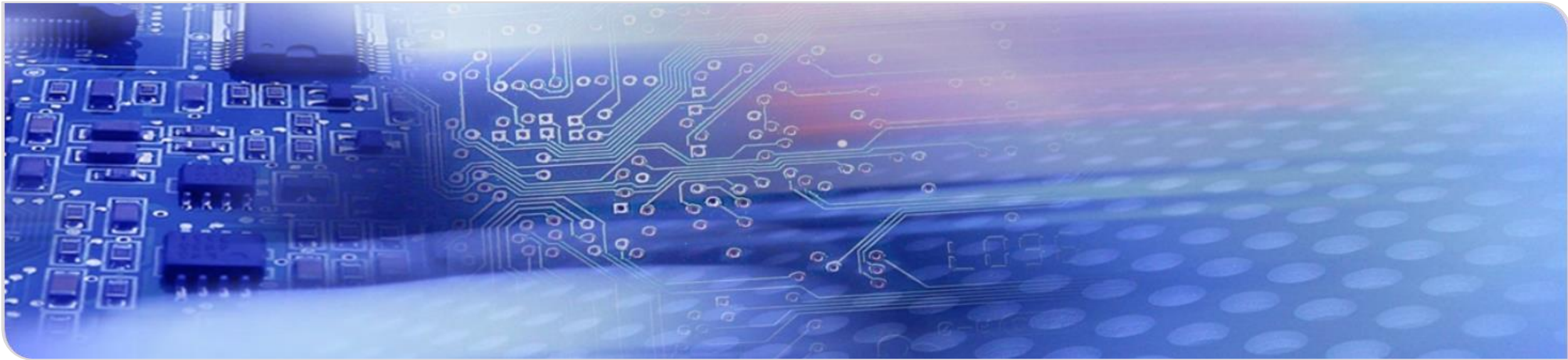


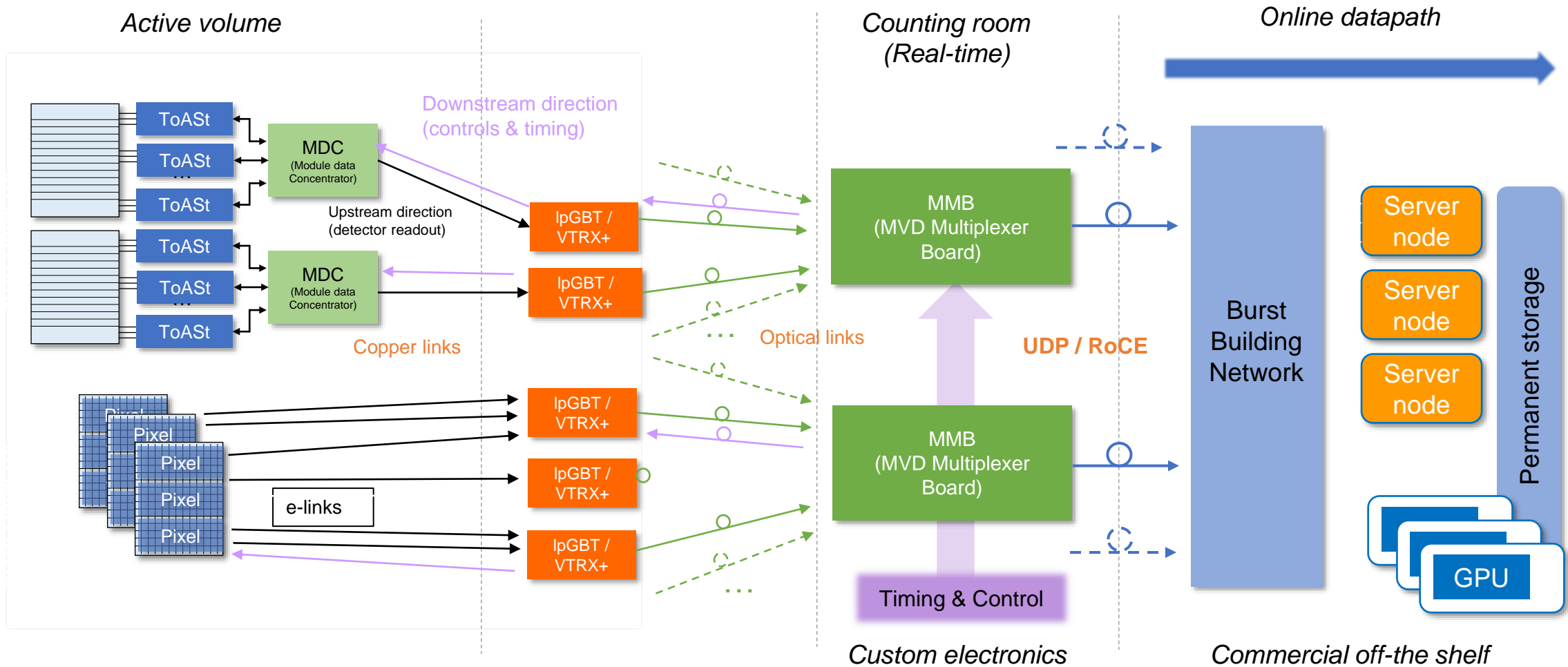
# Status of the KIT-AMC Readout Card & Integration

PANDA Collaboration Meeting 24/2, FEE/DAQ Workshop

Olena Manzhura, Michele Caselle, Timo Dritschler

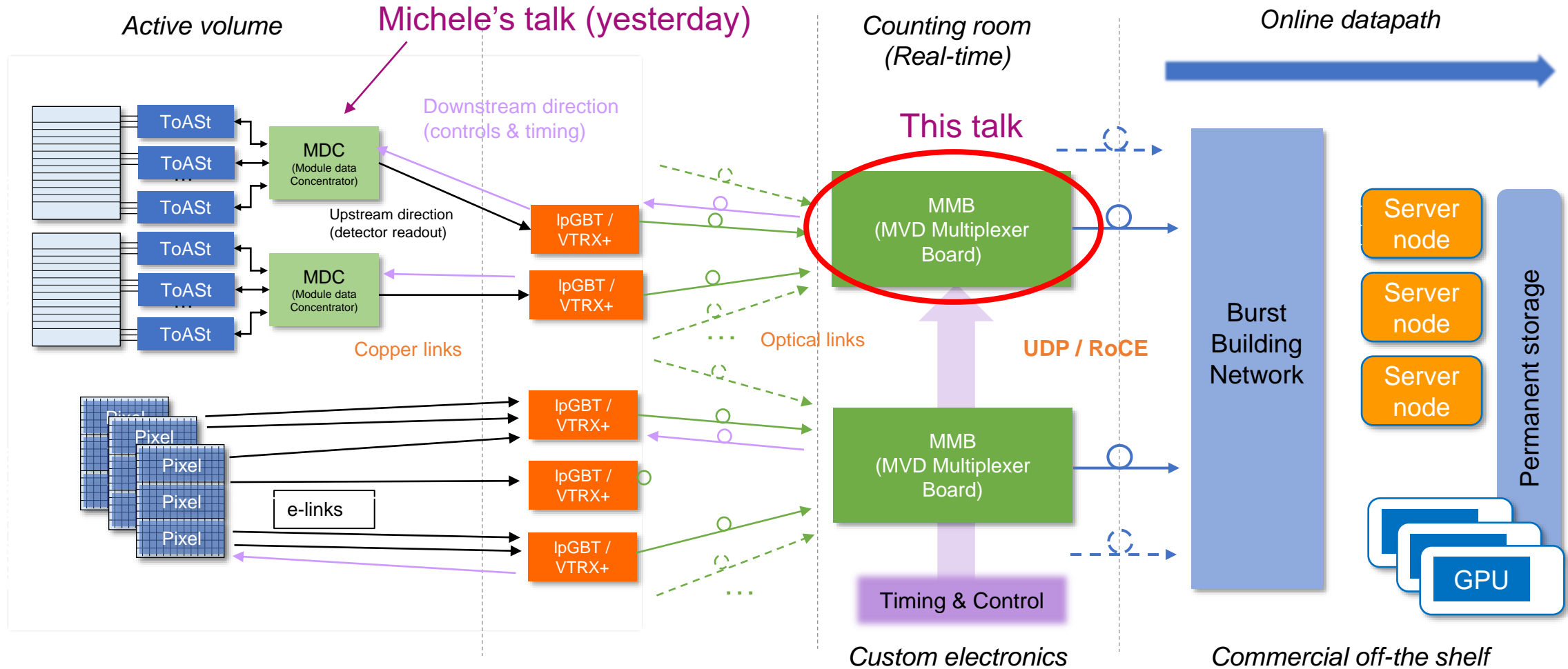


# MVD DAQ Chain



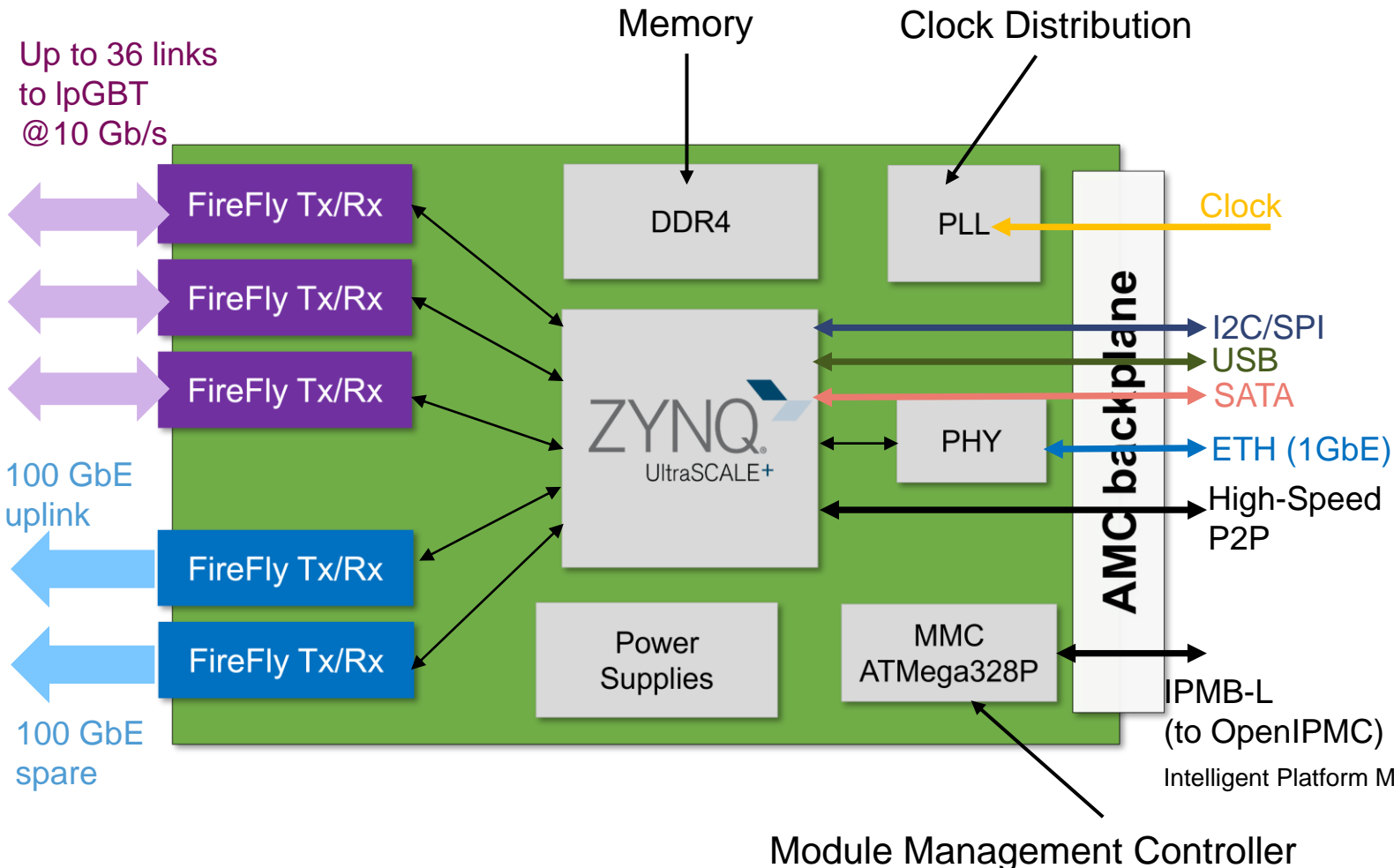
Ref: M. Caselle, A. Kopmann, S. Chilingaryan, PANDA\_DAQ\_TDR (2020)

# MVD DAQ Chain



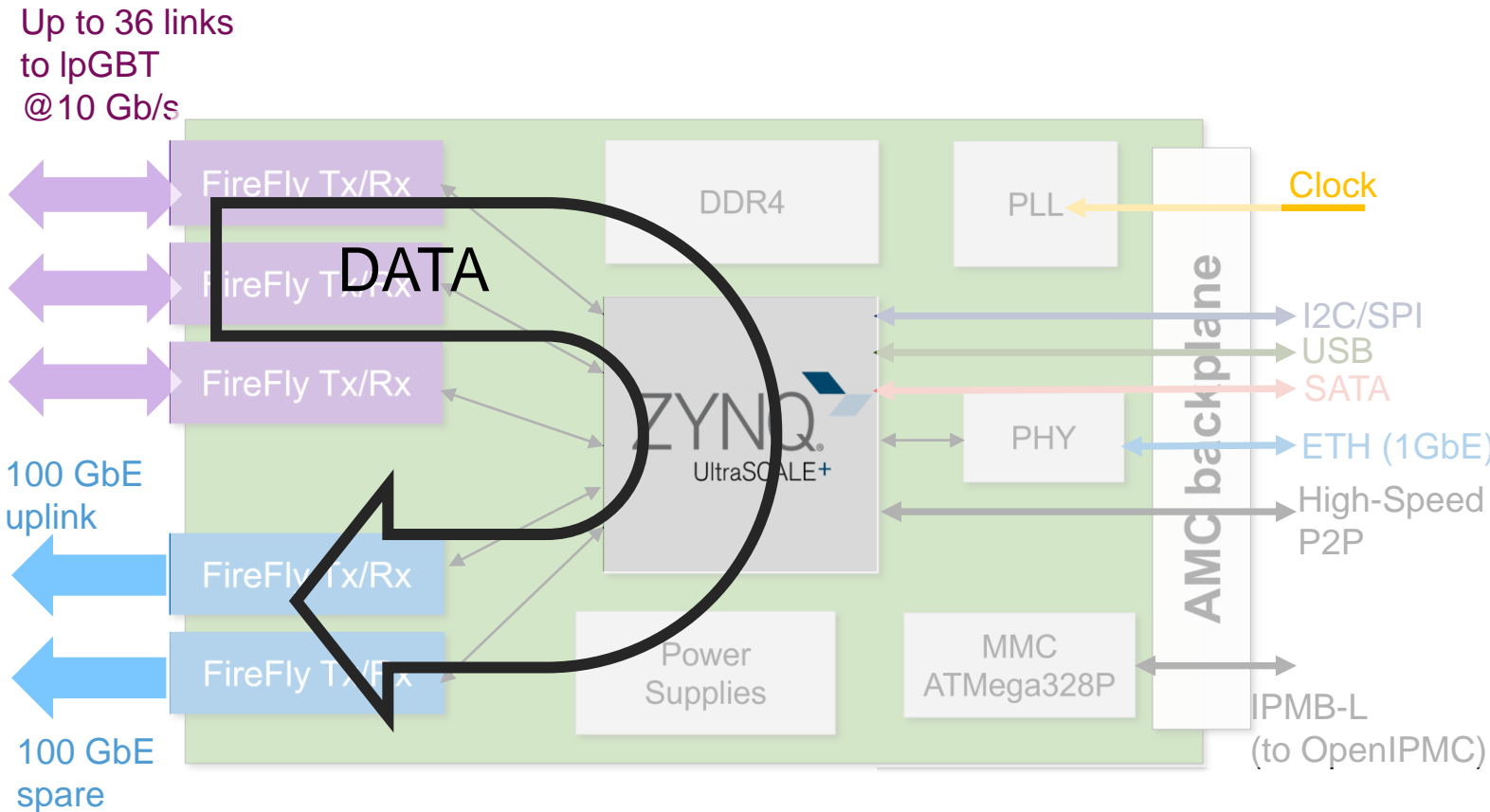
Ref: M. Caselle, A. Kopmann, S. Chilingaryan, PANDA\_DAQ\_TDR (2020)

# MMB Overview - Features



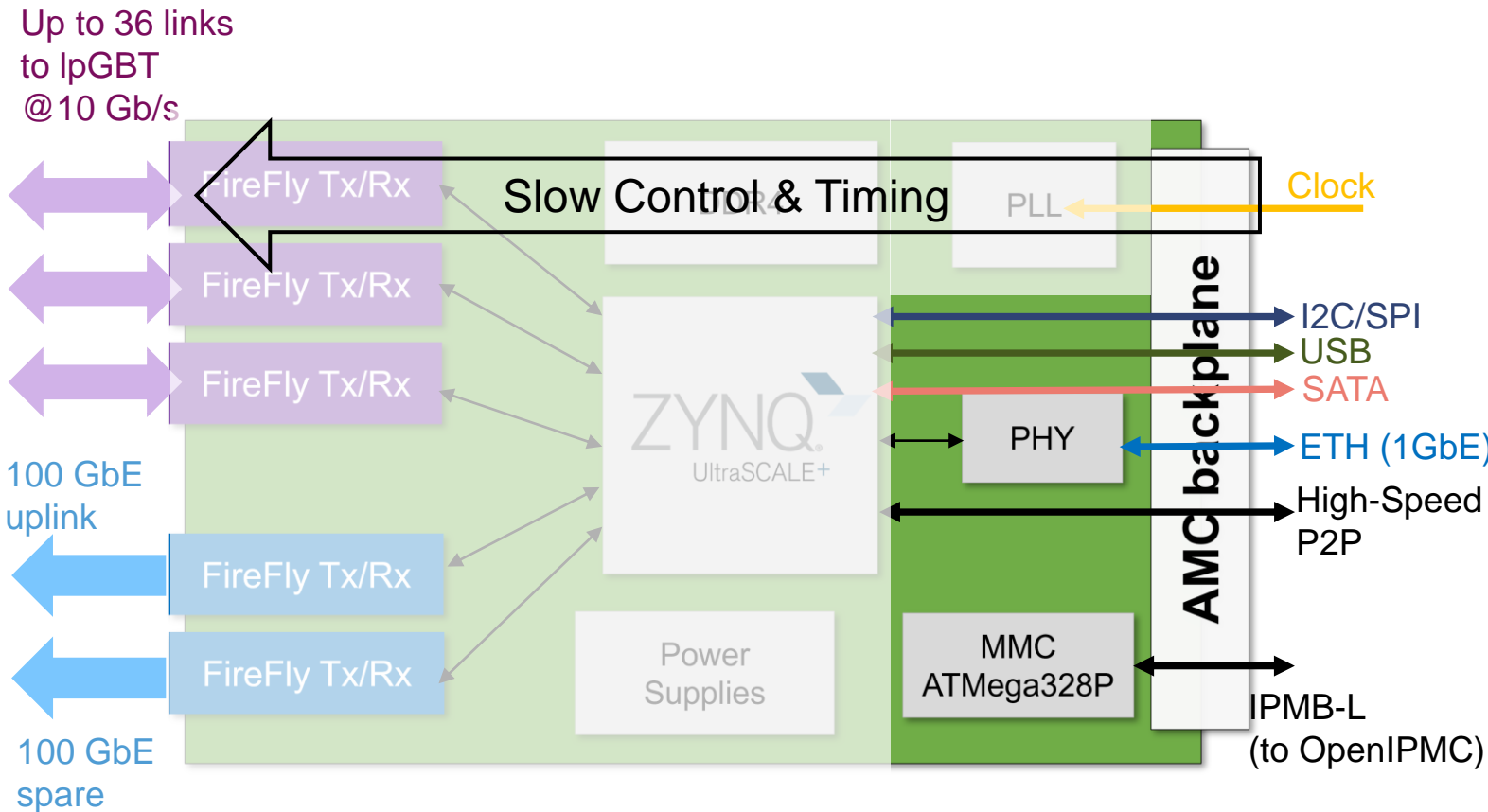
- Advanced Mezzanine Card (AMC) Module
- Compatible with  $\mu$ TCA & ATCA
- Exchangeable with AMC Data Concentrator of P. Marciniewski
- Dramatical reduction of number of off-detector cards to readout complete MVD with three cards

# MMB Overview – Data Flow



- From/To detectors: 36 optical links
  - Via IpGBT (low power GigaBit Transceiver)
    - designed by CERN
- From/To counting room: 8 optical links
- Two ETH links: one active, one spare
  - data throughput up to 200 Gb/s

# MMB Overview - Management

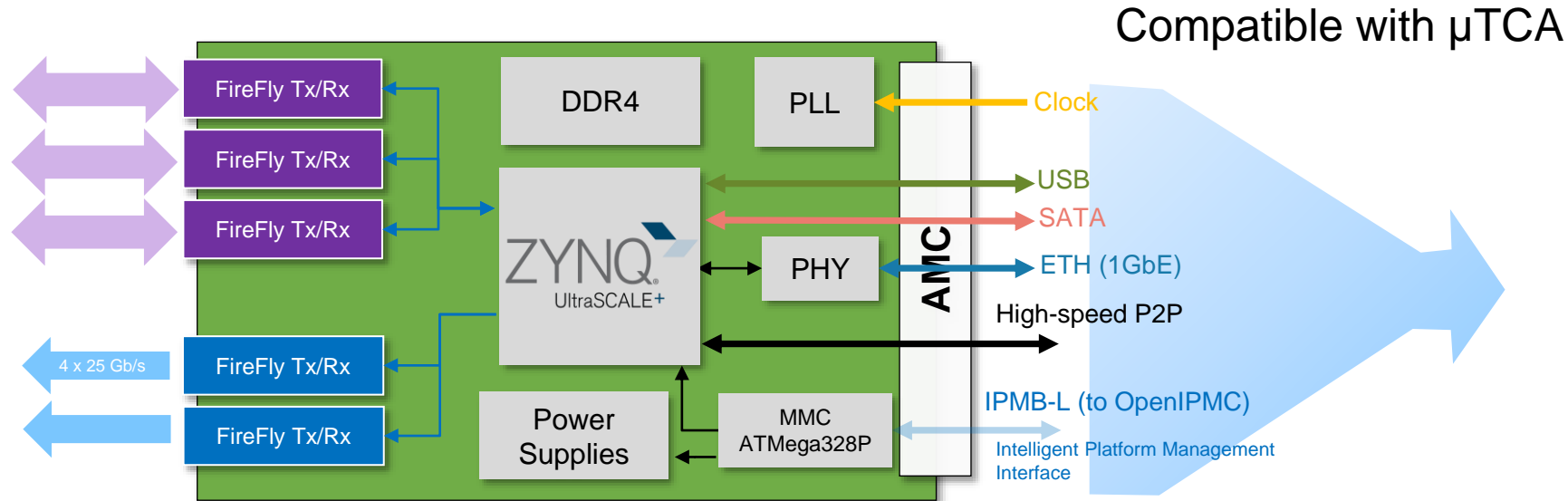


## Interfaces:

- ETH, PCIe, UART
- Slow Control & Timing:
- Integration by ETH over AMC backplane
- Intelligent Platform Management Interface (IPMI), same of AMC card from P. Marciniewski

# Unifying all Standards

## Accelerating Science Common Readout Platform



Compatible with many MCH (MicroTCA Carrier Hub) controllers

- Direct integration card in μTCA systems

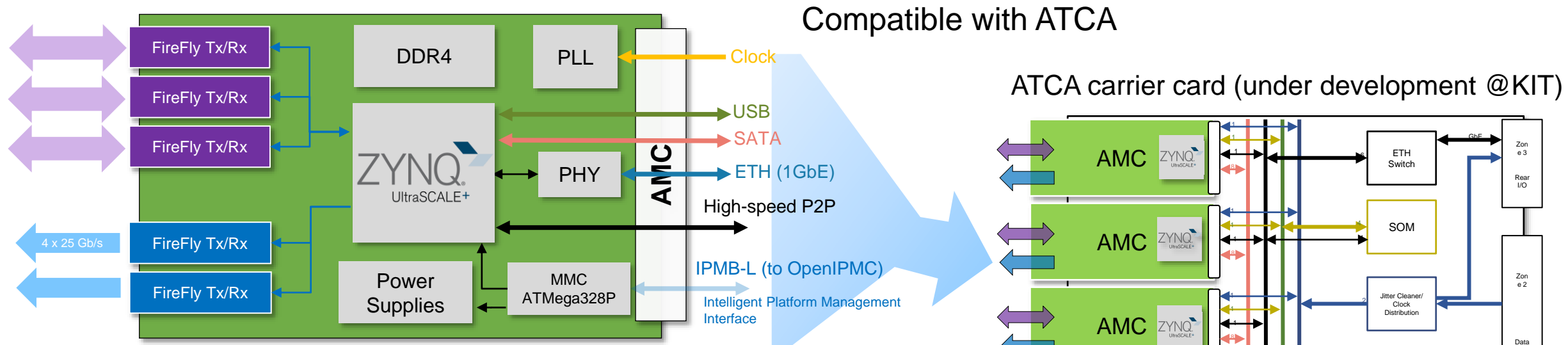
- Applications:

- Beam diagnostics instrumentation (Helmholtz framework: EuXFEL, FLUTE, FLASH, ...)
- Several sub-detectors at HL-LHC and GSI/FAIR is based on μTCA readout frame
- ... and many more



# Unifying all Standards

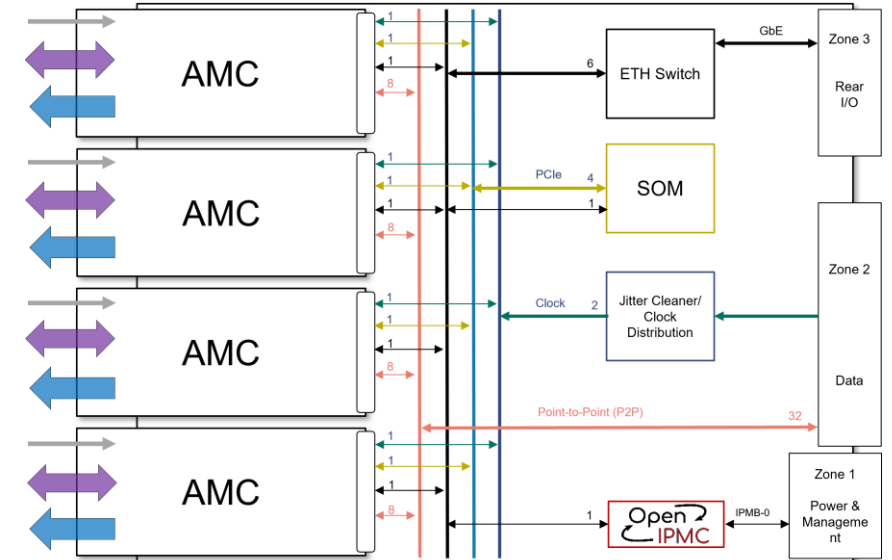
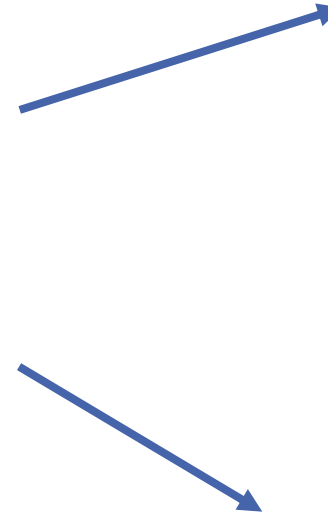
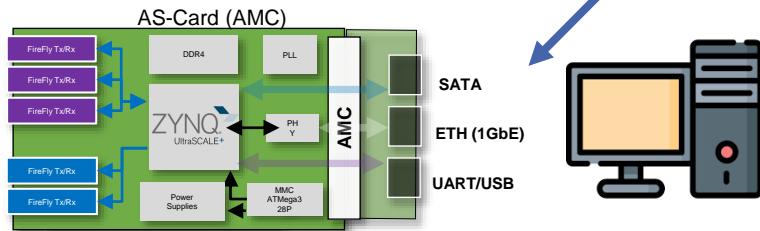
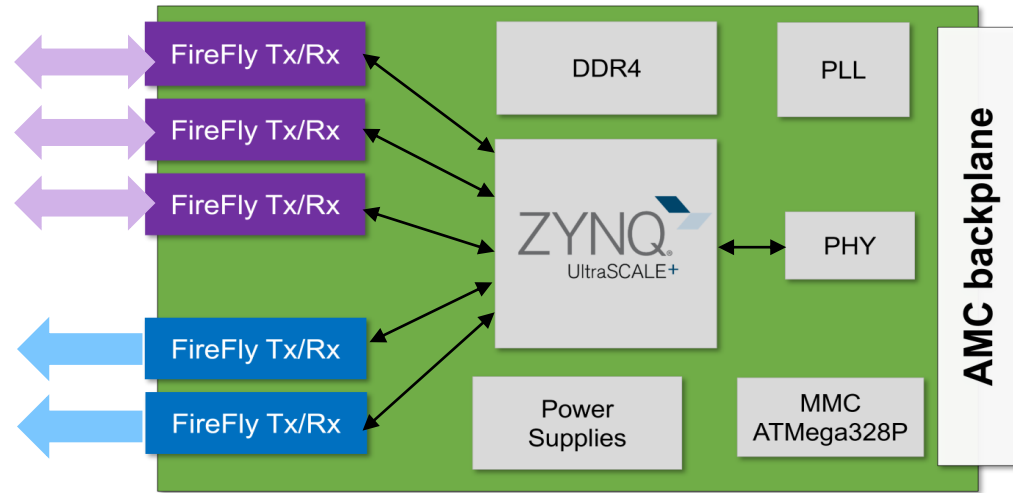
## Accelerating Science Common Readout Platform



- Direct integration on ATCA systems
- Applications:
  - HL-LHC experiments with a higher modularity & scalability
- The system features: # 144 optical links from/to detector + up to 8 data links to DAQ (800 GbE)
  - Can be extended up to 240 optical links
  - Four ZYNQ US+ processors → Compatible with Graph NN for AI-tracking

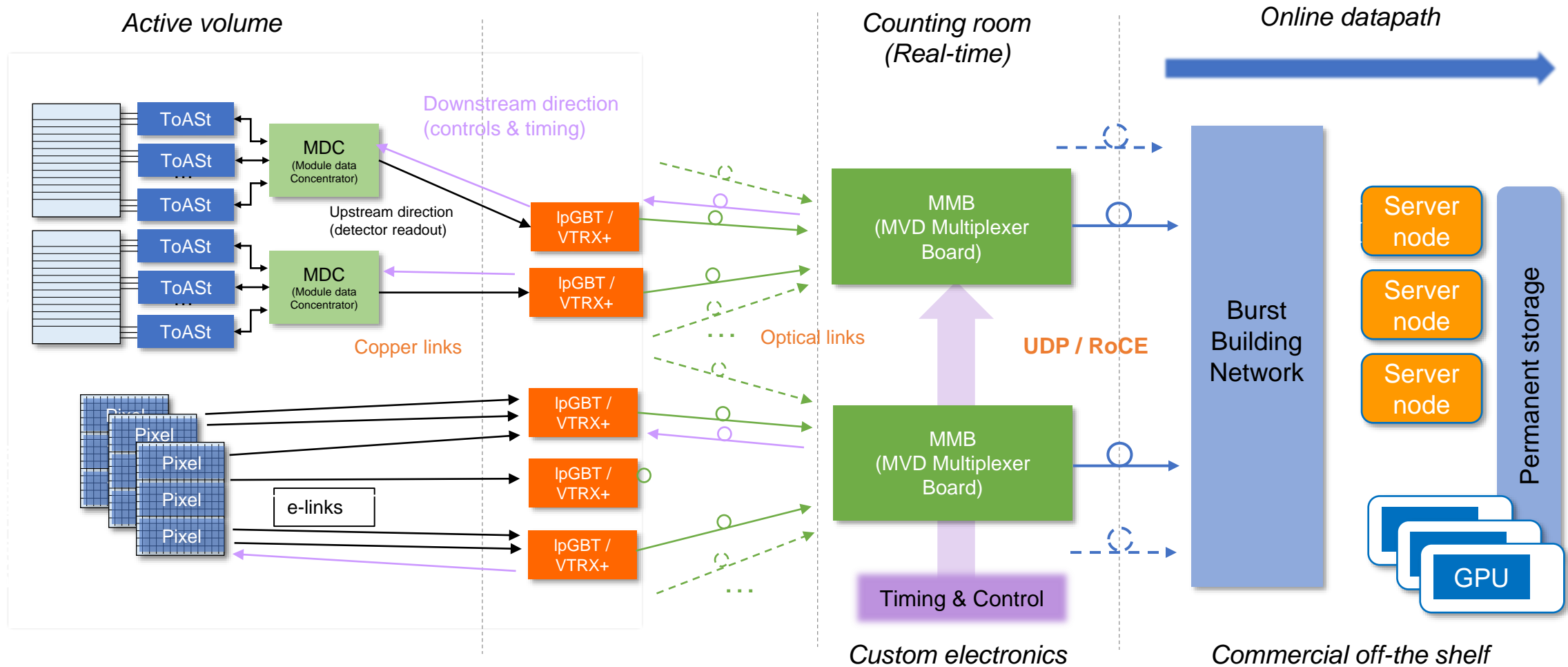


# One System - Multiple Standards



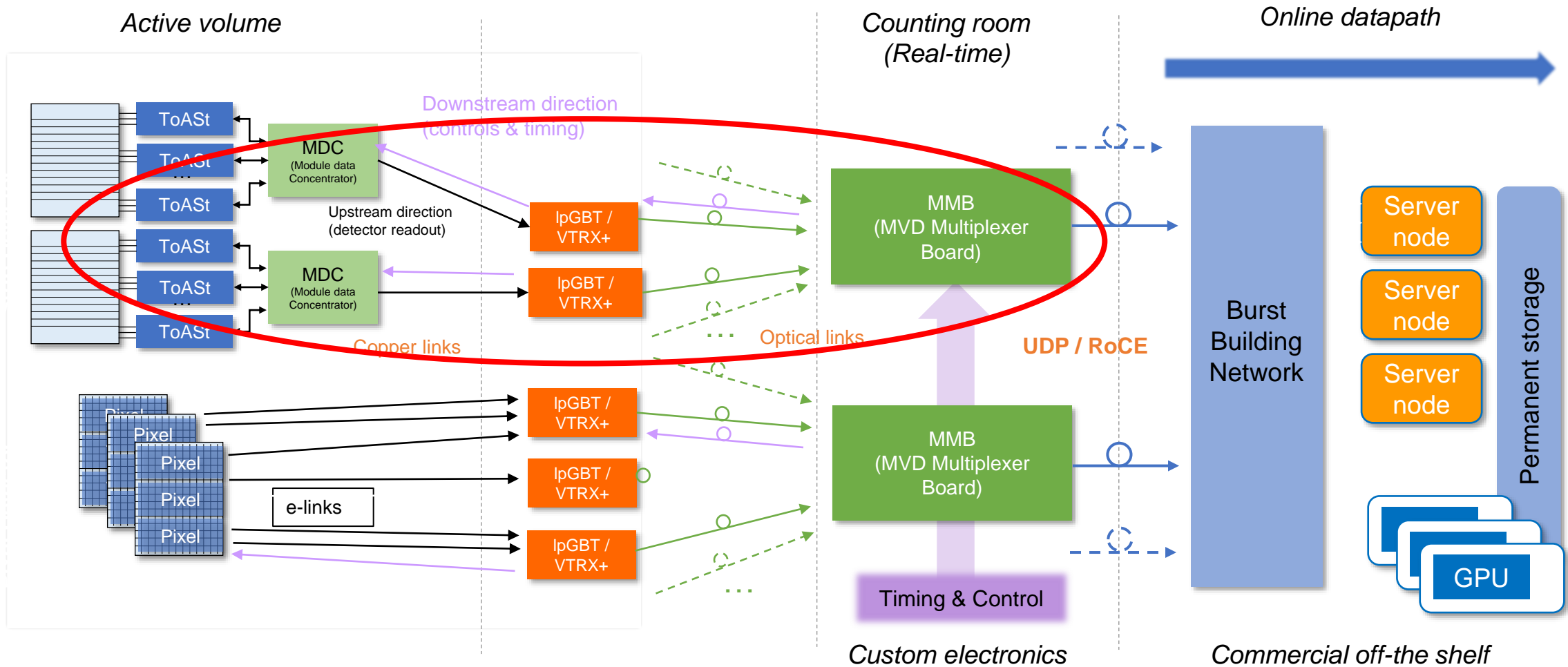
Standalone for lab. test & characterization covered by the same hardware

# MVD DAQ Chain



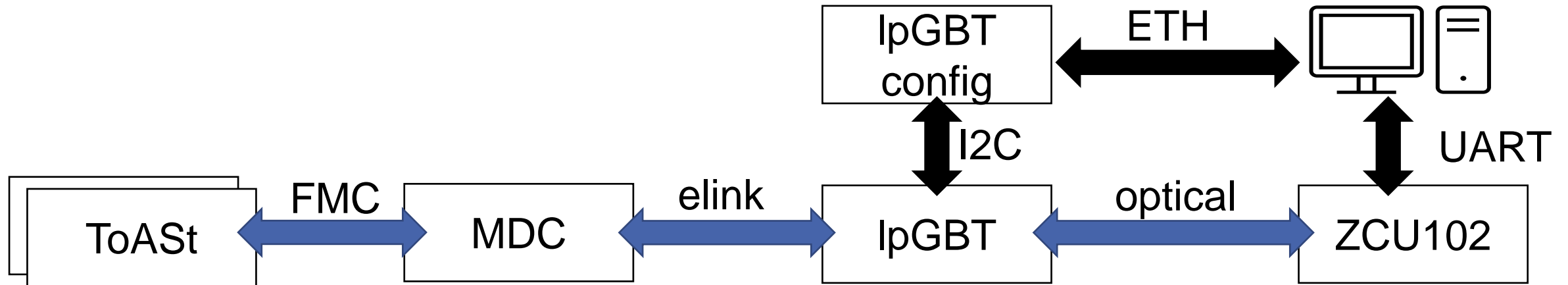
Ref: M. Caselle, A. Kopmann, S. Chilingaryan, PANDA\_DAQ\_TDR (2020)

# MVD DAQ Chain



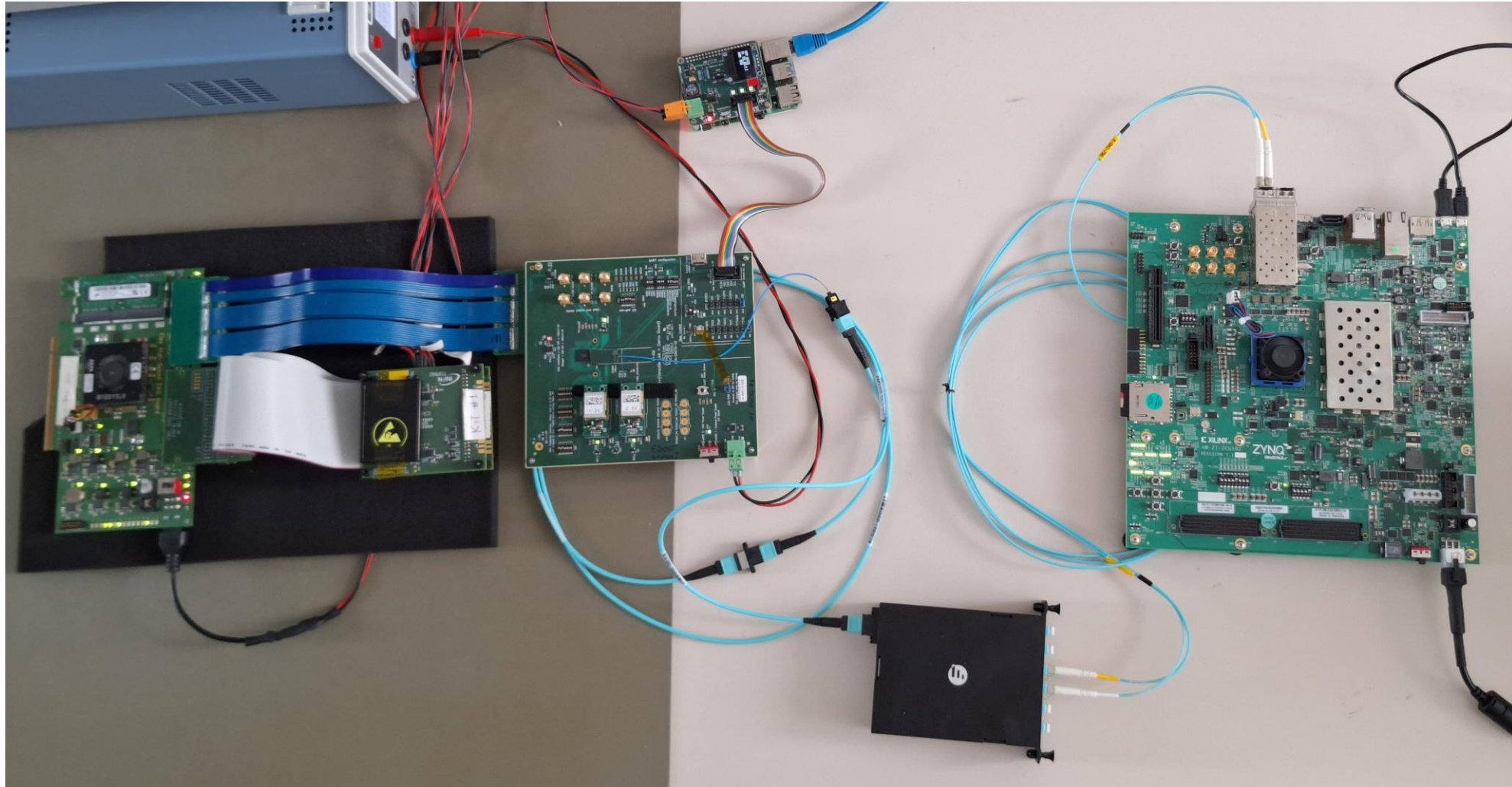
Ref: M. Caselle, A. Kopmann, S. Chilingaryan, PANDA\_DAQ\_TDR (2020)

# Test Setup – Full MVD Readout Chain



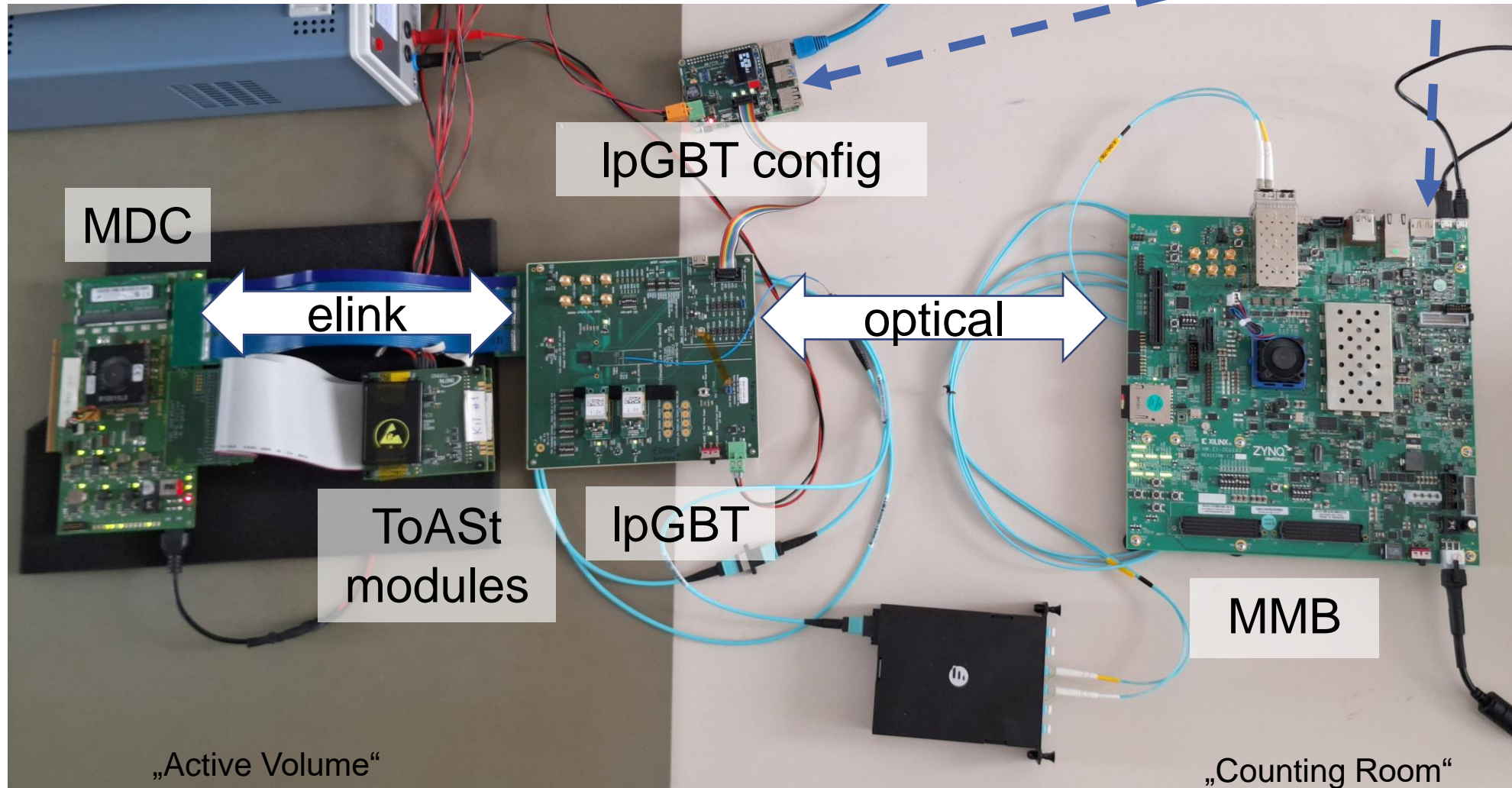
- Two ToASt chips
- High Flex
- Mimics MDC
- Versatile Link Plus Demonstrator Board (VLDB+)
- Configuration via Raspberry Pi
- AMD-Xilinx ZCU102 evaluation board
- Mimics MMB
- FPGA on ZYNQ US+ for real-time processing
- ARM processor for config & debug and data quality check

# Test Setup – Full MVD Readout Chain (ctd.)

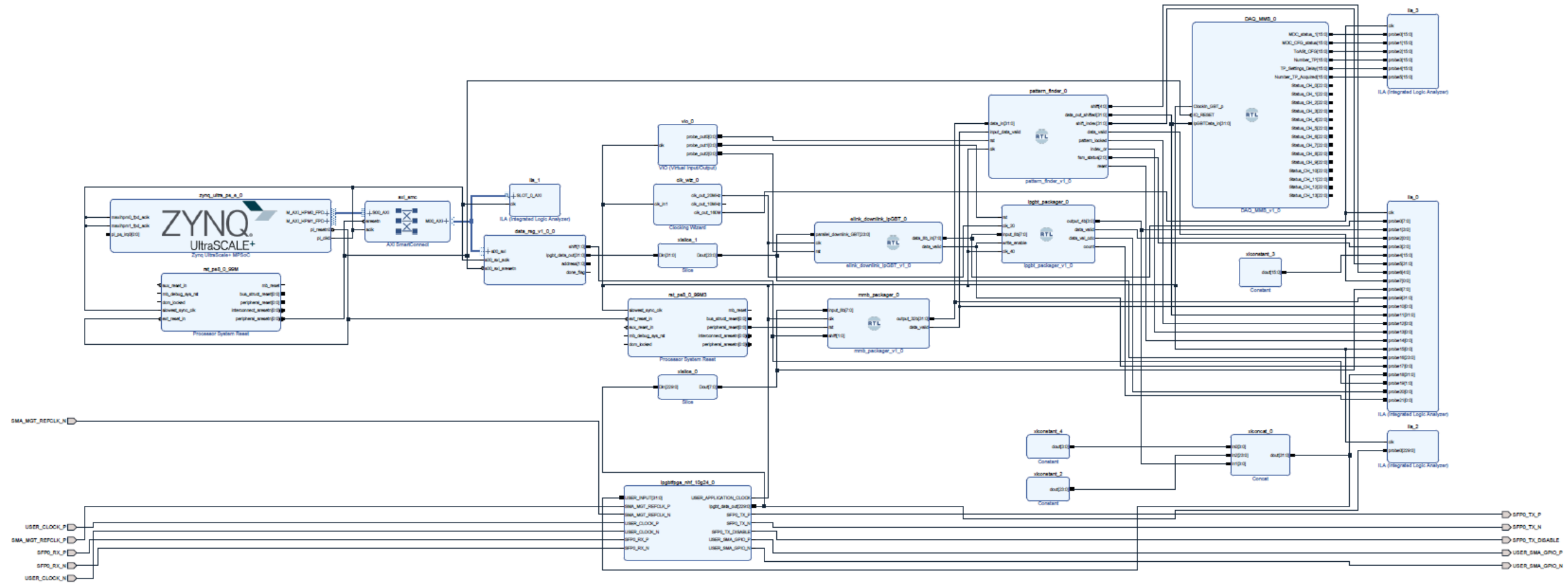




# Test Setup – Full MVD Readout Chain (ctd.)



# Test Setup – Firmware





# Test Setup – Firmware

Data from ToASt (Readout DATA)

Data to ToASt (Configuration & Commands)

ARM processor

User Bank  
Reg

ToASt configuration via Linux  
SoC (ARM processor)

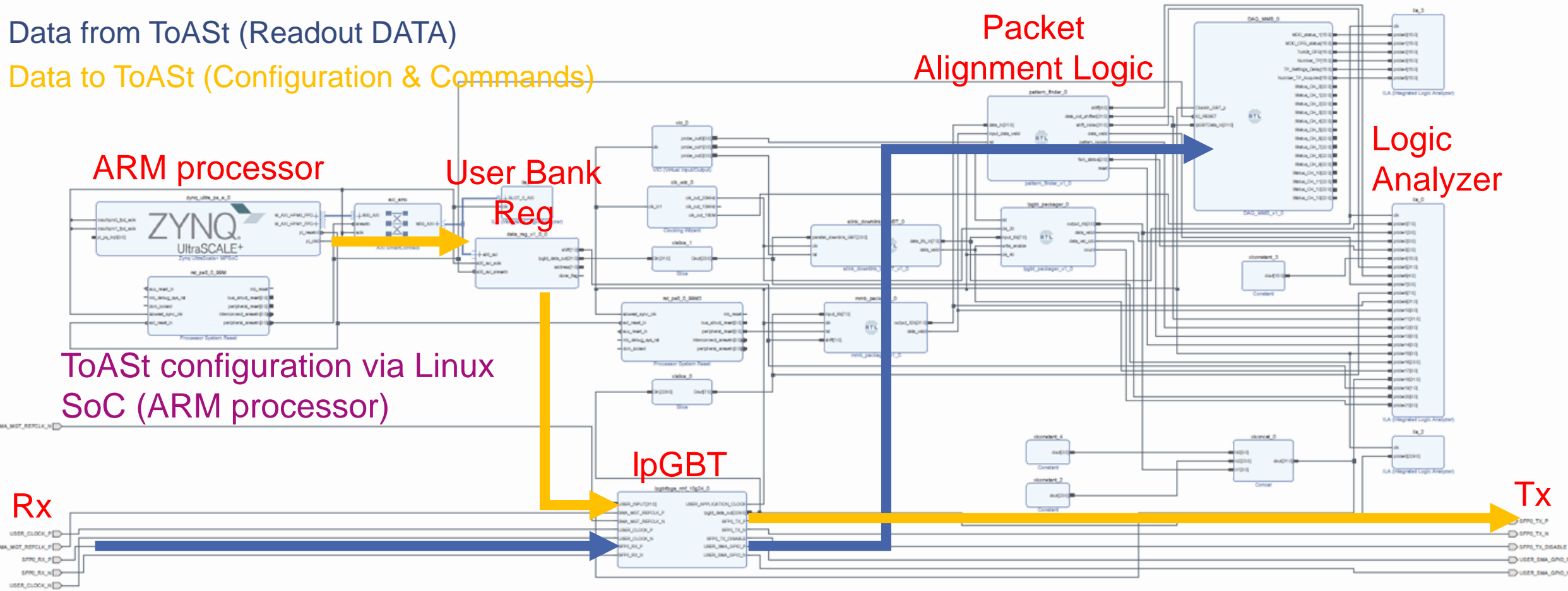
IpGBT

Packet  
Alignment Logic

Packet  
Decoder

Logic  
Analyzer

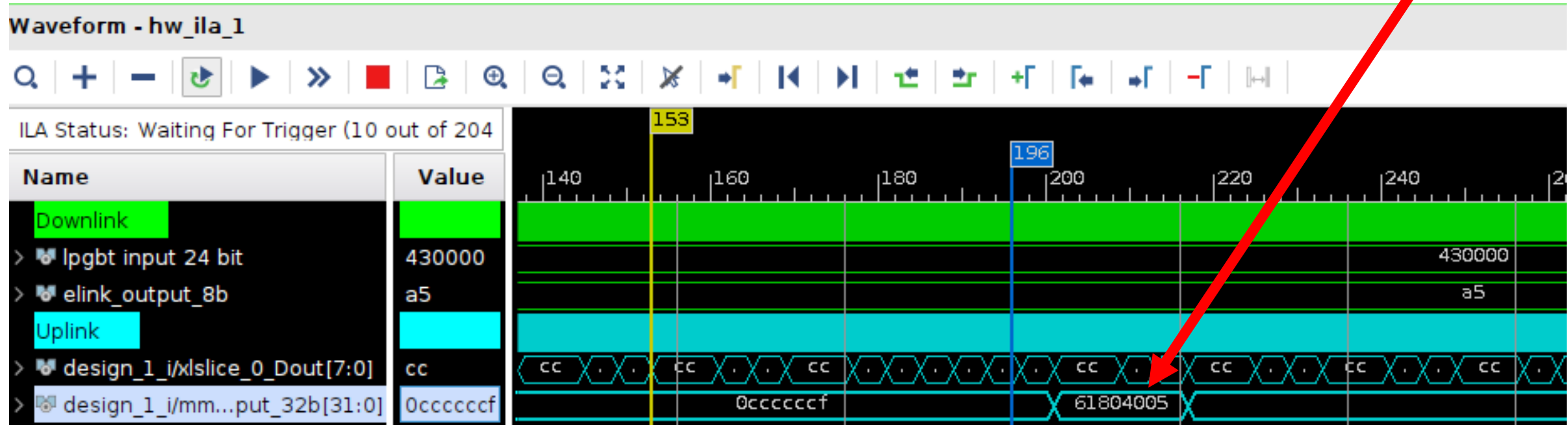
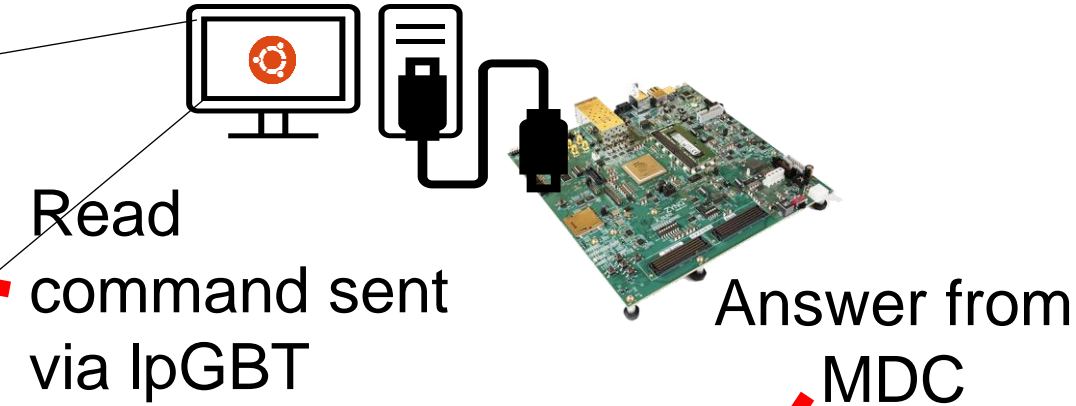
Tx



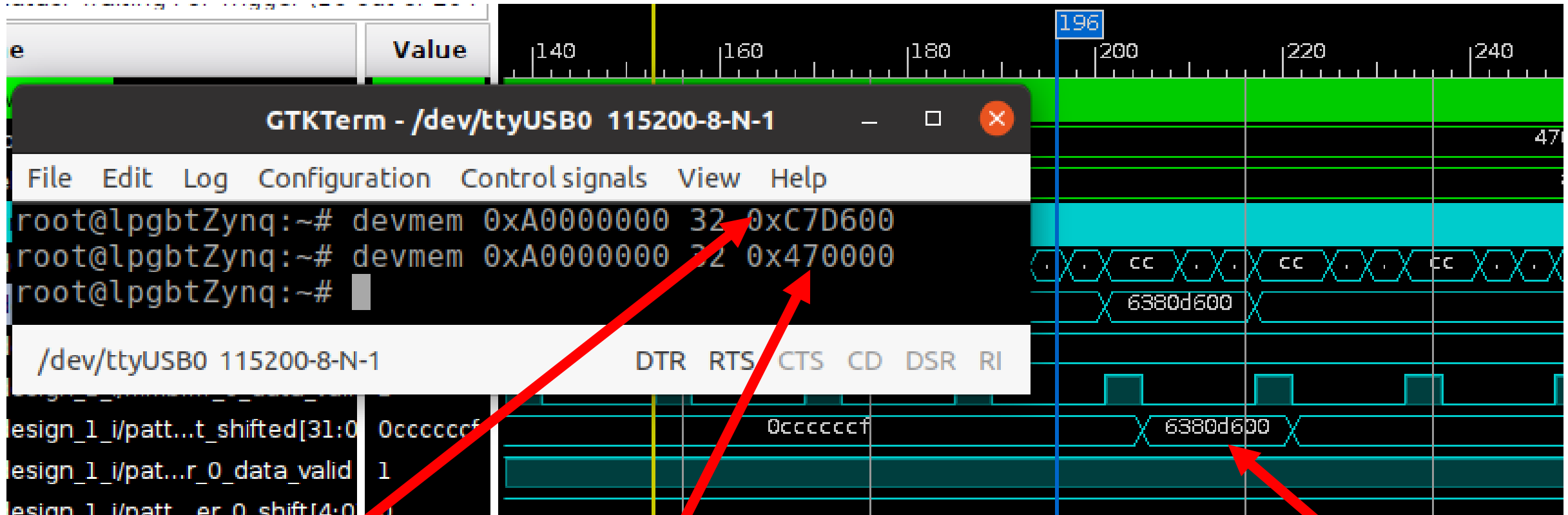
# Communication with the MDC

```

GTKTerm - /dev/ttyUSB0 115200-8-N-1
File Edit Log Configuration Controlsignals View Help
root@lpgbtZynq:~# devmem 0xA0000000 32 0x430000
root@lpgbtZynq:~#
  
```



# Writing and Reading Registers



The image shows a terminal window and a logic analyzer. The terminal window, titled 'GTKTerm - /dev/ttyUSB0 115200-8-N-1', displays the following commands and output:

```

root@lpGBTZynq:~# devmem 0xA0000000 32 0xC7D600
root@lpGBTZynq:~# devmem 0xA0000000 32 0x470000
root@lpGBTZynq:~#
  
```

The logic analyzer shows the data bus signals. A red arrow points from the terminal output '0xC7D600' to a signal labeled '6380d600'. Another red arrow points from the terminal output '0x470000' to a signal labeled '6380d600'. A third red arrow points from the terminal output '0x470000' to a signal labeled '6380d600'.

Write command  
(writing „D600“ to address 7)

Read command

Answer from MDC

# Outlook

- MMB schematic reviewed, layout will start in July (2024)
- Test setup for continuous integration of MVD readout chain with real detectors ✓
  - IpGBT interface on ZYNQ device developed and available ✓
  - Control, configuration and debugging by ARM processor ✓
  - Readout of multiple ToASt chips via IpGBT ✗
- Data readout firmware
  - 100 GbE communication (UDP/RoCE) ✗
  - Aurora Sync protocol integration (support from Grzegorz's team very appreciated) ✗

# Thank you!

