Case Study

Consumer Electronics

EdgeStream* Software Enables Broadcast Quality Streaming VoD to Reach a Global Audience

Summary

While the growth in DSL broadband penetration creates significant new service and revenue opportunities for broadband operators, consumers expect video quality that is comparable to broadcast TV, cable and satellite.

When the public Internet is used for the transmission of IP-TV and streaming video, network congestion and latency can occur at any time, which can significantly impact quality of service (QoS).

The EdgeStream* software suite provides a highly reliable and scalable platform that enables full screen DVD-quality video on demand/streaming over the public Internet, enabling operators to develop new sources of revenue while keeping capital costs and operating expenses down.

According to Edgestream, operators adopting the EdgeStream Platform can provide broadcast quality delivery with the convenience of true video on demand services to audiences/subscribers anywhere in the world.

Edgestream says that best results are achieved when the quality of streaming video measured is as close to the TV display as possible. Intel® Architecture-based IP-digital set top box platforms provide the processing power that enables EdgeStream's client software to perform optimum quality measurements and take appropriate actions to maintain error free high quality streaming. EdgeStream has ported its client software to an IP-digital set-top box based on the Intel® 815 Chipset IP-Digital Set Top Box Reference Design.

To help accelerate adoption of IPTV applications over the public Internet, EdgeStream is licensing its client software without charge to STB and PC manufacturers.

With worldwide broadband deployment topping 100 million subscribers in 2004 and the number of users projected to reach nearly 300 million by the beginning of 2005,[1] the delivery of IP-TV and streaming video on demand (VoD) provides broadband operators with significant opportunities for new revenue. According to research sponsored by the DSL Forum, DSL reached 78 million subscribers in 2004, and was growing at twice the rate of other broadband technologies.[2]

IP-TV and VoD have attracted the attention of broadband operators and content owners who seek new global distribution channels for potentially high-revenue services. The quality of the consumer's viewing experience will be one of the critical determinants of consumer acceptance during the introduction of these new IP-based video services.

To date, the use of the public Internet to transmit live TV streams and real-time VoD has proved very challenging for operators. This is because network latency and congestion issues can critically affect video quality, and these conditions may arise at any time. Traditional solutions, including the addition of more servers at the edge of the network, can impose significant capital and operating expenses.

According to EdgeStream, its Internet Congestion Breakthrough Technology (ICBT)* enables media files to be streamed over the public Internet at bit rates of up to 2 Mbps or higher, error free to broadband enabled clients from relatively few centralized servers.

"Consumers will not pay to watch video of substandard quality. EdgeStream* technology provides access to true video on demand over IP broadband with quality of service similar to cable or satellite."

Rajeev Sehgal
Chief Business Development Officer
EdgeStream*

Network Latency and Congestion

As its name implies, the Internet is comprised of multiple interconnected networks. The need to transmit data from network-to-network through multiple "hops," coupled with dramatic variations in daily traffic volume, can result in network latency and congestion. These service impairments can arise at any time, and last from a few minutes to as long as several hours, affecting traffic carried over the dozen or so major Internet backbones at scattered locations.

Network latency is defined as the time delay required for a packet of data to move on the network, in this case the round-trip interval that begins when a request packet is sent and ends when a response packet is received. Latency is increased by delays caused by packet transmission through network equipment.

Network congestion occurs when the capacity of a network link is exceeded. It often occurs during peak traffic periods at points where data is passed from one network to another. Congestion can also be caused by equipment downtime or network routing difficulties. Congestion is a leading cause of higher latency and packet loss.

Broadcast-quality IP video streaming demands continuous monitoring and updating of network capacity. Conventional approaches to network capacity issues include:

- Updating network capacity based on short-term peak load requirements
- Adding more servers to the edge of the network, located as close as possible to users
- Maintaining peering arrangements with other networks in as many metro areas as possible

All of these approaches are very expensive for network operators, and continually adding additional edge servers and increasing peering capacity are no guarantees for effective universal coverage.

EdgeStream ICBT

EdgeStream's ICBT is a proprietary technology for improving high-speed, error-free video delivery, based on familiar HTTP and TCP/IP protocols. These protocols support error-free streaming, because the underlying TCP protocol is designed to respond to errors by retransmitting missing or erroneous data until the data is correctly received. HTTP actually uses the TCP protocol to transmit data, so the transmission speed is governed by how quickly TCP delivers data. According to EdgeStream, ICBT enables error-free video to be delivered at bit rates up to five times faster than conventional TCP-based techniques, even when the network path is impacted by high latency and packet loss.

For example, on a congested path with 1 percent packet loss and 160 milliseconds of round trip latency, conventional delivery slows down to about 500 Kbps, while EdgeStream delivery can maintain delivery in excess of 3000 Kbps.[3]

Using the ICBT proprietary algorithms, original media files are processed and stored in such a way that allows smooth transmittal of data over the high latency networks. This processing to tolerate high latencies allows EdgeStream's system to deliver streaming media over much longer distances to a global audience, permitting optimum utilization of the server system. This also allows operators to locate and maintain their data/server centers in the least expensive locations.

In addition, because the EdgeStream solution is designed to mitigate the effects of latency, it eliminates the need for operators to pay for special peering arrangements or additional edge servers in the effort to lower latency for all users.

Instead, network operators can provide high speed video delivery to a global customer base from just a few centralized server sites, enabling what EdgeStream calls "Video on Demand Without Boundaries."

Continuous Route Optimization Software

EdgeStream's proprietary Continuous Route Optimization Software* (CROS) builds on ICBT and is designed to provide further improvements in IP-video reach and availability for broadband users. Requiring no modifications to network equipment between the servers and the clients, CROS adapts to network congestion or equipment failure, enabling operators to continuously deliver high-speed video with high QoS.

The client software running on the IP-digital set top box (IP-DSTB), entertainment PC or other customer premises equipment measures streaming video data in real-time and uses only those servers capable of delivering video at the required rate.

"EdgeStream's intelligent client approach is ideally suited for the high speed Intel® processors available in the new generation of IP-digital set top boxes and entertainment PCs."

Randy Chung
Chief Technology Officer
EdgeStream

Video delivery is monitored on a second-by-second basis, and if necessary the EdgeStream client software will switch to an unimpaired path or server, even in mid-delivery. This re-routing can happen multiple times, as often as necessary to keep the data flowing smoothly. The switching does not affect video playback and is transparent to the user.

This delivery method also improves overall network utilization while providing a "relief valve" for overloaded network segments. Network congestion along a network path will cause the EdgeStream software to adaptively switch to a different server location via a different path, automatically lessening the load at the network congestion point.

EdgeStream believes that this results in the best utilization of the network resources under constantly changing load conditions within the large and complex public Internet infrastructure without causing appreciable disruption to other traffic flow.

Modular Platform

EdgeStream software runs on video sourcing servers and clients. All of the enhancements in availability, reliability and reach for video streaming are obtained without requiring changes to the network equipment on the Internet. The EdgeStream Platform includes the client software that resides on the IP-digital set top box, entertainment PC, digital TV or other client device and four server software modules as shown in Figure 2.

In a minimal system configuration, an EdgeStream server system can be deployed with a single standard server that runs all four of the EdgeStream server software modules, or the server modules can run on multiple servers for increased streaming capacity.

- The Streaming Server module runs on standard Microsoft* Windows* based Web servers and produces the video stream data.

TCP Streaming Speed (80 msecs Latency)

Figure 1 The graphs compare video streaming performance between standard TCP transfers and EdgeStream transfers. The video was a 1 Mbps average clip. Measurements were taken over a 60 second average. While the standard TCP streaming bandwidth drops sharply with increasing packet loss, EdgeStream bandwidth remains practically unchanged.[1]

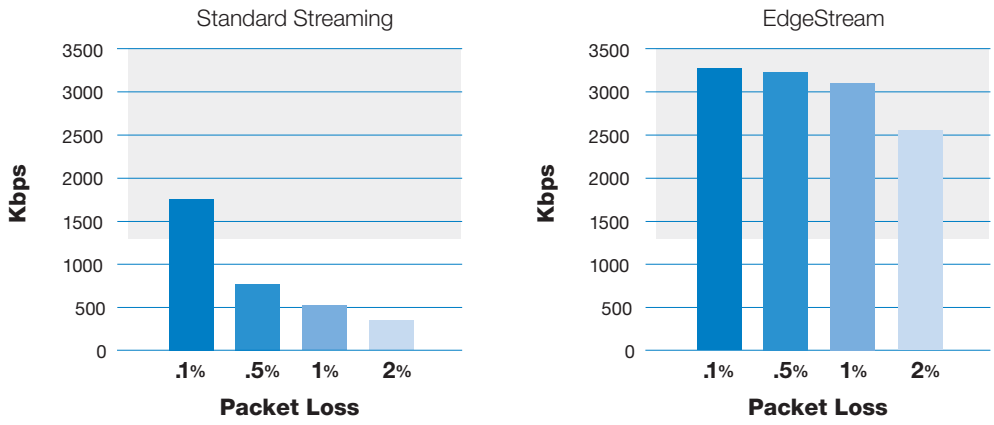
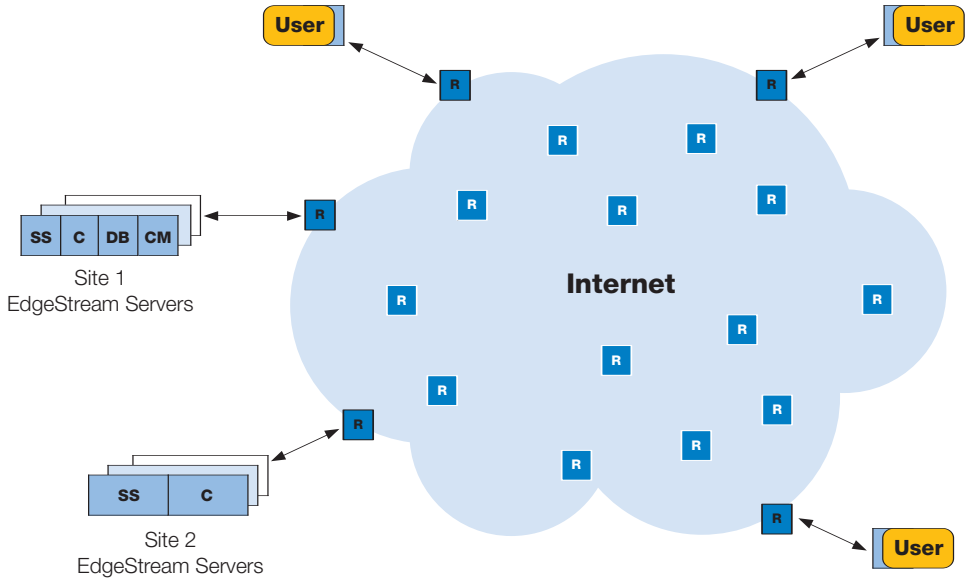


Figure 2 The EdgeStream Platform is capable of scaling to support millions of simultaneous users. Software modules include Control Server (C), Database Server (DB), Content Management and On-Line Reporting Server (CM) and Streaming Server (SS), in addition to a client module on the DSTB. The software is designed to enable error-free streaming video at high bit-rates over a large number of router hops (R), overcoming network impairments that would block conventional delivery methods.



- The EdgeStream Control Server module works with the client software to load balance the video streams of the available servers and also performs automatic fail-over if a server or network link goes down.
- Database and Content Management modules control billing and event-logging and the entry of new content within the system.

The system is designed to support redundancy for high availability, including full active/active database replication to protect critical billing and logging data.

High bit-rate streaming benefits from the use of Intel® Architecture-based servers, which provide high memory bandwidth and efficient data transfers. To obtain the highest streaming capacity from a server, EdgeStream recommends the use of dual Intel® Xeon® processors with one to four GB of RAM. If local disk storage is used, the server should include at least four S-ATA or SCSI drives with hardware RAID. The use of a network card with TCP/IP acceleration can enhance streaming capacity even further.

Running on Intel® Architecture-based IP-DSTBs

The Client module uses the processing power of the IP-DSTB to measure the quality of the incoming video stream in real time and adaptively connect to different servers as needed. According to EdgeStream, IP-DSTB's based on Intel® Architecture provide the system-level performance to handle standard digital video protocols such as MPEG-2 or MPEG-4 and user interfaces, while supporting EdgeStream's Client module, which optimizes the data delivery for the media player in the set top box.

An intelligent Intel® Architecture-based IP-DSTB enables optimization of video content delivery based on direct measurements of network performance at each client site. Because of this distributed intelligent client traffic monitoring, the EdgeStream Platform is capable of scaling to support millions of simultaneous users.

"The best place to make a decision on the quality of streaming video is as close to the display as possible. Having extra processing power on the IP-DSTB enables our software to make optimum quality measurements. We have ported our client software to a set-top box based on the Intel® 815 Chipset Reference Design."

Randy Chung
Chief Technology Officer
EdgeStream

Results

According to EdgeStream, its platform can help reduce capital costs and operating expenses, resulting in lower total cost of ownership (TCO) for network operators.

- The EdgeStream platform works with existing network infrastructure. By avoiding the need for additional servers and the added expense of network peering arrangements, operators can save capital costs up-front.
- The use of standards-based Intel® Architecture and Windows-based servers can help reduce equipment costs.
- The platform's self-healing architecture negates the need for 24x7 maintenance and staffing requirements.
- The ability to distribute video content to a global audience from a handful of locations maximizes the capacity utilization of servers and available network bandwidth.

"The EdgeStream system has undergone extensive trials. Viewers did not notice any impairment, even when we brought down an entire data center."

Rajeev Sehgal
Chief Business Development Officer
EdgeStream

According to EdgeStream, a major network operator in Japan evaluated EdgeStream software by providing content to a group of subscribers over the operator's private network. The operator then asked users to view the same content delivered over the public Internet from EdgeStream servers in the US. Viewers found no quality difference between the two, and many reported that the video coming across the Pacific actually started faster than the stream delivered over the private network.

EdgeStream conducted another trial in which subscribers to a Japanese network watched more than 25,000 on-demand movies with no reported quality of service issues. All the movies were encoded at greater than 1 Mbps and were hosted on EdgeStream servers in the US. In this trial, lower bandwidth videos were also made available using a competing infrastructure. According to Edgestream, the service provider found that paying customers overwhelmingly favored watching higher quality video enabled by EdgeStream and that 70 percent of VoD pay per view revenues were generated by the EdgeStream network.

Conclusion

Continuing growth in worldwide broadband deployment, especially DSL, is creating real opportunities for network operators to enhance revenue by delivering real-time VoD over IP. The success of these new services will depend on consumer acceptance. Viewers will expect at least the same video quality they experience with broadcast TV, cable and satellite.

Quality of service (QoS) is a challenge for network operators because the public Internet is subject to network congestion and latency that can occur at any time, even in well-managed networks. Such issues can seriously impair the quality of IP-TV and VoD. Traditional solutions attempt to avoid network latency and congestion by adding edge servers, or through the use of relatively costly network peering arrangements.

The EdgeStream software suite provides a reliable and scalable platform that enables full screen DVD-quality video on demand/streaming with excellent QoS over the public Internet. Because the system uses centralized servers, and intelligent IP-DSTB's and other client devices, it helps operators keep capital and operational costs down by avoiding the need for additional edge servers or network peering configurations. By combining low total cost of ownership, high quality streaming VoD and extending reach to a global Internet audience, EdgeStream's software platform is helping to maximize profitability for network operators.

For more information, visit the Intel Consumer Electronics home page at:
www.intel.com/go/consumerelectronics

[1]Source: Broadband Worldwide 2004: Subscriber Update, Research and Markets, April 2004, provided courtesy of EdgeStream.
[2]Source: DSL Maintains Global Broadband Dominance: Wins North American Broadband Growth Race, DSL Forum press release including data collected by Point Topic, September 2004.
[3]Source: Network Latency and Its Effect on Video Streaming, EdgeStream white paper by Randy Chung, EdgeStream Chief Technology Officer, August 2004.

 Printed in USA/1204/5K/MB/RN/IL Order Number: 305533-001