



# **Laser Megajoule Facility (L.M.J.) Control system status report**

***J.P. Arnoul, F. Signol CEA/CESTA, Le Barp, 33114, France  
J. Nicoloso CEA/DIF, Bruyères le Châtel, 91297, Arpajon, France***

---

# Presentation overview

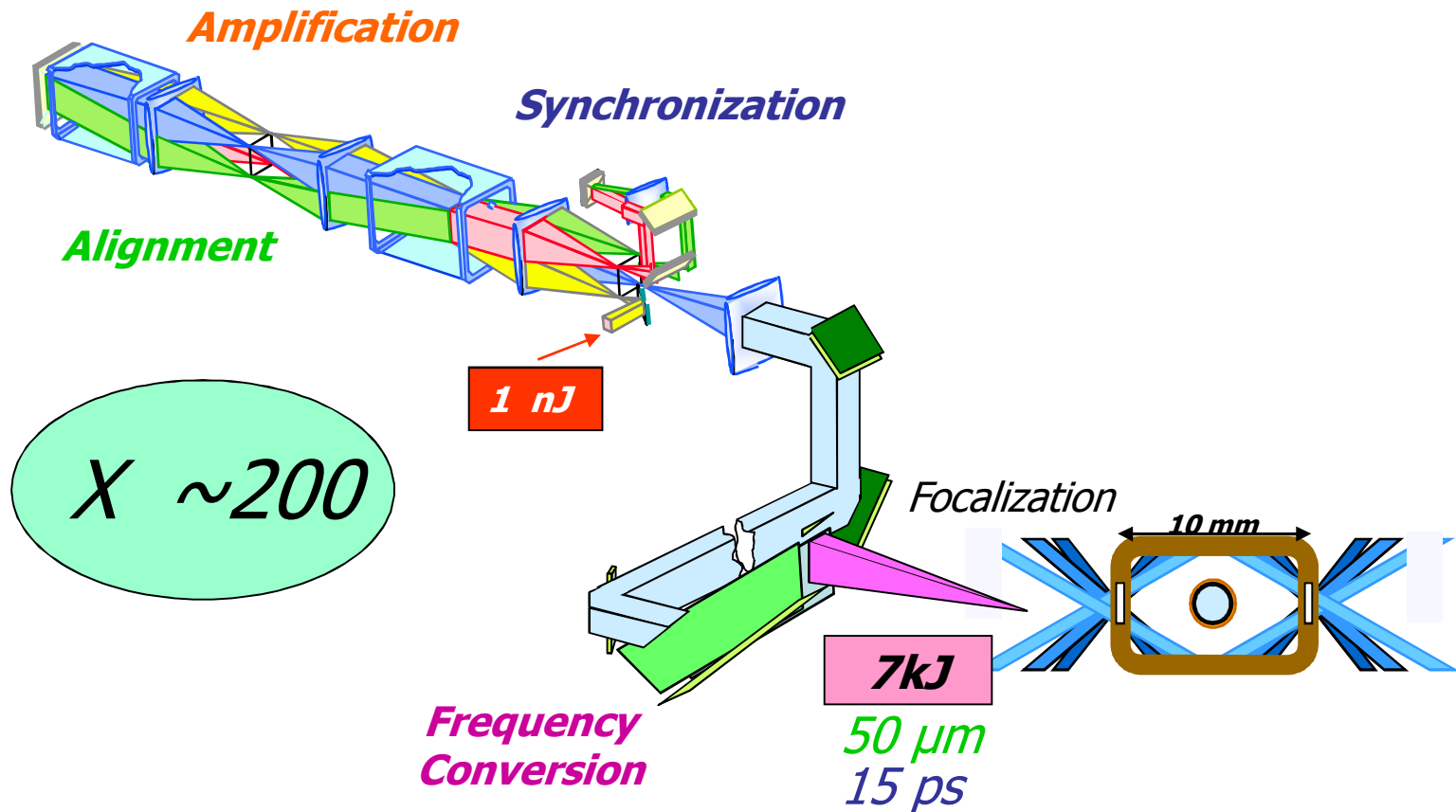


- **Laser Megajoule (L.M.J.) facility**
- **Control system architecture and industrial policy**
- **Software framework architecture**
- **Hardware architecture & virtualization**
- **Command control milestones**

# LMJ facility overview



LMJ is designed to deliver about 1.5 MJ of energy on tiny targets for high density plasma physics and fusion experiments

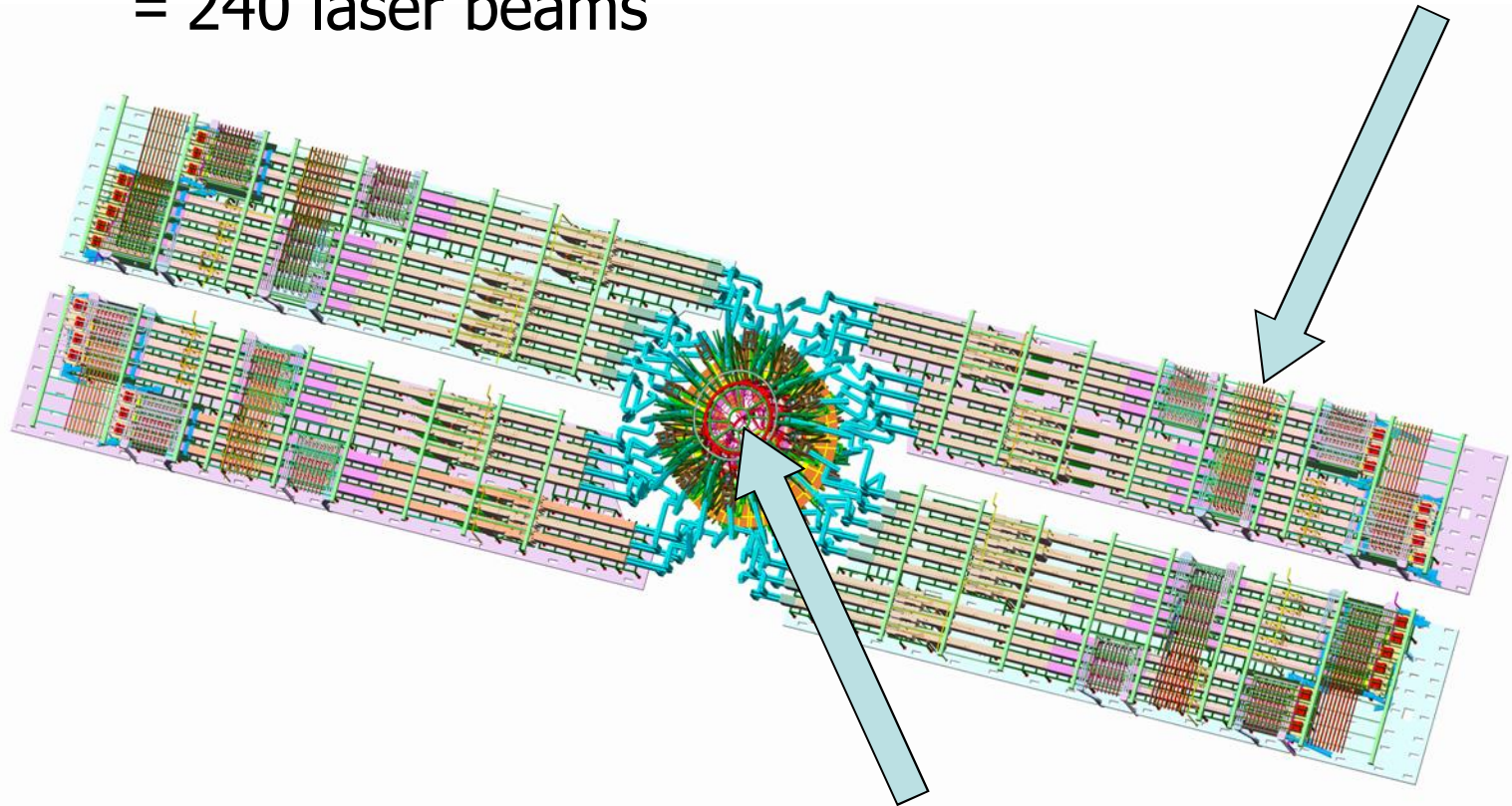


---

# LMJ facility overview

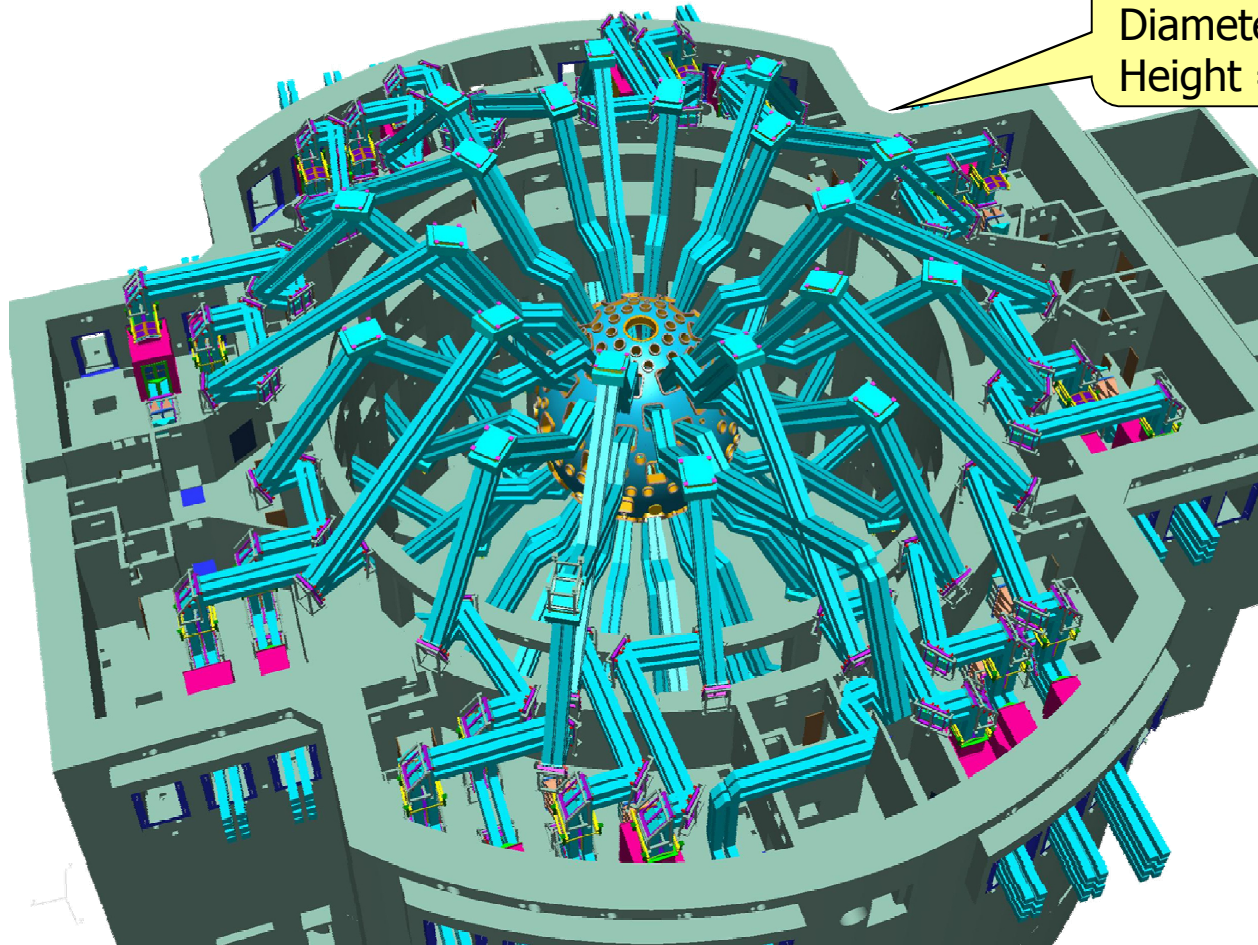


Up to 30 bundles of 8 beams located in 4 bays  
= 240 laser beams



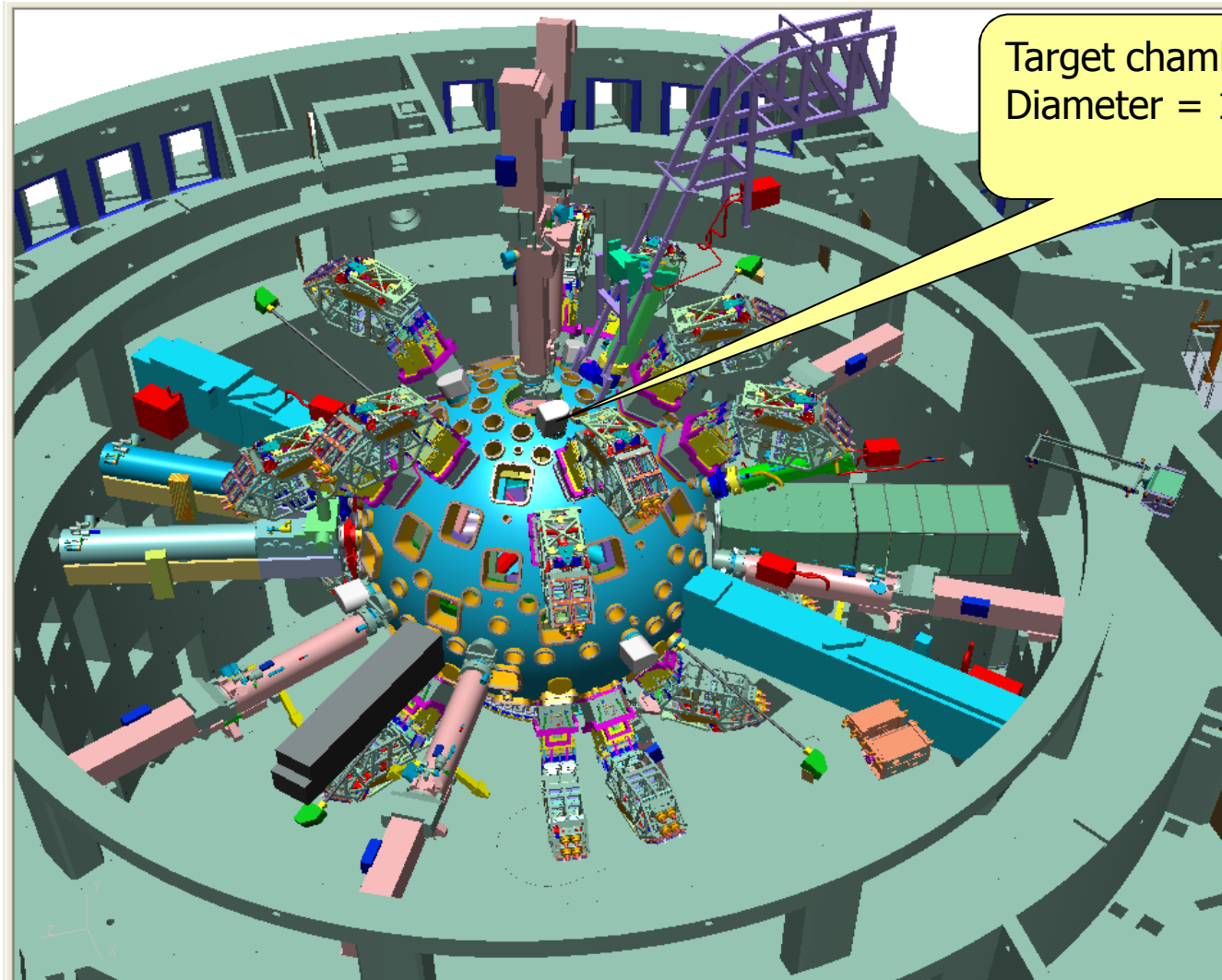
More than 1 MJ of 350 nm UV light on a target

# LMJ facility overview



Target bay:  
Diameter = 60 m  
Height = 38 m

# LMJ facility overview



Target chamber:  
Diameter = 10 m

# LMJ building



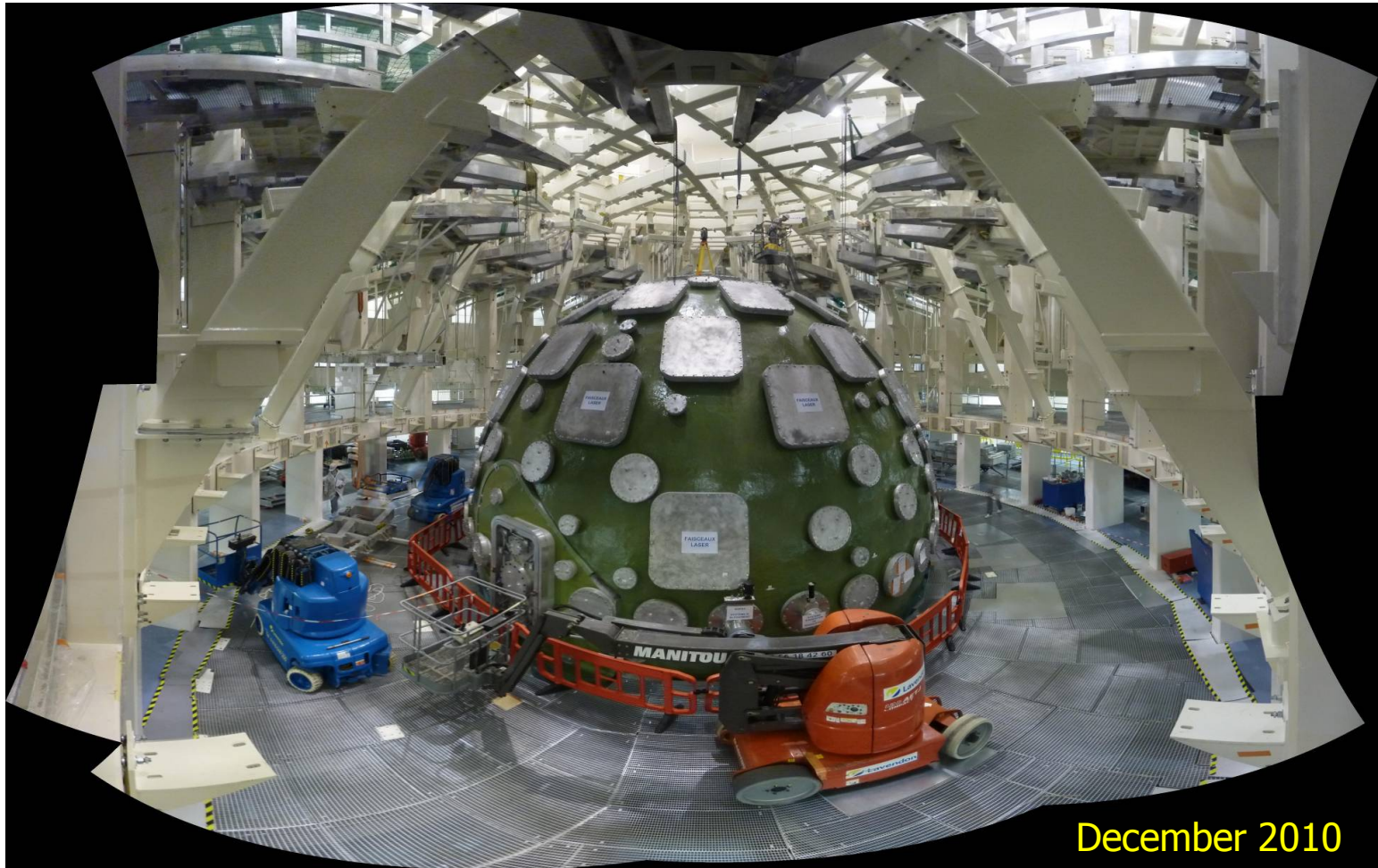
**Mai 2003: beginning**  
**End 2006: target chamber put in place**  
**End 2008: building completed**

# Laser bays



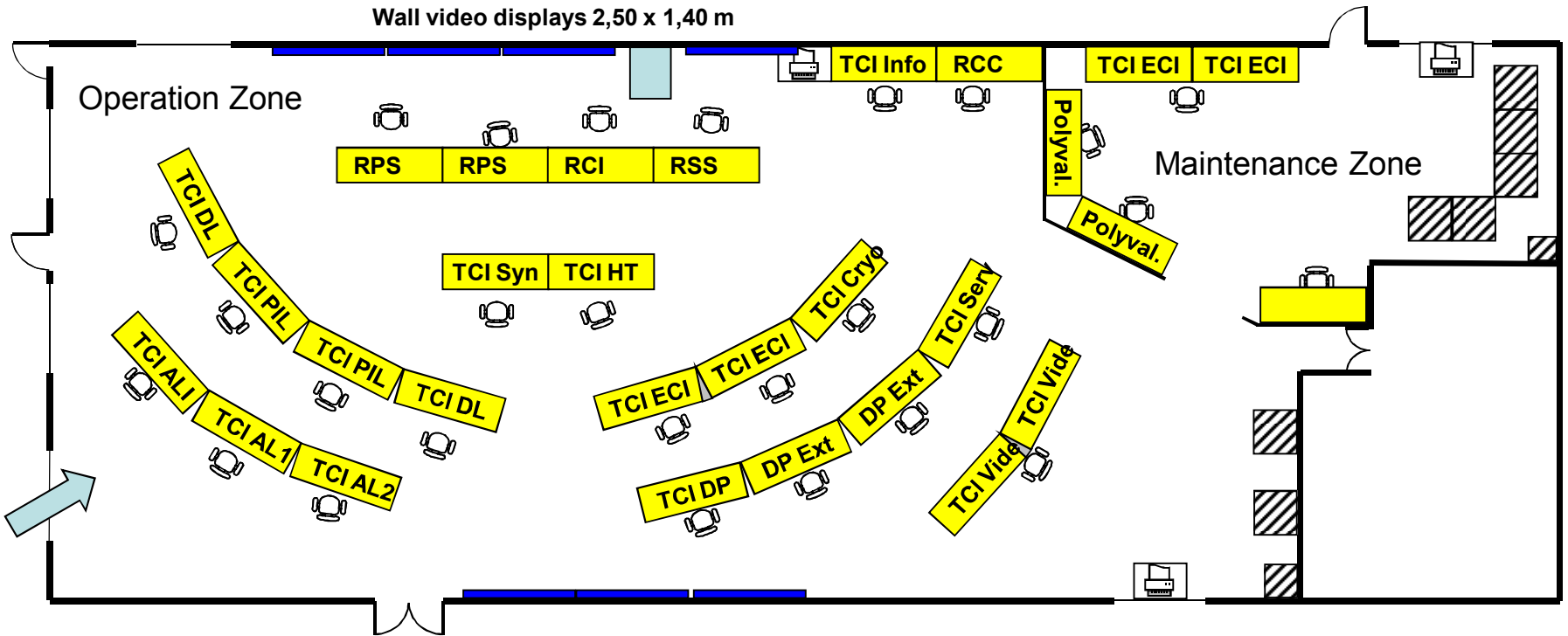


# Target bay



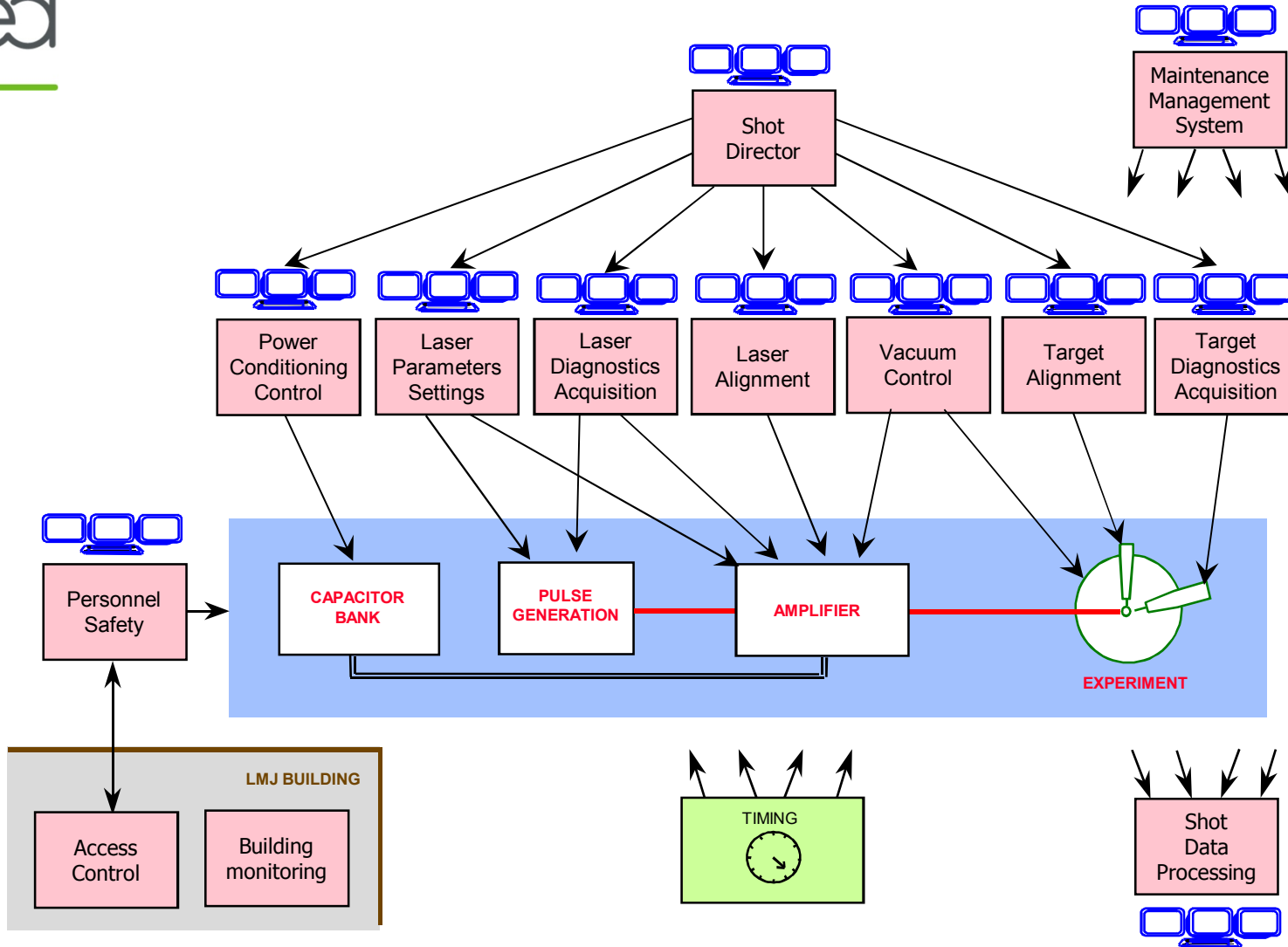
December 2010

# Control room



300 m<sup>2</sup> (13 X 23)

# Control system main functions



# Control system architecture

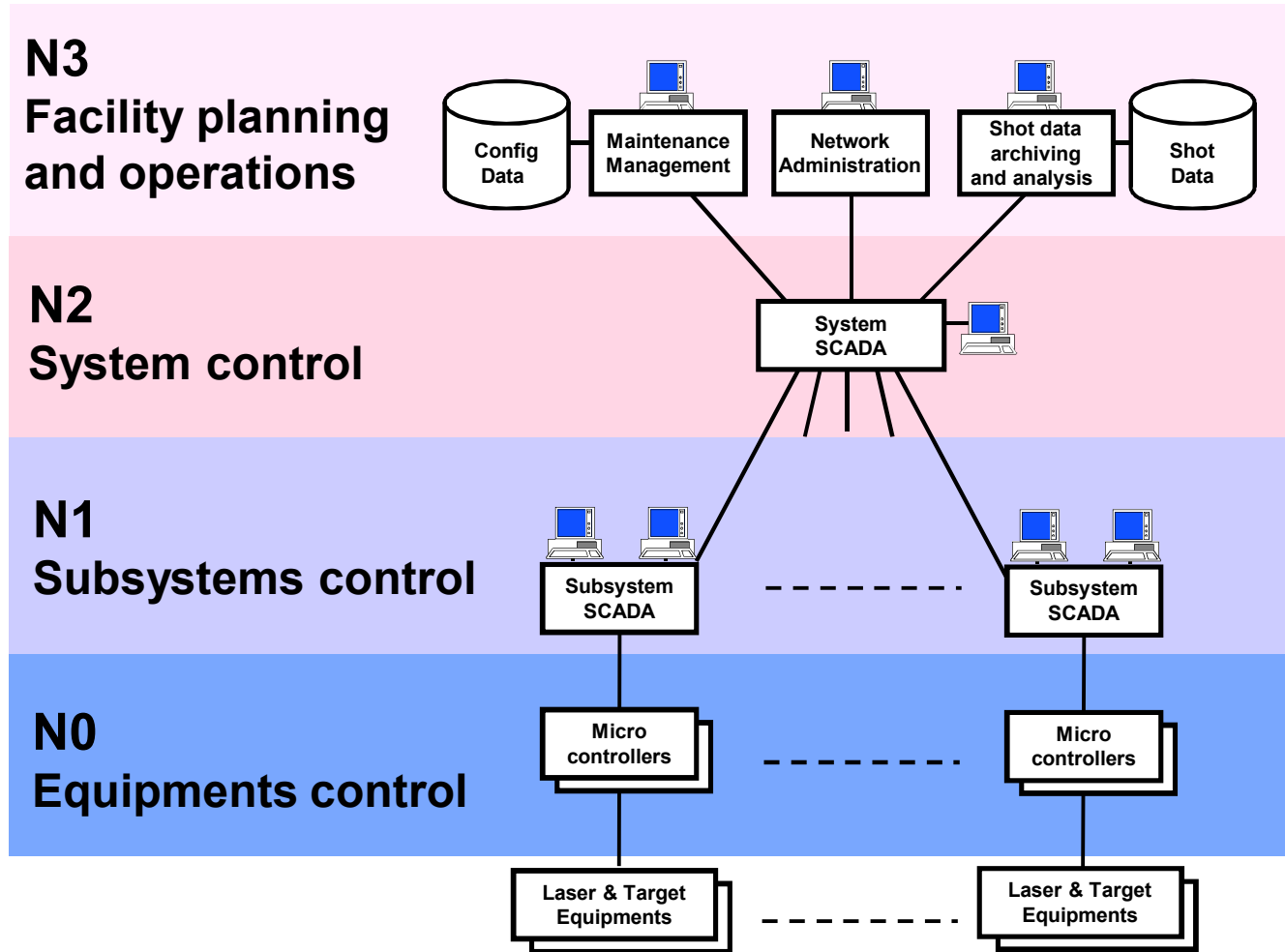


**Control Points**  
**500 000**

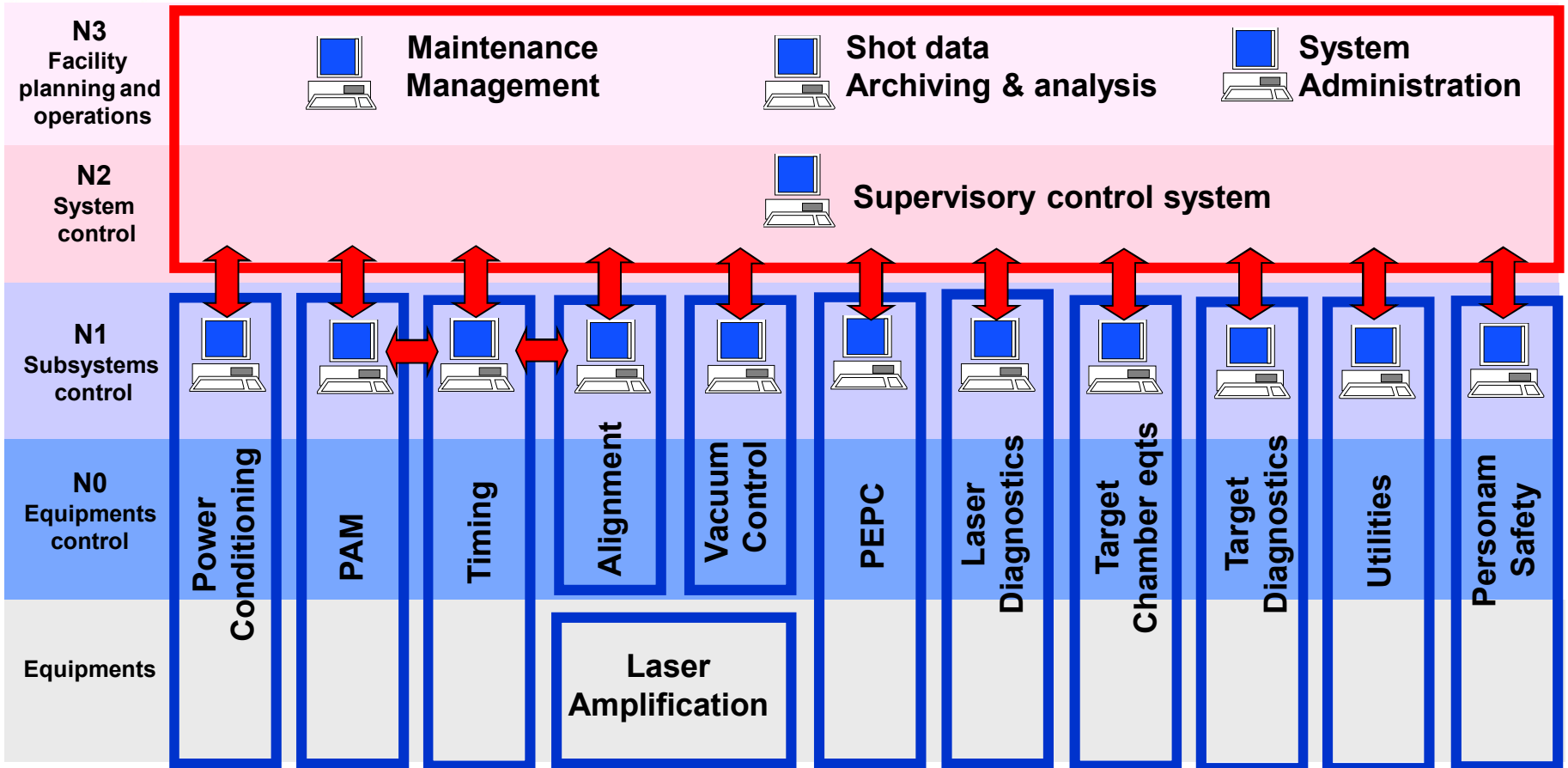
**Alarms**  
**100 000**

**Processors**  
**500**

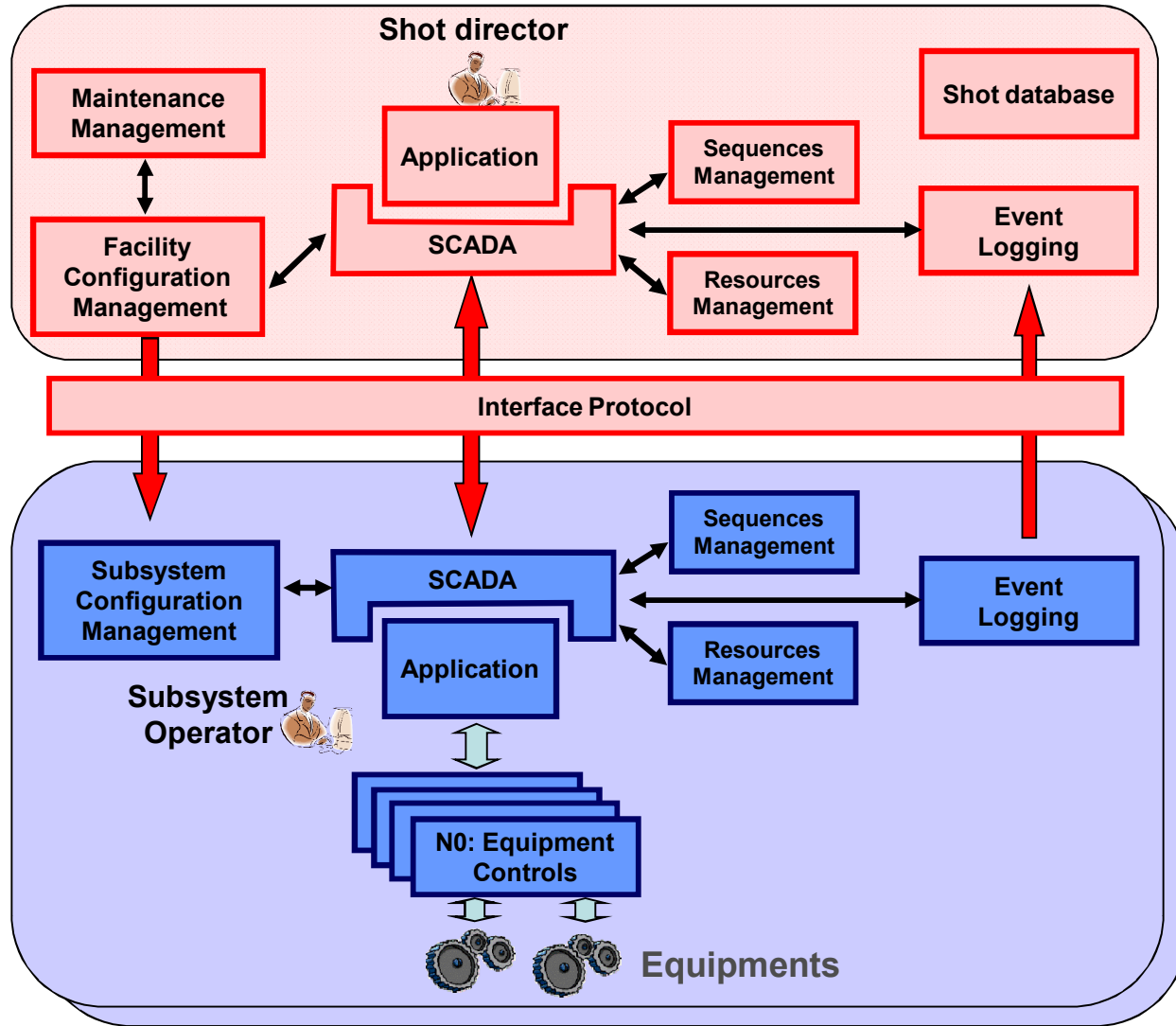
**Shot data**  
**~1 GB / shot**  
**2 years on line**



# Contracts management

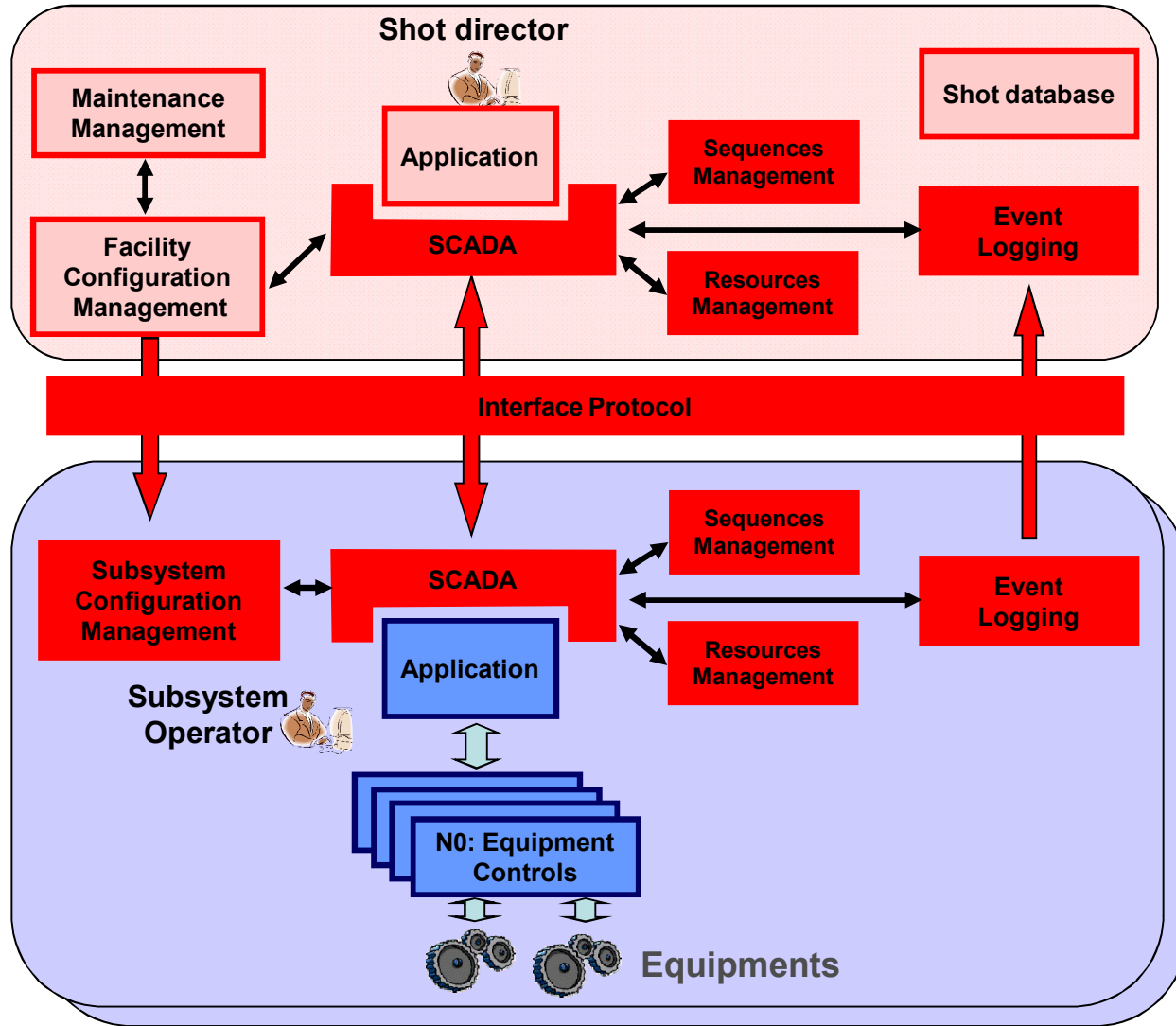


# Software architecture



X12

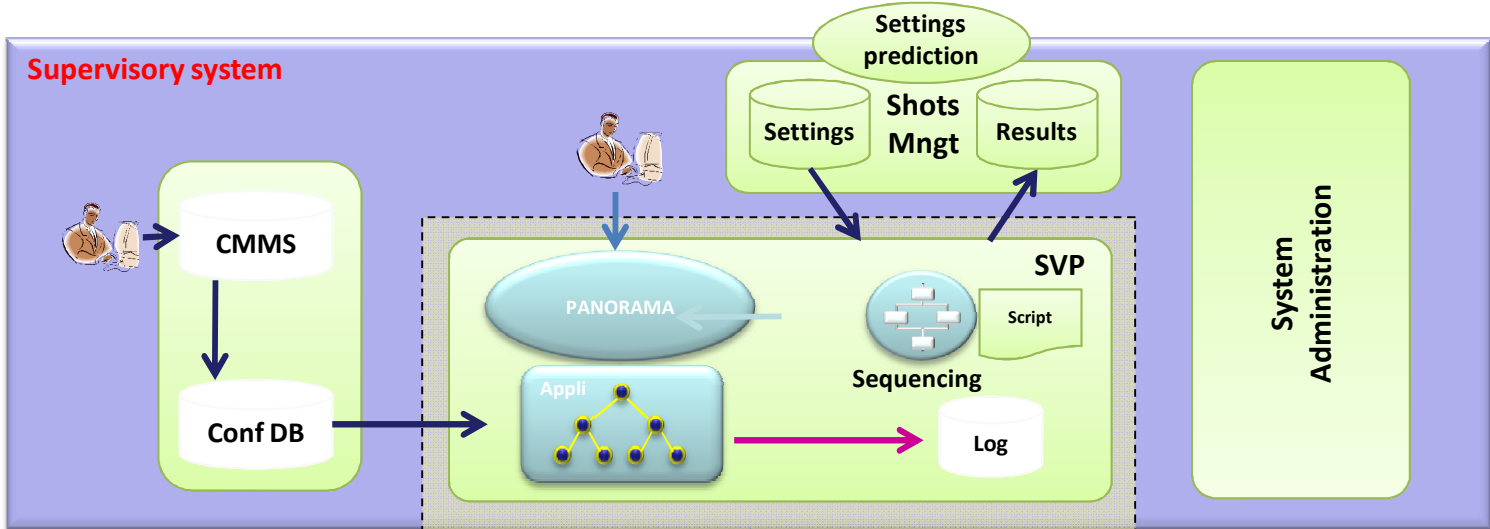
# Software common framework



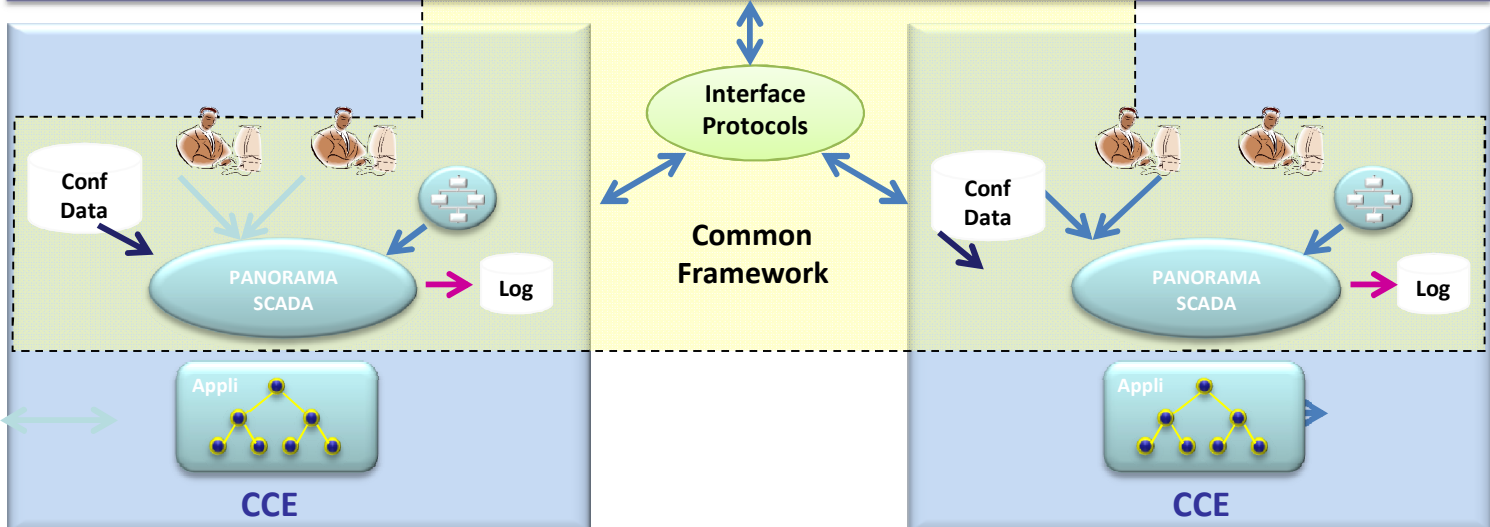
# Software architecture global view



N2-N3  
Layers

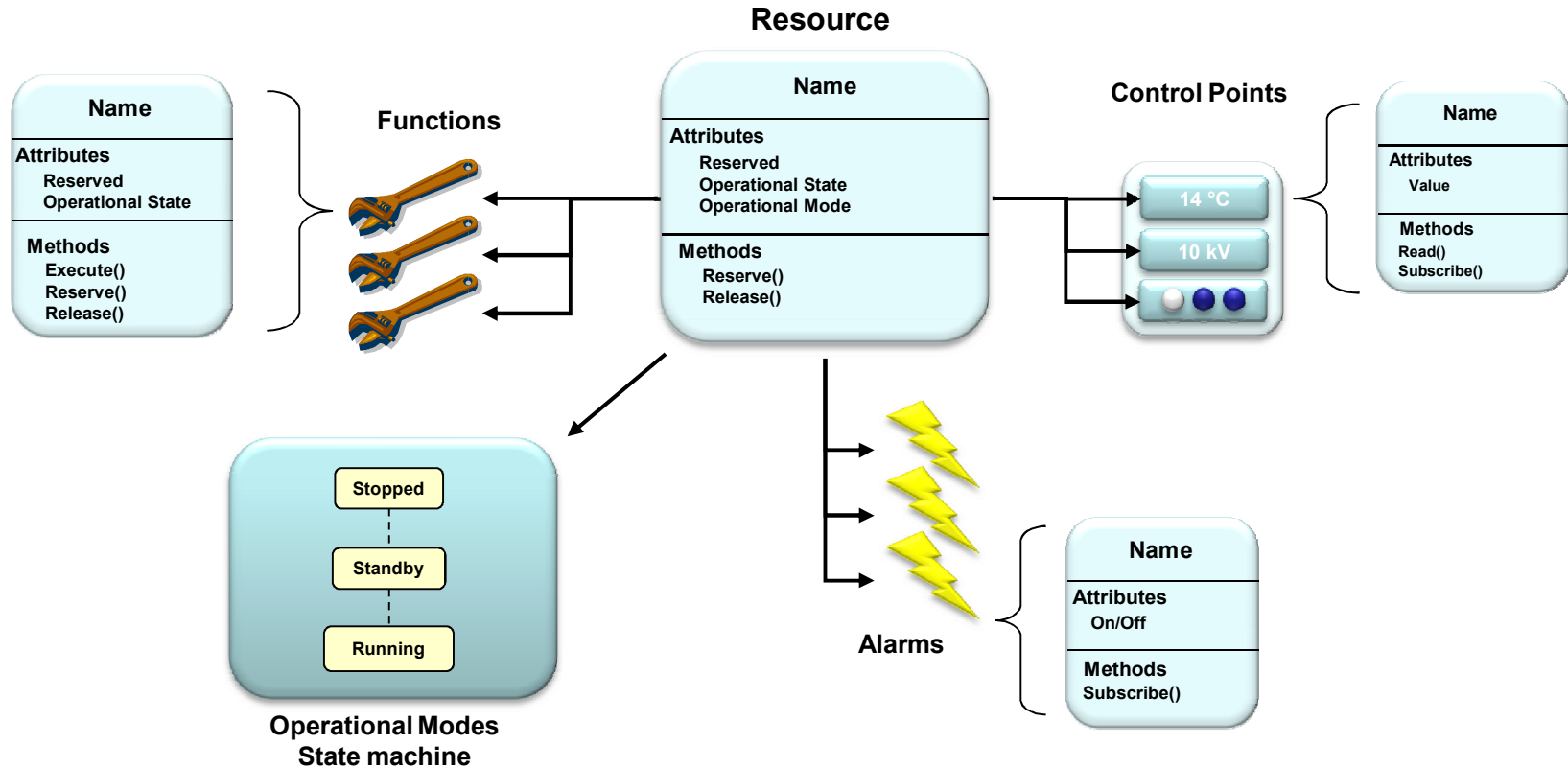


N0-N1  
Layers





# Framework data model



# Framework functional trees



System Resources

Supervisory Control System

Chain[i]

Upper Quadruplet

Lower Quadruplet

Injection

Amplifiers

Transport

Focalization

Public Resources

Subsystem Resources

PAM1

PAM2

Amplifiers

Transport

Focalization

Master Oscillator

Source

Beam 1

Beam 2

Beam 3

Beam 4

Alignment






Sensors

Motors

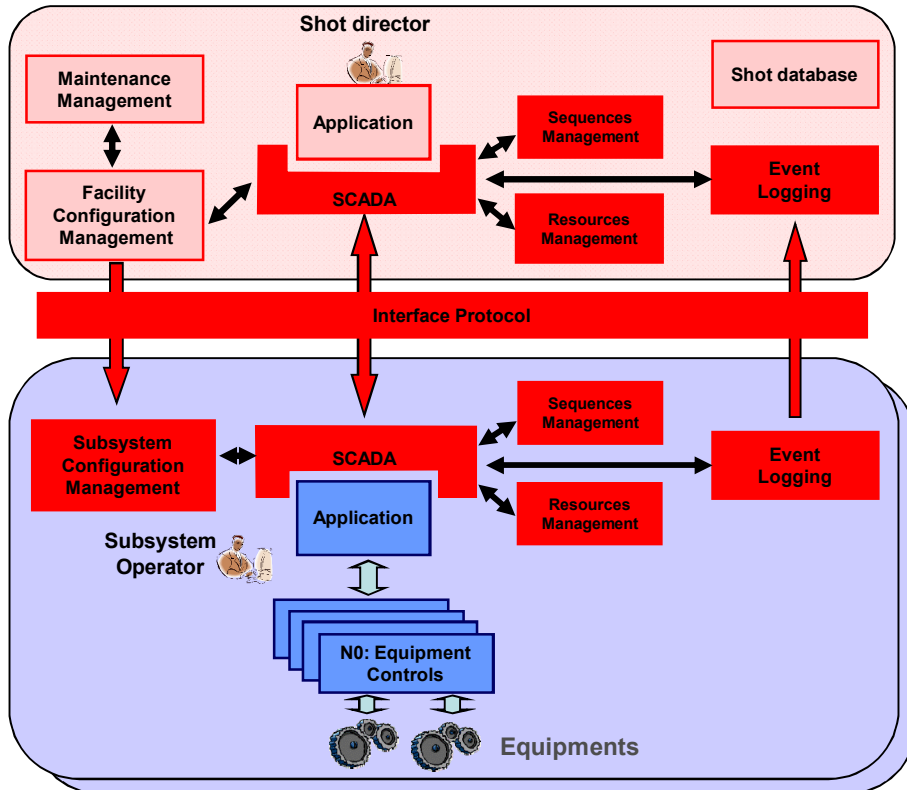
Private Resources

Master Oscillator CCE

Alignment CCE

-  Resource
-  System view
-  Master oscillator view
-  Alignment view
-  Utilisation relationship

# Technical choices



- Platform : PC, Windows
- SCADA: Panorama E<sup>2</sup> from CODRA
- Specific developments: .Net
- Database: Oracle 10g , SQL-Server
- CMMS: D7i product from Datastream
- Interface protocols: WCF
- File exchange: XML, HDF5

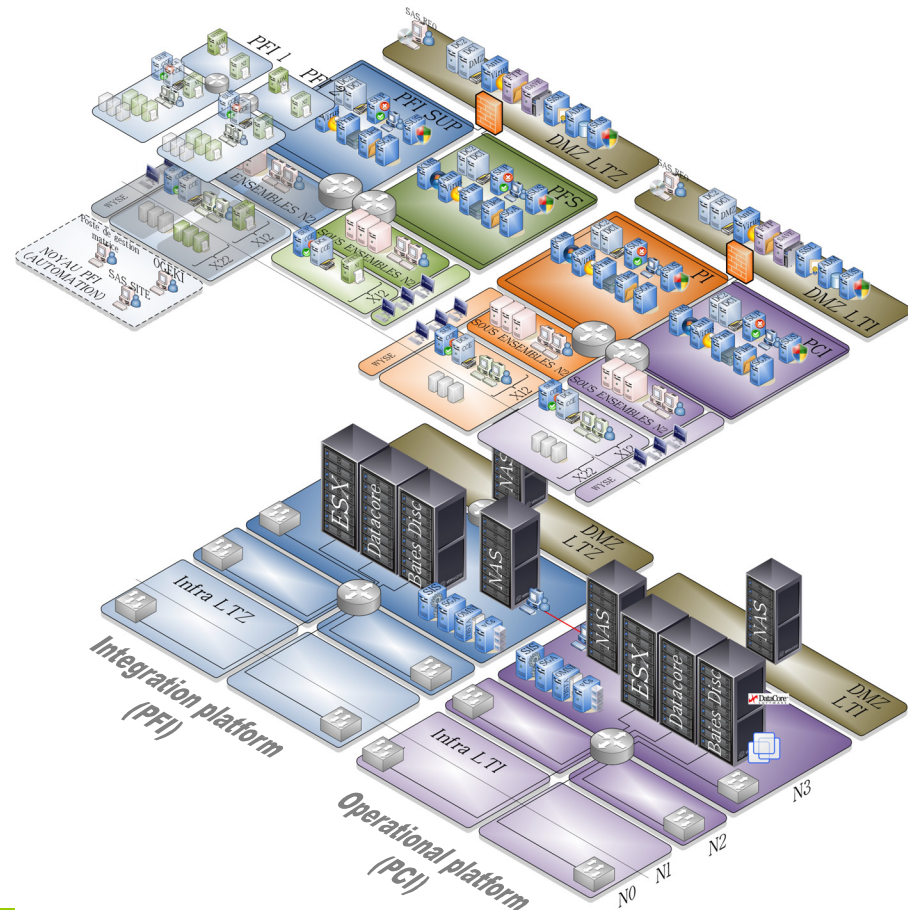
# Hardware architecture



- N1, N2 and N3 layers are virtualized using the VMware VSphere Enterprise Plus suite

Logical Architecture:  
- 500 virtual machines

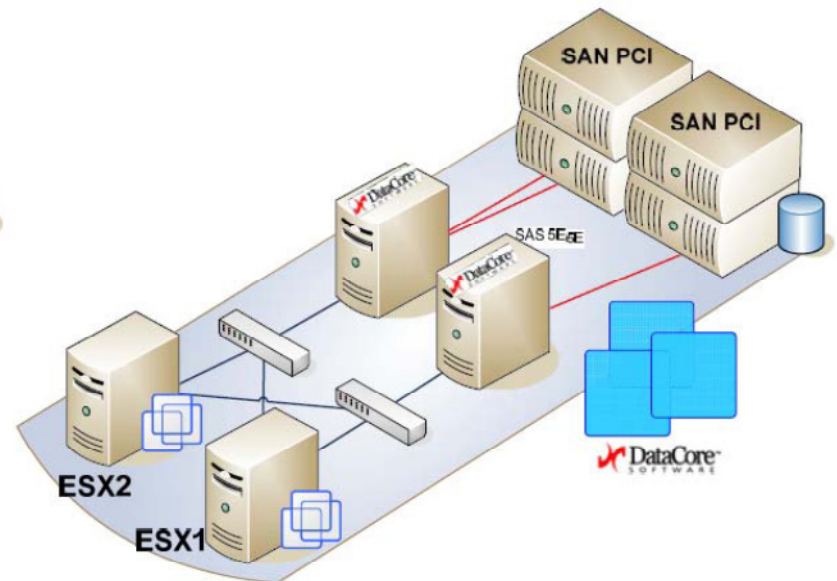
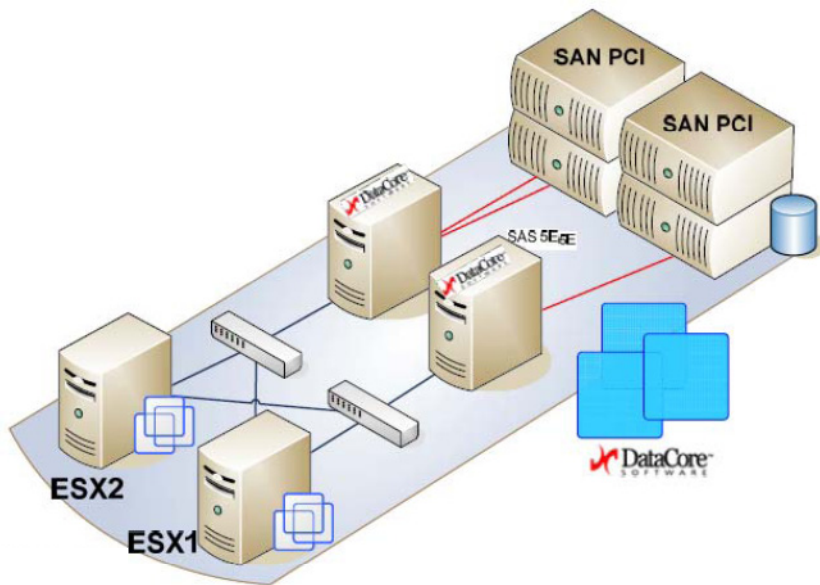
Physical Architecture:  
- 15 hi-perf servers  
- 100 TB disk space



# Hardware architecture



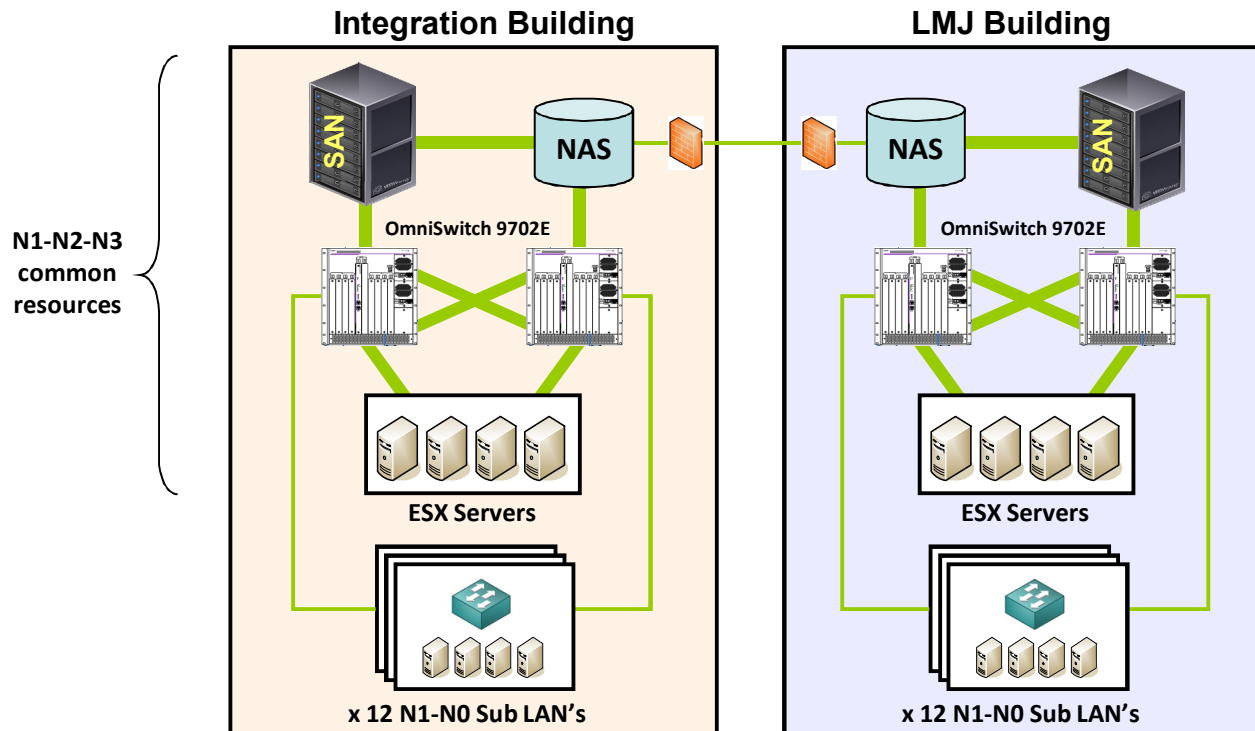
- Each PFI & PCI platform consists of two virtualization infrastructures composed of:
  - 2 DataCore servers, each one managing 12 To of disks,
  - 2 ESX Dell PowerEdge R815 servers, with 4x12 cores and 128 Go of RAM,
  - 1 VCenter Server to manage the VMware infrastructure.



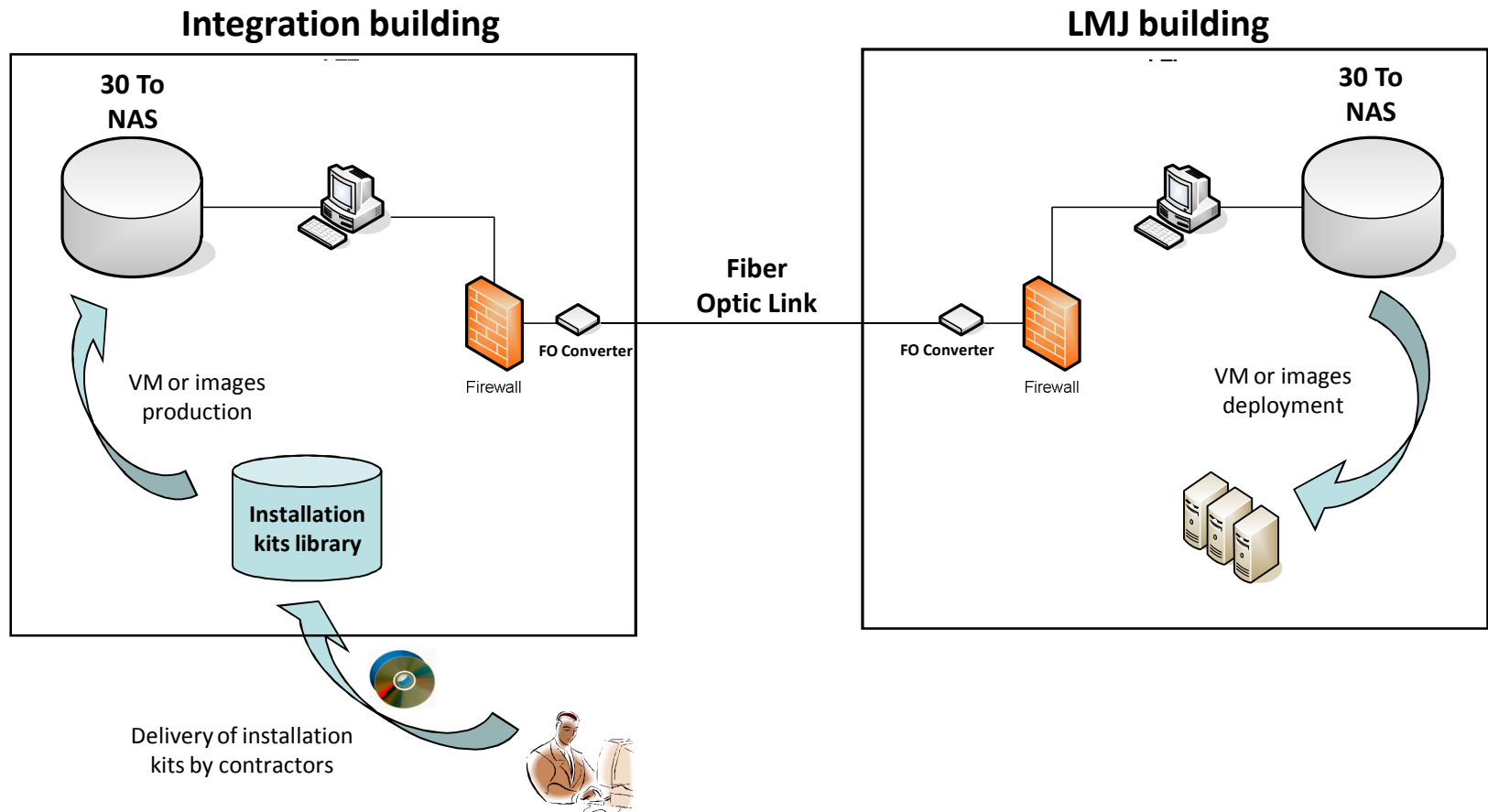
# Network architecture



- Two LAN's will be installed: one for the integration building, one for the LMJ building
- Each one's backbone is constituted of 2 redundant Alcatel Lucent OmniSwitch 9702E chassis federating N0-N1 sub LAN's and N1-N2-N3 layers common resources

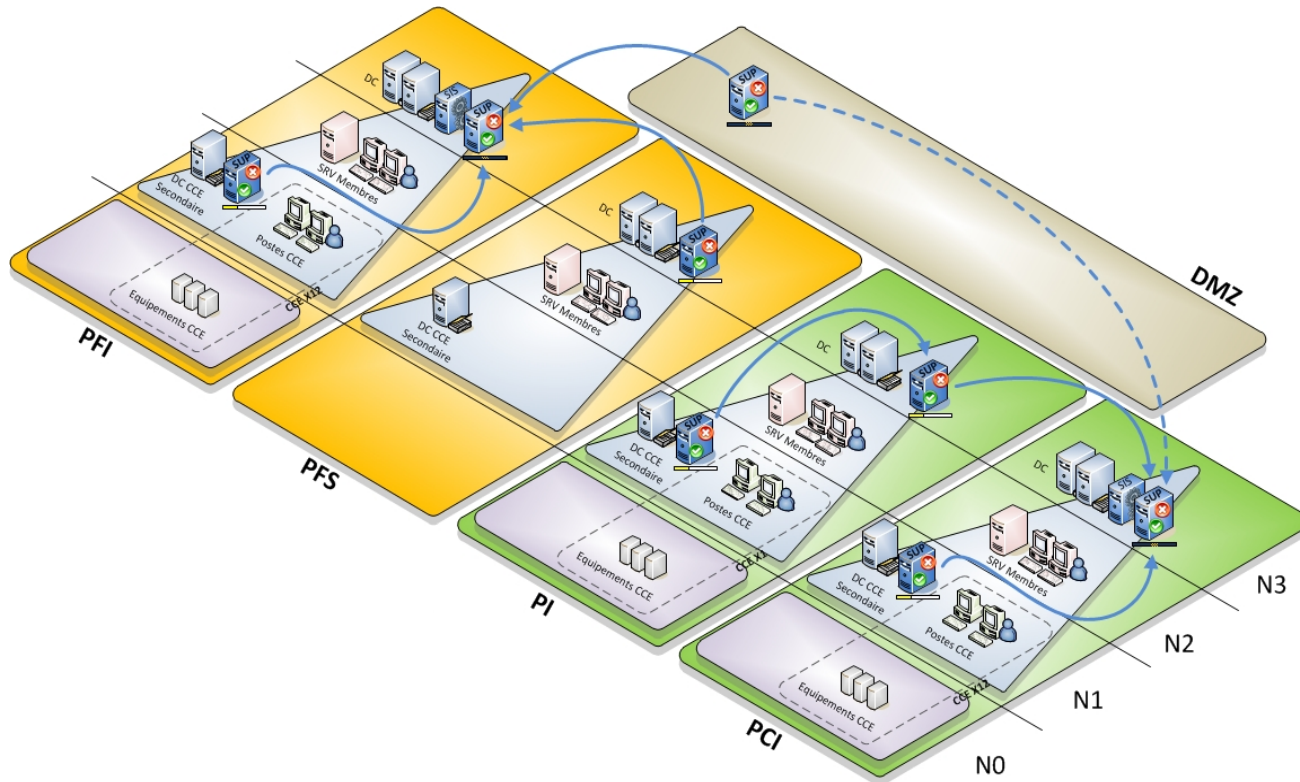


# Software configuration management



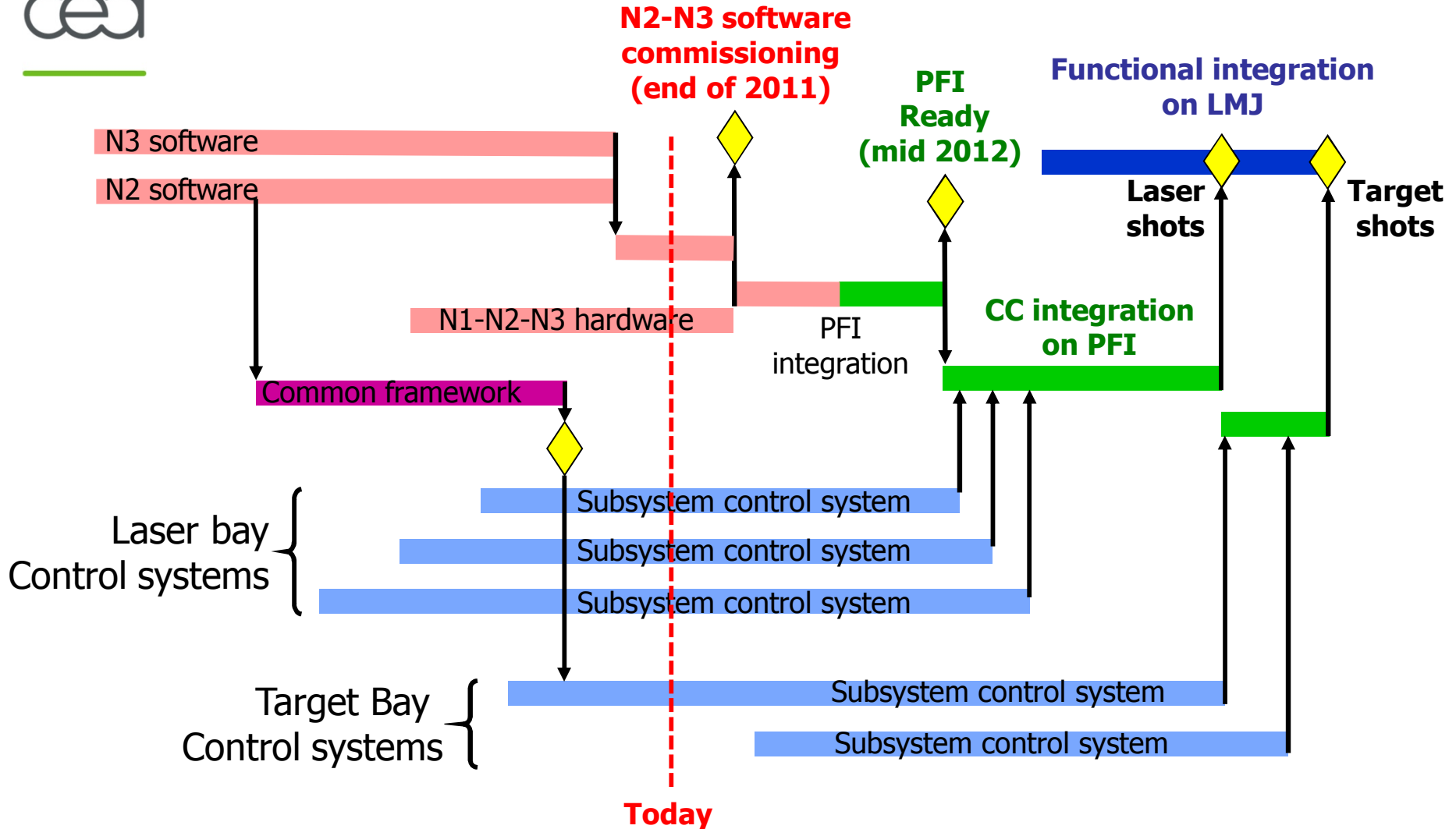
# VRF contexts

- Virtual independent contexts are configured using Virtual Routing and Forwarding technologies (VRF) to allow different test or operational contexts to be operated at the same time





# Control system milestones





Thank you for your attention