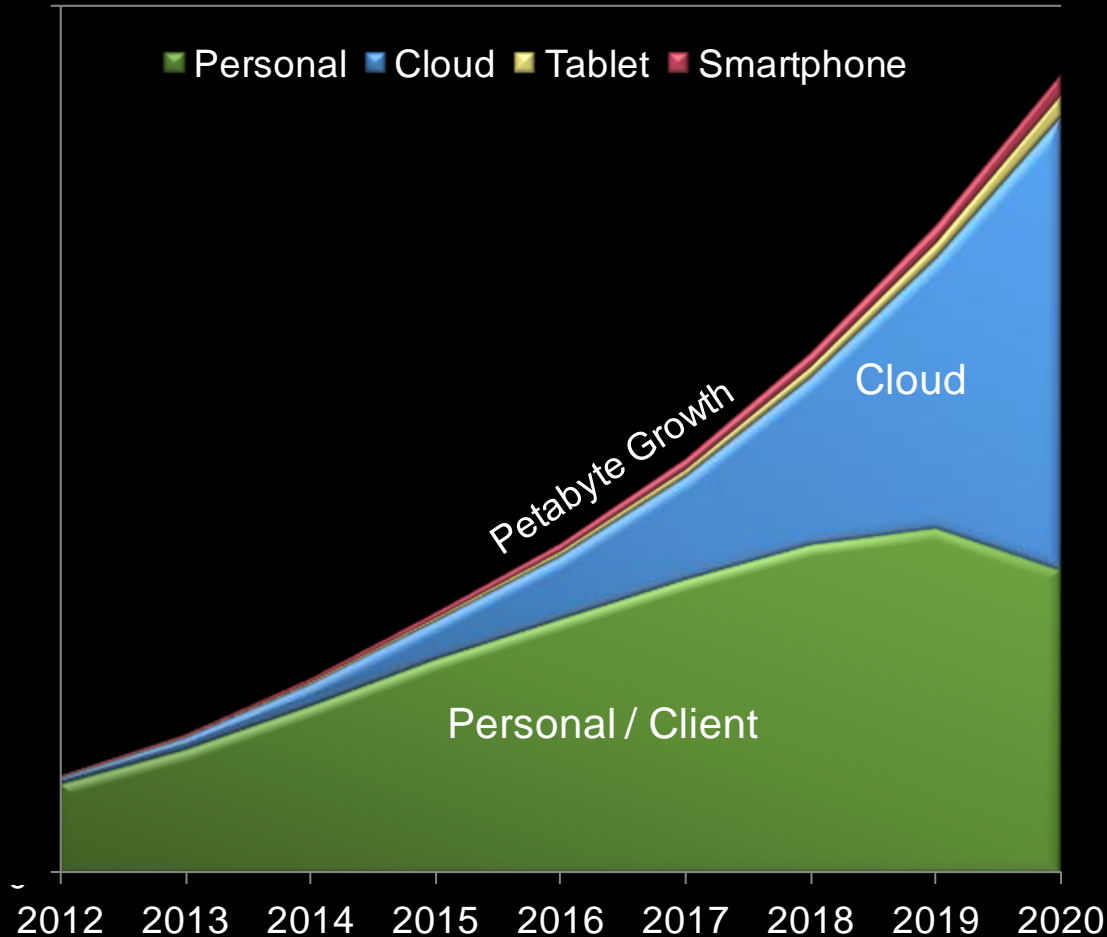




Four Walls Do Not a Make a Datacenter – It's the Ecosystem

Brendan Collins
Vice President of Product Marketing

- Growth in Mobility is shifting the location of data from Client to the Cloud
- Threat to HDD from Tablets and Client SSD is mostly offset by growth in Cloud and Personal Storage
- Gap between Areal Density growth and Petabyte Consumption will drive higher unit volume and price stability
- Paradigm shift from Wintel Platform to Open Source is creating room for innovation



Hot Topics

- Big Data / Analytics
- SSD & Tiering
- Data Explosion & Cold Storage

Customer Shifts

Cloud Becoming Roadmap Driver
Evolution of the storage OEM
ODMs & SIs increasing influence

New Architectures

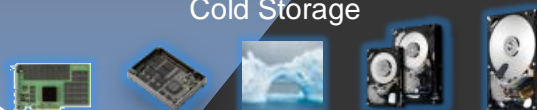
“Brawny” vs. “Wimpy” CPUs
RAID → Replication → Erasure Codes
Open Compute Disruption
Distributed File Systems
Modular Systems

Acceptance of Open Source



More Storage Tiering

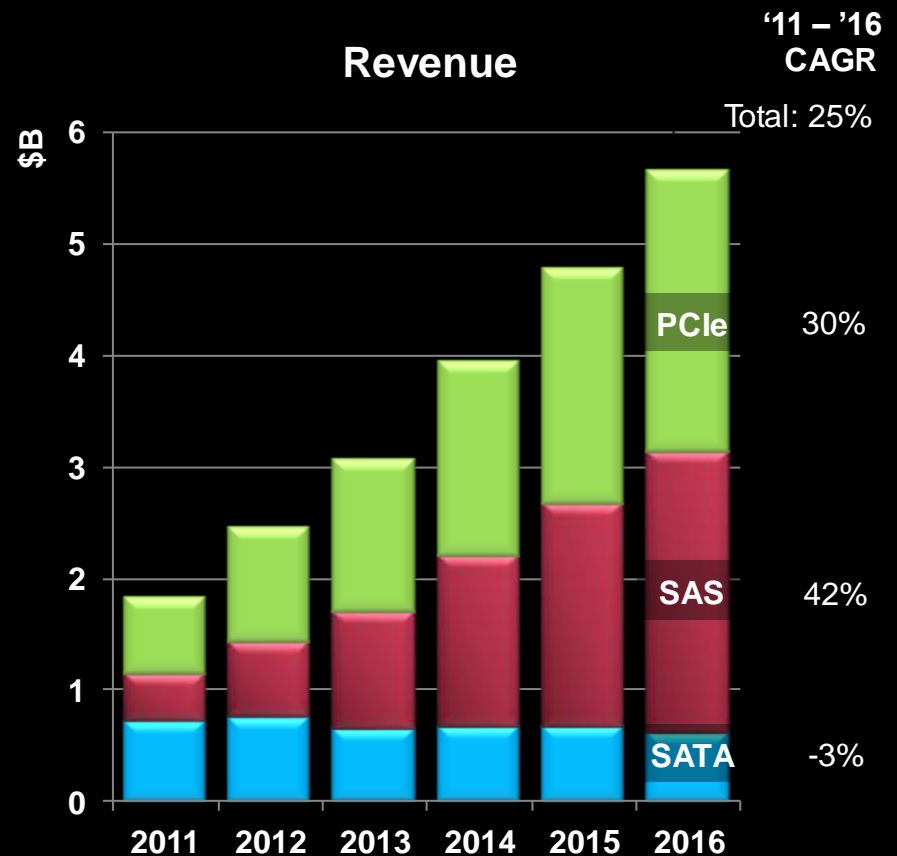
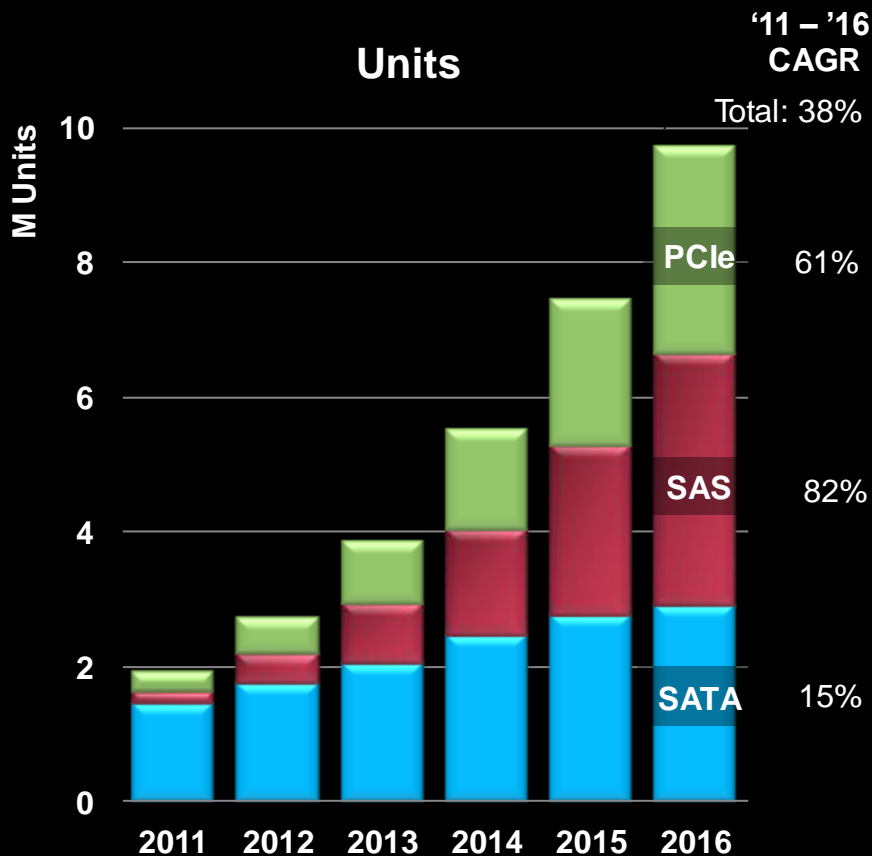
Resurgence of 15K HDD
Price-Performance-Capacity “Gap”
SSD/Flash segment fragmentation
Cold Storage



TCO a Critical Decision Factor

Cost of Power
Cost of Cooling
Floor Space, Weight, Density
Scalability, Manageability
Reliability

SATA revenue growth is expected to level off in 2012 as SAS and PCIe are driving SSD growth in storage systems and servers, respectively

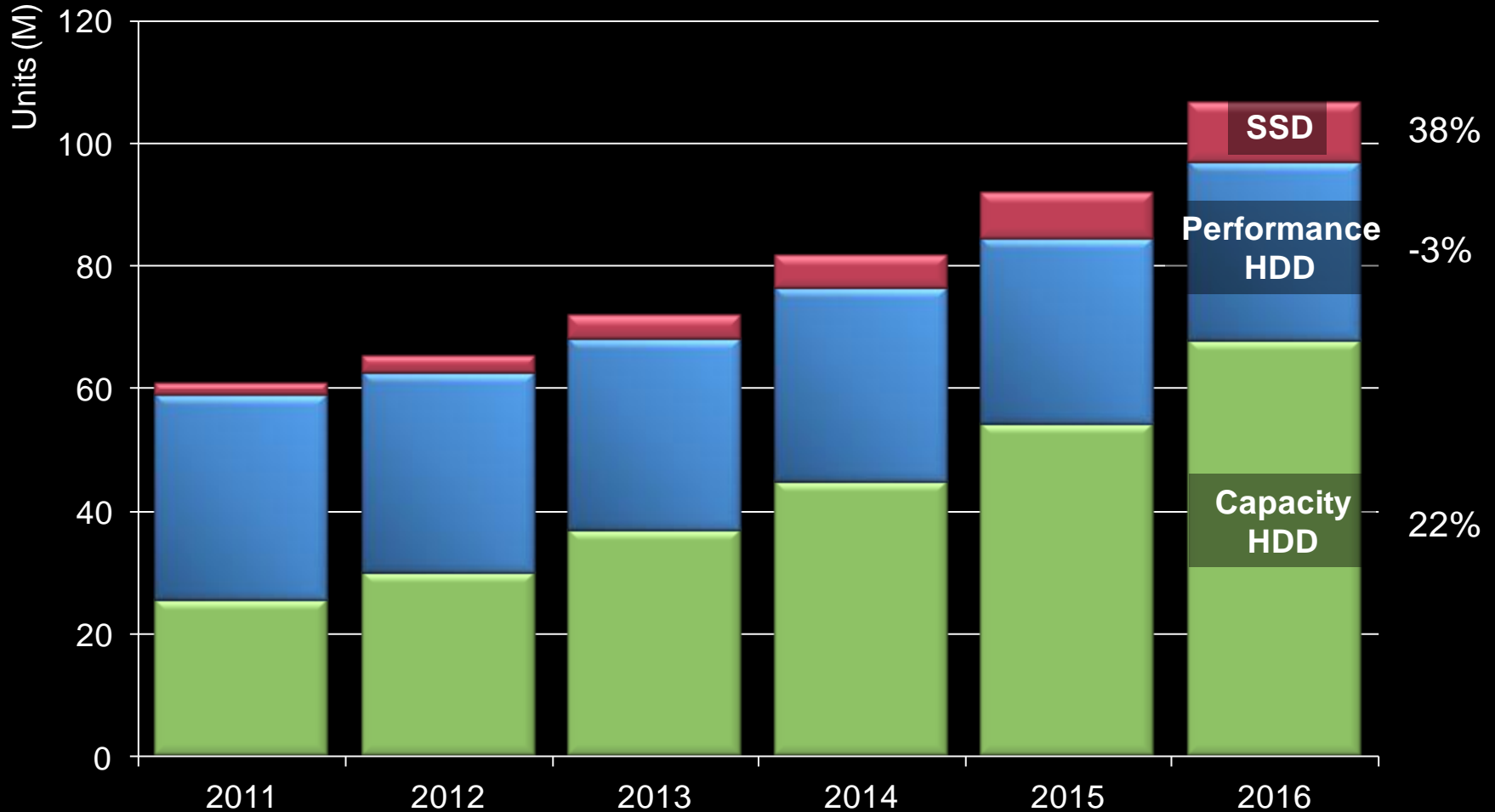


Enterprise Market — Growth in SSD & Capacity HDD

'11-'16 CAGR

Total: 12%

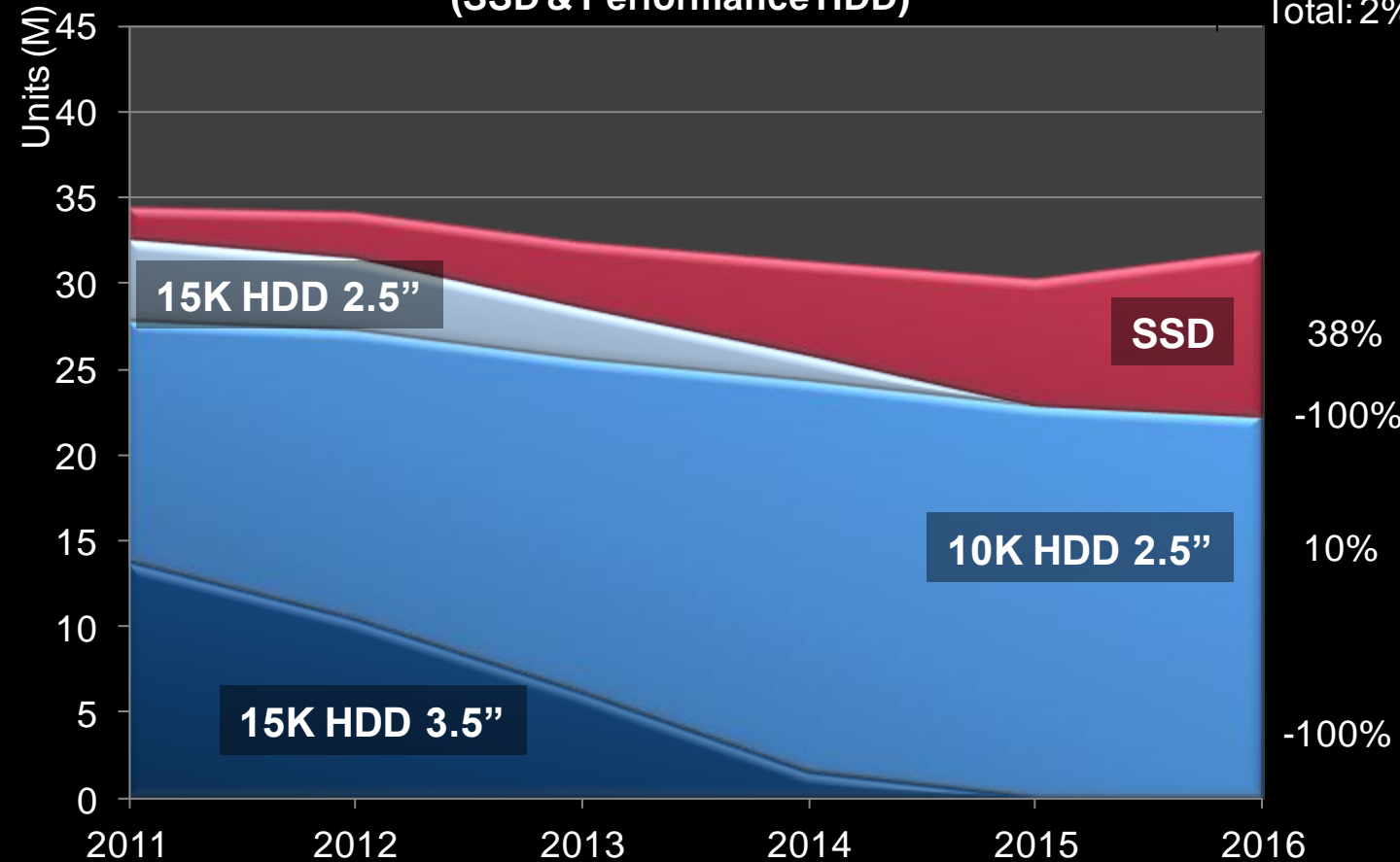
TAM by Volume



A Funny Thing Happened On Our Way To Replacing High Performance HDD with SSD...

**Performance Drive TAM
(SSD & Performance HDD)**

'11 - '16
CAGR
Total: 2%



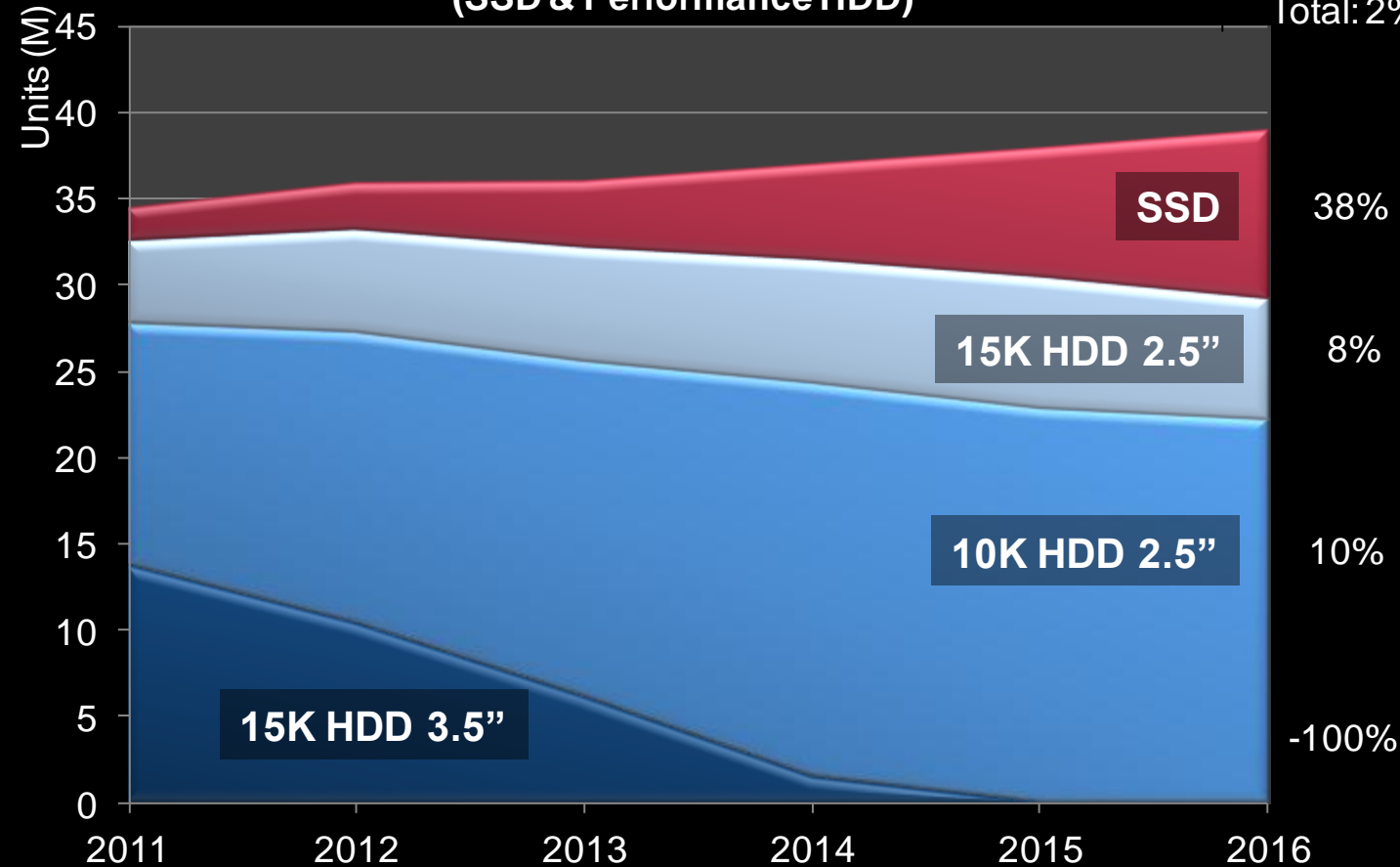
2009

- SSD market showed the highest area of growth in performance segment
- SFF 15K was forecasted to slowly disappear and be replaced by SSD

A Funny Thing Happened On Our Way To Replacing High Performance HDD with SSD...

**Performance Drive TAM
(SSD & Performance HDD)**

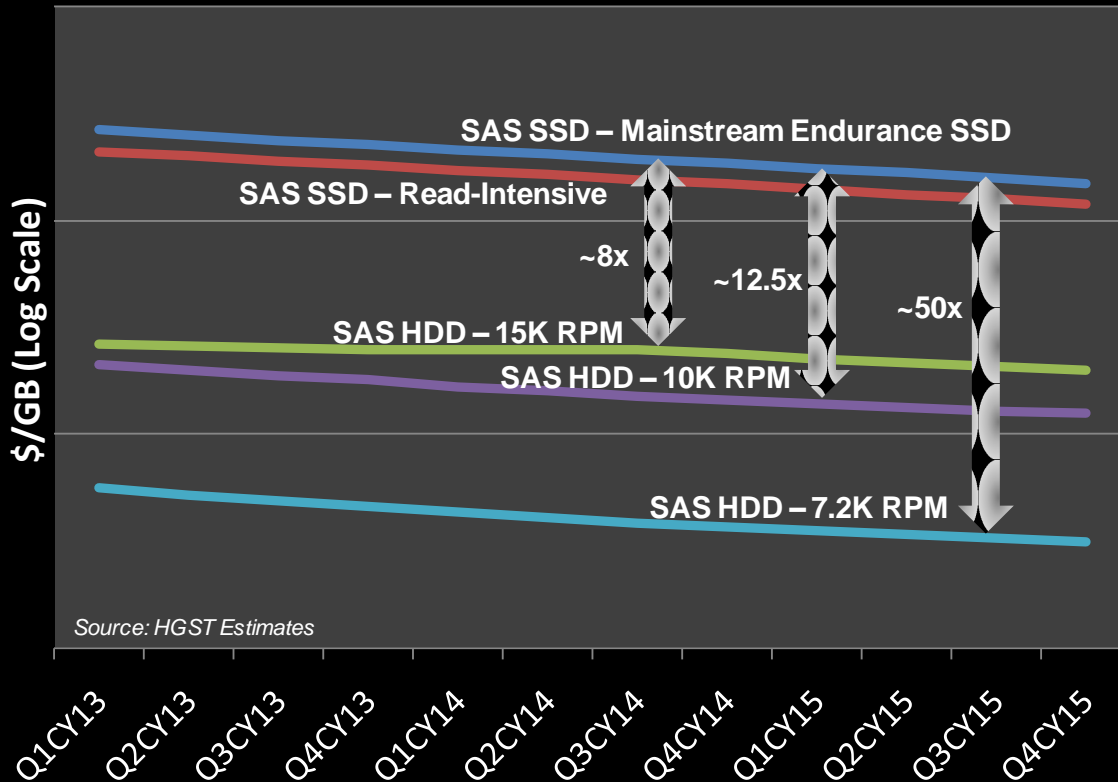
'11 - '16
CAGR
Total: 2%



2012 Forecast

- SSD market grew as expected
- But demand for SFF 15K increased over this period
- HDD vendors had to extend SFF 15K one more generation and maybe two

Enterprise Drive Price Projection

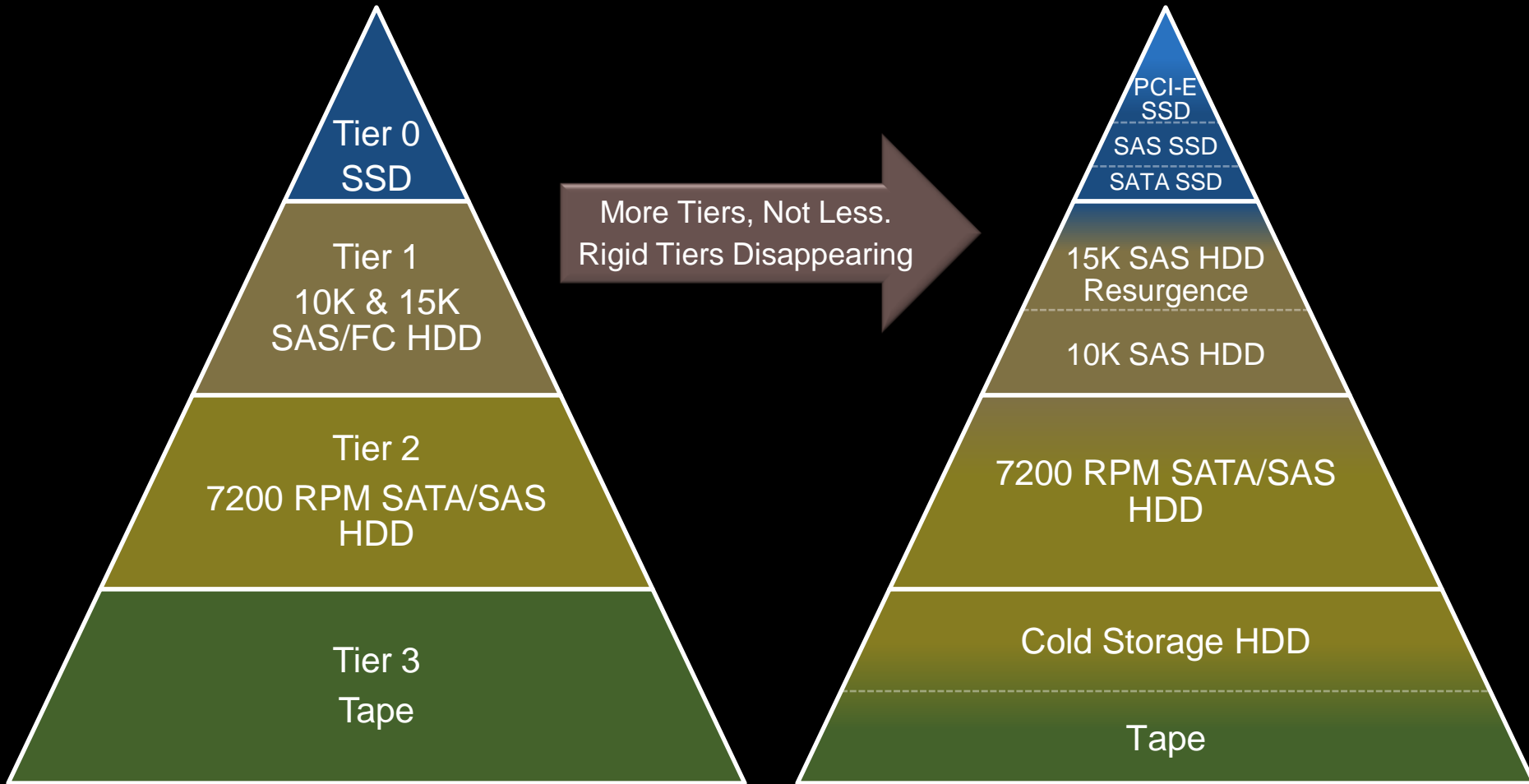


Pricing Dynamics

- Price/GB curves for Flash and HDD are very similar
- Creates opportunity for sub-tiering
- Implies that SSD and Performance HDD will be complimentary for the foreseeable future

Enterprise SSDs will continue to carry a significant \$/GB premium over Enterprise HDDs – SSDs will be deployed where performance justified

Evolution of Tiering



The New Tiering— Datacenter Application Needs

"few" ms latency

PCI-e Solutions

- Highest performance

~7ms latency

SLC & MLC NAND SSD

- Best IOPS/\$, IOPS/Watt

10-15ms latency

10K & 15K SAS HDD

- Balances capacity & performance

Performance

"10's" ms latency

Cloud Computing / Virtualized Server (Blocks)

7200 RPM SAS & SATA HDD

- Best \$/TB value
- Highest capacities

sec-min latency

Cold Storage Solutions

- New storage class
- Very low \$/TB, Low TCO

Gigabytes

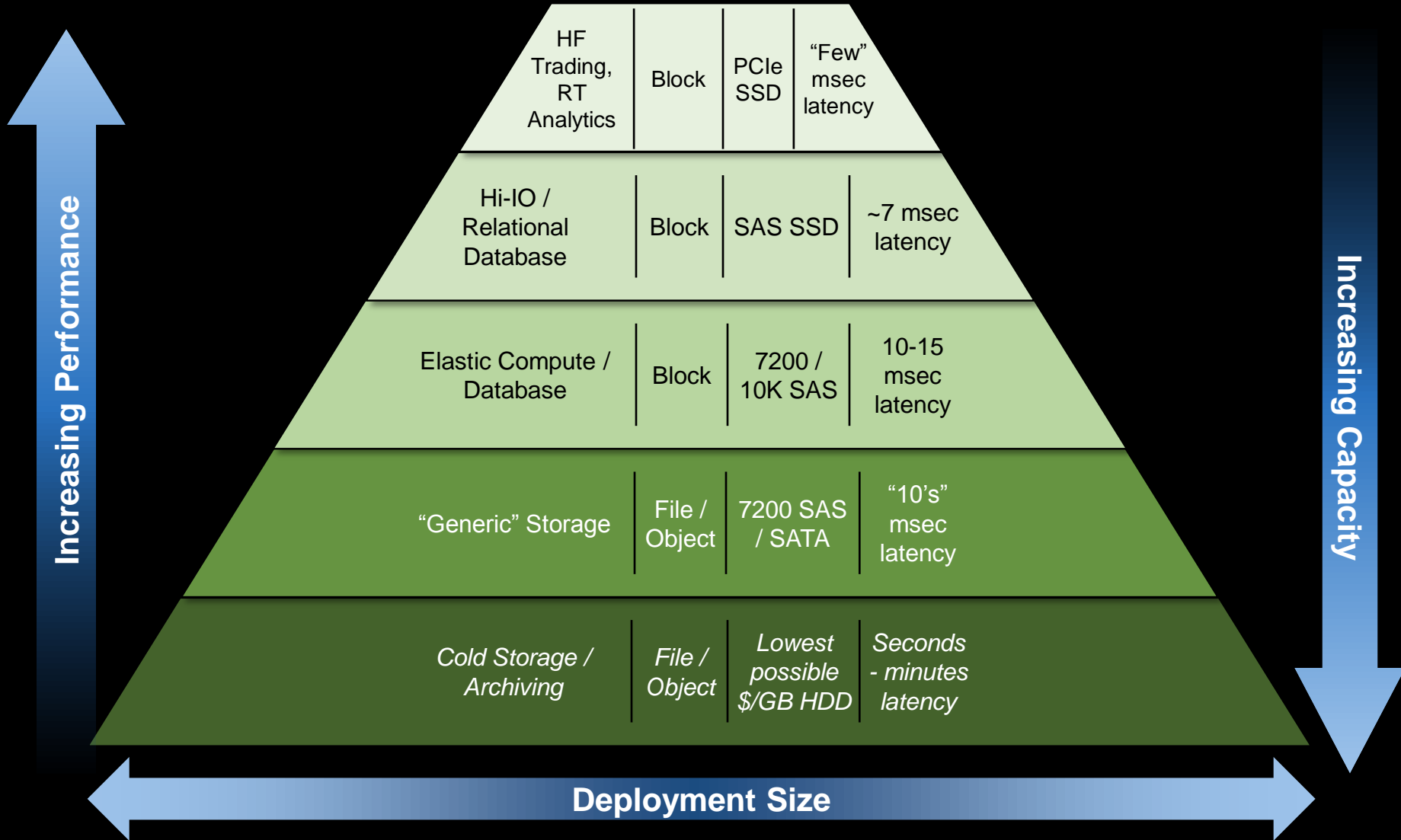
Terabytes

Capacity

Petabytes

Exabytes

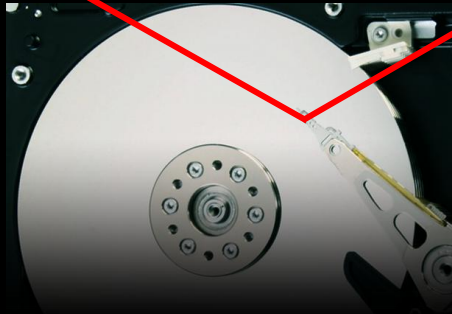
Cloud Storage Tiers



“Traditional” Workloads



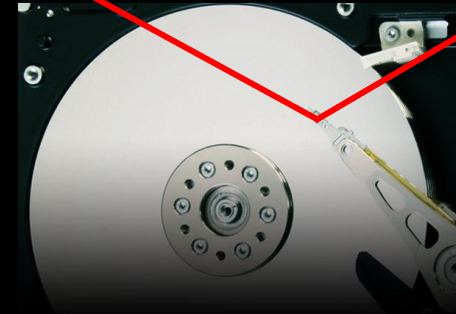
Sequential & Random Accesses



Cloud Server Workload



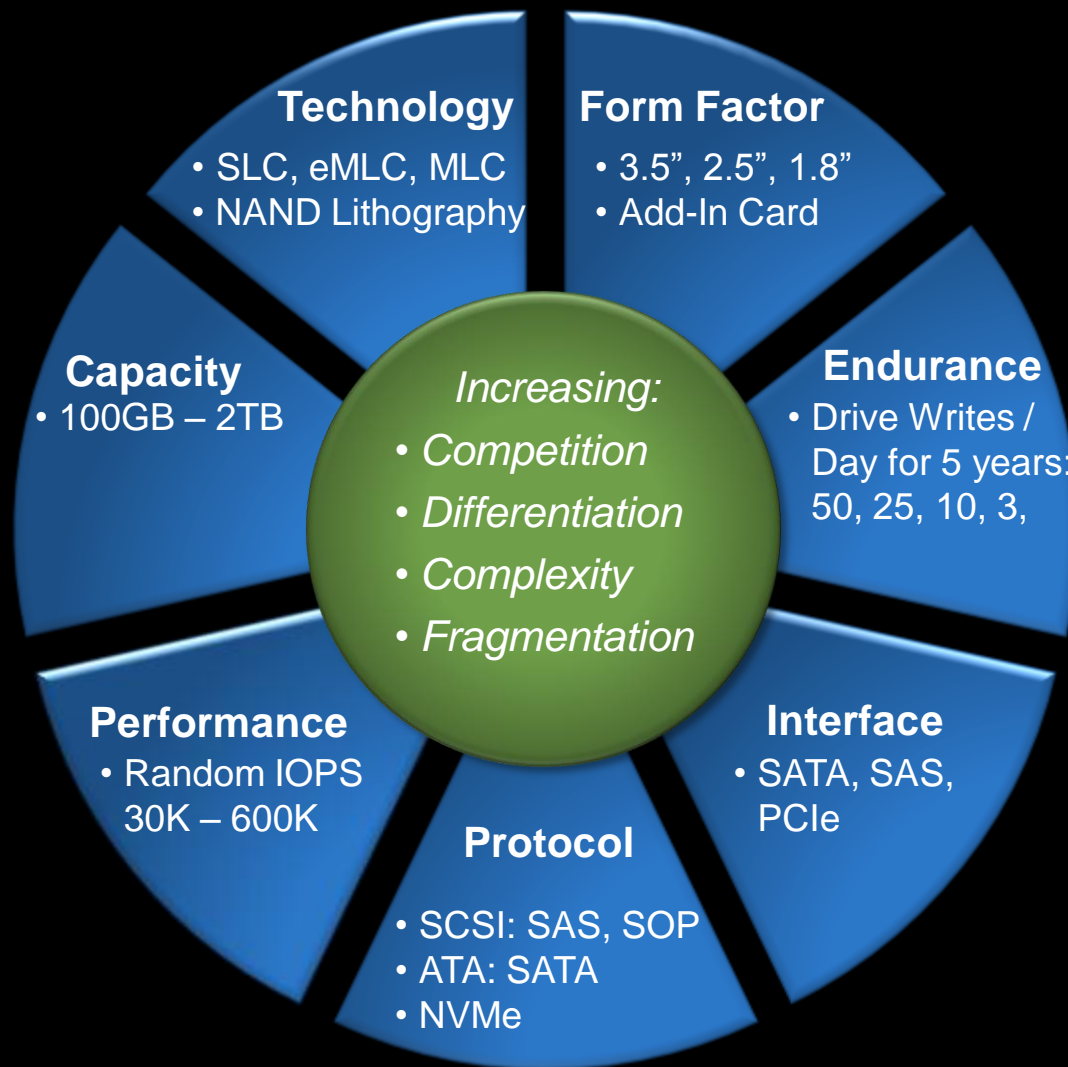
More Highly Randomized Accesses



- Sequential throughput and IOPs important
- Utilization can be low
- Broad mix of HDD solutions are sufficient for performance demands

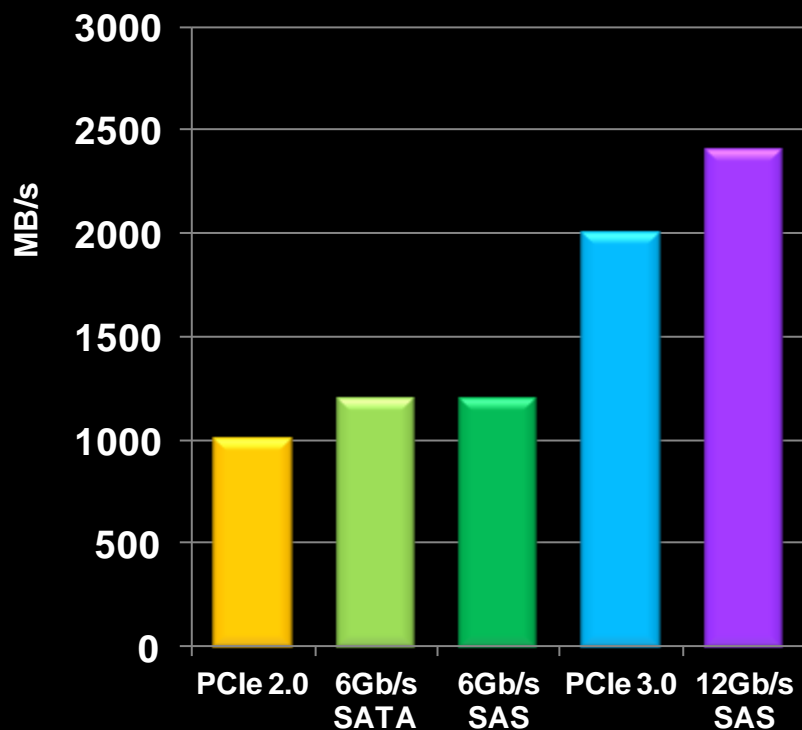
- High capacity HDDs & more VMs drive random IO (and fragmentation)
- IOPs critical
- 24x7 Operation
- SSD and Enterprise-Class HDDs preferred

SSD Segment Fragmenting

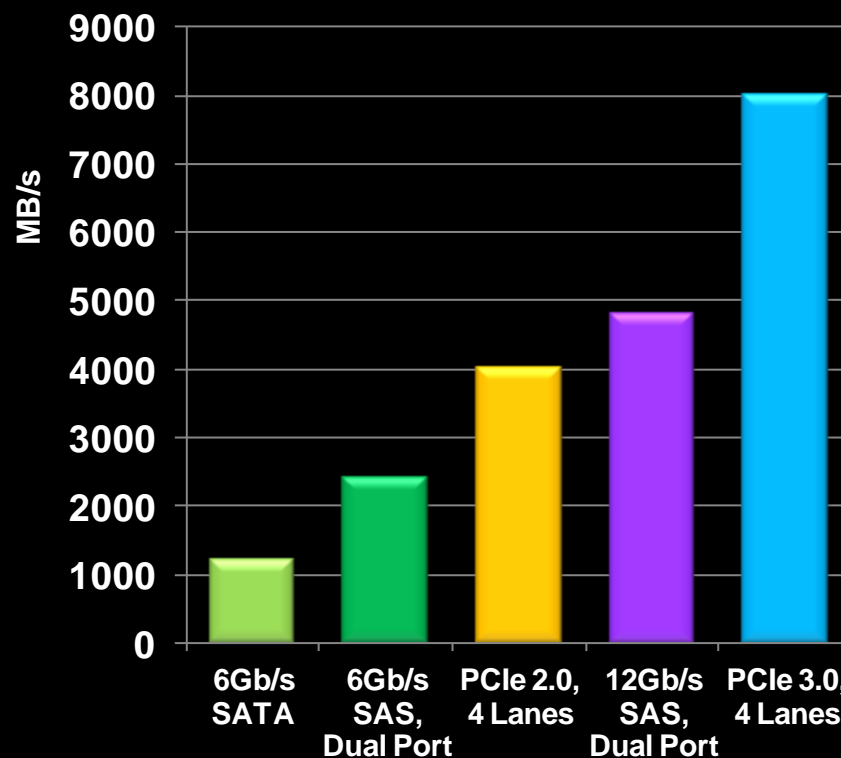


The Next Gen— Removing Storage Bottlenecks

**Bandwidth per Port / Lane
(Full Duplex)**



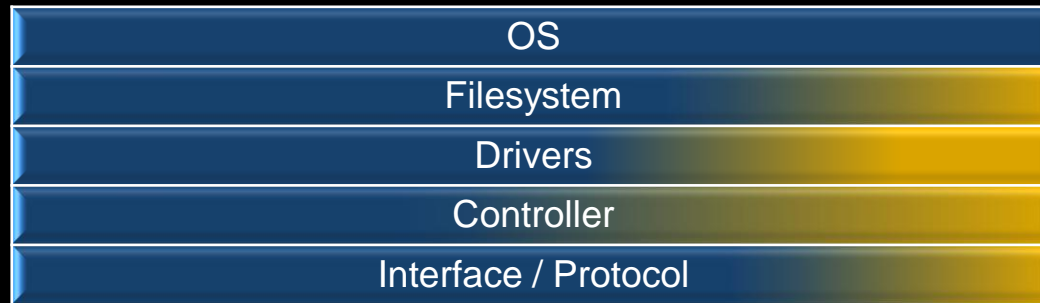
**Bandwidth for Typical Drive Configurations
(Full Duplex)**



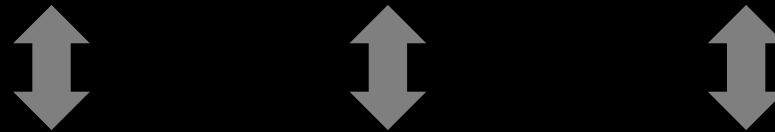
Not Shown: 4 port MultiLink SAS or 8 Lane PCIe

With Dual Port SAS and Multi-lane PCIe the bottleneck is not Storage I/O bandwidth

Common Architectures Drive Compatibility & Interoperability



Storage system designers prefer to minimize changes to their stack— Value & differentiation comes at the “application” layer



	Performance HDD	Capacity HDD	SSD
Scalability			
Data Integrity			
Error Recovery			
Command Queuing			
PLI			
Endurance Mgmt			

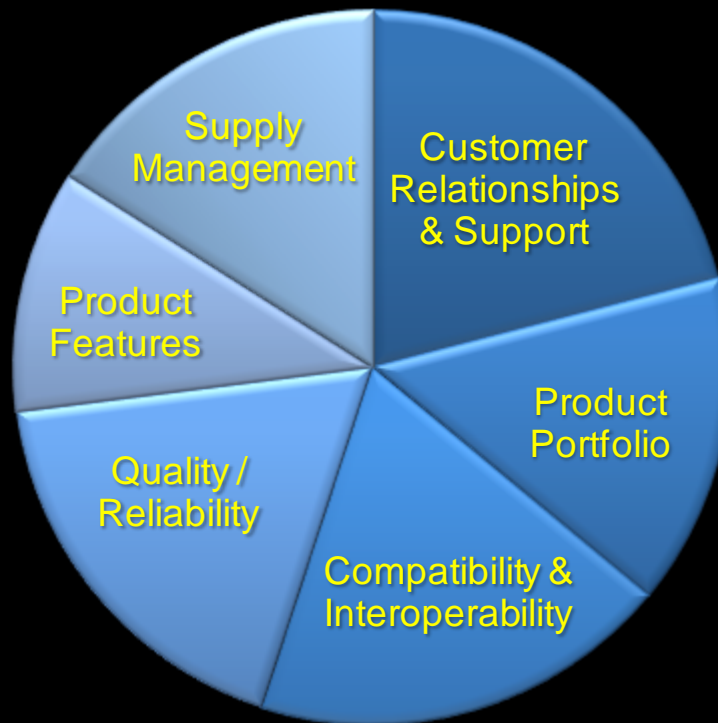
Firmware & features commonality enables more flexibility, fewer integration issues, faster TTM for system builders

Compatibility & Interoperability is key to driving SSD in the Enterprise



Succeeding in the Enterprise

Winning in the Enterprise market is a complex matrix of relationships, interoperability, flexibility (and products)



Key Takeaways



- Tectonic shifts in the cloud are creating opportunities for innovation
- Enterprise SSD and Performance HDD will be complementary for the foreseeable future
- Rigid Tiering Structure giving way to multiple sub-tiers creating opportunities for differentiation
- Compatibility & Interoperability is key to driving SSD adoption in the Enterprise
- Key to market success is a holistic approach to the customer engagement model