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Developments for the TileCal readout electronics system

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TileCal is the central hadronic calorimeter of the ATLAS experiment at the Large Hadron Collider (LHC) at CERN.
It is a sampling detector made of iron as absorber and scintillator as active material.
The light produced by charged particles crossing the scintillator tiles is collected by wavelength shifting fibers attached to the edge of the tiles and routed to photomultiplier tubes (PMTs).The PMT signals are digitized synchronously with the LHC clock and the samples are stored in pipeline buffers in the front-end electronics. The data for events selected by the Level 1 trigger system are transmitted to the ReadOut Drivers (RODs) located in the back-end system at a maximum sustained rate of 100 kHz.
The ROD is the core element of the back-end electronics and it represents the interface between the front-end electronics and the ATLAS overall Data AcQuisition (DAQ) system. It is responsible of energy and time reconstruction, trigger and data synchronization, busy handling, data integrity checking and lossless data compression. The TileCal ROD is a standard 9U VME board equipped with DSP based Processing Units mezzanine cards. A total of 32 ROD modules are required to read-out the entire TileCal detector. Each ROD module has to process the data from up to 360 PMTs in real time in less than 10μs. Our group was responsible of the design, production, installation and now the maintenance of the ROD system including the control software and firmware of the DSPs.
In parallel, we are working on the development of the new TileCal readout system for the HL-LHC. The readout architecture will radically change and the photomultiplier signals will be digitized and transferred to the TileCal PreProcessors (TilePPr) located off-detector for every bunch crossing, requiring a data bandwidth of 40 Tbps. The TilePPr will be the interface between the on-detector electronics and the overall ATLAS trigger and data acquisition systems. Our group is responsible of the design, production and installation of the TilePPr system. The TilePPr is a modular ATCA system composed of a custom ATCA Carrier board equipped with several mezzanine cards.
This contribution will briefly introduce the current TileCal readout system and the upgrade for the HL-LHC. It will also include a description of the reconstruction firmware used in the ROD system and the design details and control software of the ATCA Carrier board for the TilePPr module.

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