INCREASE ARPU BY MANAGING ABR VIDEO TRAFFIC

Video traffic continues to rise dramatically both in overall volume as well as in the total proportion of traffic. This increase is being fueled by improvements in technology like 4K HD video or for gaming, over-the-top (OTT) video, and the ubiquitous availability of consumable video. Service providers must not only manage the amount and type of video traffic they support to minimize network CapEx and OpEx, but also to introduce new services and increase average revenue per unit (ARPU). This is especially true of resource-constrained mobile service providers.

KEY BENEFITS OF VIDEO TRAFFIC MANAGEMENT:

- **Reduce CapeEX costs**—Optimizing video bandwidth (for example, by matching appropriate resolution to the device) minimizes the need for new CapEx for new traffic.
- **Increase user QoE**—Intelligent congestion management when bandwidth usage is high maintains user QoE and reduces customer churn.
- **Generate new revenue streams**—Identification of video streams and their bitrates opens the door to offering new differentiated and profitable subscriber plans.
- **Increase ARPU**—Granular new data plans drive user QoE and increase ARPU.
- **Adapt to new applications**—A machine learning-powered traffic management solution allows providers to quickly adapt and control new video apps, for example video conferencing.

During the recent COVID-19 pandemic, we saw OTT providers YouTube and Netflix voluntarily throttle back the bandwidth allocated to their content to reduce the strain on the network. Service providers have the tools to manage their video bandwidth usage, but didn't have an impetus to use them until pandemic-related restrictions on recreational activities created an unprecedented demand for streaming video. This highlights the importance of having ready-to-deploy intelligent video traffic management and optimization solutions. This document explores these solutions.

SERVICE PROVIDERS ARE GRAPPLING WITH HUGE AMOUNTS OF VIDEO TRAFFIC

Video already makes up a majority of mobile traffic. Video traffic in mobile networks is forecast to grow by around 30 percent annually through 2025. By then it will account for three-quarters of mobile data traffic, up from 63% in 2019.[1]

Increased intake of video on mobile devices, embedded video, and emerging video formats are driving data consumption. That growth is itself fueled by improvements in viewing technology, like larger, higher resolution screens and the rise of new platforms that support live streaming. Internet video services such as Hulu, Netflix, Facebook, and YouTube, as well as gaming and webcams, are among the most common mobile video applications. Streaming video resolution impacts data traffic consumption. HD video (1080p) consumes about four times as much data traffic volume as standard resolution (480p).

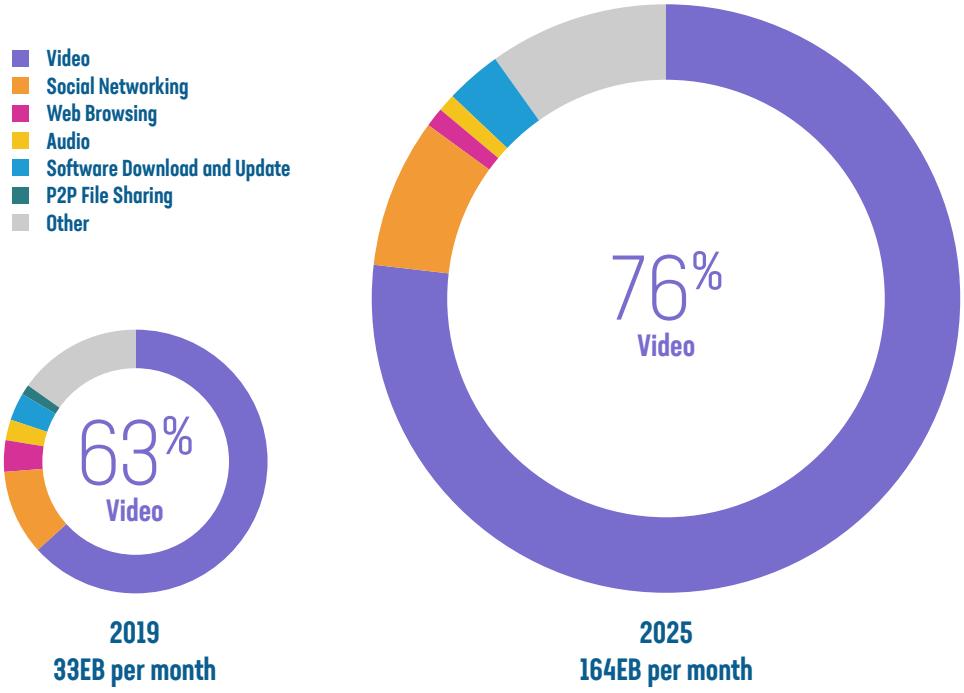


Figure 1: Percentage of mobile traffic consumed by application category per month.[2]

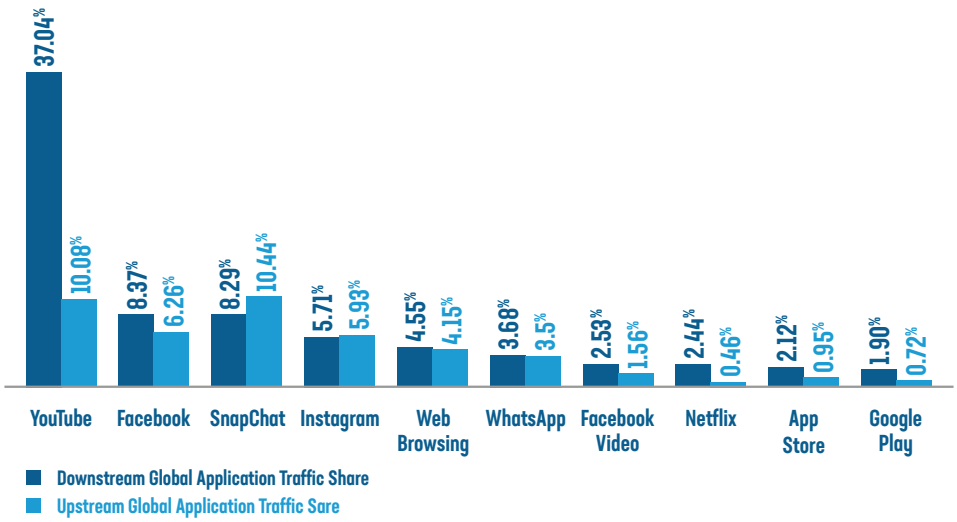


Figure 2: Downstream and upstream global mobile application traffic share.[3]

VIDEO TRAFFIC TRENDS

1. The rise of Adaptive Bit Rate Video streaming

Top video sites like YouTube, Netflix, Hulu, and Facebook have embraced adaptive bit rate (ABR) video technology. ABR video technology enables the client to adaptively select the appropriate bit rate based on current network conditions and device capabilities. ABR formats include Dynamic Adaptive Streaming over HTTP (DASH), which is the MPEG and 3GPP standardized version, and proprietary technologies such as Apple HTTP Live Streaming (HLS) or Microsoft Smooth Streaming (MSS). Today, almost all video traffic is ABR video.

2. The increase in UDP/QUIC traffic

Traditionally, a majority of video traffic has been TCP-based. Hence, most optimization/traffic management methodologies tune themselves to handle TCP traffic. In recent years, there has been an increase in UDP traffic on service provider networks. Google developed the Quick UDP Internet Connections (QUIC) protocol to enhance user experience and overcome some issues TCP faces when handling real time web applications. QUIC supports a set of multiplexed connections between two endpoints over UDP. It was designed in hopes of delivering secure (TLS/SSL), low latency connections with better loss recovery, and improved congestion control mechanisms. YouTube is driving a large part of QUIC-based traffic on mobile networks, which now comprises close to 40% of network traffic. This presents a challenge to service providers, who must ensure that they implement mechanisms to deal with growing UDP traffic.

3. Increase in encrypted traffic

Most video traffic—including content offered by major players like YouTube, Facebook, Netflix, and Snapchat—is now encrypted. The Google Transparency Report[4] shows that the percentage of encrypted web traffic on the Internet was 95% in October 2020. Browser vendors have announced they would never implement an unencrypted version of HTTP2, so HTTP2 is a de-facto encrypted protocol.

THE IMPACT OF THESE TRENDS ON SERVICE PROVIDERS

One of the top concerns for mobile service providers is ensuring that they have the ability to manage, monetize and differentiate their offerings while accommodating ongoing development in video trends and technology. Today, most video that users watch is encrypted ABR video, and it is often UDP based. That video is consuming valuable radio resources for the mobile service provider. The ability to detect and control ABR video traffic is important because it gives the service provider the ability to optimize their network and increase network resource savings while maintaining subscriber quality of experience (QoE) and enabling monetization of new services.

F5 VIDEO SOLUTIONS

F5 has several approaches to video management, as can be seen in figure 3. F5 can support a managed video service that the service provider offers to its customers. F5's video caching solution, based on NGINX Plus, can be incorporated into a Content Delivery network. F5 also offers an ADC solution in the IPTV datacenter. This solution provides ADC and security (for example, SSL offload of the video stream), and protects user authentication.

The remainder of this paper will focus on unmanaged video traffic from the content provider into the service provider network—traffic that flows in through the S/Gi-LAN/N6 interface and out via the limited resources of the access network. This includes over-the-top (OTT) traffic from the top streaming video services.

The diagram below shows how both managed and unmanaged video traffic can be supported by F5 solutions. For unmanaged traffic, F5's primary role is ABR video optimization, though video optimization is just one of a variety of different virtual services that F5 can provide in a single virtual, consolidated S/Gi-LAN (others include DNS caching, resolving, and security, CGNAT, Firewall and DDoS services, and more). The video solution and the consolidated LAN solution are both provided by F5® BIG-IP® Policy Enforcement Manager™ (PEM).

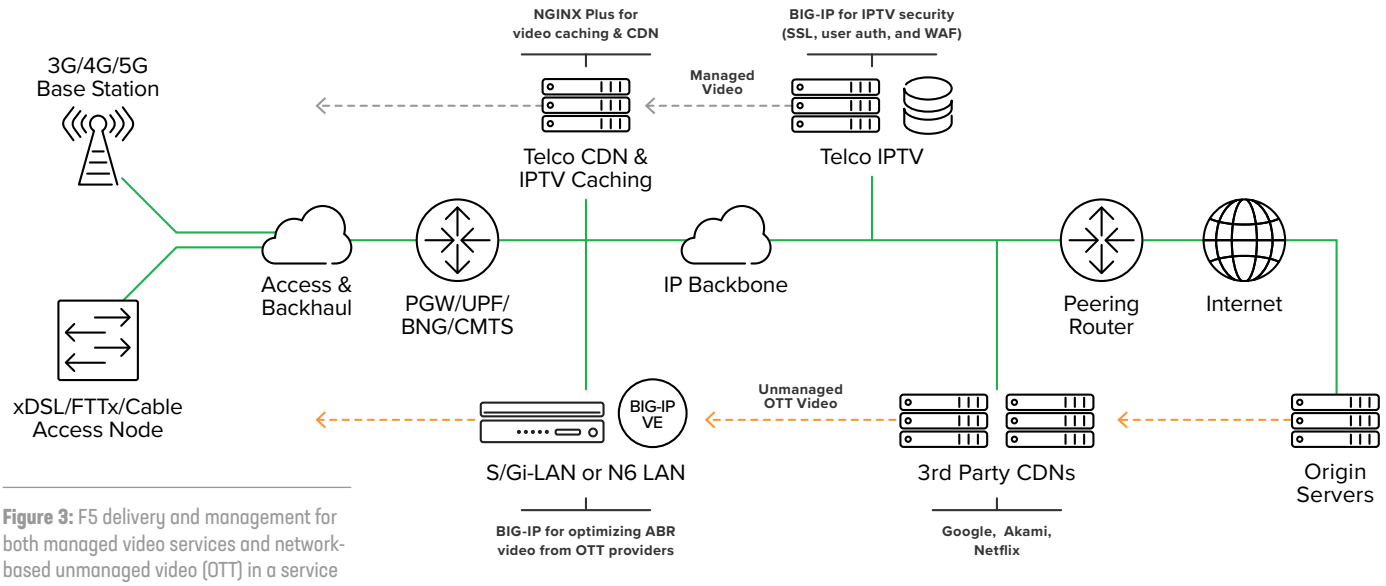


Figure 3: F5 delivery and management for both managed video services and network-based unmanaged video (OTT) in a service provider network.

HOW DOES F5 ABR VIDEO DETECTION AND CONTROL WORK? A RESOLUTION CONTROL USE CASE

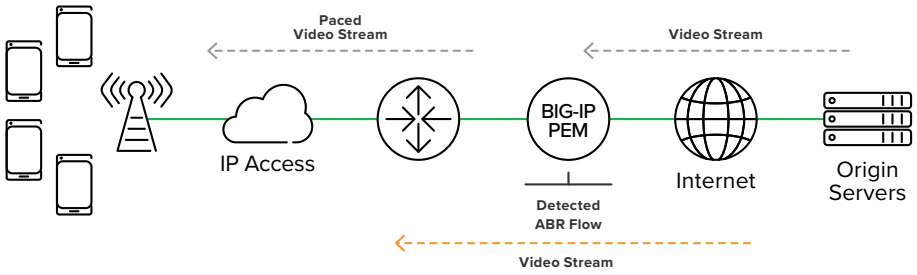
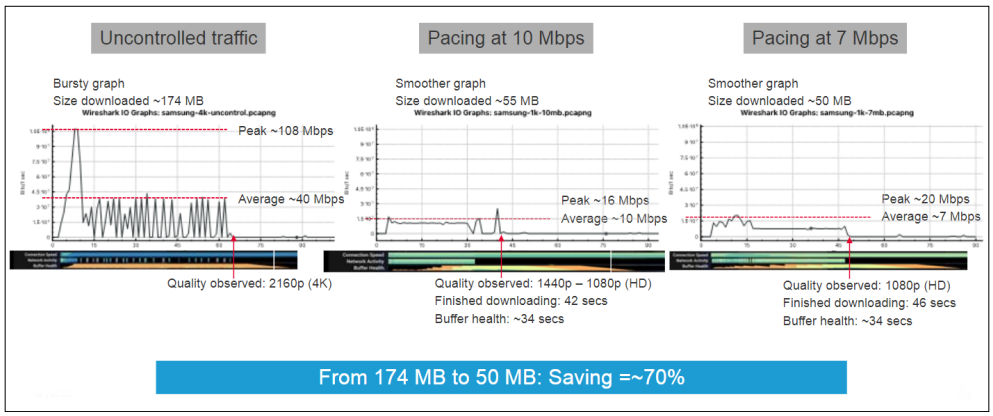


Figure 4: F5 video traffic management improves rate pacing for unmanaged video traffic.

In this use case, the service provider wants to apply a policy that lowers video resolution, as measured by bit rate, for the client. The video stream comes from the origin servers. Typically, it is very bursty. There are several strategies that can be employed to apply rate limiting to the traffic. For TCP traffic, BIG-IP PEM can act as a full proxy. UDP traffic is encrypted; in this case the solution just identifies the flows. The service provider can detect ABR video content, encrypted or not, using a myriad of different criteria (for example, flows from a specific source at a specific resolution, client, or policy) and apply a policy to those ABR flows. For example, all 4k traffic could be reduced to HD 1080p traffic after 6pm, or all 1080p traffic being viewed on a mobile phone could be reduced to SD 480p resolution. The resolution can also be adjusted for the specifications of the device being used, maintaining a good quality of experience on different devices.

In the example below, the use of ABR video detection and control saves 71% of radio bandwidth. The graph on the left shows an uncontrolled 4K stream, averaging 40Mbps with a peak of 108Mbps, consuming 174 MB in all. In the middle graph, pacing is introduced at 10Mbps. In the graph on the right, pacing is introduced at 7Mbps. Here, the peak is 20Mbps, and the average bandwidth is 7Mbps—still sufficient for a full HD stream. The total bandwidth usage in this scenario is 50MB, a savings of 71% compared to 174MB in the uncontrolled scenario.

Figure 5: A comparison of uncontrolled traffic and traffic controlled by the ABR detection and control tools.



MACHINE LEARNING-BASED SIGNATURE DETECTION AND CLASSIFICATION OF ABR VIDEO STREAMS

F5's BIG-IP PEM is able to detect and classify ABR traffic flows, whether they are TCP or UDP (QUIC) traffic, and whether they are encrypted or unencrypted. The service provider can then apply protocol-agnostic bandwidth control to any unmanaged video traffic.

Identifying the types of applications and services—as well as the protocols being used in the network—is key to determining the best way to manage subscribers' bandwidth consumption for optimal network performance. It's also key to developing and monetizing innovative services while monitoring utilization and ensuring optimal network efficiency. This strategic use of data helps to improve the subscriber experience and create a platform for increasing ARPU.

BIG-IP PEM comes with a powerful traffic classification engine that includes a comprehensive application signature database. This classification engine can detect application-based on signatures without having to decrypt encrypted TLS and QUIC traffic. The application signature database module can identify more than 4000 applications.

BIG-IP PEM can:

- Detect and classify all major OTT video content providers, including both ABR and non-ABR video traffic, regardless of encryption.
- Manage classified video traffic through proprietary rate limiting and bandwidth control policies.
- Create and apply granular policies based on a number of characteristics including per subscriber, subscriber group, application, device type, location, and content provider contexts.
- Provide an extensive set of application data statistics, including throughput, latency, packet loss, PPS, resolution, and URL category.

In addition, PEM now utilizes a statistical machine learning-based classification. The machine learning model is fed with large amounts of training data and identifies multiple metadata attributes about each video flow. Based on this purpose-built statistical machine learning algorithm, the model can accurately identify the source, resolution (360p, 480p, 720p, or 1080p), bandwidth, and flow duration of the video flows. Unique to F5, this machine learning technology means that the provider can create a policy for individual streams based on the resolution (for example, limiting all 4k traffic, or all 1080p traffic).

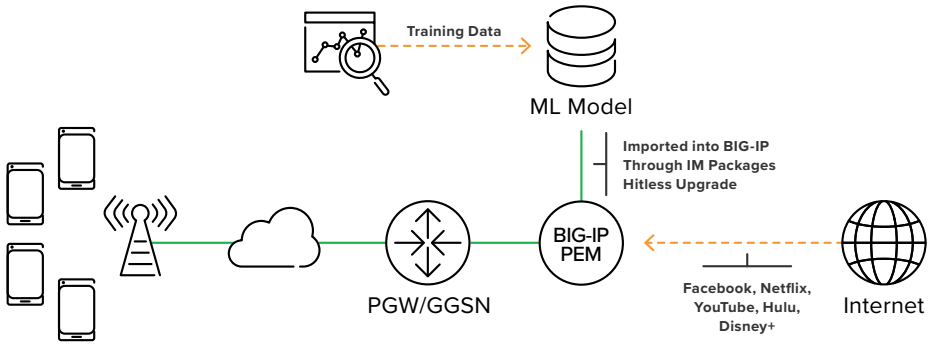


Figure 6: BIG-IP PEM's video traffic detection and classification uses a unique machine learning-based model.

As the number of apps and services being used in the network grows, BIG-IP PEM's signature libraries are updated based on subscribers' usage patterns to ensure that protocol classifications and subscriber plans are accurate. BIG-IP PEM supports dynamic and hitless signature upgrades, so service providers can seamlessly receive new signatures for both new and existing applications without having to perform a software release upgrade. BIG-IP PEM also has the capacity to classify traffic based on behavior and heuristics analysis and deep packet inspection.

CREATE DIFFERENTIATED SERVICES BY LEVERAGING SUBSCRIBER AND APPLICATION AWARENESS

BIG-IP PEM performs subscriber discovery via RADIUS and DHCP, and provides information such as IP address, IMSI, and username. When correlated with application flows, this information allows for deeper understanding of the type of applications and services subscribers are using and how they are being used. In addition, BIG-IP PEM can retrieve info on radio access technology (RAT) type via RADIUS messages, allowing service providers to apply different policies based on subscriber use. This means that the service provider can detect specific subscribers and traffic types and apply a bandwidth control policy on a case-by-case basis.

With this subscriber and application awareness, time-based, per subscriber, application, and device type policies can be created allowing use case-driven bandwidth policies that improve QoE. For example, during the COVID-19 pandemic, many enterprise users have moved from using their corporate network to working from home using their everyday consumer network. A provider might offer a high-performance enterprise service that excludes Netflix or Hulu traffic and prioritizes Zoom traffic. Or providers could use video controls to manage congestion during the midmorning peak in network traffic.

Bandwidth management policies can also be used to create performance tiers, offering service providers a monetization opportunity: a gold plan subscriber could enjoy a video stream at 5 Mbps (suitable for 1080p resolution), while a silver plan subscriber is only able to stream up to 3 Mbps (suitable for 480p resolution). The policy could also manage heavy video usership—restricting HD at certain times or after a certain amount of content is downloaded. And, critically, bandwidth can be reduced while still meeting the throughput and quality requirement for a particular device, like SD (480p resolution) for a mobile phone.

EXPORT OF STATISTICS

BIG-IP PEM also provides service providers with better visibility into their data. Providers can export an extensive set of application data statistics, such as the source, resolution, bandwidth, and duration of video flows. These can be exported into a wide range of commercially available and open source analytics tools. For the most widely used analytics tools, this data is automatically formatted to the correct specifications, simplifying the export process.

SUMMARY

Proactive management of video bandwidth in your network can provide significant network resource savings—especially premium RAN resources—while maintaining and improving a quality user experience. Combining multiple tools, such as TCP optimization, ABR video detection and control, and subscriber awareness provides flexibility. Managing bandwidth and maximizing traffic throughput allows service providers to manage continued growth in video traffic These strategies can help you deliver increased performance, lower your TCO, and improve your subscriber QoE and ARPU.

To learn more, contact your F5 representative.

[1] Ericsson Mobility Report, (June 2020), page 18

[2] Ericsson Mobility Report, (June 2020), page 18

[3] The Sandvine Mobile Internet Phenomena Report, (February 2019), page 6

[4] Google Transparency Report, (retrieved October 2020)