

Future of Optical Networking

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European Union Plans & Activities

Bernhard FABIANEK

Bernhard.Fabianek@cec.eu.int

www.cordis.europa.eu.int/ist/rn/home.html

European Commission, Information Society and Media Directorate-General

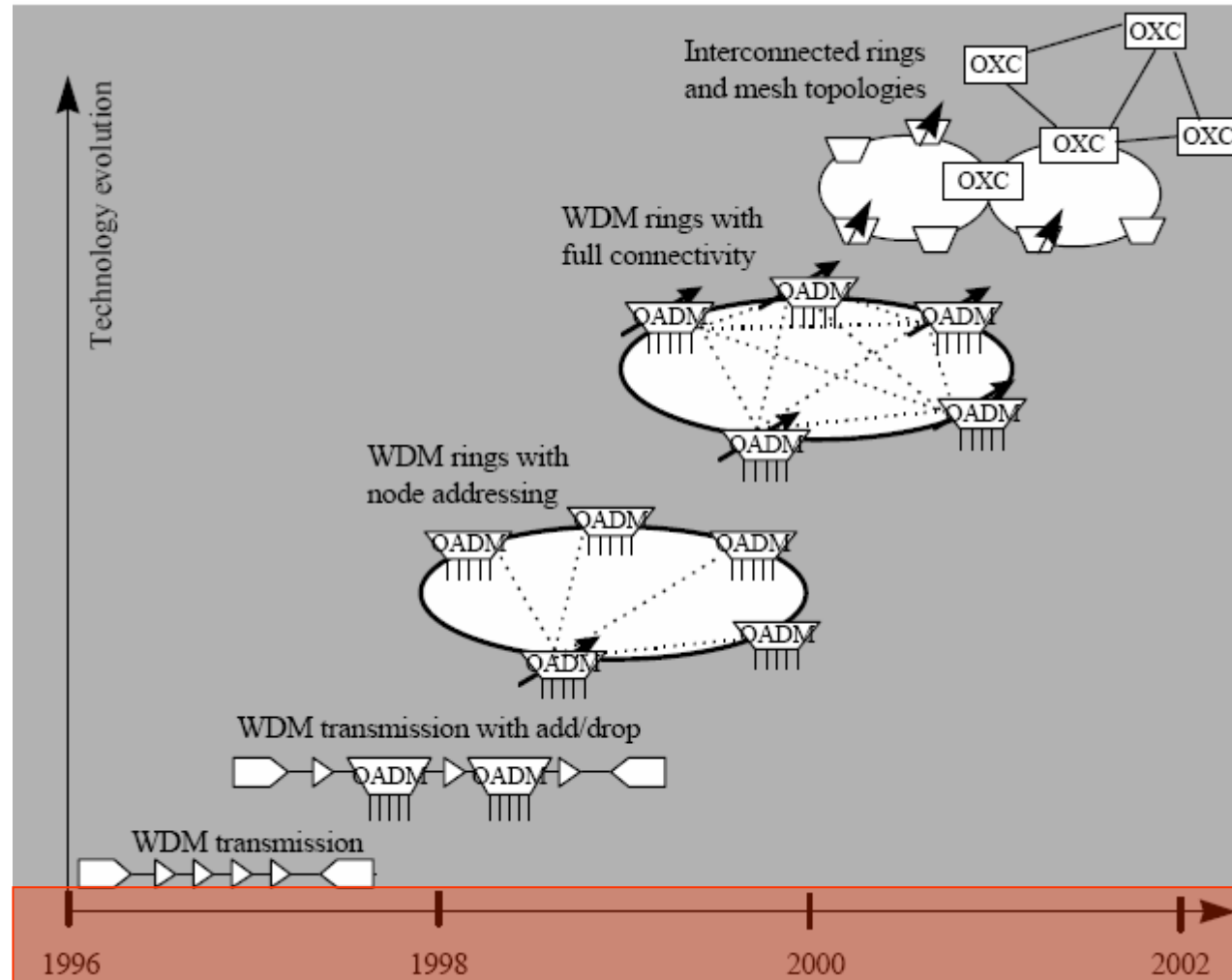
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ACTS Fibre Trials – 1997!



Evolution scenario optical network architecture

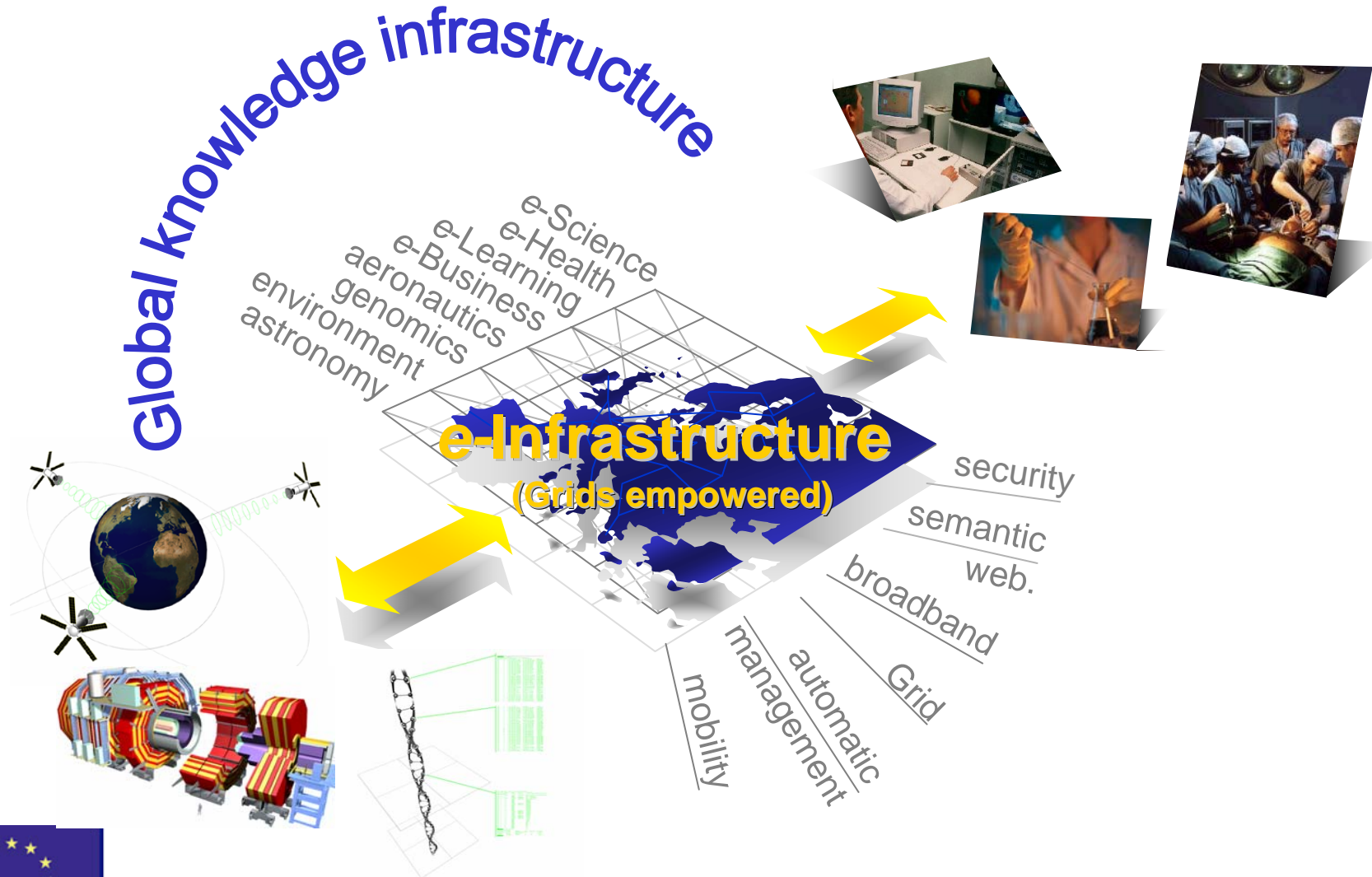


Source: ACTS Photonics Roadmap 1999

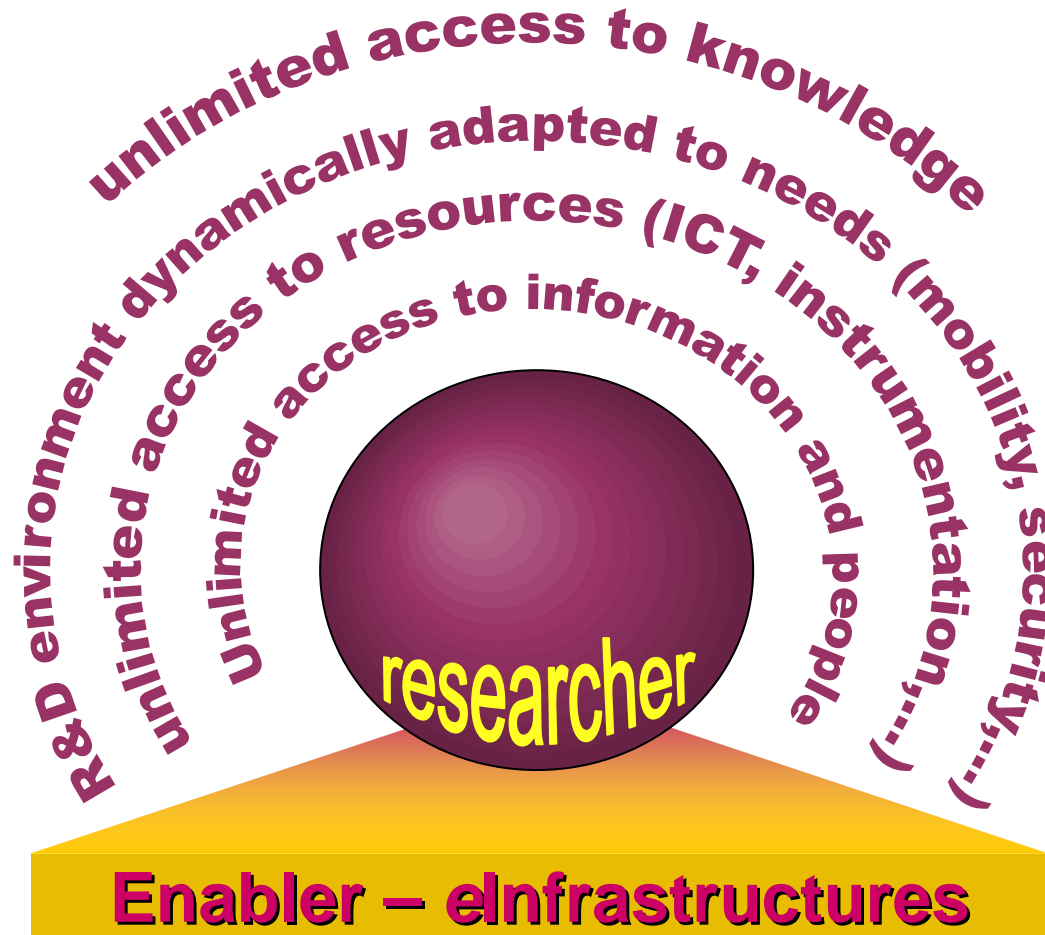
What's gone wrong?



Connect Everything Everywhere



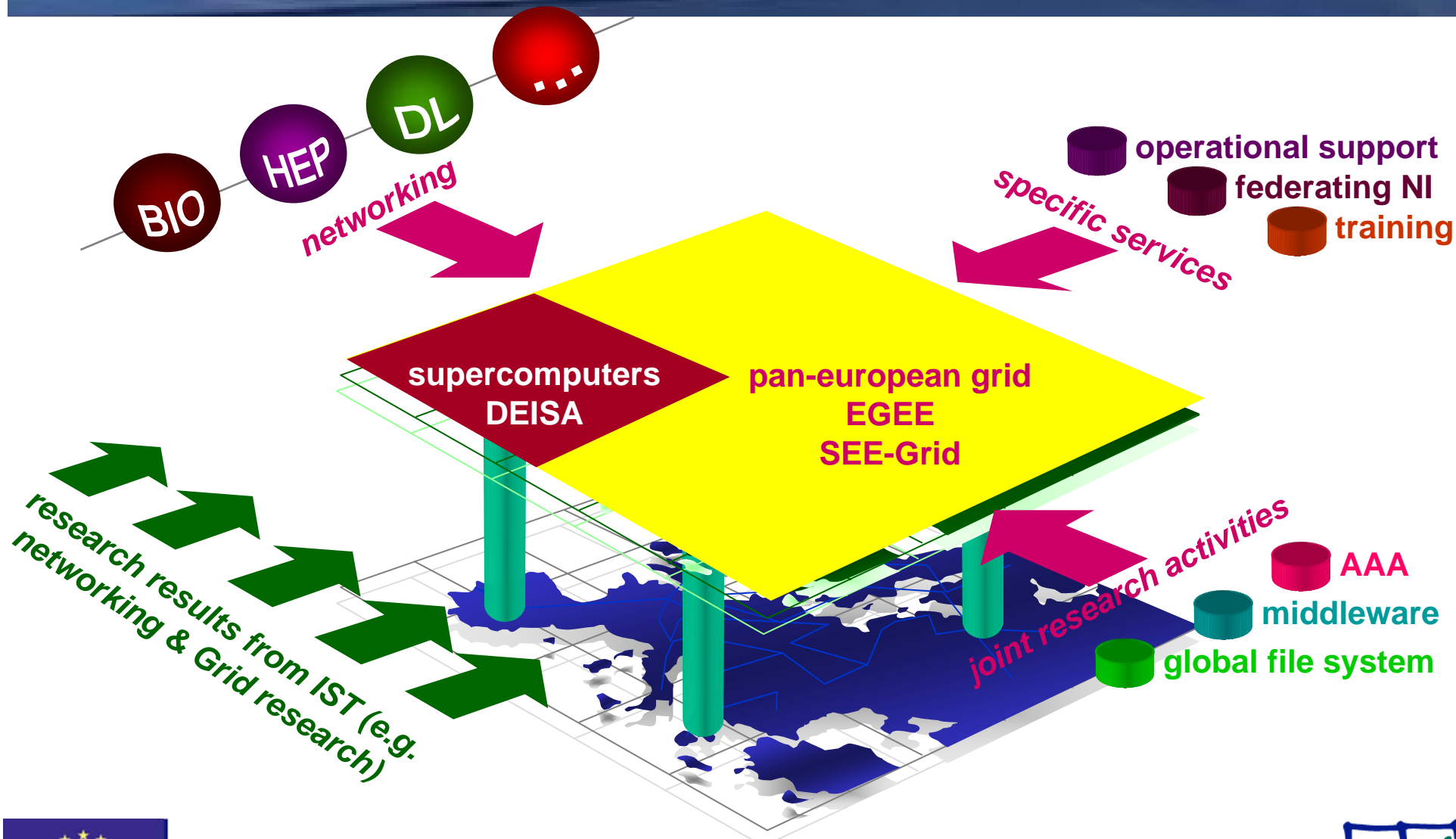
Researcher: Fast Growing Needs



Researcher: the most precious capital and the centre of all developments!



Linking National and International Networks



international dimension intrinsic from the start



GÉANT2: The Flagship of Networking Activities in Europe

GÉANT2: a pan-European network infrastructure exploring the latest developments in telecommunications technology

- ➔ Network Services for National Research and Education Networks (NRENs)**
- ➔ Platform for Testing – Lambdas, GRIDs, IPv6,...**



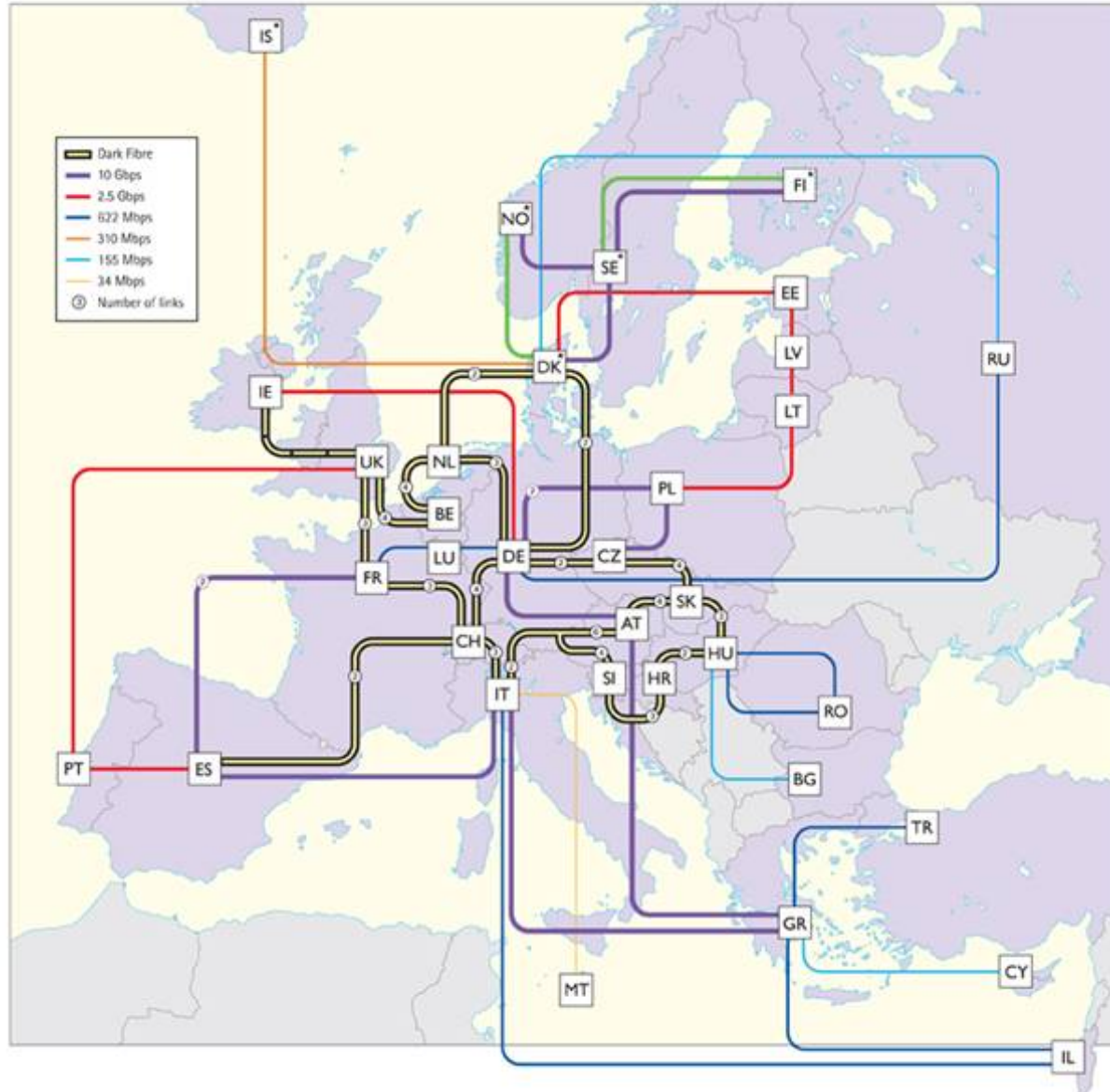
New GÉANT2 Dark-Fibre Network

↕ 12 000 km Fibre

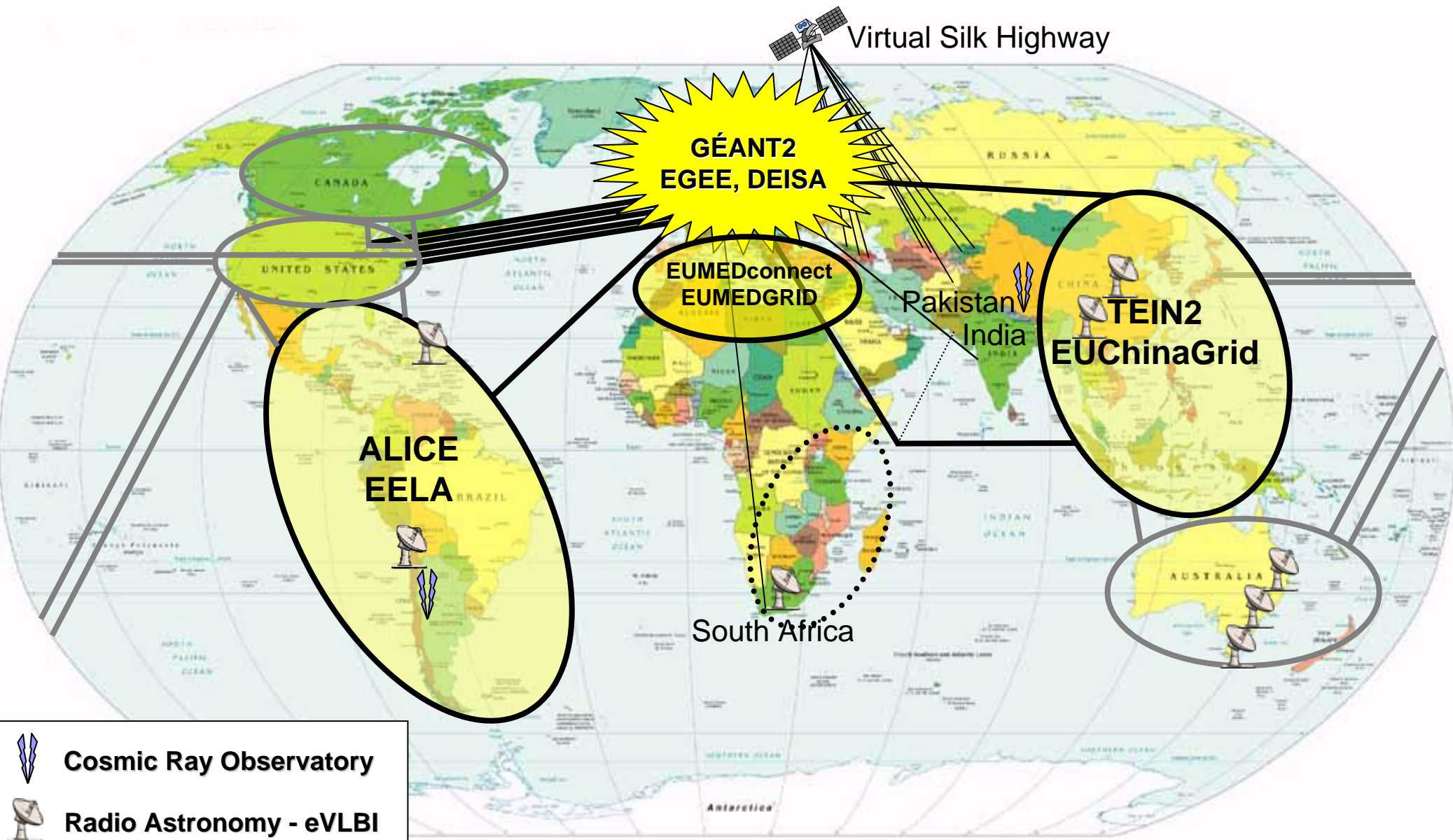
↕ 400+ Active Elements

↕ Hybrid Network:

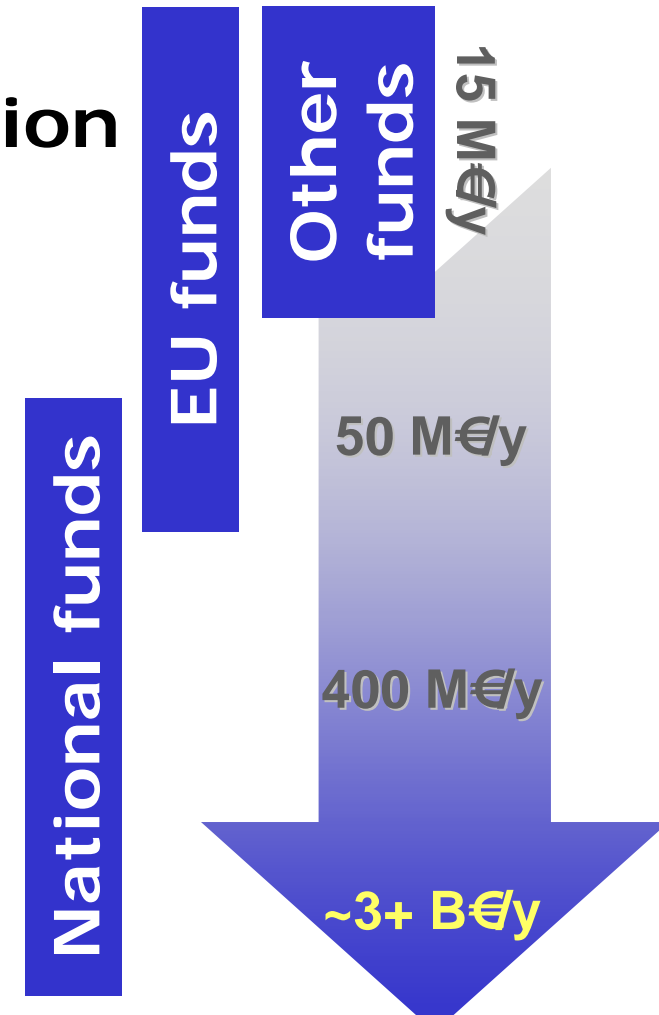
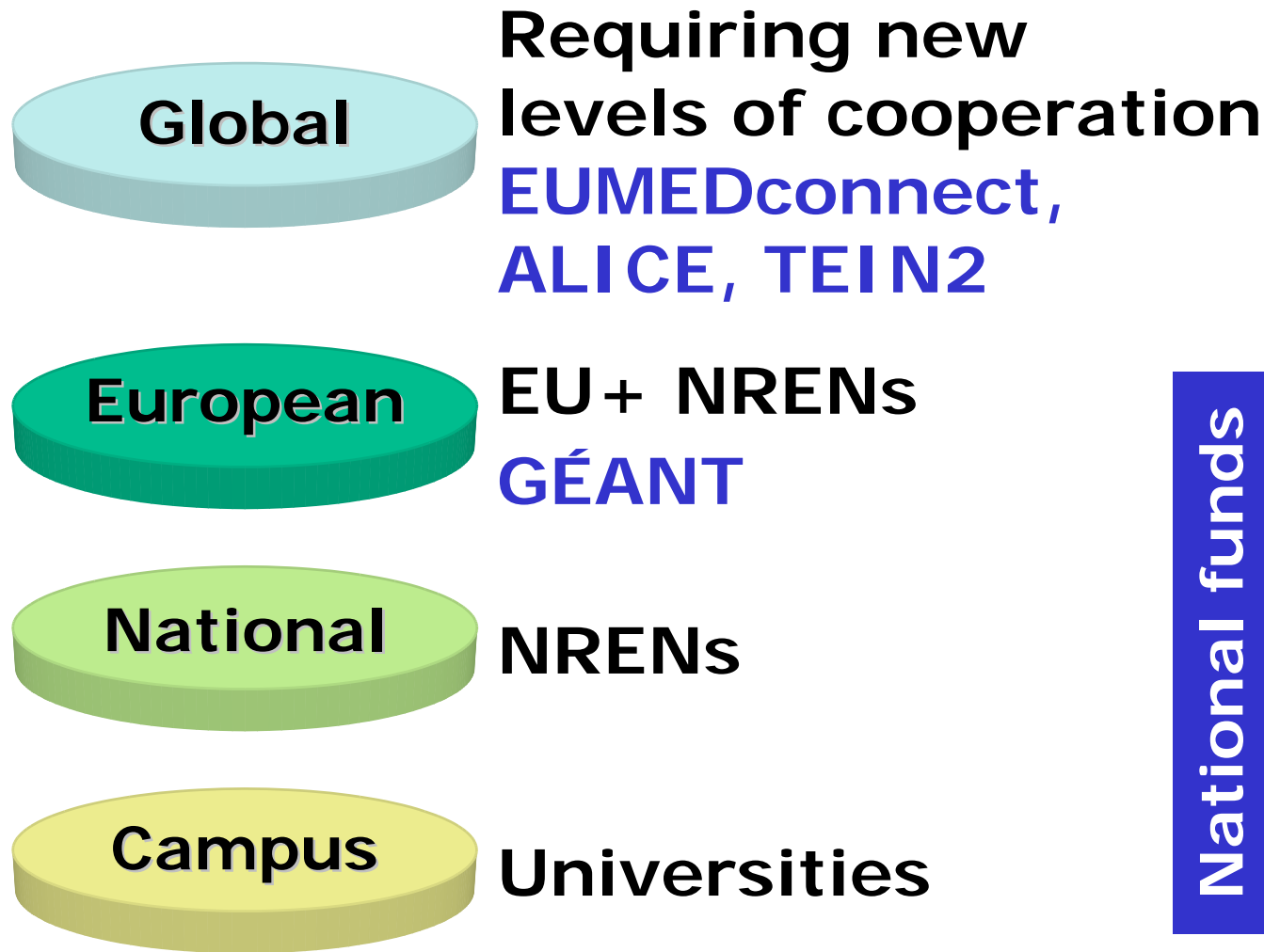
Photonics + IP



Interconnecting e-Science Initiatives across the World



GÉANT: The Model



What is NOT Needed?

⇒ New technology

“Everything” has already been done
No need to re-invent the wheel

⇒ An overall management and control layer

⇒ 40 Gb/s interfaces

100 Gb/s has to be the next step to make it worthwhile
(technically and economically) to upgrade

⇒ SDH on steroids

SDH for point-to-point links is sufficient

⇒ Intelligent optical network



What is Needed!

⇒ **10 Gb/s Ethernet switches with C/DWDM interfaces**

Previously one would have called this EXC

⇒ **Even better a Router with 10 (or 100) Gb/s C/DWDM interfaces**

⇒ **An easy way to manage and monitor line equipment**

SNMP for amplifiers, etc. via out of band links?

⇒ **A “working implementation” of the X-interface**

To allow for an easy way to provision chunks of 1GE across domains and different technologies

⇒ **Optical Burst Switching**

To allow for statistical multiplexing of wavelengths

⇒ **Global coordination on an operational level**

To allow for end-to-end on-demand wavelengths across multiple domains



Watch out for

➔ Cheap and dirty photonic networking

It does not always need a fully specified and engineered solution to reliably deliver data

➔ Campus networks are triggering a huge demand for a photonic network infrastructure (1 GE to the desktop)

➔ Developing regions will use this opportunity to leapfrog several technology steps (Digital Divide)

➔ The NRENs rolling out national fibre optic backbones

Consequently photonics know-how will be widespread and readily available

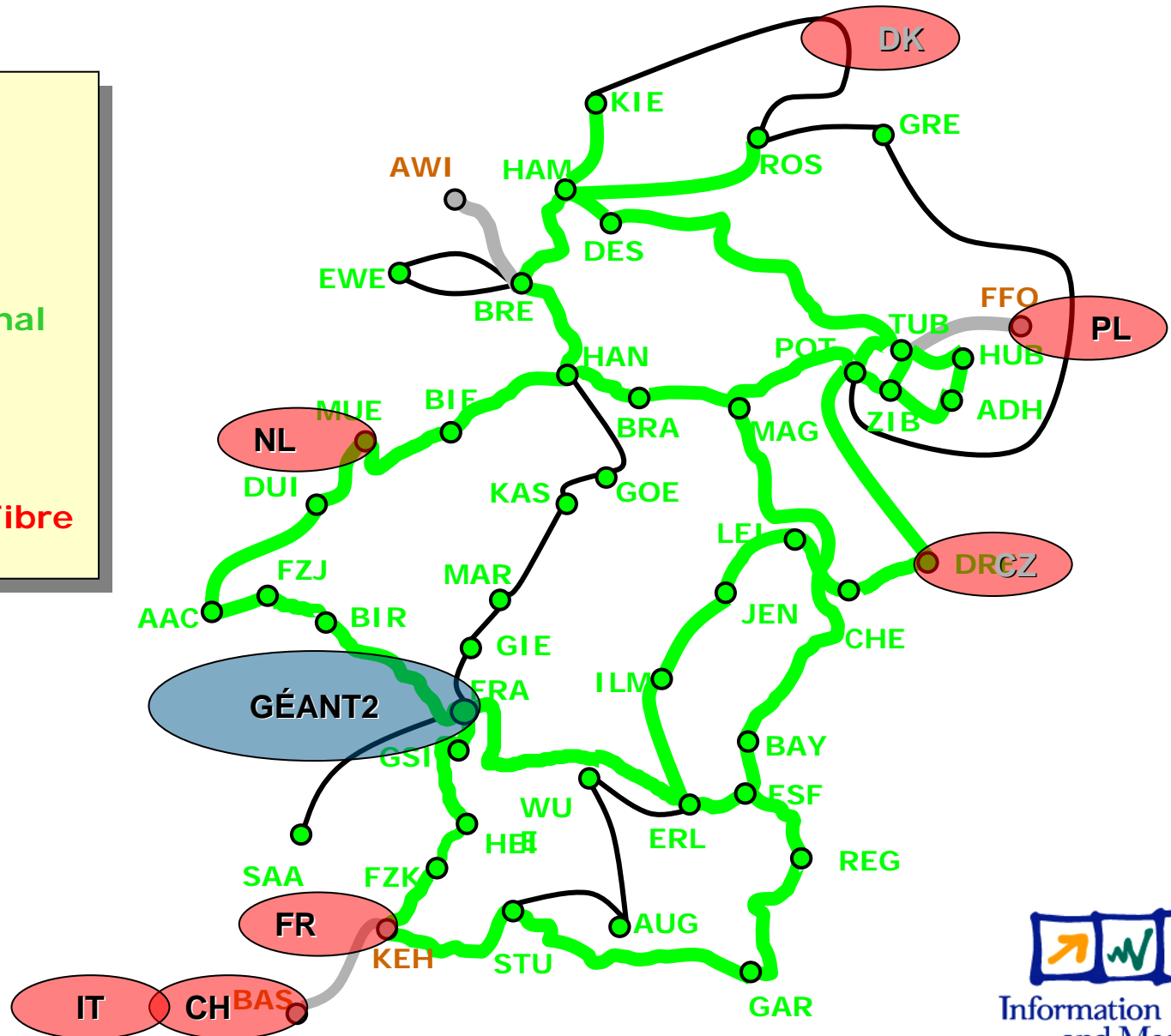


Germany - DFN Dark-Fiber Network

DFN-Location

- DWDM installiert
- Fibre ordered
- Fibre operational
5500 km
- Wavelength

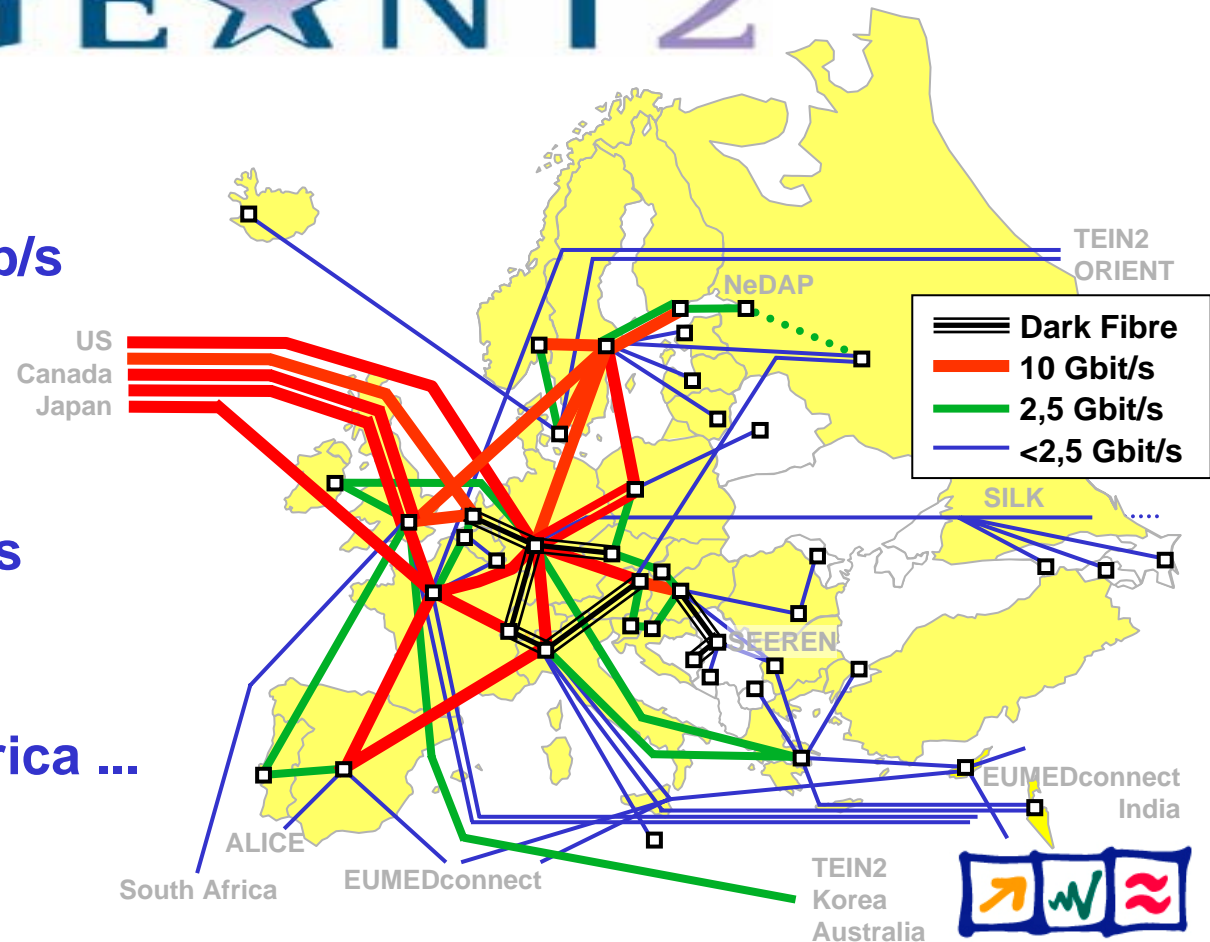
FR Cross Border Fibre



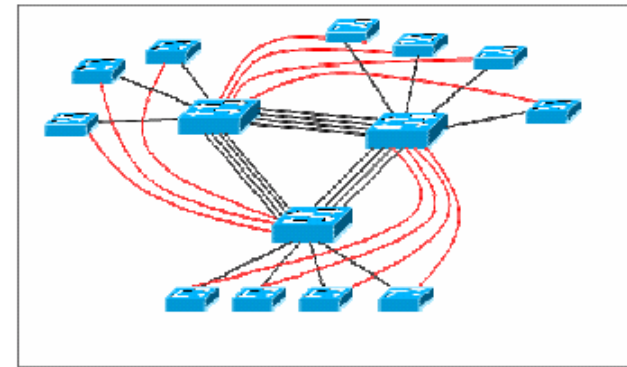
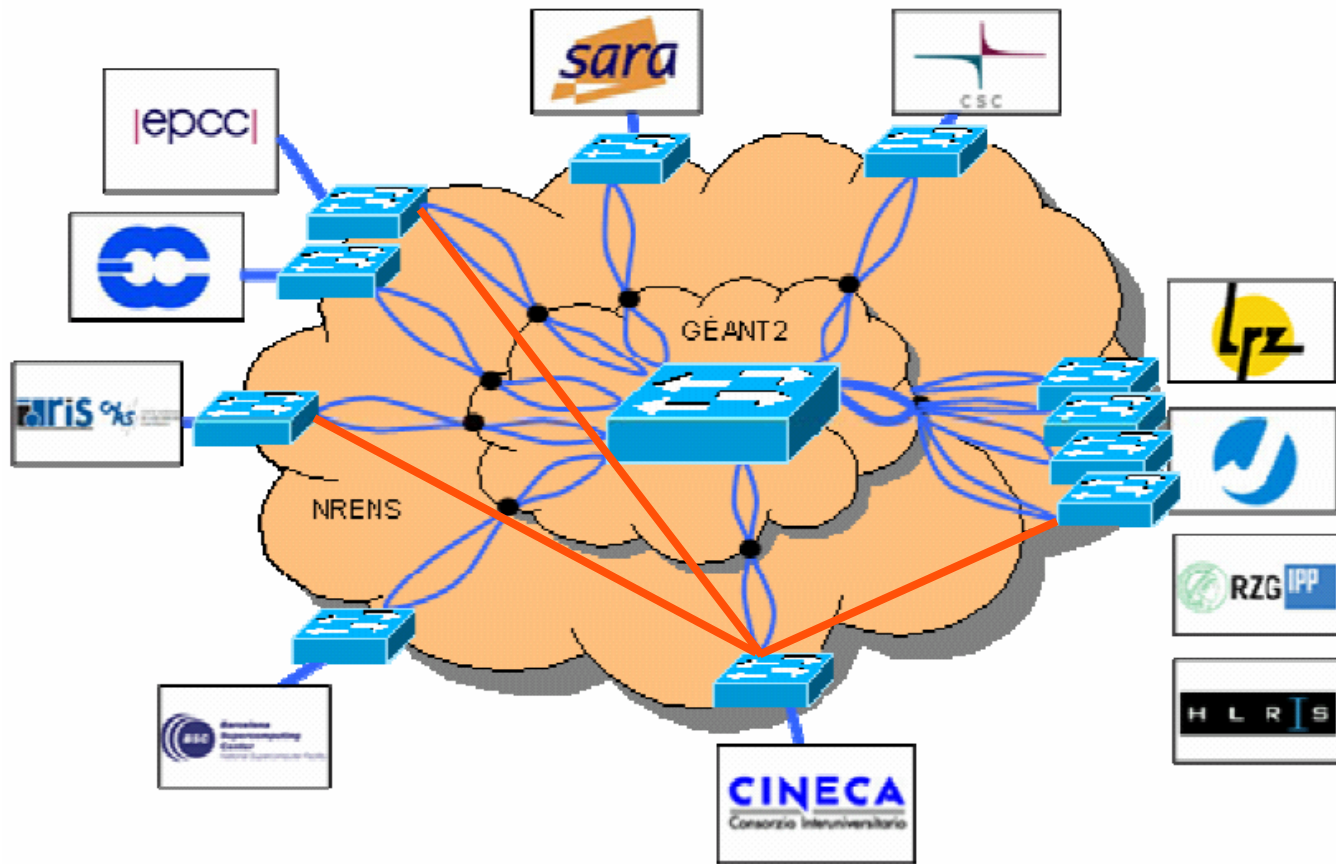
Research Networking

- Pan-European coverage (40+ Countries/NRENs)
- Dark fiber wavelength and Gigabit connectivity at 10 Gb/s
- Linking more than 3900 Universities
- 30+ Million Students
- Total 200 MEuro over 4 years (93 MEuro from EU)
- Extend to Mediterranean, Asia Pacific Rim, Latin America ...

GEANT2

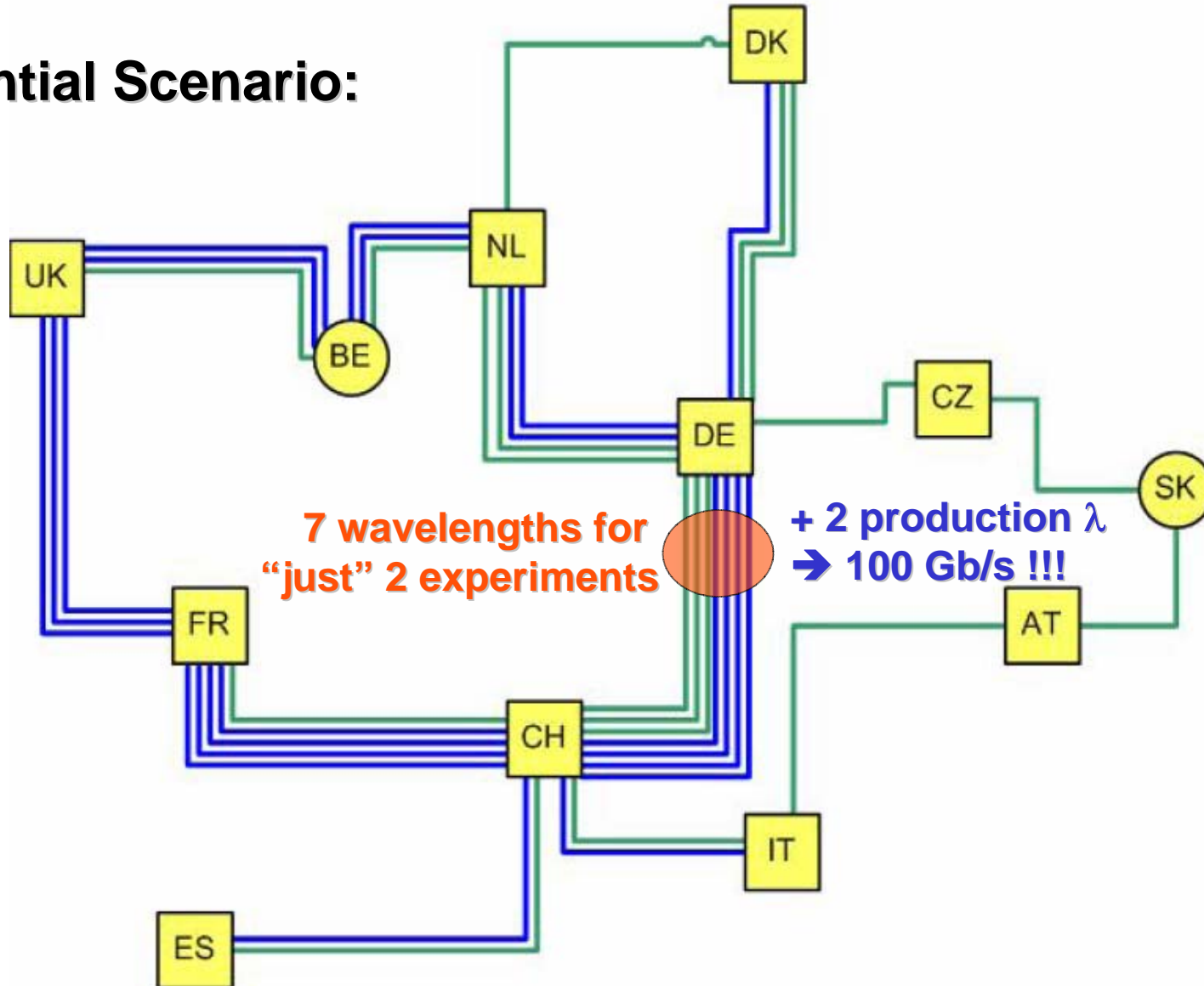


DEISA: Linking Supercomputers



Large Hadron Collider + DEISA

A potential Scenario:



Conclusions

- ➔ **With the support of the European Union's R&D Programmes a new generation of infrastructures for research (GÉANT and Grids) has been launched – **elInfrastructures****
- ➔ **The European Union is investing in Lambda and Photonics technologies to support highly demanding user communities**

The provision of an elInfrastructure is fundamental for the realisation of the European Research Area (ERA)



The Future

- ⇒ **The 7th EU Framework Programme for R&D 2007 until 2013**
- ⇒ **Research Infrastructures substantially strengthened in scope and in money**
- ⇒ **New areas of work addressing supercomputers and scientific repositories in addition to GÉANT and Grids**
- ⇒ **Test-bed Facility for the Future of the Internet under discussion**
- ⇒ **Practical co-operation needed between industry (vendors) and advanced user communities (buyers)**





Connect ★ **Communicate** ★ **Collaborate**

GEANT2

