NEWS RELEASE

NTT

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Press Release

Uncompressed HDTV Transmission System Over the Internet

--- World's First Successful Long-haul Transmission Field Test ---

Nippon Telegraph and Telephone Corporation (NTT) has successfully developed and demonstrated a system for delivering 1.5 Gbps volume uncompressed HDTV(1) video data in real time over the Internet.

This uncompressed HDTV transmission system, developed by NTT Network Innovation Laboratories, uses PCs with HDTV interfaces and super-high-speed network interfaces. The system was deployed at the NTT Musashino R&D Center (Musashino City in Tokyo) and at The Graduate School of Information Systems, The University of Electro-Communications (directed by Professor Shuichi Itoh) located some 20 kilometers away (Chofu City also in Tokyo). HDTV images were transmitted over an IP Internet connection using a 2.4-Gbps fiber-optic line, and it was verified that the transmission was stably received (Ref. Fig. 1). The processing capacity of a 1.5-Gbps uncompressed HDTV video data stream can support up to 70 HDTV-quality MPEG-2 streams (22 Mbps per stream) or 150 to 300 DVD-quality streams (5-10 Mbps per stream) (Ref. Fig. 2).

NTT Network Innovation Laboratories plan to exhibit the new system and present the results at the International Broadcast Equipment Exhibition (InterBEE 2001) that will be held at the Nippon Convention Center (Makuhari Messe) from November 14 to 16, 2001.

Development Background

As the Internet is being rapidly upgraded to accommodate broadband delivery, personal computers in homes and offices are already able to receive streaming(2) video content. While present-day throughputs ranging from several tens of kbps to several Mbps only support a mediocre picture quality somewhat worse than a regular television picture, faster access lines and more powerful computers will soon permit users to view crystal-clear HDTV-class images on their home and office PCs.

In order for end-users to receive steady streams of large quantities of data, something must be done address the potential for massive traffic concentrations, particularly on the network side. One solution is the CDN,(3) a technology specifically engineered to enable large quantities of data to be efficiently delivered over a network. The CDN deploys cache(4) and mirror(5) systems throughout the network in order to distribute the load on the network and on servers, and thereby speeds up the delivery of contents. NTT is currently making good headway on a number of R&D projects contributing to the development of a high-performance and cost-efficient CDN system. As part of this

effort, the NTT Network Innovation Laboratories is addressing the need for an uncompressed HDTV content delivery capability, that of course requires very high streaming performance.

Technical Features

- Implemented from general-purpose components at low cost

  The system consists of commercially available PCs and HDTV interfaces, while Linux is used for the operating system. In order for the system to support Gbps-class streaming data, a number of speed enhancement techniques were applied to the operating system and the application program: the internal bus scheduling and memory access were optimized and parallel processing using multiple processors was adopted. With this development, we succeeded in reducing the processing load by transmitting longer packets and demonstrated Gbps-class transport even with generic PCs that are now commercially available. In the future, the system will be capable of not only delivering video contents but also of manipulating the processing of video contents.

- High-speed, long-haul, and multi-point transmission capability

  The network interface is a super-high-speed 2.4-Gbps IP-based interface developed by NTT Network Innovation Laboratories. The network interface complies with SDH(7) standards used by the telephone trunk network, thus ensuring long-haul transmission capability over the trunk network. It is also fully compliant with the NTT-developed MAPOS protocol(6) that enables multi-point access capability. In addition, the Internet Protocol (IP) is used at higher layers of the network, so multiple PCs can be linked via switches or routers by IP connections, and the uncompressed HDTV video can be combined or mixed with all sorts of other data for transmission.

Future Developments

Through the development and pilot implementation addressed in this paper, we have demonstrated the ability to deliver high-quality video streams over the Internet even assuming the performance capabilities of currently available PCs. NTT Network Innovation Laboratories are continuing to assess the protocol processing of Gbps-class streaming data over the trial system, while at the same time exploring the applicability of the system to caches, servers, and mirror sites with the ultimate aim of building very-large-capacity streaming content delivery networks.

Terminology

- (1) HDTV
  High-Definition Television.

- (2) Streaming
  Playing sound or video in real time as it is transferred over the Internet, as opposed to downloading and storing it in a local file first.

- (3) CDN

Contents Delivery Network. Networks optimized for delivering contents. Multiple content delivery servers are deployed on the network by the content provider, and the user connects to the server providing the best quality of service.

- (4) Cache
  A buffer deployed on a network between a server and a client that temporarily stores (i.e., caches) data sent from the upstream server to the downstream client, and that serves the buffered data as a proxy of the original server when the downstream client request the cached data. The net effect is that this reduces the load on the server or the traffic volume of the network upstream.

- (5) Mirror
  Servers holding the same contents (mirror servers) are dispersed throughout the network, and this effectively distributes client accesses and reduces the load on any one server. More stable content delivery is also assured when a client downloads data from a server that is relatively closer.

- (6) MAPOS
  Multiple Access Protocol Over SONET/SDH. While a formal data communications hierarchy model has been established for the Internet, MAPOS is a Layer 2 protocol (the data link layer) for super-high-speed data communications using SONET/SDH for Layer 1 (the physical layer). By using SONET/SDH, MAPOS can be used as a high-speed network protocol supporting extensive applications ranging from LANs to wide-area networks (WANs).

- (7) SDH
  Synchronous Digital Hierarchy. SDH is a very-high-speed optical dedicated-line standard used on the trunk portions of the telephone network that supports a multiplexed hierarchy of transmission speeds: 155 Mbps, 622 Mbps, 2.4 Gbps, and 10 Gbps.

Attachment
-Figure 1 Schematic of the experimental system
-Figure 2 Data speeds of various video transmission modes

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