e-Infrastructures as a Service:
The Role of NRENs/GÉANT in Future Internet Experimental Research
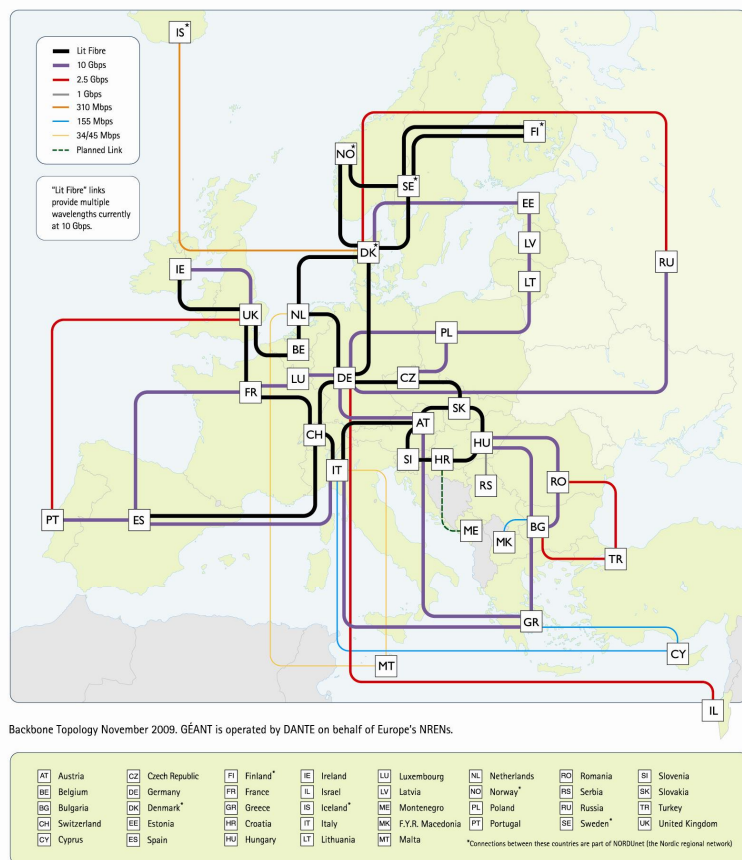
Vasilis Maglaris

Professor of Electrical & Computer Engineering, NTUA
Chairman, NREN Policy Committee - GÉANT Consortium
maglaris@netmode.ntua.gr

e-IRG Workshop

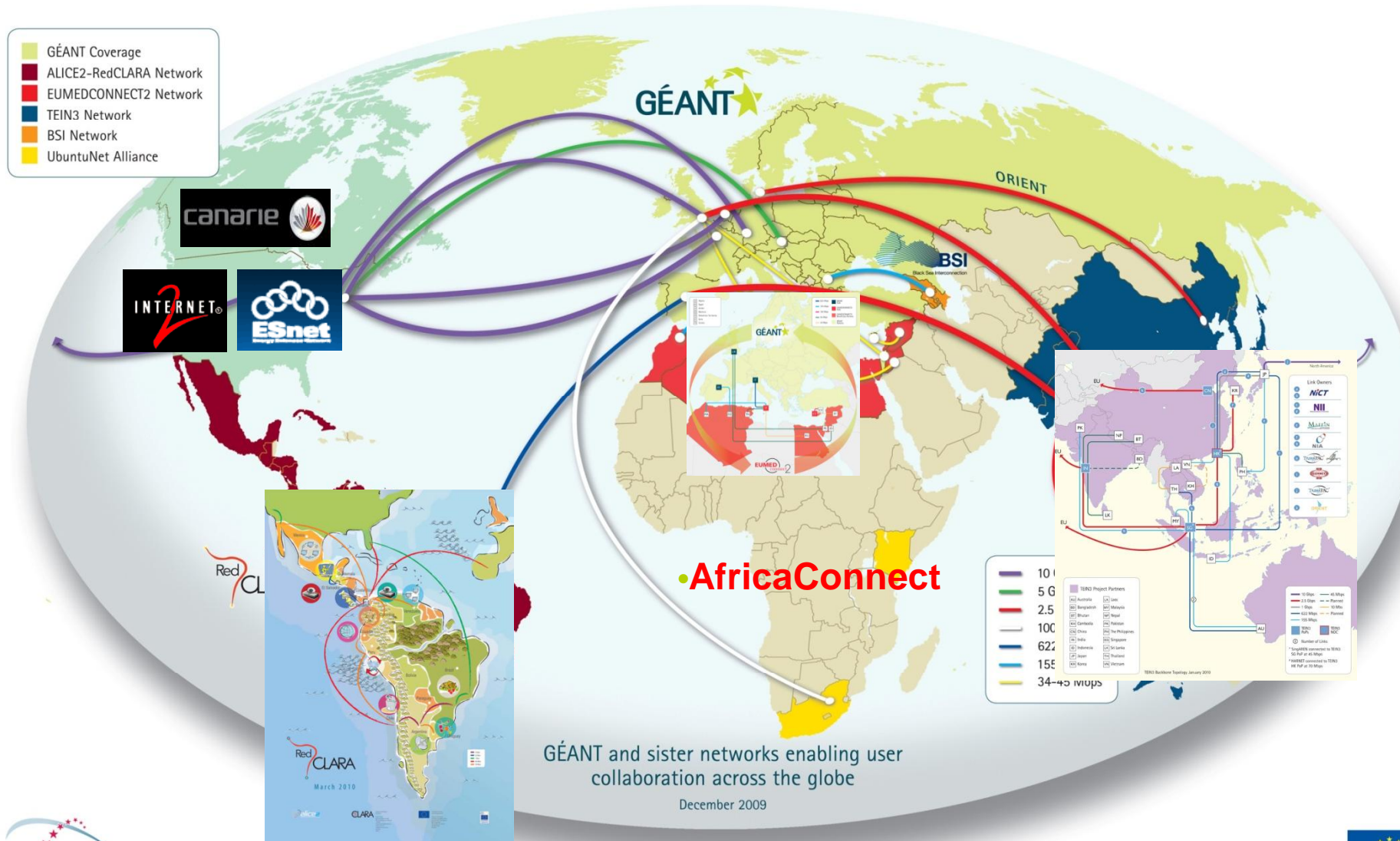13th October 2010
Brussels, Belgium

The GÉANT Service Area

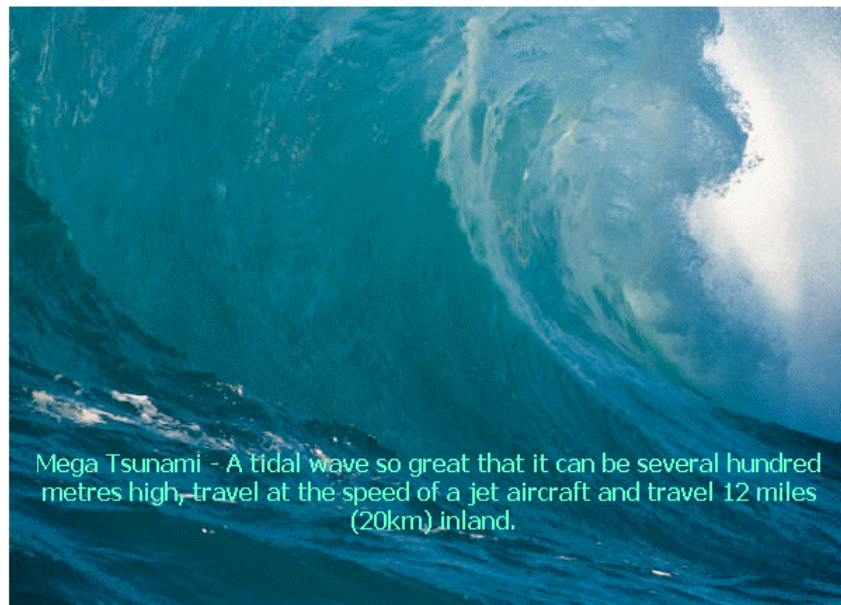Backbone Topology November 2009. GÉANT is operated by DANTE on behalf of Europe's NRENs.

GÉANT COST: 40 M€/year

Not just the GÉANT backbone

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

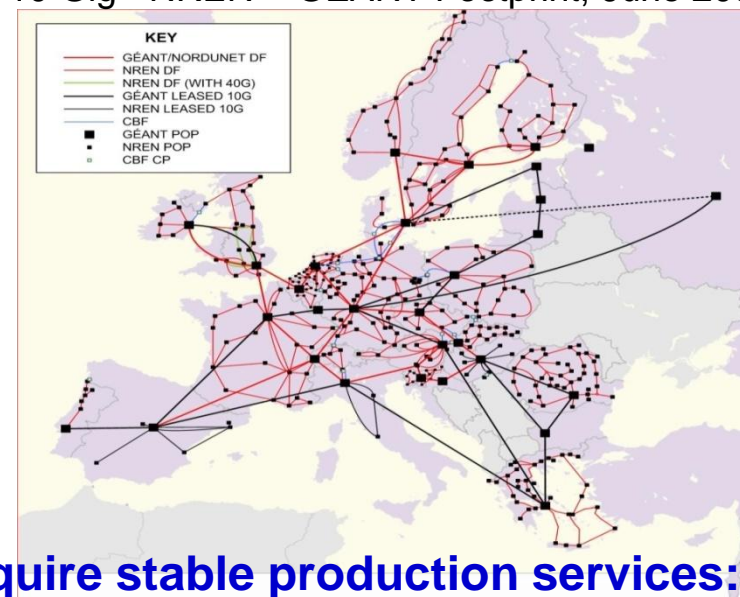NTUA – NATIONAL TECHNICAL UNIVERSITY OF ATHENS

GÉANT ★ At the Heart of Global Research Networking

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

•AfricaConnect

GÉANT and sister networks enabling user collaboration across the globe

December 2009

connect • communicate • collaborate

DANTE
www.dante.net

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European Commission
Information Society
and Media

The 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

KEY
- GÉANT/NORDUNET DF
- NREN DF
- NREN DF (WITH 40G)
- GÉANT LEASED 10G
- NREN LEASED 10G
- CBF
- GÉANT POP
- NREN POP
- CBF CP

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 → **Infrastructure as a Service IaaS,** e.g. **Future Internet (FI) Services & Applications**

4

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netmode
Network Management & Optimal Design Laboratory

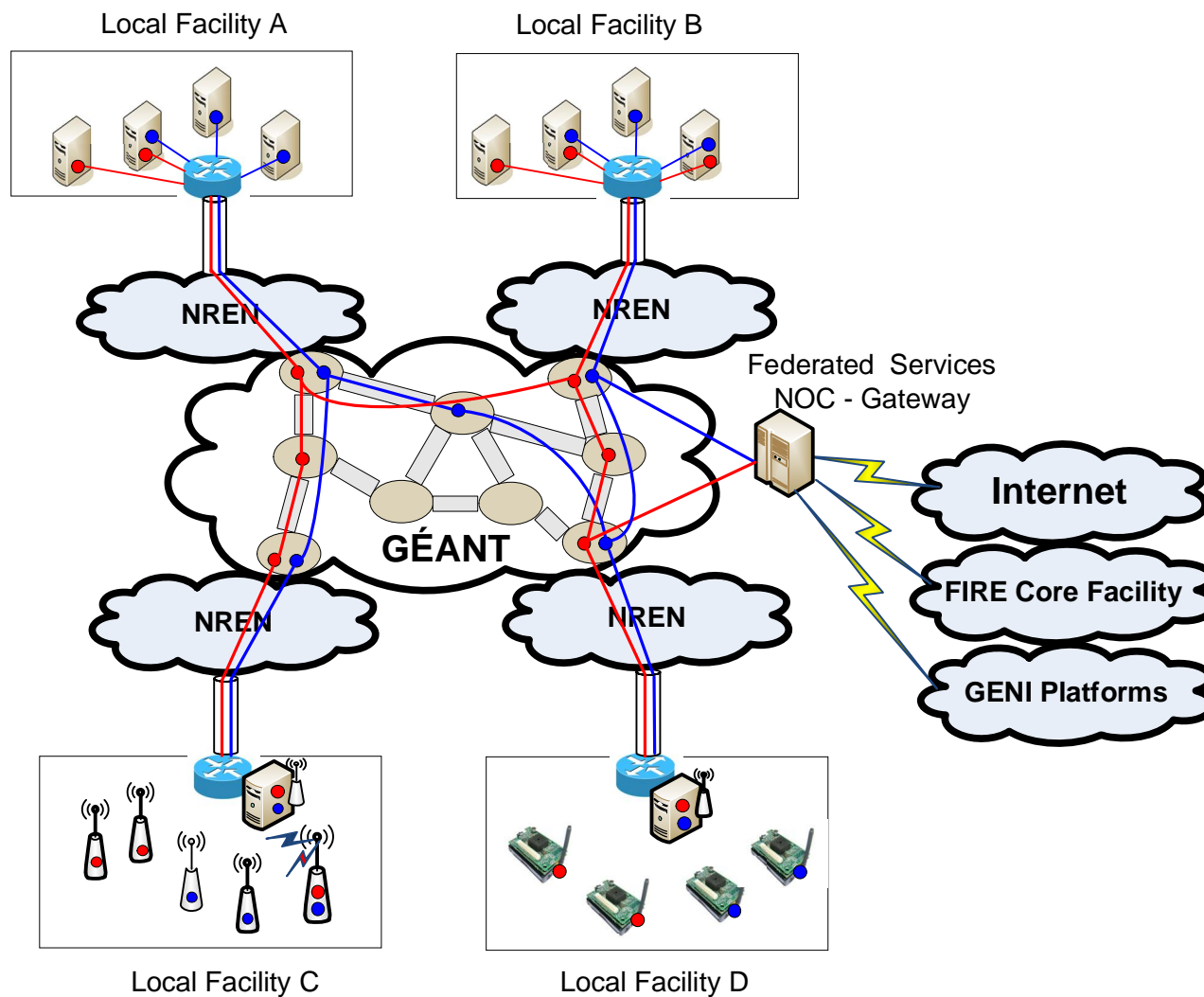# LHC Tier0 – Tier1 Optical Private Network
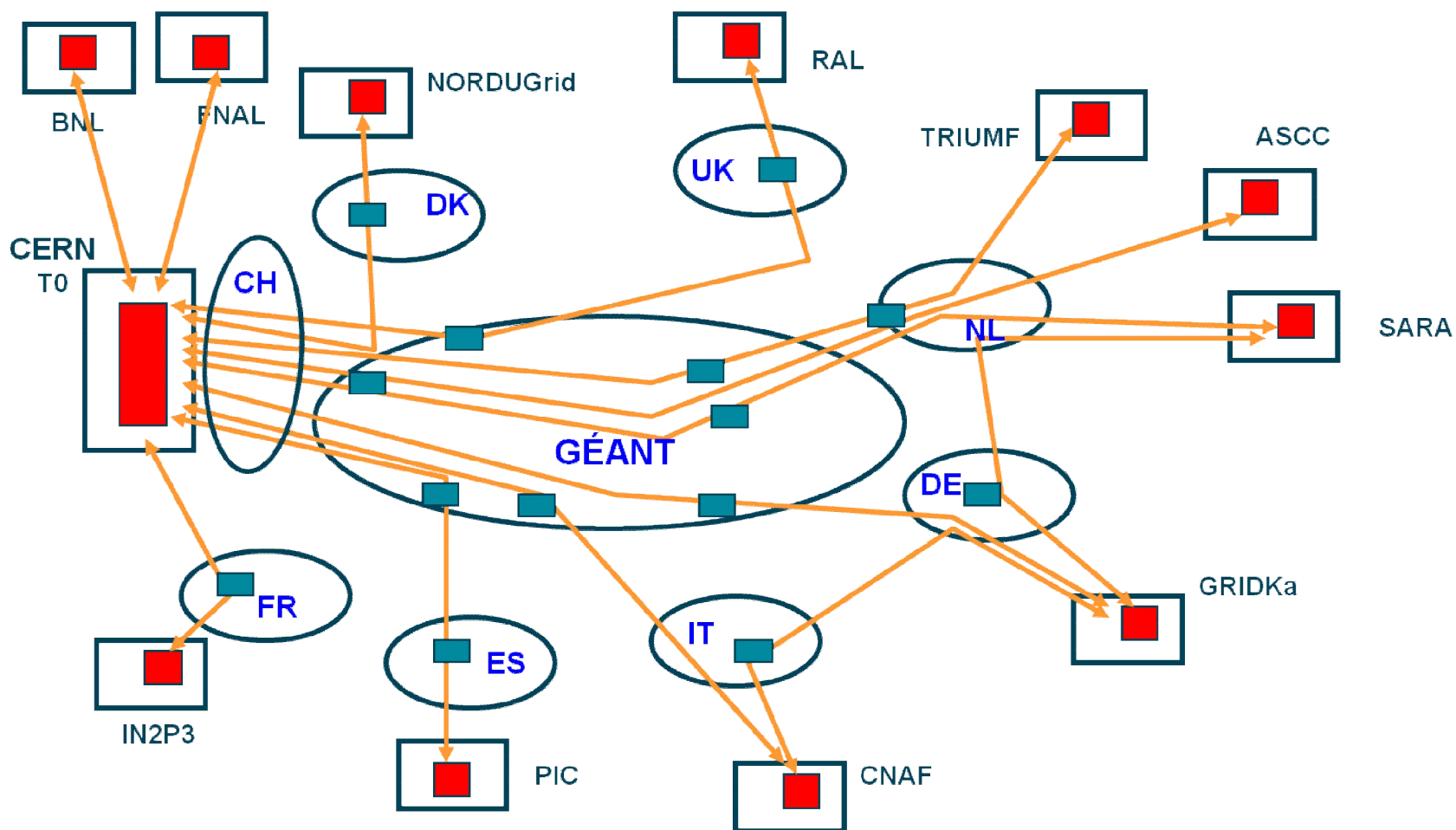
ITER Proposed Connectivity

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-Pubic 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, CERNET, KOREN …

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Virtualization over GÉANT - NRENs

Local Facility A

Local Facility B

NREN

NREN

Federated Services
NOC - Gateway

GÉANT

Internet

FIRE Core Facility

GENI Platforms

NREN

NREN

Local Facility C

Local Facility D

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Potential role of GÉANT – NRENs in FI Experimental Research

- **Contribute to FI Core facilities** (FIRE, FI PPP) with 1-10 (*40 -100*) Gbps connectivity at all layers (including Bandwidth on Demand) & virtual infrastructures (including end-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...)

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A Research Infrastructure Project: *FEDERICA*

*F*ederated *E*-infrastructure *D*edicated to *E*uropean *R*esearchers
*I*nnovating in *C*omputing network *A*rchitectures
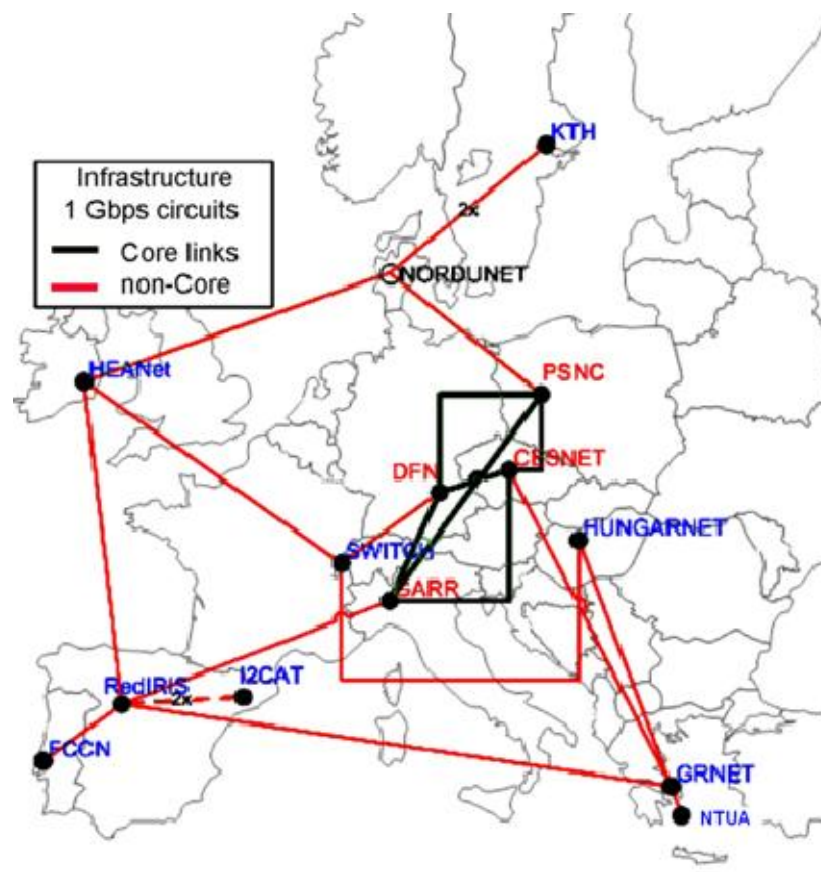
- EC FP7 – Capacities (DG INFSO-F, e-Infrastructures/GÉANT Unit)

- 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
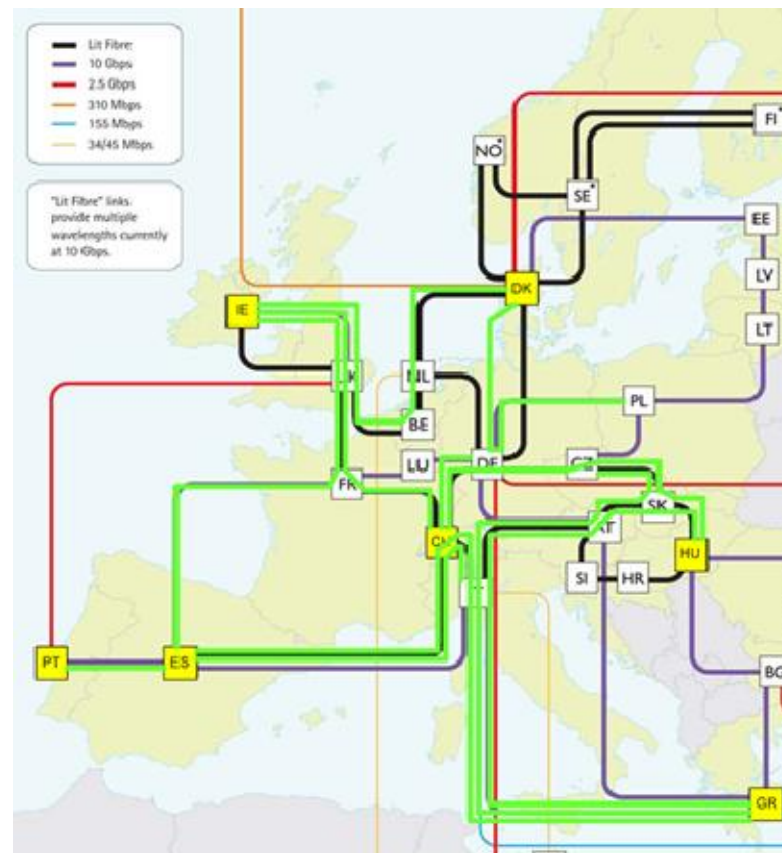
The FEDERICA Concept
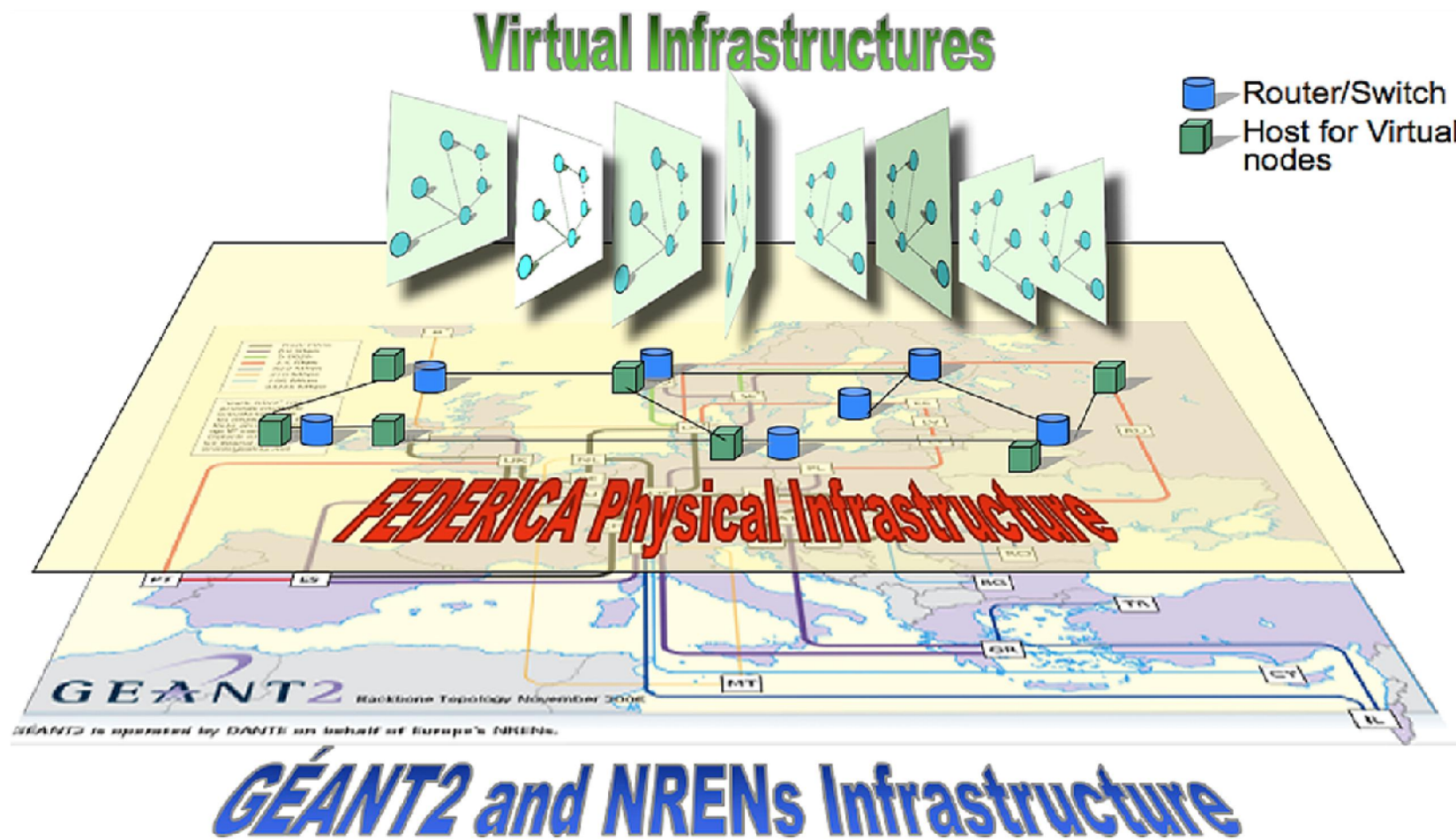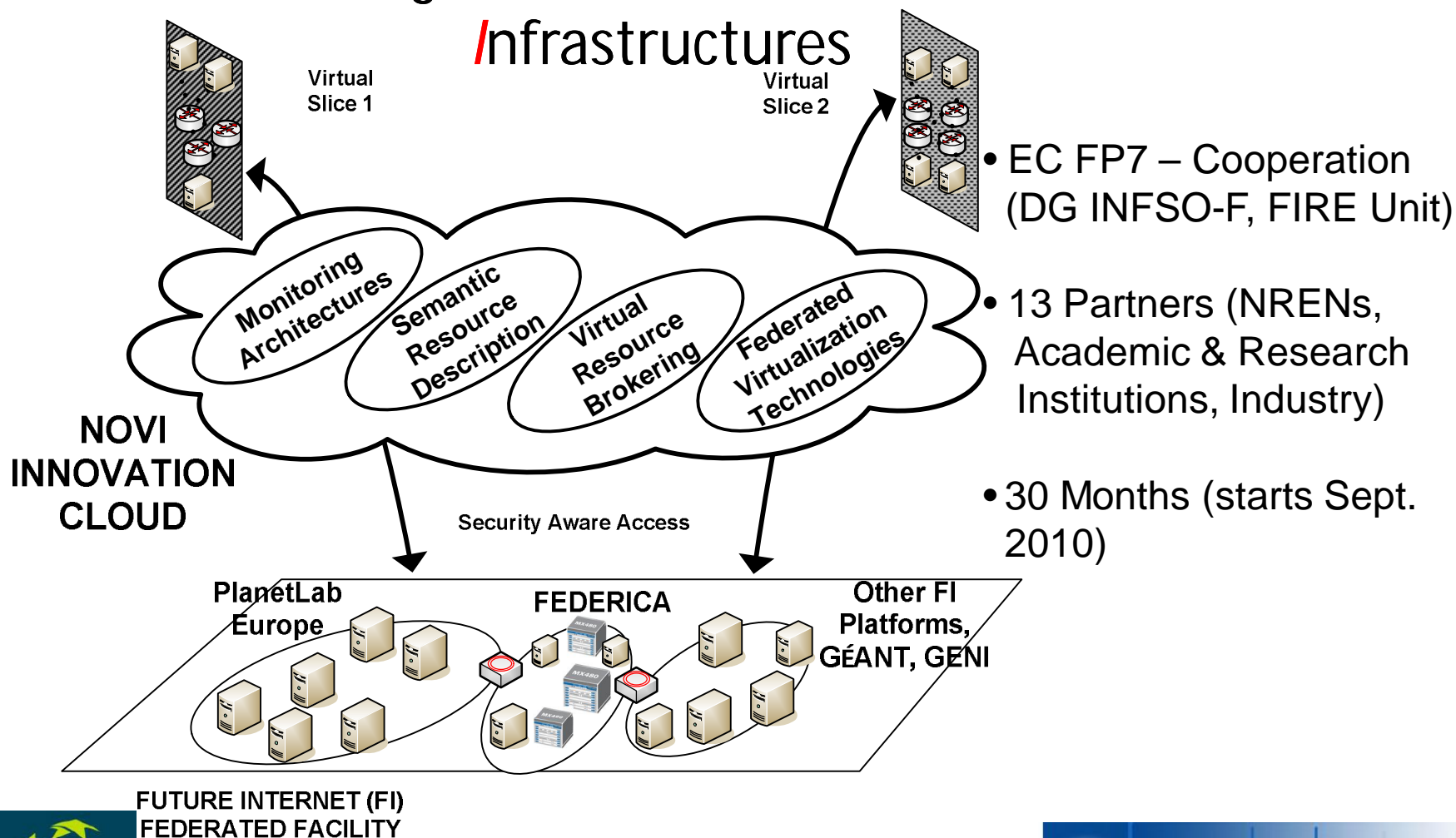
FEDERICA usage of GÉANT+ 1Gbps Circuits
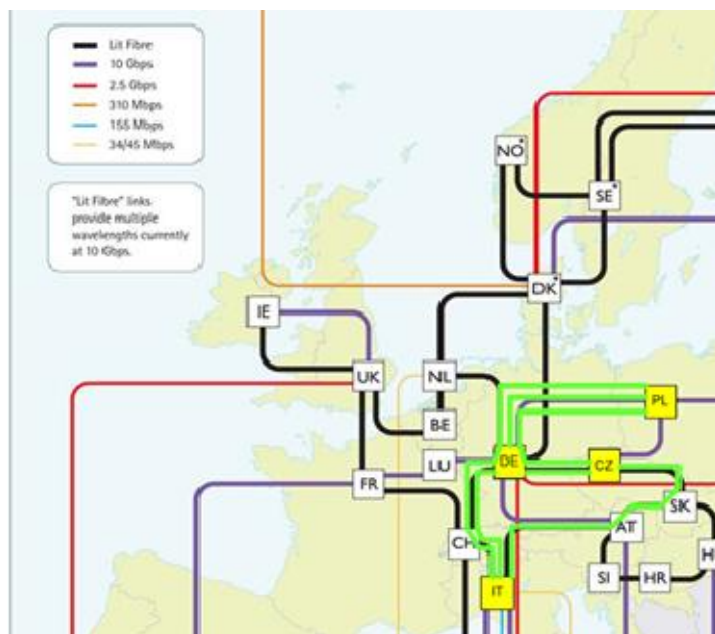

Core Site Connectivity

Non-core Site Connectivity

A FIRE Research Project: *NOVI*

*N*etworking innovations *O*ver *V*irtualized *I*nfrastructures

Virtual Slice 1

Virtual Slice 2

Monitoring Architectures

Semantic Resource Description

Virtual Resource Brokering

Federated Virtualization Technologies

NOVI INNOVATION CLOUD

Security Aware Access

PlanetLab Europe

FEDERICA

Other FI Platforms, GÉANT, GENI

FUTURE INTERNET (FI) FEDERATED FACILITY

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

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

- 30 Months (starts Sept. 2010)

Federated Platform for NOVI Experiments
(FEDERICA, PlanetLab, NRENs, GÉANT, Internet)
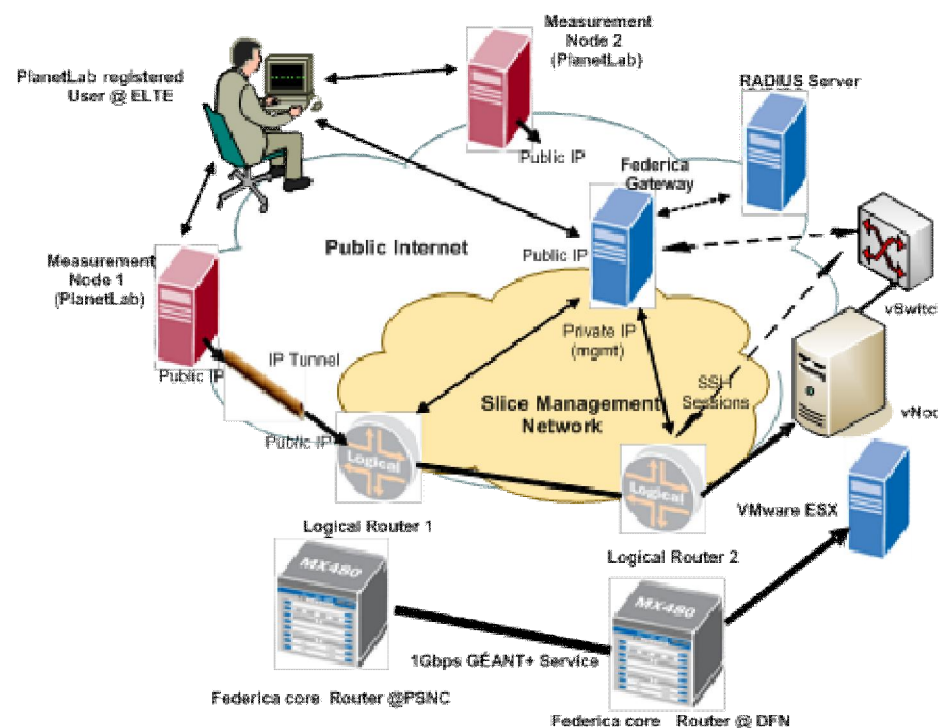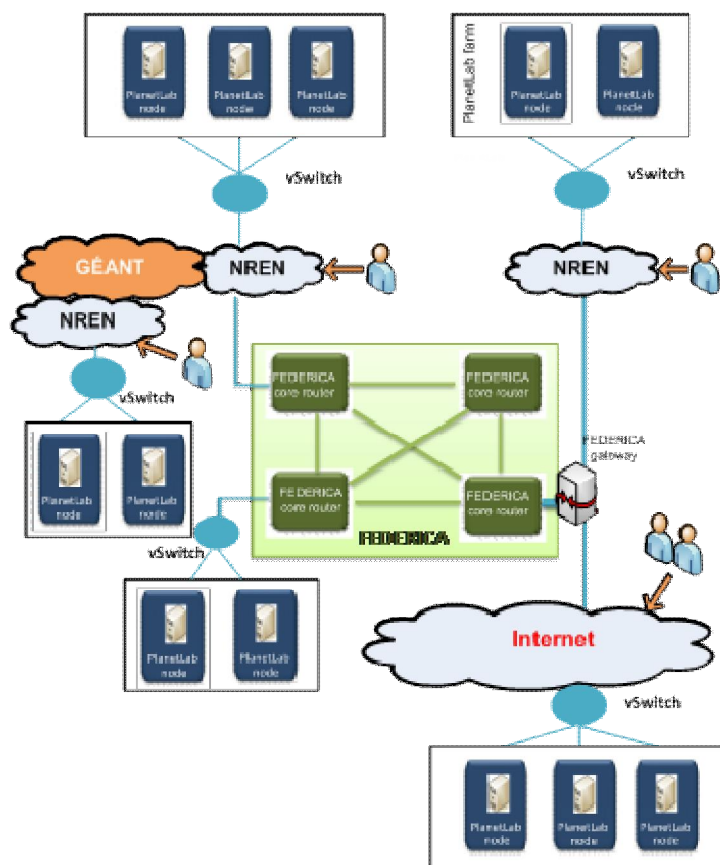
Related Public Web Pages

- 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.netmode.ntua.gr/Projects/NOVI%20-%20Fire%20Brochure%202010v2.pdf (link to NOVI brochure)

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