





## Instruments used

### Particle accelerator:

Boost particles to high energies and make them collide. Flagship is the 27km in circumference Large Hadron Collider (LHC), which is just the last in a chain of accelerators

### Detectors:

Gigantic instruments that observe and record the results of the collisions

(particle trajectories, energy, charge...)

### Computers:

**Collect, store, and distribute around the world the large quantity of data collected from the detectors for data analysis using the WLCG**

# IT Department Structure



Department Infrastructure

WLCG

openlab

Security

EC Projects

Collaboration, Devices  
& Applications

Storage

Databases

Compute & Monitoring

Communication Systems

Computing Facilities

# CERN Data Centre(s)



Geneva + co-location (Wigner)

## Overview

- 3.8MW (~2.8MW) + 2.7MW (~1MW)
- 15 000 servers
  - 230 000 cores
- 2 500 disk arrays
  - 90 000 disks
  - 280 petabytes of disk
- 40 routers and 1 300+ switches

## Procurement (average)

- 20% annual refresh
- Investment 2016/2017: ~15 MCHF / year



# CERN Data Centre

## Technologies currently used:

- Chillers
- Cold aisle containment
- Hot aisle containment
- Air and water cooled racks
- Intelligent PDUs
- UPS systems
- Adiabatic air cooling
- In-house monitoring and limited experience with commercial DC monitoring systems



# CERN Data Centre

## Challenges:

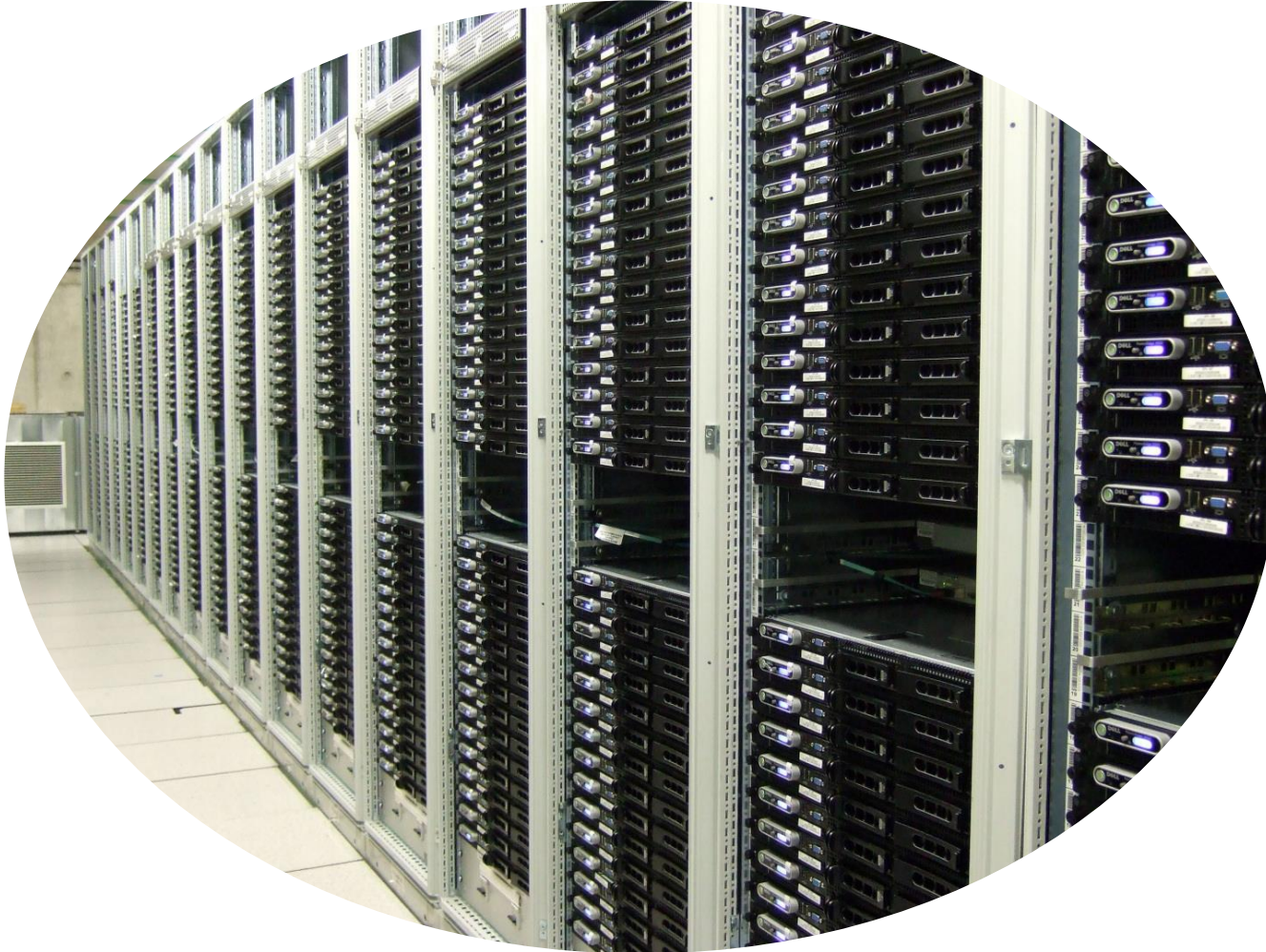
- Maximise the usage of current DC with the existing limitations on power and cooling
- Prepare for a needed increase in capacity of more than one order of magnitude for the 2025 timeframe

# Data Acquisition and Trigger farms

Each of the four LHC experiments have significant data centres near the detectors.

1-2MW data centres with ~2000-4000 servers

Two experiments (LHCb, ALICE) are installing new **container-based** data centres in 2019-20.





## Data centre and campus communication systems

Routers : 250

Star points: 692

Switches 4k

Wifi points 1.2k→4-5k

Annual investment 2016/2017 for switches and routers: 1.5 MCHF

+

Fixed & mobile telephony (4G/5G, private LTE, LTE/Wi-Fi integration) plus digital radio (TETRA).



# Outlook 2018-2022

## Estimates:

### 2018 - 2019:

- **Servers:** 500 - 1 000 / year
- **Network:** 10-20 switches / year

### 2020:

- **Servers:** ~6 000
- **Disk arrays:** ~1 000
- **Network:** ~125 standard + ~10 high-bandwidth (40Gbs) switches

### 2021 – 2022:

- **Servers:** ~2 500 / year
- **Disk arrays:** ~500 / year
- **Network:** 50 standard + 5 high bandwidth switches / year

A project for the construction of a 2<sup>nd</sup> DC on the CERN site is also in consideration for this timeframe.



# Others:

## Audiovisual equipment:

- all audio, video and control equipment installed in CERN meeting rooms

## desktop equipment tenders, which include:

- Desktop and mini desktops (NUCs) : 1300
- Laptops: 550
- Monitors 1500

## Services, software:

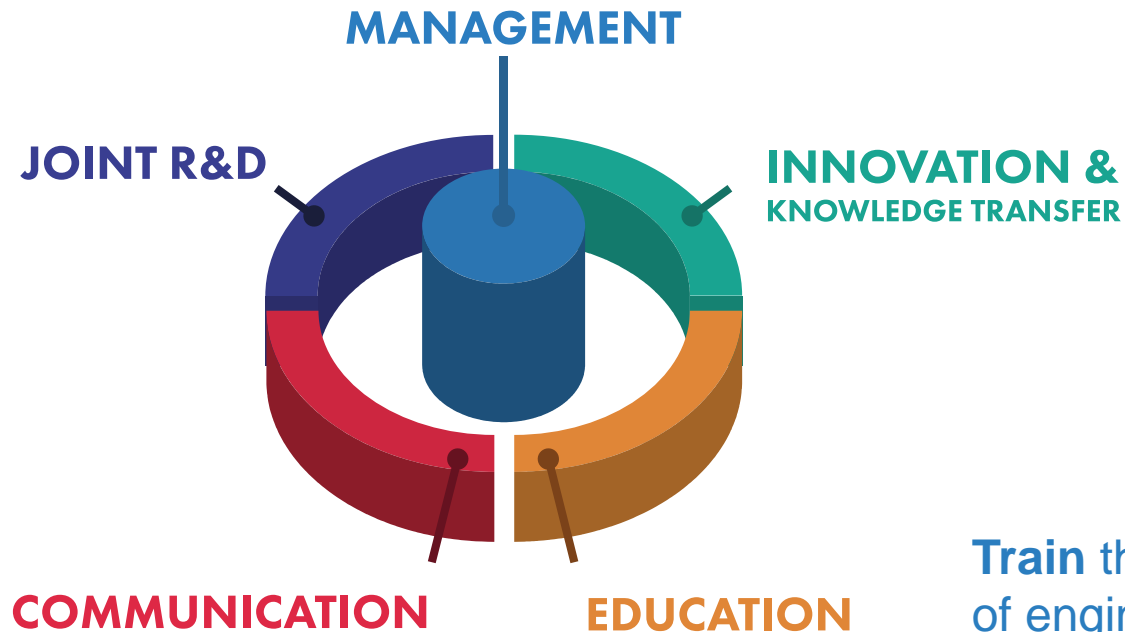
- First line support for network & telecommunications services
- Computing Services Support (helpdesk and first line)
- Central Computing Facilities (CC operators)
- SW: service management, videoconferencing, open software for core services

# CERN OPENLAB'S MISSION (<https://openlab.cern/>)

## Our recipe for success

- **Evaluate and test** state-of-the-art technologies in a challenging environment and improve them in collaboration with industry.

**Communicate** results, demonstrate impact, and reach new audiences.



**Collaborate** and exchange ideas with other communities to create knowledge and innovation.

**Train** the next generation of engineers/researchers, **promote** education and cultural exchanges.

# JOINT R&D PROJECTS

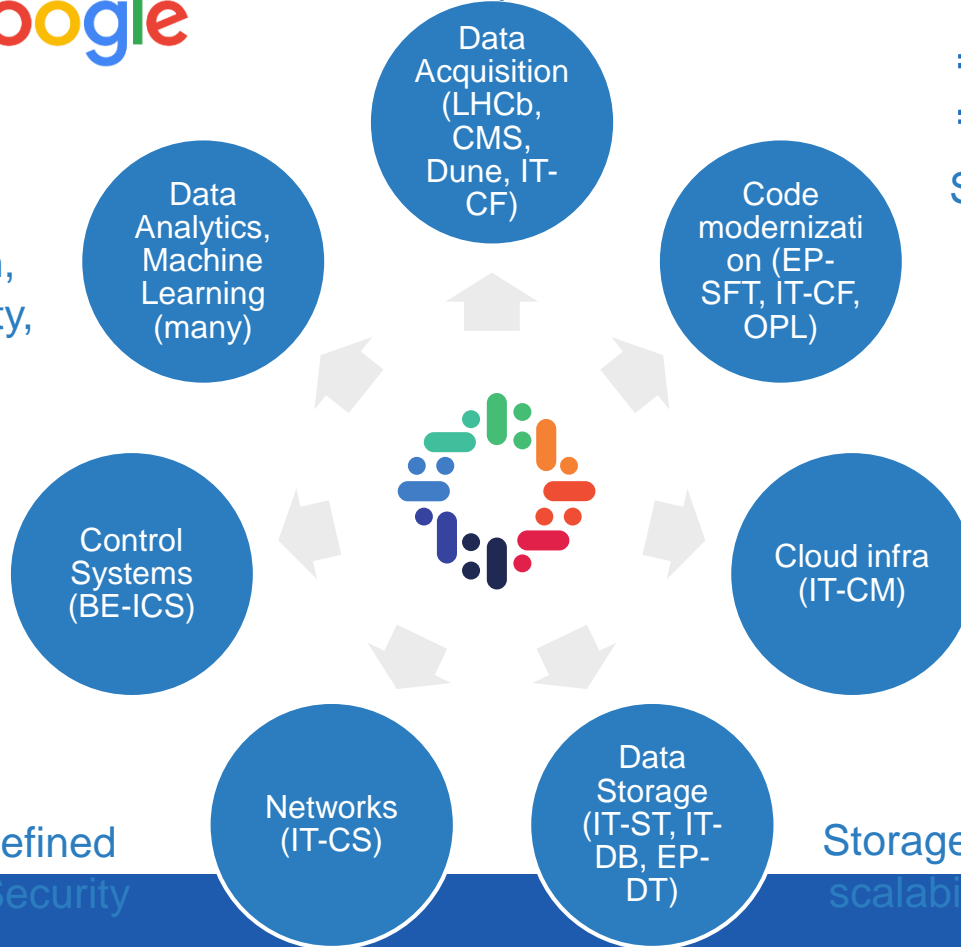
High-bandwidth fabrics,  
accelerated platforms for  
data acquisition



Fast simulation, Data quality monitoring, anomaly detection, physics data reduction, benchmarking/scalability, systems biology and large-scale multi-disciplinary platforms

Predictive/proactive maintenance and operations

Software Defined Networks, Security



Simulation, HPC on the Cloud, benchmarking



Cloud federations, containers, scalability



Storage architectures, scalability, monitoring

