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™

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

CineGrid™

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

CineGrid™
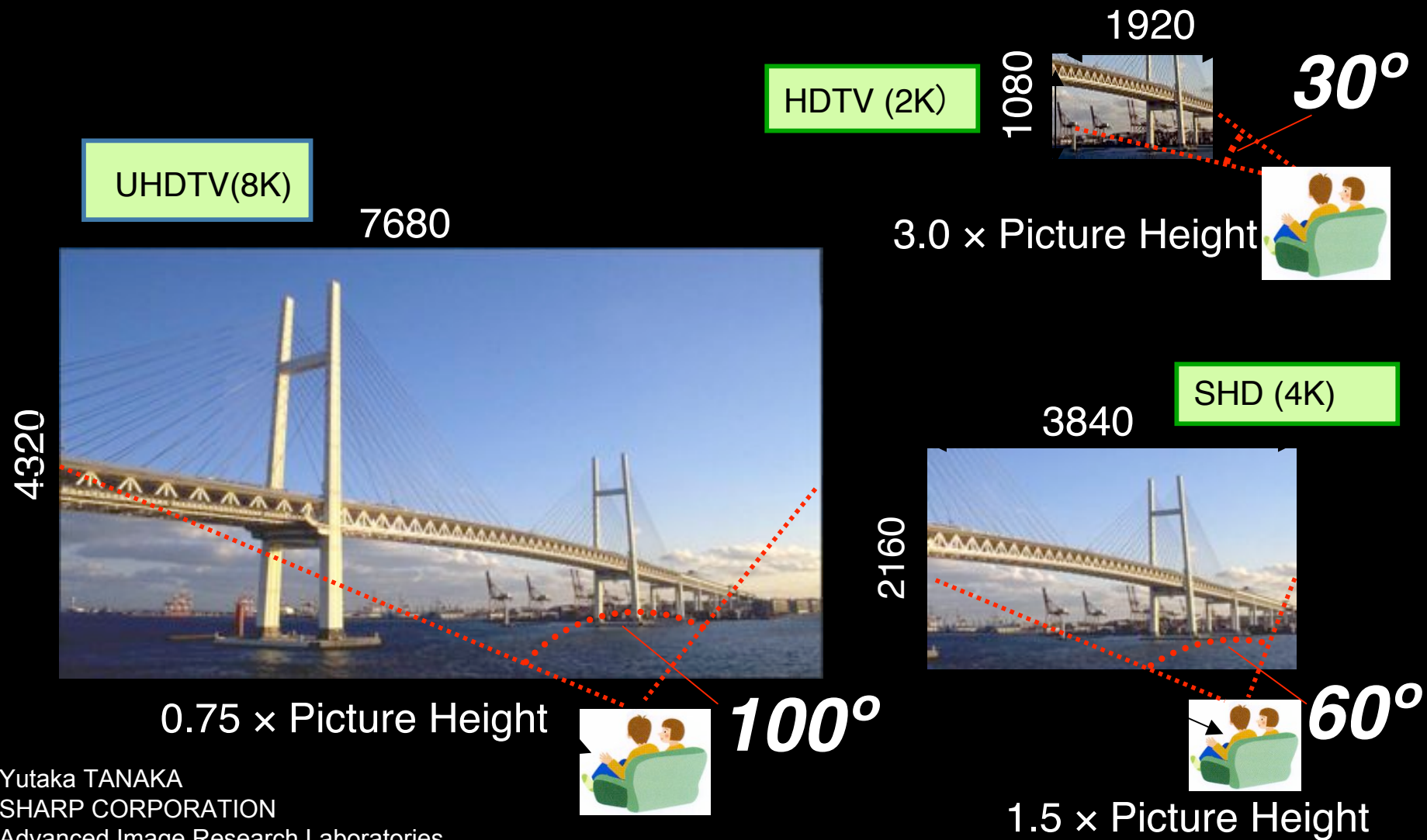
Keio/Calit2 Collaboration: Trans-Pacific 4K Teleconference

Like High-Def? Here Comes the Next Level

By JOHN MARKOFF
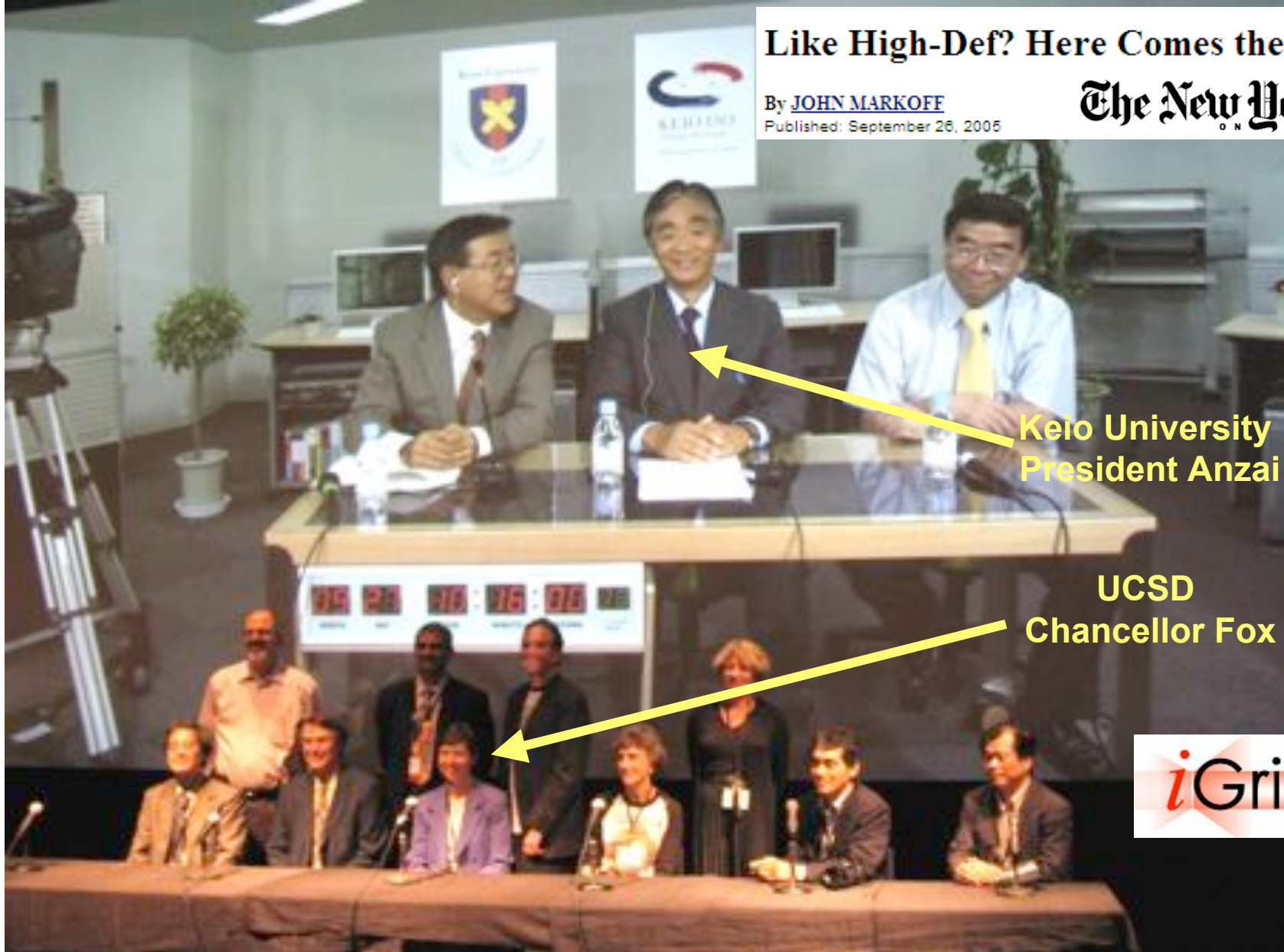Published: September 26, 2005

The New York Times
ON THE WEB

Used
1Gbps
Dedicated

Sony
NTT
SGI

Keio University
President Anzai

UCSD
Chancellor Fox

iGrid 2005

CineGrid@SARA

CineGrid @ Holland Festival 2007

Era la Notte, June 20-21, 2007 (Live!)

CineGrid @ Holland Festival 2007
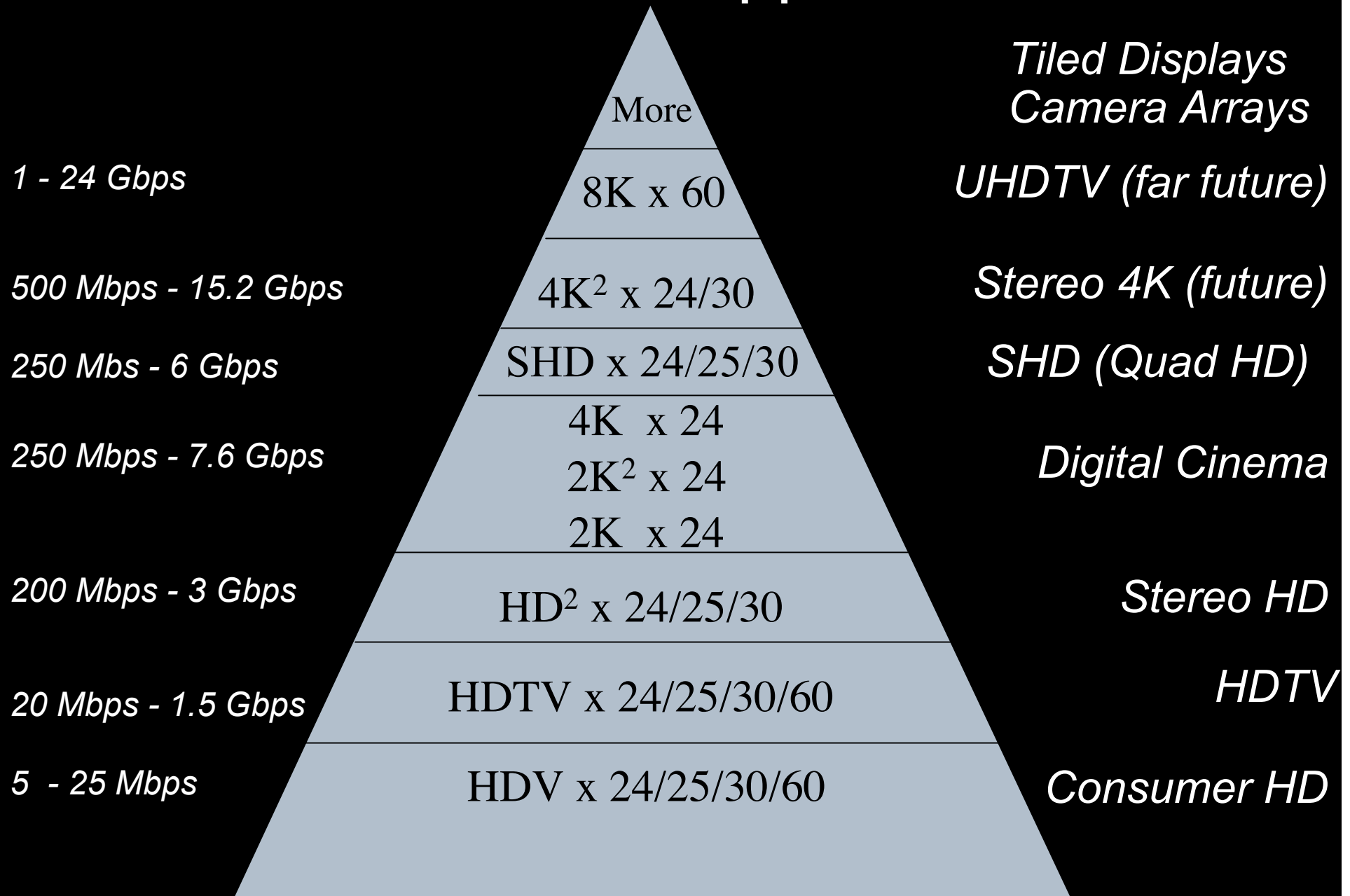
Swimming Fiber the Last 500m

CineGrid @ GLIF 2007 (Prague)

CineGrid: A Scalable Approach

	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

CGA
320×200

NTSC
720×480

WVGA
854×480

QVGA
320×240

1152×768

HD 720
1280×720

VGA
640×480

1280×854

PAL
768×576

1440×960

WSXGA+
1680×1050

SVGA
800×600

XGA
1024×768

HD 1080
1920×1080

1280×960

WUXGA
1920×1200

SXGA
1280×1024

WQXGA
2560×1600

16:9

SXGA+
1400×1050

16:10

UXGA
1600×1200

3:2

QXGA
2048×1536

5:4   4:3

QSXGA
2560×2048

3840*2160

4096*2160

Formats - Numbers - Bits

Format - Numbers - Bits (examples!)

Format	X	Y	Rate	Color bits/pix	Frame #pix	Frame MByte	Flow MByt/s	Stream Gbit/s
720p HD	1280	720	60	24	921600	2.8	170	1.3
1080p HD	1920	1080	30	24	2073600	6.2	190	1.5
2k	2048	1080	24 48	36	2211840	10	240 480	1.2 2.4
SHD	3840	2160	30	24	8294400	25	750	6.0
4k	4096	2160	24	36	8847360	40	960	7.6

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

Rembrandt Cluster
total 22 TByte diskspace
@ LightHouse

M Y R I N E T

comp node

⋮ 77x

comp node

head node

bridge node

bridge node

bridge node

bridge node

bridge node

bridge node

bridge node

bridge node

storage node

2 * 48 TByte

NetherLight, StarPlane
the cp testbeds
and beyond

10 Gbit/s

10 Gbit/s

**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

NORTEL
8600
L2/3 switch

F10
L2/3 switch

streaming node
8 TByte

10 Gbit/s
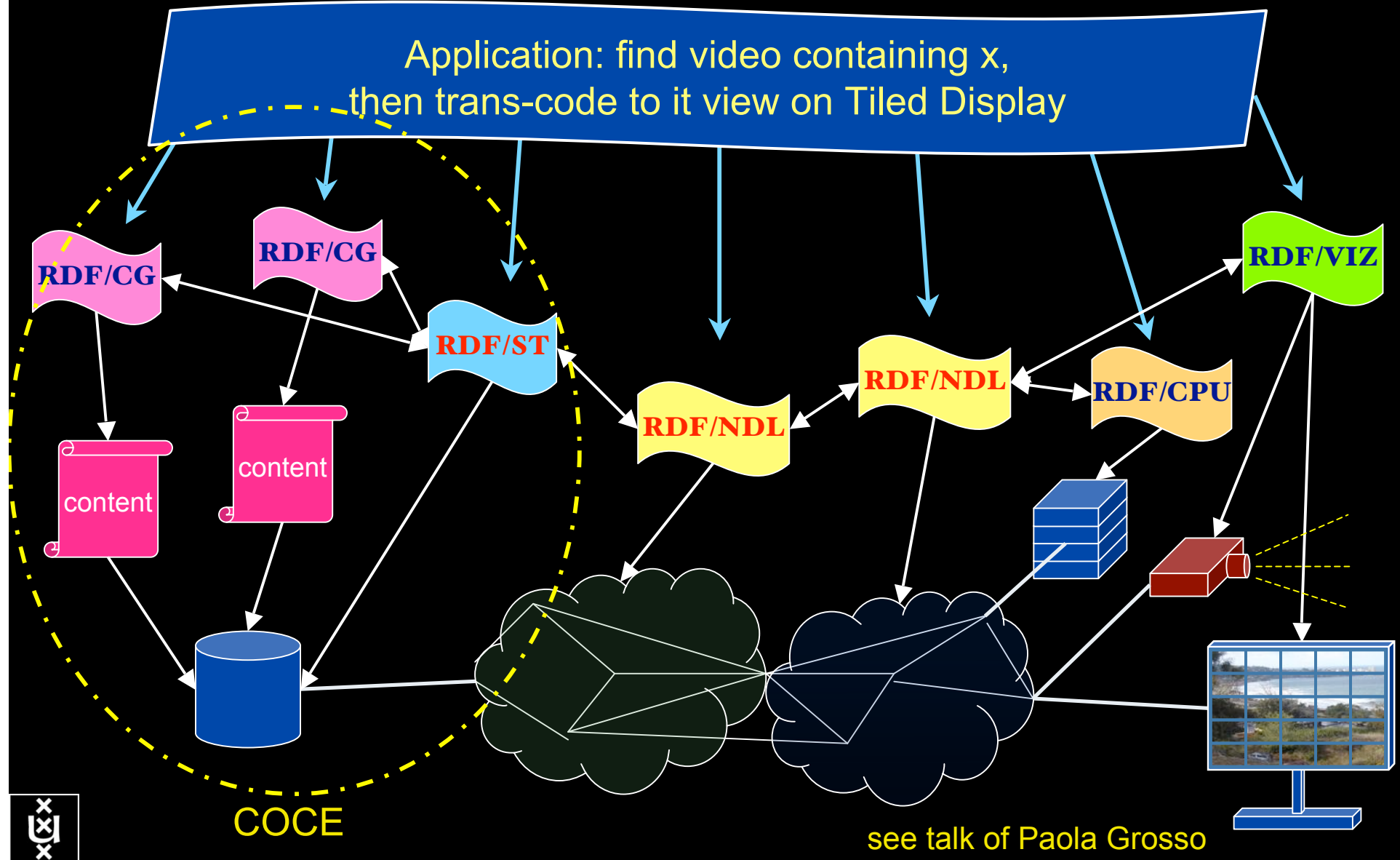
suitcees &
briefcees

SURF NET

Node 41

sara

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

RDF/CG

RDF/CG

RDF/CG

RDF/VIZ

RDF/ST

RDF/NDL

RDF/NDL

RDF/CPU

RDF/NDL

content

content

COCE

see talk of Paola Grosso

Questions ?

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