PUSH FOR MORE MONEY: REASSESSING THE BANDWIDTH CONSUMPTION MODEL FOR HIGH SPEED DATA

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Abstract

Streaming can provide an acceptable viewing experience for broadband video depending on the monitor size, subject matter, and bandwidth allocated to the stream. Typically, the bandwidth allocated for streaming video is insufficient to rival broadcast television and certainly will be of less than DVD-quality. In addition, for video and other on-line entertainment content, buffering and interruptions can occur during peak periods, degrading the consumer experience. It is beneficial to both the consumer and the cable operator to adopt a more efficient delivery model for the most commonly requested types of content. The current unicast model allocates bandwidth per subscriber, thus resulting in higher distribution costs and decreasing image quality. Content that is delivered via IP Multicast with secure caching combines broadcast efficiency with a substantially improved consumer experience.

Overview:

Streaming has been the prevalent mechanism that is used for broadband video delivery. Streaming is an appropriate technology for providing content that has low common usage among the subscribers on a particular system. For example, if someone living in New Orleans wants to watch some video highlights of a regatta held in Boston, this content will have a low common usage and is therefore well suited to streaming distribution. Conversely, video coverage of an NCAA Final Four game, distributed in Raleigh, NC, would have a high common usage level. Therefore IP Multicast, a one: many delivery mechanism, would be a more suitable distribution method. Moreover, it would be possible to offer a longer, higher quality video than is typically available via streaming.

The ideal distribution model for this kind of video combines IP Multicast with caching content on a local storage device. This method allows viewers to watch higher quality, longer video segments on demand, without requiring the cable operator to repeatedly carousel broadcasts of the video for subscribers who were not online during the previous delivery of the video segment.

In terms of quality, streaming can provide an acceptable quality signal, sometimes even capable of delivering a reasonable full-screen experience, depending on the monitor size, subject matter, and bandwidth allocated to the stream. We can expect that some continued improvements in codecs and compression algorithms will occur.

However, streaming video is not often considered to be any more than an adequate viewing experience when compared with higher bandwidth, higher resolution video that viewers experience from broadcast and from stored media. Higher bandwidth and/or Quality of Service (QoS) devoted to a single stream improves the image quality of that stream, but this increases costs and reduces the bandwidth available to other streams.

The willingness of subscribers to pay a fee for on-demand content will increase if the provider improves the quality of the viewing experience, eliminating buffering delays and interruption.

Storage or Caching:

In any discussion of caching, the question of storage space is always a primary consideration. In fact, available home storage space is rapidly becoming an underutilized, cost-free “asset” for the bandwidth provider. The cost of storage has continued to fall, and the amount of storage in the home has grown rapidly.

Hard drive storage is now doubling approximately every 9-12 months such that 60 GB hard drives are now found on PCs that cost under $900. In fewer than 5 years, terabyte (1,000 GB) drives will become available on consumer PCs.

In fact, not only is hard drive capacity increasing rapidly but portable media storage is increasing at an even greater pace. It was not so long ago that the only portable storage medium most consumers had access to was a 1.44 MB Floppy Drive.

Now, R/W CD drives are common in new desktop PCs and DVD drives that allow consumers to write DVDs are available. DVD drive manufacturers already have prototypes available of 50 GB capacity R/W DVDs. The drives that write these DVDs that use different wavelength lasers from those used in current DVD drives. This means that a chassis that currently holds 10-20 DVDs could be adapted, with these new DVD technologies, to store 5 – 10 terabytes of content.

Before long, the amount of storage available to the average consumer will dwarf the bandwidth available to place content on these storage devices. The efficient delivery of content to both fixed and portable storage devices will become essential.

Broadband Content Delivery Landscape:

Today third party providers delivering content over the broadband connection to cable modem subscribers are limited by the fact that only unicast delivery mechanisms are available to them. This forces these third party content delivery companies to rely on: (1) Streaming and (2) Downloading of large compressed files (e.g. movies).

Streaming takes advantage of the bandwidth of the broadband connection. Downloading takes advantage of both the speed of the broadband connection and the increasingly large amounts of storage becoming available to consumers.

The relationship between cable operators and the business model(s) of these third party content providers depends on three critical factors. First, consumers using these services use proportionately more of the available bandwidth on a system than other subscribers. Watching streamed content or downloading large files such as a compressed movie is much more bandwidth-intensive than simply viewing Web pages. Second, third party content providers are competitive, in many cases, with the cable operator’s core video business. Third, these new services typically generate no revenue for the cable operator but directly increase operating costs.

As High Speed Data (HSD) penetration grows and third party video, music, and games distributors proliferate, they will capture increasing attention from consumers and use increasing amounts of bandwidth. The increasing storage available to consumers will only increase the opportunities available to these third party providers.

Detailed Discussion:

Streaming video at 400-500 kb/s will normally not be perceived as comparable to television quality. Further, the buffering delays of streaming are not only an unwelcome aspect of the experience but also an inhibitor to use and, more importantly, to monetization. Finally, and most importantly, the use of unicast streaming is an inefficient use of bandwidth that does not scale well as demand grows.

Consider a node size of 600 homes with HSD penetration of 20 percent. If, during primetime, half of those HSD subscribers view streaming video, that 50% of subscribers will demand virtually all of the available downstream bandwidth of a 6 MHz channel, using 256 QAM modulation. This is clearly an inefficient usage of bandwidth. This inefficiency is especially apparent when many of these subscribers are either viewing the same streaming event or accessing a few streaming events of predominant interest.

The alternative to unicast streaming is IP Multicast. IP Multicast allows the delivery of content in a broadcast, one-to-many format. The operator now has a rational justification for delivering a higher resolution signal (i.e., using higher bandwidth) to deliver high demand content. However, since IP Multicast is a "push" delivery, the user must be ready to view the video when it is sent or (1) it will have to be sent repeatedly, or (2) it will have to be stored. The problem with sending content multiple times is obvious: the more times a stream is sent the less advantage it offers compared to multiple on-demand streams.

The storing (caching) and time-shifting of a single IP Multicast stream allows the capture of one IP Multicast delivery by all interested subscribers, with time-shifted viewing at the consumer's discretion. However, capture or caching of content requires more robust methods of copy protection to prevent unauthorized secondary distribution.

A comparison of the streaming, IP Multicast, and IP Multicast with caching as broadband delivery options is shown in Table 1.

Streaming	IP Multicast	IP Multicast with Caching
Low/Medium Quality Video	High Quality Video	High Quality Video
Significant Latency Issues	Low Latency Issues	Low Latency Issues
High Bandwidth Application	Medium/High Bandwidth Application	Low Bandwidth Application
Low Content Protection Requirements	Medium Content Protection Requirements	High Content Protection Requirements

Table 1. A Comparison of Distribution Mechanisms for Broadband Content

The quality of the experience, convenience and cost of the delivery of broadband video via IP Multicast to a local cache is superior both to streaming and real-time IP Multicast (essentially one to many streaming).

Further, by delivering such a service, the cable operator is creating a new variable revenue stream for consumers who would otherwise look to third party providers for music, video, and games consumed on the PC.

By using IP Multicast with caching, the cable operator not only provides a superior consumer experience as compared to third party providers, but also realizes the most efficient model for bandwidth usage. Content is delivered once to every customer who is interested in that content.

The only additional requirement for the use of broadband IP Multicast with caching is the need to provide an adequate content protection mechanism that must be more robust than current minimalist solutions used on the PC. This raises two considerations:

Firstly, the content must be locked in a secured space prior to consumption. Secondly, the content is of a higher resolution than streamed content, which means that protecting it after consumption is a higher priority.

The first issue can be readily resolved by dedicating a portion of the subscriber's PC's hard drive for storing the content. This cache functions as a secure content server, conveniently located on the subscriber's home PC.

The cache must be enabled with strong security mechanisms, such as key storage in a protected hardware device to prevent unauthorized unlocking (access) of content, and a distinct real-time clock (not the PC's clock) that the cannot be tampered with, which reliably measures (meters) the withdrawal of content from the cached according to permitted usage models.

In fact, to secure high value cached content a platform that provides for conditional access (CA) as well as "hardened" digital rights management (DRM) is ideal. The platform should utilize strong encryption and authentication, a true (non-deterministic) random number generator, and secured memory spaces to load applications that allow CA and DRM to be run securely on the subscriber's PC.

Summary:

Streaming is the best choice for low-commonality demand content; the optimal delivery method for high value, high demand content is IP Multicast to a secure cache.

IP Multicast with secure caching combines the best attributes of content-on-demand and bandwidth efficiency and allows cable operators to deliver a higher quality service to consumers than third parties competitors employing unicast delivery mechanisms.

A hardware security platform, with adequate content security mechanisms, provides the key to launching an IP Multicast with secure caching in the cable broadband network.

References:

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