ThunderX2: End2End – From Silicon to System Delivery

LarryWikelius – VP Software Ecosystem & Partner Enabling
Arm based Server CPUs are a compelling alternative

Arm: The industry’s architecture of choice
130+ billion chips shipped since 1990

- Highest performance
- Efficiency
- Open architecture
- Industry Standards
- Broad ecosystem
- Lowest TCO

1991
50 billion chips shipped
22 years
2013
50 billion chips shipped
4 years
2017
100 billion chips expected to ship
4 years
2021
50 billion chips shipped
100 billion chips expected to ship

130+ billion chips shipped since 1990

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Marvell – A Leader in Infrastructure Semiconductor Solutions
### Overview

<table>
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<tr>
<th>COMPANY FOUNDED</th>
<th>FY19 REVENUE</th>
<th>EMPLOYEES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>$2.9B</td>
<td>5,000+</td>
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- **LOCATED IN**
  - Santa Clara, CA

- **R&D CENTERS**
  - US, Israel, India, Germany, China

- **PATENTS WORLDWIDE**
  - 10,000+

- **MOST RESPECTED SEMICONDUCTOR COMPANY**
  - GSA Winner
Marvell delivers the essential building blocks for infrastructure

<table>
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<tr>
<th>Computing</th>
<th>Networking</th>
<th>Storage</th>
<th>Security</th>
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<tr>
<td>Server, baseband and</td>
<td>Ethernet switches, PHYs,</td>
<td>HDD &amp; SSD controllers,</td>
<td>FIPS and virtual offload</td>
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<td>embedded processors</td>
<td>NICs</td>
<td>Fibre Channel</td>
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<th>Data Center Storage Solutions</th>
<th>Artificial Intelligence</th>
<th>Automotive</th>
<th>Wireless Connectivity</th>
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<tr>
<td>NVMe aggregators, accelerators &amp; converters</td>
<td>Accelerators and offload processors</td>
<td>Secure Ethernet, PHYs, storage &amp; Wi-Fi</td>
<td>Wi-Fi access points &amp; clients</td>
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Marvell designs the SOC

- Arm architectural license
- Custom micro-architecture design
- Optimized for key target workloads
Enabling the HW & System SW Ecosystem

Reference System Implementation
- Full Chip/System collateral
- SBSA and SBBR standards based
- Lead Partner ODM
- Reference FW Implementation – UEFI & BMC
- Upstream kernel support – prior to silicon

Chip and System Testing & Optimization:
- IHV AVL – networking & storage
- Stress and performance testing
- OS, compiler, tools enablement
Moving from x86 to Armv8/ThunderX2 made easy

Same development costs:
• OS, Tools & applications
• Management tools & infrastructure

Same deployment costs:
• Chassis, heat sinks, fans, power supply as x86
• Manufacturing tools & assemblies
Success Stories with Target Use Cases
Marvell ThunderX2® well-suited for data center applications

Big Data/HPC

Arm-native

Cloud Compute
Marvell powers the world’s fastest Arm supercomputer
Driven by 145,512 ThunderX2 cores
Securing U.S. nuclear arsenal
Marvell ThunderX2 enables efficient computing for Department of Energy

Maximizes usable operations instead of peak FLOPS for national security research
Marvell ThunderX2 is Azure’s Arm-based server platform of choice
Marvell ThunderX2 powers memory intensive applications at CEA

Running scenario modeling in support of France’s Nuclear Energy and Defense arsenal
Marvell-University of Michigan Partnership

Built on long Cavium/Marvell-Michigan relationship

Deploy ThunderX for Big Data
- 4800 Cores
- 25 TB Memory
- 40 & 100 Gbps networking
- 3 PB Hadoop File System

Accelerating the software ecosystem for data science for ARM.

Directly consuming Linaro Big Data software builds

We bring an advanced user base in the data science domain
Benchmarks
Marvell ThunderX2 beats Intel

### Better application throughput
- ThunderX2: 1.15
- Xeon Skylake: 1

### Lower application latency
- ThunderX2: 1.33
- Xeon Skylake: 1

### Flexible networking/storage
- ThunderX2: 1.15
- Xeon Skylake: 1

### Compelling performance/$
- ThunderX2: 2
- Xeon Skylake: 1

Source: Intel & Marvell data sheets
Marvell ThunderX2 delivers a significantly lower TCO

15% LESS POWER

Total power

Marvell ThunderX2 Intel Xeon Skylake

45% LOWER COST

Total cost

Marvell ThunderX2 Intel Xeon Skylake

Source: Intel & Marvell data sheets
Marvell ThunderX2 Processors are Optimized for Cloud

- Higher core count → Improved application throughput
- Higher thread count → More VMs per server
- Higher memory bandwidth & memory capacity → Improved application latency
- Lower acquisition cost – Better Performance/$$$

Comparison between Intel 6148 Gold with 32 core 2.2GHz
Marvell ThunderX2 Delivers Compelling Value Proposition for HPC

- More cores → Higher perf for compute bound applications
- Higher memory bandwidth → Higher perf for majority of HPC applications
- Lower acquisition cost → Better performance/$$$

Comparison between Intel Skylake Gold 6148 vs. ThunderX2 CN9980
Source: AnandTech and other publicly-available sources
Marvell ThunderX2 is perfect for Android in the Cloud

- Native execution, no emulation
- Full hypervisor/container support
- Highest Arm application density per $ (lower is better)

Source: Intel & Marvell data sheets
Call to Action – Now What?
Linaro opportunities to further accelerate Arm based Server Adoption

- **Continue to show leadership in upstream** – especially kernel and compilers/tools

- **Learn from and replicate Big Data Hadoop project**
  - Successful engagement with Apache
  - Focused Use Case that has NO commercial alternative on Arm
  - Work directly with lead end users

- **Walk the Talk** – drive internal development and deployment infrastructure to be 100% Arm based

- **Expand lead end user engagements** – HPC SIG is a model to further invest/grow