Lambda-Grid developments

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Cees de Laat

SURFnet

EU

University of Amsterdam

SARA

TI

TNO

NCF

Contents

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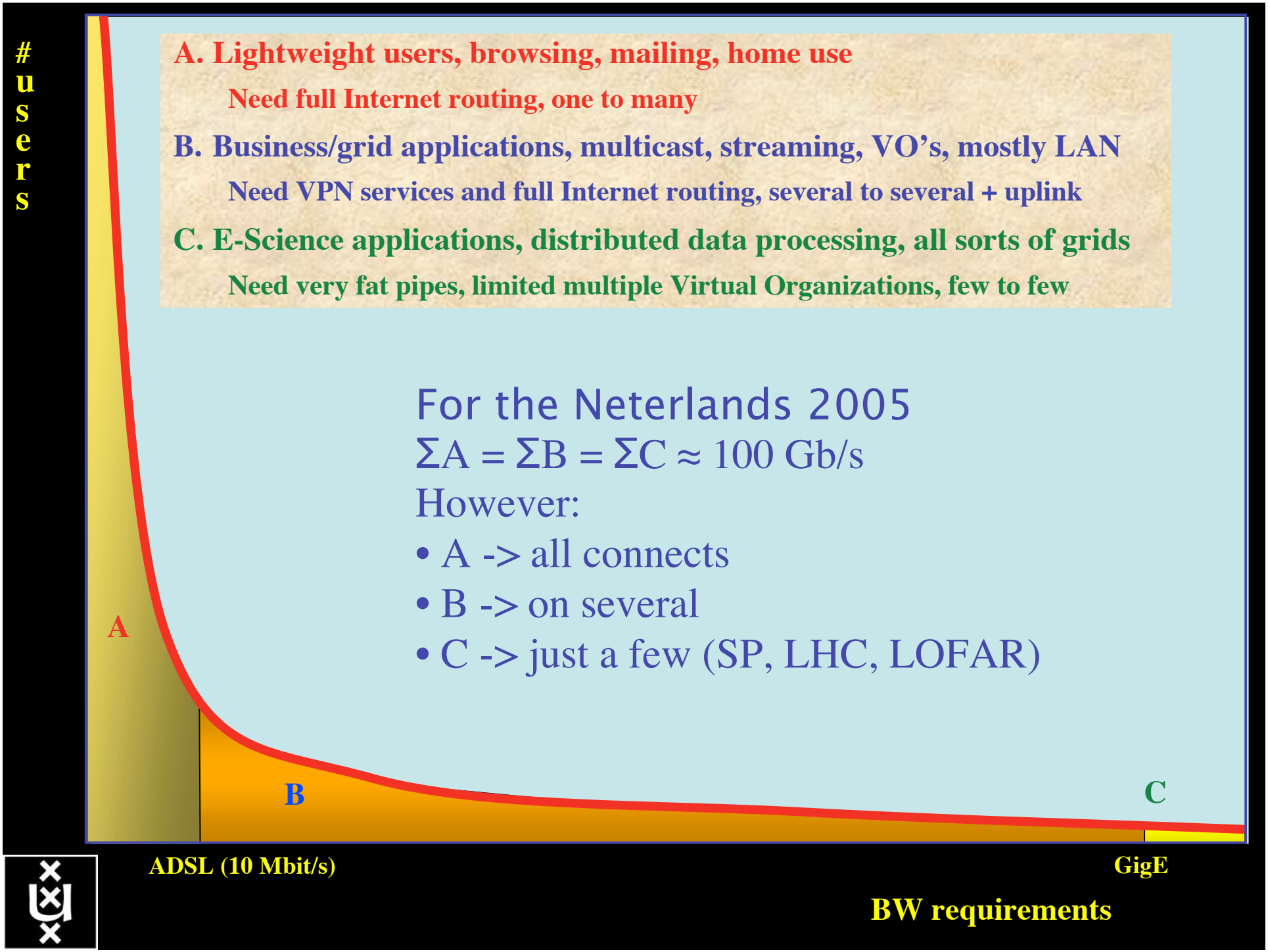
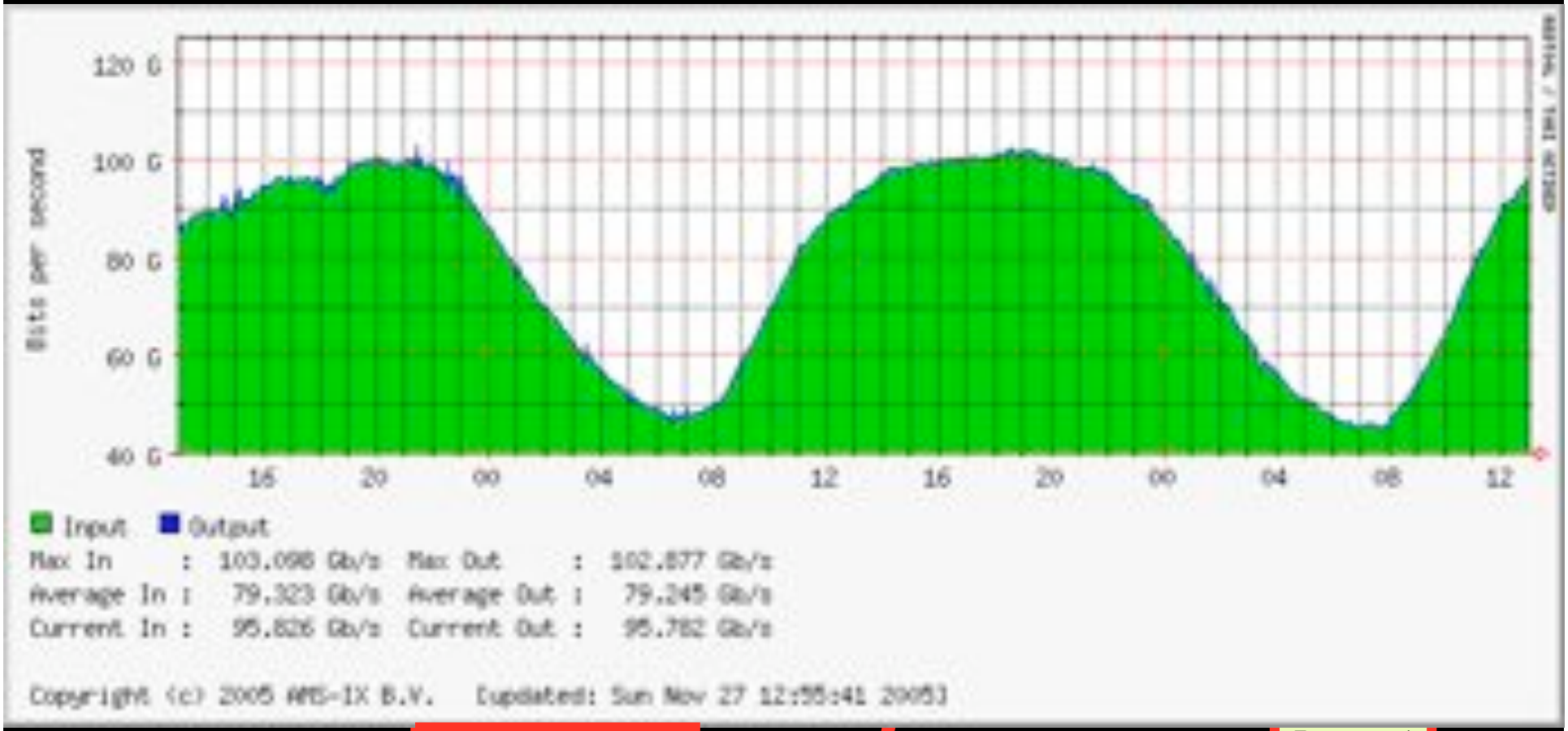
- Ref: www.this-page-intentionally-left-blank.org


#users
A. Lightweight users, browsing, mailing, home use
Need full Internet routing, one to many
B. Business/grid applications, multicast, streaming, VO's, mostly LAN
Need VPN services and full Internet routing, several to several + uplink
C. E-Science applications, distributed data processing, all sorts of grids
Need very fat pipes, limited multiple Virtual Organizations, few to few
For the Neterlands 2005
ΣA = ΣB = ΣC ≈ 100 Gb/s
However:
• A -> all connects
• B -> on several
• C -> just a few (SP, LHC, LOFAR)
A
B
C
ADSL (10 Mbit/s)
GigE
BW requirements

AMS-IX

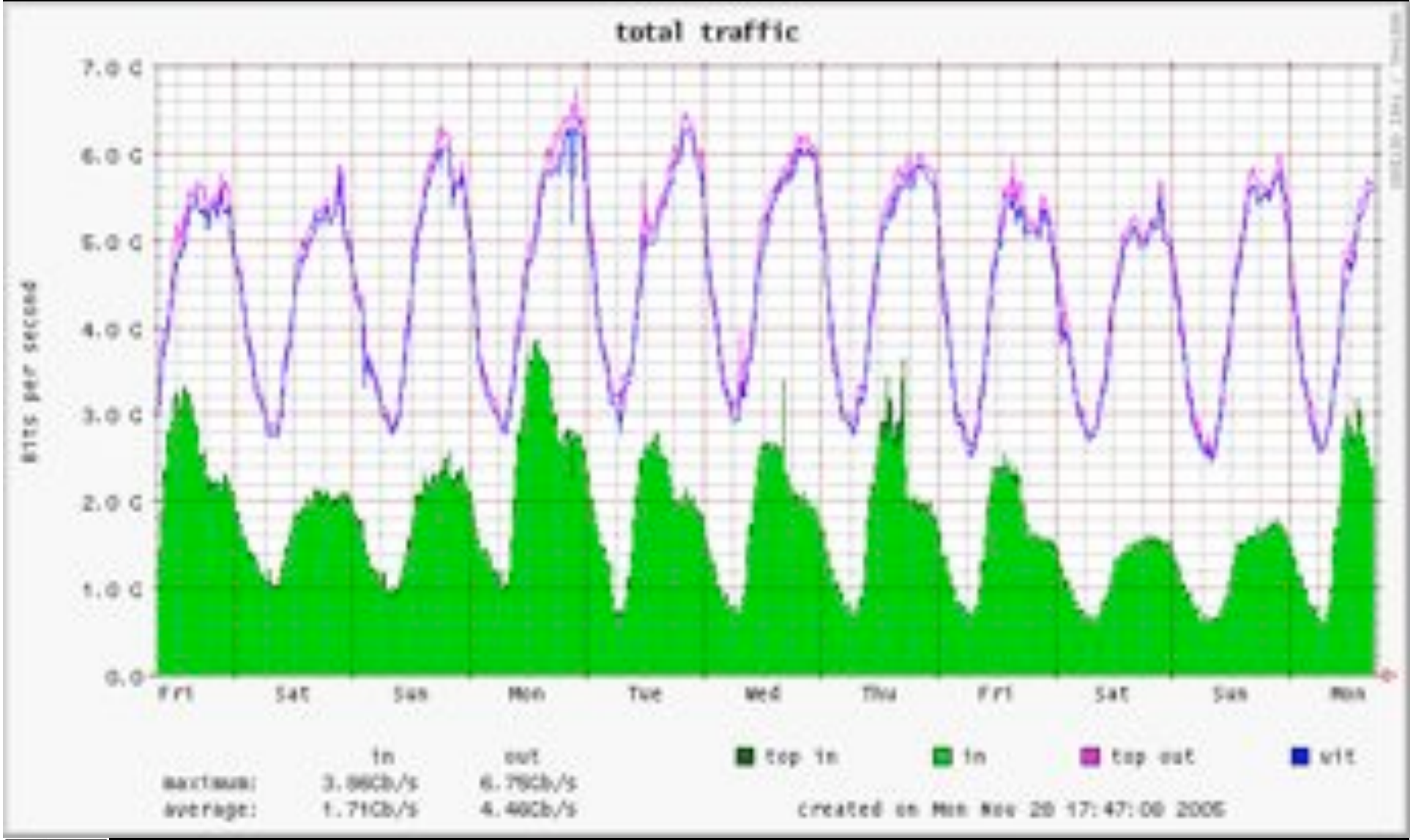


Nov 21th 2005

Lost :-(

European championship football Holland -- Czech Republic

SURFnet5 border router last week



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
- Give each packet in the network the service it needs, but no more !

L1 ≈ 0.5-1.5 k$/port

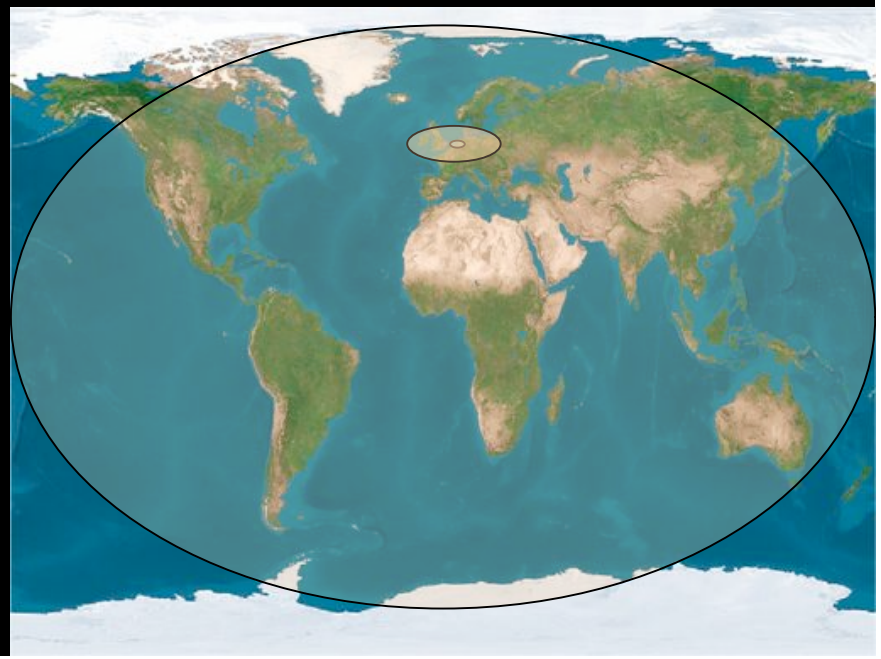
L2 ≈ 5-8 k$/port

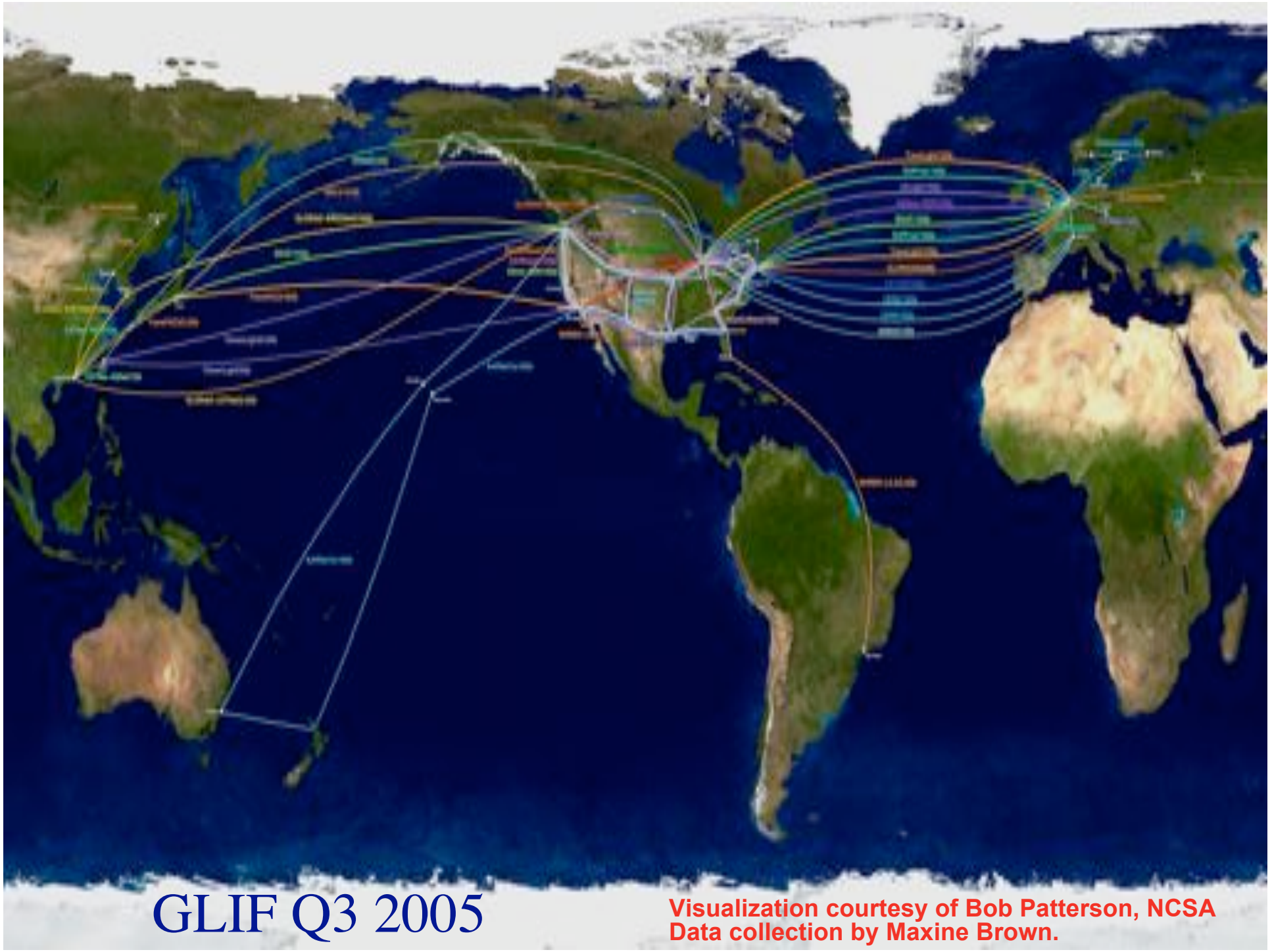
L3 ≈ 75+ k$/port

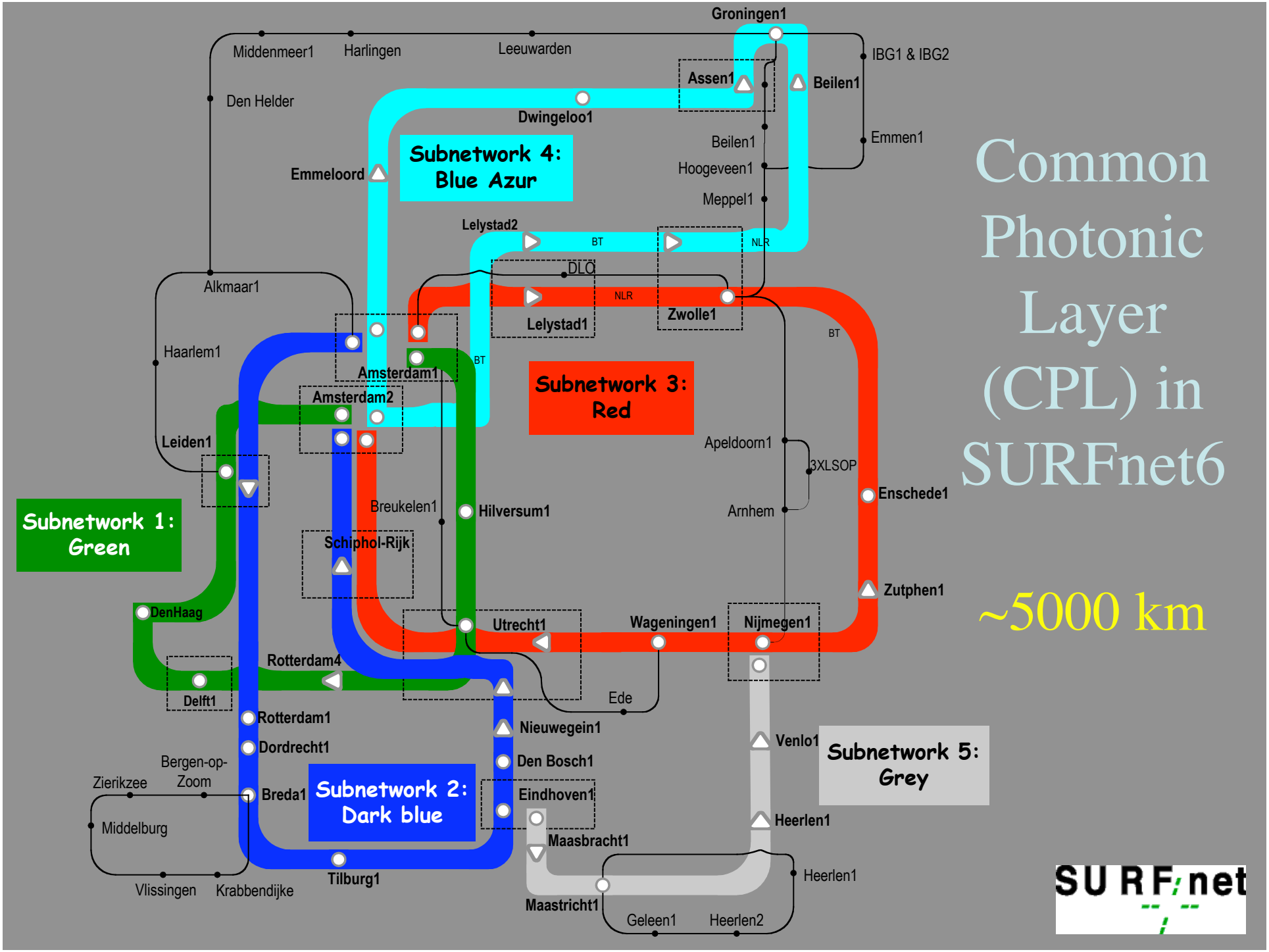
Scale of Infrastructure

- Global scale (200 ms)
  - Trans oceanic lambda's
  - Few Lambda's usually SONET framed
- Regional scale (20 ms)
  - Continent or big country wide network
  - Either dark fiber of many Lambda's on someone's infrastructure
- Metro scale (2 ms)
  - Dark fiber network
  - Photonic devices
- Degrees of Freedom
  - L > R > M

$$\#\lambda \approx \frac{200 * e^{(t-2002)}}{rtt}$$



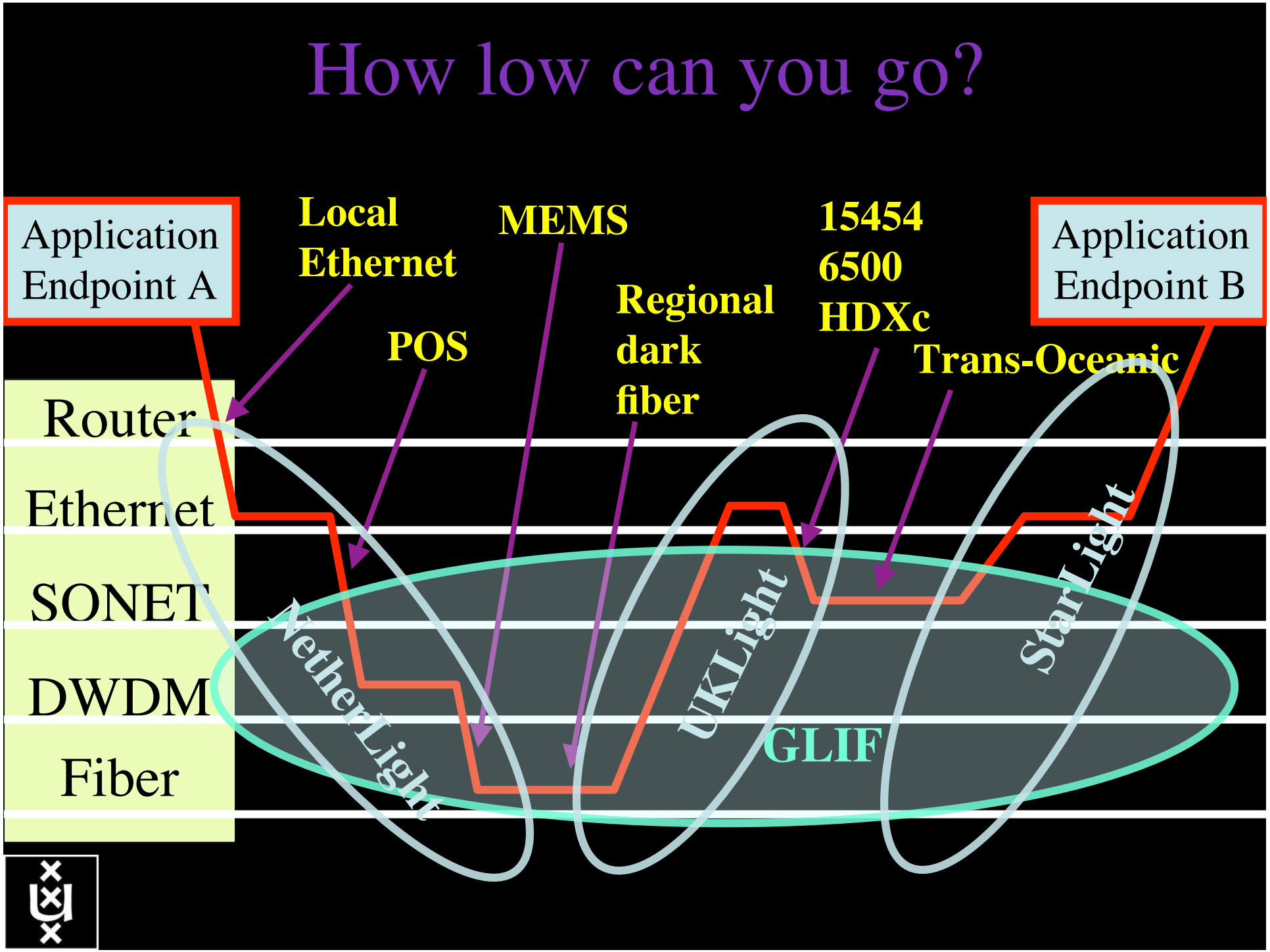

GLIF Q3 2005
Visualization courtesy of Bob Patterson, NCSA
Data collection by Maxine Brown.



Common Photonic Layer (CPL) in SURFnet6

~5000 km

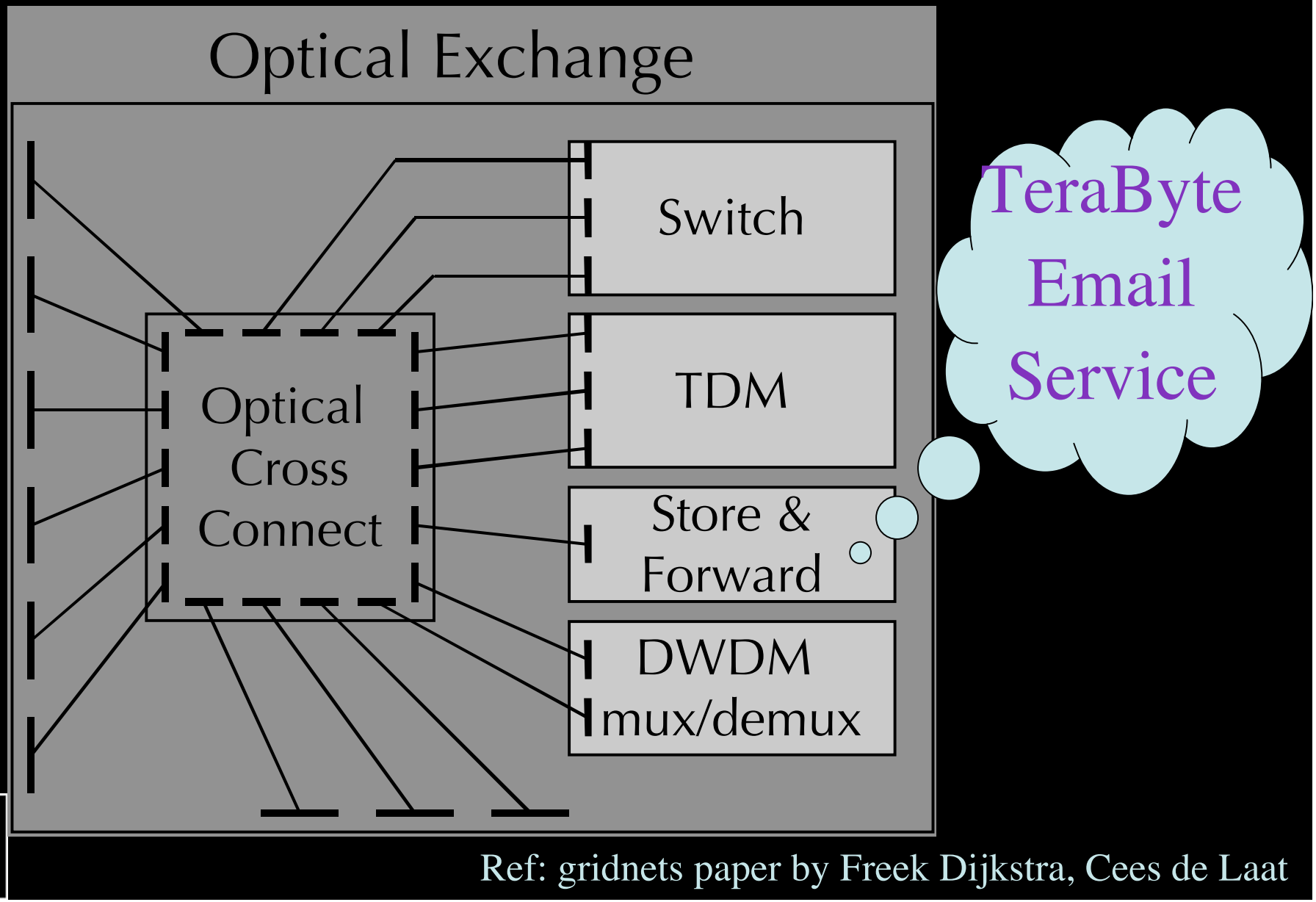
How low can you go?



Services

CLASS \ SCALE	2 Metro	20 Regional	200 World
A	Switching/ Routing	Routers	ROUTER$
B	Switches VPN's E-WANPHY	Routing Switches (G)MPLS E-WANPHY	ROUTER$
C	dark fiber DWDM WSS Photonic switch	DWDM, TDM / SONET Lambda switching	VLAN's TDM SONET Ethernet

Optical Exchange as Black Box

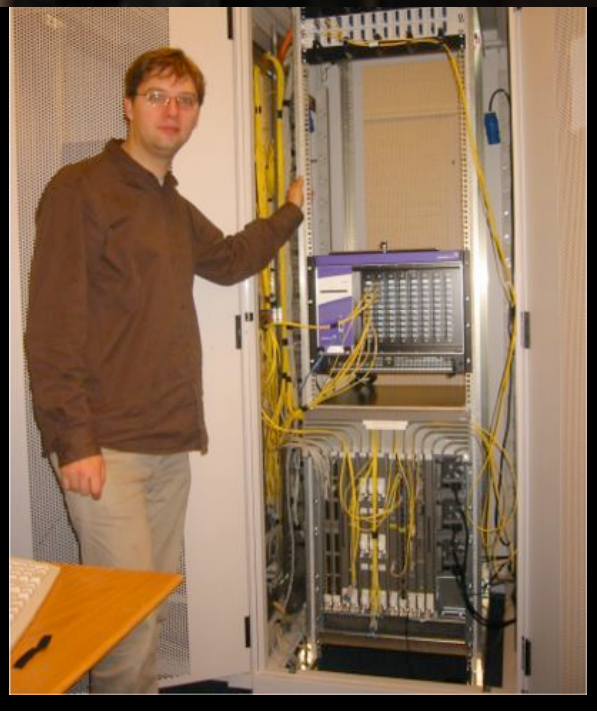


Ref: gridnets paper by Freek Dijkstra, Cees de Laat

R&D

- Resource virtualization
- Path description/selection
- Web services
- Authorization
- Photonic switching

LIGHTHOUSE



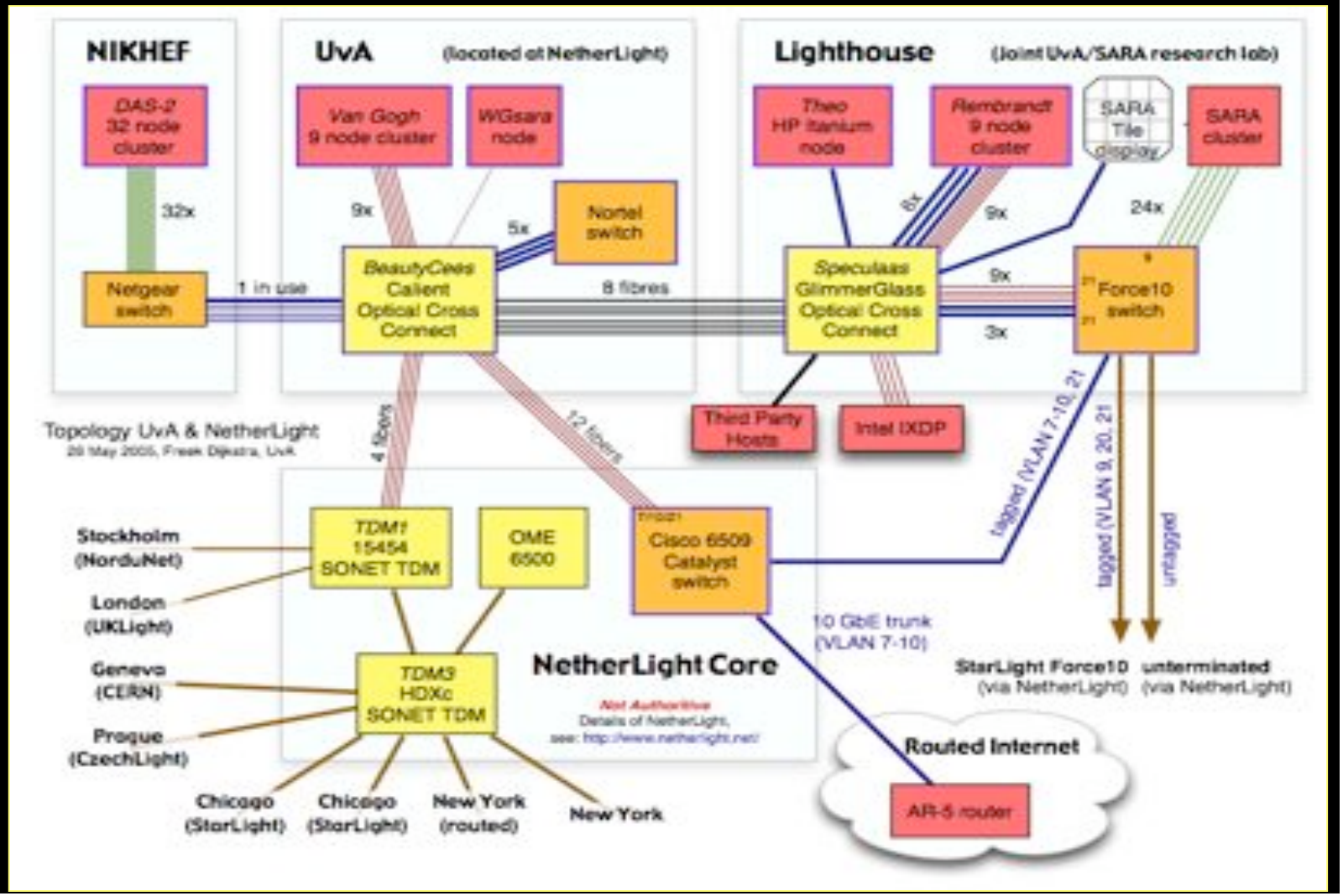
sara
Computing & Networking Services

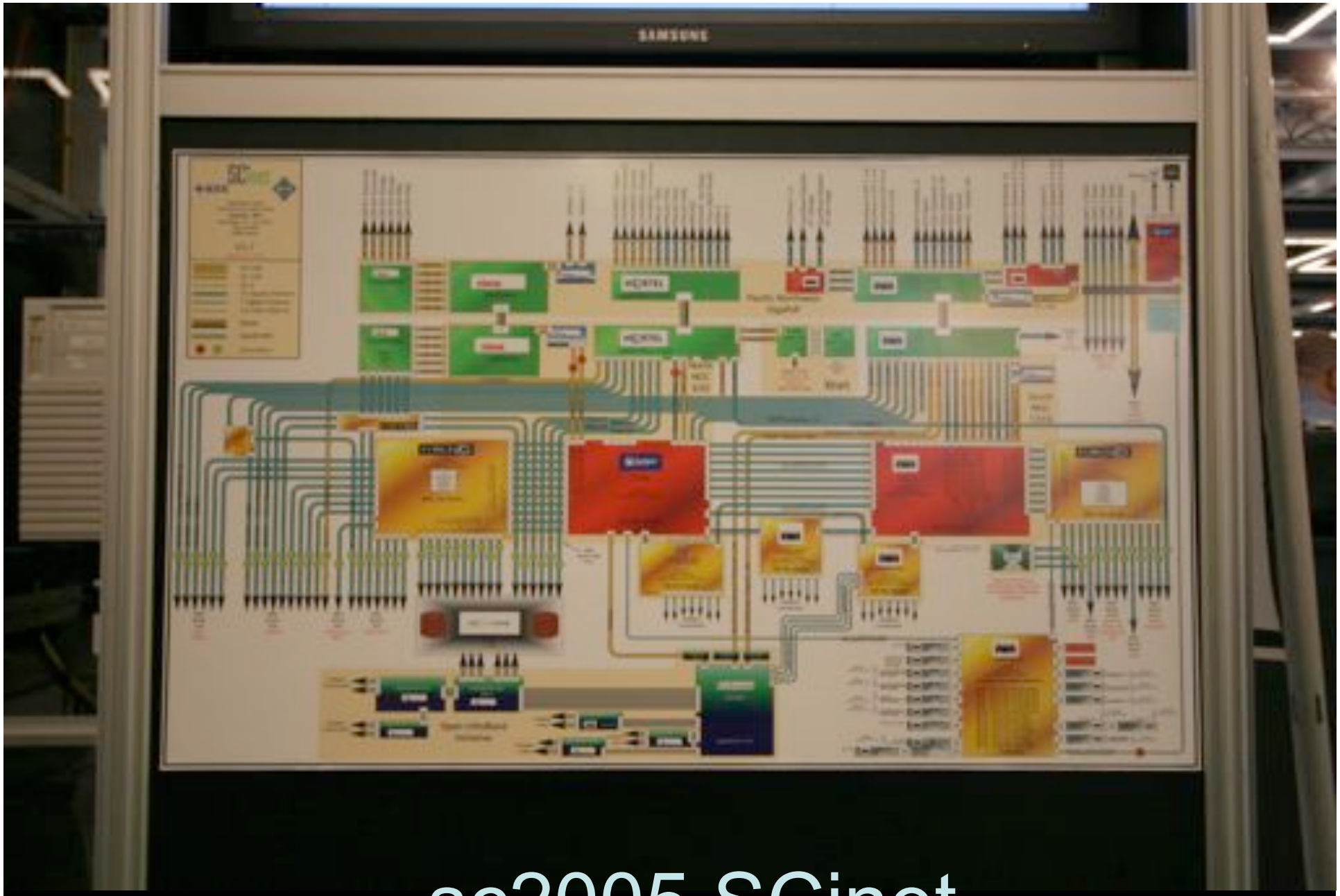
DEMO US117b – GLVF TOPS

- 2D and 3D datasets located at SARA
- Render cluster (29 nodes) at SARA
- 20 Gbps connectivity from cluster via UvA-F10 to NetherLight
- 2 * 10 Gbps lambda between Amsterdam and San Diego (SURFnet, CaveWave, WANPHY Amsterdam-SD)
- UCSD LambdaVision display at iGrid: 100 Megapixel Tiled Display
- 1 Frame = 100 Mpixel*24 bits = 2.4 Gbits

SARA/UvA LightHouse

- A joint network research lab of the University of Amsterdam and SARA.
- Connects end resources to NetherLight.
- Proof of concept e.g. tier 0/1, webservices, GSP





sc2005 SCinet

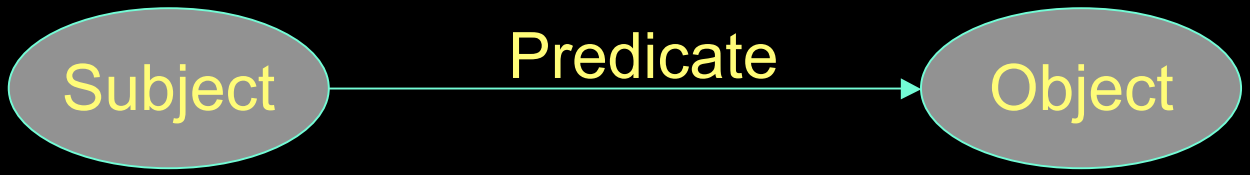
Key issue #1:
how to describe such networks?

Semantic web

"a universal medium for the exchange of data where data can be shared and processed by automated tools as well as by people"

The Resource Description Framework (RDF) uses XML as an interchange syntax.

Data is described by triplets:



NDL - Network Description Language

A way to describe network resources using RDF.

Parser can use the data to:

- generate network maps
- provide information to schedulers

```
<ndl:Device rdf:about="#Vangogh3">
   <ndl:name>Vangogh3</ndl:name>
   <rb:isOfType>ComputingElement</rb:isOfType>
  <ndl:locatedAt rdf:resource="#Lighthouse"/>
  <ndl:hasInterface rdf:resource="#Vangogh3:eth2"/>
</ndl:Device>
```

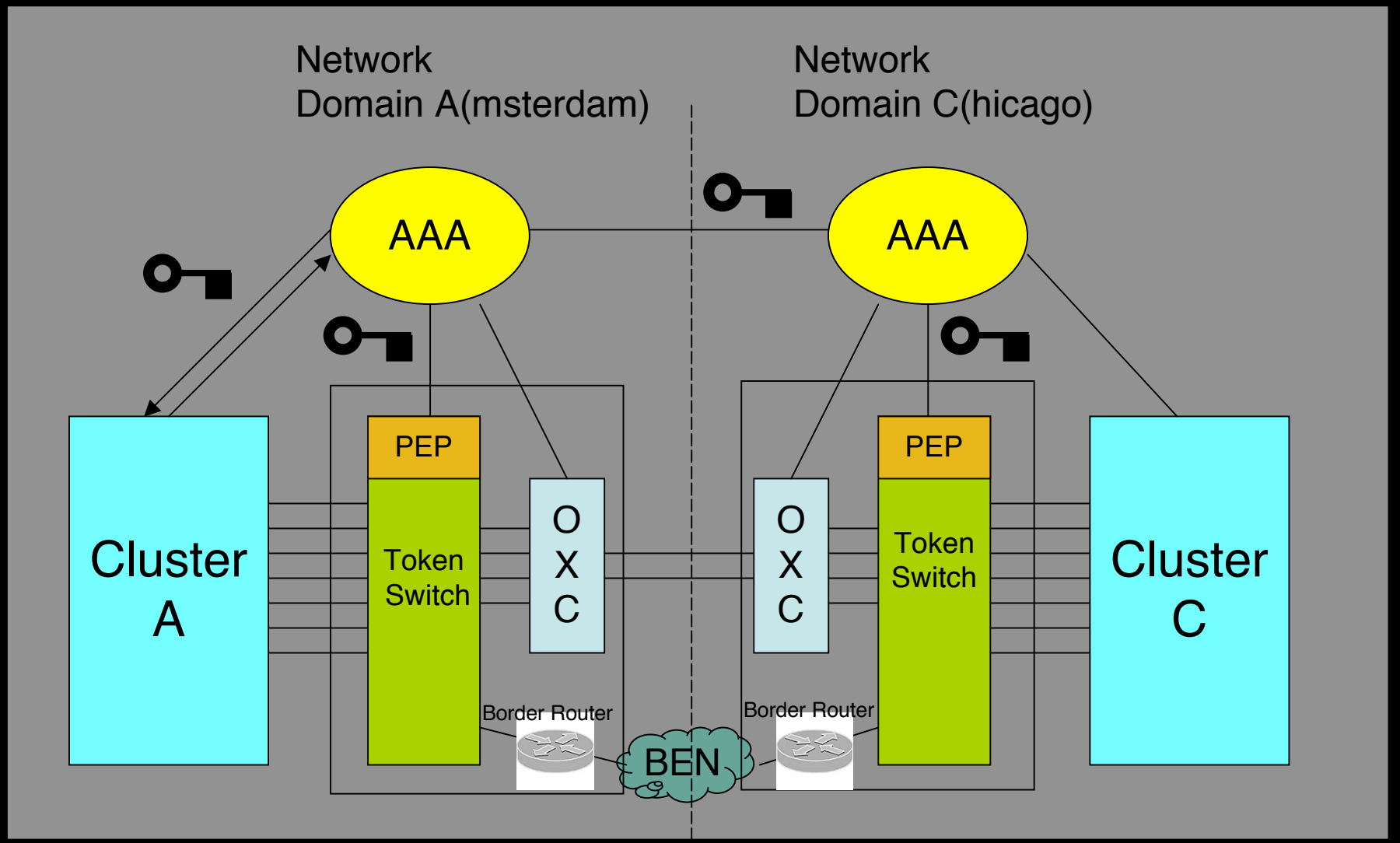
Key issue #2:
How to book resources on such networks?

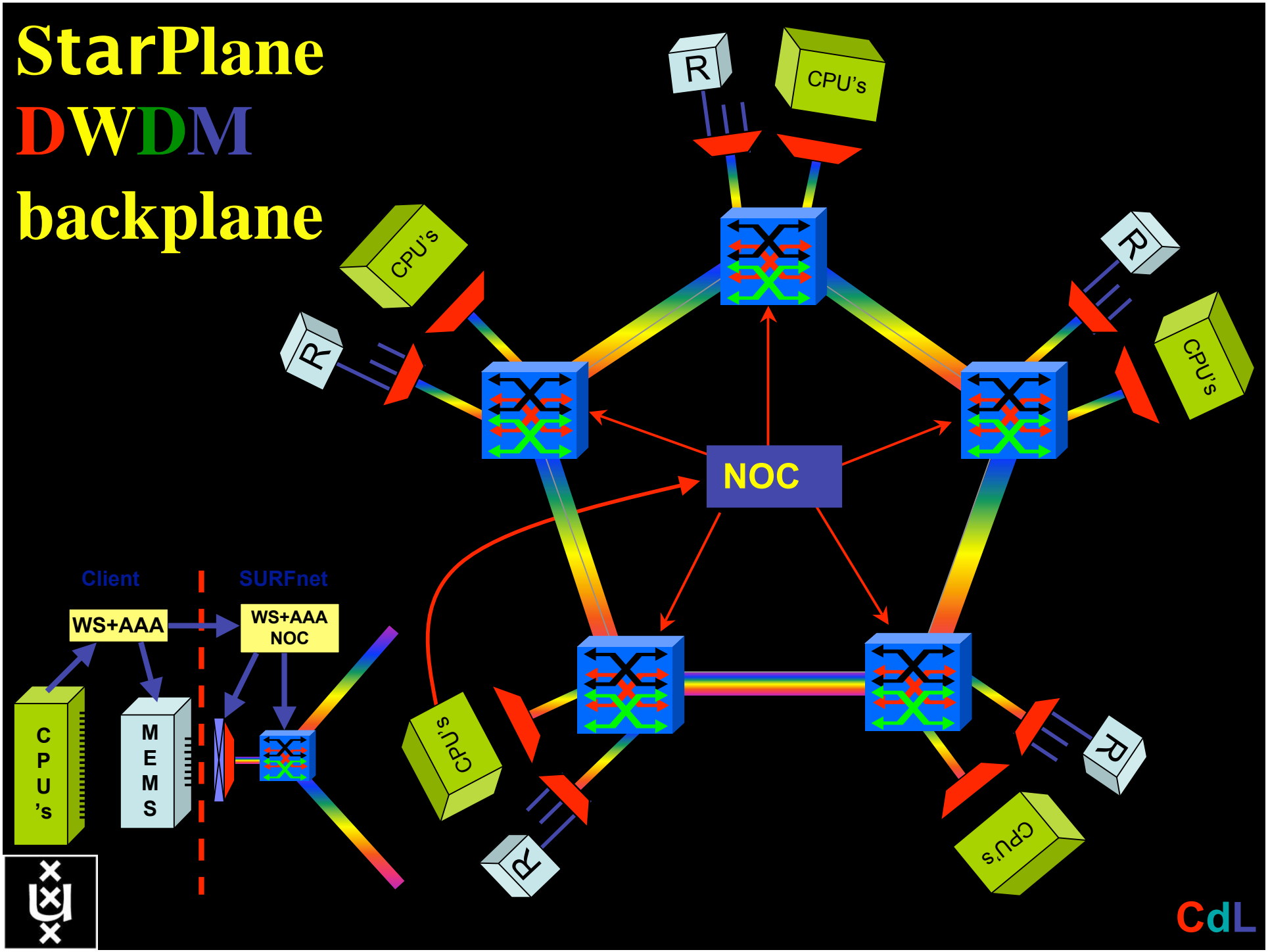
Web services

Web services interfaces provide the API for the reservation framework:

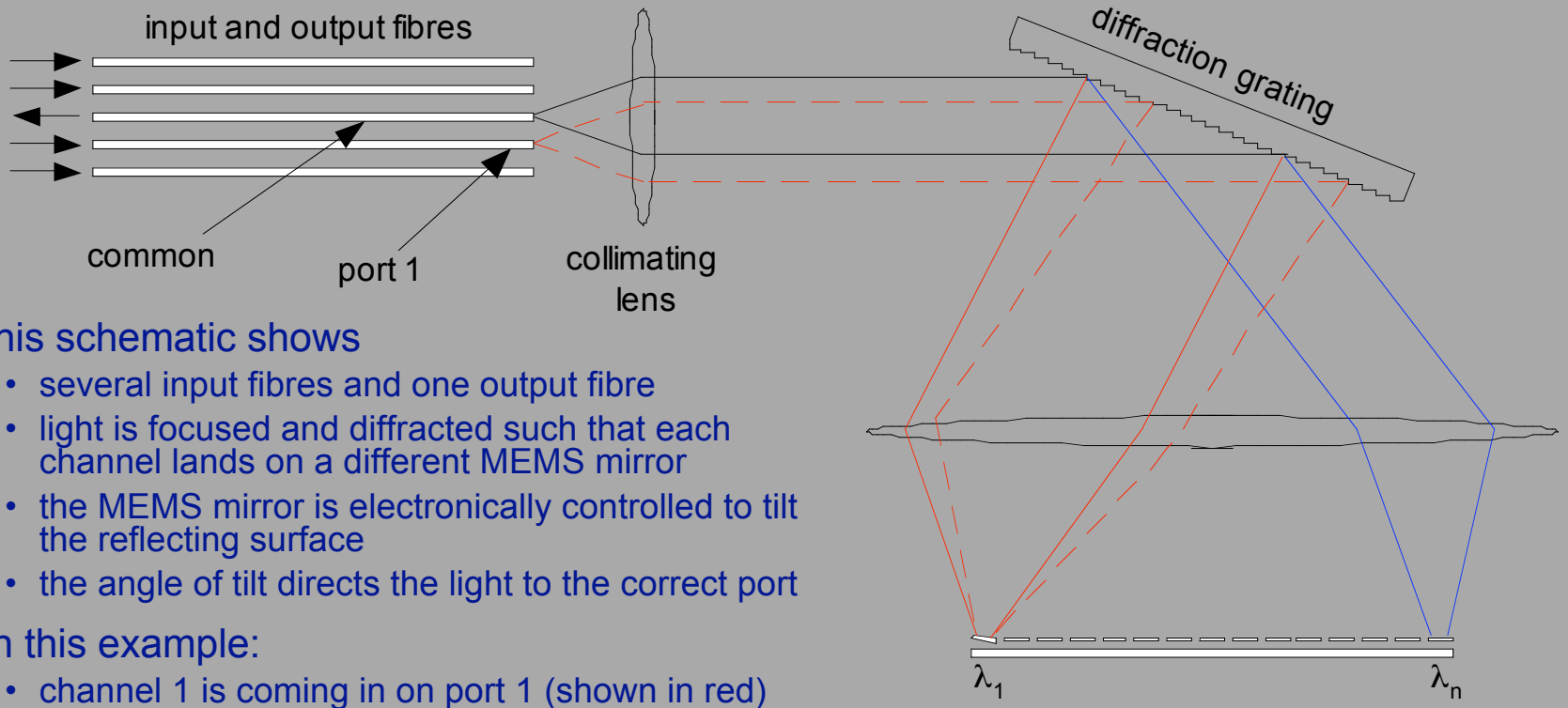
```
<wsdl:operation name="getResourceInformation">
<wsdl:operation name="getResourceList">
<wsdl:operation name="getTypeList">
<wsdl:operation name="getResourcesOfType">
<wsdl:operation name="reservePath">
<wsdl:operation name="getPossiblePaths">
<wsdl:operation name="isPathAvailable">
<wsdl:operation name="confirmPathReservation">
<wsdl:operation name="cancelPathReservation">
```

Token Based Networking




StarPlane
DWDM
backplane
R
CPU's
NOC
Client
SURFnet
WS+AAA
WS+AAA
NOC
CPU's
MEMS
CdL

Module Operation

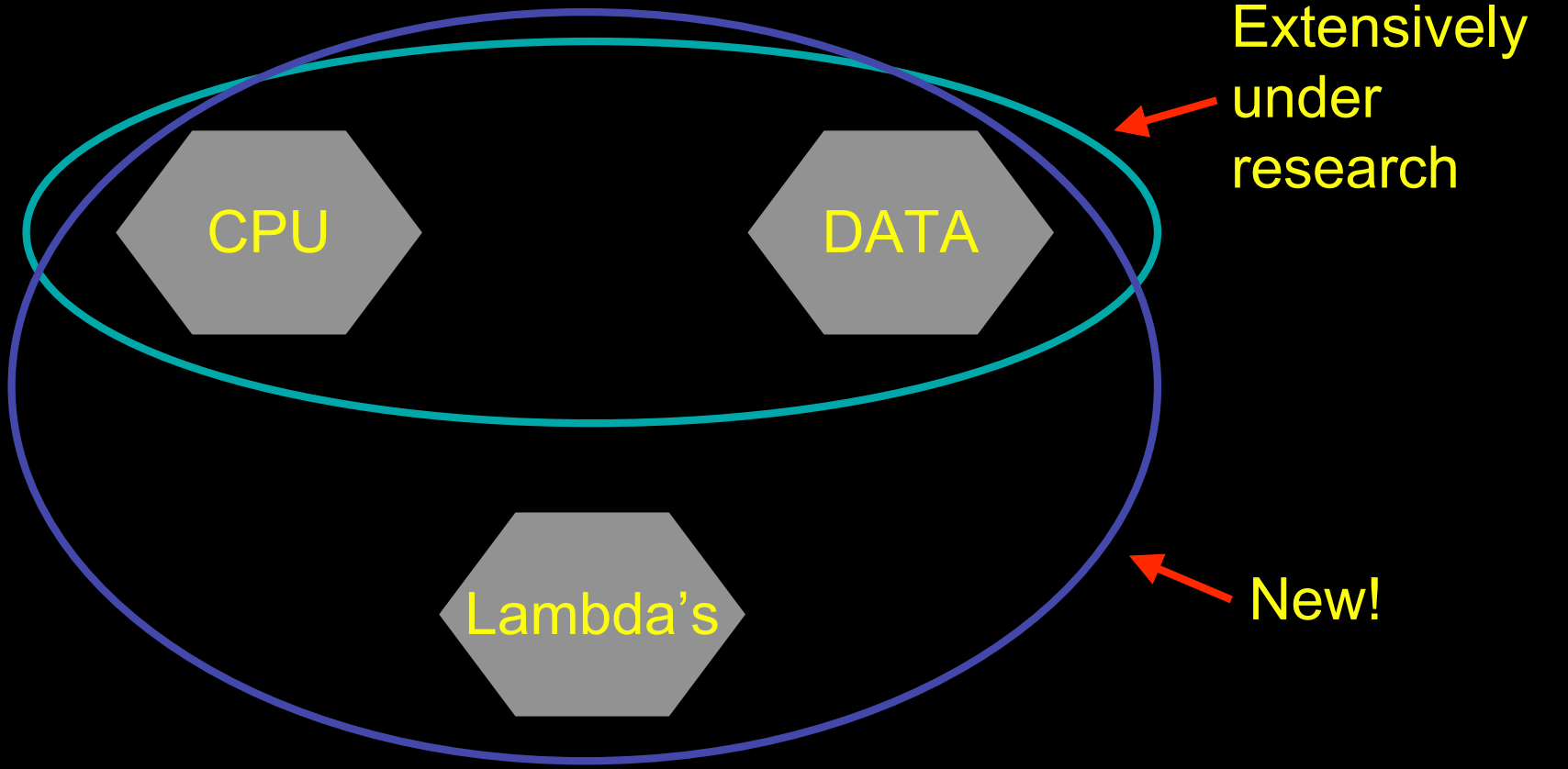


> this schematic shows
  - several input fibres and one output fibre
  - light is focused and diffracted such that each channel lands on a different MEMS mirror
  - the MEMS mirror is electronically controlled to tilt the reflecting surface
  - the angle of tilt directs the light to the correct port

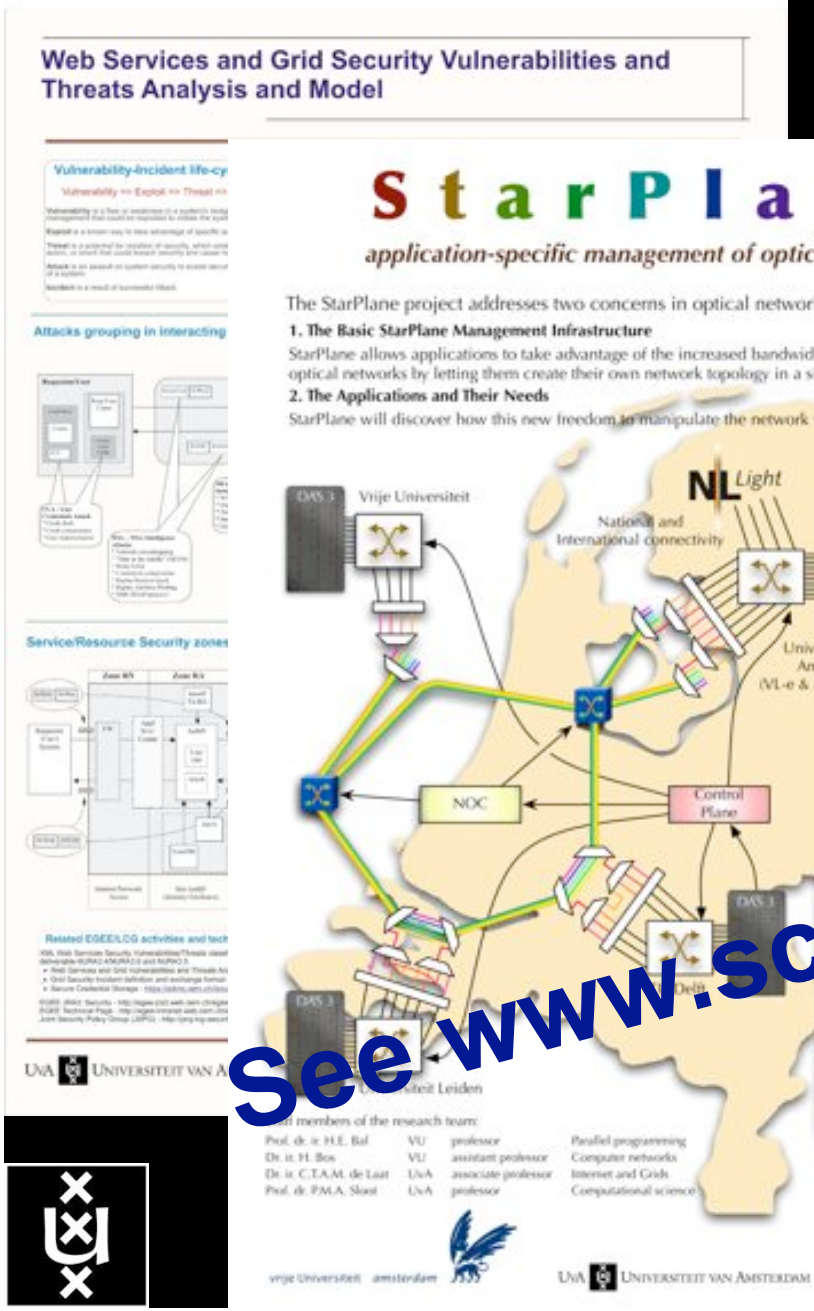
> in this example:
  - channel 1 is coming in on port 1 (shown in red)
  - when it hits the MEMS mirror the mirror is tilted to direct this channel from port 1 to the common
  - only port 1 satisfies this angle, therefore all other ports are blocked

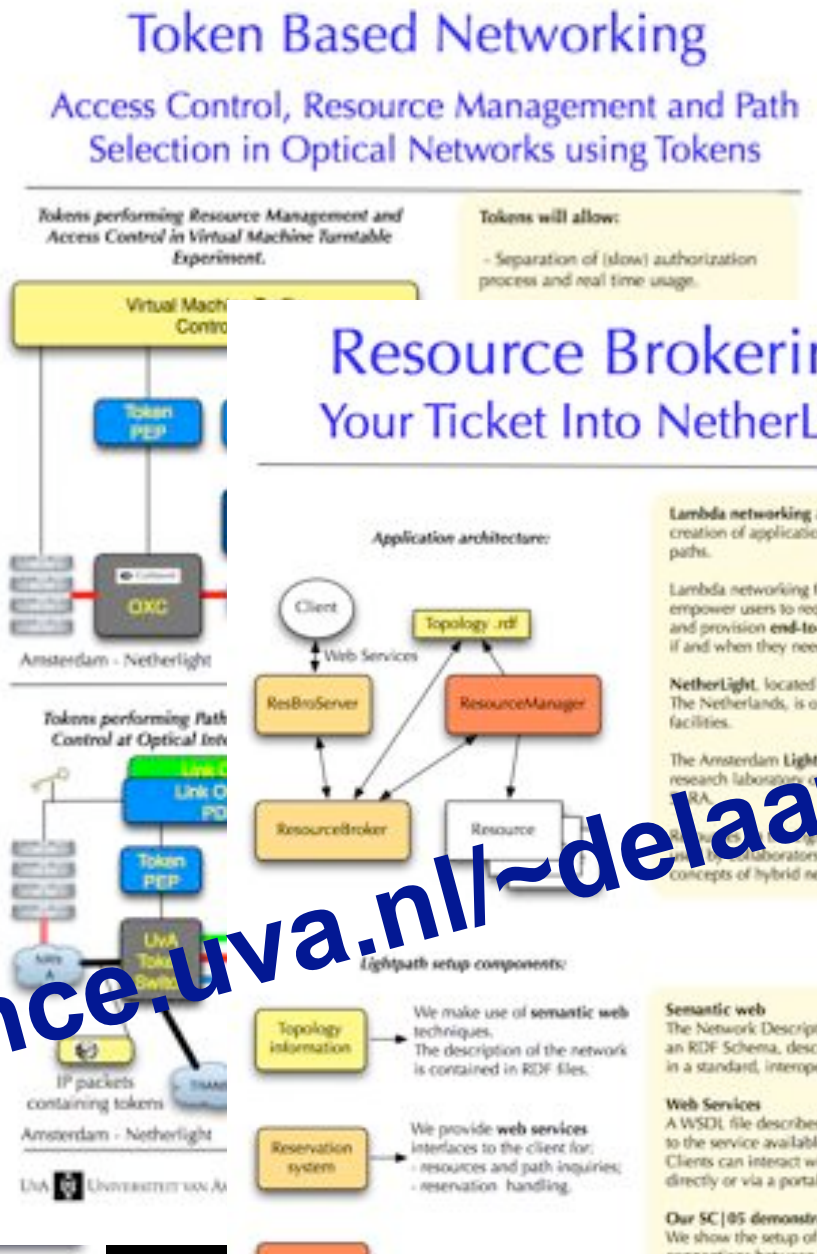
ref Eric Bernier, NORTEL

GRID-Colocation problem space



Posters @ sc2005





Questions ?

Credits:

- Leon Gommans, Paola Grosso, Bas Oudenaarde, Arie Taal, Freek Dijkstra, Bert Andree, Jeroen van der Ham, Hans Blom, Yuri Demchenko, Fred Wan, Karst Koymans, Martijn Steenbakkers Jaap van Ginkel
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- SARA: Anwar Osseryan, Paul Wielinga, Pieter de Boer, Ronald van der Pol, teams
- Joe Mambretti, Bill stArnaud, GLIF community
- Tom & Maxine & Larry, Laurin, OptIPuter, OnVector team !!!!