

The South African contribution based on the TileCoM and Tile GbE Switch to the Tile Pre-Processor Modules for the ATLAS Tile Calorimeter: Progress and Current Status.

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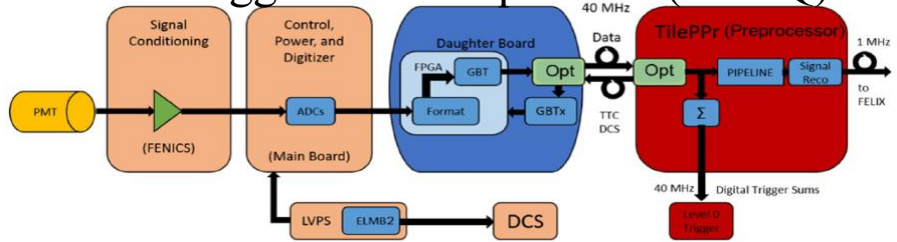


Abstract

University of Johannesburg contributes 25% to the final design of the Tile Pre-Processor Modules for the ATLAS Tile Calorimeter at the High-Luminosity Large Hadron Collider (HL-LHC). This work focuses on the status of the Tile Computer-on-Module (TileCoM) and the Tile Gigabit Ethernet Switch (Tile GbE) in terms of firmware, software and hardware integration. The procurement of 62 Xilinx FPGAs for the Control Processing Module (CPM) and 60 Zynq FPGAs for the TileCoM has been initiated, ensuring robust data processing capabilities. Additionally, a dedicated test station at the University of Johannesburg has been established to integrate the TileCoM, Tile GbE, and CPM for validation in terms of sensor data acquisition and performance testing. Significant progress has also been made on the TileCoM’s Open Platform Communications Unified Architecture (OPC UA) server, a key component for remote control and monitoring.

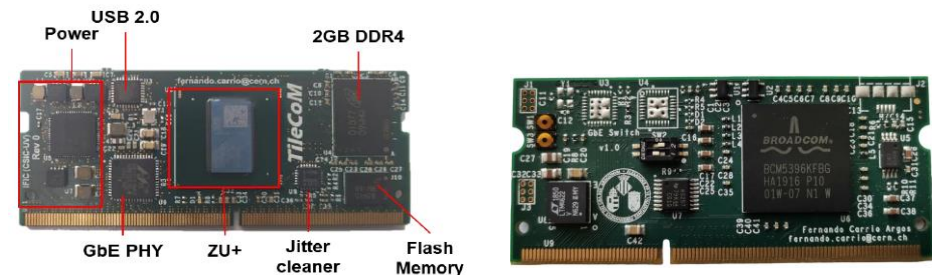
ATLAS TileCal Phase-II

ATLAS Tile Phase II Upgrade system divided into Front-End (FE) electronics that are on the detector and Back-End (BE) electronics that are off the detector. The Back-End (BE) electronics consists of Tile Pre-Processor (TilePPr) that receives digital data and process it in a pipeline FPGA to Trigger Data Acquisition (TDAQ)



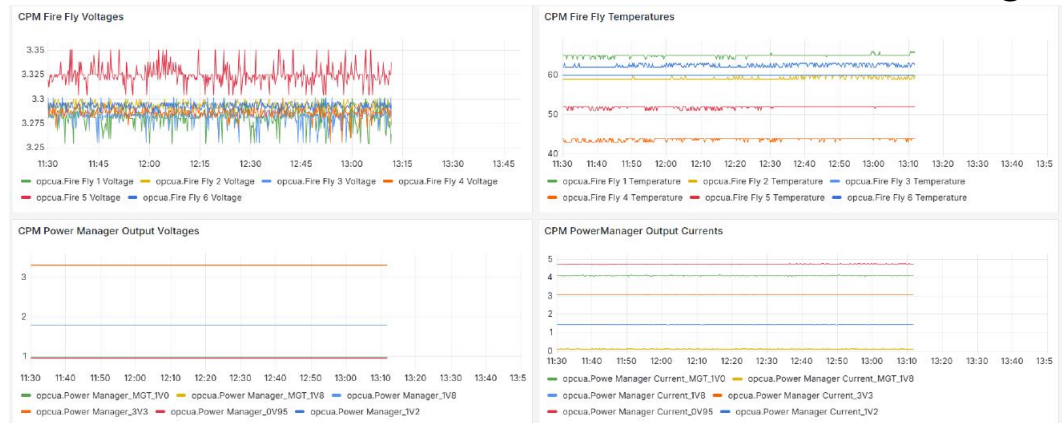
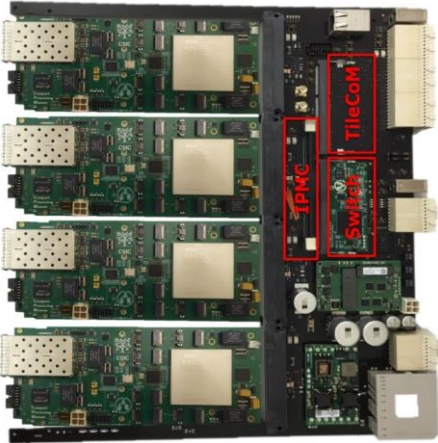
TilePPr Module

The TilePPr consists of four Compact Processing Modules (CPM), Tile Computer-On-Module (TileCoM), Tile GbE Switch, etc. University of Johannesburg contributes 24 % towards the final design and production of TilePPr. This is in terms of firmware/software and production of PCBs for the full integration of electronic system



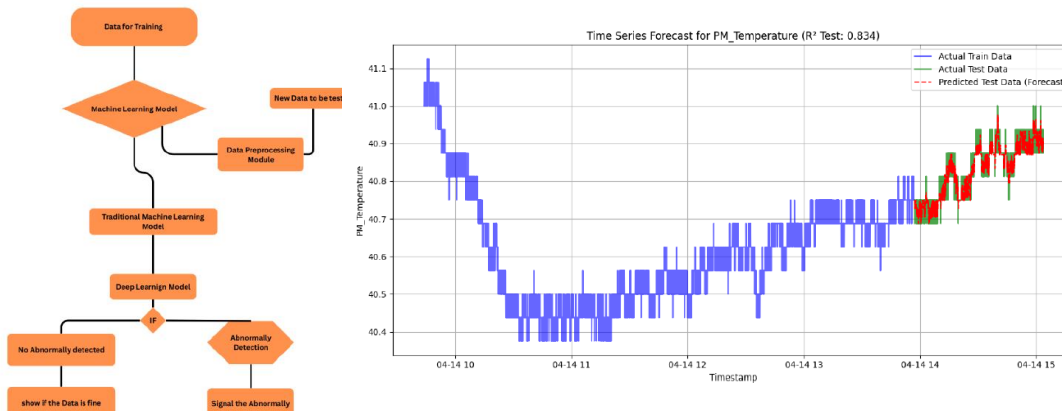
UJ ATLAS TileCal Phase-II Projects

Project 1: TileCoM Firmware Development for ATLAS Tile Calorimeter Phase-II Upgrades
A Open Platform Communications Unified Architecture (OPC UA) Server server implemented on the TileCoM is used to monitor sensor data from the CPM and TDAQi modules during the Test Beam.

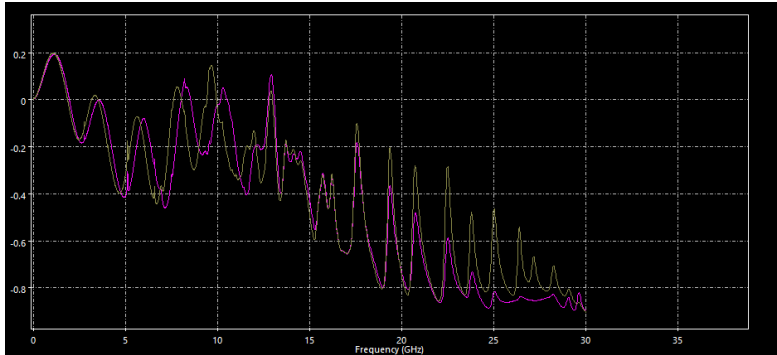
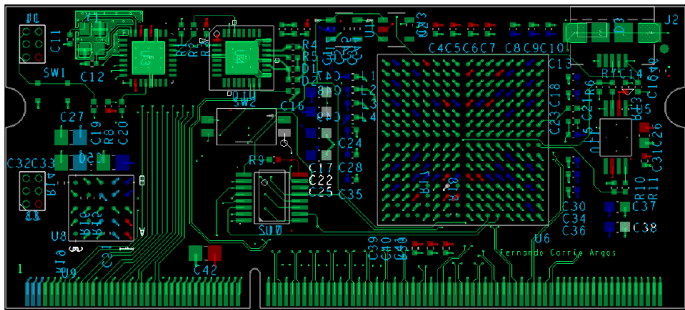


Project 2: Predictive ML analysis for anomaly detection project

In order to discover anomalies in control and monitoring data from the Tile TileCoM, CPM, and TDAQi systems, this project focuses on quality assurance using predictive ML approaches.



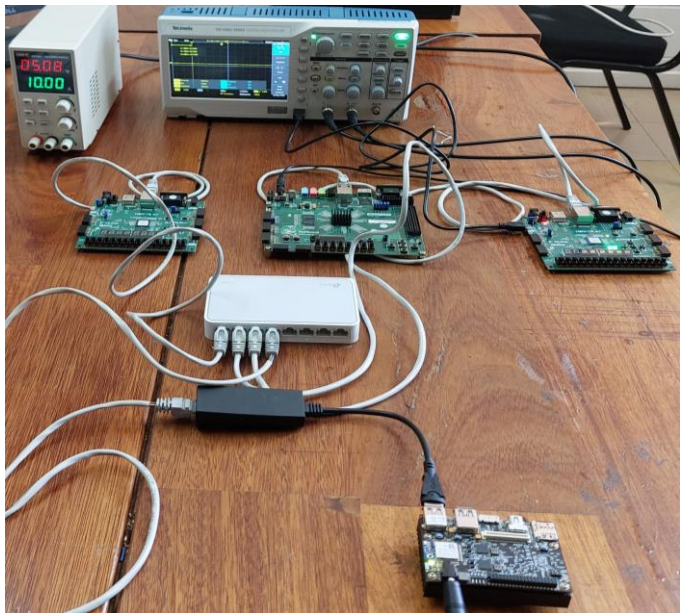
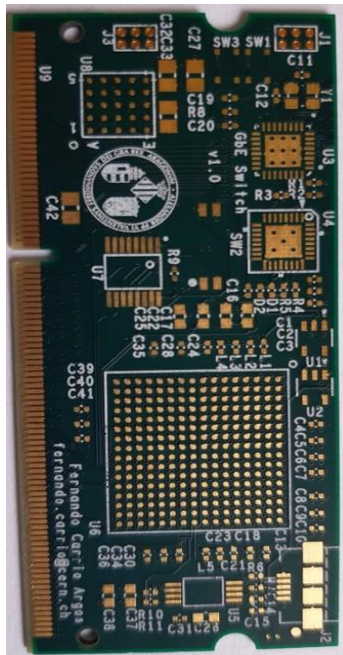
Project 3: Tile GigaBit Ethernet Switch project



TilePPr –Preproduction status and test bench

At the University of Johannesburg, 50 TileCoM and 50 Tile Gigabit Ethernet (Tile GbE) Switch PCBs must be assembled and validated as part of the TilePPr pre-production phase. To perform thorough functionality and quality assurance tests on these boards, a specialized test bench has been set up at UJ. This guarantees that only dependable and completely compliant modules are sent to CERN to be integrated into the ATLAS detector upgrade.

Four important PCBs are integrated into the University of Johannesburg test bench with a 12V power source. An oscilloscope is used to assess voltage levels and current consumption in real time while these components are connected. This configuration guarantees that every board satisfies the necessary electrical and functional requirements by enabling thorough diagnostics and performance evaluation.



Summary and Acknowledgement

The University of the Witwatersrand is contributing 24% to the back-end electronics for Tile Calorimeter Phase-II upgrades. The current contribution involves software and firmware implementation on the TileCoM and; production and testing of the Tile GbE Switch and the TileCoM. Three running projects are 50% complete for the year 2025 and some of them have been integrated to the TileCal electronics system test beam. Pre-production of PCBs currently in progress from South African companies, Trax and Jemstech, and PCBs will be tested at UJ in the laboratory.

