The view's great with U-vMOS

Huawei's U-vMOS video experience standard enables operators to assess and optimize video services so they can build carrier networks that give users the best experience.

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In a survey by Conviva, 35 percent of users ranked video viewing experience as the top factor when choosing a streaming video service, above even content. Moreover, 84 percent stated they give up on videos in less than a minute if the quality deteriorates.

Video quality is something operators didn't focus on in the past because they regarded the video source and carrier network as separate, with faults possible at any point on the network, from the video server to the user's terminal. Rapid fault demarcation and troubleshooting were incredibly difficult.

Enter U-vMOS

When developing the Unified Video Mean Opinion Score (U-vMOS) standard for video experience, Huawei considered a huge quantity of user research. The result was a series of engineering tests based on a modified and improved version of the ITU-D's existing vMOS standard.

An objective measurement, U-vMOS considers three things: video quality, viewing experience, and interactive experience. Rated on a 1 to 5 scale, sub-categories include video definition, quantity of video sources, screen size, usage experience, and streaming smoothness.

Analysis by Huawei iLAB on 4K video viewing experience shows that quality drops considerably when bandwidth falls below a certain threshold or when latency and packet loss exceed certain levels.

Better networks with U-vMOS

U-vMOS collects real-time network indicators and corresponding U-vMOS scores. It uses big data analysis to determine the key network indicators that affect video experience, and outputs recommendations for network optimization and O&M.

The minimum key network

indicators for an optimal 4K video experience are 100 Mbps bandwidth, 30 ms latency, and 0.002 percent packet loss. These indicators correspond to a U-vMOS score of 4, a "good" experience, which requires operators to ensure E2E bandwidth of at least 100 Mbps.

Operators have historically deployed multi-layer aggregation to avoid buying more network ports when user numbers grow. However, as network traffic models have changed due to the rise of video, more operators are flattening network layers and reducing the concentration ratio from 10:1 to 2:1. The reason is that multi-layer aggregation networks cannot multiplex the bandwidth, and the cost of expanding network capacity is high. This kind of network architecture is set to become mainstream in the future.

Operators' video services will go through three stages of development, with each characterized by particular service features, experience guarantees, and challenges that need specific approaches:

Stage 1: (4K) video services emerge. With few users, the main concern of operators is ensuring E2E traffic throughput for single users and that bandwidth access capability can support video services.

Operators should implement Fiber-to-the-Home (FTTH) to increase access rates to between 100 Mbps and 1 Gbps. If that’s not possible, they should consider Vectoring or G.fast to increase copper rates to fiber-equivalent levels. Replacing copper with fiber or shortening the distance of the copper line to the home reduces latency and packet loss.

Other techniques can improve experience, like deploying TCP accelerators to increase TCP throughput and improving the TCP-based VoD experience. Tests show that TCP acceleration is highly effective against random packet loss due to poor copper line quality, guaranteeing a TCP throughput of 80 percent bandwidth under conditions where latency is less than 100 ms and packet loss is below 10^-3.

To resolve issues with Broadcast TV (BTV) and User Datagram Protocol (UDP) VoD experience, FCC/RET should be deployed on the IPTV platform.

Stage 2: rapid user growth. The growth of video users in key regions can lead to excessive local network loads, so operators must focus on optimizing the user access network and reducing network congestion caused by high user concurrency. Reducing the optical line terminal (OLT) split ratio on the access segment is necessary to build Passive Optical Networks (PON) with zero congestion that support single-channel 4K streaming video for concurrent users on GPON and EPON. This configuration can be upgraded in the future to support single household multiplex 4K video streaming on 10G PON.

In metropolitan area networks (MAN), operators need to plan bandwidth in accordance with peak concurrent user numbers. For network planning, a concurrency rate of 20 percent is recommended; that is, a concentration ratio of less than 5:1.

More users cause the central Content Delivery Network (CDN) loads and backbone traffic to increase. CDNs should be moved down to reduce pressure on MANs and backbone networks.

Stage 3: mass number of active users. MAN users in this stage hit 1 million, with massive variations in maximum concurrency in different regions and at different times. If capacity planning for the entire network is based on a unified average concurrency rate, congestion is very likely in some regions at certain times, leading to lower U-vMOS. At the same time, CDNs and network capacity in other regions will be lightly loaded. Conversely, setting network capacity according to a maximum concurrency rate will lead to low average network utilization.

In the third stage, operators need to focus on high burst traffic and precise operations. Establishing a collection system that regularly collects data on network loads and quality can provide big data for video service platforms and network synergy. When a user plays a video, the CDN can assign the optimal server, and the network controller can determine the network path.

Better home networks with U-vMOS

According to video O&M departments, home networks cause over 60 percent of user complaints. Most home Wi-Fi equipment currently delivers a maximum bandwidth of 50 Mbps against a backdrop of unstable or weak signals, interference, and multiple walls. Upgrades are needed in three areas: coverage, bandwidth and network quality.

Coverage: Coverage needs to be improved so that users can receive connection speeds of 100 Mbps and above on multiple terminals from anywhere in the home. This requires multiple Wi-Fi APs distributed throughout the home rather than a single router.

Bandwidth: 4K experiences need at least 100 Mbps bandwidth, but the vast majority of homes use 802.11n Wi-Fi routers that deliver speeds of less than 50 Mbps. The newer 802.11ac standard offers a throughput of 1 Gbps and above, and future-proofs home networks so they can support other services requiring high bandwidth.

Wi-Fi signal interference: The G.hn Power Line Communications (PLC) solution use selectrical wiring to carry data across different rooms to reduce interference between APs. One AP will be deployed per room, and each will be set with different frequencies to reduce interference.

Video O&M

The rise of streaming video services has created new challenges for O&M systems. In addition to managing connectivity and traffic, they now need to handle E2E video and rapidly deal with faults.

Traditional O&M tools lack information about service flow paths, preventing operators from detecting quality changes in real time. However, U-vMOS-based O&M systems focus on video experience, and can extend all the way to the user's home terminal to capture service data in real time so operators can deal with faults.

These O&M systems need to sense and manage data originating from every point on the network to gather real-time U-vMOS indicator metrics. Through big data analysis, E2E experience can be predicted, and the network dynamically optimized. In the traditional O&M model, problems are fixed after they're found. But, in the new model, they're anticipated and eliminated in advance. When they do occur, they're dealt with quickly. Real-time O&M systems involve the following processes:

Real-time U-vMOS video experience detection: analyzes video flow in real time using quality-sensing network equipment or U-vMOS sensor modules at the user end, and issues U-vMOS warnings when video indicators deteriorate. This allows operators to be proactive with O&M rather than relying totally on user complaints to detect faults.

Real-time video service path tracking: uses probes to monitor service flow information and restore single service paths in real time based on the combined analysis of service flow and network information.

Real time video fault demarcation: analyzes all links in the network with real-time service path tracking to demarcate faults in real time.

Closed-loop fault handling: resolves non-physical line connection issues with a real-time trouble shooting system, and predicts network-wide changes to U-vMOS indicators based on the O&M system's analysis of individual faults.

Video will become the major medium for a wide range of Internet services and will account for the highest use of network traffic. For operators, a good user experience is the key to success. The U-vMOS video experience standard measures and optimizes video services, and is useful for all players in the video industry. Operators, for example, can use U-vMOS to assess and optimize video services so they can build optimal carrier networks. U-vMOS is a must for the video industry to develop.