VXS, A High Speed Cu Switch Fabric Interconnect for VME

Henry Wong
Motorola
henryw@motorola.com

James Lee Fedder
Tyco Electronics
jlfedder@tycoelectronics.com

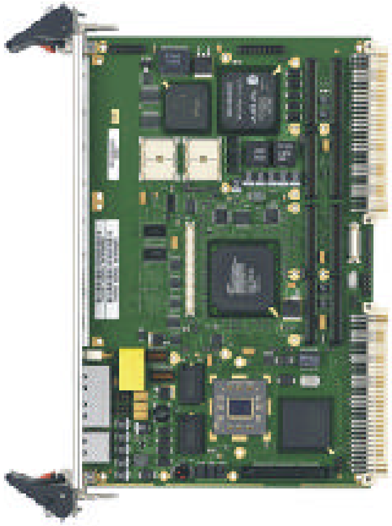
James L Thompson
Crane Division, Naval Surface
Thompson_j@crane.navy.mil

MOTOROLA

NAVSEA
CRANE
Surface Warfare Center Division

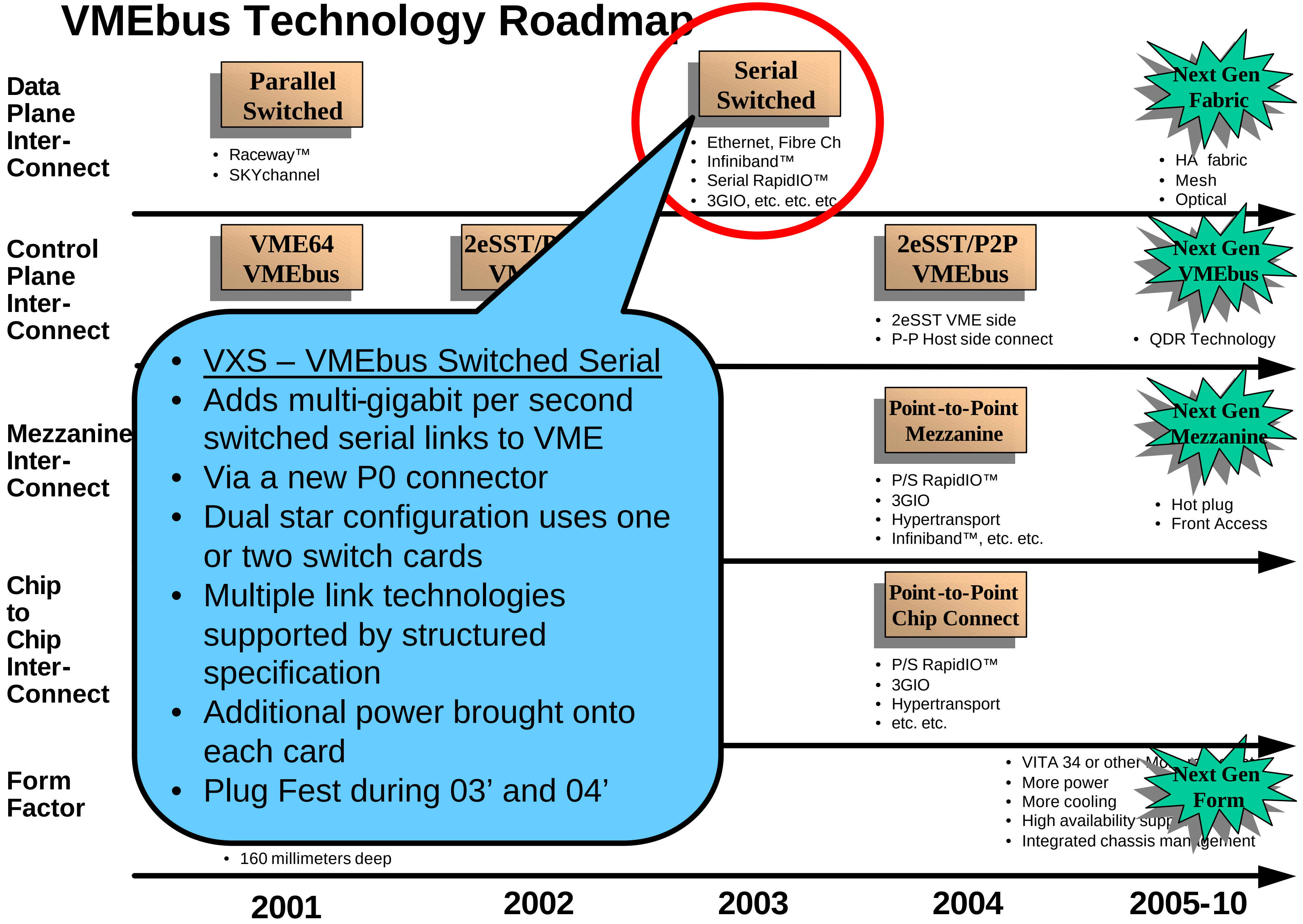
tyco
Electronics

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

Serial Switched
- Ethernet, Fibre Ch
- Infiniband™
- Serial RapidIO™
- 3GIO, etc. etc. etc

Next Gen Fabric
- HA fabric
- Mesh
- Optical

Control Plane Inter-Connect

VME64 VMEbus

2eSST/P VM

2eSST/P2P VMEbus
- 2eSST VME side
- P-P Host side connect

Next Gen VMEbus
- QDR Technology

Mezzanine Inter-Connect

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

Next Gen Mezzanine
- Hot plug
- Front Access

Chip to Chip Inter-Connect

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

Form Factor

- 160 millimeters deep

- VITA 34 or other Mo
- More power
- More cooling
- High availability supp
- Integrated chassis man gement

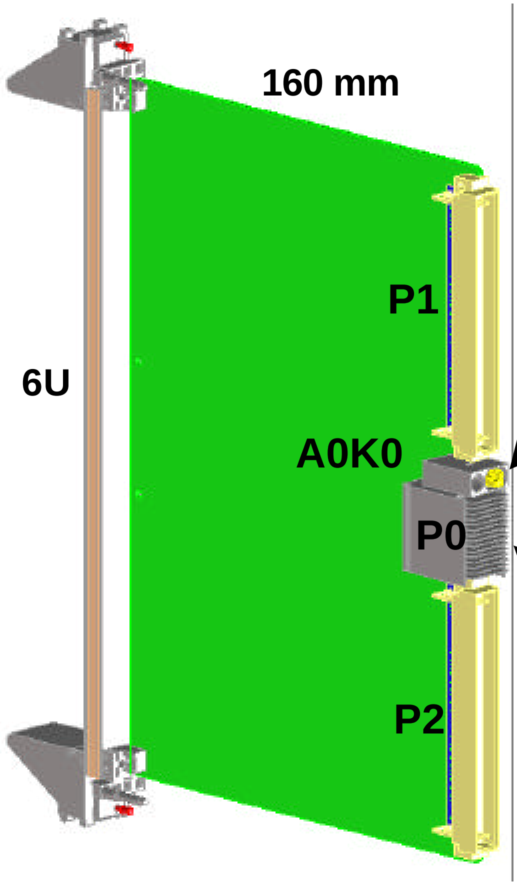
Next Gen Form

- <u>VXS – VMEbus Switched Serial</u>
- 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’

2001 **2002** **2003** **2004** **2005-10**

Source: Jeff Harris, Motorola

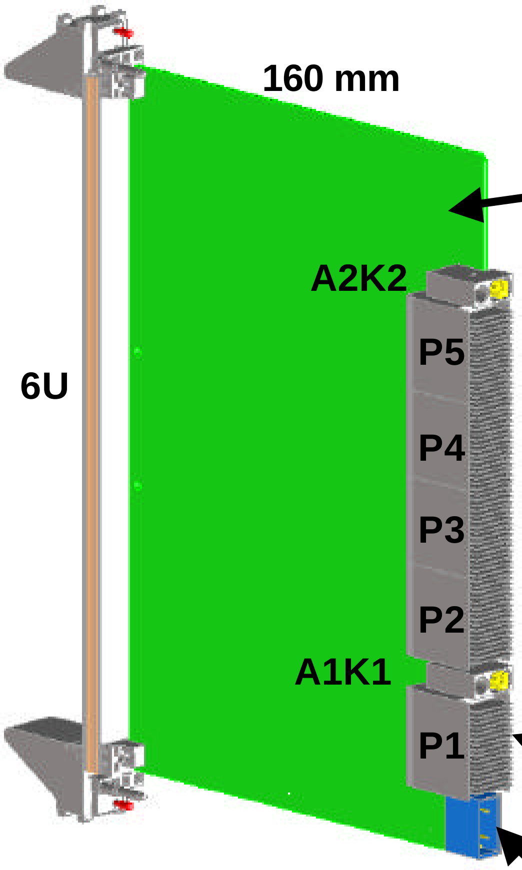
Payload and Switch Boards



Alignment + Keying

Two 4X channels + mgnt

Payload



User I/O

Twenty 4X channels

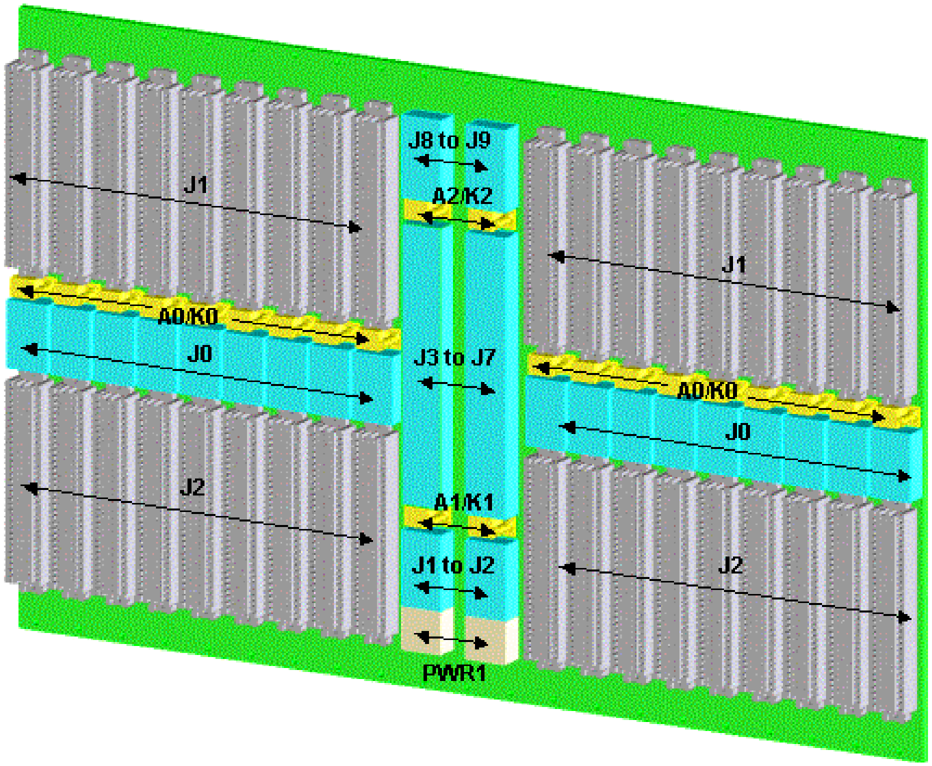
VME cntrl + mgnt + live insert

Power

Switch

Interconnect Topologies

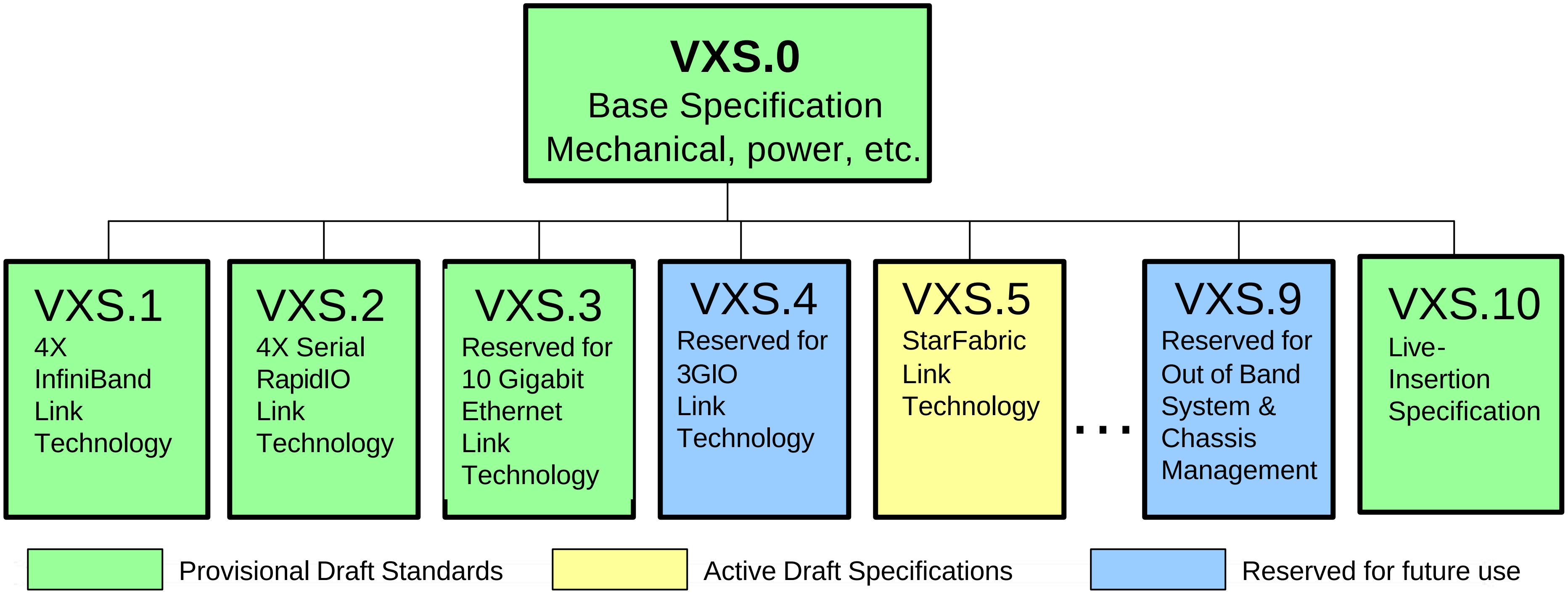
- VXS is topology agnostic
- Only Payload and Switch Board Pin outs defined
- Dual star
- Mesh
- Ring



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)



VXS.0
Base Specification
Mechanical, power, etc.

VXS.1
4X InfiniBand Link Technology

VXS.2
4X Serial RapidIO Link Technology

VXS.3
Reserved for 10 Gigabit Ethernet Link Technology

VXS.4
Reserved for 3GIO Link Technology

VXS.5
StarFabric Link Technology

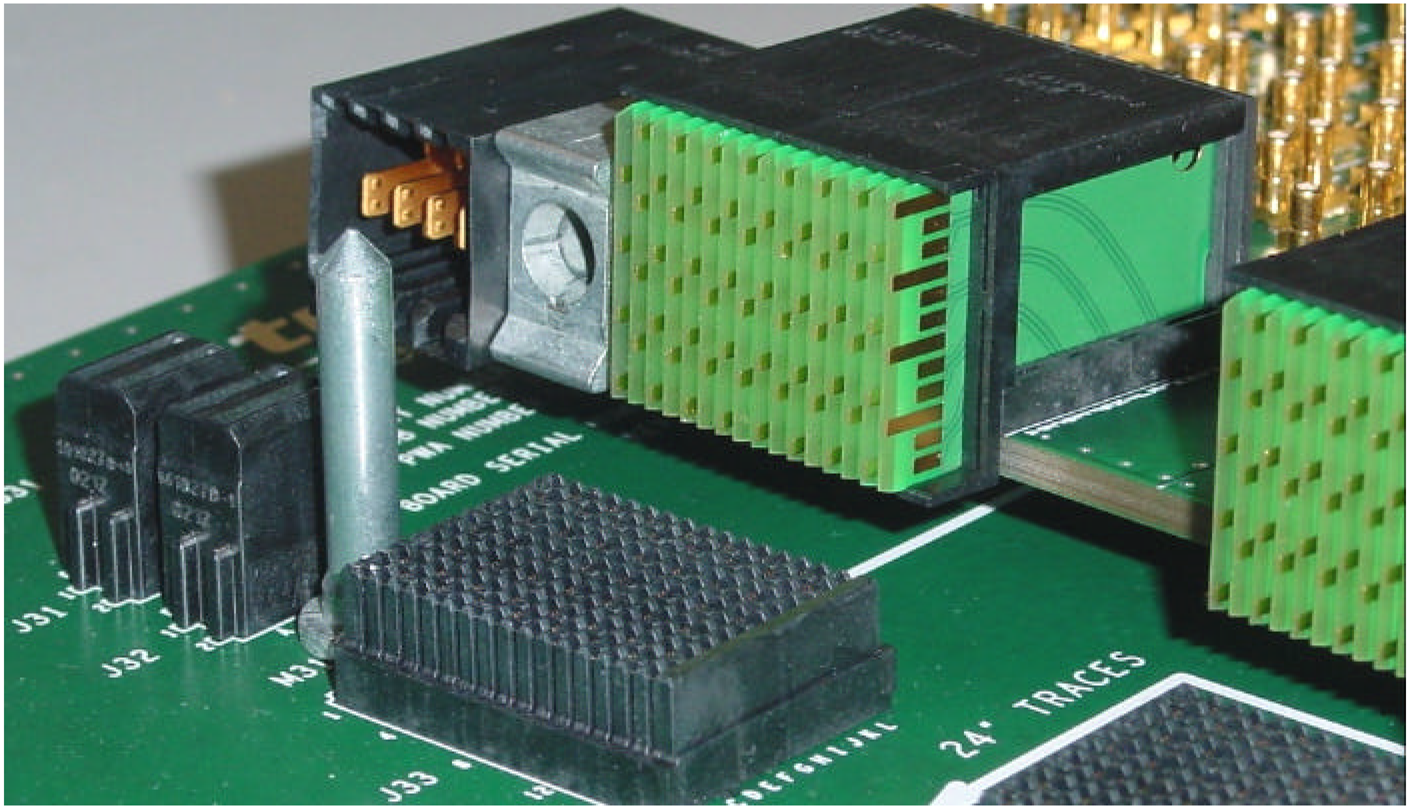
…

VXS.9
Reserved for Out of Band System & Chassis Management

VXS.10
Live-Insertion Specification

🟩 Provisional Draft Standards
🟨 Active Draft Specifications
🟦 Reserved for future use

MultiGig RT-2 Assembly

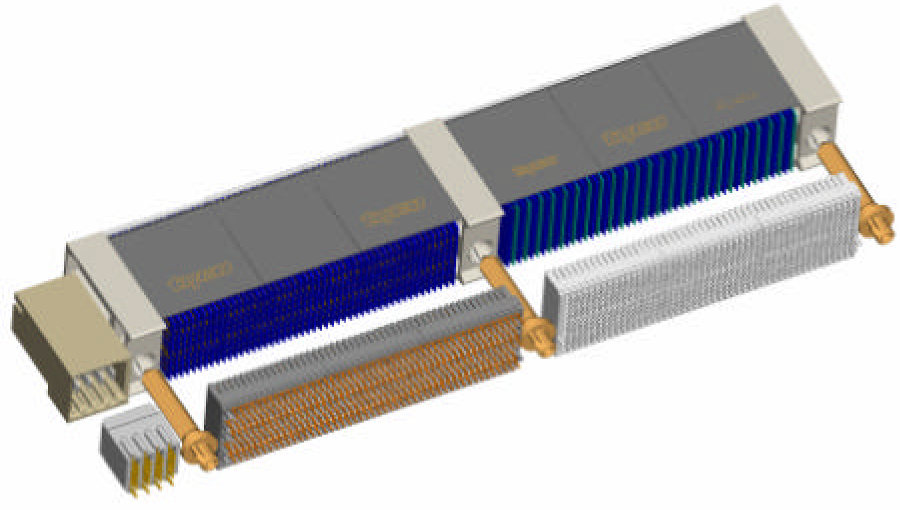


Most Flexible, Most Dense, and Quiet
A Solution Revolution for Multi-Gigabit Backplane applications

MultiGig Product Family Overview

Options

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

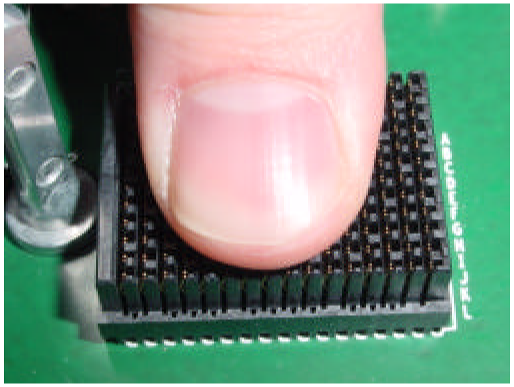


Power Connectors	18 A contacts, 2 & 4 lines/module
Guide Modules	8 keys/pin, Positive ESD Contact option
DC Organizer	Modules can be organized as monoblocks
Cross Connect	Orthogonal Design in Dev.

MultiGig Product Family Overview

Features and Benefits

>Mechanically Robust



- Pinless Backplane Solution
- Bellcore Compliant
- 250 cycle durability

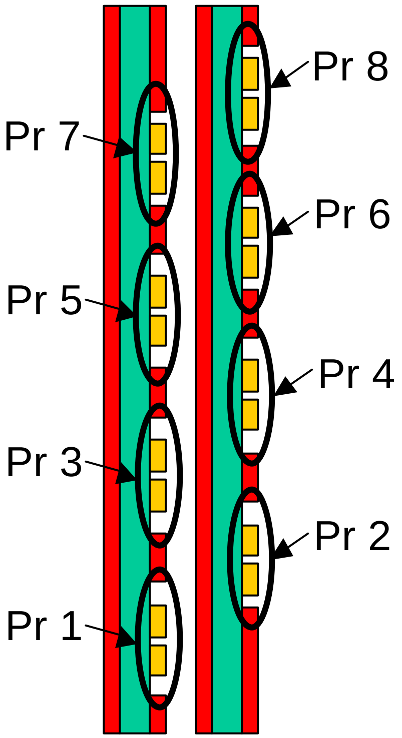
>Electrically Flexible

- 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

Pair 7	2.9%	Pair 8	1.7%
Pair 5	3.0%	Pair 6	3.1%
Pair 3	2.9%	Pair 4	2.9%
Pair 1	2.7%	Pair 2	2.8%

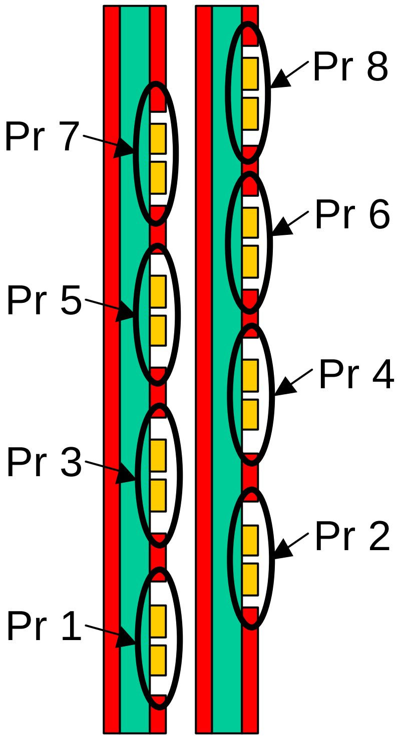


Edge rate: 47 ps (20-80%)

MultiGig RT-2 Differential - Far End Noise

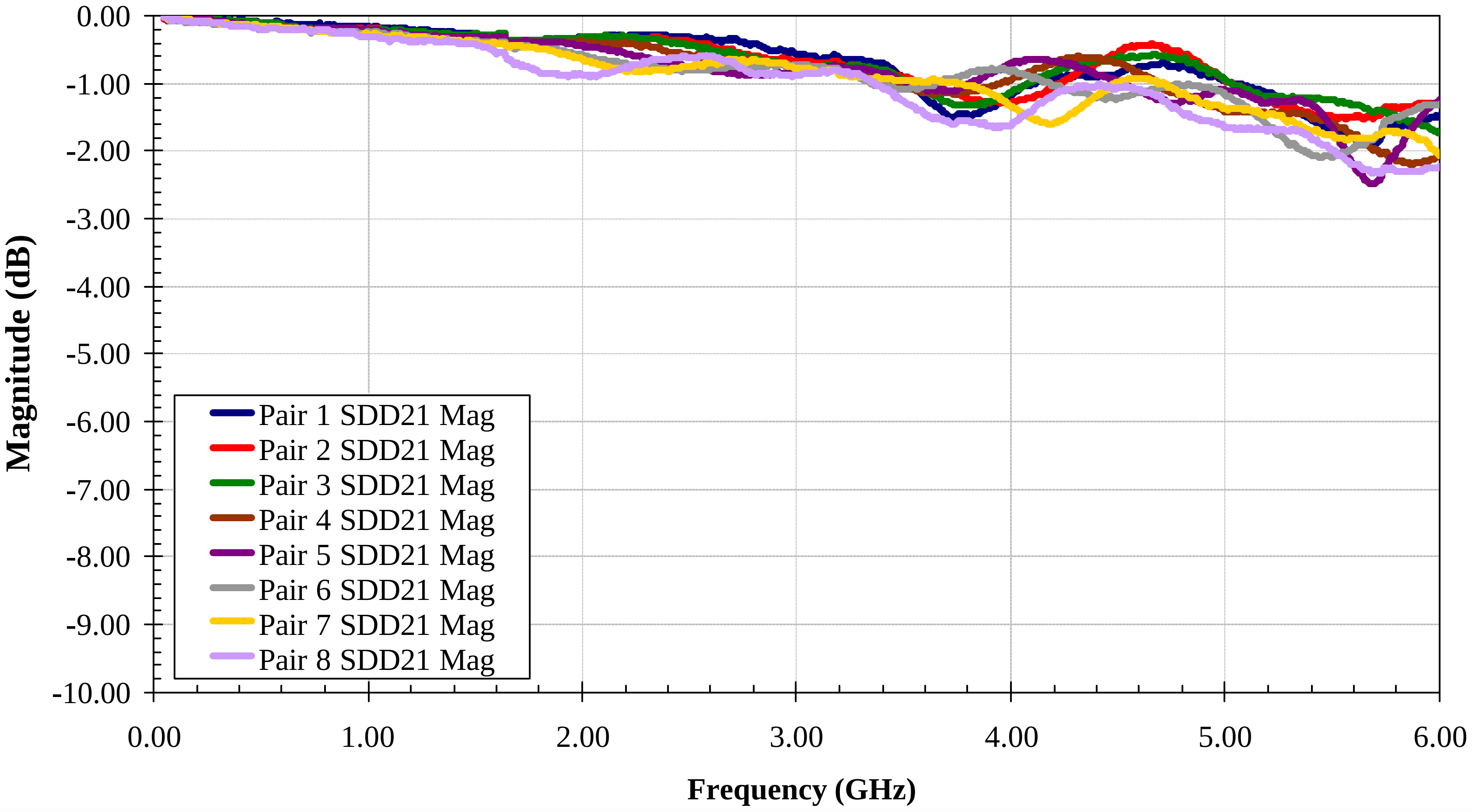
Synchronous Noise
Multiple aggressors

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%

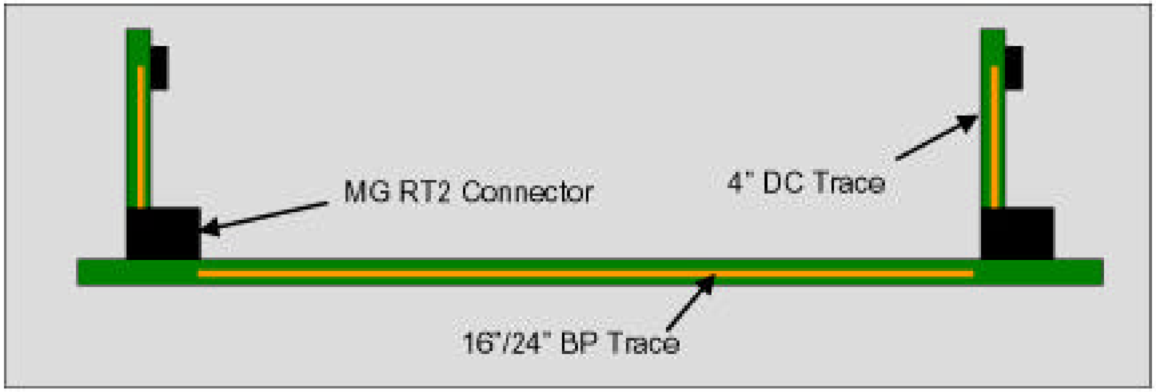


Edge rate: 47 ps (20-80%)

MultiGig RT-2 Differential - Throughput



Physical Test Environment

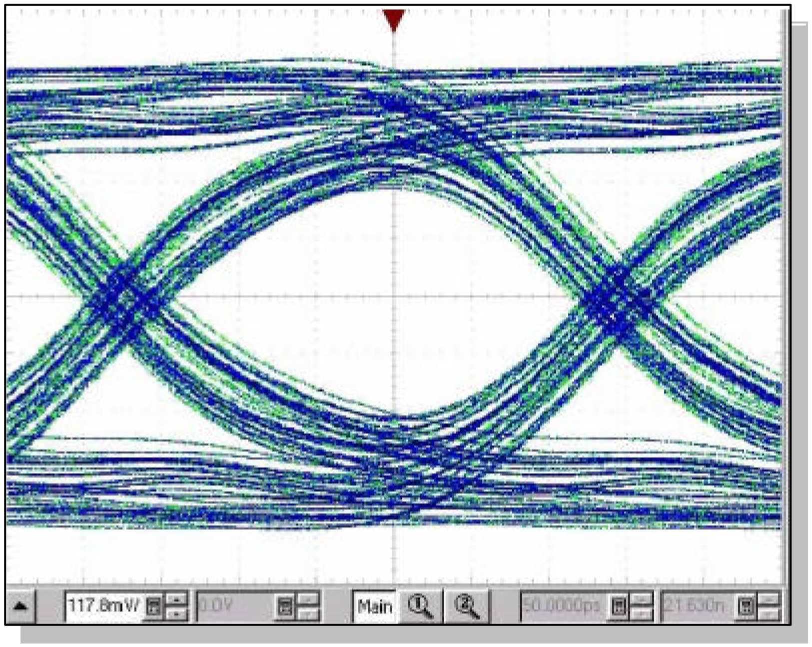


- Two RT2 connectors, a backplane and 2 daughtercards
- Backplane thickness designed at 0.200” with common FR4 material
- Daughtercard thicknesses designed at 0.125” with common FR4 material
- Trace widths designed at 6 mils on backplane and daughtercards
- 100 differential pairs on all boards
- All 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)

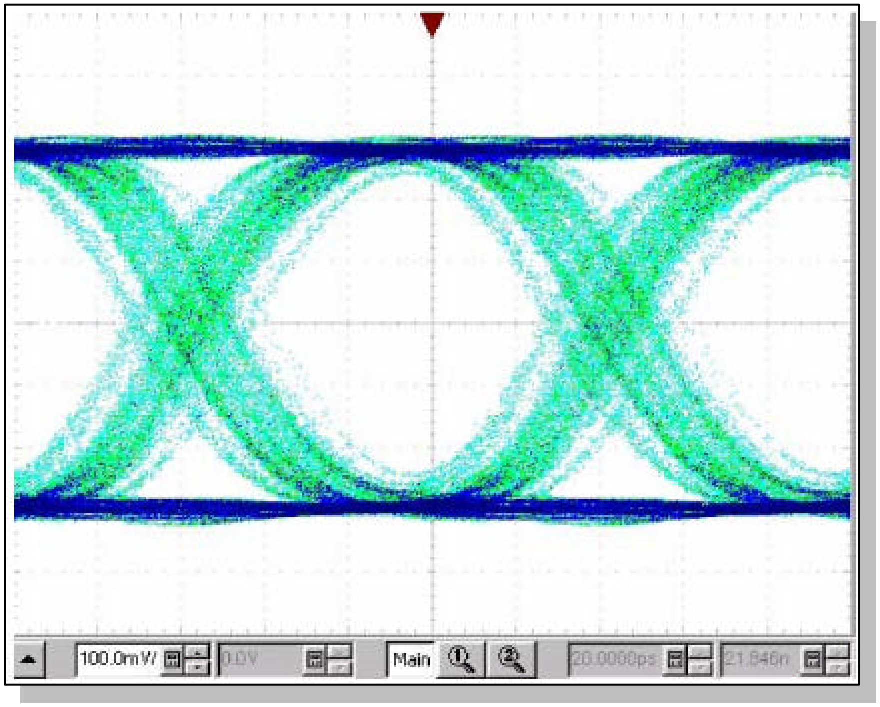
Test Conditions:

- 16” FR4 backplane traces
- 4” FR4 daughtercard traces
- Top layer via connection
- No counterboring
- 2 7 -1 PRBS
- 46.8% Eye Opening



Measured RT2 Eye Pattern – 16” Backplane, Top Layer, No Counterbore

10 Gbps Data with Advanced Silicon



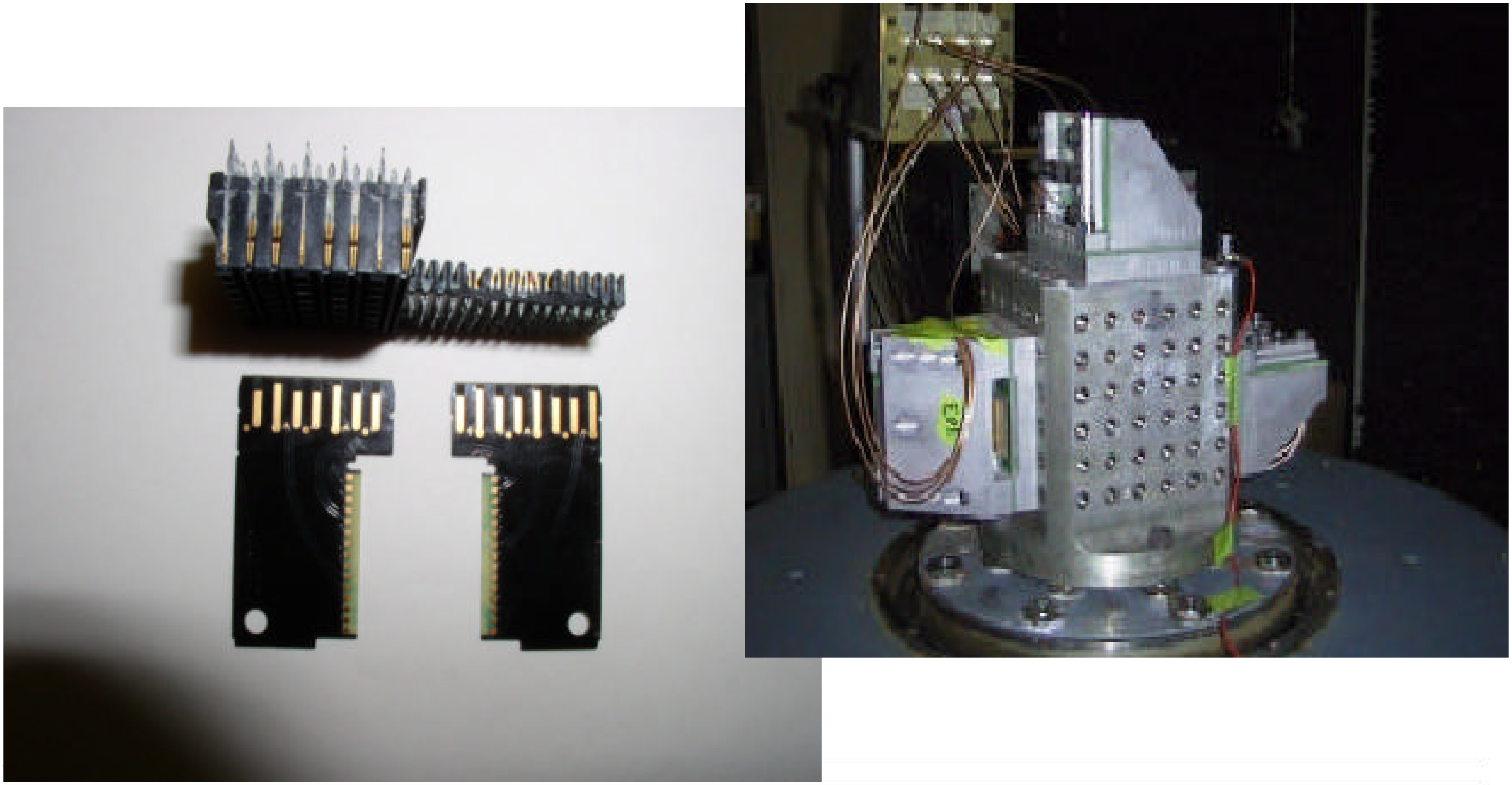
- Successful recovery of signal
- Not possible at 10 Gbps without advanced silicon
- Test Conditions
  - 24” FR4 backplane traces
  - 4” FR4 daughtercard traces
  - 6-mil trace widths
  - Top layer via connection
  - Counterbored vias
  - 2 7 -1 PRBS
  - Advanced Silicon
  - Successful data recovery
- 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)**

Test	Group A: Static Test at Component Level	Group B; Dynamic Test at Component Level
Initial Examination of Product	1	1
Vibration – Sine (+ monitor for discontinuity)		5
Vibration – Random (+ monitor for discontinuity)		6
Vibration – Shock (+ monitor for discontinuity)	5	7
Thermal Shock	7	
Salt Fog	11	
Low-Signal Level Contact Resistance (LLCR)	2, 6, 8, 12	2, 8
Insulation Resistance	3, 14	3, 9
Dielectric Withstanding Voltage	4, 15	4, 10
Visual examination w/ microscope at 8X magnification.	9, 13	11
Mate/unmate 25 cycles	10	

Test Setup & Test Sample



Pass/Fail Criteria

- Discontinuity
  - **Test Method EIA-367-87 Nanosecond-Event Detection for electrical Connectors.**
  - **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)**