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International Telecommunication Union

Grid networks in the research community

Kees Neggers

SURFnet

OpenGridForum

ITU-T/OGF Workshop on Next Generation Networks and Grids
Geneva, 23-24 October 2006

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History of research networking

- 1972 First public demo of ARPANET
- 1982 Start of EUnet via dial up links
- 1992 Start of Ebone 256 Kbps
- 2002 Start of Lambda Networking 10 Gbps
- 2012 ???

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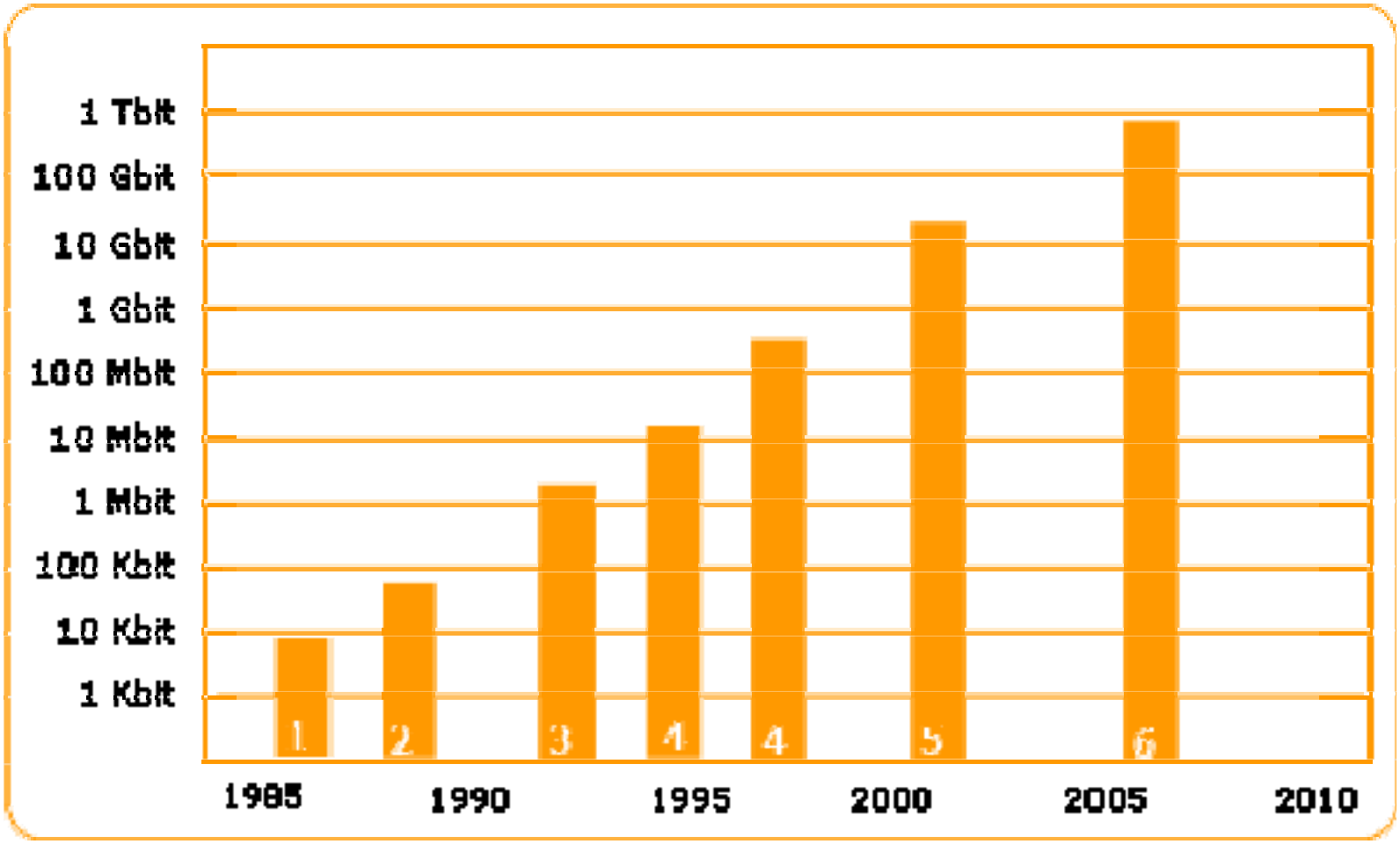
Capacity evolution of the SURFnet network



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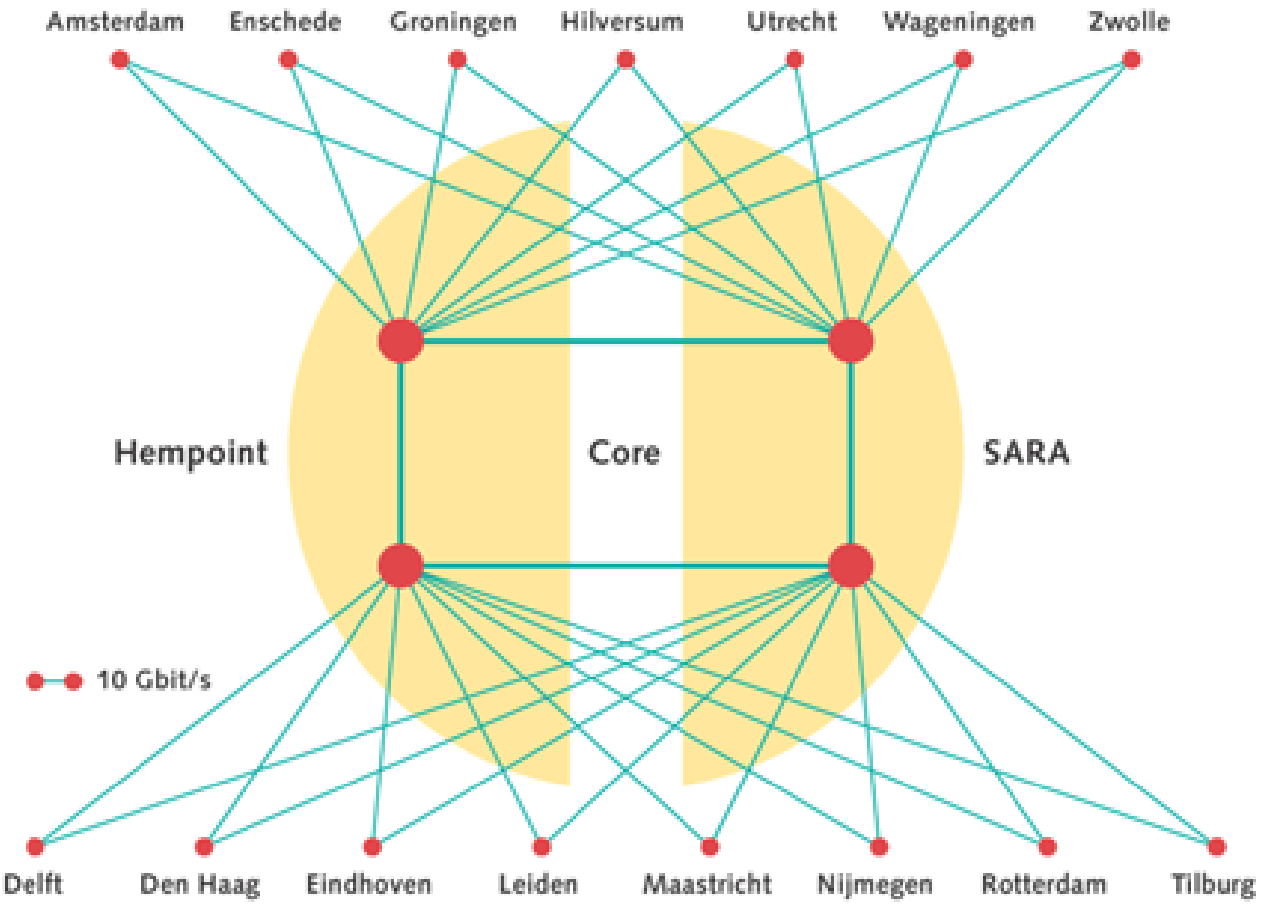
SURFnet5 network, 10G lambdas and routers



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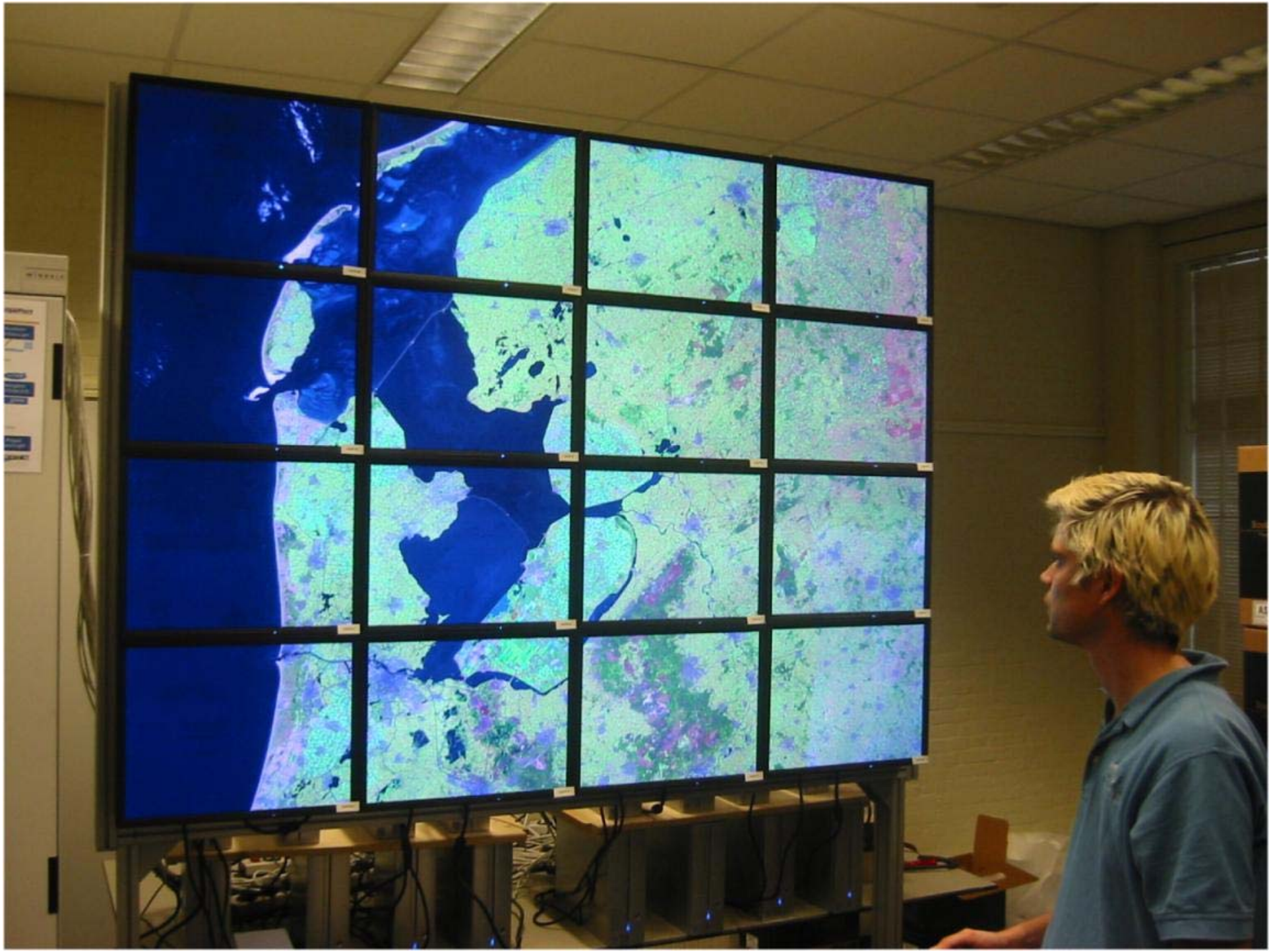
How long will SURFnet5 last?

- Concern on how to serve demanding science and research applications on the common layer3 Internet.
- Astronomy
  - eVLBI
  - LOFAR
- Particle Physics
  - Large Hadron Collider



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NREN Challenge

- How to accommodate needs of scientific users for higher speed, higher quality networking
- While protecting the performance of the network for current users
- And keeping the successful end-to-end model of the internet

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We realized that…

- Counting on bigger routers and fatter pipes was no longer a realistic option.
- And introducing QoS was not a viable alternative of course.
- Next Generation Research Networks would not be a simple extrapolation of the current Internet evolution anymore.

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What researchers want…

- Ubiquities available networking: using networking should be like breathing air
- Total freedom how to use the networks: intelligence at the edge
- So they need a simple transport network, no complex services
- Solution: Complement the Internet service with a *LambdaGrid* in which the lambda networks themselves are resources that can be scheduled, like all other computing resources.

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So we concluded…

- Challenge is how to seamlessly integrate the large amounts of bandwidth that will become available.
- Exploring the potential of lambdas looked the way forward.
- International Co-operation is essential.
- And SURFnet installed a lambda to StarLight as a research facility available for anyone interested in international lambda networking.

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LambdaGrid Workshops

- September 2001: first LambdaGrid Workshop in Amsterdam organized by SURFnet and TERENA
- September 2002 second LambdaGrid Workshop in Amsterdam was attached to iGrid2002 organized by Science Park Amsterdam
- August 2003: third LambdaGrid Workshop in Reykjavik hosted by NORDUnet and attached to the NORDUnet 2003 Conference

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GLIF

- In Reykjavik with 33 participants from Europe, Asia and North America it was agreed to continue lambda networking cooperation for research networking under the name:

GLIF

Global Lambda Integrated Facility

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What is GLIF

- International virtual organization to promote and support optical networking.
- Managed as cooperative activity with 'participants' rather than 'members' under a lightweight governance structure.
- Open to anybody sharing the vision of optical interconnection of different facilities, who voluntarily contributes network resources (e.g. equipment, lambdas) or actively participates in relevant activities.
- Secretariat functions provided by TERENA with voluntary contributions from participants.

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GLIF Participants

GLIF Vision

Linking the World with Light

- Optical networks are the central architectural element in support of this decade's most demanding e-science applications.
- A research world without geographical boundaries.
- Hybrid research networks with
  - Packet-switched Internet for regular many-to-many usage
  - Dedicated lightpaths for guaranteed high-speed few-to-few usage.

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What is GLIF doing

- Providing a platform for global cooperation of Research Networks, institutions and consortia working with lambdas.
- Helping to create a global-scale laboratory to facilitate application and middleware development, and to build distributed systems.
- Providing a forum for making contacts, exchanging information and experiences, and resolving technical problems.
- Working towards harmonization of policy, service and fault management processes.

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GLIF Working groups

- Governance & Growth Working Group
  - Chair: Kees Neggers (SURFnet)
- Technical Issues Working Group
  - Co-Chairs: Erik-Jan Bos (SURFnet) & René Hatem (CANARIE)
- Control Plane & Grid Integration Middleware Working Group
  - Chair: Gigi Karmous-Edwards (MCNC)
- Research & Applications Working Group
  - Co-Chairs: Maxine Brown (UIC) & Larry Smarr (UCSD)

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SURFnet6 network, dark fiber and DWDM

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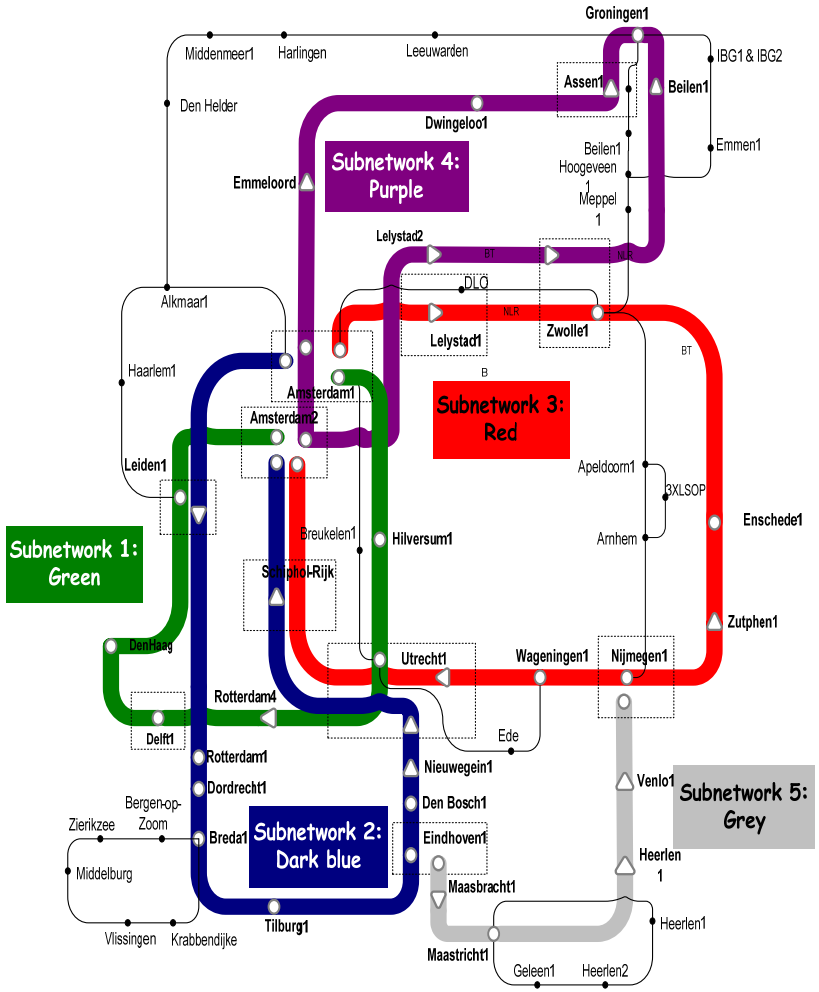

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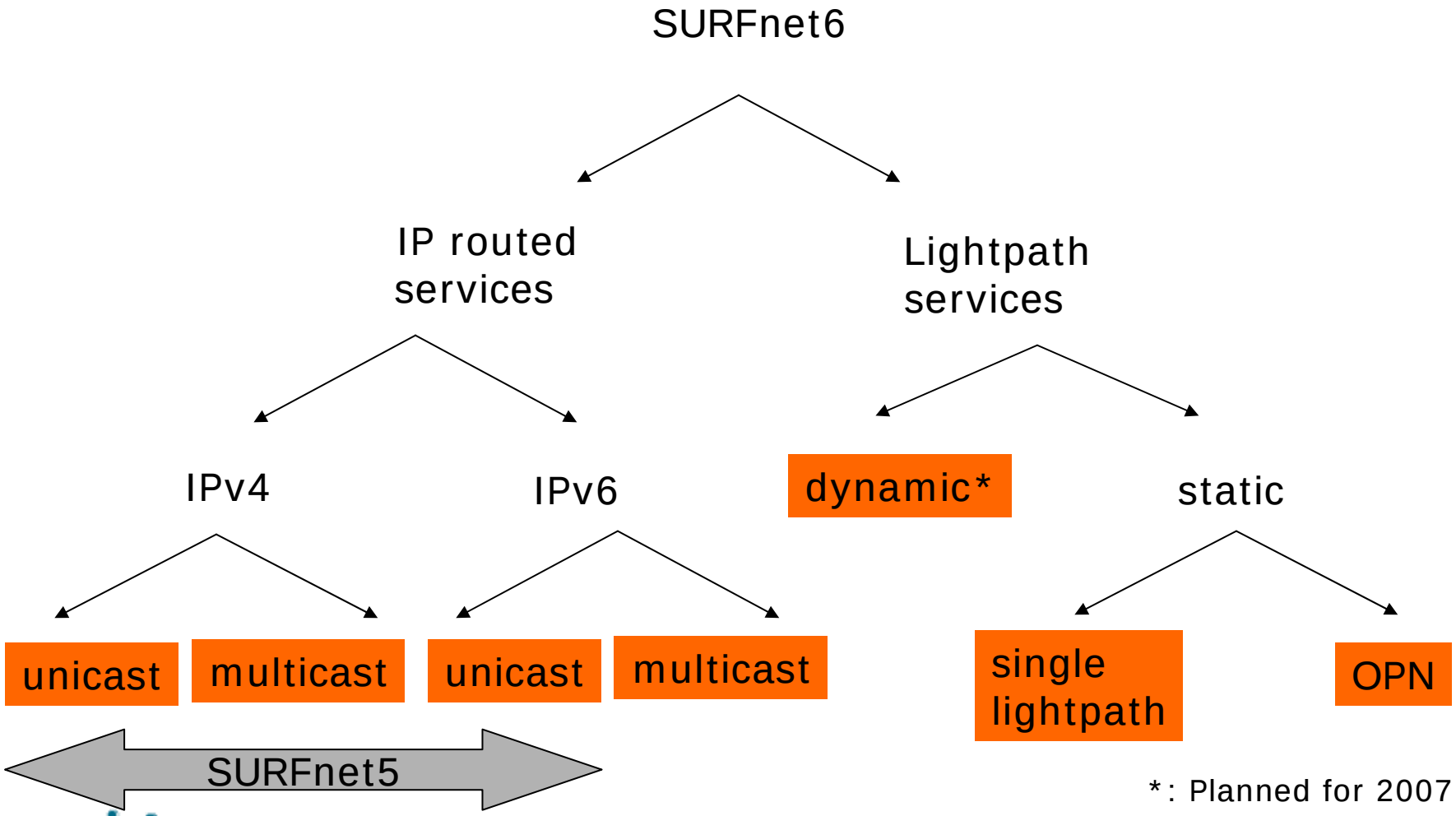
Services on SURFnet6



*: Planned for 2007

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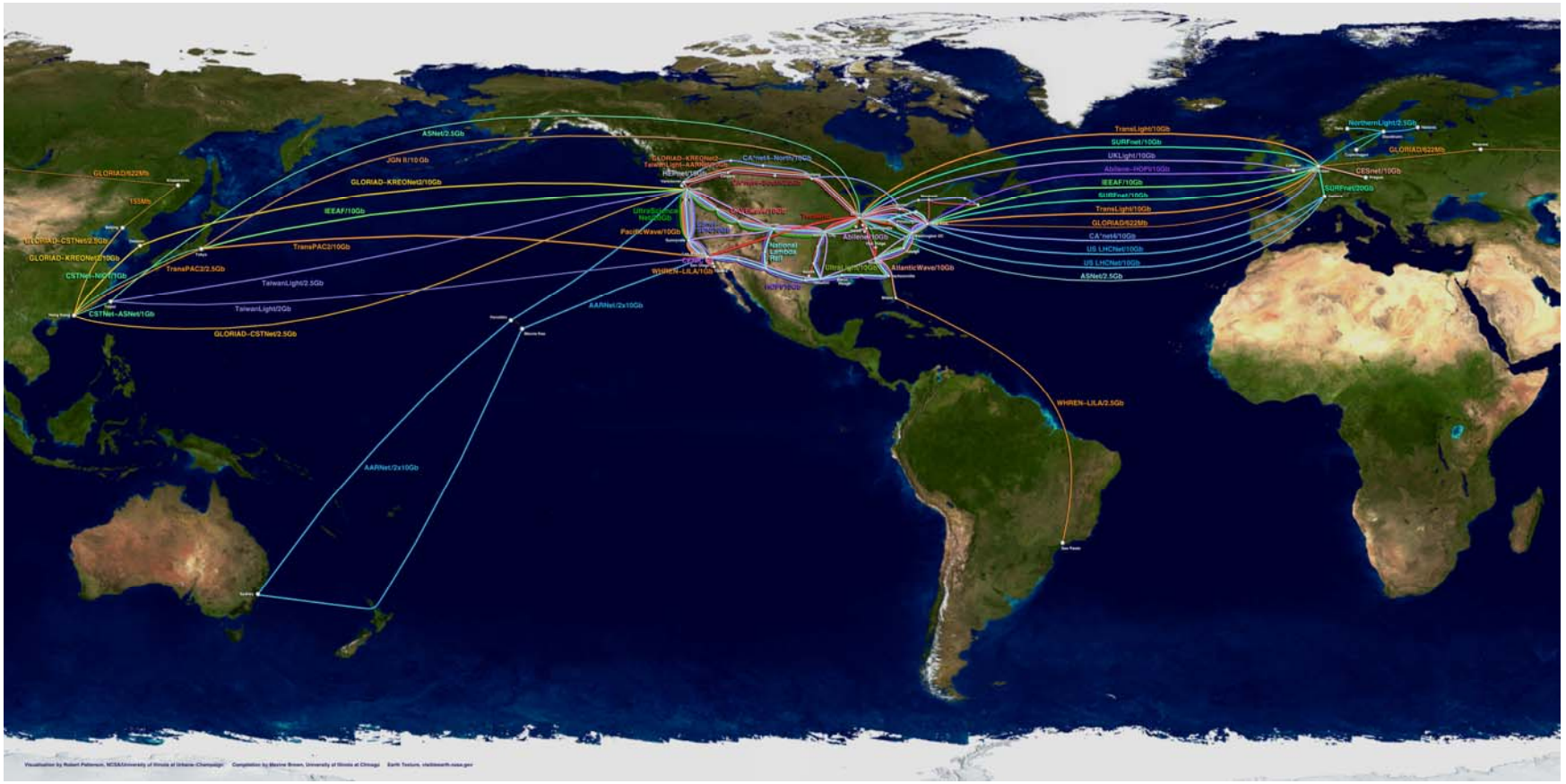
GLIF Infrastructure



Lambdas and GOLEs

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GLIF Open Lightpaths Exchanges (GOLEs)

- GLIF lambdas are interconnected through established exchange points known as GOLEs.
- GOLEs are comprised of equipment capable of terminating lambdas and performing lightpath switching, allowing end-to-end connections.
- GLIF infrastructure will be Multi-domain
- Open connection policy, AUP free, no restriction on interconnection with commercial networks.

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NetherLight: GLIF Open Lightpath Exchange

- GLIF Open Lightpath Exchange in the Science Park Amsterdam
  - Operational since January 2002
  - Built and operated by SURFnet
- Nortel Networks HDXc at the centre with full duplex 640G non-blocking cross-connect capability.
- Nortel OME6500 and Cisco15454 at the edge.

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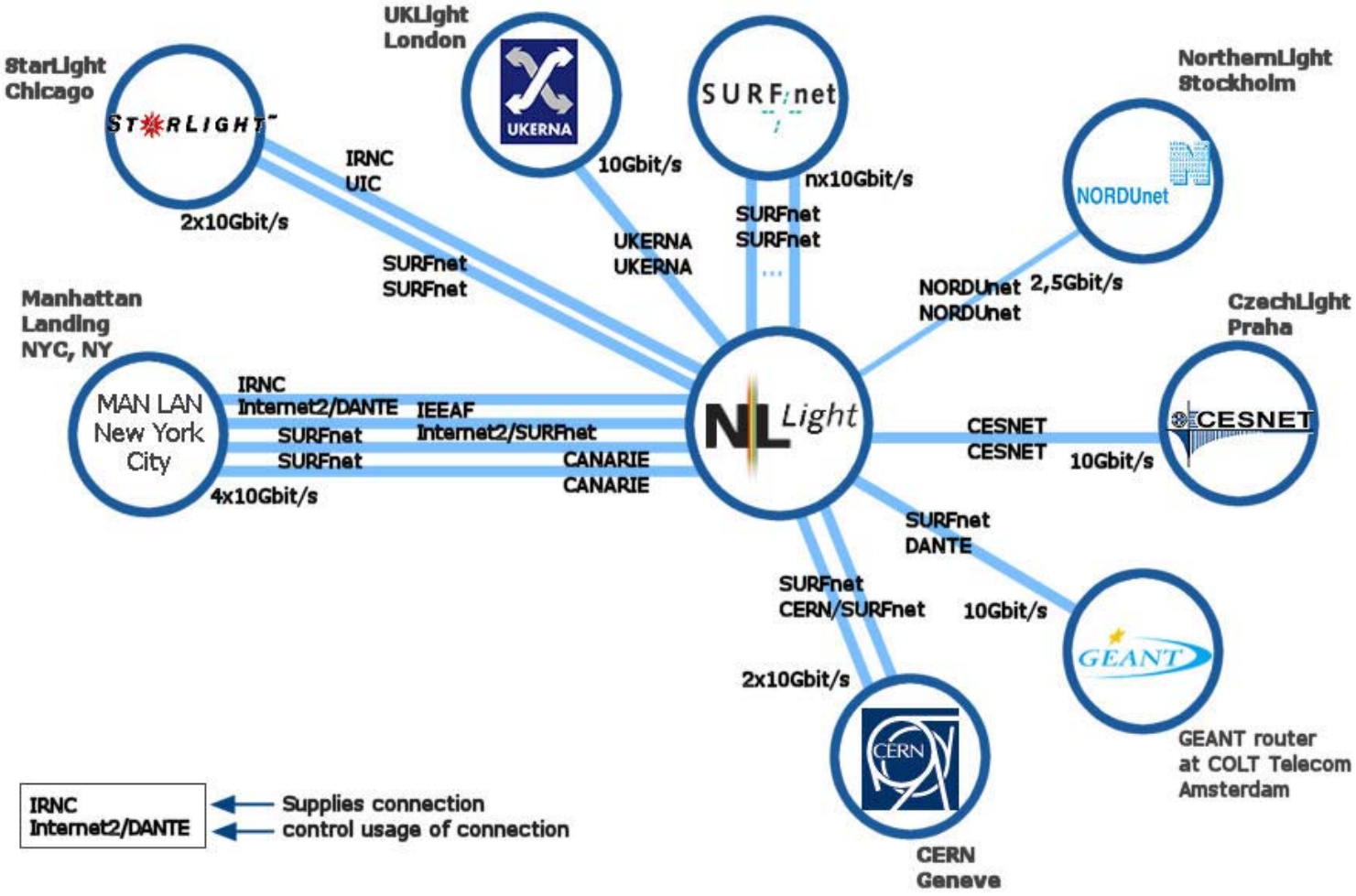
Example Topology of a GOLE - NetherLight



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GLIF at work

- Proof of concept for LHC and eVLBI OPNs, Optical Private networks
- Common agreement to use GFP-F
- TL1 Toolkit
- Network Definition Language

- Lots of demo's at SCxx and iGrids

4K videoconference at iGrid 2005

7th Annual Global LambdaGrid Workshop

- The 2007 GLIF Workshop will be held on 17-18 September 2007 in Prague, Czech Republic.
- Hosted by CESNET