Cees de Laat
On behalf of the CineGrid Amsterdam Collaboration

**Many slides from
Laurin Herr, Pacific Interface Inc.
CineGrid.org**

What is CineGrid?

- ☐ Formed 2004 – non-profit international membership organization
- ☐ Members – media arts schools, research universities, scientific labs, post-production facilities & hardware and software developers around the world
- ☐ Connected via 1 G - 100 G Photonic - Ethernet networks
- ☐ For – research & education, experimentation, prototyping

CineGrid™

CineGrid 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 4K ?

Most broadly, "4K" describes any new format for motion pictures with 8+ Megapixels per frame.

Some "4K" is really Quad HDTV (*also known as* SHD)
- 3840 x 2160; 24/25/30/60fps; 4:2:2/4:4:4; 10-bit Rec 709; Progressive Scan; Square Pixels; multiple codecs

Strictly speaking, "4K" is one of two new SMPTE DC-28 standard formats for Digital Cinema Theatrical Distribution as recommended by Digital Cinema Initiatives (DCI).
- 4096 x 2160; 24 fps; 4:4:4; 12-bit SMPTE XYZ
- Progressive Scan; Square Pixels; JPEG 2000 codec only

CineGrid™

1981
Francis Ford Coppola with Dr. Takashi Fujio
"First Look" at Electronic Cinema

2001
NTT Network Innovations Laboratory
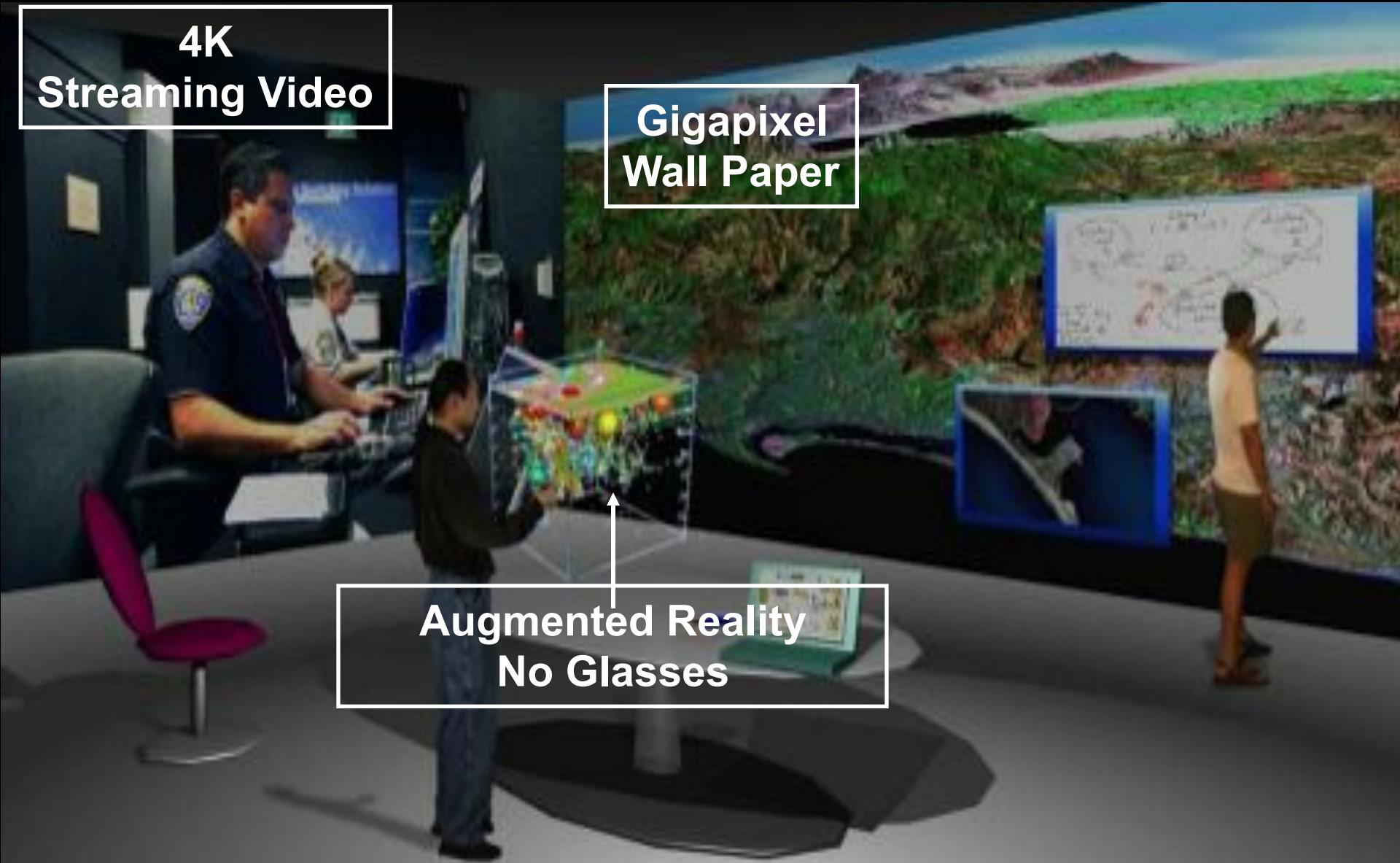# "First Look" at 4K Digital Cinema

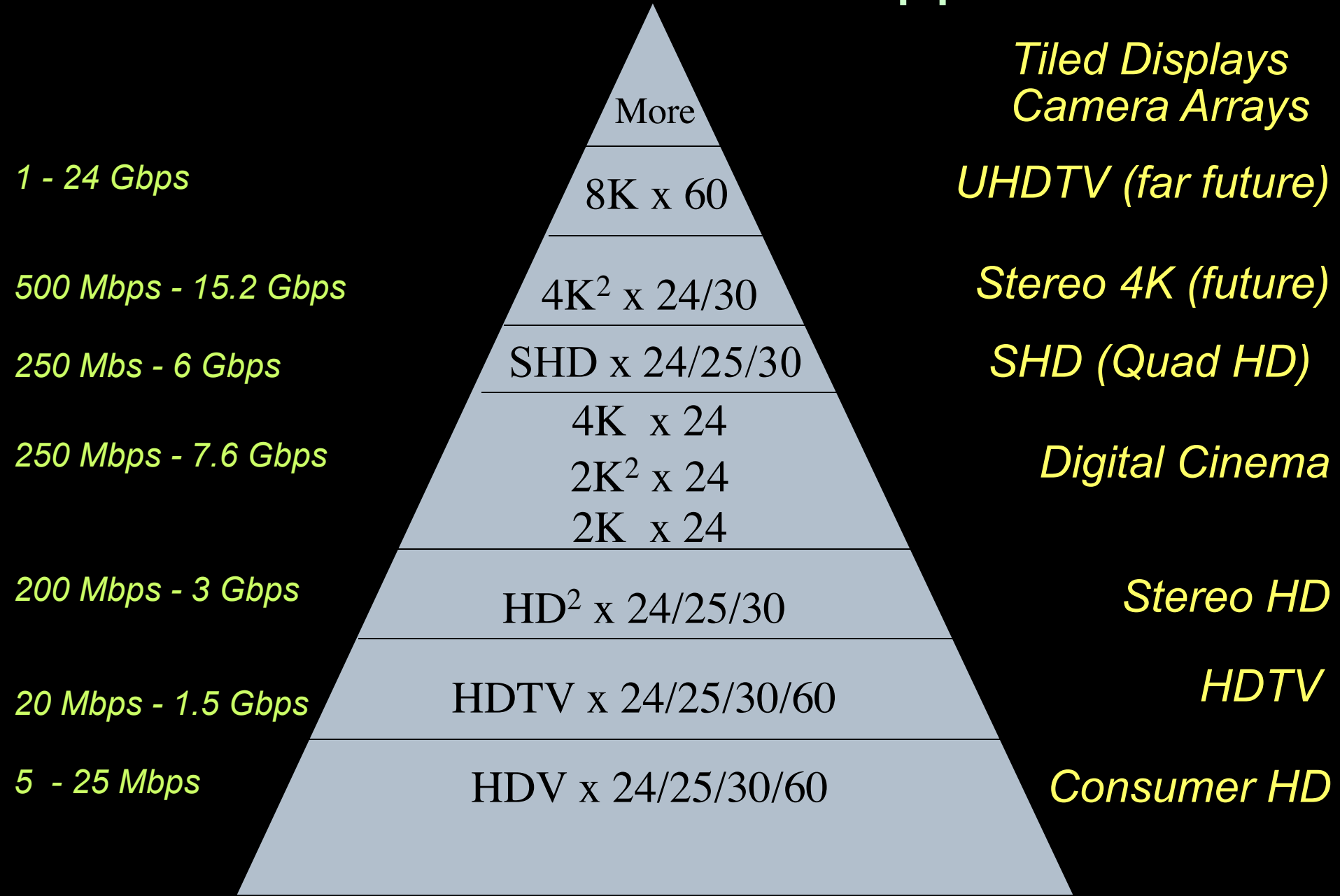**2004 OptIPuter Vision for the Next Decade**
Gigapixels @ Terabits/sec

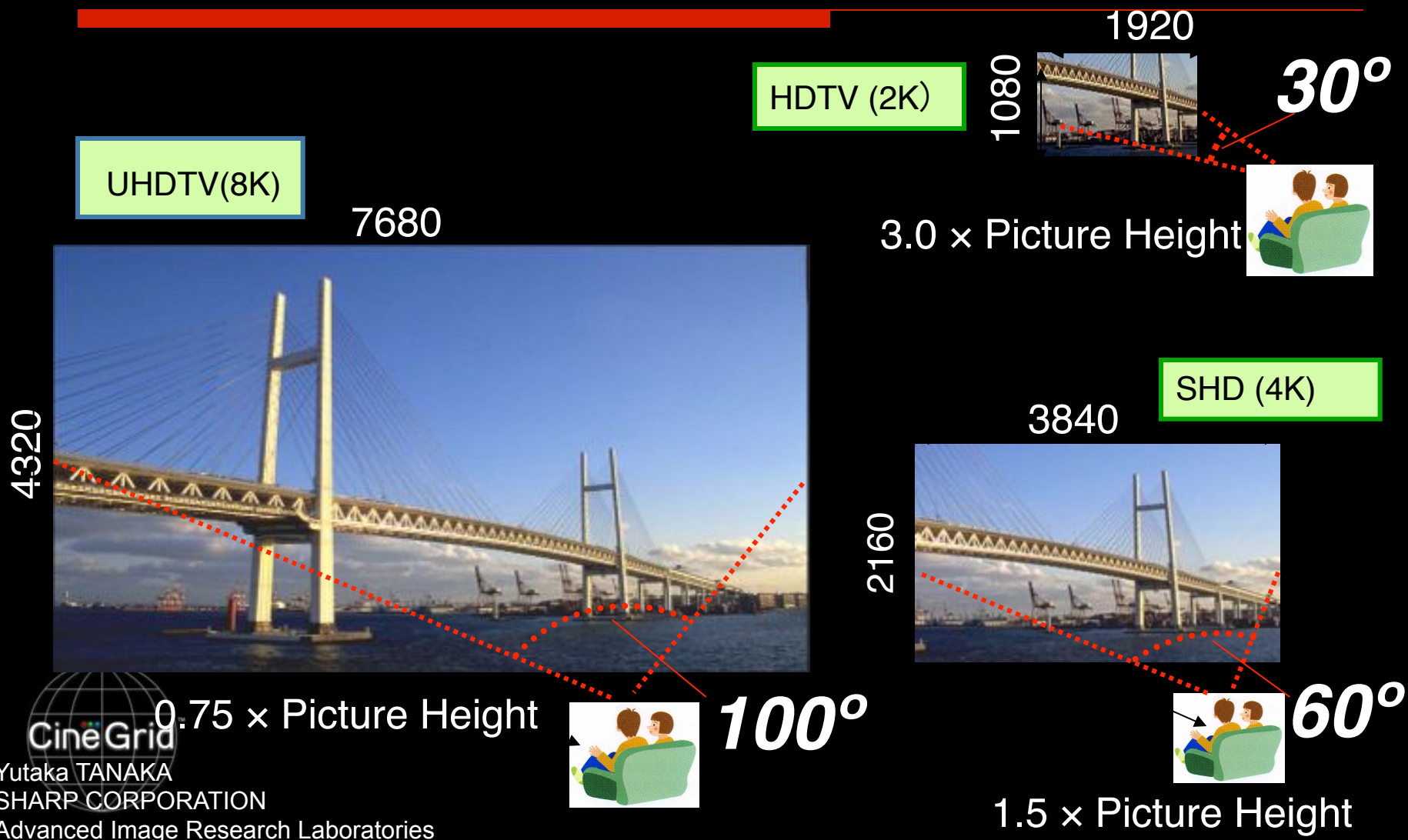4K Streaming Video

Gigapixel Wall Paper

Augmented Reality No Glasses

CineGrid: A Scalable Approach

Bandwidth	Pyramid Level	Application
	More	Tiled Displays / Camera Arrays
1 - 24 Gbps	8K x 60	UHDTV (far future)
500 Mbps - 15.2 Gbps	$4K^2$ x 24/30	Stereo 4K (future)
250 Mbs - 6 Gbps	SHD x 24/25/30	SHD (Quad HD)
250 Mbps - 7.6 Gbps	4K x 24 / $2K^2$ x 24 / 2K x 24	Digital Cinema
200 Mbps - 3 Gbps	HD^2 x 24/25/30	Stereo HD
20 Mbps - 1.5 Gbps	HDTV x 24/25/30/60	HDTV
5 - 25 Mbps	HDV x 24/25/30/60	Consumer HD

Why is more resolution is better?
1. More Resolution Allows Closer Viewing of Larger Image
2. Closer Viewing of Larger Image Increases Viewing Angle
3. Increased Viewing Angle Produces Stronger Emotional Response

HDTV (2K)

1920

1080

30°

3.0 × Picture Height

UHDTV(8K)

7680

4320

SHD (4K)

3840

2160

0.75 × Picture Height

100°

60°

1.5 × Picture Height

Yutaka TANAKA
SHARP CORPORATION
Advanced Image Research Laboratories

CineGrid

Moving Big Data Objects Globally

☐ **Digital Motion Picture for Audio Post-Production**
- 1 TV Episode Dubbing Reference ~ 1 GB
- 1 Theatrical 5.1 Final Mix ~ 8 GB
- 1 Theatrical Feature Dubbing reference ~ 30 GB

☐ **Digital Motion Picture Acquisition**
- 4K RGB x 24 FPS x 10bit/color: ~ 48MB/Frame uncompressed *(ideal)*
- 6:1 ~ 20:1 shooting ratios => 48TB ~ 160TB digital camera originals

☐ **Digital Dailies**
- HD compressed MPEG-2 @ 25 ~ 50 Mb/s

☐ **Digital Post-production and Visual Effects**
- Gigabytes - Terabytes to Select Sites Depending on Project

☐ **Digital Motion Picture Distribution**
- Film Printing in Regions
  - ☐ Features ~ 8TB
  - ☐ Trailers ~ 200GB
- Digital Cinema Package to Theatres
  - ☐ Features ~ 100 - 300GB per DCP
  - ☐ Trailers ~ 2 - 4GB per DCP

"Learning by Doing"
Early CineGrid Projects

CineGrid @ iGrid 2005

CineGrid @ AES 2006

CineGrid @ Holland Festival 2007

CineGrid @ GLIF 2007

CineGrid Exchange

- TERABYTES PILING UP. To store & distribute its own collection of digital media assets. Members access materials for experiments and demonstrations.

- Create global-scale testbed = high quality media assets + distributed storage + fast networks.

- Enable exploration of strategic issues in digital media storage, access, distribution and preservation – for cinema, scientific visualization, medical imaging, etc.

- THE DIGITAL DILEMMA. Report published by Academy of Motion Picture Arts and Sciences 2007

THE DIGITAL DILEMMA

CineGrid

Multi-user distributed collaboration at UIC/EVL
scalable Vizcasting and distributed GUI using SAGE

4K/2K multipoint interactive telepresence

live 4K JPEG 2000 streaming over IP

Keio@Tokyo ◂┄┄▸ EVL@Chicago ◂┄┄▸ Calit2@San Diego

CineGrid™

8K x 2K x 60p live remote sensing
dual 4K/60p cameras & dual 4K JPEG 2000 codecs
synchronized 4K JPEG 2000 streaming over IP
Monterey Bay Aquarium ·····➤ NPS@Monterey ·····➤ Calit2@San Diego

CineGrid™

4K interactive digital cinema color grading
realtime 4K uncompressed streaming over IP
◄·······►
CinePOST@Prague   Calit2@San Diego

Tele-collaboration for audio post-production
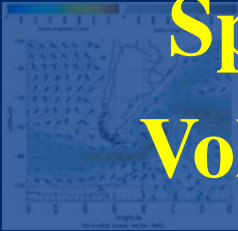realtime picture and sound editing synchronized over IP

Skywalker Sound@Marin ◀······▶ Calit2@San Diego

... more data!

Internet developments

Speed
Volume

Deterministic
Real-time ...re realtime!

Scalable
Secure
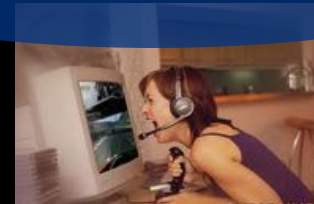
... more users!

We investigate: TomTom for complex networks!

CineGrid Network 2011

Keio Univ./DMC

UIUC/NCSA

Northwestern Univ.

Univ. Amsterdam

Waag

sara

NTT

Univ. Washington

UIC/EVL

Ryerson Univ.

KTH

Tohoku Univ.

Seattle

Chicago

Amsterdam

Poznan

Tokyo

CinePost

Los Angels

KAIST

HK Cyberport

USC

NPS

Digital Domain

Sao Paolo

Mackenzie Univ.

AMPAS

UCSD/CALIT2

Lucasfilm

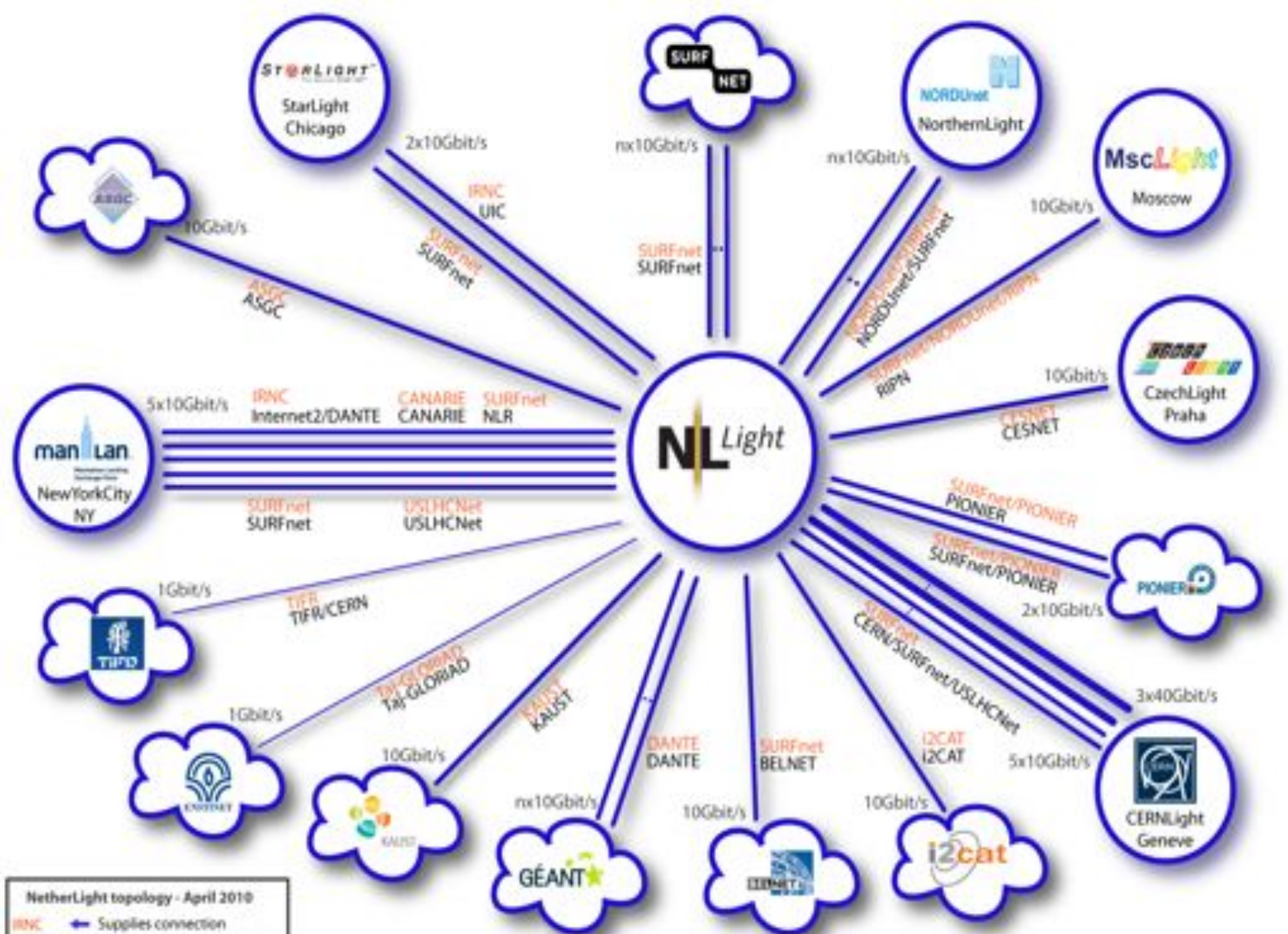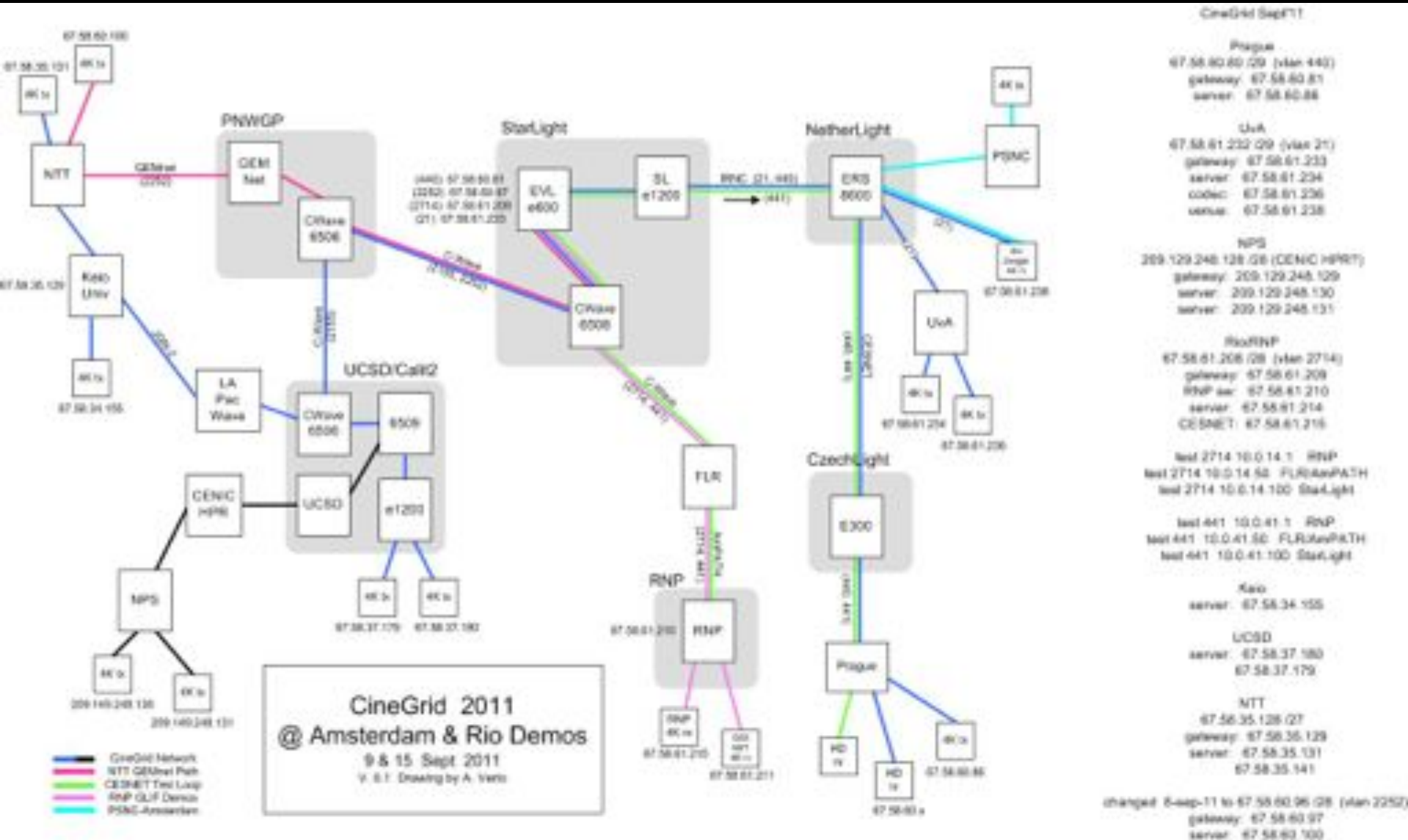Disney
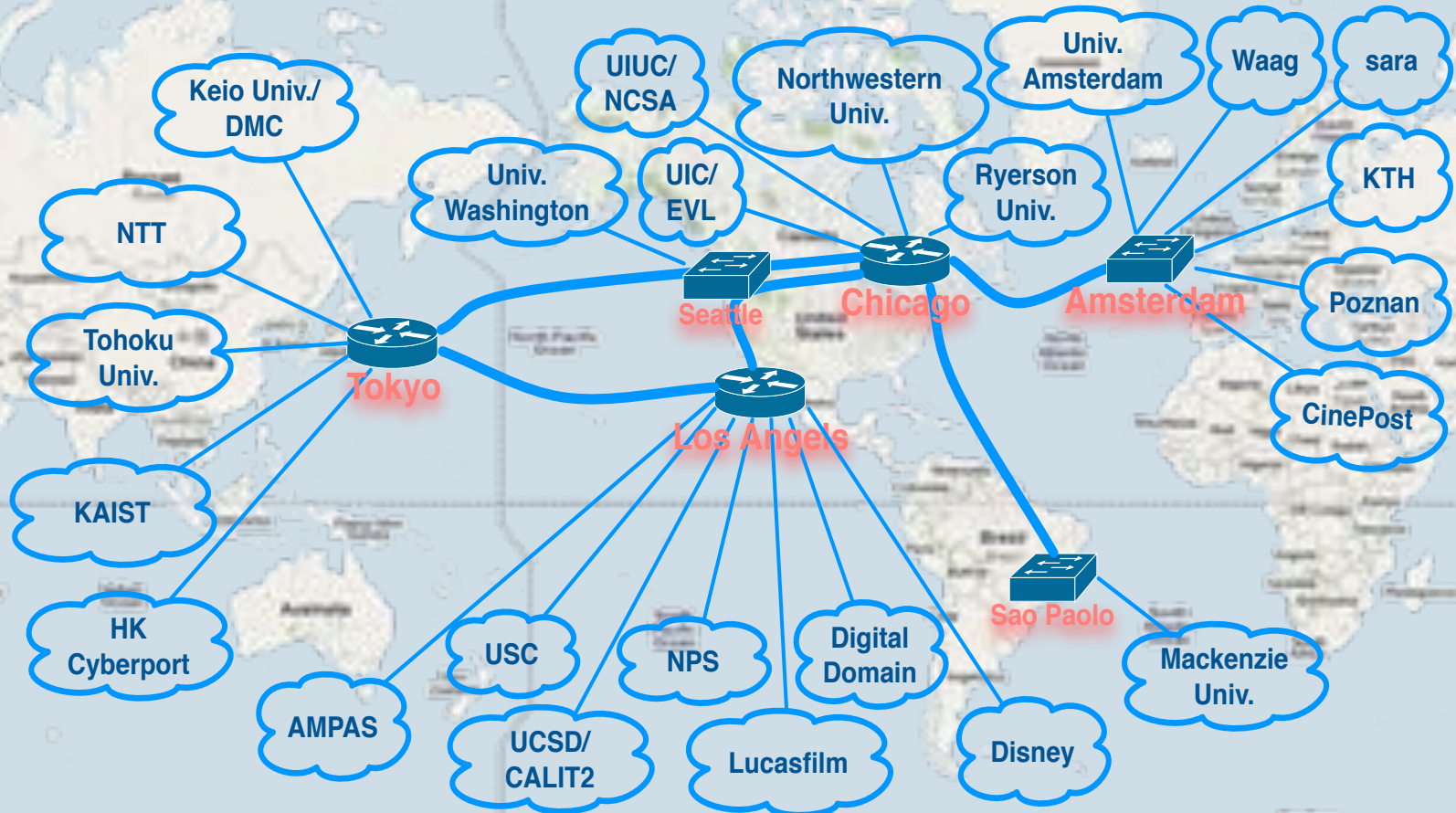
Network Resources are kindly provided by:
AMPATH, C-Wave, CANARIE, CaveWave, CENIC, CESNET, CzechLight, GEMNET, Internet2, JANET, JGN2plus, NetherLight, NLR, NORDUnet, PacificWave, PNWGP, RNP, StarLight, SOL, SURFnet, TransLight/StarLight, T-LEX, WIDE
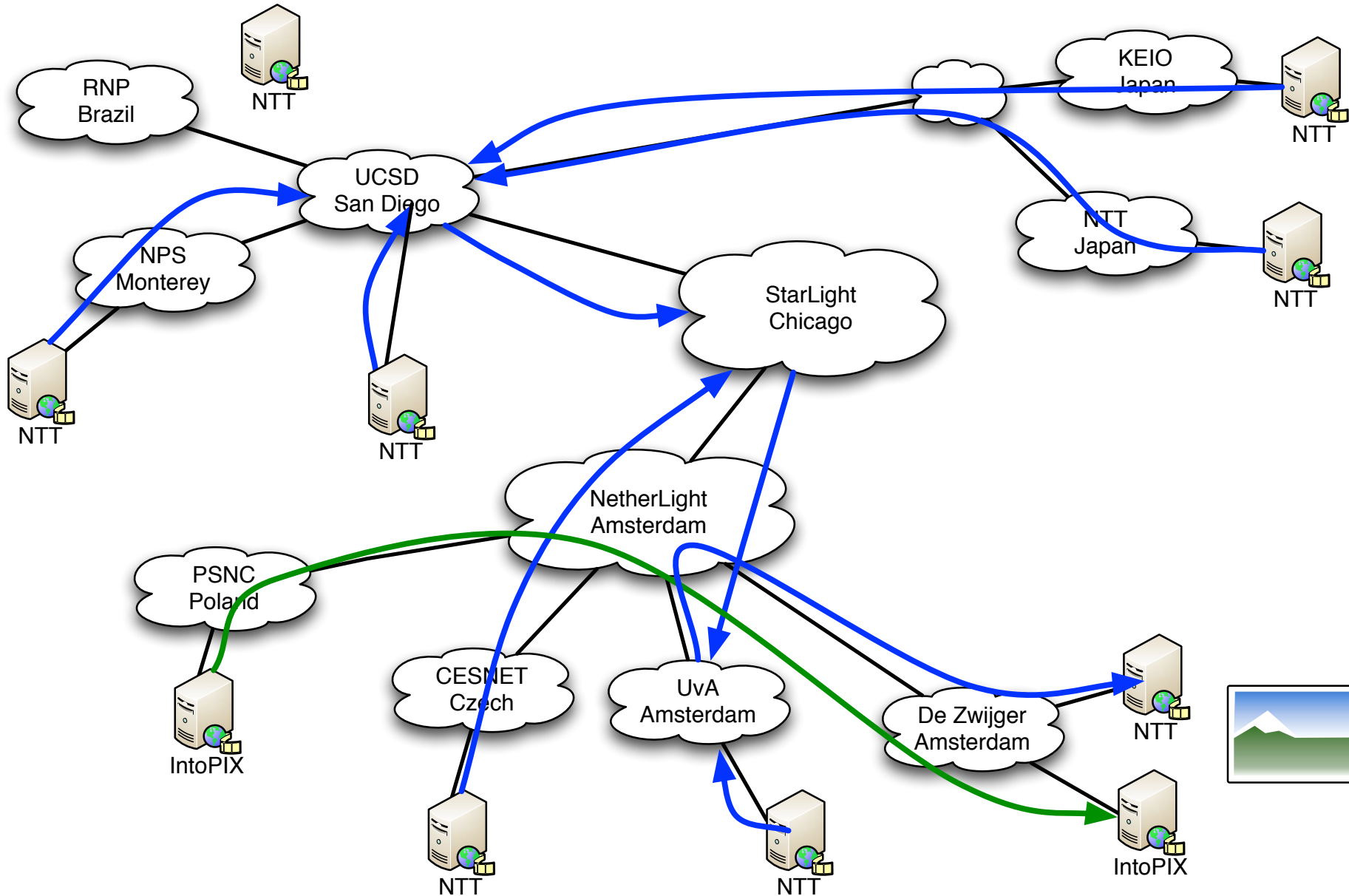
NetherLight topology - April 2010

StarLight Chicago

SURF NET

NORDUnet NorthernLight

MscLight Moscow

ASGC

2x10Gbit/s

IRNC UIC

SURFnet SURFnet

nx10Gbit/s

SURFnet SURFnet

nx10Gbit/s

NORDUnet/SURFnet

10Gbit/s

RPN

CzechLight Praha

10Gbit/s

10Gbit/s ASGC ASGC

NL Light

CESNET CESNET

5x10Gbit/s

IRNC Internet2/DANTE

CANARIE CANARIE

SURFnet NLR

manLan NewYorkCity NY

SURFnet SURFnet

USLHCNet USLHCNet

SURFnet/PIONIER PIONIER

SURFnet/PIONIER SURFnet/PIONIER

PIONIER

2x10Gbit/s

1Gbit/s

TIFR TIFR/CERN

SURFnet CERN/SURFnet/USLHCNet

TIFD

1Gbit/s

TIFR/GLORIAD TIFR GLORIAD

KAUST KAUST

10Gbit/s

DANTE DANTE

SURFnet BELNET

i2CAT i2CAT

3x40Gbit/s

5x10Gbit/s

CERNLight Geneve

KAUST

nx10Gbit/s

GÉANT

10Gbit/s

i2cat

10Gbit/s

NetherLight topology - April 2010

IRNC   ←→ Supplies connection

SURFnet ←→ Controls usage of connection

More info: admin@netherlight.net

CINEGRID AMSTERDAM

Research-, development- and outreach facility for production, transport and projection of digital cinema:

- Digital projection and sound in very high quality
- Editing and capture facilities
- Rendering & disk space
- Extremely high quality networks

In the center of Amsterdam

International context

- Focus on spin-offs & lasting value

CINEGRID AMSTERDAM GOALS

Assemble technology, science, art and education to create new concepts, pilots & business models that result in:

- New forms of storytelling
- New domains for scientific exploration
- Transformation of workflows in creative media production
- Better education
- Enhanced economic growth

PARTNERS

CONSORTIUM PARTNERS

SURFnet, UvA, SARA, Dutch Film- and Television Academy, DELL, TNO, Holland Festival, Blender Institute, Sandberg Institute, MediaGuild, Waag Society

COLLABORATORS

Poznan Supercomputing Center, Amsterdam Innovatie Motor, UCSD, University of Illinois, NHK, KTH, KEIO University, Pathé Benelux, Filmmuseum, Salto, Nationale Computer Faciliteiten, IDFA, BeamSystems, ISOC, IDFA, DutchView, PICNIC, GridForum and many more

RESOURCES

CineGrid Studio for 4K postproduction

- 100 TB of Highly Connected Storage Space
- High Performance Render Cluster
- 3 * 4K Screens and
- 1 – 10 Gb/s light path connections

Expertise in

- Production
- Encoding
- Transmission
- Screening

SO FAR

Mediapark Jaarcongres '08 '09 '10

Holland Animation Film Festival

Holland Festival '07 & '10

Content, content content..

Educational contest

4K How to Cookbook

PICNIC '08 & '09

SURFnet GigaPort

Workshops 4K

ICT Delta '09

BeamLab

Handelingen
Maarten de Heer

SEEING IS BELIEVING

Red End

Robin Noorda & Bethany de Forest

STEREO 4K Recording
Viktoria Mullova
Holland Festival 2010

Scientific Publications: FGCS Special Issue on CineGrid!

Volume 27, Issue 7, june 2011

Guest Editors: Naohisa Ohta & Paul Hearty & Cees de Laat

Editorial: CineGrid: Super high definition media over optical networks.

1. Real-time long-distance transfer of uncompressed 4K video for remote collaboration.
2. Media Network (HPDMnet): An advanced international research initiative and global experimental testbed.
3. Producing and streaming high resolution digital movies of microscopic subjects.
4. Enabling multi-user interaction in large high-resolution distributed environments.
5. Tri-continental premiere of 4K feature movie via network streaming at FILE 2009.
6. A collaborative computing model for audio post-production.
7. Design and implementation of live image file feeding to dome theaters.
8. Beyond 4K: 8K 60p live video streaming to multiple sites.
9. Using ontologies for resource description in the CineGrid Exchange.
10. CineGrid Exchange: A workflow-based peta-scale distributed storage platform on a high-speed network.
11. CSTP: A parallel data transfer protocol using cross-stream coding.
12. Multi-point 4K/2K layered video streaming for remote collaboration.

CineGrid-Amsterdam is supported by

City of Amsterdam, Pieken in de Delta

EFRO / Kansen voor West, Province of Noord-Holland

www.cinegrid.nl

CineGrid International Workshop 2010

CineGrid 2011 in San Diego
December 4 - 7