The Lambda Grid

www.science.uva.nl/~delaat

Cees de Laat

SURFnet
EU
University of Amsterdam

SARA
NIKHEF
NCF

Group

- Advanced About 8 people
- Located Science Park Amsterdam, Watergraafsmeer
  - Producers
  - Consumers
  - Researchers
- Local Collaborations
  - UvA
    - VLE
  - NIKHEF apps from HEF
    - Grids and DataTransport
    - DAS
  - SARA
    - Optical lab / housing
    - Integration LambdaGrid node

VLBI

ger term VLBI is easily capable of generating many Gb of data per
The sensitivity of the VLBI array scales w
(=data-rate) and there is a strong push to
Rates of 8Gb/s or more are entirely feasibl
der development. It is expected that para
orrelator will remain the most efficient approa
s distributed processing may have an appli
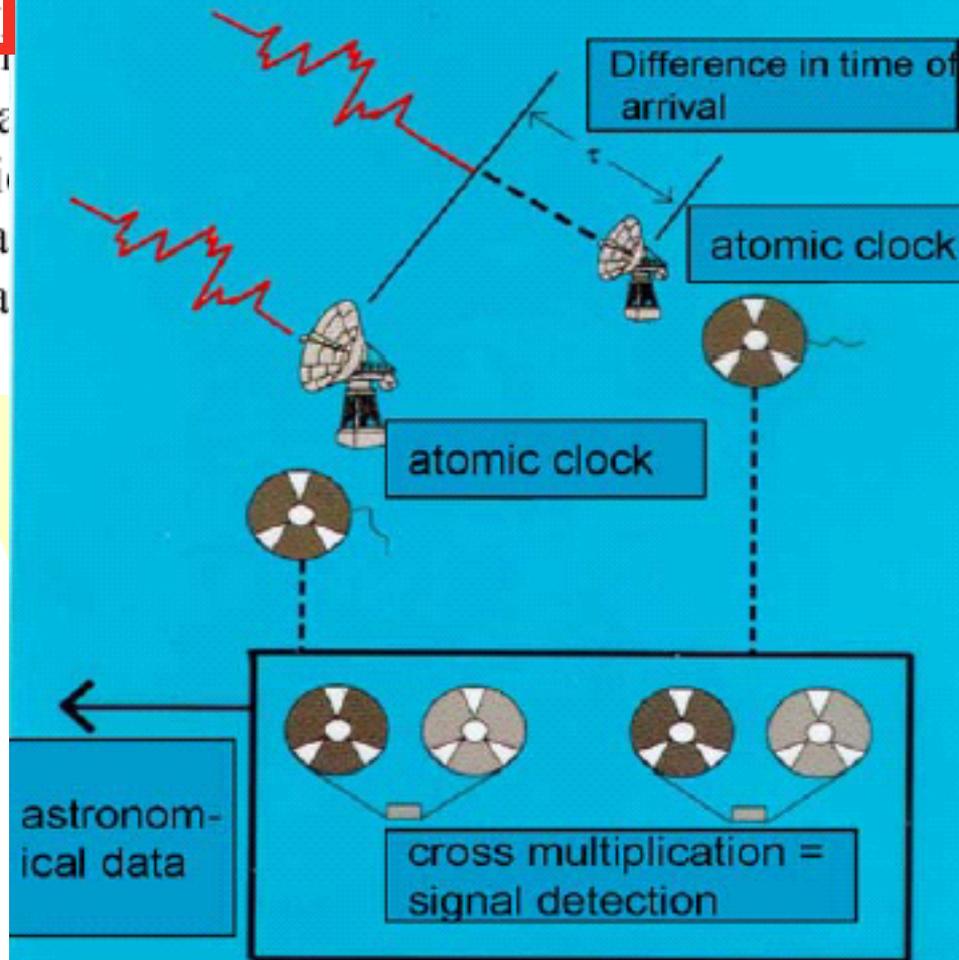lti-gigabit data streams will aggregate into la
or and the capacity of the final link to the da
tor.

Westerbork Synthesis Radio Telescope - Netherlands

VLBI configuration

Difference in time of arrival

atomic clock

atomic clock

astronom-ical data

cross multiplication = signal detection

iGrid 2002

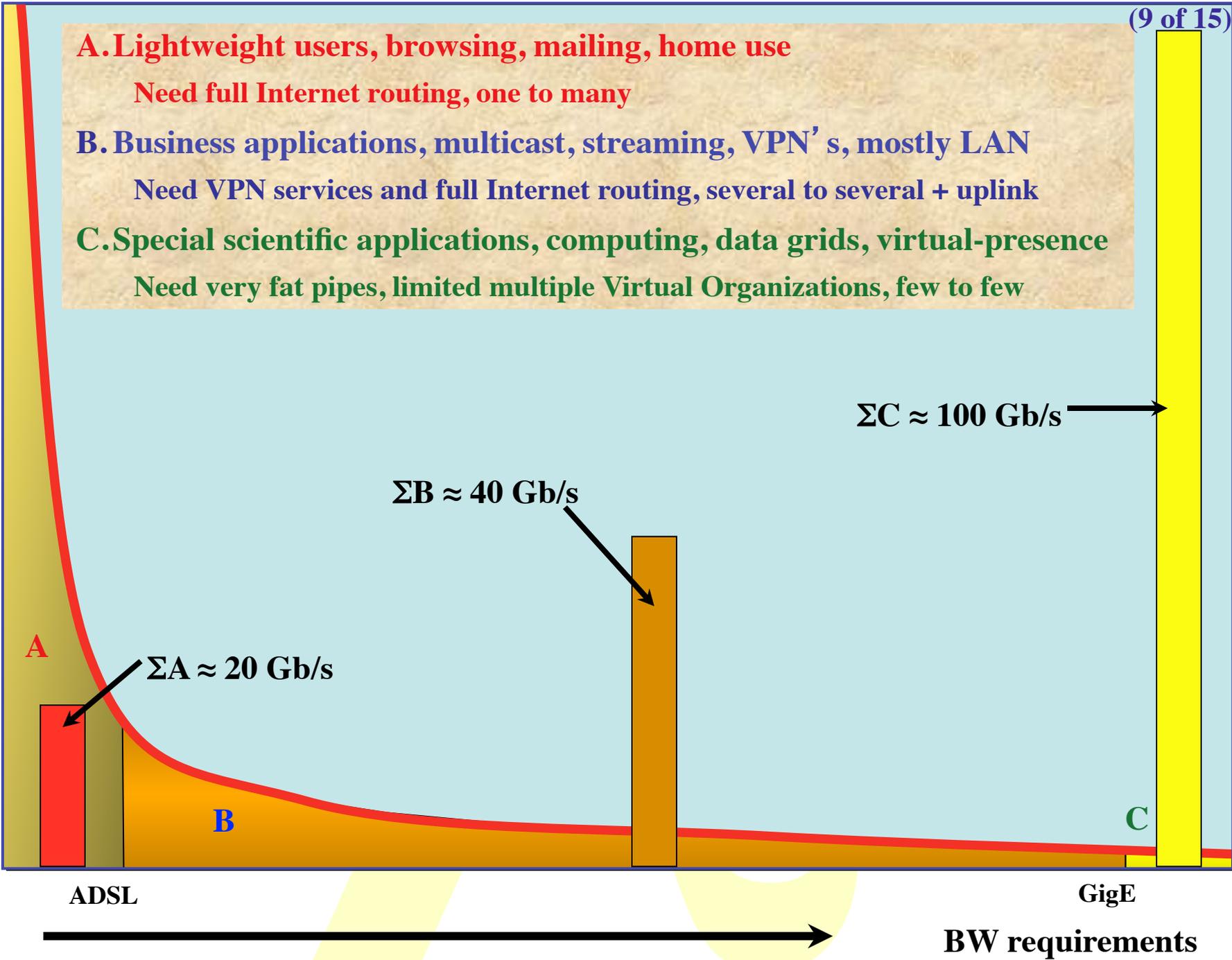## September 24-26, 2002, Amsterdam, The Netherlands

- 28 demonstrations from 16 countries: Australia, Canada, CERN, France, Finland, Germany, Greece, Italy, Japan, The Netherlands, Singapore, Spain, Sweden, Taiwan, United Kingdom, United States

- Applications demonstrated: art, bioinformatics, chemistry, cosmology, cultural heritage, education, high-definition media streaming, manufacturing, medicine, neuroscience, physics, tele-science

- Grid technologies demonstrated: Major emphasis on grid middleware, data management grids, data replication grids, visualization grids, data/visualization grids, computational grids, access grids, grid portals

- 25Gb transatlantic bandwidth (100Mb/attendee, 250x iGrid2000!)

www.igrid2002.org

A. **Lightweight users, browsing, mailing, home use**
   Need full Internet routing, one to many

B. **Business applications, multicast, streaming, VPN's, mostly LAN**
   Need VPN services and full Internet routing, several to several + uplink

C. **Special scientific applications, computing, data grids, virtual-presence**
   Need very fat pipes, limited multiple Virtual Organizations, few to few
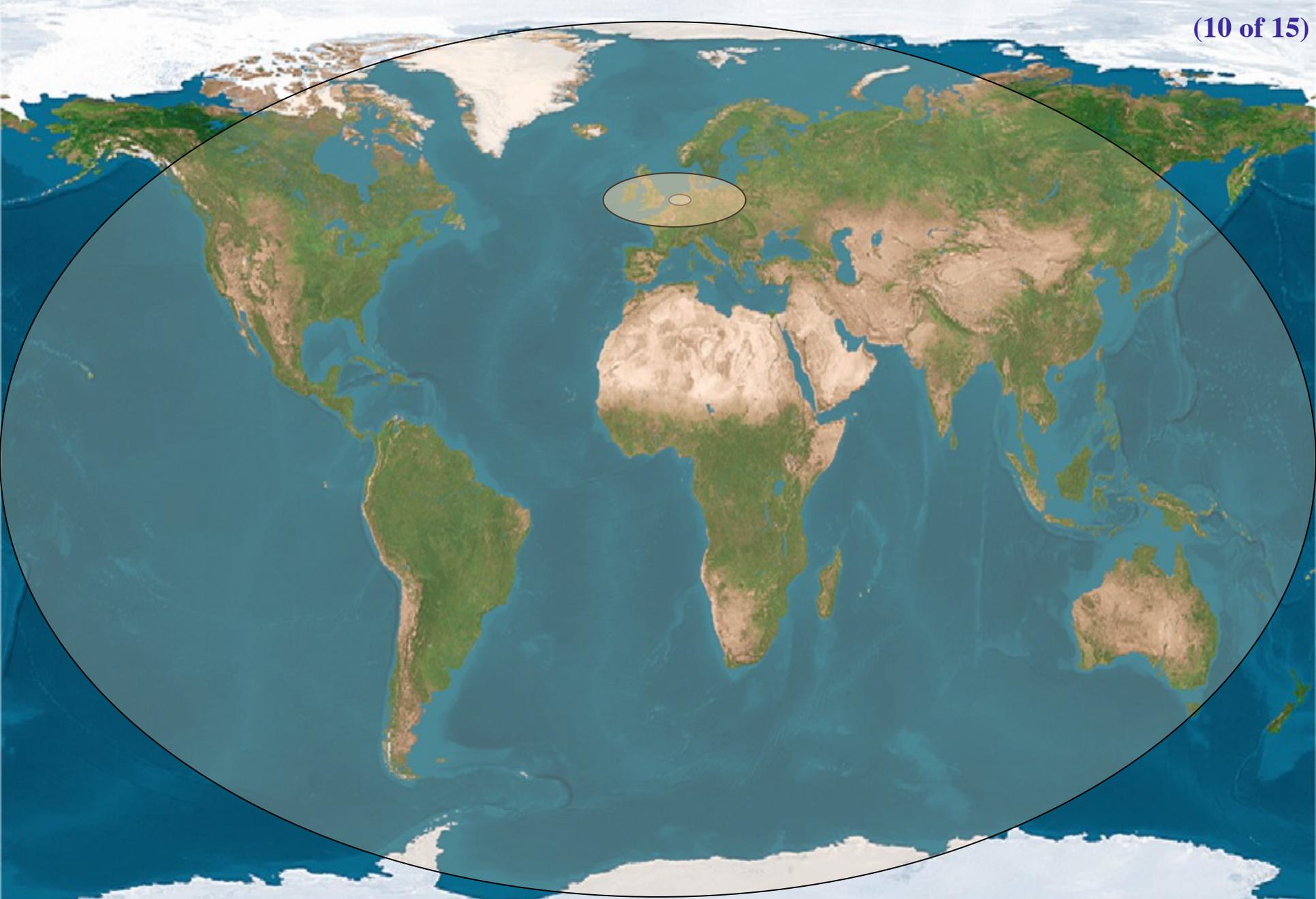
users

$\Sigma C \approx 100$ Gb/s

$\Sigma B \approx 40$ Gb/s
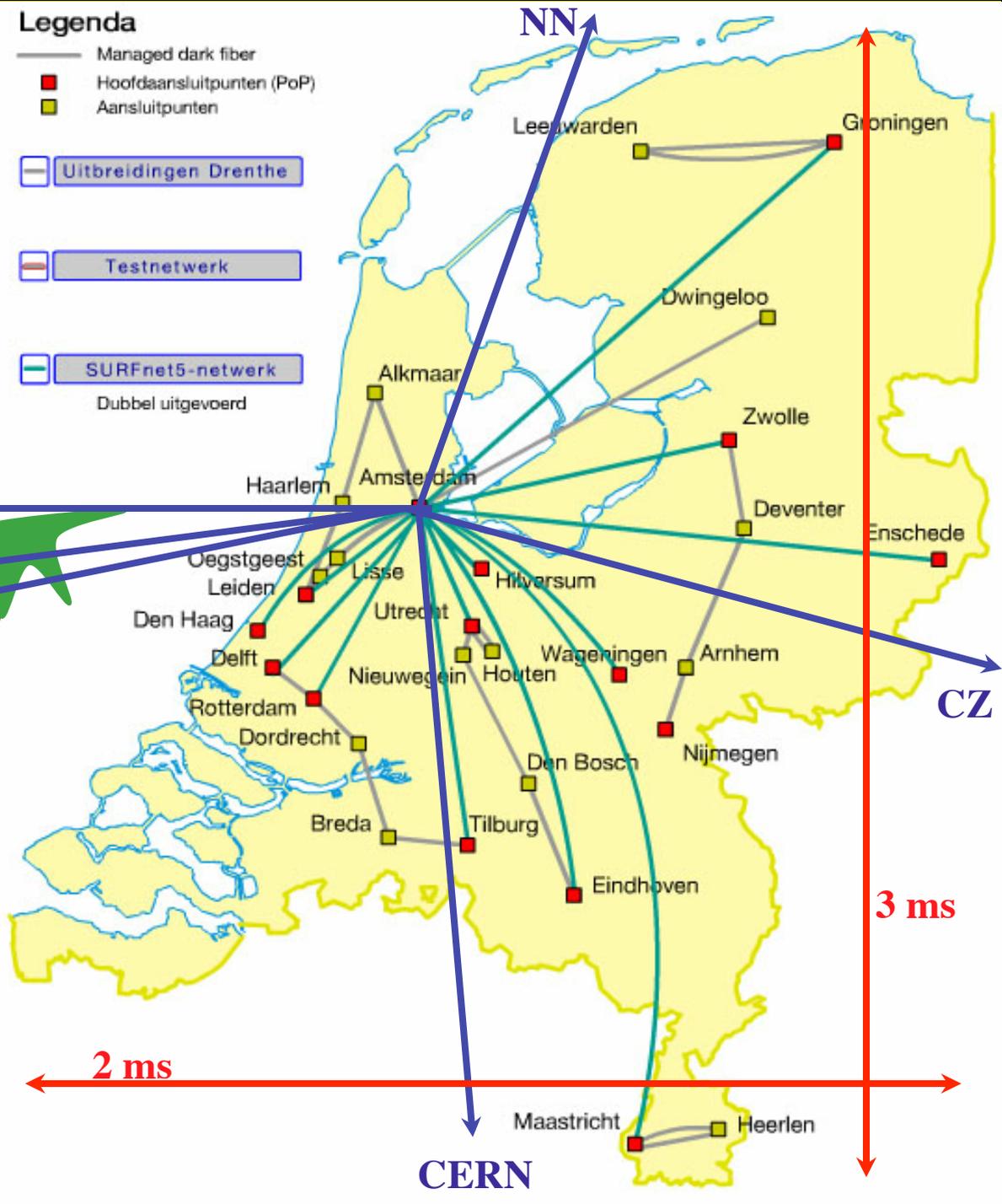
A

$\Sigma A \approx 20$ Gb/s

B

C

ADSL

GigE

BW requirements

λ's on scale 2-20-200 ms rtt
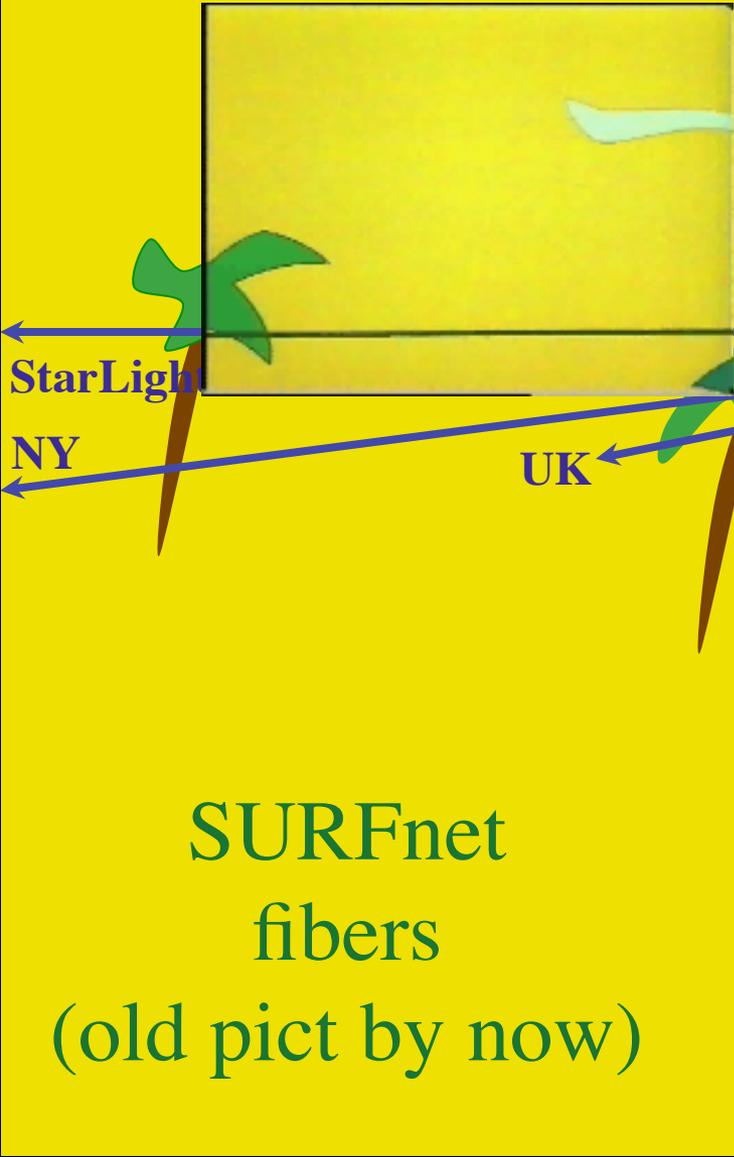
SURFnet
fibers
(old pict by now)

Services

SCALE / CLASS	2 Metro	20 National/ regional	200 World
A	Switching/ routing	Routing	ROUTER$
B	Switches + E-WANPHY VPN's,	Switches + E-WANPHY (G)MPLS	ROUTER$
C	dark fiber Optical switching	Lambda switching	Sub-lambdas, ethernet-sdh
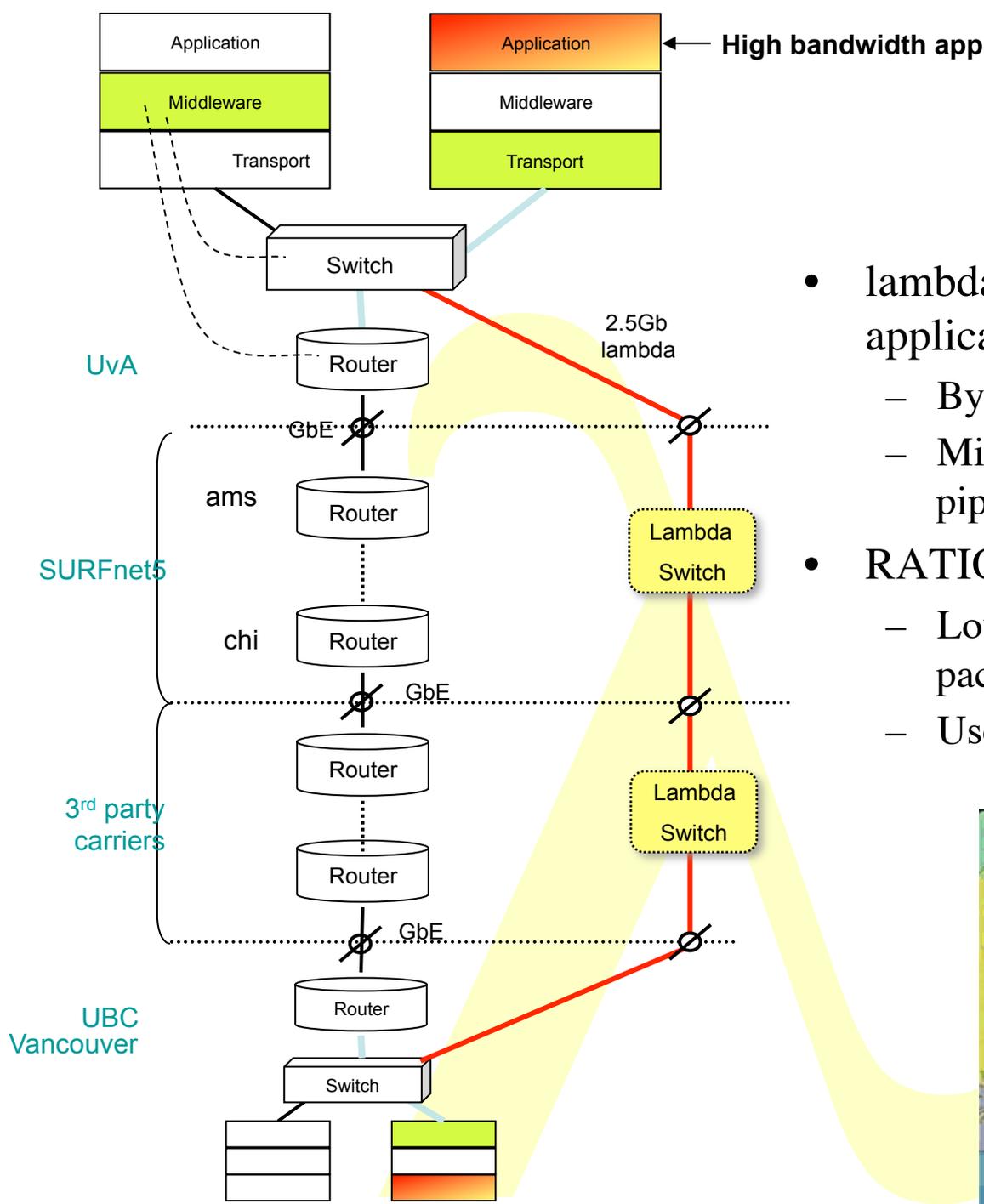
High bandwidth app

- lambda for high bandwidth applications
  - Bypass of production network
  - Middleware may request (optical) pipe
- RATIONALE:
  - Lower the cost of transport per packet
  - Use Internet as controlplane!

UVA/EVL's
64*64
Optical Switch
@ NetherLight
in SURFnet POP
@ SARA
Costs 1/100th of
a similar
throughput router
but with specific
services!

BeautyCees

High performance computing and Processor memory co-allocation

Security and Generic AAA

Optical Networking

Researched in other programlines

Imported from the Globus toolkit

Problem Solving Environment

Applications and Supporting Tools

Application Development Support

Collective Grid Services

- Brokering
- Global Queuing
- Co-Scheduling
- Data Cataloguing
- Auditing
- Authorization
- Monitoring
- Fault Management
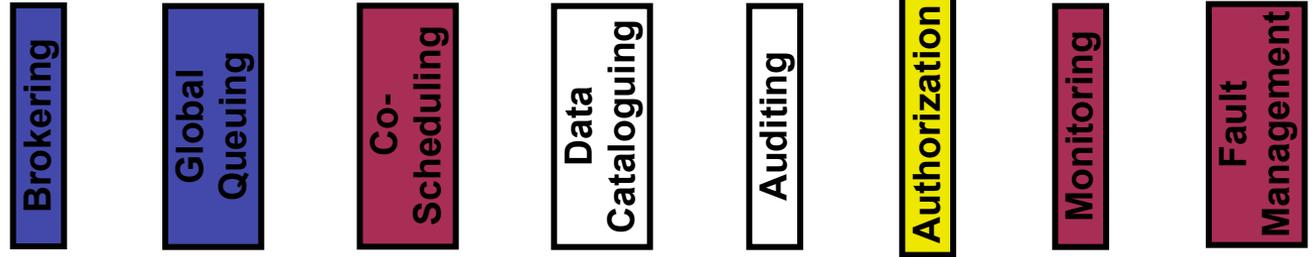
Common Grid Services

- Grid Information Service
- Uniform Resource Access
- Global Event Services
- Uniform Data Access
- Data Replication
- Communication Services
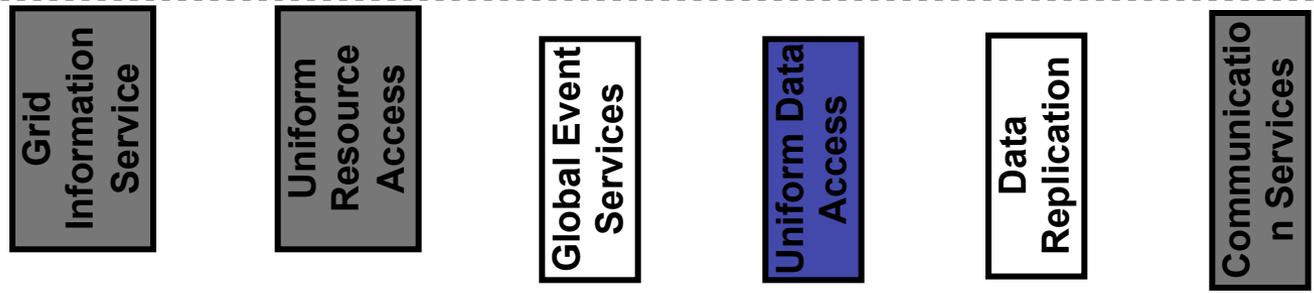
Grid Security Infrastructure (authentication, proxy, secure transport)

Communication

Grid access (proxy authentication, authorization, initiation)

Fabric

Grid task initiation

Local Resources

Resource Manager	Resource Manager	Resource Manager	Resource Manager	Resource Manager	Resource Manager	Resource Manager
CPUs	Monitors	On-Line Storage	Scientific Instruments	Tertiary Storage	Highspeed Data Transport	net QoS

layers of increasing abstraction taxonomy

Starting point

RFC 2903 - 2906 , 3334 , policy draft
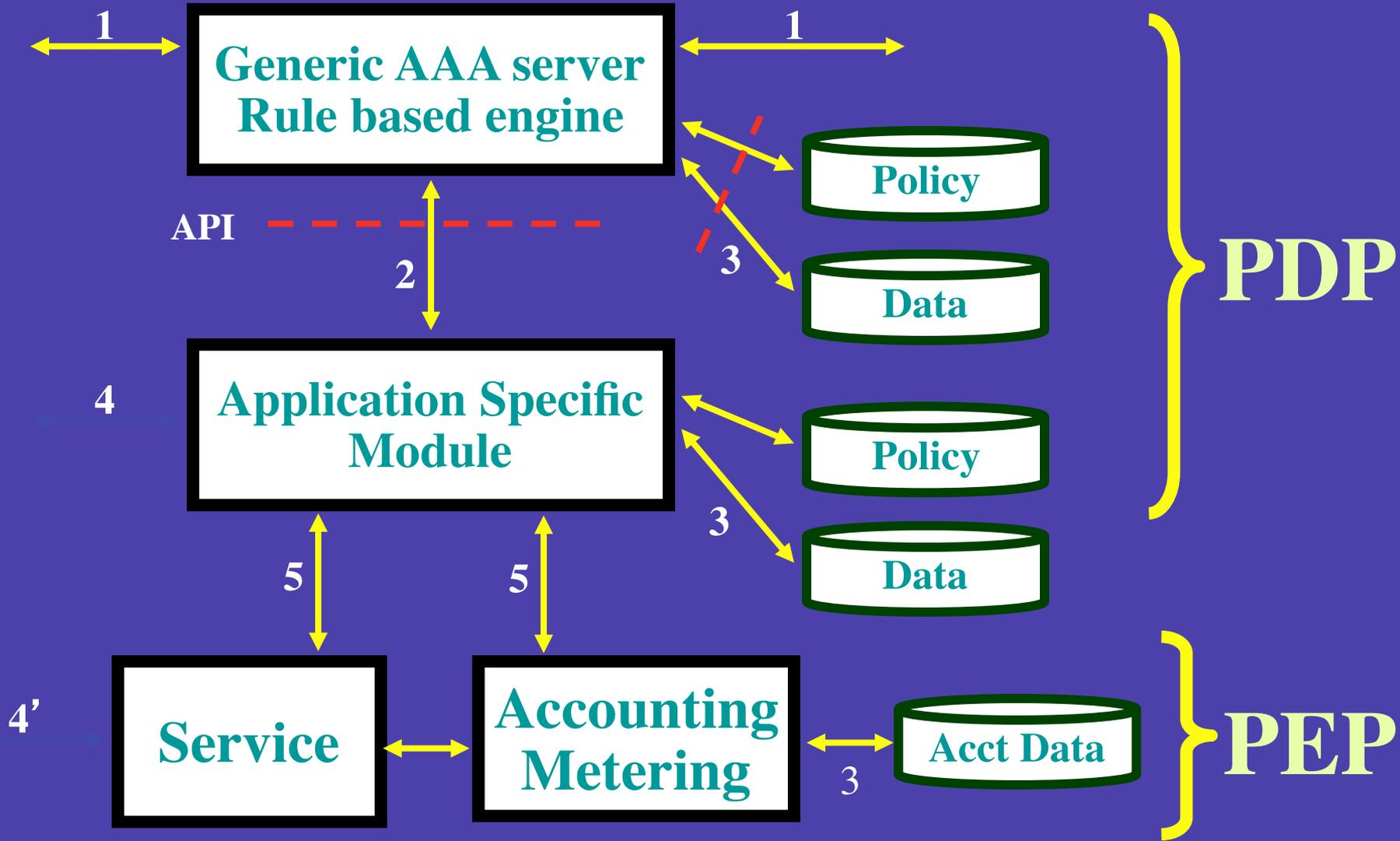
AAA and ISO Telecommunications Management Networks (TMN) reference model

User

Carrier

AAA — Business Management Level — Integrate Pizza, network, movie

WS

AAA — Service Management Level — Manage a 99.9995 % available network

WS

AAA — Network Management Level — Create best route

WS

AAA — Element Management Level — Offer manageable elements

TL1, SNMP,XMLCONF,COPS

Network Elements — Optical switches
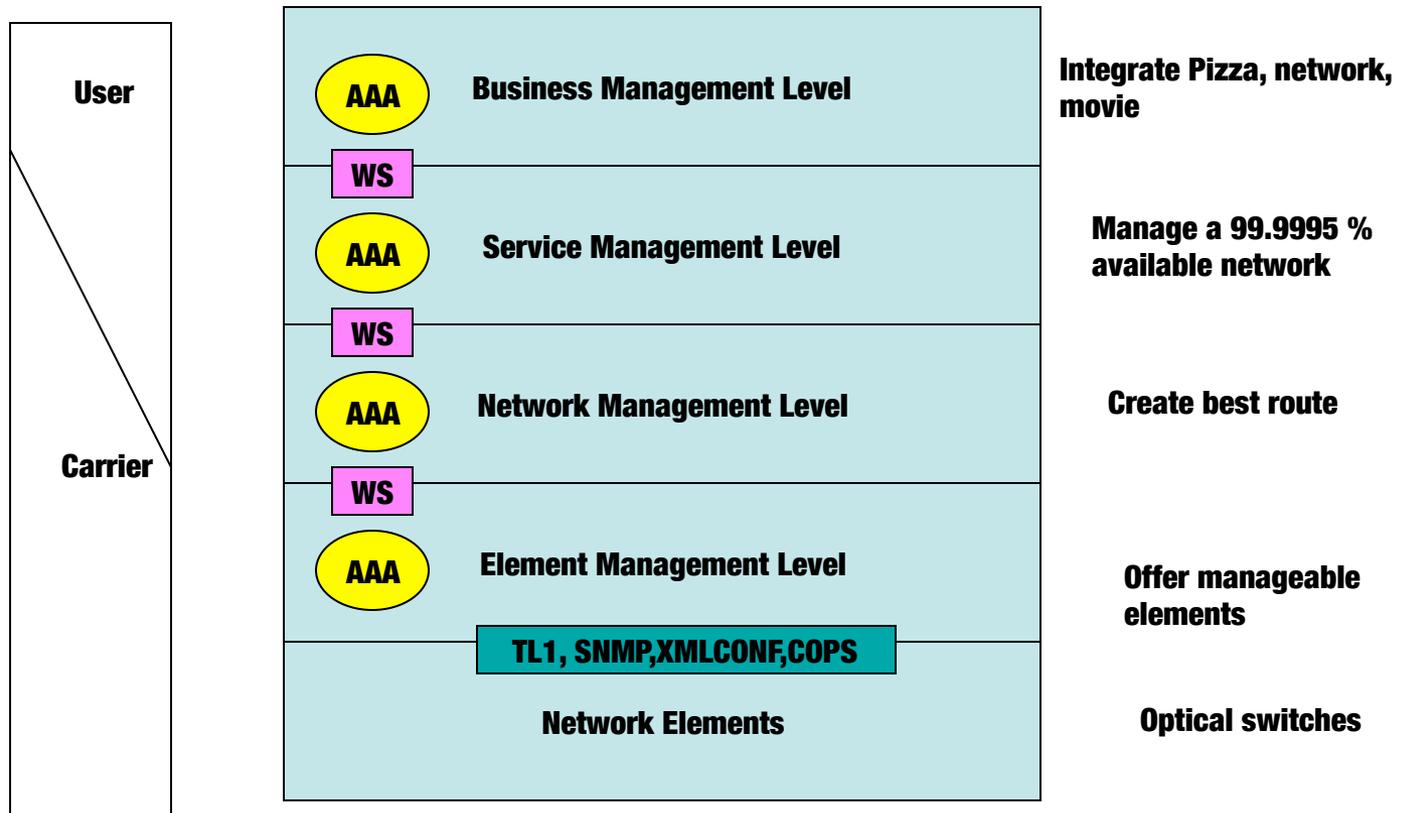
TMN is based on the OSI management framework and uses an object–oriented approach, with managed information in network resources modeled as attributes in managed objects. TMN is defined in ITU–T M.3000 series recommendations

AAA based design example

PIN Architecture

AAA Server (PDP) — Policy Negotiation — AAA Server (PDP) — Policy Negotiation — AAA Server (PDP)

Policy Repository   Policy Repository   Policy Repository

Inter-Domain   Control Plane

PIN Server (PEP)
- Topology Database
- BGP Routing
- RFORP Signaling

Inter-domain Routing
Inter-domain Signaling

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Intra-Domain Control Plane 1

Intra-Domain Control Plane 2

Intra-Domain Control Plane 3

Domain 1

Domain 2

Domain 3

DARPA DWDM-RAM Large Scale Data +Dynamic Lambdas – Demonstrated at GGF9 & SC2003

HP-PPFS	Data Intensive App2	Data Intensive App3	Data Intensive App4

Grid Data Management Services	Data Web Services	Data Grid Services

Grid L3-L7 OGSA Compliant

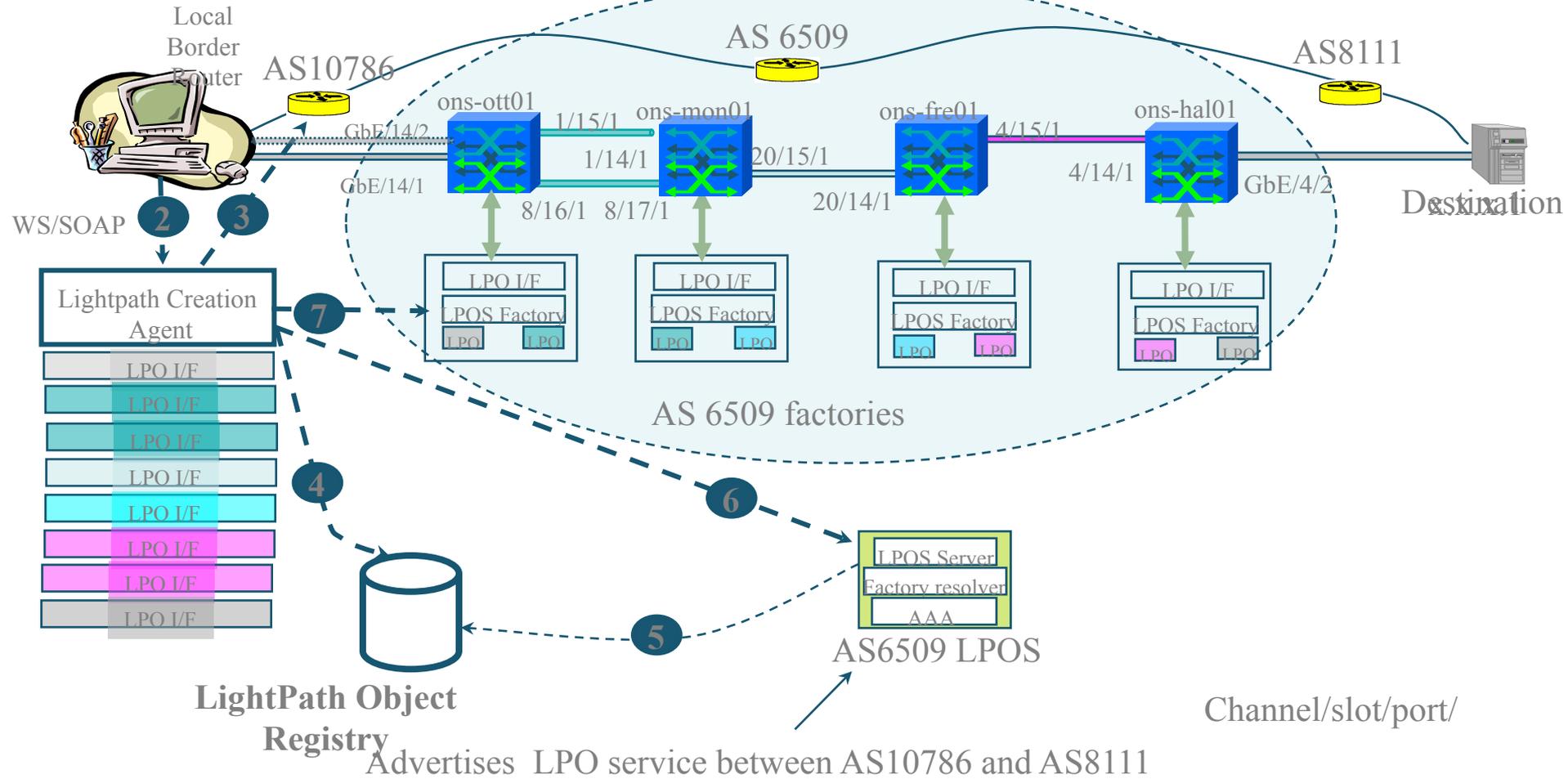**Dynamic Path Services (ODIN, THOR, etc),OGSA Compliant, Soon WSRF**

Dynamic vLANs

Dynamic Lightpaths

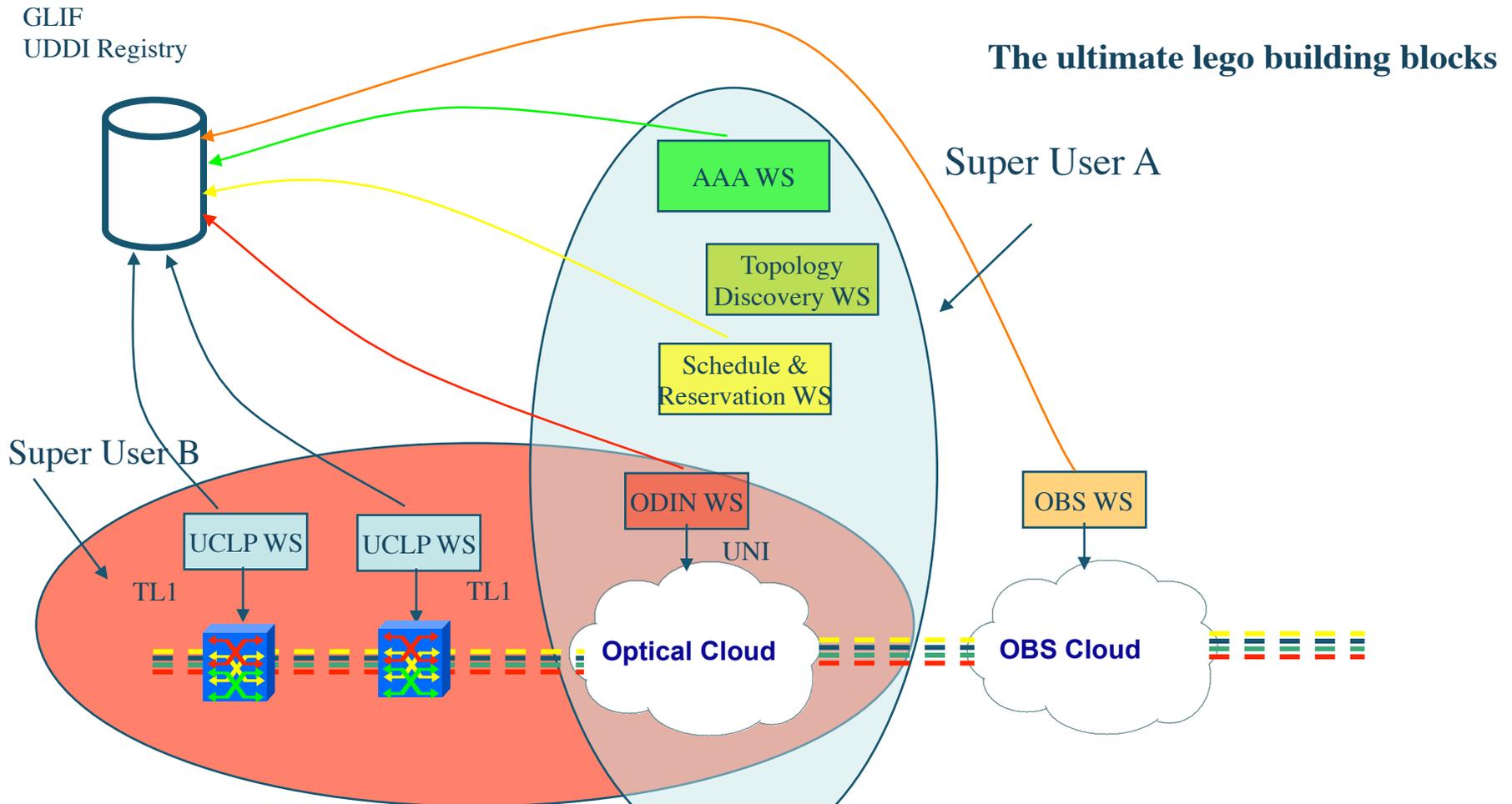Physical Processing Monitoring and Adjustment

New Control Plane And Management Plane Processes

iCAIR

Example – Server to server

AS 6509

AS10786

AS8111

Local Border Router

ons-ott01   ons-mon01   ons-fre01   ons-hal01

1/15/1
GbE/14/2   20/15/1   4/15/1
1/14/1   4/14/1
GbE/14/1   GbE/4/2
8/16/1 8/17/1   20/14/1   Destination

WS/SOAP

2   3

Lightpath Creation Agent

LPO I/F   LPO I/F   LPO I/F   LPO I/F   LPO I/F
LPO I/F   LPOS Factory   LPOS Factory   LPOS Factory   LPOS Factory
LPO I/F   LPO   LPO   LPO   LPO   LPO   LPO   LPO   LPO
LPO I/F
LPO I/F   AS 6509 factories
LPO I/F
LPO I/F
LPO I/F

7

4

6

LPOS Server
Factory resolver
AAA

5

AS6509 LPOS

LightPath Object Registry

Channel/slot/port/

Advertises LPO service between AS10786 and AS8111

CANARIE   NETWORKS > COLLABORATION > RESULTS > RÉSEAUX > COLLABORATION > RÉSULTATS

Coordination with Optiputer, OBS and others

Research topics

- Optical networking architectures and models for usage

- Transport protocols for massive amounts of data

- Authorization of complex resources in multiple domains

- Embedding in Grid environments

Research

- 3 main topics
  - Optical technologies
  - Transport
  - AAA
- Grid integration
- Application <-> Network awareness

Optical

- Topology optimization, description
- Techniaclities
- 10G Ethernet Wanphy
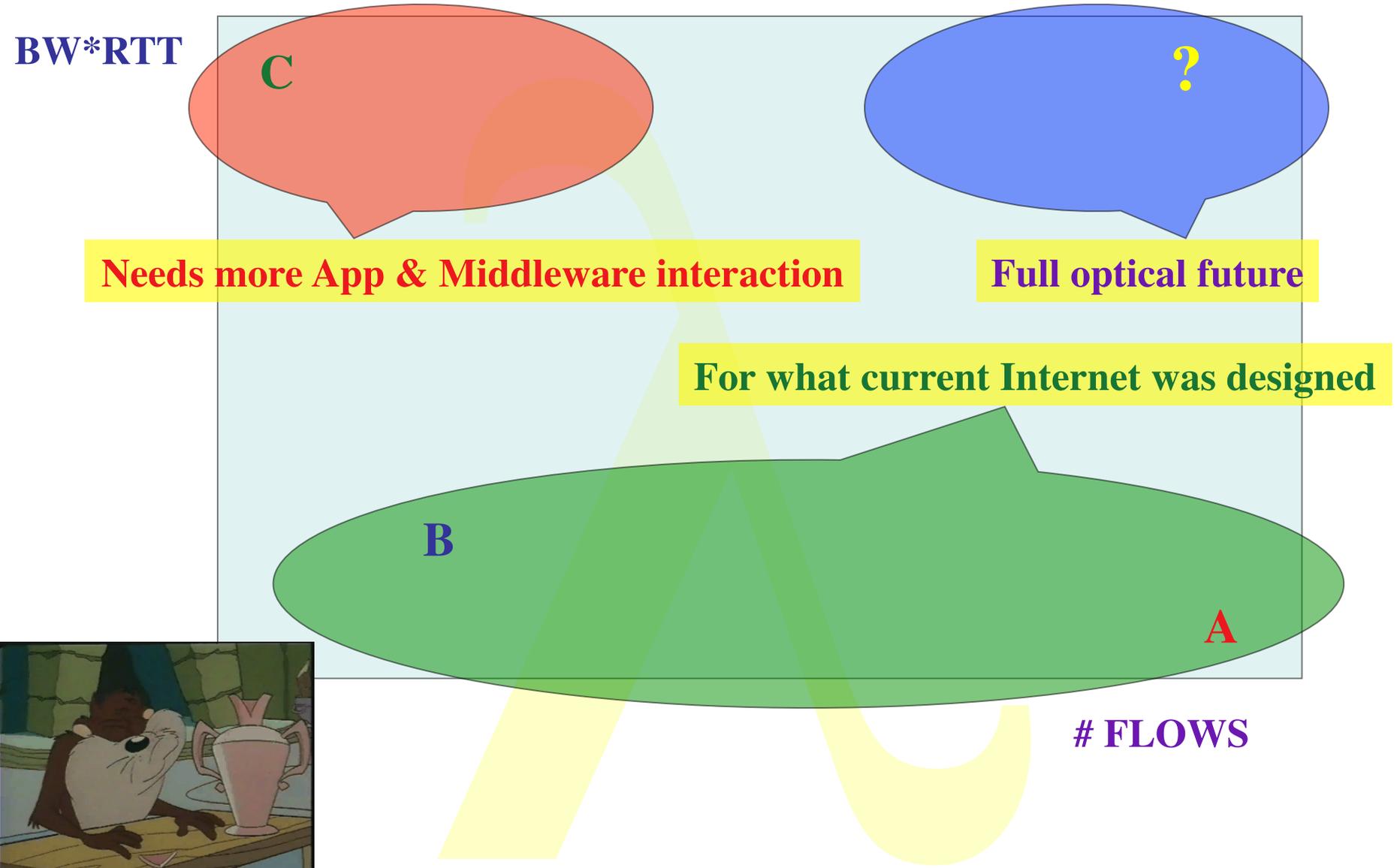- Opt exchange
- Control plane
- Laboratory

Transport

- Protocols

- Protocol testbed

- Test of networks with grids (why not if grids are that demanding?)

AAA

- Demonstratiens
- Accounting
- Toolkit
- WSRF
- Standardization
- Solve problem of lambda setup
- 250 email, phone conferences, 2 months, etc.

Transport in the corners

The END

RESERVED

Case
Delaat

3/12/2003

9:00 AM - 3:00 PM
Wednesday

70-4 Lot H2

NWO/NCF

Partially complete list:
Caas
Chase
Cess
Kess
Case

SURF net