Interacting with User Projects: The Network Perspective

Richard Hughes-Jones
DANTE Delivery of Advanced Network Technology to Europe
EEF Meeting, CERN, 2 November 2010

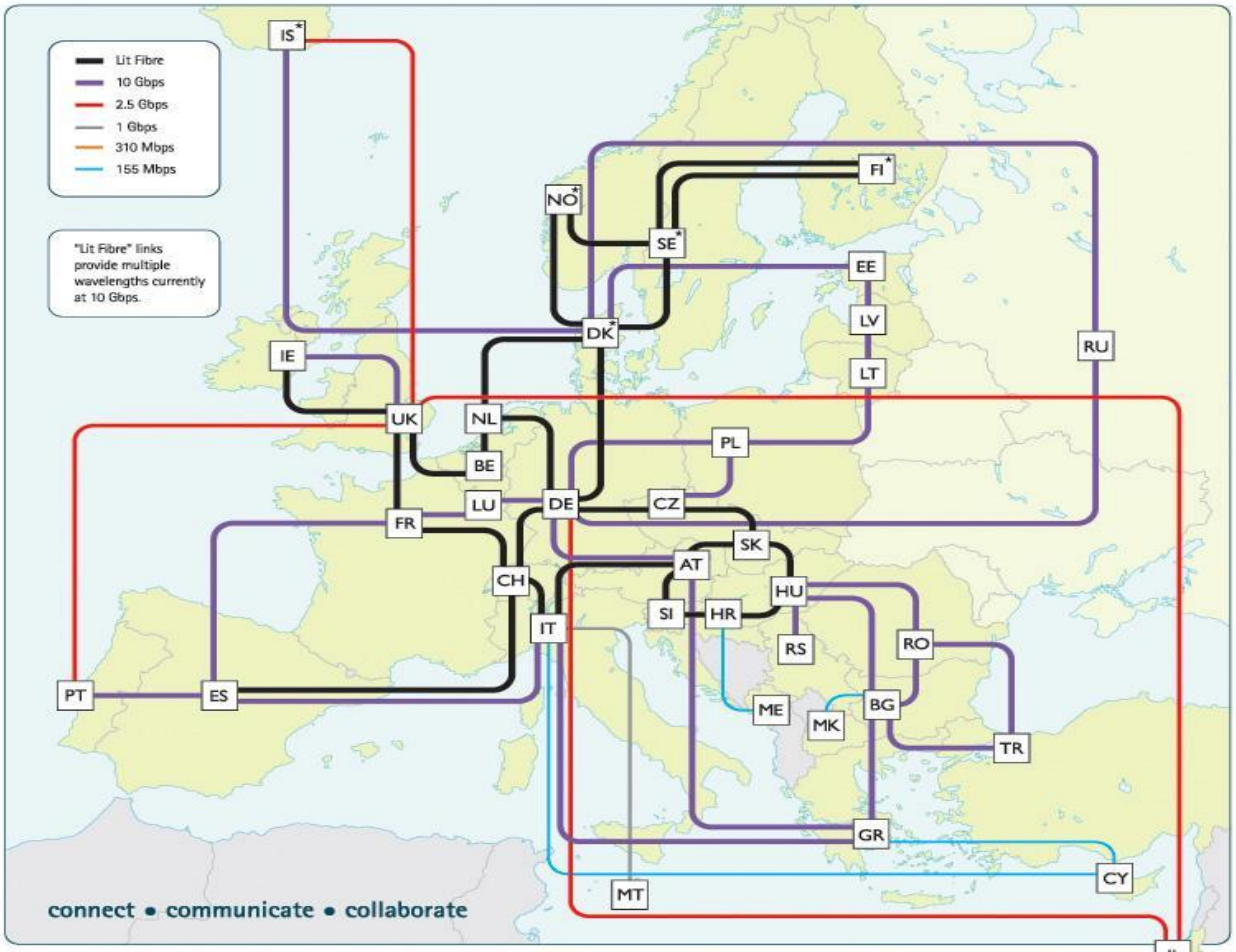
About the Users

- Three types of users or potential users:
  - The existing academic users who have already operated with the campus-NREN. They may be extending or forming new collaborations.
  - Academic users from disciplines new or relatively new to using the network for their research. Sometimes these user groups are quite unsure what networking services are available.
  - Potential users with both commercial and research collaborators. They often have experience of procuring a network (VPN) from an ISP and running it.

The Requirements Phase

- Liaise with new and existing user groups.
- Determine their networking requirements.
  - Understand basic aims of the project
  - Discuss their computing and storage needs
  - Locate the data provides and data users
- Inform them of the connectivity and network services available to them in the GÉANT-NREN portfolio.
- Provide advice on matching their requirements to the services.

GÉANT & NREN
Connectivity & Network Services

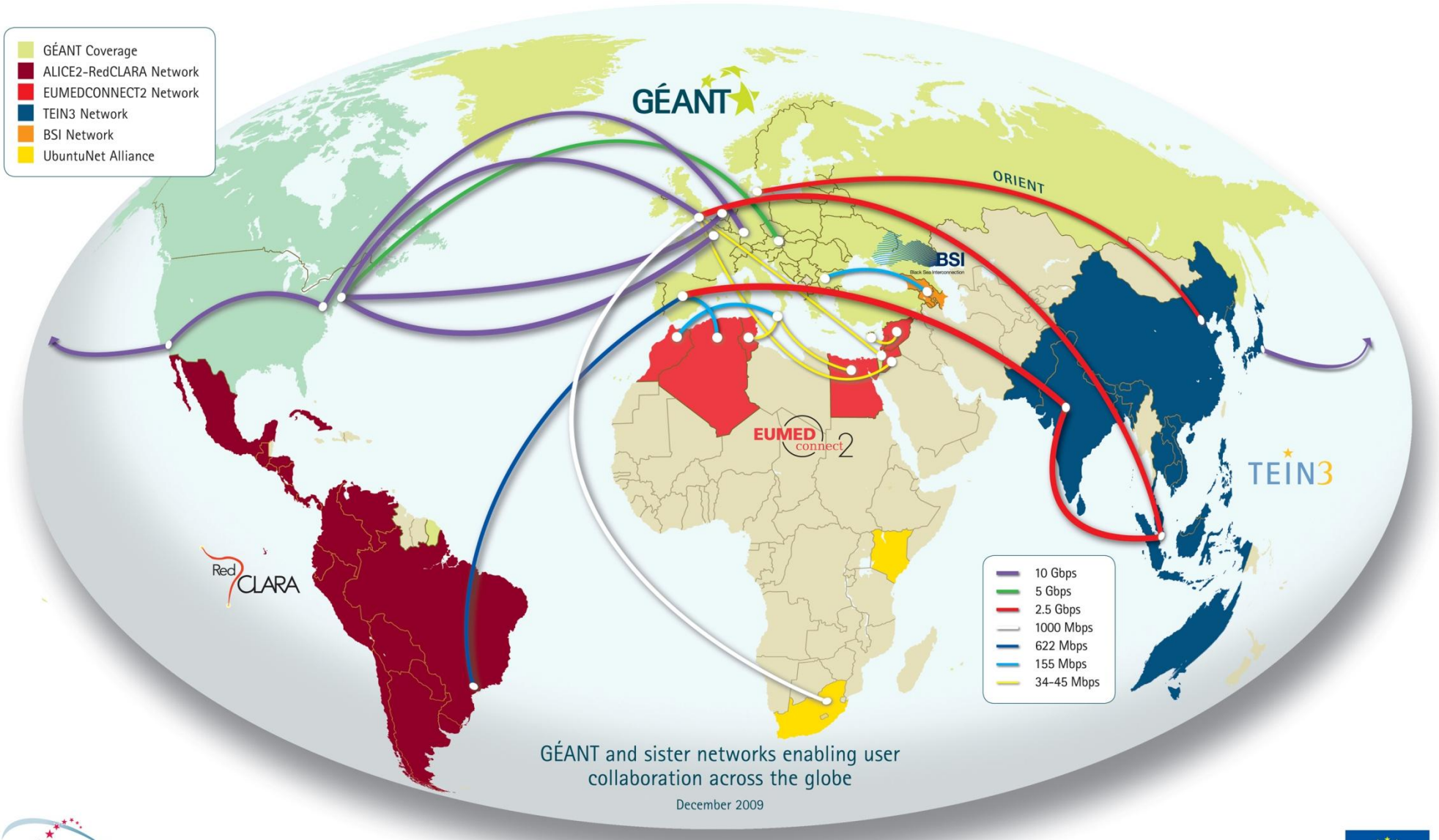


Planned Backbone Topology by the end of 2010. GÉANT is operated by DANTE on behalf of Europe's NRENs.

- 38 European Countries
- Dark Fibre + DWDM
- Hybrid network:
  - IP Packet routed
    IPv6, multicast, VPN
  - Point-to-point Circuits
    typically 1Gbit/s
  - Dedicated Lambdas
    Full 10Gbit/s
- Network monitoring
- Network provisioning
- Security & Mobility

GÉANT topology expected by end 2010

GÉANT Global Connectivity
World-wide Research Village



GÉANT and sister networks enabling user collaboration across the globe

December 2009

DANTE
www.dante.net

connect • communicate • collaborate

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European Commission
Information Society
and Media

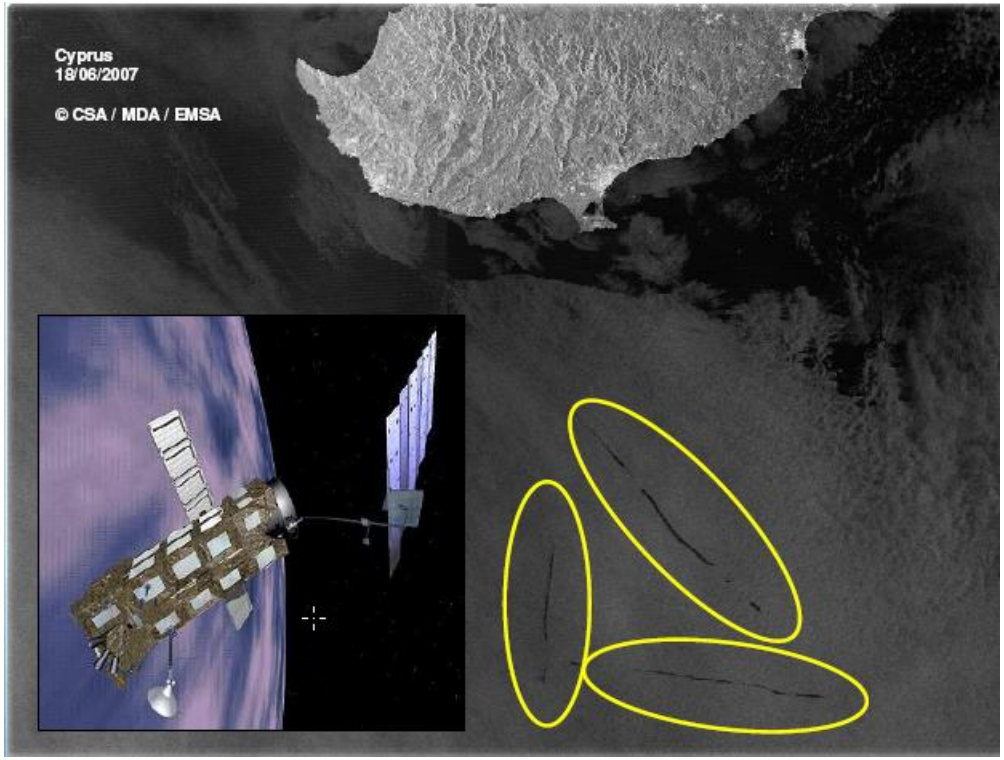
Technical Support & Consultancy: Working with User Communities

- Help the users to use the network to the best advantage.
  - Advice on incorporating IP, circuit & lambda connectivity into Campus Policy.
  - Consideration of IP addressing and routing.
  - Help with campus/site policy issues e.g. security.
  - Location of the bottleneck or resource problems in a multi-domain environment.
  - Advice/ help on tuning applications, TCP, and hosts to obtain the expected and desired performance.

A LOOK AT SOME OF THE PROJECTS

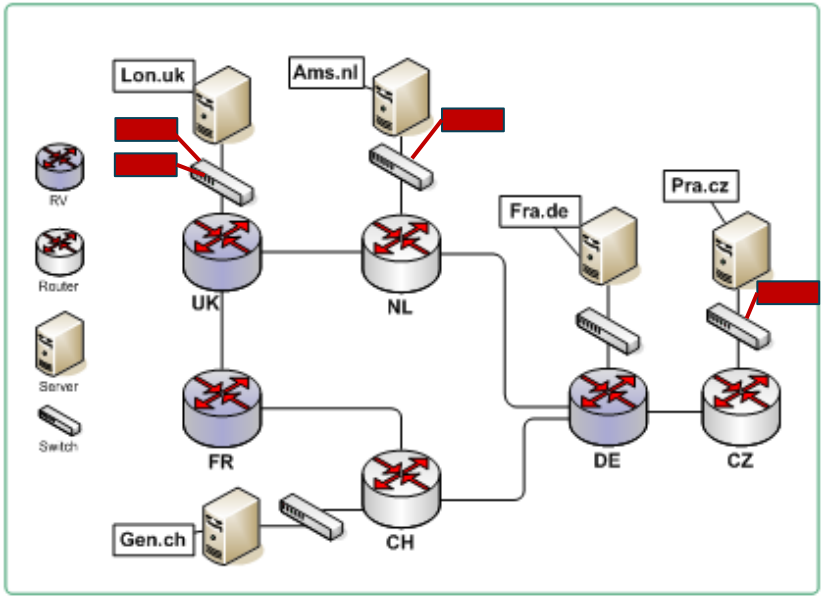
EMSA
The European Maritime Safety

- Developed the CleanSeaNet service a satellite-based monitoring system for marine oil spill surveillance and detection, uses imagery acquired by SAR satellites.
- Obtain data from ground stations throughout Europe, process and analyse satellite data within maximum of 30 minutes after satellite overpass.
- Uses Routed IP
- Working with them to test the transfer times.

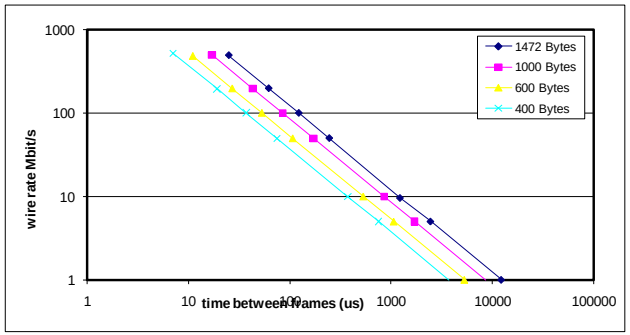


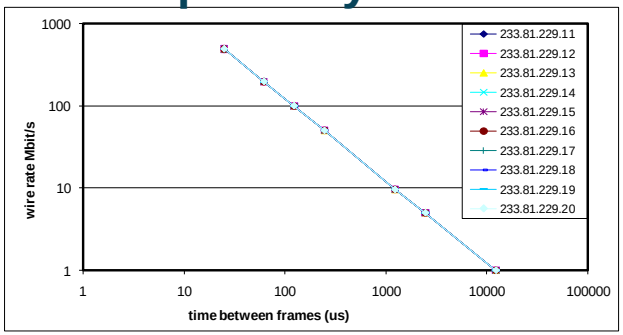
Proof of Concept for EUMETSAT High Bandwidth Multicast

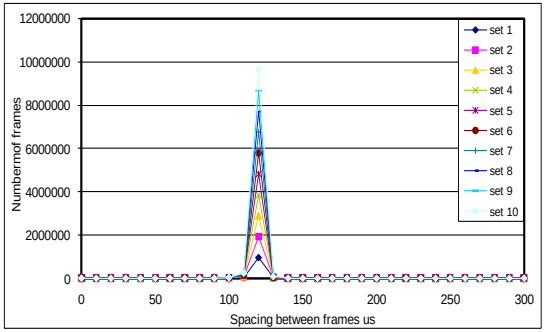
- Collaborative project with the end user.
- Emulated the project data flows over the backbone using multicast.
- At each site measured:
  - Throughput
  - Packet loss
  - Inter-packet arrival times
- Next Steps:
  - Laptops now installed at GÉANT PoPs
  - Tests started using EUMETSAT data moving code.



GÉANT Preparatory Tests



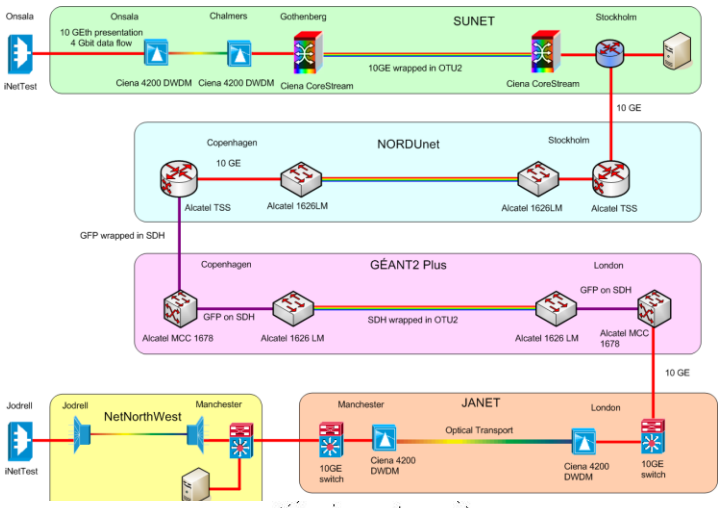


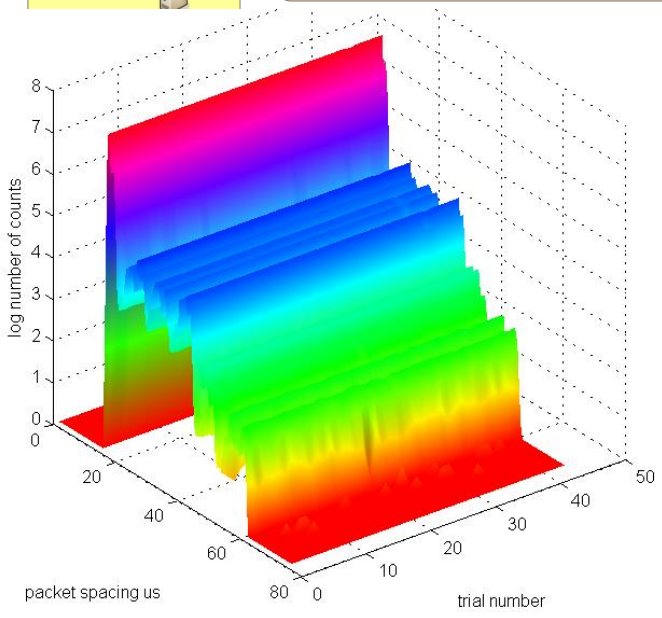


- Throughput stable to 500 Mbit/s
- No packet loss once the multicast tree is formed.
- Multiple simultaneous flows work well
- Jitter 11 µs

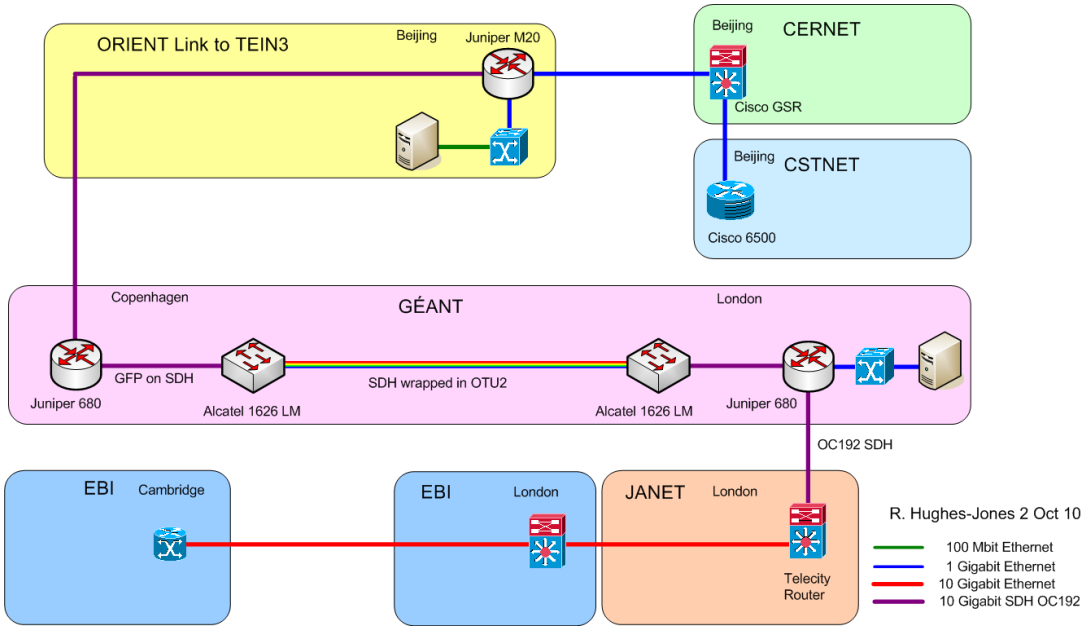
Collaborating with Users: VLBI Long Term Stability 4 Gigabit flow

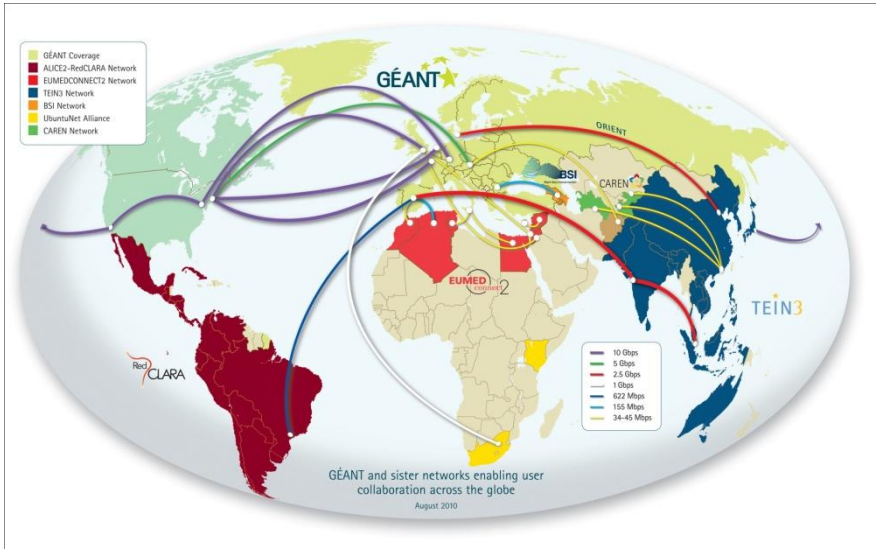
- True multi-domain 4 Gigabit circuit Onsala, Sweden and Jodrell Bank, UK.
- Radio Astronomy require real-time data.
- 24 hr of trials sending 100M packets trials take ~27 min.
- Measure:
  - Throughput = 4.094 Gbit/s
  - **Packet loss Zero**
  - Inter-packet arrival times
- Configured path to meet requirements.
- Very stable
  - Peak at 16 µs, tail extends to ~70 µs
  - Tail ~ 10^{-3} smaller

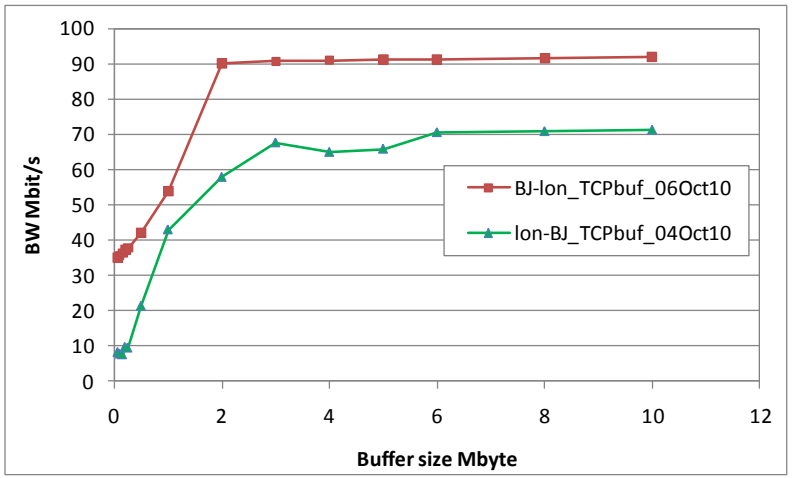




Bio-Informatics: Network Performance EBI, London, Beijing



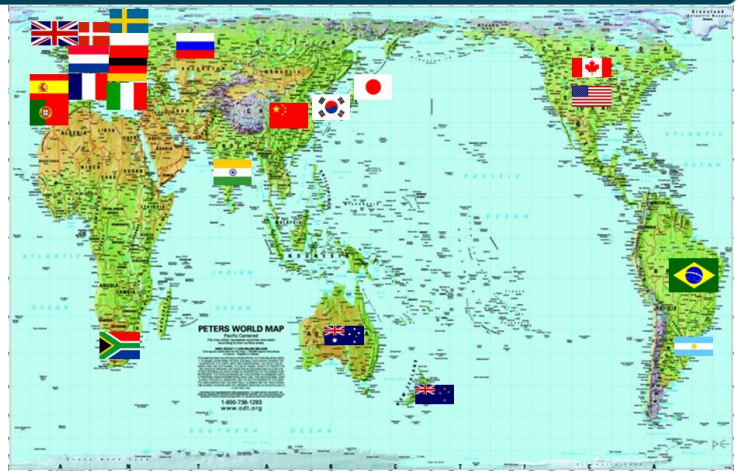


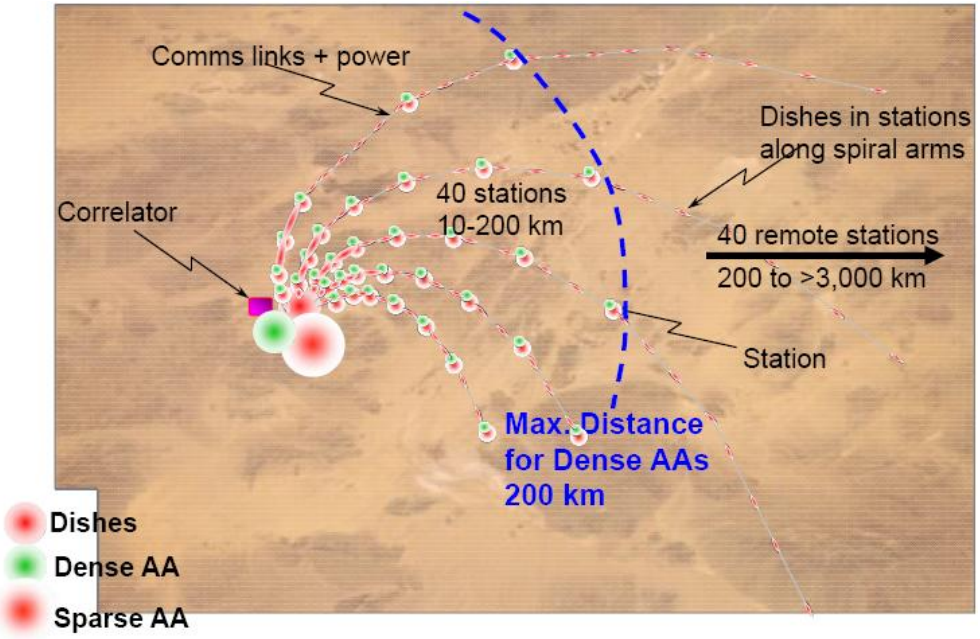


- TCP Throughput
- Traceroute: PC-lon-cop-BJ-PC
- RTT 197 ms BDP TCP buffer 2.5 MByte
- BJ→Lon as expected.
- Lon→BJ not clear yet why 70 Mbit/s plateau.

Radio Astronomy
The Square Kilometre Array

- A truly Global collaboration: 21 countries
- Radio Telescope 1 M m^2 collection area over 3000 km is size
- Phase 1, 2015 has 2 detector technologies
  - Sparse Aperture Arrays – 70-300MHz
  - Dish Array – 450 MHz – 3 GHz
- Phase 2, 2018 adds
  - Dense Aperture Arrays – 10 GHz

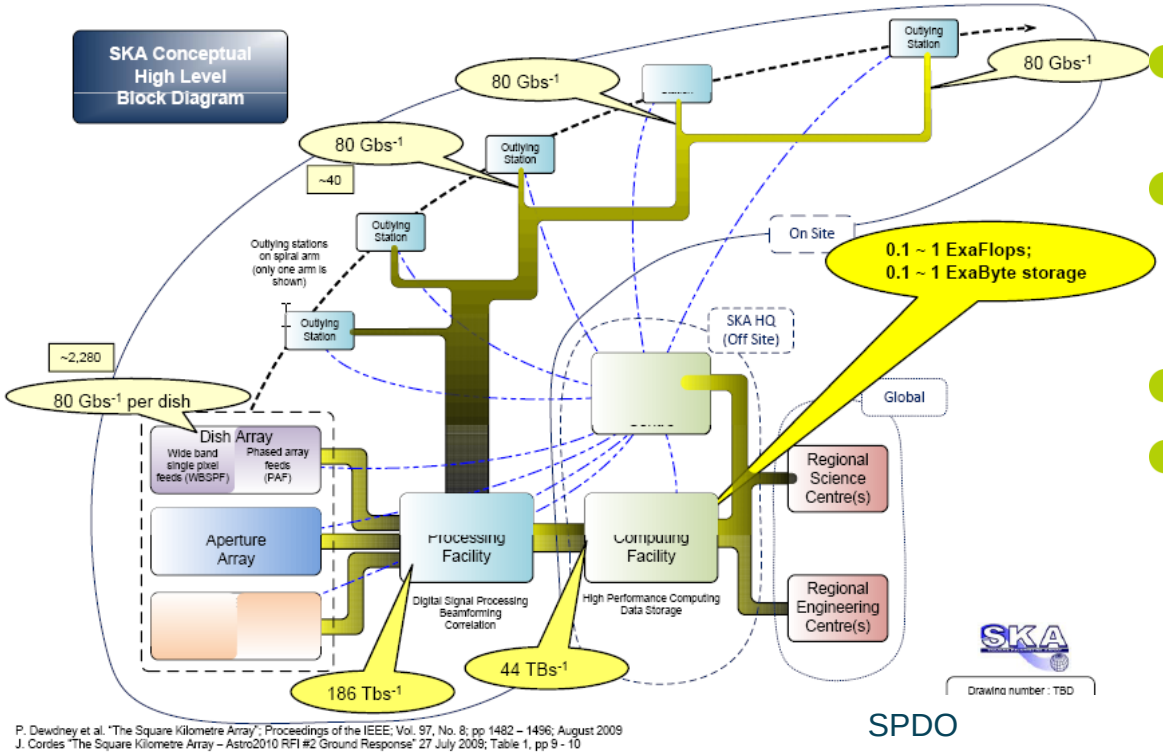




- Most of the detectors in a 5 km core
- Outlying stations located on spiral arms
- Sparse Aperture Arrays & Dishes out to > 3000 km.

- Candidate sites
  - South Africa & 7 countries
  - Australia & New Zealand

SKA Data Flows



P. Dewdney et al. "The Square Kilometre Array", Proceedings of the IEEE, Vol. 97, No. 8, pp 1482 – 1496, August 2009
J. Cordes "The Square Kilometre Array – Astro2010 RFI #2 Ground Response" 27 July 2009; Table 1, pp 9 - 10

SPDO

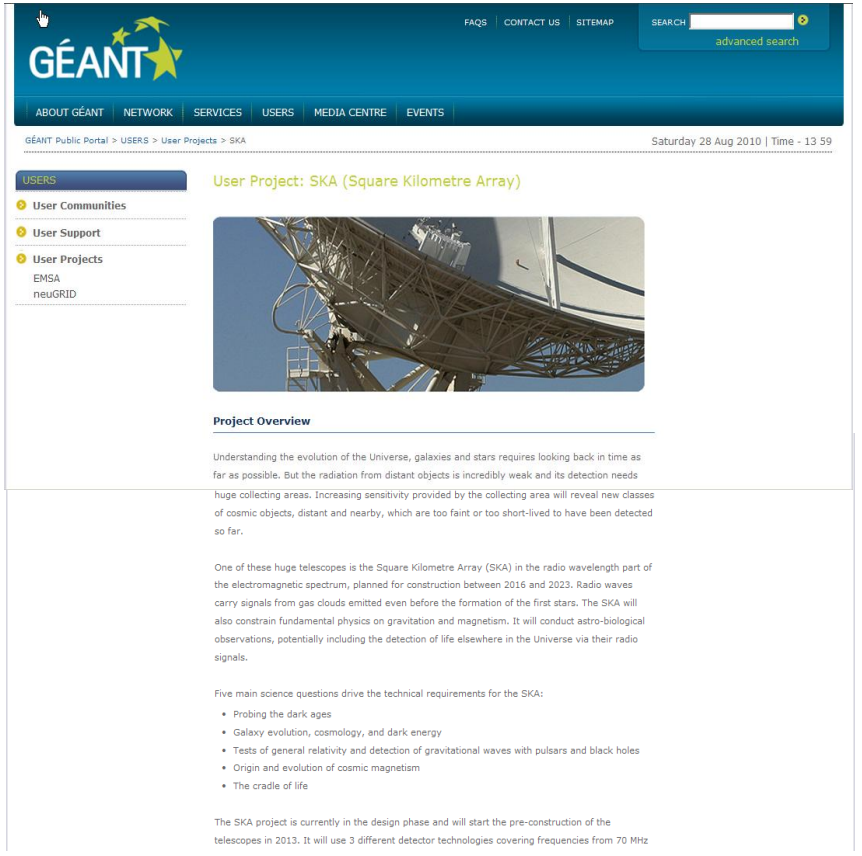
- Each outlying stations sends 80 Gbit/s
- Each dish in the core sends 80 Gbit/s
- Correlator input 186 Tbit/s
- Output to HPC 44 TBytes/s (only about 60 fibres!)

- HPC is in a nearby town, calibrates the data and constructs the images.
- Image output rate is 44 GBytes/s or 352 Gbit/s
- Images stored at Regional Repositories around the world – user access.
- Phase 1 with 250 dishes will produce image data at ~40 Gbit/s

- High bandwidth on a world scale
- 100 Gigabits current estimate

DISSEMINATION & OUTREACH

Public Outreach: Projects on the GÉANT Web Site



- About the Project
- The Role of GÉANT & NRENs
- Key Benefits of the network to the project
- Further Information pointers

The GÉANT Training Portal

- Training courses support the introduction of the new GÉANT services.
- Designed for NREN staff to install, configure, use & troubleshoot GÉANT software.
- "train-the-trainer" to help knowledge transfer to local and regional networks.
- Very much Internal to the GÉANT Project .

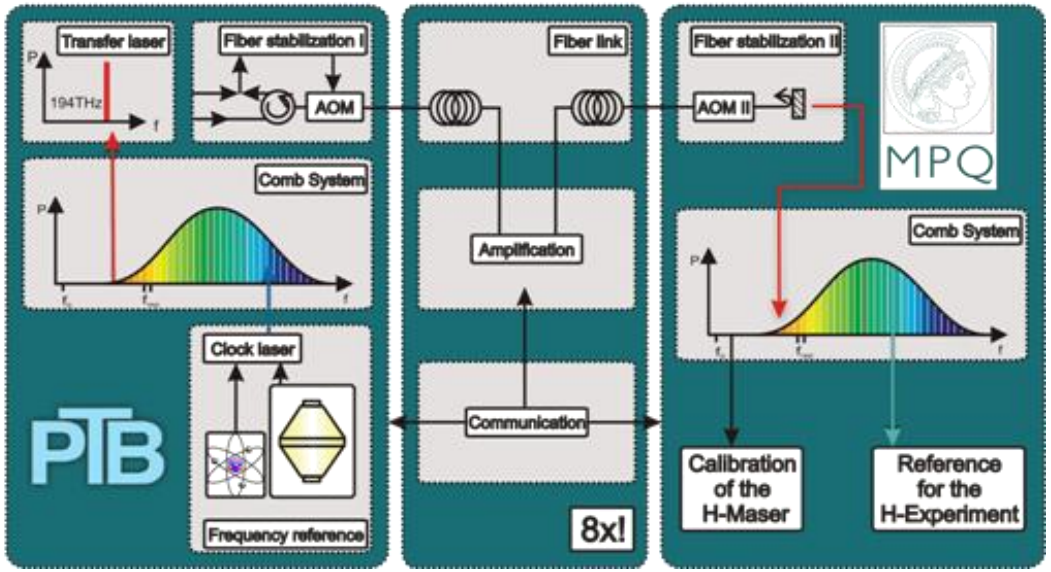
Training – 2005
Networking for Non-Networkers

- **Life of a Packet** - Mark Leese and Robin Tasker, CCLRC Daresbury Laboratory.
  Setting the scene. What happens to your bytes when they leave your application?
- **Just What is OC-48?** - Robin Tasker, CCLRC Daresbury Laboratory.
  Explanation of networking terms, & overview of global research and educational networks.
- **TCP** - Brian L. Tierney, Lawrence Berkeley National Laboratory.
  This talk will introduce TCP, outline new TCP stacks designed to combat problems associated with LFNs (Long Fat Networks) and will consider ways to tune TCP .
- **End-User Systems**: NICs, the OS and discs - Richard Hughes-Jones, Manchester HEP.
  Hardware and software issues affecting the network performance of end-user systems.
- **Local Area Network issues** Sam Wilson, The University of Edinburgh.
- **Security** - Paul Kummer, CCLRC Daresbury Laboratory.
  An introduction to network security issues, and the performance aspects.
- **Diagnostic Steps** - Les Cottrell, Stanford Linear Accelerator Center.
  Steps end users can take in measuring network performance and diagnosing problems.

ANY QUESTIONS ?

Metrology:
TFT – Time Frequency Transfer

- They wish to synchronise Optical Clocks across Europe
- NPL London, LPL Paris, PTB and MPQ Germany Subject Leaders
- Discussions in progress with Renater, DFN, JANET, DANTE
- Method: use optical frequency comb to lock the phase of Optical Clock to 1.5 um laser (ITU Grid) and transmit this to the remote site.
- Requirements:
  - All Optical path
  - Phase noise correction to get to 10^{-16} – need bi-directional amplifiers
  - Fibre path important to reduce noise

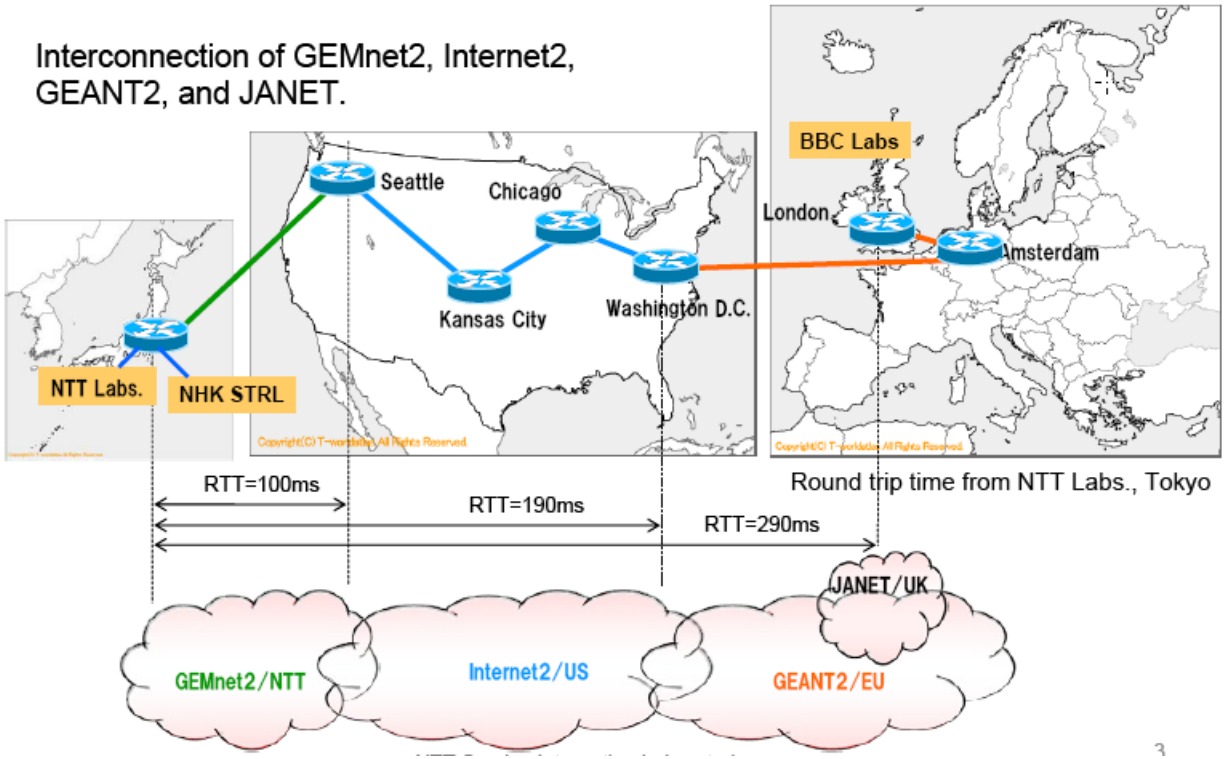


Implications for the optical infrastructure

Gesine Grosche PTB

SHV Proof of Concept: High Definition Multi-media over IP

- Super Hi- Vision (SHV) is an ultra-high definition video system resolution of 8k * 4K
- Collaboration of NTT BBC and NHK together with the Academic networks in Japan, US and Europe to test sending SHV signals over the network.
- gemNet, SINET3, JGN2plus, Internet2, GEANT & JANET
- Requirements are 300-500 Mbit/s bandwidth and stable delay & jitter.



- GÉANT working with BBC and JANET on evaluation of requirements
- Performance & jitter measurements in progress.