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MTCA.4 & PXI Express

Debriefing of Proof-of-Concept projects

Controls Coordination Committee (CO^3)

Geneva, 26 April 2018

Agenda

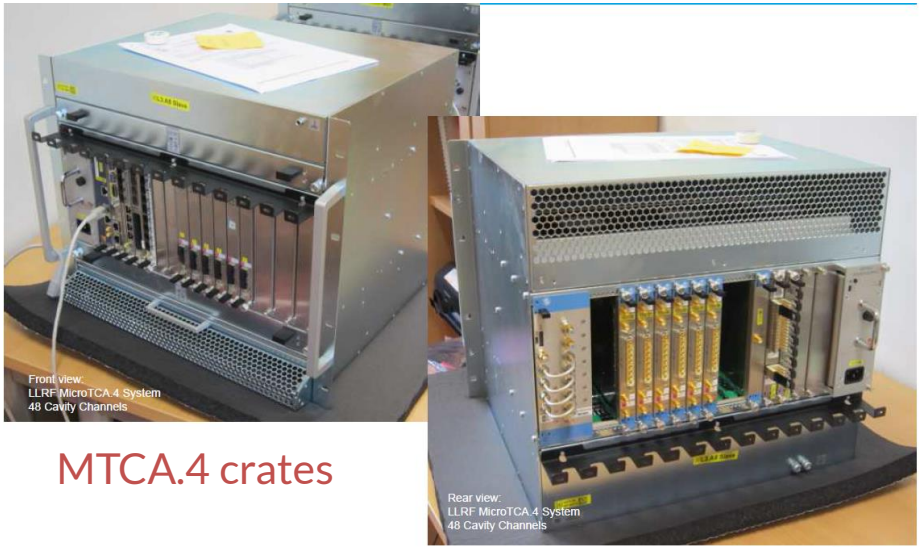
- MTCA.4 PoC
  - Project status
  - MTCA.4 equipment
  - CO Services for MTCA.4
  - Where to use the platform?
- PXIe status
- Summary

MTCA.4 PoC status

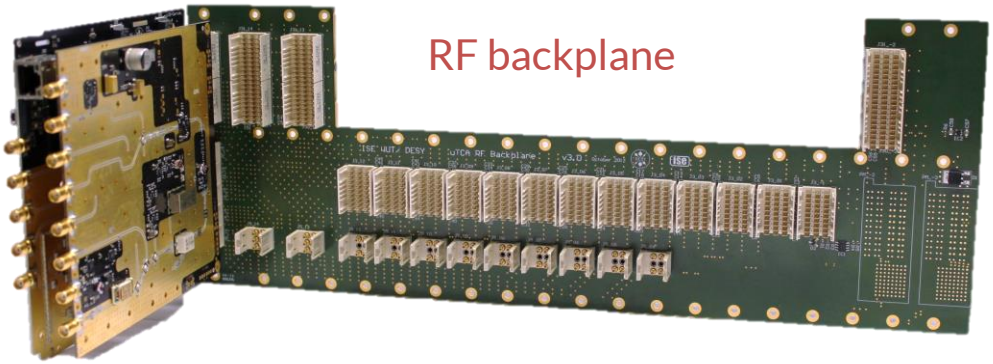
- **April 2017:** BE-RF and BE-CO decide to co-develop a proof of concept RF cavity controller in MTCA.4.
- **August 2017:** MTCA.4 equipment arrived (4 systems). Development of HDL & low-level software started.
- **February 2018:** first version of RF firmware implemented on the test MTCA.4 system.
- **March 2018:** SPS LLRF review decision: go for MTCA.4.
- No significant technical issues observed during the PoC.
- Good collaboration with the hardware vendors (NAT and Struck). Less good with DESY.
- BE-CO and BE-RF working **together** on HDL and low-level software development.

MTCA.4 Equipment

- Crate: 12 slots, made by Schroff/Pentair.
- CPU: Xeon E3, by N.A.T.
- MCH: provides crate management and PCIe/Ethernet backplane connectivity. Made by N.A.T.
- RF Backplane: standardized additional backplane for low-noise RF signals (e.g. clocks).

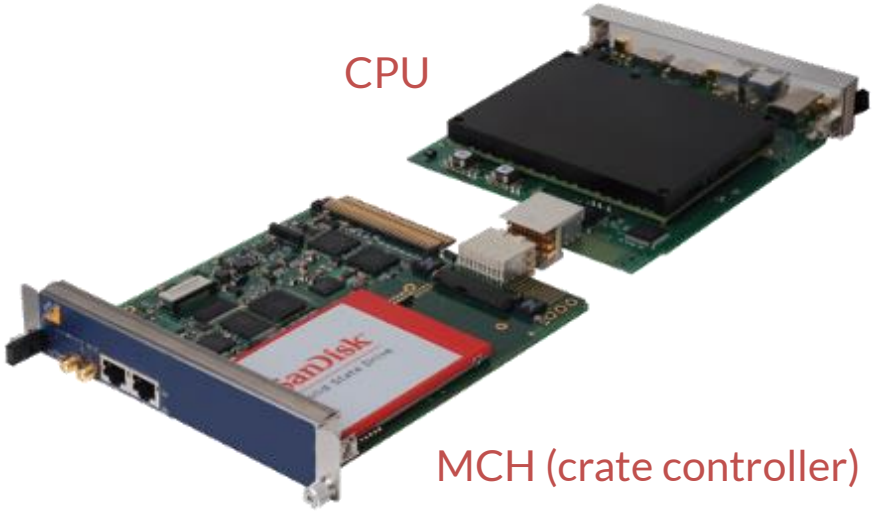


MTCA.4 crates



RF backplane

CPU



MCH (crate controller)

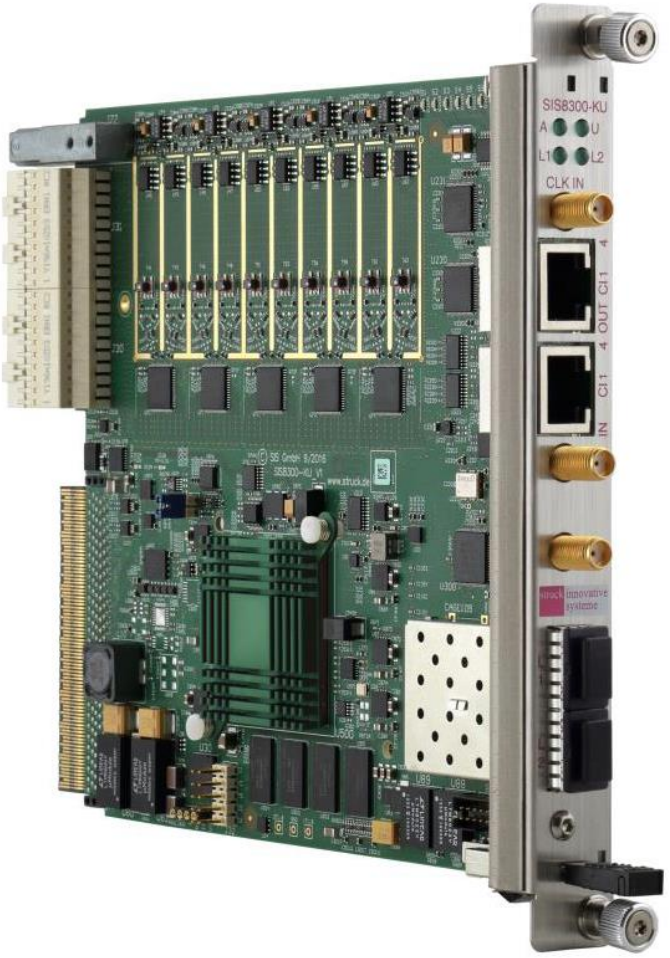
MTCA.4 Equipment

SIS8300-KU board:

- Flexible COTS platform for RF feedback systems development.
- 10 16-bit ADC channels @ 125 MHz
- 1x 16-bit vector DAC @ 500 MHz
- Powerful FPGA (Kintex Ultrascale 7KU35)
- 512 MiB DDR4 memory
- Built-in White Rabbit support.

DS8VM1 RTM Module:

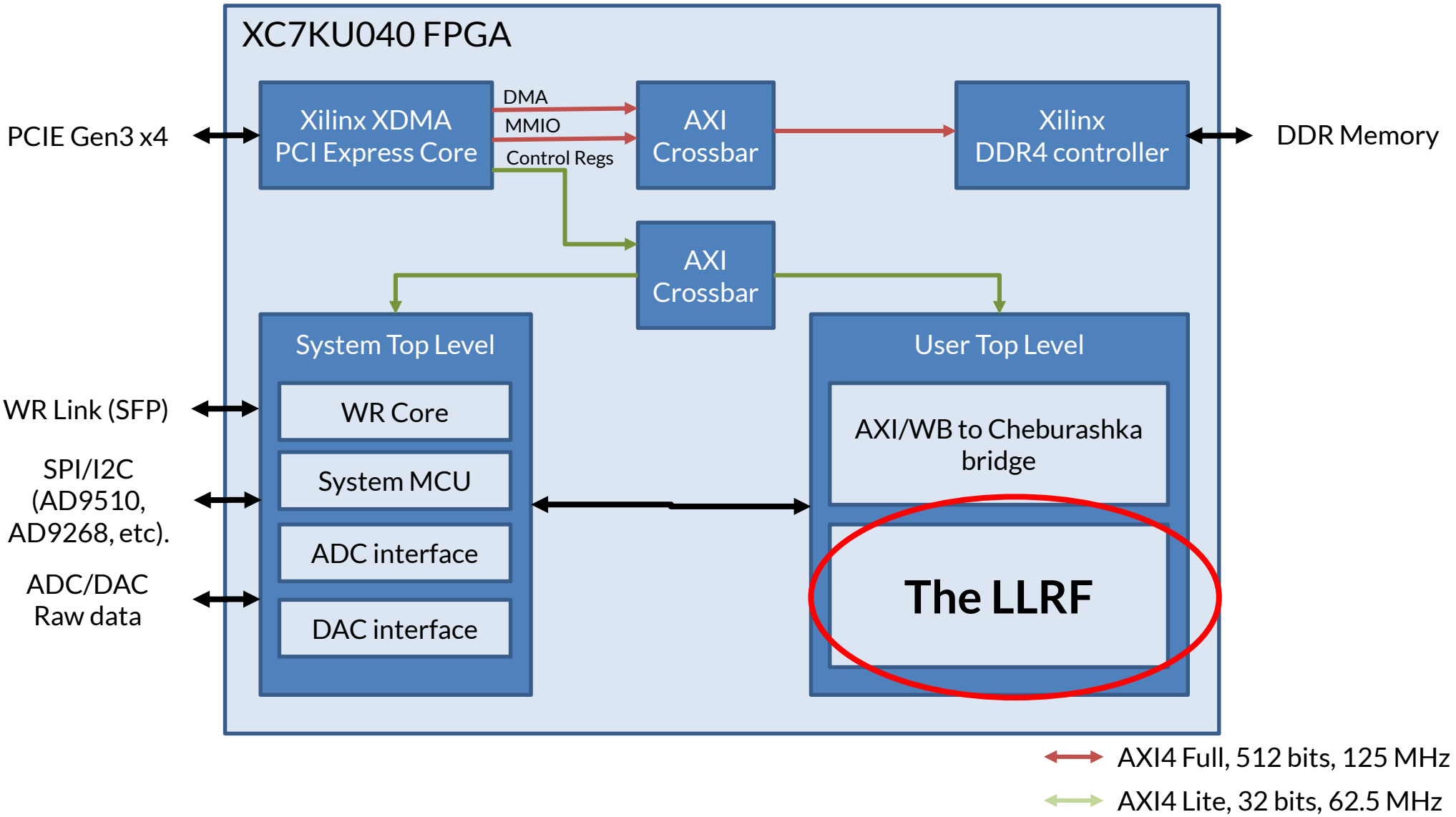
- Analog front-end for the ADCs
- Vector modulator/upconverter for the DACs.



CO Services for MTCA.4

- Standard platform services, just like VME:
  - CC7 support
  - remote reset & power-cycle
  - remote console
  - monitoring
- Stock of standard modules (crates, CPU+MCH, timing).
- Procurement of standard MTCA.4 components:
  - CO will take care of specification (together with the Eqp Groups), market survey and tendering process.
  - Ensure stable contracts for delivery of equipment in the coming years.
  - Reliable partnership with the industry.
- Benefit from EP department experience with MTCA.4
- Provide design expertise:
  - FPGA and MMC design aid and troubleshooting.

Example: RF FPGA



Where to use MTCA.4?

MTCA.4 provides a lot of features but its complex and currently not cheap*

Benefits	Disadvantages
▪ Digital feedback systems (LLRF) ▪ High-end signal acquisition and instrumentation ▪ Multi-gigabit communication between the boards ▪ Ultra-low jitter timing	▪ Simple digital I/O ▪ Interfaces (e.g. fieldbuses) ▪ Low to mid-range signal acquisition ▪ Motion control ▪ Sensors

* cost of a 12-slot Schroff crate with NAT MCH, CPU and PS: 8588 EUR.

MTCA.4 PoC: conclusions

MTCA.4 PoC going well.

- New project within BE-CO to provide full set of services for MTCA.4:
  - See next presentation by Marc.
- New model of collaboration (CO supporting HDL and software developers).

PXIe PoC status

- 2 installations operational in the LHC since May 2017.
- System working well, but…
  - Only simple acquisition with Spectrum M4i digitizers.
  - No PXIe-specific features in use (e.g. triggers).

PXI PoC: working with NI

- Negotiations with NI since 2016.
- Still no crate that meets CERN requirements available:
  - Field-replaceable PSU & fans
  - AMT available only on few CPU models
- Extremely expensive for the features it provides:
  - 8.5 k$ for a basic PXIe crate and a mid-range CPU*.
  - Our recent deal with Microsoft (and others) proves discounts don't last forever…
- NI refusing to provide open source device drivers:
  - Countless meetings with NI representatives brought promises, but no deliverables.
  - Drivers that are of most interest to CERN are scheduled as the last (e.g. NIScope at the end of 2019).

* PXIe-1082 crate (4065 $) and PXIe-8840 CPU (4649 $)

PXI(e): conclusions

BE-CO cannot recommend PXIe as an operational platform as it is right now.

- Similar price as MTCA.4 for less features
- No crate designed for field use
- Poor driver support for NI devices
- Only one CPU and crate vendor available for CERN (NI):
  - ADLink not in a member state
  - Bad support experience with Keysight

… but this does not mean we are done with PXI(e)!

Summary

- MTCA.4 PoC with RF well on track.
  - BE-CO will provide official support for MTCA.4.
  - Tests in BA3 in summer/autumn 2018.
  - Looking for more MTCA.4 pilot projects.
- PXIe cannot be recommended in its current state.
  - Too expensive for the features it provides.
  - Single vendor (NI). Difficult collaboration.
  - Design of a rugged PXIe crate is a possible long term solution.