



Federated E-infrastructure Dedicated to  
European Researchers  
Innovating in Computing network Architectures

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**What:** European Community co-funded project in its 7<sup>th</sup> Framework Program in the area “Capacities - Research Infrastructures”  
3.7 MEuro EC contribution, 5.2 ME budget, 461 Man Months

**When:** 1<sup>st</sup> January 2008 - 30 June 2010 (30 months)

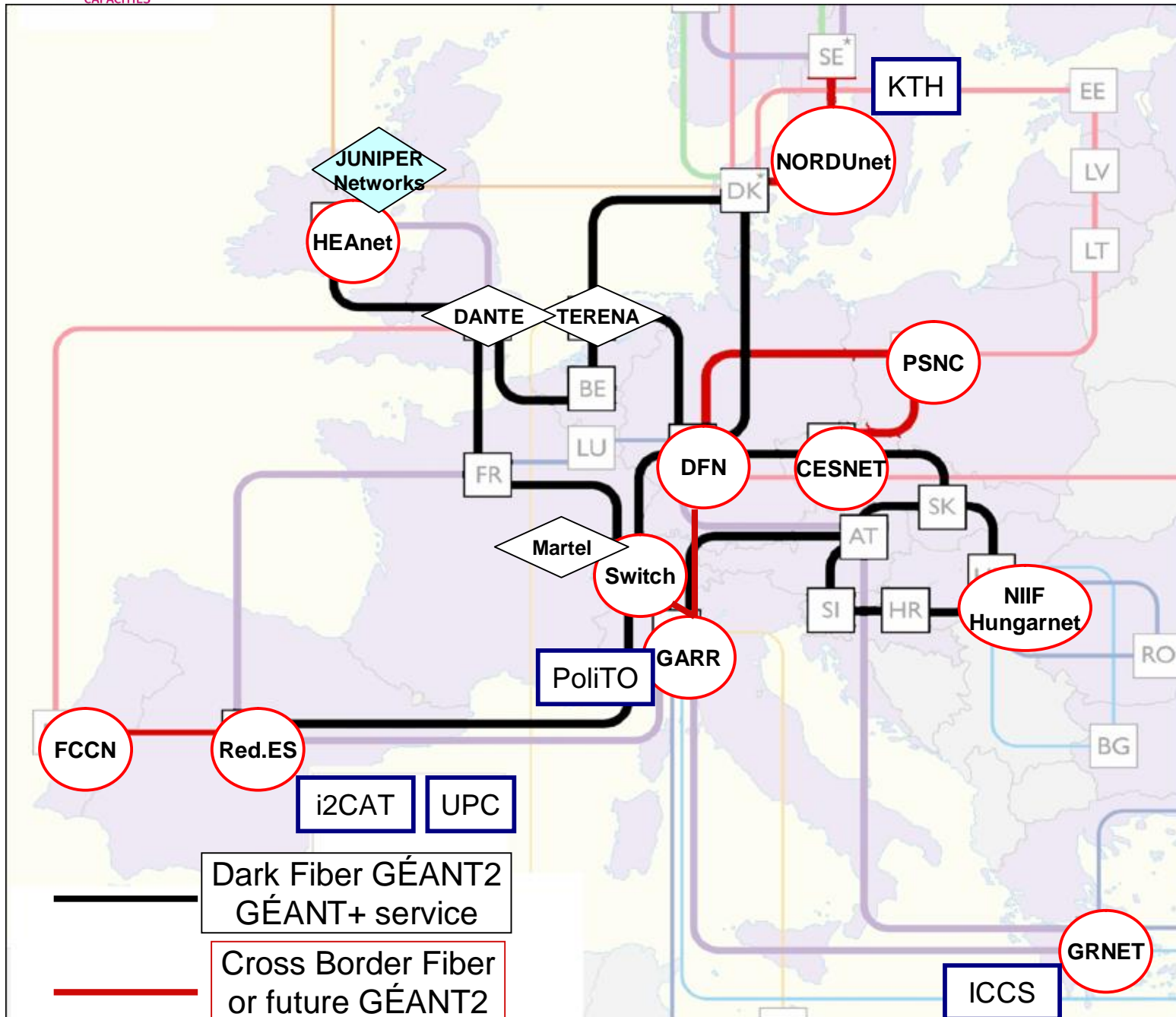
**Who:** 20 partners, based on stakeholders on network research and management:

11 National Research and Education Networks, DANTE (GÉANT2), TERENA, 4 Universities, Juniper Networks, 1 small enterprise (MARTEL), 1 research centre (i2CAT) - Coordinator: GARR (Italian NREN)

**Where:** Europe-wide e-Infrastructure, open to external connections

- Support research in virtualization of e-Infrastructures integrating **network resources and nodes capable of virtualization** (V-Nodes). In particular multi-virtual-domain **control, management and monitoring**, including **user oriented control** in a federated environment
- Create an **e-Infrastructure** for all researchers on Future Internet, allowing **disruptive emulations** in a short time frame (similar to the Global Environment for Network Innovation - GENI - initiative in US, which is in the definition phase).
- Pave the way/create experience for the **next generation** of the European Research and Education networks

# Partners' Location



NREN partners provide a European coverage using the GN2+ service and

- allow *connection* to Univ. and Research Center partners
- Provide “*HUB*” functionalities and possibility extend the e-Infrastructure to other countries and projects using physical or logical circuits
- Contribute with *tools and specific expertise*

## National Research & Education Networks (11)

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

## Small Enterprise

Martel Consulting	Switzerland
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## NREN Organizations

TERENA	The Netherlands
DANTE	United Kingdom

## Universities - Research Centers

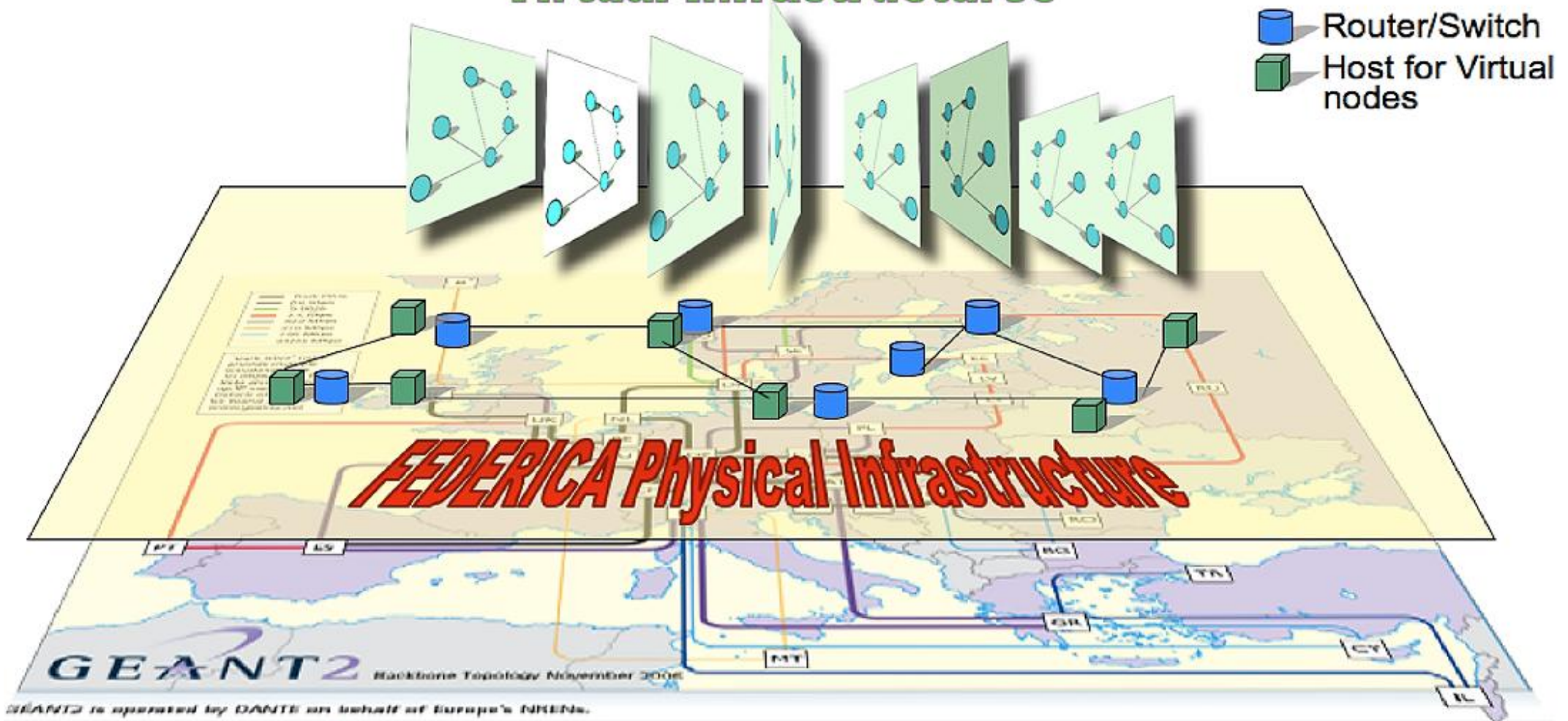
i2CAT	Spain
KTH	Sweden
ICCS (NTUA)	Greece
UPC	Spain
PoliTO	Italy

## System Vendor

Juniper Networks	Ireland
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1. Be **agnostic** and **neutral** (transparent)
2. Create “**slices**” which are a set of (virtual) network and computing resources according to user’s request
3. Provide to the user **complete control** within a slice up to the lowest possible layer (in particular allow any application and protocol)
4. Strive for **reproducibility** of experiments, i.e. given the same initial conditions, the results of an experiment are the same
5. Allow slices (if requested) to connect to **general Internet**, to access **external services/nodes** (e.g. for content/delivery, specialized HW)
6. Ensure **isolation** between slices (superset of 4) with explicit possibility to cross-connect slides
7. Allow **simultaneous use** without conflict
8. Force/be exposed to **topology changes** (various level of resiliency)
9. Open **to interconnect / federate** with other e-Infrastructures and to host researchers equipments (space permitting)
10. Access granted through a User Policy Board

## Virtual Infrastructures



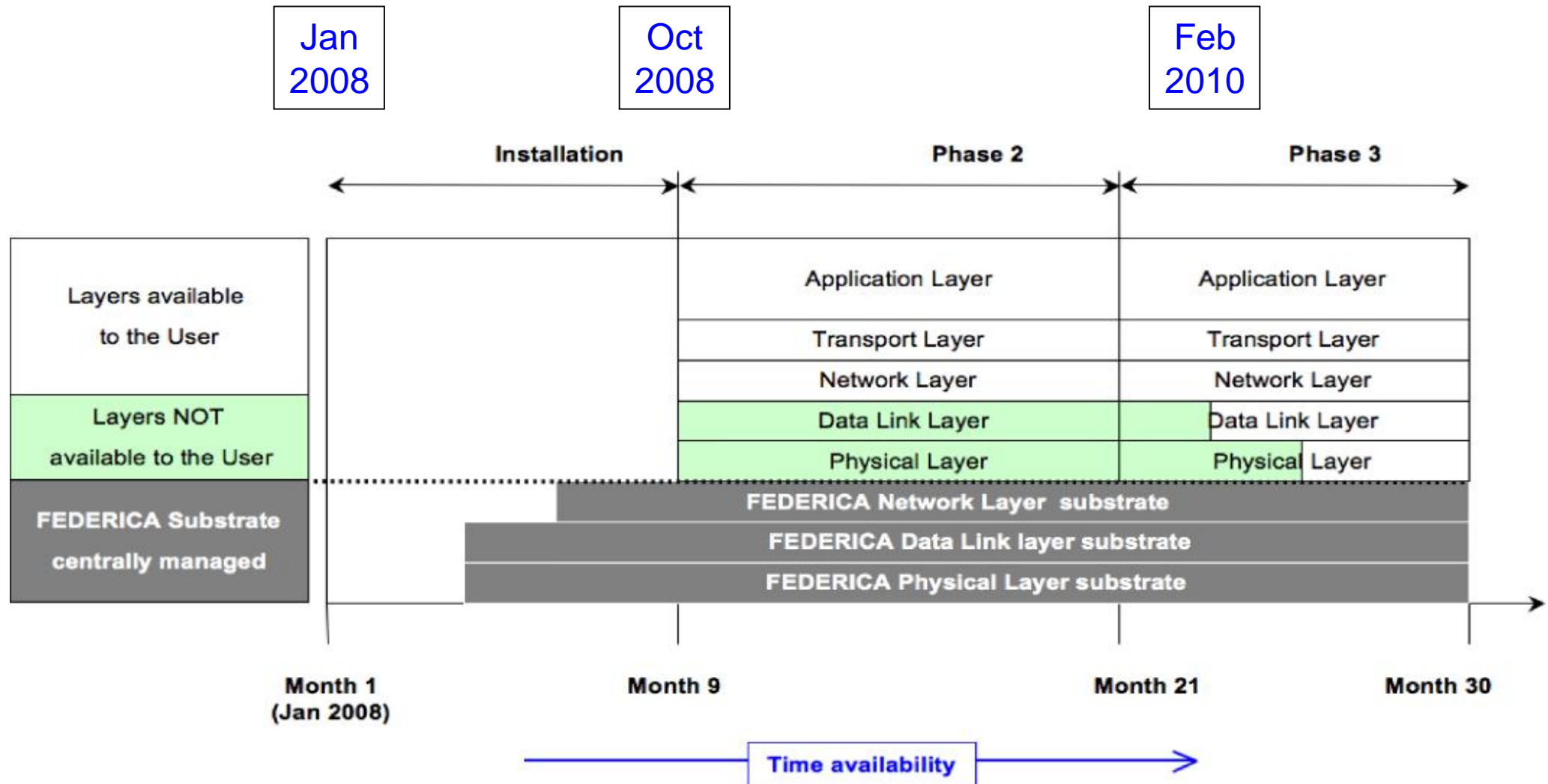
# GEANT2 and NRENs Infrastructure

# The Enabling Elements

1. **Virtualization** in computing systems and in network is **available**. It creates “**resources**”, given a supporting physical substrate, which :
  - Have a looser or none dependency from a specific physical location or entity (computing, data, circuits may migrate)
  - On-the-fly reconfiguration, cancellation and creation of resources in the e-Infrastructure (e.g. a routing element)
  - off-the-shelf components offers embedded virtualization functionalities.
2. The European **NRENs** are managing owned **hybrid infrastructures** and actively performing **network research**, starting from users’ needs. The **federated** NREN architecture scenario offers now significant **interdomain** services and research capabilities.
3. The traditional testbed, focused on a small number of technologies has a usefulness limited to the specialized nature of users. It also implies a long set-up time and a fast obsolescence.



# Work plan outline (I3)



- NA1: Project Management
- NA2: Building and Consolidating the User Community
- NA3: Standardization and Liaisons
- NA4: Dissemination and Training

## Network Activities

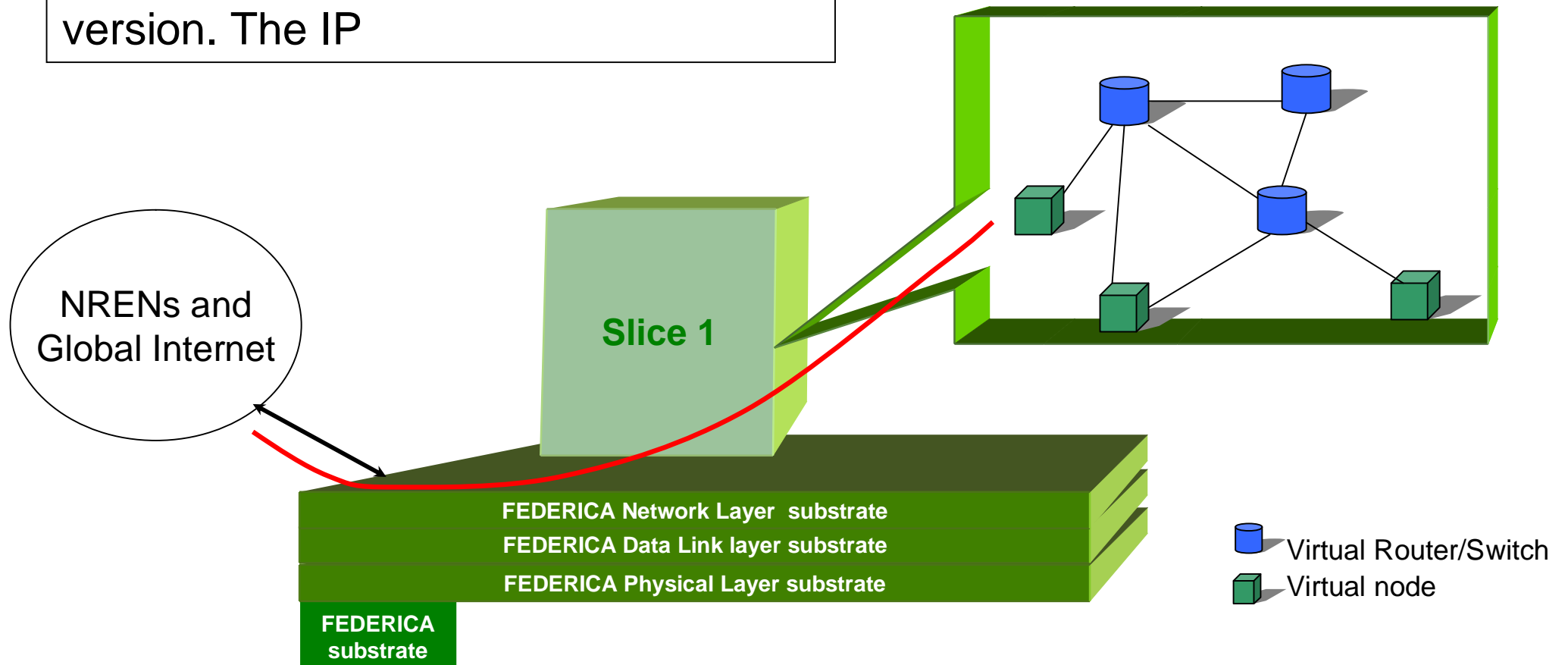
- SA1: Infrastructure Support
- SA2: Operational User support and Tool bench development

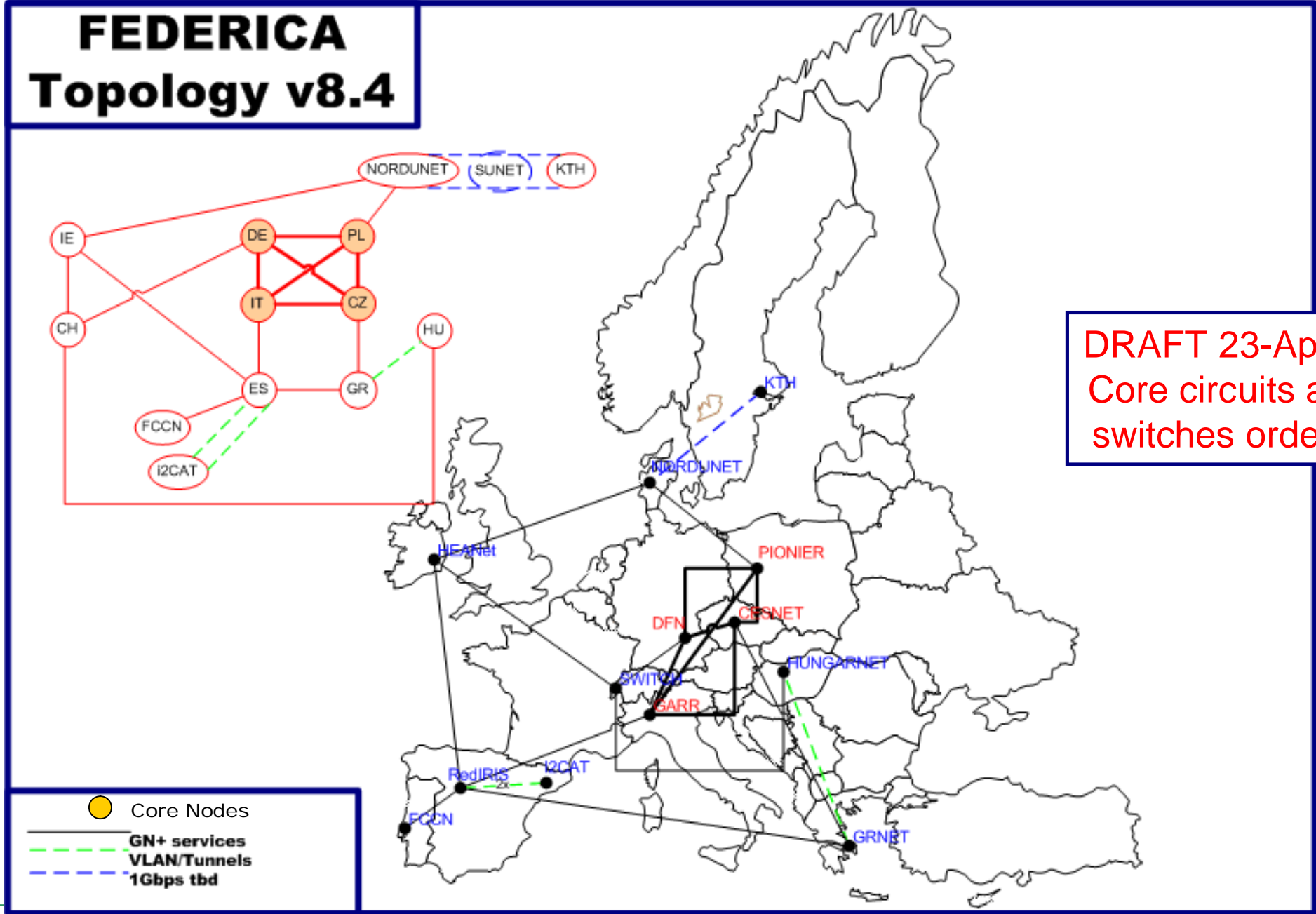
## Service Activities

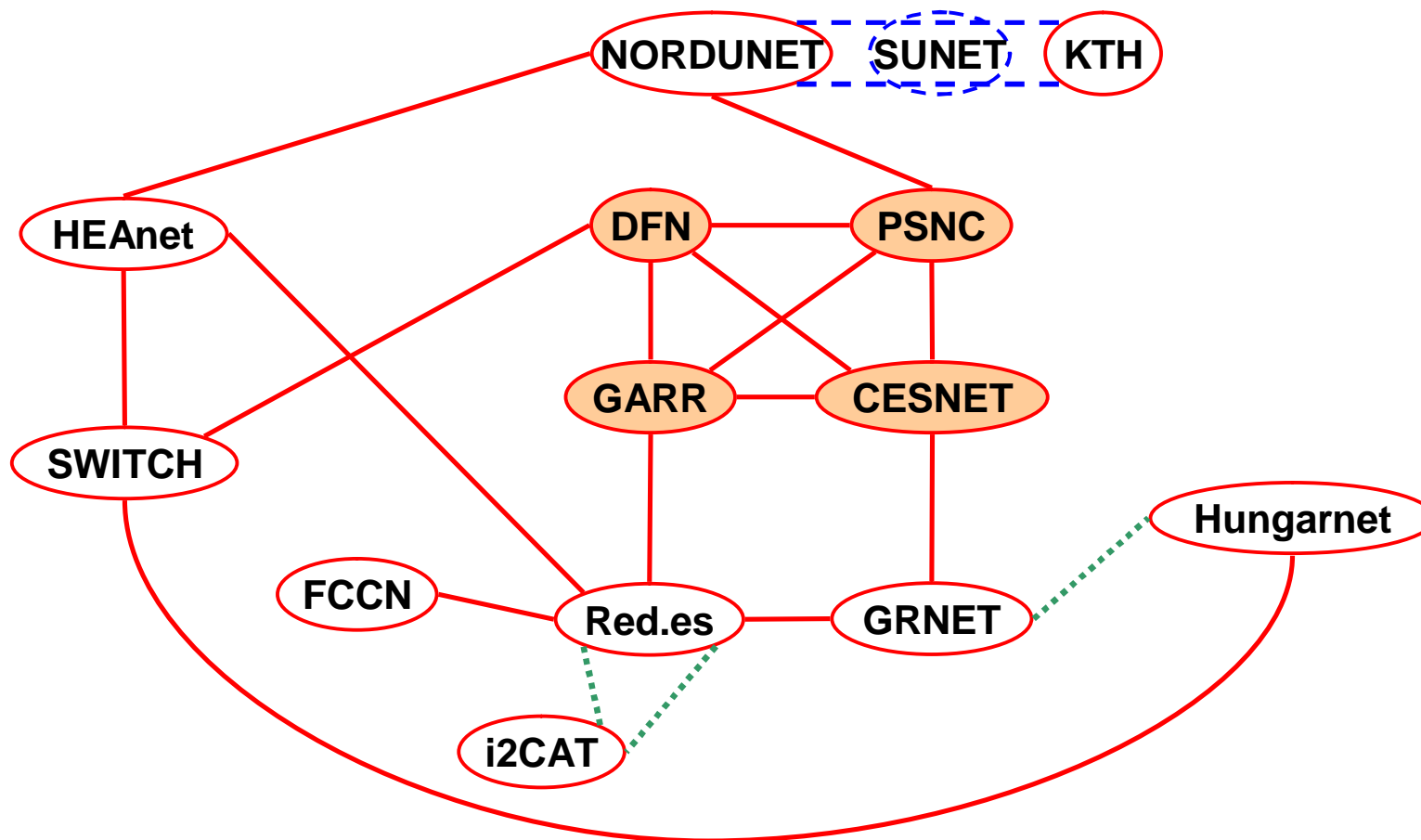
- JRA1: Network Control and Management
- JRA2: Novel Paradigms and User Control

## Join Research Activities





The user requests an Infrastructure made of L2 circuits, un-configured virtual nodes, to test a new BGP version. The IP

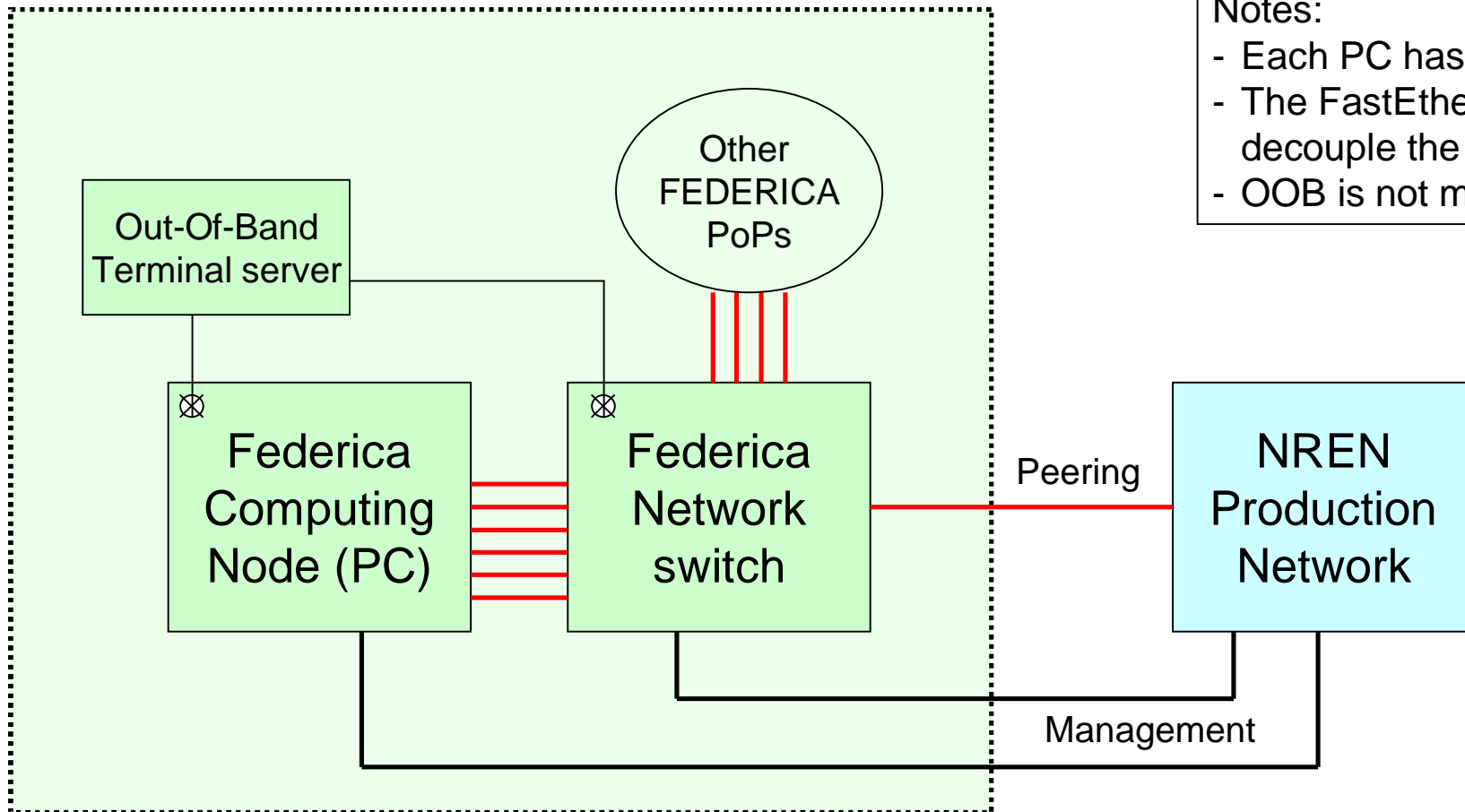






**Legenda**

	Core Nodes		1 GbE VLAN or L2MPLS
	1 Physical GbE from GN2+		1 Physical GbE tbd



**Notes:**

- Each PC has many GbE interfaces
- The FastEthernet Interfaces are to decouple the control and data plane
- OOB is not mandatory

The FEDERICA substrate  
(physical infrastructure and  
Single IP AS public number)

**Legenda**

- 1 FastEthernet
- 1 FastEthernet
- ⊗ RS-232

- A **User Policy Board** will receive and approve project for the use of the infrastructure
- Access to the infrastructure is subject to the signature of an “**Acceptable User Policy**”, which includes providing feedback
- The access to the core network will be **free of charge if no additional equipment is requested**
- **Interconnection** with other infrastructures, labs is possible the cost is to be defined/shared.
- The **time duration** of the project will be in principle limited to facilitate turnover
- Access is **open** to research groups from **academia and private sector** with priority to European Community funded projects.
- The code and tool bench produced will be **Open Source**

*Users' requirements are fundamental and are being collected*

## In scope

- Provide on European scale network and system **agnostic e-Infrastructure** to be deployed in phases for Future Internet research (and not only). Provide its operation, maintenance and on-demand configuration
- Act as a **forum** and **support** for researchers/projects on “Future Internet”. Support of **experimental activities** to validate theoretical concepts, scenarios, architectures, control and management solutions. Users have full control of their slice
- Validate and gather experimental information for the next generation of research networking also through basic tool validation
- **Dissemination and cooperation between NRENs and researchers’ community**
- **Contribution to standards** in form of requirements and experience

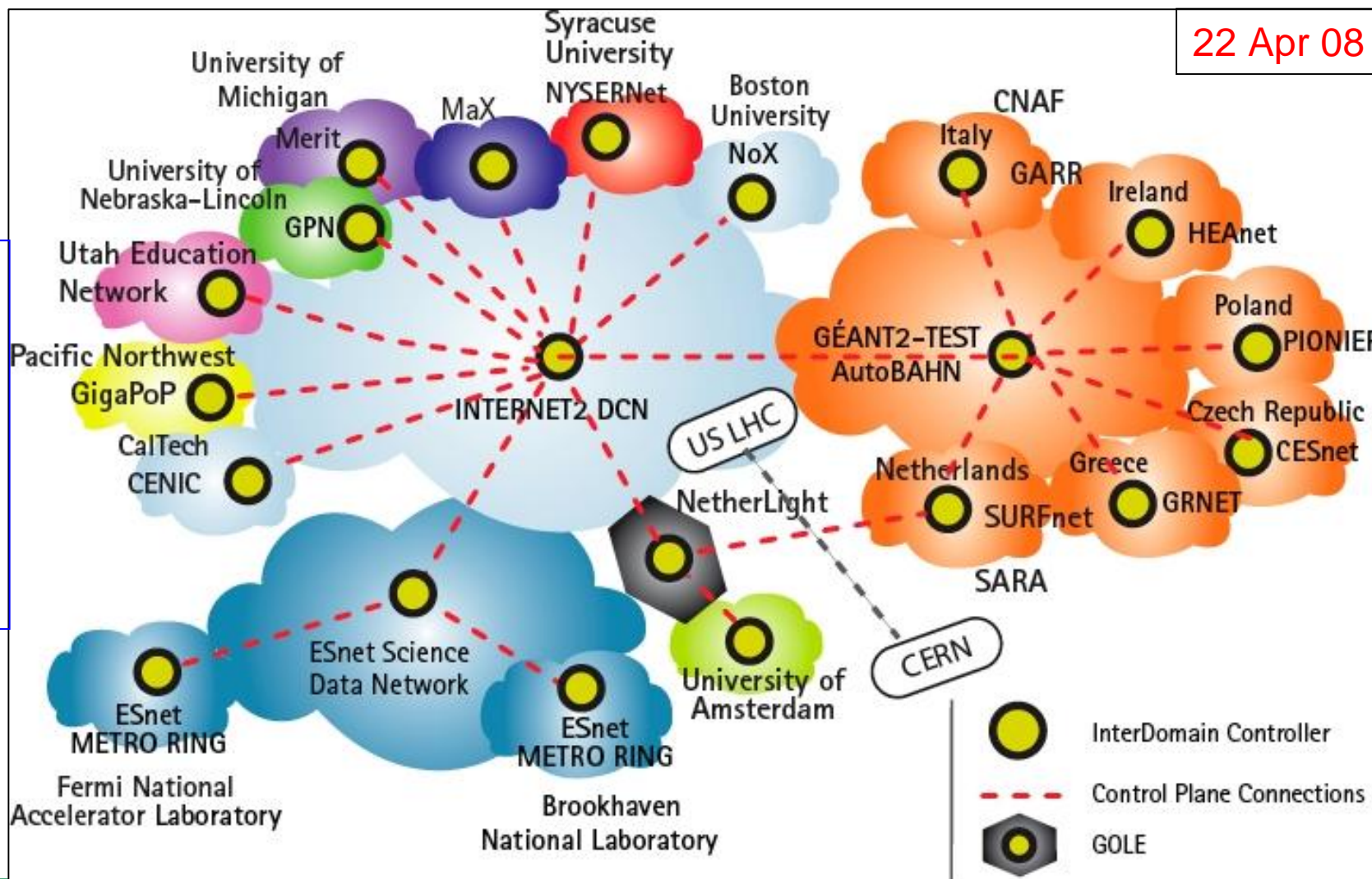
## Out of scope

- **Internal extended research**, e.g. advanced optical technology
- Development of **Grid** applications (but open to hosting)
- Offer **raw computing power**
- Offer **transit capacity**



Perfsonar (monitoring), Common Network Information Service (cNIS)  
 AutoBAHN (Circuits on Demand), EduGAIN (AAI), ....

Transatlantic  
 demo this  
 week of  
 dynamic  
 1Gbps  
 circuits



# Personal Summary

- The NRENs employ a network **architecture** and own a federated **infrastructure**, which took many years to create and is still under development. Such infrastructure can play a significant role in the **development** of research in Europe. Thanks to its characteristics can be used to support (almost all) researcher's needs, including the provision of an almost **clean slate** e-Infrastructure for Future Internet research.
- The research ongoing in NRENs/GÉANT2, started from researchers' needs (LHC, DEISA, Astronomers, GRIDs), is tackling **fundamental network research areas** (e.g. network representation, multidomain, multilayer monitoring, control plane) which place Europe in top position and which has also important **collaboration and outcome on the private sector**.
- The **international collaborations, a federated model** and the contribution to **standards** are key elements, which must be even more enforced
- System complexity (and its maintenance) is a risk which should be faced upfront

Thank you for your  
attention

# FEDERICA Partners

