VXS, A High Speed Cu Switch Fabric Interconnect for VME

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VME Renaissance

- VME is a +20 year old technology.
- VME Renaissance is an intense period of intellectual activity and technology infusion surrounding VMEbus
- Many innovations, including but not limited to
  - Faster 2eSST parallel bus
  - Multi-gigabit switched serial interconnects
  - PCI-X chip to chip interconnect
  - PCI-X mezzanines
  - Point to point intra-connects
  - Point-to-point mezzanines
VMEbus Technology Roadmap

Data Plane Inter-Connect
- Parallel Switched
  - Raceway™
  - SKYchannel

Control Plane Inter-Connect
- VME64 VMEbus
- 2eSST/P2P VMEbus

Mezzanine Inter-Connect
- 2eSST/P2P VMEbus
  - 2eSST VME side
  - P-P Host side connect

Chip to Chip Inter-Connect
- Point-to-Point Chip Connect
  - P/S RapidIO™
  - 3GIO
  - Hypertransport
  - Infiniband™, etc. etc.

Form Factor
- Next Gen Mezzanine
  - HA fabric
  - Mesh
  - Optical

Next Gen Fabric
- Next Gen VMEbus
  - QDR Technology

Next Gen Mezzanine
- Point-to-Point Mezzanine
  - P/S RapidIO™
  - 3GIO
  - Hypertransport
  - Infiniband™, etc. etc.

VXS – VMEbus Switched Serial
- Adds multi-gigabit per second switched serial links to VME
- Via a new P0 connector
- Dual star configuration uses one or two switch cards
- Multiple link technologies supported by structured specification
- Additional power brought onto each card
- Plug Fest during 03’ and 04’

- 160 millimeters deep

Source: Jeff Harris, Motorola
Payload and Switch Boards

Payload

Two 4X channels + mgnt
A0K0
P0
P1
P2

Switch

User I/O

Two 4X channels
VME cntrl + mgnt + live insert
Power

160 mm
6U

Alignment + Keying

Motorola
NAVSEA
Tyco Electronics
Interconnect Topologies

- VXS is topology agnostic
- Only Payload and Switch Board Pin outs defined
- Dual star
- Mesh
- Ring

Example Backplane
20 slot dual star
VSO (VITA Standards Organization)

- All work done under VSO (March 2002 to present)

- SIG (6 companies) -> Working Group (+20 companies)
MultiGig RT-2 Assembly

Most Flexible, Most Dense, and Quiet
A Solution Revolution for Multi-Gigabit Backplane applications
MultiGig Product Family Overview

Options

- Complete integrated solution
- Designed to fit within same envelope as signal modules

<table>
<thead>
<tr>
<th>Component</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Connectors</td>
<td>18 A contacts, 2 &amp; 4 lines/module</td>
</tr>
<tr>
<td>Guide Modules</td>
<td>8 keys/pin, Positive ESD Contact option</td>
</tr>
<tr>
<td>DC Organizer</td>
<td>Modules can be organized as monoblocks</td>
</tr>
<tr>
<td>Cross Connect</td>
<td>Orthogonal Design in Dev.</td>
</tr>
</tbody>
</table>
MultiGig Product Family Overview

Features and Benefits

> Mechanically Robust
  - Pinless Backplane Solution
  - Bellcore Compliant
  - 250 cycle durability

> Electrically Flexible
  - Single Ended and Differential lines within a module
  - PWB’s for Power options available
  - Length Matching
  - Skew Control
  - Options available down to 3% Noise at 50 ps
MultiGig RT-2 Differential - Near End Noise

Synchronous Noise
Multiple aggressors

<table>
<thead>
<tr>
<th>Pair</th>
<th>Noise Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pair 7</td>
<td>2.9%</td>
</tr>
<tr>
<td>Pair 5</td>
<td>3.0%</td>
</tr>
<tr>
<td>Pair 3</td>
<td>2.9%</td>
</tr>
<tr>
<td>Pair 1</td>
<td>2.7%</td>
</tr>
<tr>
<td>Pair 8</td>
<td>1.7%</td>
</tr>
<tr>
<td>Pair 6</td>
<td>3.1%</td>
</tr>
<tr>
<td>Pair 4</td>
<td>2.9%</td>
</tr>
<tr>
<td>Pair 2</td>
<td>2.8%</td>
</tr>
</tbody>
</table>

Edge rate: 47 ps (20-80%)
MultiGig RT-2 Differential - Far End Noise

Synchronous Noise
Multiple aggressors

Pair 7  1.6%  Pair 8  2.7%
Pair 5  2.1%  Pair 6  2.4%
Pair 3  2.6%  Pair 4  2.2%
Pair 1  3.0%  Pair 2  1.0%

Edge rate:  47 ps (20-80%)
MultiGig RT-2 Differential - Throughput
Physical Test Environment

- Two RT2 connectors, a backplane and 2 daughtercards
- Backplane thickness designed at 0.200” with common FR4 material
- Daughtercard thicknesses designed at 0.125” with common FR4 material
- Trace widths designed at 6 mils on backplane and daughtercards
- 100 differential pairs on all boards
- All connector rows analyzed during the testing
- Top and bottom layer via connections included
- Top layer via connections designed with and without counterboring
Measured RT2 Eye Pattern
(Worst-case trace-to-via connection)

Test Conditions:

• 16” FR4 backplane traces
• 4” FR4 daughtercard traces
• Top layer via connection
• No counterboring
• 27 -1 PRBS
• 46.8% Eye Opening
10 Gbps Data with Advanced Silicon

- Successful recovery of signal
- Not possible at 10 Gbps without advanced silicon

Test Conditions
- 24” FR4 backplane traces
- 4” FR4 daughtercard traces
- 6-mil trace widths
- Top layer via connection
- Counterbored vias
- 27 -1 PRBS
- Advanced Silicon
- Successful data recovery

- Advanced materials will further improve results.
Environmental Testing (MIL-COTS-Telco)

- Concerns raised about MIL-COTS-Teclo acceptance of edge card connectors
  - Address gas tight seal concerns
  - Verifies acceptable operation under vibration
- MIL environment
  - Shock (50g’s), Vibration (15g’s), Humidity (condensing)
  - Salt fog
- Recognized Standards
  - MIL-STD-1344A (MIL-COTS)
  - IEC 603.2 (General)
  - Telcordia GR-1217 (Telco)
<table>
<thead>
<tr>
<th>Test</th>
<th>Group A: Static Test at Component Level</th>
<th>Group B: Dynamic Test at Component Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Examination of Product</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Vibration – Sine (+ monitor for discontinuity)</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Vibration – Random (+ monitor for discontinuity)</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Vibration – Shock (+ monitor for discontinuity)</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Thermal Shock</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Salt Fog</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Low-Signal Level Contact Resistance (LLCR)</td>
<td>2, 6, 8, 12</td>
<td>2, 8</td>
</tr>
<tr>
<td>Insulation Resistance</td>
<td>3, 14</td>
<td>3, 9</td>
</tr>
<tr>
<td>Dielectric Withstanding Voltage</td>
<td>4, 15</td>
<td>4, 10</td>
</tr>
<tr>
<td>Visual examination w/ microscope at 8X magnification.</td>
<td>9, 13</td>
<td>11</td>
</tr>
<tr>
<td>Mate/unmate 25 cycles</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>
Test Setup & Test Sample
Pass/Fail Criteria

• Discontinuity
  – Contacts were continuously monitored for discontinues of 10 Ohms or greater during Shock and vibration testing.
  – No Discontinuities were noted.

• Low-Signal Level Contact Resistance (LLCR)
  – 20 mV open circuit, 100 mA short circuit

• Insulation Resistance
  – 500 Volts DC applied for 2 minutes to mated connector
  – 100 MegOhm minimum allowed
Test Conclusions

• Passed MIL-STD-1344A tests for
  – Humidity, Condensing
  – Salt Fog
  – Thermal Shock, -55 to +125 C
  – Vibration, random 11.95 GRMS
  – Vibration, simple harmonic motion, 15 gravity units
  – Shock, half-sine, 11 milliseconds, 50g’s

• Passed Telcordia GR1217
  – Quality level III (highest)