TUPV025

Control System of Upgraded High Voltage for ATLAS Tile Calorimeter

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Tile Calorimeter

- ATLAS hadronic calorimeter
- Uses scintillating tiles as active material read out by Wavelength-Shifting (WLS) optical fibers
- 10 000 Photomultiplier Tubes (PMTs)

TileCal Phase-2 HV System

- Regulation and distribution system located of detector
- Voltages ranging from 500V to 950V
- HV delivered to the PMTs by 100 m long cables

Crate Controller and software

- System-on-chip
- Python based
- TCP/IP communication

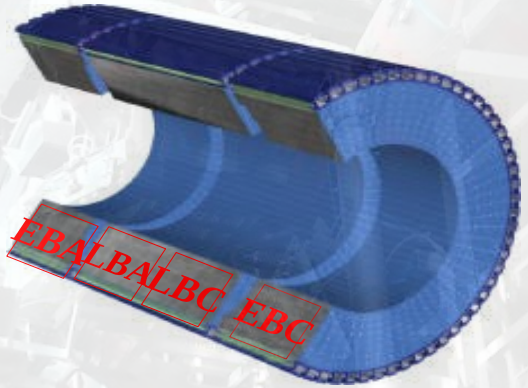
Integration with Detector Control System(DCS)

- Based on a commercial SCADA tool
- DCS handles periodic queries and the commands
- Data archiving and user interfaces

Tile Calorimeter

- Composed 3 barrels, organized in 4 partitions EBA, LBA, LBC, EBC
- Each partition is divided in 64 radial modules
- Each module has its own Front-End electronics mounted In drawers

Barrel view of Tile Calorimeter

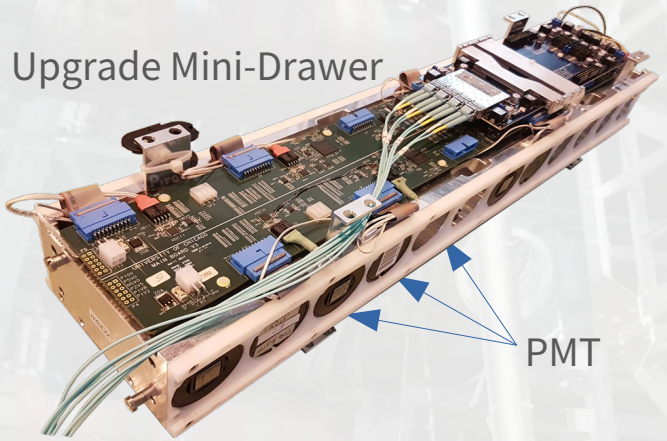


Front-end Electronics Upgrade for HL-LHC

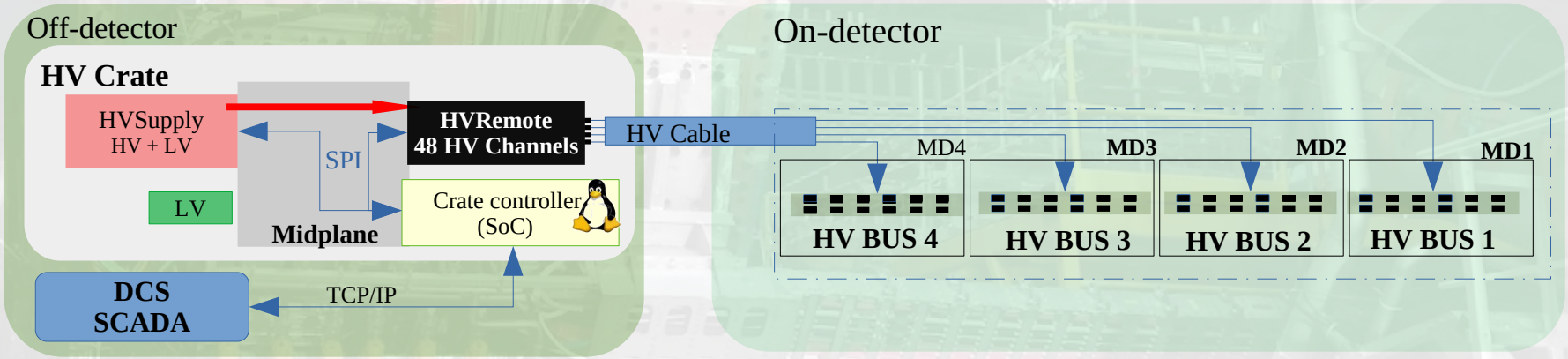
Installed in Mini-Drawers, with independent:

- Data acquisition system
- Redundant Low Voltage power
- High Voltage power

Upgrade Mini-Drawer



Upgrade HV System

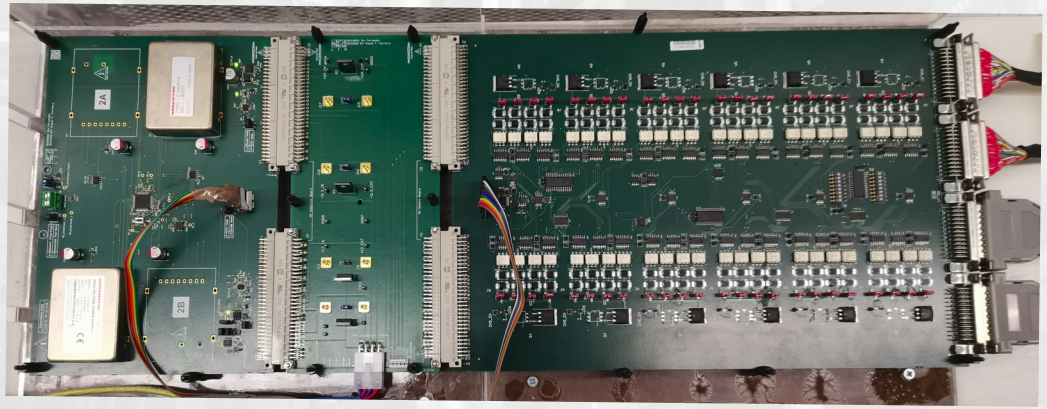


TileCal Phase 2 HV System

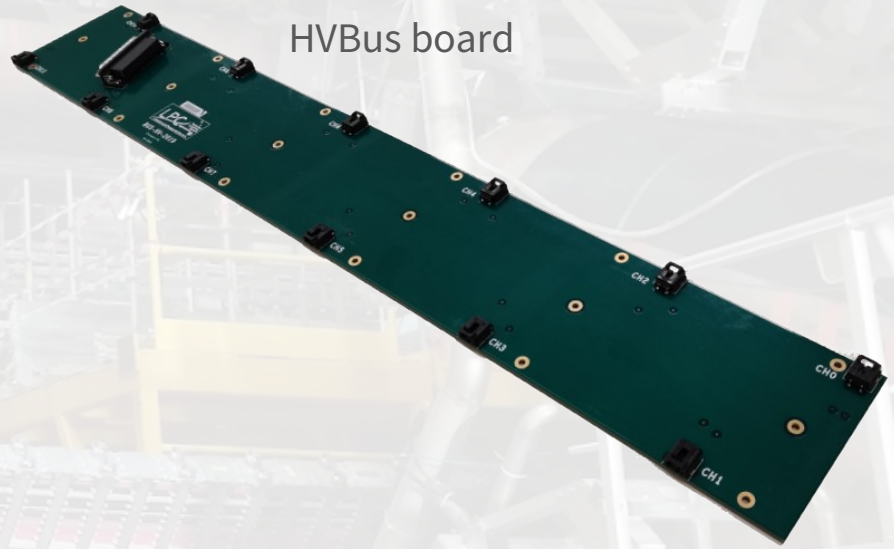
The HV system for HL-LHC consists of HV crates located in the off-detector area, with the HV being delivered to each PMT by 100m long cables

- HVSupply
  - Provides the DC HV and low DC voltages to the HVRemote board
  - Supplied by two DC/DC converters with a maximum output current of 20mA and regulated voltages up to -1kV
  - Digital control and monitoring by dedicated SPI bus
- HVRemote
  - Composed of 48 individual HV channels
  - Programmable voltages in range of -500V to -950V
  - Enabling and disabling of output HV available by software and hardware
  - Dedicated SPI bus for control and monitoring
- HVBus
  - Root the HV delivered by 100m long cables to each PMT
  - Equipped for 12 PMTs

HVSupply(left) and HVRemote (right)



HVBus board



Crate Control and software

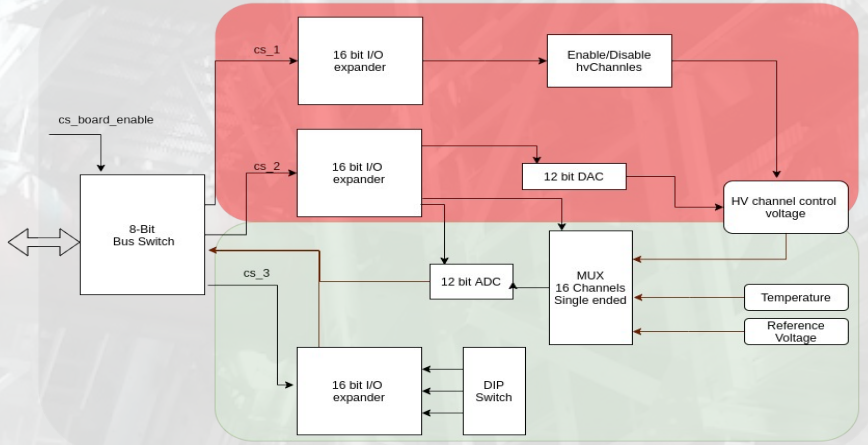
Crate Controller

- Evolution from single board controller to one controller for all boards
  - Reducing the complexity of the system
- Dedicated SPI buses for HVRemote and HVSupply boards

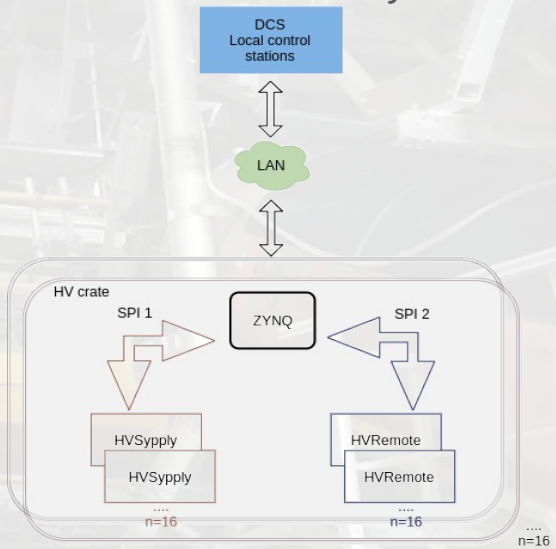
Software

- Written in Python and implements SPI instructions required to operate the control chips
  - Raspberry Pi has been used for tests
- An home-made protocol over TCP/IP sets the communication between the DCS and the controller

Block diagram of the HVRemote control



Architecture of the HV Remote system control tree



Integration with Tilecal DCS

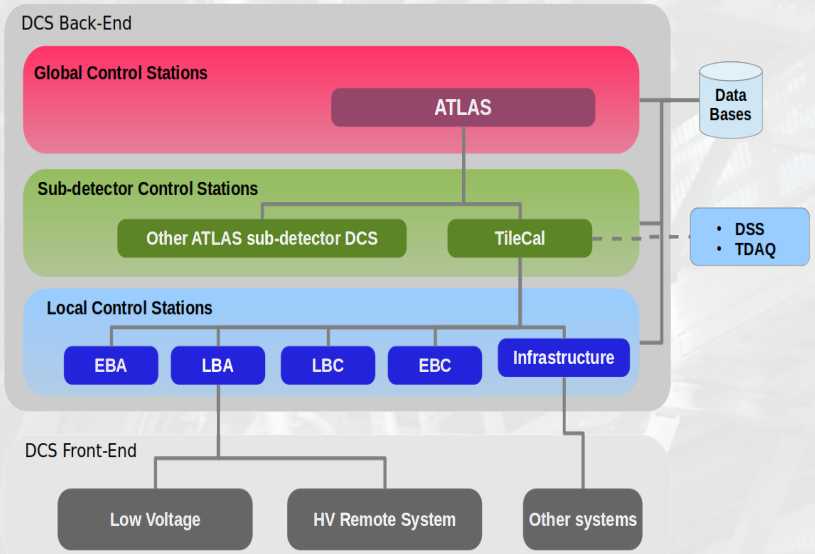
TileCal DCS

- Based on commercial SCADA tool – WinCC OA
- Distributed among two control station layers of ATLAS DCS back-end hierarchy

SCADA component

- HV system will be integrated in the Local Control Stations
- Data structures representing the crate and boards were prepared, containing temperature probes, voltages, etc
- The commands and periodic readings are handled by DCS
- A set of Graphical User Interfaces allows the control and monitoring of the boards
- Smoothing conditions are applied to the archive of monitored data

TileCal DCS hierarchy



Monitoring of HV source