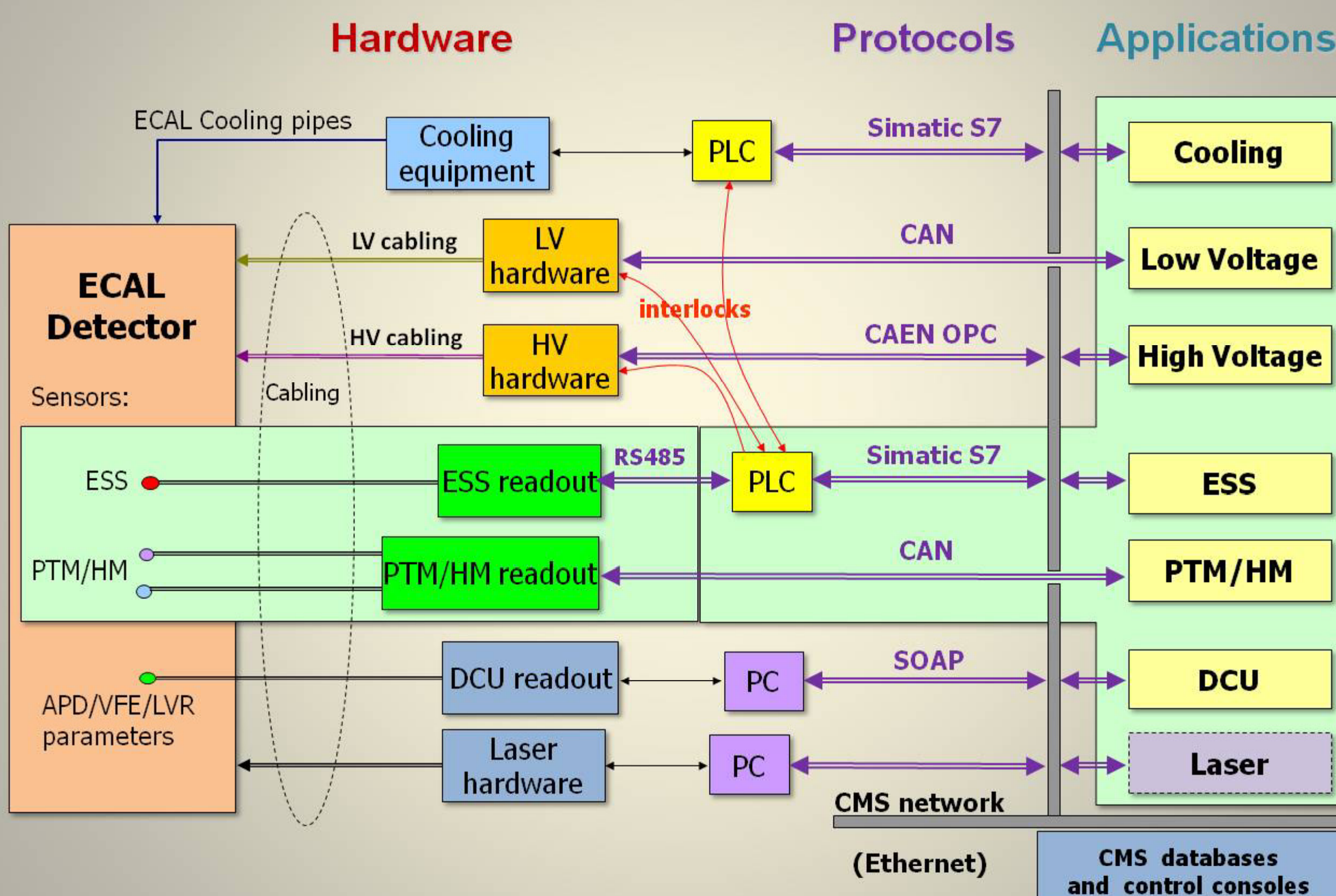


P. Adzic¹, A. Brett², F. Cavallari³, D. Di Calafiori², E. Di Marco³, G. Dissertori², R. Gomez-Reino⁴, A. Inyakin⁵, D. Jovanovic^{6,1}, G. Leshev², P. Milenovic^{2,1}, X. Pons⁴, T. Punz², J. Puzovic^{6,1}, S.Zelepoukine^{7,2}

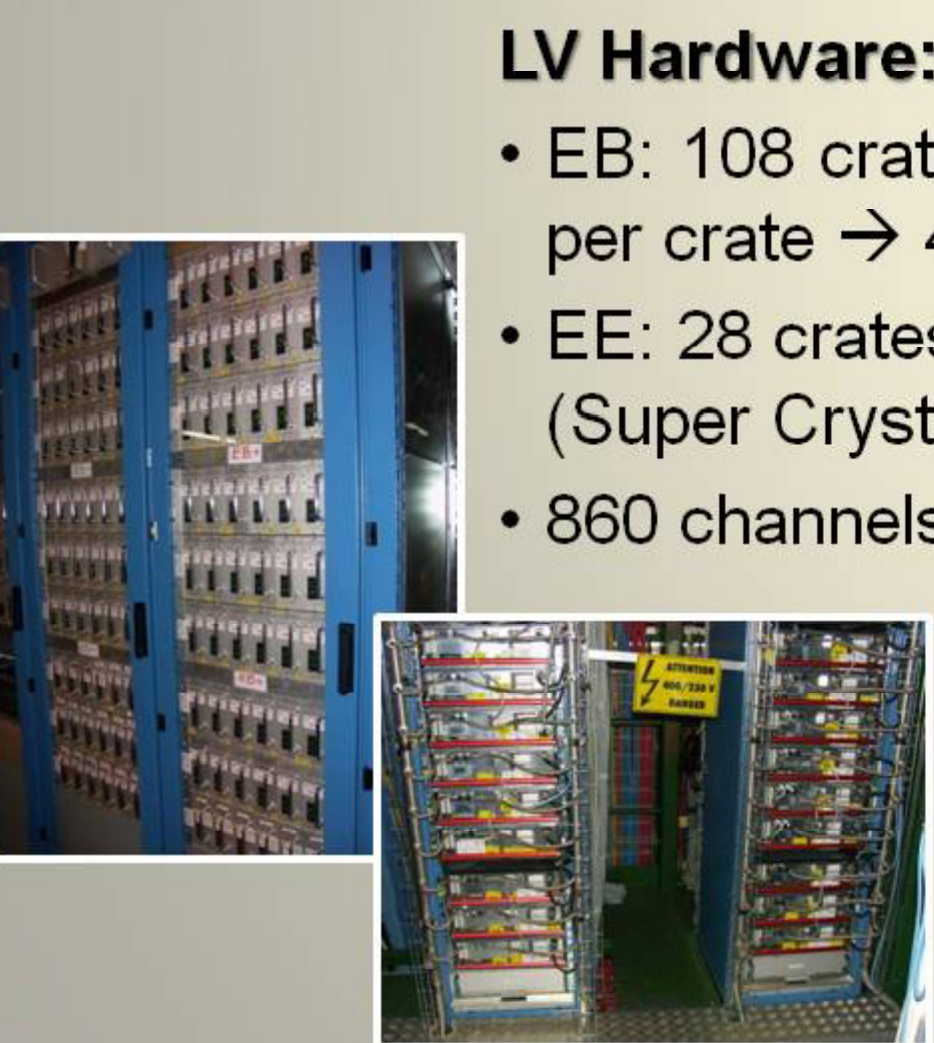
CMS ECAL DCS layout



ECAL LV

LV PVSS application:

- Fully implemented to support the detector
- Running on 3 PCs, 2 PCs for EB, 1 for EE (to reduce CPU load)
- Controls WIENER crates
- Configures output voltage set points with SM / Dee granularity
- Troubleshooting and monitoring of WIENER hardware



LV Hardware:

- EB: 108 crates → 3 crates per SM (Super Module) → 6(7) channels per crate → 4 TT (Trigger Towers) per channel
- EE: 28 crates → 7 crates per Dee → 6(7) channels per crate → 4 SC (Super Crystal) per channel
- 860 channels in total → EB: 684, EE: 176

Statistics on solved problems:

- 1 OPFC power bin failure
- 14 OPFC units failures
- 5 MARATON power bin failures
- 19 MARATON power units failures



ECAL Supervisor

ECAL Supervisor application:

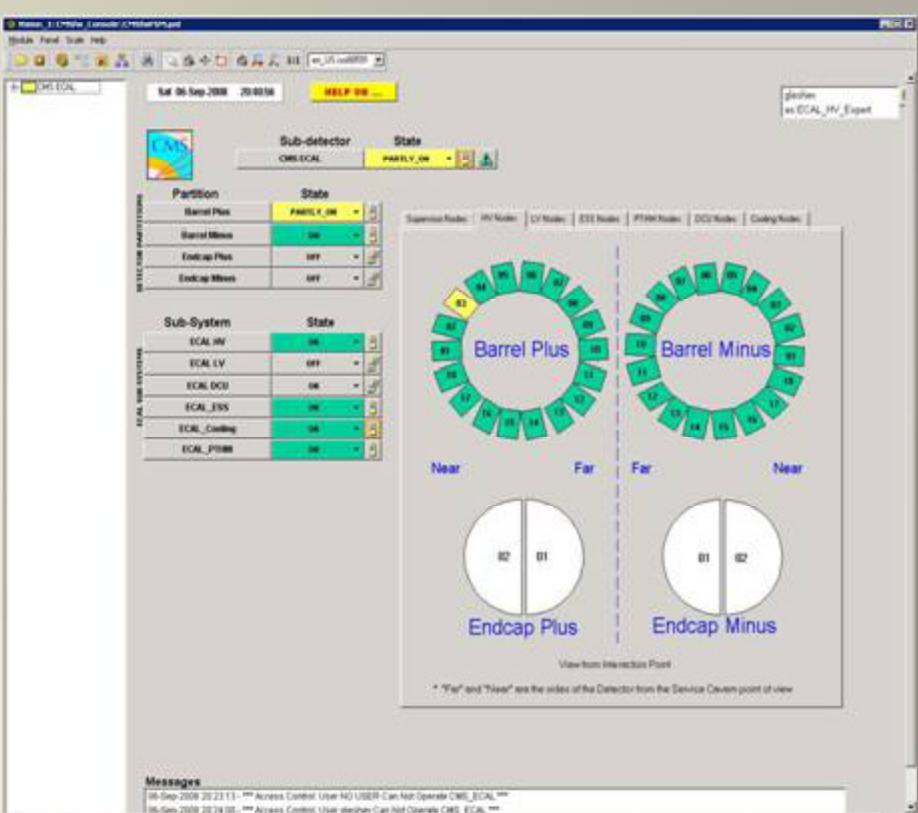
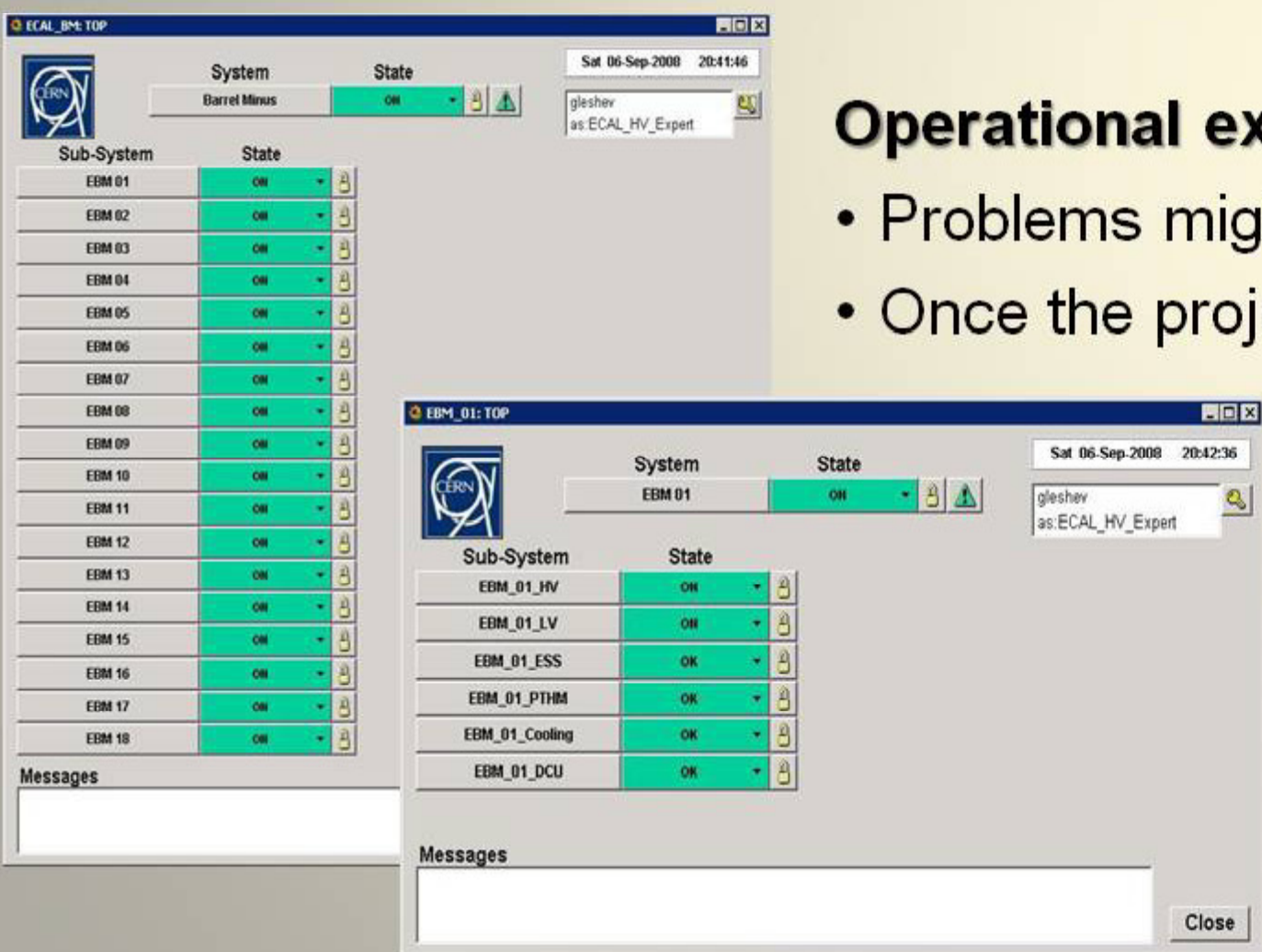
- Summarizes the status of all ECAL DCS subsystems
- Implemented as a Finite State Machine (FSM) using JCOP FSM component
- Updates with new features and improvements released regularly

Operational experience:

- Problems might occur during new installations
- Once the project is running it is completely stable

Main issue:

- Work ongoing to understand stability issues of JCOP fw FSM



ECAL DCU

DCU System:

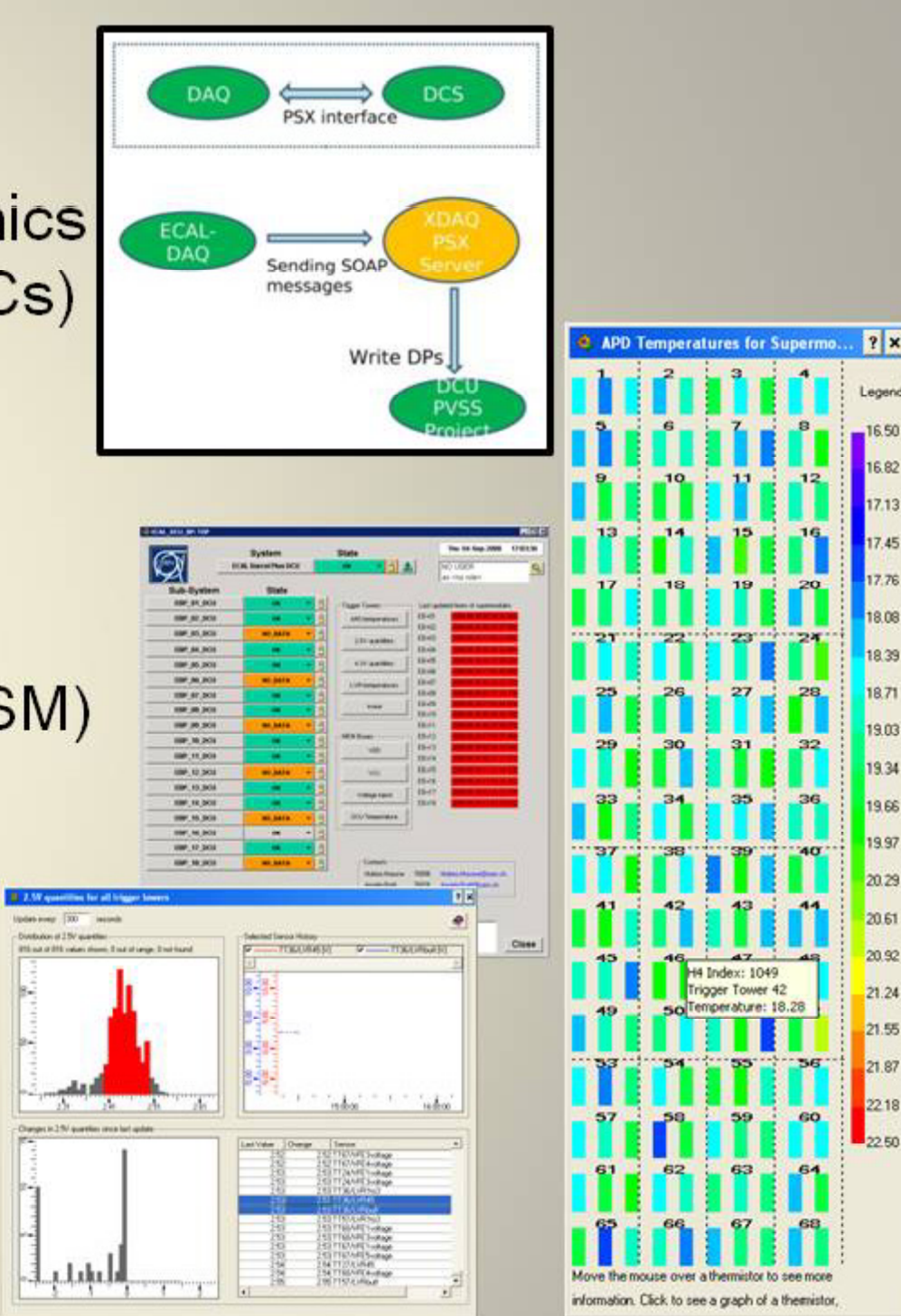
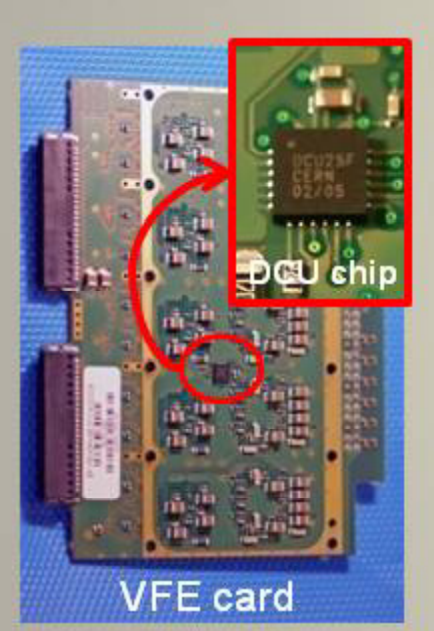
- Monitors APD parameters, VFE and FE electronics
- Chips located inside SM, accessible via the off detector electronics (token rings through the CCS boards, controlled by ECAL DAQ PCs)
- Connection from XDAQ to DCS via the PSX SOAP service

Information provided by DCU chips:

- APD currents (1 value for crystal = 1700/SM)
- APD temperatures (1 value every 10 crystal = 170/SM)
- DCU chips internal temperatures (8x68 = 544/SM)
- MEM boxes parameters (10 quantities/SM)
- LVR voltage settings and LVR card temperatures (18x68=1224 values / SM)
- Data sent to PVSS with low level filtering (comparison of old and new values)

Operational experience:

- All issues solved during commissioning



ECAL Cooling Control

Software:

- Siemens PLC control connected to PVSS Cooling Supervisor
- Designed and implemented through the UNICOS fw, developed by CERN
- Regulation tuned +/-0.02C, at the detector input
- Running since 1 year

Hardware:

- 72 pneumatic valves, 45 temperature sensors PT100, 42 flow meters reading in magnetic field and radiation environment
- 150 kW heater powered by thyristors controlled by PID + PWM regulation
- Failsafe Hardware interlock connection to ESS by SM
- Cooling PLC monitored by ESS (watch-dog)

Main issues:

- Power cuts (UPS not installed)
- Connection to DCS Cooling Monitoring System (work ongoing)



ECAL PTM/HM

PTM/HM application:

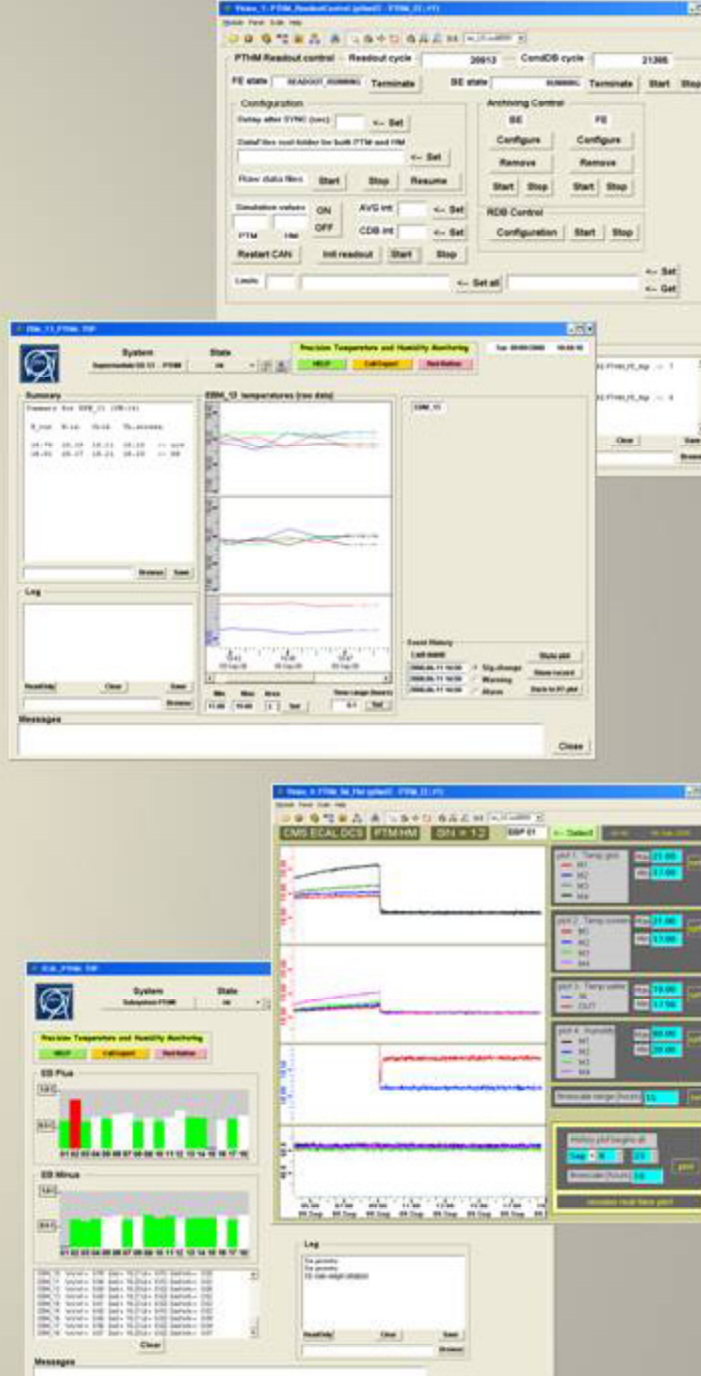
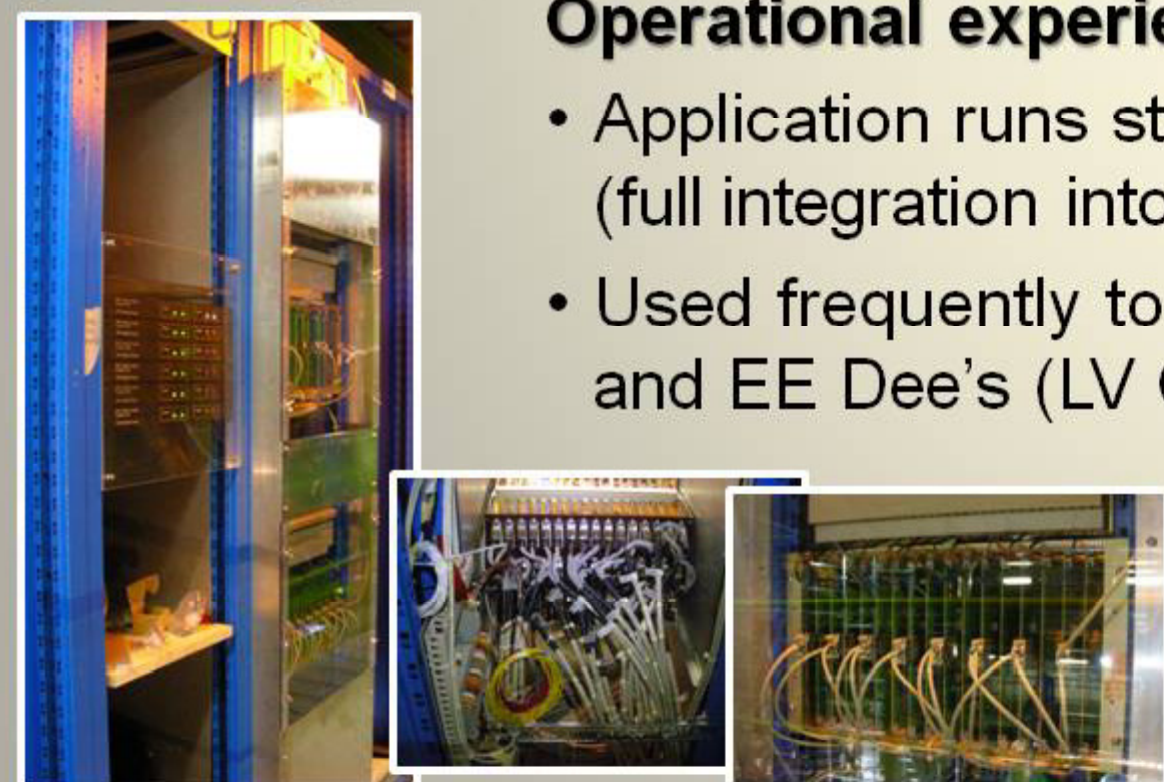
- Monitors temperatures and humidity in ECAL detector (relative temp. measurement precision is ~0.01C – in order to monitor the ECAL cooling system and provide precise information for physics data processing)
- Has its own readout chain (probes/electronics/cabling/computing) separate from ECAL DAQ readout – provides non-stop monitoring even in CMS shutdowns
- Generates warning/alarm indications to ECAL Supervisor to shutdown LV/HV in case of over-temperature or high humidity conditions (SM/Dee granularity)

Operational experience:

- Application runs stable since the very beginning in P5 (full integration into CMS DCS ongoing)
- Used frequently to verify the actual status of EB SMs and EE Dee's (LV ON/OFF)

Issues to be solved:

- Integration to CMS DCS
- Migration to the CMS Cond-DB
- More services for equipment troubleshooting



ECAL HV

HV PVSS application:

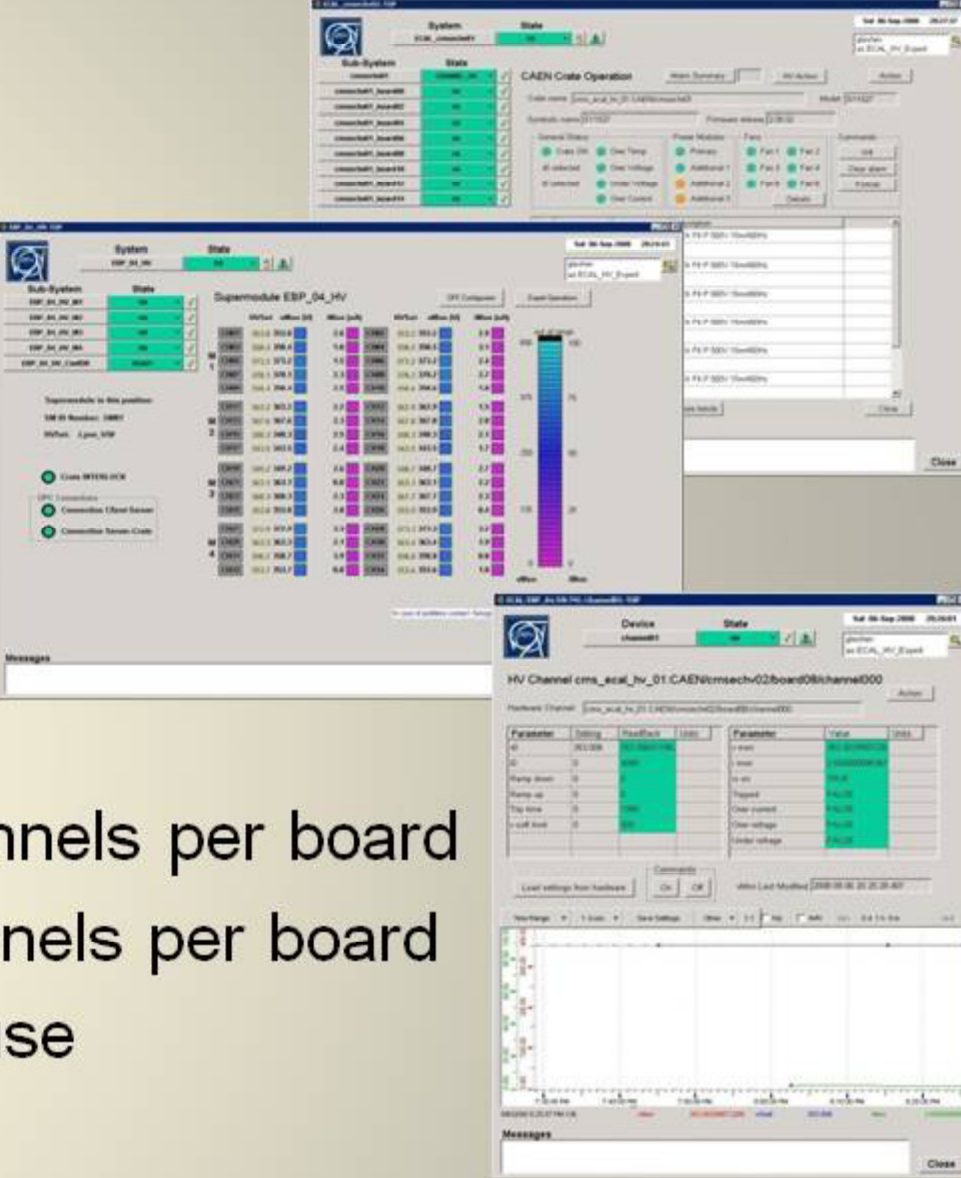
- Fully implemented to support the detector
- Running on 4 PCs (to reduce CPU load)
- Controls CAEN crates - switches ON/OFF specific set of channels
- Configures output voltage setpoints with SM / Dee granularity
- Troubleshooting and monitoring of CAEN hardware

HV Hardware:

- EB: 18 crates → 8 boards per crate → 9 channels per board
- EE: 2 crates → 2 boards per crate → 4 channels per board
- 1312 channels in total → 1240 channels in use

Main issue → Power cuts:

- Up to 10 channels not working after an event
- 50% of affected channels are repairable
- 0.2 to 0.5% of unrecoverable channels
- All repairs realized without delaying operations



ECAL Safety System

ESS functionalities:

- Full autonomy of the system
- Temp. monitoring of ECAL electronics (precision <0.1°C)
- Detection of water leak (WLD) inside ECAL and LV racks
- Radiation tolerance according to specifications
- Reliable hardware interlocks and control signals to / from:
 - HV crates
 - MSS
 - Cooling system
 - LV crates
 - DSS
 - Operator and Experts

Operational experiences:

- DSS alarm events – ESS takes correct actions by shutting down safely all ECAL subsystems
- 100% of correct actions on all alarms signals

Main issue:

- Two Siemens communication modules CP 341 defective during commissioning (under investigation)

