MPV – Parallel Readout Architecture for the VME data acquisition system

RIKEN Nishina Center, CNS University of Tokyo A, Tokyo City University B, Kyoto University C, Tohoku University D, Tennessee University E

Concept = Parallelize data readout of VME modules

1 CPU Board readout all VME module data
1 module per 1 readout board

Parallelize!!

New architecture = MPV (compatible with 32bit VME standard) MOCO + Parallelized Backplane + Controller

Overview

Side view

MPV Controller LVDS I/O (4 x 6 Lines)

Communicate with controller via the backplane (serial lines)

Data lines are separated between slots
Power lines are shared as same as the standard bus

Xilinx Zynq (PicoZed)

MPV Backplane (parallelized backplane)

Controller position

VME module from front side, MOCO from rear side

Parallelized Backplane

MPV Controller merge data from MOCO
Dataway

- CAEN V792 34word readout
- **15us** dead time
  - conversion 7.4us
  - readout 7.6us
- interrupt latency < 20ns

MOCO
cost-efficient VME master (FPGA)

merge data
(CPU resource)

1. FPGA : Receive data from MOCO
2. FPGA : store data into FIFO
3. FPGA : copy data to DDR
4. CPU : merge data from DDR
5. CPU : send merged data to server

1-3 = Real Time
4-5 = depends on CPU resource

max 1.2Gbps

2.8Gbps throughput
Performance measurements

- Random trigger
- Compared with VMIVME (CPU board)
- readout data from x1 or x2 V792 QDCs
- VMIVME (CPU board)
  - dead time depends on the number of modules
  - OS’s interrupt latency, 20us
- MPV (Parallel readout)
  - the same dead time for x1, x2 V792
  - no interrupt latency

- 10kHz periodic trigger
- 40, 80, 160 Mbps dummy data / MOCO
- Maximum data throughput = 400Mbps
  - w/o data merge = 580Mbps

The graph shows the maximum throughput of the test event sender as a function of the number of MOCO. The throughput values are 160 Mbps/MOCO, 80 Mbps/MOCO, and 40 Mbps/MOCO.

The graph also shows the live time ratio as a function of the trigger rate for different configurations:
- MPV V792×1
- MPV V792×2
- VMIVME V792×1
- VMIVME V792×2

The live time ratio is represented by different lines with varying tau values: τ = 15.5us/event, τ = 33.7us/event, and τ = 43.8us/event.