Peripheral Crate VMEbus Controller

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EMU – ESR

CERN, November 2003
Dynatem D360

- 25 MHz 68360 based VMEbus Single Board Controller
- Operating System: µCLinux
- Communicates with Linux PC (in USC55) via 10BaseFL Ethernet (10BaseT has magnetic components)
- Software for PC-D360-VME communications has been written and tested.

- Radiation tolerant
  - Tested with 63 MeV protons.
  - Observed 35 upsets with a proton fluence of $0.74 \times 10^{11}$ p/cm$^2$.
  - Recover from upsets with “system reset”. Requires 47 resets in 10 LHC-years.

- Speed
  - Transfer rate: 10 Mb/s bit rate, though-put ~ 2.5 Mbits/s achievable.
  - Speed of loading FPGA firmware to EPROM dominated by required erase/program delays on chip.

- Cost ~ $1100 per unit
A VMEbus Controller with Gigabit Ethernet

- A custom board designed and developed at OSU
- Based on XILINX Virtex-II Pro
  - XC2VP4 – FF672 FPGA
  - Built in RocketIO™
    - Supports Gigabit Ethernet
    - 8B/10B Encoding, SerDes, Clock Recovery included (no Logic Cells used)
- Optical transceiver (for Gigabit Ethernet)
- VME Interface Buffers
- Command FIFO (for buffering VME commands)
- Flash Memory (for storing configurations)
- Flash PROM (for storing the firmware)
Advantages

General Advantages
- Communicates with stand-alone PC (in USC55) via Ethernet
- GbE network cards commercially available (with optical fiber connections).
- Customizable firmware.

Advantages Over Dynatem
- A much simpler crate controller.
- No 10BaseT to 10BaseFL converters needed.
- No operating system or software on the controller.
- No sockets to open for each connection.
- All programming done on PC.
- Customized packets reduce overhead (explained on next slide)
- Faster: transfer rate 1 Gb/s bit rate (compare to 10 Mb/s) through-put ~ 600 Mb/s (compare to 2.5 Mb/s)
- Less expensive: ~ $600 per unit (compare to $1,100 per unit)
Advantages

Packet Structure in use with Dynatem (with TCP/IP):

<table>
<thead>
<tr>
<th>Bytes:</th>
<th>7</th>
<th>1</th>
<th>6</th>
<th>6</th>
<th>2</th>
<th>46 - 1500</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preamble</td>
<td>S</td>
<td>O</td>
<td>MAC</td>
<td>DST</td>
<td>MAC</td>
<td>SRC</td>
<td>Length</td>
</tr>
</tbody>
</table>

Physical Layer — Data Link Header — Protocol and User Data — Physical Layer

Min. Packet Size: 64+8
Worst case overhead with TCP/IPV6 and 1 VME: 7/(12+8+14+67+4)=6.7%
Best case overhead with TCP/IPV4 and 208 VME: 1456/(12+8+14+1496+4)=94.7%

IPv4 | TCP | Data
---|---|---
20 | 20 | 6 - 1460

IPv6 | TCP | Data
---|---|---
40 | 20 | 0 - 1440

**Customized Packets (with GbE)**

- Can eliminate TCP/IP layer
- Can utilize jumbo packets (9000 bytes of data)
- Bit rate is 100 times faster than 10BaseT
Hardware Development
- Non-Restrictive board design.
- Sent to PC house last week.
- Most parts are on hand.
- Board Stuffing to take place next week.

Firmware Development
- Will be developed in stages.
- RocketIO™ implementation has been previously tried and tested.
- Start with rudimentary A24 D16 VME master.
- Add other functionality, flexibility, configuration control, and robustness as progress is made.
Any Questions?
Distributing GbE to 60 Crates

- Need a Level 2 GbE Network Switch
  - Level 2 means MAC address level.
  - Must have optical fiber outputs.

- Commercially available
  - Netgear makes one with 12 GbE fiber optic outputs for about $2000.