Press Release

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Keio University
Nippon Telegraph and Telephone Corporation
California Institute for Information and Telecommunications Technology (Calit2)
University of Illinois at Chicago (UIC)/
Electronic Visualization Laboratory (EVL)
Pacific Interface Inc.

World's First Trans-Pacific(15000km), Real-t Time Transmission Streaming of 4k Digital Cinema Images

Keio University (Chancellor: Yuuichirou Anzai), Nippon Telegraph and Telephone Corporation (NTT: President & CEO: Norio Wada), University of California San Diego (UCSD/Calit2) (*1), University of Illinois University at Chicago school (UIC/EVL) (*2), and the Pacific Interface Co. together successfully demonstrated during the international conference "iGrid2005"(*3) the world's first real time distribution of a super-high-definition (SHD) 4K digital video over the Pacific Ocean (from Keio University, Tokyo, to University of California, San Diego); its resolution of 8 million pixels is 4 times higher than that of HDTV.
This proves that SHD 4K digital images based on the digital cinema specifications (*4) can be distributed live through the gigabit IP network, and that these technologies can be put into practical use in the fields of academia, education, medicine, as well as cultural activities.

1. Content of experiment

(1) Real-time transmission experiment of 4K digital video
At Keio University, a 4K live digital motion picture was captured in the Research Institute for Digital Media and Content (DMC) by using a 4K digital video camera. The movie stream of about 6 Gbps was compressed through the real-time JPEG2000 codec(*5), developed by the NTT Network Innovation Labs., down to 200M-400Mbps and then transmitted over the Gbps IP optical fiber networks.
In one session of "iGrid2005", Keio Chancellor Yuuichirou Anzai, and UCSD Chancellor Marye Anne Fox held a teleconference using the 4K live video transmission system. They confirmed their agreement to strengthen cooperation in the fields of research and education regarding state-of-the-art networks and video technologies.
In the above-mentioned transmission experiment, it was proven that a global gigabit IP network (Figure 1) can be constructed by directly connecting optical lines with Ethernet switches between Japan-U.S.: the total length is 15,000 km.
A live relay system that offered low latency and thus excellent responsiveness was achieved by connecting NICT JGN II Japan-U.S. line (*6) with the US domestic optical transmission line CAVEwave (*7) from StarLight (Chicago) to Pacific Northwest GigaPOP(Seattle)to UCSD(San Diego).

(2) 4K multicast contents delivery
During "iGrid2005" (Japan standard time 27th-29th), the world's first multicast distribution experiment of a 4K digital motion picture stream (200M-400Mbps) across

the Pacific Ocean will be conducted by employing the NTT Flexcast technology (*8). The experiments will use materials shot with 4K digital motion picture cameras, 4K CG pictures synthesized in real-time, and 4K digital movies scanned from 35mm and 65mm motion picture film.
The above mentioned distribution experiment makes use of the layer- two (Ethernet) facility of Pacific Wave (*7) which is used to connect the academic networks of North America and Asia. The experiment also uses the optical-wavelength-based network developed for advanced research that is being operated by CENIC (*7).
The plan is to evaluate the performance over longer distances and higher loads by distributing contents through the Flexcast to two bases at the UCSD/Calit2 from the Keio University Mita campus.

2. Future plans
Keio University DMC Institute, NTT Network Innovation Labs., UCSD/Calit2, UIL/EVL, and the Pacific Interface Co. plan to jointly advance research on the distribution and development technologies of high-quality digital contents by using a high-speed network as well as on application technologies in the fields of academia, education, medicine and cultural activities.

3. Cooperation
Keio University participation was supported by funds for promotion of science and technology from the Ministry of Education, Culture, Sports, Science and Technology. Moreover, some experiments were conducted in the course of "Research and development of the next generation video contents distribution and production technologies" supported by the Ministry of Internal Affairs and Communications.
In addition, these experiments received the backup of Digital Cinema Technology Forum (DCTF) (*9) and Digital Cinema Consortium of Japan (DCCJ) (*10), and received the support of JGN II (*6) for the Pacific Ocean crossing network.

(reference)
List of the organizations who collaborated in the above experiments
4K digital motion picture camera: Olympus
4K projector: Sony Electronics USA
4K non-compression image server: Japan SGI
Contents, equipment, and transmission lines, etc.: NICT, Toppan, Tokyo University of Technology, Tatsun-ko Production Co., Ltd, Mitsubishi Electric Corporation, Astro Design, UIUC/NCSA, SGI, Southern California university (USC), SDSU, The Pixel Farm, Yamaha USA, DALSA, Miranda, BAPS Swaminarayan Sanstha, Skywalker Sound, and a Lucasfilm Ltd. Company, San Francisco State University Institute, Youth Radio, Arizona State University Digital Media Instructional Technologies, CAVEwave, Pacific Wave, CENIC, StarLight, Pacific Northwest GigaPOP,UCOP

Terminology

*1 Calit2 (California Institute for Telecommunications and Information Technology) Research laboratories addressing communication and information technology which University of California set up by the San Diego school (UCSD) and Irvine school (UCI).

*2 EVL (Electronic Visualization Laboratory)

A research laboratory, under Illinois University at Chicago (UIL) computer science faculty, which unites engineering and fine art studies.

*3 iGrid2005 (International Grid 2005) http://www.igrid2005.org
A joint proof experiment event created by international collaboration that promotes the development of up-to-date applications demanding super-wideband networks. It has been meeting every two or three years since 1998. This is the fourth meeting.

*4 4K digital cinema specifications
Standard developed by DCI (Digital Cinema Initiatives, LLC) for future digital cinema theatrical distribution. DCI was organized by the seven major Hollywood studios. JPEG2000 format (*5) is adopted in the specifications. Note that the use of contents beyond traditional theatrical-release feature movies, such as live music concerts, sports, are referred to as ODS (Other Digital Stuff) in DCI.

*5 JPEG2000 codec
Device which encodes or decodes digital image signals by using the high-quality encoding method called the JPEG2000 format. JPEG2000 is a compression encoding method to decrease the amount of digital information frame by frame. It offers excellent quality though the compression rate is lower than MPEG which uses the correlation between frames.

*6 JGN II(Japan Gigabit Network II)
Research and development test bed network that has access points in all Japanese prefectures as well as over the United States. The National Institute of Information and Communications Technology (NICT), an Independent Administrative Legal Entity, started operation in April, 2004.
The objective is to activate the economy and enhance the competitiveness of Japan by accelerating the development of Next Generation Advanced Networks through the cooperation of Industries, Academia, and Government bodies.

*7 Optical transmission line in the US
StarLight: A switch/router facility for international academic and commercial communities to create a proving ground in support of grid-intensive e-Science applications being set up within the Northwestern university in Chicago.
Pacific Northwest GigaPOP: Base for network connection for non-profit-uses; it offers the connection of science networks around the Pacific Rim (Point of Presence)
CAVEwave: Ten Gigabit Ethernet line for research use which links University of Washington (Seattle), University of California (San Diego), and Illinois University (Chicago).
CENIC(The Corporation for Education Network Initiatives in California):
Non-profit-making enterprise which operates networks for education and science research at California state.
Pacific Wave: Joint project of Pacific Northwest GigaPOP and CENIC

*8 Flexcast technology
A method (Figure 2) to construct route autonomously on the usual IP unicast net and to achieve multicast functionality. A terminal that supports the IP multicast protocol can be connected through a gateway. Multicast distribution is possible via. networks that do not support IP multicast. Gradual introduction is possible according to the traffic increase and business strategies. It is being deployed as a technology that adds the lecture-type multicast capability to the videoconferencing service.

*9 Digital Cinema Technology Forum (DCTF)

A Forum established in May, 2004, through the cooperation of the Japanese Ministry of Internal affairs and Communications, by the National Institute of Information and Communications Technology (NICT), Digital Cinema Consortium of Japan (DCCJ) and enterprises, groups, and individuals related to digital video.
The Forum promotes the experiments and international cooperation aiming at establishing the technologies to distribute, evaluate, and secure 4K-standard Digital Cinema where Super-high capacity Digital Cinema is considered as important digital contents for network distribution.
http://www.scat.or.jp/dctf/index.html

*10 Digital Cinema Consortium of Japan (DCCJ)
The world's first NPO, established in January, 2001, to advocate the necessity of 4K Digital Cinema. Actually, DCCJ demonstrated the 4K Digital Cinema to the entire world, including Hollywood, the practicality of a system that was developed by the enterprise group within this consortia and thus has greatly contributed to the adoption of 4K as a DCI specifications (*4).
http://www12.ocn.ne.jp/~d-cinema/index2.htm

- (Figure 1) Japan-US network
- (Figure 2) Outline of Flexcast

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