Next Generation research networking in The Netherlands

Erik-Jan Bos

Director of Network Services, SURFnet

e-IRG Workshop

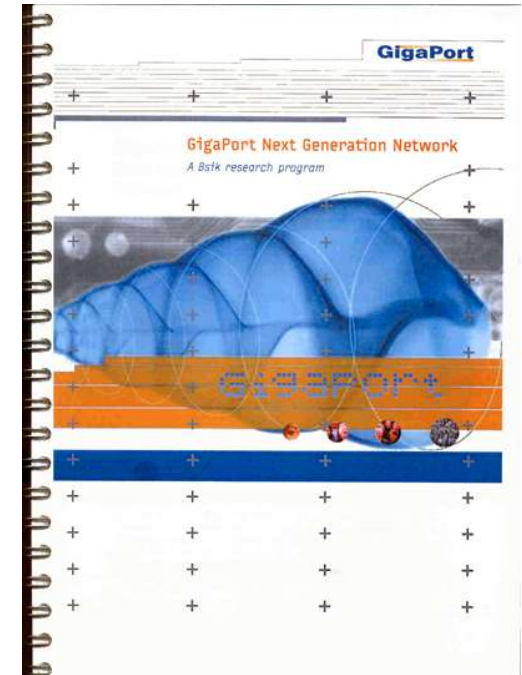**Den Haag, November 18, 2004**

GigaPort

- ✦ **Provides the Dutch National Research Network**
- ✦ **Not for profit company, 55 employees**
- ✦ **100% subsidiary of Stichting SURF**
- ✦ **170 connected organizations, 750.000 users**
- ✦ **Turnover (2003): 30 M€**
- ✦ **Infrastructure services:**
  - – **innovation paid for by government**
  - – **cost effective exploitation for higher education and research**

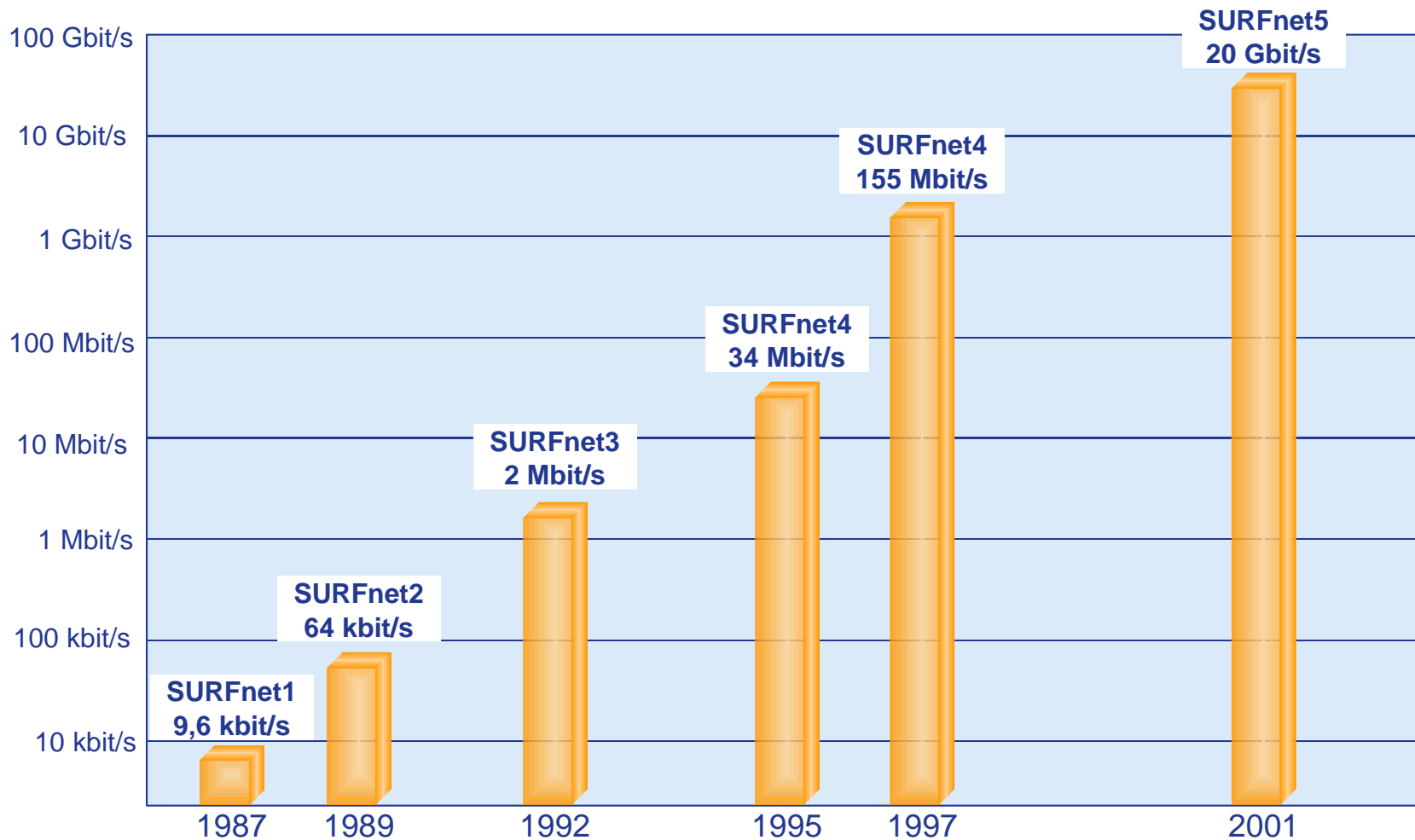**SURF net**

GigaPort Next Generation Network

✦ **Research networking as innovation engine between research and market introduction of new services**

GigaPort NG Network (2004-2008)
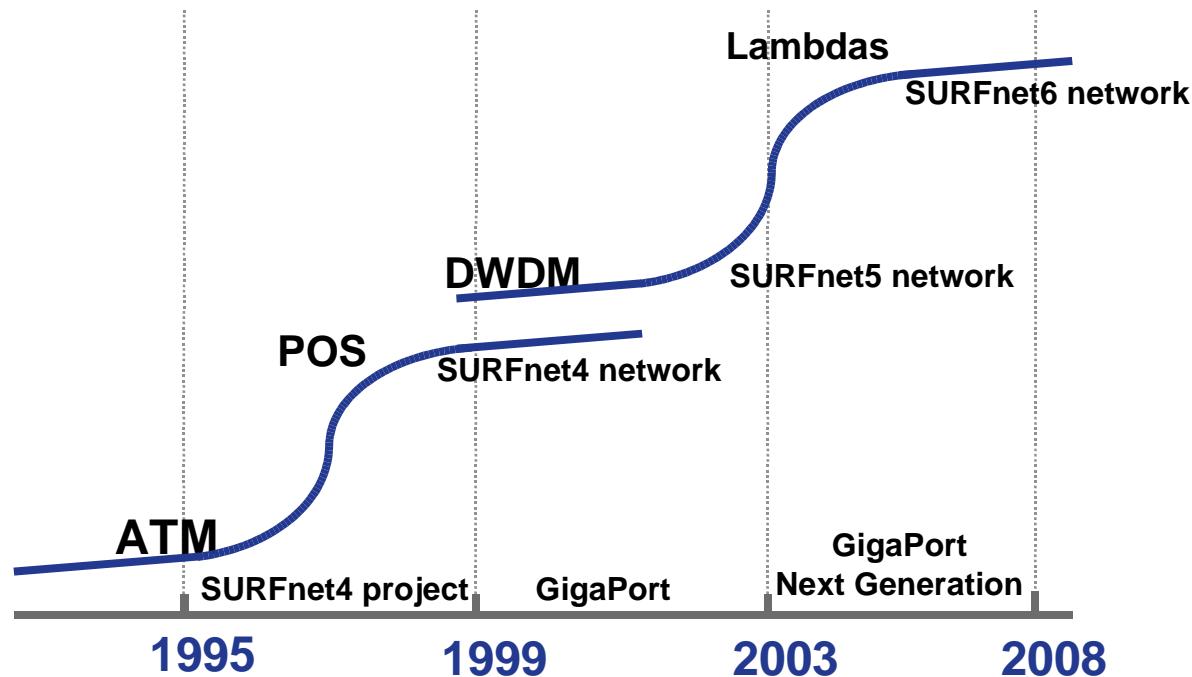
  ✦ **Consortium of 50 Dutch research organizations**

  ✦ **Government grant 40 M€**

  ✦ **Project started January 1st, 2004**

  ✦ **Builds on GigaPort project ended in 2003**

  ✦ **Partnership with industry**

SURF/net

History of the SURFnet infrastructure

GigaPort

SURFnet5
20 Gbit/s

SURFnet4
155 Mbit/s

SURFnet4
34 Mbit/s

SURFnet3
2 Mbit/s

SURFnet2
64 kbit/s

SURFnet1
9,6 kbit/s

100 Gbit/s
10 Gbit/s
1 Gbit/s
100 Mbit/s
10 Mbit/s
1 Mbit/s
100 kbit/s
10 kbit/s

1987   1989   1992   1995   1997   2001

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Paradigm shift

Next generation is not a simple extrapolation of current networks

Hybrid network architecture seems to be the only valuable NREN option for the future:

 ★ **Packet switched internet for regular many-to-many usage**
 ★ **Light Paths for new high speed few-to-few usage**

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SURFnet

★ **Research on Networks:**

– **Optical Networking**

– **High Performance Routing & Switching**

– **Management & Monitoring**

– **Grids & Access**

– **Testing Methodology**

★ **Networks for Research:**

– **Contract Industry Partner signed March 23rd, 2004**

– **Blue Print SURFnet6 finalized in September 2004**

SURFnet's new Industry Partners (2004-2010)

NORTEL NETWORKS™

* **Leader of the consortium**
* **Optical equipment**
* **Ethernet equipment**
* **Network management equipment**

AVICI SYSTEMS

* **Routing equipment**

TELiNDUS

* **Installation services**
* **Maintenance services**

SURF/net

GigaPort

- ✦ **A hybrid optical and packet switching infrastructure**

- ✦ **Based on customer-owned managed dark fiber**

- ✦ **Native IPv4, IPv6 and Light Path Provisioning over a single transmission infrastructure**

  - **Managed via a single control plane**

  - **Network nodes reduced from 20 routed locations to 2 routed locations**

Paving the way to a ubiquitous and scalable Services Grid
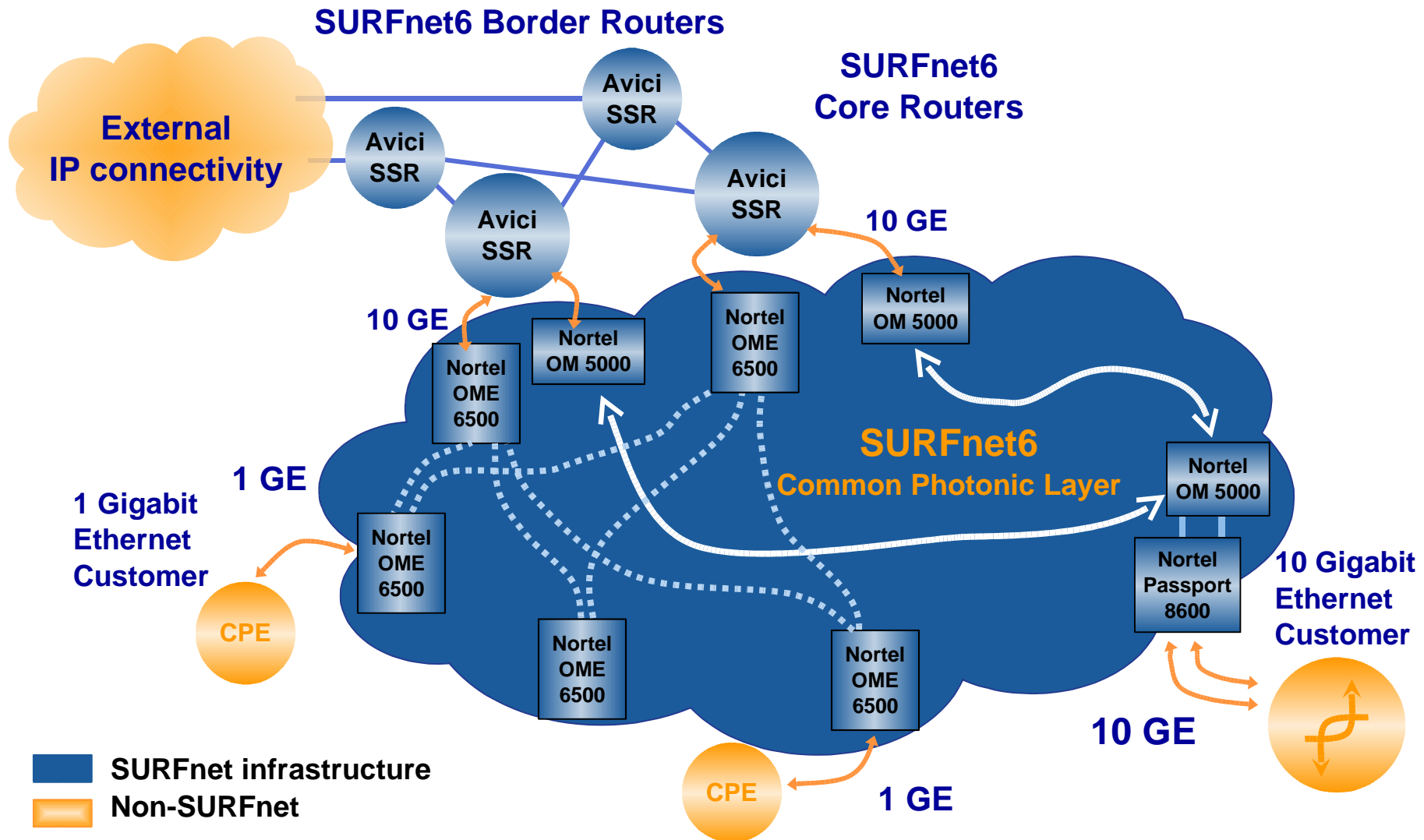
SURF;net

SURFnet6 on dark fiber

✴ **SURFnet6 will be entirely based on SURFnet owned managed dark fiber via the customer premises**

✴ **Over 5300 km fiber pairs available today; average price paid for 15 year IRUs:**

< 6 €/meter per pair

✴ **Managed dark fiber infrastructure will be extended with new routes, to be ready for SURFnet6**

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SURFnet6: IP Services

✦ **IPv4 and IPv6 connectivity**

– **Unicast**

– **Multicast**

✦ **1 and 10 Gigabit Ethernet connections**

✦ **Small routed IP core in Amsterdam at two separate locations**

✦ **Congestion-free via overprovisioning**

✦ **Resilient**

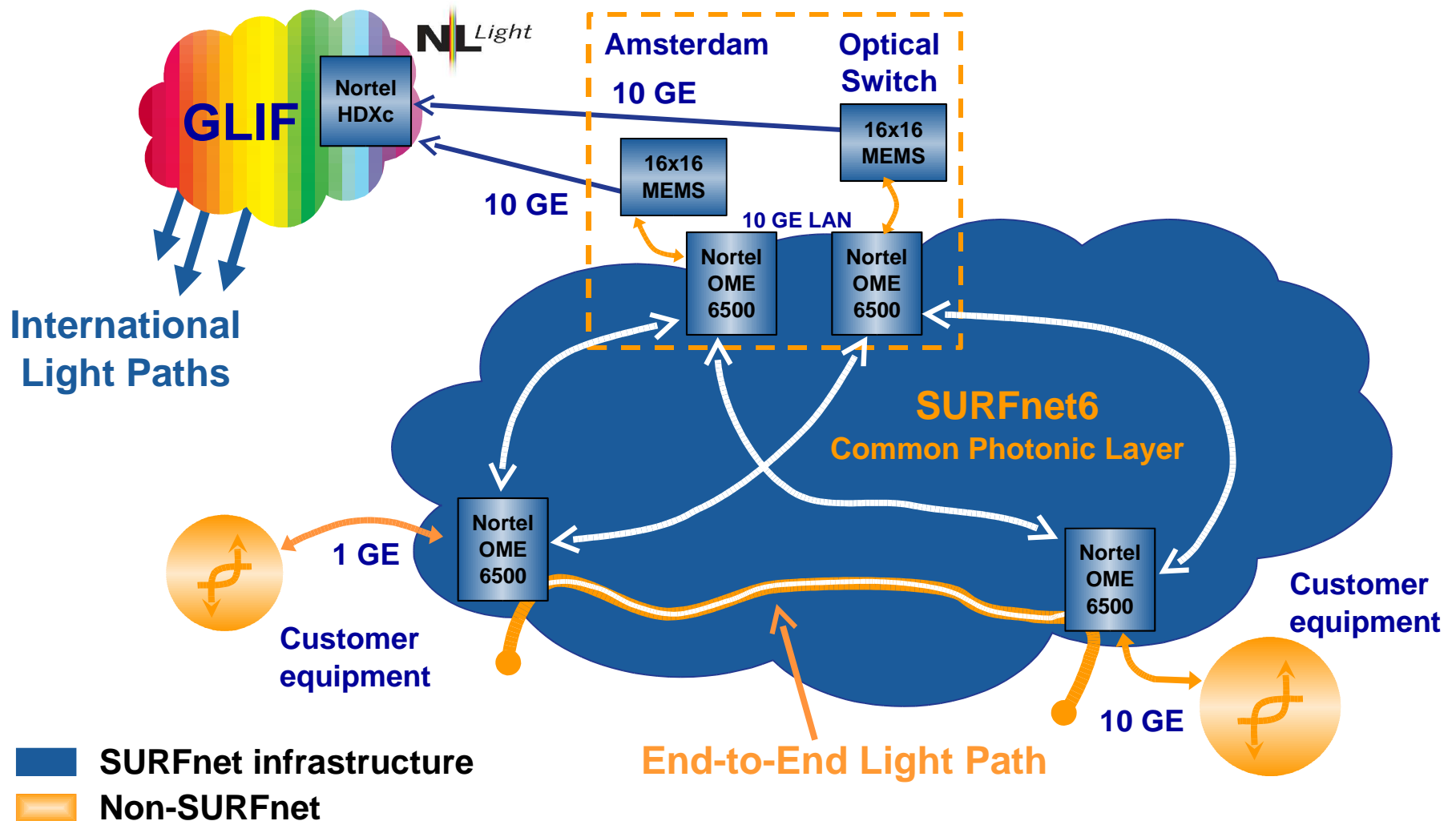**SURF/net**

SURFnet6: IP network implementation

GigaPort

SURFnet6 Border Routers

SURFnet6 Core Routers

External IP connectivity

Avici SSR

Avici SSR

Avici SSR

Avici SSR

10 GE

10 GE

Nortel OME 6500

Nortel OM 5000

Nortel OME 6500

Nortel OM 5000

SURFnet6 Common Photonic Layer

Nortel OM 5000

1 GE

1 Gigabit Ethernet Customer

Nortel OME 6500

Nortel Passport 8600

10 Gigabit Ethernet Customer

CPE

Nortel OME 6500

Nortel OME 6500

10 GE

SURFnet infrastructure

Non-SURFnet

CPE

1 GE

SURF/net

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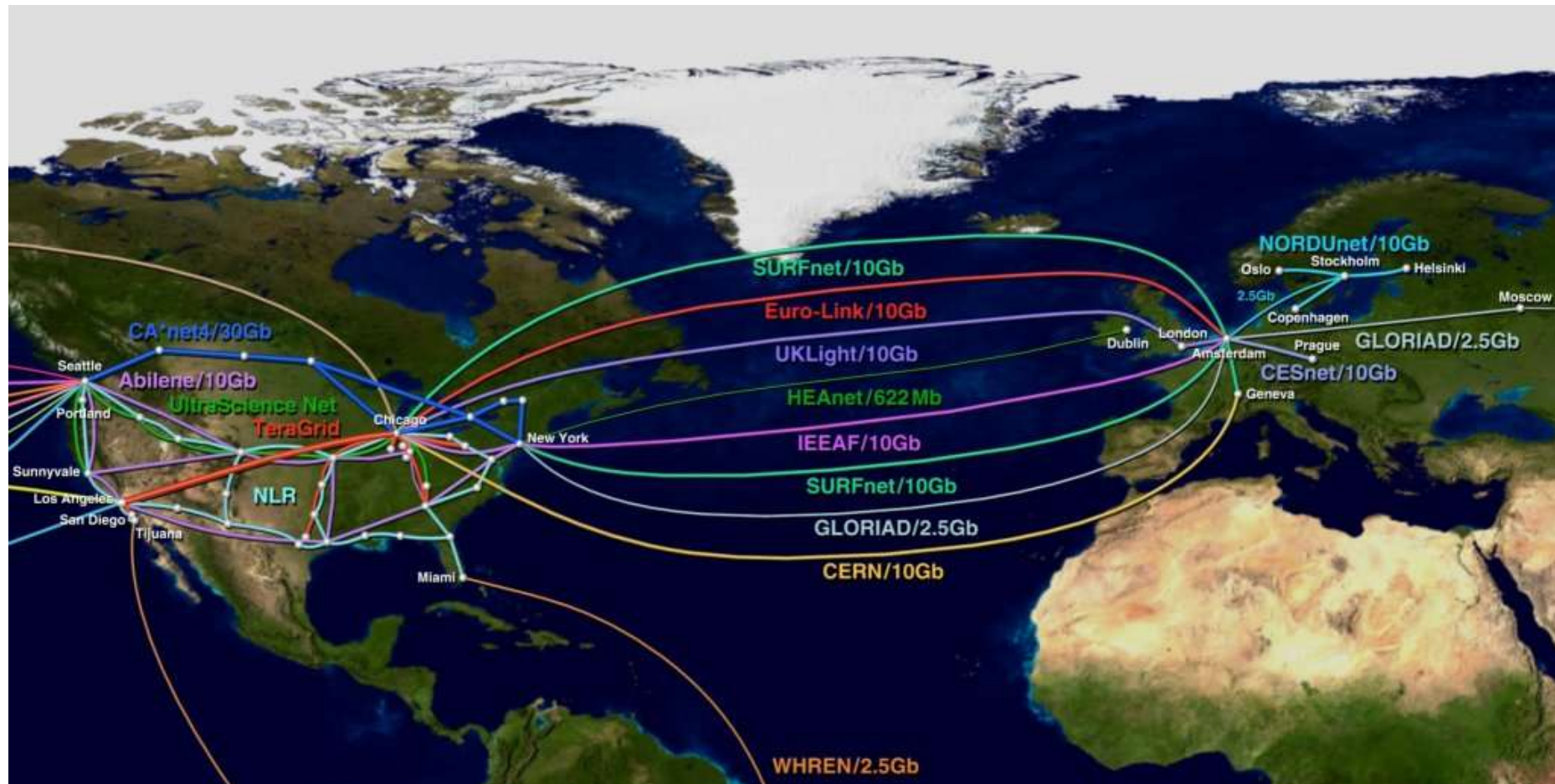## Lambdas:

✴ **form an excellent basis for IP networking**

✴ **enable layer 1/2 end-to-end Light Paths**

✴ **provide excellent quality on point-to-point connections at very high speed (1-10G)**

✴ **not constrained by traditional framing, routing, and transport protocols**

✴ **are becoming integral part of scientific instruments**

✴ **enable creation of Optical Private Networks (OPN)**
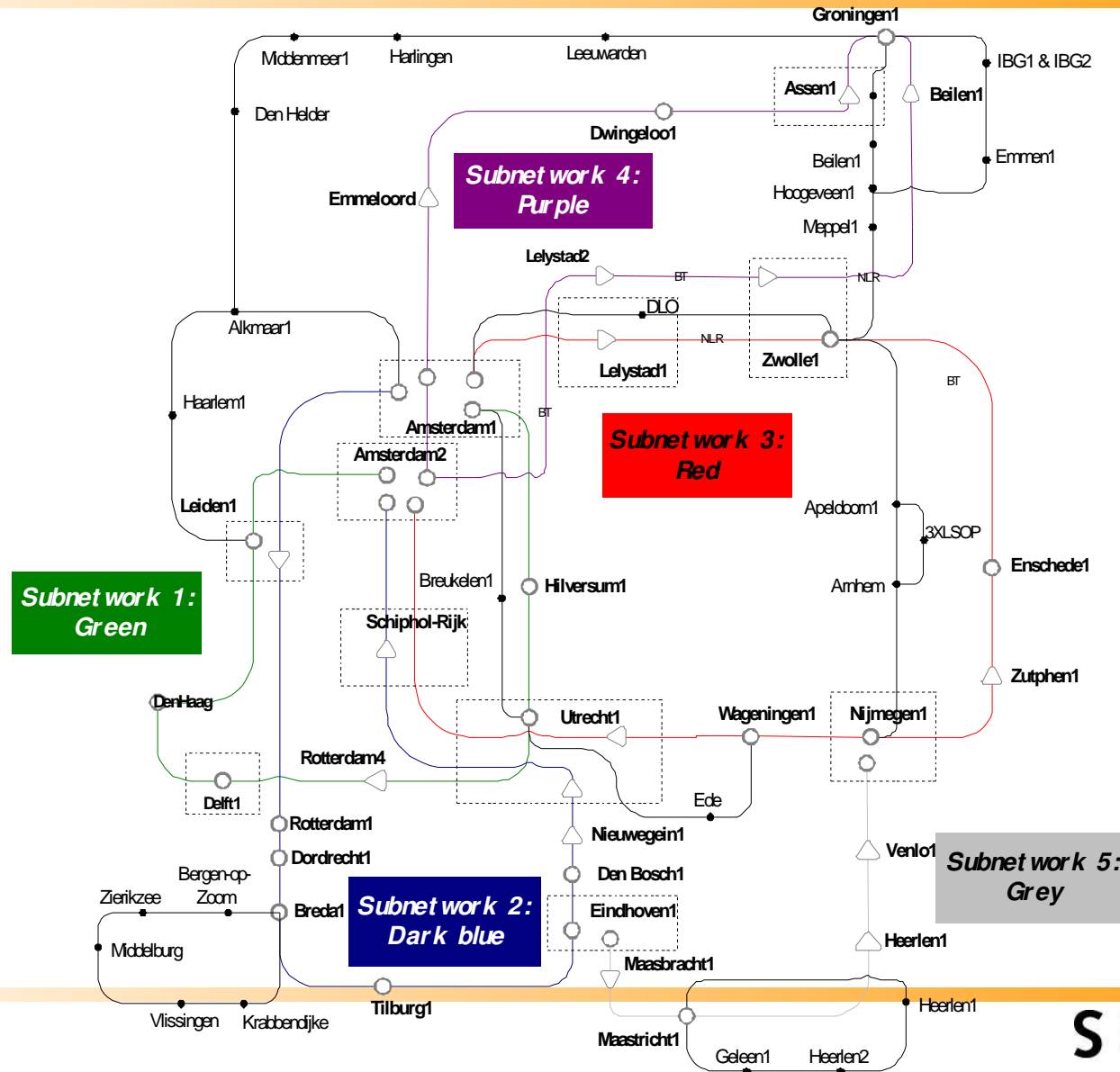
SURFnet6: Light Path Provisioning implementation

GigaPort

NL^{Light}

GLIF
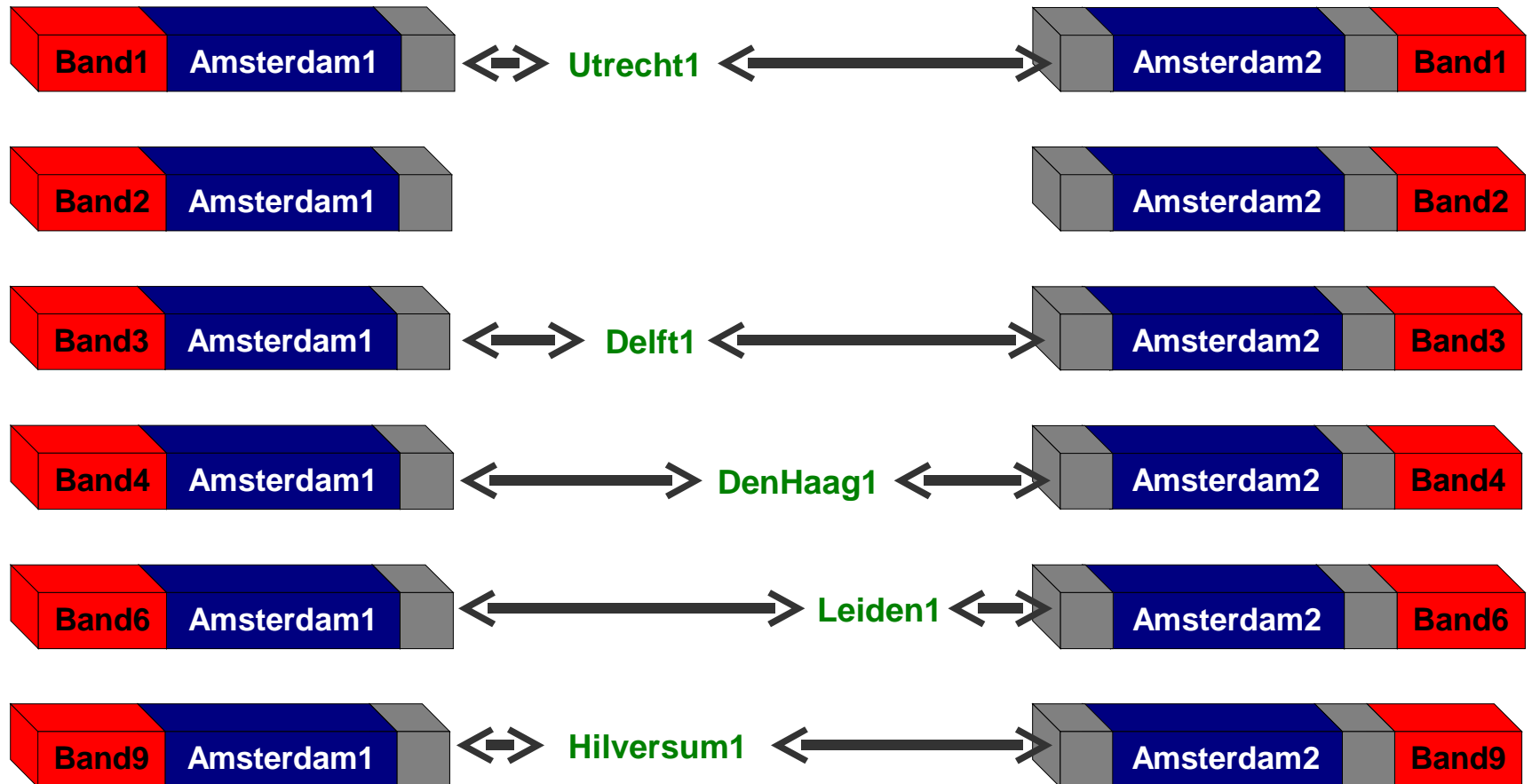
International Light Paths

Nortel HDXc

Amsterdam
10 GE

Optical Switch

10 GE

16x16 MEMS

16x16 MEMS

10 GE LAN

Nortel OME 6500

Nortel OME 6500

SURFnet6
Common Photonic Layer

Nortel OME 6500

1 GE

Customer equipment

Nortel OME 6500

Customer equipment

10 GE

SURFnet infrastructure
Non-SURFnet

End-to-End Light Path

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Global Lambda Integrated Facility

Visualization courtesy of Bob Patterson, NCSA.

www.glif.is

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Common Photonic Layer (CPL) in SURFnet6

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Optical Private Network (OPN)

AMS 2 # 11

AMS 2 # 13

AMS 2 OME # 22

AMS2 Centerstage

AMS1 Centerstage

AMS 1 # 11

10 G

10 G

10 G

10 G

10 G

10 G

AMS 2 OME # 23

10 G

AMS 1 OME # 23

10 G DWDM

1 * GE Unprotected

Zwolle

1 * GE Unprotected

DLO Lelystad

1 * GE Unprotected

10 G DWDM

10 G DWDM

Leiden 1

1 * GE Unprotected

WUR Lisse

Den Haag

10 G DWDM

1 * GE Protected

10 G DWDM

WUR1 Wageningen

10 G DWDM

LEI DenHaag

1 * GE Protected

Wageningen 1

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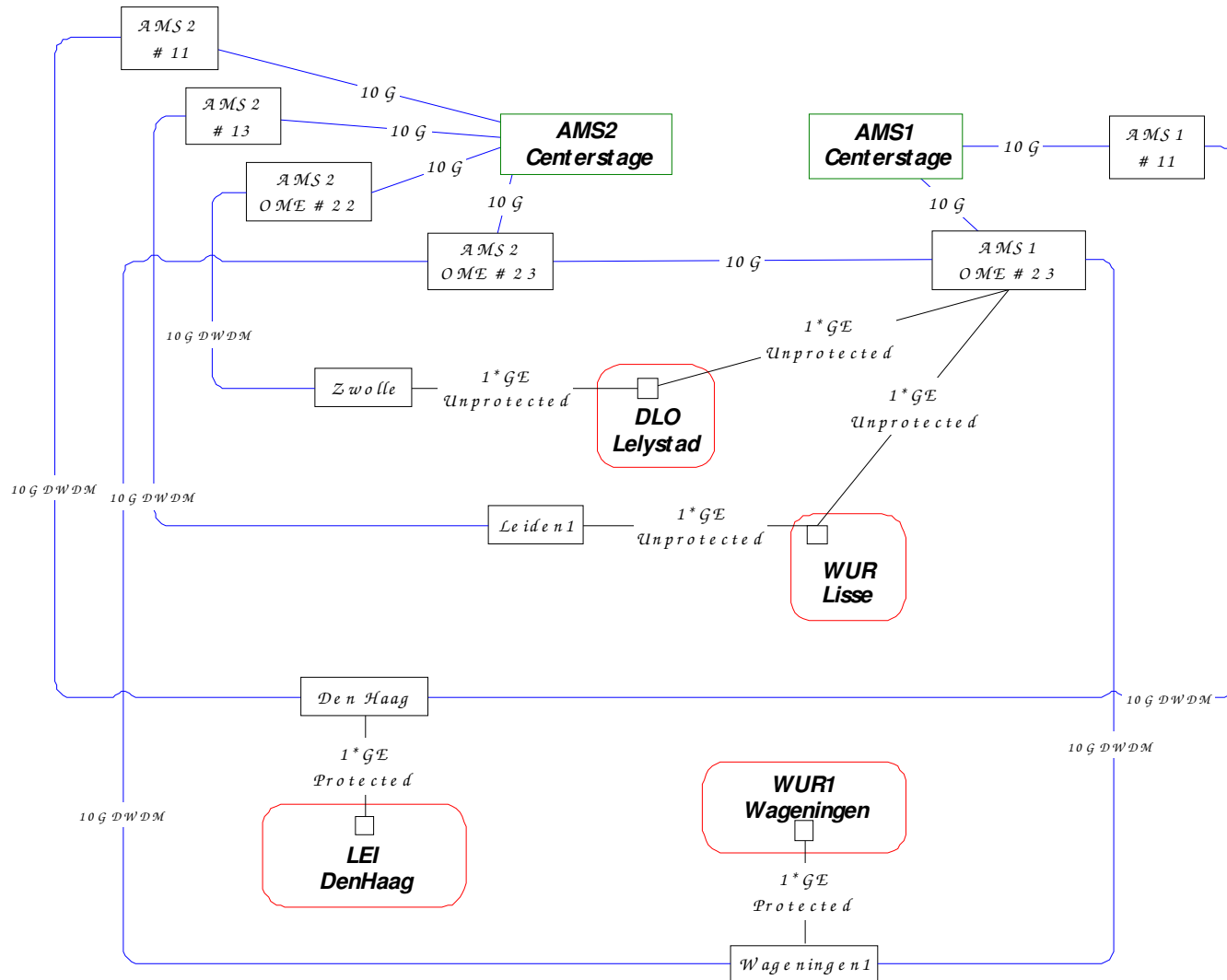
**GigaPort**

* **Open Optical Exchange in Amsterdam**
  – **Operational since January 2002**
  – **Built and operated by SURFnet**
* **Nortel Networks HDXc at the centre**
* **Full duplex 640G non-blocking cross-connect capability**
* **GE grooming, GE switch for access to clusters**

* **Experiments with Light Path provisioning in a multi-domain environment, successful demo at SC04**

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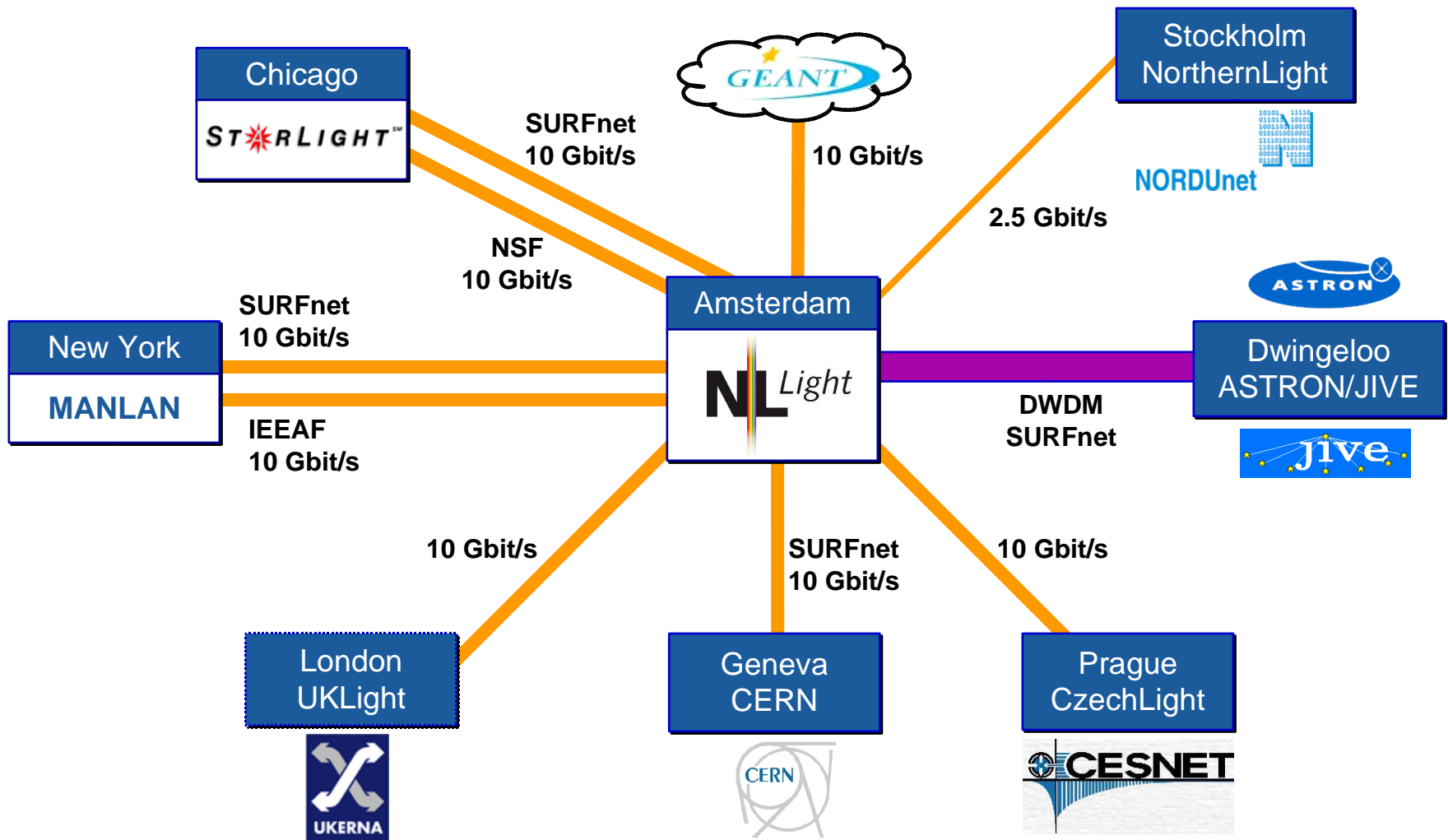
Lambdas as part of research instruments
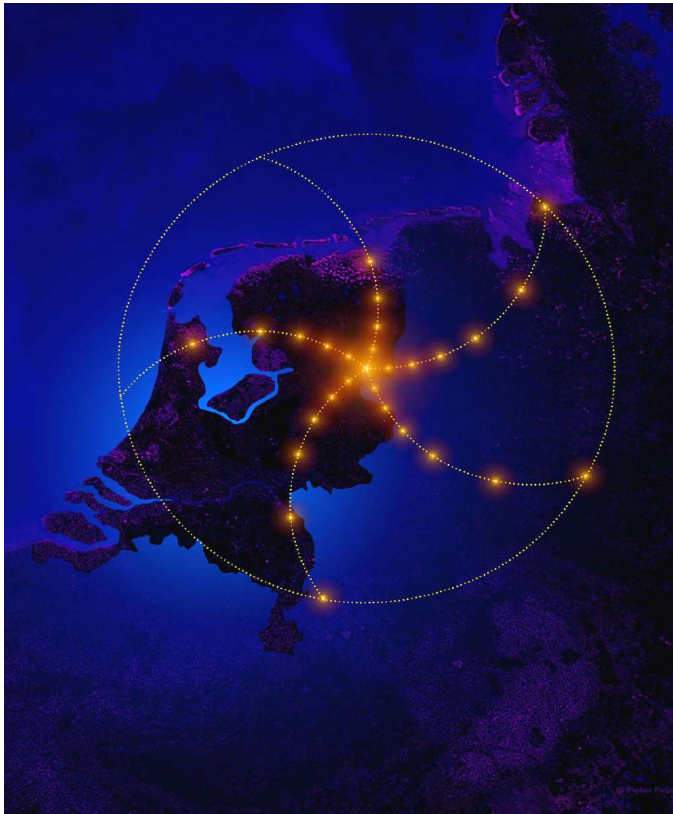
- **Many data collection points**
- **Processing in Groningen**
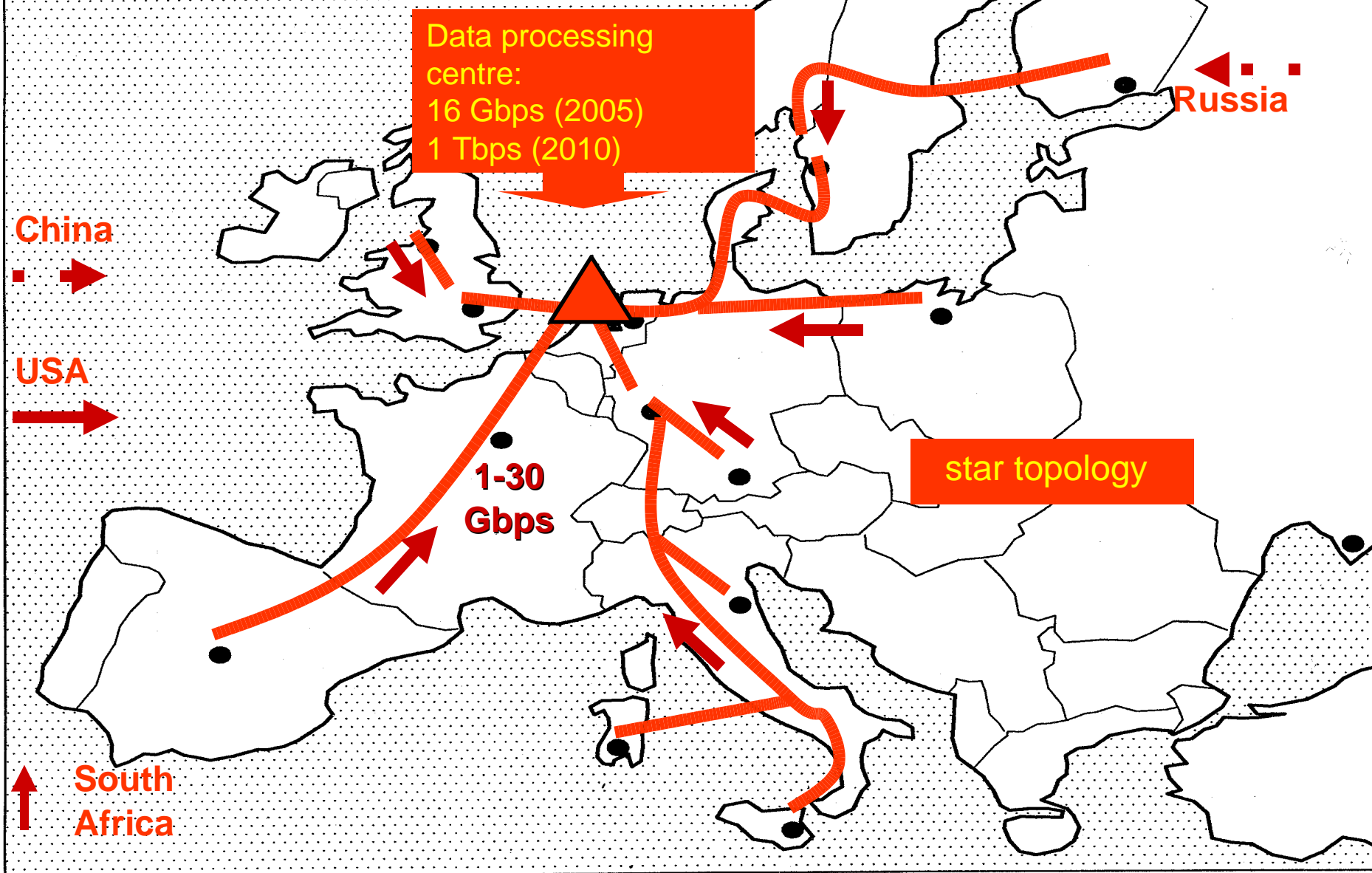- **Large data sets distributed to many destinations in The Netherlands and abroad**

LOFAR

www.lofar.org

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VLBI at JIVE in Dwingeloo, NL today

SURF/net

eEVN: European VLBI Network

Data processing centre:
16 Gbps (2005)
1 Tbps (2010)

Russia

China

USA

1-30 Gbps

star topology

South Africa

GLIF: Global Lambda Integrated Facility

- ✦ **Established at the 3rd LambdaGrid Workshop, August 2003 in Reykjavik, Iceland**

- ✦ **Collaborative initiative among worldwide NRENs, institutions and their users**

- ✦ **A world-scale Lambda-based Laboratory for application and middleware development**

GLIF vision:

> **To build a new grid-computing paradigm, in which the central architectural element is optical networks, not computers, to support this decade's most demanding E-science applications.**

SURF,net

Conclusion

* **Users need new services that current networks cannot support**

* **Telecommunication infrastructures will become part of the Grid and will be integrated in scientific instruments**

* **Hybrid networks delivering IP and Lambda Services can meet user demand within budget constraints**

* **SURFnet6 will enable advanced multimedia collaboration and applications, and the use of Grid technology in research**

SURF/net

Thank you

bos@surfnet.nl

http://www.surfnet.nl/

http://www.gigaport.nl/

http://www.netherlight.net/

http://www.glif.is/

SURF_inet