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 off-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
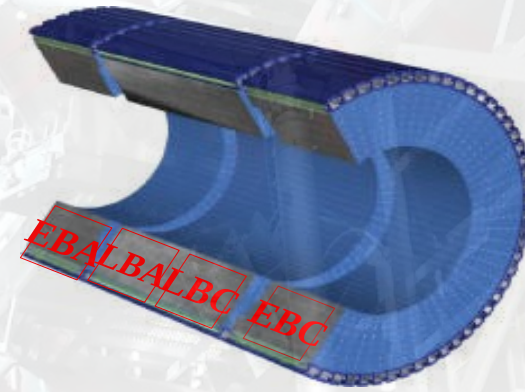- Data archiving and user interfaces

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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
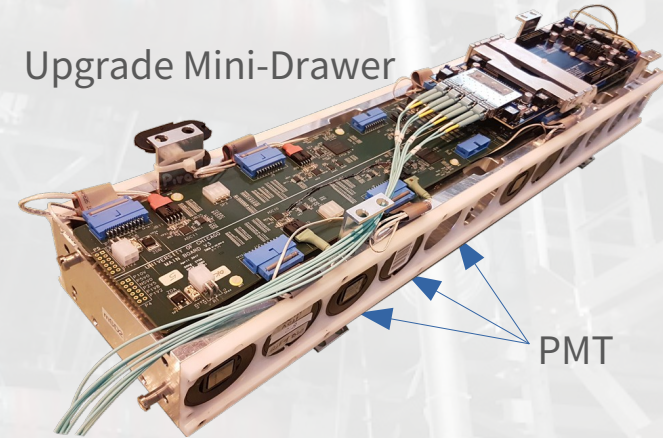
Front-end Electronics Upgrade for HL-LHC

Installed in Mini-Drawers, with independent:

- Data acquisition system
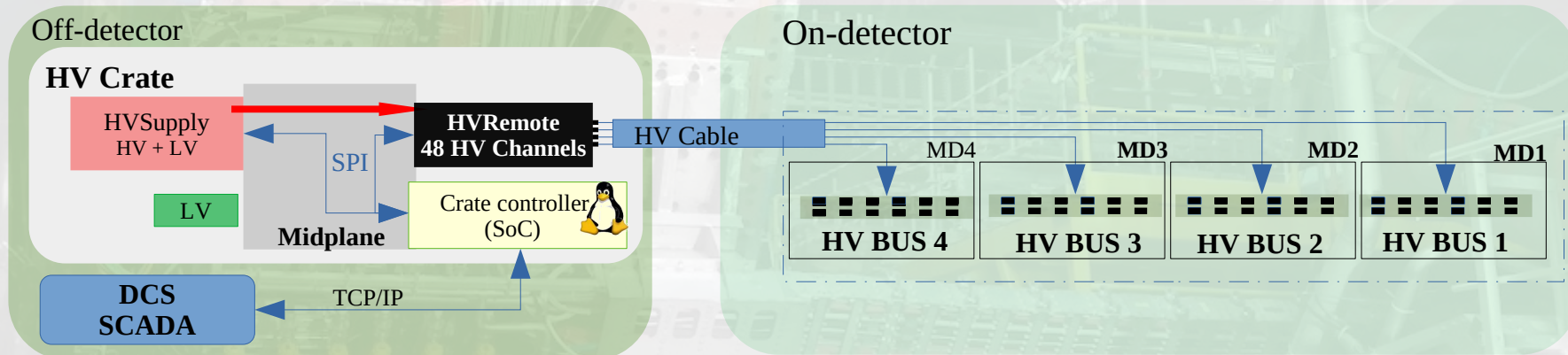
- Redundant Low Voltage power

- High Voltage power

Barrel view of Tile Calorimeter

EBA LBA LBC EBC

Upgrade Mini-Drawer

PMT

Upgrade HV System

Off-detector

HV Crate

HVSupply HV + LV

SPI

LV

Midplane

HVRemote 48 HV Channels

Crate controller (SoC)

DCS SCADA

TCP/IP

On-detector

HV Cable

MD4   MD3   MD2   MD1

HV BUS 4   **HV BUS 3**   **HV BUS 2**   **HV BUS 1**

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
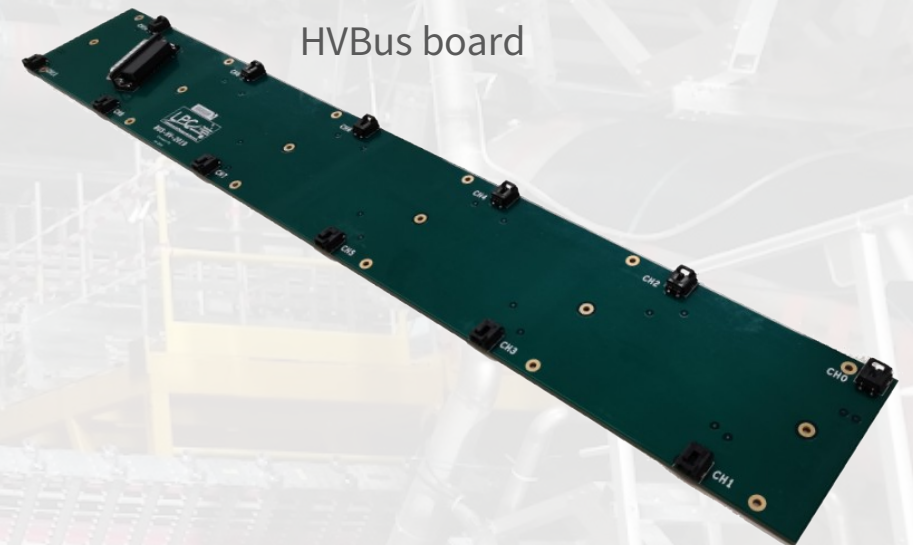 - Dedicated SPI bus for control and monitoring

- ## HVBus
  - Root the HV delivered by 100m long cables to each PMT
  - Equipped for 12 PMTs

HVSupply(left) and HVRemote (right)
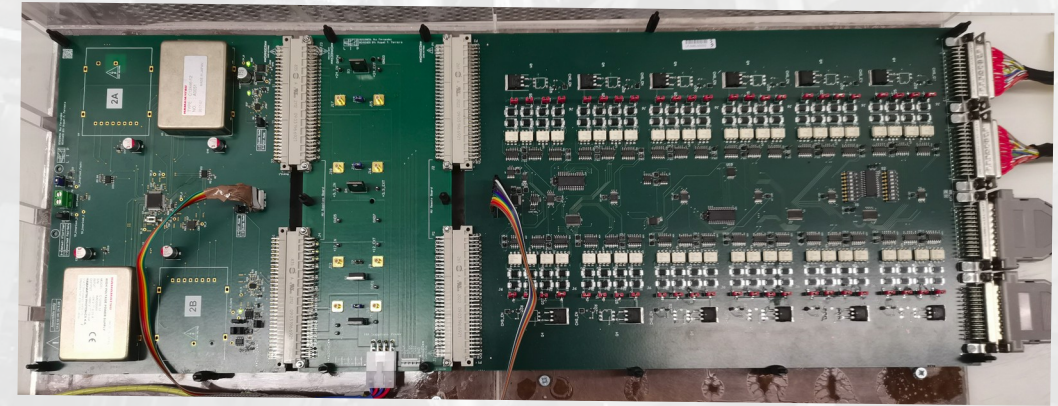
HVBus board

# 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
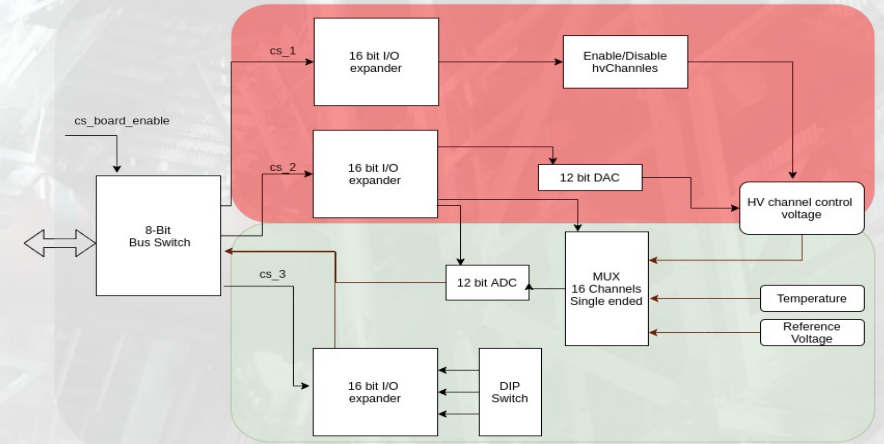
Architecture of the HV Remote system control tree
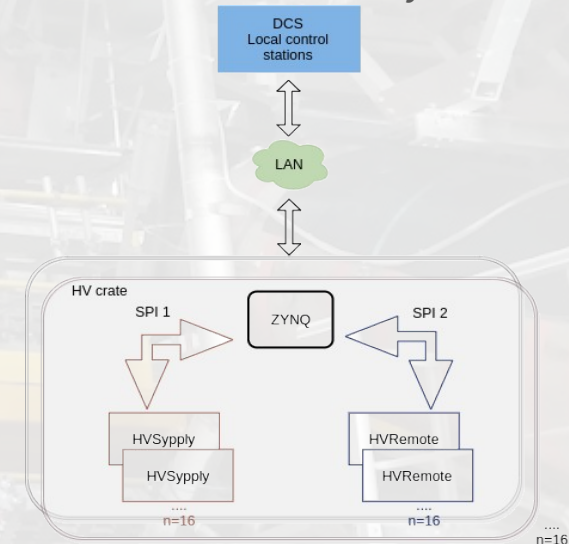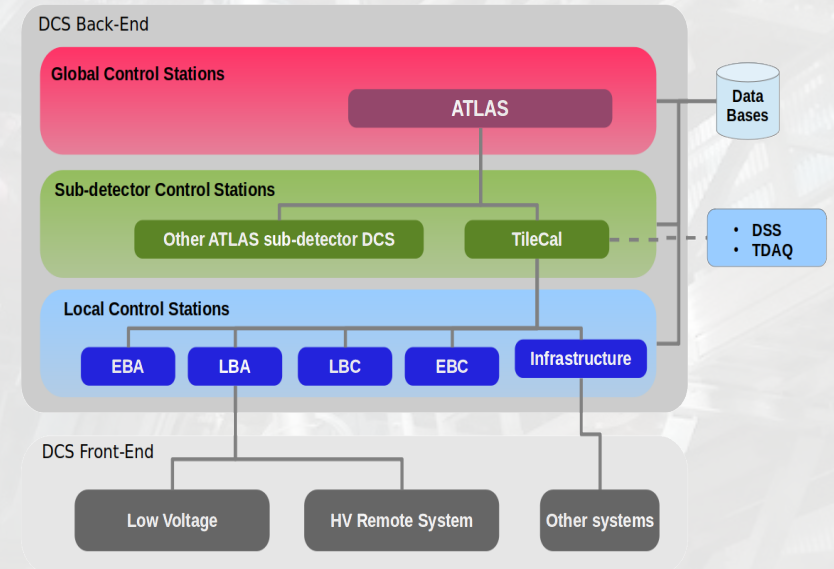
Integration with Tilecal DCS

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

ATLTILLV01:TileHvRemoteCrate1_HvSupply1_signal_HV...

Time Range | Y Axes | Save | Other | 1:1 | log | auto

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