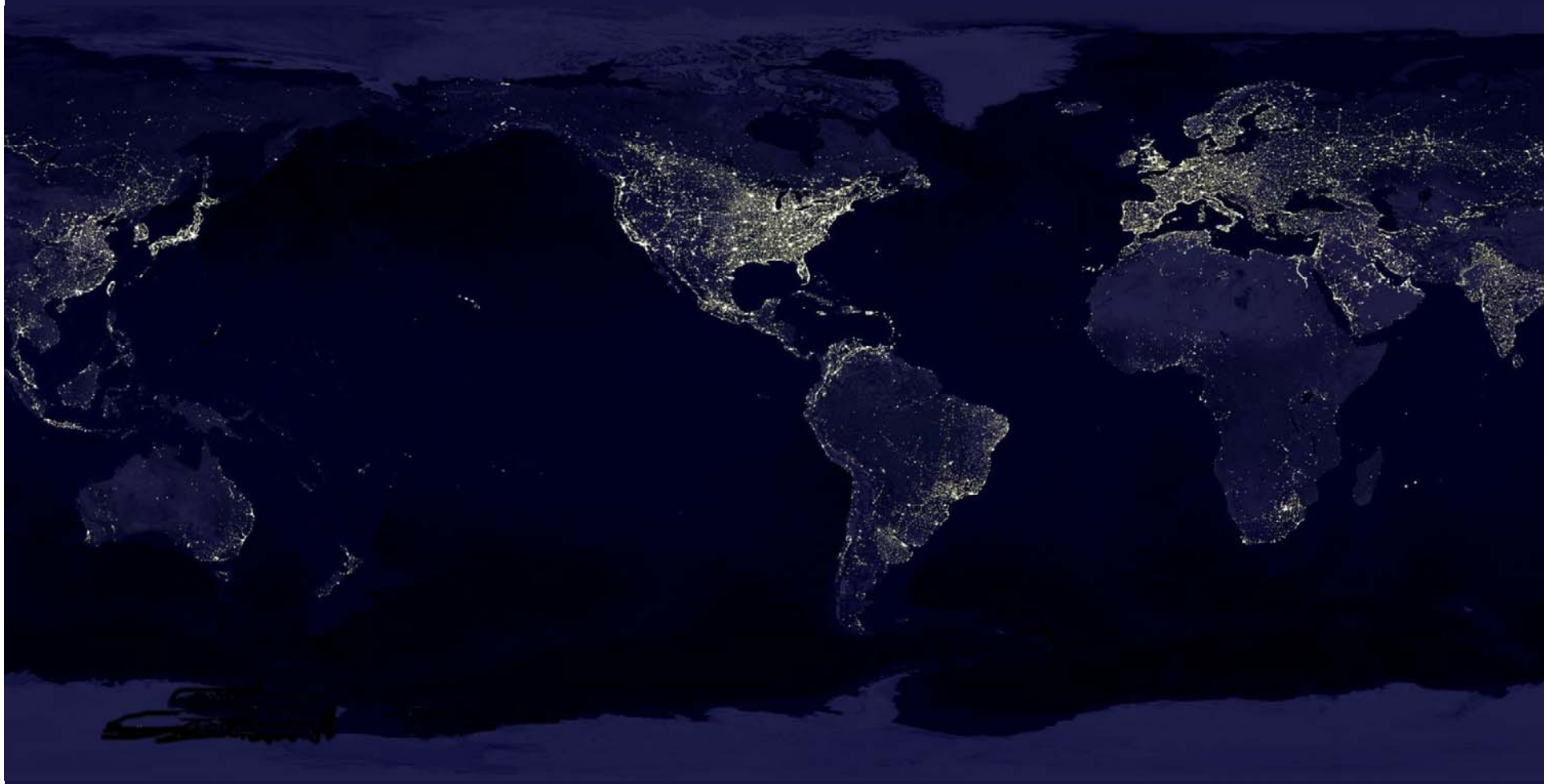
ICFA HEP Grid and Digital Divide Workshop

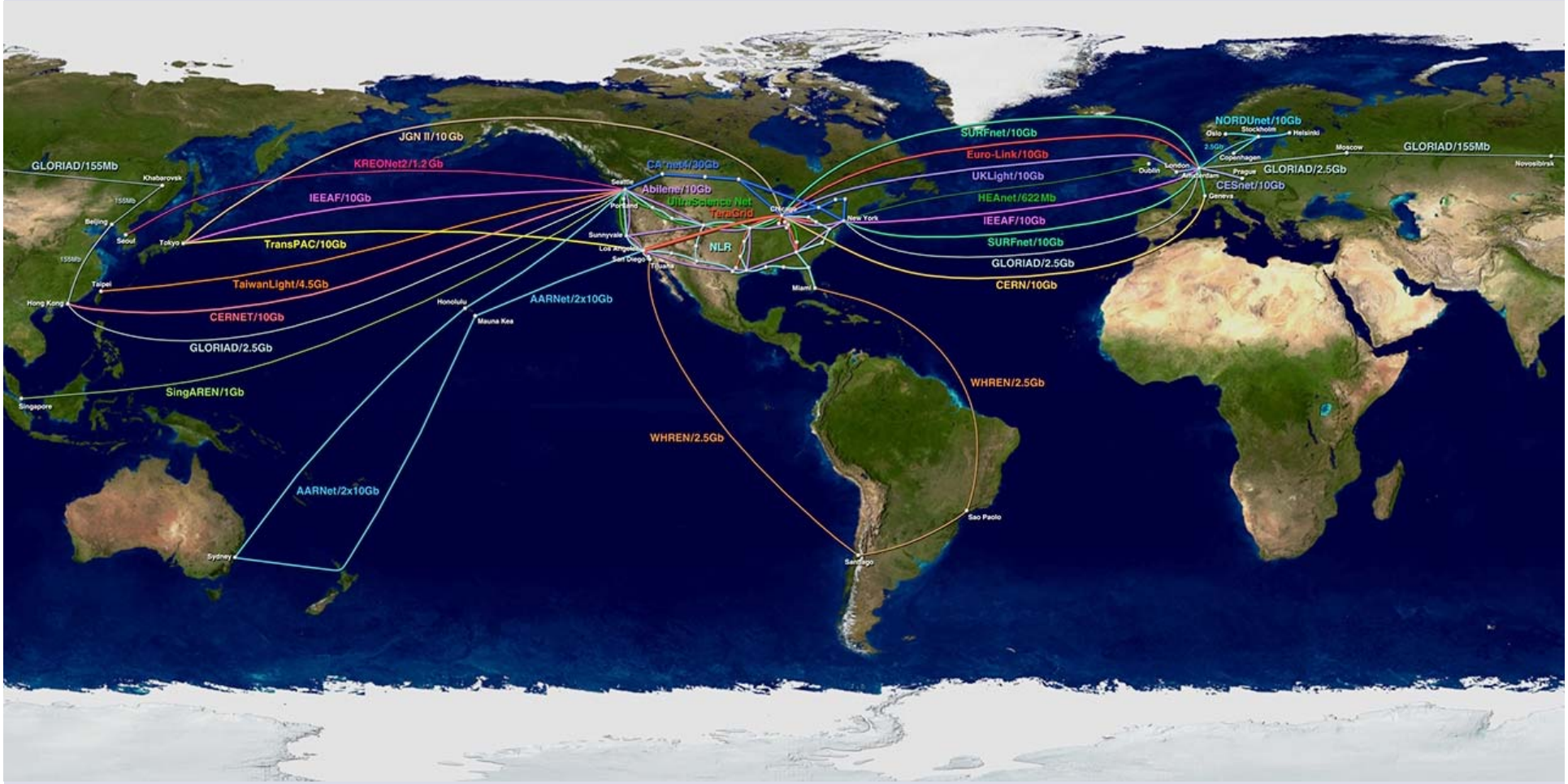
22-27 May 2005 Daegu, Korea



George McLaughlin
Director, International Developments
AARNet

Kees Neggers
Managing Director
SURFnet

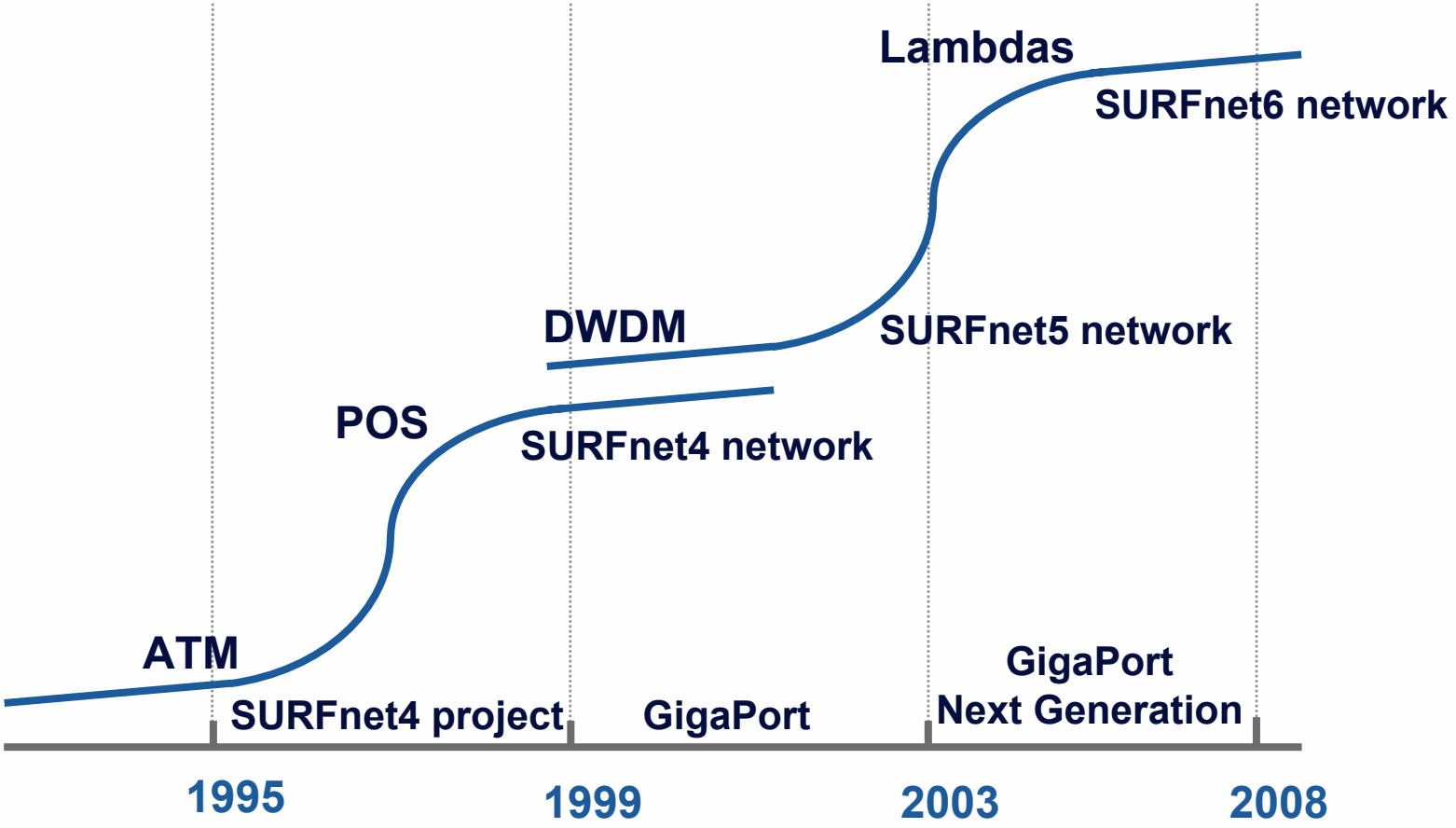
Linking the World with Light – the GLIF Challenge



GLIF vision

- Linking the World with Light
- It is no longer sufficient to connect researchers to the internet, they have to be connected to each other.
- GLIF community shares a common vision of building 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.

Paradigm shift



Next generation is not a simple extrapolation of current networks

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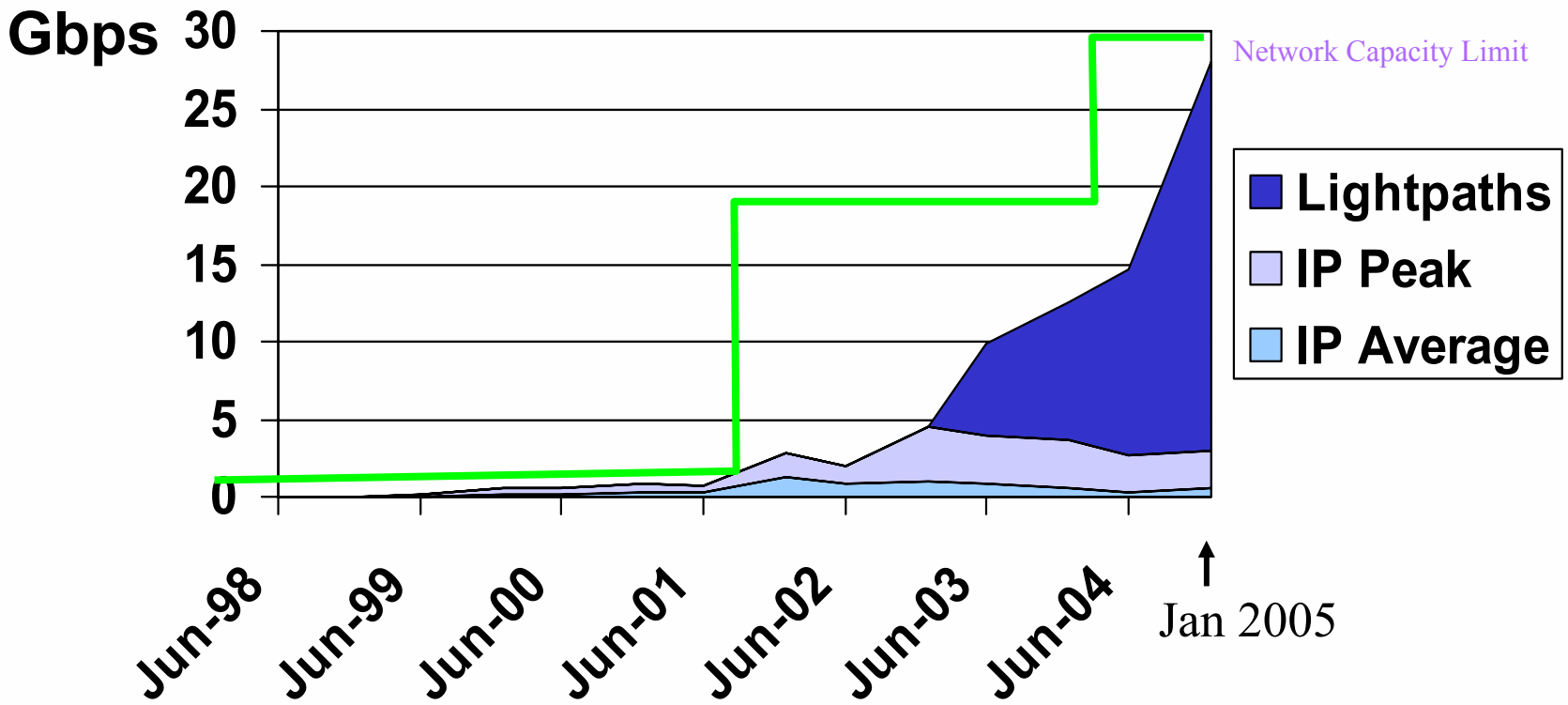
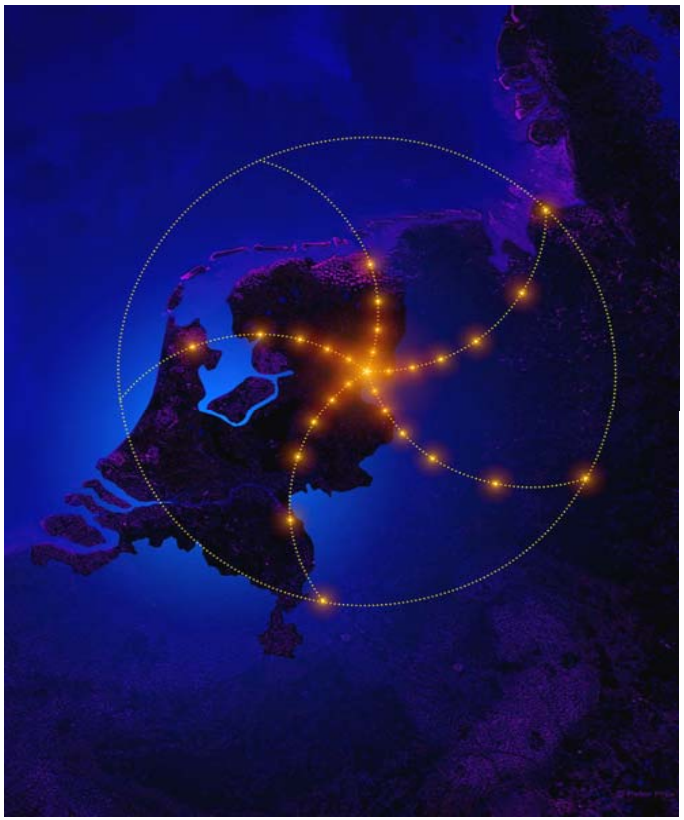
Utilisation trends



VLBI at JIVE in Dwingeloo, NL

Lambdas as part of research instruments



- Many data collection points
  collecting ~ 20 Tbit/s
- Processing in Groningen
- Large data sets distributed to many destinations in The Netherlands and abroad

LOFAR

www.lofar.org

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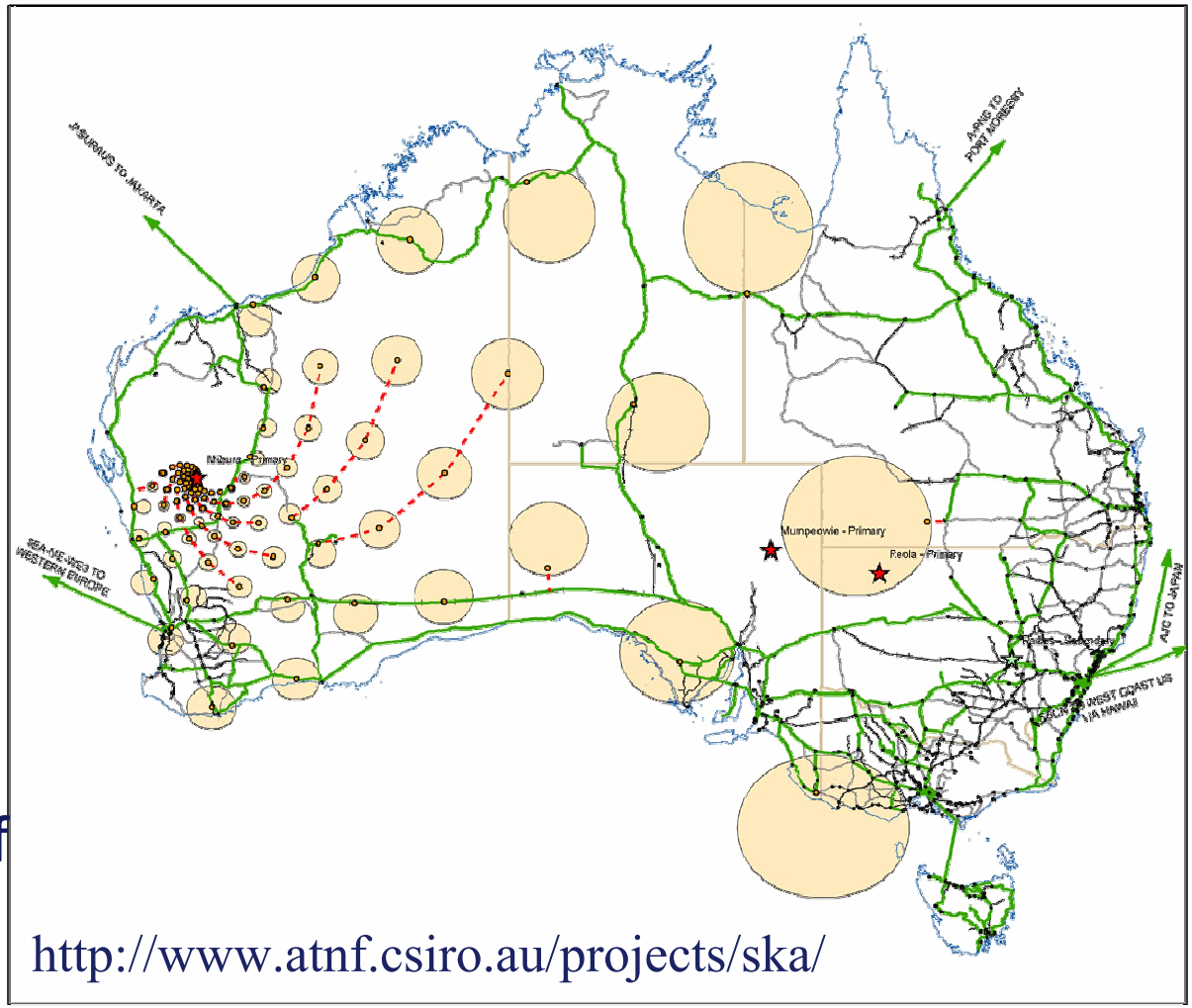
The Square Kilometre Array

- $2Bn investment in infrastructure
- Real-time data analysis at Petabits per second
- Storage >40 years



http://www.atnf.csiro.au/projects/ska/

Building the world's largest computational & data facility in one of the world's most isolated locations

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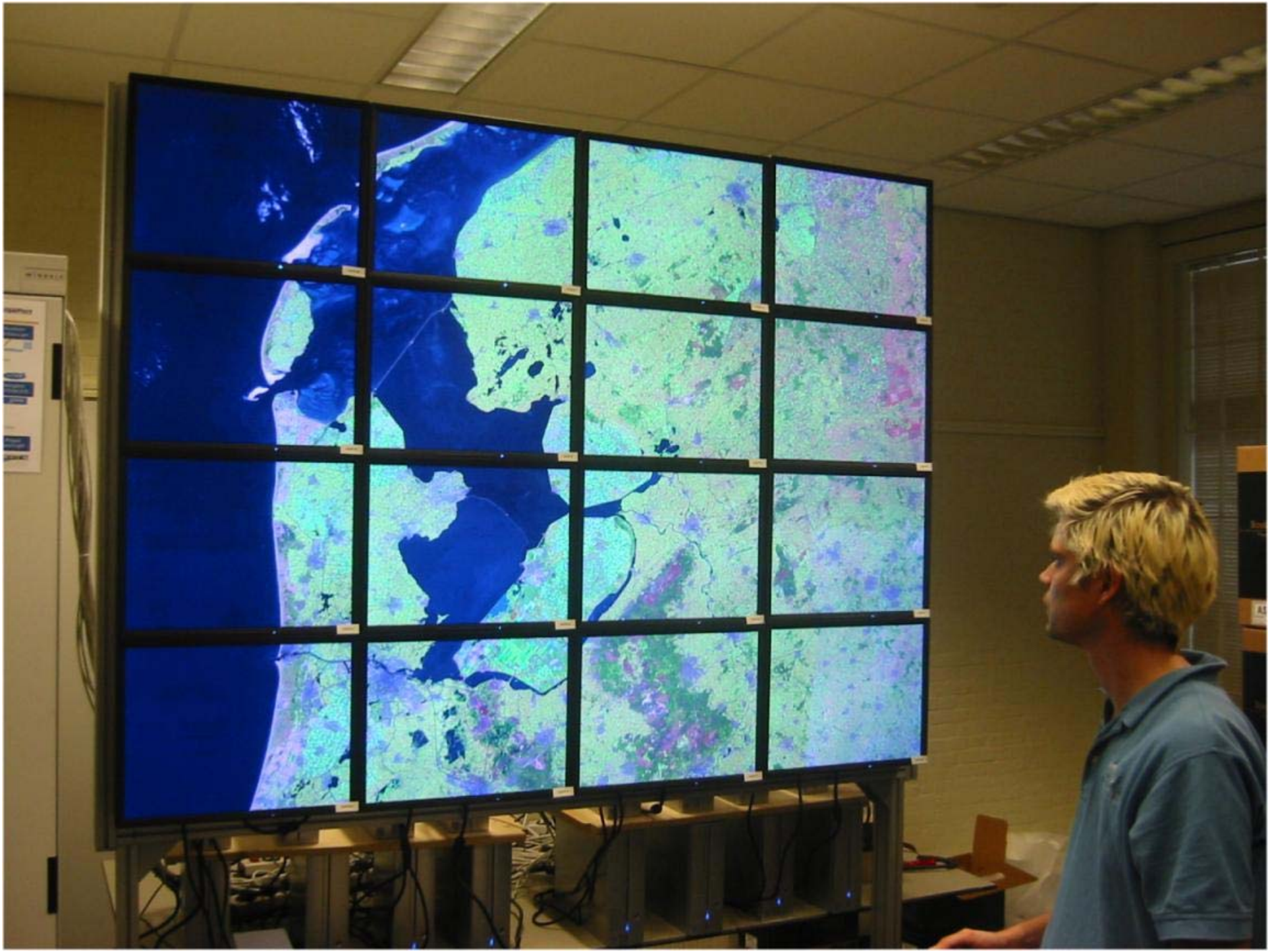
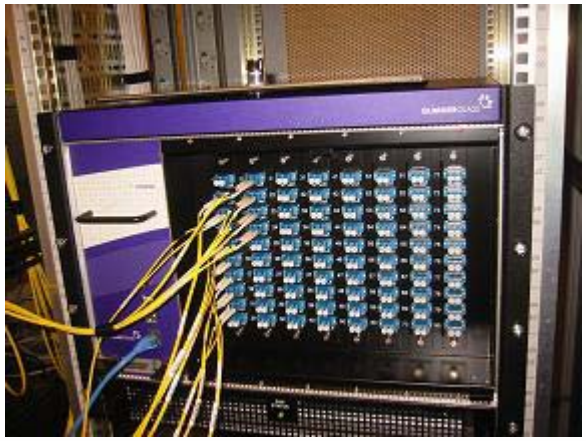
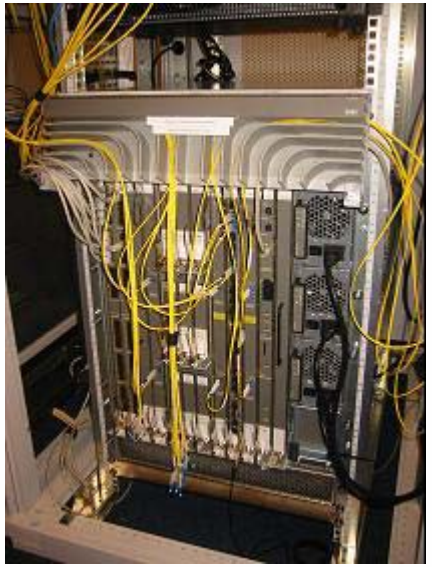


A word on networking costs

- Costs of optical port is 10% of switching port is 10% of router port with same characteristics
  - 10G routerblade -> 100+ k$, 10G switch port >10k$, MEMS port -> 1 k$
- Give each packet in the network the service it needs, but no more





Courtesy Cees de Laat

Paradigm shift

Hybrid networking

IP + lambdas

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

Light Path Provisioning

Lambdas:

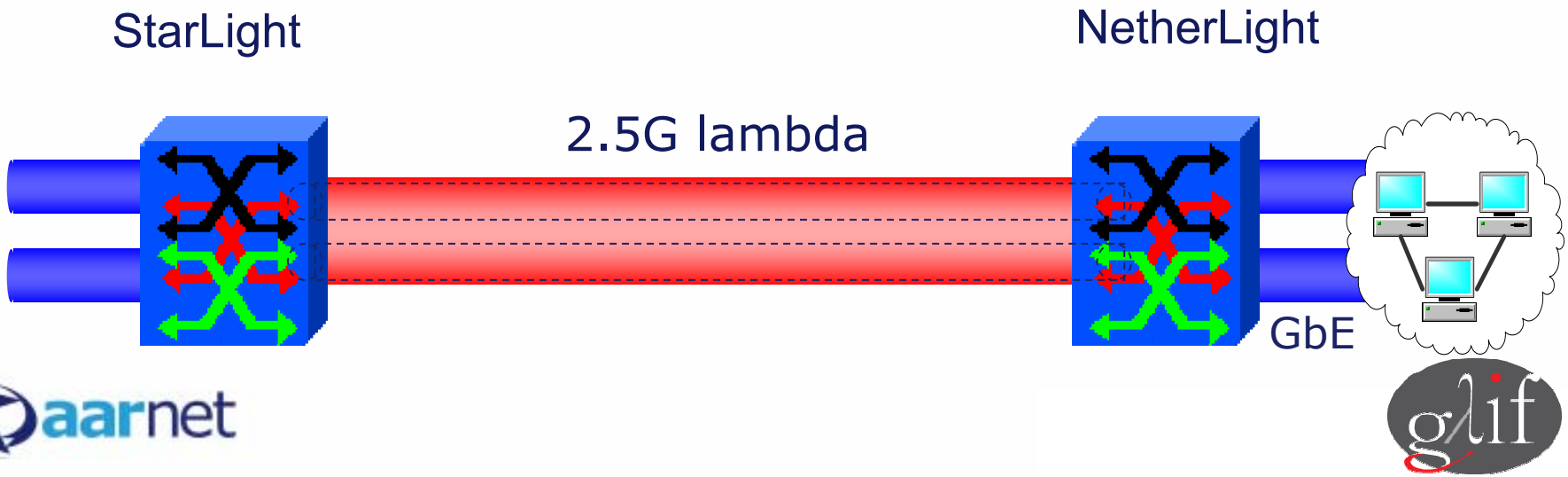
- enable layer 1 and 2 end-to-end Light Paths

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)

Spring 2001 Start of lambda networking

- 2.5Gbit/s lambda ordered by SURFnet between StarLight, Chicago, USA and NetherLight, Amsterdam, NL
- Lambda terminated on Cisco ONS15454 muxes,
  - –WAN side: SONET framed: OC48c
  - –LAN side: GbE interfaces to computer clusters



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History of Lambda Workshops

- Brainstorming in Antalya, TR at TERENA Networking Conference in 2001
- Lambda workshops so far were by invitation only but always attached to an open event related to lambda networking:
- September 2001: first Lambda Workshop in Amsterdam followed by open Lambda Workshop organized by TERENA

GLIF History

- Second Lambda Workshop in 2002 in Amsterdam was attached to iGrid2002, hosted by Science Park Amsterdam

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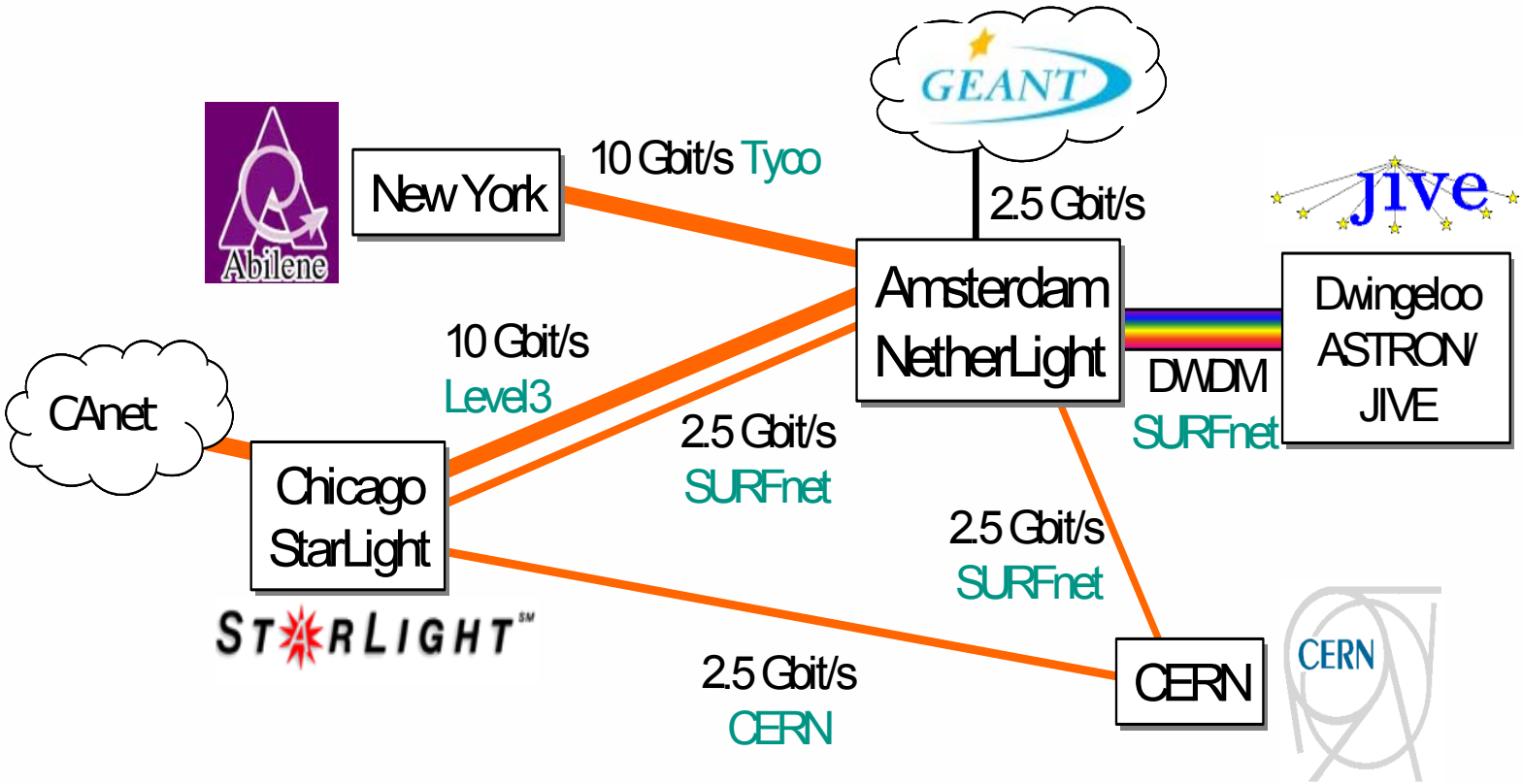
NetherLight Network 2002

- The iGrid2002 event brought many lambdas to Amsterdam



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GLIF

- August 2003: third Lambda Workshop in Reykjavik hosted by NORDUnet and attached to the NORDUnet 2003 Conference

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

GLIF: Global Lambda Integrated Facility

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GLIF Founding Members

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GLIF after Reykjavik

- GLIF is a collaborative initiative among worldwide NRENs, consortia and institutions with lambdas, as such GLIF is clearly positioned on the demand side of the market
- GLIF is a world-scale Lambda-based Laboratory to facilitate application and middleware development
- GLIF will be managed as a cooperative activity
- WWW.GLIF.IS will be the home for all interested in the GLIF activities

GLIF Working Groups

- Governance and Growth
  - **Kees Neggers - kees.neggers@surfnet.nl - chair.**
    Goal: To identify future goals in terms of lambdas, connections and applications support, and to decide what cross-domain policies need to be put in place
- Research and Applications
  - **Peter Clarke - clarke@hep.ucl.ac.uk - chair**
    Goal: To identify applications that can benefit from LambdaGrids, and to define the services that the user communities need
- Technical Issues
  - **Erik-Jan Bos - erik-jan.bos @ surfnet.nl - chair**
    Rene Hatem - rene.hatem@canarie.ca - co-chair.
    Goal: To design and implement an international LambdaGrid infrastructure, identifying equipment, connection requirements, and engineering functions and services
- Control Plane and Grid Integration Middleware
  - **Gigi Karmous-Edwards - gigi@mcnc.org - chair**
    Goal: To agree on the interfaces and protocols that talk to each other on the control planes of the contributed Lambda resources

GLIF 4th Annual Workshop

- The GLIF 4th Annual Global LambdaGrid Workshop was held in Nottingham, United Kingdom on September 2 and 3, 2004 attached to the UK All Hands eScience Meeting

Organized by Cees de Laat of University of Amsterdam and Maxine Brown of University of Illinois at Chicago.

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GLIF Nottingham Participants

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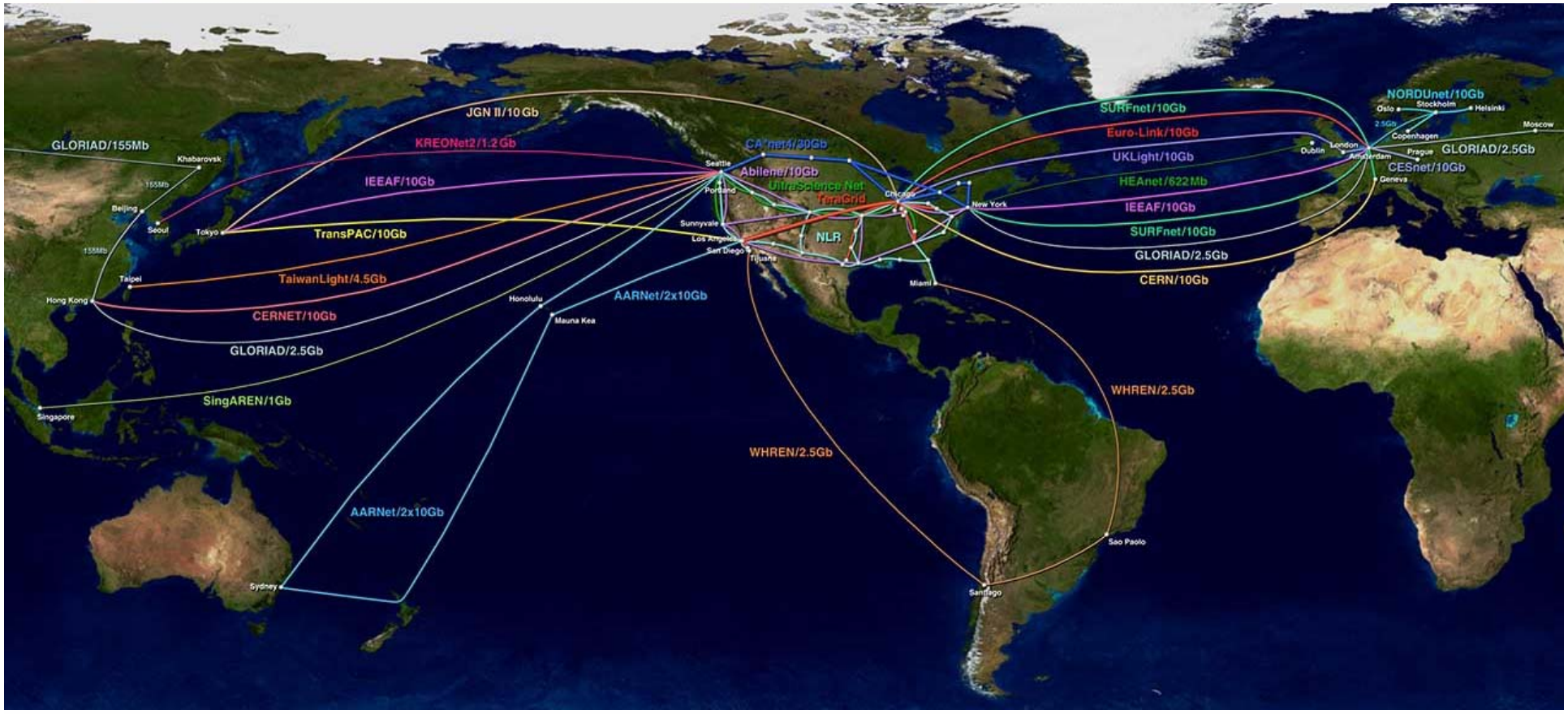
GLIF after Nottingham

- GLIF is an open community
- GLIF has participants, not members
- GLIF “glues” together the networks and resources of its participants
- TERENA to serve as the GLIF Secretariat

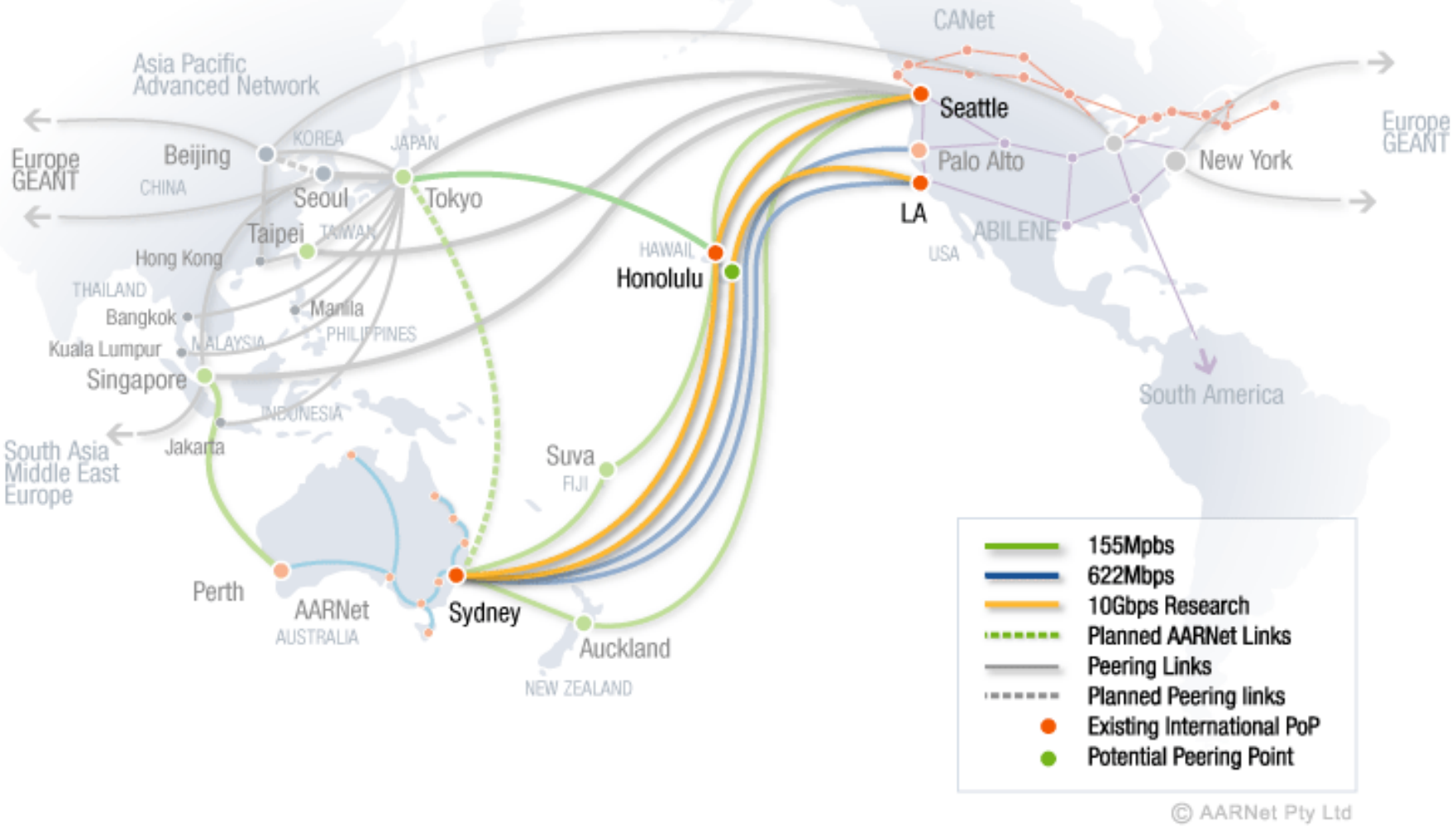
Appropriate to their mission and the spirit of community cooperation, GLIF participants implemented a “lightweight” governance structure.

GLIF World Map – December 2004

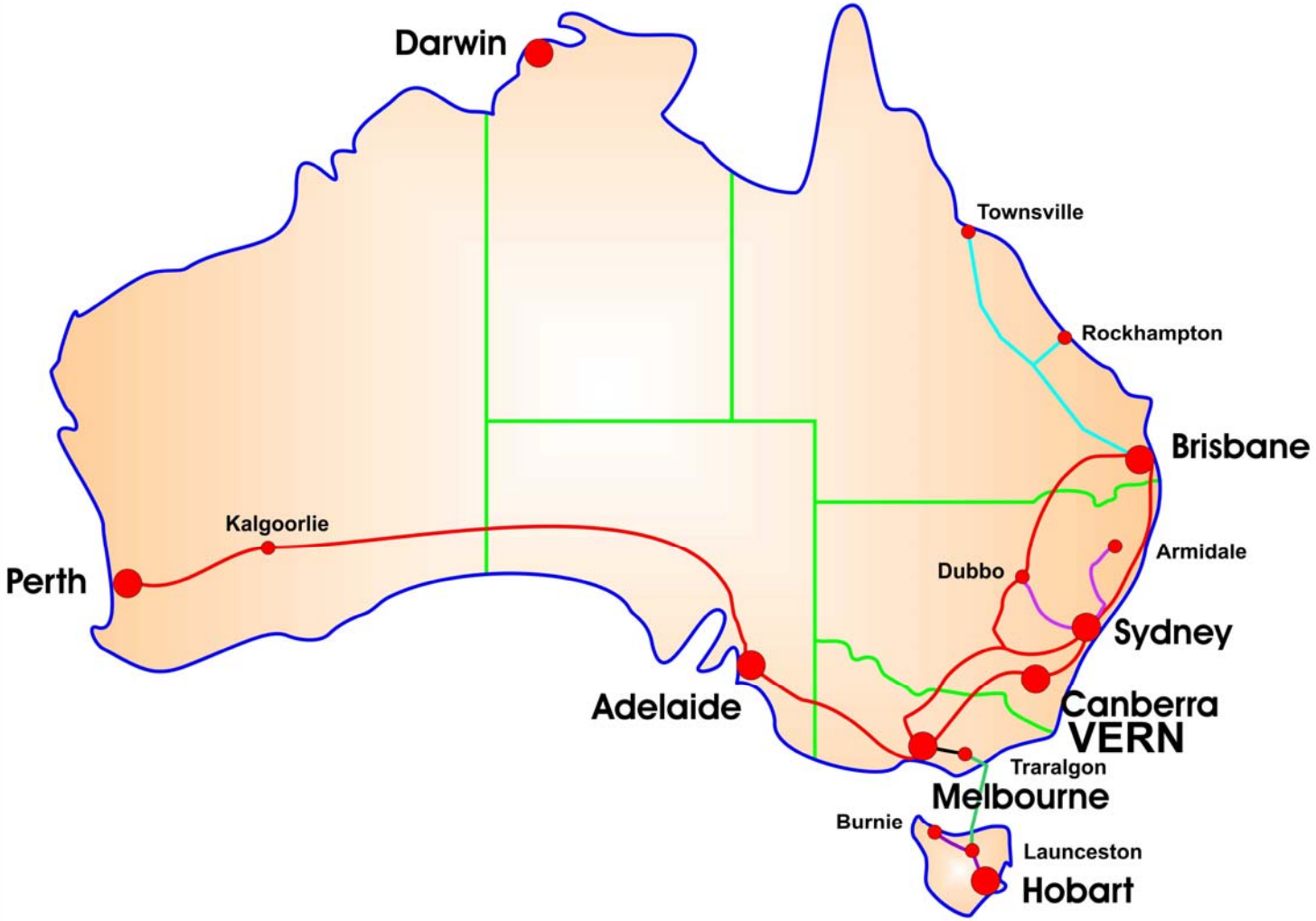


Visualization courtesy of Bob Patterson, NCSA.

SXTransPORT dual 10Gbps circuits



AARNet Australia – fibre coverage



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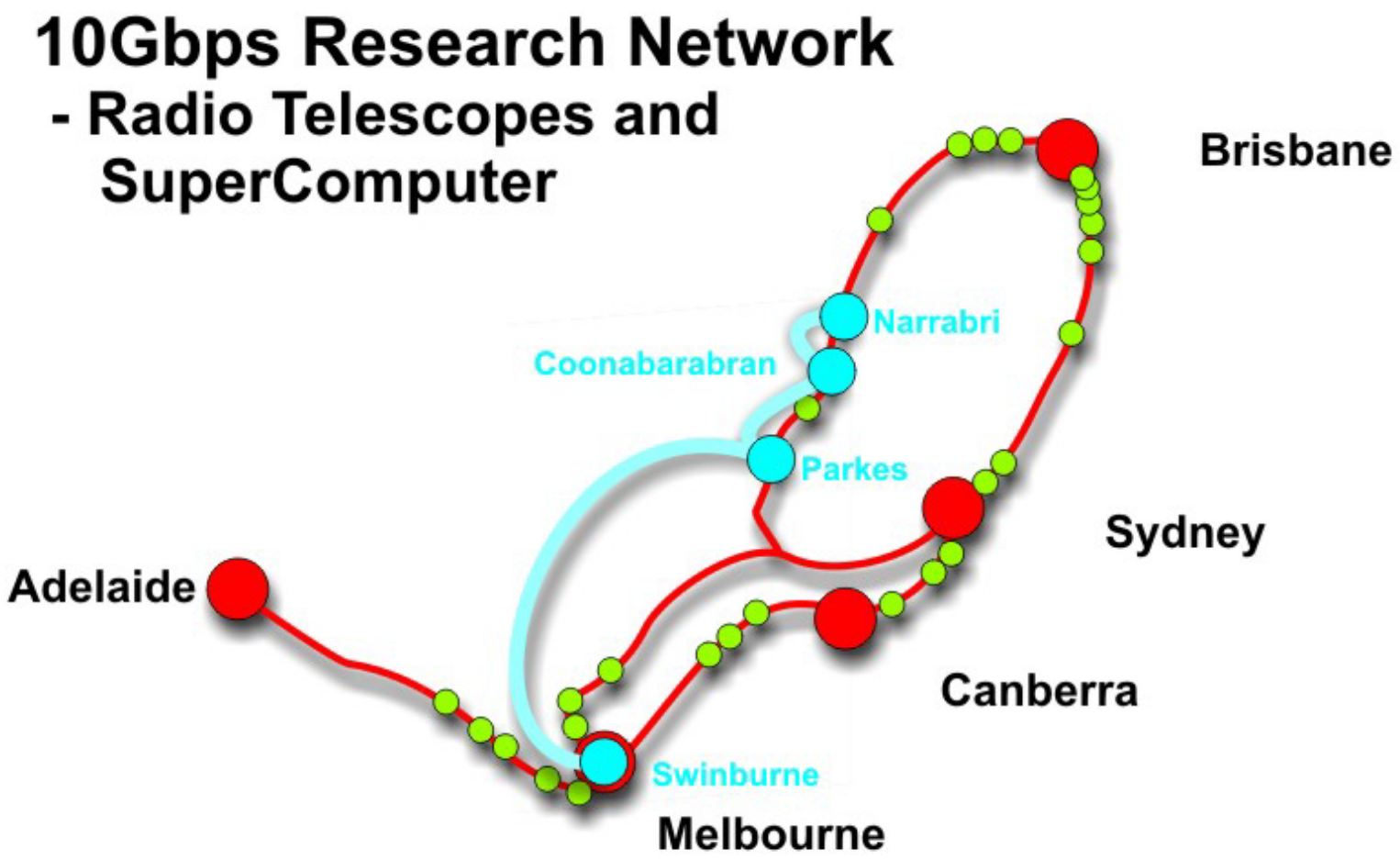
Overlay networks



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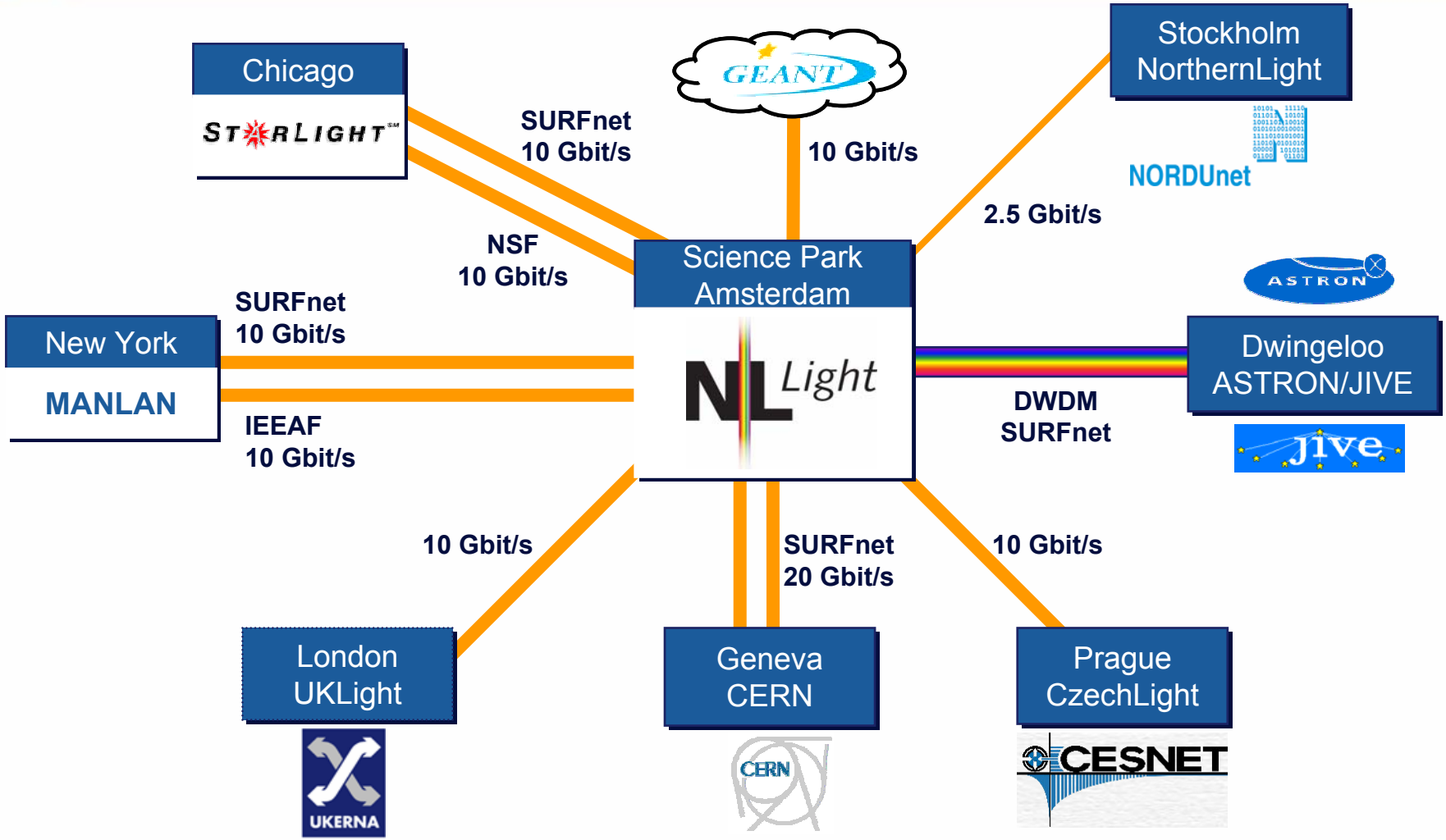
NetherLight 2005



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NetherLight: Open Optical Exchange

- Open Optical Exchange in Amsterdam
  - Operational since January 2002
  - Established in Science Park Amsterdam
  - Built and operated by SURFnet
- Nortel Networks HDXc at the centre
- Full duplex 640G non-blocking cross-connect capability

Australian eVLBI data sent over high speed links to the Netherlands

- The data from two of the Australian telescopes were transferred to the Netherlands over high-speed links and were the first to be received by JIVE
- The data was transferred at an average rate of 400Mbps
- The data from these two telescopes were reformatted and correlated within hours of the end of the landing
- This early correlation allowed early calibration of the data processor at JIVE, ready for the data from other telescopes to be added
- Significant international collaborative effort

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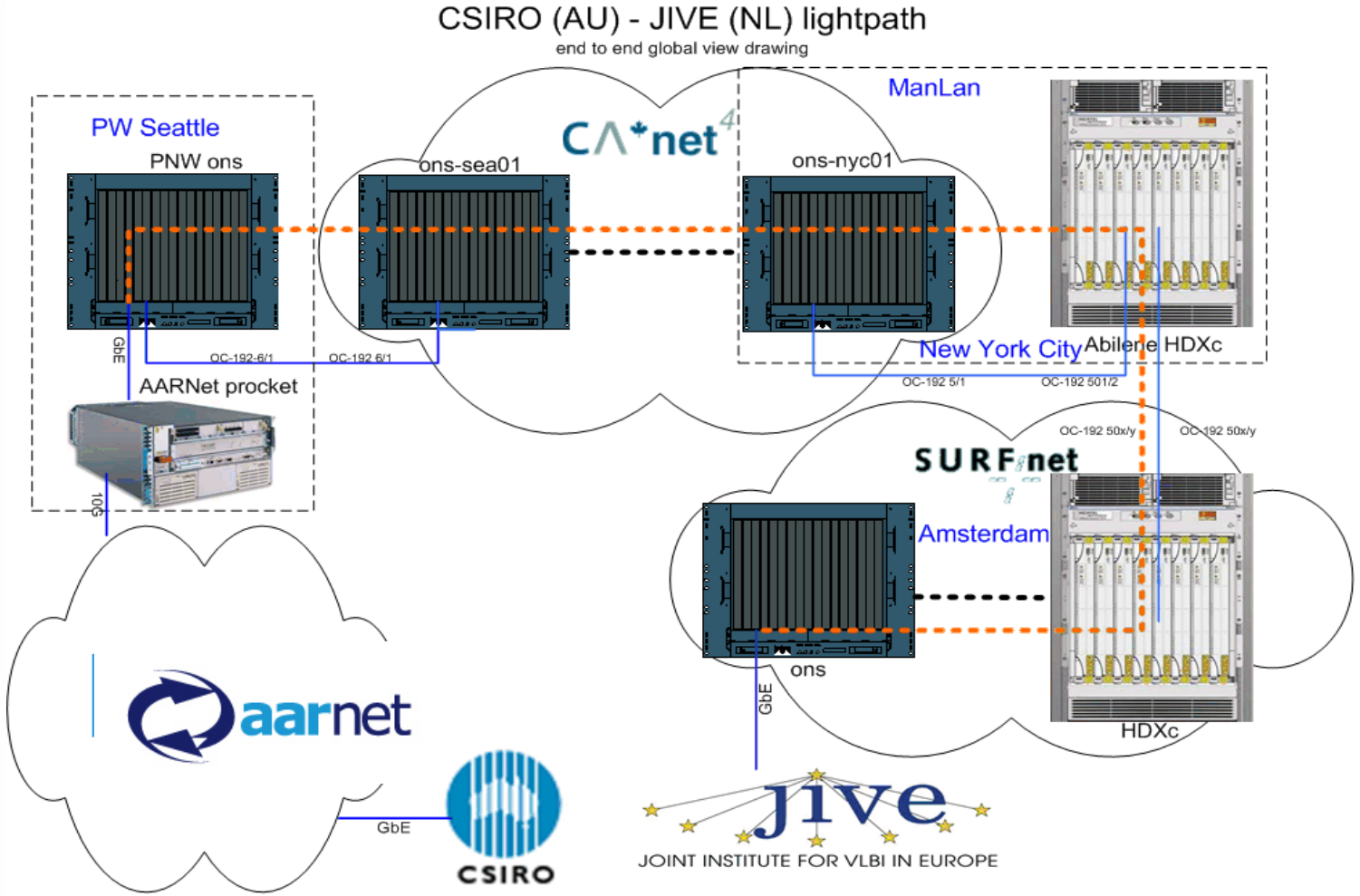
Australia → Europe wide-band (near-real-time) data transfer



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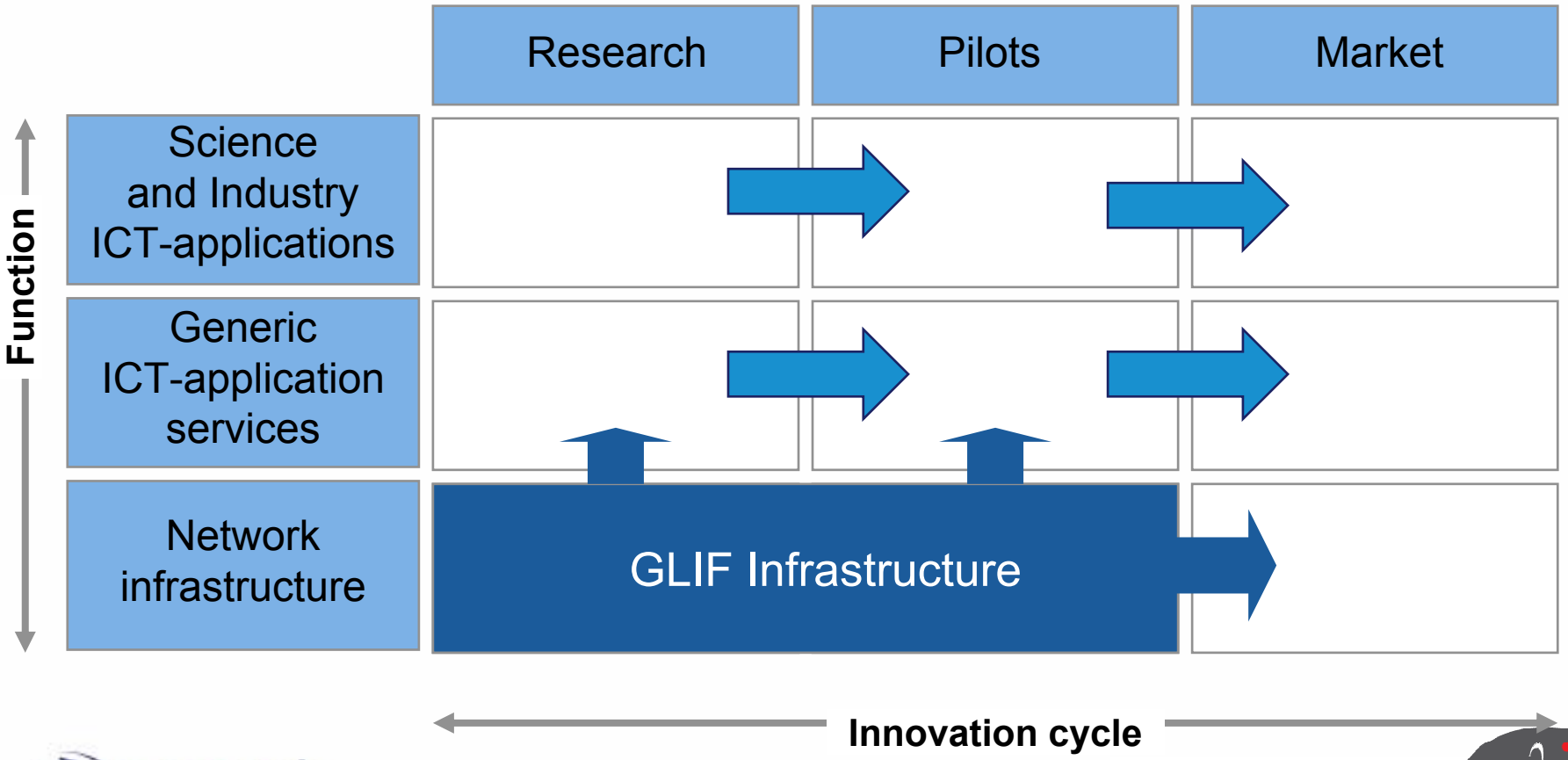
GLIF Next Steps

- Best Current practice documents:
  - Interoperability and interconnectivity
  - Definition of open optical exchange
- Register of GLIF Resources

- Next Global LambdaGrid Workshops:
  - 2005 at UCSD, hosted by Cal-(IT)2 in conjunction with iGrid2005
  - 2006 in Japan, hosted by the WIDE Project (Jun Murai) and JGN-II (Tomonori Aoyama)

GLIF's major challenge

How to create an effective 'shift register' for innovative ICT-applications, using the new infrastructure ?



Connectivity challenge

- Reaching out to the users
- So far most researchers have to come to the emerging GLIF infrastructure
- Challenge is to bring GLIF to the desk top of the researchers and to their scientific instruments
- This means dark fiber to remote instruments and hybrid networking functionality into the LANs at the campuses

Middleware challenge

- How do we glue things together?
- Users need ubiquitous end to end lightpaths connectivity over a multi-domain infrastructure
- Harmonize use of existing protocols
- Invent new protocols
- Create user friendly AAA features

Paving the way to a ubiquitous and scalable Services Grid

Application Challenge

- In the end its all about applications
- Stimulate the development of applications that explore the new hybrid functionality
- Work closely with the GLIF users on best practices to overcome the connectivity and middleware challenges
- Explain the opportunities to other researchers

GLIF 5th Annual Workshop

The GLIF 5th Annual Global LambdaGrid Workshop will be held in September 2005 in conjunction with iGrid 2005 meeting in the new UCSD Cal-(IT)² building in San Diego, California, USA,

iGrid 2005

THE GLOBAL LAMBDA INTEGRATED FACILITY

September 26-30, 2005
University of California, San Diego
California Institute for Telecommunications and Information Technology [Cal-(IT)²]
United States

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