

**Cees de Laat** 

**On behalf of the CineGrid Amsterdam Collaboration**

**Laurin Herr, Pacific Interface Inc.**

**On behalf of Cinegrid.org**

**Many slides from partners & CineGrid.org**



# What is CineGrid?

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- ❑ 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 2013 International Workshop  
December 9 – 11, 2013  
San Diego, CA



# CineGrid Mission

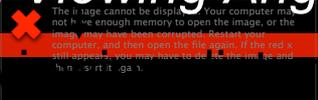
To build an interdisciplinary **community** that is focused on the **research, development, and demonstration** of **networked** collaborative tools to enable the production, **use** and **exchange** of very-high-quality digital media over **photonic networks**.

<http://www.cinegrid.org/>



# 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



UHDTV(8K)

7680



4320



0.75 x Picture Height



100°

HDTV (2K)

1080

1920



30°

3.0 x Picture Height



UHDTV(4K)

3840



2160



60°

1.5 x Picture Height

# 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





4K/2K multipoint interactive telepresence

live 4K JPEG 2000 streaming over IP

Keio@Tokyo ◀.....▶ EVL@Chicago ◀.....▶ Calit2@San Diego



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



4K interactive digital cinema color grading  
realtime 4K uncompressed streaming over IP

CinePOST@Prague



Calit2@San Diego





# Tele-collaboration for cinema post-production

Disney + Skywalker Sound + Digital Domain + Laser Pacific

NTT Labs + UCSD/Calit2 + UIC/EVL + Pacific Interface



# The Growing Documentary

## Lenses + Landscapes

- The first iteration of the Growing Documentary conceived and created by graduate students from KMD Keio University.
- Response to the devastation and aftermath of the Great East Japan Earthquake and Tsunami.
- Produced by crowd-sourcing the photographers, translators and audio via social networks.



**lenses+landscapes**  
A Growing Documentary about Tohoku

2011年10月25日 - 午後12時50分  
六本木ヒルズ49Fアカデミーヒルズオーデトリウム

DIRECTED BY JANAK BHIMANI, PRODUCED BY NAOHISA OHTA, EDITED BY ANNISA MAHDIA  
PHOTOGRAPHS BY KENSUKE MORI, MAX HODGES AND YUKOH NAKAMURA  
SPONSORED BY 慶應義塾大学大学院 メディアデザイン研究科 AND NTT未来ねっと研究所  
CONTACT : janak@kmd.keio.ac.jp

KEIO MEDIA DESIGN  
\*\*\*\*\*

TIFF TOKYO  
Cine 1  
gfm  
CineGrid  
NYT  
4K NARRATIVE

# The Growing Documentary

## Places + Perspectives

- Second iteration of Growing Documentary focussed on remote collaboration.
- International collaboration between graduate students from Keio Media Design, Keio University and undergraduate students from the Visual Arts Department at the University of California, San Diego.



# Places + Perspectives

A Growing Documentary in HD

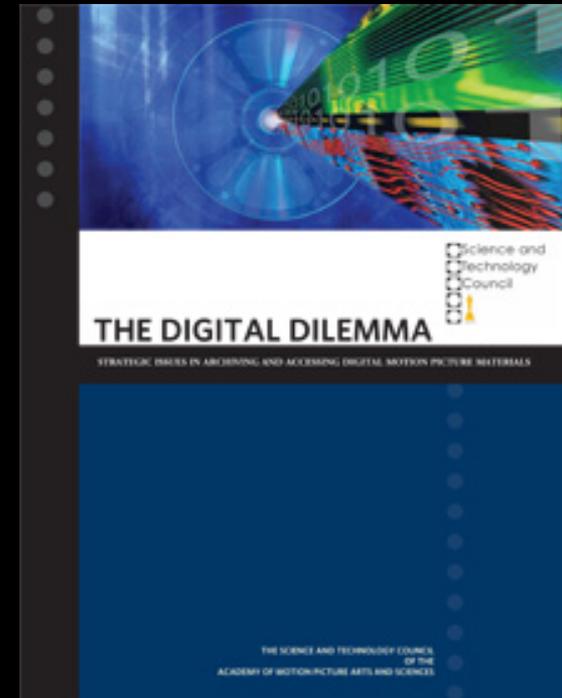
Keio University/KMD @ Hiyoshi  
UCSD/Calit2 @ San Diego



- Explore network-supported collaboration process
- Combine traditional production tools with emerging tools for media sharing, review and critique such as Vroom, CineSAGE & PIX
- Use cloud server for media transfer and storage
- Use multi-channel 4K/HD video teleconferencing for face-to-face discussions, context sharing and project development

# 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



# 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
- High Performance Render Cluster
- 3 \* 4K Screens and
- 1 – 100 Gb/s light path connections

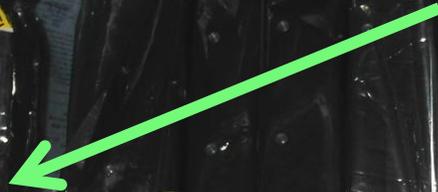
Expertise in

- Production
- Encoding
- Transmission
- Screening



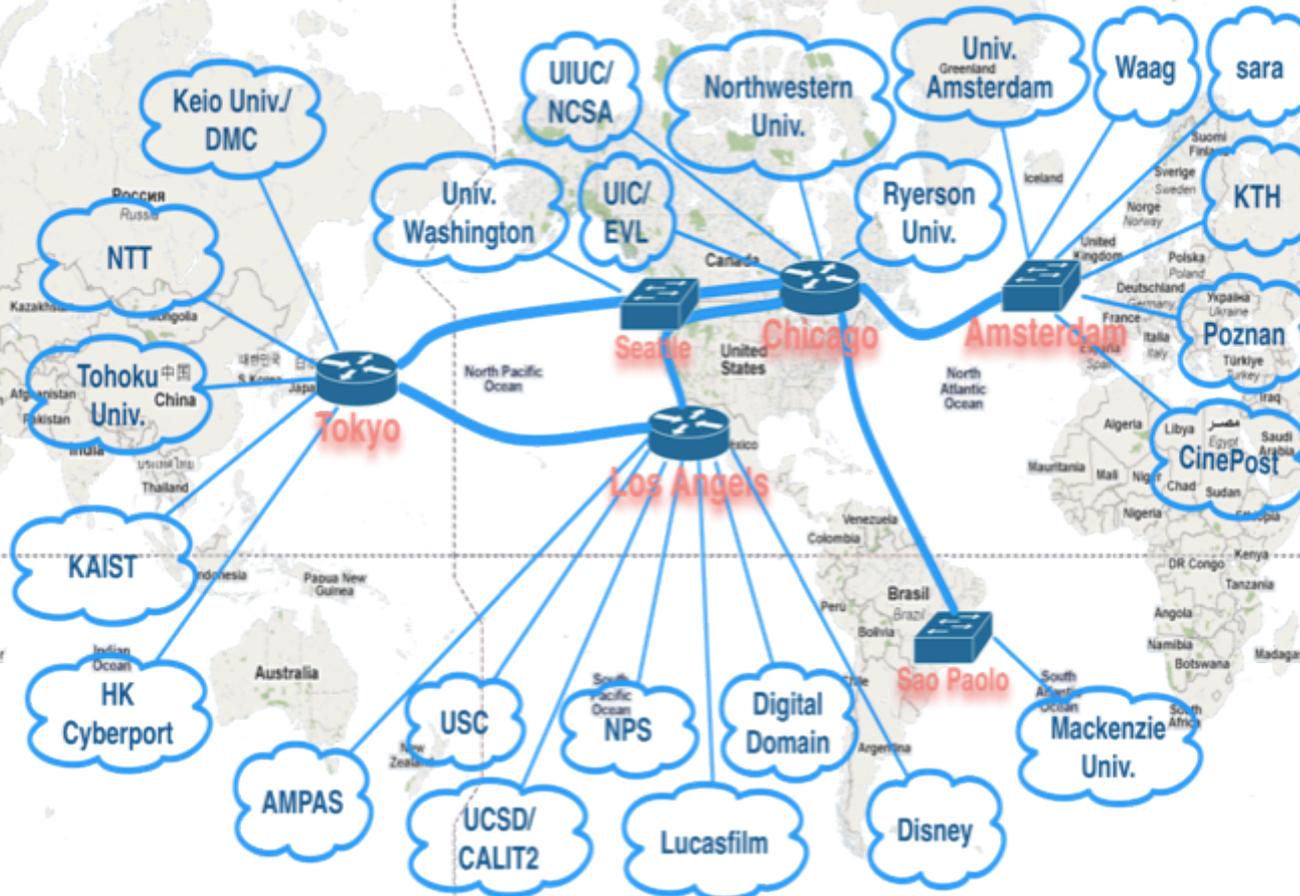
# Yesterday's Media Transport Method!

8 TByte





# CineGrid Network 2012

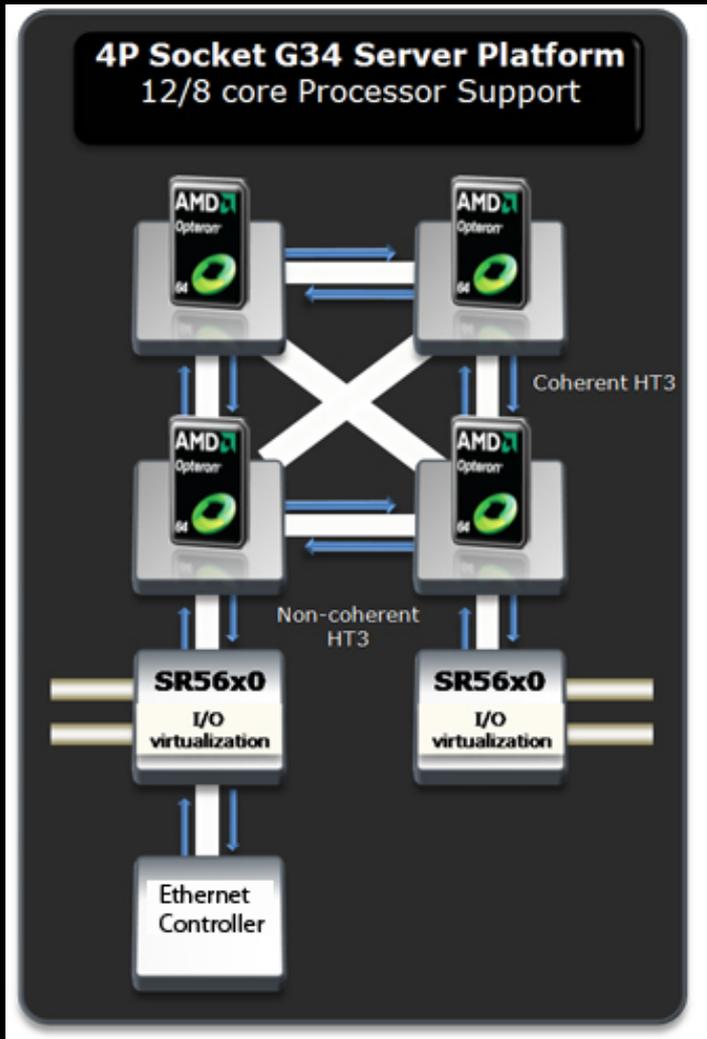


Network Resources are kindly provided by:

AMPATH, C-Wave, CANARIE, CaveWave, CENIC, CESNET, CzechLight, GEMNET, Internet2, JANET, JGN-X, NetherLight, NLR, NORDUnet, PacificWave, PNWGP, RNP, StarLight, SOL, SURFnet, TransLight/StarLight, T-LEX, WIDE

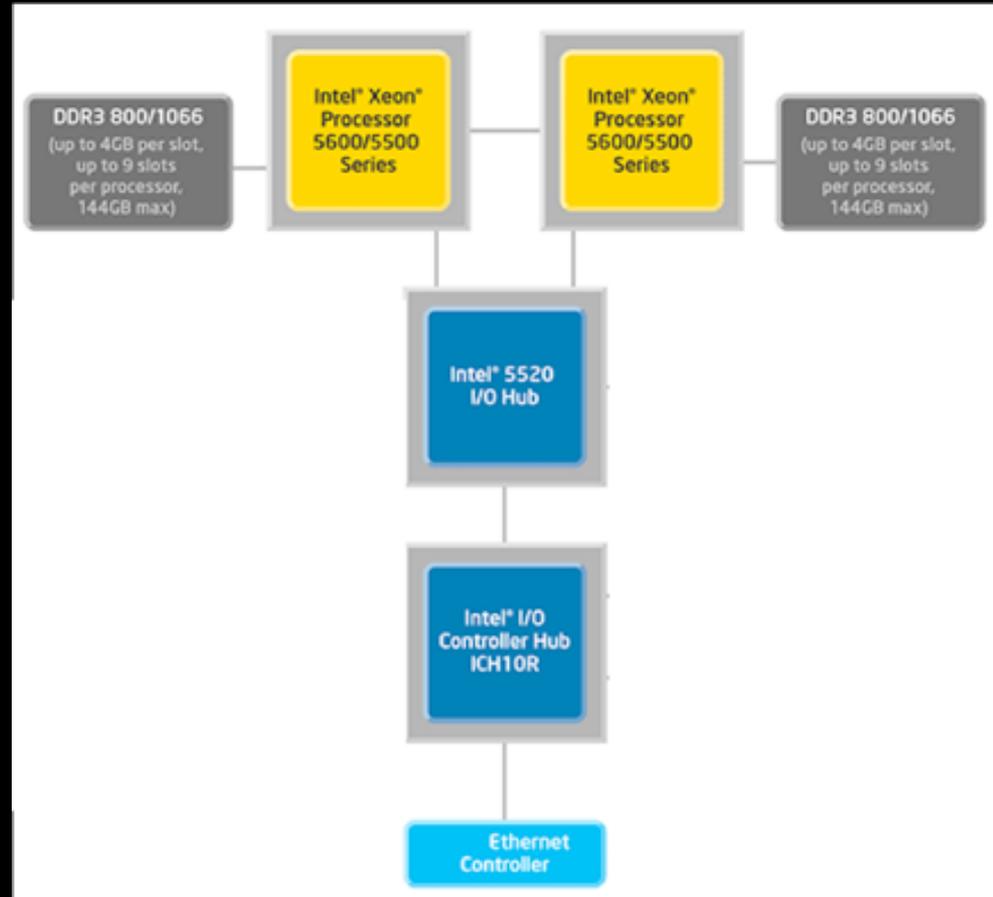
kaneko@dmc.keio.ac.jp, as of 2012/07/27

# Server Architecture



DELL R815

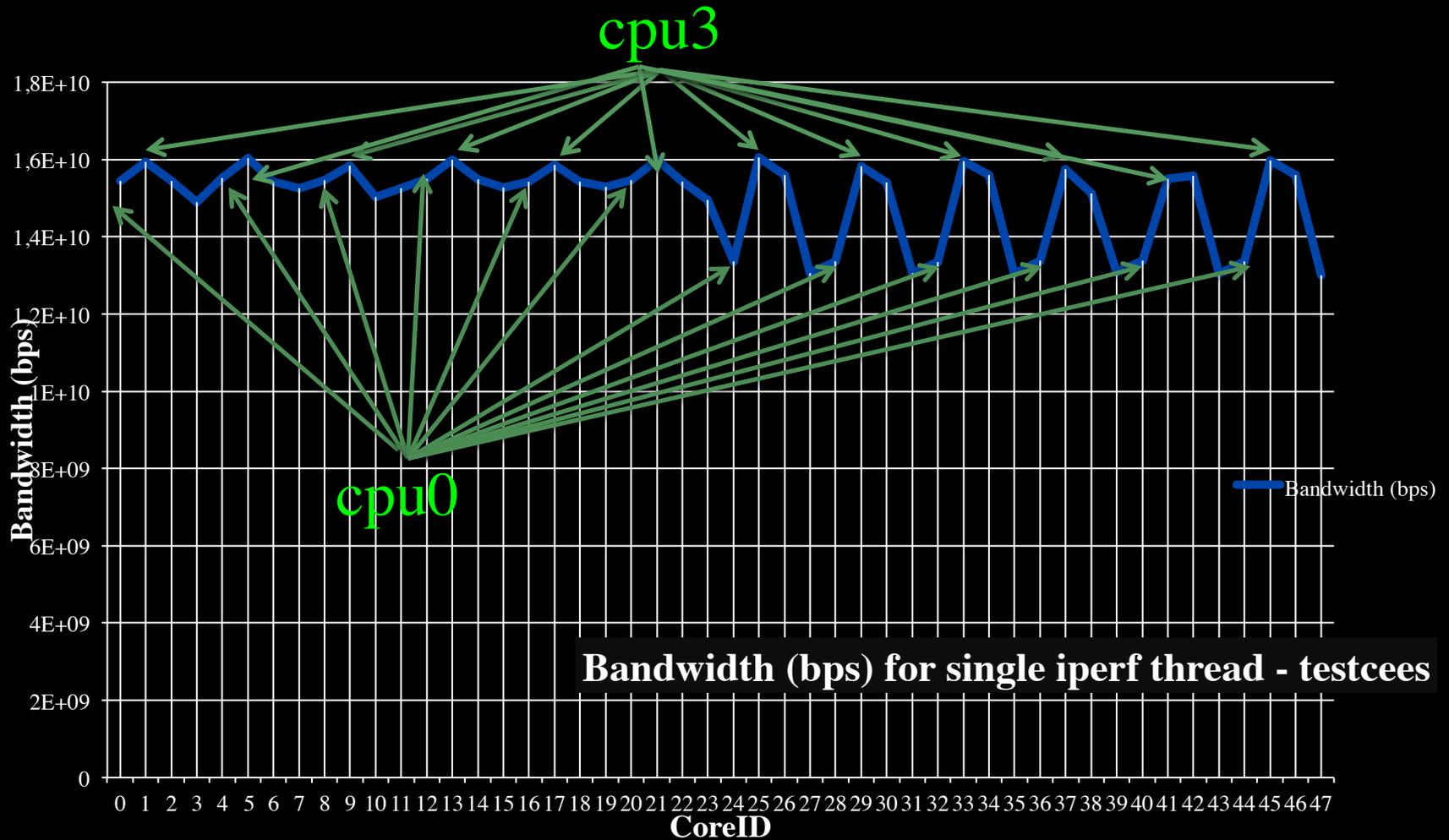
4 x AMD Opteron 6100



Supermicro X8DTT-HIBQF

2 x Intel Xeon

# CPU Topology benchmark



We used numactl to bind iperf to cores

- CineGrid 2011 & 2012
- One minutes
- 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



A large crowd of people is shown in a dimly lit setting, likely a theater or concert hall. Many individuals are holding binoculars to their eyes, and some are using cameras. The scene is captured in a cinematic style with a cool, blue-toned color palette. The focus is sharp on the people in the middle ground, while the foreground and background are slightly blurred, creating a sense of depth and immersion in the event.

**SEEING IS BELIEVING**



# Handelingen Maarten de Heer



**STEREO 4K Recording**  
**Viktorija Mullova**  
**Holland Festival 2010**



*Hey, sit still.*



*We're almost done. Sshh...*



# One Minutes: Enchanting Detail Contest

de **betoverende**  
oproep voor  
one minutes in **4K**  
Wedstrijd **detail**ende



# One Minutes: stunning quality





Why?



I want to:

“Show Big Bug Bunny in 4K on my Tiled Display using green Infrastructure”

- Big Bugs Bunny can be on multiple servers on the Internet.
- Movie may need processing / recoding to get to 4K for Tiled Display.
- Needs deterministic Green infrastructure for Quality of Experience.
- Consumer / Scientist does not want to know the underlying details.  
→ His refrigerator also just works.

# Greening the Processing System

***Positive proof of global warming.***



**18th  
Century**

**1900**

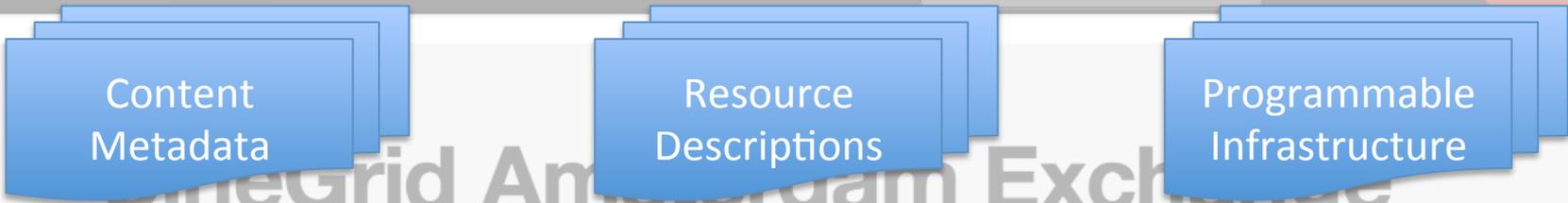
**1950**

**1970**

**1980**

**1990**

**2006**



Browse content



**Portal**

The purpose of this portal is to make the public familiar with super-high-quality video and to make the content more accessible for other CineGrid members.

**CineGrid**

Find out more about Cinegrid Amsterdam.

**Research**

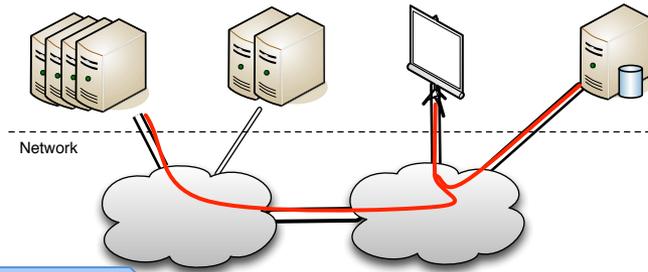
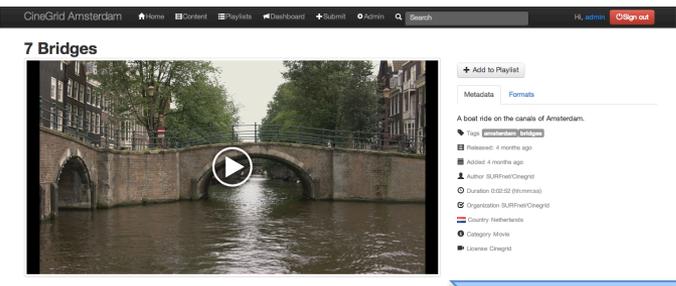
Find out more about the Cinegrid Description Language

**Infrastructure**

The Amsterdam node now has over 64 Terabytes of storage dedicated for CineGrid.

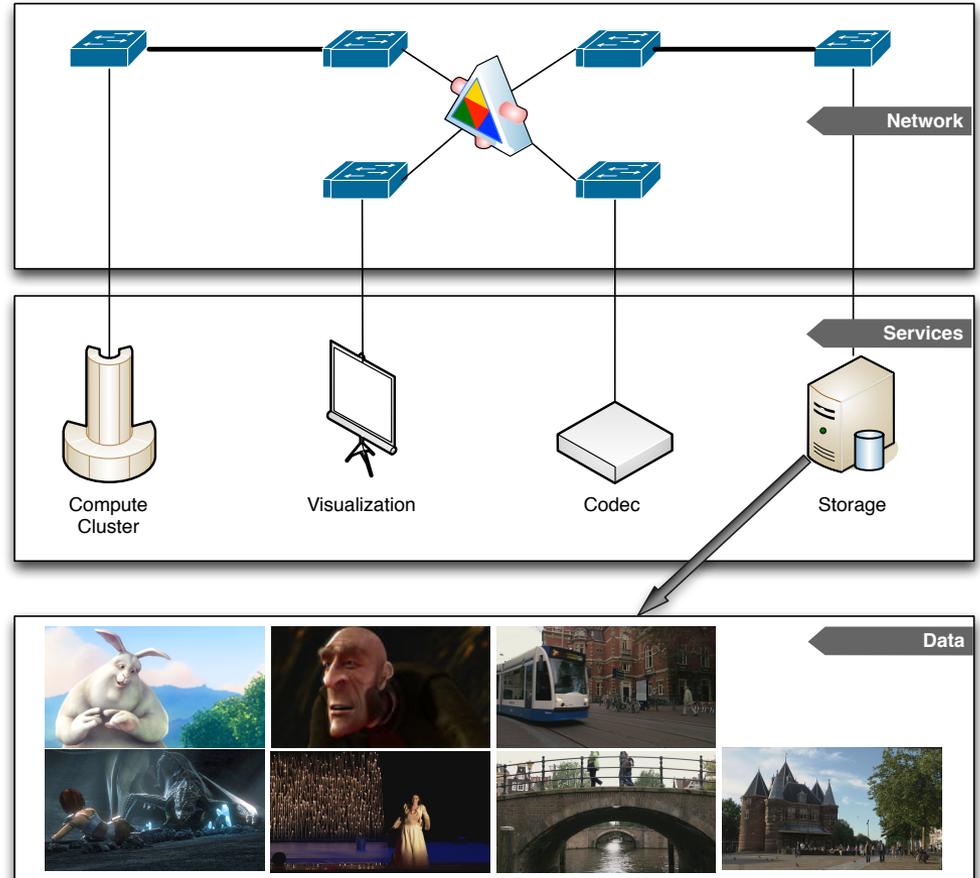
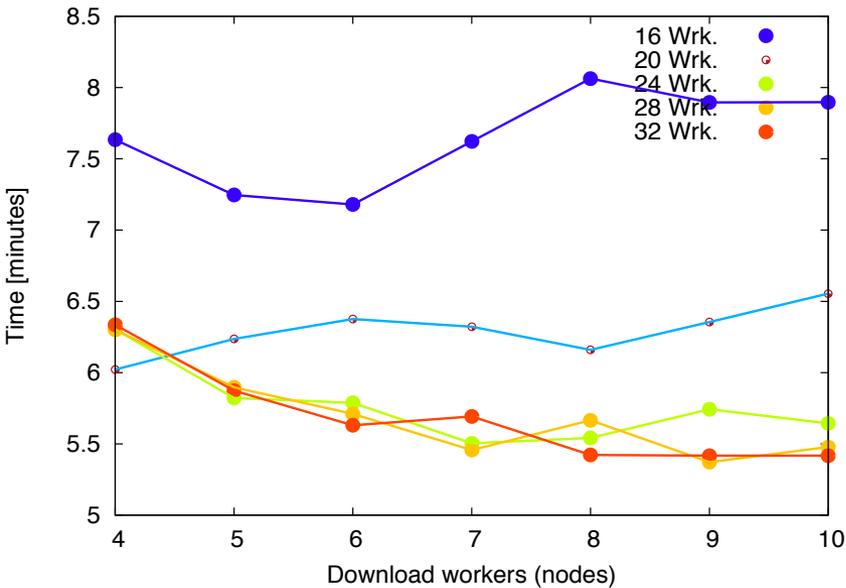
# CineGrid Portal

## Unified orchestration of distributed CineGrid resources



# HyperFlow

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

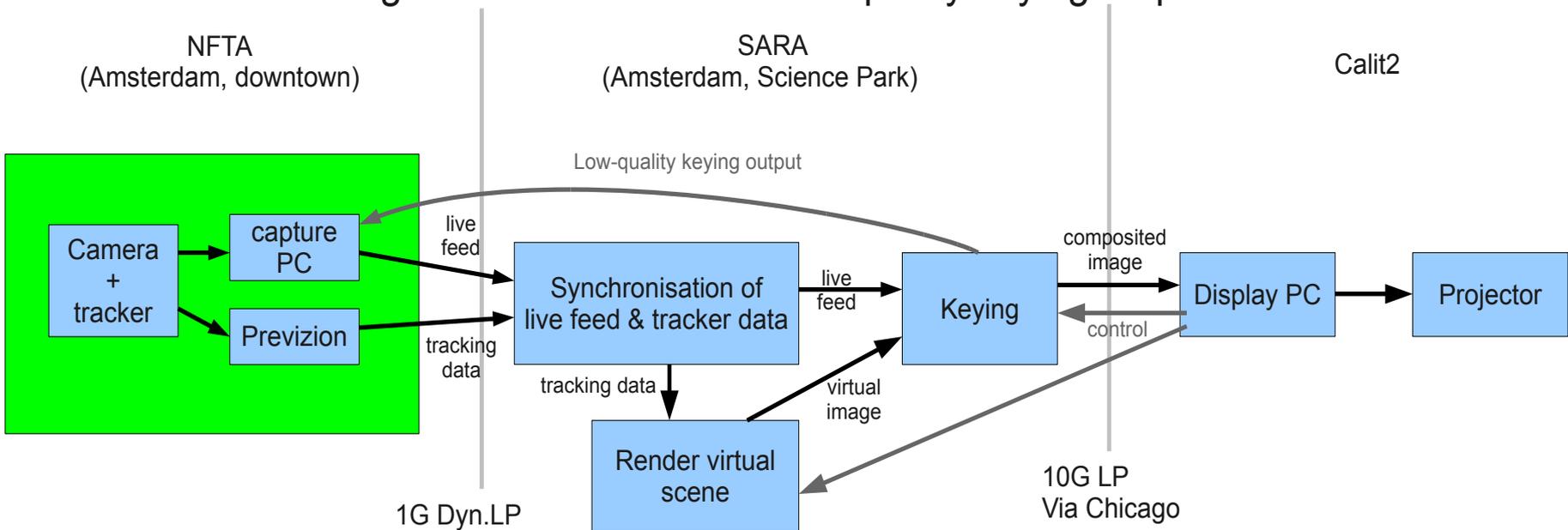


C. Dumitru, Z. Zhao, P. Grosso and C. de Laat  
*HybridFlow: Towards Intelligent Video Delivery and Processing Over Hybrid Infrastructures*  
 (In CTS 2013)

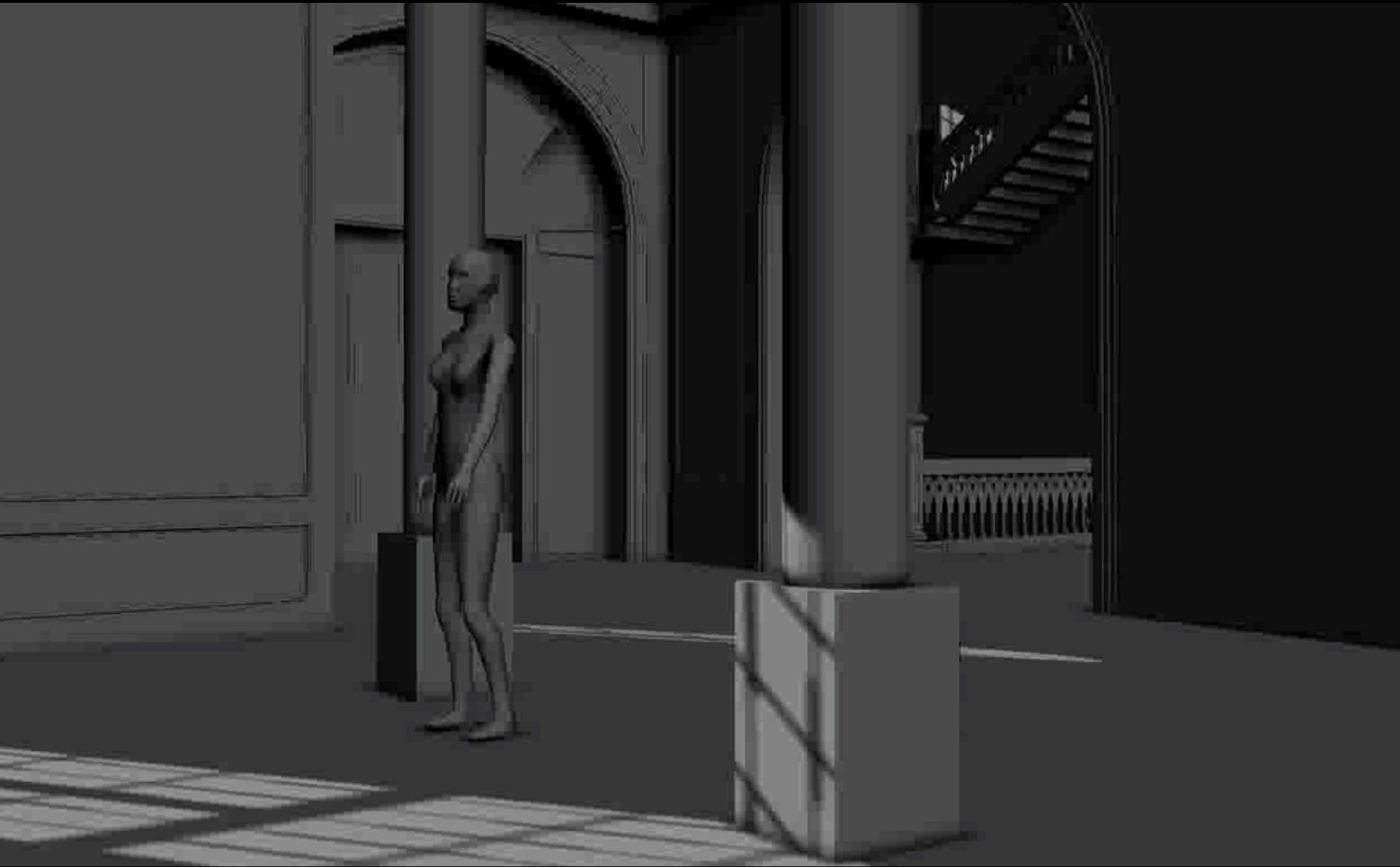
# Real Time Rendering Workflow

## 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









# 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)

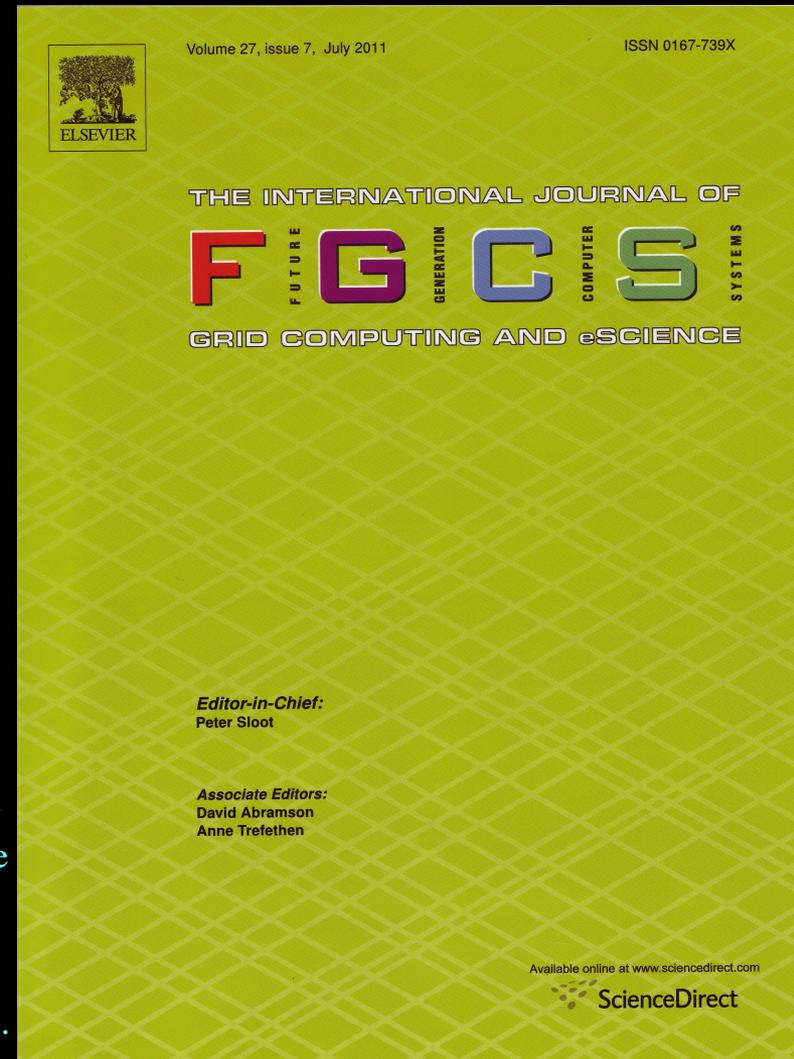
# Scientific Publications: FGCS Special Issue on CineGrid!

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. CSTEP: A parallel data transfer protocol using cross-stream coding.
12. Multi-point 4K/2K layered video streaming for remote collaboration.



# 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



# CineGrid-Amsterdam is supported by

City of Amsterdam, Pieken in de Delta

EFRO / Kansen voor West, Province of Noord-Holland



**X**  
**X**  
**X** Gemeente  
Amsterdam



[www.cinegrid.nl](http://www.cinegrid.nl)