



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

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November 28, 2017

# Forward-Looking Statements

## *Safe Harbor | Disclaimers*

This presentation contains certain forward-looking statements that involve risks and uncertainties, including, but not limited to, statements regarding: the RISC-V Foundation and its initiatives; our contributions to and investments in the RISC-V ecosystem; the transition of our devices, platforms and systems to RISC-V architectures; shipments of RISC-V processor cores; our business strategy, growth opportunities and technology development efforts; market trends and data growth and its drivers. Forward-looking statements should not be read as a guarantee of future performance or results, and will not necessarily be accurate indications of the times at, or by, which such performance or results will be achieved, if at all. Forward-looking statements are subject to risks and uncertainties that could cause actual performance or results to differ materially from those expressed in or suggested by the forward-looking statements.

Additional key risks and uncertainties include the impact of continued uncertainty and volatility in global economic conditions; actions by competitors; difficulties associated with the integration of SanDisk and HGST into our company; business conditions; growth in our markets; and pricing trends and fluctuations in average selling prices. More information about the other risks and uncertainties that could affect our business are listed in our filings with the Securities and Exchange Commission (the "SEC") and available on the SEC's website at [www.sec.gov](http://www.sec.gov), including our most recently filed periodic report, to which your attention is directed. We do not undertake any obligation to publicly update or revise any forward-looking statement, whether as a result of new information, future developments or otherwise, except as otherwise required by law.

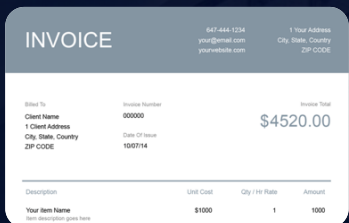


# The Evolving Role of Data

*Creating the data-driven economy*

Richness

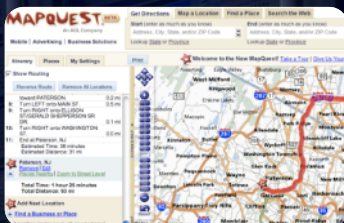
## Data as a record



## Data as communication



## Data as efficiency



## Data as currency



Value



# Diverse and Connected Data Types

*Tight coupling between Big Data and Fast Data*

## Big Data

Insight



Prediction



Prescription



Scale

## Fast Data

Mobility



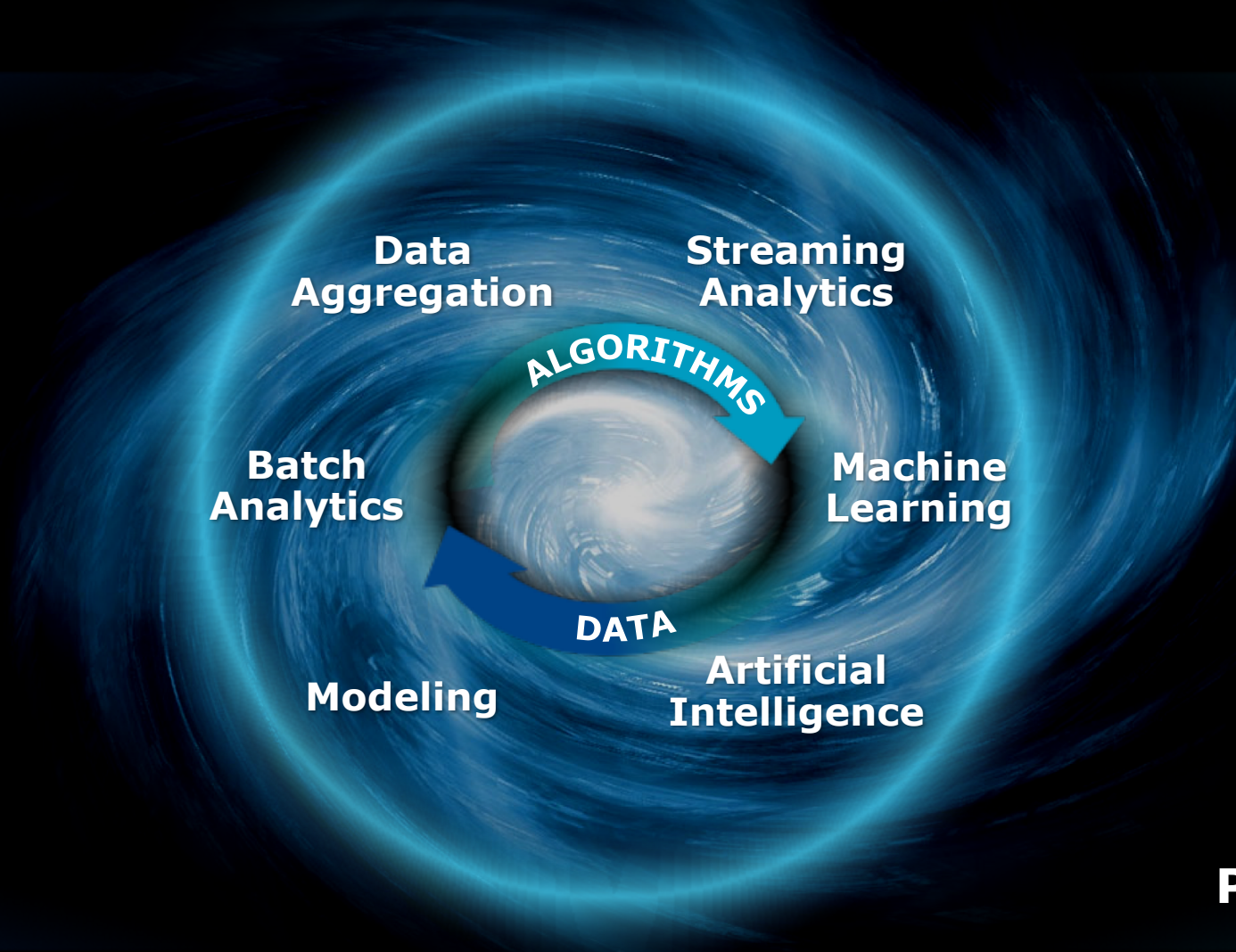
Real-time Results



Smart Machines



Performance





# 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

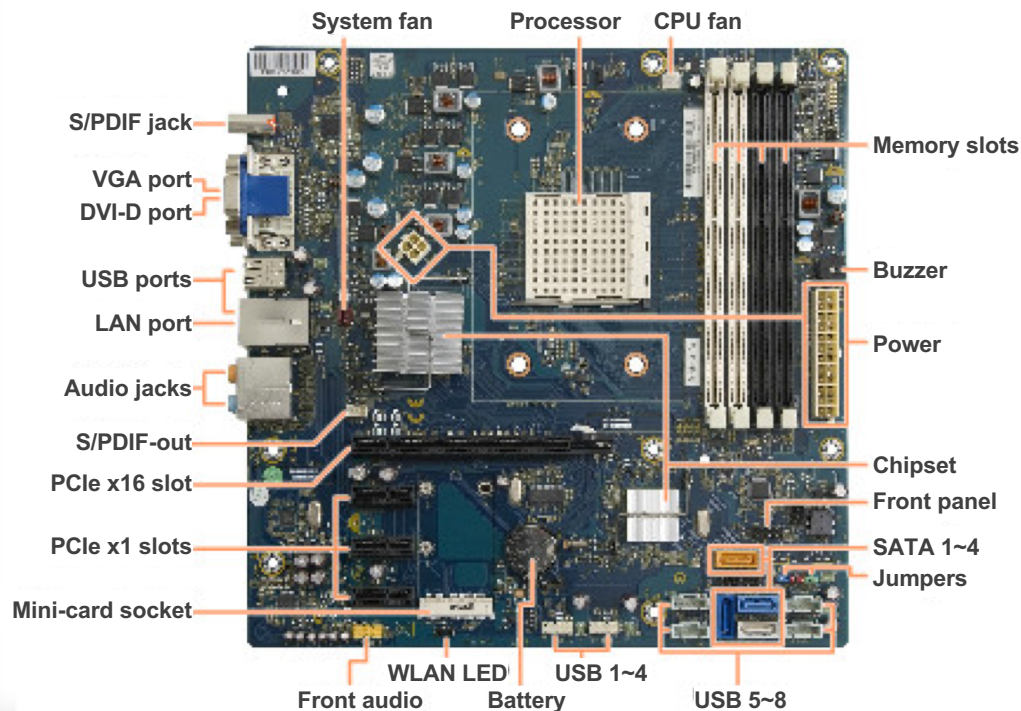
Platforms

Devices

# General Purpose Architectures No Longer Sufficient

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

## General Purpose Compute Architecture



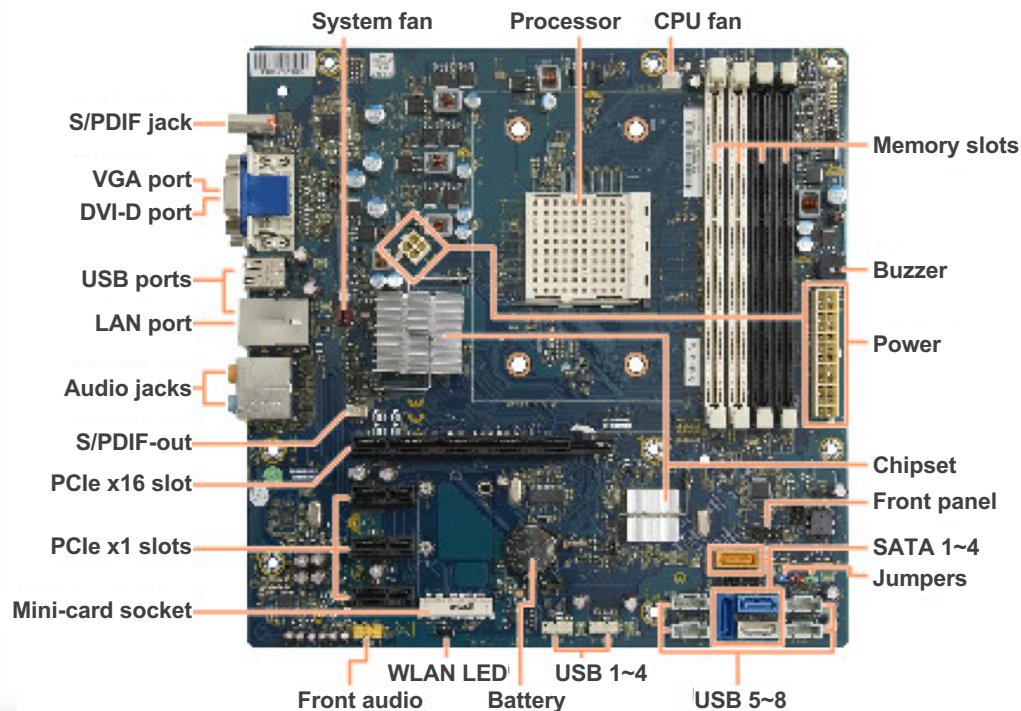
- Predetermined ratios of:
  - OS/App Processor
  - Specialty Processor
  - Memory
  - Storage
  - Interconnect
- Overhead of “PC” logic
- CPU-centric



# General Purpose Architectures No Longer Sufficient

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

## General Purpose Compute Architecture



## General Purpose Transportation



# General Purpose Architectures No Longer Sufficient

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





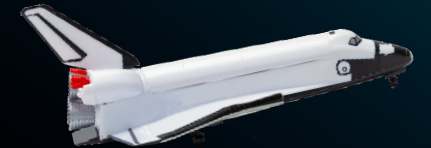
# General Purpose Architectures No Longer Sufficient

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

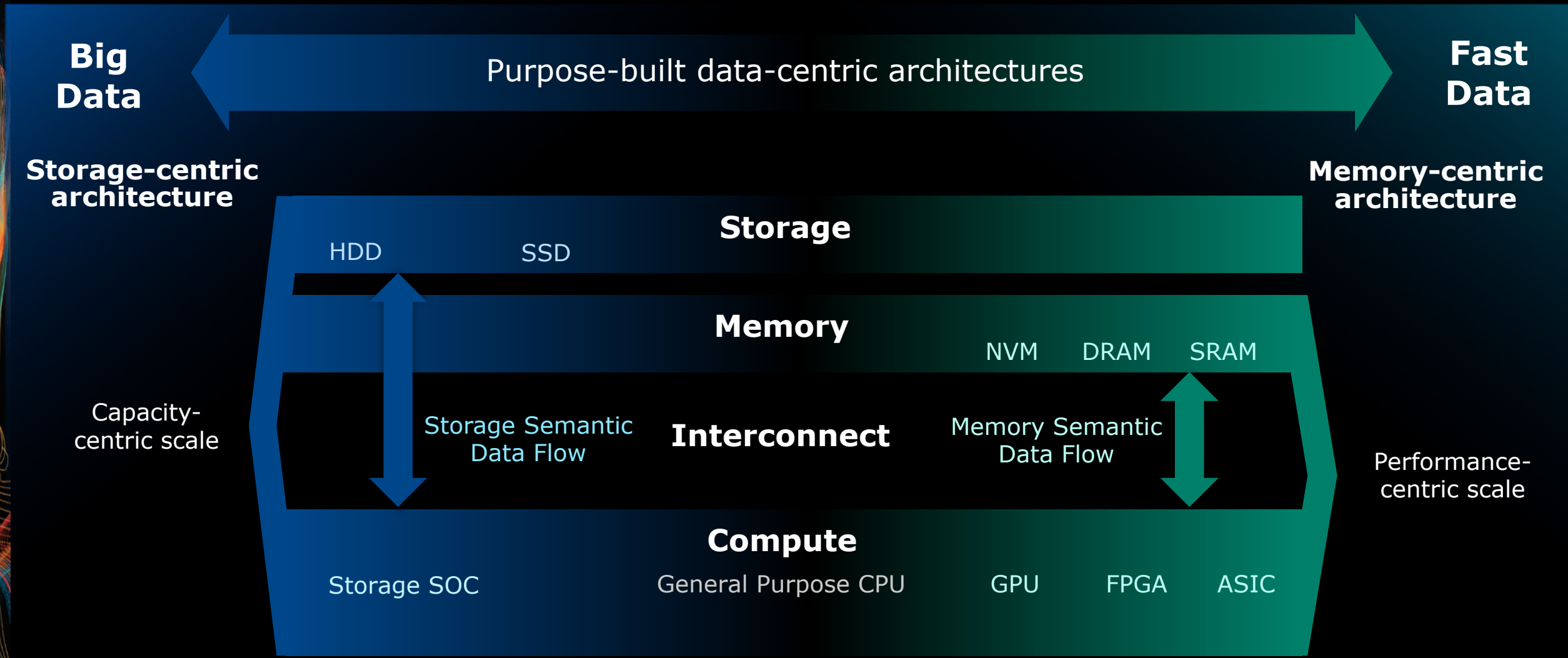
**Big  
Data**



**Fast  
Data**



# Workload Diversity Demands Diverse Technologies and Architectures





# Data-Centric Environments

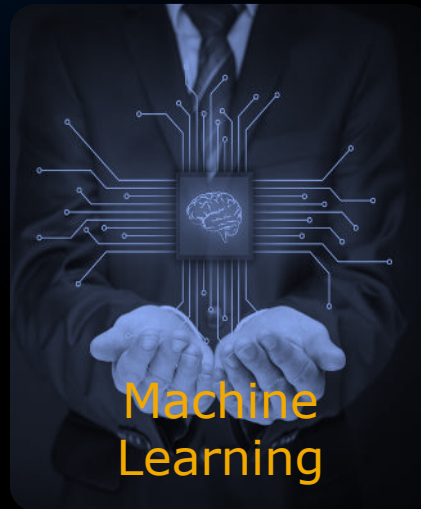
*Big Data and Fast Data workloads need independent scaling of resources*

## Big Data



Analytics

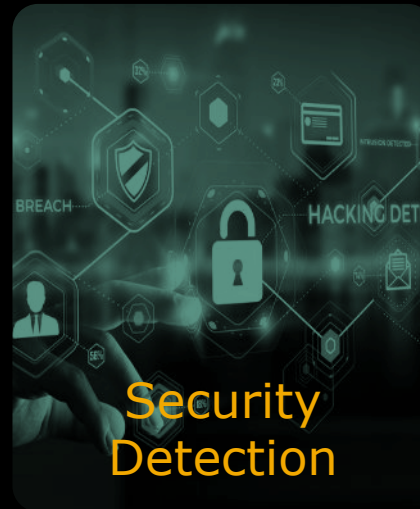
- Massive Storage
- Moderate Processing



Machine Learning

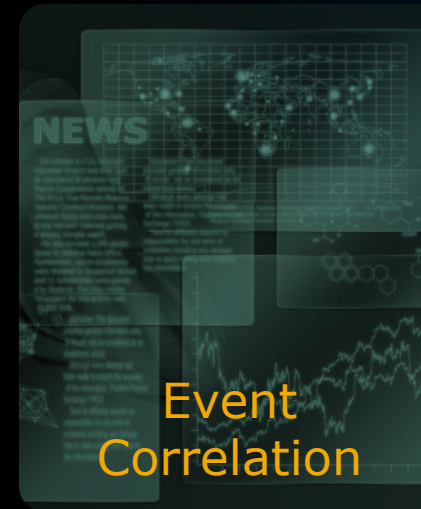
- Massive Storage
- Massive Specialty Processing

## Fast Data



Security Detection

- Large Memory
- Specialty Processing



Event Correlation

- High-bandwidth interconnect
- Large Memory and Specialty Processing



Blockchain

- High-bandwidth interconnect
- 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

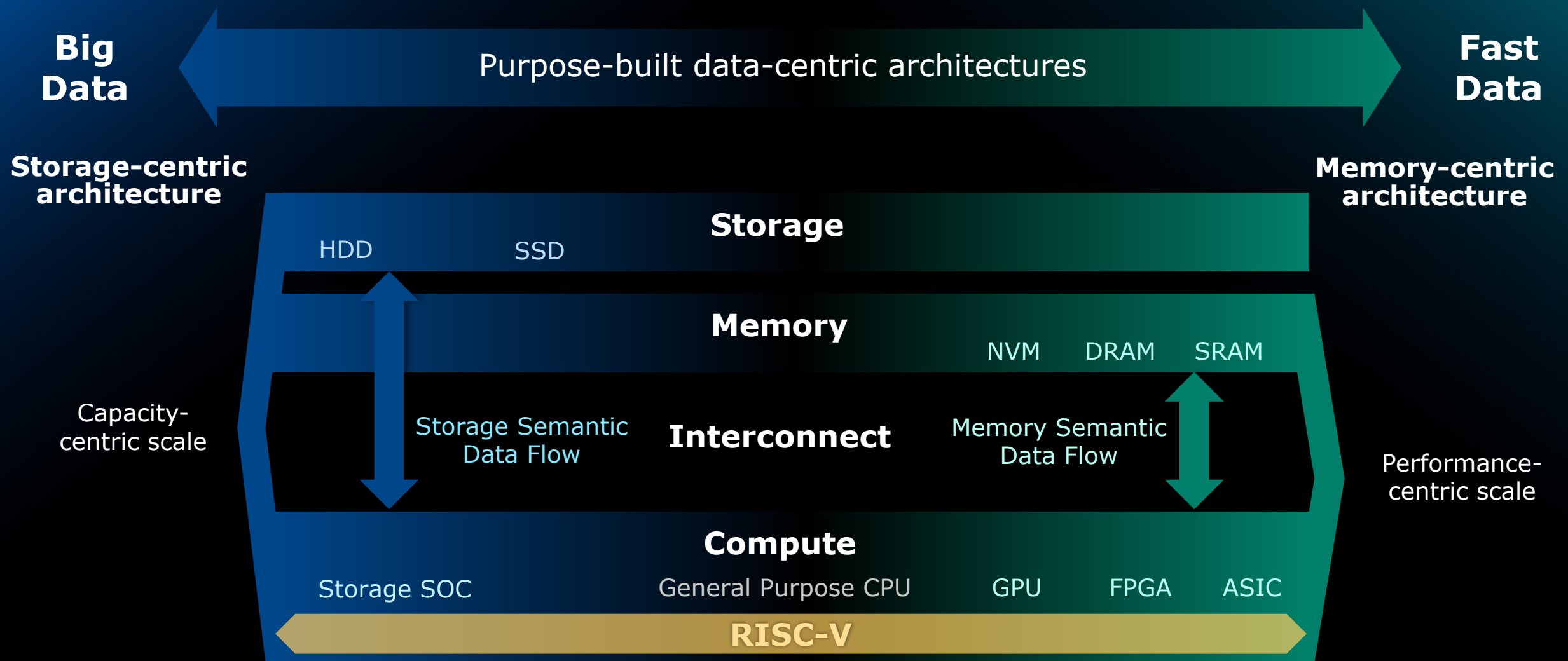
- Highly scalable main memory
- Minimize data movement
- Heterogeneous processor support
- Scalable accelerators/offload engines



- 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





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





# 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

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2

Actively partner and invest in the ecosystem

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3

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

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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**<sup>®</sup>

**RISC-V**

Abstract, flowing lines in shades of orange, red, and blue, resembling data streams or digital art, set against a black background.

# Western Digital<sup>®</sup>

We create environments for data to thrive

#LetDataThrive