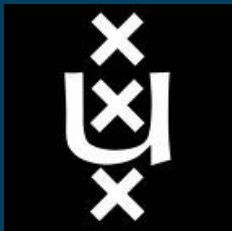




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Automated Bandwidth Allocation across Heterogeneous Networks

SCARLe



Andrew Mackarel
Guy Roberts
Damien Marchal

AutoBAHN is...



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- ... a **research** activity for engineering, automating and streamlining the **inter-domain setup** of **guaranteed** capacity (Gbps) end-to-end **paths**
- ... a Joint Research Activity of the GN2 project
 - **GN2** is an **European Commission-funded** project, with all the European Research and Education networks (**NRENs**) as partners

SCARIE / e-VLBI



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- The SCARIE project aims to develop a distributed software correlator that can be used for real-time e-VLBI, integrating it with advanced networking technologies.
- The project is a collaboration between the **Joint Institute for VLBI in Europe (JIVE)**, the **University of Amsterdam** and **SARA**, and is funded by the **Netherlands Organisation for Scientific Research (NWO)**.

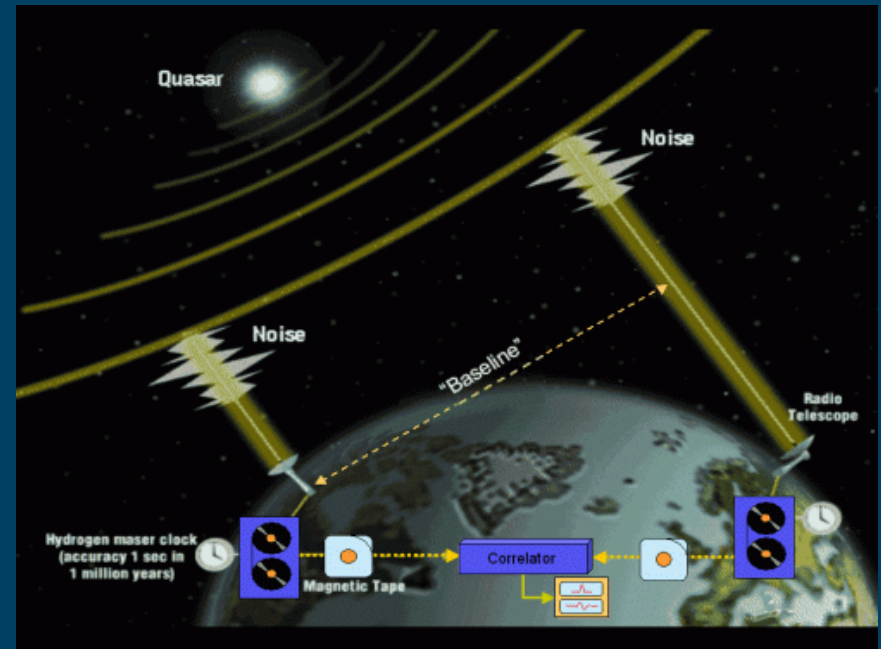
Very Long Baseline Interferometry (VLBI)



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Radio-Astronomical technique used to make extremely high-resolution images of cosmic sources.

Signals from radio telescopes across the globe need to be correlated at a central facility.



Electronic VLBI (e-VLBI)



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Replace physical shipping of magnetic media by real-time streaming of data via high-bandwidth fibre networks

- Up to 16 telescopes producing up to 1 Gbps each, more in future...

Advantages:

- Rapid response to transient phenomena (supernovae, gamma ray burst): immediate analysis of data, flexible observing
- Immediate feedback: increased robustness of telescope network
- Fewer consumables, reduced logistics
- Growth path for more bandwidth : increased sensitivity

(Distributed) Software Correlation



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Traditional hardware correlators based on special-purpose hardware (ASICs, FPGAs). Current EVN correlator at JIVE produces ~40 Tops. Next generation EVN correlator will need at least 200 Tops

- Powerful, but hard/expensive to build, lack flexibility

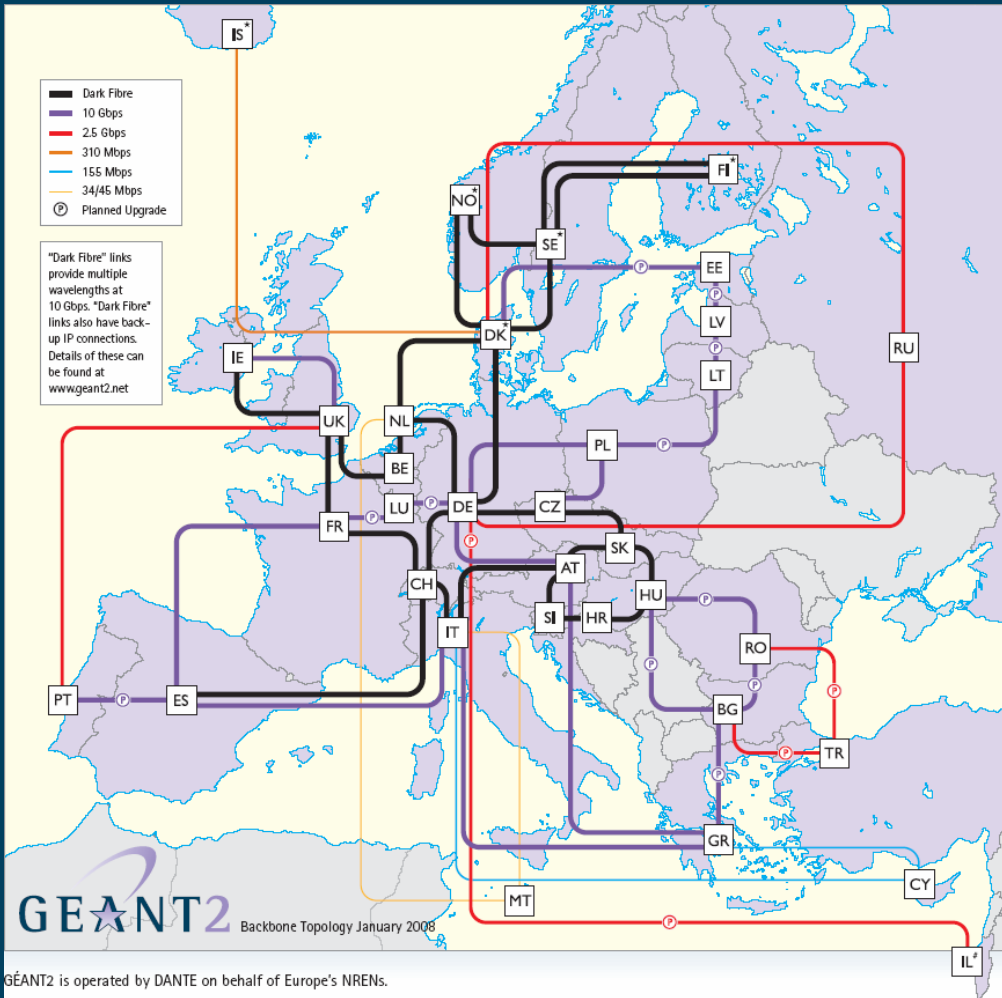
Software correlation (on standard CPUs) is slowly becoming feasible, offering ease of use and maintenance, flexibility

- But very large amounts of computing power needed
- **SCARle project**: distribute correlation on number of clusters, in this case DAS-3 grid in Netherlands

GÉANT2 Network



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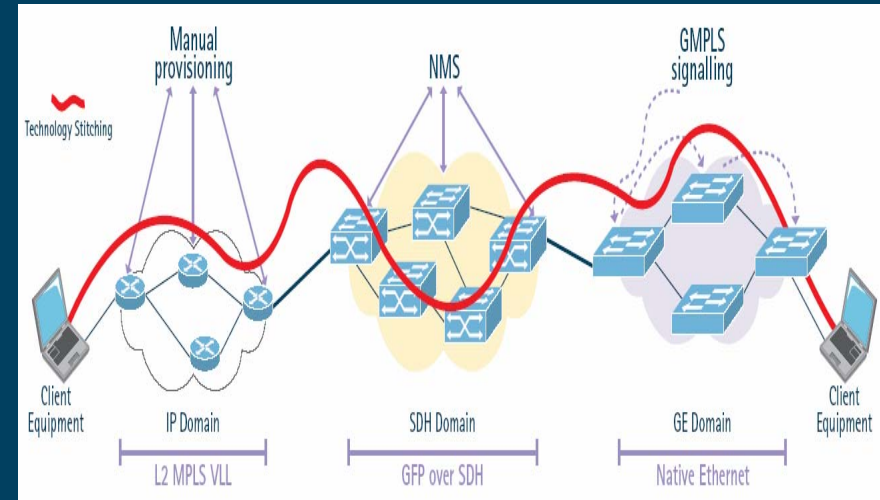
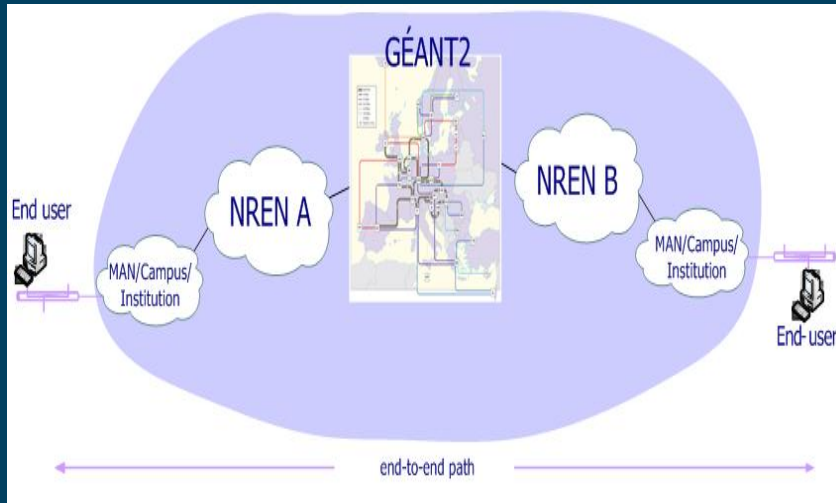
- 25 POPs (+4) serve >30 NRENs
- 11600 km of fibre + 140 ILA sites
 - DWDM
- 50+ x (own) 10G lambdas, (leased) 10G lambda, 2.5G (leased) "lambdas" + some lower speed links
- Alcatel MCC 1678
- Juniper T640, M160, M40 routers
- NREN accesses at up to 10Gbps (+ backup) + P2P
- 4 x 10G to North America
- POP in NY
- connections to other R&E networks: Abilene, ESnet, CA*net4, SINET, TENET, RedCLARA, EUMEDCONNECT, TEIN2 (coming)

End-to-end paths issues



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- Multiple administrative domains
- Multiple data plane technologies

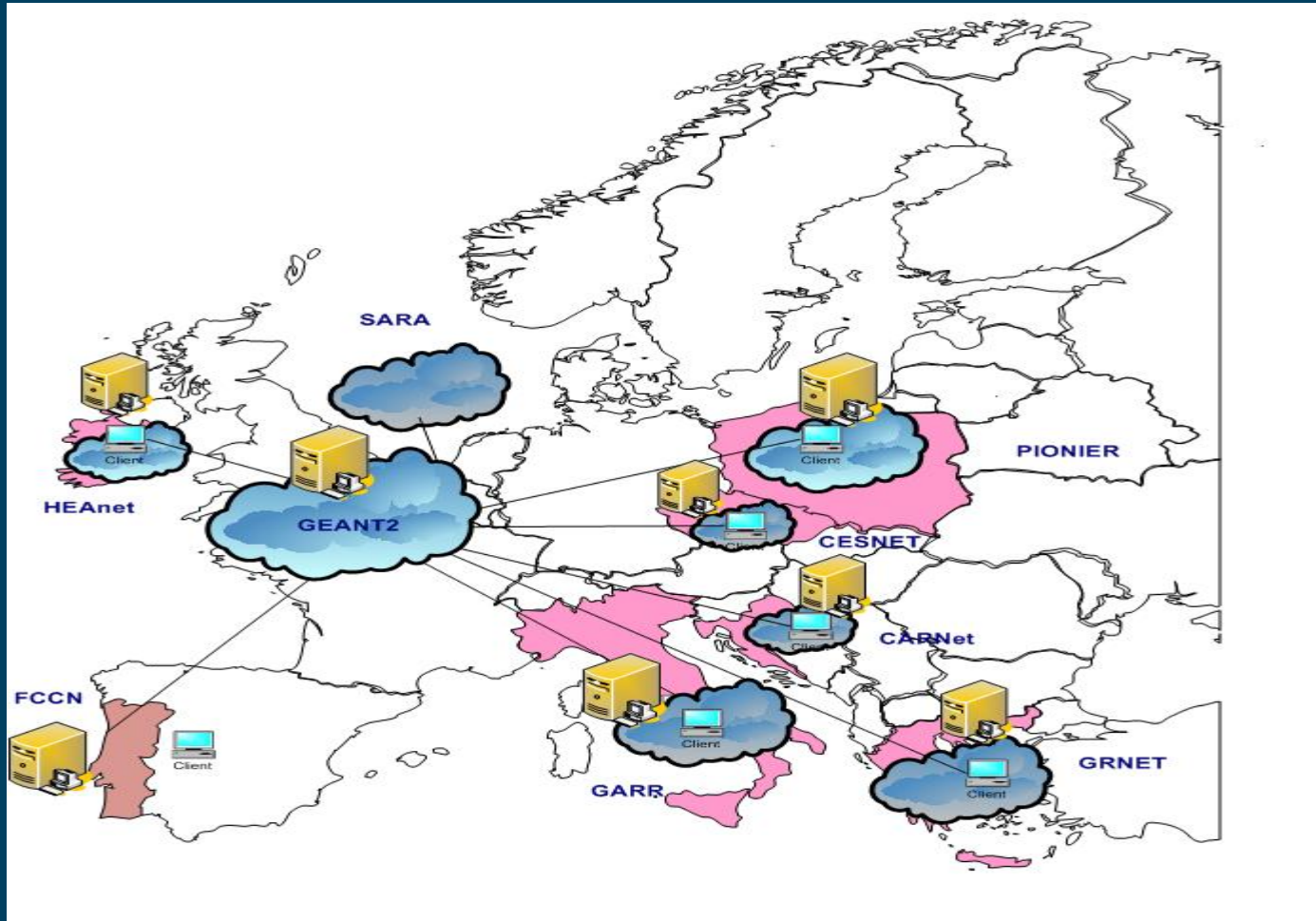


- The European VLBI Network does not operate continuously, so a BoD system is a suitable application for connectivity.
- The actual telescopes that participate in observations vary.

GEANT2 AutoBAHN Current Deployment



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Yesterday's Demo Network



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**DAS-3 CLUSTER
UNIVERSITY OF AMSTERDAM**

10 Gbps



1 Gbps 1 Gbps 1 Gbps 1 Gbps



Normal AutoBAHN application

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Autobahn client portal



Menu

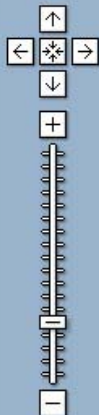
- Home
- Request service
- Submitted services
- Autobahn map
- Domain settings
- Domain logs

Reservation states

- UNKNOWN
- ACCEPTED
- PATHFINDING
- LOCAL_CHECK
- SCHEDULING
- SCHEDULED
- CANCELLING
- DEFERRED_CANCEL
- ACTIVE
- GLOBAL_CONSTRAINTS
- UNKNOWN
- FINISHED
- CANCELLED
- FAILED

AutoBahn GUI

Login as: null (null)

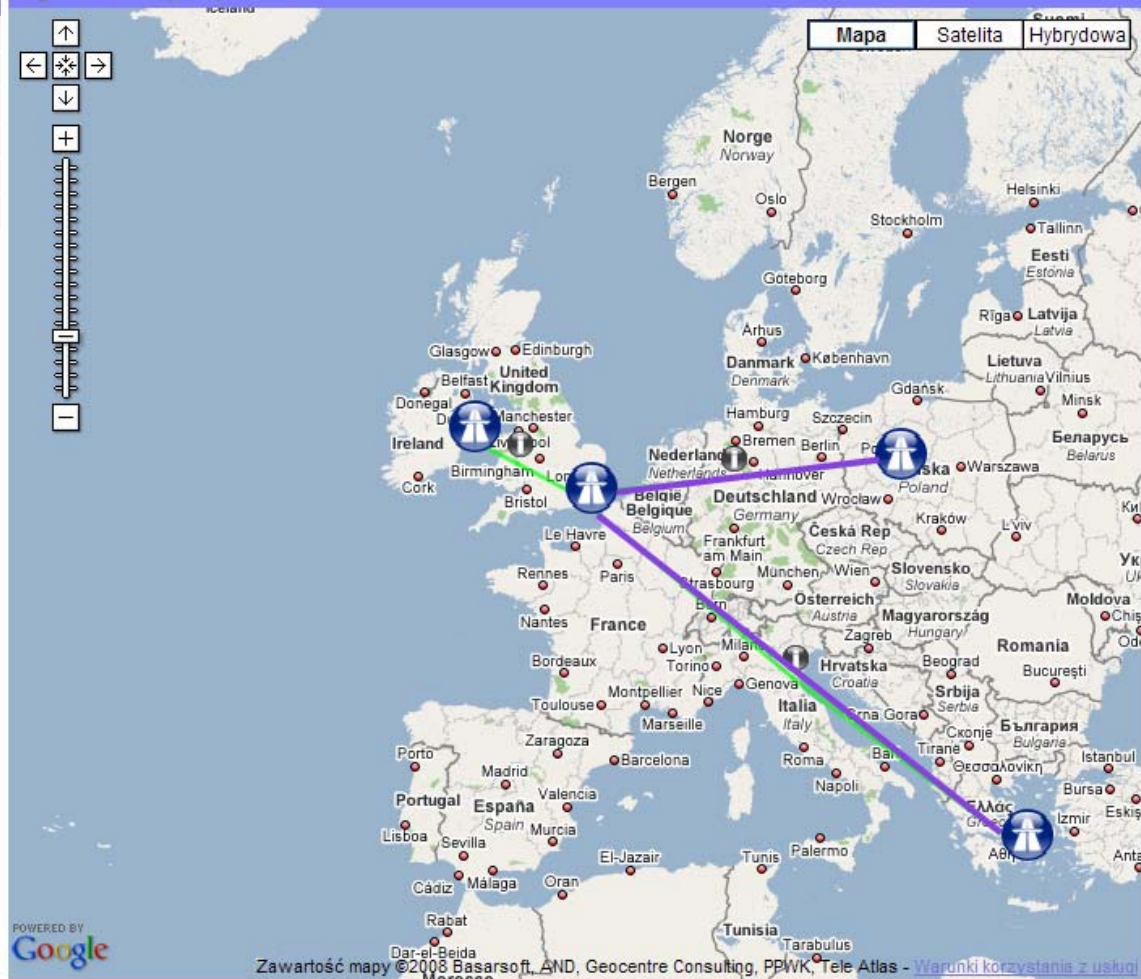


Mapa Satelita Hybrydowa

To show clear map click link below [Clear map](#)

Submitted services

- gn2jira3.grnet.gr:8443@1200579194585
- gn2jira3.grnet.gr:8443@1200578943853



POWERED BY Google

Zawartość mapy ©2008 Basarsoft, AND, Geocentre Consulting, PPKW, Tele Atlas - [Warunki korzystania z usługi](#)

Final Experimental result



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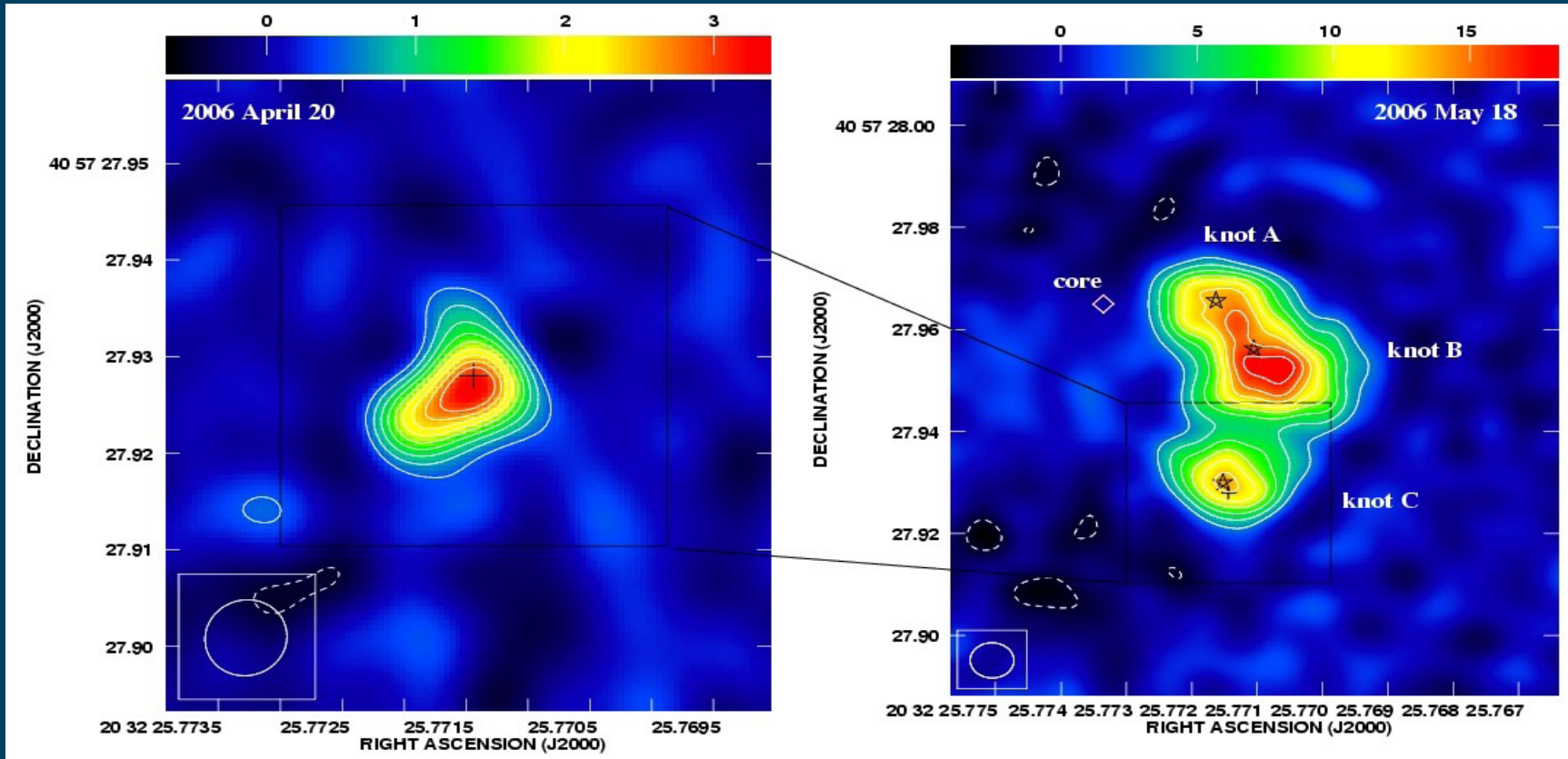
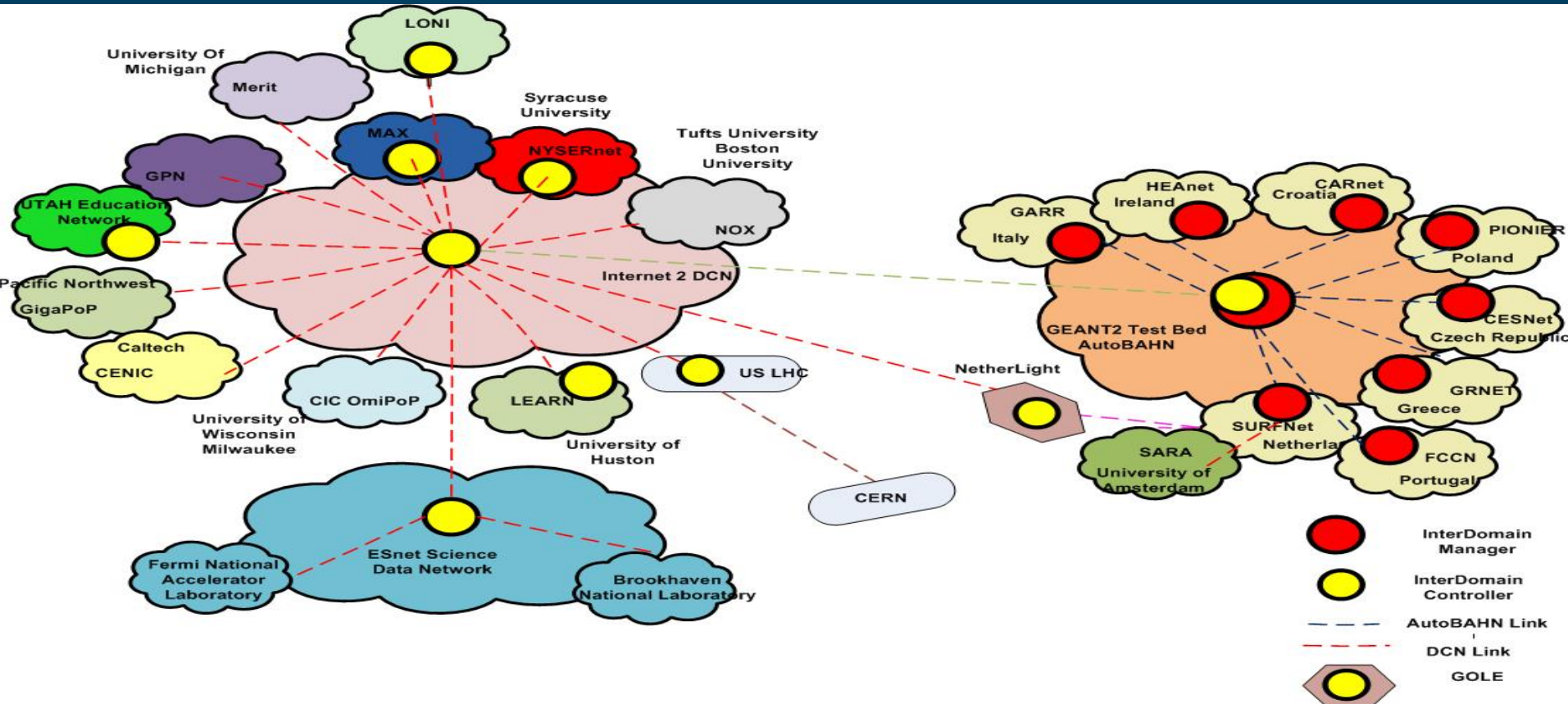


Image of Cygnus X-3, an X-ray binary system, at 5 GHz in its quasi-quiet state (left) and a few days after a major flare (right) obtained using e-VLBI

AutoBAHN is IDC-compatible

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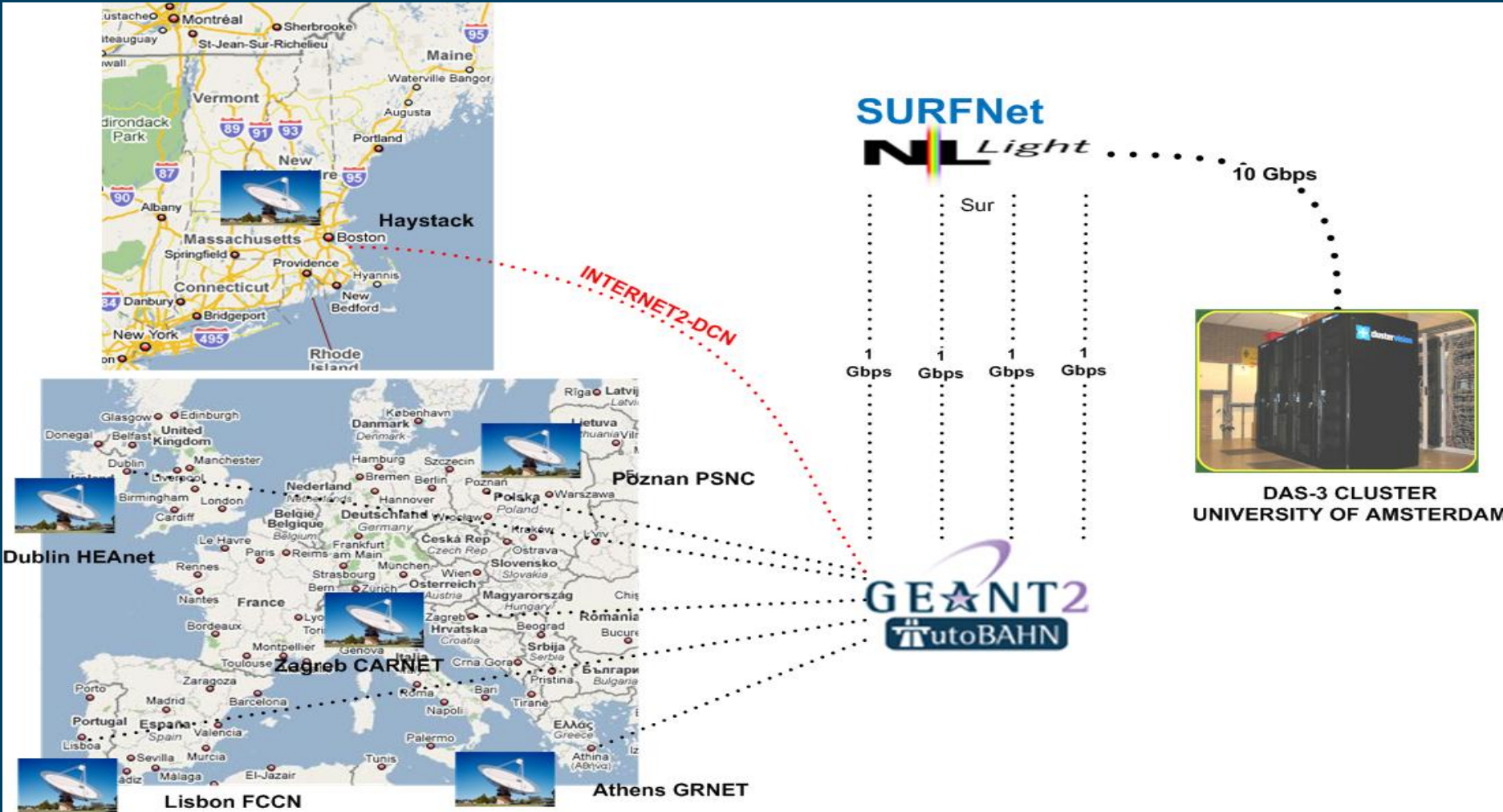


=> Links to US NREN Networks => Intercontinental VLBI

SC 08 Demo



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Thanks to efforts of all the team especially
Damien Marchal
SCARle, University of Amsterdam, PSNC,
FCCN, GRNET, DANTE,
CARNET, SARA, SURFnet,
HEANET, DANTE,
University of Washington
GLIF Conference Organisers



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Visit: <http://www.geant2.net/autobahn>

SCARI/e Contact **Mark Kettenis**
kettenis@jive.nl

Thank you



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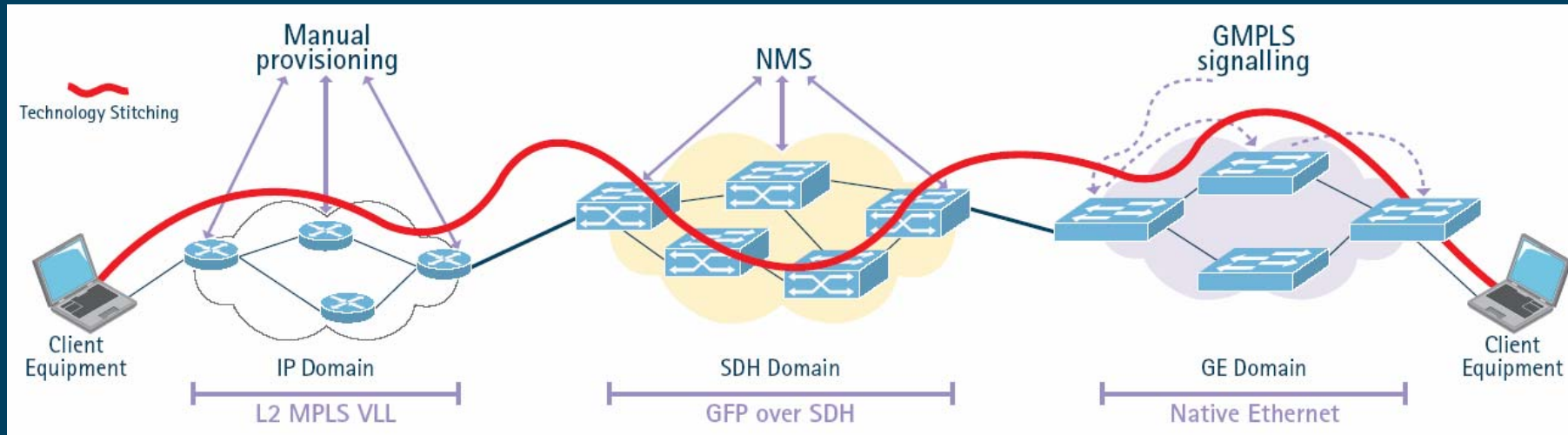
Backup Slides

AutoBAHN approach



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- Control and provisioning has to be distributed
- Business-layer related interactions include AA, policies, advance reservations etc.
- Privacy and control of intra-domain resources must be safeguarded



AutoBAHN approach

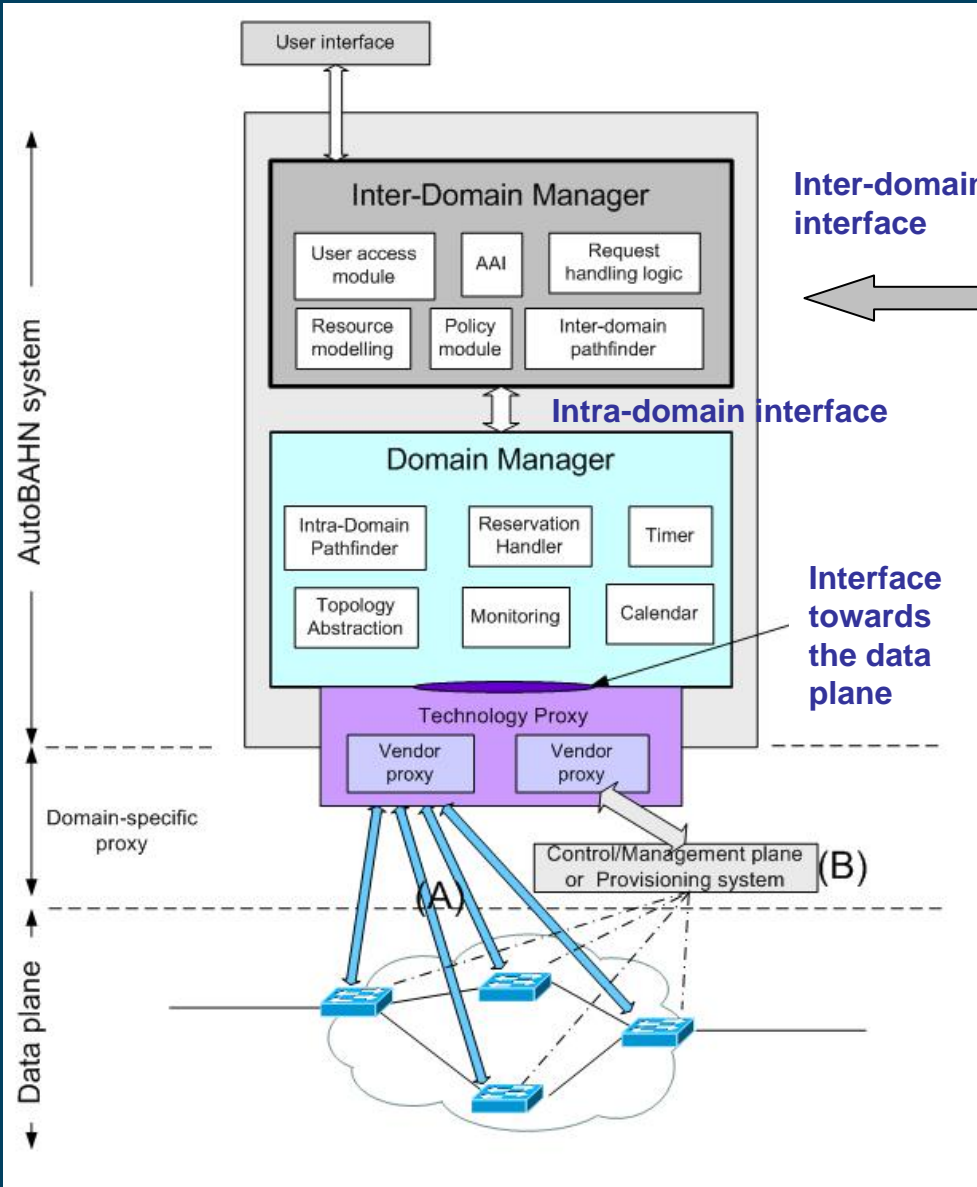


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- Definition of an architecture
 - Distributed operation
 - Inter-Domain manager (IDM)
 - Domain manager (DM)
 - Interfaces
- Reference implementation including business layer and control plane functionality



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Inter-Domain Controller (IDC) protocol

A result of a joint effort between AutoBAHN (GÉANT2), Internet2, ESnet

AutoBAHN system overview