enabled on a log group, deletion protection blocks all deletion operations until it is explicitly disabled. By default, deletion protection is not enabled. This optional feature helps protect critical operational and compliance data from unintended removal, such as log groups that contain audit data, and production application logs for troubleshooting and analysis.

Amazon CloudWatch Logs billing and cost

For detailed information about how to analyze your costs and usage for CloudWatch Logs and CloudWatch, and for best practices about how to reduce your costs, see CloudWatch billing and cost.

For more information about pricing, see Amazon CloudWatch Pricing.

When you sign up for AWS, you can get started with CloudWatch Logs for free using the AWS Free Tier.

Standard rates apply for logs stored by other services using CloudWatch Logs (for example, Amazon VPC flow logs and Lambda logs).

Log classes

CloudWatch Logs offers two classes of log groups:

- The *CloudWatch Logs Standard* log class is a full-featured option for logs that require real-time monitoring or logs that you access frequently.
- The *CloudWatch Logs Infrequent Access* log class is a new log class that you can use to cost-effectively consolidate your logs. This log class offers a subset of CloudWatch Logs capabilities including managed ingestion, storage, cross-account log analytics, and encryption with a lower ingestion price per GB. The Infrequent Access log class is ideal for ad-hoc querying and after-the-fact forensic analysis on infrequently accessed logs.

Note

For charges, the Standard and Infrequent Access log classes differ in ingestion costs only. Storage charges and CloudWatch Logs Insights charges are the same in each log class.

For more information about CloudWatch Logs pricing, see Amazon CloudWatch Pricing.

Important

After a log group is created, its log class can't be changed.

Supported features

The following table lists the features for each log class.

Feature	Standard	Infrequent Access	
Fully managed log ingestion and storage	Yes ✓	Yes ✓	
Cross-account features	Yes ✓	Yes ✓	
Encryption with AWS KMS	Yes ✓	Yes ✓	

Feature	Standard	Infrequent Access	
CloudWatch Logs Insights query commands	Yes ✓	Yes ✓ (Most commands–see Logs Insights QL commands supported in log classes.)	
CloudWatch Logs Insights discovered fields	Yes ✓	Yes ✓	
Facets	Yes ✓	No	
Using CloudWatch Pipeline to transform logs	Yes ✓	Yes ✓	
Export to Amazon S3	Yes ✓	Yes ✓	
S3 Tables Integration	Yes ✓	Yes ✓	
Scheduled Queries	Yes ✓	Yes ✓	
Using OpenSearch PPL or OpenSearch SQL to query in CloudWatch Logs Insights;	Yes ✓	Yes ✓	
Natural language query assist	Yes ✓	No	
CloudWatch Logs Anomaly Detection	Yes ✓	No	
Live Tail	Yes ✓	No	
Field indexing	Yes ✓	No	
Compare to previous time range	Yes ✓	No	
Subscription filters	Yes ✓	No	

Feature	Standard	Infrequent Access	
GetLogEvents and FilterLogEvents API operations	Yes ✓	Not supported. Use CloudWatch Logs Insights to view log events stored in log groups in the Infrequent Access log class.	
Metric filters	Yes ✓	No	
Container Insights log ingestion	Yes ✓	No	
Lambda Insights log ingestion	Yes ✓	No	
Sensitive data protection with masking	Yes ✓	Yes ✓	
Embedded metrics format	Yes ✓	No	

Note

In addition to these two log classes, there is a `Delivery` log class. Use the `Delivery` log class only for delivering AWS Lambda logs to store in Amazon S3 or Amazon Data Firehose. Log events in log groups in the Delivery class are kept in CloudWatch Logs for two days. This retention period is fixed and cannot be changed. This log class doesn't offer rich CloudWatch Logs capabilities such as CloudWatch Logs Insights queries.

Optimize storage costs with Amazon CloudWatch Logs Intelligent Tiering

Amazon CloudWatch Logs Intelligent Tiering automatically classifies your log data across three access tiers based on access patterns: Standard, Infrequent Access, and Archive Instant Access. With Intelligent Tiering, you can retain high-volume, long-retention logs at lower-cost tiers without any operational overhead. Instead of filtering logs or offloading them to separate storage solutions, you can keep them natively in CloudWatch Logs and benefit from the same query experience regardless of which tier your data resides in.

CloudWatch Logs monitors access patterns and automatically reclassifies data not accessed for 30 days to the Infrequent Access tier, and data not accessed for 90 days to the Archive Instant Access tier. When you access older data, CloudWatch Logs automatically promotes it back to the Standard tier for 30 days. By consolidating all your logs in CloudWatch Logs, you get full visibility in one tool—eliminating the operational overhead of managing multiple storage solutions and reducing your mean time to resolution (MTTR) by querying, analyzing, and alerting on all your logs in a single place.

To start optimizing storage costs, enable Intelligent Tiering at the account level within a Region by using the CloudWatch console or by calling `PutStorageTierPolicy`. After you enable Intelligent Tiering, it applies to all log groups in your account within that Region.

Amazon CloudWatch Logs Intelligent Tiering is available in all AWS commercial regions except the Middle East (Bahrain) and Middle East (UAE) Regions.

CloudWatch Logs Intelligent Tiering access tiers

Your query experience remains the same regardless of which access tier your log data resides in.

Standard (default)

> This is the default tier. All newly ingested log data starts in the Standard tier. Log data remains in the Standard tier while it is actively accessed (0 to 30 days since last access). The Standard tier provides low latency and high-throughput performance for queries, exports, live tail, and log retrieval.

Infrequent Access

If log data is not accessed for 30 consecutive days, it moves to the Infrequent Access tier. This tier holds data that was last accessed 31 to 90 days ago. The Infrequent Access tier provides the same query latency and throughput as the Standard tier, at a lower storage cost.

Archive Instant Access

If log data is not accessed for 90 consecutive days, it moves to the Archive Instant Access tier. This tier holds data that was last accessed more than 90 days ago. The Archive Instant Access tier provides the same millisecond query latency as other tiers, at the lowest storage cost.

Actions that constitute access

The following access patterns automatically promote log data from the Infrequent Access tier or Archive Instant Access tier back to the Standard tier. When any of these operations read log events in a lower-cost tier, those log events move back to the Standard tier for 30 days. The timer resets on each subsequent access.

> **Tier classification for log centralization**
>
> Accessing replicated logs in a destination account through cross-account cross-Region log centralization only promotes the log data in destination account.

- **Egress with query or alarm configuration** – Use `StartQuery` or `CreateScheduledQuery` to query log data with CloudWatch Logs Insights or to configure alarms on logs
- **Filtering and retrieving log events** – Use `FilterLogEvents` or `GetLogEvents` to read log events
- **Export** – Export log data to Amazon S3 with `CreateExportTask`

Enabling CloudWatch Logs Intelligent Tiering

Required permissions

To manage the storage tier for your account, you need the following IAM permissions:

- `logs:PutStorageTierPolicy` – Required to set or change the storage tier for your account.

- `logs:GetStorageTierPolicy` – Required to retrieve the storage tier that is currently configured. Also required to enable Intelligent Tiering from the console.

Users with the `CloudWatchLogsFullAccess` managed policy already have both permissions. Users with the `CloudWatchLogsReadOnlyAccess` managed policy have the `logs:GetStorageTierPolicy` permission.

The following example shows a policy statement that grants both permissions:

```
{
    "Effect": "Allow",
    "Action": [
        "logs:PutStorageTierPolicy",
        "logs:GetStorageTierPolicy"
    ],
    "Resource": "*"
}
```

Enable using the console

To enable Intelligent Tiering using the CloudWatch console:

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Settings**.
3. On the **Settings** page, choose the **Logs** tab.
4. In the **Intelligent Tiering** section, choose **Enable**.

Enable using the AWS CLI

To enable Intelligent Tiering, use the `put-storage-tier-policy` command:

```
aws logs put-storage-tier-policy --storage-tier INTELLIGENT_TIERING
```

The command returns the storage tier that was set and the time it was last updated:

```
{
    "storageTier": "INTELLIGENT_TIERING",
    "lastUpdatedTime": 1751328000000
```

```
}
```

To disable Intelligent Tiering, set the storage tier back to STANDARD:

```
aws logs put-storage-tier-policy --storage-tier STANDARD
```

When you set the storage tier back to STANDARD, all log groups in your account are billed at the Standard storage rate.

Viewing your current configuration

To view the current storage tier for your account, use the `get-storage-tier-policy` command:

```
aws logs get-storage-tier-policy
```

The command returns the current storage tier and the time it was last updated:

```
{
    "storageTier": "INTELLIGENT_TIERING",
    "lastUpdatedTime": 1751328000000
}
```

Monitoring storage per tier

When Intelligent Tiering is enabled, CloudWatch Logs publishes a vended metric that shows the amount of data stored in each tier for each log group:

- **Namespace:** `AWS/Logs`
- **Metric name:** `StoredBytes`
- **Dimensions:** `LogGroupName`, `StorageType` (values: `Standard`, `Infrequent_Access`, `Archival_Instant_Access`)

You can use this metric to create CloudWatch dashboards that show per-tier storage breakdown, set alarms on tier sizes, or track cost optimization over time.

> **Note**
>
> This metric is published once per day and might not reflect tier transitions in real time.

Pricing for CloudWatch Logs Intelligent Tiering

With Intelligent Tiering, you pay different storage rates based on the tier where your data resides. There is no additional charge for enabling Intelligent Tiering, and no charge for tier transitions. You pay only for the storage consumed in each tier.

For more information about pricing, see Amazon CloudWatch pricing.

To view per-tier storage costs, use Athena and filter by the `TimedStorage-ByteHrs` (Standard), `TimedStorage-IA-ByteHrs` (Infrequent Access), and `TimedStorage-AIA-ByteHrs` (Archive Instant Access) usage types. For more information about CloudWatch Logs usage types in your bill, see Analyzing, optimizing, and reducing CloudWatch costs.

Getting started with CloudWatch Logs

To collect logs from your Amazon EC2 instances and on-premises servers into CloudWatch Logs, use the unified CloudWatch agent. It enables you to collect both logs and advanced metrics with one agent. It offers support across operating systems, including servers running Windows Server. This agent also provides better performance.

If you're using the unified CloudWatch agent to collect CloudWatch metrics, it enables the collection of additional system metrics, for in-guest visibility. It also supports collecting custom metrics using `StatsD` or `collectd`.

For more information, see Installing the CloudWatch Agent in the *Amazon CloudWatch User Guide*.

The older CloudWatch Logs agent, which supports only the collection of logs from servers running Linux, is deprecated and is no longer supported. For information about migrating from the older CloudWatch Logs agent to the unified agent, see Create the CloudWatch agent configuration file with the wizard.

Contents

Prerequisites

To use Amazon CloudWatch Logs you need an AWS account. Your AWS account allows you to use services (for example, Amazon EC2) to generate logs that you can view in the CloudWatch console, a web-based interface. In addition, you can install and configure the AWS Command Line Interface (AWS CLI).

Sign up for an AWS account

To get started with AWS, you need an AWS account. For information about creating an AWS account, see Getting started with an AWS account in the *AWS Account Management Reference Guide*.

Set up the Command Line Interface

You can use the AWS CLI to perform CloudWatch Logs operations.

For information about how to install and configure the AWS CLI, see Getting Set Up with the AWS Command Line Interface in the *AWS Command Line Interface User Guide*.

Use the unified CloudWatch agent to get started with CloudWatch Logs

For more information about using the unified CloudWatch agent to get started with CloudWatch Logs, see Collect Metrics and Logs from Amazon EC2 Instances and On-Premises Servers with the CloudWatch Agent in the *Amazon CloudWatch User Guide*. You complete the steps listed in this section to install, configure, and start the agent. If you are not using the agent to also collect CloudWatch metrics, you can ignore any sections that refer to metrics.

If you are currently using the older CloudWatch Logs agent and want to migrate to using the new unified agent, we recommend that you use the wizard included in the new agent package. This wizard can read your current CloudWatch Logs agent configuration file and set up the CloudWatch agent to collect the same logs. For more information about the wizard, see Create the CloudWatch Agent Configuration File with the Wizard in the *Amazon CloudWatch User Guide*.

Use the previous CloudWatch agent to get started with CloudWatch Logs

Important

CloudWatch includes a unified CloudWatch agent that can collect both logs and metrics from EC2 instances and on-premises servers. The older logs-only agent is deprecated and is no longer supported.
For information about migrating from the older logs-only agent to the unified agent, see Create the CloudWatch agent configuration file with the wizard.
The rest of this section explains the use of the older CloudWatch Logs agent for customers who are still using it.

Using the CloudWatch Logs agent, you can publish log data from Amazon EC2 instances running Linux or Windows Server, and logged events from AWS CloudTrail. We recommend instead using the CloudWatch unified agent to publish your log data. For more information about the new agent, see Collect Metrics and Logs from Amazon EC2 Instances and On-Premises Servers with the CloudWatch Agent in the *Amazon CloudWatch User Guide*.

Contents

CloudWatch Logs agent prerequisites

The CloudWatch Logs agent requires Python version 2.7, 3.0, or 3.3, and any of the following versions of Linux:

- Amazon Linux version 2014.03.02 or later. Amazon Linux 2 is not supported
- Ubuntu Server version 12.04, 14.04, or 16.04
- CentOS version 6, 6.3, 6.4, 6.5, or 7.0
- Red Hat Enterprise Linux (RHEL) version 6.5 or 7.0
- Debian 8.0

Quick Start: Install and configure the CloudWatch Logs agent on a running EC2 Linux instance

Important

The older logs agent is deprecated. CloudWatch includes a unified agent that can collect both logs and metrics from EC2 instances and on-premises servers. For more information, see Getting started with CloudWatch Logs.
For information about migrating from the older CloudWatch Logs agent to the unified agent, see Create the CloudWatch agent configuration file with the wizard.
The older logs agent supports only versions 2.6 to 3.5 of Python. Additionally, the older CloudWatch Logs agent doesn't support Instance Metadata Service Version 2 (IMDSv2).
If your server uses IMDSv2, you must use the newer unified agent instead of the older CloudWatch Logs agent.
The rest of this section explains the use of the older CloudWatch Logs agent for customers who are still using it.

Tip

CloudWatch includes a new unified agent that can collect both logs and metrics from EC2 instances and on-premises servers. If you are not already using the older CloudWatch Logs agent, we recommend that you use the newer unified CloudWatch agent. For more information, see Getting started with CloudWatch Logs.
Additionally, the older agent doesn't support Instance Metadata Service Version 2 (IMDSv2).
If your server uses IMDSv2, you must use the newer unified agent instead of the older CloudWatch Logs agent.
The rest of this section explains the use of the older CloudWatch Logs agent.

Configure the older CloudWatch Logs agent on a running EC2 Linux instance

You can use the CloudWatch Logs agent installer on an existing EC2 instance to install and configure the CloudWatch Logs agent. After installation is complete, logs automatically flow from the instance to the log stream you create while installing the agent. The agent confirms that it has started and it stays running until you disable it.

In addition to using the agent, you can also publish log data using the AWS CLI, CloudWatch Logs SDK, or the CloudWatch Logs API. The AWS CLI is best suited for publishing data at the command line or through scripts. The CloudWatch Logs SDK is best suited for publishing log data directly from applications or building your own log publishing application.

Step 1: Configure your IAM role or user for CloudWatch Logs

The CloudWatch Logs agent supports IAM roles and users. If your instance already has an IAM role associated with it, make sure that you include the IAM policy below. If you don't already have an IAM role assigned to your instance, you can use your IAM credentials for the next steps or you can assign an IAM role to that instance. For more information, see Attaching an IAM Role to an Instance.

To configure your IAM role or user for CloudWatch Logs

1. Open the IAM console at https://console.aws.amazon.com/iam/.
2. In the navigation pane, choose **Roles**.
3. Choose the role by selecting the role name (do not select the check box next to the name).
4. Choose **Attach Policies**, **Create Policy**.

   A new browser tab or window opens.
5. Choose the **JSON** tab and type the following JSON policy document.

```
{
  "Version":"2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "logs:CreateLogGroup",
        "logs:CreateLogStream",
        "logs:PutLogEvents",
        "logs:DescribeLogStreams"
    ],
      "Resource": [
        "*"
    ]
  }
 ]
```

```
}
```

6. When you are finished, choose **Review policy**. The Policy Validator reports any syntax errors.
7. On the **Review Policy** page, type a **Name** and a **Description** (optional) for the policy that you are creating. Review the policy **Summary** to see the permissions that are granted by your policy. Then choose **Create policy** to save your work.
8. Close the browser tab or window, and return to the **Add permissions** page for your role. Choose **Refresh**, and then choose the new policy to attach it to your role.
9. Choose **Attach Policy**.

Step 2: Install and configure CloudWatch Logs on an existing Amazon EC2 instance

The process for installing the CloudWatch Logs agent differs depending on whether your Amazon EC2 instance is running Amazon Linux, Ubuntu, CentOS, or Red Hat. Use the steps appropriate for the version of Linux on your instance.

To install and configure CloudWatch Logs on an existing Amazon Linux instance

Starting with Amazon Linux AMI 2014.09, the CloudWatch Logs agent is available as an RPM installation with the awslogs package. Earlier versions of Amazon Linux can access the awslogs package by updating their instance with the `sudo yum update -y` command. By installing the awslogs package as an RPM instead of the using the CloudWatch Logs installer, your instance receives regular package updates and patches from AWS without having to manually reinstall the CloudWatch Logs agent.

> **Warning**
>
> Do not update the CloudWatch Logs agent using the RPM installation method if you previously used the Python script to install the agent. Doing so may cause configuration issues that prevent the CloudWatch Logs agent from sending your logs to CloudWatch.

1. Connect to your Amazon Linux instance. For more information, see Connect to Your Instance in the *Amazon EC2 User Guide*.

   For more information about connection issues, see Troubleshooting Connecting to Your Instance in the *Amazon EC2 User Guide*.
2. Update your Amazon Linux instance to pick up the latest changes in the package repositories.

```
sudo yum update -y
```

3. Install the `awslogs` package. This is the recommended method for installing awslogs on Amazon Linux instances.

   ```
   sudo yum install -y awslogs
   ```

4. Edit the `/etc/awslogs/awslogs.conf` file to configure the logs to track. For more information about editing this file, see CloudWatch Logs agent reference.
5. By default, the `/etc/awslogs/awscli.conf` points to the us-east-1 Region. To push your logs to a different Region, edit the `awscli.conf` file and specify that Region.
6. Start the `awslogs` service.

   ```
   sudo service awslogs start
   ```

   If you are running Amazon Linux 2, start the `awslogs` service with the following command.

   ```
   sudo systemctl start awslogsd
   ```

7. (Optional) Check the `/var/log/awslogs.log` file for errors logged when starting the service.
8. (Optional) Run the following command to start the `awslogs` service at each system boot.

   ```
   sudo chkconfig awslogs on
   ```

   If you are running Amazon Linux 2, use the following command to start the service at each system boot.

   ```
   sudo systemctl enable awslogsd.service
   ```

9. You should see the newly created log group and log stream in the CloudWatch console after the agent has been running for a few moments.

   For more information, see View log data sent to CloudWatch Logs.

To install and configure CloudWatch Logs on an existing Ubuntu Server, CentOS, or Red Hat instance

If you're using an AMI running Ubuntu Server, CentOS, or Red Hat, use the following procedure to manually install the CloudWatch Logs agent on your instance.

1. Connect to your EC2 instance. For more information, see Connect to Your Instance in the *Amazon EC2 User Guide*.

   For more information about connection issues, see Troubleshooting Connecting to Your Instance in the *Amazon EC2 User Guide*.
2. Run the CloudWatch Logs agent installer using one of two options. You can run it directly from the internet, or download the files and run it standalone.

   > **Note**
   >
   > If you are running CentOS 6.x, Red Hat 6.x, or Ubuntu 12.04, use the steps for downloading and running the installer standalone. Installing the CloudWatch Logs agent directly from the internet is not supported on these systems.

   > **Note**
   >
   > On Ubuntu, run `apt-get update` before running the commands below.

   To run it directly from the internet, use the following commands and follow the prompts:

   ```
   curl https://s3.amazonaws.com/aws-cloudwatch/downloads/latest/awslogs-agent-setup.py -O
   ```

   ```
   sudo python ./awslogs-agent-setup.py --region us-east-1
   ```

   If the preceding command does not work, try the following:

   ```
   sudo python3 ./awslogs-agent-setup.py --region us-east-1
   ```

   To download and run it standalone, use the following commands and follow the prompts:

```
curl https://s3.amazonaws.com/aws-cloudwatch/downloads/latest/awslogs-agent-
setup.py -O
```

```
curl https://s3.amazonaws.com/aws-cloudwatch/downloads/latest/
AgentDependencies.tar.gz -O
```

```
tar xvf AgentDependencies.tar.gz -C /tmp/
```

```
sudo python ./awslogs-agent-setup.py --region us-east-1 --dependency-path /tmp/
AgentDependencies
```

You can install the CloudWatch Logs agent by specifying the us-east-1, us-west-1, us-west-2, ap-south-1, ap-northeast-2, ap-southeast-1, ap-southeast-2, ap-northeast-1, eu-central-1, eu-west-1, or sa-east-1 Regions.

> **Note**
>
> For more information about the current version and the version history of `awslogs-agent-setup`, see CHANGELOG.txt.

The CloudWatch Logs agent installer requires certain information during setup. Before you start, you need to know which log file to monitor and its time stamp format. You should also have the following information ready.

Item	Description
AWS access key ID	Press Enter if using an IAM role. Otherwise, enter your AWS access key ID.
AWS secret access key	Press Enter if using an IAM role. Otherwise, enter your AWS secret access key.

Item	Description
Default Region name	Press Enter. The default is us-east-2. You can set this to us-east-1 , us-west-1, us-west-2, ap-south-1, ap-northeast-2, ap-southeas t-1, ap-southeast-2, ap-northeast-1, eu-central-1, eu-west-1, or sa-east-1.
Default output format	Leave blank and press Enter.
Path of log file to upload	The location of the file that contains the log data to send. The installer suggests a path for you.
Destination Log Group name	The name for your log group. The installer suggests a log group name for you.
Destination Log Stream name	By default, this is the name of the host. The installer suggests a host name for you.
Timestamp format	Specify the format of the time stamp within the specified log file. Choose custom to specify your own format.
Initial position	How data is uploaded. Set this to start_of_file to upload everythin g in the data file. Set to end_of_file to upload only newly appended data.

After you have completed these steps, the installer asks about configuring another log file. You can run the process as many times as you like for each log file. If you have no more log files to monitor, choose **N** when prompted by the installer to set up another log. For more information about the settings in the agent configuration file, see CloudWatch Logs agent reference.

> **Note**
>
> Configuring multiple log sources to send data to a single log stream is not supported.

3. You should see the newly created log group and log stream in the CloudWatch console after the agent has been running for a few moments.

   For more information, see View log data sent to CloudWatch Logs.

Quick Start: Install and configure the CloudWatch Logs agent on an EC2 Linux instance at launch

Tip

The older CloudWatch Logs agent discussed in this section is on the path to deprecation. We strongly recommend that you instead use the new unified CloudWatch agent that can collect both logs and metrics. Additionally, the older CloudWatch Logs agent requires Python 3.3 or earlier, and these versions are not installed on new EC2 instances by default. For more information about the unified CloudWatch agent, see Installing the CloudWatch Agent.

The rest of this section explains the use of the older CloudWatch Logs agent.

Installing the older CloudWatch Logs agent on an EC2 Linux instance at launch

You can use Amazon EC2 user data, a feature of Amazon EC2 that allows parametric information to be passed to the instance on launch, to install and configure the CloudWatch Logs agent on that instance. To pass the CloudWatch Logs agent installation and configuration information to Amazon EC2, you can provide the configuration file in a network location such as an Amazon S3 bucket.

Configuring multiple log sources to send data to a single log stream is not supported.

Prerequisite

Create an agent configuration file that describes all your log groups and log streams. This is a text file that describes the log files to monitor as well as the log groups and log streams to upload them to. The agent consumes this configuration file and starts monitoring and uploading all the log files described in it. For more information about the settings in the agent configuration file, see CloudWatch Logs agent reference.

The following is a sample agent configuration file for Amazon Linux 2

```
[general]
state_file = /var/lib/awslogs/state/agent-state

[/var/log/messages]
file = /var/log/messages
log_group_name = /var/log/messages
log_stream_name = {instance_id}
```

```
datetime_format = %b %d %H:%M:%S
```

The following is a sample agent configuration file for Ubuntu

```
[general]
state_file = /var/awslogs/state/agent-state

[/var/log/syslog]
file = /var/log/syslog
log_group_name = /var/log/syslog
log_stream_name = {instance_id}
datetime_format = %b %d %H:%M:%S
```

To configure your IAM role

1. Open the IAM console at https://console.aws.amazon.com/iam/.
2. In the navigation pane, choose **Policies**, **Create Policy**.
3. On the **Create Policy** page, for **Create Your Own Policy**, choose **Select**. For more information about creating custom policies, see IAM Policies for Amazon EC2 in the *Amazon EC2 User Guide*.
4. On the **Review Policy** page, for **Policy Name**, type a name for the policy.
5. For **Policy Document**, paste in the following policy:

   JSON

```
{
    "Version":"2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": [
                "logs:CreateLogGroup",
                "logs:CreateLogStream",
                "logs:PutLogEvents",
                "logs:DescribeLogStreams"
            ],
            "Resource": [
                "arn:aws:logs:*:*:*"
            ]
        },
```

```
        {
            "Effect": "Allow",
            "Action": [
                "s3:GetObject"
            ],
            "Resource": [
                "arn:aws:s3:::amzn-s3-demo-bucket/*"
            ]
        }
    ]
}
```

6. Choose **Create Policy**.
7. In the navigation pane, choose **Roles**, **Create New Role**.
8. On the **Set Role Name** page, type a name for the role and then choose **Next Step**.
9. On the **Select Role Type** page, choose **Select** next to **Amazon EC2**.
10. On the **Attach Policy** page, in the table header, choose **Policy Type**, **Customer Managed**.
11. Select the IAM policy that you created and then choose **Next Step**.
12. Choose **Create Role**.

    For more information about users and policies, see IAM Users and Groups and Managing IAM Policies in the *IAM User Guide*.

To launch a new instance and enable CloudWatch Logs

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. Choose **Launch Instance**.

   For more information, see Launching an Instance in *Amazon EC2 User Guide*.
3. On the **Step 1: Choose an Amazon Machine Image (AMI)** page, select the Linux instance type to launch, and then on the **Step 2: Choose an Instance Type** page, choose **Next: Configure Instance Details**.

   Make sure that cloud-init is included in your Amazon Machine Image (AMI). Amazon Linux AMIs, and AMIs for Ubuntu and RHEL already include cloud-init, but CentOS and other AMIs in the AWS Marketplace might not.
4. On the **Step 3: Configure Instance Details** page, for **IAM role**, select the IAM role that you created.

5. Under **Advanced Details**, for **User data**, paste the following script into the box. Then update that script by changing the value of the **-c** option to the location of your agent configuration file:

```
#!/bin/bash
curl https://s3.amazonaws.com/aws-cloudwatch/downloads/latest/awslogs-agent-
setup.py -O
chmod +x ./awslogs-agent-setup.py
./awslogs-agent-setup.py -n -r us-east-1 -c s3://amzn-s3-demo-bucket/my-config-file
```

6. Make any other changes to the instance, review your launch settings, and then choose **Launch**.
7. You should see the newly created log group and log stream in the CloudWatch console after the agent has been running for a few moments.

   For more information, see View log data sent to CloudWatch Logs.

Quick Start: Enable your Amazon EC2 instances running Windows Server 2016 to send logs to CloudWatch Logs using the CloudWatch Logs agent

> **Tip**
>
> CloudWatch includes a new unified agent that can collect both logs and metrics from EC2 instances and on-premises servers. We recommend that you use the newer unified CloudWatch agent. For more information, see Getting started with CloudWatch Logs. The rest of this section explains the use of the older CloudWatch Logs agent.

Enable your Amazon EC2 instances running Windows Server 2016 to send logs to CloudWatch Logs using the older CloudWatch Logs agent

There are multiple methods you can use to enable instances running Windows Server 2016 to send logs to CloudWatch Logs. The steps in this section use Systems Manager Run Command. For information about the other possible methods, see Sending Logs, Events, and Performance Counters to Amazon CloudWatch.

Steps

- Download the sample configuration file
- Configure the JSON file for CloudWatch
- Create an IAM role for Systems Manager
- Verify Systems Manager prerequisites
- Verify internet access
- Enable CloudWatch Logs using Systems Manager Run Command

Download the sample configuration file

Download the following sample file to your computer: `AWS.EC2.Windows.CloudWatch.json`.

Configure the JSON file for CloudWatch

You determine which logs to send to CloudWatch by specifying your choices in a configuration file. The process of creating this file and specifying your choices can take 30 minutes or more to complete. After you have completed this task once, you can reuse the configuration file on all of your instances.

Steps

- Step 1: Enable CloudWatch Logs
- Step 2: Configure settings for CloudWatch
- Step 3: Configure the data to send
- Step 4: Configure flow control
- Step 5: Save JSON content

Step 1: Enable CloudWatch Logs

At the top of the JSON file, change "false" to "true" for `IsEnabled`:

```
"IsEnabled": true,
```

Step 2: Configure settings for CloudWatch

Specify credentials, Region, a log group name, and a log stream namespace. This enables the instance to send log data to CloudWatch Logs. To send the same log data to different locations, you can add additional sections with unique IDs (for example, "CloudWatchLogs2" and CloudWatchLogs3") and a different Region for each ID.

To configure settings to send log data to CloudWatch Logs

1. In the JSON file, locate the `CloudWatchLogs` section.

```
{
    "Id": "CloudWatchLogs",
    "FullName":
 "AWS.EC2.Windows.CloudWatch.CloudWatchLogsOutput,AWS.EC2.Windows.CloudWatch",
    "Parameters": {
        "AccessKey": "",
        "SecretKey": "",
        "Region": "us-east-1",
        "LogGroup": "Default-Log-Group",
        "LogStream": "{instance_id}"
    }
},
```

2. Leave the `AccessKey` and `SecretKey` field blank. You configure credentials using an IAM role.
3. For `Region`, type the Region to which to send log data (for example, `us-east-2`).
4. For `LogGroup`, type the name for your log group. This name appears on the **Log Groups** screen in the CloudWatch console.
5. For `LogStream`, type the destination log stream. This name appears on the **Log Groups > Streams** screen in the CloudWatch console.

   If you use `{instance_id}`, the default, the log stream name is the instance ID of this instance.

   If you specify a log stream name that doesn't already exist, CloudWatch Logs automatically creates it for you. You can define a log stream name using a literal string, the predefined variables `{instance_id}`, `{hostname}`, and `{ip_address}`, or a combination of these.

Step 3: Configure the data to send

You can send event log data, Event Tracing for Windows (ETW) data, and other log data to CloudWatch Logs.

To send Windows application event log data to CloudWatch Logs

1. In the JSON file, locate the `ApplicationEventLog` section.

```
{
    "Id": "ApplicationEventLog",
    "FullName":
 "AWS.EC2.Windows.CloudWatch.EventLog.EventLogInputComponent,AWS.EC2.Windows.CloudWatch",
    "Parameters": {
        "LogName": "Application",
        "Levels": "1"
    }
},
```

2. For `Levels`, specify the type of messages to upload. You can specify one of the following values:

   - **1** - Upload only error messages.
   - **2** - Upload only warning messages.
   - **4** - Upload only information messages.

   You can combine values to include more than one type of message. For example, a value of **3** uploads error messages (**1**) and warning messages (**2**). A value of **7** uploads error messages (**1**), warning messages (**2**), and information messages (**4**).

To send security log data to CloudWatch Logs

1. In the JSON file, locate the `SecurityEventLog` section.

```
{
    "Id": "SecurityEventLog",
    "FullName":
 "AWS.EC2.Windows.CloudWatch.EventLog.EventLogInputComponent,AWS.EC2.Windows.CloudWatch",
    "Parameters": {
        "LogName": "Security",
        "Levels": "7"
    }
},
```

2. For `Levels`, type **7** to upload all messages.

To send system event log data to CloudWatch Logs

1. In the JSON file, locate the `SystemEventLog` section.

```
{
    "Id": "SystemEventLog",
    "FullName":
 "AWS.EC2.Windows.CloudWatch.EventLog.EventLogInputComponent,AWS.EC2.Windows.CloudWatch",
    "Parameters": {
        "LogName": "System",
        "Levels": "7"
    }
},
```

2. For `Levels`, specify the type of messages to upload. You can specify one of the following values:

   - **1** - Upload only error messages.
   - **2** - Upload only warning messages.
   - **4** - Upload only information messages.

   You can combine values to include more than one type of message. For example, a value of **3** uploads error messages (**1**) and warning messages (**2**). A value of **7** uploads error messages (**1**), warning messages (**2**), and information messages (**4**).

To send other types of event log data to CloudWatch Logs

1. In the JSON file, add a new section. Each section must have a unique `Id`.

```
{
    "Id": "Id-name",
    "FullName":
 "AWS.EC2.Windows.CloudWatch.EventLog.EventLogInputComponent,AWS.EC2.Windows.CloudWatch",
    "Parameters": {
        "LogName": "Log-name",
        "Levels": "7"
    }
},
```

2. For `Id`, type a name for the log to upload (for example, **`WindowsBackup`**).

3. For `LogName`, type the name of the log to upload. You can find the name of the log as follows.

   a. Open Event Viewer.

   b. In the navigation pane, choose **Applications and Services Logs**.

   c. Navigate to the log, and then choose **Actions**, **Properties**.

4. For `Levels`, specify the type of messages to upload. You can specify one of the following values:

   - **1** - Upload only error messages.
   - **2** - Upload only warning messages.
   - **4** - Upload only information messages.

   You can combine values to include more than one type of message. For example, a value of **3** uploads error messages (**1**) and warning messages (**2**). A value of **7** uploads error messages (**1**), warning messages (**2**), and information messages (**4**).

To send Event Tracing for Windows data to CloudWatch Logs

ETW (Event Tracing for Windows) provides an efficient and detailed logging mechanism that applications can write logs to. Each ETW is controlled by a session manager that can start and stop the logging session. Each session has a provider and one or more consumers.

1. In the JSON file, locate the `ETW` section.

```
{
    "Id": "ETW",
    "FullName":
 "AWS.EC2.Windows.CloudWatch.EventLog.EventLogInputComponent,AWS.EC2.Windows.CloudWatch",
    "Parameters": {
        "LogName": "Microsoft-Windows-WinINet/Analytic",
        "Levels": "7"
    }
},
```

2. For `LogName`, type the name of the log to upload.
3. For `Levels`, specify the type of messages to upload. You can specify one of the following values:

- **1** - Upload only error messages.
- **2** - Upload only warning messages.
- **4** - Upload only information messages.

You can combine values to include more than one type of message. For example, a value of **3** uploads error messages (**1**) and warning messages (**2**). A value of **7** uploads error messages (**1**), warning messages (**2**), and information messages (**4**).

To send custom logs (any text-based log file) to CloudWatch Logs

1. In the JSON file, locate the `CustomLogs` section.

```
{
    "Id": "CustomLogs",
    "FullName":
 "AWS.EC2.Windows.CloudWatch.CustomLog.CustomLogInputComponent,AWS.EC2.Windows.CloudWatch",
    "Parameters": {
        "LogDirectoryPath": "C:\\CustomLogs\\",
        "TimestampFormat": "MM/dd/yyyy HH:mm:ss",
        "Encoding": "UTF-8",
        "Filter": "",
        "CultureName": "en-US",
        "TimeZoneKind": "Local",
        "LineCount": "5"
    }
},
```

2. For `LogDirectoryPath`, type the path where logs are stored on your instance.
3. For `TimestampFormat`, type the time stamp format to use. For more information about supported values, see the Custom Date and Time Format Strings topic on MSDN.

> **Important**
>
> Your source log file must have the time stamp at the beginning of each log line and there must be a space following the time stamp.

4. For `Encoding`, type the file encoding to use (for example, UTF-8). For a list of supported values, see the Encoding Class topic on MSDN.

> **Note**
>
> Use the encoding name, not the display name.

5. (Optional) For `Filter`, type the prefix of log names. Leave this parameter blank to monitor all files. For more information about supported values, see the FileSystemWatcherFilter Property topic on MSDN.
6. (Optional) For `CultureName`, type the locale where the time stamp is logged. If `CultureName` is blank, it defaults to the same locale currently used by your Windows instance. For more information about, see the `Language tag` column in the table in the Product Behavior topic on MSDN.

> **Note**
>
> The `div`, `div-MV`, `hu`, and `hu-HU` values are not supported.

7. (Optional) For `TimeZoneKind`, type `Local` or `UTC`. You can set this to provide time zone information when no time zone information is included in your log's time stamp. If this parameter is left blank and if your time stamp doesn't include time zone information, CloudWatch Logs defaults to the local time zone. This parameter is ignored if your time stamp already contains time zone information.
8. (Optional) For `LineCount`, type the number of lines in the header to identify the log file. For example, IIS log files have virtually identical headers. You could enter **5**, which would read the first three lines of the log file header to identify it. In IIS log files, the third line is the date and time stamp, but the time stamp is not always guaranteed to be different between log files. For this reason, we recommend including at least one line of actual log data to uniquely fingerprint the log file.

To send IIS log data to CloudWatch Logs

1. In the JSON file, locate the `IISLog` section.

```
{
    "Id": "IISLogs",
    "FullName":
 "AWS.EC2.Windows.CloudWatch.CustomLog.CustomLogInputComponent,AWS.EC2.Windows.CloudWatch",
    "Parameters": {
```

```
        "LogDirectoryPath": "C:\\inetpub\\logs\\LogFiles\\W3SVC1",
        "TimestampFormat": "yyyy-MM-dd HH:mm:ss",
        "Encoding": "UTF-8",
        "Filter": "",
        "CultureName": "en-US",
        "TimeZoneKind": "UTC",
        "LineCount": "5"
    }
},
```

2. For `LogDirectoryPath`, type the folder where IIS logs are stored for an individual site (for example, `C:\inetpub\logs\LogFiles\W3SVC`*n*).

> **Note**
>
> Only W3C log format is supported. IIS, NCSA, and Custom formats are not supported.

3. For `TimestampFormat`, type the time stamp format to use. For more information about supported values, see the Custom Date and Time Format Strings topic on MSDN.
4. For `Encoding`, type the file encoding to use (for example, UTF-8). For more information about supported values, see the Encoding Class topic on MSDN.

> **Note**
>
> Use the encoding name, not the display name.

5. (Optional) For `Filter`, type the prefix of log names. Leave this parameter blank to monitor all files. For more information about supported values, see the FileSystemWatcherFilter Property topic on MSDN.
6. (Optional) For `CultureName`, type the locale where the time stamp is logged. If `CultureName` is blank, it defaults to the same locale currently used by your Windows instance. For more information about supported values, see the `Language tag` column in the table in the Product Behavior topic on MSDN.

> **Note**
>
> The `div`, `div-MV`, hu, and `hu-HU` values are not supported.

7. (Optional) For `TimeZoneKind`, enter `Local` or `UTC`. You can set this to provide time zone information when no time zone information is included in your log's time stamp. If this parameter is left blank and if your time stamp doesn't include time zone information, CloudWatch Logs defaults to the local time zone. This parameter is ignored if your time stamp already contains time zone information.
8. (Optional) For `LineCount`, type the number of lines in the header to identify the log file. For example, IIS log files have virtually identical headers. You could enter **5**, which would read the first five lines of the log file's header to identify it. In IIS log files, the third line is the date and time stamp, but the time stamp is not always guaranteed to be different between log files. For this reason, we recommend including at least one line of actual log data for uniquely fingerprinting the log file.

Step 4: Configure flow control

Each data type must have a corresponding destination in the `Flows` section. For example, to send the custom log, ETW log, and system log to CloudWatch Logs, add `(CustomLogs,ETW,SystemEventLog),CloudWatchLogs` to the `Flows` section.

> **Warning**
>
> Adding a step that is not valid blocks the flow. For example, if you add a disk metric step, but your instance doesn't have a disk, all steps in the flow are blocked.

You can send the same log file to more than one destination. For example, to send the application log to two different destinations that you defined in the `CloudWatchLogs` section, add `ApplicationEventLog,(CloudWatchLogs,CloudWatchLogs2)` to the `Flows` section.

To configure flow control

1. In the `AWS.EC2.Windows.CloudWatch.json` file, locate the `Flows` section.

```
"Flows": {
    "Flows": [
      "PerformanceCounter,CloudWatch",
      "(PerformanceCounter,PerformanceCounter2), CloudWatch2",
      "(CustomLogs, ETW, SystemEventLog),CloudWatchLogs",
      "CustomLogs, CloudWatchLogs2",
      "ApplicationEventLog,(CloudWatchLogs, CloudWatchLogs2)"
```

```
    ]
}
```

2. For `Flows`, add each data type that is to be uploaded (for example, `ApplicationEventLog`) and its destination (for example, `CloudWatchLogs`).

Step 5: Save JSON content

You are now finished editing the JSON file. Save it, and paste the file contents into a text editor in another window. You will need the file contents in a later step of this procedure.

Create an IAM role for Systems Manager

An IAM role for instance credentials is required when you use Systems Manager Run Command. This role enables Systems Manager to perform actions on the instance. For more information, see Configuring Security Roles for Systems Manager in the *AWS Systems Manager User Guide*. For information about how to attach an IAM role to an existing instance, see Attaching an IAM Role to an Instance in the *Amazon EC2 User Guide*.

Verify Systems Manager prerequisites

Before you use Systems Manager Run Command to configure integration with CloudWatch Logs, verify that your instances meet the minimum requirements. For more information, see Systems Manager Prerequisites in the *AWS Systems Manager User Guide*.

Verify internet access

Your Amazon EC2 Windows Server instances and managed instances must have outbound internet access in order to send log and event data to CloudWatch. For more information about how to configure internet access, see Internet Gateways in the *Amazon VPC User Guide*.

Enable CloudWatch Logs using Systems Manager Run Command

Run Command enables you to manage the configuration of your instances on demand. You specify a Systems Manager document, specify parameters, and execute the command on one or more instances. The SSM agent on the instance processes the command and configures the instance as specified.

To configure integration with CloudWatch Logs using Run Command

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.

2. Open the SSM console at https://console.aws.amazon.com/systems-manager/.
3. In the navigation pane, choose **Run Command**.
4. Choose **Run a command**.
5. For **Command document**, choose **AWS-ConfigureCloudWatch**.
6. For **Target instances**, choose the instances to integrate with CloudWatch Logs. If you do not see an instance in this list, it might not be configured for Run Command. For more information, see Systems Manager Prerequisites in the *Amazon EC2 User Guide*.
7. For **Status**, choose **Enabled**.
8. For **Properties**, copy and paste the JSON content you created in the previous tasks.
9. Complete the remaining optional fields and choose **Run**.

Use the following procedure to view the results of command execution in the Amazon EC2 console.

To view command output in the console

1. Select a command.
2. Choose the **Output** tab.
3. Choose **View Output**. The command output page shows the results of your command execution.

Quick Start: Enable your Amazon EC2 instances running Windows Server 2012 and Windows Server 2008 to send logs to CloudWatch Logs

> **Tip**
>
> CloudWatch includes a new unified agent that can collect both logs and metrics from EC2 instances and on-premises servers. We recommend that you use the newer unified CloudWatch agent. For more information, see Getting started with CloudWatch Logs. The rest of this section explains the use of the older CloudWatch Logs agent.

Enable your Amazon EC2 instances running Windows Server 2012 and Windows Server 2008 to send logs to CloudWatch Logs

Use the following steps to enable your instances running Windows Server 2012 and Windows Server 2008 to send logs to CloudWatch Logs.

Download the sample configuration file

Download the following sample JSON file to your computer: `AWS.EC2.Windows.CloudWatch.json`. You edit it in the following steps.

Configure the JSON file for CloudWatch

You determine which logs to send to CloudWatch by specifying your choices in the JSON configuration file. The process of creating this file and specifying your choices can take 30 minutes or more to complete. After you have completed this task once, you can reuse the configuration file on all of your instances.

Steps

- Step 1: Enable CloudWatch Logs
- Step 2: Configure settings for CloudWatch
- Step 3: Configure the data to send
- Step 4: Configure flow control

Step 1: Enable CloudWatch Logs

At the top of the JSON file, change "false" to "true" for `IsEnabled`:

```
"IsEnabled": true,
```

Step 2: Configure settings for CloudWatch

Specify credentials, Region, a log group name, and a log stream namespace. This enables the instance to send log data to CloudWatch Logs. To send the same log data to different locations, you can add additional sections with unique IDs (for example, "CloudWatchLogs2" and CloudWatchLogs3") and a different Region for each ID.

To configure settings to send log data to CloudWatch Logs

1. In the JSON file, locate the `CloudWatchLogs` section.

```
{
    "Id": "CloudWatchLogs",
    "FullName":
 "AWS.EC2.Windows.CloudWatch.CloudWatchLogsOutput,AWS.EC2.Windows.CloudWatch",
    "Parameters": {
        "AccessKey": "",
        "SecretKey": "",
        "Region": "us-east-1",
        "LogGroup": "Default-Log-Group",
        "LogStream": "{instance_id}"
    }
},
```

2. Leave the `AccessKey` and `SecretKey` field blank. You configure credentials using an IAM role.
3. For `Region`, type the Region to which to send log data (for example, `us-east-2`).
4. For `LogGroup`, type the name for your log group. This name appears on the **Log Groups** screen in the CloudWatch console.
5. For `LogStream`, type the destination log stream. This name appears on the **Log Groups > Streams** screen in the CloudWatch console.

   If you use `{instance_id}`, the default, the log stream name is the instance ID of this instance.

   If you specify a log stream name that doesn't already exist, CloudWatch Logs automatically creates it for you. You can define a log stream name using a literal string, the predefined variables `{instance_id}`, `{hostname}`, and `{ip_address}`, or a combination of these.

Step 3: Configure the data to send

You can send event log data, Event Tracing for Windows (ETW) data, and other log data to CloudWatch Logs.

To send Windows application event log data to CloudWatch Logs

1. In the JSON file, locate the `ApplicationEventLog` section.

```
{
    "Id": "ApplicationEventLog",
```

```
    "FullName":
 "AWS.EC2.Windows.CloudWatch.EventLog.EventLogInputComponent,AWS.EC2.Windows.CloudWatch",
    "Parameters": {
        "LogName": "Application",
        "Levels": "1"
    }
},
```

2. For `Levels`, specify the type of messages to upload. You can specify one of the following values:

   - **1** - Upload only error messages.
   - **2** - Upload only warning messages.
   - **4** - Upload only information messages.

   You can combine values to include more than one type of message. For example, a value of **3** uploads error messages (**1**) and warning messages (**2**). A value of **7** uploads error messages (**1**), warning messages (**2**), and information messages (**4**).

To send security log data to CloudWatch Logs

1. In the JSON file, locate the `SecurityEventLog` section.

```
{
    "Id": "SecurityEventLog",
    "FullName":
 "AWS.EC2.Windows.CloudWatch.EventLog.EventLogInputComponent,AWS.EC2.Windows.CloudWatch",
    "Parameters": {
        "LogName": "Security",
        "Levels": "7"
    }
},
```

2. For `Levels`, type **7** to upload all messages.

To send system event log data to CloudWatch Logs

1. In the JSON file, locate the `SystemEventLog` section.

```
{
    "Id": "SystemEventLog",
    "FullName":
 "AWS.EC2.Windows.CloudWatch.EventLog.EventLogInputComponent,AWS.EC2.Windows.CloudWatch",
    "Parameters": {
        "LogName": "System",
        "Levels": "7"
    }
},
```

2. For `Levels`, specify the type of messages to upload. You can specify one of the following values:

   - **1** - Upload only error messages.
   - **2** - Upload only warning messages.
   - **4** - Upload only information messages.

   You can combine values to include more than one type of message. For example, a value of **3** uploads error messages (**1**) and warning messages (**2**). A value of **7** uploads error messages (**1**), warning messages (**2**), and information messages (**4**).

To send other types of event log data to CloudWatch Logs

1. In the JSON file, add a new section. Each section must have a unique `Id`.

```
{
    "Id": "Id-name",
    "FullName":
 "AWS.EC2.Windows.CloudWatch.EventLog.EventLogInputComponent,AWS.EC2.Windows.CloudWatch",
    "Parameters": {
        "LogName": "Log-name",
        "Levels": "7"
    }
},
```

2. For `Id`, type a name for the log to upload (for example, **`WindowsBackup`**).
3. For `LogName`, type the name of the log to upload. You can find the name of the log as follows.

   a. Open Event Viewer.

b. In the navigation pane, choose **Applications and Services Logs**.

c. Navigate to the log, and then choose **Actions**, **Properties**.

4. For `Levels`, specify the type of messages to upload. You can specify one of the following values:

   - **1** - Upload only error messages.
   - **2** - Upload only warning messages.
   - **4** - Upload only information messages.

   You can combine values to include more than one type of message. For example, a value of **3** uploads error messages (**1**) and warning messages (**2**). A value of **7** uploads error messages (**1**), warning messages (**2**), and information messages (**4**).

To send Event Tracing for Windows data to CloudWatch Logs

ETW (Event Tracing for Windows) provides an efficient and detailed logging mechanism that applications can write logs to. Each ETW is controlled by a session manager that can start and stop the logging session. Each session has a provider and one or more consumers.

1. In the JSON file, locate the `ETW` section.

```
{
    "Id": "ETW",
    "FullName":
 "AWS.EC2.Windows.CloudWatch.EventLog.EventLogInputComponent,AWS.EC2.Windows.CloudWatch",
    "Parameters": {
        "LogName": "Microsoft-Windows-WinINet/Analytic",
        "Levels": "7"
    }
},
```

2. For `LogName`, type the name of the log to upload.
3. For `Levels`, specify the type of messages to upload. You can specify one of the following values:

   - **1** - Upload only error messages.
   - **2** - Upload only warning messages.

- **4** - Upload only information messages.

You can combine values to include more than one type of message. For example, a value of **3** uploads error messages (**1**) and warning messages (**2**). A value of **7** uploads error messages (**1**), warning messages (**2**), and information messages (**4**).

To send custom logs (any text-based log file) to CloudWatch Logs

1. In the JSON file, locate the `CustomLogs` section.

```
{
    "Id": "CustomLogs",
    "FullName":
 "AWS.EC2.Windows.CloudWatch.CustomLog.CustomLogInputComponent,AWS.EC2.Windows.CloudWatch",
    "Parameters": {
        "LogDirectoryPath": "C:\\CustomLogs\\",
        "TimestampFormat": "MM/dd/yyyy HH:mm:ss",
        "Encoding": "UTF-8",
        "Filter": "",
        "CultureName": "en-US",
        "TimeZoneKind": "Local",
        "LineCount": "5"
    }
},
```

2. For `LogDirectoryPath`, type the path where logs are stored on your instance.
3. For `TimestampFormat`, type the time stamp format to use. For more information about supported values, see the Custom Date and Time Format Strings topic on MSDN.

> **Important**
>
> Your source log file must have the time stamp at the beginning of each log line and there must be a space following the time stamp.

4. For `Encoding`, type the file encoding to use (for example, UTF-8). For more information about supported values, see the Encoding Class topic on MSDN.

> **Note**
>
> Use the encoding name, not the display name.

5. (Optional) For `Filter`, type the prefix of log names. Leave this parameter blank to monitor all files. For more information about supported values, see the FileSystemWatcherFilter Property topic on MSDN.
6. (Optional) For `CultureName`, type the locale where the time stamp is logged. If `CultureName` is blank, it defaults to the same locale currently used by your Windows instance. For more information about supported values, see the `Language tag` column in the table in the Product Behavior topic on MSDN.

> **Note**
>
> The `div`, `div-MV`, hu, and `hu-HU` values are not supported.

7. (Optional) For `TimeZoneKind`, type `Local` or UTC. You can set this to provide time zone information when no time zone information is included in your log's time stamp. If this parameter is left blank and if your time stamp doesn't include time zone information, CloudWatch Logs defaults to the local time zone. This parameter is ignored if your time stamp already contains time zone information.
8. (Optional) For `LineCount`, type the number of lines in the header to identify the log file. For example, IIS log files have virtually identical headers. You could enter **5**, which would read the first three lines of the log file header to identify it. In IIS log files, the third line is the date and time stamp, but the time stamp is not always guaranteed to be different between log files. For this reason, we recommend including at least one line of actual log data to uniquely fingerprint the log file.

To send IIS log data to CloudWatch Logs

1. In the JSON file, locate the `IISLog` section.

```
{
    "Id": "IISLogs",
    "FullName":
 "AWS.EC2.Windows.CloudWatch.CustomLog.CustomLogInputComponent,AWS.EC2.Windows.CloudWatch",
    "Parameters": {
```

```
        "LogDirectoryPath": "C:\\inetpub\\logs\\LogFiles\\W3SVC1",
        "TimestampFormat": "yyyy-MM-dd HH:mm:ss",
        "Encoding": "UTF-8",
        "Filter": "",
        "CultureName": "en-US",
        "TimeZoneKind": "UTC",
        "LineCount": "5"
    }
},
```

2. For `LogDirectoryPath`, type the folder where IIS logs are stored for an individual site (for example, `C:\inetpub\logs\LogFiles\W3SVC`*n*).

> **Note**
>
> Only W3C log format is supported. IIS, NCSA, and Custom formats are not supported.

3. For `TimestampFormat`, type the time stamp format to use. For more information about supported values, see the Custom Date and Time Format Strings topic on MSDN.
4. For `Encoding`, type the file encoding to use (for example, UTF-8). For more information about supported values, see the Encoding Class topic on MSDN.

> **Note**
>
> Use the encoding name, not the display name.

5. (Optional) For `Filter`, type the prefix of log names. Leave this parameter blank to monitor all files. For more information about supported values, see the FileSystemWatcherFilter Property topic on MSDN.
6. (Optional) For `CultureName`, type the locale where the time stamp is logged. If `CultureName` is blank, it defaults to the same locale currently used by your Windows instance. For more information about supported values, see the `Language tag` column in the table in the Product Behavior topic on MSDN.

> **Note**
>
> The `div`, `div-MV`, hu, and `hu-HU` values are not supported.

7. (Optional) For `TimeZoneKind`, enter `Local` or `UTC`. You can set this to provide time zone information when no time zone information is included in your log's time stamp. If this parameter is left blank and if your time stamp doesn't include time zone information, CloudWatch Logs defaults to the local time zone. This parameter is ignored if your time stamp already contains time zone information.
8. (Optional) For `LineCount`, type the number of lines in the header to identify the log file. For example, IIS log files have virtually identical headers. You could enter **5**, which would read the first five lines of the log file's header to identify it. In IIS log files, the third line is the date and time stamp, but the time stamp is not always guaranteed to be different between log files. For this reason, we recommend including at least one line of actual log data for uniquely fingerprinting the log file.

Step 4: Configure flow control

Each data type must have a corresponding destination in the `Flows` section. For example, to send the custom log, ETW log, and system log to CloudWatch Logs, add `(CustomLogs,ETW,SystemEventLog),CloudWatchLogs` to the `Flows` section.

> **⚠ Warning**
>
> Adding a step that is not valid blocks the flow. For example, if you add a disk metric step, but your instance doesn't have a disk, all steps in the flow are blocked.

You can send the same log file to more than one destination. For example, to send the application log to two different destinations that you defined in the `CloudWatchLogs` section, add `ApplicationEventLog,(CloudWatchLogs,CloudWatchLogs2)` to the `Flows` section.

To configure flow control

1. In the `AWS.EC2.Windows.CloudWatch.json` file, locate the `Flows` section.

```
"Flows": {
    "Flows": [
      "PerformanceCounter,CloudWatch",
      "(PerformanceCounter,PerformanceCounter2), CloudWatch2",
      "(CustomLogs, ETW, SystemEventLog),CloudWatchLogs",
      "CustomLogs, CloudWatchLogs2",
      "ApplicationEventLog,(CloudWatchLogs, CloudWatchLogs2)"
```

```
    ]
}
```

2. For `Flows`, add each data type that is to be uploaded (for example, `ApplicationEventLog`) and its destination (for example, `CloudWatchLogs`).

You are now finished editing the JSON file. You use it in a later step.

Start the agent

To enable an Amazon EC2 instance running Windows Server 2012 or Windows Server 2008 to send logs to CloudWatch Logs, use the EC2Config service (`EC2Config.exe`). Your instance should have EC2Config 4.0 or later, and you can use this procedure.

To configure CloudWatch using EC2Config 4.x

1. Check the encoding of the `AWS.EC2.Windows.CloudWatch.json` file that you edited earlier in this procedure. Only UTF-8 without BOM encoding is supported. Then save the file in the following folder on your Windows Server 2008 - 2012 R2 instance: `C:\Program Files \Amazon\SSM\Plugins\awsCloudWatch\`.
2. Start or restart the SSM agent (`AmazonSSMAgent.exe`) using the Windows Services control panel or using the following PowerShell command:

```
PS C:\> Restart-Service AmazonSSMAgent
```

After the SSM agent restarts, it detects the configuration file and configures the instance for CloudWatch integration. If you change parameters and settings in the local configuration file, you need to restart the SSM agent to pick up the changes. To disable CloudWatch integration on the instance, change `IsEnabled` to `false` and save your changes in the configuration file.

Report the CloudWatch Logs agent status

Use the following procedure to report the status of the CloudWatch Logs agent on your EC2 instance.

To report the agent status

1. Connect to your EC2 instance. For more information, see Connect to Your Instance in the *Amazon EC2 User Guide*.

For more information about connection issues, see Troubleshooting Connecting to Your Instance in the *Amazon EC2 User Guide*

2. At a command prompt, type the following command:

```
sudo service awslogs status
```

If you are running Amazon Linux 2, type the following command:

```
sudo service awslogsd status
```

3. Check the **/var/log/awslogs.log** file for any errors, warnings, or issues with the CloudWatch Logs agent.

Start the CloudWatch Logs agent

If the CloudWatch Logs agent on your EC2 instance did not start automatically after installation, or if you stopped the agent, you can use the following procedure to start the agent.

To start the agent

1. Connect to your EC2 instance. For more information, see Connect to Your Instance in the *Amazon EC2 User Guide*.

   For more information about connection issues, see Troubleshooting Connecting to Your Instance in the *Amazon EC2 User Guide*.

2. At a command prompt, type the following command:

```
sudo service awslogs start
```

If you are running Amazon Linux 2, type the following command:

```
sudo service awslogsd start
```

Stop the CloudWatch Logs agent

Use the following procedure to stop the CloudWatch Logs agent on your EC2 instance.

To stop the agent

1. Connect to your EC2 instance. For more information, see Connect to Your Instance in the *Amazon EC2 User Guide*.

   For more information about connection issues, see Troubleshooting Connecting to Your Instance in the *Amazon EC2 User Guide*.

2. At a command prompt, type the following command:

   ```
   sudo service awslogs stop
   ```

   If you are running Amazon Linux 2, type the following command:

   ```
   sudo service awslogsd stop
   ```

CloudWatch Logs agent reference

> **Important**
>
> This section is a reference for those using the deprecated CloudWatch Logs agent. If you're using Instance Metadata Service Version 2 (IMDSv2), you must use the new unified CloudWatch agent. However, even if you're not using IMDSv2, we strongly recommend using the newer unified CloudWatch agent instead of the deprecated CloudWatch Logs agent. For information about the newer unified CloudWatch agent, see Collecting metrics and logs from Amazon EC2 instance and on-premises servers with the CloudWatch agent. For information about migrating from the deprecated CloudWatch Logs agent to the unified agent, Create the CloudWatch agent configuration file with the wizard.

The CloudWatch Logs agent provides an automated way to send log data to CloudWatch Logs from Amazon EC2 instances. The agent includes the following components:

- A plug-in to the AWS CLI that pushes log data to CloudWatch Logs.
- A script (daemon) that initiates the process to push data to CloudWatch Logs.
- A cron job that ensures that the daemon is always running.

Agent configuration file

The CloudWatch Logs agent configuration file describes information needed by the CloudWatch Logs agent. The agent configuration file's [general] section defines common configurations that apply to all log streams. The [logstream] section defines the information necessary to send a local file to a remote log stream. You can have more than one [logstream] section, but each must have a unique name within the configuration file, e.g., [logstream1], [logstream2], and so on. The [logstream] value along with the first line of data in the log file, define the log file's identity.

```
[general]
state_file = value
logging_config_file = value
use_gzip_http_content_encoding = [true | false]

[logstream1]
log_group_name = value
log_stream_name = value
datetime_format = value
time_zone = [LOCAL|UTC]
file = value
file_fingerprint_lines = integer | integer-integer
multi_line_start_pattern = regex | {datetime_format}
initial_position = [start_of_file | end_of_file]
encoding = [ascii|utf_8|..]
buffer_duration = integer
batch_count = integer
batch_size = integer

[logstream2]
...
```

state_file

Specifies where the state file is stored.

logging_config_file

(Optional) Specifies the location of the agent logging config file. If you do not specify an agent logging config file here, the default file awslogs.conf is used. The default file location is `/var/awslogs/etc/awslogs.conf` if you installed the agent with a script, and is `/etc/awslogs/awslogs.conf` if you installed the agent with rpm. The file is in Python configuration file

format (https://docs.python.org/2/library/logging.config.html#logging-config-fileformat). Loggers with the following names can be customized.

```
cwlogs.push
cwlogs.push.reader
cwlogs.push.publisher
cwlogs.push.event
cwlogs.push.batch
cwlogs.push.stream
cwlogs.push.watcher
```

The sample below changes the level of reader and publisher to WARNING while the default value is INFO.

```
[loggers]
keys=root,cwlogs,reader,publisher

[handlers]
keys=consoleHandler

[formatters]
keys=simpleFormatter

[logger_root]
level=INFO
handlers=consoleHandler

[logger_cwlogs]
level=INFO
handlers=consoleHandler
qualname=cwlogs.push
propagate=0

[logger_reader]
level=WARNING
handlers=consoleHandler
qualname=cwlogs.push.reader
propagate=0

[logger_publisher]
level=WARNING
handlers=consoleHandler
qualname=cwlogs.push.publisher
```

```
propagate=0

[handler_consoleHandler]
class=logging.StreamHandler
level=INFO
formatter=simpleFormatter
args=(sys.stderr,)

[formatter_simpleFormatter]
format=%(asctime)s - %(name)s - %(levelname)s - %(process)d - %(threadName)s -
 %(message)s
```

use_gzip_http_content_encoding

When set to true (default), enables gzip http content encoding to send compressed payloads to CloudWatch Logs. This decreases CPU usage, lowers NetworkOut, and decreases put latency. To disable this feature, add **use_gzip_http_content_encoding = false** to the **[general]** section of the CloudWatch Logs agent configuration file, and then restart the agent.

> **Note**
>
> This setting is only available in awscli-cwlogs version 1.3.3 and later.

log_group_name

Specifies the destination log group. A log group is created automatically if it doesn't already exist. Log group names can be between 1 and 512 characters long. Allowed characters include a-z, A-Z, 0-9, '_' (underscore), '-' (hyphen), '/' (forward slash), and '.' (period).

log_stream_name

Specifies the destination log stream. You can use a literal string or predefined variables ({instance_id}, {hostname}, {ip_address}), or combination of both to define a log stream name. A log stream is created automatically if it doesn't already exist.

datetime_format

Specifies how the timestamp is extracted from logs. The timestamp is used for retrieving log events and generating metrics. The current time is used for each log event if the **datetime_format** isn't provided. If the provided **datetime_format** value is invalid for a given log

message, the timestamp from the last log event with a successfully parsed timestamp is used. If no previous log events exist, the current time is used.

The common datetime_format codes are listed below. You can also use any datetime_format codes supported by Python, datetime.strptime(). The timezone offset (%z) is also supported even though it's not supported until python 3.2, [+-]HHMM without colon(:). For more information, see strftime() and strptime() Behavior.

%y: Year without century as a zero-padded decimal number. 00, 01, ..., 99

%Y: Year with century as a decimal number.1970, 1988, 2001, 2013

%b: Month as locale's abbreviated name. Jan, Feb, ..., Dec (en_US);

%B: Month as locale's full name. January, February, ..., December (en_US);

%m: Month as a zero-padded decimal number. 01, 02, ..., 12

%d: Day of the month as a zero-padded decimal number. 01, 02, ..., 31

%H: Hour (24-hour clock) as a zero-padded decimal number. 00, 01, ..., 23

%I: Hour (12-hour clock) as a zero-padded decimal number. 01, 02, ..., 12

%p: Locale's equivalent of either AM or PM.

%M: Minute as a zero-padded decimal number. 00, 01, ..., 59

%S: Second as a zero-padded decimal number. 00, 01, ..., 59

%f: Microsecond as a decimal number, zero-padded on the left. 000000, ..., 999999

%z: UTC offset in the form +HHMM or -HHMM. +0000, -0400, +1030

Example formats:

```
Syslog: '%b %d %H:%M:%S', e.g. Jan 23 20:59:29

Log4j: '%d %b %Y %H:%M:%S', e.g. 24 Jan 2014 05:00:00

ISO8601: '%Y-%m-%dT%H:%M:%S%z', e.g. 2014-02-20T05:20:20+0000
```

time_zone

Specifies the time zone of log event timestamp. The two supported values are UTC and LOCAL. The default is LOCAL, which is used if time zone can't be inferred based on **datetime_format**.

file

Specifies log files that you want to push to CloudWatch Logs. File can point to a specific file or multiple files (using wildcards such as /var/log/system.log*). Only the latest file is pushed to CloudWatch Logs based on file modification time. We recommend that you use wildcards to specify a series of files of the same type, such as access_log.2014-06-01-01, access_log.2014-06-01-02, and so on, but not multiple kinds of files, such as access_log_80 and access_log_443. To specify multiple kinds of files, add another log stream entry to the configuration file so each kind of log file goes to a different log stream. Zipped files are not supported.

file_fingerprint_lines

Specifies the range of lines for identifying a file. The valid values are one number or two dash delimited numbers, such as '1', '2-5'. The default value is '1' so the first line is used to calculate fingerprint. Fingerprint lines are not sent to CloudWatch Logs unless all the specified lines are available.

multi_line_start_pattern

Specifies the pattern for identifying the start of a log message. A log message is made of a line that matches the pattern and any following lines that don't match the pattern. The valid values are regular expression or {datetime_format}. When using {datetime_format}, the datetime_format option should be specified. The default value is '^[^\s]' so any line that begins with non-whitespace character closes the previous log message and starts a new log message.

initial_position

Specifies where to start to read data (start_of_file or end_of_file). The default is start_of_file. It's only used if there is no state persisted for that log stream.

encoding

Specifies the encoding of the log file so that the file can be read correctly. The default is utf_8. Encodings supported by Python codecs.decode() can be used here.

> **⚠ Warning**
>
> Specifying an incorrect encoding might cause data loss because characters that cannot be decoded are replaced with some other character.

Below are some common encodings:

```
ascii, big5, big5hkscs, cp037, cp424, cp437, cp500, cp720, cp737,
cp775, cp850, cp852, cp855, cp856, cp857, cp858, cp860, cp861, cp862,
cp863, cp864, cp865, cp866, cp869, cp874, cp875, cp932, cp949, cp950,
cp1006, cp1026, cp1140, cp1250, cp1251, cp1252, cp1253, cp1254, cp1255,
cp1256, cp1257, cp1258, euc_jp, euc_jis_2004, euc_jisx0213, euc_kr,
gb2312, gbk, gb18030, hz, iso2022_jp, iso2022_jp_1, iso2022_jp_2,
iso2022_jp_2004, iso2022_jp_3, iso2022_jp_ext, iso2022_kr, latin_1,
iso8859_2, iso8859_3, iso8859_4, iso8859_5, iso8859_6, iso8859_7,
iso8859_8, iso8859_9, iso8859_10, iso8859_13, iso8859_14, iso8859_15,
iso8859_16, johab, koi8_r, koi8_u, mac_cyrillic, mac_greek, mac_iceland,
mac_latin2, mac_roman, mac_turkish, ptcp154, shift_jis, shift_jis_2004,
shift_jisx0213, utf_32, utf_32_be, utf_32_le, utf_16, utf_16_be,
utf_16_le, utf_7, utf_8, utf_8_sig
```

buffer_duration

Specifies the time duration for the batching of log events. The minimum value is 5000ms and default value is 5000ms.

batch_count

Specifies the max number of log events in a batch, up to 10000. The default value is 10000.

batch_size

Specifies the max size of log events in a batch, in bytes, up to 1048576 bytes. The default value is 1048576 bytes. This size is calculated as the sum of all event messages in UTF-8, plus 26 bytes for each log event.

Using the CloudWatch Logs agent with HTTP proxies

You can use the CloudWatch Logs agent with HTTP proxies.

> **Note**
>
> HTTP proxies are supported in awslogs-agent-setup.py version 1.3.8 or later.

To use the CloudWatch Logs agent with HTTP proxies

1. Do one of the following:

a. For a new installation of the CloudWatch Logs agent, run the following commands:

```
curl https://s3.amazonaws.com/aws-cloudwatch/downloads/latest/awslogs-agent-setup.py -O
```

```
sudo python awslogs-agent-setup.py --region us-east-1 --http-proxy http://your/proxy --https-proxy http://your/proxy --no-proxy 169.254.169.254
```

In order to maintain access to the Amazon EC2 metadata service on EC2 instances, use **--no-proxy 169.254.169.254** (recommended). For more information, see Instance Metadata and User Data in the *Amazon EC2 User Guide*.

In the values for `http-proxy` and `https-proxy`, you specify the entire URL.

b. For an existing installation of the CloudWatch Logs agent, edit /var/awslogs/etc/proxy.conf, and add your proxies:

```
HTTP_PROXY=
HTTPS_PROXY=
NO_PROXY=
```

2. Restart the agent for the changes to take effect:

```
sudo service awslogs restart
```

If you are using Amazon Linux 2, use the following command to restart the agent:

```
sudo service awslogsd restart
```

Compartmentalizing CloudWatch Logs agent configuration files

If you're using awslogs-agent-setup.py version 1.3.8 or later with awscli-cwlogs 1.3.3 or later, you can import different stream configurations for various components independently of one another by creating additional configuration files in the **/var/awslogs/etc/config/** directory. When the CloudWatch Logs agent starts, it includes any stream configurations in these additional configuration files. Configuration properties in the [general] section must be defined in the main

configuration file (/var/awslogs/etc/awslogs.conf) and are ignored in any additional configuration files found in /var/awslogs/etc/config/.

If you don't have a **/var/awslogs/etc/config/** directory because you installed the agent with rpm, you can use the **/etc/awslogs/config/** directory instead.

Restart the agent for the changes to take effect:

```
sudo service awslogs restart
```

If you are using Amazon Linux 2, use the following command to restart the agent:

```
sudo service awslogsd restart
```

CloudWatch Logs agent FAQ

What kinds of file rotations are supported?

The following file rotation mechanisms are supported:

- Renaming existing log files with a numerical suffix, then re-creating the original empty log file. For example, /var/log/syslog.log is renamed /var/log/syslog.log.1. If /var/log/syslog.log.1 already exists from a previous rotation, it is renamed /var/log/syslog.log.2.
- Truncating the original log file in place after creating a copy. For example, /var/log/syslog.log is copied to /var/log/syslog.log.1 and /var/log/syslog.log is truncated. There might be data loss for this case, so be careful about using this file rotation mechanism.
- Creating a new file with a common pattern as the old one. For example, /var/log/syslog.log.2014-01-01 remains and /var/log/syslog.log.2014-01-02 is created.

The fingerprint (source ID) of the file is calculated by hashing the log stream key and the first line of file content. To override this behavior, the **file_fingerprint_lines** option can be used. When file rotation happens, the new file is supposed to have new content and the old file is not supposed to have content appended; the agent pushes the new file after it finishes reading the old file.

How can I determine which version of agent am I using?

If you used a setup script to install the CloudWatch Logs agent, you can use **/var/awslogs/bin/awslogs-version.sh** to check what version of the agent you are using. It prints out the version

of the agent and its major dependencies. If you used yum to install the CloudWatch Logs agent, you can use **"yum info awslogs"** and **"yum info aws-cli-plugin-cloudwatch-logs"** to check the version of the CloudWatch Logs agent and plugin.

How are log entries converted to log events?

Log events contain two properties: the timestamp of when the event occurred, and the raw log message. By default, any line that begins with non-whitespace character closes the previous log message if there is one, and starts a new log message. To override this behavior, the **multi_line_start_pattern** can be used and any line that matches the pattern starts a new log message. The pattern could be any regex or '{datetime_format}'. For example, if the first line of every log message contains a timestamp like '2014-01-02T13:13:01Z', then the **multi_line_start_pattern** can be set to '\d{4}-\d{2}-\d{2}T\d{2}:\d{2}:\d{2}Z'. To simplify the configuration, the ‘{datetime_format}' variable can be used if the **datetime_format option** is specified. For the same example, if **datetime_format** is set to '%Y-%m-%dT%H:%M:%S%z', then multi_line_start_pattern could be simply '{datetime_format}'.

The current time is used for each log event if the **datetime_format** isn't provided. If the provided **datetime_format** is invalid for a given log message, the timestamp from the last log event with a successfully parsed timestamp is used. If no previous log events exist, the current time is used. A warning message is logged when a log event falls back to the current time or time of previous log event.

Timestamps are used for retrieving log events and generating metrics, so if you specify the wrong format, log events could become non-retrievable and generate wrong metrics.

How are log events batched?

A batch becomes full and is published when any of the following conditions are met:

1. The **buffer_duration** amount of time has passed since the first log event was added.
2. Less than **batch_size** of log events have been accumulated but adding the new log event exceeds the **batch_size**.
3. The number of log events has reached **batch_count**.
4. Log events from the batch don't span more than 24 hours, but adding the new log event exceeds the 24 hours constraint.

What would cause log entries, log events, or batches to be skipped or truncated?

To follow the constraint of the `PutLogEvents` operation, the following issues could cause a log event or batch to be skipped.

> **Note**
>
> The CloudWatch Logs agent writes a warning to its log when data is skipped.

1. If the size of a log event exceeds 256 KB, the log event is skipped completely.
2. If the timestamp of log event is more than 2 hours in future, the log event is skipped.
3. If the timestamp of log event is more than 14 days in past, the log event is skipped.
4. If any log event is older than the retention period of log group, the whole batch is skipped.
5. If the batch of log events in a single `PutLogEvents` request spans more than 24 hours, the `PutLogEvents` operation fails.

Does stopping the agent cause data loss/duplicates?

Not as long as the state file is available and no file rotation has happened since the last run. The CloudWatch Logs agent can start from where it stopped and continue pushing the log data.

Can I point different log files from the same or different hosts to the same log stream?

Configuring multiple log sources to send data to a single log stream is not supported.

What API calls does the agent make (or what actions should I add to my IAM policy)?

The CloudWatch Logs agent requires permission to perform `CreateLogGroup`, `CreateLogStream`, `DescribeLogStreams`, `DescribeLogGrooupd`, `PutLogEvents` and `PutRetentionPolicy` actions. If you're using the latest agent, `DescribeLogStreams` is not needed. See the sample IAM policy below.

JSON

```
{
"Version":"2012-10-17",
"Statement": [
  {
    "Effect": "Allow",
    "Action": [
      "logs:CreateLogGroup",
      "logs:CreateLogStream",
      "logs:PutLogEvents",
      "logs:DescribeLogStreams",
      "logs:DescribeLogGroups",
      "logs:PutRetentionPolicy"
```

```
    ],
    "Resource": [
      "arn:aws:logs:*:*:*"
    ]
  }
 ]
}
```

I don't want the CloudWatch Logs agent to create either log groups or log streams automatically. How can I prevent the agent from recreating both log groups and log streams?

In your IAM policy, you can restrict the agent to only the following operations: `DescribeLogStreams`, `PutLogEvents`.

Before you revoke the `CreateLogGroup` and `CreateLogStream` permissions from the agent, be sure to create both the log groups and log streams that you want the agent to use. The logs agent cannot create log streams in a log group that you have created unless it has both the `CreateLogGroup` and `CreateLogStream` permissions.

What logs should I look at when troubleshooting?

The agent installation log is at `/var/log/awslogs-agent-setup.log` and the agent log is at `/var/log/awslogs.log`.

Quick Start: Use CloudFormation to get started with CloudWatch Logs

AWS CloudFormation enables you to describe and provision your AWS resources in JSON format. The advantages of this method include being able to manage a collection of AWS resources as a single unit, and easily replicating your AWS resources across Regions.

When you provision AWS using CloudFormation, you create templates that describe the AWS resources to use. The following example is a template snippet that creates a log group and a metric filter that counts 404 occurrences and sends this count to the log group.

```
"WebServerLogGroup": {
    "Type": "AWS::Logs::LogGroup",
    "Properties": {
        "RetentionInDays": 7
    }
```

```
},

"404MetricFilter": {
    "Type": "AWS::Logs::MetricFilter",
    "Properties": {
        "LogGroupName": {
            "Ref": "WebServerLogGroup"
        },
        "FilterPattern": "[ip, identity, user_id, timestamp, request, status_code =
 404, size, ...]",
        "MetricTransformations": [
            {
                "MetricValue": "1",
                "MetricNamespace": "test/404s",
                "MetricName": "test404Count"
            }
        ]
    }
}
```

This is a basic example. You can set up much richer CloudWatch Logs deployments using CloudFormation. For more information about template examples, see Amazon CloudWatch Logs Template Snippets in the *AWS CloudFormation User Guide*. For more information about getting started, see Getting Started with AWS CloudFormation in the *AWS CloudFormation User Guide*.

Log ingestion through HTTP endpoints

Amazon CloudWatch Logs provides HTTP endpoints that allow you to send logs directly to CloudWatch Logs using simple HTTP POST requests. These endpoints support both SigV4 and bearer token authentication.

Important

We recommend using SigV4 authentication for all production workloads where AWS SDK integration is possible. SigV4 uses short-term credentials and provides the strongest security posture. Bearer token (API key) authentication is intended for scenarios where SigV4 is not feasible, such as third-party log forwarders that do not support AWS SDK integration. For more information, see Alternatives to long-term access keys in the *IAM User Guide*.

CloudWatch Logs supports the following HTTP ingestion endpoints:

Endpoint	Path	Content-Type	Format
OpenTelemetry Logs	`/v1/logs`	`application/json` or `application/x-protobuf`	OTLP JSON or Protobuf
HLC Logs	`/services/collector/event`	`application/json`	HLC format
ND-JSON Logs	`/ingest/bulk`	`application/json` or `application/x-ndjson`	Newline-delimited JSON
Structured JSON Logs	`/ingest/json`	`application/json`	JSON object or array

Common behavior

All HTTP ingestion endpoints share the following behavior:

Authentication

All endpoints support both SigV4 and bearer token authentication:

- **SigV4 (recommended)** – Standard AWS Signature Version 4 signing. Use SigV4 whenever your application or infrastructure supports the AWS SDK or can sign requests. SigV4 uses short-term credentials and is the most secure authentication method.
- **Bearer token** – Use the `Authorization: Bearer <ACWL token>` header.
  - Token must be a valid ACWL bearer token. For setup instructions, see the section called "Bearer token authentication".
  - Requires the `logs:PutLogEvents` and `logs:CallWithBearerToken` IAM permissions.

Log group and log stream

- Provided via headers: `x-aws-log-group` and `x-aws-log-stream`
- Query parameters `?logGroup=<name>&logStream=<name>` are also supported on all endpoints except OTLP.
- You cannot use both query parameters and headers for the same parameter.
- Both log group and log stream are required.

Response

- Success: `HTTP 200` with body `{}`
- Validation errors: `HTTP 400`
- Auth failures: `HTTP 401`

Setting up bearer token authentication

Before you can send logs using bearer token authentication with any of the HTTP ingestion endpoints, you need to:

- Create an IAM user with CloudWatch Logs permissions
- Generate service-specific credentials (bearer token)
- Create a log group and log stream
- Enable bearer token authentication on the log group

Important

We recommend using SigV4 authentication with short-term credentials for all workloads where this is possible. SigV4 provides the strongest security posture. Restrict the use of API keys (bearer tokens) to scenarios where short-term credential-based authentication is not feasible. When you are ready to incorporate CloudWatch Logs into applications with greater security requirements, you should switch to short-term credentials. For more information, see Alternatives to long-term access keys in the *IAM User Guide*.

Option 1: Quick start using the AWS console

The AWS Management Console provides a streamlined workflow to generate API keys for HTTP endpoint access.

To set up HTTP endpoint access using the console

1. Sign in to the AWS Management Console.
2. Navigate to **CloudWatch** > **Settings** > **Logs**.
3. In the API Keys section, choose **Generate API key**.
4. For **API key expiration**, do one of the following:
   - Select an API key expiration duration of **1**, **5**, **30**, **90**, or **365** days.
   - Choose **Custom duration** to specify a custom API key expiration date.
   - Select **Never expires** (not recommended).
5. Choose **Generate API key**.

   The console automatically:
   - Creates a new IAM user with appropriate permissions
   - Attaches the CloudWatchLogsAPIKeyAccess managed policy (includes `logs:PutLogEvents` and `logs:CallWithBearerToken` permissions)
   - Generates service-specific credentials (API key)
6. Copy and securely save the displayed credentials:
   - **API Key ID** (Service-specific credential ID)
   - **API Key Secret** (Bearer token)

> **Important**
>
> Save the API Key Secret immediately. It cannot be retrieved later. If you lose it, you'll need to generate a new API key.

7. Create the log group and log stream where your logs will be stored:

```
# Create the log group
aws logs create-log-group \
    --log-group-name /aws/hlc-logs/my-application \
    --region us-east-1

# Create the log stream
aws logs create-log-stream \
    --log-group-name /aws/hlc-logs/my-application \
    --log-stream-name application-stream-001 \
    --region us-east-1
```

8. Enable bearer token authentication on the log group:

```
aws logs put-bearer-token-authentication \
    --log-group-identifier /aws/hlc-logs/my-application \
    --bearer-token-authentication-enabled \
    --region us-east-1
```

   Verify the configuration:

```
aws logs describe-log-groups \
    --log-group-name-prefix /aws/hlc-logs/my-application \
    --region us-east-1
```

Permissions included: The automatically created IAM user will have the following permissions:

- `logs:PutLogEvents` – Send log events to CloudWatch Logs
- `logs:CallWithBearerToken` – Authenticate using bearer token
- `kms:Describe*`, `kms:GenerateDataKey*`, `kms:Decrypt` – Access KMS-encrypted log groups (with condition restricting to logs service)

Option 2: Manual setup

If you prefer more control over the IAM configuration or need to customize permissions, you can set up the HTTP endpoint access manually.

Step 1: Create an IAM user

Create an IAM user that will be used for log ingestion:

1. Sign in to the AWS Management Console and navigate to IAM.
2. In the left navigation pane, choose **Users**.
3. Choose **Create user**.
4. Enter a user name (for example, `cloudwatch-logs-hlc-user`).
5. Choose **Next**.
6. Attach one of the following IAM policies:

   Option A: Use the managed policy (recommended)

   Attach the CloudWatchLogsAPIKeyAccess managed policy.

   Option B: Create a custom policy

   Create and attach the following IAM policy:

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Sid": "LogsAPIs",
            "Effect": "Allow",
            "Action": [
                "logs:CallWithBearerToken",
                "logs:PutLogEvents"
            ],
            "Resource": "*"
        },
        {
            "Sid": "KMSAPIs",
            "Effect": "Allow",
            "Action": [
```

```
                "kms:Describe*",
                "kms:GenerateDataKey*",
                "kms:Decrypt"
            ],
            "Condition": {
                "StringEquals": {
                    "kms:ViaService": [
                        "logs.*.amazonaws.com"
                    ]
                }
            },
            "Resource": "arn:aws:kms:*:*:key/*"
        }
    ]
}
```

7. Choose **Next** and then **Create user**.

> **Note**
>
> The KMS permissions are required if you plan to send logs to KMS-encrypted log groups. The condition restricts KMS access to only keys used via CloudWatch Logs service.

Step 2: Generate service-specific credentials (API key)

Generate the CloudWatch Logs API key using the CreateServiceSpecificCredential API. You can also use the create-service-specific-credential CLI command. For the credential age, you can specify a value between 1–36600 days. If you don't specify a credential age, the API key will not expire.

To generate an API key with an expiration of 30 days:

```
aws iam create-service-specific-credential \
    --user-name cloudwatch-logs-hlc-user \
    --service-name logs.amazonaws.com \
    --credential-age-days 30
```

The response is a ServiceSpecificCredential object. The `ServiceCredentialSecret` value is your CloudWatch Logs API key (bearer token).

Important

Store the `ServiceCredentialSecret` value securely, as you cannot retrieve it later. If you lose it, you'll need to generate a new API key.

Step 3: Create log group and log stream

Create the log group and log stream where your logs will be stored:

```
# Create the log group
aws logs create-log-group \
    --log-group-name /aws/hlc-logs/my-application \
    --region us-east-1

# Create the log stream
aws logs create-log-stream \
    --log-group-name /aws/hlc-logs/my-application \
    --log-stream-name application-stream-001 \
    --region us-east-1
```

Step 4: Enable bearer token authentication

Enable bearer token authentication on the log group:

```
aws logs put-bearer-token-authentication \
    --log-group-identifier /aws/hlc-logs/my-application \
    --bearer-token-authentication-enabled \
    --region us-east-1
```

Verify the configuration:

```
aws logs describe-log-groups \
    --log-group-name-prefix /aws/hlc-logs/my-application \
    --region us-east-1
```

Control permissions for generating and using CloudWatch Logs API keys

The generation and usage of CloudWatch Logs API keys is controlled by actions and condition keys in both the CloudWatch Logs and IAM services.

Controlling the generation of CloudWatch Logs API keys

The iam:CreateServiceSpecificCredential action controls the generation of a service-specific key (such as a CloudWatch Logs API key). You can scope this action to IAM users as a resource to limit the users for which a key can be generated.

You can use the following condition keys to impose conditions on the permission for the `iam:CreateServiceSpecificCredential` action:

- iam:ServiceSpecificCredentialAgeDays – Lets you specify, in the condition, the key's expiration time in days. For example, you can use this condition key to only allow the creation of API keys that expire within 90 days.
- iam:ServiceSpecificCredentialServiceName – Lets you specify, in the condition, the name of a service. For example, you can use this condition key to only allow the creation of API keys for CloudWatch Logs and not other services.

Controlling the usage of CloudWatch Logs API keys

The `logs:CallWithBearerToken` action controls the use of a CloudWatch Logs API key. To prevent an identity from using CloudWatch Logs API keys, attach a policy that denies the `logs:CallWithBearerToken` action to the IAM user associated with the key.

Example policies

Prevent an identity from generating and using CloudWatch Logs API keys

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Sid": "DenyCWLAPIKeys",
            "Effect": "Deny",
            "Action": [
```

```
                "iam:CreateServiceSpecificCredential",
                "logs:CallWithBearerToken"
            ],
            "Resource": "*"
        }
    ]
}
```

> **Warning**
>
> This policy will prevent the creation of credentials for all AWS services that support creating service-specific credentials. For more information, see Service-specific credentials for IAM users.

Prevent an identity from using CloudWatch Logs API keys

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Deny",
            "Action": "logs:CallWithBearerToken",
            "Resource": "*"
        }
    ]
}
```

Allow the creation of CloudWatch Logs keys only if they expire within 90 days

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": "iam:CreateServiceSpecificCredential",
            "Resource": "arn:aws:iam::123456789012:user/username",
            "Condition": {
                "StringEquals": {
                    "iam:ServiceSpecificCredentialServiceName": "logs.amazonaws.com"
                },
                "NumericLessThanEquals": {
```

```
                    "iam:ServiceSpecificCredentialAgeDays": "90"
                }
            }
        }
    ]
}
```

Rotating API keys

Regularly rotating your API keys reduces the risk of unauthorized access. We recommend establishing a rotation schedule that aligns with your organization's security policies.

Rotation process

To rotate an API key without interrupting log delivery, follow this procedure:

1. Create a new (secondary) credential for the IAM user:

```
aws iam create-service-specific-credential \
    --user-name cloudwatch-logs-hlc-user \
    --service-name logs.amazonaws.com \
    --credential-age-days 90
```

2. (Optional) Store the new credential in AWS Secrets Manager for secure retrieval and automated rotation.
3. Import the new credential into your vendor's portal or update your application configuration to use the new API key.
4. Set the original credential to inactive:

```
aws iam update-service-specific-credential \
    --user-name cloudwatch-logs-hlc-user \
    --service-specific-credential-id ACCA1234EXAMPLE1234 \
    --status Inactive
```

5. Verify that log delivery is not impacted by monitoring the `IncomingBytes` metric for your log group in CloudWatch. For more information, see Monitoring with CloudWatch metrics.
6. After confirming successful delivery with the new key, delete the previous credential:

```
aws iam delete-service-specific-credential \
    --service-specific-credential-id ACCA1234EXAMPLE1234
```

Monitoring key expiration

To check the creation date and status of your existing API keys, use the list-service-specific-credentials command:

```
aws iam list-service-specific-credentials \
    --user-name cloudwatch-logs-hlc-user \
    --service-name logs.amazonaws.com
```

The response includes `CreateDate` and `Status` for each credential. Use this information to identify keys that are approaching expiration or have been active longer than your rotation policy allows.

Responding to a compromised API key

If you suspect that an API key has been compromised, take the following steps immediately:

1. **Deactivate the key immediately** to prevent further unauthorized use:

   ```
   aws iam update-service-specific-credential \
       --user-name cloudwatch-logs-hlc-user \
       --service-specific-credential-id ACCA1234EXAMPLE1234 \
       --status Inactive
   ```

2. **Review CloudTrail logs** to determine the scope of unauthorized access. See the section called "Logging API key usage with CloudTrail" for how to enable auditing of API key usage.
3. **Create a replacement key** following the rotation process described in the section called "Rotation process".
4. **Delete the compromised key** after the replacement is in place:

   ```
   aws iam delete-service-specific-credential \
       --service-specific-credential-id ACCA1234EXAMPLE1234
   ```

5. **Attach a deny policy** if you need to immediately block all bearer token access for the IAM user while you investigate:

   ```
   {
       "Version": "2012-10-17",
       "Statement": {
           "Effect": "Deny",
   ```

```
        "Action": "logs:CallWithBearerToken",
        "Resource": "*"
    }
}
```

> **Note**
>
> To carry out these actions through the API, you must authenticate with AWS credentials and not with a CloudWatch Logs API key.

You can also use the following IAM API operations to manage compromised keys:

- ResetServiceSpecificCredential – Reset the key to generate a new password without deleting the credential. The key must not have expired.

Security best practices for API keys

Follow these best practices to protect your CloudWatch Logs API keys:

- **Never embed API keys in source code.** Do not hard-code API keys in application code or commit them to version control systems. If a key is accidentally committed to a public repository, AWS automated scanning may flag it and you should rotate the key immediately.
- **Use a secrets manager.** Store API keys in AWS Secrets Manager or an equivalent secrets management solution. This enables centralized access control, audit logging, and automated rotation.
- **Set an expiration on all keys.** Always specify a `--credential-age-days` value when creating API keys. To enforce a maximum key lifetime across your organization, use the `iam:ServiceSpecificCredentialAgeDays` IAM condition key. For an example, see the section called “Allow the creation of CloudWatch Logs keys only if they expire within 90 days”.
- **Apply least-privilege permissions.** Scope the IAM user's permissions to only the log groups and actions required. Use the managed CloudWatchLogsAPIKeyAccess policy as a starting point and restrict further as needed.
- **Enable CloudTrail logging.** Audit API key usage by enabling CloudTrail data events for `AWS::Logs::LogGroupAuthorization`. See the section called “Logging API key usage with CloudTrail”.

- **Monitor with IAM Access Analyzer.** Use IAM Access Analyzer to identify unused credentials and overly permissive policies associated with your API key IAM users.
- **Rotate keys regularly.** Establish a rotation schedule and follow the process described in the section called "Rotating API keys".

Logging API key usage with CloudTrail

You can use AWS CloudTrail to log data events for CloudWatch Logs API key usage. CloudWatch Logs emits `AWS::Logs::LogGroupAuthorization` data events for `CallWithBearerToken` calls, enabling you to audit when and how API keys are used to send logs.

To enable CloudTrail logging for CloudWatch Logs API key usage:

> **Note**
>
> The S3 bucket that you specify for the trail must have a bucket policy that allows CloudTrail to write log files to it. For more information, see Amazon S3 bucket policy for CloudTrail.

1. Create a trail:

```
aws cloudtrail create-trail \
    --name cloudwatch-logs-api-key-audit \
    --s3-bucket-name my-cloudtrail-bucket \
    --region us-east-1
```

2. Configure advanced event selectors to capture CloudWatch Logs log group authorization events:

```
aws cloudtrail put-event-selectors \
    --region us-east-1 \
    --trail-name cloudwatch-logs-api-key-audit \
    --advanced-event-selectors '[{
        "Name": "CloudWatch Logs API key authorization events",
        "FieldSelectors": [
            { "Field": "eventCategory", "Equals": ["Data"] },
            { "Field": "resources.type", "Equals":
 ["AWS::Logs::LogGroupAuthorization"] }
        ]
```

```
    }]'
```

3. Start trail logging:

```
aws cloudtrail start-logging \
    --name cloudwatch-logs-api-key-audit \
    --region us-east-1
```

Sending logs using the OTLP endpoint (OpenTelemetry Logs)

The OpenTelemetry Logs endpoint (`/v1/logs`) accepts OpenTelemetry Protocol (OTLP) log data in either JSON or Protobuf encoding. For detailed information about the OTLP endpoint, including configuration and usage, see Send metrics and traces to CloudWatch with OpenTelemetry.

If you are using bearer token authentication, complete the setup steps in the section called "Bearer token authentication" before proceeding.

Request format

- Method: POST
- Content-Type: `application/json` or `application/x-protobuf`
- Log group: `x-aws-log-group` header only (query parameter not supported)
- Log stream: `x-aws-log-stream` header

Example request

```
curl -X POST "https://logs.<region>.amazonaws.com/v1/logs" \
  -H "Authorization: Bearer ACWL<token>" \
  -H "Content-Type: application/json" \
  -H "x-aws-log-group: MyLogGroup" \
  -H "x-aws-log-stream: MyLogStream" \
  -d '{
  "resourceLogs": [
    {
      "resource": {
        "attributes": [
          {
            "key": "service.name",
```

```
            "value": { "stringValue": "my-service" }
          }
        ]
      },
      "scopeLogs": [
        {
          "scope": {
            "name": "my-library",
            "version": "1.0.0"
          },
          "logRecords": [
            {
              "timeUnixNano": "1741900000000000000",
              "severityNumber": 9,
              "severityText": "INFO",
              "body": {
                "stringValue": "User logged in successfully"
              },
              "attributes": [
                {
                  "key": "user.id",
                  "value": { "stringValue": "12345" }
                }
              ]
            }
          ]
        }
      ]
    }
  ]
}'
```

Responses

Success (all events accepted):

```
HTTP 200 OK
{}
```

Partial success (some events rejected):

```
{
```

```
  "partialSuccess": {
    "rejectedLogRecords": 5,
    "errorMessage": "{\"tooOldLogEventCount\": 3, \"tooNewLogEventCount\": 1,
 \"expiredLogEventCount\": 1}"
  }
}
```

When the request Content-Type is `application/x-protobuf`, the response is returned as a serialized `ExportLogsServiceResponse` protobuf message with the same fields.

OTLP-specific behaviors

The following behaviors are specific to the OTLP endpoint and are not present on the other HTTP ingestion endpoints:

- **Retry-After header** – Included on 503 and 429 responses to indicate when the client should retry.

Sending logs using the HLC endpoint (HLC Logs)

The HLC Logs endpoint (`/services/collector/event`) is based on the HTTP Log Collector (HLC) format.

If you are using bearer token authentication, complete the setup steps in the section called “Bearer token authentication” before proceeding.

Input modes

Each event is a JSON object with a required `"event"` field. Optional metadata fields: `"time"`, `"host"`, `"source"`, `"sourcetype"`, `"index"`.

Single event:

```
{"event":"Hello world!","time":1486683865.0}
```

JSON array of events:

```
[
  {"event":"msg1","time":1486683865.0},
```

```
  {"event":"msg2","time":1486683866.0}
]
```

Concatenated/batched events (no array wrapper):

```
{"event":"msg1","time":1486683865.0}{"event":"msg2","time":1486683866.0}
```

Event field (required)

The `"event"` field is mandatory. Its value can be any JSON type:

```
{"event":"a string message"}
{"event":{"message":"structured data","severity":"INFO"}}
{"event":42}
{"event":true}
```

Objects without an `"event"` field are silently skipped:

```
{"message":"this is skipped — no event field"}
```

Time field (optional)

The `"time"` field is in epoch seconds (not milliseconds), with optional decimal for sub-second precision.

Format	Example	Interpreted as
Float	`"time":1486683865.500`	1486683865500 ms
Integer	`"time":1486683865`	1486683865000 ms
String (float)	`"time":"1486683865.500"`	1486683865500 ms
String (integer)	`"time":"1486683865"`	1486683865000 ms
Missing	(no time field)	Server current time
Invalid	`"time":"invalid"`	Server current time

Content-Type

Only `application/json` is accepted.

Accepted JSON value types

Top-level type	Behavior
Object with `"event"`	Accepted
Object without `"event"`	Skipped
Array of objects	Each element processed individually
Concatenated objects	Each object processed individually
Primitive (string, number, boolean, null)	Skipped

Endpoint format

The HLC endpoint URL follows this format:

```
https://logs.<region>.amazonaws.com/services/collector/event?
logGroup=<name>&logStream=<name>[&entityName=<name>&entityEnvironment=<environment>]
```

Required parameters:

- `<region>` – AWS Region (for example, `us-east-1`, `eu-west-1`)
- `logGroup` – URL-encoded log group name
- `logStream` – URL-encoded log stream name

Optional parameters:

You can optionally associate your log events with a `Service` entity by including the following query parameters. Because logs sent through the HLC endpoint are custom telemetry, they are not automatically associated with an entity. By providing these parameters, CloudWatch Logs creates

an entity with `KeyAttributes.Type` set to `Service` and associates it with your log events. This enables the **Explore related** feature in CloudWatch to correlate these logs with other telemetry (metrics, traces, and logs) from the same service, making it easier to troubleshoot and monitor your applications across different signal types. For more information about entities and related telemetry, see Adding related information to custom telemetry.

- `entityName` – The name of the service entity to associate with the log events. This value is stored as the entity `KeyAttributes.Name` (for example, `my-application` or `api.myservice.com`).
- `entityEnvironment` – The environment where the service is hosted or what it belongs to. This value is stored as the entity `KeyAttributes.Environment` (for example, `production`, `ec2:default`, or `eks:my-cluster/default`).

Request format

Send logs using HTTP POST with the following headers and body:

Headers:

- `Authorization: Bearer <your-bearer-token>`
- `Content-Type: application/json`

Body format:

The request body should be in JSON format with an array of events:

```
{
    "event": [
        {
            "time": 1730141374.001,
            "event": "Application started successfully",
            "host": "web-server-1",
            "source": "application.log",
            "severity": "info"
        },
        {
            "time": 1730141374.457,
            "event": "User login successful",
            "host": "web-server-1",
```

```
            "source": "auth.log",
            "user": "john.doe"
        }
    ]
}
```

Field descriptions:

- `time` – Unix epoch timestamp in seconds, with optional decimal for sub-second precision (optional)
- `event` – The log message or event data (required)
- `host` – Source hostname or identifier (optional)
- `source` – Log source identifier (optional)

Additional custom fields can be included as needed.

Example request

```
curl -X POST "https://logs.<region>.amazonaws.com/services/collector/event?
logGroup=MyLogGroup&logStream=MyStream" \
  -H "Authorization: Bearer ACWL<token>" \
  -H "Content-Type: application/json" \
  -d '{"event":{"message":"User logged
 in","user_id":"u-123"},"time":1486683865.0,"host":"web-01","source":"auth-service"}'
```

Best practices

Batching events

For better performance and efficiency:

- Batch multiple events in a single request when possible
- Recommended batch size: 10–100 events per request
- Maximum request size: 1 MB

Error handling

Implement proper error handling in your application. Common HTTP status codes:

- `200 OK` – Logs successfully ingested
- `400 Bad Request` – Invalid request format or parameters
- `401 Unauthorized` – Invalid or expired bearer token
- `403 Forbidden` – Insufficient permissions
- `404 Not Found` – Log group or stream doesn't exist
- `429 Too Many Requests` – Rate limit exceeded
- `500 Internal Server Error` – Service error (retry with exponential backoff)

Limitations

- Maximum event size: 256 KB per event
- Maximum request size: 1 MB
- Maximum events per request: 10,000
- Log group names must follow CloudWatch Logs naming conventions
- Bearer token authentication must be enabled on the log group if bearer token authentication is used.

Sending logs using the NDJSON endpoint (ND-JSON Logs)

The ND-JSON Logs endpoint (`/ingest/bulk`) accepts logs in NDJSON (Newline Delimited JSON) format. Each line contains exactly one JSON value, separated by newline characters.

If you are using bearer token authentication, complete the setup steps in the section called “Bearer token authentication” before proceeding.

Request format

Send one JSON value per line, separated by `\n` (LF) or `\r\n` (CRLF). Empty lines are silently ignored.

```
{"timestamp":1771007942000,"message":"event one","level":"INFO"}
{"timestamp":1771007943000,"message":"event two","level":"ERROR"}
{"timestamp":1771007944000,"message":"event three","level":"DEBUG"}
```

Both `application/json` and `application/x-ndjson` are accepted as the Content-Type.

Accepted JSON value types

Per the NDJSON spec (RFC 8259), any valid JSON value is accepted on each line.

JSON objects (most common):

```
{"timestamp":1771007942000,"message":"User logged in","service":"auth"}
{"timestamp":1771007943000,"error":"Connection timeout","service":"api"}
```

JSON arrays (flattened into individual events):

```
[{"timestamp":1000,"message":"a"},{"timestamp":2000,"message":"b"}]
```

This single line produces 2 events. Each array element becomes a separate log event.

Primitive values:

```
"a plain string log message"
42
true
null
```

Each primitive becomes its own event with the server's current timestamp.

Mixed types:

```
{"timestamp":1771007942000,"message":"structured event"}
"unstructured string message"
42
{"timestamp":1771007943000,"error":"something failed"}
```

All 4 lines are accepted as valid events.

Line content	Behavior
JSON object	Accepted, timestamp extracted if present
JSON array	Flattened – each element becomes a separate event

Line content	Behavior
Empty array `[]`	Accepted, produces 0 events
JSON string	Accepted as event message
JSON number	Accepted as event message
JSON boolean	Accepted as event message
JSON null	Accepted as event message
Invalid JSON	Skipped (counted, processing continues)
Empty line	Ignored (not counted as skipped)

Timestamp field

The `"timestamp"` field is in epoch milliseconds (not seconds).

Format	Example	Interpreted as
Numeric (millis)	`"timestamp":1771007942000`	1771007942000 ms
Missing	(no timestamp field)	Server current time
Non-numeric	`"timestamp":"invalid"`	Server current time
Non-object line	`"hello"`, `42`, `true`	Server current time

Invalid lines

Lines that are not valid JSON are silently skipped and counted. Processing continues with the next line.

```
{"message":"valid event"}
```

```
this is not valid json
{"message":"another valid event"}
```

Result: 2 events ingested, 1 skipped. Returns `HTTP 200`.

If all lines are invalid, returns `HTTP 400` with `"All events were invalid"`.

Example request

```
curl -X POST "https://logs.<region>.amazonaws.com/ingest/bulk?
logGroup=MyLogGroup&logStream=MyStream" \
  -H "Authorization: Bearer ACWL<token>" \
  -H "Content-Type: application/x-ndjson" \
  -d '{"timestamp":1771007942000,"message":"User logged in","level":"INFO"}
{"timestamp":1771007943000,"message":"Query took 42ms","level":"DEBUG"}
{"timestamp":1771007944000,"error":"Connection refused","level":"ERROR"}'
```

Responses

Success (all events accepted):

```
HTTP 200 OK
{}
```

Partial success (some events rejected):

```
{
  "partialSuccess": {
    "rejectedLogRecords": 5,
    "errorMessage": "{\"tooOldLogEventCount\": 3, \"tooNewLogEventCount\": 1,
 \"expiredLogEventCount\": 1}"
  }
}
```

The `rejectedLogRecords` field is the total number of rejected events. The `errorMessage` field contains a JSON-encoded breakdown by rejection reason:

- `tooOldLogEventCount` – Events with timestamps older than the retention period
- `tooNewLogEventCount` – Events with timestamps too far in the future

- `expiredLogEventCount` – Events that expired during processing

Best practices

Batching events

For better performance and efficiency:

- Batch multiple events in a single request when possible
- Recommended batch size: 10–100 events per request
- Maximum request size: 1 MB

Error handling

Implement proper error handling in your application. Common HTTP status codes:

- `200 OK` – Logs successfully ingested
- `400 Bad Request` – Invalid request format or parameters
- `401 Unauthorized` – Invalid or expired bearer token
- `403 Forbidden` – Insufficient permissions
- `404 Not Found` – Log group or stream doesn't exist
- `429 Too Many Requests` – Rate limit exceeded
- `500 Internal Server Error` – Service error (retry with exponential backoff)

Limitations

- Maximum event size: 256 KB per event
- Maximum request size: 1 MB
- Maximum events per request: 10,000
- Log group names must follow CloudWatch Logs naming conventions
- Bearer token authentication must be enabled on the log group if bearer token authentication is used.

Sending logs using the Structured JSON endpoint (Structured JSON Logs)

The Structured JSON Logs endpoint (`/ingest/json`) accepts standard JSON – either a single JSON object or a JSON array of objects. This endpoint is designed for structured log data where each event is a JSON object.

If you are using bearer token authentication, complete the setup steps in the section called "Bearer token authentication" before proceeding.

Request format

Only `application/json` is accepted as the Content-Type.

Single JSON object:

```
{"timestamp":1771007942000,"message":"single event","level":"INFO"}
```

JSON array of objects:

```
[
  {"timestamp":1771007942000,"message":"event one","level":"INFO"},
  {"timestamp":1771007943000,"message":"event two","level":"ERROR"}
]
```

Accepted JSON value types

This endpoint is strict – only JSON objects are accepted as events.

Input	Behavior
Single JSON object	Accepted as one event
JSON array of objects	Each object becomes a separate event
Empty array `[]`	Accepted, produces 0 events
Non-object in array (string, number, etc.)	Skipped

Input	Behavior
Top-level primitive (`"hello"`, `42`)	Skipped
Concatenated objects `{...}{...}`	Only first object parsed

Example – array with mixed types:

```
[
  {"timestamp":1771007942000,"message":"valid object"},
  "just a string",
  42,
  {"timestamp":1771007943000,"message":"another valid object"}
]
```

Result: 2 events ingested (the objects), 2 skipped (the string and number).

Timestamp field

The `"timestamp"` field is in epoch milliseconds, same as the NDJSON endpoint.

Format	Example	Interpreted as
Numeric (millis)	`"timestamp":1771007942000`	1771007942000 ms
Missing	(no timestamp field)	Server current time
Non-numeric	`"timestamp":"invalid"`	Server current time

Example request

```
curl -X POST "https://logs.<region>.amazonaws.com/ingest/json?
logGroup=MyLogGroup&logStream=MyStream" \
  -H "Authorization: Bearer ACWL<token>" \
  -H "Content-Type: application/json" \
  -d '[{"timestamp":1771007942000,"message":"User logged in","user_id":"u-123"},
{"timestamp":1771007943000,"message":"Order placed","order_id":"o-456"}]'
```

Responses

Success (all events accepted):

```
HTTP 200 OK
{}
```

Partial success (some events rejected):

```
{
  "partialSuccess": {
    "rejectedLogRecords": 5,
    "errorMessage": "{\"tooOldLogEventCount\": 3, \"tooNewLogEventCount\": 1,
 \"expiredLogEventCount\": 1}"
  }
}
```

The `rejectedLogRecords` field is the total number of rejected events. The `errorMessage` field contains a JSON-encoded breakdown by rejection reason:

- `tooOldLogEventCount` – Events with timestamps older than the retention period
- `tooNewLogEventCount` – Events with timestamps too far in the future
- `expiredLogEventCount` – Events that expired during processing

Best practices

Batching events

For better performance and efficiency:

- Batch multiple events in a single request when possible
- Recommended batch size: 10–100 events per request
- Maximum request size: 1 MB

Error handling

Implement proper error handling in your application. Common HTTP status codes:

- `200 OK` – Logs successfully ingested

- `400 Bad Request` – Invalid request format or parameters
- `401 Unauthorized` – Invalid or expired bearer token
- `403 Forbidden` – Insufficient permissions
- `404 Not Found` – Log group or stream doesn't exist
- `429 Too Many Requests` – Rate limit exceeded
- `500 Internal Server Error` – Service error (retry with exponential backoff)

Limitations

- Maximum event size: 256 KB per event
- Maximum request size: 1 MB
- Maximum events per request: 10,000
- Log group names must follow CloudWatch Logs naming conventions
- Bearer token authentication must be enabled on the log group if bearer token authentication is used.

Comparison of HTTP ingestion endpoints

Feature	HLC Logs	ND-JSON Logs	Structured JSON Logs	OpenTelemetry Logs
Path	`/services/collector/event`	`/ingest/bulk`	`/ingest/json`	`/v1/logs`
Content-Type	`application/json`	`application/json` or `application/x-ndjson`	`application/json`	`application/json` or `application/x-protobuf`
Timestamp field	`"time"` (seconds)	`"timestamp"` (milliseconds)	`"timestamp"` (milliseconds)	`"timeUnixNano"` (nanoseconds)

Feature	HLC Logs	ND-JSON Logs	Structured JSON Logs	OpenTelemetry Logs
Required fields	`"event"`	None	None	OTLP structure (`"resourceLogs" `)
Partial success response	No	Yes	Yes	Yes
Query parameter support	Yes	Yes	Yes	No (headers only)
Entity metadata	Yes	Yes	Yes	No
Accepts primitives	No	Yes	No	No
Line-based parsing	No	Yes	No	No
Protobuf support	No	No	No	Yes
Retry-After header	No	No	No	Yes

Choosing an endpoint

- **Using HLC format?** Use HLC Logs. Your existing HLC payloads work with minimal changes.
- **Streaming line-by-line logs?** Use ND-JSON Logs. Best for log pipelines that emit one event per line. Most flexible – accepts any JSON value type.
- **Sending structured JSON payloads?** Use Structured JSON Logs. Best for applications that produce well-formed JSON objects or arrays.
- **Already using OpenTelemetry?** Use OpenTelemetry Logs. Accepts OTLP JSON or Protobuf format and supports partial success responses with retry semantics.

Syslog ingestion

Amazon CloudWatch Logs managed syslog ingestion lets you send syslog messages (RFC 5424, RFC 3164, and Cisco FTD/ASA) from firewalls, routers, switches, and Linux servers directly into CloudWatch Logs – without installing or managing any agents. Your syslog sources send messages over TCP, TCP+TLS, or UDP to a VPC endpoint in your account. The traffic is tunneled via AWS PrivateLink to the CloudWatch Logs syslog service, which automatically parses incoming messages and extracts structured fields such as facility, severity, hostname, and application name – eliminating the need for custom parsing pipelines. You can then query these fields using CloudWatch Logs Analytics to investigate security events or troubleshoot connectivity issues. This helps you centralize infrastructure log visibility, simplify operational workflows, and reduce the overhead of deploying and maintaining log collection agents across distributed environments.

If your syslog sources are already within your Amazon VPC, they can send messages directly to the VPC endpoint. If your sources are outside AWS (on-premises data centers, branch offices, or co-location facilities), they can reach the VPC endpoint through your VPN or Direct Connect connection.

Supported protocols and ports

Protocol	Port	Notes
TCP + TLS	6514	Encrypted in transit. Recommended for compliance requirements.
TCP plaintext	1514	Plaintext over AWS PrivateLink (network-isolated).
UDP	514	Best-effort delivery.

TLS on port 6514 is terminated at the network load balancer using an AWS-managed certificate issued by Amazon Trust Services. Your syslog clients trust this certificate automatically without any special configuration.

> **Note**
>
> UDP is a best-effort protocol. Messages may be lost due to network conditions. Use TCP for reliable delivery.

Supported syslog formats

CloudWatch Logs automatically detects and parses the following syslog formats:

- **RFC 5424** (the newer format) – Includes structured data, ISO 8601 timestamps, and explicit application name and process ID fields.
- **RFC 3164** (BSD syslog, the legacy format) – Includes BSD-style timestamps and a TAG field. Still widely used by network devices such as firewalls, routers, and switches.
- **Cisco FTD/ASA** – The syslog format used by Cisco Firepower Threat Defense (FTD) and Adaptive Security Appliance (ASA) devices. Messages are identified by the `%FTD-` or `%ASA-` tag in the message body.

Messages are stored in your log group in their original raw format. CloudWatch Logs automatically extracts structured fields from each format, which you can query using CloudWatch Logs Insights.

RFC 5424 extracted fields

Field	Description
`facility`	Log category name (for example, `kern`, `auth`, `local0`).
`facilityCode`	Numeric facility code (0–23).
`severity`	Severity level name (for example, `emerg`, `err`, `info`).
`severityCode`	Numeric severity code (0–7).
`timestamp`	Message timestamp in ISO 8601 format.
`hostname`	Source device hostname.
`appName`	Application name.

Field	Description
procId	Process ID.
msgId	Message identifier.
structuredData	RFC 5424 structured data elements (key-value metadata).
message	Message body.

RFC 3164 extracted fields

Field	Description
facility	Log category name.
facilityCode	Numeric facility code (0–23).
severity	Severity level name.
severityCode	Numeric severity code (0–7).
timestamp	Message timestamp (converted from BSD format to ISO 8601).
hostname	Source device hostname.
appName	Application name (extracted from TAG field).
procId	Process ID (extracted from TAG field, if present).
message	Message body.

Cisco FTD/ASA extracted fields

Field	Description
device	Device type (FTD, ASA, or FMC-AUDIT-LOG).

Field	Description
`timestamp`	Message timestamp (RFC 3164 or RFC 5424 format, depending on device configuration).
`deviceId`	Device hostname (present when `device-id` logging is configured on the appliance).
`severity`	Severity level name (for example, `informational` , `warning`, `critical`).
`severityLevel`	Numeric severity level (0–7).
`messageId`	Cisco numeric message identifier (for example, `106023`, `302013`).
`subsystem`	Subsystem name (present for certain message types).
`message`	Message body (plain text), or individual key-value fields when the body uses Cisco's structured format.

Message delivery

Unlike HTTP-based ingestion where the server returns a status code for each request, syslog does not provide a per-message success acknowledgment back to the sender. Once messages are received by the service, they are buffered and delivered to your log group with retries for transient errors. Delivery guarantees depend on the transport protocol you choose:

- **TCP (ports 6514 and 1514)** – Provides reliable delivery under normal operating conditions.

  When delivery is not possible, the service resets the TCP connection to signal the failure to your client. Messages in flight on that connection may be dropped, but the connection reset provides immediate backpressure so your client can detect the issue and buffer messages locally until the condition is resolved. Under capacity pressure, the service rejects new TCP connections early, providing the same backpressure signal.

  Conditions that cause a connection reset include:

  - The VPC endpoint policy denies access
  - Your account's `PutLogEvents` quota is exceeded

  - The target log group does not exist
  - The resource policy on the log group denies access
- **UDP (port 514)** – Best-effort delivery. Messages that cannot be delivered are dropped with no feedback to the sender. Messages may also be lost due to network congestion or capacity constraints. Use TCP if reliable delivery is important for your use case.

To detect and respond to delivery issues, monitor the `SyslogMessagesDropped` metric in CloudWatch. The `Reason` dimension indicates why messages were dropped so you can take corrective action. For more information, see the section called “Monitoring”.

Quotas and limits

Limit	Value	Notes
Maximum message size (TCP)	64 KB	Standard syslog messages are typically well under this limit. If you have a use case that requires larger messages, contact AWS Support.
Maximum message size (UDP)	8 KB	Standard syslog messages are typically well under this limit. If you have a use case that requires larger messages, contact AWS Support.
Ingestion throughput	Shared with `PutLogEvents`	Syslog ingestion counts against your account's `PutLogEvents` quota (5,000 requests per second per account per Region by default).

The `PutLogEvents` quota is adjustable. If your syslog traffic requires higher throughput, request a quota increase through Service Quotas.

Setting up syslog ingestion

This section walks you through the steps to set up syslog ingestion into CloudWatch Logs. You will create a VPC endpoint for the syslog service, a log group to receive the messages, a resource policy to authorize the syslog service, and a syslog configuration that routes traffic from your VPC endpoint to your log group.

You can perform all of these steps using the AWS Management Console, the AWS CLI, or the AWS SDKs. The following instructions provide both console and AWS CLI examples.

Prerequisites

The IAM identity (user or role) that you use to set up syslog ingestion must have permissions to create VPC endpoints, log groups, resource policies, and syslog configurations. The following example policy shows the minimum required permissions:

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "logs:CreateLogGroup",
        "logs:PutResourcePolicy",
        "logs:DeleteResourcePolicy",
        "logs:PutSyslogConfiguration",
        "logs:ListSyslogConfigurations",
        "logs:DeleteSyslogConfiguration"
      ],
      "Resource": "*"
    },
    {
      "Effect": "Allow",
      "Action": [
        "ec2:CreateVpc",
        "ec2:ModifyVpcAttribute",
        "ec2:CreateSubnet",
        "ec2:CreateSecurityGroup",
        "ec2:AuthorizeSecurityGroupIngress",
        "ec2:CreateVpcEndpoint",
        "ec2:ModifyVpcEndpoint",
        "ec2:DescribeVpcEndpoints"
```

```
      ],
      "Resource": "*"
    }
  ]
}
```

> **Note**
>
> If you already have a VPC, subnet, and security group, you only need the `ec2:CreateVpcEndpoint`, `ec2:ModifyVpcEndpoint`, and `ec2:DescribeVpcEndpoints` permissions for the EC2 actions.

Step 1: Create or identify a VPC

You need a VPC that is reachable from your on-premises network (via VPN or Direct Connect) where your syslog-generating devices reside. If you already have a VPC connected to your data center, skip this step and use your existing VPC and subnet IDs.

Console

To create a VPC (console)

1. Open the Amazon VPC console at https://console.aws.amazon.com/vpc/.
2. In the navigation pane, choose **Your VPCs**, then choose **Create VPC**.
3. For **Resources to create**, choose **VPC only**.
4. For **IPv4 CIDR block**, enter `10.0.0.0/16` (or a CIDR that does not conflict with your on-premises network).
5. Choose **Create VPC**.
6. Select the newly created VPC, choose **Actions**, **Edit VPC settings**. Enable both **DNS resolution** and **DNS hostnames**, then choose **Save**.
7. Create a subnet for the VPC endpoint:
   a. In the navigation pane, choose **Subnets**, then choose **Create subnet**.
   b. For **VPC ID**, select the VPC you created.
   c. For **Availability Zone**, choose an Availability Zone.
   d. For **IPv4 subnet CIDR block**, enter `10.0.1.0/24`.

e. Choose **Create subnet**.

AWS CLI

```
REGION=us-east-1

# Create VPC
VPC_ID=$(aws ec2 create-vpc \
  --cidr-block 10.0.0.0/16 \
  --region $REGION \
  --query 'Vpc.VpcId' --output text)

aws ec2 modify-vpc-attribute --vpc-id $VPC_ID --enable-dns-support --region $REGION
aws ec2 modify-vpc-attribute --vpc-id $VPC_ID --enable-dns-hostnames --region
 $REGION

# Create a subnet for the VPC endpoint
SUBNET_ID=$(aws ec2 create-subnet \
  --vpc-id $VPC_ID \
  --cidr-block 10.0.1.0/24 \
  --availability-zone ${REGION}a \
  --region $REGION \
  --query 'Subnet.SubnetId' --output text)

echo "VPC: $VPC_ID, Subnet: $SUBNET_ID"
```

Note

The VPC endpoint creates an elastic network interface (ENI) with a private IP in your subnet. Your on-premises devices reach this IP via your VPN or Direct Connect connection. Ensure your network routing allows traffic from your devices to the subnet CIDR.

Step 2: Create a security group

Create a security group for the VPC endpoint that allows inbound syslog traffic from your VPC. This controls which resources can send syslog to the endpoint.

Console

To create a security group (console)

1. Open the Amazon VPC console at https://console.aws.amazon.com/vpc/.
2. In the navigation pane, choose **Security groups**, then choose **Create security group**.
3. For **Security group name**, enter `syslog-vpce-sg`.
4. For **Description**, enter `Allow syslog traffic to VPC endpoint`.
5. For **VPC**, select the VPC you created or identified in Step 1.
6. In the **Inbound rules** section, choose **Add rule** and add the following rules:
   - **Rule 1:** Type = **Custom TCP**, Port range = 6514, Source = `10.0.0.0/16` (your VPC CIDR)
   - **Rule 2:** Type = **Custom TCP**, Port range = 1514, Source = `10.0.0.0/16`
   - **Rule 3:** Type = **Custom UDP**, Port range = 514, Source = `10.0.0.0/16`
7. Choose **Create security group**.

AWS CLI

```
VPCE_SG_ID=$(aws ec2 create-security-group \
  --group-name syslog-vpce-sg \
  --description "Allow syslog traffic to VPC endpoint" \
  --vpc-id $VPC_ID \
  --region $REGION \
  --query 'GroupId' --output text)

# Allow TCP+TLS (port 6514), TCP plaintext (port 1514), and UDP (port 514)
aws ec2 authorize-security-group-ingress --group-id $VPCE_SG_ID \
  --protocol tcp --port 6514 --cidr 10.0.0.0/16 --region $REGION
aws ec2 authorize-security-group-ingress --group-id $VPCE_SG_ID \
  --protocol tcp --port 1514 --cidr 10.0.0.0/16 --region $REGION
aws ec2 authorize-security-group-ingress --group-id $VPCE_SG_ID \
  --protocol udp --port 514 --cidr 10.0.0.0/16 --region $REGION
```

Tip

If you only plan to use one protocol (for example, TCP+TLS on port 6514), you only need to open that port in the security group.

Step 3: Create the VPC endpoint

Create an interface VPC endpoint pointing to the syslog AWS PrivateLink service. This gives your VPC a private entry point to the CloudWatch Logs syslog service.

Note

You can specify multiple subnet IDs across different Availability Zones when creating the endpoint. The endpoint creates an ENI in each subnet, providing higher availability without needing separate VPC endpoints per Availability Zone. A single VPC endpoint with subnets in multiple Availability Zones is sufficient.

Console

To create the VPC endpoint (console)

1. Open the Amazon VPC console at https://console.aws.amazon.com/vpc/.
2. In the navigation pane, choose **Endpoints**, then choose **Create endpoint**.
3. For **Name tag**, enter a name for the endpoint (for example, `syslog-vpce`).
4. For **Service category**, choose **AWS services**.
5. In the **Services** search field, enter `syslog-logs` and select the service `com.amazonaws.Region.syslog-logs`.
6. For **VPC**, select the VPC you created or identified in Step 1.
7. In the **Subnets** section, select one or more Availability Zones and choose the subnets where you want to create the endpoint network interfaces.
8. For **Security groups**, select the security group you created in Step 2 (`syslog-vpce-sg`).
9. (Optional) If you want to restrict what traffic is allowed through the endpoint, configure a VPC endpoint policy. For more information, see the section called “VPC endpoint policies”.
10. Choose **Create endpoint**.

11. After the endpoint state changes to **Available**, select the endpoint and note the **DNS names** value. This is the address your syslog devices will send to.

AWS CLI

```
VPCE_ID=$(aws ec2 create-vpc-endpoint \
  --vpc-id $VPC_ID \
  --service-name com.amazonaws.${REGION}.syslog-logs \
  --vpc-endpoint-type Interface \
  --subnet-ids $SUBNET_ID \
  --security-group-ids $VPCE_SG_ID \
  --region $REGION \
  --query 'VpcEndpoint.VpcEndpointId' --output text)

echo "VPC Endpoint: $VPCE_ID"
```

Wait for the endpoint to become available (approximately 60 seconds), then retrieve the DNS name:

```
VPCE_DNS=$(aws ec2 describe-vpc-endpoints --vpc-endpoint-ids $VPCE_ID \
  --region $REGION --query 'VpcEndpoints[0].DnsEntries[0].DnsName' --output text)

echo "Endpoint DNS: $VPCE_DNS"
```

Save the VPCE_DNS value – you'll configure your syslog devices to send to this address.

Step 4: Create a log group

Create the CloudWatch Logs log group where your syslog messages will be delivered. You can use any log group name. We recommend using a `/syslog/` prefix for organizational clarity.

Console

To create a log group (console)

1. Open the CloudWatch Logs console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, under **Log Management**, choose **Log groups**.
3. Choose **Create log group**.
4. For **Log group name**, enter `/syslog/my-devices`.

5. (Optional) Configure retention settings and encryption as needed.
6. Choose **Create**.

AWS CLI

```
aws logs create-log-group \
  --log-group-name /syslog/my-devices \
  --region $REGION
```

You do not need to create a log stream. The syslog service automatically creates a log stream named *VPCE_ID*_Syslog_*Region* (for example, vpce-0abc123def456_Syslog_us-east-1) when the first message is delivered.

Step 5: Add a resource policy

The CloudWatch Logs syslog service writes to your log group using the syslog.logs.amazonaws.com Service Principal. You must grant it permission via a resource policy on your log group. The aws:SourceArn condition ensures only traffic from your specific VPC endpoint can write to this log group.

```
ACCOUNT_ID=$(aws sts get-caller-identity --query 'Account' --output text)

aws logs put-resource-policy \
  --policy-name syslog-ingestion \
  --policy-document '{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Principal": {
        "Service": "syslog.logs.amazonaws.com"
      },
      "Action": [
        "logs:PutLogEvents",
        "logs:CreateLogStream"
      ],
      "Resource": "arn:aws:logs:'$REGION':'$ACCOUNT_ID':log-group:/syslog/my-
devices:*",
      "Condition": {
        "StringEquals": {
```

```
          "aws:SourceAccount": "'$ACCOUNT_ID'"
        },
        "ArnEquals": {
          "aws:SourceArn": "arn:aws:ec2:'$REGION':'$ACCOUNT_ID':vpc-
endpoint/'$VPCE_ID'"
        }
      }
    }
  ]
}' \
  --region $REGION
```

The conditions in the resource policy provide the following protections:

- `aws:SourceAccount` – Prevents confused deputy attacks. Only your account's traffic is accepted.
- `aws:SourceArn` – Scopes access to a specific VPC endpoint. If you have multiple VPC endpoints, add each one as a separate ARN in the condition.

To allow multiple VPC endpoints to write to the same log group, use the `ArnLike` condition operator with a wildcard:

```
"ArnLike": {
    "aws:SourceArn": "arn:aws:ec2:us-east-1:123456789012:vpc-endpoint/*"
}
```

Step 6: Create the syslog configuration

This step tells the CloudWatch Logs syslog service that traffic arriving from your VPC endpoint should be routed to your log group. Without this configuration, traffic from your endpoint is rejected.

Console

To create the syslog configuration (console)

1. Open the CloudWatch Logs console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, under **Log Management**, choose **Log groups**.
3. Choose the log group you created in Step 4 (for example, `/syslog/my-devices`).

4. In the log group details, locate the **Syslog Ingestion** section.
5. Choose **Configure**.
6. From the VPC endpoint dropdown, select the VPC endpoint you created in Step 3.
7. Choose **Create**.

AWS CLI

```
aws logs put-syslog-configuration \
  --log-group-identifier /syslog/my-devices \
  --vpc-endpoint-id $VPCE_ID \
  --region $REGION
```

Verify the configuration:

```
aws logs list-syslog-configurations \
  --log-group-identifier /syslog/my-devices \
  --region $REGION
```

Your syslog ingestion pipeline is now active. Any syslog messages sent to the VPC endpoint will be delivered to the `/syslog/my-devices` log group.

Step 7: Verify delivery and field extraction

Send a test message from any EC2 host or device that can reach the VPC endpoint, then use CloudWatch Log Analytics to verify that the message was delivered and that structured fields were extracted correctly. Messages typically appear within 10–20 seconds.

Send a test message (TCP plaintext):

```
echo "<134>1 $(date -u +%Y-%m-%dT%H:%M:%SZ) myhost myapp 1234 - - Hello from syslog" |
 \
  nc $VPCE_DNS 1514
```

Verify delivery and extracted fields:

Console

To verify delivery using Log Analytics (console)

1. Open the CloudWatch Logs console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, under **Logs**, choose **Log Analytics**.
3. In the log group selector, choose your log group (for example, `/syslog/my-devices`).
4. Enter the following query and choose **Run query**:

```
fields @timestamp, facility, severity, hostname, appName, procId, message
| sort @timestamp desc
| limit 10
```

5. Verify that your test message appears and that the extracted fields are populated correctly. For the test message above, you should see `facility` = `local0`, `severity` = `info`, `hostname` = `myhost`, `appName` = `myapp`, and `procId` = `1234`.

AWS CLI

Start a Log Analytics query to verify delivery and field extraction:

```
QUERY_ID=$(aws logs start-query \
  --log-group-name /syslog/my-devices \
  --start-time $(date -d '5 minutes ago' +%s 2>/dev/null || echo $(date -v-5M +%s))
 \
  --end-time $(date +%s) \
  --query-string 'fields @timestamp, facility, severity, hostname, appName, procId,
 message | sort @timestamp desc | limit 10' \
  --region $REGION \
  --query 'queryId' --output text)

# Wait a few seconds for the query to complete, then retrieve results
aws logs get-query-results \
  --query-id $QUERY_ID \
  --region $REGION
```

Verify that your test message appears and that the extracted fields are populated correctly. For the test message above, you should see `facility` = `local0`, `severity` = `info`, `hostname` = `myhost`, `appName` = `myapp`, and `procId` = `1234`.

Configuring syslog devices

After setting up syslog ingestion, configure your syslog sources to send messages to the VPC endpoint DNS name. Your devices reach the endpoint via your VPN or Direct Connect connection to the VPC.

> **Note**
>
> The following configurations are provided as examples. For complete configuration options and best practices, refer to the official documentation for your syslog implementation (rsyslog, syslog-ng, or your device vendor).

In the following examples, replace *VPCE_DNS* with the VPC endpoint DNS name from the setup procedure (for example, `vpce-0abc123def456.syslog-logs.us-east-1.vpce.amazonaws.com`).

rsyslog

rsyslog is the default syslog daemon on most Linux distributions. Add the following configuration to `/etc/rsyslog.d/50-cwl-syslog.conf`.

TCP + TLS:

```
# Forward all logs to CloudWatch Logs via TCP+TLS
action(type="omfwd"
  target="VPCE_DNS"
  port="6514"
  protocol="tcp"
  StreamDriver="gtls"
  StreamDriverMode="1"
  StreamDriverAuthMode="x509/certvalid"
  template="RSYSLOG_SyslogProtocol23Format"
  queue.type="LinkedList"
  queue.filename="cwl_fwd"
  queue.saveOnShutdown="on"
  action.resumeRetryCount="-1")
```

TCP plaintext:

```
# Forward all logs to CloudWatch Logs via plaintext TCP
action(type="omfwd"
  target="VPCE_DNS"
  port="1514"
  protocol="tcp"
  template="RSYSLOG_SyslogProtocol23Format"
  queue.type="LinkedList"
  queue.filename="cwl_fwd"
  queue.saveOnShutdown="on"
  action.resumeRetryCount="-1")
```

UDP:

```
# Forward all logs to CloudWatch Logs via UDP
action(type="omfwd"
  target="VPCE_DNS"
  port="514"
  protocol="udp"
  template="RSYSLOG_SyslogProtocol23Format")
```

After adding the configuration, restart rsyslog:

```
sudo systemctl restart rsyslog
```

> **Note**
>
> The `queue.type="LinkedList"` and `queue.saveOnShutdown="on"` directives enable disk-assisted queuing. If the connection to the VPC endpoint is temporarily lost, rsyslog buffers messages locally and retries delivery.

Filtering by facility or severity:

To send only specific messages, add a filter before the action:

```
# Send only auth messages via TCP+TLS
auth,authpriv.* action(type="omfwd"
  target="VPCE_DNS"
  port="6514"
  protocol="tcp"
```

```
  StreamDriver="gtls"
  StreamDriverMode="1"
  StreamDriverAuthMode="x509/certvalid"
  template="RSYSLOG_SyslogProtocol23Format")
```

syslog-ng

syslog-ng is commonly used on network appliances and enterprise Linux systems. Add the following configuration to `/etc/syslog-ng/conf.d/cwl-syslog.conf`.

TCP + TLS:

```
destination d_cwl_syslog {
  network("VPCE_DNS"
    port(6514)
    transport("tls")
    tls(
      peer-verify(required-trusted)
      ca-dir("/etc/ssl/certs")
    )
  );
};

log {
  source(s_sys);
  destination(d_cwl_syslog);
};
```

TCP plaintext:

```
destination d_cwl_syslog {
  network("VPCE_DNS"
    port(1514)
    transport("tcp")
  );
};

log {
  source(s_sys);
  destination(d_cwl_syslog);
};
```

UDP:

```
destination d_cwl_syslog {
  network("VPCE_DNS"
    port(514)
    transport("udp")
  );
};

log {
  source(s_sys);
  destination(d_cwl_syslog);
};
```

After adding the configuration, restart syslog-ng:

```
sudo systemctl restart syslog-ng
```

Quick validation

Use the following commands from any host that can reach the VPC endpoint to verify connectivity.

TCP plaintext (port 1514):

```
echo "<134>1 $(date -u +%Y-%m-%dT%H:%M:%SZ) myhost myapp 1234 - - Hello from syslog" |
 \
  nc VPCE_DNS 1514
```

TCP + TLS (port 6514):

```
echo "<134>1 $(date -u +%Y-%m-%dT%H:%M:%SZ) myhost myapp 1234 - - Hello TLS syslog" | \
  openssl s_client -connect VPCE_DNS:6514 -quiet -no_ign_eof
```

UDP (port 514):

```
echo "<134>1 $(date -u +%Y-%m-%dT%H:%M:%SZ) myhost myapp 1234 - - Hello UDP syslog" | \
  nc -u -w1 VPCE_DNS 514
```

After sending test messages, verify delivery in CloudWatch Logs (usually within 10–20 seconds):

```
aws logs filter-log-events \
  --log-group-name /syslog/my-devices \
  --start-time $(date -d '5 minutes ago' +%s000 2>/dev/null || echo $(($(date -v-5M +
%s) * 1000))) \
  --region $REGION
```

Network appliances

Most firewalls, routers, and switches support configuring an external syslog server by specifying a destination IP address and port. Use the private IP address of the VPC endpoint ENI (visible in the Amazon VPC console under **Endpoints**) and one of the supported ports (6514, 1514, or 514).

Consult your device's documentation for the specific configuration syntax. The key settings to configure are:

- **Server address** – The VPC endpoint DNS name or ENI private IP address.
- **Port** – 6514 (TCP+TLS), 1514 (TCP), or 514 (UDP).
- **Protocol** – TCP (recommended) or UDP.
- **Format** – RFC 5424 (preferred) or RFC 3164 (legacy). Both are supported.

TLS certificate trust

The TLS connection on port 6514 uses an AWS-managed certificate issued by Amazon Trust Services. Most operating systems and syslog daemons trust this certificate automatically because the Amazon Trust Services root certificates are included in standard CA trust stores.

If your device does not trust the certificate by default, download the Amazon Trust Services root certificates from https://www.amazontrust.com/repository/ and add them to your device's CA trust store.

Monitoring syslog ingestion

The syslog ingestion service publishes metrics to CloudWatch in the `AWS/Logs` namespace. These metrics give you visibility into your syslog ingestion pipeline – what was received, what was dropped, and why.

To view these metrics in the CloudWatch console, navigate to **Metrics** > **All metrics** > **AWS/Logs** and filter by the metric names listed below.

Syslog metrics

Metric	Dimensions	Description
SyslogMessagesReceived	LogGroupName	The number of syslog messages successfully ingested into your log group.
SyslogMessagesDropped	LogGroupName , Reason	The number of syslog messages that could not be delivered. See the section called "Drop reasons" for details.
SyslogConnectionsRejected	Reason	The number of TCP connections that were rejected.
SyslogConnectionsEstablished	—	The number of TCP connections successfully accepted.
SyslogConnectionsClosed	—	The number of TCP connections closed.

Drop reasons

The SyslogMessagesDropped metric includes a Reason dimension that indicates why messages were dropped.

Reason	Description
MessageRateLimitExceeded	Your account's PutLogEvents quota was exceeded. Consider requesting a quota increase.
MessageSizeExceeded	A UDP datagram exceeded the maximum message size.
ServiceUnavailable	Internal capacity or rate limit exceeded. This is typically transient.
ResourceNotFound	The target log group does not exist. Verify that the log group has not been deleted.

Reason	Description
AccessDenied	The resource policy on the log group does not grant access to the syslog service. Verify that the resource policy is correct.
VpcePolicyDenied	The VPC endpoint policy denied the request. Review your VPC endpoint policy.
InternalError	An unexpected internal error occurred. If this persists, contact AWS Support.

Connection rejection reasons

The SyslogConnectionsRejected metric includes a Reason dimension.

Reason	Description
VpcePolicyDenied	The VPC endpoint policy denied the connection.
ServiceUnavailable	Connection dropped due to an internal error.

Recommended alarms

We recommend creating CloudWatch alarms on the following conditions to detect issues early:

Alarm	Condition	Suggested action
Messages being dropped	SyslogMessagesDropped > 0 for 5 minutes	Investigate the Reason dimension to determine the cause.
Access denied	SyslogMessagesDropped with Reason=AccessDenied	Verify that the resource policy on the log group is correctly configured.

Alarm	Condition	Suggested action
Log group missing	`SyslogMessagesDropped` with `Reason=ResourceNotFound`	Verify that the log group exists and has not been deleted.
No messages received	`SyslogMessagesReceived` = 0 for 15 minutes (when normally > 0)	Verify that devices are still sending and that network connectivity to the VPC endpoint is intact.

For information about creating CloudWatch alarms, see Creating CloudWatch alarms in the *CloudWatch User Guide*.

Viewing syslog metrics on the automatic dashboard

CloudWatch provides an automatic dashboard for CloudWatch Logs that includes a **Syslog Ingestion** section. This dashboard appears automatically when your account publishes syslog metrics – no manual setup is required. The dashboard includes one chart for each metric described in the section called "Syslog metrics". Each chart displays the metric rate broken down by the relevant dimensions, such as log group or reason.

Accessing the dashboard

To view the syslog automatic dashboard:

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Dashboards**, then choose **Automatic dashboards**.
3. Choose the **CloudWatch Logs** dashboard.
4. Scroll to the **Syslog Ingestion** section.

Sample queries for syslog data

The following CloudWatch Logs Insights queries demonstrate common analysis patterns for syslog data. They use the structured fields that CloudWatch Logs automatically extracts from RFC 5424, RFC 3164, and Cisco FTD/ASA messages. For the complete list of extracted fields, see the section called "Supported syslog formats".

These queries are also available in the CloudWatch console. In CloudWatch Logs Insights, choose **Queries**, and then expand the **Syslog** category.

Security and access monitoring

Sudo and privilege escalation events

The following query lists recent sudo privilege-escalation activity on Linux hosts. It filters for the sudo application name and works with both RFC 3164 and RFC 5424 messages.

```
filter appName="sudo"
| fields @timestamp, hostname, message
| sort @timestamp desc
| limit 50
```

Top 50 hosts with failed SSH authentication

The following query counts failed SSH authentication attempts for each host. It matches sshd messages that contain "Failed password" or "Failed publickey". Use it to identify hosts that are targets of brute-force attacks.

```
filter appName="sshd" and (message like /Failed password/ or message like /Failed
 publickey/)
| stats count(*) as failedAttempts by hostname
| sort failedAttempts desc
| limit 50
```

Operational visibility

Log volume by host over time

The following query counts messages for each host in 5-minute intervals. Use it to measure fleet activity, identify volume spikes, or detect hosts that have stopped sending. This query works with all syslog format types.

```
stats count(*) as messages by hostname, bin(5m)
| sort messages desc
```

Message volume by facility and severity

The following query counts messages grouped by facility and severity level. Use it to understand which subsystems generate the most log traffic and at what severity level.

```
stats count(*) as messageCount by facility, severity
| sort messageCount desc
```

High-severity messages by application

The following query filters to high-priority messages (severityCode 0–3, which corresponds to emerg, alert, crit, and err) and counts them by application. Use it to identify which applications are generating the most errors.

```
filter severityCode<=3
| stats count(*) as errorCount by appName
| sort errorCount desc
```

Warning-and-above trend over time

The following query counts messages at warning severity or higher (severityCode 0–4) in 5-minute intervals. Use it with the visualization feature in Logs Insights to chart error spikes over time.

```
filter severityCode<=4
| stats count(*) as events by bin(5m)
| sort @timestamp
```

Firewall and network device queries

Cisco denied connections (ACL 106023)

The following query is for Cisco ASA and FTD firewalls. It counts ACL-denied connections (Cisco message ID 106023) grouped by device, which helps you identify devices with the most denied traffic.

```
filter messageId="106023"
| stats count(*) as denies by deviceId
| sort denies desc
```

```
| limit 20
```

Cisco ASA/FTD events by message ID

The following query is for Cisco FTD and ASA firewalls. It counts events grouped by Cisco message ID and severity to help you identify the most frequent event types across your firewall fleet.

```
filter ispresent(messageId)
| stats count(*) as eventCount by messageId, severity
| sort eventCount desc
```

Firewall dropped packets by source IP

The following query parses firewall DROP messages (for example, from iptables or nftables) to count dropped packets by source IP address. Use it to identify the top sources of blocked traffic.

```
filter message like /DROP/
| parse message /SRC=(?<srcAddr>\S+)/
| stats count(*) as drops by srcAddr
| sort drops desc
| limit 20
```

VPC endpoint policies for syslog

You can attach a VPC endpoint policy to your syslog VPC endpoint to control what traffic is allowed through it. This provides an additional layer of access control beyond security groups and resource policies.

By default, a VPC endpoint has a full-access policy that allows all traffic. You can restrict this by attaching a custom policy. For more information about VPC endpoint policies, see Control access using endpoint policies in the *AWS PrivateLink Guide*.

> **Important**
>
> Syslog traffic arrives as an anonymous principal (no IAM identity on the wire). Policies must use `"Principal": "*"` and scope access using action, resource, or VPC condition keys. Principal-scoped policies (for example, policies that allow only a specific IAM role) will deny all syslog traffic.

Supported condition keys

The following condition keys are supported in VPC endpoint policies for syslog:

Condition key	Description	Example value
`aws:SourceVpc`	The VPC from which the traffic originates.	`vpc-111bbb22`
`aws:SourceVpce`	The VPC endpoint through which the traffic arrives.	`vpce-0abc123def456`
`aws:VpcSourceIp`	The private IP address of the sender within the VPC.	`10.0.1.50`
`aws:ResourceAccount`	The account that owns the target log group.	`123456789012`
`aws:ResourceOrgID`	The organization ID of the account that owns the target log group.	`o-aa111bb222`
`aws:ResourceOrgPaths`	The organizational unit path of the account that owns the target log group.	`o-aa111bb222/r-ab12/ou-ab12-11111111/*`

The following condition keys are **not supported** because syslog traffic has no IAM principal identity:

- `aws:PrincipalArn`
- `aws:PrincipalAccount`
- `aws:PrincipalOrgID`
- `aws:PrincipalOrgPaths`
- `aws:PrincipalTag/*`

Policies that use unsupported condition keys will result in an implicit deny, blocking all syslog traffic through the endpoint.

Restrict to a specific log group

The following policy allows syslog traffic only to a specific log group:

```
aws ec2 modify-vpc-endpoint \
  --vpc-endpoint-id $VPCE_ID \
  --policy-document '{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Principal": "*",
      "Action": "logs:PutLogEvents",
      "Resource": "arn:aws:logs:Region:account-id:log-group:/syslog/my-devices"
    }
  ]
}' \
  --region $REGION
```

Deny all traffic

The following policy blocks all syslog traffic through the endpoint. This is useful for temporarily stopping ingestion without deleting the endpoint:

```
aws ec2 modify-vpc-endpoint \
  --vpc-endpoint-id $VPCE_ID \
  --policy-document '{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Deny",
      "Principal": "*",
      "Action": "*",
      "Resource": "*"
    }
  ]
}' \
  --region $REGION
```

Reset to default policy

To restore the default allow-all policy:

```
aws ec2 modify-vpc-endpoint \
  --vpc-endpoint-id $VPCE_ID \
  --reset-policy \
  --region $REGION
```

Policy propagation

After you create or modify a VPC endpoint policy, it can take up to several minutes for the policy change to take effect. During this propagation period, the previous policy (or default policy) continues to apply.

If a VPC endpoint policy denies syslog traffic, you will see the following indicators:

- TCP connections are closed immediately after the policy evaluation.
- UDP datagrams are dropped.
- The `SyslogMessagesDropped` metric with `Reason=VpcePolicyDenied` is emitted.
- The `SyslogConnectionsRejected` metric with `Reason=VpcePolicyDenied` is emitted for TCP connections.

Troubleshooting syslog ingestion

This section describes common issues with syslog ingestion and how to resolve them.

Messages not appearing in the log group

If you have sent syslog messages but they are not appearing in your log group, check the following in order:

1. **Verify the syslog configuration exists.**

   Run `list-syslog-configurations` to confirm that your VPC endpoint is registered with the log group:

   ```
   aws logs list-syslog-configurations \
     --log-group-identifier /syslog/my-devices \
     --region $REGION
   ```

   If no configuration is returned, create one with `put-syslog-configuration`.

2. **Verify the resource policy.**

   Ensure the resource policy on the log group grants `logs:PutLogEvents` and `logs:CreateLogStream` to `syslog.logs.amazonaws.com`, and that the `aws:SourceArn` condition matches your VPC endpoint ARN exactly:

   ```
   aws logs describe-resource-policies --region $REGION
   ```

   Check the `SyslogMessagesDropped` metric with `Reason=AccessDenied` to confirm if authorization is the issue.

3. **Verify the security group.**

   Ensure the security group attached to the VPC endpoint allows inbound traffic on the port you are using (6514, 1514, or 514) from the source CIDR:

   ```
   aws ec2 describe-security-groups \
     --group-ids $VPCE_SG_ID \
     --region $REGION \
     --query 'SecurityGroups[0].IpPermissions'
   ```

4. **Verify network connectivity.**

   From the device or a host on the same network, test TCP connectivity to the endpoint:

   ```
   # TCP connectivity test
   nc -zv $VPCE_DNS 6514
   nc -zv $VPCE_DNS 1514
   ```

   If the connection is refused or times out, verify VPN/Direct Connect routing and that the device can reach the VPC endpoint subnet.

5. **Check the VPC endpoint policy.**

   If you have attached a custom VPC endpoint policy, verify it allows the required actions. Check the `SyslogMessagesDropped` metric with `Reason=VpcePolicyDenied`.

TLS handshake failures

If your syslog client fails to establish a TLS connection on port 6514:

- **Certificate trust** – Ensure your device's CA trust store includes the Amazon Trust Services root certificates. Most operating systems include these by default. Download them from https://www.amazontrust.com/repository/ if needed.
- **TLS version** – The service supports TLS 1.2 and TLS 1.3. Ensure your syslog client supports at least TLS 1.2.
- **Hostname verification** – If your client verifies the server hostname, ensure it is configured to connect using the VPC endpoint DNS name (not an IP address).

Test the TLS connection manually with OpenSSL:

```
openssl s_client -connect $VPCE_DNS:6514 -brief
```

A successful connection shows the TLS version and cipher suite. If it fails, the error message indicates the cause.

UDP messages lost

UDP is a best-effort protocol. Some message loss is expected behavior under the following conditions:

- Network congestion between your device and the VPC endpoint.
- Messages exceed the maximum UDP datagram size.
- Temporary service capacity constraints (indicated by `SyslogMessagesDropped` with `Reason=ServiceUnavailable`).

If reliable delivery is required, use TCP (port 1514 or 6514) instead. TCP provides delivery acknowledgment and automatic retransmission.

Connection refused

If your device reports "connection refused" when connecting to the VPC endpoint:

- Verify the VPC endpoint is in the `available` state:

```
aws ec2 describe-vpc-endpoints --vpc-endpoint-ids $VPCE_ID \
  --region $REGION --query 'VpcEndpoints[0].State'
```

- Verify you are connecting on a supported port (6514, 1514, or 514).
- Verify VPN or Direct Connect routing allows traffic from your device's network to the VPC endpoint subnet.
- Check the security group allows inbound traffic on the port you are using.

Messages dropped due to rate limiting

If the `SyslogMessagesDropped` metric shows `Reason=MessageRateLimitExceeded`, your syslog traffic is exceeding your account's `PutLogEvents` quota.

To resolve this:

1. Check your current quota in the Service Quotas console under Amazon CloudWatch Logs.
2. Request a quota increase if your syslog throughput requires it. See Requesting a quota increase in the *Service Quotas User Guide*.

Using CloudWatch Logs with an AWS SDK

AWS software development kits (SDKs) are available for many popular programming languages. Each SDK provides an API, code examples, and documentation that make it easier for developers to build applications in their preferred language.

SDK documentation	Code examples
AWS SDK for C++	AWS SDK for C++ code examples
AWS CLI	AWS CLI code examples
AWS SDK for Go	AWS SDK for Go code examples
AWS SDK for Java	AWS SDK for Java code examples
AWS SDK for JavaScript	AWS SDK for JavaScript code examples
AWS SDK for Kotlin	AWS SDK for Kotlin code examples
AWS SDK for .NET	AWS SDK for .NET code examples
AWS SDK for PHP	AWS SDK for PHP code examples
AWS Tools for PowerShell	AWS Tools for PowerShell code examples
AWS SDK for Python v4	AWS SDK for Python v4 code examples
AWS SDK for Python (Boto3)	AWS SDK for Python (Boto3) code examples
AWS SDK for Ruby	AWS SDK for Ruby code examples
AWS SDK for Rust	AWS SDK for Rust code examples
AWS SDK for SAP ABAP	AWS SDK for SAP ABAP code examples
AWS SDK for Swift	AWS SDK for Swift code examples

For examples specific to CloudWatch Logs, see Code examples for CloudWatch Logs using AWS SDKs.

Example availability

Can't find what you need? Request a code example by using the **Provide feedback** link at the bottom of this page.

Log management

CloudWatch Logs provides advanced log management capabilities that help you organize, transform, and analyze your log data more effectively. These features include cross-account and cross-region data centralization, automatic data discovery and schema management, log transformation during ingestions, and enhanced analytics with facets for interactive log exploration.

Topics

Data source discovery and management

CloudWatch Logs automatically discovers and categorizes your log data by data source and type, making it easier to understand and manage your logs at scale. This feature provides schema discovery for AWS vended sources such as Amazon VPC Flow Logs, CloudTrail, and Route 53, as well as third-party security tools.

The Logs Management console provides a high-level view of your logs organized by data source and type, rather than just log groups. This organization helps you:

- View logs categorized by AWS services, third-party sources (such as Okta or CrowdStrike), and custom sources
- Understand the schema and structure of your log data automatically
- Create field index policies based on discovered schema fields
- Manage logs more efficiently across different data sources
- Query logs by different data sources

When you enable CloudWatch Logs logging for supported AWS services, CloudWatch Logs automatically applies the appropriate schema to your logs. This automatic schema application helps maintain consistency and provides immediate insights into your log structure.

What is CloudWatch Logs Data Sources?

CloudWatch Logs Data Sources is a feature that provides a new way to organize and categorize your logs data based on the source that generates the logs. While CloudWatch Logs traditionally uses log groups to organize logs, Data Sources offers an additional layer of organization that groups logs by their originating service and log type.

How Data Sources work

Data Sources provide service-based log organization and simplified discovery across your AWS infrastructure. You can easily locate logs from specific services and filter by log type without needing to know individual log group names or structures.

For third-party sources and optionally for application logs sources, Data Sources work with CloudWatch pipelines to categorize your logs. When you configure a pipeline to ingest and transform logs, you specify the data source name and type. CloudWatch Logs then automatically categorizes all logs that the pipeline processes. For more information, see CloudWatch pipelines in the *Amazon CloudWatch User Guide*.

Data Sources categorize logs using two key identifiers:

- **Data Source Name**: The AWS service, third-party source, or application that generates the logs (for example, Route 53, Amazon VPC, CloudTrail, Okta SSO, or CrowdStrike Falcon).
- **Data Source Type**: The specific type of log generated by that service.

A schema defines the structure of log data, including what fields are present and how information is organized. A single data source can produce multiple types of logs with different schemas and purposes. For example, the AWS CloudTrail data source has two types: management events (which track control plane operations like creating or deleting resources) and data events (which track data plane operations like S3 object access). Each type has a different schema because they capture different kinds of information.

How to get started

CloudWatch Logs categorizes your logs into data sources based on their origin. The method depends on the type of logs you're working with:

AWS service logs

Logs from supported AWS services are automatically grouped by data source without any configuration required. CloudWatch Logs recognizes these logs and applies the appropriate data source name and type based on the originating service.

Third-party logs

Third-party logs require pipelines for data source categorization. When you configure a pipeline to ingest logs from supported third-party sources such as Microsoft Office 365, Okta, CrowdStrike, or Palo Alto Networks, you specify the data source name and type in the pipeline configuration. CloudWatch Logs automatically categorizes all logs that the pipeline processes using those identifiers.

Pipelines can optionally transform third-party logs into Open Cybersecurity Schema Framework (OCSF) format for standardized security event analysis. When OCSF transformation is enabled, the data source name and type are automatically determined based on the OCSF schema mapping. Without OCSF transformation, you specify the data source name and type in the pipeline configuration.

Application logs

For custom application logs, you can categorize them by data source using one of these methods:

- **Log group tags** - Add tags to your log groups using the keys `cw:datasource:name` and `cw:datasource:type` to specify the data source name and type respectively for all logs ingested in the log group. Tag values can be up to 64 characters and may contain only lower case letters, numbers and underscore. They must start with either a letter or a number and they may not contain double underscores(__) .
- **Pipeline configuration** - Configure data source information through log processing pipelines when ingesting your application logs.

> **Note**
>
> Data source names cannot start with "aws" or "amazon" to avoid conflicts with AWS service logs.

System fields

CloudWatch Logs automatically adds three system fields to logs that are categorized by data source. These fields serve as default facets:

- `@data_source_name` - Contains the name of the data source, or "Unknown" if not determined
- `@data_source_type` - Contains the type of the data source, or "Unknown" if not determined
- `@data_format` - Indicates the format of the log data

When the data source name or type cannot be determined, these fields are set to "Unknown". Data sources with "Unknown" values are still visible in facets and in the data sources table under "Log Management" in Console, allowing you to identify uncategorized logs and from which log group they come from.

The `@data_format` field can contain one of the following values:

- `Default` - Logs ingested without modification.
- `Custom` - Logs processed through pipeline processors or logs ingested into log group with data source name/type tags.
- `OCSF-<version>` - Logs processed with OCSF (Open Cybersecurity Schema Framework) processors in pipelines.
- `AWS-OTEL-LOG-V<version>` - OpenTelemetry logs ingested through the CloudWatch OTLP endpoint.
- `AWS-OTEL-TRACE-V<version>` - OpenTelemetry traces ingested through the CloudWatch OTLP endpoint.

These system fields enable you to filter and query your logs based on their source and format, making it easier to work with logs from different origins and processing pipelines.

Accessing Data Sources

Console

In the CloudWatch Logs console, you use the **Log Management** tab to access your data sources. CloudWatch Logs automatically consolidates your log data by data sources and types, continuously discovering newly ingested data. From the data sources list, you can create pipelines, define field indexes and facets.

AWS CLI

Use the following command to list distinct data sources and types of logs in your account:

```
aws logs list-aggregate-log-group-summaries --group-by DATA_SOURCE_NAME_AND_TYPE
```

Relationship to log groups

Data sources complement rather than replace log groups. Your logs continue to be stored in log groups as before, but now they're also automatically tagged with data source information. This dual organization allows you to:

- Use log groups for fine-grained access control and retention policies
- Use data sources for service-based log discovery and analysis
- Query logs using either organizational method depending on your needs

Data sources make it easier to work with logs at scale by providing a service-centric view of your log data across your AWS infrastructure.

Features enabled by data sources

Data sources enable advanced log processing and analytics capabilities through field discovery and consistent data structures.

- **Facets**: Facets are indexed log fields that provide interactive filtering and analysis without writing queries. CloudWatch Logs automatically creates facets for data source name and type, and you can create facet policies on discovered fields to accelerate troubleshooting. Facets display value distributions and counts in CloudWatch Logs Insights, making it easy to identify patterns through point-and-choose exploration.
- **Pipelines**: Create transformation pipelines that apply to all logs from a specific data source name and type. This allows you to define consistent processing rules for logs from the same source.
- **Field discovery**: CloudWatch Logs automatically discovers fields and their data types for each data source name and type combination based on pipeline processors. For AWS managed logs, field structures are predefined. For application logs, we recommend maintaining consistent log formats to maximize compatibility with analytics tools such as Amazon S3 tables that require well-defined field structures.

You can view the complete list of fields and their types for any data source using the `GetLogFields` API:

```
aws logs get-log-fields --data-source-name <name>  --data-source-type <type>
```

This field discovery and consistency enables advanced analytics and integrations, as external tools can work with predictable field structures when processing your log data.

Supported data sources

CloudWatch Logs supports a wide range of data sources including AWS services, third-party security and IT tools, and custom application sources. This page provides a comprehensive catalog of all supported data sources. For information about how data sources are discovered and managed, see the section called “Data source discovery and management”.

Topics

Supported AWS services for data sources

The following table lists the AWS services that are automatically categorized by CloudWatch Logs as data sources:

Data Source Name (@data_source_name field)	Data Source Type (@data_source_type field)
amazon_api_gateway	access
amazon_bedrock_agentcore	browser_usage
amazon_bedrock_agentcore	code_interpreter_application
amazon_bedrock_agentcore	code_interpreter_usage
amazon_bedrock_agentcore	gateway_application

Data Source Name (@data_source_name field)	Data Source Type (@data_source_type field)
amazon_bedrock_agentcore	identity_workload_application
amazon_bedrock_agentcore	memory_application
amazon_bedrock_agentcore	online_evaluation_config
amazon_bedrock_agentcore	runtime_application
amazon_bedrock_agentcore	runtime_usage
amazon_bedrock_agents	application
amazon_bedrock_agents	event
amazon_bedrock_knowledge_bases	application
amazon_cloudfront	access
amazon_cloudfront	connection
amazon_cloudwatch	rum_app_monitor
amazon_cognito	user_pool
amazon_ec2	verified_access
amazon_eks	api_server
amazon_eks	audit
amazon_eks	authenticator
amazon_eks	controller_manager
amazon_eks	scheduler
amazon_elasticache	cluster
amazon_eventbridge	eventbus_error

Data Source Name (@data_source_name field)	Data Source Type (@data_source_type field)
amazon_eventbridge	eventbus_info
amazon_eventbridge	pipes_execution
amazon_interactive_video_service	chat
amazon_managed_prometheus	scraper
amazon_managed_prometheus	workspace
amazon_msk	broker
amazon_msk	connect
amazon_opensearch_service	pipeline
amazon_q_business	events
amazon_q_business	sync_job
amazon_q_connect	events
amazon_route53	global_resolver_query
amazon_route53	hosted_zones
amazon_route53	profiles_resolver_query
amazon_route53	resolver_query
amazon_sagemaker	workteam_activity
amazon_ses	ingress_endpoints
amazon_ses	rule_sets
amazon_ses	traffic_policy
amazon_vpc	flow

Data Source Name (@data_source_name field)	Data Source Type (@data_source_type field)
amazon_vpc	route_server_peer
amazon_vpc_lattice	access
amazon_vpc_lattice	resource_access
amazon_workmail	access_control
amazon_workmail	authentication
amazon_workmail	personal_access
amazon_workmail	workmail_access
amazon_workmail	workmail_availability
aws_b2b_data_interchange	execution
aws_backup	data_access
aws_backup	hypervisor
aws_clean_rooms	analysis
aws_client_vpn	connection
aws_client_vpn	event
aws_cloudtrail	data
aws_cloudtrail	management
aws_elemental_mediapackage	egress_access
aws_elemental_mediapackage	ingress_access
aws_elemental_mediatailor	ad_decision
aws_elemental_mediatailor	manifest

Data Source Name (@data_source_name field)	Data Source Type (@data_source_type field)
aws_elemental_mediatailor	transcode
aws_entity_resolution	id_mapping_workflow
aws_entity_resolution	matching_workflow
aws_iot_fleetwise	error
aws_mainframe_modernization	batch_job
aws_mainframe_modernization	config
aws_mainframe_modernization	console
aws_mainframe_modernization	dataset_import
aws_network_firewall	alert
aws_network_firewall	flow
aws_network_firewall	tls
aws_nlb	access
aws_pcs	job_completion
aws_pcs	scheduler
aws_security_hub	compliance_finding
aws_security_hub	data_security_finding
aws_security_hub	detection_finding
aws_security_hub	vulnerability_finding
aws_security_hub_cspm	asff_finding
aws_shield	protection_flow

Data Source Name (@data_source_name field)	Data Source Type (@data_source_type field)
aws_step_functions	express
aws_step_functions	standard
aws_transfer_family	server
aws_waf	access

Supported third-party sources for data sources

The following table lists the third-party sources that are automatically categorized by CloudWatch Logs as data sources when ingested through pipelines:

Data Source Name (@data_source_name field)	Data Source Type (@data_source_type field)
akamai_datastream_2	base_event
akamai_datastream_2	dns_activity
akamai_datastream_2	http_activity
cisco_meraki	api_activity
cisco_meraki	detection_finding
cisco_meraki	network_activity
cisco_umbrella	data_security_finding
cisco_umbrella	dns_activity
cisco_umbrella	entity_management
cisco_umbrella	network_activity

Data Source Name (@data_source_name field)	Data Source Type (@data_source_type field)
crowdstrike_falcon	detection_finding
crowdstrike_falcon	process_activity
drupal_core	application_lifecycle
drupal_core	authentication
drupal_core	entity_management
drupal_core	http_activity
entrust_idaas	authentication
entrust_idaas	entity_management
f5_bigip	http_activity
f5_bigip	network_activity
github_auditlogs	account_change
github_auditlogs	api_activity
github_auditlogs	entity_management
microsoft_entraid	account_change
microsoft_entraid	authentication
microsoft_entraid	entity_management
microsoft_entraid	user_access_management
microsoft_office365	account_change
microsoft_office365	application_lifecycle
microsoft_office365	authentication

Data Source Name (@data_source_name field)	Data Source Type (@data_source_type field)
microsoft_office365	compliance_finding
microsoft_office365	detection_finding
microsoft_office365	email_activity
microsoft_office365	file_hosting_activity
microsoft_office365	group_management
microsoft_office365	incident_finding
microsoft_office365	user_access_management
microsoft_office365	vulnerability_finding
microsoft_office365	web_resources_activity
microsoft_windows	account_change
microsoft_windows	authentication
microsoft_windows	entity_management
microsoft_windows	event_log_activity
microsoft_windows	file_system_activity
microsoft_windows	group_management
microsoft_windows	kernel_activity
netskope_cloudexchange	account_change
netskope_cloudexchange	authentication
netskope_cloudexchange	data_security_finding
netskope_cloudexchange	detection_finding

Data Source Name (@data_source_name field)	Data Source Type (@data_source_type field)
netskope_cloudexchange	device_inventory_info
netskope_cloudexchange	entity_management
netskope_cloudexchange	file_hosting_activity
netskope_cloudexchange	network_activity
okta_auth0	api_activity
okta_auth0	authentication
okta_sso	api_activity
okta_sso	authentication
okta_sso	detection_finding
okta_sso	entity_management
onelogin_identity	account_change
onelogin_identity	authentication
onelogin_identity	entity_management
paloaltonetworks_nextgenerationfirewall	authentication
paloaltonetworks_nextgenerationfirewall	detection_finding
paloaltonetworks_nextgenerationfirewall	network_activity
paloaltonetworks_nextgenerationfirewall	process_activity

Data Source Name (@data_source_name field)	Data Source Type (@data_source_type field)
pingidentity_pingone	account_change
pingidentity_pingone	authentication
pingidentity_pingone	entity_management
sentinelone_endpointsecurity	dns_activity
sentinelone_endpointsecurity	file_system_activity
sentinelone_endpointsecurity	http_activity
sentinelone_endpointsecurity	process_activity
servicenow_cmdb	api_activity
servicenow_cmdb	datastore_activity
servicenow_cmdb	entity_management
slack_auditlog	account_change
slack_auditlog	authentication
slack_auditlog	detection_finding
slack_auditlog	entity_management
slack_auditlog	file_hosting_activity
slack_auditlog	user_access_management
slack_auditlog	web_resources_activity
tanium_endpointmanagement	account_change
tanium_endpointmanagement	authentication
tanium_endpointmanagement	compliance_finding

Data Source Name (@data_source_name field)	Data Source Type (@data_source_type field)
tanium_endpointmanagement	detection_finding
tanium_endpointmanagement	device_inventory_info
tanium_endpointmanagement	entity_management
tanium_endpointmanagement	group_management
tanium_endpointmanagement	vulnerability_finding
wiz_cnapp	api_activity
wiz_cnapp	authentication
wiz_cnapp	compliance_finding
wiz_cnapp	detection_finding
wiz_cnapp	vulnerability_finding
zeek	authentication
zeek	base_event
zeek	detection_finding
zeek	dhcp_activity
zeek	dns_activity
zeek	email_activity
zeek	ftp_activity
zeek	http_activity
zeek	network_activity
zeek	rdp_activity

Data Source Name (@data_source_name field)	Data Source Type (@data_source_type field)
zeek	smb_activity
zeek	software_inventory_info
zeek	ssh_activity
zeek	tunnel_activity
zscaler_internetaccess	authentication
zscaler_internetaccess	dns_activity
zscaler_internetaccess	http_activity
zscaler_internetaccess	network_activity

Additional third-party sources via AWS Security Hub CSPM

Additional third-party security findings are available through AWS Security Hub CSPM integration. The following partners send findings to Security Hub CSPM, which are then available as data sources in CloudWatch Logs. For comprehensive details about these integrations, see Third-party product integrations with Security Hub CSPM in the *AWS Security Hub User Guide*.

Partner	Integration
3CORESec – NTA	Sends findings via Security Hub CSPM
Alert Logic – SIEMless Threat Management	Sends findings via Security Hub CSPM
Aqua Security – Cloud Native Security Platform	Sends findings via Security Hub CSPM
Aqua Security – Kube-bench	Sends findings via Security Hub CSPM

Partner	Integration
Armor – Armor Anywhere	Sends findings via Security Hub CSPM
AttackIQ	Sends findings via Security Hub CSPM
Barracuda Networks – Cloud Security Guardian	Sends findings via Security Hub CSPM
BigID – BigID Enterprise	Sends findings via Security Hub CSPM
Blue Hexagon	Sends findings via Security Hub CSPM
Check Point – CloudGuard IaaS	Sends findings via Security Hub CSPM
Check Point – CloudGuard Posture Management	Sends findings via Security Hub CSPM
Claroty – xDome	Sends findings via Security Hub CSPM
Cloud Storage Security – Antivirus for Amazon S3	Sends findings via Security Hub CSPM
Contrast Security – Contrast Assess	Sends findings via Security Hub CSPM
CrowdStrike – CrowdStrike Falcon	Sends findings via Security Hub CSPM
CyberArk – Privileged Threat Analytics	Sends findings via Security Hub CSPM
Data Theorem	Sends findings via Security Hub CSPM

Partner	Integration
Drata	Sends findings via Security Hub CSPM
Forcepoint – CASB	Sends findings via Security Hub CSPM
Forcepoint – Cloud Security Gateway	Sends findings via Security Hub CSPM
Forcepoint – DLP	Sends findings via Security Hub CSPM
Forcepoint – NGFW	Sends findings via Security Hub CSPM
Fugue	Sends findings via Security Hub CSPM
Guardicore – Centra	Sends findings via Security Hub CSPM
HackerOne – Vulnerability Intelligence	Sends findings via Security Hub CSPM
JFrog – Xray	Sends findings via Security Hub CSPM
Juniper Networks – vSRX Next Generation Firewall	Sends findings via Security Hub CSPM
k9 Security – Access Analyzer	Sends findings via Security Hub CSPM
Lacework	Sends findings via Security Hub CSPM
McAfee – MVISION CNAPP	Sends findings via Security Hub CSPM

Partner	Integration
NETSCOUT – Cyber Investigator	Sends findings via Security Hub CSPM
Orca – Cloud Security Platform	Sends findings via Security Hub CSPM
Palo Alto Networks – Prisma Cloud Compute	Sends findings via Security Hub CSPM
Palo Alto Networks – Prisma Cloud Enterprise	Sends findings via Security Hub CSPM
Plerion – Cloud Security Platform	Sends findings via Security Hub CSPM
Prowler	Sends findings via Security Hub CSPM
Qualys – Vulnerability Management	Sends findings via Security Hub CSPM
Rapid7 – InsightVM	Sends findings via Security Hub CSPM
SentinelOne	Sends findings via Security Hub CSPM
Snyk	Sends findings via Security Hub CSPM
Sonrai Security – Sonrai Dig	Sends findings via Security Hub CSPM
Sophos – Server Protection	Sends findings via Security Hub CSPM
StackRox – Kubernetes Security	Sends findings via Security Hub CSPM

Partner	Integration
Sumo Logic – Machine Data Analytics	Sends findings via Security Hub CSPM
Symantec – Cloud Workload Protection	Sends findings via Security Hub CSPM
Tenable.io	Sends findings via Security Hub CSPM
Trend Micro – Cloud One	Sends findings via Security Hub CSPM
Vectra – Cognito Detect	Sends findings via Security Hub CSPM
Wiz	Sends findings via Security Hub CSPM
Caveonix – Caveonix Cloud	Sends and receives findings via Security Hub CSPM
Cloud Custodian	Sends and receives findings via Security Hub CSPM
DisruptOps	Sends and receives findings via Security Hub CSPM
Kion	Sends and receives findings via Security Hub CSPM
Turbot	Sends and receives findings via Security Hub CSPM

Note

This list reflects the Security Hub partner integrations that send findings at the time of writing. Because AWS Security Hub regularly adds new partner integrations, refer to Third-

party product integrations with Security Hub CSPM in the *AWS Security Hub User Guide* for the most up-to-date list of available partners.

Custom sources

For custom application logs, you can define your own data source categorization using one of the following methods:

- **Log group tags** – Add tags to your log groups using the keys `cw:datasource:name` and `cw:datasource:type` to specify the data source name and type for all logs ingested in the log group.
- **Pipeline configuration** – Configure data source information through log processing pipelines when ingesting your application logs.

Note

Custom data source names cannot start with "aws" or "amazon" to avoid conflicts with AWS service logs.

Analyzing log data with CloudWatch Log Analytics

Log Analytics is a unified console experience in Amazon CloudWatch Logs that brings together log analysis capabilities in one place. You can query and analyze log data with CloudWatch Logs Insights, stream logs in real time with Live Tail, and identify your top contributors with CloudWatch Contributor Insights. Log Analytics is the default experience for analyzing logs in the CloudWatch Logs console.

What you can do with Log Analytics

Log Analytics brings together the following capabilities:

- **Query and analyze log data** – Run queries against your log groups with CloudWatch Logs Insights. You can run multiple queries in different tabs, save and reuse queries with parameters, explore your data with facets, generate queries using natural language, and visualize results. For more information, see Analyzing log data with CloudWatch Logs Insights.
- **Stream logs in near real time** – Use Live Tail to view a streaming list of log events as they are ingested, and filter or highlight the events that matter to you. For more information, see Troubleshoot with CloudWatch Logs Live Tail.
- **Identify top contributors** – Use CloudWatch Contributor Insights to analyze high-cardinality log data and see the contributors that have the greatest impact on your system. For more information, see Use Contributor Insights to analyze high-cardinality data.

Get started with Log Analytics

To use Log Analytics, sign in to the CloudWatch console, and choose **Log Analytics** under **Logs** in the navigation pane.

Log Analytics is the default experience. If you opt out, you can continue to use CloudWatch Logs Insights, Live Tail, and Contributor Insights as distinct experiences alongside Log Analytics, and you can switch back at any time to Log Analytics.

Log Analytics uses the same pricing as its underlying capabilities: CloudWatch Logs Insights queries, Live Tail, and Contributor Insights. For pricing details, see CloudWatch pricing.

Analyzing log data with CloudWatch Logs Insights

With CloudWatch Logs Insights, you can interactively search and analyze your log data in Amazon CloudWatch Logs. You can perform queries to help you more efficiently and effectively respond to operational issues. In addition to querying using log groups, you can query using facets, data source, and data type. If an issue occurs, you can use CloudWatch Logs Insights to identify potential causes and validate deployed fixes. You are limited to 100 concurrent CloudWatch Logs Insights QL per account, including queries added to dashboards. Additionally, you can run 15 concurrent queries for either OpenSearch Service PPL or OpenSearch Service SQL.

CloudWatch Logs Insights supports 3 query languages that you can use for your queries:

- A purpose-built **Logs Insights query language (Logs Insights QL)** with a few simple but powerful commands.
- **OpenSearch Service Piped Processing Language (PPL)**. OpenSearch PPL enables you to analyze your logs using a set of commands delimited by pipes (|).

  With OpenSearch PPL you can retrieve, query, and analyze data by using commands that are piped together, making it easier to understand and compose complex queries. The syntax enables the chaining of commands to transform and process data. With PPL, you can filter and aggregate data, and use a rich set of math, string, date, conditional and other functions for analysis.
- **OpenSearch Service Structured Query Language (SQL)**. With OpenSearch SQL queries, you can analyze your logs in a declarative manner. You can use commands such as SELECT, FROM, WHERE, GROUP BY, HAVING, and various other commands and functions available in SQL. You can execute JOINs across log groups, correlate data across logs using sub-queries, and use the rich set of JSON, Mathematical, String, Conditional and other SQL functions to perform powerful analysis on logs.

  When you use either SQL or PPL commands, make sure to enclose fields with special characters (non-alphabetic and non-numeric) in backticks to successfully query them. For example, enclose `@message`, `Operation.Export`, and `Test::Field` in backticks. You don't need to enclose fields with purely alphabetical names in backticks.

CloudWatch Logs Insights offers the following features that are available for use with any of the query languages.

- Automatic *discovery of log fields* in logs from AWS services such as Amazon Route 53, AWS Lambda, AWS CloudTrail, and Amazon VPC, and any application or custom log that emits log events as JSON.
- Creating *field indexes* to reduce costs and speed results, especially for queries of large number of log groups or log events. After creating field indexes of fields that are common in your log events, you can use them in a query. The query skips processing log events that are known to not include the indexed field, and processes less data.

> **Note**
>
> The `filterIndex` command is available only in Logs Insights QL.

- *Detection and analysis of patterns* in your log events. A pattern is a shared text structure that recurs among your log fields. When you view the results of a query, you can choose the **Patterns** tab to see the patterns that CloudWatch Logs found based on a sample of your results.
- *Saving queries*, seeing your query history, re-running saved queries, and using saved queries with parameters.
- *Adding queries to dashboards*.
- *Encrypting query results with AWS Key Management Service*.
- Query generation using natural language lets you use natural language to create CloudWatch Logs Insights queries. You can ask questions about or describe the data you're looking for, then the AI generates a query based on your prompt and provides a line-by-line explanation of how the query works.
- Use facets to group, filter, and interactively explore your logs.
- *Surrounding logs* lets you view log lines before and after any specific log record in your query results to get instant context around critical log events. You can configure the range to view 5, 10, 20, 50, or 100 log lines before and after a selected record, and search for specific keywords within the surrounding logs.

The following CloudWatch Logs Insights features are supported only when you use Logs Insights QL.

- Comparison queries that compare log events in a log group with log events from a previous time period.

> **Important**
>
> CloudWatch Logs Insights can't access log events with timestamps that pre-date the creation time of the log group.

If you are signed in to an account set up as a monitoring account in CloudWatch cross-account observability, you can run CloudWatch Logs Insights queries on log groups in source accounts linked to this monitoring account. You can run a query that queries multiple log groups located in different accounts. For more information, see CloudWatch cross-account observability.

When you create queries using Logs Insights QL, you can also use natural language to create CloudWatch Logs Insights queries. To do so, ask questions about or describe the data you're looking for. This AI-assisted capability generates a query based on your prompt and provides a line-by-line explanation of how the query works. For more information, see Use natural language to generate and update CloudWatch Logs Insights queries.

Queries using any of the supported query languages time out after 60 minutes, if they have not completed. Query results are available for 7 days.

CloudWatch Logs Insights queries incur charges based on the amount of uncompressed log data scanned, regardless of query language. For more information, see Amazon CloudWatch Pricing.

You can use CloudWatch Logs Insights to search log data that was sent to CloudWatch Logs on November 5, 2018 or later.

> **Important**
>
> If your network security team doesn't allow the use of web sockets, you can't currently access the CloudWatch Logs Insights portion of the CloudWatch console. You can use the CloudWatch Logs Insights query capabilities using APIs. For more information, see StartQuery in the *Amazon CloudWatch Logs API Reference*.

Contents

- Create field indexes to improve query performance and reduce scan volume
- Use facets to group and explore logs
- Viewing surrounding logs in CloudWatch Logs Insights
- Pattern analysis
- Save and re-run CloudWatch Logs Insights queries
- Add query to dashboard or export query results
- View running queries or query history
- Encrypt query results with AWS Key Management Service
- Generate a natural language summary from CloudWatch Logs Insights query results

Supported query languages

The following sections list the commands supported in each query language. They also describe the syntax format and provide sample queries.

Topics

- CloudWatch Logs Insights query language (Logs Insights QL)
- OpenSearch Piped Processing Language (PPL)
- OpenSearch Structured Query Language (SQL)

CloudWatch Logs Insights query language (Logs Insights QL)

This section includes full documentation of Logs Insights QL commands and functions. It also includes sample queries for this language.

For information on other query languages you can use, see OpenSearch Service PPL, OpenSearch Service SQL, and CloudWatch Metrics Insights.

Topics

- CloudWatch Logs Insights language query syntax
- Get started with Logs Insights QL: Query tutorials
- Sample queries
- Compare (diff) with previous time ranges

- Visualize log data in graphs

CloudWatch Logs Insights language query syntax

This section provides details about the Logs Insights QL. The query syntax supports different functions and operations that include but aren't limited to general functions, arithmetic and comparison operations, and regular expressions.

Important

To avoid incurring excessive charges by running large queries, keep in mind the following best practices:

- Select only the necessary log groups for each query.
- Always specify the narrowest possible time range for your queries.
- When you use the console to run queries, cancel all your queries before you close the CloudWatch Logs Insights console page. Otherwise, queries continue to run until completion.
- When you add a CloudWatch Logs Insights widget to a dashboard, ensure that the dashboard is not refreshing at a high frequency, because each refresh starts a new query.

To create queries that contain multiple commands, separate the commands with the pipe character (**|**).

To create queries that contain comments, set off the comments with the hash character (**#**).

Note

CloudWatch Logs Insights automatically discovers fields for different log types and generates fields that start with the **@** character. For more information about these fields, see Supported logs and discovered fields in the *Amazon CloudWatch User Guide*.

The following table briefly describes each command. Following this table is a more comprehensive description of each command, with examples.

Note

All Logs Insights QL query commands are supported on log groups in the Standard log class. Log groups in the Infrequent Access log class support all Logs Insights QL query commands except `pattern`, `diff`, and `unmask`.

addtotals	Computes row totals and column totals for numeric fields.
anomaly	Identifies unusual patterns in your log data using machine learning.
display	Displays a specific field or fields in query results.
fields	Displays specific fields in query results and supports functions and operations you can use to modify field values and create new fields to use in your query.
filter	Filters the query to return only the log events that match one or more conditions.
filterIndex	Forces a query to attempt to scan only the log groups that are both indexed on the field mentioned in a field index and also contain a value for that field index. This reduces scanned volume by attempting to scan only log events from these log groups that contain the value specified in the query for this field index. This command is not supported for log groups in the Infrequent Access log class.
pattern	Automatically clusters your log data into patterns. A pattern is shared text structure that recurs among your log fields. CloudWatch Logs Insights provides ways for you to analyze the patterns found in your log events. For more information, see Pattern analysis.
diff	Compares the log events found in your requested time period with the log events from a previous time period of equal length, so that you can look for trends and find out if certain log events are new.

parse	Extracts data from a log field to create an extracted field that you can process in your query. **parse** supports both glob mode using wildcards , and regular expressions.
sort	Displays the returned log events in ascending (asc) or descending (desc) order.
SOURCE	Including SOURCE in a query is a useful way to specify a large amount of log groups to include in a query based on log group name prefix, account identifiers, log group class, data sources, or log group tags. This command is supported only when you create a query in the AWS CLI or programmatically, not in the CloudWatch console.
stats	Calculate aggregate statistics using values in the log fields.
limit	Specifies a maximum number of log events that you want your query to return. Useful with **sort** to return "top 20" or "most recent 20" results. Use `limit any` to stop scanning early once enough results are found.
dedup	Removes duplicate results based on specific values in fields that you specify.
unmask	Displays all the content of a log event that has some content masked because of a data protection policy. For more information about data protection in log groups, see Help protect sensitive log data with masking.
unnest	Flattens a list taken as input to produce multiple records with a single record for each element in the list.
lookup	Enriches log events with data from a lookup table by matching field values. Use lookup tables to add reference data such as user details, application names, or product information to your query results.

join	Combines log events from a source log group with events from another log group or query result based on a matching field. Use the join command to correlate related log events across different sources using keys common across them such as matching request identifiers or transaction IDs.
subqueries	A subquery is a nested Logs Insights query that can be used as an input to another query. Subqueries can be used to derive intermediate result sets that are then consumed by subsequent commands.
autoregress	Creates lagged (previous-row) copies of a field's values.
logcompare	Compares the current time window against a baseline window shifted back by a duration.
filldown	Carries the last non-null value forward to fill gaps.
fillmissing	Inserts rows for empty time bins after stats by bin(), optionally filling fields with a constant.
cidrlookup	Enriches events by matching an IP field against CIDR ranges in a lookup table.
outlier	Detects statistical outliers based on the interquartile range (IQR) and can remove or transform outlier rows.
accum	Computes a running cumulative sum of a numeric field.
appendcols	Appends columns from a sub-query to the current results by positional row matching.
sessionize	Groups events into sessions by identity fields and inactivity gap.
countFrequent	Returns an approximate count of each unique field-value combination, sorted in descending order.
where	Acts as a grammar alias for the `filter` command and accepts identical syntax.

estimate	Returns the estimated bytes that the query would scan over the selected log groups and time range, without running the query.
Other operations and functions	CloudWatch Logs Insights also supports many comparison, arithmetic, datetime, numeric, string, IP address, and general functions and operations.

The following sections provide more details about the CloudWatch Logs Insights query commands.

Topics

- subqueries
- autoregress
- logcompare
- filldown
- fillmissing
- cidrlookup
- outlier
- accum
- appendcols
- sessionize
- countFrequent
- where
- estimate
- Boolean, comparison, numeric, datetime, and other functions
- Hashing functions
- Time-series functions
- Fields that contain special characters
- Use aliases and comments in queries

Logs Insights QL commands supported in log classes

All Logs Insights QL query commands are supported on log groups in the Standard log class. Log groups in the Infrequent Access log class support all query commands except `pattern`, `diff`, `filterIndex`, and `unmask`.

addtotals

Use `addtotals` to compute row totals and column totals for numeric fields. Row totals are computed per-chunk. Column totals (`col=true`) are computed post-merge for correctness across distributed chunks. You can use custom field selection, a custom fieldname, and `row=false` to disable row totals.

Syntax

```
| addtotals [fieldname=Name] [row=bool] [col=bool] [field1, field2, ...]
```

- `fieldname=Name` — Sets the name of the row total column. The default is `Total`.
- `row=bool` — Enable or disable row totals. The default is `true`.
- `col=bool` — Enable or disable column totals, which adds a summary row at the bottom. The default is `false`.
- `field1, field2, ...` — Optional list of specific fields to sum. If omitted, all numeric fields are summed.

Examples

```
# Row totals (default) - adds a Total column summing all numeric fields
fields a, b
| addtotals
```

```
# Sum only specific fields
fields price, tax, qty
| addtotals price, tax
```

```
# Custom total column name
fields val
| addtotals fieldname=RowSum
```

```
# Column totals - adds a Summary row at the bottom
fields x
| addtotals col=true x
```

anomaly

Use `anomaly` to automatically identify unusual patterns and potential issues within your log data using machine learning.

The `anomaly` command extends the existing `pattern` functionality and uses advanced analytics to help identify potential anomalies in log data. You can use `anomaly` to reduce the time it takes to identify and resolve operational issues by automatically surfacing unusual patterns or behaviors in your logs.

The `anomaly` command works with the `pattern` command to first identify log patterns, then detect anomalies within those patterns. You can also combine `anomaly` with the `filter` or `sort` commands to focus anomaly detection on specific subsets of your data.

Anomaly Command Input

The `anomaly` command is typically used after the `pattern` command to analyze the patterns identified in your log data. The command does not require additional parameters and analyzes the output from preceding commands in your query.

Types of Anomalies Identified

The `anomaly` command identifies five distinct types of anomalies:

- *Pattern Frequency Anomalies*: Unusual frequencies of specific log patterns, such as when an application starts generating more error messages than usual.
- *New Pattern Anomalies*: Previously unseen log patterns that may indicate new types of errors or messages appearing in your logs.
- *Token Variation Anomalies*: Unexpected changes in log message contents that may indicate unusual variations in expected log formats.
- *Numerical Token Anomalies*: Unusual changes in numerical values within logs that can help detect potential performance issues or unexpected metric variations.
- *HTTP Error Code Anomalies*: Patterns related to HTTP error responses, particularly useful when monitoring web applications and APIs.

Anomaly Command Output

The `anomaly` command preserves all fields from the input data and adds anomaly detection results to help identify unusual patterns in your log data.

Examples

The following command identifies patterns in your log data and then detects anomalies within those patterns:

```
fields @timestamp, @message
| pattern @message
| anomaly
```

The `anomaly` command can be used with filtering to focus on specific log types:

```
fields @timestamp, @message
| filter @type = "REPORT"
| pattern @message
| anomaly
```

The `anomaly` command can be combined with sorting to organize results:

```
fields @timestamp, @message
| filter @type = "ERROR"
| pattern @message
| anomaly
| sort @timestamp desc
```

display

Use `display` to show a specific field or fields in query results.

The `display` command shows only the fields you specify. If your query contains multiple `display` commands, the query results show only the field or fields that you specified in the final `display` command.

Example: Display one field

The code snippet shows an example of a query that uses the parse command to extract data from `@message` to create the extracted fields `loggingType` and `loggingMessage`. The query returns all log events where the values for `loggingType` are **ERROR**. `display` shows only the values for `loggingMessage` in the query results.

```
fields @message
| parse @message "[*] *" as loggingType, loggingMessage
| filter loggingType = "ERROR"
| display loggingMessage
```

> **Tip**
>
> Use `display` only once in a query. If you use `display` more than once in a query, the query results show the field specified in the last occurrence of `display` command being used.

fields

Use `fields` to show specific fields in query results.

If your query contains multiple `fields` commands and doesn't include a `display` command, the results display all of the fields that are specified in the `fields` commands.

Example: Display specific fields

The following example shows a query that returns 20 log events and displays them in descending order. The values for `@timestamp` and `@message` are shown in the query results.

```
fields @timestamp, @message
| sort @timestamp desc
| limit 20
```

Use `fields` instead of `display` when you want to use the different functions and operations supported by `fields` for modifying field values and creating new fields that can be used in queries.

You can use the `fields` command with the keyword *as* to create extracted fields that use fields and functions in your log events. For example, `fields ispresent as isRes` creates an extracted field named `isRes`, and the extracted field can be used in the rest of your query.

filter

Use `filter` to get log events that match one or more conditions.

Example: Filter log events using one condition

The code snippet shows an example of a query that returns all log events where the value for `range` is greater than ***3000***. The query limits the results to 20 log events and sorts the logs events by `@timestamp` and in descending order.

```
fields @timestamp, @message
| filter (range>3000)
| sort @timestamp desc
| limit 20
```

Example: Filter log events using more than one condition

You can use the keywords `and` and `or` to combine more than one condition.

The code snippet shows an example of a query that returns log events where the value for `range` is greater than ***3000*** and value for `accountId` is equal to ***123456789012***. The query limits the results to 20 log events and sorts the logs events by `@timestamp` and in descending order.

```
fields @timestamp, @message
| filter (range>3000 and accountId=123456789012)
| sort @timestamp desc
| limit 20
```

Indexed fields and the filter command

If you have created field indexes for a log group, you can use those field indexes to make your `filter` queries more efficient and reduce scanned volume. For example, suppose you have created a field index for `requestId`. Then, any CloudWatch Logs Insights query on that log group that includes `filter requestId = value` or `filter requestId IN [value, value, ...]` will attempt to skip processing log events that are known not to include the indexed field. By attempting to scan only the log events that are known to contain that indexed field, scan volume can be reduced and the query is faster.

For more information about field indexes and how to create them, see Create field indexes to improve query performance and reduce scan volume.

> **Important**
>
> Only queries with `filter fieldName =...` and `filter fieldName IN...` will benefit from the field index improvements. Queries with `filter fieldName like` don't use indexes and always scan all log events in the selected log groups.

Example: Find log events that are related to a certain request ID, using indexes

This example assumes that you have created a field index on `requestId`. For log groups that use this field index, the query will use field indexes to attempt to scan the least amount of log events to find events with `requestId` with a value of 123456

```
fields @timestamp, @message
| filter requestId = "1234656"
| limit 20
```

Matches and regular expressions in the filter command

The filter command supports the use of regular expressions. You can use the following comparison operators (=, !=, <, <=, >, >=) and Boolean operators (and, or, and not).

You can use the keyword in to test for set membership and check for elements in an array. To check for elements in an array, put the array after in. You can use the Boolean operator not with in. You can create queries that use in to return log events where fields are string matches. The fields must be complete strings. For example, the following code snippet shows a query that uses in to return log events where the field logGroup is the complete string example_group.

```
fields @timestamp, @message
| filter logGroup in ["example_group"]
```

You can use the keyword phrases like and not like to match substrings. You can use the regular expression operator =~ to match substrings. To match a substring with like and not like, enclose the substring that you want to match in single or double quotation marks. You can use regular expression patterns with like and not like. To match a substring with the regular expression operator, enclose the substring that you want to match in forward slashes. The following examples contain code snippets that show how you can match substrings using the filter command.

Examples: Match substrings

The following examples return log events where f1 contains the word ***Exception***. All three examples are case sensitive.

The first example matches a substring with like.

```
fields f1, f2, f3
| filter f1 like "Exception"
```

The second example matches a substring with like and a regular expression pattern.

```
fields f1, f2, f3
| filter f1 like /Exception/
```

The third example matches a substring with a regular expression.

```
fields f1, f2, f3
```

```
| filter f1 =~ /Exception/
```

Example: Match substrings with wildcards

You can use the period symbol (`.`) as a wildcard in regular expressions to match substrings. In the following example, the query returns matches where the value for `f1` begins with the string `ServiceLog`.

```
fields f1, f2, f3
| filter f1 like /ServiceLog./
```

You can place the asterisk symbol after the period symbol (`.*`) to create a greedy quantifier that returns as many matches as possible. For example, the following query returns matches where the value for `f1` not only begins with the string `ServiceLog`, but also includes the string `ServiceLog`.

```
fields f1, f2, f3
| filter f1 like /ServiceLog.*/
```

Possible matches can be formatted like the following:

- `ServiceLogSampleApiLogGroup`
- `SampleApiLogGroupServiceLog`

Example: Exclude substrings from matches

The following example shows a query that returns log events where `f1` doesn't contain the word ***Exception***. The example is case senstive.

```
fields f1, f2, f3
| filter f1 not like "Exception"
```

Example: Match substrings with case-insensitive patterns

You can match substrings that are case insensitive with `like` and regular expressions. Place the following parameter (**?i**) before the substring you want to match. The following example shows a query that returns log events where `f1` contains the word ***Exception*** or ***exception***.

```
fields f1, f2, f3
```

```
| filter f1 like /(?i)Exception/
```

filterIndex

Use `filterIndex` to return indexed data only, by forcing a query to scan only log groups that are indexed on a field that you specify in the query. For these log groups that are indexed on this field, it further optimizes the query by skipping the log groups that do not have any log events containing the field specified in the query for the indexed field. It further reduces scanned volume by attempting to scan only log events from these log groups that match the value specified in the query for this field index. For more information about field indexes and how to create them, see Create field indexes to improve query performance and reduce scan volume.

Using `filterIndex` with indexed fields can help you query log groups that include petabytes of log data efficiently by limiting the actual search space to log groups and log events that have field indexes.

For example, suppose that you have created a field index for `IPaddress` in some of the log groups in your account. You can then create the following query and choose to query all log groups in the account to find log events that include the value `198.51.100.0` in the `IPaddress` field.

```
fields @timestamp, @message
| filterIndex IPaddress = "198.51.100.0"
| limit 20
```

The `filterIndex` command causes this query to attempt to skip all log groups that are not indexed for `IPaddress`. Additionally, within the log groups that are indexed, the query skips log events that have an `IPaddress` field but not observed `198.51.100.0` as the value for that field.

Use the `IN` operator to expand the results to any of multiple values for the indexed fields. The following example finds logs events that include either the value `198.51.100.0` or `198.51.100.1` in the `IPaddress` field.

```
fields @timestamp, @message
| filterIndex IPaddress in ["198.51.100.0", "198.51.100.1"]
| limit 20
```

CloudWatch Logs provides default field indexes for all log groups in the Standard log class. Default field indexes are automatically available for the following fields:

- `@logStream`

- `@aws.region`
- `@aws.account`
- `@source.log`
- `@data_source_name`
- `@data_source_type`
- `@data_format`
- `traceId`
- `severityText`
- `attributes.session.id`

CloudWatch Logs provides default field indexes for certain data source name and type combinations as well. Default field indexes are automatically available for the following data source name and type combinations:

Data Source Name and Type	Default Field Indexes

`amazon_vpc.flow`	`action`
	`logStatus`
	`region`
	`flowDirection`
	`type`

`amazon_route53.resolver_query`	`query_type`
	`transport`
	`rcode`

`aws_waf.access`	`action` `httpRequest.country`
`aws_cloudtrail.data`	`eventSource`

Data Source Name and Type	Default Field Indexes
aws_cloudtrail.management	eventName awsRegion userAgent errorCode eventType managementEvent readOnly eventCategory requestId

Default field indexes are in addition to any custom field indexes you define within your policy. Default field indexes are not counted towards your field index quota.

filterIndex compared to filter

To illustrate the difference between `filterIndex` and `filter`, consider the following example queries. Assume that you have created a field index for `IPaddress`, for four of your log groups, but not for a fifth log group. The following query using `filterIndex` will skip scanning the log group that doesn't have the field indexed. For each indexed log group, it attempts to scan only log events that have the indexed field, and it also returns only results from after the field index was created.

```
fields @timestamp, @message
| filterIndex IPaddress = "198.51.100.0"
| limit 20
```

In contrast, if you use `filter` instead of `filterIndex` for a query of the same five log groups, the query will attempt to scan not only the log events that contain the value in the indexed log groups, but will also scan the fifth log group that isn't indexed, and it will scan every log event in that fifth log group.

```
fields @timestamp, @message
| filter IPaddress = "198.51.100.0"
| limit 20
```

SOURCE

Including SOURCE in a query is a useful way to specify the log groups and/or data sources to include in a query when you are using the AWS CLI or API to create a query. The SOURCE command is supported only in the AWS CLI and API, not in the CloudWatch console. When you use the CloudWatch console to start a query, you use the console interface to specify the log groups.

Query log groups

To use SOURCE to specify the log groups to query, you can use the following keywords:

- `namePrefix` runs the query against log groups that have names that start with the string that you specify. If you omit this, all log groups are queried.

  You can include as many as 5 prefixes in the list.
- `accountIdentifier` runs the query against log groups in the specified AWS account. This works only when you run the query in a monitoring account. If you omit this, the default is to query all linked source accounts and the current monitoring account. For more information about cross-account observability, see CloudWatch cross-account observability.

  You can include as many as 20 account identifiers in the list.
- `logGroupClass` runs the query against log groups that are in the specified log class, either Standard or Infrequent Access. If you omit this, the default of Standard log class is used. For more information about log classes, see Log classes.

Because you can specify large numbers of log groups to query this way, we recommend that you use SOURCE only in queries that use field indexes that you have created. For more information about indexing fields in log groups, see Create field indexes to improve query performance and reduce scan volume

The following example selects all log groups in the account. If this is a monitoring account then the log groups across monitoring and all the source accounts will be selected. If the total number of log groups exceed 10,000 then you will see an error prompting you to reduce the number of log groups by using a different log group selection method.

```
SOURCE logGroups()
```

The following example selects the log groups in the 111122223333 source account. If you start a query in a monitoring account in CloudWatch cross-account observability, log groups in all source accounts and in the monitoring account are selected by default.

```
SOURCE logGroups(accountIdentifier:['111122223333'])
```

The next example selects log groups based on name prefixes.

```
SOURCE logGroups(namePrefix: ['namePrefix1', 'namePrefix2'])
```

The following example selects all log groups in the Infrequent Access log class. If you don't include the `class` identifier, the query applies only to log groups in the Standard log class, which is the default.

```
SOURCE logGroups(class: ['INFREQUENT_ACCESS'])
```

The next example selects log groups in the 111122223333 account that start with specific name prefixes and are in the Standard log class. The class is not mentioned in the command because Standard is the default log class value.

```
SOURCE logGroups(accountIdentifier:['111122223333'], namePrefix: ['namePrefix1',
 'namePrefix2'])
```

The final example displays how to use the SOURCE command with the `start-query` AWS CLI command.

```
aws logs start-query
--region us-east-1
--start-time 1729728200
--end-time 1729728215
--query-string "SOURCE logGroups(namePrefix: ['Query']) | fields @message | limit 5"
```

Query data sources

To use SOURCE to specify the data sources to query, you can use the `dataSource` keyword. You can include as many as ten data sources in the list.

The following example selects the `amazon_vpc.flow` data source.

```
SOURCE dataSource(['amazon_vpc.flow'])
```

The following example selects the `amazon_vpc.flow` data source and limits the log groups based on a log group name prefix.

```
SOURCE dataSource(['amazon_vpc.flow']) logGroups(namePrefix: ['namePrefix1'])
```

Query log groups by tags

To use SOURCE to filter log groups by their tags, use the `logGroupTags` function. Specify tags as a list of tag filters, each with a `key` and optional `values` array.

- Multiple tag filters with different keys are combined with AND logic.
- Multiple values within the same tag filter are combined with OR logic.
- Use `*` for wildcard matching. For example, `payment*` matches values that start with `payment`.
- Use `!` as a prefix for negation. For example, `!production` matches values that are not `production`.
- You can include as many as 5 tag filters, each with up to 5 values.

The following example selects all log groups tagged with `team=team1 OR team=team2`.

```
SOURCE logGroupTags([{"key":"team", "values":["team1", "team2"]}])
| fields @message, @timestamp
```

The next example selects log groups where the `service` tag starts with `payment`, and the `environment` tag is not `production`.

```
SOURCE logGroupTags([{"key":"service", "values":["payment*"]}, {"key":"environment",
 "values":["!production"]}])
| fields @message, @timestamp
```

The following example combines tag filtering with a name prefix filter.

```
SOURCE logGroups(namePrefix: ['/aws/lambda']) logGroupTags([{"key":"environment",
 "values":["production"]}])
| fields @message, @timestamp
```

pattern

Use `pattern` to automatically cluster your log data into patterns.

A pattern is a shared text structure that recurs among your log fields. You can use `pattern` to surface emerging trends, monitor known errors, and identify frequently occurring or high-cost log lines. CloudWatch Logs Insights also provides a console experience you can use to find and further analyze patterns in your log events. For more information, see Pattern analysis.

Because the `pattern` command automatically identifies common patterns, you can use it as a starting point to search and analyze yours logs. You can also combine `pattern` with the `filter`, `parse`, or `sort` commands to identify patterns in more fine-tuned queries.

Pattern Command Input

The `pattern` command expects one of the following inputs: the `@message` field, an extracted field created using the `parse` command, or a string manipulated using one or more String functions.

If CloudWatch Logs can't infer the type of data that a dynamic token represents, displays it as <Token-*number*>, and *number* indicates where in the pattern this token appears, compared to the other dynamic tokens.

Common examples of dynamic tokens include error codes, IP addresses, timestamps, and request IDs.

Pattern Command Output

The `pattern` command produces the following output:

- `@pattern`: A shared text structure that recurs among your log event fields. Fields that vary within a pattern, such as a request ID or timestamp, are represented by *tokens*. If CloudWatch Logs can determine the type of data that a dynamic token represents, it displays the token as <*string*-*number*>. The *string* is a description of the type of data that the token represents. The *number* shows where in the pattern this token appears, compared to the other dynamic tokens.

  CloudWatch Logs assigns the string part of the name based on analyzing the content of the log events that contain it.

  If CloudWatch Logs can't infer the type of data that a dynamic token represents, displays it as <Token-*number*>, and *number* indicates where in the pattern this token appears, compared to the other dynamic tokens.

For example, `[INFO] Request time: <Time-1> ms` is a potential output for the log message `[INFO] Request time: 327 ms`.

- `@ratio`: The ratio of log events from a selected time period and specified log groups that match an identified pattern. For example, if half of the log events in the selected log groups and time period match the pattern, `@ratio` returns `0.50`
- `@sampleCount`: A count of the number of log events from a selected time period and specified log groups that match an identified pattern.
- `@severityLabel`: The log severity or level, which indicates the type of information contained in a log. For example, `Error`, `Warning`, `Info`, or `Debug`.

Examples

The following command identifies logs with similar structures in specified log group(s) over the selected time range, grouping them by pattern and count

```
pattern @message
```

The `pattern` command can be used in combination with the `filter` command

```
filter @message like /ERROR/
| pattern @message
```

The `pattern` command can be use with the `parse` and `sort` commands

```
filter @message like /ERROR/
| parse @message 'Failed to do: *' as cause
| pattern cause
| sort @sampleCount asc
```

diff

Compares the log events found in your requested time period with the log events from a previous time period of equal length. This way, you can look for trends and find whether specific log events are new.

Add a modifier to the `diff` command to specify the time period that you want to compare with:

- `diff` compares the log events in the currently selected time range to the log events of the immediately preceding time range.
- `diff previousDay` compares the log events in the currently selected time range to the log events from the same time the preceding day.
- `diff previousWeek` compares the log events in the currently selected time range to the log events from the same time the preceding week.
- `diff previousMonth` compares the log events in the currently selected time range to the log events from the same time the preceding month.

For more information, see Compare (diff) with previous time ranges.

parse

Use `parse` to extract data from a log field and create extracted fields that you can process in your query. The `parse` command supports four modes: glob expressions, regular expressions, logfmt, and CSV.

If `fieldName` is omitted, `@message` is used by default. You can parse from any named field by specifying the field name as the first argument.

If a log event doesn't match the specified pattern, you still see it in the results, but without the extracted fields.

Glob mode

Use wildcards (*) as placeholders for values you want to extract, and assign them to named fields with `as`.

Syntax

```
parse fieldName "pattern" as alias1, alias2
```

The number of * wildcards must equal the number of aliases.

Examples

```
parse @message "user=*, method:*, latency := *" as @user,
    @method, @latency | stats avg(@latency) by @method, @user
```

```
parse @logStream "*/*/*/*" as env, service, instance, shard
| stats count(*) by env, service
```

Chained parse

Extract a field, then parse the extracted field further.

```
parse @message "url=*" as url
| parse url "/api/*/users/*" as apiVersion, userId
| display apiVersion, userId
```

Regex mode

Use a regular expression with named capture groups to extract fields. For information about regular expression syntax, see Supported regular expressions (regex) syntax.

Syntax

```
parse fieldName /regex/
```

Use named capture groups (`?<name>...`) to define extracted fields.

Examples

Use named capture groups to extract fields

```
parse @message /user=(?<user2>.*?), method:(?<method2>.*?),
    latency := (?<latency2>.*?)/ | stats avg(latency2) by @method2,
    @user2
```

Use a named capture group to extract the ENI from a VPC flow log

```
parse @message /(?<NetworkInterface>eni-.*?) /
| display NetworkInterface, @message
```

Multi-match mode

Use multi-match mode to extract all matches of a regular expression from a field, producing multiple rows per log event. Add the keyword `multi` after the regex pattern.

Syntax

```
parse fieldName /regex/ multi
```

Examples

Extract all IP addresses from a log line (multi-match)

```
parse @message /(\d+\.\d+\.\d+\.\d+)/ as ip_addr multi
| stats count(*) by ip_addr
```

Logfmt mode

Use `parse logfmt` to parse logfmt-formatted log lines into key-value pairs. Logfmt is a structured logging format where each line contains space-separated `key=value` pairs.

Syntax

```
parse fieldName logfmt as alias
```

The result is a map that you access with dot notation (for example, `lf.level`, `lf.msg`).

Examples

```
parse @message logfmt as lf
| filter lf.level = "error"
| display lf.msg, lf.duration
```

```
parse @message logfmt as lf
| stats count(*) by lf.host
```

CSV mode

Use `parse csv` to parse CSV-formatted log lines into structured fields. Each comma-separated value is assigned to the corresponding alias.

Syntax

```
parse fieldName csv as alias1, alias2, alias3
```

Examples

```
parse @message csv as timestamp, level, message
| filter level = "ERROR"
| display timestamp, message
```

```
parse @message csv as host, method, path, status, duration
| stats avg(duration) by method
```

JSON field extraction

Use `json field=`*`fieldName`* for explicit chained JSON extraction from a previously parsed object field. This enables you to extract nested keys from a structured field without re-parsing the raw message.

Syntax

```
json field=fieldName "key.subkey" as alias
```

Examples

```
parse @message /(?<payload>\{.*\})/ as payload
| json field=payload "user.name" as username
| display username
```

```
json field=requestContext "identity.sourceIp" as caller_ip
| stats count(*) by caller_ip
```

relevantfields

Use `relevantfields` to automatically identify which fields in your log data are most relevant to a given condition. The command compares the baseline logs against the subset matching your condition, and returns fields ranked by their relevance score.

Syntax

```
relevantfields [field1, field2, ...] where condition
```

The field list is optional. If omitted, all fields are analyzed.

The command returns the following output fields:

- `@fieldName` — Name of the field
- `@relevanceScore` — A score indicating relevancy on a scale of 0 to 1
- `@topRelevanceContributors` — For categorical fields, shows entries with the highest shifts in frequency.
- `@conditionalMedian` — For numerical fields, the median of values in logs that meet the condition
- `@baselineMedian` — For numerical fields, the median of values in logs that do not meet the condition

Examples

Analyze all fields for slow API responses

```
relevantfields where Time > 400
```

Focus analysis on specific fields

```
relevantfields Controller, Path, Service where Time > 400
```

Identify drivers of Lambda timeouts

```
relevantfields where Duration > 5000
```

expand

Use `expand` to take a field containing a JSON array and create a separate log event for each element in the array. All other fields from the original log event are duplicated in each new event.

Syntax

```
expand fieldName
```

Example

If a log event contains `items = ["apple","banana","cherry"]` and `host = "web-01"`, then `expand items` produces three log events: `{items: "apple", host: "web-01"}`, `{items: "banana", host: "web-01"}`, and `{items: "cherry", host: "web-01"}`.

```
expand items
| stats count(*) by items, host
```

sort

Use `sort` to display log events in ascending (`asc`) or descending (`desc`) order by a specified field. You can use this with the `limit` command to create "top N" or "bottom N" queries.

The sorting algorithm is an updated version of natural sorting. If you sort in ascending order, the following logic is used.

- All non-number values come before all number values. *Number values* are values that include only numbers, not a mix of numbers and other characters.
- For non-number values, the algorithm groups consecutive numeric characters and consecutive alphabetic characters into separate chunks for comparison. It orders non-numeric portions by their Unicode values, and it orders numeric portions by their length first and then by their numerical value.

For more information about Unicode order, see List of Unicode characters.

For example, the following is the result of a sort in ascending order.

```
!: >>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>> sorted by unicode order
#
*%04
0# >>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>> Alphanumeric starting with numbers
5A
111A   >>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>  Starts with more digits than 5A, so it sorted
 to be later than 5A
2345_
@ >>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>> 2345 is compared with @ in the unicode order,
@_
A >>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>> Values starting with letters
A9876fghj
a12345hfh
0 >>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>> Number values
01
1
2
3
```

If you sort in descending order, the sort results are the reverse.

For example, the following query for Amazon VPC flow logs finds the top 15 packet transfers across hosts.

```
stats sum(packets) as packetsTransferred by srcAddr, dstAddr
    | sort packetsTransferred  desc
    | limit 15
```

stats

Use `stats` to create visualizations of your log data such as bar charts, line charts, and stacked area charts. This helps you more efficiently identify patterns in your log data. CloudWatch Logs Insights generates visualizations for queries that use the `stats` function and one or more aggregation functions.

For example, the following query in a Route 53 log group returns visualizations showing the distribution of Route 53 records per hour, by query type.

```
stats count(*) by queryType, bin(1h)
```

The following query collects the distinct status values for each service.

```
stats values(status) as statuses by service
```

All such queries can produce bar charts. If your query uses the `bin()` function to group the data by one field over time, you can also see line charts and stacked area charts.

The following time units and abbreviations are supported with the `bin` function. For all units and abbreviations that include more than one character, adding `s` to pluralize is supported. So both `hr` and `hrs` work to specify hours.

- `millisecond` `ms` `msec`
- `second` `s` `sec`
- `minute` `m` `min`
- `hour` `h` `hr`
- `day` `d`
- `week` `w`

- `month mo mon`
- `quarter q qtr`
- `year y yr`

Topics

- Visualize time series data
- Visualize log data grouped by fields
- Use multiple stats commands in a single query
- Functions to use with stats

Visualize time series data

Time series visualizations work for queries with the following characteristics:

- The query contains one or more aggregation functions. For more information, see Aggregation Functions in the Stats Command.
- The query uses the `bin()` function to group the data by one field.

These queries can produce line charts, stacked area charts, bar charts, and pie charts.

Examples

For a complete tutorial, see the section called “Tutorial: Run a query that produces a time series visualization”.

Here are more example queries that work for time series visualization.

The following query generates a visualization of the average values of the `myfield1` field, with a data point created every five minutes. Each data point is the aggregation of the averages of the `myfield1` values from the logs from the previous five minutes.

```
stats avg(myfield1) by bin(5m)
```

The following query generates a visualization of three values based on different fields, with a data point created every five minutes. The visualization is generated because the query contains aggregate functions and uses `bin()` as the grouping field.

```
stats avg(myfield1), min(myfield2), max(myfield3) by bin(5m)
```

Line chart and stacked area chart restrictions

Queries that aggregate log entry information but don't use the `bin()` function can generate bar charts. However, the queries cannot generate line charts or stacked area charts. For more information about these types of queries, see the section called “Visualize log data grouped by fields”.

Visualize log data grouped by fields

You can produce bar charts for queries that use the `stats` function and one or more aggregation functions. For more information, see Aggregation Functions in the Stats Command.

To see the visualization, run your query. Then choose the **Visualization** tab, select the arrow next to **Line**, and choose **Bar**. Visualizations are limited to up to 100 bars in the bar chart.

Examples

For a complete tutorial, see the section called “Tutorial: Run a query that produces a visualization grouped by log fields”. The following paragraphs include more example queries for visualization by fields.

The following VPC flow log query finds the average number of bytes transferred per session for each destination address.

```
stats avg(bytes) by dstAddr
```

You can also produce a chart that includes more than one bar for each resulting value. For example, the following VPC flow log query finds the average and maximum number of bytes transferred per session for each destination address.

```
stats avg(bytes), max(bytes) by dstAddr
```

The following query finds the number of Amazon Route 53 query logs for each query type.

```
stats count(*) by queryType
```

Use multiple stats commands in a single query

You can use multiple `stats` commands in a single query. This enables you to perform additional aggregations on the output of the first aggregation. The maximum number of `stats` commands allowed in a query depends on the log class of the log group.

Example: Query with two `stats` commands

For example, the following query first finds the total traffic volume in 5-minute bins, then calculates the highest, lowest, and average traffic volume among those 5-minute bins.

```
FIELDS strlen(@message) AS message_length
| STATS sum(message_length)/1024/1024 as logs_mb BY bin(5m)
| STATS max(logs_mb) AS peak_ingest_mb,
        min(logs_mb) AS min_ingest_mb,
        avg(logs_mb) AS avg_ingest_mb
```

Example: Combine multiple stats commands with other functions such as `filter`, `fields`, `bin`

You can combine multiple `stats` commands with other commands such as `filter` and `fields` in a single query. For example, the following query finds the number of distinct IP addresses in sessions and finds the number of sessions by client platform, filters those IP addresses, and then finally finds the average of session requests per client platform.

```
STATS countDistinct(client_ip) AS session_ips,
      count(*) AS requests BY session_id, client_platform
| FILTER session_ips > 1
| STATS count(*) AS multiple_ip_sessions,
        sum(requests) / count(*) AS avg_session_requests BY client_platform
```

You can use `bin` and `dateceil` functions in queries with multiple `stats` commands. For example, the following query first combines messages into 5-minute blocks, then aggregates those 5-minute blocks into 10-minute blocks and calculates the highest, lowest, and average traffic volumes within each 10-minute block.

```
FIELDS strlen(@message) AS message_length
| STATS sum(message_length) / 1024 / 1024 AS logs_mb BY BIN(5m) as @t
| STATS max(logs_mb) AS peak_ingest_mb,
        min(logs_mb) AS min_ingest_mb,
        avg(logs_mb) AS avg_ingest_mb BY dateceil(@t, 10m)
```

Notes and limitations

A query can have a maximum of 10 `stats` commands. This quota can't be changed.

If you use a `sort` or `limit` command, it must appear after the last `stats` command. If it is before the last `stats` command, the query is not valid.

When a query has multiple `stats` commands, the partial results from the query do not begin displaying until the first `stats` aggregation is complete.

In subsequent `stats` commands in a single query, you can refer only to fields that are defined in the preceding `stats` command. For example, the following query is not valid because the `@message` field won't be available after the first `stats` aggregation.

```
FIELDS @message
| STATS SUM(Fault) by Operation
# You can only reference `SUM(Fault)` or Operation at this point
| STATS MAX(strlen(@message)) AS MaxMessageSize # Invalid reference to @message
```

Any fields that you reference after a `stats` command must be defined in that `stats` command.

```
STATS sum(x) as sum_x by y, z
| STATS max(sum_x) as max_x by z
# You can only reference `max(sum_x)`, max_x or z at this point
```

Important

The `bin` function always implicitly uses the `@timestamp` field. This means that you can't use `bin` in a subsequent `stats` command without using the preceding `stats` command to propagate the `timestamp` field. For example, the following query is not valid.

```
FIELDS strlen(@message) AS message_length
 | STATS sum(message_length) AS ingested_bytes BY @logStream
 | STATS avg(ingested_bytes) BY bin(5m) # Invalid reference to @timestamp field
```

Instead, define the `@timestamp` field in the preceding `stats` command, and then you can use it with `dateceil` in a subsequent `stats` command as in the following example.

```
FIELDS strlen(@message) AS message_length
 | STATS sum(message_length) AS ingested_bytes, max(@timestamp) as @t BY
 @logStream
```

```
| STATS avg(ingested_bytes) BY dateceil(@t, 5m)
```

Functions to use with stats

CloudWatch Logs Insights supports both stats aggregation functions and stats non-aggregation functions.

Use statsaggregation functions in the `stats` command and as arguments for other functions.

Function	Result type	Description
`avg(fieldName: NumericLogField)`	number	The average of the values in the specified field.

`count()`
 	
`count(fieldName: LogField)`
	number	Counts the log events. `count()` (or `count(*)`) counts all events returned by the query, while `count(fieldName)` counts all records that include the specified field name.

`countDistinct(fieldName: LogField)`	number	Returns the number of unique values for the field. If the field has very high cardinality (contains many unique values), the value returned by `countDistinct` is just an approximation.
`max(fieldName: LogField)`	LogFieldValue	The maximum of the values for this log field in the queried logs.
`min(fieldName: LogField)`	LogFieldValue	The minimum of the values for this log field in the queried logs.
`pct(fieldName: LogFieldValue, percent: number)`	LogFieldValue	A percentile indicates the relative standing of a value in a dataset. For example, `pct(@duration, 95)` returns the `@duration` value at which 95 percent of the values of `@duration` are lower than this value, and 5 percent are higher than this value.

Function	Result type	Description
`stddev(fieldName: NumericLogField)`	number	The standard deviation of the values in the specified field.
`sum(fieldName: NumericLogField)`	number	The sum of the values in the specified field.
`values(fieldName: LogField)`	array	Collects the distinct values of the specified field for each group. Also known as `COLLECT_VALUES` .
`variance(fieldName: NumericLogField)`	number	Population variance of the values in the specified field. Example: `stats variance(responseTime) as rt_var by service`
`topk(k: number, fieldName: LogField)`	array	Returns the k most frequent values of the specified field. Valid values for k range from 1 to 10000. This function cannot be combined with `by` or other aggregation functions. Example: `stats topk(3, status)`

Stats non-aggregation functions

Use non-aggregation functions in the `stats` command and as arguments for other functions.

Function	Result type	Description
`earliest(fieldName: LogField)`	LogField	Returns the value of `fieldName` from the log event that has the earliest timestamp in the queried logs.
`latest(fieldName: LogField)`	LogField	Returns the value of `fieldName` from the log event that has the latest timestamp in the queried logs.

Function	Result type	Description
`sortsFirst(fieldName: LogField)`	LogField	Returns the value of `fieldName` that sorts first in the queried logs.
`sortsLast(fieldName: LogField)`	LogField	Returns the value of `fieldName` that sorts last in the queried logs.

limit

Use `limit` to specify the number of log events that you want your query to return. If you omit `limit`, the query defaults to returning up to 10,000 log events. You can specify a `limit` value of up to 100,000.

For example, the following example returns only the 25 most recent log events

```
fields @timestamp, @message | sort @timestamp desc | limit 25
```

limit any

Use `limit any` *N* to stop the query as soon as *N* matching log events are found, without scanning remaining data. This can significantly reduce the amount of data scanned and speed up queries when you need only a sample of matching events rather than a specific ordered set.

With a regular `limit`, the query scans all data in the time range and then returns the top *N* results. With `limit any`, the query completes early once enough results are found, which means the returned events may come from any portion of the time range.

For example, the following query returns 1 log event and stops scanning as soon as it finds a match:

```
fields @message | limit any 1
```

> **Note**
>
> Because `limit any` stops scanning early, the results are not guaranteed to be in any particular order. If you need ordered results, use `limit` without `any` together with `sort`.

dedup

Use dedup to remove duplicate results based on specific values in fields that you specify. You can use dedup with one or more fields. If you specify one field with dedup, only one log event is returned for each unique value of that field. If you specify multiple fields, then one log event is returned for each unique combination of values for those fields.

Duplicates are discarded based on the sort order, with only the first result in the sort order being kept. We recommend that you sort your results before putting them through the dedup command. If the results are not sorted before being run through dedup, then the default descending sort order using `@timestamp` is used.

Null values are not considered duplicates for evaluation. Log events with null values for any of the specified fields are retained. To eliminate fields with null values, use **`filter`** using the `isPresent(field)` function.

The only query command that you can use in a query after the dedup command is `limit`.

When you use dedup in a query, the console displays a message such as **Showing X of Y records**, where X is the number of deduplicated results and Y is the total number of records matched before deduplication. This indicates that duplicate records were removed and does not mean that data is missing.

Example: See only the most recent log event for each unique value of the field named `server`

The following example displays the `timestamp`, `server`, `severity`, and `message` fields for only the most recent event for each unique value of `server`.

```
fields @timestamp, server, severity, message
| sort @timestamp desc
| dedup server
```

For more samples of CloudWatch Logs Insights queries, see General queries.

unmask

Use unmask to display all the content of a log event that has some content masked because of a data protection policy. To use this command, you must have the `logs:Unmask` permission.

For more information about data protection in log groups, see Help protect sensitive log data with masking.

unnest

Use `unnest` to flatten a list taken as input to produce multiple records with a single record for each element in the list. Based on the number of items a field contains, this command discards the current record and generates new records. Each record includes the `unnested_field`, which represents an item. All other fields come from the original record.

The input for `unnest` is `LIST`, which comes from the `jsonParse` function. For more information, see Structure types. Any other types, such as `MAP`, `String` and `numbers`, are treated as a list with one item in `unnest`.

Command structure

The following example describes the format of this command.

```
unnest field into unnested_field
```

Example query

The following example parses a JSON object string and expands a list of field events.

```
fields jsonParse(@message) as json_message
| unnest json_message.events into event
| display event.name
```

The log event for this example query could be a JSON string as follows:

```
{
   "events": [
        {
            "name": "exception"
        },
        {
            "name": "user action"
        }
   ]
}
```

In this case, the sample query produces two records in the query result, one with `event.name` as `exception` and another with `event.name` as **user action**

Example query

The following example flattens a list and then filters out items.

```
fields jsonParse(@message) as js
| unnest js.accounts into account
| filter account.type = "internal"
```

Example query

The following example flattens a list for aggregation.

```
fields jsonParse(trimmedData) as accounts
| unnest accounts into account
| stats sum(account.droppedSpans) as n by account.accountId
| sort n desc
| limit 10
```

lookup

Use `lookup` to enrich your query results with reference data from a lookup table. You can populate a lookup table with CSV data that you upload to Amazon CloudWatch Logs, or with the results of a completed or cancelled log query. When a query runs, the `lookup` command matches a field in your log events against a field in the lookup table and appends the specified output fields to the results.

Use lookup tables for data enrichment scenarios such as mapping user IDs to user details, product codes to product information, or error codes to error descriptions.

Creating and managing lookup tables

Before you can use the `lookup` command in a query, you must create a lookup table. You can create and manage lookup tables from the CloudWatch console or by using the Amazon CloudWatch Logs API.

To create a lookup table (console)

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Settings**, and then choose the **Logs** tab.
3. Scroll to **Lookup tables** and choose **Manage**.

4. Choose **Create lookup table**.
5. Enter a name for the lookup table. The name can contain only alphanumeric characters and underscores.
6. (Optional) Enter a description.
7. Upload a CSV file. The file must include a header row with column names, use UTF-8 encoding, and not exceed 10 MB.
8. (Optional) Specify a AWS KMS key to encrypt the table data.
9. Choose **Create**.

After you create a lookup table, you can view it in the CloudWatch Logs Insights query editor. Choose the **Lookup tables** tab to browse available tables and their fields.

To update a lookup table, select the table and choose **Actions**, **Update**. Upload a new CSV file to replace all existing content. To delete a lookup table, choose **Actions**, **Delete**.

Instead of uploading CSV data, you can also create or update a lookup table from the results of a completed or cancelled log query that you run in the Log Analytics console or with the Amazon CloudWatch Logs API. Specify the query ID with the `queryId` parameter of the `CreateLookupTable` or `UpdateLookupTable` API. A cancelled query populates the table with the partial results that were available when the query was stopped. You must specify either the CSV content or a query ID, but not both. Updating a table is a full replacement operation—all existing content is replaced regardless of the source. To refresh a lookup table with query results automatically on a schedule, use a scheduled query with a lookup table destination. For more information, see Configuring lookup table destinations for scheduled queries.

Note

You can create up to 100 lookup tables per account per AWS Region. CSV files can be up to 10 MB. You can also manage lookup tables by using the Amazon CloudWatch Logs API. For more information, see CreateLookupTable in the *Amazon CloudWatch Logs API Reference*.

Note

If the lookup table is encrypted with a KMS key, the caller must have the `kms:Decrypt` permission on the key (the KMS key used to encrypt the lookup table) to use the

`StartQuery` API with a query that references that lookup table. For more information, see Encrypt lookup tables in CloudWatch Logs using AWS Key Management Service.

Query syntax for lookup

Command structure

The following shows the format of this command.

```
lookup table match-fields output-mode output-field[,...]
```

The command uses the following arguments:

- *table* – The name of the lookup table to use.
- *match-fields* – Specify one or more fields to match log events against the lookup table. You can use either of the following forms:
  - *lookup-field* `as` *log-field* `[,...]` – Use `as` when the lookup table column name differs from the log event field name. For example, `ip_address as srcAddr` matches the `ip_address` column in the lookup table against the `srcAddr` field in your log events.
  - *lookup-field* `[,...]` – When the log event field name is the same as the lookup table column name, you can omit `as` and specify the field name directly. For example, `department, role` matches both columns against log event fields with the same names.

  When multiple match fields are specified, a row in the lookup table must match all fields to produce a result (AND logic).
- *output-mode* – Specifies how output fields are added to the results. Use one of the following:
  - `OUTPUT` – Adds the output fields to the results. If a field with the same name already exists in the log event, it is overwritten with the lookup table value. If no match is found, the field is set to null.
  - `OUTPUTNEW` – Adds the output fields to the results only if the field does not already exist in the log event. If the field already has a value, the original value is kept. If no match is found, the field is left unchanged.
- *output-field* – One or more fields from the lookup table to add to the results.

Example: Enrich log events with user details

Suppose you have a log group with events that contain an `id` field, and a lookup table named `user_data` with columns `id`, `name`, `email`, and `department`. The following query enriches each log event with the user's name, email, and department from the lookup table.

```
fields action, status, name, email, department
| lookup user_data id OUTPUT name, email, department
```

Example: Use lookup with aggregation

You can use lookup output fields with aggregation functions. The following query enriches log events with user details and then counts events grouped by email address.

```
fields user_id, action, username, email, department
| lookup user_data user_id OUTPUT username, email, department
| stats count(*) by email
```

Example: Use lookup with filter

You can filter results based on fields returned by the lookup. The following query enriches log events and then filters to show only events from a specific department.

```
fields user_id, action
| lookup user_data user_id OUTPUT username, email, department
| filter department = "Engineering"
```

Example: Use OUTPUTNEW to enrich without overwriting

If your log events already contain a `hostname` field but it's sometimes empty, use `OUTPUTNEW` to fill in missing values without overwriting existing ones.

```
fields srcAddr, hostname
| lookup known_hosts ip_address as srcAddr OUTPUTNEW hostname, region
```

Example: Use lookup with multiple match fields

You can match on more than one field. The following query matches both `srcAddr` and `dstPort` against the lookup table to identify known network services.

```
fields @timestamp, srcAddr, dstAddr, dstPort
```

```
| lookup network_services ip_address as srcAddr, port as dstPort OUTPUT service_name,
 owner
| filter ispresent(service_name)
```

Example: Use lookup with matching field names

When your log event field names match the lookup table column names exactly, you can omit the `as` keyword. The following query matches both `department` and `role` fields directly against the lookup table.

```
fields @timestamp, department, role
| lookup employees department, role OUTPUT office, manager
```

join

Combines log events from a source log group with events from another log group or query result based on a matching field.

Use the `join` command to correlate related log events across different sources like log groups using keys common across them such as matching request identifiers or transaction IDs.

Syntax

```
join type=<join_type> left=<left_alias> right=<right_alias>
    where <left_alias>.<field>=<right_alias>.<field>
    (SOURCE <right_log_group>)
```

Parameters

- `<right_log_group>` – The secondary data source to join with.
- `<left_alias>` and `<right_alias>` – Aliases to distinguish fields from the left (primary) and right (secondary) data sources.
- `where <field>` – Specifies the field used as the join key. The field must exist in both data sources.
- `type=<join_type>` (optional) – Specifies the join type. Valid values are:
  - `inner` (default) – Returns only matching records

- `left` – Returns all records from the primary data source and matching records from the secondary data source

Examples

Example 1: Correlate API Gateway requests with Lambda execution logs

This example shows how to join API Gateway access logs with Lambda function logs to correlate incoming requests with their backend processing. This is useful for troubleshooting end-to-end request flows and identifying which Lambda invocations correspond to specific API requests.

```
filter status >= 500
| join type=inner left=api right=lambda
    where api.requestId=lambda.requestId
    (SOURCE '/aws/lambda/my-function')
| fields api.requestId, api.status, api.latency, lambda.duration, lambda.memoryUsed
| sort api.latency desc
```

This query:

1. Queries API Gateway access logs and filters for server errors (status >= 500)
2. Joins with Lambda function logs using the `requestId` field that appears in both log sources
3. Uses aliases (`api` and `lambda`) to distinguish fields from each source
4. Returns combined information showing API latency alongside Lambda execution duration and memory usage
5. Sorts results by API latency to identify the slowest requests

Example 2: Track distributed transactions across microservices

When debugging issues in a microservices architecture, you often need to trace a transaction across multiple services. This example shows how to join logs from two different services using a common transaction ID.

```
filter eventType = "ORDER_CREATED"
| join type=left left=order right=payment
    where order.transactionId=payment.transactionId
    (SOURCE '/aws/lambda/payment-service')
```

```
| filter payment.eventType = "PAYMENT_PROCESSED" or !ispresent(payment.eventType)
| fields order.transactionId, order.orderId, order.customerId,
    payment.paymentStatus, payment.amount
| filter payment.paymentStatus != "SUCCESS" or !ispresent(payment.paymentStatus)
```

This query:

1. Starts with order creation events from the order service
2. Uses a `left join` to include all orders, even those without matching payment records
3. Joins with payment processing events using the shared `transactionId` field
4. Filters the final results to show only orders with failed payments or missing payment records

The left join is important here because it ensures you see orders that were created but never had a corresponding payment event, which could indicate a system failure.

Behavior

- The primary data source (left side) is processed first.
- The secondary data source is evaluated and matched using the specified join key.
- Matching is performed using equality comparison on the join field.
- For left joins, unmatched records from the primary data source are retained with null values for secondary fields.

Notes and limitations

- Only equality (=) conditions are supported.
- Only one join command is supported per query.
- Join keys must exist in both data sources and be of compatible types.
- Queries using join may scan more data and incur higher costs.
- The number of unique key values in the secondary data source is limited to 50,000 to ensure query performance.
- Subqueries on right side of join are not supported.

Related commands

- fields
- filter
- parse
- stats
- sort
- limit

subqueries

A subquery is a nested Logs Insights query that can be used as an input to another query. Subqueries can be used to derive intermediate result sets that are then consumed by subsequent commands.

Syntax

Subquery in filter

```
filter <field> in (
    <subquery>
)
```

Parameters

- `<subquery>` – A valid Logs Insights query that returns a result set. The subquery must produce fields referenced by the outer query.

Examples

Example 1: Find requests that encountered errors in downstream services

This example shows how to use a subquery to identify requests in your main service that resulted in errors in a downstream service. This is useful for troubleshooting cascading failures in distributed systems.

```
filter requestId in (
    SOURCE '/aws/lambda/database-service'
    | filter errorType = "DatabaseConnectionTimeout"
    | fields requestId
)
| fields @timestamp, requestId, endpoint, userId, responseTime
| sort @timestamp desc
```

This query:

1. The subquery finds all `requestId` values from the database service that experienced connection timeouts
2. The outer query filters your main service's logs to show only requests that match those error-prone request IDs
3. Results show the full context of requests that failed downstream, including which endpoints and users were affected

This pattern helps you understand the upstream impact of downstream failures.

Example 2: Identify frequently failing requests for targeted investigation

This example demonstrates using a subquery with aggregation to find requests that fail repeatedly, which often indicates systematic issues rather than transient errors.

```
filter requestId in (
    SOURCE '/aws/lambda/payment-processor'
    | filter status = "FAILED"
    | stats count(*) as failureCount by requestId
    | filter failureCount > 3
    | fields requestId
)
| fields @timestamp, requestId, customerId, amount, failureReason
| sort @timestamp asc
```

This query:

1. The subquery aggregates failed payment attempts and identifies request IDs that failed more than 3 times
2. The outer query retrieves all log events for those problematic request IDs

3. Results are sorted chronologically to show the progression of retry attempts

This helps distinguish between transient failures (single occurrence) and persistent issues (multiple failures) that require deeper investigation.

Behavior

- Subqueries are executed independently of the outer query.
- Results are materialized before being consumed by the outer query.
- Only fields explicitly selected in the subquery are available to the outer query.

Notes and limitations

- Subqueries must return fields referenced by the outer query.
- Nested subqueries are not supported.
- Subqueries may increase query execution time and cost.
- Correlated subqueries are not supported.
- Inner query execution is limited to 30 seconds.

Related commands

- fields
- filter
- parse
- stats
- sort
- limit

autoregress

Use the `autoregress` command to create lagged (previous-row) copies of a field's values. This is the lag/lead equivalent for CloudWatch Logs Insights.

Syntax

```
| autoregress field [AS alias] [p=start[-end]]
```

The command uses the following arguments:

- *field* – The field to create lag values for.
- AS *alias* (Optional) – An alias for the output field.
- p=*N* (Optional) – Single lag depth (default 1). Use p=*N*-*M* for a range of lags.

Example

The following query creates four lag fields (bytes_p1 through bytes_p4).

```
fields @timestamp, bytes
| autoregress bytes p=1-4
```

logcompare

Use the logcompare command to compare the current time window against a baseline window shifted back by a specified duration.

Syntax

```
| logcompare timeshift duration
```

The command uses the following arguments:

- timeshift *duration* – The duration to shift back for the baseline window (for example, 7d).

Example

The following query compares the past day's logs against the same period one week earlier.

```
SOURCE lg start=-1d end=now
| logcompare timeshift 7d
```

filldown

Use the `filldown` command to carry the last non-null value forward to fill gaps. You can specify field names or use wildcards. If you do not specify fields, all fields are filled.

Syntax

```
| filldown [field1 [field2 ...]]
```

The command uses the following arguments:

- *`field`* (Optional) – One or more field names or wildcard patterns. If omitted, all fields are filled.

Example

The following query carries forward non-null values in the `host` field and all fields matching `cpu*`.

```
fields @timestamp, host, cpu_user, cpu_system
| filldown host cpu*
```

fillmissing

Use the `fillmissing` command to insert rows for empty time bins after `stats ... by bin()`. You can optionally fill fields with a constant value.

Syntax

```
| fillmissing [with value for field [, value for field ...]]
```

The command uses the following arguments:

- `with` *`value`* `for` *`field`* (Optional) – The constant value to assign to the specified field in the inserted rows.

Example

The following query fills empty 1-minute bins with 0 for the `avg_latency` field.

```
fields @timestamp, latency
| stats avg(latency) as avg_latency by bin(1m)
| fillmissing with 0 for avg_latency
```

cidrlookup

Use the `cidrlookup` command to enrich events by matching an IP field against CIDR ranges in a lookup table.

Syntax

```
| cidrlookup table ipField [AS cidrColumn]
    OUTPUT|OUTPUTNEW lookupField [AS eventField] [, ...]
```

The command uses the following arguments:

- *`table`* – The name of the lookup table containing CIDR ranges.
- *`ipField`* – The event field containing the IP address to match.
- `AS` *`cidrColumn`* (Optional) – The column in the lookup table that contains the CIDR ranges.
- `OUTPUT|OUTPUTNEW` – Use `OUTPUT` to overwrite existing fields, or `OUTPUTNEW` to fill only empty fields.
- *`lookupField`* – One or more fields from the lookup table to add to the event.

Example

The following query enriches events with region, owner, and datacenter from a network lookup table.

```
fields @timestamp, srcAddr
| cidrlookup net_table srcAddr OUTPUT region, owner, datacenter
```

outlier

Use the `outlier` command to detect statistical outliers in numeric fields based on the interquartile range (IQR). You can remove or clamp outlier rows.

Syntax

```
| outlier [action=remove|transform] [param=n] [uselower=true|false] [mark=true|
false] field [field ...]
```

The command uses the following arguments:

- `action` (Optional) – Either `remove` (drops outlier rows) or `transform` (clamps to boundary). Default: `transform`.
- `param` (Optional) – The IQR multiplier. Default: `2.5`.
- `uselower` (Optional) – Whether to detect lower-bound outliers. Default: `false`.
- `mark` (Optional) – Whether to add a boolean marker field. Default: `false`.
- *`field`* – One or more numeric fields to check for outliers.

Example

The following query removes rows where cpu or memory are outliers, using a 3.0 IQR multiplier with lower-bound detection and marking.

```
fields @timestamp, cpu, memory
| outlier action=remove param=3.0 uselower=true mark=true cpu memory
```

accum

Use the `accum` command to compute a running cumulative sum of a numeric field.

Syntax

```
| accum field [AS out]
```

The command uses the following arguments:

- *`field`* – The numeric field to accumulate.
- AS *`out`* (Optional) – An alias for the output field.

Example

The following query computes a running total of bytes.

```
fields @timestamp, bytes
| accum bytes AS totalBytes
```

appendcols

Use the `appendcols` command to append a sub-query's columns to the current results by positional row matching.

Syntax

```
| appendcols [override=true|false] [max=n] ( subquery )
```

The command uses the following arguments:

- `override` (Optional) – Whether to overwrite existing fields. Default: `false`.
- `max` (Optional) – Maximum rows to process (1–100000, default 10000).
- *`subquery`* – A complete CloudWatch Logs Insights query enclosed in parentheses.

Example

The following query appends average latency per service from another log group.

```
fields svc
| stats count(*) as cnt by svc
| appendcols override=true ( SOURCE lg | stats avg(latency) as avgLat by svc )
```

sessionize

Use the `sessionize` command to group events into sessions by identity fields and an inactivity gap. The command emits a session identifier field.

Syntax

```
| sessionize field[, field ...] [maxspan duration] [AS out]
```

The command uses the following arguments:

- *field* – One or more identity fields to group by.
- `maxspan` *duration* (Optional) – The maximum inactivity gap before starting a new session. Default: `30m`.
- `AS` *out* (Optional) – The output field name. Default: `session_id`.

Example

The following query groups events into sessions by user and device with a 1-hour inactivity gap.

```
fields @timestamp, userId, deviceId
| sessionize userId, deviceId maxspan 1h as my_session
```

countFrequent

Use the `countFrequent` command (also available as `count_frequent`) to compute an approximate count of each unique field-value combination, sorted in descending order. The command emits an `_approxcount` field.

Syntax

```
| countFrequent field[, field ...]
```

The command uses the following arguments:

- *field* – One or more fields to count frequencies for.

Example

The following query counts the frequency of method and status combinations.

```
fields method, status
| countFrequent method, status
```

where

Use the `where` command as an alias for the `filter` command. It accepts identical syntax and behavior.

Syntax

```
| where condition
```

The command uses the following arguments:

- *condition* – A boolean expression identical to what the `filter` command accepts.

Example

The following query filters for log events containing "error".

```
fields @timestamp, @message
| where @message like /error/
```

estimate

Use the `estimate` command to return the estimated bytes that the query would scan over the selected log groups and time range, without running the query. Using the estimated bytes returned by this command, you can refine your log group selection, time range and filters before you run the query. The `estimate` command incurs no CloudWatch Logs Insights query charges.

The `estimate` command must be the last command in the query.

> **Note**
>
> The value that `estimate` returns is approximate and can differ from the actual volume of data scanned when you run the query.

Syntax

```
| estimate
```

Example

The following query returns an estimate of the volume of data, in bytes, that the query would scan without running it.

```
fields @timestamp, @message
| filter @message like /error/
| estimate
```

Boolean, comparison, numeric, datetime, and other functions

CloudWatch Logs Insights supports many other operations and functions in queries, as explained in the following sections.

Topics

Arithmetic operators

Arithmetic operators accept numeric data types as arguments and return numeric results. Use arithmetic operators in the `filter` and `fields` commands and as arguments for other functions.

Operation	Description
`a + b`	Addition
`a - b`	Subtraction
`a * b`	Multiplication
`a / b`	Division

Operation	Description
a ^ b	Exponentiation (2 ^ 3 returns 8)
a % b	Remainder or modulus (10 % 3 returns 1)

Boolean operators

Use the Boolean operators **and**, **or**, and **not**.

> **Note**
>
> Use Boolean operators only in functions that return a value of **TRUE** or **FALSE**.

Comparison operators

Comparison operators accept all data types as arguments and return a Boolean result. Use comparison operations in the `filter` command and as arguments for other functions.

Operator	Description
=	Equal
!=	Not equal
<	Less than
>	Greater than
<=	Less than or equal to
>=	Greater than or equal to

Numeric operators

Numeric operations accept numeric data types as arguments and return numeric results. Use numeric operations in the `filter` and `fields` commands and as arguments for other functions.

Operation	Result type	Description
`abs(a: number)`	number	Absolute value
`ceil(a: number)`	number	Round to ceiling (the smallest integer that is greater than the value of a)
`floor(a: number)`	number	Round to floor (the largest integer that is smaller than the value of a)
`greatest(a: number, ...numbers: number[])`	number	Returns the largest value
`least(a: number, ...numbers: number[])`	number	Returns the smallest value
`log(a: number)`	number	Natural log
`round(a: number [, d: number])`	number	Rounds the value of a. With one argument, rounds to the nearest integer. With two arguments, rounds to d decimal places.
`sqrt(a: number)`	number	Square root
`haversine(lat1: number, lon1: number, lat2: number, lon2: number)`	number	Computes the great-cir cle distance in kilometers between two geographic points specified by latitude and longitude in degrees.
`toNumber(fieldName: string)`	number	Converts a string field value to a numeric value.

Operation	Result type	Description
`toInt(fieldName: string)`	number	Converts a field value to an integer (32-bit).
`toLong(fieldName: string)`	number	Converts a field value to a long integer (64-bit).
`toDouble(fieldName: string)`	number	Converts a field value to a double-precision floating point number.

Structure types

A map or list is a structure type in CloudWatch Logs Insights that allows you to access and use attributes for queries.

Example: To get a map or list

Use `jsonParse` to parse a field that's a json string into a map or a list.

```
fields jsonParse(@message) as json_message
```

Example: To access attributes

Use the dot access operator (map.attribute) to access items in a map.. If an attribute in a map contains special characters, use backticks to enclose the attribute name (map.attributes.`special.char`).

```
fields jsonParse(@message) as json_message
| stats count() by json_message.status_code
```

Use the bracket access operator (list[index]) to retrieve an item at a specific position within the list.

```
fields jsonParse(@message) as json_message
| filter json_message.users[1].action = "PutData"
```

Wrap special characters in backticks (``) when special characters are present in the key name.

```
fields jsonParse(@message) as json_message
```

```
| filter json_message.`user.id` = "123"
```

Example: empty results

Maps and lists are treated as null for string, number, and datetime functions.

```
fields jsonParse(@message) as json_message
| display toupper(json_message)
```

Comparing map and list to any other fields result in `false`.

> **Note**
>
> Using map and list in dedup,`pattern`, `sort`, and `stats` isn't supported.

Datetime functions

Datetime functions

Use datetime functions in the `fields` and `filter`commands and as arguments for other functions. Use these functions to create time buckets for queries with aggregate functions. Use time periods that consist of a number and one of the following:

- `ms` for milliseconds
- `s` for seconds
- `m` for minutes
- `h` for hours

For example, `10m` is 10 minutes, and `1h` is 1 hour.

> **Note**
>
> Use the most appropriate time unit for your datetime function. CloudWatch Logs caps your request according to the time unit that you choose. For example, it caps 60 as the maximum value for any request that uses `s`. So, if you specify `bin(300s)`, CloudWatch Logs actually implements this as 60 seconds, because 60 is the number of seconds in a minute so CloudWatch Logs won't use a number higher than 60 with `s`. To create a 5-minute bucket, use `bin(5m)` instead.

The cap for `ms` is 1000, the caps for `s` and `m` are 60, and the cap for `h` is 24.

The following table contains a list of the different datetime functions that you can use in query commands. The table lists each function's result type and contains a description of each function.

Tip

When you create a query command, you can use the time interval selector to select a time period that you want to query. For example, you can set a time period between 5 and 30-minute intervals; 1, 3, and 12-hour intervals; or a custom time frame. You also can set time periods between specific dates.

Function	Result type	Description

`bin(period: Period)`	Timestamp	Rounds the value of `@timestamp` to the given time period and then truncates. For example, `bin(5m)` rounds the value of `@timestamp` to the nearest 5 minutes.
		
		You can use this to group multiple log entries together in a query. The following example returns the count of exceptions per hour:
		
		`filter @message like /Exception/`
		`    | stats count(*) as exceptionCount`
		`by bin(1h)`
		`    | sort exceptionCount desc`
		
		The following time units and abbreviations are supported with the `bin` function. For all units and abbreviations that include more than one character, adding `s` to pluralize is supported. So both `hr` and `hrs` work to specify hours.
		
		• `millisecond ms msec`
		• `second s sec`

Function	Result type	Description
		• minute m min • hour h hr • day d • week w • month mo mon • quarter q qtr • year y yr
datefloor(timestamp: Timestamp, period: Period)	Timestamp	Truncates the timestamp to the given period. For example, datefloor(@timestamp, 1h) truncates all values of @timestamp to the bottom of the hour.
dateceil(timestamp : Timestamp, period: Period)	Timestamp	Rounds up the timestamp to the given period and then truncates. For example, dateceil(@timestamp, 1h) truncates all values of @timestamp to the top of the hour.
fromMillis(fieldNa me: number)	Timestamp	Interprets the input field as the number of milliseconds since the Unix epoch and converts it to a timestamp.
toMillis(fieldName: Timestamp)	number	Converts the timestamp found in the named field into a number representing the milliseco nds since the Unix epoch. For example, toMillis(@timestamp) converts the timestamp 2022-01-14T13:18:0 31.000-08:00 to 1642195111000 .

Function	Result type	Description

now()	number	Returns the time that the query processing was started, in epoch seconds. This function takes no arguments.
		
		You can use this to filter your query results according to the current time.
		
		For example, the following query returns all 4xx errors from the past two hours:
		
		`parse @message "Status Code: *;" as statusCode\n | filter statusCode >= 400 and statusCode <= 499 \n | filter toMillis(@timestamp) >= (now() * 1000 - 7200000)`
		
		The following example returns all log entries from the past five hours that contain either the word `error` or `failure`
		
		`fields @timestamp, @message | filter @message like /(?i)(error|failure)/ | filter toMillis(@timestamp) >= (now() * 1000 - 18000000)`

parseDate(fieldName: string, format: string [, timezone: string])	number	Parses a date string to epoch milliseconds using a Java DateTimeFormatter pattern. The optional `timezone` argument specifies the time zone to use for parsing. Example: `fields parseDate(field, "yyyy-MM-dd", "UTC") as epoch`

Function	Result type	Description
`formatDate(timestamp: LogField, format: string [, timezone: string])`	string	Formats a timestamp using a strftime-style format string. Also available as the alias `strftime`. The optional `timezone` argument specifies the time zone for formatting. Example: `fields formatDate(@timestamp, "%Y-%m-%d", "UTC") as date`

Note

Currently, CloudWatch Logs Insights doesn't support filtering logs with human readable timestamps.

General functions

General functions

Use general functions in the `fields` and `filter` commands and as arguments for other functions.

Function	Result type	Description
`ispresent(fieldName: LogField)`	Boolean	Returns `true` if the field exists
`coalesce(fieldName: LogField, ...fieldNames: LogField[])`	LogField	Returns the first non-null value from the list
`case(cond1, val1, cond2, val2, ..., [default])`	LogField	Evaluates conditions in order and returns the value for the first true condition. If no condition is true and a default is provided, returns

Function	Result type	Description
		the default. Supports up to 10 branches.
`if(condition: Boolean, trueValue: LogField, falseValue: LogField)`	LogField	Evaluates a condition and returns `trueValue` if the condition is true, or `falseValue` otherwise.
`isNumeric(fieldName: LogField)`	Boolean	Returns `true` if the field value can be parsed as a number. Example: `filter isNumeric(@duration)`
`messageSize(fieldName: LogField)`	number	Returns the byte length of a string field. Example: `fields messageSize(@message) as size`
`queryStartTime()`	number	Returns the query window start time as epoch milliseconds.
`queryEndTime()`	number	Returns the query window end time as epoch milliseconds.
`queryTimeRange()`	number	Returns the query window duration in milliseconds.

JSON functions

JSON functions

Use JSON functions in the `fields` and `filter` commands and as arguments for other functions.

Function	Result type	Description
`jsonParse(fieldName: string)`	Map | List | Empty	Returns a map or list when the input is a string represent ation of JSON object or a JSON array. Returns an empty value, if the input is not one of the representation.
`jsonStringify(fieldName: Map | List)`	String	Returns a JSON string from a map or list data.
`jsonArraySize(fieldName: LogField)`	number	Returns the element count of a JSON array string field. Example: `fields jsonArraySize(Oper ation) as arrayLen`
`jsonArrayContains(fieldName: LogField, value: string)`	Boolean	Returns `true` (1) if the JSON array in the field contains the specified value. Returns `false` (0) for invalid JSON, non-array, or empty array. Uses case-sensitive compariso n. Example: `filter jsonArrayContains( @roles, "admin")`

IP address string functions

IP address string functions

Use IP address string functions in the `filter` and `fields` commands and as arguments for other functions.

Function	Result type	Description
`isValidIp(fieldName: string)`	boolean	Returns `true` if the field is a valid IPv4 or IPv6 address.
`isValidIpV4(fieldName: string)`	boolean	Returns `true` if the field is a valid IPv4 address.
`isValidIpV6(fieldName: string)`	boolean	Returns `true` if the field is a valid IPv6 address.
`isIpInSubnet(fieldName: string, subnet: string)`	boolean	Returns `true` if the field is a valid IPv4 or IPv6 address within the specified v4 or v6 subnet. When you specify the subnet, use CIDR notation such as `192.0.2.0/24` or `2001:db8::/32` , where `192.0.2.0` or `2001:db8::` is the start of the CIDR block.
`isIpv4InSubnet(fieldName: string, subnet: string)`	boolean	Returns `true` if the field is a valid IPv4 address within the specified v4 subnet. When you specify the subnet, use CIDR notation such as `192.0.2.0/24` where `192.0.2.0` is the start of the CIDR block..
`isIpv6InSubnet(fieldName: string, subnet: string)`	boolean	Returns `true` if the field is a valid IPv6 address within the specified v6 subnet. When you specify the subnet, use CIDR notation such as `2001:db8::/32` where `2001:db8::` is the start of the CIDR block.
`ipv4ToNumber(fieldName: string)`	number	Converts an IPv4 address string to its numeric representation.
`isPrivateIP(fieldName: string)`	boolean	Returns `true` if the IP address is in a private range (RFC 1918).

Function	Result type	Description
`isPublicIP(fieldName: string)`	boolean	Returns `true` if the IP address is publicly routable.
`isReservedIP(fieldName: string)`	boolean	Returns `true` if the IP address is in a reserved range.

String functions

String functions

Use string functions in the `fields` and `filter` commands and as arguments for other functions.

Function	Result type	Description
`isempty(fieldName: string)`	Number	Returns 1 if the field is missing or is an empty string.
`isblank(fieldName: string)`	Number	Returns 1 if the field is missing, an empty string, or contains only white space.
`concat(str: string, ...strings: string[])`	string	Concatenates the strings.

`ltrim(str: string)`
 	
`ltrim(str: string, trimChars: string)`
	string	If the function does not have a second argument, it removes white space from the left of the string. If the function has a second string argument, it does not remove white space. Instead, it removes the characters in `trimChars` from the left of `str`. For example, `ltrim("xy`

Function	Result type	Description
		`ZxyfooxyZ","xyZ")` returns `"fooxyZ"`.

`rtrim(str: string)`
 	
`rtrim(str: string, trimChars: string)`
	string	If the function does not have a second argument, it removes white space from the right of the string. If the function has a second string argument, it does not remove white space. Instead, it removes the characters of `trimChars` from the right of `str`. For example, `rtrim("xyZfooxyxyZ","xyZ")` returns `"xyZfoo"`.

`trim(str: string)`
 	
`trim(str: string, trimChars: string)`
	string	If the function does not have a second argument, it removes white space from both ends of the string. If the function has a second string argument, it does not remove white space. Instead, it removes the characters of `trimChars` from both sides of `str`. For example, `trim("xyZxyfooxyxyZ","xyZ")` returns `"foo"`.

`strlen(str: string)`	number	Returns the length of the string in Unicode code points.
`toupper(str: string)`	string	Converts the string to uppercase.

Function	Result type	Description
`tolower(str: string)`	string	Converts the string to lowercase.

`substr(str: string, startIndex: number)`
 	
`substr(str: string, startIndex: number, length: number)`
	string	Returns a substring from the index specified by the number argument to the end of the string. If the function has a second number argument, it contains the length of the substring to be retrieved. For example, `substr("xyZfooxyZ",3, 3)` returns `"foo"`.

`replace(fieldName: string, searchValue: string, replaceValue: string)`	string	Replaces all instances of `searchValue` in `fieldName: string` with `replaceValue` . For example, the function `replace(logGroup,"smoke_test","Smoke")` searches for log events where the field `logGroup` contains the string value `smoke_test` and replaces the value with the string `Smoke`.
`regexReplace(fieldName: string, pattern: string, replacement: string)`	string	Replaces all substrings matching the regular expression `pattern` with `replacement` . Uses RE2 regex syntax.

Function	Result type	Description

`strcontains(str: string, searchValue: string)`
 	
`strcontains(str: string, searchValue: string, caseInsensitive: boolean)`
	number	Returns 1 if `str` contains `searchValue` and 0 otherwise. If the third parameter is set to `true`, the match is case-insensitive.

`startsWith(str: string, searchValue: string)`	number	Returns 1 if `str` starts with `searchValue` and 0 otherwise.
`endsWith(str: string, searchValue: string)`	number	Returns 1 if `str` ends with `searchValue` and 0 otherwise.
`urlencode(str: string)`	string	URL-encodes the string.
`urldecode(str: string)`	string	URL-decodes the string.
`base64encode(str: string)`	string	Base64-encodes the string.
`base64decode(str: string)`	string	Base64-decodes the string.
`split(str: string, delimiter: string)`	array	Splits a string by the specified delimiter and returns an array of substrings.
`hexToAscii(value: string)`	string	Converts a hexadecimal string to ASCII text. Example: `fields hexToAscii("48656c6c6f") as text`

Function	Result type	Description
`hexToDec(value: string)`	number	Converts a hexadecimal string to a decimal number. Example: `fields hexToDec("0xff") as dec`
`decToHex(value: number)`	string	Converts a decimal integer to a lowercase hex string with `0x` prefix. Negative numbers produce `-0x` prefix. Non-integers are truncated. Example: `fields decToHex(255) as hex`

Hashing functions

You can use hashing functions in `fields` and `filter` commands.

Function	Result type	Description
`md5(fieldName: string)`	string	Computes the MD5 hash of the string value.
`sha256(fieldName: string)`	string	Computes the SHA-256 hash of the string value.

Time-series functions

Use time-series functions with the `stats` command to analyze metrics over time windows and compute rates of change.

Function	Result type	Description
`rate(fieldName: NumericLogField, interval: Period)`	number	Computes the per-interval rate of change for a numeric field.
`countOverTime(fieldName: LogField)`	number	Counts log events per time bin. Use with by `bin(interval)` to set the window.
`sumOverTime(fieldName: NumericLogField)`	number	Sums field values per time bin. Use with by `bin(interval)` to set the window.
`histogram(fieldName: NumericLogField, buckets: number)`	map	Bucketizes numeric field values into the specified number of equal-width ranges and returns the distribution.

offset

Use `offset` at the end of a `stats ... by bin()` clause to shift time-series bins by a specified duration. This enables time-shifted comparisons, such as comparing current metrics against the same period in the previous hour or day.

Syntax

```
stats <aggregation> by bin(<period>) offset <duration>
```

Examples

```
stats count(*) by bin(5m) offset 1h
```

```
stats avg(latency) by bin(1m) offset 1d
```

Fields that contain special characters

If a field contains non-alphanumeric characters other than the @ symbol or the period (.), you must surround the field with backtick characters (`). For example, the log field `foo-bar` must be enclosed in backticks (`` `foo-bar` ``) because it contains a non-alphanumeric character, the hyphen (-).

For system fields that start with @ and contain special characters in the remaining name, place the @ symbol outside the backticks and enclose only the field name portion. For example, resource tag fields use the pattern `@aws.tag.<tagKey>`. If the tag key contains special characters such as colons, you must use the following syntax:

```
@`aws.tag.aws:cloudformation:stack-name`
```

The following example shows a filter query that uses this syntax:

```
filter @`aws.tag.aws:cloudformation:stack-name` = "my-stack"
```

Use aliases and comments in queries

Create queries that contain aliases. Use aliases to rename log fields or when extracting values into fields. Use the keyword `as` to give a log field or result an alias. You can use more than one alias in a query. You can use aliases in the following commands:

- `fields`
- `parse`
- `sort`
- `stats`

The following examples show how to create queries that contain aliases.

Example

The query contains an alias in the `fields` command.

```
fields @timestamp, @message, accountId as ID
| sort @timestamp desc
| limit 20
```

The query returns the values for the fields `@timestamp`, `@message`, and `accountId`. The results are sorted in descending order and limited to 20. The values for `accountId` are listed under the alias `ID`.

Example

The query contains aliases in the `sort` and `stats` commands.

```
stats count(*) by duration as time
| sort time desc
```

The query counts the number of times the field `duration` occurs in the log group and sorts the results in descending order. The values for `duration` are listed under the alias `time`.

Use comments

CloudWatch Logs Insights supports comments in queries. Use the hash character (**#**) to set off comments. You can use comments to ignore lines in queries or document queries.

Example: Query

When the following query is run, the second line is ignored.

```
fields @timestamp, @message, accountId
# | filter accountId not like "7983124201998"
| sort @timestamp desc
| limit 20
```

Get started with Logs Insights QL: Query tutorials

The following sections include sample query tutorials to help you get started with Logs Insights QL.

Topics

- Tutorial: Run and modify a sample query

- Tutorial: Run a query with an aggregation function
- Tutorial: Run a query that produces a visualization grouped by log fields
- Tutorial: Run a query that produces a time series visualization

Tutorial: Run and modify a sample query

The following tutorial helps you get started with CloudWatch Logs Insights. You run a sample query in Logs Insights QL, and then see how to modify and rerun it.

To run a query, you must already have logs stored in CloudWatch Logs. If you are already using CloudWatch Logs and have log groups and log streams set up, you are ready to start. You may also already have logs if you use services such as AWS CloudTrail, Amazon Route 53, or Amazon VPC and you have set up logs from those services to go to CloudWatch Logs. For more information about sending logs to CloudWatch Logs, see Getting started with CloudWatch Logs.

Queries in CloudWatch Logs Insights return either a set of fields from log events or the result of a mathematical aggregation or other operation performed on log events. This tutorial demonstrates a query that returns a list of log events.

Run a sample query

To run a CloudWatch Logs Insights sample query

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Logs**, and then choose **Logs Insights**.

   On the **Logs Insights** page, the query editor contains a default query in Logs Insights QL that returns the 20 most recent log events.
3. In the **Select log group(s)** drop down, choose one or more log groups to query.

   If this is a monitoring account in CloudWatch cross-account observability, you can select log groups in the source accounts as well as the monitoring account. A single query can query logs from different accounts at once.

   You can filter the log groups by log group name, account ID, or account label.

   When you select a log group in the Standard log class, CloudWatch Logs Insights automatically detects data fields in the group. To see discovered fields, select the **Fields** menu near the top right of the page.

> **Note**
>
> Discovered fields is supported only for log groups in the Standard log class. For more information about log classes, see Log classes.

4. (Optional) Use the time interval selector to select a time period that you want to query.

   You can choose between 5 and 30-minute intervals; 1, 3, and 12-hour intervals; or a custom time frame.

5. Choose **Run** to view the results.

   For this tutorial, the results include the 20 most recently added log events.

   CloudWatch Logs displays a bar graph of log events in the log group over time. The bar graph shows not only the events in the table, but also the distribution of events in the log group that match the query and timeframe.

6. To see all fields for a returned log event, choose the triangular dropdown icon left of the numbered event.

Modify the sample query

In this tutorial, you modify the sample query to show the 50 most recent log events.

If you haven't already run the previous tutorial, do that now. This tutorial starts where that previous tutorial ends.

> **Note**
>
> Some sample queries provided with CloudWatch Logs Insights use `head` or `tail` commands instead of `limit`. These commands are being deprecated and have been replaced with `limit`. Use `limit` instead of `head` or `tail` in all queries that you write.

To modify the CloudWatch Logs Insights sample query

1. In the query editor, change **20** to **50**, and then choose **Run**.

The results of the new query appear. Assuming there is enough data in the log group in the default time range, there are now 50 log events listed.

2. (Optional) You can save queries that you have created. To save this query, choose **Save**. For more information, see Save and re-run CloudWatch Logs Insights queries.

Add a filter command to the sample query

This tutorial shows how to make a more powerful change to the query in the query editor. In this tutorial, you filter the results of the previous query based on a field in the retrieved log events.

If you haven't already run the previous tutorials, do that now. This tutorial starts where that previous tutorial ends.

To add a filter command to the previous query

1. Decide on a field to filter. To see the most common fields that CloudWatch Logs has detected in the log events contained in the selected log groups in the past 15 minutes, and the percentage of those log events in which each field appears, select **Fields** on the right side of the page.

   To see the fields contained in a particular log event, choose the icon to the left of that row.

   The **awsRegion** field might appear in your log event, depending on which events are in your logs. For the rest of this tutorial, we use **awsRegion** as the filter field, but you can use a different field if that field isn't available.
2. In the query editor box, place your cursor after **50** and press Enter.
3. On the new line, first enter | (the pipe character) and a space. Commands in a CloudWatch Logs Insights query must be separated by the pipe character.
4. Enter **`filter awsRegion="us-east-1"`**.
5. Choose **Run**.

   The query runs again, and now displays the 50 most recent results that match the new filter.

   If you filtered on a different field and got an error result, you might need to escape the field name. If the field name includes non-alphanumeric characters, you must put backtick characters (`) before and after the field name (for example, **`` `error-code`="102" ``**).

You must use the backtick characters for field names that contain non-alphanumeric characters, but not for values. Values are always contained in quotation marks (").

Logs Insights QL includes powerful query abilities, including several commands and support for regular expressions, mathematical, and statistical operations. For more information, see CloudWatch Logs Insights language query syntax.

Tutorial: Run a query with an aggregation function

You can use aggregation functions with the `stats` command and as arguments for other functions. In this tutorial, you run a query command that counts the number of log events containing a specified field. The query command returns a total count that's grouped by the specified field's value or values. For more information about aggregation functions, see Supported operations and functions in the *Amazon CloudWatch Logs User Guide*.

To run a query with an aggregation function

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Logs**, and then choose **Logs Insights**.
3. Confirm that the **Logs Insights QL** tab is selected.
4. In the **Select log group(s)** drop down, choose one or more log groups to query.

   If this is a monitoring account in CloudWatch cross-account observability, you can select log groups in the source accounts as well as the monitoring account. A single query can query logs from different accounts at once.

   You can filter the log groups by log group name, account ID, or account label.

   When you select a log group, CloudWatch Logs Insights automatically detects data fields in the log group if it is a Standard class log group. To see discovered fields, select the **Fields** menu near the top right of the page.
5. Delete the default query in the query editor, and enter the following command:

   ```
   stats count(*) by fieldName
   ```
6. Replace *fieldName* with a discovered field from the **Fields** menu.

The **Fields** menu is located at the top right of the page and displays all of the discovered fields that CloudWatch Logs Insights detects in your log group.

7. Choose **Run** to view the query results.

   The query results show the number of records in your log group that match the query command and the total count that's grouped by the specified field's value or values.

Tutorial: Run a query that produces a visualization grouped by log fields

When you run a query that uses the `stats` function to group the returned results by the values of one or more fields in the log entries, you can view the results as a bar chart, pie chart, line graph or stacked area graph. This helps you more efficiently visualize trends in your logs.

To run a query for visualization

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Logs**, and then choose **Logs Insights**.
3. In the **Select log group(s)** drop down, choose one or more log groups to query.

   If this is a monitoring account in CloudWatch cross-account observability, you can select log groups in the source accounts as well as the monitoring account. A single query can query logs from different accounts at once.

   You can filter the log groups by log group name, account ID, or account label.
4. In the query editor, delete the current contents, enter the following `stats` function, and then choose **Run query**.

   ```
   stats count(*) by @logStream
       | limit 100
   ```

   The results show the number of log events in the log group for each log stream. The results are limited to only 100 rows.
5. Choose the **Visualization** tab.
6. Select the arrow next to **Line**, and then choose **Bar**.

   The bar chart appears, showing a bar for each log stream in the log group.

Tutorial: Run a query that produces a time series visualization

When you run a query that uses the `bin()` function to group the returned results by a time period, you can view the results as a line graph, stacked area graph, pie chart, or bar chart. This helps you more efficiently visualize trends in log events over time.

To run a query for visualization

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Logs**, and then choose **Logs Insights**.
3. Confirm that the **Logs Insights QL** tab is selected.
4. In the **Select log group(s)** drop down, choose one or more log groups to query.

   If this is a monitoring account in CloudWatch cross-account observability, you can select log groups in the source accounts as well as the monitoring account. A single query can query logs from different accounts at once.

   You can filter the log groups by log group name, account ID, or account label.
5. In the query editor, delete the current contents, enter the following `stats` function, and then choose **Run query**.

   ```
   stats count(*) by bin(30s)
   ```

   The results show the number of log events in the log group that were received by CloudWatch Logs for each 30-second period.
6. Choose the **Visualization** tab.

   The results are shown as a line graph. To switch to a bar chart, pie chart, or stacked area chart, choose the arrow next to **Line** at the upper left of the graph.

Sample queries

This section contains a list of general and useful query commands that you can run in the CloudWatch console. For information about how to run a query command, see Tutorial: Run and modify a sample query in the *Amazon CloudWatch Logs User Guide*.

For more information about query syntax, see CloudWatch Logs Insights language query syntax.

Topics

General queries

Find the 25 most recently added log events.

```
fields @timestamp, @message | sort @timestamp desc | limit 25
```

Get a list of the number of exceptions per hour.

```
filter @message like /Exception/
    | stats count(*) as exceptionCount by bin(1h)
    | sort exceptionCount desc
```

Get a list of log events that aren't exceptions.

```
fields @message | filter @message not like /Exception/
```

Get the most recent log event for each unique value of the `server` field.

```
fields @timestamp, server, severity, message
| sort @timestamp asc
```

```
| dedup server
```

Get the most recent log event for each unique value of the `server` field for each `severity` type.

```
fields @timestamp, server, severity, message
| sort @timestamp desc
| dedup server, severity
```

Queries for Lambda logs

Determine the amount of overprovisioned memory.

```
filter @type = "REPORT"
    | stats max(@memorySize / 1000 / 1000) as provisonedMemoryMB,
        min(@maxMemoryUsed / 1000 / 1000) as smallestMemoryRequestMB,
        avg(@maxMemoryUsed / 1000 / 1000) as avgMemoryUsedMB,
        max(@maxMemoryUsed / 1000 / 1000) as maxMemoryUsedMB,
        provisonedMemoryMB - maxMemoryUsedMB as overProvisionedMB
```

Create a latency report.

```
filter @type = "REPORT" |
    stats avg(@duration), max(@duration), min(@duration) by bin(5m)
```

Search for slow function invocations, and eliminate duplicate requests that can arise from retries or client-side code. In this query, `@duration` is in milliseconds.

```
fields @timestamp, @requestId, @message, @logStream
| filter @type = "REPORT" and @duration > 1000
| sort @timestamp desc
| dedup @requestId
| limit 20
```

Queries for Amazon VPC flow logs

Find the top 15 packet transfers across hosts:

```
stats sum(packets) as packetsTransferred by srcAddr, dstAddr
    | sort packetsTransferred  desc
```

```
    | limit 15
```

Find the top 15 byte transfers for hosts on a given subnet.

```
filter isIpv4InSubnet(srcAddr, "192.0.2.0/24")
    | stats sum(bytes) as bytesTransferred by dstAddr
    | sort bytesTransferred desc
    | limit 15
```

Find the IP addresses that use UDP as a data transfer protocol.

```
filter protocol=17 | stats count(*) by srcAddr
```

Find the IP addresses where flow records were skipped during the capture window.

```
filter logStatus="SKIPDATA"
    | stats count(*) by bin(1h) as t
    | sort t
```

Find a single record for each connection, to help troubleshoot network connectivity issues.

```
fields @timestamp, srcAddr, dstAddr, srcPort, dstPort, protocol, bytes
| filter logStream = 'vpc-flow-logs' and interfaceId = 'eni-0123456789abcdef0'
| sort @timestamp desc
| dedup srcAddr, dstAddr, srcPort, dstPort, protocol
| limit 20
```

Queries for Route 53 logs

Find the distribution of records per hour by query type.

```
stats count(*) by queryType, bin(1h)
```

Find the 10 DNS resolvers with the highest number of requests.

```
stats count(*) as numRequests by resolverIp
    | sort numRequests desc
```

```
    | limit 10
```

Find the number of records by domain and subdomain where the server failed to complete the DNS request.

```
filter responseCode="SERVFAIL" | stats count(*) by queryName
```

Queries for CloudTrail logs

Find the number of log entries for each service, event type, and AWS Region.

```
stats count(*) by eventSource, eventName, awsRegion
```

Find the Amazon EC2 hosts that were started or stopped in a given AWS Region.

```
filter (eventName="StartInstances" or eventName="StopInstances") and awsRegion="us-
east-2"
```

Find the AWS Regions, user names, and ARNs of newly created IAM users.

```
filter eventName="CreateUser"
    | fields awsRegion, requestParameters.userName, responseElements.user.arn
```

Find the number of records where an exception occurred while invoking the API `UpdateTrail`.

```
filter eventName="UpdateTrail" and ispresent(errorCode)
    | stats count(*) by errorCode, errorMessage
```

Find log entries where TLS 1.0 or 1.1 was used

```
filter tlsDetails.tlsVersion in [ "TLSv1", "TLSv1.1" ]
| stats count(*) as numOutdatedTlsCalls by userIdentity.accountId, recipientAccountId,
 eventSource, eventName, awsRegion, tlsDetails.tlsVersion, tlsDetails.cipherSuite,
 userAgent
| sort eventSource, eventName, awsRegion, tlsDetails.tlsVersion
```

Find the number of calls per service that used TLS versions 1.0 or 1.1

```
filter tlsDetails.tlsVersion in [ "TLSv1", "TLSv1.1" ]
| stats count(*) as numOutdatedTlsCalls by eventSource
| sort numOutdatedTlsCalls desc
```

Queries for Amazon API Gateway

Find the last 10 4XX errors

```
fields @timestamp, status, ip, path, httpMethod
| filter status>=400 and status<=499
| sort @timestamp desc
| limit 10
```

Identify the 10 longest-running Amazon API Gateway requests in your Amazon API Gateway access log group

```
fields @timestamp, status, ip, path, httpMethod, responseLatency
| sort responseLatency desc
| limit 10
```

Return the list of the most popular API paths in your Amazon API Gateway access log group

```
stats count(*) as requestCount by path
| sort requestCount desc
| limit 10
```

Create an integration latency report for your Amazon API Gateway access log group

```
filter status=200
| stats avg(integrationLatency), max(integrationLatency),
min(integrationLatency) by bin(1m)
```

Queries for NAT gateway

If you notice higher than normal costs in your AWS bill, you can use CloudWatch Logs Insights to find the top contributors. For more information about the following query commands, see How

can I find the top contributors to traffic through the NAT gateway in my VPC? at the AWS premium support page.

> **Note**
>
> In the following query commands, replace "x.x.x.x" with the private IP of your NAT gateway, and replace "y.y" with the first two octets of your VPC CIDR range.

Find the instances that are sending the most traffic through your NAT gateway.

```
filter (dstAddr like 'x.x.x.x' and srcAddr like 'y.y.')
| stats sum(bytes) as bytesTransferred by srcAddr, dstAddr
| sort bytesTransferred desc
| limit 10
```

Determine the traffic that's going to and from the instances in your NAT gateways.

```
filter (dstAddr like 'x.x.x.x' and srcAddr like 'y.y.') or (srcAddr like 'xxx.xx.xx.xx'
 and dstAddr like 'y.y.')
| stats sum(bytes) as bytesTransferred by srcAddr, dstAddr
| sort bytesTransferred desc
| limit 10
```

Determine the internet destinations that the instances in your VPC communicate with most often for uploads and downloads.

For uploads

```
filter (srcAddr like 'x.x.x.x' and dstAddr not like 'y.y.')
| stats sum(bytes) as bytesTransferred by srcAddr, dstAddr
| sort bytesTransferred desc
| limit 10
```

For downloads

```
filter (dstAddr like 'x.x.x.x' and srcAddr not like 'y.y.')
| stats sum(bytes) as bytesTransferred by srcAddr, dstAddr
| sort bytesTransferred desc
| limit 10
```

Queries for Apache server logs

You can use CloudWatch Logs Insights to query Apache server logs. For more information about the following queries, see Simplifying Apache server logs with CloudWatch Logs Insights at the AWS Cloud Operations & Migrations Blog.

Find the most relevant fields, so you can review your access logs and check for traffic in the */admin* path of your application.

```
fields @timestamp, remoteIP, request, status, filename| sort @timestamp desc
| filter filename="/var/www/html/admin"
| limit 20
```

Find the number unique GET requests that accessed your main page with status code "200" (success).

```
fields @timestamp, remoteIP, method, status
| filter status="200" and referrer= http://34.250.27.141/ and method= "GET"
| stats countDistinct(remoteIP) as UniqueVisits
| limit 10
```

Find the number of times your Apache service restarted.

```
fields @timestamp, function, process, message
| filter message like "resuming normal operations"
| sort @timestamp desc
| limit 20
```

Queries for Amazon EventBridge

Get the number of EventBridge events grouped by event detail type

```
fields @timestamp, @message
| stats count(*) as numberOfEvents by `detail-type`
| sort numberOfEvents desc
```

Queries for resource tags

Filter logs by a resource tag value.

```
filter @aws.tag.env = "production"
```

Filter by a tag key that contains special characters.

```
filter @`aws.tag.aws:cloudformation:stack-name` = "my-stack"
```

Get a count of log events grouped by a tag value.

```
stats count(*) by @aws.tag.team
```

Examples of the parse command

Use a glob expression to extract the fields `@user`, `@method`, and `@latency` from the log field `@message` and return the average latency for each unique combination of `@method` and `@user`.

```
parse @message "user=*, method:*, latency := *" as @user,
    @method, @latency | stats avg(@latency) by @method,
    @user
```

Use a regular expression to extract the fields `@user2`, `@method2`, and `@latency2` from the log field `@message` and return the average latency for each unique combination of `@method2` and `@user2`.

```
parse @message /user=(?<user2>.*?), method:(?<method2>.*?),
    latency := (?<latency2>.*?)/ | stats avg(latency2) by @method2,
    @user2
```

Extracts the fields `loggingTime`, `loggingType` and `loggingMessage`, filters down to log events that contain `ERROR` or `INFO` strings, and then displays only the `loggingMessage` and `loggingType` fields for events that contain an `ERROR` string.

```
FIELDS @message
    | PARSE @message "* [*] *" as loggingTime, loggingType, loggingMessage
    | FILTER loggingType IN ["ERROR", "INFO"]
    | DISPLAY loggingMessage, loggingType = "ERROR" as isError
```

Compare (diff) with previous time ranges

You can use CloudWatch Logs Insights with the Logs Insights QL to compare changes in your log events over time. You can compare the log events ingested during a recent time range with the logs from the immediately previous time period. Alternatively, you can compare with similar past

time periods. This can help you find whether an error in your logs was recently introduced or was already occurring, and can help you find other trends.

Comparison queries return only patterns in the results, not raw log events. The patterns returned will help you quickly see the trends and changes in the log events over time. After you run a comparison query and have the pattern results, you can see sample raw log events for the patterns that you're interested in. For more information about log patterns, see Pattern analysis.

When you run a comparison query, your query is analyzed against two different time periods: the original query period that you select, and the comparison period. The comparison period is always of equal length to your original query period. The default time intervals for the comparisons are the following.

- **Previous period**— Compares to the time period immediately before your query time period.
- **Previous day**— Compares to the time period one day before your query time period.
- **Previous week**— Compares to the time period one week before your query time period.
- **Previous month**— Compares to the time period one month before your query time period.

> **Note**
>
> Queries using comparisons incur charges similar to running a single CloudWatch Logs Insights query over the combined time range. For more information, see Amazon CloudWatch Pricing.

To run a comparison query

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Logs**, **Logs Insights**.

   A default query appears in the query box.
3. Confirm that the **Logs Insights QL** tab is selected.
4. Keep the default query or enter a different query.
5. In the **Select log group(s)** drop-down, choose one or more log groups to query.
6. (Optional) Use the time interval selector to select a time period that you want to query. The default query is for the previous hour of log data.

7. By the time range selector, choose **Compare**. Then choose the previous time period that you want to compare the original logs with, and choose **Apply**.
8. Choose **Run query**.

   To cause the query to fetch the data from the comparison period, the `diff` command is appended to your query.
9. Choose the **Patterns** tab to see the results.

   The table displays the following information:

   - Each **Pattern**, with variable parts of the pattern replaced by the dynamic token symbol <*string*-*number*>. The *string* is a description of the type of data that the token represents. The *number* shows where in the pattern this token appears, compared to the other dynamic tokens. For more information, see Pattern analysis.
   - **Event count** is the number of log events with that pattern in the original, more current time period.
   - **Difference event count** is the difference between the number of matching log events in the current time period versus the comparison time period. A positive different means there are more such events in the current time period.
   - **Difference description** briefly summarizes the change in that pattern between the current time period and the comparison period.
   - **Severity type** is the probable severity of the logs events with this pattern, based on words found in the log events such as `FATAL`, `ERROR`, and `WARN`.
10. To further inspect one of the patterns in the list, choose the icon in the **Inspect** column for one of the patterns.

    The **Pattern inspect** pane appears and displays the following:

    - The **Pattern**. Select a token within the pattern to analyze that token's values.
    - A histogram showing the number of occurrences of the pattern over the queried time range. This can help you to identify interesting trends such as a sudden increase in occurrence of a pattern.
    - The **Log samples** tab displays a few of the log events that match the selected pattern.
    - The **Token Values** tab displays the values of the selected dynamic token, if you have selected one.

> **Note**
>
> A maximum of 10 token values is captured for each token. Token counts might not be precise. CloudWatch Logs uses a probabilistic counter to generate the token count, not the absolute value.

- The **Related patterns** tab displays other patterns that frequently occurred near the same time as the pattern that you are inspecting. For example, if a pattern for an `ERROR` message was usually accompanied by another log event marked as `INFO` with additional details, that pattern is displayed here.

Visualize log data in graphs

You can use visualizations such as bar charts, line charts, and stacked area charts to more efficiently identify patterns in your log data. CloudWatch Logs Insights generates visualizations for queries that use the `stats` function and one or more aggregation functions. For more information, see stats.

OpenSearch Piped Processing Language (PPL)

This section contains a basic introduction to querying CloudWatch Logs using OpenSearch PPL. With PPL, you can retrieve, query, and analyze data using piped-together commands, making it easier to understand and compose complex queries. Its syntax is based on Unix pipes, and enables chaining of commands to transform and process data. With PPL, you can filter and aggregate data, and use a rich set of math, string, date, conditional, and other functions for analysis.

Including `SOURCE` in a PPL query is a useful way to specify the log groups field indexes, and data sources to include in a query when you are using the AWS CLI or API to create a query. The `SOURCE` command is supported only in the AWS CLI and API, not in the CloudWatch console. When you use the CloudWatch console to start a query, you use the console interface to specify the log groups and data source name and type.

Use `aws:fieldIndex` to return indexed data only, by forcing a query to scan only log groups that are indexed on a field that you specify in the query. The relevant log groups are automatically selected, based on the fields specified in the `filterIndex` command. This reduces scanned volume by skipping log groups that do not have any log events containing the field specified in the query, and only scanning log groups that match the value specified in the query for this field

index. Use `aws:fieldIndex` to specify the field name, along with the field name and value in the source command to query only indexed data containing the field and value specified. For more information, see Create field indexes to improve query performance and reduce scan volume

You can use OpenSearch PPL for queries of log groups in the Standard Log Class.

> **Note**
>
> For information about all OpenSearch PPL query commands supported in CloudWatch Logs and detailed information about syntax and restrictions, see Supported PPL commands in the OpenSearch Service Developer Guide.
> For information on other query languages you can use see, CloudWatch Logs Insights, OpenSearch Service SQL, and CloudWatch Metrics Insights

Command or function	Example query	Description
`fields`	`fields field1, field2`	Displays a set of fields which needs projectio n.
`join`	`LEFT JOIN left=l, right=r on l.id = r.id` `` `join_right_lg` `` `| fields l.field_1, r.field_2`	Joins two datasets together.
`where`	`where field1="success" | where field2 ! = "i-023fe0a90929d8822" | fields field3, field4, field5,field6 | head 1000`	Filters the data based on the conditions that you specify.
`aws:field Index`	`source = [` `` `aws:fieldIndex` `` `="region",` `` `region` `` `= "us-west-2"] | where status = 200 | head 10`	Returns indexed data only, by forcing a query to scan only log groups that are indexed on a

Command or function	Example query	Description
		field that you specify in the query.
stats	`stats count(), count(field1), min(field1), max(field1), avg(field1) by field2 | head 1000`	Performs aggregations and calculations
parse	`parse field1 ".*/(?<field2>[^/]+$)" | where field2 = "requestId" | fields field1, field2 | head 1000`	Extracts a regular expression (regex) pattern from a string and displays the extracted pattern. The extracted pattern can be further used to create new fields or filter data.
sort	`stats count(), count(field1), min(field1) as field1Alias, max(`field1`), avg(`field1`) by field2 | sort -field1Alias | head 1000`	Sort the displayed results by a field name. Use sort -FieldName to sort in descending order.

Command or function	Example query	Description
`eval`	`eval field2 = field1 * 2 | fields field1, field2 | head 20`	Modifies or processes the value of a field and stores it in a different field. This is useful to mathemati cally modify a column, apply string functions to a column, or apply date functions to a column.
`rename`	`rename field2 as field1 | fields field1;`	Renames one or more fields in the search result.
`head`	`fields `@message` | head 20`	Limits the displayed query results to the first N rows.
`top`	`top 2 field1 by field2`	Finds the most frequent values for a field.
`dedup`	`dedup field1 | fields field1, field2, field3`	Removes duplicate entries based on the fields that you specify.

Command or function	Example query	Description
rare	`rare field1 by field2`	Finds the least frequent values of all fields in the field list.
subquery	`where field_1 IN [ search source= `subquery_lg` | fields field_2 ] | fields id, field_1`	Performs complex, nested queries within your PPL statements.
trendline	`trendline sma(2, field1) as field1Alias`	Calculates the moving averages of fields.
eventStats	`eventstats sum(field1) by field2`	Enriches your event data with calculated summary statistics. It analyzes specified fields within your events, computes various statistical measures, and then appends these results to each original event as new fields.

Command or function	Example query	Description
expand	`eval tags_array_string = json_extract(`@message`, '$.tags')\| eval tags_array = json_array(json_extract(tags_string, '$[0]'), json_extract(tags_string, '$[1]'))| expand tags_array as color_tags`	Breaks down a field containing multiple values into separate rows, creating a new row for each value in the specified field.
fillnull	`fields `@timestamp`, error_code, status_code | fillnull using status_code = "UNKNOWN", error_code = "UNKNOWN"`	Fills null fields with the value that you provide. It can be used in one or more fields.
flatten	`eval metadata_struct = json_object('size', json_extract(metadata_string, '$.size'), 'color', json_extract(metadata_string, '$.color')) | flatten metadata_struct as (meta_size, meta_color)`	Flattens a field. The field must be of this type: `struct<?,?>` or `array<struct<?,?>>` .
cidrmatch	`where cidrmatch(ip, '2003:db8::/32') | fields ip`	Checks if the specified IP address is within the given CIDR range.

Command or function	Example query	Description
fieldsummary	`where field1 != 200 | fieldsummary includefields= field1 nulls=true`	Calculates basic statistics for each field (count, distinct count, min, max, avg, stddev, and mean).
grok	`grok email '.+@%{HOSTNAME:host}' | fields email, host`	Parses a text field with a grok pattern and appends the results to the search result.
String functions	`eval field1Len = LENGTH(field1) | fields field1Len`	Built-in functions in PPL that can manipulate and transform string and text data within PPL queries. For example, converting case, combining strings, extracting parts, and cleaning text.

Command or function	Example query	Description
Date-Time functions	`eval newDate = ADDDATE(DATE('2020-08-26'), 1) | fields newDate`	Built-in functions for handling and transforming date and timestamp data in PPL queries. For example, date_add, date_format, datediff, date-sub, timestamp add, timestamp diff, current_timezone, utc_timestamp, and current_date.
Condition functions	`eval field2 = isnull(field1) | fields field2, field1, field3`	Built-in functions that check for specific field conditions, and evaluate expressions conditionally. For example, if field1 is null, return field2.

Command or function	Example query	Description
Math functions	`eval field2 = ACOS(field1) | fields field1`	Built-in functions for performing mathematical calculations and transformations in PPL queries. For example, abs (absolute value), round (rounds numbers), sqrt (square root), pow (power calculation), and ceil (rounds up to nearest integer).
CryptoGraphic functions	`eval crypto = MD5(field)| head 1000`	To calculate the hash of given field

Command or function	Example query	Description
JSON functions	`eval valid_json = json('[1,2,3,{"f1":1,"f2":[5,6]},4]') | fields valid_json`	Built-in functions for handling JSON including arrays, extracting, and validation. For example, json_object, json_array, to_json_string, json_array_length, json_extract, json_keys, and json_valid.

Query scope

Including SOURCE in a query is a useful way to specify the log groups to include in a query when you are using the AWS CLI or API to create a query. The SOURCE command is supported only in the AWS CLI and API, not in the CloudWatch console. When you use the CloudWatch console to start a query, you use the console interface to specify the log groups and data source name and type.

PPL's source command now support multiple ways to specify them:

1. Log group
2. Field indexes - New
3. Data source and type - New

Log Group

Log Group source selection can be used when customers know which exact log group(s) need to be searched

```
source = [lg:`/aws/lambda/my-function`] | where status = 200 | head 10
```

Field Indexes

Field index-based source selection reduces the amount of data queried by limiting results to only indexed data when your filters target fields that have been indexed. The relevant log groups are automatically selected, based on the fields specified in the `filterIndex` command. For more information about field indexes and how to create them, see Create field indexes to improve query performance and reduce scan volume.

Use `aws:fieldIndex` to return indexed data only, by forcing a query to scan only log groups that are indexed on a field that you specify in the query. For these log groups that are indexed on this field, it further optimizes the query by skipping the log groups that do not have any log events containing the field specified in the query for the indexed field. It further reduces scanned volume by attempting to scan only log events from these log groups that match the value specified in the query for this field index. For more information about field indexes and how to create them, see Create field indexes to improve query performance and reduce scan volume.

In PPL, `aws:fieldIndex` is used to specify which key value pairs should be treated as indexes. The syntax is as follows

```
source = [`aws:fieldIndex`="region", `region` = "us-west-2"] | where status = 200 |
 head 10
```

where,

1. `` `aws:fieldIndex`="region" `` identifies region as field Index.
   a. Note: Instead of = customers can use IN to specify multiple indexes (example below)
2. `` `region`="us-west-2" `` identifies the filter condition to be applied
   a. Note: Instead of = customers can use IN to specify multiple values (example below)

Customers can specify multiple fieldIndexes as follows

```
source = [`aws:fieldIndex` IN ("status", "region"), `status` = 200, `region` IN ("us-
west-2", "us-east-1")] | head 10
```

Data Source and Type

Data source and type based source selection can be used when customers know which exact data sources need to be queried. This query is executed over one or more log groups which contain the specified data source and type.

```
source = [ds:`data_source.type`] | where status = 200 | head 10
```

Supported PPL for data source queries

To support the use case for querying data sources in PPL, you can use the dynamic source selector clause. Using this syntax, you can query data sources by specifying them in the search command. You can specify up to 10 data sources.

Syntax

```
source=[ds:`DataSource1.Type1`, ds:`DataSource2.Type2`, ...ds:`DataSourcen.Typen`]
```

Example query

```
search source=[ds:`DataSource1.Type1`, ds:`DataSource2.Type2`] | fields field1, field2
```

Combined example

Customers can specify all the source selection operators in any order & the results would be the intersection of the all the conditions applied.

For example, /aws/lambda/my-function-1 might contain multiple data source & types including wide variety of indexes, when the following query was ran, the results returned will only have events of source and type DataSource1.Type1 and matching the criteria of 'status' = 200.

```
search source=[
    ds:`DataSource1.Type1`,
    lg:`/aws/lambda/my-function-1`,
    `aws:fieldIndex` IN ("status"), `status` = 200
]
```

Restrictions

The following restrictions apply when you use OpenSearch PPL to query in CloudWatch Logs Insights.

- You cannot use join or subquery commands with data source queries.

OpenSearch Structured Query Language (SQL)

This section contains a basic introduction to querying CloudWatch Logs using OpenSearch SQL. It provides a familiar option if you're used to working with relational databases. OpenSearch SQL offers a subset of SQL functionality, making it a good choice for performing ad-hoc queries and data analysis tasks. With OpenSearch SQL, you can use commands such as SELECT, FROM, WHERE, GROUP BY, HAVING, and various other SQL commands and functions. You can execute JOINs across log groups, correlate data across log groups using sub-queries, and use the rich set of JSON, mathematical, string, conditional, and other SQL functions to perform powerful analysis on log and security data.

Use `filterIndex` to return indexed data only, by forcing a query to scan only log groups that are indexed on a field that you specify in the query. Reduce scanned volume by skipping log groups that do not have any log events containing the field specified in the query, and only scanning log groups that match the value specified in the query for this field index. Use `filterIndex` to specify the field name, along with the field name and value to query only indexed data containing the field and value specified.

You can use OpenSearch SQL for queries of log groups in the Standard Log Class. SQL also supports querying using data source name and data source type.

> **Note**
>
> The following table lists the SQL commands and functions supported in CloudWatch Logs For information about all OpenSearch SQL commands including syntax, see Supported SQL commands in the OpenSearch Service Developer Guide.
> For information on other query languages you can use, seeCloudWatch Logs Insights, OpenSearch Service PPL, and CloudWatch Metrics Insights.

Supported SQL commands

> **Note**
>
> In the example query column, replace *<logGroup>* as needed depending on which data source you're querying.

Command or function	Example query	Description
SELECT	`SELECT \`@message\`, Operation FROM \`LogGroupA\``	Displays projected values.
FROM	`SELECT \`@message\`, Operation FROM \`LogGroupA\``	Built-in clause that specifies the source table(s) or view(s) from which to retrieve data, supportin g various types of joins and subqueries.
WHERE	`SELECT * FROM \`LogGroupA\` WHERE Operation = 'x'`	Filters log events based on the provided field criteria.
filterIndex	`SELECT * FROM \`filterIndex('region' = 'us-east-1')\` WHERE status = 200 LIMIT 10;`	Returns indexed data only, by forcing a query to scan only log groups that are indexed on a field that you

Command or function	Example query	Description
		specify in the query.
GROUP BY	`SELECT `@logStream`, COUNT(*) as log_count FROM `LogGroupA` GROUP BY `@logStream``	Groups log events based on category and finds the average based on stats.
HAVING	`SELECT `@logStream`, COUNT(*) as log_count FROM `LogGroupA` GROUP BY `@logStream` HAVING log_count > 100`	Filters the results based on grouping conditions.
ORDER BY	`SELECT * FROM `LogGroupA` ORDER BY `@timestamp` DESC`	Orders the results based on fields in the ORDER BY clause. You can sort in either descending or ascending order.
JOIN	`SELECT A.`@message`, B.`@timestamp`FROM `LogGroupA` as A INNER JOIN `LogGroupB` as B ON A.`requestId` = B.`requestId``	Joins the results for two tables based on common fields. Inner JOIN or Left Outer Join must be specified

Command or function	Example query	Description
LIMIT	`Select * from `LogGroupA` limit 10`	Limits the displayed query results to the first N rows.
String functions	`SELECT upper(Operation) , lower(Operation), Operation FROM `LogGroupA``	Built-in functions in SQL that can manipulate and transform string and text data within SQL queries. For example, converting case, combining strings, extracting parts, and cleaning text.
Date functions	`SELECT current_date() as today, date_add(current_date(), 30) as thirty_days_later, last_day(current_date()) as month_end FROM `LogGroupA``	Built-in functions for handling and transforming date and timestamp data in SQL queries. For example, date_add, date_format, datediff, and current_date.

Command or function	Example query	Description
Conditional functions	`SELECT Operation, IF(Error > 0, 'High', 'Low') as error_category FROM `LogGroup A`;`	Built-in functions that perform actions based on specified conditions, or that evaluate expressions conditionally. For example, CASE and IF.
Aggregate functions	`SELECT AVG(bytes) as bytesWritten FROM `LogGroupA``	Built-in functions that perform calculations on multiple rows to produce a single summarize d value. For example, SUM, COUNT, AVG, MAX, and MIN.

Command or function	Example query	Description
JSON functions	`SELECT get_json_object(json_column, '$.name') as name FROM `LogGroupA``	Built-in functions for parsing, extracting, modifying, and querying JSON-formatted data within SQL queries (e.g., from_json , to_json, get_json_ object, json_tupl e) allowing manipulation of JSON structures in datasets.
Array functions	`SELECT scores, size(scores) as length, array_contains(scores, 90) as has_90 FROM `LogGroupA`;`	Built-in functions for working with array-type columns in SQL queries, allowing operations like accessing , modifying, and analyzing array data (e.g., size, explode, array_contains).

Command or function	Example query	Description
Window functions	`SELECT field1, field2, RANK() OVER (ORDER BY field2 DESC) as field2Rank FROM` `` `LogGroupA` ``;	Built-in functions that perform calculations across a specified set of rows related to the current row (window), enabling operations like ranking, running totals, and moving averages. For example, ROW_NUMBER, RANK, LAG, and LEAD

Command or function	Example query	Description
Conversion functions	`SELECT CAST('123' AS INT) as converted_number, CAST(123 AS STRING) as converted_string FROM `LogGroupA``	Built-in functions for converting data from one type to another within SQL queries, enabling data type transformations and format conversions. For example, CAST, TO_DATE, TO_TIMESTAMP, and BINARY.
Predicate functions	`SELECT scores, size(scores) as length, array_contains(scores, 90) as has_90 FROM `LogGroupA`;`	Built-in functions that evaluate conditions and return boolean values (true/false) based on specified criteria or patterns. For example, IN, LIKE, BETWEEN, IS NULL, and EXISTS.
Select multiple log groups	`SELECT lg1.field1, lg1.field2 from `logGroups(logGroupIdentifier: ['LogGroup1', 'LogGroup2'])` as lg1 where lg1.field3= "Success"`	Enables you to specify multiple log groups in a SELECT statement

Command or function	Example query	Description
Select multiple data sources	`SELECT ds1.field1, ds1.field2 from` `dataSource(['DataSource1', 'DataSource2'])` `as ds1 where ds1.field3= "Success"`	Enables you to specify multiple data sources in a SELECT statement

Supported SQL for multi-log-group queries

To support the use case for querying multiple log groups in SQL, you can use the `logGroups` command. Using this syntax, you can query multiple log groups by specifying them in the FROM command.

Syntax:

```
`logGroups(
    logGroupIdentifier: ['LogGroup1','LogGroup2', ...'LogGroupn']
)`
```

In this syntax, you can specify up to 50 log groups in the `logGroupIdentifier` parameter. To reference log groups in a monitoring account, use ARNs instead of `LogGroup` names.

Example query:

```
SELECT LG1.Column1, LG1.Column2 from `logGroups(
    logGroupIdentifier: ['LogGroup1', 'LogGroup2']
)` as LG1 WHERE LG1.Column1 = 'ABC'
```

The following syntax involving multiple log groups after the `FROM` statement is NOT supported when querying CloudWatch Logs.

```
SELECT Column1, Column2 FROM 'LogGroup1', 'LogGroup2', ...'LogGroupn'
WHERE Column1 = 'ABC'
```

Supported SQL for data source queries

To support the use case for querying data sources in SQL, you can use the dataSource command. Using this syntax, you can query data sources by specifying them in the FROM command. You can specify up to 10 data sources.

Syntax

```
`dataSource(
    ['DataSource1', 'DataSource2', ...'DataSourcen']
)`
```

Example query

```
SELECT DS1.Column1, DS1.Column2 from `dataSource(
    ['DataSource1', 'DataSource2']
)` as DS1 WHERE DS1.Column1 = 'ABC'
```

Query scope

In the AWS CLI and API, you can specify which logs to query by using the log group, data source and type, and field indexes.

Log Group

Log Group source selection can be used when customers know which exact log group(s) need to be searched

```
SELECT * FROM `logGroups(logGroupIdentifier: ['/aws/lambda/my-function'])`;
```

Data Source and Type

Customers can query their logs using data source name and data source type.

Data source and type based source selection can be used when customers know which exact data sources need to be queried. This query is executed over one or more log groups which contain the specified data source and type.

To support the use case for querying data sources in SQL, you can use the dataSource command. Using this syntax, you can query data sources by specifying them in the FROM command. You can specify up to 10 data sources.

Syntax:

```
`dataSource(
    ['DataSource1.Type1', 'DataSource2.Type2', ...'DataSourcen.Typen']
)`
```

Example query:

```
SELECT DS1.Column1, DS1.Column2 from `dataSource(
    ['DataSource1.Type1', 'DataSource2.Type2']
)` as DS1 WHERE DS1.Column1 = 'ABC'
```

For more information on querying by data sources, see Use facets to group and explore logs.

Combined example

Customers can specify all the source selection operators within the backticks in any order and the results would be based on the intersection of the all the conditions applied.

For example, /aws/lambda/my-function-1 might contain multiple data source & types including wide variety of indexes, when the following query was ran, the results returned will only have events of source and type DataSource1.Type1 and matching the criteria of 'status' = 200.

```
SELECT * FROM `
   logGroups(logGroupIdentifier: ['/aws/lambda/my-function'])
   filterIndex('status' = 200)
   dataSource(['DataSource1.Type1'])
`;
```

Field Indexes

Field Index-based source selection automatically identifies relevant log groups when your filters target indexed fields, reducing scan volume and query runtime.

Use `filterIndex` to return indexed data only, by forcing a query to scan only log groups that are indexed on a field that you specify in the query. For these log groups that are indexed on this field, it further optimizes the query by skipping the log groups that do not have any log events containing the field specified in the query for the indexed field. It further reduces scanned volume by attempting to scan only log events from these log groups that match the value specified in the

query for this field index. For more information about field indexes and how to create them, see Create field indexes to improve query performance and reduce scan volume.

In SQL, filterIndex is used to specify which key value pairs should be treated as indexes. The syntax is as follows

```
SELECT * FROM `filterIndex('region' = 'us-east-1')`;
```

where,

1. filterIndex(...) specifies, treat the key values within them as field indexes. Each key value pair is separated by a comma (example below)
2. 'region' = 'us-east-1' specifies the actual condition to be applied
   a. Note: Instead of = customers can use IN to specify multiple values (example below)

Using multiple filterIndex would combine the conditions using "AND". In the example, logs matching status=200 and region in us-east-1 or us-west-2 would be queried.

```
SELECT * FROM `filterIndex('status' = 200, 'region' IN ['us-east-1', 'us-west-2'])`;
```

Restrictions

The following restrictions apply when you use OpenSearch SQL to query in CloudWatch Logs Insights.

- You can include only one JOIN in a SELECT statement.
- You cannot use JOIN or subqueries with data source queries.
- Only one level of nested subqueries is supported.
- Multiple statement queries separated by semi-colons (;) aren't supported.
- Queries containing field names that are identical but differ only in case (such as field1 and FIELD1) are not supported.

  For example, the following query isn't supported:

  ```
  Select AWSAccountId, AwsAccountId from LogGroup
  ```

However, the following query is supported because the field name (`@logStream`) is identical in both log groups:

```
Select a.`@logStream`, b.`@logStream` from Table A INNER Join Table B on a.id = b.id
```

- Functions and expressions must operate on field names and be part of a SELECT statement with a log group specified in the FROM clause.

  For example, this query is not supported:

  ```
  SELECT cos(10) FROM LogGroup
  ```

  This query is supported:

  ```
  SELECT cos(field1) FROM LogGroup
  ```

- When using SQL or PPL commands, enclose certain fields in backticks to successfully query them. Backticks are necessary for fields with special characters (non-alphabetic and non-numeric). For example, enclose `@message`, `Operation.Export`, and `Test::Field` in backticks. You don't need to enclose fields with purely alphabetic names in backticks.

  Example query with simple fields:

  ```
  SELECT SessionToken, Operation, StartTime  FROM `LogGroup-A`
  LIMIT 1000;
  ```

  Similar query with backticks appended:

  ```
  SELECT `@SessionToken`, `@Operation`, `@StartTime`  FROM `LogGroup-A` LIMIT 1000;
  ```

Use natural language to generate and update CloudWatch Logs Insights queries

CloudWatch Logs supports a natural language query capability to help you generate and update queries for CloudWatch Logs Insights, OpenSearch Service PPL, OpenSearch Service SQL, and CloudWatch Metrics Insights.

With this capability, you can ask questions about or describe the CloudWatch Logs data you're looking for in plain English. The natural language capability generates a query based on a prompt that you enter and provides a line-by-line explanation of how the query works. You can also update your query to further investigate your data.

Depending on your environment, you can enter prompts like "What are the top 100 source IP addresses by bytes transferred?" and "Find the 10 slowest Lambda function requests."

> **Note**
>
> The natural-language query feature is a Regional service. For some Regions, the feature makes cross-Region calls to Regions in the United States to process the query prompts. For more information, see Amazon CloudWatch expands region support for natural language query result summarization and query generation .

To generate a CloudWatch Logs Insights query with this capability, open the CloudWatch Logs Insights query editor, select the log group you want to query, and choose **Generate query**.

> **Important**
>
> To use the natural language query capability, you must be signed in with the CloudWatchLogsFullAccess, CloudWatchLogsReadOnlyAccess, AdministratorAccess, or ReadOnlyAccess IAM policies, or have the `cloudwatch:GenerateQuery` permission.

Example queries

The examples in this section describe how to generate and update queries using the natural language capability.

> **Note**
>
> For more information on the CloudWatch Logs Insights query editor and syntax, see CloudWatch Logs Insights query syntax.

Examples: Generate a natural language query

To generate a query using natural language, enter a prompt and choose **Generate new query**. These example shows queries that perform a basic search.

Prompt

The following is an example of a prompt that directs the capability to search for the 10 slowest Lambda function invocations.

```
Find the 10 slowest requests
```

Query

The following is the query using the CloudWatch Logs Insights query language that the natural language capability generated based on the prompt. Notice how the prompt appears in a comment before the query. After the query, you can read an explanation that describes how the query works.

```
# Find the 10 slowest requests
fields @timestamp, @message, @duration
| sort @duration desc
| limit 10
# This query retrieves the timestamp, message and duration fields from the logs and
 sorts them in descending order by duration to find the 10 slowest requests.
```

> **Note**
>
> To turn off the appearance of your prompt and the explanation of how the query works, use the gear icon in your editor.

Prompt

To generate an OpenSearch SQL query, select the OpenSearch SQL tab, then open the query generator prompt box to enter your natural language prompt. The following is an example of a prompt that uses the natural language capability to generate an OpenSearch SQL query.

```
Give me the number of errors and exceptions per hour
```

Query

The following is the SQL query generated by that prompt that you can use to find the number of errors and exceptions aggregated per hour:

```
SELECT DATE_FORMAT(`@timestamp`, 'yyyy-MM-dd HH') AS hour,
       COUNT(*) AS error_count
FROM `/aws/lambda/CloudWatchOdysseyQueryGen`
WHERE `@message` LIKE '%error%'
  OR `@message` LIKE '%exception%'
GROUP BY DATE_FORMAT(`@timestamp`, 'yyyy-MM-dd HH')
ORDER BY hour
```

Prompt

To generate an OpenSearch PPL query, select the OpenSearch PPL tab, then open the query generator prompt box to enter your natural language prompt. The following is an example of a prompt that uses the natural language capability to generate an OpenSearch PPL query.

```
Give me all unique exception messages
```

Query

The following is the PPL query generated by that prompt that you can use to find the unique exception messages in your logs:

```

dedup @message
| fields @message

```

Example: Update a natural language query

You can update a query by editing the initial prompt and then choosing **Update query**.

Updated prompt

The following example shows an updated version of the previous prompt. Instead of a prompt that searches for the 10 slowest Lambda function invocations, this prompt now directs the capability to

search for the 20 slowest Lambda function invocations and include another column for additional log events.

```
Show top 20 slowest requests instead and display requestId as a column
```

Updated query

The following is an example of the updated query using the CloudWatch Logs Insights query language. Notice how the updated prompt appears in a comment before the updated query. After the query, you can read an explanation that describes how the original query has been updated.

```
# Show top 20 slowest requests instead and display requestId as a column
fields @timestamp, @message, @requestId, @duration
| sort @duration desc
| limit 20
# This query modifies the original query by replacing the @message field with the
 @requestId field and changing the limit from 10 to 20 to return the top 20 log events
 by duration instead of the top 10.
```

Opting out of using your data for service improvement

The natural language prompt data you provide to train the AI model and generate relevant queries is used solely to provide and maintain your service. This data might be used to improve the quality of CloudWatch Logs Insights. Your trust and privacy, as well as the security of your content, is our highest priority. For more information, see AWS Service Terms and AWS responsible AI policy.

You can opt out of having your content used to develop or improve the quality of natural language queries by creating an AI service opt-out policy. To opt-out of data collection for all CloudWatch Logs AI features, including the query generation capability, you must create an opt-out policy for CloudWatch Logs. For more information, see AI services opt-out policies in the *AWS Organizations User Guide*.

Supported logs and discovered fields

CloudWatch Logs Insights supports different log types. For every log that's sent to a Standard class log group in Amazon CloudWatch Logs, CloudWatch Logs Insights automatically generates five system fields:

- `@message` contains the raw unparsed log event. This is the equivalent to the `message` field in InputLogevent.
- `@timestamp` contains the event timestamp in the log event's `timestamp` field. This is the equivalent to the `timestamp` field in InputLogevent.
- `@ingestionTime` contains the time when CloudWatch Logs received the log event.
- `@logStream` contains the name of the log stream that the log event was added to. Log streams group logs through the same process that generated them.
- `@log` is a log group identifier in the form of *`account-id`*:*`log-group-name`*. When querying multiple log groups, this can be useful to identify which log group a particular event belongs to.
- `@entity` contains flattened JSON related to entities for the Explore related telemetry feature.

  For example, this JSON can represent an entity.

```
{
  "Entity": {
    "KeyAttributes": {
      "Type": "Service",
      "Name": "PetClinic"
    },
    "Attributes": {
      "PlatformType": "AWS::EC2",
      "EC2.InstanceId": "i-1234567890123"
    }
  }
}
```

  For this entity, the extracted system fields would be the following:

```
@entity.KeyAttributes.Type = Service
@entity.KeyAttributes.Name = PetClinic
@entity.Attributes.PlatformType = AWS::EC2
@entity.Attributes.EC2.InstanceId = i-1234567890123
```

Note

Field discovery is supported only for log groups in the Standard log class. For more information about log classes, see Log classes.

CloudWatch Logs Insights inserts the **@** symbol at the start of fields that it generates.

For many log types, CloudWatch Logs also automatically discovers the log fields contained in the logs. These automatic discovery fields are shown in the following table.

For other types of logs with fields that CloudWatch Logs Insights doesn't automatically discover, you can use the `parse` command to extract and create extracted fields for use in that query. For more information, see CloudWatch Logs Insights language query syntax.

If the name of a discovered log field starts with the `@` character, CloudWatch Logs Insights displays it with an additional `@` appended to the beginning. For example, if a log field name is `@example.com`, this field name is displayed as `@@example.com`.

> **Note**
>
> Except for `@message`, `@timestamp`, or `@log`, you can create field indexes for discovered fields. For more information about field indexes, see Create field indexes to improve query performance and reduce scan volume.

Log type	Discovered log fields
Amazon VPC flow logs	`@timestamp` , `@logStream` , `@message`, `accountId` , `endTime`, `interfaceId` , `logStatus` , `startTime` , `version`, `action`, `bytes`, `dstAddr`, `dstPort`, `packets`, `protocol`, `srcAddr`, `srcPort`
Route 53 logs	`@timestamp` , `@logStream` , `@message`, `edgeLocation` , `ednsClientSubnet` , `hostZoneId` , `protocol`, `queryName` , `queryTimestamp` , `queryType` , `resolverIp` , `responseCode` , `version`
Lambda logs	`@timestamp` , `@logStream` , `@message`, `@requestId` , `@duration`, `@billedDuration` , `@type`, `@maxMemoryUsed` , `@memorySize` If a Lambda log line contains an X-Ray trace ID, it also includes the following fields: `@xrayTraceId` and `@xraySegmentId` . CloudWatch Logs Insights automatically discovers log fields in Lambda logs, but only for the first embedded JSON fragment in each log event. If a Lambda log event contains multiple JSON fragments, you can parse and

Log type	Discovered log fields
	extract the log fields by using the **`parse`** command. For more information, see Fields in JSON logs.
CloudTrail logs Logs in JSON format	For more information, see Fields in JSON logs.
Other log types	`@timestamp` , `@ingestionTime` , `@logStream` , `@message`, `@log`.

Fields in JSON logs

With CloudWatch Logs Insights, you use dot notation to represent JSON fields. This section contains an example JSON event and code snippet that show how you can access JSON fields using dot notation.

Example: JSON event

```
{
    "eventVersion": "1.0",
    "userIdentity": {
        "type": "IAMUser",
        "principalId": "EX_PRINCIPAL_ID",
        "arn": "arn: aws: iam: : 123456789012: user/Alice",
        "accessKeyId": "EXAMPLE_KEY_ID",
        "accountId": "123456789012",
        "userName": "Alice"
    },
    "eventTime": "2014-03-06T21: 22: 54Z",
    "eventSource": "ec2.amazonaws.com",
    "eventName": "StartInstances",
    "awsRegion": "us-east-2",
    "sourceIPAddress": "192.0.2.255",
    "userAgent": "ec2-api-tools1.6.12.2",
    "requestParameters": {
        "instancesSet": {
            "items": [
                {
                    "instanceId": "i-abcde123"
```

```
                }
            ]
        }
    },
    "responseElements": {
        "instancesSet": {
            "items": [
                {
                    "instanceId": "i-abcde123",
                    "currentState": {
                        "code": 0,
                        "name": "pending"
                    },
                    "previousState": {
                        "code": 80,
                        "name": "stopped"
                    }
                }
            ]
        }
    }
}
```

The example JSON event contains an object that's named `userIdentity`. `userIdentity` contains a field that's named `type`. To represent value of `type` using dot notation, you use `userIdentity.type`.

The example JSON event contains arrays that flatten to lists of nested field names and values. To represent the value of `instanceId` for the first item in `requestParameters.instancesSet`, you use `requestParameters.instancesSet.items.0.instanceId`. The number `0` that's placed before the field `instanceID` refers to the position of values for the field `items`. The following example contains a code snippet that shows how you can access nested JSON fields in a JSON log event.

Example: Query

```
fields @timestamp, @message
| filter requestParameters.instancesSet.items.0.instanceId="i-abcde123"
| sort @timestamp desc
```

The code snippet shows a query that uses dot notation with the `filter` command to access the value of the nested JSON field `instanceId`. The query filters on messages where the value of

`instanceId` equals `"i-abcde123"` and returns all of the log events that contain the specified value.

Dot notation and JSON-encoded string fields

Dot notation traverses only fields that are stored as structurally nested JSON objects at ingest time. If a field's value is a JSON-encoded string (a string whose content happens to be valid JSON), dot notation treats it as an opaque leaf value and does not access sub-fields within it.

This commonly occurs with:

- Logs transformed by OCSF pipelines (for example, `api.request.data` is typed as `json_t` in the OCSF schema)
- Any log source where variable-structure payloads are serialized as strings before ingestion

For example, if `api.request.data` contains `{"startTime":1234,"endTime":5678}` as a string value, then `api.request.data.startTime` returns no results because CloudWatch Logs Insights treats the entire string as a single leaf value rather than a nested object.

To access sub-fields within a JSON-encoded string, use `jsonParse` to convert the string into a traversable map.

Example: Query using jsonParse for a JSON-encoded string field

```
fields jsonParse(api.request.data).startTime as startTime
```

This query uses `jsonParse` to parse the JSON-encoded string in `api.request.data` into a map, and then accesses the `startTime` sub-field with dot notation. For more information about `jsonParse`, see Structure types.

> **Note**
>
> CloudWatch Logs Insights can extract a maximum of 200 log event fields from a JSON log. For additional fields that aren't extracted, you can use the `parse` command to extract the fields from the raw unparsed log event in the message field. For more information about the `parse` command, see Query syntax in the Amazon CloudWatch User Guide.

Create field indexes to improve query performance and reduce scan volume

You can create *field indexes* of fields in your log events for efficient equality-based searches. When you then use a field index in a CloudWatch Logs Insights query, the query attempts to skip processing log events that are known to not include the indexed field. This reduces the scan volume of your queries that use field indexes, making it possible to return results faster. This can help you quickly search petabytes of total logs across thousands of log groups, and hone in on relevant logs faster. Good fields to index are fields that you often need to query for. Fields that have high cardinality of values are also good candidates for field indexes because a query using these field indexes will complete faster because it limits the log events that are being matched to the target value.

For example, suppose you have created a field index for `requestId`. Then, any CloudWatch Logs Insights query on that log group that includes `requestId = value` or `requestId IN [value, value, ...]` will attempt to process only the log events that are known to contain that indexed field and the queried value, and that CloudWatch Logs has detected a value for that field in the past.

You can also use your field indexes to create efficient queries of larger numbers of log groups. When you use the `filterIndex` command in your query instead of the `filter` command, the query will run against selected log groups on log events that have field indexes. These queries can scan as many as 10,000 log groups which you choose by specifying as many as five log group name prefixes. If this is a monitoring account in CloudWatch cross-account observability, you can choose all the source accounts or specify individual source accounts to select the log groups".

Indexed fields are case-sensitive. For example, a field index of `RequestId` won't match a log event containing `requestId`.

Fields indexes are supported only for the structured log formats of JSON and service logs.

CloudWatch Logs provides default field indexes for all log groups in the Standard log class. Default field indexes are automatically available for the following fields:

- `@logStream`
- `@aws.region`
- `@aws.account`

- @source.log
- @data_source_name
- @data_source_type
- @data_format
- traceId
- severityText
- attributes.session.id

CloudWatch Logs provides default field indexes for certain data source name and type combinations as well. Default field indexes are automatically available for the following data source name and type combinations:

Data Source Name and Type	Default Field Indexes
amazon_vpc.flow	action logStatus region flowDirection type
amazon_route53.resolver_query	query_type transport rcode
aws_waf.access	action httpRequest.country
aws_cloudtrail.data aws_cloudtrail.management	eventSource eventName awsRegion

Data Source Name and Type	Default Field Indexes

	`userAgent`
	`errorCode`
	`eventType`
	`managementEvent`
	`readOnly`
	`eventCategory`
	`requestId`

Default field indexes are in addition to any custom field indexes you define within your policy. Default field indexes are not counted towards your field index quota.

CloudWatch Logs indexes only the log events ingested after an index policy is created. It doesn't index log events ingested before the policy was created. After you create a field index, each matching log event remains indexed for 30 days from the log event's ingestion time.

> **Note**
>
> If you create a field index policy in a monitoring account, that policy is not used for log groups in linked source accounts. A field index policy applies only in the account where it is created.

The rest of the topics in this section explain automatically indexed fields and how to create field indexes. For information about referring to field indexes in your queries, see filterIndex and filter.

Topics

- Automatically indexed fields
- Field index syntax and quotas
- Create an account-level field index policy
- Create a log-group level field index policy

- Log group selection options when creating a query
- Effects of deleting a field index policy

Automatically indexed fields

CloudWatch Logs automatically indexes fields based on their recent use in CloudWatch Logs Insights equality filters that use the = or `IN` operators. These indexes are in addition to default field indexes and the field indexes that you configure in policies. You do not need to configure a policy for automatically indexed fields.

CloudWatch Logs updates the set of automatically indexed fields based on recent query activity. When CloudWatch Logs removes a field from the set, it stops indexing newly ingested events for that field. CloudWatch Logs manages automatically indexed fields and retains them for 30 days. To keep a field indexed permanently, add it to an account-level or log-group level field index policy.

> ⚠ **Use filter instead of filterIndex for automatically indexed fields**
>
> We recommend that you use `filter` instead of `filterIndex` with automatically indexed fields. CloudWatch Logs can update or remove these fields based on query patterns. CloudWatch Logs retains them for only 30 days. The `filterIndex` command returns only indexed data. Because CloudWatch Logs updates the set based on query activity, a `filterIndex` query does not search events ingested before CloudWatch Logs selected the field or after CloudWatch Logs stopped indexing it. If you use `filterIndex`, add the field to a field index policy to keep it indexed regardless of query activity. For more information, see filterIndex compared to filter.

The **Field indexes** tab for a log group lists automatically indexed fields.

You can also use the `DescribeFieldIndexes` operation to list automatically indexed fields. Include `AUTO` in the `indexCategories` request parameter. The response sets `indexCategory` to `AUTO` for automatically indexed fields. Requests that omit `indexCategories` do not return automatically indexed fields.

To add an automatically indexed field to a log-group level index policy

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the left navigation pane, choose **Logs**, **Log groups**.

3. Choose the name of the log group.
4. Choose the **Field indexes** tab, and then choose **Manage field indexes**.
5. On the **Manage log group level field indexes** page, review the fields in the policy. Add or remove fields as needed, and then choose **Save**.

Field index syntax and quotas

You create field indexes by creating *field index policies*. You can create account-level index policies that apply to your whole account, and you can also create policies that apply to only a single log group. For account-wide index policies, you can have one that applies to all log groups in the account. You can also create account-level index policies that apply to a subset of log groups in the account, selected by the prefixes of their log group names. If you have multiple account-level policies in the same account, the log group name prefixes for these policies can't overlap. Similarly, you can create account-level index policies that apply to a specific data source name and type combination. Only one account policy can be created per data source name and type combination.

Log group-level field index policies override account-level field index policies: which apply to the log group as a whole (such as, account-level policies with no selection criteria or with log group name prefix based selection criteria). Account-level policies which match at the log event level (such as, for a given data source name and type combination) will apply in addition to policies which match the log group as a whole. If you create log-group level index policy, that log group does not use account-level policies that match at the log group level.

Matches of log events to the names of field indexes are case-sensitive. For example, a field index of `RequestId` won't match a log event containing `requestId`.

You can have as many as 40 account-level index policies, of these policies 20 can use log group name prefix selection criteria and 20 can use data source based selection criteria. If you have multiple account-level index policies filtered to log group name prefixes, no two of them can use the same or overlapping log group name prefixes. For example, if you have one policy filtered to log groups that start with `my-log`, you can't have another field index policy filtered to `my-logpprod` or `my-logging`. Similarly, if you have multiple account-level index policies filtered to data source name and type combinations, no two of them can use the same data source name and type. For example, if you have one policy filtered to the data source name `amazon_vpc` and data source type `flow` you cannot create another policy with this combination.

If you have an account-level index policy that has no name prefixes and applies to all log groups, then no other account-level index policy with log group name prefix filters can be created; you can create account-level index policies which use data source name and type filters.

Each index policy has the following quotas and restrictions:

- As many as 20 fields can be included in the policy.
- Each field name can include as many as 100 characters.
- To create an index of a custom field in your log groups that starts with `@`, you must specify the field with an extra `@` at the beginning of the field name. For example, if your log events include a field named `@userId`, you must specify `@@userId` to create an index for this field.

For account-level index policies with data source name and type based selection criteria an additional restriction applies: all of the fields must be primitive data types, nested primitives are only supported for structs.

Generated fields and reserved fields

CloudWatch Logs Insights automatically generates system fields in each log event. These generated fields are prefixed with `@` For more information about generated fields, see Supported logs and discovered fields.

Of these generated fields, the following are supported for use as field indexes:

- `@logStream`
- `@ingestionTime`
- `@requestId`
- `@type`
- `@initDuration`
- `@duration`
- `@billedDuration`
- `@memorySize`
- `@maxMemoryUsed`
- `@xrayTraceId`
- `@xraySegmentId`

To index these generated fields, you don't need to add an extra @ when specifying them, as you have to do for custom fields that start with @. For example, to create a field index for `@logStream`, just specify `@logStream` as the field index.

CloudWatch Logs provides default field indexes for all log groups in the Standard log class. Default field indexes are automatically available for the following fields:

- `@logStream`
- `@aws.region`
- `@aws.account`
- `@source.log`
- `@data_source_name`
- `@data_source_type`
- `@data_format`
- `traceId`
- `severityText`
- `attributes.session.id`

CloudWatch Logs provides default field indexes for certain data source name and type combinations as well. Default field indexes are automatically available for the following data source name and type combinations:

Data Source Name and Type	Default Field Indexes

`amazon_vpc.flow`	`action`
	`logStatus`
	`region`
	`flowDirection`
	`type`

`amazon_route53.resolver_query`	`query_type` `transport`

Data Source Name and Type	Default Field Indexes
	rcode
aws_waf.access	action httpRequest.country
aws_cloudtrail.data aws_cloudtrail.management	eventSource eventName awsRegion userAgent errorCode eventType managementEvent readOnly eventCategory requestId

Default field indexes are in addition to any custom field indexes you define within your policy. Default field indexes are not counted towards your field index quota.

Child fields and array fields in JSON logs

You can index fields that are nested child fields or array fields in JSON logs.

For example, you can create an index of the `accessKeyId` child field within the `userIdentity` field within this log:

```
{
    "eventVersion": "1.0",
    "userIdentity": {
        "type": "IAMUser",
```

```
        "principalId": "EXAMPLE_PRINCIPAL_ID",
        "arn": "arn: aws: iam: : 123456789012: user/Alice",
        "accessKeyId": "11112222",
        "accountId": "123456789012",
        "userName": "Alice"
    },
    "eventTime": "2014-03-06T21: 22: 54Z",
    "eventSource": "ec2.amazonaws.com",
    "eventName": "StartInstances",
    "awsRegion": "us-east-2",
    "sourceIPAddress": "192.0.2.255",
    "userAgent": "ec2-api-tools1.6.12.2",
    "requestParameters": {
        "instancesSet": {
            "items": [{
                "instanceId": "i-abcde123",
                "currentState": {
                    "code": 0,
                    "name": "pending"
                },
                "previousState": {
                    "code": 80,
                    "name": "stopped"
                }
            }]
        }
    }
}
```

To create this field, you refer to it using dot notation (`userIdentity.accessKeyId`) both when creating the field index and when specifying it in a query. The query could look like this:

```
fields @timestamp, @message
| filterIndex userIdentity.accessKeyId = "11112222"
```

In the previous example event, the `instanceId` field is in an array within `requestParameters.instancesSet.items` To represent this field both when creating the field index and when querying, refer to it as `requestParameters.instancesSet.items.0.instanceId` The 0 refers to that field's place in the array.

Then a query for this field could be the following:

```
fields @timestamp, @message
| filterIndex requestParameters.instancesSet.items.0.instanceId="i-abcde123"
```

Create an account-level field index policy

Use the steps in this section to create a field index policy that applies to all log groups in the account, or to multiple log groups that have log group names that start with the same string.

To create an account-level field index policy

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the left navigation pane, choose **Settings** and then choose the **Logs** tab.
3. In the **Account level index policies** section, choose **Manage**.
4. Choose **Create index policy**.
5. For **Policy name**, enter a name for your new policy.
6. For **Select scope of policy**, do one of the following:
   - Choose **All standard log groups** to have the index policy apply to all Standard Class log groups in the account.
   - Choose **Log groups by prefix match** to apply the policy to a subset of log groups that all have names that start with the same string. Then, enter the prefix for these log groups in **Enter a prefix name**.

     After you enter your prefix, you can choose **Preview prefix matched log groups** to confirm that your prefix matches the log groups that you expected.

     Choose **Logs Data by Data source** to apply the policy to a specific data source name and type combination. You can then select the **Data source** and **Data type** from the drop-down menu.

     After you select the data source name and type you can select **Get fields** to populate the **Configure field indexes and facets** section with relevant information such as the fields available, included log groups, as well as default and custom field indexes.
7. For **Custom index field configuration**, choose **Add field path** to enter the first field to index.

   Then enter the string to use as the value of the field name or select a field from the drop-down menu. This must be an exact case match to what appears in the log events. For example,

if your log events include `requestId`, you must enter `requestId` here. `RequestId`, `requestID`, and `request Id` wouldn't match.

If you want to index a custom log field that starts with the `@` character, you must include an extra `@` character when you enter the index string. For example, if you have a custom log field `@emailname`, enter `@@emailname` in the **Add field path** box.

You can also create indexes for the `@ingestionTime` and `@logStream` fields that CloudWatch Logs automatically generates. If you do, you don't need to add an extra `@` when specifying them.

8. (Optional)In addition to specifying the field path, you can select **Set as a facet** to create the field as a facet.
9. Repeat the previous step to add as many as 20 field indexes.
10. When you have finished, choose **Create**.

Create a log-group level field index policy

Use the steps in this section to create a field index policy that applies to a single log group.

To create a log-group level field index policy

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the left navigation pane, choose **Logs**, **Log groups**.
3. Choose the name of the log group.
4. Choose the **Field indexes** tab.
5. Choose **Manage field indexes for this log group**
6. For **Manage log group level field indexes**, choose **Add field path** to enter the first field to index.

   Then enter the string to use as the value of the field name. This must be an exact case match to what appears in the log events. For example, if your log events include `requestId`, you must enter `requestId` here. `RequestId`, `requestID`, and `request Id` would not match.

   If you want to index a custom log field that starts with the `@` character, you must include an extra `@` character when you enter the index string. For example, if you have a custom log field `@emailname`, enter `@@emailname` in the **Add field path** box.

You can also create indexes for the `@ingestionTime` and `@logStream` fields that CloudWatch Logs automatically generates. If you do, do not need to add an extra `@` when specifying them.

7. (Optional) In addition to specifying the field path, you can select **Set as a facet** to create the field as a facet.
8. Repeat the previous step to add as many as 20 field indexes.
9. When you have finished, choose **Save**.

Log group selection options when creating a query

This section explains the various ways that you can select log groups to include in a query.

To select log groups for a query in the console

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Logs**, **Logs Insights**.
3. Select the query language you want to use for this query. You can choose either: **Logs Insights QL**, **OpenSearch PPL**, or **OpenSearch SQL**.
4. There are three ways to select log groups for the query:
   - Use the **Log group name** box. This is the default selection method. You can enter as many as 50 log group names with this method. If this is a monitoring account in CloudWatch cross-account observability, you can select log groups in the source accounts as well as the monitoring account. A single query can query logs from different accounts at once.
   - Use the **Log group criteria** section. In this section, you can choose log groups based on the prefix of the log group names. You can include as many as five prefixes in one query. Log groups having these prefixes in their names will be selected. Alternatively, the **All log groups** option selects all the log groups from the account.
   - If this is a monitoring account in CloudWatch cross-account observability, you can select **All accounts** in the account dropdown menu to select the log groups from all linked accounts. Alternatively, you can individually select which accounts should be included for this query.

   If your choices match more than 10,000 log groups, you'll see an error that prompts you to narrow your selection.

5. The default log class for a query is **Standard**. You can use **Log class** to change it to **Infrequent access**.

Using the AWS CLI

To make these types of selections when you start a query from the command line, you can use the `source` command in your query. For more information and examples, see SOURCE.

Effects of deleting a field index policy

If you delete a field index policy that has been in effect for a time, the following happens:

- For up to 30 days after the policy is deleted, queries can still benefit from the indexed log events.
- If you delete a log-group level index policy, and there is already an account-level policy in place that would apply to that log group, the account-level policy will eventually apply to that log group.

Use facets to group and explore logs

Facets are useful for analyzing logs as they allow you to interactively filter and group your data without running queries. A facet is a field in your logs (such as `ServiceName` or `StatusCode`) that enables filtering, aggregation and analysis across log groups. You can view the list of faceted fields in the CloudWatch Logs Insights console, along with the count of log events for each facet value based on your selected time range. As you select different facets and values, the facet values and counts are updated in real-time, enabling you to interactively explore your logs.

Each facet shows available values and counts automatically extracted from fields in your logs based on the selected time range and query scope, and retained for 30 days. Facet counts shown are approximate. You can use the default facets such as data source name or data source type to explore your logs, or create custom facets on any of the fields in your logs. Data Source name is an AWS service or application that generates the logs (for example, Route 53, Amazon VPC, or CloudTrail) and Data Source type is the specific type of log generated by that service. Default facets are created by CloudWatch and include `@aws.region`, `@data_source_name`, `@data_source_type`, and `@data_format`. For more information, see Log management. Facets are only available for logs that are ingested in the account. If you have set up cross account observability, the monitoring account cannot view facets based on logs from source accounts.

If you have resource tags for telemetry enabled, resource tag fields (`@aws.tag.*`) are automatically added as default facets. These facets enable you to filter and group log events by the tags of the resources that produced them.

To create additional facets, select the fields in your logs that are relevant to your troubleshooting and configure them using the index policies. For custom facets, we recommend creating them on low-cardinality fields (fields having less than 100 unique values per day such as Status and ApplicationName). Facets with more than 100 unique values per day are classified as high-cardinality and values for these facets are not displayed. Select one or more facets and choose to run queries across your logs.

To get started with facets in CloudWatch Logs Insights:

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Logs**, **Logs Insights**.
3. (Optional) Use the time range selector to select a time period that you want to analyze. For the selected time range, available facets and values are shown in the panel.
4. Select facets to explore your data and see real-time updates of the value distributions across the facets.

   Facets with more than 100 unique values are not displayed. To query specific values, use filters in your query instead.

To run a facet-based query

1. Select one or more values across facets.
2. The event count will update based on the facets and values selected.
3. As facet values are selected, the query scope is updated to reflect the selection.
4. After selecting the facets values, choose run to execute your query.
5. The maximum number of unique values supported per facet is 100. For example, if there are more than 100 values for a facet, then all the counts are displayed as "-", indicating that the values are unknown.

To save a facet-based query

1. Create your query using one or more facet values.

2. The rest of the steps are the same as saving a Logs Insights query. See Saving CloudWatch Logs Insights queries.
3. Your saved queries are available in the Saved Queries section. When you retrieve a saved query, it will automatically include the facets and values used for the query, making it easy to analyze your logs.

To create an account-level facet

1. To create facets, you need to first create the field as an index and configure it as a facet. In the navigation pane, choose **Settings**, **Logs**, **Account level index policies**. Alternatively, you can select **Manage facets** on the facets panel.
2. Choose **Create new index policy**. For details on creating index policies, see Create an account-level field index policy.
3. To create a facet, check **Set as facet** for the selected field in the index policy creation page.

Facet Management using APIs

Facet management can be done using the field index policy. See `field index` APIs for details.

Field Index APIs

No.	Name	Description
1	PutIndexPolicy	Creates or updates a field index policy for the specific log group
2	PutAccountPolicy	Creates an account-level data protection policy, subscription filter policy, field index policy, transformer policy, or metric extraction policy that applies to all log groups or a subset of log groups in the account
3	DeleteIndexPolicy	Deletes a log-group level field index policy that was applied to a single log group
4	DeleteAccountPolicy	Deletes a CloudWatch Logs account policy

Viewing surrounding logs in CloudWatch Logs Insights

You can view log events that occurred before and after a specific log record returned by your CloudWatch Logs Insights query. Surrounding logs help you understand the context around errors, warnings, or other significant events.

How surrounding logs work

When you run a CloudWatch Logs Insights query, each log record in the results includes a **Surrounding logs** option. When you choose this option, CloudWatch Logs Insights displays additional log events from the same log stream that occurred immediately before and after the selected record. These events appear even if they don't match your original query filters.

You can configure the number of surrounding log lines to display. Choose from 5, 10, 20, 50, or 100 log lines above and below the selected record.

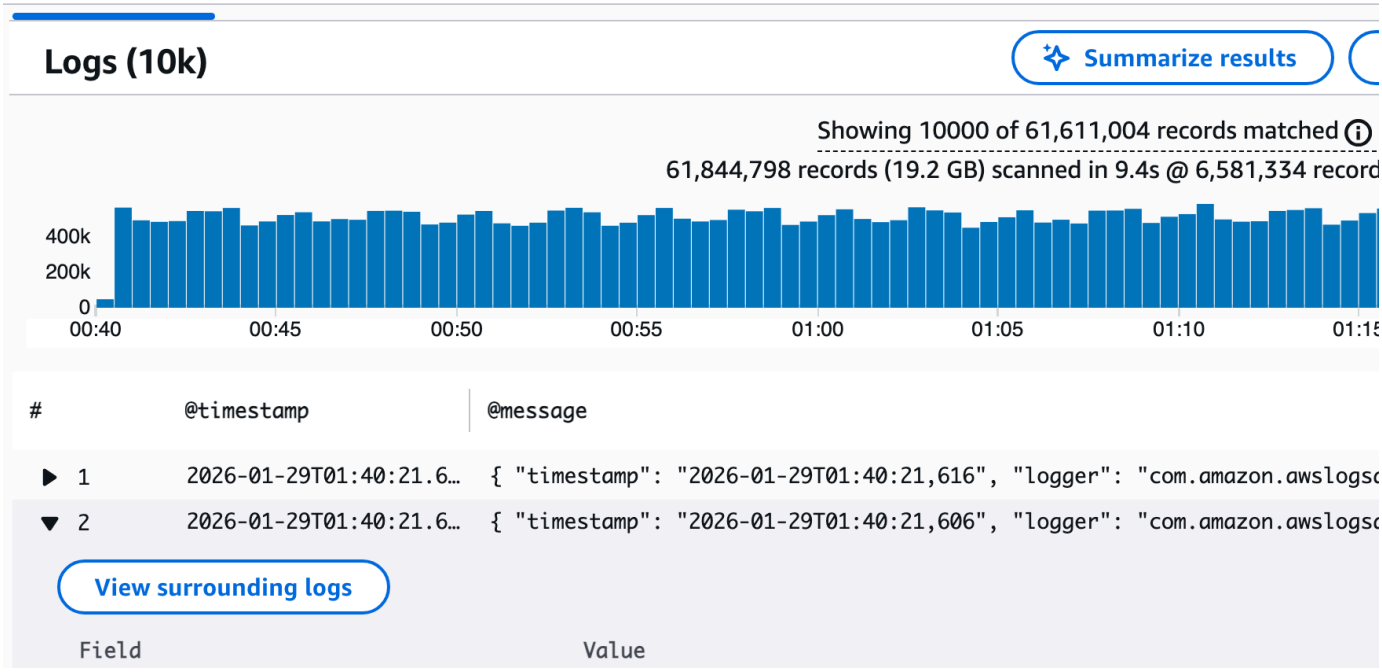
Surrounding logs are useful in the following scenarios:

- Debugging errors by viewing the events that led to a failure
- Investigating warnings or timeouts in distributed systems
- Understanding the sequence of events across your application
- Analyzing issues in high-volume log environments

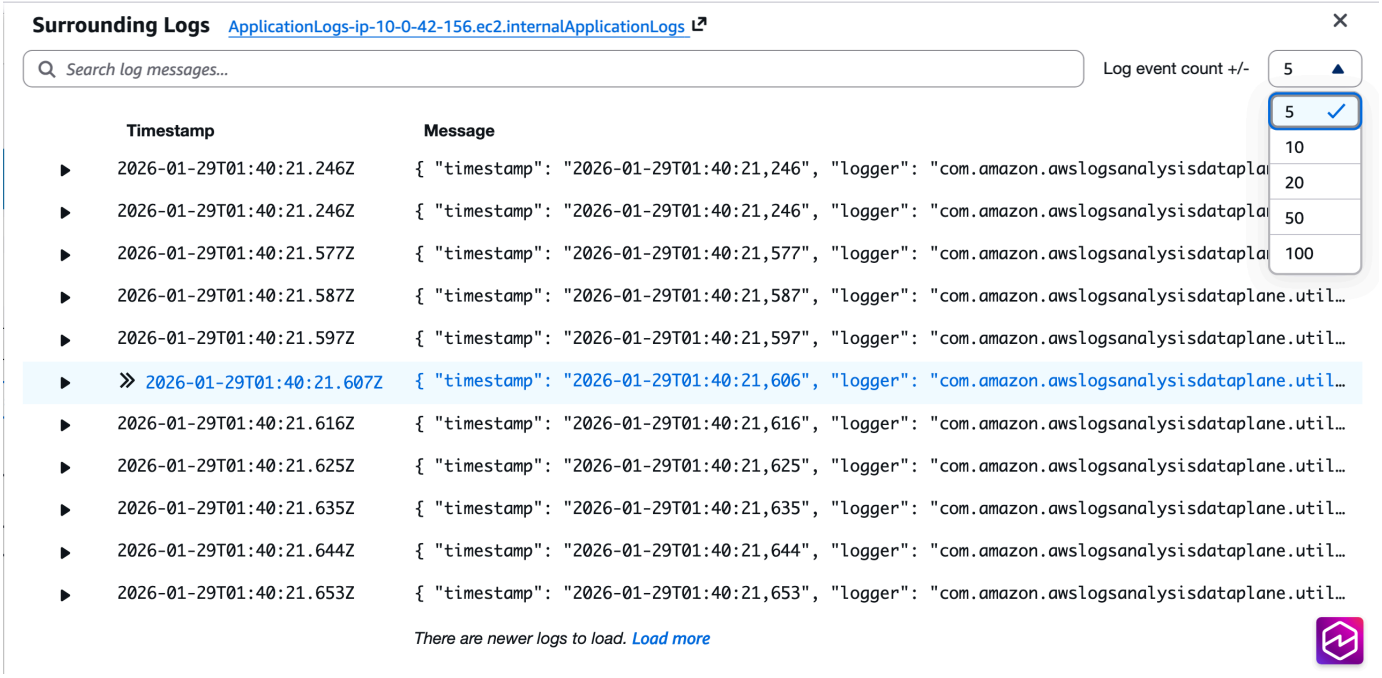
View surrounding logs

To view surrounding logs

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Logs**, **Logs Insights**.
3. Run your query.
4. In the query results, locate the log record that you want to investigate.
5. Choose **Surrounding logs**.



6. In the **Number of events** dropdown, choose the number of log events to display above and below the selected record. You can choose 5, 10, 20, 50, or 100.

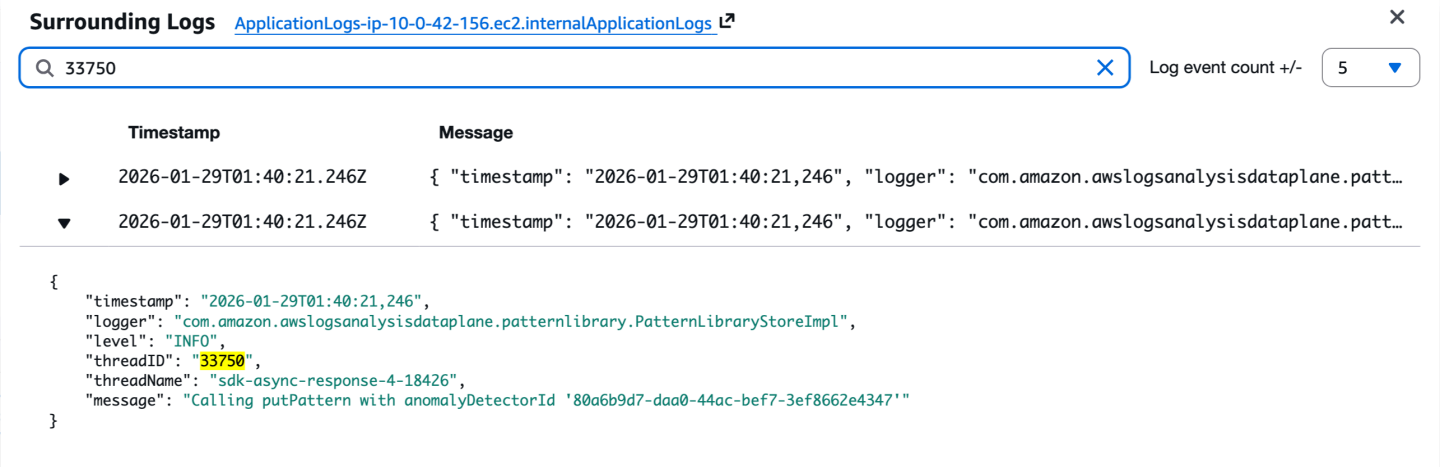


Search within surrounding logs

After you open the surrounding logs panel, you can search for specific keywords to locate relevant context.

To search within surrounding logs

1. In the surrounding logs panel, enter your search term in the search box.
2. Review the highlighted matching log lines.
3. Use the navigation controls to move between matches.



Pattern analysis

CloudWatch Logs Insights uses machine learning algorithms to find *patterns* when you query your logs. A pattern is a shared text structure that recurs among your log fields. When you view the results of a query, you can choose the **Patterns** tab to see the patterns that CloudWatch Logs found based on a sample of your results. Alternatively, you can append the `pattern` command to your query to analyze the patterns in the entire set of matching log events.

Patterns are useful for analyzing large log sets because a large number of log events can often be compressed into a few patterns.

Consider the following sample of three log events.

```
2023-01-01 19:00:01 [INFO] Calling DynamoDB to store for resource id 12342342k124-12345
2023-01-01 19:00:02 [INFO] Calling DynamoDB to store for resource id 324892398123-12345
2023-01-01 19:00:03 [INFO] Calling DynamoDB to store for resource id 3ff231242342-12345
```

In the previous sample, all three log events follow one pattern:

```
<Time-1> [INFO] Calling DynamoDB to store for resource id <ID-2>
```

Fields within a pattern are called *tokens*. Fields that vary within a pattern, such as a request ID or timestamp, are *dynamic tokens*. Each dynamic token is represented by <*string*-*number*>. The *string* is a description of the type of data that the token represents. The *number* shows where in the pattern this token appears, compared to the other dynamic tokens.

Common examples of dynamic tokens include error codes, timestamps, and request IDs. A *token value* represents a particular value of a dynamic token. For example, if a dynamic token represents an HTTP error code, then a token value could be `501`.

Pattern detection is also used in the CloudWatch Logs anomaly detector and compare features. For more information, see Log anomaly detection and Compare (diff) with previous time ranges.

Getting started with pattern analysis

Pattern detection is automatically performed in any CloudWatch Logs Insights query. Queries that don't include the `pattern` command get both log events and patterns in the results.

If you include the `pattern` command in your query, pattern analysis is performed on the entire matched set of log events. This gives you more accurate pattern results, but the raw log events are not returned when you use the `pattern` command. When a query doesn't include `pattern`, the pattern results are based either on the first 1000 returned log events, or on the limit value you used in your query. If you include `pattern` in the query, then the results displayed in the **Patterns** tab are derived from all log events matched by the query.

To get started with pattern analysis in CloudWatch Logs Insights

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Logs**, **Logs Insights**.

   On the **Logs Insights** page, the query editor contains a default query that returns the 20 most recent log events.
3. Remove the `| limit 20` line in the query box, so that the query looks like the following:

   ```
   fields @timestamp, @message, @logStream, @log
   | sort @timestamp desc
   ```
4. In the **Select log group(s)** drop-down, choose one or more log groups to query.
5. (Optional) Use the time interval selector to select a time period that you want to query.

You can choose between 5-minute and 30-minute intervals; 1-hour, 3-hour, and 12-hour intervals; or a custom time frame.

6. Choose **Run query** to start the query.

   When the query finishes running, the **Logs** tab displays a table of log events returned by the query. Above the table is a message about how many records matched the query, similar to **Showing 10,000 of 71,101 records matched**.

7. Choose the **Patterns** tab.

8. The table now displays the patterns found in the query. Because the query did not include the `pattern` command, this tab displays only the patterns discovered among the 10,000 log events that were shown in the table in the **Logs** tab.

   For each pattern, the following information is displayed:

   - The **Pattern**, with each dynamic token displayed as <*string*-*number*>. The *string* is a description of the type of data that the token represents. The *number* shows where in the pattern this token appears, compared to the other dynamic tokens.
   - The **Event count**, which is the number of times that the pattern appeared in the queried log events. Choose the **Event count** column heading to sort the patterns by frequency.
   - The **Event ratio**, which is the percentage of the queried log events that contain this pattern.
   - The **Severity type**, which will be one of the following:
     - **ERROR** if the pattern contains the word **Error**.
     - **WARN** if the pattern contains the word **Warn** but doesn't contain **Error**.
     - **INFO** if the pattern doesn't contain either **Warn** or **Error**.

   Choose the **Severity info** column heading to sort the patterns by severity.

9. Now change the query. Replace the `| sort @timestamp desc` line in the query with `| pattern @message`, so that the complete query is as follows:

```
fields @timestamp, @message, @logStream, @log
| pattern @message
```

10. Choose **Run query**.

When the query finishes, there are no results in the **Logs** tab. However, the **Patterns** tab likely has a larger number of patterns listed, depending on the total number of log events that were queried.

11. Regardless of whether you included `pattern` in your query, you can further inspect the patterns that the query returns. To do so, choose the icon in the **Inspect** column for one of the patterns.

    The **Pattern inspect** pane appears and displays the following:

    - The **Pattern**. Select a token within the pattern to analyze that token's values.
    - A histogram showing the number of occurrences of the pattern over the queried time range. This can help you to identify interesting trends such as a sudden increase in occurrence of a pattern.
    - The **Log samples** tab displays a few of the log events that match the selected pattern.
    - The **Token Values** tab displays the values of the selected dynamic token, if you have selected one.

      > **Note**
      >
      > A maximum of 10 token values is captured for each token. Token counts might not be precise. CloudWatch Logs uses a probabilistic counter to generate the token count, not the absolute value.

    - The **Related patterns** tab displays other patterns that frequently occurred near the same time as the pattern that you are inspecting. For example, if a pattern for an `ERROR` message was usually accompanied by another log event marked as `INFO` with additional details, that pattern is displayed here.

Details about the pattern command

This section contains more details about the `pattern` command and its uses.

- In the previous tutorial, we removed the `sort` command when we added `pattern` because a query is not valid if it includes a `pattern` command after a `sort` command. It is valid to have a `pattern` before a `sort`.

  For more details about `pattern` syntax, see pattern.

- When you use `pattern` in a query, `@message` must be one of the fields selected in the `pattern` command.
- You can include the `filter` command before a `pattern` command to cause only the filtered set of log events to be used as input for pattern analysis.
- To see pattern results for a particular field, such as a field derived from the `parse` command, use `pattern @fieldname`.
- Queries with non-log output, such as queries with the `stats` command, do not return pattern results.

Save and re-run CloudWatch Logs Insights queries

After you create a query, you can save it, and run it again later. Queries are saved in a folder structure, so you can organize them. You can save as many as 1000 queries per region and per account.

Queries are saved on a Region-specific level, not a user-specific level. If you create and save a query, other users with access to CloudWatch Logs in the same Region can see all saved queries and their folder structures in the Region.

To save a query, you must be logged into a role that has the permission `logs:PutQueryDefinition`. To see a list of your saved queries, you must be logged into a role that has the permission`logs:DescribeQueryDefinitions`.

> **Note**
>
> You can create and save queries with parameters — reusable templates with named placeholders. Instead of saving multiple variations of the same query with different values, create one template and provide different parameter values when you run it. This functionality is currently supported for queries using Logs Insights query language only. For more information, see Using saved queries with parameters.

Console

To save a query

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Logs**, and then choose **Logs Insights**.
3. In the query editor, create a query.
4. Choose **Save**.
5. Enter a name for the query.
6. (Optional) Choose a folder where you want to save the query. Select **Create new** to create a folder. If you create a new folder, you can use slash (/) characters in the folder name to define a folder structure. For example, naming a new folder **`folder-level-1/folder-level-2`** creates a top-level folder called **`folder-level-1`**, with another folder called **`folder-level-2`** inside that folder. The query is saved in **`folder-level-2`**.
7. (Optional) Change the query's log groups or query text.
8. (Optional) To use parameters in your query, follow these additional steps:
   a. **Add parameters to your query.** Replace static values with placeholders using the `{{parameter}}` syntax (double braces before and after the parameter name).

      Example: Original query with static values:

      ```
      fields @timestamp, @message
      | filter level = "Error"
      | filter applicationName = "OrderService"
      ```

      Updated query with parameters:

      ```
      fields @timestamp, @message
      | filter level = {{logLevel}}
      | filter applicationName = {{applicationName}}
      ```

   b. **Define the parameters used in your query.** For each placeholder parameter, specify:
      - **Name**: Must exactly match the placeholder name (for example, `logLevel`, `applicationName`).
      - **Default value** (optional): The value to use if no parameter value is provided.
      - **Description** (optional): Explains the parameter's purpose.
   c. Queries with parameters can be run by using the query name with a $ prefix and passing the parameter names as key-value pairs. See **To run a saved query** for details.
9. Choose **Save**.

AWS CLI

To save a query, use `put-query-definition`:

```
aws logs put-query-definition \
  --name "ErrorsByLevel" \
  --query-string "fields @timestamp, @message | filter level = \"ERROR\"" \
  --log-group-names "/aws/lambda/my-function" \
  --region us-east-1
```

(Optional) To save a query with parameters, add the `--parameters` option and use `{{parameterName}}` placeholders in the query string:

```
aws logs put-query-definition \
  --name "ErrorsByLevel" \
  --query-string "fields @timestamp, @message | filter level = {{logLevel}} | filter
 applicationName = {{applicationName}}" \
  --parameters '[{"name":"logLevel","defaultValue":"ERROR","description":"Log level
 to filter"},
{"name":"applicationName","defaultValue":"OrderService","description":"Application
 name to filter"}]' \
  --log-group-names "/aws/lambda/my-function" \
  --region us-east-1
```

To save a query in a folder, prefix the query name with the folder path:

```
aws logs put-query-definition \
  --name "my-folder/ErrorsByLevel" \
  --query-string "fields @timestamp, @message | filter level = {{logLevel}}" \
  --parameters '[{"name":"logLevel","defaultValue":"ERROR","description":"Log level
 to filter"}]' \
  --log-group-names "/aws/lambda/my-function" \
  --region us-east-1
```

API

To save a query, call PutQueryDefinition:

```
{
  "name": "ErrorsByLevel",
  "queryString": "fields @timestamp, @message | filter level = \"ERROR\"",
  "logGroupNames": ["/aws/lambda/my-function"]
```

```
}
```

(Optional) To save a query with parameters, include the `parameters` field and use `{{parameterName}}` placeholders in the query string:

```
{
  "name": "ErrorsByLevel",
  "queryString": "fields @timestamp, @message | filter level = {{logLevel}} | filter
 applicationName = {{applicationName}}",
  "logGroupNames": ["/aws/lambda/my-function"],
  "parameters": [
    {
      "name": "logLevel",
      "defaultValue": "ERROR",
      "description": "Log level to filter"
    },
    {
      "name": "applicationName",
      "defaultValue": "OrderService",
      "description": "Application name to filter"
    }
  ]
}
```

Tip

You can create a folder for saved queries with `PutQueryDefinition`. To create a folder for your saved queries, use a forward slash (/) to prefix your desired query name with your desired folder name: <*folder-name*>/<*query-name*>. For more information about this action, see PutQueryDefinition.

Console

To run a saved query

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Logs**, and then choose **Logs Insights**.
3. On the right, choose **Queries**.

4. Select your query from the **Saved queries** list. The query text appears in the query editor.
5. (Optional) To use a query with parameters:
   a. Choose the **+** icon next to the query name in the **Saved queries** side panel.
   b. The query with parameters appears in the query editor. For example, if you choose the **+** icon next to `ErrorsByLevel`, the query editor is populated with: `$ErrorsByLevel(level=, applicationName=)`
   c. Provide the values for the parameters (level, applicationName) and run the query. For example: `$ErrorsByLevel(level= "ERROR", applicationName= "OrderService")`
6. Choose **Run**.

AWS CLI

To run a saved query with parameters

Use `start-query` with the `$QueryName( )` syntax:

```
aws logs start-query \
  --log-group-names "/aws/lambda/my-function" \
  --start-time 1707566400 --end-time 1707570000 \
  --query-string '$ErrorsByLevel(level= "ERROR", applicationName= "OrderService")' \
  --region us-east-1
```

API

To run a saved query with parameters

Call StartQuery with the `$QueryName( )` syntax in the `queryString` field:

```
{
  "logGroupNames": ["/aws/lambda/my-function"],
  "startTime": 1707566400,
  "endTime": 1707570000,
  "queryString": "$ErrorsByLevel(level=\"ERROR\", applicationName= \"OrderService
\")"
}
```

To save a new version of a saved query

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Logs**, and then choose **Logs Insights**.
3. On the right, choose **Queries**.
4. Select your query from **Saved queries** list. It appears in the query editor.
5. Modify the query. If you need to run it to check your work, choose **Run query**.
6. When you are ready to save the new version, choose **Actions**, **Save as**.
7. Enter a name for the query.
8. (Optional) Choose a folder where you want to save the query. Select **Create new** to create a folder. If you create a new folder, you can use slash (/) characters in the folder name to define a folder structure. For example, naming a new folder **`folder-level-1/folder-level-2`** creates a top-level folder called **`folder-level-1`**, with another folder called **`folder-level-2`** inside that folder. The query is saved in **`folder-level-2`**.
9. (Optional) Change the query's log groups or query text.
10. Choose **Save**.

To delete a query, you must be logged in to a role that has the `logs:DeleteQueryDefinition` permission.

To edit or delete a saved query

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Logs**, and then choose **Logs Insights**.
3. On the right, choose **Queries**.
4. Select your query from **Saved queries** list. It appears in the query editor.
5. Choose **Actions**, **Edit** or **Actions**, **Delete**.

Using saved queries with parameters

Saved queries with parameters are reusable query templates with named placeholders. Instead of maintaining multiple copies of nearly identical queries, you can save a template and supply different parameter values when running the query. Parameters are only supported in the CloudWatch Logs Insights query language.

How it works

When saving a query, placeholders identify the values which you can provide at query execution time. Placeholders use the `{{parameterName}}` syntax. The following is an example of a saved query named `ErrorsByLevel` with two parameters `logLevel` and `applicationName`.

```
fields @timestamp, @message
| filter level = {{logLevel}}
| filter applicationName = {{applicationName}}
```

To run a saved query, you can invoke it using the query name prefixed with $ and passing the parameter values. The CloudWatch Logs Insights query engine replaces each placeholder. If a parameter contains default values, then those values are used if no other values are provided.

```
# Run query by using query name and passing parameter values explicitly
$ErrorsByLevel(logLevel = "WARN", applicationName = "OrderService")

# Run query without specifying parameter values - default values are used in this case.
$ErrorsByLevel()
```

Saved query names containing spaces or special characters need to be enclosed with backticks:

```
$`Errors By Level`(logLevel = "WARN")
```

Sample saved queries with parameters

Adding a result limit as a parameter

Query name: `ErrorsByLevel` with parameters `logLevel` (default: `"ERROR"`), `applicationName` (default: `"OrderService"`), and `maxResults` (default: `50`)

```
fields @timestamp, @message, @logStream
| filter level = {{logLevel}}
| filter applicationName = {{applicationName}}
| sort @timestamp desc
| limit {{maxResults}}
```

```
# Run the query using the query name and passing parameter values
$ErrorsByLevel(logLevel = "WARN", applicationName = "OrderService", maxResults = 100)
```

Using multiple saved queries with parameters

The example below uses `ErrorsByLevel` and a second saved query `RecentN` which is defined as `sort @timestamp desc | limit {{count}}` (with parameter `count`, default `20`). The CloudWatch Logs Insights query engine expands each query before running it.

```
# Using multiple queries with parameters in sequence
$ErrorsByLevel(logLevel = "WARN", applicationName = "OrderService")
| $RecentN(count = 10)

# Each of the queries is expanded, resulting in the following query when it is run.
fields @timestamp, @message
| filter level = "WARN"
| filter applicationName = "OrderService"
| sort @timestamp desc
| limit 10
```

Quotas and error handling

> **Note**
>
> Each saved query can have a maximum of 20 parameters.

The expanded query string cannot exceed 10,000 characters. Parameter names must start with a letter or underscore. A saved query cannot reference another saved query (nested invocations are not supported).

Common errors

Error	Cause
Parameters are only supported for CWLI query language	Parameters are only supported in the CloudWatch Logs Insights query language.
Required parameters not found in queryString	A parameter name in `--parameters` does not have a matching `{{placeholder}}` in the query string.
Parameter count exceeds the maximum of 20	Saved queries currently only support 20 parameters.

Error	Cause
Duplicate parameter name	The query definition has duplicate parameters in `parameters` .

> **Note**
>
> To create or update a saved query with parameters, you need the `logs:PutQueryDefinition` permission. To run one, you need `logs:StartQuery` and `logs:DescribeQueryDefinitions`.

Add query to dashboard or export query results

After you run a query, you can add the query to a CloudWatch dashboard or copy the results to the clipboard.

Queries added to dashboards run every time you load the dashboard and every time that the dashboard refreshes. These queries count toward your limit of 100 concurrent CloudWatch Logs Insights queries.

To add query results to a dashboard

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Logs**, and then choose **Logs Insights**.
3. Choose one or more log groups and run a query.
4. Choose **Add to dashboard**.
5. Select the dashboard, or choose **Create new** to create a dashboard for the query results.
6. Select the widget type to use for the query results.
7. Enter a name for the widget.
8. Choose **Add to dashboard**.

To copy query results to the clipboard or download the query results

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.

2. In the navigation pane, choose **Logs**, and then choose **Logs Insights**.
3. Choose one or more log groups and run a query.
4. Choose **Export results**, and then choose the option you want.

View running queries or query history

You can view the queries currently in progress as well as your recent query history.

Queries currently running includes queries you have added to a dashboard. You are limited to 100 concurrent CloudWatch Logs Insights queries per account, including queries added to dashboards. Additionally, You can run 15 concurrent queries for either OpenSearch Service PPL or OpenSearch Service SQL.

To view your recent query history

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Logs**, and then choose **Logs Insights**.
3. Choose **History**, if you are using the new design for the CloudWatch Logs console. If you are using the old design, choose **Actions**, **View query history for this account**.

   A list of your recent queries appears. You can run any of them again by selecting the query and choosing **Run**.

   Under **Status**, CloudWatch Logs displays **In progress** for any queries that are currently running.

Encrypt query results with AWS Key Management Service

By default, CloudWatch Logs encrypts the stored results of your CloudWatch Logs Insights queries using the default CloudWatch Logs server-side encryption method. You can choose to use a AWS KMS key to encrypt these results instead. If you associate a AWS KMS key with your encryption results, then CloudWatch Logs uses that key to encrypt the stored results of all queries in the account.

If you later disassociate a the key from your query results, CloudWatch Logs goes back to the default encryption method for later queries. But the queries that ran while the key was associated are still encrypted with that key. CloudWatch Logs can still return those results after the KMS key is disassociated, because CloudWatch Logs can still continue to reference the key. However, if the

key is later disabled, then CloudWatch Logs is unable to read the query results that were encrypted with that key.

> **Important**
>
> CloudWatch Logs supports only symmetric KMS keys. Do not use an asymmetric key to encrypt your query results. For more information, see Using Symmetric and Asymmetric Keys.

Limits

- To perform the following steps, you must have the following permissions: `kms:CreateKey`, `kms:GetKeyPolicy`, and `kms:PutKeyPolicy`.
- After you associate or disassociate a key from your query results, it can take up to five minutes for the operation to take effect.
- If you revoke CloudWatch Logs access to an associated key or delete an associated KMS key, your encrypted data in CloudWatch Logs can no longer be retrieved.
- You can't use the CloudWatch console to associate a key, you must use the AWS CLI or CloudWatch Logs API.

Step 1: Create an AWS KMS key

To create a KMS key use the following create-key command:

```
aws kms create-key
```

The output contains the key ID and Amazon Resource Name (ARN) of the key. The following is example output:

```
{
    "KeyMetadata": {
        "Origin": "AWS_KMS",
        "KeyId": "1234abcd-12ab-34cd-56ef-1234567890ab",
        "Description": "",
        "KeyManager": "CUSTOMER",
        "Enabled": true,
```

```
        "CustomerMasterKeySpec": "SYMMETRIC_DEFAULT",
        "KeyUsage": "ENCRYPT_DECRYPT",
        "KeyState": "Enabled",
        "CreationDate": 1478910250.94,
        "Arn": "arn:aws:kms:us-west-2:123456789012:key/6f815f63-e628-448c-8251-
e40cb0d29f59",
        "AWSAccountId": "123456789012",
        "EncryptionAlgorithms": [
            "SYMMETRIC_DEFAULT"
        ]
    }
}
```

Step 2: Set permissions on the KMS key

By default, all KMS keys are private. Only the resource owner can use it to encrypt and decrypt data. However, the resource owner can grant permissions to access the key to other users and resources. With this step, you give the CloudWatch Logs service principal permission to use the key. This service principal must be in the same AWS Region where the key is stored.

As a best practice, we recommend that you restrict the use of the key to only those AWS accounts that you specify.

First, save the default policy for your KMS key as `policy.json` using the following get-key-policy command:

```
aws kms get-key-policy --key-id key-id --policy-name default --output text > ./
policy.json
```

Open the `policy.json` file in a text editor and add the section in bold from one of the following statements. Separate the existing statement from the new statement with a comma. These statements use `Condition` sections to enhance the security of the AWS KMS key. For more information, see AWS KMS keys and encryption context.

The `Condition` section in this example limits the use of the AWS KMS key to the CloudWatch Logs Insights query results in the specified account.

JSON

```
{
```

```
    "Version":"2012-10-17",
    "Id": "key-default-1",
    "Statement": [
        {
            "Sid": "Enable IAM User Permissions",
            "Effect": "Allow",
            "Principal": {
                "AWS": "arn:aws:iam::111122223333:root"
            },
            "Action": "kms:*",
            "Resource": "*"
        },
        {
            "Effect": "Allow",
            "Principal": {
                "Service": "logs.region.amazonaws.com"
            },
            "Action": [
                "kms:Encrypt*",
                "kms:Decrypt*",
                "kms:ReEncrypt*",
                "kms:GenerateDataKey*",
                "kms:Describe*"
            ],
            "Resource": "*",
            "Condition": {
                "ArnEquals": {
                "aws:SourceArn": "arn:aws:logs:us-east-1:111122223333:query-
result:*"
                },
                "StringEquals": {
                "aws:SourceAccount": "111122223333"
                }
            }
        }
    ]
}
```

Finally, add the updated policy using the following put-key-policy command:

```
aws kms put-key-policy --key-id key-id --policy-name default --policy file://
policy.json
```

Step 3: Associate a KMS key with your query results

To associate the KMS key with the query results in the account

Use the disassociate-kms-key command as follows:

```
aws logs associate-kms-key --resource-identifier "arn:aws:logs:region:account-id:query-result:*" --kms-key-id "key-arn"
```

Step 4: Disassociate a key from query results in the account

To disassociate the KMS key associated with query results, use the following disassociate-kms-key command:

```
aws logs disassociate-kms-key --resource-identifier "arn:aws:logs:region:account-id:query-result:*"
```

Generate a natural language summary from CloudWatch Logs Insights query results

Analyzing log data is crucial for understanding your applications' behavior, but interpreting large volumes of log entries can be time-consuming. CloudWatch Logs Insights now offers a natural language summarization capability that transforms complex query results into clear, concise summaries. This capability helps you quickly identify issues and gain actionable insights from your log data.

How it works

CloudWatch Logs Insights can generate a human-readable summary from your query results using Amazon Bedrock. The feature supports all CloudWatch Logs Insights query languages and provides clear, actionable insights from your log data.

Regional availability and data processing

Important

When you use this feature, your query results might be processed in a different AWS Region. For example, if you run a query in US East (N. Virginia), the summarization might occur in US West (Oregon).

The following table lists the possible processing AWS Region for the different geographies in which the query results feature is available:

Supported CloudWatch Logs geography	Possible Processing Region
United States (US)	US East (N. Virginia) Region US East (Ohio) Region US West (Oregon) Region
Europe	Europe (Frankfurt) Region Europe (Ireland) Region Europe (Paris) Region Europe (Stockholm) Region Europe (London) Region
Asia Pacific	US East (N. Virginia) Region US East (Ohio) Region US West (Oregon) Region
South America	US East (N. Virginia) Region US East (Ohio) Region US West (Oregon) Region

Getting started

To generate a natural language summary

1. Run your CloudWatch Logs Insights query.
2. After the query completes, select **Summarize results**.

Permissions

You must have one of the following:

- `CloudWatchLogsFullAccess` permission
- `CloudWatchLogsReadOnlyAccess` permission
- Custom IAM policy including the `cloudwatch:GenerateQueryResultsSummary`, `logs:GetQueryResults`, `logs:DescribeQueries` and `logs:FilterLogEvents` actions

Data privacy

Your query results are processed securely and aren't used to train or improve CloudWatch Logs Insights or Amazon Bedrock. If you choose to provide feedback on the query results summary using the feedback buttons, your feedback indicates your level of satisfaction with the capability provided in CloudWatch Logs Insights.

Automating log analysis with scheduled queries

Scheduled queries enable you to automate the execution of log queries on a regular schedule. Instead of manually running queries to analyze your log data, you can configure scheduled queries to run automatically and deliver results to destinations such as Amazon S3 buckets, Amazon EventBridge event buses, or lookup tables. This automation is ideal for generating regular reports, monitoring trends, keeping lookup tables current with your latest log data, or triggering downstream processes based on log analysis results.

Scheduled queries support all three query languages available for log queries:

- **Logs Insights query language (Logs Insights QL)**
- **OpenSearch Service Piped Processing Language (PPL)**
- **OpenSearch Service Structured Query Language (SQL)**

Contents

Understanding scheduled queries concepts

Before creating scheduled queries, understand these key concepts that affect how your queries run and where results are delivered.

IAM role separation

Scheduled queries require two separate IAM roles: one for executing queries and another for delivering results to destinations such as Amazon S3 buckets, Amazon EventBridge event buses, or

lookup tables. Understanding why this separation exists helps you configure permissions correctly and use the security and operational benefits it provides.

The two-role architecture divides responsibilities between data access and data delivery. The query execution role accesses your log data and runs queries, while the destination delivery role writes results to your chosen destination. This separation follows the principle of least privilege—each role has only the permissions it needs for its specific function.

Query execution role

Allows CloudWatch Logs to run CloudWatch Logs Insights queries on your behalf. This role needs permissions to access your log groups and execute queries, but doesn't need access to destination resources. Required permissions:

- `logs:StartQuery`
- `logs:StopQuery`
- `logs:GetQueryResults`
- `logs:DescribeLogGroups`
- `logs:Unmask` if unmask data is required

For KMS-encrypted log groups: `kms:Decrypt` and `kms:DescribeKey` permissions for the KMS key used to encrypt the log groups. These permissions need to be added as well.

Trust relationship requirement: The query execution role must include a trust policy that allows the CloudWatch Logs service (`logs.amazonaws.com`) to assume the role. Without this trust relationship, scheduled queries will fail with permission errors.

Example trust policy for the query execution role:

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Principal": {
                "Service": "logs.amazonaws.com"
            },
            "Action": "sts:AssumeRole"
        }
    ]
```

```
}
```

Example permissions policy for the query execution role:

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": [
                "logs:StartQuery",
                "logs:StopQuery",
                "logs:GetQueryResults",
                "logs:DescribeLogGroups"
            ],
            "Resource": "*"
        }
    ]
}
```

Destination delivery role

Allows CloudWatch Logs to deliver query results to your chosen destination. This role only needs permissions for the specific destination service, following the principle of least privilege. Required permissions vary by destination type.

Trust relationship requirement: The destination delivery role must also include a trust policy that allows the CloudWatch Logs service (`logs.amazonaws.com`) to assume the role.

Example permissions policy for S3 destination delivery role:

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": [
                "s3:PutObject"
            ],
            "Resource": "arn:aws:s3:::your-scheduled-query-results-bucket/*"
        }
    ]
```

```
}
```

Example permissions policy for a lookup table destination delivery role:

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": [
                "logs:CreateLookupTable",
                "logs:UpdateLookupTable",
                "logs:GetQueryResults"
            ],
            "Resource": "*"
        }
    ]
}
```

This separation provides practical benefits for your operations. From a security perspective, if you need to change where results are delivered, you only modify the destination delivery role without changing the query execution permissions. For compliance and auditing, you can clearly track which role accesses sensitive log data and which role writes to external systems. This makes it easier to demonstrate that your log analysis infrastructure follows security best practices.

Cross-region and cross-account usage

A scheduled query is created in a specific region and runs in that region. However, you can query log groups and deliver results across regions and accounts. You need to set up one or more AWS accounts as *monitoring accounts* and link them with multiple *source accounts*. A monitoring account is a central AWS account that can view and interact with observability data generated from source accounts. A source account is an individual AWS account that generates observability data for the resources that reside in it. Source accounts share their observability data with the monitoring account. So you can setup scheduled queries from the monitoring account using the log groups of all linked accounts.

Querying cross-region log groups

Your scheduled query can access log groups in any region. Specify log groups using their full ARN format: `arn:aws:logs:region:account-id:log-group:log-group-name`. The

query execution role needs `logs:StartQuery` and `logs:GetQueryResults` permissions for log groups in all target regions.

Important

When querying log groups or delivering results across regions, log data crosses regional boundaries. Consider the following:

- **Data residency requirements** - Ensure cross-region data transfer complies with your organization's data governance policies and regulatory requirements
- **Data transfer costs** - Cross-region data transfer incurs additional charges
- **Network latency** - Queries accessing log groups in distant regions may experience higher latency

For optimal performance and cost efficiency, create scheduled queries in the same region as your primary log groups.

Alternative approach: Use CloudWatch Logs centralization to replicate log data from multiple accounts and regions into a central monitoring account. This allows you to create scheduled queries in a single region that access all your centralized logs, avoiding cross-region queries and simplifying IAM permissions management.

Schedule expressions and timezone handling

The schedule you define determines when your query runs and how often it executes. Choosing the right schedule expression affects when you receive results and how much data you query. Understanding the expression types helps you choose between simplicity and precision.

Cron expressions provide precise control over timing, allowing you to specify exact times, days of the week, or days of the month. Use cron expressions when you need queries to run at specific business hours or align with operational schedules. In the console you can also scheduled queries using easy calendar options.

Cron expressions

Run queries at specific times. Format: `cron(minute hour day-of-month month day-of-week year)`. Examples:

- `cron(0 9 * * ? *)` - Every day at 9:00 AM UTC
- `cron(0 18 ? * MON-FRI *)` - Weekdays at 6:00 PM UTC
- `cron(0 0 1 * ? *)` - First day of every month at midnight UTC
- `cron(0 12 ? * SUN *)` - Every Sunday at noon UTC
- `cron(30 8 1 1 ? *)` - January 1st at 8:30 AM UTC

All scheduled queries run in UTC, regardless of your local timezone or where your AWS resources are located. This is particularly important when you schedule queries for business hours or time-sensitive analysis. For example, if your business operates in US Eastern Time and you want a daily report at 9 AM ET, you need to account for the UTC offset (14:00 UTC during daylight saving time, 13:00 UTC otherwise). Plan your schedule expressions with UTC in mind to ensure queries run at the intended times.

Choosing a query language

Scheduled queries support three different query languages, and your choice affects both how you write queries and how easily your team can maintain them. The right language depends on your analysis requirements and your team's existing skills.

If you are primarily filtering and aggregating log data, CloudWatch Logs Insights Query Language offers the most straightforward syntax. For complex data transformations where you need to reshape or enrich data through multiple steps, PPL's pipeline approach makes the logic easier to follow. When you need to perform joins or complex aggregations similar to database operations, SQL provides familiar syntax that database-experienced teams can adopt quickly.

CloudWatch Logs Insights Query Language (CWLI)

Purpose-built for log analysis with intuitive syntax. Best for:

- Text-based log analysis and filtering
- Time-series aggregations and statistics
- Teams new to log analysis

OpenSearch Service Piped Processing Language (PPL)

Pipeline-based query language with powerful data transformation capabilities. Best for:

- Complex data transformations and enrichment
- Multi-step data processing workflows

- Teams familiar with pipeline-based processing

OpenSearch Service Structured Query Language (SQL)

Standard SQL syntax for familiar database-style queries. Best for:

- Complex joins and aggregations
- Business intelligence and reporting
- Teams with strong SQL experience

Destination selection and use cases

Where you send query results determines what you can do with them. This choice shapes your entire downstream workflow—whether you are building long-term analytics, triggering automated responses, or both. Understanding the strengths of each destination type helps you design the right architecture for your use case.

Amazon S3 destinations are optimized for storage and batch processing. When you need to keep query results for months or years, analyze trends over time, or feed data into analytics platforms, Amazon S3 provides cost-effective storage with unlimited retention. EventBridge destinations are optimized for real-time automation. When query results should trigger immediate actions—like sending alerts, starting workflows, or updating systems—EventBridge delivers results as events that your applications can respond to instantly. By default all query completion events are automatically sent as events to the default event bus, enabling integration with downstream processing systems, Lambda functions, or other event-driven architectures. Results are only published to destinations when query is executed successfully. Lookup table destinations are optimized for keeping reference data current. A lookup table destination automatically populates or refreshes the specified lookup table with the query results on each scheduled execution, so other queries can reference the latest data with the `lookup` command.

Amazon S3 destinations

Store query results as JSON files for long-term retention and batch processing. Amazon S3 destinations work best for the following scenarios:

- Historical analysis and data archiving
- Integration with data lakes and analytics platforms
- Compliance and audit requirements
- Cost-effective storage of large result sets

EventBridge destinations

Send query results as events for real-time processing and automation. Use the `queryId` in the event to retrieve the query results, which remain available for 30 days after the query runs. EventBridge destinations work best for the following scenarios:

- Triggering automated responses to query results
- Integration with serverless workflows and Lambda functions
- Real-time alerting and notification systems
- Event-driven architectures and microservices

Lookup table destinations

Automatically create or refresh a lookup table with query results on each scheduled execution. Each refresh is a full replacement of the table content. Lookup table destinations work best for the following scenarios:

- Keeping reference data current for the `lookup` command in your log queries
- Maintaining allowlists, denylists, or entity inventories derived from log data
- Enriching queries with recent activity summaries, such as active user or resource lists

Query result format and structure

Scheduled queries deliver results in JSON format, but each destination type receives a different payload. For a lookup table destination, the query results become the content of the lookup table, and each run replaces that content. For more information, see Configuring lookup table destinations for scheduled queries.

Amazon S3 destinations receive the result rows of the query. Each object contains a JSON array with one entry for each row in the result set, and each entry maps the output field names of the query to their values. The object does not contain query metadata or query statistics, and it omits the `@ptr` field even if the query requests it, because that field is usable only in the console.

EventBridge destinations receive query metadata, including the query statistics, but no result rows. To retrieve the rows of a completed query, call GetQueryResults with the value of `queryId` from the event.

The following example shows the event that CloudWatch Logs publishes to EventBridge when a scheduled query completes.

```
{
    "version": "0",
    "id": "be72061b-eca2-e068-a7e1-83e01d6fe807",
    "detail-type": "Scheduled Query Completed",
    "source": "aws.logs",
    "account": "123456789012",
    "time": "2025-11-18T11:31:48Z",
    "region": "us-east-1",
    "resources": [
        "arn:aws:logs:us-east-1:123456789012:scheduled-query:477b4380-b098-474e-9c5e-
e10a8cc2e6e7"
    ],
    "detail": {
        "queryId": "2038fd57-ab4f-4018-bb2f-61d363f4a004",
        "queryString": "fields @timestamp, @message, @logStream\n| filter @message
 like /ERROR/\n| sort @timestamp desc\n| limit 10000",
        "logGroupIdentifiers": [
            "/aws/lambda/my-function"
        ],
        "status": "Complete",
        "startTime": 1763465460,
        "statistics": {
            "recordsMatched": 1842,
            "recordsScanned": 48325,
            "estimatedRecordsSkipped": 0,
            "bytesScanned": 12081250,
            "estimatedBytesSkipped": 0,
            "logGroupsScanned": 1,
            "resultCount": 1842
        }
    }
}
```


This query does not aggregate, and it returned fewer rows than its `limit` of 10,000, so each of the 1,842 matching log events became one output row and `recordsMatched` and `resultCount` are equal. A query that aggregates, or one whose result set is truncated by `limit`, produces a `resultCount` lower than `recordsMatched`. For more information, see Understanding recordsScanned, recordsMatched, and resultCount.

Key elements include:

- `statistics` - Counters that describe how much log data the query read and how large the result set is. For a description of each field, see the following table.
- `startTime` - When the query execution started (Unix timestamp)
- `queryString` - The actual query that was executed
- `queryId` - Query id of the query using which results can be retrieved
- `logGroupIdentifiers` - List of log groups that were queried
- `status` - Query execution status (Complete, Failed, etc.)

The following table describes each field in the `statistics` object. For the API definitions of these fields, see QueryStatistics.

Field	Description
`recordsScanned`	The total number of log events scanned during the query.
`recordsMatched`	The number of log events that matched the query string. This value counts log events, not output rows. For the number of rows in the result set, use `resultCount` .
`resultCount`	The number of rows in the query result set. This value counts only the rows that survived all operations in the query, so it might be less than `recordsMatched` . It covers all pages of results that `GetQueryResults` returns. For more information, see Understanding recordsScanned, recordsMatched, and resultCount.
`estimatedRecordsSkipped`	An estimate of the number of log events that were skipped when processing this query, because the query contained an indexed field. Skipping these entries lowers query costs and improves the query performance time. For more information, see Create field indexes to improve query performance and reduce scan volume.
`bytesScanned`	The total number of bytes in the log events scanned during the query.

Field	Description
`estimatedBytesSkipped`	An estimate of the number of bytes in the log events that were skipped when processing this query, because the query contained an indexed field.
`logGroupsScanned`	The number of log groups that were scanned by this query.

Understanding recordsScanned, recordsMatched, and resultCount

Three of the query statistics count different things, and comparing them directly can be misleading. Each one measures a different stage of query processing:

- `recordsScanned` - The number of log events that the query read from your log groups. This is the input to the query.
- `recordsMatched` - The number of those log events that matched the query string. This value counts log events.
- `resultCount` - The number of rows in the result set that the query produced. This value counts output rows.

Each stage narrows the data. A command such as `stats` combines many log events into a single output row, so `resultCount` can be much smaller than `recordsMatched`. A large `recordsMatched` with a small `resultCount` does not mean that rows are missing from the result set.

Example – Aggregation

The following query counts the error messages in each log stream of one log group over a one-hour period.

```
filter @message like /ERROR/
| stats count(*) as errorCount by @logStream
```

If the query reads 1,500,000 log events, 24,318 of them contain ERROR, and those matching log events come from 12 log streams, then the query completes with the following statistics.

```
"statistics": {
```

```
    "recordsMatched": 24318,
    "recordsScanned": 1500000,
    "estimatedRecordsSkipped": 0,
    "bytesScanned": 450000000,
    "estimatedBytesSkipped": 0,
    "logGroupsScanned": 1,
    "resultCount": 12
}
```

`stats` produces one row for each log stream, so `resultCount` is 12 while `recordsMatched` is 24,318. The 12 values of `errorCount` add up to 24,318.

Example – Post-aggregation filter

The following query keeps only the log streams that produced more than 1,000 errors.

```
filter @message like /ERROR/
| stats count(*) as errorCount by @logStream
| filter errorCount > 1000
```

The final `filter` command runs after grouping, so it removes rows from the result set instead of log events from the scan. If 3 of the 12 log streams have an `errorCount` greater than 1,000, then `resultCount` is 3 instead of 12. `recordsScanned` and `bytesScanned` do not change, because the query reads the same log data either way.

Example – Limit

A `limit` command reduces `resultCount` without any aggregation. The following query returns the 100 most recent error messages.

```
filter @message like /ERROR/
| sort @timestamp desc
| limit 100
```

If the query scans the same 1,500,000 log events and matches the same 24,318, then `resultCount` is 100, because `limit` caps the result set at 100 rows. In the console, you see this relationship as **Showing 100 of 24,318 records matched**.

Each statistic answers a different question.

How many rows did this query return?

Use `resultCount`. A value of 0 means that the query produced no rows. Do not use `recordsMatched` for this purpose, because it counts log events rather than rows.

How much log data did this query read?

Use `recordsScanned` and `bytesScanned`. Scan volume determines the cost and the run time of a query. To reduce it, shorten the time range, query fewer log groups, or create field indexes. For more information, see Create field indexes to improve query performance and reduce scan volume.

How many log events matched this query?

Use `recordsMatched`.

> **Note**
>
> CloudWatch Logs omits a statistic from the `statistics` object when no value is available for it, rather than reporting the statistic as 0.
> If your event consumer does not find `resultCount` in an event, treat the value as unknown rather than as 0. Write event consumers so that they tolerate statistics that are absent and ignore statistics that they do not recognize.

Schedule expression reference

Use these reference tables to construct schedule expressions for your scheduled queries. All times are in UTC.

Cron expression syntax

Format: `cron(minute hour day-of-month month day-of-week year)`

Use Case	Cron Expression	Description	Use When
Daily Schedules	`cron(0 9 * * ? *)`	Every day at 9:00 AM UTC	Daily reports

Use Case	Cron Expression	Description	Use When
	`cron(0 */6 * * ? *)`	Every 6 hours (00:00, 06:00, 12:00, 18:00 UTC)	Frequent monitoring
	`cron(30 2 * * ? *)`	Every day at 2:30 AM UTC	Off-peak analysis
Business Hours	`cron(0 9-17 ? * MON-FRI *)`	Every hour from 9 AM to 5 PM, Monday to Friday UTC	Business monitoring
	`cron(0 18 ? * MON-FRI *)`	Weekdays at 6:00 PM UTC	End of business day
	`cron(0 8,12,17 ? * MON-FRI *)`	8 AM, noon, and 5 PM on weekdays UTC	Key business times
Weekly Schedules	`cron(0 12 ? * SUN *)`	Every Sunday at noon UTC	Weekly summaries
	`cron(0 9 ? * MON *)`	Every Monday at 9:00 AM UTC	Week start reports
	`cron(0 23 ? * FRI *)`	Every Friday at 11:00 PM UTC	Week end cleanup
Monthly Schedules	`cron(0 0 1 * ? *)`	First day of every month at midnight UTC	Monthly reports
	`cron(0 9 L * ? *)`	Last day of every month at 9:00 AM UTC	Month end processing

Use Case	Cron Expression	Description	Use When
	`cron(0 10 1 1,4,7,10 ? *)`	First day of each quarter at 10:00 AM UTC	Quarterly analysis
High Frequency	`cron(*/15 * * * ? *)`	Every 15 minutes	Real-time monitoring
	`cron(0,30 * * * ? *)`	Every 30 minutes (at :00 and :30)	Frequent checks
	`cron(0 */2 * * ? *)`	Every 2 hours	Regular intervals
Special Cases	`cron(30 8 1 1 ? *)`	January 1st at 8:30 AM UTC	Annual reports
	`cron(0 6 * * SAT,SUN *)`	Weekends at 6:00 AM UTC	Weekend processing
	`cron(0 0 ? * MON#1 *)`	First Monday of every month at midnight UTC	Monthly planning

Cron expression field reference

Field	Values	Wildcards	Examples
Minute (1st)	0-59	`* , - /`	`0` (top of hour), `*/15` (every 15 min), `0,30` (twice hourly)
Hour (2nd)	0-23	`* , - /`	9 (9 AM), `*/2` (every 2 hrs), `9-17` (business hours)
Day-of-month (3rd)	1-31, L, W	`* , - / ?`	1 (1st day), L (last day), ? (when using day-of-week)

Field	Values	Wildcards	Examples
Month (4th)	1-12 or JAN-DEC	* , - /	1 (January), JAN, 1,4,7,10 (quarterly)
Day-of-week (5th)	1-7 or SUN-SAT	* , - / ? # L	MON-FRI (weekdays), SUN, MON#1 (1st Monday)
Year (6th)	1970-2199	* , - /	* (every year), 2024 (specific year), 2024-2026 (range)

Wildcard characters and special expressions

*** (asterisk)**

Matches all values in the field. Example: * in the hour field means every hour.

? (question mark)

No specific value. Use in day-of-month or day-of-week when the other is specified. Example: Use ? in day-of-month when specifying MON-FRI in day-of-week.

- (dash)

Range of values. Example: MON-FRI (Monday through Friday), 9-17 (9 AM through 5 PM).

, (comma)

Multiple specific values. Example: MON,WED,FRI (Monday, Wednesday, Friday), 8,12,17 (8 AM, noon, 5 PM).

/ (slash)

Step values or increments. Example: 0/15 in minutes means every 15 minutes starting at minute 0 (0, 15, 30, 45). */2 in hours means every 2 hours.

L (last)

Last day of month or last occurrence of weekday. Example: L in day-of-month means last day of month. FRIL means last Friday of month.

W (weekday)

Nearest weekday. Example: 15W means nearest weekday to the 15th of the month.

 # (nth occurrence)

Nth occurrence of weekday in month. Example: `MON#1` means first Monday of month, `FRI#2` means second Friday of month.

Common patterns and best practices

- **For business applications:** Use `MON-FRI` and business hours (e.g., `9-17`) to avoid running queries during weekends or off-hours.
- **For high-frequency monitoring:** Use increments like `*/15` (every 15 minutes) but be mindful of query concurrency limits.
- **For resource efficiency:** Schedule resource-intensive queries during off-peak hours using early morning times like `2-6` UTC.
- **For monthly reports:** Use `L` for last day of month or specific dates like `1` for first day to ensure consistent timing.

Best practices

Follow these best practices to ensure reliable and efficient scheduled query operations:

Query optimization

- Test queries manually before scheduling to verify performance and results
- Use filter indexes early in your query to reduce data processing
- Limit time ranges to avoid timeouts with high-volume log groups
- Consider query complexity and execution time limits

Schedule planning

- Avoid overlapping executions by ensuring queries complete before the next scheduled run
- Consider log ingestion delays when setting time ranges
- Use cron expressions for specific times
- Spread out the schedules to ensure you do not hit query concurrency limit

Monitoring and maintenance

- Monitor execution history regularly to identify failures or performance issues
- Review and update IAM roles periodically to maintain security

- Test destination accessibility before deploying to production

Authorization

- All the APIs for scheduled query authorize on the scheduled query resource and not on the resources it takes in the input like log groups. Set up IAM policies accordingly
- Manage authorization of log groups using the execution role passed in the APIs

Getting started with scheduled queries

When you create a scheduled query, you'll configure several key components that define how your query runs and where results are delivered. Understanding these components will help you set up effective automated log analysis.

Each scheduled query consists of the following key components:

Query configuration

The CloudWatch Logs Insights query string, target log groups, and query language to use for analysis.

Schedule expression

A cron expression or frequency calendar that defines when the query runs. You can specify timezone settings to ensure queries run at the correct local time. The console displays a human-readable description of your schedule, such as "Run query on every Tuesday at 15:10 for a time range of 5 minutes, effective immediately, on UTC, until indefinitely."

Time range

The lookback period for each query execution, defined by a start time offset from the execution time. This determines how much historical data each query execution will analyze.

Execution schedule preview

The console shows the next three scheduled query runs with exact dates and times (for example, 2025/10/28 15:10, UTC; 2025/11/04 15:10, UTC; 2025/11/11 15:10, UTC), helping you verify that the schedule is configured correctly.

Destinations

Where query results are delivered after successful execution. Supported destinations include Amazon S3 buckets and by default result metadata is send to the default event bus.

Execution role

An IAM role that CloudWatch Logs assumes to execute the query and deliver results to the specified destinations.

Before creating scheduled queries, ensure you have the necessary permissions and resources configured.

Creating a scheduled query

Create a scheduled query that automatically runs CloudWatch Logs Insights queries and delivers results to your chosen destinations.

Prerequisites

Before creating a scheduled query, ensure you have the following:

- **Log groups** - One or more log groups containing the data you want to analyze
- **Execution IAM role** - An IAM role with the following permissions:
  - `logs:StartQuery` - Permission to start CloudWatch Logs Insights queries
  - `logs:GetQueryResults` - Permission to retrieve query results
  - `logs:DescribeLogGroups` - Permission to access log group information. This is only required for prefix based log groups for log group discovery
- **Destination permissions** - Additional IAM permissions for your chosen destination:
  - For Amazon S3 destinations: `s3:PutObject`
- **For AWS CLI and API usage** - Configured AWS credentials with permissions to call CloudWatch Logs APIs

For detailed IAM policy examples, see Identity and access management for Amazon CloudWatch Logs. Also to be noted you can have only 1000 scheduled queries per account.

Console

To create a scheduled query (console)

1. Open the CloudWatch Logs console at https://us-east-1.console.aws.amazon.com/cloudwatch/home?region=us-east-1#logsV2:logs-insights.

2. In the navigation pane, choose **Logs Insights**.
3. Choose **Create scheduled query**.
4. In the **Query definition** section:
   a. For **Query language**, choose the query language to use from the list.
   b. For **Query string**, enter your CloudWatch Logs Insights query in the box.
   c. For **Log groups**, select the log groups to query from the list.
5. In the **Schedule setup** section:
   a. For **Schedule expression**, configure when the query runs. Choose from predefined options or enter a custom cron expression.
   b. For **Effective upon creation**, specify when the schedule becomes active. Choose to start immediately or at a specific date and time using YYYY/MM/DD format.
   c. For **Time range**, specify the lookback period for each query execution. Enter the duration in minutes that defines how far back from the execution time to query.
   d. For **Continue indefinitely**, specify when the schedule ends. Choose to run indefinitely or until a specific date and time using YYYY/MM/DD format.
6. The console displays the next three scheduled query runs based on your configuration, showing the exact dates and times in UTC when the query will execute.
7. In the **Post query results to S3 - optional** section (if using S3 destination):
   a. For **S3 bucket**, select **This account** if the destination bucket is in the same AWS account, or select **Another account** if the bucket is in a different AWS account and provide the account ID of the bucket-owning account as input.
   b. For **Amazon S3 URI**, enter the Amazon S3 bucket and prefix where results will be stored (for example, `s3://my-bucket/query-results/`). If you selected **This account**, you can choose **Browse Amazon S3** to navigate and select an existing Amazon S3 location.
   c. (Optional) For **KMS key ARN**, enter the ARN of a customer managed AWS KMS key to encrypt the query results using SSE-KMS. The key must be in the same AWS Region as the destination Amazon S3 bucket.
8. In the **IAM role for posting query results to Amazon S3** section, choose one of the following options:

a. Choose **Auto-create a new role with default permissions** to automatically set up an IAM role with the permissions required for CloudWatch Logs to deliver query results to Amazon S3.

b. Choose **Use an existing role** to select an existing IAM role with the required policies for CloudWatch Logs to deliver query results to Amazon S3. Use the search field to find and select the appropriate IAM role from the list.

> **Note**
>
> If role manager is enabled in your account, CloudWatch attaches the role for you, and the role options described here (for example the **Create new role** button) are replaced by a **Customize** option. To use a different role, choose **Customize**. For more information about IAM role creation, see IAM role creation in the *IAM User Guide*.

9. In the **IAM role for scheduled query execution** section, choose one of the following options:

a. Choose **Auto-create a new role with default permissions** to automatically set up an IAM role with the permissions required for CloudWatch Logs to execute scheduled queries.

b. Choose **Use an existing role** to select an existing IAM role with the required policies for CloudWatch Logs to execute scheduled queries. Use the search field to find and select the appropriate IAM role from the list.

> **Note**
>
> If role manager is enabled in your account, CloudWatch attaches the role for you, and the role options described here (for example the **Create new role** button) are replaced by a **Customize** option. To use a different role, choose **Customize**. For more information about IAM role creation, see IAM role creation in the *IAM User Guide*.

10. Choose **Create schedule** to create the scheduled query.

AWS CLI

To create a scheduled query (AWS CLI)

- Use the `create-scheduled-query` command to create a new scheduled query:

```
aws logs create-scheduled-query \
    --name "ErrorAnalysisQuery" \
    --query-language "CWLI" \
    --query-string "fields @timestamp, @message | filter @message like /ERROR/ |
 stats count() by bin(5m)" \
    --schedule-expression "cron(8 * * * ? *)" \
    --execution-role-arn "arn:aws:iam::123456789012:role/
CloudWatchLogsScheduledQueryRole" \
    --log-group-identifiers "/aws/lambda/my-function" "/aws/apigateway/my-api" \
    --state "ENABLED"
```

API

To create a scheduled query (API)

- Use the `CreateScheduledQuery` action to create a new scheduled query. The following example creates a scheduled query that runs every hour:

```
{
    "name": "ErrorAnalysisQuery",
    "queryLanguage": "CWLI",
    "queryString": "fields @timestamp, @message | filter @message like /ERROR/ |
 stats count() by bin(5m)",
    "scheduleExpression": "cron(8 * * * ? *)",
    "executionRoleArn": "arn:aws:iam::123456789012:role/
CloudWatchLogsScheduledQueryRole",
    "logGroupIdentifiers": ["/aws/lambda/my-function", "/aws/apigateway/my-
api"],
    "state": "ENABLED"
}
```

After creating the scheduled query, you can view and manage it from the **Scheduled queries** page and using ListScheduledQueries API, which shows all your scheduled queries with their names, creation dates, status of last run, last triggered time, and repeat frequency.

Viewing and managing scheduled queries

The following information is available for each query:

Name

The unique name you assigned to the scheduled query. Select the name to view detailed configuration and execution history.

Creation date

The date when the scheduled query was created, displayed in YYYY-MM-DD format.

Status of last run

The execution status of the most recent query run. Possible values include:

- **Complete** - The query executed successfully and results were delivered to all configured destinations.
- **Failed** - The query execution or result delivery failed. Check the execution history for error details.
- **Invalid Query** - The query is invalid and has syntactical issues
- **Timeout** - The query has timed out. A query times out automatically after 60 mins

Last triggered time

The date and time when the query was last executed, displayed in YYYY-MM-DD HH:MM:SS format. Shows **Never** if the query has not yet run.

Repeating every

The schedule frequency for the query. Shows **Custom** for queries using cron expressions or specific frequency descriptions for simpler schedules.

The **Scheduled queries** page provides an overview of all your scheduled queries, showing their current status and execution history so that you can view, monitor, and manage all your scheduled queries from a centralized location. Use this information to monitor query performance, identify issues, and manage your automated log analysis workflows.

Console

To view scheduled queries (console)

1. Open the CloudWatch Logs console at https://us-east-1.console.aws.amazon.com/cloudwatch/home?region=us-east-1#logsV2:logs-insights.
2. In the CloudWatch Logs console, choose **Scheduled query**, **View scheduled queries**.

AWS CLI

To list scheduled queries (AWS CLI)

- Use the `list-scheduled-queries` command to list all scheduled queries:

```
aws logs list-scheduled-queries --max-results 10
```

API

To list scheduled queries (API)

- Use the `ListScheduledQueries` action to retrieve all scheduled queries:

```
{
    "maxResults": 10
}
```

The **Scheduled queries** page header shows the total number of scheduled queries in your account, helping you track your usage and manage your automated log analysis workflows effectively.

Viewing scheduled query execution history

Use the execution history to monitor the performance of your scheduled queries and troubleshoot any issues with query execution or result delivery.

The execution history shows the status of each query run, including successful executions, failures, and destination processing results. You can use this information to identify patterns, diagnose problems, and verify that your queries are running as expected.

Console

To view execution history (console)

1. In the CloudWatch Logs console, choose **Scheduled query**, **View scheduled queries**.
2. Select the scheduled query you want to examine.
3. Choose the **Execution history** tab.

AWS CLI

To view execution history (AWS CLI)

1. Use the `get-scheduled-query-history` command to retrieve execution history for a scheduled query:

```
aws logs get-scheduled-query-history \
    --identifier "DailyErrorMonitoring" \
    --start-time 1743379200 \
    --end-time 1743465600 \
    --max-results 10
```

2. To filter by execution status, add the `--execution-statuses` parameter:

```
aws logs get-scheduled-query-history \
    --identifier "DailyErrorMonitoring" \
    --start-time 1743379200 \
    --end-time 1743465600 \
    --max-results 1 \
    --execution-statuses "SUCCEEDED"
```

API

To view execution history (API)

- Use the `GetScheduledQueryHistory` action to retrieve execution history:

```
{
    "identifier": "DailyErrorMonitoring",
    "startTime": 1743379200,
    "endTime": 1743465600,
```

```
    "maxResults": 10,
    "executionStatuses": ["SUCCEEDED", "FAILED"]
}
```

The execution history displays:

- **Execution status** - Running, Complete, Failed, Timeout, or InvalidQuery
- **Triggered time** - When the query was executed
- **Destinations** - Processing status for each configured destination including S3, EventBridge, and lookup tables
- **Error messages** - Details about any failures in query execution or destination processing

Updating a scheduled query

Modify your scheduled query configuration to change the query string, schedule, destinations, or execution role as your requirements evolve.

You can update any aspect of a scheduled query, including the query string, schedule expression, destinations, and execution role. Changes take effect immediately for future executions.

Console

To update a scheduled query (console)

1. In the CloudWatch Logs console, choose **Scheduled query**, **View scheduled queries**.
2. Select the scheduled query you want to update.
3. Choose **Edit**.
4. Modify the configuration as needed.
5. Choose **Save changes**.

AWS CLI

To update a scheduled query (AWS CLI)

- Use the `update-scheduled-query` command to modify an existing scheduled query:

```
aws logs update-scheduled-query \
```

```
    --identifier "arn:aws:logs:us-east-1:111122223333:scheduled-
query:5e0c0228-1c29-4d26-904f-59f1f1ba3c8f" \
    --description "Monitor for ERROR level logs daily" \
    --query-language "LogsQL" \
    --query-string "fields @timestamp, @message | filter @message like /ERROR/"
 \
    --log-group-identifiers "/aws/lambda/my-function-1" "/aws/lambda/my-
function-2"
```

API

To update a scheduled query (API)

1. Use the `UpdateScheduledQuery` action to modify scheduled query configuration:

```
{
    "identifier": "arn:aws:logs:us-east-1:111122223333:scheduled-
query:5e0c0228-1c29-4d26-904f-59f1f1ba3c8f",
    "queryString": "fields @timestamp, @message | filter @message like /WARNING|
ERROR/ | stats count() by bin(5m)",
    "scheduleExpression": "cron(0 */2 * * ? *)",
    "state": "ENABLED"
}
```

2. To update multiple configuration parameters at once:

```
{
    "identifier": "arn:aws:logs:us-east-1:111122223333:scheduled-
query:5e0c0228-1c29-4d26-904f-59f1f1ba3c8f",
    "queryString": "fields @timestamp, @message, @level | filter @level =
 'ERROR'",
    "scheduleExpression": "cron(0 8,12,16 * * ? *)",
    "executionRoleArn": "arn:aws:iam::111122223333:role/
UpdatedScheduledQueryRole",
    "logGroupIdentifiers": ["/aws/lambda/my-function", "/aws/lambda/another-
function"],
    "destinationConfiguration": {
        "s3Configuration": {
            "destinationIdentifier": "s3://111122223333-sqn-results-bucket/
processed-results",
            "roleArn": "arn:aws:iam::111122223333:role/Admin"
        }
```

```
    }
}
```

Configuring S3 destinations for scheduled queries

Configure Amazon S3 as a destination to store your scheduled query results as JSON files for long-term retention and analysis.

When using Amazon S3 as a destination, query results are stored as JSON files in the specified bucket and prefix. This option is ideal for archiving results, performing batch analysis, or integrating with other AWS services that process S3 data.

You can deliver query results to an Amazon S3 bucket in the same AWS account as the scheduled query or to a bucket in a different AWS account. You can also optionally encrypt query results using a customer managed AWS KMS key (SSE-KMS).

Delivering results to an Amazon S3 bucket in the same account

When the destination Amazon S3 bucket is in the same AWS account as the scheduled query, you can browse and select the bucket directly from the console.

To configure a same-account Amazon S3 destination (console)

1. In the **Post query results to S3** section, for **S3 bucket**, select **This account**.
2. For **Amazon S3 URI**, enter the Amazon S3 bucket and prefix where results will be stored (for example, `s3://my-bucket/query-results/`), or choose **Browse Amazon S3** to navigate and select an existing Amazon S3 location.
3. (Optional) To encrypt results with a customer managed AWS KMS key, enter the ARN of the AWS KMS key in the **KMS key ARN** field. The key must be in the same AWS Region as the destination Amazon S3 bucket. If you don't specify a AWS KMS key, the bucket's default encryption settings apply.
4. In the **IAM role for posting query results to Amazon S3** section, choose **Auto-create a new role with default permissions** to automatically set up the required permissions, or choose **Use an existing role** to select an existing IAM role with the required policies.

The destination delivery IAM role requires the following permissions:

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": "s3:PutObject",
            "Resource": "arn:aws:s3:::my-bucket/prefix/*",
            "Condition": {
                "StringEquals": {
                    "aws:ResourceAccount": "111122223333"
                }
            }
        }
    ]
}
```

Delivering results to an Amazon S3 bucket in another account

You can deliver scheduled query results to an Amazon S3 bucket in a different AWS account. When using a cross-account bucket, you must provide the Amazon S3 URI and the account ID of the bucket-owning account.

To configure a cross-account Amazon S3 destination (console)

1. In the **Post query results to S3** section, for **S3 bucket**, select **Another account** and provide the account ID of the bucket-owning account as input.
2. For **Amazon S3 URI**, enter the full Amazon S3 URI of the destination bucket and prefix in the other account (for example, `s3://cross-account-bucket/query-results/`).
3. (Optional) To encrypt results with a customer managed AWS KMS key, enter the ARN of the AWS KMS key in the **KMS key ARN** field. The key must be in the same AWS Region as the destination Amazon S3 bucket.
4. In the **IAM role for posting query results to Amazon S3** section, choose **Auto-create a new role with default permissions** to automatically set up the required permissions, or choose **Use an existing role** to select an existing IAM role with the required policies.

Cross-account delivery requires permissions on both sides. The destination delivery IAM role in the source account requires the following permissions:

```
{
```

```
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": "s3:PutObject",
            "Resource": "arn:aws:s3:::cross-account-bucket/prefix/*",
            "Condition": {
                "StringEquals": {
                    "aws:ResourceAccount": "123456789012"
                }
            }
        }
    ]
}
```

The Amazon S3 bucket policy in the destination account must grant the source account's IAM role permission to write objects:

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Sid": "AllowScheduledQueryRolePutObject",
            "Effect": "Allow",
            "Principal": {
                "AWS": "arn:aws:iam::111122223333:role/my-s3-delivery-role"
            },
            "Action": "s3:PutObject",
            "Resource": "arn:aws:s3:::cross-account-bucket/prefix/*"
        }
    ]
}
```

Encrypting results with a customer managed AWS KMS key

You can optionally specify a customer managed AWS KMS key to encrypt query results delivered to Amazon S3 using SSE-KMS. The AWS KMS key can be in the same account as the scheduled query or in a different account.

When you specify a AWS KMS key, the scheduled query uses that key to encrypt results via SSE-KMS. When you don't specify a AWS KMS key, the bucket's default encryption settings apply. If

the bucket is configured with default SSE-KMS encryption using a customer managed key, the destination delivery IAM role must still have `kms:GenerateDataKey` permission on that key.

The destination delivery IAM role requires `kms:GenerateDataKey` permission on the AWS KMS key. The following example shows the required permissions for an Amazon S3 destination with a customer managed AWS KMS key:

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": "s3:PutObject",
            "Resource": "arn:aws:s3:::my-bucket/prefix/*",
            "Condition": {
                "StringEquals": {
                    "aws:ResourceAccount": "111122223333"
                }
            }
        },
        {
            "Effect": "Allow",
            "Action": "kms:GenerateDataKey",
            "Resource": "arn:aws:kms:us-east-1:111122223333:key/key-id",
            "Condition": {
                "StringEquals": {
                    "kms:ViaService": "s3.us-east-1.amazonaws.com"
                },
                "StringLike": {
                    "kms:EncryptionContext:aws:s3:arn": "arn:aws:s3:::my-bucket*"
                }
            }
        }
    ]
}
```

When the AWS KMS key is in a different account than the destination delivery IAM role, the AWS KMS key policy in the key-owning account must explicitly grant the role access:

```
{
    "Version": "2012-10-17",
    "Statement": [
```

```
        {
            "Sid": "AllowScheduledQueryRoleToEncrypt",
            "Effect": "Allow",
            "Principal": {
                "AWS": "arn:aws:iam::111122223333:role/my-s3-delivery-role"
            },
            "Action": "kms:GenerateDataKey",
            "Resource": "*",
            "Condition": {
                "StringEquals": {
                    "kms:ViaService": "s3.us-east-1.amazonaws.com"
                },
                "StringLike": {
                    "kms:EncryptionContext:aws:s3:arn": "arn:aws:s3:::my-bucket*"
                }
            }
        }
    ]
}
```

> **Note**
>
> When the AWS KMS key and the destination delivery IAM role are in the same account, the IAM identity policy alone is sufficient if the AWS KMS key policy includes the default "Enable IAM policies" root statement. An explicit AWS KMS key policy grant is only required if the key policy does not delegate to IAM.

The IAM role for posting query results to Amazon S3 must be configured separately from the IAM role for scheduled query execution. This separation allows for fine-grained access control, where the execution role can run queries while the Amazon S3 role specifically handles result delivery. Both roles must include a trust policy that allows the CloudWatch Logs service (`logs.amazonaws.com`) to assume the role.

Configuring lookup table destinations for scheduled queries

Configure a lookup table as a destination to automatically refresh a lookup table with your scheduled query results. On each scheduled execution, CloudWatch Logs populates the specified lookup table with the query results, keeping the table current with your latest log data. You can

then reference the table with the `lookup` command in other log queries. For more information about lookup tables, see lookup.

If the lookup table doesn't exist, CloudWatch Logs creates it on the first successful execution. Each subsequent execution is a full replacement operation—all existing table content is replaced with the new query results.

The lookup table configuration includes the following settings:

- **Table name** – The name of the lookup table to create or refresh. The name can contain only alphanumeric characters and underscores.
- **Delivery role** – The ARN of the IAM role that grants CloudWatch Logs permissions to create or update the lookup table with query results.
- **Description** – (Optional) A description of the lookup table.
- **AWS KMS key** – (Optional) The ARN of the AWS KMS key to use to encrypt the lookup table data. If you don't specify a key, the data is encrypted with an AWS-owned key.
- **Tags** – (Optional) Key-value pairs to associate with the lookup table. Tags are applied only when the table is initially created.

The destination delivery IAM role requires the following permissions, and must include a trust policy that allows the CloudWatch Logs service (`logs.amazonaws.com`) to assume the role:

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": [
                "logs:CreateLookupTable",
                "logs:UpdateLookupTable",
                "logs:GetQueryResults"
            ],
            "Resource": "*"
        }
    ]
}
```

> **Note**
>
> Lookup table destination results are subject to the same lookup table quotas as tables that you create directly, such as the maximum number of lookup tables per account per AWS Region. If a scheduled execution fails to refresh the table, the existing table content remains unchanged, and the failure appears in the scheduled query execution history.

Troubleshooting scheduled queries

Use these troubleshooting topics to resolve common issues with scheduled queries.

Query execution fails with permission errors

Resolve permission errors that prevent scheduled queries from executing or delivering results to destinations.

Permission errors occur when the execution role lacks the necessary permissions to read from log groups or write to destination resources.

To resolve permission errors

1. Verify that the execution role has `logs:StartQuery`, `logs:GetQueryResults`, and `logs:DescribeLogGroups` permissions for the target log groups.
2. Ensure the execution role has write permissions for the destination resources (such as `s3:PutObject` for S3 buckets).
3. Check that the trust policy allows CloudWatch Logs to assume the execution role. The role should trust the logs service principal (`logs.amazonaws.com`) in its trust policy.

Common causes include missing IAM permissions, incorrect resource ARNs in the policy, or trust policy configuration issues.

To prevent permission errors, use the principle of least privilege when creating execution roles and test permissions before deploying scheduled queries to production.

Query times out

Resolve timeout errors that occur when scheduled queries exceed the maximum execution time limit.

Query timeouts happen when the query takes more than 60 mins to process the specified data range, often due to large datasets or complex query logic.

To resolve timeout errors

1. Reduce the time range by decreasing the start time offset to process less data per execution.
2. Optimize the query by adding filters early in the query to reduce the amount of data processed. Use filter indexes to reduce the data scan size.
3. Consider breaking complex queries into simpler, more focused queries.

Common causes include querying large time ranges, processing high-volume log groups, or using complex aggregations without proper filtering.

To prevent timeouts, test queries manually in CloudWatch Logs Insights with your expected data volume and optimize performance before scheduling.

Destination processing fails

Resolve failures that occur when scheduled query results cannot be delivered to the configured destinations.

Destination processing failures happen when the target Amazon S3 bucket or EventBridge event bus is inaccessible or incorrectly configured.

To resolve failures where query results are not getting published to destination

1. Verify that the specified Amazon S3 bucket exists and is accessible.
2. Check the destination configuration for correct URIs.
3. Ensure the execution role has the necessary permissions to write to the destination.

Common causes include deleted or renamed destination resources, incorrect destination URIs, or network connectivity issues.

To prevent destination failures, regularly validate destination configurations and monitor destination resource availability.

Invalid query errors

Resolve syntax and logic errors in scheduled query strings that prevent successful execution.

Invalid query errors occur when the query string contains syntax errors, references non-existent fields, or uses unsupported query language features.

To resolve invalid query errors

1. Test your query manually in CloudWatch Logs Insights to verify syntax and logic.
2. Check that all referenced log fields exist in your target log groups.
3. Verify that the query language features you're using are supported for scheduled queries.

Common causes include typos in field names, incorrect query syntax, or using query features not supported in the scheduled execution environment.

To prevent invalid query errors, always test queries interactively before scheduling and use field discovery features to verify field names.

Query Concurrency Errors

There are some important points mentioned below to keep in mind when concurrency errors are seen as scheduled queries use the same quota as of Cloudwatch Logs insights queries. It is recommended to spread out your schedules to avoid hitting the concurrency limit.

- **Quota:** You can run up to 100 concurrent CloudWatch Logs Insights queries per AWS account.
- **Dashboards:** Queries added to CloudWatch dashboards also count towards this concurrency limit, as they are executed when the dashboard is loaded or refreshed.
- **OpenSearch Service PPL/SQL:** You can run up to 15 concurrent OpenSearch PPL or OpenSearch SQL queries per AWS account.
- **Cross-account queries:** The concurrency quota applies to both single and cross-account queries. When using CloudWatch cross-account observability, queries initiated in a monitoring account against a linked source account also count towards the monitoring account's concurrency limit.
- **Infrequent Access Log Groups:** For log groups in the infrequent access log class, the maximum number of concurrent Logs Insights queries is limited to five.

Log anomaly detection

You can detect anomalies in your log data in two ways: by creating a *log anomaly detector* for continuous monitoring, or by using the `anomaly detection` command in CloudWatch Logs Insights queries for on-demand analysis.

A log anomaly detector scans the log events ingested into a log group and finds anomalies in the log data automatically. Anomaly detection uses machine-learning and pattern recognition to establish baselines of typical log content. For on-demand analysis, you can use the `anomaly detection` command in CloudWatch Logs Insights queries to identify unusual patterns in time-series data. For more information about query-based anomaly detection, see Using anomaly detection in CloudWatch Logs Insights.

After you create an anomaly detector for a log group, it trains using the past two weeks of log events in the log group for training. The training period can take up to 15 minutes. After the training is complete, it begins to analyze incoming logs to identify anomalies, and the anomalies are displayed in the CloudWatch Logs console for you to examine.

CloudWatch Logs pattern recognition extracts log patterns by identifying static and dynamic content in your logs. Patterns are useful for analyzing large log sets because a large number of log events can often be compressed into a few patterns.

For example, see the following sample of three log events.

```
2023-01-01 19:00:01 [INFO] Calling DynamoDB to store for ResourceID: 12342342k124-12345
2023-01-01 19:00:02 [INFO] Calling DynamoDB to store for ResourceID: 324892398123-1234R
2023-01-01 19:00:03 [INFO] Calling DynamoDB to store for ResourceID: 3ff231242342-12345
```

In the previous sample, all three log events follow one pattern:

```
<Date-1> <Time-2> [INFO] Calling DynamoDB to store for resource id <ResourceID-3>
```

Fields within a pattern are called *tokens*. Fields that vary within a pattern, such as a request ID or timestamp, are referred to as *dynamic tokens*. Each different value found for a dynamic token is called a *token value*.

If CloudWatch Logs can infer the type of data that a dynamic token represents, it displays the token as <*string*-*number*>. The *string* is a description of the type of data that the token

represents. The *number* shows where in the pattern this token appears, compared to the other dynamic tokens.

CloudWatch Logs assigns the string part of the name based on analyzing the content of the log events that contain it.

If CloudWatch Logs can't infer the type of data that a dynamic token represents, it displays the token as <Token-*number*>, and *number* indicates where in the pattern this token appears, compared to the other dynamic tokens.

Common examples of dynamic tokens include error codes, IP addresses, timestamps, and request IDs.

Logs anomaly detection uses these patterns to find anomalies. After the anomaly detector model training period, logs are evaluated against known trends. The anomaly detector flags significant fluctuations as anomalies.

This chapter describes how to enable anomaly detection, view anomalies, create alarms for log anomaly detectors, and metrics that log anomaly detectors publish. It also describes how to encrypt anomaly detector and its results with AWS Key Management Service.

Creating log anomaly detectors doesn't incur charges.

Severity and priority of anomalies and patterns

Each anomaly found by a log anomaly detector is assigned a *priority*. Each pattern found is assigned a *severity*.

- *Priority* is automatically computed, and is based on both the severity level of the pattern and the amount of deviation from expected values. For example, if a certain token value suddenly increases by 500%, that anomaly might be designated as `HIGH` priority even if its severity is `NONE`.
- *Severity* is based only on keywords found in the patterns such as `FATAL`, `ERROR`, and `WARN`. If none of these keywords are found, the severity of a pattern is marked as `NONE`.

Anomaly visibility time

When you create an anomaly detector, you specify the maximum anomaly visibility period for it. This is the number of days that the anomaly is displayed in the console and is returned by the

ListAnomalies API operation. After this time period has elapsed for an anomaly, if it continues to happen, it's automatically accepted as regular behavior and the anomaly detector model stops flagging it as an anomaly.

If you don't adjust the visibility time when you create an anomaly detector, 21 days is used as the default.

Suppressing an anomaly

After an anomaly has been found, you can choose to suppress it temporarily or permanently. Suppressing an anomaly causes the anomaly detector to stop flagging this occurrence as an anomaly for the amount of time that you specify. When you suppress an anomaly, you can choose to suppress only that specific anomaly, or suppress all anomalies related to the pattern that the anomaly was found in.

You can still view suppressed anomalies in the console. You can also choose to stop suppressing them.

Frequently asked questions

Does AWS use my data to train machine-learning algorithms for AWS use or for other customers?

No. The anomaly detection model created by the training is based on the log events in a log group and is used only within that log group and that AWS account.

What types of log events work well with anomaly detection?

Log anomaly detection is well-suited for: Application logs and other types of logs where most log entries fit typical patterns. Log groups with events that contain a log level or severity keywords such as **INFO**, **ERROR**, and **DEBUG** are especially well-suited to log anomaly detection.

Log anomaly detection is not suited for: Log events with extremely long JSON structures, such as CloudTrail Logs. Pattern analysis analyzes only up to the first 1500 characters of a log line, so any characters beyond that limit are skipped.

Audit or access logs, such as VPC flow logs, will also have less success with anomaly detection. Anomaly detection is meant to find application issues, so it might not be well-suited for network or access anomalies.

To help you determine whether an anomaly detector is suited to a certain log group, use CloudWatch Logs pattern analysis to find the number of patterns in the log events in the group. If the number of patterns is no more than about 300, anomaly detection might work well. For more information about pattern analysis, see Pattern analysis.

What gets flagged as an anomaly?

The following occurrences can cause a log event to be flagged as an anomaly:

- A log event with a pattern not seen before in the log group.
- A significant variation to a known pattern.
- A new value for a dynamic token that has a discrete set of usual values.
- A large change in the number of occurrences of a value for a dynamic token.

While all the preceding items might be flagged as anomalies, they don't all mean that the application is performing poorly. For example, a higher-than-usual number of `200` success values might be flagged as an anomaly. In cases like this, you might consider suppressing these anomalies that don't indicate problems.

What happens with sensitive data that is being masked?

Any parts of log events that are masked as sensitive data are not scanned for anomalies. For more information about masking sensitive data, see Help protect sensitive log data with masking.

Using anomaly detection in CloudWatch Logs Insights

In addition to creating log anomaly detectors for continuous monitoring, you can also use the `anomaly` command in CloudWatch Logs Insights queries to identify unusual patterns in your log data on-demand. This command extends the existing `pattern` functionality and uses machine learning to detect five types of anomalies including pattern frequency changes, new patterns, and token variations.

The `anomaly` command is particularly useful for:

- Ad-hoc analysis of historical log data to identify unusual patterns
- Investigating specific time periods for anomalous behavior
- Monitoring applications like Lambda functions for execution issues

For more information about using the `anomaly` command in your queries, see anomaly.

This query-based anomaly detection complements the continuous anomaly detectors described in the following sections, giving you both real-time monitoring and on-demand analysis capabilities.

Enable anomaly detection on a log group

Use the following steps to use the CloudWatch console to create a log anomaly detector that scans a log group for anomalies.

You can also create anomaly detectors programmatically. For more information, see CreateLogAnomalyDetector.

To create a log anomaly detector

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. Choose **Logs**, **Log Anomalies**.
3. Choose **Create anomaly detector**.
4. Select the log group to create this anomaly detector for.
5. Enter a name for the detector in **Anomaly detector name**.
6. (Optional) Change the **Evaluation frequency** from the default of 5 minutes. Set this value according to the frequency that the log group receives new logs. For example, if the log group receives new log events in batches every 10 minutes, then setting the evaluation frequency to 15 minutes might be appropriate.
7. (Optional) To configure the anomaly detector to look for anomalies only in log events that contain certain words or strings, choose **Filter patterns**.

   Then, enter a pattern in **Anomaly detection filter pattern**. For more information about pattern syntax, Filter pattern syntax for metric filters, subscription filters, filter log events, and Live Tail.

   (Optional) To test your filter pattern, enter some log messages into **Log event messages** and then choose **Test Pattern**.
8. (Optional) To change the anomaly visibility period from the default or to associate an AWS KMS key with this anomaly detector, choose **Advanced configuration**.

   a. To change the anomaly visibility period from the default, enter a new value in **Maximum anomaly visibility period (days)**.

b. To associate an AWS KMS key with this anomaly detector, enter the ARN in **KMS key ARN**. If you assign a key, the anomaly information found by this detector is encrypted at rest with the key. Users must have permissions for this key and for the anomaly detector to retrieve information about the anomalies that it finds.

   You must also ensure that the CloudWatch Logs service principal has permission to use the key. For more information, see Encrypt an anomaly detector and its results with AWS KMS.

9. Choose **Enable Anomaly Detection**.

   The anomaly detector is created and starts training its model, based on the log events the log group is ingesting. After about 15 minutes, anomaly detection is active and begins to find and surface anomalies.

View anomalies that have been found

After you create one or more log anomaly detectors, you can use the CloudWatch console to view the anomalies that they have found.

You can view anomalies programmatically. For more information, see ListAnomalies.

To view the anomalies found by all of your log anomaly detectors

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. Choose **Logs**, **Log Anomalies**.

   The **Logs anomalies** table appears. The number at the top next to **Log anomalies** displays how many log anomalies are listed in the table. Each row in the table displays the following information:

   - The **Anomaly** column displays a short summary of the anomaly. These summaries are generated by CloudWatch Logs.
   - The **Priority** of the anomaly. Priority is automatically computed based on the amount of change in the log events, key words such as `Exception` occurring in a log event, and more.
   - The **Log pattern** that the anomaly is based on. For more information about patterns, see Log anomaly detection.
   - **Anomaly log trend** displays a histogram depicting the volume of logs matching the pattern.

- **Last detection time** displays the most recent time that this anomaly was found.
- **First detection time** displays the first time that this anomaly was found.
- **Anomaly detector** displays the name of the log group containing the log events related to this anomaly. You can choose this name to see the log group details page.

3. To further inspect one anomaly, choose the radio button in its row.

   The **Pattern inspect** pane appears and displays the following:

   - The **Pattern** that this anomaly is based on. Select a token within the pattern to analyze that token's values.
   - A histogram showing the number of occurrences of the anomaly over the queried time range.
   - The **Log samples** tab displays a few of the log events that are part of the anomaly.
   - The **Token Values** tab displays the values of the selected dynamic token, if you have selected one.

   > **Note**
   >
   > A maximum of 10 token values is captured for each token. Token counts might not be precise. CloudWatch Logs uses a probabilistic counter to generate the token count, not the absolute value.

4. To suppress an anomaly, choose the radio button in its row and then do the following:

   a. Choose **Actions**, **Suppress Anomaly**.

   b. Then specify how long you want the anomaly to be suppressed.

   c. To suppress all anomalies related to this pattern, select **Suppress Pattern**.

   d. Choose **Suppress anomaly**.

To view the anomalies found in a single log group

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. Choose **Logs**, **Log groups**.
3. Choose the name of a log group, and then choose the **Anomaly detection** tab.

The **Anomaly detection** table appears. The number at the top next to **Log anomalies** displays how many log anomalies are listed in the table. Each row in the table displays the following information:

- The **Anomaly** column displays a short summary of the anomaly. These summaries are generated by CloudWatch Logs.
- The **Priority** of the anomaly. Priority is automatically computed based on the amount of change in the log events, key words such as `Exception` occurring in a log event, and more.
- The **Log pattern** that the anomaly is based on. For more information about patterns, see Log anomaly detection.
- **Anomaly log trend** displays a histogram depicting the volume of logs matching the pattern.
- **Last detection time** displays the most recent time that this anomaly was found.
- **First detection time** displays the first time that this anomaly was found.

4. To further inspect one anomaly, choose the radio button in its row.

   The **Pattern inspect** pane appears and displays the following:

   - The **Pattern** that this anomaly is based on. Select a token within the pattern to analyze that token's values.
   - A histogram showing the number of occurrences of the anomaly over the queried time range.
   - The **Log samples** tab displays a few of the log events that are part of the anomaly.
   - The **Token Values** tab displays the values of the selected dynamic token, if you have selected one.

   > **Note**
   >
   > A maximum of 10 token values is captured for each token. Token counts might not be precise. CloudWatch Logs uses a probabilistic counter to generate the token count, not the absolute value.

5. To suppress an anomaly, choose the radio button in its row and then do the following:

   a. Choose **Actions**, **Suppress Anomaly**.

   b. Then specify how long you want the anomaly to be suppressed.

c. To suppress all anomalies related to this pattern, select **Suppress Pattern**.

d. Choose **Suppress anomaly**.

Create alarms on log anomaly detectors

You can create an alarm for a log anomaly detector in a log group. You can specify for the alarm to go into ALARM state when a specified number of anomalies are found in the log group during a specified period of time. You can also use filters so that only anomalies of specified priorities are counted by the alarm.

To create an alarm for a log anomaly detector

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Logs**, **Log Anomalies**.

   The table of log anomaly detectors appears.
3. Choose the radio button for the anomaly detector that you want to set the alarm for, and choose **Create alarm**.

   The CloudWatch alarm creation wizard appears. The **LogAnomalyDetector** field displays the name of the anomaly detector that you chose. The **Metric name** field displays **AnomalyCount**.
4. (Optional) To filter this alarm for anomaly priority, do one of the following:
   - To have the alarm count only high-priority anomalies, enter **`HIGH`** for **LogAnomalyPriority**.
   - To have the alarm count only high- and medium-priority anomalies, enter **`MEDIUM`** for **LogAnomalyPriority**.

   For more information about priority levels, see Severity and priority of anomalies and patterns.
5. Choose to use a static or metric anomaly detection threshold for the alarm. This selection determines how the alarm threshold is set. A **Static** threshold means that the alarm threshold is a static, constant number that you choose. An **Anomaly detection** threshold means that CloudWatch determines a range of usual values, and the alarm triggers if the actual count crosses the threshold of this band. You don't have to choose **Anomaly detection** for a log anomaly detection alarm. For more information about metric anomaly detection, see Using CloudWatch anomaly detection.

6. For **Whenever *your-metric-name* is . . .**, choose **Greater**, **Greater/Equal**, **Lower/Equal**, or **Lower**. Then for **than . . .**, specify a number for your threshold value. The alarm goes into ALARM state if the anomaly detector finds more than this number of alarms during a time specified by **Period**.
7. Choose **Additional configuration**. For **Datapoints to alarm**, specify how many evaluation periods (data points) must be in the ALARM state to trigger the alarm. If the two values here match, you create an alarm that goes to ALARM state if that many consecutive periods are breaching.

   To create an M out of N alarm, specify a number for the first value that is lower than the number for the second value. For more information, see Evaluating an alarm.
8. For **Missing data treatment**, choose how the alarm behaves when some data points are missing. For more information, see Configuring how CloudWatch alarms treat missing data.
9. Choose **Next**.
10. For **Notification**, choose **Add notification**, and then specify an Amazon SNS topic to notify when your alarm transitions to the ALARM, OK, or INSUFFICIENT_DATA state.

    a. (Optional) To send multiple notifications for the same alarm state or for different alarm states, choose **Add notification**.

    > **Note**
    >
    > We recommend that you set the alarm to take actions when it goes into **Insufficient data** state in addition to when it goes into **Alarm** state. This is because many issues with the Lambda function that connects to the data source can cause the alarm to transition to **Insufficient data**.

    b. (Optional) To not send Amazon SNS notifications, choose **Remove**.
11. (Optional) If you want your alarm to perform actions for Amazon EC2 Auto Scaling, Amazon EC2, tickets, or AWS Systems Manager, choose the appropriate button, and specify the alarm state and action.

> **Note**
>
> Your alarm can perform Systems Manager actions only when it's in the ALARM state. For information about Systems Manager actions, see Configuring CloudWatch to create OpsItems and Incident creation.

12. Choose **Next**.
13. Under **Name and description**, enter a name and description for your alarm, and choose **Next**. The name must contain only UTF-8 characters, and can't contain ASCII control characters. The description can include markdown formatting, which is displayed only in the alarm **Details** tab in the CloudWatch console. The markdown can be useful to add links to runbooks or other internal resources.

> **Tip**
>
> The alarm name must contain only UTF-8 characters. It can't contain ASCII control characters.

14. Under **Preview and create**, confirm that your alarm's information and conditions are correct, and choose **Create alarm**.

Metrics published by log anomaly detectors

CloudWatch Logs publishes the **AnomalyCount** metric to CloudWatch metrics. This metric is published to the AWS/Logs namespace.

The **AnomalyCount** metric is published with the following dimensions:

- **LogAnomalyDetector**– The name of the anomaly detector
- **LogAnomalyPriority**– The priority level of the anomaly

Encrypt an anomaly detector and its results with AWS KMS

Anomaly detector data is always encrypted in CloudWatch Logs. By default, CloudWatch Logs uses server-side encryption for the data at rest. As an alternative, you can use AWS Key Management Service for this encryption. If you do, the encryption is done using an AWS KMS key. Encryption

using AWS KMS is enabled at the anomaly detector level, by associating a KMS key with an anomaly detector.

> **Important**
>
> CloudWatch Logs supports only symmetric KMS keys. Do not use an asymmetric key to encrypt the data in your log groups. For more information, see Using Symmetric and Asymmetric Keys.

Limits

- To perform the following steps, you must have the following permissions: `kms:CreateKey`, `kms:GetKeyPolicy`, and `kms:PutKeyPolicy`.
- After you associate or disassociate a key from an anomaly detector, it can take up to five minutes for the operation to take effect.
- If you revoke CloudWatch Logs access to an associated key or delete an associated KMS key, your encrypted data in CloudWatch Logs can no longer be retrieved.

Step 1: Create an AWS KMS key

To create an KMS key, use the following create-key command:

```
aws kms create-key
```

The output contains the key ID and Amazon Resource Name (ARN) of the key. The following is example output:

```
{
    "KeyMetadata": {
        "Origin": "AWS_KMS",
        "KeyId": "key-default-1",
        "Description": "",
        "KeyManager": "CUSTOMER",
        "Enabled": true,
        "CustomerMasterKeySpec": "SYMMETRIC_DEFAULT",
        "KeyUsage": "ENCRYPT_DECRYPT",
        "KeyState": "Enabled",
        "CreationDate": 1478910250.94,
```

```
        "Arn": "arn:aws:kms:us-west-2:123456789012:key/key-default-1",
        "AWSAccountId": "123456789012",
        "EncryptionAlgorithms": [
            "SYMMETRIC_DEFAULT"
        ]
    }
}
```

Step 2: Set permissions on the KMS key

By default, all AWS KMS keys are private. Only the resource owner can use it to encrypt and decrypt data. However, the resource owner can grant permissions to access the KMS key to other users and resources. With this step, you give the CloudWatch Logs service principal permission to use the key. This service principal must be in the same AWS Region where the KMS key is stored.

As a best practice, we recommend that you restrict the use of the KMS key to only those AWS accounts or anomaly detectors that you specify.

First, save the default policy for your KMS key as `policy.json` using the following get-key-policy command:

```
aws kms get-key-policy --key-id key-id --policy-name default --output text > ./
policy.json
```

Open the `policy.json` file in a text editor and add the section in bold from one of the following statements. Separate the existing statement from the new statement with a comma. These statements use `Condition` sections to enhance the security of the AWS KMS key. For more information, see AWS KMS keys and encryption context.

The `Condition` section in this example limits the use of the AWS KMS key to the specified account, but it can be used for any anomaly detector.

JSON

```
{
"Version":"2012-10-17",
"Id": "key-default-1",
"Statement": [
    {
        "Sid": "EnableIAMUserPermissions",
```

```
            "Effect": "Allow",
            "Principal": {
                "AWS": "arn:aws:iam::111122223333:root"
            },
            "Action": "kms:*",
            "Resource": "*"
        },
        {
            "Sid": "AllowCloudWatchLogsEncryption",
            "Effect": "Allow",
            "Principal": {
                "Service": "logs.us-east-1.amazonaws.com"
            },
            "Action": [
                "kms:Encrypt",
                "kms:Decrypt",
                "kms:GenerateDataKey*"
            ],
            "Resource": "*",
            "Condition": {
                "StringEquals": {
                    "aws:SourceAccount": "123456789012"
                },
                "StringLike": {
                    "kms:EncryptionContext:aws:logs:arn": "arn:aws:logs:us-
east-1:123456789012:anomaly-detector:*"
                },
                "ArnLike": {
                    "aws:SourceArn": "arn:aws:logs:us-
east-1:123456789012:anomaly-detector:*"
                }
            }
        },
        {
            "Sid": "AllowCloudWatchLogsDescribeKey",
            "Effect": "Allow",
            "Principal": {
                "Service": "logs.us-east-1.amazonaws.com"
            },
            "Action": "kms:DescribeKey",
            "Resource": "*",
            "Condition": {
                "StringEquals": {
                    "aws:SourceAccount": "123456789012"
```

```
                }
            }
        },
        {
            "Sid": "AllowCloudWatchLogsReEncryption",
            "Effect": "Allow",
            "Principal": {
                "Service": "logs.us-east-1.amazonaws.com"
            },
            "Action": [
                "kms:Encrypt",
                "kms:Decrypt",
                "kms:ReEncrypt*",
                "kms:GenerateDataKey*"
            ],
            "Resource": "*",
            "Condition": {
                "StringEquals": {
                    "aws:SourceAccount": "123456789012"
                },
                "StringLike": {
                    "kms:EncryptionContext:aws-crypto-ec:aws:logs:arn":
 "arn:aws:logs:us-east-1:123456789012:anomaly-detector:*"
                },
                "ArnLike": {
                    "aws:SourceArn": "arn:aws:logs:us-
east-1:123456789012:anomaly-detector:*"
                }
            }
        },
        {
            "Sid": "AllowCloudWatchLogsDescribeKeyForReEncryption",
            "Effect": "Allow",
            "Principal": {
                "Service": "logs.us-east-1.amazonaws.com"
            },
            "Action": "kms:DescribeKey",
            "Resource": "*",
            "Condition": {
                "StringEquals": {
                    "aws:SourceAccount": "123456789012"
                }
            }
        }
```

```
    ]
}
```

Finally, add the updated policy using the following put-key-policy command:

```
aws kms put-key-policy --key-id key-id --policy-name default --policy file://
policy.json
```

Step 3: Associate a KMS key with an anomaly detector

You can associate a KMS key with an anomaly detector when you create it in the console or using the AWS CLI or APIs.

Step 4: Disassociate key from an anomaly detector

After a key has been associated with an anomaly detector, you can't update the key. The only way to remove the key is to delete the anomaly detector, and then re-create it.

Troubleshoot with CloudWatch Logs Live Tail

CloudWatch Logs Live Tail helps you quickly troubleshoot incidents by viewing a streaming list of new log events as they are ingested. You can view, filter, and highlight ingested logs in near real time, helping you to detect and resolve issues quickly. You can filter the logs based on terms you specify, and also highlight logs that contain specified terms to help you quickly find what you are looking for.

Live Tail sessions incur costs by session usage time, per minute. For more information about pricing, see the **Logs** tab at Amazon CloudWatch Pricing.

Live Tail is supported only for log groups in the Standard log class. For more information about log classes, see Log classes.

The following sections explain how to use Live Tail in the console and in the AWS CLI. You can also start a Live Tail session programatically. For more information, see StartLiveTail. For SDK examples, see Start a Live Tail session using an AWS SDK.

You can also use Live Tail in the AWS Toolkit for Visual Studio Code. To start a Live Tail session from the VS Code Command Palette, see the Amazon CloudWatch Logs Live Tail section of the AWS Toolkit for Visual Studio Code User Guide.

The Live Tail feature is available in all commercial AWS Regions. It is not available in the China Regions or the AWS GovCloud (US) Regions.

> **Note**
>
> The `StartLiveTail` API routes requests using SDK host prefix injection. SDK versions released before April 1, 2026 route to `streaming-logs.`*`Region`*`.amazonaws.com`, which does not support VPC endpoints. SDK versions released on or after April 1, 2026 route to `stream-logs.`*`Region`*`.amazonaws.com`, which supports VPC endpoints. To set up a VPC endpoint for this API, see Creating a VPC endpoint for CloudWatch Logs .

Start a Live Tail session using the AWS CLI

The `start-live-tail` AWS CLI command starts a Live Tail streaming session for one or more log groups in a terminal. A Live Tail session can last for up to three hours. If more than 500 log

events per second match the filter, the log events that are displayed are a sample of the total log events, to provide a real-time tailing experience. For more information about the `start-live-tail` command, see start-live-tail

You can use the `start-live-tail` in two modes:

- **print-only**– this is the default mode
- **interactive**

print-only

In `print-only` mode, log events are streamed on the terminal. New events are added at the bottom every second, creating a near real-time tailing experience similar to `tail -f` on Linux.

To start a Live Tail session in print-only mode, enter the following command.

```
aws logs start-live-tail --log-group-identifiers arn:aws:logs:us-
east-1:111111222222:log-group:my-logs
```

When you use print-only mode, you can also pipe it with other Linux commands to increase its analytical capabilities. The following example filters log events with the `error` keyword and prints the second and fourth column of these events to help you extract particular information.

```
aws logs start-live-tail --log-group-identifiers arn:aws:logs:us-
east-1:111111222222:log-group:my-logs --mode print-only | grep "error" | awk '{print
 $2, $4}'
```

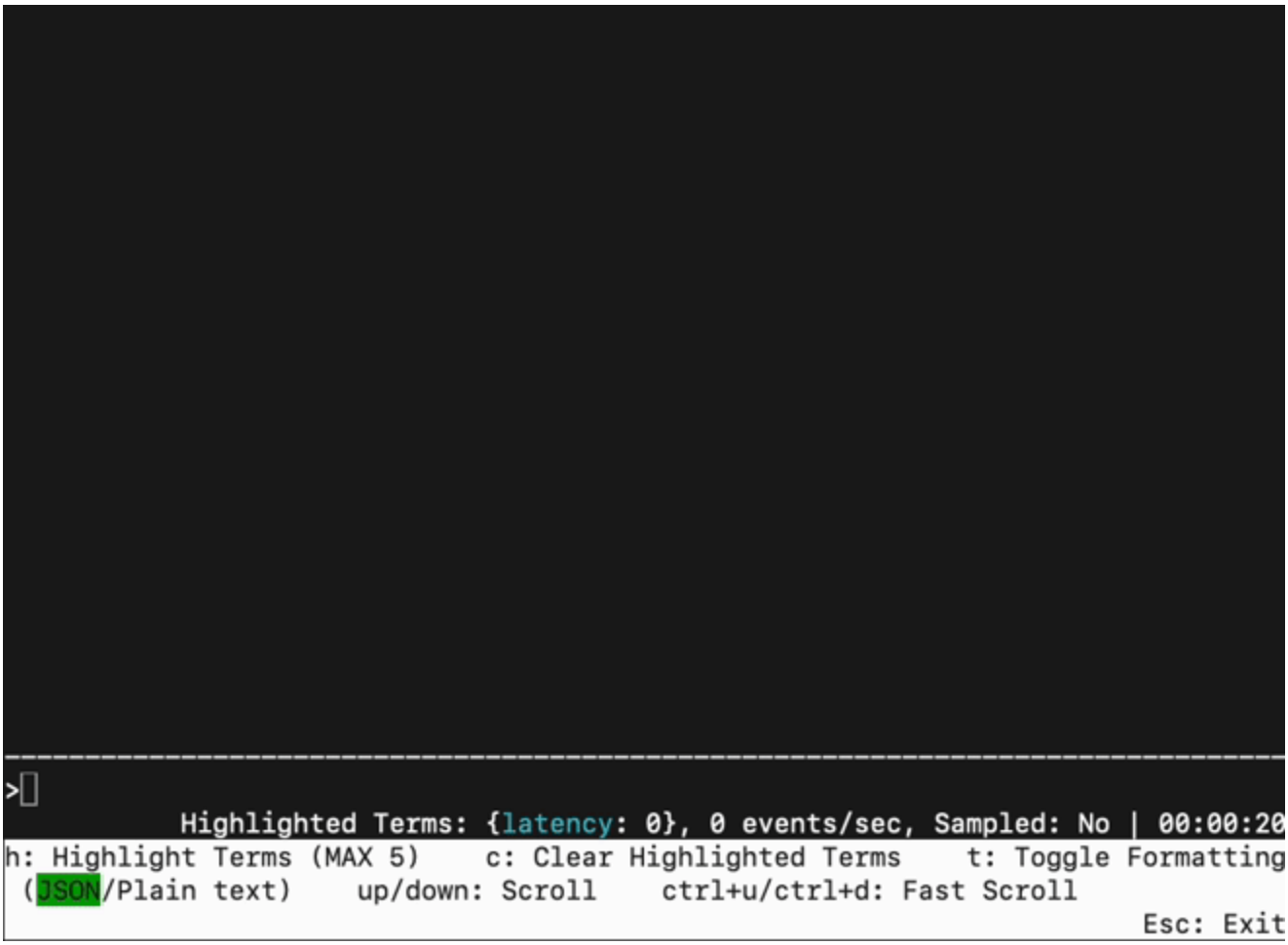
interactive

In `interactive` mode, you can highlight terms and toggle the format of the output log events between JSON and plain text. Interactive mode also displays information about the Live Tail session such as session duration, whether the session is being sampled, and the current highlighted terms and the count of the times they have been encountered.

To start a Live Tail session in interactive mode, enter the following command.

```
aws logs start-live-tail --log-group-identifiers arn:aws:logs:us-
east-1:111111222222:log-group:my-logs --mode interactive
```

The Live Tail session begins. The following video shows part of an example session.



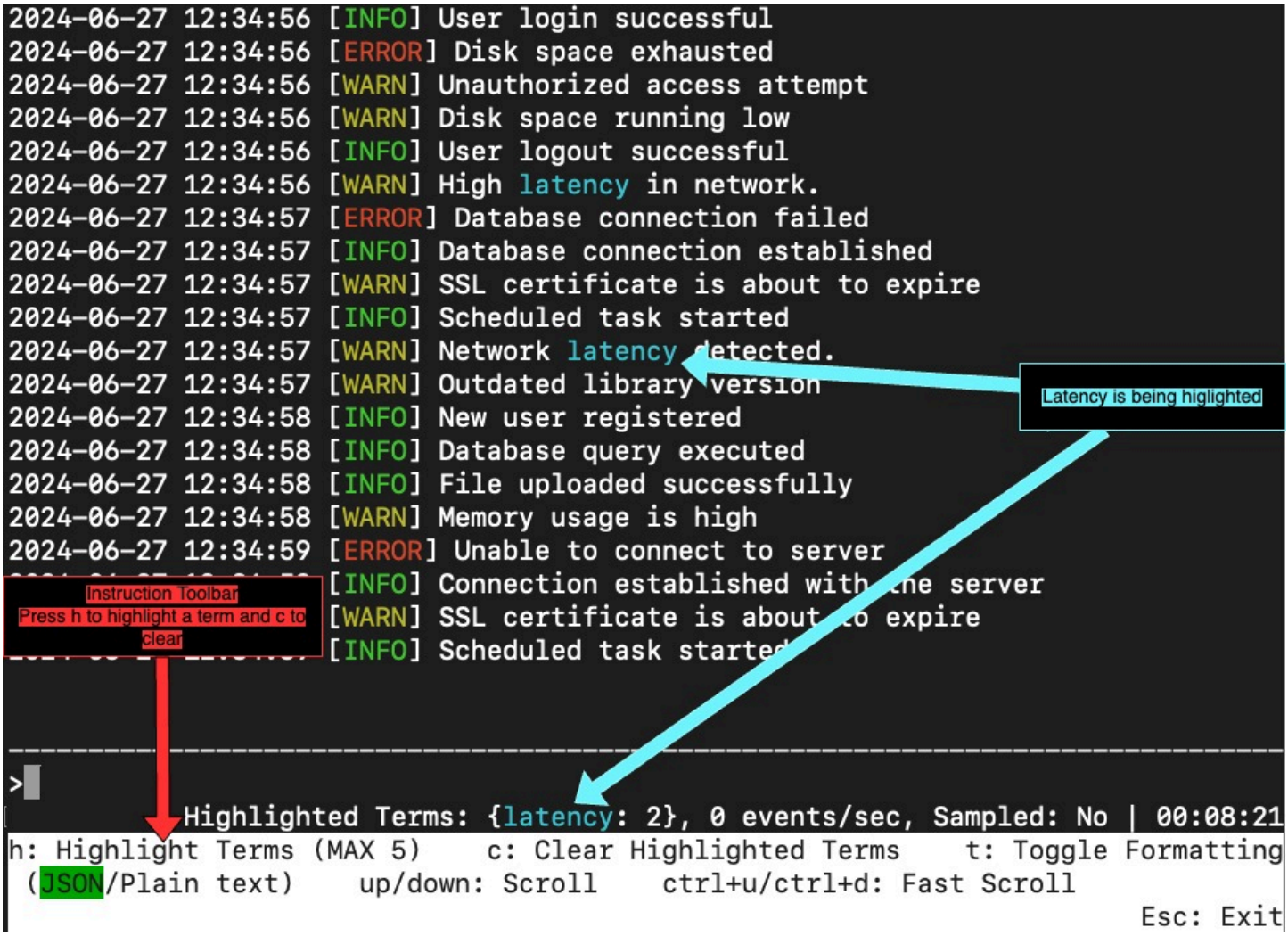
To highlight a term in the streaming logs, press **h** and then enter the term. The following shows the screen after the term `latency` has been highlighted.

To clear a highlighted term, press **c** and then type the number that represents the term that you want to stop highlighting.

You can press **t** to toggle the display format of incoming events between JSON and plain text. This toggle functionality is best-effort and happens only if the log event format is compatible.

You can use the up arrow and down arrow keys to scroll, and use `CTRL+u` and `CTRL+d` to scroll faster.

The following image displays the highlighting of the `latency` term during a Live Tail session.



Start a Live Tail session in the console

You use the CloudWatch console to start a Live Tail session. The following procedure explains how to start a Live Tail session by using the **Live tail** option in the left navigation pane. You can also start Live Tail sessions from the Log Groups page or the CloudWatch Logs Insights page.

If you are using data protection policies to mask sensitive data in a log group that you are viewing with Live Tail, the sensitive data always appears masked in the Live Tail session. For more information about masking sensitive data in log groups, see Help protect sensitive log data with masking.

Important

If your network security team doesn't allow the use of web sockets, you can't currently access the Live Tail portion of the CloudWatch console. You can use Live Tail with the AWS CLI or APIs. For more information, see Start a Live Tail session using the AWS CLI and StartLiveTail.

To start a Live Tail session

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Logs**, **Live tail**.
3. For **Select log groups**, select the log groups that you want to view events from, in the Live Tail session. You can select as many as 10 log groups.
4. (Optional) If you selected only one log group, you can filter your Live Tail session further by selecting one or more log streams to view log events from. To do so, under **Select log streams**, select the names of the log streams from the drop down list. Alternatively, you can use the second box under **Select log streams** to enter a log stream name prefix, and then all log streams with names that match the prefix will be selected.
5. (Optional) To display only log events that contain certain words or other strings, enter the word or string in `Add filter patterns`.

   For example, to display only log events that include the word `Warning`, enter **`Warning`**. The filters field is case-sensitive. You can include multiple terms and pattern operators in this field:

   - **`error 404`** displays only log events that include both `error` and `404`
   - **`?Error ?error`** displays log events that include either `Error` or `error`
   - **`-INFO`** displays all log events that don't include `INFO`
   - **`{ $.eventType = "UpdateTrail" }`** displays all JSON log events where the value of the event type field is `UpdateTrail`

   You can also use regular expression (regex) to filter:

   - **`%ERROR%`** uses regex to display all log events consisting of the **ERROR** keyword
   - **`{ $.names = %Steve% }`** uses regex to display JSON log events where **Steve** is in the property `"name"`

- **`[ w1 = %abc%, w2 ]`** uses regex to display space-delimited log events where the first word is **abc**

For more information about pattern syntax, see Filter pattern syntax.

6. (0ptional) To highlight some of the displayed log events, enter a term to search for and highlight under **Live Tail**. Enter highlight terms one at a time. If you add multiple terms to highlight, a different color is assigned to represent each term. A highlight indicator is displayed to the left of any log event that contains the specified term, and also appears under the term itself when you expand the log event in the main window to view the full log event.

   You can use filtering along with highlighting to quickly troubleshoot issues. For example, you might filter the events to display only the events that contain `Error`, and then also highlight the events that contain `404`.

7. To start the session, choose **Apply filters**

   Matching log events begin appearing in the window. The following information is also displayed:

   - The timer displays how long the Live Tail session has been active.
   - **events/sec** displays how many ingested log events per second match the filters that you have set.
   - To keep the session from scrolling too fast because many events match the filters, CloudWatch Logs might display only some matching events. If this happens, the percentage of matching events that are displayed on screen is shown in **% displayed**.

8. To pause the flow of events to investigate what is currently displayed, choose anywhere in the events window.

9. During the session, you can use the following to see more details about each log event.

   - To display the entire text for a log event in the main window, choose the arrow next to that log event.
   - To display the entire text for a log event in a side window, choose the **+** magnifying glass next to that log event. The event flow pauses and the side window appears.

     Displaying a log event text in the side window can be useful to compare its text to other events in the main window.

10. To stop the Live Tail session, choose **Stop**.

11. To restart the session, optionally use the **Filter** panel to modify the filtering criteria, and choose **Apply filters**. Then choose **Start**.

Cross-account cross-Region log centralization

Amazon CloudWatch Logs data centralization works with AWS Organizations to collect log data from multiple member accounts into one data repository using cross-account and cross-region centralization rules. You define the rules that automatically replicate log data from multiple accounts and AWS Regions into a centralized account within your organization. This capability streamlines log consolidation for improved centralized monitoring, analysis, and compliance across your entire AWS infrastructure.

CloudWatch Logs data centralization offers configuration flexibility to meet operational and security requirements, such as the ability to configure a backup region during rule setup within the destination account to ensure increased resiliency. Additionally, you have full control over encryption behavior for log groups copied from source accounts to handle data originally encrypted with customer managed KMS keys.

> **Note**
>
> The CloudWatch Logs centralization feature only processes new log data that arrives in source accounts after you create the centralization rule. Historical log data (logs that existed before rule creation) is not centralized.

Data centralization concepts

Before you begin using CloudWatch Logs data centralization, familiarize yourself with the following concepts:

Centralization rule

A configuration that defines how log data from source accounts and regions is replicated to a destination account and region. Rules specify source criteria and destination settings.

Source account

The AWS account where log data originates. Log events from source accounts are replicated to the destination account based on the centralization rules you define.

Destination account

The destination AWS account where replicated log data is stored. This account serves as the centralized location for log analysis and monitoring.

Backup region

An optional secondary region within the destination account where log data can be replicated for increased resiliency and disaster recovery purposes.

Tag propagation

An opt-in capability that propagates resource tags from source log groups to their corresponding destination log groups. Tag propagation uses a customer-managed IAM role in the destination account to add, update, and remove tags on destination log groups. You configure tag propagation by adding a `TagPropagationConfiguration` block to your centralization rule's destination configuration.

Encryption in CloudWatch Logs

Log group data is always encrypted in CloudWatch Logs. By default, CloudWatch Logs uses server-side encryption with 256-bit Advanced Encryption Standard Galois/Counter Mode (AES-GCM) to encrypt log data at rest. As an alternative, you can use AWS Key Management Service for this encryption. For more information, see CloudWatch Logs Encryption documentation.

- **How encryption works during centralization**: CloudWatch Logs centralization actively copies log data at ingestion time from source accounts to destination accounts. During this process, your data remains encrypted in transit using an AWS owned service key. Data at rest in both source and destination log groups is encrypted using your chosen encryption method (customer managed or AWS owned KMS keys). If you are using customer managed KMS key in your destination log groups, add the tag `LogsManaged = true` to the kms key for Centralization service to access it.
- **When KMS permissions are required**:
  - If you are using customer managed KMS keys in your source accounts, CloudWatch Logs requires KMS permissions in the following example scenarios:
    - **Throughput Management**: When centralization throughput limits are reached, log data is temporarily stored encrypted with your customer managed KMS key until bandwidth becomes available.
    - **Data Protection and Redaction**: When source log groups have data protection policies enabled, CloudWatch Logs requires decrypt permissions to access raw log data to centralize it.

> **Important**
>
> Centralization rules are managed by the AWS Organizations management account or delegated administrator. To exclude customer managed KMS-encrypted log groups from centralization, configure the rule settings to "Do not centralize log groups encrypted with AWS KMS key."

Setting up log centralization

To set up CloudWatch Logs Centralization, you need to configure centralization rules that define how log data flows from log groups in source accounts to log groups in your destination account.

Once the centralization rule is enabled and log events are being replicated to the destination account, you can create metric, subscription, and account filters on centralized log groups with enhanced filtering capabilities. These filters can target log events from specific source accounts and regions, and can emit source account and region information as metric dimensions. For more information, see Creating metrics from log events using filters.

Prerequisites

- AWS Organizations must be set up and the source and destination accounts must both belong to the organization.
- Trusted access must be enabled for CloudWatch, the management account and the destination account so provide access to the log data.

> **Note**
>
> It is recommended to enable trusted access through the console, which automatically creates the required service-linked role (SLR). If trusted access is enabled through other methods, the service-linked role will need to be created separately.

Tag propagation prerequisites

To enable tag propagation, you must complete the following additional setup:

Create a customer-managed IAM role

You must create a customer-managed IAM role in the destination account with the following configuration:

Trust policy

The role's trust policy must allow the centralization service-linked role to assume it. The following example trust policy grants the `AWSServiceRoleForObservabilityAdmin_LogsCentralization` service-linked role permission to assume the destination role. Replace `<destination-account-id>` with your destination account ID and `<organization-id>` with your AWS Organizations ID.

```
{
  "Version": "2012-10-17",
  "Statement": [{
    "Effect": "Allow",
    "Principal": {
      "AWS": "arn:aws:iam::<destination-account-id>:role/aws-
service-role/logs-centralization.observabilityadmin.amazonaws.com/
AWSServiceRoleForObservabilityAdmin_LogsCentralization"
    },
    "Action": "sts:AssumeRole",
    "Condition": {
      "StringEquals": {
        "sts:ExternalId": "<organization-id>"
      }
    }
  }]
}
```

Permissions policy

The role's permissions policy must grant tag operations on the destination log groups. The following example grants the minimum required permissions. Replace `<destination-account-id>` with your value. You can scope the `Resource` further to specific log group ARN patterns.

```
{
  "Version": "2012-10-17",
  "Statement": [{
    "Effect": "Allow",
    "Action": [
```

```
      "logs:ListTagsForResource",
      "logs:TagResource",
      "logs:UntagResource"
    ],
    "Resource": "arn:aws:logs:*:<destination-account-id>:log-group:*"
  }]
}
```

Grant iam:PassRole permission

You must have `iam:PassRole` permission on the destination role, scoped to the centralization service via the `iam:PassedToService` condition key. The following example grants permission to pass the role. Replace `<destination-account-id>` and `<your-tag-role-name>` with your values.

> **Note**
>
> This statement goes on your identity policy (the principal calling `CreateCentralizationRuleForOrganization` or `UpdateCentralizationRuleForOrganization`), not on the destination role itself.

```
{
  "Version": "2012-10-17",
  "Statement": [{
    "Effect": "Allow",
    "Action": "iam:PassRole",
    "Resource": "arn:aws:iam::<destination-account-id>:role/<your-tag-role-name>",
    "Condition": {
      "StringEquals": {
        "iam:PassedToService": "logs-centralization.observabilityadmin.amazonaws.com"
      }
    }
  }]
}
```

Customizing destination log group names

When you create a centralization rule, you can customize how destination log group names are structured using attributes. These attributes are automatically replaced with actual values when

log groups are created, allowing you to organize logs hierarchically in your destination account. By default, only the `${source.logGroup}` attribute is used, which merges all log groups with the same name in the destination account. If a variable cannot be resolved, it inherits the value from its parent variable in the hierarchy.

Available attributes

You can use the following attributes in your destination log group name pattern:

Destination log group name attributes

Attribute	Description
`${source.accountId}`	The AWS account ID where the log originated.
`${source.region}`	The AWS Region where the log originated.
`${source.logGroup}`	The original log group name from the source account.
`${source.org.id}`	Your AWS Organizations ID of the source account.
`${source.org.ouId}`	The organizational unit ID of the source account
`${source.org.rootId}`	The organization root ID
`${source.org.path}`	The full organizational path from account to root

Examples

Preserve original log group structure

Pattern: `/centralized/${source.accountId}${source.logGroup}`

Result: `/centralized/123456789012/aws/lambda/my-function`

Organize by account and region

Pattern: `/centralized/${source.accountId}/${source.region}`

Result: `/centralized/123456789012/us-east-1`

Organize by organization structure

Pattern: `/logs/${source.org.id}/${source.org.ouId}/${source.accountId}`

Result: `/logs/o-abc123/ou-xyz-12345678/123456789012`

Simple flat structure

Pattern: `/centralized-logs`

Result: `/centralized-logs`

Best practices

- Include the source account ID to easily identify which account logs came from.
- Include the source region if you are centralizing from multiple regions.
- Structure destination log group names to be under 512 characters. CloudWatch Logs enforces a maximum log group name length of 512 characters.
- If you enable tag propagation, the pattern must contain all three attributes: `${source.logGroup}`, `${source.accountId}`, and `${source.region}`. This ensures each source log group maps to a unique destination log group.

Creating a centralization rule

Use the following procedure to create a centralization rule that replicates log data from source accounts to your destination account.

To create a centralization rule

1. Navigate to the CloudWatch console in the Management or Delegated Administrator account of the organization.
2. Choose **Settings**.
3. Navigate to the **Organization** tab.
4. Choose **Configure rule**.
5. Specify source details by setting the following fields, then choose **Next**:

    a. **Centralization rule name**: Enter a unique name for the centralization rule.

b. **Source accounts**: Define source selection criteria to pick accounts from which telemetry data will be centralized. The selection criteria can include:

- A list of member accounts in the organization
- A list of organization units in the organization
- The entire organization

You can provide the selection criteria in two modes:

- **Builder**: A click-based experience to generate the source selection criteria
- **Editor**: A free-form text box to provide the source selection criteria

Supported syntax for source selection criteria:

- *Supported Keys:* OrganizationId | OrganizationUnitId | AccountId | *
- *Supported Operators:* = | IN | OR

c. **Source Regions**: Select a list of regions to look for the telemetry data to centralize.

6. Specify destination details by setting the following fields, then choose **Next**:

a. **Destination account**: Select an account in the organization that acts as a central destination for telemetry data.

b. **Destination Region**: Select a primary region that stores a copy of the centralized telemetry data.

c. **Backup Region**: Optionally select a region that stores a second copy of the centralized telemetry data.

7. Specify telemetry data by setting the following fields, then choose **Next**:

a. **Log groups**: Choose one of the following options:

- **All log groups**: Centralize logs from all log groups in the source accounts.
- **Filter log group**: Centralize logs from a subset of log groups in the source accounts, matching selection criteria. You can provide the selection criteria in two modes:
  - **Builder**: A choose-based experience to generate the selection criteria
  - **Editor**: A free-form text box to provide the selection criteria

There are two selection criteria that you can use to filter logs:

- **Log group selection criteria**: The selection criteria that specifies which source log groups to centralize.
  - *Supported Keys:* LogGroupName | *
  - *Supported Operators:* = | != | IN | NOT IN | AND | OR | LIKE | NOT LIKE
- **Data source selection criteria**: The selection criteria that specifies which data sources to centralize.
  - *Supported Keys:* DataSourceName | DataSourceType
  - *Supported Operators:* = | != | IN | NOT IN | AND | OR | LIKE | NOT LIKE

When both log group selection criteria and data source selection criteria are specified, a log event must match both criteria to be centralized.

b. **KMS Encrypted Log Group**

> **Important**
>
> CloudWatch centralization rules will fail to deliver logs from the source account to the destination log groups if the KMS Key provided in the Centralization rule doesn't permit CloudWatch Logs to use it. If you are using customer managed KMS key in your destination log groups, add the tag LogsManaged = true to the kms key. For more information, see Step 2: Set permissions on the KMS key.

Choose one of the following options:

- **Centralize source log groups encrypted with customer managed KMS keys using a destination specific customer managed KMS key** : Centralize log events from source log groups encrypted with customer managed KMS keys into destination log groups encrypted with a customer managed KMS key in the destination account.

  When this setting is selected, you must also set the following:

  - **Destination encryption key ARN**: ARN of the customer managed KMS key in the destination account and primary destination region, to be associated with newly created destination log groups.
  - **Backup destination encryption key ARN** (if backup region is selected): ARN of the customer managed KMS key in the destination account and backup destination region, to be associated with newly created destination log groups.

- **Skip centralizing to unencrypted destination log groups** (optional): If a log group already exists without a customer managed KMS key, CloudWatch cannot update its encryption. Choose this option to skip centralization of log events from source log groups encrypted with customer managed KMS keys into destination log groups that are not associated with a customer managed KMS key.
- **Centralize log groups encrypted with customer managed KMS keys in destination account with AWS owned KMS key**: Centralize log events from source log groups encrypted with customer managed KMS keys into newly created destination log groups encrypted using an AWS owned KMS key.
- **Do not centralize log groups encrypted with customer managed KMS keys**: Skip centralization of log events from source log groups encrypted with customer managed KMS keys.

8. Review the centralization rule, optionally make any last-minute edits, and choose **Create Centralization policy**.

Modifying a centralization rule

Use the following procedure to modify an existing centralization rule.

To modify a centralization rule

1. Navigate to the CloudWatch console in the Management or Delegated Administrator account of the organization.
2. Choose **Settings**.
3. Navigate to the **Organization** tab.
4. Choose **Manage rules**.
5. Select the rule to update and choose **Edit**.
6. Update the rule configuration as needed, choosing **Next** to proceed through each step.
7. In Step 4, Review and configure, choose **Update centralization policy**.

Viewing a centralization rule

Use the following procedure to view details of an existing centralization rule.

To view a centralization rule

1. Navigate to the CloudWatch console in the Management or Delegated Administrator account of the organization.
2. Choose **Settings**.
3. Navigate to the **Organization** tab.
4. Choose **Manage rules**.
5. View a list of all existing centralization rules and choose a specific rule name to view its details.

Deleting a centralization rule

Use the following procedure to delete an existing centralization rule.

To delete a centralization rule

1. Navigate to the CloudWatch console in the Management or Delegated Administrator account of the organization.
2. Choose **Settings**.
3. Navigate to the **Organization** tab.
4. Choose **Manage rules**.
5. Select the rule to delete and choose **Delete**.
6. Confirm deletion and choose **Delete**.

Monitoring and troubleshooting centralization rules

You can monitor the status and performance of your centralization rules using CloudWatch metrics, the CloudWatch Logs console, and AWS CloudTrail logs. This helps you ensure that log data is being replicated successfully and identify any issues with your centralization configuration.

CloudWatch Logs provides:

1. *Rule health per Centralization rule*
   a. Choose **Settings**.
   b. Navigate to the **Organization** tab.

c. Choose **Manage rules**.

2. *Logs API calls with AWS CloudTrail*
3. CloudWatch also publishes metrics for centralization, including log events replicated, errors, and throttling. For more information about these metrics and their dimensions, see Centralization metrics and dimensions.

Centralization rule health status

Each centralization rule has a health status that indicates whether it's operating correctly. You can check rule health through the console or programmatically using the API.

Rule health statuses include:

- `HEALTHY`: The rule is operating normally and replicating log data as configured
- `UNHEALTHY`: The rule has encountered issues and may not be replicating data correctly
- `PROVISIONING`: Centralization for the organization is in the process of being set up.

When a rule is marked as UNHEALTHY, the `FailureReason` field provides details about the specific issue that needs to be addressed.

Tag propagation health status

Tag propagation has its own health status (`TagPropagationStatus`) that is independent of the overall `RuleHealth` for log delivery. If you misconfigure the destination role, your overall rule health is not affected — only tag propagation shows as unhealthy.

- `Healthy`: The most recent tag-propagation attempt succeeded.
- `Unhealthy`: The most recent tag-propagation attempt failed. Check the `TagPropagationFailureReason` field for details. See the troubleshooting section below for remediation steps.

Monitoring centralization API calls with AWS CloudTrail

AWS CloudTrail logs API calls made to the centralization service, allowing you to track configuration changes and troubleshoot issues for accounts that are members of your AWS Organizations.

Key CloudTrail events for centralization include:

- `CreateCentralizationRuleForOrganization`: When a new centralization rule is created
- `UpdateCentralizationRuleForOrganization`: When an existing rule is modified
- `DeleteCentralizationRuleForOrganization`: When a rule is deleted
- `GetCentralizationRuleForOrganization`: When rule details are retrieved
- `ListCentralizationRulesForOrganization`: When rules are listed

You can use CloudTrail logs to audit centralization configuration changes and correlate them with performance issues or replication failures.

Monitoring recommendations

To ensure centralization is working correctly, we recommend setting up CloudWatch alarms on key centralization metrics that we vend to CloudWatch Metrics. This proactive monitoring helps you detect issues early and maintain reliable log centralization across your organization.

Key metrics to monitor include:

- `IncomingCopiedBytes`: Monitor the volume of log data being successfully replicated to your destination account. A sudden drop or absence of this metric may indicate centralization issues.
- `CentralizationError`: Set up alarms for any errors in the centralization process to quickly identify and resolve issues.
- `CentralizationThrottled`: Monitor for throttling events that could impact log replication performance.

For a complete list of available centralization metrics and their dimensions, see Centralization metrics and dimensions.

If logs are not being centralized as expected, review the following common scenarios that can prevent log centralization.

Historical log data

The CloudWatch Logs centralization feature only processes new log data that arrives in source accounts after you create the centralization rule. Historical log data (logs that existed before rule creation) is not centralized.

KMS key permissions

Centralization rules will fail to deliver logs from the source account to the destination log groups if the KMS key provided in the centralization rule doesn't permit CloudWatch Logs to use it. Ensure that the KMS key policy grants the necessary permissions to CloudWatch Logs. For more information, see Step 2: Set permissions on the KMS key.

Customer Managed KMS key configuration

If you selected **Do not centralize log groups encrypted with Customer Managed KMS key** during rule creation, log events from source log groups encrypted with Customer Managed KMS key will be skipped and not centralized.

Destination encryption mismatch

If the destination log group already exists with a different KMS encryption configuration than what the centralization rule specifies, and the conflict resolution is set to SKIP, records will be dropped and a `DestinationEncryptionMismatch` error will be emitted. For example, this occurs when the destination has default encryption but the rule specifies a customer managed KMS key.

Trusted access not enabled

Trusted access must be enabled for CloudWatch in AWS Organizations for the management account and the destination account to provide access to the log data.

Source selection criteria

Verify that your centralization rule's source selection criteria is configured correctly:

- *Accounts and regions*: Ensure that the source accounts and regions where logs originate are included in the rule. Log groups from accounts or regions not specified in the rule will not be centralized.
- *Log group filters*: If you configured log group filters, only log groups matching the specified criteria will be centralized. Verify that your log group selection criteria includes the log groups you expect to centralize.
- *Organization membership*: Both source and destination accounts must belong to the same AWS Organizations organization. Accounts outside the organization cannot participate in centralization.

Log group quota limit reached

If the destination account has reached its log group quota limit, new log groups cannot be created for centralization. Verify that the destination account has sufficient quota to

accommodate centralized log groups from all source accounts. You can request a quota increase if needed.

Log stream name length limit exceeded

Log stream names have maximum length restrictions. When centralization replicates log streams to the destination account, a suffix is added to the log stream name. If the resulting log stream name exceeds the maximum allowed length, records will be dropped and an `InvalidLogStream` error will be emitted to the customer account.

Rule health status

Check the centralization rule health status in the console or using the `GetCentralizationRuleForOrganization` API. If the rule is marked as UNHEALTHY, review the `FailureReason` field for specific details about the issue.

Tag propagation health status

If `TagPropagationStatus` shows `Unhealthy`, check the `TagPropagationFailureReason` field:

- `RoleNotAssumable`: The service cannot assume the destination role. Verify that the role's trust policy allows the centralization service-linked role to assume it and that the `sts:ExternalId` matches your organization ID.
- `RoleLacksPermissions`: The role was assumed but the tag API call was denied. Ensure the role's permissions policy grants `logs:ListTagsForResource`, `logs:TagResource`, and `logs:UntagResource` on the destination log groups.

To diagnose centralization issues, review the centralization rule health status in the console, check CloudWatch metrics for errors and throttling, and examine AWS CloudTrail logs for API call failures. For more information about centralization metrics, see Centralization metrics and dimensions.

Working with log groups and log streams

A log stream is a sequence of log events that share the same source. Each separate source of logs in CloudWatch Logs makes up a separate log stream.

A log group is a group of log streams that share the same retention, monitoring, and access control settings. You can define log groups and specify which streams to put into each group. There is no limit on the number of log streams that can belong to one log group.

For organizations that need to consolidate log data from multiple accounts and regions, you can use CloudWatch Logs Centralization to automatically replicate log groups to a central account. For more information, see Cross-account cross-Region log centralization.

You can use the procedures in this section to work with log groups and log streams.

Create a log group in CloudWatch Logs

When you install the CloudWatch Logs agent on an Amazon EC2 instance using the steps in previous sections of the Amazon CloudWatch Logs User Guide, the log group is created as part of that process. You can also create a log group directly in the CloudWatch console.

To create a log group

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Log Management**.
3. Choose **Actions**, and then choose **Create log group**.
4. Enter a name for the log group, and then choose **Create log group**.

> **Tip**
>
> You can favorite log groups, as well as dashboards and alarms, from the ***Favorites and recents*** menu in the navigation pane. Under the ***Recently visited*** column, hover over the log group that you want to favorite, and choose the star symbol next to it.

Send logs to a log group

CloudWatch Logs automatically receives log events from several AWS services. You can also send other log events to CloudWatch Logs using one of the following methods:

- **CloudWatch agent**— The unified CloudWatch agent can send both metrics and logs to CloudWatch Logs. For information about installing and using the CloudWatch agent, see Collecting Metrics and Logs from Amazon EC2 Instances and On-Premises Servers with the CloudWatch Agent in the *Amazon CloudWatch User Guide*.
- **AWS CLI**—The put-log-events uploads batches of log events to CloudWatch Logs.
- **Programmatically**— The PutLogEvents API enables you to programmatically upload batches of log events to CloudWatch Logs.

View log data sent to CloudWatch Logs

You can view and scroll through log data on a stream-by-stream basis as sent to CloudWatch Logs by the CloudWatch Logs agent. You can specify the time range for the log data to view.

To view log data

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Log Management**.
3. For **Log Groups**, choose the log group to view the streams.
4. In the list of log groups, choose the name of the log group that you want to view.
5. In the list of log streams, choose the name of the log stream that you want to view.
6. To change how the log data is displayed, do one of the following:
   - To expand a single log event, choose the arrow next to that log event.
   - To expand all log events and view them as plain text, above the list of log events, choose **Text**.
   - To filter the log events, enter the desired search filter in the search field. For more information, see Creating metrics from log events using filters.
   - To view log data for a specified date and time range, next to the search filter, choose the arrow next to the date and time. To specify a date and time range, choose **Absolute**. To

choose a predefined number of minutes, hours, days, or weeks, choose **Relative**. You can also switch between UTC and local time zone.

Search log data using filter patterns

You can search your log data using the Filter pattern syntax for metric filters, subscription filters, filter log events, and Live Tail. You can search all the log streams within a log group, or by using the AWS CLI you can also search specific log streams. When each search runs, it returns up to the first page of data found and a token to retrieve the next page of data or to continue searching. If no results are returned, you can continue searching.

You can set the time range you want to query to limit the scope of your search. You could start with a larger range to see where the log lines you are interested in fall, and then shorten the time range to scope the view to logs in the time range that interest you.

You can also pivot directly from your logs-extracted metrics to the corresponding logs.

If you are signed in to an account set up as a monitoring account in CloudWatch cross-account observability, you can search and filter log events from the source accounts linked to this monitoring account. For more information, see CloudWatch cross-account observability.

Search log entries using the console

You can search for log entries that meet a specified criteria using the console.

To search your logs using the console

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Log Management**.
3. For **Log Groups**, choose the name of the log group containing the log stream to search.
4. For **Log Streams**, choose the name of the log stream to search.
5. Under **Log events**, enter the filter syntax to use.

To search all log entries for a time range using the console

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Log Management**.

3. For **Log Groups**, choose the name of the log group containing the log stream to search.
4. Choose **Search log group**.
5. For **Log events**, select the date and time range, and enter the filter syntax.

Search log entries using the AWS CLI

You can search for log entries that meet a specified criteria using the AWS CLI.

To search log entries using the AWS CLI

At a command prompt, run the following filter-log-events command. Use `--filter-pattern` to limit the results to the specified filter pattern and `--log-stream-names` to limit the results to the specified log streams.

```
aws logs filter-log-events --log-group-name my-group [--log-stream-
names LIST_OF_STREAMS_TO_SEARCH] [--filter-pattern VALID_METRIC_FILTER_PATTERN]
```

To search log entries over a given time range using the AWS CLI

At a command prompt, run the following filter-log-events command:

```
aws logs filter-log-events --log-group-name my-group [--log-stream-
names LIST_OF_STREAMS_TO_SEARCH] [--start-time 1482197400000] [--end-
time 1482217558365] [--filter-pattern VALID_METRIC_FILTER_PATTERN]
```

Pivot from metrics to logs

You can get to specific log entries from other parts of the console.

To get from dashboard widgets to logs

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Dashboards**.
3. Choose a dashboard.
4. On the widget, choose the **View logs** icon, and then choose **View logs in this time range**. If there is more than one metric filter, select one from the list. If there are more metric filters than we can display in the list, choose **More metric filters** and select or search for a metric filter.

To get from metrics to logs

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Metrics**.
3. In the search field on the **All metrics** tab, type the name of the metric and press Enter.
4. Select one or more metrics from the results of your search.
5. Choose **Actions**, **View logs**. If there is more than one metric filter, select one from the list. If there are more metric filters than we can display in the list, choose **More metric filters** and select or search for a metric filter.

Troubleshooting

Search takes too long to complete

If you have a lot of log data, search might take a long time to complete. To speed up a search, you can do the following:

- If you are using the AWS CLI, you can limit the search to just the log streams you are interested in. For example, if your log group has 1000 log streams, but you just want to see three log streams that you know are relevant, you can use the AWS CLI to limit your search to only those three log streams within the log group.
- Use a shorter, more granular time range, which reduces the amount of data to be searched and speeds up the query.

Change log data retention in CloudWatch Logs

By default, log data is stored in CloudWatch Logs indefinitely. However, you can configure how long to store log data in a log group. Any data older than the current retention setting is deleted. You can change the log retention for each log group at any time.

> **Note**
>
> CloudWatch Logs doesn't immediately delete log events when they reach their retention setting. It typically takes up to 72 hours after that before log events are deleted, but in rare situations might take longer.
> This means that if you change a log group to have a longer retention setting when it contains log events that are past the expiration date, but haven't been actually deleted,

those log events will take up to 72 hours to be deleted after the new retention date is reached. To make sure that log data is deleted permanently, keep a log group at its lower retention setting until 72 hours has passed after the end of the previous retention period, or you have confirmed that the older log events are deleted.
When log events reach their retention setting they are marked for deletion. After they are marked for deletion, they do not add to your archival storage costs anymore, even if they are not actually deleted until later. These log events marked for deletion are also not included when you use an API to retrieve the `storedBytes` value to see how many bytes a log group is storing.

To change the logs retention setting

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Logs**, **Log groups**.
3. Find the log group to update.
4. In the **Retention** column for that log group, choose the current retention setting, such as **Never Expire**.
5. In **Retention setting**, for **Expire events after**, choose a log retention value, and then choose **Save**.

Protecting log groups from deletion

You can optionally enable deletion protection to prevent accidental deletion of important log groups. For detailed information about deletion protection, see Protecting log groups from deletion.

Protecting log groups from deletion

Enabling deletion protection

You can enable deletion protection when creating a new log group or on existing log groups. During log group creation, select "Enabled deletion protection" or by passing the parameter `--deletion-protection-enabled`. By default, deletion protection is not enabled.

To enable or disable deletion protection on an existing log group (console)

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Log Management**.
3. Select the log group you want to protect.
4. Choose **Actions**, **Edit deletion protection**.
5. In the dialog box, review and then submit changes.

If using the AWS CLI, to enable deletion protection on an existing log group:

```
aws logs put-log-group-deletion-protection \
--log-group-identifier "/my-application/logs" \
--deletion-protection-enabled
```

To remove deletion protection on an existing log group:

```
aws logs put-log-group-deletion-protection \
--log-group-identifier "/my-application/logs" \
--no-deletion-protection-enabled
```

Error handling

If you attempt to delete a log group with deletion protection enabled, you receive a `ValidationException` with the message: "Cannot delete log group with deletion protection enabled. Disable deletion protection first."

Tag log groups in Amazon CloudWatch Logs

You can assign your own metadata to the log groups you create in Amazon CloudWatch Logs in the form of *tags*. A tag is a key-value pair that you define for a log group. Using tags is a simple yet powerful way to manage AWS resources and organize data, including billing data.

> **Note**
>
> You can use tags to control access to CloudWatch Logs resources, including log groups and destinations. Access to log streams is controlled at the log group level, because of the hierarchical relation between log groups and log streams. For more information about

using tags to control access, see Controlling access to Amazon Web Services resources using tags.

Contents

Tag basics

You use AWS CloudFormation the AWS CLI, or CloudWatch Logs API to complete the following tasks:

- Add tags to a log group when you create it.
- Add tags to an existing log group.
- List the tags for a log group.
- Remove tags from a log group.

You can use tags to categorize your log groups. For example, you can categorize them by purpose, owner, or environment. Because you define the key and value for each tag, you can create a custom set of categories to meet your specific needs. For example, you might define a set of tags that helps you track log groups by owner and associated application. Here are several examples of tags:

- Project: Project name
- Owner: Name
- Purpose: Load testing
- Application: Application name
- Environment: Production

Tracking costs using tagging

You can use tags to categorize and track your AWS costs. When you apply tags to your AWS resources, including log groups, your AWS cost allocation report includes usage and costs aggregated by tags. You can apply tags that represent business categories (such as cost centers, application names, or owners) to organize your costs across multiple services. For more information, see Use Cost Allocation Tags for Custom Billing Reports in the *AWS Billing User Guide*.

Tag restrictions

The following restrictions apply to tags.

Basic restrictions

- The maximum number of tags per log group is 50.
- Tag keys and values are case sensitive.
- You can't change or edit tags for a deleted log group.

Tag key restrictions

- Each tag key must be unique. If you add a tag with a key that's already in use, your new tag overwrites the existing key-value pair.
- You can't start a tag key with `aws:` because this prefix is reserved for use by AWS. AWS creates tags that begin with this prefix on your behalf, but you can't edit or delete them.
- Tag keys must be between 1 and 128 Unicode characters in length.
- Tag keys must consist of the following characters: Unicode letters, digits, white space, and the following special characters: `_ . / = + - @`.

Tag value restrictions

- Tag values must be between 0 and 255 Unicode characters in length.
- Tag values can be blank. Otherwise, they must consist of the following characters: Unicode letters, digits, white space, and any of the following special characters: `_ . / = + - @`.

Tagging log groups using the AWS CLI

You can add, list, and remove tags using the AWS CLI. For examples, see the following documentation:

create-log-group

Creates a log group. You can optionally add tags when you create the log group.

tag-resource

Assigns one or more tags (key-value pairs) to the specified CloudWatch Logs resource.

list-tags-for-resource

Displays the tags the are associated with a CloudWatch Logs resource.

untag-resource

Removes one or more tags from the specified CloudWatch Logs resource.

Tagging log groups using the CloudWatch Logs API

You can add, list, and remove tags using the CloudWatch Logs API. For examples, see the following documentation:

CreateLogGroup

Creates a log group. You can optionally add tags when you create the log group.

TagResource

Assigns one or more tags (key-value pairs) to the specified CloudWatch Logs resource.

ListTagsForResource

Displays the tags the are associated with a CloudWatch Logs resource.

UntagResource

Removes one or more tags from the specified CloudWatch Logs resource.

Encrypt log data in CloudWatch Logs using AWS Key Management Service

Log group data is always encrypted in CloudWatch Logs. By default, CloudWatch Logs uses server-side encryption with 256-bit Advanced Encryption Standard Galois/Counter Mode (AES-GCM) to encrypt log data at rest. As an alternative, you can use AWS Key Management Service for this encryption. If you do, the encryption is done using an AWS KMS key. Encryption using AWS KMS is enabled at the log group level, by associating a KMS key with a log group, either when you create the log group or after it exists.

Important

CloudWatch Logs now supports encryption context, using `kms:EncryptionContext:aws:logs:arn` as the key and the ARN of the log group as the value for that key. If you have log groups that you have already encrypted with a KMS key, and you would like to restrict the key to be used with a single account and log group, you should assign a new KMS key that includes a condition in the IAM policy. For more information, see AWS KMS keys and encryption context.

Important

CloudWatch Logs now supports `kms:ViaService` which allows logs to make AWS KMS calls on your behalf. You should add this to your roles which call CloudWatch Logs in either your Key Policy or in IAM. For more information, see kms:ViaService.

After you associate a KMS key with a log group, all newly ingested data for the log group is encrypted using this key. This data is stored in encrypted format throughout its retention period. CloudWatch Logs decrypts this data whenever it is requested. CloudWatch Logs must have permissions for the KMS key whenever encrypted data is requested.

If you later disassociate a KMS key from a log group, CloudWatch Logs encrypts newly ingested data using the CloudWatch Logs default encryption method. All previously ingested data that was encrypted with the KMS key remains encrypted with the KMS key. CloudWatch Logs can still return that data after the KMS key is disassociated, because CloudWatch Logs can still continue to

reference the key. However, if the key is later disabled, then CloudWatch Logs is unable to read the logs that were encrypted with that key.

> **Important**
>
> CloudWatch Logs supports only symmetric KMS keys. Do not use an asymmetric key to encrypt the data in your log groups. For more information, see Using Symmetric and Asymmetric Keys.

Limits

- To perform the following steps, you must have the following permissions: `kms:CreateKey`, `kms:GetKeyPolicy`, and `kms:PutKeyPolicy`.
- After you associate or disassociate a key from a log group, it can take up to five minutes for the operation to take effect.
- If you revoke CloudWatch Logs access to an associated key or delete an associated KMS key, your encrypted data in CloudWatch Logs can no longer be retrieved.
- You can't associate a KMS key with an existing log group using the CloudWatch console.

Step 1: Create an AWS KMS key

To create an KMS key, use the following create-key command:

```
aws kms create-key
```

The output contains the key ID and Amazon Resource Name (ARN) of the key. The following is example output:

```
{
    "KeyMetadata": {
        "Origin": "AWS_KMS",
        "KeyId": "1234abcd-12ab-34cd-56ef-1234567890ab",
        "Description": "",
        "KeyManager": "CUSTOMER",
        "Enabled": true,
        "CustomerMasterKeySpec": "SYMMETRIC_DEFAULT",
        "KeyUsage": "ENCRYPT_DECRYPT",
```

```
        "KeyState": "Enabled",
        "CreationDate": 1478910250.94,
        "Arn": "arn:aws:kms:us-west-2:123456789012:key/6f815f63-e628-448c-8251-
e40cb0d29f59",
        "AWSAccountId": "123456789012",
        "EncryptionAlgorithms": [
            "SYMMETRIC_DEFAULT"
        ]
    }
}
```

Step 2: Set permissions on the KMS key

By default, all AWS KMS keys are private. Only the resource owner can use it to encrypt and decrypt data. However, the resource owner can grant permissions to access the KMS key to other users and resources. With this step, you give the CloudWatch Logs service principal and the caller role permission to use the key. This service principal must be in the same AWS Region where the KMS key is stored.

As a best practice, we recommend that you restrict the use of the KMS key to only those AWS accounts or log groups you specify.

First, save the default policy for your KMS key as `policy.json` using the following get-key-policy command:

```
aws kms get-key-policy --key-id key-id --policy-name default --output text > ./
policy.json
```

Open the `policy.json` file in a text editor and add the section in bold from one of the following statements. Separate the existing statement from the new statement with a comma. These statements use `Condition` sections to enhance the security of the AWS KMS key. For more information, see AWS KMS keys and encryption context.

The `Condition` section in this example restricts the key to a single log group ARN.

JSON

```
{
    "Version":"2012-10-17",
    "Id": "key-default-1",
```

```
    "Statement": [
        {
            "Sid": "Enable IAM User Permissions",
            "Effect": "Allow",
            "Principal": {
            "AWS": "arn:aws:iam::123456789012:root"
            },
            "Action": "kms:*",
            "Resource": "*"
        },
        {
            "Effect": "Allow",
            "Principal": {
                "Service": "logs.us-east-1.amazonaws.com"
            },
            "Action": [
                "kms:Encrypt",
                "kms:Decrypt",
                "kms:ReEncrypt*",
                "kms:GenerateDataKey*",
                "kms:Describe*"
            ],
            "Resource": "*",
            "Condition": {
                "ArnEquals": {
                "kms:EncryptionContext:aws:logs:arn": "arn:aws:logs:us-
east-1:111122223333:log-group:log-group-name"
                }
            }
        }
    ]
}
```

The `Condition` section in this example limits the use of the AWS KMS key to the specified account, but it can be used for any log group.

JSON

```
{
    "Version":"2012-10-17",
    "Id": "key-default-1",
```

```
    "Statement": [
        {
            "Sid": "Enable IAM User Permissions",
            "Effect": "Allow",
            "Principal": {
            "AWS": "arn:aws:iam::123456789012:root"
            },
            "Action": "kms:*",
            "Resource": "*"
        },
        {
            "Effect": "Allow",
            "Principal": {
            "Service": "logs.us-east-1.amazonaws.com"
            },
            "Action": [
                "kms:Encrypt",
                "kms:Decrypt",
                "kms:ReEncrypt*",
                "kms:GenerateDataKey*",
                "kms:Describe*"
            ],
            "Resource": "*",
            "Condition": {
                "ArnLike": {
                "kms:EncryptionContext:aws:logs:arn": "arn:aws:logs:us-
east-1:123456789012:*"
                }
            }
        }
    ]
}
```

Step 3: Set permissions on the calling IAM principal

Add permissions to the IAM principal (user or role) that will be calling CloudWatch Logs APIs. The permissions required depend on which operations the principal needs to perform. You can add these permissions in the AWS KMS key policy or through IAM on the role itself. CloudWatch Logs uses `kms:ViaService` to make calls to AWS KMS on the customer's behalf. For more information, see kms:ViaService.

Permissions for associating a KMS key with a log group

The IAM principal that calls `CreateLogGroup` with a `kmsKeyId` parameter, or calls `AssociateKmsKey`, must have `kms:DescribeKey` permission on the specified KMS key. If the caller does not have this permission, the API call will fail with an `AccessDeniedException`.

The following example key policy statement grants the minimum permissions needed to associate a KMS key with a log group:

```
{
  "Effect": "Allow",
  "Principal": {
    "AWS": "arn:aws:iam::account_id:role/role_name"
  },
  "Action": [
    "kms:Describe*"
  ],
  "Resource": "*",
  "Condition": {
    "StringEquals": {
      "kms:ViaService": [
        "logs.region.amazonaws.com"
      ]
    }
  }
}
```

Permissions for reading and writing encrypted log data

If the IAM principal also needs to read or write encrypted log data (for example, calling `PutLogEvents`, `GetLogEvents`, `FilterLogEvents`, or `StartQuery` on a log group encrypted with a customer managed KMS key), the principal needs additional AWS KMS permissions. The following example key policy statement grants the full set of permissions needed for both associating a key and reading or writing encrypted log data:

```
{
  "Effect": "Allow",
  "Principal": {
    "AWS": "arn:aws:iam::account_id:role/role_name"
  },
  "Action": [
```

```
    "kms:Encrypt",
    "kms:ReEncrypt*",
    "kms:Decrypt",
    "kms:GenerateDataKey*",
    "kms:Describe*"
  ],
  "Resource": "*",
  "Condition": {
    "StringEquals": {
      "kms:ViaService": [
        "logs.region.amazonaws.com"
      ]
    }
  }
}
```

As a best practice, scope the policy to only the roles that will be interacting with AWS KMS encrypted log groups.

Alternatively, to grant the full set of permissions for both associating a key and reading or writing encrypted log data via IAM, you can add the following policy to the caller role. This can be added to an existing role policy or attached to a role as an additional separate policy. If you use this method, as best practice, scope the policy to only the AWS KMS keys which will be used for log encryption. For more information, see Edit IAM policies.

JSON

```
{
    "Version":"2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": [
                "kms:Encrypt",
                "kms:ReEncrypt*",
                "kms:Decrypt",
                "kms:GenerateDataKey*",
                "kms:Describe*"
            ],
            "Condition": {
                "StringEquals": {
                    "kms:ViaService": [
```

```
                        "logs.us-east-1.amazonaws.com"
                    ]
                }
            },
            "Resource": "arn:aws:kms:us-east-1:444455556666:key/key_id"
        }
    ]
}
```

Finally, add the updated policy using the following put-key-policy command:

```
aws kms put-key-policy --key-id key-id --policy-name default --policy file://
policy.json
```

Step 4: Associate a KMS key with a log group

You can associate a KMS key with a log group when you create it or after it exists.

To find whether a log group already has a KMS key associated, use the following describe-log-groups command:

```
aws logs describe-log-groups --log-group-name-prefix "log-group-name-prefix"
```

If the output includes a `kmsKeyId` field, the log group is associated with the key displayed for the value of that field.

To associate the KMS key with a log group when you create it

Use the create-log-group command as follows:

```
aws logs create-log-group --log-group-name my-log-group --kms-key-id "key-arn"
```

To associate the KMS key with an existing log group

Use the associate-kms-key command as follows:

```
aws logs associate-kms-key --log-group-name my-log-group --kms-key-id "key-arn"
```

Step 5: Disassociate key from a log group

To disassociate the KMS key associated with a log group, use the following disassociate-kms-key command:

```
aws logs disassociate-kms-key --log-group-name my-log-group
```

AWS KMS keys and encryption context

To enhance the security of your AWS Key Management Service keys and your encrypted log groups, CloudWatch Logs now puts log group ARNs as part of the *encryption context* used to encrypt your log data. Encryption context is a set of key-value pairs that are used as additional authenticated data. The encryption context enables you to use IAM policy conditions to limit access to your AWS KMS key by AWS account and log group. For more information, see Encryption context and IAM JSON Policy Elements: Condition.

We recommend that you use different KMS keys for each of your encrypted log groups.

If you have a log group that you encrypted previously and now want to change the log group to use a new KMS key that works only for that log group, follow these steps.

To convert an encrypted log group to use a KMS key with a policy limiting it to that log group

1. Enter the following command to find the ARN of the log group's current key:

   ```
   aws logs describe-log-groups
   ```

   The output includes the following line. Make a note of the ARN. You need to use it in step 7.

   ```
   ...
   "kmsKeyId": "arn:aws:kms:us-west-2:123456789012:key/01234567-89ab-
   cdef-0123-456789abcdef"
   ...
   ```

2. Enter the following command to create a new KMS key:

   ```
   aws kms create-key
   ```

3. Enter the following command to save the new key's policy to a `policy.json` file:

```
aws kms get-key-policy --key-id new-key-id --policy-name default --output text > ./
policy.json
```

4. Use a text editor to open `policy.json` and add a `Condition` expression to the policy:

   JSON

```
{
    "Version":"2012-10-17",
    "Id": "key-default-1",
    "Statement": [
        {
            "Sid": "Enable IAM User Permissions",
            "Effect": "Allow",
            "Principal": {
                "AWS": "arn:aws:iam::111122223333:root"
            },
            "Action": "kms:*",
            "Resource": "*"
        },
        {
            "Effect": "Allow",
            "Principal": {
            "Service": "logs.us-east-1.amazonaws.com"
            },
            "Action": [
                "kms:Encrypt",
                "kms:Decrypt",
                "kms:ReEncrypt*",
                "kms:GenerateDataKey*",
                "kms:Describe*"
            ],
            "Resource": "*",
            "Condition": {
                "ArnLike": {
                "kms:EncryptionContext:aws:logs:arn": "arn:aws:logs:us-
east-1:111122223333:log-group:LOG-GROUP-NAME"
                }
            }
        }
    ]
```

```
}
```

5. Enter the following command to add the updated policy to the new KMS key:

```
aws kms put-key-policy --key-id new-key-ARN --policy-name default --policy file://
policy.json
```

6. Enter the following command to associate the policy with your log group:

```
aws logs associate-kms-key --log-group-name my-log-group --kms-key-id new-key-ARN
```

CloudWatch Logs now encrypts all new data using the new key.

7. Next, revoke all permissions except `Decrypt` from the old key. First, enter the following command to retrieve the old policy:

```
aws kms get-key-policy --key-id old-key-ARN --policy-name default --output text
 > ./policy.json
```

8. Use a text editor to open `policy.json` and remove all values from the `Action` list, except for `kms:Decrypt`

JSON

```
{
    "Version":"2012-10-17",
    "Id": "key-default-1",
    "Statement": [
        {
            "Sid": "Enable IAM User Permissions",
            "Effect": "Allow",
            "Principal": {
                "AWS": "arn:aws:iam::111122223333:root"
            },
            "Action": "kms:*",
            "Resource": "*"
        },
        {
            "Effect": "Allow",
            "Principal": {
                "Service": "logs.region.amazonaws.com"
            },
```

```
            "Action": [
                "kms:Decrypt"
            ],
            "Resource": "*"
        }
    ]
}
```

9. Enter the following command to add the updated policy to the old key:

```
aws kms put-key-policy --key-id old-key-ARN --policy-name default --policy file://
policy.json
```

Help protect sensitive log data with masking

You can help safeguard sensitive data that's ingested by CloudWatch Logs by using log group *data protection policies*. These policies let you audit and mask sensitive data that appears in log events ingested by the log groups in your account.

When you create a data protection policy, then by default, sensitive data that matches the data identifiers you've selected is masked at all egress points, including CloudWatch Logs Insights, metric filters, and subscription filters. Only users who have the `logs:Unmask` IAM permission can view unmasked data.

You can create a data protection policy for all log groups in your account, and you can also create a data protection policies for individual log groups. When you create a policy for your entire account, it applies to both existing log groups and log groups that are created in the future.

If you create a data protection policy for your entire account and you also create a policy for a single log group, both policies apply to that log group. All managed data identifiers that are specified in either policy are audited and masked in that log group.

> **Note**
>
> Masking sensitive data is supported for log groups in both the Standard and Infrequent Access log classes. For more information about log classes, see Log classes.

Each log group can have only one log group-level data protection policy, but that policy can specify many managed data identifiers to audit and mask. The limit for a data protection policy is 30,720 characters.

> **Important**
>
> Sensitive data is detected and masked when it is ingested into the log group. When you set a data protection policy, log events ingested to the log group before that time are not masked.

CloudWatch Logs supports many *managed data identifiers*, which offer preconfigured data types you can select to protect financial data, personal health information (PHI), and personally identifiable information (PII). CloudWatch Logs data protection allows you to leverage pattern matching and machine learning models to detect sensitive data. For some types of managed data identifiers, the detection depends on also finding certain keywords in proximity with the sensitive data. You can also use custom data identifiers to create data identifiers tailored to your specific use case.

A metric is emitted to CloudWatch when sensitive data is detected that matches the data identifiers you select. This is the **LogEventsWithFindings** metric and it is emitted in the **AWS/Logs** namespace. You can use this metric to create CloudWatch alarms, and you can visualize it in graphs and dashboards. Metrics emitted by data protection are vended metrics and are free of charge. For more information about metrics that CloudWatch Logs sends to CloudWatch, see Monitoring with CloudWatch metrics.

Each managed data identifier is designed to detect a specific type of sensitive data, such as credit card numbers, AWS secret access keys, or passport numbers for a particular country or region. When you create a data protection policy, you can configure it to use these identifiers to analyze logs ingested by the log group, and take actions when they are detected.

CloudWatch Logs data protection can detect the following categories of sensitive data by using managed data identifiers:

- Credentials, such as private keys or AWS secret access keys
- Financial information, such as credit card numbers
- Personally Identifiable Information (PII) such as driver's licenses or social security numbers
- Protected Health Information (PHI) such as health insurance or medical identification numbers

- Device identifiers, such as IP addresses or MAC addresses

For details about the types of data that you can protect, see Types of data that you can protect.

Contents

Understanding data protection policies

Topics

What are data protection policies?

CloudWatch Logs uses **data protection policies** to select the sensitive data for which you want to scan, and the actions that you want to take to protect that data. To select the sensitive data of interest, you use data identifiers. CloudWatch Logs data protection then detects the sensitive data by using machine learning and pattern matching. To act upon data identifiers that are found, you can define **audit** and **de-identify** operations. These operations let you log the sensitive data that is found (or not found), and to mask the sensitive data when the log events are viewed.

How is the data protection policy structured?

As illustrated in the following figure, a data protection policy document includes the following elements:

- Optional policy-wide information at the top of the document
- One statement that defines the audit and de-identify actions

Only one data protection policy can be defined per CloudWatch Logs log group. The data protection policy can have one or more deny or de-identify statements, but only one audit statement.

JSON properties for the data protection policy

A data protection policy requires the following basic policy information for identification:

- **Name** – The policy name.
- **Description** (Optional) – The policy description.
- **Version** – The policy language version. The current version is 2021-06-01.
- **Statement** – A list of statements that specifies data protection policy actions.

```
{
  "Name": "CloudWatchLogs-PersonalInformation-Protection",
  "Description": "Protect basic types of sensitive data",
  "Version": "2021-06-01",
  "Statement": [
        ...
  ]
}
```

JSON properties for a policy statement

A policy statement sets the detection context for the data protection operation.

- **Sid** (Optional) – The statement identifier.
- **DataIdentifier** – The sensitive data for which CloudWatch Logs should scan. For example, name, address, or phone number.

- **Operation** – The follow-on actions, either **Audit** or **De-identify**. CloudWatch Logs performs these actions when it finds sensitive data.

```
{
  ...
  "Statement": [
    {
      "Sid": "audit-policy",
      "DataIdentifier": [
        "arn:aws:dataprotection::aws:data-identifier/Address"
      ],
      "Operation": {
        "Audit": {
          "FindingsDestination": {}
        }
      }
    },
```

JSON properties for a policy statement operation

A policy statement sets one of the following data protection operations.

- **Audit** – Emits metrics and findings reports without interrupting logging. Strings that match increment the **LogEventsWithFindings** metric that CloudWatch Logs publishes to the **AWS/Logs** namespace in CloudWatch. You can use these metrics to create alarms.

  For an example of a findings report, see Audit findings reports.

  For more information about metrics that CloudWatch Logs sends to CloudWatch, see Monitoring with CloudWatch metrics.
- **De-identify** – Mask the sensitive data without interrupting logging.

IAM permissions required to create or work with a data protection policy

To be able to work with data protection policies for log groups, you must have certain permissions as shown in the following tables. The permissions are different for account-wide data protection policies and for data protection policies that apply to a single log group.

Permissions required for account-level data protection policies

> **Note**
>
> If you are performing any of these operations inside a Lambda function, the Lambda execution role and permissions boundary must also include the following permissions.

Operation	IAM permission needed	Resource
Create a data protection policy with no audit destinations	`logs:PutAccountPolicy`	*
	`logs:PutDataProtectionPolicy`	*
Create a data protection policy with CloudWatch Logs as an audit destination	`logs:PutAccountPolicy`	*
	`logs:PutDataProtectionPolicy`	*
	`logs:CreateLogDelivery`	*
	`logs:PutResourcePolicy`	*
	`logs:DescribeResourcePolicies`	*
	`logs:DescribeLogGroups`	*
Create a data protection policy with Firehose as an audit destination	`logs:PutAccountPolicy`	*
	`logs:PutDataProtectionPolicy`	*

Operation	IAM permission needed	Resource
	logs:CreateLogDelivery	*
	firehose:TagDeliveryStream	arn:aws:logs:::deliverystream/ *YOUR_DELIVERY_STREAM*
Create a data protection policy with Amazon S3 as an audit destination	logs:PutAccountPolicy	*
	logs:PutDataProtectionPolicy	*
	logs:CreateLogDelivery	*
	s3:GetBucketPolicy	arn:aws:s3::: *YOUR_BUCKET*
	s3:PutBucketPolicy	arn:aws:s3::: *YOUR_BUCKET*
Unmask masked log events in a specified log group	logs:Unmask	arn:aws:logs:::log-group:*
View an existing data protection policy	logs:GetDataProtectionPolicy	*
Delete a data protection policy	logs:DeleteAccountPolicy	*
	logs:DeleteDataProtectionPolicy	*

If any data protection audit logs are already being sent to a destination, then other policies that send logs to the same destination only need the `logs:PutDataProtectionPolicy` and `logs:CreateLogDelivery` permissions.

Permissions required for data protection policies for a single log group

> **Note**
>
> If you are performing any of these operations inside a Lambda function, the Lambda execution role and permissions boundary must also include the following permissions.

Operation	IAM permission needed	Resource
Create a data protection policy with no audit destinations	`logs:PutDataProtectionPolicy`	`arn:aws:logs:::log-group:` *YOUR_LOG_GROUP* `:*`

Create a data protection policy with CloudWatch Logs as an audit destination	`logs:PutDataProtectionPolicy`
	`logs:CreateLogDelivery`
	`logs:PutResourcePolicy`
	`logs:DescribeResourcePolicies`
	`logs:DescribeLogGroups`
		`arn:aws:logs:::log-group:` *YOUR_LOG_GROUP* `:*`
		`*`
		`*`
		`*`
		`*`

Create a data protection policy with Firehose as an audit destination	`logs:PutDataProtectionPolicy` `logs:CreateLogDelivery`	`arn:aws:logs:::log-group:` *YOUR_LOG_GROUP* `:*` `*`

Operation	IAM permission needed	Resource
	`firehose:TagDeliveryStream`	`arn:aws:logs:::deliverystream/` *YOUR_DELIVERY_STREAM*

Create a data protection policy with Amazon S3 as an audit destination	`logs:PutDataProtectionPolicy`
	
	`logs:CreateLogDelivery`
	
	`s3:GetBucketPolicy`
	
	`s3:PutBucketPolicy`
		`arn:aws:logs:::log-group:` *YOUR_LOG_GROUP* `:*`
		
		`*`
		
		`arn:aws:s3:::` *YOUR_BUCKET*
		
		`arn:aws:s3:::` *YOUR_BUCKET*

Unmask masked log events	`logs:Unmask`	`arn:aws:logs:::log-group:` *YOUR_LOG_GROUP* `:*`
View an existing data protection policy	`logs:GetDataProtectionPolicy`	`arn:aws:logs:::log-group:` *YOUR_LOG_GROUP* `:*`
Delete a data protection policy	`logs:DeleteDataProtectionPolicy`	`arn:aws:logs:::log-group:` *YOUR_LOG_GROUP* `:*`

If any data protection audit logs are already being sent to a destination, then other policies that send logs to the same destination only need the `logs:PutDataProtectionPolicy` and `logs:CreateLogDelivery` permissions.

Sample data protection policy

The following sample policy allows a user to create, view, and delete data protection policies that can sending audit findings to all three types of audit destinations. It does not permit the user to view unmasked data.

JSON

```
    {
    "Version":"2012-10-17",
    "Statement": [
        {
            "Sid": "AllowLogDeliveryConfiguration",
            "Effect": "Allow",
            "Action": [
                "logs:CreateLogDelivery",
                "logs:PutResourcePolicy",
                "logs:DescribeLogGroups",
                "logs:DescribeResourcePolicies"
            ],
            "Resource": "*"
        },
        {
            "Sid": "AllowDataProtectionAndBucketConfiguration",
            "Effect": "Allow",
            "Action": [
                "logs:GetDataProtectionPolicy",
                "logs:DeleteDataProtectionPolicy",
                "logs:PutDataProtectionPolicy",
                "s3:PutBucketPolicy",
                "firehose:TagDeliveryStream",
                "s3:GetBucketPolicy"
            ],
            "Resource": [
            "arn:aws:firehose:us-east-1:111122223333:deliverystream/delivery-
stream-name",
            "arn:aws:s3:::amzn-s3-demo-destination-bucket",
            "arn:aws:logs:us-east-1:111122223333:log-group:log-group-name:*"
            ]
        }
    ]
```

```
}
```

Create an account-wide data protection policy

You can use the CloudWatch Logs console or AWS CLI commands to create a data protection policy to mask sensitive data for all log groups in your account. Doing so affects both current log groups and log groups that you create in the future.

> **Important**
>
> Sensitive data is detected and masked when it is ingested into the log group. When you set a data protection policy, log events ingested to the log group before that time are not masked.

Topics

Console

To use the console to create an account-wide data protection policy

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Settings**. It is located near the bottom of the list.
3. Choose the **Logs** tab.
4. Choose **Configure**.
5. For **Managed data identifiers**, select the types of data that you want to audit and mask for all of your log groups. You can type in the selection box to find the identifiers that you want.

   We recommend that you select only the data identifiers that are relevant for your log data and your business. Choosing many types of data can lead to false positives.

   For details about which types of data that you can protect, see Types of data that you can protect.

6. (Optional) If you want to audit and mask other types of data by using custom data identifiers, choose **Add custom data identifier**. Then enter a name for the data type and the regular expression to use to search for that type of data in the log events. For more information, see Custom data identifiers.

   A single data protection policy can include up to 10 custom data identifiers. Each regular expression that defines a custom data identifier must be 200 characters or fewer.

7. (Optional) Choose one or more services to send the audit findings to. Even if you choose not to send audit findings to any of these services, the sensitive data types that you select will still be masked.

8. Choose **Activate data protection**.

AWS CLI

To use the AWS CLI to create a data protection policy

1. Use a text editor to create a policy file named `DataProtectionPolicy.json`. For information about the policy syntax, see the following section.

2. Enter the following command:

```
aws logs put-account-policy \
--policy-name TEST_POLICY --policy-type "DATA_PROTECTION_POLICY" \
--policy-document file://policy.json \
--scope "ALL" \
--region us-west-2
```

Data protection policy syntax for AWS CLI or API operations

When you create a JSON data protection policy to use in an AWS CLI command or API operation, the policy must include two JSON blocks:

- The first block must include both a `DataIdentifer` array and an `Operation` property with an `Audit` action. The `DataIdentifer` array lists the types of sensitive data that you want to mask. For more information about the available options, see Types of data that you can protect.

  The `Operation` property with an `Audit` action is required to find the sensitive data terms. This `Audit` action must contain a `FindingsDestination` object. You can optionally use

that `FindingsDestination` object to list one or more destinations to send audit findings reports to. If you specify destinations such as log groups, Amazon Data Firehose streams, and S3 buckets, they must already exist. For an example of an audit findins report, see Audit findings reports.

- The second block must include both a `DataIdentifer` array and an `Operation` property with an `Deidentify` action. The `DataIdentifer` array must exactly match the `DataIdentifer` array in the first block of the policy.

  The `Operation` property with the `Deidentify` action is what actually masks the data, and it must contain the `"MaskConfig": {}` object. The `"MaskConfig": {}` object must be empty.

The following is an example of a data protection policy using only managed data identifiers. This policy masks email addresses and United States driver's licenses.

For information about policies that specify custom data identifiers, see Using custom data identifiers in your data protection policy.

```
{
    "Name": "data-protection-policy",
    "Description": "test description",
    "Version": "2021-06-01",
    "Statement": [{
            "Sid": "audit-policy",
            "DataIdentifier": [
                "arn:aws:dataprotection::aws:data-identifier/EmailAddress",
                "arn:aws:dataprotection::aws:data-identifier/DriversLicense-US"
            ],
            "Operation": {
                "Audit": {
                    "FindingsDestination": {
                        "CloudWatchLogs": {
                            "LogGroup": "EXISTING_LOG_GROUP_IN_YOUR_ACCOUNT,"
                        },
                        "Firehose": {
                            "DeliveryStream": "EXISTING_STREAM_IN_YOUR_ACCOUNT"
                        },
                        "S3": {
                            "Bucket": "EXISTING_BUCKET"
                        }
                    }
```

```
                }
            }
        },
        {
            "Sid": "redact-policy",
            "DataIdentifier": [
                "arn:aws:dataprotection::aws:data-identifier/EmailAddress",
                "arn:aws:dataprotection::aws:data-identifier/DriversLicense-US"
            ],
            "Operation": {
                "Deidentify": {
                    "MaskConfig": {}
                }
            }
        }
    ]
}
```

Create a data protection policy for a single log group

You can use the CloudWatch Logs console or AWS CLI commands to create a data protection policy to mask sensitive data.

You can assign one data protection policy to each log group. Each data protection policy can audit for multiple types of information. Each data protection policy can include one audit statement.

Topics

- Console
- AWS CLI

Console

To use the console to create a data protection policy

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Logs**, **Log groups**.
3. Choose the name of the log group.
4. Choose **Actions**, **Create data protection policy**.

5. For **Managed data identifiers**, select the types of data that you want to audit and mask in this log group. You can type in the selection box to find the identifiers that you want.

   We recommend that you select only the data identifiers that are relevant for your log data and your business. Choosing many types of data can lead to false positives.

   For details about which types of data that you can protect by using managed data identifiers, see Types of data that you can protect.

6. (Optional) If you want to audit and mask other types of data by using custom data identifiers, choose **Add custom data identifier**. Then enter a name for the data type and the regular expression to use to search for that type of data in the log events. For more information, see Custom data identifiers.

   A single data protection policy can include up to 10 custom data identifiers. Each regular expression that defines a custom data identifier must be 200 characters or fewer.

7. (Optional) Choose one or more services to send the audit findings to. Even if you choose not to send audit findings to any of these services, the sensitive data types that you select will still be masked.

8. Choose **Activate data protection**.

AWS CLI

To use the AWS CLI to create a data protection policy

1. Use a text editor to create a policy file named `DataProtectionPolicy.json`. For information about the policy syntax, see the following section.

2. Enter the following command:

```
aws logs put-data-protection-policy --log-group-identifier "my-log-group" --policy-
document file:///Path/DataProtectionPolicy.json --region us-west-2
```

Data protection policy syntax for AWS CLI or API operations

When you create a JSON data protection policy to use in an AWS CLI command or API operation, the policy must include two JSON blocks:

- The first block must include both a `DataIdentifer` array and an `Operation` property with an `Audit` action. The `DataIdentifer` array lists the types of sensitive data that you want to mask. For more information about the available options, see Types of data that you can protect.

  The `Operation` property with an `Audit` action is required to find the sensitive data terms. This `Audit` action must contain a `FindingsDestination` object. You can optionally use that `FindingsDestination` object to list one or more destinations to send audit findings reports to. If you specify destinations such as log groups, Amazon Data Firehose streams, and S3 buckets, they must already exist. For an example of an audit findins report, see Audit findings reports.
- The second block must include both a `DataIdentifer` array and an `Operation` property with an `Deidentify` action. The `DataIdentifer` array must exactly match the `DataIdentifer` array in the first block of the policy.

  The `Operation` property with the `Deidentify` action is what actually masks the data, and it must contain the `"MaskConfig": {}` object. The `"MaskConfig": {}` object must be empty.

The following is an example of a data protection policy that masks email addresses and United States driver's licenses.

```
{
    "Name": "data-protection-policy",
    "Description": "test description",
    "Version": "2021-06-01",
    "Statement": [{
            "Sid": "audit-policy",
            "DataIdentifier": [
                "arn:aws:dataprotection::aws:data-identifier/EmailAddress",
                "arn:aws:dataprotection::aws:data-identifier/DriversLicense-US"
            ],
            "Operation": {
                "Audit": {
                    "FindingsDestination": {
                        "CloudWatchLogs": {
                            "LogGroup": "EXISTING_LOG_GROUP_IN_YOUR_ACCOUNT,"
                        },
                        "Firehose": {
                            "DeliveryStream": "EXISTING_STREAM_IN_YOUR_ACCOUNT"
                        },
```

```
                        "S3": {
                            "Bucket": "EXISTING_BUCKET"
                        }
                    }
                }
            }
        },
        {
            "Sid": "redact-policy",
            "DataIdentifier": [
                "arn:aws:dataprotection::aws:data-identifier/EmailAddress",
                "arn:aws:dataprotection::aws:data-identifier/DriversLicense-US"
            ],
            "Operation": {
                "Deidentify": {
                    "MaskConfig": {}
                }
            }
        }
    ]
}
```

View unmasked data

To view unmasked data, a user must have the `logs:Unmask` permission. Users with this permission can see the unmasked data in the following ways:

- When viewing the events in a log stream, choose **Display**, **Unmask**.
- Use a CloudWatch Logs Insights query that includes the **unmask(@message)** command. The following example query displays the 20 most recent log events in the stream, unmasked:

  ```
  fields @timestamp, @message, unmask(@message)
  | sort @timestamp desc
  | limit 20
  ```

  For more information about CloudWatch Logs Insights commands, see CloudWatch Logs Insights language query syntax.
- Use a GetLogEvents or FilterLogEvents operation with the `unmask` parameter.

The **CloudWatchLogsFullAccess** policy includes the `logs:Unmask` permission. To grant `logs:Unmask` to a user who does not have **CloudWatchLogsFullAccess**, you can attach a custom IAM policy to that user. For more information, see Adding permissions to a user (console).

Audit findings reports

If you set up CloudWatch Logs data protection audit policies to write audit reports to CloudWatch Logs, Amazon S3, or Firehose, these findings reports are similar to the following example. CloudWatch Logs writes one findings report for each log event that contains sensitive data.

```
{
    "auditTimestamp": "2023-01-23T21:11:20Z",
    "resourceArn": "arn:aws:logs:us-west-2:111122223333:log-group:/aws/lambda/
MyLogGroup:*",
    "dataIdentifiers": [
        {
            "name": "EmailAddress",
            "count": 2,
            "detections": [
                {
                    "start": 13,
                    "end": 26
                },
{
                    "start": 30,
                    "end": 43
                }
            ]
        }
    ]
}
```

The fields in the report are as follows:

- The `resourceArn` field displays the log group where the sensitive data was found.
- The `dataIdentifiers` object displays information about the findings for one type of senssitive data that you are auditing.
- The `name` field identifies which type of sensitive data this section is reporting about.
- The `count` field displays the number of times this type of sensitive data appears in the log event.

- The `start` and end fields show where in the log event, by character count, each occurrence of the sensitive data appears.

The previous example shows a report of finding two email addresses in one log event. The first email address starts at the 13th character of the log event and ends at the 26th character. The second email address runs from the 30th character to the 43rd character. Even though this log event has two email addresses, the value of the `LogEventsWithFindings` metric is incremented only by one, because that metric counts the number of log events that contain sensitive data, not the number of occurrences of sensitive data.

Required key policy to send audit findings to an bucket protected by AWS KMS

You can protect the data in an Amazon S3 bucket by enabling either Server-Side Encryption with Amazon S3-Managed Keys (SSE-S3) or Server-Side Encryption with KMS Keys (SSE-KMS). For more information, see Protecting data using server-side encryption in the Amazon S3 User Guide.

If you send audit findings to a bucket that is protected with SSE-S3, no additional configuration is required. Amazon S3 handles the encryption key.

If you send audit findings to a bucket that is protected with SSE-KMS, you must update the key policy for your KMS key so that the log delivery account can write to your S3 bucket. For more information about the required key policy for use with SSE-KMS, see Amazon S3 in the Amazon CloudWatch Logs User Guide.

Types of data that you can protect

This section contains information about the types of data that you can protect in a CloudWatch Logs data protection policy. CloudWatch Logs managed data identifiers offer preconfigured data types for protecting financial data, personal health information (PHI), and personally identifiable information (PII). You can also use custom data identifiers to create data identifiers tailored to your specific use case.

Contents

CloudWatch Logs managed data identifiers for sensitive data types

This section contains information about the types of data that you can protect using managed data identifiers, and which countries and regions are relevant for each of those types of data.

For some types of sensitive data, CloudWatch Logs data protection scans for keywords in the proximity of the data, and finds a match only if it finds that keyword. If a keyword has to be in proximity of a particular type of data, the keyword typically has to be within 30 characters (inclusively) of the data.

If a keyword contains a space, CloudWatch Logs data protection automatically matches keyword variations that are missing the space or that contain an underscore (_) or hyphen (-) instead of the space. In some cases, CloudWatch Logs also expands or abbreviates a keyword to address common variations of the keyword.

The following tables lists the types of credential, device, financial, medical, and protected health information (PHI) that CloudWatch Logs can detect using managed data identifiers. These are in addition to certain types of data that might also qualify as personally identifiable information (PII).

Supported identifiers that are language and region independent

Identifier	Category
`Address`	Personal
`AwsSecretKey`	Credentials
`CreditCardExpiration`	Financial
`CreditCardNumber`	Financial
`CreditCardSecurityCode`	Financial
`EmailAddress`	Personal
`IpAddress`	Personal
`LatLong`	Personal
`Name`	Personal
`OpenSshPrivateKey`	Credentials
`PgpPrivateKey`	Credentials
`PkcsPrivateKey`	Credentials
`PuttyPrivateKey`	Credentials
`VehicleIdentificationNumber`	Personal

Region-dependent data identifiers must include the identifier name, then a hyphen, and then the two-letter (ISO 3166-1 alpha-2) codes. For example, `DriversLicense-US`.

Supported identifiers that must include a two-letter country or region code

Identifier	Category	Countries and languages
BankAccountNumber	Financial	DE, ES, FR, GB, IT, US

Identifier	Category	Countries and languages
CepCode	Personal	BR
Cnpj	Personal	BR
CpfCode	Personal	BR
DriversLicense	Personal	AT, AU, BE, BG, CA, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IT, LT, LU, LV, MT, NL, PL, PT, RO, SE, SI, SK, US
DrugEnforcementAgencyNumber	Health	US
ElectoralRollNumber	Personal	GB
HealthInsuranceCardNumber	Health	EU
HealthInsuranceClaimNumber	Health	US
HealthInsuranceNumber	Health	FR
HealthcareProcedureCode	Health	US
IndividualTaxIdentificationNumber	Personal	US
InseeCode	Personal	FR
MedicareBeneficiaryNumber	Health	US
NationalDrugCode	Health	US
NationalIdentificationNumber	Personal	DE, ES, IT
NationalInsuranceNumber	Personal	GB
NationalProviderId	Health	US

Identifier	Category	Countries and languages
NhsNumber	Health	GB
NieNumber	Personal	ES
NifNumber	Personal	ES
PassportNumber	Personal	CA, DE, ES, FR, GB, IT, US
PermanentResidenceNumber	Personal	CA
PersonalHealthNumber	Health	CA
PhoneNumber	Personal	BR, DE, ES, FR, GB, IT, US
PostalCode	Personal	CA
RgNumber	Personal	BR
SocialInsuranceNumber	Personal	CA
Ssn	Personal	ES, US
TaxId	Personal	DE, ES, FR, GB
ZipCode	Personal	US

Credentials

CloudWatch Logs data protection can find the following types of credentials.

Type of data	Data identifier ID	Keyword required	Countries and regions
AWS secret access key	`AwsSecretKey`	`aws_secret_access_key ,credentials , secret access key,`	All

Type of data	Data identifier ID	Keyword required	Countries and regions
		`secret key`, `set-awscredential`	
OpenSSH private key	`OpenSSHPrivateKey`	None	All
PGP private key	`PgpPrivateKey`	None	All
Pkcs Private Key	`PkcsPrivateKey`	None	All
PuTTY private key	`PuttyPrivateKey`	None	All

Data identifier ARNs for credential data types

The following lists the Amazon Resource Names (ARNs) for the data identifiers that you can add to your data protection policies.

Credential data identifier ARNs
`arn:aws:dataprotection::aws:data-identifier/AwsSecretKey`
`arn:aws:dataprotection::aws:data-identifier/OpenSshPrivateKey`
`arn:aws:dataprotection::aws:data-identifier/PgpPrivateKey`
`arn:aws:dataprotection::aws:data-identifier/PkcsPrivateKey`
`arn:aws:dataprotection::aws:data-identifier/PuttyPrivateKey`

Device identifiers

CloudWatch Logs data protection can find the following types of device identifiers.

Type of data	Data identifier ID	Keyword required	Countries and regions
IP address	`IpAddress`	None	All

Data identifier ARNs for device data types

The following lists the Amazon Resource Names (ARNs) for the data identifiers that you can add to your data protection policies.

Device data identifier ARN
`arn:aws:dataprotection::aws:data-identifier/IpAddress`

Financial information

CloudWatch Logs data protection can find the following types of financial information.

If you set a data protection policy, CloudWatch Logs scans for the data identifiers that you specify no matter what geolocation the log group is located in. The information in the **Countries and regions** column in this table designates whether two-letter country codes must be appended to the data identifier to detect the appropriate keywords for those countries and regions.

Type of data	Data identifier ID	Keyword required	Countrie and regions	Notes
Bank account number	`BankAccountNumber`	Yes. Different keywords apply to different countries. For details, see the **Keywords for bank account numbers** table later in this section.	France, Germany Italy, Spain, United Kingdom United States	Includes International Bank Account Numbers (IBANs) that

Type of data	Data identifier ID	Keyword required	Countrie and regions	Notes
				consist of up to 34 alphanume ric character s, including elements such as country codes.
Credit card expiration date	`CreditCar dExpirati on`	`exp d`, `exp m`, `exp y`, `expiration` , `expiry`	All	

Type of data	Data identifier ID	Keyword required	Countries and regions	Notes
Credit card number	CreditCardNumber	account number, american express, amex, bank card, card, card number, card num, cc #, ccn, check card, credit, credit card#, dankort, debit, debit card, diners club, discover, electron, japanese card bureau, jcb, mastercard , mc, pan, payment account number, payment card number, pcn, union pay, visa	All	Detection requires the data to be a 13–19 digit sequence that adheres to the Luhn check formula, and uses a standard card number prefix for any of the following types of credit cards: American Express, Dankort, Diner's Club,

Type of data	Data identifier ID	Keyword required	Countrie and regions	Notes
				Discover, Electron, Japanese Card Bureau (JCB), Mastercard, UnionPay, and Visa.
Credit card verification code	`CreditCardSecurityCode`	`card id`, `card identification code`, `card identification number` , `card security code`, `card validation code` , `card validation number` , `card verification data` , `card verification value`, `cvc`, `cvc2`, `cvv`, `cvv2`, `elo verification code`	All	

Keywords for bank account numbers

Use the following keywords to bank account numbers. This includes International Bank Account Numbers (IBANs) that consist of up to 34 alphanumeric characters, including elements such as country codes.

Country	Keywords
France	account code, account number, accountno# , accountnumber# , bban, code bancaire, compte bancaire, customer account id, customer account number, customer bank account id, iban, numéro de compte
Germany	account code, account number, accountno# , accountnumber# , bankleitzahl , bban, customer account id, customer account number, customer bank account id, geheimzahl , iban, kartennummer , kontonummer , kreditkartennummer , sepa
Italy	account code, account number, accountno# , accountnumber# , bban, codice bancario, conto bancario, customer account id, customer account number, customer bank account id, iban, numero di conto
Spain	account code, account number, accountno# , accountnumber# , bban, código cuenta, código cuenta bancaria, cuenta cliente id, customer account ID, customer account number, customer bank account id, iban, número cuenta bancaria cliente, número cuenta cliente
United Kingdom	account code, account number, accountno# , accountnumber# , bban, customer account ID, customer account number, customer bank account id, iban, sepa
United States	bank account, bank acct, checking account, checking acct, deposit account, deposit acct, savings account, savings acct, chequing account, chequing acct

CloudWatch Logs doesn't report occurrences of the following sequences, which credit card issuers have reserved for public testing.

```
122000000000003, 2222405343248877, 2222990905257051, 2223007648726984,
 2223577120017656,
```

30569309025904, 34343434343434, 3528000700000000, 3530111333300000, 3566002020360505,
 36148900647913,
36700102000000, 371449635398431, 378282246310005, 378734493671000, 38520000023237,
 4012888888881881,
4111111111111111, 4222222222222, 4444333322221111, 4462030000000000, 4484070000000000,
 4911830000000,
4917300800000000, 4917610000000000, 4917610000000000003, 5019717010103742,
 5105105105105100,
5111010030175156, 5185540810000019, 5200828282828210, 5204230080000017,
 5204740009900014, 5420923878724339,
5454545454545454, 5455330760000018, 5506900490000436, 5506900490000444,
 5506900510000234, 5506920809243667,
5506922400634930, 5506927427317625, 5553042241984105, 5555553753048194,
 5555555555554444, 5610591081018250,
6011000990139424, 6011000400000000, 6011111111111117, 630490017740292441,
 630495060000000000,
6331101999990016, 6759649826438453, 6799990100000000019, and 76009244561.

Data identifier ARNs for financial data types

The following lists the Amazon Resource Names (ARNs) for the data identifiers that you can add to your data protection policies.

Financial data identifier ARNs
arn:aws:dataprotection::aws:data-identifier/BankAccountNumber-DE
arn:aws:dataprotection::aws:data-identifier/BankAccountNumber-ES
arn:aws:dataprotection::aws:data-identifier/BankAccountNumber-FR
arn:aws:dataprotection::aws:data-identifier/BankAccountNumber-GB
arn:aws:dataprotection::aws:data-identifier/BankAccountNumber-IT
arn:aws:dataprotection::aws:data-identifier/BankAccountNumber-US
arn:aws:dataprotection::aws:data-identifier/CreditCardExpiration
arn:aws:dataprotection::aws:data-identifier/CreditCardNumber

Financial data identifier ARNs
arn:aws:dataprotection::aws:data-identifier/CreditCardSecurityCode

Protected health information (PHI)

CloudWatch Logs data protection can find the following types of protected health information (PHI).

If you set a data protection policy, CloudWatch Logs scans for the data identifiers that you specify no matter what geolocation the log group is located in. The information in the **Countries and regions** column in this table designates whether two-letter country codes must be appended to the data identifier to detect the appropriate keywords for those countries and regions.

Type of data	Data identifier ID	Keyword required	Countries and regions
Drug Enforcement Agency (DEA) registration number	DrugEnforcementAgencyNumber	dea number, dea registration	United States
Health Insurance Card Number (EHIC)	HealthInsuranceCardNumber	assicurazione sanitaria numero, carta assicurazione numero, carte d’assurance maladie , carte européenne d'assurance maladie , ceam, ehic, ehic#, finlandehicnumber# , gesundheitskarte , hälsokort , health card, health card number, health insurance card, health insurance number,	European Union

Type of data	Data identifier ID	Keyword required	Countries and regions
		insurance card number, krankenversicherungskarte , krankenversicherungsnummer , medical account number, numero conto medico, numéro d’assurance maladie , numéro de carte d’assurance , numéro de compte medical, número de cuenta médica, número de seguro de salud, número de tarjeta de seguro, sairaanhoitokortin , sairausvakuutuskortti , sairausvakuutusnumero , sjukförsäkringnummer, sjukförsäkringskort , suomi ehic-numero , tarjeta de salud, terveyskortti , tessera sanitaria assicurazione numero , versicherungsnummer	
Health Insurance Claim Number (HICN)	HealthInsuranceClaimNumber	health insurance claim number, hic no, hic no., hic number, hic#, hicn, hicn#, hicno#	United States

Type of data	Data identifier ID	Keyword required	Countries and regions
Health insurance or medical identification number	`HealthInsuranceNumber`	`carte d'assuré social`, `carte vitale`, `insurance card`	France
Healthcare Common Procedure Coding System (HCPCS) code	`HealthcareProcedureCode`	`current procedural terminology` , `hcpcs`, `healthcare common procedure coding system`	United States
Medicare Beneficiary Number (MBN)	`MedicareBeneficiaryNumber`	`mbi`, `medicare beneficiary`	United States
National Drug Code (NDC)	`NationalDrugCode`	`national drug code`, `ndc`	United States
National Provider Identifier (NPI)	`NationalProviderId`	`hipaa`, `n.p.i.`, `national provider`, `npi`	United States
National Health Service (NHS) number	`NhsNumber`	`national health service`, `NHS`	Great Britain
Personal Health Number	`PersonalHealthNumber`	`canada healthcare number`, `msp number`, `care number`, `phn`, `soins de santé`	Canada

Data identifier ARNs for protected health information data types (PHI)

The following lists the data identifier Amazon Resource Names (ARNs) that can be used in protected health information (PHI) data protection policies.

PHI data identifier ARNs
arn:aws:dataprotection::aws:data-identifier/DrugEnforcementAgencyNumber-US
arn:aws:dataprotection::aws:data-identifier/HealthcareProcedureCode-US
arn:aws:dataprotection::aws:data-identifier/HealthInsuranceCardNumber-EU
arn:aws:dataprotection::aws:data-identifier/HealthInsuranceClaimNumber-US
arn:aws:dataprotection::aws:data-identifier/HealthInsuranceNumber-FR
arn:aws:dataprotection::aws:data-identifier/MedicareBeneficiaryNumber-US
arn:aws:dataprotection::aws:data-identifier/NationalDrugCode-US
arn:aws:dataprotection::aws:data-identifier/NationalInsuranceNumber-GB
arn:aws:dataprotection::aws:data-identifier/NationalProviderId-US
arn:aws:dataprotection::aws:data-identifier/NhsNumber-GB
arn:aws:dataprotection::aws:data-identifier/PersonalHealthNumber-CA

Personally identifiable information (PII)

CloudWatch Logs data protection can find the following types of personally identifiable information (PII).

If you set a data protection policy, CloudWatch Logs scans for the data identifiers that you specify no matter what geolocation the log group is located in. The information in the **Countries and**

regions column in this table designates whether two-letter country codes must be appended to the data identifier to detect the appropriate keywords for those countries and regions.

Type of data	Data identifier ID	Keyword required	Countrie and regions	Notes
Birth date	`DateOfBirth`	dob, `date of birth`, `birthdate` , `birth date`, `birthday`, `b-day`, `bday`	Any	Support includes most date formats, such as all digits and combinations of digits and names of months. Date components can be separated by spaces, slashes (/), or hyphens (-).
Código de Endereçamento Postal (CEP)	`CepCode`	`cep`, `código de endereçamento`	Brazil	

Type of data	Data identifier ID	Keyword required	Countries and regions	Notes
		`postal`, `codigo de endereçamento postal`		
Cadastro Nacional da Pessoa Jurídica (CNPJ)	`Cnpj`	`cadastro nacional da pessoa jurídica`, `cadastro nacional da pessoa juridica`, `cnpj`	Brazil	
Cadastro de Pessoas Físicas (CPF)	`CpfCode`	`Cadastro de pessoas fisicas`, `cadastro de pessoas físicas`, `cadastro de pessoa física`, `cadastro de pessoa fisica`, `cpf`	Brazil	
Driver's license identification number	`DriversLicense`	Yes. Different keywords apply to different countries. For details, see the **Drivers license identification numbers** table later in this section.	Many countries. For details, see the **Drivers license identification numbers** table.	

Type of data	Data identifier ID	Keyword required	Countrie and regions	Notes
Electoral roll number	`ElectoralRollNumber`	`electoral #`, `electoral number`, `electoral roll #`, `electoral roll no.`, `electoral roll number`, `electoral rollno`	United Kingdom	
Individual taxpayer identification	`IndividualTaxIdentificationNumber`	Yes. Different keywords apply to different countries. For details, see the **Individual taxpayer identification numbers** table later in this section.	Brazil, France, Germany Spain, United Kingdom	
National Institute for Statistics and Economic Studies (INSEE)	`InseeCode`	Yes. Different keywords apply to different countries. For details, see the **Keywords for national identification numbers** table later in this section.	France	

Type of data	Data identifier ID	Keyword required	Countrie and regions	Notes
National Identification Number	`NationalIdentificationNumber`	Yes. For details, see the **Keywords for national identification numbers** table later in this section.	Germany Italy, Spain	This includes Documento Nacional de Identidad (DNI) identifiers (Spain), Codice fiscale codes (Italy), and National Identity Card numbers (German).
National Insurance Number (NINO)	`NationalInsuranceNumber`	`insurance no.`, `insurance number`, `insurance# `, `national insurance number`, `nationalinsurance# `, `nationalinsurancenumber `, `nin`, `nino`	United Kingdom	–

Type of data	Data identifier ID	Keyword required	Countrie and regions	Notes
Número de identidad de extranjero (NIE)	`NieNumber`	Yes. Different keywords apply to different countries. For details, see the **Individual taxpayer identification numbers** table later in this section.	Spain	
Número de Identificación Fiscal (NIF)	`NifNumber`	Yes. Different keywords apply to different countries. For details, see the **Individual taxpayer identification numbers** table later in this section.	Spain	
Passport number	`PassportNumber`	Yes. Different keywords apply to different countries. For details, see the **Keywords for passport numbers** table later in this section.	Canada, France, Germany Italy, Spain, United Kingdom United States	

Type of data	Data identifier ID	Keyword required	Countrie and regions	Notes
Permanent residence number	Permanent Residence Number	carte résident permanent , numéro carte résident permanent , numéro résident permanent , permanent resident card, permanent resident card number, permanent resident no, permanent resident no., permanent resident number, pr no, pr no., pr non, pr number, résident permanent no., résident permanent non	Canada	

Type of data	Data identifier ID	Keyword required	Countrie and regions	Notes
Phone number	PhoneNumber	Brazil: keywords also include: `cel`, `celular`, `fone`, `móvel`, `número residencial` , `numero residencial` , `telefone` Others: `cell`, `contact`, `fax`, `fax number`, `mobile`, phone, phone number, `tel`, `telephone` , `telephone number`	Brazil, Canada, France, Germany Italy, Spain, United Kingdom United States	This includes toll-free numbers in the United States and fax numbers. If a keyword is in proximity of the data, the number doesn't have to include a country code. If a keyword isn't in proximity of the data,

Type of data	Data identifier ID	Keyword required	Countrie and regions	Notes
				the number has to include a country code.
Postal Code	`PostalCode`	None	Canada	
Registro Geral (RG)	`RgNumber`	Yes. Different keywords apply to different countries. For details, see the **Individual taxpayer identification numbers** table later in this section.	Brazil	
Social Insurance Number (SIN)	`SocialInsuranceNumber`	`canadian id`, `numéro d'assurance sociale`, `social insurance number`, `sin`	Canada	
Social Security Number (SSN)	`Ssn`	Spain – `número de la seguridad social`, `social security no.`, `social security no.` `número de la seguridad social`, `social security number`, `socialsecurityno#` , `ssn`, `ssn#` United States – `social security`, `ss#`, `ssn`	Spain, United States	

Type of data	Data identifier ID	Keyword required	Countrie and regions	Notes
Taxpayer identification or reference number	`TaxId`	Yes. Different keywords apply to different countries. For details, see the **Individual taxpayer identification numbers** table later in this section. .	France, Germany Spain, United Kingdom	This includes TIN (France); Steueride ntifikati onsnummer (Germany) ; CIF (Spain); and TRN, UTR (United Kingdom).
ZIP code	`ZipCode`	`zip code`, `zip+4`	United States	United States postal code.

Type of data	Data identifier ID	Keyword required	Countrie and regions	Notes
Mailing address	`Address`	None	Australia, Canada, France, Germany Italy, Spain, United Kingdom United States	Although a keyword isn't required, detection requires the address to include the name of a city or place and a ZIP code or Postal Code.
Electronic mail address	`EmailAddress`	None	Any	

Type of data	Data identifier ID	Keyword required	Countrie and regions	Notes
Global Positioning System (GPS) coordinates	`LatLong`	`coordinate , coordinates ,lat long, latitude longitude ,location, position`	Any	CloudWatch Logs can detect GPS coordinates if the latitude and longitude coordinates are stored as a pair and they're in Decimal Degrees (DD) format, for example, 41.948614,-87.655311. Support doesn't include coordinat

Type of data	Data identifier ID	Keyword required	Countrie and regions	Notes
				es in Degrees Decimal Minutes (DDM) format, for example 41°56.9168'N 87°39.3187'W, or Degrees, Minutes, Seconds (DMS) format, for example 41°56'55.0104"N 87°39'19.1196"W.

Type of data	Data identifier ID	Keyword required	Countrie and regions	Notes
Full name	`Name`	None	Any	CloudWatch Logs can detect full names only. Support is limited to Latin character sets.

Type of data	Data identifier ID	Keyword required	Countrie and regions	Notes
Vehicle Identification Number (VIN)	VehicleIdentificationNumber	Fahrgestellnummer , niv, numarul de identificare , numarul seriei de sasiu, serie sasiu, numer VIN, Número de Identificação do Veículo, Número de Identificación de Automóviles , numéro d'identification du véhicule, vehicle identification number, vin, VIN numeris	Any	CloudWatch Logs can detect VINs that consist of a 17-character sequence and adhere to the ISO 3779 and 3780 standards. These standards were designed for worldwide use.

Keywords for driver's license identification numbers

To detect various types of driver's license identification numbers, CloudWatch Logs requires a keyword to be in proximity of the numbers. The following table lists the keywords that CloudWatch Logs recognizes for specific countries and regions.

Country or region	Keywords
Australia	dl# dl:, dl :, dlno# driver licence, driver license, driver permit, drivers lic., drivers licence, driver's licence, drivers license, driver's license, drivers permit, driver's permit, drivers permit number, driving licence, driving license, driving permit
Austria	führerschein, fuhrerschein, führerschein republik österreich, fuhrerschein republik osterreich
Belgium	fuehrerschein, fuehrerschein- nr, fuehrersc heinnummer, fuhrerschein, führerschein, fuhrerschein- nr, führerschein- nr, fuhrersch einnummer, führerscheinnummer, numéro permis conduire, permis de conduire, rijbewijs, rijbewijsnummer
Bulgaria	превозно средство, свидетелство за управление на моторно, свидетелство за управление на мпс, сумпс, шофьорска книжка
Canada	dl#, dl:, dlno#, driver licence, driver licences, driver license, driver licenses, driver permit, drivers lic., drivers licence, driver's licence, drivers licences, driver's licences, drivers license, driver's license, drivers licenses, driver's licenses, drivers permit, driver's permit,

Country or region	Keywords
	drivers permit number, driving licence, driving license, driving permit, permis de conduire
Croatia	vozačka dozvola
Cyprus	άδεια οδήγησης
Czech Republic	číslo licence, číslo licence řidiče, číslo řidičskéh o průkazu, ovladače lic., povolení k jízdě, povolení řidiče, řidiči povolení, řidičský prúkaz, řidičský průkaz
Denmark	kørekort, kørekortnummer
Estonia	juhi litsentsi number, juhiloa number, juhiluba, juhiluba number
Finland	ajokortin numero, ajokortti, förare lic., körkort, körkort nummer, kuljettaja lic., permis de conduire
France	permis de conduire
Germany	fuehrerschein, fuehrerschein- nr, fuehrersc heinnummer, fuhrerschein, führerschein, fuhrerschein- nr, führerschein- nr, fuhrersch einnummer, führerscheinnummer
Greece	δεια οδήγησης, adeia odigisis
Hungary	illesztőprogramok lic, jogosítvány, jogsi, licencszám, vezető engedély, vezetői engedély
Ireland	ceadúnas tiomána
Italy	patente di guida, patente di guida numero, patente guida, patente guida numero

Country or region	Keywords
Latvia	autovadītāja apliecība, licences numurs, vadītāja apliecība, vadītāja apliecības numurs, vadītāja atļauja, vadītāja licences numurs, vadītāji lic.
Lithuania	vairuotojo pažymėjimas
Luxembourg	fahrerlaubnis, führerschäin
Malta	liċenzja tas-sewqan
Netherlands	permis de conduire, rijbewijs, rijbewijsnummer
Poland	numer licencyjny, prawo jazdy, zezwolenie na prowadzenie
Portugal	carta de condução, carteira de habilitação, carteira de motorist, carteira habilitação, carteira motorist, licença condução, licença de condução, número de licença, número licença, permissão condução, permissão de condução
Romania	numărul permisului de conducere, permis de conducere
Slovakia	číslo licencie, číslo vodičského preukazu, ovládače lic., povolenia vodičov, povolenie jazdu, povolenie na jazdu, povolenie vodiča, vodičský preukaz
Slovenia	vozniško dovoljenje

Country or region	Keywords
Spain	carnet conducer, el carnet de conducer, licencia conducer, licencia de manejo, número carnet conducer, número de carnet de conducer, número de permiso conducer, número de permiso de conducer, número licencia conducer, número permiso conducer, permiso conducción, permiso conducer, permiso de conducción
Sweden	ajokortin numero, dlno# ajokortti, drivere lic., förare lic., körkort, körkort nummer, körkortsn ummer, kuljettajat lic.
United Kingdom	dl#, dl:, dlno#, driver licence, driver licences, driver license, driver licenses, driver permit, drivers lic., drivers licence, driver's licence, drivers licences, driver's licences, drivers license, driver's license, drivers licenses, driver's licenses, drivers permit, driver's permit, drivers permit number, driving licence, driving license, driving permit
United States	dl#, dl:, dlno#, driver licence, driver licences, driver license, driver licenses, driver permit, drivers lic., drivers licence, driver's licence, drivers licences, driver's licences, drivers license, driver's license, drivers licenses, driver's licenses, drivers permit, driver's permit, drivers permit number, driving licence, driving license, driving permit

Keywords for national identification numbers

To detect various types of national identification numbers, CloudWatch Logs requires a keyword to be in close proximity to the numbers. This includes Documento Nacional de Identidad (DNI)

identifiers (Spain), French National Institute for Statistics and Economic Studies (INSEE) codes, German National Identity Card numbers, and Registro Geral (RG) numbers (Brazil).

The following table lists the keywords that CloudWatch Logs recognizes for specific countries and regions.

Country or region	Keywords
Brazil	registro geral, rg
France	assurance sociale, carte nationale d’identit é, cni, code sécurité sociale, French social security number, fssn#, insee, insurance number, national id number, nationalid#, numéro d'assurance, sécurité sociale, sécurité sociale non., sécurité sociale numéro, social, social security, social security number, socialsecuritynumber, ss#, ssn, ssn#
Germany	ausweisnummer, id number, identification number, identity number, insurance number, personal id, personalausweis
Italy	codice fiscal, dati anagrafici, ehic, health card, health insurance card, p. iva, partita i.v.a., personal data, tax code, tessera sanitaria
Spain	dni, dni#, dninúmero#, documento nacional de identidad, identidad único, identidad único#, insurance number, national identific ation number, national identity, nationalid#, nationalidno#, número nacional identidad , personal identification number, personal identity no, unique identity number, uniqueid#

Keywords for passport numbers

To detect various types of passport numbers, CloudWatch Logs requires a keyword to be in proximity of the numbers. The following table lists the keywords that CloudWatch Logs recognizes for specific countries and regions.

Country or region	Keywords
Canada	passeport, passeport#, passport, passport#, passportno, passportno#
France	numéro de passeport, passeport, passeport #, passeport #, passeportn °, passeport n °, passeportNon, passeport non
Germany	ausstellungsdatum, ausstellungsort, geburtsdatum, passport, passports, reisepass, reisepass–nr, reisepassnummer
Italy	italian passport number, numéro passeport , numéro passeport italien, passaporto, passaporto italiana, passaporto numero, passport number, repubblica italiana passaporto
Spain	españa pasaporte, libreta pasaporte, número pasaporte, pasaporte, passport, passport book, passport no, passport number, spain passport
United Kingdom	passeport #, passeport n °, passeportNon, passeport non, passeportn °, passport #, passport no, passport number, passport#, passportid
United States	passport, travel document

Keywords for taxpayer identification and reference numbers

To detect various types of taxpayer identification and reference numbers, CloudWatch Logs requires a keyword to be in proximity of the numbers. The following table lists the keywords that CloudWatch Logs recognizes for specific countries and regions.

Country or region	Keywords
Brazil	cadastro de pessoa física, cadastro de pessoa fisica, cadastro de pessoas físicas, cadastro de pessoas fisicas, cadastro nacional da pessoa jurídica, cadastro nacional da pessoa juridica, cnpj, cpf
France	numéro d'identification fiscale, tax id, tax identification number, tax number, tin, tin#
Germany	identifikationsnummer, steuer id, steueride ntifikationsnummer, steuernummer, tax id, tax identification number, tax number
Spain	cif, cif número, cifnúmero#, nie, nif, número de contribuyente, número de identidad de extranjero, número de identificación fiscal, número de impuesto corporativo, personal tax number, tax id, tax identification number, tax number, tin, tin#
United Kingdom	paye, tax id, tax id no., tax id number, tax identification, tax identification#, tax no., tax number, tax reference, tax#, taxid#, temporary reference number, tin, trn, unique tax reference, unique taxpayer reference, utr
United States	individual taxpayer identification number, itin, i.t.i.n.

Data identifier ARNs for personally identifiable information (PII)

The following table lists the Amazon Resource Names (ARNs) for the personally identifiable information (PII) data identifiers that you can add to your data protection policies.

PII data identifier ARNs
arn:aws:dataprotection::aws:data-identifier/Address
arn:aws:dataprotection::aws:data-identifier/CepCode-BR
arn:aws:dataprotection::aws:data-identifier/Cnpj-BR
arn:aws:dataprotection::aws:data-identifier/CpfCode-BR
arn:aws:dataprotection::aws:data-identifier/DriversLicense-AT
arn:aws:dataprotection::aws:data-identifier/DriversLicense-AU
arn:aws:dataprotection::aws:data-identifier/DriversLicense-BE
arn:aws:dataprotection::aws:data-identifier/DriversLicense-BG
arn:aws:dataprotection::aws:data-identifier/DriversLicense-CA
arn:aws:dataprotection::aws:data-identifier/DriversLicense-CY
arn:aws:dataprotection::aws:data-identifier/DriversLicense-CZ
arn:aws:dataprotection::aws:data-identifier/DriversLicense-DE
arn:aws:dataprotection::aws:data-identifier/DriversLicense-DK
arn:aws:dataprotection::aws:data-identifier/DriversLicense-EE
arn:aws:dataprotection::aws:data-identifier/DriversLicense-ES
arn:aws:dataprotection::aws:data-identifier/DriversLicense-FI
arn:aws:dataprotection::aws:data-identifier/DriversLicense-FR
arn:aws:dataprotection::aws:data-identifier/DriversLicense-GB

PII data identifier ARNs
arn:aws:dataprotection::aws:data-identifier/DriversLicense-GR
arn:aws:dataprotection::aws:data-identifier/DriversLicense-HR
arn:aws:dataprotection::aws:data-identifier/DriversLicense-HU
arn:aws:dataprotection::aws:data-identifier/DriversLicense-IE
arn:aws:dataprotection::aws:data-identifier/DriversLicense-IT
arn:aws:dataprotection::aws:data-identifier/DriversLicense-LT
arn:aws:dataprotection::aws:data-identifier/DriversLicense-LU
arn:aws:dataprotection::aws:data-identifier/DriversLicense-LV
arn:aws:dataprotection::aws:data-identifier/DriversLicense-MT
arn:aws:dataprotection::aws:data-identifier/DriversLicense-NL
arn:aws:dataprotection::aws:data-identifier/DriversLicense-PL
arn:aws:dataprotection::aws:data-identifier/DriversLicense-PT
arn:aws:dataprotection::aws:data-identifier/DriversLicense-RO
arn:aws:dataprotection::aws:data-identifier/DriversLicense-SE
arn:aws:dataprotection::aws:data-identifier/DriversLicense-SI
arn:aws:dataprotection::aws:data-identifier/DriversLicense-SK
arn:aws:dataprotection::aws:data-identifier/DriversLicense-US
arn:aws:dataprotection::aws:data-identifier/ElectoralRollNumber-GB
arn:aws:dataprotection::aws:data-identifier/EmailAddress

PII data identifier ARNs
arn:aws:dataprotection::aws:data-identifier/IndividualTaxIdentificationNumber-US
arn:aws:dataprotection::aws:data-identifier/InseeCode-FR
arn:aws:dataprotection::aws:data-identifier/LatLong
arn:aws:dataprotection::aws:data-identifier/Name
arn:aws:dataprotection::aws:data-identifier/NationalIdentificationNumber-DE
arn:aws:dataprotection::aws:data-identifier/NationalIdentificationNumber-ES
arn:aws:dataprotection::aws:data-identifier/NationalIdentificationNumber-IT
arn:aws:dataprotection::aws:data-identifier/NieNumber-ES
arn:aws:dataprotection::aws:data-identifier/NifNumber-ES
arn:aws:dataprotection::aws:data-identifier/PassportNumber-CA
arn:aws:dataprotection::aws:data-identifier/PassportNumber-DE
arn:aws:dataprotection::aws:data-identifier/PassportNumber-ES
arn:aws:dataprotection::aws:data-identifier/PassportNumber-FR
arn:aws:dataprotection::aws:data-identifier/PassportNumber-GB
arn:aws:dataprotection::aws:data-identifier/PassportNumber-IT
arn:aws:dataprotection::aws:data-identifier/PassportNumber-US
arn:aws:dataprotection::aws:data-identifier/PermanentResidenceNumber-CA

PII data identifier ARNs
arn:aws:dataprotection::aws:data-identifier/PhoneNumber-BR
arn:aws:dataprotection::aws:data-identifier/PhoneNumber-DE
arn:aws:dataprotection::aws:data-identifier/PhoneNumber-ES
arn:aws:dataprotection::aws:data-identifier/PhoneNumber-FR
arn:aws:dataprotection::aws:data-identifier/PhoneNumber-GB
arn:aws:dataprotection::aws:data-identifier/PhoneNumber-IT
arn:aws:dataprotection::aws:data-identifier/PhoneNumber-US
arn:aws:dataprotection::aws:data-identifier/PostalCode-CA
arn:aws:dataprotection::aws:data-identifier/RgNumber-BR
arn:aws:dataprotection::aws:data-identifier/SocialInsuranceNumber-CA
arn:aws:dataprotection::aws:data-identifier/Ssn-ES
arn:aws:dataprotection::aws:data-identifier/Ssn-US
arn:aws:dataprotection::aws:data-identifier/TaxId-DE
arn:aws:dataprotection::aws:data-identifier/TaxId-ES
arn:aws:dataprotection::aws:data-identifier/TaxId-FR
arn:aws:dataprotection::aws:data-identifier/TaxId-GB
arn:aws:dataprotection::aws:data-identifier/VehicleIdentificationNumber
arn:aws:dataprotection::aws:data-identifier/ZipCode-US

Custom data identifiers

Topics

What are custom data identifiers?

Custom data identifiers (CDIs) let you define your own custom regular expressions that can be used in your data protection policy. Using custom data identifiers, you can target business-specific personally identifiable information (PII) use cases that managed data identifiers can't provide. For example, you can use a custom data identifier to look for company-specific employee IDs. Custom data identifiers can be used in conjunction with managed data identifiers.

Custom data identifier constraints

CloudWatch Logs custom data identifiers have the following limitations:

- A maximum of 10 custom data identifiers are supported for each data protection policy.
- Custom data identifier names have a maximum length of 128 characters. The following characters are supported:
  - Alphanumeric: (a-zA-Z0-9)
  - Symbols: ('_' | '-')
- RegEx has a maximum length of 200 characters. The following characters are supported:
  - Alphanumeric: (a-zA-Z0-9)
  - Symbols: ('_' | '#' | '=' | '@' |'/' | ';' | ',' | '-' | ' ')
  - RegEx reserved characters: ('^' | '$' | '?' | '[' | ']' | '{' | '}' | '|' | '\\' | '*' | '+' | '.')
- Custom data identifiers cannot share the same name as a managed data identifier.
- Custom data identifiers can be specified within an account-level data protection policy or in log group-level data protection policies. Similar to managed data identifiers, custom data identifiers defined within an account-level policy work in combination with custom data identifiers defined in a log group-level policy.

Using custom data identifiers in the console

When you use the CloudWatch console to create or edit a data protection policy, to specify a custom data identifier you just enter a name and regular expression for the data identifier. For example, you might enter **`Employee_ID`** for the name and **`EmployeeID-\d{9}`** as the regular expression. This regular expression will detect and mask log events with nine numbers after `EmployeeID-`. For example, `EmployeeID-123456789`

Using custom data identifiers in your data protection policy

If you are using the AWS CLI or AWS API to specify a custom data identifier, you need to include the data identifier name and regular expression in the JSON policy used to define the data protection policy. The following data protection policy detects and masks log events that carry company-specific employee IDs.

1. Create a `Configuration` block within your data protection policy.
2. Enter a `Name` for your custom data identifier. For example, **`EmployeeId`**.
3. Enter a `Regex` for your custom data identifier. For example, **`EmployeeID-\d{9}`**. This regular expression will match log events containing `EmployeeID-` that have nine digits after `EmployeeID-`. For example, `EmployeeID-123456789`
4. Refer to the following custom data identifier in a policy statement.

```
{
    "Name": "example_data_protection_policy",
    "Description": "Example data protection policy with custom data identifiers",
    "Version": "2021-06-01",
    "Configuration": {
      "CustomDataIdentifier": [
        {"Name": "EmployeeId", "Regex": "EmployeeId-\\d{9}"}
      ]
    },
    "Statement": [
        {
            "Sid": "audit-policy",
            "DataIdentifier": [
                "EmployeeId"
            ],
            "Operation": {
                "Audit": {
                    "FindingsDestination": {
                        "S3": {
```

```
                            "Bucket": "EXISTING_BUCKET"
                        }
                    }
                }
            }
        },
        {
            "Sid": "redact-policy",
            "DataIdentifier": [
            "EmployeeId"
            ],
            "Operation": {
                "Deidentify": {
                    "MaskConfig": {
                    }
                }
            }
        }
    ]
}
```

5. (Optional) Continue to add additional **custom data identifiers** to the `Configuration` block as needed. Data protection policies currently support a maximum of 10 custom data identifiers.

Transform logs during ingestion

With logs transformation and enrichment, you can normalize all your logs in a consistent and context-rich format at the time of ingestion into CloudWatch Logs. You can add structure to your logs by using pre-configured templates for common AWS services such as AWS WAF and Amazon Route 53, or build custom transformers with native parsers such as Grok. You can also rename existing attributes and add additional metadata to your logs such as account ID, and Region.

Log transformation helps simplify and shorten your log queries across your applications, and helps simplify creating alerts on your logs. This feature provides transformation for common log types with out-of-the-box transformation templates for major AWS log sources like VPC Flow logs, Route 53, and Amazon RDS for PostgreSQL. You can use pre-configured transformation templates or create custom transformers to suit your needs.

Log transformation helps you manage logs emitted from various sources that vary widely in format and attribute names.

After you create a transformer, ingested log events are converted and stored in a standard format. You can leverage these transformed logs to accelerate your analytics experience with the following features:

- Field indexes
- CloudWatch Logs Insights discovered fields
- Flexibility in alarming using metric filters
- Forwarding via subscription filters
- Creating metric data from log events with Contributor Insights, where you can choose to have the Contributor Insights rule evaluate log events either before or after they are transformed.

Transformations happen only during log ingestion. You can't transform log events that have already been ingested. Transformations are not reversible. Both original and transformed logs are stored in CloudWatch Logs with the same retention policy. Log transformation and enrichment capability is included in the existing Standard log class ingestion price. Log storage costs will be based on log size after transformation, which might exceed the original log volume.

Important

After log events have been transformed, you must use CloudWatch Logs Insights queries to view the transformed versions of the logs. The GetLogEvents and FilterLogEvents actions return only the original versions of the log events, before they were transformed.

Important

Despite a single log event in PutLogEvents allowing upto 1MB, logs transformation can only handle log event of size less than 512kb. Any log events greather than 512kb will fail in transformation and emit an error. Total size of PutLogEvents can still go over 512kb.

In addition to transforming into different formats, you can also enrich your logs with additional context, such as account ID, Region, and keyword. These are extracted from the log group name and from static keywords.

Log transformation helps you with logs emitted from various sources that vary widely in format and attribute names.

Log transformation and enrichment is supported only for log groups in the Standard log class.

You can create transformers for individual log groups, and you can also create account-level transformers that apply to all or many log groups in your account. If a log group has a log group-level transformer, that transformer overrides any account-level transformer that would otherwise apply to that log group.

Topics

Create and manage log transformers

A log transformer includes one or more *processors* that are in a logical pipeline together. Each processor is applied to a log event, one after the other in the order that they are listed in the transformer configuration.

Some processors are of the *parser* type. Each transformer must have at least one parser, and the first processor in a transformer must be a parser.

Some of the parsers are built-in parsers that are configured for a certain type of AWS vended log.

Other processor types are string mutators, JSON mutators, and data processors.

You can create transformers for individual log groups, and you can also create account-level transformers that apply to all or many log groups in your account. If a log group has a log group-level transformer, that transformer overrides any account-level transformer that would otherwise apply to that log group. You can have as many as 20 account-level transformers in a Region in your account.

You must follow these guidelines when you create a transformer:

- If you include a pre-configured parser for a type of AWS vended logs, it must be the first processor listed in the transformer. You can include only one such processor in a transformer.
- You can include only one `grok` processor in a transformer.
- You must have at least one parser-type processor in a transformer. You can include as many as five parser-type processors. This limit of five includes both built-in parsers and configurable parsers.
- You can have as many as 20 processors in a transformer.
- You can include only one **addKeys** processor in a transformer.
- You can include only one **copyValue** processor in a transformer.
- Each transformer can extract up to 200 fields from a log event.
- Each log event **MUST** be below 512KB. Total size of log events can still go over 512KB.

Topics

- Create a log-group-level log transformer from scratch
- Create a log-group-level transformer by copying an existing one
- Edit a log-group-level transformer
- Delete a log-group-level transformer

Create an account-level transformer policy

Use the steps in this section to create a transformer policy that applies to all log groups in the account, or to multiple log groups that have log group names that start with the same string (prefix). You can have as many as 20 account-level transformer policies in a Region.

You can't create two transformer policies in the same Region that use the same prefix or have one prefix contained within another. For example, if you create one transformer policy for the string prefix `/aws/lambda`, you can't create another with the prefix `/aws`. But you could have one transformer for `/aws/lambda` and another for `/aws/waf`

To create an account-level transformer policy

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the left navigation pane, choose **Settings** and then choose the **Logs** tab.
3. In the **Transformer policy for account** section, choose **Create transformer policy**.
4. For **Transformer policy name**, enter a name for your new poiicy.
5. For **Select log groups**, do one of the following:
   - Choose **All standard log groups** to have the transformer policy apply to all Standard Class log groups in the account.
   - choose **Log groups by prefix match** to apply the policy to a subset of log groups that all have names that start with the same string. Then, enter the prefix for these log groups in **Selection criteria**.
6. In the **Select parsers** area, use **Parsers** to select a parser to include in your transformer.

   If it is a pre-configured parser for a type of AWS vended log, you don't have to specify any configuration for it.

   If it is a different parser, you need to specify its configuration. For more information, see the information for that processor in Configurable parser-type processors.

7. To add another processor, choose **Select processor**. Then select the processor that you want in the **Processor** box, and fill in the configuration parameters.

   Remember that processors operate on the log events in the order that you add them to the transformer.
8. (Optional) To add additional processors, choose **+ Processor** and repeat the previous step.
9. (Optional) At any time, you can test the transformer that you have built so far on a sample log event. To do so, do one of the following in the **Transformer preview** section:
   - Select as many as five log groups in **Select log groups** and then choose **Load latest log events**. Then choose **Test transformer**.
   - Copy log events directly into **Sample log events** and then choose **Test transformer**.

   The transformed version of the log then appears.
10. When you are finished adding processors and satisfied with the tests on sample logs, choose **Save**.
11. When you have finished, choose **Create**.

Edit or delete an account-level transformer policy

Use the steps in this section to edit or delete an account-level transformer policy.

To edit or delete an account-level transformer policy

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the left navigation pane, choose **Settings** and then choose the **Logs** tab.
3. In the **Transformer account policy** section, choose **Manage**.
4. Select the button by the transformer policy that you want to manage, and then choose **Edit** or **Delete**.

   If you're editing the policy, see steps 5-11 in Configurable parser-type processors to see your options.

Create a log-group-level log transformer from scratch

Use these steps to create a log-group-level transformer from scratch.

To use the console to create a log transformer for a log group

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Logs**, **Log groups**.
3. Choose the log group that you want to create the transformer for.
4. Choose the **Transformer** tab. You might have to scroll the tab list to the right to see it.
5. Choose **Create transformer**.
6. In the **Choose a parser** box, select a parser to include in your transformer.

   If it is a pre-configured parser for a type of AWS vended log, you don't have to specify any configuration for it.

   If it is a different parser, you need to specify its configuration. For more information, see the information for that processor in Configurable parser-type processors.
7. To add another processor, choose **+ Add processor**. Then select the processor that you want in the **Choose processors** box, and fill in the configuration parameters.

   Remember that processors operate on the log events in the order that you add them to the transformer.
8. (Optional) At any time, you can test the transformer that you have built so far on a sample log event. To do so, do the following:

   - In the **Transformation preview** section, either choose **Load sample log** to load a sample log event from the log group that this transformer is for, or paste a log event into the text box.

     Choose **Test transformer**. The transformed version of the log appears
9. When you are finished adding processors and satisfied with the tests on sample logs, choose **Save**.

To use the AWS CLI to create a log transformer from scratch

- Use the `aws logs put-transformer` command. When using `parseJSON` as the first processor, you must parse the entire log event using `@message` as the source field. After the initial JSON parsing, you can then manipulate specific fields in subsequent processors. The following is an example that creates a transformer that includes the `parseJSON` and `addKeys` processors:

```
 aws logs put-transformer \
  --transformer-config '[{"parseJSON":{"source":"@message"}},{"addKeys":
{"entries":[{"key":"metadata.transformed_in","value":"CloudWatchLogs"},
{"key":"feature","value":"Transformation"}]}},{"trimString":{"withKeys":
["status"]}}]' \
  --log-group-identifier my-log-group-name
```

Create a log-group-level transformer by copying an existing one

You can use the console to copy the JSON configuration of an existing transformer. You can then use that code to create an identical transformer by using the AWS CLI, or you can modify the configuration first.

To create a log transformer by copying an existing one

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Logs**, **Log groups**.
3. Choose the log group that has the transformer that you want to copy.
4. Choose the **Transformations** tab. You might have to scroll the tab list to the right to see it.
5. Choose **Manage transformer**.
6. Choose **Copy transformer**. This copies the transformer JSON to your clipboard.
7. Create a file and paste in the transformer configuration. In this example we'll call the file `CopiedTransformer.json`
8. Use the AWS CLI to create a new transformer with that configuration.

```
aws logs put-transformer --log-group-identifier my-log-group-name \
--transformer-config file://CopiedTransformer.json
```

Edit a log-group-level transformer

Use these steps to edit an existing log transformer.

To edit a log transformer

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.

2. In the navigation pane, choose **Logs**, **Log groups**.
3. Choose the log group that has the transformer that you want to edit.
4. Choose the **Transformations** tab. You might have to scroll the tab list to the right to see it.
5. Choose **Manage transformer**.
6. In the **Parsers** and **Processors** sections, make your changes.
7. To add another processor, choose **+ Add Processor**. Then select the processor that you want in the **Processor** box, and fill in the configuration parameters.

   Remember that processors operate on the log events in the order that you add them to the transformer.
8. (Optional) At any time, you can test the transformer that you have built so far on a sample log event. To do so, do the following:

   - In the **Transformation Preview** section, either choose **Load Sample Log** to load a sample log event from the log group that this transformer is for, or paste a log event into the text box.

     Choose **Test Transformation**. The transformed version of the log appears
9. When you are finished adding processors and satisfied with the tests on sample logs, choose **Save**.

Delete a log-group-level transformer

Use these steps to delete a log transformer.

To delete a log transformer

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Logs**, **Log groups**.
3. Choose the log group that has the transformer that you want to edit.
4. Choose the **Transformations** tab. You might have to scroll the tab list to the right to see it.
5. Choose **Delete**.
6. In the confirmation box, choose **Delete Policy**.

Configurable parser-type processors

This section contains information about the configurable data parser processors that you can use in a log event transformer.

Contents

parseJSON

The **parseJSON** processor parses JSON log events and inserts extracted JSON key-value pairs under the destination. If you don't specify a destination, the processor places the key-value pair under the root node. When using `parseJSON` as the first processor, you must parse the entire log event using `@message` as the source field. After the initial JSON parsing, you can then manipulate specific fields in subsequent processors.

The original `@message` content is not changed, the new keys are added to the message.

Field	Description	Required?	Default	Limits
source	Path to the field in the log event that will be parsed. Use dot	No	`@message`	Maximum length: 128

Field	Description	Required?	Default	Limits
	notation to access child fields. For example, `store.book`			Maximum nested key depth: 3
destination	The destination field of the parsed JSON	No	`Parent JSON node`	Maximum length: 128 Maximum nested key depth: 3

Example

Suppose an ingested log event looks like this:

```
{
    "outer_key": {
        "inner_key": "inner_value"
    }
}
```

Then if we have this **parseJSON** processor:

```
[
   {
        "parseJSON": {
            "destination": "new_key"
        }
   }
]
```

The transformed log event would be the following.

```
{
    "new_key": {
        "outer_key": {
            "inner_key": "inner_value"
        }
    }
}
```

grok

Use the grok processor to parse and structure unstructured data using pattern matching. This processor can also extract fields from log messages.

Field	Description	Required	Default	Limits	Notes
source	Path of the field to apply Grok matching on	No	`@messag`	Maximum length: 128 Maximum nested key depth: 3	
match	The grok pattern to match against the log event	Yes		Maximum length: 512 Maximum grok patterns: 20 Some grok pattern types have individual usage limits. Any combination of the following patterns can be used as many as five times: {URI, URIPARAM, URIPATHPARAM, SPACE, DATA, GREEDYDAT A, GREEDYDAT A_MULTILINE} Grok patterns don't support type conversions.	See all supported Grok patterns

Field	Description	Required	Default	Limits	Notes
				For common log format patterns (APACHE_ACCESS_LOG, NGINX_ACCESS_LOG, SYSLOG5424), only DATA, GREEDYDATA, or GREEDYDATA_MULTILINE patterns are supported to be included after the common log pattern.	

Structure of a Grok Pattern

This is the supported grok pattern structure:

```
%{PATTERN_NAME:FIELD_NAME}
```

- **PATTERN_NAME**: Refers to a pre-defined regular expression for matching a specific type of data. Only predefined grok patterns are supported. Creating custom patterns is not allowed.
- **FIELD_NAME**: Assigns a name to the extracted value. `FIELD_NAME` is optional, but if you don't specify this value then the extracted data will be dropped from the transformed log event. If `FIELD_NAME` uses dotted notation (e.g., "parent.child"), it is considered as a JSON path.
- **Type Conversion**: Explicit type conversions are not be supported. Use TypeConverter processor to convert the datatype of any value extracted by grok.

To create more complex matching expressions, you can combine several grok patterns. As many as 20 grok patterns can be combined to match a log event. For example, this combination of patterns

`%{NUMBER:timestamp} [%{NUMBER:db} %{IP:client_ip}:%{NUMBER:client_port}] %{GREEDYDATA:data}` can be used to extract fields from a Redis slow log entry like this:

`1629860738.123456 [0 127.0.0.1:6379] "SET" "key1" "value1"`

Grok examples

Example 1: Use grok to extract a field from unstructured logs

Sample log:

```
293750 server-01.internal-network.local OK "[Thread-000] token generated"
```

Transformer used:

```
[
     {
         "grok": {
             "match": "%{NUMBER:version} %{HOSTNAME:hostname} %{NOTSPACE:status}
 %{QUOTEDSTRING:logMsg}"
         }
    }
]
```

Output:

```
{
  "version": "293750",
  "hostname": "server-01.internal-network.local",
  "status": "OK",
  "logMsg": "[Thread-000] token generated"
}
```

Sample log:

```
23/Nov/2024:10:25:15 -0900 172.16.0.1 200
```

Transformer used:

```
[
```

```
    {
        "grok": {
            "match": "%{HTTPDATE:timestamp} %{IPORHOST:clientip}
 %{NUMBER:response_status}"
        }
    }
]
```

Output:

```
{
  "timestamp": "23/Nov/2024:10:25:15 -0900",
  "clientip": "172.16.0.1",
  "response_status": "200"
}
```

Example 2: Use grok in combination with parseJSON to extract fields from a JSON log event

Sample log:

```
{
    "timestamp": "2024-11-23T16:03:12Z",
    "level": "ERROR",
    "logMsg": "GET /page.html HTTP/1.1"
}
```

Transformer used:

```
[
     {
        "parseJSON": {}
    },
    {
         "grok": {
            "source": "logMsg",
             "match": "%{WORD:http_method} %{NOTSPACE:request} HTTP/
%{NUMBER:http_version}"
         }
    }
]
```

Output:

```
{
  "timestamp": "2024-11-23T16:03:12Z",
  "level": "ERROR",
  "logMsg": "GET /page.html HTTP/1.1",
  "http_method": "GET",
  "request": "/page.html",
  "http_version": "1.1"
}
```

Example 3: Grok pattern with dotted annotation in FIELD_NAME

Sample log:

```
192.168.1.1 GET /index.html?param=value 200 1234
```

Transformer used:

```
[
    {
        "grok": {
            "match": "%{IP:client.ip} %{WORD:method} %{URIPATHPARAM:request.uri}
 %{NUMBER:response.status} %{NUMBER:response.bytes}"
        }
    }
]
```

Output:

```
{
  "client": {
    "ip": "192.168.1.1"
  },
  "method": "GET",
  "request": {
    "uri": "/index.html?param=value"
  },
  "response": {
    "status": "200",
    "bytes": "1234"
  }
}
```

Supported grok patterns

The following tables list the patterns that are supported by the `grok` processor.

General grok patterns

Grok Pattern	Description	Maximum pattern limit	Example
USERNAME or USER	Matches one or more characters that can include lowercase letters (a-z), uppercase letters (A-Z), digits (0-9), dots (.), underscores (_), or hyphens (-)	20	Input: `user123.name-TEST` Pattern: `%{USERNAME:name}` Output: `{"name": "user123.name-TEST"}`
INT	Matches an optional plus or minus sign followed by one or more digits.	20	Input: `-456` Pattern: `%{INT:num}` Output: `{"num": "-456"}`
BASE10NUM	Matches an integer or a floating-point number with optional sign and decimal point	20	Input: `-0.67` Pattern: `%{BASE10NUM:num}` Output: `{"num": "-0.67"}`
BASE16NUM	Matches decimal and hexadecimal numbers with an optional sign (+ or -) and an optional 0x prefix	20	Input: `+0xA1B2` Pattern: `%{BASE16NUM:num}` Output: `{"num": "+0xA1B2"}`
POSINT	Matches whole positive integers without leading	20	Input: `123`

Grok Pattern	Description	Maximum pattern limit	Example
	zeros, consisting of one or more digits (1-9 followed by 0-9)		Pattern: `%{POSINT:num}` Output: `{"num": "123"}`
NONNEGINT	Matches any whole numbers (consisting of one or more digits 0-9) including zero and numbers with leading zeros.	20	Input: `007` Pattern: `%{NONNEGINT:num}` Output: `{"num": "007"}`
WORD	Matches whole words composed of one or more word characters (\w), including letters, digits, and underscores	20	Input: `user_123` Pattern: `%{WORD:user}` Output: `{"user": "user_123"}`
NOTSPACE	Matches one or more non-whitespace characters.	5	Input: `hello_world123` Pattern: `%{NOTSPACE:msg}` Output: `{"msg": "hello_world123"}`
SPACE	Matches zero or more whitespace characters.	5	Input: `" "` Pattern: `%{SPACE:extra}` Output: `{"extra": " "}`
DATA	Matches any character (except newline) zero or more times, non-greedy.	5	Input: `abc def ghi` Pattern: `%{DATA:x} %{DATA:y}` Output: `{"x": "abc", "y": "def ghi"}`

Grok Pattern	Description	Maximum pattern limit	Example
GREEDYDATA	Matches any character (except newline) zero or more times, greedy.	5	Input: `abc def ghi` Pattern: `%{GREEDYDATA:x} %{GREEDYDATA:y}` Output: `{"x": "abc def", "y": "ghi"}`

GREEDYDATA_MULTILINE	Matches any character (including newline) zero or more times, greedy.	1	Input:
			
			`abc`
			
			`def`
			
			`ghi`
			
			Pattern: `%{GREEDYDATA_MULTILINE:data}`
			
			Output: `{"data": "abc\ndef\nghi"}`

QUOTEDSTRING	Matches quoted strings (single or double quotes) with escaped characters.	20	Input: `"Hello, world!"` Pattern: `%{QUOTEDSTRING:msg}` Output: `{"msg": "Hello, world!"}`

Grok Pattern	Description	Maximum pattern limit	Example
UUID	Matches a standard UUID format: 8 hexadecimal characters, followed by three groups of 4 hexadecimal characters, and ending with 12 hexadecimal characters, all separated by hyphens.	20	Input: `550e8400-e29b-41d4-a716-446655440000` Pattern: `%{UUID:id}` Output: `{"id": "550e8400-e29b-41d4-a716-446655440000"}`
URN	Matches URN (Uniform Resource Name) syntax.	20	Input: `urn:isbn:0451450523` Pattern: `%{URN:urn}` Output: `{"urn": "urn:isbn:045145052 3"}`

AWS grok patterns

Pattern	Description	Maximum pattern limit	Example
ARN	Matches AWS Amazon Resource Names (ARNs), capturing the partition (`aws`, `aws-cn`, or `aws-us-gov`), service, Region, account ID, and up to 5 hierarchi cal resource identifiers separated by slashes. It will not match ARNs that are	5	Input: `arn:aws:iam:us-east-1:123456789012:user/johndoe` Pattern: `%{ARN:arn}` Output: `{"arn": "arn:aws:iam:us-east-1:123456789012:user/johndoe"}`

Pattern	Description	Maximum pattern limit	Example
	missing information between colons.		

Networking grok patterns

Grok Pattern	Description	Maximum pattern limit	Example
CISCOMAC	Matches a MAC address in 4-4-4 hexadecimal format.	20	Input: `0123.4567.89AB` Pattern: `%{CISCOMAC:MacAddress}` Output: `{"MacAddress": "0123.4567.89AB"}`
WINDOWSMAC	Matches a MAC address in hexadecimal format with hyphens	20	Input: `01-23-45-67-89-AB` Pattern: `%{WINDOWSMAC:MacAddress}` Output: `{"MacAddress": "01-23-45-67-89-AB"}`
COMMONMAC	Matches a MAC address in hexadecimal format with colons.	20	Input: `01:23:45:67:89:AB` Pattern: `%{COMMONMAC:MacAddress}` Output: `{"MacAddress": "01:23:45:67:89:AB"}`

Grok Pattern	Description	Maximum pattern limit	Example
MAC	Matches one of CISCOMAC, WINDOWSMAC or COMMONMAC grok patterns	20	Input: `01:23:45:67:89:AB` Pattern: `%{MAC:m1}` Output: `{"m1":"01:23:45:67:89:AB"}`
IPV6	Matches IPv6 addresses, including compressed forms and IPv4-mapped IPv6 addresses.	5	Input: `2001:db8:3333:4444:5555:6666:7777:8888` Pattern: `%{IPV6:ip}` Output: `{"ip": "2001:db8:3333:4444:5555:6666:7777:8888"}`
IPV4	Matches an IPv4 address.	20	Input: `192.168.0.1` Pattern: `%{IPV4:ip}` Output: `{"ip": "192.168.0.1"}`
IP	Matches either IPv6 addresses as supported by %{IPv6} or IPv4 addresses as supported by %{IPv4}	5	Input: `192.168.0.1` Pattern: `%{IP:ip}` Output: `{"ip": "192.168.0.1"}`

Grok Pattern	Description	Maximum pattern limit	Example
HOSTNAME or HOST	Matches domain names, including subdomains	5	Input: `server-01.internal-network.local` Pattern: `%{HOST:host}` Output: `{"host": "server-01.internal-network.local"}`
IPORHOST	Matches either a hostname or an IP address	5	Input: `2001:db8:3333:4444:5555:6666:7777:8888` Pattern: `%{IPORHOST:ip}` Output: `{"ip": "2001:db8:3333:4444:5555:6666:7777:8888"}`
HOSTPORT	Matches an IP address or hostname as supported by %{IPORHOST} pattern followed by a colon and a port number, capturing the port as "PORT" in the output.	5	Input: `192.168.1.1:8080` Pattern: `%{HOSTPORT:ip}` Output: `{"ip":"192.168.1.1:8080","PORT":"8080"}`

Grok Pattern	Description	Maximum pattern limit	Example
URIHOST	Matches an IP address or hostname as supported by %{IPORHOST} pattern, optionally followed by a colon and a port number, capturing the port as "port" if present.	5	Input: `example.com:443 10.0.0.1` Pattern: `%{URIHOST:host} %{URIHOST:ip}` Output: `{"host":" example.com:443","port":"443","ip":" 10.0.0.1"}`

Path grok patterns

Grok Pattern	Description	Maximum pattern limit	Example
UNIXPATH	Matches URL paths, potentially including query parameters.	20	Input: `/search?q=regex` Pattern: `%{UNIXPATH:path}` Output: `{"path":"/search?q=regex"}`
WINPATH	Matches Windows file paths.	5	Input: `C:\Users\John\Documents\file.txt` Pattern: `%{WINPATH:path}` Output: `{"path": "C:\\Users\\John\\Documents\\file.txt"}`

Grok Pattern	Description	Maximum pattern limit	Example
PATH	Matches either URL or Windows file paths	5	Input: `/search?q=regex` Pattern: `%{PATH:path}` Output: `{"path":"/search?q=regex"}`
TTY	Matches Unix device paths for terminals and pseudo-terminals.	20	Input: `/dev/tty1` Pattern: `%{TTY:path}` Output: `{"path":"/dev/tty1"}`
URIPROTO	Matches letters, optionally followed by a plus (+) character and additional letters or plus (+) characters	20	Input: `web+transformer` Pattern: `%{URIPROTO:protocol}` Output: `{"protocol":"web+transformer"}`
URIPATH	Matches the path component of a URI	20	Input: `/category/sub-category/product_name` Pattern: `%{URIPATH:path}` Output: `{"path":"/category/sub-category/product_name"}`

Grok Pattern	Description	Maximum pattern limit	Example
URIPARAM	Matches URL query parameters	5	Input: `?param1=value1&param2=value2` Pattern: `%{URIPARAM:url}` Output: `{"url":"?param1=value1&param2=value2"}`
URIPATHPARAM	Matches a URI path optionally followed by query parameters	5	Input: `/category/sub-category/product?id=12345&color=red` Pattern: `%{URIPATHPARAM:path}` Output: `{"path":"/category/sub-category/product?id=12345&color=red"}`
URI	Matches a complete URI	5	Input: `https://user:password@example.com/path/to/resource?param1=value1&param2=value2` Pattern: `%{URI:uri}` Output: `{"path":"https://user:password@example.com/path/to/resource?param1=value1&param2=value2"}`

Date and time grok patterns

Grok Pattern	Description	Maximum pattern limit	Example
MONTH	Matches full or abbreviated english month names as whole words	20	Input: `Jan` Pattern: `%{MONTH:month}` Output: `{"month": "Jan"}` Input: `January` Pattern: `%{MONTH:month}` Output: `{"month": "January"}`
MONTHNUM	Matches month numbers from 1 to 12, with optional leading zero for single-digit months.	20	Input: `5` Pattern: `%{MONTHNUM:month}` Output: `{"month": "5"}` Input: `05` Pattern: `%{MONTHNUM:month}` Output: `{"month": "05"}`
MONTHNUM	Matches two-digit month numbers from 01 to 12.	20	Input: `05` Pattern: `%{MONTHNUM2:month}`

Grok Pattern	Description	Maximum pattern limit	Example
			Output: `{"month": "05"}`
MONTHDAY	Matches day of the month from 1 to 31, with optional leading zero.	20	Input: `31` Pattern: `%{MONTHDAY:monthDay}` Output: `{"monthDay":"31"}`
YEAR	Matches year in two or four digits	20	Input: `2024` Pattern: `%{YEAR:year}` Output: `{"year":"2024"}` Input: `24` Pattern: `%{YEAR:year}` Output: `{"year":"24"}`
DAY	Matches full or abbreviated day names.	20	Input: `Tuesday` Pattern: `%{DAY:day}` Output: `{"day":"Tuesday"}`

Grok Pattern	Description	Maximum pattern limit	Example
HOUR	Matches hour in 24-hour format with an optional leading zero (0)0-23.	20	Input: 22 Pattern: `%{HOUR:hour}` Output: `{"hour":"22"}`
MINUTE	Matches minutes (00-59).	20	Input: 59 Pattern: `%{MINUTE:min}` Output: `{"min":"59"}`

Grok Pattern	Description	Maximum pattern limit	Example
SECOND	Matches a number representing seconds (0)0-60, optionally followed by a decimal point or colon and one or more digits for fractional minutes	20	Input: `3` Pattern: `%{SECOND:second}` Output: `{"second":"3"}` Input: `30.5` Pattern: `%{SECOND:minSec}` Output: `{"minSec":"30.5"}` Input: `30:5` Pattern: `%{SECOND:minSec}` Output: `{"minSec":"30:5"}`
TIME	Matches a time format with hours, minutes, and seconds in the format (H)H:mm:(s)s. Seconds include leap second (0)0-60.	20	Input: `09:45:32` Pattern: `%{TIME:time}` Output: `{"time":"09:45:32"}`

Grok Pattern	Description	Maximum pattern limit	Example
DATE_US	Matches a date in the format of (M)M/(d)d /(yy)yy or (M)M-(d)d-(yy)yy.	20	Input: `11/23/2024` Pattern: `%{DATE_US :date}` Output: `{"date":" 11/23/2024"}` Input: `1-01-24` Pattern: `%{DATE_US :date}` Output: `{"date":" 1-01-24"}`
DATE_EU	Matches date in format of (d)d/(M)M/(yy)yy, (d)d-(M)M-(yy)yy, or (d)d.(M)M.(yy)yy.	20	Input: `23/11/2024` Pattern: `%{DATE_EU :date}` Output: `{"date":" 23/11/2024"}` Input: `1.01.24` Pattern: `%{DATE_EU :date}` Output: `{"date":" 1.01.24"}`

Grok Pattern	Description	Maximum pattern limit	Example
ISO8601_TIMEZONE	Matches UTC offset 'Z' or time zone offset with optional colon in format [+-](H)H(:)mm.	20	Input: `+05:30` Pattern: `%{ISO8601_TIMEZONE:tz}` Output: `{"tz":"+05:30"}` Input: `-530` Pattern: `%{ISO8601_TIMEZONE:tz}` Output: `{"tz":"-530"}` Input: `Z` Pattern: `%{ISO8601_TIMEZONE:tz}` Output: `{"tz":"Z"}`
ISO8601_SECOND	Matches a number representing seconds (0)0-60, optionally followed by a decimal point or colon and one or more digits for fractional seconds	20	Input: `60` Pattern: `%{ISO8601_SECOND:second}` Output: `{"second":"60"}`

Grok Pattern	Description	Maximum pattern limit	Example
TIMESTAMP_ISO8601	Matches ISO8601 datetime format (yy)yy-(M)M-(d)dT(H)H:mm:((s)s)(Z|[+-](H)H:mm) with optional seconds and timezone.	20	Input: `2023-05-15T14:30:00+05:30` Pattern: `%{TIMESTAMP_ISO8601:timestamp}` Output: `{"timestamp":"2023-05-15T14:30:00+05:30"}` Input: `23-5-1T1:25+5:30` Pattern: `%{TIMESTAMP_ISO8601:timestamp}` Output: `{"timestamp":"23-5-1T1:25+5:30"}` Input: `23-5-1T1:25Z` Pattern: `%{TIMESTAMP_ISO8601:timestamp}` Output: `{"timestamp":"23-5-1T1:25Z"}`

Grok Pattern	Description	Maximum pattern limit	Example
DATE	Matches either a date in the US format using %{DATE_US} or in the EU format using %{DATE_EU}	20	Input: `11/29/2024` Pattern: `%{DATE:date}` Output: `{"date":"11/29/2024"}` Input: `29.11.2024` Pattern: `%{DATE:date}` Output: `{"date":"29.11.2024"}`
DATESTAMP	Matches %{DATE} followed by %{TIME} pattern, separated by space or hyphen.	20	Input: `29-11-2024 14:30:00` Pattern: `%{DATESTAMP:dateTime}` Output: `{"dateTime":"29-11-2024 14:30:00"}`
TZ	Matches common time zone abbreviations (PST, PDT, MST, MDT, CST CDT, EST, EDT, UTC).	20	Input: `PDT` Pattern: `%{TZ:tz}` Output: `{"tz":"PDT"}`

Grok Pattern	Description	Maximum pattern limit	Example
DATESTAMP_RFC822	Matches date and time in format: Day MonthName (D)D (YY)YY (H)H:mm:(s)s Timezone	20	Input: `Monday Jan 5 23 1:30:00 CDT` Pattern: `%{DATESTAMP_RFC822:dateTime}` Output: `{"dateTime":"Monday Jan 5 23 1:30:00 CDT"}` Input: `Mon January 15 2023 14:30:00 PST` Pattern: `%{DATESTAMP_RFC822:dateTime}` Output: `{"dateTime":"Mon January 15 2023 14:30:00 PST"}`

Grok Pattern	Description	Maximum pattern limit	Example
DATESTAMP_RFC2822	Matches RFC2822 date-time format: Day, (d)d MonthName (yy)yy (H)H:mm:(s)s Z|[+-](H)H:mm	20	Input: `Mon, 15 May 2023 14:30:00 +0530` Pattern: `%{DATESTAMP_RFC2822:dateTime}` Output: `{"dateTime":"Mon, 15 May 2023 14:30:00 +0530"}` Input: `Monday, 15 Jan 23 14:30:00 Z` Pattern: `%{DATESTAMP_RFC2822:dateTime}` Output: `{"dateTime":"Monday, 15 Jan 23 14:30:00 Z"}`
DATESTAMP_OTHER	Matches date and time in format: Day MonthName (d)d (H)H:mm:(s)s Timezone (yy)yy	20	Input: `Mon May 15 14:30:00 PST 2023` Pattern: `%{DATESTAMP_OTHER:dateTime}` Output: `{"dateTime":"Mon May 15 14:30:00 PST 2023"}`

Grok Pattern	Description	Maximum pattern limit	Example
DATESTAMP_EVENTLOG	Matches compact datetime format without separators: (yy)yyMM(d)d(H)Hmm(s)s	20	Input: `20230515143000` Pattern: `%{DATESTAMP_EVENTLOG:dateTime}` Output: `{"dateTime":"20230515143000"}`

Log grok patterns

Grok Pattern	Description	Maximum pattern limit	Example
LOGLEVEL	Matches standard log levels in different capitalizations and abbreviations, including the following: `Alert/ALERT`, `Trace/TRACE`, `Debug/DEBUG`, `Notice/NOTICE`, `Info/INFO`, `Warn/Warning/WARN/WARNING`, `Err/Error/ERR/ERROR`, `Crit/Critical/CRIT/CRITICAL`, `Fatal/FATAL`, `Severe/SEVERE`, `Emerg/Emergency/EMERG/EMERGENCY`	20	Input: `INFO` Pattern: `%{LOGLEVEL:logLevel}` Output: `{"logLevel":"INFO"}`

Grok Pattern	Description	Maximum pattern limit	Example
HTTPDATE	Matches date and time format often used in log files. Format: (d)d/MonthName/(yy)yy:(H)H:mm:(s)s Timezone MonthName: Matches full or abbreviated english month names (Example: "Jan" or "January") Timezone: Matches %{INT} grok pattern	20	Input: `23/Nov/20 24:14:30:00 +0640` Pattern: `%{HTTPDATE:date}` Output: `{"date":" 23/Nov/20 24:14:30:00 +0640"}`
SYSLOGTIMESTAMP	Matches date format with MonthName (d)d (H)H:mm:(s)s MonthName: Matches full or abbreviated english month names (Example: "Jan" or "January")	20	Input: `Nov 29 14:30:00` Pattern: `%{SYSLOGTIMESTAMP:dateTime}` Output: `{"dateTime":"Nov 29 14:30:00"}`
PROG	Matches a program name consisting of string of letters, digits, dot, underscore, forward slash, percent sign, and hyphen characters.	20	Input: `user.profile/settings-page` Pattern: `%{PROG:program}` Output: `{"program":"user.profile/settings-page"}`

Grok Pattern	Description	Maximum pattern limit	Example
SYSLOGPROG	Matches PROG grok pattern optionally followed by a process ID in square brackets.	20	Input: `user.profile/settings-page[1234]` Pattern: `%{SYSLOGPROG:programWithId}` Output: `{"programWithId":"user.profile/settings-page[1234]","program":"user.profile/settings-page","pid":"1234"}`
SYSLOGHOST	Matches either a %{HOST} or %{IP} pattern	5	Input: `2001:db8:3333:4444:5555:6666:7777:8888` Pattern: `%{SYSLOGHOST:ip}` Output: `{"ip":"2001:db8:3333:4444:5555:6666:7777:8888"}`

Grok Pattern	Description	Maximum pattern limit	Example
SYSLOGFACILITY	Matches syslog priority in decimal format. The value should be enclosed in angular brackets (<>).	20	Input: `<13.6>` Pattern: `%{SYSLOGFACILITY:syslog}` Output: `{"syslog":"<13.6>","facility":"13","priority":"6"}`

Common log grok patterns

You can use pre-defined custom grok patterns to match Apache, NGINX and Syslog Protocol (RFC 5424) log formats. When you use these specific patterns, they must be the first patterns in your matching configuration, and no other patterns can precede them. Also, you can follow them only with exactly one **DATA**. **GREEDYDATA** or **GREEDYDATA_MULTILINE** pattern.

Grok pattern	Description	Maximum pattern limit
APACHE_ACCESS_LOG	Matches Apache access logs	1
NGINX_ACCESS_LOG	Matches NGINX access logs	1
SYSLOG5424	Matches Syslog Protocol (RFC 5424) logs	1

The following shows valid and invalid examples for using these common log format patterns.

```
"%{NGINX_ACCESS_LOG} %{DATA}" // Valid
"%{SYSLOG5424}%{DATA:logMsg}" // Valid
"%{APACHE_ACCESS_LOG} %{GREEDYDATA:logMsg}" // Valid
"%{APACHE_ACCESS_LOG} %{SYSLOG5424}" // Invalid (multiple common log patterns used)
"%{NGINX_ACCESS_LOG} %{NUMBER:num}" // Invalid (Only GREEDYDATA and DATA patterns are
 supported with common log patterns)
"%{GREEDYDATA:logMsg} %{SYSLOG5424}" // Invalid (GREEDYDATA and DATA patterns are
 supported only after common log patterns)
```

Common log format examples

Apache log example

Sample log:

```
127.0.0.1 - - [03/Aug/2023:12:34:56 +0000] "GET /page.html HTTP/1.1" 200 1234
```

Transformer:

```
[
     {
        "grok": {
            "match": "%{APACHE_ACCESS_LOG}"
        }
    }
]
```

Output:

```
{
    "request": "/page.html",
    "http_method": "GET",
    "status_code": 200,
    "http_version": "1.1",
    "response_size": 1234,
    "remote_host": "127.0.0.1",
    "timestamp": "2023-08-03T12:34:56Z"
}
```

NGINX log example

Sample log:

```
192.168.1.100 - Foo [03/Aug/2023:12:34:56 +0000] "GET /account/login.html HTTP/1.1"
 200 42 "https://www.amazon.com/" "Mozilla/5.0 (Windows NT 10.0; Win64; x64)
 AppleWebKit/537.36 (KHTML, like Gecko) Chrome/92.0.4515.131 Safari/537.36"
```

Transformer:

```
[
     {
        "grok": {
            "match": "%{NGINX_ACCESS_LOG}"
        }
    }
]
```

Output:

```
{
    "request": "/account/login.html",
    "referrer": "https://www.amazon.com/",
    "agent": "Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like
 Gecko) Chrome/92.0.4515.131 Safari/537.36",
    "http_method": "GET",
    "status_code": 200,
    "auth_user": "Foo",
    "http_version": "1.1",
    "response_size": 42,
    "remote_host": "192.168.1.100",
    "timestamp": "2023-08-03T12:34:56Z"
}
```

Syslog Protocol (RFC 5424) log example

Sample log:

```
<165>1 2003-10-11T22:14:15.003Z mymachine.example.com evntslog - ID47
 [exampleSDID@32473 iut="3" eventSource= "Application" eventID="1011"]
[examplePriority@32473 class="high"]
```

Transformer:

```
[
     {
```

```
        "grok": {
            "match": "%{SYSLOG5424}"
        }
    }
]
```

Output:

```
{
  "pri": 165,
  "version": 1,
  "timestamp": "2003-10-11T22:14:15.003Z",
  "hostname": "mymachine.example.com",
  "app": "evntslog",
  "msg_id": "ID47",
  "structured_data": "exampleSDID@32473 iut=\"3\" eventSource= \"Application\" eventID=
\"1011\"",
  "message": "[examplePriority@32473 class=\"high\"]"
}
```

csv

The **csv** processor parses comma-separated values (CSV) from the log events into columns.

Field	Description	Required?	Default	Limits
source	Path to the field in the log event that will be parsed	No	`@message`	Maximum length: 128 Maximum nested key depth: 3
delimiter	The character used to separate each column in the original comma-separated value log event	No	`,`	Maximum length: 1 unless the value is `\t` or `\s`
quoteCharacter	Character used as a text qualifier for a single column of data	No	`"`	Maximum length: 1
columns	List of names to use for the columns in the transformed log event.	No	`[column_1, column_2`	Maximum CSV columns: 100

Field	Description	Required?	Default	Limits
				Maximum length: 128 Maximum nested key depth: 3
destination	The parent field to put transformed key value pairs under	No	`Root node`	Maximum length: 128 Maximum nested key depth: 3

Setting `delimiter` to `\t` will separate each column on a tab character, and `\t` will separate each column on a single space character.

Example

Suppose part of an ingested log event looks like this:

```
'Akua Mansa':28:'New York: USA'
```

Suppose we use only the **csv** processor:

```
[
     {
        "csv": {
            "delimiter": ":",
            "quoteCharacter": "'"
        }
    }
]
```

The transformed log event would be the following.

```
{
  "column_1": "Akua Mansa",
  "column_2": "28",
  "column_3": "New York: USA"
}
```

Example 2

Suppose an ingested log event looks like this:

```
{
    "timestamp": "2024-11-23T16:03:12Z",
    "type": "user_data",
    "logMsg": "'Akua Mansa':28:'New York: USA'"
}
```

Suppose we parse the event as JSON, they parse a JSON field with the **csv** processor, specifying column names and destination:

```
[
    {
        "parseJSON": {}
    },
    {
        "csv": {
            "source": "logMsg",
            "delimiter": ":",
            "quoteCharacter": "'",
            "columns":["name","age","location"],
            "destination": "msg"
        }
    }
]
```

The transformed log event would be the following.

```
{
    "timestamp": "2024-11-23T16:03:12Z",
    "logMsg": "'Akua Mansa':28:'New York: USA'",
    "type": "user_data",
    "msg": {
        "name": "Akua Mansa",
        "age": "28",
        "location": "New York: USA"
    }
}
```

parseKeyValue

Use the **parseKeyValue** processor to parse a specified field into key-value pairs. You can customize the processor to parse field information with the following options.

Field	Description	Required?	Default	Limits
source	Path to the field in the log event that will be parsed	No	`@message`	Maximum length: 128 Maximum nested key depth: 3
destination	The destination field to put the extracted key-value pairs into	No		Maximum length: 128
fieldDelimiter	The field delimiter string that is used between key-value pairs in the original log events	No	`&`	Maximum length: 128
keyValueDelimiter	The delimiter string to use between the key and value in each pair in the transformed log event	No	`=`	Maximum length: 128
nonMatchValue	A value to insert into the value field in the result, when a key-value pair is not successfully split.	No		Maximum length: 128
keyPrefix	If you want to add a prefix toall transformed keys, specify it here.	No		Maximum length: 128
overwriteIfExists	Whether to overwrite the value if the destination key already exists	No	`false`	

Example

Take the following example log event:

```
key1:value1!key2:value2!key3:value3!key4
```

Suppose we use the following processor configuration:

```
[
    {
        "parseKeyValue": {
            "destination": "new_key",
            "fieldDelimiter": "!",
            "keyValueDelimiter": ":",
            "nonMatchValue": "defaultValue",
            "keyPrefix": "parsed_"
        }
    }
]
```

The transformed log event would be the following.

```
{
  "new_key": {
    "parsed_key1": "value1",
    "parsed_key2": "value2",
    "parsed_key3": "value3",
    "parsed_key4": "defaultValue"
  }
}
```

Built-in processors for AWS vended logs

This section contains information about the built-in processors that you can use with AWS services that vend logs.

Contents

parseWAF

Use this processor to parse AWS WAF vended logs, It takes the contents of `httpRequest.headers` and creates JSON keys from each header name, with the corresponding value. It also does the same for `labels`. These transformations can make querying AWS WAF logs much easier. For more information about AWS WAF log format, see Log examples for web ACL traffic.

This processor accepts only `@message` as the input.

> **Important**
>
> If you use this processor, it must be the first processor in your transformer.

Example

Take the following example log event:

```
{
  "timestamp": 1576280412771,
  "formatVersion": 1,
  "webaclId": "arn:aws:wafv2:ap-southeast-2:111122223333:regional/webacl/
STMTest/1EXAMPLE-2ARN-3ARN-4ARN-123456EXAMPLE",
  "terminatingRuleId": "STMTest_SQLi_XSS",
  "terminatingRuleType": "REGULAR",
  "action": "BLOCK",
  "terminatingRuleMatchDetails": [
    {
      "conditionType": "SQL_INJECTION",
      "sensitivityLevel": "HIGH",
      "location": "HEADER",
      "matchedData": ["10", "AND", "1"]
    }
  ],
  "httpSourceName": "-",
  "httpSourceId": "-",
  "ruleGroupList": [],
  "rateBasedRuleList": [],
  "nonTerminatingMatchingRules": [],
  "httpRequest": {
    "clientIp": "1.1.1.1",
```

```
    "country": "AU",
    "headers": [
      { "name": "Host", "value": "localhost:1989" },
      { "name": "User-Agent", "value": "curl/7.61.1" },
      { "name": "Accept", "value": "*/*" },
      { "name": "x-stm-test", "value": "10 AND 1=1" }
    ],
    "uri": "/myUri",
    "args": "",
    "httpVersion": "HTTP/1.1",
    "httpMethod": "GET",
    "requestId": "rid"
  },
  "labels": [{ "name": "value" }]
}
```

The processor configuration is this:

```
[
    {
        "parseWAF": {}
    }
]
```

The transformed log event would be the following.

```
{
  "httpRequest": {
    "headers": {
      "Host": "localhost:1989",
      "User-Agent": "curl/7.61.1",
      "Accept": "*/*",
      "x-stm-test": "10 AND 1=1"
    },
    "clientIp": "1.1.1.1",
    "country": "AU",
    "uri": "/myUri",
    "args": "",
    "httpVersion": "HTTP/1.1",
    "httpMethod": "GET",
    "requestId": "rid"
  },
  "labels": { "name": "value" },
```

```
  "timestamp": 1576280412771,
  "formatVersion": 1,
  "webaclId": "arn:aws:wafv2:ap-southeast-2:111122223333:regional/webacl/
STMTest/1EXAMPLE-2ARN-3ARN-4ARN-123456EXAMPLE",
  "terminatingRuleId": "STMTest_SQLi_XSS",
  "terminatingRuleType": "REGULAR",
  "action": "BLOCK",
  "terminatingRuleMatchDetails": [
    {
      "conditionType": "SQL_INJECTION",
      "sensitivityLevel": "HIGH",
      "location": "HEADER",
      "matchedData": ["10", "AND", "1"]
    }
  ],
  "httpSourceName": "-",
  "httpSourceId": "-",
  "ruleGroupList": [],
  "rateBasedRuleList": [],
  "nonTerminatingMatchingRules": []
}
```


parsePostgres

Use this processor to parse Amazon RDS for PostgreSQL vended logs, extract fields, and convert them to JSON format. For more information about RDS for PostgreSQL log format, see RDS for PostgreSQL database log files.

This processor accepts only `@message` as the input.

> **Important**
>
> If you use this processor, it must be the first processor in your transformer.

Example

Take the following example log event:

```
2019-03-10 03:54:59 UTC:10.0.0.123(52834):postgres@logtestdb:[20175]:ERROR: column
 "wrong_column_name" does not exist at character 8
```

The processor configuration is this:

```
[
    {
        "parsePostgres": {}
    }
]
```

The transformed log event would be the following.

```
{
  "logTime": "2019-03-10 03:54:59 UTC",
  "srcIp": "10.0.0.123(52834)",
  "userName": "postgres",
  "dbName": "logtestdb",
  "processId": "20175",
  "logLevel": "ERROR"
}
```

parseCloudfront

Use this processor to parse Amazon CloudFront vended logs, extract fields, and convert them into JSON format. Encoded field values are decoded. Values that are integers and doubles are treated as such. For more information about Amazon CloudFront log format, see Configure and use standard logs (access logs).

This processor accepts only `@message` as the input.

> **Important**
>
> If you use this processor, it must be the first processor in your transformer.

Example

Take the following example log event:

```
2019-12-04  21:02:31   LAX1   392    192.0.2.24    GET
 d111111abcdef8.cloudfront.net  /index.html    200    -  Mozilla/5.0%20(Windows
%20NT%2010.0;%20Win64;%20x64)%20AppleWebKit/537.36%20(KHTML,
%20like%20Gecko)%20Chrome/78.0.3904.108%20Safari/537.36  -  -  Hit
```

```
    SOX4xwn4XV6Q4rgb7XiVGOHms_BGlTAC4KyHmureZmBNrjGdRLiNIQ==
 d111111abcdef8.cloudfront.net  https  23 0.001  -  TLSv1.2    ECDHE-RSA-AES128-GCM-
SHA256    Hit    HTTP/2.0   -  -  11040  0.001  Hit    text/html  78 -  -
```

The processor configuration is this:

```
[
    {
        "parseCloudfront": {}
    }
]
```

The transformed log event would be the following.

```
{
  "date": "2019-12-04",
  "time": "21:02:31",
  "x-edge-location": "LAX1",
  "sc-bytes": 392,
  "c-ip": "192.0.2.24",
  "cs-method": "GET",
  "cs(Host)": "d111111abcdef8.cloudfront.net",
  "cs-uri-stem": "/index.html",
  "sc-status": 200,
  "cs(Referer)": "-",
  "cs(User-Agent)": "Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36
 (KHTML, like Gecko) Chrome/78.0.3904.108 Safari/537.36",
  "cs-uri-query": "-",
  "cs(Cookie)": "-",
  "x-edge-result-type": "Hit",
  "x-edge-request-id": "SOX4xwn4XV6Q4rgb7XiVGOHms_BGlTAC4KyHmureZmBNrjGdRLiNIQ==",
  "x-host-header": "d111111abcdef8.cloudfront.net",
  "cs-protocol": "https",
  "cs-bytes": 23,
  "time-taken": 0.001,
  "x-forwarded-for": "-",
  "ssl-protocol": "TLSv1.2",
  "ssl-cipher": "ECDHE-RSA-AES128-GCM-SHA256",
  "x-edge-response-result-type": "Hit",
  "cs-protocol-version": "HTTP/2.0",
  "fle-status": "-",
  "fle-encrypted-fields": "-",
  "c-port": 11040,
```

```
  "time-to-first-byte": 0.001,
  "x-edge-detailed-result-type": "Hit",
  "sc-content-type": "text/html",
  "sc-content-len": 78,
  "sc-range-start": "-",
  "sc-range-end": "-"
}
```

parseRoute53

Use this processor to parse Amazon Route 53 Public Data Plane vended logs, extract fields, and convert them into JSON format. Encoded field values are decoded. This processor does not support Amazon Route 53 Resolver logs.

This processor accepts only `@message` as the input.

> **Important**
>
> If you use this processor, it must be the first processor in your transformer.

Example

Take the following example log event:

```
1.0 2017-12-13T08:15:50.235Z Z123412341234 example.com AAAA NOERROR TCP IAD12 192.0.2.0
 198.51.100.0/24
```

The processor configuration is this:

```
[
    {
        "parseRoute53": {}
    }
]
```

The transformed log event would be the following.

```
{
  "version": 1.0,
```

```
  "queryTimestamp": "2017-12-13T08:15:50.235Z",
  "hostZoneId": "Z123412341234",
  "queryName": "example.com",
  "queryType": "AAAA",
  "responseCode": "NOERROR",
  "protocol": "TCP",
  "edgeLocation": "IAD12",
  "resolverIp": "192.0.2.0",
  "ednsClientSubnet": "198.51.100.0/24"
}
```

parseVPC

Use this processor to parse Amazon VPC vended logs, extract fields, and convert them into JSON format. Encoded field values are decoded.

This processor accepts only `@message` as the input.

> **Important**
>
> If you use this processor, it must be the first processor in your transformer.

Example

Take the following example log event:

```
2 123456789010 eni-abc123de 192.0.2.0 192.0.2.24 20641 22 6 20 4249 1418530010
 1418530070 ACCEPT OK
```

The processor configuration is this:

```
[
    {
        "parseVPC": {}
    }
]
```

The transformed log event would be the following.

```
{
```

```
  "version": 2,
  "accountId": "123456789010",
  "interfaceId": "eni-abc123de",
  "srcAddr": "192.0.2.0",
  "dstAddr": "192.0.2.24",
  "srcPort": 20641,
  "dstPort": 22,
  "protocol": 6,
  "packets": 20,
  "bytes": 4249,
  "start": 1418530010,
  "end": 1418530070,
  "action": "ACCEPT",
  "logStatus": "OK"
}
```

parseToOCSF

The `parseToOCSF` processor converts logs into Open Cybersecurity Schema Framework (OCSF) events. OCSF is an open standard that provides a common schema for security data, enabling better interoperability and analysis across different security tools and platforms.

This processor is particularly useful for security analytics workflows where you need to standardize log formats from various AWS services into a consistent schema for downstream analysis.

Parameters

`eventSource` (required)

Specifies the AWS service or process that produces the log events to be converted. Valid values are:

- `CloudTrail` - CloudTrail logs
- `Route53Resolver` - Route 53 Resolver logs
- `VPCFlow` - Amazon VPC Flow Logs
- `EKSAudit` - Amazon EKS audit logs
- `AWSWAF` - AWS WAF logs

`ocsfVersion` (required)

Specifies which version of the OCSF schema to use for the transformed log events. Currently supported versions: `V1.1, V1.5`

`mappingVersion` (optional)

Specifies the OCSF transformation mapping version. Controls which transformation logic is applied when converting logs to OCSF format. If not specified, uses the latest available version at policy creation time. Existing policies do not automatically upgrade when new mapping versions are released. Current latest version: `v1.5.0`.

Note: Not supported when `ocsfVersion` is `V1.1`.

`source` (optional)

The path to the field in the log event that you want to parse. If omitted, the entire log message is parsed.

Example

The following example shows how to use `parseToOCSF` to convert VPC Flow Logs to OCSF format:

```
{
  "parseToOCSF": {
    "eventSource": "VPCFlow",
    "ocsfVersion": "V1.1"
  }
}
```

The following example shows how to specify a particular mapping version for consistent transformation behavior:

```
{
  "parseToOCSF": {
    "eventSource": "CloudTrail",
    "ocsfVersion": "V1.5",
    "mappingVersion": "v1.5.0"
  }
}
```

String mutate processors

This section contains information about the string mutate processors that you can use with a log event transformer.

Contents

lowerCaseString

The `lowerCaseString` processor converts a string to its lowercase version.

Field	Description	Required?	Default	Limits
withKeys	A list of keys to convert to lowercase	Yes		Maximum entries: 10

Example

Take the following example log event:

```
{
    "outer_key": {
        "inner_key": "INNER_VALUE"
    }
}
```

The transformer configuration is this, using `lowerCaseString` with `parseJSON`:

```
[
    {
        "parseJSON": {}
    },
    {
        "lowerCaseString": {
            "withKeys":["outer_key.inner_key"]
        }
    }
```

```
]
```

The transformed log event would be the following.

```
{
  "outer_key": {
    "inner_key": "inner_value"
  }
}
```

upperCaseString

The `upperCaseString` processor converts a string to its uppercase version.

Field	Description	Required?	Default	Limits
withKeys	A list of keys to convert to uppercase	Yes		Maximum entries: 10

Example

Take the following example log event:

```
{
    "outer_key": {
        "inner_key": "inner_value"
    }
}
```

The transformer configuration is this, using `upperCaseString` with `parseJSON`:

```
[
    {
        "parseJSON": {}
    },
    {
        "upperCaseString": {
            "withKeys":["outer_key.inner_key"]
        }
    }
```

```
]
```

The transformed log event would be the following.

```
{
  "outer_key": {
    "inner_key": "INNER_VALUE"
  }
}
```

splitString

The `splitString` processor is a type of string mutate processor which splits a field into an array using a delimiting character.

Field	Description	Required?	Default	Limits
entries	Array of entries. Each item in the array must contain `source` and `delimiter` fields.	Yes		Maximum entries: 10
source	The key of the field value to split	Yes		Maximum length: 128
delimiter	The delimiter string to split the field value on	Yes		Maximum length: 128

Example 1

Take the following example log event:

```
{
    "outer_key": {
        "inner_key": "inner_value"
    }
}
```

The transformer configuration is this, using `splitString` with `parseJSON`:

```
[
```

```
     {
        "parseJSON": {}
    },
    {
         "splitString": {
            "entries": [
                {
                    "source": "outer_key.inner_key",
                    "delimiter": "_"
                }
            ]
        }
    }
]
```

The transformed log event would be the following.

```
{
  "outer_key": {
    "inner_key": [
      "inner",
      "value"
    ]
  }
}
```

Example 2

The delimiter to split the string on can be multiple characters long.

Take the following example log event:

```
{
    "outer_key": {
        "inner_key": "item1, item2, item3"
    }
}
```

The transformer configuration is as follows:

```
[
     {
```

```
        "parseJSON": {}
    },
    {
         "splitString": {
            "entries": [
                {
                    "source": "outer_key.inner_key",
                    "delimiter": ", "
                }
            ]
        }
    }
]
```

The transformed log event would be the following.

```
{
  "outer_key": {
    "inner_key": [
      "item1",
      "item2",
      "item3"
    ]
  }
}
```

substituteString

The `substituteString` processor is a type of string mutate processor which matches a key's value against a regular expression and replaces all matches with a replacement string.

Field	Description	Required?	Default	Limits
entries	Array of entries. Each item in the array must contain `source`, `from`, and `to` fields.	Yes		Maximum entries: 10
source	The key of the field to modify	Yes		Maximum length: 128 Maximum nested key depth: 3

Field	Description	Required?	Default	Limits
from	The regular expression string to be replaced. Special regex characters such as [and] must be escaped using \\ when using double quotes and with \ when using single quotes or when configured from the AWS Management Console. For more information, see Class Pattern on the Oracle web site. You can wrap a pattern in `(...)` to create a numbered capturing group and create `(?P<group_name>...)` named capturing groups that can be referenced in the `to` field.	Yes		Maximum length: 128
to	The string to be substituted for each match of `from` Backrefer ences to capturing groups can be used. Use the form $n for numbered groups such as $1 and use `${group_name}` for named groups such as `${my_group}` .>	Yes		Maximum length: 128 Maximum number of backreferences: 10 Maximum number of duplicate backrefer ences: 2

Example 1

Take the following example log event:

```
{
    "outer_key": {
        "inner_key1": "[]",
        "inner_key2": "123-345-567",
        "inner_key3": "A cat takes a catnap."
    }
```

```
}
```

The transformer configuration is this, using `substituteString` with `parseJSON`:

```
[
    {
        "parseJSON": {}
    },
    {
        "substituteString": {
            "entries": [
                {
                    "source": "outer_key.inner_key1",
                    "from": "\\[\\]",
                    "to": "value1"
                },
                {
                    "source": "outer_key.inner_key2",
                    "from": "[0-9]{3}-[0-9]{3}-[0-9]{3}",
                    "to": "xxx-xxx-xxx"
                },
                {
                    "source": "outer_key.inner_key3",
                    "from": "cat",
                    "to": "dog"
                }
            ]
        }
    }
]
```

The transformed log event would be the following.

```
{
  "outer_key": {
    "inner_key1": "value1",
    "inner_key2": "xxx-xxx-xxx",
    "inner_key3": "A dog takes a dognap."
  }
}
```

Example 2

Take the following example log event:

```
{
    "outer_key": {
        "inner_key1": "Tom, Dick, and Harry",
        "inner_key2": "arn:aws:sts::123456789012:assumed-role/MyImportantRole/
MySession"
    }
}
```

The transformer configuration is this, using `substituteString` with `parseJSON`:

```
[
    {
        "parseJSON": {}
    },
    {
        "substituteString": {
            "entries": [
                {
                    "source": "outer_key.inner_key1",
                    "from": "(\w+), (\w+), and (\w+)",
                    "to": "$1 and $3"
                },
                {
                    "source": "outer_key.inner_key2",
                    "from": "^arn:aws:sts::(?P<account_id>\\d{12}):assumed-role/(?
P<role_name>[\\w+=,.@-]+)/(?P<role_session_name>[\\w+=,.@-]+)$",
                    "to": "${account_id}:${role_name}:${role_session_name}"
                }
            ]
        }
    }
]
```

The transformed log event would be the following.

```
{
  "outer_key": {
    "inner_key1": "Tom and Harry",
    "inner_key2": "123456789012:MyImportantRole:MySession"
  }
```

```
}
```

trimString

The `trimString` processor removes whitespace from the beginning and end of a key.

Field	Description	Required?	Default	Limits
withKeys	A list of keys to trim	Yes		Maximum entries: 10

Example

Take the following example log event:

```
{
    "outer_key": {
        "inner_key": "   inner_value  "
    }
}
```

The transformer configuration is this, using `trimString` with `parseJSON`:

```
[
    {
        "parseJSON": {}
    },
    {
        "trimString": {
            "withKeys":["outer_key.inner_key"]
        }
    }
]
```

The transformed log event would be the following.

```
{
  "outer_key": {
    "inner_key": "inner_value"
  }
}
```

JSON mutate processors

This section contains information about the JSON mutate processors that you can use with a log event transformer.

Contents

addKeys

Use the `addKeys` processor to add new key-value pairs to the log event.

Field	Description	Required?	Default	Limits
entries	Array of entries. Each item in the array can contain `key`, `value`, and `overwriteIfExists` fields.	Yes		Maximum entries: 5
key	The key of the new entry to be added	Yes		Maximum length: 128 Maximum nested key depth: 3
value	The value of the new entry to be added	Yes		Maximum length: 256
overwriteIfExists	If you set this to `true`, the existing value is overwritten if `key` already exists in the event. The default value is `false`.	No	false	No limit

Example

Take the following example log event:

```
{
    "outer_key": {
        "inner_key": "inner_value"
    }
}
```

The transformer configuration is this, using `addKeys` with `parseJSON`:

```
[
    {
        "parseJSON": {}
    },
    {
        "addKeys": {
            "entries": [
                {
                    "key": "outer_key.new_key",
                    "value": "new_value"
                }
            ]
        }
    }
]
```

The transformed log event would be the following.

```
{
  "outer_key": {
    "inner_key": "inner_value",
    "new_key": "new_value"
  }
}
```

deleteKeys

Use the `deleteKeys` processor to delete fields from a log event. These fields can include key-value pairs.

Field	Description	Required?	Default	Limits
withKeys	The list of keys to delete.	Yes	No limit	Maximum entries: 5

Example

Take the following example log event:

```
{
    "outer_key": {
        "inner_key": "inner_value"
    }
}
```

The transformer configuration is this, using `deleteKeys` with `parseJSON`:

```
[
    {
        "parseJSON": {}
    },
    {
        "deleteKeys": {
            "withKeys":["outer_key.inner_key"]
        }
    }
]
```

The transformed log event would be the following.

```
{
  "outer_key": {}
}
```

moveKeys

Use the `moveKeys` processor to move a key from one field to another.

Field	Description	Required?	Default	Limits
entries	Array of entries. Each item in the array can contain `source`, `target`, and `overwriteIfExists` fields.	Yes		Maximum entries: 5
source	The key to move	Yes		Maximum length: 128 Maximum nested key depth: 3
target	The key to move to	Yes		Maximum length: 128 Maximum nested key depth: 3
overwriteIfExists	If you set this to `true`, the existing value is overwritten if `key` already exists in the event. The default value is `false`.	No	false	No limit

Example

Take the following example log event:

```
{
    "outer_key1": {
        "inner_key1": "inner_value1"
    },
    "outer_key2": {
        "inner_key2": "inner_value2"
    }
}
```

The transformer configuration is this, using `moveKeys` with `parseJSON`:

```
[
    {
```

```
        "parseJSON": {}
    },
    {
        "moveKeys": {
            "entries": [
                {
                    "source": "outer_key1.inner_key1",
                    "target": "outer_key2"
                }
            ]
        }
    }
]
```

The transformed log event would be the following.

```
{
  "outer_key1": {},
  "outer_key2": {
    "inner_key2": "inner_value2",
    "inner_key1": "inner_value1"
  }
}
```

renameKeys

Use the `renameKeys` processor to rename keys in a log event.

Field	Description	Required?	Default	Limits
entries	Array of entries. Each item in the array can contain `key`, `target`, and `overwriteIfExists` fields.	Yes	No limit	Maximum entries: 5
key	The key to rename	Yes	No limit	Maximum length: 128
target	The new key name	Yes	No limit	Maximum length: 128 Maximum nested key depth: 3

Field	Description	Required?	Default	Limits
overwriteIfExists	If you set this to `true`, the existing value is overwritten if `key` already exists in the event. The default value is `false`.	No	false	No limit

Example

Take the following example log event:

```
{
    "outer_key": {
        "inner_key": "inner_value"
    }
}
```

The transformer configuration is this, using `renameKeys` with `parseJSON`:

```
[
    {
        "parseJSON": {}
    },
    {
        "renameKeys": {
            "entries": [
                {
                    "key": "outer_key",
                    "target": "new_key"
                }
            ]
        }
    }
]
```

The transformed log event would be the following.

```
{
  "new_key": {
    "inner_key": "inner_value"
```

```
  }
}
```

copyValue

Use the `copyValue` processor to copy values within a log event. You can also use this processor to add metadata to log events, by copying the values of the following metadata keys into the log events: `@logGroupName`, `@logGroupStream`, `@accountId`, `@regionName`. This is illustrated in the following example.

Field	Description	Required?	Default	Limits
entries	Array of entries. Each item in the array can contain `source`, `target`, and `overwriteIfExists` fields.	Yes		Maximum entries: 5
source	The key to copy	Yes		Maximum length: 128 Maximum nested key depth: 3
target	The key to copy the value to	Yes	No limit	Maximum length: 128 Maximum nested key depth: 3
overwriteIfExists	If you set this to `true`, the existing value is overwritten if `key` already exists in the event. The default value is `false`.	No	false	No limit

Example

Take the following example log event:

```
{
    "outer_key": {
```

```
        "inner_key": "inner_value"
    }
}
```

The transformer configuration is this, using `copyValue` with `parseJSON`:

```
[
    {
        "parseJSON": {}
    },
    {
        "copyValue": {
            "entries": [
                {
                    "key": "outer_key.new_key",
                    "target": "new_key"
                },
                {
                    "source": "@logGroupName",
                    "target": "log_group_name"
                },
                {
                    "source": "@logGroupStream",
                    "target": "log_group_stream"
                },
                {
                    "source": "@accountId",
                    "target": "account_id"
                },
                {
                    "source": "@regionName",
                    "target": "region_name"
                }
            ]
        }
    }
]
```

The transformed log event would be the following.

```
{
  "outer_key": {
    "inner_key": "inner_value"
```

```
  },
  "new_key": "inner_value",
  "log_group_name": "myLogGroupName",
  "log_group_stream": "myLogStreamName",
  "account_id": "012345678912",
  "region_name": "us-east-1"
}
```

listToMap

The `listToMap` processor takes a list of objects that contain key fields, and converts them into a map of target keys.

Field	Description	Required?	Default	Limits
source	The key in the ProcessingEvent with a list of objects that will be converted to a map	Yes		Maximum length: 128 Maximum nested key depth: 3
key	The key of the fields to be extracted as keys in the generated map	Yes		Maximum length: 128
valueKey	If this is specified, the values that you specify in this parameter will be extracted from the `source` objects and put into the values of the generated map. Otherwise, original objects in the source list will be put into the values of the generated map.	No		Maximum length: 128
target	The key of the field that will hold the generated map	No	Root node	Maximum length: 128 Maximum nested key depth: 3
flatten	A Boolean value to indicate whether the list will be flattened	No	false	

Field	Description	Required?	Default	Limits
	into single items or if the values in the generated map will be lists. By default the values for the matching keys will be represented in an array. Set `flatten` to `true` to convert the array to a single value based on the value of `flattenedElement` .			
flattenedElement	If you set `flatten` to `true`, use `flattenedElement` to specify which element, `first` or `last`, to keep.	Required when `flatten` is set to `true`		Value can only be `first` or `last`

Example

Take the following example log event:

```
{
    "outer_key": [
        {
            "inner_key": "a",
            "inner_value": "val-a"
        },
        {
            "inner_key": "b",
            "inner_value": "val-b1"
        },
        {
            "inner_key": "b",
            "inner_value": "val-b2"
        },
        {
            "inner_key": "c",
            "inner_value": "val-c"
        }
```

```
    ]
}
```

Transformer for use case 1: `flatten` is `false`

```
[
    {
        "parseJSON": {}
    },
    {
        "listToMap": {
            "source": "outer_key"
            "key": "inner_key",
            "valueKey": "inner_value",
            "flatten": false
        }
    }
]
```

The transformed log event would be the following.

```
{
    "outer_key": [
        {
            "inner_key": "a",
            "inner_value": "val-a"
        },
        {
            "inner_key": "b",
            "inner_value": "val-b1"
        },
        {
            "inner_key": "b",
            "inner_value": "val-b2"
        },
        {
            "inner_key": "c",
            "inner_value": "val-c"
        }
    ],
    "a": [
        "val-a"
    ],
```

```
    "b": [
        "val-b1",
        "val-b2"
    ],
    "c": [
        "val-c"
    ]
}
```

Transformer for use case 2: `flatten` is `true` and `flattenedElement` is `first`

```
[
    {
        "parseJSON": {}
    },
    {
        "listToMap": {
            "source": "outer_key"
            "key": "inner_key",
            "valueKey": "inner_value",
            "flatten": true,
            "flattenedElement": "first"
        }
    }
]
```

The transformed log event would be the following.

```
{
    "outer_key": [
        {
            "inner_key": "a",
            "inner_value": "val-a"
        },
        {
            "inner_key": "b",
            "inner_value": "val-b1"
        },
        {
            "inner_key": "b",
            "inner_value": "val-b2"
        },
        {
```

```
            "inner_key": "c",
            "inner_value": "val-c"
        }
    ],
    "a": "val-a",
    "b": "val-b1",
    "c": "val-c"
}
```

Transformer for use case 3: `flatten` is `true` and `flattenedElement` is `last`

```
[
    {
        "parseJSON": {}
    },
    {
        "listToMap": {
            "source": "outer_key"
            "key": "inner_key",
            "valueKey": "inner_value",
            "flatten": true,
            "flattenedElement": "last"
        }
    }
]
```

The transformed log event would be the following.

```
{
    "outer_key": [
        {
            "inner_key": "a",
            "inner_value": "val-a"
        },
        {
            "inner_key": "b",
            "inner_value": "val-b1"
        },
        {
            "inner_key": "b",
            "inner_value": "val-b2"
        },
        {
```

```
            "inner_key": "c",
            "inner_value": "val-c"
        }
    ],
    "a": "val-a",
    "b": "val-b2",
    "c": "val-c"
}
```

Datatype converter processors

This section contains information about the datatype converter processors that you can use with a log event transformer.

Contents

typeConverter

Use the `typeConverter` processor to convert a value type associated with the specified key to the specified type. It's a casting processor that changes the types of the specified fields. Values can be converted into one of the following datatypes: `integer`, `double`, `string` and `boolean`.

Field	Description	Required?	Default	Limits
entries	Array of entries. Each item in the array must contain `key` and `type` fields.	Yes		Maximum entries: 10
key	The key with the value that is to be converted to a different type	Yes		Maximum length: 128 Maximum nested key depth: 3
type	The type to convert to. Valid values are `integer`, `double`, `string` and `boolean`.	Yes		

Example

Take the following example log event:

```
{
    "name": "value",
    "status": "200"
}
```

The transformer configuration is this, using `typeConverter` with `parseJSON`:

```
[
    {
        "parseJSON": {}
    },
    {
        "typeConverter": {
            "entries": [
                {
                    "key": "status",
                    "type": "integer"
                }
            ]
        }
    }
]
```

The transformed log event would be the following.

```
{
    "name": "value",
    "status": 200
}
```

datetimeConverter

Use the `datetimeConverter` processor to convert a datetime string into a format that you specify.

Field	Description	Required?	Default	Limits
source	The key to apply the date conversion to.	Yes		Maximum entries: 10
matchPatterns	A list of patterns to match against the `source` field	Yes		Maximum entries: 5
target	The JSON field to store the result in.	Yes		Maximum length: 128 Maximum nested key depth: 3
targetFormat	The datetime format to use for the converted data in the target field.	No	`yyyy-MM-dd'T'HH:mm:ss.SSS'Z`	Maximum length:64
sourceTimezone	The time zone of the source field. For a list of possible values, see Java Supported Zone Ids and Offsets.	No	UTC	Minimum length:1
targetTimezone	The time zone of the target field. For a list of possible values, see Java Supported Zone Ids and Offsets.	No	UTC	Minimum length:1
locale	The locale of the source field. For a list of possible values, see Locale getAvailableLocales() Method in Java with Examples.	Yes		Minimum length:1

Example

Take the following example log event:

```
{"german_datetime": "Samstag 05. Dezember 1998 11:00:00"}
```

The transformer configuration is this, using `dateTimeConverter` with `parseJSON`:

```
[
    {
        "parseJSON": {}
    },
    {
        "dateTimeConverter": {
            "source": "german_datetime",
            "target": "target_1",
            "locale": "de",
            "matchPatterns": ["EEEE dd. MMMM yyyy HH:mm:ss"],
            "sourceTimezone": "Europe/Berlin",
            "targetTimezone": "America/New_York",
            "targetFormat": "yyyy-MM-dd'T'HH:mm:ss z"
        }
    }
]
```

The transformed log event would be the following.

```
{
    "german_datetime": "Samstag 05. Dezember 1998 11:00:00",
    "target_1": "1998-12-05T17:00:00 MEZ"
}
```

Transformation metrics and errors

CloudWatch Logs publishes transformation metrics to CloudWatch. These metrics include `TransformedLogEvents`, `TransformedBytes`, and `TransformationErrors`. For more information, see Log transformer metrics and dimensions.

Whenever CloudWatch Logs tries and fails to transform a log event, it adds a `@transformationError` system field to that log event. When you run a CloudWatch Logs Insights query, you will see this field in all log events that had a transformation failure. You can

query for this field with a query such as `filter ispresent(@transformationError)` to find all the failed transformation events.

Access logs with S3 Tables Integration

The S3 Tables Integration with CloudWatch allows you to access log data ingested into CloudWatch using analytics engines such as Amazon Athena, Amazon Redshift, and third-party tools that support connection to Apache Iceberg-compatible stores. This integration enables you to perform comprehensive log analysis using tools of your preference and correlate data in CloudWatch Logs with non-CloudWatch data. **This feature is available at no additional cost.**

Understanding S3 Tables Integration

Amazon S3 Tables Integration is a fully managed solution that makes your logs in CloudWatch Logs available as managed Amazon S3 tables. With this integration, you gain greater flexibility on how you analyze your logs in addition to CloudWatch Logs features.

The integration works by creating a managed Amazon S3 table bucket (`aws-cloudwatch`) and associating specific log sources with Amazon S3 Tables based on data source name and type (that can be managed from the **Log Management > Data Sources** tab in CloudWatch Logs Console). Once associated, CloudWatch Logs data becomes accessible through Amazon S3 Tables using the Apache Iceberg format. This format provides a standardized way for various analytics engines to query the data efficiently.

Core Components

Apache Iceberg Tables

: The underlying table format used by S3 Tables that provides structured data storage and enables compatibility with multiple analytics engines.

Data Source Association

: The process of linking specific CloudWatch Logs sources to the S3 Tables integration based on data source and type criteria.

Data flow to S3 tables

Understanding how data flows between CloudWatch Logs and S3 Tables helps you plan your integration and manage your log data effectively.

When you create an association, CloudWatch Logs automatically delivers new log events matching the associated data source name and type to a CloudWatch-managed S3 table bucket. These events appear in the logs namespace under the corresponding table for that data source. The integration processes only log events received after the association is created. Existing log data is not backfilled. When you create an S3 Tables integration, if you leave the **Enable all log sources and types to be available in the S3 table** checkbox selected, all data sources in your account are automatically associated and delivered to S3 Tables by default, including any data sources added in the future. To deliver only specific data sources to S3 Tables, clear this checkbox during integration creation and then individually associate the data sources you want to include.

Data retention in the S3 table bucket matches the retention policy set for the log group. For example, if you set a log group to 1-day retention, CloudWatch Logs removes the data from both CloudWatch Logs and the S3 Table after one day. When you delete a log group or log stream, CloudWatch Logs also removes the data from the S3 table bucket.

When to Use S3 Tables Integration

Consider using S3 Tables integration to correlate log data with other external or non-CloudWatch data or when you prefer using other analytics tools such as Amazon Athena to perform analytics on CloudWatch Logs data. Use this integration when you need capabilities that go beyond what's available in CloudWatch Logs. This integration is particularly valuable when:

- You need to run complex SQL-like queries across large volumes of log data
- You want to integrate log analysis with existing analytics workflows and tools
- You require comprehensive log analysis capabilities that span multiple data sources

There are no additional storage or table maintenance charges for S3 tables created through this integration, beyond existing CloudWatch ingestion and storage pricing.

Prerequisites

Before implementing the integration, ensure you have the following:

- Existing CloudWatch Logs data
- Appropriate IAM permissions for cross-service access between CloudWatch Logs and S3 Tables, as described in the following section

IAM permissions

To integrate CloudWatch Logs with S3 Tables, you need to configure IAM permissions for two separate entities: the user or role that sets up the integration, and the service role that CloudWatch Logs assumes to write data to S3 Tables.

For the role or user creating the integration

The user or role that sets up the integration requires the following permissions:

- `observabilityadmin:CreateS3TableIntegration` to create the integration and `logs:AssociateSourceToS3TableIntegration` to add sources
- `s3tables:CreateTableBucket`, `s3tables:PutTableBucketEncryption`, and `s3tables:PutTableBucketPolicy` to configure the S3 table bucket

For the service role

Attach the following IAM policy to the IAM service role that CloudWatch Logs uses to write data to the table bucket. This policy grants permission to write to the tables. Replace *aws-region*, *123456789012*, and *log-group-name* with your AWS Region, account ID, and log group name.

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": [
                "logs:integrateWithS3Table"
            ],
            "Resource": ["arn:aws:logs:aws-region:123456789012:log-group:log-group-
name"],
            "Condition": {
                "StringEquals": {
                    "aws:ResourceAccount": "123456789012"
                }
            }
        }
    ]
}
```

Attach the following trust policy to the IAM service role that CloudWatch Logs will assume to write log data to S3 Tables. You create or select this role during the integration setup. The conditions restrict the role so that CloudWatch Logs can only assume it for the specified account and log group. Replace *aws-region*, *123456789012*, and *log-group-name* with your AWS Region, account ID, and log group name.

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Principal": {
                "Service": "logs.amazonaws.com"
            },
            "Action": "sts:AssumeRole",
            "Condition": {
                "StringEquals": {
                    "aws:SourceAccount": "123456789012"
                },
                "ArnLike": {
                    "aws:SourceArn": ["arn:aws:logs:aws-region:123456789012:log-
group:log-group-name"]
                }
            }
        }
    ]
}
```

KMS key policy (for encrypted data)

If you use a customer managed key to encrypt your log data, you must grant the CloudWatch service principal and the S3 Tables maintenance service principal access to the key. Add the following statements to your KMS key policy. Replace the placeholder values with your AWS account ID, Region, KMS key ID, and S3 table or table bucket ARN.

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Sid": "EnableSystemTablesKeyUsage",
            "Effect": "Allow",
```

```
            "Principal": {
                "Service": "systemtables.cloudwatch.amazonaws.com"
            },
            "Action": [
                "kms:DescribeKey",
                "kms:GenerateDataKey",
                "kms:Decrypt"
            ],
            "Resource": "arn:aws:kms:aws-region:123456789012:key/key-id",
            "Condition": {
                "StringEquals": {
                    "aws:SourceAccount": "123456789012"
                }
            }
        },
        {
            "Sid": "EnableKeyUsage",
            "Effect": "Allow",
            "Principal": {
                "Service": "maintenance.s3tables.amazonaws.com"
            },
            "Action": [
                "kms:GenerateDataKey",
                "kms:Decrypt"
            ],
            "Resource": "arn:aws:kms:aws-region:123456789012:key/key-id",
            "Condition": {
                "StringLike": {
                    "kms:EncryptionContext:aws:s3:arn": "<table-or-table-bucket-arn>/*"
                }
            }
        }
    ]
}
```

Getting Started

To get started with S3 Tables Integration, you need to set up the integration between your CloudWatch Logs and S3 Tables. This process involves configuring data source associations and setting up appropriate IAM permissions.

To create an S3 Tables Integration

1. Open the CloudWatch Logs console at https://console.aws.amazon.com/cloudwatch/".
2. Choose **Settings**, **Global**, **Create S3 Table Integration**.
3. Customize how logs will be encrypted in S3 Tables, and the role that CloudWatch Logs will use to write your logs into S3 Tables.
4. If you want all data sources to be automatically associated with the integration, leave the **Enable all log sources and types to be available in the S3 table** checkbox selected (it is selected by default). If you want to associate only specific data sources, clear this checkbox.
5. Choose **Create S3 Table Integration**.

> **Note**
>
> If you selected **Enable all log sources and types to be available in the S3 table** during creation, all data sources are automatically associated, including any data sources added in the future. You can stop here. The following steps are only needed if you cleared the checkbox and want to associate specific data sources.

To associate sources to an S3 Table Integration

1. Open the CloudWatch Logs console at https://console.aws.amazon.com/cloudwatch/".
2. Choose **Settings**, **Global**, **Manage S3 Table Integration**.
3. Choose **Associate data source**.
4. Select the data source name and data source type that you want to enable integration for.
5. Choose **Associate data source**.

To associate sources to an S3 Table Integration from the Log Management Page

1. Open the CloudWatch Logs console at https://console.aws.amazon.com/cloudwatch/".
2. Choose **Log Management** in the navigation pane.
3. Select **Data Sources** tab.
4. Choose the data source name and data source type that you want to integrate.
5. Choose **Data source actions**.

6. Select **Associate with S3 Tables Integration**.
7. Review the data sources, and then choose **Associate Data source**.

Before you can use the data you have to do the following 3 steps:

1. Integrating Amazon Amazon S3 Tables with AWS analytics services - Using the Amazon S3 console
2. Configure Lake Formation Permissions
3. Connect with Analytics Tools

Integrating Amazon Amazon S3 Tables with AWS analytics services - Using the Amazon S3 console (Link)

To enable S3 Tables integration using the S3 console

1. Open the Amazon S3 console at https://console.aws.amazon.com/s3/.
2. In the left navigation pane, choose **Table buckets**.
3. Choose the **Enable integration** on the top.
4. The first time that you integrate table buckets in any Region, Amazon Amazon S3 creates a new IAM service role on your behalf. This role allows Lake Formation to access all table buckets in your account and federate access to your tables in AWS Glue Data Catalog.

Configure Lake Formation Permissions

While CloudWatch Logs has permission to write to the table (configured in previous steps), users and analytics roles do not automatically have permission to read the data. You must explicitly grant access using AWS Lake Formation. You have to do this for every IAM principal you want to provide access to the table.

To grant query access to users or roles

You must grant SELECT and DESCRIBE permissions to the IAM principals (users or roles) that will be running queries in Athena or Redshift.

1. Open the AWS Lake Formation console.
2. In the navigation pane, under **Permissions**, choose **Data lake permissions**.

3. Choose **Grant**.
4. **Principals**: Select the IAM users or roles that require access (e.g., your data analysts or the Admin role you are currently using).
5. **LF-Tags or Catalog resources**: Select **Named Data Catalog resources**.
6. **Databases and Tables**:
   - Select the S3 Table bucket created by the CloudWatch integration (`aws-cloudwatch`).
   - Select the specific table associated with your data source (optional).
7. **Table Permissions**: Select **Select** and **Describe**.
8. Choose **Grant**.

> **Note**
>
> If you encounter "Access Denied" errors when querying logs in Athena, ensure that the user running the query has both the appropriate IAM permissions for Athena and the Lake Formation permissions defined above.

Learn more about Lake Formation permissions at https://docs.aws.amazon.com/lake-formation/latest/dg/granting-catalog-permissions.html.

Connect with Analytics Tools

Once permissions are granted, you can configure your preferred analytics service to query the S3 Tables. S3 Tables use the Apache Iceberg format, which is natively supported by Amazon Athena, Amazon Redshift, and Amazon EMR.

To query log data in Amazon Athena

Amazon Athena interacts with S3 Tables through the Amazon S3 Tables catalog.

To set up Athena to query your log data

1. Open the Amazon Athena console at https://console.aws.amazon.com/athena/.
2. In the query editor, select the **Amazon S3 Tables** catalog from the data source dropdown.
3. If you do not see the catalog, ensure you have completed the Lake Formation permission steps above for your specific user role.

4. Once the catalog is selected, your log tables will appear in the database list. You can now run standard SQL queries against your log data.

Example Query: `SELECT * FROM "amazon_vpc__flow" LIMIT 100;`

Learn more about connecting Analytics services with S3 Tables at https://docs.aws.amazon.com/AmazonS3/latest/userguide/s3-tables-integrating-aws.html.

Creating metrics from log events using filters

You can search and filter the log data coming into CloudWatch Logs by creating one or more *metric filters*. Metric filters define the terms and patterns to look for in log data as it is sent to CloudWatch Logs. CloudWatch Logs uses these metric filters to turn log data into numerical CloudWatch metrics that you can graph or set an alarm on.

When you create a metric from a log filter, you can also choose to assign dimensions and a unit to the metric. If you specify a unit, be sure to specify the correct one when you create the filter. Changing the unit for the filter later will have no effect.

If you have configured AWS Organizations and are working with member accounts you can use log centralization to collect log data from source accounts into a central monitoring account.

When working with centralized log groups you can use these system fields dimensions when creating metric filters.

- `@aws.account` - This dimension represents the AWS account ID from which the log event originated.
- `@aws.region` - This dimension represents the AWS region where the log event was generated.

These dimensions help in identifying the source of log data, allowing for more granular filtering and analysis of metrics derived from centralized logs. For more information, see Cross-account cross-Region log centralization.

If a log group with a subscription uses log transformation, the filter pattern is applied to the transformed versions of the log events. For more information, see Transform logs during ingestion.

> **Note**
>
> Metric filters are supported only for log groups in the Standard log class. For more information about log classes, see Log classes.

You can use any type of CloudWatch statistic, including percentile statistics, when viewing these metrics or setting alarms.

> **Note**
>
> Percentile statistics are supported for a metric only if none of the metric's values are negative. If you set up your metric filter so that it can report negative numbers, percentile statistics will not be available for that metric when it has negative numbers as values. For more information, see Percentiles.

Filters do not retroactively filter data. Filters only publish the metric data points for events that happen after the filter was created. When testing a filter pattern, the **Filter results** preview shows up to the first 50 matching log lines for validation purposes. If the timestamp on the filtered results is earlier than the metric creation time, no logs are displayed.

> **Note**
>
> Metric filters ensure at least one time delivery of log events to the specified metric, while duplicate deliveries may occasionally occur.

Contents

Concepts

Each metric filter is made up of the following key elements:

default value

The value reported to the metric filter during a period when logs are ingested but no matching logs are found. By setting this to 0, you ensure that data is reported during every such period, preventing "spotty" metrics with periods of no matching data. If no logs are ingested during a one-minute period, then no value is reported.

If you assign dimensions to a metric created by a metric filter, you can't assign a default value for that metric.

dimensions

Dimensions are the key-value pairs that further define a metric. You can assign dimensions to the metric created from a metric filter. Because dimensions are part of the unique identifier for a metric, whenever a unique name/value pair is extracted from your logs, you are creating a new variation of that metric.

filter pattern

A symbolic description of how CloudWatch Logs should interpret the data in each log event. For example, a log entry may contain timestamps, IP addresses, strings, and so on. You use the pattern to specify what to look for in the log file.

metric name

The name of the CloudWatch metric to which the monitored log information should be published. For example, you may publish to a metric called ErrorCount.

metric namespace

The destination namespace of the new CloudWatch metric.

metric value

The numerical value to publish to the metric each time a matching log is found. For example, if you're counting the occurrences of a particular term like "Error", the value will be "1" for each occurrence. If you're counting the bytes transferred, you can increment by the actual number of bytes found in the log event.

Filter pattern syntax for metric filters

Note

How metric filters differ from CloudWatch Logs Insights queries
Metric filters differ from CloudWatch Logs Insights queries in that a specified numerical value is added to a metric filter each time a matching log is found. For more information, see Configuring metric values for a metric filter.
For information about how to query your log groups with the Amazon CloudWatch Logs Insights query language, see CloudWatch Logs Insights language query syntax.

Generic filter pattern examples

For more information on generic filter pattern syntax applicable to metric filters as well as subscription filters and filter log events, see Filter pattern syntax for metric filters, subscription filters, and filter log events, which includes the following examples:

- Supported regular expressions (regex) syntax
- Matching terms in unstructured log events
- Matching terms in JSON log events
- Matching terms in space-delimited log events

Metric filters allow you to search and filter log data coming into CloudWatch Logs, extract metric observations from the filtered log data, and transform the data points into a CloudWatch Logs metric. You define the terms and patterns to look for in log data as it is sent to CloudWatch Logs. Metric filters are assigned to log groups, and all of the filters assigned to a log group are applied to their log streams.

When a metric filter matches a term, it increments the metric's count by a specified numerical value. For example, you can create a metric filter that counts the number of times the word ***ERROR*** occurs in your log events.

You can assign units of measure and dimensions to metrics. For example, if you create a metric filter that counts the number of times the word ***ERROR*** occurs in your log events, you can specify a dimension that's called `ErrorCode` to show the total number of log events that contain the word ***ERROR*** and filter data by reported error codes.

Tip

When you assign a unit of measure to a metric, make sure to specify the correct one. If you change the unit later, your change might not take effect. For the complete list of the units that CloudWatch supports, see MetricDatum in the Amazon CloudWatch API Reference.

Topics

- Configuring metric values for a metric filter
- Publishing dimensions with metrics from values in JSON or space-delimited log events
- Using values in log events to increment a metric's value

Configuring metric values for a metric filter

When you create a metric filter, you define your filter pattern and specify your metric's value and default value. You can set metric values to numbers, named identifiers, or numeric identifiers. If you don't specify a default value, CloudWatch won't report data when your metric filter doesn't find a match. We recommend that you specify a default value, even if the value is 0. Setting a default value helps CloudWatch report data more accurately and prevents CloudWatch from aggregating spotty metrics. CloudWatch aggregates and reports metric values every minute.

When your metric filter finds a match in your log events, it increments your metric's count by your metric's value. If your metric filter doesn't find a match, CloudWatch reports the metric's default value. For example, your log group publishes two records every minute, the metric value is 1, and the default value is 0. If your metric filter finds matches in both log records within the first minute, the metric value for that minute is 2. If your metric filter doesn't find matches in either records during the second minute, the default value for that minute is 0. If you assign dimensions to metrics that metric filters generate, you can't specify default values for those metrics.

You also can set up a metric filter to increment a metric with a value extracted from a log event, instead of a static value. For more information, see Using values in log events to increment a metric's value.

Publishing dimensions with metrics from values in JSON or space-delimited log events

You can use the CloudWatch console or AWS CLI to create metric filters that publish dimensions with metrics that JSON and space-delimited log events generate. Dimensions are name/value value pairs and only available for JSON and space-delimited filter patterns. You can create JSON and space-delimited metric filters with up to three dimensions. For more information about dimensions and information about how to assign dimensions to metrics, see the following sections:

- Dimensions in the *Amazon CloudWatch User guide*
- Example: Extract fields from an Apache log and assign dimensions in the *Amazon CloudWatch Logs User Guide*

Important

Dimensions contain values that gather charges the same as custom metrics. To prevent unexpected charges, don't specify high-cardinality fields, such as `IPAddress` or `requestID`, as dimensions.

If you extract metrics from log events, you're charged for custom metrics. To prevent you from collecting accidental high charges, Amazon might disable your metric filter if it generates 1000 different name/value pairs for specified dimensions over a certain amount of time.

You can create billing alarms that notify you of your estimated charges. For more information, see Creating a billing alarm to monitor your estimated AWS charges.

Publishing dimensions with metrics from JSON log events

The following examples contain code snippets that describe how to specify dimensions in a JSON metric filter.

Example: JSON log event

```
{
  "eventType": "UpdateTrail",
  "sourceIPAddress": "111.111.111.111",
  "arrayKey": [
        "value",
        "another value"
  ],
  "objectList": [
       {"name": "a",
         "id": 1
       },
       {"name": "b",
         "id": 2
       }
  ]

}
```

> **Note**
>
> If you test the example metric filter with the example JSON log event, you must enter the example JSON log on a single line.

Example: Metric filter

The metric filter increments the metric whenever a JSON log event contain the properties `eventType` and `"sourceIPAddress"`.

```
{ $.eventType = "*" && $.sourceIPAddress != 123.123.* }
```

When you create a JSON metric filter, you can specify any of the properties in the metric filter as a dimension. For example, to set `eventType` as a dimension, use the following:

```
"eventType" : $.eventType
```

The example metric contains a dimension that's named `"eventType"`, and the dimension's value in the example log event is `"UpdateTrail"`.

Publishing dimensions with metrics from space-delimited log events

The following examples contain code snippets that describe how to specify dimensions in a space-delimited metric filter.

Example: Space-delimited log event

```
127.0.0.1 Prod frank [10/Oct/2000:13:25:15 -0700] "GET /index.html HTTP/1.0" 404
 1534
```

Example: Metric filter

```
[ip, server, username, timestamp, request, status_code, bytes > 1000]
```

The metric filter increments the metric when a space-delimited log event includes any of the fields that are specified in the filter. For example, the metric filter finds following fields and values in the example space-delimited log event.

```
{
   "$bytes": "1534",
   "$status_code": "404",

   "$request": "GET /index.html HTTP/1.0",
   "$timestamp": "10/Oct/2000:13:25:15 -0700",
   "$username": "frank",
   "$server": "Prod",
   "$ip": "127.0.0.1"
}
```

When you create a space-delimited metric filter, you can specify any of the fields in the metric filter as a dimension. For example, to set `server` as a dimension, use the following:

```
"server" : $server
```

The example metric filter has a dimension that's named `server`, and the dimension's value in the example log event is `"Prod"`.

Example: Match terms with AND (&&) and OR (||)

You can use the logical operators AND ("&&") and OR ("||") to create space-delimited metric filters that contain conditions. The following metric filter returns log events where the first word in the events is ERROR or any superstring of WARN.

```
[w1=ERROR || w1=%WARN%, w2]
```

Using values in log events to increment a metric's value

You can create metric filters that publish numeric values found in your log events. The procedure in this section uses the following example metric filter to show how you can publish a numeric value in a JSON log event to a metric.

```
{ $.latency = * } metricValue: $.latency
```

To create a metric filter that publishes a value in a log event

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Logs**, and then choose **Log groups**.
3. Select or create a log group.

   For information about how to create a log group, see Create a log group in CloudWatch Logs in the *Amazon CloudWatch Logs User Guide*.
4. Choose **Actions**, and then choose **Create metric filter**.
5. For **Filter Pattern**, enter **`{ $.latency = * }`**, and then choose **Next**.
6. For **Metric Name**, enter **myMetric**.
7. For **Metric Value**, enter **`$.latency`**.
8. (Optional) For **Default Value**, enter **0**, and then choose **Next**.

   We recommend that you specify a default value, even if the value is 0. Setting a default value helps CloudWatch report data more accurately and prevents CloudWatch from aggregating spotty metrics. CloudWatch aggregates and reports metric values every minute.
9. Choose **Create metric filter**.

The example metric filter matches the term `"latency"` in the example JSON log event and publishes a numeric value of 50 to the metric **myMetric**.

```
{
"latency": 50,
"requestType": "GET"
```

```
}
```

Creating metric filters

The following procedure and examples show how to create metric filters.

Examples

- Create a metric filter for a log group
- Example: Count log events
- Example: Count occurrences of a term
- Example: Count HTTP 404 codes
- Example: Count HTTP 4xx codes
- Example: Extract fields from an Apache log and assign dimensions

Create a metric filter for a log group

To create a metric filter for a log group, follow these steps. The metric won't be visible until there are some data points for it.

To create a metric filter using the CloudWatch console

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Logs**, and then choose **Log groups**.
3. Choose the name of the log group.
4. Choose `Actions`, and then choose **Create metric filter**.
5. For **Filter pattern**, enter a filter pattern. For more information, see Filter pattern syntax for metric filters, subscription filters, filter log events, and Live Tail.
6. (Optional) If you are using centralized log groups, under **Filter selection criteria**, you can specify filters based on source account (`@aws.account`), source region (`@aws.region`), or both conditions.
7. (Optional) To test your filter pattern, under **Test Pattern**, enter one or more log events to test the pattern. Each log event must be formatted on one line. Line breaks are used to separate log events in the **Log event messages** box.
8. Choose **Next**, and then enter a name for your metric filter.

9. Under **Metric details**, for **Metric namespace**, enter a name for the CloudWatch namespace where the metric will be published. If the namespace doesn't already exist, make sure that **Create new** is selected.
10. For **Metric name**, enter a name for the new metric.
11. For **Metric value**, if your metric filter is counting occurrences of the keywords in the filter, enter 1. This increments the metric by 1 for each log event that includes one of the keywords.

    Alternatively, enter a token, such as **`$size`**. This increments the metric by the value of the number in the `size` field for every log event that contains a `size` field.
12. (Optional) For **Unit**, select a unit to assign to the metric. If you do not specify a unit, the unit is set as None.
13. (Optional) Enter the names and tokens for as many as three dimensions for the metric. If you assign dimensions to metrics that metric filters create, you cannot assign default values for those metrics.

    > **Note**
    >
    > Dimensions are supported only in JSON or space-delimited metric filters.
14. Choose **Create metric filter**. You can find the metric filter that you created from the navigation pane. Choose **Logs**, and then choose **Log groups**. Choose the name of the log group that you created your metric filter for, and then select the **Metric filters** tab.

Example: Count log events

The simplest type of log event monitoring is to count the number of log events that occur. You might want to do this to keep a count of all events, to create a "heartbeat" style monitor or just to practice creating metric filters.

In the following CLI example, a metric filter called MyAppAccessCount is applied to the log group MyApp/access.log to create the metric EventCount in the CloudWatch namespace MyNamespace. The filter is configured to match any log event content and to increment the metric by "1".

To create a metric filter using the CloudWatch console

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Log groups**.

3. Choose the name of a log group.
4. Choose `Actions`, **Create metric filter**.
5. Leave **Filter Pattern** and **Select Log Data to Test** blank.
6. Choose **Next**, and then for **Filter Name**, type **`EventCount`**.
7. Under **Metric Details**, for **Metric Namespace**, type **`MyNameSpace`**.
8. For **Metric Name**, type **`MyAppEventCount`**.
9. Confirm that **Metric Value** is 1. This specifies that the count is incremented by 1 for every log event.
10. For **Default Value** enter 0, and then choose **Next**. Specifying a default value ensures that data is reported even during periods when no log events occur, preventing spotty metrics where data sometimes does not exist.
11. Choose **Create metric filter**.

To create a metric filter using the AWS CLI

At a command prompt, run the following command:

```
aws logs put-metric-filter \
  --log-group-name MyApp/access.log \
  --filter-name EventCount \
  --filter-pattern " " \
  --metric-transformations \
  metricName=MyAppEventCount,metricNamespace=MyNamespace,metricValue=1,defaultValue=0
```

You can test this new policy by posting any event data. You should see data points published to the metric MyAppAccessEventCount.

To post event data using the AWS CLI

At a command prompt, run the following command:

```
aws logs put-log-events \
  --log-group-name MyApp/access.log --log-stream-name TestStream1 \
  --log-events \
    timestamp=1394793518000,message="Test event 1" \
    timestamp=1394793518000,message="Test event 2" \
    timestamp=1394793528000,message="This message also contains an Error"
```

Example: Count occurrences of a term

Log events frequently include important messages that you want to count, maybe about the success or failure of operations. For example, an error may occur and be recorded to a log file if a given operation fails. You may want to monitor these entries to understand the trend of your errors.

In the example below, a metric filter is created to monitor for the term Error. The policy has been created and added to the log group **MyApp/message.log**. CloudWatch Logs publishes a data point to the CloudWatch custom metric ErrorCount in the **MyApp/message.log** namespace with a value of "1" for every event containing Error. If no event contains the word Error, then a value of 0 is published. When graphing this data in the CloudWatch console, be sure to use the sum statistic.

After you create a metric filter, you can view the metric in the CloudWatch console. When you are selecting the metric to view, select the metric namespace that matches the log group name. For more information, see Viewing Available Metrics.

To create a metric filter using the CloudWatch console

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Log groups**.
3. Choose the name of the log group.
4. Choose **Actions**, **Create metric filter**.
5. For **Filter Pattern**, enter **`Error`**.

   > **Note**
   >
   > All entries in **Filter Pattern** are case-sensitive.

6. (Optional) To test your filter pattern, under **Test Pattern**, enter one or more log events to use to test the pattern. Each log event must be within one line, because line breaks are used to separate log events in the **Log event messages** box.
7. Choose **Next**, and then on the **Assign metric** page, for **Filter Name**, type **`MyAppErrorCount`**.
8. Under **Metric Details**, for **Metric Namespace**, type **MyNameSpace**.
9. For **Metric Name**, type **ErrorCount**.
10. Confirm that **Metric Value** is 1. This specifies that the count is incremented by 1 for every log event containing "Error".

11. For **Default Value** type 0, and then choose **Next**.
12. Choose **Create metric filter**.

To create a metric filter using the AWS CLI

At a command prompt, run the following command:

```
aws logs put-metric-filter \
  --log-group-name MyApp/message.log \
  --filter-name MyAppErrorCount \
  --filter-pattern 'Error' \
  --metric-transformations \
      metricName=ErrorCount,metricNamespace=MyNamespace,metricValue=1,defaultValue=0
```

You can test this new policy by posting events containing the word "Error" in the message.

To post events using the AWS CLI

At a command prompt, run the following command. Note that patterns are case-sensitive.

```
aws logs put-log-events \
  --log-group-name MyApp/access.log --log-stream-name TestStream1 \
  --log-events \
    timestamp=1394793518000,message="This message contains an Error" \
    timestamp=1394793528000,message="This message also contains an Error"
```

Example: Count HTTP 404 codes

Using CloudWatch Logs, you can monitor how many times your Apache servers return a HTTP 404 response, which is the response code for page not found. You might want to monitor this to understand how often your site visitors do not find the resource they are looking for. Assume that your log records are structured to include the following information for each log event (site visit):

- Requestor IP Address
- RFC 1413 Identity
- Username
- Timestamp
- Request method with requested resource and protocol
- HTTP response code to request

- Bytes transferred in request

An example of this might look like the following:

```
127.0.0.1 - frank [10/Oct/2000:13:55:36 -0700] "GET /apache_pb.gif HTTP/1.0" 404 2326
```

You could specify a rule which attempts to match events of that structure for HTTP 404 errors, as shown in the following example:

To create a metric filter using the CloudWatch console

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Log groups**.
3. Choose `Actions`, **Create metric filter**.
4. For **Filter Pattern**, type **`[IP, UserInfo, User, Timestamp, RequestInfo, StatusCode=404, Bytes]`**.
5. (Optional) To test your filter pattern, under **Test Pattern**, enter one or more log events to use to test the pattern. Each log event must be within one line, because line breaks are used to separate log events in the **Log event messages** box.
6. Choose **Next**, and then for **Filter Name**, type **HTTP404Errors**.
7. Under **Metric Details**, for **Metric Namespace**, enter **`MyNameSpace`**.
8. For **Metric Name**, enter **`ApacheNotFoundErrorCount`**.
9. Confirm that **Metric Value** is 1. This specifies that the count is incremented by 1 for every 404 Error event.
10. For **Default Value** enter 0, and then choose **Next**.
11. Choose **Create metric filter**.

To create a metric filter using the AWS CLI

At a command prompt, run the following command:

```
aws logs put-metric-filter \
  --log-group-name MyApp/access.log \
  --filter-name HTTP404Errors \
  --filter-pattern '[ip, id, user, timestamp, request, status_code=404, size]' \
```

```
  --metric-transformations \
      metricName=ApacheNotFoundErrorCount,metricNamespace=MyNamespace,metricValue=1
```

In this example, literal characters such as the left and right square brackets, double quotes and character string 404 were used. The pattern needs to match with the entire log event message for the log event to be considered for monitoring.

You can verify the creation of the metric filter by using the **describe-metric-filters** command. You should see output that looks like this:

```
aws logs describe-metric-filters --log-group-name MyApp/access.log

{
    "metricFilters": [
        {
            "filterName": "HTTP404Errors",
            "metricTransformations": [
                {
                    "metricValue": "1",
                    "metricNamespace": "MyNamespace",
                    "metricName": "ApacheNotFoundErrorCount"
                }
            ],
            "creationTime": 1399277571078,
            "filterPattern": "[ip, id, user, timestamp, request, status_code=404,
 size]"
        }
    ]
}
```

Now you can post a few events manually:

```
aws logs put-log-events \
--log-group-name MyApp/access.log --log-stream-name hostname \
--log-events \
timestamp=1394793518000,message="127.0.0.1 - bob [10/Oct/2000:13:55:36 -0700] \"GET /
apache_pb.gif HTTP/1.0\" 404 2326" \
timestamp=1394793528000,message="127.0.0.1 - bob [10/Oct/2000:13:55:36 -0700] \"GET /
apache_pb2.gif HTTP/1.0\" 200 2326"
```

Soon after putting these sample log events, you can retrieve the metric named in the CloudWatch console as ApacheNotFoundErrorCount.

Example: Count HTTP 4xx codes

As in the previous example, you might want to monitor your web service access logs and monitor the HTTP response code levels. For example, you might want to monitor all of the HTTP 400-level errors. However, you might not want to specify a new metric filter for every return code.

The following example demonstrates how to create a metric that includes all 400-level HTTP code responses from an access log using the Apache access log format from the Example: Count HTTP 404 codes example.

To create a metric filter using the CloudWatch console

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Log groups**.
3. Choose the name of the log group for the Apache server.
4. Choose `Actions`, **Create metric filter**.
5. For **Filter pattern**, enter **`[ip, id, user, timestamp, request, status_code=4*, size]`**.
6. (Optional) To test your filter pattern, under **Test Pattern**, enter one or more log events to use to test the pattern. Each log event must be within one line, because line breaks are used to separate log events in the **Log event messages** box.
7. Choose **Next**, and then for **Filter name**, type **`HTTP4xxErrors`**.
8. Under **Metric details**, for **Metric namespace**, enter **`MyNameSpace`**.
9. For **Metric name**, enter **HTTP4xxErrors**.
10. For **Metric value**, enter 1. This specifies that the count is incremented by 1 for every log containing a 4xx error.
11. For **Default value** enter 0, and then choose **Next**.
12. Choose **Create metric filter**.

To create a metric filter using the AWS CLI

At a command prompt, run the following command:

```
aws logs put-metric-filter \
  --log-group-name MyApp/access.log \
```

```
  --filter-name HTTP4xxErrors \
  --filter-pattern '[ip, id, user, timestamp, request, status_code=4*, size]' \
  --metric-transformations \
  metricName=HTTP4xxErrors,metricNamespace=MyNamespace,metricValue=1,defaultValue=0
```

You can use the following data in put-event calls to test this rule. If you did not remove the monitoring rule in the previous example, you will generate two different metrics.

```
127.0.0.1 - - [24/Sep/2013:11:49:52 -0700] "GET /index.html HTTP/1.1" 404 287
127.0.0.1 - - [24/Sep/2013:11:49:52 -0700] "GET /index.html HTTP/1.1" 404 287
127.0.0.1 - - [24/Sep/2013:11:50:51 -0700] "GET /~test/ HTTP/1.1" 200 3
127.0.0.1 - - [24/Sep/2013:11:50:51 -0700] "GET /favicon.ico HTTP/1.1" 404 308
127.0.0.1 - - [24/Sep/2013:11:50:51 -0700] "GET /favicon.ico HTTP/1.1" 404 308
127.0.0.1 - - [24/Sep/2013:11:51:34 -0700] "GET /~test/index.html HTTP/1.1" 200 3
```

Example: Extract fields from an Apache log and assign dimensions

Sometimes, instead of counting, it is helpful to use values within individual log events for metric values. This example shows how you can create an extraction rule to create a metric that measures the bytes transferred by an Apache webserver.

This example also shows how to assign dimensions to the metric that you are creating.

To create a metric filter using the CloudWatch console

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Log groups**.
3. Choose the name of the log group for the Apache server.
4. Choose `Actions`, **Create metric filter**.
5. For **Filter pattern**, enter **`[ip, id, user, timestamp, request, status_code, size]`**.
6. (Optional) To test your filter pattern, under **Test Pattern**, enter one or more log events to use to test the pattern. Each log event must be within one line, because line breaks are used to separate log events in the **Log event messages** box.
7. Choose **Next**, and then for **Filter name**, type **`size`**.
8. Under **Metric details**, for **Metric namespace**, enter **`MyNameSpace`**. Because this is a new namespace, be sure that **Create new** is selected.

9. For **Metric name**, enter **`BytesTransferred`**
10. For **Metric value**, enter **`$size`**.
11. For **Unit**, select **Bytes**.
12. For **Dimension Name**, type **`IP`**.
13. For **Dimension Value**, type **`$ip`** and then choose **Next**.
14. Choose **Create metric filter**.

To create this metric filter using the AWS CLI

At a command prompt, run the following command

```
aws logs put-metric-filter \
--log-group-name MyApp/access.log \
 --filter-name BytesTransferred \
 --filter-pattern '[ip, id, user, timestamp, request, status_code, size]' \
 --metric-transformations  \
 metricName=BytesTransferred,metricNamespace=MyNamespace,metricValue='$size'
```

```
aws logs put-metric-filter \
--log-group-name MyApp/access.log \
--filter-name BytesTransferred \
--filter-pattern '[ip, id, user, timestamp, request, status_code, size]' \
--metric-transformations  \
metricName=BytesTransferred,metricNamespace=MyNamespace,metricValue='$size',unit=Bytes,dimensio
$ip}}'
```

Note

In this command, use this format to specify multiple dimensions.

```
aws logs put-metric-filter \
--log-group-name my-log-group-name \
--filter-name my-filter-name \
--filter-pattern 'my-filter-pattern' \
--metric-transformations  \
metricName=my-metric-name,metricNamespace=my-metric-namespace,metricValue=my-
token,unit=unit,dimensions='{dimension1=$dim,dimension2=$dim2,dim3=$dim3}'
```

You can use the following data in put-log-event calls to test this rule. This generates two different metrics if you did not remove monitoring rule in the previous example.

```
127.0.0.1 - - [24/Sep/2013:11:49:52 -0700] "GET /index.html HTTP/1.1" 404 287
127.0.0.1 - - [24/Sep/2013:11:49:52 -0700] "GET /index.html HTTP/1.1" 404 287
127.0.0.1 - - [24/Sep/2013:11:50:51 -0700] "GET /~test/ HTTP/1.1" 200 3
127.0.0.1 - - [24/Sep/2013:11:50:51 -0700] "GET /favicon.ico HTTP/1.1" 404 308
127.0.0.1 - - [24/Sep/2013:11:50:51 -0700] "GET /favicon.ico HTTP/1.1" 404 308
127.0.0.1 - - [24/Sep/2013:11:51:34 -0700] "GET /~test/index.html HTTP/1.1" 200 3
```

Listing metric filters

You can list all metric filters in a log group.

To list metric filters using the CloudWatch console

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Log groups**.
3. In the contents pane, in the list of log groups, in the **Metric Filters** column, choose the number of filters.

   The **Log Groups > Filters for** screen lists all metric filters associated with the log group.

To list metric filters using the AWS CLI

At a command prompt, run the following command:

```
aws logs describe-metric-filters --log-group-name MyApp/access.log
```

The following is example output:

```
{
    "metricFilters": [
        {
            "filterName": "HTTP404Errors",
            "metricTransformations": [
                {
                    "metricValue": "1",
                    "metricNamespace": "MyNamespace",
```

```
                    "metricName": "ApacheNotFoundErrorCount"
                }
            ],
            "creationTime": 1399277571078,
            "filterPattern": "[ip, id, user, timestamp, request, status_code=404,
 size]"
        }
    ]
}
```

Deleting a metric filter

A policy is identified by its name and the log group it belongs to.

To delete a metric filter using the CloudWatch console

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Log groups**.
3. In the contents pane, in the **Metric Filter** column, choose the number of metric filters for the log group.
4. Under **Metric Filters** screen, select the check box to the right of the name of the filter that you want to delete. Then choose **Delete**.
5. When prompted for confirmation, choose **Delete**.

To delete a metric filter using the AWS CLI

At a command prompt, run the following command:

```
aws logs delete-metric-filter --log-group-name MyApp/access.log \
 --filter-name MyFilterName
```

Real-time processing of log data with subscriptions

You can use subscriptions to get access to a real-time feed of log events from CloudWatch Logs and have it delivered to other services such as an Amazon Kinesis stream, an Amazon Data Firehose stream, or AWS Lambda for custom processing, analysis, or loading to other systems. When log events are sent to the receiving service, they are base64 encoded and compressed with the gzip format.

You can also use CloudWatch Logs centralization to replicate log data from multiple accounts and regions into a central location. For more information, see Cross-account cross-Region log centralization.

To begin subscribing to log events, create the receiving resource, such as a Amazon Kinesis Data Streams stream, where the events will be delivered. A subscription filter defines the filter pattern to use for filtering which log events get delivered to your AWS resource, as well as information about where to send matching log events to. Log events are sent to the receiving resource soon after being ingested, usually less than three minutes.

> **Note**
>
> If a log group with a subscription uses log transformation, the filter pattern is compared to the transformed versions of the log events. For more information, see Transform logs during ingestion.

You can create subscriptions at the account level and at the log group level. Each account can have one account-level subscription filter per Region. Each log group can have up to five subscription filters associated with it.

> **Note**
>
> If the destination service returns a retryable error such as a throttling exception or a retryable service exception (HTTP 5xx for example), CloudWatch Logs continues to retry delivery for up to 24 hours. CloudWatch Logs doesn't try to re-deliver if the error is a non-retryable error, such as AccessDeniedException or ResourceNotFoundException. In these cases the subscription filter is disabled for up to 10 minutes, and then CloudWatch Logs retries sending logs to the destination. During this disabled period, logs are skipped.

CloudWatch Logs also produces CloudWatch metrics about the forwarding of log events to subscriptions. For more information, see Monitoring with CloudWatch metrics.

You can also use a CloudWatch Logs subscription to stream log data in near real time to an Amazon OpenSearch Service cluster. For more information, see Streaming CloudWatch Logs data to Amazon OpenSearch Service.

Subscriptions are supported only for log groups in the Standard log class. For more information about log classes, see Log classes.

> **Note**
>
> Subscription filters might batch log events to optimize transmission and reduce the amount of calls made to the destination. Batching is not guaranteed but is used when possible.

For batch processing and analysis of log data on a schedule, consider using Automating log analysis with scheduled queries. Scheduled queries run CloudWatch Logs Insights queries automatically and deliver results to destinations such as Amazon S3 buckets or Amazon EventBridge event buses.

> **Note**
>
> Subscription filters ensure at least one time delivery of events, while duplicate events may occasionally occur.

Contents

Concepts

Each subscription filter is made up of the following key elements:

filter pattern

A symbolic description of how CloudWatch Logs should interpret the data in each log event, along with filtering expressions that restrict what gets delivered to the destination AWS resource. For more information about the filter pattern syntax, see Filter pattern syntax for metric filters, subscription filters, filter log events, and Live Tail.

destination arn

The Amazon Resource Name (ARN) of the Amazon Kinesis Data Streams stream, Firehose stream, or Lambda function you want to use as the destination of the subscription feed.

role arn

An IAM role that grants CloudWatch Logs the necessary permissions to put data into the chosen destination. This role is not needed for Lambda destinations because CloudWatch Logs can get the necessary permissions from access control settings on the Lambda function itself.

> **Note**
>
> If role manager is enabled in your account, CloudWatch attaches the role for you, and the role options described here (for example the **Create new role** button) are replaced by a **Customize** option. To use a different role, choose **Customize**. For more information about IAM role creation, see IAM role creation in the *IAM User Guide*.

distribution

The method used to distribute log data to the destination, when the destination is a stream in Amazon Kinesis Data Streams. By default, log data is grouped by log stream. For a more even distribution, you can group log data randomly.

For log group-level subscriptions, the following key element is also included:

log group name

The log group to associate the subscription filter with. All log events uploaded to this log group would be subject to the subscription filter, and those that match the filter are delivered to the destination service that is receiving the matching log events.

For account-level subscriptions, the following key element is also included:

selection criteria

The criteria used for selecting which log groups have the account-level subscription filter applied. If you don't specify this, the account-level subscription filter is applied to all log groups in the account. This field is used to prevent infinite log loops. For more information about the infinite log loop issue, see Log recursion prevention.

Selection criteria has a size limit of 25 KB.

For centralized log groups, the following key elements are also included. These elements can be used as field selection criteria to help in identifying the source of log data, allowing for more granular filtering and analysis of metrics derived from centralized logs.

@aws.account

This field identifies the AWS account ID from which the log event originated.

@aws.region

This field identifies the AWS Region where the log event was generated.

@source.log

This field identifies the source log group from which the log event originated.

Log group-level subscription filters

You can use a subscription filter with Amazon Kinesis Data Streams, AWS Lambda, Amazon Data Firehose, or Amazon OpenSearch Service. Logs sent to a service through a subscription filter are base64 encoded and compressed with the gzip format. If you are using centralized logs with your AWS Organizations, you can choose to emit the `@aws.account`, `@aws.region`, and `@source.log` system fields to identify which data comes from which accounts, Regions, and

source log groups in your organization. This section provides examples you can follow to create a CloudWatch Logs subscription filter that sends log data to Firehose, Lambda, Amazon Kinesis Data Streams, and OpenSearch Service.

> **Note**
>
> If you want to search your log data, see Filter and pattern syntax.

Examples

- Example 1: Subscription filters with Amazon Kinesis Data Streams
- Example 2: Subscription filters with AWS Lambda
- Example 3: Subscription filters with Amazon Data Firehose
- Example 4: Subscription filters with Amazon OpenSearch Service

Example 1: Subscription filters with Amazon Kinesis Data Streams

The following example associates a subscription filter with a log group containing AWS CloudTrail events. The subscription filter delivers every logged activity made by "Root" AWS credentials to a stream in Amazon Kinesis Data Streams called "RootAccess." For more information about how to send AWS CloudTrail events to CloudWatch Logs, see Sending CloudTrail Events to CloudWatch Logs in the *AWS CloudTrail User Guide*.

> **Note**
>
> Before you create the stream, calculate the volume of log data that will be generated. Be sure to create a stream with enough shards to handle this volume. If the stream does not have enough shards, the log stream will be throttled. For more information about stream volume limits, see Quotas and Limits.
> Throttled deliverables are retried for up to 24 hours. After 24 hours, the failed deliverables are dropped.
> To mitigate the risk of throttling, you can take the following steps:
>
> - Specify `random` for `distribution` when you create the subscription filter with PutSubscriptionFilter or put-subscription-filter. By default, the stream filter distribution is by log stream and this can cause throttling.

- Monitor your stream using CloudWatch metrics. This helps you identify any throttling and adjust your configuration accordingly. For example, the `DeliveryThrottling` metric can be used to track the number of log events for which CloudWatch Logs was throttled when forwarding data to the subscription destination. For more information about monitoring, see Monitoring with CloudWatch metrics.
- Use the on-demand capacity mode for your stream in Amazon Kinesis Data Streams. On-demand mode instantly accommodates your workloads as they ramp up or down. More information about on-demand capacity mode, see On-demand mode.
- Restrict your CloudWatch subscription filter pattern to match the capacity of your stream in Amazon Kinesis Data Streams. If you are sending too much data to the stream, you might need to reduce the filter size or adjust the filter criteria.

To create a subscription filter for Amazon Kinesis Data Streams

1. Create a destination stream using the following command:

```
$ C:\>  aws kinesis create-stream --stream-name "RootAccess" --shard-count 1
```

2. Wait until the stream becomes Active (this might take a minute or two). You can use the following Amazon Kinesis Data Streams describe-stream command to check the **StreamDescription.StreamStatus** property. In addition, note the **StreamDescription.StreamARN** value, as you will need it in a later step:

```
aws kinesis describe-stream --stream-name "RootAccess"
```

   The following is example output:

```
{
    "StreamDescription": {
        "StreamStatus": "ACTIVE",
        "StreamName": "RootAccess",
        "StreamARN": "arn:aws:kinesis:us-east-1:123456789012:stream/RootAccess",
        "Shards": [
            {
                "ShardId": "shardId-000000000000",
                "HashKeyRange": {
                    "EndingHashKey": "340282366920938463463374607431768211455",
                    "StartingHashKey": "0"
```

```
                },
                "SequenceNumberRange": {
                    "StartingSequenceNumber":
                    "49551135218688818456679503831981458784591352702181572610"
                }
            }
        ]
    }
}
```

3. Create the IAM role that will grant CloudWatch Logs permission to put data into your stream. First, you'll need to create a trust policy in a file (for example, `~/TrustPolicyForCWL-Kinesis.json`). Use a text editor to create this policy. Do not use the IAM console to create it.

   This policy includes a `aws:SourceArn` global condition context key to help prevent the confused deputy security problem. For more information, see Confused deputy prevention.

```
{
  "Statement": {
    "Effect": "Allow",
    "Principal": { "Service": "logs.amazonaws.com" },
    "Action": "sts:AssumeRole",
    "Condition": {
        "ArnLike": { "aws:SourceArn": "arn:aws:logs:region:123456789012:*" }
     }
   }
}
```

4. Use the **create-role** command to create the IAM role, specifying the trust policy file. Note the returned **Role.Arn** value, as you will also need it for a later step:

```
aws iam create-role --role-name CWLtoKinesisRole --assume-role-policy-document
 file://~/TrustPolicyForCWL-Kinesis.json
```

   The following is an example of the output.

```
{
    "Role": {
        "AssumeRolePolicyDocument": {
            "Statement": {
                "Action": "sts:AssumeRole",
                "Effect": "Allow",
```

```
                "Principal": {
                    "Service": "logs.amazonaws.com"
                },
                "Condition": {
                    "StringLike": {
                        "aws:SourceArn": { "arn:aws:logs:region:123456789012:*" }
                    }
                }
            }
        },
        "RoleId": "AAOIIAH450GAB4HC5F431",
        "CreateDate": "2015-05-29T13:46:29.431Z",
        "RoleName": "CWLtoKinesisRole",
        "Path": "/",
        "Arn": "arn:aws:iam::123456789012:role/CWLtoKinesisRole"
    }
}
```

5. Create a permissions policy to define what actions CloudWatch Logs can do on your account. First, you'll create a permissions policy in a file (for example, `~/PermissionsForCWL-Kinesis.json`). Use a text editor to create this policy. Do not use the IAM console to create it.

```
{
  "Statement": [
    {
      "Effect": "Allow",
      "Action": "kinesis:PutRecord",
      "Resource": "arn:aws:kinesis:region:123456789012:stream/RootAccess"
    }
  ]
}
```

6. Associate the permissions policy with the role using the following put-role-policy command:

```
aws iam put-role-policy  --role-name CWLtoKinesisRole  --policy-name Permissions-Policy-For-CWL  --policy-document file://~/PermissionsForCWL-Kinesis.json
```

7. After the stream is in **Active** state and you have created the IAM role, you can create the CloudWatch Logs subscription filter. The subscription filter immediately starts the flow of real-time log data from the chosen log group to your stream:

```
aws logs put-subscription-filter \
```

```
    --log-group-name "CloudTrail/logs" \
    --filter-name "RootAccess" \
    --filter-pattern "{$.userIdentity.type = Root}" \
    --destination-arn "arn:aws:kinesis:region:123456789012:stream/RootAccess" \
    --role-arn "arn:aws:iam::123456789012:role/CWLtoKinesisRole"
```

8. After you set up the subscription filter, CloudWatch Logs forwards all the incoming log events that match the filter pattern to your stream. You can verify that this is happening by grabbing a Amazon Kinesis Data Streams shard iterator and using the Amazon Kinesis Data Streams get-records command to fetch some Amazon Kinesis Data Streams records:

```
aws kinesis get-shard-iterator --stream-name RootAccess --shard-id
 shardId-000000000000 --shard-iterator-type TRIM_HORIZON
```

```
{
    "ShardIterator":
    "AAAAAAAAAAFGU/
kLvNggvndHq2UIFOw5PZc6F01s3e3afsSscRM70JSbjIefg2ub07nk1y6CDxYR1UoGHJNP4m4NFUetzfL
+wev+e2P4djJg4L9wmXKvQYoE+rMUiFq
+p4Cn3IgvqOb5dRA0yybNdRcdzvnC35KQANoHzzahKdRGb9v4scv+3vaq+f+OIK8zM5My8ID
+g6rMo7UKWeI4+IWiK2OSh0uP"
}
```

```
aws kinesis get-records --limit 10 --shard-iterator "AAAAAAAAAAFGU/
kLvNggvndHq2UIFOw5PZc6F01s3e3afsSscRM70JSbjIefg2ub07nk1y6CDxYR1UoGHJNP4m4NFUetzfL
+wev+e2P4djJg4L9wmXKvQYoE+rMUiFq
+p4Cn3IgvqOb5dRA0yybNdRcdzvnC35KQANoHzzahKdRGb9v4scv+3vaq+f+OIK8zM5My8ID
+g6rMo7UKWeI4+IWiK2OSh0uP"
```

Note that you might need to make this call a few times before Amazon Kinesis Data Streams starts to return data.

You should expect to see a response with an array of records. The **Data** attribute in a Amazon Kinesis Data Streams record is base64 encoded and compressed with the gzip format. You can examine the raw data from the command line using the following Unix commands:

```
echo -n "<Content of Data>" | base64 -d | zcat
```

The base64 decoded and decompressed data is formatted as JSON with the following structure:

```
{
    "owner": "111111111111",
    "logGroup": "CloudTrail/logs",
    "logStream": "111111111111_CloudTrail/logs_us-east-1",
    "subscriptionFilters": [
        "Destination"
    ],
    "messageType": "DATA_MESSAGE",
    "logEvents": [
        {
            "id": "31953106606966983378809025079804211143289615424298221568",
            "timestamp": 1432826855000,
            "message": "{\"eventVersion\":\"1.03\",\"userIdentity\":{\"type\":
\"Root\"}"
        },
        {
            "id": "31953106606966983378809025079804211143289615424298221569",
            "timestamp": 1432826855000,
            "message": "{\"eventVersion\":\"1.03\",\"userIdentity\":{\"type\":
\"Root\"}"
        },
        {
            "id": "31953106606966983378809025079804211143289615424298221570",
            "timestamp": 1432826855000,
            "message": "{\"eventVersion\":\"1.03\",\"userIdentity\":{\"type\":
\"Root\"}"
        }
    ]
}
```

The key elements in the above data structure are the following:

owner

The AWS Account ID of the originating log data.

logGroup

The log group name of the originating log data.

logStream

The log stream name of the originating log data.

subscriptionFilters

The list of subscription filter names that matched with the originating log data.

messageType

Data messages will use the "DATA_MESSAGE" type. Sometimes CloudWatch Logs may emit Amazon Kinesis Data Streams records with a "CONTROL_MESSAGE" type, mainly for checking if the destination is reachable.

logEvents

The actual log data, represented as an array of log event records. The "id" property is a unique identifier for every log event.

Example 2: Subscription filters with AWS Lambda

In this example, you'll create a CloudWatch Logs subscription filter that sends log data to your AWS Lambda function.

> **Note**
>
> Before you create the Lambda function, calculate the volume of log data that will be generated. Be sure to create a function that can handle this volume. If the function does not have enough volume, the log stream will be throttled. For more information about Lambda limits, see AWS Lambda Limits.

To create a subscription filter for Lambda

1. Create the AWS Lambda function.

   Ensure that you have set up the Lambda execution role. For more information, see Step 2.2: Create an IAM Role (execution role) in the *AWS Lambda Developer Guide*.
2. Open a text editor and create a file named `helloWorld.js` with the following contents:

```
var zlib = require('zlib');
```

```
exports.handler = function(input, context) {
    var payload = Buffer.from(input.awslogs.data, 'base64');
    zlib.gunzip(payload, function(e, result) {
        if (e) {
            context.fail(e);
        } else {
            result = JSON.parse(result.toString());
            console.log("Event Data:", JSON.stringify(result, null, 2));
            context.succeed();
        }
    });
};
```

3. Zip the file helloWorld.js and save it with the name `helloWorld.zip`.
4. Use the following command, where the role is the Lambda execution role you set up in the first step:

```
aws lambda create-function \
    --function-name helloworld \
    --zip-file fileb://file-path/helloWorld.zip \
    --role lambda-execution-role-arn \
    --handler helloWorld.handler \
    --runtime nodejs12.x
```

5. Grant CloudWatch Logs the permission to execute your function. Use the following command, replacing the placeholder account with your own account and the placeholder log group with the log group to process:

```
aws lambda add-permission \
    --function-name "helloworld" \
    --statement-id "helloworld" \
    --principal "logs.amazonaws.com" \
    --action "lambda:InvokeFunction" \
    --source-arn "arn:aws:logs:region:123456789123:log-group:TestLambda:*" \
    --source-account "123456789012"
```

6. Create a subscription filter using the following command, replacing the placeholder account with your own account and the placeholder log group with the log group to process:

```
aws logs put-subscription-filter \
    --log-group-name myLogGroup \
    --filter-name demo \
```

```
    --filter-pattern "" \
    --destination-arn arn:aws:lambda:region:123456789123:function:helloworld
```

7. (Optional) Test using a sample log event. At a command prompt, run the following command, which will put a simple log message into the subscribed stream.

   To see the output of your Lambda function, navigate to the Lambda function where you will see the output in /aws/lambda/helloworld:

```
aws logs put-log-events --log-group-name myLogGroup --log-stream-name stream1 --
log-events "[{\"timestamp\":<CURRENT TIMESTAMP MILLIS> , \"message\": \"Simple
 Lambda Test\"}]"
```

   You should expect to see a response with an array of Lambda. The **Data** attribute in the Lambda record is base64 encoded and compressed with the gzip format. The actual payload that Lambda receives is in the following format `{ "awslogs": {"data": "BASE64ENCODED_GZIP_COMPRESSED_DATA"} }` You can examine the raw data from the command line using the following Unix commands:

```
echo -n "<BASE64ENCODED_GZIP_COMPRESSED_DATA>" | base64 -d | zcat
```

   The base64 decoded and decompressed data is formatted as JSON with the following structure:

```
{
    "owner": "123456789012",
    "logGroup": "CloudTrail",
    "logStream": "123456789012_CloudTrail_us-east-1",
    "subscriptionFilters": [
        "Destination"
    ],
    "messageType": "DATA_MESSAGE",
    "logEvents": [
        {
            "id": "31953106606966983378809025079804211143289615424298221568",
            "timestamp": 1432826855000,
            "message": "{\"eventVersion\":\"1.03\",\"userIdentity\":{\"type\":
\"Root\"}"
        },
        {
            "id": "31953106606966983378809025079804211143289615424298221569",
```

```
            "timestamp": 1432826855000,
            "message": "{\"eventVersion\":\"1.03\",\"userIdentity\":{\"type\":
\"Root\"}"
        },
        {
            "id": "31953106606966983378809025079804211143289615424298221570",
            "timestamp": 1432826855000,
            "message": "{\"eventVersion\":\"1.03\",\"userIdentity\":{\"type\":
\"Root\"}"
        }
    ]
}
```

The key elements in the above data structure are the following:

owner

The AWS Account ID of the originating log data.

logGroup

The log group name of the originating log data.

logStream

The log stream name of the originating log data.

subscriptionFilters

The list of subscription filter names that matched with the originating log data.

messageType

Data messages will use the "DATA_MESSAGE" type. Sometimes CloudWatch Logs may emit Lambda records with a "CONTROL_MESSAGE" type, mainly for checking if the destination is reachable.

logEvents

The actual log data, represented as an array of log event records. The "id" property is a unique identifier for every log event.

Example 3: Subscription filters with Amazon Data Firehose

In this example, you'll create a CloudWatch Logs subscription that sends any incoming log events that match your defined filters to your Amazon Data Firehose delivery stream. Data sent from CloudWatch Logs to Amazon Data Firehose is already compressed with gzip level 6 compression, so you do not need to use compression within your Firehose delivery stream. You can then use the decompression feature in Firehose to automatically decompress the logs. For more information, see Send CloudWatch Logs to Firehose.

> **Note**
>
> Before you create the Firehose stream, calculate the volume of log data that will be generated. Be sure to create a Firehose stream that can handle this volume. If the stream cannot handle the volume, the log stream will be throttled. For more information about Firehose stream volume limits, see Amazon Data Firehose Data Limits.

To create a subscription filter for Firehose

1. Create an Amazon Simple Storage Service (Amazon S3) bucket. We recommend that you use a bucket that was created specifically for CloudWatch Logs. However, if you want to use an existing bucket, skip to step 2.

   Run the following command, replacing the placeholder Region with the Region you want to use:

   ```
   aws s3api create-bucket --bucket amzn-s3-demo-bucket2 --create-bucket-configuration
    LocationConstraint=region
   ```

   The following is example output:

   ```
   {
       "Location": "/amzn-s3-demo-bucket2"
   }
   ```

2. Create the IAM role that grants Amazon Data Firehose permission to put data into your Amazon S3 bucket.

For more information, see Controlling Access with Amazon Data Firehose in the *Amazon Data Firehose Developer Guide*.

First, use a text editor to create a trust policy in a file ~/TrustPolicyForFirehose.json as follows:

```
{
  "Statement": {
    "Effect": "Allow",
    "Principal": { "Service": "firehose.amazonaws.com" },
    "Action": "sts:AssumeRole"
    }
}
```

3. Use the **create-role** command to create the IAM role, specifying the trust policy file. Note of the returned **Role.Arn** value, as you will need it in a later step:

```
aws iam create-role \
 --role-name FirehosetoS3Role \
 --assume-role-policy-document file://~/TrustPolicyForFirehose.json

{
    "Role": {
        "AssumeRolePolicyDocument": {
            "Statement": {
                "Action": "sts:AssumeRole",
                "Effect": "Allow",
                "Principal": {
                    "Service": "firehose.amazonaws.com"
                }
            }
        },
        "RoleId": "AAOIIAH450GAB4HC5F431",
        "CreateDate": "2015-05-29T13:46:29.431Z",
        "RoleName": "FirehosetoS3Role",
        "Path": "/",
        "Arn": "arn:aws:iam::123456789012:role/FirehosetoS3Role"
    }
}
```

4. Create a permissions policy to define what actions Firehose can do on your account. First, use a text editor to create a permissions policy in a file ~/PermissionsForFirehose.json:

```
{
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
          "s3:AbortMultipartUpload",
          "s3:GetBucketLocation",
          "s3:GetObject",
          "s3:ListBucket",
          "s3:ListBucketMultipartUploads",
          "s3:PutObject" ],
      "Resource": [
          "arn:aws:s3:::amzn-s3-demo-bucket2",
          "arn:aws:s3:::amzn-s3-demo-bucket2/*" ]
    }
  ]
}
```

5. Associate the permissions policy with the role using the following put-role-policy command:

```
aws iam put-role-policy --role-name FirehosetoS3Role --policy-name Permissions-
Policy-For-Firehose --policy-document file://~/PermissionsForFirehose.json
```

6. Create a destination Firehose delivery stream as follows, replacing the placeholder values for **RoleARN** and **BucketARN** with the role and bucket ARNs that you created:

```
aws firehose create-delivery-stream \
   --delivery-stream-name 'my-delivery-stream' \
   --s3-destination-configuration \
  '{"RoleARN": "arn:aws:iam::123456789012:role/FirehosetoS3Role", "BucketARN":
 "arn:aws:s3:::amzn-s3-demo-bucket2"}'
```

Note that Firehose automatically uses a prefix in YYYY/MM/DD/HH UTC time format for delivered Amazon S3 objects. You can specify an extra prefix to be added in front of the time format prefix. If the prefix ends with a forward slash (/), it appears as a folder in the Amazon S3 bucket.

7. Wait until the stream becomes active (this might take a few minutes). You can use the Firehose **describe-delivery-stream** command to check the

DeliveryStreamDescription.DeliveryStreamStatus property. In addition, note the **DeliveryStreamDescription.DeliveryStreamARN** value, as you will need it in a later step:

```
aws firehose describe-delivery-stream --delivery-stream-name "my-delivery-stream"
{
    "DeliveryStreamDescription": {
        "HasMoreDestinations": false,
        "VersionId": "1",
        "CreateTimestamp": 1446075815.822,
        "DeliveryStreamARN": "arn:aws:firehose:us-
east-1:123456789012:deliverystream/my-delivery-stream",
        "DeliveryStreamStatus": "ACTIVE",
        "DeliveryStreamName": "my-delivery-stream",
        "Destinations": [
            {
                "DestinationId": "destinationId-000000000001",
                "S3DestinationDescription": {
                    "CompressionFormat": "UNCOMPRESSED",
                    "EncryptionConfiguration": {
                        "NoEncryptionConfig": "NoEncryption"
                    },
                    "RoleARN": "delivery-stream-role",
                    "BucketARN": "arn:aws:s3:::amzn-s3-demo-bucket2",
                    "BufferingHints": {
                        "IntervalInSeconds": 300,
                        "SizeInMBs": 5
                    }
                }
            }
        ]
    }
}
```

8. Create the IAM role that grants CloudWatch Logs permission to put data into your Firehose delivery stream. First, use a text editor to create a trust policy in a file `~/TrustPolicyForCWL.json`:

   This policy includes a `aws:SourceArn` global condition context key to help prevent the confused deputy security problem. For more information, see Confused deputy prevention.

```
{
  "Statement": {
```

```
    "Effect": "Allow",
    "Principal": { "Service": "logs.amazonaws.com" },
    "Action": "sts:AssumeRole",
    "Condition": {
         "ArnLike": {
             "aws:SourceArn": "arn:aws:logs:region:123456789012:*"
         }
     }
  }
}
```

9. Use the **create-role** command to create the IAM role, specifying the trust policy file. Note of the returned **Role.Arn** value, as you will need it in a later step:

```
aws iam create-role \
--role-name CWLtoKinesisFirehoseRole \
--assume-role-policy-document file://~/TrustPolicyForCWL.json

{
    "Role": {
        "AssumeRolePolicyDocument": {
            "Statement": {
                "Action": "sts:AssumeRole",
                "Effect": "Allow",
                "Principal": {
                    "Service": "logs.amazonaws.com"
                },
                "Condition": {
                     "StringLike": {
                         "aws:SourceArn": "arn:aws:logs:region:123456789012:*"
                     }
                 }
            }
        },
        "RoleId": "AAOIIAH450GAB4HC5F431",
        "CreateDate": "2015-05-29T13:46:29.431Z",
        "RoleName": "CWLtoKinesisFirehoseRole",
        "Path": "/",
        "Arn": "arn:aws:iam::123456789012:role/CWLtoKinesisFirehoseRole"
    }
}
```

10. Create a permissions policy to define what actions CloudWatch Logs can do on your account. First, use a text editor to create a permissions policy file (for example, ~/PermissionsForCWL.json):

```
{
    "Statement":[
      {
        "Effect":"Allow",
        "Action":["firehose:PutRecord"],
        "Resource":[
            "arn:aws:firehose:region:account-id:deliverystream/delivery-stream-
name"]
      }
    ]
}
```

11. Associate the permissions policy with the role using the put-role-policy command:

```
aws iam put-role-policy --role-name CWLtoKinesisFirehoseRole --policy-
name Permissions-Policy-For-CWL --policy-document file://~/PermissionsForCWL.json
```

12. After the Amazon Data Firehose delivery stream is in active state and you have created the IAM role, you can create the CloudWatch Logs subscription filter. The subscription filter immediately starts the flow of real-time log data from the chosen log group to your Amazon Data Firehose delivery stream:

```
aws logs put-subscription-filter \
    --log-group-name "CloudTrail" \
    --filter-name "Destination" \
    --filter-pattern "{$.userIdentity.type = Root}" \
    --destination-arn "arn:aws:firehose:region:123456789012:deliverystream/my-
delivery-stream" \
    --role-arn "arn:aws:iam::123456789012:role/CWLtoKinesisFirehoseRole"
```

13. After you set up the subscription filter, CloudWatch Logs will forward all the incoming log events that match the filter pattern to your Amazon Data Firehose delivery stream. Your data will start appearing in your Amazon S3 based on the time buffer interval set on your Amazon Data Firehose delivery stream. Once enough time has passed, you can verify your data by checking your Amazon S3 Bucket.

```
aws s3api list-objects --bucket 'amzn-s3-demo-bucket2' --prefix 'firehose/'
```

```
{
    "Contents": [
        {
            "LastModified": "2015-10-29T00:01:25.000Z",
            "ETag": "\"a14589f8897f4089d3264d9e2d1f1610\"",
            "StorageClass": "STANDARD",
            "Key": "firehose/2015/10/29/00/my-delivery-stream-2015-10-29-00-01-21-
a188030a-62d2-49e6-b7c2-b11f1a7ba250",
            "Owner": {
                "DisplayName": "cloudwatch-logs",
                "ID": "1ec9cf700ef6be062b19584e0b7d84ecc19237f87b5"
            },
            "Size": 593
        },
        {
            "LastModified": "2015-10-29T00:35:41.000Z",
            "ETag": "\"a7035b65872bb2161388ffb63dd1aec5\"",
            "StorageClass": "STANDARD",
            "Key": "firehose/2015/10/29/00/my-delivery-
stream-2015-10-29-00-35-40-7cc92023-7e66-49bc-9fd4-fc9819cc8ed3",
            "Owner": {
                "DisplayName": "cloudwatch-logs",
                "ID": "1ec9cf700ef6be062b19584e0b7d84ecc19237f87b6"
            },
            "Size": 5752
        }
    ]
}
```

```
aws s3api get-object --bucket 'amzn-s3-demo-bucket2' --key 'firehose/2015/10/29/00/
my-delivery-stream-2015-10-29-00-01-21-a188030a-62d2-49e6-b7c2-b11f1a7ba250'
 testfile.gz

{
    "AcceptRanges": "bytes",
    "ContentType": "application/octet-stream",
    "LastModified": "Thu, 29 Oct 2015 00:07:06 GMT",
    "ContentLength": 593,
    "Metadata": {}
}
```

The data in the Amazon S3 object is compressed with the gzip format. You can examine the raw data from the command line using the following Unix command:

```
zcat testfile.gz
```

Example 4: Subscription filters with Amazon OpenSearch Service

In this example, you'll create a CloudWatch Logs subscription that sends incoming log events that match your defined filters to your OpenSearch Service domain.

To create a subscription filter for OpenSearch Service

1. Create an OpenSearch Service domain. For more information, see Creating OpenSearch Service domains
2. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
3. In the navigation pane, choose **Log groups**.
4. Select the name of the log group.
5. Choose **Actions**, **Subscription filters**, **Create Amazon OpenSearch Service subscription filter**.
6. Choose whether you want to stream to a cluster in this account or another account.
   - If you chose **This account**, select the domain that you created in step 1.
   - If you chose **Another account**, enter ARN and endpoint of that domain.
7. If you chose another account, provide the domain ARN and endpoint.
8. For Amazon OpenSearch Service cluster choose the name of the cluster where the log group data will be delivered
9. Choose a log format.
10. For **Subscription filter pattern**, enter the terms or pattern to find in your log events. This ensures that you send only the data that you're interested in to your OpenSearch Service cluster. For more information, see Filter pattern syntax for metric filters.
11. (Optional) For **Select log data to test**, select a log stream and then choose **Test pattern** to verify that your search filter is returning the results you expect.
12. Choose **Start streaming**.

Account-level subscription filters

Important

There is a risk of causing an infinite recursive loop with subscription filters that can lead to a large increase in ingestion billing if not addressed. To mitigate this risk, we recommend that you use selection criteria in your account-level subscription filters to exclude log groups that ingest log data from resources that are part of the subscription delivery workflow. For more information on this problem and determining which log groups to exclude, see Log recursion prevention.

You can set an account-level subscription policy that includes a subset of log groups in the account. The account subscription policy can work with Amazon Kinesis Data Streams, AWS Lambda, or Amazon Data Firehose. Logs sent to a service through an account-level subscription policy are base64 encoded and compressed with the gzip format. This section provides examples you can follow to create an account-level subscription for Amazon Kinesis Data Streams, Lambda, and Firehose.

Note

To view a list of all subscription filter policies in your account, use the `describe-account-policies` command with a value of `SUBSCRIPTION_FILTER_POLICY` for the `--policy-type` parameter. For more information, see describe-account-policies¶.

Examples

- Example 1: Subscription filters with Amazon Kinesis Data Streams
- Example 2: Subscription filters with AWS Lambda
- Example 3: Subscription filters with Amazon Data Firehose

Example 1: Subscription filters with Amazon Kinesis Data Streams

Before you create a Amazon Kinesis Data Streams data stream to use with an account-level subscription policy, calculate the volume of log data that will be generated. Be sure to create a stream with enough shards to handle this volume. If a stream doesn't have enough shards, it is

throttled. For more information about stream volume limits, see Quotas and Limits in the Amazon Kinesis Data Streams documentation.

> **Warning**
>
> Because the log events of multiple log groups are forwarded to the destination, there is a risk of throttling. Throttled deliverables are retried for up to 24 hours. After 24 hours, the failed deliverables are dropped.
> To mitigate the risk of throttling, you can take the following steps:
>
> - Monitor your Amazon Kinesis Data Streams stream with CloudWatch metrics. This helps you identify throttling and adjust your configuration accordingly. For example, the `DeliveryThrottling` metric tracks the number of log events for which CloudWatch Logs was throttled when forwarding data to the subscription destination. For more information, see Monitoring with CloudWatch metrics.
> - Use the on-demand capacity mode for your stream in Amazon Kinesis Data Streams. On-demand mode instantly accommodates your workloads as they ramp up or down. For more information, see On-demand mode.
> - Restrict your CloudWatch Logs subscription filter pattern to match the capacity of your stream in Amazon Kinesis Data Streams. If you are sending too much data to the stream, you might need to reduce the filter size or adjust the filter criteria.

The following example uses an account-level subscription policy to forward all log events to a stream in Amazon Kinesis Data Streams. The filter pattern matches any log events with the text `Test` and forwards them to the stream in Amazon Kinesis Data Streams.

To create an account-level subscription policy for Amazon Kinesis Data Streams

1. Create a destination stream using the following command:

```
$ C:\>  aws kinesis create-stream –stream-name "TestStream" –shard-count 1
```

2. Wait a few minutes for the stream to become active. You can verify whether the stream is active by using the describe-stream command to check the **StreamDescription.StreamStatus** property.

```
aws kinesis describe-stream --stream-name "TestStream"
```

The following is example output:

```
{
    "StreamDescription": {
        "StreamStatus": "ACTIVE",
        "StreamName": "TestStream",
        "StreamARN": "arn:aws:kinesis:region:123456789012:stream/TestStream",
        "Shards": [
            {
                "ShardId": "shardId-000000000000",
                "HashKeyRange": {
                    "EndingHashKey": "EXAMPLE84634633746074317682114555",
                    "StartingHashKey": "0"
                },
                "SequenceNumberRange": {
                    "StartingSequenceNumber":
                    "EXAMPLE688818456679503831981458784591352702181572610"
                }
            }
        ]
    }
}
```

3. Create the IAM role that will grant CloudWatch Logs permission to put data into your stream. First, you'll need to create a trust policy in a file (for example, `~/TrustPolicyForCWL-Kinesis.json`). Use a text editor to create this policy.

   This policy includes a `aws:SourceArn` global condition context key to help prevent the confused deputy security problem. For more information, see Confused deputy prevention.

```
{
  "Statement": {
    "Effect": "Allow",
    "Principal": { "Service": "logs.amazonaws.com" },
    "Action": "sts:AssumeRole",
    "Condition": {
        "ArnLike": { "aws:SourceArn": "arn:aws:logs:region:123456789012:*" }
     }
   }
}
```

4. Use the **create-role** command to create the IAM role, specifying the trust policy file. Note the returned **Role.Arn** value, as you will also need it for a later step:

```
aws iam create-role --role-name CWLtoKinesisRole --assume-role-policy-document
 file://~/TrustPolicyForCWL-Kinesis.json
```

The following is an example of the output.

```
{
    "Role": {
        "AssumeRolePolicyDocument": {
            "Statement": {
                "Action": "sts:AssumeRole",
                "Effect": "Allow",
                "Principal": {
                    "Service": "logs.amazonaws.com"
                },
                "Condition": {
                    "StringLike": {
                        "aws:SourceArn": { "arn:aws:logs:region:123456789012:*" }
                    }
                }
            }
        },
        "RoleId": "EXAMPLE450GAB4HC5F431",
        "CreateDate": "2023-05-29T13:46:29.431Z",
        "RoleName": "CWLtoKinesisRole",
        "Path": "/",
        "Arn": "arn:aws:iam::123456789012:role/CWLtoKinesisRole"
    }
}
```

5. Create a permissions policy to define what actions CloudWatch Logs can do on your account. First, you'll create a permissions policy in a file (for example, `~/PermissionsForCWL-Kinesis.json`). Use a text editor to create this policy. Don't use the IAM console to create it.

```
{
  "Statement": [
    {
      "Effect": "Allow",
      "Action": "kinesis:PutRecord",
      "Resource": "arn:aws:kinesis:region:123456789012:stream/TestStream"
```

```
    }
  ]
}
```

6. Associate the permissions policy with the role using the following put-role-policy command:

```
aws iam put-role-policy  --role-name CWLtoKinesisRole  --policy-name Permissions-
Policy-For-CWL  --policy-document file://~/PermissionsForCWL-Kinesis.json
```

7. After the stream is in the **Active** state and you have created the IAM role, you can create the CloudWatch Logs subscription filter policy. The policy immediately starts the flow of real-time log data to your stream. In this example, all log events that contain the string ERROR are streamed, except those in the log groups named `LogGroupToExclude1` and `LogGroupToExclude2`.

```
aws logs put-account-policy \
    --policy-name "ExamplePolicy" \
    --policy-type "SUBSCRIPTION_FILTER_POLICY" \
    --policy-document '{"RoleArn":"arn:aws:iam::123456789012:role/
CWLtoKinesisRole", "DestinationArn":"arn:aws:kinesis:region:123456789012:stream/
TestStream", "FilterPattern": "Test", "Distribution": "Random"}' \
    --selection-criteria 'LogGroupName NOT IN ["LogGroupToExclude1",
 "LogGroupToExclude2"]' \
    --scope "ALL"
```

8. After you set up the subscription filter, CloudWatch Logs forwards all the incoming log events that match the filter pattern and selection criteria to your stream.

   The `selection-criteria` field is optional, but is important for excluding log groups that can cause an infinite log recursion from a subscription filter. For more information about this issue and determining which log groups to exclude, see Log recursion prevention. Currently, NOT IN is the only supported operator for `selection-criteria`.

   You can verify that the flow of log events by by using a Amazon Kinesis Data Streams shard iterator and using the Amazon Kinesis Data Streams `get-records` command to fetch some Amazon Kinesis Data Streams records::

```
aws kinesis get-shard-iterator --stream-name TestStream --shard-id
 shardId-000000000000 --shard-iterator-type TRIM_HORIZON
```

```
{
    "ShardIterator":
    "AAAAAAAAAAFGU/
kLvNggvndHq2UIFOw5PZc6F01s3e3afsSscRM70JSbjIefg2ub07nk1y6CDxYR1UoGHJNP4m4NFUetzfL
+wev+e2P4djJg4L9wmXKvQYoE+rMUiFq
+p4Cn3IgvqOb5dRA0yybNdRcdzvnC35KQANoHzzahKdRGb9v4scv+3vaq+f+OIK8zM5My8ID
+g6rMo7UKWeI4+IWiK2OSh0uP"
}
```

```
aws kinesis get-records --limit 10 --shard-iterator "AAAAAAAAAAFGU/
kLvNggvndHq2UIFOw5PZc6F01s3e3afsSscRM70JSbjIefg2ub07nk1y6CDxYR1UoGHJNP4m4NFUetzfL
+wev+e2P4djJg4L9wmXKvQYoE+rMUiFq
+p4Cn3IgvqOb5dRA0yybNdRcdzvnC35KQANoHzzahKdRGb9v4scv+3vaq+f+OIK8zM5My8ID
+g6rMo7UKWeI4+IWiK2OSh0uP"
```

You might need to use this command a few times before Amazon Kinesis Data Streams starts to return data.

You should expect to see a response with an array of records. The **Data** attribute in a Amazon Kinesis Data Streams record is base64 encoded and compressed with the gzip format. You can examine the raw data from the command line using the following Unix commands:

```
echo -n "<Content of Data>" | base64 -d | zcat
```

The base64 decoded and decompressed data is formatted as JSON with the following structure:

```
{
    "messageType": "DATA_MESSAGE",
    "owner": "123456789012",
    "logGroup": "Example1",
    "logStream": "logStream1",
    "subscriptionFilters": [
        "ExamplePolicy"
    ],
    "logEvents": [
        {
            "id": "31953106606966983378809025079804211143289615424298221568",
            "timestamp": 1432826855000,
```

```
            "message": "{\"eventVersion\":\"1.03\",\"userIdentity\":{\"type\":
\"Root\"}"
        },
        {
            "id": "31953106606966983378809025079804211143289615424298221569",
            "timestamp": 1432826855000,
            "message": "{\"eventVersion\":\"1.03\",\"userIdentity\":{\"type\":
\"Root\"}"
        },
        {
            "id": "31953106606966983378809025079804211143289615424298221570",
            "timestamp": 1432826855000,
            "message": "{\"eventVersion\":\"1.03\",\"userIdentity\":{\"type\":
\"Root\"}"
        }
    ],
    "policyLevel": "ACCOUNT_LEVEL_POLICY"
}
```

The key elements in the data structure are the following:

messageType

Data messages will use the "DATA_MESSAGE" type. Sometimes CloudWatch Logs might emit Amazon Kinesis Data Streams records with a "CONTROL_MESSAGE" type, mainly for checking if the destination is reachable.

owner

The AWS Account ID of the originating log data.

logGroup

The log group name of the originating log data.

logStream

The log stream name of the originating log data.

subscriptionFilters

The list of subscription filter names that matched with the originating log data.

logEvents

The actual log data, represented as an array of log event records. The "id" property is a unique identifier for every log event.

policyLevel

The level at which the policy was enforced. "ACCOUNT_LEVEL_POLICY" is the `policyLevel` for an account-level subscription filter policy.

Example 2: Subscription filters with AWS Lambda

In this example, you'll create a CloudWatch Logs account-level subscription filter policy that sends log data to your AWS Lambda function.

> **Warning**
>
> Before you create the Lambda function, calculate the volume of log data that will be generated. Be sure to create a function that can handle this volume. If the function can't handle the volume, the log stream will be throttled. Because the log events of either all log groups or a subset of the account's log groups are forwarded to the destination, there is a risk of throttling. For more information about Lambda limits, see AWS Lambda Limits.

To create an account-level subscription filter policy for Lambda

1. Create the AWS Lambda function.

   Ensure that you have set up the Lambda execution role. For more information, see Step 2.2: Create an IAM Role (execution role) in the *AWS Lambda Developer Guide*.
2. Open a text editor and create a file named `helloWorld.js` with the following contents:

```
var zlib = require('zlib');
exports.handler = function(input, context) {
    var payload = Buffer.from(input.awslogs.data, 'base64');
    zlib.gunzip(payload, function(e, result) {
        if (e) {
            context.fail(e);
        } else {
            result = JSON.parse(result.toString());
```

```
            console.log("Event Data:", JSON.stringify(result, null, 2));
            context.succeed();
        }
    });
};
```

3. Zip the file helloWorld.js and save it with the name `helloWorld.zip`.
4. Use the following command, where the role is the Lambda execution role you set up in the first step:

```
aws lambda create-function \
    --function-name helloworld \
    --zip-file fileb://file-path/helloWorld.zip \
    --role lambda-execution-role-arn \
    --handler helloWorld.handler \
    --runtime nodejs18.x
```

5. Grant CloudWatch Logs the permission to execute your function. Use the following command, replacing the placeholder account with your own account.

```
aws lambda add-permission \
    --function-name "helloworld" \
    --statement-id "helloworld" \
    --principal "logs.amazonaws.com" \
    --action "lambda:InvokeFunction" \
    --source-arn "arn:aws:logs:region:123456789012:log-group:*" \
    --source-account "123456789012"
```

6. Create an account-level subscription filter policy using the following command, replacing the placeholder account with your own account. In this example, all log events that contain the string ERROR are streamed, except those in the log groups named `LogGroupToExclude1` and `LogGroupToExclude2`.

```
aws logs put-account-policy \
    --policy-name "ExamplePolicyLambda" \
    --policy-type "SUBSCRIPTION_FILTER_POLICY" \
    --policy-document
 '{"DestinationArn":"arn:aws:lambda:region:123456789012:function:helloWorld",
 "FilterPattern": "Test", "Distribution": "Random"}' \
    --selection-criteria 'LogGroupName NOT IN ["LogGroupToExclude1",
 "LogGroupToExclude2"]' \
```

```
    --scope "ALL"
```

After you set up the subscription filter, CloudWatch Logs forwards all the incoming log events that match the filter pattern and selection criteria to your stream.

The `selection-criteria` field is optional, but is important for excluding log groups that can cause an infinite log recursion from a subscription filter. For more information about this issue and determining which log groups to exclude, see Log recursion prevention. Currently, NOT IN is the only supported operator for `selection-criteria`.

7. (Optional) Test using a sample log event. At a command prompt, run the following command, which will put a simple log message into the subscribed stream.

   To see the output of your Lambda function, navigate to the Lambda function where you will see the output in /aws/lambda/helloworld:

```
aws logs put-log-events --log-group-name Example1 --log-stream-name logStream1 --
log-events "[{\"timestamp\":CURRENT TIMESTAMP MILLIS , \"message\": \"Simple Lambda
 Test\"}]"
```

   You should expect to see a response with an array of Lambda. The **Data** attribute in the Lambda record is base64 encoded and compressed with the gzip format. The actual payload that Lambda receives is in the following format `{ "awslogs": {"data": "BASE64ENCODED_GZIP_COMPRESSED_DATA"} }` You can examine the raw data from the command line using the following Unix commands:

```
echo -n "<BASE64ENCODED_GZIP_COMPRESSED_DATA>" | base64 -d | zcat
```

   The base64 decoded and decompressed data is formatted as JSON with the following structure:

```
{
    "messageType": "DATA_MESSAGE",
    "owner": "123456789012",
    "logGroup": "Example1",
    "logStream": "logStream1",
    "subscriptionFilters": [
        "ExamplePolicyLambda"
    ],
    "logEvents": [
```

```
        {
            "id": "31953106606966983378809025079804211143289615424298221568",
            "timestamp": 1432826855000,
            "message": "{\"eventVersion\":\"1.03\",\"userIdentity\":{\"type\":
\"Root\"}"
        },
        {
            "id": "31953106606966983378809025079804211143289615424298221569",
            "timestamp": 1432826855000,
            "message": "{\"eventVersion\":\"1.03\",\"userIdentity\":{\"type\":
\"Root\"}"
        },
        {
            "id": "31953106606966983378809025079804211143289615424298221570",
            "timestamp": 1432826855000,
            "message": "{\"eventVersion\":\"1.03\",\"userIdentity\":{\"type\":
\"Root\"}"
        }
    ],
    "policyLevel": "ACCOUNT_LEVEL_POLICY"
}
```

Note

The account-level subscription filter will not be applied to the destination Lambda function's log group. This is to prevent an infinite log recursion that can lead to an increase in ingestion billing. For more information about this problem, see Log recursion prevention .

The key elements in the data structure are the following:

messageType

Data messages will use the "DATA_MESSAGE" type. Sometimes CloudWatch Logs might emit Amazon Kinesis Data Streams records with a "CONTROL_MESSAGE" type, mainly for checking if the destination is reachable.

owner

The AWS Account ID of the originating log data.

logGroup

The log group name of the originating log data.

logStream

The log stream name of the originating log data.

subscriptionFilters

The list of subscription filter names that matched with the originating log data.

logEvents

The actual log data, represented as an array of log event records. The "id" property is a unique identifier for every log event.

policyLevel

The level at which the policy was enforced. "ACCOUNT_LEVEL_POLICY" is the `policyLevel` for an account-level subscription filter policy.

Example 3: Subscription filters with Amazon Data Firehose

In this example, you'll create a CloudWatch Logs account-level subscription filter policy that sends incoming log events that match your defined filters to your Amazon Data Firehose delivery stream. Data sent from CloudWatch Logs to Amazon Data Firehose is already compressed with gzip level 6 compression, so you do not need to use compression within your Firehose delivery stream. You can then use the decompression feature in Firehose to automatically decompress the logs. For more information, see Writing to Kinesis Data Firehose Using CloudWatch Logs.

Warning

Before you create the Firehose stream, calculate the volume of log data that will be generated. Be sure to create a Firehose stream that can handle this volume. If the stream cannot handle the volume, the log stream will be throttled. For more information about Firehose stream volume limits, see Amazon Data Firehose Data Limits.

To create a subscription filter for Firehose

1. Create an Amazon Simple Storage Service (Amazon S3) bucket. We recommend that you use a bucket that was created specifically for CloudWatch Logs. However, if you want to use an existing bucket, skip to step 2.

   Run the following command, replacing the placeholder Region with the Region you want to use:

   ```
   aws s3api create-bucket --bucket amzn-s3-demo-bucket2 --create-bucket-configuration
    LocationConstraint=region
   ```

   The following is example output:

   ```
   {
       "Location": "/amzn-s3-demo-bucket2"
   }
   ```

2. Create the IAM role that grants Amazon Data Firehose permission to put data into your Amazon S3 bucket.

   For more information, see Controlling Access with Amazon Data Firehose in the *Amazon Data Firehose Developer Guide*.

   First, use a text editor to create a trust policy in a file ~/TrustPolicyForFirehose.json as follows:

   ```
   {
     "Statement": {
       "Effect": "Allow",
       "Principal": { "Service": "firehose.amazonaws.com" },
       "Action": "sts:AssumeRole"
       }
   }
   ```

3. Use the **create-role** command to create the IAM role, specifying the trust policy file. Keep a note of the returned **Role.Arn** value, as you will need it in a later step:

   ```
   aws iam create-role \
    --role-name FirehosetoS3Role \
    --assume-role-policy-document file://~/TrustPolicyForFirehose.json
   ```

```
{
    "Role": {
        "AssumeRolePolicyDocument": {
            "Statement": {
                "Action": "sts:AssumeRole",
                "Effect": "Allow",
                "Principal": {
                    "Service": "firehose.amazonaws.com"
                }
            }
        },
        "RoleId": "EXAMPLE50GAB4HC5F431",
        "CreateDate": "2023-05-29T13:46:29.431Z",
        "RoleName": "FirehosetoS3Role",
        "Path": "/",
        "Arn": "arn:aws:iam::123456789012:role/FirehosetoS3Role"
    }
}
```

4. Create a permissions policy to define what actions Firehose can do on your account. First, use a text editor to create a permissions policy in a file ~/PermissionsForFirehose.json:

```
{
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
          "s3:AbortMultipartUpload",
          "s3:GetBucketLocation",
          "s3:GetObject",
          "s3:ListBucket",
          "s3:ListBucketMultipartUploads",
          "s3:PutObject" ],
      "Resource": [
          "arn:aws:s3:::amzn-s3-demo-bucket2",
          "arn:aws:s3:::amzn-s3-demo-bucket2/*" ]
    }
  ]
}
```

5. Associate the permissions policy with the role using the following put-role-policy command:

```
aws iam put-role-policy --role-name FirehosetoS3Role --policy-name Permissions-
Policy-For-Firehose --policy-document file://~/PermissionsForFirehose.json
```

6. Create a destination Firehose delivery stream as follows, replacing the placeholder values for **RoleARN** and **BucketARN** with the role and bucket ARNs that you created:

```
aws firehose create-delivery-stream \
   --delivery-stream-name 'my-delivery-stream' \
   --s3-destination-configuration \
  '{"RoleARN": "arn:aws:iam::123456789012:role/FirehosetoS3Role", "BucketARN":
 "arn:aws:s3:::amzn-s3-demo-bucket2"}'
```

   NFirehose automatically uses a prefix in YYYY/MM/DD/HH UTC time format for delivered Amazon S3 objects. You can specify an extra prefix to be added in front of the time format prefix. If the prefix ends with a forward slash (/), it appears as a folder in the Amazon S3 bucket.

7. Wait a few minutes for the stream becomes active. You can use the Firehose **describe-delivery-stream** command to check the **DeliveryStreamDescription.DeliveryStreamStatus** property. In addition, note the **DeliveryStreamDescription.DeliveryStreamARN** value, as you will need it in a later step:

```
aws firehose describe-delivery-stream --delivery-stream-name "my-delivery-stream"
{
    "DeliveryStreamDescription": {
        "HasMoreDestinations": false,
        "VersionId": "1",
        "CreateTimestamp": 1446075815.822,
        "DeliveryStreamARN": "arn:aws:firehose:us-
east-1:123456789012:deliverystream/my-delivery-stream",
        "DeliveryStreamStatus": "ACTIVE",
        "DeliveryStreamName": "my-delivery-stream",
        "Destinations": [
            {
                "DestinationId": "destinationId-000000000001",
                "S3DestinationDescription": {
                    "CompressionFormat": "UNCOMPRESSED",
                    "EncryptionConfiguration": {
                        "NoEncryptionConfig": "NoEncryption"
                    },
```

```
                    "RoleARN": "delivery-stream-role",
                    "BucketARN": "arn:aws:s3:::amzn-s3-demo-bucket2",
                    "BufferingHints": {
                        "IntervalInSeconds": 300,
                        "SizeInMBs": 5
                    }
                }
            }
        ]
    }
}
```

8. Create the IAM role that grants CloudWatch Logs permission to put data into your Firehose delivery stream. First, use a text editor to create a trust policy in a file `~/TrustPolicyForCWL.json`:

   This policy includes a `aws:SourceArn` global condition context key to help prevent the confused deputy security problem. For more information, see Confused deputy prevention.

```
{
  "Statement": {
    "Effect": "Allow",
    "Principal": { "Service": "logs.amazonaws.com" },
    "Action": "sts:AssumeRole",
    "Condition": {
         "ArnLike": {
             "aws:SourceArn": "arn:aws:logs:region:123456789012:*"
         }
     }
  }
}
```

9. Use the **create-role** command to create the IAM role, specifying the trust policy file. Make a note of the returned **Role.Arn** value, as you will need it in a later step:

```
aws iam create-role \
--role-name CWLtoKinesisFirehoseRole \
--assume-role-policy-document file://~/TrustPolicyForCWL.json

{
    "Role": {
        "AssumeRolePolicyDocument": {
            "Statement": {
```

```
                "Action": "sts:AssumeRole",
                "Effect": "Allow",
                "Principal": {
                    "Service": "logs.amazonaws.com"
                },
                "Condition": {
                     "StringLike": {
                         "aws:SourceArn": "arn:aws:logs:region:123456789012:*"
                     }
                 }
            }
        },
        "RoleId": "AAOIIAH450GAB4HC5F431",
        "CreateDate": "2015-05-29T13:46:29.431Z",
        "RoleName": "CWLtoKinesisFirehoseRole",
        "Path": "/",
        "Arn": "arn:aws:iam::123456789012:role/CWLtoKinesisFirehoseRole"
    }
}
```

10. Create a permissions policy to define what actions CloudWatch Logs can do on your account. First, use a text editor to create a permissions policy file (for example, ~/PermissionsForCWL.json):

```
{
    "Statement":[
      {
        "Effect":"Allow",
        "Action":["firehose:PutRecord"],
        "Resource":[
            "arn:aws:firehose:region:account-id:deliverystream/delivery-stream-name"]
      }
    ]
}
```

11. Associate the permissions policy with the role using the put-role-policy command:

```
aws iam put-role-policy --role-name CWLtoKinesisFirehoseRole --policy-name Permissions-Policy-For-CWL --policy-document file://~/PermissionsForCWL.json
```

12. After the Amazon Data Firehose delivery stream is in the active state and you have created the IAM role, you can create the CloudWatch Logs account-level subscription filter policy. The

policy immediately starts the flow of real-time log data from the chosen log group to your Amazon Data Firehose delivery stream:

```
aws logs put-account-policy \
    --policy-name "ExamplePolicyFirehose" \
    --policy-type "SUBSCRIPTION_FILTER_POLICY" \
    --policy-document '{"RoleArn":"arn:aws:iam::123456789012:role/
CWLtoKinesisFirehoseRole", "DestinationArn":"arn:aws:firehose:us-
east-1:123456789012:deliverystream/delivery-stream-name", "FilterPattern": "Test",
 "Distribution": "Random"}' \
    --selection-criteria 'LogGroupName NOT IN ["LogGroupToExclude1",
 "LogGroupToExclude2"]' \
    --scope "ALL"
```

13. After you set up the subscription filter, CloudWatch Logs forwards the incoming log events that match the filter pattern to your Amazon Data Firehose delivery stream.

    The `selection-criteria` field is optional, but is important for excluding log groups that can cause an infinite log recursion from a subscription filter. For more information about this issue and determining which log groups to exclude, see Log recursion prevention. Currently, NOT IN is the only supported operator for `selection-criteria`.

    Your data will start appearing in your Amazon S3 based on the time buffer interval set on your Amazon Data Firehose delivery stream. Once enough time has passed, you can verify your data by checking your Amazon S3 Bucket.

```
aws s3api list-objects --bucket 'amzn-s3-demo-bucket2' --prefix 'firehose/'
{
    "Contents": [
        {
            "LastModified": "2023-10-29T00:01:25.000Z",
            "ETag": "\"a14589f8897f4089d3264d9e2d1f1610\"",
            "StorageClass": "STANDARD",
            "Key": "firehose/2015/10/29/00/my-delivery-stream-2015-10-29-00-01-21-
a188030a-62d2-49e6-b7c2-b11f1a7ba250",
            "Owner": {
                "DisplayName": "cloudwatch-logs",
                "ID": "1ec9cf700ef6be062b19584e0b7d84ecc19237f87b5"
            },
            "Size": 593
        },
        {
```

```
            "LastModified": "2015-10-29T00:35:41.000Z",
            "ETag": "\"a7035b65872bb2161388ffb63dd1aec5\"",
            "StorageClass": "STANDARD",
            "Key": "firehose/2023/10/29/00/my-delivery-stream-2023-10-29-00-35-40-
EXAMPLE-7e66-49bc-9fd4-fc9819cc8ed3",
            "Owner": {
                "DisplayName": "cloudwatch-logs",
                "ID": "EXAMPLE6be062b19584e0b7d84ecc19237f87b6"
            },
            "Size": 5752
        }
    ]
}
```

```
aws s3api get-object --bucket 'amzn-s3-demo-bucket2' --key 'firehose/2023/10/29/00/
my-delivery-stream-2023-10-29-00-01-21-a188030a-62d2-49e6-b7c2-b11f1a7ba250'
 testfile.gz

{
    "AcceptRanges": "bytes",
    "ContentType": "application/octet-stream",
    "LastModified": "Thu, 29 Oct 2023 00:07:06 GMT",
    "ContentLength": 593,
    "Metadata": {}
}
```

The data in the Amazon S3 object is compressed with the gzip format. You can examine the raw data from the command line using the following Unix command:

```
zcat testfile.gz
```

Cross-account cross-Region subscriptions

You can collaborate with an owner of a different AWS account and receive their log events on your AWS resources, such as an Amazon Kinesis or Amazon Data Firehose stream (this is known as cross-account data sharing). For example, this log event data can be read from a centralized Amazon Kinesis Data Streams or Firehose stream to perform custom processing and analysis. Custom processing is especially useful when you collaborate and analyze data across many accounts.

For example, a company's information security group might want to analyze data for real-time intrusion detection or anomalous behaviors so it could conduct an audit of accounts in all divisions in the company by collecting their federated production logs for central processing. A real-time stream of event data across those accounts can be assembled and delivered to the information security groups, who can use Amazon Kinesis Data Streams to attach the data to their existing security analytic systems.

> **Note**
>
> The log group and the destination must be in the same AWS Region. However, the AWS resource that the destination points to can be located in a different Region. In the examples in the following sections, all Region-specific resources are created in US East (N. Virginia)).

If you have configured AWS Organizations and are working with member accounts you can use log centralization to collect log data from source accounts into a central monitoring account.

When working with centralized log groups you can use these system fields dimensions when creating subscription filters:

- `@aws.account` - This dimension represents the AWS account ID from which the log event originated.
- `@aws.region` - This dimension represents the AWS region where the log event was generated.
- `@source.log` - This dimension represents the source log group from which the log event originated.

These dimensions help in identifying the source of log data, allowing for more granular filtering and analysis of metrics derived from centralized logs.

Topics

Cross-account cross-Region log data sharing using Amazon Kinesis Data Streams

When you create a cross-account subscription, you can specify a single account or an organization to be the sender. If you specify an organization, then this procedure enables all accounts in the organization to send logs to the receiver account.

To share log data across accounts, you need to establish a log data sender and receiver:

- **Log data sender**—gets the destination information from the recipient and lets CloudWatch Logs know that it's ready to send its log events to the specified destination. In the procedures in the rest of this section, the log data sender is shown with a fictional AWS account number of 111111111111.

  If you're going to have multiple accounts in one organization send logs to one recipient account, you can create a policy that grants all accounts in the organization the permission to send logs to the recipient account. You still have to set up separate subscription filters for each sender account.
- **Log data recipient**—sets up a destination that encapsulates a Amazon Kinesis Data Streams stream and lets CloudWatch Logs know that the recipient wants to receive log data. The recipient then shares the information about this destination with the sender. In the procedures in the rest of this section, the log data recipient is shown with a fictional AWS account number of 999999999999.

To start receiving log events from cross-account users, the log data recipient first creates a CloudWatch Logs destination. Each destination consists of the following key elements:

Destination name

The name of the destination you want to create.

Target ARN

The Amazon Resource Name (ARN) of the AWS resource that you want to use as the destination of the subscription feed.

Role ARN

An AWS Identity and Access Management (IAM) role that grants CloudWatch Logs the necessary permissions to put data into the chosen stream.

Access policy

An IAM policy document (in JSON format, written using IAM policy grammar) that governs the set of users that are allowed to write to your destination.

> **Note**
>
> The log group and the destination must be in the same AWS Region. However, the AWS resource that the destination points to can be located in a different Region. In the examples in the following sections, all Region-specific resources are created in US East (N. Virginia).

Topics

Setting up a new cross-account subscription

Follow the steps in these sections to set up a new cross-account log subscription.

Topics

Step 1: Create a destination

> **Important**
>
> All steps in this procedure are to be done in the log data recipient account.

For this example, the log data recipient account has an AWS account ID of 999999999999, while the log data sender AWS account ID is 111111111111.

This example creates a destination using a Amazon Kinesis Data Streams stream called RecipientStream, and a role that enables CloudWatch Logs to write data to it.

When the destination is created, CloudWatch Logs sends a test message to the destination on the recipient account's behalf. When the subscription filter is active later, CloudWatch Logs sends log events to the destination on the source account's behalf.

To create a destination

1. In the recipient account, create a destination stream in Amazon Kinesis Data Streams. At a command prompt, type:

```
aws kinesis create-stream --stream-name "RecipientStream" --shard-count 1
```

2. Wait until the stream becomes active. You can use the **aws kinesis describe-stream** command to check the **StreamDescription.StreamStatus** property. In addition, take note of the **StreamDescription.StreamARN** value because you will pass it to CloudWatch Logs later:

```
aws kinesis describe-stream --stream-name "RecipientStream"
{
  "StreamDescription": {
    "StreamStatus": "ACTIVE",
    "StreamName": "RecipientStream",
    "StreamARN": "arn:aws:kinesis:us-east-1:999999999999:stream/RecipientStream",
    "Shards": [
      {
        "ShardId": "shardId-000000000000",
        "HashKeyRange": {
          "EndingHashKey": "340282366920938463463374607431768EXAMPLE",
          "StartingHashKey": "0"
        },
        "SequenceNumberRange": {
          "StartingSequenceNumber":
 "49551135218688818456679503831981458784591352702 18EXAMPLE"
        }
      }
    ]
  }
}
```

It might take a minute or two for your stream to show up in the active state.

3. Create the IAM role that grants CloudWatch Logs the permission to put data into your stream. First, you'll need to create a trust policy in a file **~/TrustPolicyForCWL.json**. Use a text editor to create this policy file, do not use the IAM console.

   This policy includes a `aws:SourceArn` global condition context key that specifies the `sourceAccountId` to help prevent the confused deputy security problem. If you don't yet know the source account ID in the first call, we recommend that you put the destination ARN in the source ARN field. In the subsequent calls, you should set the source ARN to be the actual source ARN that you gathered from the first call. For more information, see Confused deputy prevention.

   ```
   {
       "Statement": {
           "Effect": "Allow",
           "Principal": {
               "Service": "logs.amazonaws.com"
           },
           "Condition": {
               "ArnLike": {
                   "aws:SourceArn": [
                       "arn:aws:logs:region:sourceAccountId:*",
                       "arn:aws:logs:region:recipientAccountId:*"
                   ]
               }
           },
           "Action": "sts:AssumeRole"
       }
   }
   ```

4. Use the **aws iam create-role** command to create the IAM role, specifying the trust policy file. Take note of the returned Role.Arn value because it will also be passed to CloudWatch Logs later:

   ```
   aws iam create-role \
   --role-name CWLtoKinesisRole \
   --assume-role-policy-document file://~/TrustPolicyForCWL.json

   {
       "Role": {
   ```

```
        "AssumeRolePolicyDocument": {
            "Statement": {
                "Action": "sts:AssumeRole",
                "Effect": "Allow",
                "Condition": {
                    "StringLike": {
                        "aws:SourceArn": [
                            "arn:aws:logs:region:sourceAccountId:*",
                            "arn:aws:logs:region:recipientAccountId:*"
                        ]
                    }
                },
                "Principal": {
                    "Service": "logs.amazonaws.com"
                }
            }
        },
        "RoleId": "AAOIIAH450GAB4HC5F431",
        "CreateDate": "2015-05-29T13:46:29.431Z",
        "RoleName": "CWLtoKinesisRole",
        "Path": "/",
        "Arn": "arn:aws:iam::999999999999:role/CWLtoKinesisRole"
    }
}
```

5. Create a permissions policy to define which actions CloudWatch Logs can perform on your account. First, use a text editor to create a permissions policy in a file **~/PermissionsForCWL.json**:

```
{
  "Statement": [
    {
      "Effect": "Allow",
      "Action": "kinesis:PutRecord",
      "Resource": "arn:aws:kinesis:region:999999999999:stream/RecipientStream"
    }
  ]
}
```

6. Associate the permissions policy with the role by using the **aws iam put-role-policy** command:

```
aws iam put-role-policy \
    --role-name CWLtoKinesisRole \
```

```
    --policy-name Permissions-Policy-For-CWL \
    --policy-document file://~/PermissionsForCWL.json
```

7. After the stream is in the active state and you have created the IAM role, you can create the CloudWatch Logs destination.

   a. This step doesn't associate an access policy with your destination and is only the first step out of two that completes a destination creation. Make a note of the **DestinationArn** that is returned in the payload:

```
aws logs put-destination \
    --destination-name "testDestination" \
    --target-arn "arn:aws:kinesis:region:999999999999:stream/RecipientStream" \
    --role-arn "arn:aws:iam::999999999999:role/CWLtoKinesisRole"

{
  "DestinationName" : "testDestination",
  "RoleArn" : "arn:aws:iam::999999999999:role/CWLtoKinesisRole",
  "DestinationArn" : "arn:aws:logs:us-
east-1:999999999999:destination:testDestination",
  "TargetArn" : "arn:aws:kinesis:us-east-1:999999999999:stream/RecipientStream"
}
```

   b. After step 7a is complete, in the log data recipient account, associate an access policy with the destination. This policy must specify the **logs:PutSubscriptionFilter** action and grants permission to the sender account to access the destination.

      The policy grants permission to the AWS account that sends logs. You can specify just this one account in the policy, or if the sender account is a member of an organization, the policy can specify the organization ID of the organization. This way, you can create just one policy to allow multiple accounts in one organization to send logs to this destination account.

      Use a text editor to create a file named `~/AccessPolicy.json` with one of the following policy statements.

      This first example policy allows all accounts in the organization that have an ID of `o-1234567890` to send logs to the recipient account.

JSON

```
{
    "Version":"2012-10-17",
    "Statement": [
        {
            "Sid": "",
            "Effect": "Allow",
            "Principal": "*",
            "Action": "logs:PutSubscriptionFilter",
            "Resource": "arn:aws:logs:us-
east-1:999999999999:destination:testDestination",
            "Condition": {
                "StringEquals": {
                    "aws:PrincipalOrgID": [
                        "o-1234567890"
                    ]
                }
            }
        }
    ]
}
```

This next example allows just the log data sender account (111111111111) to send logs to the log data recipient account.

JSON

```
{
    "Version":"2012-10-17",
    "Statement": [
        {
            "Sid": "",
            "Effect": "Allow",
            "Principal": {
                "AWS": "111111111111"
            },
            "Action": "logs:PutSubscriptionFilter",
```

```
            "Resource": "arn:aws:logs:us-
east-1:999999999999:destination:testDestination"
        }
    ]
}
```

c. Attach the policy you created in the previous step to the destination.

```
aws logs put-destination-policy \
    --destination-name "testDestination" \
    --access-policy file://~/AccessPolicy.json
```

This access policy enables users in the AWS Account with ID 111111111111 to call **PutSubscriptionFilter** against the destination with ARN arn:aws:logs:*region*:999999999999:destination:testDestination. Any other user's attempt to call PutSubscriptionFilter against this destination will be rejected.

To validate a user's privileges against an access policy, see Using Policy Validator in the *IAM User Guide*.

When you have finished, if you're using AWS Organizations for your cross-account permissions, follow the steps in Step 2: (Only if using an organization) Create an IAM role. If you're granting permissions directly to the other account instead of using Organizations, you can skip that step and proceed to Step 4: Create a subscription filter.

Step 2: (Only if using an organization) Create an IAM role

In the previous section, if you created the destination by using an access policy that grants permissions to the organization that account 111111111111 is in, instead of granting permissions directly to account 111111111111, then follow the steps in this section. Otherwise, you can skip to Step 4: Create a subscription filter.

The steps in this section create an IAM role, which CloudWatch can assume and validate whether the sender account has permission to create a subscription filter against the recipient destination.

Perform the steps in this section in the sender account. The role must exist in the sender account, and you specify the ARN of this role in the subscription filter. In this example, the sender account is 111111111111.

To create the IAM role necessary for cross-account log subscriptions using AWS Organizations

1. Create the following trust policy in a file `/TrustPolicyForCWLSubscriptionFilter.json`. Use a text editor to create this policy file; do not use the IAM console.

```
{
  "Statement": {
    "Effect": "Allow",
    "Principal": { "Service": "logs.amazonaws.com" },
    "Action": "sts:AssumeRole"
  }
}
```

2. Create the IAM role that uses this policy. Take note of the `Arn` value that is returned by the command, you will need it later in this procedure. In this example, we use `CWLtoSubscriptionFilterRole` for the name of the role we're creating.

```
aws iam create-role \
     --role-name CWLtoSubscriptionFilterRole \
     --assume-role-policy-document file://~/
TrustPolicyForCWLSubscriptionFilter.json
```

3. Create a permissions policy to define the actions that CloudWatch Logs can perform on your account.

   a. First, use a text editor to create the following permissions policy in a file named `~/PermissionsForCWLSubscriptionFilter.json`.

```
{
    "Statement": [
        {
            "Effect": "Allow",
            "Action": "logs:PutLogEvents",
            "Resource": "arn:aws:logs:region:111111111111:log-
group:LogGroupOnWhichSubscriptionFilterIsCreated:*"
        }
    ]
}
```

   b. Enter the following command to associate the permissions policy you just created with the role that you created in step 2.

```
aws iam put-role-policy
    --role-name CWLtoSubscriptionFilterRole
    --policy-name Permissions-Policy-For-CWL-Subscription-filter
    --policy-document file://~/PermissionsForCWLSubscriptionFilter.json
```

When you have finished, you can proceed to Step 4: Create a subscription filter.

Step 3: Add/validate IAM permissions for the cross-account destination

According to AWS cross-account policy evaluation logic, in order to access any cross-account resource (such as an Kinesis or Firehose stream used as a destination for a subscription filter) you must have an identity-based policy in the sending account which provides explicit access to the cross-account destination resource. For more information about policy evaluation logic, see Cross-account policy evaluation logic.

You can attach the identity-based policy to the IAM role or IAM user that you are using to create the subscription filter. This policy must be present in the sending account. If you are using the Administrator role to create the subscription filter, you can skip this step and move on to Step 4: Create a subscription filter.

To add or validate the IAM permissions needed for cross-account

1. Enter the following command to check which IAM role or IAM user is being used to run AWS logs commands.

   ```
   aws sts get-caller-identity
   ```

   The command returns output similar to the following:

   ```
   {
   "UserId": "User ID",
   "Account": "sending account id",
   "Arn": "arn:aws:sending account id:role/user:RoleName/UserName"
   }
   ```

   Make note of the value represented by *RoleName* or *UserName*.

2. Sign into the AWS Management Console in the sending account and search for the attached policies with the IAM role or IAM user returned in the output of the command you entered in step 1.
3. Verify that the policies attached to this role or user provide explicit permissions to call `logs:PutSubscriptionFilter` on the cross-account destination resource.

   The following policy provides permissions to create a subscription filter on any destination resource only in a single AWS account, account 999999999999:

   JSON

```
{
     "Version":"2012-10-17",
     "Statement": [
        {
            "Sid": "AllowSubscriptionFiltersOnAccountResources",
            "Effect": "Allow",
            "Action": "logs:PutSubscriptionFilter",
            "Resource": [
                "arn:aws:logs:*:*:log-group:*",
                "arn:aws:logs:*:123456789012:destination:*"
            ]
        }
    ]
}
```

   The following policy provides permissions to create a subscription filter only on a specific destination resource named `sampleDestination` in single AWS account, account 123456789012:

   JSON

```
{
    "Version":"2012-10-17",
    "Statement": [
        {
            "Sid": "AllowSubscriptionFiltersonAccountResource",
            "Effect": "Allow",
            "Action": "logs:PutSubscriptionFilter",
```

```
            "Resource": [
                "arn:aws:logs:*:*:log-group:*",
                "arn:aws:logs:*:123456789012:destination:sampleDestination"
            ]
        }
    ]
}
```

Step 4: Create a subscription filter

After you create a destination, the log data recipient account can share the destination ARN (arn:aws:logs:us-east-1:999999999999:destination:testDestination) with other AWS accounts so that they can send log events to the same destination. These other sending accounts users then create a subscription filter on their respective log groups against this destination. The subscription filter immediately starts the flow of real-time log data from the chosen log group to the specified destination.

> **Note**
>
> If you are granting permissions for the subscription filter to an entire organization, you will need to use the ARN of the IAM role that you created in Step 2: (Only if using an organization) Create an IAM role.

In the following example, a subscription filter is created in a sending account. the filter is associated with a log group containing AWS CloudTrail events so that every logged activity made by "Root" AWS credentials is delivered to the destination you previously created. That destination encapsulates a stream called "RecipientStream".

The rest of the steps in the following sections assume that you have followed the directions in Sending CloudTrail Events to CloudWatch Logs in the *AWS CloudTrail User Guide* and created a log group that contains your CloudTrail events. These steps assume that the name of this log group is `CloudTrail/logs`.

When you enter the following command, be sure you are signed in as the IAM user or using the IAM role that you added the policy for, in Step 3: Add/validate IAM permissions for the cross-account destination.

```
aws logs put-subscription-filter \
```

```
    --log-group-name "CloudTrail/logs" \
    --filter-name "RecipientStream" \
    --filter-pattern "{$.userIdentity.type = Root}" \
    --destination-arn "arn:aws:logs:region:999999999999:destination:testDestination"
```

The log group and the destination must be in the same AWS Region. However, the destination can point to an AWS resource such as a Amazon Kinesis Data Streams stream that is located in a different Region.

Validate the flow of log events

After you create the subscription filter, CloudWatch Logs forwards all the incoming log events that match the filter pattern to the stream that is encapsulated within the destination stream called "**RecipientStream**". The destination owner can verify that this is happening by using the **aws kinesis get-shard-iterator** command to grab a Amazon Kinesis Data Streams shard, and using the **aws kinesis get-records** command to fetch some Amazon Kinesis Data Streams records:

```
aws kinesis get-shard-iterator \
      --stream-name RecipientStream \
      --shard-id shardId-000000000000 \
      --shard-iterator-type TRIM_HORIZON

{
    "ShardIterator":
    "AAAAAAAAAAFGU/
kLvNggvndHq2UIFOw5PZc6F01s3e3afsSscRM70JSbjIefg2ub07nk1y6CDxYR1UoGHJNP4m4NFUetzfL+wev
+e2P4djJg4L9wmXKvQYoE+rMUiFq+p4Cn3IgvqOb5dRA0yybNdRcdzvnC35KQANoHzzahKdRGb9v4scv+3vaq+f
+OIK8zM5My8ID+g6rMo7UKWeI4+IWiKEXAMPLE"
}

aws kinesis get-records \
      --limit 10 \
      --shard-iterator
      "AAAAAAAAAAFGU/
kLvNggvndHq2UIFOw5PZc6F01s3e3afsSscRM70JSbjIefg2ub07nk1y6CDxYR1UoGHJNP4m4NFUetzfL+wev
+e2P4djJg4L9wmXKvQYoE+rMUiFq+p4Cn3IgvqOb5dRA0yybNdRcdzvnC35KQANoHzzahKdRGb9v4scv+3vaq+f
+OIK8zM5My8ID+g6rMo7UKWeI4+IWiKEXAMPLE"
```

> **Note**
>
> You might need to rerun the get-records command a few times before Amazon Kinesis Data Streams starts to return data.

You should see a response with an array of Amazon Kinesis Data Streams records. The data attribute in the Amazon Kinesis Data Streams record is compressed in gzip format and then base64 encoded. You can examine the raw data from the command line using the following Unix command:

```
echo -n "<Content of Data>" | base64 -d | zcat
```

The base64 decoded and decompressed data is formatted as JSON with the following structure:

```
{
    "owner": "111111111111",
    "logGroup": "CloudTrail/logs",
    "logStream": "111111111111_CloudTrail/logs_us-east-1",
    "subscriptionFilters": [
        "RecipientStream"
    ],
    "messageType": "DATA_MESSAGE",
    "logEvents": [
        {
            "id": "31953106606966983378809025079804211143289615424 29EXAMPLE",
            "timestamp": 1432826855000,
            "message": "{\"eventVersion\":\"1.03\",\"userIdentity\":{\"type\":\"Root
\"}"
        },
        {
            "id": "31953106606966983378809025079804211143289615424 29EXAMPLE",
            "timestamp": 1432826855000,
            "message": "{\"eventVersion\":\"1.03\",\"userIdentity\":{\"type\":\"Root
\"}"
        },
        {
            "id": "31953106606966983378809025079804211143289615424 29EXAMPLE",
            "timestamp": 1432826855000,
            "message": "{\"eventVersion\":\"1.03\",\"userIdentity\":{\"type\":\"Root
\"}"
```

```
        }
    ]
}
```

The key elements in this data structure are as follows:

owner

The AWS Account ID of the originating log data.

logGroup

The log group name of the originating log data.

logStream

The log stream name of the originating log data.

subscriptionFilters

The list of subscription filter names that matched with the originating log data.

messageType

Data messages use the "DATA_MESSAGE" type. Sometimes CloudWatch Logs may emit Amazon Kinesis Data Streams records with a "CONTROL_MESSAGE" type, mainly for checking if the destination is reachable.

logEvents

The actual log data, represented as an array of log event records. The ID property is a unique identifier for every log event.

Modify destination membership at runtime

You might encounter situations where you have to add or remove membership of some users from a destination that you own. You can use the `put-destination-policy` command on your destination with a new access policy. In the following example, a previously added account **111111111111** is stopped from sending any more log data, and account **222222222222** is enabled.

1. Fetch the policy that is currently associated with the destination **testDestination** and make a note of the **AccessPolicy**:

   ```
   aws logs describe-destinations \
   ```

```
    --destination-name-prefix "testDestination"

{
 "Destinations": [
   {
     "DestinationName": "testDestination",
     "RoleArn": "arn:aws:iam::999999999999:role/CWLtoKinesisRole",
     "DestinationArn":
 "arn:aws:logs:region:999999999999:destination:testDestination",
     "TargetArn": "arn:aws:kinesis:region:999999999999:stream/RecipientStream",
     "AccessPolicy": "{\"Version\": \"2012-10-17\", \"Statement\":
 [{\"Sid\": \"\", \"Effect\": \"Allow\", \"Principal\": {\"AWS\":
 \"111111111111\"}, \"Action\": \"logs:PutSubscriptionFilter\", \"Resource\":
 \"arn:aws:logs:region:999999999999:destination:testDestination\"}] }"
   }
 ]
}
```

2. Update the policy to reflect that account **111111111111** is stopped, and that account **222222222222** is enabled. Put this policy in the **~/NewAccessPolicy.json** file:

   JSON

   ```
   {
       "Version":"2012-10-17",
       "Statement": [
           {
               "Sid": "",
               "Effect": "Allow",
               "Principal": {
                   "AWS": "222222222222"
               },
               "Action": "logs:PutSubscriptionFilter",
               "Resource": "arn:aws:logs:us-
   east-1:999999999999:destination:testDestination"
           }
       ]
   }
   ```

3. Call **PutDestinationPolicy** to associate the policy defined in the **NewAccessPolicy.json** file with the destination:

```
aws logs put-destination-policy \
--destination-name "testDestination" \
--access-policy file://~/NewAccessPolicy.json
```

This will eventually disable the log events from account ID **111111111111**. Log events from account ID **222222222222** start flowing to the destination as soon as the owner of account **222222222222** creates a subscription filter.

Updating an existing cross-account subscription

If you currently have a cross-account logs subscription where the destination account grants permissions only to specific sender accounts, and you want to update this subscription so that the destination account grants access to all accounts in an organization, follow the steps in this section.

Topics

Step 1: Update the subscription filters

> **Note**
>
> This step is needed only for cross-account subscriptions for logs that are created by the services listed in Enable logging from AWS services. If you are not working with logs created by one of these log groups, you can skip to Step 2: Update the existing destination access policy.

In certain cases, you must update the subscription filters in all the sender accounts that are sending logs to the destination account. The update adds an IAM role, which CloudWatch can assume and validate that the sender account has permission to send logs to the recipient account.

Follow the steps in this section for every sender account that you want to update to use organization ID for the cross-account subscription permissions.

In the examples in this section, two accounts, 111111111111 and 222222222222 already have subscription filters created to send logs to account 999999999999. The existing subscription filter values are as follows:

```
## Existing Subscription Filter parameter values
    \ --log-group-name "my-log-group-name"
    \ --filter-name "RecipientStream"
    \ --filter-pattern "{$.userIdentity.type = Root}"
    \ --destination-arn "arn:aws:logs:region:999999999999:destination:testDestination"
```

If you need to find the current subscription filter parameter values, enter the following command.

```
aws logs describe-subscription-filters
    \ --log-group-name "my-log-group-name"
```

To update a subscription filter to start using organization IDs for cross-account log permissions

1. Create the following trust policy in a file ~/TrustPolicyForCWL.json. Use a text editor to create this policy file; do not use the IAM console.

   ```
   {
     "Statement": {
       "Effect": "Allow",
       "Principal": { "Service": "logs.amazonaws.com" },
       "Action": "sts:AssumeRole"
     }
   }
   ```

2. Create the IAM role that uses this policy. Take note of the Arn value of the Arn value that is returned by the command, you will need it later in this procedure. In this example, we use CWLtoSubscriptionFilterRole for the name of the role we're creating.

   ```
   aws iam create-role
       \ --role-name CWLtoSubscriptionFilterRole
       \ --assume-role-policy-document file://~/TrustPolicyForCWL.json
   ```

3. Create a permissions policy to define the actions that CloudWatch Logs can perform on your account.

   a. First, use a text editor to create the following permissions policy in a file named / PermissionsForCWLSubscriptionFilter.json.

```
{
    "Statement": [
        {
            "Effect": "Allow",
            "Action": "logs:PutLogEvents",
            "Resource": "arn:aws:logs:region:111111111111:log-
group:LogGroupOnWhichSubscriptionFilterIsCreated:*"
        }
    ]
}
```

b. Enter the following command to associate the permissions policy you just created with the role that you created in step 2.

```
aws iam put-role-policy
    --role-name CWLtoSubscriptionFilterRole
    --policy-name Permissions-Policy-For-CWL-Subscription-filter
    --policy-document file://~/PermissionsForCWLSubscriptionFilter.json
```

4. Enter the following command to update the subscription filter.

```
aws logs put-subscription-filter
    \ --log-group-name "my-log-group-name"
    \ --filter-name "RecipientStream"
    \ --filter-pattern "{$.userIdentity.type = Root}"
    \ --destination-arn
 "arn:aws:logs:region:999999999999:destination:testDestination"
    \ --role-arn "arn:aws:iam::111111111111:role/CWLtoSubscriptionFilterRole"
```

Step 2: Update the existing destination access policy

After you have updated the subscription filters in all of the sender accounts, you can update the destination access policy in the recipient account.

In the following examples, the recipient account is 999999999999 and the destination is named `testDestination`.

The update enables all accounts that are part of the organization with ID `o-1234567890` to send logs to the recipient account. Only the accounts that have subscription filters created will actually send logs to the recipient account.

To update the destination access policy in the recipient account to start using an organization ID for permissions

1. In the recipient account, use a text editor to create a `~/AccessPolicy.json` file with the following contents.

   JSON

```
{
    "Version":"2012-10-17",
    "Statement": [
        {
            "Sid": "",
            "Effect": "Allow",
            "Principal": "*",
            "Action": "logs:PutSubscriptionFilter",
            "Resource": "arn:aws:logs:us-
east-1:999999999999:destination:testDestination",
            "Condition": {
                "StringEquals": {
                    "aws:PrincipalOrgID": [
                        "o-1234567890"
                    ]
                }
            }
        }
    ]
}
```

2. Enter the following command to attach the policy that you just created to the existing destination. To update a destination to use an access policy with an organization ID instead of an access policy that lists specific AWS account IDs, include the `force` parameter.

> **Warning**
>
> If you are working with logs sent by an AWS service listed in Enable logging from AWS services, then before doing this step, you must have first updated the subscription filters in all the sender accounts as explained in Step 1: Update the subscription filters.

```
aws logs put-destination-policy
    \ --destination-name "testDestination"
    \ --access-policy file://~/AccessPolicy.json
    \ --force
```

Cross-account cross-Region log data sharing using Firehose

To share log data across accounts, you need to establish a log data sender and receiver:

- **Log data sender**—gets the destination information from the recipient and lets CloudWatch Logs know that it is ready to send its log events to the specified destination. In the procedures in the rest of this section, the log data sender is shown with a fictional AWS account number of 111111111111.
- **Log data recipient**—sets up a destination that encapsulates a Amazon Kinesis Data Streams stream and lets CloudWatch Logs know that the recipient wants to receive log data. The recipient then shares the information about this destination with the sender. In the procedures in the rest of this section, the log data recipient is shown with a fictional AWS account number of 222222222222.

The example in this section uses a Firehose delivery stream with Amazon S3 storage. You can also set up Firehose delivery streams with different settings. For more information, see Creating a Firehose Delivery Stream.

> **Note**
>
> The log group and the destination must be in the same AWS Region. However, the AWS resource that the destination points to can be located in a different Region.

> **Note**
>
> Firehose subscription filter for a ***same account*** and ***cross-Region*** delivery stream is supported.

Topics

Step 1: Create a Firehose delivery stream

> **Important**
>
> Before you complete the following steps, you must use an access policy, so Firehose can access your Amazon S3 bucket. For more information, see Controlling Access in the *Amazon Data Firehose Developer Guide*.
> All of the steps in this section (Step 1) must be done in the log data recipient account.
> US East (N. Virginia) is used in the following sample commands. Replace this Region with the correct Region for your deployment.

To create a Firehose delivery stream to be used as the destination

1. Create an Amazon S3 bucket:

```
aws s3api create-bucket --bucket amzn-s3-demo-bucket --create-bucket-configuration
 LocationConstraint=us-east-1
```

2. Create the IAM role that grants Firehose permission to put data into the bucket.

   a. First, use a text editor to create a trust policy in a file `~/TrustPolicyForFirehose.json`.

```
{ "Statement": { "Effect": "Allow", "Principal": { "Service":
 "firehose.amazonaws.com" }, "Action": "sts:AssumeRole", "Condition":
 { "StringEquals": { "sts:ExternalId":"222222222222" } } } }
```

   b. Create the IAM role, specifying the trust policy file that you just made.

```
aws iam create-role \
    --role-name FirehosetoS3Role \
    --assume-role-policy-document file://~/TrustPolicyForFirehose.json
```

c. The output of this command will look similar to the following. Make a note of the role name and the role ARN.

```
{
    "Role": {
        "Path": "/",
        "RoleName": "FirehosetoS3Role",
        "RoleId": "AROAR3BXASEKW7K635M53",
        "Arn": "arn:aws:iam::222222222222:role/FirehosetoS3Role",
        "CreateDate": "2021-02-02T07:53:10+00:00",
        "AssumeRolePolicyDocument": {
            "Statement": {
                "Effect": "Allow",
                "Principal": {
                    "Service": "firehose.amazonaws.com"
                },
                "Action": "sts:AssumeRole",
                "Condition": {
                    "StringEquals": {
                        "sts:ExternalId": "222222222222"
                    }
                }
            }
        }
    }
}
```

3. Create a permissions policy to define the actions that Firehose can perform in your account.

a. First, use a text editor to create the following permissions policy in a file named ~/PermissionsForFirehose.json. Depending on your use case, you might need to add more permissions to this file.

```
{
    "Statement": [{
        "Effect": "Allow",
        "Action": [
            "s3:PutObject",
```

```
            "s3:PutObjectAcl",
            "s3:ListBucket"
        ],
        "Resource": [
            "arn:aws:s3:::amzn-s3-demo-bucket",
            "arn:aws:s3:::amzn-s3-demo-bucket/*"
        ]
    }]
}
```

b. Enter the following command to associate the permissions policy that you just created with the IAM role.

```
aws iam put-role-policy --role-name FirehosetoS3Role --policy-name
 Permissions-Policy-For-Firehose-To-S3 --policy-document file://~/
PermissionsForFirehose.json
```

4. Enter the following command to create the Firehose delivery stream. Replace *my-role-arn* and *amzn-s3-demo-bucket2-arn* with the correct values for your deployment.

```
aws firehose create-delivery-stream \
   --delivery-stream-name 'my-delivery-stream' \
   --s3-destination-configuration \
  '{"RoleARN": "arn:aws:iam::222222222222:role/FirehosetoS3Role", "BucketARN":
 "arn:aws:s3:::amzn-s3-demo-bucket"}'
```

The output should look similar to the following:

```
{
    "DeliveryStreamARN": "arn:aws:firehose:us-east-1:222222222222:deliverystream/
my-delivery-stream"
}
```

Step 2: Create a destination

> **Important**
>
> All steps in this procedure are to be done in the log data recipient account.

When the destination is created, CloudWatch Logs sends a test message to the destination on the recipient account's behalf. When the subscription filter is active later, CloudWatch Logs sends log events to the destination on the source account's behalf.

To create a destination

1. Wait until the Firehose stream that you created in Step 1: Create a Firehose delivery stream becomes active. You can use the following command to check the **StreamDescription.StreamStatus** property.

```
aws firehose describe-delivery-stream --delivery-stream-name "my-delivery-stream"
```

In addition, take note of the **DeliveryStreamDescription.DeliveryStreamARN** value, because you will need to use it in a later step. Sample output of this command:

```
{
    "DeliveryStreamDescription": {
        "DeliveryStreamName": "my-delivery-stream",
        "DeliveryStreamARN": "arn:aws:firehose:us-
east-1:222222222222:deliverystream/my-delivery-stream",
        "DeliveryStreamStatus": "ACTIVE",
        "DeliveryStreamEncryptionConfiguration": {
            "Status": "DISABLED"
        },
        "DeliveryStreamType": "DirectPut",
        "VersionId": "1",
        "CreateTimestamp": "2021-02-01T23:59:15.567000-08:00",
        "Destinations": [
            {
                "DestinationId": "destinationId-000000000001",
                "S3DestinationDescription": {
                    "RoleARN": "arn:aws:iam::222222222222:role/FirehosetoS3Role",
                    "BucketARN": "arn:aws:s3:::amzn-s3-demo-bucket",
                    "BufferingHints": {
                        "SizeInMBs": 5,
                        "IntervalInSeconds": 300
                    },
                    "CompressionFormat": "UNCOMPRESSED",
                    "EncryptionConfiguration": {
                        "NoEncryptionConfig": "NoEncryption"
                    },
                    "CloudWatchLoggingOptions": {
```

```
                        "Enabled": false
                    }
                },
                "ExtendedS3DestinationDescription": {
                    "RoleARN": "arn:aws:iam::222222222222:role/FirehosetoS3Role",
                    "BucketARN": "arn:aws:s3:::amzn-s3-demo-bucket",
                    "BufferingHints": {
                        "SizeInMBs": 5,
                        "IntervalInSeconds": 300
                    },
                    "CompressionFormat": "UNCOMPRESSED",
                    "EncryptionConfiguration": {
                        "NoEncryptionConfig": "NoEncryption"
                    },
                    "CloudWatchLoggingOptions": {
                        "Enabled": false
                    },
                    "S3BackupMode": "Disabled"
                }
            }
        ],
        "HasMoreDestinations": false
    }
}
```

It might take a minute or two for your delivery stream to show up in the active state.

2. When the delivery stream is active, create the IAM role that will grant CloudWatch Logs the permission to put data into your Firehose stream. First, you'll need to create a trust policy in a file **~/TrustPolicyForCWL.json**. Use a text editor to create this policy. For more information about CloudWatch Logs endpoints, see Amazon CloudWatch Logs endpoints and quotas.

   This policy includes a `aws:SourceArn` global condition context key that specifies the `sourceAccountId` to help prevent the confused deputy security problem. If you don't yet know the source account ID in the first call, we recommend that you put the destination ARN in the source ARN field. In the subsequent calls, you should set the source ARN to be the actual source ARN that you gathered from the first call. For more information, see Confused deputy prevention.

```
{
    "Statement": {
        "Effect": "Allow",
```

```
        "Principal": {
            "Service": "logs.region.amazonaws.com"
        },
        "Action": "sts:AssumeRole",
        "Condition": {
            "ArnLike": {
                "aws:SourceArn": [
                    "arn:aws:logs:region:sourceAccountId:*",
                    "arn:aws:logs:region:recipientAccountId:*"
                ]
            }
        }
     }
}
```

3. Use the **aws iam create-role** command to create the IAM role, specifying the trust policy file that you just created.

```
aws iam create-role \
      --role-name CWLtoKinesisFirehoseRole \
      --assume-role-policy-document file://~/TrustPolicyForCWL.json
```

The following is a sample output. Take note of the returned `Role.Arn` value, because you will need to use it in a later step.

```
{
    "Role": {
        "Path": "/",
        "RoleName": "CWLtoKinesisFirehoseRole",
        "RoleId": "AROAR3BXASEKYJYWF243H",
        "Arn": "arn:aws:iam::222222222222:role/CWLtoKinesisFirehoseRole",
        "CreateDate": "2021-02-02T08:10:43+00:00",
        "AssumeRolePolicyDocument": {
            "Statement": {
                "Effect": "Allow",
                "Principal": {
                    "Service": "logs.region.amazonaws.com"
                },
                "Action": "sts:AssumeRole",
                "Condition": {
                    "ArnLike": {
                        "aws:SourceArn": [
```

```
                            "arn:aws:logs:region:sourceAccountId:*",
                            "arn:aws:logs:region:recipientAccountId:*"
                        ]
                    }
                }
            }
        }
    }
}
```

4. Create a permissions policy to define which actions CloudWatch Logs can perform on your account. First, use a text editor to create a permissions policy in a file **~/PermissionsForCWL.json**:

```
{
    "Statement":[
      {
        "Effect":"Allow",
        "Action":["firehose:*"],
        "Resource":["arn:aws:firehose:region:222222222222:*"]
      }
    ]
}
```

5. Associate the permissions policy with the role by entering the following command:

```
aws iam put-role-policy --role-name CWLtoKinesisFirehoseRole --policy-name
 Permissions-Policy-For-CWL --policy-document file://~/PermissionsForCWL.json
```

6. After the Firehose delivery stream is in the active state and you have created the IAM role, you can create the CloudWatch Logs destination.

   a. This step will not associate an access policy with your destination and is only the first step out of two that completes a destination creation. Make a note of the ARN of the new destination that is returned in the payload, because you will use this as the `destination.arn` in a later step.

```
aws logs put-destination \

    --destination-name "testFirehoseDestination" \
    --target-arn "arn:aws:firehose:us-east-1:222222222222:deliverystream/my-
delivery-stream" \
```

```
    --role-arn "arn:aws:iam::222222222222:role/CWLtoKinesisFirehoseRole"

{
    "destination": {
        "destinationName": "testFirehoseDestination",
        "targetArn": "arn:aws:firehose:us-east-1:222222222222:deliverystream/
my-delivery-stream",
        "roleArn": "arn:aws:iam::222222222222:role/CWLtoKinesisFirehoseRole",
        "arn": "arn:aws:logs:us-
east-1:222222222222:destination:testFirehoseDestination"}
}
```

b. After the previous step is complete, in the log data recipient account (222222222222), associate an access policy with the destination.

   This policy enables the log data sender account (111111111111) to access the destination in just the log data recipient account (222222222222). You can use a text editor to put this policy in the **~/AccessPolicy.json** file:

   JSON

```
{
  "Version":"2012-10-17",
  "Statement" : [
    {
      "Sid" : "",
      "Effect" : "Allow",
      "Principal" : {
        "AWS" : "111111111111"
      },
      "Action" : "logs:PutSubscriptionFilter",
      "Resource" : "arn:aws:logs:us-
east-1:222222222222:destination:testFirehoseDestination"
    }
  ]
}
```

c. This creates a policy that defines who has write access to the destination. This policy must specify the **logs:PutSubscriptionFilter** action to access the destination. Cross-account users will use the **PutSubscriptionFilter** action to send log events to the destination:

```
aws logs put-destination-policy \
```

```
    --destination-name "testFirehoseDestination" \
    --access-policy file://~/AccessPolicy.json
```

Step 3: Add/validate IAM permissions for the cross-account destination

According to AWS cross-account policy evaluation logic, in order to access any cross-account resource (such as an Kinesis or Firehose stream used as a destination for a subscription filter) you must have an identity-based policy in the sending account which provides explicit access to the cross-account destination resource. For more information about policy evaluation logic, see Cross-account policy evaluation logic.

You can attach the identity-based policy to the IAM role or IAM user that you are using to create the subscription filter. This policy must be present in the sending account. If you are using the Administrator role to create the subscription filter, you can skip this step and move on to Step 4: Create a subscription filter.

To add or validate the IAM permissions needed for cross-account

1. Enter the following command to check which IAM role or IAM user is being used to run AWS logs commands.

   ```
   aws sts get-caller-identity
   ```

   The command returns output similar to the following:

   ```
   {
   "UserId": "User ID",
   "Account": "sending account id",
   "Arn": "arn:aws:sending account id:role/user:RoleName/UserName"
   }
   ```

   Make note of the value represented by *RoleName* or *UserName*.

2. Sign into the AWS Management Console in the sending account and search for the attached policies with the IAM role or IAM user returned in the output of the command you entered in step 1.

3. Verify that the policies attached to this role or user provide explicit permissions to call `logs:PutSubscriptionFilter` on the cross-account destination resource.

The following policy provides permissions to create a subscription filter on any destination resource only in a single AWS account, account 999999999999:

JSON

```
{
    "Version":"2012-10-17",
    "Statement": [
        {
            "Sid":
 "AllowSubscriptionFiltersOnAnyResourceInOneSpecificAccount",
            "Effect": "Allow",
            "Action": "logs:PutSubscriptionFilter",
            "Resource": [
                "arn:aws:logs:*:*:log-group:*",
                "arn:aws:logs:*:123456789012:destination:*"
            ]
        }
    ]
}
```

The following policy provides permissions to create a subscription filter only on a specific destination resource named `sampleDestination` in single AWS account, account 123456789012:

JSON

```
{
    "Version":"2012-10-17",
    "Statement": [
        {
        "Sid": "AllowSubscriptionFiltersOnSpecificResource",
            "Effect": "Allow",
            "Action": "logs:PutSubscriptionFilter",
            "Resource": [
                "arn:aws:logs:*:*:log-group:*",
                "arn:aws:logs:*:123456789012:destination:amzn-s3-demo-bucket"
            ]
        }
```

```
    ]
}
```

Step 4: Create a subscription filter

Switch to the sending account, which is 111111111111 in this example. You will now create the subscription filter in the sending account. In this example, the filter is associated with a log group containing AWS CloudTrail events so that every logged activity made by "Root" AWS credentials is delivered to the destination you previously created. For more information about how to send AWS CloudTrail events to CloudWatch Logs, see Sending CloudTrail Events to CloudWatch Logs in the *AWS CloudTrail User Guide*.

When you enter the following command, be sure you are signed in as the IAM user or using the IAM role that you added the policy for, in Step 3: Add/validate IAM permissions for the cross-account destination.

```
aws logs put-subscription-filter \
    --log-group-name "aws-cloudtrail-logs-111111111111-300a971e" \
    --filter-name "firehose_test" \
    --filter-pattern "{$.userIdentity.type = AssumedRole}" \
    --destination-arn "arn:aws:logs:us-
east-1:222222222222:destination:testFirehoseDestination"
```

The log group and the destination must be in the same AWS Region. However, the destination can point to an AWS resource such as a Firehose stream that is located in a different Region.

Validating the flow of log events

After you create the subscription filter, CloudWatch Logs forwards all the incoming log events that match the filter pattern to the Firehose delivery stream. The data starts appearing in your Amazon S3 bucket based on the time buffer interval that is set on the Firehose delivery stream. Once enough time has passed, you can verify your data by checking the Amazon S3 bucket. To check the bucket, enter the following command:

```
aws s3api list-objects --bucket 'amzn-s3-demo-bucket'
```

The output of that command will be similar to the following:

```
{
```

```
    "Contents": [
        {
            "Key": "2021/02/02/08/my-delivery-
stream-1-2021-02-02-08-55-24-5e6dc317-071b-45ba-a9d3-4805ba39c2ba",
            "LastModified": "2021-02-02T09:00:26+00:00",
            "ETag": "\"EXAMPLEa817fb88fc770b81c8f990d\"",
            "Size": 198,
            "StorageClass": "STANDARD",
            "Owner": {
                "DisplayName": "firehose+2test",
                "ID": "EXAMPLE27fd05889c665d2636218451970ef79400e3d2aecca3adb1930042e0"
            }
        }
    ]
}
```

You can then retrieve a specific object from the bucket by entering the following command. Replace the value of `key` with the value you found in the previous command.

```
aws s3api get-object --bucket 'amzn-s3-demo-bucket' --key '2021/02/02/08/my-delivery-
stream-1-2021-02-02-08-55-24-5e6dc317-071b-45ba-a9d3-4805ba39c2ba' testfile.gz
```

The data in the Amazon S3 object is compressed with the gzip format. You can examine the raw data from the command line using one of the following commands:

Linux:

```
zcat testfile.gz
```

macOS:

```
zcat <testfile.gz
```

Modifying destination membership at runtime

You might encounter situations where you have to add or remove log senders from a destination that you own. You can use the **PutDestinationPolicy** action on your destination with new access policy. In the following example, a previously added account **111111111111** is stopped from sending any more log data, and account **333333333333** is enabled.

1. Fetch the policy that is currently associated with the destination **testDestination** and make a note of the **AccessPolicy**:

```
aws logs describe-destinations \
    --destination-name-prefix "testFirehoseDestination"

{
    "destinations": [
        {
            "destinationName": "testFirehoseDestination",
            "targetArn": "arn:aws:firehose:us-east-1:222222222222:deliverystream/
my-delivery-stream",
            "roleArn": "arn:aws:iam:: 222222222222:role/CWLtoKinesisFirehoseRole",
            "accessPolicy": "{\n  \"Version\" : \"2012-10-17\",\n  \"Statement
\" : [\n    {\n      \"Sid\" : \"\",\n      \"Effect\" : \"Allow\",\n
 \"Principal\" : {\n        \"AWS\" : \"111111111111 \"\n      },\n      \"Action
\" : \"logs:PutSubscriptionFilter\",\n      \"Resource\" : \"arn:aws:logs:us-
east-1:222222222222:destination:testFirehoseDestination\"\n    }\n  ]\n}\n\n",
            "arn": "arn:aws:logs:us-east-1:
 222222222222:destination:testFirehoseDestination",
            "creationTime": 1612256124430
        }
    ]
}
```

2. Update the policy to reflect that account **111111111111** is stopped, and that account **333333333333** is enabled. Put this policy in the **~/NewAccessPolicy.json** file:

   JSON

```
{
  "Version":"2012-10-17",
  "Statement" : [
    {
      "Sid" : "",
      "Effect" : "Allow",
      "Principal" : {
        "AWS" : "333333333333 "
      },
      "Action" : "logs:PutSubscriptionFilter",
      "Resource" : "arn:aws:logs:us-
east-1:222222222222:destination:testFirehoseDestination"
```

```
    }
  ]
}
```

3. Use the following command to associate the policy defined in the **NewAccessPolicy.json** file with the destination:

```
aws logs put-destination-policy \
    --destination-name "testFirehoseDestination" \

    --access-policy file://~/NewAccessPolicy.json
```

This eventually disables the log events from account ID **111111111111**. Log events from account ID **333333333333** start flowing to the destination as soon as the owner of account **333333333333** creates a subscription filter.

Cross-account cross-Region account-level subscriptions using Amazon Kinesis Data Streams

When you create a cross-account subscription, you can specify a single account or an organization to be the sender. If you specify an organization, then this procedure enables all accounts in the organization to send logs to the receiver account.

To share log data across accounts, you need to establish a log data sender and receiver:

- **Log data sender**—gets the destination information from the recipient and lets CloudWatch Logs know that it's ready to send its log events to the specified destination. In the procedures in the rest of this section, the log data sender is shown with a fictional AWS account number of 111111111111.

  If you're going to have multiple accounts in one organization send logs to one recipient account, you can create a policy that grants all accounts in the organization the permission to send logs to the recipient account. You still have to set up separate subscription filters for each sender account.
- **Log data recipient**—sets up a destination that encapsulates a Amazon Kinesis Data Streams stream and lets CloudWatch Logs know that the recipient wants to receive log data. The recipient then shares the information about this destination with the sender. In the procedures in the

rest of this section, the log data recipient is shown with a fictional AWS account number of 999999999999.

To start receiving log events from cross-account users, the log data recipient first creates a CloudWatch Logs destination. Each destination consists of the following key elements:

Destination name

The name of the destination you want to create.

Target ARN

The Amazon Resource Name (ARN) of the AWS resource that you want to use as the destination of the subscription feed.

Role ARN

An AWS Identity and Access Management (IAM) role that grants CloudWatch Logs the necessary permissions to put data into the chosen stream.

Access policy

An IAM policy document (in JSON format, written using IAM policy grammar) that governs the set of users that are allowed to write to your destination.

> **Note**
>
> The log group and the destination must be in the same AWS Region. However, the AWS resource that the destination points to can be located in a different Region. In the examples in the following sections, all Region-specific resources are created in US East (N. Virginia).

Topics

Setting up a new cross-account subscription

Follow the steps in these sections to set up a new cross-account log subscription.

Topics

Step 1: Create a destination

> **Important**
>
> All steps in this procedure are to be done in the log data recipient account.

For this example, the log data recipient account has an AWS account ID of 999999999999, while the log data sender AWS account ID is 111111111111.

This example creates a destination using an Amazon Kinesis Data Streams stream called RecipientStream, and a role that enables CloudWatch Logs to write data to it.

When the destination is created, CloudWatch Logs sends a test message to the destination on the recipient account's behalf. When the subscription filter is active later, CloudWatch Logs sends log events to the destination on the source account's behalf.

To create a destination

1. In the recipient account, create a destination stream in Amazon Kinesis Data Streams. At a command prompt, type:

   ```
   aws kinesis create-stream --stream-name "RecipientStream" --shard-count 1
   ```

2. Wait until the stream becomes active. You can use the **aws kinesis describe-stream** command to check the **StreamDescription.StreamStatus** property. In addition, take note of the **StreamDescription.StreamARN** value because you will pass it to CloudWatch Logs later:

   ```
   aws kinesis describe-stream --stream-name "RecipientStream"
   {
     "StreamDescription": {
   ```

```
    "StreamStatus": "ACTIVE",
    "StreamName": "RecipientStream",
    "StreamARN": "arn:aws:kinesis:us-east-1:999999999999:stream/RecipientStream",
    "Shards": [
      {
        "ShardId": "shardId-000000000000",
        "HashKeyRange": {
          "EndingHashKey": "340282366920938463463374607431768EXAMPLE",
          "StartingHashKey": "0"
        },
        "SequenceNumberRange": {
          "StartingSequenceNumber":
 "49551135218688818456679503831981458784591352702 18EXAMPLE"
        }
      }
    ]
  }
}
```

It might take a minute or two for your stream to show up in the active state.

3. Create the IAM role that grants CloudWatch Logs the permission to put data into your stream. First, you'll need to create a trust policy in a file **~/TrustPolicyForCWL.json**. Use a text editor to create this policy file, do not use the IAM console.

   This policy includes a `aws:SourceArn` global condition context key that specifies the `sourceAccountId` to help prevent the confused deputy security problem. If you don't yet know the source account ID in the first call, we recommend that you put the destination ARN in the source ARN field. In the subsequent calls, you should set the source ARN to be the actual source ARN that you gathered from the first call. For more information, see Confused deputy prevention.

```
{
    "Statement": {
        "Effect": "Allow",
        "Principal": {
            "Service": "logs.amazonaws.com"
        },
        "Condition": {
            "ArnLike": {
                "aws:SourceArn": [
                    "arn:aws:logs:region:sourceAccountId:*",
```

```
                    "arn:aws:logs:region:recipientAccountId:*"
                ]
            }
        },
        "Action": "sts:AssumeRole"
    }
}
```

4. Use the **aws iam create-role** command to create the IAM role, specifying the trust policy file. Take note of the returned Role.Arn value because it will also be passed to CloudWatch Logs later:

```
aws iam create-role \
--role-name CWLtoKinesisRole \
--assume-role-policy-document file://~/TrustPolicyForCWL.json

{
    "Role": {
        "AssumeRolePolicyDocument": {
            "Statement": {
                "Action": "sts:AssumeRole",
                "Effect": "Allow",
                "Condition": {
                    "StringLike": {
                        "aws:SourceArn": [
                            "arn:aws:logs:region:sourceAccountId:*",
                            "arn:aws:logs:region:recipientAccountId:*"
                        ]
                    }
                },
                "Principal": {
                    "Service": "logs.amazonaws.com"
                }
            }
        },
        "RoleId": "AAOIIAH450GAB4HC5F431",
        "CreateDate": "2023-05-29T13:46:29.431Z",
        "RoleName": "CWLtoKinesisRole",
        "Path": "/",
        "Arn": "arn:aws:iam::999999999999:role/CWLtoKinesisRole"
    }
}
```

5. Create a permissions policy to define which actions CloudWatch Logs can perform on your account. First, use a text editor to create a permissions policy in a file **~/PermissionsForCWL.json**:

```
{
  "Statement": [
    {
      "Effect": "Allow",
      "Action": "kinesis:PutRecord",
      "Resource": "arn:aws:kinesis:region:999999999999:stream/RecipientStream"
    }
  ]
}
```

6. Associate the permissions policy with the role by using the **aws iam put-role-policy** command:

```
aws iam put-role-policy \
    --role-name CWLtoKinesisRole \
    --policy-name Permissions-Policy-For-CWL \
    --policy-document file://~/PermissionsForCWL.json
```

7. After the stream is in the active state and you have created the IAM role, you can create the CloudWatch Logs destination.

   a. This step doesn't associate an access policy with your destination and is only the first step out of two that completes a destination creation. Make a note of the **DestinationArn** that is returned in the payload:

```
aws logs put-destination \
    --destination-name "testDestination" \
    --target-arn "arn:aws:kinesis:region:999999999999:stream/RecipientStream" \
    --role-arn "arn:aws:iam::999999999999:role/CWLtoKinesisRole"

{
  "DestinationName" : "testDestination",
  "RoleArn" : "arn:aws:iam::999999999999:role/CWLtoKinesisRole",
  "DestinationArn" : "arn:aws:logs:us-
east-1:999999999999:destination:testDestination",
  "TargetArn" : "arn:aws:kinesis:us-east-1:999999999999:stream/RecipientStream"
}
```

b. After step 7a is complete, in the log data recipient account, associate an access policy with the destination. This policy must specify the **logs:PutSubscriptionFilter** action and grants permission to the sender account to access the destination.

The policy grants permission to the AWS account that sends logs. You can specify just this one account in the policy, or if the sender account is a member of an organization, the policy can specify the organization ID of the organization. This way, you can create just one policy to allow multiple accounts in one organization to send logs to this destination account.

Use a text editor to create a file named `~/AccessPolicy.json` with one of the following policy statements.

This first example policy allows all accounts in the organization that have an ID of `o-1234567890` to send logs to the recipient account.

JSON

```
{
    "Version":"2012-10-17",
    "Statement": [
        {
            "Sid": "",
            "Effect": "Allow",
            "Principal": "*",
            "Action": [
                "logs:PutSubscriptionFilter",
                "logs:PutAccountPolicy"
            ],
            "Resource": "arn:aws:logs:us-
east-1:999999999999:destination:testDestination",
            "Condition": {
                "StringEquals": {
                    "aws:PrincipalOrgID": [
                        "o-1234567890"
                    ]
                }
            }
        }
    ]
```

```
}
```

This next example allows just the log data sender account (111111111111) to send logs to the log data recipient account.

JSON

```
{
    "Version":"2012-10-17",
    "Statement": [
        {
            "Sid": "",
            "Effect": "Allow",
            "Principal": {
                "AWS": "111111111111"
            },
            "Action": [
                "logs:PutSubscriptionFilter",
                "logs:PutAccountPolicy"
            ],
            "Resource": "arn:aws:logs:us-
east-1:999999999999:destination:testDestination"
        }
    ]
}
```

c. Attach the policy you created in the previous step to the destination.

```
aws logs put-destination-policy \
    --destination-name "testDestination" \
    --access-policy file://~/AccessPolicy.json
```

This access policy enables users in the AWS Account with ID 111111111111 to call **PutSubscriptionFilter** against the destination with ARN arn:aws:logs:*region*:999999999999:destination:testDestination. Any other user's attempt to call PutSubscriptionFilter against this destination will be rejected.

To validate a user's privileges against an access policy, see Using Policy Validator in the *IAM User Guide*.

When you have finished, if you're using AWS Organizations for your cross-account permissions, follow the steps in Step 2: (Only if using an organization) Create an IAM role. If you're granting permissions directly to the other account instead of using Organizations, you can skip that step and proceed to Step 3: Create an account-level subscription filter policy.

Step 2: (Only if using an organization) Create an IAM role

In the previous section, if you created the destination by using an access policy that grants permissions to the organization that account 111111111111 is in, instead of granting permissions directly to account 111111111111, then follow the steps in this section. Otherwise, you can skip to Step 3: Create an account-level subscription filter policy.

The steps in this section create an IAM role, which CloudWatch can assume and validate whether the sender account has permission to create a subscription filter against the recipient destination.

Perform the steps in this section in the sender account. The role must exist in the sender account, and you specify the ARN of this role in the subscription filter. In this example, the sender account is 111111111111.

To create the IAM role necessary for cross-account log subscriptions using AWS Organizations

1. Create the following trust policy in a file `/TrustPolicyForCWLSubscriptionFilter.json`. Use a text editor to create this policy file; do not use the IAM console.

```
{
  "Statement": {
    "Effect": "Allow",
    "Principal": { "Service": "logs.amazonaws.com" },
    "Action": "sts:AssumeRole"
  }
}
```

2. Create the IAM role that uses this policy. Take note of the `Arn` value that is returned by the command, you will need it later in this procedure. In this example, we use `CWLtoSubscriptionFilterRole` for the name of the role we're creating.

```
aws iam create-role \
     --role-name CWLtoSubscriptionFilterRole \
     --assume-role-policy-document file://~/
TrustPolicyForCWLSubscriptionFilter.json
```

3. Create a permissions policy to define the actions that CloudWatch Logs can perform on your account.

   a. First, use a text editor to create the following permissions policy in a file named ~/PermissionsForCWLSubscriptionFilter.json.

```
{
    "Statement": [
        {
            "Effect": "Allow",
            "Action": "logs:PutLogEvents",
            "Resource": "arn:aws:logs:region:111111111111:log-
group:LogGroupOnWhichSubscriptionFilterIsCreated:*"
        }
    ]
}
```

   b. Enter the following command to associate the permissions policy you just created with the role that you created in step 2.

```
aws iam put-role-policy
    --role-name CWLtoSubscriptionFilterRole
    --policy-name Permissions-Policy-For-CWL-Subscription-filter
    --policy-document file://~/PermissionsForCWLSubscriptionFilter.json
```

When you have finished, you can proceed to Step 3: Create an account-level subscription filter policy.

Step 3: Create an account-level subscription filter policy

After you create a destination, the log data recipient account can share the destination ARN (arn:aws:logs:us-east-1:999999999999:destination:testDestination) with other AWS accounts so that they can send log events to the same destination. These other sending accounts users then create a subscription filter on their respective log groups against this destination. The subscription filter immediately starts the flow of real-time log data from the chosen log group to the specified destination.

> **Note**
>
> If you are granting permissions for the subscription filter to an entire organization, you will need to use the ARN of the IAM role that you created in Step 2: (Only if using an organization) Create an IAM role.

In the following example, an account-level subscription filter policy is created in a sending account. the filter is associated with the sender account 111111111111 so that every log event matching the filter and selection criteria is delivered to the destination you previously created. That destination encapsulates a stream called "RecipientStream".

The `selection-criteria` field is optional, but is important for excluding log groups that can cause an infinite log recursion from a subscription filter. For more information about this issue and determining which log groups to exclude, see Log recursion prevention. Currently, NOT IN is the only supported operator for `selection-criteria`.

```
aws logs put-account-policy \
    --policy-name "CrossAccountStreamsExamplePolicy" \
    --policy-type "SUBSCRIPTION_FILTER_POLICY" \
    --policy-document
 '{"DestinationArn":"arn:aws:logs:region:999999999999:destination:testDestination",
 "FilterPattern": "", "Distribution": "Random"}' \
    --selection-criteria 'LogGroupName NOT IN ["LogGroupToExclude1",
 "LogGroupToExclude2"]' \
    --scope "ALL"
```

The sender account's log groups and the destination must be in the same AWS Region. However, the destination can point to an AWS resource such as a Amazon Kinesis Data Streams stream that is located in a different Region.

Validate the flow of log events

After you create the account-level subscription filter policy, CloudWatch Logs forwards all the incoming log events that match the filter pattern and selection criteria to the stream that is encapsulated within the destination stream called "**RecipientStream**". The destination owner can verify that this is happening by using the **aws kinesis get-shard-iterator** command to grab a Amazon Kinesis Data Streams shard, and using the **aws kinesis get-records** command to fetch some Amazon Kinesis Data Streams records:

```
aws kinesis get-shard-iterator \
      --stream-name RecipientStream \
      --shard-id shardId-000000000000 \
      --shard-iterator-type TRIM_HORIZON

{
    "ShardIterator":
    "AAAAAAAAAAFGU/
kLvNggvndHq2UIFOw5PZc6F01s3e3afsSscRM70JSbjIefg2ub07nk1y6CDxYR1UoGHJNP4m4NFUetzfL+wev
+e2P4djJg4L9wmXKvQYoE+rMUiFq+p4Cn3IgvqOb5dRA0yybNdRcdzvnC35KQANoHzzahKdRGb9v4scv+3vaq+f
+OIK8zM5My8ID+g6rMo7UKWeI4+IWiKEXAMPLE"
}

aws kinesis get-records \
      --limit 10 \
      --shard-iterator
      "AAAAAAAAAAFGU/
kLvNggvndHq2UIFOw5PZc6F01s3e3afsSscRM70JSbjIefg2ub07nk1y6CDxYR1UoGHJNP4m4NFUetzfL+wev
+e2P4djJg4L9wmXKvQYoE+rMUiFq+p4Cn3IgvqOb5dRA0yybNdRcdzvnC35KQANoHzzahKdRGb9v4scv+3vaq+f
+OIK8zM5My8ID+g6rMo7UKWeI4+IWiKEXAMPLE"
```

> **Note**
>
> You might need to rerun the `get-records` command a few times before Amazon Kinesis Data Streams starts to return data.

You should see a response with an array of Amazon Kinesis Data Streams records. The data attribute in the Amazon Kinesis Data Streams record is compressed in gzip format and then base64 encoded. You can examine the raw data from the command line using the following Unix command:

```
echo -n "<Content of Data>" | base64 -d | zcat
```

The base64 decoded and decompressed data is formatted as JSON with the following structure:

```
{
    "owner": "111111111111",
    "logGroup": "CloudTrail/logs",
    "logStream": "111111111111_CloudTrail/logs_us-east-1",
```

```
    "subscriptionFilters": [
        "RecipientStream"
    ],
    "messageType": "DATA_MESSAGE",
    "logEvents": [
        {
            "id": "31953106606966983378809025079804211143289615424 29EXAMPLE",
            "timestamp": 1432826855000,
            "message": "{\"eventVersion\":\"1.03\",\"userIdentity\":{\"type\":\"Root
\"}"
        },
        {
            "id": "31953106606966983378809025079804211143289615424 29EXAMPLE",
            "timestamp": 1432826855000,
            "message": "{\"eventVersion\":\"1.03\",\"userIdentity\":{\"type\":\"Root
\"}"
        },
        {
            "id": "31953106606966983378809025079804211143289615424 29EXAMPLE",
            "timestamp": 1432826855000,
            "message": "{\"eventVersion\":\"1.03\",\"userIdentity\":{\"type\":\"Root
\"}"
        }
    ]
}
```


The key elements in the data structure are the following:

messageType

Data messages will use the "DATA_MESSAGE" type. Sometimes CloudWatch Logs might emit Amazon Kinesis Data Streams records with a "CONTROL_MESSAGE" type, mainly for checking if the destination is reachable.

owner

The AWS Account ID of the originating log data.

logGroup

The log group name of the originating log data.

logStream

The log stream name of the originating log data.

subscriptionFilters

The list of subscription filter names that matched with the originating log data.

logEvents

The actual log data, represented as an array of log event records. The "id" property is a unique identifier for every log event.

policyLevel

The level at which the policy was enforced. "ACCOUNT_LEVEL_POLICY" is the `policyLevel` for an account-level subscription filter policy.

Modify destination membership at runtime

You might encounter situations where you have to add or remove membership of some users from a destination that you own. You can use the `put-destination-policy` command on your destination with a new access policy. In the following example, a previously added account **111111111111** is stopped from sending any more log data, and account **222222222222** is enabled.

1. Fetch the policy that is currently associated with the destination **testDestination** and make a note of the **AccessPolicy**:

```
aws logs describe-destinations \
    --destination-name-prefix "testDestination"

{
 "Destinations": [
   {
     "DestinationName": "testDestination",
     "RoleArn": "arn:aws:iam::999999999999:role/CWLtoKinesisRole",
     "DestinationArn":
 "arn:aws:logs:region:999999999999:destination:testDestination",
     "TargetArn": "arn:aws:kinesis:region:999999999999:stream/RecipientStream",
     "AccessPolicy": "{\"Version\": \"2012-10-17\", \"Statement\":
 [{\"Sid\": \"\", \"Effect\": \"Allow\", \"Principal\": {\"AWS\":
 \"111111111111\"}, \"Action\": \"logs:PutSubscriptionFilter\", \"Resource\":
 \"arn:aws:logs:region:999999999999:destination:testDestination\"}] }"
   }
 ]
```

```
}
```

2. Update the policy to reflect that account **111111111111** is stopped, and that account **222222222222** is enabled. Put this policy in the **~/NewAccessPolicy.json** file:

   JSON

```
{
    "Version":"2012-10-17",
    "Statement": [
        {
            "Sid": "",
            "Effect": "Allow",
            "Principal": {
                "AWS": "222222222222"
            },
            "Action": [
                "logs:PutSubscriptionFilter",
                "logs:PutAccountPolicy"
            ],
            "Resource": "arn:aws:logs:us-
east-1:999999999999:destination:testDestination"
        }
    ]
}
```

3. Call **PutDestinationPolicy** to associate the policy defined in the **NewAccessPolicy.json** file with the destination:

```
aws logs put-destination-policy \
--destination-name "testDestination" \
--access-policy file://~/NewAccessPolicy.json
```

   This will eventually disable the log events from account ID **111111111111**. Log events from account ID **222222222222** start flowing to the destination as soon as the owner of account **222222222222** creates a subscription filter.

Updating an existing cross-account subscription

If you currently have a cross-account logs subscription where the destination account grants permissions only to specific sender accounts, and you want to update this subscription so that the destination account grants access to all accounts in an organization, follow the steps in this section.

Topics

Step 1: Update the subscription filters

> **Note**
>
> This step is needed only for cross-account subscriptions for logs that are created by the services listed in Enable logging from AWS services. If you are not working with logs created by one of these log groups, you can skip to Step 2: Update the existing destination access policy.

In certain cases, you must update the subscription filters in all the sender accounts that are sending logs to the destination account. The update adds an IAM role, which CloudWatch can assume and validate that the sender account has permission to send logs to the recipient account.

Follow the steps in this section for every sender account that you want to update to use organization ID for the cross-account subscription permissions.

In the examples in this section, two accounts, 111111111111 and 222222222222 already have subscription filters created to send logs to account 999999999999. The existing subscription filter values are as follows:

```
## Existing Subscription Filter parameter values
{
    "DestinationArn": "arn:aws:logs:region:999999999999:destination:testDestination",
    "FilterPattern": "{$.userIdentity.type = Root}",
    "Distribution": "Random"
}
```

If you need to find the current subscription filter parameter values, enter the following command.

```
aws logs describe-account-policies \
--policy-type "SUBSCRIPTION_FILTER_POLICY" \
--policy-name "CrossAccountStreamsExamplePolicy"
```

To update a subscription filter to start using organization IDs for cross-account log permissions

1. Create the following trust policy in a file ~/TrustPolicyForCWL.json. Use a text editor to create this policy file; do not use the IAM console.

   ```
   {
     "Statement": {
       "Effect": "Allow",
       "Principal": { "Service": "logs.amazonaws.com" },
       "Action": "sts:AssumeRole"
     }
   }
   ```

2. Create the IAM role that uses this policy. Take note of the Arn value of the Arn value that is returned by the command, you will need it later in this procedure. In this example, we use CWLtoSubscriptionFilterRole for the name of the role we're creating.

   ```
   aws iam create-role
       \ --role-name CWLtoSubscriptionFilterRole
       \ --assume-role-policy-document file://~/TrustPolicyForCWL.json
   ```

3. Create a permissions policy to define the actions that CloudWatch Logs can perform on your account.

   a. First, use a text editor to create the following permissions policy in a file named / PermissionsForCWLSubscriptionFilter.json.

      ```
      {
          "Statement": [
              {
                  "Effect": "Allow",
                  "Action": "logs:PutLogEvents",
                  "Resource": "arn:aws:logs:region:111111111111:log-
      group:LogGroupOnWhichSubscriptionFilterIsCreated:*"
              }
          ]
      }
      ```

b. Enter the following command to associate the permissions policy you just created with the role that you created in step 2.

```
aws iam put-role-policy
    --role-name CWLtoSubscriptionFilterRole
    --policy-name Permissions-Policy-For-CWL-Subscription-filter
    --policy-document file://~/PermissionsForCWLSubscriptionFilter.json
```

4. Enter the following command to update the subscription filter policy.

```
aws logs put-account-policy \
    --policy-name "CrossAccountStreamsExamplePolicy" \
    --policy-type "SUBSCRIPTION_FILTER_POLICY" \
    --policy-document
 '{"DestinationArn":"arn:aws:logs:region:999999999999:destination:testDestination",
 "FilterPattern": "{$.userIdentity.type = Root}", "Distribution": "Random"}' \
    --selection-criteria 'LogGroupName NOT IN ["LogGroupToExclude1",
 "LogGroupToExclude2"]' \
    --scope "ALL"
```

Step 2: Update the existing destination access policy

After you have updated the subscription filters in all of the sender accounts, you can update the destination access policy in the recipient account.

In the following examples, the recipient account is 999999999999 and the destination is named `testDestination`.

The update enables all accounts that are part of the organization with ID `o-1234567890` to send logs to the recipient account. Only the accounts that have subscription filters created will actually send logs to the recipient account.

To update the destination access policy in the recipient account to start using an organization ID for permissions

1. In the recipient account, use a text editor to create a `~/AccessPolicy.json` file with the following contents.

JSON

```
{
    "Version":"2012-10-17",
    "Statement": [
        {
            "Sid": "",
            "Effect": "Allow",
            "Principal": "*",
            "Action": [
                "logs:PutSubscriptionFilter",
                "logs:PutAccountPolicy"
            ],
            "Resource": "arn:aws:logs:us-
east-1:999999999999:destination:testDestination",
            "Condition": {
                "StringEquals": {
                    "aws:PrincipalOrgID": [
                        "o-1234567890"
                    ]
                }
            }
        }
    ]
}
```

2. Enter the following command to attach the policy that you just created to the existing destination. To update a destination to use an access policy with an organization ID instead of an access policy that lists specific AWS account IDs, include the `force` parameter.

> **Warning**
>
> If you are working with logs sent by an AWS service listed in Enable logging from AWS services, then before doing this step, you must have first updated the subscription filters in all the sender accounts as explained in Step 1: Update the subscription filters.

```
aws logs put-destination-policy
    \ --destination-name "testDestination"
    \ --access-policy file://~/AccessPolicy.json
```

```
    \ --force
```

Cross-account cross-Region account-level subscriptions using Firehose

To share log data across accounts, you need to establish a log data sender and receiver:

- **Log data sender**—gets the destination information from the recipient and lets CloudWatch Logs know that it is ready to send its log events to the specified destination. In the procedures in the rest of this section, the log data sender is shown with a fictional AWS account number of 111111111111.
- **Log data recipient**—sets up a destination that encapsulates a Amazon Kinesis Data Streams stream and lets CloudWatch Logs know that the recipient wants to receive log data. The recipient then shares the information about this destination with the sender. In the procedures in the rest of this section, the log data recipient is shown with a fictional AWS account number of 222222222222.

The example in this section uses a Firehose delivery stream with Amazon S3 storage. You can also set up Firehose delivery streams with different settings. For more information, see Creating a Firehose Delivery Stream.

> **Note**
>
> The log group and the destination must be in the same AWS Region. However, the AWS resource that the destination points to can be located in a different Region.

> **Note**
>
> Firehose subscription filter for a ***same account*** and ***cross-Region*** delivery stream is supported.

Topics

- Validating the flow of log events
- Modifying destination membership at runtime

Step 1: Create a Firehose delivery stream

> **Important**
>
> Before you complete the following steps, you must use an access policy, so Firehose can access your Amazon S3 bucket. For more information, see Controlling Access in the *Amazon Data Firehose Developer Guide*.
> All of the steps in this section (Step 1) must be done in the log data recipient account.
> US East (N. Virginia) is used in the following sample commands. Replace this Region with the correct Region for your deployment.

To create a Firehose delivery stream to be used as the destination

1. Create an Amazon S3 bucket:

```
aws s3api create-bucket --bucket amzn-s3-demo-bucket --create-bucket-configuration
 LocationConstraint=us-east-1
```

2. Create the IAM role that grants Firehose permission to put data into the bucket.

   a. First, use a text editor to create a trust policy in a file `~/TrustPolicyForFirehose.json`.

```
{ "Statement": { "Effect": "Allow", "Principal": { "Service":
 "firehose.amazonaws.com" }, "Action": "sts:AssumeRole", "Condition":
 { "StringEquals": { "sts:ExternalId":"222222222222" } } } }
```

   b. Create the IAM role, specifying the trust policy file that you just made.

```
aws iam create-role \
    --role-name FirehosetoS3Role \
    --assume-role-policy-document file://~/TrustPolicyForFirehose.json
```

   c. The output of this command will look similar to the following. Make a note of the role name and the role ARN.

```
{
    "Role": {
        "Path": "/",
        "RoleName": "FirehosetoS3Role",
        "RoleId": "AROAR3BXASEKW7K635M53",
        "Arn": "arn:aws:iam::222222222222:role/FirehosetoS3Role",
        "CreateDate": "2021-02-02T07:53:10+00:00",
        "AssumeRolePolicyDocument": {
            "Statement": {
                "Effect": "Allow",
                "Principal": {
                    "Service": "firehose.amazonaws.com"
                },
                "Action": "sts:AssumeRole",
                "Condition": {
                    "StringEquals": {
                        "sts:ExternalId": "222222222222"
                    }
                }
            }
        }
    }
}
```

3. Create a permissions policy to define the actions that Firehose can perform in your account.

   a. First, use a text editor to create the following permissions policy in a file named ~/PermissionsForFirehose.json. Depending on your use case, you might need to add more permissions to this file.

```
{
    "Statement": [{
        "Effect": "Allow",
        "Action": [
            "s3:PutObject",
            "s3:PutObjectAcl",
            "s3:ListBucket"
        ],
        "Resource": [
            "arn:aws:s3:::amzn-s3-demo-bucket",
            "arn:aws:s3:::amzn-s3-demo-bucket/*"
        ]
```

```
    }]
}
```

b. Enter the following command to associate the permissions policy that you just created with the IAM role.

```
aws iam put-role-policy --role-name FirehosetoS3Role --policy-name
 Permissions-Policy-For-Firehose-To-S3 --policy-document file://~/
PermissionsForFirehose.json
```

4. Enter the following command to create the Firehose delivery stream. Replace *my-role-arn* and *amzn-s3-demo-bucket2-arn* with the correct values for your deployment.

```
aws firehose create-delivery-stream \
   --delivery-stream-name 'my-delivery-stream' \
   --s3-destination-configuration \
  '{"RoleARN": "arn:aws:iam::222222222222:role/FirehosetoS3Role", "BucketARN":
 "arn:aws:s3:::amzn-s3-demo-bucket"}'
```

The output should look similar to the following:

```
{
    "DeliveryStreamARN": "arn:aws:firehose:us-east-1:222222222222:deliverystream/
my-delivery-stream"
}
```

Step 2: Create a destination

> **Important**
>
> All steps in this procedure are to be done in the log data recipient account.

When the destination is created, CloudWatch Logs sends a test message to the destination on the recipient account's behalf. When the subscription filter is active later, CloudWatch Logs sends log events to the destination on the source account's behalf.

To create a destination

1. Wait until the Firehose stream that you created in Step 1: Create a Firehose delivery stream becomes active. You can use the following command to check the **StreamDescription.StreamStatus** property.

```
aws firehose describe-delivery-stream --delivery-stream-name "my-delivery-stream"
```

In addition, take note of the **DeliveryStreamDescription.DeliveryStreamARN** value, because you will need to use it in a later step. Sample output of this command:

```
{
    "DeliveryStreamDescription": {
        "DeliveryStreamName": "my-delivery-stream",
        "DeliveryStreamARN": "arn:aws:firehose:us-
east-1:222222222222:deliverystream/my-delivery-stream",
        "DeliveryStreamStatus": "ACTIVE",
        "DeliveryStreamEncryptionConfiguration": {
            "Status": "DISABLED"
        },
        "DeliveryStreamType": "DirectPut",
        "VersionId": "1",
        "CreateTimestamp": "2021-02-01T23:59:15.567000-08:00",
        "Destinations": [
            {
                "DestinationId": "destinationId-000000000001",
                "S3DestinationDescription": {
                    "RoleARN": "arn:aws:iam::222222222222:role/FirehosetoS3Role",
                    "BucketARN": "arn:aws:s3:::amzn-s3-demo-bucket",
                    "BufferingHints": {
                        "SizeInMBs": 5,
                        "IntervalInSeconds": 300
                    },
                    "CompressionFormat": "UNCOMPRESSED",
                    "EncryptionConfiguration": {
                        "NoEncryptionConfig": "NoEncryption"
                    },
                    "CloudWatchLoggingOptions": {
                        "Enabled": false
                    }
                },
                "ExtendedS3DestinationDescription": {
```

```
                    "RoleARN": "arn:aws:iam::222222222222:role/FirehosetoS3Role",
                    "BucketARN": "arn:aws:s3:::amzn-s3-demo-bucket",
                    "BufferingHints": {
                        "SizeInMBs": 5,
                        "IntervalInSeconds": 300
                    },
                    "CompressionFormat": "UNCOMPRESSED",
                    "EncryptionConfiguration": {
                        "NoEncryptionConfig": "NoEncryption"
                    },
                    "CloudWatchLoggingOptions": {
                        "Enabled": false
                    },
                    "S3BackupMode": "Disabled"
                }
            }
        ],
        "HasMoreDestinations": false
    }
}
```

It might take a minute or two for your delivery stream to show up in the active state.

2. When the delivery stream is active, create the IAM role that will grant CloudWatch Logs the permission to put data into your Firehose stream. First, you'll need to create a trust policy in a file **~/TrustPolicyForCWL.json**. Use a text editor to create this policy. For more information about CloudWatch Logs endpoints, see Amazon CloudWatch Logs endpoints and quotas.

   This policy includes a `aws:SourceArn` global condition context key that specifies the `sourceAccountId` to help prevent the confused deputy security problem. If you don't yet know the source account ID in the first call, we recommend that you put the destination ARN in the source ARN field. In the subsequent calls, you should set the source ARN to be the actual source ARN that you gathered from the first call. For more information, see Confused deputy prevention.

```
{
    "Statement": {
        "Effect": "Allow",
        "Principal": {
            "Service": "logs.amazonaws.com"
        },
        "Action": "sts:AssumeRole",
```

```
        "Condition": {
            "ArnLike": {
                "aws:SourceArn": [
                    "arn:aws:logs:region:sourceAccountId:*",
                    "arn:aws:logs:region:recipientAccountId:*"
                ]
            }
        }
    }
}
```

3. Use the **aws iam create-role** command to create the IAM role, specifying the trust policy file that you just created.

```
aws iam create-role \
      --role-name CWLtoKinesisFirehoseRole \
      --assume-role-policy-document file://~/TrustPolicyForCWL.json
```

The following is a sample output. Take note of the returned `Role.Arn` value, because you will need to use it in a later step.

```
{
    "Role": {
        "Path": "/",
        "RoleName": "CWLtoKinesisFirehoseRole",
        "RoleId": "AROAR3BXASEKYJYWF243H",
        "Arn": "arn:aws:iam::222222222222:role/CWLtoKinesisFirehoseRole",
        "CreateDate": "2023-02-02T08:10:43+00:00",
        "AssumeRolePolicyDocument": {
            "Statement": {
                "Effect": "Allow",
                "Principal": {
                    "Service": "logs.amazonaws.com"
                },
                "Action": "sts:AssumeRole",
                "Condition": {
                    "ArnLike": {
                        "aws:SourceArn": [
                            "arn:aws:logs:region:sourceAccountId:*",
                            "arn:aws:logs:region:recipientAccountId:*"
                        ]
                    }
```

```
                }
            }
        }
    }
}
```

4. Create a permissions policy to define which actions CloudWatch Logs can perform on your account. First, use a text editor to create a permissions policy in a file **~/PermissionsForCWL.json**:

```
{
    "Statement":[
      {
        "Effect":"Allow",
        "Action":["firehose:*"],
        "Resource":["arn:aws:firehose:region:222222222222:*"]
      }
    ]
}
```

5. Associate the permissions policy with the role by entering the following command:

```
aws iam put-role-policy --role-name CWLtoKinesisFirehoseRole --policy-name
 Permissions-Policy-For-CWL --policy-document file://~/PermissionsForCWL.json
```

6. After the Firehose delivery stream is in the active state and you have created the IAM role, you can create the CloudWatch Logs destination.

   a. This step will not associate an access policy with your destination and is only the first step out of two that completes a destination creation. Make a note of the ARN of the new destination that is returned in the payload, because you will use this as the `destination.arn` in a later step.

```
aws logs put-destination \

    --destination-name "testFirehoseDestination" \
    --target-arn "arn:aws:firehose:us-east-1:222222222222:deliverystream/my-
delivery-stream" \
    --role-arn "arn:aws:iam::222222222222:role/CWLtoKinesisFirehoseRole"

{
    "destination": {
```

```
        "destinationName": "testFirehoseDestination",
        "targetArn": "arn:aws:firehose:us-east-1:222222222222:deliverystream/
my-delivery-stream",
        "roleArn": "arn:aws:iam::222222222222:role/CWLtoKinesisFirehoseRole",
        "arn": "arn:aws:logs:us-
east-1:222222222222:destination:testFirehoseDestination"}
}
```

b. After the previous step is complete, in the log data recipient account (222222222222), associate an access policy with the destination. This policy enables the log data sender account (111111111111) to access the destination in just the log data recipient account (222222222222). You can use a text editor to put this policy in the ~/AccessPolicy.json file:

JSON

```
{
  "Version":"2012-10-17",
  "Statement" : [
    {
      "Sid" : "",
      "Effect" : "Allow",
      "Principal" : {
        "AWS" : "111111111111"
      },
      "Action" : ["logs:PutSubscriptionFilter","logs:PutAccountPolicy"],
      "Resource" : "arn:aws:logs:us-
east-1:222222222222:destination:testFirehoseDestination"
    }
  ]
}
```

c. This creates a policy that defines who has write access to the destination. This policy must specify the logs:PutSubscriptionFilter and logs:PutAccountPolicy actions to access the destination. Cross-account users will use the PutSubscriptionFilter and PutAccountPolicy actions to send log events to the destination.

```
aws logs put-destination-policy \
    --destination-name "testFirehoseDestination" \
    --access-policy file://~/AccessPolicy.json
```

Step 3: Create an account-level subscription filter policy

Switch to the sending account, which is 111111111111 in this example. You will now create the account-level subscription filter policy in the sending account. In this example, the filter causes every log event containing the string ERROR in all but two log groups to be delivered to the destination you previously created.

```
aws logs put-account-policy \
    --policy-name "CrossAccountFirehoseExamplePolicy" \
    --policy-type "SUBSCRIPTION_FILTER_POLICY" \
    --policy-document '{"DestinationArn":"arn:aws:logs:us-
east-1:222222222222:destination:testFirehoseDestination", "FilterPattern":
 "{$.userIdentity.type = AssumedRole}", "Distribution": "Random"}' \
    --selection-criteria 'LogGroupName NOT IN ["LogGroupToExclude1",
 "LogGroupToExclude2"]' \
    --scope "ALL"
```

The sending account's log groups and the destination must be in the same AWS Region. However, the destination can point to an AWS resource such as a Firehose stream that is located in a different Region.

Validating the flow of log events

After you create the subscription filter, CloudWatch Logs forwards all the incoming log events that match the filter pattern and selection criteria to the Firehose delivery stream. The data starts appearing in your Amazon S3 bucket based on the time buffer interval that is set on the Firehose delivery stream. Once enough time has passed, you can verify your data by checking the Amazon S3 bucket. To check the bucket, enter the following command:

```
aws s3api list-objects --bucket 'amzn-s3-demo-bucket'
```

The output of that command will be similar to the following:

```
{
    "Contents": [
        {
            "Key": "2021/02/02/08/my-delivery-
stream-1-2021-02-02-08-55-24-5e6dc317-071b-45ba-a9d3-4805ba39c2ba",
            "LastModified": "2023-02-02T09:00:26+00:00",
            "ETag": "\"EXAMPLEa817fb88fc770b81c8f990d\"",
```

```
            "Size": 198,
            "StorageClass": "STANDARD",
            "Owner": {
                "DisplayName": "firehose+2test",
                "ID": "EXAMPLE27fd05889c665d2636218451970ef79400e3d2aecca3adb1930042e0"
            }
        }
    ]
}
```

You can then retrieve a specific object from the bucket by entering the following command. Replace the value of `key` with the value you found in the previous command.

```
aws s3api get-object --bucket 'amzn-s3-demo-bucket' --key '2021/02/02/08/my-delivery-
stream-1-2021-02-02-08-55-24-5e6dc317-071b-45ba-a9d3-4805ba39c2ba' testfile.gz
```

The data in the Amazon S3 object is compressed with the gzip format. You can examine the raw data from the command line using one of the following commands:

Linux:

```
zcat testfile.gz
```

macOS:

```
zcat <testfile.gz
```

Modifying destination membership at runtime

You might encounter situations where you have to add or remove log senders from a destination that you own. You can use the **PutDestinationPolicy** and `PutAccountPolicy` actions on your destination with the new access policy. In the following example, a previously added account **111111111111** is stopped from sending any more log data, and account **333333333333** is enabled.

1. Fetch the policy that is currently associated with the destination **testDestination** and make a note of the **AccessPolicy**:

   ```
   aws logs describe-destinations \
   ```

```
    --destination-name-prefix "testFirehoseDestination"
```

The returned data might look like this.

```
{
    "destinations": [
        {
            "destinationName": "testFirehoseDestination",
            "targetArn": "arn:aws:firehose:us-east-1:222222222222:deliverystream/
my-delivery-stream",
            "roleArn": "arn:aws:iam:: 222222222222:role/CWLtoKinesisFirehoseRole",
            "accessPolicy": "{\n  \"Version\" : \"2012-10-17\",\n  \"Statement
\" : [\n    {\n      \"Sid\" : \"\",\n      \"Effect\" : \"Allow\",\n
 \"Principal\" : {\n        \"AWS\" : \"111111111111 \"\n      },\n      \"Action
\" : \"logs:PutSubscriptionFilter\",\n      \"Resource\" : \"arn:aws:logs:us-
east-1:222222222222:destination:testFirehoseDestination\"\n    }\n  ]\n}\n\n",
            "arn": "arn:aws:logs:us-east-1:
 222222222222:destination:testFirehoseDestination",
            "creationTime": 1612256124430
        }
    ]
}
```

2. Update the policy to reflect that account **111111111111** is stopped, and that account **333333333333** is enabled. Put this policy in the **~/NewAccessPolicy.json** file:

   JSON

   ```
   {
     "Version":"2012-10-17",
     "Statement" : [
       {
         "Sid" : "",
         "Effect" : "Allow",
         "Principal" : {
           "AWS" : "333333333333 "
         },
         "Action" : ["logs:PutSubscriptionFilter","logs:PutAccountPolicy"],
         "Resource" : "arn:aws:logs:us-
   east-1:222222222222:destination:testFirehoseDestination"
       }
     ]
   ```

```
}
```

3. Use the following command to associate the policy defined in the **NewAccessPolicy.json** file with the destination:

```
aws logs put-destination-policy \
    --destination-name "testFirehoseDestination" \

    --access-policy file://~/NewAccessPolicy.json
```

This eventually disables the log events from account ID **111111111111**. Log events from account ID **333333333333** start flowing to the destination as soon as the owner of account **333333333333** creates a subscription filter.

Confused deputy prevention

The confused deputy problem is a security issue where an entity that doesn't have permission to perform an action can coerce a more-privileged entity to perform the action. In AWS, cross-service impersonation can result in the confused deputy problem. Cross-service impersonation can occur when one service (the calling service) calls another service (the called service). The calling service can be manipulated to use its permissions to act on another customer's resources in a way it should not otherwise have permission to access. To prevent this, AWS provides tools that help you protect your data for all services with service principals that have been given access to resources in your account.

We recommend using the `aws:SourceArn`, `aws:SourceAccount`, `aws:SourceOrgID`, and `aws:SourceOrgPaths` global condition context keys in resource policies to limit the permissions that gives another service to the resource. Use `aws:SourceArn` to associate only one resource with cross-service access. Use `aws:SourceAccount` to let any resource in that account be associated with the cross-service use. Use `aws:SourceOrgID` to allow any resource from any account within an organization be associated with the cross-service use. Use `aws:SourceOrgPaths` to associate any resource from accounts within an AWS Organizations path with the cross-service use. For more information about using and understanding paths, see Understand the AWS Organizations entity path.

The most effective way to protect against the confused deputy problem is to use the `aws:SourceArn` global condition context key with the full ARN of the resource. If you don't know the full ARN of the resource or if you are specifying multiple resources, use the `aws:SourceArn`

global context condition key with wildcard characters (*) for the unknown portions of the ARN. For example, `arn:aws:servicename:*:123456789012:*`.

If the `aws:SourceArn` value does not contain the account ID, such as an Amazon S3 bucket ARN, you must use both `aws:SourceAccount` and `aws:SourceArn` to limit permissions.

To protect against the confused deputy problem at scale, use the `aws:SourceOrgID` or `aws:SourceOrgPaths` global condition context key with the organization ID or organization path of the resource in your resource-based policies. Policies that include the `aws:SourceOrgID` or `aws:SourceOrgPaths` key will automatically include the correct accounts and you don't have to manually update the policies when you add, remove, or move accounts in your organization.

The policies documented for granting access to CloudWatch Logs to write data to Amazon Kinesis Data Streams and Firehose in Step 1: Create a destination and Step 2: Create a destination show how you can use the `aws:SourceArn` global condition context key to help prevent the confused deputy problem.

Log recursion prevention

There is a risk of causing an infinite log recursion with subscription filters that can lead to a large increase in ingestion billing in both CloudWatch Logs and your destination, if not prevented. This can occur when a subscription filter is associated with a log group that receives log events as a result of your subscription delivery workflow. The logs ingested into the log group will be delivered to the destination, causing the log group to ingest more logs which will then be forwarded again to the destination, creating a recursion loop.

For example, consider a subscription filter with the destination as Firehose, which delivers log events to Amazon S3. Additionally, there is also a Lambda function that processes new events delivered to Amazon S3 and produces some logs itself. If the subscription filter is applied to the Lambda function's log group, then the log events produced by the function will get forwarded to Firehose and Amazon S3 at the destination, which will then invoke the function again, causing more logs to be produced and forwarded to Firehose and Amazon S3, causing another invocation of the function and so on. This will occur in an infinite loop, leading to an unexpected billing increase on log ingestion, Firehose, and Amazon S3.

If the Lambda function is attached to a VPC with flow logs enabled for CloudWatch Logs, then the VPC's log group can cause a log recursion as well.

We recommend that you don't apply subscription filters to log groups that are a part of your subscription delivery workflow. For account-level subscription filters, use the `selectionCriteria` parameter in the `PutAccountPolicy` API to exclude these log groups from the policy.

When excluding log groups, consider the following AWS services that produce logs and may be a part of your subscription delivery workflows:

- Amazon EC2 with Fargate
- Lambda
- AWS Step Functions
- Amazon VPC flow logs that are enabled for CloudWatch Logs

> **Note**
>
> Log events produced by a Lambda destination's log group will not be forwarded back to the Lambda function for an account-level subscription filter policy. In this case, excluding the destination Lambda function's log group using `selectionCriteria` is not required for account subscription policies.

Filter pattern syntax for metric filters, subscription filters, filter log events, and Live Tail

> **Note**
>
> For information about how to query your log groups with the Amazon CloudWatch Logs Insights query language, see CloudWatch Logs Insights language query syntax.

With CloudWatch Logs, you can use metric filters to transform log data into actionable metrics, subscription filters to route log events to other AWS services, filter log events to search for log events, and Live Tail to interactively view your logs in real-time as they are ingested.

Filter patterns make up the syntax that metric filters, subscription filters, log events, and Live Tail use to match terms in log events. Terms can be words, exact phrases, or numeric values. Regular expressions (regex) can be used to create standalone filter patterns, or can be incorporated with JSON and space-delimited filter patterns.

Create filter patterns with the terms that you want to match. Filter patterns only return the log events that contain the terms you define. You can test filter patterns in the CloudWatch console.

Topics

Supported regular expressions (regex) syntax

Supported regex syntax

When using regex to search and filter log data, you must surround your expressions with %.

Filter patterns with regex can only include the following:

- Alphanumeric characters – An alphanumeric character is a character that is either a letter (from A to Z or a to z) or a digit (from 0 to 9).
- Supported symbol characters – These include: ':', '_', '#', '=', '@','/', ';', ',', and '-'. For example, `%something!%` would be rejected since '!' is not supported.
- Supported operators – These include: '^', '$', '?', '[', ']', '{', '}', '|', '\', '*', '+', and '.'.

The (and) operators are not supported. You cannot use parentheses to define a subpattern.

Multi-byte characters are not supported.

> **Note**
>
> **Quotas**
> There is a maximum of 5 filter patterns containing regex for each log group when creating metric filters or subscription filters.
> There is a limit of 2 regex for each filter pattern when creating a delimited or JSON filter pattern for metric filters and subscription filters or when filtering log events or Live Tail.

Usage of supported operators

- ^: Anchors the match to the beginning of a string. For example, `%^[hc]at%` matches "hat" and "cat", but only at the beginning of a string.
- $: Anchors the match to the end of a string. For example, `%[hc]at$%` matches "hat" and "cat", but only at the end of a string.
- ?: Matches zero or one occurrence of the preceding term. For example, `%colou?r%` can match both "color" and "colour".
- `[]`: Defines a character class. Matches the character list or character range contained within the brackets. For example, `%[abc]%` matches "a", "b", or "c"; `%[a-z]%` matches any lowercase letter from "a" to "z"; and `%[abcx-z]%`matches "a", "b", "c", "x", "y", or "z".
- `{m, n}`: Matches the preceding term at least *m* and not more than *n* times. For example, `%a{3,5}%` matches only "aaa", "aaaa", and "aaaaa".

> **Note**
>
> Either *m* or *n* can be omitted if you chose not to define a minimum or maximum.

- `|`: Boolean "Or", which matches the term on either side of the vertical bar. For example:
  - `%gra|ey%` can match "gray" or "grey"
  - `%^starting|^initializing|^shutting down%` can match match "starting ...", or "initializing ...", or "shutting down", but won't match "skipping initializing ..."
  - `%abcc|ab[^c]$%` can match "abcc ..." and "aba", but won't match "aac ..."
- `\`: Escape character, which allows you to use the literal meaning of an operator instead of its special meaning. For example, `%\[.\]%` matches any single character surrounded by "[" and "]" since the brackets are escaped, such as "[a]", "[b]", "[7]", "[@]", "[]]", and "[ ]".

  > **Note**
  >
  > `%10\.10\.0\.1%` is the correct way to create a regex to match the IP address 10.10.0.1.

- `*`: Matches zero or more instances of the preceding term. For example, `%ab*c%` can match "ac", "abc", and "abbbc"; `%ab[0-9]*%` can match "ab", "ab0", and "ab129".
- `+`: Matches one or more instances of the preceding term. For example, `%ab+c%` can match "abc", "abbc", and "abbbc", but not "ac".
- `.`: Matches any single character. For example, `%.at%` matches any three character string ending with "at", including "hat", "cat", "bat", "4at", "#at" and " at" (starting with a space).

  > **Note**
  >
  > When creating a regex to match IP addresses, it is important to escape the `.` operator. For example, `%10.10.0.1%` can match "10010,051" which might not be the actual intended purpose of the expression.

- `\d`, `\D`: Matches a digit/non-digit character. For example, `%\d%` is equivalent to `%[0-9]%` and `%\D%` is equivalent to `%[^0-9]%`.

  > **Note**
  >
  > The uppercase operator denotes the inverse of its lowercase counterpart.

- `\s`, `\S`: Matches a whitespace character/non-whitespace character.

> **Note**
>
> The uppercase operator denotes the inverse of its lowercase counterpart. Whitespace characters include the tab (\t), space( ), and newline (\n) characters.

- \w, \W: Matches an alphanumeric character/non-alphanumeric character. For example, %\w% is equivalent to %[a-zA-Z_0-9]% and %\W% is equivalent to %[^a-zA-Z_0-9]%.

> **Note**
>
> The uppercase operator denotes the inverse of its lowercase counterpart.

- \xhh: Matches the ASCII mapping for a two-digit hexadecimal character. \x is the escape sequence which indicates that the following characters represent the hexadecimal value for ASCII. hh specifies the two hexadecimal digits (0-9 and A-F) which point to a character in the ASCII table.

> **Note**
>
> You can use \xhh to match symbol characters that are not supported by the filter pattern. For example, %\x3A% matches :; and %\x28% matches (.

Using filter patterns to match terms with a regular expression (regex)

Match terms using regex

You can match terms in your log events using a regex pattern surrounded with % (percentage signs before and after the regex pattern). The following code snippet shows an example of a filter pattern that returns all log events consisting of the **AUTHORIZED** keyword.

For a list of supported regular expressions, see Supported regular expressions.

```
%AUTHORIZED%
```

This filter pattern returns log event messages, such as the following:

- `[ERROR 401] UNAUTHORIZED REQUEST`
- `[SUCCESS 200] AUTHORIZED REQUEST`

Using filter patterns to match terms in unstructured log events

Match terms in unstructured log events

The following examples contain code snippets that show how you can use filter patterns to match terms in unstructured log events.

> **Note**
>
> Filter patterns are case sensitive. Enclose exact phrases and terms that include non-alphanumeric characters in double quotation marks ("").

Example: Match a single term

The following code snippet shows an example of a single-term filter pattern that returns all log events where messages contain the word ***ERROR***.

```
ERROR
```

This filter pattern matches log event messages, such as the following:

- `[ERROR 400] BAD REQUEST`
- `[ERROR 401] UNAUTHORIZED REQUEST`
- `[ERROR 419] MISSING ARGUMENTS`
- `[ERROR 420] INVALID ARGUMENTS`

Example: Match multiple terms

The following code snippet shows an example of a multiple-term filter pattern that returns all log events where messages contain the words ***ERROR*** and ***ARGUMENTS***.

```
ERROR ARGUMENTS
```

The filter returns log event messages, such as the following:

- `[ERROR 419] MISSING ARGUMENTS`
- `[ERROR 420] INVALID ARGUMENTS`

This filter pattern doesn't return the following log event messages because they don't contain both of the terms specified in the filter pattern.

- `[ERROR 400] BAD REQUEST`
- `[ERROR 401] UNAUTHORIZED REQUEST`

Example: Match optional terms

You can use pattern matching to create filter patterns that return log events containing optional terms. Place a question mark ("?") before the terms that you want to match. The following code snippet shows an example of a filter pattern that returns all log events where messages contain the word ***ERROR*** or the word ***ARGUMENTS***.

```
?ERROR ?ARGUMENTS
```

This filter pattern matches log event messages, such as the following:

- `[ERROR 400] BAD REQUEST`
- `[ERROR 401] UNAUTHORIZED REQUEST`
- `[ERROR 419] MISSING ARGUMENTS`
- `[ERROR 420] INVALID ARGUMENTS`

Note

You cant' combine the question mark ("?") with other filter patterns, such as include and exclude terms. If you combine "?" with other filter patterns, all question mark terms will be ignored.
For example, the following filter pattern matches all events containing the word REQUEST, but the question mark ("?") filter terms are ignored and have no effect.

```
?ERROR ?ARGUMENTS REQUEST
```

Log event matches

- `[INFO] REQUEST FAILED`
- `[WARN] UNAUTHORIZED REQUEST`
- `[ERROR] 400 BAD REQUEST`

Example: Match exact phrases

The following code snippet shows an example of a filter pattern that returns log events where messages contain the exact phrase ***INTERNAL SERVER ERROR***.

```
"INTERNAL SERVER ERROR"
```

This filter pattern returns the following log event message:

- `[ERROR 500] INTERNAL SERVER ERROR`

Example: Include and exclude terms

You can create filter patterns that return log events where messages include some terms and exclude other terms. Place a minus symbol (**"-"**) before the terms that you want to exclude. The following code snippet shows an example of a filter pattern that returns log events where messages include the term ***ERROR*** and exclude the term ***ARGUMENTS***.

```
ERROR -ARGUMENTS
```

This filter pattern returns log event messages, such as the following:

- `[ERROR 400] BAD REQUEST`
- `[ERROR 401] UNAUTHORIZED REQUEST`

This filter pattern doesn't return the following log event messages because they contain the word ***ARGUMENTS***.

- `[ERROR 419] MISSING ARGUMENTS`
- `[ERROR 420] INVALID ARGUMENTS`

Example: Match everything

You can match everything in your log events with double quotation marks. The following code snippet shows an example of a filter pattern that returns all log events.

```
" "
```

Using filter patterns to match terms in JSON log events

Writing filter patterns for JSON log events

The following describes how to write the syntax for filter patterns that match JSON terms containing strings and numeric values.

Writing filter patterns that match strings

You can create filter patterns to match strings in JSON log events. The following code snippet shows an example of the syntax for string-based filter pattern.

```
{ PropertySelector EqualityOperator String }
```

Enclose filter patterns in curly braces ("{}"). String-based filter patterns must contain the following parts:

- **Property selector**

  Set off property selectors with a dollar sign followed by a period ("$."). Property selectors are alphanumeric strings that support hyphen ("-") and underscore ("_") characters. Strings don't support scientific notation. Property selectors point to value nodes in JSON log events. Value nodes can be strings or numbers. Place arrays after property selectors. The elements in arrays follow a zero-based numbering system, meaning that the first element in the array is element 0, the second element is element 1, and so on. Enclose elements in brackets ("[]"). If a property selector points to an array or object, the filter pattern won't match the log format. If the JSON property contains a period (" . "), then the bracket notation may be used to select that property.

  > **Note**
  >
  > **Wildcard selector**
  > You can use the JSON wildcard to select any array element or any JSON object field.
  > **Quotas**
  > You can only use up to one wildcard selector in a property selector.

- **Equality operator**

  Set off equality operators with one of the following symbols: equal ("=") or not equal ("!="). Equality operators return a Boolean value (true or false).

- **String**

  You can enclose strings in double quotation marks (""). Strings that contain types other than alphanumeric characters and the underscore symbol must be placed in double quotation marks. Use the asterisk ("*") as a wild card to match text.

> **Note**
>
> You can use any conditional regular expression when creating filter patterns to match terms in JSON log events. For a list of supported regular expressions, see Supported regular expressions.

The following code snippet contains an example of a filter pattern showing how you can format a filter pattern to match a JSON term with a string.

```
{ $.eventType = "UpdateTrail" }
```

Writing filter patterns that match numeric values

You can create filter patterns to match numeric values in JSON log events. The following code snippet shows an example of the syntax for filter patterns that match numeric values.

```
{ PropertySelector NumericOperator Number }
```

Enclose filter patterns in curly braces ("{}"). Filter patterns that match numeric values must have the following parts:

- **Property selector**

  Set off property selectors with a dollar sign followed by a period ("$."). Property selectors are alphanumeric strings that support hyphen ("-") and underscore ("_") characters. Strings don't support scientific notation. Property selectors point to value nodes in JSON log events. Value nodes can be strings or numbers. Place arrays after property selectors. The elements in arrays follow a zero-based numbering system, meaning that the first element in the array is element 0, the second element is element 1, and so on. Enclose elements in brackets ("[]"). If a property selector points to an array or object, the filter pattern won't match the log format. If the JSON property contains a period (" . "), then the bracket notation may be used to select that property.

> **Note**
>
> **Wildcard selector**
> You can use the JSON wildcard to select any array element or any JSON object field.
> **Quotas**
> You can only use up to one wildcard selector in a property selector.

- **Numeric operator**

  Set off numeric operators with one of the following symbols: greater than (">"), less than ("<"), equal ("="), not equal ("!="), greater than or equal to (">="), or less than or equal to ("<=").

- **Number**

  You can use integers that contain plus ("+") or minus ("-") symbols and follow scientific notation. Use the asterisk ("*") as a wild card to match numbers.

The following code snippet contains examples showing how you can format filter patterns to match JSON terms with numeric values.

```
// Filter pattern with greater than symbol
{ $.bandwidth > 75 }
// Filter pattern with less than symbol
{ $.latency < 50 }
// Filter pattern with greater than or equal to symbol
{ $.refreshRate >= 60 }
// Filter pattern with less than or equal to symbol
{ $.responseTime <= 5 }
// Filter pattern with equal sign
{ $.errorCode = 400}
// Filter pattern with not equal sign
{ $.errorCode != 500 }
// Filter pattern with scientific notation and plus symbol
{ $.number[0] = 1e+3 }
// Filter pattern with scientific notation and minus symbol
{ $.number[0] != 1e-3 }
```

Match terms in JSON log events using simple expressions

The following examples contain code snippets that show how filter patterns can match terms in a JSON log event.

> **Note**
>
> If you test an example filter pattern with the example JSON log event, you must enter the example JSON log on a single line.

JSON log event

```
{
      "eventType": "UpdateTrail",
      "sourceIPAddress": "111.111.111.111",
      "arrayKey": [
            "value",
            "another value"
      ],
      "objectList": [
           {
             "name": "a",
             "id": 1
           },
           {
             "name": "b",
             "id": 2
           }
      ],
      "SomeObject": null,
      "cluster.name": "c"
}
```

Example: Filter pattern that matches string values

This filter pattern matches the string `"UpdateTrail"` in the property `"eventType"`.

```
{ $.eventType = "UpdateTrail" }
```

Example: Filter pattern that matches string values (IP address)

This filter pattern contains a wild card and matches the property "sourceIPAddress" because it doesn't contain a number with the prefix "123.123.".

```
{ $.sourceIPAddress != 123.123.* }
```

Example: Filter pattern that matches a specific array element with a string value

This filter pattern matches the element "value" in the array "arrayKey".

```
{ $.arrayKey[0] = "value" }
```

Example: Filter pattern that matches a string using regex

This filter pattern matches the string "Trail" in the property "eventType".

```
{ $.eventType = %Trail% }
```

Example: Filter pattern that uses a wildcard to match values of any element in the array using regex

The filter pattern contain regex which matches the element "value" in the array "arrayKey".

```
{ $.arrayKey[*] = %val.{2}% }
```

Example: Filter pattern that uses a wildcard to match values of any element with a specific prefix and subnet using regex (IP address)

This filter pattern contains regex which matches the element "111.111.111.111" in the property "sourceIPAddress".

```
{ $.* = %111\.111\.111\.1[0-9]{1,2}% }
```

> **Note**
>
> **Quotas**
>
> You can only use up to one wildcard selector in a property selector.

Example: Filter pattern that matches a JSON property with a period (.) in the key

```
{ $.['cluster.name'] = "c" }
```

Example: Filter pattern that matches JSON logs using IS

You can create filter patterns that match fields in JSON logs with the `IS` variable. The `IS` variable can match fields that contain the values `NULL`, `TRUE`, or `FALSE`. The following filter pattern returns JSON logs where the value of `SomeObject` is `NULL`.

```
{ $.SomeObject IS NULL }
```

Example: Filter pattern that matches JSON logs using NOT EXISTS

You can create filter patterns with the `NOT EXISTS` variable to return JSON logs that don't contain specific fields in the log data. The following filter pattern uses `NOT EXISTS` to return JSON logs that don't contain the field `SomeOtherObject`.

```
{ $.SomeOtherObject NOT EXISTS }
```

> **Note**
>
> The variables `IS NOT` and `EXISTS` currently aren't supported.

Match terms in JSON objects using compound expressions

You can use the logical operators AND ("&&") and OR ("||") in filter patterns to create compound expressions that match log events where two or more conditions are true. Compound expressions support the use of parentheses ("()") and the following standard order of operations: () > && > ||. The following examples contain code snippets that show how you can use filter patterns with compound expressions to match terms in a JSON object.

JSON object

```
{
    "user": {
        "id": 1,
        "email": "John.Stiles@example.com"
    },
    "users": [
        {
         "id": 2,
         "email": "John.Doe@example.com"
        },
        {
         "id": 3,
         "email": "Jane.Doe@example.com"
        }
    ],
    "actions": [
        "GET",
        "PUT",
        "DELETE"
    ],
    "coordinates": [
        [0, 1, 2],
        [4, 5, 6],
        [7, 8, 9]
    ]
}
```

Example: Expression that matches using AND (&&)

This filter pattern contains a compound expression that matches `"id"` in `"user"` with a numeric value of 1 and `"email"` in the first element of the `"users"` array with the string `"John.Doe@example.com"`.

```
{ ($.user.id = 1) && ($.users[0].email = "John.Doe@example.com") }
```

Example: Expression that matches using OR (||)

This filter pattern contains a compound expression that matches `"email"` in `"user"` with the string `"John.Stiles@example.com"`.

```
{ $.user.email = "John.Stiles@example.com" || $.coordinates[0][1] = "nonmatch" &&
 $.actions[2] = "nonmatch" }
```

Example: Expression that doesn't match using AND (&&)

This filter pattern contains a compound expression that doesn't find a match because the expression doesn't match the third action in `"actions"`.

```
{ ($.user.email = "John.Stiles@example.com" || $.coordinates[0][1] = "nonmatch") &&
 $.actions[2] = "nonmatch" }
```

Note

Quotas

You can only use up to one wildcard selector in a property selector, and up to three wildcard selectors in a filter pattern with compound expressions.

Example: Expression that doesn't match using OR (||)

This filter pattern contains a compound expression that doesn't find a match because the expression doesn't match the first property in `"users"` or the third action in `"actions"`.

```
{ ($.user.id = 2 && $.users[0].email = "nonmatch") || $.actions[2] = "GET" }
```

Using filter patterns to match terms in space-delimited log events

Writing filter patterns for space-delimited log events

You can create filter patterns to match terms in space-delimited log events. The following provides an example space-delimited log event and describes how to write the syntax for filter patterns that match terms in the space-delimited log event.

> **Note**
>
> You can use any conditional regular expression when creating filter patterns to match terms in space-delimited log events. For a list of supported regular expressions, see Supported regular expressions.

Example: Space-delimited log event

The following code snippet shows a space-delimited log event that contains seven fields: `ip`, `user`, `username`, `timestamp`, `request`, `status_code`, and `bytes`.

```
127.0.0.1 Prod frank [10/Oct/2000:13:25:15 -0700] "GET /index.html HTTP/1.0" 404
 1534
```

> **Note**
>
> Characters between brackets ("[]") and double quotation marks ("") are considered single fields.

Writing filter patterns that match terms in a space-delimited log event

To create a filter pattern that matches terms in a space-delimited log event, enclose the filter pattern in brackets ("[]"), and specify fields with names that are separated by commas (","). The following filter pattern parses seven fields.

```
[ip=%127\.0\.0\.[1-9]%, user, username, timestamp, request =*.html*, status_code =
 4*, bytes]
```

You can use numeric operators (>, <, =, !=, >=, or <=) and the asterisk (*) as a wild card or regex to give your filter pattern conditions. In the example filter pattern, `ip` uses regex that matches IP address range 127.0.0.1 - 127.0.0.9, `request` contains a wildcard that states it must extract a value with `.html`, and `status_code` contains a wildcard that states it must extract a value beginning with `4`.

If you don't know the number of fields that you're parsing in a space-delimited log event, you can use ellipsis (...) to reference any unnamed field. Elipsis can reference as many fields as needed. The following example shows a filter pattern with ellipsis that represent the first four unnamed fields shown in the previous example filter pattern.

```
[..., request =*.html*, status_code = 4*, bytes]
```

You also can use the logical operators AND (&&) and OR (||) to create compound expressions. The following filter pattern contains a compound expression that states the value of `status_code` must be `404` or `410`.

```
[ip, user, username, timestamp, request =*.html*, status_code = 404 || status_code =
 410, bytes]
```

Match terms in space-delimited log events using pattern matching

You can use pattern matching to create space-delimited filter patterns that match terms in a specific order. Specify the order of your terms with indicators. Use **w1** to represent your first term and **w2** and so on to represent the order of your subsequent terms. Place commas (",") between your terms. The following examples contain code snippets that show how you can use pattern matching with space-delimited filter patterns.

> **Note**
>
> You can use any conditional regular expression when creating filter patterns to match terms in space-delimited log events. For a list of supported regular expressions, see Supported regular expressions.

Space-delimited log event

```
INFO 09/25/2014 12:00:00 GET /service/resource/67 1200
INFO 09/25/2014 12:00:01 POST /service/resource/67/part/111 1310
WARNING 09/25/2014 12:00:02 Invalid user request
ERROR 09/25/2014 12:00:02 Failed to process request
```

Example: Match terms in order

The following space-delimited filter pattern returns log events where the first word in the log events is ***ERROR***.

```
[w1=ERROR, w2]
```

> **Note**
>
> When you create space-delimited filter patterns that use pattern matching, you must include a blank indicator after you specify the order of your terms. For example, if you create a filter pattern that returns log events where the first word is ***ERROR***, include a blank **w2** indicator after the **w1** term.

Example: Match terms with AND (&&) and OR (||)

You can use the logical operators AND ("&&") and OR ("||") to create space-delimited filter patterns that contain conditions. The following filter pattern returns log events where the first word in the events is ***ERROR*** or ***WARNING***.

```
[w1=ERROR || w1=WARNING, w2]
```

Example: Exclude terms from matches

You can create space-delimited filter patterns that return log events excluding one or more terms. Place a not equal symbol ("!=") before the term or terms that you want to exclude. The following code snippet shows an example of a filter pattern that returns log events where the first words aren't ***ERROR*** and ***WARNING***.

```
[w1!=ERROR && w1!=WARNING, w2]
```

Example: Match the top level item in a resource URI

The following code snippet shows an example of a filter pattern that matches the top level item in a resource URI using regex.

```
[logLevel, date, time, method, url=%/service/resource/[0-9]+$%, response_time]
```

Example: Match the child level item in a resource URI

The following code snippet shows an example of a filter pattern that matches the child level item in a resource URI using regex.

```
[logLevel, date, time, method, url=%/service/resource/[0-9]+/part/[0-9]+$%,
 response_time]
```

Enable logging from AWS services

While many services publish logs only to CloudWatch Logs, some AWS services can publish logs directly to Amazon Simple Storage Service or Amazon Data Firehose. If your main requirement for logs is storage or processing in one of these services, you can easily have the service that produces the logs send them directly to Amazon S3 or Firehose without additional setup.

Even when you publish logs directly to Amazon S3 or Firehose, CloudWatch delivery charges apply. If you send logs to Amazon S3, then *AWS_REGION*-S3-Egress-Bytes charges appear in Cost Explorer or on your bill. If you send logs to Firehose, then *AWS_REGION*-FH-Egress-Bytes charges appear. For more information about vended logs pricing, see the **Logs** tab at Amazon CloudWatch Pricing.

Some AWS services use a common infrastructure to send their logs. To enable logging from these services, you must be logged in as a user that has certain permissions. Additionally, you must grant permissions to AWS to enable the logs to be sent.

For services that require these permissions, there are two versions of the permissions needed. The services that require these extra permissions are noted as **Supported (V1 permissions)** and **Supported (V2 permissions)** in the the section called “Supported log destinations”. For information about these required permissions, see the sections after the table.
<integration-catalog>
<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>

<integration></integration>
<integration></integration>
<integration></integration>

<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>
<integration></integration>
</integration-catalog>

Supported log destinations

The following table shows which destinations each AWS service supports for sending logs, and which permissions version is required.

Log source	Log type	the section called "Logs sent to CloudWatch Logs"	the section called "Logs sent to Amazon S3"	the section called "Logs sent to Firehose"	the section called "Traces sent to X-Ray"
Amazon API Gateway access logs	Vended logs	Supported (V1 permissions)			
Application Load Balancer access logs	Vended logs	Supported [V2 Permissions]	Supported [V2 Permissions]	Supported [V2 Permissions]	
AWS AppSync logs	Custom logs	Supported			
Amazon Aurora MySQL logs	Custom logs	Supported			
Amazon Bedrock Knowledge bases logging	Vended logs	Supported (V2 permissions)	Supported (V2 permissions)	Supported (V2 permissions)	Supported (V2 permissions)
Amazon Bedrock Agent logging	Vended logs	Supported (V2 permissions)	Supported (V2 permissions)	Supported (V2 permissions)	

Log source	Log type	the section called "Logs sent to CloudWatch Logs"	the section called "Logs sent to Amazon S3"	the section called "Logs sent to Firehose"	the section called "Traces sent to X-Ray"
Amazon Bedrock AgentCore Runtime	Vended logs	Supported (V2 permissions)	Supported (V2 permissions)	Supported (V2 permissions)	Supported (V2 permissions)
Amazon Bedrock AgentCore Gateway	Vended logs	Supported (V2 permissions)	Supported (V2 permissions)	Supported (V2 permissions)	Supported (V2 permissions)
Amazon Bedrock AgentCore Identity	Vended logs	Supported (V2 permissions)	Supported (V2 permissions)	Supported (V2 permissions)	Supported (V2 permissions)
Amazon Bedrock AgentCore Memory	Vended logs	Supported (V2 permissions)	Supported (V2 permissions)	Supported (V2 permissions)	Supported (V2 permissions)
Amazon Bedrock AgentCore Payments	Vended logs	Supported (V2 permissions)	Supported (V2 permissions)	Supported (V2 permissions)	Supported (V2 permissions)
Amazon Bedrock AgentCore Tools	Vended logs	Supported (V2 permissions)	Supported (V2 permissions)	Supported (V2 permissions)	Supported (V2 permissions)

Log source	Log type	the section called "Logs sent to CloudWatch Logs"	the section called "Logs sent to Amazon S3"	the section called "Logs sent to Firehose"	the section called "Traces sent to X-Ray"
Amazon Chime media quality metric logs and SIP message logs	Vended logs	Supported (V1 permissions)			
CloudFront: access logs	Vended logs	Supported (V2 permissions)	Supported (V2 permissions)	Supported (V2 permissions)	
AWS CloudHSM audit logs	Custom logs	Supported			
CloudWatch Evidently evaluation event logs	Vended logs	Supported (V1 permissions)	Supported (V1 permissions)		
CloudWatch Internet Monitor logs	Vended logs		Supported (V1 permissions)		
CloudTrail logs	Custom logs	Supported			
AWS CodeBuild logs	Custom logs	Supported			

Log source	Log type	the section called "Logs sent to CloudWatch Logs"	the section called "Logs sent to Amazon S3"	the section called "Logs sent to Firehose"	the section called "Traces sent to X-Ray"
Amazon CodeWhisperer event logs	Vended logs	Supported (V2 permissions)	Supported (V2 permissions)	Supported (V2 permissions)	
Amazon Cognito logs	Vended logs	Supported (V1 permissions)			
Amazon Connect Customer logs	Custom logs	Supported			
AWS DataSync logs	Custom logs	Supported			
AWS DevOps Agent logs	Vended logs	Supported (V2 permissions)	Supported (V2 permissions)	Supported (V2 permissions)	
Amazon ElastiCache (Redis OSS) logs	Vended logs	Supported (V1 permissions)		Supported (V1 permissions)	
AWS Elastic Beanstalk logs	Custom logs	Supported			

Log source	Log type	the section called "Logs sent to CloudWatch Logs"	the section called "Logs sent to Amazon S3"	the section called "Logs sent to Firehose"	the section called "Traces sent to X-Ray"
Amazon Elastic Container Service logs	Custom logs	Supported			
Amazon Elastic Kubernetes Service Auto Mode logs	Vended logs	Supported (V2 permissions)	Supported (V2 permissions)	Supported (V2 permissions)	
Amazon Elastic Kubernetes Service Capability Logs	Vended logs	Supported (V2 permissions)	Supported (V2 permissions)	Supported (V2 permissions)	
Amazon Elastic Kubernetes Service control plane logs	Vended logs	Supported			
AWS Elemental MediaPackage access logs	Vended logs	Supported (V2 permissions)	Supported (V2 permissions)	Supported (V2 permissions)	
AWS Elemental MediaTailor logs	Vended logs	Supported (V2 permissions)	Supported (V2 permissions)	Supported (V2 permissions)	
AWS Entity Resolution logs	Vended logs	Supported (V2 permissions)	Supported (V2 permissions)	Supported (V2 permissions)	

Log source	Log type	the section called "Logs sent to CloudWatch Logs"	the section called "Logs sent to Amazon S3"	the section called "Logs sent to Firehose"	the section called "Traces sent to X-Ray"
Amazon EventBridge Pipes logging	Vended logs	Supported (V1 permissions)	Supported (V1 permissions)	Supported (V1 permissions)	
Amazon EventBridge event buses	Vended logs	Supported (V2 permissions)	Supported (V2 permissions)	Supported (V2 permissions)	
AWS Fargate logs	Custom logs	Supported			
AWS Fault Injection Service experiment logs	Vended logs		Supported (V1 permissions)		
Amazon FinSpace	Vended logs	Supported (V1 permissions)	Supported (V1 permissions)	Supported (V1 permissions)	
AWS Global Accelerator flow logs	Vended logs		Supported (V1 permissions)		
AWS Glue job logs	Custom logs	Supported			

Log source	Log type	the section called "Logs sent to CloudWatch Logs"	the section called "Logs sent to Amazon S3"	the section called "Logs sent to Firehose"	the section called "Traces sent to X-Ray"
IAM Identity Center error logs	Vended logs	Supported (V2 permissions)	Supported (V2 permissions)	Supported (V2 permissions)	
Amazon Interactive Video Service chat logs	Vended logs	Supported (V1 permissions)	Supported (V1 permissions)	Supported (V1 permissions)	
AWS IoT logs	Custom logs	Supported			
AWS IoT FleetWise logs	Vended logs	Supported (V1 permissions)	Supported (V1 permissions)	Supported (V1 permissions)	
AWS Lambda logs	Vended logs	Supported	Supported	Supported	
Amazon Macie logs	Custom logs	Supported			
Amazon SES logs	Vended logs	Supported (V2 permissions)	Supported (V2 permissions)	Supported (V2 permissions)	

Log source	Log type	the section called "Logs sent to CloudWatch Logs"	the section called "Logs sent to Amazon S3"	the section called "Logs sent to Firehose"	the section called "Traces sent to X-Ray"
AWS Mainframe Modernization	Vended logs	Supported (V1 permissions)	Supported (V1 permissions)	Supported (V1 permissions)	
Amazon Managed Service for Prometheus logs	Vended logs	Supported (V1 permissions)			
Amazon MSK broker logs	Vended logs	Supported (V1 permissions)	Supported (V1 permissions)	Supported (V1 permissions)	
Amazon MSK Connect logs	Vended logs	Supported (V1 permissions)	Supported (V1 permissions)	Supported (V1 permissions)	
Amazon MQ logs	Custom logs	Supported			
AWS Network Firewall logs	Vended logs	Supported (V1 permissions)	Supported (V1 permissions)	Supported (V1 permissions)	

Log source	Log type	the section called "Logs sent to CloudWatch Logs"	the section called "Logs sent to Amazon S3"	the section called "Logs sent to Firehose"	the section called "Traces sent to X-Ray"
AWS Network Firewall Proxy logs	Vended logs	Supported (V2 permissions)	Supported (V2 permissions)	Supported (V2 permissions)	
Network Load Balancer access logs	Vended logs	Supported (V2 permissions)	Supported (V2 permissions)	Supported (V2 permissions)	
OpenSearch logs	Custom logs	Supported			
Amazon OpenSearch Service ingestion logs	Vended logs	Supported (V1 permissions)	Supported (V1 permissions)	Supported (V1 permissions)	
AWS PCS logs	Vended logs	Supported (V2 permissions)	Supported (V2 permissions)	Supported (V2 permissions)	
Amazon Q Business connector logs	Vended logs	Supported (V2 permissions)	Supported (V2 permissions)	Supported (V2 permissions)	

Log source	Log type	the section called "Logs sent to CloudWatch Logs"	the section called "Logs sent to Amazon S3"	the section called "Logs sent to Firehose"	the section called "Traces sent to X-Ray"
Amazon Q Business conversation logs	Vended logs	Supported (V2 permissions)	Supported (V2 permissions)	Supported (V2 permissions)	
Amazon Quick logs	Vended logs	Supported (V2 permissions)	Supported (V2 permissions)	Supported (V2 permissions)	
Amazon Relational Database Service PostgreSQL logs	Custom logs	Supported			
AWS RTB Fabric logs	Vended logs	Supported (V2 permissions)	Supported (V2 permissions)	Supported (V2 permissions)	
AWS Security Hub CSPM	Vended logs	Supported (V2 permissions)			
AWS Security Hub	Vended logs	Supported (V2 permissions)			
Amazon Route 53 public DNS query logs	Vended logs	Supported			

Log source	Log type	the section called "Logs sent to CloudWatch Logs"	the section called "Logs sent to Amazon S3"	the section called "Logs sent to Firehose"	the section called "Traces sent to X-Ray"
Amazon Route 53 resolver query logs	Vended logs	Supported (V1 permissions)	Supported (V1 permissions)		
Amazon Simple Storage Service server access logs	Vended logs	Supported (V2 permissions)	Supported (V2 permissions)	Supported (V2 permissions)	
Amazon SageMaker AI events	Vended logs	Supported (V1 permissions)			
Amazon SageMaker AI worker events	Vended logs	Supported (V1 permissions)			
AWS Site-to-Site VPN logs	Vended logs	Supported (V1 permissions)	Supported (V1 permissions)	Supported (V1 permissions)	
Amazon Simple Email Service logs	Vended logs	Supported (V2 permissions)	Supported (V2 permissions)	Supported (V2 permissions)	

Log source	Log type	the section called "Logs sent to CloudWatch Logs"	the section called "Logs sent to Amazon S3"	the section called "Logs sent to Firehose"	the section called "Traces sent to X-Ray"
Amazon Simple Notification Service logs	Custom logs	Supported			
Amazon Simple Notification Service data protection policy logs	Custom logs	Supported			
EC2 Spot Instance data feed files	Vended logs		Supported (V1 permissions)		
AWS Step Functions Express Workflow and Standard Workflow logs	Vended logs	Supported (V1 permissions)			
Storage Gateway audit logs and health logs	Vended logs	Supported (V1 permissions)			
AWS Transfer Family logs	Vended logs	Supported (V1 permissions)	Supported (V1 permissions)	Supported (V1 permissions)	

Log source	Log type	the section called "Logs sent to CloudWatch Logs"	the section called "Logs sent to Amazon S3"	the section called "Logs sent to Firehose"	the section called "Traces sent to X-Ray"
AWS Verified Access logs	Vended logs	Supported (V1 permissions)	Supported (V1 permissions)	Supported (V1 permissions)	
Amazon Virtual Private Cloud flow logs	Vended logs	Supported	Supported (V1 permissions)	Supported (V1 permissions)	
Amazon VPC Lattice access logs	Vended logs	Supported (V1 permissions)	Supported (V1 permissions)	Supported (V1 permissions)	
Amazon VPC Route Server	Vended logs	Supported (V2 permissions)	Supported (V2 permissions)	Supported (V2 permissions)	
AWS WAF logs	Vended logs	Supported (V1 permissions)	Supported (V1 permissions)	Supported	
Amazon WorkMail audit logs	Vended logs	Supported (V2 permissions)	Supported (V2 permissions)	Supported (V2 permissions)	

Logging that requires additional permissions [V1]

Some AWS services use a common infrastructure to send their logs to CloudWatch Logs, Amazon S3, or Firehose. To enable the AWS services listed in the preceding table to send their logs to these destinations, you must be logged in as a user that has certain permissions.

Additionally, permissions must be granted to AWS to enable the logs to be sent. AWS can automatically create those permissions when the logs are set up, or you can create them yourself first before you set up the logging. For cross-account delivery, you must manually create the permission policies yourself.

If you choose to have AWS automatically set up the necessary permissions and resource policies when you or someone in your organization first sets up the sending of logs, then the user who is setting up the sending of logs must have certain permissions, as explained later in this section. Alternatively, you can create the resource policies yourself, and then the users who set up the sending of logs do not need as many permissions.

The following topics provide more details for each of these destinations.

Topics

Logs sent to CloudWatch Logs

> **Important**
>
> When you set up the log types in the following list to be sent to CloudWatch Logs, AWS creates or changes the resource policies associated with the log group receiving the logs, if needed. Continue reading this section to see the details.

This section applies when the types of logs listed in the table in the preceding section are sent to CloudWatch Logs:

User permissions

To be able to set up sending any of these types of logs to CloudWatch Logs for the first time, you must be logged into an account with the following permissions.

- `logs:CreateLogDelivery`
- `logs:PutResourcePolicy`
- `logs:DescribeResourcePolicies`
- `logs:DescribeLogGroups`

> **Note**
>
> When you specify the `logs:DescribeLogGroups`, `logs:DescribeResourcePolicies`, or `logs:PutResourcePolicy` permission, be sure to set the ARN of its `Resource` line to use a `*` wildcard, instead of specifying only a single log group name. For example, `"Resource": "arn:aws:logs:us-east-1:111122223333:log-group:*"`

If any of these types of logs is already being sent to a log group in CloudWatch Logs, then to set up the sending of another one of these types of logs to that same log group, you only need the `logs:CreateLogDelivery` permission.

Log group resource policy

The log group where the logs are being sent must have a resource policy that includes certain permissions. If the log group currently does not have a resource policy, and the user setting up the logging has the `logs:PutResourcePolicy`, `logs:DescribeResourcePolicies`, and `logs:DescribeLogGroups` permissions for the log group, then AWS automatically creates the following policy for it when you begin sending the logs to CloudWatch Logs. For newly created subscriptions, resource policies are configured at the log group level and have a maximum size of 51,200 bytes. If an existing account-level resource policy already grants permissions through wildcards, a separate log group level policy would not be created. To check the logGroup-level resource policy for a specific log group, use the `describe-resource-policies` command with the `--resource-arn` parameter set to the log group ARN and the `--policy-scope` parameter set to `RESOURCE`.

JSON

```
{
    "Version":"2012-10-17",
    "Statement": [
        {
            "Sid": "AWSLogDeliveryWrite20150319",
            "Effect": "Allow",
            "Principal": {
                "Service": [
                    "delivery.logs.amazonaws.com"
                ]
            },
            "Action": [
                "logs:CreateLogStream",
                "logs:PutLogEvents"
            ],
            "Resource": [
                "arn:aws:logs:us-east-1:111122223333:log-group:my-log-group:log-
stream:*"
            ],
            "Condition": {
                "StringEquals": {
                    "aws:SourceAccount": [
                        "0123456789"
                    ]
                },
                "ArnLike": {
                    "aws:SourceArn": [
                        "arn:aws:logs:us-east-1:111122223333:*"
                    ]
                }
            }
        }
    ]
}
```

The log group's resource policy limit is 51,200 bytes. Once this limit is reached, AWS cannot add new permissions. This requires customers to manually modify the policy to grant the `delivery.logs.amazonaws.com` service principal permissions on the `logs:CreateLogStream`

and `logs:PutLogEvents` actions. Customers should use a log group name prefix with wildcards such as `/aws/vendedlogs/*` and use this log group name for future Delivery creation.

JSON

```
{
    "Version":"2012-10-17",
    "Statement": [
        {
            "Sid": "AWSLogDeliveryWrite20150319",
            "Effect": "Allow",
            "Principal": {
                "Service": [
                    "delivery.logs.amazonaws.com"
                ]
            },
            "Action": [
                "logs:CreateLogStream",
                "logs:PutLogEvents"
            ],
            "Resource": [
                "arn:aws:logs:us-east-1:111122223333:log-group:my-log-group/aws/
vendedlogs/*"
            ],
            "Condition": {
                "StringEquals": {
                    "aws:SourceAccount": [
                        "0123456789"
                    ]
                },
                "ArnLike": {
                    "aws:SourceArn": [
                        "arn:aws:logs:us-east-1:111122223333:*"
                    ]
                }
            }
        }
    ]
}
```

Logs sent to Amazon S3

When you set logs to be sent to Amazon S3, AWS creates or changes the resource policies associated with the S3 bucket that is receiving the logs, if needed.

Logs published directly to Amazon S3 are published to an existing bucket that you specify. One or more log files are created every five minutes in the specified bucket.

When you deliver logs for the first time to an Amazon S3 bucket, the service that delivers logs records the owner of the bucket to ensure that the logs are delivered only to a bucket belonging to this account. As a result, to change the Amazon S3 bucket owner, you must re-create or update the log subscription in the originating service.

Note

CloudFront uses a different permissions model than the other services that send vended logs to S3. For more information, see Permissions required to configure standard logging and to access your log files.
Additionally, if you use the same S3 bucket for CloudFront access logs and another log source, enabling ACL on the bucket for CloudFront also grants permission to all other log sources that use this bucket.

Important

If you're sending logs to an Amazon S3 bucket and the bucket policy contains a `NotAction` or `NotPrincipal` element, adding log delivery permissions to the bucket automatically and creating a log subscription will fail. To create a log subscription successfully, you need to manually add the log delivery permissions to the bucket policy, then create the log subscription. For more information, see the instructions in this section.
If the bucket has server-side encryption using a customer managed AWS KMS key, you must also add the key policy for your customer managed key. For more information, see Amazon S3.
If the destination bucket has SSE-KMS and a Bucket Key enabled, the attached customer managed KMS key policy no longer works as expected for all requests. For more information, see Reducing the cost of SSE-KMS with Amazon S3 Bucket Keys.

If you're using vended logs and S3 encryption with a customer managed AWS KMS key, you must use a fully qualified AWS KMS key ARN instead of a key ID when you configure the bucket. For more information, see put-bucket-encryption.

User permissions

To be able to set up sending any of these types of logs to Amazon S3 for the first time, you must be logged into an account with the following permissions.

- `logs:CreateLogDelivery`
- `S3:GetBucketPolicy`
- `S3:PutBucketPolicy`

If any of these types of logs is already being sent to an Amazon S3 bucket, then to set up the sending of another one of these types of logs to the same bucket you only need to have the `logs:CreateLogDelivery` permission.

S3 bucket resource policy

The S3 bucket where the logs are being sent must have a resource policy that includes certain permissions. If the bucket currently does not have a resource policy and the user setting up the logging has the `S3:GetBucketPolicy` and `S3:PutBucketPolicy` permissions for the bucket, then AWS automatically creates the following policy for it when you begin sending the logs to Amazon S3.

JSON

```
{
    "Version":"2012-10-17",
    "Id": "AWSLogDeliveryWrite20150319",
    "Statement": [
        {
            "Sid": "AWSLogDeliveryAclCheck",
            "Effect": "Allow",
            "Principal": {
                "Service": "delivery.logs.amazonaws.com"
            },
            "Action": "s3:GetBucketAcl",
```

```
            "Resource": "arn:aws:s3:::amzn-s3-demo-bucket",
            "Condition": {
                "StringEquals": {
                    "aws:SourceAccount": [
                        "0123456789"
                    ]
                },
                "ArnLike": {
                    "aws:SourceArn": [
                        "arn:aws:logs:us-east-1:111122223333:*"
                    ]
                }
            }
        },
        {
            "Sid": "AWSLogDeliveryWrite",
            "Effect": "Allow",
            "Principal": {
                "Service": "delivery.logs.amazonaws.com"
            },
            "Action": "s3:PutObject",
            "Resource": "arn:aws:s3:::amzn-s3-demo-bucket/AWSLogs/account-ID/*",
            "Condition": {
                "StringEquals": {
                    "s3:x-amz-acl": "bucket-owner-full-control",
                    "aws:SourceAccount": [
                        "0123456789"
                    ]
                },
                "ArnLike": {
                    "aws:SourceArn": [
                        "arn:aws:logs:us-east-1:111122223333:*"
                    ]
                }
            }
        }
    ]
}
```

In the previous policy, for `aws:SourceAccount`, specify the list of account IDS for which logs are being delivered to this bucket. For `aws:SourceArn`, specify the list of ARNs of the resource that generates the logs, in the form `arn:aws:logs:`*`source-region`*`:`*`source-account-id`*`:*`.

If the bucket has a resource policy but that policy doesn't contain the statement shown in the previous policy, and the user setting up the logging has the `S3:GetBucketPolicy` and `S3:PutBucketPolicy` permissions for the bucket, that statement is appended to the bucket's resource policy.

> **Note**
>
> In some cases, you may see `AccessDenied` errors in AWS CloudTrail if the `s3:ListBucket` permission has not been granted to `delivery.logs.amazonaws.com`. To avoid these errors in your CloudTrail logs, you must grant the `s3:ListBucket` permission to `delivery.logs.amazonaws.com` and you must include the `Condition` parameters shown with the `s3:GetBucketAcl` permission set in the preceding bucket policy. To make this simpler, instead of creating a new `Statement`, you can directly update the `AWSLogDeliveryAclCheck` to be `"Action": ["s3:GetBucketAcl", "s3:ListBucket"]`

Amazon S3 bucket server-side encryption

You can protect the data in your Amazon S3 bucket by enabling either server-side Encryption with Amazon S3-managed keys (SSE-S3) or server-side encryption with a AWS KMS key stored in AWS Key Management Service (SSE-KMS). For more information, see Protecting data using server-side encryption.

If you choose SSE-S3, no additional configuration is required. Amazon S3 handles the encryption key.

> **Warning**
>
> If you choose SSE-KMS, you must use a customer managed key, because using an AWS managed key is not supported for this scenario. If you set up encryption using an AWS managed key, the logs will be delivered in an unreadable format.

When you use a customer managed AWS KMS key, you can specify the Amazon Resource Name (ARN) of the customer managed key when you enable bucket encryption. You must add the following to the key policy for your customer managed key (not to the bucket policy for your S3 bucket), so that the log delivery account can write to your S3 bucket.

If you choose SSE-KMS, you must use a customer managed key, because using an AWS managed key is not supported for this scenario. When you use a customer managed AWS KMS key, you can specify the Amazon Resource Name (ARN) of the customer managed key when you enable bucket encryption. You must add the following to the key policy for your customer managed key (not to the bucket policy for your S3 bucket), so that the log delivery account can write to your S3 bucket.

```
{
    "Sid": "Allow Logs Delivery to use the key",
    "Effect": "Allow",
    "Principal": {
        "Service": [ "delivery.logs.amazonaws.com" ]
    },
    "Action": [
        "kms:Encrypt",
        "kms:Decrypt",
        "kms:ReEncrypt*",
        "kms:GenerateDataKey*",
        "kms:DescribeKey"
    ],
    "Resource": "*",
    "Condition": {
        "StringEquals": {
            "aws:SourceAccount": ["0123456789"]
        },
        "ArnLike": {
            "aws:SourceArn": ["arn:aws:logs:us-east-1:0123456789:*"]
        }
        }
}
```

For `aws:SourceAccount`, specify the list of account IDS for which logs are being delivered to this bucket. For `aws:SourceArn`, specify the list of ARNs of the resource that generates the logs, in the form `arn:aws:logs:`*`source-region`*`:`*`source-account-id`*`:*`.

Logs sent to Firehose

This section applies when the types of logs listed in the table in the preceding section are sent to Firehose:

User permissions

To be able to set up sending any of these types of logs to Firehose for the first time, you must be logged into an account with the following permissions.

- `logs:CreateLogDelivery`
- `firehose:TagDeliveryStream`
- `iam:CreateServiceLinkedRole`

If any of these types of logs is already being sent to Firehose, then to set up the sending of another one of these types of logs to Firehose you need to have only the `logs:CreateLogDelivery` and `firehose:TagDeliveryStream` permissions.

IAM roles used for permissions

Because Firehose does not use resource policies, AWS uses IAM roles when setting up these logs to be sent to Firehose. AWS creates a service-linked role named **AWSServiceRoleForLogDelivery**. This service-linked role includes the following permissions.

JSON

```
{
    "Version":"2012-10-17",
    "Statement": [
        {
            "Action": [
                "firehose:PutRecord",
                "firehose:PutRecordBatch",
                "firehose:ListTagsForDeliveryStream"
            ],
            "Resource": "*",
            "Condition": {
                "StringEquals": {
                    "aws:ResourceTag/LogDeliveryEnabled": "true"
                }
            },
            "Effect": "Allow"
        }
    ]
}
```

This service-linked role grants permission for all Firehose delivery streams that have the `LogDeliveryEnabled` tag set to `true`. AWS gives this tag to the destination delivery stream when you set up the logging.

This service-linked role also has a trust policy that allows the `delivery.logs.amazonaws.com` service principal to assume the needed service-linked role. That trust policy is as follows:

JSON

```
{
  "Version":"2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Principal": {
        "Service": "delivery.logs.amazonaws.com"
      },
      "Action": "sts:AssumeRole"
    }
  ]
}
```

Logging that requires additional permissions [V2]

Some AWS services use a new method to send their logs. This is a flexible method that enables you to set up log delivery from these services to one or more of the following destinations: CloudWatch Logs, Amazon S3, or Firehose and X-Ray for trace delivery.

A working log delivery consists of three elements:

- A `DeliverySource`, which is a logical object that represents the resource(s) that actually send the logs.
- A `DeliveryDestination`, which is a logical object that represents the actual delivery destination.
- A `Delivery`, which connects a delivery source to delivery destination

To configure logs delivery between a supported AWS service and a destination, you must do the following:

- Create a delivery source with PutDeliverySource.
- Create a delivery destination with PutDeliveryDestination.
- If you are delivering logs cross-account, you can use only Amazon S3 and Firehose destinations. You must use PutDeliveryDestinationPolicy in the destination account to assign an IAM policy to the destination. This policy authorizes creating a delivery from the delivery source in account A to the delivery destination in account B. For cross-account delivery, you must manually create the permission policies yourself. For setup examples, see Cross-account delivery example.
- Create a delivery by pairing exactly one delivery source and one delivery destination, by using CreateDelivery.

Log delivery setup examples

The following examples create the delivery source and delivery destination in the same AWS account. Replace the source resource ARN and log type with values supported by the service that generates the logs. These examples don't require a delivery destination policy.

Create a delivery source

Create the delivery source, and then use one of the destination examples that follow.

```
aws logs put-delivery-source \
    --name my-delivery-source \
    --resource-arn source-resource-arn \
    --log-type log-type
```

Create a delivery to CloudWatch Logs

Create a delivery destination for an existing log group.

```
aws logs put-delivery-destination \
    --name my-cwl-delivery-destination \
    --delivery-destination-configuration \
    "destinationResourceArn=arn:aws:logs:region:account-id:log-group:log-group-name"
```

Create the delivery.

```
aws logs create-delivery \
```

```
    --delivery-source-name my-delivery-source \
    --delivery-destination-arn arn:aws:logs:region:account-id:delivery-destination:my-
cwl-delivery-destination
```

Create a delivery to Amazon S3

Create a delivery destination for an existing bucket.

```
aws logs put-delivery-destination \
    --name my-s3-delivery-destination \
    --delivery-destination-configuration \
    "destinationResourceArn=arn:aws:s3:::bucket-name"
```

Create the delivery.

```
aws logs create-delivery \
    --delivery-source-name my-delivery-source \
    --delivery-destination-arn arn:aws:logs:region:account-id:delivery-destination:my-
s3-delivery-destination
```

To configure a destination prefix, suffix path, or Hive-compatible path, see Amazon S3 object key format.

Create a delivery to Firehose

Create a delivery destination for an existing DirectPut delivery stream.

```
aws logs put-delivery-destination \
    --name my-firehose-delivery-destination \
    --delivery-destination-configuration \
    "destinationResourceArn=arn:aws:firehose:region:account-id:deliverystream/delivery-
stream-name"
```

Create the delivery.

```
aws logs create-delivery \
    --delivery-source-name my-delivery-source \
    --delivery-destination-arn arn:aws:logs:region:account-id:delivery-destination:my-
firehose-delivery-destination
```

Create a delivery to X-Ray

For trace delivery, use a source service and log type that supports delivery to X-Ray. Create the logical X-Ray delivery destination.

```
aws logs put-delivery-destination \
    --name my-xray-delivery-destination \
    --delivery-destination-type XRAY
```

Create the delivery.

```
aws logs create-delivery \
    --delivery-source-name my-delivery-source \
    --delivery-destination-arn arn:aws:logs:region:account-id:delivery-destination:my-
xray-delivery-destination
```

To verify the delivery, use the following command.

```
aws logs describe-deliveries \
    --delivery-source-name-prefix my-delivery-source
```

The following sections provide the details of the permissions you need to have when you are signed in to set up log delivery to each type of destination, using the V2 process. These permissions can be granted to an IAM role that you are signed in with.

Important

It is your responsibility to remove log delivery resources after deleting the log-generating resource. To do so, follow these steps.

1. Delete the `Delivery` by using the DeleteDelivery operation.
2. Delete the `DeliverySource` by using the DeleteDeliverySource operation.
3. If the `DeliveryDestination` associated with the `DeliverySource` that you just deleted is used only for this specific `DeliverySource`, then you can remove it by using the DeleteDeliveryDestinations operation.

Contents

- User permissions
  - Log group resource policy
- Logs sent to Amazon S3
  - User permissions
  - Amazon S3 bucket resource policy
  - Amazon S3 bucket server-side encryption
  - Amazon S3 object key format
- Logs sent to Firehose
  - User permissions
  - IAM roles used for resource permissions
- Traces sent to X-Ray
  - User permissions
  - X-Ray resource policy
  - Enable transaction search

Logs sent to CloudWatch Logs

For an AWS CLI example, see Create a delivery to CloudWatch Logs.

User permissions

To enable sending logs to CloudWatch Logs, you must be signed in with the following permissions.

JSON

```
{
    "Version":"2012-10-17",
    "Statement": [
        {
            "Sid": "ReadWriteAccessForLogDeliveryActions",
            "Effect": "Allow",
            "Action": [
                "logs:GetDelivery",
                "logs:GetDeliverySource",
                "logs:PutDeliveryDestination",
                "logs:GetDeliveryDestinationPolicy",
```

```
                "logs:DeleteDeliverySource",
                "logs:PutDeliveryDestinationPolicy",
                "logs:CreateDelivery",
                "logs:GetDeliveryDestination",
                "logs:PutDeliverySource",
                "logs:DeleteDeliveryDestination",
                "logs:DeleteDeliveryDestinationPolicy",
                "logs:DeleteDelivery",
                "logs:UpdateDeliveryConfiguration"
            ],
            "Resource": [
            "arn:aws:logs:us-east-1:111122223333:delivery:*",
            "arn:aws:logs:us-east-1:444455556666:delivery-source:*",
            "arn:aws:logs:us-east-1:777788889999:delivery-destination:*"
            ]
        },
        {
            "Sid": "ListAccessForLogDeliveryActions",
            "Effect": "Allow",
            "Action": [
                "logs:DescribeDeliveryDestinations",
                "logs:DescribeDeliverySources",
                "logs:DescribeDeliveries",
                "logs:DescribeConfigurationTemplates"
            ],
            "Resource": "*"
        },
        {
            "Sid": "AllowUpdatesToResourcePolicyCWL",
            "Effect": "Allow",
            "Action": [
                "logs:PutResourcePolicy",
                "logs:DescribeResourcePolicies",
                "logs:DescribeLogGroups"
            ],
            "Resource": [
            "arn:aws:logs:us-east-1:123456789012:*"
            ]
        }
    ]
}
```

Log group resource policy

The log group where the logs are being sent must have a resource policy that includes certain permissions. If the log group currently does not have a resource policy, and the user setting up the logging has the `logs:PutResourcePolicy`, `logs:DescribeResourcePolicies`, and `logs:DescribeLogGroups` permissions for the log group, then AWS automatically creates the following policy for it when you begin sending the logs to CloudWatch Logs. For newly created subscriptions, resource policies are configured at the log group level and have a maximum size of 51,200 bytes. If an existing account-level resource policy already grants permissions through wildcards, a separate log group level policy would not be created. To check the logGroup-level resource policy for a specific log group, use the `describe-resource-policies` command with the `--resource-arn` parameter set to the log group ARN and the `--policy-scope` parameter set to RESOURCE.

JSON

```
{
    "Version":"2012-10-17",
    "Statement": [
        {
            "Sid": "AWSLogDeliveryWrite20150319",
            "Effect": "Allow",
            "Principal": {
                "Service": [
                    "delivery.logs.amazonaws.com"
                ]
            },
            "Action": [
                "logs:CreateLogStream",
                "logs:PutLogEvents"
            ],
            "Resource": [
                "arn:aws:logs:us-east-1:111122223333:log-group:my-log-group:log-
stream:*"
            ],
            "Condition": {
                "StringEquals": {
                    "aws:SourceAccount": [
                        "0123456789"
                    ]
                },
```

```
                "ArnLike": {
                    "aws:SourceArn": [
                        "arn:aws:logs:us-east-1:111122223333:*"
                    ]
                }
            }
        }
    ]
}
```

The log group's resource policy limit is 51,200 bytes. Once this limit is reached, AWS cannot add new permissions. This requires customers to manually modify the policy to grant the `delivery.logs.amazonaws.com` service principal permissions on the `logs:CreateLogStream` and `logs:PutLogEvents` actions. Customers should use a log group name prefix with wildcards such as `/aws/vendedlogs/*` and use this log group name for future Delivery creation.

JSON

```
{
    "Version":"2012-10-17",
    "Statement": [
        {
            "Sid": "AWSLogDeliveryWrite20150319",
            "Effect": "Allow",
            "Principal": {
                "Service": [
                    "delivery.logs.amazonaws.com"
                ]
            },
            "Action": [
                "logs:CreateLogStream",
                "logs:PutLogEvents"
            ],
            "Resource": [
                "arn:aws:logs:us-east-1:111122223333:log-group:my-log-group/aws/
vendedlogs/*"
            ],
            "Condition": {
                "StringEquals": {
                    "aws:SourceAccount": [
                        "0123456789"
```

```
                    ]
                },
                "ArnLike": {
                    "aws:SourceArn": [
                        "arn:aws:logs:us-east-1:111122223333:*"
                    ]
                }
            }
        }
    ]
}
```

Logs sent to Amazon S3

For an AWS CLI example, see Create a delivery to Amazon S3.

User permissions

To enable sending logs to Amazon S3, you must be signed in with the following permissions.

JSON

```
{
    "Version":"2012-10-17",
    "Statement": [
        {
            "Sid": "ReadWriteAccessForLogDeliveryActions",
            "Effect": "Allow",
            "Action": [
                "logs:GetDelivery",
                "logs:GetDeliverySource",
                "logs:PutDeliveryDestination",
                "logs:GetDeliveryDestinationPolicy",
                "logs:DeleteDeliverySource",
                "logs:PutDeliveryDestinationPolicy",
                "logs:CreateDelivery",
                "logs:GetDeliveryDestination",
                "logs:PutDeliverySource",
                "logs:DeleteDeliveryDestination",
                "logs:DeleteDeliveryDestinationPolicy",
                "logs:DeleteDelivery",
                "logs:UpdateDeliveryConfiguration"
```

```
            ],
            "Resource": [
            "arn:aws:logs:us-east-1:111122223333:delivery:*",
    "arn:aws:logs:us-east-1:111122223333:delivery-source:*",
    "arn:aws:logs:us-east-1:111122223333:delivery-destination:*"
            ]
        },
        {
            "Sid": "ListAccessForLogDeliveryActions",
            "Effect": "Allow",
            "Action": [
                "logs:DescribeDeliveryDestinations",
                "logs:DescribeDeliverySources",
                "logs:DescribeDeliveries",
                "logs:DescribeConfigurationTemplates"
            ],
            "Resource": "*"
        },
        {
            "Sid": "AllowUpdatesToResourcePolicyS3",
            "Effect": "Allow",
            "Action": [
                "s3:PutBucketPolicy",
                "s3:GetBucketPolicy"
            ],
            "Resource": "arn:aws:s3:::bucket-name"
        }
    ]
}
```

Amazon S3 bucket resource policy

The S3 bucket where the logs are being sent must have a resource policy that includes certain permissions. If the bucket currently does not have a resource policy and the user setting up the logging has the `S3:GetBucketPolicy` and `S3:PutBucketPolicy` permissions for the bucket, then AWS automatically creates the following policy for it when you begin sending the logs to Amazon S3.

JSON

```
{
```

```
    "Version":"2012-10-17",
    "Id": "AWSLogDeliveryWrite20150319",
    "Statement": [
        {
            "Sid": "AWSLogDeliveryWrite",
            "Effect": "Allow",
            "Principal": {
                "Service": "delivery.logs.amazonaws.com"
            },
            "Action": "s3:PutObject",
            "Resource": "arn:aws:s3:::amzn-s3-demo-bucket/AWSLogs/account-ID/*",
            "Condition": {
                "StringEquals": {
                    "s3:x-amz-acl": "bucket-owner-full-control",
                    "aws:SourceAccount": [
                        "0123456789"
                    ]
                },
                "ArnLike": {
                    "aws:SourceArn": [
                        "arn:aws:logs:us-east-1:111122223333:delivery-source:*"
                    ]
                }
            }
        }
    ]
}
```

In the previous policy, for `aws:SourceAccount`, specify the list of account IDS for which logs are being delivered to this bucket. For `aws:SourceArn`, specify the list of ARNs of the resource that generates the logs, in the form `arn:aws:logs:`*`source-region`*`:`*`source-account-id`*`:*`.

If the bucket has a resource policy but that policy doesn't contain the statement shown in the previous policy, and the user setting up the logging has the `S3:GetBucketPolicy` and `S3:PutBucketPolicy` permissions for the bucket, that statement is appended to the bucket's resource policy.

> **Note**
>
> In some cases, you may see `AccessDenied` errors in AWS CloudTrail if the `s3:ListBucket` permission has not been granted to `delivery.logs.amazonaws.com`.

To avoid these errors in your CloudTrail logs, you must grant the `s3:ListBucket` permission to `delivery.logs.amazonaws.com` and you must include the `Condition` parameters shown with the `s3:GetBucketAcl` permission set in the preceding bucket policy. To make this simpler, instead of creating a new `Statement`, you can directly update the `AWSLogDeliveryAclCheck` to be `“Action”: [“s3:GetBucketAcl”, “s3:ListBucket”]`

Amazon S3 bucket server-side encryption

You can protect the data in your Amazon S3 bucket by enabling server-side encryption. You can use Amazon S3-managed keys (SSE-S3) or a AWS KMS key stored in AWS Key Management Service (SSE-KMS). For more information, see Protecting data using server-side encryption.

If you choose SSE-S3, no additional configuration is required. Amazon S3 handles the encryption key.

Customer managed key required

If you choose SSE-KMS, you must use a customer managed key. You can't use an AWS managed key. If you configure encryption with an AWS managed key, CloudWatch Logs delivers the logs in an unreadable format.

For SSE-KMS, specify the Amazon Resource Name (ARN) of the key when you enable bucket encryption. Add the following to the key policy (not to the bucket policy for your S3 bucket), so that the log delivery account can write to your S3 bucket.

```
{
    "Sid": "Allow Logs Delivery to use the key",
    "Effect": "Allow",
    "Principal": {
        "Service": [ "delivery.logs.amazonaws.com" ]
    },
    "Action": [
        "kms:Encrypt",
        "kms:Decrypt",
        "kms:ReEncrypt*",
        "kms:GenerateDataKey*",
        "kms:DescribeKey"
```

```
    ],
    "Resource": "*",
    "Condition": {
        "StringEquals": {
            "aws:SourceAccount": ["012345678901"]
        },
        "ArnLike": {
            "aws:SourceArn": ["arn:aws:logs:us-east-1:012345678901:delivery-source:*"]
        }
        }
}
```

For `aws:SourceAccount`, specify the account IDs whose logs are delivered to this bucket. For `aws:SourceArn`, specify the delivery source ARNs in the following format: `arn:aws:logs:source-region:source-account-id:delivery-source:*`.

Amazon S3 object key format

For deliveries that use V2 permissions, the Amazon S3 object key is determined by the destination prefix, the log type, the delivery's suffix path, and whether Hive-compatible paths are enabled. The exact service-defined path and supported suffix variables vary by log type.

Destination prefix

An optional path that you append to the bucket ARN when you call PutDeliveryDestination. For example, `arn:aws:s3:::bucket-name/MyLogPrefix`. Delivered objects begin with this prefix. For log types that otherwise use a default `AWSLogs/source-account-id/service-name/` path, the destination prefix replaces that default path.

Suffix path

An optional path that you configure for an individual delivery in its S3DeliveryConfiguration. A suffix can contain static text and variables. To find the variables supported by a log type, call DescribeConfigurationTemplates and check `allowedSuffixPathFields`. If you don't specify a suffix path, the log type's default suffix path is used when one is available.

Hive-compatible path

When `enableHiveCompatiblePath` is `true`, variables in the effective path are rendered as `key=value`. For example, the default account segment `AWSLogs/source-account-id/` becomes `AWSLogs/aws-account-id=source-account-id/`. Hive-compatible formatting also applies when you omit `suffixPath` and the log type uses its default suffix.

The following examples show the beginning of an Application Load Balancer access-log object key for account `111122223333` in `us-east-1`. Unless noted, the examples assume no destination prefix.

Configuration	Beginning of the object key
Hive-compatible path disabled, suffix omitted	`AWSLogs/111122223333/elasticloadbalancing/us-east-1/2026/09/10/`
Hive-compatible path enabled, suffix omitted	`AWSLogs/aws-account-id=111122223333/elasticloadbalancing/region=us-east-1/year=2026/month=09/day=10/`
Hive-compatible path enabled, suffix `myFolder/{yyyy}/{MM}/{dd}`	`AWSLogs/aws-account-id=111122223333/elasticloadbalancing/myFolder/year=2026/month=09/day=10/`
Destination prefix `MyLogPrefix` , Hive-compatible path disabled, suffix omitted	`MyLogPrefix/us-east-1/2026/09/10/`

Note

CloudFront documents its standard logging (v2) path behavior and examples in Send logs to Amazon S3.

Note

Changing the destination prefix, suffix path, or Hive-compatible setting affects new objects only. Existing objects are not moved. The bucket policy must allow `s3:PutObject` for the resulting prefix. When you manage the bucket policy, keep the `aws:SourceAccount` and `aws:SourceArn` conditions shown in the Amazon S3 bucket policy in Amazon S3 bucket resource policy, and grant access only to the required prefix.

Logs sent to Firehose

For an AWS CLI example, see Create a delivery to Firehose.

User permissions

To enable sending logs to Firehose, you must be signed in with the following permissions.

JSON

```
{
    "Version":"2012-10-17",
    "Statement": [
        {
            "Sid": "ReadWriteAccessForLogDeliveryActions",
            "Effect": "Allow",
            "Action": [
                "logs:GetDelivery",
                "logs:GetDeliverySource",
                "logs:PutDeliveryDestination",
                "logs:GetDeliveryDestinationPolicy",
                "logs:DeleteDeliverySource",
                "logs:PutDeliveryDestinationPolicy",
                "logs:CreateDelivery",
                "logs:GetDeliveryDestination",
                "logs:PutDeliverySource",
                "logs:DeleteDeliveryDestination",
                "logs:DeleteDeliveryDestinationPolicy",
                "logs:DeleteDelivery",
                "logs:UpdateDeliveryConfiguration"
            ],
            "Resource": [
            "arn:aws:logs:us-east-1:111122223333:delivery:*",
    "arn:aws:logs:us-east-1:111122223333:delivery-source:*",
    "arn:aws:logs:us-east-1:111122223333:delivery-destination:*"
            ]
        },
        {
            "Sid": "ListAccessForLogDeliveryActions",
            "Effect": "Allow",
            "Action": [
                "logs:DescribeDeliveryDestinations",
                "logs:DescribeDeliverySources",
```

```
                "logs:DescribeDeliveries",
                "logs:DescribeConfigurationTemplates"
            ],
            "Resource": "*"
        },
        {
            "Sid": "AllowUpdatesToResourcePolicyFH",
            "Effect": "Allow",
            "Action": [
                "firehose:TagDeliveryStream"
            ],
            "Resource": [
            "arn:aws:firehose:us-east-1:111122223333:deliverystream/*"
            ]
        },
        {
            "Sid": "CreateServiceLinkedRole",
            "Effect": "Allow",
            "Action": [
                "iam:CreateServiceLinkedRole"
            ],
            "Resource": "arn:aws:iam::111122223333:role/aws-service-role/
delivery.logs.amazonaws.com/AWSServiceRoleForLogDelivery"
        }
    ]
}
```

IAM roles used for resource permissions

Because Firehose does not use resource policies, AWS uses IAM roles when setting up these logs to be sent to Firehose. AWS creates a service-linked role named **AWSServiceRoleForLogDelivery**. This service-linked role includes the following permissions.

JSON

```
{
    "Version":"2012-10-17",
    "Statement": [
        {
            "Action": [
                "firehose:PutRecord",
```

```
                "firehose:PutRecordBatch",
                "firehose:ListTagsForDeliveryStream"
            ],
            "Resource": "*",
            "Condition": {
                "StringEquals": {
                    "aws:ResourceTag/LogDeliveryEnabled": "true"
                }
            },
            "Effect": "Allow"
        }
    ]
}
```

This service-linked role grants permission for all Firehose delivery streams that have the `LogDeliveryEnabled` tag set to `true`. AWS gives this tag to the destination delivery stream when you set up the logging.

This service-linked role also has a trust policy that allows the `delivery.logs.amazonaws.com` service principal to assume the needed service-linked role. That trust policy is as follows:

JSON

```
{
  "Version":"2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Principal": {
        "Service": "delivery.logs.amazonaws.com"
      },
      "Action": "sts:AssumeRole"
    }
  ]
}
```

Traces sent to X-Ray

For an AWS CLI example, see Create a delivery to X-Ray.

User permissions

To enable sending traces to AWS X-Ray, you must be signed in with the following permissions.

JSON

```
{
    "Version":"2012-10-17",
    "Statement": [
        {
            "Sid": "ReadWriteAccessForLogDeliveryActions",
            "Effect": "Allow",
              "Action": [
                "logs:GetDelivery",
                "logs:GetDeliverySource",
                "logs:PutDeliveryDestination",
                "logs:GetDeliveryDestinationPolicy",
                "logs:DeleteDeliverySource",
                "logs:PutDeliveryDestinationPolicy",
                "logs:CreateDelivery",
                "logs:GetDeliveryDestination",
                "logs:PutDeliverySource",
                "logs:DeleteDeliveryDestination",
                "logs:DeleteDeliveryDestinationPolicy",
                "logs:DeleteDelivery",
                "logs:UpdateDeliveryConfiguration"
            ],
            "Resource": [
            "arn:aws:logs:us-east-1:111122223333:delivery:*",
            "arn:aws:logs:us-east-1:111122223333:delivery-source:*",
            "arn:aws:logs:us-east-1:111122223333:delivery-destination:*"
            ]
        },
        {
            "Sid": "ListAccessForLogDeliveryActions",
            "Effect": "Allow",
            "Action": [
                "logs:DescribeDeliveryDestinations",
                "logs:DescribeDeliverySources",
                "logs:DescribeDeliveries",
                "logs:DescribeConfigurationTemplates"
            ],
            "Resource": "*"
```

```
        },
        {
            "Sid": "AllowUpdatesToResourcePolicyXRay",
            "Effect": "Allow",
            "Action": [
                "xray:PutResourcePolicy",
                "xray:ListResourcePolicies",
                "xray:GetTraceSegmentDestination"
            ],
            "Resource": "*"
        }
    ]
}
```

X-Ray resource policy

The destination account where the traces are being sent must have a resource policy that includes certain permissions. When the user setting up the tracing has `xray:PutResourcePolicy` and `xray:ListResourcePolicies` permissions in the account, AWS automatically creates the resource policy when you begin sending traces to X-Ray. The policy that is created depends on the source service :

Amazon Bedrock AgentCore resources

AWS creates one resource policy per resource type. The policy uses wildcard patterns scoped to the account boundary, covering all resources of the same Amazon Bedrock AgentCore resource type in the account. For example, if a *Amazon Bedrock AgentCore Memory* resource is enabled for trace delivery, the policy covers all memory resources in that account — including any memory resources created in the future.

JSON

```
{
  "Version":"2012-10-17",
  "Statement": [
    {
      "Sid": "AWSLogDeliveryWrite",
      "Effect": "Allow",
      "Principal": {
        "Service": "delivery.logs.amazonaws.com"
      },
```

```
      "Action": "xray:PutTraceSegments",
      "Resource": "*",
      "Condition": {
        "StringEquals": {
          "aws:SourceAccount": "123456789012"
        },
        "ForAllValues:ArnLike": {
          "logs:LogGeneratingResourceArns": "arn:aws:bedrock-agentcore:us-
east-1:123456789012:memory/*"
        },
        "ArnLike": {
          "aws:SourceArn": "arn:aws:logs:us-east-1:123456789012:delivery-
source:*"
        }
      }
    }
  ]
}
```

Other AWS services

For other services that support trace delivery, AWS creates a resource policy scoped to the specific source resource.

JSON

```
{
  "Version":"2012-10-17",
  "Statement": [
    {
      "Sid": "AWSLogDeliveryWrite",
      "Effect": "Allow",
      "Principal": {
        "Service": "delivery.logs.amazonaws.com"
      },
      "Action": "xray:PutTraceSegments",
      "Resource": "*",
      "Condition": {
        "StringEquals": {
          "aws:SourceAccount": "123456789012"
        },
        "ForAllValues:ArnLike": {
          "logs:LogGeneratingResourceArns": "arn:aws:bedrock:us-
east-1:123456789012:knowledge-base/KnowledgeBaseId"
```

```
        },
        "ArnLike": {
          "aws:SourceArn": "arn:aws:logs:us-east-1:123456789012:delivery-
source:xray-test"
        }
      }
    }
  ]
}
```

Enable transaction search

To enable sending traces to X-Ray, you must enable transaction search.

Service-specific permissions

In addition to the destination-specific permissions listed in the previous sections, some services require explicit authorization that customers are allowed to send logs from their resources, as an additional layer of security. This policy authorizes the `AllowVendedLogDeliveryForResource` action for resources that vend logs within that service. For these services, use the following policy and replace the service namespace (*`service`*), the Region (*`region`*), the AWS account ID (*`account-id`*), and the resource type (*`resource-type`*) with the appropriate values for your resource. Not every service that vends logs uses this action. Confirm the required permissions and values, including whether the `AllowVendedLogDeliveryForResource` action applies, in the vended logs documentation for the service that you are granting access to. The following example shows the policy for vending logs from Amazon SES.

JSON

```
{
    "Version":"2012-10-17",
    "Statement": [
        {
            "Sid": "ServiceLevelAccessForLogDelivery",
            "Effect": "Allow",
            "Action": [
                "ses:AllowVendedLogDeliveryForResource"
            ],
            "Resource": "arn:aws:ses:us-east-1:123456789012:resource-type/*"
```

```
        }
    ]
}
```

Console-specific permissions

In addition to the permissions listed in the previous sections, if you are setting up log delivery using the console instead of the APIs, you also need the following additional permissions:

JSON

```
{
    "Version":"2012-10-17",
    "Statement": [
        {
            "Sid": "AllowLogDeliveryActionsConsoleCWL",
            "Effect": "Allow",
            "Action": [
                "logs:DescribeLogGroups",
                "logs:CreateLogGroup"
            ],
            "Resource": [
                "arn:aws:logs:us-east-1:111122223333:log-group:*"
            ]
        },
        {
            "Sid": "AllowLogDeliveryActionsConsoleS3",
            "Effect": "Allow",
            "Action": [
                "s3:ListAllMyBuckets",
                "s3:ListBucket",
                "s3:GetBucketLocation"
            ],
            "Resource": [
                "arn:aws:s3:::*"
            ]
        },
        {
            "Sid": "AllowLogDeliveryActionsConsoleFH",
            "Effect": "Allow",
            "Action": [
```

```
                "firehose:ListDeliveryStreams",
                "firehose:DescribeDeliveryStream"
            ],
            "Resource": [
                "*"
            ]
        }
    ]
}
```

Cross-account delivery example

In this example, two accounts are involved. The account with the log-generating resource is Account A, ID: *123456789012*, and the account with the log-consuming resource is Account B, ID: *111122223333*.

Account A wants to deliver logs from the Amazon Bedrock knowledge base in their account with the ARN arn:aws:bedrock:*us-east-1*:*123456789012*:knowledge-base/*kb-12345678*.

For this example, account A needs the following permissions:

JSON

```
{
    "Version":"2012-10-17",
    "Statement": [
        {
            "Sid": "AllowVendedLogDeliveryForKnowledgeBase",
            "Effect": "Allow",
            "Action": [
                "bedrock:AllowVendedLogDeliveryForResource"
            ],
            "Resource": "arn:aws:bedrock:us-east-1:123456789012:knowledge-
base/XXXXXXXXXX"
        },
        {
            "Sid": "CreateLogDeliveryPermissions",
            "Effect": "Allow",
            "Action": [
                "logs:PutDeliverySource",
                "logs:CreateDelivery"
```

```
            ],
            "Resource": [
            "arn:aws:logs:us-east-1:123456789012:delivery-source:*",
    "arn:aws:logs:us-east-1:123456789012:delivery:*",
    "arn:aws:logs:us-east-1:444455556666:delivery-destination:*"
            ]
        }
    ]
}
```

Create delivery source

To begin, account A creates a delivery source with their bedrock knowledge base:

```
aws logs put-delivery-source --name my-delivery-source --log-type APPLICATION_LOGS --
resource-arn arn:aws:bedrock:region:AAAAAAAAAAAA:knowledge-base/XXXXXXXXXX
```

Next, account B must create the delivery destination using one of the flows below:

- Configure delivery to an Amazon S3 bucket
- Configure delivery to a Firehose stream

Configure delivery to an Amazon S3 bucket

Account B wants to receive the logs into their S3 bucket with the ARN arn:aws:s3:::amzn-s3-demo-bucket For this example, account B will need the following permissions:

JSON

```
{
    "Version":"2012-10-17",
    "Statement": [
        {
            "Sid": "PutLogDestinationPermissions",
            "Effect": "Allow",
            "Action": [
                "logs:PutDeliveryDestination",
                "logs:PutDeliveryDestinationPolicy"
            ],
```

```
            "Resource": "arn:aws:logs:us-east-1:111122223333:delivery-
destination:*"
        }
    ]
}
```

The bucket will need the following permissions in its bucket policy:

JSON

```
{
    "Version":"2012-10-17",
    "Statement": [
        {
            "Sid": "AWSLogsDeliveryWrite",
            "Effect": "Allow",
            "Principal": {
                "Service": "delivery.logs.amazonaws.com"
            },
            "Action": [
                "s3:PutObject"
            ],
            "Resource": "arn:aws:s3:::amzn-s3-demo-bucket/AWSLogs/123456789012/
*",
            "Condition": {
                "StringEquals": {
                    "s3:x-amz-acl": "bucket-owner-full-control",
                    "aws:SourceAccount": [
                    "123456789012"
                    ]
                },
                "ArnLike": {
                    "aws:SourceArn": [
                    "arn:aws:logs:us-east-1:123456789012:delivery-source:my-
delivery-source"
                    ]
                }
            }
        }
    ]
}
```

If the bucket is encrypted with SSE-KMS, ensure the AWS KMS key policy has the appropriate permissions. For example, if the KMS key is `arn:aws:kms:us-east-1:111122223333:key/1234abcd-12ab-34cd-56ef-1234567890ab`, use the following:

JSON

```
{
    "Version":"2012-10-17",
    "Statement": [
        {
            "Sid": "AllowLogsGenerateDataKey",
            "Effect": "Allow",
            "Principal": {
                "Service": "delivery.logs.amazonaws.com"
            },
            "Action": [
                "kms:GenerateDataKey"
            ],
            "Resource": "arn:aws:kms:us-
east-1:111122223333:key/1234abcd-12ab-34cd-56ef-1234567890ab",
            "Condition": {
                "StringEquals": {
                    "aws:SourceAccount": [
                    "123456789012"
                    ]
                },
                "ArnLike": {
                    "aws:SourceArn": [
                    "arn:aws:logs:us-east-1:123456789012:delivery-source:my-
delivery-source"
                    ]
                }
            }
        }
    ]
}
```

Account B can then create a delivery destination with the S3 bucket as the destination resource:

```
aws logs put-delivery-destination --name my-s3-delivery-destination --delivery-
destination-configuration "destinationResourceArn=arn:aws:s3:::amzn-s3-demo-bucket"
```

Next, Account B creates a delivery destination policy on their newly created delivery destination, which will give permission for Account A to create a log delivery. The policy that will be added to the newly created delivery destination is the following:

JSON

```
    {
    "Version":"2012-10-17",
    "Statement": [
        {
            "Sid": "AllowCreateDelivery",
            "Effect": "Allow",
            "Principal": {
                "AWS": "123456789012"
            },
            "Action": [
                "logs:CreateDelivery"
            ],
            "Resource": "arn:aws:logs:us-east-1:111122223333:delivery-
destination:amzn-s3-demo-bucket"
        }
    ]
}
```

This policy will be saved in Account B's computer as `destination-policy-s3.json` To attach this resource, Account B will run the following command:

```
aws logs put-delivery-destination-policy --delivery-destination-name my-s3-delivery-
destination --delivery-destination-policy file://destination-policy-s3.json
```

Lastly, Account A creates the delivery, which links the delivery source in Account A to the delivery destination in Account B.

```
aws logs create-delivery --delivery-source-name my-delivery-source --delivery-
destination-arn arn:aws:logs:region:BBBBBBBBBBBB:delivery-destination:my-s3-delivery-
destination
```

Configure delivery to a Firehose stream

In this example, Account B wants to receive logs into their Firehose stream. The Firehose stream has the following ARN and is configured to use the DirectPut delivery stream type:

`arn:aws:firehose:us-east-1:111122223333:deliverystream/log-delivery-stream`

For this example, Account B needs the following permissions:

JSON

```
{
    "Version":"2012-10-17",
    "Statement": [
        {
            "Sid": "AllowFirehoseCreateSLR",
            "Effect": "Allow",
            "Action": [
                "iam:CreateServiceLinkedRole"
            ],
            "Resource": "arn:aws:iam::111122223333:role/aws-service-role/
delivery.logs.amazonaws.com/AWSServiceRoleForLogDelivery"
        },
        {
            "Sid": "AllowFirehoseTagging",
            "Effect": "Allow",
            "Action": [
                "firehose:TagDeliveryStream"
            ],
            "Resource": "arn:aws:firehose:us-
east-1:111122223333:deliverystream/X"
        },
        {
            "Sid": "AllowFirehoseDeliveryDestination",
            "Effect": "Allow",
            "Action": [
                "logs:PutDeliveryDestination",
```

```
                "logs:PutDeliveryDestinationPolicy"
            ],
            "Resource": "arn:aws:logs:us-east-1:111122223333:delivery-
destination:*"
        }
    ]
}
```

The Firehose stream must have the tag `LogDeliveryEnabled` set to `true`.

Account B will then create a delivery destination with the Firehose stream as the destination resource:

```
aws logs put-delivery-destination --name my-fh-delivery-destination --delivery-
destination-configuration
 "destinationResourceArn=arn:aws:firehose:region:BBBBBBBBBBBB:deliverystream/X"
```

Next, Account B creates a delivery destination policy on their newly created delivery destination, which will give permission for Account A to create a log delivery. The policy to be added to the newly created delivery destination is the following:

JSON

```
{
    "Version":"2012-10-17",
    "Statement": [
        {
            "Sid": "AllowCreateDelivery",
            "Effect": "Allow",
            "Principal": {
            "AWS": "123456789012"
            },
            "Action": [
                "logs:CreateDelivery"
            ],
            "Resource": "arn:aws:logs:us-east-1:111122223333:delivery-
destination:amzn-s3-demo-bucket"
        }
    ]
}
```

This policy will be saved in Account B's computer as `destination-policy-fh.json` To attach this resource, Account B runs the following command:

```
aws logs put-delivery-destination-policy --delivery-destination-name my-fh-delivery-destination --delivery-destination-policy file://destination-policy-fh.json
```

Lastly, Account A creates the delivery, which links the delivery source in Account A to the delivery destination in Account B.

```
aws logs create-delivery --delivery-source-name my-delivery-source --delivery-destination-arn arn:aws:logs:region:BBBBBBBBBBBB:delivery-destination:my-fh-delivery-destination
```

Cross-service confused deputy prevention

The confused deputy problem is a security issue where an entity that doesn't have permission to perform an action can coerce a more-privileged entity to perform the action. In AWS, cross-service impersonation can result in the confused deputy problem. Cross-service impersonation can occur when one service (the *calling service*) calls another service (the *called service*). The calling service can be manipulated to use its permissions to act on another customer's resources in a way it should not otherwise have permission to access. To prevent this, AWS provides tools that help you protect your data for all services with service principals that have been given access to resources in your account.

We recommend using the `aws:SourceArn`, `aws:SourceAccount`, `aws:SourceOrgID`, and `aws:SourceOrgPaths` global condition context keys in resource policies to limit the permissions that CloudWatch Logs gives another service to the resource. Use `aws:SourceArn` to associate only one resource with cross-service access. Use `aws:SourceAccount` to let any resource in that account be associated with the cross-service use. Use `aws:SourceOrgID` to allow any resource from any account within an organization be associated with the cross-service use. Use `aws:SourceOrgPaths` to associate any resource from accounts within an AWS Organizations path with the cross-service use. For more information about using and understanding paths, see Understand the AWS Organizations entity path.

The most effective way to protect against the confused deputy problem is to use the `aws:SourceArn` global condition context key with the full ARN of the resource. If you don't know the full ARN of the resource or if you are specifying multiple resources, use the `aws:SourceArn`

global context condition key with wildcard characters (*) for the unknown portions of the ARN. For example, `arn:aws:servicename:*:123456789012:*`.

If the `aws:SourceArn` value does not contain the account ID, such as an Amazon S3 bucket ARN, you must use both `aws:SourceAccount` and `aws:SourceArn` to limit permissions.

To protect against the confused deputy problem at scale, use the `aws:SourceOrgID` or `aws:SourceOrgPaths` global condition context key with the organization ID or organization path of the resource in your resource-based policies. Policies that include the `aws:SourceOrgID` or `aws:SourceOrgPaths` key will automatically include the correct accounts and you don't have to manually update the policies when you add, remove, or move accounts in your organization.

The policies documented for granting access to CloudWatch Logs to write data to Kinesis Data Streams and Firehose in Step 1: Create a destination and Step 2: Create a destination show how you can use the `aws:SourceArn` global condition context key to help prevent the confused deputy problem.

Automate log enablement with telemetry enablement rules

You can use telemetry enablement rules to automatically configure log collection for your AWS resources. Rules help you standardize log collection across your organization or accounts and ensure consistent monitoring coverage.

Enablement rules let you:

- Automatically enable logging for new and existing resources that match your rule scope
- Apply rules at the organization, organizational unit (OU), or individual account level
- Filter which resources a rule affects using tags

Enablement rules currently support the following AWS telemetry sources: Amazon VPC Flow Logs, AWS WAF Logs, Route 53 Resolver Query Logs, NLB Access Logs, Amazon EKS Control Plane Logs, CloudTrail Data and Management Events, Amazon Bedrock AgentCore Logs, Amazon EC2 Detailed Metrics, AWS Security Hub, Amazon Bedrock AgentCore Gateway, Amazon Bedrock AgentCore Memory, and CloudFront Distribution.

For complete details on enablement rules including rule behavior, managing rules, troubleshooting, and service-specific considerations, see Telemetry enablement rules in the *Amazon CloudWatch User Guide*.

Rule evaluation hierarchy

Enablement rules are evaluated hierarchically: organizational rules first, then OU-level rules, then account-level rules. Rules at higher levels provide the baseline telemetry. Lower-level rules can add additional telemetry but cannot reduce it. If conflicting rules exist at the same scope, none are applied until the conflict is resolved.

Creating an enablement rule

To create a telemetry enablement rule

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Telemetry config**.
3. Choose the **Enablement rules** tab.
4. Choose **Add rule**.
5. Specify the rule name, scope (organization, OU, or account), data source, and telemetry type.
6. Optionally add tags to filter which resources the rule affects.
7. Choose **Create rule**.

Enable logging from third-party sources

CloudWatch Logs supports ingesting logs from third-party sources through direct API integrations and Amazon S3 bucket integrations. You can also receive additional third-party security findings through AWS Security Hub CSPM.

Direct third-party integrations

CloudWatch Logs provides direct integrations with the following third-party sources. These integrations use either direct API connections or Amazon S3 bucket integrations to ingest logs into CloudWatch Logs:

- CrowdStrike Falcon
- Microsoft Office 365
- Okta Auth0
- Microsoft Entra ID
- Palo Alto Networks NGFW
- Microsoft Windows Events
- Wiz
- Zscaler Internet Access
- Okta SSO
- SentinelOne Endpoint Security
- GitHub Audit Logs
- ServiceNow CMDB
- Cisco Umbrella

For setup instructions, see the third-party integration setup guide in the *Amazon CloudWatch User Guide*.

Additional sources via AWS Security Hub CSPM

In addition to the direct integrations, third-party security partners send findings to AWS Security Hub CSPM, which are then available as data sources in CloudWatch Logs. The following table lists the Security Hub CSPM partner integrations and their integration type.

To enable Security Hub CSPM findings as a data source in CloudWatch Logs, create a telemetry enablement rule for AWS Security Hub in the CloudWatch console. The enablement rule configures CloudWatch to automatically ingest findings from Security Hub CSPM into a managed log group. For step-by-step instructions, see Telemetry enablement rules in the *Amazon CloudWatch User Guide*.

Partner	Integration
3CORESec – NTA	Sends findings via Security Hub CSPM
Alert Logic – SIEMless Threat Management	Sends findings via Security Hub CSPM
Aqua Security – Cloud Native Security Platform	Sends findings via Security Hub CSPM
Aqua Security – Kube-bench	Sends findings via Security Hub CSPM
Armor – Armor Anywhere	Sends findings via Security Hub CSPM
AttackIQ	Sends findings via Security Hub CSPM
Barracuda Networks – Cloud Security Guardian	Sends findings via Security Hub CSPM
BigID – BigID Enterprise	Sends findings via Security Hub CSPM
Blue Hexagon	Sends findings via Security Hub CSPM
Check Point – CloudGuard IaaS	Sends findings via Security Hub CSPM

Partner	Integration
Check Point – CloudGuard Posture Management	Sends findings via Security Hub CSPM
Claroty – xDome	Sends findings via Security Hub CSPM
Cloud Storage Security – Antivirus for Amazon S3	Sends findings via Security Hub CSPM
Contrast Security – Contrast Assess	Sends findings via Security Hub CSPM
CrowdStrike – CrowdStrike Falcon	Sends findings via Security Hub CSPM
CyberArk – Privileged Threat Analytics	Sends findings via Security Hub CSPM
Data Theorem	Sends findings via Security Hub CSPM
Drata	Sends findings via Security Hub CSPM
Forcepoint – CASB	Sends findings via Security Hub CSPM
Forcepoint – Cloud Security Gateway	Sends findings via Security Hub CSPM
Forcepoint – DLP	Sends findings via Security Hub CSPM
Forcepoint – NGFW	Sends findings via Security Hub CSPM
Fugue	Sends findings via Security Hub CSPM

Partner	Integration
Guardicore – Centra	Sends findings via Security Hub CSPM
HackerOne – Vulnerability Intelligence	Sends findings via Security Hub CSPM
JFrog – Xray	Sends findings via Security Hub CSPM
Juniper Networks – vSRX Next Generation Firewall	Sends findings via Security Hub CSPM
k9 Security – Access Analyzer	Sends findings via Security Hub CSPM
Lacework	Sends findings via Security Hub CSPM
McAfee – MVISION CNAPP	Sends findings via Security Hub CSPM
NETSCOUT – Cyber Investigator	Sends findings via Security Hub CSPM
Orca – Cloud Security Platform	Sends findings via Security Hub CSPM
Palo Alto Networks – Prisma Cloud Compute	Sends findings via Security Hub CSPM
Palo Alto Networks – Prisma Cloud Enterprise	Sends findings via Security Hub CSPM
Plerion – Cloud Security Platform	Sends findings via Security Hub CSPM
Prowler	Sends findings via Security Hub CSPM

Partner	Integration
Qualys – Vulnerability Management	Sends findings via Security Hub CSPM
Rapid7 – InsightVM	Sends findings via Security Hub CSPM
SentinelOne	Sends findings via Security Hub CSPM
Snyk	Sends findings via Security Hub CSPM
Sonrai Security – Sonrai Dig	Sends findings via Security Hub CSPM
Sophos – Server Protection	Sends findings via Security Hub CSPM
StackRox – Kubernetes Security	Sends findings via Security Hub CSPM
Sumo Logic – Machine Data Analytics	Sends findings via Security Hub CSPM
Symantec – Cloud Workload Protection	Sends findings via Security Hub CSPM
Tenable.io	Sends findings via Security Hub CSPM
Trend Micro – Cloud One	Sends findings via Security Hub CSPM
Vectra – Cognito Detect	Sends findings via Security Hub CSPM
Wiz	Sends findings via Security Hub CSPM

Partner	Integration
Caveonix – Caveonix Cloud	Sends and receives findings via Security Hub CSPM
Cloud Custodian	Sends and receives findings via Security Hub CSPM
DisruptOps	Sends and receives findings via Security Hub CSPM
Kion	Sends and receives findings via Security Hub CSPM
Turbot	Sends and receives findings via Security Hub CSPM

Note

This list reflects the Security Hub partner integrations that send findings at the time of writing. Because AWS Security Hub regularly adds new partner integrations, refer to Third-party product integrations with Security Hub CSPM in the *AWS Security Hub User Guide* for the most up-to-date list of available partners.

Exporting log data to Amazon S3

This chapter provides you with information, so you can export log data from your log groups to an Amazon S3 bucket for custom processing and analysis, or to load onto other systems. You can export to an S3 bucket in the same account or a different account.

You can do the following:

- Export log data to S3 buckets that are encrypted by SSE-KMS in AWS Key Management Service (AWS KMS)
- Export log data to S3 buckets that have S3 Object Lock enabled with a retention period

We recommend that you don't regularly export to Amazon S3 as a way to continuously archive your logs. For that use case, we instead recommend that you use subscriptions. For more information about subscriptions, see Real-time processing of log data with subscriptions.

To begin the export process, you must create an S3 bucket to store the exported log data. You can store the exported files in your S3 bucket and define Amazon S3 lifecycle rules to archive or delete exported files automatically.

You can export to S3 buckets that are encrypted with AES-256 or with SSE-KMS. Exporting to buckets encrypted with DSSE-KMS is not supported.

You can export logs from multiple log groups or multiple time ranges to the same S3 bucket. To organize exported data, specify a prefix for each export task which will be used as the Amazon S3 key prefix for all exported objects. For example `prod/app-logs/2026-01-03/` or `log-group-name/backup/`

Note

Time-based sorting on chunks of log data inside an exported file is not guaranteed. You can sort the exported log field data by using Linux utilities. For example, the following utility command sorts the events in all `.gz` files in a single folder.

```
find . -exec zcat {} + | sed -r 's/^[0-9]+/\x0&/' | sort -z
```

The following utility command sorts .gz files from multiple subfolders.

```
find ./*/ -type f -exec zcat {} + | sed -r 's/^[0-9]+/\x0&/' | sort -z
```

Additionally, you can use another `stdout` command to pipe the sorted output to another file to save it.

Log data can take up to 12 hours to become available for export. Export tasks time out after 24 hours. If your export tasks are timing out, reduce the time range when you create the export task.

For near real-time analysis of log data, see Analyzing log data with CloudWatch Logs Insights or Real-time processing of log data with subscriptions instead.

Contents

Concepts

Before you begin, become familiar with the following export concepts:

log group name

The name of the log group associated with an export task. The log data in this log group will be exported to the specified S3 bucket.

from (timestamp)

A required timestamp expressed as the number of milliseconds since Jan 1, 1970 00:00:00 UTC. All log events in the log group that were ingested on or after this time will be exported.

to (timestamp)

A required timestamp expressed as the number of milliseconds since Jan 1, 1970 00:00:00 UTC. All log events in the log group that were ingested before this time will be exported.

destination bucket

The name of the S3 bucket associated with an export task. This bucket is used to export the log data from the specified log group.

destination prefix

An optional attribute that is used as the Amazon S3 key prefix for all exported objects. This helps create a folder-like organization in your bucket.

Export log data to Amazon S3 using the console

In the following examples, you use the Amazon CloudWatch console to export all data from an Amazon CloudWatch Logs log group named `my-log-group` to an Amazon S3 bucket named `amzn-s3-demo-bucket`.

Exporting log data to S3 buckets that are encrypted by SSE-KMS is supported. Exporting to buckets encrypted with DSSE-KMS is not supported.

The details of how you set up the export depends on whether the Amazon S3 bucket that you want to export to is in the same account as your logs that are being exported, or in a different account.

Topics

Same-account export (console)

If the Amazon S3 bucket is in the same account as the logs that are being exported, use the instructions in this section.

Topics

Create an Amazon S3 bucket (console)

We recommend that you use a bucket that was created specifically for CloudWatch Logs. However, if you want to use an existing bucket, you can skip to step 2.

> **Note**
>
> The Amazon S3 bucket must reside in the same Region as the log data to export. CloudWatch Logs doesn't support exporting data to Amazon S3 buckets in a different Region.

To create an Amazon S3 bucket

1. Open the Amazon S3 console at https://console.aws.amazon.com/s3/.
2. If necessary, change the Region. From the navigation bar, choose the Region where your CloudWatch Logs reside.
3. Choose **Create Bucket**.
4. For **Bucket Name**, enter a name for the bucket.
5. For **Region**, select the Region where your CloudWatch Logs data resides.
6. Choose **Create**.

Set up access permissions (console)

To create the export task, you'll need to be signed on with the `AmazonS3ReadOnlyAccess` IAM role and with the following permissions:

- `logs:CreateExportTask`
- `logs:CancelExportTask`
- `logs:DescribeExportTasks`
- `logs:DescribeLogStreams`
- `logs:DescribeLogGroups`

To provide access, add permissions to your users, groups, or roles:

- Users and groups in AWS IAM Identity Center:

Create a permission set. Follow the instructions in Create a permission set in the *AWS IAM Identity Center User Guide*.

- Users managed in IAM through an identity provider:

  Create a role for identity federation. Follow the instructions in Create a role for a third-party identity provider (federation) in the *IAM User Guide*.

- IAM users:
  - Create a role that your user can assume. Follow the instructions in Create a role for an IAM user in the *IAM User Guide*.
  - (Not recommended) Attach a policy directly to a user or add a user to a user group. Follow the instructions in Adding permissions to a user (console) in the *IAM User Guide*.

Set permissions on an Amazon S3 bucket (console)

By default, all Amazon S3 buckets and objects are private. Only the resource owner, the AWS account that created the bucket, can access the bucket and any objects that it contains. However, the resource owner can choose to grant access permissions to other resources and users by writing an access policy.

When you set the policy, we recommend that you include a randomly generated string as the prefix for the bucket, so that only intended log streams are exported to the bucket.

> **Important**
>
> To make exports to Amazon S3 buckets more secure, we now require you to specify the list of source accounts that are allowed to export log data to your S3 bucket.
> In the following example, the list of account IDs in the `aws:SourceAccount` key would be the accounts from which a user can export log data to your Amazon S3 bucket. The `aws:SourceArn` key would be the resource for which the action is being taken. You may restrict this to a specific log group, or use a wildcard as shown in this example.
> We recommend that you also include the account ID of the account where the S3 bucket is created, to allow export within the same account.

To set permissions on an Amazon S3 bucket

1. In the Amazon S3 console, choose the bucket that you created.

2. Choose **Permissions**, **Bucket policy**.
3. In the **Bucket Policy Editor**, add the following policy. Change `amzn-s3-demo-bucket` to the name of your S3 bucket. Be sure to specify the correct Region endpoint, such as `us-west-1`, for **Principal**.

   JSON

```
{
    "Version":"2012-10-17",
    "Statement": [
      {
          "Sid": "AllowCloudWatchLogsGetBucketAcl",
          "Action": "s3:GetBucketAcl",
          "Effect": "Allow",
          "Resource": "arn:aws:s3:::amzn-s3-demo-bucket",
          "Principal": { "Service": "logs.us-east-1.amazonaws.com" },
          "Condition": {
            "StringEquals": {
                "aws:SourceAccount": [
                    "123456789012",
                    "111122223333"
                ]
            },
            "ArnLike": {
                    "aws:SourceArn": [
                        "arn:aws:logs:us-east-1:123456789012:log-group:*",
                        "arn:aws:logs:us-east-1:111122223333:log-group:*"
                    ]
            }
          }
      },
      {
          "Sid": "AllowCloudWatchLogsPutObject",
          "Action": "s3:PutObject",
          "Effect": "Allow",
          "Resource": "arn:aws:s3:::amzn-s3-demo-bucket/*",
          "Principal": { "Service": "logs.us-east-1.amazonaws.com" },
          "Condition": {
            "StringEquals": {
                "s3:x-amz-acl": "bucket-owner-full-control",
                "aws:SourceAccount": [
```

```
                    "123456789012",
                    "111122223333"
                ]
            },
            "ArnLike": {
                    "aws:SourceArn": [
                        "arn:aws:logs:us-east-1:123456789012:log-group:*",
                        "arn:aws:logs:us-east-1:111122223333:log-group:*"
                    ]
            }
          }
      }
    ]
}
```

4. Choose **Save** to set the policy that you just added as the access policy on your bucket. This policy enables CloudWatch Logs to export log data to your Amazon S3 bucket. The bucket owner has full permissions on all of the exported objects.

> **Warning**
>
> If the existing bucket already has one or more policies attached to it, add the statements for CloudWatch Logs access to that policy or policies. We recommend that you evaluate the resulting set of permissions to be sure that they're appropriate for the users who will access the bucket.

(Optional) Exporting to a destination Amazon S3 bucket encrypted with SSE-KMS (console)

This step is necessary only if you are exporting to an Amazon S3 bucket that uses server-side encryption with AWS KMS keys. This encryption is known as SSE-KMS.

To export to a bucket encrypted with SSE-KMS

1. Open the AWS KMS console at https://console.aws.amazon.com/kms.
2. To change the AWS Region, use the Region selector in the upper-right corner of the page.
3. In the left navigation bar, choose **Customer managed keys**.

Choose **Create Key**.

4. For **Key type**, choose **Symmetric**.
5. For **Key usage**, choose **Encrypt and decrypt** and then choose **Next**.
6. Under **Add labels**, enter an alias for the key and optionally add a description or tags. Then choose **Next**.
7. Under **Key administrators**, select who can administer this key, and then choose **Next**.
8. Under **Define key usage permissions**, make no changes and choose **Next**.
9. Review the settings and choose **Finish**.
10. Back at the **Customer managed keys** page, choose the name of the key that you just created.
11. Choose the **Key policy** tab and choose **Switch to policy view**.
12. In the **Key policy** section, choose **Edit**.
13. Add the following statement to the key policy statement list. When you do, replace *Region* with the Region of your logs and replace *account-ARN* with the ARN of the account that owns the KMS key.

    JSON

```
{
    "Version":"2012-10-17",
    "Statement": [
        {
            "Sid": "Allow CWL Service Principal usage",
            "Effect": "Allow",
            "Principal": {
                "Service": "logs.Region.amazonaws.com"
            },
            "Action": [
                "kms:GenerateDataKey",
                "kms:Decrypt"
            ],
            "Resource": "*"
        },
        {
            "Sid": "Enable IAM User Permissions",
            "Effect": "Allow",
            "Principal": {
                "AWS": "account-ARN"
```

```
            },
            "Action": [
                "kms:GetKeyPolicy*",
                "kms:PutKeyPolicy*",
                "kms:DescribeKey*",
                "kms:CreateAlias*",
                "kms:ScheduleKeyDeletion*",
                "kms:Decrypt"
            ],
            "Resource": "*"
        }
    ]
}
```

14. Choose **Save changes**.
15. Open the Amazon S3 console at https://console.aws.amazon.com/s3/.
16. Find the bucket that you created in Create an S3 bucket (CLI) and choose the bucket name.
17. Choose the **Properties** tab. Then, under **Default Encryption**, choose **Edit**.
18. Under **Server-side Encryption**, choose **Enable**.
19. Under **Encryption type**, choose **AWS Key Management Service key (SSE-KMS)**.
20. Choose **Choose from your AWS KMS keys** and find the key that you created.
21. For **Bucket key**, choose **Enable**.
22. Choose **Save changes**.

Create an export task (console)

In this procedure, you create the export task for exporting logs from a log group.

To export data to Amazon S3 using the CloudWatch console

1. Sign in with sufficient permissions as documented in Set up access permissions (console).
2. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
3. In the navigation pane, choose **Log groups**.
4. On the **Log Groups** screen, choose the name of the log group.
5. Choose **Actions**, **Export data to Amazon S3**.
6. On the **Export data to Amazon S3** screen, under **Define data export**, set the time range for the data to export using **From** and **To**.

7. If your log group has multiple log streams, you can provide a log stream prefix to limit the log group data to a specific stream. Choose **Advanced**, and then for **Stream prefix**, enter the log stream prefix.
8. Under **Choose S3 bucket**, choose the account associated with the S3 bucket.
9. For **S3 bucket name**, choose an &S3; bucket.
10. For **S3 Bucket prefix**, enter the randomly generated string that you specified in the bucket policy.
11. Choose **Export** to export your log data to Amazon S3.
12. To view the status of the log data that you exported to Amazon S3, choose **Actions** and then **View all exports to Amazon S3**.

Cross-account export (console)

If the Amazon S3 bucket is in a different account than the logs that are being exported, use the instructions in this section.

Topics

Create an Amazon S3 bucket for cross-account export (console)

We recommend that you use a bucket that was created specifically for CloudWatch Logs. However, if you want to use an existing bucket, you can skip this procedure.

> **Note**
>
> The Amazon S3 bucket must reside in the same Region as the log data to export. CloudWatch Logs doesn't support exporting data to Amazon S3 buckets in a different Region.

To create an Amazon S3 bucket

1. Open the Amazon S3 console at https://console.aws.amazon.com/s3/.
2. If necessary, change the Region. From the navigation bar, choose the Region where your CloudWatch Logs reside.
3. Choose **Create Bucket**.
4. For **Bucket Name**, enter a name for the bucket.
5. For **Region**, select the Region where your CloudWatch Logs data resides.
6. Choose **Create**.

Set up access permissions for cross-account export (console)

First, you must create a new IAM policy to enable CloudWatch Logs to have the `s3:PutObject` action for the destination Amazon S3 bucket in the destination account.

Along with `s3:PutObject` action, additional actions included in the policy depend on whether the destination bucket uses AWS KMS encryption or has ACLs enabled using the S3 Object Ownership setting.

- If using KMS encryption, add the `kms:GenerateDataKey` and `kms:Decrypt` actions for the key resource
- If ACLs are enabled on the bucket add the `s3:PutObjectAcl` action for the bucket resource

Change `amzn-s3-demo-bucket` to the name of your destination S3 bucket in the following policies.

To create an IAM policy to export logs to an Amazon S3 bucket

1. Open the IAM console at https://console.aws.amazon.com/iam/.
2. In the navigation pane on the left, choose **Policies**.
3. Choose **Create policy**.
4. In the **Policy editor** section, choose **JSON**.
5. If the destination bucket does not use AWS KMS encryption, paste the following policy into the editor.

JSON

```
{
    "Version":"2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": "s3:PutObject",
            "Resource": "arn:aws:s3:::amzn-s3-demo-bucket/*"
        }
    ]
}
```

If the destination bucket does use AWS KMS encryption, paste the following policy into the editor.

JSON

```
{
  "Version":"2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Action": "s3:PutObject",
      "Resource": "arn:aws:s3:::amzn-s3-demo-bucket/*"
    },
    {
      "Effect": "Allow",
      "Action": [
        "kms:GenerateDataKey",
        "kms:Decrypt"
      ],
      "Resource": "arn:aws:kms:us-
east-1:123456789012:key/1234abcd-12ab-34cd-56ef-1234567890ab"
    }
  ]
}
```

If the ACLs are enabled on destination bucket then add s3:PutObjectAcl to s3:PutObject Action block in the above policies.

JSON

```
{
    "Version":"2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": [
               "s3:PutObject",
               "s3:PutObjectAcl"
            ],
            "Resource": "arn:aws:s3:::amzn-s3-demo-bucket/*"
        }
    ]
}
```

6. Choose **Next**.
7. Enter a policy name. You will use this name to attach the policy to your IAM role.
8. Choose **Create policy** to save the new policy.

To create an export task, you must be signed in with a IAM role that has the `AmazonS3ReadOnlyAccess` managed policy attached, the IAM policy created above, and also with the following permissions:

- `logs:CreateExportTask`
- `logs:CancelExportTask`
- `logs:DescribeExportTasks`
- `logs:DescribeLogStreams`
- `logs:DescribeLogGroups`

To provide access, add permissions to your users, groups, or roles:

- Users and groups in AWS IAM Identity Center:

Create a permission set. Follow the instructions in Create a permission set in the *AWS IAM Identity Center User Guide*.

- Users managed in IAM through an identity provider:

  Create a role for identity federation. Follow the instructions in Create a role for a third-party identity provider (federation) in the *IAM User Guide*.

- IAM users:
  - Create a role that your user can assume. Follow the instructions in Create a role for an IAM user in the *IAM User Guide*.
  - (Not recommended) Attach a policy directly to a user or add a user to a user group. Follow the instructions in Adding permissions to a user (console) in the *IAM User Guide*.

Set permissions on an S3 bucket for cross-account export (console)

By default, all S3 buckets and objects are private. Only the resource owner, the AWS account that created the bucket, can access the bucket and any objects that it contains. However, the resource owner can choose to grant access permissions to other resources and users by writing an access policy.

When you set the policy, we recommend that you include a randomly generated string as the prefix for the bucket, so that only intended log streams are exported to the bucket.

> **Important**
>
> To make exports to S3 buckets more secure, we now require you to specify the list of source accounts that are allowed to export log data to your S3 bucket.
> In the following example, the list of account IDs in the `aws:SourceAccount` key would be the accounts from which a user can export log data to your S3 bucket. The `aws:SourceArn` key would be the resource for which the action is being taken. You may restrict this to a specific log group, or use a wildcard as shown in this example.
> We recommend that you also include the account ID of the account where the S3 bucket is created, to allow export within the same account.

To set permissions on an Amazon S3 bucket

1. In the Amazon S3 console, choose the bucket that you created.

2. Choose **Permissions**, **Bucket policy**.
3. In the **Bucket Policy Editor**, add the following policy. Change `amzn-s3-demo-bucket` to the name of your S3 bucket. Be sure to specify the correct Region endpoint, such as `us-east-1`, for **Principal**.

   JSON

```
{
    "Version":"2012-10-17",
    "Statement": [
      {
          "Action": "s3:GetBucketAcl",
          "Effect": "Allow",
          "Resource": "arn:aws:s3:::amzn-s3-demo-bucket",
          "Principal": { "Service": "logs.us-east-1.amazonaws.com" },
          "Condition": {
            "StringEquals": {
                "aws:SourceAccount": [
                    "123456789012",
                    "111122223333"
                ]
            },
            "ArnLike": {
                    "aws:SourceArn": [
                        "arn:aws:logs:us-east-1:123456789012:log-group:*",
                        "arn:aws:logs:us-east-1:111122223333:log-group:*"
                    ]
            }
          }
      },
      {
          "Action": "s3:PutObject",
          "Effect": "Allow",
          "Resource": "arn:aws:s3:::amzn-s3-demo-bucket/*",
          "Principal": { "Service": "logs.us-east-1.amazonaws.com" },
          "Condition": {
            "StringEquals": {
                "s3:x-amz-acl": "bucket-owner-full-control",
                "aws:SourceAccount": [
                    "123456789012",
                    "111122223333"
```

```
                ]
            },
            "ArnLike": {
                    "aws:SourceArn": [
                        "arn:aws:logs:us-east-1:123456789012:log-group:*",
                        "arn:aws:logs:us-east-1:111122223333:log-group:*"
                    ]
            }
        }
      },
      {
          "Effect": "Allow",
          "Principal": {
            "AWS": "arn:aws:iam::111122223333:role/role_name"
          },
          "Action": "s3:PutObject",
          "Resource": "arn:aws:s3:::amzn-s3-demo-bucket/*",
          "Condition": {
            "StringEquals": {
                "s3:x-amz-acl": "bucket-owner-full-control"
            }
          }
       }
    ]
}
```

4. Choose **Save** to set the policy that you just added as the access policy on your bucket. This policy enables CloudWatch Logs to export log data to your S3 bucket. The bucket owner has full permissions on all of the exported objects.

> **Warning**
>
> If the existing bucket already has one or more policies attached to it, add the statements for CloudWatch Logs access to that policy or policies. We recommend that you evaluate the resulting set of permissions to be sure that they're appropriate for the users who will access the bucket.

(Optional) Exporting to a destination Amazon S3 bucket encrypted with SSE-KMS for cross-account export (console)

This procedure is necessary only if you are exporting to an S3 bucket that uses server-side encryption with AWS KMS keys. This encryption is known as SSE-KMS.

To export to a bucket encrypted with SSE-KMS

1. Open the AWS KMS console at https://console.aws.amazon.com/kms.
2. To change the AWS Region, use the Region selector in the upper-right corner of the page.
3. In the left navigation bar, choose **Customer managed keys**.

   Choose **Create Key**.
4. For **Key type**, choose **Symmetric**.
5. For **Key usage**, choose **Encrypt and decrypt** and then choose **Next**.
6. Under **Add labels**, enter an alias for the key and optionally add a description or tags. Then choose **Next**.
7. Under **Key administrators**, select who can administer this key, and then choose **Next**.
8. Under **Define key usage permissions**, make no changes and choose **Next**.
9. Review the settings and choose **Finish**.
10. Back at the **Customer managed keys** page, choose the name of the key that you just created.
11. Choose the **Key policy** tab and choose **Switch to policy view**.
12. In the **Key policy** section, choose **Edit**.
13. Add the following statement to the key policy statement list. When you do, replace *us-east-1* with the Region of your logs, *account-ARN* with the ARN of the account that owns the KMS key, *123456789012* with the account number that owns the KMS key,*key_id* with the kms-key Id and *role_name* with the role used for creating export task.

    JSON

```
{
    "Version":"2012-10-17",
    "Statement": [
        {
            "Sid": "Allow CWL Service Principal usage",
            "Effect": "Allow",
```

```
            "Principal": {
            "Service": "logs.us-east-1.amazonaws.com"
            },
            "Action": [
                "kms:GenerateDataKey",
                "kms:Decrypt"
            ],
            "Resource": "*"
        },
        {
            "Sid": "Enable IAM User Permissions",
            "Effect": "Allow",
            "Principal": {
                "AWS": "account-ARN"
            },
            "Action": [
                "kms:GetKeyPolicy*",
                "kms:PutKeyPolicy*",
                "kms:DescribeKey*",
                "kms:CreateAlias*",
                "kms:ScheduleKeyDeletion*",
                "kms:Decrypt"
            ],
            "Resource": "*"
        },
        {
            "Sid": "Enable IAM Role Permissions",
            "Effect": "Allow",
            "Principal": {
                "AWS": "arn:aws:iam::111122223333:role/role_name"
            },
            "Action": [
                "kms:GenerateDataKey",
                "kms:Decrypt"
            ],
            "Resource": "arn:aws:kms:us-east-1:123456789012:key/key-id"
        }
    ]
}
```

14. Choose **Save changes**.
15. Open the Amazon S3 console at https://console.aws.amazon.com/s3/.
16. Find the bucket that you created in Create an S3 bucket (CLI) and choose the bucket name.

17. Choose the **Properties** tab. Then, under **Default Encryption**, choose **Edit**.
18. Under **Server-side Encryption**, choose **Enable**.
19. Under **Encryption type**, choose **AWS Key Management Service key (SSE-KMS)**.
20. Choose **Choose from your AWS KMS keys** and find the key that you created.
21. For **Bucket key**, choose **Enable**.
22. Choose **Save changes**.

Create an export task for cross-account export (console)

In this procedure, you create the export task for exporting logs from a log group.

To export data to Amazon S3 using the CloudWatch console

1. Sign in with sufficient permissions as documented in Set up access permissions (console).
2. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
3. In the navigation pane, choose **Log groups**.
4. On the **Log Groups** screen, choose the name of the log group.
5. Choose **Actions**, **Export data to Amazon S3**.
6. On the **Export data to Amazon S3** screen, under **Define data export**, set the time range for the data to export using **From** and **To**.
7. If your log group has multiple log streams, you can provide a log stream prefix to limit the log group data to a specific stream. Choose **Advanced**, and then for **Stream prefix**, enter the log stream prefix.
8. Under **Choose S3 bucket**, choose the account associated with the S3 bucket.
9. For **S3 bucket name**, choose an S3 bucket.
10. For **S3 Bucket prefix**, enter the randomly generated string that you specified in the bucket policy.
11. Choose **Export** to export your log data to Amazon S3.
12. To view the status of the log data that you exported to Amazon S3, choose **Actions** and then **View all exports to Amazon S3**.

Export log data to Amazon S3 using the AWS CLI

In the following example, you use an export task to export all data from a CloudWatch Logs log group named `my-log-group` to an Amazon S3 bucket named `amzn-s3-demo-bucket`. This example assumes that you have already created a log group called `my-log-group`.

Exporting log data to S3 buckets that are encrypted by AWS KMS is supported. Exporting to buckets encrypted with DSSE-KMS is not supported.

The details of how you set up the export depends on whether the Amazon S3 bucket that you want to export to is in the same account as your logs that are being exported, or in a different account.

Topics

Same-account export (CLI)

If the Amazon S3 bucket is in the same account as the logs that are being exported, use the instructions in this section.

Topics

Create an S3 bucket (CLI)

We recommend that you use a bucket that was created specifically for CloudWatch Logs. However, if you want to use an existing bucket, you can skip this procedure.

> **Note**
>
> The S3 bucket must reside in the same Region as the log data to export. CloudWatch Logs doesn't support exporting data to S3 buckets in a different Region.

To create an S3 bucket using the AWS CLI

At a command prompt, run the following create-bucket command, where `LocationConstraint` is the Region where you are exporting log data.

```
aws s3api create-bucket --bucket amzn-s3-demo-bucket --create-bucket-configuration
 LocationConstraint=us-east-2
```

The following is example output.

```
{
    "Location": "/amzn-s3-demo-bucket"
}
```

Set up access permissions (CLI)

To create the export task later, you'll need to be signed on with the `AmazonS3ReadOnlyAccess` IAM role and with the following permissions:

- `logs:CreateExportTask`
- `logs:CancelExportTask`
- `logs:DescribeExportTasks`
- `logs:DescribeLogStreams`
- `logs:DescribeLogGroups`

To provide access, add permissions to your users, groups, or roles:

- Users and groups in AWS IAM Identity Center:

  Create a permission set. Follow the instructions in Create a permission set in the *AWS IAM Identity Center User Guide*.

- Users managed in IAM through an identity provider:

  Create a role for identity federation. Follow the instructions in Create a role for a third-party identity provider (federation) in the *IAM User Guide*.

- IAM users:
  - Create a role that your user can assume. Follow the instructions in Create a role for an IAM user in the *IAM User Guide*.
  - (Not recommended) Attach a policy directly to a user or add a user to a user group. Follow the instructions in Adding permissions to a user (console) in the *IAM User Guide*.

Set permissions on an S3 bucket (CLI)

By default, all S3 buckets and objects are private. Only the resource owner, the account that created the bucket, can access the bucket and any objects that it contains. However, the resource owner can choose to grant access permissions to other resources and users by writing an access policy.

> **Important**
>
> To make exports to S3 buckets more secure, we now require you to specify the list of source accounts that are allowed to export log data to your S3 bucket.
> In the following example, the list of account IDs in the `aws:SourceAccount` key would be the accounts from which a user can export log data to your S3 bucket. The `aws:SourceArn` key would be the resource for which the action is being taken. You may restrict this to a specific log group, or use a wildcard as shown in this example.
> We recommend that you also include the account ID of the account where the S3 bucket is created, to allow export within the same account.

To set permissions on an S3 bucket

1. Create a file named `policy.json` and add the following access policy, changing `amzn-s3-demo-bucket` to the name of your S3 bucket and `Principal` to the endpoint of the Region where you are exporting log data, such as `us-east-1`. Use a text editor to create this policy file. Don't use the IAM console.

JSON

```
{
"Version":"2012-10-17",
"Statement": [
  {
      "Sid": "AllowGetBucketAcl",
      "Action": "s3:GetBucketAcl",
      "Effect": "Allow",
      "Resource": "arn:aws:s3:::amzn-s3-demo-bucket",
      "Principal": { "Service": "logs.us-east-1.amazonaws.com" },
      "Condition": {
        "StringEquals": {
            "aws:SourceAccount": [
                "123456789012",
                "111122223333"
            ]
        },
        "ArnLike": {
                "aws:SourceArn": [
                    "arn:aws:logs:us-east-1:123456789012:log-group:*",
                    "arn:aws:logs:us-east-1:111122223333:log-group:*"
                ]
        }
      }
  },
  {
      "Sid": "AllowPutObject",
      "Action": "s3:PutObject",
      "Effect": "Allow",
      "Resource": "arn:aws:s3:::amzn-s3-demo-bucket/*",
      "Principal": { "Service": "logs.us-east-1.amazonaws.com" },
      "Condition": {
        "StringEquals": {
            "s3:x-amz-acl": "bucket-owner-full-control",
            "aws:SourceAccount": [
                "123456789012",
                "111122223333"
            ]
        },
        "ArnLike": {
```

```
                    "aws:SourceArn": [
                        "arn:aws:logs:us-east-1:123456789012:log-group:*",
                        "arn:aws:logs:us-east-1:111122223333:log-group:*"
                    ]
                }
            }
        }
    ]
}
```

2. Set the policy that you just added as the access policy on your bucket by using the put-bucket-policy command. This policy enables CloudWatch Logs to export log data to your S3 bucket. The bucket owner will have full permissions on all of the exported objects.

```
aws s3api put-bucket-policy --bucket amzn-s3-demo-bucket --policy file://
policy.json
```

> **Warning**
>
> If the existing bucket already has one or more policies attached to it, add the statements for CloudWatch Logs access to that policy or policies. We recommend that you evaluate the resulting set of permissions to be sure that they're appropriate for the users who will access the bucket.

(Optional) Exporting to a destination Amazon S3 bucket encrypted with SSE-KMS (CLI)

This procedure is necessary only if you are exporting to an S3 bucket that uses server-side encryption with AWS KMS keys. This encryption is known as SSE-KMS.

To export to a bucket encrypted with SSE-KMS

1. Use a text editor to create a file named `key_policy.json` and add the following access policy. When you add the policy, make the following changes:

   - Replace *`Region`* with the Region of your logs.
   - Replace *`account-ARN`* with the ARN of the account that owns the KMS key.

JSON

```
{
    "Version":"2012-10-17",
    "Statement": [
        {
            "Sid": "Allow CWL Service Principal usage",
            "Effect": "Allow",
            "Principal": {
                "Service": "logs.Region.amazonaws.com"
            },
            "Action": [
                "kms:GenerateDataKey",
                "kms:Decrypt"
            ],
            "Resource": "*"
        },
        {
            "Sid": "Enable IAM User Permissions",
            "Effect": "Allow",
            "Principal": {
                "AWS": "account-ARN"
            },
            "Action": [
                "kms:GetKeyPolicy*",
                "kms:PutKeyPolicy*",
                "kms:DescribeKey*",
                "kms:CreateAlias*",
                "kms:ScheduleKeyDeletion*",
                "kms:Decrypt"
            ],
            "Resource": "*"
        }
    ]
}
```

2. Enter the following command:

```
aws kms create-key --policy file://key_policy.json
```

The following is example output from this command:

```
{
    "KeyMetadata": {
        "AWSAccountId": "account_id",
        "KeyId": "key_id",
        "Arn": "arn:aws:kms:us-east-2:account-ARN:key/key_id",
        "CreationDate": "time",
        "Enabled": true,
        "Description": "",
        "KeyUsage": "ENCRYPT_DECRYPT",
        "KeyState": "Enabled",
        "Origin": "AWS_KMS",
        "KeyManager": "CUSTOMER",
        "CustomerMasterKeySpec": "SYMMETRIC_DEFAULT",
        "KeySpec": "SYMMETRIC_DEFAULT",
        "EncryptionAlgorithms": [
            "SYMMETRIC_DEFAULT"
        ],
        "MultiRegion": false
    }
```

3. Use a text editor to create a file called `bucketencryption.json` with the following contents.

```
{
  "Rules": [
    {
      "ApplyServerSideEncryptionByDefault": {
        "SSEAlgorithm": "aws:kms",
        "KMSMasterKeyID": "{KMS Key ARN}"
      },
      "BucketKeyEnabled": true
    }
  ]
}
```

4. Enter the following command, replacing *amzn-s3-demo-bucket* with the name of the bucket that you are exporting logs to.

```
aws s3api put-bucket-encryption --bucket amzn-s3-demo-bucket --server-side-
encryption-configuration file://bucketencryption.json
```

If the command doesn't return an error, the process is successful.

Create an export task (CLI)

Use the following command to create the export task. After you create it, the export task might take anywhere from a few seconds to a few hours, depending on the size of the data to export.

To export data to Amazon S3 using the AWS CLI

1. Sign in with sufficient permissions as documented in Set up access permissions (CLI).
2. At a command prompt, use the following create-export-task command to create the export task.

```
aws logs create-export-task --profile CWLExportUser --task-name "my-log-
group-09-10-2015" --log-group-name "my-log-group" --from 1441490400000 --
to 1441494000000 --destination "amzn-s3-demo-bucket" --destination-prefix "export-
task-output"
```

The following is example output.

```
{
    "taskId": "cda45419-90ea-4db5-9833-aade86253e66"
}
```

Cross-account export (CLI)

If the Amazon S3 bucket is in a different account than the logs that are being exported, use the instructions in this section.

Topics

- Create an S3 bucket for cross-account export (CLI)
- Set up access permissions for cross-account export (CLI)
- Set permissions on an S3 bucket for cross-account export (CLI)

- (Optional) Exporting to a destination Amazon S3 bucket encrypted with SSE-KMS for cross-account export (CLI)
- Create an export task for cross-account export (CLI)

Create an S3 bucket for cross-account export (CLI)

We recommend that you use a bucket that was created specifically for CloudWatch Logs. However, if you want to use an existing bucket, you can skip to step 2.

> **Note**
>
> The S3 bucket must reside in the same Region as the log data to export. CloudWatch Logs doesn't support exporting data to S3 buckets in a different Region.

To create an S3 bucket using the AWS CLI

At a command prompt, run the following create-bucket command, where `LocationConstraint` is the Region where you are exporting log data.

```
aws s3api create-bucket --bucket amzn-s3-demo-bucket --create-bucket-configuration
 LocationConstraint=us-east-2
```

The following is example output.

```
{
    "Location": "/amzn-s3-demo-bucket"
}
```

Set up access permissions for cross-account export (CLI)

First, you must create a new IAM policy to enable CloudWatch Logs to have the `s3:PutObject` action for the destination Amazon S3 bucket in the destination account.

Along with `s3:PutObject` action, additional actions included in the policy depend on whether the destination bucket uses AWS KMS encryption or has ACLs enabled using the S3 Object Ownership setting.

- If using KMS encryption, add the `kms:GenerateDataKey` and `kms:Decrypt` actions for the key resource
- If ACLs are enabled on the bucket add the `s3:PutObjectAcl` action for the bucket resource

Change `amzn-s3-demo-bucket` to the name of your destination S3 bucket in the following policies.

The policy that you create depends on whether the destination bucket uses AWS KMS encryption. If it does not use AWS KMS encryption, create a policy with the following contents.

JSON

```
{
    "Version":"2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": "s3:PutObject",
            "Resource": "arn:aws:s3:::amzn-s3-demo-bucket/*"
        }
    ]
}
```

If the destination bucket uses AWS KMS encryption, create a policy with the following contents.

JSON

```
{
    "Version":"2012-10-17",
    "Statement": [{
            "Effect": "Allow",
            "Action": "s3:PutObject",
            "Resource": "arn:aws:s3:::amzn-s3-demo-bucket/*"
        },
        {
            "Effect": "Allow",
            "Action": [
                "kms:GenerateDataKey",
                "kms:Decrypt"
```

```
            ],
            "Resource": "arn:aws:kms:us-
east-1:123456789012:key/1234abcd-12ab-34cd-56ef-1234567890ab"
        }
    ]
}
```

If the ACLs are enabled on destination bucket then add s3:PutObjectAcl to s3:PutObject Action block in the above policies.

JSON

```
{
    "Version":"2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": [
               "s3:PutObject",
               "s3:PutObjectAcl"
            ],
            "Resource": "arn:aws:s3:::amzn-s3-demo-bucket/*"
        }
    ]
}
```

To create an export task, you must be signed in with a IAM role that has the `AmazonS3ReadOnlyAccess` managed policy attached, the IAM policy created above, and also with the following permissions:

- `logs:CreateExportTask`
- `logs:CancelExportTask`
- `logs:DescribeExportTasks`
- `logs:DescribeLogStreams`
- `logs:DescribeLogGroups`

To provide access, add permissions to your users, groups, or roles:

- Users and groups in AWS IAM Identity Center:

  Create a permission set. Follow the instructions in Create a permission set in the *AWS IAM Identity Center User Guide*.
- Users managed in IAM through an identity provider:

  Create a role for identity federation. Follow the instructions in Create a role for a third-party identity provider (federation) in the *IAM User Guide*.
- IAM users:
  - Create a role that your user can assume. Follow the instructions in Create a role for an IAM user in the *IAM User Guide*.
  - (Not recommended) Attach a policy directly to a user or add a user to a user group. Follow the instructions in Adding permissions to a user (console) in the *IAM User Guide*.

Set permissions on an S3 bucket for cross-account export (CLI)

By default, all S3 buckets and objects are private. Only the resource owner, the account that created the bucket, can access the bucket and any objects that it contains. However, the resource owner can choose to grant access permissions to other resources and users by writing an access policy.

> **Important**
>
> To make exports to S3 buckets more secure, we now require you to specify the list of source accounts that are allowed to export log data to your S3 bucket.
> In the following example, the list of account IDs in the `aws:SourceAccount` key would be the accounts from which a user can export log data to your S3 bucket. The `aws:SourceArn` key would be the resource for which the action is being taken. You may restrict this to a specific log group, or use a wildcard as shown in this example.
> We recommend that you also include the account ID of the account where the S3 bucket is created, to allow export within the same account.

To set permissions on an S3 bucket

1. Create a file named `policy.json` and add the following access policy, changing `amzn-s3-demo-bucket` to the name of your destination S3 bucket, `Principal` to the endpoint of the

Region where you are exporting log data, such as `us-west-1`. Use a text editor to create this policy file. Don't use the IAM console.

JSON

```
{
    "Version":"2012-10-17",
    "Statement": [
      {
          "Action": "s3:GetBucketAcl",
          "Effect": "Allow",
          "Resource": "arn:aws:s3:::amzn-s3-demo-bucket",
          "Principal": { "Service": "logs.us-east-1.amazonaws.com" },
          "Condition": {
            "StringEquals": {
                "aws:SourceAccount": [
                "123456789012",
                "111122223333"
                ]
            },
            "ArnLike": {
                    "aws:SourceArn": [
                    "arn:aws:logs:us-east-1:123456789012:log-group:*",
                    "arn:aws:logs:us-east-1:111122223333:log-group:*"
                     ]
            }
          }
      },
      {
          "Action": "s3:PutObject" ,
          "Effect": "Allow",
          "Resource": "arn:aws:s3:::amzn-s3-demo-bucket/*",
          "Principal": { "Service": "logs.us-east-1.amazonaws.com" },
          "Condition": {
            "StringEquals": {
                "s3:x-amz-acl": "bucket-owner-full-control",
                "aws:SourceAccount": [
                "123456789012",
                "111122223333"
                ]
            },
```

```
            "ArnLike": {
                    "aws:SourceArn": [
                    "arn:aws:logs:us-east-1:123456789012:log-group:*",
                    "arn:aws:logs:us-east-1:111122223333:log-group:*"
                    ]
            }
          }
      },
      {
          "Effect": "Allow",
          "Principal": {
          "AWS": "arn:aws:iam::111122223333:role/role_name"
          },
          "Action": "s3:PutObject",
          "Resource": "arn:aws:s3:::>amzn-s3-demo-bucket/*",
          "Condition": {
            "StringEquals": {
                "s3:x-amz-acl": "bucket-owner-full-control"
            }
          }
       }
    ]
}
```

2. Set the policy that you just added as the access policy on your bucket by using the put-bucket-policy command. This policy enables CloudWatch Logs to export log data to your S3 bucket. The bucket owner will have full permissions on all of the exported objects.

```
aws s3api put-bucket-policy --bucket amzn-s3-demo-bucket --policy file://
policy.json
```

> **Warning**
>
> If the existing bucket already has one or more policies attached to it, add the statements for CloudWatch Logs access to that policy or policies. We recommend that you evaluate the resulting set of permissions to be sure that they're appropriate for the users who will access the bucket.

(Optional) Exporting to a destination Amazon S3 bucket encrypted with SSE-KMS for cross-account export (CLI)

This procedure is necessary only if you are exporting to an S3 bucket that uses server-side encryption with AWS KMS keys. This encryption is known as SSE-KMS.

To export to a bucket encrypted with SSE-KMS

1. Use a text editor to create a file named `key_policy.json` and add the following access policy. When you add the policy, make the following changes:

   - Replace *`us-east-1`* with the Region of your logs.
   - Replace *`account-ARN`* with the ARN of the account that owns the KMS key.
   - Replace *`123456789012`* with the account number that owns the KMS key.
   - *`key_id`* with the kms-key Id.
   - *`role_name`* with the role used for creating export task.

   JSON

```
{
"Version":"2012-10-17",
"Statement": [
    {
        "Sid": "AllowCWLServicePrincipalUsage",
        "Effect": "Allow",
        "Principal": {
            "Service": "logs.us-east-1.amazonaws.com"
        },
        "Action": [
            "kms:GenerateDataKey",
            "kms:Decrypt"
        ],
        "Resource": "*"
    },
    {
        "Sid": "EnableIAMUserPermissions",
        "Effect": "Allow",
        "Principal": {
```

```
                "AWS": "account-ARN"
            },
            "Action": [
                "kms:GetKeyPolicy*",
                "kms:PutKeyPolicy*",
                "kms:DescribeKey*",
                "kms:CreateAlias*",
                "kms:ScheduleKeyDeletion*",
                "kms:Decrypt"
            ],
            "Resource": "*"
        },
        {
            "Sid": "EnableIAMRolePermissions",
            "Effect": "Allow",
            "Principal": {
                "AWS": "arn:aws:iam::111122223333:role/role_name"
            },
            "Action": [
                "kms:GenerateDataKey",
                "kms:Decrypt"
            ],
            "Resource": "arn:aws:kms:us-
east-1:123456789012:key/1234abcd-12ab-34cd-56ef-1234567890ab"
        }
    ]
}
```

2. Enter the following command:

```
aws kms create-key --policy file://key_policy.json
```

The following is example output from this command:

```
{
    "KeyMetadata": {
        "AWSAccountId": "account_id",
        "KeyId": "key_id",
        "Arn": "arn:aws:kms:us-east-1:123456789012:key/key_id",
        "CreationDate": "time",
        "Enabled": true,
        "Description": "",
        "KeyUsage": "ENCRYPT_DECRYPT",
```

```
        "KeyState": "Enabled",
        "Origin": "AWS_KMS",
        "KeyManager": "CUSTOMER",
        "CustomerMasterKeySpec": "SYMMETRIC_DEFAULT",
        "KeySpec": "SYMMETRIC_DEFAULT",
        "EncryptionAlgorithms": [
            "SYMMETRIC_DEFAULT"
        ],
        "MultiRegion": false
    }
```

3. Use a text editor to create a file called `bucketencryption.json` with the following contents.

```
{
  "Rules": [
    {
      "ApplyServerSideEncryptionByDefault": {
        "SSEAlgorithm": "aws:kms",
        "KMSMasterKeyID": "{KMS Key ARN}"
      },
      "BucketKeyEnabled": true
    }
  ]
}
```

4. Enter the following command, replacing *amzn-s3-demo-bucket* with the name of the bucket that you are exporting logs to.

```
aws s3api put-bucket-encryption --bucket amzn-s3-demo-bucket --server-side-
encryption-configuration file://bucketencryption.json
```

If the command doesn't return an error, the process is successful.

Create an export task for cross-account export (CLI)

Use the following command to create the export task. After you create it, the export task might take anywhere from a few seconds to a few hours, depending on the size of the data to export.

To export data to Amazon S3 using the AWS CLI

1. Sign in with sufficient permissions as documented in Set up access permissions (CLI).
2. At a command prompt, use the following create-export-task command to create the export task.

```
aws logs create-export-task --profile CWLExportUser --task-name "my-log-group-09-10-2015" --log-group-name "my-log-group" --from 1441490400000 --to 1441494000000 --destination "amzn-s3-demo-bucket" --destination-prefix "export-task-output"
```

The following is example output.

```
{
    "taskId": "cda45419-90ea-4db5-9833-aade86253e66"
}
```

Describe export tasks (CLI)

After you create an export task, you can get the current status of the task.

To describe export tasks using the AWS CLI

At a command prompt, use the following describe-export-tasks command.

```
aws logs --profile CWLExportUser describe-export-tasks --task-id
 "cda45419-90ea-4db5-9833-aade86253e66"
```

The following is example output.

```
{
   "exportTasks": [
   {
      "destination": "my-exported-logs",
      "destinationPrefix": "export-task-output",
      "executionInfo": {
         "creationTime": 1441495400000
      },
      "from": 1441490400000,
      "logGroupName": "my-log-group",
```

```
      "status": {
         "code": "RUNNING",
         "message": "Started Successfully"
      },
      "taskId": "cda45419-90ea-4db5-9833-aade86253e66",
      "taskName": "my-log-group-09-10-2015",
      "tTo": 1441494000000
   }]
}
```

You can use the `describe-export-tasks` command in three different ways:

- **Without any filters** – Lists all of your export tasks, in reverse order of creation.
- **Filter on task ID** – Lists the export task, if one exists, with the specified ID.
- **Filter on task status** – Lists the export tasks with the specified status.

For example, use the following command to filter on the `FAILED` status.

```
aws logs --profile CWLExportUser describe-export-tasks --status-code "FAILED"
```

The following is example output.

```
{
   "exportTasks": [
   {
      "destination": "amzn-s3-demo-bucket",
      "destinationPrefix": "export-task-output",
      "executionInfo": {
         "completionTime": 1441498600000
         "creationTime": 1441495400000
      },
      "from": 1441490400000,
      "logGroupName": "my-log-group",
      "status": {
         "code": "FAILED",
         "message": "FAILED"
      },
      "taskId": "cda45419-90ea-4db5-9833-aade86253e66",
      "taskName": "my-log-group-09-10-2015",
      "to": 1441494000000
   }]
```

```
}
```

Cancel an export task (CLI)

You can cancel an export task if it's in a `PENDING` or `RUNNING` state.

To cancel an export task using the AWS CLI

At a command prompt, use the following cancel-export-task command:

```
aws logs --profile CWLExportUser cancel-export-task --task-id "cda45419-90ea-4db5-9833-aade86253e66"
```

You can use the describe-export-tasks command to verify that the task was canceled successfully.

Streaming CloudWatch Logs data to Amazon OpenSearch Service

You can configure a log group in Amazon CloudWatch Logs, so you can stream data to your Amazon OpenSearch Service cluster in near real-time. For more information, see Real-time processing of log data with subscriptions.

> **Note**
>
> Streaming to OpenSearch Service is supported only for log groups in the Standard log class. For more information about log classes, see Log classes.

Depending on the amount of log data that's streamed, consider setting a function-level concurrency limit. For more information, see Lambda function scaling.

> **Note**
>
> Because streaming large amounts of CloudWatch Logs data to OpenSearch Service might result in high usage charges, we recommend that you create a budget in the AWS Billing and Cost Management console. For more information, see Managing your costs with AWS Budgets.

This section describes the prerequisites you must complete before subscribing a log group to OpenSearch Service. It also describes how to subscribe a log group to OpenSearch Service.

Prerequisites

Before you begin, create an OpenSearch Service domain. The domain can have either public access or VPC access, but you can't then modify the type of access after the domain is created. You might want to review your OpenSearch Service domain settings later, and modify your cluster configuration based on the amount of data your cluster will be processing. For instructions to create a domain, see Creating OpenSearch Service domains.

For more information about OpenSearch Service, see the Amazon OpenSearch Service Developer Guide.

Subscribe a log group to OpenSearch Service

You can use the CloudWatch console to subscribe a log group to OpenSearch Service.

To subscribe a log group to OpenSearch Service

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Log groups**.
3. Select the name of the log group.
4. Choose **Actions**, **Subscription filters**, **Create Amazon OpenSearch Service subscription filter**.
5. Choose whether you want to stream to a cluster in this account or another account.
   - If you chose this account, select the domain you created in the previous step.
   - If you chose another account, provide the domain ARN and endpoint.
6. For **Lambda IAM Execution Role**, choose the IAM role that Lambda should use when executing calls to OpenSearch.

   The IAM role you choose must fulfill these requirements:

   - It must have `lambda.amazonaws.com` in the trust relationship.
   - It must include the following policy:

     JSON

```
{
    "Version":"2012-10-17",
    "Statement": [
        {
            "Sid": "AllowOpenSearchStreamingAccess",
            "Action": [
                "es:*"
            ],
            "Effect": "Allow",
            "Resource": "arn:aws:es:us-
east-1:123456789012:domain/cloudwatch-logs/*"
        }
    ]
}
```

- If the target OpenSearch Service domain uses VPC access, the role must have the **AWSLambdaVPCAccessExecutionRole** policy attached. This Amazon-managed policy grants Lambda access to the customer's VPC, enabling Lambda to write to the OpenSearch endpoint in the VPC.

7. For **Log format**, choose a log format.
8. For **Subscription filter pattern**, type the terms or pattern to find in your log events. This ensures that you send only the data you're interested in to your OpenSearch cluster. For more information, see Creating metrics from log events using filters.
9. (Optional) For **Select log data to test**, select a log stream and then choose **Test pattern** to verify that your search filter is returning the results you expect.
10. Choose **Start streaming**.

Code examples for CloudWatch Logs using AWS SDKs

The following code examples show how to use CloudWatch Logs with an AWS software development kit (SDK).

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios.

Scenarios are code examples that show you how to accomplish specific tasks by calling multiple functions within a service or combined with other AWS services.

For a complete list of AWS SDK developer guides and code examples, see Using CloudWatch Logs with an AWS SDK. This topic also includes information about getting started and details about previous SDK versions.

Code examples

- Scenarios for CloudWatch Logs using AWS SDKs
  - Configure container service connectivity
  - Creating your first serverless function
  - Use CloudWatch Logs to run a large query
  - Use scheduled events to invoke a Lambda function

Basic examples for CloudWatch Logs using AWS SDKs

The following code examples show how to use the basics of Amazon CloudWatch Logs with AWS SDKs.

Examples

- Actions for CloudWatch Logs using AWS SDKs
  - Use AssociateKmsKey with an AWS SDK
  - Use CancelExportTask with an AWS SDK
  - Use CreateExportTask with an AWS SDK
  - Use CreateLogGroup with an AWS SDK or CLI
  - Use CreateLogStream with an AWS SDK or CLI
  - Use DeleteLogGroup with an AWS SDK or CLI
  - Use DeleteSubscriptionFilter with an AWS SDK
  - Use DescribeExportTasks with an AWS SDK
  - Use DescribeLogGroups with an AWS SDK or CLI
  - Use DescribeLogStreams with an AWS SDK or CLI
  - Use DescribeSubscriptionFilters with an AWS SDK
  - Use GetLogEvents with an AWS SDK or CLI
  - Use GetQueryResults with an AWS SDK
  - Use PutSubscriptionFilter with an AWS SDK
  - Use StartLiveTail with an AWS SDK
  - Use StartQuery with an AWS SDK

Actions for CloudWatch Logs using AWS SDKs

The following code examples demonstrate how to perform individual CloudWatch Logs actions with AWS SDKs. Each example includes a link to GitHub, where you can find instructions for setting up and running the code.

These excerpts call the CloudWatch Logs API and are code excerpts from larger programs that must be run in context. You can see actions in context in Scenarios for CloudWatch Logs using AWS SDKs.

The following examples include only the most commonly used actions. For a complete list, see the Amazon CloudWatch Logs API Reference.

Examples

- Use AssociateKmsKey with an AWS SDK
- Use CancelExportTask with an AWS SDK
- Use CreateExportTask with an AWS SDK
- Use CreateLogGroup with an AWS SDK or CLI
- Use CreateLogStream with an AWS SDK or CLI
- Use DeleteLogGroup with an AWS SDK or CLI
- Use DeleteSubscriptionFilter with an AWS SDK
- Use DescribeExportTasks with an AWS SDK
- Use DescribeLogGroups with an AWS SDK or CLI
- Use DescribeLogStreams with an AWS SDK or CLI
- Use DescribeSubscriptionFilters with an AWS SDK
- Use GetLogEvents with an AWS SDK or CLI
- Use GetQueryResults with an AWS SDK
- Use PutSubscriptionFilter with an AWS SDK
- Use StartLiveTail with an AWS SDK
- Use StartQuery with an AWS SDK

Use `AssociateKmsKey` with an AWS SDK

The following code example shows how to use `AssociateKmsKey`.

.NET

SDK for .NET

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
    using System;
    using System.Threading.Tasks;
    using Amazon.CloudWatchLogs;
    using Amazon.CloudWatchLogs.Model;

    /// <summary>
    /// Shows how to associate an AWS Key Management Service (AWS KMS) key with
    /// an Amazon CloudWatch Logs log group.
    /// </summary>
    public class AssociateKmsKey
    {
        public static async Task Main()
        {
            // This client object will be associated with the same AWS Region
            // as the default user on this system. If you need to use a
            // different AWS Region, pass it as a parameter to the client
            // constructor.
            var client = new AmazonCloudWatchLogsClient();

            string kmsKeyId = "arn:aws:kms:us-west-2:<account-
number>:key/7c9eccc2-38cb-4c4f-9db3-766ee8dd3ad4";
            string groupName = "cloudwatchlogs-example-loggroup";

            var request = new AssociateKmsKeyRequest
            {
                KmsKeyId = kmsKeyId,
                LogGroupName = groupName,
            };

            var response = await client.AssociateKmsKeyAsync(request);

            if (response.HttpStatusCode == System.Net.HttpStatusCode.OK)
```

```
            {
                Console.WriteLine($"Successfully associated KMS key ID:
{kmsKeyId} with log group: {groupName}.");
            }
            else
            {
                Console.WriteLine("Could not make the association between:
{kmsKeyId} and {groupName}.");
            }
        }
    }
```

- For API details, see AssociateKmsKey in *AWS SDK for .NET API Reference*.

For a complete list of AWS SDK developer guides and code examples, see Using CloudWatch Logs with an AWS SDK. This topic also includes information about getting started and details about previous SDK versions.

Use `CancelExportTask` with an AWS SDK

The following code example shows how to use `CancelExportTask`.

.NET

SDK for .NET

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
using System;
using System.Threading.Tasks;
using Amazon.CloudWatchLogs;
using Amazon.CloudWatchLogs.Model;

/// <summary>
/// Shows how to cancel an Amazon CloudWatch Logs export task.
```

```
/// </summary>
public class CancelExportTask
{
    public static async Task Main()
    {
        // This client object will be associated with the same AWS Region
        // as the default user on this system. If you need to use a
        // different AWS Region, pass it as a parameter to the client
        // constructor.
        var client = new AmazonCloudWatchLogsClient();
        string taskId = "exampleTaskId";

        var request = new CancelExportTaskRequest
        {
            TaskId = taskId,
        };

        var response = await client.CancelExportTaskAsync(request);

        if (response.HttpStatusCode == System.Net.HttpStatusCode.OK)
        {
            Console.WriteLine($"{taskId} successfully canceled.");
        }
        else
        {
            Console.WriteLine($"{taskId} could not be canceled.");
        }
    }
}
```

- For API details, see CancelExportTask in *AWS SDK for .NET API Reference*.

For a complete list of AWS SDK developer guides and code examples, see Using CloudWatch Logs with an AWS SDK. This topic also includes information about getting started and details about previous SDK versions.

Use `CreateExportTask` with an AWS SDK

The following code example shows how to use `CreateExportTask`.

.NET

SDK for .NET

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
    using System;
    using System.Threading.Tasks;
    using Amazon.CloudWatchLogs;
    using Amazon.CloudWatchLogs.Model;

    /// <summary>
    /// Shows how to create an Export Task to export the contents of the Amazon
    /// CloudWatch Logs to the specified Amazon Simple Storage Service (Amazon
S3)
    /// bucket.
    /// </summary>
    public class CreateExportTask
    {
        public static async Task Main()
        {
            // This client object will be associated with the same AWS Region
            // as the default user on this system. If you need to use a
            // different AWS Region, pass it as a parameter to the client
            // constructor.
            var client = new AmazonCloudWatchLogsClient();
            string taskName = "export-task-example";
            string logGroupName = "cloudwatchlogs-example-loggroup";
            string destination = "amzn-s3-demo-bucket";
            var fromTime = 1437584472382;
            var toTime = 1437584472833;

            var request = new CreateExportTaskRequest
            {
                From = fromTime,
                To = toTime,
                TaskName = taskName,
                LogGroupName = logGroupName,
```

```
                Destination = destination,
            };

            var response = await client.CreateExportTaskAsync(request);

            if (response.HttpStatusCode == System.Net.HttpStatusCode.OK)
            {
                Console.WriteLine($"The task, {taskName} with ID: " +
                                  $"{response.TaskId} has been created
successfully.");
            }
        }
    }
```

- For API details, see CreateExportTask in *AWS SDK for .NET API Reference*.

For a complete list of AWS SDK developer guides and code examples, see Using CloudWatch Logs with an AWS SDK. This topic also includes information about getting started and details about previous SDK versions.

Use `CreateLogGroup` with an AWS SDK or CLI

The following code examples show how to use `CreateLogGroup`.

Action examples are code excerpts from larger programs and must be run in context. You can see this action in context in the following code example:

- Configure container service connectivity

.NET

SDK for .NET

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
    using System;
    using System.Threading.Tasks;
    using Amazon.CloudWatchLogs;
    using Amazon.CloudWatchLogs.Model;

    /// <summary>
    /// Shows how to create an Amazon CloudWatch Logs log group.
    /// </summary>
    public class CreateLogGroup
    {
        public static async Task Main()
        {
            // This client object will be associated with the same AWS Region
            // as the default user on this system. If you need to use a
            // different AWS Region, pass it as a parameter to the client
            // constructor.
            var client = new AmazonCloudWatchLogsClient();

            string logGroupName = "cloudwatchlogs-example-loggroup";

            var request = new CreateLogGroupRequest
            {
                LogGroupName = logGroupName,
            };

            var response = await client.CreateLogGroupAsync(request);

            if (response.HttpStatusCode == System.Net.HttpStatusCode.OK)
            {
                Console.WriteLine($"Successfully create log group with ID:
{logGroupName}.");
            }
            else
            {
                Console.WriteLine("Could not create log group.");
            }
        }
    }
```

- For API details, see CreateLogGroup in *AWS SDK for .NET API Reference*.

CLI

AWS CLI

The following command creates a log group named `my-logs`:

```
aws logs create-log-group --log-group-name my-logs
```

- For API details, see CreateLogGroup in *AWS CLI Command Reference*.

JavaScript

SDK for JavaScript (v3)

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
import { CreateLogGroupCommand } from "@aws-sdk/client-cloudwatch-logs";
import { client } from "../libs/client.js";

const run = async () => {
  const command = new CreateLogGroupCommand({
    // The name of the log group.
    logGroupName: process.env.CLOUDWATCH_LOGS_LOG_GROUP,
  });

  try {
    return await client.send(command);
  } catch (err) {
    console.error(err);
  }
};

export default run();
```

- For API details, see CreateLogGroup in *AWS SDK for JavaScript API Reference*.

For a complete list of AWS SDK developer guides and code examples, see Using CloudWatch Logs with an AWS SDK. This topic also includes information about getting started and details about previous SDK versions.

Use `CreateLogStream` with an AWS SDK or CLI

The following code examples show how to use `CreateLogStream`.

.NET

SDK for .NET

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
using System;
using System.Threading.Tasks;
using Amazon.CloudWatchLogs;
using Amazon.CloudWatchLogs.Model;

/// <summary>
/// Shows how to create an Amazon CloudWatch Logs stream for a CloudWatch
/// log group.
/// </summary>
public class CreateLogStream
{
    public static async Task Main()
    {
        // This client object will be associated with the same AWS Region
        // as the default user on this system. If you need to use a
        // different AWS Region, pass it as a parameter to the client
        // constructor.
        var client = new AmazonCloudWatchLogsClient();
        string logGroupName = "cloudwatchlogs-example-loggroup";
        string logStreamName = "cloudwatchlogs-example-logstream";

        var request = new CreateLogStreamRequest
        {
            LogGroupName = logGroupName,
```

```
                LogStreamName = logStreamName,
            };

            var response = await client.CreateLogStreamAsync(request);

            if (response.HttpStatusCode == System.Net.HttpStatusCode.OK)
            {
                Console.WriteLine($"{logStreamName} successfully created for
{logGroupName}.");
            }
            else
            {
                Console.WriteLine("Could not create stream.");
            }
        }
    }
```

- For API details, see CreateLogStream in *AWS SDK for .NET API Reference*.

CLI

AWS CLI

The following command creates a log stream named `20150601` in the log group `my-logs`:

```
aws logs create-log-stream --log-group-name my-logs --log-stream-name 20150601
```

- For API details, see CreateLogStream in *AWS CLI Command Reference*.

For a complete list of AWS SDK developer guides and code examples, see Using CloudWatch Logs with an AWS SDK. This topic also includes information about getting started and details about previous SDK versions.

Use `DeleteLogGroup` with an AWS SDK or CLI

The following code examples show how to use `DeleteLogGroup`.

Action examples are code excerpts from larger programs and must be run in context. You can see this action in context in the following code examples:

- Configure container service connectivity
- Creating your first serverless function

.NET

SDK for .NET

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
    using System;
    using System.Threading.Tasks;
    using Amazon.CloudWatchLogs;
    using Amazon.CloudWatchLogs.Model;

    /// <summary>
    /// Uses the Amazon CloudWatch Logs Service to delete an existing
    /// CloudWatch Logs log group.
    /// </summary>
    public class DeleteLogGroup
    {
        public static async Task Main()
        {
            var client = new AmazonCloudWatchLogsClient();
            string logGroupName = "cloudwatchlogs-example-loggroup";

            var request = new DeleteLogGroupRequest
            {
                LogGroupName = logGroupName,
            };

            var response = await client.DeleteLogGroupAsync(request);

            if (response.HttpStatusCode == System.Net.HttpStatusCode.OK)
            {
                Console.WriteLine($"Successfully deleted CloudWatch log group,
{logGroupName}.");
            }
```

```
        }
    }
```

- For API details, see DeleteLogGroup in *AWS SDK for .NET API Reference*.

CLI

AWS CLI

The following command deletes a log group named `my-logs`:

```
aws logs delete-log-group --log-group-name my-logs
```

- For API details, see DeleteLogGroup in *AWS CLI Command Reference*.

JavaScript

SDK for JavaScript (v3)

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
import { DeleteLogGroupCommand } from "@aws-sdk/client-cloudwatch-logs";
import { client } from "../libs/client.js";

const run = async () => {
  const command = new DeleteLogGroupCommand({
    // The name of the log group.
    logGroupName: process.env.CLOUDWATCH_LOGS_LOG_GROUP,
  });

  try {
    return await client.send(command);
  } catch (err) {
    console.error(err);
  }
```

```
};

export default run();
```

- For API details, see DeleteLogGroup in *AWS SDK for JavaScript API Reference*.

For a complete list of AWS SDK developer guides and code examples, see Using CloudWatch Logs with an AWS SDK. This topic also includes information about getting started and details about previous SDK versions.

Use `DeleteSubscriptionFilter` with an AWS SDK

The following code examples show how to use `DeleteSubscriptionFilter`.

C++

SDK for C++

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

Include the required files.

```
#include <aws/core/Aws.h>
#include <aws/core/utils/Outcome.h>
#include <aws/logs/CloudWatchLogsClient.h>
#include <aws/logs/model/DeleteSubscriptionFilterRequest.h>
#include <iostream>
```

Delete the subscription filter.

```
        Aws::CloudWatchLogs::CloudWatchLogsClient cwl;
        Aws::CloudWatchLogs::Model::DeleteSubscriptionFilterRequest request;
        request.SetFilterName(filter_name);
```

```
        request.SetLogGroupName(log_group);

        auto outcome = cwl.DeleteSubscriptionFilter(request);
        if (!outcome.IsSuccess()) {
            std::cout << "Failed to delete CloudWatch log subscription filter "
                << filter_name << ": " << outcome.GetError().GetMessage() <<
                std::endl;
        } else {
            std::cout << "Successfully deleted CloudWatch logs subscription " <<
                "filter " << filter_name << std::endl;
        }
```

- For API details, see DeleteSubscriptionFilter in *AWS SDK for C++ API Reference*.

Java

SDK for Java 2.x

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
import software.amazon.awssdk.services.cloudwatch.model.CloudWatchException;
import software.amazon.awssdk.services.cloudwatchlogs.CloudWatchLogsClient;
import
 software.amazon.awssdk.services.cloudwatchlogs.model.DeleteSubscriptionFilterRequest;

/**
 * Before running this Java V2 code example, set up your development
 * environment, including your credentials.
 *
 * For more information, see the following documentation topic:
 *
 * https://docs.aws.amazon.com/sdk-for-java/latest/developer-guide/get-
started.html
 */
public class DeleteSubscriptionFilter {
    public static void main(String[] args) {
        final String usage = """
```

```
                Usage:
                  <filter> <logGroup>

                Where:
                  filter - The name of the subscription filter (for example,
 MyFilter).
                  logGroup - The name of the log group. (for example, testgroup).
                """;

        if (args.length != 2) {
            System.out.println(usage);
            System.exit(1);
        }

        String filter = args[0];
        String logGroup = args[1];
        CloudWatchLogsClient logs = CloudWatchLogsClient.builder()
                .build();

        deleteSubFilter(logs, filter, logGroup);
        logs.close();
    }

    public static void deleteSubFilter(CloudWatchLogsClient logs, String filter,
 String logGroup) {
        try {
            DeleteSubscriptionFilterRequest request =
 DeleteSubscriptionFilterRequest.builder()
                    .filterName(filter)
                    .logGroupName(logGroup)
                    .build();

            logs.deleteSubscriptionFilter(request);
            System.out.printf("Successfully deleted CloudWatch logs subscription
 filter %s", filter);

        } catch (CloudWatchException e) {
            System.err.println(e.awsErrorDetails().errorMessage());
            System.exit(1);
        }
    }
}
```

- For API details, see DeleteSubscriptionFilter in *AWS SDK for Java 2.x API Reference*.

JavaScript

SDK for JavaScript (v3)

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
import { DeleteSubscriptionFilterCommand } from "@aws-sdk/client-cloudwatch-
logs";
import { client } from "../libs/client.js";

const run = async () => {
  const command = new DeleteSubscriptionFilterCommand({
    // The name of the filter.
    filterName: process.env.CLOUDWATCH_LOGS_FILTER_NAME,
    // The name of the log group.
    logGroupName: process.env.CLOUDWATCH_LOGS_LOG_GROUP,
  });

  try {
    return await client.send(command);
  } catch (err) {
    console.error(err);
  }
};

export default run();
```

- For API details, see DeleteSubscriptionFilter in *AWS SDK for JavaScript API Reference*.

SDK for JavaScript (v2)

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
// Load the AWS SDK for Node.js
var AWS = require("aws-sdk");
// Set the region
AWS.config.update({ region: "REGION" });

// Create the CloudWatchLogs service object
var cwl = new AWS.CloudWatchLogs({ apiVersion: "2014-03-28" });

var params = {
  filterName: "FILTER",
  logGroupName: "LOG_GROUP",
};

cwl.deleteSubscriptionFilter(params, function (err, data) {
  if (err) {
    console.log("Error", err);
  } else {
    console.log("Success", data);
  }
});
```

- For more information, see AWS SDK for JavaScript Developer Guide.
- For API details, see DeleteSubscriptionFilter in *AWS SDK for JavaScript API Reference*.

Kotlin

SDK for Kotlin

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
suspend fun deleteSubFilter(
    filter: String?,
    logGroup: String?,
) {
    val request =
        DeleteSubscriptionFilterRequest {
            filterName = filter
            logGroupName = logGroup
        }

    CloudWatchLogsClient.fromEnvironment { region = "us-west-2" }.use { logs ->
        logs.deleteSubscriptionFilter(request)
        println("Successfully deleted CloudWatch logs subscription filter named
 $filter")
    }
}
```

- For API details, see DeleteSubscriptionFilter in *AWS SDK for Kotlin API reference*.

For a complete list of AWS SDK developer guides and code examples, see Using CloudWatch Logs with an AWS SDK. This topic also includes information about getting started and details about previous SDK versions.

Use `DescribeExportTasks` with an AWS SDK

The following code example shows how to use `DescribeExportTasks`.

.NET

SDK for .NET

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
using System;
using System.Threading.Tasks;
using Amazon.CloudWatchLogs;
using Amazon.CloudWatchLogs.Model;

/// <summary>
/// Shows how to retrieve a list of information about Amazon CloudWatch
/// Logs export tasks.
/// </summary>
public class DescribeExportTasks
{
    public static async Task Main()
    {
        // This client object will be associated with the same AWS Region
        // as the default user on this system. If you need to use a
        // different AWS Region, pass it as a parameter to the client
        // constructor.
        var client = new AmazonCloudWatchLogsClient();

        var request = new DescribeExportTasksRequest
        {
            Limit = 5,
        };

        var response = new DescribeExportTasksResponse();

        do
        {
            response = await client.DescribeExportTasksAsync(request);
            response.ExportTasks.ForEach(t =>
            {
```

```
                    Console.WriteLine($"{t.TaskName} with ID: {t.TaskId} has
status: {t.Status}");
                });
            }
            while (response.NextToken is not null);
        }
    }
```

- For API details, see DescribeExportTasks in *AWS SDK for .NET API Reference*.

For a complete list of AWS SDK developer guides and code examples, see Using CloudWatch Logs with an AWS SDK. This topic also includes information about getting started and details about previous SDK versions.

Use `DescribeLogGroups` with an AWS SDK or CLI

The following code examples show how to use `DescribeLogGroups`.

.NET

SDK for .NET

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
using System;
using System.Threading.Tasks;
using Amazon.CloudWatchLogs;
using Amazon.CloudWatchLogs.Model;

/// <summary>
/// Retrieves information about existing Amazon CloudWatch Logs log groups
/// and displays the information on the console.
/// </summary>
public class DescribeLogGroups
{
```

```
        public static async Task Main()
        {
            // Creates a CloudWatch Logs client using the default
            // user. If you need to work with resources in another
            // AWS Region than the one defined for the default user,
            // pass the AWS Region as a parameter to the client constructor.
            var client = new AmazonCloudWatchLogsClient();

            bool done = false;
            string newToken = null;

            var request = new DescribeLogGroupsRequest
            {
                Limit = 5,
            };

            DescribeLogGroupsResponse response;

            do
            {
                if (newToken is not null)
                {
                    request.NextToken = newToken;
                }

                response = await client.DescribeLogGroupsAsync(request);

                response.LogGroups.ForEach(lg =>
                {
                    Console.WriteLine($"{lg.LogGroupName} is associated with the
key: {lg.KmsKeyId}.");
                    Console.WriteLine($"Created on:
{lg.CreationTime.Date.Date}");
                    Console.WriteLine($"Date for this group will be stored for:
{lg.RetentionInDays} days.\n");
                });

                if (response.NextToken is null)
                {
                    done = true;
                }
                else
                {
                    newToken = response.NextToken;
```

```
                }
            }
            while (!done);
        }
    }
```

- For API details, see DescribeLogGroups in *AWS SDK for .NET API Reference*.

CLI

AWS CLI

The following command describes a log group named `my-logs`:

```
aws logs describe-log-groups --log-group-name-prefix my-logs
```

Output:

```
{
    "logGroups": [
        {
            "storedBytes": 0,
            "metricFilterCount": 0,
            "creationTime": 1433189500783,
            "logGroupName": "my-logs",
            "retentionInDays": 5,
            "arn": "arn:aws:logs:us-west-2:0123456789012:log-group:my-logs:*"
        }
    ]
}
```

- For API details, see DescribeLogGroups in *AWS CLI Command Reference*.

JavaScript

SDK for JavaScript (v3)

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
import {
  paginateDescribeLogGroups,
  CloudWatchLogsClient,
} from "@aws-sdk/client-cloudwatch-logs";

const client = new CloudWatchLogsClient({});

export const main = async () => {
  const paginatedLogGroups = paginateDescribeLogGroups({ client }, {});
  const logGroups = [];

  for await (const page of paginatedLogGroups) {
    if (page.logGroups?.every((lg) => !!lg)) {
      logGroups.push(...page.logGroups);
    }
  }

  console.log(logGroups);
  return logGroups;
};
```

- For API details, see DescribeLogGroups in *AWS SDK for JavaScript API Reference*.

For a complete list of AWS SDK developer guides and code examples, see Using CloudWatch Logs with an AWS SDK. This topic also includes information about getting started and details about previous SDK versions.

Use `DescribeLogStreams` with an AWS SDK or CLI

The following code examples show how to use `DescribeLogStreams`.

Action examples are code excerpts from larger programs and must be run in context. You can see this action in context in the following code example:

- Creating your first serverless function

CLI

AWS CLI

The following command shows all log streams starting with the prefix 2015 in the log group my-logs:

```
aws logs describe-log-streams --log-group-name my-logs --log-stream-name-
prefix 2015
```

Output:

```
{
    "logStreams": [
        {
            "creationTime": 1433189871774,
            "arn": "arn:aws:logs:us-west-2:0123456789012:log-group:my-logs:log-
stream:20150531",
            "logStreamName": "20150531",
            "storedBytes": 0
        },
        {
            "creationTime": 1433189873898,
            "arn": "arn:aws:logs:us-west-2:0123456789012:log-group:my-logs:log-
stream:20150601",
            "logStreamName": "20150601",
            "storedBytes": 0
        }
    ]
}
```

- For API details, see DescribeLogStreams in *AWS CLI Command Reference*.

Java

SDK for Java 2.x

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

Searches for log streams within a specified log group that match a given prefix.

```
/**
 * Before running this Java V2 code example, set up your development
 * environment, including your credentials.
 * <p>
 * For more information, see the following documentation topic:
 * <p>
 * https://docs.aws.amazon.com/sdk-for-java/latest/developer-guide/get-
started.html
 */
public class CloudWatchLogsSearch {

    public static void main(String[] args) {
        final String usage = """

                Usage:
                  <logGroupName> <logStreamName>

                Where:
                  logGroupName - The name of the log group (for example,
 WeathertopJavaContainerLogs).
                  logStreamName - The name of the log stream (for example,
 weathertop-java-stream).
                  pattern - the pattern to use (for example, INFO)

                """;

        if (args.length != 3) {
            System.out.print(usage);
            System.exit(1);
        }
```

```
        String logGroupName = args[0] ;
        String logStreamName = args[1] ;
        String pattern = args[2] ;

        CloudWatchLogsClient cwlClient = CloudWatchLogsClient.builder()
                .region(Region.US_EAST_1)
                .build();

        searchLogStreamsAndFilterEvents(cwlClient, logGroupName, logStreamName,
pattern);
    }

    /**
     * Searches for log streams with a specific prefix within a log group and
filters log events based on a specified pattern.
     *
     * @param cwlClient       the CloudWatchLogsClient used to interact with AWS
CloudWatch Logs
     * @param logGroupName    the name of the log group to search within
     * @param logStreamPrefix the prefix of the log streams to search for
     * @param pattern         the pattern to filter log events by
     */
    public static void searchLogStreamsAndFilterEvents(CloudWatchLogsClient
cwlClient, String logGroupName, String logStreamPrefix, String pattern) {
        DescribeLogStreamsRequest describeLogStreamsRequest =
DescribeLogStreamsRequest.builder()
                .logGroupName(logGroupName)
                .logStreamNamePrefix(logStreamPrefix)
                .build();

        DescribeLogStreamsResponse describeLogStreamsResponse =
cwlClient.describeLogStreams(describeLogStreamsRequest);
        List<LogStream> logStreams = describeLogStreamsResponse.logStreams();

        for (LogStream logStream : logStreams) {
            String logStreamName = logStream.logStreamName();
            System.out.println("Searching in log stream: " + logStreamName);

            FilterLogEventsRequest filterLogEventsRequest =
FilterLogEventsRequest.builder()
                    .logGroupName(logGroupName)
                    .logStreamNames(logStreamName)
                    .filterPattern(pattern)
```

```
                    .build();

            FilterLogEventsResponse filterLogEventsResponse =
 cwlClient.filterLogEvents(filterLogEventsRequest);

            for (FilteredLogEvent event : filterLogEventsResponse.events()) {
                System.out.println(event.message());
            }


 System.out.println("-------------------------------------------------"); //
 Separator for better readability
        }
    }
}
```

Prints metadata about the most recent log stream in a specified log group.

```
/**
 * Before running this Java V2 code example, set up your development
 * environment, including your credentials.
 * <p>
 * For more information, see the following documentation topic:
 * <p>
 * https://docs.aws.amazon.com/sdk-for-java/latest/developer-guide/get-
started.html
 */
public class CloudWatchLogQuery {
    public static void main(final String[] args) {
        final String usage = """
                Usage:
                  <logGroupName>

                Where:
                  logGroupName - The name of the log group (for example, /aws/
lambda/ChatAIHandler).
                """;

        if (args.length != 1) {
            System.out.print(usage);
            System.exit(1);
```

```
        }

        String logGroupName = "/aws/lambda/ChatAIHandler" ; //args[0];
        CloudWatchLogsClient logsClient = CloudWatchLogsClient.builder()
                .region(Region.US_EAST_1)
                .build();

        describeMostRecentLogStream(logsClient, logGroupName);
    }

    /**
     * Describes and prints metadata about the most recent log stream in the
specified log group.
     *
     * @param logsClient   the CloudWatchLogsClient used to interact with AWS
CloudWatch Logs
     * @param logGroupName the name of the log group
     */
    public static void describeMostRecentLogStream(CloudWatchLogsClient
logsClient, String logGroupName) {
        DescribeLogStreamsRequest streamsRequest =
DescribeLogStreamsRequest.builder()
                .logGroupName(logGroupName)
                .orderBy(OrderBy.LAST_EVENT_TIME)
                .descending(true)
                .limit(1)
                .build();

        try {
            DescribeLogStreamsResponse streamsResponse =
logsClient.describeLogStreams(streamsRequest);
            List<LogStream> logStreams = streamsResponse.logStreams();

            if (logStreams.isEmpty()) {
                System.out.println("No log streams found for log group: " +
logGroupName);
                return;
            }

            LogStream stream = logStreams.get(0);
            System.out.println("Most Recent Log Stream:");
            System.out.println("  Name: " + stream.logStreamName());
            System.out.println("  ARN: " + stream.arn());
            System.out.println("  Creation Time: " + stream.creationTime());
```

```
            System.out.println("  First Event Time: " +
 stream.firstEventTimestamp());
            System.out.println("  Last Event Time: " +
 stream.lastEventTimestamp());
            System.out.println("  Stored Bytes: " + stream.storedBytes());
            System.out.println("  Upload Sequence Token: " +
 stream.uploadSequenceToken());

        } catch (CloudWatchLogsException e) {
            System.err.println("Failed to describe log stream: " +
 e.awsErrorDetails().errorMessage());
        }
    }
}
```

- For API details, see DescribeLogStreams in *AWS SDK for Java 2.x API Reference*.

For a complete list of AWS SDK developer guides and code examples, see Using CloudWatch Logs with an AWS SDK. This topic also includes information about getting started and details about previous SDK versions.

Use `DescribeSubscriptionFilters` with an AWS SDK

The following code examples show how to use `DescribeSubscriptionFilters`.

C++

SDK for C++

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

Include the required files.

```
#include <aws/core/Aws.h>
#include <aws/core/utils/Outcome.h>
#include <aws/logs/CloudWatchLogsClient.h>
```

```
#include <aws/logs/model/DescribeSubscriptionFiltersRequest.h>
#include <aws/logs/model/DescribeSubscriptionFiltersResult.h>
#include <iostream>
#include <iomanip>
```

List the subscription filters.

```
        Aws::CloudWatchLogs::CloudWatchLogsClient cwl;
        Aws::CloudWatchLogs::Model::DescribeSubscriptionFiltersRequest request;
        request.SetLogGroupName(log_group);
        request.SetLimit(1);

        bool done = false;
        bool header = false;
        while (!done) {
            auto outcome = cwl.DescribeSubscriptionFilters(
                    request);
            if (!outcome.IsSuccess()) {
                std::cout << "Failed to describe CloudWatch subscription filters
 "
                    << "for log group " << log_group << ": " <<
                    outcome.GetError().GetMessage() << std::endl;
                break;
            }

            if (!header) {
                std::cout << std::left << std::setw(32) << "Name" <<
                    std::setw(64) << "FilterPattern" << std::setw(64) <<
                    "DestinationArn" << std::endl;
                header = true;
            }

            const auto &filters = outcome.GetResult().GetSubscriptionFilters();
            for (const auto &filter : filters) {
                std::cout << std::left << std::setw(32) <<
                    filter.GetFilterName() << std::setw(64) <<
                    filter.GetFilterPattern() << std::setw(64) <<
                    filter.GetDestinationArn() << std::endl;
            }

            const auto &next_token = outcome.GetResult().GetNextToken();
            request.SetNextToken(next_token);
```

```
            done = next_token.empty();
        }
```

- For API details, see DescribeSubscriptionFilters in *AWS SDK for C++ API Reference*.

Java

SDK for Java 2.x

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
import software.amazon.awssdk.auth.credentials.ProfileCredentialsProvider;
import software.amazon.awssdk.services.cloudwatch.model.CloudWatchException;
import software.amazon.awssdk.services.cloudwatchlogs.CloudWatchLogsClient;
import
 software.amazon.awssdk.services.cloudwatchlogs.model.DescribeSubscriptionFiltersRequest;
import
 software.amazon.awssdk.services.cloudwatchlogs.model.DescribeSubscriptionFiltersResponse
import software.amazon.awssdk.services.cloudwatchlogs.model.SubscriptionFilter;

/**
 * Before running this Java V2 code example, set up your development
 * environment, including your credentials.
 *
 * For more information, see the following documentation topic:
 *
 * https://docs.aws.amazon.com/sdk-for-java/latest/developer-guide/get-
started.html
 */
public class DescribeSubscriptionFilters {
    public static void main(String[] args) {

        final String usage = """

                Usage:
                  <logGroup>
```

```
                Where:
                  logGroup - A log group name (for example, myloggroup).
                """;

        if (args.length != 1) {
            System.out.println(usage);
            System.exit(1);
        }

        String logGroup = args[0];
        CloudWatchLogsClient logs = CloudWatchLogsClient.builder()
                .credentialsProvider(ProfileCredentialsProvider.create())
                .build();

        describeFilters(logs, logGroup);
        logs.close();
    }

    public static void describeFilters(CloudWatchLogsClient logs, String
logGroup) {
        try {
            boolean done = false;
            String newToken = null;

            while (!done) {
                DescribeSubscriptionFiltersResponse response;
                if (newToken == null) {
                    DescribeSubscriptionFiltersRequest request =
DescribeSubscriptionFiltersRequest.builder()
                            .logGroupName(logGroup)
                            .limit(1).build();

                    response = logs.describeSubscriptionFilters(request);
                } else {
                    DescribeSubscriptionFiltersRequest request =
DescribeSubscriptionFiltersRequest.builder()
                            .nextToken(newToken)
                            .logGroupName(logGroup)
                            .limit(1).build();
                    response = logs.describeSubscriptionFilters(request);
                }

                for (SubscriptionFilter filter : response.subscriptionFilters())
{
```

```
                    System.out.printf("Retrieved filter with name %s, " +
 "pattern %s " + "and destination arn %s",
                            filter.filterName(),
                            filter.filterPattern(),
                            filter.destinationArn());
                }

                if (response.nextToken() == null) {
                    done = true;
                } else {
                    newToken = response.nextToken();
                }
            }

        } catch (CloudWatchException e) {
            System.err.println(e.awsErrorDetails().errorMessage());
            System.exit(1);
        }
        System.out.printf("Done");
    }
}
```

- For API details, see DescribeSubscriptionFilters in *AWS SDK for Java 2.x API Reference*.

JavaScript

SDK for JavaScript (v3)

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
import { DescribeSubscriptionFiltersCommand } from "@aws-sdk/client-cloudwatch-
logs";
import { client } from "../libs/client.js";

const run = async () => {
  // This will return a list of all subscription filters in your account
  // matching the log group name.
```

```
  const command = new DescribeSubscriptionFiltersCommand({
    logGroupName: process.env.CLOUDWATCH_LOGS_LOG_GROUP,
    limit: 1,
  });

  try {
    return await client.send(command);
  } catch (err) {
    console.error(err);
  }
};

export default run();
```

- For API details, see DescribeSubscriptionFilters in *AWS SDK for JavaScript API Reference*.

SDK for JavaScript (v2)

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
// Load the AWS SDK for Node.js
var AWS = require("aws-sdk");
// Set the region
AWS.config.update({ region: "REGION" });

// Create the CloudWatchLogs service object
var cwl = new AWS.CloudWatchLogs({ apiVersion: "2014-03-28" });

var params = {
  logGroupName: "GROUP_NAME",
  limit: 5,
};

cwl.describeSubscriptionFilters(params, function (err, data) {
  if (err) {
    console.log("Error", err);
  } else {
    console.log("Success", data.subscriptionFilters);
```

```
  }
});
```

- For more information, see AWS SDK for JavaScript Developer Guide.
- For API details, see DescribeSubscriptionFilters in *AWS SDK for JavaScript API Reference*.

Kotlin

SDK for Kotlin

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
suspend fun describeFilters(logGroup: String) {
    val request =
        DescribeSubscriptionFiltersRequest {
            logGroupName = logGroup
            limit = 1
        }

    CloudWatchLogsClient.fromEnvironment { region = "us-west-2" }.use { cwlClient
 ->
        val response = cwlClient.describeSubscriptionFilters(request)
        response.subscriptionFilters?.forEach { filter ->
            println("Retrieved filter with name  ${filter.filterName} pattern
 ${filter.filterPattern} and destination ${filter.destinationArn}")
        }
    }
}
```

- For API details, see DescribeSubscriptionFilters in *AWS SDK for Kotlin API reference*.

For a complete list of AWS SDK developer guides and code examples, see Using CloudWatch Logs with an AWS SDK. This topic also includes information about getting started and details about previous SDK versions.

Use `GetLogEvents` with an AWS SDK or CLI

The following code examples show how to use `GetLogEvents`.

Action examples are code excerpts from larger programs and must be run in context. You can see this action in context in the following code example:

- Creating your first serverless function

CLI

AWS CLI

The following command retrieves log events from a log stream named `20150601` in the log group `my-logs`:

```
aws logs get-log-events --log-group-name my-logs --log-stream-name 20150601
```

Output:

```
{
    "nextForwardToken":
 "f/31961209122447488583055879464742346735121166569214640130",
    "events": [
        {
            "ingestionTime": 1433190494190,
            "timestamp": 1433190184356,
            "message": "Example Event 1"
        },
        {
            "ingestionTime": 1433190516679,
            "timestamp": 1433190184356,
            "message": "Example Event 1"
        },
        {
            "ingestionTime": 1433190494190,
            "timestamp": 1433190184358,
            "message": "Example Event 2"
        }
    ],
    "nextBackwardToken":
 "b/31961209122358285602261756944988674324553373268216709120"
```

```
}
```

- For API details, see GetLogEvents in *AWS CLI Command Reference*.

Java

SDK for Java 2.x

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
import software.amazon.awssdk.regions.Region;
import software.amazon.awssdk.services.cloudwatch.model.CloudWatchException;
import software.amazon.awssdk.services.cloudwatchlogs.CloudWatchLogsClient;
import
 software.amazon.awssdk.services.cloudwatchlogs.model.DescribeLogStreamsRequest;
import
 software.amazon.awssdk.services.cloudwatchlogs.model.DescribeLogStreamsResponse;
import software.amazon.awssdk.services.cloudwatchlogs.model.GetLogEventsRequest;
import software.amazon.awssdk.services.cloudwatchlogs.model.GetLogEventsResponse;

import java.time.Instant;
import java.time.temporal.ChronoUnit;

/**
 * Before running this Java V2 code example, set up your development
 * environment, including your credentials.
 *
 * For more information, see the following documentation topic:
 *
 * https://docs.aws.amazon.com/sdk-for-java/latest/developer-guide/get-
started.html
 */
public class GetLogEvents {

    public static void main(String[] args) {

        final String usage = """
```

```
                Usage:
                  <logGroupName> <logStreamName>

                Where:
                  logGroupName - The name of the log group (for example,
 myloggroup).
                  logStreamName - The name of the log stream (for example,
 mystream).

                """;

       // if (args.length != 2) {
       //     System.out.print(usage);
       //     System.exit(1);
//        }

        String logGroupName = "WeathertopJavaContainerLogs" ; //args[0];
        String logStreamName = "weathertop-java-stream" ; //args[1];

        Region region = Region.US_EAST_1 ;
        CloudWatchLogsClient cloudWatchLogsClient =
 CloudWatchLogsClient.builder()
                .region(region)
                .build();

        getCWLogEvents(cloudWatchLogsClient, logGroupName, logStreamName);
        cloudWatchLogsClient.close();
    }

    public static void getCWLogEvents(CloudWatchLogsClient cloudWatchLogsClient,
                                      String logGroupName,
                                      String logStreamPrefix) {
        try {
            // First, find the exact log stream name
            DescribeLogStreamsRequest describeRequest =
 DescribeLogStreamsRequest.builder()
                    .logGroupName(logGroupName)
                    .logStreamNamePrefix(logStreamPrefix)
                    .limit(1) // get the first matching stream
                    .build();

            DescribeLogStreamsResponse describeResponse =
 cloudWatchLogsClient.describeLogStreams(describeRequest);
```

```
            if (describeResponse.logStreams().isEmpty()) {
                System.out.println("No matching log streams found for prefix: " +
 logStreamPrefix);
                return;
            }

            String exactLogStreamName =
 describeResponse.logStreams().get(0).logStreamName();
            System.out.println("Using exact log stream: " + exactLogStreamName);

            long startTime = Instant.now().minus(7,
 ChronoUnit.DAYS).toEpochMilli();
            long endTime = Instant.now().toEpochMilli();

            GetLogEventsRequest getLogEventsRequest =
 GetLogEventsRequest.builder()
                    .logGroupName(logGroupName)
                    .logStreamName(exactLogStreamName) // <-- exact name, not
 prefix
                    .startTime(startTime)
                    .endTime(endTime)
                    .startFromHead(true)
                    .build();

            GetLogEventsResponse response =
 cloudWatchLogsClient.getLogEvents(getLogEventsRequest);

            if (response.events().isEmpty()) {
                System.out.println("No log events found in the past 7 days.");
            } else {
                response.events().forEach(e -> System.out.println(e.message()));
            }

        } catch (CloudWatchException e) {
            System.err.println(e.awsErrorDetails().errorMessage());
            System.exit(1);
        }
    }
}
```

- For API details, see GetLogEvents in *AWS SDK for Java 2.x API Reference*.

For a complete list of AWS SDK developer guides and code examples, see Using CloudWatch Logs with an AWS SDK. This topic also includes information about getting started and details about previous SDK versions.

Use `GetQueryResults` with an AWS SDK

The following code examples show how to use `GetQueryResults`.

Action examples are code excerpts from larger programs and must be run in context. You can see this action in context in the following code example:

- Run a large query

.NET

SDK for .NET (v4)

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
   /// <summary>
   /// Gets the results of a CloudWatch Logs Insights query.
   /// </summary>
   /// <param name="queryId">The ID of the query.</param>
   /// <returns>The query results response.</returns>
   public async Task<GetQueryResultsResponse?> GetQueryResultsAsync(string
queryId)
   {
       try
       {
           var request = new GetQueryResultsRequest
           {
               QueryId = queryId
           };

           var response = await
_amazonCloudWatchLogs.GetQueryResultsAsync(request);
           return response;
```

```
        }
        catch (ResourceNotFoundException ex)
        {
            _logger.LogError($"Query not found: {ex.Message}");
            return null;
        }
        catch (Exception ex)
        {
            _logger.LogError($"An error occurred while getting query results:
{ex.Message}");
            return null;
        }
    }
```

- For API details, see GetQueryResults in *AWS SDK for .NET API Reference*.

JavaScript

SDK for JavaScript (v3)

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
/**
 * Simple wrapper for the GetQueryResultsCommand.
 * @param {string} queryId
 */
_getQueryResults(queryId) {
  return this.client.send(new GetQueryResultsCommand({ queryId }));
}
```

- For API details, see GetQueryResults in *AWS SDK for JavaScript API Reference*.

Python

SDK for Python (Boto3)

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
    def _wait_for_query_results(self, client, query_id):
        """
        Waits for the query to complete and retrieves the results.

        :param query_id: The ID of the initiated query.
        :type query_id: str
        :return: A list containing the results of the query.
        :rtype: list
        """
        while True:
            time.sleep(1)
            results = client.get_query_results(queryId=query_id)
            if results["status"] in [
                "Complete",
                "Failed",
                "Cancelled",
                "Timeout",
                "Unknown",
            ]:
                return results.get("results", [])
```

- For API details, see GetQueryResults in *AWS SDK for Python (Boto3) API Reference*.

SAP ABAP

SDK for SAP ABAP

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
    TRY.
        oo_result = lo_cwl->getqueryresults(
          iv_queryid = iv_query_id ).

        " Display query status and result count
        DATA(lv_status) = oo_result->get_status( ).
        DATA(lt_results) = oo_result->get_results( ).
        DATA(lv_result_count) = lines( lt_results ).

        MESSAGE |Query status: { lv_status }. Retrieved { lv_result_count } log
event(s).| TYPE 'I'.
      CATCH /aws1/cx_cwlinvalidparameterex.
        MESSAGE 'Invalid parameter.' TYPE 'E'.
      CATCH /aws1/cx_cwlresourcenotfoundex.
        MESSAGE 'Resource not found.' TYPE 'E'.
      CATCH /aws1/cx_cwlserviceunavailex.
        MESSAGE 'Service unavailable.' TYPE 'E'.
    ENDTRY.
```

- For API details, see GetQueryResults in *AWS SDK for SAP ABAP API reference*.

For a complete list of AWS SDK developer guides and code examples, see Using CloudWatch Logs with an AWS SDK. This topic also includes information about getting started and details about previous SDK versions.

Use `PutSubscriptionFilter` with an AWS SDK

The following code examples show how to use `PutSubscriptionFilter`.

C++

SDK for C++

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

Include the required files.

```
#include <aws/core/Aws.h>
#include <aws/logs/CloudWatchLogsClient.h>
#include <aws/logs/model/PutSubscriptionFilterRequest.h>
#include <aws/core/utils/Outcome.h>
#include <iostream>
```

Create the subscription filter.

```
        Aws::CloudWatchLogs::CloudWatchLogsClient cwl;
        Aws::CloudWatchLogs::Model::PutSubscriptionFilterRequest request;
        request.SetFilterName(filter_name);
        request.SetFilterPattern(filter_pattern);
        request.SetLogGroupName(log_group);
        request.SetDestinationArn(dest_arn);
        auto outcome = cwl.PutSubscriptionFilter(request);
        if (!outcome.IsSuccess())
        {
            std::cout << "Failed to create CloudWatch logs subscription filter "
                << filter_name << ": " << outcome.GetError().GetMessage() <<
                std::endl;
        }
        else
        {
            std::cout << "Successfully created CloudWatch logs subscription " <<
                "filter " << filter_name << std::endl;
        }
```

- For API details, see PutSubscriptionFilter in *AWS SDK for C++ API Reference*.

Java

SDK for Java 2.x

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
import software.amazon.awssdk.regions.Region;
import software.amazon.awssdk.services.cloudwatchlogs.CloudWatchLogsClient;
import
 software.amazon.awssdk.services.cloudwatchlogs.model.CloudWatchLogsException;
import
 software.amazon.awssdk.services.cloudwatchlogs.model.PutSubscriptionFilterRequest;

/**
 * Before running this code example, you need to grant permission to CloudWatch
 * Logs the right to execute your Lambda function.
 * To perform this task, you can use this CLI command:
 *
 * aws lambda add-permission --function-name "lamda1" --statement-id "lamda1"
 * --principal "logs.us-west-2.amazonaws.com" --action "lambda:InvokeFunction"
 * --source-arn "arn:aws:logs:us-west-2:111111111111:log-group:testgroup:*"
 * --source-account "111111111111"
 *
 * Make sure you replace the function name with your function name and replace
 * '111111111111' with your account details.
 * For more information, see "Subscription Filters with AWS Lambda" in the
 * Amazon CloudWatch Logs Guide.
 *
 *
 * Also, before running this Java V2 code example,set up your development
 * environment,including your credentials.
 *
 * For more information,see the following documentation topic:
 *
 * https://docs.aws.amazon.com/sdk-for-java/latest/developer-guide/get-
started.html
 *
 */
```

```
public class PutSubscriptionFilter {
    public static void main(String[] args) {
        final String usage = """

                Usage:
                  <filter> <pattern> <logGroup> <functionArn>\s

                Where:
                  filter - A filter name (for example, myfilter).
                  pattern - A filter pattern (for example, ERROR).
                  logGroup - A log group name (testgroup).
                  functionArn - An AWS Lambda function ARN (for example,
 arn:aws:lambda:us-west-2:111111111111:function:lambda1) .
                """;

        if (args.length != 4) {
            System.out.println(usage);
            System.exit(1);
        }

        String filter = args[0];
        String pattern = args[1];
        String logGroup = args[2];
        String functionArn = args[3];
        Region region = Region.US_WEST_2;
        CloudWatchLogsClient cwl = CloudWatchLogsClient.builder()
                .region(region)
                .build();

        putSubFilters(cwl, filter, pattern, logGroup, functionArn);
        cwl.close();
    }

    public static void putSubFilters(CloudWatchLogsClient cwl,
            String filter,
            String pattern,
            String logGroup,
            String functionArn) {

        try {
            PutSubscriptionFilterRequest request =
 PutSubscriptionFilterRequest.builder()
                    .filterName(filter)
```

```
                    .filterPattern(pattern)
                    .logGroupName(logGroup)
                    .destinationArn(functionArn)
                    .build();

            cwl.putSubscriptionFilter(request);
            System.out.printf(
                    "Successfully created CloudWatch logs subscription filter
 %s",
                    filter);

        } catch (CloudWatchLogsException e) {
            System.err.println(e.awsErrorDetails().errorMessage());
            System.exit(1);
        }
    }
}
```

- For API details, see PutSubscriptionFilter in *AWS SDK for Java 2.x API Reference*.

JavaScript

SDK for JavaScript (v3)

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
import { PutSubscriptionFilterCommand } from "@aws-sdk/client-cloudwatch-logs";
import { client } from "../libs/client.js";

const run = async () => {
  const command = new PutSubscriptionFilterCommand({
    // An ARN of a same-account Kinesis stream, Kinesis Firehose
    // delivery stream, or Lambda function.
    // https://docs.aws.amazon.com/AmazonCloudWatch/latest/logs/
SubscriptionFilters.html
    destinationArn: process.env.CLOUDWATCH_LOGS_DESTINATION_ARN,
```

```
    // A name for the filter.
    filterName: process.env.CLOUDWATCH_LOGS_FILTER_NAME,

    // A filter pattern for subscribing to a filtered stream of log events.
    // https://docs.aws.amazon.com/AmazonCloudWatch/latest/logs/
FilterAndPatternSyntax.html
    filterPattern: process.env.CLOUDWATCH_LOGS_FILTER_PATTERN,

    // The name of the log group. Messages in this group matching the filter
 pattern
    // will be sent to the destination ARN.
    logGroupName: process.env.CLOUDWATCH_LOGS_LOG_GROUP,
  });

  try {
    return await client.send(command);
  } catch (err) {
    console.error(err);
  }
};

export default run();
```

- For API details, see PutSubscriptionFilter in *AWS SDK for JavaScript API Reference*.

SDK for JavaScript (v2)

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
// Load the AWS SDK for Node.js
var AWS = require("aws-sdk");
// Set the region
AWS.config.update({ region: "REGION" });

// Create the CloudWatchLogs service object
var cwl = new AWS.CloudWatchLogs({ apiVersion: "2014-03-28" });

var params = {
```

```
  destinationArn: "LAMBDA_FUNCTION_ARN",
  filterName: "FILTER_NAME",
  filterPattern: "ERROR",
  logGroupName: "LOG_GROUP",
};

cwl.putSubscriptionFilter(params, function (err, data) {
  if (err) {
    console.log("Error", err);
  } else {
    console.log("Success", data);
  }
});
```

- For more information, see AWS SDK for JavaScript Developer Guide.
- For API details, see PutSubscriptionFilter in *AWS SDK for JavaScript API Reference*.

For a complete list of AWS SDK developer guides and code examples, see Using CloudWatch Logs with an AWS SDK. This topic also includes information about getting started and details about previous SDK versions.

Use `StartLiveTail` with an AWS SDK

The following code examples show how to use `StartLiveTail`.

.NET

SDK for .NET

Include the required files.

```
using Amazon;
using Amazon.CloudWatchLogs;
using Amazon.CloudWatchLogs.Model;
```

Start the Live Tail session.

```
            var client = new AmazonCloudWatchLogsClient();
            var request = new StartLiveTailRequest
```

```
            {
                LogGroupIdentifiers = logGroupIdentifiers,
                LogStreamNames = logStreamNames,
                LogEventFilterPattern = filterPattern,
            };

            var response = await client.StartLiveTailAsync(request);

            // Catch if request fails
            if (response.HttpStatusCode != System.Net.HttpStatusCode.OK)
            {
                Console.WriteLine("Failed to start live tail session");
                return;
            }
```

You can handle the events from the Live Tail session in two ways:

```
            /* Method 1
            * 1). Asynchronously loop through the event stream
            * 2). Set a timer to dispose the stream and stop the Live Tail
session at the end.
            */
            var eventStream = response.ResponseStream;
            var task = Task.Run(() =>
            {
                foreach (var item in eventStream)
                {
                    if (item is LiveTailSessionUpdate liveTailSessionUpdate)
                    {
                        foreach (var sessionResult in
liveTailSessionUpdate.SessionResults)
                        {
                            Console.WriteLine("Message : {0}",
sessionResult.Message);
                        }
                    }
                    if (item is LiveTailSessionStart)
                    {
                        Console.WriteLine("Live Tail session started");
                    }
                    // On-stream exceptions are processed here
                    if (item is CloudWatchLogsEventStreamException)
```

```
                    {
                        Console.WriteLine($"ERROR: {item}");
                    }
                }
            });
            // Close the stream to stop the session after a timeout
            if (!task.Wait(TimeSpan.FromSeconds(10))){
                eventStream.Dispose();
                Console.WriteLine("End of line");
            }
```

```
            /* Method 2
            * 1). Add event handlers to each event variable
            * 2). Start processing the stream and wait for a timeout using
AutoResetEvent
            */
            AutoResetEvent endEvent = new AutoResetEvent(false);
            var eventStream = response.ResponseStream;
            using (eventStream) // automatically disposes the stream to stop the
session after execution finishes
            {
                eventStream.SessionStartReceived += (sender, e) =>
                {
                    Console.WriteLine("LiveTail session started");
                };
                eventStream.SessionUpdateReceived += (sender, e) =>
                {
                    foreach (LiveTailSessionLogEvent logEvent in
e.EventStreamEvent.SessionResults){
                        Console.WriteLine("Message: {0}", logEvent.Message);
                    }
                };
                // On-stream exceptions are captured here
                eventStream.ExceptionReceived += (sender, e) =>
                {
                    Console.WriteLine($"ERROR:
{e.EventStreamException.Message}");
                };

                eventStream.StartProcessing();
                // Stream events for this amount of time.
                endEvent.WaitOne(TimeSpan.FromSeconds(10));
```

```
                Console.WriteLine("End of line");
            }
```

- For API details, see StartLiveTail in *AWS SDK for .NET API Reference*.

Go

SDK for Go V2

Include the required files.

```
import (
 "context"
 "log"
 "time"

 "github.com/aws/aws-sdk-go-v2/config"
 "github.com/aws/aws-sdk-go-v2/service/cloudwatchlogs"
 "github.com/aws/aws-sdk-go-v2/service/cloudwatchlogs/types"
)
```

Handle the events from the Live Tail session.

```
func handleEventStreamAsync(stream *cloudwatchlogs.StartLiveTailEventStream) {
 eventsChan := stream.Events()
 for {
  event := <-eventsChan
  switch e := event.(type) {
  case *types.StartLiveTailResponseStreamMemberSessionStart:
   log.Println("Received SessionStart event")
  case *types.StartLiveTailResponseStreamMemberSessionUpdate:
   for _, logEvent := range e.Value.SessionResults {
    log.Println(*logEvent.Message)
   }
  default:
   // Handle on-stream exceptions
   if err := stream.Err(); err != nil {
    log.Fatalf("Error occured during streaming: %v", err)
   } else if event == nil {
    log.Println("Stream is Closed")
```

```
    return
   } else {
    log.Fatalf("Unknown event type: %T", e)
   }
  }
 }
}
```

Start the Live Tail session.

```
cfg, err := config.LoadDefaultConfig(context.TODO())
if err != nil {
 panic("configuration error, " + err.Error())
}
client := cloudwatchlogs.NewFromConfig(cfg)

request := &cloudwatchlogs.StartLiveTailInput{
 LogGroupIdentifiers:   logGroupIdentifiers,
 LogStreamNames:        logStreamNames,
 LogEventFilterPattern: logEventFilterPattern,
}

response, err := client.StartLiveTail(context.TODO(), request)
// Handle pre-stream Exceptions
if err != nil {
 log.Fatalf("Failed to start streaming: %v", err)
}

// Start a Goroutine to handle events over stream
stream := response.GetStream()
go handleEventStreamAsync(stream)
```

Stop the Live Tail session after a period of time has elapsed.

```
// Close the stream (which ends the session) after a timeout
time.Sleep(10 * time.Second)
stream.Close()
log.Println("Event stream closed")
```

- For API details, see StartLiveTail in *AWS SDK for Go API Reference*.

Java

SDK for Java 2.x

Include the required files.

```
import io.reactivex.FlowableSubscriber;
import io.reactivex.annotations.NonNull;
import org.reactivestreams.Subscription;
import software.amazon.awssdk.auth.credentials.ProfileCredentialsProvider;
import software.amazon.awssdk.services.cloudwatchlogs.CloudWatchLogsAsyncClient;
import
 software.amazon.awssdk.services.cloudwatchlogs.model.LiveTailSessionLogEvent;
import software.amazon.awssdk.services.cloudwatchlogs.model.LiveTailSessionStart;
import
 software.amazon.awssdk.services.cloudwatchlogs.model.LiveTailSessionUpdate;
import software.amazon.awssdk.services.cloudwatchlogs.model.StartLiveTailRequest;
import
 software.amazon.awssdk.services.cloudwatchlogs.model.StartLiveTailResponseHandler;
import
 software.amazon.awssdk.services.cloudwatchlogs.model.CloudWatchLogsException;
import
 software.amazon.awssdk.services.cloudwatchlogs.model.StartLiveTailResponseStream;

import java.util.Date;
import java.util.List;
import java.util.concurrent.atomic.AtomicReference;
```

Handle the events from the Live Tail session.

```
    private static StartLiveTailResponseHandler
 getStartLiveTailResponseStreamHandler(
            AtomicReference<Subscription> subscriptionAtomicReference) {
        return StartLiveTailResponseHandler.builder()
            .onResponse(r -> System.out.println("Received initial response"))
            .onError(throwable -> {
                CloudWatchLogsException e = (CloudWatchLogsException)
 throwable.getCause();
                System.err.println(e.awsErrorDetails().errorMessage());
                System.exit(1);
            })
            .subscriber(() -> new FlowableSubscriber<>() {
```

```
                @Override
                public void onSubscribe(@NonNull Subscription s) {
                    subscriptionAtomicReference.set(s);
                    s.request(Long.MAX_VALUE);
                }

                @Override
                public void onNext(StartLiveTailResponseStream event) {
                    if (event instanceof LiveTailSessionStart) {
                        LiveTailSessionStart sessionStart =
(LiveTailSessionStart) event;
                        System.out.println(sessionStart);
                    } else if (event instanceof LiveTailSessionUpdate) {
                        LiveTailSessionUpdate sessionUpdate =
(LiveTailSessionUpdate) event;
                        List<LiveTailSessionLogEvent> logEvents =
sessionUpdate.sessionResults();
                        logEvents.forEach(e -> {
                            long timestamp = e.timestamp();
                            Date date = new Date(timestamp);
                            System.out.println("[" + date + "] " + e.message());
                        });
                    } else {
                        throw CloudWatchLogsException.builder().message("Unknown
event type").build();
                    }
                }

                @Override
                public void onError(Throwable throwable) {
                    System.out.println(throwable.getMessage());
                    System.exit(1);
                }

                @Override
                public void onComplete() {
                    System.out.println("Completed Streaming Session");
                }
            })
            .build();
    }
```

Start the Live Tail session.

```
        CloudWatchLogsAsyncClient cloudWatchLogsAsyncClient =
                CloudWatchLogsAsyncClient.builder()
                    .credentialsProvider(ProfileCredentialsProvider.create())
                    .build();

        StartLiveTailRequest request =
                StartLiveTailRequest.builder()
                    .logGroupIdentifiers(logGroupIdentifiers)
                    .logStreamNames(logStreamNames)
                    .logEventFilterPattern(logEventFilterPattern)
                    .build();

        /* Create a reference to store the subscription */
        final AtomicReference<Subscription> subscriptionAtomicReference = new
AtomicReference<>(null);

        cloudWatchLogsAsyncClient.startLiveTail(request,
getStartLiveTailResponseStreamHandler(subscriptionAtomicReference));
```

Stop the Live Tail session after a period of time has elapsed.

```
        /* Set a timeout for the session and cancel the subscription. This will:
         * 1). Close the stream
         * 2). Stop the Live Tail session
         */
        try {
            Thread.sleep(10000);
        } catch (InterruptedException e) {
            throw new RuntimeException(e);
        }
        if (subscriptionAtomicReference.get() != null) {
            subscriptionAtomicReference.get().cancel();
            System.out.println("Subscription to stream closed");
        }
```

- For API details, see StartLiveTail in *AWS SDK for Java 2.x API Reference*.

JavaScript

SDK for JavaScript (v3)

Include the required files.

```
import { CloudWatchLogsClient, StartLiveTailCommand } from "@aws-sdk/client-
cloudwatch-logs";
```

Handle the events from the Live Tail session.

```
async function handleResponseAsync(response) {
    try {
      for await (const event of response.responseStream) {
        if (event.sessionStart !== undefined) {
          console.log(event.sessionStart);
        } else if (event.sessionUpdate !== undefined) {
          for (const logEvent of event.sessionUpdate.sessionResults) {
            const timestamp = logEvent.timestamp;
            const date = new Date(timestamp);
            console.log("[" + date + "] " + logEvent.message);
          }
        } else {
            console.error("Unknown event type");
        }
      }
    } catch (err) {
        // On-stream exceptions are captured here
        console.error(err)
    }
}
```

Start the Live Tail session.

```
    const client = new CloudWatchLogsClient();

    const command = new StartLiveTailCommand({
        logGroupIdentifiers: logGroupIdentifiers,
        logStreamNames: logStreamNames,
        logEventFilterPattern: filterPattern
    });
```

```
    try{
        const response = await client.send(command);
        handleResponseAsync(response);
    } catch (err){
        // Pre-stream exceptions are captured here
        console.log(err);
    }
```

Stop the Live Tail session after a period of time has elapsed.

```
    /* Set a timeout to close the client. This will stop the Live Tail session.
 */
    setTimeout(function() {
        console.log("Client timeout");
        client.destroy();
      }, 10000);
```

- For API details, see StartLiveTail in *AWS SDK for JavaScript API Reference*.

Kotlin

SDK for Kotlin

Include the required files.

```
import aws.sdk.kotlin.services.cloudwatchlogs.CloudWatchLogsClient
import aws.sdk.kotlin.services.cloudwatchlogs.model.StartLiveTailRequest
import aws.sdk.kotlin.services.cloudwatchlogs.model.StartLiveTailResponseStream
import kotlinx.coroutines.flow.takeWhile
```

Start the Live Tail session.

```
    val client = CloudWatchLogsClient.fromEnvironment()

    val request = StartLiveTailRequest {
        logGroupIdentifiers = logGroupIdentifiersVal
        logStreamNames = logStreamNamesVal
        logEventFilterPattern = logEventFilterPatternVal
    }
```

```
    val startTime = System.currentTimeMillis()

    try {
        client.startLiveTail(request) { response ->
            val stream = response.responseStream
            if (stream != null) {
                /* Set a timeout to unsubcribe from the flow. This will:
                * 1). Close the stream
                * 2). Stop the Live Tail session
                */
                stream.takeWhile { System.currentTimeMillis() - startTime <
10000 }.collect { value ->
                    if (value is StartLiveTailResponseStream.SessionStart) {
                        println(value.asSessionStart())
                    } else if (value is
StartLiveTailResponseStream.SessionUpdate) {
                        for (e in value.asSessionUpdate().sessionResults!!) {
                            println(e)
                        }
                    } else {
                        throw IllegalArgumentException("Unknown event type")
                    }
                }
            } else {
                throw IllegalArgumentException("No response stream")
            }
        }
    } catch (e: Exception) {
        println("Exception occurred during StartLiveTail: $e")
        System.exit(1)
    }
```

- For API details, see StartLiveTail in *AWS SDK for Kotlin API reference*.

Python

SDK for Python (Boto3)

Include the required files.

```
import boto3
```

```
import time
from datetime import datetime
```

Start the Live Tail session.

```
    # Initialize the client
    client = boto3.client('logs')

    start_time = time.time()

    try:
        response = client.start_live_tail(
            logGroupIdentifiers=log_group_identifiers,
            logStreamNames=log_streams,
            logEventFilterPattern=filter_pattern
        )
        event_stream = response['responseStream']
        # Handle the events streamed back in the response
        for event in event_stream:
            # Set a timeout to close the stream.
            # This will end the Live Tail session.
            if (time.time() - start_time >= 10):
                event_stream.close()
                break
            # Handle when session is started
            if 'sessionStart' in event:
                session_start_event = event['sessionStart']
                print(session_start_event)
            # Handle when log event is given in a session update
            elif 'sessionUpdate' in event:
                log_events = event['sessionUpdate']['sessionResults']
                for log_event in log_events:
                    print('[{date}]
{log}'.format(date=datetime.fromtimestamp(log_event['timestamp']/1000),log=log_event['me
            else:
                # On-stream exceptions are captured here
                raise RuntimeError(str(event))
    except Exception as e:
        print(e)
```

- For API details, see StartLiveTail in *AWS SDK for Python (Boto3) API Reference*.

For a complete list of AWS SDK developer guides and code examples, see Using CloudWatch Logs with an AWS SDK. This topic also includes information about getting started and details about previous SDK versions.

Use `StartQuery` with an AWS SDK

The following code examples show how to use `StartQuery`.

Action examples are code excerpts from larger programs and must be run in context. You can see this action in context in the following code example:

- Run a large query

.NET

SDK for .NET (v4)

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
    /// <summary>
    /// Starts a CloudWatch Logs Insights query.
    /// </summary>
    /// <param name="logGroupName">The name of the log group to query.</param>
    /// <param name="queryString">The CloudWatch Logs Insights query string.</
param>
    /// <param name="startTime">The start time for the query (seconds since
 epoch).</param>
    /// <param name="endTime">The end time for the query (seconds since epoch).</
param>
    /// <param name="limit">The maximum number of results to return.</param>
    /// <returns>The query ID if successful, null otherwise.</returns>
    public async Task<string?> StartQueryAsync(
        string logGroupName,
        string queryString,
        long startTime,
        long endTime,
        int limit = 10000)
```

```
    {
        try
        {
            var request = new StartQueryRequest
            {
                LogGroupName = logGroupName,
                QueryString = queryString,
                StartTime = startTime,
                EndTime = endTime,
                Limit = limit
            };

            var response = await _amazonCloudWatchLogs.StartQueryAsync(request);
            return response.QueryId;
        }
        catch (InvalidParameterException ex)
        {
            _logger.LogError($"Invalid parameter for query: {ex.Message}");
            return null;
        }
        catch (ResourceNotFoundException ex)
        {
            _logger.LogError($"Log group not found: {ex.Message}");
            return null;
        }
        catch (Exception ex)
        {
            _logger.LogError($"An error occurred while starting query:
{ex.Message}");
            return null;
        }
    }
```

- For API details, see StartQuery in *AWS SDK for .NET API Reference*.

JavaScript

SDK for JavaScript (v3)

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
/**
 * Wrapper for the StartQueryCommand. Uses a static query string
 * for consistency.
 * @param {[Date, Date]} dateRange
 * @param {number} maxLogs
 * @returns {Promise<{ queryId: string }>}
 */
async _startQuery([startDate, endDate], maxLogs = 10000) {
  try {
    return await this.client.send(
      new StartQueryCommand({
        logGroupNames: this.logGroupNames,
        queryString: "fields @timestamp, @message | sort @timestamp asc",
        startTime: startDate.valueOf(),
        endTime: endDate.valueOf(),
        limit: maxLogs,
      }),
    );
  } catch (err) {
    /** @type {string} */
    const message = err.message;
    if (message.startsWith("Query's end date and time")) {
      // This error indicates that the query's start or end date occur
      // before the log group was created.
      throw new DateOutOfBoundsError(message);
    }

    throw err;
  }
}
```

- For API details, see StartQuery in *AWS SDK for JavaScript API Reference*.

Python

SDK for Python (Boto3)

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
    def perform_query(self, date_range):
        """
        Performs the actual CloudWatch log query.

        :param date_range: A tuple representing the start and end datetime for
the query.
        :type date_range: tuple
        :return: A list containing the query results.
        :rtype: list
        """
        client = boto3.client("logs")
        try:
            try:
                start_time = round(

self.date_utilities.convert_iso8601_to_unix_timestamp(date_range[0])
                )
                end_time = round(

self.date_utilities.convert_iso8601_to_unix_timestamp(date_range[1])
                )
                response = client.start_query(
                    logGroupName=self.log_group,
                    startTime=start_time,
                    endTime=end_time,
                    queryString=self.query_string,
                    limit=self.limit,
                )
                query_id = response["queryId"]
            except client.exceptions.ResourceNotFoundException as e:
```

```
                raise DateOutOfBoundsError(f"Resource not found: {e}")
            while True:
                time.sleep(1)
                results = client.get_query_results(queryId=query_id)
                if results["status"] in [
                    "Complete",
                    "Failed",
                    "Cancelled",
                    "Timeout",
                    "Unknown",
                ]:
                    return results.get("results", [])
        except DateOutOfBoundsError:
            return []

    def _initiate_query(self, client, date_range, max_logs):
        """
        Initiates the CloudWatch logs query.

        :param date_range: A tuple representing the start and end datetime for
the query.
        :type date_range: tuple
        :param max_logs: The maximum number of logs to retrieve.
        :type max_logs: int
        :return: The query ID as a string.
        :rtype: str
        """
        try:
            start_time = round(

self.date_utilities.convert_iso8601_to_unix_timestamp(date_range[0])
            )
            end_time = round(

self.date_utilities.convert_iso8601_to_unix_timestamp(date_range[1])
            )
            response = client.start_query(
                logGroupName=self.log_group,
                startTime=start_time,
                endTime=end_time,
                queryString=self.query_string,
                limit=max_logs,
            )
            return response["queryId"]
```

```
        except client.exceptions.ResourceNotFoundException as e:
            raise DateOutOfBoundsError(f"Resource not found: {e}")
```

- For API details, see StartQuery in *AWS SDK for Python (Boto3) API Reference*.

SAP ABAP

SDK for SAP ABAP

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

```
   TRY.
       " iv_log_group_name = '/aws/lambda/my-function'
       " iv_query_string = 'fields @timestamp, @message | sort @timestamp desc |
limit 20'
       " iv_start_time and iv_end_time must be in Unix epoch milliseconds (ms
since Jan 1, 1970 00:00:00 UTC)
       oo_result = lo_cwl->startquery(
         iv_loggroupname = iv_log_group_name
         iv_starttime    = iv_start_time
         iv_endtime      = iv_end_time
         iv_querystring  = iv_query_string
         iv_limit        = iv_limit ).

       " Display the query ID for tracking
       DATA(lv_query_id) = oo_result->get_queryid( ).
       MESSAGE |Query started successfully with ID: { lv_query_id }| TYPE 'I'.
     CATCH /aws1/cx_cwlinvalidparameterex.
       MESSAGE 'Invalid parameter.' TYPE 'E'.
     CATCH /aws1/cx_cwllimitexceededex.
       MESSAGE 'Limit exceeded.' TYPE 'E'.
     CATCH /aws1/cx_cwlmalformedqueryex.
       MESSAGE 'Malformed query.' TYPE 'E'.
     CATCH /aws1/cx_cwlresourcenotfoundex.
       MESSAGE 'Resource not found.' TYPE 'E'.
     CATCH /aws1/cx_cwlserviceunavailex.
```

```
        MESSAGE 'Service unavailable.' TYPE 'E'.
    ENDTRY.
```

- For API details, see StartQuery in *AWS SDK for SAP ABAP API reference*.

For a complete list of AWS SDK developer guides and code examples, see Using CloudWatch Logs with an AWS SDK. This topic also includes information about getting started and details about previous SDK versions.

Scenarios for CloudWatch Logs using AWS SDKs

The following code examples show you how to implement common scenarios in CloudWatch Logs with AWS SDKs. These scenarios show you how to accomplish specific tasks by calling multiple functions within CloudWatch Logs or combined with other AWS services. Each scenario includes a link to the complete source code, where you can find instructions on how to set up and run the code.

Scenarios target an intermediate level of experience to help you understand service actions in context.

Examples

- Configure container service connectivity
- Creating your first serverless function
- Use CloudWatch Logs to run a large query
- Use scheduled events to invoke a Lambda function

Configure container service connectivity

The following code example shows how to:

- Create the VPC infrastructure
- Set up logging
- Create the ECS cluster
- Configure IAM roles
- Create the service with Service Connect

- Verify the deployment
- Clean up resources

Bash

AWS CLI with Bash script

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the Sample developer tutorials repository.

```
#!/bin/bash

# ECS Service Connect Tutorial Script v4 - Modified to use Default VPC
# This script creates an ECS cluster with Service Connect and deploys an nginx
 service
# Uses the default VPC to avoid VPC limits

set -e  # Exit on any error

# Configuration
SCRIPT_NAME="ECS Service Connect Tutorial"
LOG_FILE="ecs-service-connect-tutorial-v4-default-vpc.log"
REGION=${AWS_DEFAULT_REGION:-${AWS_REGION:-$(aws configure get region 2>/dev/
null)}}
if [ -z "$REGION" ]; then
    echo "ERROR: No AWS region configured."
    echo "Set one with: aws configure set region us-east-1"
    exit 1
fi
ENV_PREFIX="tutorial"
CLUSTER_NAME="${ENV_PREFIX}-cluster"
NAMESPACE_NAME="service-connect"

# Generate random suffix for unique resource names
RANDOM_SUFFIX=$(openssl rand -hex 6)

# Arrays to track created resources for cleanup
declare -a CREATED_RESOURCES=()
```

```
# Logging function
log() {
    echo "[$(date '+%Y-%m-%d %H:%M:%S')] $1" | tee -a "$LOG_FILE"
}

# Error handling function
handle_error() {
    log "ERROR: Script failed at line $1"
    log "Attempting to clean up resources..."
    cleanup_resources
    exit 1
}

# Set up error handling
trap 'handle_error $LINENO' ERR

# Function to add resource to tracking array
track_resource() {
    CREATED_RESOURCES+=("$1")
    log "Tracking resource: $1"
}

# Function to check if command output contains actual errors
check_for_errors() {
    local output="$1"
    local command_name="$2"

    # Check for specific AWS CLI error patterns, not just any occurrence of
 "error"
    if echo "$output" | grep -qi "An error occurred\|InvalidParameterException\|
AccessDenied\|ValidationException\|ResourceNotFoundException"; then
        log "ERROR in $command_name: $output"
        return 1
    fi
    return 0
}

# Function to get AWS account ID
get_account_id() {
    ACCOUNT_ID=$(aws sts get-caller-identity --query Account --output text)
    log "Using AWS Account ID: $ACCOUNT_ID"
}
```

```
# Function to wait for resources to be ready
wait_for_resource() {
    local resource_type="$1"
    local resource_id="$2"

    case "$resource_type" in
        "cluster")
            log "Waiting for cluster $resource_id to be active..."
            local attempt=1
            local max_attempts=30
            while [ $attempt -le $max_attempts ]; do
                local status=$(aws ecs describe-clusters --clusters
 "$resource_id" --query 'clusters[0].status' --output text)
                if [ "$status" = "ACTIVE" ]; then
                    log "Cluster is now active"
                    return 0
                fi
                log "Cluster status: $status (attempt $attempt/$max_attempts)"
                sleep 10
                ((attempt++))
            done
            log "ERROR: Cluster did not become active within expected time"
            return 1
            ;;
        "service")
            log "Waiting for service $resource_id to be stable..."
            aws ecs wait services-stable --cluster "$CLUSTER_NAME" --services
 "$resource_id"
            ;;
        "nat-gateway")
            log "Waiting for NAT Gateway $resource_id to be available..."
            aws ec2 wait nat-gateway-available --nat-gateway-ids "$resource_id"
            ;;
    esac
}

# Function to use default VPC infrastructure
setup_default_vpc_infrastructure() {
    log "Using default VPC infrastructure..."

    # Get default VPC
    VPC_ID=$(aws ec2 describe-vpcs --filters "Name=isDefault,Values=true" --query
 'Vpcs[0].VpcId' --output text)
    if [[ "$VPC_ID" == "None" || -z "$VPC_ID" ]]; then
```

```
        log "ERROR: No default VPC found. Please create a default VPC first."
        exit 1
    fi
    log "Using default VPC: $VPC_ID"

    # Get default subnets
    SUBNETS=$(aws ec2 describe-subnets --filters "Name=vpc-id,Values=$VPC_ID"
 "Name=default-for-az,Values=true" --query 'Subnets[].SubnetId' --output text)
    SUBNET_ARRAY=($SUBNETS)

    if [ ${#SUBNET_ARRAY[@]} -lt 2 ]; then
        log "ERROR: Need at least 2 subnets for ECS Service Connect. Found:
 ${#SUBNET_ARRAY[@]}"
        exit 1
    fi

    PUBLIC_SUBNET1=${SUBNET_ARRAY[0]}
    PUBLIC_SUBNET2=${SUBNET_ARRAY[1]}

    log "Using subnets: $PUBLIC_SUBNET1, $PUBLIC_SUBNET2"

    # Create security group for ECS tasks
    SG_OUTPUT=$(aws ec2 create-security-group \
        --group-name "${ENV_PREFIX}-ecs-sg-${RANDOM_SUFFIX}" \
        --description "Security group for ECS Service Connect tutorial" \
        --vpc-id "$VPC_ID" \
        --tag-specifications 'ResourceType=security-
group,Tags=[{Key=project,Value=doc-smith},{Key=tutorial,Value=amazon-ecs-service-
connect}]' 2>&1)
    check_for_errors "$SG_OUTPUT" "create-security-group"
    SECURITY_GROUP_ID=$(echo "$SG_OUTPUT" | grep -o '"GroupId": "[^"]*"' | cut -
d'"' -f4)
    track_resource "SG:$SECURITY_GROUP_ID"
    log "Created security group: $SECURITY_GROUP_ID"

    # Add inbound rules to security group
    aws ec2 authorize-security-group-ingress \
        --group-id "$SECURITY_GROUP_ID" \
        --protocol tcp \
        --port 80 \
        --cidr 0.0.0.0/0 >/dev/null 2>&1 || true

    aws ec2 authorize-security-group-ingress \
        --group-id "$SECURITY_GROUP_ID" \
```

```
        --protocol tcp \
        --port 443 \
        --cidr 0.0.0.0/0 >/dev/null 2>&1 || true

    log "Default VPC infrastructure setup completed"
}

# Function to create CloudWatch log groups
create_log_groups() {
    log "Creating CloudWatch log groups..."

    # Create log group for nginx container
    aws logs create-log-group --log-group-name "/ecs/service-connect-nginx"
 --tags project=doc-smith,tutorial=amazon-ecs-service-connect 2>&1 | grep -v
 "ResourceAlreadyExistsException" || {
        if [ ${PIPESTATUS[0]} -eq 0 ]; then
            log "Log group /ecs/service-connect-nginx created"
            track_resource "LOG_GROUP:/ecs/service-connect-nginx"
        else
            log "Log group /ecs/service-connect-nginx already exists"
        fi
    }

    # Create log group for service connect proxy
    aws logs create-log-group --log-group-name "/ecs/service-connect-proxy"
 --tags project=doc-smith,tutorial=amazon-ecs-service-connect 2>&1 | grep -v
 "ResourceAlreadyExistsException" || {
        if [ ${PIPESTATUS[0]} -eq 0 ]; then
            log "Log group /ecs/service-connect-proxy created"
            track_resource "LOG_GROUP:/ecs/service-connect-proxy"
        else
            log "Log group /ecs/service-connect-proxy already exists"
        fi
    }
}

# Function to create ECS cluster with Service Connect
create_ecs_cluster() {
    log "Creating ECS cluster with Service Connect..."

    CLUSTER_OUTPUT=$(aws ecs create-cluster \
        --cluster-name "$CLUSTER_NAME" \
        --service-connect-defaults namespace="$NAMESPACE_NAME" \
```

```
        --tags key=Environment,value=tutorial key=project,value=doc-smith
 key=tutorial,value=amazon-ecs-service-connect 2>&1)
    check_for_errors "$CLUSTER_OUTPUT" "create-cluster"

    track_resource "CLUSTER:$CLUSTER_NAME"
    log "Created ECS cluster: $CLUSTER_NAME"

    wait_for_resource "cluster" "$CLUSTER_NAME"

    # Track the Service Connect namespace that gets created
    # Wait a moment for the namespace to be created
    sleep 5
    NAMESPACE_ID=$(aws servicediscovery list-namespaces \
        --filters Name=TYPE,Values=HTTP \
        --query "Namespaces[?Name=='$NAMESPACE_NAME'].Id" --output text 2>/dev/
null || echo "")

    if [[ -n "$NAMESPACE_ID" && "$NAMESPACE_ID" != "None" ]]; then
        track_resource "NAMESPACE:$NAMESPACE_ID"
        log "Service Connect namespace created: $NAMESPACE_ID"
    fi
}

# Function to create IAM roles
create_iam_roles() {
    log "Creating IAM roles..."

    # Check if ecsTaskExecutionRole exists
    if aws iam get-role --role-name ecsTaskExecutionRole >/dev/null 2>&1; then
        log "IAM role ecsTaskExecutionRole exists"
    else
        log "Creating ecsTaskExecutionRole..."
        aws iam create-role \
            --role-name ecsTaskExecutionRole \
            --assume-role-policy-document '{
                "Version":"2012-10-17",
                "Statement": [{
                    "Effect": "Allow",
                    "Principal": {"Service": "ecs-tasks.amazonaws.com"},
                    "Action": "sts:AssumeRole"
                }]
            }' >/dev/null 2>&1
        aws iam attach-role-policy \
            --role-name ecsTaskExecutionRole \
```

```
            --policy-arn arn:aws:iam::aws:policy/service-role/
AmazonECSTaskExecutionRolePolicy >/dev/null 2>&1
        track_resource "ROLE:ecsTaskExecutionRole"
        aws iam tag-role --role-name ecsTaskExecutionRole --tags
 Key=project,Value=doc-smith Key=tutorial,Value=amazon-ecs-service-connect
        log "Created ecsTaskExecutionRole"
        sleep 10
    fi

    # Check if ecsTaskRole exists, create if not
    if aws iam get-role --role-name ecsTaskRole >/dev/null 2>&1; then
        log "IAM role ecsTaskRole exists"
    else
        log "IAM role ecsTaskRole does not exist, will create it"

        # Create trust policy for ECS tasks
        cat > /tmp/ecs-task-trust-policy.json << EOF
{
    "Version":"2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Principal": {
                "Service": "ecs-tasks.amazonaws.com"
            },
            "Action": "sts:AssumeRole"
        }
    ]
}
EOF

        aws iam create-role \
            --role-name ecsTaskRole \
            --assume-role-policy-document file:///tmp/ecs-task-trust-policy.json
 >/dev/null

        track_resource "IAM_ROLE:ecsTaskRole"
        aws iam tag-role --role-name ecsTaskRole --tags Key=project,Value=doc-
smith Key=tutorial,Value=amazon-ecs-service-connect
        log "Created ecsTaskRole"

        # Wait for role to be available
        sleep 10
    fi
```

```
}

# Function to create task definition
create_task_definition() {
    log "Creating task definition..."

    # Create task definition JSON
    cat > /tmp/task-definition.json << EOF
{
    "family": "service-connect-nginx",
    "networkMode": "awsvpc",
    "requiresCompatibilities": ["FARGATE"],
    "cpu": "256",
    "memory": "512",
    "executionRoleArn": "arn:aws:iam::${ACCOUNT_ID}:role/ecsTaskExecutionRole",
    "taskRoleArn": "arn:aws:iam::${ACCOUNT_ID}:role/ecsTaskRole",
    "containerDefinitions": [
        {
            "name": "nginx",
            "image": "public.ecr.aws/docker/library/nginx:latest",
            "portMappings": [
                {
                    "containerPort": 80,
                    "protocol": "tcp",
                    "name": "nginx-port"
                }
            ],
            "essential": true,
            "logConfiguration": {
                "logDriver": "awslogs",
                "options": {
                    "awslogs-group": "/ecs/service-connect-nginx",
                    "awslogs-region": "${REGION}",
                    "awslogs-stream-prefix": "ecs"
                }
            }
        }
    ]
}
EOF

    TASK_DEF_OUTPUT=$(aws ecs register-task-definition --cli-input-json file:///
tmp/task-definition.json 2>&1)
    check_for_errors "$TASK_DEF_OUTPUT" "register-task-definition"
```

```
    TASK_DEF_ARN=$(echo "$TASK_DEF_OUTPUT" | grep -o '"taskDefinitionArn":
 "[^"]*"' | cut -d'"' -f4)
    track_resource "TASK_DEF:service-connect-nginx"
    log "Created task definition: $TASK_DEF_ARN"

    # Clean up temporary file
    rm -f /tmp/task-definition.json
}

# Function to create ECS service with Service Connect
create_ecs_service() {
    log "Creating ECS service with Service Connect..."

    # Create service definition JSON
    cat > /tmp/service-definition.json << EOF
{
    "serviceName": "service-connect-nginx-service",
    "cluster": "${CLUSTER_NAME}",
    "taskDefinition": "service-connect-nginx",
    "desiredCount": 1,
    "launchType": "FARGATE",
    "networkConfiguration": {
        "awsvpcConfiguration": {
            "subnets": ["${PUBLIC_SUBNET1}", "${PUBLIC_SUBNET2}"],
            "securityGroups": ["${SECURITY_GROUP_ID}"],
            "assignPublicIp": "ENABLED"
        }
    },
    "serviceConnectConfiguration": {
        "enabled": true,
        "namespace": "${NAMESPACE_NAME}",
        "services": [
            {
                "portName": "nginx-port",
                "discoveryName": "nginx",
                "clientAliases": [
                    {
                        "port": 80,
                        "dnsName": "nginx"
                    }
                ]
            }
        ],
```

```
        "logConfiguration": {
            "logDriver": "awslogs",
            "options": {
                "awslogs-group": "/ecs/service-connect-proxy",
                "awslogs-region": "${REGION}",
                "awslogs-stream-prefix": "ecs-service-connect"
            }
        }
    },
    "tags": [
        {
            "key": "Environment",
            "value": "tutorial"
        },
        {
            "key": "project",
            "value": "doc-smith"
        },
        {
            "key": "tutorial",
            "value": "amazon-ecs-service-connect"
        }
    ]
}
EOF

    SERVICE_OUTPUT=$(aws ecs create-service --cli-input-json file:///tmp/service-
definition.json 2>&1)
    check_for_errors "$SERVICE_OUTPUT" "create-service"

    track_resource "SERVICE:service-connect-nginx-service"
    log "Created ECS service: service-connect-nginx-service"

    wait_for_resource "service" "service-connect-nginx-service"

    # Clean up temporary file
    rm -f /tmp/service-definition.json
}

# Function to verify deployment
verify_deployment() {
    log "Verifying deployment..."

    # Check service status
```

```
    SERVICE_STATUS=$(aws ecs describe-services \
        --cluster "$CLUSTER_NAME" \
        --services "service-connect-nginx-service" \
        --query 'services[0].status' --output text)
    log "Service status: $SERVICE_STATUS"

    # Check running tasks
    RUNNING_COUNT=$(aws ecs describe-services \
        --cluster "$CLUSTER_NAME" \
        --services "service-connect-nginx-service" \
        --query 'services[0].runningCount' --output text)
    log "Running tasks: $RUNNING_COUNT"

    # Get task ARN
    TASK_ARN=$(aws ecs list-tasks \
        --cluster "$CLUSTER_NAME" \
        --service-name "service-connect-nginx-service" \
        --query 'taskArns[0]' --output text)

    if [[ "$TASK_ARN" != "None" && -n "$TASK_ARN" ]]; then
        log "Task ARN: $TASK_ARN"

        # Try to get task IP address
        TASK_IP=$(aws ecs describe-tasks \
            --cluster "$CLUSTER_NAME" \
            --tasks "$TASK_ARN" \
            --query 'tasks[0].attachments[0].details[?
name==`privateIPv4Address`].value' \
            --output text 2>/dev/null || echo "")

        if [[ -n "$TASK_IP" && "$TASK_IP" != "None" ]]; then
            log "Task IP address: $TASK_IP"
        else
            log "Could not retrieve task IP address"
        fi
    fi

    # Check Service Connect namespace
    NAMESPACE_STATUS=$(aws servicediscovery list-namespaces \
        --filters Name=TYPE,Values=HTTP \
        --query "Namespaces[?Name=='$NAMESPACE_NAME'].Id" --output text 2>/dev/
null || echo "")

    if [[ -n "$NAMESPACE_STATUS" && "$NAMESPACE_STATUS" != "None" ]]; then
```

```
        log "Service Connect namespace '$NAMESPACE_NAME' is active"
    else
        log "Service Connect namespace '$NAMESPACE_NAME' not found or not active"
    fi

    # Display Service Connect configuration
    log "Service Connect configuration:"
    aws ecs describe-services \
        --cluster "$CLUSTER_NAME" \
        --services "service-connect-nginx-service" \
        --query 'services[0].serviceConnectConfiguration' 2>/dev/null || true
}

# Function to display created resources
display_resources() {
    echo ""
    echo "============================================="
    echo "CREATED RESOURCES"
    echo "============================================="
    for resource in "${CREATED_RESOURCES[@]}"; do
        echo "- $resource"
    done
    echo "============================================="
    echo ""
}

# Function to cleanup resources
cleanup_resources() {
    log "Starting cleanup process..."

    # Delete resources in reverse order of creation
    for ((i=${#CREATED_RESOURCES[@]}-1; i>=0; i--)); do
        resource="${CREATED_RESOURCES[i]}"
        resource_type=$(echo "$resource" | cut -d':' -f1)
        resource_id=$(echo "$resource" | cut -d':' -f2)

        log "Cleaning up $resource_type: $resource_id"

        case "$resource_type" in
            "SERVICE")
                aws ecs update-service --cluster "$CLUSTER_NAME" --service
 "$resource_id" --desired-count 0 2>&1 | grep -qi "error" && log "Warning: Failed
 to scale down service $resource_id"
```

```
                aws ecs wait services-stable --cluster "$CLUSTER_NAME" --services
 "$resource_id" 2>/dev/null || true
                aws ecs delete-service --cluster "$CLUSTER_NAME" --service
 "$resource_id" --force 2>&1 | grep -qi "error" && log "Warning: Failed to delete
 service $resource_id"
                ;;
            "TASK_DEF")
                TASK_DEF_ARNS=$(aws ecs list-task-definitions --family-prefix
 "$resource_id" --query 'taskDefinitionArns' --output text 2>/dev/null)
                for arn in $TASK_DEF_ARNS; do
                    aws ecs deregister-task-definition --task-definition "$arn"
 >/dev/null 2>&1 || true
                done
                ;;
            "ROLE")
                aws iam detach-role-policy --role-name "$resource_id" --policy-
arn "arn:aws:iam::aws:policy/service-role/AmazonECSTaskExecutionRolePolicy" 2>/
dev/null || true
                aws iam delete-role --role-name "$resource_id" 2>&1 | grep -qi
 "error" && log "Warning: Failed to delete role $resource_id"
                ;;
            "IAM_ROLE")
                aws iam detach-role-policy --role-name "$resource_id" --policy-
arn "arn:aws:iam::aws:policy/service-role/AmazonECSTaskExecutionRolePolicy" 2>/
dev/null || true
                aws iam delete-role --role-name "$resource_id" 2>&1 | grep -qi
 "error" && log "Warning: Failed to delete role $resource_id"
                ;;
            "CLUSTER")
                aws ecs delete-cluster --cluster "$resource_id" 2>&1 | grep -qi
 "error" && log "Warning: Failed to delete cluster $resource_id"
                ;;
            "SG")
                for attempt in 1 2 3 4 5; do
                    if aws ec2 delete-security-group --group-id "$resource_id"
 2>/dev/null; then
                        break
                    fi
                    log "Security group $resource_id still has dependencies,
 retrying in 30s ($attempt/5)..."
                    sleep 30
                done
                ;;
            "LOG_GROUP")
```

```
                aws logs delete-log-group --log-group-name "$resource_id" 2>&1 |
 grep -qi "error" && log "Warning: Failed to delete log group $resource_id"
                ;;
            "NAMESPACE")
                # First, delete any services in the namespace
                NAMESPACE_SERVICES=$(aws servicediscovery list-services \
                    --filters Name=NAMESPACE_ID,Values="$resource_id" \
                    --query 'Services[].Id' --output text 2>/dev/null || echo "")

                if [[ -n "$NAMESPACE_SERVICES" && "$NAMESPACE_SERVICES" !=
 "None" ]]; then
                    for service_id in $NAMESPACE_SERVICES; do
                        aws servicediscovery delete-service --id "$service_id" >/
dev/null 2>&1 || true
                        sleep 2
                    done
                fi

                # Then delete the namespace
                aws servicediscovery delete-namespace --id "$resource_id" >/dev/
null 2>&1 || true
                ;;
        esac

        sleep 2  # Brief pause between deletions
    done

    # Clean up temporary files
    rm -f /tmp/ecs-task-trust-policy.json
    rm -f /tmp/task-definition.json
    rm -f /tmp/service-definition.json

    log "Cleanup completed"
}

# Main execution
main() {
    log "Starting $SCRIPT_NAME v4 (Default VPC)"
    log "Region: $REGION"
    log "Log file: $LOG_FILE"

    # Get AWS account ID
    get_account_id
```

```
    # Setup infrastructure using default VPC
    setup_default_vpc_infrastructure

    # Create CloudWatch log groups
    create_log_groups

    # Create ECS cluster
    create_ecs_cluster

    # Create IAM roles
    create_iam_roles

    # Create task definition
    create_task_definition

    # Create ECS service
    create_ecs_service

    # Verify deployment
    verify_deployment

    log "Tutorial completed successfully!"

    # Display created resources
    display_resources

    # Ask user if they want to clean up
    echo ""
    echo "============================================="
    echo "CLEANUP CONFIRMATION"
    echo "============================================="
    echo "Do you want to clean up all created resources? (y/n): "
    CLEANUP_CHOICE="y"

    if [[ "$CLEANUP_CHOICE" =~ ^[Yy]$ ]]; then
        cleanup_resources
        log "All resources have been cleaned up"
    else
        log "Resources left intact. You can clean them up later by running the
cleanup function."
        echo ""
        echo "To clean up resources later, you can use the AWS CLI commands or
the AWS Management Console."
```

```
        echo "Remember to delete resources in the correct order to avoid
 dependency issues."
    fi
}

# Make script executable and run
chmod +x "$0"
main "$@"
```

- For API details, see the following topics in *AWS CLI Command Reference*.
  - AttachRolePolicy
  - AuthorizeSecurityGroupIngress
  - CreateCluster
  - CreateLogGroup
  - CreateRole
  - CreateSecurityGroup
  - CreateService
  - DeleteCluster
  - DeleteLogGroup
  - DeleteNamespace
  - DeleteRole
  - DeleteSecurityGroup
  - DeleteService (AWS Cloud Map)
  - DeleteService (Amazon ECS)
  - DeregisterTaskDefinition
  - DescribeClusters
  - DescribeServices
  - DescribeSubnets
  - DescribeTasks
  - DescribeVpcs
  - DetachRolePolicy
  - GetCallerIdentity

- GetRole
- ListNamespaces
- ListServices
- ListTaskDefinitions
- ListTasks
- RegisterTaskDefinition
- UpdateService
- Wait (Amazon EC2)
- Wait (Amazon ECS)

For a complete list of AWS SDK developer guides and code examples, see Using CloudWatch Logs with an AWS SDK. This topic also includes information about getting started and details about previous SDK versions.

Creating your first serverless function

The following code example shows how to:

- Create an IAM role for Lambda
- Create function code
- Create a Lambda function
- Test your Lambda function
- Clean up resources

Bash

AWS CLI with Bash script

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the Sample developer tutorials repository.

```
#!/bin/bash
```

```
# AWS Lambda - Create Your First Function
# This script creates a Lambda function, invokes it with a test event,
# views CloudWatch logs, and cleans up all resources.
#
# Source: https://docs.aws.amazon.com/lambda/latest/dg/getting-started.html
#
# Resources created:
#   - IAM role (Lambda execution role with basic logging permissions)
#   - Lambda function (Python 3.13 or Node.js 22.x runtime)
#   - CloudWatch log group (created automatically by Lambda on invocation)

set -eE -o pipefail

################################################################################
# Setup
################################################################################

UNIQUE_ID=$(head -c 8 /dev/urandom | od -An -tx1 | tr -d ' ')
FUNCTION_NAME="my-lambda-function-${UNIQUE_ID}"
ROLE_NAME="lambda-execution-role-${UNIQUE_ID}"
LOG_GROUP_NAME="/aws/lambda/${FUNCTION_NAME}"

TEMP_DIR=$(mktemp -d)
readonly TEMP_DIR
LOG_FILE="${TEMP_DIR}/lambda-gettingstarted.log"

exec > >(tee -a "$LOG_FILE") 2>&1

declare -a CREATED_RESOURCES

################################################################################
# Helper functions
################################################################################

cleanup_resources() {
    # Disable error trap to prevent recursion during cleanup
    trap - ERR
    set +eE

    echo ""
    echo "Cleaning up resources..."
    echo ""

    for ((i=${#CREATED_RESOURCES[@]}-1; i>=0; i--)); do
```

```
        local RESOURCE="${CREATED_RESOURCES[$i]}"
        local TYPE="${RESOURCE%%:*}"
        local NAME="${RESOURCE#*:}"

        case "$TYPE" in
            log-group)
                echo "Deleting CloudWatch log group: ${NAME}"
                aws logs delete-log-group \
                    --log-group-name "$NAME" 2>&1 || echo "  WARNING: Could not
delete log group ${NAME}."
                ;;
            lambda-function)
                echo "Deleting Lambda function: ${NAME}"
                aws lambda delete-function \
                    --function-name "$NAME" 2>&1 || echo "  WARNING: Could not
delete Lambda function ${NAME}."
                echo "  Waiting for function deletion to complete..."
                local DELETE_WAIT=0
                while aws lambda get-function --function-name "$NAME" > /dev/null
2>&1; do
                    sleep 2
                    DELETE_WAIT=$((DELETE_WAIT + 2))
                    if [ "$DELETE_WAIT" -ge 60 ]; then
                        echo "  WARNING: Timed out waiting for function
deletion."
                        break
                    fi
                done
                ;;
            iam-role-policy)
                local ROLE_PART="${NAME%%|*}"
                local POLICY_PART="${NAME#*|}"
                echo "Detaching policy from role: ${ROLE_PART}"
                aws iam detach-role-policy \
                    --role-name "$ROLE_PART" \
                    --policy-arn "$POLICY_PART" 2>&1 || echo "  WARNING: Could
not detach policy from role ${ROLE_PART}."
                ;;
            iam-role)
                echo "Deleting IAM role: ${NAME}"
                aws iam delete-role \
                    --role-name "$NAME" 2>&1 || echo "  WARNING: Could not delete
IAM role ${NAME}."
                ;;
```

```
        esac
    done

    if [ -d "$TEMP_DIR" ]; then
        rm -rf "$TEMP_DIR"
    fi

    echo ""
    echo "Cleanup complete."
}

handle_error() {
    echo ""
    echo "========================================="
    echo "ERROR: Script failed at $1"
    echo "========================================="
    echo ""
    if [ ${#CREATED_RESOURCES[@]} -gt 0 ]; then
        echo "Attempting to clean up ${#CREATED_RESOURCES[@]} resource(s)..."
        cleanup_resources
    fi
    exit 1
}

trap 'handle_error "line $LINENO"' ERR

wait_for_resource() {
    local DESCRIPTION="$1"
    local COMMAND="$2"
    local TARGET_VALUE="$3"
    local TIMEOUT=300
    local ELAPSED=0
    local INTERVAL=5

    echo "Waiting for ${DESCRIPTION}..."
    while true; do
        local RESULT
        RESULT=$(eval "$COMMAND" 2>&1) || true
        if echo "$RESULT" | grep -q "$TARGET_VALUE"; then
            echo "  ${DESCRIPTION} is ready."
            return 0
        fi
        if [ "$ELAPSED" -ge "$TIMEOUT" ]; then
```

```
            echo "ERROR: Timed out waiting for ${DESCRIPTION} after ${TIMEOUT}
 seconds."
            return 1
        fi
        sleep "$INTERVAL"
        ELAPSED=$((ELAPSED + INTERVAL))
    done
}

validate_input() {
    local input="$1"
    local pattern="$2"
    if ! [[ "$input" =~ $pattern ]]; then
        echo "ERROR: Invalid input: $input"
        return 1
    fi
    return 0
}

###############################################################################
# Region pre-check
###############################################################################

CONFIGURED_REGION=$(aws configure get region 2>/dev/null || true)
if [ -z "$CONFIGURED_REGION" ] && [ -z "$AWS_DEFAULT_REGION" ] && [ -z
 "$AWS_REGION" ]; then
    echo "ERROR: No AWS region configured."
    echo "Run 'aws configure set region <region>' or export AWS_DEFAULT_REGION."
    exit 1
fi

###############################################################################
# Runtime selection
###############################################################################

echo ""
echo "========================================="
echo "AWS Lambda - Create Your First Function"
echo "========================================="
echo ""
echo "Select a runtime for your Lambda function:"
echo "  1) Python 3.13"
echo "  2) Node.js 22.x"
echo ""
```

```
echo "Using default: Python 3.13"
RUNTIME_CHOICE="1"

case "$RUNTIME_CHOICE" in
    1)
        RUNTIME="python3.13"
        HANDLER="lambda_function.lambda_handler"
        CODE_FILE="lambda_function.py"
        cat > "${TEMP_DIR}/${CODE_FILE}" << 'PYTHON_EOF'
import json
import logging
logger = logging.getLogger()
logger.setLevel(logging.INFO)
def lambda_handler(event, context):
    if not isinstance(event, dict) or 'length' not in event or 'width' not in
 event:
        raise ValueError('Event must contain length and width')
    try:
        length = float(event['length'])
        width = float(event['width'])
        if length < 0 or width < 0:
            raise ValueError('Length and width must be non-negative')
        area = calculate_area(length, width)
        print(f'The area is {area}')
        logger.info(f'CloudWatch logs group: {context.log_group_name}')
        return json.dumps({'area': area})
    except (TypeError, ValueError) as e:
        logger.error(f'Error processing input: {str(e)}')
        raise
def calculate_area(length, width):
    return length * width
PYTHON_EOF
        echo "Selected runtime: Python 3.13"
        ;;
    2)
        RUNTIME="nodejs22.x"
        HANDLER="index.handler"
        CODE_FILE="index.mjs"
        cat > "${TEMP_DIR}/${CODE_FILE}" << 'NODEJS_EOF'
export const handler = async (event, context) => {
  if (!event || typeof event.length !== 'number' || typeof event.width !==
 'number') {
    throw new Error('Event must contain numeric length and width');
  }
```

```
  if (event.length < 0 || event.width < 0) {
    throw new Error('Length and width must be non-negative');
  }
  const area = event.length * event.width;
  console.log(`The area is ${area}`);
  console.log('CloudWatch log group: ', context.logGroupName);
  return JSON.stringify({area});
};
NODEJS_EOF
        echo "Selected runtime: Node.js 22.x"
        ;;
    *)
        echo "ERROR: Invalid choice. Please enter 1 or 2."
        exit 1
        ;;
esac

# ================================================================================
# Step 1: Create IAM execution role
# ================================================================================

echo ""
echo "=========================================="
echo "Step 1: Create IAM execution role"
echo "=========================================="
echo ""

TRUST_POLICY='{
    "Version":"2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Principal": {
                "Service": "lambda.amazonaws.com"
            },
            "Action": "sts:AssumeRole"
        }
    ]
}'

echo "Creating IAM role: ${ROLE_NAME}"
ROLE_OUTPUT=$(aws iam create-role \
    --role-name "$ROLE_NAME" \
    --assume-role-policy-document "$TRUST_POLICY" \
```

```
    --query 'Role.Arn' \
    --output text 2>&1)

if ! validate_input "$ROLE_OUTPUT" "^arn:aws:iam::[0-9]+:role/"; then
    echo "ERROR: Failed to create IAM role"
    exit 1
fi

echo "$ROLE_OUTPUT"
ROLE_ARN="$ROLE_OUTPUT"
CREATED_RESOURCES+=("iam-role:${ROLE_NAME}")
echo "Role ARN: ${ROLE_ARN}"

aws iam tag-role \
    --role-name "$ROLE_NAME" \
    --tags Key=project,Value=doc-smith Key=tutorial,Value=lambda-gettingstarted

echo ""
echo "Attaching AWSLambdaBasicExecutionRole policy..."
aws iam attach-role-policy \
    --role-name "$ROLE_NAME" \
    --policy-arn "arn:aws:iam::aws:policy/service-role/
AWSLambdaBasicExecutionRole" 2>&1
CREATED_RESOURCES+=("iam-role-policy:${ROLE_NAME}|arn:aws:iam::aws:policy/
service-role/AWSLambdaBasicExecutionRole")
echo "Policy attached."

# IAM roles can take a few seconds to propagate
echo "Waiting for IAM role to propagate..."
sleep 10

################################################################################
# Step 2: Create Lambda function
################################################################################

echo ""
echo "========================================="
echo "Step 2: Create Lambda function"
echo "========================================="
echo ""

echo "Creating deployment package..."
ORIGINAL_DIR=$(pwd)
cd "$TEMP_DIR" || exit 1
```

```
zip -j function.zip "$CODE_FILE" > /dev/null 2>&1 || {
    echo "ERROR: Failed to create deployment package"
    exit 1
}
cd "$ORIGINAL_DIR" || exit 1

if [ ! -f "${TEMP_DIR}/function.zip" ]; then
    echo "ERROR: Deployment package creation failed"
    exit 1
fi

echo "Creating Lambda function: ${FUNCTION_NAME}"
echo "  Runtime: ${RUNTIME}"
echo "  Handler: ${HANDLER}"
echo ""

CREATE_OUTPUT=$(aws lambda create-function \
    --function-name "$FUNCTION_NAME" \
    --runtime "$RUNTIME" \
    --role "$ROLE_ARN" \
    --handler "$HANDLER" \
    --architectures x86_64 \
    --zip-file "fileb://${TEMP_DIR}/function.zip" \
    --tags project=doc-smith,tutorial=lambda-gettingstarted \
    --query '[FunctionName, FunctionArn, Runtime, State]' \
    --output text 2>&1)

if [ -z "$CREATE_OUTPUT" ]; then
    echo "ERROR: Failed to create Lambda function"
    exit 1
fi

echo "$CREATE_OUTPUT"
CREATED_RESOURCES+=("lambda-function:${FUNCTION_NAME}")

wait_for_resource "Lambda function to become Active" \
    "aws lambda get-function-configuration --function-name ${FUNCTION_NAME} --
query State --output text" \
    "Active"

################################################################################
# Step 3: Invoke the function
################################################################################
```

```
echo ""
echo "========================================="
echo "Step 3: Invoke the function"
echo "========================================="
echo ""

TEST_EVENT='{"length": 6, "width": 7}'
echo "Invoking function with test event: ${TEST_EVENT}"
echo ""

echo "$TEST_EVENT" > "${TEMP_DIR}/test-event.json"

if ! validate_input "$TEST_EVENT" '"length": [0-9]+, "width": [0-9]+'; then
    echo "ERROR: Invalid test event format"
    exit 1
fi

INVOKE_OUTPUT=$(aws lambda invoke \
    --function-name "$FUNCTION_NAME" \
    --payload "fileb://${TEMP_DIR}/test-event.json" \
    --cli-read-timeout 30 \
    "${TEMP_DIR}/response.json" 2>&1)
echo "$INVOKE_OUTPUT"

if [ ! -f "${TEMP_DIR}/response.json" ]; then
    echo "ERROR: No response file generated"
    exit 1
fi

RESPONSE=$(cat "${TEMP_DIR}/response.json")
echo ""
echo "Function response: ${RESPONSE}"
echo ""

if echo "$INVOKE_OUTPUT" | grep -qi "functionerror"; then
    echo "WARNING: Function returned an error."
fi

################################################################################
# Step 4: View CloudWatch logs
################################################################################

echo ""
echo "========================================="
```

```
echo "Step 4: View CloudWatch Logs"
echo "========================================="
echo ""

echo "Log group: ${LOG_GROUP_NAME}"
echo ""

echo "Waiting for CloudWatch logs to be available..."

LOG_STREAMS=""
for i in $(seq 1 6); do
    LOG_STREAMS=$(aws logs describe-log-streams \
        --log-group-name "$LOG_GROUP_NAME" \
        --order-by LastEventTime \
        --descending \
        --query 'logStreams[0].logStreamName' \
        --output text 2>/dev/null) || true
    if [ -n "$LOG_STREAMS" ] && [ "$LOG_STREAMS" != "None" ]; then
        break
    fi
    LOG_STREAMS=""
    sleep 5
done

if [ -n "$LOG_STREAMS" ] && [ "$LOG_STREAMS" != "None" ]; then
    echo "Latest log stream: ${LOG_STREAMS}"
    echo ""
    echo "--- Log events ---"
    LOG_EVENTS=$(aws logs get-log-events \
        --log-group-name "$LOG_GROUP_NAME" \
        --log-stream-name "$LOG_STREAMS" \
        --query 'events[].message' \
        --output text 2>&1) || true
    echo "$LOG_EVENTS"
    echo "--- End of log events ---"
else
    echo "No log streams found yet. Logs may take a moment to appear."
    echo "You can view them in the CloudWatch console:"
    echo "  Log group: ${LOG_GROUP_NAME}"
fi

CREATED_RESOURCES+=("log-group:${LOG_GROUP_NAME}")

aws logs tag-log-group \
```

```
    --log-group-name "$LOG_GROUP_NAME" \
    --tags project=doc-smith,tutorial=lambda-gettingstarted

################################################################################
# Summary and cleanup
################################################################################

echo ""
echo "========================================="
echo "SUMMARY"
echo "========================================="
echo ""
echo "Resources created:"
echo "  IAM role:          ${ROLE_NAME}"
echo "  Lambda function:   ${FUNCTION_NAME}"
echo "  CloudWatch logs:   ${LOG_GROUP_NAME}"
echo ""
echo "========================================="
echo "CLEANUP"
echo "========================================="
echo ""
echo "Cleaning up all created resources..."
cleanup_resources

echo ""
echo "Done."
```

- For API details, see the following topics in *AWS CLI Command Reference*.
  - AttachRolePolicy
  - CreateFunction
  - CreateRole
  - DeleteFunction
  - DeleteLogGroup
  - DeleteRole
  - DescribeLogStreams
  - DetachRolePolicy
  - GetFunction
  - GetFunctionConfiguration
  - GetLogEvents

- Invoke

For a complete list of AWS SDK developer guides and code examples, see Using CloudWatch Logs with an AWS SDK. This topic also includes information about getting started and details about previous SDK versions.

Use CloudWatch Logs to run a large query

The following code examples show how to use CloudWatch Logs to query more than 10,000 records.

.NET

SDK for .NET (v4)

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

This is the main workflow that demonstrates the large query scenario.

```
using System.Diagnostics;
using System.Text.RegularExpressions;
using Amazon.CloudFormation;
using Amazon.CloudFormation.Model;
using Amazon.CloudWatchLogs;
using Amazon.CloudWatchLogs.Model;
using CloudWatchLogsActions;
using Microsoft.Extensions.DependencyInjection;
using Microsoft.Extensions.Hosting;
using Microsoft.Extensions.Logging;

namespace CloudWatchLogsScenario;

public class LargeQueryWorkflow
{
    /*
    Before running this .NET code example, set up your development environment,
 including your credentials.
```

```
    This .NET code example performs the following tasks for the CloudWatch Logs
 Large Query workflow:

    1. Prepare the Application:
       - Prompt the user to deploy CloudFormation stack and generate sample logs.
       - Deploy the CloudFormation template for resource creation.
       - Generate 50,000 sample log entries using CloudWatch Logs API.
       - Wait 5 minutes for logs to be fully ingested.

    2. Execute Large Query:
       - Perform recursive queries to retrieve all logs using binary search.
       - Display progress for each query executed.
       - Show total execution time and logs found.

    3. Clean up:
       - Prompt the user to delete the CloudFormation stack and all resources.
       - Destroy the CloudFormation stack and wait until removed.
    */

    public static ILogger<LargeQueryWorkflow> _logger = null!;
    public static CloudWatchLogsWrapper _wrapper = null!;
    public static IAmazonCloudFormation _amazonCloudFormation = null!;

    private static string _logGroupName = "/workflows/cloudwatch-logs/large-
query";
    private static string _logStreamName = "stream1";
    private static long _queryStartDate;
    private static long _queryEndDate;

    public static bool _interactive = true;
    public static string _stackName = "CloudWatchLargeQueryStack";
    private static string _stackResourcePath = "../../../../../../../scenarios/
features/cloudwatch_logs_large_query/resources/stack.yaml";

    public static async Task Main(string[] args)
    {
        using var host = Host.CreateDefaultBuilder(args)
            .ConfigureLogging(logging =>
                logging.AddFilter("System", LogLevel.Debug)
                    .AddFilter("Microsoft", LogLevel.Information))
            .ConfigureServices((_, services) =>
                services.AddAWSService<IAmazonCloudWatchLogs>()
                    .AddAWSService<IAmazonCloudFormation>()
                    .AddTransient<CloudWatchLogsWrapper>()
```

```
            )
            .Build();

        if (_interactive)
        {
            _logger = LoggerFactory.Create(builder => { builder.AddConsole(); })
                .CreateLogger<LargeQueryWorkflow>();

            _wrapper = host.Services.GetRequiredService<CloudWatchLogsWrapper>();
            _amazonCloudFormation =
host.Services.GetRequiredService<IAmazonCloudFormation>();
        }

        Console.WriteLine(new string('-', 80));
        Console.WriteLine("Welcome to the CloudWatch Logs Large Query
Scenario.");
        Console.WriteLine(new string('-', 80));
        Console.WriteLine("This scenario demonstrates how to perform large-scale
queries on");
        Console.WriteLine("CloudWatch Logs using recursive binary search to
retrieve more than");
        Console.WriteLine("the 10,000 result limit.");
        Console.WriteLine();

        try
        {
            Console.WriteLine(new string('-', 80));
            var prepareSuccess = await PrepareApplication();
            Console.WriteLine(new string('-', 80));

            if (prepareSuccess)
            {
                Console.WriteLine(new string('-', 80));
                await ExecuteLargeQuery();
                Console.WriteLine(new string('-', 80));
            }

            Console.WriteLine(new string('-', 80));
            await Cleanup();
            Console.WriteLine(new string('-', 80));
        }
        catch (Exception ex)
        {
```

```
            _logger.LogError(ex, "There was a problem with the scenario,
initiating cleanup...");
            _interactive = false;
            await Cleanup();
        }

        Console.WriteLine("CloudWatch Logs Large Query scenario completed.");
    }

    /// <summary>
    /// Runs the scenario workflow. Used for testing.
    /// </summary>
    public static async Task RunScenario()
    {
        Console.WriteLine(new string('-', 80));
        Console.WriteLine("Welcome to the CloudWatch Logs Large Query
Scenario.");
        Console.WriteLine(new string('-', 80));
        Console.WriteLine("This scenario demonstrates how to perform large-scale
queries on");
        Console.WriteLine("CloudWatch Logs using recursive binary search to
retrieve more than");
        Console.WriteLine("the 10,000 result limit.");
        Console.WriteLine();

        try
        {
            Console.WriteLine(new string('-', 80));
            var prepareSuccess = await PrepareApplication();
            Console.WriteLine(new string('-', 80));

            if (prepareSuccess)
            {
                Console.WriteLine(new string('-', 80));
                await ExecuteLargeQuery();
                Console.WriteLine(new string('-', 80));
            }

            Console.WriteLine(new string('-', 80));
            await Cleanup();
            Console.WriteLine(new string('-', 80));
        }
        catch (Exception ex)
        {
```

```
            _logger.LogError(ex, "There was a problem with the scenario,
initiating cleanup...");
            _interactive = false;
            await Cleanup();
        }

        Console.WriteLine("CloudWatch Logs Large Query scenario completed.");
    }

    /// <summary>
    /// Prepares the application by creating the necessary resources.
    /// </summary>
    /// <returns>True if the application was prepared successfully.</returns>
    public static async Task<bool> PrepareApplication()
    {
        Console.WriteLine("Preparing the application...");
        Console.WriteLine();

        try
        {
            var deployStack = !_interactive || GetYesNoResponse(
                "Would you like to deploy the CloudFormation stack and generate
sample logs? (y/n) ");

            if (deployStack)
            {
                if (_interactive)
                {
                    Console.Write(
                        $"Enter a path for the CloudFormation stack
resource .yaml file (or press Enter for default '{_stackResourcePath}'): ");
                    string? inputPath = Console.ReadLine();
                    if (!string.IsNullOrWhiteSpace(inputPath))
                    {
                        _stackResourcePath = inputPath;
                    }
                }

                _stackName = PromptUserForStackName();

                var deploySuccess = await DeployCloudFormationStack(_stackName);

                if (deploySuccess)
                {
```

```
                    Console.WriteLine();
                    Console.WriteLine("Generating 50,000 sample log entries...");
                    var generateSuccess = await GenerateSampleLogs();

                    if (generateSuccess)
                    {
                        Console.WriteLine();
                        Console.WriteLine("Sample logs created. Waiting 5 minutes
for logs to be fully ingested...");
                        await WaitWithCountdown(300);

                        Console.WriteLine("Application preparation complete.");
                        return true;
                    }
                }
            }
            else
            {
                _logGroupName = PromptUserForInput("Enter the log group name ",
_logGroupName);
                _logStreamName = PromptUserForInput("Enter the log stream name ",
_logStreamName);

                var startDateMs = PromptUserForLong("Enter the query start date
(milliseconds since epoch): ");
                var endDateMs = PromptUserForLong("Enter the query end date
(milliseconds since epoch): ");

                _queryStartDate = startDateMs / 1000;
                _queryEndDate = endDateMs / 1000;

                Console.WriteLine("Application preparation complete.");
                return true;
            }
        }
        catch (Exception ex)
        {
            _logger.LogError(ex, "An error occurred while preparing the
application.");
        }

        Console.WriteLine("Application preparation failed.");
        return false;
    }
```

```
    /// <summary>
    /// Deploys the CloudFormation stack with the necessary resources.
    /// </summary>
    /// <param name="stackName">The name of the CloudFormation stack.</param>
    /// <returns>True if the stack was deployed successfully.</returns>
    private static async Task<bool> DeployCloudFormationStack(string stackName)
    {
        Console.WriteLine($"\nDeploying CloudFormation stack: {stackName}");

        try
        {
            var request = new CreateStackRequest
            {
                StackName = stackName,
                TemplateBody = await File.ReadAllTextAsync(_stackResourcePath)
            };

            var response = await _amazonCloudFormation.CreateStackAsync(request);

            if (response.HttpStatusCode == System.Net.HttpStatusCode.OK)
            {
                Console.WriteLine($"CloudFormation stack creation started:
{stackName}");

                bool stackCreated = await
WaitForStackCompletion(response.StackId);

                if (stackCreated)
                {
                    Console.WriteLine("CloudFormation stack created
successfully.");
                    return true;
                }
                else
                {
                    _logger.LogError($"CloudFormation stack creation failed:
{stackName}");
                    return false;
                }
            }
            else
            {
```

```
                _logger.LogError($"Failed to create CloudFormation stack:
{stackName}");
                return false;
            }
        }
        catch (AlreadyExistsException)
        {
            _logger.LogWarning($"CloudFormation stack '{stackName}' already
exists. Please provide a unique name.");
            var newStackName = PromptUserForStackName();
            return await DeployCloudFormationStack(newStackName);
        }
        catch (Exception ex)
        {
            _logger.LogError(ex, $"An error occurred while deploying the
CloudFormation stack: {stackName}");
            return false;
        }
    }

    /// <summary>
    /// Waits for the CloudFormation stack to be in the CREATE_COMPLETE state.
    /// </summary>
    /// <param name="stackId">The ID of the CloudFormation stack.</param>
    /// <returns>True if the stack was created successfully.</returns>
    private static async Task<bool> WaitForStackCompletion(string stackId)
    {
        int retryCount = 0;
        const int maxRetries = 30;
        const int retryDelay = 10000;

        while (retryCount < maxRetries)
        {
            var describeStacksRequest = new DescribeStacksRequest
            {
                StackName = stackId
            };

            var describeStacksResponse = await
_amazonCloudFormation.DescribeStacksAsync(describeStacksRequest);

            if (describeStacksResponse.Stacks.Count > 0)
            {
```

```
                if (describeStacksResponse.Stacks[0].StackStatus ==
StackStatus.CREATE_COMPLETE)
                {
                    return true;
                }
                if (describeStacksResponse.Stacks[0].StackStatus ==
StackStatus.CREATE_FAILED ||
                    describeStacksResponse.Stacks[0].StackStatus ==
StackStatus.ROLLBACK_COMPLETE)
                {
                    return false;
                }
            }

            Console.WriteLine("Waiting for CloudFormation stack creation to
complete...");
            await Task.Delay(retryDelay);
            retryCount++;
        }

        _logger.LogError("Timed out waiting for CloudFormation stack creation to
complete.");
        return false;
    }

    /// <summary>
    /// Generates sample logs directly using CloudWatch Logs API.
    /// Creates 50,000 log entries spanning 5 minutes.
    /// </summary>
    /// <returns>True if logs were generated successfully.</returns>
    private static async Task<bool> GenerateSampleLogs()
    {
        const int totalEntries = 50000;
        const int entriesPerBatch = 10000;
        const int fiveMinutesMs = 5 * 60 * 1000;

        try
        {
            // Calculate timestamps
            var startTimeMs = DateTimeOffset.UtcNow.ToUnixTimeMilliseconds();
            var timestampIncrement = fiveMinutesMs / totalEntries;

            Console.WriteLine($"Generating {totalEntries} log entries...");
```

```
            var entryCount = 0;
            var currentTimestamp = startTimeMs;
            var numBatches = totalEntries / entriesPerBatch;

            // Generate and upload logs in batches
            for (int batchNum = 0; batchNum < numBatches; batchNum++)
            {
                var logEvents = new List<InputLogEvent>();

                for (int i = 0; i < entriesPerBatch; i++)
                {
                    logEvents.Add(new InputLogEvent
                    {
                        Timestamp =
 DateTimeOffset.FromUnixTimeMilliseconds(currentTimestamp).UtcDateTime,
                        Message = $"Entry {entryCount}"
                    });

                    entryCount++;
                    currentTimestamp += timestampIncrement;
                }

                // Upload batch
                var success = await _wrapper.PutLogEventsAsync(_logGroupName,
 _logStreamName, logEvents);
                if (!success)
                {
                    _logger.LogError($"Failed to upload batch {batchNum + 1}/
{numBatches}");
                    return false;
                }

                Console.WriteLine($"Uploaded batch {batchNum + 1}/{numBatches}");
            }

            // Set query date range (convert milliseconds to seconds for query
 API)
            _queryStartDate = startTimeMs / 1000;
            _queryEndDate = (currentTimestamp - timestampIncrement) / 1000;

            Console.WriteLine($"Query start date:
 {DateTimeOffset.FromUnixTimeSeconds(_queryStartDate):yyyy-MM-
ddTHH:mm:ss.fffZ}");
```

```
            Console.WriteLine($"Query end date:
{DateTimeOffset.FromUnixTimeSeconds(_queryEndDate):yyyy-MM-ddTHH:mm:ss.fffZ}");
            Console.WriteLine($"Successfully uploaded {totalEntries} log
entries");

            return true;
        }
        catch (Exception ex)
        {
            _logger.LogError(ex, "An error occurred while generating sample
logs.");
            return false;
        }
    }

    /// <summary>
    /// Executes the large query workflow.
    /// </summary>
    public static async Task ExecuteLargeQuery()
    {
        Console.WriteLine("Starting recursive query to retrieve all logs...");
        Console.WriteLine();

        var queryLimit = PromptUserForInteger("Enter the query limit (max 10000)
", 10000);
        if (queryLimit > 10000) queryLimit = 10000;

        var queryString = "fields @timestamp, @message | sort @timestamp asc";

        var stopwatch = Stopwatch.StartNew();
        var allResults = await PerformLargeQuery(_logGroupName, queryString,
_queryStartDate, _queryEndDate, queryLimit);
        stopwatch.Stop();

        Console.WriteLine();
        Console.WriteLine($"Queries finished in
{stopwatch.Elapsed.TotalSeconds:F3} seconds.");
        Console.WriteLine($"Total logs found: {allResults.Count}");

        // Check for duplicates
        Console.WriteLine();
        Console.WriteLine("Checking for duplicate logs...");
        var duplicates = FindDuplicateLogs(allResults);
        if (duplicates.Count > 0)
```

```
        {
            Console.WriteLine($"WARNING: Found {duplicates.Count} duplicate log
entries!");
            Console.WriteLine("Duplicate entries (showing first 10):");
            foreach (var dup in duplicates.Take(10))
            {
                Console.WriteLine($"  [{dup.Timestamp}] {dup.Message} (appears
{dup.Count} times)");
            }

            var uniqueCount = allResults.Count - duplicates.Sum(d => d.Count -
1);
            Console.WriteLine($"Unique logs: {uniqueCount}");
        }
        else
        {
            Console.WriteLine("No duplicates found. All logs are unique.");
        }
        Console.WriteLine();

        var viewSample = !_interactive || GetYesNoResponse("Would you like to see
a sample of the logs? (y/n) ");
        if (viewSample)
        {
            Console.WriteLine();
            Console.WriteLine($"Sample logs (first 10 of {allResults.Count}):");
            for (int i = 0; i < Math.Min(10, allResults.Count); i++)
            {
                var timestamp = allResults[i].Find(f => f.Field ==
"@timestamp")?.Value ?? "N/A";
                var message = allResults[i].Find(f => f.Field ==
"@message")?.Value ?? "N/A";
                Console.WriteLine($"[{timestamp}] {message}");
            }
        }
    }

    /// <summary>
    /// Performs a large query using recursive binary search.
    /// </summary>
    private static async Task<List<List<ResultField>>> PerformLargeQuery(
        string logGroupName,
        string queryString,
        long startTime,
```

```
        long endTime,
        int limit)
    {
        var queryId = await _wrapper.StartQueryAsync(logGroupName, queryString,
 startTime, endTime, limit);
        if (queryId == null)
        {
            return new List<List<ResultField>>();
        }

        var results = await PollQueryResults(queryId);
        if (results == null || results.Count == 0)
        {
            return new List<List<ResultField>>();
        }

        var startDate =
 DateTimeOffset.FromUnixTimeSeconds(startTime).ToString("yyyy-MM-
ddTHH:mm:ss.fffZ");
        var endDate = DateTimeOffset.FromUnixTimeSeconds(endTime).ToString("yyyy-
MM-ddTHH:mm:ss.fffZ");
        Console.WriteLine($"Query date range: {startDate} ({startTime}s) to
 {endDate} ({endTime}s). Found {results.Count} logs.");

        if (results.Count < limit)
        {
            Console.WriteLine($"  -> Returning {results.Count} logs (less than
 limit of {limit})");
            return results;
        }

        Console.WriteLine($"  -> Hit limit of {limit}. Need to split and
 recurse.");

        // Get the timestamp of the last log (sorted to find the actual last one)
        var lastLogTimestamp = GetLastLogTimestamp(results);
        if (lastLogTimestamp == null)
        {
            Console.WriteLine($"  -> No timestamp found in results. Returning
 {results.Count} logs.");
            return results;
        }

        Console.WriteLine($"  -> Last log timestamp: {lastLogTimestamp}");
```

```
        // Parse the timestamp and add 1 millisecond to avoid querying the same
 log again
        var lastLogDate = DateTimeOffset.Parse(lastLogTimestamp + " +0000");
        Console.WriteLine($"  -> Last log as DateTimeOffset: {lastLogDate:yyyy-
MM-ddTHH:mm:ss.fffZ} ({lastLogDate.ToUnixTimeSeconds()}s)");

        var offsetLastLogDate = lastLogDate.AddMilliseconds(1);
        Console.WriteLine($"  -> Offset timestamp (last
 + 1ms): {offsetLastLogDate:yyyy-MM-ddTHH:mm:ss.fffZ}
 ({offsetLastLogDate.ToUnixTimeSeconds()}s)");

        // Convert to seconds, but round UP to the next second to avoid
 overlapping with logs in the same second
        // This ensures we don't re-query logs that share the same second as the
 last log
        var offsetLastLogTime = offsetLastLogDate.ToUnixTimeSeconds();
        if (offsetLastLogDate.Millisecond > 0)
        {
            offsetLastLogTime++; // Move to the next full second
            Console.WriteLine($"  -> Adjusted to next full second:
 {offsetLastLogTime}s
 ({DateTimeOffset.FromUnixTimeSeconds(offsetLastLogTime):yyyy-MM-
ddTHH:mm:ss.fffZ})");
        }

        Console.WriteLine($"  -> Comparing:
 offsetLastLogTime={offsetLastLogTime}s vs endTime={endTime}s");
        Console.WriteLine($"  -> End time as date:
 {DateTimeOffset.FromUnixTimeSeconds(endTime):yyyy-MM-ddTHH:mm:ss.fffZ}");

        // Check if there's any time range left to query
        if (offsetLastLogTime >= endTime)
        {
            Console.WriteLine($"  -> No time range left to query. Offset time
 ({offsetLastLogTime}s) >= end time ({endTime}s)");
            return results;
        }

        // Split the remaining date range in half
        var (range1Start, range1End, range2Start, range2End) =
 SplitDateRange(offsetLastLogTime, endTime);
```

```
        var range1StartDate =
 DateTimeOffset.FromUnixTimeSeconds(range1Start).ToString("yyyy-MM-
ddTHH:mm:ss.fffZ");
        var range1EndDate =
 DateTimeOffset.FromUnixTimeSeconds(range1End).ToString("yyyy-MM-
ddTHH:mm:ss.fffZ");
        var range2StartDate =
 DateTimeOffset.FromUnixTimeSeconds(range2Start).ToString("yyyy-MM-
ddTHH:mm:ss.fffZ");
        var range2EndDate =
 DateTimeOffset.FromUnixTimeSeconds(range2End).ToString("yyyy-MM-
ddTHH:mm:ss.fffZ");

        Console.WriteLine($"  -> Splitting remaining range:");
        Console.WriteLine($"     Range 1: {range1StartDate} ({range1Start}s) to
 {range1EndDate} ({range1End}s)");
        Console.WriteLine($"     Range 2: {range2StartDate} ({range2Start}s) to
 {range2EndDate} ({range2End}s)");

        // Query both halves recursively
        Console.WriteLine($"  -> Querying range 1...");
        var results1 = await PerformLargeQuery(logGroupName, queryString,
 range1Start, range1End, limit);
        Console.WriteLine($"  -> Range 1 returned {results1.Count} logs");

        Console.WriteLine($"  -> Querying range 2...");
        var results2 = await PerformLargeQuery(logGroupName, queryString,
 range2Start, range2End, limit);
        Console.WriteLine($"  -> Range 2 returned {results2.Count} logs");

        // Combine all results
        var allResults = new List<List<ResultField>>(results);
        allResults.AddRange(results1);
        allResults.AddRange(results2);

        Console.WriteLine($"  -> Combined total: {allResults.Count} logs
 ({results.Count} + {results1.Count} + {results2.Count})");

        return allResults;
    }

    /// <summary>
    /// Gets the timestamp string of the most recent log from a list of logs.
    /// Sorts timestamps to find the actual last one.
```

```
    /// </summary>
    private static string? GetLastLogTimestamp(List<List<ResultField>> logs)
    {
        var timestamps = logs
            .Select(log => log.Find(f => f.Field == "@timestamp")?.Value)
            .Where(t => !string.IsNullOrEmpty(t))
            .OrderBy(t => t)
            .ToList();

        if (timestamps.Count == 0)
        {
            return null;
        }

        return timestamps[timestamps.Count - 1];
    }

    /// <summary>
    /// Splits a date range in half.
    /// Range 2 starts at midpoint + 1 second to avoid overlap.
    /// </summary>
    private static (long range1Start, long range1End, long range2Start, long
range2End) SplitDateRange(long startTime, long endTime)
    {
        var midpoint = startTime + (endTime - startTime) / 2;
        // Range 2 starts at midpoint + 1 to avoid querying the same second twice
        return (startTime, midpoint, midpoint + 1, endTime);
    }

    /// <summary>
    /// Polls for query results until complete.
    /// </summary>
    private static async Task<List<List<ResultField>>?> PollQueryResults(string
queryId)
    {
        int retryCount = 0;
        const int maxRetries = 60;
        const int retryDelay = 1000;

        while (retryCount < maxRetries)
        {
            var response = await _wrapper.GetQueryResultsAsync(queryId);
            if (response == null)
            {
```

```
                return null;
            }

            if (response.Status == QueryStatus.Complete)
            {
                return response.Results;
            }

            if (response.Status == QueryStatus.Failed ||
                response.Status == QueryStatus.Cancelled ||
                response.Status == QueryStatus.Timeout ||
                response.Status == QueryStatus.Unknown)
            {
                _logger.LogError($"Query failed with status: {response.Status}");
                return null;
            }

            await Task.Delay(retryDelay);
            retryCount++;
        }

        _logger.LogError("Timed out waiting for query results.");
        return null;
    }

    /// <summary>
    /// Cleans up the resources created during the scenario.
    /// </summary>
    public static async Task<bool> Cleanup()
    {
        var cleanup = !_interactive || GetYesNoResponse(
            "Do you want to delete the CloudFormation stack and all resources?
(y/n) ");

        if (cleanup)
        {
            try
            {
                var stackDeleteSuccess = await
DeleteCloudFormationStack(_stackName, false);
                return stackDeleteSuccess;
            }
            catch (Exception ex)
            {
```

```
                _logger.LogError(ex, "An error occurred while cleaning up the
resources.");
                return false;
            }
        }

        Console.WriteLine($"Resources will remain. Stack name: {_stackName}, Log
group: {_logGroupName}");
        _logger.LogInformation("CloudWatch Logs Large Query scenario is
complete.");
        return true;
    }

    /// <summary>
    /// Deletes the CloudFormation stack and waits for confirmation.
    /// </summary>
    private static async Task<bool> DeleteCloudFormationStack(string stackName,
bool forceDelete)
    {
        var request = new DeleteStackRequest
        {
            StackName = stackName,
        };

        if (forceDelete)
        {
            request.DeletionMode = DeletionMode.FORCE_DELETE_STACK;
        }

        await _amazonCloudFormation.DeleteStackAsync(request);
        Console.WriteLine($"CloudFormation stack '{stackName}' is being deleted.
This may take a few minutes.");

        bool stackDeleted = await WaitForStackDeletion(stackName, forceDelete);

        if (stackDeleted)
        {
            Console.WriteLine($"CloudFormation stack '{stackName}' has been
deleted.");
            return true;
        }
        else
        {
```

```
            _logger.LogError($"Failed to delete CloudFormation stack
'{stackName}'.");
            return false;
        }
    }

    /// <summary>
    /// Waits for the stack to be deleted.
    /// </summary>
    private static async Task<bool> WaitForStackDeletion(string stackName, bool
forceDelete)
    {
        int retryCount = 0;
        const int maxRetries = 30;
        const int retryDelay = 10000;

        while (retryCount < maxRetries)
        {
            var describeStacksRequest = new DescribeStacksRequest
            {
                StackName = stackName
            };

            try
            {
                var describeStacksResponse = await
_amazonCloudFormation.DescribeStacksAsync(describeStacksRequest);

                if (describeStacksResponse.Stacks.Count == 0 ||
                    describeStacksResponse.Stacks[0].StackStatus ==
StackStatus.DELETE_COMPLETE)
                {
                    return true;
                }

                if (!forceDelete && describeStacksResponse.Stacks[0].StackStatus
== StackStatus.DELETE_FAILED)
                {
                    return await DeleteCloudFormationStack(stackName, true);
                }
            }
            catch (AmazonCloudFormationException ex) when (ex.ErrorCode ==
"ValidationError")
            {
```

```
                return true;
            }

            Console.WriteLine($"Waiting for CloudFormation stack '{stackName}' to
be deleted...");
            await Task.Delay(retryDelay);
            retryCount++;
        }

        _logger.LogError($"Timed out waiting for CloudFormation stack
'{stackName}' to be deleted.");
        return false;
    }

    /// <summary>
    /// Waits with a countdown display.
    /// </summary>
    private static async Task WaitWithCountdown(int seconds)
    {
        for (int i = seconds; i > 0; i--)
        {
            Console.Write($"\rWaiting: {i} seconds remaining...  ");
            await Task.Delay(1000);
        }
        Console.WriteLine("\rWait complete.                      ");
    }

    /// <summary>
    /// Helper method to get a yes or no response from the user.
    /// </summary>
    private static bool GetYesNoResponse(string question)
    {
        Console.WriteLine(question);
        var ynResponse = Console.ReadLine();
        var response = ynResponse != null && ynResponse.Equals("y",
StringComparison.InvariantCultureIgnoreCase);
        return response;
    }

    /// <summary>
    /// Prompts the user for a stack name.
    /// </summary>
    private static string PromptUserForStackName()
    {
```

```
        if (_interactive)
        {
            Console.Write($"Enter a name for the CloudFormation stack (press
Enter for default '{_stackName}'): ");
            string? input = Console.ReadLine();
            if (!string.IsNullOrWhiteSpace(input))
            {
                var regex = "[a-zA-Z][-a-zA-Z0-9]*";
                if (!Regex.IsMatch(input, regex))
                {
                    Console.WriteLine($"Invalid stack name. Using default:
{_stackName}");
                    return _stackName;
                }
                return input;
            }
        }
        return _stackName;
    }

    /// <summary>
    /// Prompts the user for input with a default value.
    /// </summary>
    private static string PromptUserForInput(string prompt, string defaultValue)
    {
        if (_interactive)
        {
            Console.Write($"{prompt}(press Enter for default '{defaultValue}'):
");
            string? input = Console.ReadLine();
            return string.IsNullOrWhiteSpace(input) ? defaultValue : input;
        }
        return defaultValue;
    }

    /// <summary>
    /// Prompts the user for an integer value.
    /// </summary>
    private static int PromptUserForInteger(string prompt, int defaultValue)
    {
        if (_interactive)
        {
            Console.Write($"{prompt}(press Enter for default '{defaultValue}'):
");
```

```
            string? input = Console.ReadLine();
            if (string.IsNullOrWhiteSpace(input) || !int.TryParse(input, out var
result))
            {
                return defaultValue;
            }
            return result;
        }
        return defaultValue;
    }

    /// <summary>
    /// Prompts the user for a long value.
    /// </summary>
    private static long PromptUserForLong(string prompt)
    {
        if (_interactive)
        {
            Console.Write(prompt);
            string? input = Console.ReadLine();
            if (long.TryParse(input, out var result))
            {
                return result;
            }
        }
        return 0;
    }

    /// <summary>
    /// Finds duplicate log entries based on timestamp and message.
    /// </summary>
    private static List<(string Timestamp, string Message, int Count)>
FindDuplicateLogs(List<List<ResultField>> logs)
    {
        var logSignatures = new Dictionary<string, int>();

        foreach (var log in logs)
        {
            var timestamp = log.Find(f => f.Field == "@timestamp")?.Value ?? "";
            var message = log.Find(f => f.Field == "@message")?.Value ?? "";
            var signature = $"{timestamp}|{message}";

            if (logSignatures.ContainsKey(signature))
            {
```

```
                logSignatures[signature]++;
            }
            else
            {
                logSignatures[signature] = 1;
            }
        }

        return logSignatures
            .Where(kvp => kvp.Value > 1)
            .Select(kvp =>
            {
                var parts = kvp.Key.Split('|');
                return (Timestamp: parts[0], Message: parts[1], Count:
 kvp.Value);
            })
            .OrderByDescending(x => x.Count)
            .ToList();
    }
}
```

- For API details, see the following topics in *AWS SDK for .NET API Reference*.
  - GetQueryResults
  - StartQuery

JavaScript

SDK for JavaScript (v3)

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

This is the entry point.

```
// Copyright Amazon.com, Inc. or its affiliates. All Rights Reserved.
// SPDX-License-Identifier: Apache-2.0
import { CloudWatchLogsClient } from "@aws-sdk/client-cloudwatch-logs";
```

```
import { CloudWatchQuery } from "./cloud-watch-query.js";

console.log("Starting a recursive query...");

if (!process.env.QUERY_START_DATE || !process.env.QUERY_END_DATE) {
  throw new Error(
    "QUERY_START_DATE and QUERY_END_DATE environment variables are required.",
  );
}

const cloudWatchQuery = new CloudWatchQuery(new CloudWatchLogsClient({}), {
  logGroupNames: ["/workflows/cloudwatch-logs/large-query"],
  dateRange: [
    new Date(Number.parseInt(process.env.QUERY_START_DATE)),
    new Date(Number.parseInt(process.env.QUERY_END_DATE)),
  ],
});

await cloudWatchQuery.run();

console.log(
  `Queries finished in ${cloudWatchQuery.secondsElapsed} seconds.\nTotal logs
 found: ${cloudWatchQuery.results.length}`,
);
```

This is a class that splits queries into multiple steps if necessary.

```
// Copyright Amazon.com, Inc. or its affiliates. All Rights Reserved.
// SPDX-License-Identifier: Apache-2.0
import {
  StartQueryCommand,
  GetQueryResultsCommand,
} from "@aws-sdk/client-cloudwatch-logs";
import { splitDateRange } from "@aws-doc-sdk-examples/lib/utils/util-date.js";
import { retry } from "@aws-doc-sdk-examples/lib/utils/util-timers.js";

class DateOutOfBoundsError extends Error {}

export class CloudWatchQuery {
  /**
   * Run a query for all CloudWatch Logs within a certain date range.
   * CloudWatch logs return a max of 10,000 results. This class
```

```
   * performs a binary search across all of the logs in the provided
   * date range if a query returns the maximum number of results.
   *
   * @param {import('@aws-sdk/client-cloudwatch-logs').CloudWatchLogsClient}
client
   * @param {{ logGroupNames: string[], dateRange: [Date, Date], queryConfig:
{ limit: number } }} config
   */
  constructor(client, { logGroupNames, dateRange, queryConfig }) {
    this.client = client;
    /**
     * All log groups are queried.
     */
    this.logGroupNames = logGroupNames;

    /**
     * The inclusive date range that is queried.
     */
    this.dateRange = dateRange;

    /**
     * CloudWatch Logs never returns more than 10,000 logs.
     */
    this.limit = queryConfig?.limit ?? 10000;

    /**
     * @type {import("@aws-sdk/client-cloudwatch-logs").ResultField[][]}
     */
    this.results = [];
  }

  /**
   * Run the query.
   */
  async run() {
    this.secondsElapsed = 0;
    const start = new Date();
    this.results = await this._largeQuery(this.dateRange);
    const end = new Date();
    this.secondsElapsed = (end - start) / 1000;
    return this.results;
  }

  /**
```

```
   * Recursively query for logs.
   * @param {[Date, Date]} dateRange
   * @returns {Promise<import("@aws-sdk/client-cloudwatch-logs").ResultField[]
[]>}
   */
  async _largeQuery(dateRange) {
    const logs = await this._query(dateRange, this.limit);

    console.log(
      `Query date range: ${dateRange
        .map((d) => d.toISOString())
        .join(" to ")}. Found ${logs.length} logs.`,
    );

    if (logs.length < this.limit) {
      return logs;
    }

    const lastLogDate = this._getLastLogDate(logs);
    const offsetLastLogDate = new Date(lastLogDate);
    offsetLastLogDate.setMilliseconds(lastLogDate.getMilliseconds() + 1);
    const subDateRange = [offsetLastLogDate, dateRange[1]];
    const [r1, r2] = splitDateRange(subDateRange);
    const results = await Promise.all([
      this._largeQuery(r1),
      this._largeQuery(r2),
    ]);
    return [logs, ...results].flat();
  }

  /**
   * Find the most recent log in a list of logs.
   * @param {import("@aws-sdk/client-cloudwatch-logs").ResultField[][]} logs
   */
  _getLastLogDate(logs) {
    const timestamps = logs
      .map(
        (log) =>
          log.find((fieldMeta) => fieldMeta.field === "@timestamp")?.value,
      )
      .filter((t) => !!t)
      .map((t) => `${t}Z`)
      .sort();
```

```
    if (!timestamps.length) {
      throw new Error("No timestamp found in logs.");
    }

    return new Date(timestamps[timestamps.length - 1]);
  }

  /**
   * Simple wrapper for the GetQueryResultsCommand.
   * @param {string} queryId
   */
  _getQueryResults(queryId) {
    return this.client.send(new GetQueryResultsCommand({ queryId }));
  }

  /**
   * Starts a query and waits for it to complete.
   * @param {[Date, Date]} dateRange
   * @param {number} maxLogs
   */
  async _query(dateRange, maxLogs) {
    try {
      const { queryId } = await this._startQuery(dateRange, maxLogs);
      const { results } = await this._waitUntilQueryDone(queryId);
      return results ?? [];
    } catch (err) {
      /**
       * This error is thrown when StartQuery returns an error indicating
       * that the query's start or end date occur before the log group was
       * created.
       */
      if (err instanceof DateOutOfBoundsError) {
        return [];
      }
      throw err;
    }
  }

  /**
   * Wrapper for the StartQueryCommand. Uses a static query string
   * for consistency.
   * @param {[Date, Date]} dateRange
   * @param {number} maxLogs
   * @returns {Promise<{ queryId: string }>}
```

```
   */
  async _startQuery([startDate, endDate], maxLogs = 10000) {
    try {
      return await this.client.send(
        new StartQueryCommand({
          logGroupNames: this.logGroupNames,
          queryString: "fields @timestamp, @message | sort @timestamp asc",
          startTime: startDate.valueOf(),
          endTime: endDate.valueOf(),
          limit: maxLogs,
        }),
      );
    } catch (err) {
      /** @type {string} */
      const message = err.message;
      if (message.startsWith("Query's end date and time")) {
        // This error indicates that the query's start or end date occur
        // before the log group was created.
        throw new DateOutOfBoundsError(message);
      }

      throw err;
    }
  }

  /**
   * Call GetQueryResultsCommand until the query is done.
   * @param {string} queryId
   */
  _waitUntilQueryDone(queryId) {
    const getResults = async () => {
      const results = await this._getQueryResults(queryId);
      const queryDone = [
        "Complete",
        "Failed",
        "Cancelled",
        "Timeout",
        "Unknown",
      ].includes(results.status);

      return { queryDone, results };
    };

    return retry(
```

```
      { intervalInMs: 1000, maxRetries: 60, quiet: true },
      async () => {
        const { queryDone, results } = await getResults();
        if (!queryDone) {
          throw new Error("Query not done.");
        }

        return results;
      },
    );
  }
}
```

- For API details, see the following topics in *AWS SDK for JavaScript API Reference*.
  - GetQueryResults
  - StartQuery

Python

SDK for Python (Boto3)

> **Note**
>
> There's more on GitHub. Find the complete example and learn how to set up and run in the AWS Code Examples Repository.

This file invokes an example module for managing CloudWatch queries exceeding 10,000 results.

```
import logging
import os
import sys

import boto3
from botocore.config import Config

from cloudwatch_query import CloudWatchQuery
from date_utilities import DateUtilities
```

```
# Configure logging at the module level.
logging.basicConfig(
    level=logging.INFO,
    format="%(asctime)s - %(levelname)s - %(filename)s:%(lineno)d - %(message)s",
)

DEFAULT_QUERY_LOG_GROUP = "/workflows/cloudwatch-logs/large-query"


class CloudWatchLogsQueryRunner:
    def __init__(self):
        """
        Initializes the CloudWatchLogsQueryRunner class by setting up date
 utilities
        and creating a CloudWatch Logs client with retry configuration.
        """
        self.date_utilities = DateUtilities()
        self.cloudwatch_logs_client = self.create_cloudwatch_logs_client()

    def create_cloudwatch_logs_client(self):
        """
        Creates and returns a CloudWatch Logs client with a specified retry
 configuration.

        :return: A CloudWatch Logs client instance.
        :rtype: boto3.client
        """
        try:
            return boto3.client("logs", config=Config(retries={"max_attempts":
 10}))
        except Exception as e:
            logging.error(f"Failed to create CloudWatch Logs client: {e}")
            sys.exit(1)

    def fetch_environment_variables(self):
        """
        Fetches and validates required environment variables for query start and
 end dates.
        Fetches the environment variable for log group, returning the default
 value if it
        does not exist.

        :return: Tuple of query start date and end date as integers and the log
 group.
```

```
        :rtype: tuple
        :raises SystemExit: If required environment variables are missing or
invalid.
        """
        try:
            query_start_date = int(os.environ["QUERY_START_DATE"])
            query_end_date = int(os.environ["QUERY_END_DATE"])
        except KeyError:
            logging.error(
                "Both QUERY_START_DATE and QUERY_END_DATE environment variables
are required."
            )
            sys.exit(1)
        except ValueError as e:
            logging.error(f"Error parsing date environment variables: {e}")
            sys.exit(1)

        try:
            log_group = os.environ["QUERY_LOG_GROUP"]
        except KeyError:
            logging.warning("No QUERY_LOG_GROUP environment variable, using
default value")
            log_group = DEFAULT_QUERY_LOG_GROUP

        return query_start_date, query_end_date, log_group

    def convert_dates_to_iso8601(self, start_date, end_date):
        """
        Converts UNIX timestamp dates to ISO 8601 format using DateUtilities.

        :param start_date: The start date in UNIX timestamp.
        :type start_date: int
        :param end_date: The end date in UNIX timestamp.
        :type end_date: int
        :return: Start and end dates in ISO 8601 format.
        :rtype: tuple
        """
        start_date_iso8601 =
self.date_utilities.convert_unix_timestamp_to_iso8601(
            start_date
        )
        end_date_iso8601 = self.date_utilities.convert_unix_timestamp_to_iso8601(
            end_date
        )
```

```
        return start_date_iso8601, end_date_iso8601

    def execute_query(
        self,
        start_date_iso8601,
        end_date_iso8601,
        log_group="/workflows/cloudwatch-logs/large-query",
        query="fields @timestamp, @message | sort @timestamp asc"
    ):
        """
        Creates a CloudWatchQuery instance and executes the query with provided
 date range.

        :param start_date_iso8601: The start date in ISO 8601 format.
        :type start_date_iso8601: str
        :param end_date_iso8601: The end date in ISO 8601 format.
        :type end_date_iso8601: str
        :param log_group: Log group to search: "/workflows/cloudwatch-logs/large-
query"
        :type log_group: str
        :param query: Query string to pass to the CloudWatchQuery instance
        :type query: str
        """
        cloudwatch_query = CloudWatchQuery(
            log_group=log_group,
            query_string=query
        )
        cloudwatch_query.query_logs((start_date_iso8601, end_date_iso8601))
        logging.info("Query executed successfully.")
        logging.info(
            f"Queries completed in {cloudwatch_query.query_duration} seconds.
 Total logs found: {len(cloudwatch_query.query_results)}"
        )


def main():
    """
    Main function to start a recursive CloudWatch logs query.
    Fetches required environment variables, converts dates, and executes the
 query.
    """
    logging.info("Starting a recursive CloudWatch logs query...")
    runner = CloudWatchLogsQueryRunner()
```

```
    query_start_date, query_end_date, log_group =
 runner.fetch_environment_variables()
    start_date_iso8601 = DateUtilities.convert_unix_timestamp_to_iso8601(
        query_start_date
    )
    end_date_iso8601 =
 DateUtilities.convert_unix_timestamp_to_iso8601(query_end_date)
    runner.execute_query(start_date_iso8601, end_date_iso8601,
 log_group=log_group)


if __name__ == "__main__":
    main()
```

This module processes CloudWatch queries exceeding 10,000 results.

```
import logging
import time
from datetime import datetime
import threading
import boto3

from date_utilities import DateUtilities

DEFAULT_QUERY = "fields @timestamp, @message | sort @timestamp asc"
DEFAULT_LOG_GROUP = "/workflows/cloudwatch-logs/large-query"

class DateOutOfBoundsError(Exception):
    """Exception raised when the date range for a query is out of bounds."""

    pass


class CloudWatchQuery:
    """
    A class to query AWS CloudWatch logs within a specified date range.

    :vartype date_range: tuple
    :ivar limit: Maximum number of log entries to return.
    :vartype limit: int
    :log_group str: Name of the log group to query
    :query_string str: query
```

```
    """

    def __init__(self, log_group: str = DEFAULT_LOG_GROUP, query_string:
str=DEFAULT_QUERY) -> None:
        self.lock = threading.Lock()
        self.log_group = log_group
        self.query_string = query_string
        self.query_results = []
        self.query_duration = None
        self.datetime_format = "%Y-%m-%d %H:%M:%S.%f"
        self.date_utilities = DateUtilities()
        self.limit = 10000

    def query_logs(self, date_range):
        """
        Executes a CloudWatch logs query for a specified date range and
calculates the execution time of the query.

        :return: A batch of logs retrieved from the CloudWatch logs query.
        :rtype: list
        """
        start_time = datetime.now()

        start_date, end_date = self.date_utilities.normalize_date_range_format(
            date_range, from_format="unix_timestamp", to_format="datetime"
        )

        logging.info(
            f"Original query:"
            f"\n       START:     {start_date}"
            f"\n       END:       {end_date}"
            f"\n       LOG GROUP: {self.log_group}"
        )
        self.recursive_query((start_date, end_date))
        end_time = datetime.now()
        self.query_duration = (end_time - start_time).total_seconds()

    def recursive_query(self, date_range):
        """
        Processes logs within a given date range, fetching batches of logs
recursively if necessary.

        :param date_range: The date range to fetch logs for, specified as a tuple
(start_timestamp, end_timestamp).
```

```
        :type date_range: tuple
        :return: None if the recursive fetching is continued or stops when the
final batch of logs is processed.
                 Although it doesn't explicitly return the query results, this
method accumulates all fetched logs
                 in the `self.query_results` attribute.
        :rtype: None
        """
        batch_of_logs = self.perform_query(date_range)
        # Add the batch to the accumulated logs
        with self.lock:
            self.query_results.extend(batch_of_logs)
        if len(batch_of_logs) == self.limit:
            logging.info(f"Fetched {self.limit}, checking for more...")
            most_recent_log = self.find_most_recent_log(batch_of_logs)
            most_recent_log_timestamp = next(
                item["value"]
                for item in most_recent_log
                if item["field"] == "@timestamp"
            )
            new_range = (most_recent_log_timestamp, date_range[1])
            midpoint = self.date_utilities.find_middle_time(new_range)

            first_half_thread = threading.Thread(
                target=self.recursive_query,
                args=((most_recent_log_timestamp, midpoint),),
            )
            second_half_thread = threading.Thread(
                target=self.recursive_query, args=((midpoint, date_range[1]),)
            )

            first_half_thread.start()
            second_half_thread.start()

            first_half_thread.join()
            second_half_thread.join()

    def find_most_recent_log(self, logs):
        """
        Search a list of log items and return most recent log entry.
        :param logs: A list of logs to analyze.
        :return: log
        :type :return List containing log item details
        """
```

```
        most_recent_log = None
        most_recent_date = "1970-01-01 00:00:00.000"

        for log in logs:
            for item in log:
                if item["field"] == "@timestamp":
                    logging.debug(f"Compared: {item['value']} to
{most_recent_date}")
                    if (
                        self.date_utilities.compare_dates(
                            item["value"], most_recent_date
                        )
                        == item["value"]
                    ):
                        logging.debug(f"New most recent: {item['value']}")
                        most_recent_date = item["value"]
                        most_recent_log = log
        logging.info(f"Most recent log date of batch: {most_recent_date}")
        return most_recent_log

    def perform_query(self, date_range):
        """
        Performs the actual CloudWatch log query.

        :param date_range: A tuple representing the start and end datetime for
the query.
        :type date_range: tuple
        :return: A list containing the query results.
        :rtype: list
        """
        client = boto3.client("logs")
        try:
            try:
                start_time = round(

self.date_utilities.convert_iso8601_to_unix_timestamp(date_range[0])
                )
                end_time = round(

self.date_utilities.convert_iso8601_to_unix_timestamp(date_range[1])
                )
                response = client.start_query(
                    logGroupName=self.log_group,
                    startTime=start_time,
```

```
                    endTime=end_time,
                    queryString=self.query_string,
                    limit=self.limit,
                )
                query_id = response["queryId"]
            except client.exceptions.ResourceNotFoundException as e:
                raise DateOutOfBoundsError(f"Resource not found: {e}")
            while True:
                time.sleep(1)
                results = client.get_query_results(queryId=query_id)
                if results["status"] in [
                    "Complete",
                    "Failed",
                    "Cancelled",
                    "Timeout",
                    "Unknown",
                ]:
                    return results.get("results", [])
        except DateOutOfBoundsError:
            return []

    def _initiate_query(self, client, date_range, max_logs):
        """
        Initiates the CloudWatch logs query.

        :param date_range: A tuple representing the start and end datetime for
the query.
        :type date_range: tuple
        :param max_logs: The maximum number of logs to retrieve.
        :type max_logs: int
        :return: The query ID as a string.
        :rtype: str
        """
        try:
            start_time = round(

self.date_utilities.convert_iso8601_to_unix_timestamp(date_range[0])
            )
            end_time = round(

self.date_utilities.convert_iso8601_to_unix_timestamp(date_range[1])
            )
            response = client.start_query(
                logGroupName=self.log_group,
```

```
                startTime=start_time,
                endTime=end_time,
                queryString=self.query_string,
                limit=max_logs,
            )
            return response["queryId"]
        except client.exceptions.ResourceNotFoundException as e:
            raise DateOutOfBoundsError(f"Resource not found: {e}")


    def _wait_for_query_results(self, client, query_id):
        """
        Waits for the query to complete and retrieves the results.

        :param query_id: The ID of the initiated query.
        :type query_id: str
        :return: A list containing the results of the query.
        :rtype: list
        """
        while True:
            time.sleep(1)
            results = client.get_query_results(queryId=query_id)
            if results["status"] in [
                "Complete",
                "Failed",
                "Cancelled",
                "Timeout",
                "Unknown",
            ]:
                return results.get("results", [])
```

- For API details, see the following topics in *AWS SDK for Python (Boto3) API Reference*.
  - GetQueryResults
  - StartQuery

For a complete list of AWS SDK developer guides and code examples, see Using CloudWatch Logs with an AWS SDK. This topic also includes information about getting started and details about previous SDK versions.

Use scheduled events to invoke a Lambda function

The following code examples show how to create an AWS Lambda function invoked by an Amazon EventBridge scheduled event.

Java

SDK for Java 2.x

Shows how to create an Amazon EventBridge scheduled event that invokes an AWS Lambda function. Configure EventBridge to use a cron expression to schedule when the Lambda function is invoked. In this example, you create a Lambda function by using the Lambda Java runtime API. This example invokes different AWS services to perform a specific use case. This example demonstrates how to create an app that sends a mobile text message to your employees that congratulates them at the one year anniversary date.

For complete source code and instructions on how to set up and run, see the full example on GitHub.

Services used in this example

- CloudWatch Logs
- DynamoDB
- EventBridge
- Lambda
- Amazon SNS

JavaScript

SDK for JavaScript (v3)

Shows how to create an Amazon EventBridge scheduled event that invokes an AWS Lambda function. Configure EventBridge to use a cron expression to schedule when the Lambda function is invoked. In this example, you create a Lambda function by using the Lambda JavaScript runtime API. This example invokes different AWS services to perform a specific use case. This example demonstrates how to create an app that sends a mobile text message to your employees that congratulates them at the one year anniversary date.

For complete source code and instructions on how to set up and run, see the full example on GitHub.

This example is also available in the AWS SDK for JavaScript v3 developer guide.

Services used in this example

- CloudWatch Logs
- DynamoDB
- EventBridge
- Lambda
- Amazon SNS

Python

SDK for Python (Boto3)

This example shows how to register an AWS Lambda function as the target of a scheduled Amazon EventBridge event. The Lambda handler writes a friendly message and the full event data to Amazon CloudWatch Logs for later retrieval.

- Deploys a Lambda function.
- Creates an EventBridge scheduled event and makes the Lambda function the target.
- Grants permission to let EventBridge invoke the Lambda function.
- Prints the latest data from CloudWatch Logs to show the result of the scheduled invocations.
- Cleans up all resources created during the demo.

This example is best viewed on GitHub. For complete source code and instructions on how to set up and run, see the full example on GitHub.

Services used in this example

- CloudWatch Logs
- DynamoDB
- EventBridge
- Lambda
- Amazon SNS

For a complete list of AWS SDK developer guides and code examples, see Using CloudWatch Logs with an AWS SDK. This topic also includes information about getting started and details about previous SDK versions.

Encrypt lookup tables in CloudWatch Logs using AWS Key Management Service

Lookup table data is always encrypted in CloudWatch Logs. By default, CloudWatch Logs uses server-side encryption with 256-bit Advanced Encryption Standard Galois/Counter Mode (AES-GCM) to encrypt lookup table data at rest. As an alternative, you can use AWS Key Management Service for this encryption. If you do, the encryption is done using an AWS KMS key. Encryption using AWS KMS is enabled at the lookup table level, by associating a KMS key with a lookup table, either when you create the lookup table or when you update it.

> **Important**
>
> CloudWatch Logs supports only symmetric KMS keys. Do not use an asymmetric key to encrypt the data in your lookup tables. For more information, see Using Symmetric and Asymmetric Keys.

After you associate a KMS key with a lookup table, all data stored in the lookup table is encrypted using this key. CloudWatch Logs decrypts this data whenever it is requested. CloudWatch Logs must have permissions for the KMS key whenever encrypted data is requested.

If you later disassociate a KMS key from a lookup table, CloudWatch Logs encrypts the data using the CloudWatch Logs default encryption method. However, if the key is disabled or deleted before you disassociate it, then CloudWatch Logs is unable to read the data that was encrypted with that key.

For general information about how CloudWatch Logs uses AWS KMS to encrypt log data, see Encrypt log data in CloudWatch Logs using AWS Key Management Service.

How CloudWatch Logs uses AWS KMS for lookup tables

CloudWatch Logs uses AWS KMS envelope encryption to protect lookup table data. When you associate a KMS key with a lookup table, CloudWatch Logs sends a `GenerateDataKey` request to AWS KMS. AWS KMS generates a unique data encryption key (DEK) and returns both a plaintext copy and an encrypted copy of the DEK. CloudWatch Logs uses the plaintext DEK to encrypt the lookup table data, and then stores the encrypted DEK alongside the encrypted data. The plaintext DEK is not stored and is discarded from memory after use.

When CloudWatch Logs needs to read the lookup table data, it sends a `Decrypt` request to AWS KMS with the encrypted DEK. AWS KMS decrypts the DEK and returns the plaintext DEK to CloudWatch Logs, which then uses it to decrypt the lookup table data.

CloudWatch Logs uses the following encryption context when making requests to AWS KMS:

```
{
    "aws:logs:arn": "arn:aws:logs:region:account-id:lookup-table:lookup-table-name"
}
```

You can use this encryption context in IAM policies and AWS KMS key policies to control access to the KMS key. For more information, see AWS KMS keys and encryption context.

Required permissions

To use AWS KMS encryption with lookup tables, the IAM principal must have the following AWS KMS permissions on the KMS key:

- `kms:Decrypt`
- `kms:GenerateDataKey`

The `kms:Decrypt` permission is required when calling `GetLookupTable` on a lookup table that is encrypted with a KMS key, so that CloudWatch Logs can decrypt the data on your behalf. The `kms:Decrypt` permission is also required on the key (the KMS key used to encrypt the lookup table) when calling `StartQuery` with a query that uses the `lookup` command on an encrypted lookup table. The `kms:GenerateDataKey` permission is required when calling `CreateLookupTable` or `UpdateLookupTable` with a KMS key, so that CloudWatch Logs can generate a data encryption key to encrypt the lookup table data.

In addition, the CloudWatch Logs service must have permission to use the KMS key. You grant these permissions by adding a policy statement to the KMS key policy, as described in the following section.

Step 1: Create an AWS KMS key

To create a symmetric KMS key, use the following create-key command:

```
aws kms create-key
```

The output contains the key ID and Amazon Resource Name (ARN) of the key. The following is example output:

```
{
    "KeyMetadata": {
        "Origin": "AWS_KMS",
        "KeyId": "1234abcd-12ab-34cd-56ef-1234567890ab",
        "Description": "",
        "KeyManager": "CUSTOMER",
        "Enabled": true,
        "CustomerMasterKeySpec": "SYMMETRIC_DEFAULT",
        "KeyUsage": "ENCRYPT_DECRYPT",
        "KeyState": "Enabled",
        "CreationDate": 1478910250.94,
        "Arn": "arn:aws:kms:us-west-2:123456789012:key/6f815f63-e628-448c-8251-
e40cb0d29f59",
        "AWSAccountId": "123456789012",
        "EncryptionAlgorithms": [
            "SYMMETRIC_DEFAULT"
        ]
    }
}
```

Record the key ARN. You need it in the following steps.

Step 2: Set permissions on the KMS key

By default, all AWS KMS keys are private. Only the resource owner can use it to encrypt and decrypt data. You must grant the CloudWatch Logs service principal permission to use the key, and also grant the calling role permission to use the key.

First, save the default policy for your KMS key as `policy.json` using the following get-key-policy command:

```
aws kms get-key-policy --key-id key-id --policy-name default --output text > ./
policy.json
```

Open the `policy.json` file in a text editor and add the following statement to grant the CloudWatch Logs service principal permission to use the key. This example uses a `Condition` section that matches the encryption context to restrict the key to a specific lookup table.

```
{
    "Effect": "Allow",
    "Principal": {
        "Service": "logs.region.amazonaws.com"
    },
    "Action": [
        "kms:Decrypt",
        "kms:GenerateDataKey"
    ],
    "Resource": "*",
    "Condition": {
        "StringEquals": {
            "kms:EncryptionContext:aws:logs:arn": "arn:aws:logs:region:account-
id:lookup-table:lookup-table-name",
            "aws:SourceAccount": "account-id",
            "aws:SourceArn": "arn:aws:logs:region:account-id:lookup-table:lookup-table-
name"
        }
    }
}
```

Next, add permissions to the role that will be calling the CloudWatch Logs `CreateLookupTable` or `UpdateLookupTable` APIs. CloudWatch Logs uses `kms:ViaService` to make calls to AWS KMS on the customer's behalf. For more information, see kms:ViaService.

```
{
    "Effect": "Allow",
    "Principal": {
        "AWS": "arn:aws:iam::account-id:role/role-name"
    },
    "Action": [
        "kms:Decrypt",
        "kms:GenerateDataKey"
    ],
    "Resource": "*",
    "Condition": {
        "StringEquals": {
            "kms:ViaService": [
                "logs.region.amazonaws.com"
            ]
        }
    }
```

```
}
```

Finally, add the updated policy using the following put-key-policy command:

```
aws kms put-key-policy --key-id key-id --policy-name default --policy file://
policy.json
```

Step 3: Associate a KMS key with a lookup table

You can associate a KMS key with a lookup table when you create it using the `CreateLookupTable` API, or update an existing lookup table using the `UpdateLookupTable` API. Both APIs are part of the AWSLogsConfigService.

To associate the KMS key with a lookup table when you create it

Use the `CreateLookupTable` API and specify the `kmsKeyArn` parameter with the ARN of your KMS key:

```
aws logs create-lookup-table \
    --lookup-table-name my-lookup-table \
    --kms-key-arn "arn:aws:kms:region:account-id:key/key-id"
```

To associate the KMS key with an existing lookup table

Use the `UpdateLookupTable` API and specify the `kmsKeyArn` parameter with the ARN of your KMS key:

```
aws logs update-lookup-table \
    --lookup-table-name my-lookup-table \
    --kms-key-arn "arn:aws:kms:region:account-id:key/key-id"
```

Considerations

- After you associate or disassociate a KMS key from a lookup table, it can take up to five minutes for the operation to take effect.
- If you revoke CloudWatch Logs access to an associated key or delete an associated KMS key, your encrypted lookup table data in CloudWatch Logs can no longer be retrieved.

- To perform the steps in this topic, you must have the following permissions: `kms:CreateKey`, `kms:GetKeyPolicy`, `kms:PutKeyPolicy`, and the appropriate CloudWatch Logs permissions to call `CreateLookupTable` or `UpdateLookupTable`.

Security in Amazon CloudWatch Logs

Cloud security at AWS is the highest priority. As an AWS customer, you benefit from a data center and network architecture that is built to meet the requirements of the most security-sensitive organizations.

Security is a shared responsibility between AWS and you. The shared responsibility model describes this as security of the cloud and security in the cloud:

- **Security of the cloud** – AWS is responsible for protecting the infrastructure that runs AWS services in the AWS Cloud. AWS also provides you with services that you can use securely. Third-party auditors regularly test and verify the effectiveness of our security as part of the AWS Compliance Programs. To learn about the compliance programs that apply to WorkSpaces, see AWS Services in Scope by Compliance Program.
- **Security in the cloud** – Your responsibility is determined by the AWS service that you use. You are also responsible for other factors including the sensitivity of your data, your company's requirements, and applicable laws and regulations

This documentation helps you understand how to apply the shared responsibility model when using Amazon CloudWatch Logs. It shows you how to configure Amazon CloudWatch Logs to meet your security and compliance objectives. You also learn how to use other AWS services that help you to monitor and secure your CloudWatch Logs resources.

Contents

Data protection in Amazon CloudWatch Logs

> **Note**
>
> In addition to the following information about general data protection in AWS, CloudWatch Logs also enables you to protect sensitive data in log events by masking it. For more information, see Help protect sensitive log data with masking.

The AWS shared responsibility model applies to data protection in Amazon CloudWatch Logs. As described in this model, AWS is responsible for protecting the global infrastructure that runs all of the AWS Cloud. You are responsible for maintaining control over your content that is hosted on this infrastructure. You are also responsible for the security configuration and management tasks for the AWS services that you use. For more information about data privacy, see Data Privacy FAQ. For information about data protection in Europe, see the General Data Protection Regulation (GDPR) Center.

For data protection purposes, we recommend that you protect AWS account credentials and set up individual users with AWS IAM Identity Center or AWS Identity and Access Management (IAM). That way, each user is given only the permissions necessary to fulfill their job duties. We also recommend that you secure your data in the following ways:

- Use multi-factor authentication (MFA) with each account.
- Use SSL/TLS to communicate with AWS resources. We require TLS 1.2 and recommend TLS 1.3.
- Set up API and user activity logging with AWS CloudTrail. For information about using CloudTrail trails to capture AWS activities, see Working with CloudTrail trails in the *AWS CloudTrail User Guide*.
- Use AWS encryption solutions, along with all default security controls within AWS services.
- Use advanced managed security services such as Amazon Macie, which assists in discovering and securing sensitive data that is stored in Amazon S3.
- If you require FIPS 140-3 validated cryptographic modules when accessing AWS through a command line interface or an API, use a FIPS endpoint. For more information about the available FIPS endpoints, see Federal Information Processing Standard (FIPS) 140-3.

We strongly recommend that you never put confidential or sensitive information, such as your customers' email addresses, into tags or free-form text fields such as a **Name** field. This includes

when you work with CloudWatch Logs or other AWS services using the console, API, AWS CLI, or AWS SDKs. Any data that you enter into tags or free-form text fields used for names may be used for billing or diagnostic logs. If you provide a URL to an external server, we strongly recommend that you do not include credentials information in the URL to validate your request to that server.

Encryption at rest

CloudWatch Logs protects data at rest using encryption. All log groups are encrypted. By default, the CloudWatch Logs service manages the server-side encryption and uses server-side encryption with 256-bit Advanced Encryption Standard Galois/Counter Mode (AES-GCM) to encrypt log data at rest.

If you want to manage the keys used for encrypting and decrypting your logs, use AWS KMS keys. For more information, see Encrypt log data in CloudWatch Logs using AWS Key Management Service.

Encryption in transit

CloudWatch Logs uses end-to-end encryption of data in transit. The CloudWatch Logs service manages the server-side encryption keys.

Identity and access management for Amazon CloudWatch Logs

Access to Amazon CloudWatch Logs requires credentials that AWS can use to authenticate your requests. Those credentials must have permissions to access AWS resources, such as to retrieve CloudWatch Logs data about your cloud resources. The following sections provide details on how you can use AWS Identity and Access Management (IAM) and CloudWatch Logs to help secure your resources by controlling who can access them:

- Authentication
- Access control

Authentication

To provide access, add permissions to your users, groups, or roles:

- Users and groups in AWS IAM Identity Center:

Create a permission set. Follow the instructions in Create a permission set in the *AWS IAM Identity Center User Guide*.

- Users managed in IAM through an identity provider:

  Create a role for identity federation. Follow the instructions in Create a role for a third-party identity provider (federation) in the *IAM User Guide*.

- IAM users:
  - Create a role that your user can assume. Follow the instructions in Create a role for an IAM user in the *IAM User Guide*.
  - (Not recommended) Attach a policy directly to a user or add a user to a user group. Follow the instructions in Adding permissions to a user (console) in the *IAM User Guide*.

Access control

You can have valid credentials to authenticate your requests, but unless you have permissions you cannot create or access CloudWatch Logs resources. For example, you must have permissions to create log streams, create log groups, and so on.

The following sections describe how to manage permissions for CloudWatch Logs. We recommend that you read the overview first.

- Overview of managing access permissions to your CloudWatch Logs resources
- Using identity-based policies (IAM policies) for CloudWatch Logs
- CloudWatch Logs permissions reference

Overview of managing access permissions to your CloudWatch Logs resources

To provide access, add permissions to your users, groups, or roles:

- Users and groups in AWS IAM Identity Center:

  Create a permission set. Follow the instructions in Create a permission set in the *AWS IAM Identity Center User Guide*.

- Users managed in IAM through an identity provider:

Create a role for identity federation. Follow the instructions in Create a role for a third-party identity provider (federation) in the *IAM User Guide*.

- IAM users:
  - Create a role that your user can assume. Follow the instructions in Create a role for an IAM user in the *IAM User Guide*.
  - (Not recommended) Attach a policy directly to a user or add a user to a user group. Follow the instructions in Adding permissions to a user (console) in the *IAM User Guide*.

Topics

CloudWatch Logs resources and operations

In CloudWatch Logs the primary resources are log groups, log streams and destinations. CloudWatch Logs does not support subresources (other resources for use with the primary resource).

These resources and subresources have unique Amazon Resource Names (ARNs) associated with them as shown in the following table.

Resource type	ARN format
Log group	arn:aws:logs:*region*:*account-id* :log-group:*log_group_name*
Log stream	arn:aws:logs:*region*:*account-id* :log-group:*log_group_name* :log-stream:*log-stream-name*

Resource type	ARN format
Destination	arn:aws:logs:*region*:*account-id* :destination:*destination_name*

For more information about ARNs, see ARNs in *IAM User Guide*. For information about CloudWatch Logs ARNs, see Amazon Resource Names (ARNs) in *Amazon Web Services General Reference*. For an example of a policy that covers CloudWatch Logs, see Using identity-based policies (IAM policies) for CloudWatch Logs.

CloudWatch Logs provides a set of operations to work with the CloudWatch Logs resources. For a list of available operations, see CloudWatch Logs permissions reference.

Understanding resource ownership

The AWS account owns the resources that are created in the account, regardless of who created the resources. Specifically, the resource owner is the AWS account of the principal entity (that is, the root account, a user, or an IAM role) that authenticates the resource creation request. The following examples illustrate how this works:

- If you use the root account credentials of your AWS account to create a log group, your AWS account is the owner of the CloudWatch Logs resource.
- If you create a user in your AWS account and grant permissions to create CloudWatch Logs resources to that user, the user can create CloudWatch Logs resources. However, your AWS account, to which the user belongs, owns the CloudWatch Logs resources.
- If you create an IAM role in your AWS account with permissions to create CloudWatch Logs resources, anyone who can assume the role can create CloudWatch Logs resources. Your AWS account, to which the role belongs, owns the CloudWatch Logs resources.

Managing access to resources

A *permissions policy* describes who has access to what. The following section explains the available options for creating permissions policies.

> **Note**
>
> This section discusses using IAM in the context of CloudWatch Logs. It doesn't provide detailed information about the IAM service. For complete IAM documentation, see What is

IAM? in the *IAM User Guide*. For information about IAM policy syntax and descriptions, see IAM policy reference in the *IAM User Guide*.

Policies attached to an IAM identity are referred to as identity-based policies (IAM policies) and policies attached to a resource are referred to as resource-based policies. CloudWatch Logs supports identity-based policies, and resource-based policies for destinations, which are used to enable cross account subscriptions. For more information, see Cross-account cross-Region subscriptions.

Topics

- Log group permissions and Contributor Insights
- Resource-based policies

Log group permissions and Contributor Insights

Contributor Insights is a feature of CloudWatch that enables you to analyze data from log groups and create time series that display contributor data. You can see metrics about the top-N contributors, the total number of unique contributors, and their usage. For more information, see Using Contributor Insights to Analyze High-Cardinality Data.

Contributor Insights operations use the `cloudwatch:` IAM namespace. CloudWatch Logs (`logs:`) permissions are not evaluated when Contributor Insights processes log group data. For detailed information about the Contributor Insights permissions model, condition keys, and best practices, see Using condition keys to limit Contributor Insights users' access to log groups in the *Amazon CloudWatch User Guide*.

If your log groups contain sensitive data, use CloudWatch Logs data protection policies to mask that data before Contributor Insights or any other feature can process it. For more information, see Help protect sensitive log data with masking.

Resource-based policies

CloudWatch Logs supports resource-based policies for destinations, which you can use to enable cross account subscriptions. For more information, see Step 1: Create a destination. Destinations can be created using the PutDestination API, and you can add a resource policy to the destination using the PutDestinationPolicy API. The following example allows another AWS account with the

account ID 111122223333 to subscribe their log groups to the destination `arn:aws:logs:us-east-1:123456789012:destination:testDestination`.

JSON

```
{
  "Version":"2012-10-17",
  "Statement" : [
    {
      "Sid" : "",
      "Effect" : "Allow",
      "Principal" : {
        "AWS" : "111122223333"
      },
      "Action" : "logs:PutSubscriptionFilter",
      "Resource" : "arn:aws:logs:us-
east-1:123456789012:destination:testDestination"
    }
  ]
}
```

Specifying policy elements: Actions, effects, and principals

For each CloudWatch Logs resource, the service defines a set of API operations. To grant permissions for these API operations, CloudWatch Logs defines a set of actions that you can specify in a policy. Some API operations can require permissions for more than one action to perform the API operation. For more information about resources and API operations, see CloudWatch Logs resources and operations and CloudWatch Logs permissions reference.

The following are the basic policy elements:

- **Resource** – You use an Amazon Resource Name (ARN) to identify the resource that the policy applies to. For more information, see CloudWatch Logs resources and operations.
- **Action** – You use action keywords to identify resource operations that you want to allow or deny. For example, the `logs.DescribeLogGroups` permission allows the user permissions to perform the `DescribeLogGroups` operation.
- **Effect** – You specify the effect, either allow or deny, when the user requests the specific action. If you don't explicitly grant access to (allow) a resource, access is implicitly denied. You can also

explicitly deny access to a resource, which you might do to make sure that a user cannot access it, even if a different policy grants access.

- **Principal** – In identity-based policies (IAM policies), the user that the policy is attached to is the implicit principal. For resource-based policies, you specify the user, account, service, or other entity that you want to receive permissions (applies to resource-based policies only). CloudWatch Logs supports resource-based policies for destinations.

To learn more about IAM policy syntax and descriptions, see AWS IAM Policy Reference in the *IAM User Guide*.

For a table showing all of the CloudWatch Logs API actions and the resources that they apply to, see CloudWatch Logs permissions reference.

Specifying conditions in a policy

When you grant permissions, you can use the access policy language to specify the conditions when a policy should take effect. For example, you might want a policy to be applied only after a specific date. For more information about specifying conditions in a policy language, see Condition in the *IAM User Guide*.

To express conditions, you use predefined condition keys. For a list of context keys supported by each AWS service and a list of AWS-wide policy keys, see Actions, resources, and condition keys for AWS services and AWS global condition context keys .

> **Note**
>
> You can use tags to control access to CloudWatch Logs resources, including log groups and destinations. Access to log streams is controlled at the log group level, because of the hierarchical relation between log groups and log streams. For more information about using tags to control access, see Controlling access to Amazon Web Services resources using tags.

Using identity-based policies (IAM policies) for CloudWatch Logs

This topic provides examples of identity-based policies in which an account administrator can attach permissions policies to IAM identities (that is, users, groups, and roles).

Important

We recommend that you first review the introductory topics that explain the basic concepts and options available for you to manage access to your CloudWatch Logs resources. For more information, see Overview of managing access permissions to your CloudWatch Logs resources.

This topic covers the following:

- Permissions required to use the CloudWatch console
- AWS managed (predefined) policies for CloudWatch Logs
- Customer managed policy examples

The following is an example of a permissions policy:

JSON

```
{
  "Version":"2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "logs:CreateLogGroup",
        "logs:CreateLogStream",
        "logs:PutLogEvents",
        "logs:DescribeLogStreams"
    ],
      "Resource": [
        "arn:aws:logs:*:*:*"
    ]
  }
 ]
}
```

This policy has one statement that grants permissions to create log groups and log streams, to upload log events to log streams, and to list details about log streams.

The wildcard character (*) in the `Resource` value grants permission for the listed actions on any CloudWatch Logs resource.

- **To limit permissions to specific log group actions** (e.g., `CreateLogGroup`, `DescribeLogStreams`), replace the wildcard with the log group ARN—`arn:aws:logs:us-west-2:123456789012:log-group:MyLogGroup`
- **To limit permissions to specific log stream actions** (e.g., `CreateLogStream`, `PutLogEvents`), replace the wildcard with the log stream ARN—`arn:aws:logs:us-west-2:123456789012:log-group:MyLogGroup:*` (matches all streams) or `arn:aws:logs:us-west-2:123456789012:log-group:MyLogGroup:log-stream:MyStream` (specific stream)

See the service authorization reference for which resource type each API requires.

Permissions required to use the CloudWatch console

For a user to work with CloudWatch Logs in the CloudWatch console, that user must have a minimum set of permissions that allows the user to describe other AWS resources in their AWS account. To use CloudWatch Logs in the CloudWatch console, you must have permissions from the following services:

- CloudWatch
- CloudWatch Logs
- OpenSearch Service
- IAM
- Kinesis
- Lambda
- Amazon S3

If you create an IAM policy that is more restrictive than the minimum required permissions, the console won't function as intended for users with that IAM policy. To ensure that those users can still use the CloudWatch console, also attach the `CloudWatchReadOnlyAccess` managed policy to the user, as described in AWS managed (predefined) policies for CloudWatch Logs.

You don't need to allow minimum console permissions for users that are making calls only to the AWS CLI or the CloudWatch Logs API.

The full set of permissions required to work with the CloudWatch console for a user who is not using the console to manage log subscriptions are:

- cloudwatch:GetMetricData
- cloudwatch:ListMetrics
- logs:CancelExportTask
- logs:CreateExportTask
- logs:CreateLogGroup
- logs:CreateLogStream
- logs:DeleteLogGroup
- logs:DeleteLogStream
- logs:DeleteMetricFilter
- logs:DeleteQueryDefinition
- logs:DeleteRetentionPolicy
- logs:DeleteSubscriptionFilter
- logs:DescribeExportTasks
- logs:DescribeLogGroups
- logs:DescribeLogStreams
- logs:DescribeMetricFilters
- logs:DescribeQueryDefinitions
- logs:DescribeQueries
- logs:DescribeSubscriptionFilters
- logs:FilterLogEvents
- logs:GetLogEvents
- logs:GetLogGroupFields
- logs:GetLogRecord
- logs:GetQueryResults
- logs:PutMetricFilter
- logs:PutQueryDefinition
- logs:PutRetentionPolicy

- logs:StartQuery
- logs:StopQuery
- logs:PutSubscriptionFilter
- logs:TestMetricFilter

For a user who will also be using the console to manage log subscriptions, the following permissions are also required:

- es:DescribeElasticsearchDomain
- es:ListDomainNames
- iam:AttachRolePolicy
- iam:CreateRole
- iam:GetPolicy
- iam:GetPolicyVersion
- iam:GetRole
- iam:ListAttachedRolePolicies
- iam:ListRoles
- kinesis:DescribeStreams
- kinesis:ListStreams
- lambda:AddPermission
- lambda:CreateFunction
- lambda:GetFunctionConfiguration
- lambda:ListAliases
- lambda:ListFunctions
- lambda:ListVersionsByFunction
- lambda:RemovePermission
- s3:ListBuckets

AWS managed (predefined) policies for CloudWatch Logs

AWS addresses many common use cases by providing standalone IAM policies that are created and administered by AWS. Managed policies grant necessary permissions for common use cases so

you can avoid having to investigate what permissions are needed. For more information, see AWS Managed Policies in the *IAM User Guide*.

The following AWS managed policies, which you can attach to users and roles in your account, are specific to CloudWatch Logs:

- **CloudWatchLogsFullAccess** – Grants full access to CloudWatch Logs.
- **CloudWatchLogsReadOnlyAccess** – Grants read-only access to CloudWatch Logs.

CloudWatchLogsFullAccess

The **CloudWatchLogsFullAccess** policy grants full access to CloudWatch Logs. The policy includes the `cloudwatch:GenerateQuery` and `cloudwatch:GenerateQueryResultsSummary` permissions, so that users with this policy can generate a CloudWatch Logs Insights query string from a natural language prompt. To see the full contents of the policy, see CloudWatchLogsFullAccess in the *AWS Managed Policy Reference Guide*.

CloudWatchLogsReadOnlyAccess

The **CloudWatchLogsReadOnlyAccess** policy grants read-only access to CloudWatch Logs. It includes the `cloudwatch:GenerateQuery` and `cloudwatch:GenerateQueryResultsSummary` permissions, so that users with this policy can generate a CloudWatch Logs Insights query string from a natural language prompt. To see the full contents of the policy, see CloudWatchLogsReadOnlyAccess in the *AWS Managed Policy Reference Guide*.

CloudWatchOpenSearchDashboardsFullAccess

The **CloudWatchOpenSearchDashboardsFullAccess** policy grants access to create, manage, and delete integrations with OpenSearch Service, and to create delete and manage vended log dashboards in those integrations.

To see the full contents of the policy, see CloudWatchOpenSearchDashboardsFullAccess in the *AWS Managed Policy Reference Guide*.

CloudWatchOpenSearchDashboardAccess

The **CloudWatchOpenSearchDashboardAccess** policy grants access to view vended logs dashboards that are created with Amazon OpenSearch Service analytics.

To see the full contents of the policy, see CloudWatchOpenSearchDashboardAccess in the *AWS Managed Policy Reference Guide*.

CloudWatchLogsCrossAccountSharingConfiguration

The **CloudWatchLogsCrossAccountSharingConfiguration** policy grants access to create, manage, and view Observability Access Manager links for sharing CloudWatch Logs resources between accounts. For more information, see CloudWatch cross-account observability.

To see the full contents of the policy, see CloudWatchLogsCrossAccountSharingConfiguration in the *AWS Managed Policy Reference Guide*.

CloudWatchLogsAPIKeyAccess

The **CloudWatchLogsAPIKeyAccess** policy enables CloudWatch Logs API key authentication and encrypted log ingestion. This policy grants permissions to authenticate using bearer tokens and write log events to CloudWatch Logs, with additional AWS KMS permissions for decrypting and generating data keys when logs are encrypted.

This policy grants the following permissions:

- `logs` – Allows principals to authenticate via API key bearer tokens and write log events to CloudWatch Logs streams.
- `kms` – Allows principals to read AWS KMS key metadata, generate data keys for encryption, and decrypt data. These permissions support encrypted CloudWatch Logs by allowing the service to encrypt log data using customer-managed AWS KMS keys. Access is restricted to operations called through the CloudWatch Logs service.

To view more details about the policy, including the latest version of the JSON policy document, see CloudWatchLogsAPIKeyAccess in the *AWS Managed Policy Reference Guide*.

CloudWatch Logs updates to AWS managed policies

View details about updates to AWS managed policies for CloudWatch Logs since this service began tracking these changes. For automatic alerts about changes to this page, subscribe to the RSS feed on the CloudWatch Logs Document history page.

Change	Description	Date

Change	Description	Date
CloudWatchLogsAPIKeyAccess – New policy.	CloudWatch Logs added a new managed policy **CloudWatchLogsAPIKeyAccess**. This policy enables CloudWatch Logs API key authentication and encrypted log ingestion, granting permissions to authenticate using bearer tokens and write log events to CloudWatch Logs.	February 17, 2026
CloudWatchLogsFullAccess – Update to an existing policy.	CloudWatch Logs added permissions to **CloudWatchLogsFullAccess**. Permissions for observability administration actions were added to allow read-only access to telemetry pipelines and S3 table integrations.	December 02, 2025
CloudWatchLogsReadOnlyAccess – Update to an existing policy.	CloudWatch Logs added permissions to **CloudWatchLogsReadOnlyAccess**. Permissions for observability administration actions were added to allow read-only access to telemetry pipelines and S3 table integrations.	December 02, 2025

Change	Description	Date
CloudWatchLogsFullAccess – Update to an existing policy.	CloudWatch Logs added permissions to **CloudWatchLogsFullAccess**. Permissions for `cloudwatch:GenerateQueryResultsSummary` were added to allow for generation of a natural language summary of the query results.	May 20, 2025
CloudWatchLogsReadOnlyAccess – Update to an existing policy.	CloudWatch Logs added permissions to **CloudWatchLogsReadOnlyAccess**. Permissions for `cloudwatch:GenerateQueryResultsSummary` were added to allow for generation of a natural language summary of the query results.	May 20, 2025
CloudWatchLogsFullAccess – Update to an existing policy.	CloudWatch Logs added permissions to **CloudWatchLogsFullAccess**. Permissions for Amazon OpenSearch Service and IAM were added, to enable CloudWatch Logs integration with OpenSearch Service for some features.	December 1, 2024

Change	Description	Date
CloudWatchOpenSearchDashboardsFullAccess – New IAM policy.	CloudWatch Logs added a new IAM policy, **CloudWatchOpenSearchDashboardsFullAccess**.- This policy grants access to create, manage, and delete integrations with OpenSearch Service, and to create, manage, and delete vended log dashboards in those integrations.	December 1, 2024
CloudWatchOpenSearchDashboardAccess – New IAM policy.	CloudWatch Logs added a new IAM policy, **CloudWatchOpenSearchDashboardAccess**.- This policy grants access to view vended logs dashboards powered by Amazon OpenSearch Service.	December 1, 2024
CloudWatchLogsFullAccess – Update to an existing policy.	CloudWatch Logs added a permission to **CloudWatchLogsFullAccess**. The `cloudwatch:GenerateQuery` permission was added, so that users with this policy can generate a CloudWatch Logs Insights query string from a natural language prompt.	November 27, 2023

Change	Description	Date
CloudWatchLogsReadOnlyAccess – Update to an existing policy.	CloudWatch added a permission to **CloudWatchLogsReadOnlyAccess**. The `cloudwatch:GenerateQuery` permission was added, so that users with this policy can generate a CloudWatch Logs Insights query string from a natural language prompt.	November 27, 2023
CloudWatchLogsReadOnlyAccess – Update to an existing policy	CloudWatch Logs added permissions to **CloudWatchLogsReadOnlyAccess**. The `logs:StartLiveTail` and `logs:StopLiveTail` permissions were added so that users with this policy can use the console to start and stop CloudWatch Logs live tail sessions. For more information, see Use live tail to view logs in near real time.	June 6, 2023

Change	Description	Date
CloudWatchLogsCrossAccountSharingConfiguration – New policy	CloudWatch Logs added a new policy to enable you to manage CloudWatch cross-account observability links that share CloudWatch Logs log groups. For more information, see CloudWatch cross-account observability	November 27, 2022
CloudWatchLogsReadOnlyAccess – Update to an existing policy	CloudWatch Logs added permissions to **CloudWatchLogsReadOnlyAccess**. The `oam:ListSinks` and `oam:ListAttachedLinks` permissions were added so that users with this policy can use the console to view data shared from source accounts in CloudWatch cross-account observability.	November 27, 2022

Customer managed policy examples

You can create your own custom IAM policies to allow permissions for CloudWatch Logs actions and resources. You can attach these custom policies to the users or groups that require those permissions.

In this section, you can find example user policies that grant permissions for various CloudWatch Logs actions. These policies work when you are using the CloudWatch Logs API, AWS SDKs, or the AWS CLI.

Examples

Example 1: Allow full access to CloudWatch Logs

The following policy allows a user to access all CloudWatch Logs actions.

JSON

```
{
  "Version":"2012-10-17",
  "Statement": [
    {
      "Action": [
        "logs:*"
      ],
      "Effect": "Allow",
      "Resource": "*"
    }
  ]
}
```

Example 2: Allow read-only access to CloudWatch Logs

AWS provides a **CloudWatchLogsReadOnlyAccess** policy that enables read-only access to CloudWatch Logs data. This policy includes the following permissions.

JSON

```
{
    "Version":"2012-10-17",
    "Statement": [
        {
            "Action": [
                "logs:Describe*",
                "logs:Get*",
                "logs:List*",
                "logs:StartQuery",
```

```
                "logs:StopQuery",
                "logs:TestMetricFilter",
                "logs:FilterLogEvents",
                "logs:StartLiveTail",
                "logs:StopLiveTail",
                "cloudwatch:GenerateQuery"
            ],
            "Effect": "Allow",
            "Resource": "*"
        }
    ]
}
```

Example 3: Allow access to one log group / log stream

CloudWatch Logs has two resource types with different ARN formats:

- **Log group**: `arn:aws:logs:`*`region`*`:`*`account`*`:log-group:`*`LogGroupName`*
- **Log stream**: `arn:aws:logs:`*`region`*`:`*`account`*`:log-group:`*`LogGroupName`*`:log-stream:`*`StreamName`*

When writing IAM policies, the ARN format you use must match the resource type the API authorizes on. See the service authorization reference for which resource type each API requires.

Example 3a: Allow access to log-group-level actions on a specific log group

```
{
   "Version":"2012-10-17",
   "Statement":[
      {
      "Action": [
        "logs:DeleteLogGroup",
        "logs:PutRetentionPolicy",
        "logs:PutSubscriptionFilter",
        "logs:DescribeLogStreams"
      ],
      "Effect": "Allow",
      "Resource": "arn:aws:logs:us-west-2:123456789012:log-group:SampleLogGroupName"
      }
   ]
}
```

These actions authorize on the `log-group` resource type. The standard ARN format (without `:*`) is supported.

Example 3b: Allow access to log-stream-level actions on a specific log group

```
{
   "Version":"2012-10-17",
   "Statement":[
      {
      "Action": [
        "logs:CreateLogStream",
        "logs:PutLogEvents",
        "logs:GetLogEvents"
      ],
      "Effect": "Allow",
      "Resource": "arn:aws:logs:us-west-2:123456789012:log-group:SampleLogGroupName:*"
      }
   ]
}
```

These actions authorize on the `log-stream` resource type. The `:*` suffix is required to match all log streams within the log group, or specify a specific stream with `:log-stream:`*`StreamName`*.

Example 3c: Combined policy for both log-group and log-stream actions

```
{
   "Version":"2012-10-17",
   "Statement":[
      {
        "Action": [
          "logs:DeleteLogGroup",
          "logs:PutRetentionPolicy",
          "logs:DescribeLogStreams",
          "logs:FilterLogEvents"
        ],
        "Effect": "Allow",
        "Resource": "arn:aws:logs:us-west-2:123456789012:log-group:SampleLogGroupName"
      },
      {
        "Action": [
          "logs:CreateLogStream",
          "logs:PutLogEvents",
          "logs:GetLogEvents"
```

```
        ],
        "Effect": "Allow",
        "Resource": "arn:aws:logs:us-west-2:123456789012:log-
group:SampleLogGroupName:*"
      }
   ]
}
```

Use tagging and IAM policies for control at the log group level

You can grant users access to certain log groups while preventing them from accessing other log groups. To do so, tag your log groups and use IAM policies that refer to those tags. To apply tags to a log group, you need to have either the `logs:TagResource` or `logs:TagLogGroup` permission. This applies both if you are assigning tags to the log group when you create it. or assigning them later.

For more information about tagging log groups, see Tag log groups in Amazon CloudWatch Logs.

When you tag log groups, you can then grant an IAM policy to a user to allow access to only the log groups with a particular tag. For example, the following policy statement grants access to only log groups with the value of `Green` for the tag key `Team`.

JSON

```
{
    "Version":"2012-10-17",
    "Statement": [
        {
            "Action": [
                "logs:*"
            ],
            "Effect": "Allow",
            "Resource": "*",
            "Condition": {
                "StringLike": {
                    "aws:ResourceTag/Team": "Green"
                }
            }
        }
    ]
}
```

The **StopQuery** and **StopLiveTail** API operations don't interact with AWS resources in the traditional sense. They don't return any data, put any data, or modify a resource in any way. Instead, they operate only on a given live tail session or a given CloudWatch Logs Insights query, which are not categorized as resources. As a result, when you specify the `Resource` field in IAM policies for these operations, you must set the value of the `Resource` field as `*`, as in the following example.

JSON

```
{
    "Version":"2012-10-17",
    "Statement":
        [ {
            "Effect": "Allow",
            "Action": [
                "logs:StopQuery",
                "logs:StopLiveTail"
            ],
            "Resource": "*"
            }
        ]
}
```

For more information about using IAM policy statements, see Controlling Access Using Policies in the *IAM User Guide*.

CloudWatch Logs permissions reference

When you are setting up Access control and writing permissions policies that you can attach to an IAM identity (identity-based policies), you can use the following table as a reference. The table lists each CloudWatch Logs API operation and the corresponding actions for which you can grant permissions to perform the action. You specify the actions in the policy's `Action` field. For the `Resource` field, you can specify the ARN of a log group or log stream, or specify `*` to represent all CloudWatch Logs resources.

You can use AWS-wide condition keys in your CloudWatch Logs policies to express conditions. For a complete list of AWS-wide keys, see AWS Global and IAM Condition Context Keys in the *IAM User Guide*.

Note

To specify an action, use the `logs:` prefix followed by the API operation name. For example: `logs:CreateLogGroup`, `logs:CreateLogStream`, or `logs:*` (for all CloudWatch Logs actions).

CloudWatch Logs API operations and required permissions for actions

CloudWatch Logs API operations	Required permissions (API actions)
CancelExportTask	`logs:CancelExportTask` Required to cancel a pending or running export task.
CreateExportTask	`logs:CreateExportTask` Required to export data from a log group to an Amazon S3 bucket.
CreateLogGroup	`logs:CreateLogGroup` Required to create a new log group.
CreateLogStream	`logs:CreateLogStream` Required to create a new log stream in a log group.
DeleteDestination	`logs:DeleteDestination` Required to delete a log destination and disables any subscription filters to it.
DeleteLogGroup	`logs:DeleteLogGroup`

CloudWatch Logs API operations	Required permissions (API actions)
	Required to delete a log group and any associated archived log events.
DeleteLogStream	`logs:DeleteLogStream` Required to delete a log stream and any associated archived log events.
DeleteMetricFilter	`logs:DeleteMetricFilter` Required to delete a metric filter associated with a log group.
DeleteQueryDefinition	`logs:DeleteQueryDefinition` Required to delete a saved query definition in CloudWatch Logs Insights.
DeleteResourcePolicy	`logs:DeleteResourcePolicy` Required to delete a CloudWatch Logs resource policy.
DeleteRetentionPolicy	`logs:DeleteRetentionPolicy` Required to delete a log group's retention policy.
DeleteSubscriptionFilter	`logs:DeleteSubscriptionFilter` Required to delete the subscription filter associated with a log group.

CloudWatch Logs API operations	Required permissions (API actions)
DescribeDestinations	`logs:DescribeDestinations` Required to view all destinations associated with the account.
DescribeExportTasks	`logs:DescribeExportTasks` Required to view all export tasks associated with the account.
DescribeLogGroups	`logs:DescribeLogGroups` Required to view all log groups associated with the account.
DescribeLogStreams	`logs:DescribeLogStreams` Required to view all log streams associated with a log group.
DescribeMetricFilters	`logs:DescribeMetricFilters` Required to view all metrics associated with a log group.
DescribeQueryDefinitions	`logs:DescribeQueryDefinitions` Required to see the list of saved query definitions in CloudWatch Logs Insights.

CloudWatch Logs API operations	Required permissions (API actions)
DescribeQueries	`logs:DescribeQueries` Required to see the list of CloudWatch Logs Insights queries that are scheduled, executing, or have recently excecuted.
DescribeResourcePolicies	`logs:DescribeResourcePolicies` Required to view a list of CloudWatch Logs resource policies.
DescribeSubscriptionFilters	`logs:DescribeSubscriptionFilters` Required to view all subscription filters associated with a log group.
FilterLogEvents	`logs:FilterLogEvents` Required to sort log events by log group filter pattern.
GetLogEvents	`logs:GetLogEvents` Required to retrieve log events from a log stream.
GetLogGroupFields	`logs:GetLogGroupFields` Required to retrieve the list of fields that are included in the log events in a log group.

CloudWatch Logs API operations	Required permissions (API actions)
GetLogRecord	`logs:GetLogRecord` Required to retrieve the details from a single log event.
GetLogObject	`logs:GetLogRecord` Required to fetch the content of large portions of log events that have been ingested through the PutOpenTelemetryLogs API.
GetQueryResults	`logs:GetQueryResults` Required to retrieve the results of CloudWatch Logs Insights queries.
ListEntitiesForLogGroup (CloudWatch console-only permission)	`logs:ListEntitiesForLogGroup` Required to find the entities associated with a log group. Required to explore related logs within the CloudWatch console.
ListLogGroupsForEntity (CloudWatch console-only permission)	`logs:ListLogGroupsForEntity` Required to find the log groups associated with an entity. Required to explore related logs within the CloudWatch console.
ListTagsLogGroup	`logs:ListTagsLogGroup` Required to list the tags associated with a log group.

CloudWatch Logs API operations	Required permissions (API actions)
ListLogGroups	`logs:DescribeLogGroups` Required to view all log groups associated with the account.
ProcessWithPipeline (permission only)	`logs:ProcessWithPipeline` Required to process and transform log events through pipeline transformers before storage. This permission must be granted on the IAM role passed as the CloudWatch Logs source role in a pipeline configuration. The resource is the log group ARN.
PutDestination	`logs:PutDestination` Required to create or update a destination log stream (such as an Kinesis stream).
PutDestinationPolicy	`logs:PutDestinationPolicy` Required to create or update an access policy associated with an existing log destination.
PutLogEvents	`logs:PutLogEvents` Required to upload a batch of log events to a log stream.
PutMetricFilter	`logs:PutMetricFilter` Required to create or update a metric filter and associate it with a log group.

CloudWatch Logs API operations	Required permissions (API actions)
PutQueryDefinition	`logs:PutQueryDefinition` Required to save a query in CloudWatch Logs Insights, including saved queries with parameters.
PutResourcePolicy	`logs:PutResourcePolicy` Required to create a CloudWatch Logs resource policy.
PutRetentionPolicy	`logs:PutRetentionPolicy` Required to set the number of days to keep log events (retention) in a log group.
PutSubscriptionFilter	`logs:PutSubscriptionFilter` Required to create or update a subscription filter and associate it with a log group.
StartQuery	`logs:StartQuery` Required to start CloudWatch Logs Insights queries. To run a saved query with parameters, you also need `logs:DescribeQueryDefinitions` .
StopQuery	`logs:StopQuery` Required to stop a CloudWatch Logs Insights query that is in progress.

CloudWatch Logs API operations	Required permissions (API actions)
TagLogGroup	`logs:TagLogGroup` Required to add or update log group tags.
TestMetricFilter	`logs:TestMetricFilter` Required to test a filter pattern against a sampling of log event messages.

Using service-linked roles for CloudWatch Logs

Amazon CloudWatch Logs uses AWS Identity and Access Management (IAM) service-linked roles. A service-linked role is a unique type of IAM role that is linked directly to CloudWatch Logs. Service-linked roles are predefined by CloudWatch Logs and include all the permissions that the service requires to call other AWS services on your behalf.

A service-linked role makes setting up CloudWatch Logs more efficient because you aren't required to manually add the necessary permissions. CloudWatch Logs defines the permissions of its service-linked roles, and unless defined otherwise, only CloudWatch Logs can assume those roles. The defined permissions include the trust policy and the permissions policy. That permissions policy cannot be attached to any other IAM entity.

For information about other services that support service-linked roles, see AWS Services That Work with IAM. Look for the services that have **Yes** in the **Service-Linked Role** column. Choose a **Yes** with a link to view the service-linked role documentation for that service.

Service-linked role permissions for CloudWatch Logs

CloudWatch Logs uses the service-linked role named **AWSServiceRoleForLogDelivery**. CloudWatch Logs uses this service-linked role to write logs directly to Firehose. For more information, see Enable logging from AWS services.

The **AWSServiceRoleForLogDelivery** service-linked role trusts the following services to assume the role:

- `logs.amazonaws.com`

The role permissions policy, **AWSServiceRoleForLogDeliveryPolicy**, allows CloudWatch Logs to complete the following actions on the specified resources. For the full JSON policy document, see AWSServiceRoleForLogDeliveryPolicy in the *AWS Managed Policy Reference Guide*.

- Action: `firehose:PutRecord`, `firehose:PutRecordBatch`, and `firehose:ListTagsForDeliveryStream` on all Firehose delivery streams that have a tag with a `LogDeliveryEnabled` key with a value of `true`. This tag is automatically attached to an Firehose delivery stream when you create a subscription to deliver the logs to Firehose.
- Action: `kms:GenerateDataKey` and `kms:Decrypt` on all AWS KMS keys, but only when the request is made through Firehose (enforced by the `kms:ViaService` condition key set to `firehose.*.amazonaws.com`). These permissions allow CloudWatch Logs to deliver logs to Firehose delivery streams that use server-side encryption with customer managed keys (SSE-CMK). The customer's AWS KMS key policy must also independently grant access to the service-linked role.

You must configure permissions to allow an IAM entity to create, edit, or delete a service-linked role. This entity could be a user, group, or role. For more information, see Service-Linked Role Permissions in the *IAM User Guide*.

Creating a service-linked role for CloudWatch Logs

You aren't required to manually create a service-linked role. When you set up logs to be sent directly to a Firehose stream in the AWS Management Console, the AWS CLI, or the AWS API, CloudWatch Logs creates the service-linked role for you.

If you delete this service-linked role, and then need to create it again, you can use the same process to recreate the role in your account. When you again set up logs to be sent directly to a Firehose stream, CloudWatch Logs creates the service-linked role for you again.

Editing a service-linked role for CloudWatch Logs

CloudWatch Logs does not allow you to edit **AWSServiceRoleForLogDelivery**, or any other service-linked role, after you create it. You cannot change the name of the role because various entities might reference the role. However, you can edit the description of the role using IAM. For more information, see Editing a Service-Linked Role in the *IAM User Guide*.

Deleting a service-linked role for CloudWatch Logs

If you no longer need to use a feature or service that requires a service-linked role, we recommend that you delete that role. That way you don't have an unused entity that is not actively monitored or maintained. However, you must clean up the resources for your service-linked role before you can manually delete it.

> **Note**
>
> If the CloudWatch Logs service is using the role when you try to delete the resources, then the deletion might fail. If that happens, wait for a few minutes and try the operation again.

To delete CloudWatch Logs resources used by the AWSServiceRoleForLogDelivery service-linked role

- Stop sending logs directly to Firehose streams.

To manually delete the service-linked role using IAM

Use the IAM console, the AWS CLI, or the AWS API to delete the **AWSServiceRoleForLogDelivery** service-linked role. For more information, see Deleting a Service-Linked Role

Supported Regions for CloudWatch Logs service-linked roles

CloudWatch Logs supports using service-linked roles in all of the AWS Regions where the service is available. For more information, see CloudWatch Logs Regions and Endpoints.

CloudWatch Logs updates to AWS service linked roles

View details about updates to AWS service linked role for CloudWatch Logs since this service began tracking these changes. For automatic alerts about changes to this page, subscribe to the RSS feed on the CloudWatch Logs Document history page.

Change	Description	Date
AWSServiceRoleForLogDelivery service-linked role policy – Update to an existing policy	CloudWatch Logs added `kms:GenerateDataKe`	May 15, 2026

Change	Description	Date
	y and kms:Decrypt permissions to the IAM policy associated with the **AWSServiceRoleForLogDelivery** service-linked role. These permissions are scoped with the kms:ViaService condition key to only allow use through Firehose. This change enables CloudWatch Logs to deliver logs to Firehose delivery streams that use server-side encryption with customer managed keys (SSE-CMK).	
AWSServiceRoleForLogDelivery service-linked role policy – Update to an existing policy	CloudWatch Logs changed the permissions in the IAM policy associated with the **AWSServiceRoleForLogDelivery** service-linked role. The following change was made: • The firehose:ResourceTag/LogDeliveryEnabled": "true" condition key was changed to aws:ResourceTag/LogDeliveryEnabled": "true" .	July 15, 2021

Change	Description	Date
CloudWatch Logs started tracking changes	CloudWatch Logs started tracking changes for its AWS managed policies.	June 10, 2021

Compliance validation for Amazon CloudWatch Logs

Our new AWS sign-up experience is not designed for regulated workloads. If you're using our new AWS sign-up experience, but you want to use AWS for regulated workloads, you can sign up for AWS (advanced) or activate advanced features for your AWS environment.

To learn whether an AWS service is within the scope of specific compliance programs, see AWS services in Scope by Compliance Program and choose the compliance program that you are interested in. For general information, see AWS Compliance Programs.

You can download third-party audit reports using AWS Artifact. For more information, see Downloading Reports in AWS Artifact.

Your compliance responsibility when using AWS services is determined by the sensitivity of your data, your company's compliance objectives, and applicable laws and regulations. For more information about your compliance responsibility when using AWS services, see AWS Security Documentation.

Resilience in Amazon CloudWatch Logs

The AWS global infrastructure is built around AWS Regions and Availability Zones. Regions provide multiple physically separated and isolated Availability Zones, which are connected through low-latency, high-throughput, and highly redundant networking. With Availability Zones, you can design and operate applications and databases that automatically fail over between zones without interruption. Availability Zones are more highly available, fault tolerant, and scalable than traditional single or multiple data center infrastructures.

For more information about AWS Regions and Availability Zones, see AWS Global Infrastructure.

Infrastructure security in Amazon CloudWatch Logs

As a managed service, Amazon CloudWatch Logs is protected by AWS global network security. For information about AWS security services and how AWS protects infrastructure, see AWS Cloud Security. To design your AWS environment using the best practices for infrastructure security, see Infrastructure Protection in *Security Pillar AWS Well-Architected Framework*.

You use AWS published API calls to access CloudWatch Logs through the network. Clients must support the following:

- Transport Layer Security (TLS). We require TLS 1.2 and recommend TLS 1.3.
- Cipher suites with perfect forward secrecy (PFS) such as DHE (Ephemeral Diffie-Hellman) or ECDHE (Elliptic Curve Ephemeral Diffie-Hellman). Most modern systems such as Java 7 and later support these modes.

Using CloudWatch Logs with interface VPC endpoints

If you use Amazon Virtual Private Cloud (Amazon VPC) to host your AWS resources, you can establish a private connection between your VPC and CloudWatch Logs. You can use this connection to send logs to CloudWatch Logs without sending them through the internet. CloudWatch Logs supports IPv4 VPC endpoints in all Regions, and supports IPv6 endpoints in all Regions.

Amazon VPC is an AWS service that you can use to launch AWS resources in a virtual network that you define. With a VPC, you have control over your network settings, such the IP address range, subnets, route tables, and network gateways. To connect your VPC to CloudWatch Logs, you define an *interface VPC endpoint* for CloudWatch Logs. This type of endpoint enables you to connect your VPC to AWS services. The endpoint provides reliable, scalable connectivity to CloudWatch Logs without requiring an internet gateway, network address translation (NAT) instance, or VPN connection. For more information, see What is Amazon VPC in the *Amazon VPC User Guide*.

Interface VPC endpoints are powered by AWS PrivateLink, an AWS technology that enables private communication between AWS services using an elastic network interface with private IP addresses. For more information, see New – AWS PrivateLink for AWS Services.

The following steps are for users of Amazon VPC. For more information, see Getting Started in the *Amazon VPC User Guide*.

Availability

CloudWatch Logs currently supports VPC endpoints in all AWS Regions, including the AWS GovCloud (US) Regions.

Creating a VPC endpoint for CloudWatch Logs

To start using CloudWatch Logs with your VPC, create an interface VPC endpoint for CloudWatch Logs. The service to choose is **com.amazonaws.*Region*.logs**. To connect with a FIPS endpoint, the service to choose is `com.amazonaws.Region.logs-fips`. You do not need to change any settings for CloudWatch Logs. For more information, see Creating an Interface Endpoint in the *Amazon VPC User Guide*.

Some CloudWatch Logs APIs, such as StartLiveTail and GetLogObject, are hosted under a different endpoint and VPC endpoint: `stream-logs.Region.amazonaws.com`. To create an interface VPC endpoint for these APIs, the service to choose is **com.amazonaws.*Region*.stream-logs**. To connect with a FIPS endpoint, the service to choose is `com.amazonaws.Region.stream-logs-fips`.

Testing the connection between your VPC and CloudWatch Logs

After you create the endpoint, you can test the connection.

To test the connection between your VPC and your CloudWatch Logs endpoint

1. Connect to an Amazon EC2 instance that resides in your VPC. For information about connecting, see Connect to Your Linux Instance or Connecting to Your Windows Instance in the Amazon EC2 documentation.
2. From the instance, use the AWS CLI to create a log entry in one of your existing log groups.

   First, create a JSON file with a log event. The timestamp must be specified as the number of milliseconds after Jan 1, 1970 00:00:00 UTC.

   ```
   [
     {
       "timestamp": 1533854071310,
       "message": "VPC Connection Test"
     }
   ]
   ```

Then, use the `put-log-events` command to create the log entry:

```
aws logs put-log-events --log-group-name LogGroupName --log-stream-
name LogStreamName --log-events file://JSONFileName
```

If the response to the command includes `nextSequenceToken`, the command has succeeded and your VPC endpoint is working.

Controlling access to your CloudWatch Logs VPC endpoint

A VPC endpoint policy is an IAM resource policy that you attach to an endpoint when you create or modify the endpoint. If you don't attach a policy when you create an endpoint, we attach a default policy for you that allows full access to the service. An endpoint policy doesn't override or replace IAM policies or service-specific policies. It's a separate policy for controlling access from the endpoint to the specified service.

Endpoint policies must be written in JSON format.

For more information, see Controlling Access to Services with VPC Endpoints in the *Amazon VPC User Guide*.

The following is an example of an endpoint policy for CloudWatch Logs. This policy enables users connecting to CloudWatch Logs through the VPC to create log streams and send logs to CloudWatch Logs, and prevents them from performing other CloudWatch Logs actions.

```
{
  "Statement": [
    {
      "Sid": "PutOnly",
      "Principal": "*",
      "Action": [
        "logs:CreateLogStream",
        "logs:PutLogEvents"
      ],
      "Effect": "Allow",
      "Resource": "*"
    }
  ]
}
```

To modify the VPC endpoint policy for CloudWatch Logs

1. Open the Amazon VPC console at https://console.aws.amazon.com/vpc/.
2. In the navigation pane, choose **Endpoints**.
3. If you have not already created the endpoint for CloudWatch Logs, choose **Create Endpoint**. Then select **com.amazonaws.*Region*.logs** and choose **Create endpoint**.
4. Select the **com.amazonaws.*Region*.logs** endpoint, and choose the **Policy** tab in the lower half of the screen.
5. Choose **Edit Policy** and make the changes to the policy.

Support for VPC context keys

CloudWatch Logs supports the `aws:SourceVpc` and `aws:SourceVpce` context keys that can limit access to specific VPCs or specific VPC endpoints. These keys work only when the user is using VPC endpoints. For more information, see Keys Available for Some Services in the *IAM User Guide*.

Logging CloudWatch Logs API and console operations in AWS CloudTrail

Amazon CloudWatch Logs is integrated with AWS CloudTrail, a service that provides a record of actions taken by a user, role, or an AWS service. CloudTrail captures API calls for CloudWatch Logs as events. The calls captured include calls from the CloudWatch Logs console and code calls to the CloudWatch Logs API operations. Using the information collected by CloudTrail, you can determine the request that was made to CloudWatch Logs, the IP address from which the request was made, when it was made, and additional details.

Every event or log entry contains information about who generated the request. The identity information helps you determine the following:

- Whether the request was made with root user or user credentials.
- Whether the request was made on behalf of an IAM Identity Center user.
- Whether the request was made with temporary security credentials for a role or federated user.
- Whether the request was made by another AWS service.

CloudTrail is active in your AWS account when you create the account and you automatically have access to the CloudTrail **Event history**. The CloudTrail **Event history** provides a viewable, searchable, downloadable, and immutable record of the past 90 days of recorded management events in an AWS Region. For more information, see Working with CloudTrail Event history in the *AWS CloudTrail User Guide*. There are no CloudTrail charges for viewing the **Event history**.

For an ongoing record of events in your AWS account past 90 days, create a trail or a CloudTrail Lake event data store.

CloudTrail trails

A *trail* enables CloudTrail to deliver log files to an Amazon S3 bucket. All trails created using the AWS Management Console are multi-Region. You can create a single-Region or a multi-Region trail by using the AWS CLI. Creating a multi-Region trail is recommended because you capture activity in all AWS Regions in your account. If you create a single-Region trail, you can view only the events logged in the trail's AWS Region. For more information about trails, see Creating a trail for your AWS account and Creating a trail for an organization in the *AWS CloudTrail User Guide*.

You can deliver one copy of your ongoing management events to your Amazon S3 bucket at no charge from CloudTrail by creating a trail, however, there are Amazon S3 storage charges. For more information about CloudTrail pricing, see AWS CloudTrail Pricing. For information about Amazon S3 pricing, see Amazon S3 Pricing.

CloudTrail Lake event data stores

CloudTrail Lake lets you run SQL-based queries on your events. CloudTrail Lake converts existing events in row-based JSON format to Apache ORC format. ORC is a columnar storage format that is optimized for fast retrieval of data. Events are aggregated into *event data stores*, which are immutable collections of events based on criteria that you select by applying advanced event selectors. The selectors that you apply to an event data store control which events persist and are available for you to query. For more information about CloudTrail Lake, see Working with AWS CloudTrail Lake in the *AWS CloudTrail User Guide*.

CloudTrail Lake event data stores and queries incur costs. When you create an event data store, you choose the pricing option you want to use for the event data store. The pricing option determines the cost for ingesting and storing events, and the default and maximum retention period for the event data store. For more information about CloudTrail pricing, see AWS CloudTrail Pricing.

CloudWatch Logs supports logging the following actions as events in CloudTrail log files:

- AssociateKmsKey
- CancelExportTask
- CreateDelivery
- CreateExportTask
- CreateLogAnomalyDetector
- CreateLogGroup
- CreateLogStream
- DeleteAccountPolicy
- DeleteDataProtectionPolicy
- DeleteDelivery
- DeleteDeliveryDestination
- DeleteDeliveryDestinationPolicy

- DeleteDeliverySource
- DeleteDestination
- DeleteIndexPolicy
- DeleteIntegration
- DeleteLogAnomalyDetector
- DeleteLogGroup
- DeleteLogStream
- DeleteMetricFilter
- DeleteQueryDefinition
- DeleteResourcePolicy
- DeleteRetentionPolicy
- DeleteSubscriptionFilter
- DeleteTransformer
- DescribeAccountPolicies
- DescribeConfigurationTemplates
- DescribeDeliveries
- DescribeDeliveryDestinations
- DescribeDeliverySources
- DescribeDestinations
- DescribeExportTasks
- DescribeFieldIndexes
- DescribeIndexPolicies
- DescribeLogGroups
- DescribeLogStreams
- DescribeMetricFilters
- DescribeQueries
- DescribeQueryDefinitions
- DescribeResourcePolicies
- DescribeSubscriptionFilters

- DisassociateKmsKey
- FilterLogEvents
- GetDataProtectionPolicy
- GetDelivery
- GetDeliveryDestination
- GetDeliveryDestinationPolicy
- GetDeliverySource
- GetIntegration
- GetLogAnomalyDetector
- GetLogEvents
- GetLogGroupFields
- GetLogRecord
- GetQueryResults
- GetTransformer
- ListAnomalies
- ListIntegrations
- ListLogAnomalyDetectors
- ListLogGroups
- ListLogGroupsForQuery
- ListTagsForResource
- ListTagsLogGroup
- PutAccountPolicy
- PutDataProtectionPolicy
- PutDeliveryDestination
- PutDeliveryDestinationPolicy
- PutDeliverySource
- PutDestination
- PutDestinationPolicy
- PutIndexPolicy

- PutIntegration
- PutMetricFilter
- PutQueryDefinition
- PutResourcePolicy
- PutRetentionPolicy
- PutSubscriptionFilter
- PutTransformer
- StartLiveTail
- StartQuery
- StopQuery
- TagResource
- TestMetricFilter
- TestTransformer
- UntagResource
- UpdateAnomaly
- UpdateDeliveryConfiguration
- UpdateLogAnomalyDetector

Every event or log entry contains information about who generated the request. The identity information helps you determine the following:

- Whether the request was made with root or IAM user credentials.
- Whether the request was made with temporary security credentials for a role or federated user.
- Whether the request was made by another AWS service.

For more information, see the CloudTrail userIdentity Element.

Query generation information in CloudTrail

CloudTrail logging for Query generator console events is also supported. Query generator is currently supported for CloudWatch Logs Insights and CloudWatch Metric Insights. In these CloudTrail events, the `eventSource` is `monitoring.amazonaws.com`.

The following example shows a CloudTrail log entry that demonstrates the **GenerateQuery** action in CloudWatch Logs Insights.


```
{
    "eventVersion": "1.09",
    "userIdentity": {
        "type": "AssumedRole",
        "principalId": "EX_PRINCIPAL_ID",
        "arn": "arn:aws:iam::123456789012:assumed-role/role_name",
        "accountId": "123456789012",
        "accessKeyId": "AKIAIOSFODNN7EXAMPLE",
        "sessionContext": {
            "sessionIssuer": {
                "type": "Role",
                "principalId": "EX_PRINCIPAL_ID",
                "arn": "arn:aws:iam::111222333444:role/Administrator",
                "accountId": "123456789012",
                "userName": "SAMPLE_NAME"
            },
            "attributes": {
                "creationDate": "2020-04-08T21:43:24Z",
                "mfaAuthenticated": "false"
            }
        }
    },
    "eventTime": "2020-04-08T23:06:30Z",
    "eventSource": "monitoring.amazonaws.com",
    "eventName": "GenerateQuery",
    "awsRegion": "us-east-1",
    "sourceIPAddress": "127.0.0.1",
    "userAgent": "exampleUserAgent",
    "requestParameters": {
        "query_ask": "***",
        "query_type": "LogsInsights",
        "logs_insights": {
            "fields": "***",
            "log_group_names": ["yourloggroup"]
        },
        "include_description": true
    },
    "responseElements": null,
    "requestID": "2f56318c-cfbd-4b60-9d93-1234567890",
    "eventID": "52723fd9-4a54-478c-ac55-1234567890",
```

```
    "readOnly": true,
    "eventType": "AwsApiCall",
    "managementEvent": true,
    "recipientAccountId": "111122223333",
    "eventCategory": "Management"
}
```

Understanding log file entries

A trail is a configuration that enables delivery of events as log files to an Amazon S3 bucket that you specify. CloudTrail log files contain one or more log entries. An event represents a single request from any source and includes information about the requested action, the date and time of the action, request parameters, and so on. CloudTrail log files aren't an ordered stack trace of the public API calls, so they don't appear in any specific order.

The following log file entry shows that a user called the CloudWatch Logs **CreateExportTask** action.

```
{
        "eventVersion": "1.03",
        "userIdentity": {
            "type": "IAMUser",
            "principalId": "EX_PRINCIPAL_ID",
            "arn": "arn:aws:iam::123456789012:user/someuser",
            "accountId": "123456789012",
            "accessKeyId": "AKIAIOSFODNN7EXAMPLE",
            "userName": "someuser"
        },
        "eventTime": "2016-02-08T06:35:14Z",
        "eventSource": "logs.amazonaws.com",
        "eventName": "CreateExportTask",
        "awsRegion": "us-east-1",
        "sourceIPAddress": "127.0.0.1",
        "userAgent": "aws-sdk-ruby2/2.0.0.rc4 ruby/1.9.3 x86_64-linux Seahorse/0.1.0",
        "requestParameters": {
            "destination": "yourdestination",
            "logGroupName": "yourloggroup",
            "to": 123456789012,
            "from": 0,
            "taskName": "yourtask"
        },
        "responseElements": {
```

```
            "taskId": "15e5e534-9548-44ab-a221-64d9d2b27b9b"
        },
        "requestID": "1cd74c1c-ce2e-12e6-99a9-8dbb26bd06c9",
        "eventID": "fd072859-bd7c-4865-9e76-8e364e89307c",
        "eventType": "AwsApiCall",
        "apiVersion": "20140328",
        "recipientAccountId": "123456789012"
}
```

Monitoring with CloudWatch metrics

You can use the tables in this section to review the metrics that Amazon CloudWatch Logs sends to Amazon CloudWatch every minute.

CloudWatch Logs metrics

The AWS/Logs namespace includes the following metrics.

Metric	Description
CallCount	The number of specified API operations performed in your account. CallCount is a CloudWatch Logs service usage metric. For more information, see CloudWatch Logs service usage metrics. Valid Dimensions: Class, Resource, Service, Type Valid Statistic: Sum Units: None
DeliveryErrors	The number of log events for which CloudWatch Logs received an error when forwarding data to the subscription destination. If the destination service returns a retryable error such as a throttling exception or a retryable service exception (HTTP 5xx for example), CloudWatch Logs continues to retry delivery for up to 24 hours. CloudWatch Logs does not try to re-deliver if the error is a non-retryable error, such as AccessDeniedException or ResourceNotFoundException . Valid Dimensions: LogGroupName, DestinationType, FilterName, PolicyLevel Valid Statistic: Sum Units: None
DeliveryThrottling	The number of log events for which CloudWatch Logs was throttled when forwarding data to the subscription destination.

Metric	Description
	If the destination service returns a retryable error such as a throttlin g exception or a retryable service exception (HTTP 5xx for example), CloudWatch Logs continues to retry delivery for up to 24 hours. CloudWatch Logs does not try to re-deliver if the error is a non-retry able error, such as `AccessDeniedException` or `ResourceN otFoundException` . Valid Dimensions: LogGroupName, DestinationType, FilterName, PolicyLevel Valid Statistic: Sum Units: None
`EMFDisabl edErrors`	The number of EMF-formatted log events that were ignored due to an active account policy of type METRIC_EXTRACTION_POLICY that matches the log group.For more information about the metric extractio n policies, see PutAccountPolicy. Valid Dimensions: `LogGroupName` Valid Statistic: Sum Units: None
`EMFParsin gErrors`	The number of parsing errors encountered while processing embedded metric format logs. Such errors happen when logs are identified as embedded metric format but do not follow the correct format. For more information about the embedded metric format, see Specifica tion: Embedded metric format. Valid Dimensions: `LogGroupName` Valid Statistic: Sum Units: None

Metric	Description
`EMFValidationErrors`	The number of validation errors encountered while processing embedded metric format logs. These errors occur when metric definitions within embedded metric format logs do not adhere to the embedded metric format and `MetricDatum` specifications. For information about the CloudWatch embedded metric format, see Specification: Embedded metric format. For information about the data type `MetricDatum`, see MetricDatum in the *Amazon CloudWatch API Reference*. **Note** Certain validation errors can lead to multiple metrics within an EMF log not being published. For example, all metrics set with an invalid namespace will be dropped. Valid Dimensions: `LogGroupName` Valid Statistic: Sum Units: None
`ErrorCount`	The number of API operations performed in your account that resulted in errors. `ErrorCount` is a CloudWatch Logs service usage metric. For more information, see CloudWatch Logs service usage metrics. Valid Dimensions: Class, Resource, Service, Type Valid Statistic: Sum Units: None

Metric	Description
ForwardedBytes	The volume of log events in compressed bytes forwarded to the subscription destination. Valid Dimensions: LogGroupName, DestinationType, FilterName Valid Statistic: Sum Units: Bytes
ForwardedLogEvents	The number of log events forwarded to the subscription destination. Valid Dimensions: LogGroupName, DestinationType, FilterName, PolicyLevel Valid Statistic: Sum Units: None
IncomingBytes	The volume of log events in uncompressed bytes uploaded to CloudWatch Logs. When used with the LogGroupName dimension, this is the volume of log events in uncompressed bytes uploaded to the log group. Valid Dimensions: LogGroupName Valid Statistic: Sum Units: Bytes
IncomingLogEvents	The number of log events uploaded to CloudWatch Logs. When used with the LogGroupName dimension, this is the number of log events uploaded to the log group. Valid Dimensions: LogGroupName Valid Statistic: Sum Units: None

Metric	Description
`LogEvents WithFindings`	The number of log events that matched a data string that you are auditing using the CloudWatch Logs data protection feature. For more information, see Help protect sensitive log data with masking. Valid Dimensions: None Valid Statistic: Sum Units: None
`ThrottleCount`	The number of API operations performed in your account that were throttled because of usage quotas. `ThrottleCount` is a CloudWatch Logs service usage metric. For more information, see CloudWatch Logs service usage metrics. Valid Dimensions: Class, Resource, Service, Type Valid Statistic: Sum Units: None

Dimensions for CloudWatch Logs metrics

The dimensions that you can use with most CloudWatch Logs metrics are listed in the following table.

Dimension	Description
`LogGroupName`	The name of the CloudWatch Logs log group for which to display metrics.
`DestinationType`	The subscription destination for the CloudWatch Logs data, which can be AWS Lambda, Amazon Kinesis Data Streams, or Amazon Data Firehose.

Dimension	Description
FilterName	The name of the subscription filter that is forwarding data from the log group to the destination. The subscription filter name is automatically converted by CloudWatch to ASCII and any unsupported characters get replaced with a question mark (?).

Subscription filter metric dimensions

The dimensions for metrics related to account-level subscription filters are listed in the following table.

Dimension	Description
PolicyLevel	The level where the policy applies. Currently, the only valid value for this dimension is AccountPolicy
DestinationType	The subscription destination for the CloudWatch Logs data, which can be AWS Lambda, Amazon Kinesis Data Streams, or Amazon Data Firehose.
FilterName	The name of the subscription filter that is forwarding data from the log group to the destination. The subscription filter name is automatically converted by CloudWatch to ASCII and any unsupported characters get replaced with a question mark (?).

Log transformer metrics and dimensions

CloudWatch Logs publishes the following log transformer metrics to CloudWatch in the AWS/Logs namespace.

Metric	Description
`TransformationErrors`	The number of errors encountered while transforming log events with the specified transformer. Unit: None Valid statistic: Sum
`TransformedBytes`	The volume of the output of transformed log events, in uncompressed bytes. Unit: Bytes Valid statistic: Sum
`TransformedLogEvents`	The number of transformed log events. Unit: None Valid statistic: Sum

The following dimensions are used by transformer metrics.

Dimension	Description
`LogGroupname`	This dimension is used only for log-group-level transformers.
`PolicyLevel`	This dimension is used only for account-level transformers. Currently the only valid value for this dimension is `AccountPolicy`

Centralization metrics and dimensions

For centralized monitoring across multiple accounts and regions, you can use CloudWatch Logs Centralization to consolidate log data and metrics in a central location. For more information, see Cross-account cross-Region log centralization.

CloudWatch Logs publishes the following centralization metrics to CloudWatch in the `AWS/Logs` namespace. These metrics help you monitor the replication of log data from source accounts to destination accounts when using CloudWatch Logs centralization rules.

> **Note**
>
> CloudWatch begins reporting centralization metrics shortly after you create a centralization rule. Metrics are published on a best-effort basis and track only new log events that arrive after the centralization rule is created.

Metric	Description	Published in
`IncomingCopiedBytes`	The volume of log data in uncompressed bytes that was replicated into the destination account. This metric applies only to new log events that arrive after the centralization rule is created. Valid Dimensions: SourceRegion, SourceAccount Valid Statistic: Sum Units: Bytes	Destination account
`IncomingCopiedLogEvents`	The number of log events that were replicated into the destination account. This metric applies only to new log events that arrive after the centralization rule is created. Valid Dimensions: SourceRegion, SourceAccount Valid Statistic: Sum Units: None	Destination account

Metric	Description	Published in
`OutgoingCopiedBytes`	The volume of log data in uncompressed bytes that was sent from source accounts to the destination account. This metric applies only to new log events that are copied to the destination after the centralization rule is created. Valid Dimensions: DestinationRegion Valid Statistic: Sum Units: Bytes	Source account
`OutgoingCopiedLogEvents`	The number of log events that were sent from source accounts to the destination account. This metric applies only to new log events that are copied to the destination after the centralization rule is created. Valid Dimensions: DestinationRegion Valid Statistic: Sum Units: None	Source account

Metric	Description	Published in
`CentralizationError`	The number of errors encountered while replicating log data. Errors can occur due to various reasons such as KMS key permission issues, log group quota limits, or log tier mismatches. To identify specific log groups or log streams that failed replication and their failure reasons, monitor the `ErrorType` dimension. Valid Dimensions: ErrorType Valid Statistic: Sum Units: None	Destination account
`CentralizationThrottled`	The number of times centralization processing was throttled. Throttling results in slower processing of centralization but does not prevent log data from being replicated. Valid Dimensions: DestinationRegion Valid Statistic: Sum Units: None	Source account

The following dimensions are used by centralization metrics.

Dimension	Description
`SourceRegion`	The AWS Region where the source log data originated.
`SourceAccount`	The AWS account ID where the source log data originated.
`DestinationRegion`	The AWS Region where the log data is being replicated to.

Dimension	Description
`ErrorType`	The type of error encountered during centralization. Possible values include: • `LogGroupQuotaExceeded` : The destination account has reached its log group quota. • `InvalidKMS` : The KMS key is missing, deleted, not enabled, or is asymmetric instead of symmetric. • `AccessDenied` : Access was denied when attempting to replicate log data. This can occur due to insufficient permissions, such as incorrect KMS key permissions, missing IAM permissions, or restrictive resource policies. • `LogTierMismatch` : The log tier of the source and destinati on log groups do not match. • `InvalidLogStream` : Invalid parameter encountered when creating or writing to a log stream, such as when the log stream name exceeds the maximum length. • `InvalidLogGroup` : Invalid parameter encountered when creating or configuring a log group in the destination account. • `DestinationEncryptionMismatch` : The destinati on log group already exists with a different KMS encryption configuration than what the centralization rule specifies.

CloudWatch Logs service usage metrics

CloudWatch Logs sends metrics to CloudWatch that track the usage of CloudWatch Logs API operations. These metrics correspond to AWS service quotas. Tracking these metrics can help you proactively manage your quotas. For more information, see Service Quotas Integration and Usage Metrics.

For example, you could track the `ThrottleCount` metric or set an alarm on that metric. If the value of this metric rises, you should consider requesting a quota increase for the API operation

that is getting throttled. For more information about CloudWatch Logs service quotas, see CloudWatch Logs quotas.

CloudWatch Logs publishes service quota usage metrics every minute in both the AWS/Usage and AWS/Logs namespaces.

The following table lists the service usage metrics published by CloudWatch Logs. These metrics do not have a specified unit. The most useful statistic for these metrics is SUM, which represents the total operation count for the 1-minute period.

Each of these metrics is published with values for all of the Service, Class, Type, and Resource dimensions. They are also published with a single dimension called Account Metrics. Use the Account Metrics dimension to see the sum of metrics for all API operations in your account. Use the other dimensions and specify the name of an API operation for the Resource dimension to find the metrics for that particular API.

Metrics

Metric	Description
CallCount	The number of specified operations performed in your account. CallCount is published in both the AWS/Usage and AWS/Logs namespaces.
ErrorCount	The number of API operations performed in your account that resulted in errors. ErrorCount is published in only the AWS/Logs.
ThrottleCount	The number of API operations performed in your account that were throttled because of usage quotas. ThrottleCount is published in only the AWS/Logs.

Dimensions

Dimension	Description
`Account metrics`	Use this dimension to get a sum of the metric across all of the CloudWatch Logs APIs. If you want to see the metrics for one particular API, use the other dimensions listed in this table and specify the API name as the value of `Resource`.
`Service`	The name of the AWS service containing the resource. For CloudWatch Logs usage metrics, the value for this dimension is `Logs`.
`Class`	The class of resource being tracked. CloudWatch Logs API usage metrics use this dimension with a value of `None`.
`Type`	The type of resource being tracked. Currently, when the `Service` dimension is `Logs`, the only valid value for `Type` is `API`.
`Resource`	The name of the API operation. Valid values include all of the API operation names that are listed in Actions. For example, `PutLogEvents`

CloudWatch Logs quotas

You can use the table in this section to review the default service quotas, also referred to as limits, for an AWS account in Amazon CloudWatch Logs. Most of the service quotas, but not all, are listed under the Amazon CloudWatch Logs namespace in the Service Quotas console.

> **Note**
>
> If you want to request a quota increase for any of these quotas, see the procedure in this section.

Name	Default	Adjustable	Description
Active export task	Each supported Region: 1	No	The number of active (running or pending) export tasks per account
AssociateKmsKey throttle limit in transactions per second	Each supported Region: 5 per second	No	The maximum number of associate-kms-key calls per second per account/per region
AssociateSourceToS3TableIntegration throttle limit in transactions per second	Each supported Region: 5	No	The maximum number of AssociateSourceToS3TableIntegration calls per second per account/per region
AssociateSourceToS3TableIntegration throttle limit in transactions per second in a burst	Each supported Region: 10	No	The maximum number of AssociateSourceToS3TableIntegration calls per second per account/per region in a burst

Name	Default	Adjustable	Description
Batch size	Each supported Region: 1 Megabytes	No	The maximum batch size in MB of a put-log-events request
CancelExportTask throttle limit in transactions per second	Each supported Region: 5 per second	No	The maximum number of cancel-export-task calls per second per account/per region
CancelImportTask throttle limit in transactions per second	Each supported Region: 1	No	The maximum number of CancelImportTask calls per second per account/per region
CancelImportTask throttle limit in transactions per second in a burst	Each supported Region: 1	No	The maximum number of CancelImportTask calls per second per account/per region in a burst
CreateExportTask throttle limit in transactions per second	Each supported Region: 5 per second	No	The maximum number of create-export-task calls per second per account/per region
CreateImportTask throttle limit in transactions per second	Each supported Region: 1	No	The maximum number of CreateImportTask calls per second per account/per region
CreateImportTask throttle limit in transactions per second in a burst	Each supported Region: 1	No	The maximum number of CreateImportTask calls per second per account/per region in a burst

Name	Default	Adjustable	Description
CreateLogGroup throttle limit in transactions per second	Each supported Region: 10 per second	Yes	The maximum number of create-log-group calls per second per account/per region
CreateLogStream throttle limit in transactions per second	Each supported Region: 50 per second	Yes	The maximum number of create-log-stream calls per second per account/per region
Data archiving	Each supported Region: 5 Gigabytes	No	The maximum size in GB of free data archiving
DeleteDataProtectionPolicy throttle limit in transactions per second	Each supported Region: 5	No	The maximum number of delete-data-protection-policy calls per second per account/per region
DeleteDestination throttle limit in transactions per second	Each supported Region: 5 per second	No	The maximum number of delete-destination calls per second per account/per region
DeleteLogGroup throttle limit in transactions per second	Each supported Region: 10 per second	Yes	The maximum number of delete-log-group calls per second per account/per region
DeleteLogStream throttle limit in transactions per second	Each supported Region: 15 per second	Yes	The maximum number of delete-log-stream calls per second per account/per region

Name	Default	Adjustable	Description
DeleteMetricFilter throttle limit in transactions per second	Each supported Region: 5 per second	No	The maximum number of delete-metric-filter calls per second per account/per region
DeleteRetentionPolicy throttle limit in transactions per second	Each supported Region: 5 per second	No	The maximum number of delete-retention-policy calls per second per account/per region
DeleteSubscriptionFilter throttle limit in transactions per second	Each supported Region: 5 per second	No	The maximum number of delete-subscription-filter calls per second per account/per region
DeleteTransformer throttle limit in transactions per second	Each supported Region: 5 per second	No	The maximum number of delete-transformer calls per second per account/per region
DescribeDestinations throttle limit in transactions per second	Each supported Region: 5 per second	No	The maximum number of describe-destinations calls per second per account/per region
DescribeExportTasks throttle limit in transactions per second	Each supported Region: 5 per second	No	The maximum number of describe-export-tasks calls per second per account/per region
DescribeImportTaskBatches throttle limit in transactions per second	Each supported Region: 10	No	The maximum number of DescribeImportTaskBatches calls per second per account/per region

Name	Default	Adjustable	Description
DescribeImportTaskBatches throttle limit in transactions per second in a burst	Each supported Region: 10	No	The maximum number of DescribeImportTaskBatches calls per second per account/per region in a burst
DescribeImportTasks throttle limit in transactions per second	Each supported Region: 10	No	The maximum number of DescribeImportTasks calls per second per account/per region
DescribeImportTasks throttle limit in transactions per second in a burst	Each supported Region: 10	No	The maximum number of DescribeImportTasks calls per second per account/per region in a burst
DescribeLogGroups throttle limit in transactions per second	Each supported Region: 10 per second	Yes	The maximum number of describe-log-groups calls per second per account/per region
DescribeLogStreams throttle limit in transactions per second	Each supported Region: 25 per second	Yes	The maximum number of describe-log-streams calls per second per account/per region
DescribeMetricFilters throttle limit in transactions per second	Each supported Region: 5 per second	No	The maximum number of describe-metric-filters calls per second per account/per region

Name	Default	Adjustable	Description
DescribeSubscriptionFilters throttle limit in transactions per second	Each supported Region: 5 per second	No	The maximum number of describe-subscription-filters calls per second per account/per region
DisassociateSourceFromS3TableIntegration throttle limit in transactions per second	Each supported Region: 5	No	The maximum number of DisassociateSourceFromS3TableIntegration calls per second per account/per region
DisassociateSourceFromS3TableIntegration throttle limit in transactions per second in a burst	Each supported Region: 10	No	The maximum number of DisassociateSourceFromS3TableIntegration calls per second per account/per region in a burst
Event size	Each supported Region: 1,024 Kilobytes	No	The maximum log event size in KB

Name	Default	Adjustable	Description
FilterLogEvents throttle limit in transactions per second	us-east-1: 25 per second ap-northeast-3: 5 per second ap-southeast-3: 5 per second ca-west-1: 5 per second eu-central-1: 5 per second il-central-1: 5 per second Each of the other supported Regions: 10 per second	No	The maximum number of filter-log-events calls per second per account/per region
GetDataProtectionPolicy throttle limit in transactions per second	Each supported Region: 5	No	The maximum number of get-data-protection-policy calls per second per account/per region

Name	Default	Adjustable	Description
GetLogEvents throttle limit in transactions per second	us-west-2: 10 per second ap-northeast-3: 10 per second ap-southeast-3: 10 per second ca-west-1: 10 per second eu-central-1: 10 per second eu-west-1: 10 per second eu-west-3: 30 per second il-central-1: 10 per second Each of the other supported Regions: 25 per second	No	The maximum number of get-log-events calls per second per account/per region
GetQueryResults throttle limit in transactions per second	Each supported Region: 10	No	The maximum number of get-query-results calls per second per account/per region

Name	Default	Adjustable	Description
GetTransformer throttle limit in transactions per second	Each supported Region: 5 per second	No	The maximum number of get-transformer calls per second per account/per region
ListSourcesForS3TableIntegration throttle limit in transactions per second	Each supported Region: 5	No	The maximum number of ListSourcesForS3TableIntegration calls per second per account/per region
ListSourcesForS3TableIntegration throttle limit in transactions per second in a burst	Each supported Region: 10	No	The maximum number of ListSourcesForS3TableIntegration calls per second per account/per region in a burst
ListTagsForResource throttle limit in transactions per second	Each supported Region: 30 per second	No	The maximum number of list-tags-for-resource calls per second per account/per region
ListTagsLogGroup throttle limit in transactions per second	Each supported Region: 5 per second	No	The maximum number of list-tags-log-group calls per second per account/per region
Live Tail concurrent sessions limit	Each supported Region: 15	Yes	The maximum number of concurrent active Live Tail sessions per account
Log groups	Each supported Region: 1,000,000	Yes	The maximum number of log groups an account can have

Name	Default	Adjustable	Description
Log groups scanned per Live Tail session	Each supported Region: 10	No	The maximum number of log groups that can be scanned per Live Tail session
Metrics filters per log group	Each supported Region: 100	No	The number of metric filters per log group
PutBearerTokenAuthentication throttle limit in transactions per second	Each supported Region: 5	No	The maximum number of put-bearer-token-authentication calls per second per account/per region
PutBearerTokenAuthentication throttle limit in transactions per second in a burst	Each supported Region: 10	No	The maximum number of put-bearer-token-authentication calls per second per account/per region in a burst
PutDataProtectionPolicy throttle limit in transactions per second	Each supported Region: 5	No	The maximum number of put-data-protection-policy calls per second per account/per region
PutDestination throttle limit in transactions per second	Each supported Region: 5 per second	No	The maximum number of put-destination calls per second per account/per region
PutDestinationPolicy throttle limit in transactions per second	Each supported Region: 5 per second	No	The maximum number of put-destination-policy calls per second per account/per region

Name	Default	Adjustable	Description
PutLogEvents throttle limit in transactions per second	Each supported Region: 5,000 per second	Yes	The maximum number of put-log-events calls per second per account/per region
PutMetricFilter throttle limit in transactions per second	Each supported Region: 5 per second	No	The maximum number of put-metric-filter calls per second per account/per region
PutRetentionPolicy throttle limit in transactions per second	Each supported Region: 5 per second	No	The maximum number of put-retention-policy calls per second per account/per region
PutSubscriptionFilter throttle limit in transactions per second	Each supported Region: 5 per second	No	The maximum number of put-subscription-filter calls per second per account/per region
PutTransformer throttle limit in transactions per second	Each supported Region: 5 per second	No	The maximum number of put-transformer calls per second per account/per region
Resource policies	Each supported Region: 10	No	The maximum number of resource policies per account/per region
StartLiveTail throttle limit in transactions per second	Each supported Region: 5	No	The maximum number of start-live-tail calls per second per account/per region. This limit applies independently to both console and API

Name	Default	Adjustable	Description
StartQuery throttle limit in transactions per second	Each supported Region: 10	No	The maximum number of start-query calls per second per account/per region
Subscription filters per log group	Each supported Region: 5	No	The number of subscription filters per log group
TagLogGroup throttle limit in transactions per second	Each supported Region: 5 per second	No	The maximum number of tag-log-group calls per second per account/per region
TagResource throttle limit in transactions per second	Each supported Region: 5 per second	No	The maximum number of tag-resource calls per second per account/per region
TestMetricFilter throttle limit in transactions per second	Each supported Region: 5 per second	No	The maximum number of test-metric-filter calls per second per account/per region
TestTransformer throttle limit in transactions per second	Each supported Region: 5 per second	No	The maximum number of test-transformer calls per second per account/per region
UntagLogGroup throttle limit in transactions per second	Each supported Region: 5 per second	No	The maximum number of untag-log-group calls per second per account/per region

Name	Default	Adjustable	Description
UntagResource throttle limit in transactions per second	Each supported Region: 5 per second	No	The maximum number of untag-resource calls per second per account/per region
logs anomaly detectors	Each supported Region: 500	Yes	The maximum number of active log anomaly detectors

Managing your CloudWatch Logs service quotas

CloudWatch Logs has integrated with Service Quotas, an AWS service that enables you to view and manage your quotas from a central location. For more information, see What Is Service Quotas? in the *Service Quotas User Guide*.

Service Quotas makes it easy to look up the value of your CloudWatch Logs service quotas.

AWS Management Console

To view CloudWatch Logs service quotas using the console

1. Open the Service Quotas console at https://console.aws.amazon.com/servicequotas/.
2. In the navigation pane, choose **AWS services**.
3. From the **AWS services** list, search for and select **Amazon CloudWatch Logs**.

   In the **Service quotas** list, you can see the service quota name, applied value (if it is available), AWS default quota, and whether the quota value is adjustable.
4. To view additional information about a service quota, such as the description, choose the quota name.
5. (Optional) To request a quota increase, select the quota that you want to increase, select **Request quota increase**, enter or select the required information, and select **Request**.

To work more with service quotas using the console see the Service Quotas User Guide. To request a quota increase, see Requesting a quota increase in the *Service Quotas User Guide*.

AWS CLI

To view CloudWatch Logs service quotas using the AWS CLI

Run the following command to view the default CloudWatch Logs quotas.

```
aws service-quotas list-aws-default-service-quotas \
    --query 'Quotas[*].
{Adjustable:Adjustable,Name:QuotaName,Value:Value,Code:QuotaCode}' \
    --service-code logs \
    --output table
```

To work more with service quotas using the AWS CLI, see the Service Quotas AWS CLI Command Reference. To request a quota increase, see the `request-service-quota-increase` command in the AWS CLI Command Reference.

Document history

The following table describes important changes in each release of the CloudWatch Logs User Guide, beginning in June 2018. For notification about updates to this documentation, you can subscribe to an RSS feed.

Change	Description	Date
New estimate query command for CloudWatch Logs Insights	You can now use the `estimate` command in CloudWatch Logs Insights to return the estimated bytes that the query would scan over the selected log groups and time range, without running the query. The `estimate` command incurs no CloudWatch Logs Insights query charges. For more information, see CloudWatch Logs Insights language query syntax.	July 22, 2026
Updated AWSServiceRoleForLogDelivery service-linked role policy	CloudWatch Logs added `kms:GenerateDataKey` and `kms:Decrypt` permissions to the AWSServiceRoleForLogDelivery service-linked role policy. These permissions enable log delivery to Firehose delivery streams that use server-side encryption with customer managed keys (SSE-CMK). For more information, see	May 15, 2026

	CloudWatch Logs updates to AWS service linked roles.	
Saved queries with parameters for CloudWatch Logs Insights	You can now create reusable query templates with named parameters in CloudWatch Logs Insights. Define a single template and pass different values at run time instead of maintaining multiple near-identical saved queries. For more information, see Using saved queries with parameters.	March 26, 2026
New CloudWatch Logs managed policy CloudWatchLogsAPIKeyAccess	CloudWatch Logs has released a new managed policy `CloudWatchLogsAPIKeyAccess` that enables CloudWatch Logs API key authentication and encrypted log ingestion. For information, see CloudWatch Logs updates to AWS managed policies.	February 17, 2026
Updated CloudWatchLogsReadOnlyAccess policy	Permissions for observability administration actions were added to CloudWatchLogsReadOnlyAccess to allow read-only access to telemetry pipelines and S3 table integrations.	December 2, 2025

Updated CloudWatchLogsFullAccess policy	Permissions for observability administration actions were added to CloudWatchLogsFullAccess to allow read-only access to telemetry pipelines and S3 table integrations.	December 2, 2025
New log management feature in CloudWatch Logs	CloudWatch consolidates log management into a single service with built-in governance capabilities without storing and maintaining multiple copies of the same data across different tools and data stores. For more information, see Log management.	December 2, 2025
New data ingestion and normalization feature in CloudWatch Logs	CloudWatch automatically collects AWS vended logs across accounts and AWS Regions through integrating with AWS Organizations and pre-built connectors for third-party sources. For more information, see Transform logs during ingestion.	December 2, 2025

New analytics and querying based on data sources feature in CloudWatch Logs Insights	CloudWatch Insights introduces facets for queries. Facets are useful for analyzing logs as they allow you to interactively filter and group your data without running queries. A facet is a field in your logs (such as ServiceName or StatusCode) that enables filtering, aggregation and analysis across log groups. For more information, see Use facets to group and explore logs.	December 2, 2025
New S3 Tables Integration	The S3 Tables Integration with CloudWatch allows you to access log data ingested into CloudWatch using analytics engines such as Amazon Athena, Amazon Redshift, and third-party tools that support connection to Apache Iceberg-compatible stores.For more information, see Access logs with S3 Tables Integration.	December 2, 2025

CloudWatch Logs added support for Cross-account cross-Region log centralization	CloudWatch Logs added support for the **Cross-account cross-Region log centralization** that enables CloudWatch Logs to gather log data from AWS Organizations member accounts into a central account for analysis. For more information, see Cross-account cross-Region log centralization.	September 17, 2025
CloudWatch Logs anomaly detection updated example policy	CloudWatch Logs updated the KMS example policy to reduce its scope and improve security to by adding conditions for `aws:SourceAccount` and `aws:SourceArn` . For more information, see Encrypt an anomaly detector and its results with AWS KMS	July 14, 2025
CloudWatch Logs Insights adds support for Amazon VPC Route Server logs	CloudWatch Logs Insights adds support for Amazon VPC Route Server logs. For more information, see Enable logging from AWS services. The new log source for Amazon VPC Route Server, `EVENT_LOGS` is documented in PutDeliverySource	June 12, 2025

CloudWatch Logs Insights adds support for AWS PCS logs	CloudWatch Logs Insights adds support for AWS PCS logs. For more information, see Enable logging from AWS services. The new log sources for AWS PCS, `PCS_SCHEDULER_LOGS` and `PCS_JOBCOMP_LOGS` are documented in PutDeliverySource	June 12, 2025
CloudWatch Logs Insights adds support for AWS Entity Resolution logs	CloudWatch Logs Insights adds support for AWS Entity Resolution logs. For more information, see Enable logging from AWS services. The new log source for AWS Entity Resolution, `WORKFLOW_LOGS` is documented in PutDeliverySource	May 22, 2025
CloudWatch Logs managed policy updates to support natural language summaries	Permissions for `cloudwatch:GenerateQueryResultsSummary` were added to **CloudWatchLogsFullAccess** and **CloudWatchLogsReadOnlyAccess** allow for generation of a natural language summary of the query results. To see the contents of the policies, see CloudWatchLogsFullAccess and CloudWatchLogsReadOnlyAccessin the *AWS Managed Policy Reference Guide*.	May 20, 2025

CloudWatch Logs Insights adds support for generating natural language summaries from CloudWatch Logs Insights query results	Added support for natural language summaries in CloudWatch Logs Insights. This feature generates human-readable summaries of query results, currently available in US East (N. Virginia). For more informati on, see Generate natural language summaries from CloudWatch Logs Insights query results.	May 20, 2025
CloudWatchOpenSear chDashboardAccess and **CloudWatchOpenSear chDashboardsFullAccess** are new IAM policies	CloudWatch Logs added two new IAM policies, **CloudWatchOpenSear chDashboardsFullAccess** and **CloudWatchOpenSear chDashboardAccess**. **CloudWatchOpenSear chDashboardsFullAccess** grants permission to create and manage integrations with OpenSearch Service. **CloudWatchOpenSear chDashboardAccess** grants access to view vended logs dashboards that are created in these integrations.	December 1, 2024

CloudWatchLogsFullAccess policy updated	CloudWatch Logs added permissions for Amazon OpenSearch Service and IAM to the **CloudWatchLogsFull Access** policy, to enable CloudWatch Logs integration with OpenSearch Service for some features.	December 1, 2024
CloudWatch Logs Insights adds new structure types to the query sytnax	CloudWatch Logs Insights adds the `unnest` command and two JSON functions, which enable you to operate JSON strings as maps and lists. For more information, see Structure types.	November 21, 2024
CloudWatch Logs supports log transformation during log ingestion	You can create log transform ers which can modify log events at the time of ingestion, helping you normalize your logs in different formats and from different sources into consistent and context-rich formats. For more informati on, see Transform logs during ingestion.	November 20, 2024

CloudWatch Logs Insights adds field indexing	CloudWatch Logs Insights has added support for field indexing of logs. When you then use a field index in a CloudWatch Logs Insights query, the query attempts to skip processing log events that are known to not include the indexed field For more information, see Create field indexes to improve query performance and reduce scan volume.	November 20, 2024
CloudWatch Logs Insights support for natural language query generation is generally available	CloudWatch Logs Insights supports natural language to generate and update queries. For more information, see Use natural language to generate and update CloudWatch Logs Insights queries.	June 20, 2024
CloudWatchLogsReadOnlyAccess policy updated	CloudWatch Logs added the `cloudwatch:GenerateQuery` permission to **CloudWatchLogsReadOnlyAccess**, so that users with this policy can generate a CloudWatch Logs Insights query string from a natural language prompt.	November 26, 2023

CloudWatchLogsFullAccess policy updated	CloudWatch Logs added the `cloudwatch:GenerateQuery` permission to **CloudWatchLogsFullAccess**, so that users with this policy can generate a CloudWatch Logs Insights query string from a natural language prompt.	November 26, 2023
CloudWatch Logs adds log pattern analysis	CloudWatch Logs now scans for patterns in log events every time you perform a CloudWatch Logs Insights query. For more information, see Pattern analysis.	November 26, 2023
CloudWatch Logs adds log anomaly detection	You can create a log anomaly detector for a log group. The anomaly detector scans the log events ingested into the log group and finds anomalies in the log data. For more information, see Log anomaly detection.	November 26, 2023
CloudWatch Logs adds compare feature	You can now use CloudWatch Logs Insights to compare changes in your log events over time. . For more information, see Compare (diff) with previous time ranges.	November 26, 2023

CloudWatch Logs adds a new log class	CloudWatch Logs supports two classes of log groups so that you can have a cost-effective option for logs that you access infrequently, and you also have a full-featured option for logs that require real-time monitoring or other features. For more informati on, see Log classes.	November 26, 2023
CloudWatch Logs Insights supports natural language query generation	CloudWatch Logs Insights supports natural language to generate and update queries. For more information, see Use natural language to generate and update CloudWatch Logs Insights queries.	November 26, 2023
CloudWatch Logs adds regular expression filter pattern syntax support for Live Tail	You can now further customize your search and match operations to meet your needs with flexible regular expressions within Live Tail filter patterns. For more information, see Filter pattern syntax in the *Amazon CloudWatch Logs User Guide*.	November 13, 2023

CloudWatch Logs adds regular expression filter pattern syntax support for metric filters, subscription filters, and filter log events	You can now further customize your search and match operations to meet your needs with flexible regular expressions within filter patterns. For more information, see Filter pattern syntax in the *Amazon CloudWatch Logs User Guide*.	September 5, 2023
CloudWatch Logs Insights adds a pattern command	You can now use **pattern** in your CloudWatch Logs Insights queries to automatic ally cluster your log data into patterns. A pattern is shared text structure that recurs among your log fields. For more information, see pattern in the *Amazon CloudWatch Logs User Guide*.	July 17, 2023
CloudWatch Logs Insights adds a dedup command	You can now use **dedup** in your CloudWatch Logs Insights queries to remove duplicate results based on specific values in fields that you specify. For more information, see dedup in the *Amazon CloudWatch Logs User Guide*.	June 20, 2023

Account-level data protection policies	You can now set data protection policies at the account level. These account-level policies can audit and mask sensitive informati on in log events in all log groups in the account. For more information, see Help protect sensitive log data with masking in the *Amazon CloudWatch Logs User Guide*.	June 8, 2023
Live Tail feature added	CloudWatch Logs added Live Tail ability, so you can scan logs as they are ingested to help with troubleshooting. You can optionally filter the displayed stream of log events based on specified terms, and also highlight log events that have specified terms. For more information, see Use live tail to view logs in near real time.	June 6, 2023

CloudWatchLogsReadOnlyAccess policy updated	CloudWatch Logs added permissions to **CloudWatchLogsReadOnlyAccess**. The `logs:StartLiveTail` and `logs:StopLiveTail` permissions were added so that users with this policy can use the console to start and stop CloudWatch Logs live tail sessions. For more information, see Use live tail to view logs in near real time.	June 6, 2023
CloudWatch Logs Insights released	You can use CloudWatch Logs Insights to interactively search and analyze your log data. For more information see Analyze Log Data with CloudWatch Logs Insights in the *Amazon CloudWatch Logs User Guide*	November 27, 2018
Support for Amazon VPC endpoints	You can now establish a private connection between your VPC and CloudWatch Logs. For more information, see Using CloudWatch Logs with Interface VPC Endpoints in the *Amazon CloudWatch Logs User Guide*.	June 28, 2018

The following table describes the important changes to the Amazon CloudWatch Logs User's Guide.

Change	Description	Release date
Interface VPC endpoints	In some Regions, you can use an interface VPC endpoint to keep traffic between your Amazon VPC and CloudWatch Logs from leaving the Amazon network. For more information see Using CloudWatch Logs with interface VPC endpoints.	March 7, 2018
Route 53 DNS query logs	You can use CloudWatch Logs to store logs about the DNS queries received by Route 53. For more information see What is Amazon CloudWatch Logs? or Logging DNS Queries in the Amazon Route 53 Developer Guide.	September 7, 2017
Tag log groups	You can use tags to categorize your log groups. For more information, see Tag log groups in Amazon CloudWatch Logs.	December 13, 2016
Console improvements	You can navigate from metrics graphs to the associated log groups. For more information, see Pivot from metrics to logs.	November 7, 2016
Console usability improvements	Improved the experience to make it easier to search, filter, and troubleshoot. For example, you can now filter your log data to a date and time range. For more information, see View log data sent to CloudWatch Logs.	August 29, 2016
Added AWS CloudTrail support for Amazon CloudWatch Logs and new CloudWatch Logs metrics	Added AWS CloudTrail support for CloudWatch Logs. For more information, see Logging CloudWatch Logs API and console operations in AWS CloudTrail.	March 10, 2016

Change	Description	Release date
Added support for CloudWatch Logs export to Amazon S3	Added support for exporting CloudWatch Logs data to Amazon S3. For more information, see Exporting log data to Amazon S3.	December 7, 2015
Added support for AWS CloudTrail logged events in Amazon CloudWatch Logs	You can create alarms in CloudWatch and receive notifications of particular API activity as captured by CloudTrail and use the notification to perform troubleshooting.	November 10, 2014
Added support for Amazon CloudWatch Logs	You can use Amazon CloudWatch Logs to monitor, store, and access your system, application, and custom log files from Amazon Elastic Compute Cloud (Amazon EC2) instances or other sources. You can then retrieve the associated log data from CloudWatch Logs using the Amazon CloudWatch console, the CloudWatch Logs commands in the AWS CLI, or the CloudWatch Logs SDK. For more information, see What is Amazon CloudWatch Logs?.	July 10, 2014

AWS Glossary

For the latest AWS terminology, see the AWS glossary in the *AWS Glossary Reference*.