Status of the CMS Detector Control System

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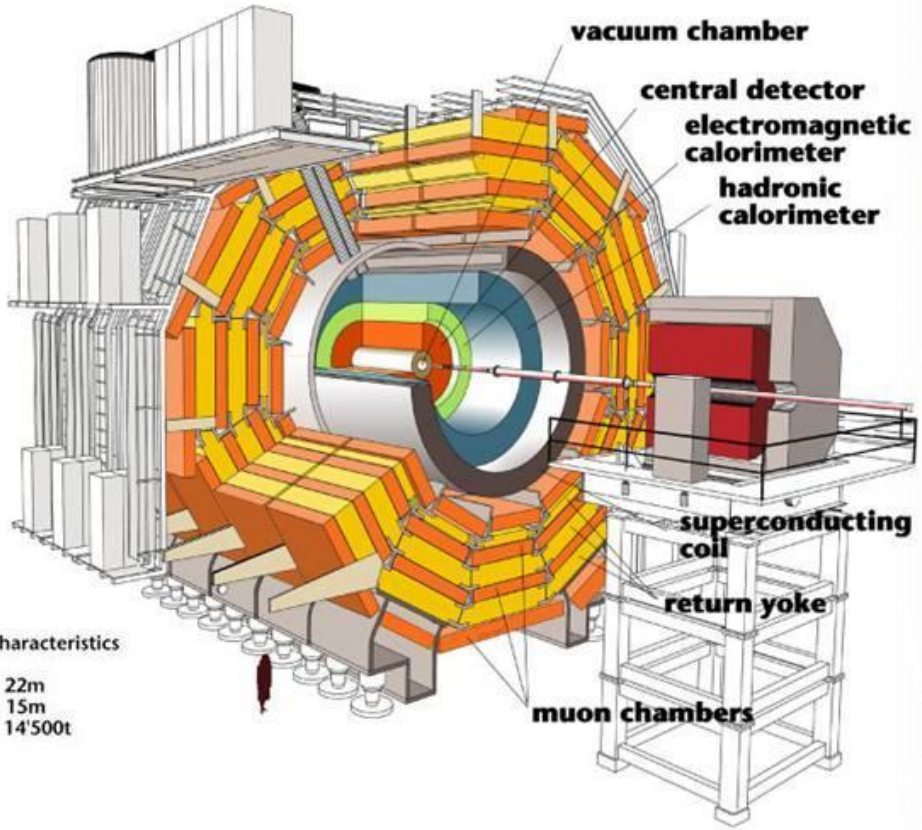
on behalf of PH-CMD CERN group

The Compact Muon Solenoid

A multi-purpose Large Hadron Collider experiment



Detector characteristics

Width: 22m
Diameter: 15m
Weight: 14'500t

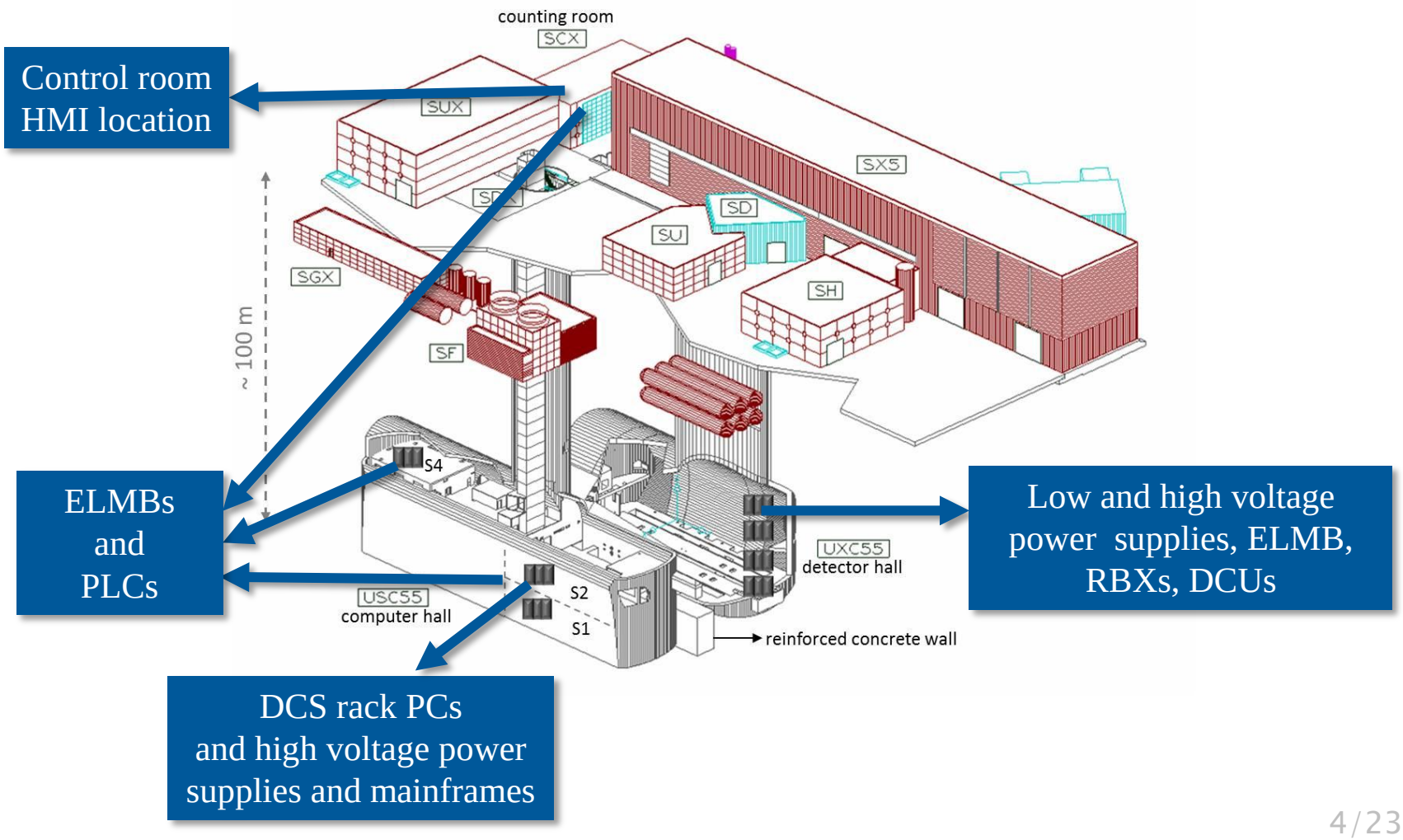
A Quick DCS Hardware Overview

Some representative examples

Device type	Usage	Brand	Driver	Parameters
Power supply	Front end electronics and detector bias	CAEN W-IE-NE-R CMS-made	OPC/Ethernet OPC/CAN DIM	~2.5 M
Embedded Local Monitoring Board (ELMB)	Temperature, humidity and pressure monitoring Water leak detection Laser monitoring	CERN-made	OPC/CAN	~24 K
DCU, RBX	Detector monitoring	CMS-made	DIM, PSX	~0.5 M
PLC	Safety, Cooling Rack electrical distribution	Siemens Schneider	S7 Modbus/tcp	~12 K

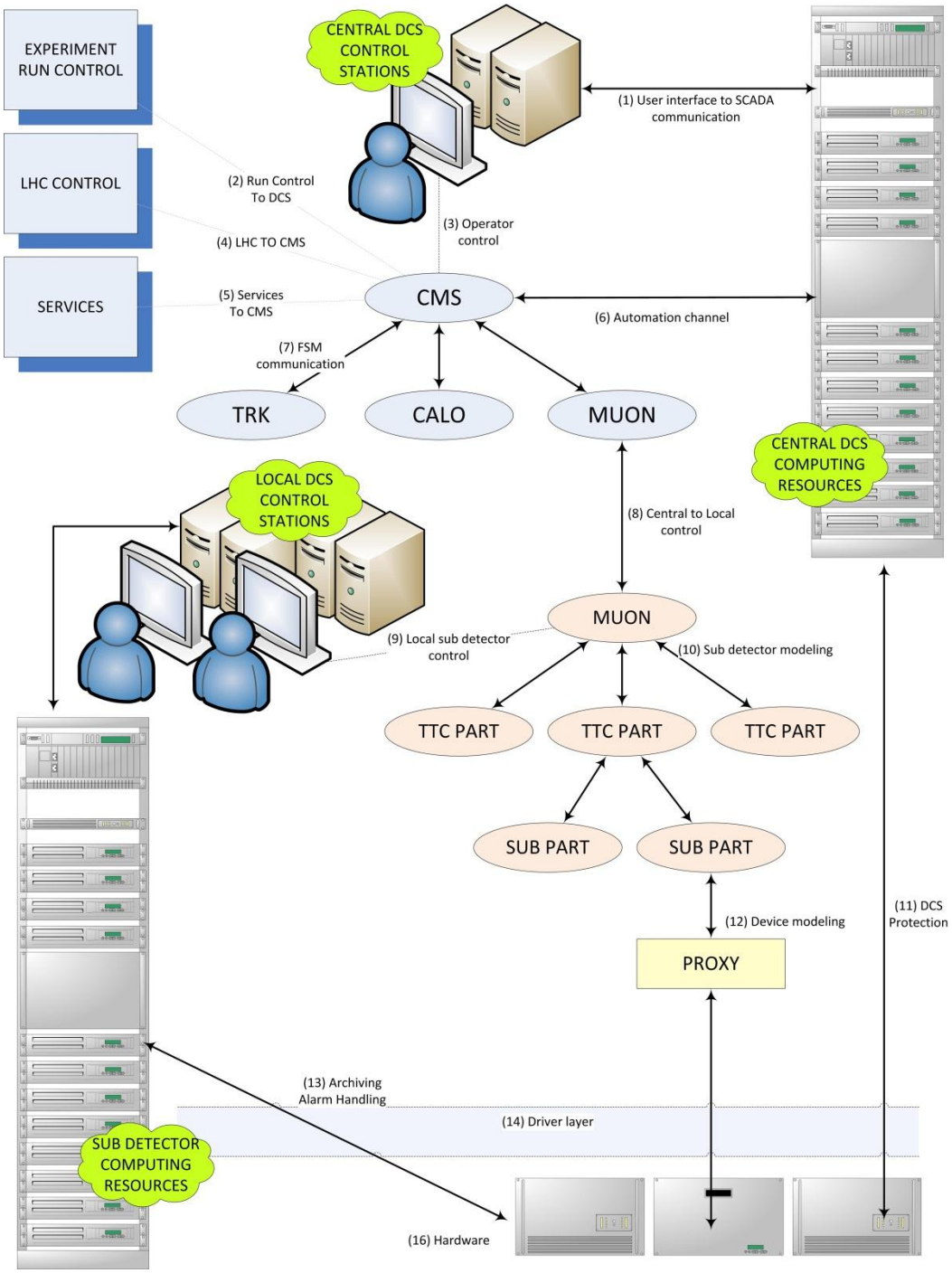
DCS Hardware distribution

Distributed across different experiment areas



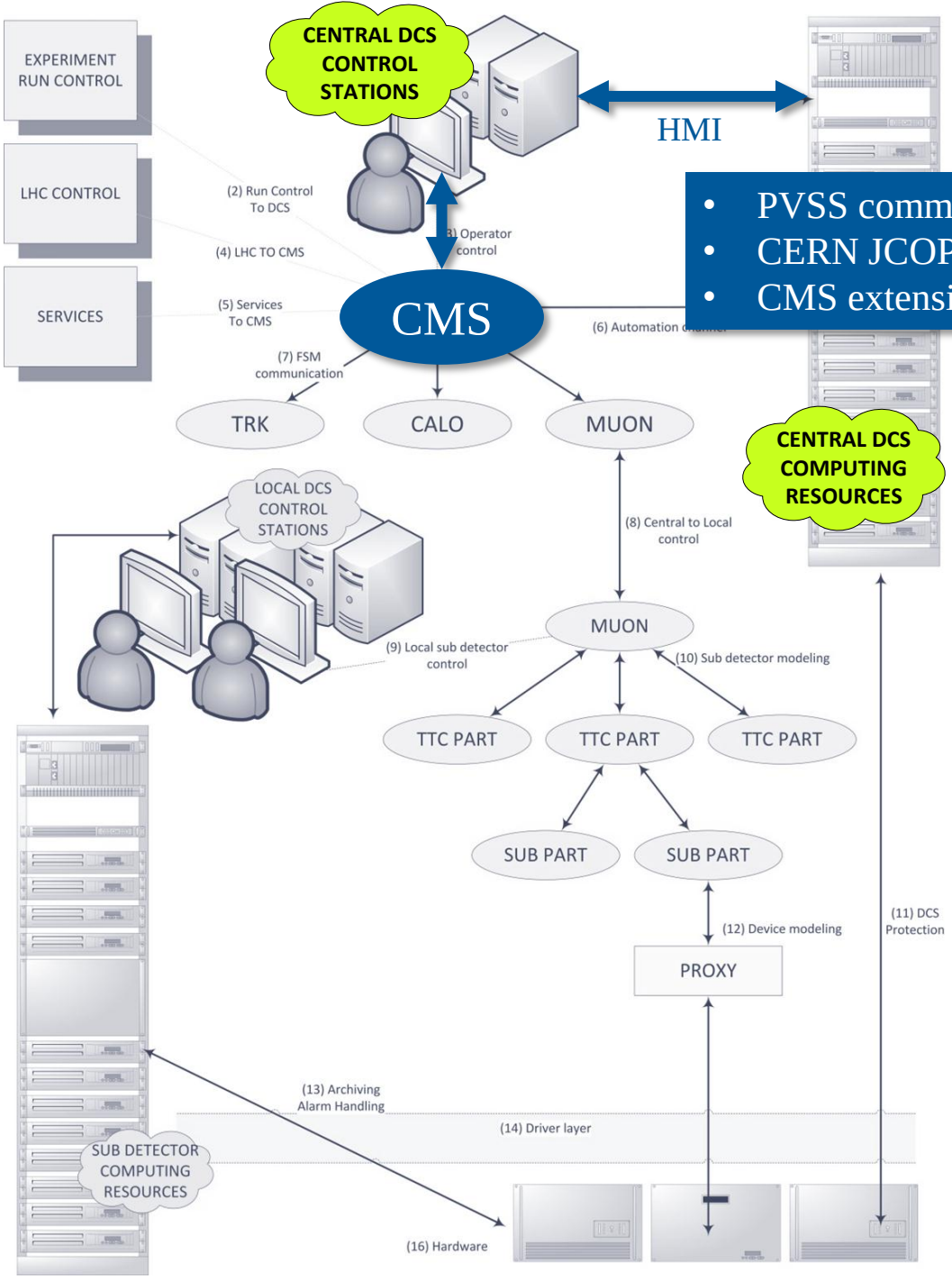
DCS

Architecture



DCS

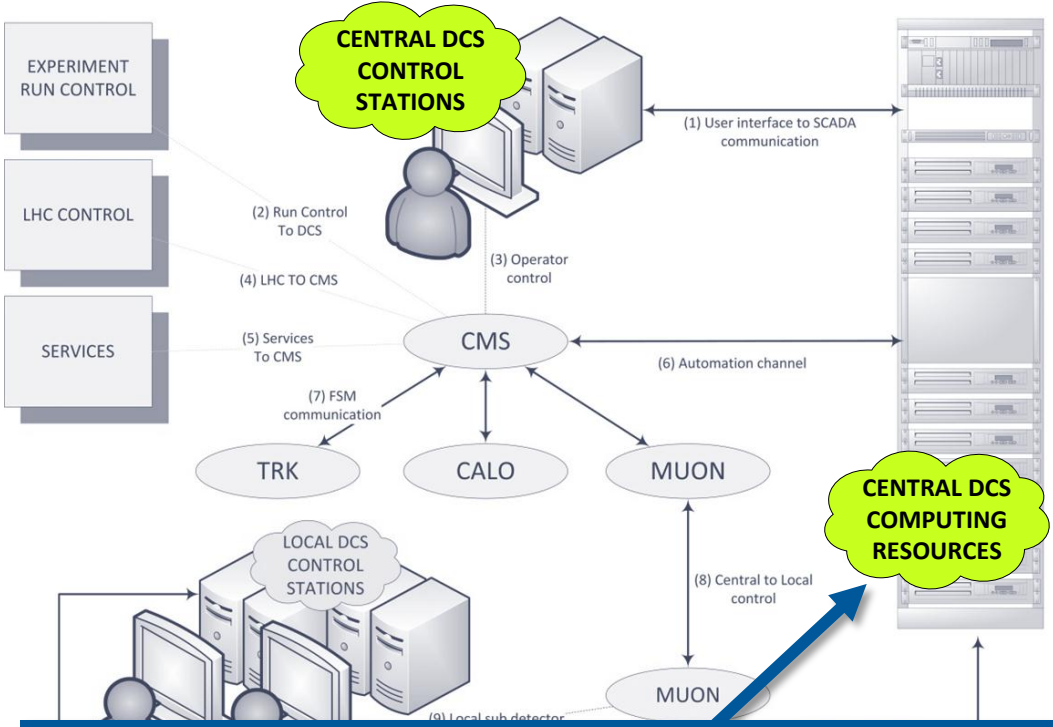
Infrastructure



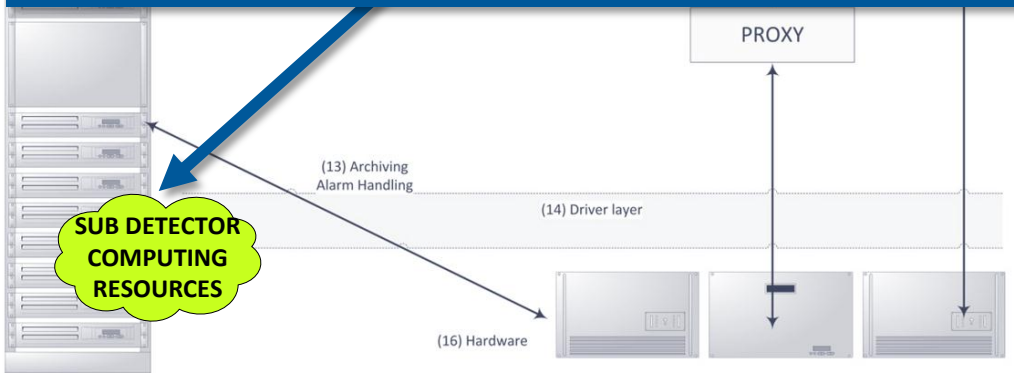
- PVSS commercial SCADA
- CERN JCOP framework
- CMS extension framework

DCS

Infrastructure

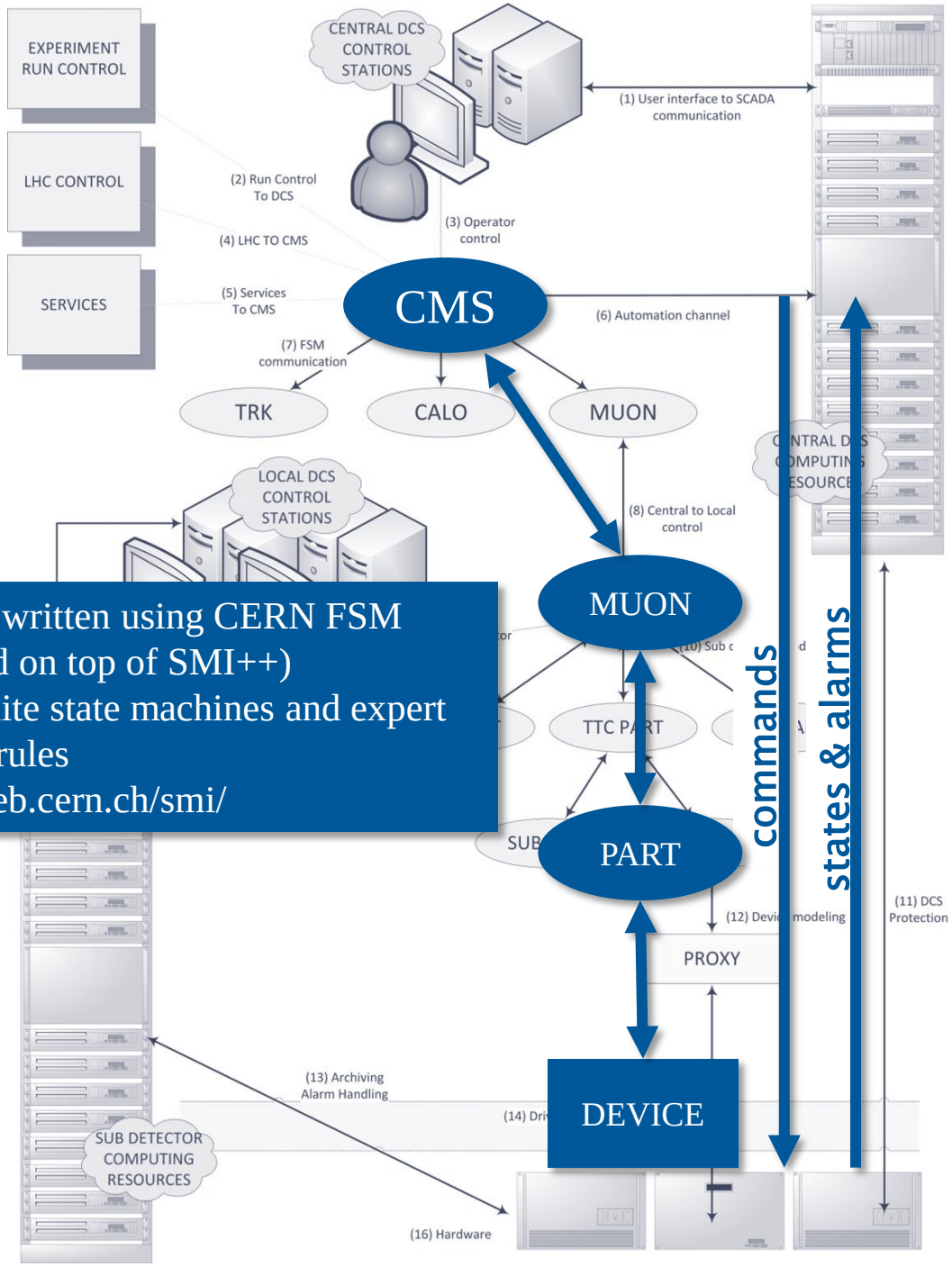


- ~100 rack mounted PCs distributed in 14 racks
- Both the supervisor and the sub-detectors PCs are centrally managed using CERN Computing Management Framework
- All PCs are running Windows XP
- DCS applications are installed using a plug-in mechanism that allows for deploying functional detector components



DCS

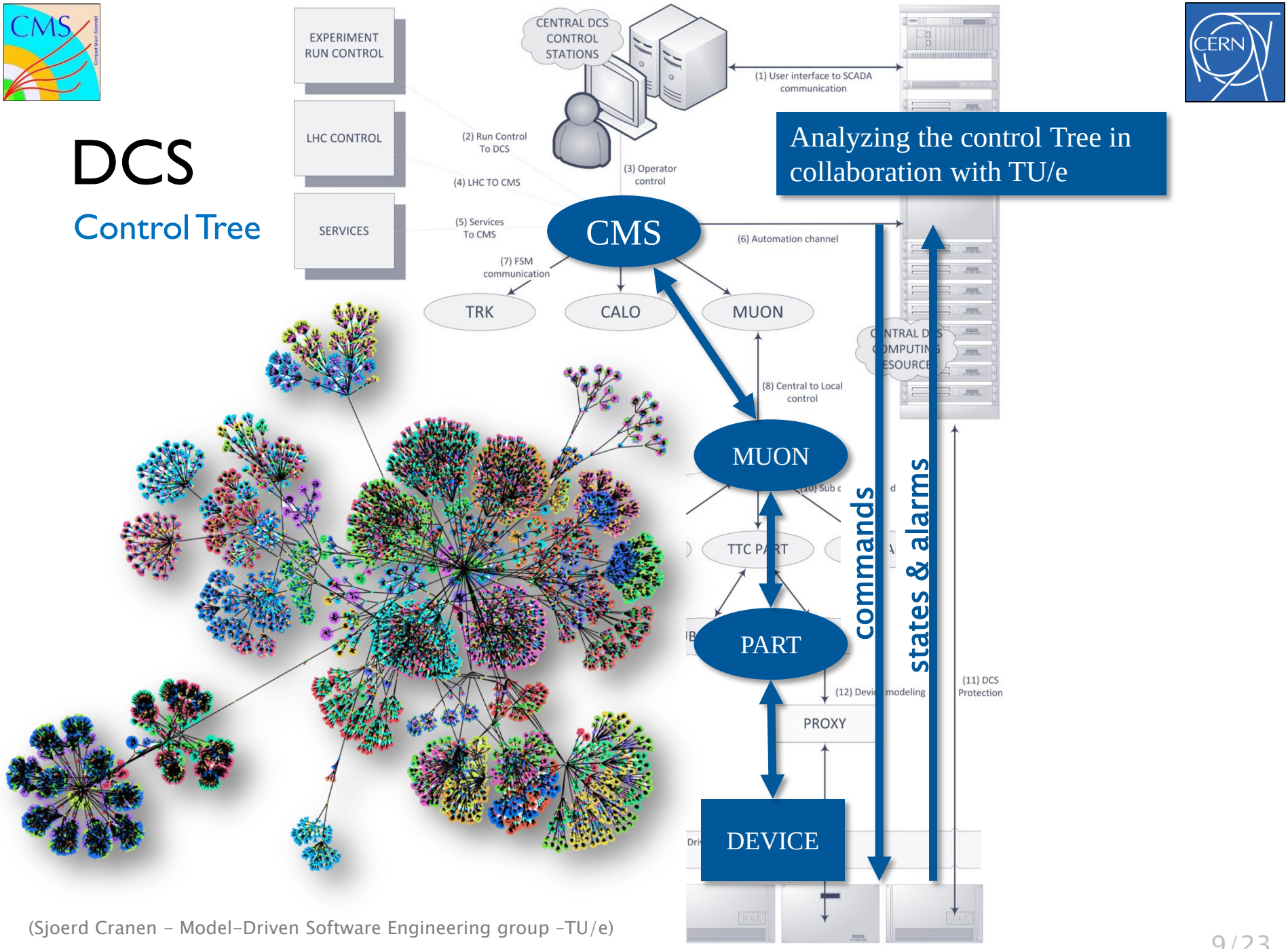
Control Tree



- Control tree written using CERN FSM toolkit (build on top of SMI++)
- Based on finite state machines and expert system-like rules
- http://smi.web.cern.ch/smi/

DCS

Control Tree

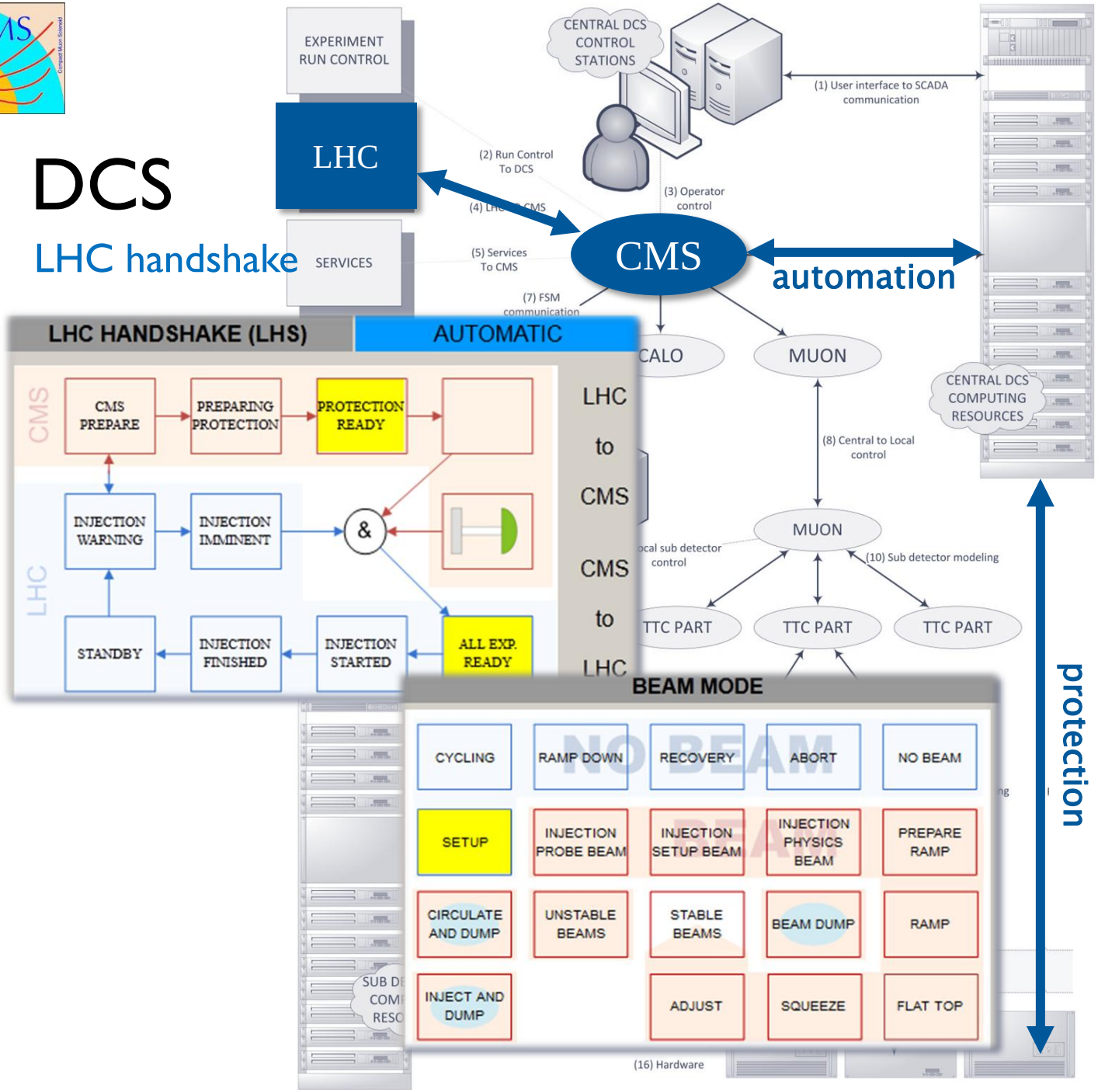


Analyzing the control Tree in collaboration with TU/e

(Sjoerd Cranen - Model-Driven Software Engineering group -TU/e)

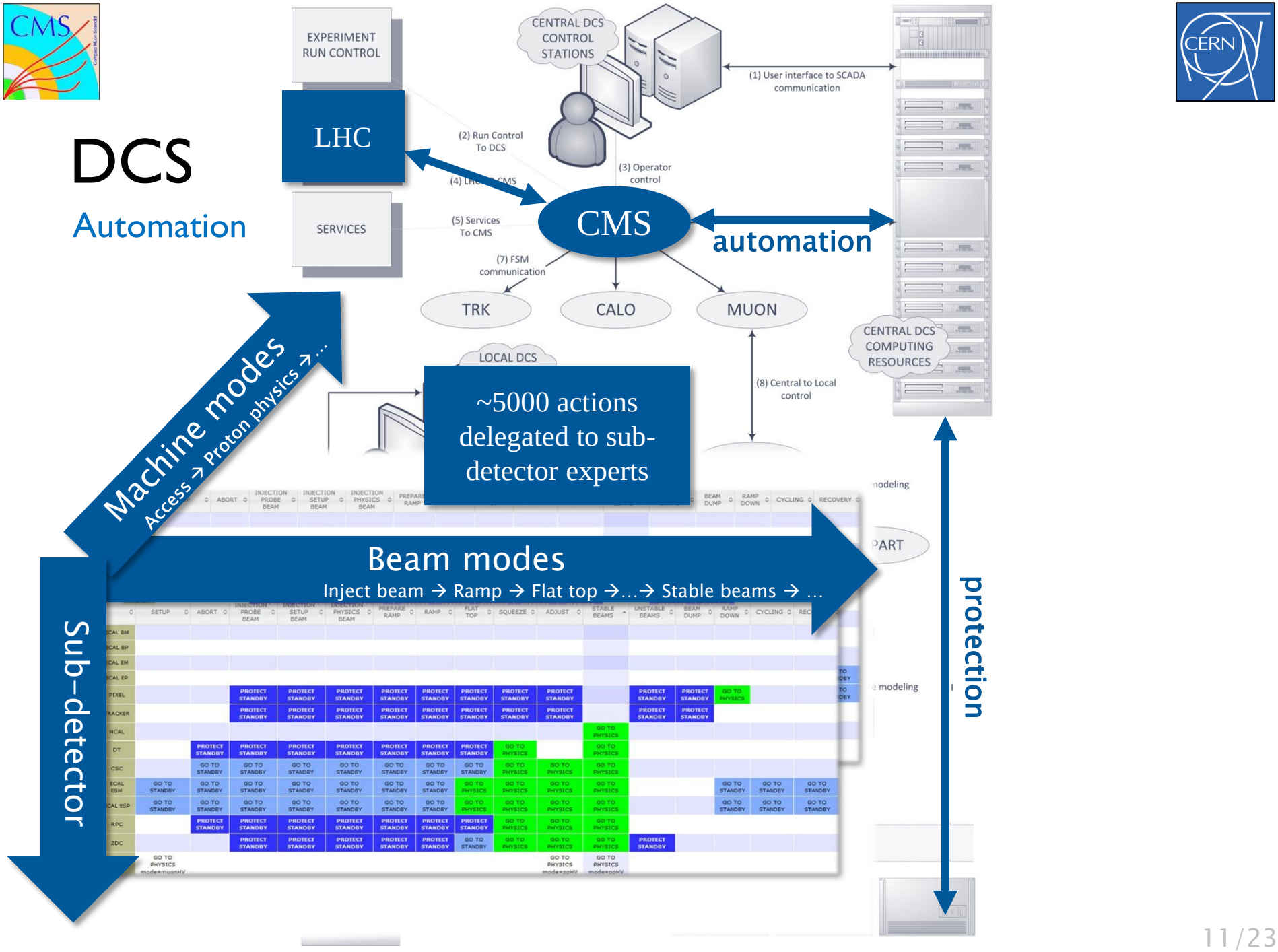
DCS

LHC handshake



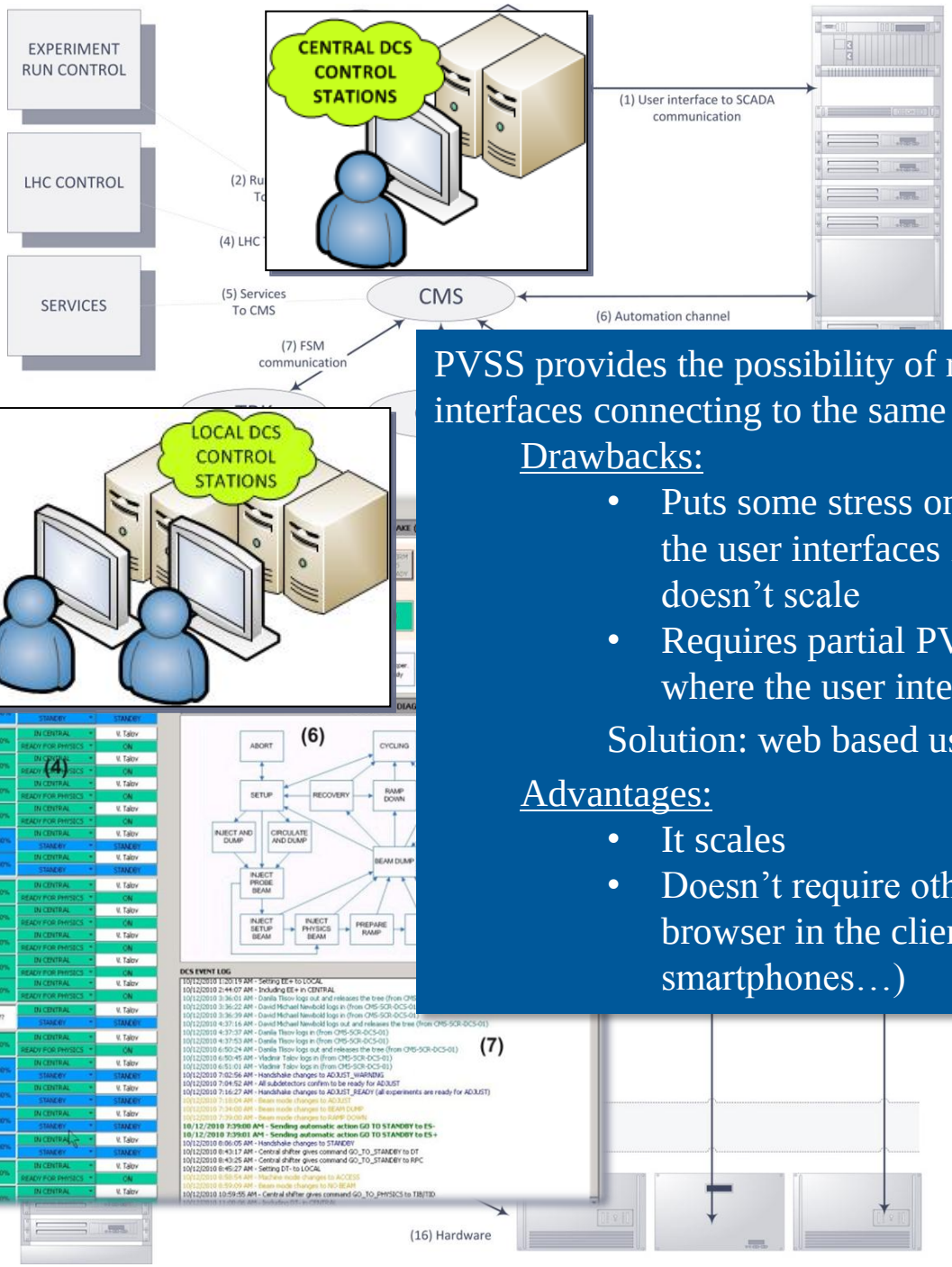
DCS

Automation



DCS

HMI



PVSS provides the possibility of running many user interfaces connecting to the same system

Drawbacks:

- Puts some stress on the system where the user interfaces is connecting to. It doesn't scale
- Requires partial PVSS installation where the user interface should run

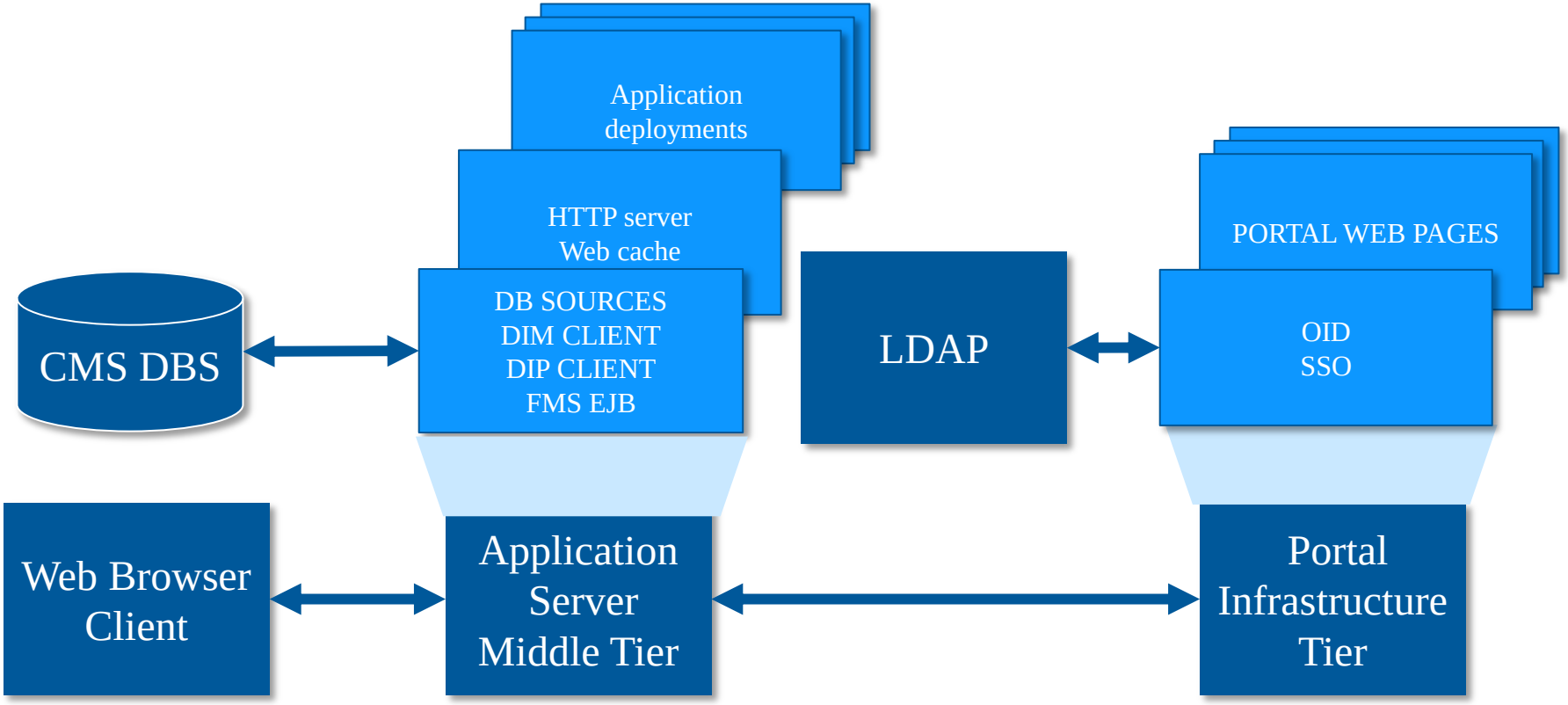
Solution: web based user interfaces

Advantages:

- It scales
- Doesn't require other than a web browser in the client side (tablets, smartphones…)

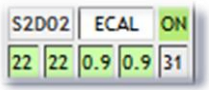
Web monitoring

Architecture



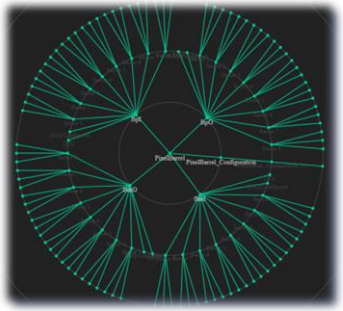
DCS web applications

Some highlights



Rack monitoring & crate control

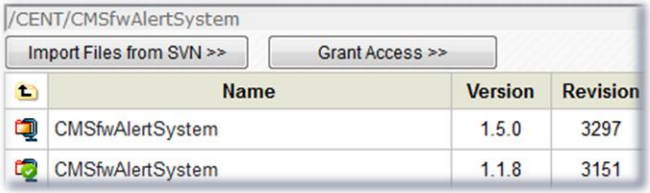
DCS operation summary



FSM monitoring

plotting online tool

cmsonline



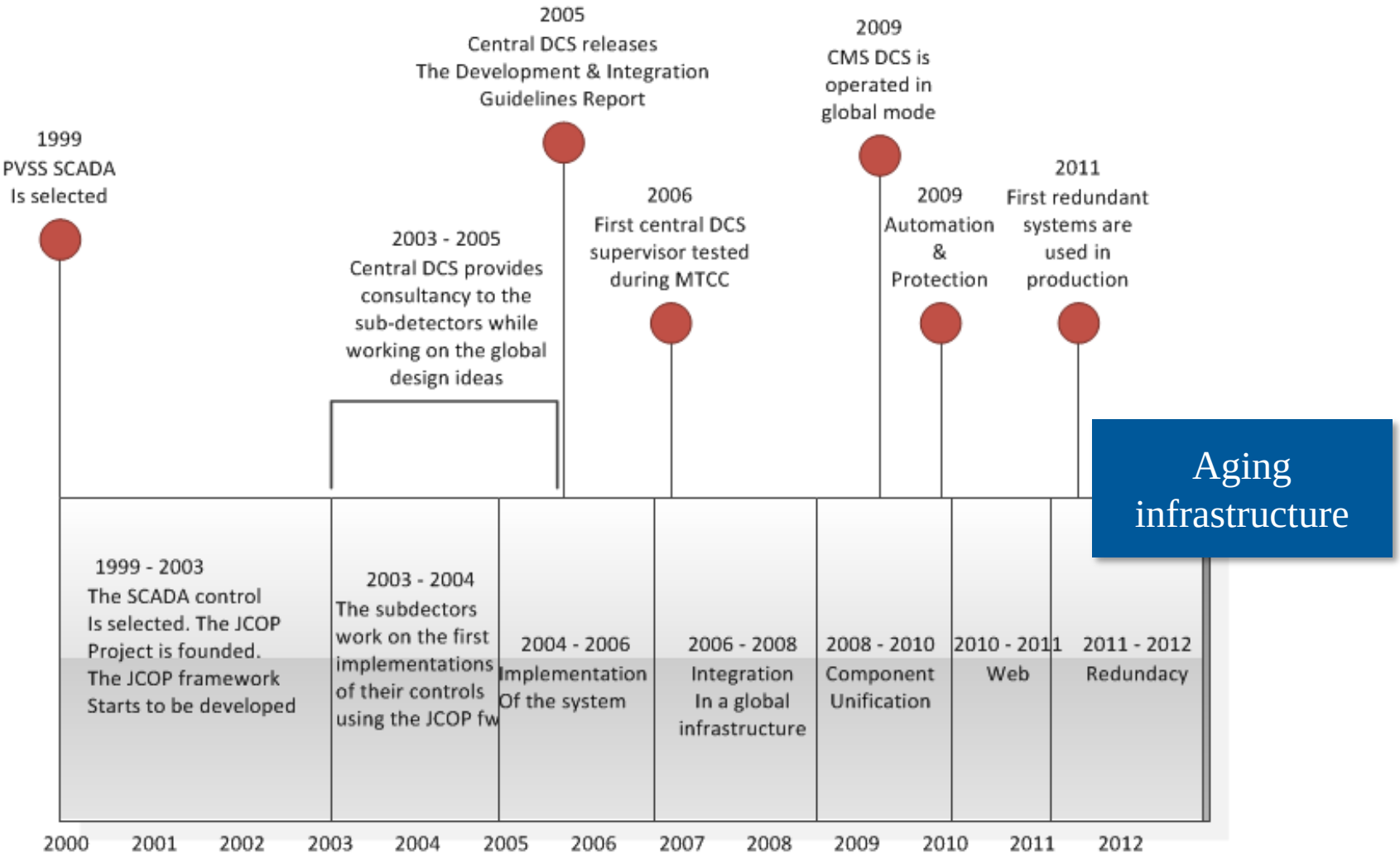
DCS component installation

DCS Alert screen

infrastructure control & monitoring

(Loads of work by L. Masetti and M. Janulis)

The DCS history



DCS upgrade

The motivation

- The Central DCS infrastructure is confronting two concurrent issues:
  - the end of life of the operating system in use (W. XP)
  - the aging of the current computing infrastructure

DCS upgrade

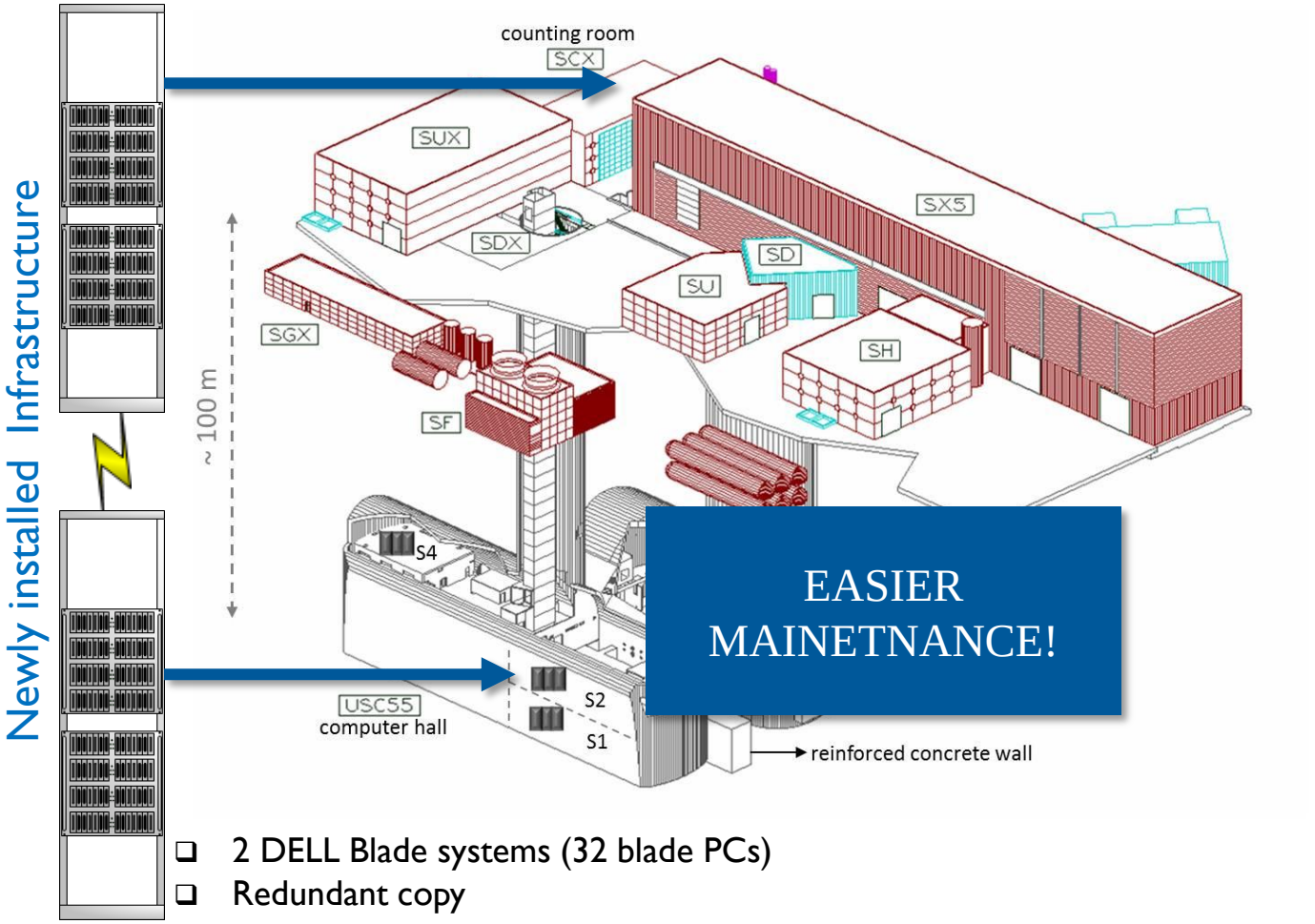
Hardware replacement

- One approach would have been to replace the current rack mounted PCs with newer ones

- The central DCS group has chosen instead for a high-density modular solution (DELL Blade systems) incorporating PCs and networking into a single chassis that provides shared power, cooling and management

DCS upgrade

New computing infrastructure location



- 2 DELL Blade systems (32 blade PCs)
- Redundant copy

Upgrade ongoing work

Some system refactoring needed

- All DCS control and monitoring hardware must be Ethernet based (USB, serial and PCI based hardware was replaced or adapted to Ethernet based solutions)
- Approximately every 3 PVSS systems (running in individual rack PCs) will be merged in one Blade PC
  - Should make sure there are no collisions (used ports, driver limitations, naming collisions…)
  - Will make use of CMS DCS factorization capabilities

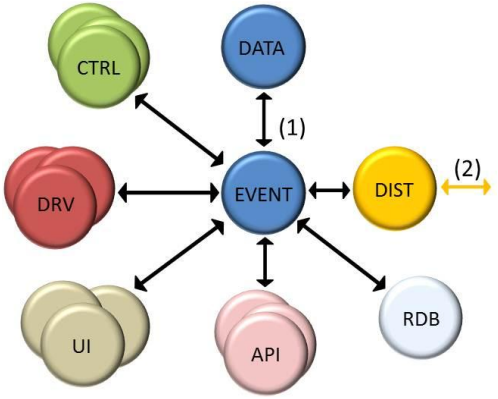
DCS upgrade

The Operating System Upgrade

- After looking at the different possibilities CMS decided to move the Windows XP systems to Windows 7
  - Windows is still CMS controls platform (OPC)
  - Windows Server version didn't add features useful in our infrastructure
  - Window 7 64b tests on new Blades very successful in terms of performance and memory management

DCS upgrade

One step further: redundancy



- To achieve the zero downtime the redundant partners will use a built-in SCADA (PVSS) functionality to run PVSS projects in a hot-standby mode taking over in case of failure

One project is active the second one in a hot-standby passive mode

Need to review DCS components for redundancy

CMS is the only LHC experiment using redundancy

PVSS managers handle redundancy JCOP and CMS extensions need to be enabled

Poster: "High availability through full redundancy of the CMS detector controls system" Dr. Polese Thursday from 13:30 to 18:15

Summarizing

- Fulfilled the operational, functional and environmental requirements, providing efficient automatic and safe detector operation.
- Used and contributed to the JCOP framework.
- Created CMS development guidelines to ease the integration on a common framework.
- Always working on unifying functional components.
- Extensive work performed on developing web applications.
- Year 2012 will be dedicated to improve our infrastructure making it fully redundant

Thank you for you attention!

CMS central DCS is an small team formed by people with different backgrounds sharing their interest and passion for control systems and for technology in general.

We are always looking for ways to increase and share our technology knowledge.

Contact us: Robert.gomez-reino@cern.ch