



## Expanding NVMe Technology to New Media Types: Rotational Media

David Allen, Seagate Technology

Dave Landsman, Western Digital



Flash Memory Summit

# Speakers



David Allen  
Technologist, Office of  
the CTO



Dave Landsman  
Director of Industry  
Standards

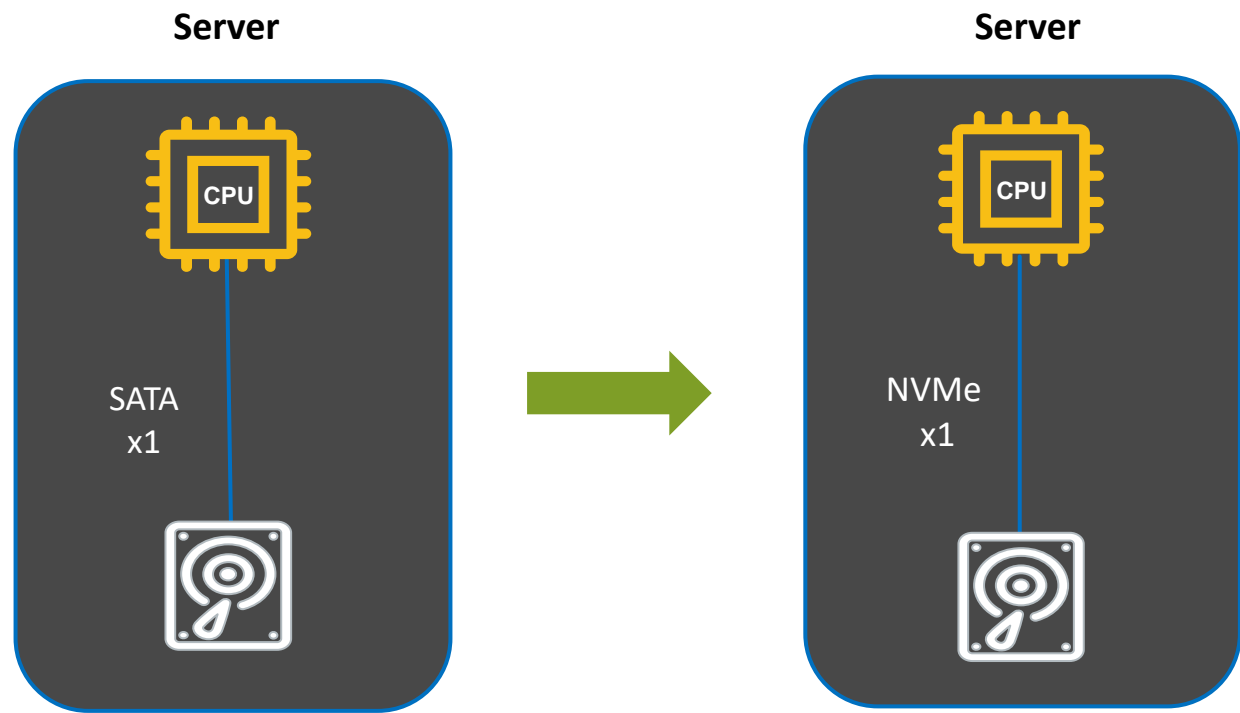


# Agenda

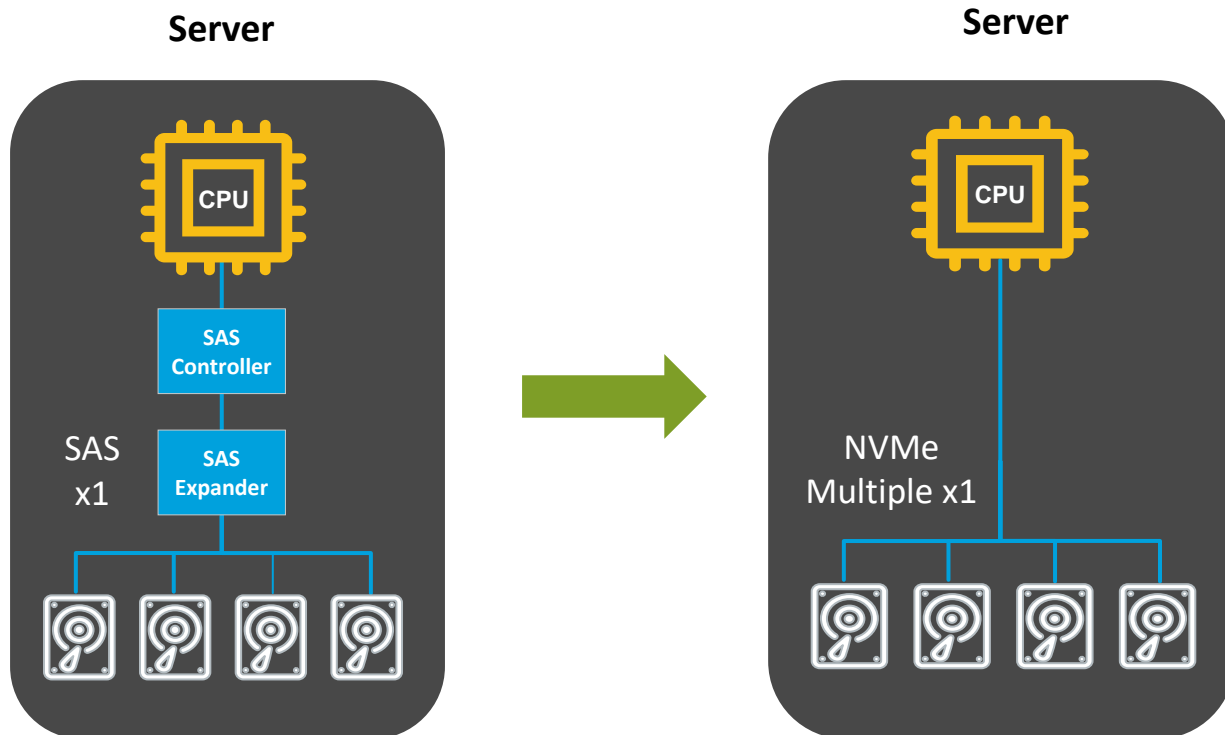
- Why NVMe<sup>®</sup> HDD?
- Standards efforts for NVMe HDD



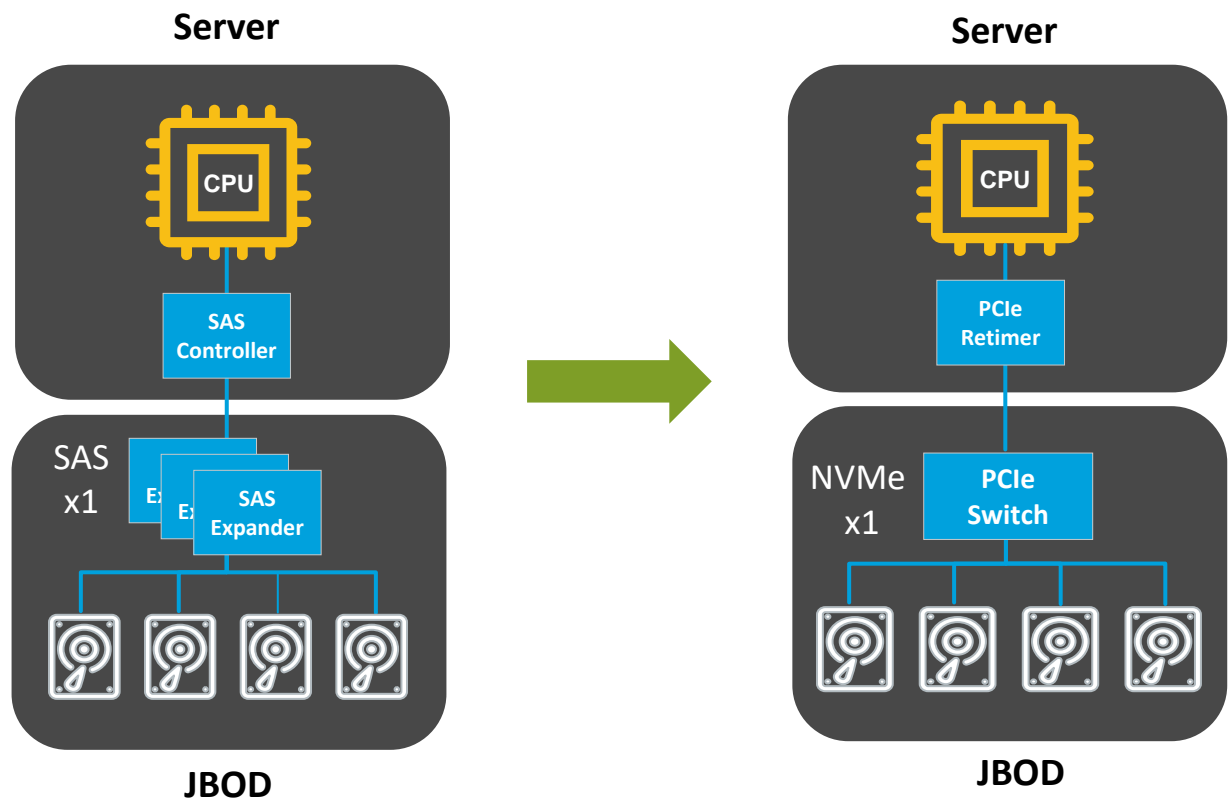
# NVMe® Technology TCO is Equivalent to SATA Direct Attach



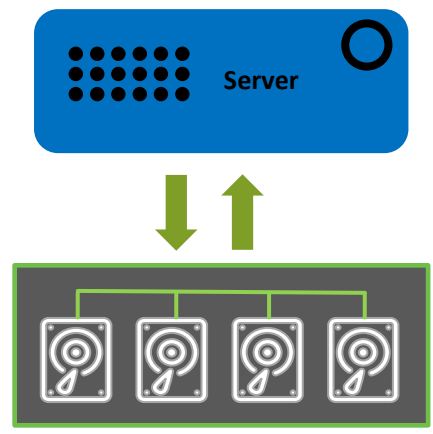
# NVMe® Technology Improves TCO Enterprise Server



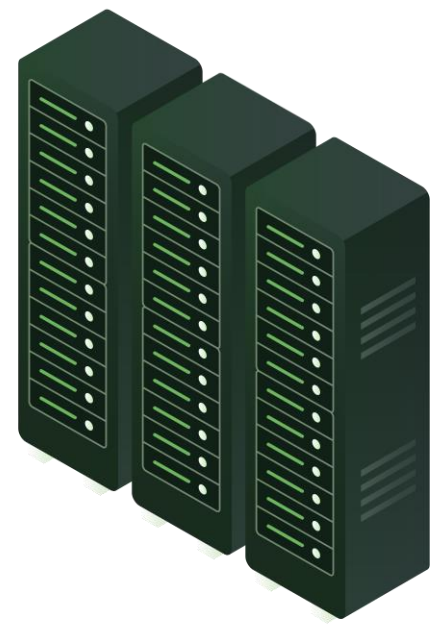
# NVMe® Technology Improves TCO for JBODs



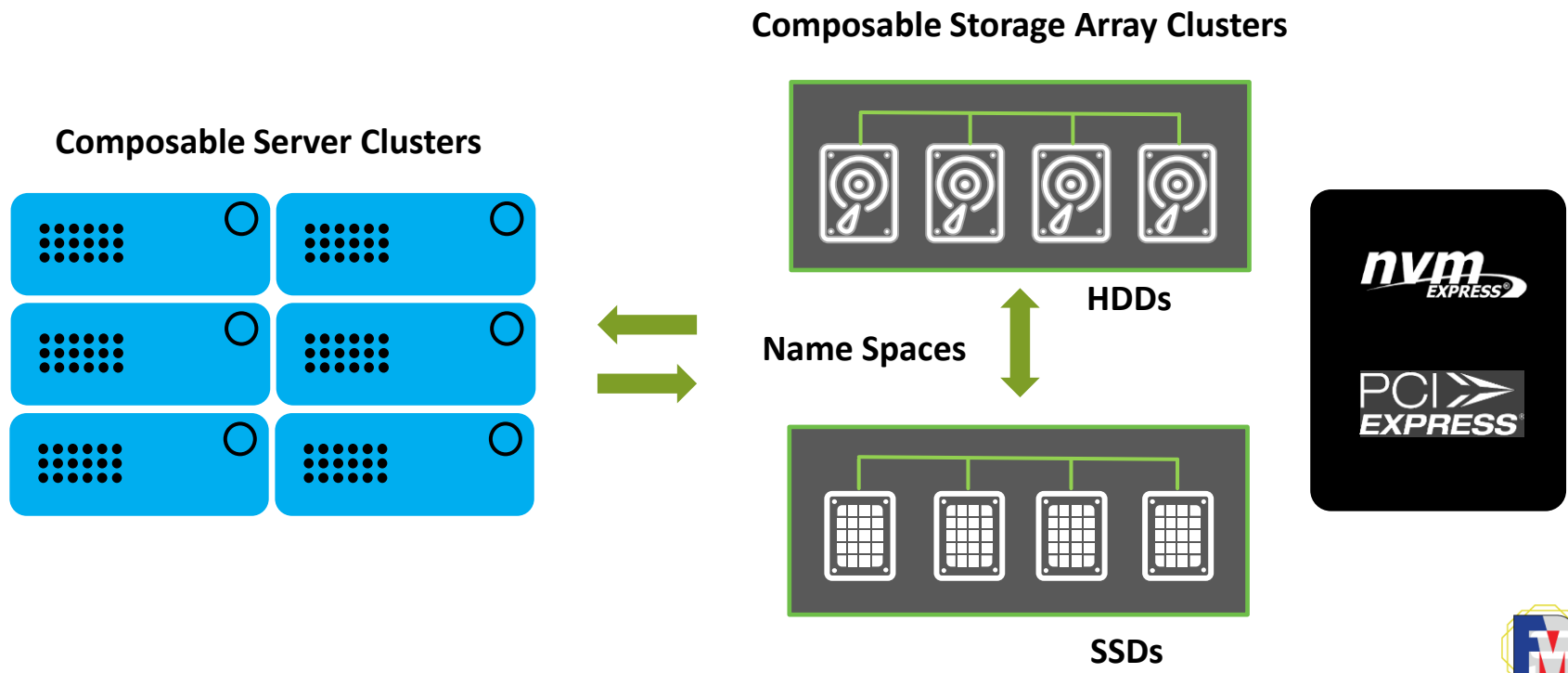
# HCI Architectures Today



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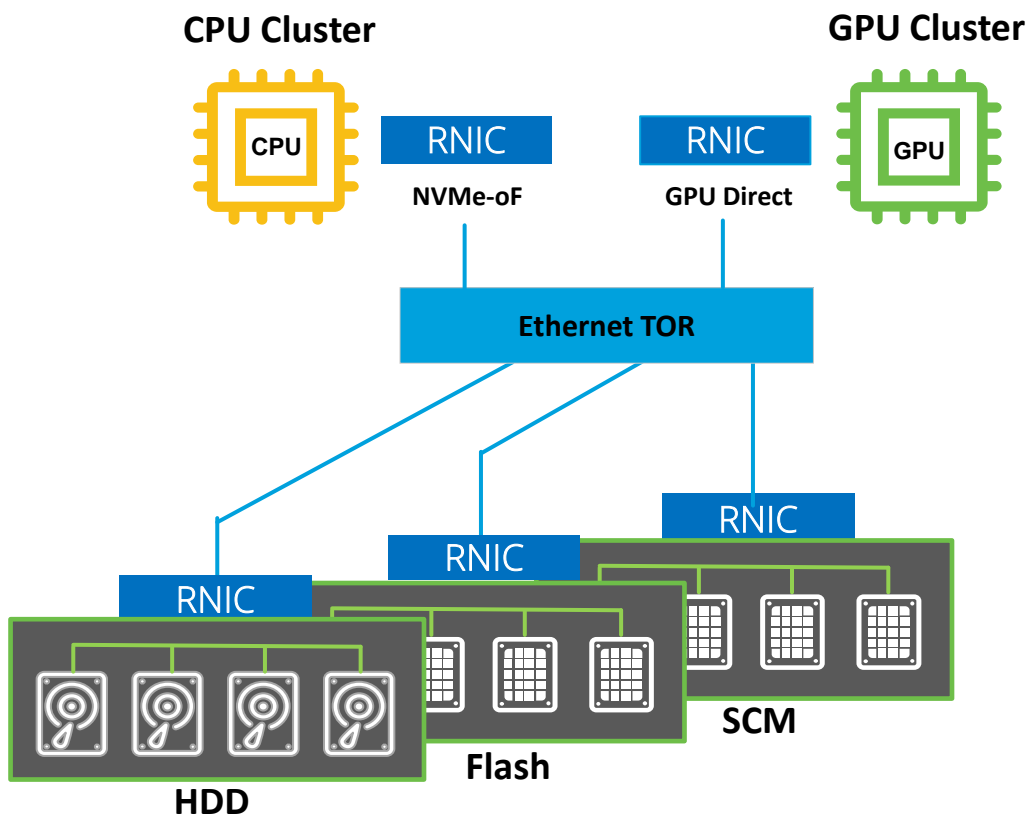


# NVMe® Architecture Consolidates and Simplifies

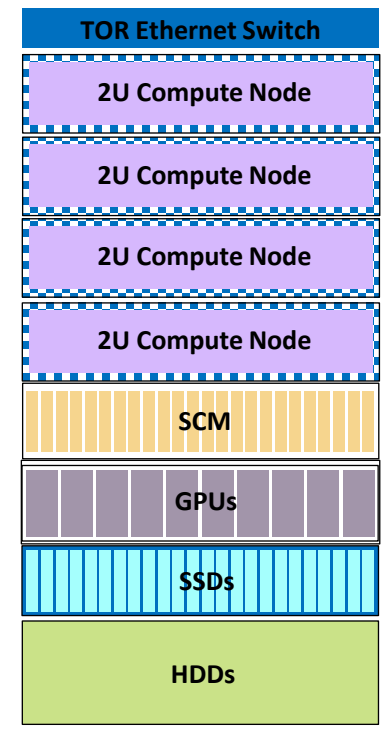
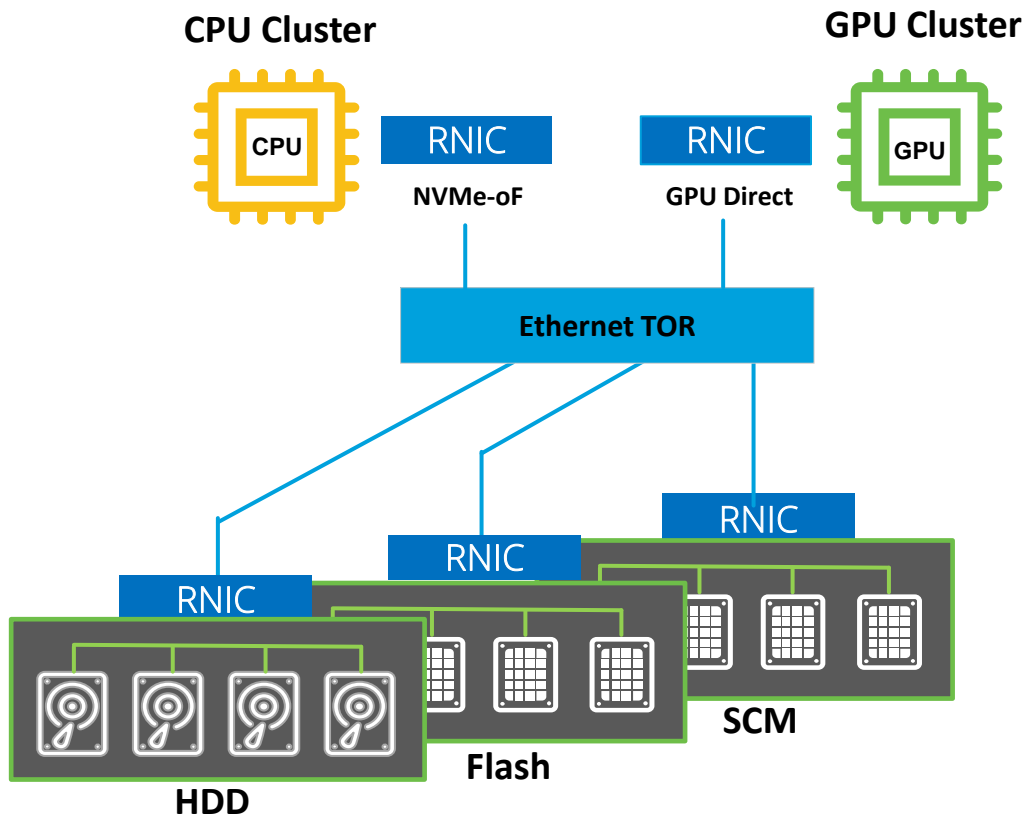




# NVMe-oF™ Technology Optimizes and Scales



# NVMe-oF™ Technology Eases Composability





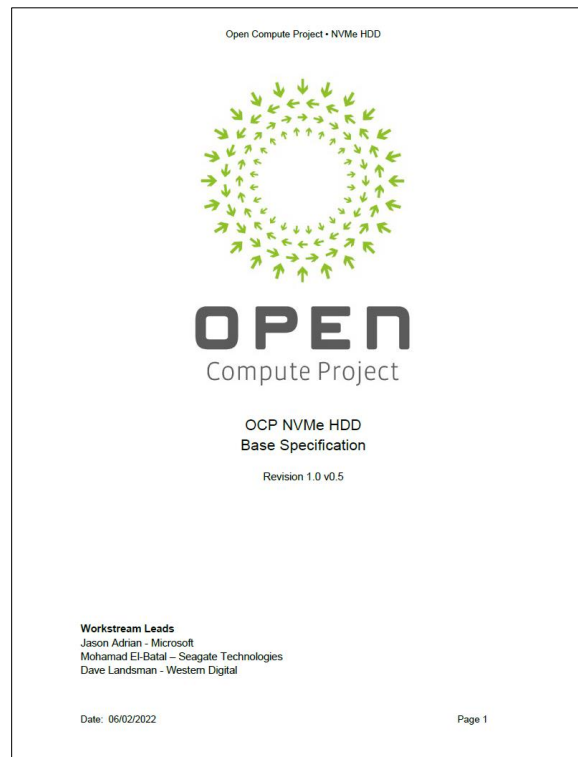
## Collaboration on Rotational Media



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# OCP NVMe<sup>®</sup> HDD Specification

- OCP NVMe HDD Spec
  - Started mid-2020
  - v0.5 now
  - v1.0 target by end 2022
- Requirements for a new category of device
  - Mechanical/Power
  - Connectors/Pinout
  - NVMe Features
  - Security Features
  - Staggered spin-up

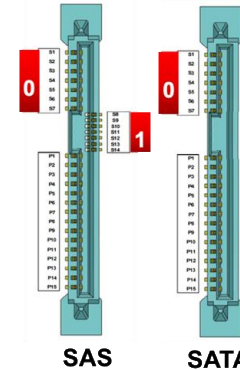


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  - [2.2. Drive Side Label](#)
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# OCP NVMe<sup>®</sup> HDD Specification - Keeping Costs Low

- Hardware requirements (“if it ain’t broke”)
  - 3.5” Form Factor - SFF 8301 & SFF 8323
  - 12V and 5V power
  - Single and dual port
  - SAS or SATA device connectors
    - Gen3 (Cost Optimized) - SATA or SAS3 connectors
    - Gen4 (Performance/HA) - Need SAS4 connectors
  - Reduced Pins
    - No PERST# (SRIS required)
    - No sideband bus
  
- Feature requirements
  - Follow NVMe Datacenter SSD spec, with variations
  - Keep things needed by both SSD/HDD (e.g., security)
  - Add rotating media specific (e.g., CDL)



Signal Integrity

Conn-Pair-Combo	PCIe Gen 3				PCIe Gen 4			
	IL	RL	NEXT	FEXT	IL	RL	NEXT	FEXT
SATA P/R-Pair	P	F	P	N/A	-	-	-	-
SAS3 P/R-Pair	P	P/M	P	N/A	P	F	P	P
SATA-P + SAS3-R Pair	P	P	P/M	N/A	P	F	F	N/A
SATA-P + SAS4-R Pair	P	P	P	P	F	F	F	N/A
SAS4 P/R-Pair	P	P	P	P	P	P	P	P
SAS3-P + SAS4-R Pair	P	P	P	P	F	F	P	P



# NVMe Features for NVMe HDDs

## Basic plumbing for rotational media in NVMe 2.0 specifications

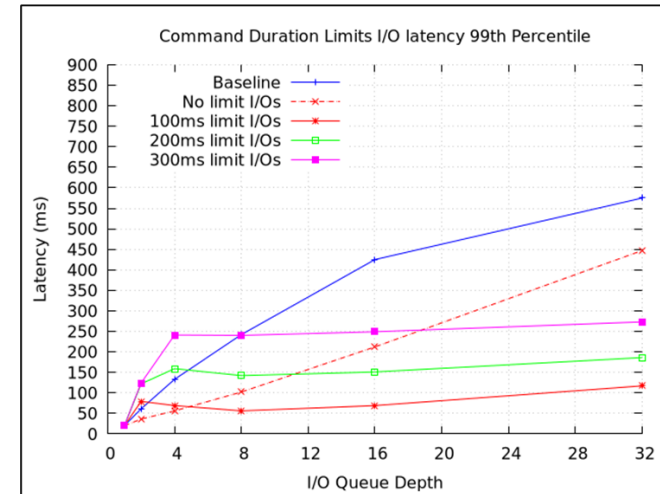
- Rotational media bits for namespaces, endurance groups
- Rotational media information
  - Number of actuators
  - Spin-up and actuator load/unload success and failure counts
- Spin-up control

## Command Duration Limits (CDL) - IOPS/TB

- Even as queue depth grows, maintains high average IOPs and predictable latency, while avoiding latency outliers
- Adapt existing SATA and SCSI spec model for NVMe technology
- Work just started in NVM Express technical workgroup

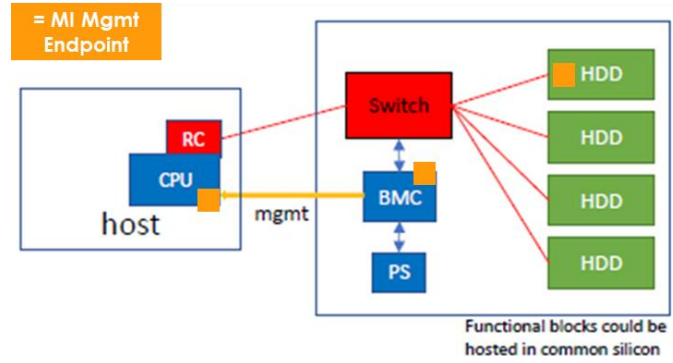
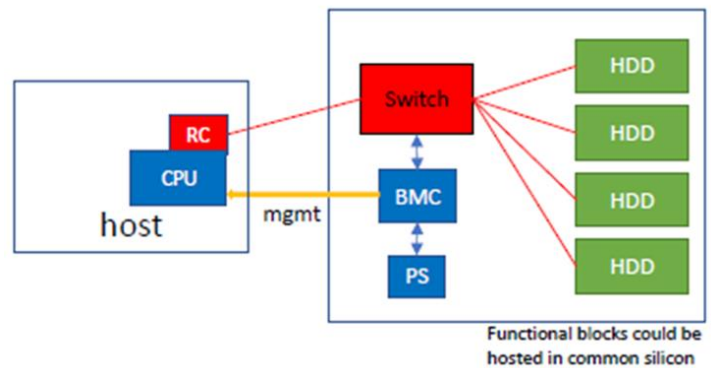
### Command Duration Limits Results

128KB random read workload, 10% of I/Os with 100ms limit, 10% with 200ms limit, 20% with 300ms limit, 60% with no limit



# NVMe<sup>®</sup> HDD - Flexible Spin-up Solutions

- NVMe<sup>®</sup> technology layer or PCIe<sup>®</sup> technology layer
- Direct Attach/RC-Managed to JBOD/Appliance w/ Enclosure Manager, or in between





*Architected for Performance*