StarPlane take-off

Cees de Laat

SURFnet

BSIK

EU

University of Amsterdam

SARA
TI
TNO
NCF

SURFnet

Advanced School for Computing and Imaging

History - 1

DAS = Distributed ASCI Supercomputer

- Project DAS-1 started in 1997 by Andrew Tanenbaum
- To prove distributed clusters were as effective as super...
- 4-5 clusters connected via high speed links
  - DAS-1 -> 6 Mbit/s full mesh ATM
  - DAS-2 -> Gbit/s L3
  - DAS-3 -> StarPlane

- DAS-1 ran BSD, changed to Linux (Andrew... :-)
- DAS-1 and 2 uniform architecture, not so in DAS-3
- http://www.cs.vu.nl/das/

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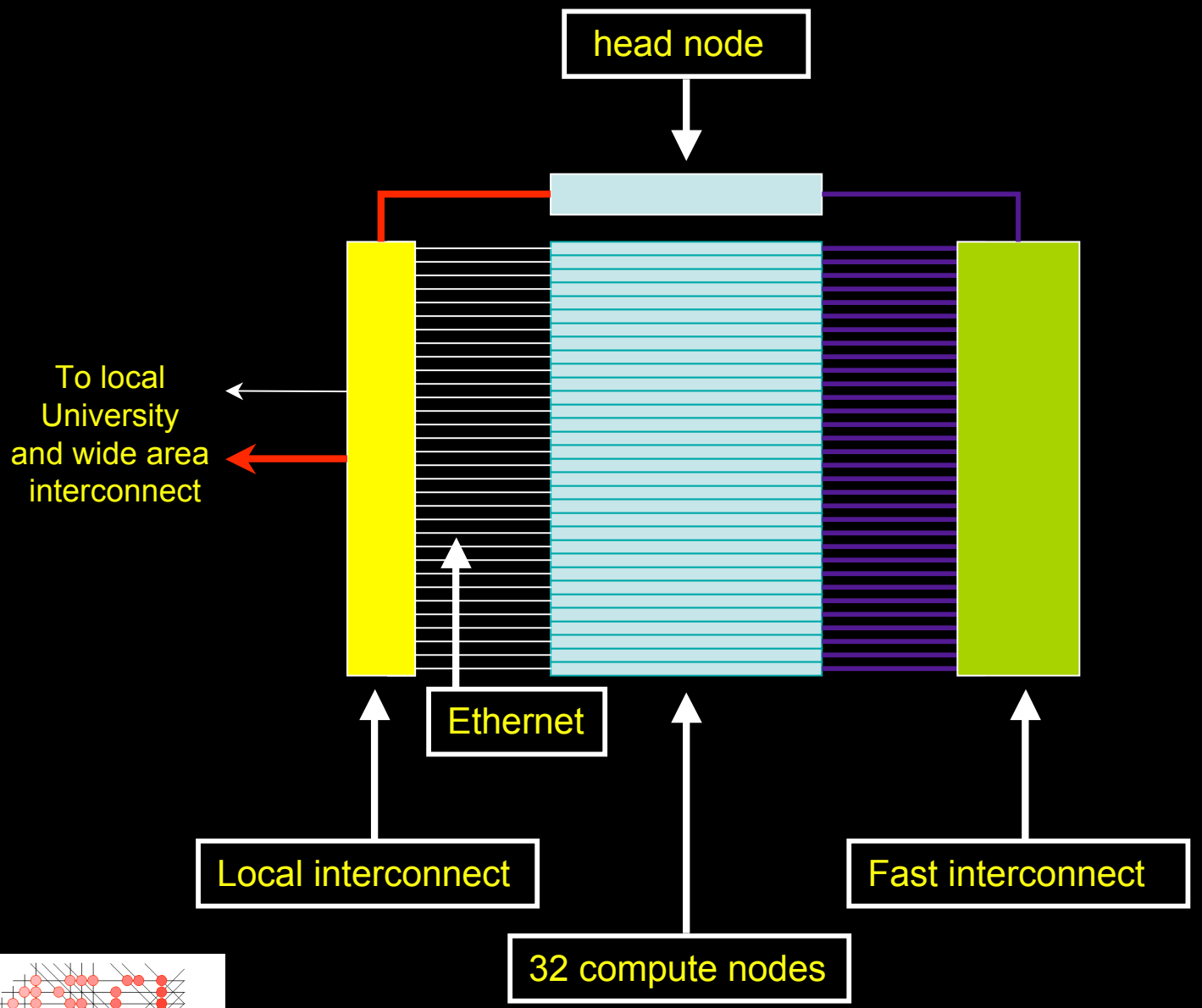
DAS 1 - 2 Cluster



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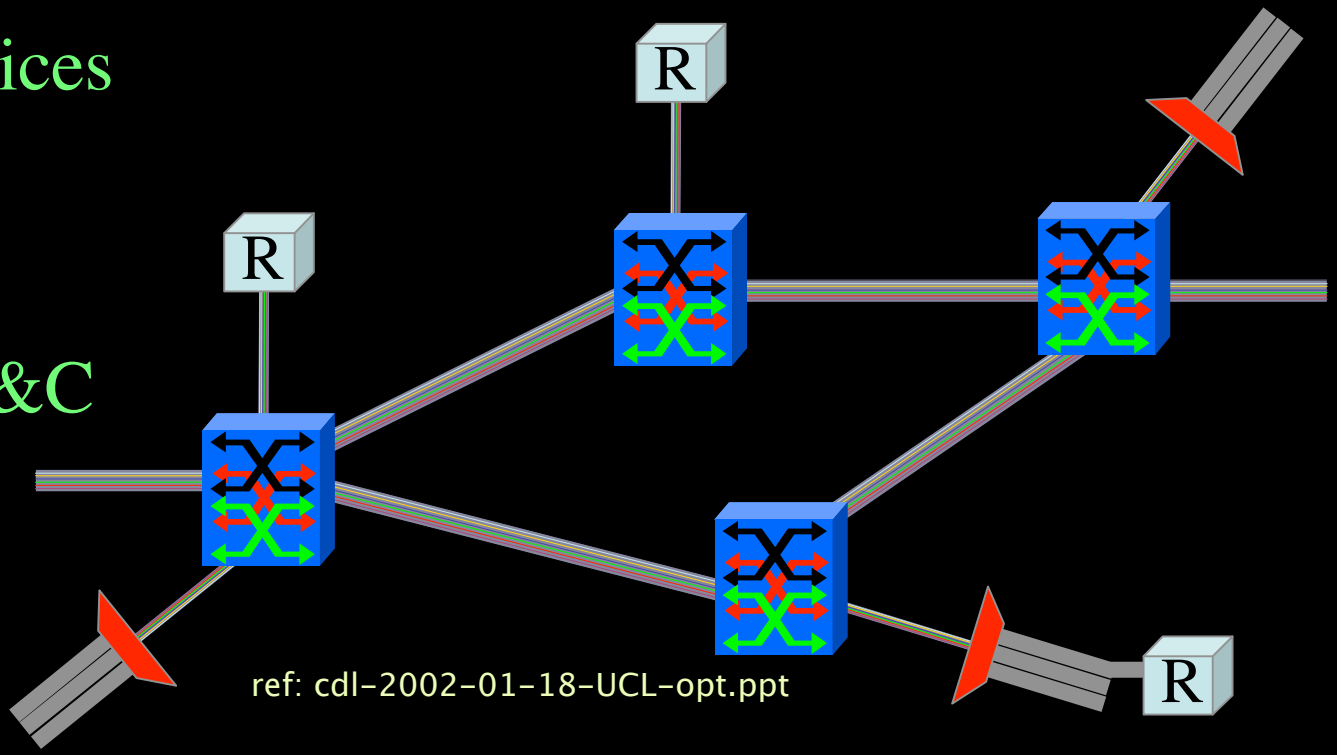
History - 2

SURFnet6 Architecture discussions 2001-2002

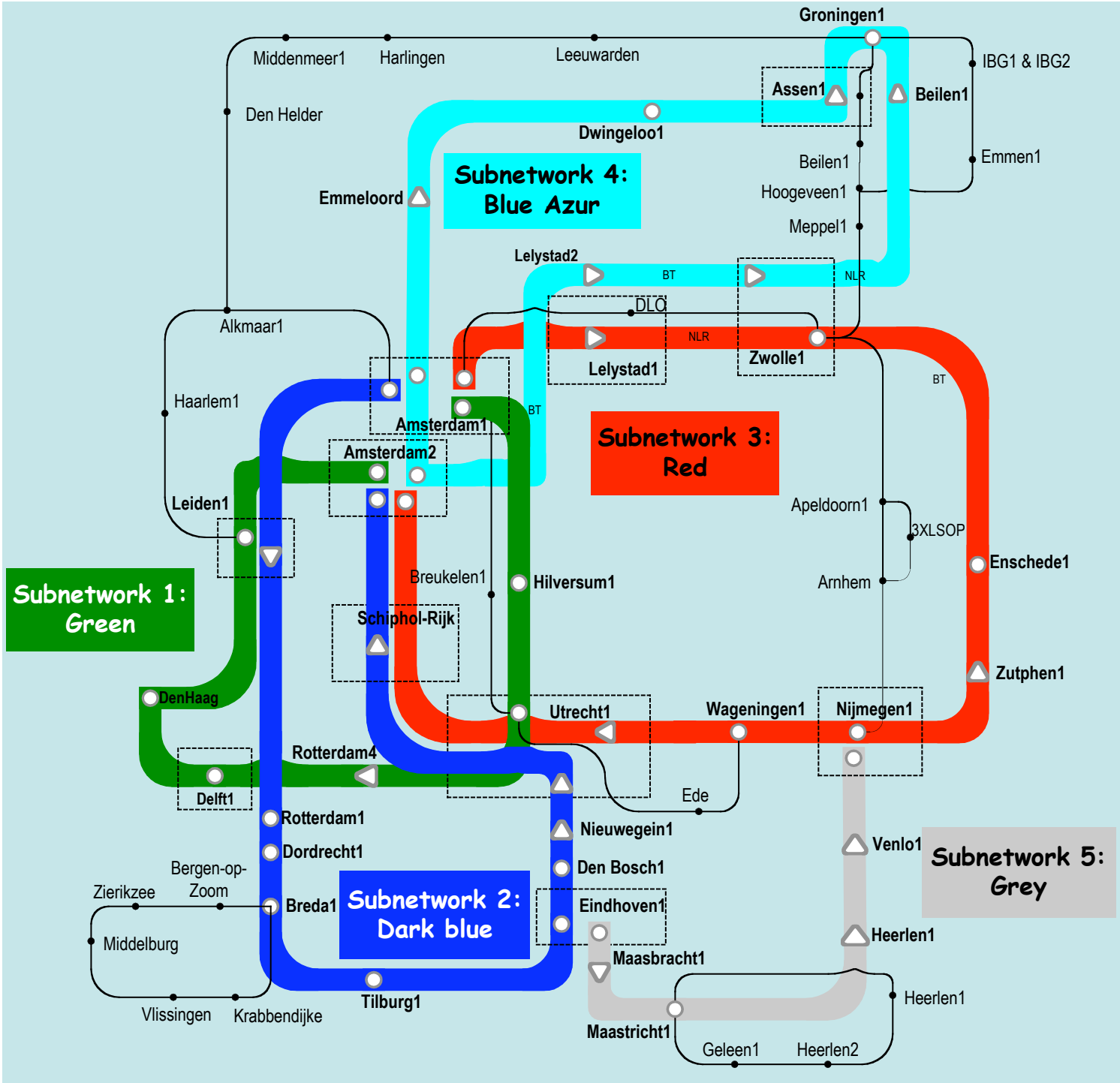
- photonic backbone
- (L2 and) L3 services
- NORTEL
- Static
- Summer 2004 K&C
- NWO-GLANCE
- StarPlane
- PHD-PD-SP



- Start 1-feb-06, Li Xu, Jan Philip Velders, Jason Maasen
  - Henri Bal, Paola Grosso, Herbert Bos, CdL, SN-folks.

SURFnet


Groningen
Leeuwarden
Assen
Emmen
Hoogeveen
Meppel
Zwolle
Lelystad
Den Helder
Alkmaar
Haarlem
Amsterdam
Deventer
Apeldoorn
Enschede
Zutphen
Leiden
Utrecht
Den Haag
Delft
Arnhem
Nijmegen
Wageningen
Dordrecht
Breda
Tilburg
Eindhoven
Venlo
Maastricht
2 ms
3 ms

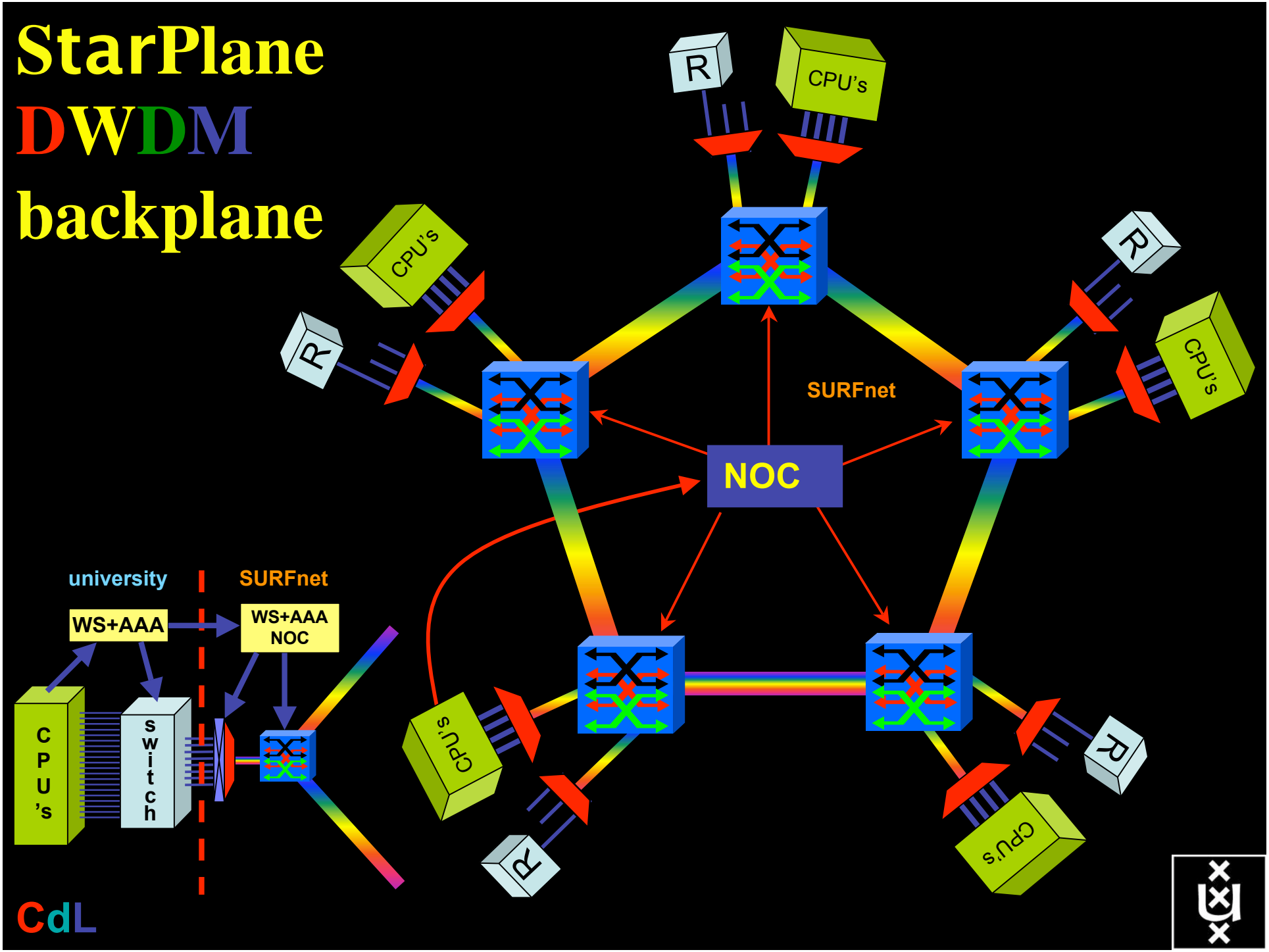


Common Photonic Layer (CPL) in SURFnet6

>5300 km

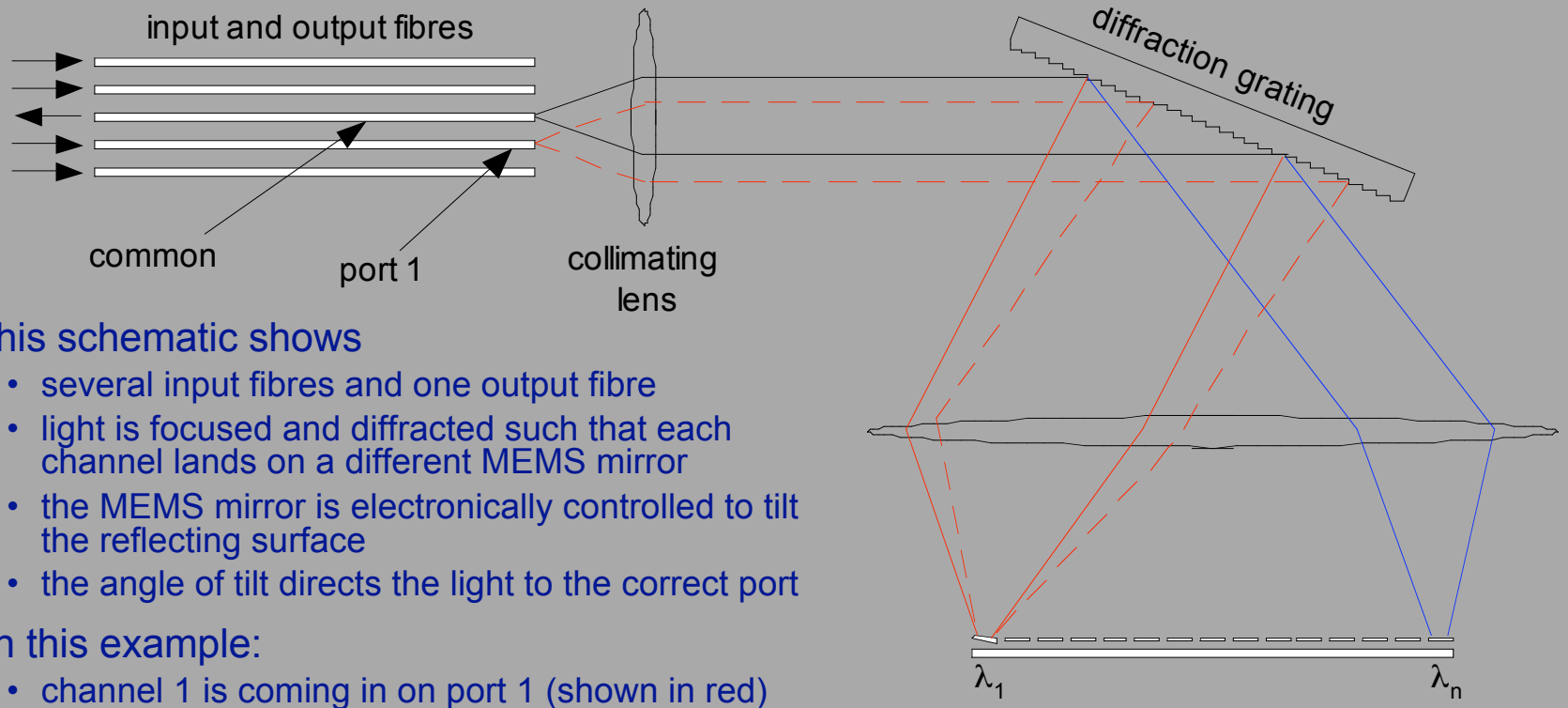
SURFnet

StarPlane
DWDM
backplane



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

DAS-3 Cluster

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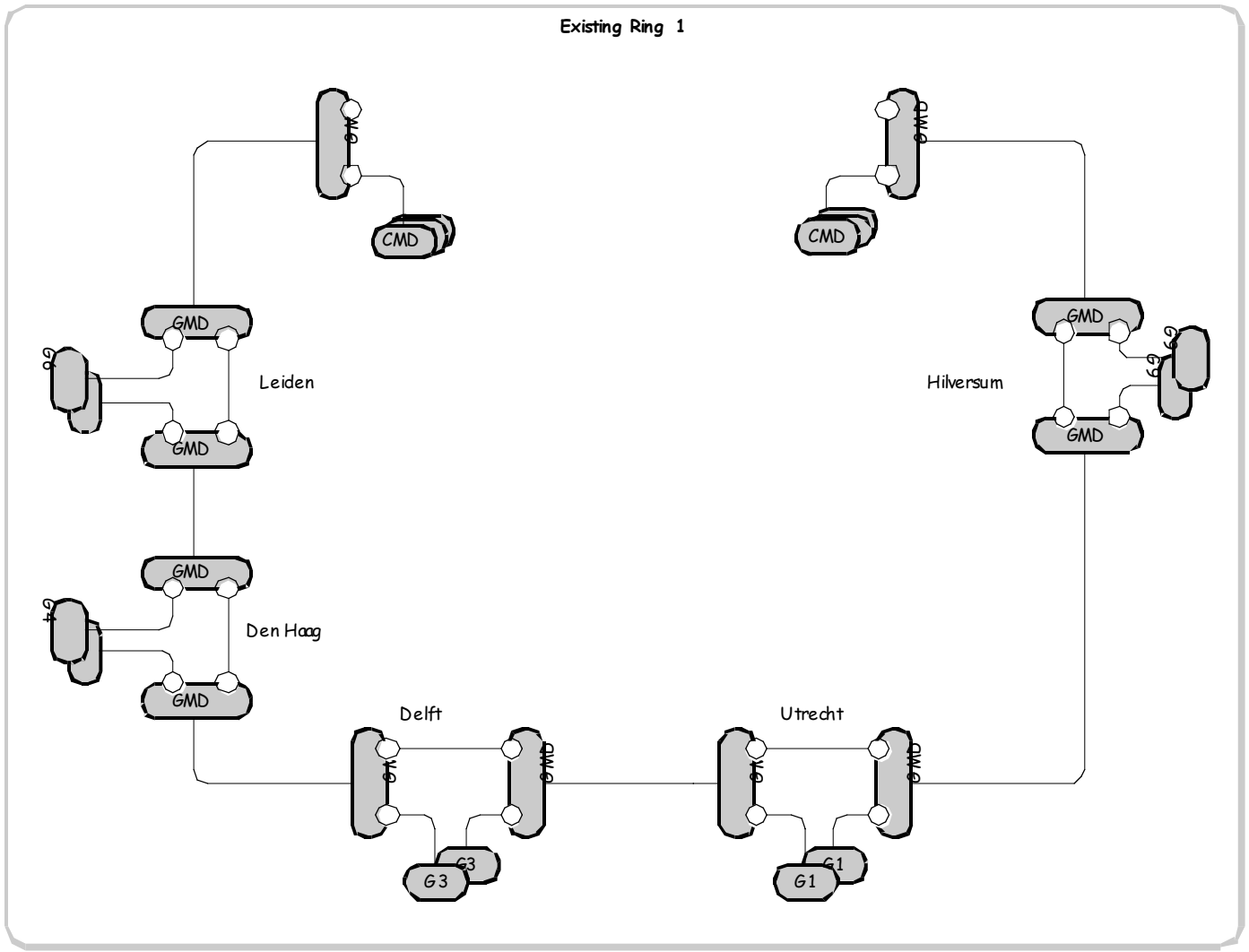
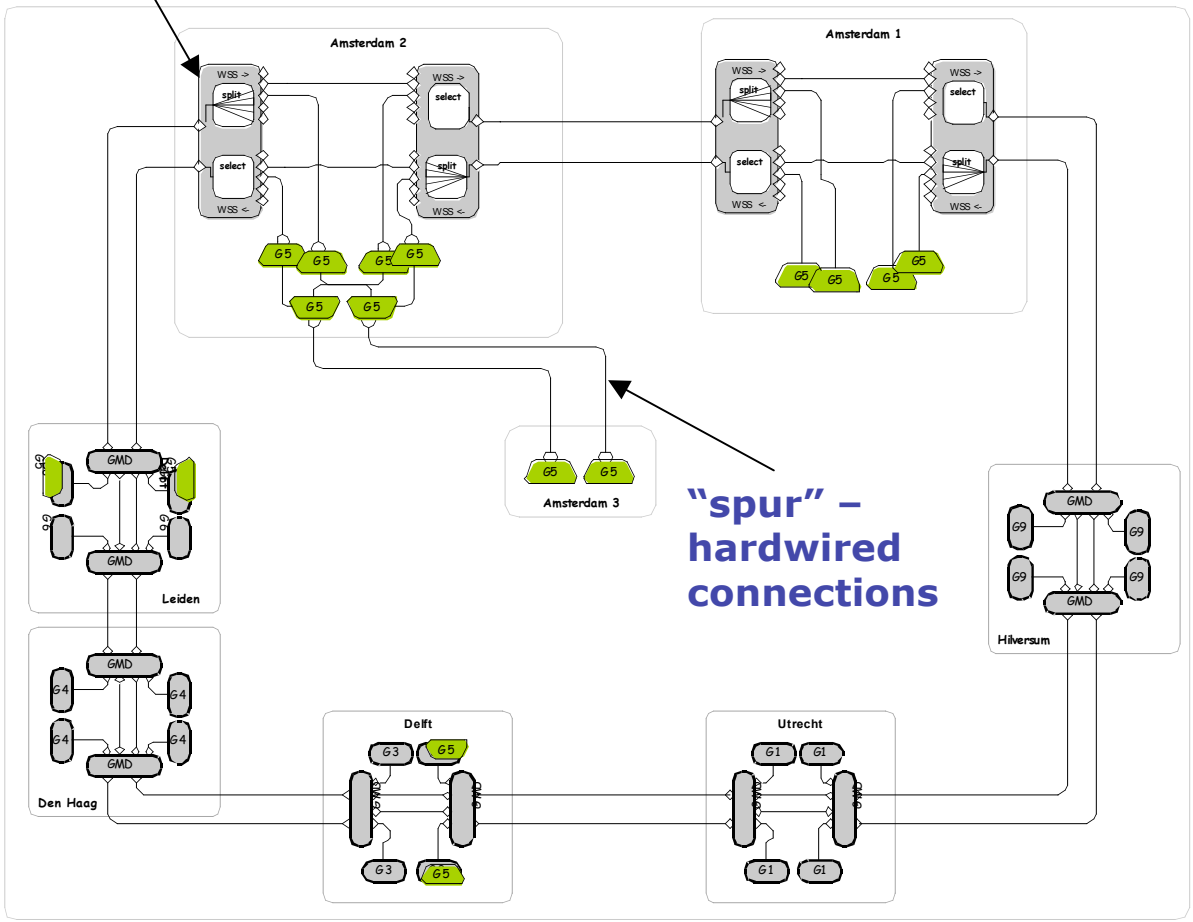
Existing ring 1 – to be upgraded

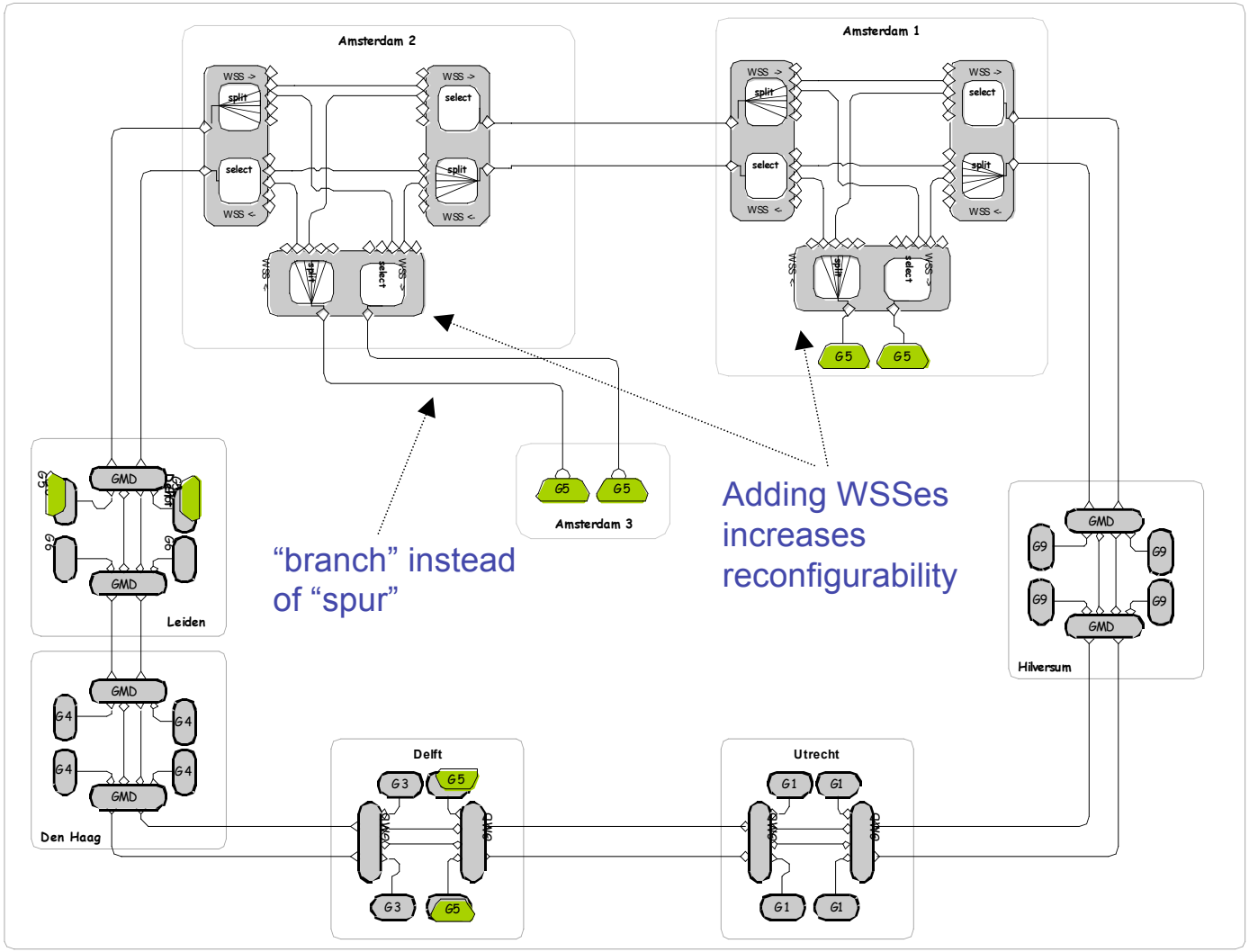


Upgrade Day 1 – creating the 'static' mesh



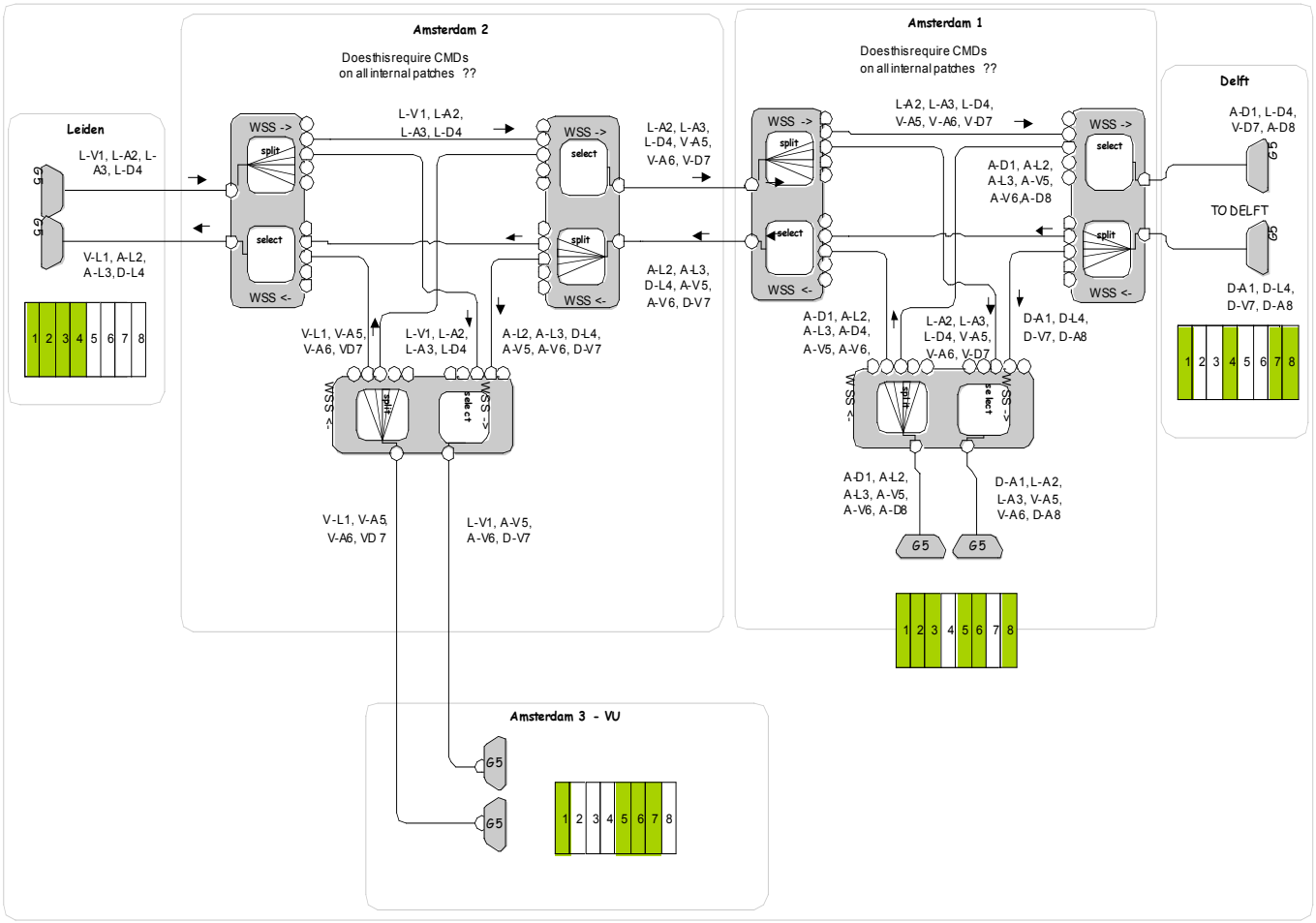
- Band 5 (up to 8 channels) added at all participating nodes
- Wavelength Selective Switches (WSS) added for reconfigurability support
- "Spur" to connect VU
- Full photonic mesh now possible between DAS-3 sites
- **This architecture is supported 'now'**

Day 2 set-up: branching out…



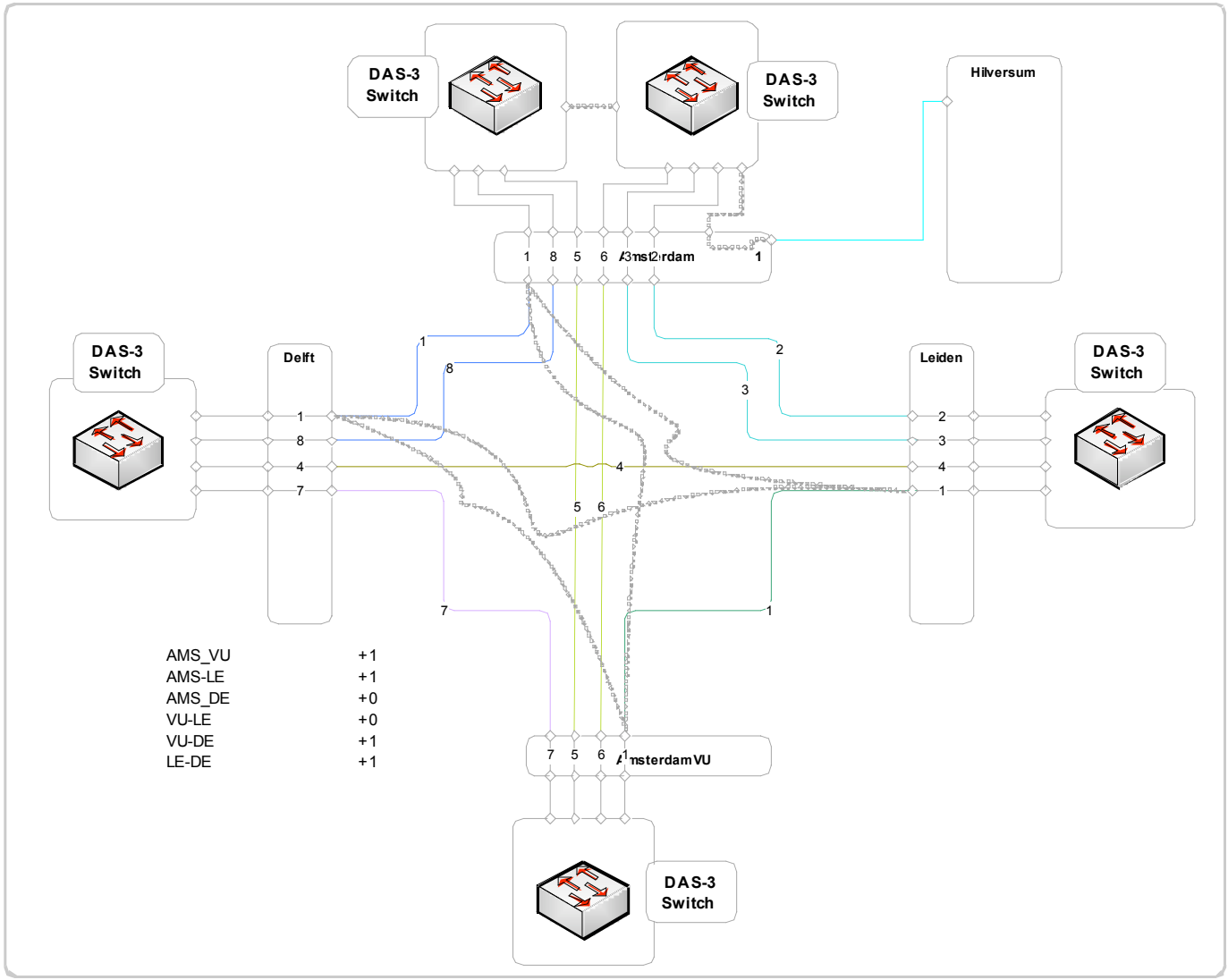
- Add WSSes at Amsterdam sites
- Is NOT supported in March 2006
- Full reconfigurability achieved
- Only limits are
  - Presence of card
  - Wavelength blocking
- No changes to basic 'static' mesh

Day 2 detail



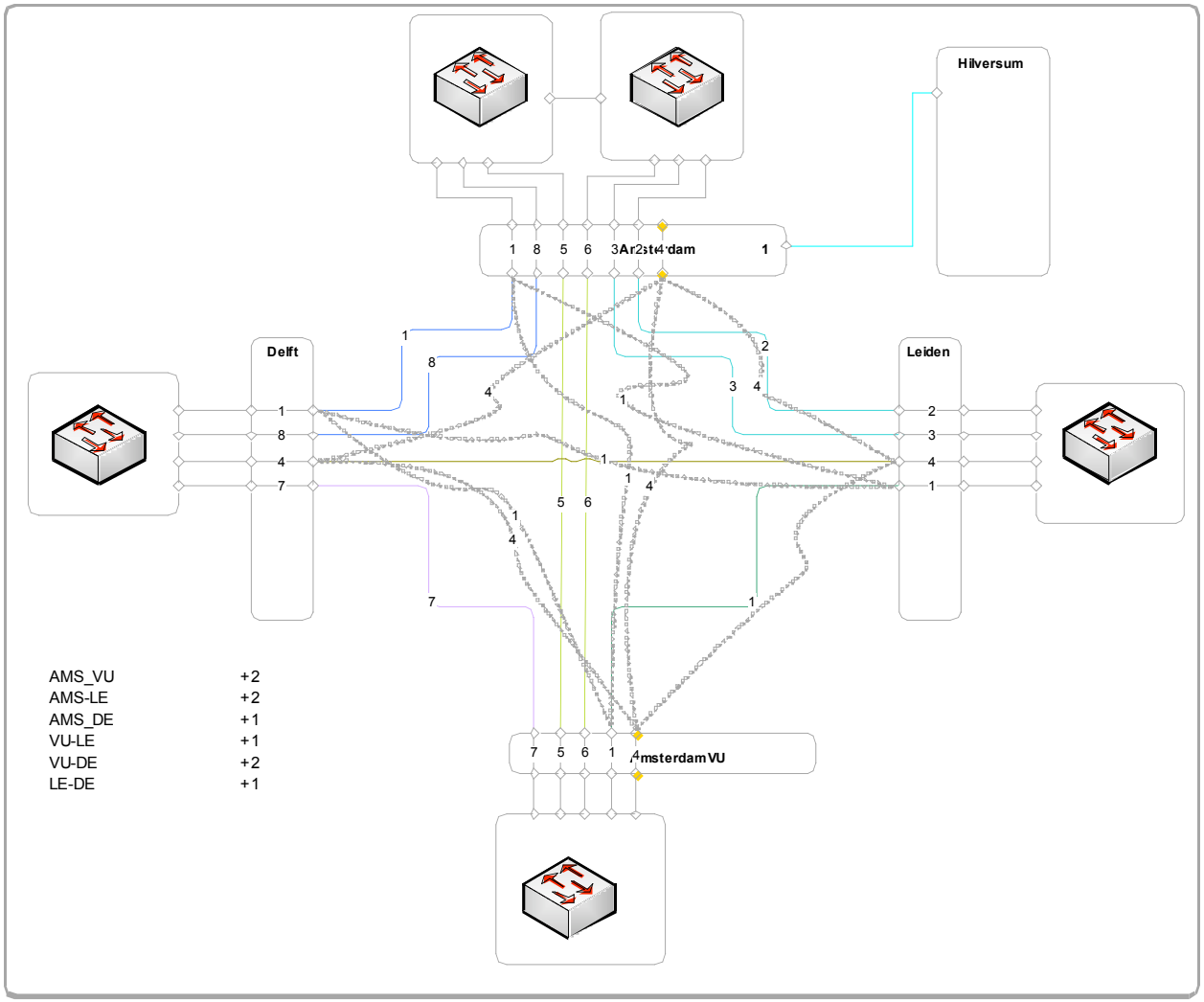
- Wavelength assignment remains – no external changes
- Adding WSSes allows redirecting wavelengths from/to VU and AMS

Day 2 – black box reconfigurability



- Compared to day 1 now four instead of one possible redirection
- Redirection only limited by presence of cards and internal wavelength blocking

Day 2 – increased reconfigurability - adding cards



- Adding two cards allows to create more connectivity between ALL sites!
- Some sites can connectivity threefold (from 10 Gb/s to 30 Gb/s)

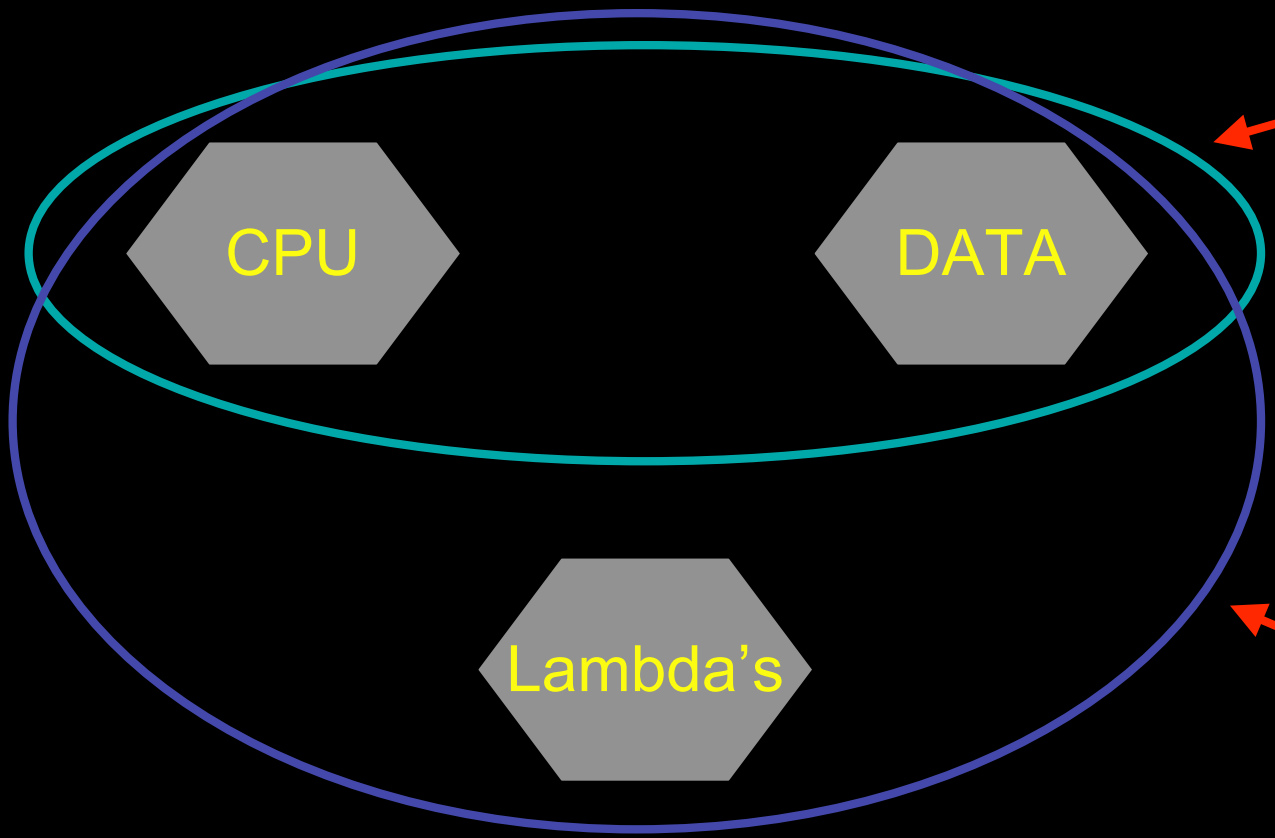
StarPlane Goals

1. fast, application-driven allocation of the photonic network resources
2. application-specific composition of the protocol stack that controls the resources
3. low-level resource partitioning (and, hence, no interference)
4. high-level requests (whereby policies and inference are used to assist the user)..

To achieve and validate these goals the project will deliver:

1. the implementation of the StarPlane management infrastructure
2. the implementation of an intelligent broker service to handle high-level requests
3. the modification of a set of real applications to exploit the functionality of such a management plane
4. a library of standard components (protocols, middleware) to support and build new applications

GRID-Colocation problem space



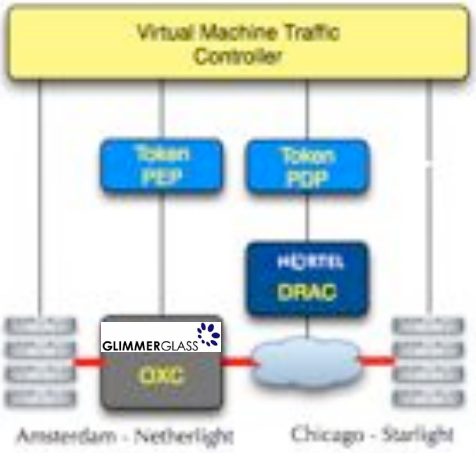
Extensively under research

New!

Token Based Networking

Access Control, Resource Management and Path Selection in Optical Networks using Tokens

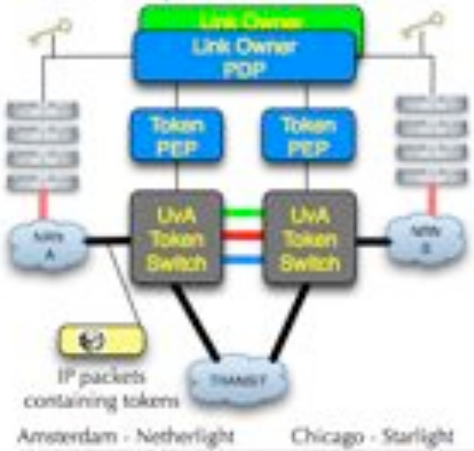
Tokens performing Resource Management and Access Control in Virtual Machine Turntable Experiment.



Tokens will allow:

- Separation of (slow) authorization process and real time usage.
- Binding to many different types of attributes: user, time, resource, etc.
- Policy Decision to be abstracted from Policy Enforcement Point.
- Anonymous usage
- Resource Management

Tokens performing Path Selection and Access Control at Optical Inter-Connection Points



Token marked IP packets will allow:

- Economic Link Owners to assign usage rights without routing changes.
- Recognition at Inter Connection Points (Optical Exchanges). When authentic and valid, token marked traffic will use the Link Owners path.
- Implementations that support different business models
- Hardware (NPU based) recognition rate expected to be a 10 Gb/s.

UvA Universiteit van Amsterdam
Leon Gommans
Fred Wan, Cees de Laat
Mihai Cristea
GigaPort
NextGRID

StarPlane

application-specific management of optical networks

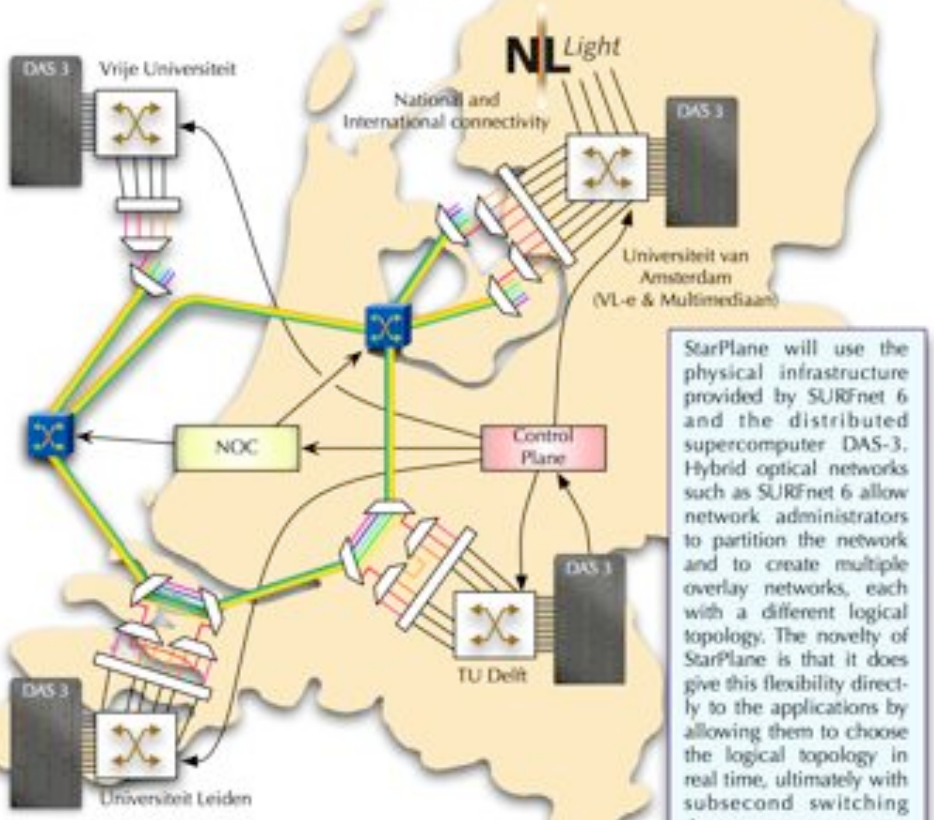
The StarPlane project addresses two concerns in optical networks:

1. The Basic StarPlane Management Infrastructure

StarPlane allows applications to take advantage of the increased bandwidth and potential flexibility in optical networks by letting them create their own network topology in a simple way.

2. The Applications and Their Needs

StarPlane will discover how this new freedom to manipulate the network will benefit the applications.



StarPlane will use the physical infrastructure provided by SURFnet 6 and the distributed supercomputer DAS-3. Hybrid optical networks such as SURFnet 6 allow network administrators to partition the network and to create multiple overlay networks, each with a different logical topology. The novelty of StarPlane is that it does give this flexibility directly to the applications by allowing them to choose the logical topology in real time, ultimately with subsecond switching times.

Staff members of the research team:

Prof. dr. ir. H.E. Bal	VU	professor	Parallel programming
Dr. ir. H. Bos	VU	assistant professor	Computer networks
Dr. ir. C.T.A.M. de Laat	UvA	associate professor	Internet and Grids
Prof. dr. P.M.A. Sloot	UvA	professor	Computational science

vrije Universiteit amsterdam

UvA Universiteit van Amsterdam

DWDM network provided by SURFnet

SURFnet

Funded by NWO in the GLANCE program

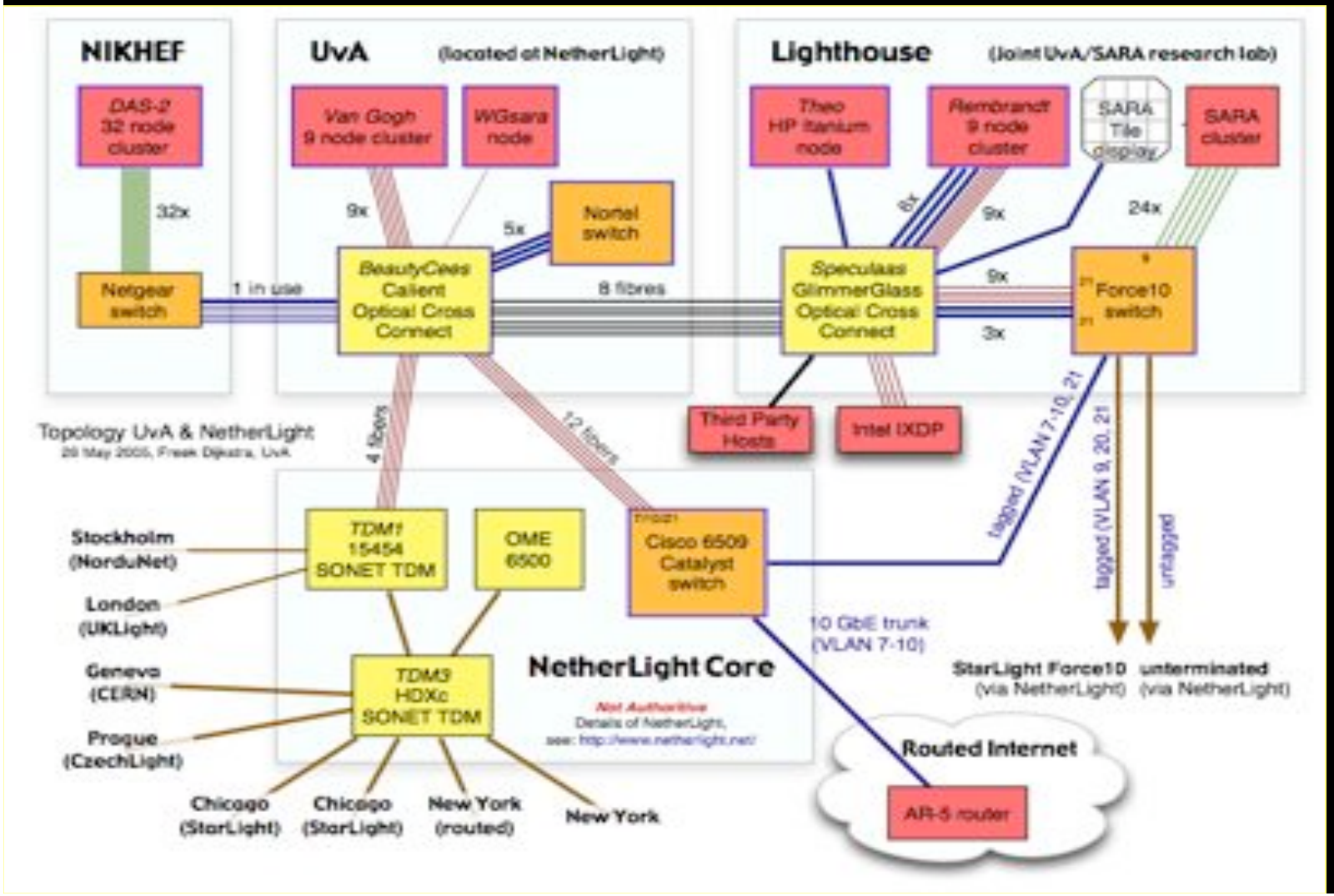
NWO

www.starplane.org

Key issue #1:
how to describe such networks?

UvA/SARA 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



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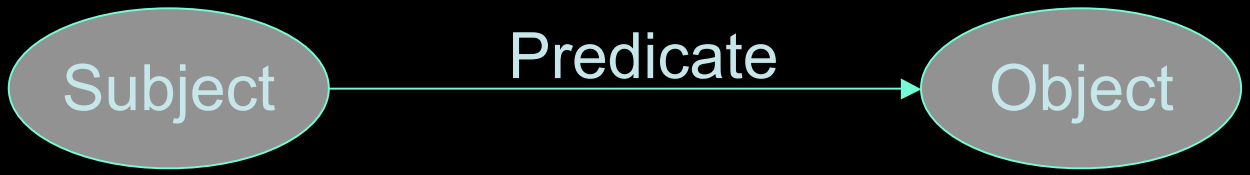
Semantic web

“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>
```

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:resour
      <ndl:hasInterface rdf:resour
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      <ndl:hasInterface rdf:resour
```
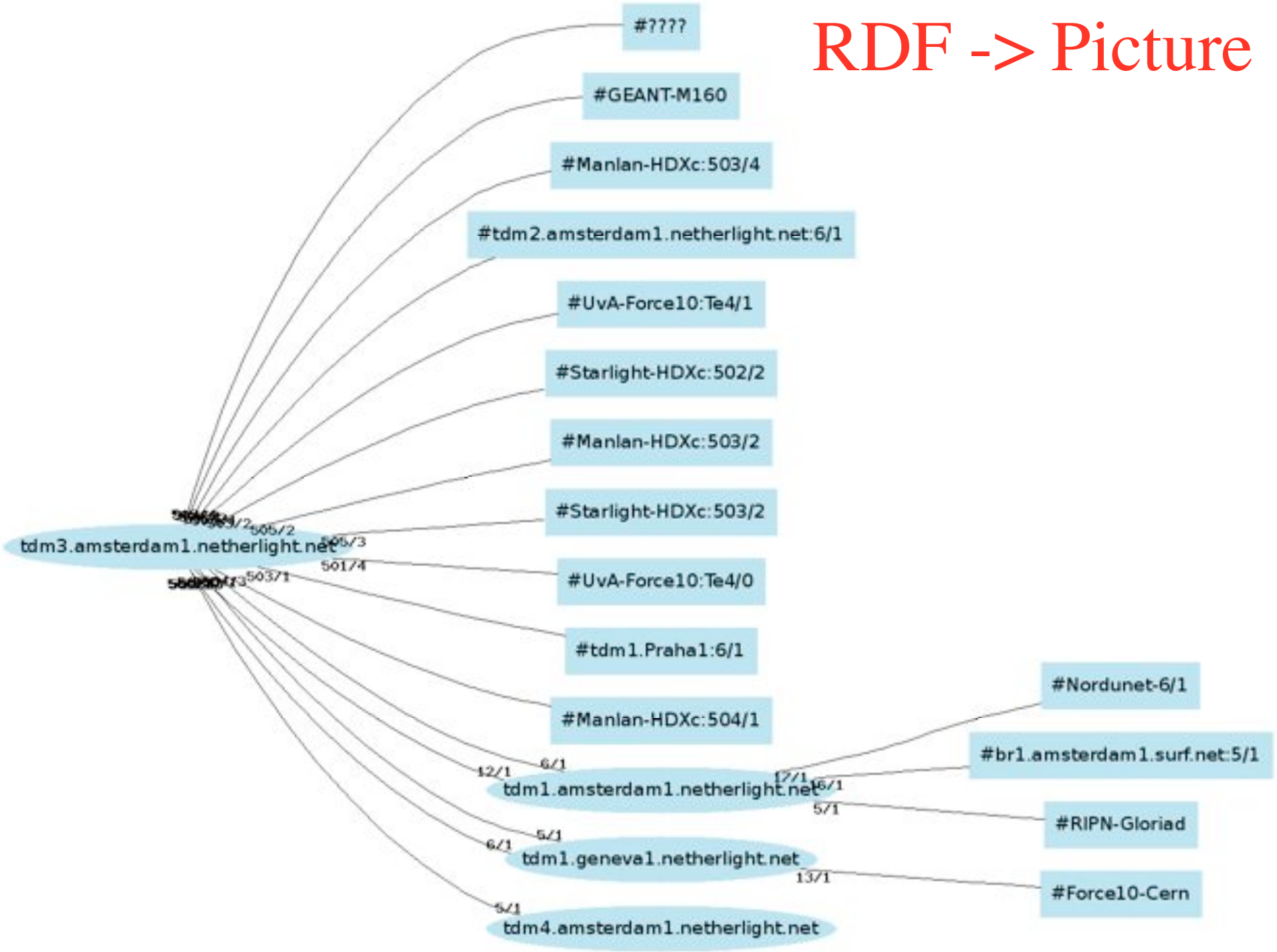

```
<!-- all the interfaces of TDM3.amsterdam1.netherlight.net -->

<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>
```

RDF -> Picture


#????
#GEANT-M160
#Manlan-HDXc:503/4
#tdm2.amsterdam1.netherlight.net:6/1
#UvA-Force10:Te4/1
#Starlight-HDXc:502/2
#Manlan-HDXc:503/2
#Starlight-HDXc:503/2
#UvA-Force10:Te4/0
#tdm1.Praha1:6/1
#Manlan-HDXc:504/1
#Nordunet-6/1
#br1.amsterdam1.surf.net:5/1
#RIPN-Gloriad
#Force10-Cern
tdm3.amsterdam1.netherlight.net
tdm1.amsterdam1.netherlight.net
tdm1.geneva1.netherlight.net
tdm4.amsterdam1.netherlight.net
505/2
505/3
501/4
503/1
12/1
6/1
12/1
6/1
5/1
6/1
5/1
13/1
5/1

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

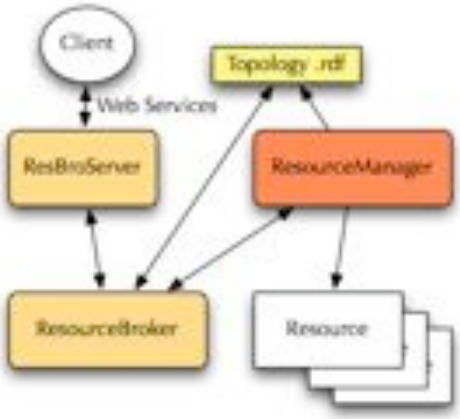
Web services

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">
```

Resource Brokering:
Your Ticket Into NetherLight

Application architecture:



Lambda networking allows the creation of application specific light paths.

Lambda networking facilities empower users to request services and provision **end-to-end light paths** if and when they need it.

NetherLight, located in Amsterdam, The Netherlands, is one of such facilities.

The Amsterdam **LightHouse** is a joint research laboratory of the UvA and SARA.

Resources in the LightHouse can be used by collaborators to prove the concepts of hybrid networks.

Lightpath setup components:

Topology information → We make use of **semantic web** techniques. The description of the network is contained in RDF files.

Reservation system → We provide **web services** interfaces to the client for:
- resources and path inquiries;
- reservation handling.

Management system → We provision the paths on the LightHouse equipment.

Semantic web
The Network Description Language, an RDF Schema, describes networks in a standard, interoperable way.

Web Services
A WSDL file describes the interfaces to the service available to clients. Clients can interact with the service directly or via a portal.

Our SC|05 demonstration
We show the setup of dynamic connections between two computing nodes through the LightHouse/ NetherLight Optical Exchange.

UvA Universiteit van Amsterdam
Paola Grosso
Jeroen van der Ham
GigaPort

Questions ?

Credits:

- Leon Gommans, Paola Grosso, Marten Hoekstra, Arie Taal, Freek Dijkstra, Bert Andree, Jeroen van der Ham, Hans Blom, Yuri Demchenko, Fred Wan, Karst Koymans, Martijn Steenbakkers Jaap van Ginkel, Li Xu
- SURFnet / GigaPort, Kees Neggers, Erik-Jan Bos, et al!
- NORTEL: Franco Travostino, Kim Roberts, Rod Wilson
- 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 !!!!

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