Cees de Laat

CineGrid Amsterdam

Many slides from partners & CineGrid.org
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/
## CineGrid: A Scalable Approach

<table>
<thead>
<tr>
<th>Bandwidth (Gbps)</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.02 - 3</td>
<td>HD² x 24/25/30</td>
</tr>
<tr>
<td>0.25 - 7.6</td>
<td>2K² x 24</td>
</tr>
<tr>
<td>0.02 - 96</td>
<td>4K x 24</td>
</tr>
<tr>
<td>20 - 192</td>
<td>8K x 60/120</td>
</tr>
<tr>
<td>12 - 1500</td>
<td>HDTV x 24/25/30/60</td>
</tr>
<tr>
<td>4 - 25</td>
<td>HDV x 24/25/30/60</td>
</tr>
<tr>
<td>0.25 - 7.6</td>
<td>SHD (Quad HD)</td>
</tr>
<tr>
<td>0.02 - 96</td>
<td>Stereo 4K (future)</td>
</tr>
<tr>
<td>20 - 192</td>
<td>UHDTV (far future)</td>
</tr>
<tr>
<td>12 - 1500</td>
<td>HDTV</td>
</tr>
<tr>
<td>4 - 25</td>
<td>Consumer HD</td>
</tr>
<tr>
<td>0.02 - 3</td>
<td>Stereo HD</td>
</tr>
<tr>
<td>0.25 - 7.6</td>
<td>Digital Cinema</td>
</tr>
<tr>
<td>0.02 - 3</td>
<td>More</td>
</tr>
<tr>
<td>0.25 - 7.6</td>
<td>Tiled Displays</td>
</tr>
<tr>
<td>0.02 - 96</td>
<td>Camera Arrays</td>
</tr>
</tbody>
</table>

### Notes on Bandwidths:
- 0.02 - 3 Gbps: Suitable for HD and SHD (Quad HD) resolutions.
- 0.25 - 7.6 Gbps: Ideal for 2K and 4K resolutions.
- 0.02 - 96 Gbps: Suitable for UHD and UHD² resolutions.
- 20 - 192 Gbps: Suitable for 8K and 12K resolutions.
- 12 - 1500 Gbps: Suitable for HDTV and HDTVx resolutions.
- 4 - 25 Gbps: Suitable for HDV and UHDx resolutions.

### Future Technologies:
- UHDTV (far future): Extremely high resolution for future displays.
- Stereo 4K (future): Advanced stereo imaging for immersive experiences.
- SHD (Quad HD): Quadruple HD resolution for enhanced visual quality.
- Tiled Displays: Multiple display panels arranged in a grid.
- Camera Arrays: Multiple cameras working together to capture broader views.
The GLIF – LightPaths around the World partnering with CineGrid building CGX’s on Lambda’s
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
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
RESOURCES

CineGrid Studio for 4K postproduction
- 100 TB of Highly Connected Storage Space - Ams-CGX
- High Performance Render Cluster
- 3 * 4K Screens and
- 1 – 100 Gb/s light path connections

Expertise in
- Production
- Encoding
- Transmission
- Screening
“Learning by Doing”
Early CineGrid Projects in Amsterdam

Red End 2009
7 Bridges @ Amsterdam 2007
CineGrid @ Holland Festival 2007
First 4k Camera on canal 2007
Handelingen
Maarten de de Heer
SO FAR

CineGrid 2011 & 2012
One minutes
Mediapark Jaarcongres ’08 ’09 ’10
Holland Animation Film 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
CineGrid Portal

Unified orchestration of distributed CineGrid resources
HyberFlow

Encoding times improve as the end nodes are connected via dynamic lightpaths

C. Dumitru, Z. Zhao, P. Grosso and C. de Laat

HybridFlow: Towards Intelligent Video Delivery and Processing Over Hybrid Infrastructures
(In CTS 2013)
Processing CineGrid with Clouds
A queuing model approach

Process large amount of independent data
• Bags-of-Tasks + Data = Bags-of-Data
• Example: Image processing
• Independent files
• Large sizes (10-100s of MBs)

Idea: rent resources
• scaling up (more resources)
• scaling out (more powerful resources)
• Which option?
• How many?

Requirements:
• Within time
• Within budget
• Simple, if possible

Diagram:
- Workload Creation
- Resource pool selection
- Sampling Phase
- Execution Phase
- Schedule Selection
- List of Optimal Schedules
Processing in the Cloud: Mean Value Analysis, Pareto fronts

Cosmin Dumitru, Ana-Maria Oprescu, Miroslav Zivkovic, Rob van der Mei, Paola Grosso, Cees de Laat, "A Queueing Theory Approach to Pareto Optimal Bags-of-Tasks Scheduling on Clouds", August 27 2014, Euro-Par 2014, Porto, Portugal
Directing Remote Live Shoot of Virtual Set Acting with Live Compositing in the Cloud

Live action camera, actors, green screen at NFTA (Amsterdam #1)
Virtual set compositing at SARA (Amsterdam #2)
Remote viewing and direction at UCSD/Calit2 Vroom (San Diego)
Real Time Rendering Workflow

Demo setup

- Three locations
  1) NFTA: greenscreen studio, Previzion, camera(+man), actress (+ dress)
  2) SARA: render node for keying, virtual scene rendering
  3) Calit2: keying controls, projection of final output, director
- Two lightpaths in between
- Video-conferencing for communication + low quality keying output back to NFTA

![Diagram showing the workflow]

- NFTA (Amsterdam, downtown)
- SARA (Amsterdam, Science Park)
- Calit2

1G Dyn.LP

- Camera + tracker
- capture PC
- Previzion

- Synchronisation of live feed & tracker data
- Render virtual scene

- Keying
- Display PC
- Projector

- Low-quality keying output
- compositing image
tracking data
live feed
virtual image
Movie Making on the GLIF

COMPOSITING IN THE CLOUD
Netherlands Film Academy
and SURFSARA present
a virtual Cinegrid demo

SAN DIEGO & AMSTERDAM
12 - 12 - 2012
an impression by Z
ROBIN NOORDA
One Minutes: Enchanting Detail Contest
One Minutes: stunning quality
Direction

- Distributed Comp -> Grid -> Cloud -> Big Data
- Lego Block approach
- Application as a Service
- Elastic Cloud
- Determinism & Real Time?
- CineGrid ToolBox
- Storage
- Deep Storage
- Very Deep Storage
Scientific Publications: FGCS Special Issue on CineGrid!
Volume 27, Issue 7, June 2011

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


1. Real-time long-distance transfer of uncompressed 4K video for remote collaboration.
3. Producing and streaming high resolution digital movies of microscopic subjects.
4. Enabling multi-user interaction in large high-resolution distributed environments.
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.
12. Multi-point 4K/2K layered video streaming for remote collaboration.
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www.cinegrid.nl