

Interacting with User Projects: The Network Perspective

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DANTE Delivery of Advanced Network Technology to Europe

EEF Meeting, CERN, 2 November 2010

- 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.

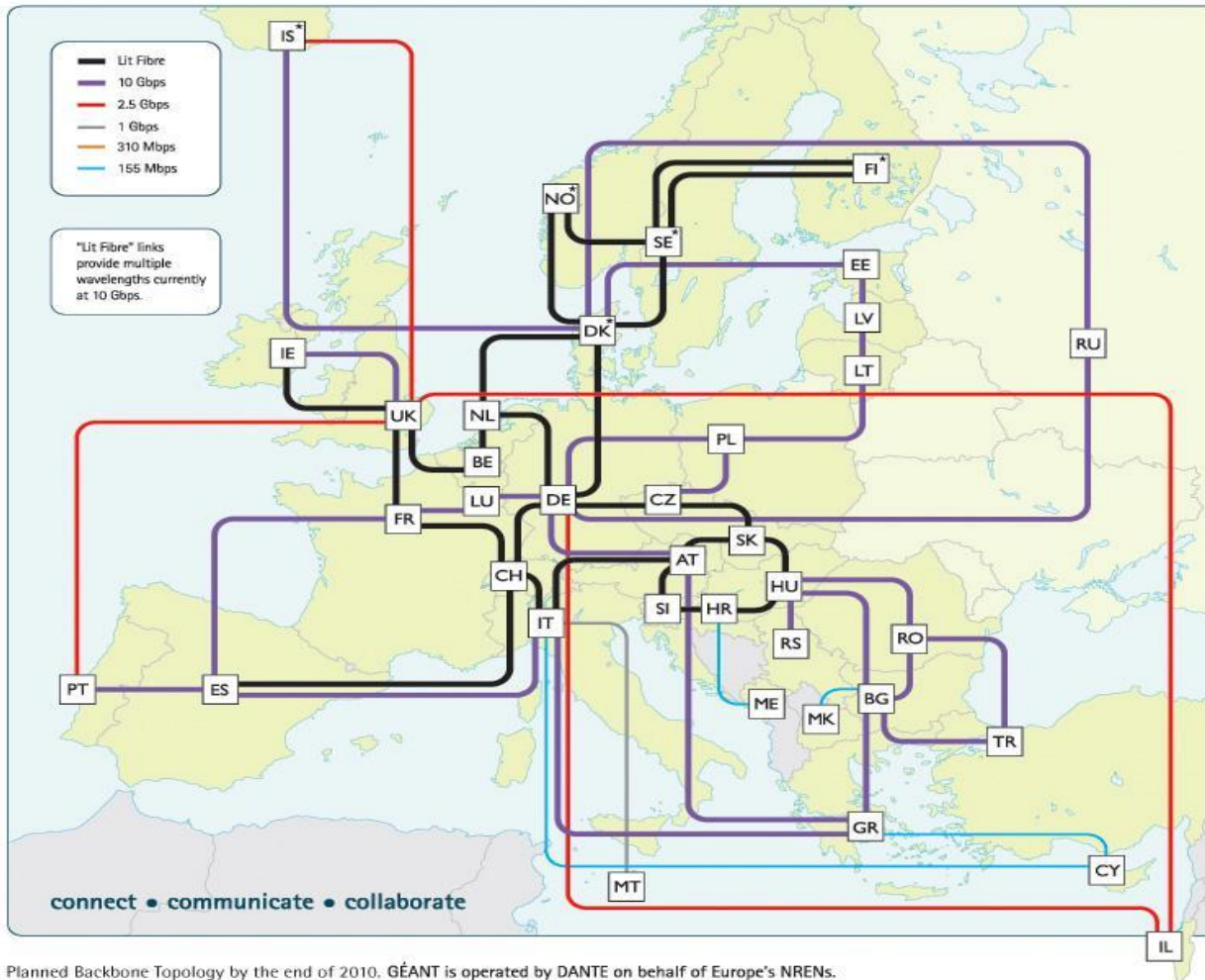
The Requirements Phase



- 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 providers 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



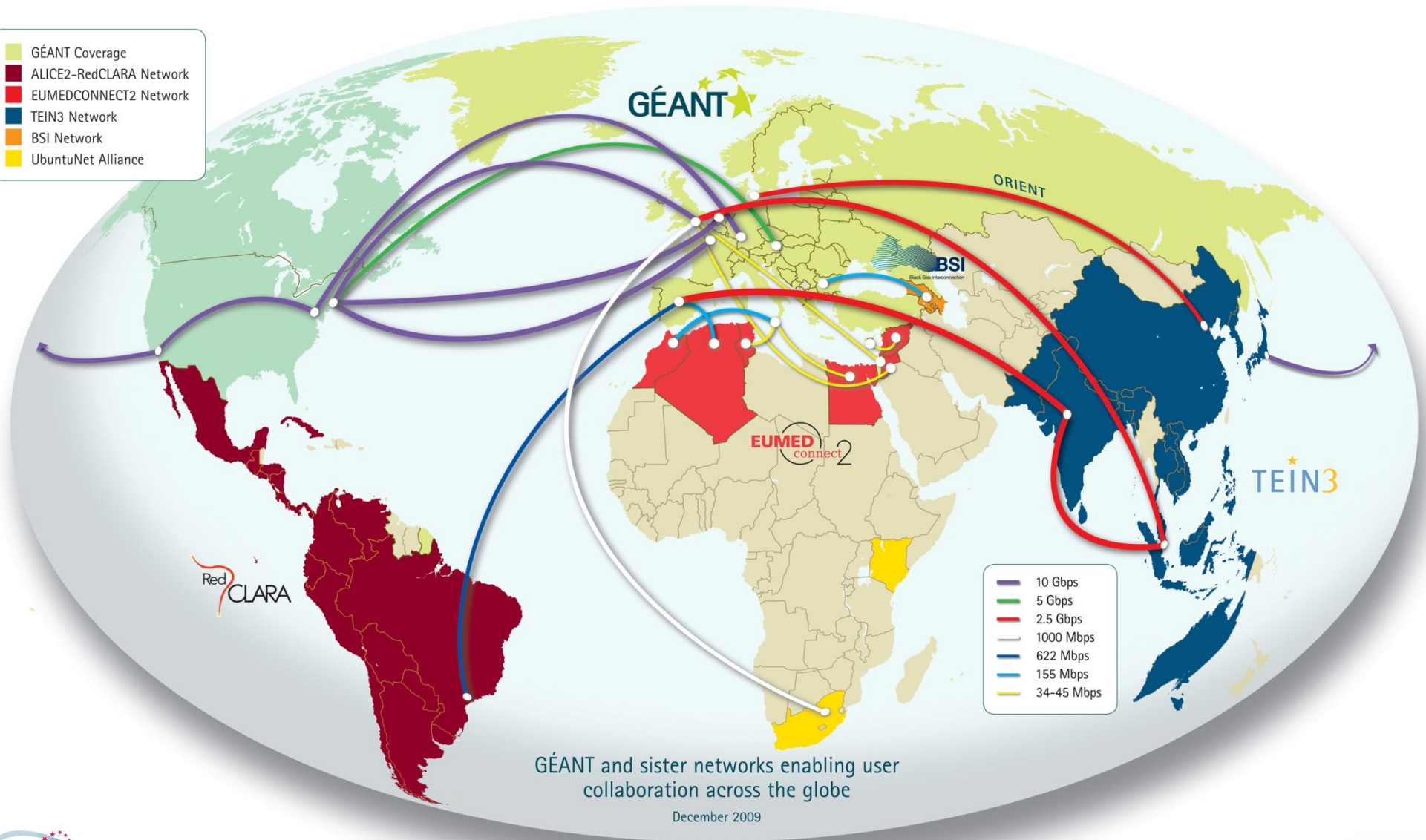
- 38 European Countries
- Dark Fibre + DWDM
- Hybrid network:
 - IP Packet routed IPv6, multicast, VPN
 - Point-to-point Circuits typically 1Gbit/s
 - Dedicated Lambdas Full 10Gbit/s
- Network monitoring
- Network provisioning
- Security & Mobility

GÉANT topology expected by end 2010

GÉANT Global Connectivity World-wide Research Village



- GÉANT Coverage
- ALICE2-RedCLARA Network
- EUMEDCONNECT2 Network
- TEIN3 Network
- BSI Network
- UbuntuNet Alliance



GÉANT and sister networks enabling user collaboration across the globe

December 2009

connect • communicate • collaborate

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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

- 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.



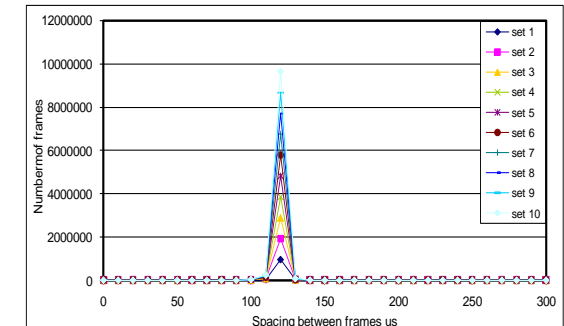
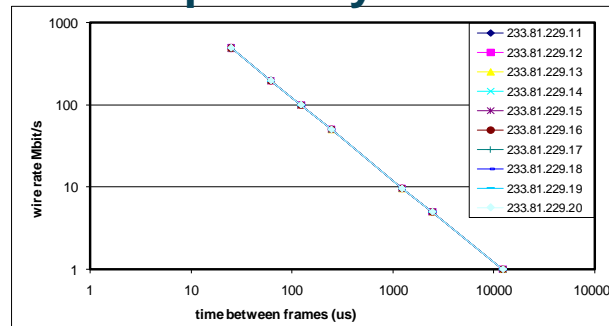
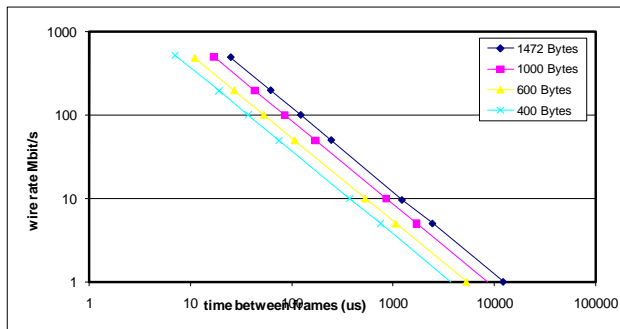
Proof of Concept for EUMETSAT High Bandwidth Multicast



- 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

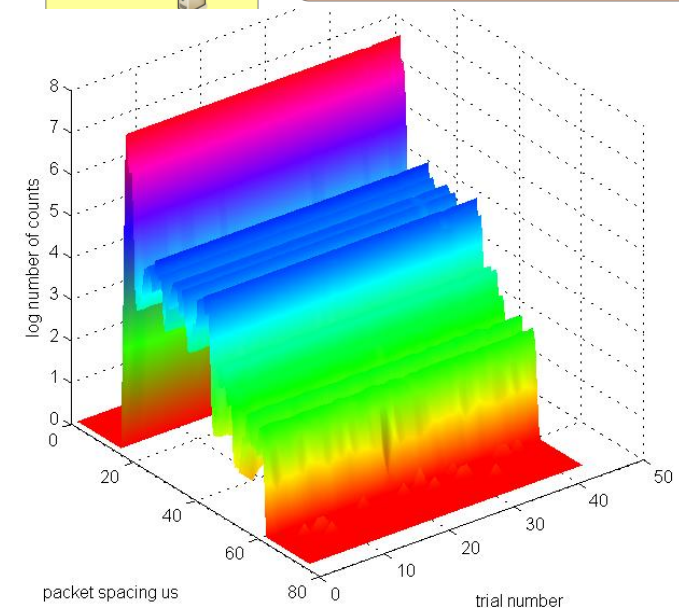
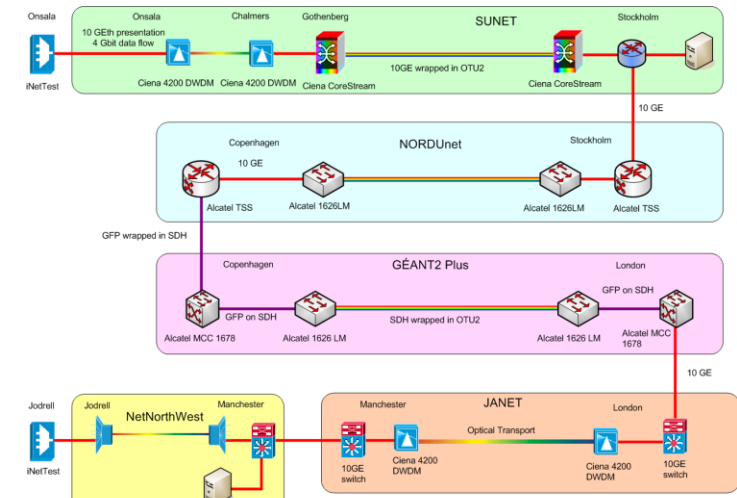


- Throughput stable to 500 Mbit/s
- No packet loss once the multicast tree is formed.
- Multiple simultaneous flows work well
- Jitter 11 μ s

Collaborating with Users: VLBI Long Term Stability 4 Gigabit flow

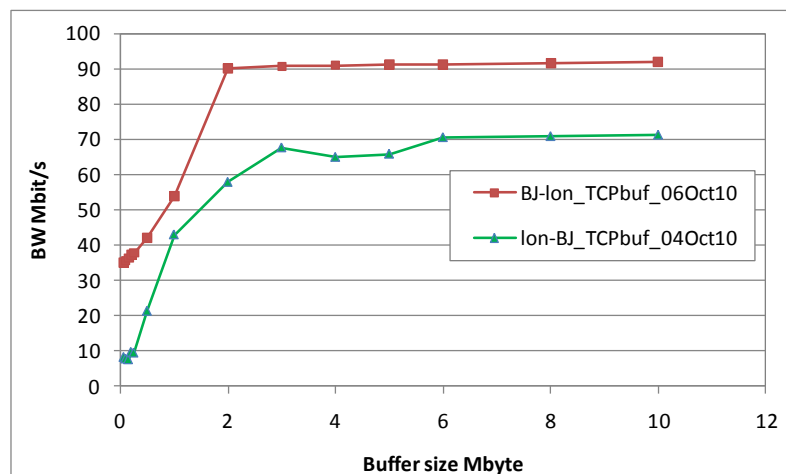
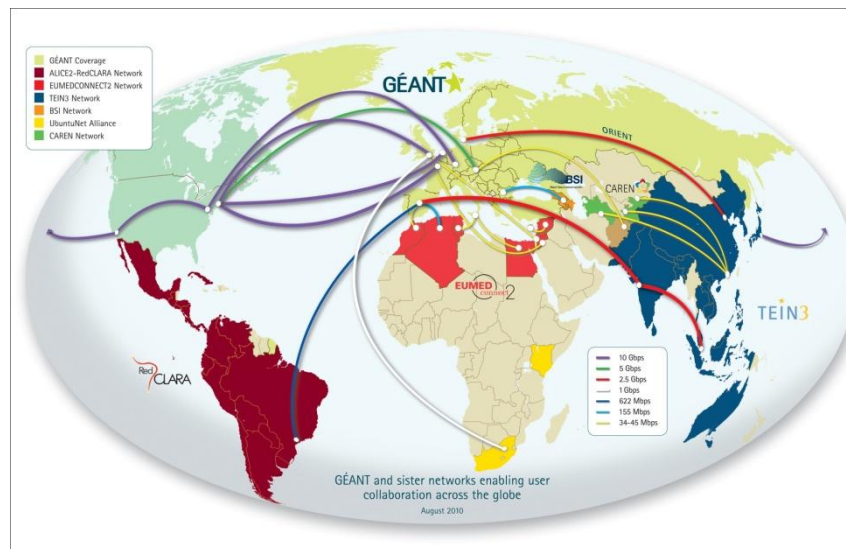
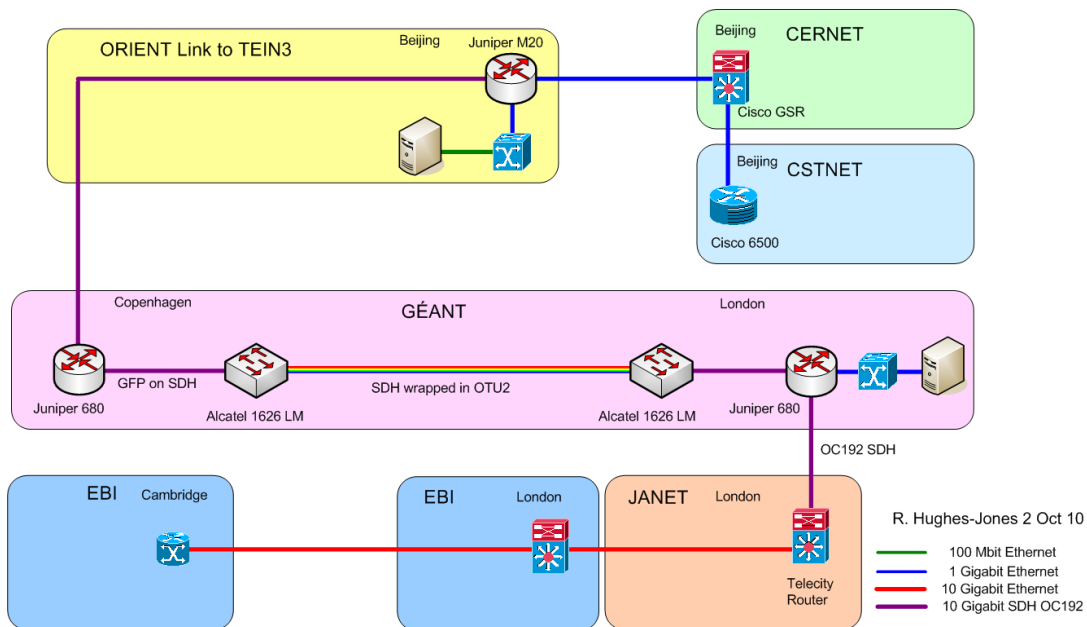


- True multi-domain 4 Gigabit circuit
Onsala, Sweden and Jodrell Bank, UK.
- Radio Astronomy require real-time data.
- 24 hr of trials sending 100M packets
trials take ~27 min.
- Measure:
 - Throughput = 4.094 Gbit/s
 - **Packet loss Zero**
 - Inter-packet arrival times
- Configured path to meet requirements.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

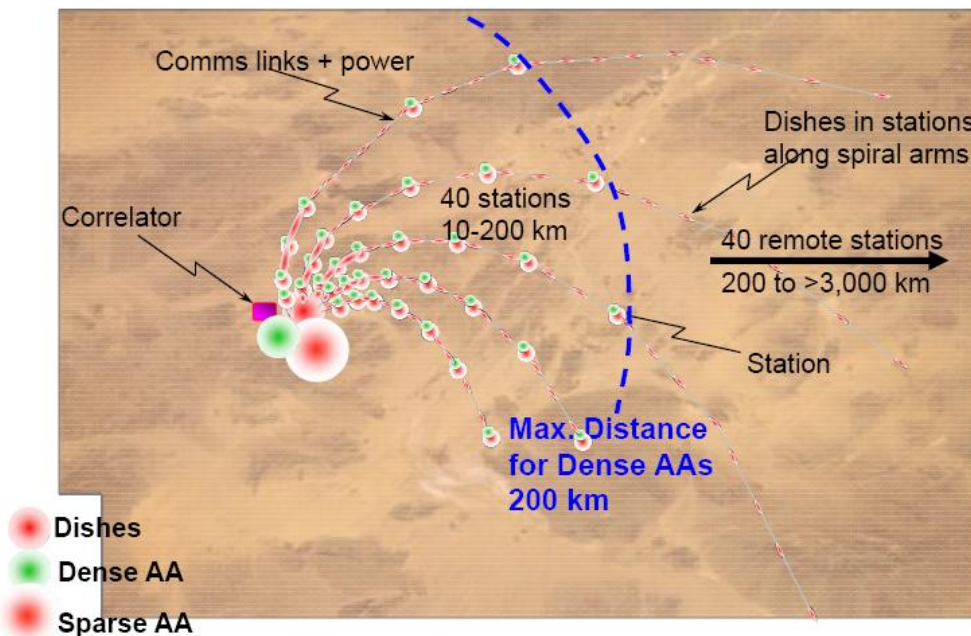
The Square Kilometre Array



- A truly Global collaboration: 21 countries
- Radio Telescope 1 M m² 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



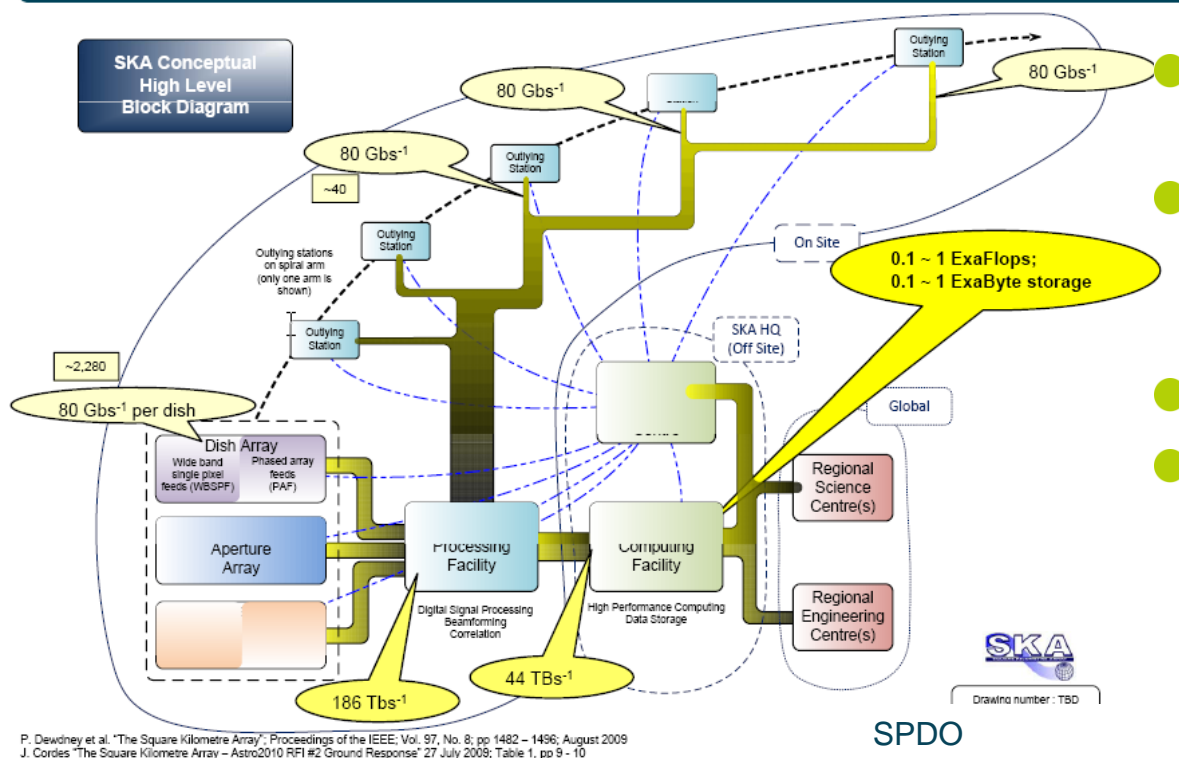
- Most of the detectors in a 5 km core
- Outlying stations located on spiral arms
- Sparse Aperture Arrays & Dishes out to > 3000 km.
- Candidate sites
 - South Africa & 7 countries
 - Australia & New Zealand



SPDO

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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 2008; 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



User Project: neuGRID



Project Overview

neuGRID aims to build a new user-friendly Grid-based research e-Infrastructure, where the collection and archiving of large amounts of imaging data is paired with computationally intensive data analyses of the images and the ability to visualise the results. They aim to provide large sets of brain images that will provide neuroscientists with the capability to identify neurodegenerative disease markers, for example, for Alzheimer's disease, through the analysis of 3D magnetic resonance brain images. The Grid infrastructure is based on EGEE's GLite middleware. Currently there are eight partner research sites distributed across Europe, each with 100 processing cores and terabytes of disk storage.

An example of the processing, called CIVET, would be to create reference images of the thickness of the cortex mantle based on the statistical compilation of 100's of individual reference and diseased magnetic resonance brain images. (On a single CPU it takes ~7 hours with 46 processing steps to process an image).

The outGRID project is a Coordination and Support Action which aims to help the three e-infrastructures - neuGRID in Europe, CBRAIN in Canada, and LONI at UCLA in the U.S. - to converge into one unique worldwide facility. outGRID will organize workshops to promote the exchange of technical information, direct the development of the infrastructures towards interoperability, and promote specific international calls aiming to achieve full interoperability.

The Role of GÉANT

neuGRID regularly transfers brain scan images from databases in the US for analysis and visualisation with the neuGRID algorithms. Once transferred, selected data is distributed to the Grid sites at the European partners.

User Project: SKA (Square Kilometre Array)



Project Overview

Understanding the evolution of the Universe, galaxies and stars requires looking back in time as far as possible. But the radiation from distant objects is incredibly weak and its detection needs huge collecting areas. Increasing sensitivity provided by the collecting area will reveal new classes of cosmic objects, distant and nearby, which are too faint or too short-lived to have been detected so far.

One of these huge telescopes is the Square Kilometre Array (SKA) in the radio wavelength part of the electromagnetic spectrum, planned for construction between 2016 and 2023. Radio waves carry signals from gas clouds emitted even before the formation of the first stars. The SKA will also constrain fundamental physics on gravitation and magnetism. It will conduct astro-biological observations, potentially including the detection of life elsewhere in the Universe via their radio signals.

Five main science questions drive the technical requirements for the SKA:

- Probing the dark ages
- Galaxy evolution, cosmology, and dark energy
- Tests of general relativity and detection of gravitational waves with pulsars and black holes
- Origin and evolution of cosmic magnetism
- The cradle of life

The SKA project is currently in the design phase and will start the pre-construction of the telescopes in 2013. It will use 3 different detector technologies covering frequencies from 70 MHz

- 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 .

The screenshot shows a presentation slide titled "perfSONAR Online Overview". The slide features the GÉANT logo and a large green star graphic. The text "perfSONAR Online Overview" is prominently displayed in the center. The slide is part of a presentation by Peter Webster, Training Manager at DANTE. The presentation is titled "perfsonar_online_overview" and is 47:08 long. The slide is currently on slide 1 of 42. The presentation is paused at 00:05 / 00:30. The presentation is created using Articulate software.

The screenshot shows the GÉANT E-Learning website. The header features the GÉANT logo and the text "E-Learning" and "innovation through participation". The navigation menu includes "LATEST COURSES", "FAQ", "ABOUT US", and "CONTACT US". The main content area displays the course "Intranet Fundamentals - Introduction" by Peter Webster. The course objectives are listed as follows:

- Describe the advantages of using the GÉANT intranet.
- Work with documents and understand versioning.
- Use the intranet's wikis.
- Understand how to record information about meetings.
- Use other GÉANT intranet functionality.

The course is estimated to take approximately two hours to complete. The slide is currently on slide 4 of 6. The presentation is created using Adobe Captivate.

Training – 2005

Networking for Non-Networkers



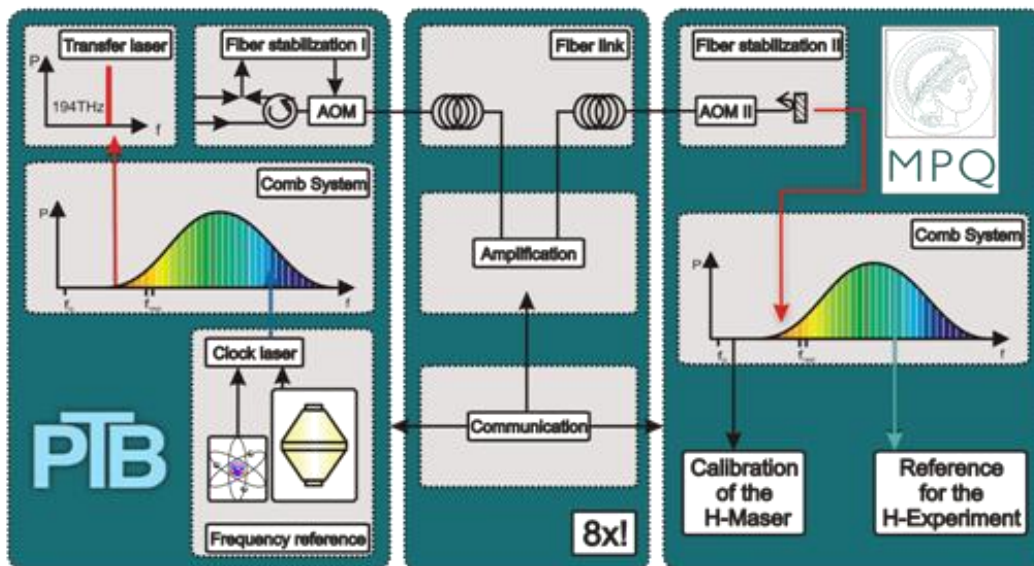
- **Life of a Packet** - Mark Leese and Robin Tasker, CCLRC Daresbury Laboratory. Setting the scene. What happens to your bytes when they leave your application?
- **Just What is OC-48?** - Robin Tasker, CCLRC Daresbury Laboratory. Explanation of networking terms, & overview of global research and educational 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

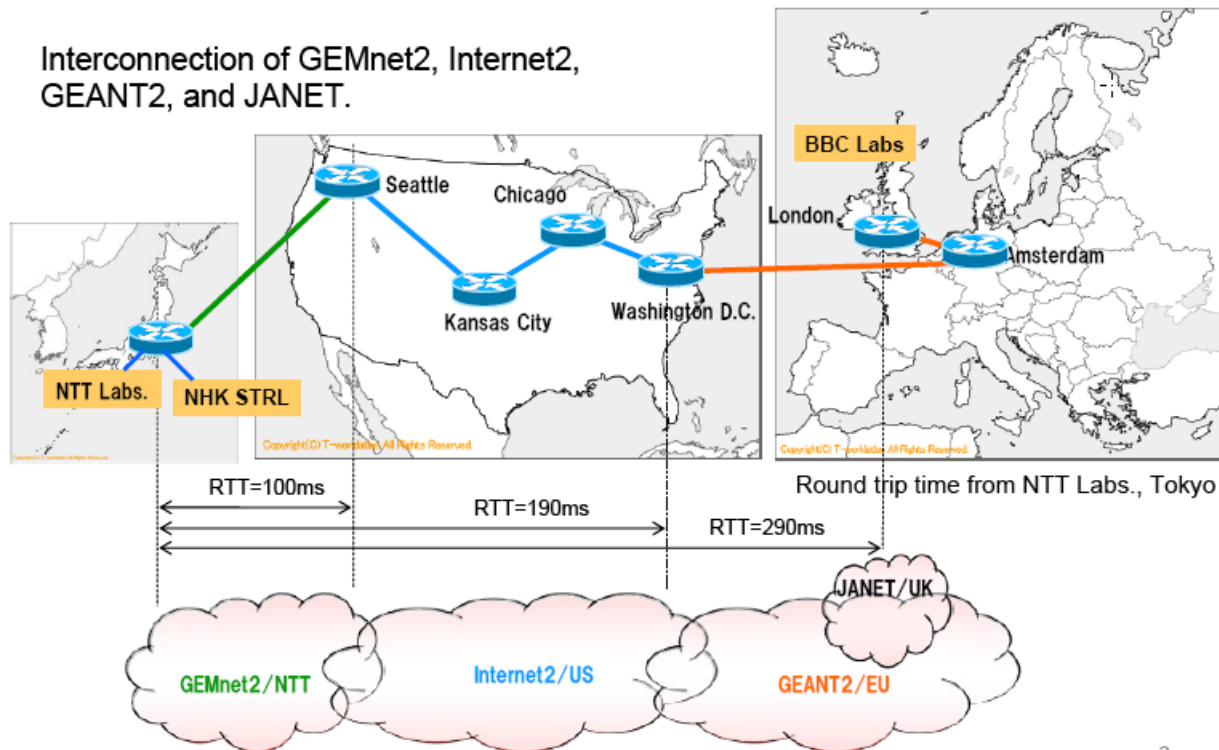
Gesine Grosche PTB

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.

Interconnection of GEMnet2, Internet2, GEANT2, and JANET.



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