Streaming Data Solution for Amazon Kinesis

Implementation Guide
# Table of Contents

Welcome .............................................................................................................................. 1
Cost ........................................................................................................................................ 3

Example cost tables ............................................................................................................. 3

Option 1: Deploy the AWS CloudFormation template using API Gateway, Amazon Kinesis Data Streams, and AWS Lambda ............................................................. 3
Option 2: Deploy the AWS CloudFormation template using Amazon EC2, KPL, Kinesis Data Streams, Kinesis Data Analytics, and CloudWatch ........................................ 4
Option 3: Deploy the AWS CloudFormation template using Kinesis Data Streams, Kinesis Data Firehose, and Amazon S3 ................................................................. 4
Option 4: Deploy the AWS CloudFormation template using Kinesis Data Streams, Kinesis Data Analytics, and API Gateway ............................................................ 5

Architecture .......................................................................................................................... 6

Option 1: Deploy the AWS CloudFormation template using API Gateway, Kinesis Data Streams, and Lambda ................................................................. 6
Option 2: Deploy the AWS CloudFormation template using Amazon EC2, KPL, Kinesis Data Streams, Kinesis Data Analytics, and CloudWatch ........................................ 7
Option 3: Deploy the AWS CloudFormation template using Kinesis Data Streams, Kinesis Data Firehose, and Amazon S3 ................................................................. 8
Option 4: Deploy the AWS CloudFormation template using Kinesis Data Streams, Kinesis Data Analytics, and API Gateway ............................................................ 9

Components ........................................................................................................................ 11

Components for option 1 ..................................................................................................... 11
Components for option 2 ..................................................................................................... 12
Components for option 3 ..................................................................................................... 14
Components for option 4 ..................................................................................................... 15
Custom resources ............................................................................................................... 16

Security ............................................................................................................................... 17

IAM roles ............................................................................................................................... 17
Security groups ..................................................................................................................... 17
Auditing ................................................................................................................................. 17

Templates ............................................................................................................................ 18

Deployment .......................................................................................................................... 19

Prerequisites ........................................................................................................................ 19

Option 1: Deploy the aws-streaming-data-solution-for-kinesis-using-api-gateway-and-lambda CloudFormation template ............................................................. 19
  Launch the Stack ................................................................................................................ 19
Option 2: Deploy the aws-streaming-data-solution-for-kinesis-using-kpl-and-kinesis-data-analytics CloudFormation template ............................................................. 21
  Deployment overview ......................................................................................................... 21
  Step 1. Launch the Stack .................................................................................................... 22
  Step 2. Post-configuration steps ......................................................................................... 24
Option 3: Deploy the aws-streaming-data-solution-for-kinesis-using-kinesis-data-firehose-and-amazon-s3 CloudFormation template .................................................. 24
  Launch the Stack ................................................................................................................ 19
  Deployment overview ......................................................................................................... 27
  Step 1. Launch the Stack .................................................................................................... 27
  Step 2. Post-configuration steps ......................................................................................... 29

Resources ............................................................................................................................ 31

Kinesis Producer Library ..................................................................................................... 32
Uninstall the solution .......................................................................................................... 33
Using the AWS Management Console .............................................................................. 33
Using AWS Command Line Interface ................................................................................ 33
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deleting the Amazon S3 Buckets</td>
<td>33</td>
</tr>
<tr>
<td>Deleting the CloudWatch Logs</td>
<td>33</td>
</tr>
<tr>
<td>Deleting the Amazon Cognito User Pool</td>
<td>34</td>
</tr>
<tr>
<td>Operational metrics</td>
<td>35</td>
</tr>
<tr>
<td>Source code</td>
<td>36</td>
</tr>
<tr>
<td>Revisions</td>
<td>37</td>
</tr>
<tr>
<td>Contributors</td>
<td>38</td>
</tr>
<tr>
<td>Notices</td>
<td>39</td>
</tr>
<tr>
<td>AWS glossary</td>
<td>40</td>
</tr>
</tbody>
</table>
Deployment framework for capturing, storing, processing, and delivering real-time streaming data

Publication date: August 2020 (last update (p. 37): November 2021)

The Streaming Data Solution for Amazon Kinesis allows you to capture, store, process, and deliver real-time streaming data. By automatically configuring the included AWS services, this solution helps you address real-time streaming use cases, for example:

- Capture high volume application log files
- Analyze website clickstreams
- Process database event streams
- Track financial transactions
- Aggregate social media feeds
- Collect IT log files
- Continuously deliver to a data lake

This solution helps accelerate your development lifecycle by minimizing or eliminating the need to model and provision resources using AWS CloudFormation, setup preconfigured Amazon CloudWatch alarms set to recommended thresholds, dashboards, and logging, and manually implement streaming data best practices. This solution is data and logic agnostic, meaning that you can start with boilerplate code and then customize it to your needs.

The solution uses templates where data flows through producers, streaming storage, consumers, and destinations. Producers continuously generate data and send it to streaming storage where it is durably captured and made available for processing by a data consumer. Data consumers process the data and then send it to a destination.

To support multiple use cases and business needs, this solution offers four AWS CloudFormation templates. You can use this solution to test new service combinations as the basis for your production environment, and to improve existing applications.

1. **Option 1** captures data from non-AWS environments (for example, mobile clients). This option uses an Amazon API Gateway as a layer of abstraction, which allows you to implement custom authentication approaches for data producers, control quotas for specific producers, and change the target Kinesis stream. This template uses AWS Lambda as the data consumer, which is best suited for use cases that don't require internal state like filtering, business event processing, and data cleansing. Lambda offers a small surface area for error scenarios and is simple to scale and operate.

2. **Option 2** is intended for use cases such as streaming extract-transform-load (ETL), real-time analytics, predictive analytics, and machine learning. It uses Apache Flink and provides a fully managed service to handle backups for snapshots, a Amazon Kinesis Data Analytics implementation of an Apache Flink Savepoint, automatically. This option also supports the Amazon Kinesis Producer Library (KPL), which is best suited when you control the code that is written to the Kinesis Data Streams. This control enables you to implement cost optimizations through buffering on the data producer and has fewer resources to manage compared to alternatives. Kinesis Data Analytics for Apache Flink is used as the data consumer, which is best suited when you require capabilities such as durable application
and exactly-once processing, that are very efficient processes for high volume data streams with low latency and high availability.

3. **Option 3** uses **Amazon Kinesis Data Firehose**. Use this option when you want a simple way to back up incoming streaming data with minimal administration for the processing layer and ability to send data into **Amazon Simple Storage Service** (Amazon S3) (among other destinations) in near real time. Kinesis Data Firehose takes care of compression and encryption, minimizing the amount of storage used at the destination and increasing security.

4. **Option 4** uses **Apache Flink**, and showcases how to asynchronously invoke an external endpoint in a streaming application, for example, when you want to enrich or filter incoming events. The external API can be any integration supported by API Gateway, such as a Lambda function or an **Amazon SageMaker** endpoint.

All templates are configured to apply best practices to monitor functionality using dashboards and alarms, and to secure data.

This implementation guide discusses architectural considerations and configuration steps for deploying the Streaming Data Solution for Amazon Kinesis in the AWS Cloud. It includes links to AWS CloudFormation templates that launches and configures the AWS services required to deploy this solution using AWS best practices for security and availability.

The guide is intended for IT architects, developers, and DevOps professionals who want to get started quickly with the core streaming services available in the AWS Cloud.
Cost

You are responsible for the cost of the AWS services used while running this solution. As of November 2021, the monthly cost for running this solution with either provided AWS CloudFormation template options, while publishing 100 records per second in the US East (N. Virginia) Region, is described in the following tables.

Prices are subject to change. For full details, refer to the pricing webpage for each AWS service used in this solution.

Example cost tables

Option 1: Deploy the AWS CloudFormation template using API Gateway, Amazon Kinesis Data Streams, and AWS Lambda

The following table provides a cost estimate to deploy the aws-streaming-data-solution-for-kinesis-using-api-gateway-and-lambda AWS CloudFormation template that uses Amazon API Gateway, Amazon Kinesis Data Streams (with enhanced monitoring turned off), and AWS Lambda.

Table for Option 1: Cost estimate for running the solution using the CloudFormation template that deploys API Gateway, Kinesis Data Streams, and AWS Lambda

<table>
<thead>
<tr>
<th>AWS service</th>
<th>Dimensions</th>
<th>Cost per month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amazon Kinesis Data Streams</td>
<td>1 shard</td>
<td>$10.95</td>
</tr>
<tr>
<td></td>
<td>100 records (4 KB) / second</td>
<td>$3.68</td>
</tr>
<tr>
<td></td>
<td>168 hours data retention</td>
<td>$14.60</td>
</tr>
<tr>
<td>Amazon API Gateway</td>
<td>2,678,400 requests / month (1/sec)</td>
<td>$10.50</td>
</tr>
<tr>
<td>Amazon Cognito</td>
<td>100 users / month</td>
<td>$5.00</td>
</tr>
<tr>
<td></td>
<td>Advanced security features added</td>
<td></td>
</tr>
<tr>
<td>AWS Lambda</td>
<td>2,678,400 requests / month (1/sec)</td>
<td>$3.33</td>
</tr>
<tr>
<td><strong>TOTAL:</strong></td>
<td></td>
<td><strong>$48.06 per month</strong></td>
</tr>
</tbody>
</table>
Option 2: Deploy the AWS CloudFormation template using Amazon EC2, KPL, Kinesis Data Streams, Kinesis Data Analytics, and CloudWatch

The following table provides a cost estimate to deploy the `aws-streaming-data-solution-for-kinesis-using-kpl-and-kinesis-data-analytics` AWS CloudFormation template that uses Amazon Elastic Compute Cloud (Amazon EC2), KPL, Kinesis Data Streams, Kinesis Data Analytics, and Amazon CloudWatch.

<table>
<thead>
<tr>
<th>AWS service</th>
<th>Dimensions</th>
<th>Cost per month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amazon Kinesis Producer Library</td>
<td>EC2 instance (t3.small)</td>
<td>$15.18</td>
</tr>
<tr>
<td>(KPL)</td>
<td>730 hours / month</td>
<td></td>
</tr>
<tr>
<td>Kinesis Data Streams</td>
<td>1 shard</td>
<td>$10.95</td>
</tr>
<tr>
<td></td>
<td>100 records (4 KB) / second</td>
<td>$3.68</td>
</tr>
<tr>
<td></td>
<td>168 hours data retention</td>
<td>$14.60</td>
</tr>
<tr>
<td>Kinesis Data Analytics</td>
<td>1 processing unit</td>
<td>$80.30</td>
</tr>
<tr>
<td></td>
<td>50 GB running application storage</td>
<td>$5.00</td>
</tr>
<tr>
<td>Amazon S3</td>
<td>1 GB storage (Amazon S3 Standard)</td>
<td>$0.02</td>
</tr>
<tr>
<td>TOTAL:</td>
<td></td>
<td>$129.73 per month</td>
</tr>
</tbody>
</table>

Option 3: Deploy the AWS CloudFormation template using Kinesis Data Streams, Kinesis Data Firehose, and Amazon S3

The following table provides a cost estimate to deploy the `aws-streaming-data-solution-for-kinesis-using-kinesis-data-firehose-and-amazon-s3` AWS CloudFormation template that uses Amazon Kinesis Data Streams (with enhanced monitoring turned off), Amazon Kinesis Data Firehose (with data transformation and dynamic partitioning turned off), and Amazon S3.

<table>
<thead>
<tr>
<th>AWS service</th>
<th>Dimensions</th>
<th>Cost per month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kinesis Data Streams</td>
<td>1 shard</td>
<td>$10.95</td>
</tr>
<tr>
<td></td>
<td>100 records (4KB) / second</td>
<td>$3.68</td>
</tr>
</tbody>
</table>
Option 4: Deploy the AWS CloudFormation template using Kinesis Data Streams, Kinesis Data Analytics, and API Gateway

The following table provides a cost estimate to deploy the AWS CloudFormation template that uses Amazon Kinesis Data Streams, Kinesis Data Analytics, and API Gateway.

*Table for Option 4: Cost estimate for running the solution using the AWS CloudFormation template that deploys Amazon Kinesis Data Streams, Kinesis Data Analytics, and API Gateway*

<table>
<thead>
<tr>
<th>AWS service</th>
<th>Dimensions</th>
<th>Cost per month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amazon Kinesis Replay</td>
<td>EC2 instance (t3.small) 730 hours / month</td>
<td>$15.18</td>
</tr>
<tr>
<td>Kinesis Data Streams</td>
<td>1 shard 100 records (4KB) / second</td>
<td>$10.95</td>
</tr>
<tr>
<td></td>
<td>168 hours data retention</td>
<td>$3.68</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$14.60</td>
</tr>
<tr>
<td>Kinesis Data Analytics</td>
<td>1 processing unit 50 GB running application storage</td>
<td>$80.30</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$5.00</td>
</tr>
<tr>
<td>API Gateway</td>
<td>2,678,400 requests / month (1/second)</td>
<td>$10.50</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>TOTAL: $140.21 per month</strong></td>
</tr>
</tbody>
</table>

Option 4: Deploy the AWS CloudFormation template using Kinesis Data Streams, Kinesis Data Analytics, and API Gateway

The following table provides a cost estimate to deploy the AWS CloudFormation template that uses Amazon Kinesis Data Streams, Kinesis Data Analytics, and API Gateway.

*Table for Option 4: Cost estimate for running the solution using the AWS CloudFormation template that deploys Amazon Kinesis Data Streams, Kinesis Data Analytics, and API Gateway*

<table>
<thead>
<tr>
<th>AWS service</th>
<th>Dimensions</th>
<th>Cost per month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kinesis Data Streams</td>
<td>1 shard 100 records (4KB) / second</td>
<td>$10.95</td>
</tr>
<tr>
<td></td>
<td>168 hours data retention</td>
<td>$3.68</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$14.60</td>
</tr>
<tr>
<td>Kinesis Data Analytics</td>
<td>1 processing unit 50 GB running application storage</td>
<td>$80.30</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$5.00</td>
</tr>
</tbody>
</table>

TOTAL: $65.59 per month
Architecture overview

This solution automatically configures the core AWS services necessary to capture, store, process, and deliver streaming data. Four reference architecture options are available. Each option includes customizable demo code and sample applications.

All AWS CloudFormation resources were created using AWS Solutions Constructs.

Option 1: Deploy the AWS CloudFormation template using API Gateway, Kinesis Data Streams, and Lambda

Deploying the aws-streaming-data-solution-for-kinesis-using-api-gateway-and-lambda AWS CloudFormation template builds the following environment in the AWS Cloud.

Figure 1: AWS CloudFormation template using Amazon API Gateway, Kinesis Data Streams, and AWS Lambda reference architecture

This AWS CloudFormation template deploys a reference architecture that includes the following:

1. An API Gateway REST API that acts as a proxy to Amazon Kinesis Data Streams, adding either an individual data record or a list of data records.
2. An Amazon Cognito user pool is used to control who can invoke REST API methods.
3. Kinesis Data Streams to store the incoming streaming data.
4. An AWS Lambda function processes the records from the data stream.
5. Errors and failed records that occur during AWS Lambda processing are annotated, and the events are stored in Amazon Simple Queue Service (Amazon SQS).

Note

For information about how AWS services handle errors, refer to Error handling in the AWS Lambda Developer Guide and AWS Lambda Supports Failure-Handling Features.
Option 2: Deploy the AWS CloudFormation template using Amazon EC2, KPL, Kinesis Data Streams, Kinesis Data Analytics, and CloudWatch


1. An Amazon Elastic Compute Cloud (Amazon EC2) instance that uses the Amazon Kinesis Producer Library (KPL) to generate data.
2. Kinesis Data Streams to store the incoming streaming data.
3. Kinesis Data Analytics Studio processes the incoming records and saves the processed data in an Amazon Simple Storage Service (Amazon S3) bucket.
4. An Amazon CloudWatch dashboard monitors application health, progress, resource utilization, events, and errors. For information on essential metrics including recommended alarms, refer to Using CloudWatch Alarms with Amazon Kinesis Data Analytics for Apache Flink in the Kinesis Data Analytics Developer Guide.

Note
You can configure the solution to use an existing Amazon Virtual Private Cloud (Amazon VPC) to allow access to private resources (for example, private databases). By default, Kinesis Data Analytics does not launch into your VPC, but you can allow your applications to access Amazon Relational Database Service (Amazon RDS) using this solution. For information about connecting to a virtual private cloud in your account, refer to Configuring Kinesis Data Analytics in the Kinesis Data Analytics Developer Guide.
**Option 3: Deploy the AWS CloudFormation template using Kinesis Data Streams, Kinesis Data Firehose, and Amazon S3**

Deploying the `aws-streaming-data-solution-for-kinesis-using-kinesis-data-firehose-and-amazon-s3` AWS CloudFormation template builds the following environment in the AWS Cloud.

![Diagram showing the flow of data from Amazon Kinesis Data Streams, through Kinesis Data Firehose, to an Amazon S3 bucket, monitored by CloudWatch.](image)

This AWS CloudFormation template deploys a reference architecture that includes the following:

1. **Amazon Kinesis Data Streams** stores the incoming streaming data.
2. **Kinesis Data Firehose** buffers the data before delivering the output to an Amazon S3 bucket. It is a fully managed service that automatically scales to match the throughput of your data and requires no ongoing administration.
3. An **Amazon CloudWatch** dashboard monitors the data ingestion and buffering. CloudWatch alarms are set on essential metrics for Kinesis Data Firehose. For information on essential metrics (including recommended alarms), refer to Monitoring Kinesis Data Firehose Using CloudWatch Metrics in the *Kinesis Data Firehose Developer Guide*. 

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**Figure 3: AWS CloudFormation template using Kinesis Data Streams, Kinesis Data Firehose, and S3 reference architecture**
Option 4: Deploy the AWS CloudFormation template using Kinesis Data Streams, Kinesis Data Analytics, and API Gateway


This AWS CloudFormation template deploys a reference architecture similar to Option 2 and includes the following:

1. An Amazon Elastic Compute Cloud (Amazon EC2) instance that uses the Amazon Kinesis Producer Library (KPL) to generate data.
2. Kinesis Data Streams stores the incoming streaming data.
3. Kinesis Data Analytics processes the incoming records and asynchronously invokes an external endpoint.
4. The demo application invokes a Lambda function.
5. The external API can be any integration supported by API Gateway (for example, an Amazon SageMaker endpoint).
6. An Amazon CloudWatch dashboard monitors application health, progress, resource utilization, events, and errors. For information on essential metrics including recommended alarms, refer to Using CloudWatch Alarms with Amazon Kinesis Data Analytics for Apache Flink in the Amazon Kinesis Data Analytics Developer Guide.

**Note**
You can configure the solution to use an existing Amazon Virtual Private Cloud (Amazon VPC) allowing access to private resources (for example, private databases). By default, Kinesis Data
Option 4: Deploy the AWS CloudFormation template using Kinesis Data Streams, Kinesis Data Analytics, and API Gateway. Analytics does not launch into your VPC, but you can allow your applications to access Amazon Relational Database Service (Amazon RDS) using this solution. For information about connecting to a virtual private cloud in your account, refer to Configuring Kinesis Data Analytics in the Kinesis Data Analytics Developer Guide.
Solution components

Component details for all templates.

Components for option 1: API Gateway, Kinesis Data Streams, and Lambda

Demo consumer application

A consumer is an application that processes data from a Kinesis data stream. The aws-streaming-data-solution-for-kinesis-using-api-gateway-and-lambda template includes a demo consumer application, which is a Node.js function that logs the data being published. The customizable source code is available from the solution's GitHub repository and can be customized to your business needs.

CloudWatch dashboards and alerts

This template deploys an Amazon CloudWatch dashboard that monitors the health of the data stream. You can customize the dashboards and alerts using Amazon CloudWatch or the source code from the solution's GitHub repository.

Figure 5: Kinesis Data Streams metrics on the CloudWatch dashboard

Figure 6: AWS Lambda metrics on the CloudWatch dashboard
Components for option 2: Amazon EC2, KPL, Kinesis Data Streams, and Kinesis Data Analytics

Demo producer application

A producer is an application that puts user data records into a Kinesis data stream (also called data ingestion). The aws-streaming-data-solution-for-kinesis-using-kpl-and-kinesis-data-analytics AWS CloudFormation template includes a demo producer application, which is implemented using the Amazon Kinesis Producer Library (KPL). The demo producer application is configured to write 100 records per second to the data stream. The customizable source code is available from the solution's GitHub repository. For information about the customizing the demo producer application, or replacing it with your own application, refer to the KPL demo README.md file in the GitHub repository.

Note
This demo producer application uses the same schema that is provided in Getting Started with Amazon Kinesis Data Analytics for Apache Fink (DataStream API) in the Amazon Kinesis Data Analytics Developer Guide.

CloudWatch dashboards and alerts

This template deploys an Amazon CloudWatch dashboard that monitors the health of the data stream. You can also view Kinesis Data Analytics Log Insights statistics.

You can customize the dashboards and alerts using Amazon CloudWatch or the source code from the solution's GitHub repository.

Figure 7: Application Health on the CloudWatch dashboard

Figure 8: Resource Utilization on the CloudWatch dashboard
Studio notebook

This template deploys an Amazon Kinesis Data Analytics Studio notebook powered by Apache Zeppelin and Apache Flink to interactively analyze streaming data.
Components for option 3: Kinesis Data Streams, Kinesis Data Firehose, and Amazon S3

CloudWatch dashboards and alerts

This template deploys an Amazon CloudWatch dashboard to monitor the health of the data ingestion and buffering. You can customize the dashboards and alerts using Amazon CloudWatch or the source code from the solution's GitHub repository.
Components for option 4: Kinesis Data Streams, Kinesis Data Analytics, and API Gateway

**Demo producer application**

The `aws-streaming-data-solution-for-kinesis-using-kinesis-data-analytics-and-api-gateway` AWS CloudFormation template includes a demo producer application, that is implemented using the Amazon Kinesis Replay project. By default, the application replays an historic dataset of New York City taxi trips derived from the public data set available from the Registry of Open Data on AWS.

**Demo consumer application**
This template also includes a demo consumer application, which is a Java application for Amazon Kinesis Data Analytics. This application demonstrates how to invoke an external API in your streaming application.

**CloudWatch dashboards and alerts**

This solution deploys an Amazon CloudWatch dashboard to monitor the health, progress, resource utilization, and specific events and errors of the data streaming activities. You can also view Log Insights statistics on the CloudWatch dashboard, which provides information on Kinesis Data Analytics application logs.

This dashboard visualizations for this template are identical to the `aws-streaming-data-solution-for-kinesis-using-kpl-and-kinesis-data-analytics` template (Option 2).

**Custom resources**

The AWS CloudFormation templates provided in this solution support enhanced monitoring for Amazon Kinesis Data Streams. When enhanced monitoring is turned on, Kinesis Data Streams sends shard-level data to Amazon CloudWatch. Additional costs may apply.


These features are not currently supported in Amazon Kinesis services, therefore, the solution provides AWS Lambda functions that implement custom resources that activate these features.
Security

When you build systems on AWS infrastructure, security responsibilities are shared between you and AWS. This shared model can reduce your operational burden as AWS operates, manages, and controls the components from the host operating system and virtualization layer down to the physical security of the facilities in which the services operate. For more information about security on AWS, refer to AWS Cloud Security.

IAM roles

AWS Identity and Access Management (IAM) roles enable customers to assign granular access policies and permissions to services and users in the AWS Cloud. This solution creates IAM roles for communication between services. For more information, refer to Providing Access to an AWS Service in the IAM User Guide.

Security groups

This solution creates a security group for the Amazon Kinesis Producer Library (KPL) instance so that it can communicate with the Amazon Kinesis endpoint. This security group does not allow any inbound traffic, and the instance can only be accessed via AWS Systems Manager Session Manager.

Auditing

Each AWS service included in this solution is integrated with AWS CloudTrail, which captures all API calls. For more details, refer to the following documentation.

- Logging Kinesis Data Analytics API Calls with AWS CloudTrail
- Logging calls to Amazon API Gateway APIs with AWS CloudTrail
- Logging AWS Lambda API calls with AWS CloudTrail
- Logging Amazon Kinesis Data Streams API Calls with AWS CloudTrail
- Logging Amazon Kinesis Data Firehose API Calls with AWS CloudTrail
AWS CloudFormation templates

This solution uses AWS CloudFormation to automate the deployment of the Streaming Data Solution for Amazon Kinesis in the AWS Cloud. It includes the following CloudFormation templates, which you can download before deployment and customize to meet your needs:

**Option 1: streaming-data-solution-for-kinesis-using-api-gateway-and-lambda.template**
Use this template to launch this solution using Amazon API Gateway, Amazon Kinesis Data Streams, and AWS Lambda. The default configuration deploys API Gateway REST APIs, Kinesis Video Streams, AWS Lambda functions, and an Amazon Simple Queue Service queue. You can also customize the template based on your specific needs.

Use this template to launch this solution using Kinesis Producer Library, Amazon Elastic Compute Cloud (Amazon EC2), and Amazon Kinesis Data Analytics. The default configuration deploys an Amazon EC2 instance, Kinesis Data Streams, Kinesis Data Analytics, Amazon CloudWatch, and an Amazon Simple Storage Service bucket. You can also customize the template based on your specific needs.

Use this template to launch the solution using Kinesis Data Streams, Kinesis Data Firehose, and S3. You can also customize the template for your specific needs.

Use this template to launch the solution using Kinesis Data Streams, Kinesis Data Analytics, and API Gateway. You can also customize the template for your specific needs.
Automated deployment

Prerequisites

Choose one of the following AWS CloudFormation templates to deploy, then follow the step-by-step instructions for your selected template:

- **Option 1:** Deploy the `aws-streaming-data-solution-for-kinesis-using-api-gateway-and-lambda.template` AWS CloudFormation template using Amazon API Gateway, Amazon Kinesis Data Streams, and AWS Lambda
- **Option 2:** Deploy the `aws-streaming-data-solution-for-kinesis-using-kpl-and-kinesis-data-analytics.template` AWS CloudFormation template using Amazon Elastic Compute Cloud (Amazon EC2), Amazon Kinesis Producer Library (KPL), Kinesis Data Streams, Amazon Kinesis Data Analytics, and Amazon CloudWatch
- **Option 3:** Deploy the `aws-streaming-data-solution-for-kinesis-using-kinesis-data-firehose-and-amazon-s3.template` AWS CloudFormation template using Kinesis Data Streams, Kinesis Data Firehose, and S3
- **Option 4:** Deploy the `aws-streaming-data-solution-for-kinesis-using-kinesis-data-analytics-and-api-gateway.template` AWS CloudFormation template using Kinesis Data Streams, Kinesis Data Analytics, and Amazon API Gateway

Option 1: Deploy the aws-streaming-data-solution-for-kinesis-using-api-gateway-and-lambda CloudFormation template

Before you launch this template, review the architecture and other considerations discussed in this guide. Follow the step-by-step instructions in this section to configure and deploy the solution into your account.

**Time to deploy:** Approximately five minutes

**Launch the Stack**

**Note**
You are responsible for the cost of the AWS services used while running this solution. Refer to the Cost (p. 3) section for more details. For full details, refer to the pricing webpage for each AWS service used in this solution.

1. Sign in to the AWS Management Console and use the button below to launch the `streaming-data-solution-for-kinesis-using-api-gateway-and-lambda` AWS CloudFormation template.
Alternatively, you can download the template as a starting point for your own implementation.

2. The template launches in the US East (N. Virginia) Region by default. To launch this solution in a different AWS Region, use the Region selector in the console navigation bar.

3. On the Create stack page, verify that the correct template URL shows in the Amazon S3 URL text box and choose Next.

4. On the Specify stack details page, assign a name to your solution stack. For information about naming character limitations, refer to IAM and STS Limits in the AWS Identity and Access Management User Guide.

5. Under Parameters, review the parameters for the template and modify them as necessary. This solution uses the following default values.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Amazon API Gateway configuration</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steady-state requests per second</td>
<td>100</td>
<td>The number of steady-state requests per second that the proxy API Gateway permits. The allowed range is from 1 to 10000.</td>
</tr>
<tr>
<td><em>(ThrottlingRateLimit)</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Burst requests per second</td>
<td>50</td>
<td>The number of burst requests per second that the proxy API Gateway permits. The allowed range is from 0 to 5000.</td>
</tr>
<tr>
<td><em>(ThrottlingBurstLimit)</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Amazon Kinesis Data Streams configuration</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of open shards</td>
<td>2</td>
<td>The number of shards that the stream uses. The allowed range is from 1 to 100 shards.</td>
</tr>
<tr>
<td><em>(ShardCount)</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data retention period (hours)</td>
<td>24</td>
<td>The number of hours that data records stored in shards will remain accessible. The allowed range is from 24 to 8760 hours.</td>
</tr>
<tr>
<td><em>(RetentionHours)</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enable enhanced (shard-level) metrics</td>
<td>false</td>
<td>Choose whether to activate enhanced monitoring for shard-level metrics. This function is turned off by default.</td>
</tr>
<tr>
<td><em>(EnableEnhancedMonitoring)</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>AWS Lambda consumer configuration</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Largest number of records that will be read from the stream at once</td>
<td>100</td>
<td>The maximum number of records to retrieve in a single batch. The allowed range is from 1 to 10000.</td>
</tr>
<tr>
<td><em>(BatchSize)</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of batches to process from each shard concurrently</td>
<td>1</td>
<td>The number of batches to process from each shard concurrently. The allowed range is from 1 to 10.</td>
</tr>
</tbody>
</table>

Before you launch this template, review the architecture and other considerations discussed in this guide. Follow the step-by-step instructions in this section to configure and deploy the solution into your account.

Time to deploy: Approximately 10 minutes

Deployment overview

Use the following steps to deploy this solution on AWS. For detailed instructions, follow the links for each step.

Step 1. Launch the Stack (p. 22)
- Launch the AWS CloudFormation template into your AWS account.
- Review the other template parameters, and adjust if necessary.

Step 2. Post-configuration steps (p. 24)
**Step 1. Launch the Stack**

**Note**
You are responsible for the cost of the AWS services used while running this solution. Refer to the Cost (p. 3) section for more details. For full details, refer to the pricing webpage for each AWS service used in this solution.

1. Sign in to the AWS Management Console and use the button below to launch the streaming-data-solution-for-kinesis-using-kpl-and-kinesis-data-analytics AWS CloudFormation template.

Alternatively, you can download the template as a starting point for your own implementation.

2. The template launches in the US East (N. Virginia) Region by default. To launch this solution in a different AWS Region, use the Region selector in the console navigation bar.

   **Note**
   This template uses Amazon Kinesis Data Analytics, which is not currently available in all AWS Regions. You must launch this solution in an AWS Region where Kinesis Data Analytics is available. For the most current availability by Region, refer to the AWS Service Region Table.

3. On the Create stack page, verify that the correct template URL shows in the Amazon S3 URL text box and choose Next.

4. On the Specify stack details page, assign a name to your solution stack. For information about naming character limitations, refer to IAM and STS Limits in the AWS Identity and Access Management User Guide.

5. Under Parameters, review the parameters for the template and modify them as necessary. This solution uses the following default values.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Amazon Kinesis Producer Library (KPL) configuration</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VPC where the KPL instance should be launched (ProducerVpcId)</td>
<td>&lt;Requires input&gt;</td>
<td>VPC where the KPL instance is launched.</td>
</tr>
<tr>
<td>Subnet where the KPL instance should be launched (ProducerSubnetId)</td>
<td>&lt;Requires input&gt;</td>
<td>Subnet where the KPL instance is launched (the subnet requires access to Kinesis Data Streams, either via IGW or NAT).</td>
</tr>
<tr>
<td><strong>Amazon Machine Image for the KPL instance (ProducerAmId)</strong></td>
<td>/aws/service/ami-amazon-linux-latest/amzn2-ami-hvm-x86_64-gp2</td>
<td>Amazon Machine Image (AMI) ID for the KPL instance.</td>
</tr>
<tr>
<td><strong>Amazon Kinesis Data Streams configuration</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Streaming Data Solution for Amazon
Kinesis Implementation Guide
Step 1. Launch the Stack

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of open shards (ShardCount)</td>
<td>2</td>
<td>The number of shards that the stream uses. The allowed range is from 1 to 100 shards.</td>
</tr>
<tr>
<td>Data retention period (hours) (RetentionHours)</td>
<td>24</td>
<td>The number of hours that data records stored in shards will remain accessible. The allowed range is from 24 to 8760 hours.</td>
</tr>
<tr>
<td>Enable enhanced (shard-level) metrics (EnableEnhancedMonitoring)</td>
<td>false</td>
<td>Choose whether to activate enhanced monitoring for shard-level metrics. This function is turned off by default.</td>
</tr>
<tr>
<td>Amazon Kinesis Data Analytics configuration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monitoring log level (LogLevel)</td>
<td>INFO</td>
<td>The level of detail of the CloudWatch Logs for an application. The available options include DEBUG, ERROR, INFO, and WARN. For information about choosing a log level, refer to Application Monitoring Levels in the Amazon Kinesis Data Analytics Developer Guide.</td>
</tr>
<tr>
<td>Comma-separated list of subnet ids for VPC connectivity (ApplicationSubnetIds)</td>
<td>&lt;Optional input&gt;</td>
<td>If subnet IDs are provided, then security groups must also be included.</td>
</tr>
<tr>
<td>Comma-separated list of security groups ids for VPC connectivity (ApplicationSecurityGroupIds)</td>
<td>&lt;Optional input&gt;</td>
<td>If security group IDs are provided, then subnets must also be included.</td>
</tr>
</tbody>
</table>

6. Choose Next.
7. On the Configure stack options page, choose Next.
8. On the Review page, review and confirm the settings. Check the box acknowledging that the template will create AWS Identity and Access Management (IAM) resources.
9. Choose Create stack to deploy the stack.

You can view the status of the stack in the AWS CloudFormation console in the Status column. You should receive a CREATE_COMPLETE status in approximately 10 minutes.

Note
This solution includes the solution-helper Lambda function, which runs only during initial configuration. This function is only created if you start the collection of operational metrics.
Step 2. Post-configuration steps

By default, the demo producer and Studio notebook will not run after the stacks are created. Follow these steps to enable them.

1. Sign in to the Amazon Kinesis console and, from the left menu pane, select Analytics applications.
2. On the Amazon Kinesis Data Analytics page, go to the Studio tab, and select Kda<studio-notebook-name>.
3. Choose Actions then choose Run application.
4. Navigate to the AWS Systems Manager console and, from the left menu pane under Instances and Nodes, select Session Manager.
5. On the AWS Systems Manager page, choose Start session.
6. On the Start a session page, select the ec2-instance-id> for the KPL instance and choose Start session.

Refer to the AWS CloudFormation Outputs tab for the Amazon EC2 instance ID.

7. In the console window, run the following command to start the demo producer application. (Replace <stream-name>, <aws-region>, and <seconds> with your specific information).

   ```
   sudo java -jar /tmp/aws-kpl-demo.jar <stream-name> <aws-region> <seconds>
   ```

You can customize or replace the demo application that is included with this solution can be customized or replaced to meet your business needs. The source code is available from the solution's GitHub repository. For information about the demo producer application and customizing the demo application or replacing it with your own application, refer to the README.md file in the GitHub repository.

Option 3: Deploy the aws-streaming-data-solution-for-kinesis-using-kinesis-data-firehose-and-amazon-s3 CloudFormation template

Before you launch this template, review the architecture and other considerations discussed in this guide. Follow the step-by-step instructions in this section to configure and deploy the solution into your account.

**Time to deploy:** Approximately five minutes

**Launch the Stack**

**Note**
You are responsible for the cost of the AWS services used while running this solution. Refer to the Cost section for more details. For full details, refer to the pricing webpage for each AWS service used in this solution.

1. Sign in to the AWS Management Console and use the button below to launch the streaming-data-solution-for-kinesis-using-kinesis-data-firehose-and-amazon-s3 AWS CloudFormation template.
Alternatively, you can download the template as a starting point for your own implementation.

2. The template launches in the US East (N. Virginia) Region by default. To launch this solution in a different AWS Region, use the Region selector in the console navigation bar.

3. On the Create stack page, verify that the correct template URL shows in the Amazon S3 URL text box and choose Next.

4. On the Specify stack details page, assign a name to your solution stack. For information about naming character limitations, refer to IAM and STS Limits in the AWS Identity and Access Management User Guide.

5. Under Parameters, review the parameters for the template and modify them as necessary. This solution uses the following default values.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amazon Kinesis Data Streams configuration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of open shards (ShardCount)</td>
<td>2</td>
<td>The number of shards that the stream uses. The allowed range is from 1 to 100 shards.</td>
</tr>
<tr>
<td>Data retention period (RetentionHours)</td>
<td>24</td>
<td>The number of hours that data records stored in shards will remain accessible. The allowed range is from 24 to 8760 hours.</td>
</tr>
<tr>
<td>Enable enhanced (shard-level) metrics</td>
<td>false</td>
<td>Choose whether to activate enhanced monitoring for shard-level metrics. This function is turned off by default.</td>
</tr>
<tr>
<td>Amazon Kinesis Data Firehose configuration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size of the buffer (in MBs) that incoming data is buffered before delivery (BufferingSize)</td>
<td>5</td>
<td>The size to buffer incoming data before delivering to S3. The allowed range is from 1 to 128.</td>
</tr>
<tr>
<td>Length of time (in seconds) that incoming data is buffered before delivery (BufferingInterval)</td>
<td>300</td>
<td>The amount of time to buffer incoming data before delivering to S3. The allowed range is from 60 to 900.</td>
</tr>
<tr>
<td>Compression format for delivered data in Amazon S3 (CompressionFormat)</td>
<td>GZIP</td>
<td>The format of data once it’s delivered to S3. Allowed values are GZIP, HADOOP_SNAPPY,</td>
</tr>
</tbody>
</table>
### Launch the Stack

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Data prefix for delivered data in S3</strong> (DataPrefix)</td>
<td>&lt;Optional input&gt;</td>
<td>Prefix to be appended to the data delivered to S3 (if dynamic partitioning is activated, you can also specify the partitionKeyFromQuery namespace).</td>
</tr>
<tr>
<td><strong>Prefix for failed records that cannot be delivered</strong> (ErrorsPrefix)</td>
<td>&lt;Optional input&gt;</td>
<td>Prefix to be used for errors when delivering data (if dynamic partitioning is activated, this parameter is required).</td>
</tr>
<tr>
<td><strong>Dynamic partitioning configuration</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Whether data on Amazon S3 will be partitioned</strong> (DynamicPartitioning)</td>
<td>Disabled</td>
<td>Whether dynamic partitioning should be activated (once activated, this feature cannot be deactivated). Allowed values are Disabled and Enabled.</td>
</tr>
<tr>
<td><strong>New line delimiter</strong> (NewLineDelimiter)</td>
<td>Disabled</td>
<td>Whether to add a new line delimiter between records. Allowed values are Disabled and Enabled.</td>
</tr>
<tr>
<td><strong>JQ expression</strong> (JqExpression)</td>
<td>&lt;Optional input&gt;</td>
<td>JQ expression to be used for inline parsing (for instance, &quot;{ ticker: .ticker }&quot;).</td>
</tr>
<tr>
<td><strong>Retry duration</strong> (RetryDurationSec)</td>
<td>300</td>
<td>Total amount of time (in seconds) that should be spent on retries. The allowed range is from 0 to 7200.</td>
</tr>
</tbody>
</table>

6. Choose **Next**.
7. On the **Configure stack options** page, choose **Next**.
8. On the **Review** page, review and confirm the settings. Check the box acknowledging that the template will create AWS Identity and Access Management (IAM) resources.
9. Choose **Create stack** to deploy the stack.

You can view the status of the stack in the AWS CloudFormation console in the **Status** column. You should receive a **CREATE_COMPLETE** status in approximately five minutes.

**Note**

This solution includes the solution-helper Lambda function, which runs only during initial configuration or when resources are updated or deleted. When you run this solution, you will notice the Lambda functions in the AWS Management Console. While it may not appear active, do not delete the solution-helper function because it is necessary to manage associated resources.

Before you launch this template, review the architecture and other considerations discussed in this guide. Follow the step-by-step instructions in this section to configure and deploy the solution into your account.

Time to deploy: Approximately 10 minutes

Deployment overview

Use the following steps to deploy this solution on AWS. For detailed instructions, follow the links for each step.

Step 1. Launch the Stack (p. 27)
- Launch the AWS CloudFormation template into your AWS account.
- Review the other template parameters, and adjust if needed.

Step 2. Post-configuration steps (p. 29)

Step 1. Launch the Stack

Note
You are responsible for the cost of the AWS services used while running this solution. Refer to the Cost (p. 3) section for more details. For full details, refer to the pricing webpage for each AWS service used in this solution.

1. Sign in to the AWS Management Console and use the button below to launch the streaming-data-solution-for-kinesis-using-kinesis-data-analytics-and-api-gateway AWS CloudFormation template.

Alternatively, you can download the template as a starting point for your own implementation.

2. The template launches in the US East (N. Virginia) Region by default. To launch this solution in a different AWS Region, use the Region selector in the console navigation bar.

Note
This template uses Amazon Kinesis Data Analytics, which is not currently available in all AWS Regions. You must launch this solution in an AWS Region where Kinesis Data Analytics is available. For the most current availability by Region, refer to the AWS Service Region Table.

3. On the Create stack page, verify that the correct template URL shows in the Amazon S3 URL text box and choose Next.
4. **On the Specify stack details page**, assign a name to your solution stack. For information about naming character limitations, refer to IAM and STS Limits in the AWS Identity and Access Management User Guide.

5. **Under Parameters**, review the parameters for the template and modify them as necessary. This solution uses the following default values.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Amazon Kinesis Replay configuration</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VPC where the KPL instance should be launched</td>
<td>&lt;Requires input&gt;</td>
<td>VPC where the KPL instance is launched.</td>
</tr>
<tr>
<td>(ProducerVpcId)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subnet where the KPL instance should be launched</td>
<td>&lt;Requires input&gt;</td>
<td>Subnet where the KPL instance is launched (the subnet requires access to Kinesis Data Streams, either via IGW or NAT).</td>
</tr>
<tr>
<td>(ProducerSubnetId)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amazon Machine Image for the KPL instance</td>
<td>/aws/service/ami-amazon-linux-latest/amzn2-ami-hvm-x86_64-gp2</td>
<td>Amazon Machine Image (AMI) ID for the KPL instance.</td>
</tr>
<tr>
<td>(ProducerAmId)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Amazon Kinesis Data Streams configuration</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of open shards</td>
<td>2</td>
<td>The number of shards that the stream uses. The allowed range is from 1 to 100 shards.</td>
</tr>
<tr>
<td>(ShardCount)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data retention period (hours)</td>
<td>24</td>
<td>The number of hours that data records stored in shards will remain accessible. The allowed range is from 24 to 8760 hours.</td>
</tr>
<tr>
<td>(RetentionHours)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enable enhanced (shard-level) metrics</td>
<td>false</td>
<td>Choose whether to activate enhanced monitoring for shard-level metrics. This function is deactivated by default.</td>
</tr>
<tr>
<td>(EnableEnhancedMonitoring)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Amazon Kinesis Data Analytics configuration</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monitoring log level</td>
<td>INFO</td>
<td>The level of detail of the CloudWatch Logs for an application. The available options include DEBUG, ERROR, INFO, and WARN. For information about choosing a log level, refer to Application Monitoring Levels in the Amazon Kinesis Data Analytics Developer Guide.</td>
</tr>
<tr>
<td>(LogLevel)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Step 2. Post-configuration steps

By default, the demo producer and demo consumer applications will not run after the stacks are created. Use the following process to start them.

1. Sign in to the Amazon Kinesis console and, from the left menu pane, select Analytics applications.
2. On the Amazon Kinesis Data Analytics page, select Kda <application-name>.
3. Choose Actions then choose Run application.
4. Navigate to the AWS Systems Manager console and, from the left menu pane under Instances and Nodes, select Session Manager.
5. On the AWS Systems Manager page, choose Start session.
6. On the Start a session page, select the <ec2-instance-id> for the KPL instance and choose Start session.

Refer to the AWS CloudFormation Outputs tab for the Amazon EC2 instance ID.

7. In the console window, run the following command to start the demo producer application.

(Replace <stream-name>, <aws-region>, and <seconds> with your information.)

```
sudo java -jar /tmp/amazon-kinesis-replay-0.1.0.jar -streamName <stream-name> -streamRegion <region> -noWatermark -objectPrefix artifacts/kinesis-analytics-taxi-consumer/taxi-trips-partitioned.json.lz4/dropoff_year=2018/
```
Note
The demo application uses an updated schema of the taxi dataset. You must specify a custom objectPrefix when running the preceding command.
Additional resources

<table>
<thead>
<tr>
<th>Amazon API Gateway</th>
<th>Amazon Simple Storage Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amazon CloudWatch</td>
<td>AWS CloudFormation</td>
</tr>
<tr>
<td>Amazon Elastic Compute Cloud</td>
<td>AWS Identity and Access Management</td>
</tr>
<tr>
<td>Amazon Kinesis Data Analytics</td>
<td>AWS Lambda</td>
</tr>
<tr>
<td>Amazon Kinesis Data Streams</td>
<td>Amazon Simple Queue Service</td>
</tr>
<tr>
<td></td>
<td>Amazon Kinesis Data Firehose</td>
</tr>
</tbody>
</table>

AWS documentation

Developing Producers Using the Amazon Kinesis Producer Library

Best practices for monitoring and data protection:

- Viewing Kinesis Data Analytics Metrics and Dimensions
- Using CloudWatch Alarms with Amazon Kinesis Data Analytics for Apache Flink
- Security in Amazon Kinesis Data Analytics
- Security in Amazon Kinesis Data Streams
- Using AWS Lambda with Amazon Kinesis
- Monitoring Kinesis Data Firehose Using CloudWatch Metrics
- Security in Amazon Kinesis Data Firehose
Kinesis Producer Library

This solution's CloudFormation resources are created from AWS CDK components, and the resources contain the template code that you can use to customize this solution. For more information about setting up your project and customizing this solution, refer to the README.md file in GitHub.

The Amazon Kinesis Producer Library (KPL) is used in the AWS CloudFormation template using Amazon Elastic Compute Cloud (Amazon EC2), Amazon Kinesis Data Analytics, and Amazon CloudWatch. The KPL is an easy-to-use, highly configurable library that helps you write to Amazon Kinesis Data Streams. It acts as an intermediary between the producer application code and the Kinesis Data Streams API actions. It also integrates seamlessly with the Kinesis Client Library (KCL) and submits Amazon CloudWatch metrics on your behalf to provide visibility into producer performance.

The sample producer application included in this solution uses the following configuration:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MaxConnections</strong></td>
<td>1</td>
<td>The maximum number of open connections to the backend. HTTP requests are sent in parallel over multiple connections. The allowed range is from 1 to 256.</td>
</tr>
<tr>
<td><strong>RequestTimeout</strong></td>
<td>60000</td>
<td>The maximum elapsed time (in milliseconds) from when an HTTP request initiates and when all responses are received. The request times out if the elapsed time is exceeded.</td>
</tr>
<tr>
<td><strong>RecordMaxBufferedTime</strong></td>
<td>2000</td>
<td>The maximum amount of buffer time (in milliseconds) that a record is allowed to be buffered before it is sent.</td>
</tr>
<tr>
<td><strong>AggregationEnabled</strong></td>
<td>false</td>
<td>Choose whether to enable aggregation. With aggregation, multiple user records are packed into a single KinesisRecord. If disabled, each user record is sent in its own KinesisRecord.</td>
</tr>
</tbody>
</table>

For more information about configuration parameters, refer to the sample properties file on the Amazon Kinesis Producer GitHub repository.
Uninstall the solution

You can uninstall the Streaming Data Solution for Amazon Kinesis using the AWS Management Console or the AWS Command Line Interface (AWS CLI). However, the Amazon Simple Storage Service (Amazon S3) bucket and Amazon CloudWatch Logs created by this solution must be manually deleted.

Using the AWS Management Console

1. Sign in to the AWS CloudFormation console.
2. On the Stacks page, select the solution stack.
3. Choose Delete.

Using AWS Command Line Interface

Determine whether AWS Command Line Interface (AWS CLI) is available in your environment. For installation instructions, see What Is the AWS Command Line Interface? in the AWS CLI User Guide. After confirming the AWS CLI is available, run the following command.

```bash
$ aws cloudformation delete-stack --stack-name <cloudformation-stack-name>
```

Replace `<cloudformation-stack-name>` with the name of your CloudFormation stack.

Deleting the Amazon S3 buckets

This solution is configured to retain the Amazon S3 buckets if you choose to delete the AWS CloudFormation stack to prevent against accidental data loss. After uninstalling the solution, you can manually delete the S3 buckets if you do not need to retain the data. Use the following procedure to delete the Amazon S3 buckets.

1. Sign in to the Amazon S3 console.
2. Choose Buckets from the left navigation pane.
3. Locate the `<stack-name>` S3 buckets.
4. Select one of the S3 buckets and choose Delete.

Repeat the steps until you have deleted all the `<stack-name>` S3 buckets.

Alternatively, you can configure the AWS CloudFormation template to delete the Amazon S3 buckets automatically. Before deleting the stack, change the deletion behavior in the AWS CloudFormation DeletionPolicy attribute.

Deleting the CloudWatch Logs

This solution retains the CloudWatch Logs if you decide to delete the AWS CloudFormation stack to prevent against accidental data loss. After uninstalling the solution, you can manually delete the logs if you do not need to retain the data. Use the following procedure to delete the CloudWatch Logs.
Deleting the Amazon Cognito User Pool

This solution retains the Cognito user pool if you decide to delete the AWS CloudFormation stack to prevent against accidental data loss. After uninstalling the solution, you can manually delete the user pool if you do not need to retain the data by using the following procedure:

1. Sign in to the Amazon Cognito console.
2. Choose Manage User Pools.
3. Locate the user pool created by the solution.

Alternatively, you can configure the AWS CloudFormation template to delete the CloudWatch Logs automatically. Before deleting the stack, change the deletion behavior in the AWS CloudFormation DeletionPolicy attribute.

1. Sign in to the Amazon CloudWatch console.
2. Choose Log Groups from the left navigation pane.
3. Locate the log groups created by the solution.
4. Select one of the log groups.
5. Choose Actions and then choose Delete.

Repeat the steps until you have deleted all the solution log groups.

Alternatively, you can configure the AWS CloudFormation template to delete the CloudWatch Logs automatically. Before deleting the stack, change the deletion behavior in the AWS CloudFormation DeletionPolicy attribute.
Collection of operational metrics

This solution includes an option to send anonymous operational metrics to AWS. We use this data to better understand how customers use this solution and related services and products. When enabled, the following information is collected and sent to AWS:

- **Solution ID**: The AWS solution identifier
- **Unique ID (UUID)**: Randomly generated, unique identifier for each solution deployment
- **Timestamp**: The UTC formatted timestamp of when the event occurred
- **Data**: The Region where the stack launched, request type (whether the stack was created, updated, or deleted), and details about the option chosen (for example, shard count, whether enhanced monitoring was enabled, buffering size, etc.). For example:

```json
{"Pattern": "KdsKdfS3", "RetentionHours": "24",  
'CompressionFormat': "GZIP", 'BufferingInterval': '300', 
'ShardCount': '2', 'EnhancedMonitoring': 'false', 'Version': 'v1.2.0', 
'BufferingSize': '5', 'Region': 'us-east-1', 'RequestType': 'Create'}
```

Note that AWS owns the data gathered through this survey. Data collection is subject to the AWS Privacy Policy. To opt out of this feature, modify the AWS CloudFormation template mapping section:

1. Download the AWS CloudFormation template to your local hard drive.
2. Open the AWS CloudFormation template with a text editor.
3. Modify the AWS CloudFormation template mapping section from:

```json
"Send" : {  
"AnonymousUsage" : { "Data" : "Yes" } 
},
```

4. Sign in to the AWS CloudFormation console.
5. Select Create stack.
6. On the Create stack page, Specify template section, select Upload a template file.
7. Under Upload a template file, choose Choose file and select the edited template from your local drive.
8. Choose Next and follow the steps in Launch the stack in the Automated deployment section of this guide.
Source code

You can visit our GitHub repository to download the templates and scripts for this solution, and to share your customizations with others.
## Document revisions

<table>
<thead>
<tr>
<th>Date</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>August 2020</td>
<td>Initial release</td>
</tr>
<tr>
<td>September 2020</td>
<td>Release version 1.1.0: Refactored the AWS CloudFormation template to use an AWS Solutions Construct; updated command to start the demo producer application in Step 2 (p. 24) of Automated Deployment; for more information about changes for v1.1.0, refer to the CHANGELOG.md file in the Github repository.</td>
</tr>
<tr>
<td>October 2020</td>
<td>Release version 1.2.0. Added additional template options. For more information about changes for v1.2.0, refer to the CHANGELOG.md file in the Github repository.</td>
</tr>
<tr>
<td>January 2021</td>
<td>Release version 1.3.0. Added support for Apache Flink 1.11.1. For more information about changes for v1.2.0, refer to the CHANGELOG.md file in the Github repository.</td>
</tr>
<tr>
<td>April 2021</td>
<td>Release version 1.4.0. Updated demo applications to use the Node.js 14x runtime. For more information, refer to the CHANGELOG.md file in the GitHub repository.</td>
</tr>
<tr>
<td>May 2021</td>
<td>Release version 1.4.1 – Added Support for Apache Kafka versions 2.8.0 and 2.6.2. For more information, refer to the CHANGELOG.md file in the GitHub repository.</td>
</tr>
<tr>
<td>July 2021</td>
<td>Release version 1.5.0 – Updated authentication for Option 1 to use Amazon Cognito user pools. For more information, refer to the CHANGELOG.md file in the GitHub repository.</td>
</tr>
<tr>
<td>November 2021</td>
<td>Release version 1.6.0 – Added support for Apache Flink 1.13.2; Added support for Amazon Kinesis Data Firehose dynamic partitioning; Updated option 2 to use Amazon Kinesis Data Analytics Studio. For more information, refer to the CHANGELOG.md file in the GitHub repository.</td>
</tr>
</tbody>
</table>
Contributors

The following individuals contributed to this document:

- Daniel Pinheiro
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AWS glossary

For the latest AWS terminology, see the AWS glossary in the AWS General Reference.