

Meeting the Challenge

Delivering Optimal Video on Demand Services

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Today's telecommunications service providers and cable MSOs are currently in a heated race to deploy next-generation services over their existing IP-based networks, and in essence offer a bundle of multiple, converged services to subscribers. This so-called "triple play" service bundle includes broadband Internet access and voice and video services over IP, and is a critical strategic weapon in the telcos' service arsenal.

Indeed, a converged "triple-play" network build-out represents a new business paradigm and a new operational strategy that is now required in order for telcos to stay relevant in today's highly competitive marketplace.

The key value add in the telcos' triple-play offerings are new, revolutionary video-based interactive services, including broadcast IPTV and IP-based Video on Demand (VOD).

These services promise to generate critically important new revenue streams necessary to offset the inexorable decline in their voice businesses, and help them gain market share by enticing customers to switch from competing satellite and cable offerings.

The VoD Opportunity

Video on Demand (VoD) especially is poised to become one of the most important video services offered over a converged IP network. Basic IP-based VoD service offers consumers a highly interactive, customized "anytime" video experience by enabling users to request live and pre-recorded video content from a network-based library of content (such as new DVD movie releases) and allows them to watch this content immediately or during a set interval of time (usually within 24 hours). Additionally, users are able to interact with the video at will by performing DVR-like functions, and it's possible to pause/resume, fast-forward or rewind or jump between "chapters" (depending on the content being delivered).

Looking forward, Video on Demand is perhaps the most critical and most promising elements of the Triple Play service bundle, and can lead to an array of new, revenue-producing services for providers such as the marketing and selling of DVDs and customized video content, as well as a host of new interactive marketing services and applications that take advantage of the tight integration of triple play services.

For example, it will be possible to integrate VoIP and video telephony within the video services framework and allow users to access personal directories and make and take calls using their remote controls, and provide the means for subscribers to respond to video-based special offers and product/service discount “coupons” – all from the living room couch.

Business and Technical Challenges

The road to a successful VoD deployment is rarely smooth and straightforward, however, as there are multiple technical and business challenges associated with delivering a successful VoD service. Content acquisition, for one, is a critically important business challenge in that providers must form relationships with the right video content partners and license high quality “in demand” content that will allow them to build a wide and deep catalog of content – and ultimately a loyal customer base.

Other major technical challenges involve ensuring that the customer’s quality of experience with the service is as optimal as possible, and that the switch from cable or satellite service is completely transparent. Specifically, providers must make sure that customer expectations are met in terms of switching from “zero delay” standard TV to IPTV, and therefore they must deliver fast channel change times and effectively manage network bandwidth efficiently. Providers must also ensure that the quality of the video delivered to the customer premise is as good as or better than what is currently available in the marketplace.

The reality is that VoD video traffic can be highly unpredictable, and scalability and network congestion issues can create service impairments that can quickly undermine a provider’s deployment.

Key Deployment Issues and Test Considerations

In order for a service provider to deliver the optimal quality of experience that’s essential for a successful deployment, there are a number of key deployment issues and considerations that must be taken into account. Each of these issues has the potential to impact the amount of network bandwidth that is available on the network or the ability of the network to scale appropriately in order to meet the demands of subscribers.

Supporting Multiple HDTVs in the Home. A typical American household has three or more TVs – more than in most parts of the world. And as the market transition to high definition display technology enters full swing, it will be only a matter of time when all standard definition sets are replaced by some type of HDTV. These facts have a direct implication on network bandwidth considerations.

Consider a common example of such a household, with the kids watching an on-demand Cartoon Network special, dad watching MSNBC, and mom watching a bunch of soap operas via VoD that she'd missed during the work week – all on different TVs in different rooms of the house. Since each TV is tuned into a different video “channel”, the provider must be assured that it provides the right amount of bandwidth in order to support the delivery of all the requested video streams.

Indeed, this takes on special significance when each person is viewing high definition content: With today's current IPTV network architectures, 1080p high definition video quality translates into approximately 18-20 Mb of bandwidth consumed per each high definition channel received. Multiply this by three (or more), and that's around 80-100 Mbps of bandwidth that is required to provide video service to our typical household – a service that is currently unavailable in most parts of the country.

Other issues include taking into account potential interactions between all the TVs in the household. Since each TV is viewing different content, not only does the provider need to be assured that it has the right amount of bandwidth available to provide sharp, clear video and fast channel change times, it needs to ensure that user interactions with their TVs don't have a negative impact on the other TVs in use.

New Coding and Connection Mechanisms. As current network speeds are not yet sufficient, today's triple play networks need to be optimized in order to support these new video services. A new breed of more efficient media encoding and connection methods – such as MPEG 4 – helps to reduce the need for bandwidth. Such encoding mechanisms need to be accurately tested in pre and post deployment.

Unicast vs. Multicast Services. The reality is that the load on a network will be many times that with VoD (unicast) than with broadcast IPTV (multicast) services, and service providers must take this into account. Consider that in large urban environments, it will be increasingly common for large groups of people in large residential buildings to purchase the same VoD content, and this will have a direct impact on the amount of bandwidth that is available.

In addition, service providers must correlate the interaction of VoD with multicast services as they work in the network, and not just test them individually. Obviously, both types of services need to coexist on the network, and testing the interoperation of both services in a realistic environment is essential for gaining a real-world assessment of performance.

Testing VoD Interactive Services. A compelling argument for the success of IP-based VoD is the power and ease of use of the service. Users can preview channels, make context sensitive searches within the catalog of video content, etc. In fact, there are multiple other technologies that work with the VoD service, and include the end users' interaction with the system. Therefore, it is

very important to test the performance of the network-based catalog of videos that are available, and other interactive features.

Troubleshooting Network Prioritization Mechanisms. In an IP-based triple-play network, even if enough bandwidth is available to effectively support services, there is still a need to ensure that priorities are applied correctly to the type of traffic occurring on the network. Authentication, authorization, and packet inspection systems are used to perform this function, and if video payloads are encrypted, there is risk that video could get treated as data and not video content. If a provider prioritizes video content over data packets (which is usually the case since video traffic is highly delay sensitive and requires such special treatment), such cases of mistaken identity could result in the video getting blocked or corrupted in the delivery network since the special treatment required wouldn't occur.

The Impact of Peer to Peer (P2P) Traffic. Today, P2P traffic is the single largest threat to service provider SLAs. Because VoD and IPTV services ride on an existing IP network that is used for both voice and Internet data traffic, there is the need to manage the load from P2P traffic. In fact, a lot of P2P traffic – such as Skype and BitTorrent and myriad file sharing services – operates in a sort of stealth mode, using non-standard ports and non-standard services. This traffic adds additional load on the network, and to make matters worse, any detection equipment in use to identify P2P traffic may also add delay into the network, adversely impacting video.

The Impact of Other Concurrent Services. Likewise, there are a host of other applications and services that may be running concurrently on the network, and each can take its toll in terms of bandwidth consumed and load on the network. Such services include online gaming, telecommuting, interactive advertising and transaction services, VPN connections, and even Web-based streaming video from the likes of youtube.com and joost.com.

Developing a Holistic VoD Testing Methodology

In order to mitigate these challenges, service providers need to invest in specialized triple play test equipment and develop holistic testing techniques that will allow them to assess the performance of their network designs with every new tweak. In short, they need to perform ongoing testing while they are fine tuning during both pre and post deployment phases.

The VoD components that require testing include content acquisition systems; content encoding systems; VoD media servers; network switching and routing platforms; packet inspection systems; and customer premise equipment, such as set top boxes.

Some of the key requirements for testing VoD infrastructure include:

(1) Measuring the performance of an IPTV deployment.

- (2) Determining the availability of the network to carry the video data.
- (3) Measure the impact of network characteristics on video quality.
- (4) Measuring the impact of middleware devices – encoders, digital media rights management systems, billing systems, add insertion devices, and conditional access systems – on network performance, and,
- (5) Assessing the perceived quality of the video content.

Testing must also determine the number of active video clients that a VoD server can handle, whereby the maximum client capacity of a server is the threshold – at which the server can no longer support any additional clients without degradation of quality in the video media streams.

The video server components must be able to support sudden increases in bandwidth and resource utilization. With a sudden increase of bursty traffic (many on-demand requests from subscribers), the rate of arrival of requests for new content may overwhelm the VoD system. Therefore, tests must measure the ratio of successful video streams delivered over the total number of requests received. This is important for modeling the scalability of a given VoD system so that providers know how to invest in the appropriate infrastructure in order to keep up with the project growth of on-demand content.

In addition, the testing of the network performance of a video server must characterize latency experienced by clients, jitter introduced on the video streams and losses due to oversubscription of resources. Characterizing how well the VoD servers deliver video is important because service providers need this information to ensure they can scale to match the projected user demand.

In addition to video servers, video cache devices which replicate frequently accessed content by several thousand users must go through a similar network performance characterization.

Finally, throughout the individual component testing that is performed, the goal is to ensure that the video delivered into the service provider's network is of the best possible quality. Therefore an overall requirement is to know the experience of users in watching the VoD content. This includes the effects of the network on the video stream, and also determining a user's perceived quality of experience based on subjective video analysis.

Meeting the VoD QoE Challenge

The challenge for today's service providers is to ensure that their VoD service is comparable, if not superior to what their new subscribers have been accustomed to. On the business side, they must determine how they can offer the best content and have their customers pay the least for it.

They also need to make sure the offer is more compelling than the experience of playing a DVD, and to ensure that the experience they offer for the first time is compelling enough that they do not turn away the early adopters. Indeed, once a customer turns away, it will be an extremely tough – if not impossible – sell.

In order to ensure a successful VoD deployment, it is critical that telcos understand that the VoD service is not a separate function from their existing IP network infrastructure. In order to validate the quality of the service offer, pre- and post deployment testing is an essential undertaking that involves not only testing specific, individual network components but also testing VoD service from a systematic, holistic point of view.

Ultimately, telcos need to test their VoD deployments according to what happens in the field during real-world scenarios, where they are able to correlate tests of the various services and applications running on their triple-play networks as they relate to real-world network dynamics. It is simply not enough for a provider to perform video tests based on the load created by a million users – it is essential that they test these users while other subscribers are making voice calls and downloading music files – in essence during real-world traffic conditions.

Finally, telcos need to ensure that an adequate degree of scalability exists in their test network in order to ensure that their new triple play network can scale for the foreseeable future.