Shaping NVMe SSD IO Performance in Multi- Virtual Environments

SSDT-203-1: Performance Optimization & Modeling Techniques for SSDs

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FMS the Future of Memory and Storage

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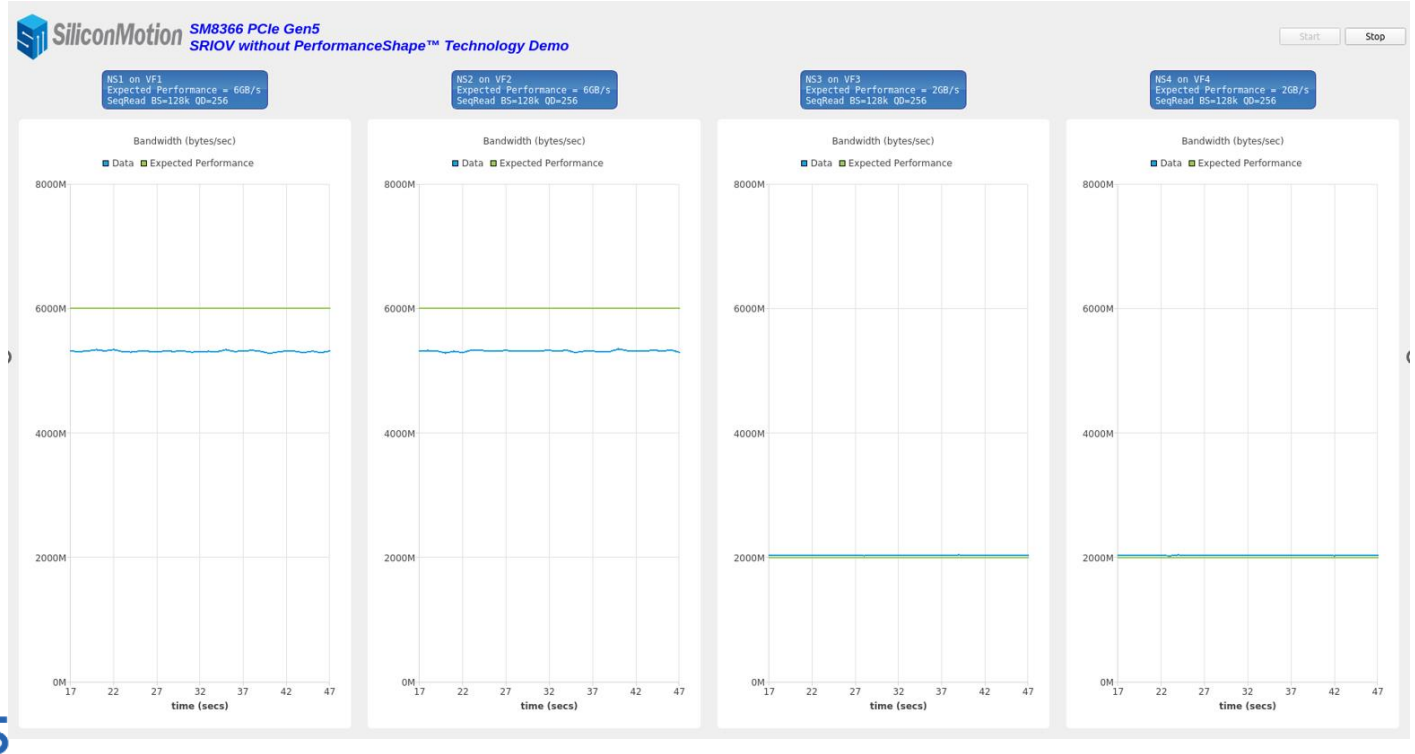
8TB SRIOV SSD with Performashape™ Experiment

- Test configuration:
  - SSD hardware : Silicon Motion 8TB PCIe Gen5 Enterprise SSD with Micron B58R QLC NAND in U.2
    SSD firmware : FIO SR-IOV FW supporting 4x VFs
  - Test platform : ASUS PRIME Z690-P (I5-12500 16GB)
  - Test program : FIO
  - Test workload : Supporting 4x VFs; using PerformaShape technologies for QOS improvement for multiple

* Picture from ASUS website

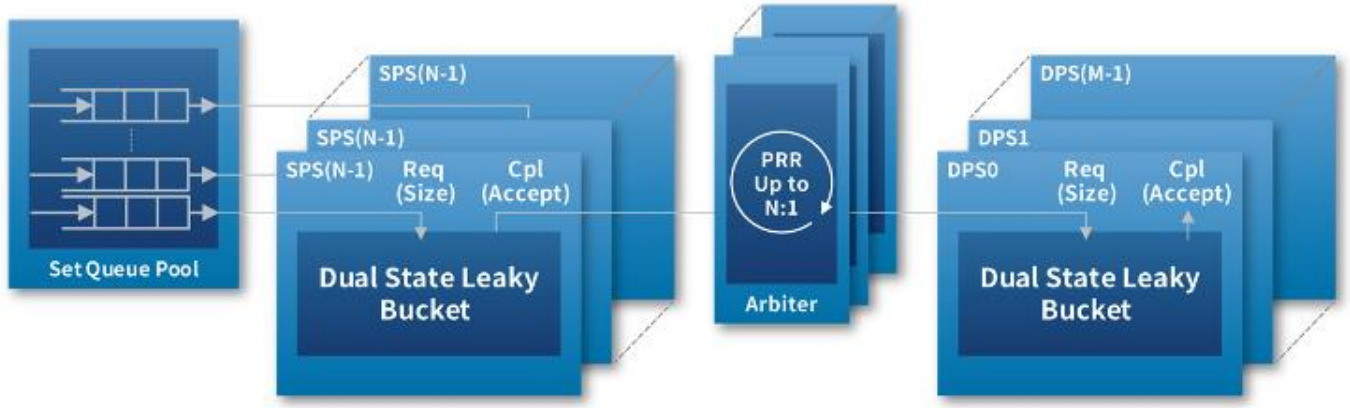
Over Subscribed SRIOV

VF/NS	Measurement	Performance Shapping Engine		Host Setting
		SPS Setting	DPS – ID4	
VF1/NS1	5.2 GB/s			6GB/S (5723MiB)
VF2/NS2	5.2 GB/s			6GB/S (5723MiB) - noisy
VF3/NS3	1.95 GB/s			2GB/S (1908MiB)
VF4/NS4	1.95 GB/s			2GB/S (1908MiB) - noisy



- ✓ 16GB/S Read Requests from Host in 13GB/S system
- ✓ Noisy and Limited performance on VF1 and VF2

Multi-Tenant Quality-of-Service (QoS) Improvement Technology



- To further enhance SSD QoS in multi-tenant environment, QoS management techniques can be deployed together with FDP
- PerformaShape™, as an example for QoS management, is developed based on “Dual State Leaky Bucket” algorithm where each QoS set is assigned with two token buckets and IO traffic flows when token is available
- PerformaShape™ benefits
  - Smooth out fluctuations
  - Isolate noisy neighbors
  - Fully utilize the SSD bandwidth

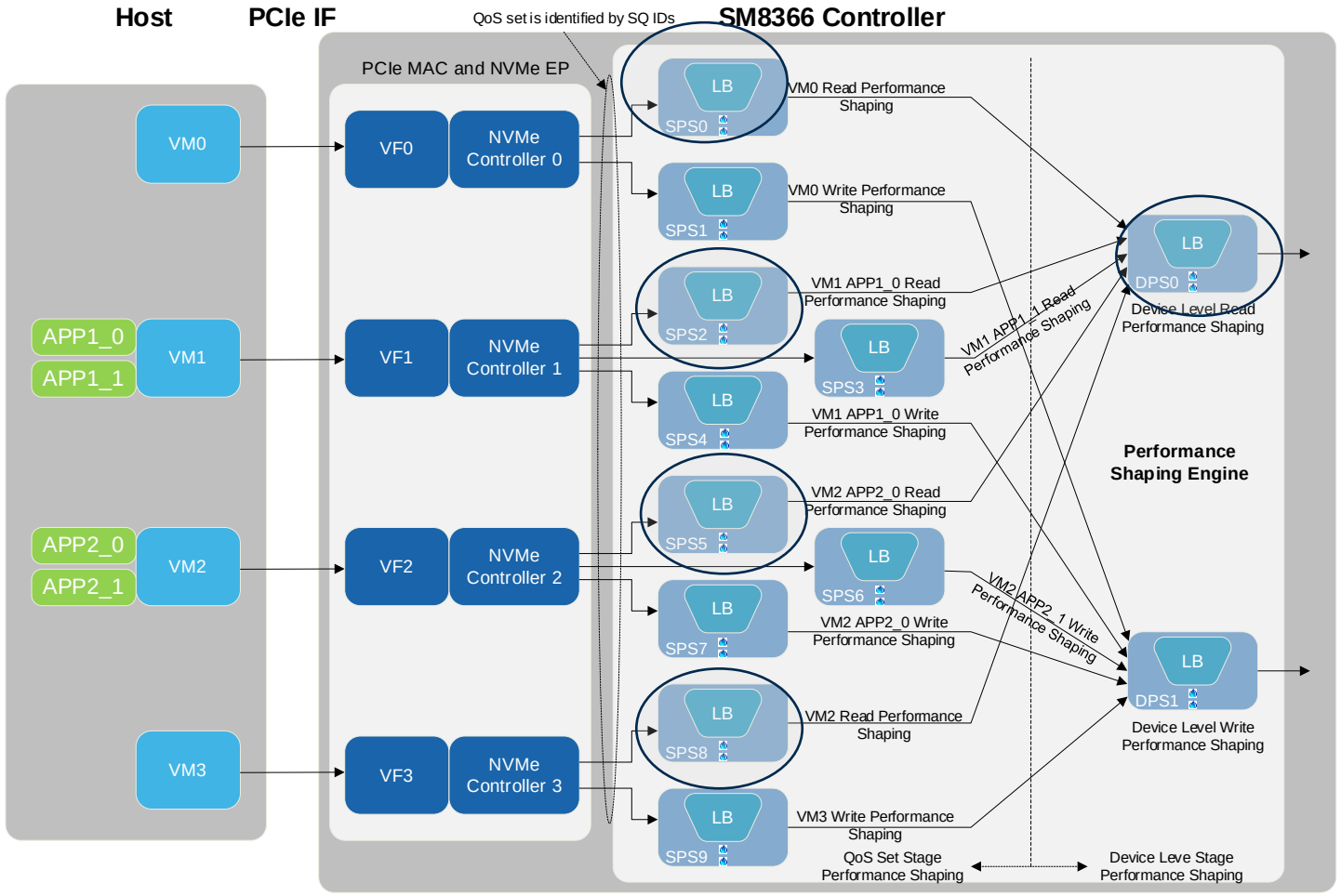
PerformaShape™ on Virtual Functions

Set Selection

- **Per NVMe Controller (per Virtual Machine)**
- **Per NVMe Namespace (per Container)**
- **Per Application**
  - Per active zone with ZNS
  - Per Reclaim Unit with FDP
  - Per submission queue

Set Configuration

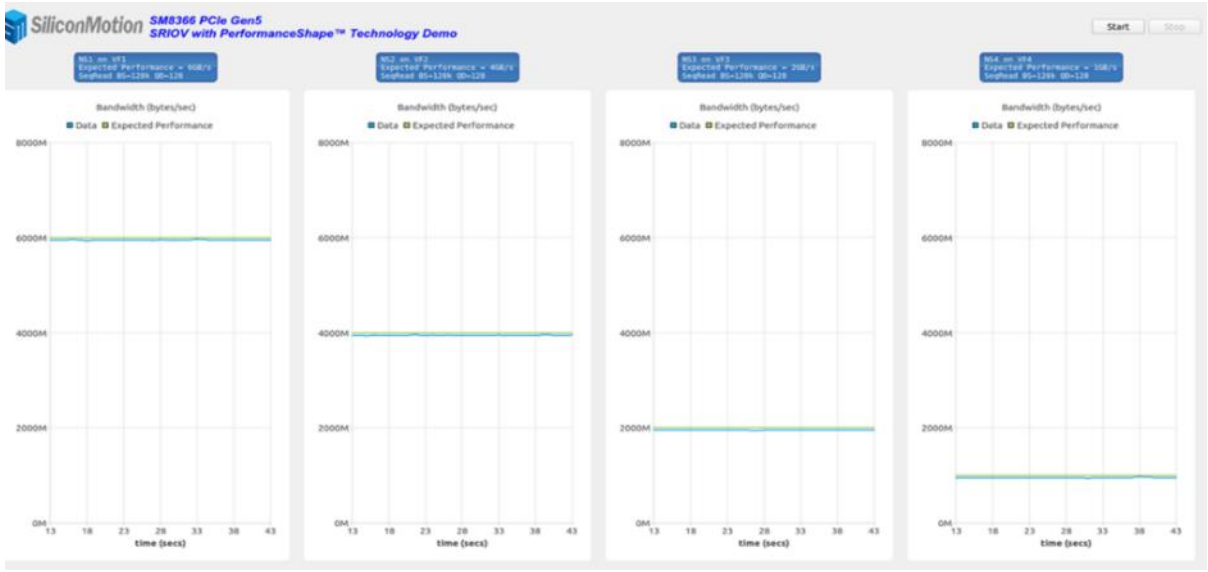
- **Access Pattern: Random (IOPS); Sequential (KB/S)**
- **Access Type: Read**



Managing SRIOV with PerformaShaping™

VF/NS	Measurement	Performance Shapping Engine		Host Setting
		SPS Setting	DPS – ID4	
VF1/NS1	5.97GB/s	6GB/S (8083)	12.9 - 13GB/s	6GB/S (5723MiB)
VF2/NS2	3.98GB/s	4GB/S (12125)		6GB/S (5723MiB) - noisy
VF3/NS3	1.99GB/s	2GB/S (24250)		2GB/S (1908MiB)
VF4/NS4	0.96GB/s	1GB/S (48500)		2GB/S (1908MiB) - noisy

- ✓ Mapped out ~ 13G Read requests from the PerformaShape™
- ✓ Isolates and Guarantees Performance per Tenant
- ✓ Removes Noisy Neighbors



Summary

- PerformaShape™ technology further improve QoS in multi-tenant applications
- We have a good starting point on looking Read Bandwidth control and look at mixed work loads next

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