CERN Networks

RAL visit

3rd of December 2018

Agenda

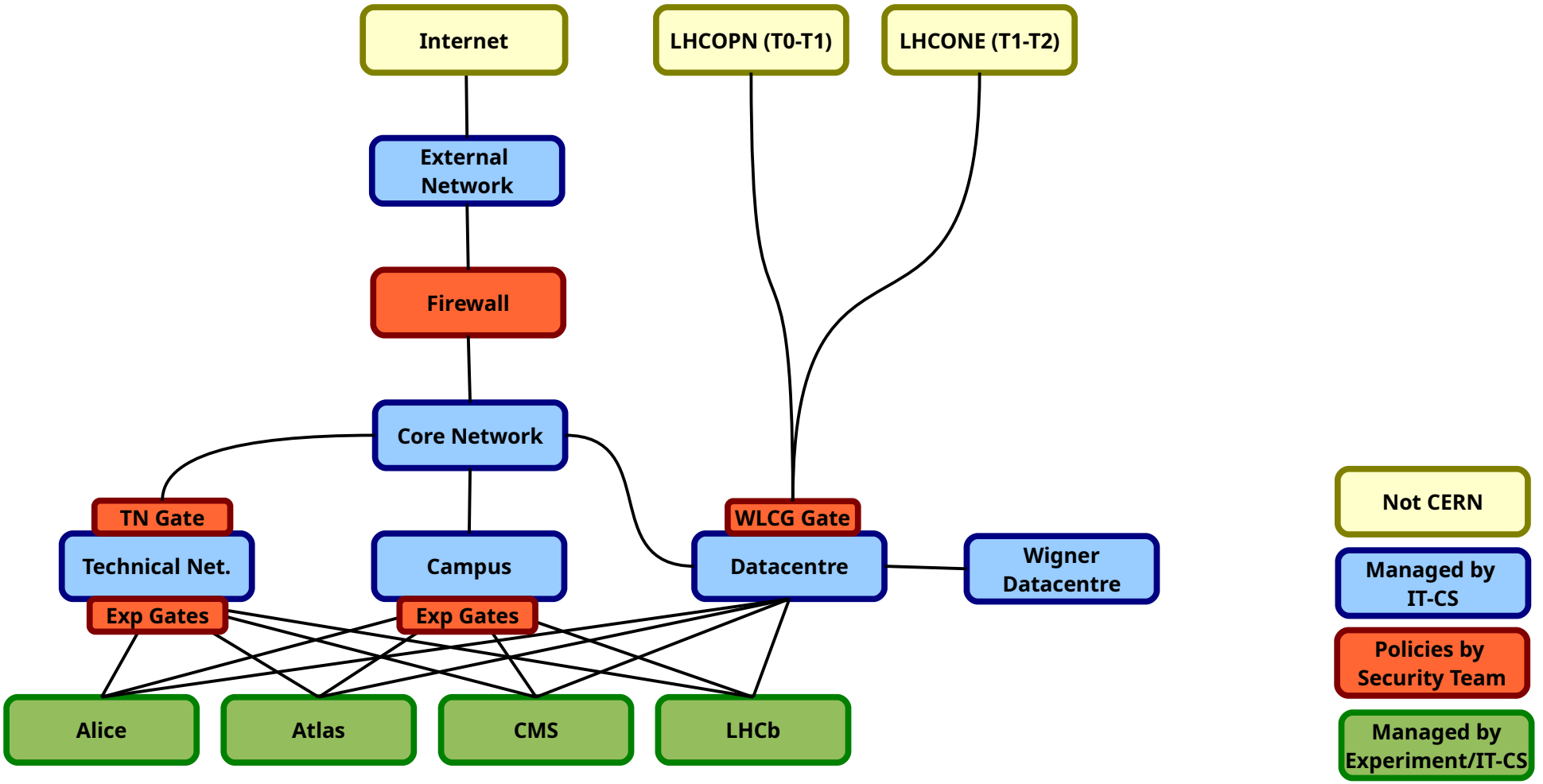
- How is the network structured (physical / logical / resilience)

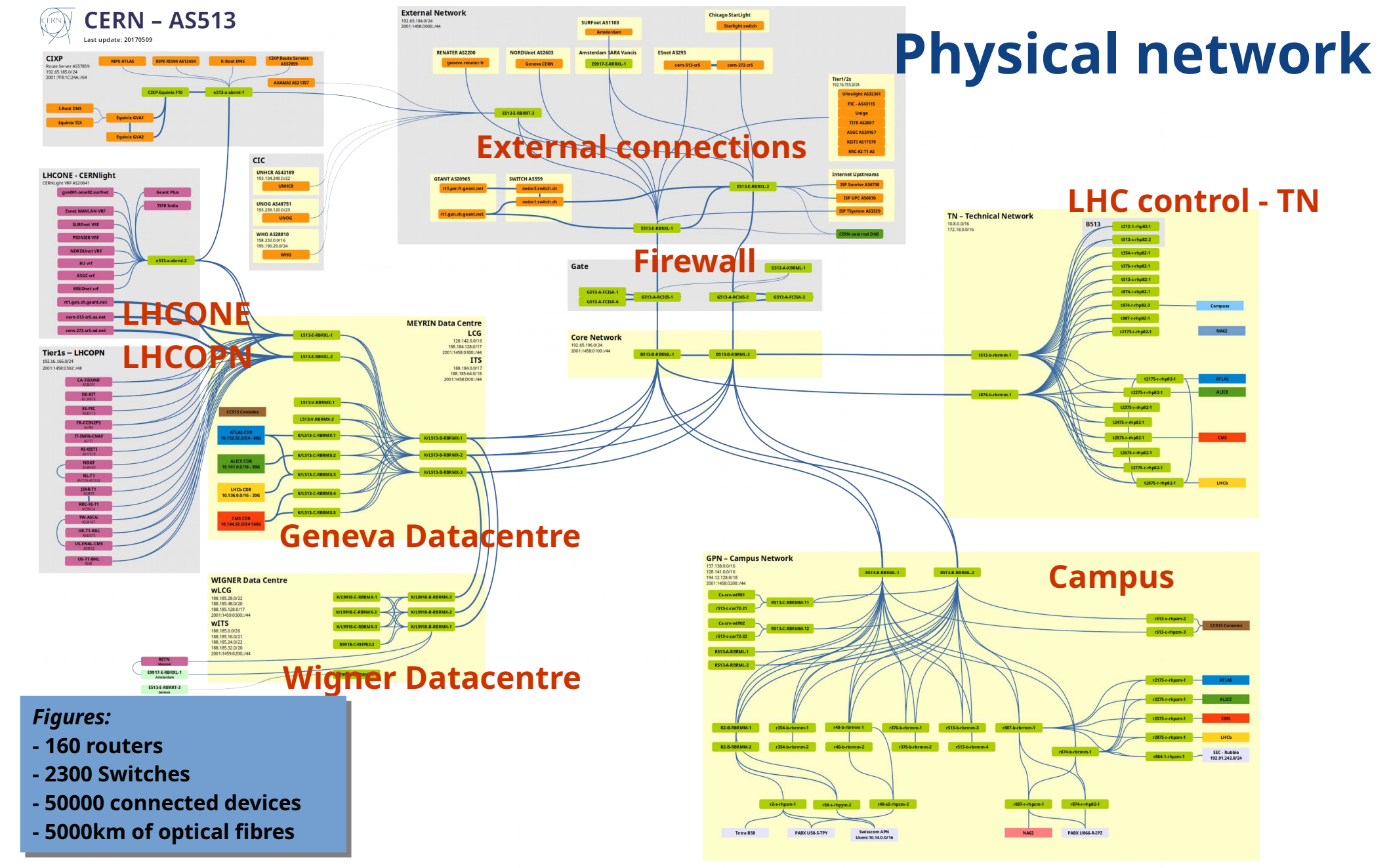
- How is the network used (Science / Office / Data Transfers / VoIP / Video)

- How is traffic managed (QoS / Over provisioning)

Network Structure

CERN Network domains and connections




CERN – AS513
Last update: 20170509
Physical network
External connections
LHC control - TN
LHCONE
LHCOPN
Firewall
Geneva Datacentre
Wigner Datacentre
Campus
External Network
CIXP
LHCONE - CERNlight
CIC
Tier1s – LHCOPN
MEYRIN Data Centre
LCG
ITS
WIGNER Data Centre
wLCG
wITS
Gate
Core Network
TN – Technical Network
B513
GPN – Campus Network
Figures:
- 160 routers
- 2300 Switches
- 50000 connected devices
- 5000km of optical fibres

Network Management System

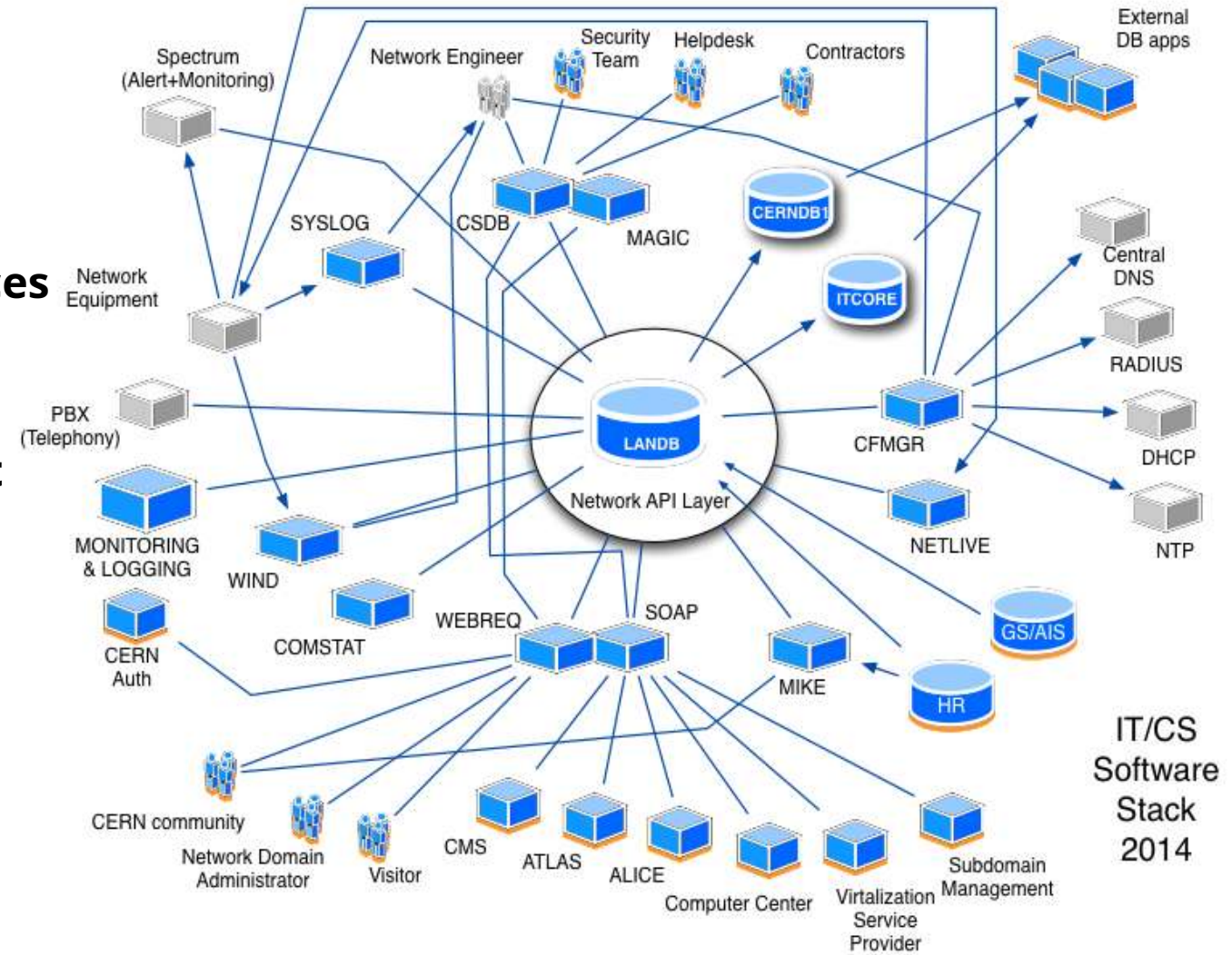
LANDB and CFMGR:

- >250 Database tables

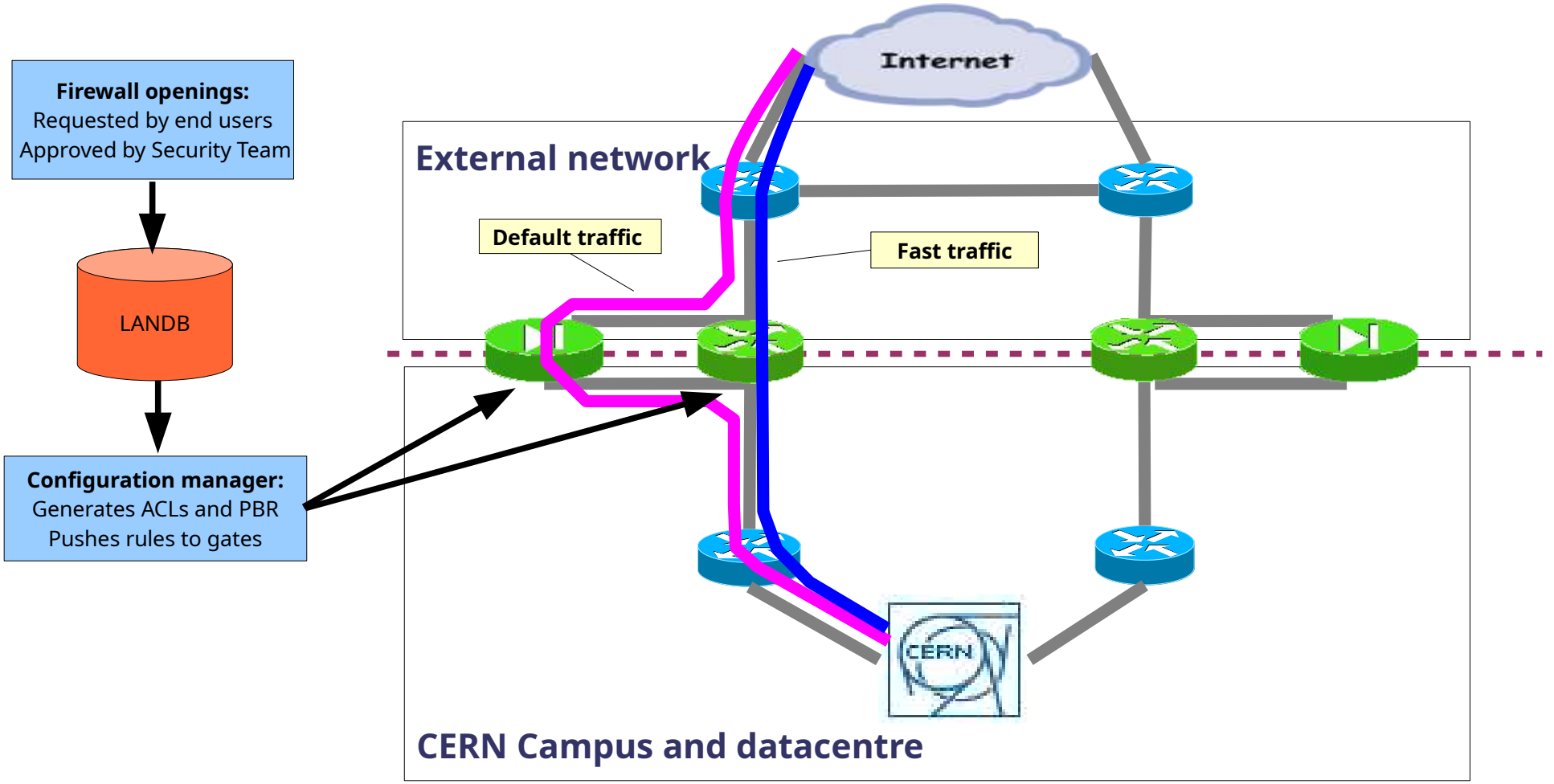
- ~200,000 Registered devices

- >1,000,000 lines of codes

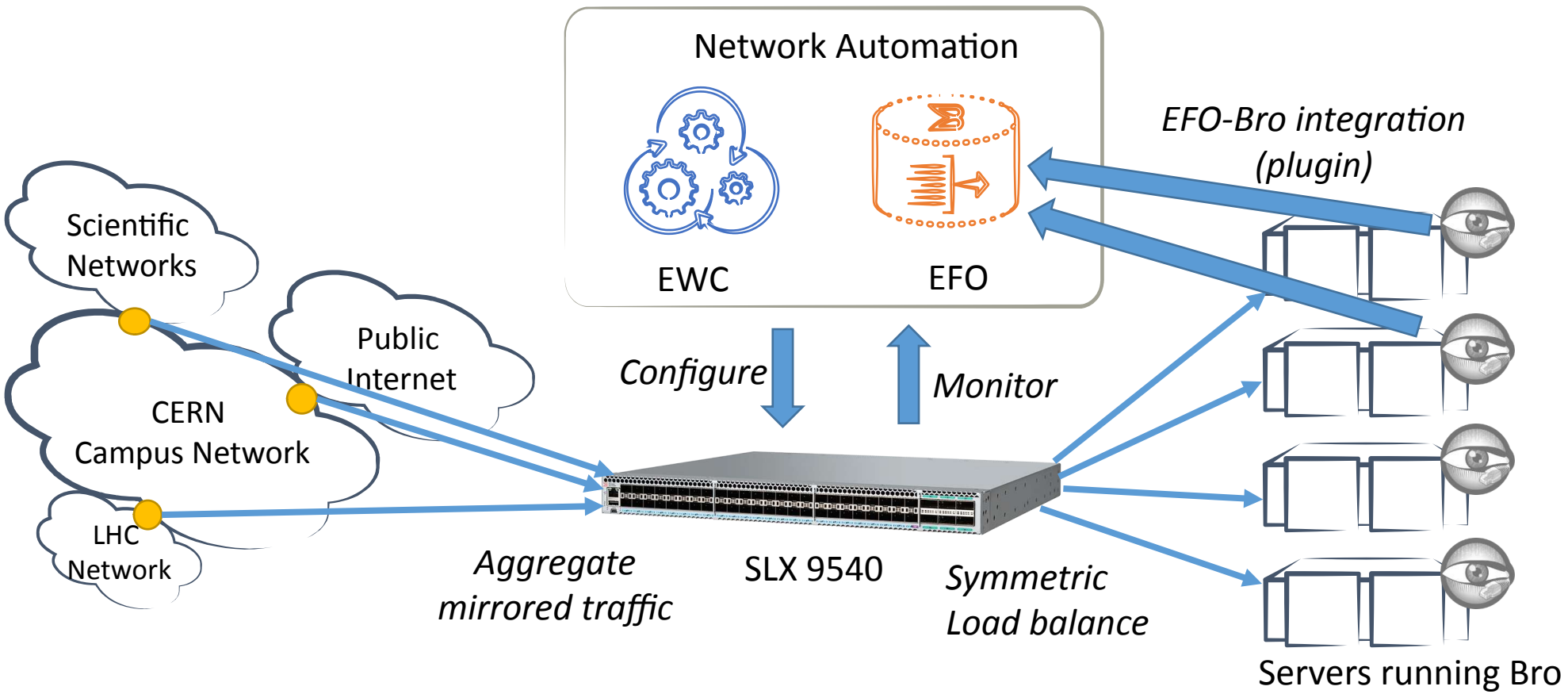
- >15 years of development



Security: Internet firewall



Security: IDS feed

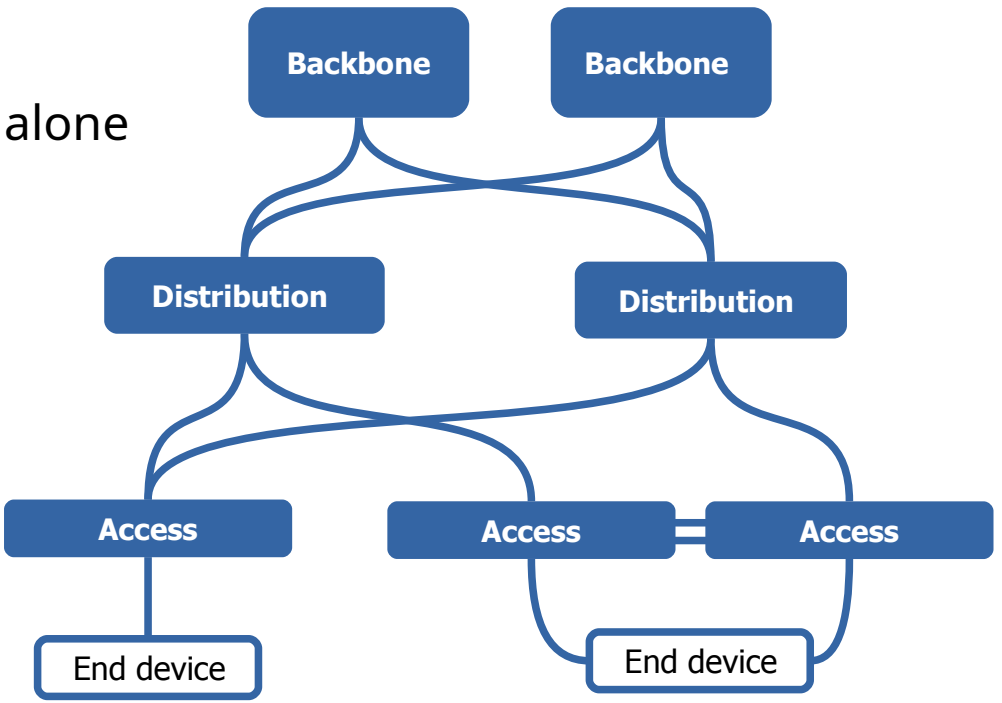


Resilience

Access:
- by default: single connection to users' devices
- special cases: stack of switches with LAGs to servers

Distribution-Backbone:
- always two twin routers
- one router must be able to carry the load alone

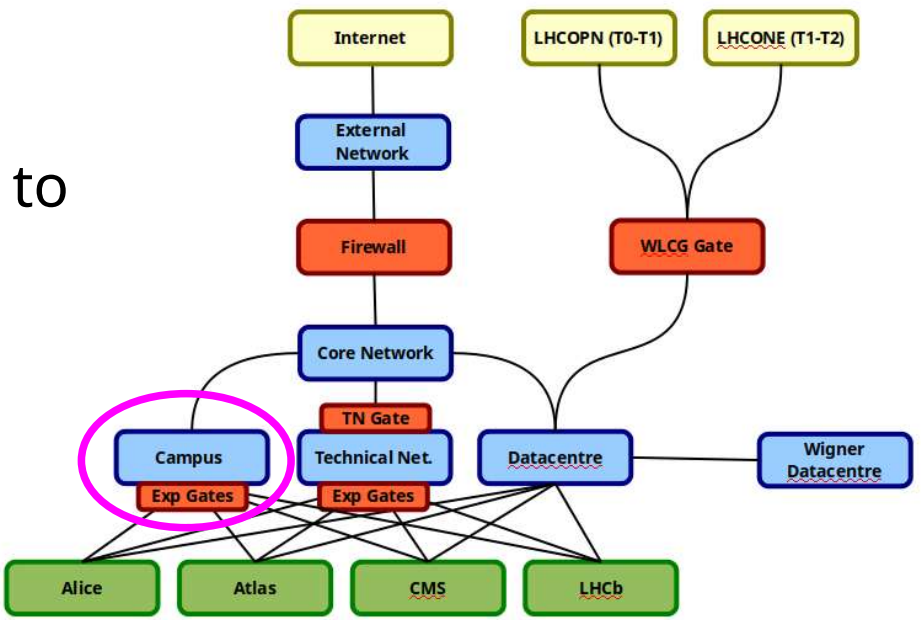
Routing everywhere, no spanning tree



Network Use

GPN Campus Network

- Reaches all the buildings in all the sites
- Connects generic users and services
- Wired and Wireless
- IPv4 and IPv6, Public (Internet) and Local (no Internet) addresses
- Transport for other services:
    - Fixed phones (VoIP)
    - Transit for Experiments' networks to IT services
    - Transit for small Experiments' DAQ to IT Datacentre
    - Multicast for LHC video streams

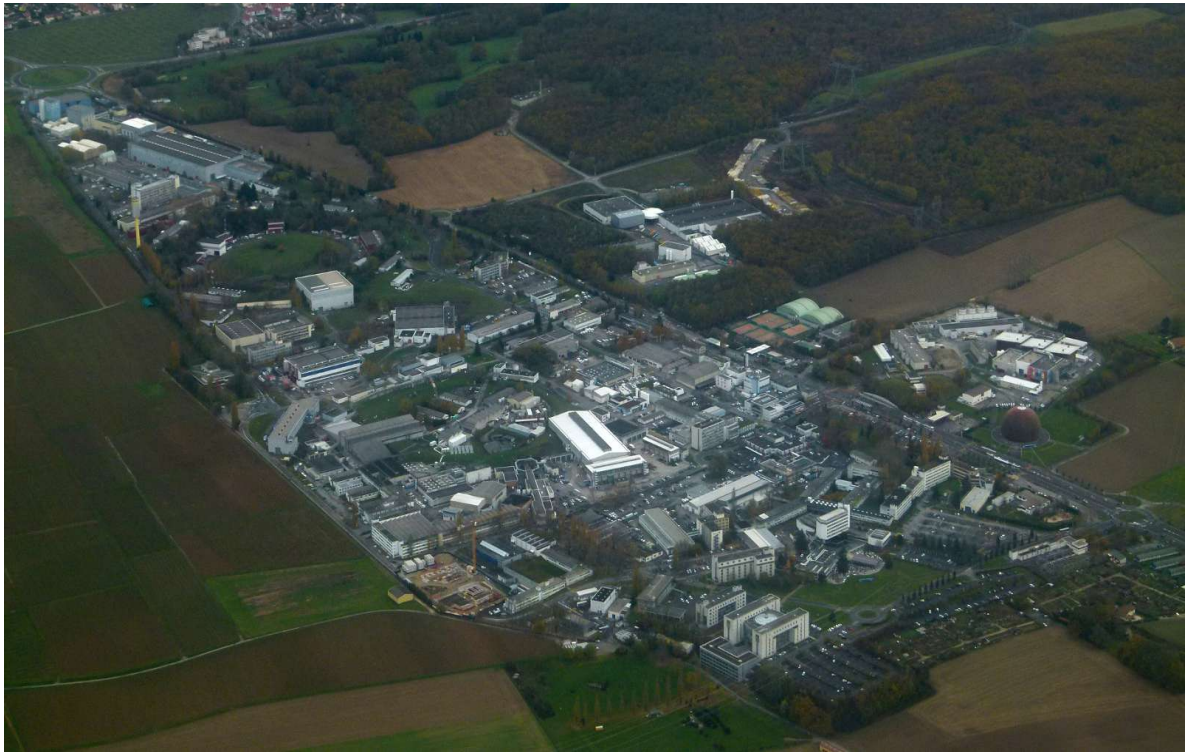


Campus Network upgrade (2020-21)

1) Replacement of existing routers (~100)
2) Implementation of new services

Main requirements:

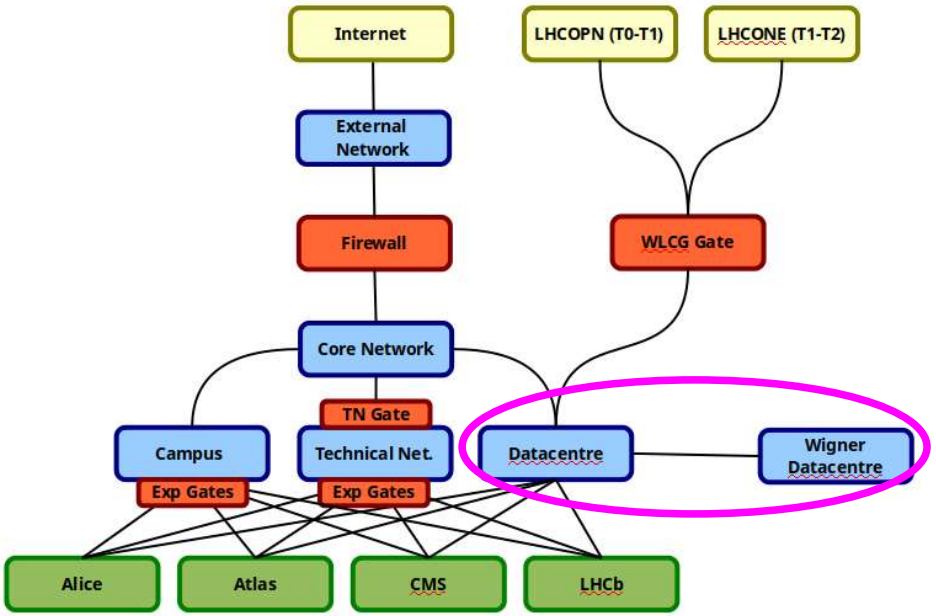
- Multi domains
  (General users, IoT…)
- Large ACLs for security
- Wired + PoE
- WIFI, LORA, Zigbee



Aerial view of the CERN campus

Data Centre Network

- Network for data-centre in B513 (Meyrin) and B9918 (Wigner)
- Connects only servers
- Wired only
- IPv4 and IPv6, Public (Internet) and Local (no Internet) addresses
- Direction connections to Experiments' DAQ



Datacentre upgrade (2018-20)

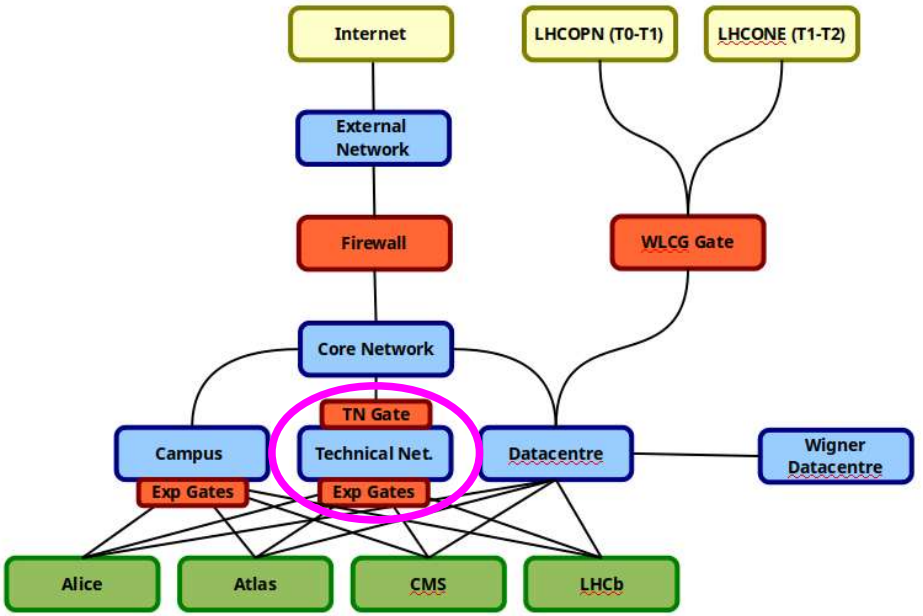
1) Replacement of existing routers with Juniper QFX10000
2) Implementation of IP fabric with QFX 10k and QFX 5k

Main requirements:

- Router redundancy
- Affordable high speed connections for large JBOD storage servers
- Multi domains with agile membership of servers
- VXLAN support for VM/Container mobility and load-balancing

Technical Network

- Network for LHC control
- Connects critical devices for LHC management and monitoring
- Wired only
- IPv4 only, Local (no Internet) addresses only
- Direction connections to Experiments' Control Networks
- Protected with firewall
- Self sufficient (DNS, DHCP.. replicated i
  network)

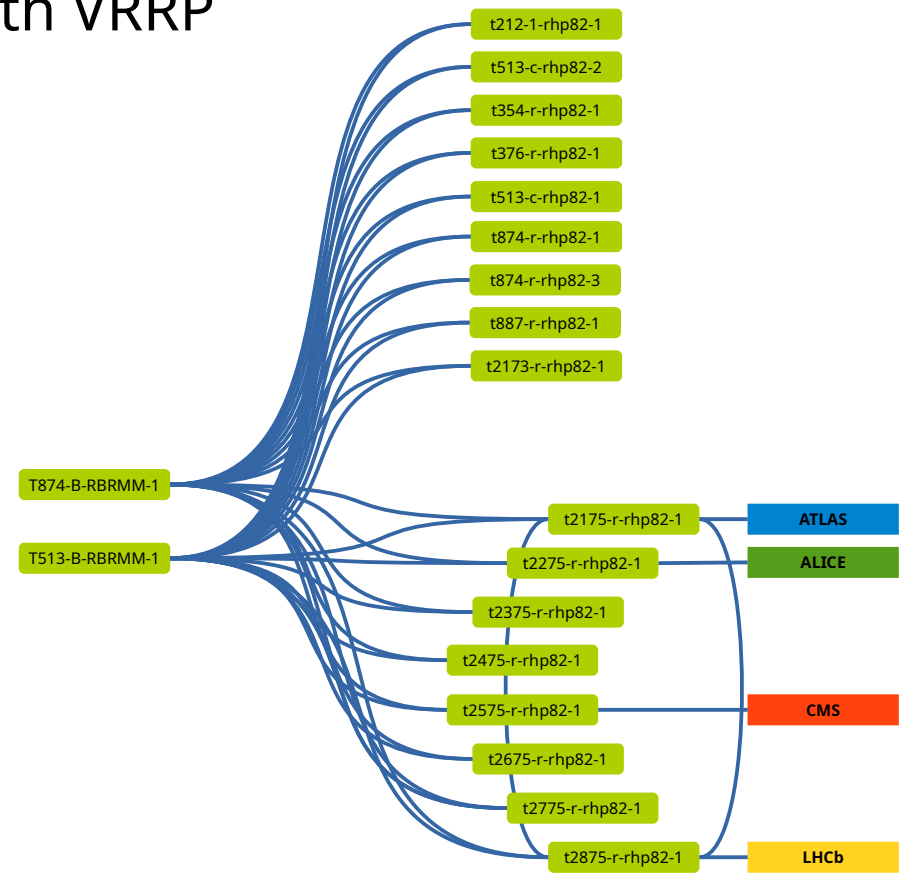


Technical Network upgrade (2019-20)

- Replace 1 by 2 aging routers (~23) with Juniper EX9200
- All switches get router redundancy with VRRP

Main requirements:

- zero downtime
- zero packet-loss
- 10 years lifetime



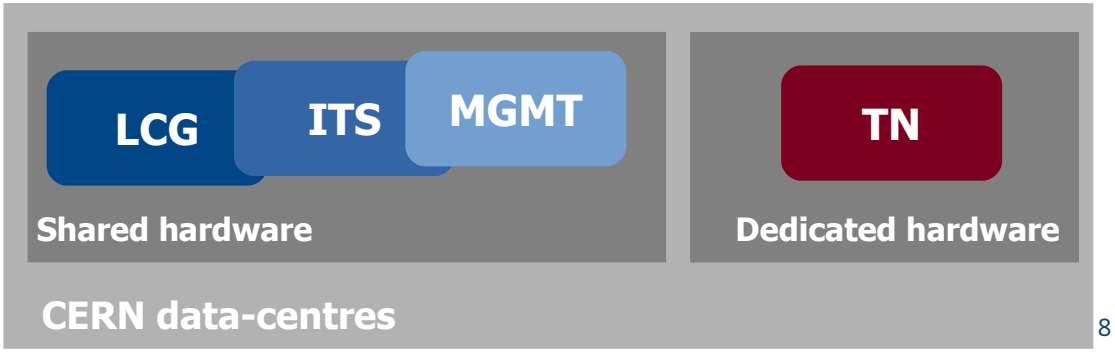
Traffic management

Multi-domain data-centre

Requirements:
- implement different routing and security policies
- share network hardware to optimize costs, except TN

These domains are defined in the data-centre:
- **ITS:** critical and generic IT services
- **LCG:** Physics services with direct access to LHCOPN/LHCONE
- **MGMT:** Data-centre monitoring and out-of-band management
- **TN:** LHC control network

Implementation:
- Use of VRFs for ITS and LCG. TN has dedicated routers and switches
- Gates (ACLs) at the border of TN and MGMT
- Over-provisioning, no QoS



Campus network

Current:

- Guest WIFI network: connected outside the Internet firewall
- Private (RFC1918) addresses routed inside CERN, but no Internet access (no NAT)
    - Used for printers, cameras, sensors…

Future:

- IoT domain: VRF for dumb devices.
    - Firewalled to protect the devices and to protect CERN from them
    - No access to Internet

Questions?

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