New version of high performance Compute Node(CN) for PANDA Streaming DAQ system







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RT2018, Williamsburg.USA

Outline



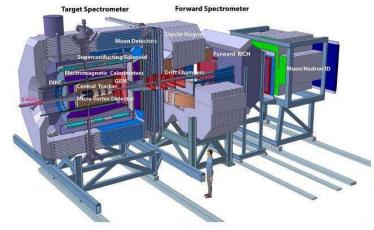
- **■** PANDA Introduction
- **♯** PANDA DAQ system
- **#** Old version of CN
- **■** New version of CN
- **■** Testing result of CN
- **#** summary

PANDA Introduction



- □ PANDA is a next generation hadron physics detector planned to be operated at the future Facility for Antiproton and Ion Research(FAIR) at Darmstadt, Germany.
- It will use cooled antiproton beams with a momentum between 1.5GeV/c and 15 GeV/c interaction with various internal targets.
- In the PANDA experiment, the antiprotons will interact with an internal target, either a hydrogen cluster jet or a high frequency frozen hydrogen pellet target, to reach a peak luminosity of up to 2x10³²cm⁻²s⁻¹.



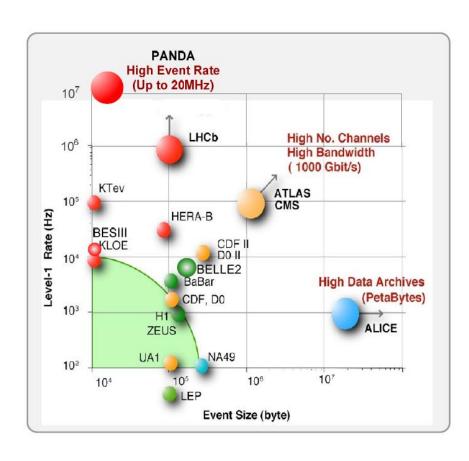


Requirements to DAQ system



- **■** Each event: 1.5Kbyte-4.5Kbyte,
- Considering electronic noise, background and signal accumulation, DAQ should has ability of data processing about 200GBps.

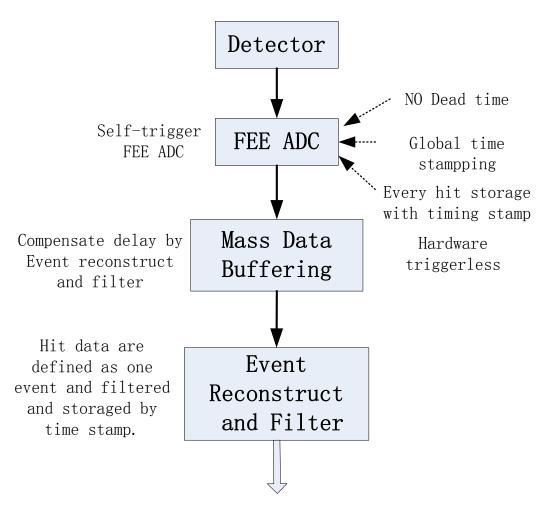
How to deal with such big data with NO Dead Time is a great challenge to DAQ system.



New concept of DAQ system



- □ Trigger-less streaming
 DAQ with event filtering
- **♯** FEE ADC self-triggered.
- **♯** FEE pipeline, NO Dead Time,
- **♯** Global time distribution for time stamping.

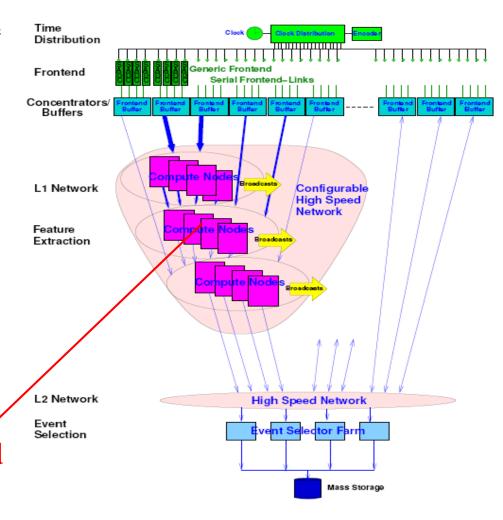


PANDA DAQ system



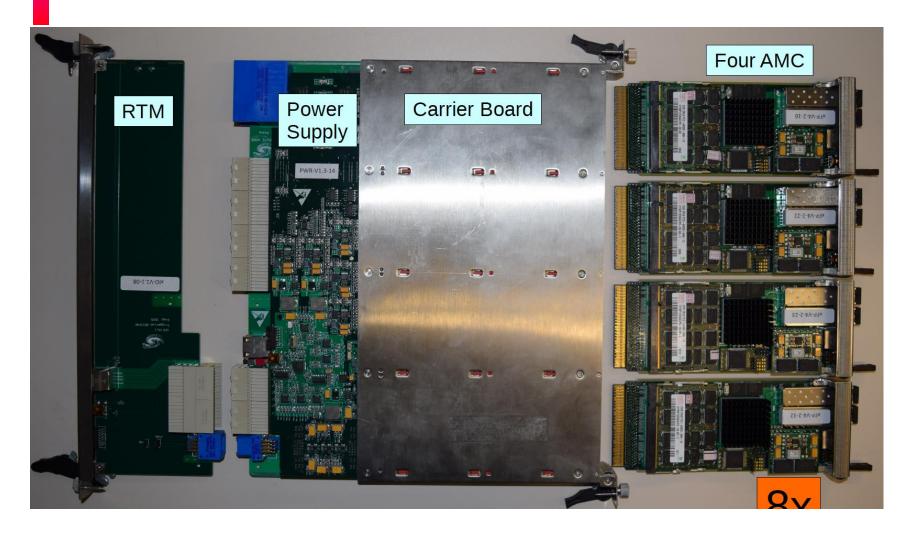
- **■** Global time distribution for time stamping,
- **■** L1 Network,
 - Extract particle information like energy, position, momentum and so on;
- L2 Network,
 - Make a preliminary reconstruction for physics events;
- Event selection will be done based on the research topics of PANDA experiment.

Compute Node is central board for PANDA DAQ.



Old Version of CN(CN_V3)



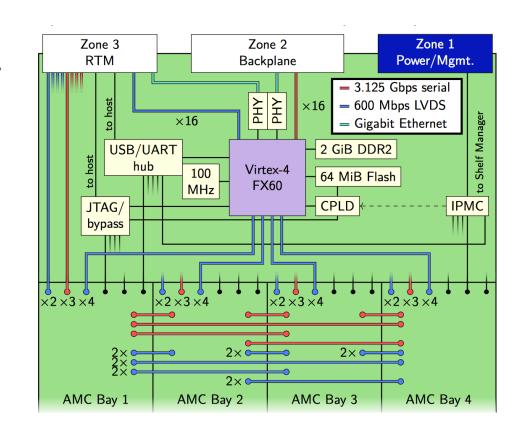


CNCB(CN Carrier Board) V3.3



Function and performance

- ATCA standard
- > Virtex-4 FX60 with PowerPC405,
- Embedded linux system for slow control,
- > 16 MGT channels connect to backplane, 3.125Gbps
- > 2GB DDR2,
- > 2 Gigabit Ethernet ports,
 - > One to ATCA Z2 basic port
 - > One to RTM RJ45
- > 64MB Flash,
- > JTAG, UART Hub,
- > IPMC,
- > AMC Full mesh connection.

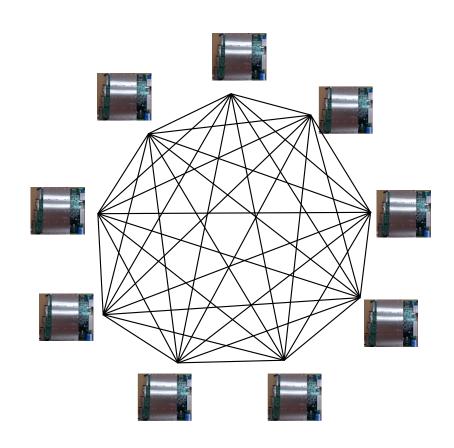


Backplane Full Mesh for CN



- Full mesh backplane for CN data sharing with each node,
- Point to Point via one MGT channel,
- **■** Line rate up to 3.125Gbps

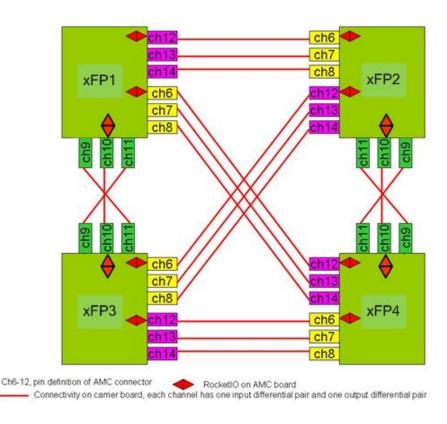




CN Carrier Full mesh for AMC



- Full mesh connection for AMC,
- Point to Point directly via Carrier board,
 - > One MGT port,
 - > Two general LVDS links
- **■** Line rate up to 3.125Gbps

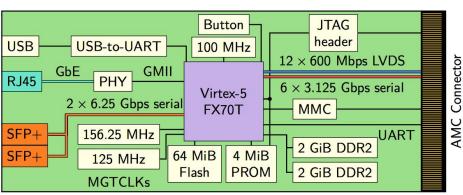


xFP(xTCA-based FPGA Processor

♯ Function and performance

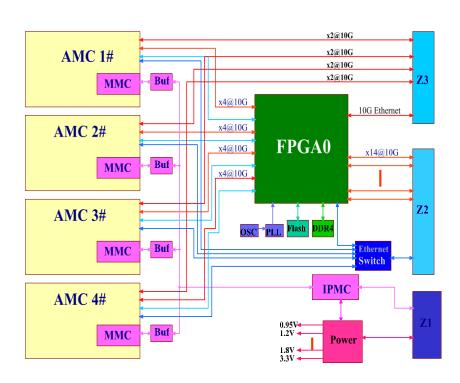
- Virtex-5 FX70T with PowerPC440,
- Embedded linux system for slow control,
- > 8 MGT channels
 - > 2xSFP+ port, 6.25Gbps/ch
 - > 6 chs to AMC connect,6.25Gbps/ch
- 12x 600 Mbps LVDS
- > 2x2GB DDR2,
- > 1 Gigabit Ethernet port,
- > 64MB Flash,
- > PROM for FPGA configuration
- > 2 UART ports,
- > MMC





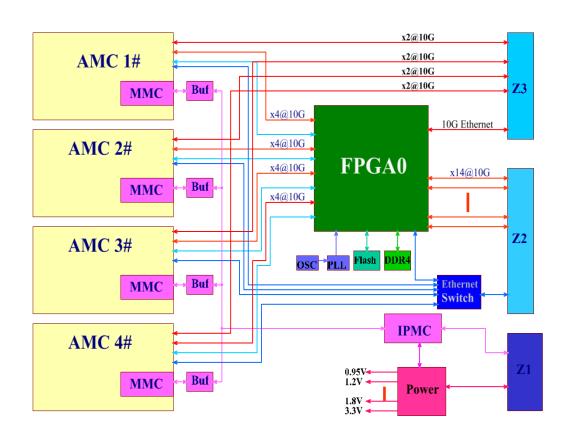
Compute Node Upgrade: Carrier Board Pinn

- **FPGA:** Virtex4 FX60 —> Ultrascale Kintex xcku060
- **RAM:** 2 GB DDR2 SODIMM —> 16 GB DDR4 (8 chips)
- **MGTs:** 6.25 Gbps → 16.3 Gbps
 - 4 links to each AMC card (currently: 4 x600 Mbps LVDS)
 - 12 links to ATCA backplane
 - 1 link to RTM (10G Ethernet)
- **GbE** switch:
 - 4 AMCs,
 - 1 switch FPGA,
 - 1 uplink to ATCA Base Interface
 - 1 RTM RJ45
- 10 Gigabit Ethernet to RTM(SPF+)



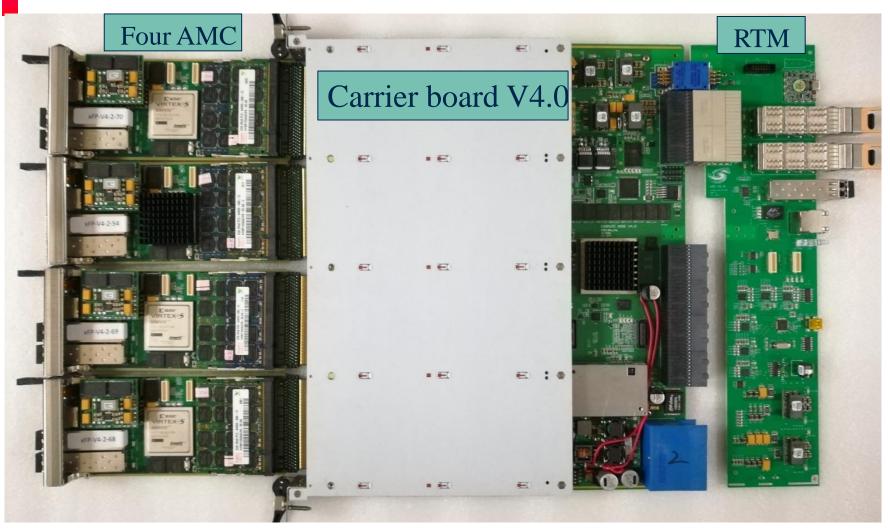
Compute Node Upgrade: Carrier Board THEP

- **★ Configuration:** Flash/CPLD (slave serial) —> automatic from NOR Flash (master BPI)
- **♯** Programmable MGT clock
- **#** CPLD as **JTAG** hub
- # Keep:
 - I2C buses, sensors
 - IPMC/MMC



First Version of CNV4.0





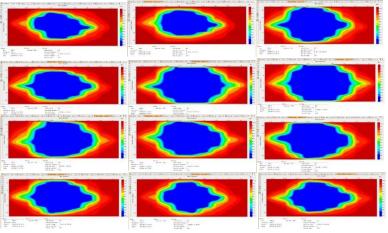
CN Backplane MGT channel test



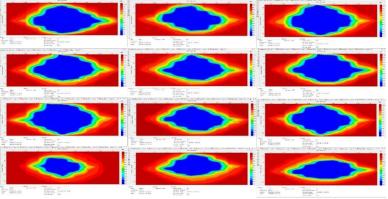
◆ Crate:

- ◆ Two ATCA Slots,
- ◆ 12 Backplane channel point-to-point, connection between two slots,
- ◆ 25Gbps/ch for Backplane connector.
- ◆ 24 hours, No error on 12.5Gbps.
- ◆ Error rate <1E-15.





Backplane MGT 10G 12channel

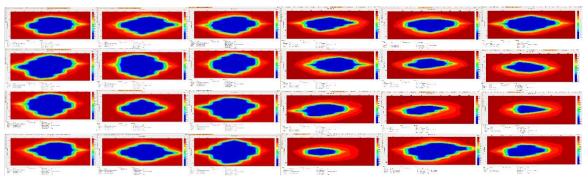


Backplane MGT 12.5G 12channel

FPGA0-AMC MGT channel test



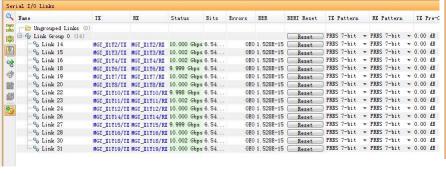
- ◆ Testing setup
 - Four AMC loopback board,
 - ♦ AMC connector on AMC and Carrier board support 10Gbps/ch,
- ◆ 12 hours, No error on 10Gbps and 12.5Gbps.
- ◆ Err rate <1E-15.

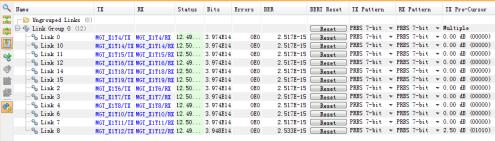




AMC MGT 10G

AMC MGT Pre-Cursor 12.5G





Summary



- New structure of Streaming DAQ system is designed for PANDA.
 - Hardware Trigger-less
 - No dead time
 - Data driving
- **♯** Compute Node is central board for PANDA DAQ.
- New version of CN based on Ultrascale Kintex is finished.
- **★** All essential functions are tested successfully.



Thanks for your attention.