Network Service Providers:

- Logo — ASNet (Asia)
- Logo — CANARIE (Canada)
- Logo — DFN (Germany)
- Logo — GARR (Italy)
- Logo — GEANT (Europe)
- Logo — USLHCNet (US)
- Logo — Nordunet (Denmark, Norway, Sweden, Finland)
- Logo — RedIRIS (Spain)
- Logo — RENATER (France)
- Logo — SURFnet (Netherlands)
- Logo — UKERNA (UK)
- Logo — ESnet (US)

LCG

OPN

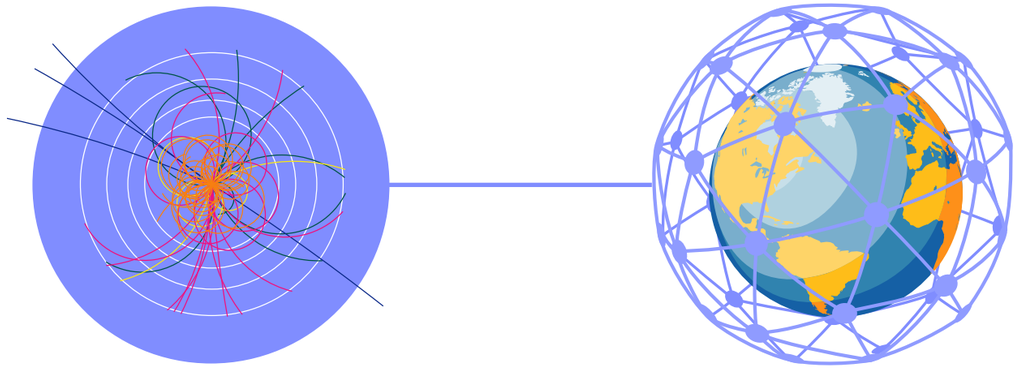
An **O**ptical **P**rivate **N**etwork for the transport of data produced by the detectors at the Large Hadron Collider at CERN in Geneva, Switzerland.

The Large Hadron Collider (LHC) at CERN[1] will start up in May 2008. In this particle accelerator two counter rotating proton beams at 7 TeV each are made to collide at 4 interaction points. At those, particle detectors are installed to study physics at the highest energies ever.

The LHC is a scientific instrument of unprecedented complexity, and at 27 kilometres in circumference, the world's largest superconducting installation. The 4 particle detectors are equally impressive, each bigger than any former particle detector. In these experiments as many as 2000 people scientists and engineers collaborate in the design, the installation and operation and in the analysis of the data.

Each of the detectors produces between 10 and 20 PetaByte of data per year. For analysis of these data all available resources of the collaborating institutions will be needed and grid technologies are used for the distribution, the storage and the processing.

To facilitate the data movement the LHC community operates it's own Optical Private Network OPN, a network of dedicated fibers between the major physics laboratories in Europe, the US and Canada and Taiwan. This network has been provided by the National Academic Network Service Providers NREN's in Europe together with the European Scientific Network Organization GEANT, the Counterparts of those in the US, USNET and LHCNET, Canari for Canada and ASNeet in Asia.



[1] CERN, the European Organization for Nuclear Research, is the world's leading laboratory for particle physics. It has its headquarters in Geneva. At present, its Member States are Austria, Belgium, Bulgaria, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Netherlands, Norway, Poland, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom. India, Israel, Japan, the Russian Federation, the United States of America, Turkey, the European Commission and UNESCO have Observer status.

LCG

Topology:
- star with the Tier0 in the centre
- partial mesh among the Tier1 centres

Bandwidth:
- 10Gbps between every pair of sites
- 110Gbps at the Tier0 centre
- 180Gbps total aggregated bandwidth

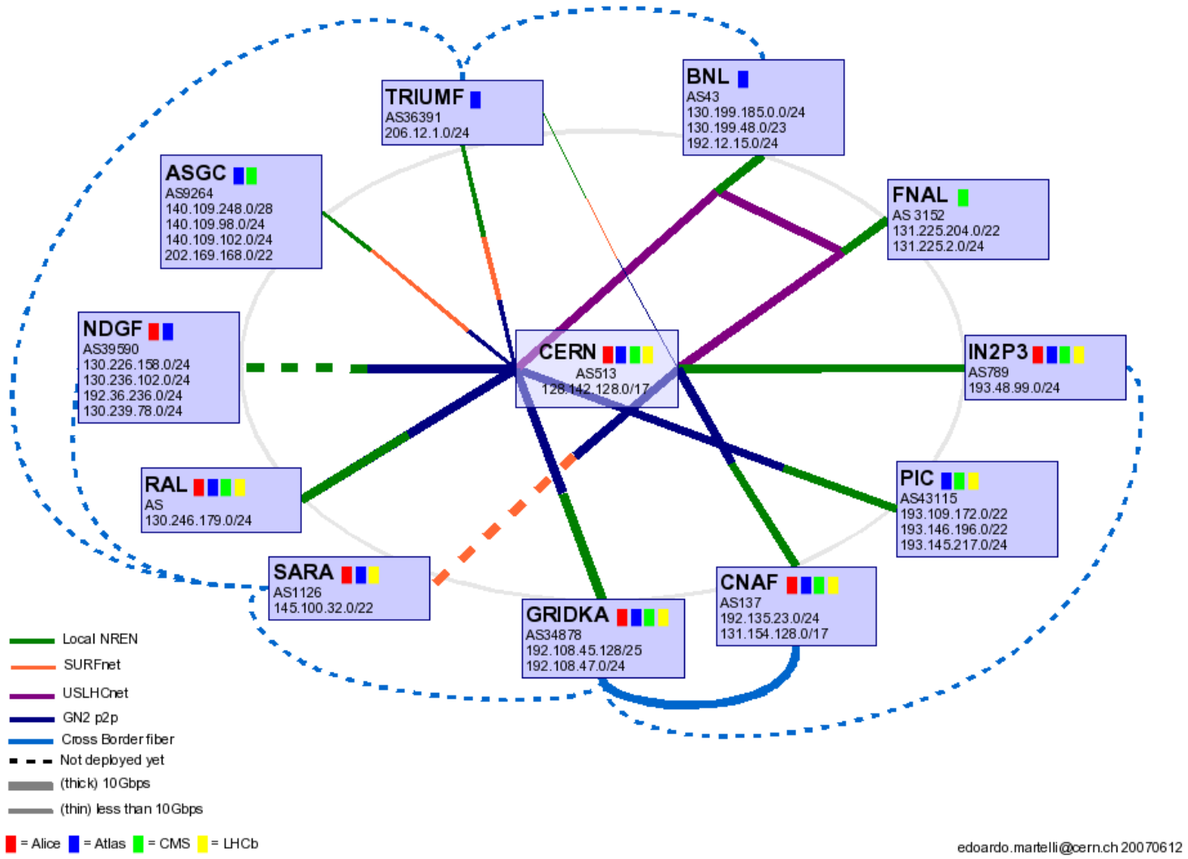
Routing policies:
- The Tier0 centre allows transit to any pair of Tier1s for Tier1-Tier1 connectivity
- Every Tier1 allows transit to any other site for Tier0-Tier1 backup connectivity

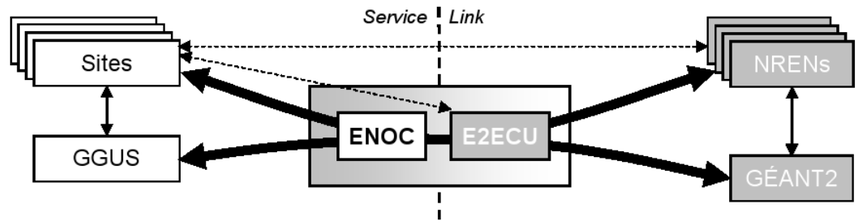
IP:
- protocol: IPv4
- addresses: public IPv4 prefixes
- IP MTU: 9000Bytes
- routing protocol: eBGP
- Autonomous Systems: public AS numbers

Transmission:
- presentation: 10G-Ethernet LAN-PHY and WANPHY
- transport: SDH/SONET infrastructure with GFP-F encapsulation

Suppliers:
- Circuit providers: ASnet, Canarie, Dante, DFN, ESnet, GARR, Janet, Nordunet, RedIRIS, Renater, Surfnet, SWITCH, USLHCnet
- Routing equipment: Cisco, Force10, Foundry, Juniper
- Transmission equipment: Alcatel-Lucent, Ciena, Nortel, Sorrento, Huawei

Security:
- only traffic from and to LHCOPN hosts is allowed
- filtering by mean of stateless Access Control Lists.
- layer 3 and layer 4 Access Control Lists





Operations

There are two entities that coordinates the operation of the LHCOPN, the End-to-End Coordination Unit (E2ECU) and the EGEE Network Operations Centre (ENOC).

E2ECU's role is to monitor the connections and to coordinate the resolution of transmission problems:
- active monitoring of all the lightpaths
- fault detection and supervision of the inter-domain links (end-to-end links)
- issues and maintenance announcements via Trouble Ticket System
- troubleshooting co-ordination
- provision of periodic reports
- liaise with the NREN's NOC and the ENOC

ENOC's role is to monitor the services provided by the LHOPN:
- - monitoring and fault detection of the services provided by the LHCOPN (routing status, performance issues...)
- issues and maintenance announcements via Trouble Ticket System
- troubleshooting co-ordination
- provision of periodic reports
- liaise with the GGUS (Global Grid User Support) and the E2ECU