Forward-looking statements

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Dan Christman
EVP, Storage Products Group
Storage products group business

Fibre Channel

HDD

Flash

CXL

Expand, Pool, Switch, Accelerate

Expanding our market opportunity
Uniquely positioned to win in storage and memory

- Technology leadership
- Advanced silicon platform
- Flexible business models
- Deep NAND/DRAM relationships
- Custom firmware support

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Thad Omura
VP, Flash Marketing
Cloud data center memory challenges

Memory tied-down to xPUs

Bandwidth per core declining

No near-memory compute

CXL is poised to address these issues
What is Compute Express Link (CXL)?

- Tremendous ecosystem momentum driven by data center leaders

- Industry standard protocol
- Runs over PCI Express
- Low-latency interconnect
- Memory-optimized
- Cache-coherent
Cloud data center memory challenges

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CXL is poised to address these issues
Cloud data center memory challenges

- Memory tied-down to xPUs
- Bandwidth per core declining
- No near-memory compute

CXL Expander

CXL Pooling

CXL Switch

CXL Expander

CXL Accelerator

CXL is poised to address these issues
Addressing memory expansion

**DIMM challenges**
- Limited scalability
- Not serviceable
- No telemetry

**CXL solution**
- Scalable
- Pluggable
- Telemetry
- Improved thermals
- Mix-and-match DRAM
- Config flexibility
CXL memory expanders improve performance

Today: 2 DIMMs per channel (2DPC)

1DPC same bandwidth as 2DPC

128GB → 256GB

1DPC + CXL Expanders

128GB → 256GB

Use PCI Express to open bandwidth

Same capacity with greater bandwidth and utilization

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Sharing memory with CXL

- Pool memory across multiple xPUs
- Rescue under-utilized DRAM
- Scale memory independent of xPUs

Flexible to connect resources into fabric
- Scalable, serviceable
- Enables fully composable infrastructure
Accelerating with CXL

**CXL Accelerator**
- Coherent, efficient
- Accelerate analytics, ML, search, etc.
- Improves efficiency and TCO

**CXL I/O Acceleration**
- DPU/NIC, SSD, …
- Accelerate protocol processing
- Composable I/O devices
CXL data center vision: full composability

<table>
<thead>
<tr>
<th>Rack fabric</th>
<th>Ethernet</th>
<th>Ethernet + CXL</th>
<th>CXL only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disaggregation</td>
<td>Storage and accelerators</td>
<td>+Partial memory</td>
<td>+Full memory, all other</td>
</tr>
</tbody>
</table>
Cloud data center memory challenges

Memory tied-down to xPUs

Bandwidth per core declining

No near-memory compute

Cannot share

Increasing gap

Degrades efficiency

Limits performance

CXL is poised to address these issues
CXL solves data center memory challenges

Disaggregated memory

More bandwidth per core

Near-memory computation

Fully composable

Optimize efficiency

Ultimate performance

CXL is disrupting cloud data center architectures
CXL technology roadmap

**CXL 1.1**

**Architect**
- Memory Expanders

**PCIe 5**

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**CXL 2.0**

**Deploy**
- + Pooling
- + Switch
- + Accelerators
- + I/O

**PCIe 5**

---

**CXL 3.0**

**Scale**
- + Full hot plug
- + Switch w/ composability

**PCIe 6**
Comprehensive end-to-end CXL solutions

CXL opportunities
- Expanders
- Pooling
- Switch
- Accelerators
- Custom Compute
- DPUs / SmartNICs
- Electro-optics
- Re-timers
- SSD Controllers

Multi-billion $ opportunity
Summary

1. CXL is disrupting cloud data center architectures
2. Uniquely positioned to enable end-to-end CXL in data center
3. CXL is driving the next multi-billion-dollar opportunity
Thank You
MARVELL™

Essential technology, done right