Summary

- Introduction: Interconnects in the Data Center
- Signal Integrity Challenges in 10Gb/s Serial Copper Cable Interconnects
- What is an Active Cable?
- Q:Active™ Active Cables For QDR InfiniBand
- Where Do We Go From Here?
Introduction: Interconnects in the Data Center

Traditional interconnects for top-of-rack, rack-to-rack and aggregation connections in datacenters:

- Passive copper
  - Limited reach at 10+ Gbps
- Fiber Optics
  - Still expensive and power-hungry

**Active Copper Cables: a new alternative rapidly gaining acceptance**

- Contains active circuitry allowing to extend reach of copper interconnects
- Low-Power Interconnect for today’s Green Data Center
Introduction (cont.): Data Center Cable Solutions

- Passive Cable (Short Reach)
- Active Copper Cable (Ultra Low Power)
- Fiber Optics (High Power)

32AWG Active Cable
24AWG

Over 95% of High Speed Data Center Interconnects can be served with Quellan’s Q:Active cable technology.
Signal Integrity Challenges in 10Gb/s Serial Copper Interconnects

Several copper channel impairments limit the reach at high speeds:

- Attenuation
- Group Delay Distortion
- Intra-Pair Skew
- Crosstalk

Analog signal processing in active cables can address these impairments, extending the reach to >15m
Active Cable Advantage

Addresses Loss, Dispersion, Skew and Noise in High Speed Interconnects

Amplitude Equalization
Group Delay Equalization
Skew Correction
Crosstalk Reduction
What is an Active Cable?

- Small Analog Silicon ICs are embedded in each end of copper cable
- Silicon restores signal that has been attenuated over cable length
- By using analog techniques, power required is minimal
- No extra latency added to signaling
- Cost Effective alternative to Optics
Key Interconnect Requirements are Met by Active Copper

- Scalable Bandwidth
- Lowest Power
- Thinner and lighter
- Lowest Latency
- Cost Effective alternative to Optics up to 15m
### Types of an Active Cable?

<table>
<thead>
<tr>
<th>Active Cable</th>
<th>Pros</th>
<th>Cons</th>
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<tbody>
<tr>
<td>Full-Active</td>
<td>Optimal performance / power consumption / simplicity</td>
<td>Reach limited to ~ 15m</td>
</tr>
<tr>
<td>Half-Active Limiting</td>
<td>Utilizes host TX FFE; Simplest Design</td>
<td>Reach limited to ~12m; Host TX difficult to train</td>
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<tr>
<td>Half-Active Linear</td>
<td>Utilizes host TX FFE and RX DFE</td>
<td>Complex design; Performance unknown</td>
</tr>
<tr>
<td>Retimed Active</td>
<td>Simplest host ASIC</td>
<td>CDR difficult to fit into the module; Huge power dissipation</td>
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![Diagram showing TX driver, Rx EQ with Limiting Amp, Rx EQ with Linear Amp, and CDR]
Q:Active™ Active Cables For QDR InfiniBand

- State of the Art Full-Active Copper Interconnect
- Highest Performance – up to 15m reach
- Market Leading Solution with Infiniband version now being deployed in Top HPC Clusters.
- Industries Lowest Power – (<1W per end)
- Industry’s Thinnest Cable – (Comparable to Fiber)
- Cable tested to better than BER 10^{-12}
- Cluster tested to better than BER 10^{-15}
- SFF-8436 Compliant
40/120G Interconnect with 32AWG Cable

40G (4X) QSFP+  
120G (12X) CXP

Cross-Sections of 48 Port Interconnect

(24AWG Passive Left and 32AWG Active Right)
Where Do we Go From Here? – Active Cables are Here to Stay!

- Data rates for HPC Interconnects will continue to increase
  - IBTA is working on FDR (14G/lane) and EDR (25G/lane) specifications
  - IEEE is beginning to fork on 4x25G Ethernet
- Passive Copper will be severely limited to <3m at such rates
- Active Cables will come to the forefront, enabling most of Data Center Connections.
THANK YOU!