

Overcoming the Design Challenges in PCIe 5.0 SSD

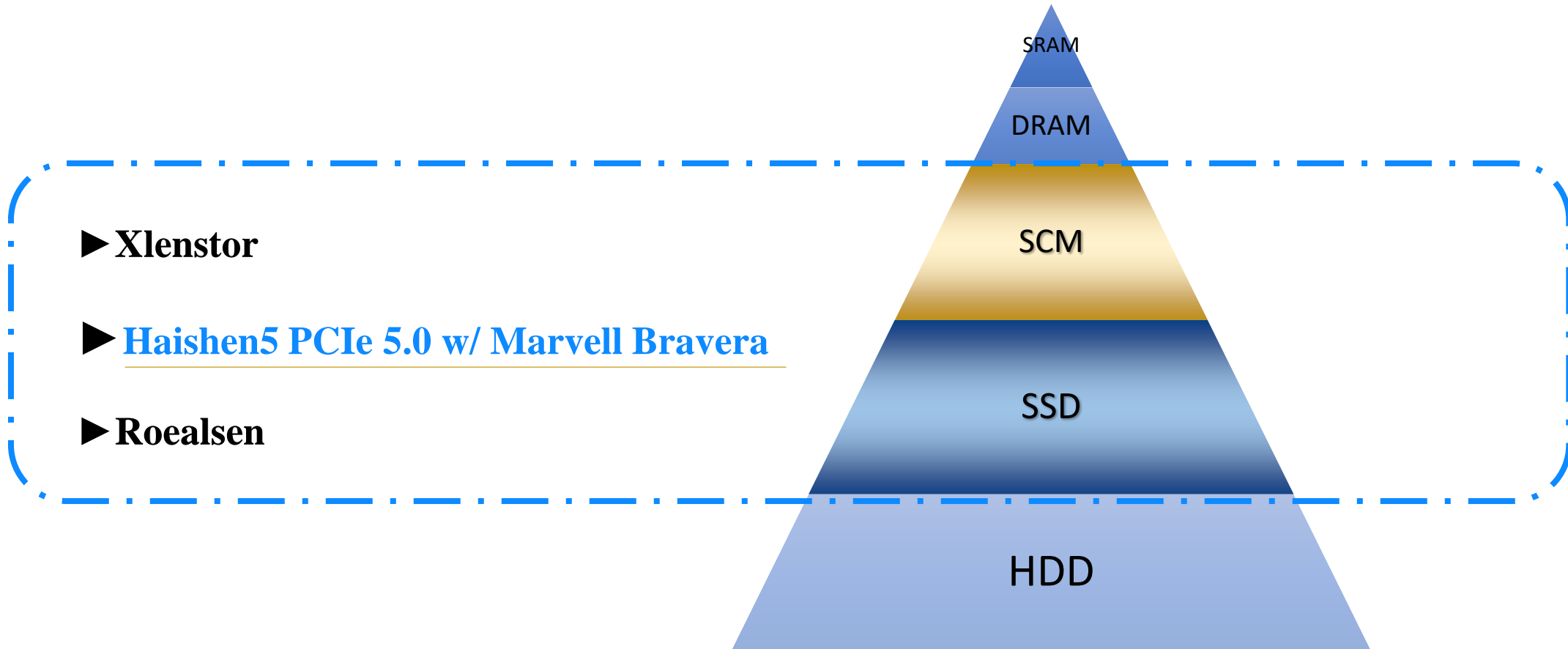
Presenter: John Li | VP of Marketing & Operations | **DapuStor**

| DapuStor Brief Introduction

High-end PCIe eSSD Solution Provider[©]

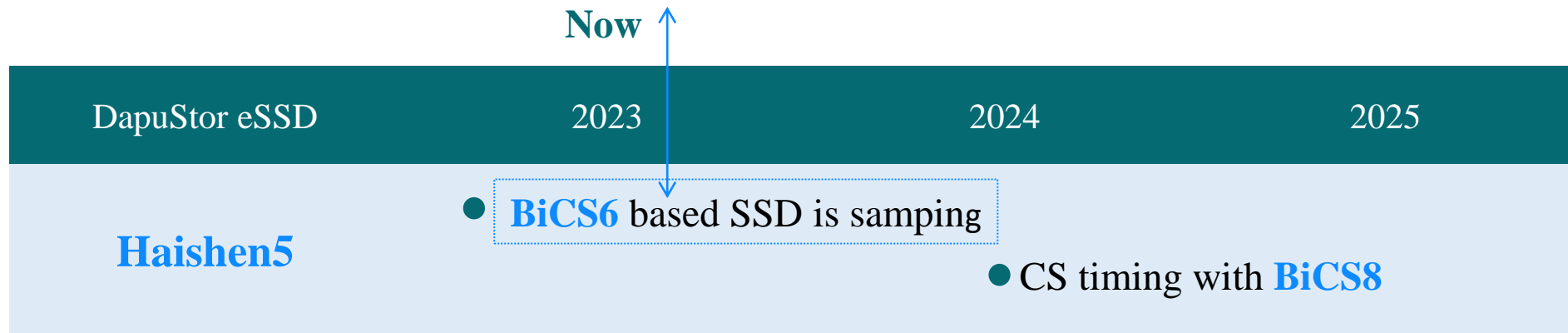


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| Challenge 1: Supply & Cost

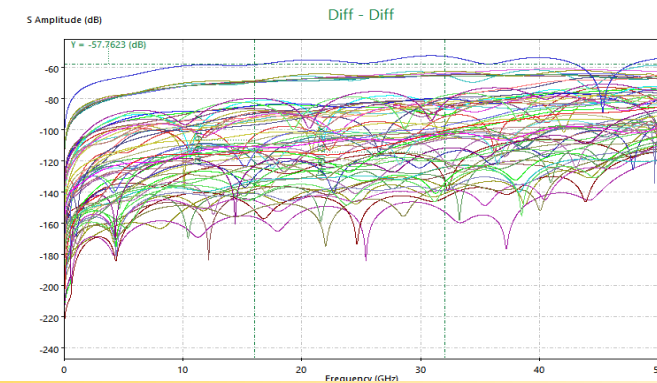
The Newest Controller & NAND Flash



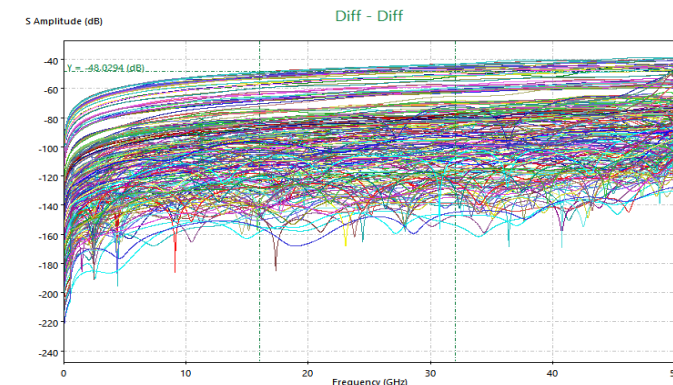
| Challenge 2: Signal Integrity

The PCIe 5.0 signaling rate addition is 32 GT/s NRZ, which requires **low insertion loss** to ensure drive performance.

- ▶ PCB Material and Loss
- ▶ Manage Return Loss
- ▶ Differential Impedance and Skew Control
- ▶ Manage Crosstalk



Differential crosstalk coupling-Near end (Crosstalk -57.76db@16GHz)



Differential crosstalk coupling-Far end (Crosstalk -48db@16GHz)

| Challenge 3: High Performance-1

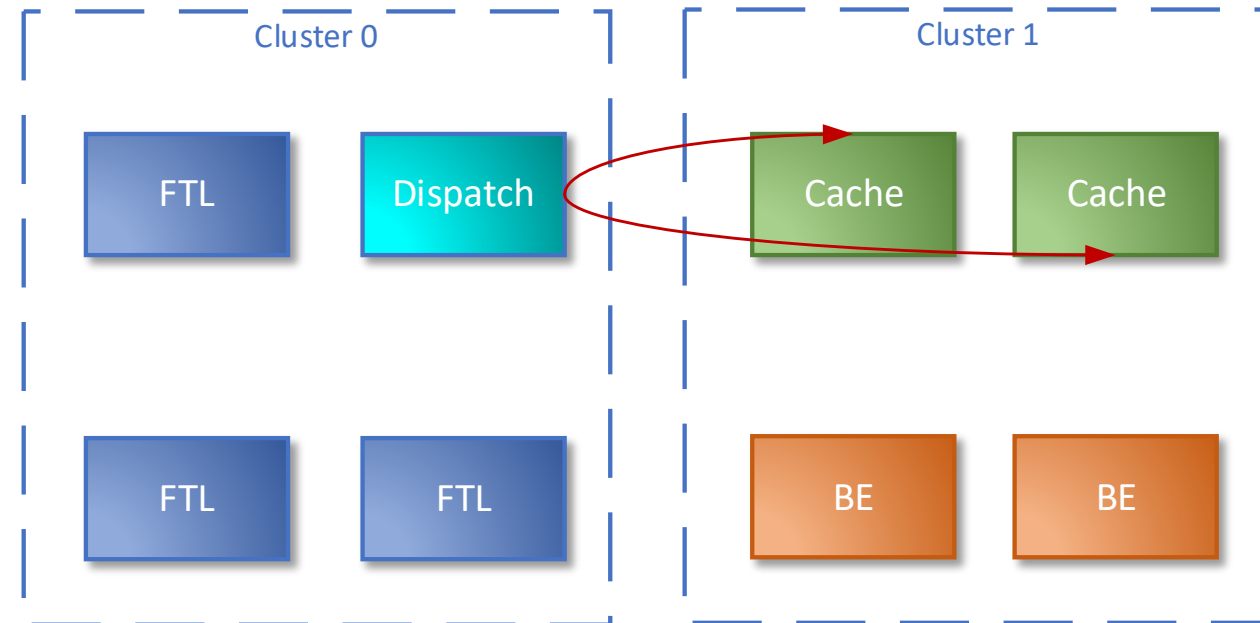
For Small Capacity[Ⓢ]

Save OP with less die quantity

- ▶ Divide eight R8-Core for different tasks
- ▶ Dispatch core dispatch commands to 2 caches
- ▶ 1 FTL (both host & GC) for write, 2FTL for read(both host & GC)
- ▶ 2 BE for NAND operation. (manage different channels)

*FTL = Flash Translation Layer

*BE = Backend

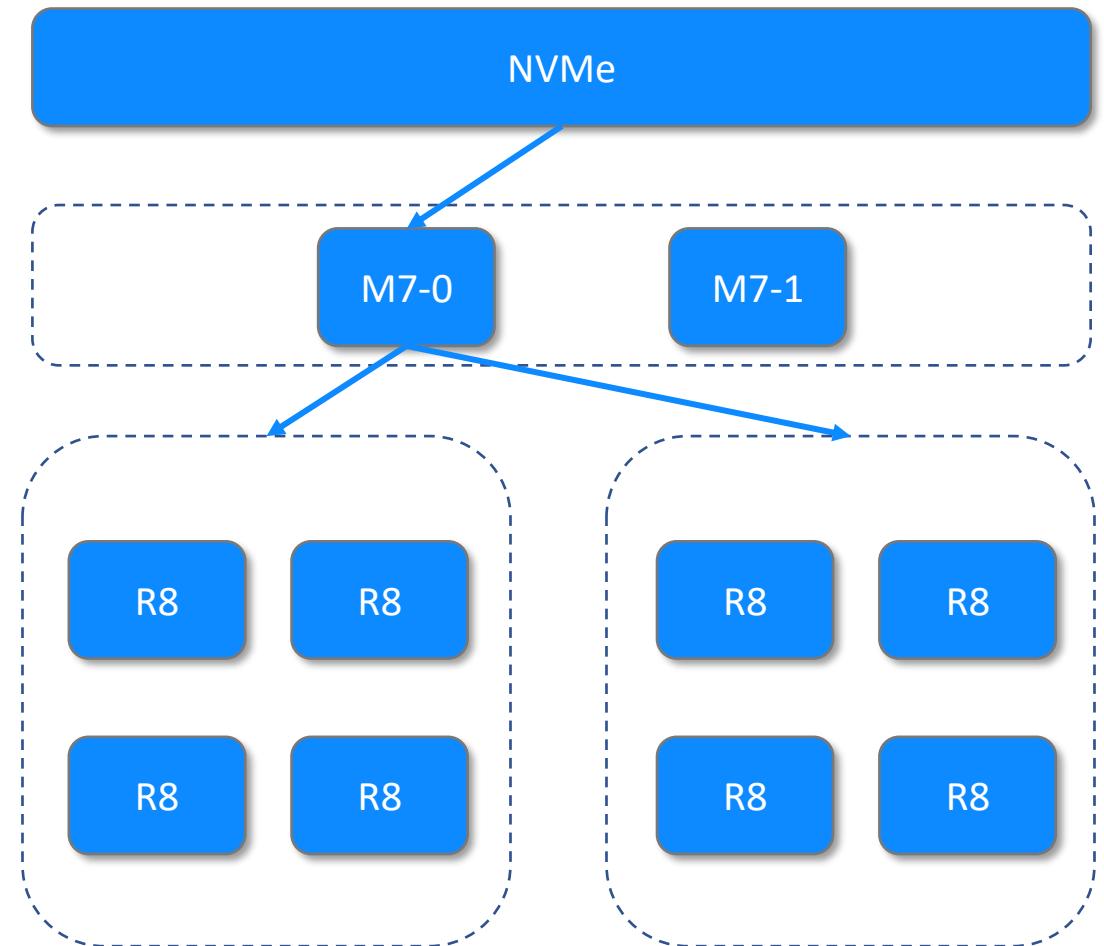


| Challenge 3: High Performance-2

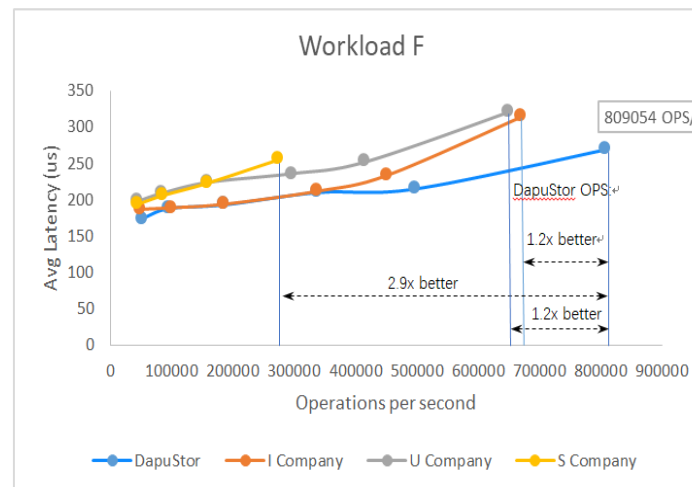
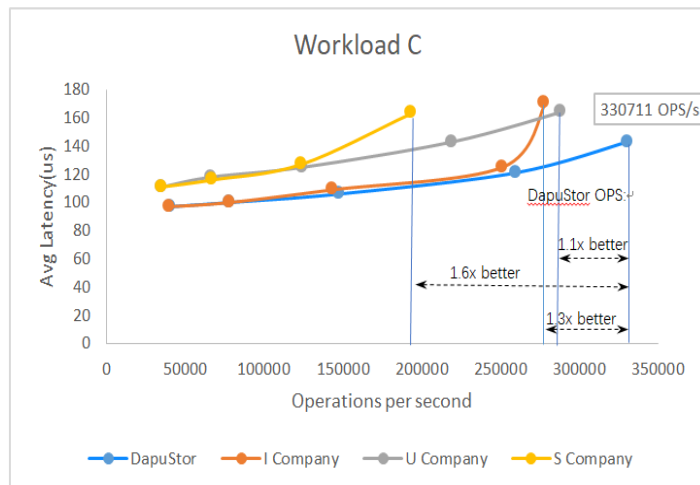
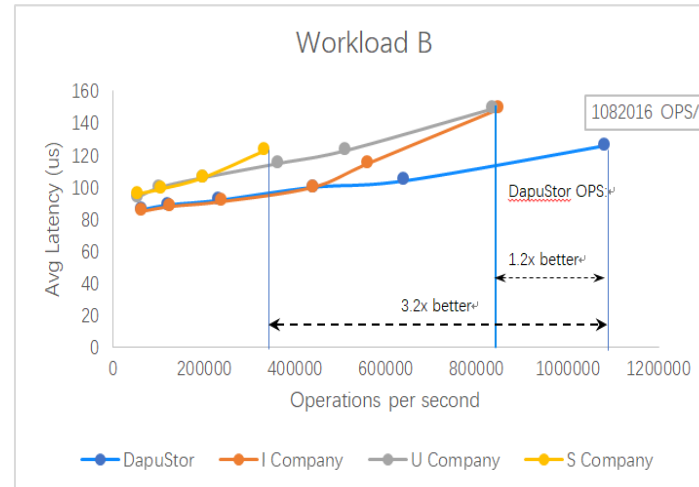
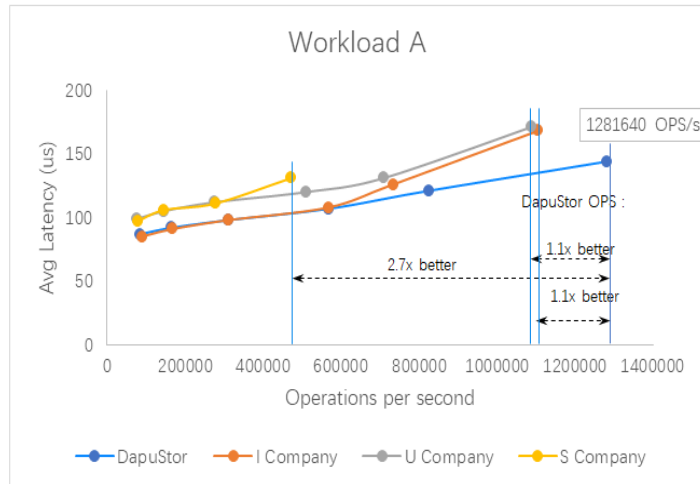
For Large Capacity[©]

Simplify architecture design

- ▶ Divide eight R8-Core as two part, both handle R/W and trim commands.
- ▶ M7-0 split io commands and handle admin commands.
- ▶ M7-1 handle some co-process such as log system.
- ▶ All R8 cores run main firmware codes such as cache, ftl, nand interface.



| Superior FW Capability Demonstration-1



AEROSPIKE

Performance

↑ Performance **16%-34%**
improved compared with U and I
company.

↑ Over **200%** improved in most
of the testing models compared with S
company.

| Superior FW Capability Demonstration-2

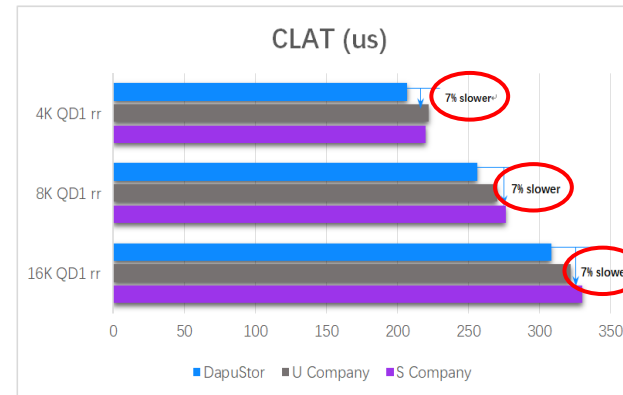
“Noisy Neighbor” Performance Test

Drive Set up		
4K QD8 1.02TB NS 1	8K QD8 1.02TB NS 2	16K QD8 1.02TB NS 3
1.5 TB Free Space		
4K QD1 1.02TB NS 4	8K QD1 1.02TB NS 5	16K QD1 1.02TB NS 6

Conduct Read & Write at the same time to NS1-NS6, perform 8QD write to NS1-NS3 and operate 1QD read to NS3-NS6.

Collect each read QoS after test.

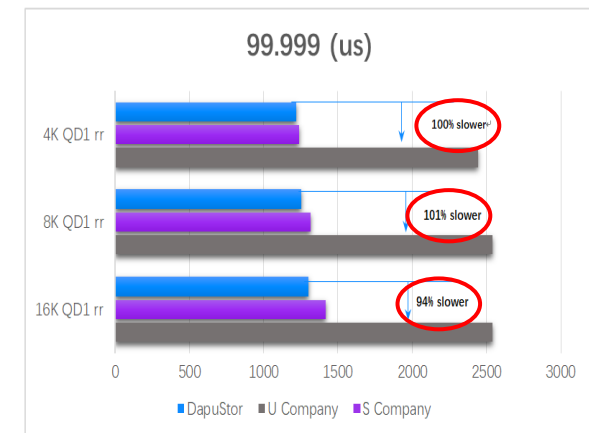
QD1 Random Read QoS CLAT



QD1 Random Read QoS 99.99

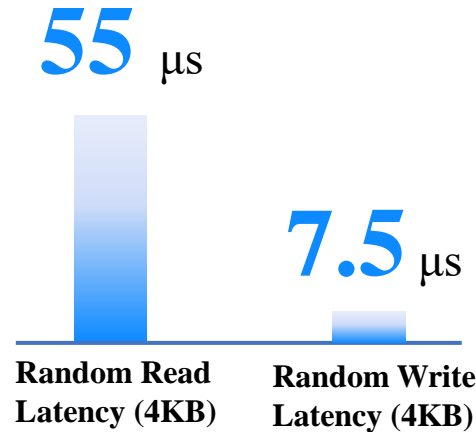


QD1 Random Read QoS 99.999



| High Performance & Low Latency & Multi-FF

Suitable for AI/ Hyper Computing Scenarios



E1.S



E3.S

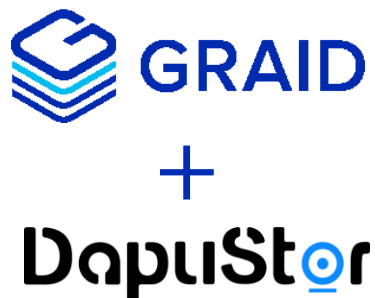


U.2

| Superior Performance With GRAID RAID Card



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Test
Configuration

Graid SupremeRAID™ SR-1010 *1

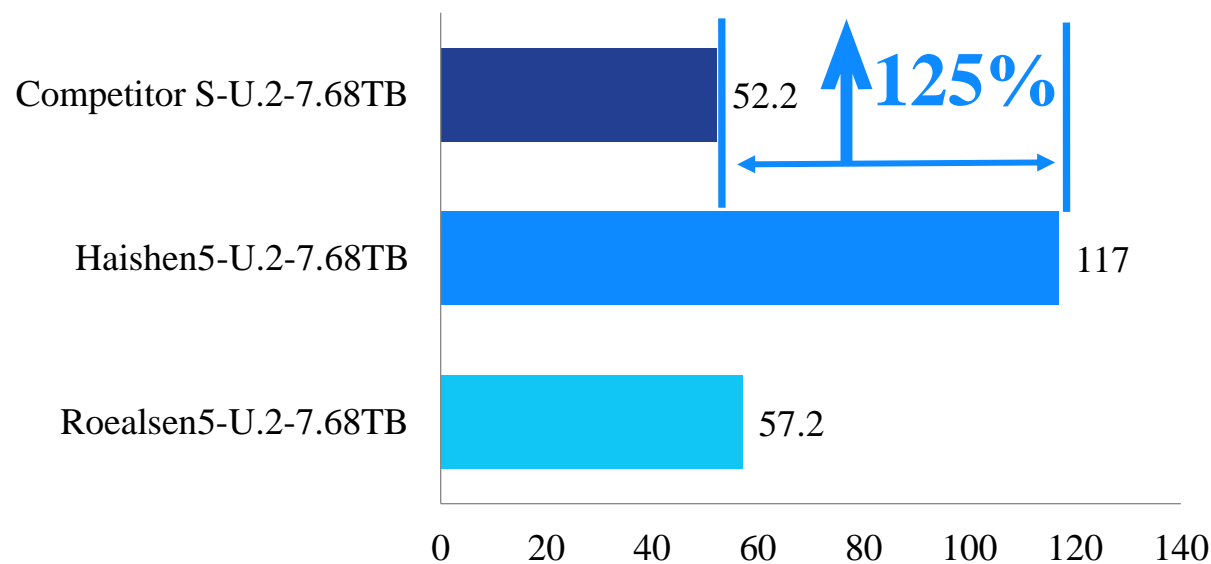
8 Drives RAID10

xFusion 2288H V7

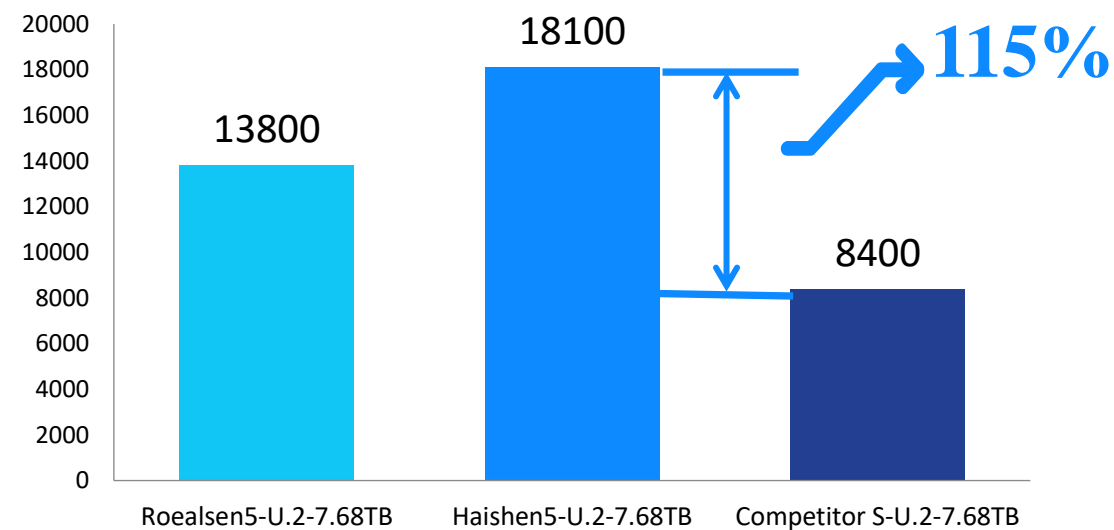
Intel(R) Xeon(R) Gold 6430 *2

DDR5 4800 MT/s 64GB *12

1MiB Sequential Read Bandwidth Benchmark (GB/s)



4KiB Random Read Benchmark (KIOPS)



| Challenge 4: Thermal Design

For Better Performance🎯



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Material



Mechanical



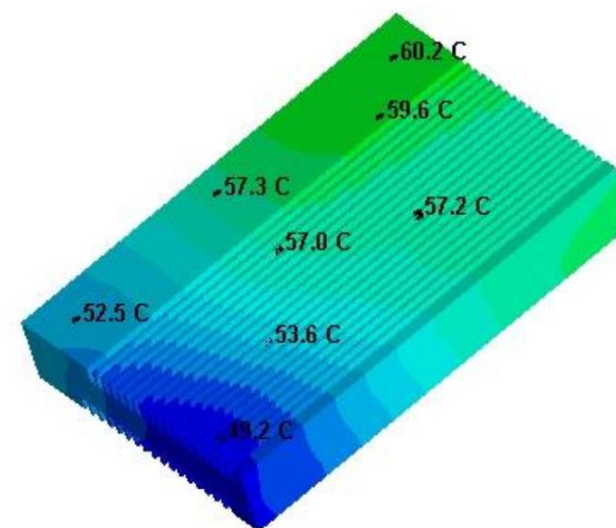
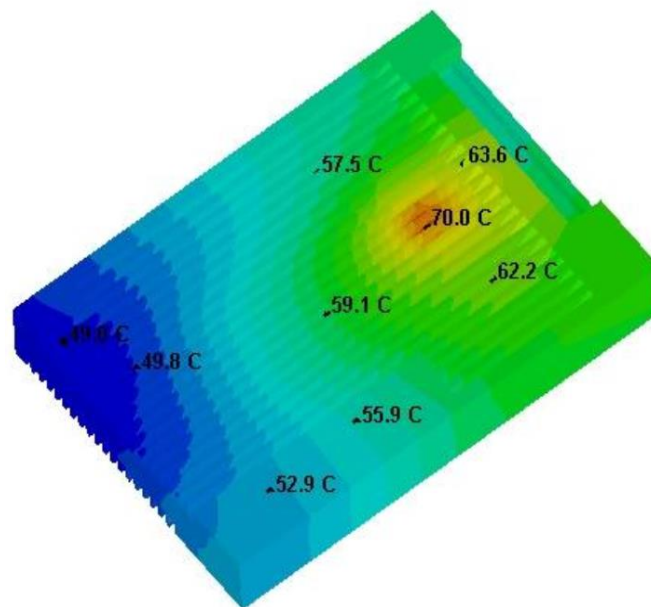
Air Duct



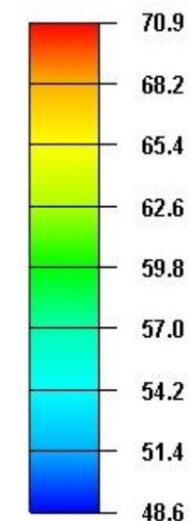
Component Layout



Circuit Design



Temperature [C]



*Haishen5 Thermal Simulation Result

| Challenge 5: SR-IOV for Cloud

SR-IOV -- Hardware-based Solution

► Configurable Virtual Function

(VF) Quantity 0-32

► Multi-stream & I/O Isolation,
maximum support 4-8 namespace(NS)

SR-IOV – **Single Root** I/O Virtualization, **PCI-SIG** maintenance standard

- PF – Physical Function
- VF – Virtual Function

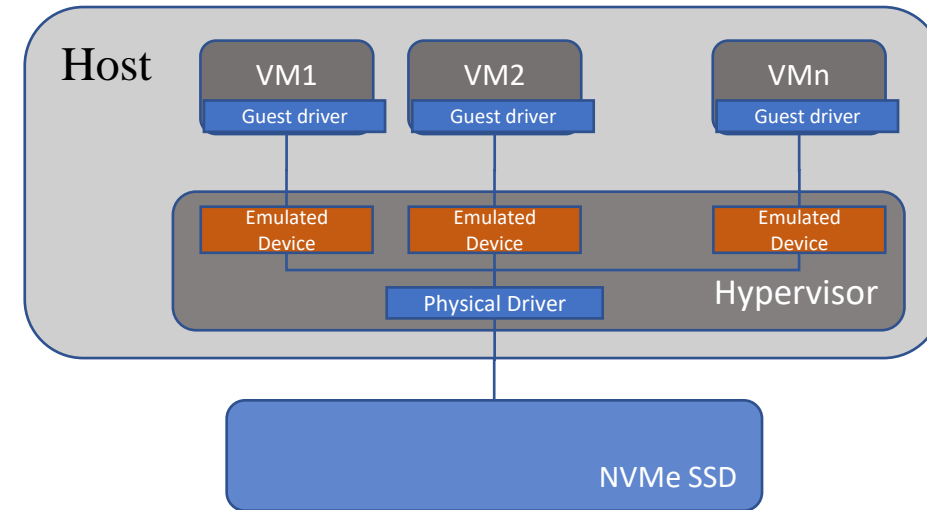
► Multiple VMS can **directly share** the same physical PCIe device

► Equivalent **I/O performance** to native hardware

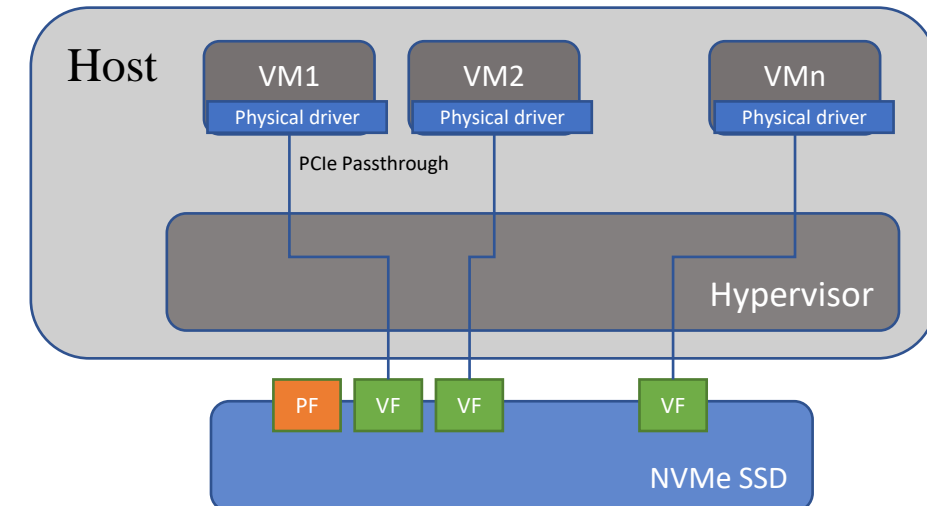
► Reduce **CPU overhead** notably

Traditional Virtualization Solution

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SR-IOV Solution





OPEN
COMMUNITY®



Comply with **OCP 2.0** @Q4/2023

Comply with **TCG Opal 2.0** @Q4/2023



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THE END

M a k i n g D a t a S t o r a g e S m a r t e r

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