CineGrid: Global Facility for very high quality digital Cinema

Cees de Laat

SURFnet

BSIK

EU

University of Amsterdam

SARA

TNO
NCF

Acknowledgement upfront!

Most slides are taken from presentations by prof. Tom DeFanti from UCSD in San Diego, one of the founding members of CINEGRID.org

Bit of history to understand the future

- working on advanced Internet topics with SURFnet since 1996
- started Internet research group in Amsterdam in 2001, got introduced to Tom Defanti, maxine Brown
- iGrid2002 @ Amsterdam
- StarLight, vision building hybrid networking
- Helped to define OptIPuter, UvA is first intl partner
- Optical networking, vizualisation, Grids
- CALIT(2) Larry Smarr + Tom DeFanti move into digital cinema area (Hollywood)

Calit2's Global Infrastructure for New Digital Cinema

- We are beginning the same sort of DIGITAL transition in movies that television and music made in the 1990s.
- Calit2 is working with the companies who will market the technology and who will use it.
- Calit2 has the most advanced digital theatre in the country with the brightest, highest-resolution digital cinema equipment and the best computing and networking available.
- Calit2 has multiple Hollywood studio-affiliated projects underway
- It is imperative to California's future economy that we couple these innovations from university prototyping into Hollywood mainstream *faster* than the rest of the world.

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CineGrid Markets

- **Digital Cinema is driven by three markets**
  - **1) Entertainment, media, art and culture**
  - **2) Science, medicine, education and research**
  - **3) Military, intelligence, security and police**

- **All three are converging on digital and need:**
  - **Fast networking with similar profiles**
  - **Access shared instruments, specialized computers and massive storage**
  - **Collaboration tools for distributed, remote teams**
  - **Robust security for their intellectual property**
  - **Upgraded systems to allow higher visual quality, greater speed, more distributed applications**
  - **A next generation of trained professionals**

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The CineGrid Node at UCSD/Calit2

200 Seats, 8.2 Sound, Sony SRXD 4K projector, SGI Prism w/21TB, 10GE connectivity

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Networked 4K Digital Cinema Theater

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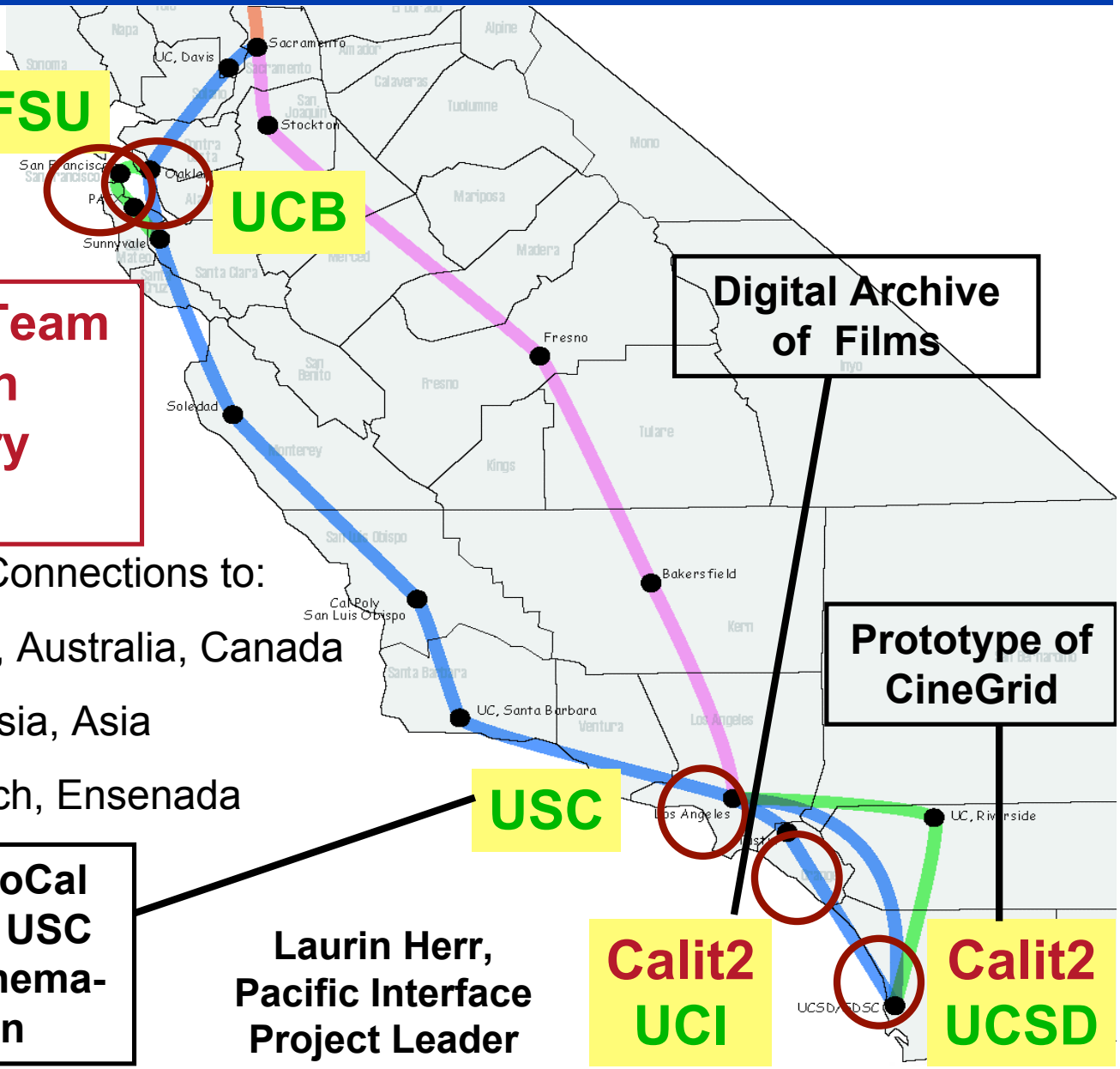
Calit2 is Partnering with CENIC to Connect California Industries and Researchers Into CineGrid

Partnering with SFSU's Institute for Next Generation Internet

Calit2's CineGrid Team is Working with Cinema Industry in LA and SF

In addition, 1Gb and 10Gb Connections to:

- Seattle thence to Asia, Australia, Canada
- Chicago, Europe, Russia, Asia
- Tijuana, Rosarita Beach, Ensenada



Extending SoCal OptIPuter to USC School of Cinema-Television

Laurin Herr, Pacific Interface Project Leader

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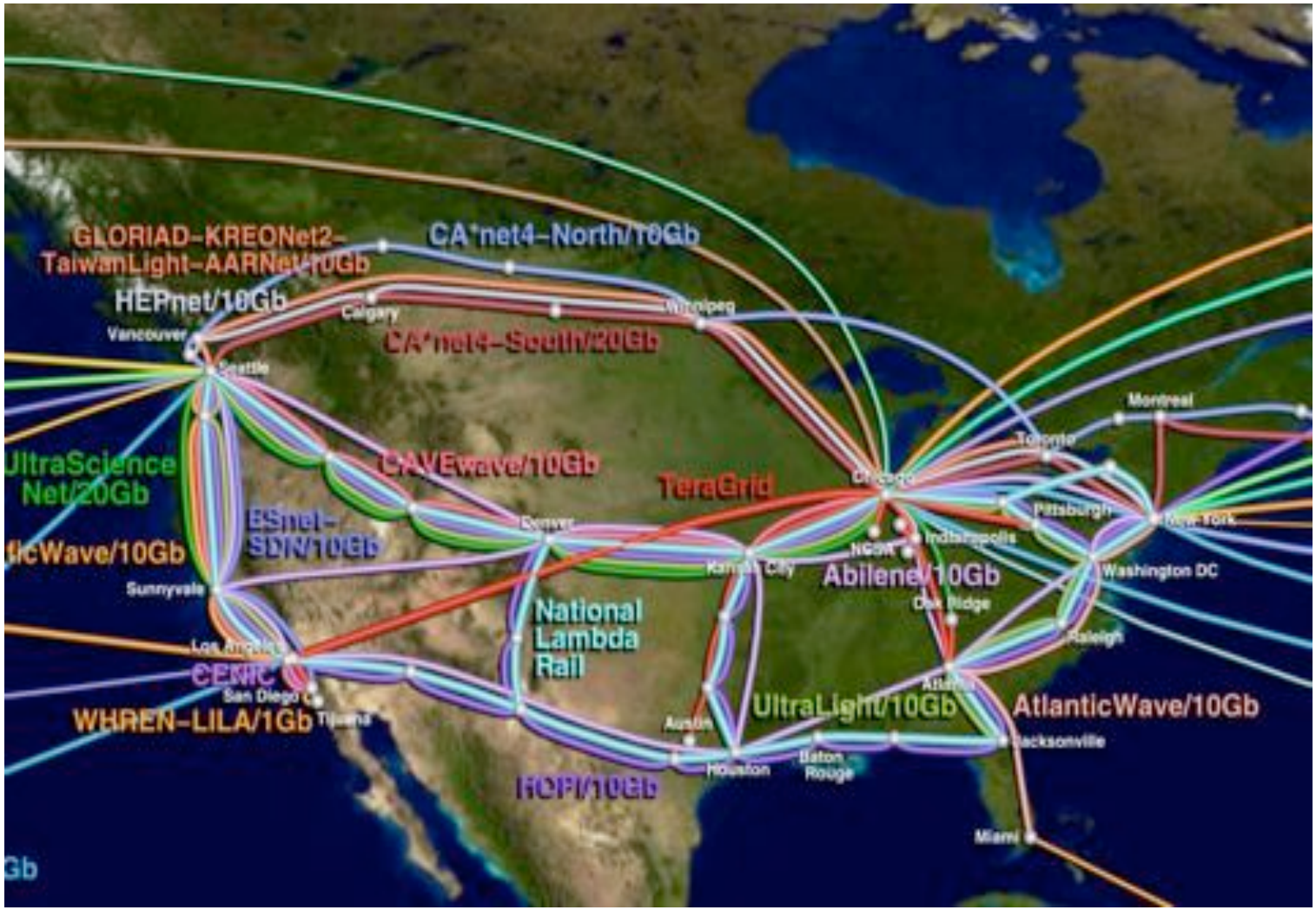
CENIC Connects to 10Gb Research and Education Networks Nationwide and Worldwide



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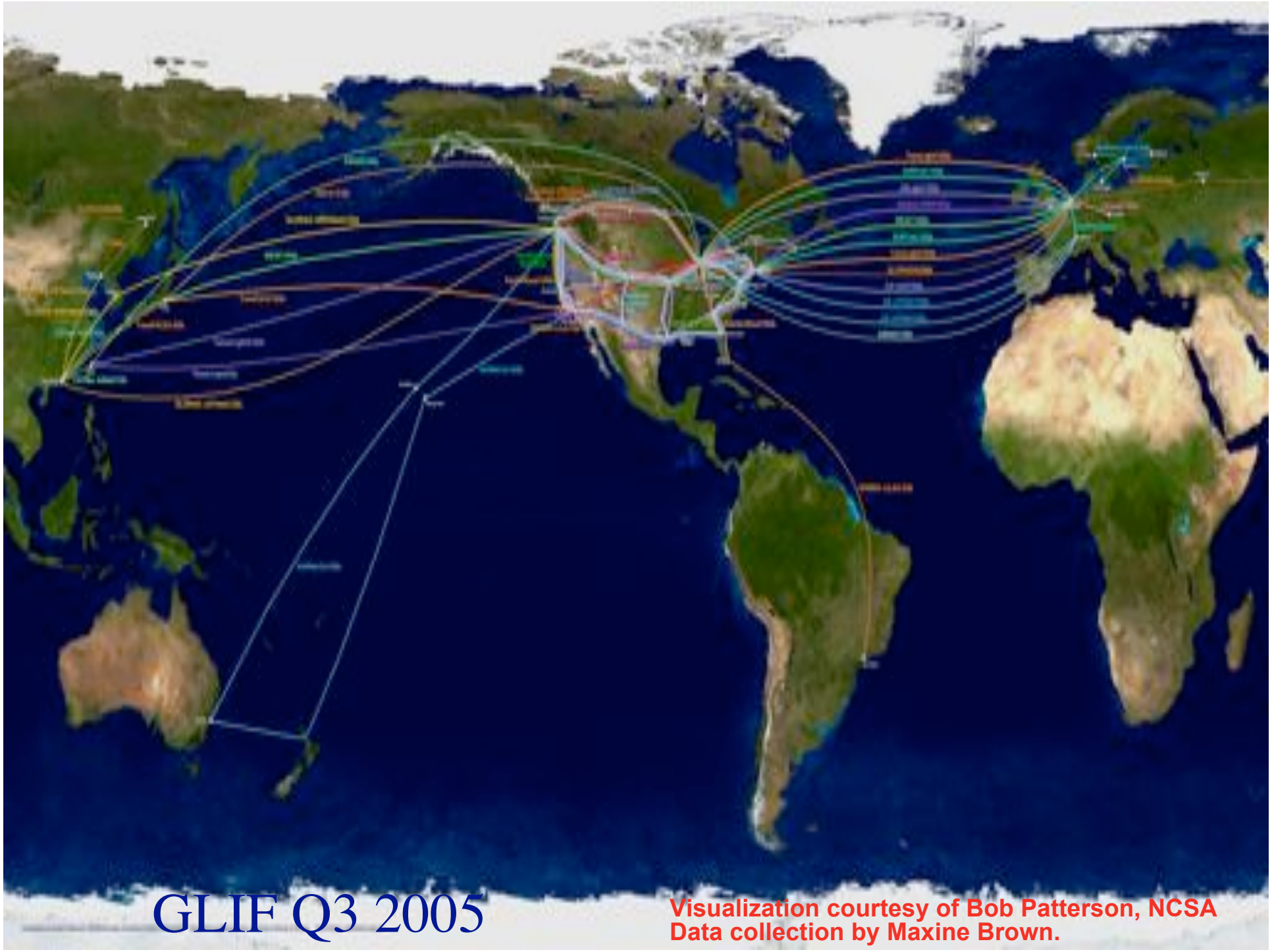
GLIF Q3 2005
Visualization courtesy of Bob Patterson, NCSA
Data collection by Maxine Brown.

The CineGrid Node at Keio University, Tokyo Japan

SXRD-110
4K Projector

SXRD-105
4K Projector

4K Film Scanner

Keio's Digital Cinema
Experimental Facility

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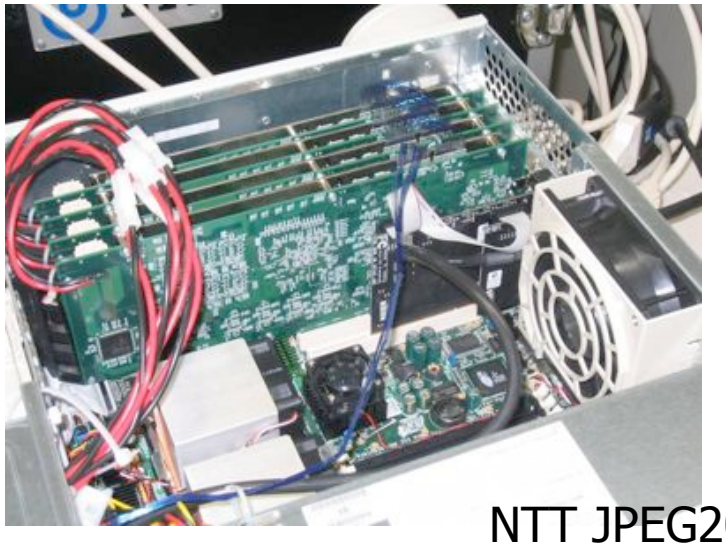
4K Facilities at Keio/DMC

Olympus
4K Cameras

SGI PRISM for
GeoFusion and
Digital Dailies

PC Cluster for
real-time 4K
rendering of Toppan's VR of the
"Nijo Castle"



NTT JPEG2000 Codec

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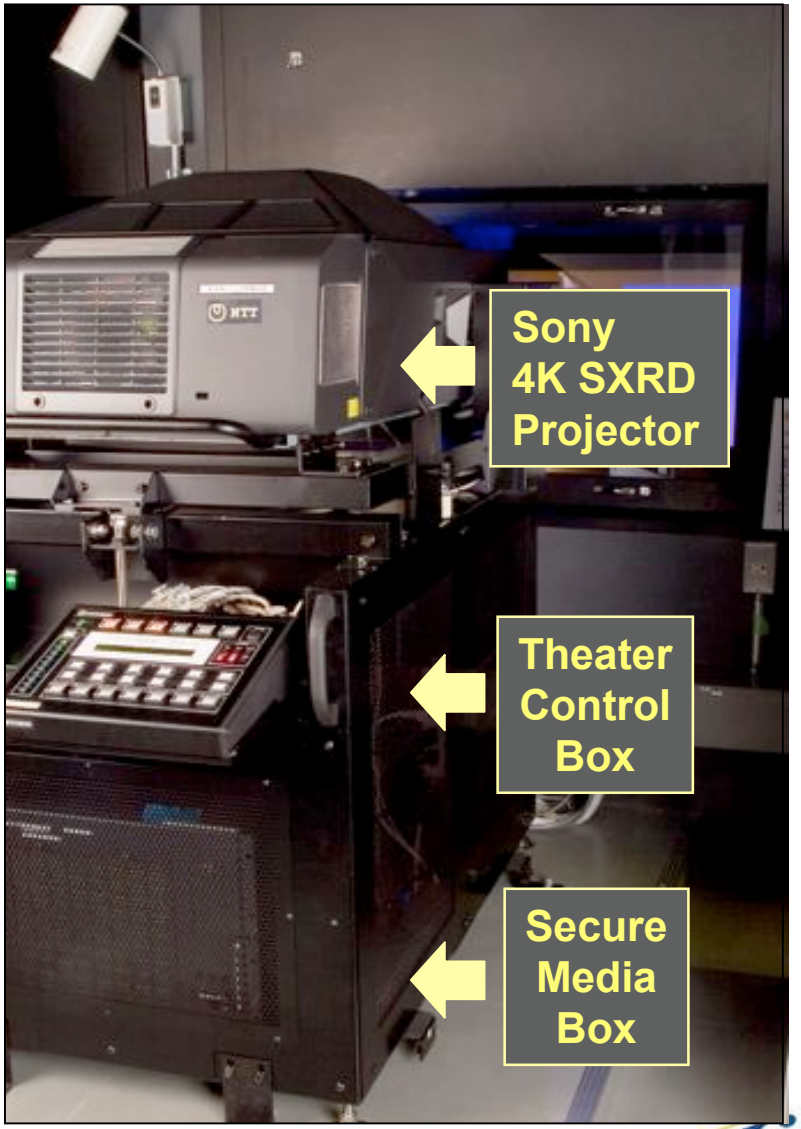
CineGrid Nodes at TOHO Cinemas in Japan

- DCI Compliant 4K digital cinema systems are located at three TOHO theaters in Japan:

- **VIRGIN TOHO CINEMAS, Roppongi, Tokyo (9 Screens)**
- **Cinema Mediage, (Daiba, Tokyo)**
- **TOHO Cinemas Takatsuki (Osaka)**



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Movies Shown in 4K via CineGrid Networks

- "4K Pure Cinema" Field Trial
  - "Tim Burton's Corpse Bride"
    - Road show from October 22, 2005 (Sat.) to November 18, 2005
  - "Harry Potter and the Goblet of Fire"
    - Advance preview on November 19, 2005 (Sat.)
    - Road show from November 26,2005 (Sat.) to February 3, 2006
- 18th Tokyo International Film Festival (TIFF)
  - Digital TiFF on 24th October, 2005
    - 4K Digital Cinema and Network distribution are the main theme
  - "Batman Begins" provided by Warner Brothers with 4K DCP
  - "Stealth" provided by SONY Picture Entertainment with 4K DCP

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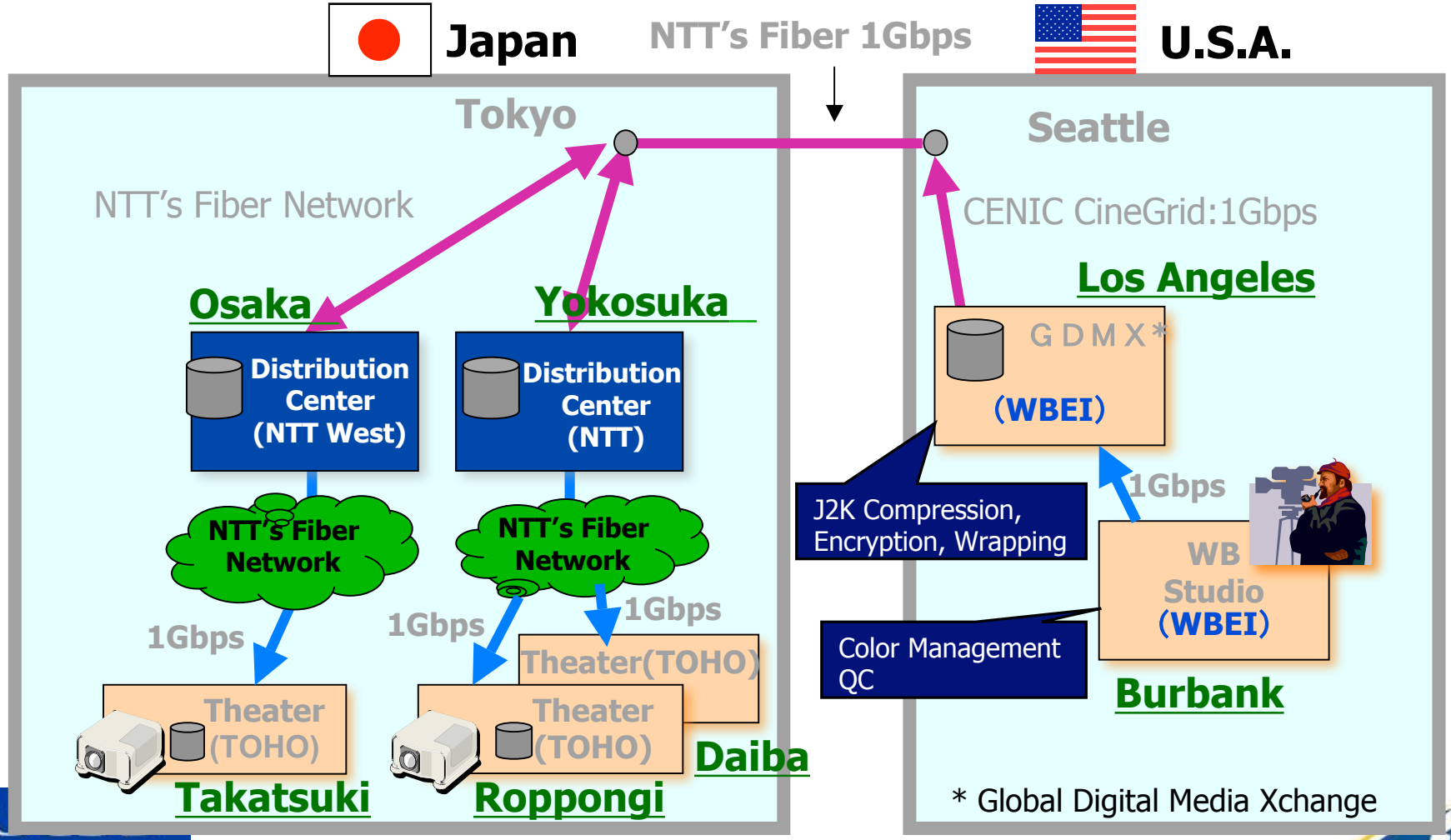
Network for “4K Pure Cinema” Trial

DCP is directly transferred from GDMX in LA to distribution centers in Japan via fiber network. Within Japan, DCP is distributed from the distribution centers to TOHO theaters. Key is distributed from Osaka center, based on the contract between WB Japan and TOHO cinemas.



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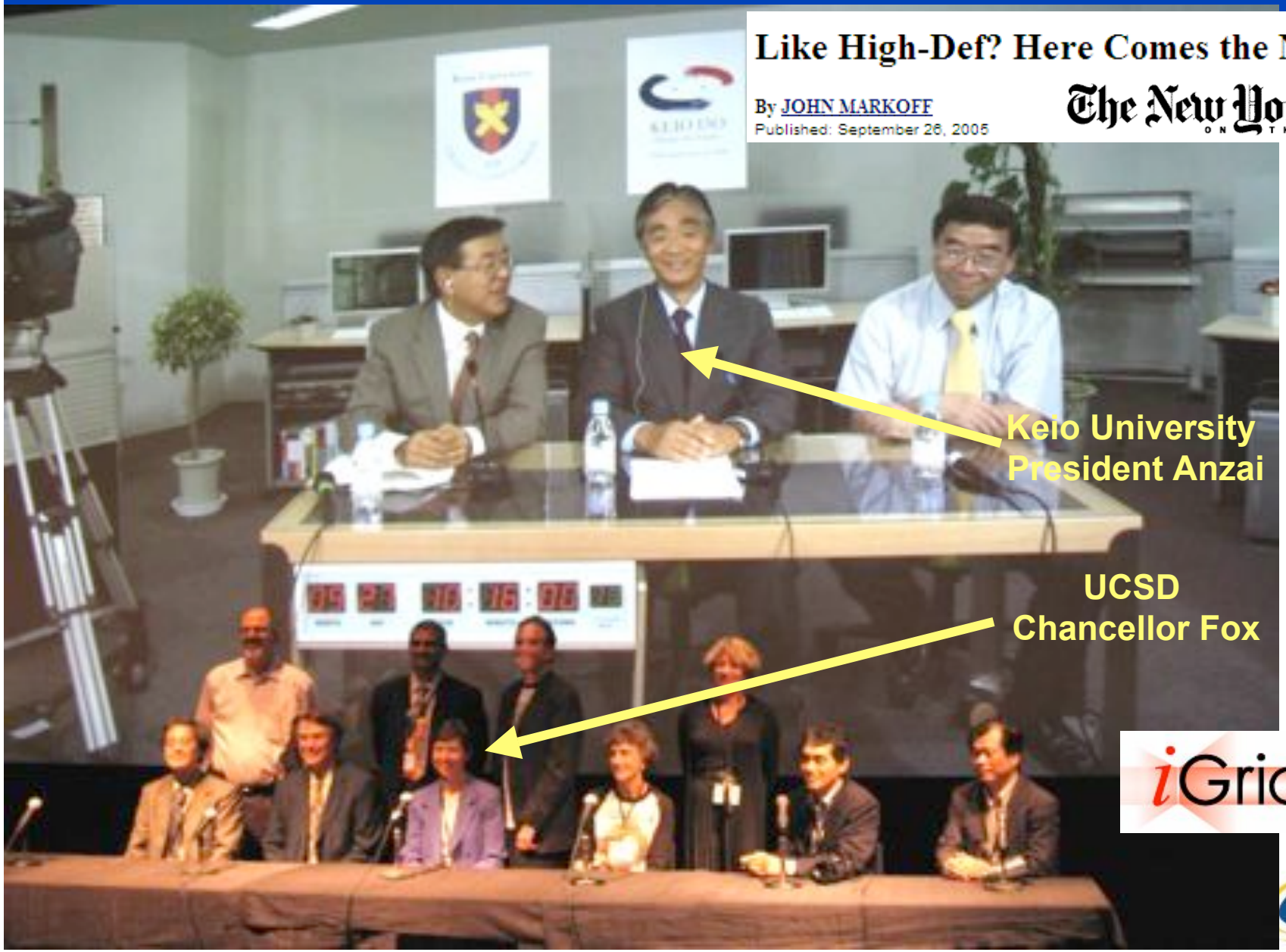
Keio/Calit2 Collaboration: Trans-Pacific 4K Teleconference



Like High-Def? Here Comes the Next Level

By JOHN MARKOFF
Published: September 26, 2005

The New York Times ON THE WEB

Keio University
President Anzai

UCSD
Chancellor Fox

Used
1Gbps
Dedicated

Sony
NTT
SGI

iGrid2005

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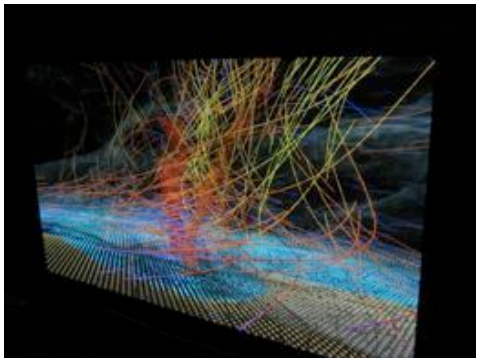
iGrid2005: Six Hours of 4K Streamed to Calit2 from Keio

4K Digital Cinema



4K Scientific Visualization

4K *Anime*

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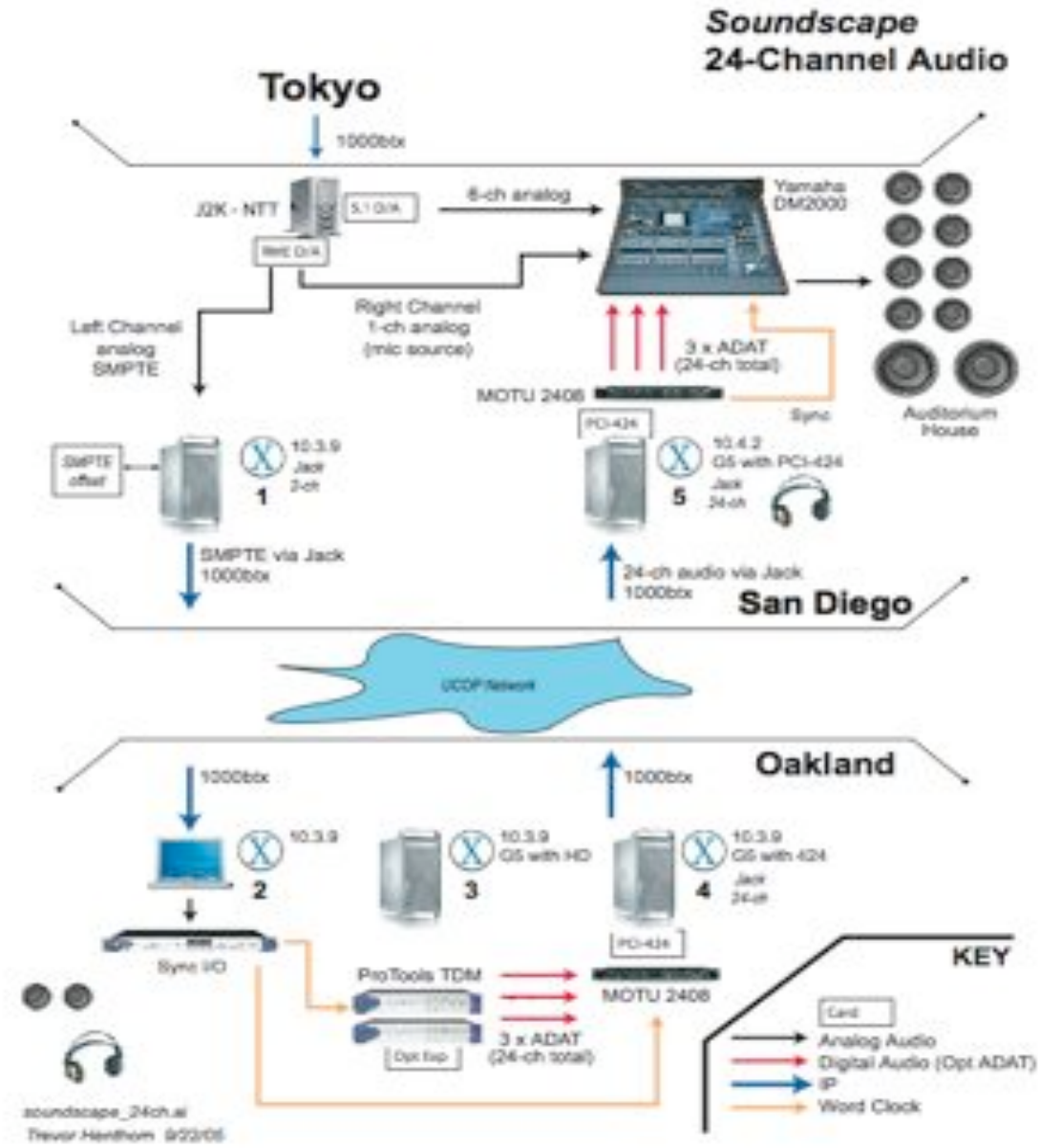
iGrid2005 4K Audio



Multi-channel Skywalker Sound audio sourced in Oakland is synched with streaming 4K video from Tokyo

Low latency and no loss in quality.

See FGCS, Vol 22, Issue 8, October 2006, p. 929.

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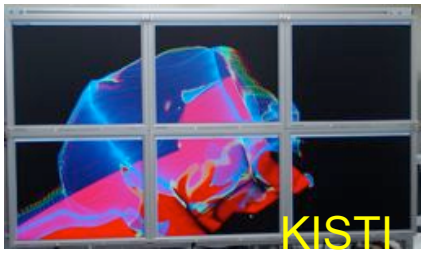
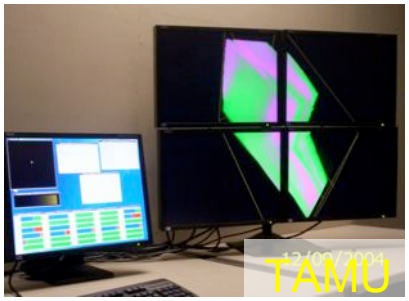
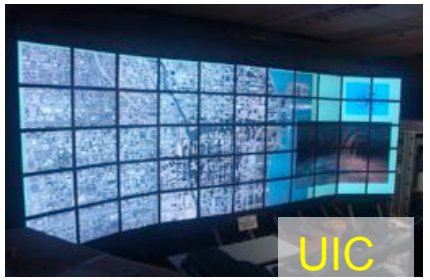
US and International OptIPortal Sites







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Six Initial CineGrid Experiment Tracks

- **Definitions and descriptions of the next focused CineGrid research activities were developed at a workshop at Keio University in Tokyo on June 2006:**
  - **Distributed film restoration**
  - **4K collaborative production**
  - **Tools and techniques for remote collaboration**
  - **Soundscape live performance and multicasting**
  - **Flexcast for 4K Digital Video: JPEG2000-based 4K Multicasting System**
  - **Distributed video editing**

- **Technologies that will be enhanced and further developed as part of these experiments include**
  - **Streaming and store-and-forward file transfer using high-speed, low-latency network protocols**
  - **HDTV for teleconferencing, telepresence, and production**
  - **2K and 4K digital cinema workflows and distribution**
  - **Stereo in high resolution (2K, 4K) and**
  - **Virtual reality in higher resolution (24-30 megapixels)**
  - **Distributed tiled displays with 20-200 megapixels**
  - **Meta-archiving of 2K and 4K digital material (that is, archiving both movies and supporting information)**

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Example CineGrid Experiment: Distributed Film Restoration – *Keio/DMC, Tohoku University, and Calit2*

- ***Resources***
  - ***Keio:*** **Film scanner and SXRD projector**
  - ***Calit2:*** **Computers and SXRD projector**
  - ***USC/ETC:*** **SXRD projector**
- **From 35mm motion film, the Keio Imagina XE film scanner outputs very large files for 4K (~50-100MB/frame). These are are sent to Calit2 as uncompressed images. An un-congested Gigabit network circuit can transmit several frames a second, up to a Terabyte (10,000 frames) every 3 hours, with the proper protocols.**
- **Calit2 has significant cluster computing capability (many 20-30 CPU clusters with some 500-processor ones). The resulting output can be viewed on Calit2's SXRD, as well as sent back to Keio's projectors, to visually inspect.**
- **We need to calibrate the projectors, parallelize/speed up the Tohoku algorithms, and pipeline the process, so one cluster corrects for blotches, for example, and then the scene goes to another machine for scratch correction, and so on. Parallelizing the workflow is another important topic of research and development.**
- **Film restoration needs a human in the loop to make sure images are correctly handled. Computations need to be steered; every scene needs to be viewed by a human to determine whether or not algorithms need to be modified. Thus distributed human-computer interaction techniques and graphical user interface are truly key elements.**
- **An OptIPortal tiled display of 2K or 4K panels would let users see one or multiple parameters change simultaneously to help select correct values.**

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CineGrid Experiment: Film Restoration

- **Most old films are seriously degraded by defects**

Frame displacement

Flicker

Blotches and Scratches

  - **These defects make viewers uncomfortable**
  - **Defects also make compression difficult**
  - **Goal is to work with museums and libraries**

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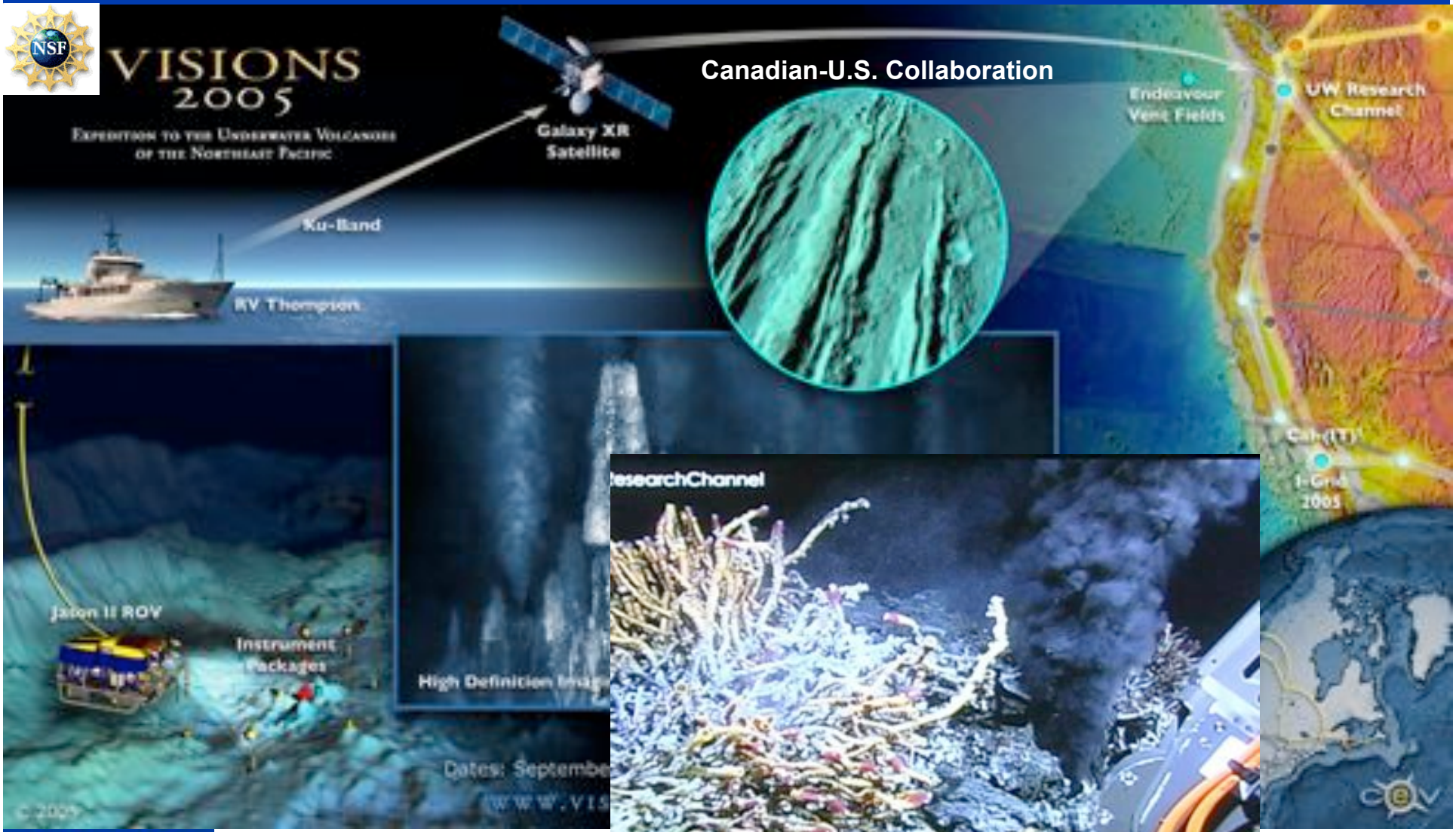
First Remote Interactive High Definition Video Exploration of Deep Sea Vents



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Source John Delaney & Deborah Kelley, UWash

More Global HDTV Partnerships at Calit2

- Real-Time Observational Data Streaming − NCHC, National Museum of Marine Biology & Aquarium, Academia Sinica, Taiwan; SDSC, Calit2, UCSD, USA; Nara Institute of Science and Technology, Osaka University, Japan; CANARIE, Canada; Edinburgh University, UK. This experiment uses mono and stereo underwater HDTV cameras as a source to stream images from Taiwan's EcoGrid
- Scalable Adaptive Graphics Environment (SAGE) − UIC, USGS, Univ. of Chicago, USA; SARA Computing and Networking Services, NL; KISTI, Korea. Displays multiple incoming streams of computer graphics and live HDTV on the 100Megapixel LambdaVision; CytoViz displays network statistics of streams <See FGCS, Vol. 22/Issue 8(2006), p. 964>
- Unreliable Stream − SARA Computing and Networking Services, NL. Transfers images using UDP, a lossy network protocol <See FGCS, Vol. 22/Issue 8(2006), p. 972>
- NCSA Streaming Stereo − NCSA, UIC, USA. A bulk movie playback package (bplay) integrated into SAGE <See FGCS, Vol. 22/Issue 8(2006), p. 967>

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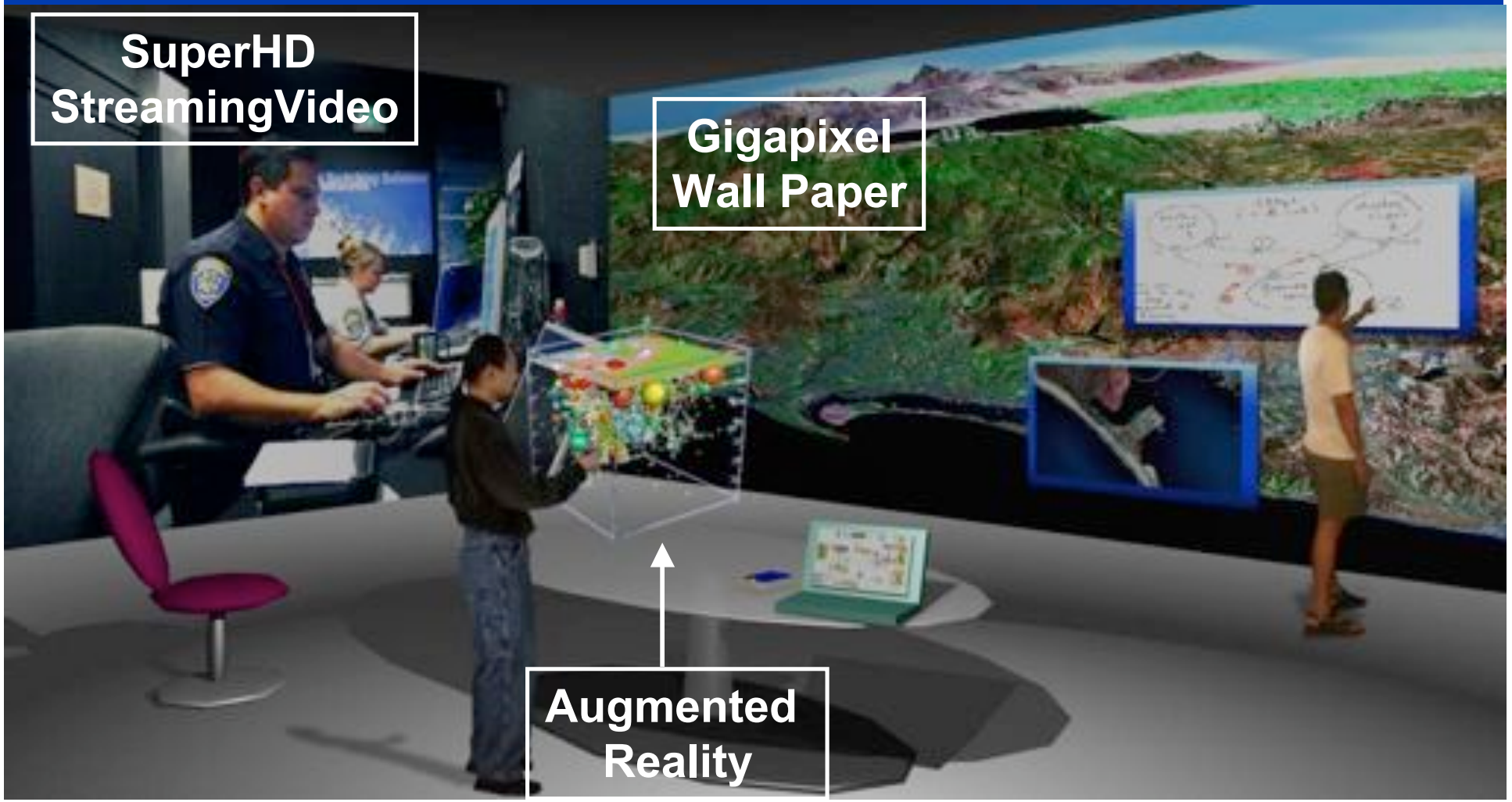
A Vision for the Future: Towards Gigapixel Displays



1 GigaPixel x 3 Bytes/pixel x 8 bits/byte x 30 frames/sec ~ 1 Terabit/sec!

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Source: Jason Leigh, EVL, UIC

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Mission

To build an interdisciplinary community that is focused on the research, development, and demonstration of networked collaborative tools to enable the production, use and exchange of very-high-quality digital media over photonic networks.

http://www.cinegrid.org/

What is it about

- CineGrid is about forming a community
- The CineGrid vision is about a worldwide collaboration
- It evolves around content
- It stretched current technology [storage, networking, grid computing]

Role of UvA

- Linking communities (CALIT(2), EVL to local organizations)
- System and Network Engineering
  - optical photonic networks
  - store & forward (terabyte email)
  - drm & AAA & security
  - grid for processing
- Metadata and make it searchable (MM)

Questions ?

www.cinegrid.org
www.cinegrid.nl
www.science.uva.nl/~delaat