



# Virtualization over the GÉANT - NREN Federation: Its role in **Future Internet Experimental Research**

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**NSF IRNC Program: Kick-off Workshop**

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Washington DC, USA

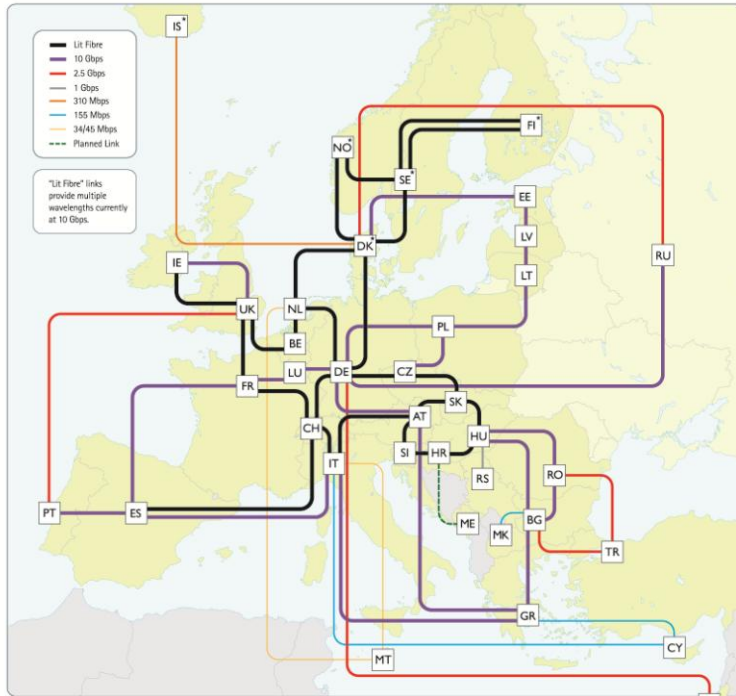


NTUA – NATIONAL TECHNICAL  
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# The GÉANT Service Area



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

|                |                   |             |              |                  |                |            |                   |
|----------------|-------------------|-------------|--------------|------------------|----------------|------------|-------------------|
| AT Austria     | CZ Czech Republic | FI Finland* | IE Ireland   | LU Luxembourg    | NL Netherlands | RO Romania | SI Slovenia       |
| BE Belgium     | DE Germany        | FR France   | IS Iceland*  | LV Latvia        | NO Norway*     | RS Serbia  | SK Slovakia       |
| BG Bulgaria    | DK Denmark*       | GR Greece   | IT Italy     | ME Montenegro    | PL Poland      | RU Russia  | TR Turkey         |
| CH Switzerland | EE Estonia        | HR Croatia  | MT Malta     | F.Y.R. Macedonia | PT Portugal    | SE Sweden* | UK United Kingdom |
| CY Cyprus      | ES Spain          | HU Hungary  | LT Lithuania |                  |                |            |                   |

\*Connections between these countries are part of NORDnet (the Nordic regional network)








**GÉANT COST: 40 M€/year**

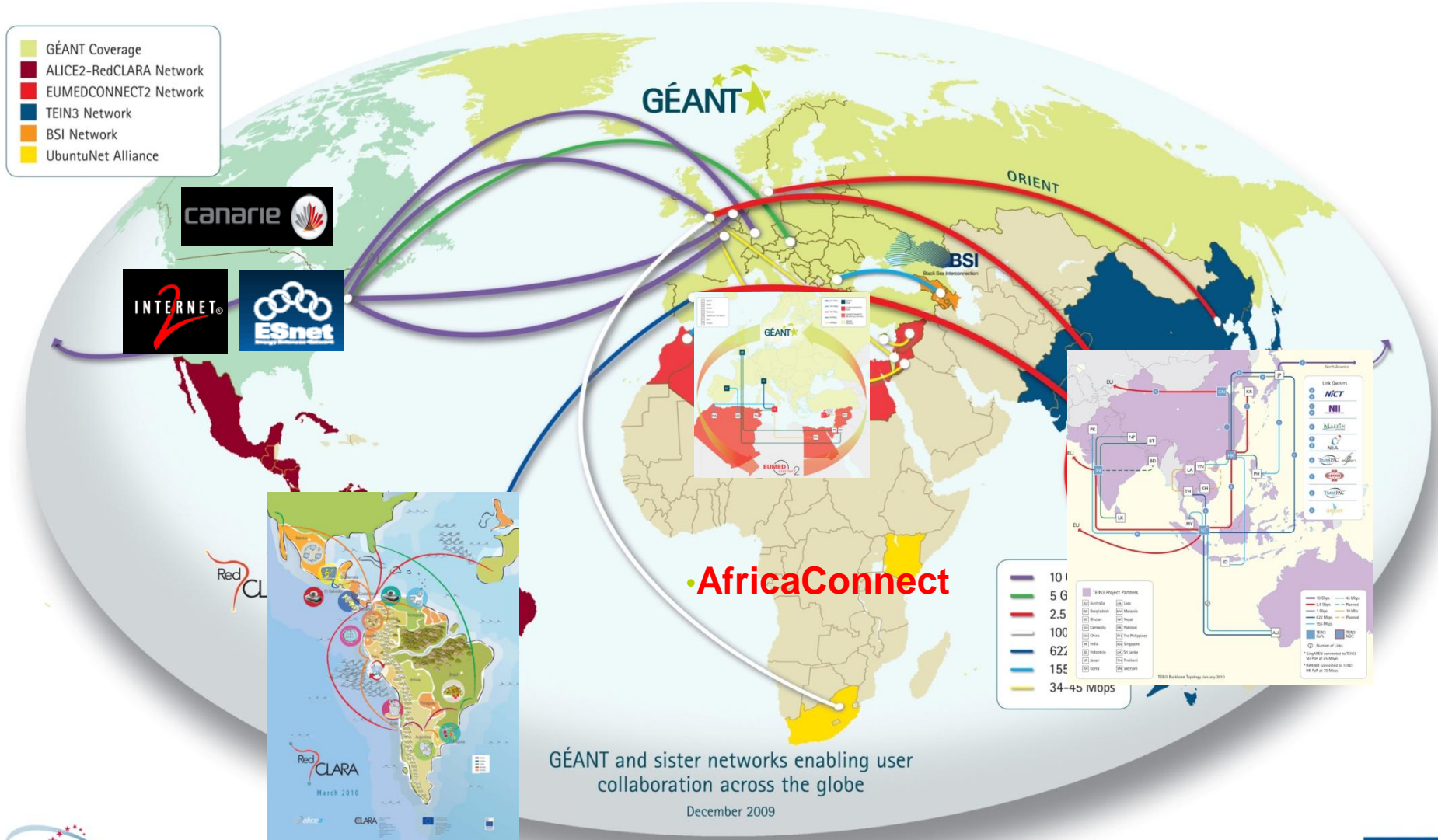
Not just the GÉANT backbone

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

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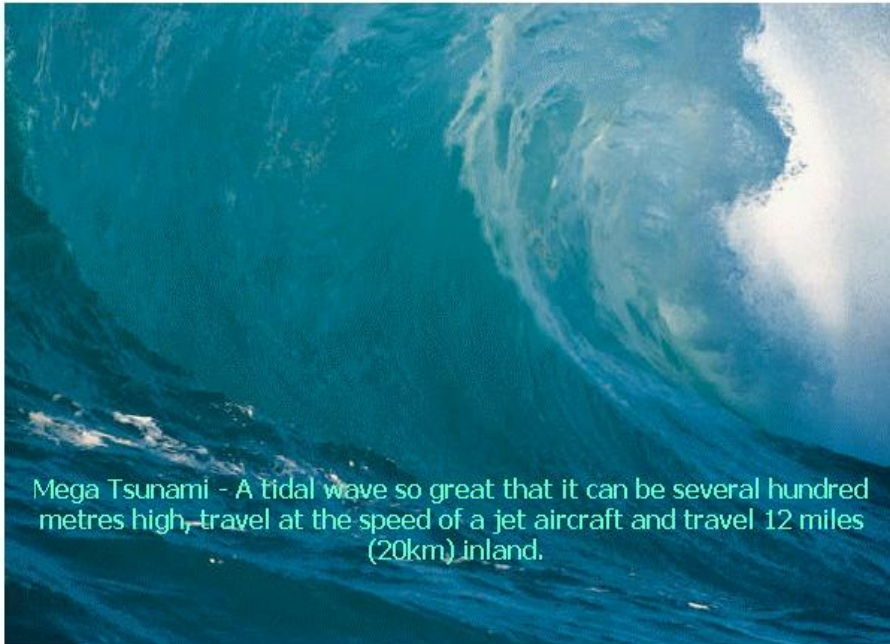


# The Key Challenge for NRENs - GÉANT:

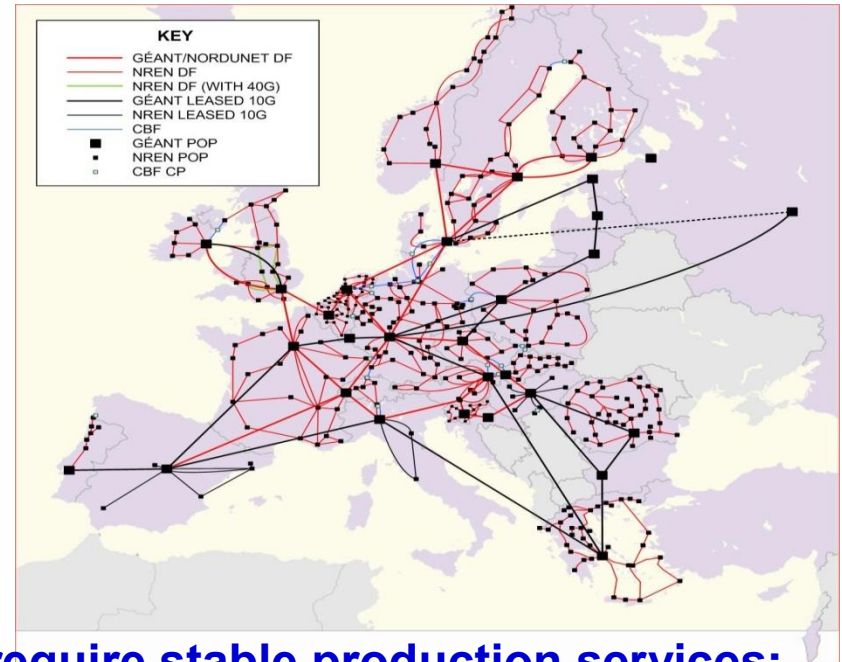


## A Tsunami of Global High-End Requirements

10 Gig+ NREN – GÉANT Footprint, June 2009



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.



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

- Provisioning 10-40-100 Gbps networks (DWDM over dark fiber, leased  $\lambda$ )
- 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 Services & Applications**





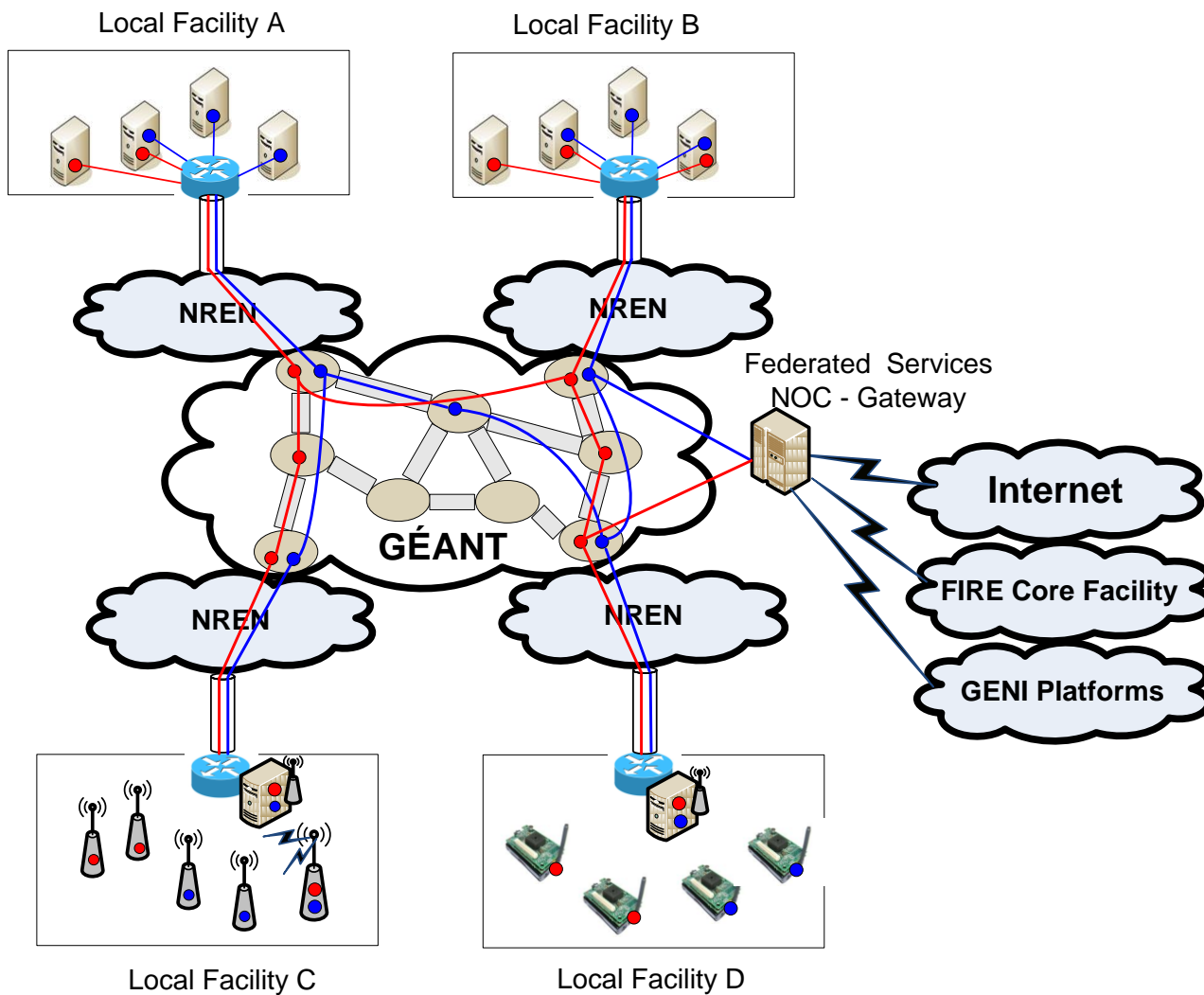
# Future Internet Experimental Research: An Opportunity for NRENs



- **Requirements:**
  - Sharing optical backbones & housing for FI experiments
    - Emulating real-world conditions
    - In isolation from production traffic (slicing, virtualization)
  - Advanced interconnection of local testbeds (e.g. 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 Internet<sup>2</sup>, NLR, ESnet, RON facilities (e.g. VINI)



# Virtualization over GÉANT - NRENs





# Potential role of GÉANT – NRENs in FI Experimental Research

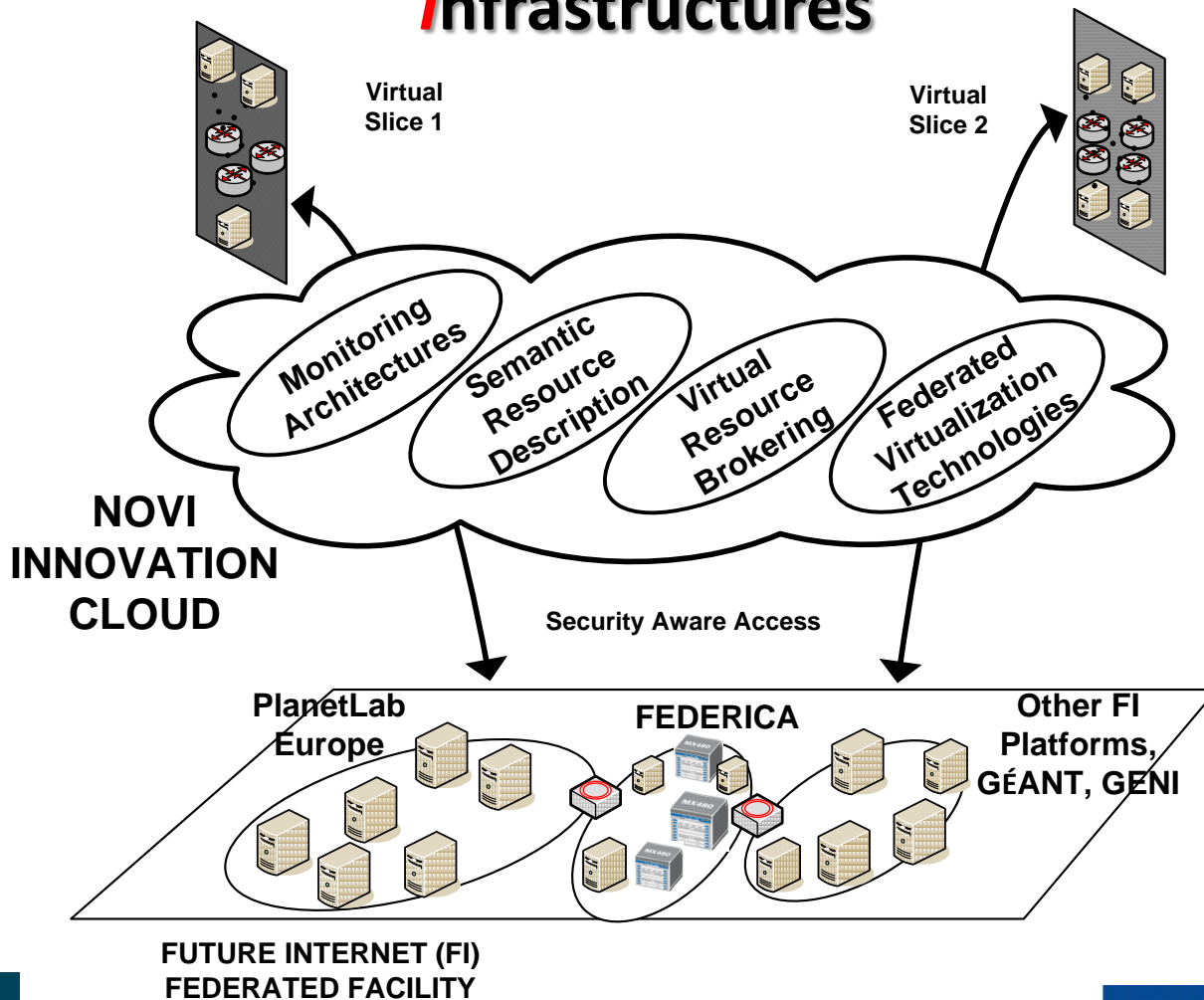


- **Complement FI Core facilities** (FIRE, FI PPP) with 1-10 Gbps connectivity & virtualization-ready switching/routing gear
- Develop – deploy tools to create, monitor and control virtual resources allocated to FI user communities according to the **network on demand** vision
- Research on common, context aware descriptions of heterogeneous virtual networking elements, enabling **resource discovery & provisioning** of composite services
- Support virtual resource allocation, scheduling, federated admission control - roaming & mechanisms for protected operation of isolated communities leading to the concept of **Infrastructure as a Service**
- 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 FIRE Research Project:

## NOVI - **N**etworking innovations **O**ver **V**irtualized **I**nfrastructures







# 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*)

