CDN Optimization for VR Streaming

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Introduction

Viewers today expect high-quality video content delivered without any interruption. Naturally, this expectation carries over to Virtual Reality (VR) 360° content. In fact, video quality is even more important with 360° content because low-quality video may cause motion sickness — clearly something to avoid when aiming to deliver delightful user experiences.

The challenge faced today with VR (360°) content is that by its very nature it is extremely voluminous. The Quality of Experience (QoE) could be managed from a bandwidth perspective on managed cable TV networks, but today’s over-the-top networks bring new hurdles. For example, YouTube recommends uploading 360° videos with a bitrate of 150 Mbps, which means a five-minute video would be around 5.5 GB. To stream such high-quality 360° video uninterrupted and with minimal buffering requires a lot of network bandwidth. With high consumer demand for OTT and other content, new approaches must be taken to deliver 360° video with an acceptable QoE.

In addition to the scale of the Akamai network, which allows content to be brought closer to the user, there are several other features of the Akamai network leveraged to derive a better QoE for 360° video.

Emerging Techniques in Adaptive Delivery for VR

As businesses and brands look to find efficient methods to decrease bandwidth to deliver VR content, many are focusing on the user’s field of vision (FOV). This emerging technique delivers content in the user’s current FOV in high quality, while delivering the rest of the video in low quality. This decreases the bandwidth required to deliver 360° content.

How is this achieved? Each of the video frames is divided into smaller pieces called tiles. Once the frames are divided, tiles can be individually delivered based on the user’s current FOV. The software that is running on the VR unit, supporting PC, or mobile device puts the tiles back before delivering it to the video decoder. This emerging technique to adapt video streams based on the current viewport has been realized by several methods by different organizations.

One method the Akamai team has hands-on experience with is tile-based adaptive VR streaming, demonstrated at past industry events. With this method, tiles are served by using a custom packaging format of the video asset to provide random access to the tiles of a frame. This process is supported by two of Akamai’s flagship products: Adaptive Media Delivery and NetStorage. High-quality tiles are fetched from the origin by the Akamai edge servers using HTTP byte-range requests based on the client-reported FOV while the URL in the manifest for the video remains unchanged.

Taking It a Step Further: Proximity-Aware Content Prepositioning

Another recommended optimization is taking a predictive approach to prefetching content based on proximity and movement. This approach proactively loads predicted content into the CDN cache server and populates tiles that will be needed in the future, based on client proximity and head movement of the user. This reduces the time it takes to switch a low-quality tile with a high-quality one in the user’s FOV by more than 50%, compared to the case when nothing is prefetched on the CDN.

Moreover, since tiles can be treated as any other simple binary object that needs to be delivered from the origin server to the client via the edge over HTTP or HTTPS, Akamai can optimize tile delivery in several ways. Hence, other tile-based approaches of VR streaming (such as the one proposed by digital innovator Fraunhofer HHI) can also benefit from such prefetching.
Next-Gen Protocols
A common approach to media delivery optimization is switching to less chatty protocol to reduce overhead. Newer protocols that may be used for VR delivery such as QUIC and HTTP/2 are already supported by Akamai out of the box and are ready to be experimented with. Researchgate’s framework shows how HTTP/2 server pushes increase throughput — especially in mobile, high-RTT networks.\(^4\)

Ad Insertion
360° video presents a new avenue for ad-based monetization. Dynamic ads can be inserted at different spatial locations in the 360° video space as the video is being played. If tile-based encoding is used, then some of the tiles can be overlaid with ads at run-time, as in Fraunhofer HHI’s research on advertisement overlay insertion.\(^5\) These tile-based ads can be stored on Akamai’s NetStorage and be delivered to the client with minimal latency. For a much more dynamic experience, the edge servers can pull tile-based ads from third-party ad servers at run-time, based on ad-targeting rules.
Conclusion

Ecosystem drivers and technology advances are aligning now to make delivering video in 360° far more pervasive. Meeting several demanding user requirements across visual quality and experience can be challenging. Akamai provides solutions to address these challenges and many other mature capabilities to lead the way in achieving high QoE and ushering in the new era of 360° content.

Contact us at consulting@akamai.com to explore how you can achieve a high QoE and create immersive, innovative, and differentiating experiences.

About the Authors

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Vishal Changrani is an Enterprise Architect at Akamai. He helps Akamai customers realize their media workflows. He has over 13 years of experience in a myriad of domains including embedded systems, biotech, and large-scale enterprise applications. Prior to Akamai, Vishal has held different positions at Ericsson, Motorola, and Silicon Valley startups. He has authored numerous patents in the field of digital media.

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