Adaptive Bitrate Streaming

Monitoring and Quality Control

WHITE PAPER

Monitoring and quality control of Adaptive Bitrate Streaming platforms is as important as the ABR systems themselves. Many Content Providers, Broadcasters and Cable Operators are now providing multiscreen services, also known as TV Everywhere or Over the Top (OTT). This delivers streaming video services to PCs, laptops, smartphones, tablets and connected-TVs.

Streaming to such a wide range of devices is complex. Each type of device has its own unique demands. The data rate an IP-enabled television needs to present an acceptable picture is far greater than that necessary for a smartphone. In addition, the networks that some of these devices use can suffer from dynamically changing characteristics.

The underlying technology used with multiscreen video is adaptive bitrate streaming (ABR). This essentially is the segmenting of content into small fragments of compressed content for transmission to viewing devices. This technology is not standardized in the same way that DVB Transport Streams are used in traditional TV applications.

There are several ABR implementations, each having different characteristics:

- Apple's HTTP Live Streaming
- Microsoft's Smooth Streaming
- Adobe's HTTP Dynamic Streaming
- MPEG-DASH

A recent survey identified 'quality of experience/quality of service' as the second most significant technical challenge (after bandwidth limitations) in offering OTT video. ABR can be hard to implement and a lot can go wrong. Waiting for subscribers to tell you about issues can be costly. Monitoring and Quality Control (QC) of ABR platforms is as important as the ABR systems themselves.

One of the biggest challenges of content streaming is that the networks and devices are far more varied than those found in the more controlled environments of Cable, Satellite, Terrestrial and IPTV. Different network conditions and device requirements make a highly adaptable architecture necessary.

ABR addresses this issue by dividing the stream into discrete fragments of fixed time duration. These are referred to as fragments, segments or chunks. A variety of bitrates for the fragments are established and commonly referred to as profiles. The device displaying the content has the intelligence to request the appropriate profile that best suits network conditions at any particular point in time. The optimal profile can change each time a fragment is requested. An ABR system works by checking the playout device's buffer to see how full it is. If it is becoming too low, then the device requests a lower bitrate profile (to prevent underflow). As the buffer becomes full, it can return to a higher bitrate profile. These decisions are made by the end-user's playout device. In theory this ensures that constant playout is maintained without the 'buffering' issues experienced with traditional progressive streaming systems.

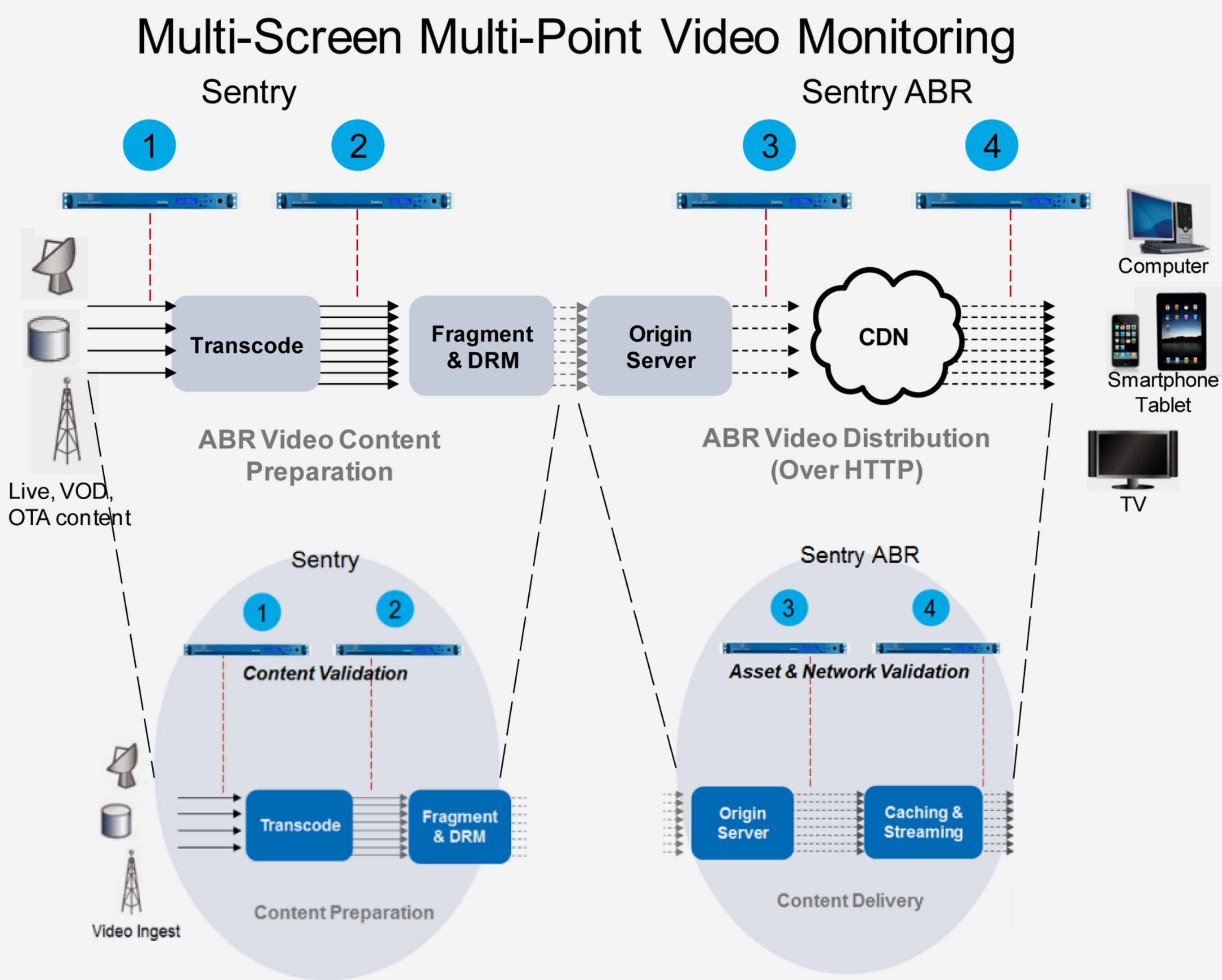
Ensuring subscriber satisfaction with such a complex architecture requires monitoring QoE and QoS at multiple points in the network to ensure that the content is of appropriate quality and that the delivery network is actually capable of delivering the content.

QoE and QoS

There are two linked ways of ensuring subscriber satisfaction, Quality of Experience (QoE) and Quality of Service (QoS). They may have similar sounding names, but they are significantly different. QoS is a measure of how well the network or physical delivery system is performing where as QoE is a measure of what the end user is experiencing and looks at customer impacting issues such as blocking artifacts, over compression artifacts and audio drop outs. It is possible to have perfect QoS scores but deliver a very poor user experience. The latter is likely to increase customer dissatisfaction, churn and lost revenue.

In the past, video service providers focused on measuring attributes related to the precision of the IP packet transport and the MPEG Transport Stream. For example, at the IP level, QoS measurements focus on delayed, out of order, and lost packets. However, as networks have matured and stabilized operators have become more confident in their ability to reliably deliver the content through their networks. This has led to greater emphasis being placed on the customer's experience. Technology has advanced to a point where service providers can use deep packet inspection and special decoding algorithm measurements to look for content related problems. QoE is now an essential element of monitoring the ABR workflow.

The overall monitoring of ABR streams is performed at four key points using a two-step process. The first step relates to content preparation. Monitoring is performed before and after transcoding, but before fragmentation and the addition of digital rights management (DRM). The second step relates to content delivery and is a network level function that ensures content can be delivered correctly. Monitoring is implemented after the origin servers and CDN caching/streaming servers.



Post transcode monitoring with Sentry

- Availability of all services, profiles/bitrates
- QoE Scoring
- Verify Audio Quality
- Perceptual Video Quality, check for over-compression artifacts
- IDR/EBP presence, cadence and alignment
- Compliance for Audio Loudness and Closed Captions

ABR content delivery with Sentry ABR

- HLS, HDS, DASH and MS-SS support
- ABR decryption and DRM support
- HTTP errors
- Manifest file verification
- Service and Profile availability
- Fragment size and bitrate
- Fragment load time and latency time
- Historical graphing/trending of KPI's

FIGURE 1.

Content Preparation

The first important point in the monitoring and Quality Control (QC) of ABR platforms is that the ingested content must be error free when received by the video service provider. If there are flaws in the ingested video and audio, it is inevitable that the final service will not be acceptable.

Transport Streams that arrive at the operator's ABR head-end from its own encoders or from other broadcasters and content providers are monitored for QoE issues such as macroblocking, compression artifacts, audio silence, levels and loudness. (Point 1 in the graphic). The ingested content is then transcoded into each of the ABR profiles (the same content at various bitrates) that the operator supports. The content quality of each profile is then verified after transcode. (Point 2 in the graphic).

Content Delivery

After transcode, each stream is fragmented into fixed time duration fragments, the content is encrypted and Digital Rights Management (DRM) is applied. The content is now ready for delivery to subscribers using a playout device known as an Origin Server. The encryption that is a key element of DRM requires that the monitoring system decrypt and decode the content. This ensures that the same level of deep packet inspection can be performed for QoE measurement, monitoring and analysis. With recent advances in ABR technology, QoE monitoring is necessary after the packager and encryption as it is possible for packagers and decryptors to drop packets causing QoE impairments.

Having employed QoE monitoring to provide confidence that the content to be delivered is good service providers can use QoS measures to ensure that the content is available and that the Origin Servers and CDN caching/streaming servers are capable of delivering it. This is performed at two points: After streams leave the origin server (Point 3 in the graphic) and when they leave content and caching servers, which is the last step before delivery to end users' devices (Point 4 in the graphic).

At these monitoring points, QoS measurements check the manifest verification, fragment load time and latency as well as ensuring that the various profile bitrates for each service are as expected. Active devices that emulate requests made by end users in order to subscribe to all services at all profiles are used to perform these tests.

ABR requires precise and exhaustive tracking of the huge number of packets that make up the various services. When the device requests a chunk at a specific bitrate the system the system needs to check the manifest file and make sure that the right bitrate is being sent. If, for example, it requests a fragment at 500 kilobits per second but the video is sent at 1 megabit per second, the service will fail.

QoS and QoE is vital to the success of ABR Streaming which uses HTTP to request each fragment in the same way that a web page is requested. This is a unicast approach in which only the stream requested is sent. This puts pressure on the system to deliver data in a precise fashion and, consequently, puts more pressure on video and audio monitoring and service assurance techniques. ABR is so complex that a very rigid and structured monitoring regime must be in place to ensure that the system is functioning correctly.

In Summary

With ABR streaming services, it is important to use a combination of QoS and QoE monitoring from ingest through transcode, fragmentation and encryption for all available profiles. This will ensure that the system delivers what the client-side player is expecting to receive. If video service providers perform all these steps, they will be best placed to deliver the highest possible quality video and audio programming over a robust and reliable service delivery platform.

FIGURE 2.

SENTRY

Identifies Quality of Service (QoS) anomalies in the network at the IP and MPEG TS layers that could prevent delivery of content. More importantly, Sentry provides large scale Quality of Experience (QoE) monitoring on multiple programs or channels simultaneously, identifying issues that represent the bulk of trouble calls from subscribers including frozen video, tiling/macroblocking and audio disruptions or audio-level and loudness issues.

In addition, Sentry includes a video artifact measurement and detection capability which enables Sentry to detect compression issues in programming while generating metrics represented as a Mean Opinion Score (MOS). Sentry can perform these measurements on streams containing H.264 and H.265 content.

Within the ABR network, Sentry is used from ingest all the way through the critical transcode process to perform comprehensive real time QoE analysis and artifact detection on the huge number of streams and profiles that are generated by any one asset being delivered to the end customer.

FIGURE 3.

SENTRY ABR

Is a post-origin server monitoring device that proactively monitors ABR content on origin servers or CDN caching/ streaming servers. It does this by actively requesting and validating program playlists / manifests that it has been configured to monitor. It then requests from the server, in turn, all of the fragments of each profile / representation for each program – calculating availability and performance metrics and generating alerts in real-time.

Contact Information:

Australia* 1 800 709 465

Austria 00800 2255 4835

Balkans, Israel, South Africa and other ISE Countries +41 52 675 3777

Belgium* 00800 2255 4835

Brazil +55 (11) 3759 7627

Canada 1 800 833 9200

Central East Europe / Baltics +41 52 675 3777

Central Europe / Greece +41 52 675 3777

Denmark +45 80 88 1401

Finland +41 52 675 3777

France* 00800 2255 4835

Germany* 00800 2255 4835

Hong Kong 400 820 5835

India 000 800 650 1835

Indonesia 007 803 601 5249

Italy 00800 2255 4835

Japan 81 (3) 6714 3010

Luxembourg +41 52 675 3777

Malaysia 1 800 22 55835

Mexico, Central/South America and Caribbean 52 (55) 56 04 50 90

Middle East, Asia, and North Africa +41 52 675 3777

The Netherlands* 00800 2255 4835

New Zealand 0800 800 238

Norway 800 16098

People's Republic of China 400 820 5835

Philippines 1 800 1601 0077

Poland +41 52 675 3777

Portugal 80 08 12370

Republic of Korea +82 2 6917 5000

Russia / CIS +7 (495) 6647564

Singapore 800 6011 473

South Africa +41 52 675 3777

Spain* 00800 2255 4835

Sweden* 00800 2255 4835

Switzerland* 00800 2255 4835

Taiwan 886 (2) 2656 6688

Thailand 1 800 011 931

United Kingdom / Ireland* 00800 2255 4835

USA 1 800 833 9200

Vietnam 12060128

*** European toll-free number. If not accessible, call:** +41 52 675 3777

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