

Future Internet Experiments over National Research & Education Networks: The Use Cases of FEDERICA & NOVI over European NRENs - GÉANT

Vasilis Maglaris

Professor of Electrical & Computer Engineering, NTUA
Chairman, NREN Policy Committee - GÉANT Consortium

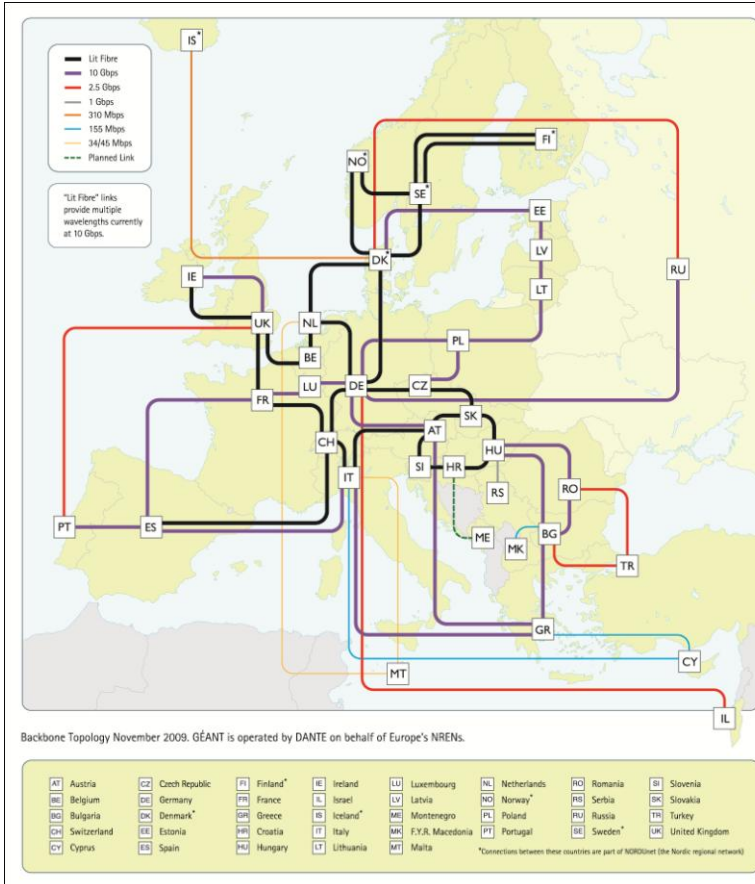
maglaris@netmode.ntua.gr

APAN 30th Meeting

11th August 2010

Hanoi, Vietnam

The GÉANT Service Area





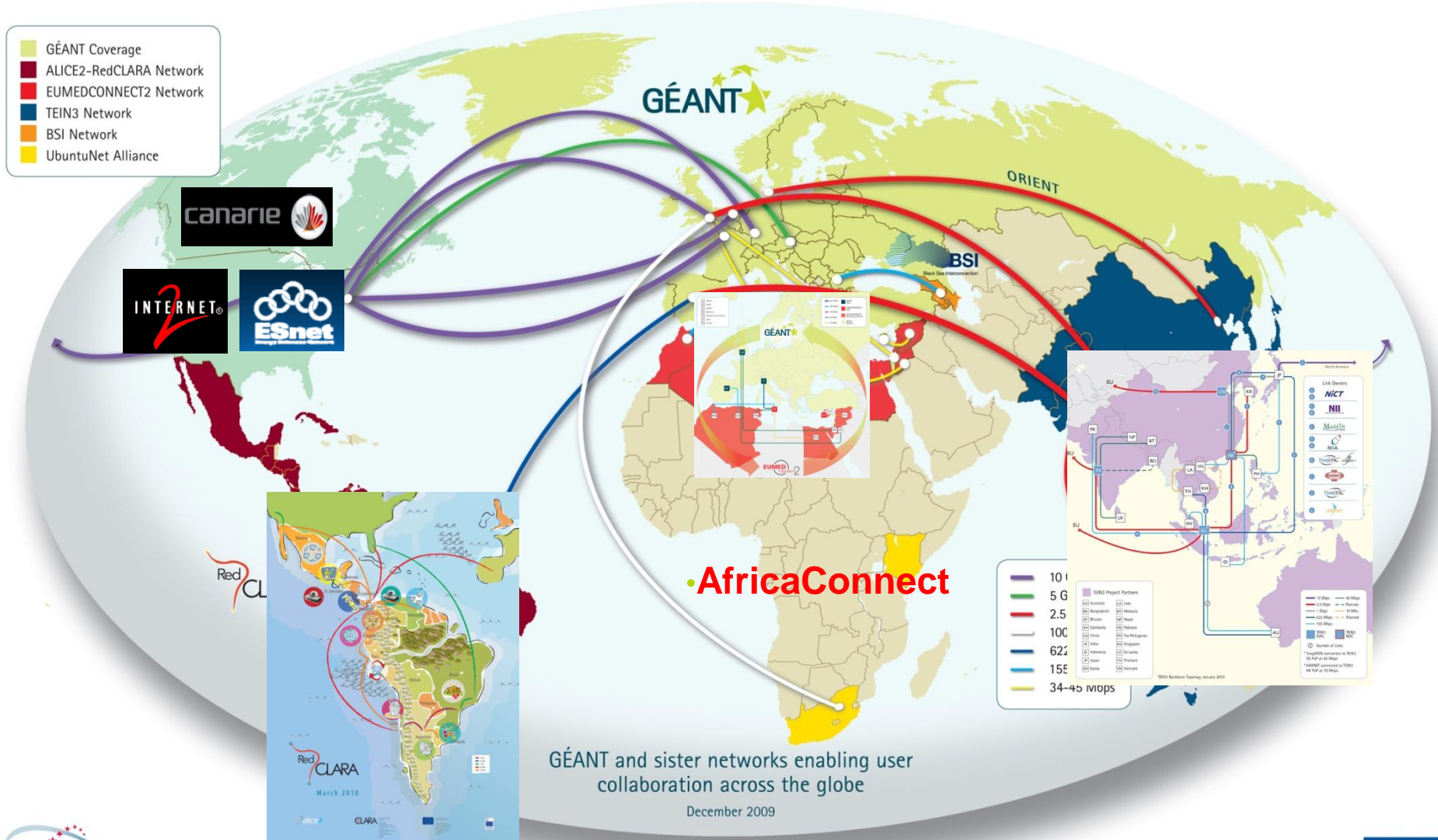
GÉANT COST: 40 M€/year

Not just the GÉANT backbone

Federated services via **36 NRENs** and **3000+ Campuses** to **40 M+ users**

GÉANT At the Heart of Global Research Networking

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



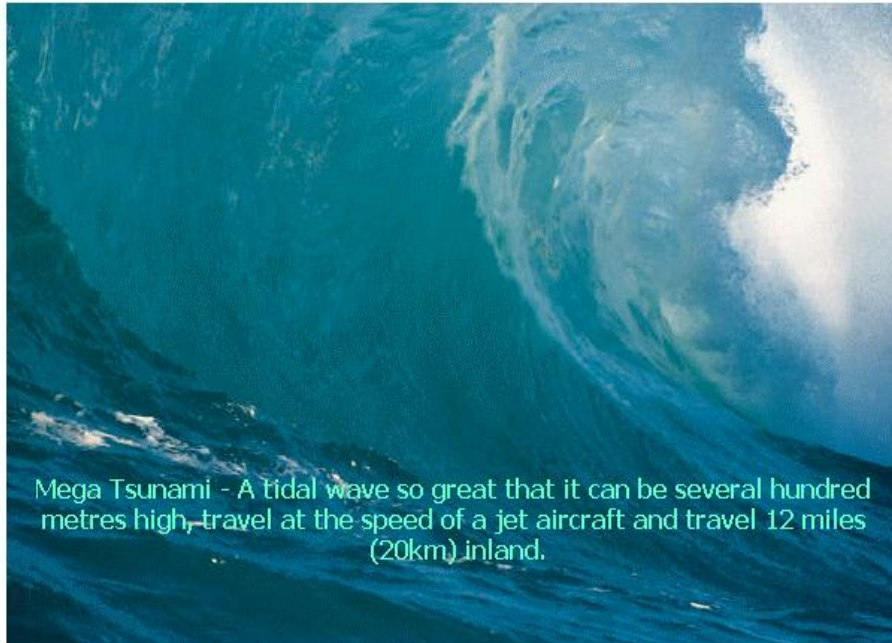
GÉANT and sister networks enabling user collaboration across the globe
December 2009

connect • communicate • collaborate

GÉANT is co-funded by the European Commission within its 7th R&D Framework Programme.

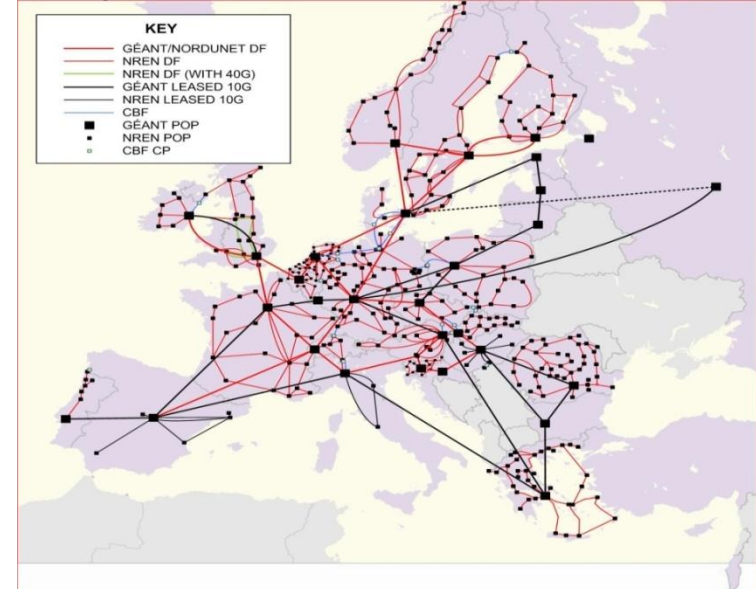
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The Key Challenge for NRENs - GÉANT: A Tsunami of Global High-End Requirements



Mega Tsunami - A tidal wave so great that it can be several hundred metres high, travel at the speed of a jet aircraft and travel 12 miles (20km) inland.

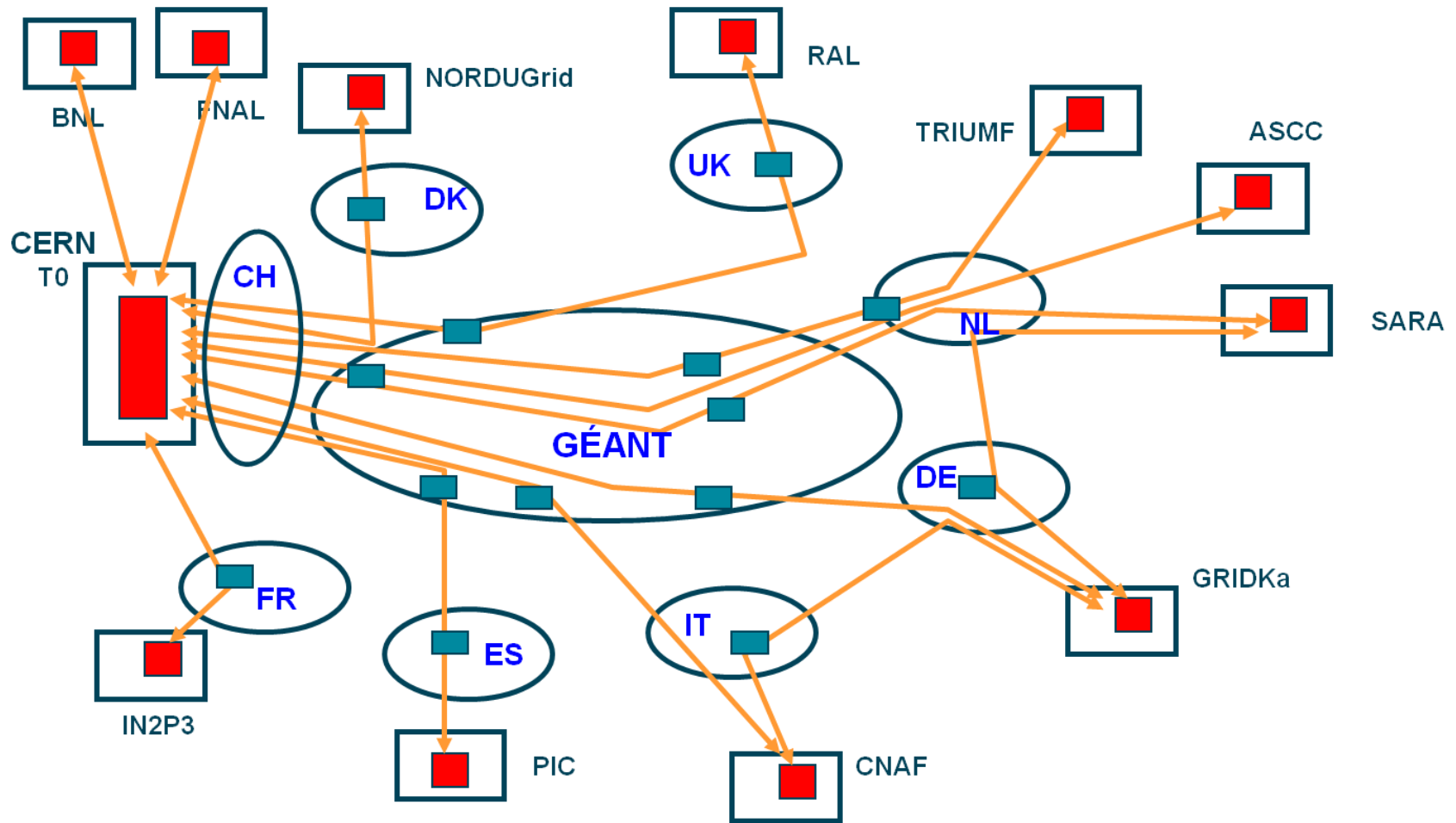
10 Gig+ NREN – GÉANT Footprint, June 2009



High-End Users (HPC, CERN, ITER,...) require stable production services:

- Provisioning 10-40-100 Gbps networks (DWDM over dark fiber, leased λ)
- Meeting robustness, reliability, security requirements
- Enabling multi-domain e2e monitoring & on-demand hybrid resource allocation
- Managing converging e-infrastructures as a High Performance Computing & Networking (HPCN) Cloud → **Future Internet (FI) Services & Applications**

LHC Tier0 – Tier1 Optical Private Network



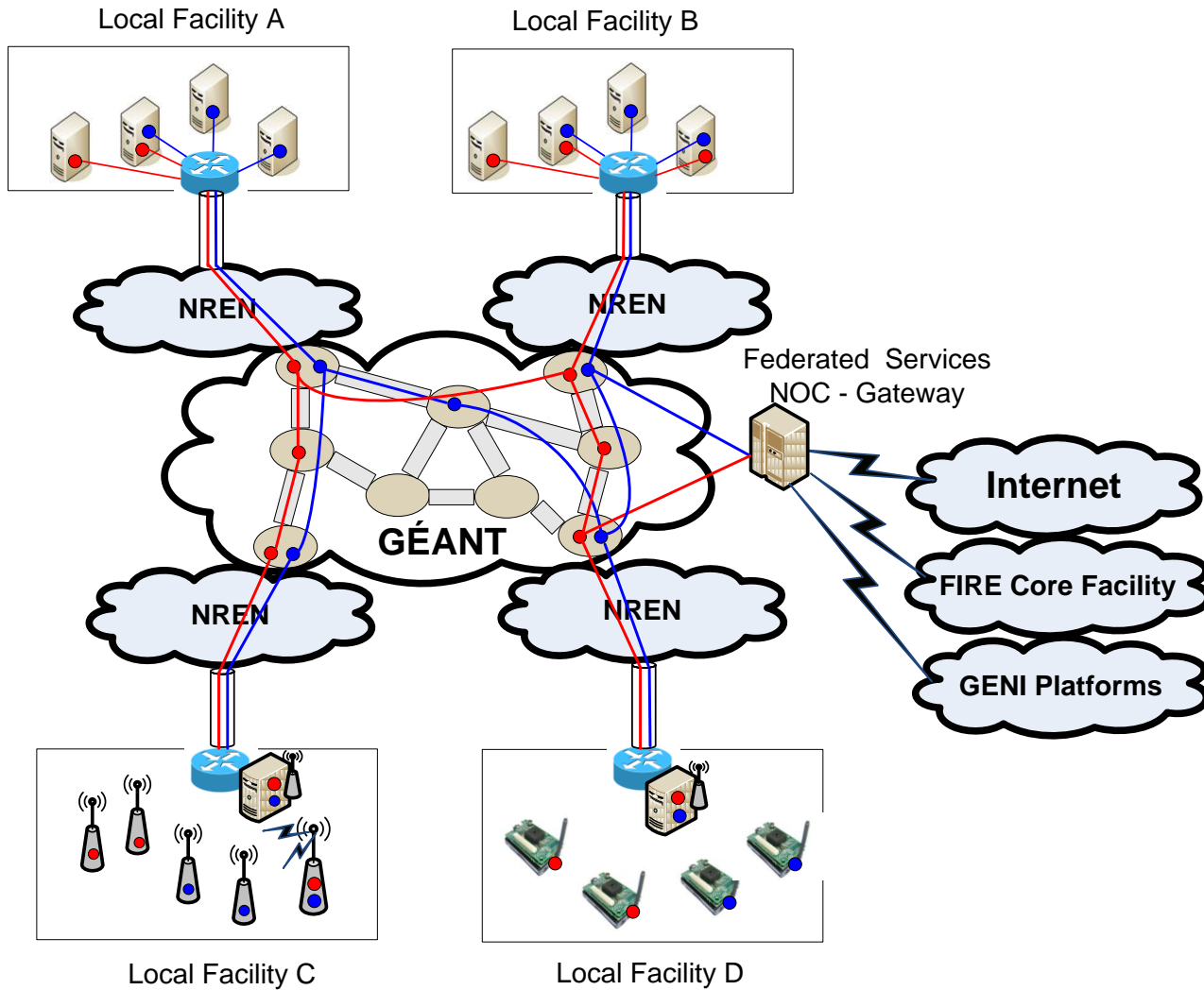
ITER Proposed Connectivity



Future Internet Experimental Research: An Opportunity for NRENs

- **Requirements:**
 - Sharing optical backbones & housing for FI experiments
 - Emulating real-world conditions
 - In isolation from production traffic (slicing, virtualization)
 - Interconnection of local testbeds (e.g. OpenFlow, wireless labs)
- **NRENs as infrastructure providers & innovation brokers:**
 - In **Europe**: FI Private-Public Partnership (PPP) & FIRE → provisioning of NREN – GÉANT facilities (e.g. FEDERICA)
 - In the **US**: GENI experimental platforms → provisioning of Internet2, NLR, ESnet, RON facilities (e.g. VINI)
 - In **APAN**: NICT (JP), CERNET (CN), KOREN (KR), AARNet (AU),...

Virtualization over GÉANT - NRENs

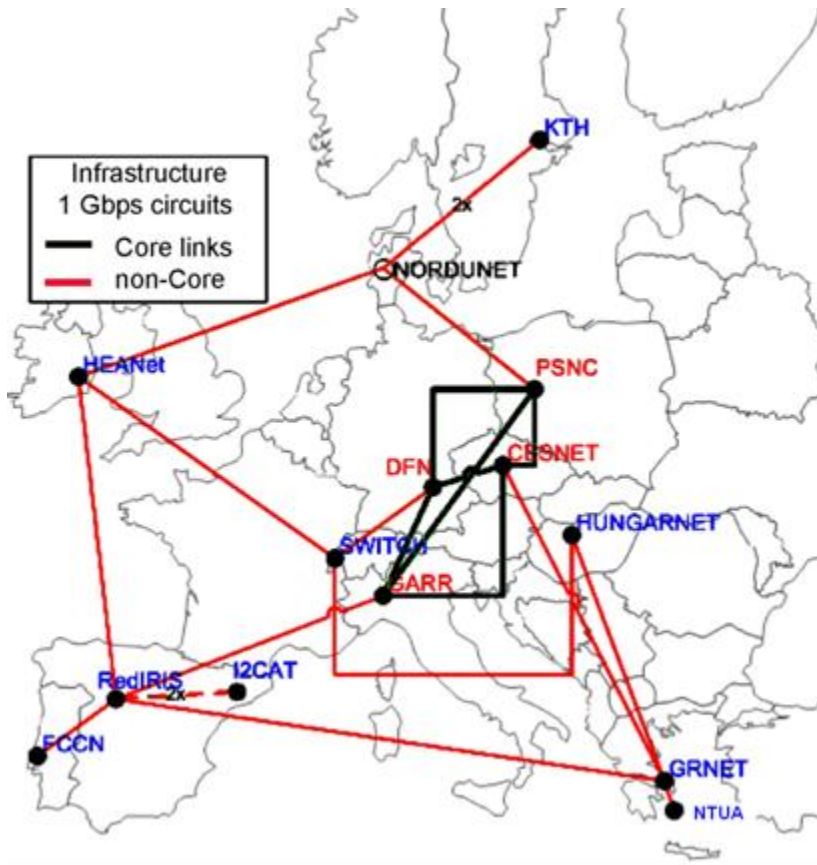


Potential role of GÉANT – NRENs in FI Experimental Research

- **Contribute to FI Core facilities** (FIRE, FI PPP) with 1-10 Gbps connectivity at all layers (including **Bandwidth on Demand**) & virtual infrastructures (including systems)
- Support virtual resource allocation, scheduling, federated admission control - roaming AAI & mechanisms for protected operation of isolated communities leading to the concept of **Infrastructure as a Service**
- Develop – deploy tools to create, monitor and control virtual resources allocated to FI user communities, towards the **Network on Demand** vision
- Research on common, context aware descriptions of heterogeneous virtual networking elements, enabling **resource discovery & provisioning** of composite services
- Provide **NOC functionality** for virtual communities based on scalable management of virtual resources by stake-holders in the federation, also leveraging collaborations with **external platforms** (Internet, GENI, FIRE...)

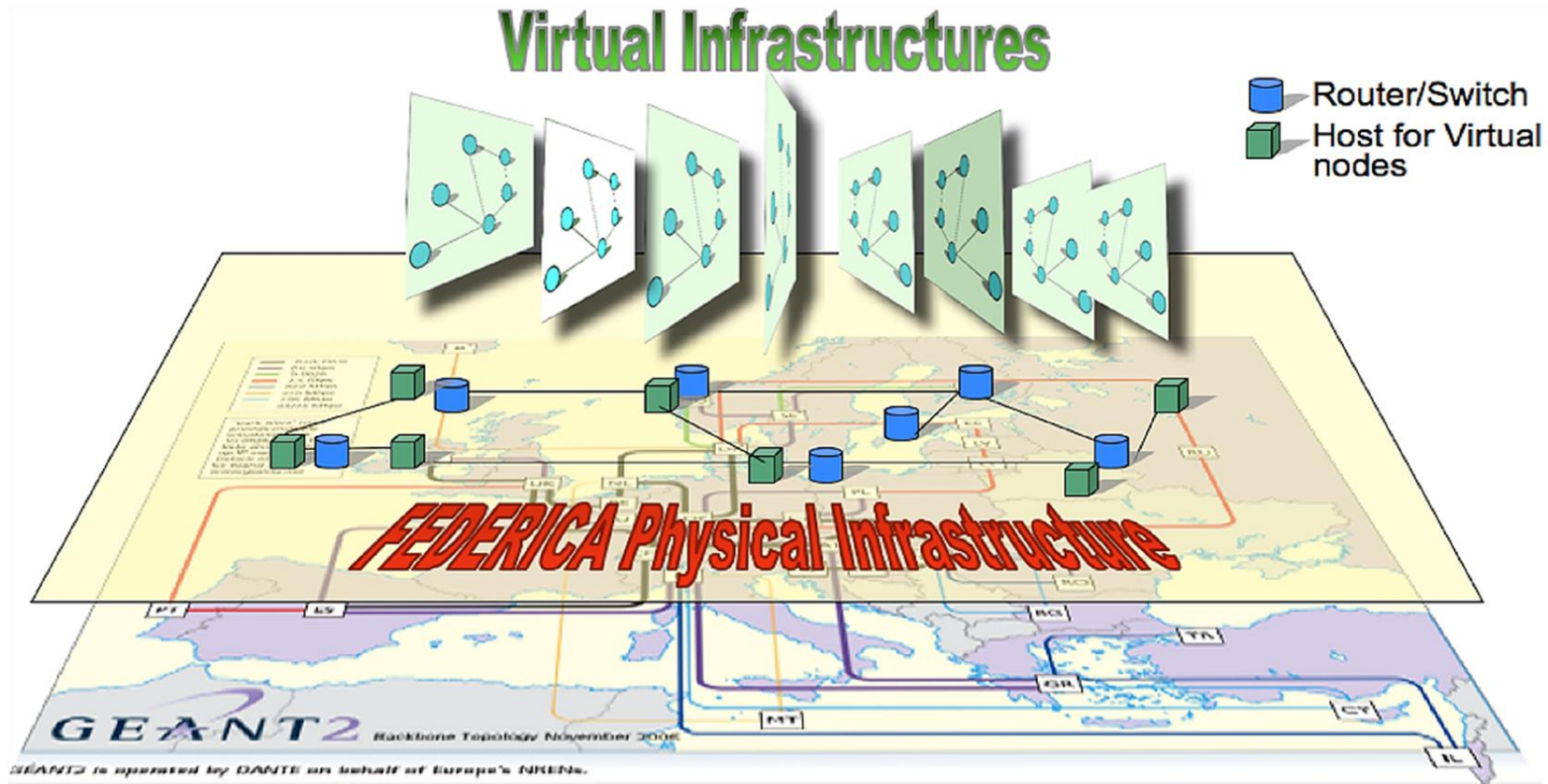
A Research Infrastructure Project: **FEDERICA**

Federated **E**-infrastructure **D**edicated to **E**uropean **R**esearchers
Innovating in **C**omputing network **A**rchitectures



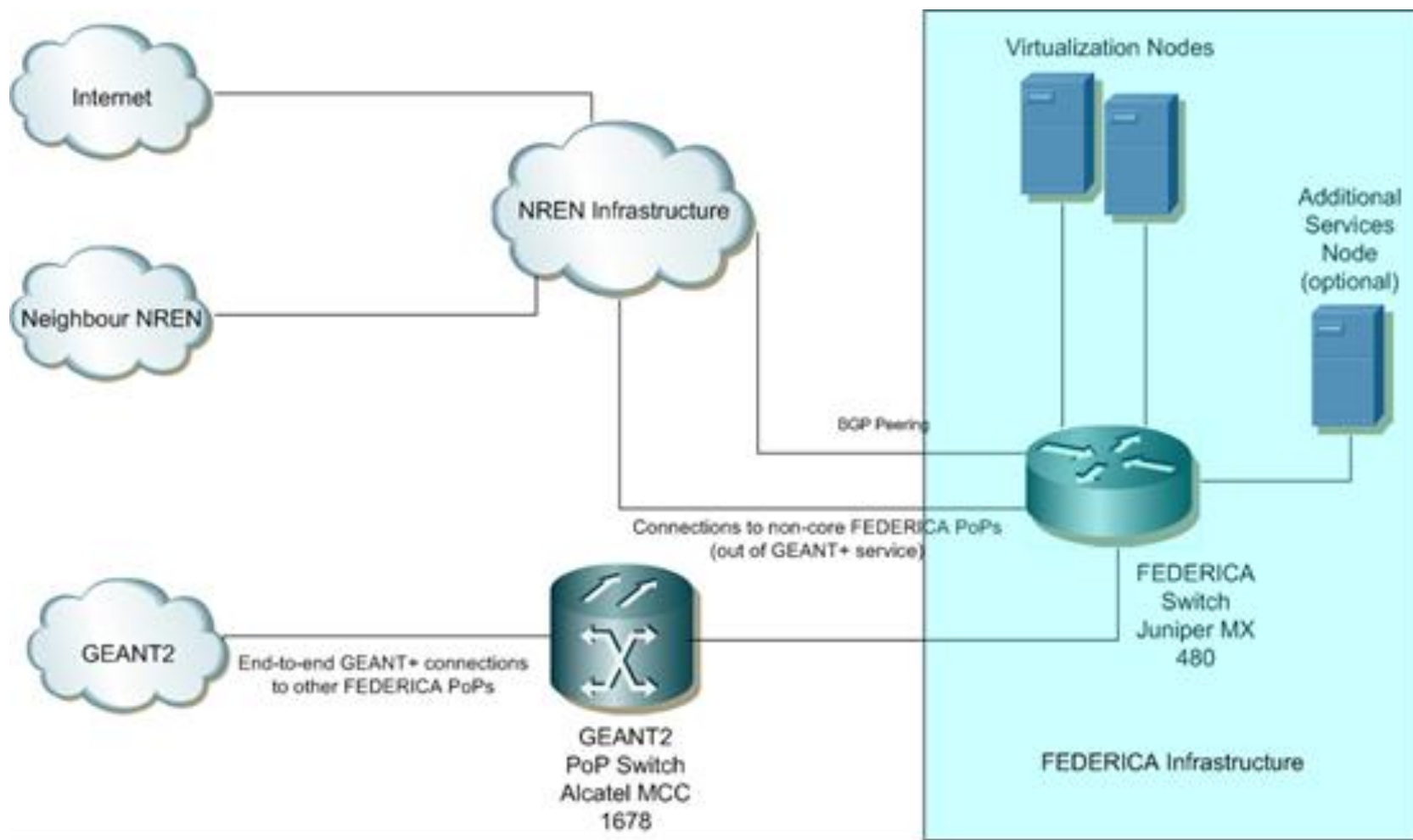
- EC FP7 – Capacities (DG INFSO-F, e-Infrastructures/GÉANT Unit)
- 20 Partners (NRENs, DANTE, TERENA, Academic & Research Institutions, Industry)
- 30 Months (ends October 2010)
- Provide FI researchers with virtualized experimental facilities as user slices (Infrastructure as a Service)
- Enable emulations in a controlled environment → reproducibility

The FEDERICA Concept



GEANT2 and NRENs Infrastructure

FEDERICA Node Configuration



Node Gear

MX480

Juniper MX480 Ethernet Services Router:

- Layer 2 and Layer 3 platform
- Provider Edge for L3VPN, L2VPN, VPLS
- Logical Routers
- Integrated tunnel functionalities
- Open APIs
- VLANs and MPLS

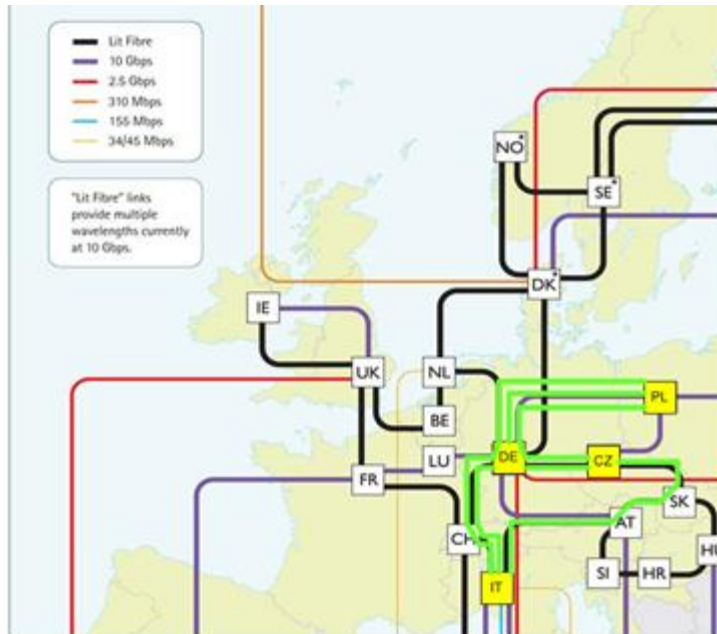


Start with “R” linecards (L2 and L3) with 40 x 1 GigE ports and “R-Q” linecards with 6K hardware traffic schedulers for QoS

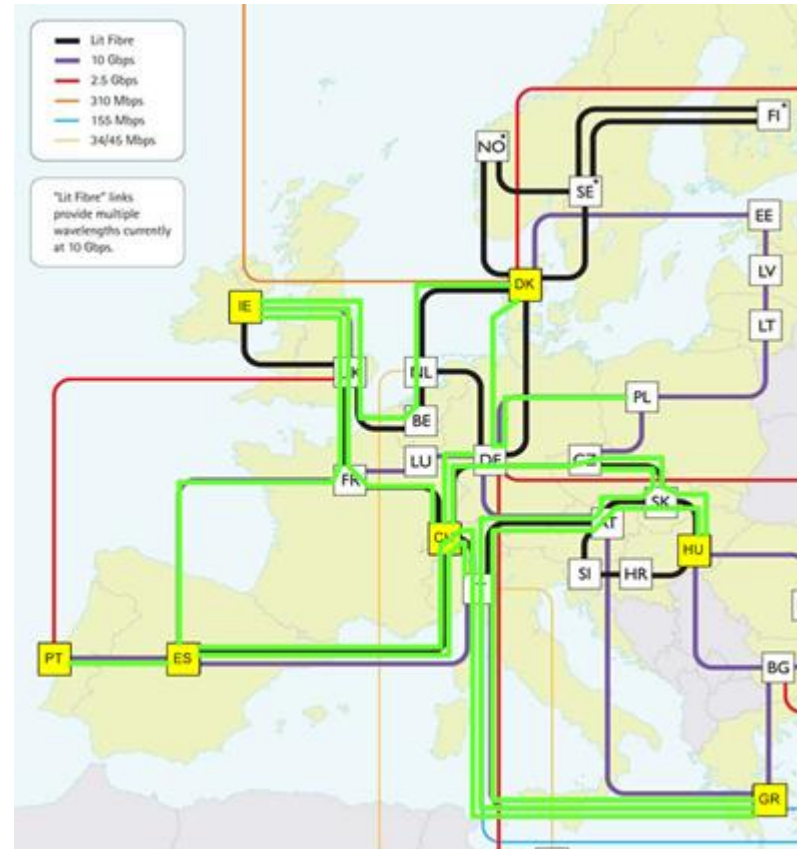
vNodes (2 per core site, 1 per non-core site):

- Sun Fire X2200M2, 8 GigE interfaces
- VMware ESXi 3.5.x
- Additional Service Nodes (in 4 sites):
 - @ PSNC – User Access Server + DNS
 - @ CESNET – Monitoring
 - @ KTH & i2CAT – Validation & Experiments

FEDERICA usage of GÉANT+ 1Gbps Circuits

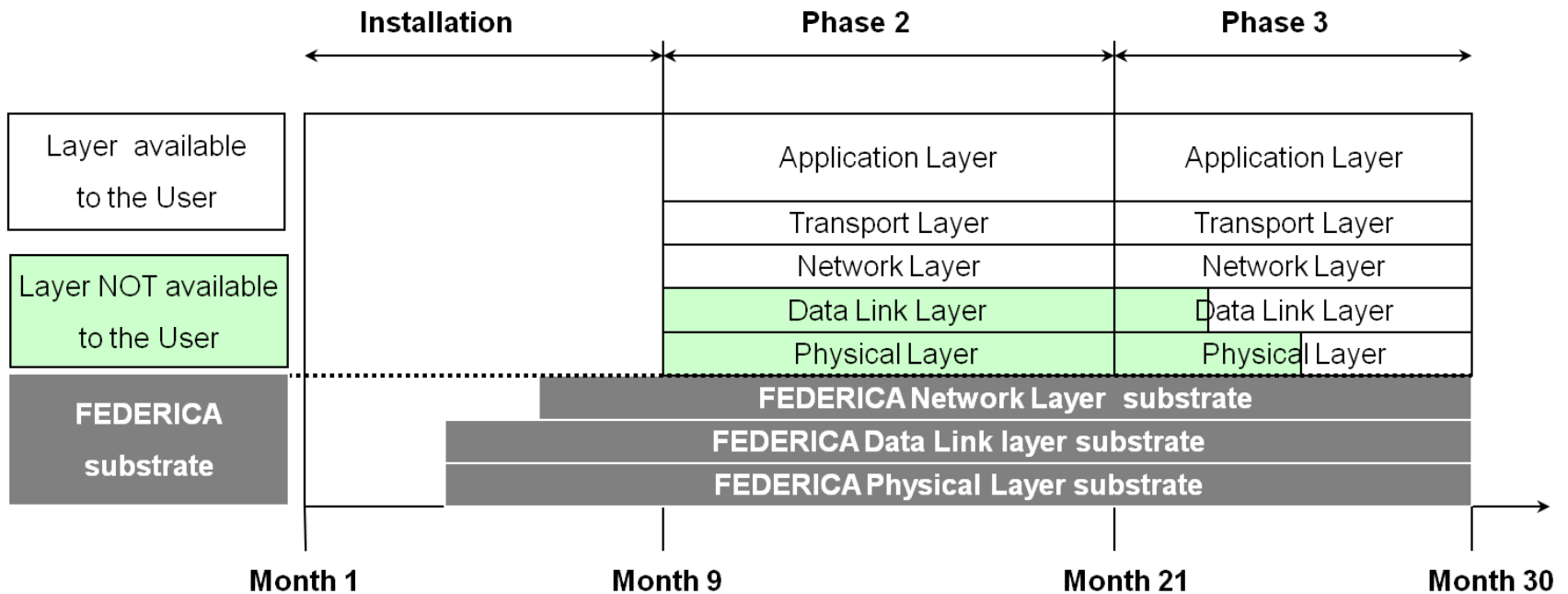


Core Site Connectivity

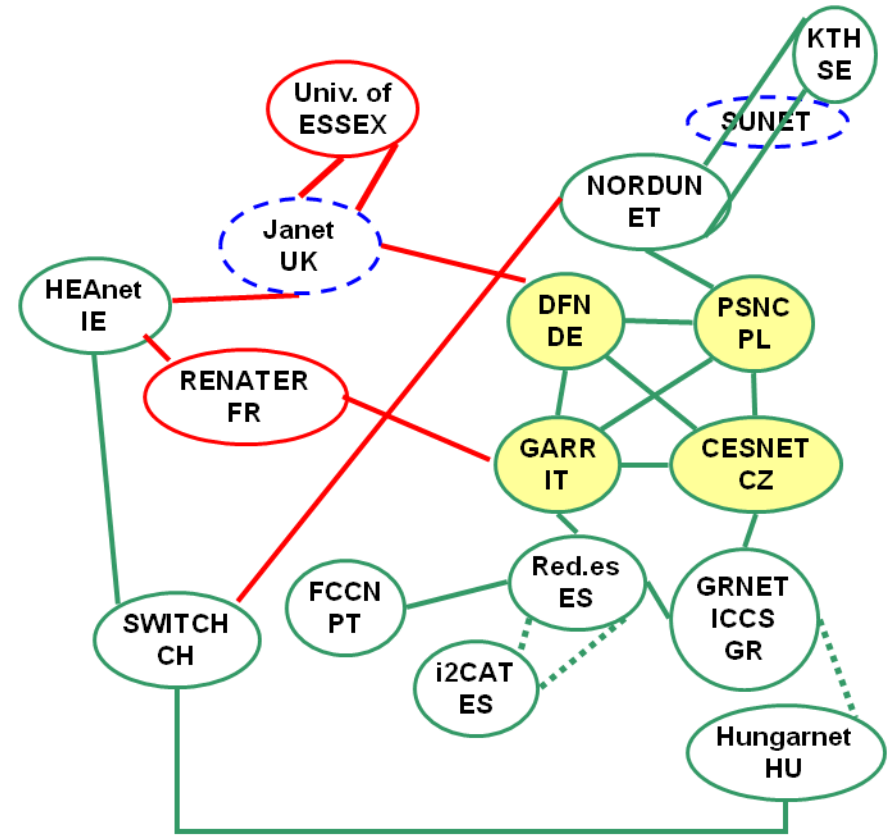
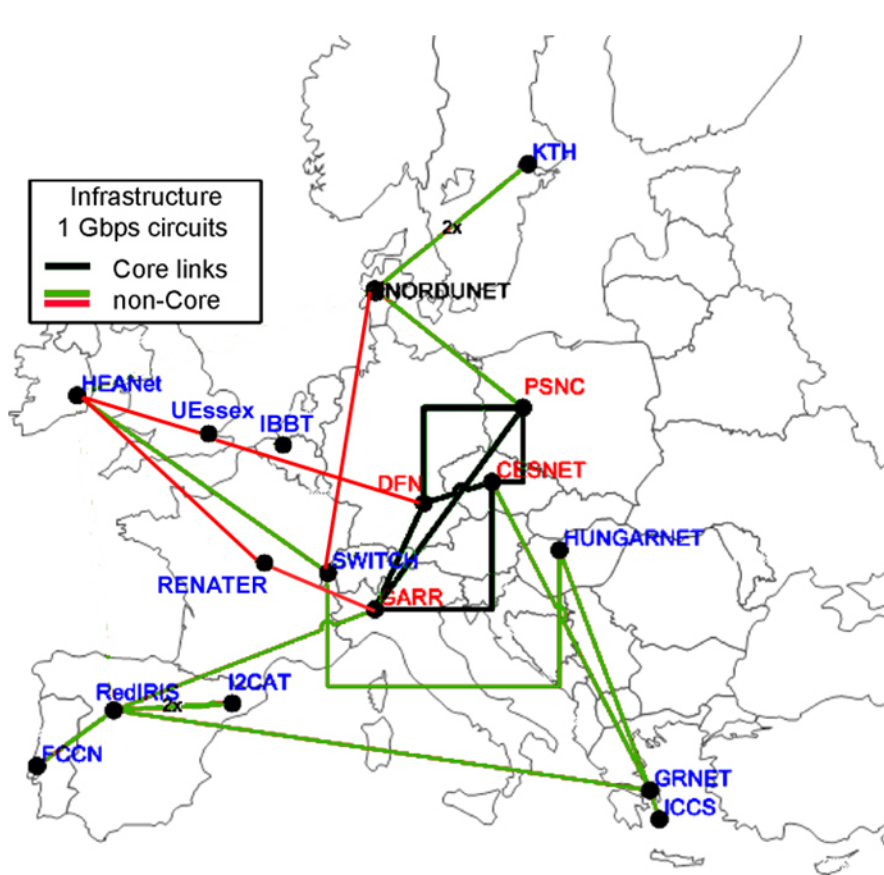


Non-core Site Connectivity

Implementation Phased Approach



FEDERICA - FEDERICA II Planned Extensions



FEDERICA II

Selected FEDERICA User Slices

OneLab/PlanetLab Europe: The proof of concept slice
(*ELTE Hungary, KTH Sweden*)

OpenFlow: The protocol experiment slices (*Friedrich -
Alexander University Germany, KTH Sweden, GARR
Italy, Stanford University USA*)

G3 system: The monitoring test slice (*CESNET Czech
Republic*)

Phosphorus: The scalability study slice (*i2CAT Spain,
PSNC Poland*)

The FEDERICA Consortium

(FEDERICAII Proposed Additions in *Red/Italics*)

National Research & Education Networks

CESNET	Czech Rep.
DFN	Germany
FCCN	Portugal
GARR (<i>coordinator</i>)	Italy
GRNET	Greece
HEAnet	Ireland
NIIF/HUNGARNET	Hungary
NORDUnet	Nordic countries
PSNC	Poland
Red.es	Spain
<i>RENATER</i>	<i>France</i>
SWITCH	Switzerland

Small Enterprise

Martel Consulting	Switzerland
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NREN Organizations

TERENA	The Netherlands
DANTE	UK

Universities - Research Centers

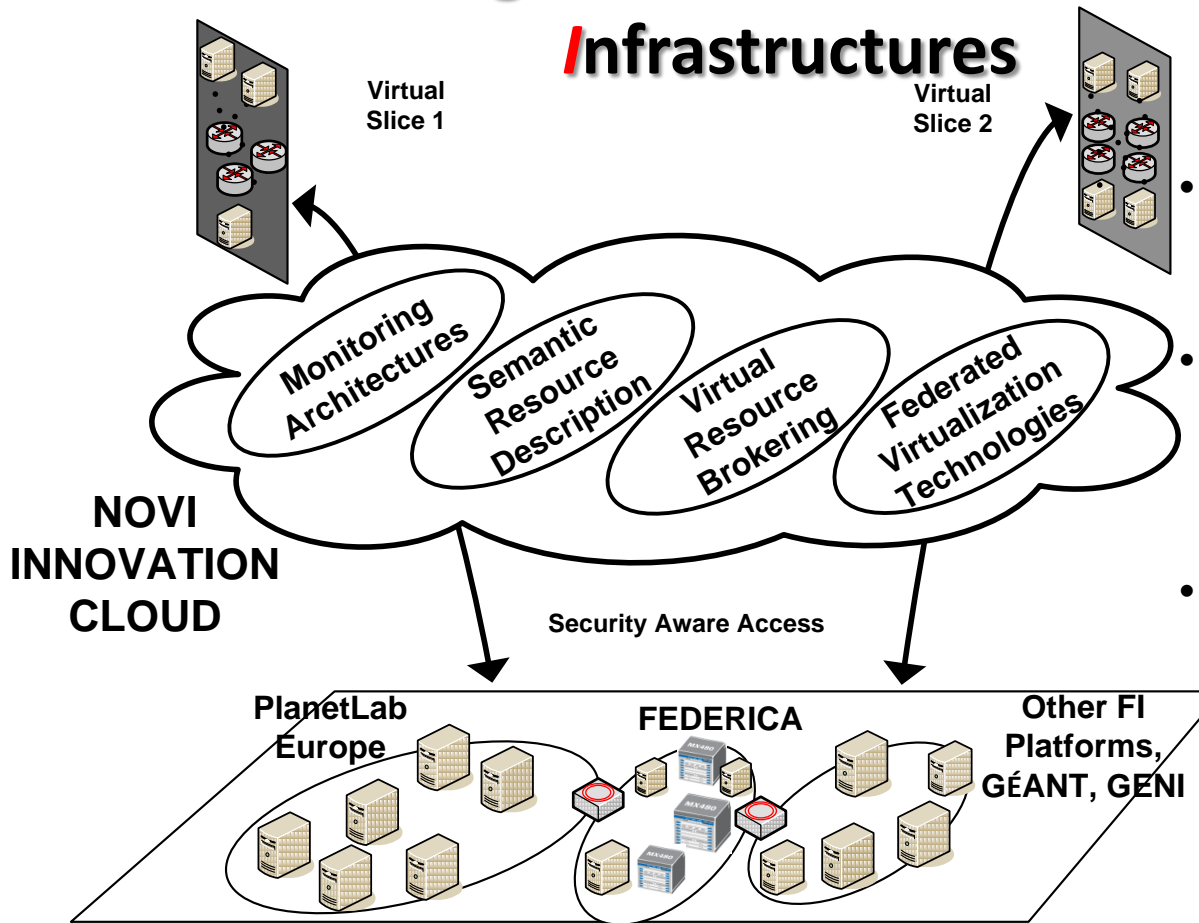
i2CAT	Spain
<i>IBBT</i>	<i>Belgium</i>
KTH	Sweden
NTUA (ICCS)	Greece
<i>Univ. of Essex</i>	<i>UK</i>
UPC	Spain
PolITO	Italy

System Vendors

Juniper Networks	Ireland
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A FIRE Research Project: NOVI

Networking innovations Over Virtualized Infrastructures



- EC FP7 – Cooperation (DG INFSO-F, FIRE Unit)

- 13 Partners (NRENs, Academic & Research Institutions, Industry)

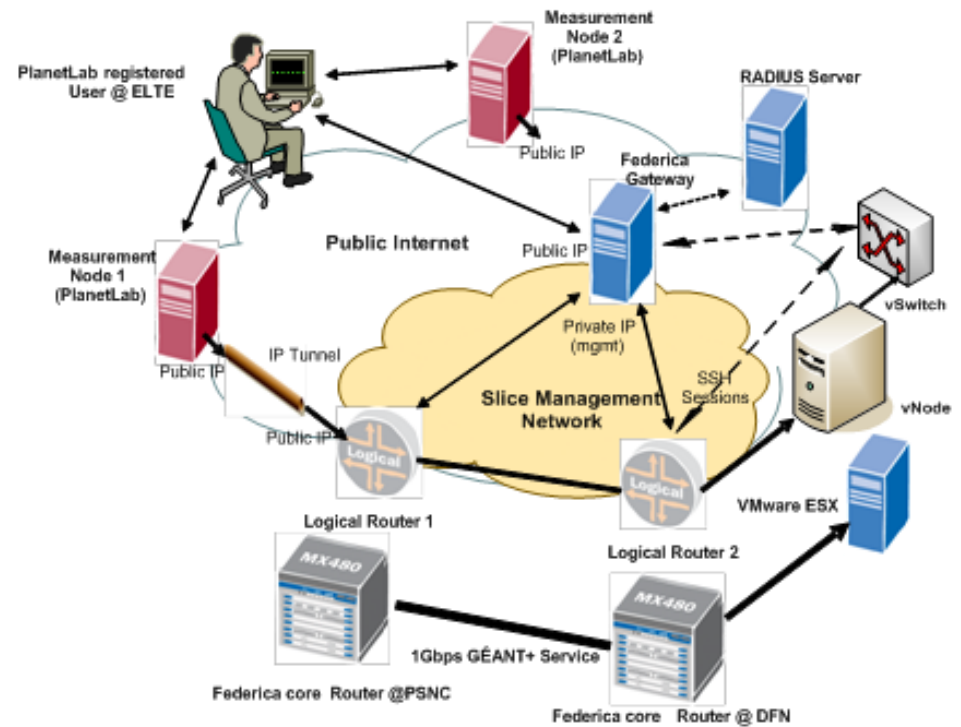
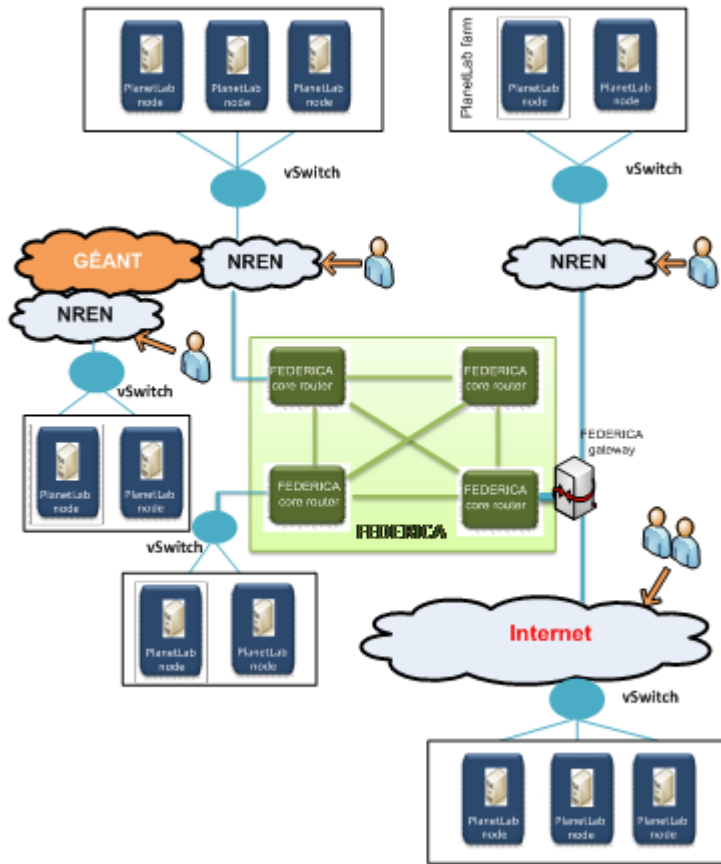
- 30 Months (starts Sept. 2010)

FUTURE INTERNET (FI)
FEDERATED FACILITY

The NOVI Consortium

1. National Technical University of Athens - **NTUA** (Coordinator, *Greece*)
2. **Martel** GmbH (*Switzerland*)
3. Université Pierre & Marie Curie - **UPMC** (*France*)
4. Consortium **GARR** (*Italy*)
5. Universiteit van Amsterdam - **UvA** (*Netherlands*)
6. Fundació **i2CAT** (*Spain*)
7. **DFN** Verein (*Germany*)
+ Universität **Erlangen** - Nürnberg
8. Institut National de Recherche en Automatique et Informatique - **INRIA** (*France*)
9. Eötvös Loránd Tudományegyetem - **ELTE** (*Hungary*)
10. Poznan Supercomputing and Networking Center - **PSNC** (*Poland*)
11. **Cisco** Systems International B. V. (*Netherlands*)
12. **Fraunhofer** Gesellschaft zur Förderung der angewandten Forschung (*Germany*)
13. Universitat Politècnica de Catalunya – **UPC** (*Spain*)

Federated Platform for NOVI Experiments (FEDERICA, PlanetLab, NRENs, GÉANT, Internet)



Related Public Web Pages

- http://ec.europa.eu/information_society/activities/foi/index_en.htm
(link to **EU Future Internet** activities)
- <http://www.geant.net/pages/home.aspx> (link to **GÉANT**)
- <http://www.fp7-federica.eu/> (link to **FEDERICA** Site)
- <http://www.fp7-federica.eu/documents/FEDERICA-DNA2.2.pdf> (link to **FEDERICA Deliverable on User Slices**)
- <http://www.netmode.ntua.gr/Projects/NOVI%20-%20Fire%20Brochure%202010v2.pdf> (link to **NOVI** brochure)
- <http://www.netmode.ntua.gr> (link to **netmode.ntua.gr** laboratory)