# Connectivity Services, Autobahn and New Services

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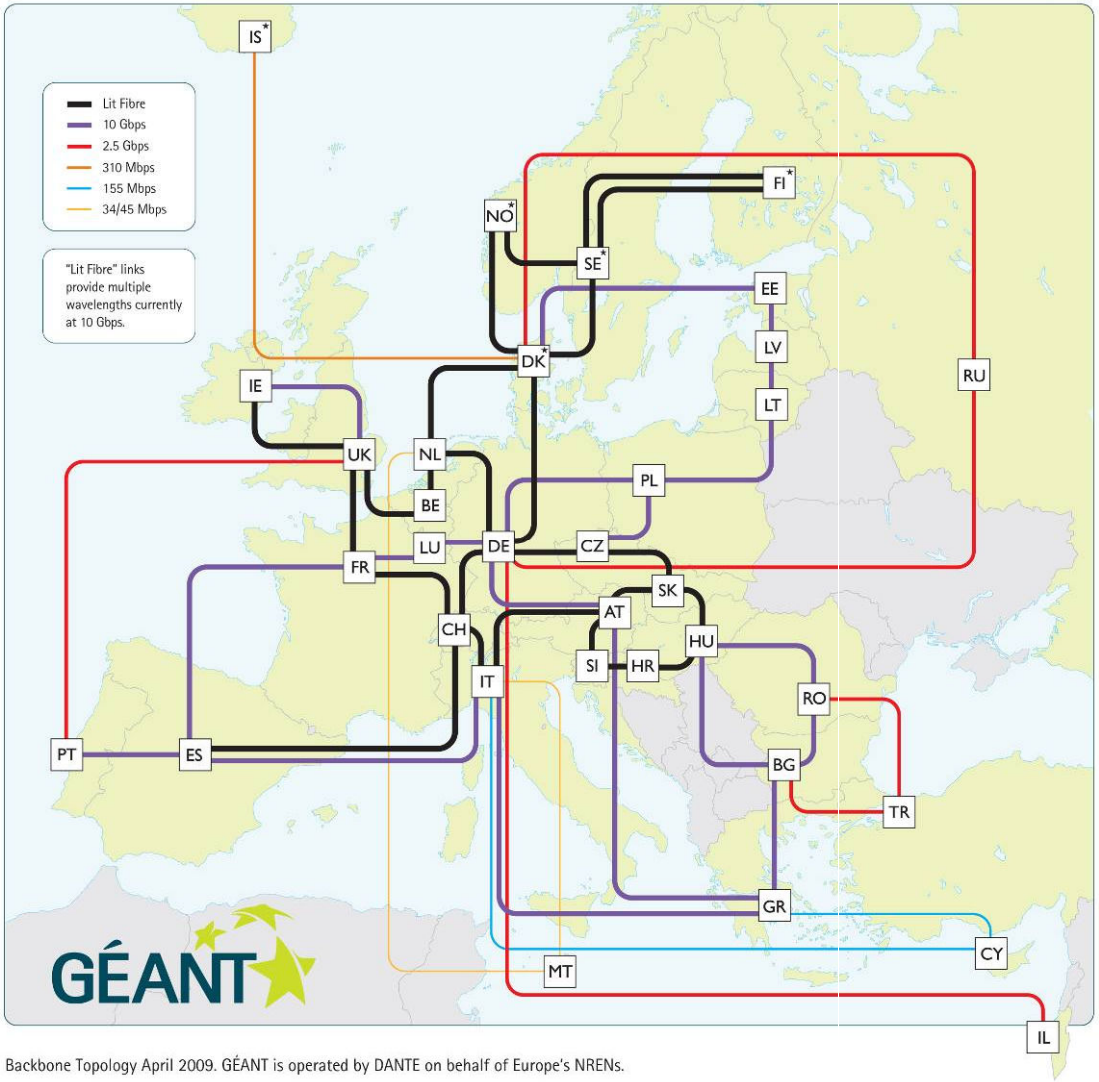
# Agenda

- Background
- GÉANT Connectivity services:
  - GÉANT IP
  - GÉANT Plus
  - GÉANT Lambda
- Autobahn
- New services
- Monitoring in Multi-domain environment
  - perfSONAR
  - End-to-End Monitoring
  - Use Case: perfSONAR for LHC-OPN, Visualization Tools
- Conclusions

# Background: Research and Education Networking in Europe


- 3-tier Federated Architecture:
  - Campus Networks:  3,500+ Institutions, 30+ Million Users
  - 34 National Research and Education Networks (NRENs)
  - The Pan-European Interconnection: GÉANT3 (GN3, started in FP7) Hybrid Optical Backbone (+Cross Border Fibers)
- Complex Applications are being built on top the network
  - Collaborative tools, conferencing,
  - GRID and e-Science distributed computing
- GÉANT provides advanced network, services and multi-domain monitoring systems
  - Help users in quick diagnosis of problems that span multiple networks
  - Develop new measurement tools (HADES, Passive monitoring, etc)

# GÉANT topology

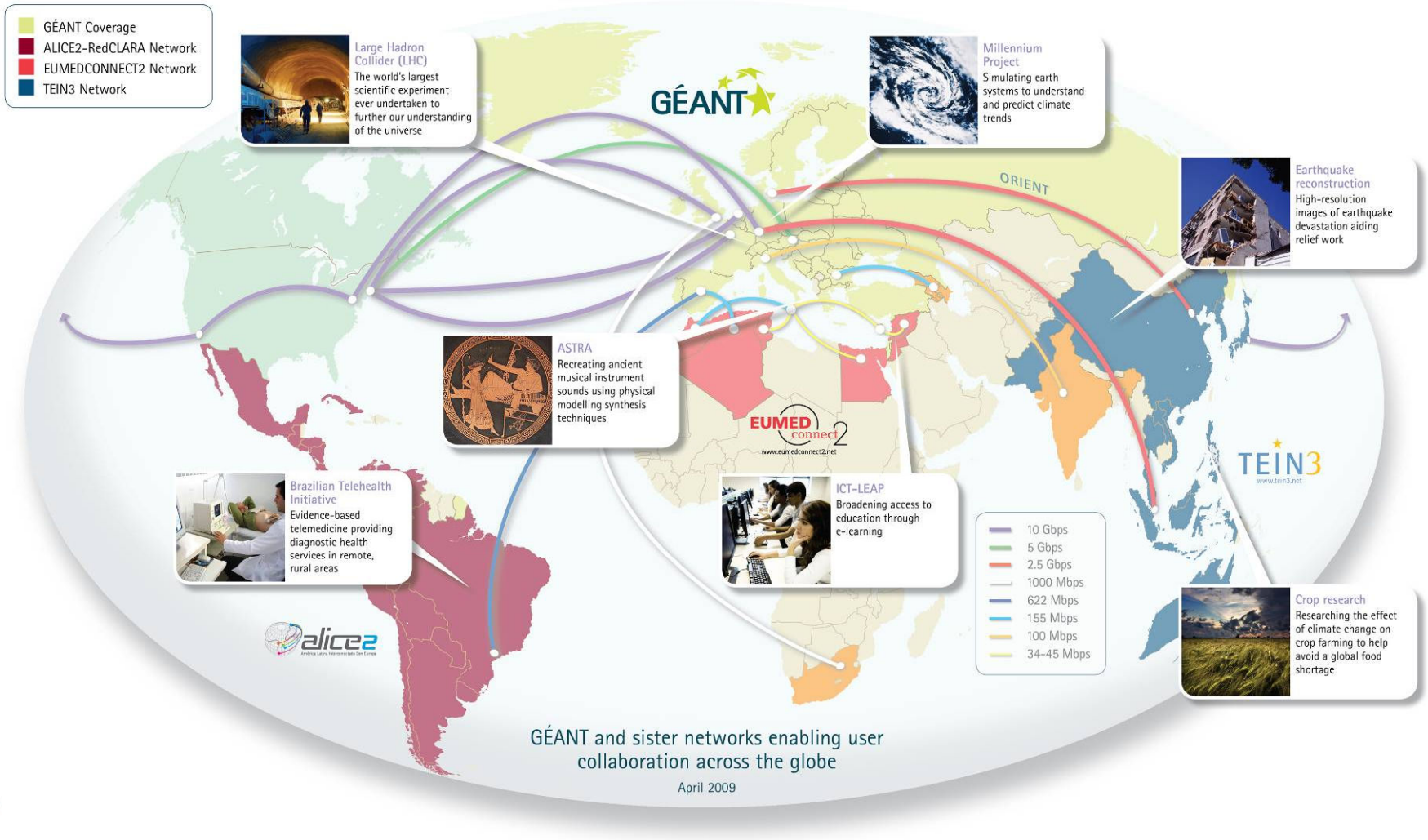



Backbone Topology April 2009. GÉANT is operated by DANTE on behalf of Europe's NRENs.

**GÉANT topology – April 2009**

- 15+ NRENs interconnected within the Dark Fibre (DF) "cloud"
- The others, via "lambda" and SDH circuits
- Hybrid architecture (routed IP traffic and switched special-purpose traffic)

# High Speed Global Network




**GÉANT global connectivity and projects**

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# Connectivity Services

# Connectivity Services

- **GÉANT IP** – providing high bandwidth international Internet connectivity for millions of academic users through NRENs via the shared GÉANT IP backbone network.
- **GÉANT Plus** and **GÉANT Lambda** point-to-point services provide dedicated bandwidth and guaranteed quality of service.
  - Benefit of a “virtual” private network created by reserving capacity on the network backbone
  - GÉANT Plus – a circuit service providing a flexible allocation of user-dedicated point-to-point connections
  - GÉANT Lambda – a service providing full 10 Gbps wavelengths to support NREN users with particularly demanding network requirements

# GÉANT IP

- The GÉANT IP service offers NRENs access to the shared European IP backbone.
- IPv4 and IPv6 support
- VPN, Multicast, Premium IP
- Robust high-bandwidth solution to the international connectivity requirements of the majority of academic users.
- Resilient service in the case of hardware failure or fibre cuts
- Advanced routing equipment to ensure fast recovery from unexpected events.
- GÉANT IP access is available to NRENs at capacities of up to 20 Gbps, subject to technical and commercial considerations.

# GÉANT Plus and GÉANT Lambda

## GÉANT Plus

- User access to point-to-point circuits of between 155 Mbps and 10 Gbps across an existing pre-provisioned network.
- Dedicated sub-wavelength point-to-point circuits configured over a network of dark fibre links and TDM (Time-Division Multiplexed) switches.
- Circuits can be established to many European NRENs
- Allows NRENs to configure transatlantic circuits to the GÉANT point-of-presence in New York (connecting to Internet2, ESnet and USLHCnet).

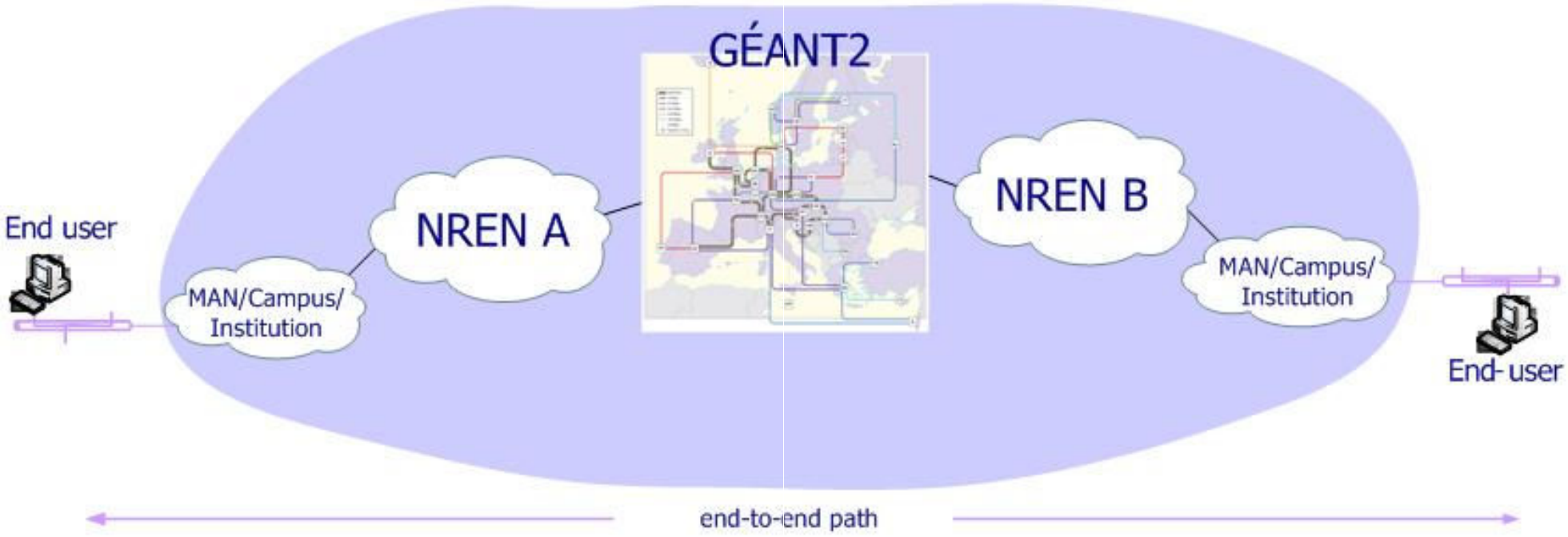
## GÉANT Lambda

- It provides private, transparent 10 Gbps wavelengths between any two GÉANT NRENs connected to the GÉANT dark fibre cloud.
- Available to pan-European projects and data intensive users via NRENs with access to GÉANT dark fibre.
- A GÉANT Lambda is presented to the NREN as a transparent wavelength on which they can then develop their own higher-level network layers.

# AutoBahn
## Dynamic circuit Services in GÉANT

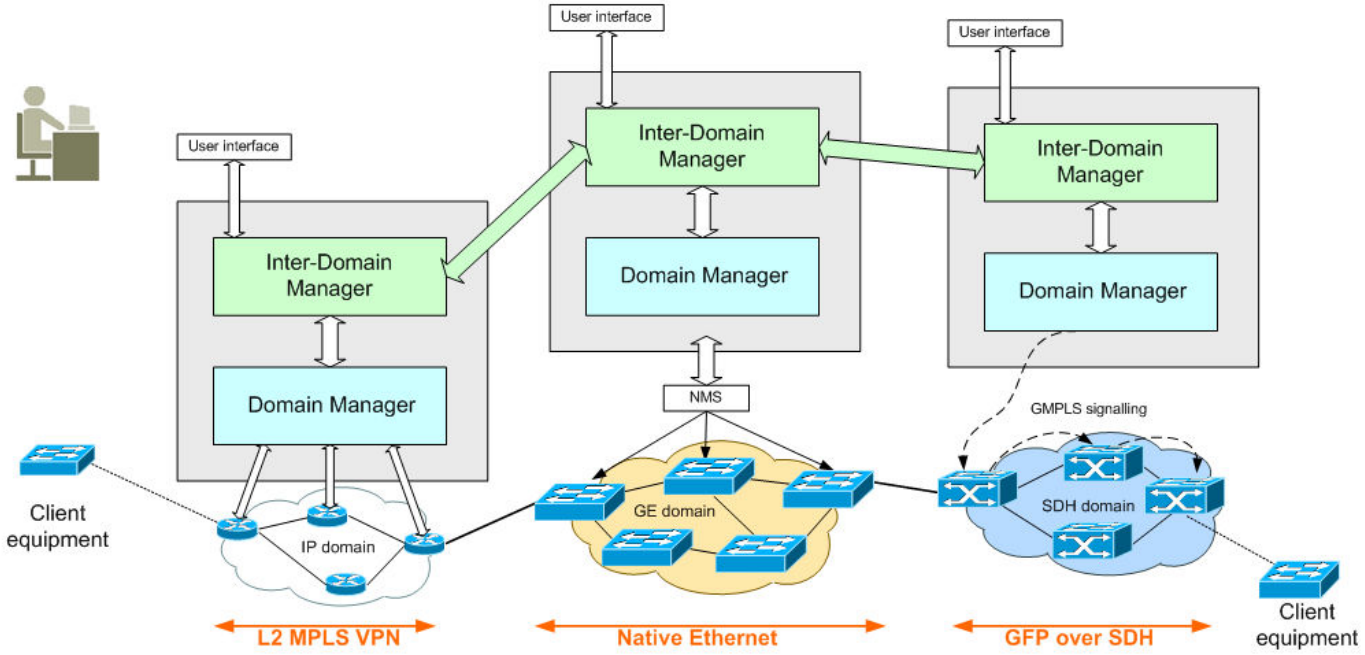
# New Services

# End-to-end paths over GÉANT - Bandwidth when you need it



# AutoBAHN approach

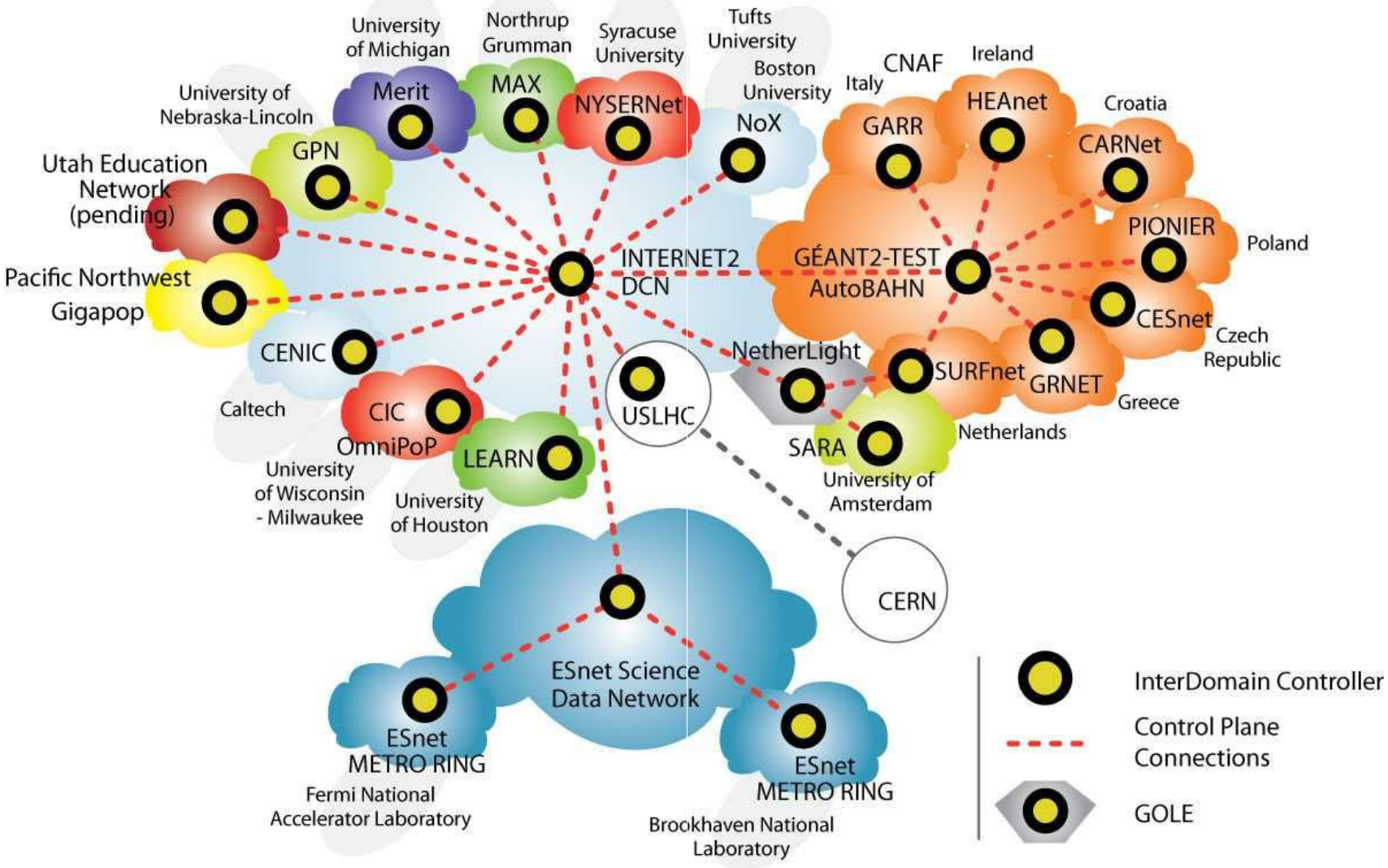
- Distributed control and provisioning
- Business-layer related interactions include AA, policies, advance reservations etc.
- Privacy and control of intra-domain resources must be safeguarded



# Latest features

- Diverse routing of circuits
- Support for future reservations
- Automatic teardown of circuits
- Federated authentication (eduGAIN compliant)
- Basic-level monitoring of circuits (Ethernet, SDH)
- Enhanced GUI (with Google maps, control plain details, user profiles etc.)

# International capabilities via IDC



# Future steps

- AutoBAHN transition to service
  - User demand drives timetable
- Rollout in European NRENs + backbone
- Operational support
- Integration in the multi-domain service portfolio of GÉANT
- Following evolution in NSI-WG
- Research activities
  - New technologies
  - New features
  - Evolution of IDC protocol

# New services

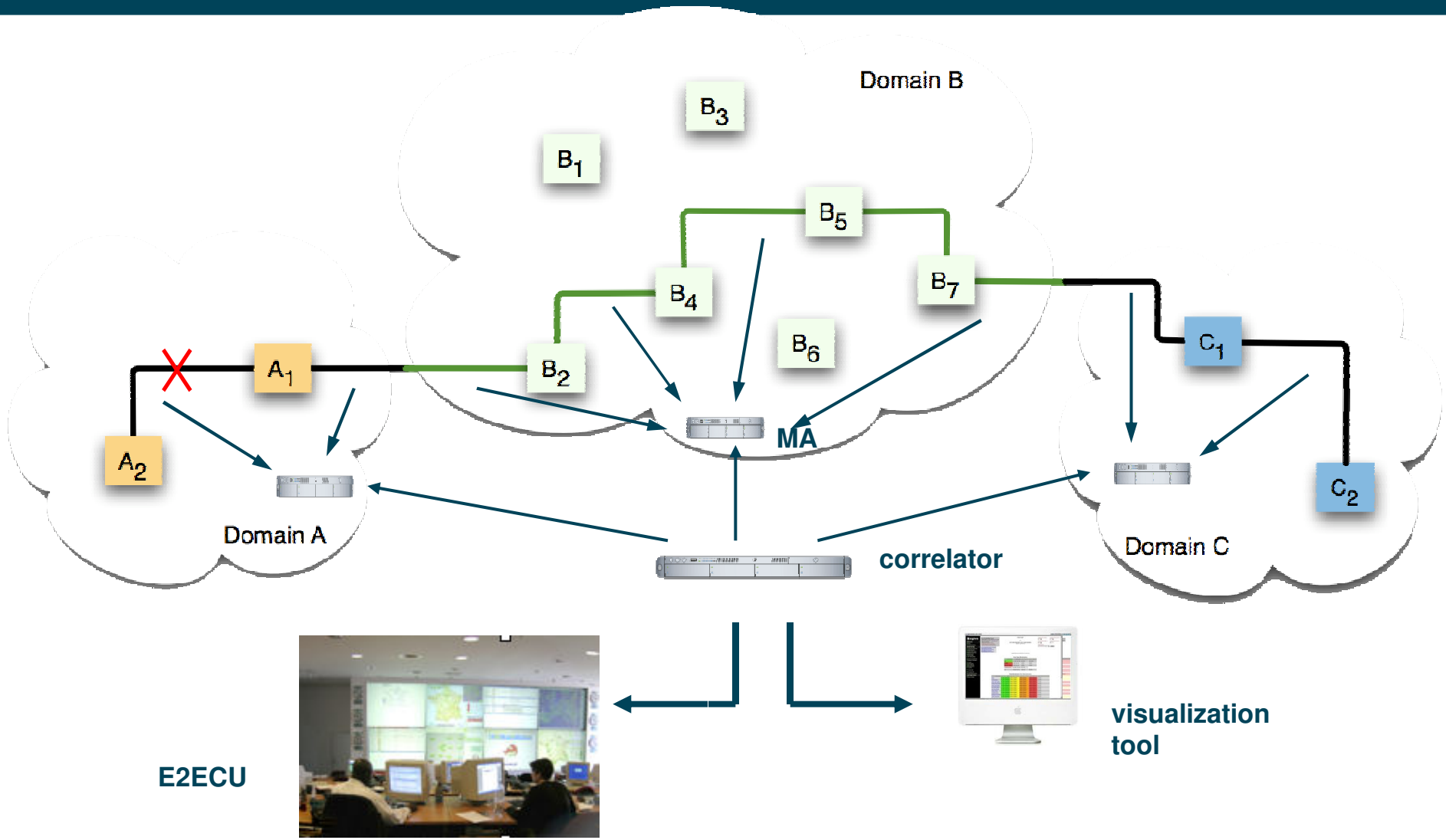
- Backbone upgrade to 40 Gb/s
  - Successful test on the Geneva-Milan link
  - Test ongoing on Geneva-Frankfurt
- Enhanced Security Services
  - Deployment of tools in the GEANT CORE for easier detection and investigation of malicious traffic (DDoS, scanning, worm spread)
  - Improve security in the NRENs by taking (coordinated) actions in the core
- Continuous enhancement of the monitoring services
  - Each connectivity service will come with its monitoring service
  - New tools been deployed
  - Proactive detection of failures and anomalies

# Monitoring services

# Monitoring for IP services: perfSONAR MDM tool

- GÉANT multi-domain monitoring (MDM) tool: perfSONAR
- Objective:
  - Correctly, efficiently and quickly identify network problems
  - Provide fast, reliable and uninterrupted network communication
  - Track issues across multiple domains
- Strategy:
  - perform network monitoring actions in different network domains
  - make the information available thanks to a common protocol
    - *cross-domain monitoring capability*
    - *access network performance metrics from across multiple domains*
  - network problems and performance bottlenecks can be traced and eliminated quickly
  - proactively identify and prevent problems before service disruption occurs

# E2EMon: Monitoring lambda services



# End-to-End Monitoring

- Each domain installs software probes to capture up/down status of their links from network hardware
- This status info sent to PerfSONAR MP or MA:
  - Collecting network status info [UP / DOWN only]
  - Historical archive for network status info
  - Checks info and reformats into XML for collection by E2EMon
- E2E Monitoring System
  - Queries PerfSONAR MPs & MAs
  - Concatenates DLs & IDLs to form E2E Links

# Support: Service Desk

- Single point of contact
- Focus on monitoring and supporting network and services provided
- Dedicated personnel
  - Network Service Desk (GÉANT NOC)
  - Application Service Desk (Monitoring, Application support, i.e. perfSONAR)
- Continuous interaction with problem management to improve products and services

# Use case:
# LHCOPN Monitoring

# LHC-OPN

- Large Hadron Collider – Optical Private Network (LHC-OPN):
  - Dedicated network to support LHC experiment
  - Large amount of data in a grid environment
  - Network architecture is organized in **Tiers**
  - Primary users are **researchers** around different institutes
  - Challenges involves **multi-domain** environment
  - Shared infrastructure to support research
  - Large amount of data – reason to have a **dedicated network**

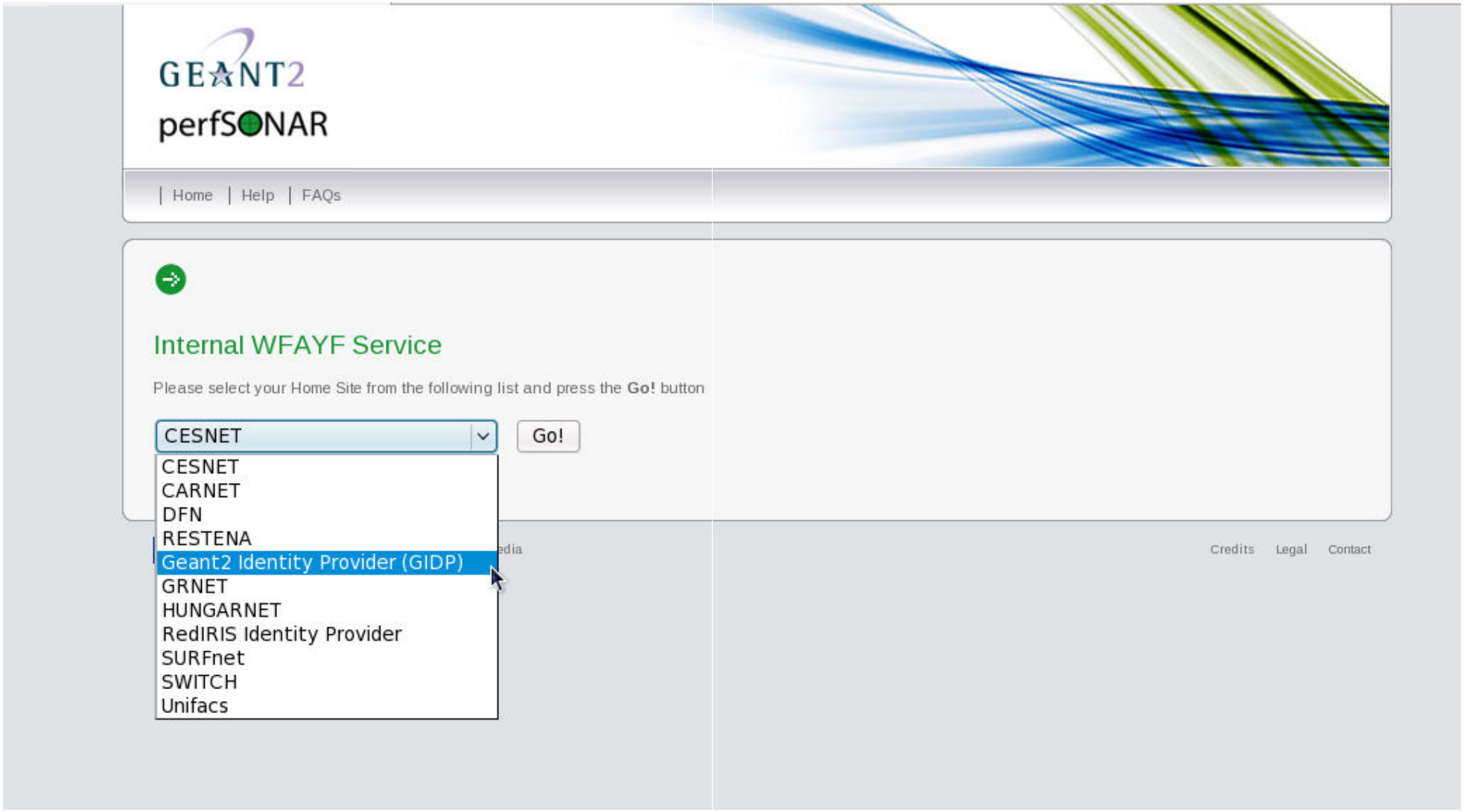
# Monitoring LHC-OPN

- 12 sites (1 Tier0, CERN, and 11 Tier1), across Europe, America, Asia
- Focus of monitoring: Network Layer (IP) and Physical Layer (Links)
- Regular Active Point-to-Point Measurements
  - One-Way Delay, Achievable Bandwidth, Historical Traceroute Changes
- Regular Passive Point-to-Point Measurements
  - Utilization, Input Errors, Packet Discards
- Customized version of perfSONAR MDM service
- Visualization tools accessible through web portal
- Monitoring tools, hardware and operating system packed in monitoring boxes,
  - To be easily deployed at any location
  - Remotely accessible by the service desk for operations and support
- Managed service (homogeneous installations, low overhead for T0/T1)

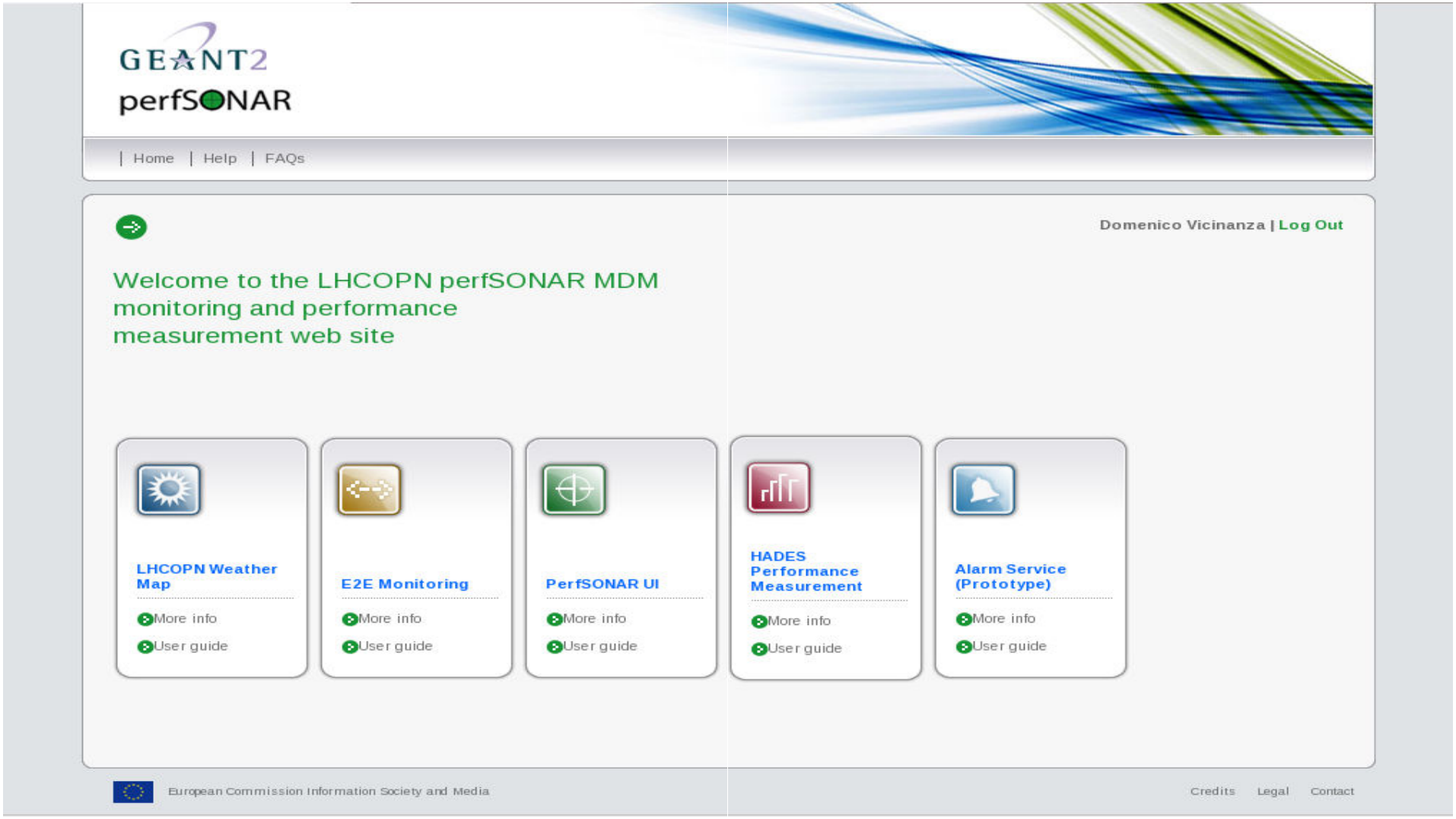
# perfSONAR Visualization Tools


- Data accessed via: LHC-OPN Portal
  - Provides a central location to reach available visualization tools
  - Authenticates users via Multi-Domain methods
- Information available:
  - Links connecting all Sites
  - Utilization Data
  - One-Way Delay
  - Traceroute Outputs
  - E2E Monitoring
    - *Monitors spans of circuits placed in different network domains*

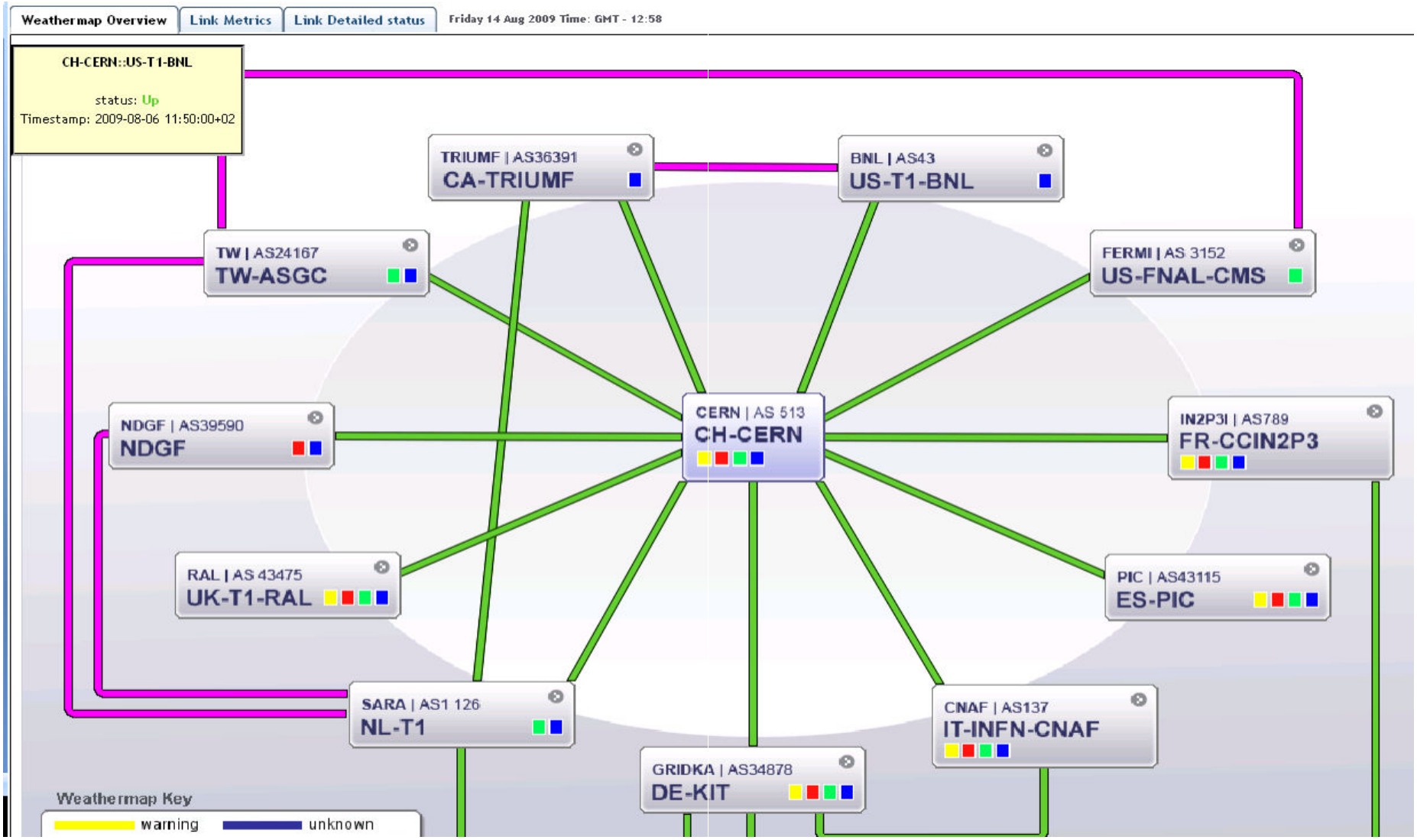
# LHC-OPN Portal



# LHC-OPN Portal



# Weathermap


Weathermap Overview
Link Metrics
Link Detailed status
Friday 14 Aug 2009 Time: GMT - 12:58
CH-CERN::US-T1-BNL
status: Up
Timestamp: 2009-08-06 11:50:00+02
TRIUMF | AS36391
CA-TRIUMF
BNL | AS43
US-T1-BNL
TW | AS24167
TW-ASGC
FERMI | AS 3152
US-FNAL-CMS
NDGF | AS39590
NDGF
CERN | AS 513
CH-CERN
IN2P3I | AS789
FR-CCIN2P3
RAL | AS 43475
UK-T1-RAL
PIC | AS43115
ES-PIC
SARA | AS1 126
NL-T1
CNAF | AS137
IT-INFN-CNAF
GRIDKA | AS34878
DE-KIT
Weathermap Key
warning
unknown

# E2E Monitoring

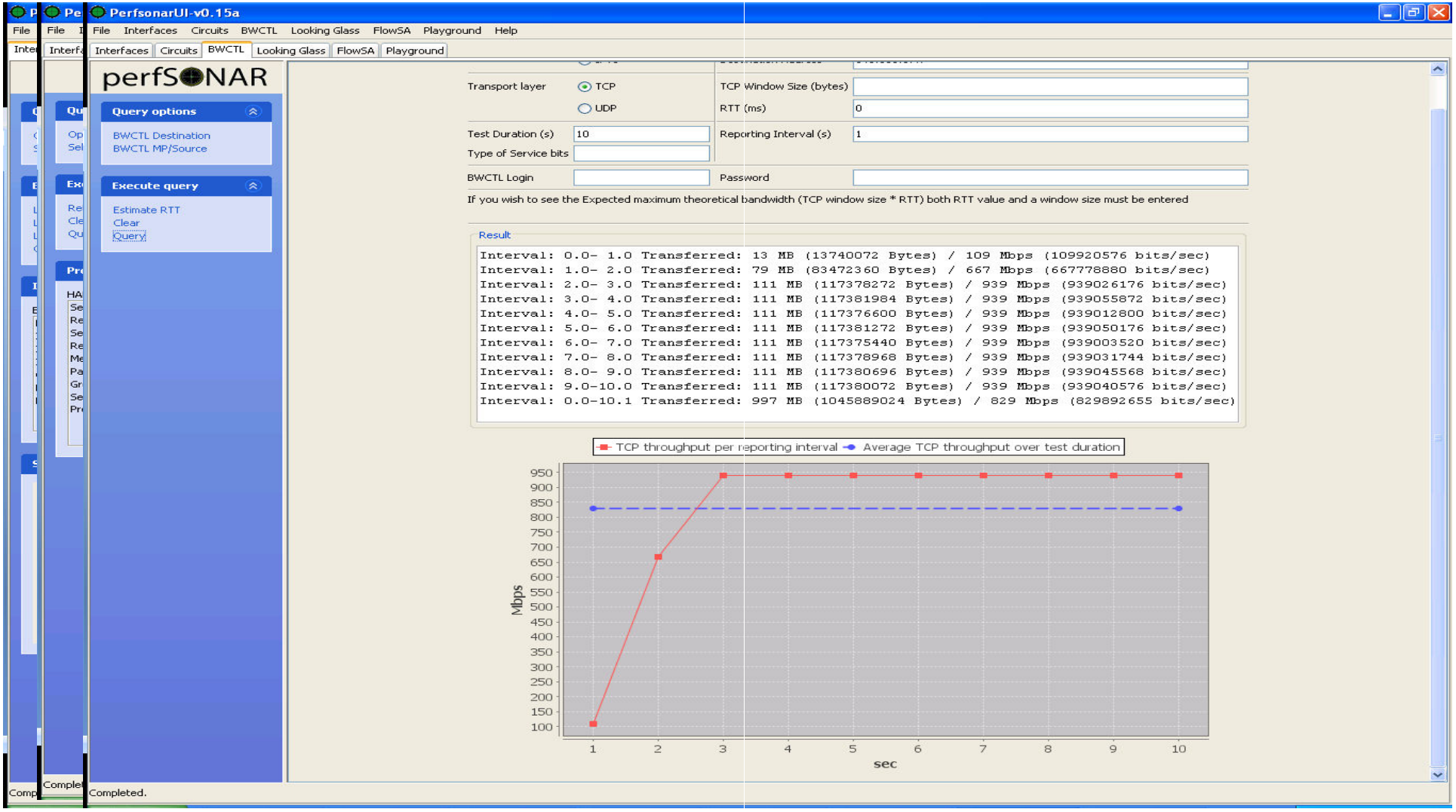
## Status of E2E Link CERN-ASGC-LHCOPN-003

**Time of State Aggregration:** 2009-08-14, 14:53:53 GMT (Cycle time: 60 s.)
**Operational State:** Up
**Administrative State:** Normal Oper.
**Error:** E2E Link is **not** contiguous (End Point missing or gap found)
**Warning:** Operational state is not known for all involved links
**Warning:** Administrative state is not known for all involved links

| Domain | NETHERLIGHT | | GEANT2 | | | | | NETHERLIGHT | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Link Structure | EP |  |  | DP |  | DP |  |  | EP |  |  |
| Type | EndPoint | ID Part.Info | ID Part.Info | Demarc | Domain Link | Demarc | ID Part.Info | ID Part.Info | EndPoint | ID Part.Info | ID Part.I |
| Local Name | NETHERLIGHT-AMS | - | AMSTERDAM-ams-fra-och1 | GEANT2-AMS | ams-gen_LHC_CERN-SURFNET_07014 | GEANT2-GEN | Geneva-fra-gen-och1 | - | NETHERLIGHT-GEN | - | S513-C-I |
| State Oper. | - | - | Up | - | Up | - | Up | - | - | - | Up |
| State Admin. | - | - | Normal Oper. | - | Normal Oper. | - | Normal Oper. | - | - | - | Normal C |
| Timestamp | - | - | 2009-08-14 T11:07:47.0+0000 | - | 2009-08-14 T11:07:47.0+0000 | - | 2009-08-14 T11:07:47.0+0000 | - | - | - | 2009-03 T17:19:44+ |

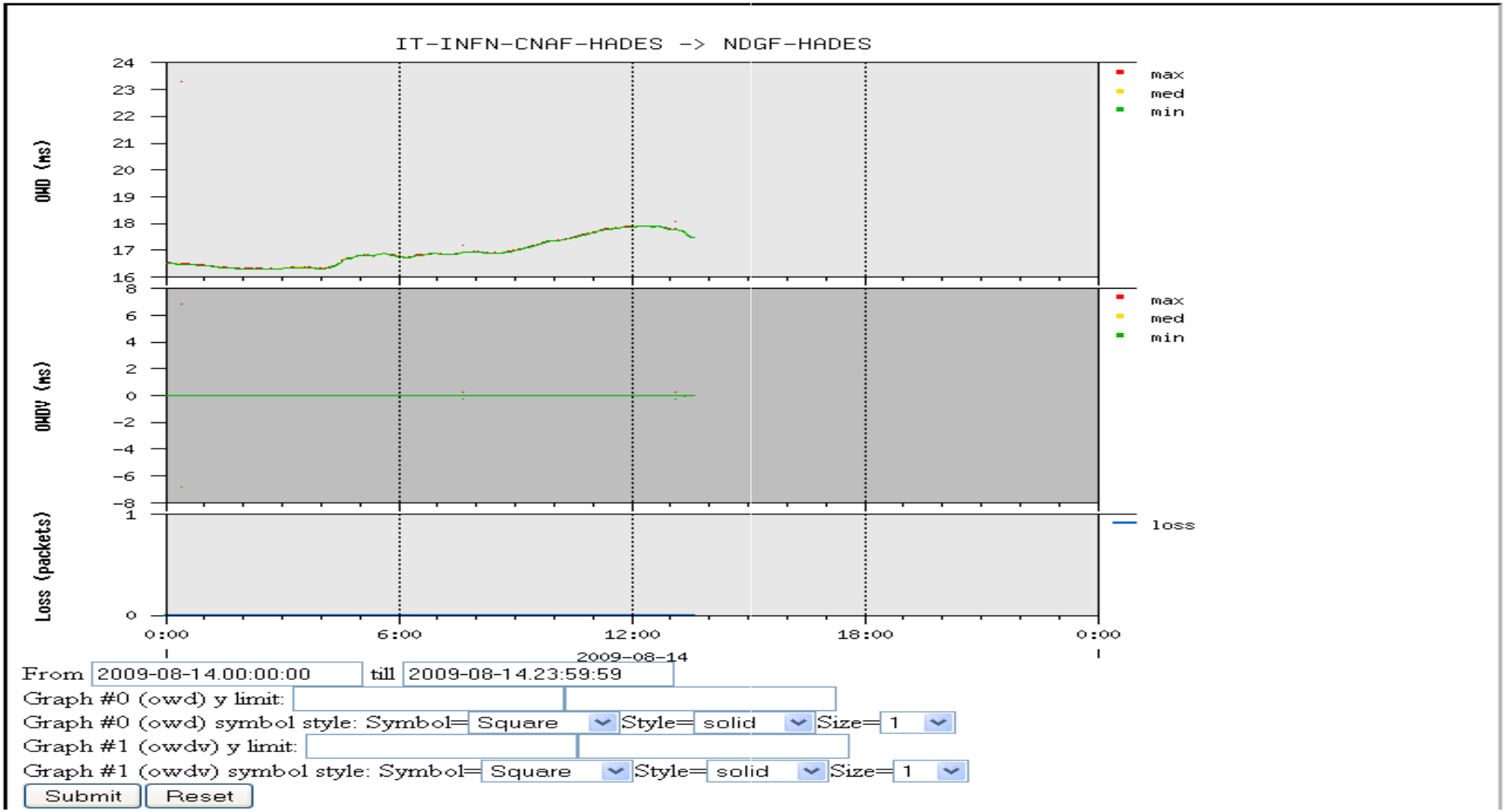
Page generated at 2009-08-14, 14:54:04 GMT

# perfSONAR-UI: Interfaces

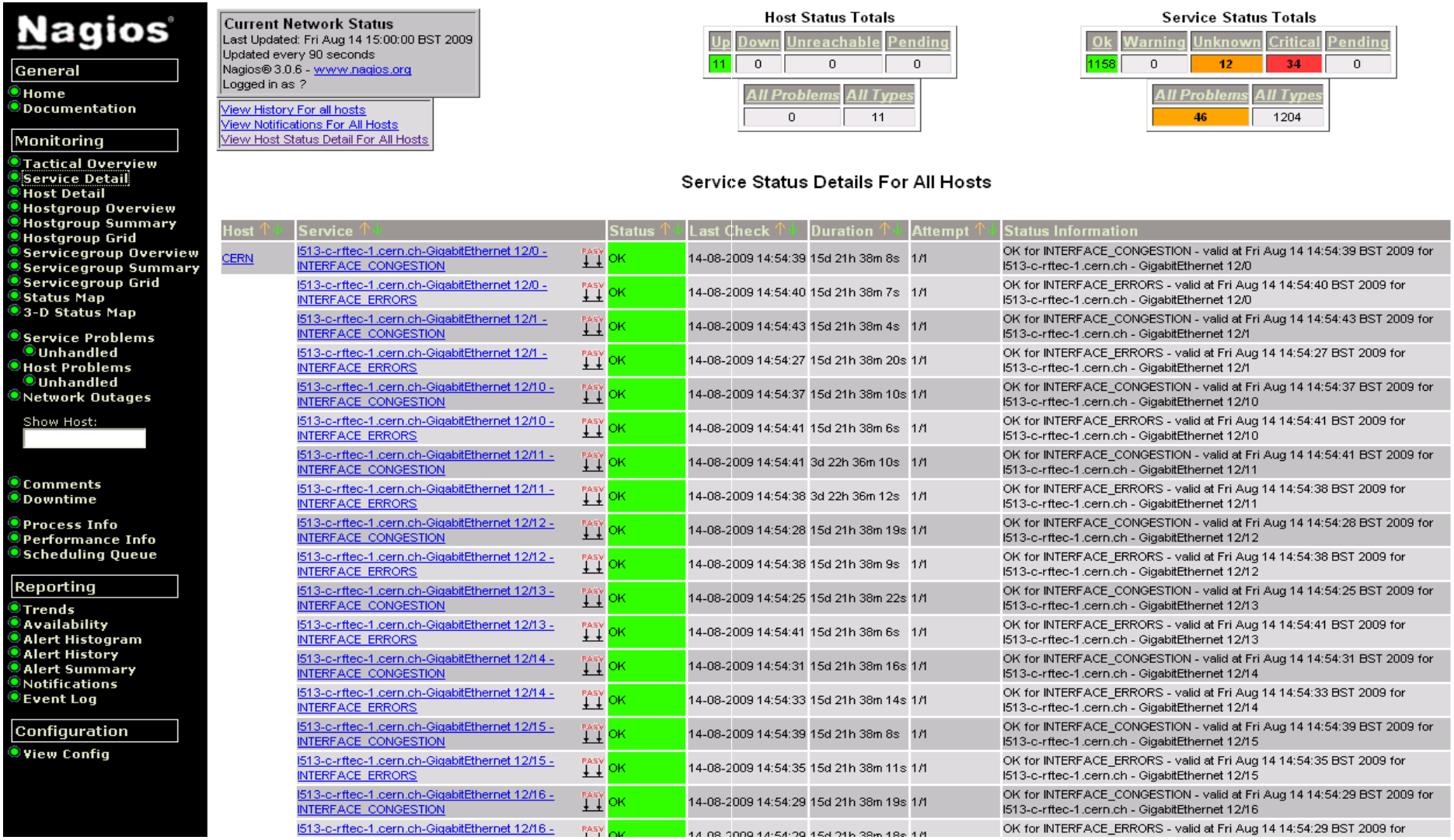


# HADES

**Time in UTC!**



# Alarms Service (prototype)



# Conclusions

- GRIDs are:
  - Complex and heterogeneous infrastructures
  - Naturally multi-domain environments
- Autobahn:
  - Support for future reservations
  - Federated authentication (eduGAIN compliant)
  - Monitoring + Enhanced GUI
- Multi-domain monitoring:
  - Advanced monitoring infrastructures and management is required
  - perfSONAR architecture/protocol can be used
- A use case: LHCOPN monitoring

# Thanks!