TileCal-IFIC Upgrade Project Meeting

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28/07/2026

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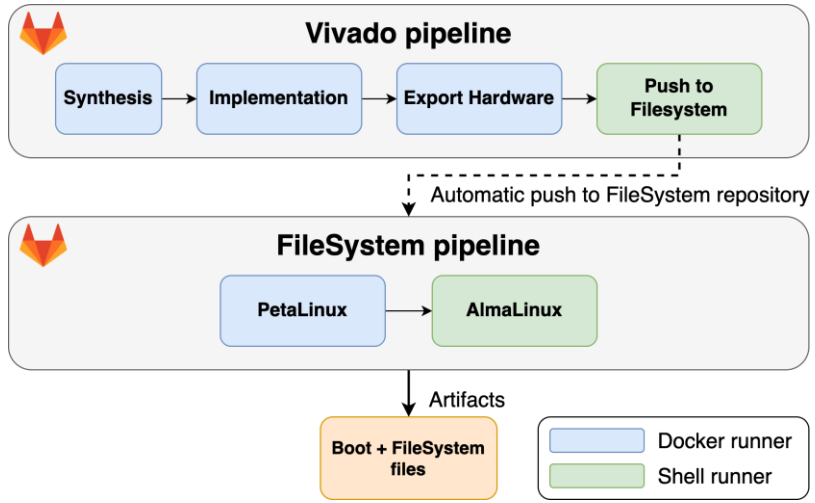
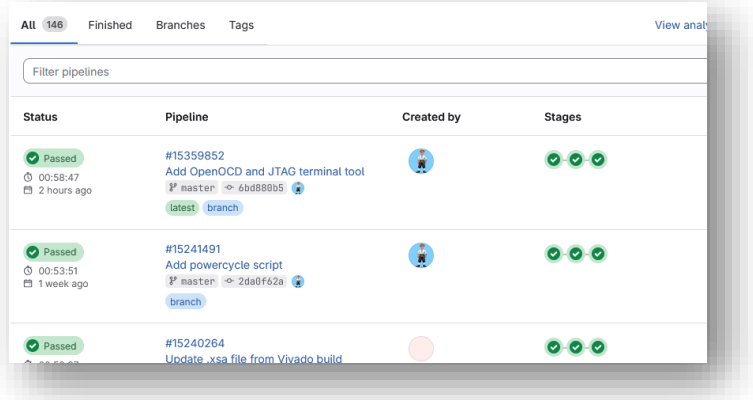
TILECOM: Build System

- **Taking responsibility for TileCom**
  - I took responsibility for the TileCom project.
  - First, I studied the server, the repositories and the build system.
  - At first, I could not build a working image.
  - I fixed the build problems and recovered the last working version.
  - I cleaned the repositories.
  - ✅ Finally, I moved the GitLab Runner to tical46



- **Build system**
  - I validated the complete Vivado and PetaLinux build pipeline.
  - The pipeline generates all the files for the root file system.
  - ✅ Finally, I tested the generated image on TileCom using an SD card.

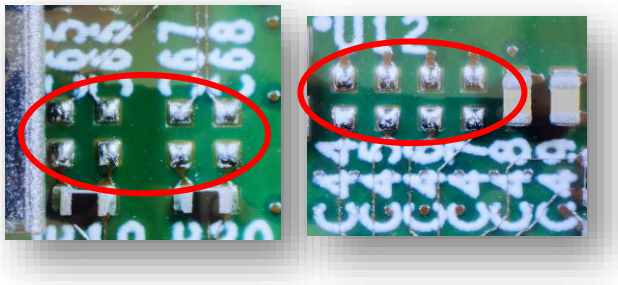


TILECOM: Ethernet Interfaces

Special thanks to Héctor for his help debugging the Ethernet PHY problems.

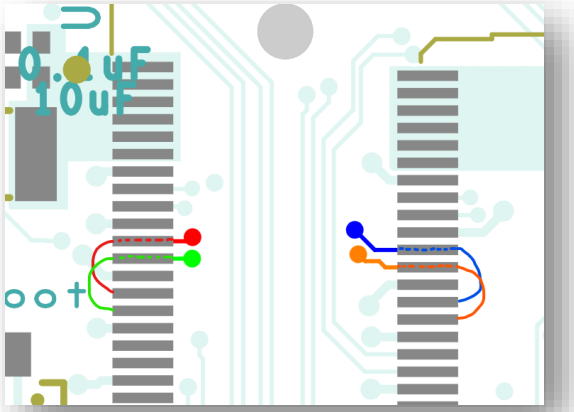
Initial problem

- The TileCom system has three Ethernet interfaces.
- None of the three interfaces was correctly detected in PetaLinux.
- All ping tests failed.



Hardware problems

- After some debugging, we found:
  - Missing capacitors on the high-speed lines.
  - Incorrect routing on the carrier.
  - The Marvell TX port and one Vitesse TX port were connected to the same PS interface.



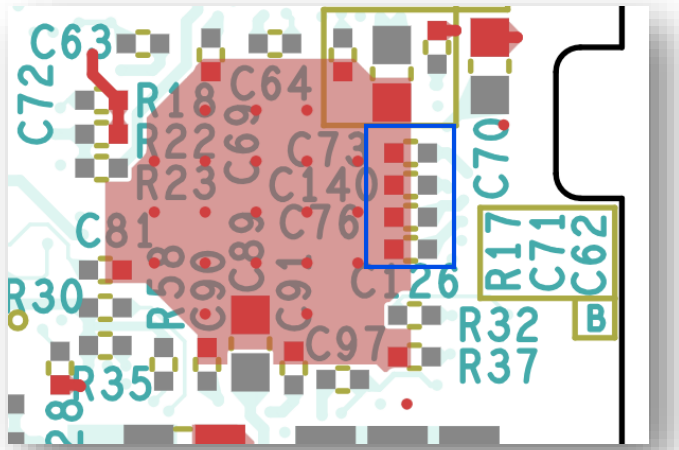
Solution

- Moved the Vitesse interface to GEM2.
- Corrected the PHY addresses.
- All three Ethernet interfaces are now working:
  - ☑ GEM0 uses the Vitesse PHY through the carrier GbE switch.
  - ☑ GEM1 uses the on-board Marvell PHY with RGMII-ID.
  - ☑ GEM2 uses the second Vitesse port through direct SGMII.

TILECOM: Hardware and Power Control

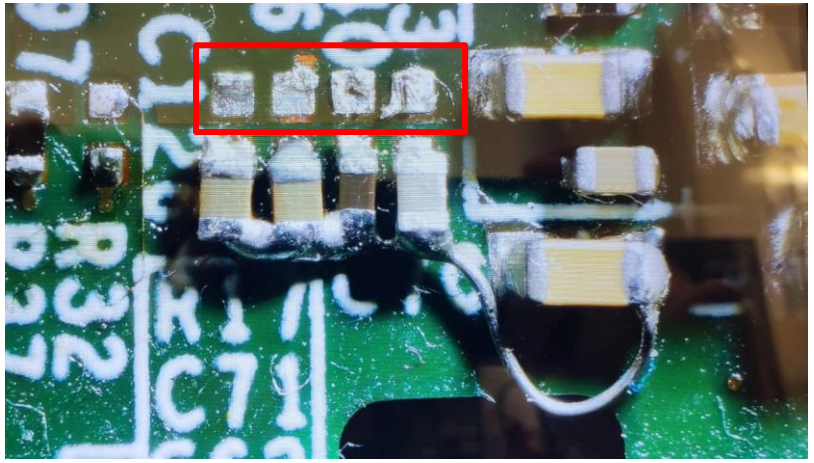
Hardware

- Tilecom reset problems:
  - Tilecom decoupling capacitors were connected to the TPS thermal pad wich generates noise.
  - We moved the decoupling capacitors from the TPS thermal pad to a direct GND connection.
  - These changes allowed stable operation up to 12.8 V.
- ☑ One TileCom was recovered after these modifications.
- ✗ The second TileCom probably has a short circuit inside the FPGA and appears not repairable.
- Two TileCom motherboards were assembled for testing.



Power-cycle circuit

- Were removed the LTC2954 component because there is no physical shutdown button.
- This function was replaced with a new power-cycle circuit.
  - The circuit uses GPIO pin to control signal reset.
- ☑ The solution was successfully tested.
- The Linux command is available as /usr/bin/powercycle.



TILECOM: UART and JTAG

IPMC UART

- The carrier pins used to access the IPMC UART were incorrect.
  - The connection was fixed by using alternative carrier pins (178 and 180), connecting them to FPGA PL pins (E4 and E3).
  - ✅ This connection allows direct serial communication with the IPMC from Tilecom.

JTAG access

- ✅ The AXI Debug Bridge and Xilinx Virtual Cable were implemented with help from Héctor.
  - This provides access to the carrier JTAG chain through the TileCom with Vivado.
- ✅ As an additional improvement, OpenOCD was integrated into PetaLinux
  - enabling JTAG operations without Vivado.
- To control OpenOCD, the jtagtool script was implemented.
- The script can:
  - Scan the complete JTAG chain.
  - Identify CPM and TDAQi FPGAs.
  - Show the detected devices and their positions.
  - Program one selected FPGA without Vivado.

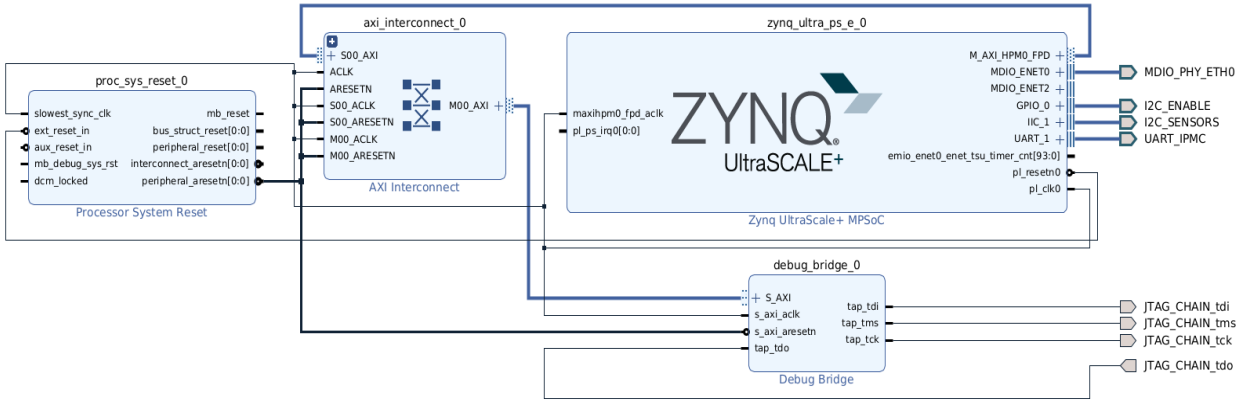
```
root@tilecompetav8:~# ./jtagtool-v0.2.1.py
Scanning JTAG chain...

JTAG Chain Tool v0.2.1
================================================================================
JTAG device chain
TDI  --->  [#4 0x14A56093]  --->  [CPM A / #3 XCKU085]  --->  [CPM A / #2 XC7A35T]  --->  [CPM B / #1 XCKU

CPM chain (non-CPM devices omitted)
TDI  --->  [ CPM A ]  --->  [ CPM B ]  --->  TDO
Other JTAG devices: #4 0x14A56093

CPM        JTAG IDX   OPENOCD TAP  PART       FAMILY              IDCODE      IRLEN    STATUS
--------------------------------------------------------------------------------------------
CPM B      0          dev0.tap     xc7a35t    Artix-7             0x0362D093  6        known
CPM B      1          dev1.tap     xcku085    Kintex UltraScale   0x1380F093  12       known
CPM A      2          dev2.tap     xc7a35t    Artix-7             0x0362D093  6        known
CPM A      3          dev3.tap     xcku085    Kintex UltraScale   0x1380F093  12       known
-          4          dev4.tap     unknown    -                   0x14A56093  ?        unknown

Detected CPM composition
```



TDAQi: MMC Investigation

Monitoring the power failure

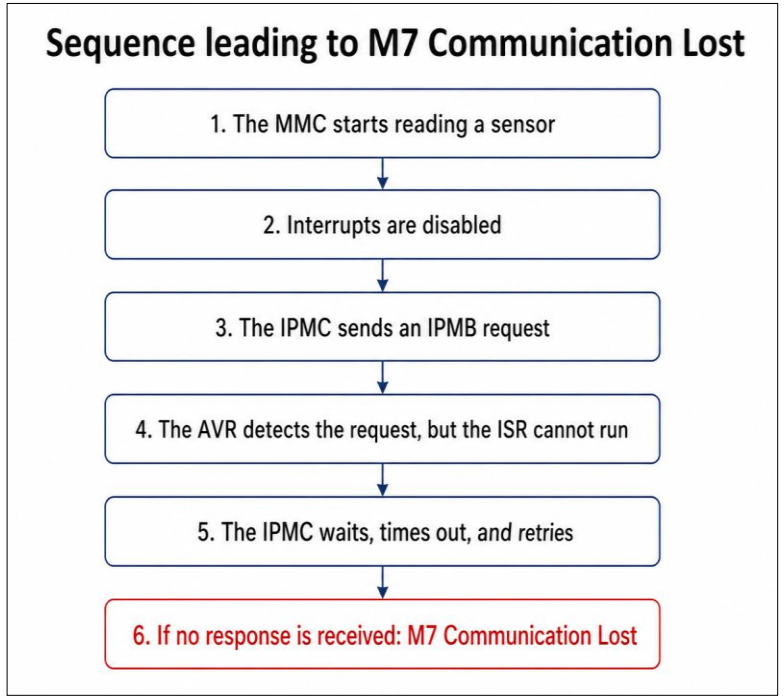
- Developed a script to monitor the TDAQi.
- The problem appears after several hours with multiple CPMs.
- TDAQi reached **M7**, followed by another AMC.
- About one minute later, the carrier payload powered off.

Firmware analysis

- Compared the CPM, TDAQi and IPMC firmware.
- Found possible IPMB communication issues.
- Two recent TDAQi commits may be related to the problem.

Future work

- Revert the I^2C changes.
- Test the TDAQi alone and with different AMC combinations.
- Compare the firmware before and after the suspicious commits.



CPM: CERN Work and Test Setup

CERN decommissioning

- I went to CERN from 12 to 16 July for the TileCal decommissioning works.
- During this visit, I also prepared new hardware for CPM tests.

CPM test hardware

- ☑ I assembled two AMC backplane boards for laboratory tests.
- ☑ I also assembled the 3D-printed test box designed by Fernando.