
MaXio Technology

# A HW/FW Co-Designed SSD Controller Architecture to Boost up SSD Performance

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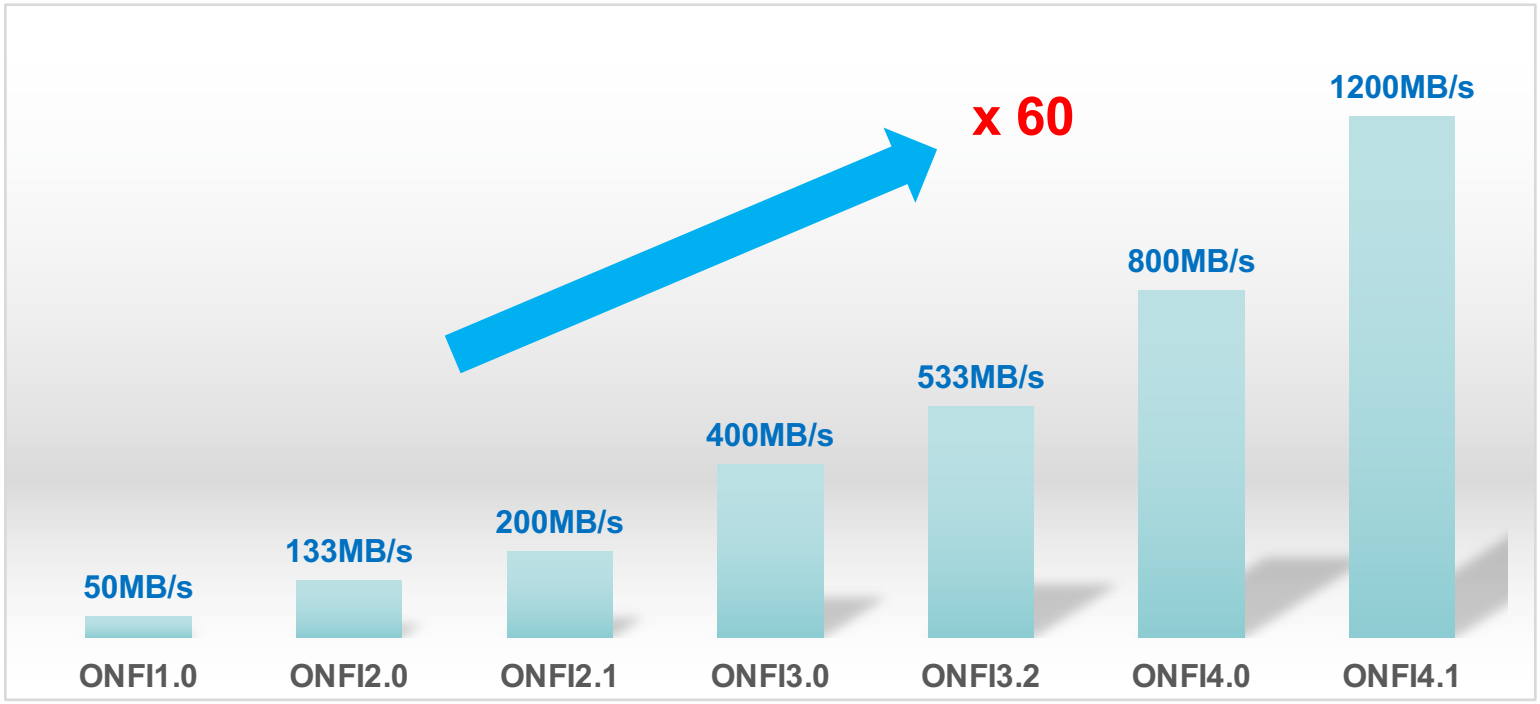
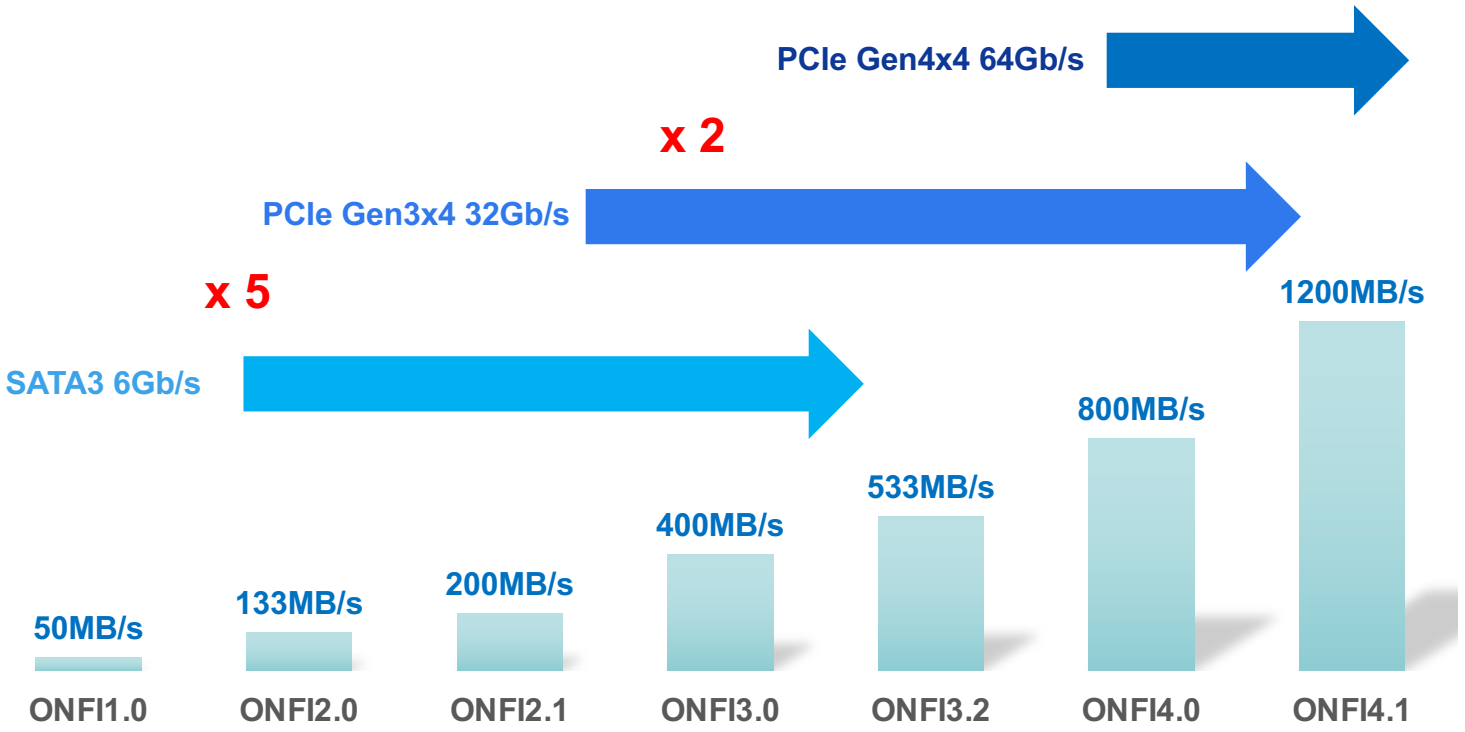
# Explosive NAND IF Bandwidth



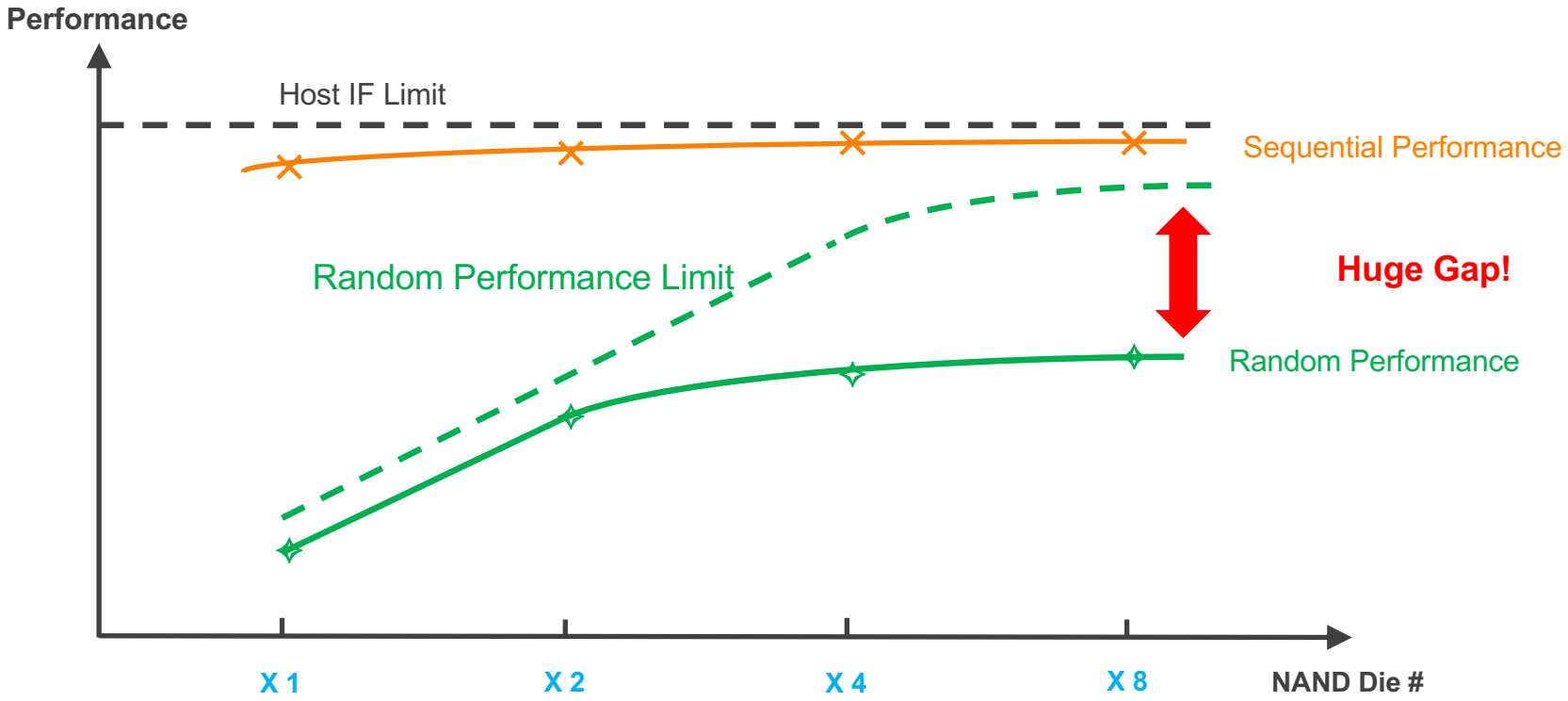
# Client SSD Trend



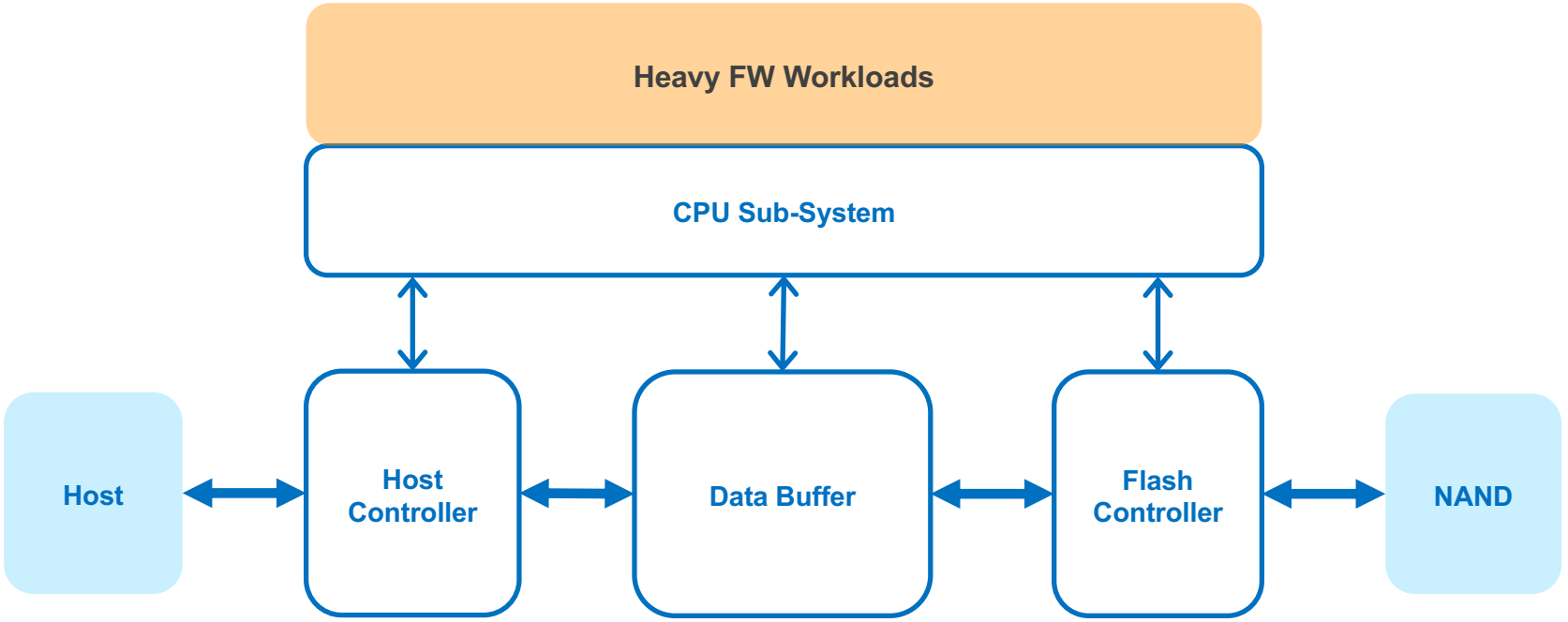


# SSD Performance Issue





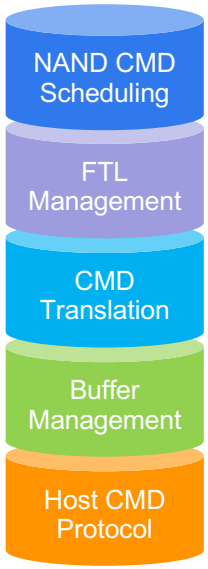

# Bottleneck of SSD Performance



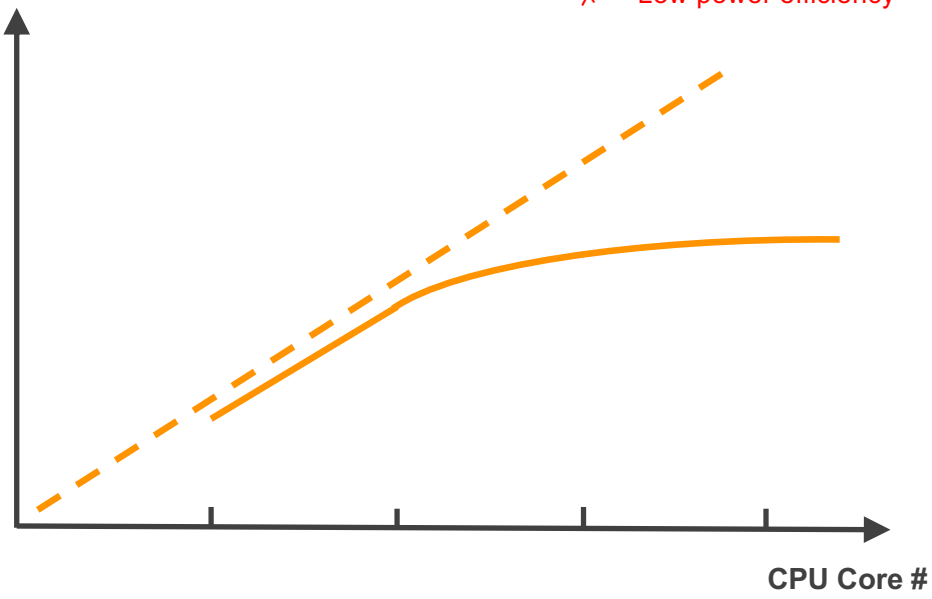
# Details of CPU Workloads

- Typical solution: Increasing CPU cores
  - ✗ More CPU partitions
  - ✗ Complicated FW architecture
  - ✗ Low power efficiency

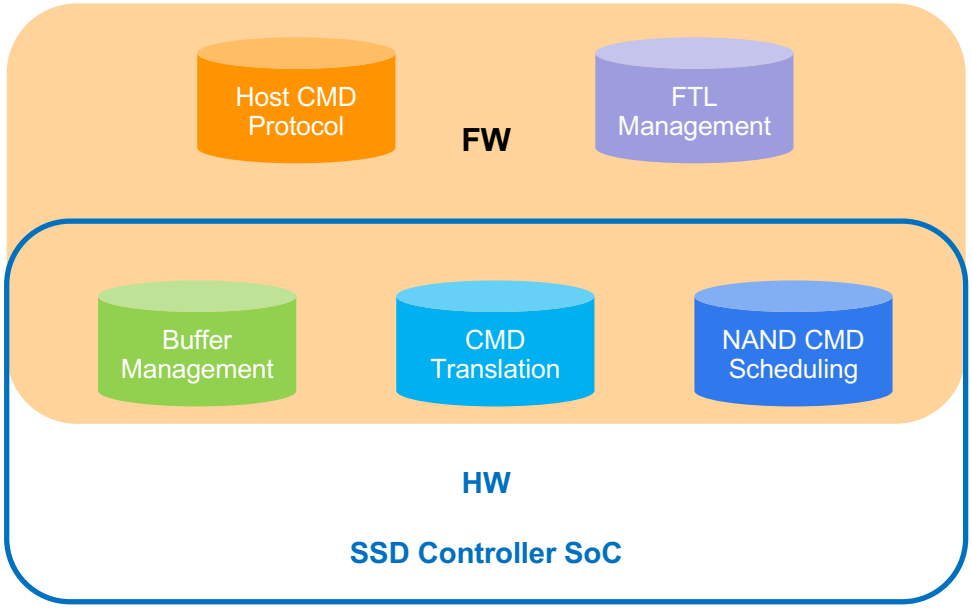
**Heavy CPU workload**




**SSD Performance**

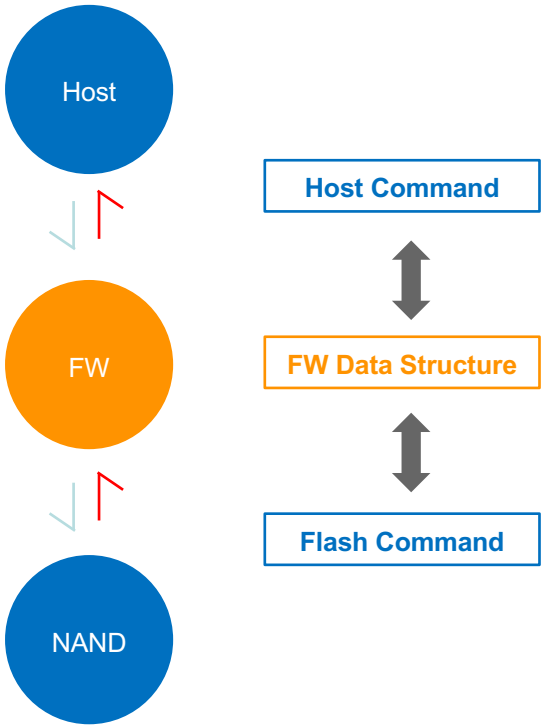


# Cross-Layer Design Methodology

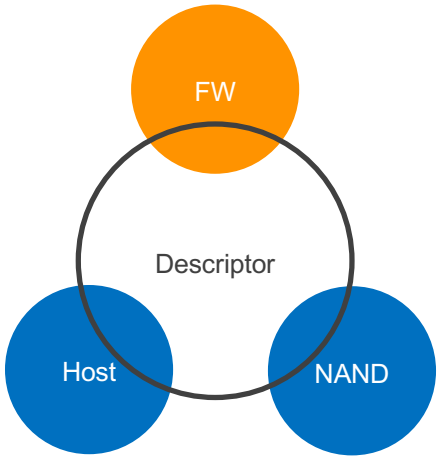



- HW/FW Co-designed architecture to offload CPU
  - ✓ Seamless FW/HW flow
  - ✓ Simple FW architecture
  - ✓ High power-efficient

# Unified HW/FW Data Structure



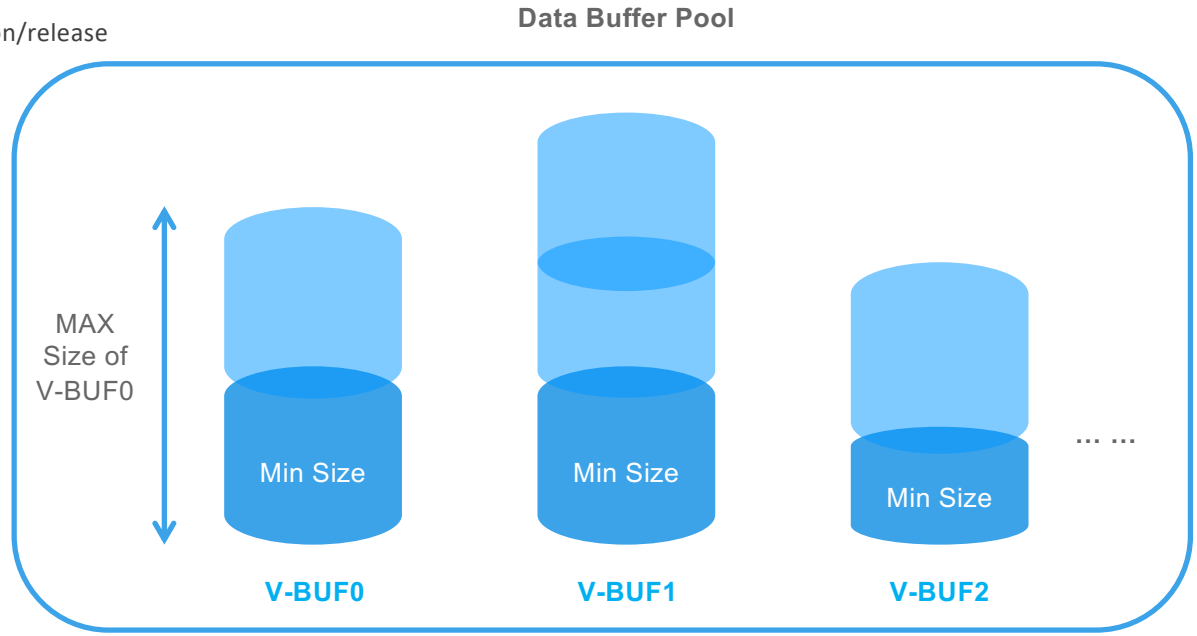

- HW/FW Shared data structure (e.g., descriptor), containing all information about the atomic data unit managed by FW.
- HW automation for descriptor pool management, including descriptor allocation/release and queue management.



# Virtual Buffer Management

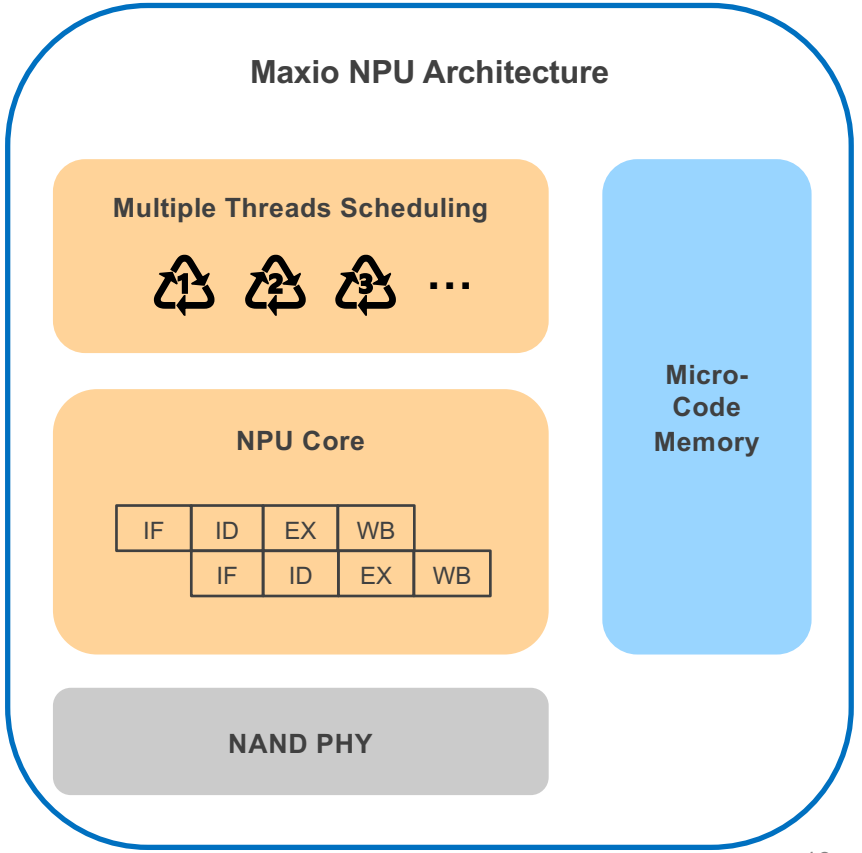


- Physical buffer segments shared by virtual buffers
  - ✓ Virtual buffers are defined by FW
  - ✓ HW automation of buffer allocation/release
- Virtual buffer attributes
  - ✓ Buffer ID
  - ✓ Min/max size
  - ✓ Buffer allocation policy

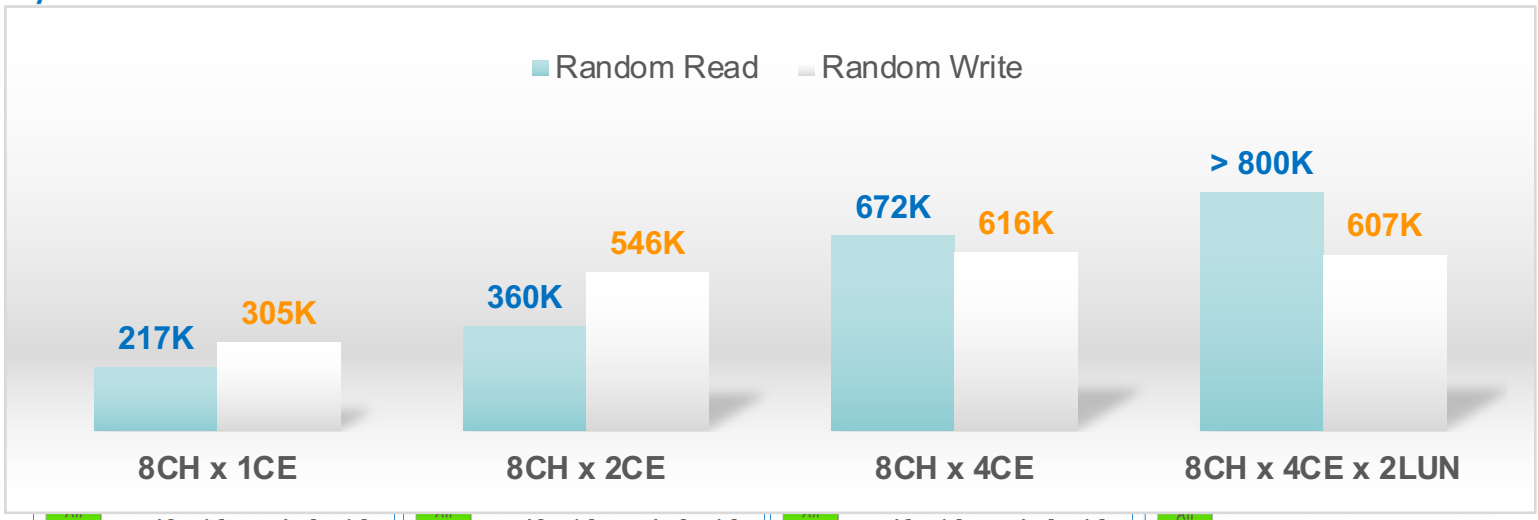


# Maxio NPU Technology

- Private instruction set for NAND flash memory
  - ✓ Flexible NAND command sequence
  - ✓ Support NAND models of all NAND vendors
- Specified NAND Processing Unit (NPU) architecture - NPU
  - ✓ Support multiple thread
  - ✓ HW automation of thread interleaving
  - ✓ NPU core: 4 pipeline stages for high speed NAND IF



# Maxio MAP1001 Performance Result




| | Read [MB/s] | Write [MB/s] |
|---|---|---|
| Seq Q32T1 | 3461 | 1282 |
| 4K Q32T8 | 889.0 | 1251 |
| Seq | 1895 | 1281 |
| 4K | 79.63 | 284.0 |

| | Read [MB/s] | Write [MB/s] |
|---|---|---|
| Seq Q32T1 | 3543 | 2549 |
| 4K Q32T8 | 1473 | 2236 |
| Seq | 2710 | 2514 |
| 4K | 80.70 | 300.1 |

| | Read [MB/s] | Write [MB/s] |
|---|---|---|
| Seq Q32T1 | 3545 | 3054 |
| 4K Q32T8 | 2753 | 2523 |
| Seq | 2780 | 3094 |
| 4K | 80.00 | 302.7 |

| | Read [MB/s] | Write [MB/s] |
|---|---|---|
| Seq Q32T1 | 3539 | 3109 |
| 4K Q32T16 | 3362 | 2485 |
| Seq | 2876 | 3111 |
| 4K | 77.39 | 289.5 |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