Maintaining and improving the control and safety systems for the Electromagnetic Calorimeter of the CMS experiment

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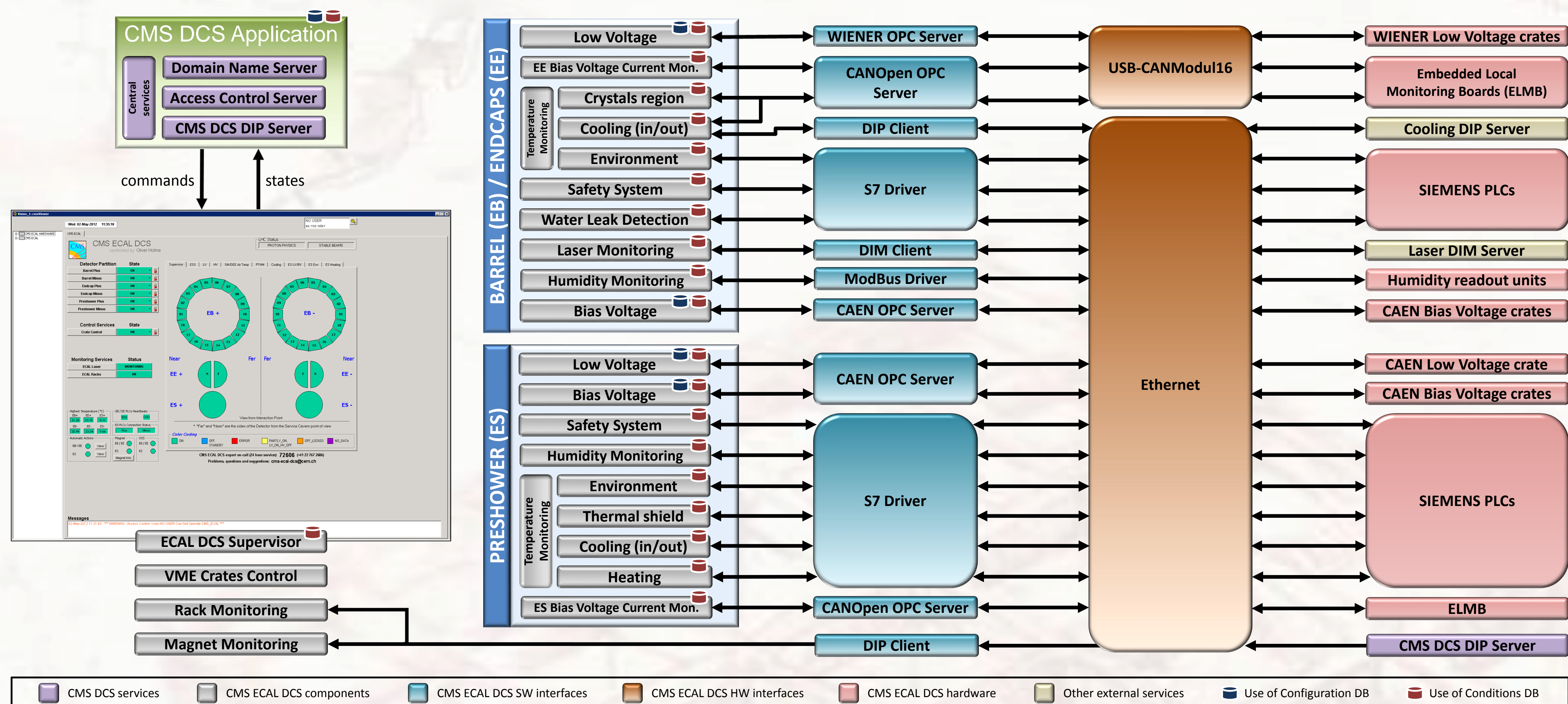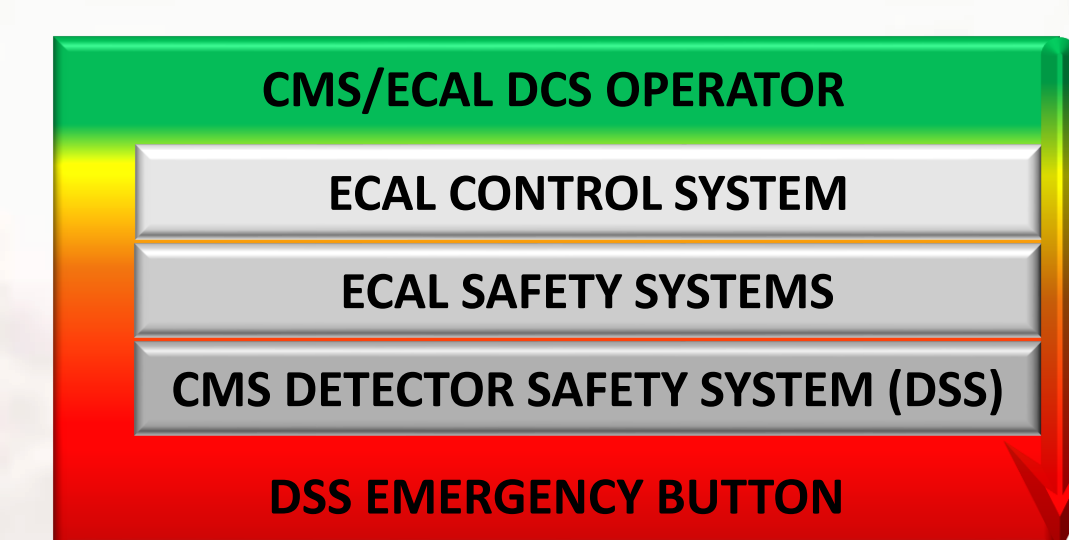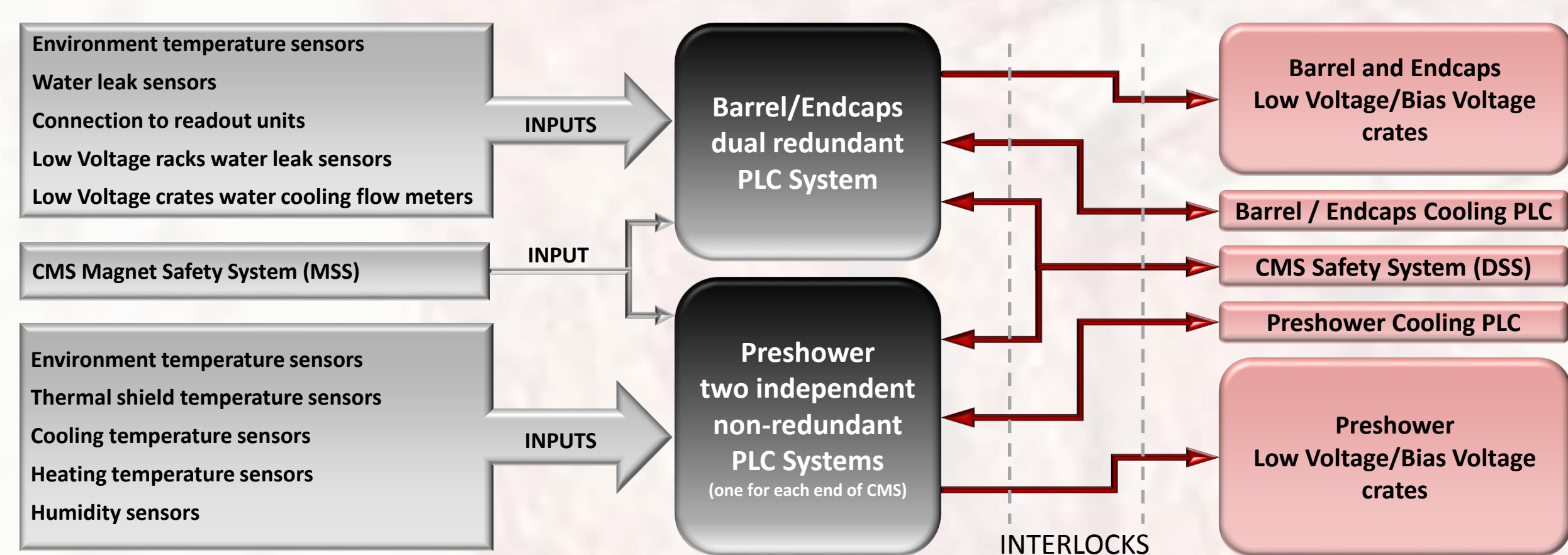*On behalf of the CMS ECAL group*

The ECAL Detector Control System (DCS) architecture

- ✓ Based on WinCC Open Architecture (formerly PVSS)
- ✓ Uses Joint COntrols Project (JCOP) and CMS frameworks
- ✓ 3-role access control (MONITOR / OPERATOR / EXPERT)
- ✓ CMS (global) and ECAL (local) operation modes
- ✓ Unified fully automated software installation mechanism
- ✓ Applications archive and retrieve data from central DBs
- ✓ In the process of achieving fully homogeneous software
- ✓ Upgraded in-line with new technologies
- ✓ 24/7 two-level on-call service (OPERATOR / EXPERT)
- ✓ Protective actions in both control and safety layers

CMS/ECAL DCS OPERATOR
ECAL CONTROL SYSTEM
ECAL SAFETY SYSTEMS
CMS DETECTOR SAFETY SYSTEM (DSS)
DSS EMERGENCY BUTTON

Legend: CMS DCS services | CMS ECAL DCS components | CMS ECAL DCS SW interfaces | CMS ECAL DCS HW interfaces | CMS ECAL DCS hardware | Other external services | Use of Configuration DB | Use of Conditions DB

The ECAL Safety Systems architecture

- ✓ Two separate systems for Barrel/Endcaps and Preshower
- ✓ Both based on SIEMENS PLC Systems
- ✓ Failsafe hardwired interlocks based on critical inputs
- ✓ Protection to prevent users from setting unsafe thresholds
- ✓ Preventive maintenance performed regularly
- ✓ Annual interlock tests for full system verification
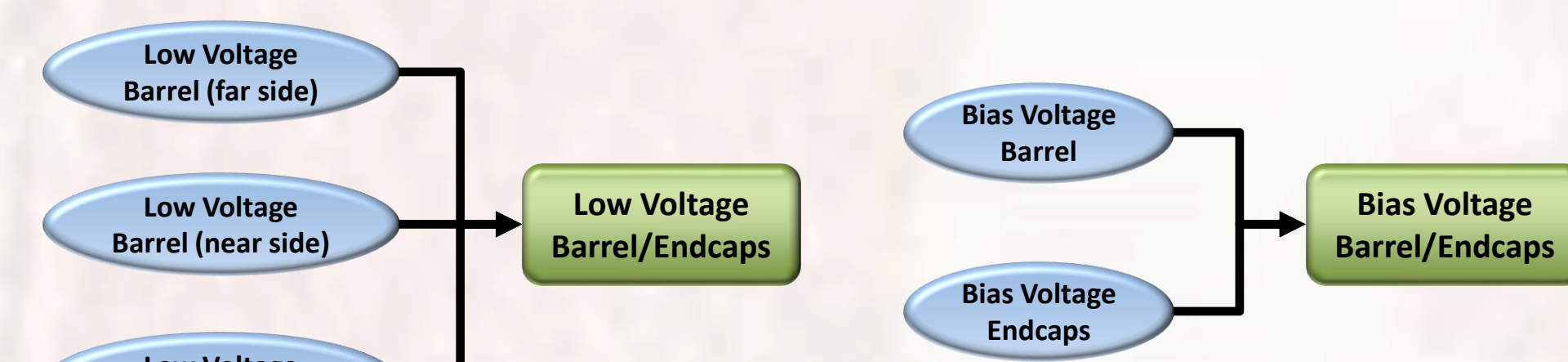- ✓ No downtime during LHC runs

Software improvements

Optimization of the WinCC OA code structure

- No duplicated code
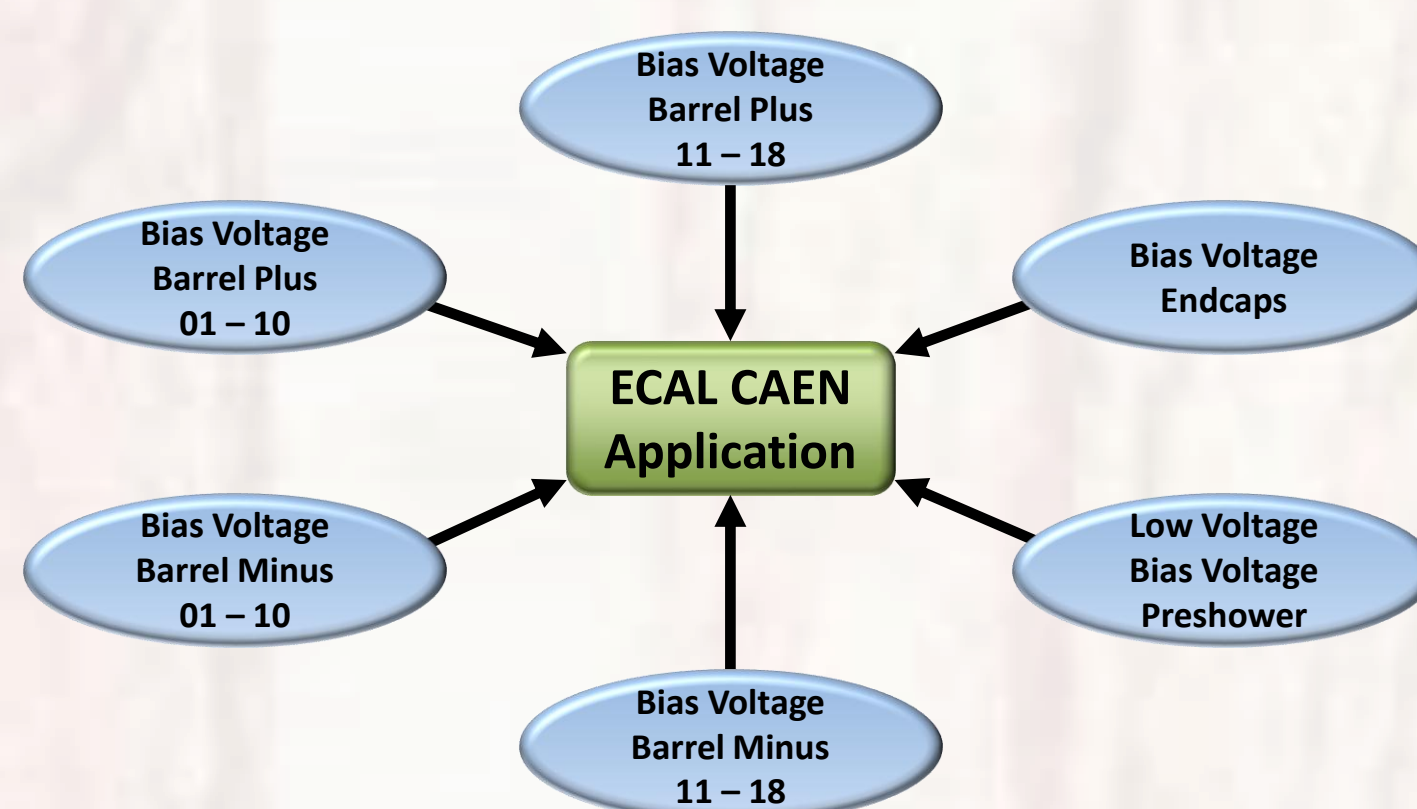- Containing duplicated code
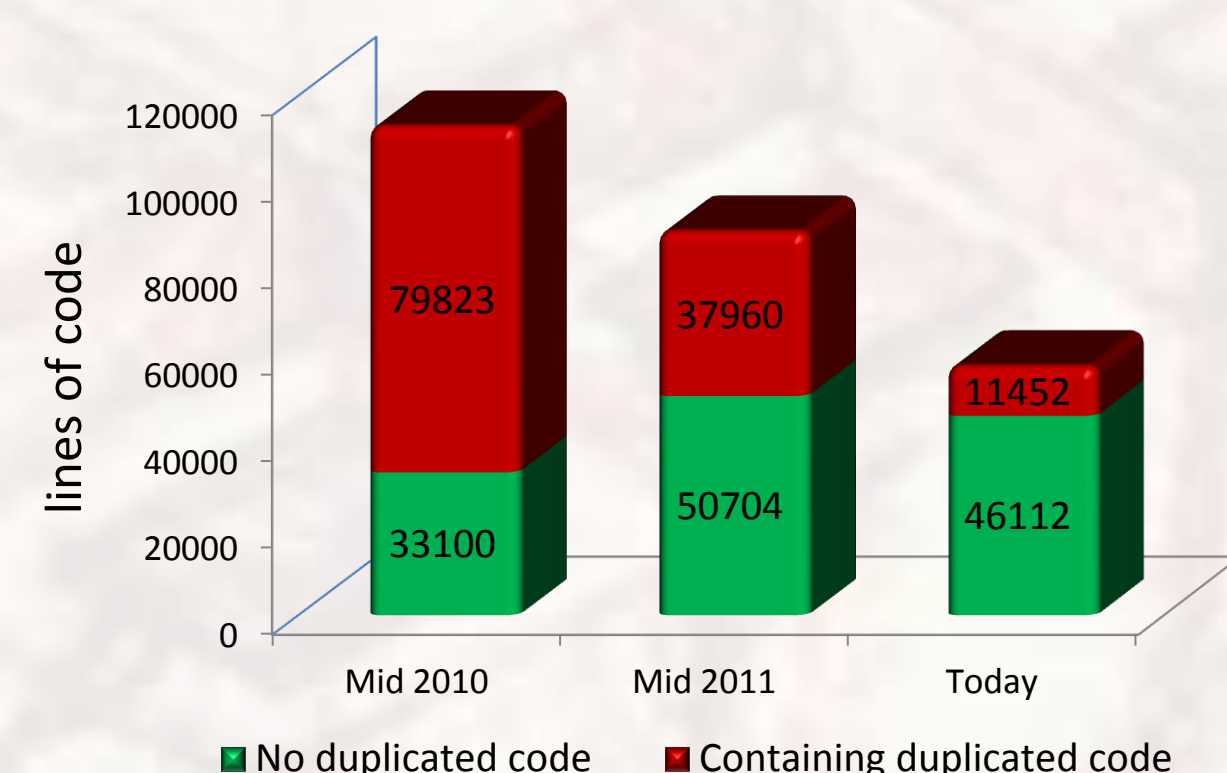
Examples of application merging
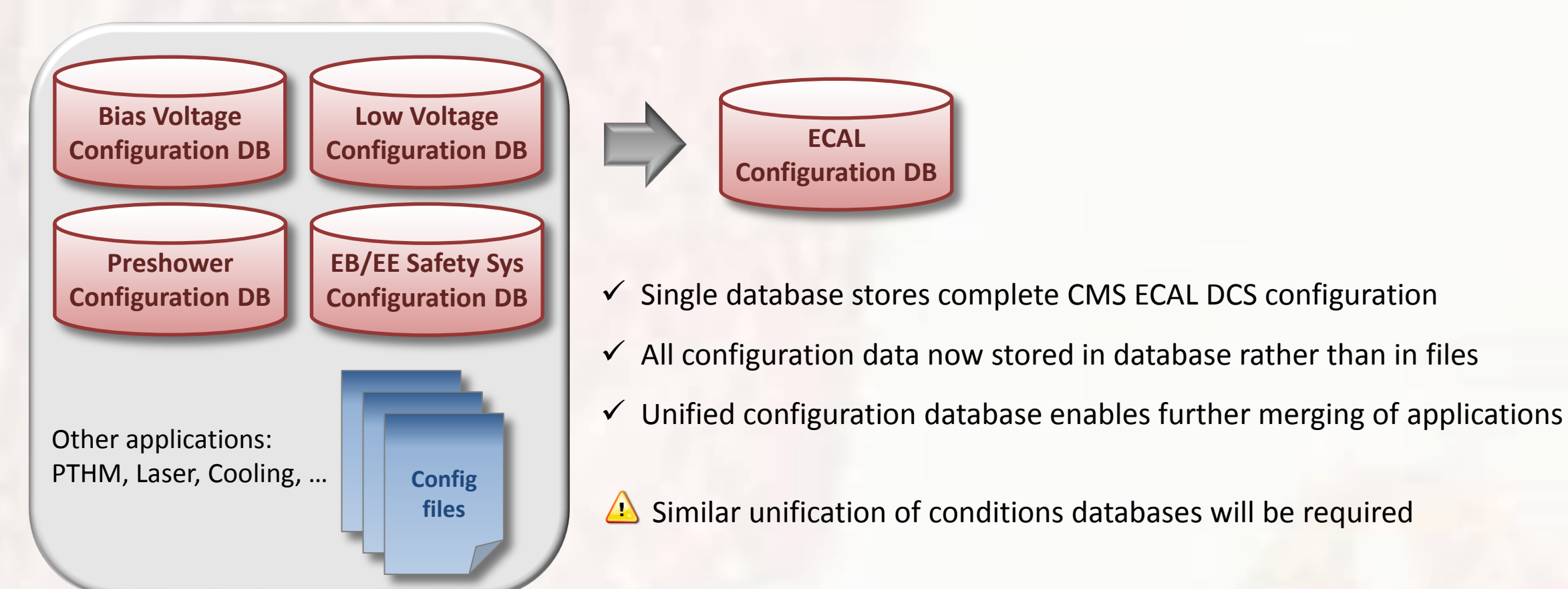(mandatory for the computers upgrade)

In terms of components

In terms of computers
(to be deployed in Dec 2012)

In terms of configuration databases

- ✓ Single database stores complete CMS ECAL DCS configuration
- ✓ All configuration data now stored in database rather than in files
- ✓ Unified configuration database enables further merging of applications
- ⚠ Similar unification of conditions databases will be required

Other applications: PTHM, Laser, Cooling, …

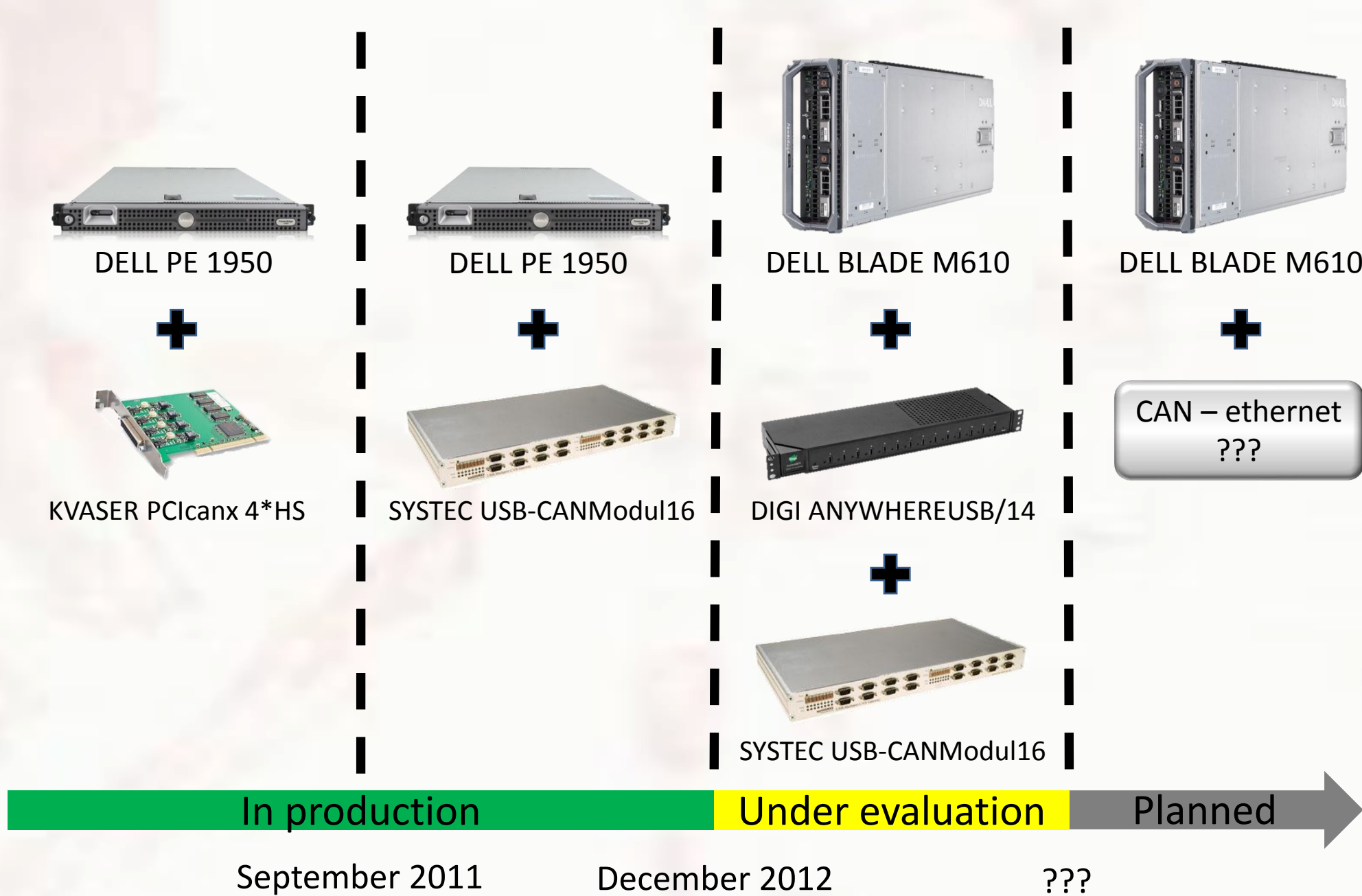## Upgrade of the ECAL DCS computers
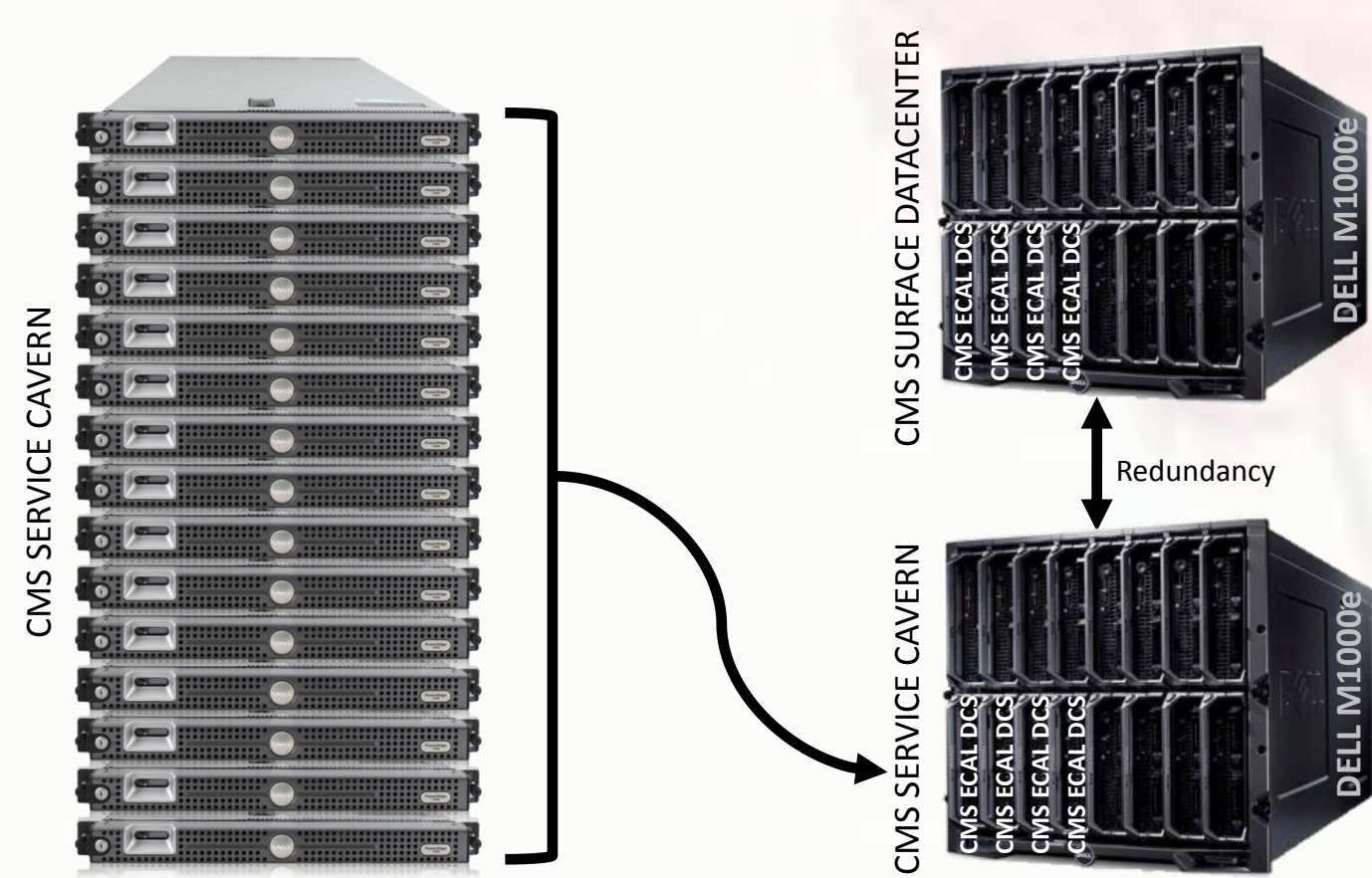
- ✓ Number of machines reduced from 15 DELL PE1950 to 4 DELL M610
- ✓ Room for implementation of a redundant WinCC OA configuration
- ✓ CPU and Memory limitations overcome by powerful servers hardware
- ✓ Software components to be merged onto fewer computers
- ✓ Mandatory move of hardware connections to ethernet

Upgrade of the EB/EE Humidity Monitoring System

Precision Temperature and Humidity Monitoring (PTHM)
Precision Temperature Monitoring (PTM)
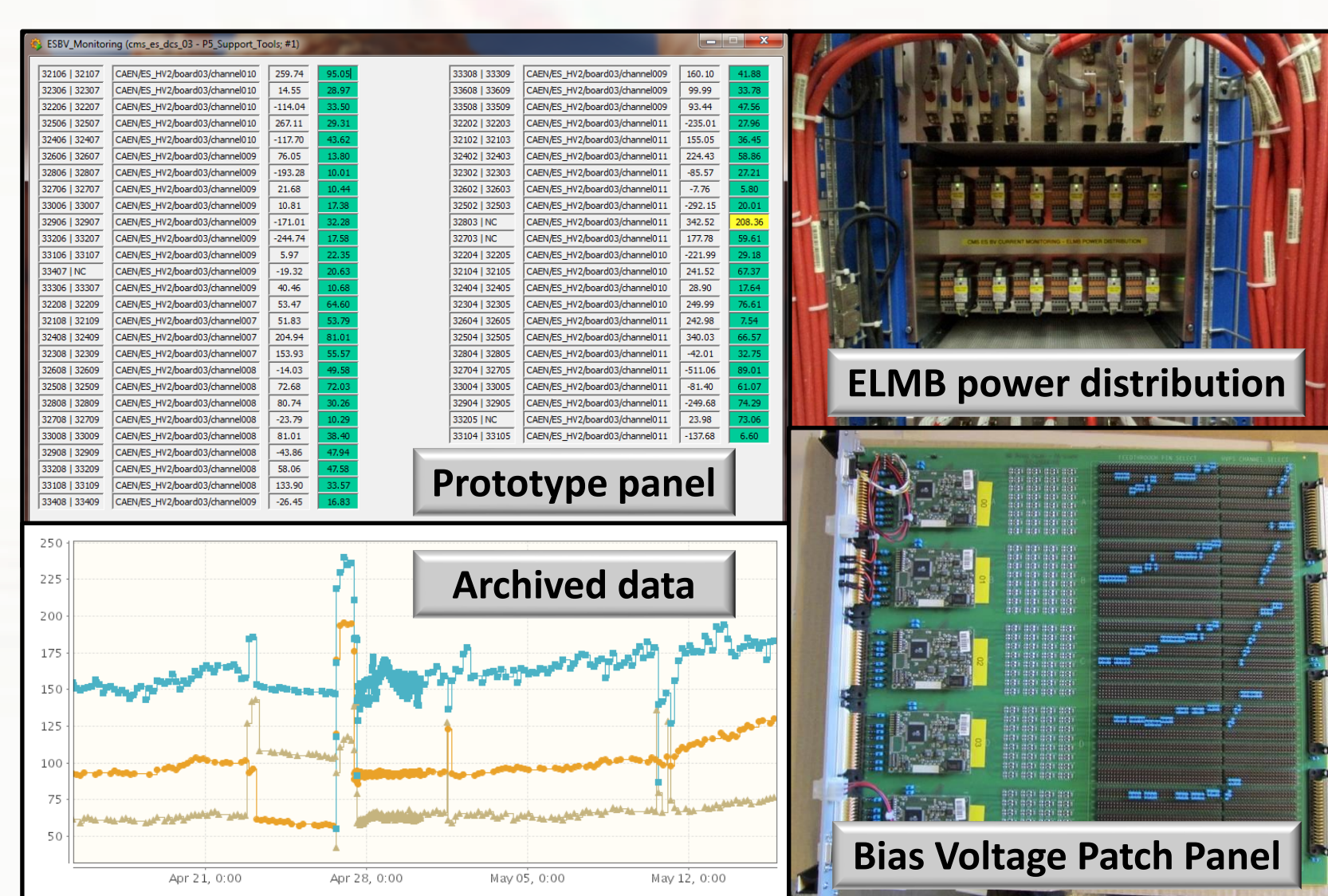Humidity Monitoring (HM)
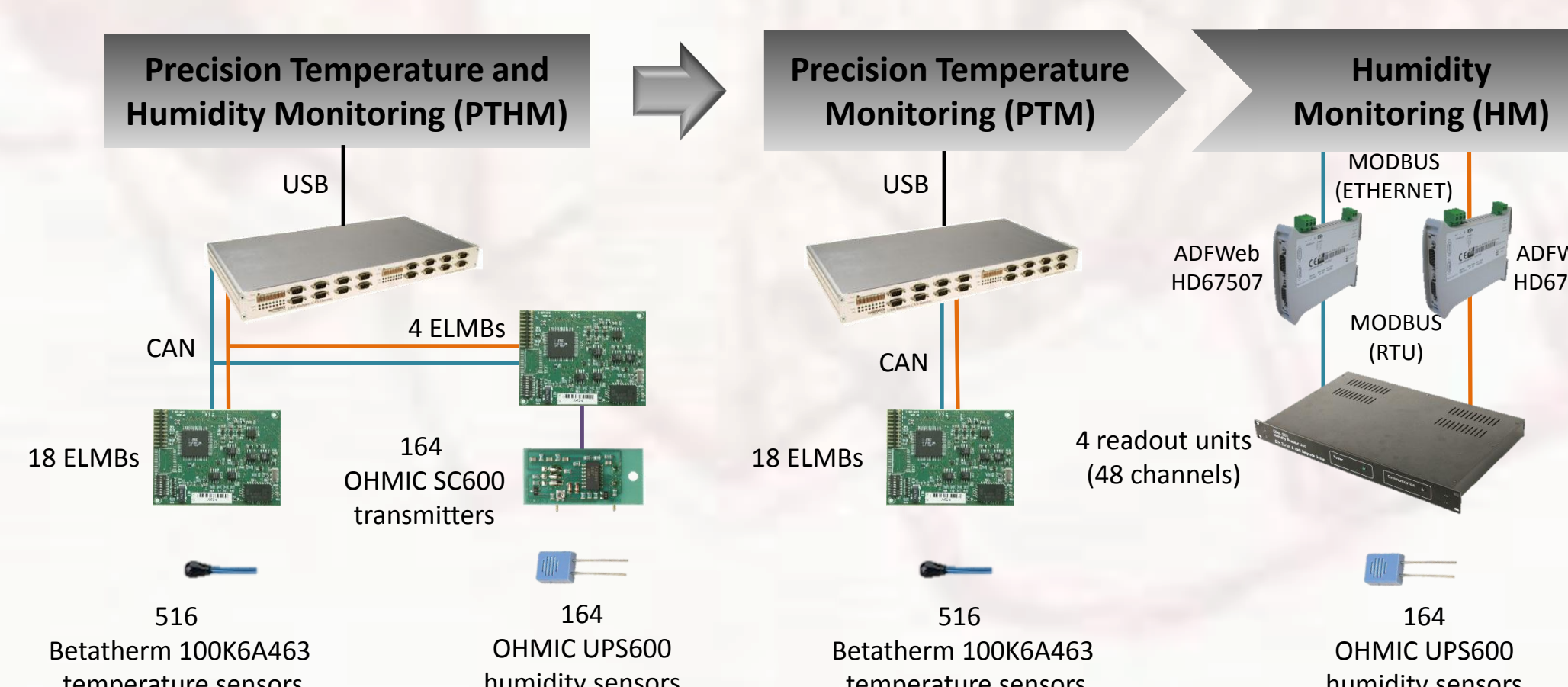
- ✓ New units designed and produced by the CMS Belgrade group
- ✓ Low frequency excitation overcomes the capacitance issue of long cabling
- ✓ Humidity readout range extended to 10 – 80% (previously ~60 – 80%)
- ✓ Modbus protocol over TCP used to ease the integration with WinCC OA
- ✓ One readout unit installed and successfully verified in the CMS environment
- ✓ Individual readout channels to be calibrated prior to final installation at CMS

Evolution of hardware interfaces

DELL PE 1950 + KVASER PCIcanx 4*HS
DELL PE 1950 + SYSTEC USB-CANModul16
DELL BLADE M610 + DIGI ANYWHEREUSB/14 + SYSTEC USB-CANModul16
DELL BLADE M610 + CAN – ethernet ???

In production — Under evaluation — Planned
September 2011 — December 2012 — ???

Preshower Bias Voltages current monitoring

ELMB power distribution
Prototype panel
Archived data
Bias Voltage Patch Panel

- ✓ Largest ELMB-based system in ECAL (80 ELMBs)
- ✓ Currents readout based on simple resistor networks
- ✓ Monitors currents of 2216 individual bias voltage lines
- ✓ Archiving on significant changes and on-time to the Conditions Database
- ✓ Important tool for understanding individual sources of current increases
- ✓ Successfully deployed and fully operational
- ✓ Requires further calibration and verification