Maverick: A Fast and Energy Efficient Next-Generation NVM-based SSD Architecture

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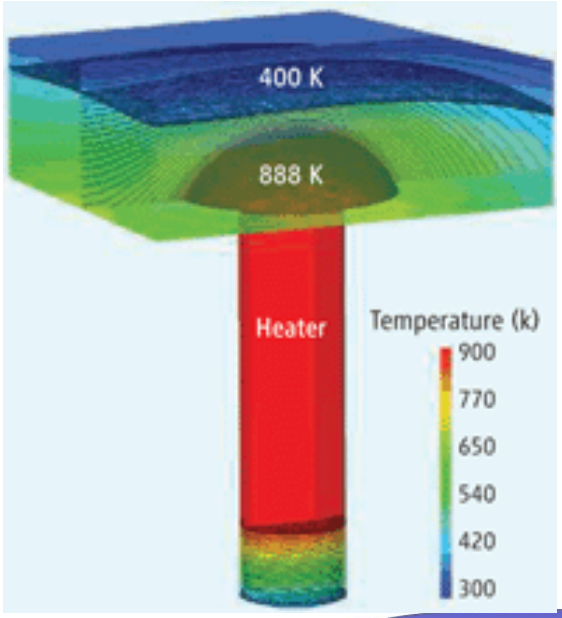
Welcome to the Data Age

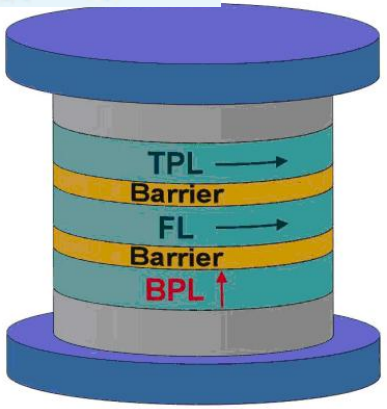
- The world processed 9 Zettabytes of data in 2008*
- Acquiring data is easy
- Extracting knowledge is hard
  - Storage performance is major bottleneck
  - Emerging non-volatile memory technologies can help

*http://hmi.ucsd.edu

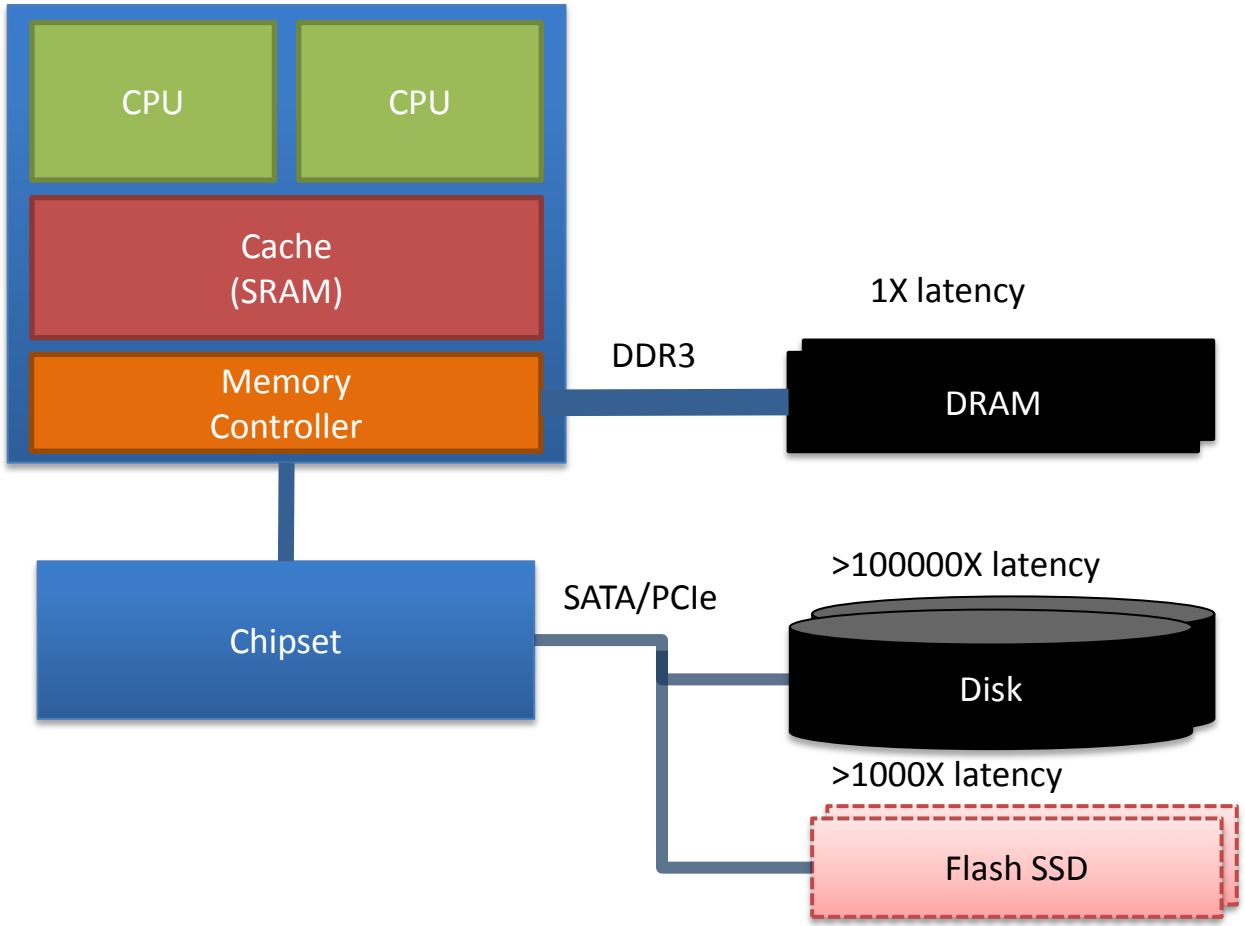
Emerging Non-Volatile Memory Technologies

- NVMs
  - Phase change memory
  - Spin-torque transfer
- Characteristics
  - DRAM-like performance
  - High density
  - Low standby power
- Potential usage
  - DRAM replacements
  - Fast storage

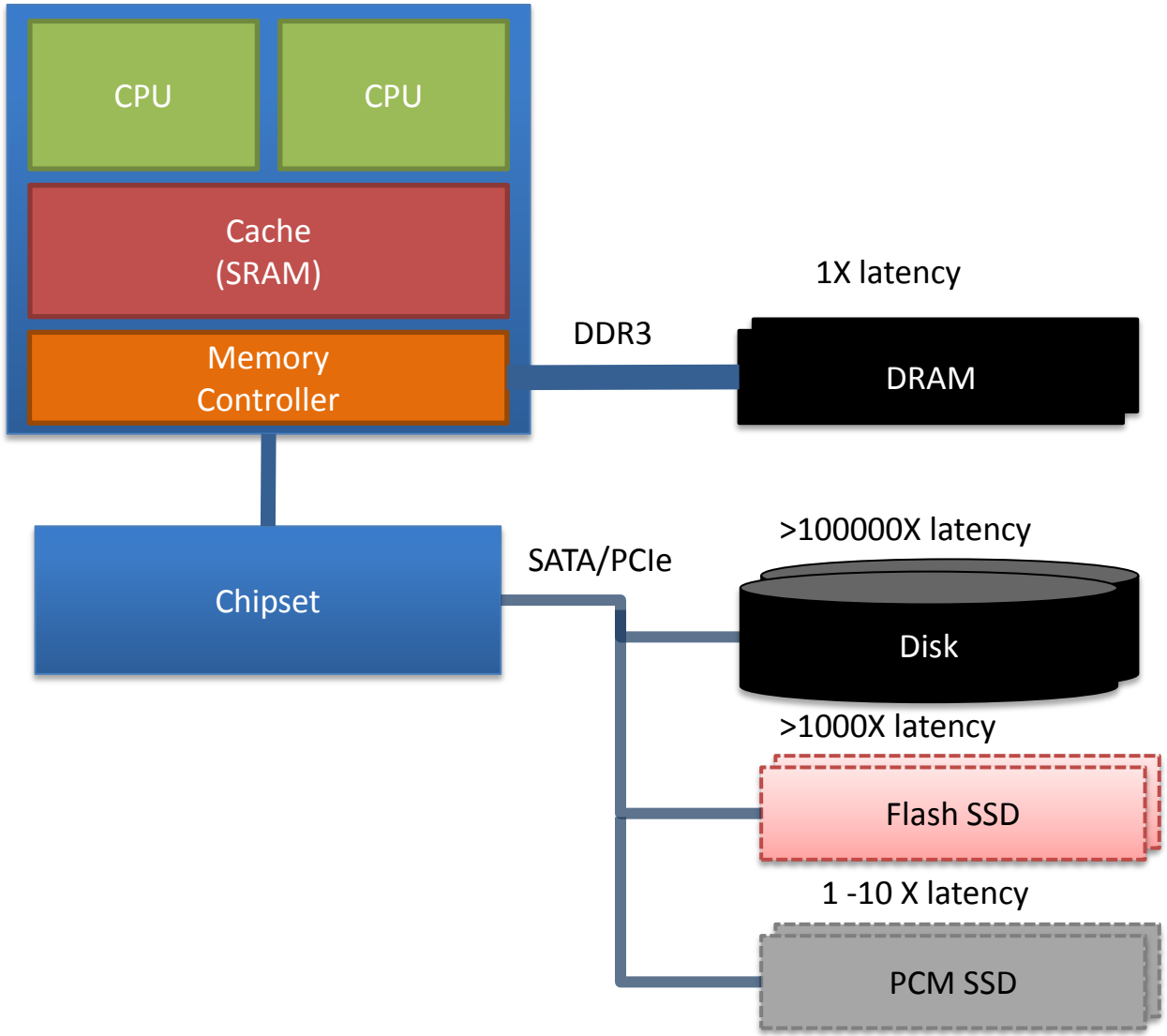




Present System Architecture

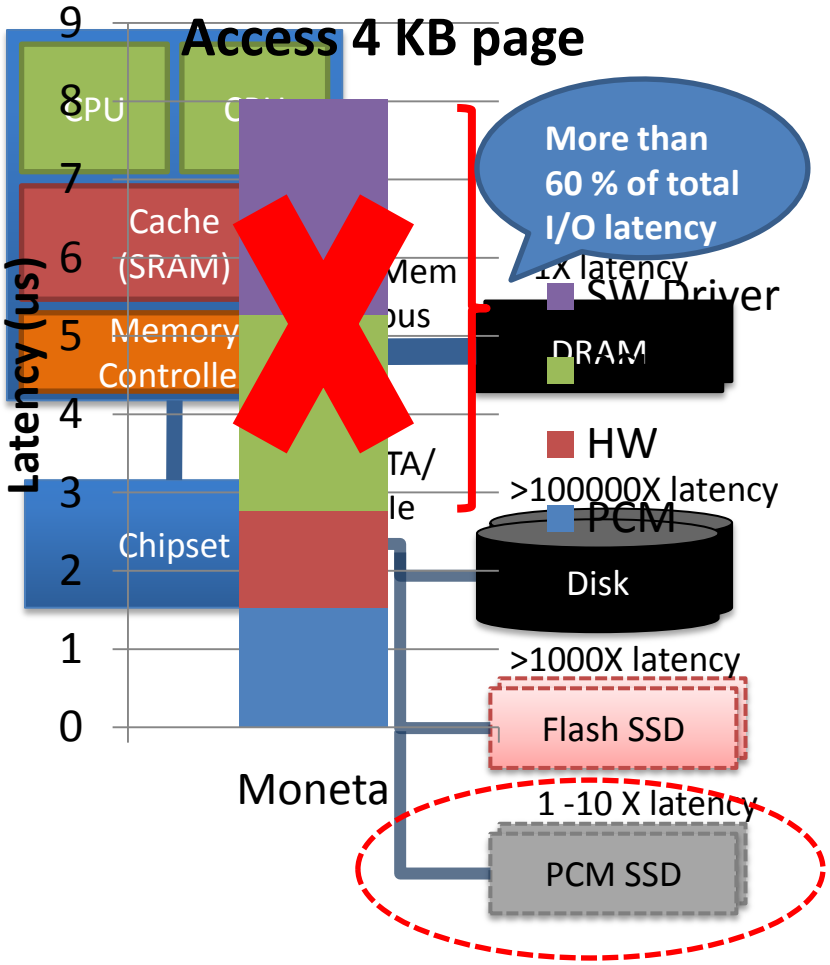


Future System Architecture



Problems with PCIe-attached PCM-based SSD?

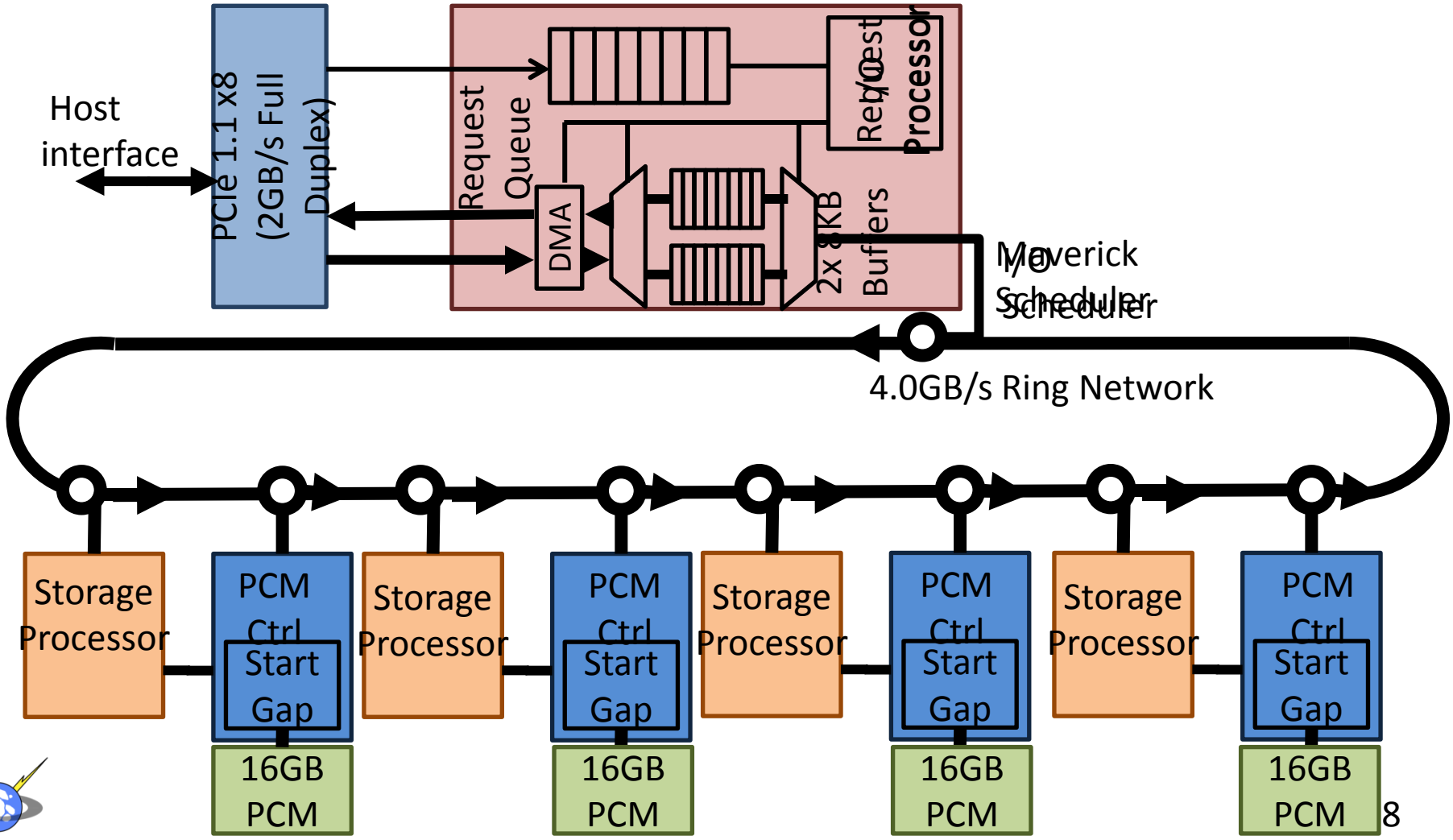
- High latency and block interface of PCIe
- Huge software driver and PCIe overhead



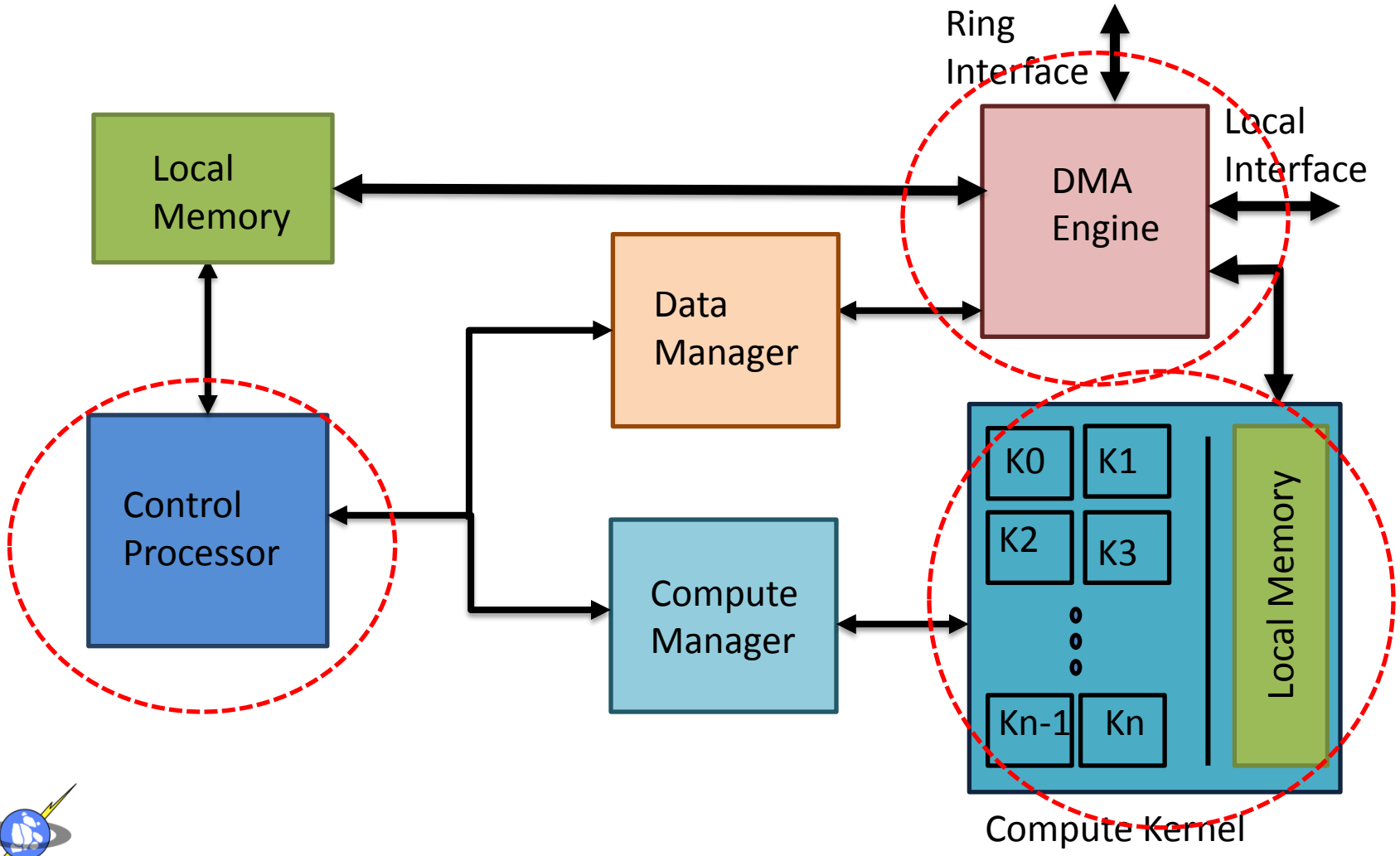
Maverick

- Based on **computation close to storage**
- Moved data or I/O intensive computations to the storage to avoid redundant data transfer between the host and the storage
- Huge power and performance gain
- Processing scales with increasing storage demand

Moneta: A High-Performance Storage Array Architecture



Storage Processor

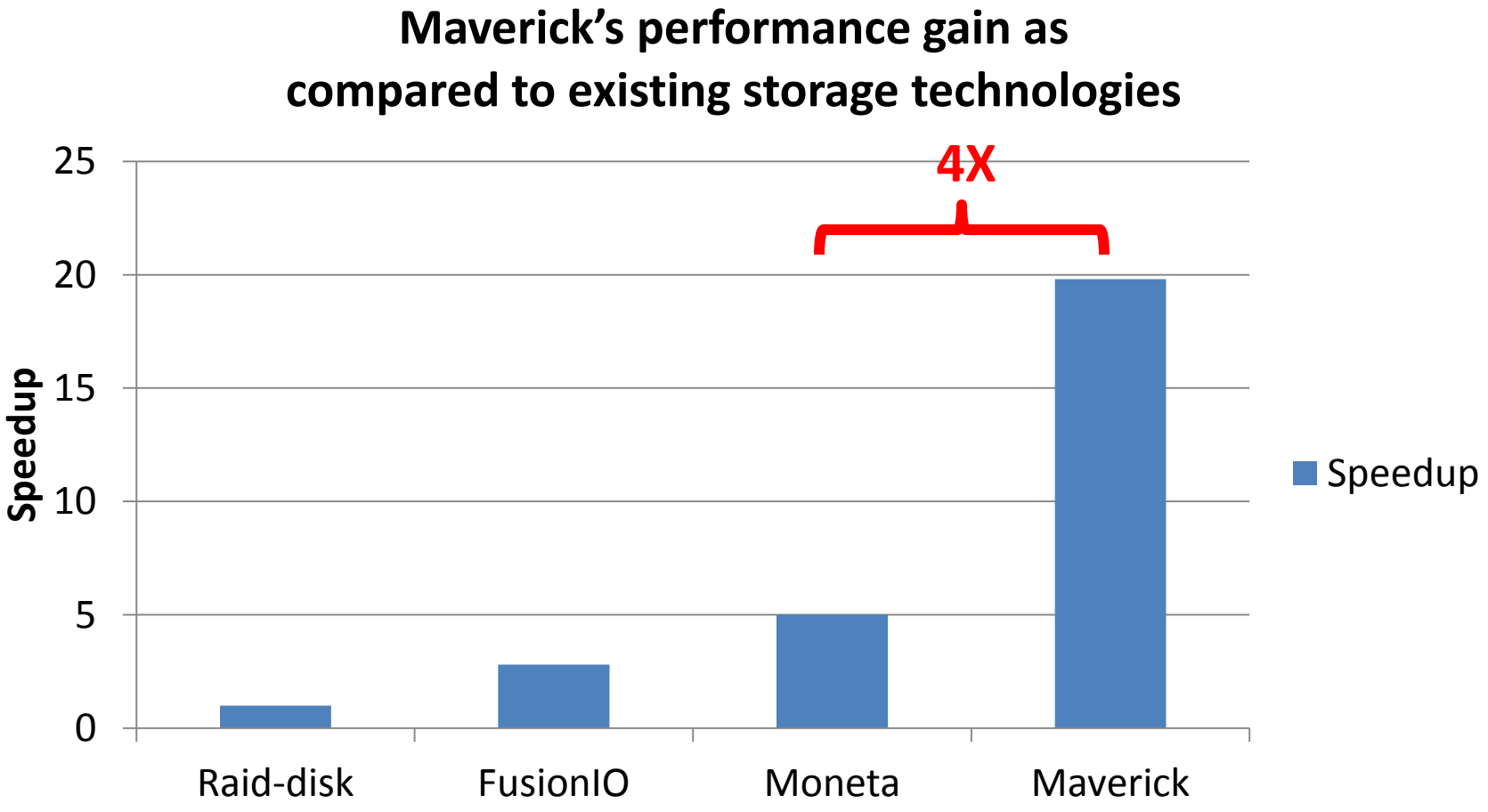


Maverick Prototype

- Built on BEE3 board
- PCIe 1.1 x8 host connection
- Clock frequency 250MHz
- Virtex 5 FPGA implements
  - Maverick scheduler
  - Network
  - Storage processor
  - Memory controller

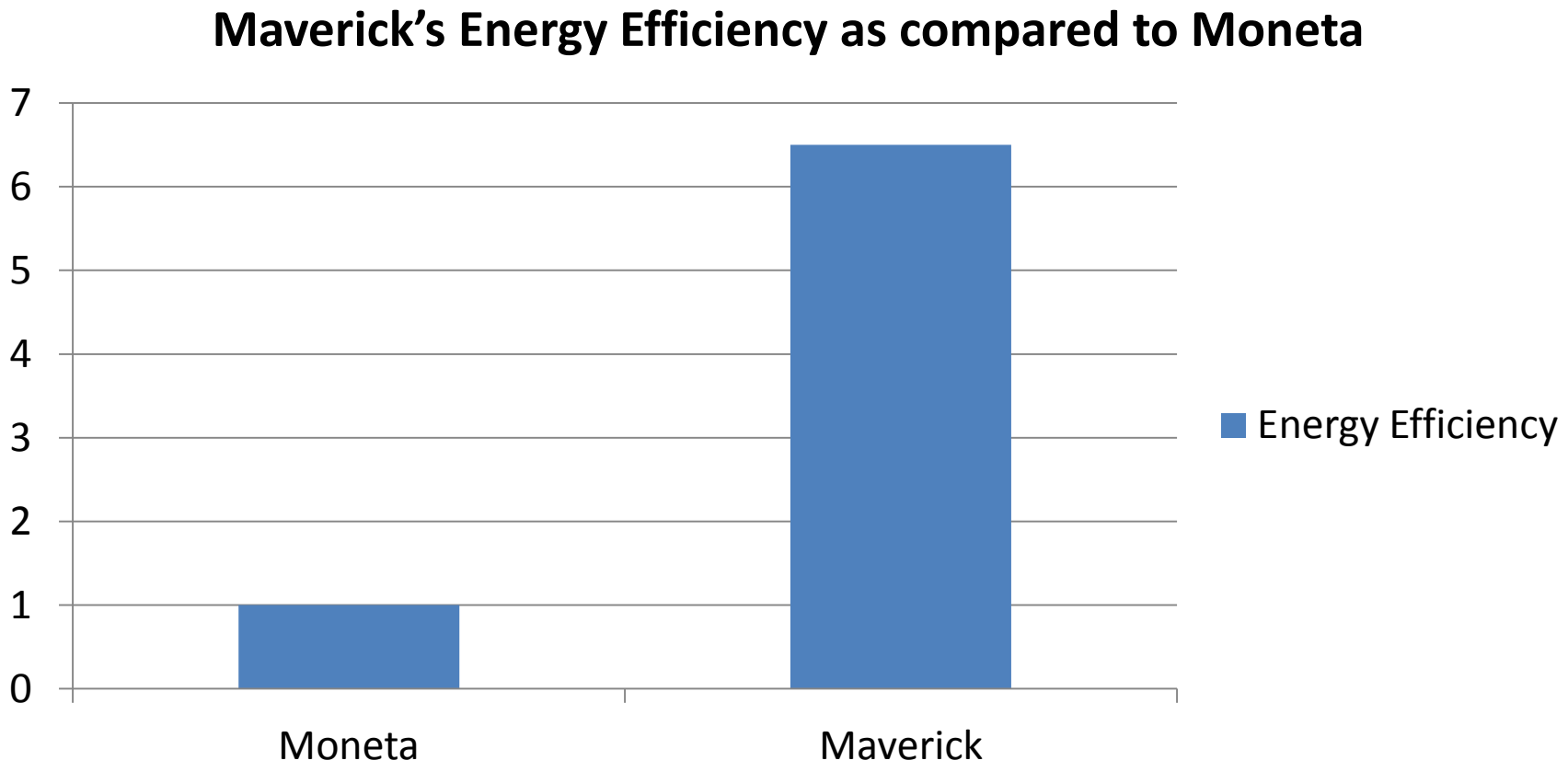
- Run the Smith-Waterman algorithm on Maverick

Performance Gain



Maverick achieves 152 GCUPS (Giga cell updates per second)

Energy Efficiency



Maverick consumes 598 J for 32 GB of biological datasets

Conclusion

- Presented Maverick architecture for next-generation non-volatile memories
- Future work
  - Support different data or I/O intensive applications
  - Support easy migration from the conventional storage to the Maverick
- NVMs can have strong impact on the future computing system

Thank You!

Any Questions?

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