

National Research & Education Networking in Europe & GÉANT: A RI Success Story & its Mission in our Globalized Scientific World

Vasilis Maglaris <maglaris@netmode.ntua.gr>

Chairman of the NREN Policy Committee – GÉANT Consortium

Professor at the National Technical University of Athens

December 10th, 2008

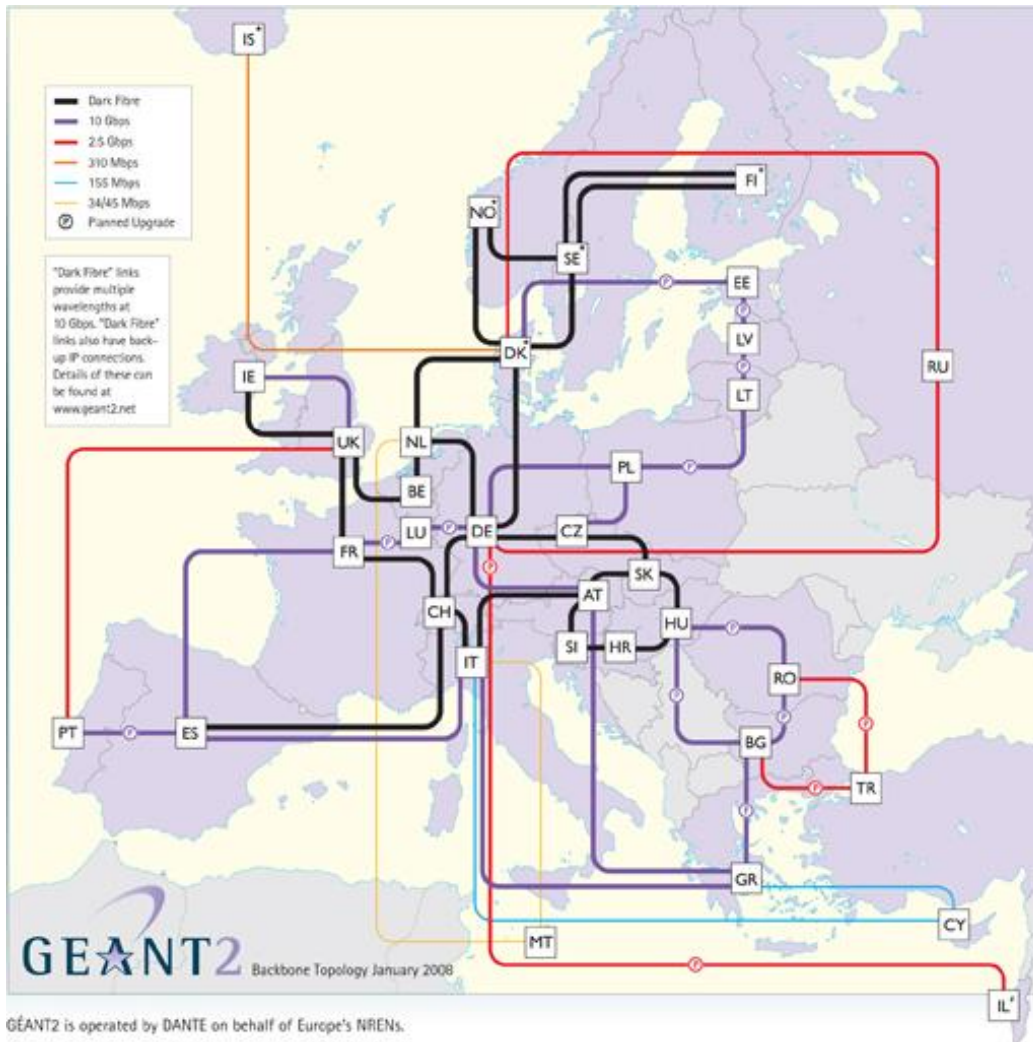


NRENs in Europe & GÉANT:
A RI Success Story & its Global Mission

R&E Networking in Europe

- **A 3-tier Federal Architecture**, partially subsidized by National and EU Research & Education funds:
 - The Campus Network (LAN/MAN) > 3,500 Institutions, >30 M Users
 - The 34 NREN's (MAN/WAN)
- The Pan-European Interconnection: **TEN34 à TEN155 à GÉANT** (GN1 in FP5) **à GÉANT2** (GN2 in FP6): **Hybrid Optical Backbone (+ Cross Border Fibers) à GÉANT3** (GN3, planned for FP7)
- **Total GÉANT Cost: 40 M€/year** (co-funded by the EC and NREN's)
European R&E Networking cost covered by National funds:
 - **100% for Campuses, MANs, NRENs**
 - **55% of GÉANT e-Infrastructures, SUBSIDIARITY PRINCIPLE**
- **GÉANT Governance:** NREN Policy Committee
- **Project Management:** Exec, DANTE

The GÉANT2 Network, Jan. 2008



GÉANT2 Topology

15+ NRENs interconnected within the Dark Fibre (DF) "cloud"

Rest, via leased "lambda" and SDH circuits

The NREN Policy Committee

1. **ACOnet** (Austria)
2. **ARNES** (Slovenia)
3. **BELNET** (Belgium)
4. **BREN** (Bulgaria)
5. **CARNet** (Croatia)
6. **CESNET** (Czech Republic)
7. **CYNET** (Cyprus)
8. **DFN** (Germany)
9. **EENet** (Estonia)
10. **FCCN** (Portugal)
11. **GARR** (Italy)
12. **GRNET** (Greece)
13. **HEANet** (Ireland)
14. **HUNGARNET** (Hungary)
15. **IUCC** (Israel)
16. **JANET** (United Kingdom)
17. **JSCC** (Russia)
18. **LITNET** (Lithuania)
19. **NORDUnet** (Nordic Countries -
Denmark, Finland, Iceland, Norway,
Sweden)

20. **PSNC** (Poland)
21. **RedIRIS** (Spain)
22. **RENATER** (France)
23. **RESTENA** (Luxembourg)
24. **RoEduNet** (Romania)
25. **SANET** (Slovakia)
26. **SigmaNet** (Latvia)
27. **SURFNET** (Netherlands)
28. **SWITCH** (Switzerland)
29. **ULAKBIM** (Turkey)
30. **UoM** (Malta)

PLUS NON-VOTING MEMBERS:

31. **DANTE** (Delivery of Advanced Network Technologies to Europe Ltd.)
32. **TERENA** (Trans-European Research & Education Networking Association)

PERMANENT OBSERVERS:

33. **AMRES** (Serbia)
34. **MARNET** (FYR of Macedonia)
35. **CERN** (European Organization for Nuclear Research)

EU NREN's – GÉANT_n: A Success Story - Why?

- Century old Telecom (+ 40 years ARPAnet - Internet) experience: Proven strong “**Network Externalities**” à Sharing tradition
- Industry needs for **Next Generation Network** proofs of concept, synergy with R&E community: The ARPAnet paradigm @ the US of America, inspiring the “**US of Europe**”
- **Foresight** of National + EU funding authorities, triggered by NREN planning – SERENATE, EARNEST Studies
- A decade (+) of success in serving R&E needs of the Continent à Smoothing-out “**digital divides**” & enabling powerful education communities (educators, students, pupils?)
- NREN's as utilities for the R&E communities – extending the “**commons**” principle aka. Open Source S/W, Wikipedia...
- **Solidarity** & orchestrated innovations within the NREN community, efficient service coordination (**DANTE**) & human networking (**TERENA**)
- Stable **Governance**: NREN Policy Committee (NREN PC)

NREN's & GÉANT n : e-Science Enablers + Networking R&D Platforms

- NREN's – GÉANT2/3 provide cost effective **e2e switched & light path connectivity** within the Dark Fiber Cloud (DWDM footprint)
 - + Global **IPv6 coverage** and **Hybrid** networking services
 - + Multi-domain Network management, resiliency & support
- e-Science **Virtual Organizations** obtain production quality hybrid networking, beyond leasing individual circuits, wave-lengths or dark fibers
- e-Infrastructures as equalizers, reduce the **DIGITAL DIVIDES** in Europe & globally: **Big Science affordable via virtual e-Science**
- NRENs – GÉANT stimulate **Network Research** & enable novel concept evaluation - **emulations** in a global production environment via virtualization of facilities & services

Bandwidth Requirements per User

(SERENATE Study Final Report, 2003)

Cees De Laat. UvA. David Williams. CERN/TERENA et. al.)

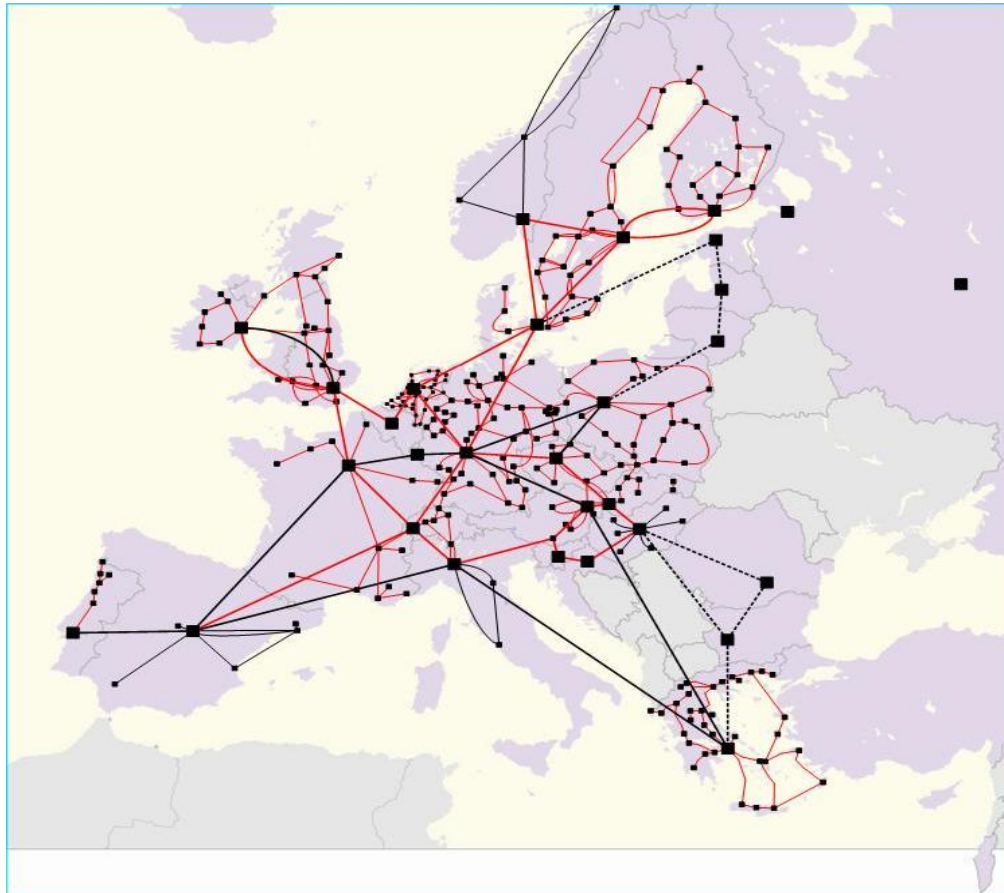
of users



ADSL

GigE

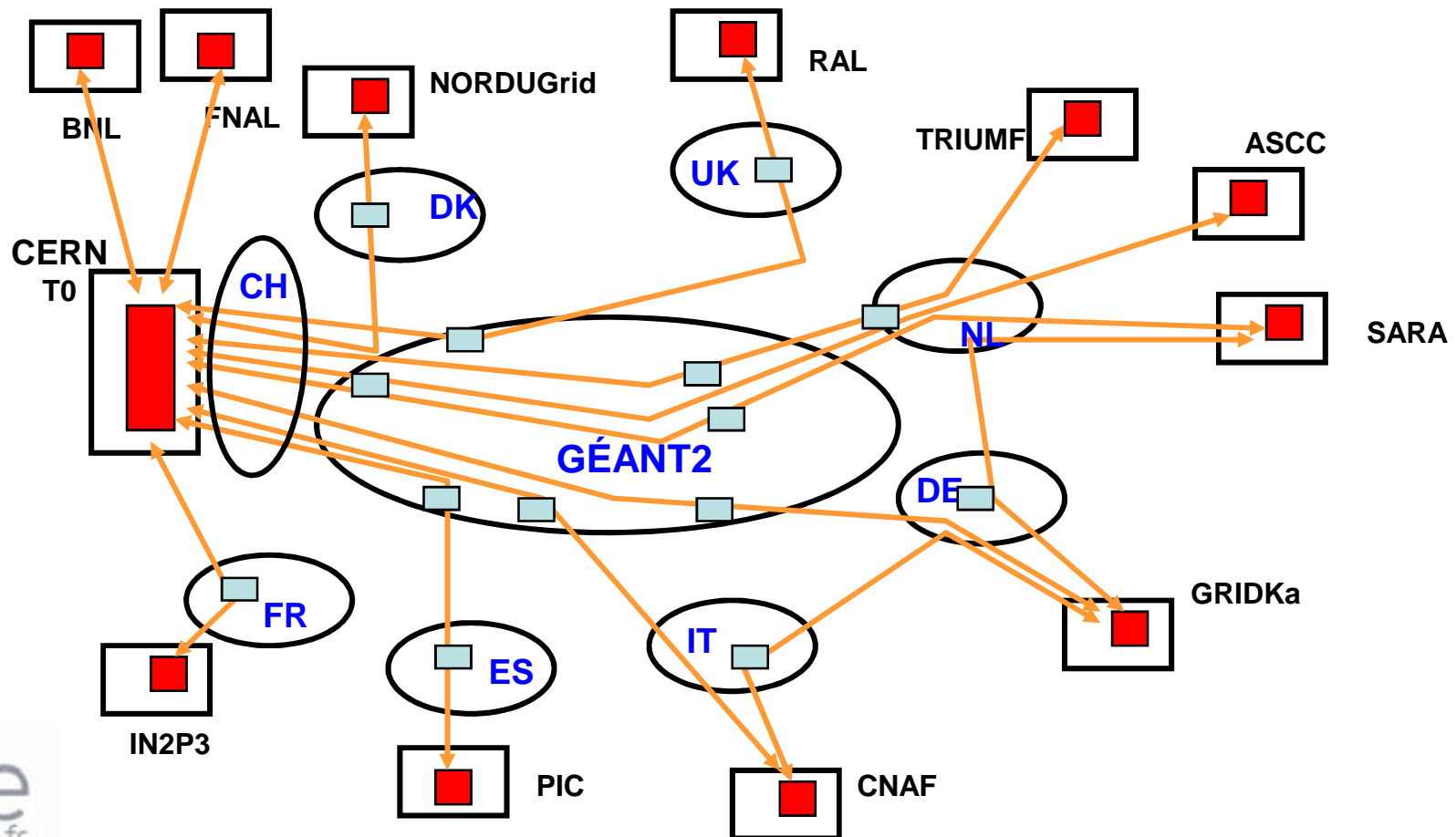
European R&E 10 Gig+ Footprint, March 2008 (based on data by DANTE & NRENs)



Enables end-to-end
Hybrid Networking &
Optical Private
Networking (**OPNs**) for
e-Science Projects

LHC TIER0 – TIER1 Optical Private Network

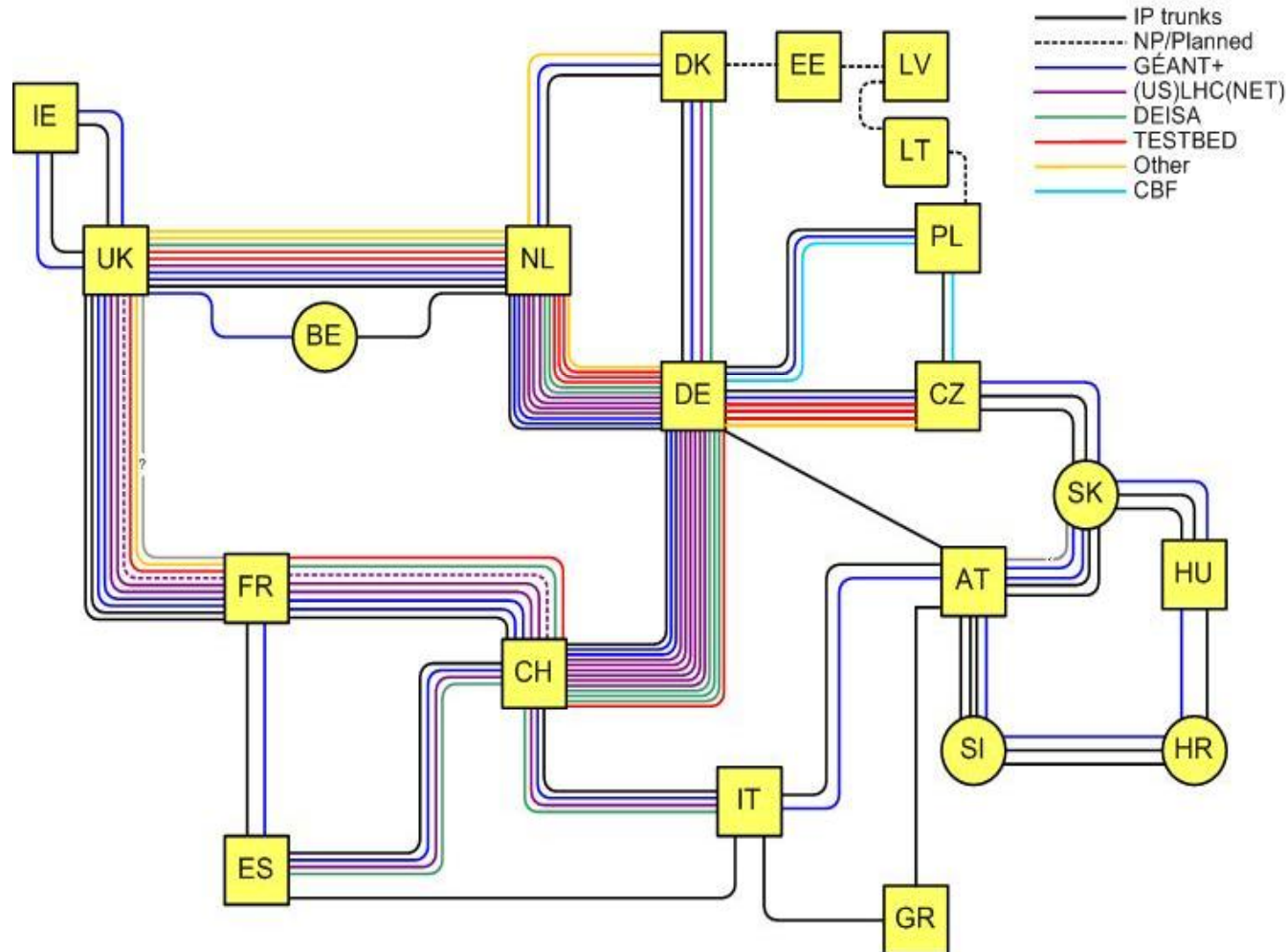
(Scenario based on work by Roberto Sabatino, DANTE)



NRENs in Europe & GEANT:
 A RI Success Story & its Global Mission

Wavelengths on GÉANT2

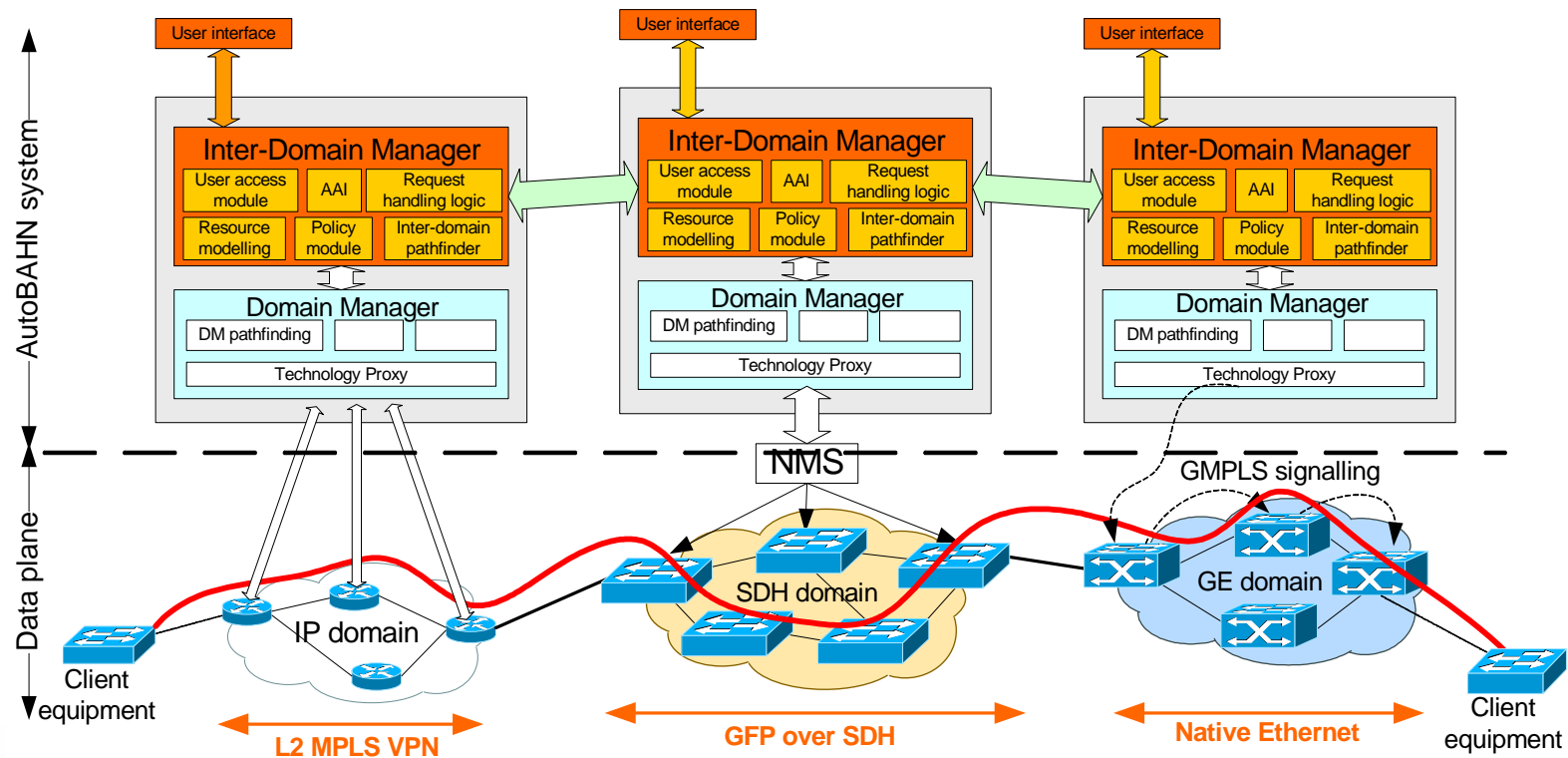
(Hans Döbbelina DANTE. 02/2008)



NRENs in Europe & GÉANT:
 A RI Success Story & its Global Mission

Automatic Bandwidth Provisioning: The AutoBAHN Concept

(based on a presentation by Afrodite Sevasti, GRNET.GR)



Summarizing the GÉANT3 Vision

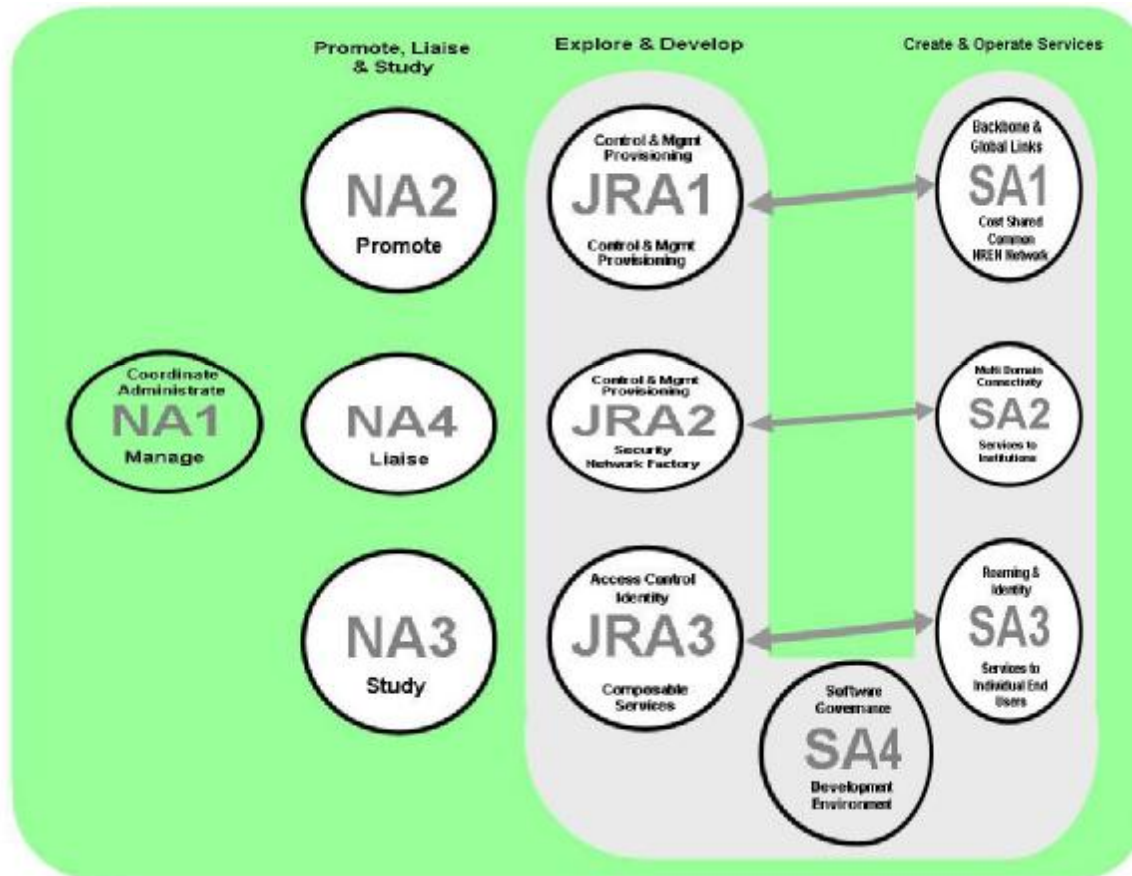
- To create an innovative **multi-domain hybrid networking** environment, using advanced transmission & switching technologies
- To enable R&E users through their Organizations with **flexible and scalable production quality services** via their constituent NRENs
- To be an enabler for Global R&E networking supporting international e-Science initiatives, creating a **Global Virtual Village** to house researchers & educators around the world
- To contribute to standards as a key participant in European & Global efforts towards the **Network of the Future**

Preparations for the GN3 Proposal

- **Two task forces** established by the NREN PC (*September 2007*):
 - **GN3 Membership Committee:** Artur Binczewski (*PSNC.PL*), Thomas Brunner (*SWITCH.CH*), Dai Davies (*DANTE*), Jan Gruntorad (*CESNET.CZ*, *Chair*), SabineJaume-Rajaonia (*RENATER.FR*), Karel Vietsch (*TERENA*)
 - Rules of membership, categories (*December 2007*)
 - **GN3 Technical Strategy:** Erik-Jan Bos (*SURFNet.NL*), Mauro Campanella (*GARR.IT*), Hans Döbbeling (*DANTE*), Lars Fischer (*NORDUNet*), David Foster (*CERN*), Vasilis Maglaris (*NREN PC*, *Chair*), Dorte Olesen (*TERENA*), Roberto Sabatino (*DANTE*), Afrodite Sevasti (*GRNET.GR*)
 - **Green Paper** (NREN consultation phase, completed by *March 2008*)
 - **White Paper** (*July 2008*) – A public document posted in:
<http://www.geant2.net/server/show/nav.858>
- **GN3 Proposal Review Board** established by the NREN PC to integrate work in accordance with NREN viewpoints

GN3 Proposal Submitted: September 11, 2008 (5 PM CET)

GN3 Proposed Structure

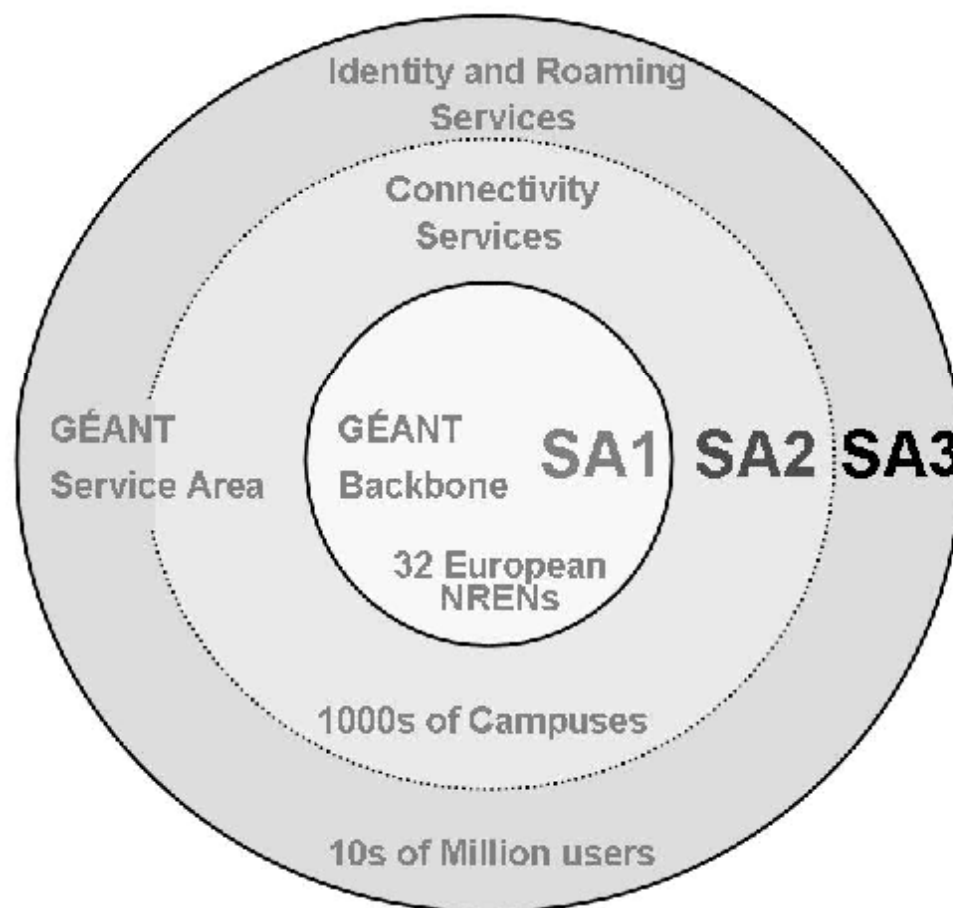


NA's:
 Networking
 Activities

SA's:
 Service
 Activities

JRA's:
 Joint
 Research
 Activities

GN3 Service Activities & Target Groups



Map of GN3 Consortium Partners



Is there Life after GÉANT2 ?

- Networking technologies enable a **sustainable advanced platform**:
 - **Terabit** hybrid optical networking (enabling the *GTRN – Global Terabit Research Networking* vision)
 - Simple connectivity to power end-users (*Super-Computing Centers...*)
 - Shared NREN facilities (*Cross Border Fibers, Lightpath Exchanges...*)
 - Will leverage **SUSTAINABILITY**; but caution on **DIGITAL DIVIDES & integrated operations & management issues** (operations – management)
 - **Virtualization**: *logical routers, service oriented middleware, cloud computing, experimental RI for network research*
- The GÉANT community undertook a **global role & commitments**
- GÉANT in concertation with global initiatives:
 - Leads hybrid networking development with *Internet2, ESnet, Canarie, APAN...*
 - Supports global e-Science initiatives (*ESFRI Roadmap*)

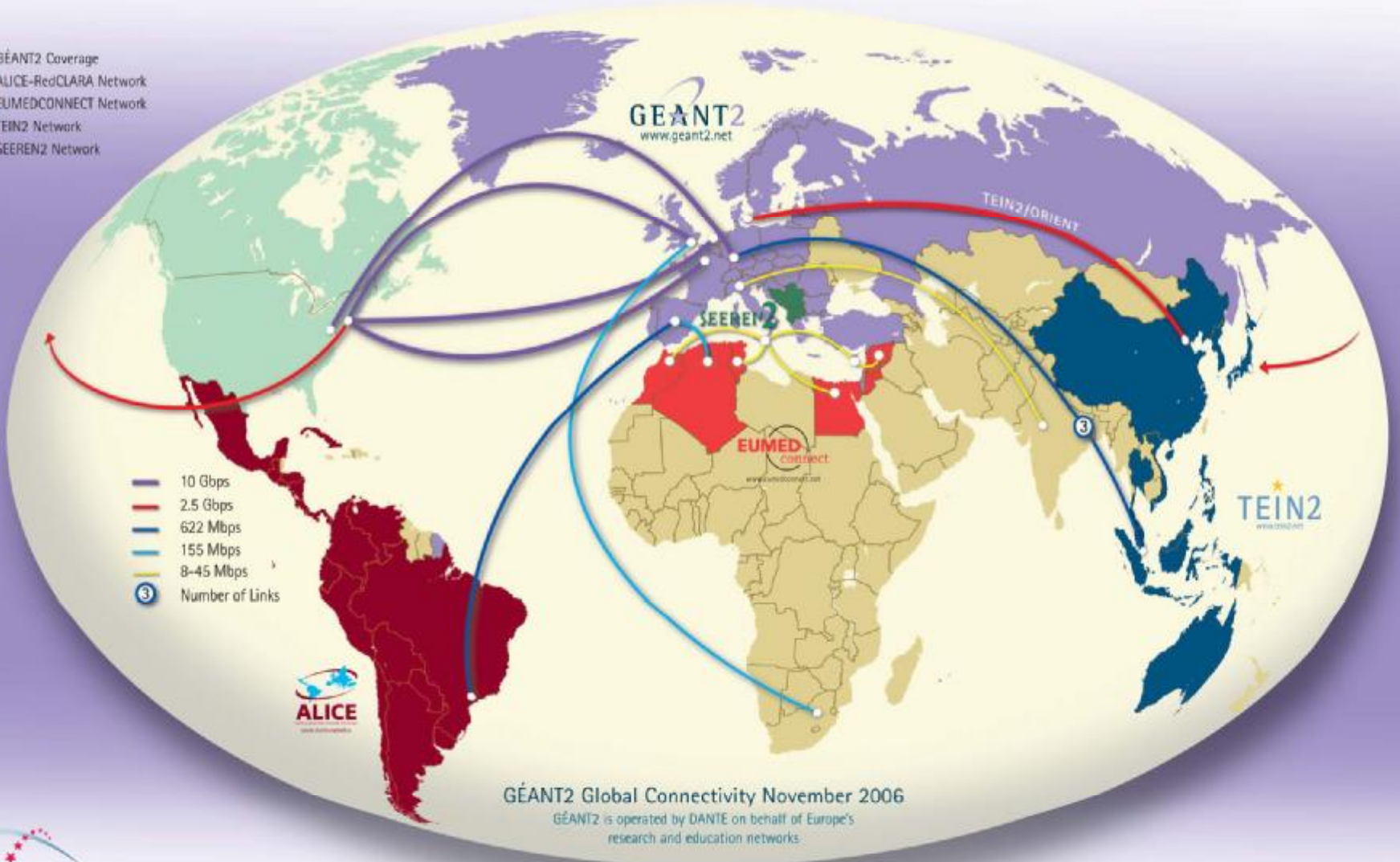
**Time is ripe to profit from global long-term investments on
Research & Education Networking**

GEANT2 At the Heart of Global Research Networking

- GEANT2 Coverage
- ALICE-RedCLARA Network
- EUMEDCONNECT Network
- TEIN2 Network
- SEEREN2 Network

www.geant2.net

- 10 Gbps
- 2.5 Gbps
- 622 Mbps
- 155 Mbps
- 8-45 Mbps
- ③ Number of Links



GEANT2 Global Connectivity November 2006

GEANT2 is operated by DANTE on behalf of Europe's research and education networks

Is the NREN - GÉANT Paradigm Applicable to Distributed – GRID Computing? *Some questions*

- Are **network externalities** of the computing community strong enough to enforce a global sharing mentality, as in the networking sector?
- Does cost & depreciation rate of computing resources favor long-term investments and sustainable institutions?
- Are conditions (politically and technologically) ripe throughout Europe for the formation of **single**, shared, production quality research GRIDs, Nationally and Continent-wide federations?
- Are computing – storage needs of researchers above & beyond commercial utility & cloud computing (Google, Amazon, IBM...)?

The NREN community can share its experience with the Distributed Computing - Grid community, ESFRI & the e-IRG (*e-Infrastructures Reflection Group*)

Conclusion: GÉANT Evolution or Revolution? (based on a presentation by Klaus Ullmann, DFN & DANTE)

- **Bandwidth**, a major problem for research networking in Europe over the past decade, will no longer be a major problem (triggers **revolutionary** changes in network planning & operations)
- GN3 challenge: Develop - deploy robust multi-domain dynamic networking services e.g. managed **VPNs/OPNs**, adaptable on-demand to user needs (**evolution** or **on-going revolution** ?)
- Manage profiles of (moving) researchers: Security, access, single-sign-on, roaming... (**evolution**)
- Improve organizational efficiency: Built on top of stable NREN – GÉANT structures (**evolution**)
- Developments for future network technology must be planned in cooperation with research groups, advanced users of **High Performance Computing** - HPC/Grids (**evolving** global synergies)

ICT e-Infrastructures: A CONCERTED EUROPEAN EFFORT

**Research Networking & HPC/GRID Communities
share a common mission**

**Provision of leading edge e-Infrastructures for
Research & Advancement as federated
High Performance Computing & Networking - HPCN
services to the extended ERA and globally:
An opportunity for European Added Value**