RISC-V: Enabling a New Era of Open Data-Centric Computing Architectures

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November 28, 2017
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The Evolving Role of Data
Creating the data-driven economy

- Data as a record
- Data as communication
- Data as efficiency
- Data as currency

Richness

Value
Diverse and Connected Data Types

Tight coupling between Big Data and Fast Data
From General Purpose to Purpose Built
Architectures designed for Big Data, Fast Data applications

Big Data

Expanding applications and workloads

Fast Data

General purpose compute-centric architecture

- Solutions
- Systems
- Platforms
- Devices
General Purpose Architectures No Longer Sufficient

Big Data and Fast Data workloads exceed capability of uniform resource ratios

- Predetermined ratios of:
  - OS/App Processor
  - Specialty Processor
  - Memory
  - Storage
  - Interconnect

- Overhead of “PC” logic

- CPU-centric
General Purpose Architectures No Longer Sufficient

Big Data and Fast Data workloads exceed capability of uniform resource ratios

General Purpose Compute Architecture

- System fan
- Processor
- CPU fan
- Memory slots
- Buzzer
- Power
- Chipset
- Front panel
- SATA 1~4
- Jumpers
- S/PDIF jack
- VGA port
- DVI-D port
- USB ports
- LAN port
- Audio jacks
- S/PDIF-out
- PCIe x16 slot
- PCIe x1 slots
- Mini-card socket
- WLAN LED
- Front audio
- Battery
- USB 1~4
- USB 5~8
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General Purpose Transportation

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General Purpose Architectures No Longer Sufficient

Big Data and Fast Data workloads exceed capability of uniform resource ratios
General Purpose Architectures No Longer Sufficient

Big Data and Fast Data workloads exceed capability of uniform resource ratios
Workload Diversity Demands Diverse Technologies and Architectures

Big Data

Storage-centric architecture

Purpose-built data-centric architectures

Capacity-centric scale

HDD SSD

Storage

Memory

NVM DRAM SRAM

Interconnect

Memory Semantic Data Flow

Storage Semantic Data Flow

Compute

Storage SOC General Purpose CPU

GPU FPGA ASIC

Fast Data

Memory-centric architecture

Performance-centric scale
Data-Centric Environments

Big Data and Fast Data workloads need independent scaling of resources

**Big Data**
- Massive Storage
- Moderate Processing
- Analytics
- Machine Learning

**Fast Data**
- Large Memory
- Specialty Processing
- Event Correlation
- High-bandwidth interconnect
- Large Memory and Specialty Processing
- Blockchain
- Large Specialty Processing
Independent Scaling Demands Openness

Rapid adoption of new open source technologies and standards
Data-Centric Applications at the Edge

Environments require modular technologies and dense integration to optimize space, weight and power consumption
RISC-V Meets the Needs of Big Data and Fast Data

Provides a foundation for purpose-built, data-centric compute environments

Big Data

Move Compute to Data
- CPU for device, platform, system
- Minimize data movement
- Offload workload to “smart” storage
- Localized machine learning

Fast Data

Memory Centric Compute
- Highly scalable main memory
- Minimize data movement
- Heterogeneous processor support
- Scalable accelerators/offload engines

• Open and free
• Enables modular chip designs
• From 16 to 128-bit

• Scales from embedded to enterprise
• Direct integration with specialty accelerators
• Extensible ISA (for special purpose functions)
RISC-V Enables Purpose-Built Environments for Big Data and Fast Data Applications

- **Big Data**
  - Purpose-built data-centric architectures

- **Fast Data**
  - Memory-centric architecture

**Storage-centric architecture**
- HDD
- SSD
- Storage Semantic Data Flow

**Memory**
- NVM
- DRAM
- SRAM
- Memory Semantic Data Flow

**Interconnect**
- Storage SOC
- General Purpose CPU
- GPU
- FPGA
- ASIC
- RISC-V

**Capacity-centric scale**
**Performance-centric scale**

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RISC-V Meets the Needs of Big Data and Fast Data

Big Data
- Genomics

Fast Data
- Predictive Analytics

- Autonomous Machines

- Safety & Security

- Private Exchange

- Machine Learning

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#LetDataThrive
Driving Momentum

Western Digital ships in excess of 1 Billion cores per year...and we expect to double that.
Accelerating the RISC-V Ecosystem

Western Digital to contribute one billion cores annually to fuel RISC-V

1. Support development of open source IP building blocks for the community

2. Actively partner and invest in the ecosystem

3. Accelerate development of purpose-built processors for a broad range of Big Data and Fast Data environments

4. Multi-year transition of Western Digital devices, platforms and systems to RISC-V purpose-built architectures
Innovating for a Data-Centric World

Big Data and Fast Data need purpose-built environments

Openness and ecosystem enable best-in-class innovation

Western Digital brings the momentum of >1B cores per year
Western Digital

We create environments for data to thrive