

A PRACTICAL GUIDE TO AWS MEDIA SERVICES

Deploying Cloud-based Services for Streaming Video



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PURPOSE OF THE GUIDE

Organizations of all types are turning to cloud-based solutions for video processing and delivery. Whether in the planning phase, in the process of migration, or in production, these organizations typically share three key objectives for making the move from data center operations to cloud video infrastructure: advancing their video capabilities, reducing capital and operational costs, and increasing the value of their content. In this Practical Guide, you will learn:

- How technology shifts and consumer expectations are impacting video providers
- How video providers are using the cloud today
- How to use AWS Media Services to deploy video workflows, including:
 - Live events
 - 24x7 live channels
 - Video-on-demand (VOD) services
 - Content personalization and monetization

A NEW ERA FOR VIDEO SERVICES

Facilitated by the increasing prevalence of high-bandwidth internet, high-speed mobile networks and a vast ecosystem of consumer devices, video is now fundamental to how people consume information and entertainment at home, on the go and at work. As video becomes more essential for business as well as entertainment, viewers have rising expectations: Today's audiences want to simply find and watch the content they want, when they want, on the device of their choosing, with excellent image quality. These expectations—and the efforts of video providers keeping pace with increasingly sophisticated audiences—have ushered in a new era in broadcast and streaming video.

If you had to choose a single word to describe what viewers want from video services today, it would be hard to do better than “flexibility.” They want to watch live events, such as sports, with seamless performance on mobile devices. They prefer catch-up TV, pause, replay and other DVR-like services in a handheld platform, and expect broadcast-level quality from app-based services. They want webcasts that bring together viewers from across the world to engage in flawless, real-time learning experiences.

However, the technologies traditionally used to process, package and deliver video at scale are anything but flexible. For example, in a recent surveyⁱ, cable TV providers said their number one concern about their current video infrastructure was its inability to adapt to 4K ultra-high-definition (UHD) content—the latest standard for high-quality entertainment in film, TV and streaming video formats. In fact, the conventional video technologies used by many video providers today closely resemble those in use for decades. They are often custom-integrated infrastructures, built to a narrow use case based on how video must be compressed, transmitted, packaged and delivered. They are complex to manage and require significant staff resources to operate and maintain. They are difficult to forecast and plan, leading to under-provisioned systems that fail under load conditions, or over-provisioned systems that waste budgets.

VIDEO MOVES TO THE CLOUD

As an alternative to conventional video processing and delivery systems, video technology vendors have begun to offer services delivered from the cloud. These cloud-based solutions typically fall into two categories: “lift-and-shift” approaches that port the same software used by video data centers into a cloud architecture, and all-in-one solutions that provide a turnkey video workflow from a single vendor. However, the former brings robust, broadcast-grade feature functionality at the expense of costly customization and burdensome management requirements; the latter assures simple usability in exchange for limited feature sets and a somewhat inflexible, one-size-fits-all approach to video services and viewing experiences.

While these approaches signal progress in the move to cloud-based video services, video providers, as well as systems integrators and all-in-one platform providers, need more capable, flexible solutions in order to stay ahead of the pace of change in video technologies and the expectations of their audiences. Ideally, they will gain access to cloud services that allow them to leave behind the limitations imposed by hardware-based video architectures, without compromise.

INTRODUCING AWS MEDIA SERVICES

In order to fully deliver on the promise of cloud-based video processing and delivery, AWS launched AWS Media Services. These services give video providers an uncompromising set of features at critical stages of the video workflow from the AWS Management Console. To take full advantage of the benefits these services can offer, below is an overview of six AWS Media Services that make up the key elements of a video workflow, with examples of how video providers can deploy them to serve their workflow requirements.

AWS Media Services represent the core of the flexible, contemporary and easy-to-use video workflow—live video transport, file-based transcoding, live video encoding, origin and packaging, media storage, and content monetization—delivered as broadcast-grade services via the AWS Management Console. These services make it easy for video providers of all kinds to build reliable, flexible and scalable video offerings in the cloud and are integrated seamlessly with other media-ready AWS services, such as AWS Direct Connect and AWS Snowball for content ingest; Amazon CloudFront for content delivery; Amazon CloudWatch for monitoring; and Amazon Rekognition and Amazon Polly for machine learning applications. Seamless integration with third-party systems, including digital rights management (DRM) platforms, content delivery networks (CDN), content management systems, workflow management software, and more, offers video providers a broad choice of tools to build best-of-breed solutions.

Whether deployed as discrete components or as the building blocks for complete, end-to-end workflows, AWS Media Services address the key priorities of today’s video providers: advancing their capabilities, better managing costs, and improving their content.

THE BUILDING BLOCKS OF A FLEXIBLE VIDEO WORKFLOW

AWS ELEMENTAL MEDIACONNECT



High-quality live video must be transported over high-bandwidth networks to enable content contribution, transformation, and business-to-business (B2B) distribution workflows. Broadcasters, content owners, and content aggregators have traditionally used satellite networks or fiber connections to send their content into the cloud or to transmit it to partners for distribution. However, organizations now have the opportunity to reduce costs, enhance reliability, and gain operational agility by adopting cloud-based solutions to transport their live video content.

AWS Elemental MediaConnect is a high-quality transport service for live video. Used as a standalone service or integrated with AWS Media Services, MediaConnect enables organizations to cost-effectively build broadcast-grade video workflows and securely share live content with their partners and customers through the AWS Management Console or API.

Use Cases

Primary contribution

Examples include broadcasters delivering 24x7 live linear video, who ingest live content from mezzanine or master sources to the AWS Cloud for processing and packaging prior to distribution.

Business-to-business distribution

Examples of business-to-business (B2B) distribution include television networks that transmit national channels to affiliate stations or to virtual multichannel video programming distributors (vMVPDs).

Sharing through entitlements

Examples include network operators who securely syndicate content to other AWS users within the AWS Cloud using the service's entitlement feature, which allows operators to share their live video with other AWS accounts and control which accounts can access specific content.

Replication

Examples include rights holders of live events who wish to replicate one video source across different video workflows or share it with multiple partners across different geographies, at the same time.

Key Features and Benefits

Reliably transport video to, from, or within the AWS Cloud

- The service adds a video-specific quality-of-service layer over standard IP transport, which maintains stream integrity through packet recovery, enabling uninterrupted, high-quality live video delivery using the public internet or AWS Direct Connect

- MediaConnect supports a range of protocols for video delivery including RTP (Real-Time Transport Protocol), RTP with FEC (forward error correction), and the Zixi protocol

Securely share live video

- Live video is protected with industry-standard security methodologies, including end-to-end AES-256 encryption, with whitelisting to limit access only to trusted sources
- The service integrates with AWS Key Management Service (KMS) for centralized key management, allowing users to supply a key at the receiver end, either through the UI or the API, to decrypt content
- Content can also be encrypted with unique keys for each output as it leaves the service, enabling flexible control over how content is secured

Easily manage high-value live content

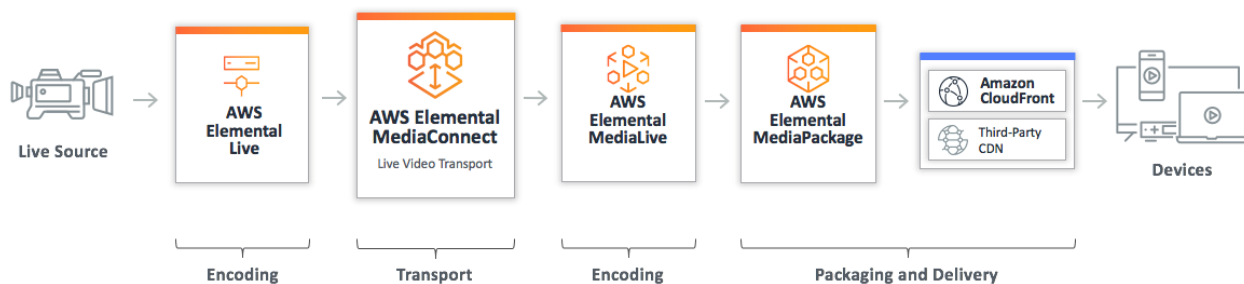
- Using AWS monitoring services, such as AWS CloudWatch, the service provides at-a-glance access to more than 15 critical metrics of video stream quality
- Broadcast industry-standard alerts identify issues with transport streams, so users can adjust settings to maximize the quality of video workflows

Reduce video transport costs

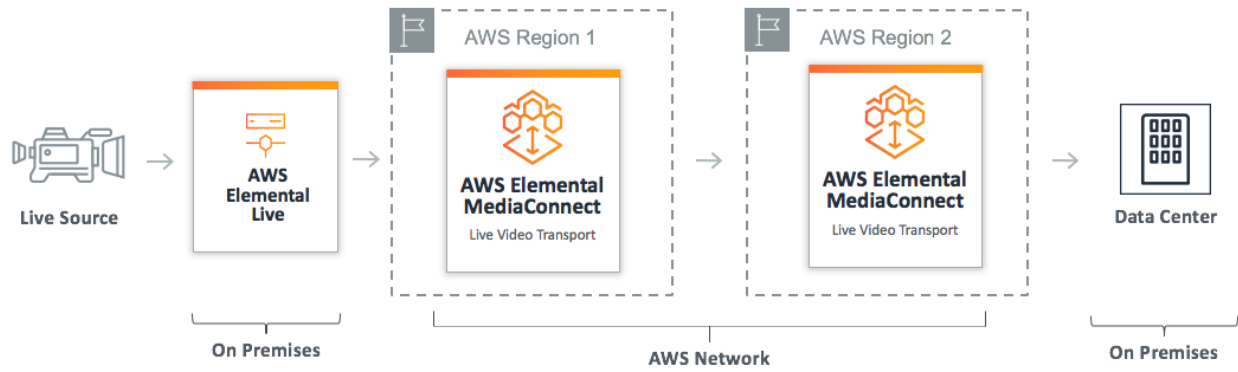
- MediaConnect uses existing IP infrastructure or AWS Direct Connect for cost-effective, high-quality video transport, offering significant savings compared to satellite or fiber approaches
- Instead of long-term commitments to satellite transponders and fixed fiber networks, customers pay only for the service as it is used

Increase flexibility for video transport

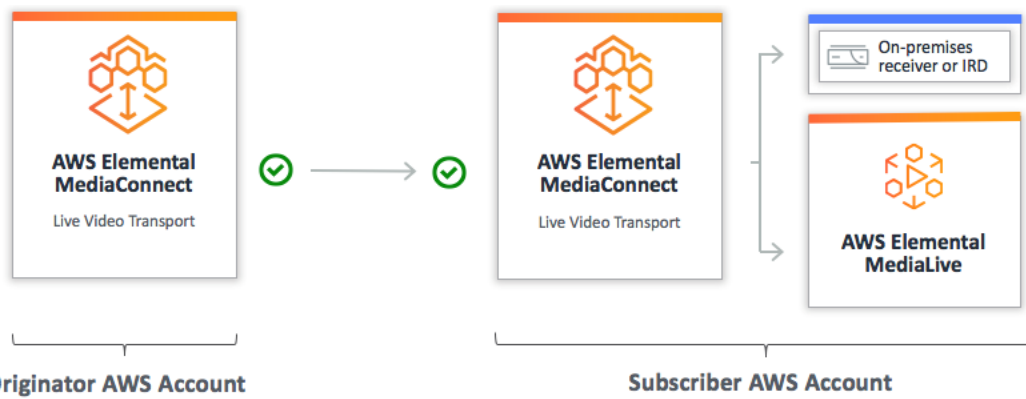
- The service supports distribution of video in virtually any configuration, from many-to-many and any-to-any, serving as a gateway platform for UDP (unicast/multicast) or protected streams (unicast)
- Support for a range of protocols for video delivery, including RTP (Real-Time Transport Protocol), RTP with FEC (forward error correction), and the Zixi protocol lets users select the protocols that best suit their workflows



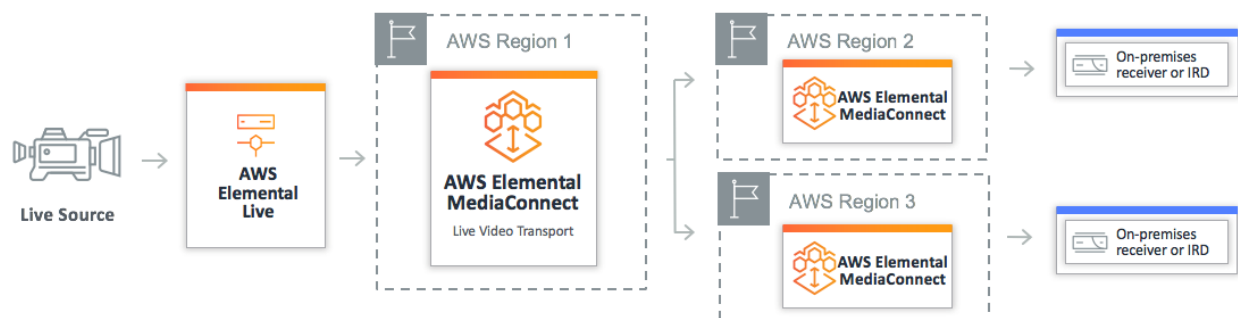
Workflow Example: Primary Contribution



Workflow Example: Business-to-business Distribution



Workflow Example: Sharing through Entitlements



Workflow Example: Replication

AWS ELEMENTAL MEDIA CONVERT



File-based transcoding processes video content ranging from high-quality studio masters to videos captured on a mobile device in order to change the size, format or device compatibility of stored content for distribution to end users or other organizations. This was traditionally done with data center infrastructure, making capacity planning is an ongoing challenge.

AWS Elemental MediaConvert is a file-based video processing service that allows anyone, with any size content library, to easily and reliably transcode on-demand content for broadcast and multiscreen delivery.

Use Cases

Studio asset creation

Examples include network TV or post-production studios generating prerecorded programming with multi-language audio, closed captions and ad availability for distribution via paid TV operators and over-the-top (OTT) services.

Library conversion

Examples include broadcast networks with massive libraries of archival content to convert to digital assets for VOD distribution, and streaming services with continuous influxes of films and other programming to prepare for on-demand delivery.

Content distribution

Examples include services that enable users to upload and/or distribute videos they create with a phone or action camera, or educational services that transcode videos for distribution via online user platforms.

Key Benefits and Features

Broadcast-ready capabilities

- Supports an extensive range of input and output formats, such as MPEG-2, AVC and HEVC 10-bit 4:2:2 codecs and HDR 10 and HLG BT.2020 formats, and the ability to convert to and from SDR and HDR
- Built-in support for adaptive bitrate packaging formats, including HLS, MSS and DASH, as well as graphic overlays, audio loudness normalization, SCTE-35 support, manifest decoration, DRM integration, and closed captions
- Deep set of configurable parameters for the advanced user to control the output quality to precise levels

Easy to deploy and manage

- No set up, management or maintenance of underlying infrastructure: simply submit jobs with the relevant settings and get started
- Processing greater volumes of content does not require additional time or effort; the volume of the job submitted can simply be increased, and queue priorities can be managed as needed

- An integrated API simplifies access to DRM providers, maximizing content protection and ensuring support for multiple monetization models

Shortened time to market

- With no need to plan, buy, provision or manage infrastructure, users can build, test and launch new services in a fraction of the time of hardware-based technologies
- Blueprints, reference architectures and solutions briefs support easy set-up of complete video workflows
- Configure Amazon CloudWatch events to automatically trigger downstream actions due to changes in job status

Reduced financial risk

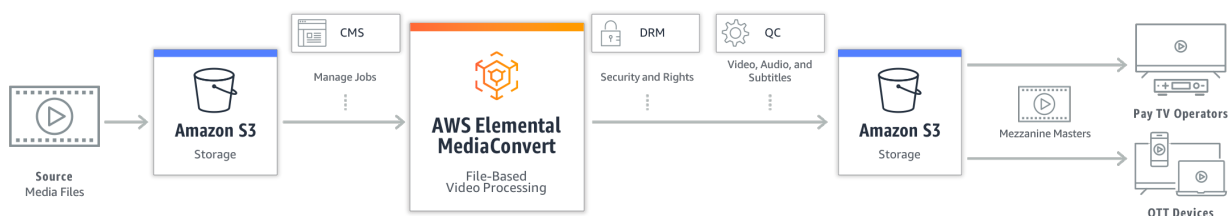
- Pay-as-you-go service allows users to start small and scale up as business needs grow
- Predictable pricing based on output content duration and features used
- Track and allocate spend with tools like resource tagging and AWS Cost Explorer

Highly scalable performance and capacity

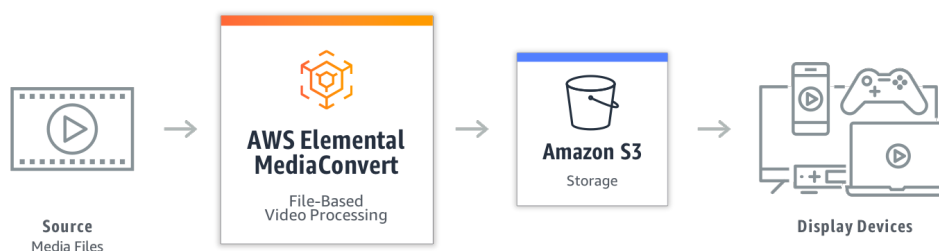
- Jobs are processed in parallel and completed as fast as the underlying infrastructure allows
- Easily scale workloads from a few videos to thousands without impacting turnaround times
- Control parallel processing capacity and order in which jobs are processed through queues

Built-in resiliency and reliability

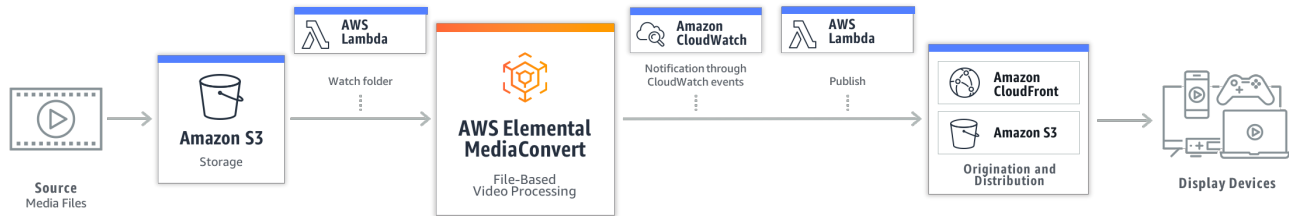
- Service is automatically deployed across multiple Availability Zones for seamless failover and built-in fault tolerance
- Jobs are automatically scheduled on available cloud instances without the need for user intervention
- Key metrics are published to Amazon CloudWatch so users can immediately identify and address service issues



Workflow Example: Studio Asset Creation for VOD Services



Workflow Example: Library Conversion for VOD Services



Workflow Example: Content Distribution for VOD Services

AWS ELEMENTAL MEDIALIVE



A live encoder compresses a live video stream, turning high-quality inputs into smaller versions for real-time, uninterrupted streaming. This is uniquely challenging as processing must happen in real-time, producing one second of video, every second, without fail.

AWS Elemental MediaLive is a live video processing service that enables video providers to encode high-quality live video streams for broadcast television and multiscreen devices. Used as a standalone service or integrated with AWS Media Services, MediaLive lets video providers build flexible 24x7 live video workflows or deliver event-based live streams with full control over encoding parameters.

Use Cases

Simple live content streaming

Examples include live events streamed to a narrow range of end-user devices or a limited number of viewers, such as corporate earnings calls or other enterprise needs.

Advanced live content streaming

Examples include broadcast network environments such as a unified headend delivering both broadcast and OTT services from a common infrastructure, or pay TV services streaming live events or 24x7 live channels to a broad set of end-user devices and a high volume of viewers.

Key Benefits and Features

Simple deployment and management

- Set up live channels through the AWS Management Console or via APIs
- Launch fully configured live video channels in minutes with a few clicks
- Key aspects of workload provisioning and management, such as channel inputs, encoding parameters and output specifications are configured automatically, with no need to manage individual instances

Broadcast-ready capabilities

- Supports an extensive range of input formats, including RTP, RTP+FEC, HLS or RTMP push and RTMP pull with credentials

- Output support for RTP, HLS, and MSS, and archive to TS is included
- Built-in support for content monetization includes pass-through and programmatic addition of ad markers and ad-avails
- Multiple caption standards, including WebVTT, TTML, teletext, SMPTE-TT, SCTE-20 and DVB-sub are supported
- Advanced audio features include multiple language audio tracks, audio descriptors, and FCC-mandated loudness correction

Flexibility and control

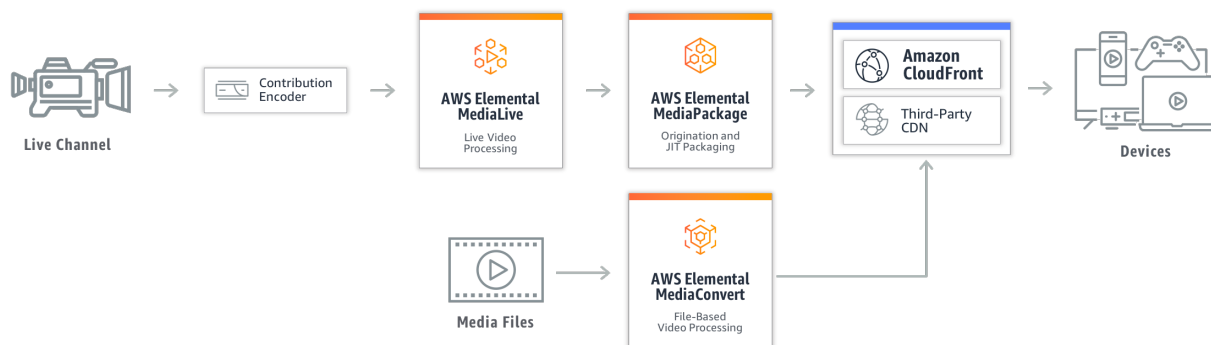
- Use the AWS Management Console or APIs for easy live channel setup
- Channel inputs, encoding parameters and output specifications are configured automatically with no need to manage individual instances
- Users may opt for templated encoding parameters or take full control over configuring encoding parameters to dictate the input and output protocol options, along with their choice of CDN for distribution

Inherent reliability and resiliency

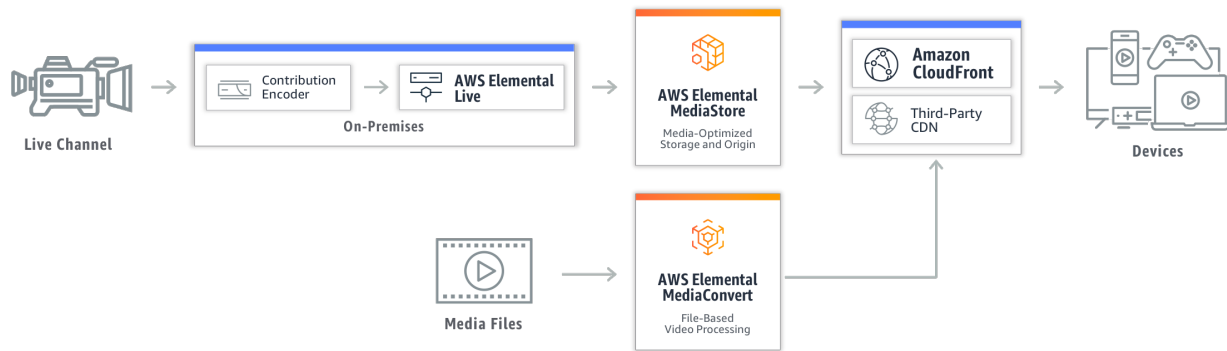
- Every live channel is automatically deployed across physically separate Availability Zones for seamless failover and built-in fault tolerance
- Jobs are automatically scheduled on available cloud instances without the need for user intervention
- The service monitors encoding resources for health and automatically replaces any degraded components without disrupting channels
- Resources scale elastically with demand, helping assure consistent high quality of service

Increased efficiency and reduced cost

- Pay-as-you-go service with no upfront investment in live encoding infrastructure and no operational overhead devoted to managing physical resources
- Pricing is based on usage and channel parameters, simplifying budgeting and allowing precise spending forecasts for each channel



Workflow Example: Simple Live Content Streaming for Live Events



Workflow Example: Advanced Live Content Streaming for Live Events or 24x7 Live Channels

AWS ELEMENTAL MEDIAPACKAGE



A just-in-time packaging origin converts video content from a single format to multiple formats and securely packages it for devices such as tablets, smartphones, connected TVs or set-top boxes. Existing origin and packaging solutions require complex, expensive integrations that slow time-to-market and yield rigid workflows that cannot scale with demand.

AWS Elemental MediaPackage is a video origination and just-in-time packaging service that allows video distributors to securely and reliably deliver streaming content at scale. As a standalone service or with other AWS Media Services, MediaPackage prepares video content for cost-effective distribution using multiple delivery and content protection standards.

Use Cases

Large-scale live events

Examples include broadcasters and content aggregators streaming sports tournaments, awards ceremonies, keynote addresses and other highly viewed live events.

24x7 live channel delivery

Examples include studios, broadcasters and pay TV service operators looking to package and deliver live linear channels OTT directly to their audiences, without a third-party distribution platform.

Key Features and Benefits

Efficient delivery to a broad range of devices

- Create multiple delivery protocols and content protection outputs from a single input for optimized content delivery to mobile phones, tablets, computers, connected TVs, set-top boxes, and game consoles
- Package content outputs for HLS, DASH and MSS protocols
- Can efficiently deliver any resolution including 4K content

Easily enrich audience experiences

- Up to 72-hour archive for live-to-VOD content creation, start-over and catch-up features
- Includes advanced support for multiple audio tracks and formats and multiple closed-caption formats
- No need to configure storage or add services to access advanced functionality

High availability and resiliency

- Built-in access throttling and origin protection features automatically handle bursts in request rates; the service scales ingest capacity as channels are added while output capacity scales to peak demand
- Elastic healing helps assure high quality of service with no need to manually intervene
- Highly available input and output architecture is built across multiple Availability Zones within a region

Robust content protection

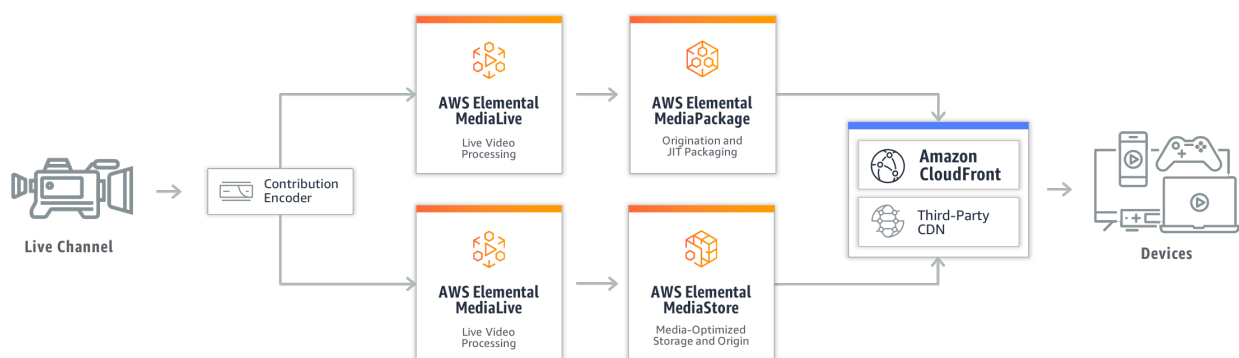
- An integrated API simplifies access to DRM providers, maximizing content protection and ensuring support for multiple monetization models
- Dynamic Packaging Encryption selects the best protection scheme for each viewer based on device

Build best-of-breed workflows

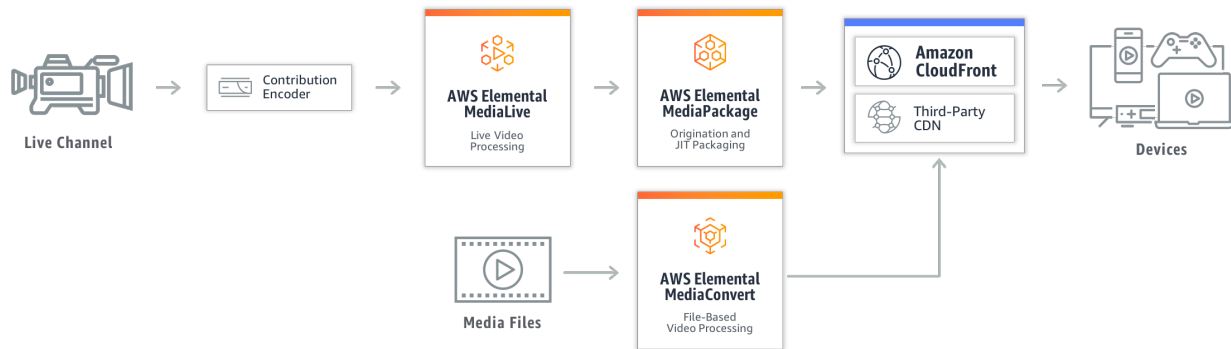
- Offers users a choice of CDN for flexible delivery options
- Integrates with other AWS services and third-party services via APIs, allowing providers to choose the components to build their optimal workflow
- Allows flexibility to choose among digital rights management providers, quality control platforms, content management systems, and player and playback devices

Easy to get started

- Pricing is based on a straightforward “content in and content out” model that simplifies budgeting and makes it easy to forecast spend



Workflow Example: Large-scale Live Events



Workflow Example: 24x7 Live Channel Delivery

AWS ELEMENTAL MEDIASTORE



Media-optimized storage handles requests for live video and distributes content for delivery to playback devices. Performance is a critical factor, as content origination for real-time video distribution generates a huge volume of storage requests, with multiple requesters accessing the same content simultaneously.

AWS Elemental MediaStore is an HTTP origination and storage service that offers the high performance, immediate consistency and predictable low latency required for live media combined with the security and durability of Amazon Simple Storage Service (S3). With MediaStore, customers can easily manage video assets and libraries as objects and collections while taking advantage of a cost-efficient method for simple pass-through content delivery with predictable, pay-as-you-go pricing.

Use Cases

Simple live video origination

Examples include video providers delivering live streaming content with no requirements for packaging or content protection.

User-generated live broadcasting

Examples include services that consumers can use to share live video content in real time, with inputs from phones, computers or other connected devices.

Key Features and Benefits

High performance, optimized for video

- Storage performance is tailored for low-latency writes and high performance reads with immediate read-after-write and read-after-update consistency
- Deliver consistent quality-of-service to end-users when processing requests at high volumes and high frequency, lowering the risk of buffering video and reducing end-to-end latency
- A consistent URL for media content provides direct and reliable access to CDNs

Improved content visibility

- View media assets as a collection of objects and groups of collections, whether a single large object such as a mezzanine or thousands of segments or images
- Integrated best practices for object storage ensure consistent performance are incorporated without impacting the sequential naming conventions common with segmented video content, easing integration with third-party systems and simplifying storage administration

Built-in security for media assets

- Integration with AWS features for access control lets providers take advantage of AWS Identity and Access Management (IAM) policies and roles
- Support for resource policies ensures robust, granular control over access to content assets
- Integration with Amazon CloudWatch event-based workflows offers easy-to-use real-time monitoring capabilities

Automatically scale with demand

- The service scales up or down automatically with the volume of requests received, eliminating the expense and complexity of pre-provisioning or de-scaling capacity
- Increases in workload do not negatively impact the quality of the viewing experience



Workflow Example: Simple Live Video Origination for Live Events



Workflow Example: User-generated Broadcasting for Live Events

AWS ELEMENTAL MEDIATAILOR



Streaming video delivery allows for a more personalized viewing experience, including tailoring advertising to the individual in a way that increases engagement and boosts monetization. Today, advertising is typically inserted within the client on the playback device. This client-side approach can struggle to match the quality of ads with that of primary content, and is vulnerable to ad blocking software.

AWS Elemental MediaTailor is a content personalization and monetization service that allows video providers to implement server-side ad insertion. Providers can serve video to multiscreen viewers with individually targeted ads while maintaining broadcast quality-of-service. Advertising is inserted upstream before delivery, on the server side; so a continuous stream arrives at the consumer device, eliminating any possibility of discrimination between content and commercials. Ads are better monetized, maintain video quality that consistently matches the primary content, and are simpler to manage.

Use Cases

VOD services

Examples include streaming video services delivering OTT content to subscribers on-demand via connected TVs and mobile device applications, with advertising inserted into on-demand streams.

Live event streaming

Examples include streaming video services, sports leagues and pay TV channel operators delivering live event content over-the-top, often as a counterpart to broadcast programming.

Key Features and Benefits

Easily deliver targeted ads to any platform

- Advertising content is inserted on-the-fly at the start of a video stream, prior to delivery, eliminating the need to build and maintain unique configurations for every type of client device in order to insert personalized ads
- Ad targeting parameters are easily set up to personalize ad content through the provider's choice of ad decision servers
- Integrated support for common ad insertion protocols affords flexible control how individual or groups of ads are served
- Ads and primary content originate from a common source, mitigating the effects of ad blocking software

Broadcast-grade viewing experiences

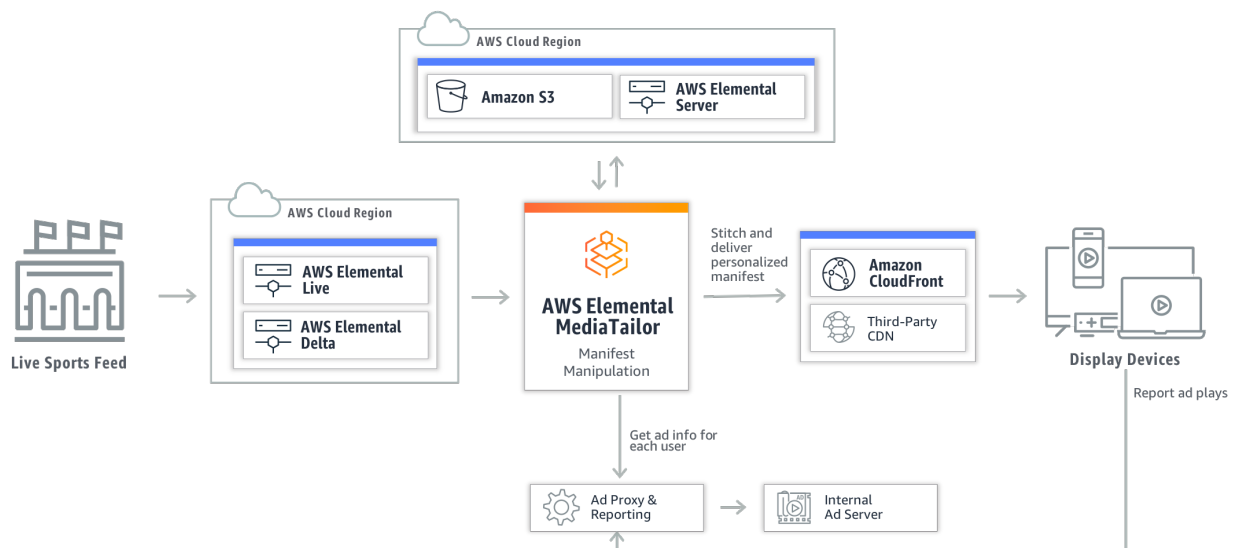
- Ads are transcribed on the fly to match the quality and format of the advertising to the video content stream.
- Ads and primary content play at the same resolution and format, without buffering, giving OTT video viewers a broadcast-quality experience
- Quality of service is maintained through peaks in viewership, using a combination of in-memory and web caching to protect unscaled origin servers as needed

Improved accuracy of ad view reporting

- Accurate measurement and reporting of internet-delivered video advertising helps ensure that advertisers and video providers are compensated for every ad placement
- Reporting on ad impressions and viewer behaviors is generated from the client side, reducing the effects of ad blocking software and following established advertising industry standard
- While many server-side ad insertion solutions can only count ad requests, MediaTailor measures the percentage viewed for each video ad placement in keeping with industry



Workflow Example: VOD Services with Content Personalization and Monetization



Workflow Example: Live Event Streaming with Content Personalization and Monetization

CONCLUSION

The conditions leading more and more video providers to adopt cloud-based infrastructure will continue to accelerate. As the universe of consumer devices becomes increasingly diverse, the viewing experiences they offer will be richer and more sophisticated, and the infrastructure to take advantage of those platforms will be expected to keep pace. Cloud-based video processing and delivery offers video providers virtually limitless capacity, a built-in path to the latest proven video and audio standards, formats and protocols, and the performance to scale to even the most extreme workloads. It



accomplishes this without sacrificing ease of use and without the expense of up-front capital investments or complex system management.

AWS Media Services offer video providers the core tools to build future-ready, cloud-based video workflows without compromise. For more information about AWS Media Services, please visit <http://aws.amazon.com/media-services>.

ⁱ Video Infrastructure Moves to the Cloud: A Global Operator Survey, 2017 edition. Kagan Industry Report, S&P Global Market Intelligence.