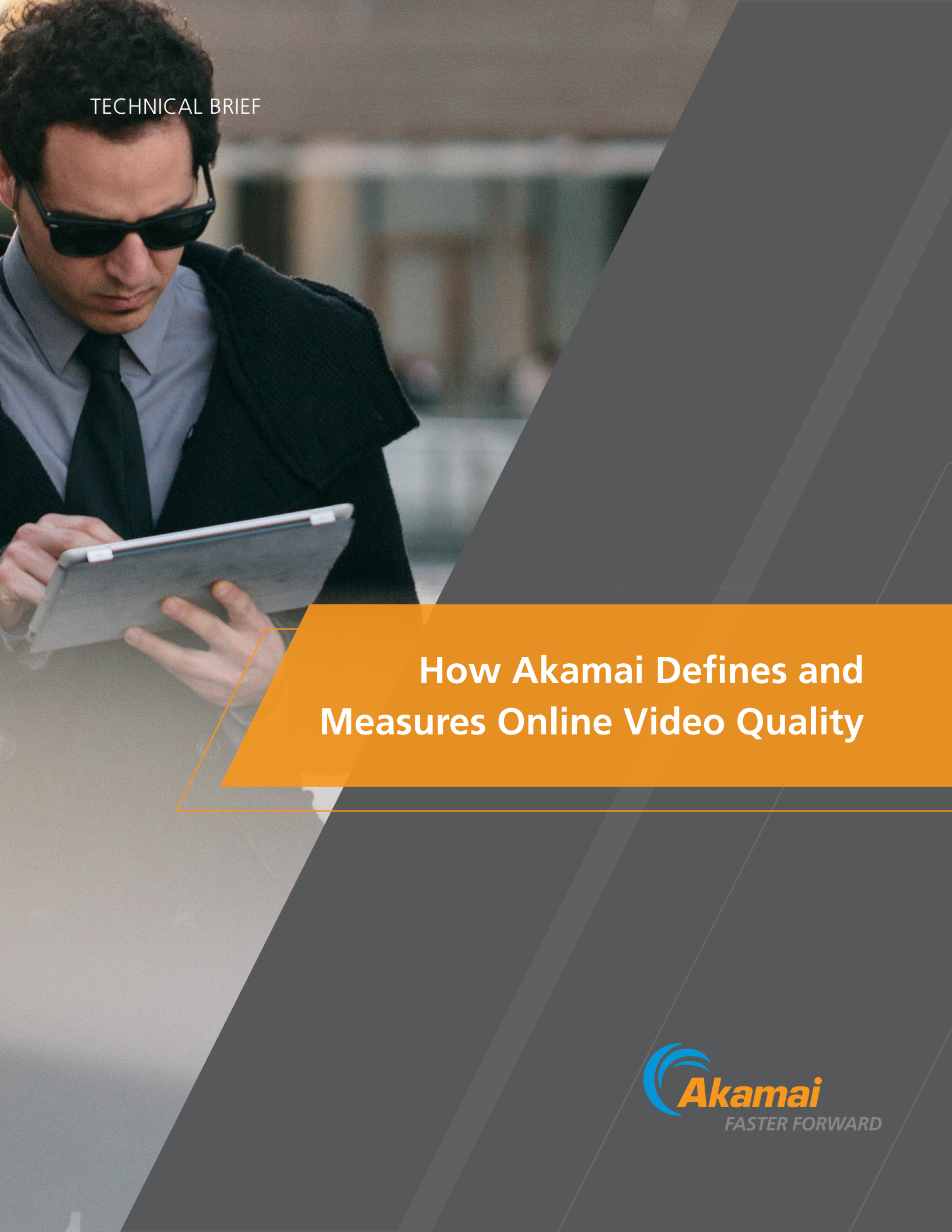


TECHNICAL BRIEF

How Akamai Defines and Measures Online Video Quality

Akamai
FASTER FORWARD

Executive Summary

Online video consumption is booming. Across every conceivable metric – watch time, engagement, monetization, content creation, and more – online video is becoming a massive, disruptive force in the broader video/TV industry. As online video becomes ubiquitous, viewers now expect a better than TV viewing experience, with the video quality of television and the interactivity and personalization of the web. That in turn puts significant pressure on content providers and their delivery partners to meet increasingly higher expectations.

Video quality can be measured in multiple ways, but the primary metrics – playback reliability and image quality – are the most critical. Get these right, and content providers are on their way to winning the loyalty of online audiences and driving monetization. Get them wrong, and viewers will defect in a heartbeat. For live-streaming events, such as sports, where there's can't-miss fast action, the ante is raised even higher.

In this white paper, we'll explore why online video quality matters and the specifics of how it should be measured. Get a peek "under the hood" to understand the core elements of video delivery that contribute to high-quality viewing experiences. Most importantly, see why the choice of a content delivery partner is essential to your online video success.

Introduction

Why quality matters

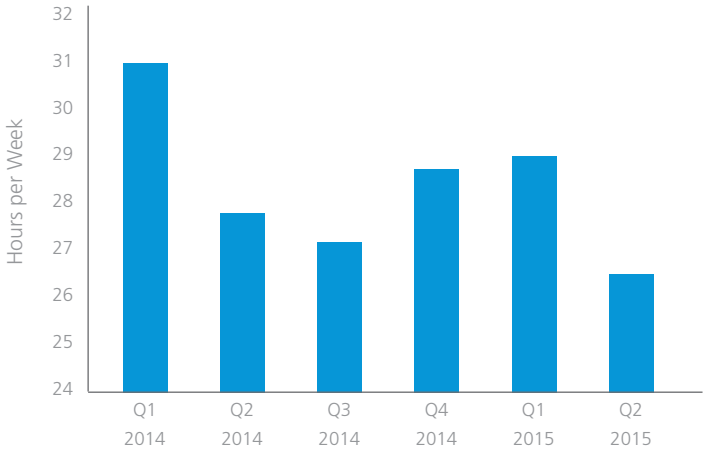
High-quality online video streaming, whether it's live or on-demand, has never been more important. Over-the-top (OTT) online video providers like Netflix, Amazon, and Hulu commit billions of dollars to licensing premium TV content and developing their own original programming. They are betting that their shows can go toe-to-toe with the finest programming that traditional television networks can deliver. However, in order for OTT video services to compete effectively, a premium quality - even ultra HD – experience is expected.

Traditional TV viewing has started to decline for the first time in the U.S. Time spent watching live TV fell 4% year over year in the second quarter of 2015, following on the heels of a 5.7% decline in the previous quarter.[1] And viewers are not transferring live viewing to recordings on their DVR. The increase in DVR viewing between Q2 2014 and Q2 2015 was just 3 minutes a week, while the decrease in live TV viewing over the same period was 1 hour and 6 minutes. With 58% of consumers using services such as Netflix and Amazon for their entertainment programming, it is becoming increasingly clear that for some viewers, OTT has become a substitute for traditional TV.[2]

The move to swap viewing time from traditional television to online video comes with an expectation that the overall experience and delivery quality won't be diminished. Unfortunately, today many online video viewers receive far less than they expect. In an always-on world, where users have been primed for instant gratification, speed matters.

With a 5-second delay in starting a video playing, a publisher may have lost a quarter of its audience, and with a 10-second delay, nearly half the audience has left.[3] This means a few seconds of delay can cost a publisher millions in potential revenue, not to mention irreparable harm to the brand. Tolerance for slow video starts also varies greatly by content type. With a two-second startup delay, for example, the abandonment rate is roughly 3% for long videos and almost double that for short videos. Similarly, with a five-second delay, the abandonment rate is nearly 13% for long videos and again, roughly twice that for short videos.[3a]

Average Weekly Live TV Viewing in the US



Source: Nielsen Q2 2015 Total Audience Reprt, nScreenMedia Calculations

Once you lose a viewer due to a poor quality viewing experience, winning them back is an uphill battle.

Exacerbating the situation, poor quality video delivery is much more visible online than it used to be, when watching short clips on a computer was the dominant online video behavior. The big-screen television is the place where poor video quality is most obvious, and it is being used more often for online viewing. As just one example, the number of video requests to BBC iPlayer from connected televisions increased 70% in July 2015![4]

Further, poor quality of experience (QoE) delivery is immediately noticeable to viewers holding a tablet or smartphone inches from their face. Smartphones and tablets are viewed by many as important video consumption devices, with 45% of online video requests coming from mobile devices. Many of these mobile screens deliver better than TV quality. The resolution of an HD TV is 1920x1080, while the resolution of a Samsung Galaxy S6 edge is 2560x1440, and Apple's iPad mini has a resolution of 2048x1536. With these mobile screens approaching ultra-HD resolutions, poor quality video is immediately obvious.

Maintaining quality at scale is one of the hardest things to do in online video streaming — never more so than with live event delivery.

Live Event Streaming

Live streaming, for sports in particular, has become an extremely challenging and complex undertaking as viewers expect the highest video quality so they're able to track every nuance of the action — as they've traditionally done on TV. Additionally, any substantial delay versus real time simply won't be tolerated. Live online sports are growing fast. Akamai reports that the peak game streaming traffic during the 2010 Soccer World Cup was 1.4Tbps.[5] Four years later, the event drove a peak 5X higher.

TRAFFIC PEAKS RECORDED DURING 2014 FIFA WORLD CUP

The simple truth is that poor quality video experiences translate directly to lost revenue. For ad-supported video, reduced viewing time means fewer ads watched. For subscription services, poor video quality means increased churn, higher subscriber acquisition costs, and lower margins. Whatever the monetization method, low-quality video is bad for business.

Though online video quality is so fundamental to the success of any provider and the stakes are so high, it's surprising that the way the industry talks about and measures quality video delivery remains vague, inexact, and not explicitly tied to key business metrics. In this paper, we will explain how Akamai measures video quality and show how this approach can help establish important benchmarks for measuring excellence and driving business success.

The components of quality

From a video viewer's perspective, the components of a quality online video experience can be broken down into two broad groups:

1. The reliability of playback

2. The video image quality

Get these two things right and an online video service will likely have satisfied viewers. Get them wrong and it can spell disaster. However, there are many things that can go wrong to disrupt either of these broad metrics.

Playback Reliability

There are two primary circumstances in which the playback of a video would appear to be unreliable to a viewer: video playback stalls while watching, or the video is slow to start.

Playback stalls: Everyone who has ever watched online video is familiar with the dreaded spinning pinwheel while the video remains frozen. This is called a rebuffering event, meaning the small video buffer the client video player maintains is empty and the client is waiting on the server to send more video. Rebuffering can be caused by several different problems.

- If the quality of the connection between server and client degrades too much during playback, the server may not have enough bandwidth to deliver even low-quality video fast enough to the client.
- A client device may be too slow or too busy with other background tasks, rendering it incapable of keeping up with the video being streamed to it.

- In rare cases the streaming server can get overloaded and can't deliver the video to a client fast enough to keep up with playback.

However it is caused, rebuffering can result in high abandonment rates, as the below data indicates.

Rebuffer Time Per Minute	*Rebuffer Abandons*
0-2 secs	*2093 (5.26%)*
2-5 secs	*1848 (4.65%)*
5-10 secs	*2606 (6.55%)*
10-20 secs	*5334 (13.42%)*
20-30 secs	*6500 (16.35%)*
> 30 secs	*21380 (53.77%)*

*This represents anonymous cross-CDN data collected by Akamai

Video start time: While playback stalls are more likely to invoke viewer annoyance, long video start times can also be problematic. Many of the reasons for startup delays are the same as those during playback delays. Startup delays can often be confused with playback stalls, as rebuffering often occurs within the first few seconds of playback.

If the video freezes for 2 seconds, 25% of the audience is liable to leave. It the video freezes for 5 seconds, half the audience will leave. Akamai calls this the "2 second rule".

Image quality

Of course, while the basic encoded quality of the video is critical, there are many other attributes that can also affect the viewer experience.

Resolution: The resolution of the video delivered to a specific display is critical. For the best viewing experience, it should match the resolution of the device's display. If resolution delivered is too low, the picture looks bad. If it is too high, the stream is more likely to be impacted by connection problems, and consumers will burn through their mobile and broadband data allotments at a much faster rate. Since the resolution is negotiated between the client player and the server before playback begins, making a mistake will affect the whole playback session.

Another problem with mismatched resolutions is that the online video provider gains no benefit. For example, delivering an ultra HD picture to a 32" or smaller display rather than a standard HD picture will not result in a viewer watching more online video. The extra resolution simply isn't perceived by the viewer. For the video provider, however, it costs as much as 4 times more to deliver ultra HD over standard HD.

Bitrate: Once the video starts to stream, the key metric in determining the quality of the image is the bitrate delivered. Adaptive bitrate (ABR) protocols succeed in keeping the video playing, even when transient conditions reduce the available bandwidth, reducing picture quality when necessary.

Smooth Playback: The primary objective for online video providers should be to deliver the highest quality image continuously without interruptions or periods where the image quality degrades. In practice, this is extremely difficult to do. Playback stalls, slow video starts, and bitrate adjustments can disrupt the viewer's engagement rate. However, there is one major source of disruption that can destroy a smooth experience: ads.

Most online ad solutions rely on the client to do the ad insertion, often resulting in playback problems. When an ad starts, the client switches playback to a new streaming server delivering the ad. Conditions between the client and the ad streaming server are likely different than between the client and the original video streaming server, and the adaptive bitrate streaming protocol will adjust accordingly. At the end of the ad, the client player switches back to the original video server, but must renegotiate the optimum quality.[7] This can lead to the video stalling or playing at a lower quality for some time after the ad.

Measuring Quality of Experience

One of the best ways to assess the overall QoE of any online video service or streaming event is to keep an eye on the audience size. The specific size of an audience for any live video event or SVOD service is, of course, dependent on the type of content it delivers and the potential size of the market for that content. However, the persistence of that audience while watching is a key indication of the QoE being provided. If the quality is poor, or suddenly degrades for everyone, the audience size will change quickly to reflect that. Akamai's "2 second rule" is a great illustration of this.

Measuring Playback Reliability

Akamai collects multiple parameters to measure the video start time and playback stall occurrences.

Video Start Time

This is the time between when the viewer first presses play for a video and when the very first video frame is displayed. There are several components of this time, including the time between pressing play and the video server initiating playback, and the time it takes to fill the local client video buffer.[8] In most cases, keeping video start times as short as possible is best.

Akamai leverages video start time to track another very important component of quality: availability. When a viewer attempts to play a video, sometimes the video fails to start. There are many reasons this can happen, including the server being overloaded and network congestion. Availability is simply the ratio of successful starts to the number of attempts.

Online video providers would like availability to be as close to 100% as possible.

Playback Stalls

Akamai measures two critical parameters to understand the impact of rebuffering events, as shown in Table A. The first is the number of times rebuffering occurs, and the second is the time spent rebuffering.

Rebuffer Per Minute	*Rebuffer Abandons*
< 1 per min	*9264 (23.29%)*
1-3 per min	*11544 (29.02%)*
3-5 per min	*6161 (15.49%)*
5-10 per min	*2123 (5.34%)*
>10 per min	*10693 (26.88%)*

Table A. Anonymous Cross CDN data collected by Akamai

Akamai measures these two parameters because it is impossible to understand the rebuffering impact without both. For example, a rebuffering event that occurs every 10 minutes lasting for less than a second each time is very different to one that occurs every 5 days lasting 10 minutes or more. Viewers might put up with the former problem and continue watching, but in the latter case they will almost certainly abandon watching after a minute or so of the video freezing.

For online video providers, the objective is as few short rebuffering events as possible. Long frequent events are a serious cause for concern.

Measuring Image Quality

Akamai tracks many parameters to assess the image quality experienced by an online video viewer. Generally, they are drawn together in the following groupings.

Smooth playback

Adaptive bitrate streaming protocols adjust the bitrate of the delivered video to compensate for limited resources in the video delivery path. If a viewer is enjoying smooth video playback, these adjustments should occur infrequently. Akamai keeps track of the number of bitrate downshifts and upshifts to assess how smooth video playback is. From a service provider's perspective, the fewer downshifts and upshifts the better.

Another key metric Akamai tracks is video frame drops. If the playback client can't keep up with the video, it will skip video frames. This can result in stuttering or pixelated video. Akamai also tracks the number of frame drops during playback. Again, the fewer of these the better.

Average bitrate delivered

To understand the quality of the online video experience enjoyed by a viewer, it's important to know how close to the target bitrate a particular video streaming session came. A key parameter necessary in assessing this is average bitrate delivered. Akamai calculates the average bitrate by taking into account all the upshifts and downshifts due to adaptive bitrate delivery. Ideally, this number will be as close to the target bitrate as possible.

Seeing the forest through the trees

Akamai pulls together audience size, availability, start up time, rebuffering, and average bitrate delivered and tracks these for many video sessions to assess the overall quality of an online video service or event. These parameters allow Akamai to gain visibility into the overall QoE, or forest view, as it relates to user engagement.

However, a forest is made up of trees, and it is still necessary to understand the health of each in order to accurately and quickly identify problems. To do this, Akamai focuses on two key parameters: startup time and the average time between rebuffering events. This data demonstrates how individual viewing sessions are performing and illuminates specific problems or issues.

Conclusions

Akamai's approach to measuring quality allows an online video provider to know both the overall quality it is delivering, and QoE at the individual viewer level. This "forest and tree" approach is the only way to establish an accurate 360° view of true online video quality. It's also the only way to build a coherent plan for the management of the business. Ultimately, delivering a high quality video experience is integral to retaining viewers' loyalty, and building a profitable online video operation.

Sources

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4. nScreenMedia, BBC iPlayer Tracker, http://www.nscreenmedia.com/bbc-iplayer/ (accessed on 10/2/2015)
5. Colin Dixon, World Cup already setting OTT live streaming records, nScreenMedia, Jun 16 2014
6. If the ad is at a different quality than the show or movie being watched (SD versus HD for example,) that will also cause a renegotiation of the optimum quality.
7. Every video client maintains a small video buffer. The buffer helps smooth video playback, because if there are network problems the video will continue to play from the buffer.

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As the global leader in Content Delivery Network *(CDN)* services, Akamai makes the Internet fast, reliable, and secure for its customers. The company's advanced web performance, mobile performance, cloud security, and media delivery solutions are revolutionizing how businesses optimize consumer, enterprise, and entertainment experiences for any device, anywhere. To learn how Akamai solutions and its team of Internet experts are helping businesses move faster forward, please visit *www.akamai.com* or *blogs.akamai.com*, and follow @Akamai on *Twitter.*

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