Summary of activities

(mainly Compact Processing Module…)

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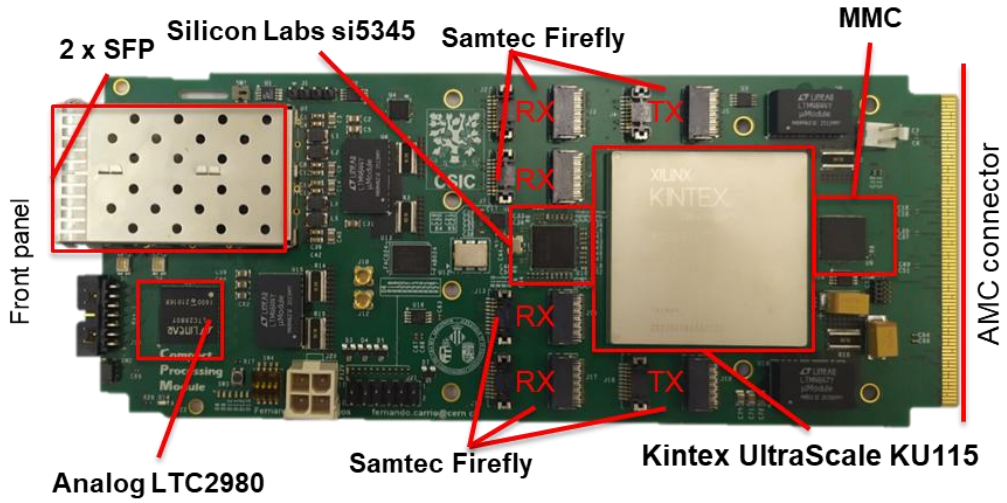
March 21th 2026

Valencia Tile meeting

Compact Processing Module - Production

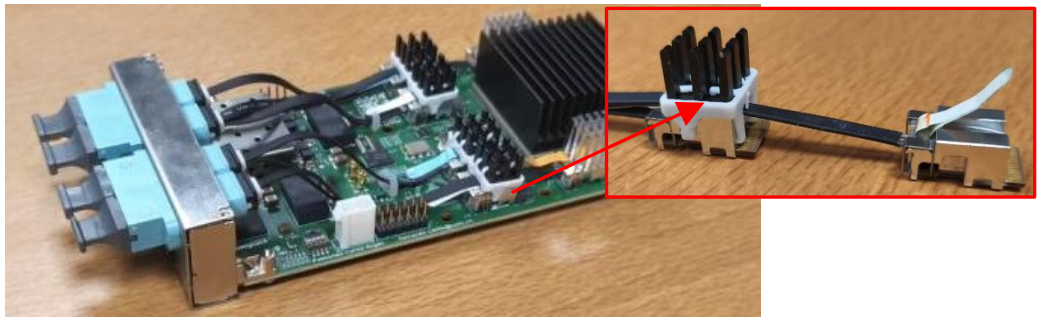
- **Single AMC board** with full-size factor
  - **32 RX channels** via 4 Samtec Firefly
  - **16 TX channels** via 2 Samtec Firefly
  - **Up to 14 channels** via AMC connector
  - **Kintex UltraScale: XCKU115-2FLVA1517E**
- Procurement status @ Valencia
  - All active components and mechanics for 128 CPMs are on hand (except for a few for v2.3)
  - Received 60% FPGAs for production + 40% procured by South Africa
  - **80% of Firefly modules received**

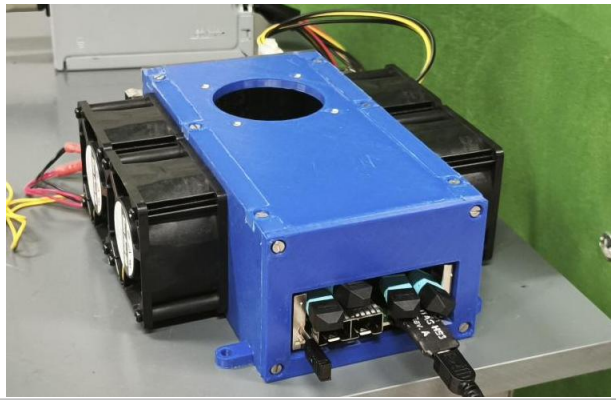


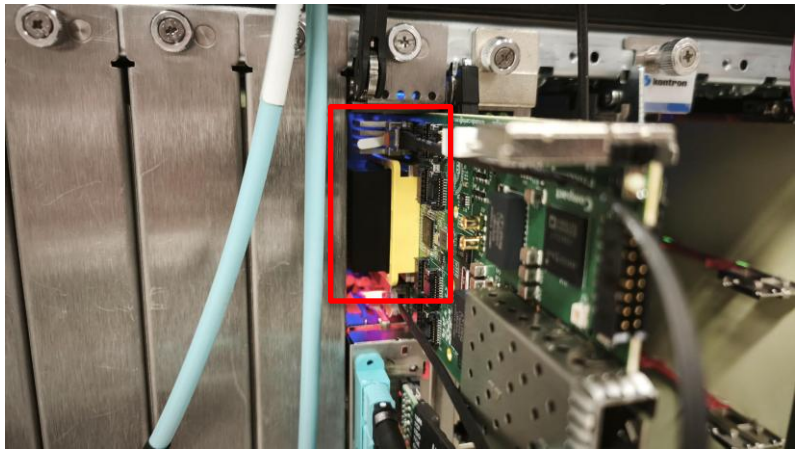
- 2 x Preproduction (v2.3) CPM boards partially tested
  - Few components had to be reworked
  - Produced 20 PCBs with Panasonic Megtron 6 Halogen Free
  - Additional batch of 9 CPMs **launched** in April after initial validation
    - Rompal didn't reply, so started iterating with them during the past weeks
    - Factory is stopped for at least 1 month due software migration and inventory
    - Announced that if boards cannot be assembled on 15th June as latest, production is moved to another company (as for Carrier and TileCoM)
    - Asked for quotation to ProDesign to assemble them ASAP
- Results from the boards:
  - Main components already tested within the "CPM box"
    - FPGA, Firefly modules (access via I2C), Flash memory, backplane
    - Atmega in one board damaged because incorrect fw - some inputs were set as output by mistake (no FPGA damage!)
  - Completing the full test coverage for all the components
    - EEPROMs, IO pins, etc
  - Required some fw and hw development for"validation tests"
    - Tropper libraries extended with lots of new functionalities
    - Vivado firmware project with several IPbus, IBERT, etc.
    - Tests to be replicated in Valencia for the other 2 CPMs + the upcoming 9
  - To be integrated in the VST to tests with 2 full modules.

Compact Processing Module - Mechanics

- Front panel design with minor modifications
- COTS heatsinks for Firefly TXs(640/640) and FPGA (70/160)
  - One heatsink covering the 4 Firefly RXs (Demonstrator)
    - Still some risk of applying stress on the PCB + maintenance remains complex
  - Custom plastic clip for independent heatsinks (Bld 175)
    - No mechanical stress, easy maintenance
    - Under tested in 175, preliminary similar results than with the big heatsink
- New heatsinks + plastic clip for the FPGA
  - Larger fins possible to fit in the carrier
  - Thermal tests in SR1 to be redone with new configuration
- New box for preliminary tests + backplane board

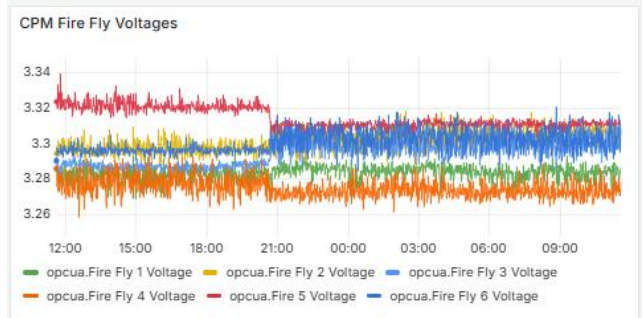






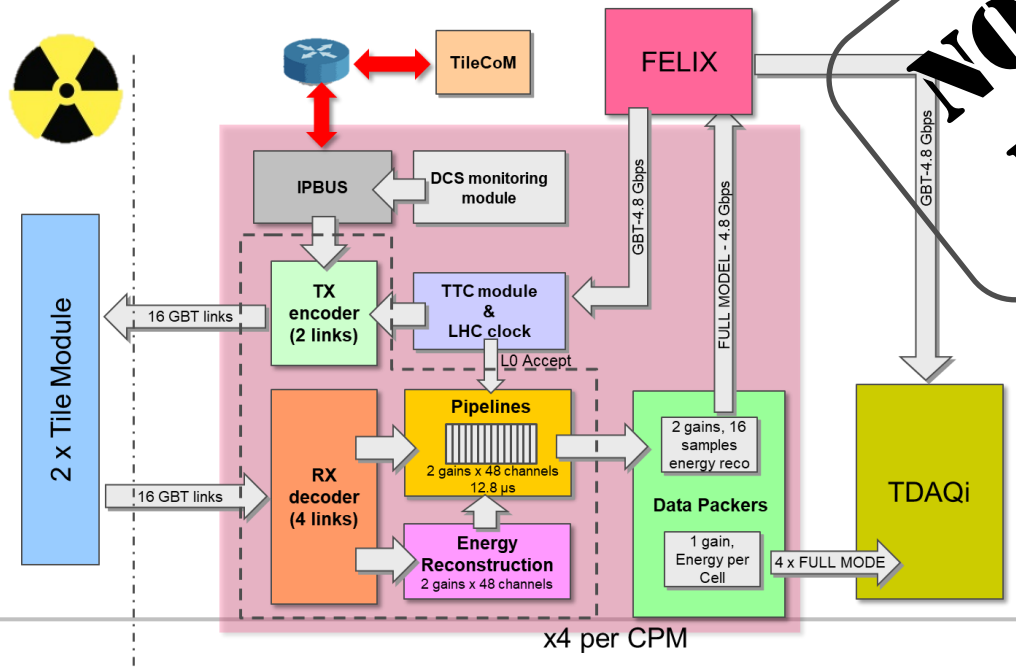
FW: Compact Processing Module

- Most functionalities in place and validated during test beams, VST and Demonstrator
  - 2 link @ 4.8 Gbps to FELIX: TTC and Readout + 1 GbE for IPbus communication
    - LTI - FULL MODE (9.6 Gbps) implemented -> tested with BNL-155!
  - 28 x links to DaughterBoards (4.8/9.6Gbps): **GBT with FEC and new data format**
  - 4 x links @ 9.6 Gbps to TDAQi: **FULL mode**
  - Remote programming via IPbus for both CPM and DaughterBoards
  - Block to detect corruption in the data samples to be added (stuck bits, spikes, etc)
  - Firmware updates for the DCS readings → Brenton as part of his Master thesis
    - Deployment in P1 by Brenton: Ipbus → IS → pBeast
  - Several firmware updates to extend debugging capabilities



DCS readings via IPbus

NO MAJOR UPDATES



DCS Integrator

117 .. 116	115	114	113	112 .. 106	105	104	103 .. 92	91 .. 80	79 .. 68	67 .. 56	55 .. 44	43 .. 32	31 .. 0
H	M	I	RB	RSV	RR	G	P6	P5	P4	P3	P2	P1	FEC

Readback config

PMT samples

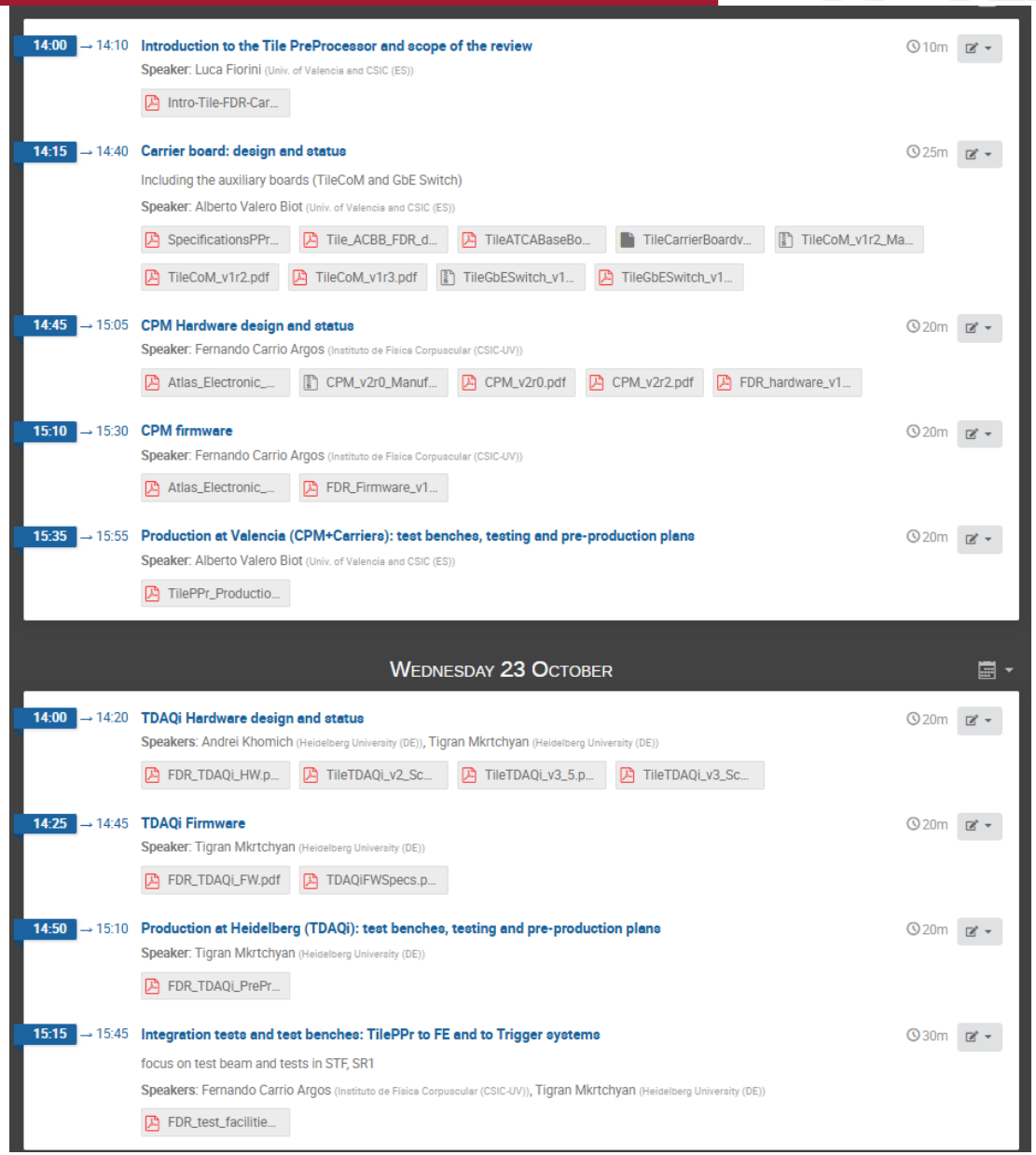
Where:

- H: GBT header.
- M: DCS & monitoring data.
- I: Integrator data.
- RB. Read back commands.
- RSV: Reserved bits.
- RR: Reset Request from the Daughterboard.
- G: FEB gain. 0 is low gain and 1 high gain.
- Px: PMT samples.
- FEC: Forward Error Correction.

BW assigned	Assigned bits	Description/ max requirement
80 Mbps	4	GBT header → Used as returned BCR
80 Mbps	1	DCS monitoring data. It includes a maximum of 100 sensors * 10 Hz * 32-bit words for monitoring of temperature sensors, voltages and currents.
80 Mbps	1	Integrator data. It includes a maximum of 6 PMTs * 200 Hz * 32-bit words
80 Mbps	1	Read back of MB and DB registers
80 Mbps	1	Reset Request from the DB
80 Mbps	1	High and Low gain identifier
5.760 Gbps	72	PMT readout data
2.56 Gbps	32	Forward Error Correction

Others

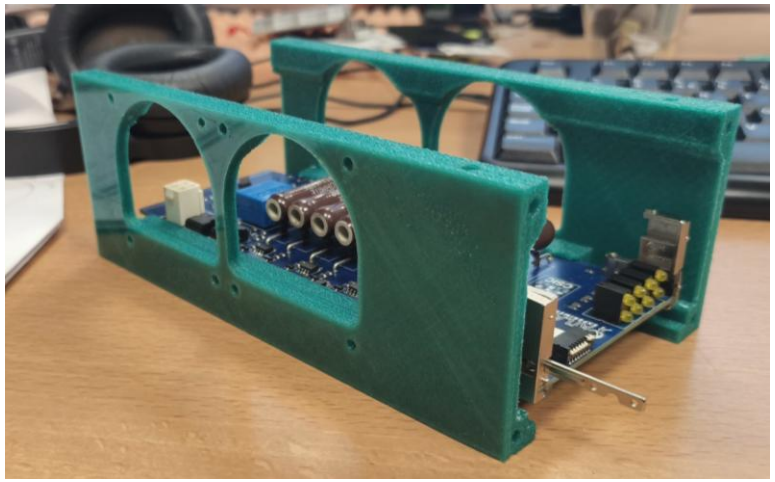
- Preparing tentative agenda with Giulio
- Review splitted in two days:
  - 29th (PPr) and 30th (TDAQi) of June
- Similar topics as in the FDR but focus on
  - Latest changes in the designs + software and firmware capabilities/status
    - No need to present the full design again
    - No deep review of the firmware (probably will come as a separate review)
    - Compact Processing Module, Carrier + mezzanine boards → Fernando/David/Alberto
  - Results from preproduction boards and highlights
    - Fernando/David/Alberto
  - Installations validation procedures, database, and production schedules
    - Alberto/Luca/Arantxa
  - Integration test results with DB, TDAQi, FELIX → Fernando/Thomas

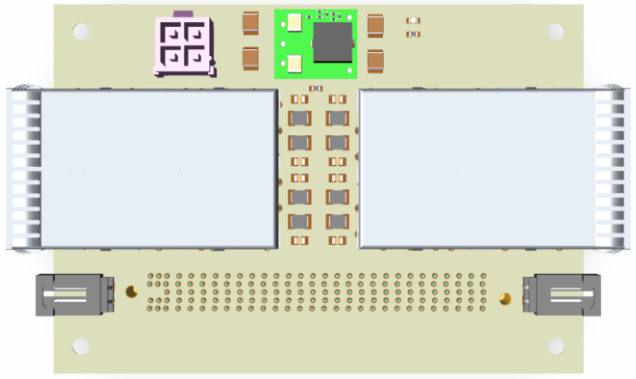


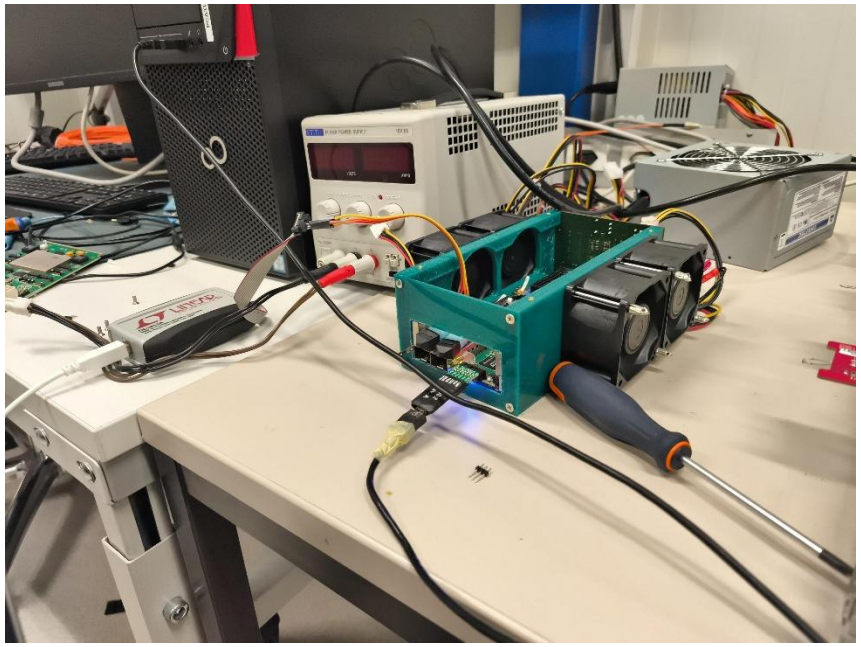
BACKUP

Miscelaneous: Hardware developments for production tests

- 3D support for on-table test benches + Ethernet backplane -> Fully working
  - Support with built-in guidelines
  - Four 60 mm x 60 mm fans screwed into the support
  - Backplane with 4 SFP and providing power to CPM and fans

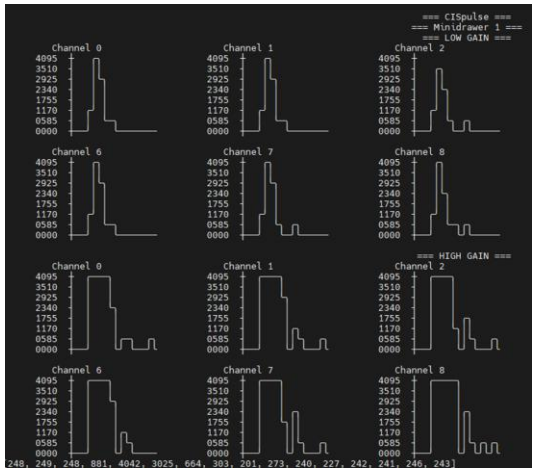






Software tools

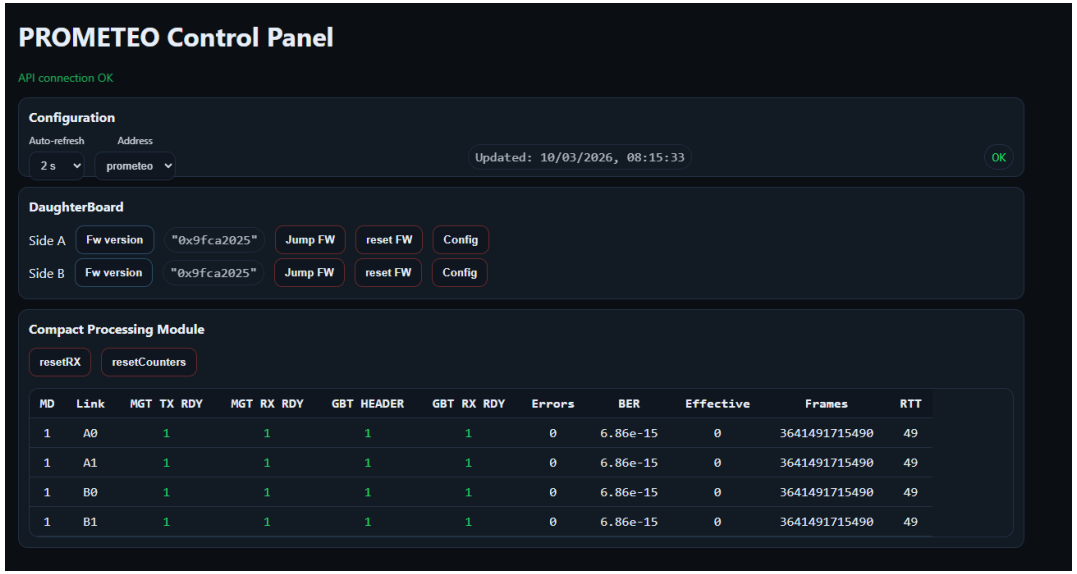
- Software ecosystem continuosly evolving and growing up: Demonstrator, Prometeo, Vertical Slice Tests
- Online libraries for the CPM: TROOPER libraries https://gitlab.cern.ch/fcarrio/tropper-libraries/-/tree/master
  - C++ libraries for TDAQ, also compiled as *.so* python libraries. Cmake, Make
- PrometeoPy application using them: https://gitlab.cern.ch/fcarrio/prometeopy



PrometeoASCII with Trooper libraries

Grafana@ testbeam using pBeast + IS

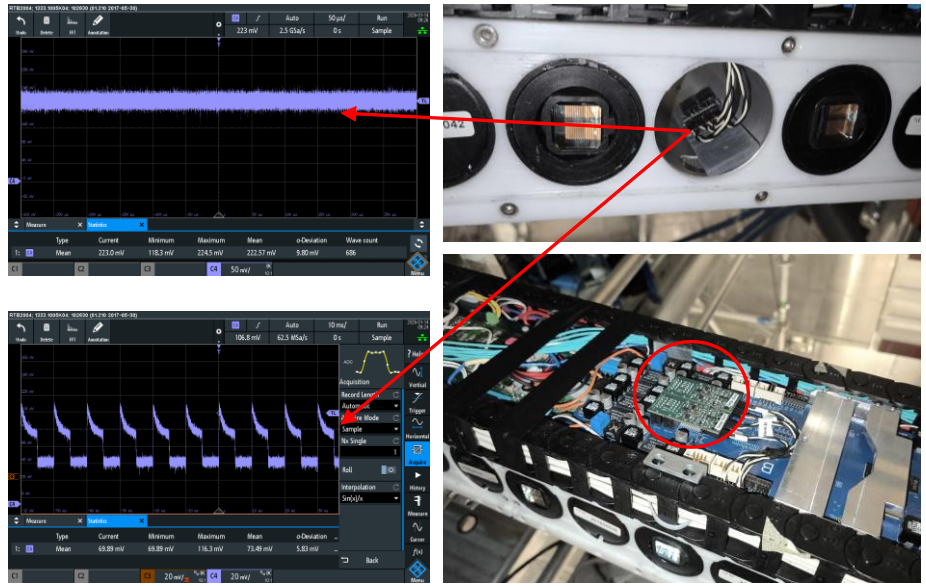
- Preliminary software for DCS monitoring for the Demonstrator (Filipe, Brenton, Mpho)
  - Publishing into ATLAS IS -> pBEAST -> Grafana
  - OPC UA developments in parallel for Phase -II
- Control Prometeo Web panel
  - Control and monitoring of links
  - Fw loading and initialization



Control Prometeo Web panel

Bonus

- Environmental sensors installed in the Demonstrator as a candidate system for Phase-II
  - System controlled from Daughterboard GPIO pins and readout using XADC
  - Analog signal conditioning for temperature (PT100) and humidity (polymer) using INA333
  - Sealicon FGDOS for TID + Dickson bridge to charge it (20V)
    - Two sensors: 0-10 Gy and 0-50 Gy with 8-bit resolution
  - 2 sensor boards equipped in MD4, where probes has been installed in PMT hole 44
- Control of I2C and SPI lines from remote CPM via IPbus
  - Propagation signals via GBT protocol over fiber at 4.8 Gbps
  - 2 × SPI interfaces and 2 × I2C interfaces
  - LED trigger with LEMO
  - Fully working now

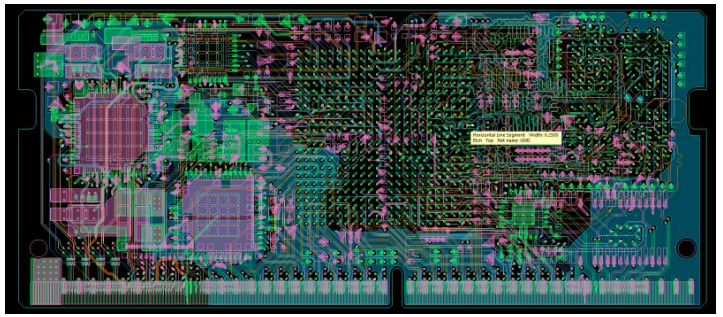


TileSensor board v1.0

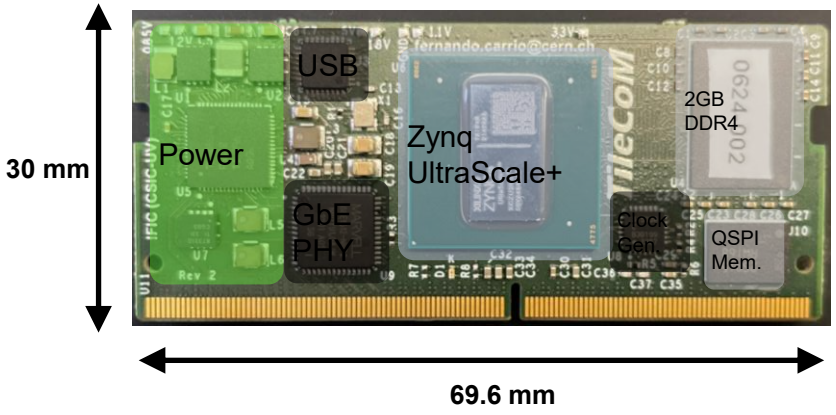
Tile GBTx board

Tile Computer-on-Module Hardware

- Custom SoM based on AMD Zynq UltraScale+ ZU2CG device
  - OPC servers for Detector Control System sensors reading
  - Remote front-end FPGA programming
  - CPM and TDAQi JTAG programming and debugging using Virtual Xilinx Cable
  - Acting similar to a SBC, configuration of CPM and front-end electronics
- 4 units of the Preproduction version (v1.3) being/or assembled
  - Expected for this week
- 53 PCBs were produced last December (MOQ).
  - A few will be shipped to SA to test/complete the preproduction in PCB Trax

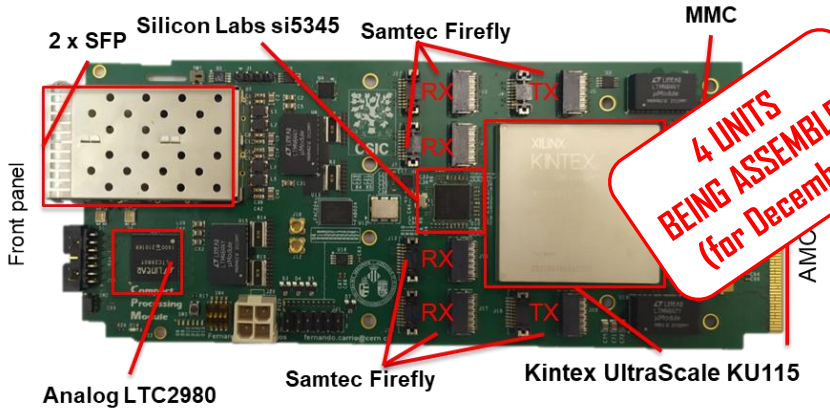


TileCoM v1.3

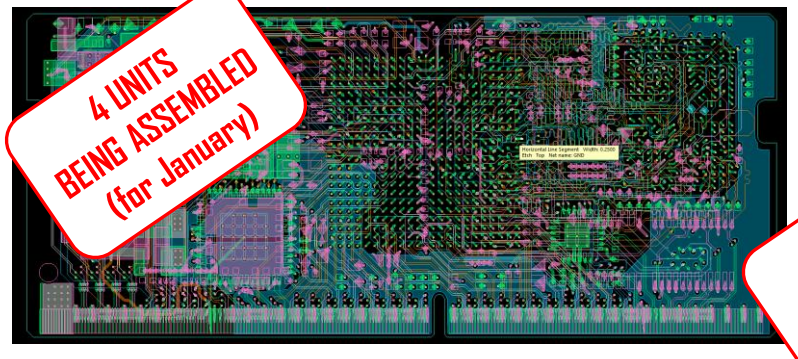


HW: Hardware developments

- Revision 2.3 of the CPM
  - Single AMC board with full-size form factor
  - 6 x Samtec Firefly
  - XCKU115-2FLVA1517E

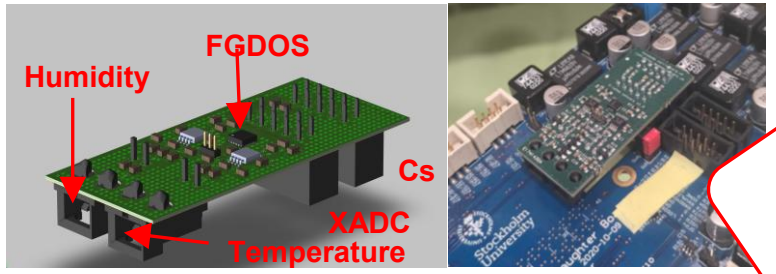


- Rev 1.3 of the TileCoM
  - SODIMM-240pin: 6.7 cm x 3 cm
  - 10 layers, 1 mm thickness, with 251 components



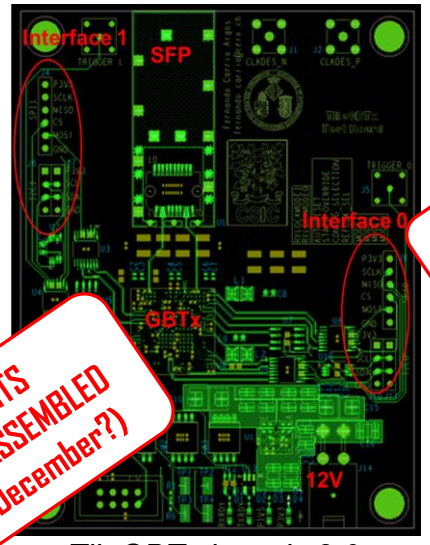
TileCoM v1.3

- Sensing environment conditions inside the TileCal modules
  - Analog signal conditioning for temperature (PT100) and humidity (polymer) using INA333 + Total Ionazing Dose (TID) sensor



TileSensor board v1.0

- Optical GBT-GPIO expander
  - Remote control of the HV and LED drivers from CPM



TileGBTx board v2.0

- Plastic support for on-table test benches + Ethernet backplane
  - Support with built-in guidelines
  - Four 60 mm x 60 mm fans
  - Backplane with 4 SFP and power distribution