NEWS RELEASE

Letterman Digital Arts Center Hosts Audio Engineering Society (AES) for a CineGrid@AES Special Event

4K digital motion pictures and 24-channel digital audio streamed in real-time via CineGrid to San Francisco from Tokyo, Los Angeles and San Diego

San Francisco, CA, October 25, 2006 -- For the first time anywhere, 2K and 4K resolution digital motion pictures and 24-channel digital audio were streamed from three different locations in real time using CineGrid™, then mixed live for an audience of audio and video professionals at the Letterman Digital Arts Center in San Francisco.

CineGrid™ is a virtual network for extreme media collaboration running on advanced research IP networks. CineGrid was one of the first major research projects at California Institute for Telecommunications and Information Technology (Calit2). Overseen by Pacific Interface, joint CineGrid research between Calit2, the Research Institute for Digital Media and Content, Keio University (Keio/DMC), and the University of Southern California School of Cinematic Arts (USC/SCA) laid the groundwork for the CineGrid@AES demonstrations.

2K images have roughly 2,000 horizontal pixels and 4K images have roughly 4,000. 4K offers approximately four times the resolution of the most widely used HD television format, and 24 times that of a standard broadcast TV signal. 2K and 4K are particularly significant new image formats because they will be widely used for future digital cinema theatrical distribution under new specifications proposed by Digital Cinema Initiatives, LLC, a consortium of the major Hollywood studios.

“The CineGrid@AES event showed that high-quality, real-time remote collaboration is possible with current equipment and technology. It is our hope that all of us working together in the industry will adopt systems like this, which will eventually decrease costs while increasing efficiency and creativity for everyone,” said Craig Mirkin, manager for Media Systems Engineering at Industrial Light & Magic (ILM), a Lucasfilm Ltd. Company and housed at LDAC.

At this AES event, the picture and sound streams originated in real time from CineGrid server nodes in Los Angeles, San Diego and Tokyo, carried at the speed of light over more than 10,000 miles of CineGrid virtual local area networks (VLAN). The streams were synchronized and then mixed “live” in full fidelity for an audience of 250 audio experts, cinema professionals and international technology leaders gathered in the Premier Theater at LDAC.

“The concept of distributed post-production for high-end audio has long been a dream of audio engineers,” explained Peter Otto, Music Technology Director at UCSD’s Department of Music and a member of the AES Technical Committee for Network Audio Solutions. “The CineGrid@AES demonstration proved that multi-channel, non-compressed cinema-quality audio streaming over IP works well, sounds good, and is now feasible for real-world applications.”

Chris Sarabosio, a sound designer at Skywalker Sound, a Lucasfilm Ltd. Company, said: “With the experimental system used at the CineGrid@AES event, I was able to control playback and mix 24-channel audio interactively while watching the synchronized picture on the big screen just like I do normally, only this time the audio servers were 500 miles away connected by CineGrid. This approach clearly has the potential to eliminate distance as a barrier to collaboration.”

Working with engineers from ILM and Skywalker Sound, the CineGrid team re-configured the LDAC Premier Theater, normally used to show traditional movies, to enable network delivery of up to 10 Gigabits per second (Gbps) for real-time playback and control of 4K digital motion pictures and 24-channel digital audio from three remote sites: the University of California, San Diego (UCSD) division of Calit2; Keio/DMC in Tokyo; and USC/SCA in Los Angeles.

Calit2 Director Larry Smarr, the Harry E. Gruber professor of computer science in UCSD’s Jacobs School of Engineering, said that CineGrid’s long-term goal is to “create a global experimental infrastructure for extreme digital media like 4K, using it to drive innovative applications from scientific research to global digital cinema production."

“Given the long-standing relationship between USC and Lucasfilm, it was particularly meaningful for me to be able to connect our facility in L.A. to the Lucasfilm campus at the Presidio in San Francisco and stream digital cinema quality movies using CineGrid,” said Richard Weinberg, Chief Technologist at USC/SCA. “The CineGrid@AES presentation brought into clear focus CineGrid's potential for ultra-high-quality collaboration over long distances for education, science and entertainment.”

“The CineGrid@AES demonstration showed the potential to leverage advanced networking in support of economic and cultural development, such as the San Francisco Digital Sister Cities initiative, a city-to-city partnership between education, industry and community-based organizations in the digital media sphere,” said Joaquin Alvarado, Director of San Francisco State University’s Institute for Next Generation Internet (SFSU/INGI) and a member of San Francisco Mayor Gavin Newsom’s Digital Media Advisory Committee (DMAC).

The program for the CineGrid@AES special event was structured in four acts, each demonstrating a different facet of the CineGrid philosophy of networked extreme media. In Act 1, a sequence of 4K “digital shorts” at 24 frames per second (fps),

together with fully mixed synchronized audio, were pulled in real time from network-connected servers in Los Angeles and San Diego. In Act 2, 4K telepresence was used for interactive video-conferencing and ultra-realistic reproduction of a classical music performance from Tokyo. Acts 3 and 4 were designed to prove the concept of networked, remote audio post-production for digital cinema by creative teams spread around the world, who demand the highest-quality production values. In Act 3, 4K motion pictures were sent compressed from Tokyo, and 24-channel non-compressed digital audio was streamed from San Diego. In Act 4, the performance system was re-configured to use uncompressed 2K motion pictures coming from ILM servers in the LDAC facility, synchronized to 24-channel, non-compressed digital audio streaming from San Diego. (The full program is attached.)

Akinori Ito, producer at Tokyo University of Technology's (TUT) Creative Lab, said: "CineGrid@AES was a good test of the CineGrid concept of using 4K cameras and multi-channel, non-compressed audio to present ultra-realistic 'live' experiences of music concerts and other kinds of performing arts to distant audiences in theaters connected by high-speed networks. I look forward to refining this concept further with my CineGrid colleagues around the world."

"I believe the very high-speed optical networks such as now being deployed by research organizations will become an essential infrastructure for digital cinema production and distribution," said Tomonori Aoyama, Professor at Keio/DMC and Chairman of the Digital Cinema Consortium of Japan (DCCJ), "But, we still have to learn how to integrate systems that creative people can use to make beautiful 4K content – picture and sound – in new ways appropriate for the 21st century. Demonstrations such as CineGrid@AES force us, in a good way, to learn by doing."

At 8 million pixels per frame, uncompressed streaming of 4K motion pictures requires more than 6 Gbps bandwidth. However, in many places, the signal must be carried over 1 Gbps circuits. To do so efficiently, the CineGrid@AES demonstration utilized 4K real-time JPEG 2000 codecs originally designed by NTT Network Innovation Labs to compress and decompress 4K digital video at streaming bit rates of 400-500 Megabits per second (Mbps).

Compressed 4K motion pictures were transported in real time over CineGrid to the theater in San Francisco, decompressed on-the-fly, and projected onto a 30-foot screen for the audience using Sony Electronics' SXRD 4K digital projector. 4K live content shown to the AES audience was shot in Tokyo with Olympus SH-880TM digital motion picture cameras. In-theater audio mixing was performed using a Yamaha DM2000 digital audio controller. A Christie DLP digital projector was also used to screen 2K digital cinema excerpts.

Jim Dolgonas, President and CEO of CENIC, which provided the network connectivity for this event in California over its California Research & Education Network (CalREN), said: "Using a new generation of cyberinfrastructure featuring multiple 10 Gigabit and 1

Gigabit lightpaths over optical fiber, we were able to extend CineGrid to the Letterman Digital Arts Center in San Francisco for the first time. CineGrid@AES and other ongoing CineGrid experiments are helping network operators better understand the requirements for large-scale digital media collaboration."

CineGrid@AES Event Organizers

CENIC/CalREN
Industrial Light & Magic, a Lucasfilm Ltd. Company
NTT Network Innovation Laboratories
Pacific Interface, Inc.
Research Institute for Digital Media and Content, Keio University
San Francisco State University, Institute for Next Generation Internet
Skywalker Sound, a Lucasfilm Ltd. Company
Tokyo University of Technology Creative Lab
University of California, San Diego
- California Institute for Telecommunications and Information Technology
- Center for Research in Computing and the Arts

University of Southern California School of Cinematic Arts

CineGrid@AES Contributors

Digital Cinema Consortium of Japan
Immersive Media Research
Keio Wagner Society String Ensemble
National Institute of Information and Communications Technology (Japan)
Meyer Sound Laboratories
Olympus Corporation
Recombinant Media Lab
San Francisco State University, Cinema Department
Sony Electronics, Inc
Tatsunoko Production Co., Ltd.
University of Illinois at Chicago Electronic Visualization Laboratory
University of Illinois at Urbana-Champaign's National Center for Supercomputing Applications
Yamaha Corporation of America

CineGrid@AES Cyberinfrastructure Providers

CAVEwave
CENIC/CalREN
JGN2/NICT
National LambdaRail (NLR)
PacificWave
Pacific Northwest GigaPOP
StarLight
WIDE/IEEAF

CineGrid@AES Program
October 8, 2006
Letterman Digital Arts Center, Premier Theater
San Francisco Presidio

Opening Remarks
- Elizabeth Cohen, AES
- Craig Mirkin, Industrial Light & Magic
- Larry Smarr, UCSD/Calit2
- Laurin Herr, Pacific Interface Inc.

Act 1: 4K Playback with Synchronized Sound from Los Angeles and San Diego
- 24 Flowers Per Second, by RichardWeinberg, USC/CSA
- Time Boiler, by Mitsuru Kaneko, TUT and Tatsunoko Productions
- Tornado, by Donna Cox and Robert Patterson, NCSA
- Monterey Bay, by Donna Cox and Robert Patterson, NCSA

Act 2: Live 4K Telepresence from Tokyo
- Interactive dialog between Keio/DMC and LDAC, with 4K-over-IP from Keio to LDAC and DV-over-IP from LDAC to Keio
- Eine Kleine Nacht Musik, by Keio Wagner Society String Ensemble, pre-recorded 4K "live" musical performance

Act 3: Digital Cinema Networked Audio Post Production for 4K
- A Study of 4D Julia Sets by Sandin, UIC/EVL and music by Stephan Vankov, UCSD/CRCA with live mix of "sound to picture" by Peter Otto, UCSD Calit2/CRCA
- Galaxy by Cox and Patterson, UIUC/NCSA and music excerpted from "On-Iron" by Philippe Manoury, with a live mix of "sound to picture" by Peter Otto, UCSD Calit2/CRCA

Act 4: Digital Cinema Networked Audio Post Production for 2K
- Lucasfilm's Star Wars Episode III: Revenge of the Sith excerpt with a live mix of "sound to picture," by Chris Scarabosio, Skywalker Sound.

Closing Remarks
- Tomonori Aoyama, Keio DMC/DCCJ/DCTF