Hardware NVMe implementation on cache and storage systems

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Agenda

- Hardware architecture
- NVMe for storage
- NVMe for cache/application accelerator
- NVMe for new NVM

Why NVMe for Data Center?

Intensive applications

Database

Virtualization

Big Data Analytics

Data Center requirements

More performances (latency, IOPS)

Higher memory capacity

Non-volatile capabilities

Lower power consumption

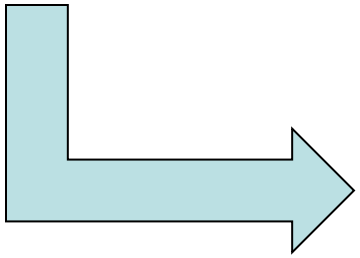
IP-Maker makes the bridge

Emerging technologies

NandFlash

New memories (MRAM/RRAM)

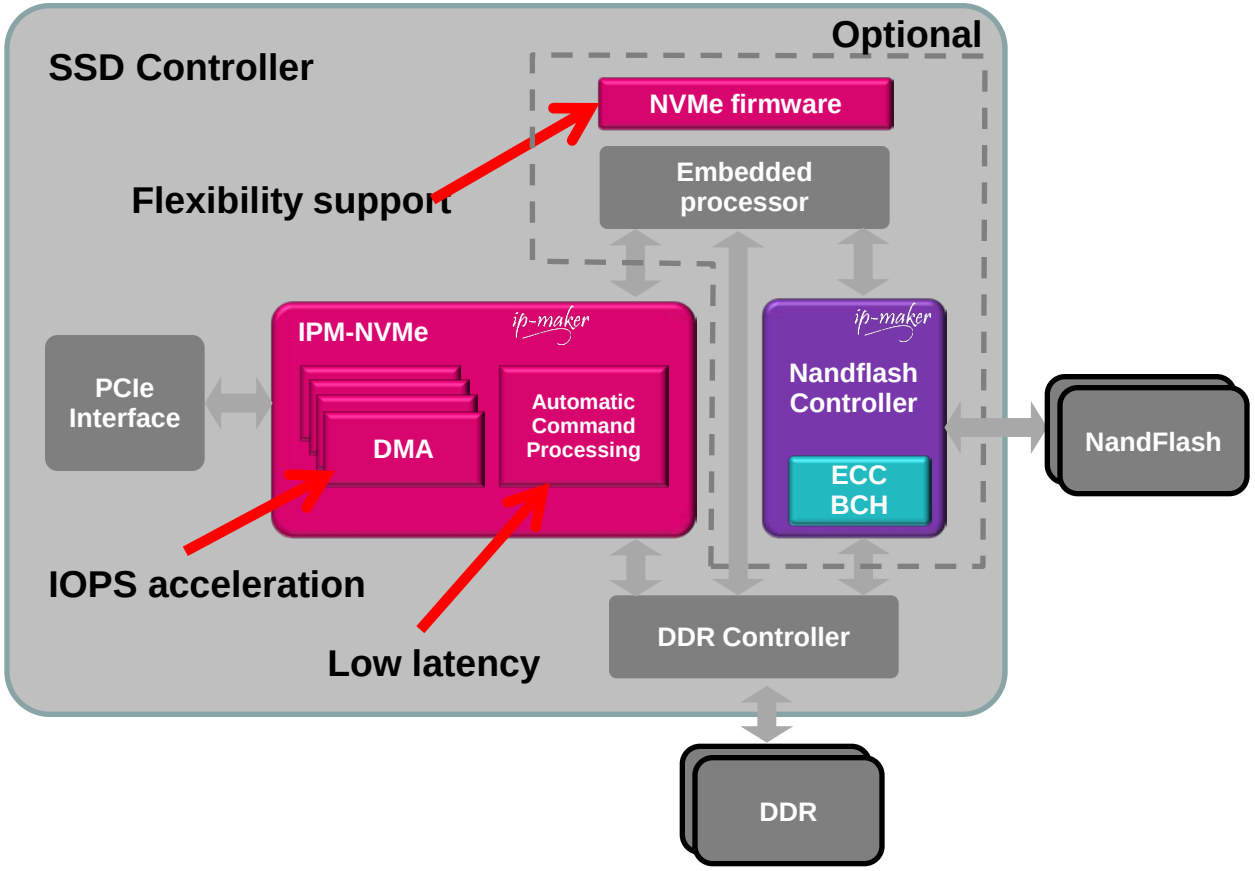
New interfaces (NVMe)



PCIe SSD for

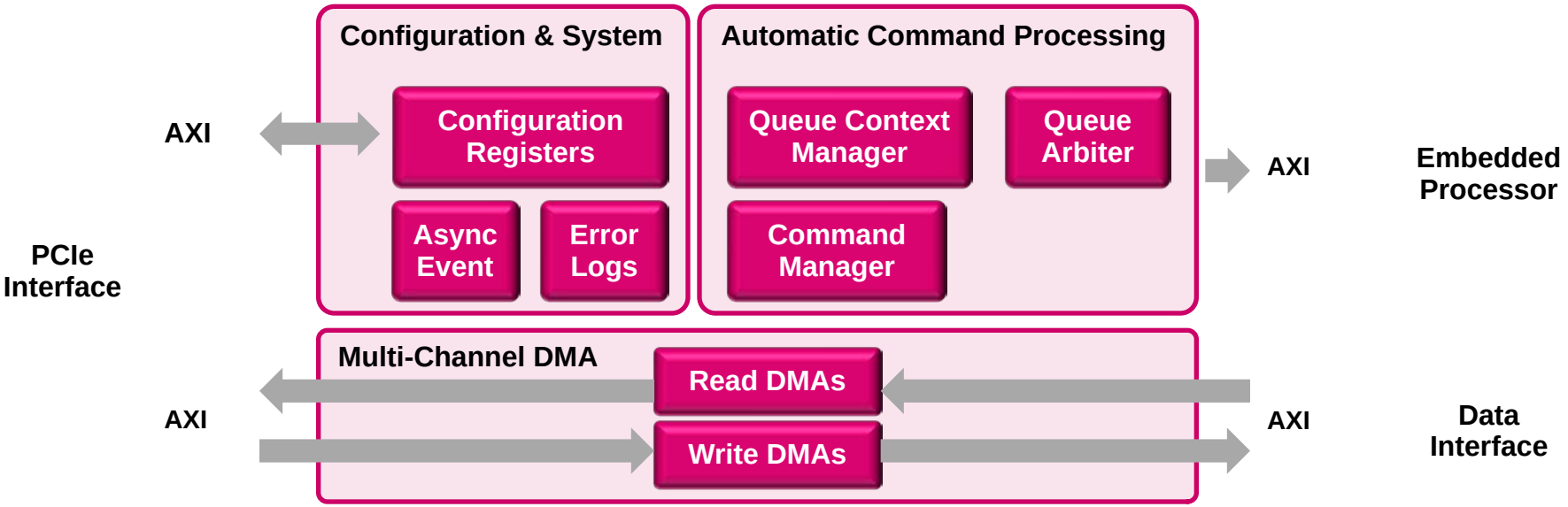
- **Storage**
- **Application acceleration**

NVMe SSD controller architecture



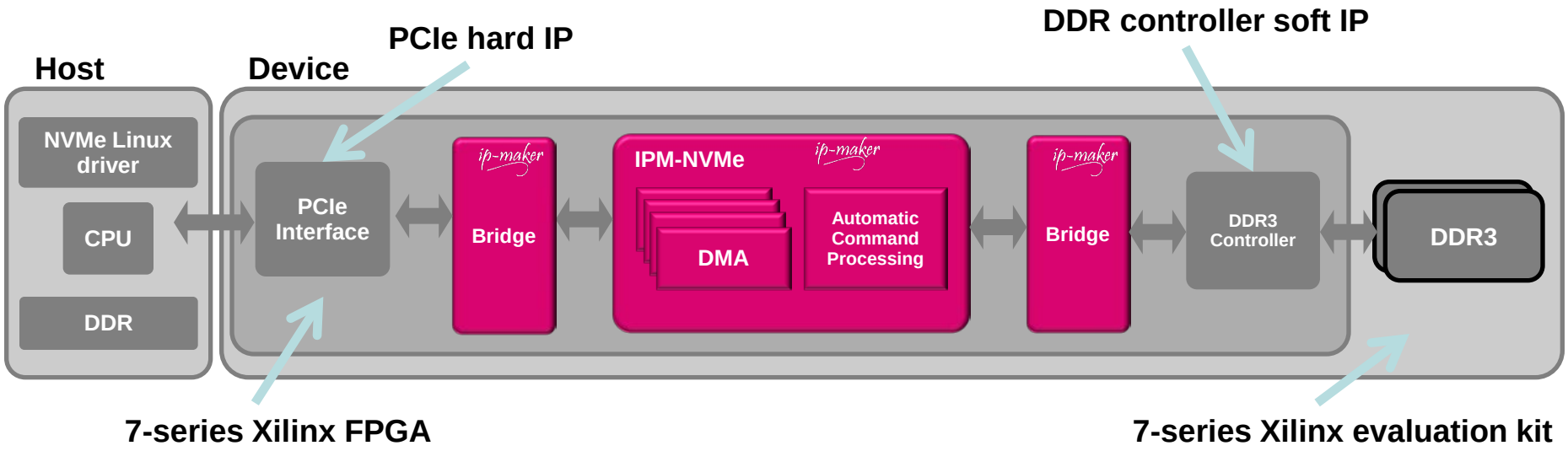
Hardware NVMe IP architecture

- Low latency with the automatic command processing
- IOPS acceleration with the multi-channel DMA



FPGA-Based reference design

- Gen2 x4 configuration performances:
  - IOPS: 350k
  - Latency: 12µs



How many kIOPS for a Gen2 x4?

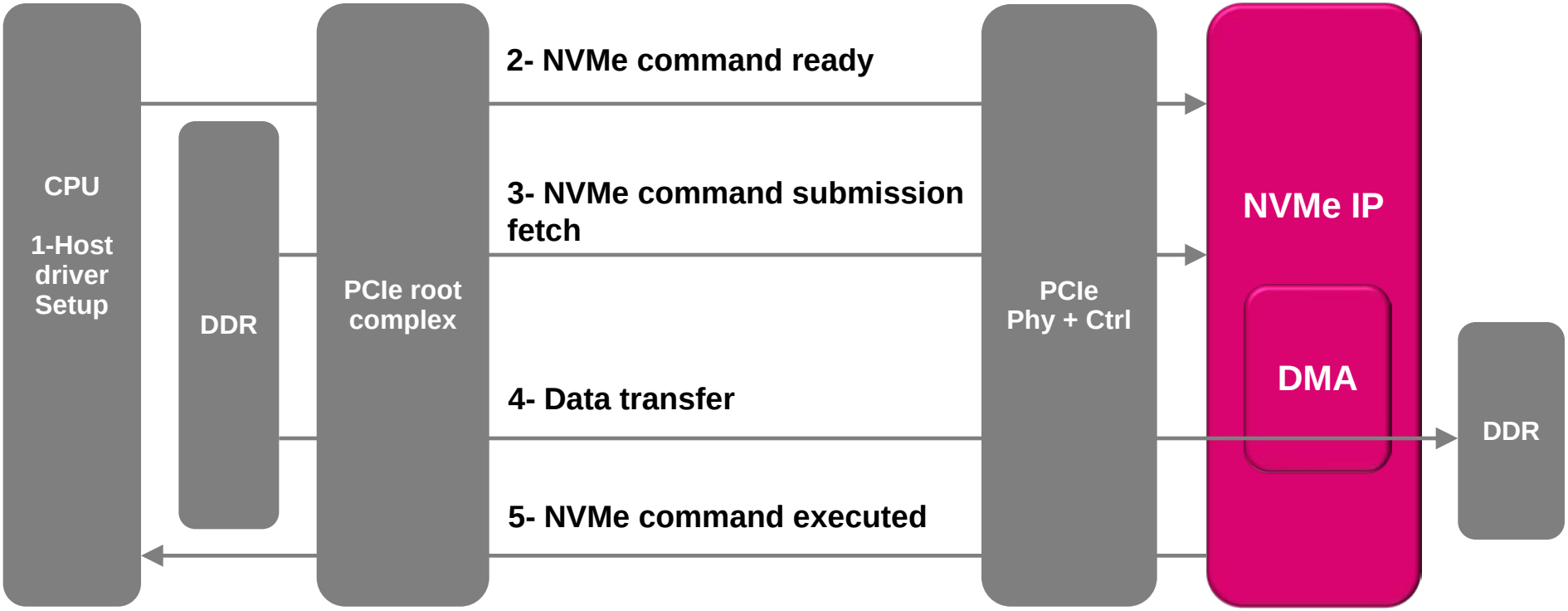
- Lane speed is 5 Gb/s => 20 Gb/s
  => **610kIOPS** max?

But,

- 8/10bit coding
  => **499kIOPS** max of data
- PCIe overhead (CRC…): 24B for a 256B payload
  => **446kIOPS** max of useful data
- 90% bus use
  => **400kIOPS** max
- And other…

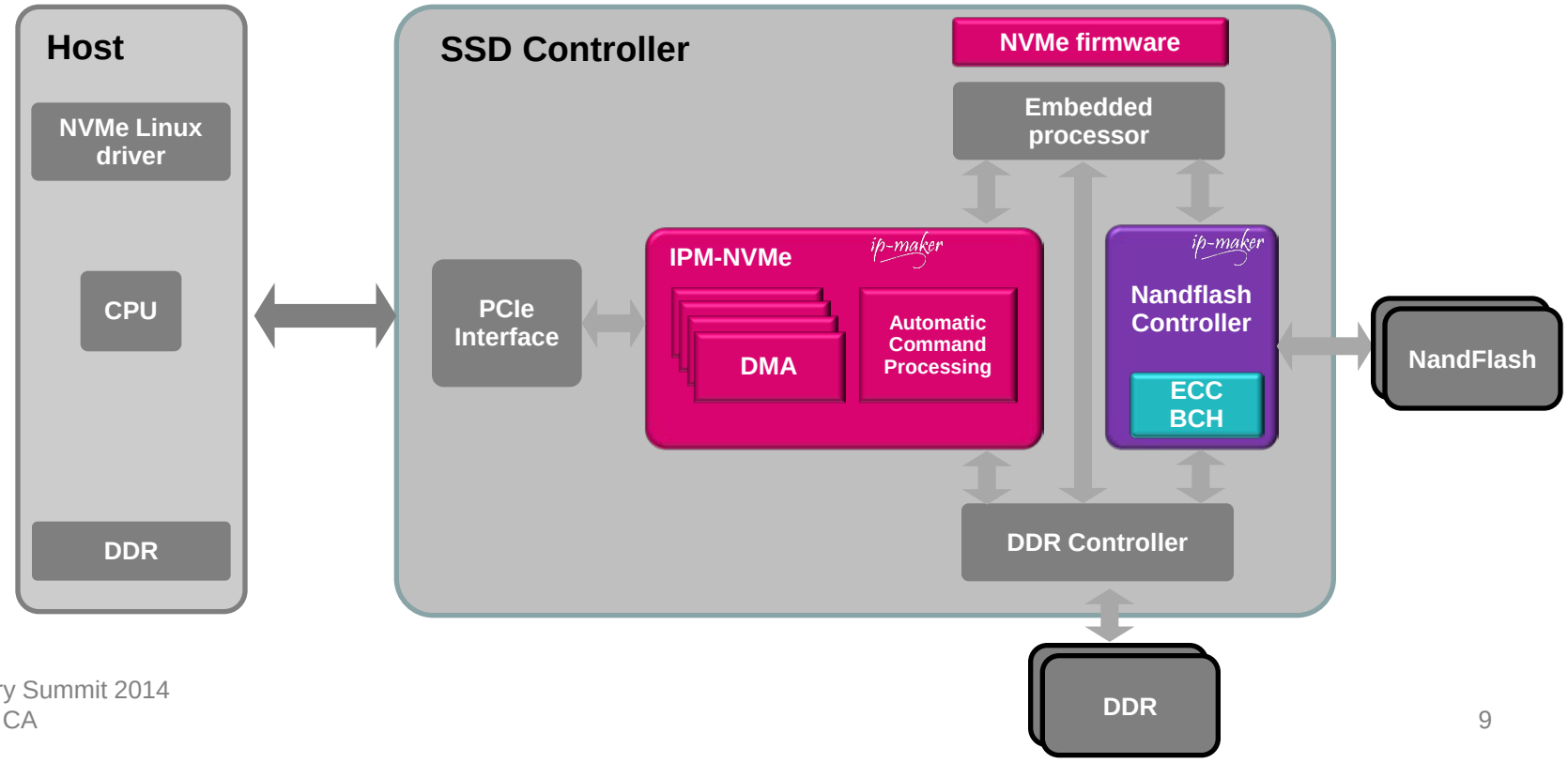
What is the latency for a Gen2 x4?

- 4µs for the host driver
- 8µs for all PCIe transactions
- Less than 0.1µs for the NVMe command processing



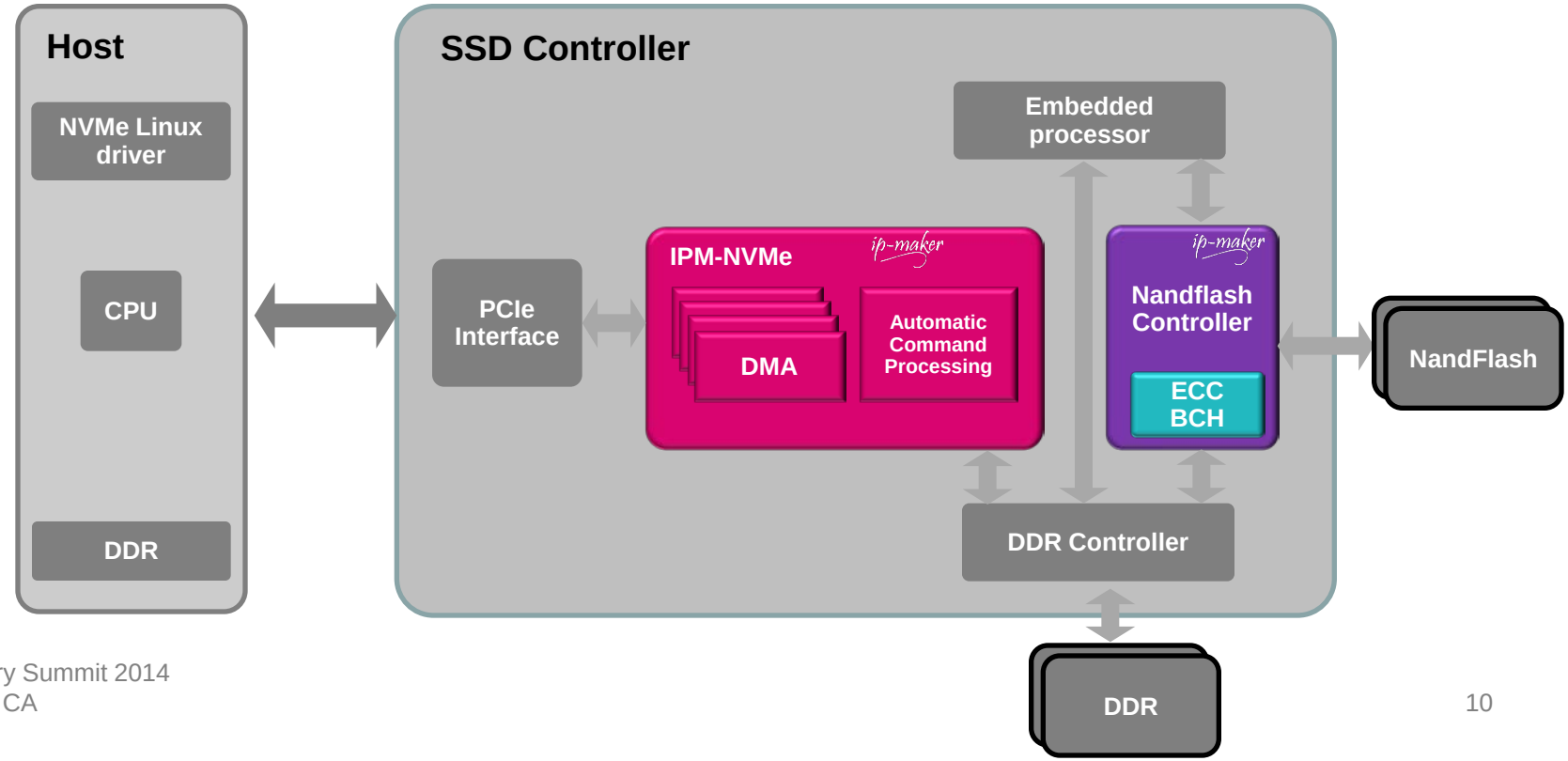
NVMe for storage

- Hardware NVMe for high performance
- Firmware NVMe for command flexibility



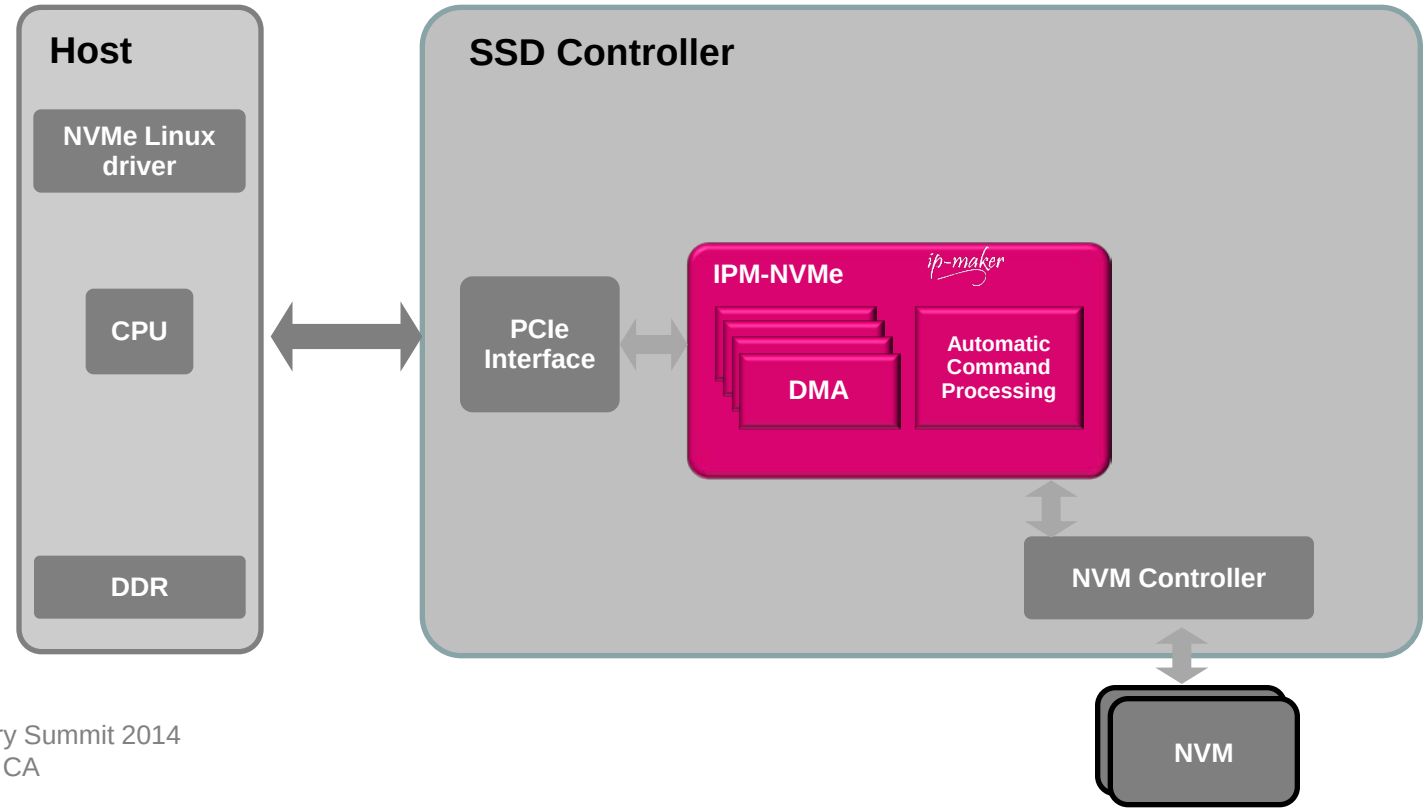
NVMe for application acceleration

- Hardware NVMe for high performance
- No need of flexibility: just performance
- CPU for NandFlash management

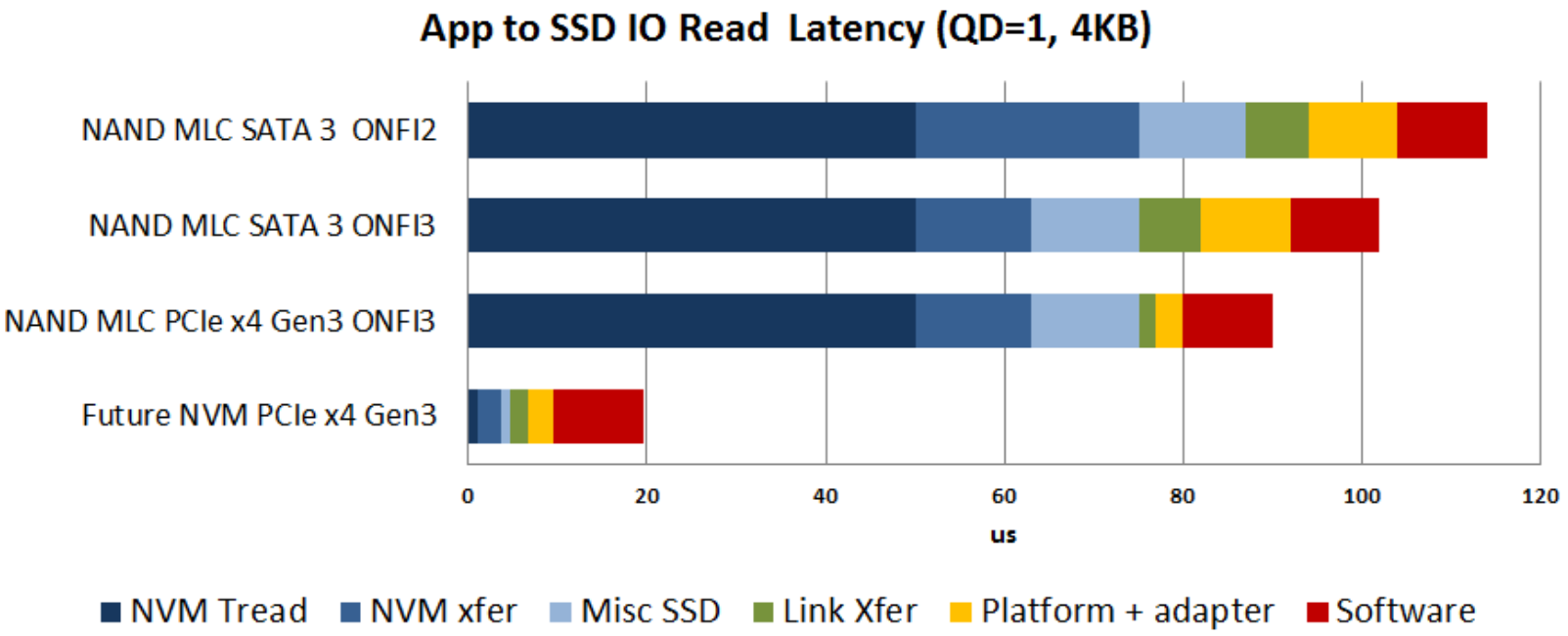


NVMe for new NVM (MRAM, RRAM)

- Simplified architecture
- Lower latency



Latency with different memories



Flash Memory Summit 2013, Amber Hufflan, Intel

Summary

- Benefits of a hardware NVMe architecture:

- Ultra low latency with hardware acceleration for NVMe command processing
- High IOPS with integrated multi-channel DMAs
- High memory capacity with scalable design
- New NVM capabilities
- Low power consumption thanks to hardware acceleration

Thanks!

Visit IP-Maker booth #619
NVMe live demo!

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