Implementation Guide

Video on Demand on AWS

Video on Demand on AWS: Implementation Guide

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Deploy a reference implementation to build a scalable, distributed video-on-demand workflow

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The Video on Demand on AWS solution automatically provisions the AWS services necessary to build a scalable, distributed workflow to ingest, store, process, and deliver video content on demand. It ingests metadata files and source videos, processes the videos for playback on a wide range of devices, stores the transcoded media files, and delivers the videos to end users through CloudFront.

This solution provides an example architecture to build a global consumer video workflow on AWS. By default, the solution can encode MP4, MPG, M4V, M2TS, and MOV files. You can customize the architecture to encode any media file type supported by AWS Elemental MediaConvert. For more information, refer to Customization.

This implementation guide provides an overview of the Video on Demand on AWS solution, its reference architecture and components, considerations for planning the deployment, configuration steps for deploying the solution to the Amazon Web Services (AWS) Cloud.

The intended audience for discovering and using this solution in their environment includes solution architects, business decision makers, DevOps engineers, data scientists, and cloud professionals.

Use this navigation table to quickly find answers to these questions:

If you want to . . .	Read . . .
Know the cost for running this solution. The estimated cost for running this solution in the US East (N. Virginia) Region is **USD $ 4.23 per month** for AWS resources.	Cost
Understand the security considerations for this solution.	Security
Know how to plan for quotas for this solution.	Quotas

If you want to . . .	Read . . .
Know which AWS Regions support this solution.	Supported AWS Regions
View or download the AWS CloudForm ation template included in this solution to automatically deploy the infrastructure resources (the "stack") for this solution.	AWS CloudFormation template

Features and benefits

The solution provides the following features:

Reference implementation

Leverage the Video on Demand on AWS solution as a reference implementation to automatically provision the AWS services necessary to build a scalable, distributed video-on-demand workflow.

Customization

The Video on Demand on AWS solution leverages AWS Step Functions, which breaks the workflow into individual steps (ingest, processing, and publishing), making it easier to customize or extend the architecture for your specific video-on-demand needs.

Digital Rights Management

With this solution, you can also choose to use AWS Elemental MediaPackage for packaging content into different formats and to apply digital rights management (DRM). MediaPackage can reduce storage costs for the outputs; however, there is a trade-off between packaging costs and storage costs.

Integration with Service Catalog AppRegistry and AWS Systems Manager Application Manager

This solution includes a Service Catalog AppRegistry resource to register the solution's CloudFormation template and its underlying resources as an application in both Service Catalog AppRegistry and AWS Systems Manager Application Manager. With this integration, you can centrally manage the solution's resources and enable application search, reporting, and management actions.

Use cases

Streaming Media

As consumer demand for video streaming increases, media and entertainment companies are looking for secure and reliable web-based video streaming alternatives to traditional television. Video on Demand on AWS deploys a solution that automatically provisions the services necessary to build a scalable, distributed architecture that ingests, stores, processes, and delivers video content. Using this solution, you can avoid inefficient trial-and-error approaches, and save on time and costs for your streaming media projects.

Educational Content Delivery

Professional development and educational initiatives create incentives for non-profit members, and can be important revenue generators for nonprofit organizations. Video on Demand on AWS can help you create modern, scalable content delivery and learning management systems (LMS) to support your membership and programming offerings. The solution streamlines the processes for delivering online training and learning content.

Concepts and definitions

This section describes key concepts and defines terminology specific to this solution:

application

A logical group of AWS resources that you want to operate as a unit.

Common Media Application Format (CMAF)

An HTTP-based streaming and packaging standard to improve delivery of media over the internet which is compatible with HLS and DASH and co-developed by Apple and Microsoft.

DRM

Digital Rights Management is a technology used to control and manage access to copyrighted material.

Dynamic Adaptive Streaming over HTTP (DASH)

An HTTP-based streaming protocol (also known as MPEG-DASH) to deliver media over the internet and developed under Motion Picture Experts Group (MPEG).

HTTP Live Streaming (HLS)

An HTTP-based streaming protocol to deliver media over the internet developed by Apple Inc.

QVBR

Quality-Defined Variable Bitrate is a video encoding technology that uses fewer bits in low-complexitiy periods of content and more bits during high-complexity periods (up to the maximum bitrate) to deliver consistently high video quality.

thumbnails

Files created by taking still images of the original video file.

workflow

Generated state machines that run a number of operations in sequence.

For a general reference of AWS terms, see the AWS glossary in the AWS General Reference.

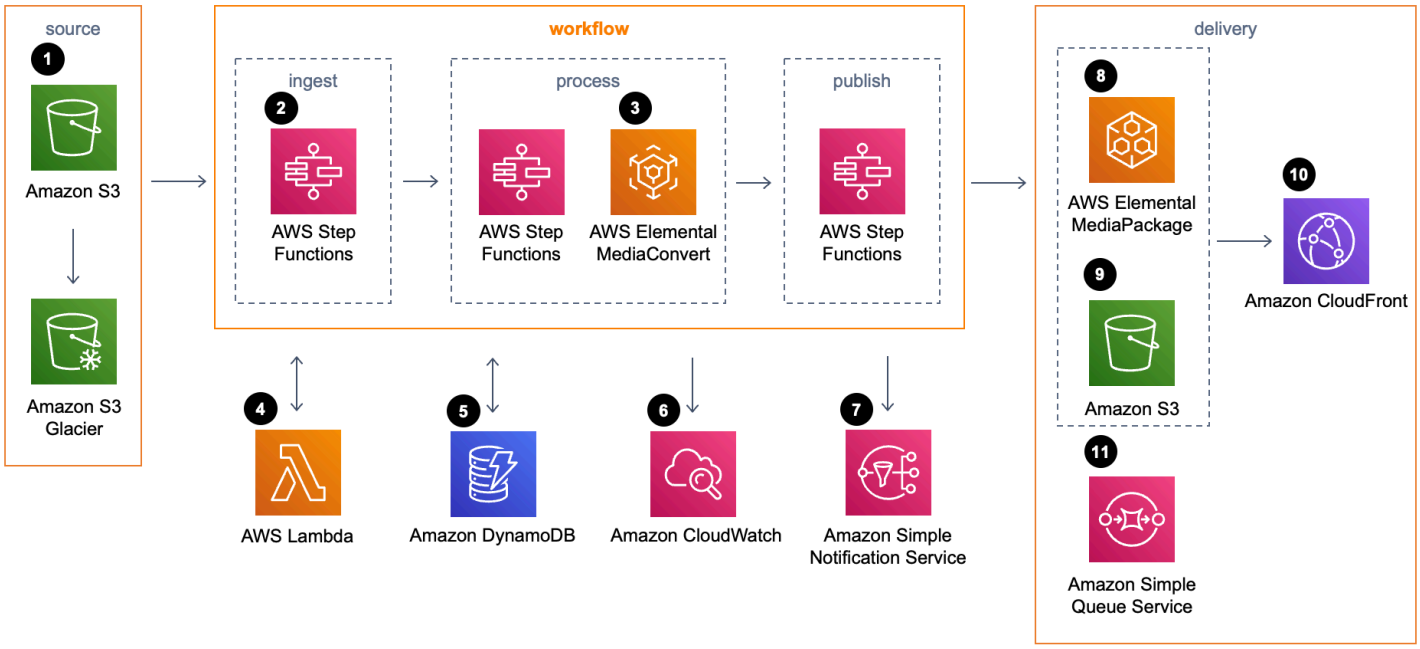
Architecture overview

The AWS CloudFormation template deploys a workflow that ingests source videos, or source videos and metadata files. When you upload a source video only, encoding options are defined in the AWS CloudFormation template at launch, and are applied to every video the solution encodes. When you upload a source video and metadata file, encoding parameters for each source video are defined in the metadata file, allowing customers to apply encoding options on a video-by-video basis.

This section provides a reference implementation architecture diagram for the components deployed with this solution.

Architecture diagram

Deploying this solution builds the following environment in the AWS Cloud.



Video on Demand on AWS architecture

The high-level process flow for the solution components deployed with the AWS CloudFormation template is as follows:

1. An Amazon S3 bucket for source media files. Content is eventually stored in Amazon S3 Glacier according to the Amazon S3 lifecycle policy.

2. AWS Step Functions, which creates ingest, processing, and publishing step functions.
3. AWS Elemental MediaConvert to transcode media files from their source format.
4. AWS Lambda functions that perform the work of each step, and process error messages. For a description of the 10 Lambda functions, refer to the README.md file on GitHub.
5. An Amazon DynamoDB table stores data captured through the workflow.
6. Amazon CloudWatch for logging and Amazon CloudWatch Events rules for AWS Elemental MediaConvert notifications.
7. Amazon SNS topics to send encoding, publishing, and error notifications.
8. AWS Elemental MediaPackage (optional) to create video streams formatted to play on several devices from a single video input, and protect content from unauthorized use through content encryption and digital rights management.
9. An Amazon S3 bucket for storing destination media files.
10. An Amazon CloudFront distribution to deliver your video content to end users.
11. An Amazon SQS queue to capture the workflow outputs.

AWS Well-Architected design considerations

This solution uses the best practices from the AWS Well-Architected Framework, which helps customers design and operate reliable, secure, efficient, and cost-effective workloads in the cloud.

This section describes how the design principles and best practices of the Well-Architected Framework benefit this solution.

Operational excellence

This section describes how we architected this solution using the principles and best practices of the operational excellence pillar.

Video on Demand on AWS solution pushes metrics to CloudWatch at various stages to provide observability into the infrastructure; Lambda functions, MediaConvert, MediaPackage, AWS S3 buckets, and the rest of the solution components.

Security

This section describes how we architected this solution using the principles and best practices of the security pillar.

```
AWS Identity and Access Management (IAM) roles allow customers to assign granular
 access policies and permissions to services and users on the AWS Cloud. Video on
 Demand on AWS creates several IAM roles, including a role that grants MediaConvert
 access to Amazon API Gateway and Amazon Simple Storage Service. This role is necessary
 to allow the services to operate in your account.

The Amazon Simple Storage Service (Amazon S3) buckets for MediaConvert output includes
 a policy that allows access from Amazon CloudFront. Because the Amazon CloudFront
 endpoints are publicly accessible, the MediaConvert output bucket is also publicly
 accessible. For information on how to secure Amazon CloudFront, refer to Serving
 Private Content through CloudFront in the Amazon CloudFront Developer Guide.
```

Reliability

This section describes how we architected this solution using the principles and best practices of the reliability pillar.

Video on Demand on AWS uses AWS serverless services wherever possible (ex Lambda, S3 and DynamoDB) to ensure high availability and quick recovery from service failure.

Performance efficiency

This section describes how we architected this solution using the principles and best practices of the performance efficiency pillar.

Video on Demand on AWS, as mentioned earlier, uses serverless architecture throughout the solution. It can be launched in any region that supports the AWS services used in the solution such as: AWS Lambda, AWS S3, MediaConvert, and (optional) MediaPackage.

This solution is automatically tested and reviewed by solutions architects and subject matter experts for areas to experiment and improve.

Cost optimization

This section describes how we architected this solution using the principles and best practices of the cost optimization pillar.

The cost for running Video on Demand on AWS varies based on several factors, including the size of the videos, the number of outputs created, and the number of views the published content receives through CloudFront. MediaConvert is the majority of the cost, and we recommend creating a budget through AWS Cost Explorer.

Customers can measure the efficiency of the workloads, and the costs associated with delivery, by using Application Manager.

Sustainability

This section describes how we architected this solution using the principles and best practices of the sustainability pillar.

Video on Demand on AWS uses managed and serverless services to minimize the environmental impact of the backend services. Customers can choose to run this solution during specific events and delete the stack after the program ends, reducing the carbon footprint compared to the footprint of continually operating on-premises servers.

Architecture details

This section describes the components and AWS services that make up this solution and the architecture details on how these components work together.

Encoding options

The Video on Demand on AWS solution leverages MediaConvert job templates to define the solution's encoding options. The solution can encode your source videos into H.264 and H.265; SD, HD, and 4K MP4; and SD and HD HTTP Live Streaming (HLS), and Dynamic Adaptive Streaming over HTTP (DASH). The workflow can be configured to encode all videos in the same or to use metadata files to apply encoding settings on a video-by-video basis.

By default, the solution creates three custom templates that produce UHD, HD, and SD output. Each template creates HTTP Live Streaming (HLS). Additionally, the solution supports Microsoft Smooth Streaming (MSS) and Common Media Application Format (CMAF) outputs.

The workflow selects one of the three templates, based on the resolution of the source video. You can also customize the solution to work with any valid MediaConvert template. For more information, refer to MediaConvert templates.

Quality-defined variable bitrate mode

This solution leverages MediaConvert Quality-Defined Variable Bitrate (QVBR) encoding mode which ensures consistent, high-quality video transcoding with the smallest file size for any type of source video content. With QVBR, the encoder determines the right number of bits to use for each part of the video to maintain the video quality that you specify. The solution configures the encoding templates to activate QBVR mode with the recommended settings for each output. For more information, refer to MediaConvert templates.

Accelerated transcoding

This solution includes an option to activate Accelerated Transcoding in MediaConvert which increases the processing speed of file-based video encoding jobs by up to 25 times. For more information, refer to the MediaConvert documentation.

Important

There are 2 options to turn on acceleration. The **Preferred** option turns on acceleration, but falls back to standard encoding if the source file isn't supported. The **Enabled** option applies acceleration to every encoding job, and the job will fail if the source file is not supported.

Frame capture

This solution can also create a set of thumbnails from your source videos. If this feature is turned on, the solution will create a set of thumbnails for each selected output. The thumbnails are stored in the Amazon S3 bucket with your video output.

MediaPackage

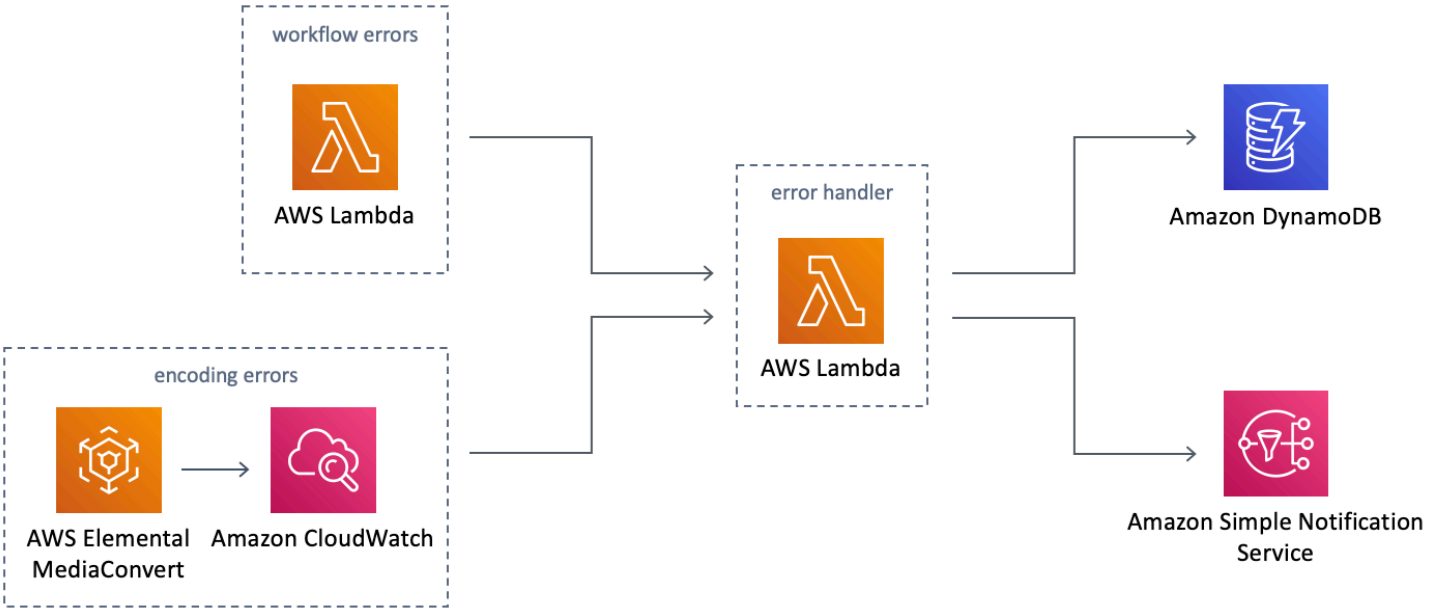
This solution includes the option to use MediaPackage as part of the workflow. When activated, the solution creates a separate set of MediaConvert custom templates that include H.265 MP4 and HLS. The solution also creates a packaging group in MediaPackage that is configured to ingest the MediaConvert HLS output stored in Amazon S3. MediaPackage packages the content, formatting it in response to playback requests from downstream devices. By default, this solution creates packaging configurations for HLS, DASH, MSS, and CMAF.

Important

Customers who ingest large quantities of files may exceed MediaPackage limits for video-on-demand content. For more information and instructions on how to request a limit increase, refer to VOD Content Limits in the *AWS Elemental MediaPackage User Guide*.

Error handling

The ingest, processing, and publishing workflow AWS Lambda functions, and Amazon CloudWatch Events are configured to invoke an *error handler* Lambda function that updates the Amazon DynamoDB table with error message details, and sends an Amazon Simple Notification Service (Amazon SNS) notification to a subscribed email address.



Video on Demand error handling

Ingest Step Functions

Video-only workflow

When a new MP4, MPG, M4V, M2TS, or MOV video is added to the source Amazon S3 bucket, a Lambda function invokes the ingest workflow. During ingestion, source video details are added to Amazon DynamoDB, the content is validated using MediaInfo, open-source software that displays technical information about media files, and details are stored in DynamoDB.

> **Important**
>
> Source video file extensions (.mp4, .mpg, .m4v, .m2ts, or .mov) must be lowercase and file names cannot contain spaces.

Metadata and video workflow

When a new metadata file is added to the source Amazon S3 bucket, a Lambda function invokes the ingest workflow. During ingestion, the metadata file, source video, and encoding configuration details are added to Amazon DynamoDB, the source video is validated using MediaInfo and details are stored in DynamoDB.

Important

You must upload the source video file to the Amazon S3 bucket before you upload the metadata file. Note that the upload must complete before you upload the metadata file.

Processing Step Functions

The solution uses the height and width of the source video to determine which job template to use to submit encoding jobs to MediaConvert. If you allow frame capture, the frame capture parameters are added to the job template. Then, the encoding job is created in MediaConvert and the details are stored in DynamoDB.

Publishing Step Functions

After the video is encoded, MediaConvert sends a notification to Amazon CloudWatch. An Amazon CloudWatch Events rule invokes the publishing AWS Step Functions step function, which validates the outputs, and updates the DynamoDB table with the new content details.

When the workflow is finished, Amazon SNS and/or Amazon SQS sends a publish notification based on the configuration you choose. If you choose to archive your source content, the source files are tagged to allow the Amazon S3 lifecycle policy to move files to Amazon Glacier or Amazon Deep Archive.

AWS services in this solution

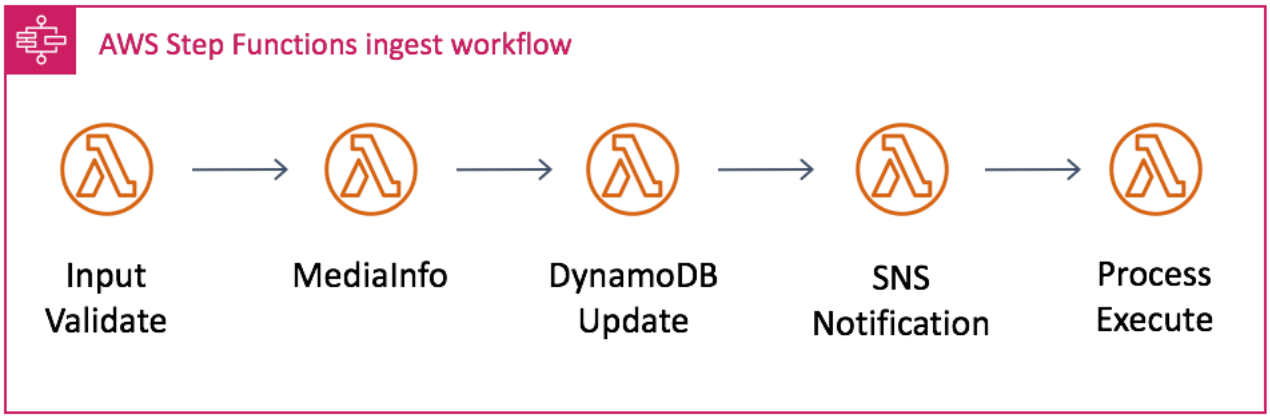
AWS service	Description
Amazon CloudFront	**Core.** Accelerates delivery of your video content to end users.
Amazon DynamoDB	**Core.** Tracks source and destination file metadata and progress through the workflow.
AWS Elemental MediaConvert	**Core.** Transcodes media files from their source format into versions that play back smartphones, tablets, PCs and other devices.

AWS service	Description
AWS Lambda	**Core.** Runs code without provisioning or managing servers.
Amazon S3	**Core.** Provides buckets for object storage.
Amazon SNS	**Core.** Sends publishing, encoding, and error notifications.
Amazon SQS	**Core.** Captures the workflow output.
AWS Step Functions	**Core.** Builds applications from individual components that each perform a discrete function.
Amazon CloudWatch	**Supporting.** Tracks encoding jobs.
AWS Identity and Access Management (IAM)	**Supporting.** Assigns granular access policies and permissions to services and users.
AWS Systems Manager	**Supporting.** Provides application-level resource monitoring and visualization of resource operations and cost data.
AWS Elemental MediaPackage	**Optional.** Creates video streams formatted to play on several devices from a single video input, and protects content from unauthorized use through content encryption and digital rights management.

How the solution works

Ingest workflow

When a new video is added to the source Amazon Simple Storage Service (Amazon S3) bucket, an AWS Lambda function starts the ingest step function. The ingest step function includes:

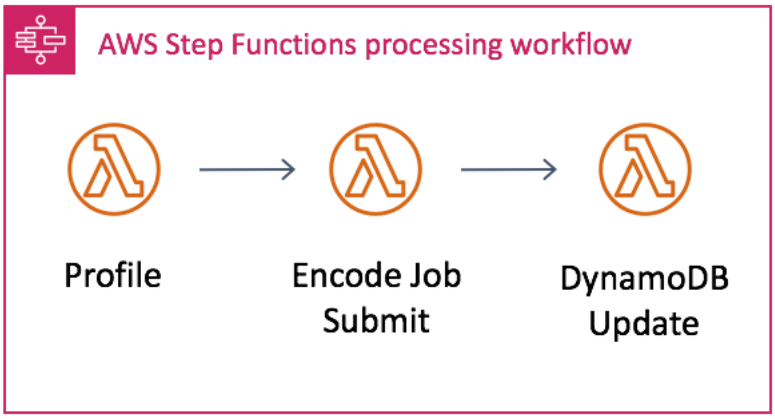


Ingest workflow

- **Input Validate** – Parses the input to the workflow, checks for the source video file, and defines the workflow configuration using the AWS Lambda function environment variables. If turned on, this step downloads the metadata file and overwrites the default environment variables with the variable definitions in the metadata file (metadata and video version only). For more information, refer to Metadata file.
- **MediaInfo** – Generates a signed Amazon S3 URL for the source video and runs MediaInfo to extract metadata about the video.
- **DynamoDB Update** – Takes accumulated data from each step and stores it in Amazon DynamoDB.
- **SNS Notification** – Sends an Amazon SNS notification with a summary of the ingest process.
- **Process Execute** – Starts the processing workflow.

Processing workflow

When the ingest workflow is complete, it starts the processing workflow. The processing workflow includes:

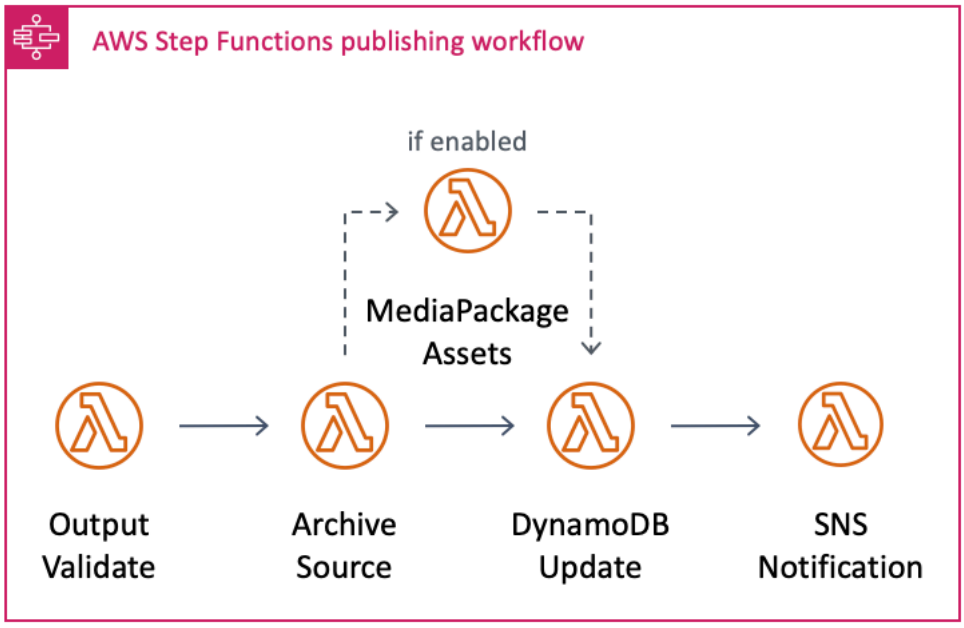


Processing workflow

- **Profiler** – Gets the source video's height and width from the metadata file, defines the settings for frame capture (if turned on), and chooses which template to use for encoding based on the source video's height. For example, if the source video is greater than or equal to 1080p, the 1080p job template will be used.
- **Encoding Profile Check, Accelerated Transcoding Check, and Frame Capture check** – Helps visualize which settings the profiler step applied.
- **Encode Job Submit** – Submits the encoding job with the template defined by the profiler to MediaConvert.
- **Dynamo Update** – Takes accumulated data from each step and stores it in Amazon DynamoDB.

Publishing workflow

When encoding is complete, Amazon Simple Notification Service (Amazon SNS) sends a notification that invokes an AWS Lambda function that starts the publishing process. The publishing process includes:



Publishing workflow

- **Output Validate** - Checks the event data for the completed encoding job, gets the GUID from the MediaConvert notification, gets the asset details from Amazon DynamoDB, and generates the Amazon S3 and Amazon CloudFront URLs for the MediaConvert outputs.
- **Archive Choice** – If Glacier or Glacier Deep Archive was activated, this step tags the source video with a unique identifier and the archive to invoke the Amazon Glacier lifecycle policy.
- **MediaPackage Choice** – If you configure the solution to use MediaPackage, this step takes the output from MediaConvert and uses it as a source for a MediaPackage asset, which contains all the information MediaPackage requires to ingest file-based video content.
- **DynamoDB Update** – Updates Amazon DynamoDB table with the event data.
- **SQS Choice** – If activated, this step sends all workflow outputs to an SQS queue that is ingested into upstream workflows or processes.
- **SNS Choice** – If activated, this step sends an Amazon SNS notification with a summary of the workflow and the Amazon CloudFront URLs.

Plan your deployment

This section describes the cost, security, Regions, and other considerations prior to deploying the solution.

Cost

You are responsible for the cost of the AWS services used while running this solution, which can vary based on the following factors:

- The size of your videos.
- The number of outputs created.
- The number of views the published content receives through CloudFront.

  MediaConvert composes the majority of the cost. For more information about MediaConvert pricing, refer to MediaConvert Pricing.

We recommend creating a budget through AWS Cost Explorer to help manage costs. Prices are subject to change. For full details, see the pricing webpage for each AWS service used in this solution.

Example cost for a 60-minute source video

As of this revision, the estimated cost for using this solution with the default encoding settings to process a 60-minute source video in the US East (N. Virginia) Region is approximately **$4.23**. This estimate may vary depending on the source video size and format. The following test was run with a 1080p 60-minute input video file. This does not include Amazon S3 storage costs, which vary depending on input file size. 4K video input will increase costs.

AWS service	Dimensions	Cost [USD
AWS Elemental MediaConvert	Output profile: AVC code 1 pass quality 30 fps	$ 4.23
Amazon CloudFront	Using the price of $0.085 per GB for CloudFront. A 60-minute video with the	$ 229.50

AWS service	Dimensions	Cost [USD
	default job settings streamed to 1,000 users would cost approximately: 0.75 MB/s * 1000 users * 3600 seconds ~= 2700 GB/hour. 2700 GB/hour * $0.085 = $229.50 an hour	
AWS Step Functions	Free tier cost is negligible even beyond free tier	$ 0.00
AWS Lambda	A 60-minute video will invoke around 24 lambda functions. When all free tier is used up, $0.0000002 * 24 requests = $0.0000048	$ 0.00000
Amazon S3	A 60-minute video will at most use 9GB of storage on S3 depending on the complexity of the video content. $0.023 per GB * 9GB = $0.207.	$ 0.21
Amazon DynamoDB	Free tier. Cost is negligible even beyond free tier	$ 0.00
Amazon CloudWatch	Free tier. Cost is negligible even beyond free tier	$ 0.00
Amazon Simple Queue Service (Amazon SQS)	Free tier. Cost is negligible even beyond free tier	$ 0.00
Amazon Simple Notification Service (Amazon SNS)	Free tier. Cost is negligible even beyond free tier	$ 0.00
Total:		**$ 233.94**
(Optional) AWS Elemental MediaPackage		$ 0.05

The following table lists the professional tier costs for the MediaConvert settings used in this example:

Output	Cost [USD]
SD resolution	$ 0.0075/min
HD resolution	$ 0.024/min

Output with calculations:

HLS profile: 3 SD and 2 HD (3 x 60 x $ 0.0075) + (2 x 60 x $ 0.024)

Total cost = $ 1.35 + $ 2.88 = **$ 4.23**

The costs for CloudFront and Amazon S3 storage varies depending on the number and format of outputs created and the number of requests to view the content delivered through CloudFront. To calculate your average cost, use the data size of your output multiplied by the average number of viewers for your stream.

Security

When you build systems on AWS infrastructure, security responsibilities are shared between you and AWS. This shared responsibility model reduces your operational burden because AWS operates, manages, and controls the components including the host operating system, the virtualization layer, and the physical security of the facilities in which the services operate. For more information about AWS security, visit AWS Cloud Security.

IAM roles

IAM roles allow customers to assign granular access policies and permissions to services and users on the AWS Cloud. This solution creates several IAM roles, including a role that grants MediaConvert access to Amazon API Gateway and Amazon Simple Storage Service. This role is necessary to allow the services to operate in your account.

Amazon S3 bucket policy

The Amazon S3 buckets for MediaConvert output includes a policy that allows access from CloudFront. Because the CloudFront endpoints are publicly accessible, the MediaConvert output

bucket is also publicly accessible. For information on how to secure Amazon CloudFront, refer to Serving Private Content through CloudFront in the Amazon CloudFront Developer Guide.

Customization

This solution leverages AWS Step Functions, which breaks the workflow into individual steps, making it easier to customize or extend the architecture for your specific video-on-demand needs. For example, you can modify or replace the encoding steps to produce different content sets. You can also add steps to extend support for more complex workflows, including image processing for poster artwork or additional custom data to the metadata file that will then be stored in DynamoDB. The solution originates MediaConvert output content directly from Amazon S3 through CloudFront. You can, however, customize the solution to leverage a dedicated origin server such as MediaPackage.

Each time the workflow is initiated, the solution creates a unique identifier. The unique identifier is used as the primary key in DynamoDB and the run ID in Step Functions. The unique identifier is passed to each step in the workflow, allowing information to be stored and retrieved in DynamoDB. This makes it easier to add and remove steps from the workflow.

Solution updates

To continue using this solution with the latest features and improvements, you must deploy the latest version of this stack. For information about updating your stack, refer to Update the solution.

Installing version 6.1.4 creates three new MediaConvert job templates that only output HLS renditions to reduce cost, without the use of presets. For more information, refer to MediaConvert templates. Updating an existing solution deployment to version 6.1.4 creates these new templates without deleting the presets or templates created by the older versions. To use an older template with the latest version of the solution, specify the template using the **JobTemplate** field in your metadata file. For more information, refer to Metadata file. Or, you can replace the default templates in the `Input Validate` AWS Lambda function by modifying the `MediaConvert_Template_<resolution>` environment variables.

Supported AWS Regions

This solution uses the MediaConvert and MediaPackage services, which are not currently available in all AWS Regions. For the most current availability of AWS services by Region, see the AWS Regional Services List.

Video on Demand on AWS is available, including the optional MediaPackage service, in the following AWS Regions:

Region name	
US East (Ohio)	Asia Pacific (Tokyo)
US East (N. Virginia)	Canada (Central)
US West (Northern California)*	Europe (Frankfurt)
US West (Oregon)	Europe (Ireland)
Asia Pacific (Mumbai)	Europe (London)
Asia Pacific (Seoul)	Europe (Paris)
Asia Pacific (Singapore)	Europe (Stockholm)
Asia Pacific (Sydney)	South America (São Paulo)

Quotas

Service quotas, also referred to as limits, are the maximum number of service resources or operations for your AWS account.

Quotas for AWS services in this solution

Make sure you have sufficient quota for each of the services implemented in this solution. For more information, see AWS service quotas.

Use the following links to go to the page for that service. To view the service quotas for all AWS services in the documentation without switching pages, view the information in the Service endpoints and quotas page in the PDF instead.

AWS CloudFormation quotas

Your AWS account has AWS CloudFormation quotas that you should be aware of when launching the stack in this solution. By understanding these quotas, you can avoid limitation errors that would prevent you from deploying this solution successfully. For more information, see AWS CloudFormation quotas in the in the *AWS CloudFormation User's Guide*.

MediaConvert quotas

All MediaConvert jobs run in a queue. If you don't specify a queue when you create your job, MediaConvert sends it to the default on-demand queue. For information about how many queues you can create and how many jobs those queues can run, refer to Queues in the *MediaConvert User Guide* and see Service quotas in the *AWS General Reference Guide*.

MediaPackage quotas

This solution includes the option to use MediaPackage as part of the workflow. Customers who ingest large quantities of files may exceed MediaPackage limits for video-on-demand content. For more information and instructions on how to request a limit increase, refer to VOD Content Limits in the *AWS Elemental MediaPackage User Guide*.

Deploy the solution

This solution uses AWS CloudFormation templates and stacks to automate its deployment. The CloudFormation template specifies the AWS resources included in this solution and their properties. The CloudFormation stack provisions the resources that are described in the template.

Deployment process overview

Before you launch the solution, review the cost, architecture, network security, and other considerations discussed earlier in this guide.

> **Important**
>
> This solution includes an option to send anonymized operational metrics to AWS. We use this data to better understand how customers use this solution and related services and products. AWS owns the data gathered though this survey. Data collection is subject to the AWS Privacy Notice.
>
> To opt out of this feature, download the template, modify the AWS CloudFormation mapping section, and then use the AWS CloudFormation console to upload your updated template and deploy the solution. For more information, see the Anonymized data collection section of this guide.

AWS CloudFormation template

You can download the CloudFormation template for this solution before deploying it.

View template

video-on-demand-on-aws.template: Use this template to launch the solution and all associated components. The default configuration deploys the core and supporting services found in the AWS services in this solution section, but you can customize the template to meet your specific needs.

Note

AWS CloudFormation resources are created from AWS Cloud Development Kit (AWS CDK) constructs.

Note

If you have previously deployed this solution, see Update the solution for update instructions. For additional options, including using an older version of this solution, refer to Solution updates.

Launch the stack

Follow the step-by-step instructions in this section to configure and deploy the solution into your account.

Time to deploy: Approximately 20 minutes

1. Sign in to the AWS Management Console and click the button below to launch the `video-on-demand-on-aws` AWS CloudFormation template.

   Launch solution

   You can also download the template as a starting point for your own implementation.
2. The template is launched 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 solution uses AWS Elemental MediaConvert and AWS Elemental MediaPackage, which are available in specific AWS Regions only. Therefore, you must deploy this solution in a Region that supports these services. For the most current service availability by Region, refer to the AWS Regional Services List.

3. On the **Select Template** page, verify that you selected the correct template and choose **Next**.
4. Under **Parameters**, review the parameters for the template, and modify them as necessary.

   This solution uses the following default values.

Parameter	Default	Description
Notification Email Address	*<Requires input>*	A valid email address to receive Amazon SNS notifications.
Workflow Trigger	*<Requires input>*	Choose `VideoFile` to ingest source videos only; choose `MetadataFile` to ingest metadata files and source videos.
Archive Source Content	`false`	Choose `GLACIER` to activate an Amazon S3 lifecycle policy on the source bucket to move applicable files to Amazon S3 Glacier after seven days, DEEP_ARCHIVE to move to Glacier Deep Archive.
Enable SNS	`true`	Choose `true` receive SNS notifications for the ingest and pushlish workflows . Choose `false` to only receive error messages.
Enable SQS	`true`	Choose `true` to deploy an SQS queue for publishing messages.
Enable Frame Capture	`false`	Choose `true` to create thumbnails for each AWS

Parameter	Default	Description
		Elemental MediaConvert output.
Accelerated Transcoding	PREFERRED	Choose PREFERRED to activate Accelerated Transcoding for supported file types (recommended), ENABLE to apply to all encoding jobs.
Enable MediaPackage	false	Choose true to activate AWS Elemental MediaPack age as part of the workflow.

5. Choose **Next**.
6. On the **Options** page, choose **Next**.
7. On the **Review** page, review and confirm the settings. Be sure to check the box acknowledging that the template will create AWS Identity and Access Management (IAM) resources.
8. Choose **Create** 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 20 minutes.

   After the stack is created, Amazon SNS sends three subscription notifications to the admin email address with links to activate encoding, publishing, and error notification.
9. In the subscription notification emails, select each link to activate SNS notifications.

> **Note**
>
> In addition to the AWS Lambda functions that create solution resources and trigger the ingest and publishing processes, this solution includes the `custom-resource` Lambda function, which runs only during initial configuration or when resources are updated or deleted.
> When running this solution, the `custom-resource` Lambda function is inactive. However, do not delete the function as it is necessary to manage associated resources.

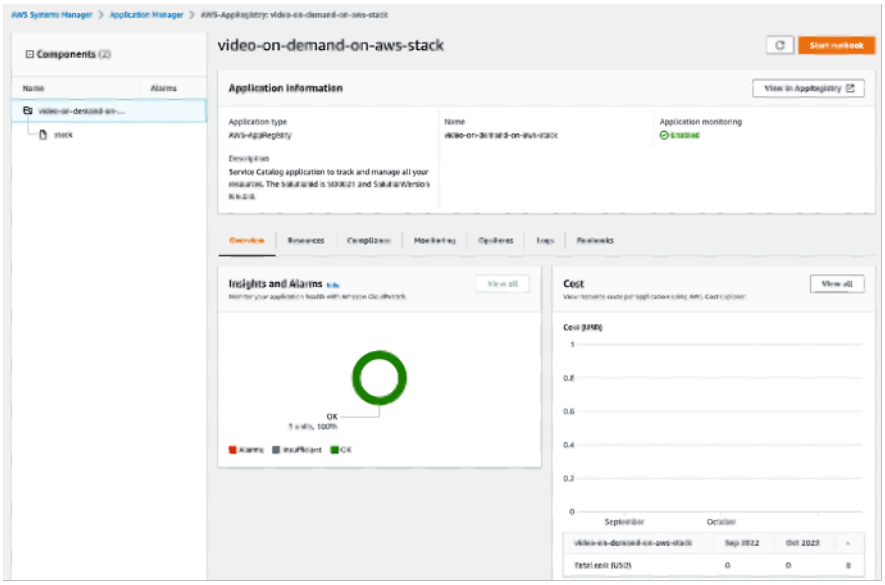
Monitoring this solution with AWS Service Catalog AppRegistry

The Video on Demand on AWS solution includes a Service Catalog AppRegistry resource to register the CloudFormation template and underlying resources as an application in both Service Catalog AppRegistry and Application Manager.

AWS Systems Manager Application Manager gives you an application-level view into this solution and its resources so that you can:

- Monitor its resources, costs for the deployed resources across stacks and AWS accounts, and logs associated with this solution from a central location.
- View operations data for the resources of this solution in the context of an application, such as deployment status, CloudWatch alarms, resource configurations, and operational issues.

The following figure depicts an example of the application view for the Video on Demand on AWS stack in Application Manager.



Video on Demand on AWS stack in Application Manager

Note

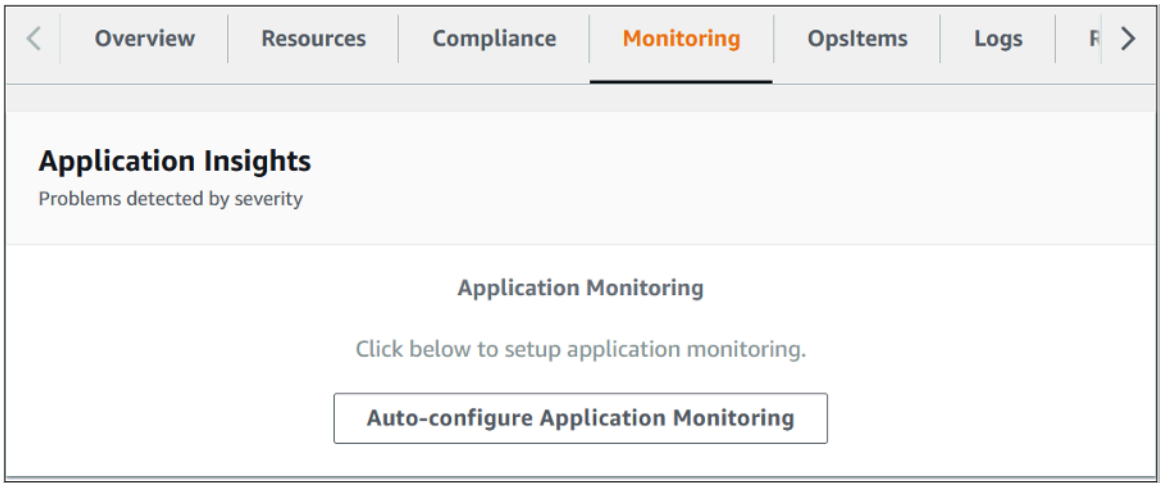
You must activate CloudWatch Application Insights, AWS Cost Explorer, and cost allocation tags associated with this solution. They are not activated by default.

Activate CloudWatch Application Insights

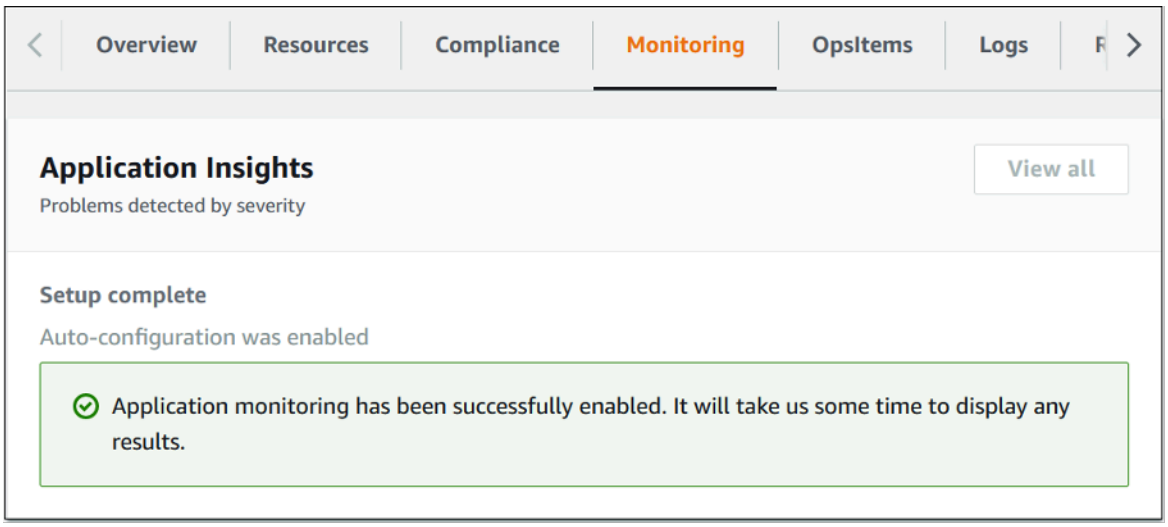
1. Sign in to the Systems Manager console.
2. In the navigation pane, choose **Application Manager**.
3. In **Applications**, choose **AppRegistry applications**.
4. In **AppRegistry applications**, search for the application name for this solution and select it.

The next time you open Application Manager, you can find the new application for your solution in the **AppRegistry application** category.

5. In the **Components** tree, choose the application stack you want to activate.
6. In the **Monitoring** tab, in **Application Insights**, select **Auto-configure Application Monitoring**.



Monitoring for your applications is now activated and the following status box appears:



Activate AWS Cost Explorer

You can see the overview of the costs associated with the application and application components within the Application Manager console through integration with AWS Cost Explorer which must be first activated. Cost Explorer helps you manage costs by providing a view of your AWS resource costs and usage over time. To activate Cost Explorer for the solution:

1. Sign in to the AWS Cost Management console.
2. In the navigation pane, select **Cost Explorer**.
3. On the **Welcome to Cost Explorer** page, choose **Launch Cost Explorer**.

The activation process can take up to 24 hours to complete. Once activated, you can open the Cost Explorer user interface to further analyze cost data for the solution.

Activate cost allocation tags associated with the solution

After you activate Cost Explorer, you must activate a cost allocation tag to see the costs for this solution. The cost allocation tags can only be activated from the management account for the organization. To activate cost allocation tags:

1. Sign in to the AWS Billing and Cost Management console.
2. In the navigation pane, select **Cost Allocation Tags**.
3. On the Cost allocation tags page, filter for the `AppManagerCFNStackKey` tag, then select the tag from the results shown.

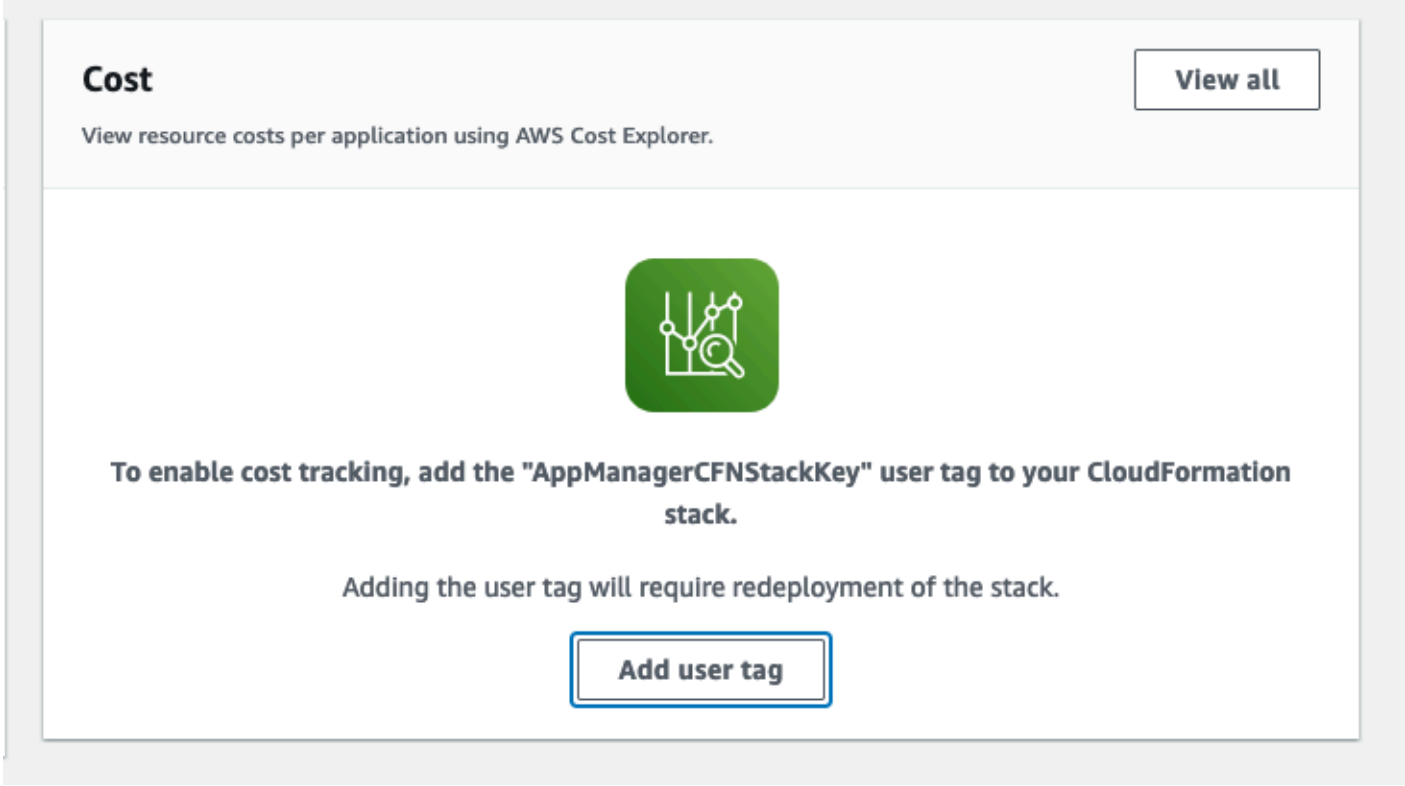
4. Choose **Activate**

The activation process can take up to 24 hours to complete and the tag data to appear.

Confirm cost tags associated with the solution

After you activate cost allocation tags associated with the solution, you must confirm the cost allocation tags to see the costs for this solution. To confirm cost allocation tags:

1. Sign in to the Systems Manager console.
2. In the navigation pane, choose **Application Manager**.
3. In **Applications**, choose the application name for this solution and select it.
4. In the **Overview** tab, in **Cost**, select **Add user tag**.



5. On the **Add user tag** page, enter `confirm`, then select **Add user tag**.

The activation process can take up to 24 hours to complete and the tag data to appear.

Update the solution

If you have previously deployed the solution, follow this procedure to update the solution's CloudFormation stack to get the latest version of the solution's framework.

1. From the main account where the solution is deployed, sign in to the CloudFormation console, select your existing Video on Demand on AWS CloudFormation stack, and select **Update**.
2. Select **Replace current template**.
3. Under Specify template:
   a. Select **Amazon S3 URL**.
   b. Copy the link of the latest template.
   c. Paste the link in the **Amazon S3 URL** box.
   d. Verify that the correct template URL shows in the **Amazon S3 URL** text box, and choose **Next**. Choose **Next** again.
4. Under **Parameters**, review the parameters for the template and modify them as necessary. For details about the parameters, see Launch the Stack.
5. Choose **Next**.
6. On the **Configure stack options** page, choose **Next**.
7. 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.
8. Choose **View change set** and verify the changes.
9. Choose **Update 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 UPDATE_COMPLETE status in approximately 20 minutes.

Troubleshooting

This solution does not have troubleshooting instructions. See the Contact AWS Support section for instructions on opening an AWS Support case for this solution.

Contact AWS Support

If you have AWS Developer Support, AWS Business Support, or AWS Enterprise Support, you can use the Support Center to get expert assistance with this solution. The following sections provide instructions.

Create case

1. Sign in to Support Center.
2. Choose **Create case.**

How can we help?

1. Choose **Technical**
2. For **Service**, select **Solutions**.
3. For **Category**, select **Video on Demand on AWS**.
4. For **Severity**, select the option that best matches your use case.
5. When you enter the **Service**, **Category**, and **Severity**, the interface populates links to common troubleshooting questions. If you can't resolve your questions with these links, choose **Next step: Additional information**.

Additional information

1. For **Subject**, enter text summarizing your question or issue.
2. For **Description**, describe the issue in detail.
3. Choose **Attach files**.
4. Attach the information that AWS Support needs to process the request.

Help us resolve your case faster

1. Enter the requested information.
2. Choose **Next step: Solve now or contact us**.

Solve now or contact us

1. Review the **Solve now** solutions.
2. If you can't resolve your issue with these solutions, choose **Contact us**, enter the requested information, and choose **Submit**.

Uninstall the solution

You can uninstall the Video on Demand on AWS solution from the AWS Management Console or by using the AWS Command Line Interface. You must manually delete the Amazon S3 buckets, a DynamoDB table, and CloudWatch Logs created by this solution. AWS Solutions do not automatically delete these resources in case you have stored data to retain.

> **Note**
>
> AWS CloudFormation StackSets are automatically deleted when you uninstall the solution's stack.

Using the AWS Management Console

1. Sign in to the CloudFormation console.
2. On the **Stacks** page, select this solution's installation stack.
3. Choose **Delete**.

Using AWS Command Line Interface

Determine whether the 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 that the AWS CLI is available, run the following command.

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

Replace *<installation-stack-name>* with the name of your CloudFormation stack.

Deleting the Amazon S3 buckets

This solution is configured to retain the solution-created Amazon S3 buckets (for deploying in an opt-in Region) if you decide to delete the AWS CloudFormation stack to prevent accidental data loss. After uninstalling the solution, you can manually delete these Amazon S3 buckets if you do not need to retain the data. Follow these steps 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>* Amazon S3 buckets.
4. Select one of the Amazon S3 buckets and choose **Delete**.

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

To delete the S3 bucket using AWS CLI, run the following command:

```
$ aws s3 rb s3://<bucket-name> --force
```

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 DynamoDB table

This solution is configured to retain the DynamoDB tables if you decide to delete the AWS CloudFormation stack to prevent accidental data loss. After uninstalling the solution, you can manually delete the DynamoDB tables if you do not need to retain the data. Follow these steps:

1. Sign in to the Amazon DynamoDB console.
2. Choose **Tables** from the left navigation pane.
3. Select the *<stack-name>* table and choose **Delete**.

To delete the DynamoDB tables using AWS CLI, run the following command:

```
$ aws dynamodb delete-table <table-name>
```

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. Follow these steps to delete the CloudWatch Logs.

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.

Developer guide

This section provides the source code for the solution and details about workflow configuration, the metadata file, and MediaConvert templates.

Source code

Visit our GitHub repository to download the source files for this solution and to share your customizations with others.

Workflow configuration

The `Input Validate` AWS Lambda function contains the following environment variables that define the workflow configuration.

Environment Variable	Description
Archive Source	Choose whether to archive source videos in Amazon Glacier or Glacier Deep Archive.
CloudFront	The CloudFront domain name. This is used to generate the playback URLs for the MediaConvert outputs.
Destination	The name of the destination Amazon S3 bucket for all MediaConvert outputs.
FrameCapture	Choose whether to create thumbnails for each MediaConvert output.
MediaConvert_Template_2160p	The name of the UHD template for MediaConvert.
MediaConvert_Template_1080p	The name of the HD template for MediaConvert.
MediaConvert_Template_720p	The name of the SD template for MediaConvert.

Environment Variable	Description
Source	The name of the source Amazon S3 bucket.
WorkflowName	Used to tag MediaConvert encoding jobs. This is defined by the AWS CloudFormation stack name.
InputRotate	Specify how MediaConvert should rotate the source video.
AcceleratedTranscoding	The option to activate Accelerated Transcodi ng in MediaConvert.
EnableSQS	The option to activate SQS.
EnableSNS	The option to activate SNS.

These variables are set when you deploy the AWS CloudFormation template and apply to all source videos uploaded to the solution's Amazon S3 bucket.

If you set the solution to ingest source videos and metadata files, you can overwrite these files using a metadata file. For more information, refer to MediaConvert templates.

Metadata file

When you set the solution to ingest source videos and metadata files, the source Amazon Simple Storage Service (Amazon S3) bucket is configured with an event notification that invokes the workflow when you upload a JSON file.

> **Note**
>
> The JSON file does not need a specific name, but it must have the JSON file extension. We recommend naming the JSON file the same name as the video file for consistency and ease of reference.

To invoke the workflow, you must upload a JSON metadata file. If you only upload a source video file, the workflow will not start.

> **Important**
>
> You must upload the source video file to the Amazon S3 bucket before you upload the metadata file. Note that the upload must complete before you upload the metadata file.

The definitions in the metadata file overwrite the default settings you specified when you deployed the solution. This allows you to define different workflow configurations for each source video. If you do not specify a definition in the metadata file, the solution will use the default value you set during deployment. Note that the metadata file must include a definition for **srcVideo**.

The following example metadata files shows all available variable definitions.

```
{
    "srcVideo": "string",
    "archiveSource": "DISABLED|GLACIER|DEEP_ARCHIVE",
    "frameCapture": boolean,
    "srcBucket":"string",
    "destBucket":"string",
    "cloudFront":"string",
    "jobTemplate_2160p":"string",
    "jobTemplate_1080p":"string",
    "jobTemplate_720p":"string",
    "acceleratedTranscoding":"DISABLED|PREFERRED|ENABLED",
    "enableSqs": boolean ,
    "enableSns": boolean ,
    "jobTemplate":"custom-job-template",
    "InputRotate":"DEGREE_0|DEGREES_90|DEGREES_180|DEGREES_270|AUTO"
}
```

The following sample JSON metadata file will overwrite the default settings for the **Archive Source Content** and **Enable Frame Capture** AWS CloudFormation template parameters for the `example.mpg` file. The file will also set the job template for AWS Elemental MediaConvert to `custom-job-template`.

```
{
    "srcVideo": "example.mpg",
    "archiveSource": "GLACIER",
    "frameCapture":false,
```

```
    "jobTemplate":"custom-job-template"
}
```

The Video on Demand on AWS solution also supports adding additional metadata, such as title, genre, or any other information, you want to store in Amazon DynamoDB.

MediaConvert templates

The Video on Demand on AWS solution outputs 4K, 1080p, and 720p MP4, and any combination of 1080p, 720p, 540p, 360p, and 270p HLS and DASH. By default, the solution selects the job template for MediaConvert based on the source video height. The solution includes three default job templates:

- MediaConvert_Template_2160p: 5 HLS outputs AVC 2160p through 270p
- MediaConvert_Template_1080p: 5 HLS outputs AVC 1080p through 270p
- MediaConvert_Template_720p: 4 HLS outputs AVC 720p through 270p

By default, the solution is configured to leverage Quality-Defined Variable Bitrate (QVBR) mode in MediaConvert. The QVBR settings are configured to the recommended values for each output, as shown in the following table.

Resolution	Maximum Bitrate	QVBR Quality Level
2160p	15,000 Kbps	9
1080p	8,500 Kbps	8
720p	6,000 Kbps	8
540p	3,500 Kbps	7
360p	1,500 Kbps	7
270p	400 Kbps	7

You can also modify the solution to use different QVBR settings, other system job templates, or your own custom job templates. For more information about working with job templates for

MediaConvert, refer to Working with MediaConvert Job Templates. For more information about QVBR Mode, refer to Using the QVBR Rate Control Mode.

If you set the solution to ingest source videos and metadata files, you can specify the template using the **JobTemplate** field in your metadata file. For more information, refer to Metadata file. Or, you can replace the default templates in the Input Validate AWS Lambda function by modifying the `MediaConvert_Template_<resolution>` environment variables.

Reference

This section includes information about an optional feature for collecting unique metrics for this solution, pointers to related resources, and a list of builders who contributed to this solution.

Anonymized data collection

This solution includes an option to send anonymized operational metrics to AWS. We use this data to better understand how customers use this solution and related services and products. When invoked, 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-name>* deployment
- **Timestamp** - Data-collection timestamp
- **Use Glacier** - Whether Amazon Glacier is used
- **Workflow Trigger** - The workflow trigger selected
- **Frame Capture** - Whether thumbnails are created for MediaConvert output
- **Enable MediaPackage** - Whether MediaPackage is enabled

AWS owns the data gathered though this survey. Data collection is subject to the AWS Privacy Notice. To opt out of this feature, complete the following steps before launching the AWS CloudFormation template.

1. Download the AWS CloudFormation template to your local hard drive.

17. Open the AWS CloudFormation template with a text editor.
18. Modify the AWS CloudFormation template mapping section from:

```
AnonymizedData:
    SendAnonymizedData:
      Data: Yes
```

to:

```
AnonymizedData:
    SendAnonymizedData:
      Data: No
```

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 Deploy the solution section of this guide.

Related resources

- MediaInfo

Contributors

- Eddie Goynes
- Tom Nightingale
- Joan Morgan
- San Dim Ciin
- Eric Thoman
- David Chung
- Raul Marquez

Revisions

Date	Change
April 2017	Initial release
June 2017	Added information on new watermark functionality and processing workflow; updated information on the ingest and publishing workflows.
October 2017	Added information on new metadata and video and video-only AWS CloudForm ation templates and functionality; updated information on the ingest process and error handling.
March 2018	Added AWS Elemental MediaConvert functionality.
November 2018	Added information on new AWS Elemental MediaConvert job templates and functionality, and environment variables; removed Amazon Elastic Transcoder functionality.
April 2019	Added information on support for AWS Elemental MediaConvert Quality-Defined Variable Bitrate (QVBR) Mode.
November 2019	Added information on support for AWS Elemental MediaPackage, and Node.js and MediaInfo updates.
April 2020	Added information about Accelerated Transcoding and notification options.
December 2020	Relese version v5.2.0: Added information about the new AWS Elemental MediaConv

Date	Change
	ert templates, installation and upgrade behavior using latest solution version. For more information about changes for v5.2.0, refer to the CHANGELOG.md file in the GitHub repository.
September 2021	Document enhancements, including updates to diagrams and architecture overview section.
November 2021	Release version v5.3.0: Added new input file formats, reduced cost by removing Dash and MP4 outputs from AWS Elemental MediaConv ert templates, changed frame rate to follow source, deinterlacer not activated by default allowing for basic tier pricing. For more information about changes for v5.3.0, refer to the CHANGELOG.md file in the GitHub repository.
December 2021	Release version v5.3.1: For more informati on about changes for v5.3.1, refer to the CHANGELOG.md file in the GitHub repository.
November 2022	Release version v6.0.0: Added a Service Catalog AppRegistry resource to register the CloudFormation template and underlying resources as an application in both Service Catalog AppRegistry and AWS Systems Manager Application Manager. You can now manage costs, view logs, implement patching, and run automation runbooks for this solution from a central location. For more informati on about changes for v6.0.0, refer to the CHANGELOG.md file in the GitHub repository.

Date	Change
February 2023	Release version v6.1.0: For more informati on about changes for v6.1.0, refer to the CHANGELOG.md file in the GitHub repository.
April 2023	Release version 6.1.1: Mitigated impact caused by new default settings for S3 Object Ownership (ACLs disabled) for all new S3 buckets. For more information, refer to the CHANGELOG.md file in the GitHub repository.
April 2023	Release version 6.1.2: Updated cache policy name to be unique for blueprint, updated stack name and logical ID for Service Catalog AppRegistry, added package-lock.json files to packages, and updated Lambda nodes to Node.js 16. For more information, refer to the CHANGELOG.md file in the GitHub repository.
July 2023	Release version 6.1.3: Upgraded to Node.js to 18 and JS SDK to v3. Updated S3 client to generate presigned URLs using v4 signature by default. Updated parameter names for consistency. Bug fixes. For more information, refer to the CHANGELOG.md file in the GitHub repository.
September 2023	Release version 6.1.4: Fixed scripts to handle whitespace in directory names. For more information, refer to the CHANGELOG.md file in the GitHub repository.
October 2023	Release version 6.1.5: Updated package versions to resolve security vulnerabilities. For more information, refer to the CHANGELOG .md file in the GitHub repository.

Date	Change
November 2023	Documentation update: Added AWS Developer Support and merged Contact AWS Support into the Troubleshooting section.
November 2023	Documentation update: Added Confirm cost tags associated with the solution to the Monitoring the solution with AWS Service Catalog AppRegistry section.

Notices

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