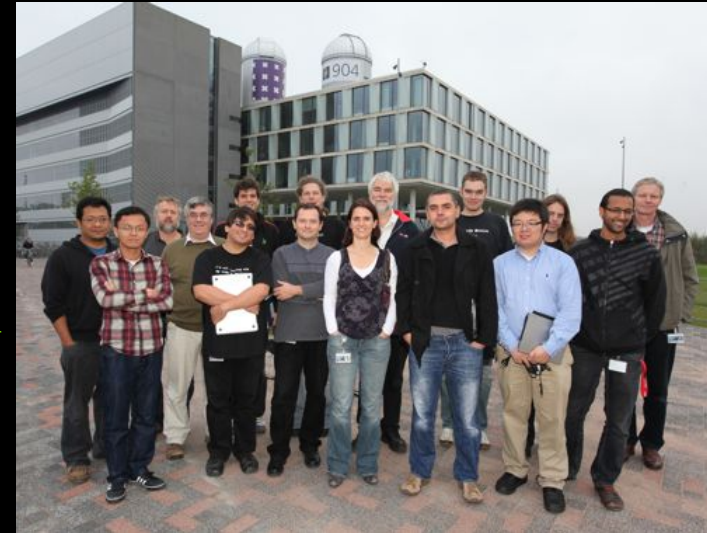


System & Network Engineering research group

- Part of Informatics Institute
- Part of Faculty of Science
- Part of University of Amsterdam
- About 28 people
- 1 full time prof (me), 3 part time profs,
- 1 assistant prof, 1 senior docent
- several senior researchers and educators, postdocs and scientific programmers, 5 PhD students.



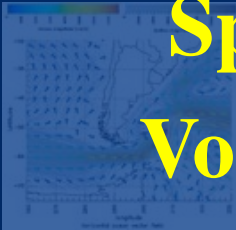
... more data!

Internet developments

Google

Speed
Volume

DATA



Deterministic

Real-time



twitter



Scalable

Secure

Linked in

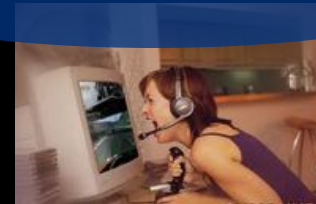


myspace

SchoolBANK

Hyves

flickr



... more users!

SNE @ UvA

Speed
Volume

Deterministic
Real-time

Scalable
Secure

Ijkdijk/Urban Flood

Medical

LifeWatch

CosmoGrid/eVLBI

CineGrid

EU-GN3/NOVI/Geysers

SURFnet/GLIF/Cloud

Green-IT

Privacy/Trust

Authorization/policy

Programmable networks

40-100Gig/TCP/WF/QoS

Topology/Architecture

Optical Photonic

X X

X

X

X X

X X

X

X

X X

X

X

X

X

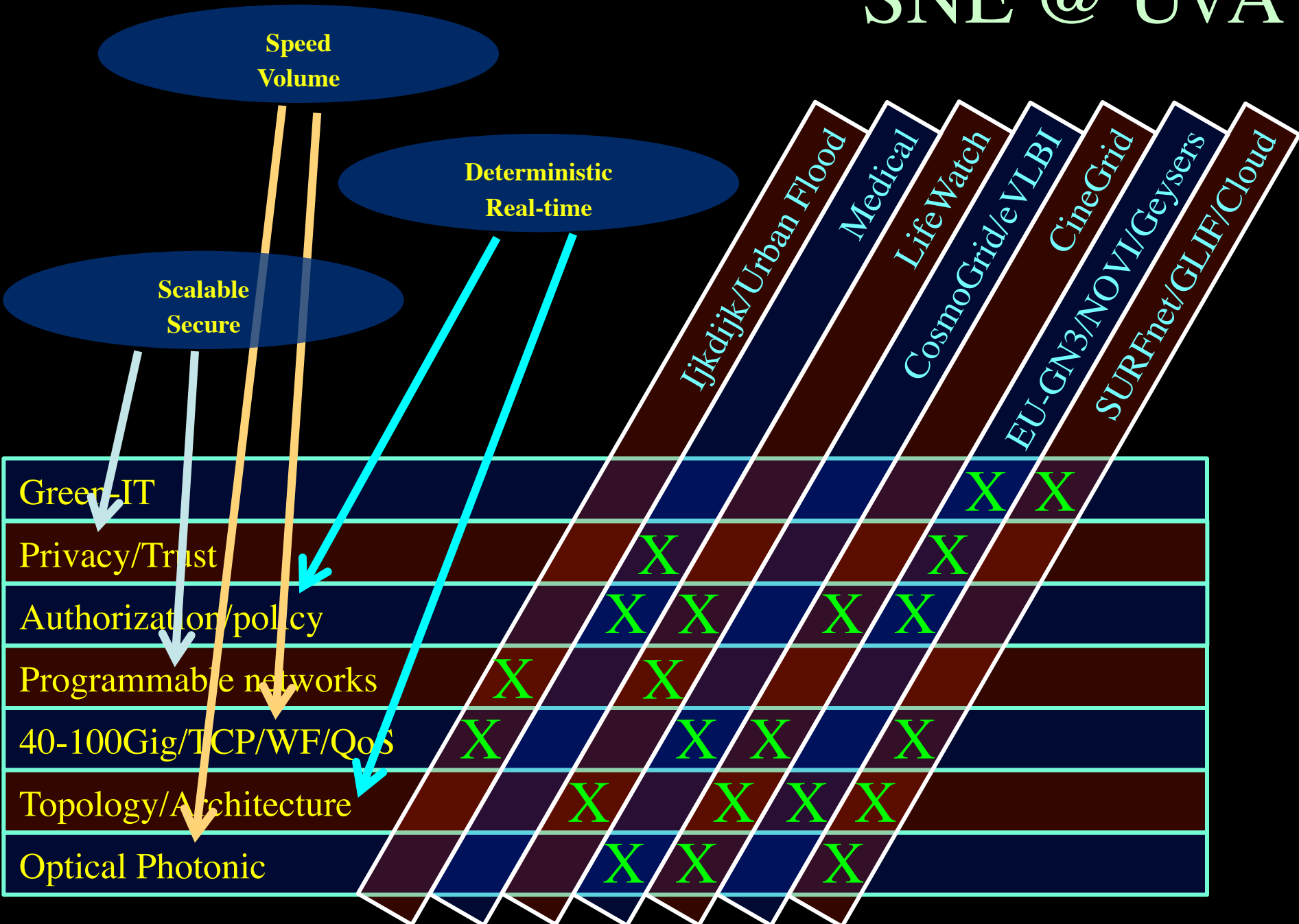
X

X

X

X

SNE @ UvA



SNE @ UvA



	Ijkdijk/Urban Flood	Medical	LifeWatch	CosmoGrid/eVLBI	CineGrid	EU-GN3/NOVI/Geysers	SURFnet/GLIF/Cloud
Green-IT				X	X		
Privacy/Trust		X			X		
Authorization/policy		X	X	X	X		
Programmable networks	X	X					
40-100Gig/TCP/WF/QoS	X	X	X	X	X		
Topology/Architecture		X	X	X	X		
Optical Photonic		X	X	X			



LOFAR as a Sensor Network

20 flops/byte

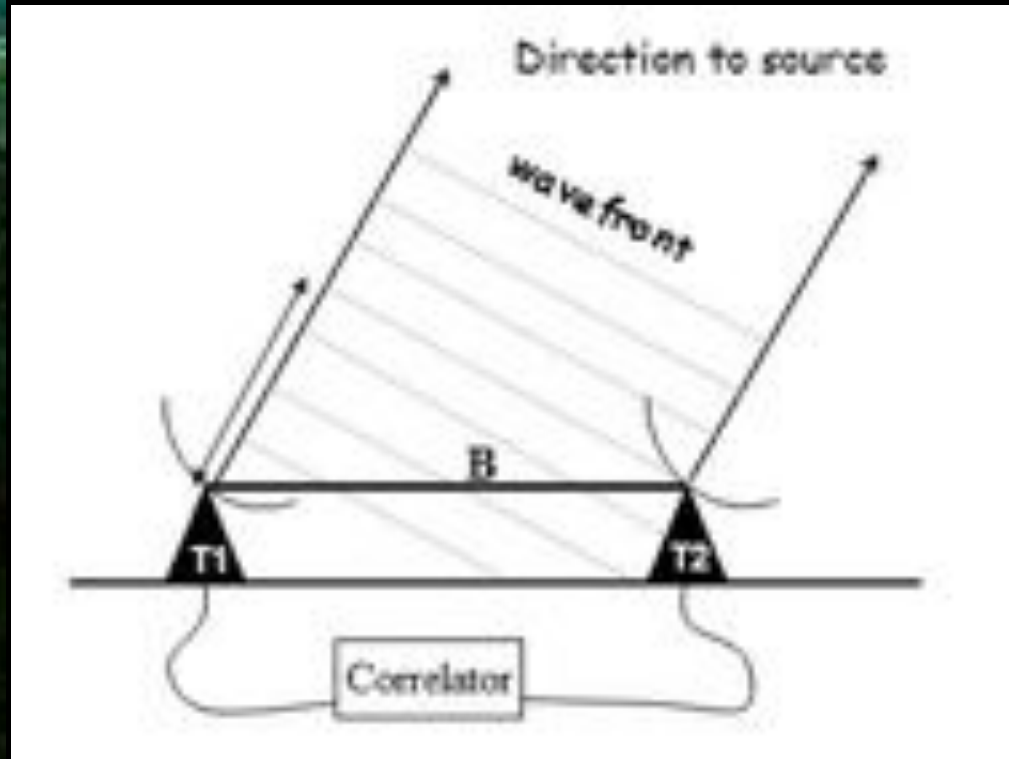
– LOFAR is a large distributed research infrastructure:

2 Tflops/s

- Astronomy:
 - >100 phased array stations
 - Combined in aperture synthesis array
 - 13,000 small “LF” antennas
 - 13,000 small “HF” tiles
- Geophysics:
 - 18 vibration sensors per station
 - Infrasound detector per station
- >20 Tbit/s generated digitally
- >40 Tflop/s supercomputer
- innovative software systems
 - new calibration approaches
 - full distributed control
 - VO and Grid integration
 - datamining and visualisation

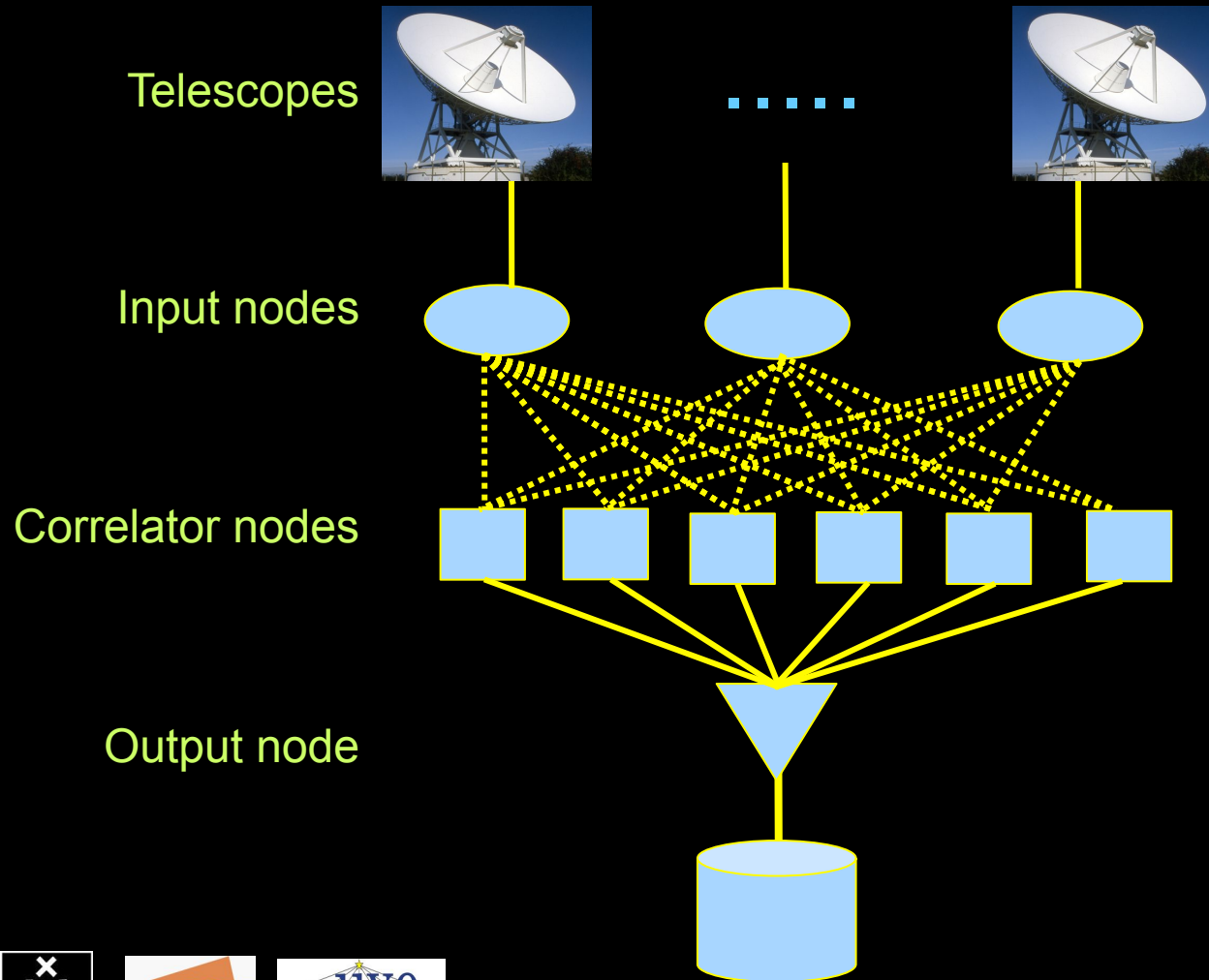


e - Very Large Base Interferometer



The SCARIE project

SCARIE: a research project to create a Software Correlator for e-VLBI.
VLBI Correlation: signal processing technique to get high precision image from spatially distributed radio-telescope.



16 Gbit/s - 2 Tflop →
THIS IS A DATA FLOW PROBLEM !!!

Research:

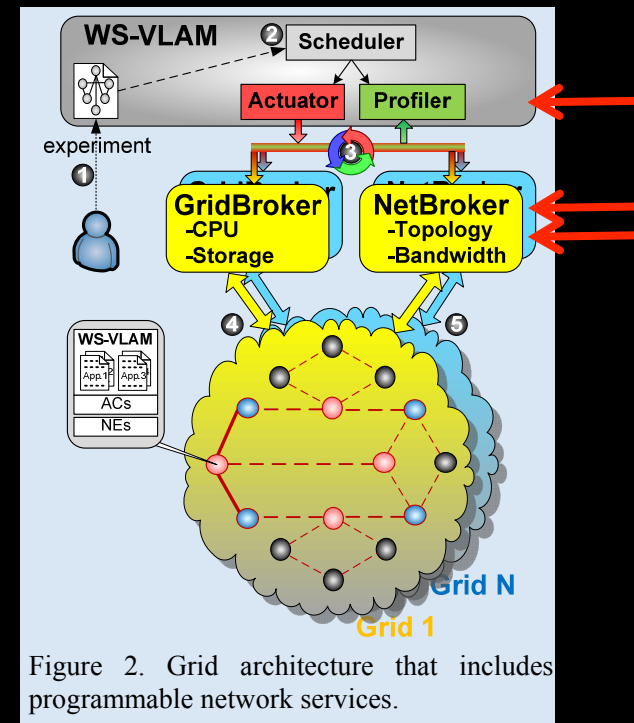


Figure 2. Grid architecture that includes programmable network services.



CosmoGrid

- Motivation:
previous simulations found >100 times more substructure than is observed!
- Simulate large structure formation in the Universe
 - Dark Energy (cosmological constant)
 - Dark Matter (particles)
- Method: Cosmological N -body code
- Computation: Intercontinental SuperComputer Grid



The hardware setup

10 Mflops/byte

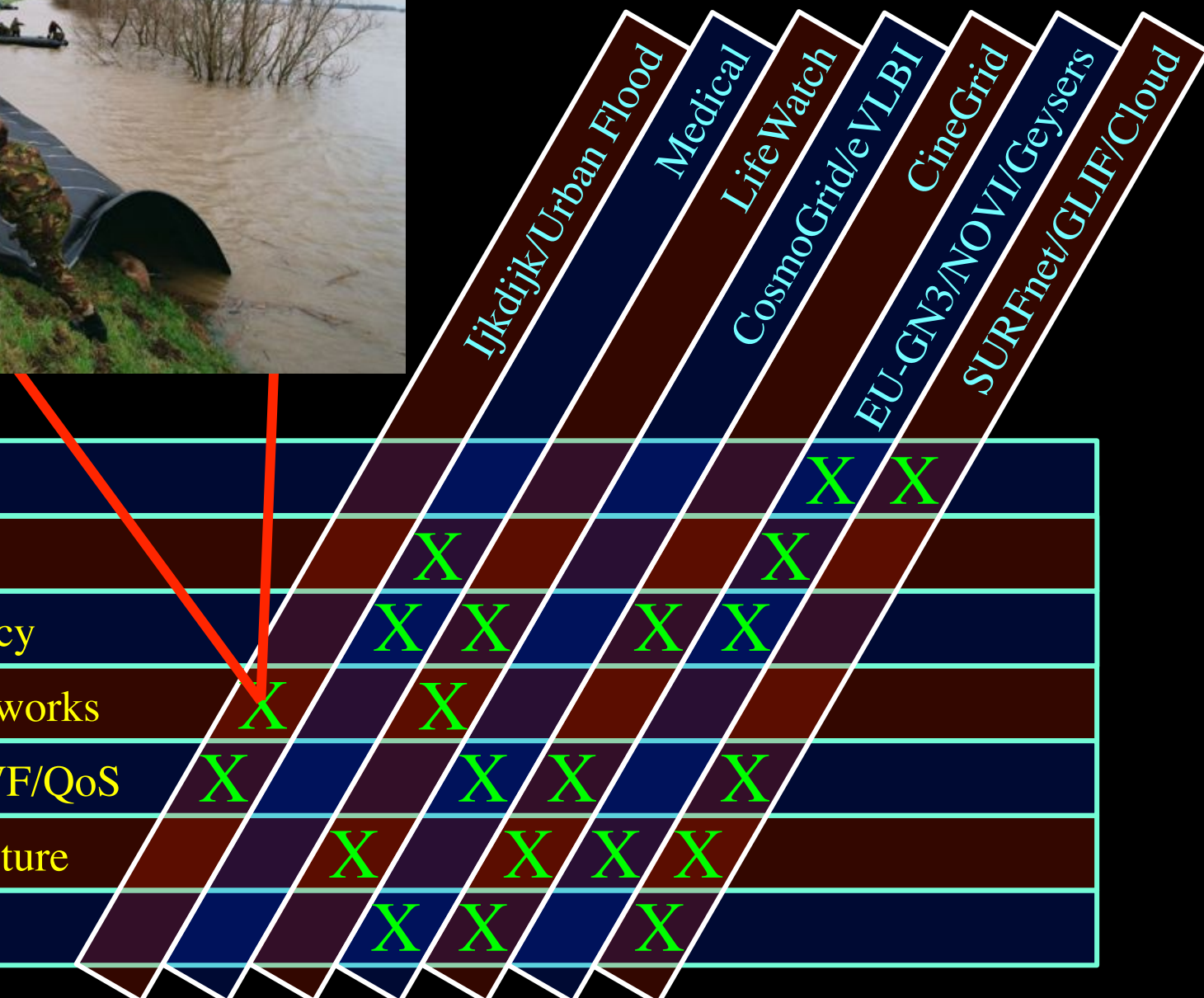
1 Eflops/s

- 2 supercomputers :
 - 1 in Amsterdam (60Tflops Power6 @ SARA)
 - 1 in Tokyo (30Tflops Cray XD0-4 @ CFCA)
- Both computers are connected via an intercontinental optical 10 Gbit/s network



Where when will it happen?

SNE @ UvA



	Ijkdijk/Urban Flood	Medical	LifeWatch	CosmoGrid/eVLBI	CineGrid	EU-GN3/NOVI/Geysers	SURFnet/GLIF/Cloud
Green-IT						X	X
Privacy/Trust		X				X	
Authorization/policy		X	X		X	X	
Programmable networks	X	X					
40-100Gig/TCP/WF/QoS	X		X	X		X	
Topology/Architecture		X		X	X	X	
Optical Photonic		X	X		X		



IJKDIJK

Sensors: 15000km* 800 bps/m ->12 Gbit/s to cover all Dutch dikes

Sensor grid: instrument the dikes

First controlled breach occurred on sept 27th '08:



Many Pflops/s

Many small flows -> 12 Gb/s

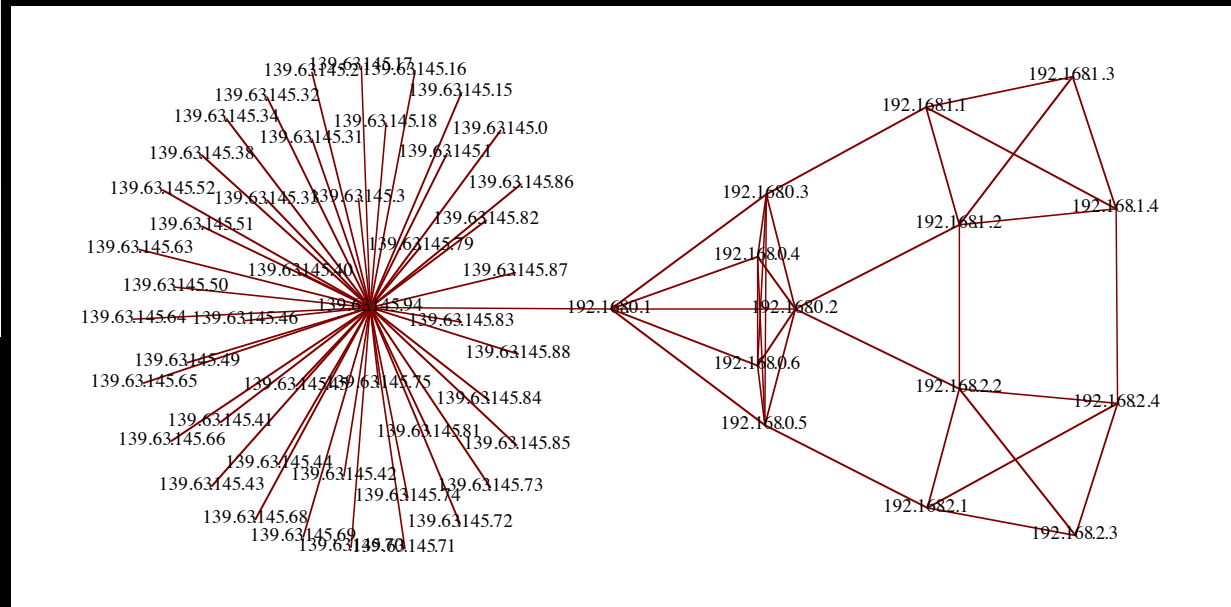
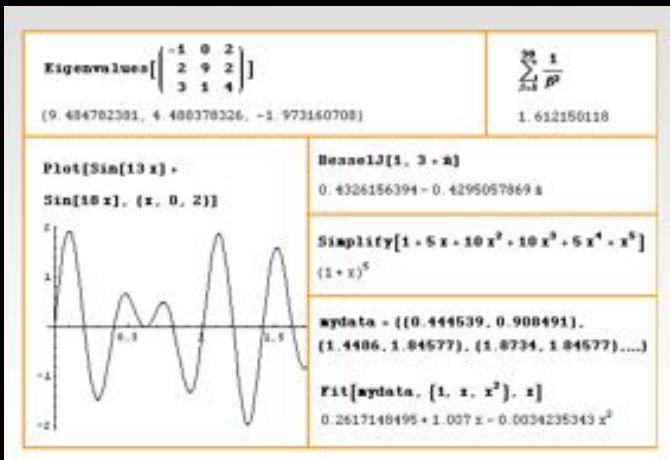
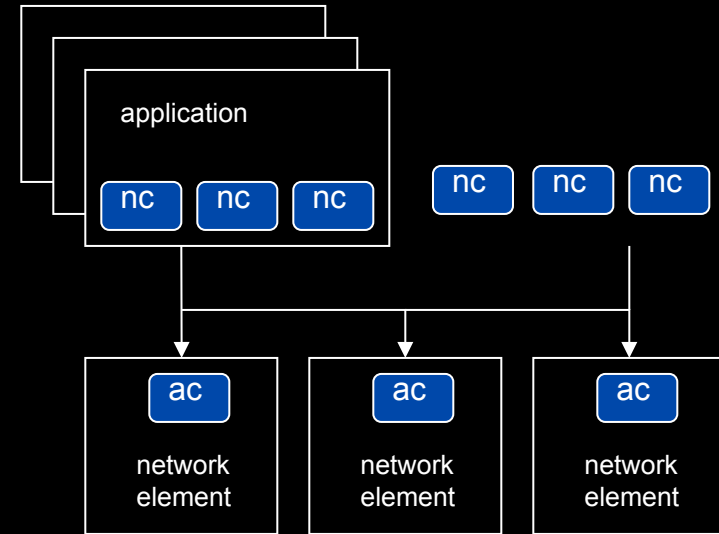
Tera-Thinking

- What constitutes a Tb/s network?
- think back to teraflop computing!
 - MPI turns a room full of pc's in a teraflop machine
- massive parallel channels in hosts, NIC's
- TeraApps programming model supported by
 - TFlops -> MPI / Globus / Cloud
 - TBytes -> DAIS / MONETdb ...
 - TPixels -> SAGE
 - TSensors -> LOFAR, LHC, LOOKING, CineGrid, ...
 - Tbit/s -> ?
 - ? -> Programmable Networks

User Programmable Virtualized Networks.

The network is virtualized as a collection of resources
UPVNs enable network resources to be programmed
as part of the application

Mathematica interacts with virtualized networks using
UPVNs and optimize network + computation

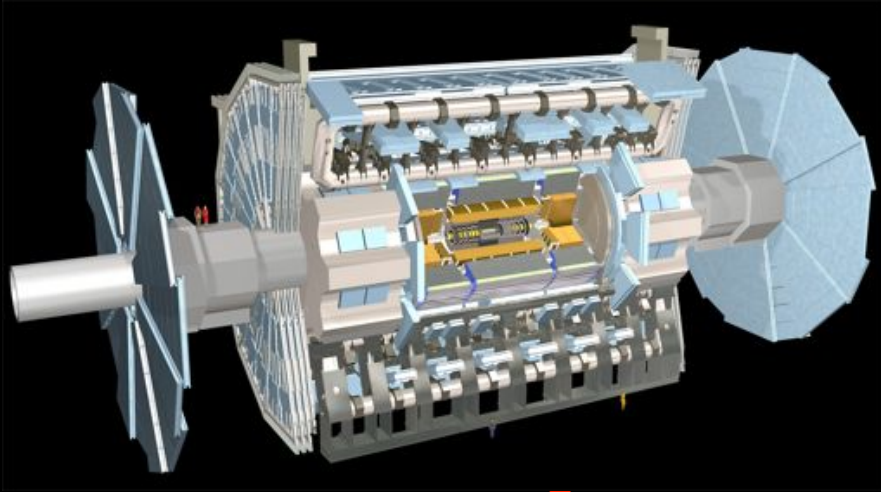


ref: Robert J. Meijer, Rudolf J. Strijkers, Leon Gommans, Cees de Laat, User Programmable Virtualized Networks, accepted for publication to the IEEE e-Science 2006 conference Amsterdam.

TouchTable Demonstration @ SC08



SNE @ UvA



Ijkdijk/Urban Flood

Medical

LifeWatch

CosmoGrid/eVLBI

CineGrid

EU-GN3/NOVI/Geysers

SURFnet/GLIF/Cloud

Green-IT

Privacy/Trust

Authorization/policy

Programmable networks

40-100Gig/TCP/WF/QoS

Topology/Architecture

Optical Photonic

X X

X

X

X X

X X

X

X

X

X X

X

X

X X

X X

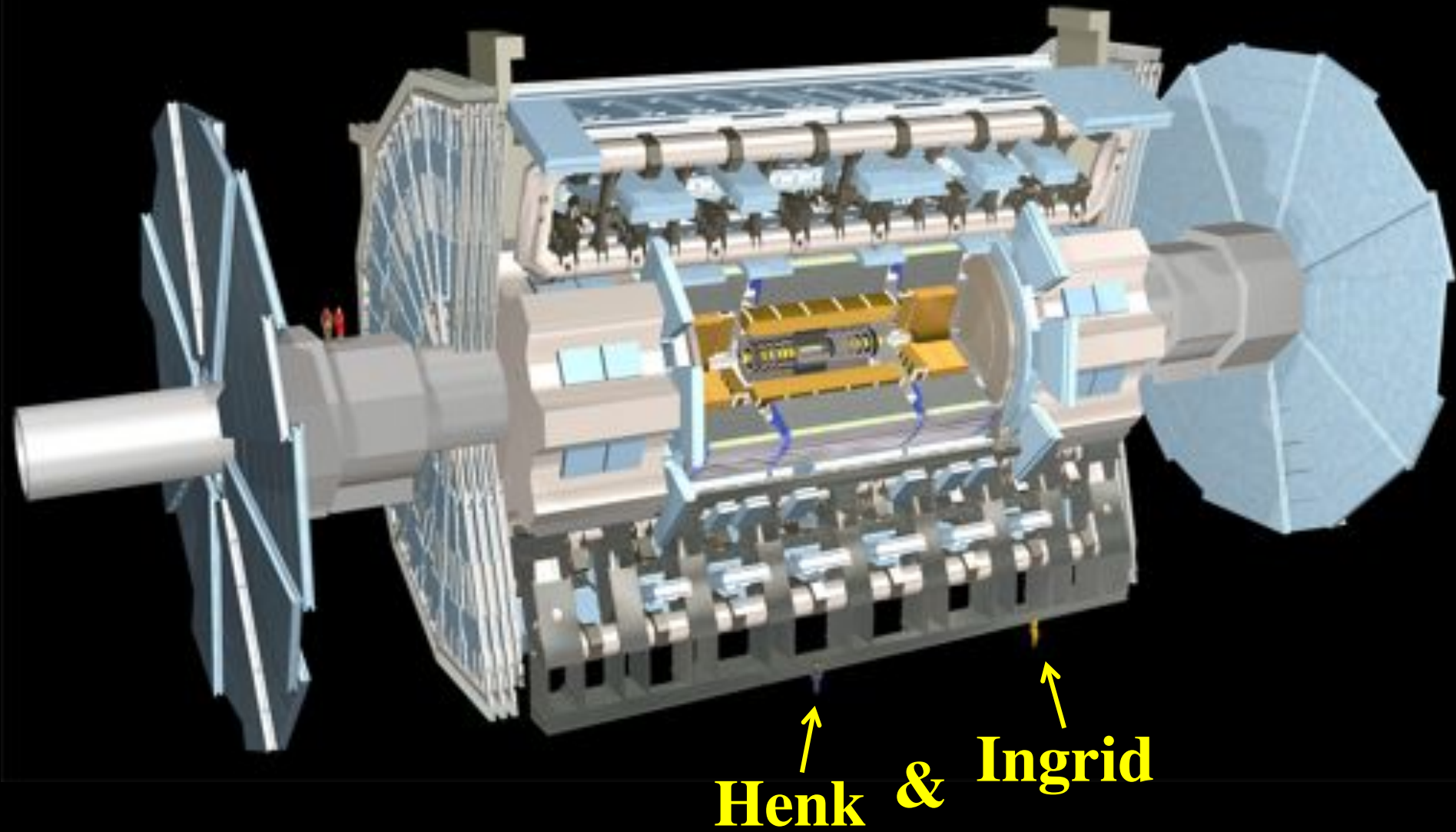
X

X

X

X

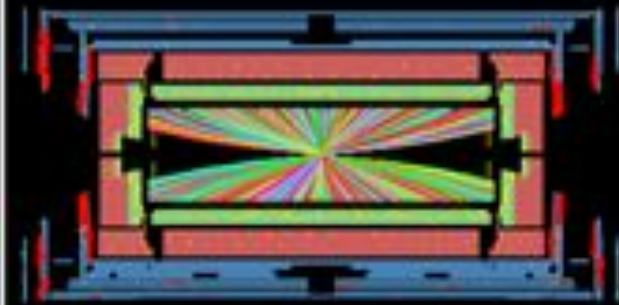
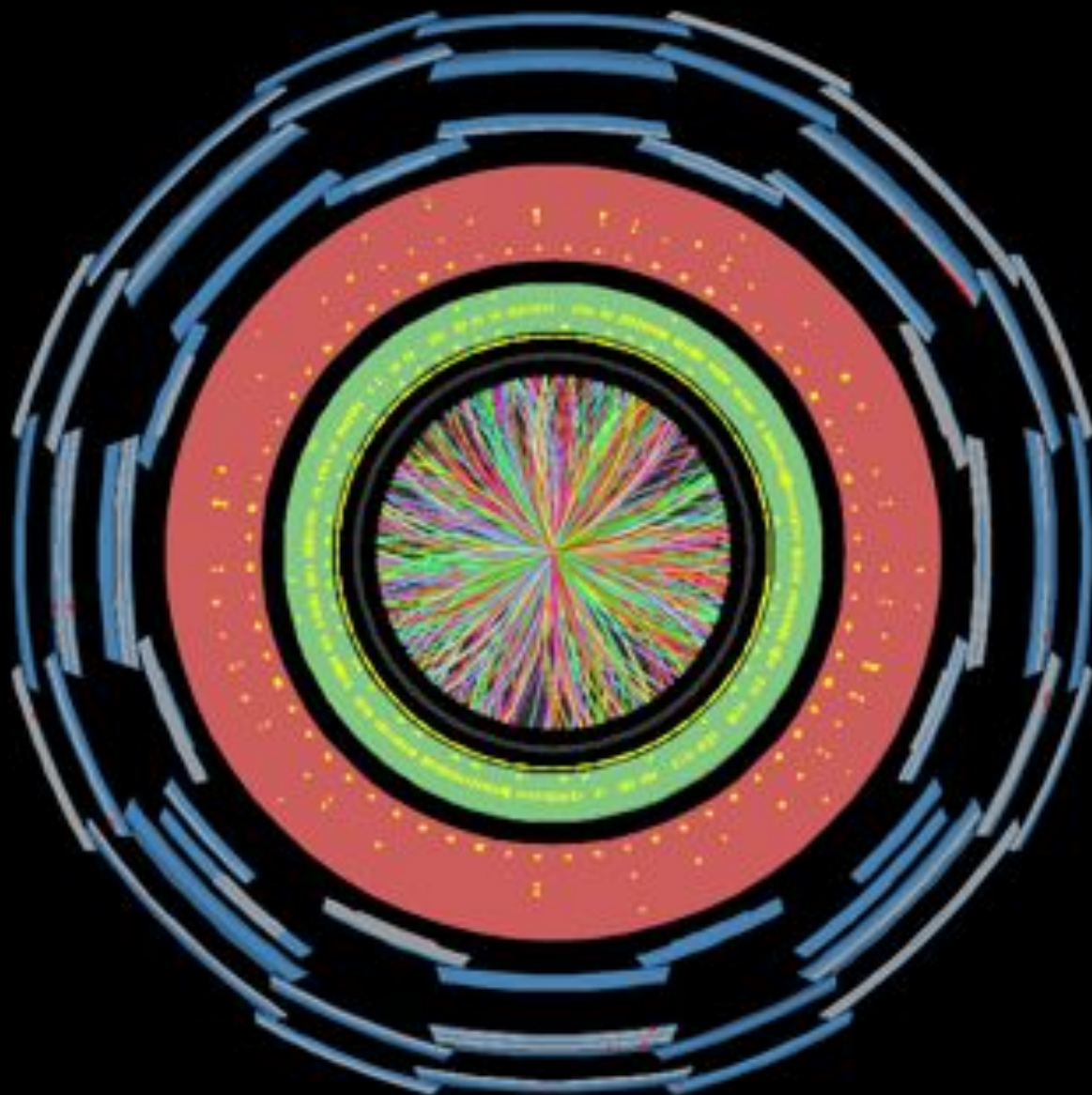
ATLAS detector @ CERN Geneve



ATLAS detector @ CERN Geneve



One Heavy Ion Collision in Atlas!

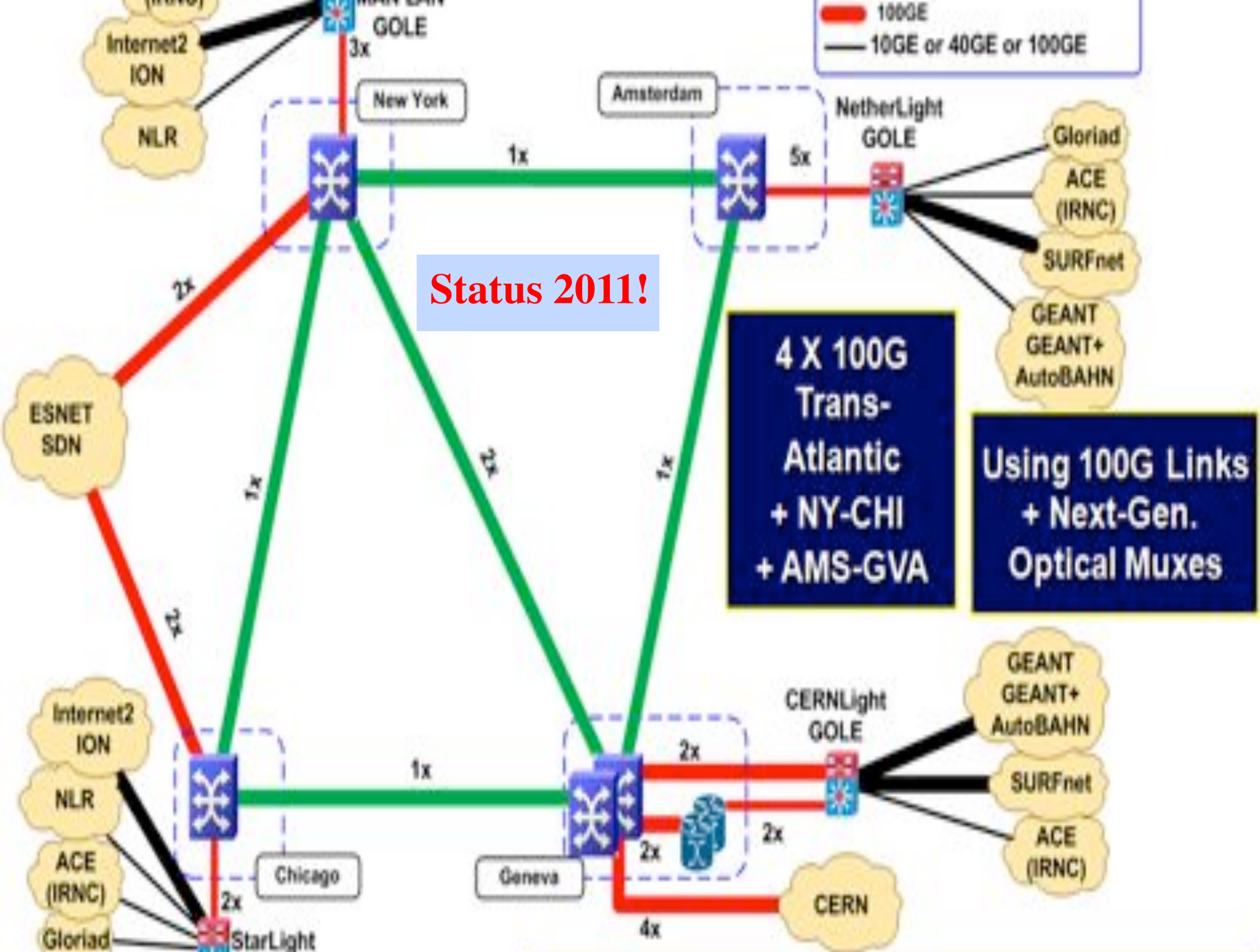


 **ATLAS**
EXPERIMENT

Run Number: 170482, Event Number: 3936308

Date: 2010-12-06 17:21:31 CET

Snapshot of a heavy ion collision
directly from the ATLAS experiment



Towards Hybrid Networking!

- Costs of photonic equipment 10% of switching 10 % of full routing
 - for same throughput!
 - Photonic vs Optical (optical used for SONET, etc, 10-50 k\$/port)
 - DWDM lasers for long reach expensive, 10-50 k\$
- Bottom line: look for a hybrid architecture which serves all classes in a cost effective way
 - map A -> L3 , B -> L2 , C -> L1 and L2
- Give each packet in the network the service it needs, but no more !

L1 \approx 2-3 k\$/port



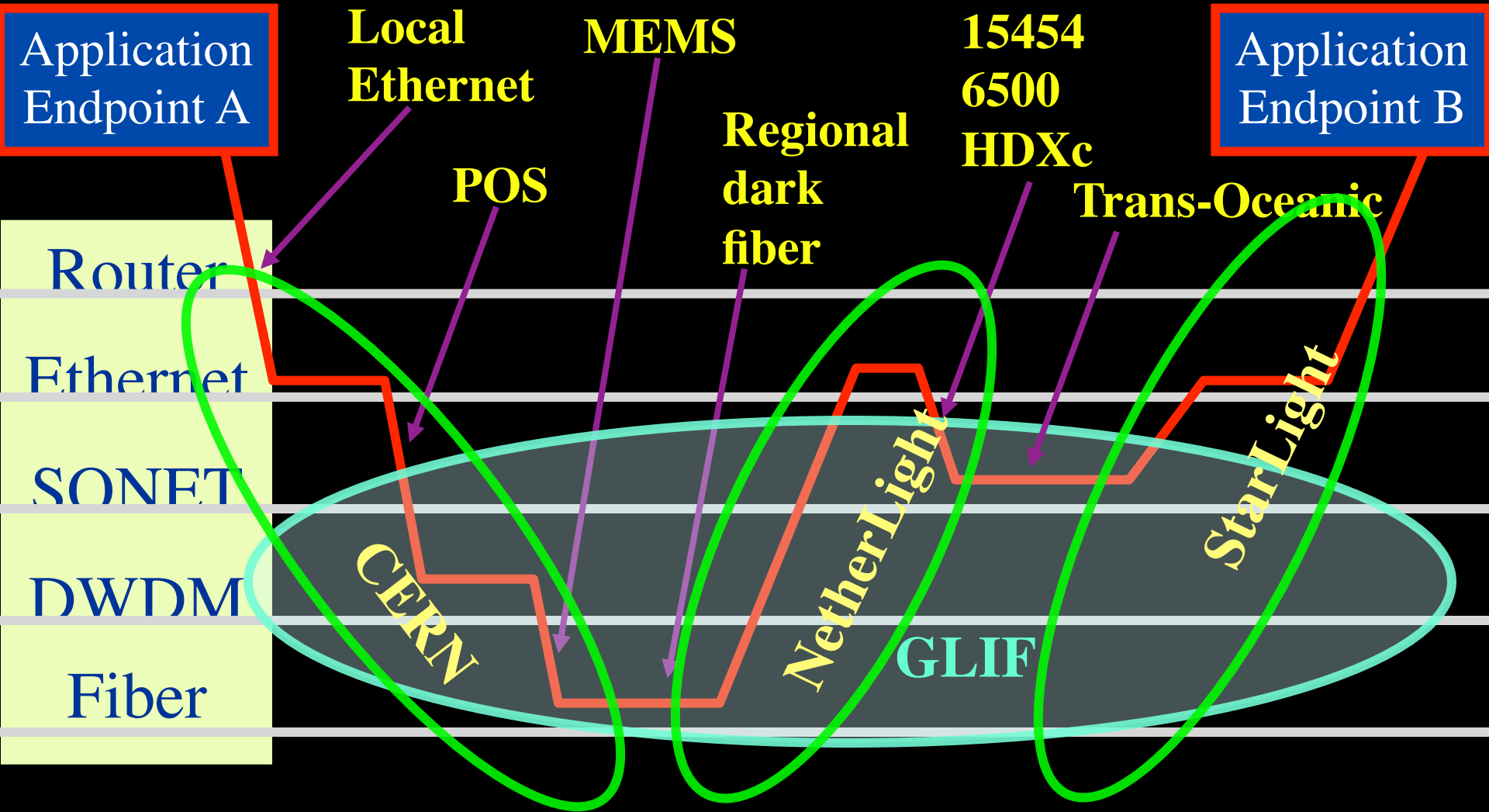
L2 \approx 5-8 k\$/port



L3 \approx 75+ k\$/port



How low can you go?





In The Netherlands SURFnet connects between 180:

- universities;
- academic hospitals;
- most polytechnics;
- research centers.

with an indirect ~750K user base

~ 8860 km
scale
comparable
to railway
system

ClearStream @ TNC2011

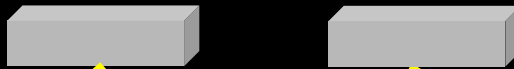
Setup codename:
FlightCees



UvA

iPerf
I7 3.2 GHz Q-core

iPerf
Amd Ph II 3.6 GHz HexC



Mellanox

40G E

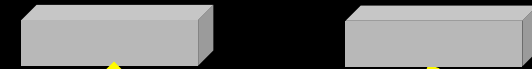


CIENA
OME
6500

Copenhagen

iPerf
2* dual 2.8 GHz Q-core

iPerf
2* dual 2.8 GHz Q-core



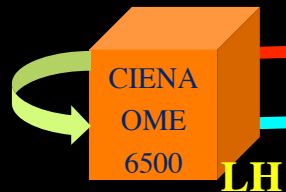
Mellanox



CIENA
OME
6500

CERN

CIENA DWDM



CIENA
OME
6500

LH

17 ms RTT

27 ms RTT

Hamburg

Alcatel DWDM



CIENA
OME
6500

LH

Amsterdam – Geneva (CERN) – Copenhagen – 4400 km (2700 km alien light)

Demo setup codename: FlightCees



Ciena ActiveFlex(OME)
6500

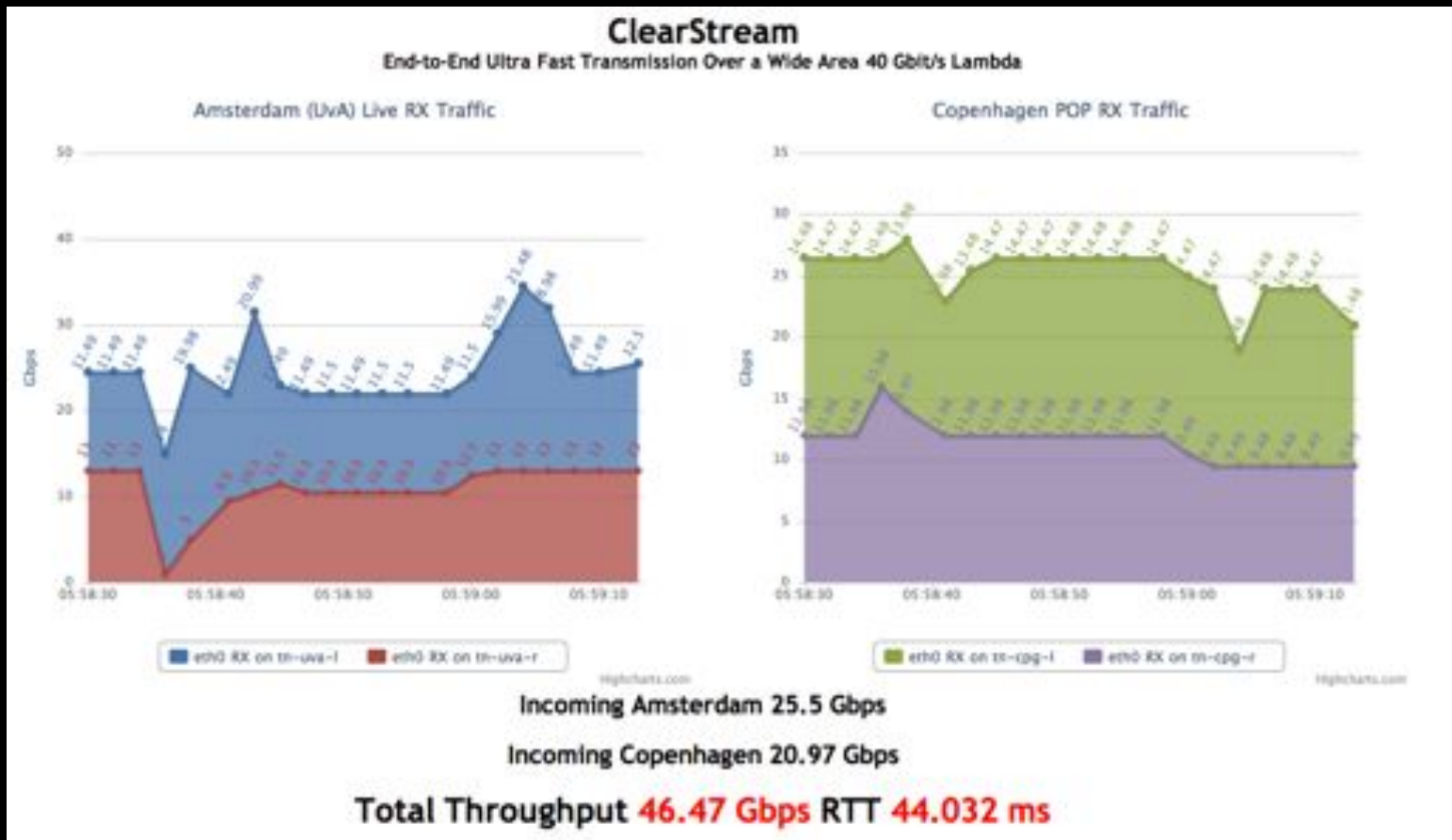
Broadcom 40GE 18 port L2
Ethernet Switch

Supermicro Intel Server

Dell R815 Server

Visit CIENA Booth

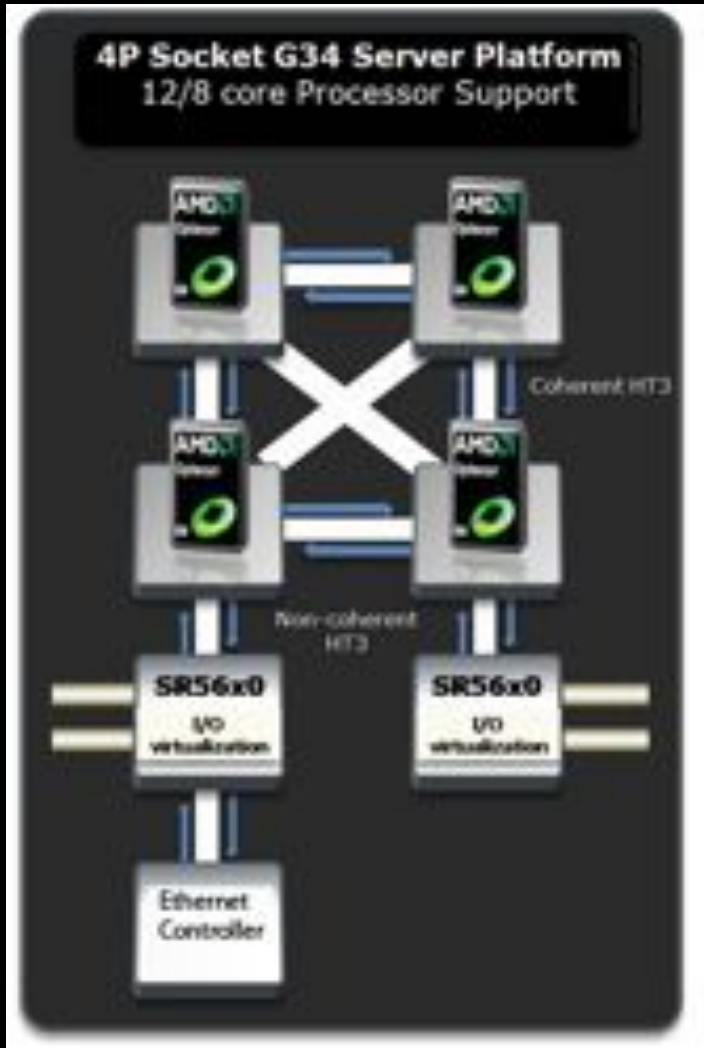
surf to <http://tnc11.delaat.net>



Results (rtt = 17 ms)

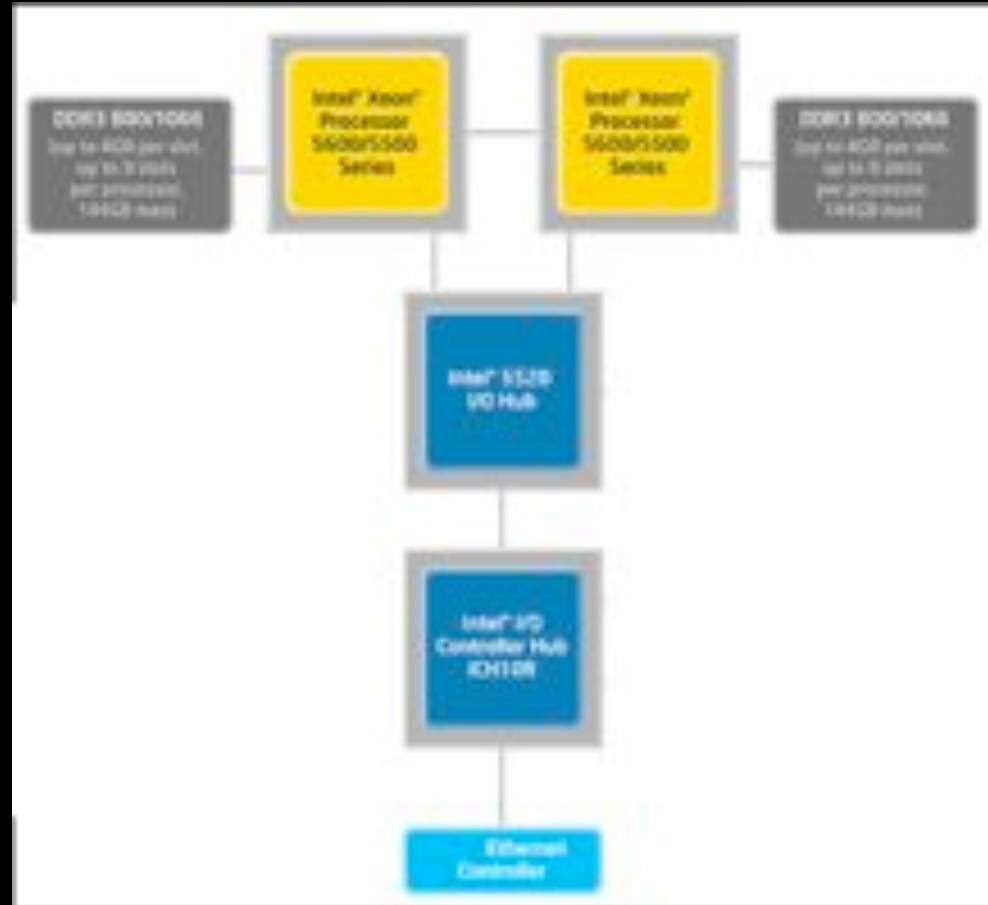
- Single flow iPerf 1 core -> 21 Gbps
- Single flow iPerf 1 core <> -> 15+15 Gbps
- Multi flow iPerf 2 cores -> 25 Gbps
- Multi flow iPerf 2 cores <> -> 23+23 Gbps
- DiViNe <> -> 11 Gbps
- Multi flow iPerf + DiVine -> 35 Gbps
- Multi flow iPerf + DiVine <> -> 35 + 35 Gbps

Server Architecture



DELL R815

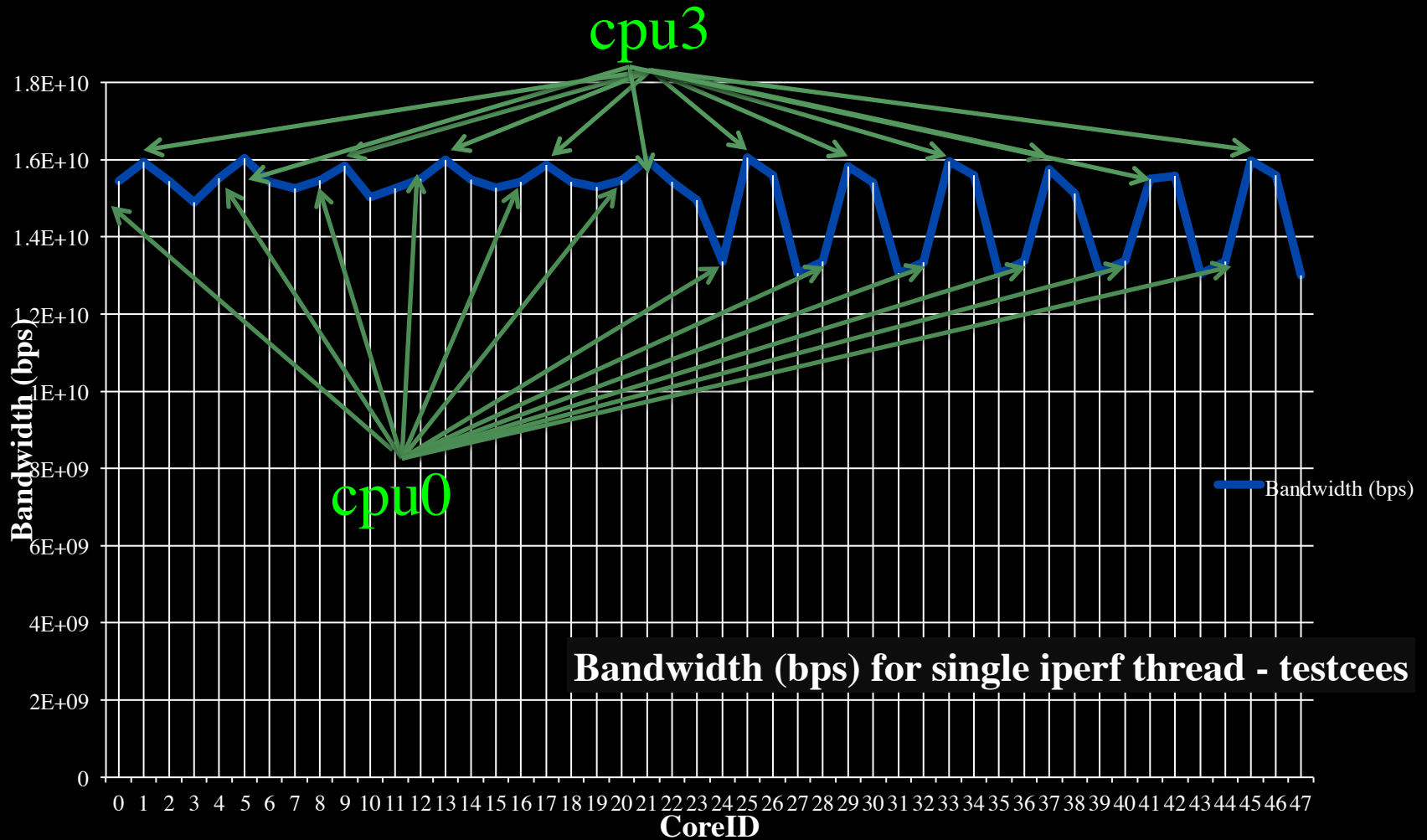
4 x AMD Opteron 6100



Supermicro X8DTT-HIBQF

2 x Intel Xeon

CPU Topology benchmark



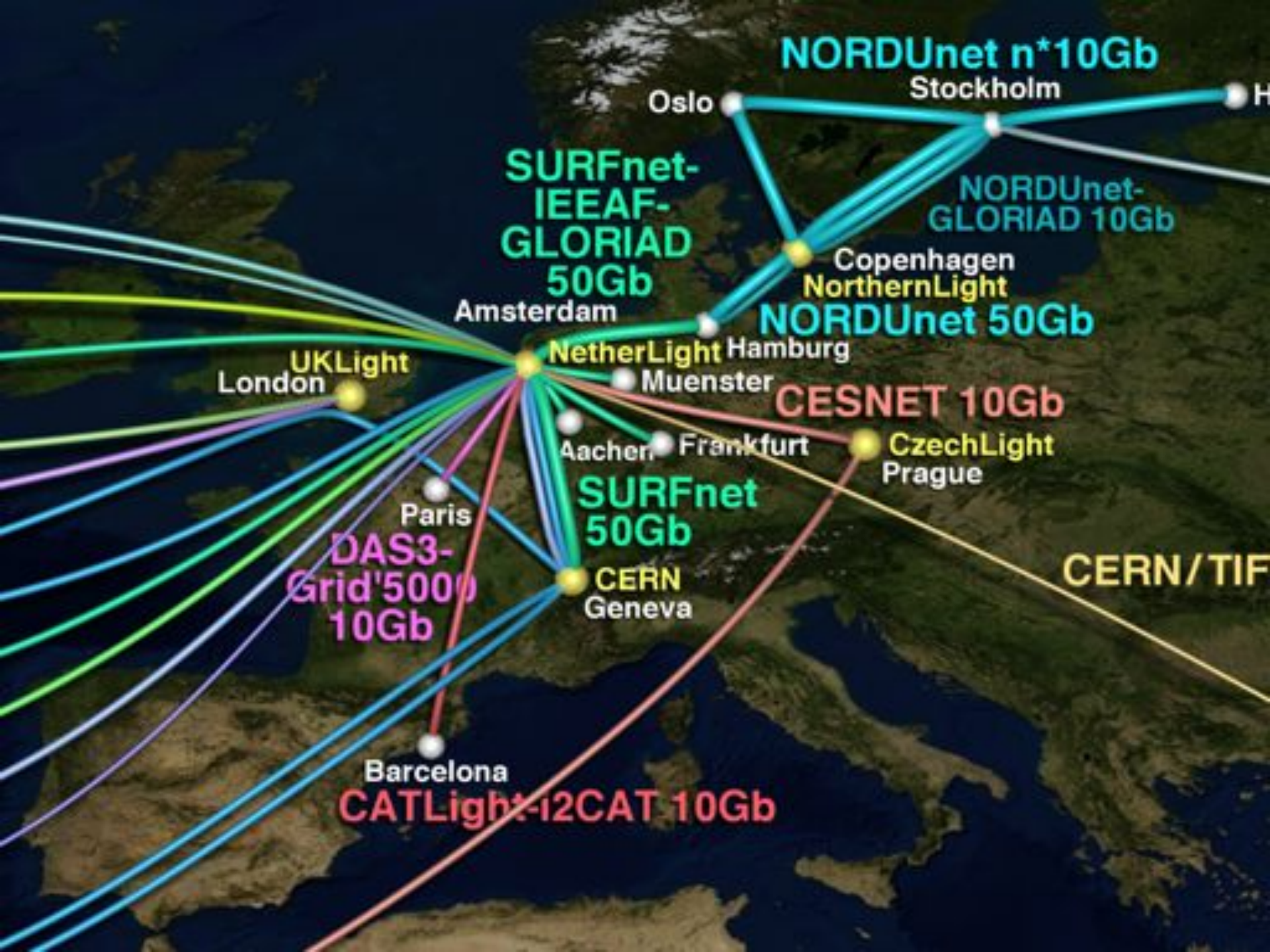
We used numactl to bind iperf to cores



GLF Map (2011: Global Links Integrated Profile) - Visualization by Robert Farnham, NOAA, University of Illinois at Urbana-Champaign Data Collection by Marco B. Rosen, University of Illinois at Chicago - Future Network by Jeff Grogan, NOAA Earth System, earthsystem.gov www.glf.it

We investigate:  for complex networks!





VIZUALIZATION

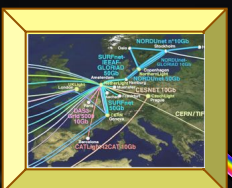
DataExploration

RemoteControl

TV

Medical

CineGrid



Gaming

Conference

Workflow

Clouds

Distributed



EventProcessing

GRID&CLOUD

Management

Mining

Web2.0

NetherLight



Meta

DATACENTER

Backup

Media

Visualisation

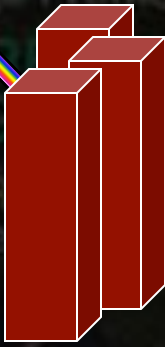
Security

Simulations

StreamProcessing

SUPERCOMUTTER

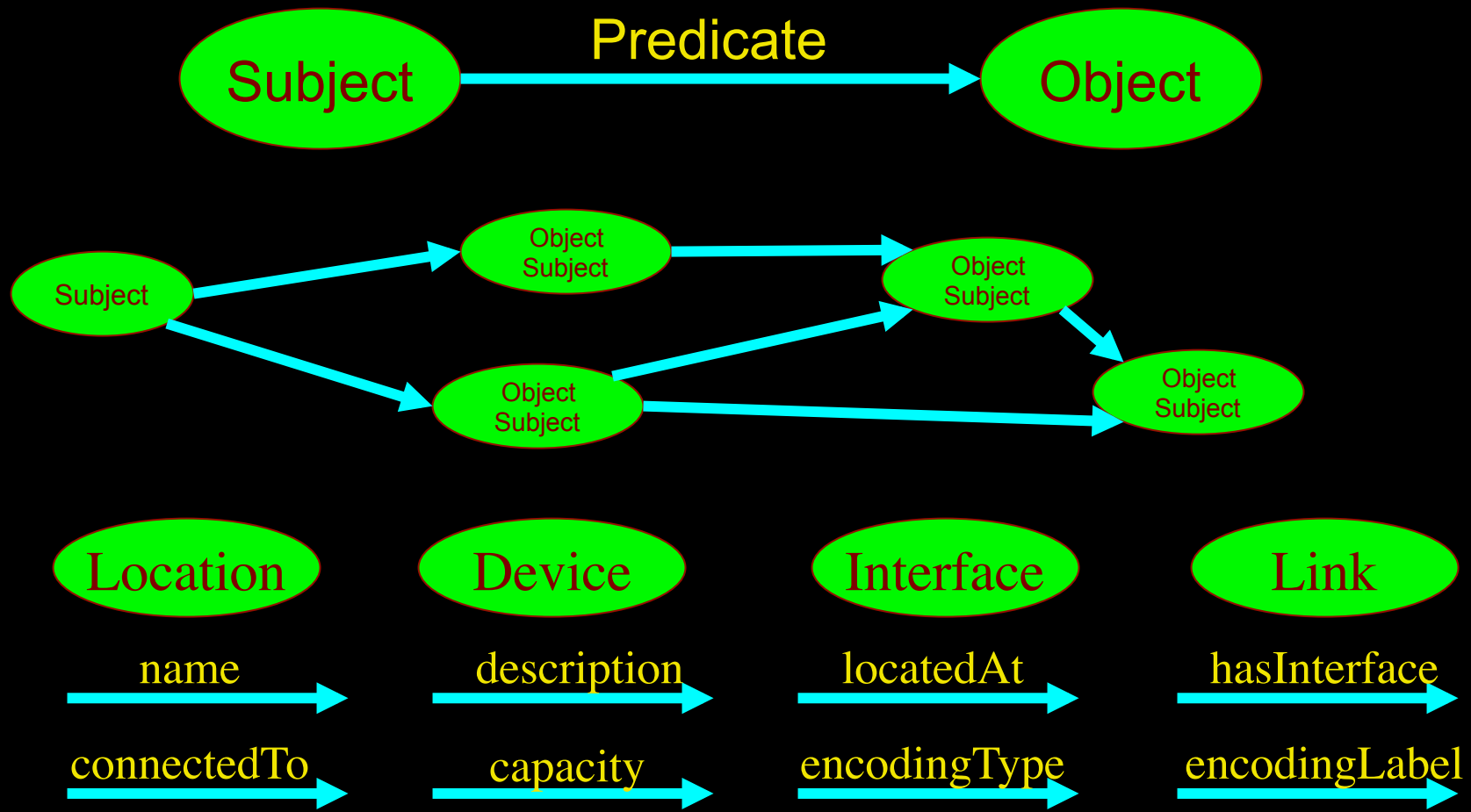
Predictions



LinkedIn for Infrastructure



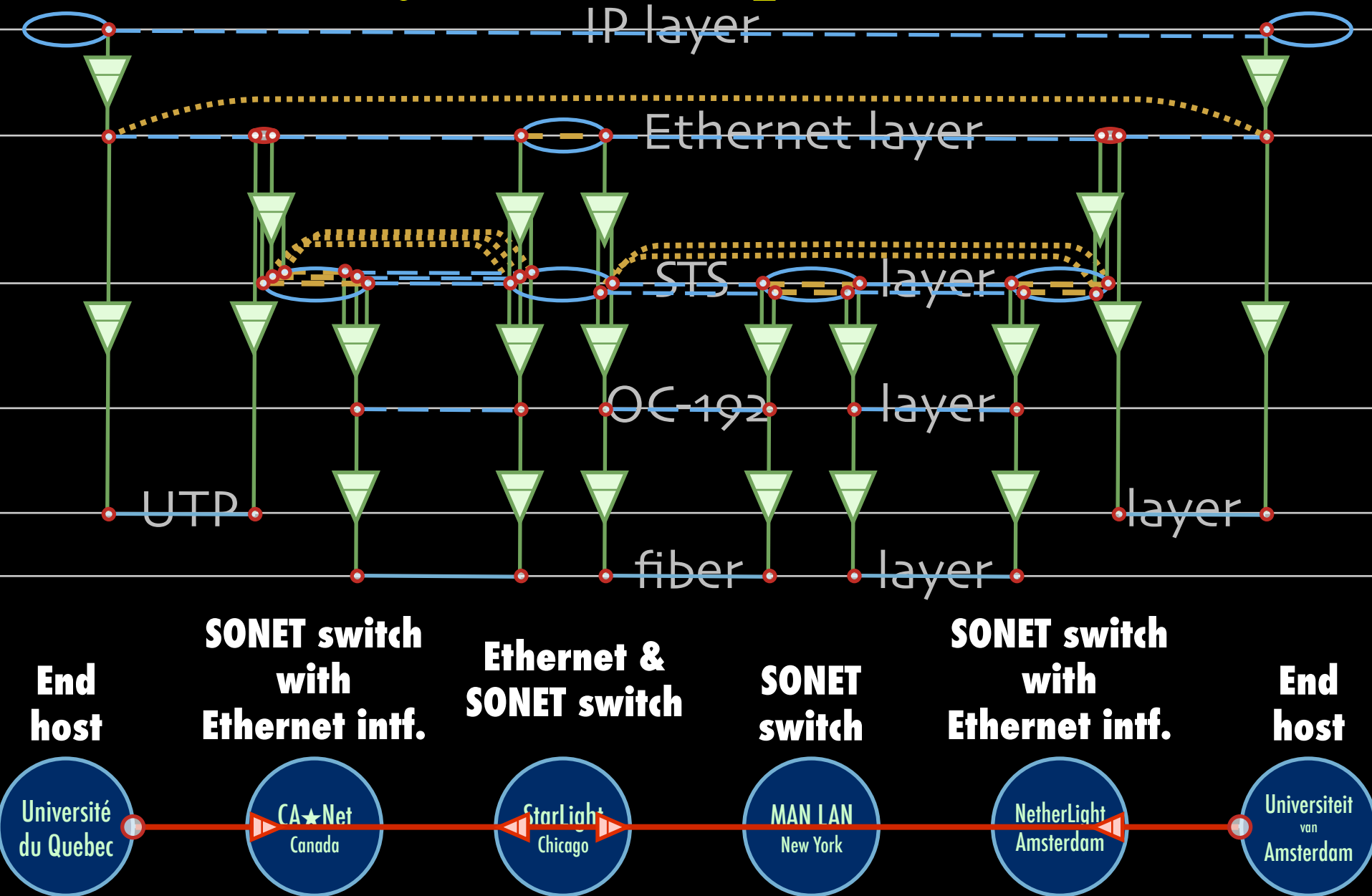
- From semantic Web / Resource Description Framework.
- The RDF uses XML as an interchange syntax.
- Data is described by triplets (Friend of a Friend):



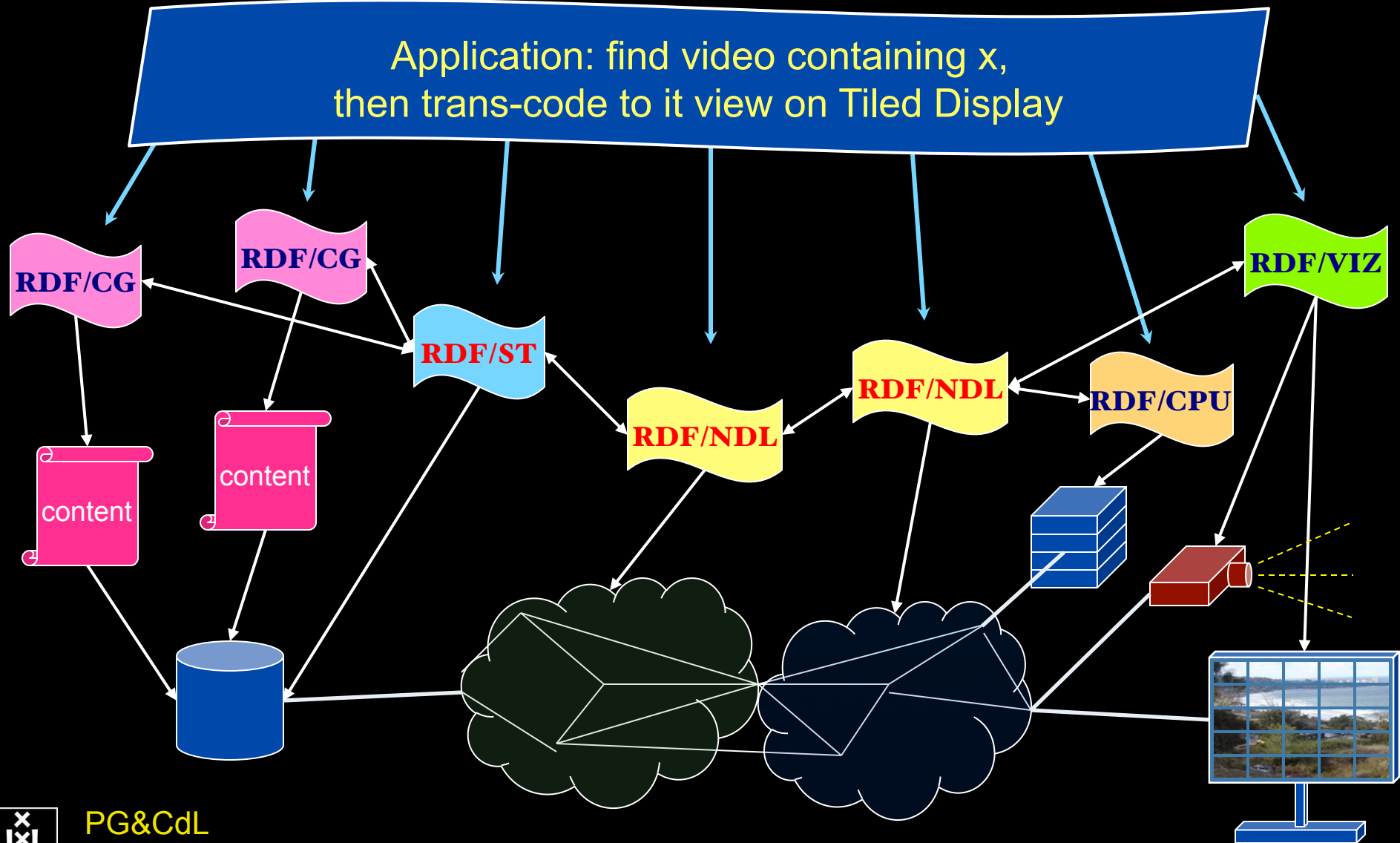
NetherLight in RDF

```
<?xml version="1.0" encoding="UTF-8"?>
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
  xmlns:ndl="http://www.science.uva.nl/research/air/ndl#">
  <!-- Description of Netherlight -->
  <ndl:Location rdf:about="#Netherlight">
    <ndl:name>Netherlight Optical Exchange</ndl:name>
  </ndl:Location>
  <!-- TDM3.amsterdam1.netherlight.net -->
  <ndl:Device rdf:about="#tdm3.amsterdam1.netherlight.net">
    <ndl:name>tdm3.amsterdam1.netherlight.net</ndl:name>
    <ndl:locatedAt rdf:resource="#amsterdam1.netherlight.net"/>
    <ndl:hasInterface rdf:resource="#tdm3.amsterdam1.netherlight.net:501/1"/>
    <ndl:hasInterface rdf:resource="#tdm3.amsterdam1.netherlight.net:501/3"/>
    <ndl:hasInterface rdf:resource="#tdm3.amsterdam1.netherlight.net:501/4"/>
    <ndl:hasInterface rdf:resource="#tdm3.amsterdam1.netherlight.net:503/1"/>
    <ndl:hasInterface rdf:resource="#tdm3.amsterdam1.netherlight.net:503/2"/>
    <!-- all the interfaces of TDM3.amsterdam1.netherlight.net -->
    <ndl:Interface rdf:about="#tdm3.amsterdam1.netherlight.net:501/1">
      <ndl:name>tdm3.amsterdam1.netherlight.net:POS501/1</ndl:name>
      <ndl:connectedTo rdf:resource="#tdm4.amsterdam1.netherlight.net:5/1"/>
    </ndl:Interface>
    <ndl:Interface rdf:about="#tdm3.amsterdam1.netherlight.net:501/2">
      <ndl:name>tdm3.amsterdam1.netherlight.net:POS501/2</ndl:name>
      <ndl:connectedTo rdf:resource="#tdm1.amsterdam1.netherlight.net:12/1"/>
    </ndl:Interface>
```

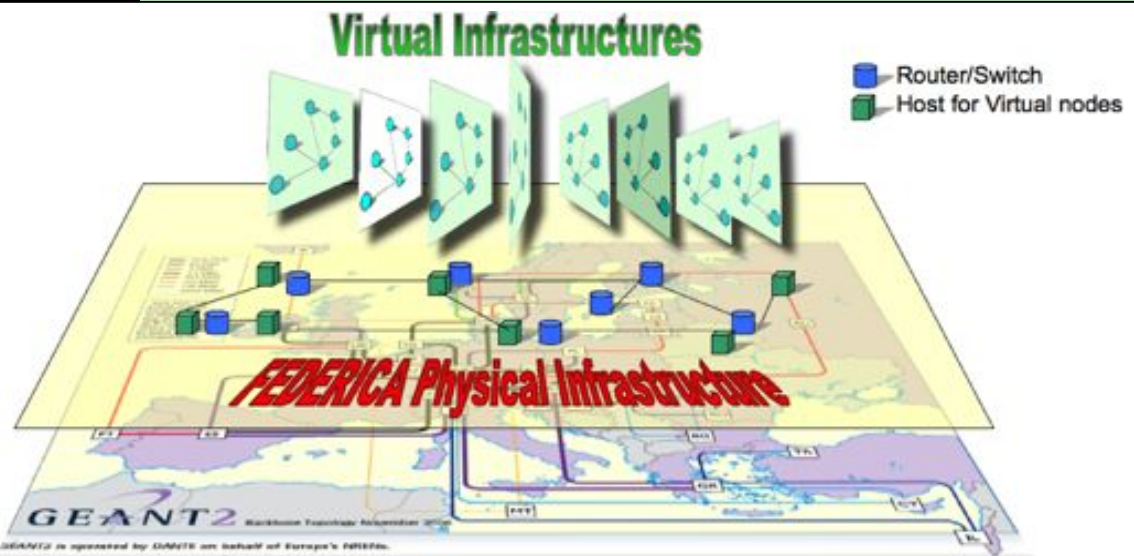
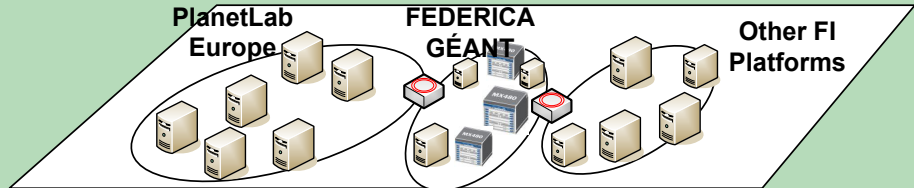
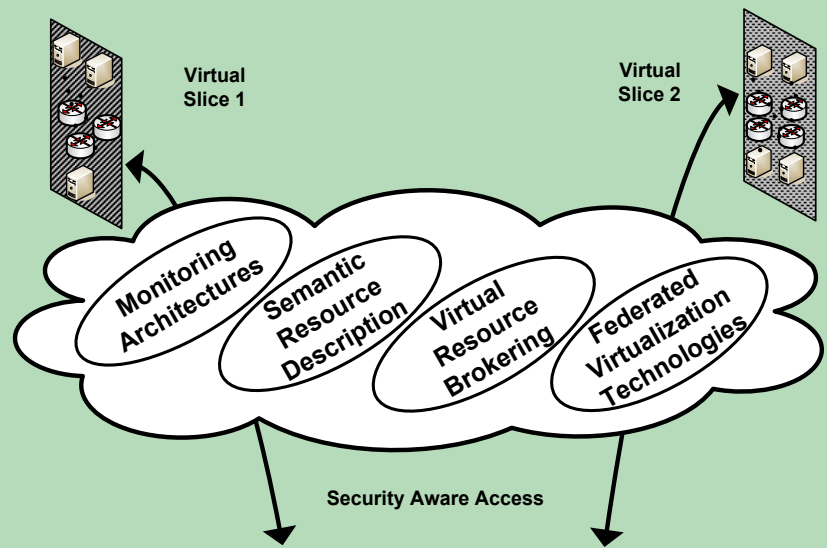
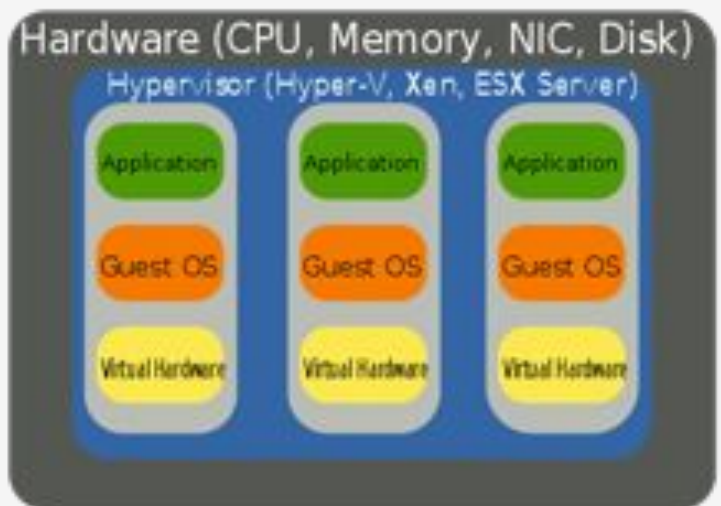
Multi-layer descriptions in NDL



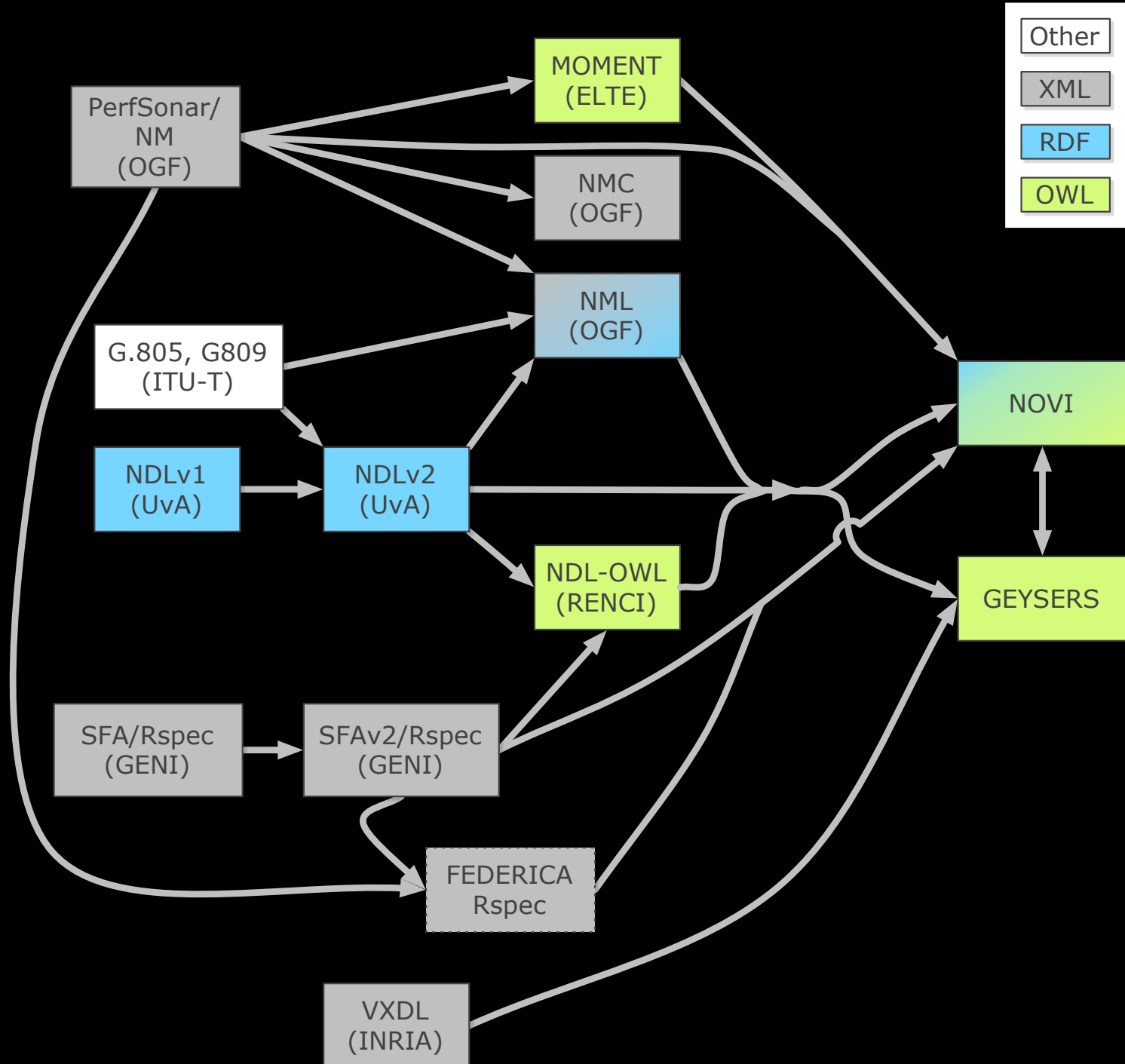
RDF describing Infrastructure



Virtualisatie van infrastructuur & QoS



GEANT2 and NRENs Infrastructure



Applications and Networks become aware of each other!

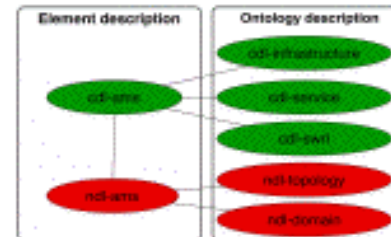
CineGrid Description Language

CineGrid is an initiative to facilitate the exchange, storage and display of high-quality digital media.

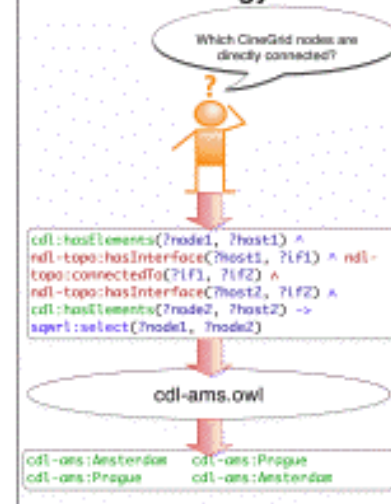
The CineGrid Description Language (CDL) describes CineGrid resources. Streaming, display and storage components are organized in a hierarchical way.

CDL has bindings to the NDL ontology that enables descriptions of network components and their interconnections.

With CDL we can reason on the CineGrid infrastructure and its services.



SQWRL is used to query the Ontology.



UML representation of CDL



CDL links to NDL using the **owl:SameAs** property. CDL defines the services, NDL the network interfaces and links. The combination of the two ontologies identifies the host pairs that support matching services via existing network connections.



SNE @ UvA



Ijkdijk/Urban Flood
Medical
LifeWatch
CosmoGrid/eVLBI
CineGrid
EU-GN3/NOVI/Geysers
SURFnet/GLIF/Cloud

Green-IT

Privacy/Trust

Authorization/policy

Programmable networks

40-100Gig/TCP/WF/QoS

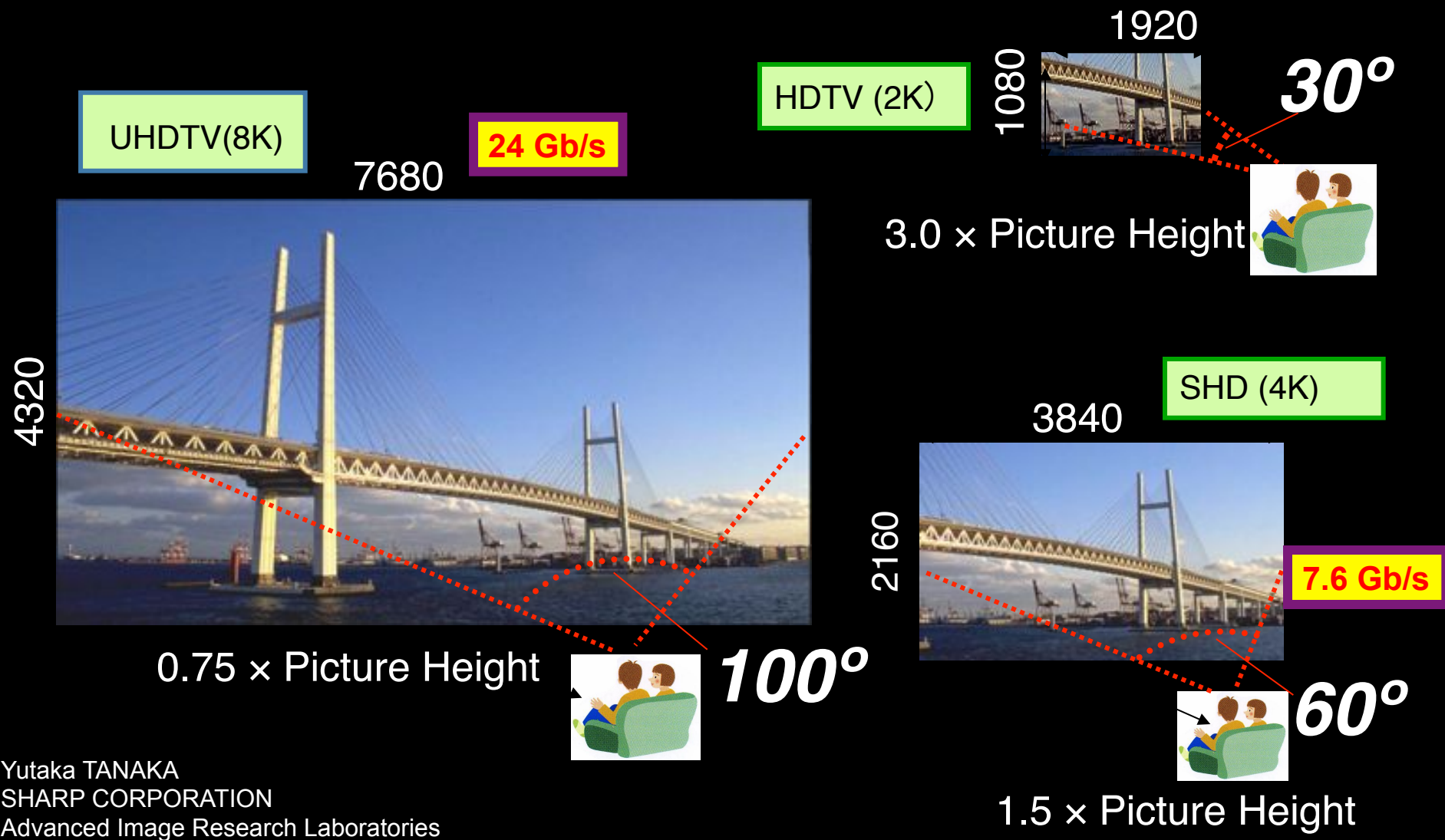
Topology/Architecture

Optical Photonic

					X	X	
		X			X		
	X	X		X	X		
X		X					
X		X	X	X		X	
	X	X	X	X			
	X	X		X			

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





Hey, not still.



We're almost done. Sshh...



The "Dead Cat" demo

1 Mflops/byte

Real time issue



SC2004,
Pittsburgh,
Nov. 6 to 12, 2004
iGrid2005,
San Diego,
sept. 2005

Many thanks to:
AMC
SARA
GigaPort
UvA/AIR
Silicon Graphics,
Inc.
Zoölogisch Museum

CineGrid portal

100 Tbyte
Cache & Store & Forward



distribution center Amsterdam

[Home](#) | [About](#) | [Browse Content](#) | [cinegrid.org](#) | [cinegrid.nl](#)

Amsterdam Node Status:

node41:
Disk space used: 8 GiB
Disk space available: 10 GiB

Search node:

Search

Browse by tag:

amsterdam animation
[antonaco](#) blender boat
bridge burna cgi delta holland
hollandfestival
leidschestraat
muziekgebouw
nieuwmarkt opera prague ship
train tram trams waag

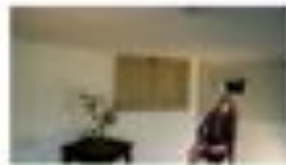
100 University van Amsterdam

CineGrid Amsterdam

Welcome to the Amsterdam CineGrid distribution node. Below are the latest additions of super-high-quality video to our node.

For more information about CineGrid and our efforts look at the about section.

Latest Additions



Wypke

Wypke

Available formats:

4k drc (4.8 KB)

Duration: 1 hour and 8 minutes

Created: 1 week, 2 days ago

Author: Wypke

Categories:



Prague Train

Steam locomotive in Prague.

Available formats:

4k drc (3.9 KB)

Duration: 27 hours and 46 minutes

Created: 1 week, 2 days ago

Author: CineGrid

Categories: delta prague train



VLC: Big Buck Bunny

(C) copyright Blender Foundation | <http://www.bigbuckbunny.org>

Available formats:

1080p H264 (1.1 GB)

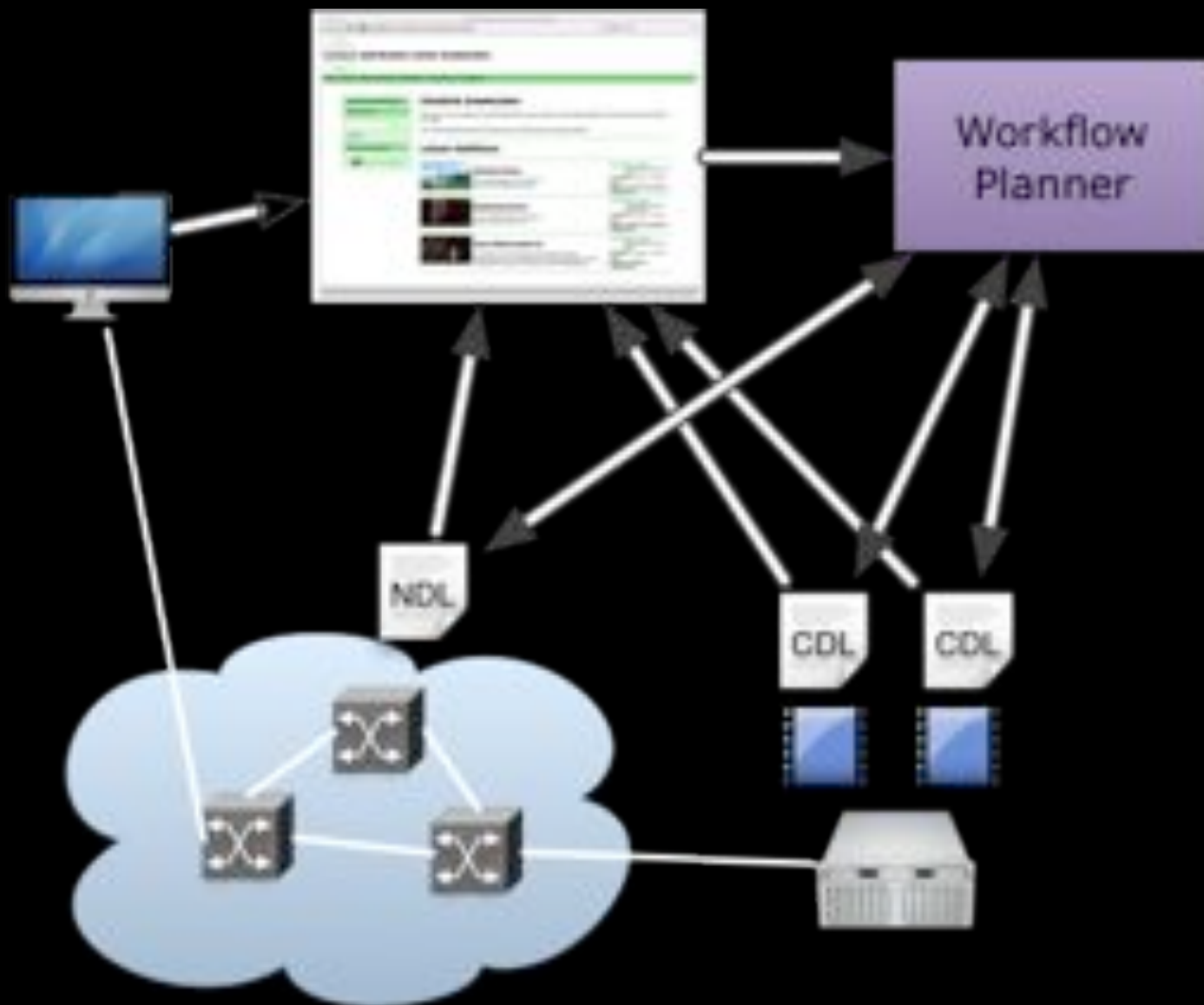
Duration: 1 hour and 9 minutes

Created: 1 month, 1 week ago

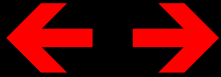
Author: Blender Foundation

Categories: animation blender bunny
cgi

CineGrid Workflow Planner



Hybrid Networking <-> Computing

Routers  Supercomputers

Ethernet switches  Grid & Cloud

Photonic transport  GPU's

What matters:

Energy consumption/multiplication

Energy consumption/bit transported



EU

SARA

SURF-ESRC

Pieken-in-de-Delta

SURFnet

FES

UVA

NWO

NWO-RCF

Onderwijs - Master SNE

- Open Source aanpak

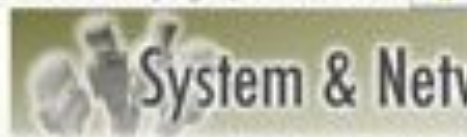
☺ Hij luistert
naar ons!



- Gebaseerd op open en non-discriminatory standaarden
- Privacy en Security
- Digitale beveiliging & forensics
- Internet infrastructuur
- Opleiding nauw verweven met de onderzoeksgroep!

Domain name:
www.os3.nl
is secured by DNSSEC.

Your computer is also secured by DNSSEC for this particular domain, so you are secured against domain name spoofing.



Trace: » Contents and links » InterNetwork

Master Education

SNE is the University of Amsterdam master education in System and Network Engineering.

We focus on **O**pen **S**tandards, **O**pen **S**oftware and **O**pen **S**ecurity, hence the name **OS3**.

Information

General information and testimonials are available at the

- [Introductory page](#)

More in depth facts can be found on our

- [Master SNE page](#)

Contact

If you want to make a personal appointment to visit our education or to attend a lecture, please contact us via [info](mailto:info@os3.nl) at [os3 dot nl](mailto:os3@os3.nl).

You can visit our [facilities](#) at the Science Faculty of the University of Amsterdam located at the Science Park Amsterdam.

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Questions ?

CookReport

feb 2009 and feb-mar 2010

november '08
interview with
Kees Neggers (SURFnet),
Cees de Laat (UvA)

and furthermore
on november '09

Wim Liebrandt (SURF),
Bob Hertzberger (UvA) and
Hans Dijkman (UvA)

BSIK projects
GigaPort &
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