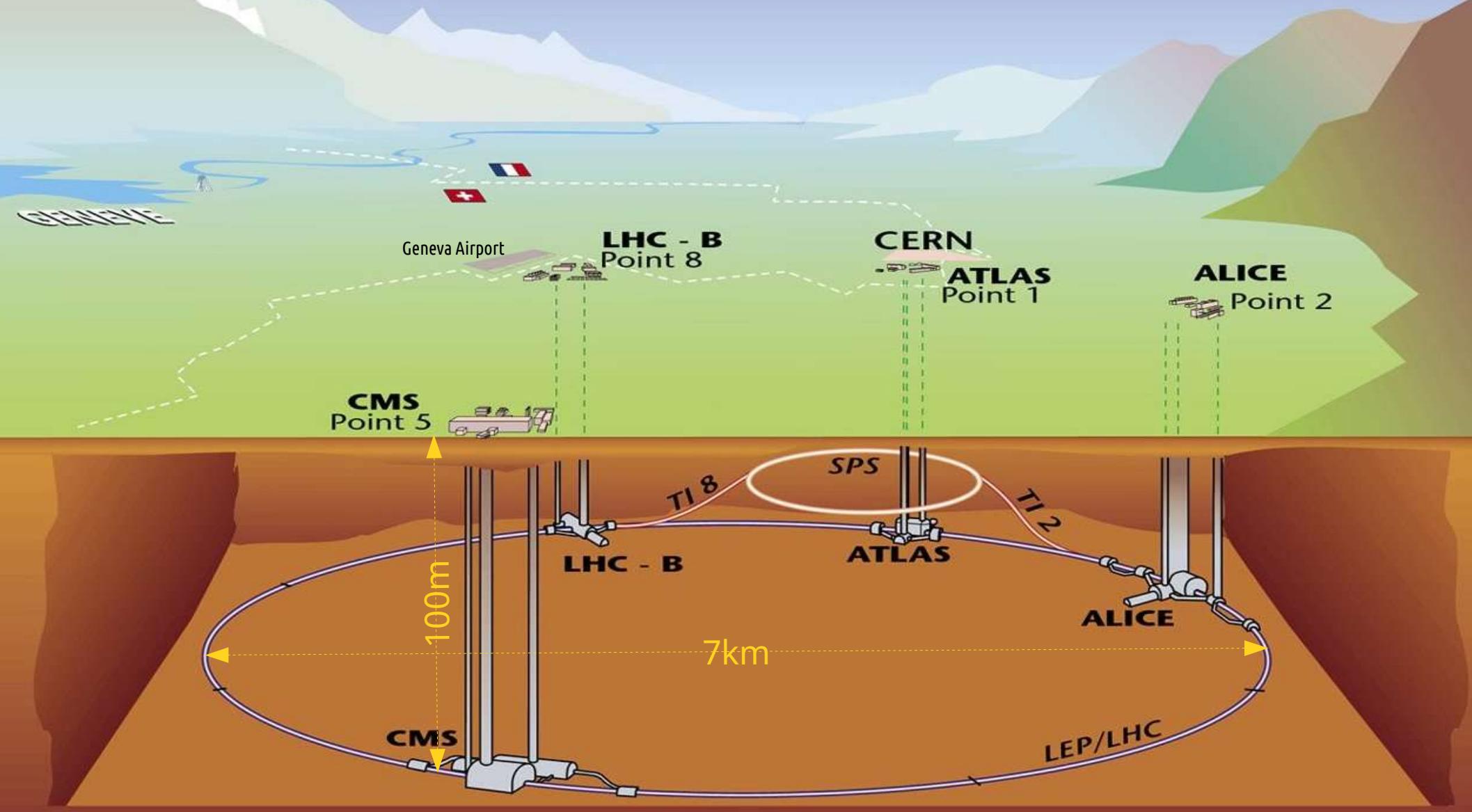


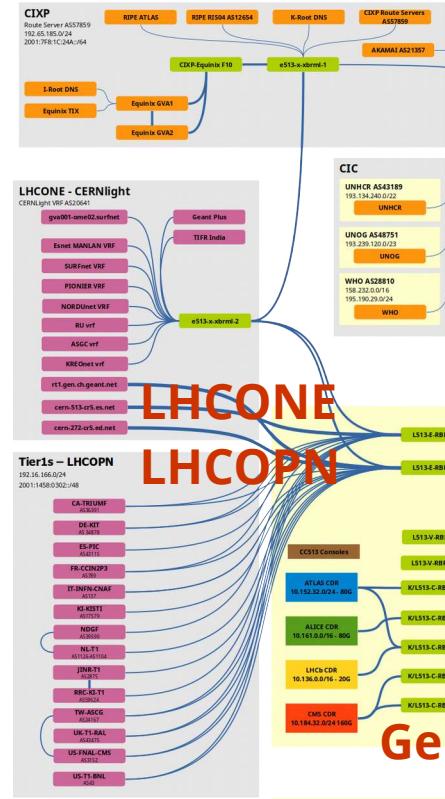
# CERN and WLCG Networks

16<sup>th</sup> of May 2017  
edoardo.martelli@cern.ch



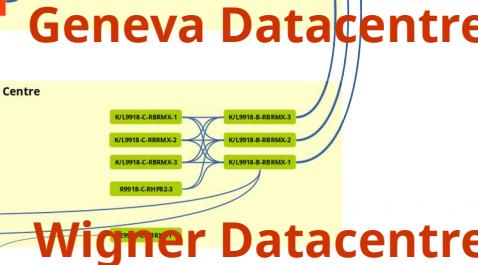
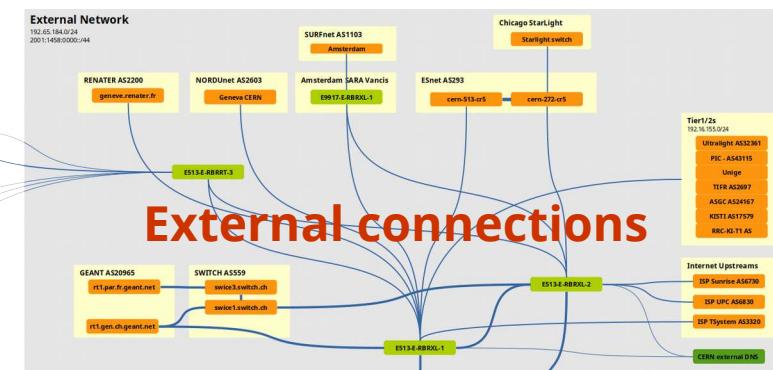
# CERN





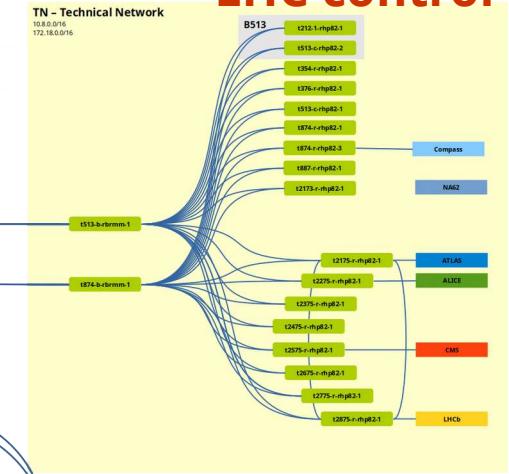
**Figures:**

- 160 routers
- 2300 Switches
- 50000 connected devices
- 5000km of optical fibres



# CERN networks

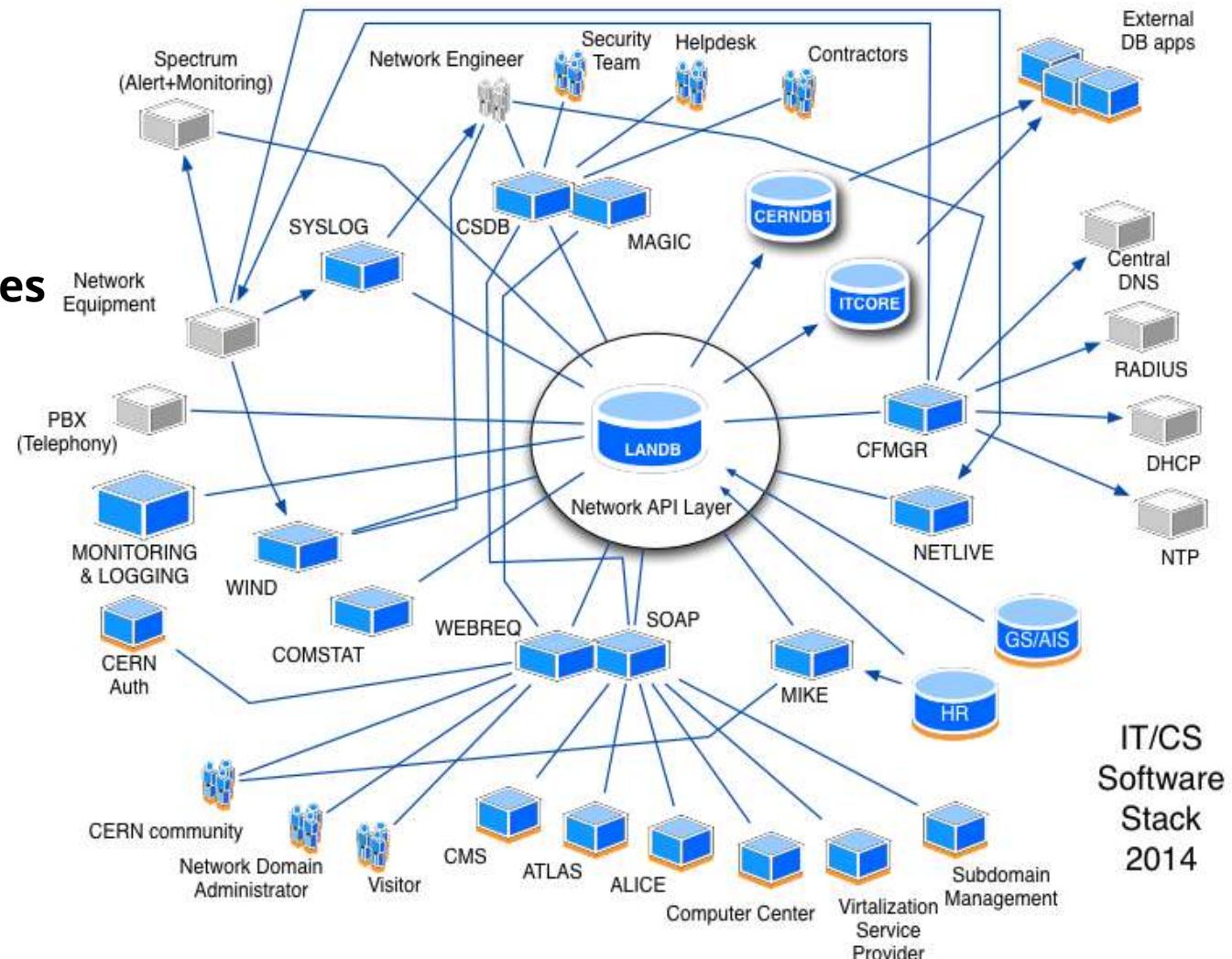
## LHC control



# Network Management System

## LANDB and CFMGR:

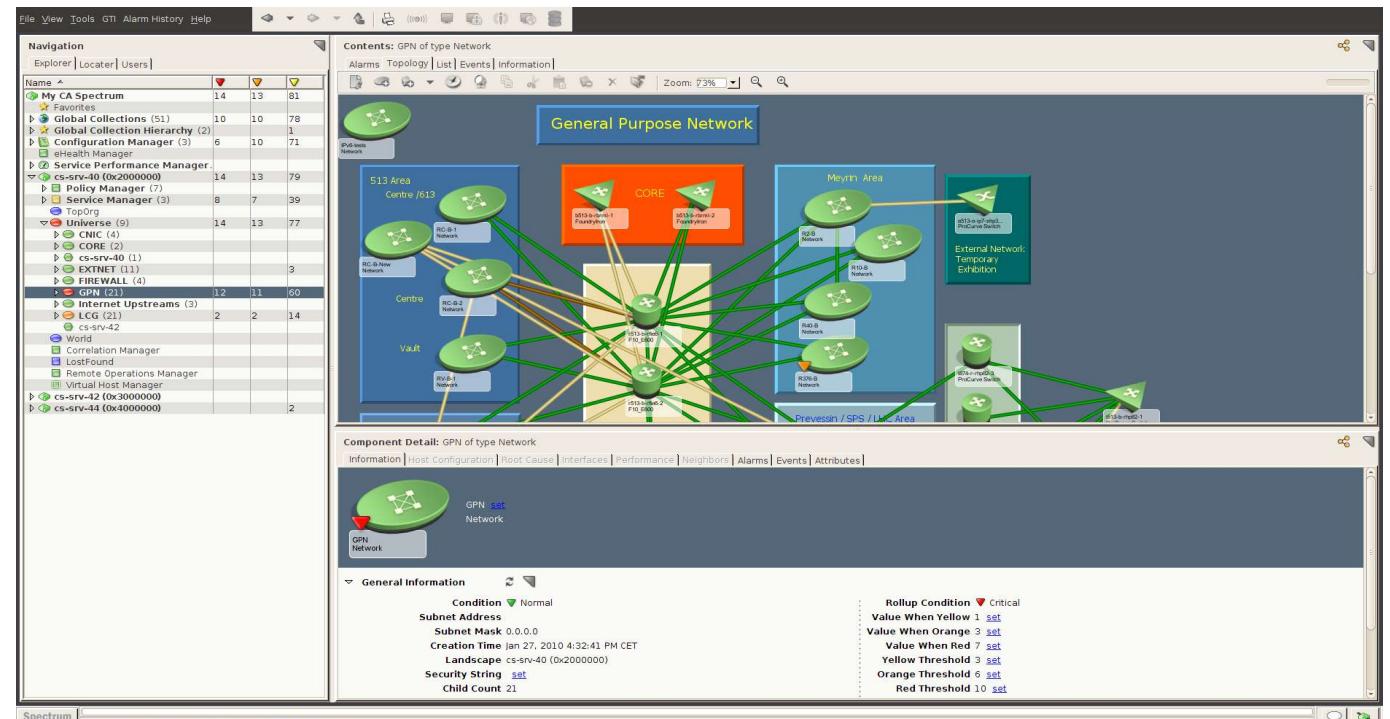
- >250 Database tables
- ~200,000 Registered devices
- >1,000,000 lines of codes
- >15 years of development



# Monitoring and Operations

The whole network is monitored and operated by the CERN NOC:

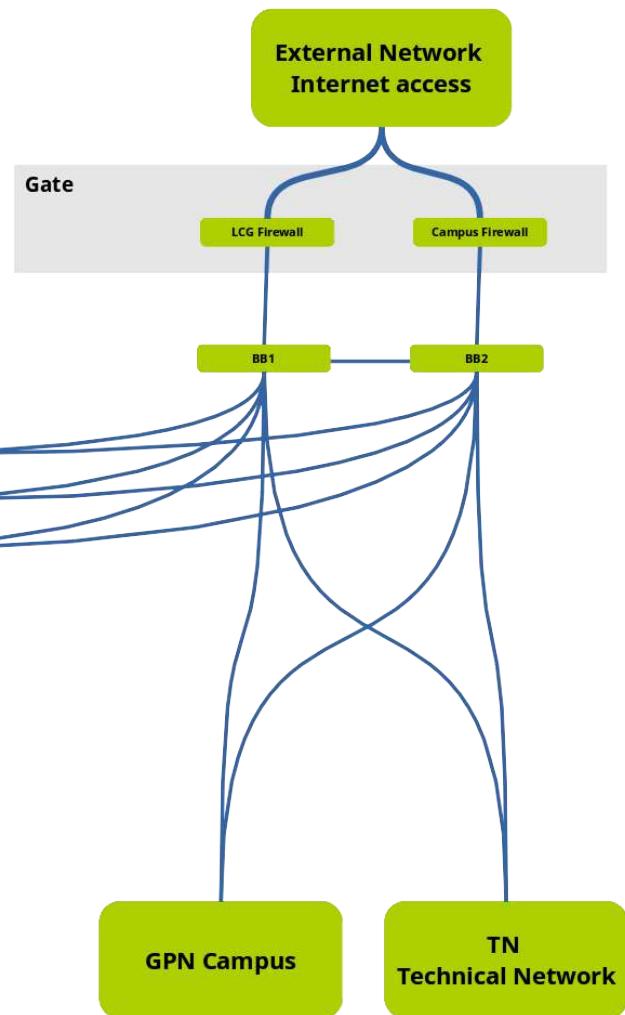
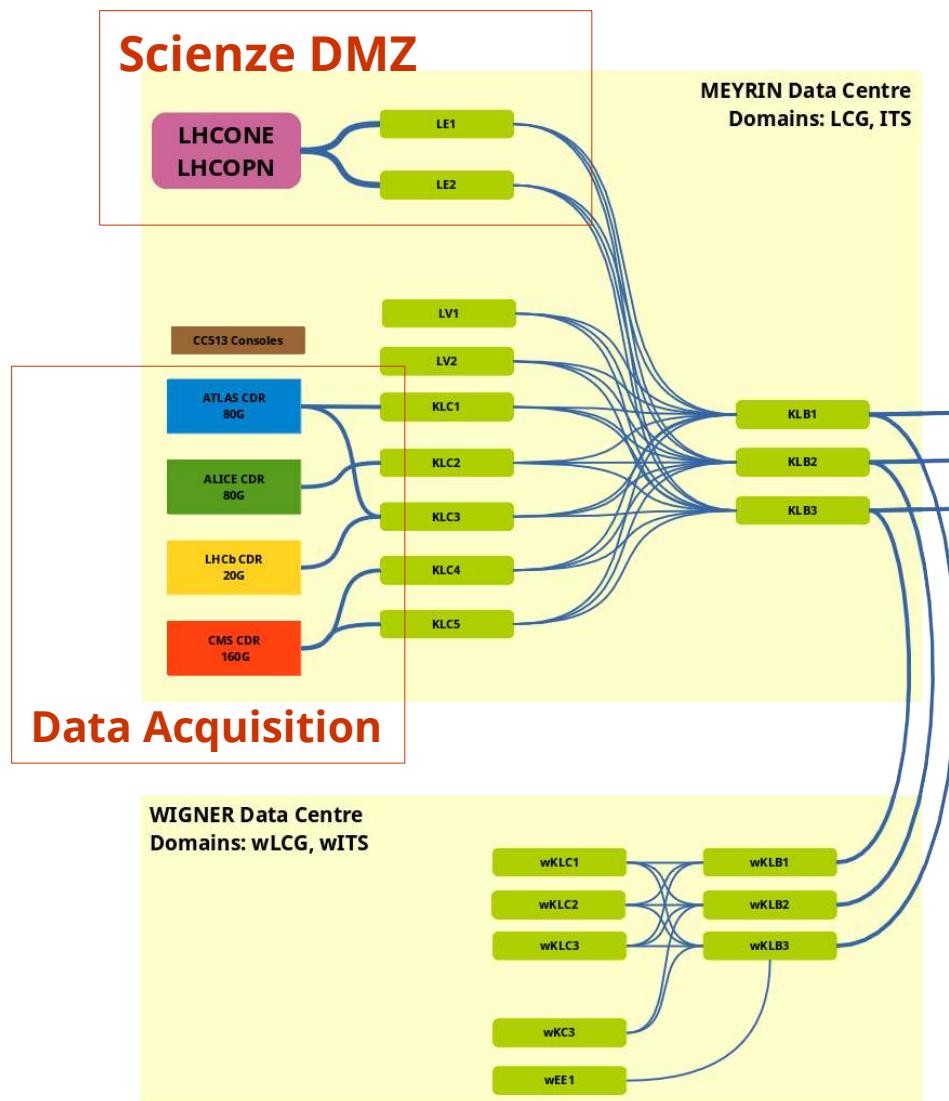
- 7500 devices
- 150 alarms treated per day



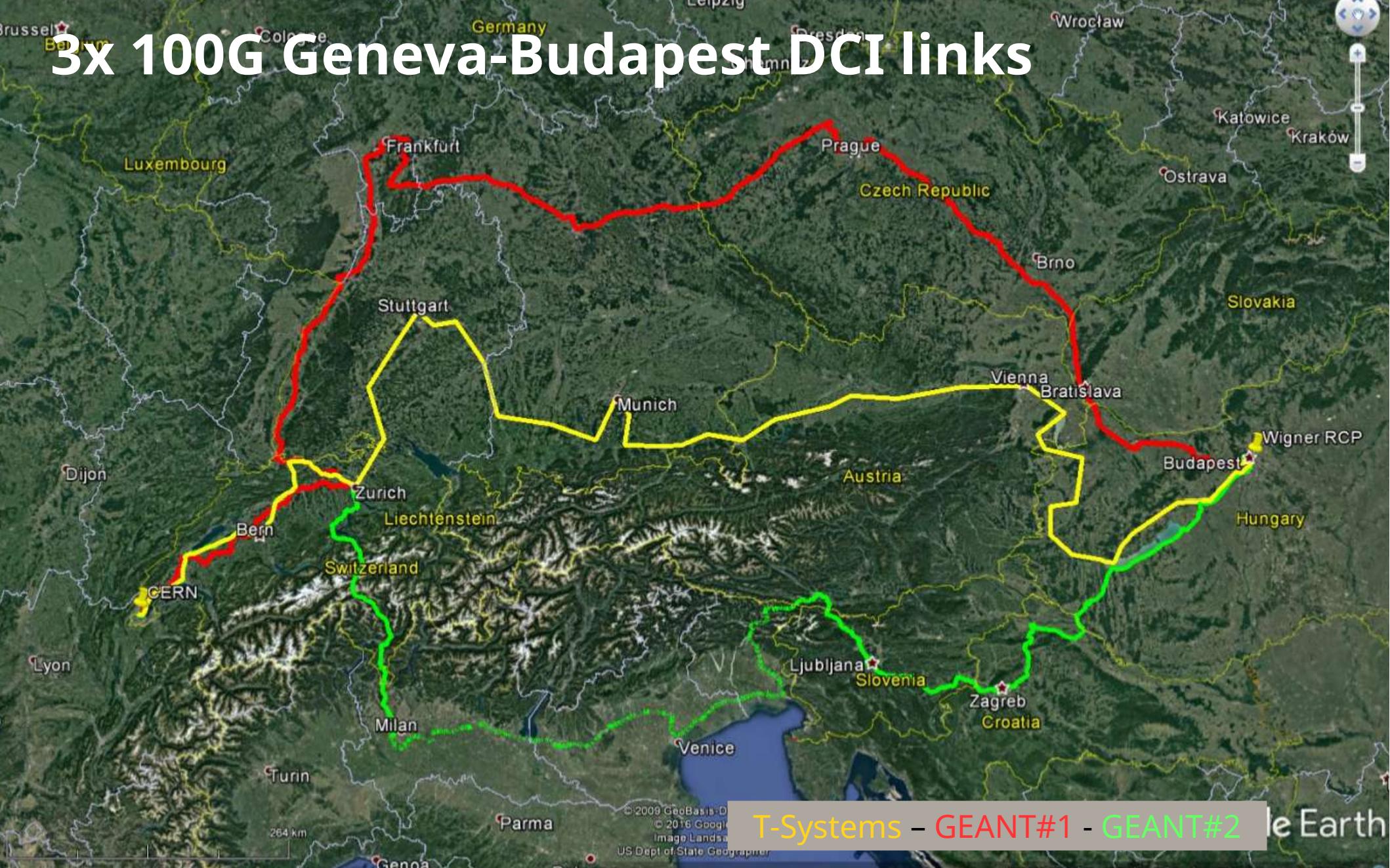
# CERN datacentres



# Data centre networks

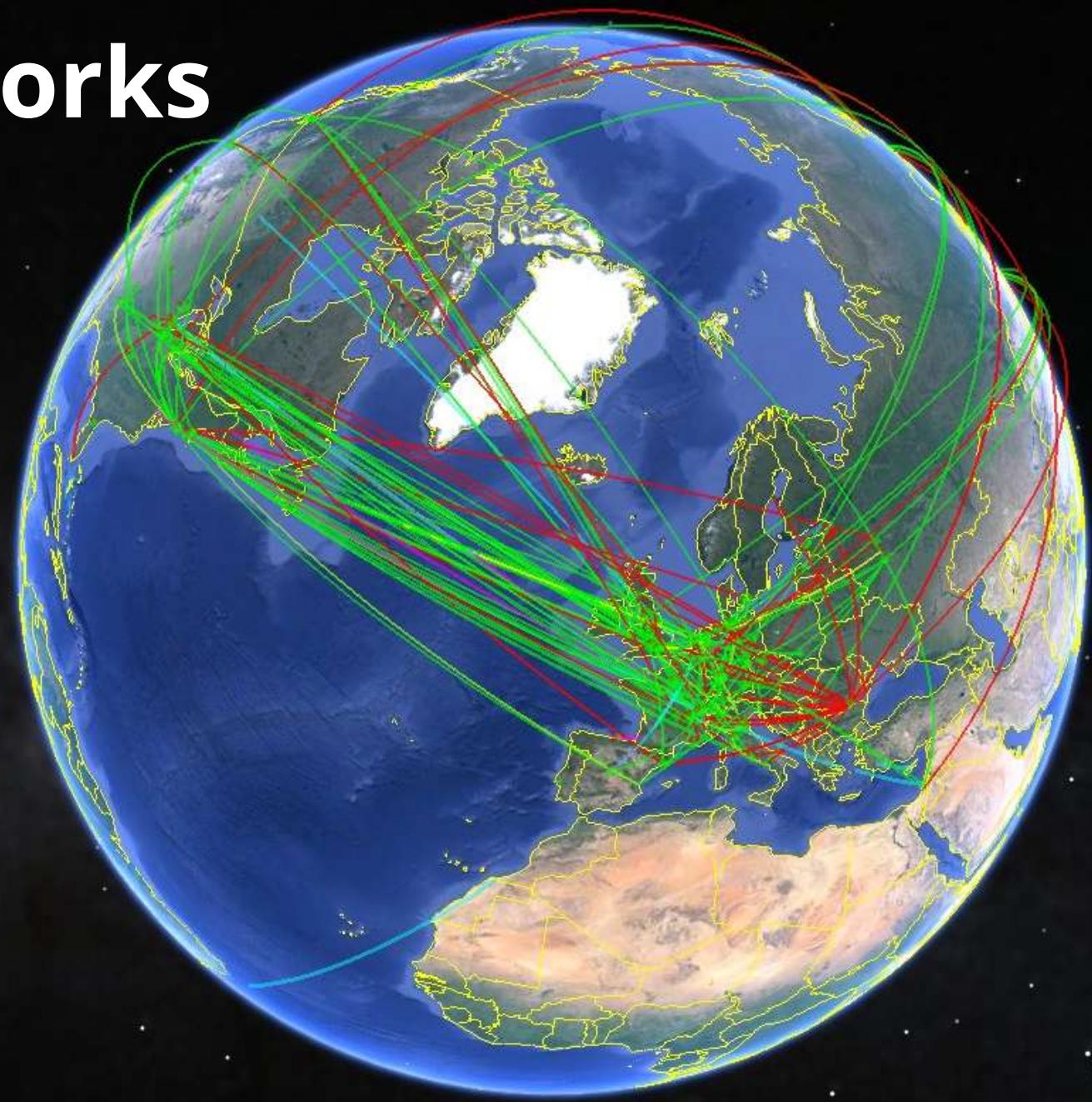


# 3x 100G Geneva-Budapest DCI links



T-Systems - GEANT#1 - GEANT#2 - GEANT#3

# WLCG Networks

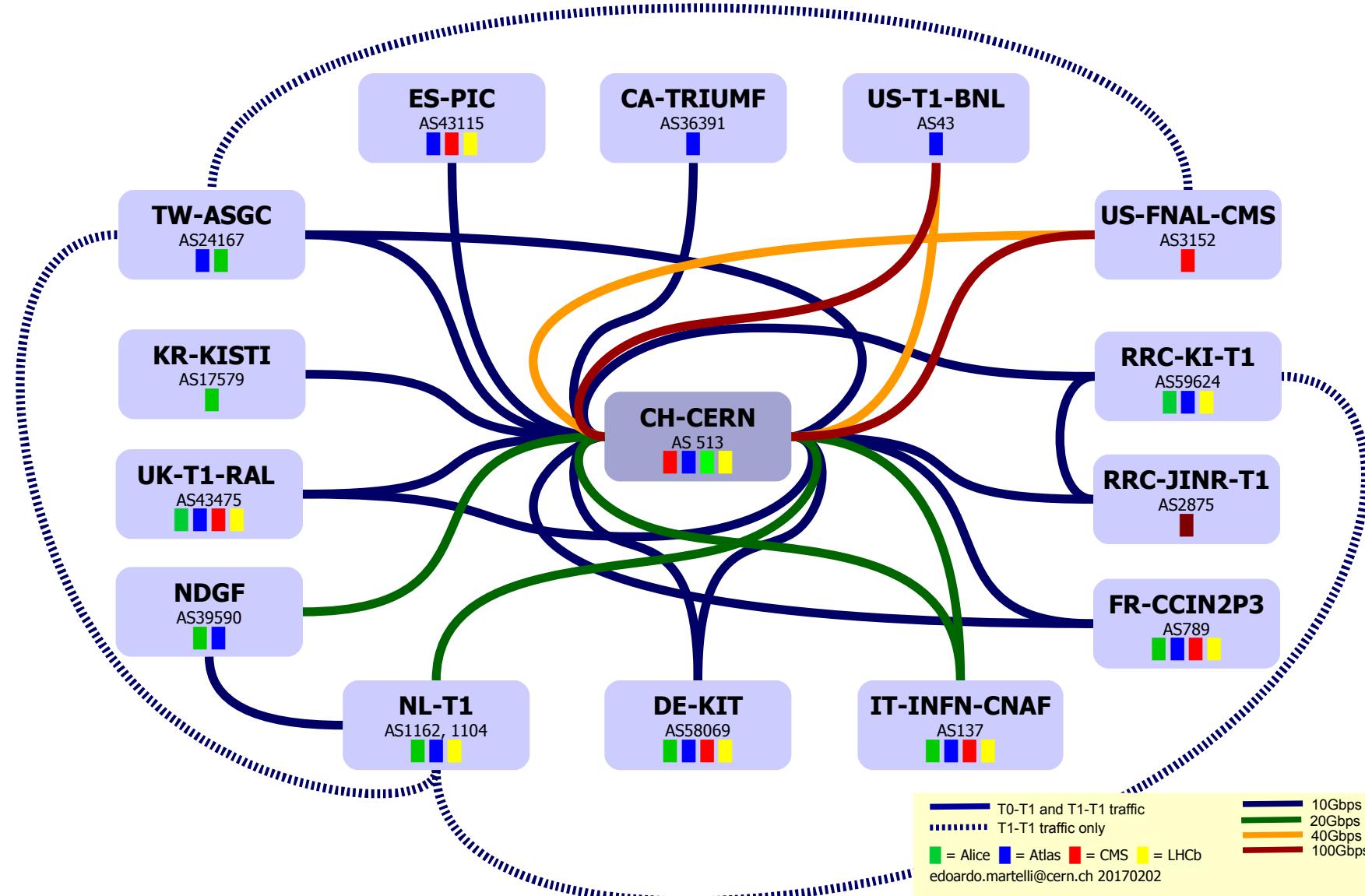


## Private network connecting Tier0 and Tier1s

- Reserved to LHC data transfers and analysis
- Single and bundled long distance 10G and 100G Ethernet links
- Star topology
- BGP routing: communities for traffic engineering, load balancing
- Security: only declared IP prefixes can exchange traffic.

<https://twiki.cern.ch/twiki/bin/view/LHCOPN/WebHome>

# LHCOPN



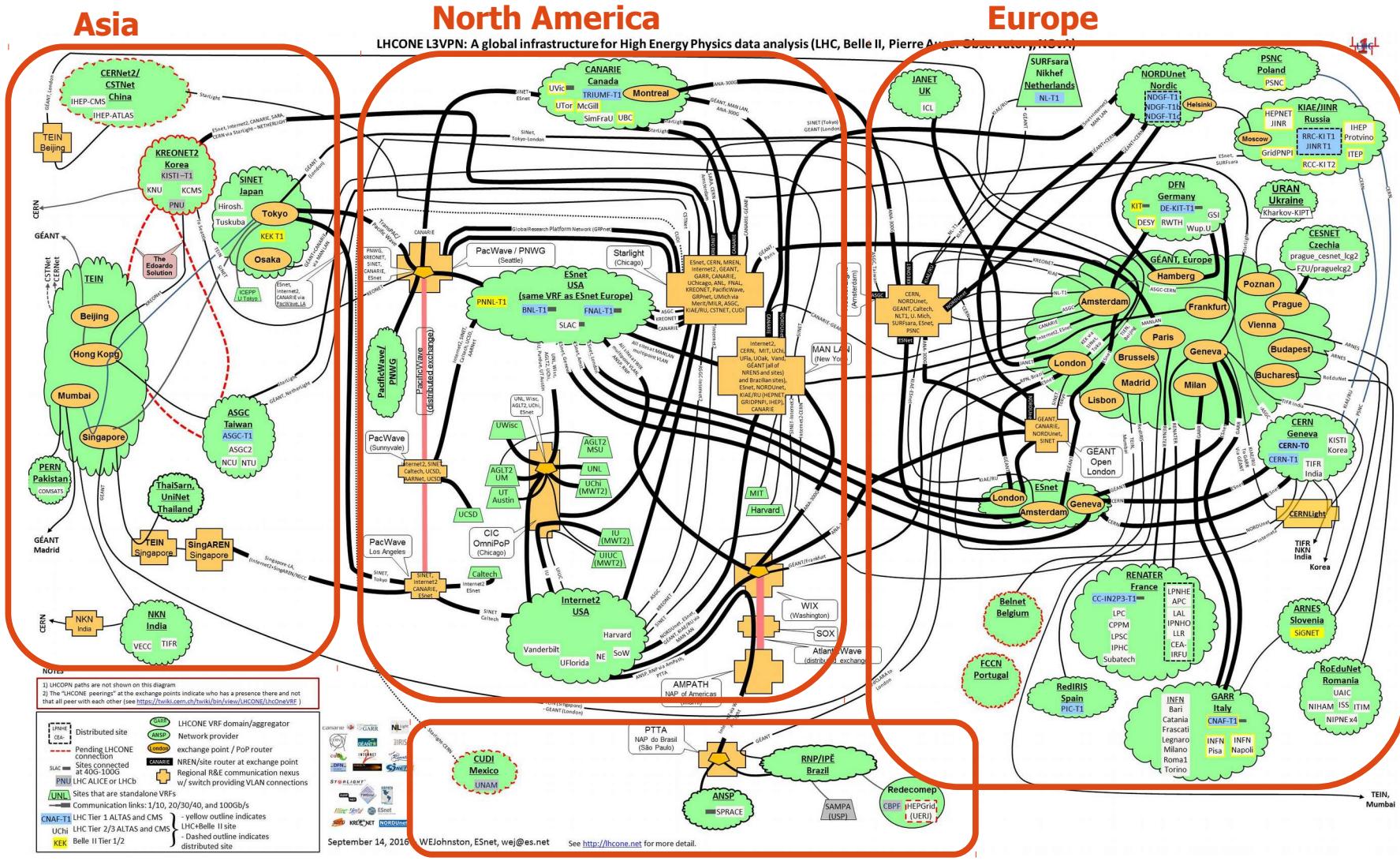
## **LHCONE L3VPN: Routed Virtual Private Network**

- Worldwide private network connecting WLCG and other HEP sites at high bandwidth
- Bandwidth dedicated to HEP data transfers, no contention with other research projects
- Trusted traffic that can bypass slow perimeter firewalls

<https://twiki.cern.ch/twiki/bin/view/LHCONE/WebHome>

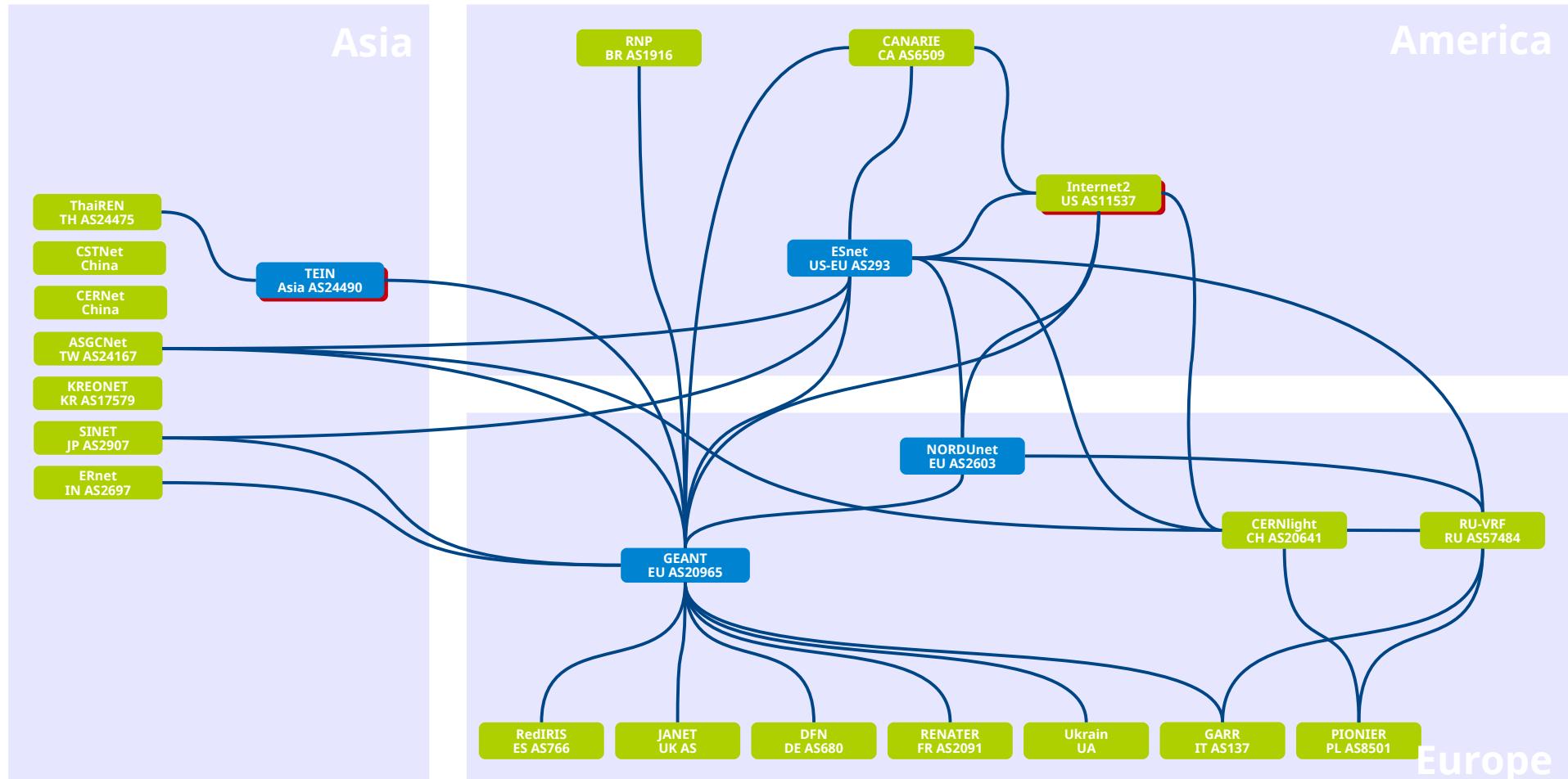


# LHCONE detailed topology



South America

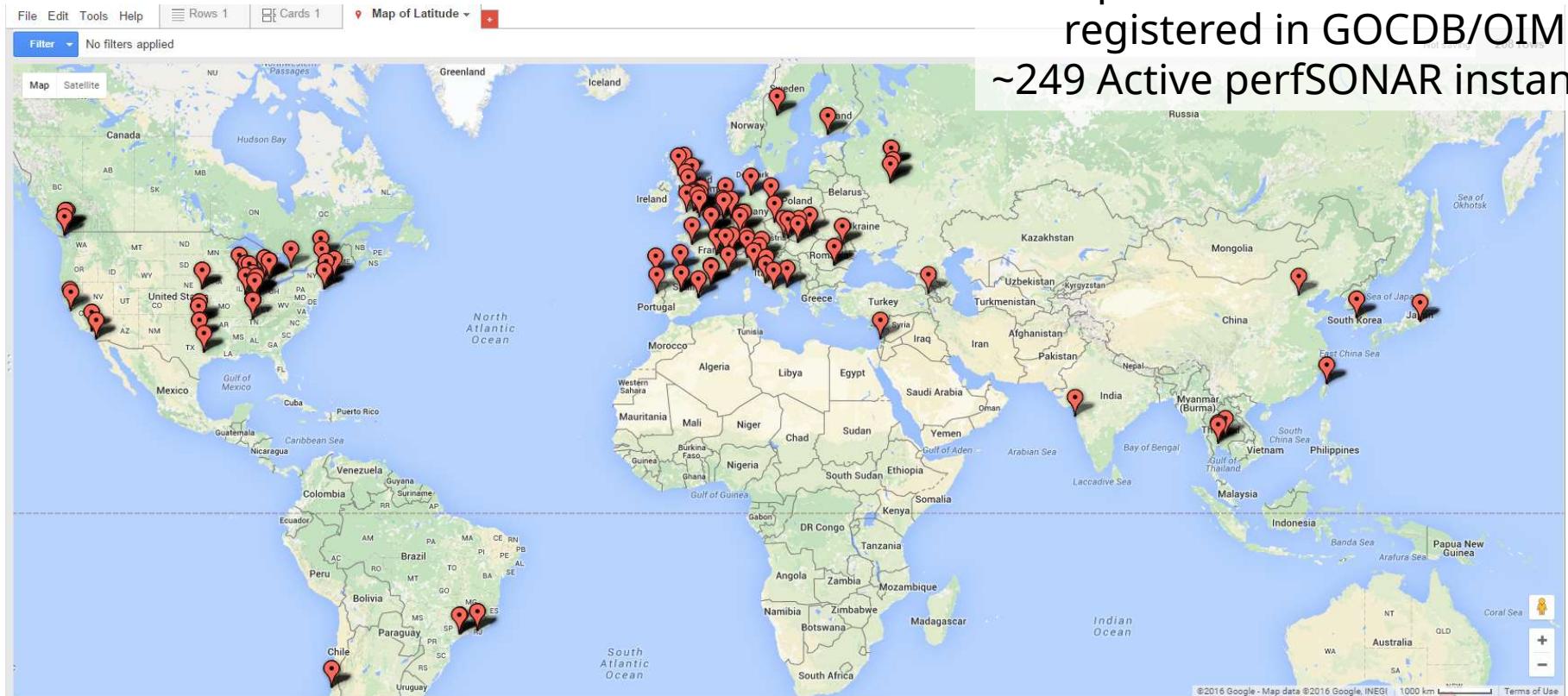
# LHCONE network providers



International VRF  
National VRF  
Transit

# LHCONE monitoring with perfSONAR

~278 perfSONAR instances  
registered in GOCDB/OIM  
~249 Active perfSONAR instances



# LHCONE: open to HEP collaborations

The L3VPN is used also by:

- Belle II experiment



- NOvA neutrino experiment



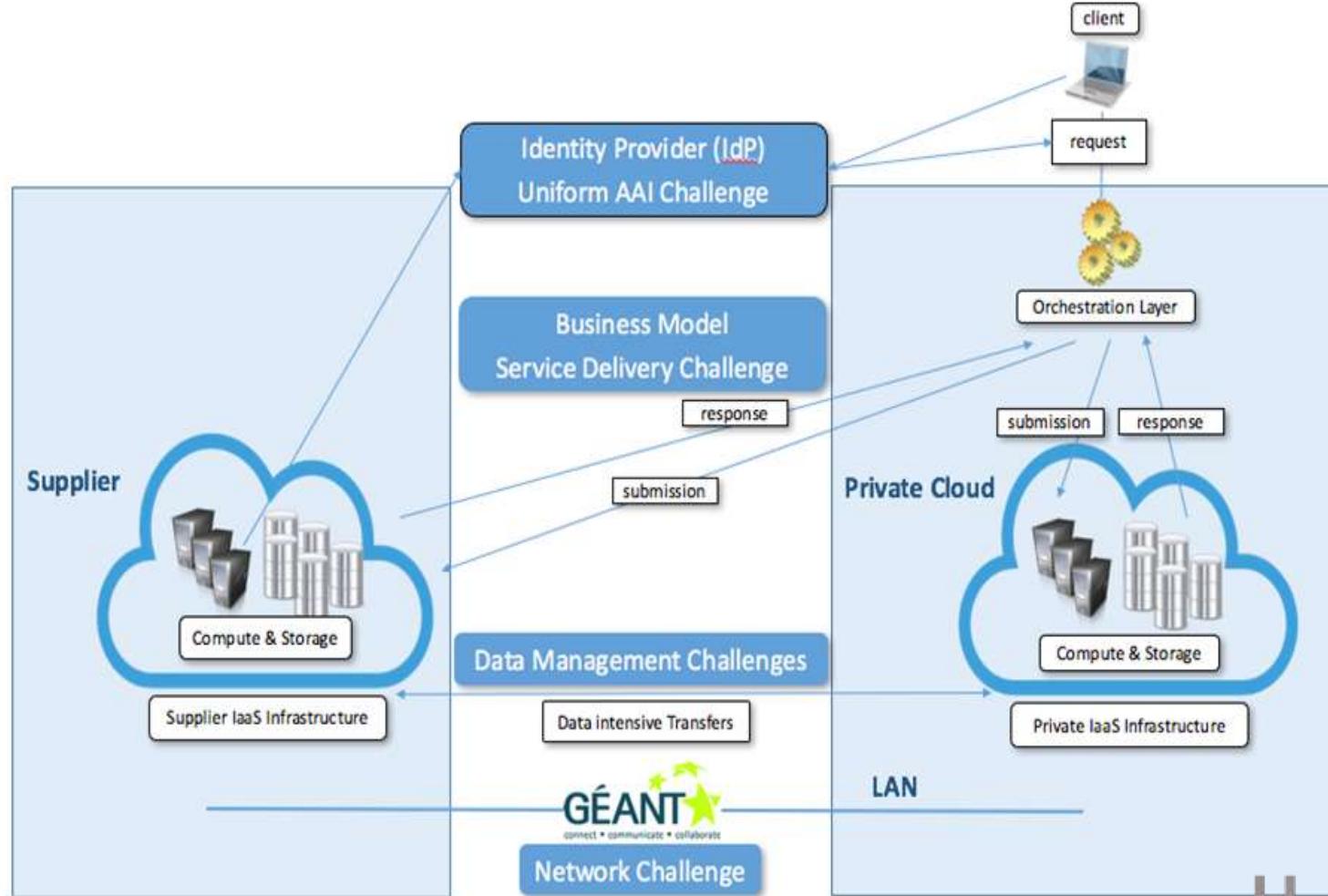
- Pierre Auger observatory



- XENON dark matter project



# Hybrid Clouds



# Networks for general services



# WIFI campus network

Strategic network for next generation user services

>1300 WIFI Access Points deployed

4500/7000 (avg/max) devices connected every day

On-going deployment to provide full campus coverage



# Mobile Telephony

**4G coverage**

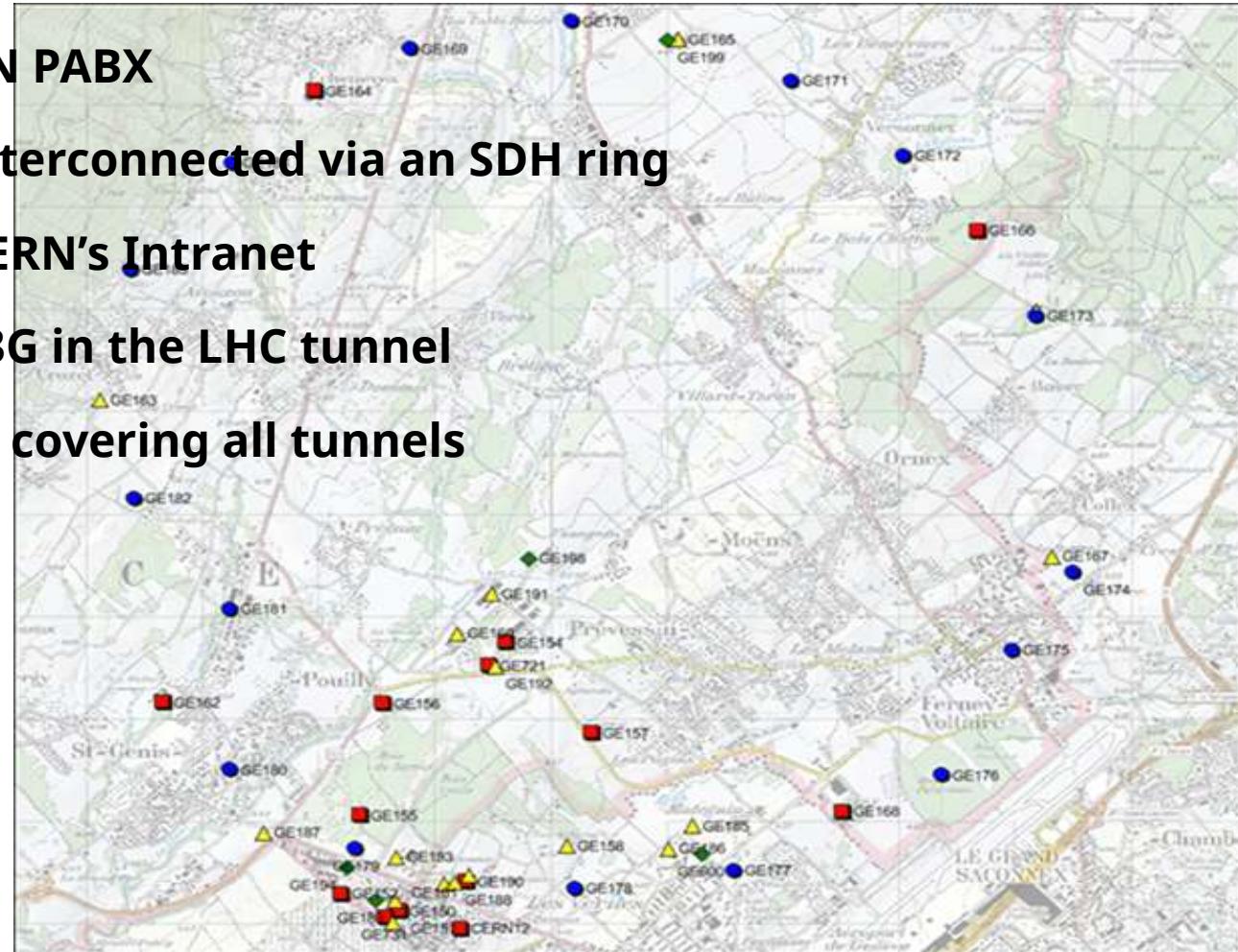
**GSM calls routed by the CERN PABX**

**>40 Transmission Stations interconnected via an SDH ring**

**Dedicated APN to connect CERN's Intranet**

**CERN's repeater system for 3G in the LHC tunnel**

**>50 km of leaky feeder cable covering all tunnels**



# Fix Telephony

4 PBX and 15 IP-PBXs

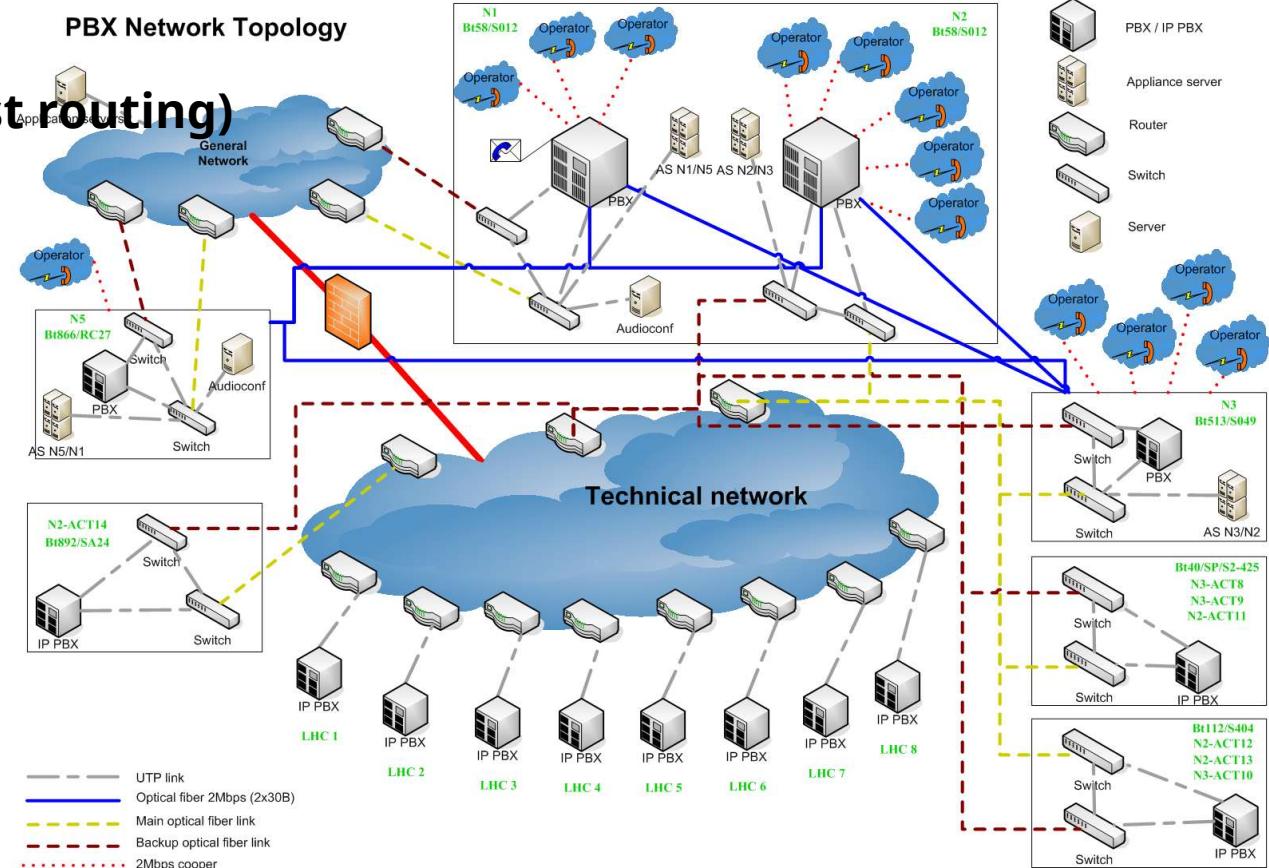
12000 fixed users (10000 traditional + 2000 IP)

2.5M outgoing calls/year

5 telecom operators (least cost routing)

IP telephony services

Emergency phones



# TETRA safety radio network

# 5 TETRA frequencies

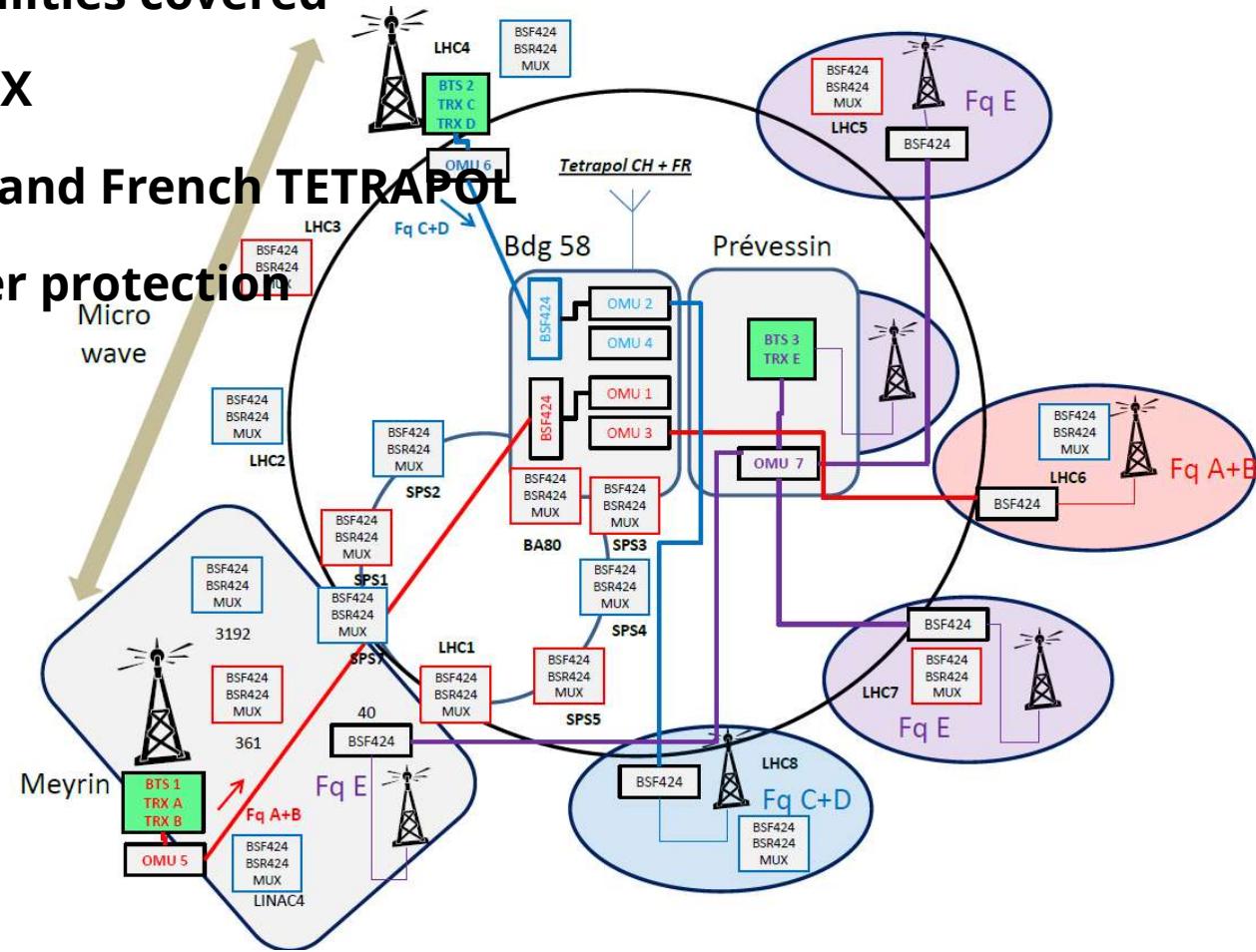
**400 km<sup>2</sup> and underground facilities covered**

## Interconnection with CERN PBX

# Gateways with VHF and Swiss and French TETRAPOL

# Geo-localization & Lone-worker protection

## Redundant architecture



# *Questions?*

*edoardo.martelli@cern.ch*