



LINEAR VIDEO DELIVERY FROM THE CLOUD

A New Paradigm for 24/7 Broadcasting

CONTENTS

Introduction 3

 A New Way to Deliver Linear Video 3

 The Benefits of Cloud-Based Infrastructure 3

Content Sourcing 3

 Building and Managing a Live-to-VOD Workflow with Elemental Solutions..... 4

Content Processing..... 4

Content Delivery and Monetization 5

High Availability and Resiliency 5

Use Case: Amazon Video 5

Conclusion: the Future of Live Television 6

INTRODUCTION

A NEW WAY TO DELIVER LINEAR VIDEO

Since the inception of traditional free-to-air television, there have been many technological and business-driven improvements in the media and entertainment industry to bring premium video content to viewers as efficiently as possible. These improvements include efforts as varied as the introduction of color television in 1953, the implementation of vast cable networks in the 1980s, the transition to high-definition (HD) broadcasting in the last decade and the nascent uptake of HDR in this one. Of most import perhaps is the now widespread implementation of advanced compression technologies and streaming protocols to enable adoption of IP video delivery to connected devices.

In today's multiscreen world, consumers no longer need be tied to a television to enjoy live programming. As content airs in real time on traditional broadcast stations, many pay TV providers and other content distributors have put forward service offerings that allow for simultaneous program streaming to IP-connected devices, making broadcast content available to viewers watching on a computer, tablet or smart phone.

The advent of cloud-based linear video processing heralds a new way to provide live broadcast programming to consumers. Cloud-based resources can support an end-to-end video processing and delivery solution for linear content distribution.

THE BENEFITS OF CLOUD-BASED INFRASTRUCTURE

In recent years, the cost of cloud resources has fallen as cloud infrastructure providers take advantage of economies of scale, accelerated data transport to the cloud, and the ability to offer enterprise-grade reliability and security aligned with Motion Picture Association of America (MPAA) requirements. This offers pay TV providers and other content distributors an opportunity to “get out of the infrastructure business,” and focus energy and innovation on what they do best – delivering the highest quality content and video services to enrich the viewing experience.

The cloud offers enterprises a way to scale video infrastructure to manage spikes in demand due to large, live events such as broadcasting the Olympics, and enables smaller start-ups to deliver content without investing capital to build out hardware for peak usage rather than expected or planned usage.

An end-to-end cloud infrastructure offers several advantages over traditional video processing and delivery architecture. It makes possible the broadcasting of live events from remote locations with little to no installed or dedicated hardware, or inadequate bandwidth for on-premises signal processing and formatting for multiscreen content delivery. And, most importantly, an end-to-end solution for video delivery to connected devices implemented in cloud infrastructure is capable of reliably delivering 24/7 linear content at scale. This is particularly crucial for high-profile sporting events, which may be global in profile and costly to procure, but which consumers increasingly expect to access live on any device.

CONTENT SOURCING

One of the greatest challenges for pay TV providers and other content distributors is moving live linear or real-time content to the cloud. Yet, this has also become significantly easier and more reliable over time. Real-time inputs typically originate through delivery to on-premises encoders, either single or paired for redundancy, which convert the input signal into a “mezzanine” format and deliver redundant outputs to

the cloud for adaptive bitrate (ABR) stream creation. The latest technology advancements allow encoders to use high-efficiency video coding (HEVC) to deliver the signal over real-time transfer protocol (RTP) with forward error correction (FEC) to ensure the resiliency of the feed to the cloud.

Today, content can be delivered to the cloud via AWS Direct Connect, over the open internet or through data center bridges between traditional fiber networks such as the Level3 Vyvx or Hibernia networks. Non-fiber cloud delivery methods have expanded from real-time messaging protocol (RTMP) to also include Apple HTTP Live Streaming (HLS) and RTP. New encoding compression options such as HEVC improve the quality of content while also reducing the overall bitrate and bandwidth load.

Combining file-based sources with real-time inputs is also becoming popular for the creation of television channels in the cloud. This new phenomenon simplifies the process of creating channels and allows for much more experimentation and customization than ever before. The workflows supporting channels with file-based sources and real-time inputs are unique. They need to be able to handle requirements directly within the encoder that would have traditionally been included in a playout server, such as the ability to remap audio and captions, overlay motion graphics, and update the content playback schedule on demand.

CONTENT PROCESSING

As today's video consumers demand more playback capabilities and augmented services, pay TV providers and content owners need workflows that personalize the viewing experience at the click of a button. The demand for both over-the-top (OTT) and live-to-VOD content is growing, and consumers increasingly expect functionality such as pause and rewind for live broadcasts. To stay competitive, pay TV operators must offer a range of live-to-VOD capabilities including time-shifted TV, catch-up TV and network personal video recorder (nPVR) as a part of OTT service offerings.

Traditionally, these capabilities were only available to the largest media organizations with sizable economic and technical resources because it is extremely complex to deliver this functionality to consumers. The cloud, used in combination with software-based video solutions, enables media organizations of all sizes to meet customer expectations efficiently and cost-effectively for 24/7 linear content delivery with nPVR functionality.

Linear services with live-to-VOD capabilities require consideration of bandwidth requirements, screen sizes and device types. Pay TV and content providers must be able to repackage content, using catch-up TV or nPVR content as deliverable mezzanine files, for the wide variety of devices that need to be supported. The implementation needs to be scalable, flexible and highly available from ingest to delivery to the consumer. With premium content, it is also important that any services

BUILDING AND MANAGING A LIVE-TO-VOD WORKFLOW WITH ELEMENTAL SOLUTIONS

Moving linear content processing to the cloud requires the orchestration of multiple components starting with an on-premises encoder delivering a mezzanine stream into the cloud. When Elemental Live encoders in the cloud receive a mezzanine feed, they transcode it to an HLS output bouquet and deliver it to an Elemental Delta instance for content origination and just-in-time packaging (JITP). The high-performance, resilient storage of live-to-VOD content in the cloud allows for catch-up TV functionality, access to start-over content, and the creation of VOD assets for later distribution and viewing, as well as server-side ad insertion. This entire process is managed through the Elemental Cloud platform running on AWS infrastructure.



incorporate digital rights management (DRM) technology to protect valuable content regardless of the device used for playback.

Pay TV operators and other content providers need to ensure they are ready to adapt their services to new and updated viewing devices and streaming protocols. By relying on a software-based approach, broadcast solutions can be more easily upgraded to embrace new standards and features as they emerge. By also including a just-in-time (JIT) packager that can adapt video streams to network and device parameters in real time, video providers can be prepared for whatever comes next.

CONTENT DELIVERY AND MONETIZATION

Delivery of premium video to the user can be simple or complicated depending on content usage, user rights and the intended monetization strategy. These considerations must be balanced with the best possible viewing experience.

After an ABR bouquet has been created and video streams are ingested and stored, an origin server such as Elemental Delta plays a key role in content delivery. It is able to repackage content to match client requests for both live and live-to-VOD OTT delivery. It can detect the user's video playback device as well as network conditions and provide the appropriate encryption and streaming format to best match its requirements. In addition, Elemental Delta enables making video available across multiple content delivery networks (CDNs) so that a user receives content from a connection with the highest available service quality. And finally, Elemental Delta allows for alternative content options when geography-based content blackouts come into play.

With respect to monetization, Elemental Delta services include targeted and personalized advertising aimed at specific devices, users and locations. Elemental Delta applies JITP to advertising content the same way it does for live-to-VOD content. Only one rendition of an advertisement per ABR profile need be maintained in storage, and it is made available for on-the-fly packaging. Through integration with a content management system (CMS) to better understand individual users with regard to content preferences, and an advertising decision service (ADS), Elemental Delta creates a customized content stream for each individual.

HIGH AVAILABILITY AND RESILIENCY

High availability is a critical requirement for any premium content. Traditionally, content providers have built redundant data centers in diverse geographic regions as a means of protecting assets and ultimately revenue streams. With the cloud, operators can now realize redundancy and high availability with virtual resources that incur costs only when used. This means that resources are available in case of a crisis such as an outage, but are not otherwise an expense.

In the event of a service failure, dynamic multilayered resiliency of virtual resources ensures uninterrupted video processing and delivery. The reliability of services is guaranteed with robust failover capabilities, physically distributed resilient resources and multiple geographic regions. This model is true for CDNs as well, providing a resilient workflow from ingest, into the cloud, all the way to the end user.

USE CASE: AMAZON VIDEO

A use case that exemplifies 24/7 OTT linear broadcast is Amazon Video – a cloud-based, end-to-end deployment of video services that relies on software-defined video solutions from Elemental running on

AWS infrastructure. The multi-channel TV service offers live broadcast channels and anytime VOD content from a single platform to consumers as a subscription service.

In the Amazon Video architecture, premium content is transferred to the Elemental Cloud platform for video processing and delivery, where it is transformed into the formats needed to support a wide array of multiscreen devices for easy and high-quality viewing. Live output streams are packaged and protected just in time with MPEG-DASH and Common Encryption (CENC) for ubiquitous playback and to address content security requirements. The streams are further enhanced with live-to-VOD capabilities including rewind and start over, before being delivered to CDNs for distribution to consumers.

This use case brings to life much of the material touched upon earlier including premium content transferred as a single mezzanine stream and delivered to cloud-based encoders; real-time encoding of ABR bouquets, which are accessed by an origin server and packager for delivery of content to the end user on request; and multilayered resiliency for seamless service. Multiple AWS services are also used throughout this signal flow.

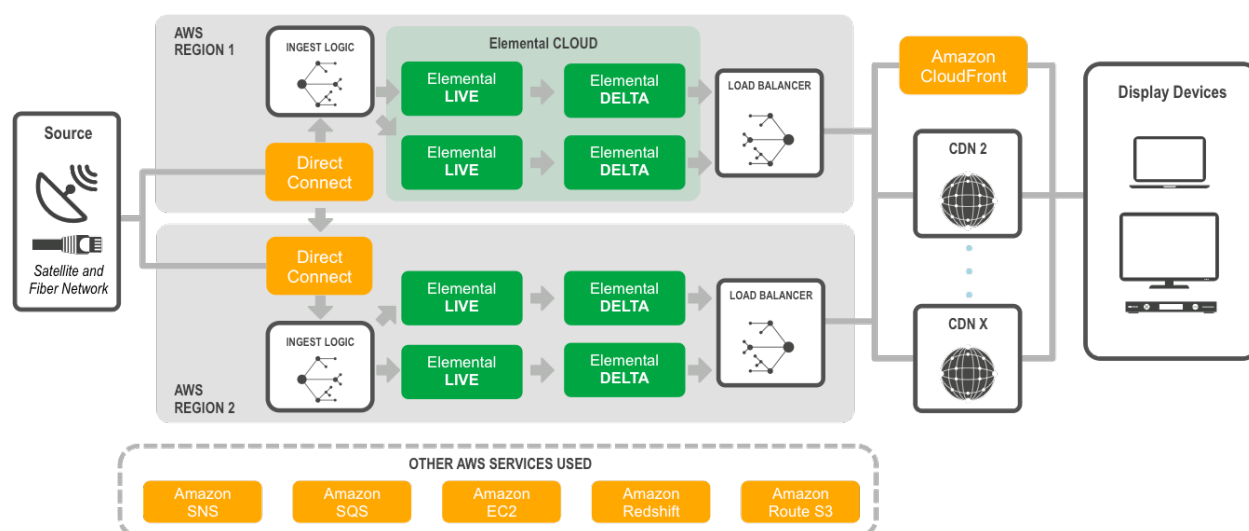


Figure 1 – Amazon Instant Video Components and Workflow

CONCLUSION: THE FUTURE OF LIVE TELEVISION

The broadcast landscape is changing. Operators accustomed to building out costly data centers in multiple geographic locations to support the secure, resilient delivery of premium content to consumers have traditionally made large investments in limited-lifespan hardware that requires physical space, resources, and IT staff to manage. With end-to-end cloud deployments, content distributors can now outsource these capabilities, with greater security, improved resiliency and faster time to market.

Elemental Cloud offers content distributors multiple benefits in support of delivering linear content: rapid deployment of services to create multiscreen offerings with the same high-quality video processing capabilities as on-premises equipment; dynamic scaling of resources as demand fluctuates to accommodate spikes in demand; securely protect valuable media by creating resilient workflows with virtual resources that only incur costs when used; and the ability to enhance video content to provide

content distributors with monetization opportunities through value-added features including time-shifted TV, dynamic ad insertion, targeted advertising and DRM.

The migration of video workloads to the cloud is just beginning. Cloud-hosted video services have the power to fundamentally change how media and entertainment companies approach content processing and delivery. By moving operational costs to variable costs and paying only for what they use, content distributors now have the opportunity to experiment with enriched offerings and pursue opportunities that resonate most with viewers. The conversation is no longer about how many systems need to be secured, racked and maintained to support an offering, but rather about how rapidly a new service can roll out, how many channels can be run, or how many VOD-asset hours can be offered per month to improve customer satisfaction. With the flexibility, scalability and resiliency of the cloud, content distributors can offer new services quickly, and implement and experiment with new features easily on a global scale, reaching more customers than ever before.