



Supporting Grids - Service Challenges for Networks

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- European Research Initiatives – GÉANT2
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Evolution of Grids

- Need for inter-disciplinary research
- Demanding applications require high computational power
- Reducing cost of resources and sharing them
 - Ever increasing geographic diversity
- Mission critical applications on Grids
- High reliability and deadline scheduling
- Shared versus Dedicated resources
- Optimum resource utilisation
 - **Quality of Service** over Networks



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Motivation for Networks

- Grids are moving from R&E to Production environments
- Traditional BE connectivity services are not sufficient
 - Static, manually provisioned with significant lead times
- Dedicated resources?
 - Not affordable to all
 - Not a scalable approach
- Grids of the future will demand dynamic services
 - With a large degree of automation
 - Delegated management

European Research Initiatives



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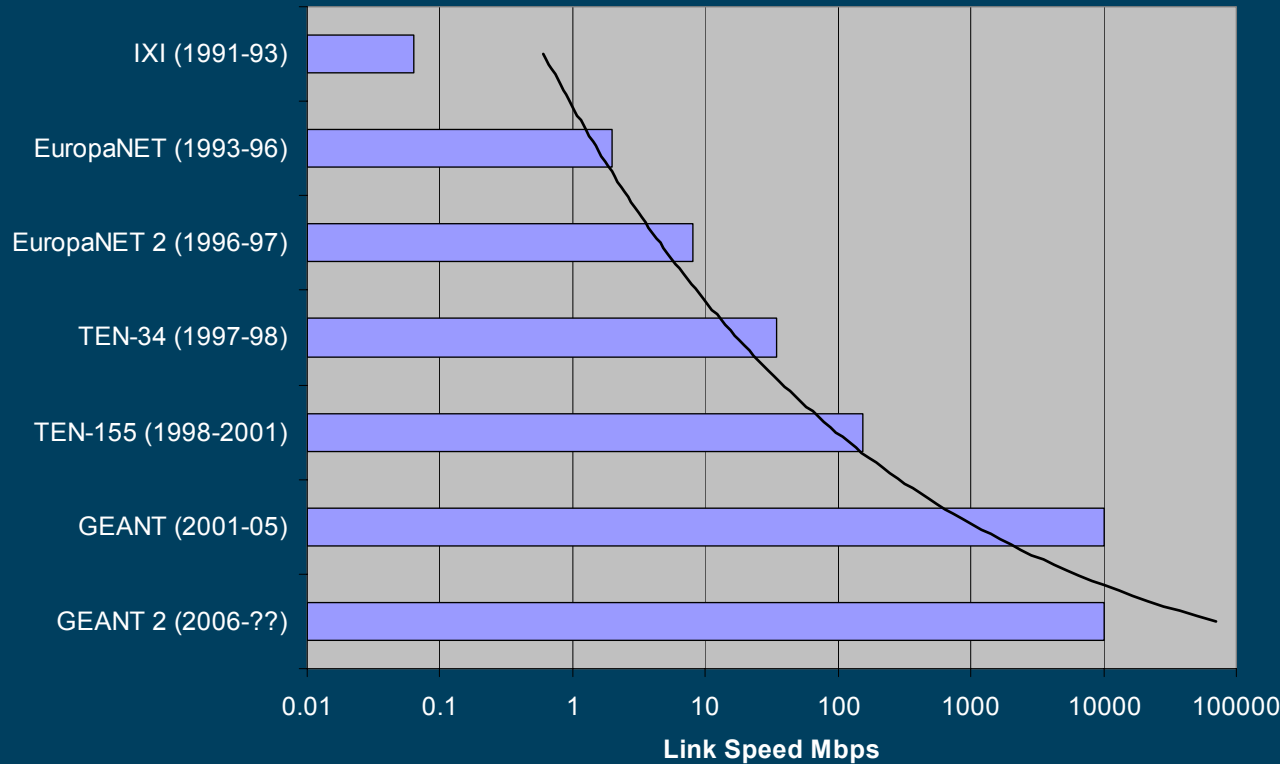
- Recognized need to provide more than just basic connectivity (value added services)
- Various research initiatives under FP6 for advanced network services e.g. **GN2**
- GN2 Objectives
 - To build a multi-gigabit pan-European network (GÉANT2)
 - Conduct joint research into development of network technologies and services
 - Offer advanced services on production network



The 7 Generations of European R&E Networks



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Services

Underlying Technology

Datagram & IP

PDH circuits

IP & ATM

ATM over SDH

IP only

waves

hybrid

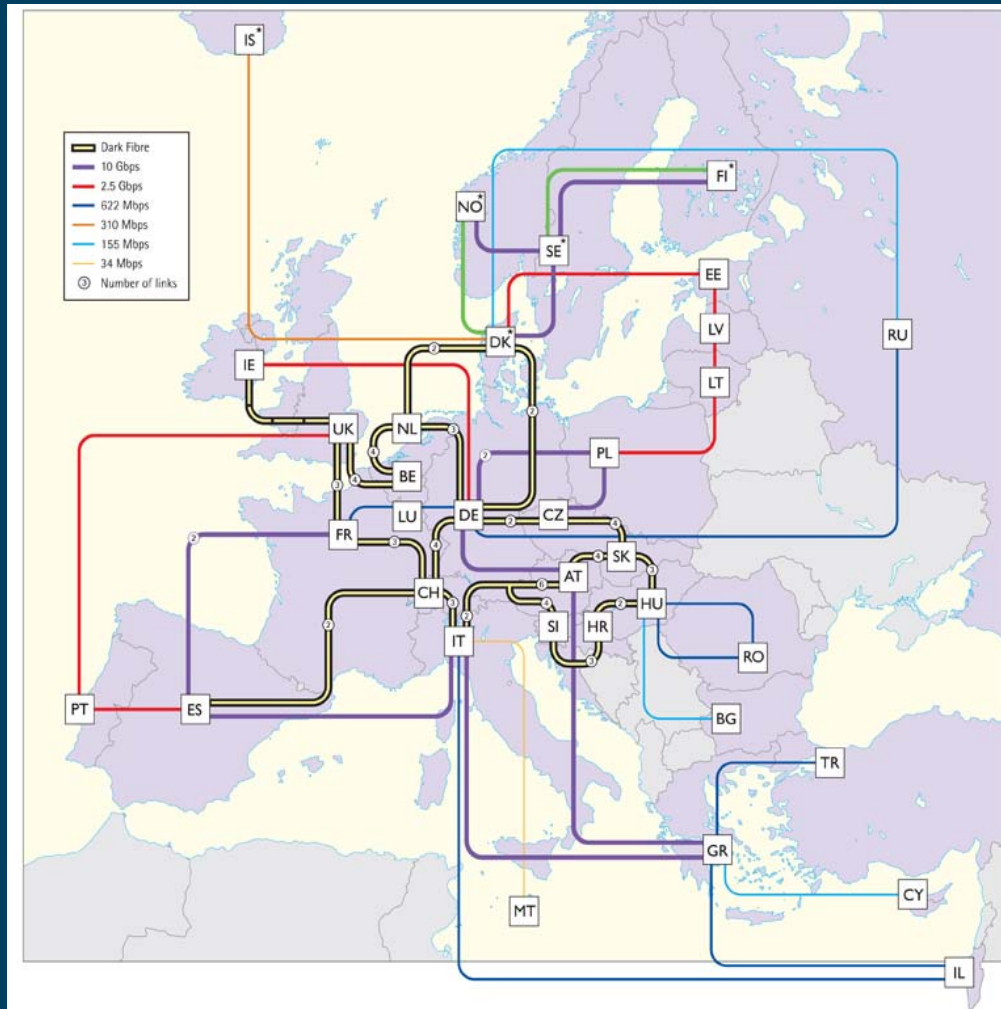
fibre



GÉANT → GÉANT2



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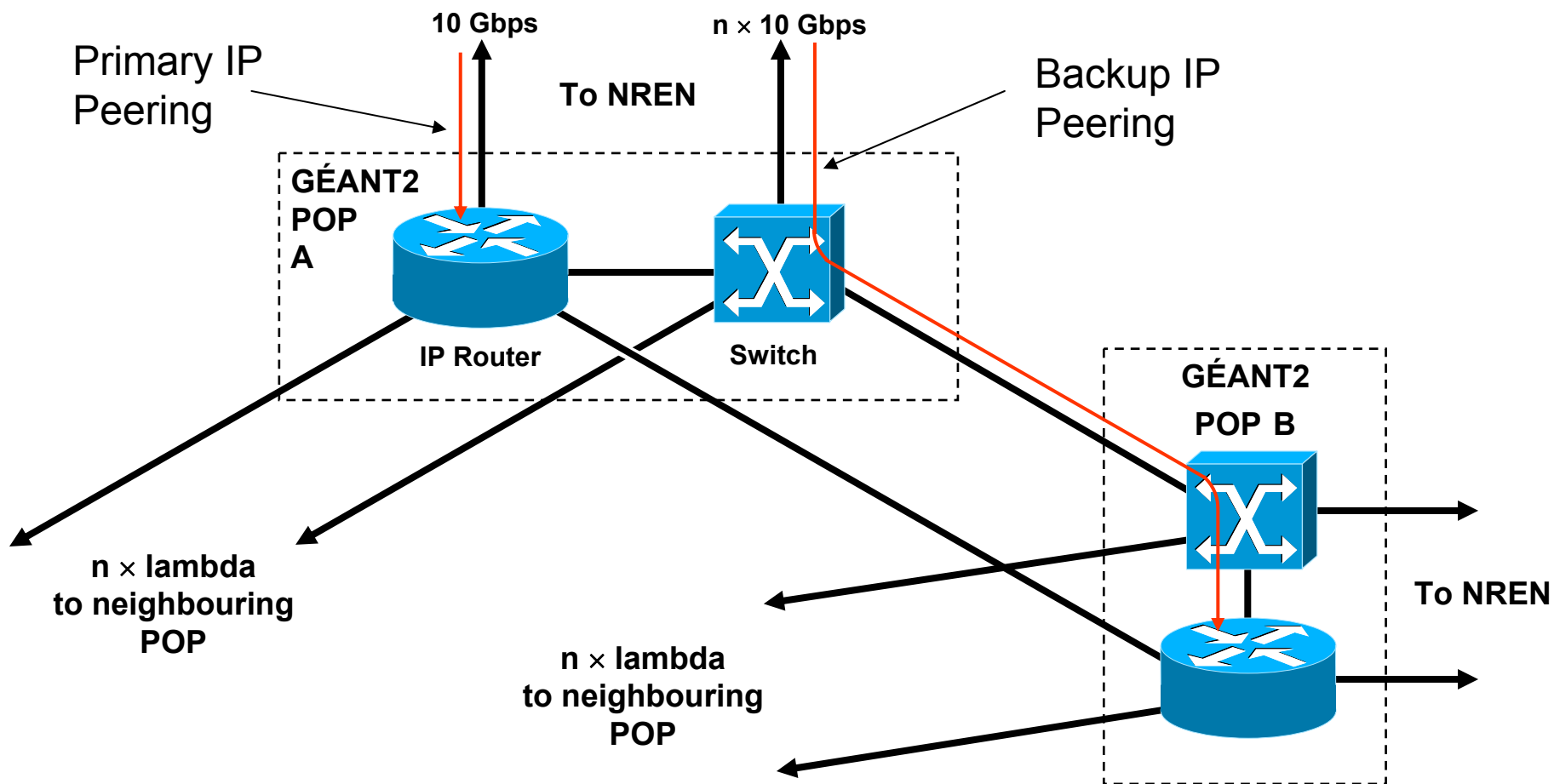
Some New Facts & Figures...

- 25 POPs (+4)
- to serve 30 NRENs (+1)
- 11600 km of fibre
- 140+ ILA sites
- 50+ x (own) 10G lambdas
- 9 x (leased) 10G lambda
- 8 x 2.5G (leased) “lambda”
- + some lower speed links
- Juniper T640, M160 & M40 routers in POPs with
- NREN accesses at up to 10Gbps (+ backup) + P2P
- 4 x 10G to North America
- POP in NY
- connections to other R&E networks as before...
Abilene, ESnet, CA*net4, SINET, TENET, EUMEDCONNECT, RedCLARA, TEIN2 (coming)

GÉANT2: A hybrid infrastructure



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Benefits for Grids (1)

What's in it for the Grids?

- Higher bandwidth – up to 10G (for now)
- Choice of dedicated or shared circuits
- More resilient IP service
- More choices for end site connectivity
 - IP, 1 GE/10GE, Light Paths over SONET/SDH/10GE LAN PHY
 - Sub 1GE (or > 1GE) connectivity
- New L1 and L2 P2P protected services
- Other services like IPv6 multicast
- **Is that all?**

GN2

NOT just a network !



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But also an **INTEGRATED INFRASTRUCTURE INITIATIVE - I3**

NETWORKING ACTIVITIES (NAs)

(Human networks)

Management

Dissemination and outreach

User support (NRENs)

SERVICE ACTIVITIES (SAs)

(focus on services, not infrastructure)

Network Service Provisioning

Network Operation and Support

JOINT RESEARCH ACTIVITIES (JRAs)

Focus on academic, technological research

and Service

Joint Research/Activities



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JRA1 (perfSONAR) – Advanced Network Monitoring

JRA2 – Security

JRA3 – Bandwidth Allocation & Reservation

JRA4 – Technology & Service Testing

JRA5 – Mobility & AAI

SA3 – Support for multi-domain Services

- Make “quality” more ubiquitous
- Develop PIP provisioning system (AMPS) and (encourage) roll-out across many NREN domains
- Operate enhanced monitoring infrastructure as “production” service
- Develop and operate PERT
- In service support for newly introduced services



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Benefits for Grids (2)

What's in it for the Grids?

- Service Oriented Architecture
- Single service access point
 - Single request for multi-domain services
- Well defined standardised web service interfaces
 - Hides complex heterogeneous underlying systems
- Uniform resource discovery mechanisms
 - Ability to query Network Information at all layers



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Benefits for Grids (3)

- Access to monitoring information
- Reassurance of an active secure network
- Bandwidth on demand
 - Premium IP, Ethernet and wavelength services
- Access to test bed to try out services
- Integration of AA infrastructure
- Operational Interface



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Service Challenges

- Network resource discovery
- On-demand & advanced provisioning
 - End-to-end multi-domain
- Fair Allocation Policy for shared resources
- Service level agreements
- End-to-end monitoring
- Standardisation of Grid-Network Interfaces
- AA integration issues
- Operational interface

Network Resource Discovery



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- To interact with networks, Grids require information about networks
 - Topology, Network Characteristics, Service Availability/Location
- Networks need to provide information
 - clear and consistent manner
 - using a common language (Ontology)
 - across layers/technologies
- GN2-SA3 WI-13 common Network Information Service
- Working with UvA NDL, OGF NML-WG



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Service Provisioning

- To operate efficiently, Grids require
 - On-demand & advanced service provisioning
 - End-to-end multi-domain service provisioning
- Across heterogeneous environment
 - multi-vendor / multi-service / multi-layer
- Automatic network element configuration
- GN2 AMPS, GN2 AutoBAHN



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GN2 - AMPS

- Advance **M**ulti-domain **P**rovisioning **S**ystem
- IP still relevant?
 - Not everyone can afford dedicated circuits
- Single request can book an end-to-end path traversing multiple domains
- Reduces high lead times of manual process to seconds
- Inclusive approach
 - Premium IP enabled or over-provisioned networks
- Deployed in GÉANT2, pilot in some NRENs soon
- Interoperability testing with GRNet ANS, ESN Net OSCARS and Internet2 BRUW



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GN2 - AutoBAHN

- **A**utomatic **B**andwidth **A**llocation over **H**eterogeneous **N**etworks
- A 'Joint Research Activity' investigating the provision of 'Bandwidth on Demand' services to the community
- Multi-domain, Multi-technology, Multi-vendor environment
 - GFP over SDH, L2 MPLS VPN, Native Ethernet
- Prototype under development
 - Prototype Demo: GN2 Technical Workshop in June '07
 - Circuit across HEANet, GÉANT2, GRNet



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Allocation Policy

- How to allocate resource fairly?
- Free: first come first serve
 - Possible misuse
- Charging systems ?
- Each domain is independent and can apply local policies
- Need for Grids to get policy agreements with each domain
- GN2-SA3 deliverable on policy of premium IP allocation
- More work needs to be done in this area
 - Especially at lower layers



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Service Level Agreements

- Need to define SLS and SLA
- Mechanism to exchange SLA
- Working with EGEE on defining/exchanging of SLA
 - Exploring Agreement Signalling (WS-Agreement)
- Issues:
 - What are the SLA parameters?
 - Is the SLA binding?
 - How to monitor?
 - What if one party defaults?



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Monitoring Vision

Information is ...

- Available
 - People can find it (Discovery)
 - “Community of trust” allows access across administrative domain boundaries (AA)
- Ubiquitous
 - Widely deployed (Paths of interest covered)
 - Reliable (Consistently configured correctly)
- Valuable
 - Actionable (Analysis suggests course of action)
 - Automatable (Applications act on data)



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perfSONAR

- perfSONAR is a Monitoring infrastructure
- Facilitate the retrieval of monitoring information from multiple administrative domains
 - Abstracts heterogeneous monitoring tools
 - Using standardised web service interface
 - GGF NMWG schemas
- Enables e2e troubleshooting and SLA monitoring
- Raw data allows custom visualisation and analysis
- Data from Europe, Internet2, ESNNet, RNP Brazil
- Successful tests with EGEE NPM Diagnostic tool



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Interface Standardisation

- Grid – Network (programmatic) interface need to be standardised
- Working with OGF in this area
 - Network Monitoring Working Group (NM-WG)
 - Network Mark-up Language Working Group (NML-WG)
- Keeping an eye on the business forum
 - IP Sphere



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AuthN .. AuthZ

- All network services will require authentication and authorisation
- Grid users will already have identity in their own domain
- GN2-JRA5 eduGAIN is building an AA framework
 - Federate the national AA infrastructures
 - Use existing identity providers
- Each domain will enforce its own AuthZ policies
- Integration of Grid and Network AA infrastructures

Operational Interface between Grids and Networks



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- Interface between GOC and NOC
 - To create a network support infrastructure in EGEE
 - Define associated operational procedures between
 - EGEE NOC (ENOC)
 - End-2-End Coordination Unit (E2ECU)
 - trace, diagnose and resolve problems
 - Networks to signal problems to Grids
 - Trouble Ticket system integration
 - Trials with CERN LHC-OPN
- Access to PERT system for performance issues



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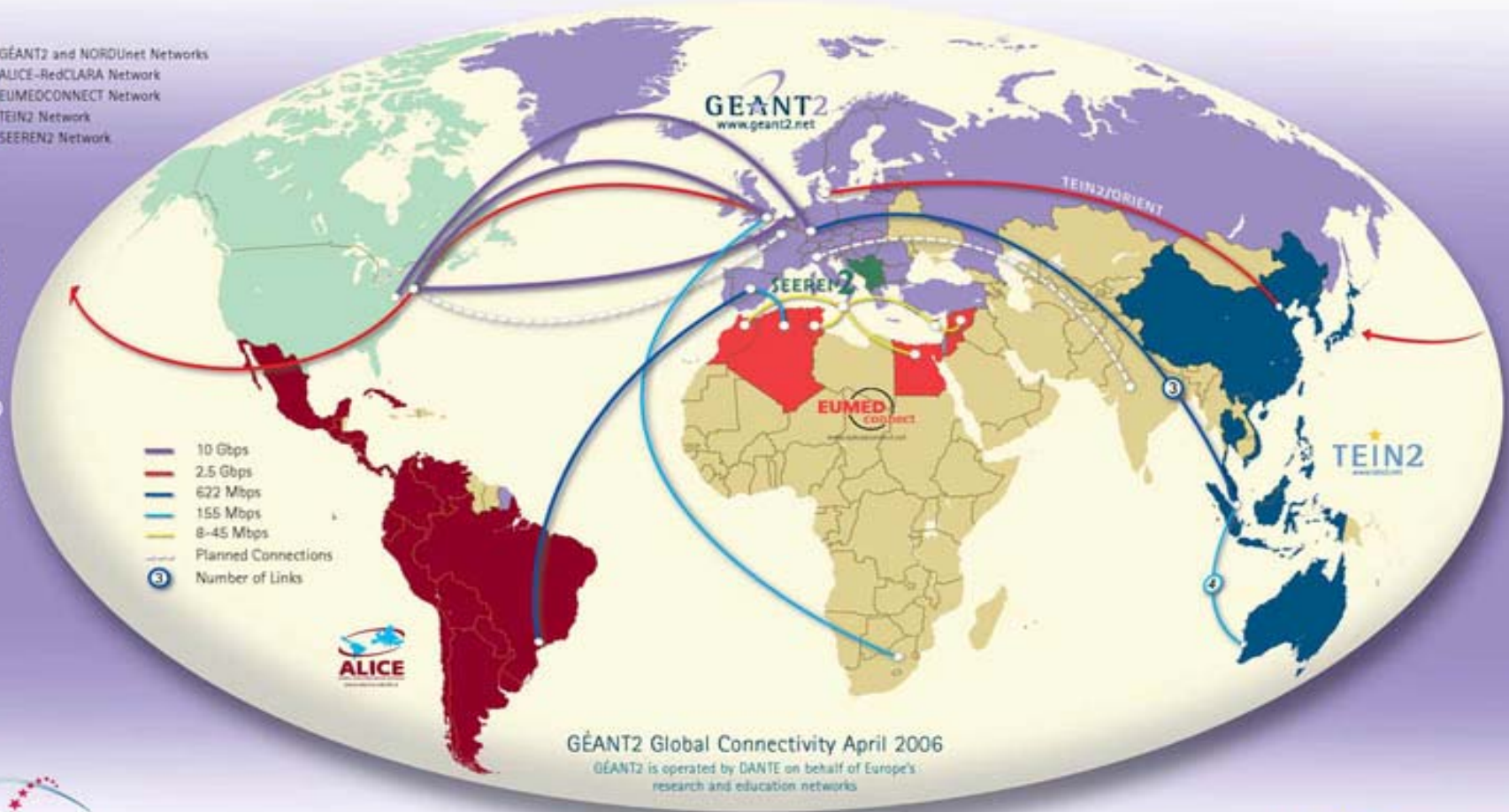
Global View

- Collaboration with other European projects
 - MUPBED, VIOLA, EGEE-2
- European initiatives are not working in isolation
- International collaboration with other similar initiatives:
 - Internet2, Canarie, ESnet, RNP Brazil
 - OSCARS, BRUW
 - HOPI, UCLP, DRAGON
- Working with other bodies
 - OIF / ITU, OGF
 - IPSphere

GEANT2 At the heart of Global Research Networking

- GEANT2 and NORDUnet Networks
- ALICE-RedCLARA Network
- EUMEDCONNECT Network
- TEIN2 Network
- SEEREN2 Network

www.geant2.net



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

GEANT2 Global Connectivity April 2006
 GEANT2 is operated by DANTE on behalf of Europe's research and education networks



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Summary

- Grids are evolving with dynamic requirements
- Existing networks services need to be adapted
- Service challenges have to be met
- GÉANT2 a hybrid pan-European network
 - Introducing advanced services
- Various research / service activities in progress
 - More work needs to be done
- A Global view – not just European !



Thank You

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Any further Questions, Comments, Feedback or Suggestions

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