



VeriStream Technology Overview

Efficient Video QoS Assurance for
Adaptive Streaming

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SUMMARY

Multiscreen, TV Everywhere and Over-the-Top (OTT) video are at the center of the video everywhere transformation. By accessing a wide range of devices (from internet TVs to video-enabled mobile devices) through non-traditional, cloud-based networks, the complexity of issues in the video network that affect the viewer experience increases. As video providers continue to strive to increase viewer satisfaction by delivering more content to more devices, assuring QoS will be essential for maintaining high video QoE and excellent customer experience.

IneoQuest's patented VeriStream QoS technology proactively identifies and prevents QoS issues that have an impact on customer QoE. For any video provider, VeriStream is the only monitoring parameter required downstream to assure high program availability for the consumer. VeriStream is a key performance indicator that evaluates system and file transfer in networks using adaptive streaming technologies, and characterizes buffer management performance in an easy-to-use color-coded and numbered status chart that easily pinpoints system errors.

This article is for informational purposes only and does not constitute legal advice. Nothing contained herein should be used as a substitute for the advice of competent legal counsel.

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1. ADAPTIVE STREAMING – A NEW APPROACH FOR VIDEO EVERYWHERE

The delivery and consumption of video is quickly changing: while traditional linear networks and television remain popular, watching video on a personal computer or mobile device is becoming a staple of everyday life. Adaptive streaming is designed to improve Over-the-Top (OTT) video delivery across complex and varied networks with unpredictable bandwidth by adapting the size (and quality) of the video files sent to the consumer. Thus, it provides the essential foundation for making video everywhere a reality. While adaptive streaming was originally intended for low-resolution mobile video it has also come to provide the necessary bandwidth flexibility for service providers to offer internet video on their existing network to their customers' televisions and computers.



High-quality and low-cost distribution of premium content place adaptive streaming firmly at the center of this video revolution.

The new OTT model is very different from traditional linear networks. With OTT, content providers send their video to a content delivery network, which in turn caches video across multiple servers in the cloud. Using this internet-based structure, content providers can expand their video offerings and services at a considerably lower cost than before by transferring video through http protocols. Subscribers gain access to more video content while service providers leverage their existing infrastructure to store and distribute thousands of video assets and interactive applications. New devices, such as IP-enabled television and internet connectable home theater devices, connect the viewer directly to internet video and services that are delivered through adaptive streaming.

The reach of internet video goes well beyond mobile applications: it presents rich opportunities for service providers to leverage the use of the embedded network while providing and expanding video offerings to customers. However, these new technologies and services add new pressures and challenges to video delivery quality. Thus, accurate and effective video quality monitoring must also adapt to ensure quality of service for video delivered through adaptive streaming.

2. THE NEW CHALLENGE OF ADAPTIVE STREAMING

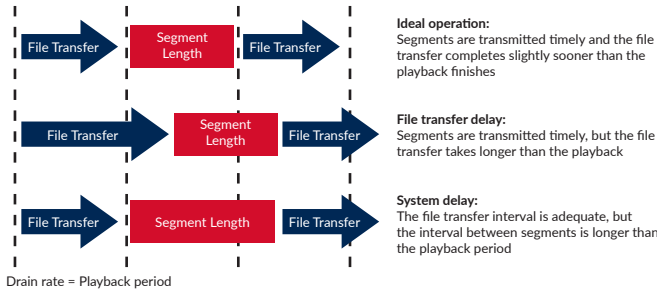
Video everywhere expands the scope of both clients and devices accessing video. Now, the video consumer is not simply sitting at the end point of a linear network in front of a television. Rather, the consumer is everywhere: at the computer monitor, on a laptop, with an entertainment device, or on a video-enabled mobile device. The ability of the consumer to access video everywhere increases the chances and instances where video degradation can occur.

Adaptive streaming technology introduces new challenges to the efforts of video providers to maintain program quality. Perhaps the single most important cause of these challenges arises from the chaotic nature of adaptive video. With regard to adaptive streaming, video is sent to the content delivery network (CDN) in a variety of resolution variants so that the file transfer stream can adapt to bandwidth limitations. After these files enter the cloud of servers and caching points across the CDN they can be accessed by the customer at those points determined to be the most efficient for continuous video streaming. In addition, interaction between the customer's video device (a mobile device or internet TV) determines which video file will be sent from the CDN for viewing. Assuring the quality of video streams derived from these decentralized networks at the best resolution possible is the essential challenge of adaptive streaming technologies. It is not enough to simply monitor video quality on the provider network if video degradation is occurring on the cloud between the service provider's network and the mobile device. Visibility into multiple servers and transport domains is required to deliver the video content.

2.1. INTRODUCING VERISTREAM

To address the new challenges to video quality presented by adaptive streaming, IneoQuest leveraged its patented and proprietary technology to develop VeriStream. VeriStream is the ideal metric to summarize the performance of adaptive video in a single, easy-to-use index. It provides a color-coded, five-level status chart to quickly and accurately identify degradation within adaptive streaming, allowing operators to address critical issues within their network quickly and efficiently.

Comparison of normal operation vs. file transfer or delay impairments



By analyzing these refresh and consumption rates, VeriStream provides the necessary information to detect and address all network-induced impairments that can occur in adaptive streaming. It provides an efficient and proactive metric to ensure proper buffer management and continuity of video delivery. By summarizing the delay factor performance for the system and file transfer, VeriStream provides a single indicator of performance by categorizing the results in a numbered, color-coded index that is easy to use and interpret as shown by the performance table below.

2.2. USING VERISTREAM FOR QOS ASSURANCE

VeriStream performance table

5	Severe Underrun	Interval between segments and the file transfer time are slower than the drain rate
4	Underrun	Segment interval is slower than the drain rate but file transfer time is faster than the drain rate
3	Warning	Interval between segments and the file transfer time are marginal
2	Growing Buffer	Interval between segments and the file transfer are faster than the drain rate
1	Balanced System	Interval between segments is balanced and the file transfer is faster than the drain rate

Adaptive streaming video is transported throughout the cloud and the only QoS factors that impair QoE are bandwidth restrictions, delays and segment loss. VeriStream provides key QoS performance indicators that are essential for analyzing and pinpointing various error occurrences.

For example, media jitter can have adverse effects down the network line, impacting buffer management in the cloud. There are diverse causes for media jitter: HTTP problems on the server network, bandwidth issues or improper encoding causing unrecognizable segments. VeriStream provides performance indicators throughout the network over time to instantly provide valuable information to diagnose system issues or file transfer delays.

With VeriStream enabled tools, operators can identify and resolve a host of issues previously left unnoticed by combining HTTP server performance indicators, PID loss occurrences, and adaptive segmentation issues in a single index. Now, operators can isolate system-level issues from file-transfer delays caused by network bottlenecks. Also, multiple adaptive video flows can be monitored in a single dashboard with conclusive pass/fail criteria to ensure program availability.

At a higher level, VeriStream technology provides the means to show the overall health of adaptive streaming video delivery, not only its specific symptoms. For example, VeriStream can warn of impending issues arising from within the network such as system-induced jitter. Now that jitter is measured, underflows can be predicted and proactively addressed. It can also be used as a targeted metric in production networks that carry large numbers of streams by monitoring the network quality of the streams and ensure that overall network performance is healthy. Finally, VeriStream is equally useful in assessing the dynamic performance of network and system delivery at end point locations. VeriStream is the key performance indicator for QoS in networks leveraging adaptive streaming technologies and helps operators maintain high program availability, minimize errored seconds, and ultimately deliver high content quality.

2.3. VERISTREAM IN ACTION – REPORTING AND INTERPRETATION

HTTP Stream Server	VS History	FRB-SYS (sec)	FRB-FT (sec)
● PRGA 300 kbps		-0.02	6.08
● PRGA 600 kbps		-5.60	8.22
● PRGA 800 kbps		1.50	2.37
● PRGA 1 Mbps		6.72	6.27
● PRGA 300 kbps		-0.01	6.08
● PRGB 1 Mbps		-1.07	-0.22
● PRGB 2 Mbps		-0.60	-0.44
● PRGB 3 Mbps		6.73	6.27

This section shows VeriStream in action. The performance table above is monitoring an active adaptive streaming network. In this example, a stressed device is experiencing problems delivering high resolution variant files. The green circular indicator of each variant shows that all streams are active, though problems are clearly pinpointed by red and amber color bars.

- Notice how all high bitrate variants experience frequent underruns caused by long delays on FRBSYS and FRBFT.
- As the system is stressed with more load than it should handle, PRGA 600 kbps is experiencing intermittent underruns. If the pattern continues, these buffers risk depletion.
- For PRGA 800 kbps, VeriStream is running on the threshold of acceptability. With frequent warning conditions, there is no margin for delays on segment transmission (FRBSYS or FRBFT).
- PRGB 1 Mbps and 2 Mbps variants are suffering continuous underrun events which will lead to buffer depletion.
- After underruns depleted the buffer of PRGB 3 Mbps, (shown on the last red VeriStream indicator) the system is trying to grow the buffer again with fast file transfers and shorter intervals between segments.

In this case, VeriStream analytics have clearly demonstrated that it is necessary to dimension the server adequately to the load it must handle. Either a more powerful device is required or the bitrate of the variants should be limited.

2.4. SUMMARY

OTT video and adaptive streaming are the technologies placed at the center of the video everywhere transformation. As video providers continue to strive to increase viewer satisfaction by delivering more content through more media, assuring QoS will be essential for maintaining QoE for the customer. By accessing a wide range of devices (from internet TVs to video-enabled mobile devices) through non- traditional, cloud based networks, the complexity of issues of the video network that affect the viewer experience increases.

IneoQuest's patented VeriStream technology is a key performance indicator that evaluates system and file transfer in networks using adaptive streaming technologies. VeriStream characterizes buffer management performance in an easy-to-use color-coded and numbered status chart that easily pinpoints system errors. It proactively identifies and prevents QoS issues that have an impact on QoE and is the only parameter required downstream to monitor high program availability for the consumer.



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