CineGrid
Global Experimental Facility for very high quality digital Cinema

CineGrid R&D in Holland

Cees de Laat
CineGrid.org founding member

University of Amsterdam
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/
Cinema combines art and science, culture and commerce, increasingly digital

- In California alone, movie industry employed 245,000 with $17 billion payroll in 2005.
- Movie-making is going global. Local talent is key!
- Regional and international networks become “infrastructure incentives” for media companies to attract cinema jobs and deliver results worldwide.

Photo: Naohisa Ohta
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; 24/25/30fps; 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
Why is more resolution 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

- UHDTV (8K)
- HDTV (2K)
- SHD (4K)
Keio/Calit2 Collaboration: Trans-Pacific 4K Teleconference

Like High-Def? Here Comes the Next Level

By JOHN MARKOFF
Published: September 26, 2005

Keio University
President Anzai

Sony
NTT
SGI

Used
1Gbps
Dedicated

UCSD
Chancellor Fox

iGrid 2005
CineGrid @ Holland Festival 2007

Era la Notte, June 20-21, 2007 (Live!)
Swimming Fiber the Last 500m
CineGrid @ GLIF 2007 (Prague)
CineGrid: A Scalable Approach

- **1 - 24 Gbps**
  - 8K x 60

- **500 Mbps - 15.2 Gbps**
  - 4K² x 24/30
  - SHD x 24/25/30

- **250 Mbs - 6 Gbps**
  - 4K x 24
  - 2K² x 24
  - 2K x 24

- **250 Mbps - 7.6 Gbps**
  - HD² x 24/25/30

- **200 Mbps - 3 Gbps**
  - HDTV x 24/25/30/60

- **20 Mbps - 1.5 Gbps**
  - HDV x 24/25/30/60

- **5 - 25 Mbps**
  - More

- **Tiled Displays**
  - Camera Arrays

- **UHDTV (far future)**

- **Stereo 4K (future)**

- **SHD (Quad HD)**

- **Digital Cinema**

- **Stereo HD**

- **HDTV**

- **Consumer HD**
Formats - Numbers - Bits
<table>
<thead>
<tr>
<th>Format</th>
<th>X</th>
<th>Y</th>
<th>Rate</th>
<th>Color bits/pix</th>
<th>Frame #pix</th>
<th>Frame MByte</th>
<th>Flow MByt/s</th>
<th>Stream Gbit/s</th>
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<tbody>
<tr>
<td>720p HD</td>
<td>1280</td>
<td>720</td>
<td>60</td>
<td>24</td>
<td>921600</td>
<td>2.8</td>
<td>170</td>
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<td>1080p HD</td>
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<td>1080</td>
<td>30</td>
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<td>1080</td>
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<td>36</td>
<td>2211840</td>
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<td>480</td>
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<td>2160</td>
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<td>24</td>
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<td>2160</td>
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<td>36</td>
<td>8847360</td>
<td>40</td>
<td>960</td>
<td>7.6</td>
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</tbody>
</table>

Note: this is excluding sound!
Note: these are raw uncompressed data rates!
Number, numbers and more numbers!

- **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**
  - 6:1 up to 20:1 shooting ratios
  - 4k @ 24 FPS @ 10bit/color: ~48MB/Frame uncompressed
  - ~8TB for Finished 2 Hr Feature

- **Digital Dailies**
  - HD compressed MPEG-2 @ 25Mb/s
  - Data Size: ~22GB for 2 Hours

- **Digital Post-production and Visual Effects**
  - Terabytes, Gigabytes, Megabytes To Select Sites Depending on Project

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

- **Online Download**
  - Features ~1.3GB
  - TV Shows ~600MB
Requirements

• Different applications, different traffic modes:
  – Conferencing - full duplex
    • typically low latency compressed, low jitter
  – from camera/production to (deep) store/forward
    • rough compression, needs transcoding, near real time
  – from store to theater or tiled display
    • compressed or uncompressed
  – from movie production to editing facility
    • no compression!
  – shared working environments
    • low jitter, no compression
Role of UvA

• Founding member CineGrid
• Linking communities (CALIT(2), EVL, NTT, Keio University) to local organizations (SURFnet, SARA, de Waag, you!)
• System and Network Engineering
  – optical photonic networks
  – store & forward (100 terabyte experimental server)
  – AAA & security
  – grid for processing
• Metadata and make it searchable (MM)
GLIF: Global Lambda Integrated Facility
Amsterdam CineGrid S/F node

“COCE”

DAS-3 @ UvA

DP AMD processor nodes

comp node

head node

bridge node

bridge node

bridge node

bridge node

bridge node

bridge node

bridge node

comp node

NetherLight, StarPlane the cp testbeds and beyond

NORTEL 8600 L2/3 switch

F10 L2/3 switch

GlimmerGlass photonic switch

Opteron 64 bit nodes

head node

comp node

comp node

comp node

comp node

comp node

comp node

comp node

comp node

comp node

comp node

comp node

comp node

streaming node

8 TByte

Node 41

Rembrandt Cluster total 22 TByte disk space @ LightHouse

suitcees & briefcees

10 Gbit/s

10 Gbit/s

10 Gbit/s
R & D

• interface portal to storage (supertube.org)
• interface portal to PBT enabled testbed and Netherlight / SURFnet_6.0
• near real time transcoding on DAS-3
• scalable streaming via bridgenodes
• embedding in semantic web
• Access control / security
• content management / deep storage / repositories
• Disk -> network performance
RDF describing Infrastructure

Application: find video containing x, then trans-code to it view on Tiled Display

see talk of Paola Grosso
Questions?

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