Quality of Service Monitoring

Multiscreen Video Quality and Service Assurance

- Adaptive Bitrate video testing and monitoring at origin servers, CDN (caching servers), and last mile (streaming servers).
- Quality assurance monitoring for multiscreen video delivery from Pay TV providers.
- Full 60-day historical reporting and real-time alerting ideal for testing, proactive monitoring, and troubleshooting.

First QOE, then QOS:

Monitoring, Measuring, and Diagnosing Adaptive Bitrate Streaming Services

Cable operators are looking forward to a great future. Attractive new revenue streams in home automation, commercial services and mobile backhaul all promise great and diversified paydays ahead.

Above and beyond these new services, however, is multiscreen video. TV Everywhere (TVE), as it is also called, builds on an operator's legacy skillset to deliver video to PCs, laptops, smartphones, tablets and any other devices that emerge. The beautiful part of multiscreen is that it is deeply connected to cable's past. It is But to say that TVE is complex is an understatement.

Each class of devices has its own unique demands:

- The amount of data an IP-television needs to present a great picture is far more than what is necessary for a smartphone.
- The wired and wireless networks that these devices use have starkly different characteristics, which shift from moment to moment.

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These devices also use different techniques to receive and display the audio and video. The underlying technology is adaptive bitrate streaming (ABR). This essentially is the segmenting of content into small chunks of compressed content for transmission to the waiting devices. The challenge is that there are several types of ABR and each have different characteristics:

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

The industry understands that multiscreen is challenging. A recent survey of 758 industry experts conducted by StreamingMedia for Verimatrix found that 55 percent identified "quality of experience/quality of service" as the most significant technical challenge in offering OTT video. It was topped only by bandwidth limitations – at 59 percent – as the top perceived challenge.

The respondents were right to be concerned. "ABR is a simple idea that is very clever but very hard to implement," said Paul Robinson, Tektronix' CTO for Video. "There is an awful lot that can go wrong. You have to check that everything is working as you think it is. The only other way to find out when things are going wrong is for people to tell you, and you don't want to find out that way."

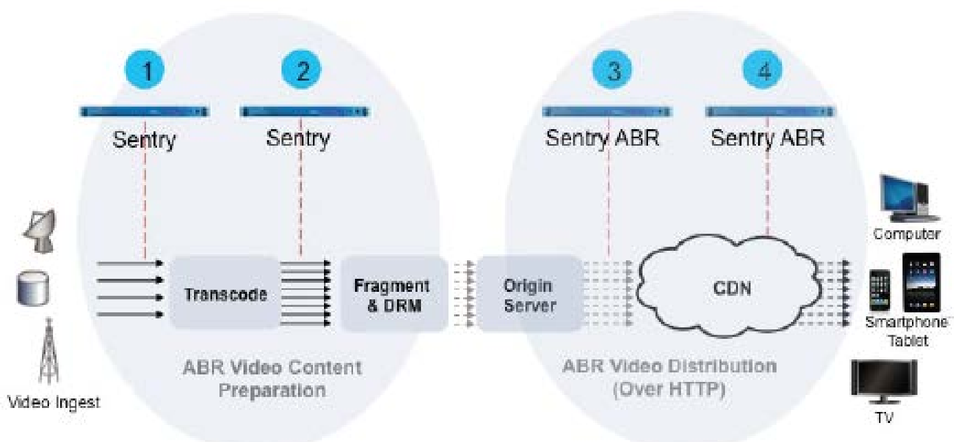
Nothing is worse for the reputation of a cable operator than a high profile service that doesn't meet expectations. Thus, monitoring and diagnostic testing of ABR platforms is as important as the ABR systems themselves.

QoE and QoS

The good news is that a tremendous amount of progress has been made in this area. There really are two linked ways of ensuring subscriber satisfaction. Though the two – Quality of Experience (QoE) and Quality of Service (QoS) – have similar sounding names, they are significantly different.

The overall monitoring of TVE streams is divided into four points.

Multi-Screen Multi-Point Video Monitoring



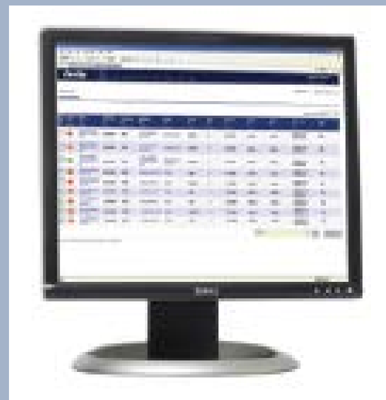
- The first two are content validation functions and occur at the QoE level. They are performed before and after transcoding and before fragmentation and the addition of digital rights management (DRM).
- The second two are asset verification – network level QoS functions that ensure content is delivered correctly – that are implemented after the origin and caching and streaming servers.

QoE is a relatively new realm for cable operators. In the past, operators focused on measuring attributes related to the precision with which packets were received. This measure – QoS – focused on delayed, out of order, and lost packets. More recently, however, technology advances have allowed cable operators to examine the packets themselves to look for deeper problems. These measures – QoE – come closer to predicting the actual experience viewers will have when they see and hear the video and audio.

Tektronix Monitoring for Adaptive Bit Rate Streams

Sentry

Sentry ABR



Cerify

Sentry, Sentry ABR and Cerify are products within the Tektronix product line of video quality monitors which enable cable operators provide quality assurance for their multiscreen services.

Sentry focuses on QoE measurements. The product identifies anomalies in the network at the IP and MPEG layers as well as in QoE identifying issues that represent the bulk of trouble calls from subscribers including frozen video, tiling/macroblocking, black screen and audio disruptions or audio-level issues.

In addition, Sentry includes a video artifact measurement and detection capability which enables Sentry to detect video and audio errors in digital programs while generating metrics that correlate to Mean Opinion Scores (MOS). Within the ABR network, Sentry is used from ingest all the way through the critical transcode process to perform comprehensive QoE analysis and artifact detection on each stream in real time.

Sentry ABR is a post-origin measurement device that focuses on QoS. Sentry ABR is an “active” monitoring product that proactively monitors ABR content on origin servers or CDN caching 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.

Cerify is a file-based, on-demand product analogous to Sentry. Cerify is a quality control tool that does two things:

1. First, it checks that the file has the expected video and audio content, that it is decodable and can be transcoded, that the overall length is correct, and that the video quality meets operator requirements.
2. The second task is a bit more complex. Operators segment content into “chunks” for transcoding into ABR streams. They choose the length of each chunk by setting the Instantaneous Decoder Refresh (IDR) frame that is a part of the H.264 spec upon which ABR platforms all are based. The IDR frame essentially signals the transcoder that nothing before it can be used to construct the audio or video in that chunk. Cerify makes sure that the IDR frames are placed and timed accurately.

First Comes QoE

The first vital point in the monitoring and diagnostics of ABR platforms is that the signals must be perfect – and be proven to be so – when they are received by the operator. The old phrase "Garbage In, Garbage Out" was never more relevant than in TVE. If there are flaws in the video and audio that is first received, it is inevitable that the final product won't be acceptable.

For this reason, program streams that arrive at the operator's facility from servers, satellites and via other traditional means are validated for QoE. The QoE measures are aimed at finding and preventing things such as macroblocking and drop outs. Audio levels – which are controlled in the United States under specifications set forth in the CALM Act – are also checked.

Once acquired programming is assured, it is transcoded into each of the ABR platforms that the operator supports. The options are:

- HTTP Live Streaming
- HTTP Dynamic Streaming
- MPEG-DASH
- Smooth Streaming

Content is validated once this step is accomplished.

The good news is that ABR platforms have a lot in common because they are all based on the H.264 compression standard that is at the heart of MPEG-4. The differences focus on what is essence is the way in which the core MPEG-4 compression is used.

One of the biggest challenges of streaming is that the networks and devices are far more differentiated than in the old and very controlled world of legacy video. Operators must acknowledge this by assuming that ABR will be used in an almost limitless mix of scenarios. Different network conditions and device requirements make a highly flexible structure necessary.

ABR addresses this issue in a clever way. Each data stream is divided into discrete groups of packets, which are referred to as chunks. A variety of transmission rate for the chunks is established, from slow to fast. These options are called profiles. The network device has the intelligence to essentially ask for the profile that best suits it based at a particular point in time. The optimal profile can change in real time.

There are a great number of profiles because the real world in which ABR operates is an ever-changing mix of network conditions and user devices. In all, six to twelve profiles of all programming streams – HBO to ESPN to local access – must be created for each of the ABR platforms the operator is supporting.

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Now Comes QoS

At this point, Digital Rights Management (DRM) software is added. Content – replicated on different ABR platforms and subdivided into numerous platforms – is sent to origin servers that answer the requests of end users.

Operators have less access at this point: The encryption that is a key element of DRM makes it impossible for the same level of packet analysis to be performed. QoE monitoring is impossible at this point: After encryption, operators are limited to assessing QoS. This is done at two points: After streams leave the origin server and then they leave content and cashing servers, which is the last step before delivery to end users' devices.

If the system has worked to this point, however, the need for QoE is passed. If the data is in good shape when it is encrypted, it is impossible for it not to be in precisely the same state when it is decrypted by the subscriber's device. Once the data is encrypted and sent to the origin server, the focus turns to QoS metrics such as latency, jitter and throughput.

In addition to the basic QoS measurements that operators traditionally monitor and test, ABR requires precise and exhaustive tracking of the billions of packets that make up the various streams. This is necessary both for delivery of content and vital ancillary services such as ad insertion. Manifest files are used to validate that packets are arriving on time and that the proper profile is being used.

"When the device requests a chunk at a specific bit rate, the system needs to check the manifest file and make sure that it's actually the right bit rate that is being sent," Robinson said. "If it requests a chunk at 500 kb/s and for whatever reason it incorrectly sends video at 1 Mb/s, it's all going to break. It will stall at that point."

The system checks the encoder's buffer to see how many packets it contains. If there are too many, the system moves to a profile in which more are dispatched through the network and improves the end product. If too few, a profile that sends less data per second is employed.

QoS indeed is vital to the success of ABR. Streaming uses the Hyper Test Transfer Protocol (the HTTP:// in a Web address, or URL), which is a unicast approach in which only the stream requested is sent. This puts tremendous 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 and has such low tolerances that a very rigid and structured monitoring regiment must be in place to ensure that the system is functioning correctly.

Monitoring and validation are done in two ways in the QoS environment. Active devices actually copy and emulate fulfillment of each request made by end users to ensure that QoS is adequate. It checks buffers to ensure that the correct profile is used. Passive devices measure QoS of the end-users' actual packets – not emulations – as they flow through the system.

Conclusion

With ABR streaming services, it is important to monitor both video and audio QoE both pre- and post-transcode for all available profiles. After encryption and fragmenting, it is important to monitor the QoS of the service delivery platform (original server) to ensure that the system delivers what the client-side player is expecting to receive. In addition, with systems offering on-demand services, it is important to verify the decodability of these assets prior to being made available for transmission. If operators 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.

Reference:

Carl Weinschenk, editor of BTR

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