



SDC 18

September 24-27, 2018
Santa Clara, CA

www.storagedeveloper.org

HDD Parallelism for Lower TCO

Dual Actuator Implementation

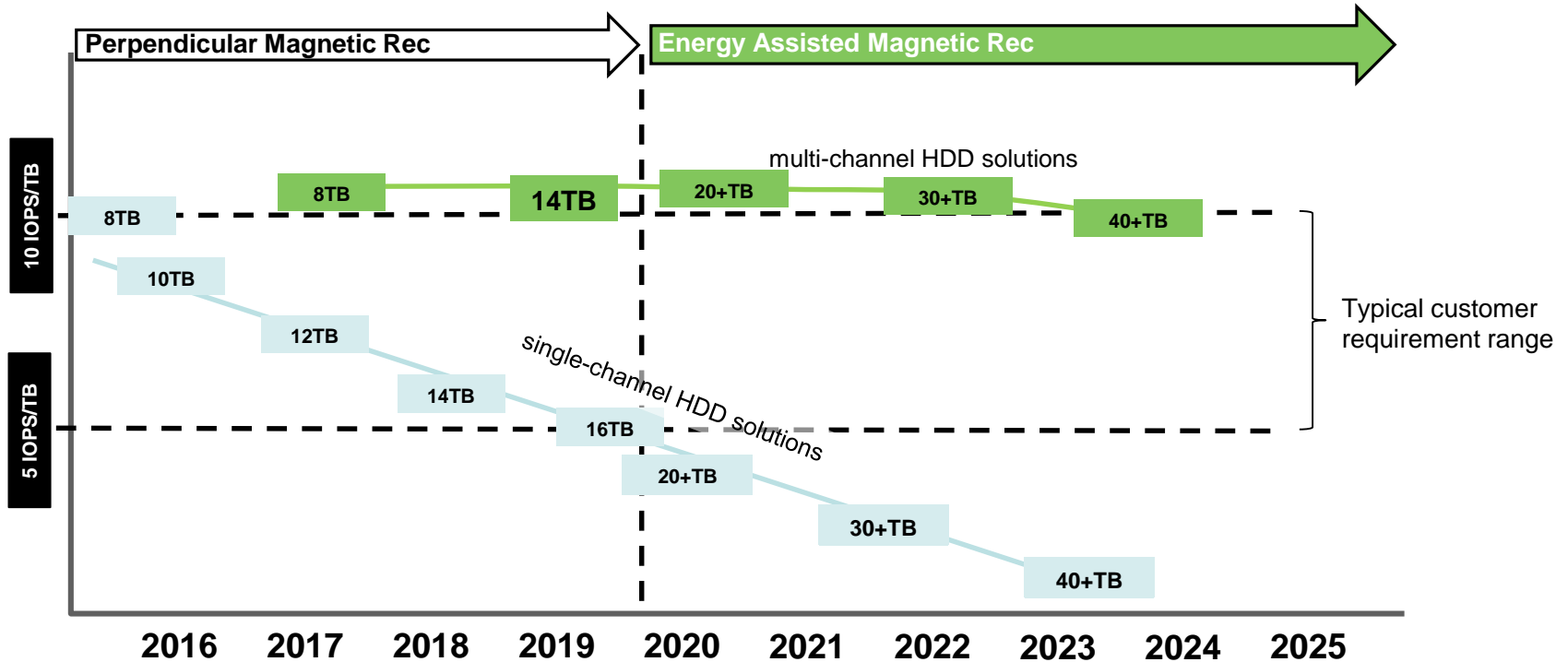
James D Borden & Timothy T Walker

Seagate Technology

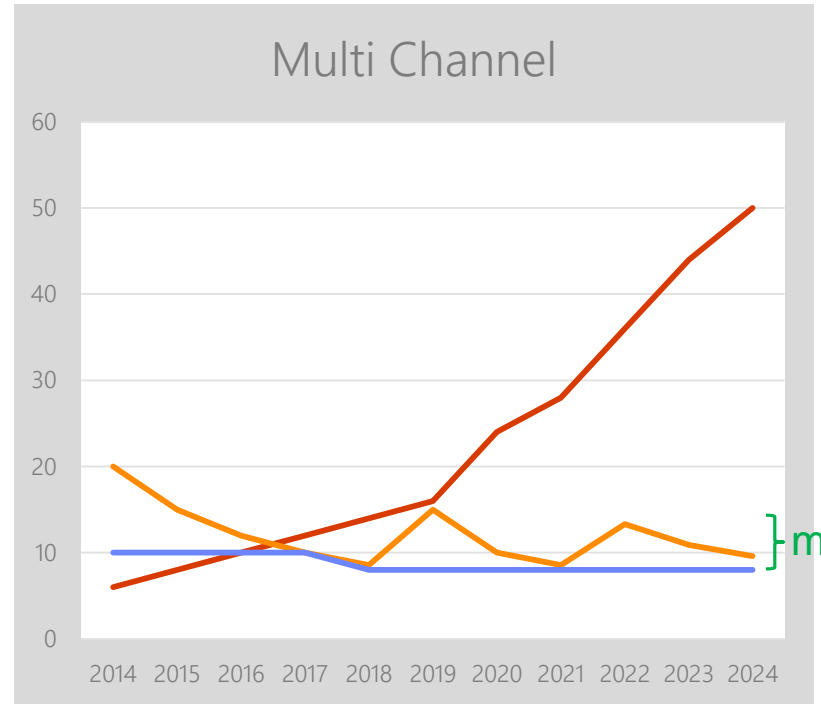
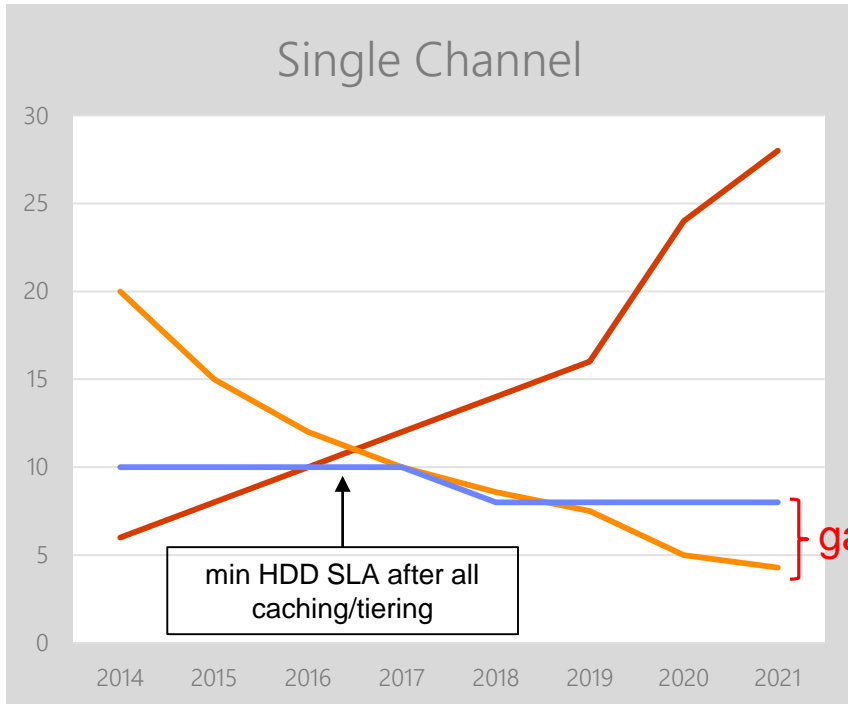
24 Sept 2018

IOPs Not Growing with Capacity

HDD IOPS are governed by mechanical physics. Access times and data rates lag capacity increases, so IOPS/TiB trend down.

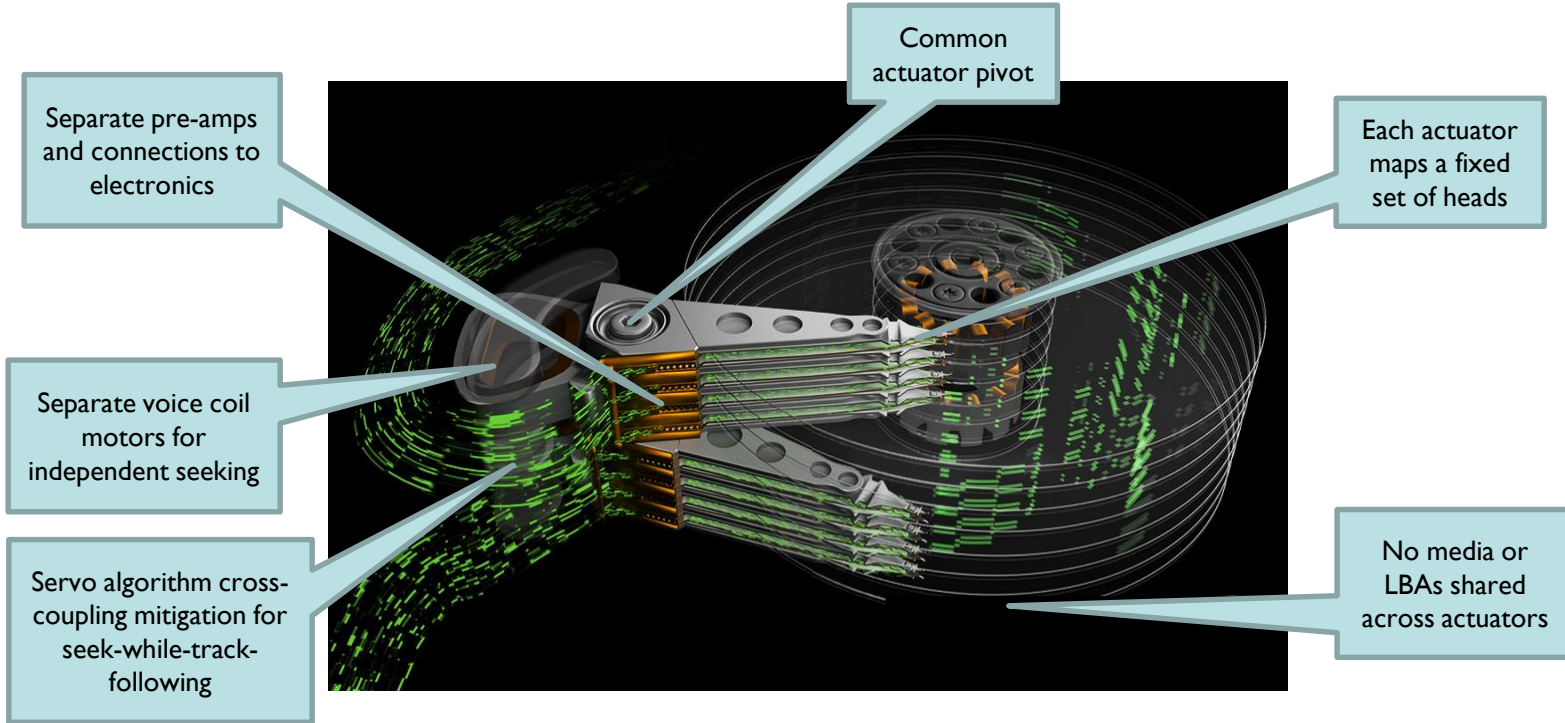


Customer Perspective: IOPs/TB 2014-2021



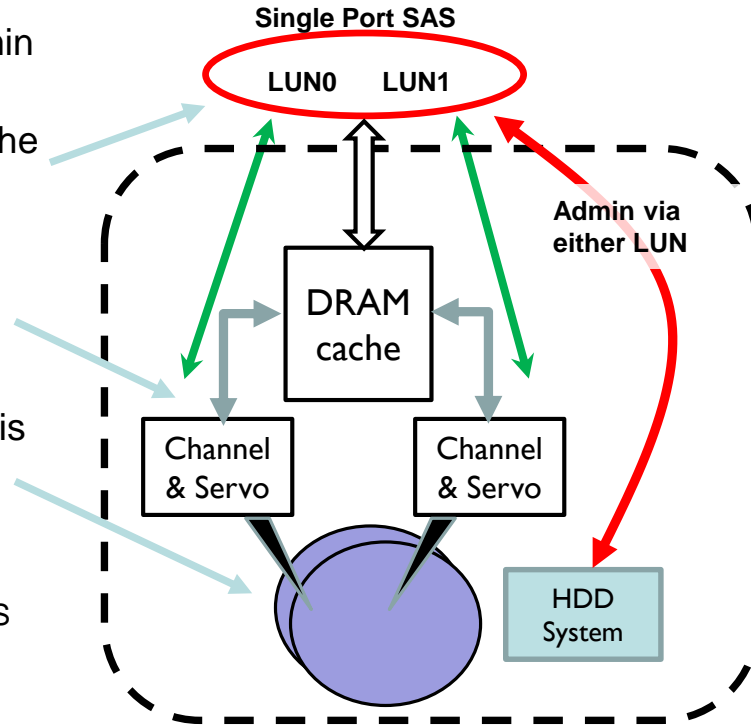
— Capacity (TiB) — IOPS/TiB SLA — IOPS/TiB

Multi-Channel HDD Inside Look



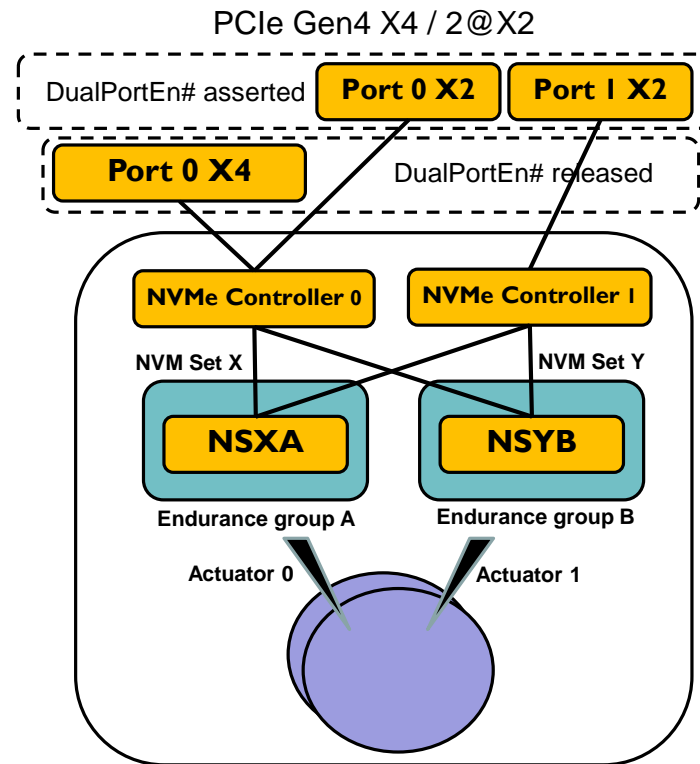
Dual Actuator SAS Architecture

- ❑ SAS block devices do not have a separate admin endpoint, other than SES.
- ❑ One World Wide Name (WWN) is assigned to the port for device address. Each LUN has a separate unique WWN in VPD.
- ❑ Two LUNs, 0 & 1, each with independent LBA space, and each connected to an independent read channel, actuator, and set of heads.
- ❑ Each LUN maps 50% of the media – no media is shared across the actuators.
- ❑ Some commands affect both LUNs
 - ❑ TUR, Log/Mode Sense/Select,
 - ❑ FORMAT UNIT, START STOP, REMOVE I_T NEXUS
 - ❑ Reman (REMOVE ELEMENT AND TRUNCATE)
 - ❑ Sanitize



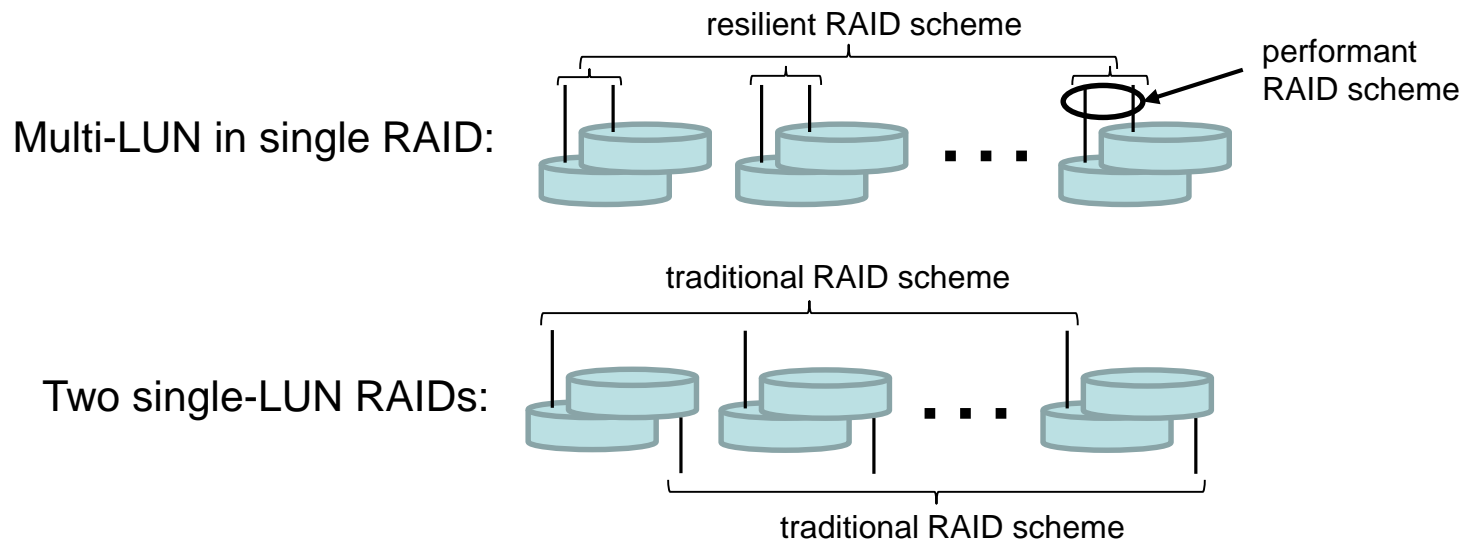
Dual Actuator PCIe-NVMe Architecture

- ❑ NVMe has clean subordinate storage support via namespaces.
- ❑ One NameSpace per actuator.
- ❑ Dual port with bifurcation; each NS shared by two ports.
- ❑ Each actuator is mapped to a unique Endurance Group/NVM set.
- ❑ All namespaces are statically created at time of manufacture, cannot be created/deleted.



RAIDing Dual Actuator HDDs

- ❑ RAID impact is from IOPS/TiB.
 - ❑ Really, both actuators in same failure domain.



Conclusion

- ❑ HDDs are very cost-competitive per TB, but not per IO.
- ❑ Current caching and tiering approaches require 8-10 IOPS/TiB; common pain-point around 14 TiB.
- ❑ Doubling HDD IOPS keeps low-TCO rotating-storage a strategic part of performant SLA storage solutions.
- ❑ Multi-actuator HDDs 90% drop in; minor engineering effort for full utilization.