



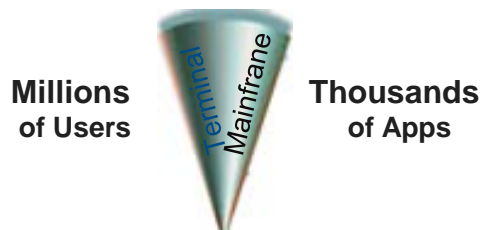
Our Growing Digital Universe, the Impact on Enterprise Storage, and the Role Solid State is Playing in the Future

Non-Volatile Memory (NVM) Summit

Jeff Janukowicz
Research Director

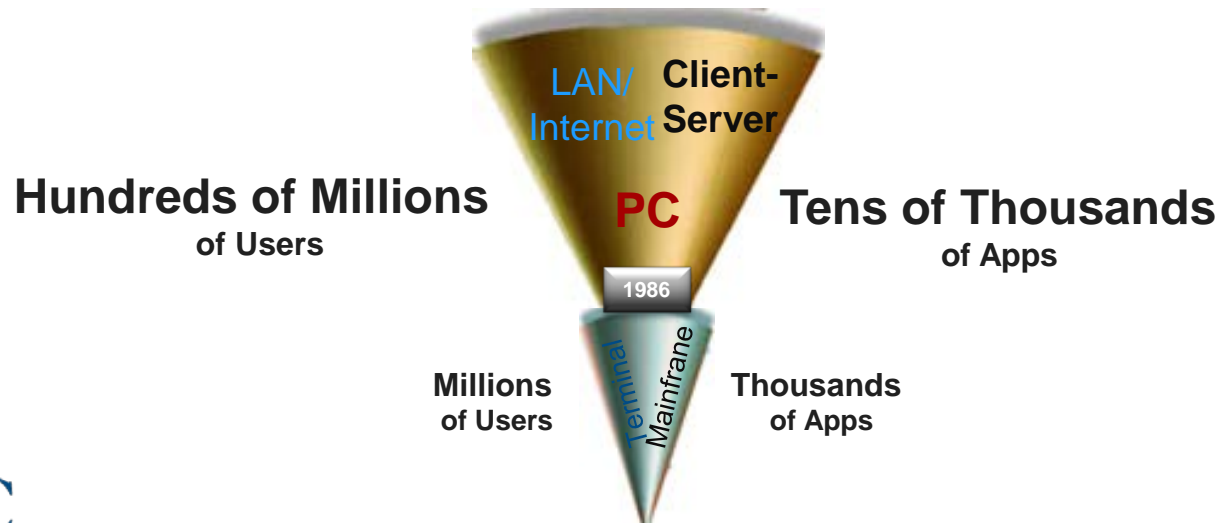
Transforming the Enterprise

Third Platform for Industry Growth



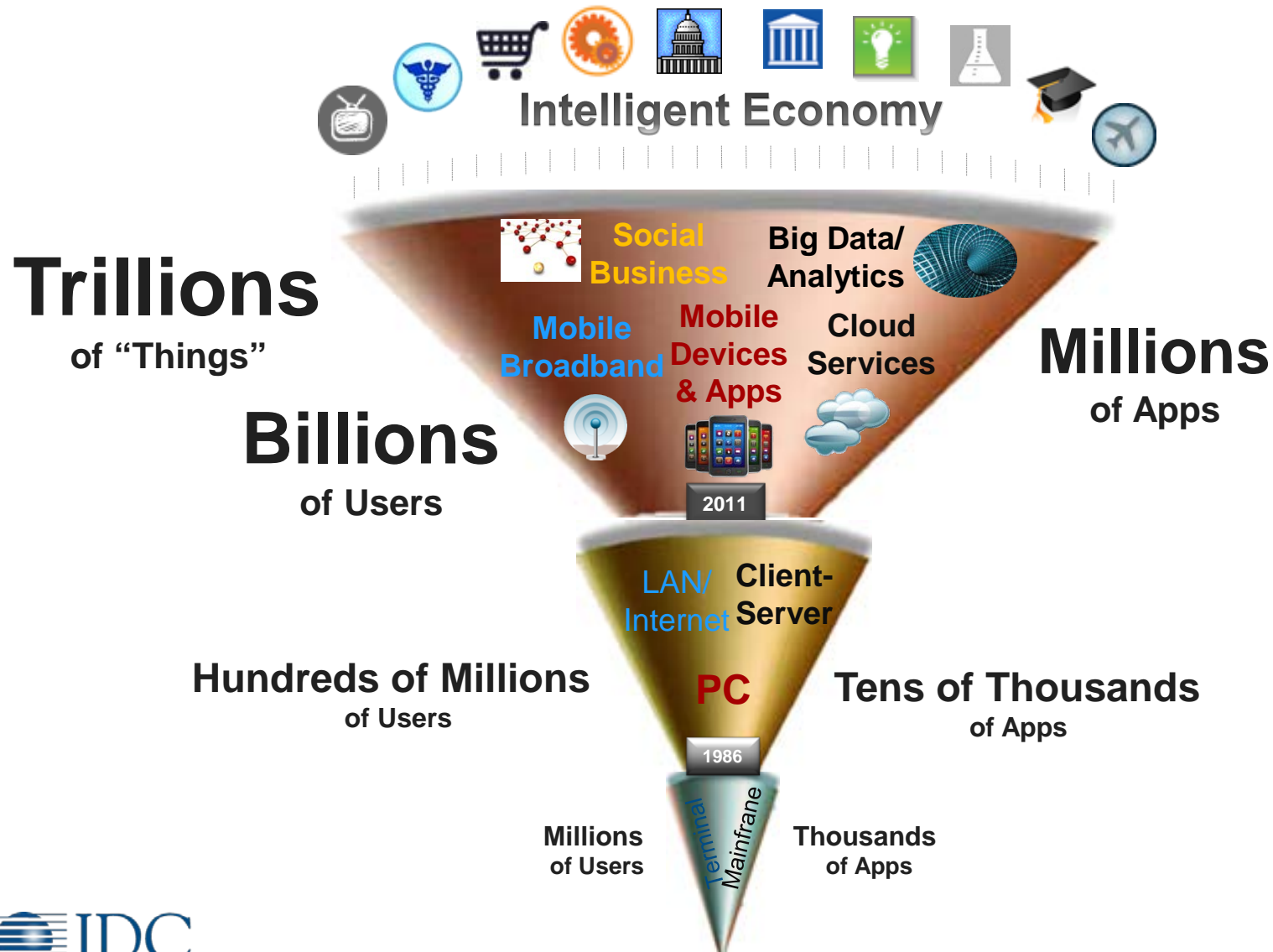
Transforming the Enterprise

Third Platform for Industry Growth

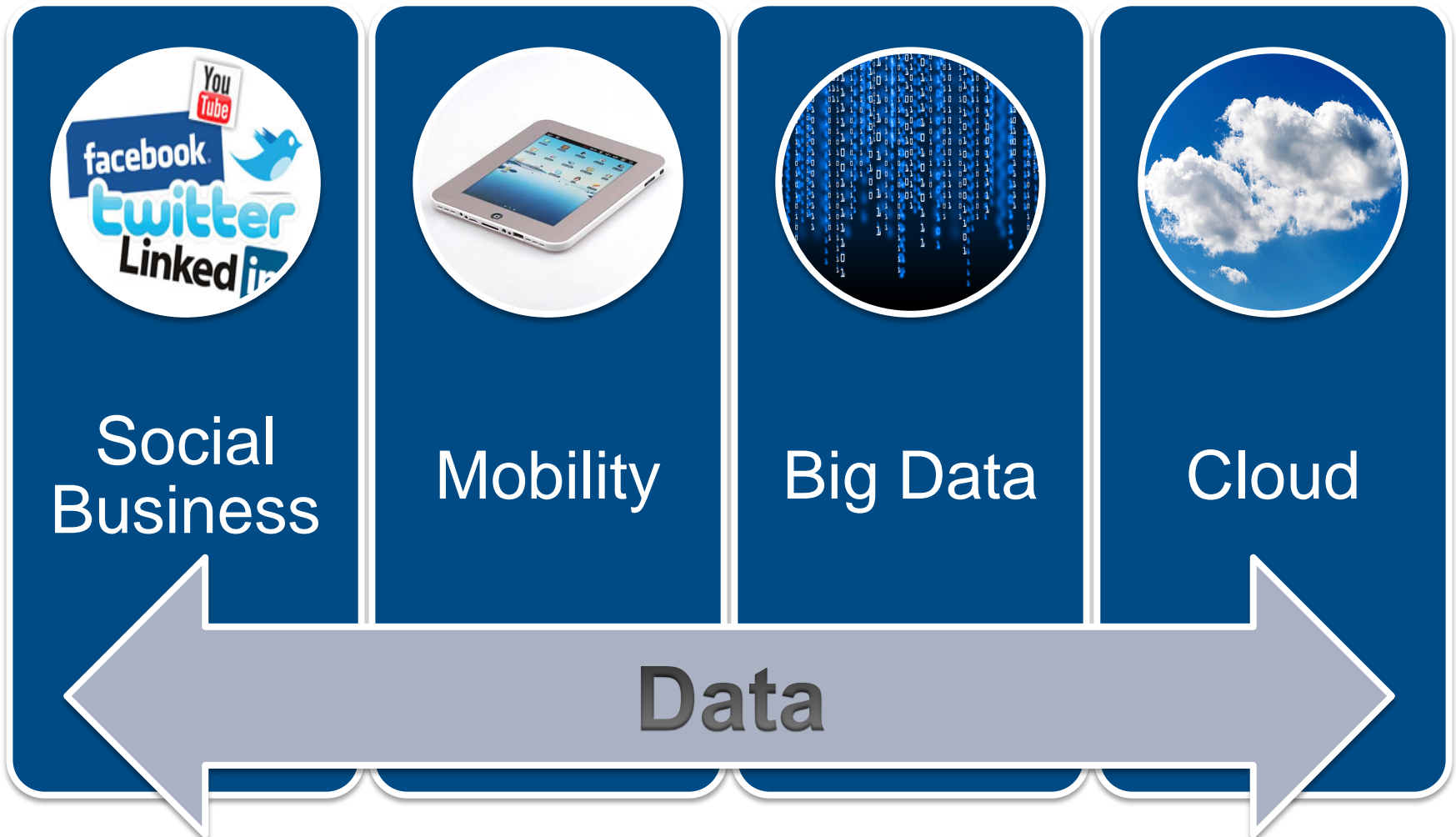


Transforming the Enterprise

Third Platform for Industry Growth

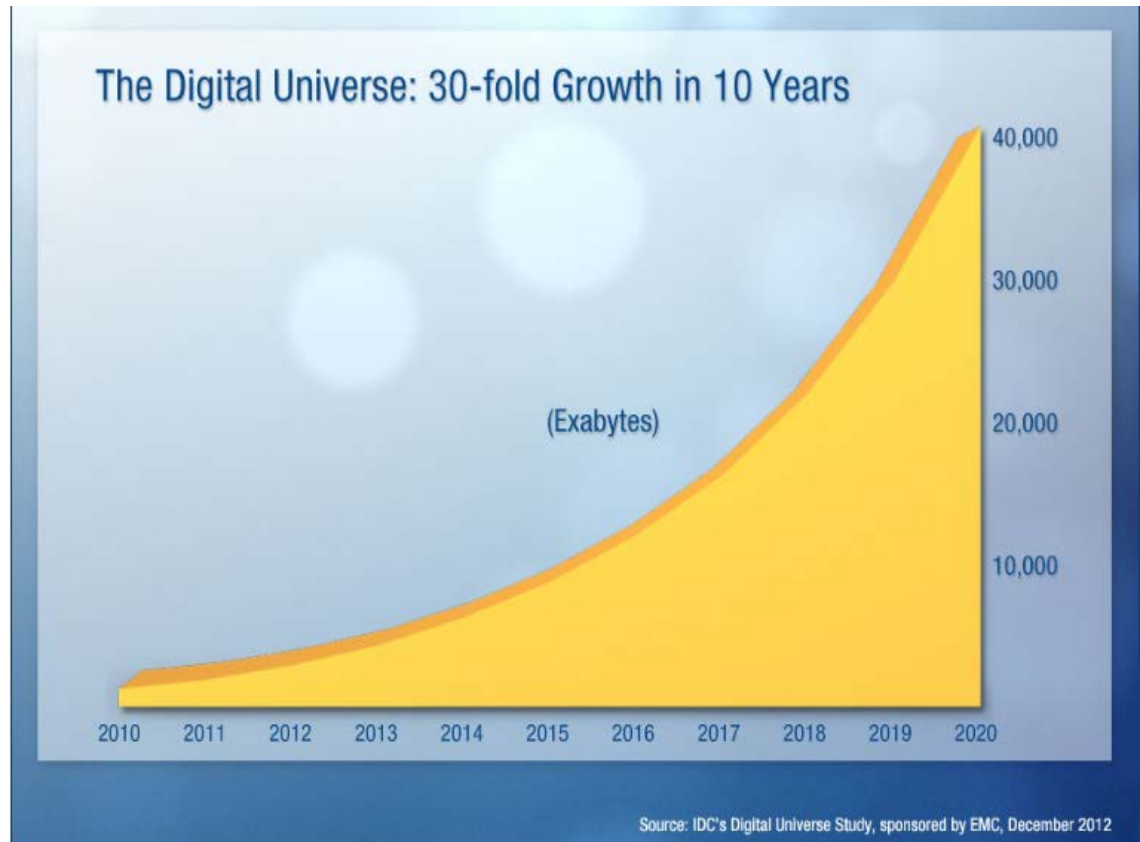


New technology platforms for growth and innovation



Demand for Data Keeps Growing

- More ...
 - Data
 - Content

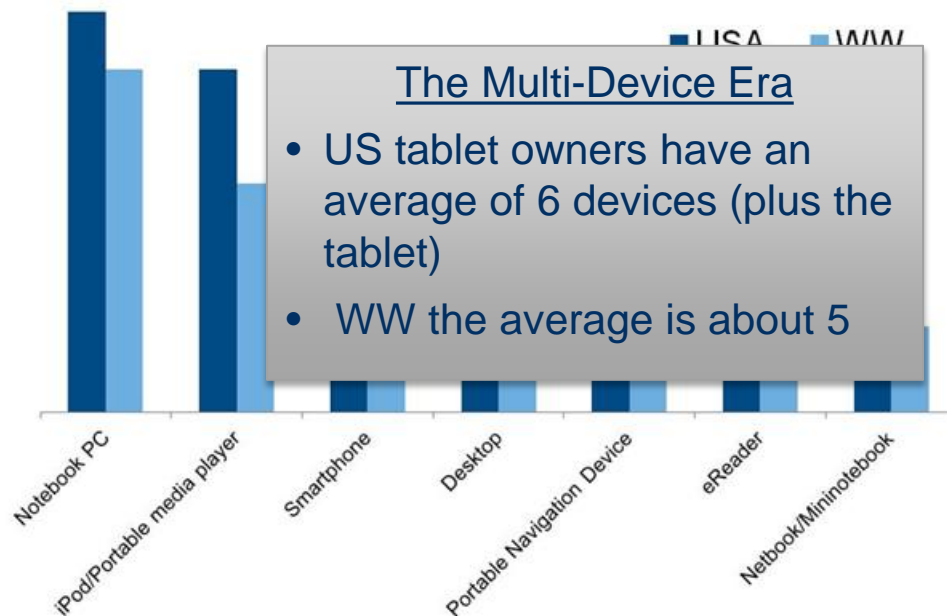


Demand for Data Keeps Growing

■ More ...

- Data
- Content
- Applications
- Devices

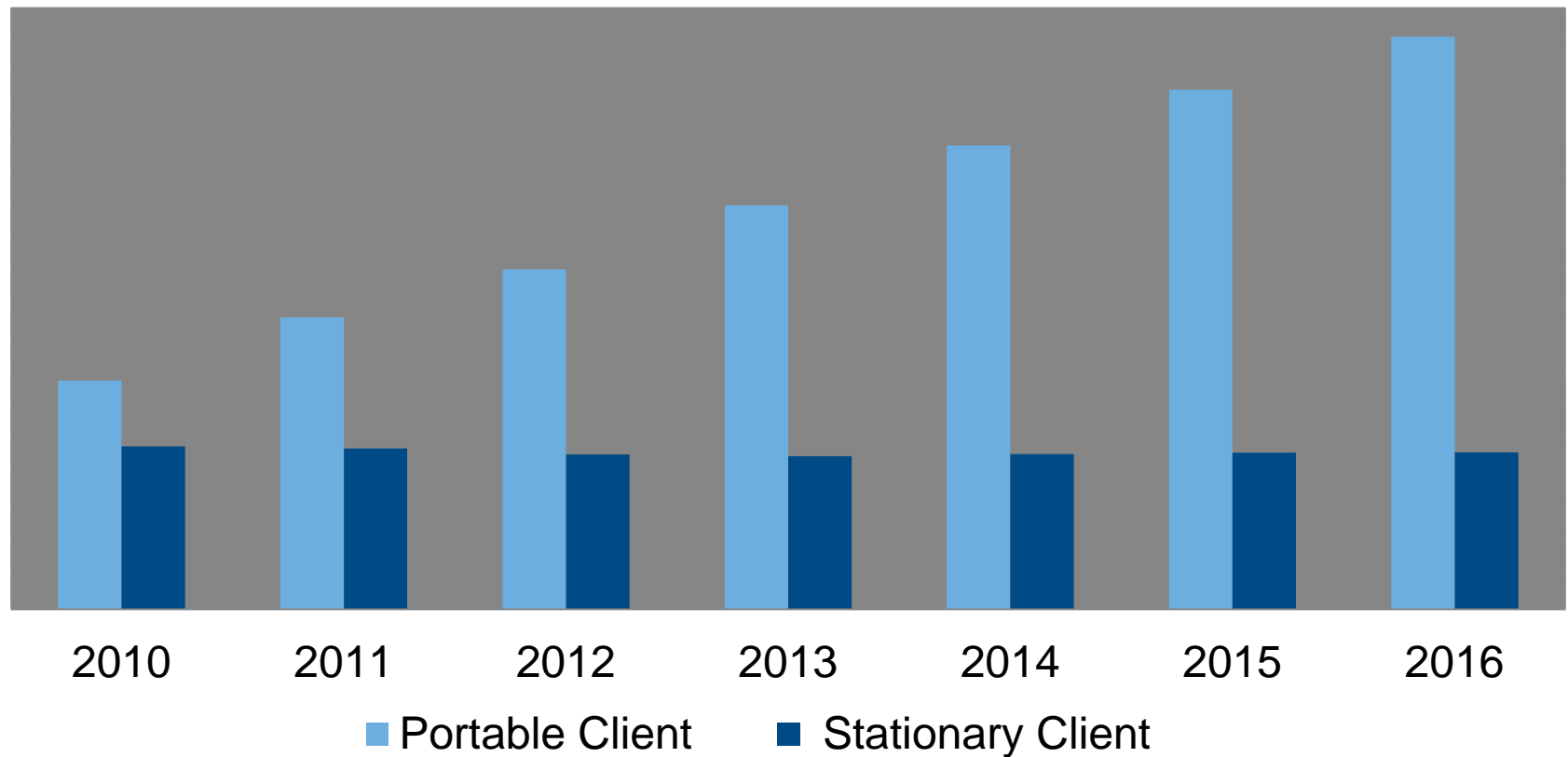
How many of each of the following devices do you own, even if not in regular use?



Stationary vs. Portable Client Devices

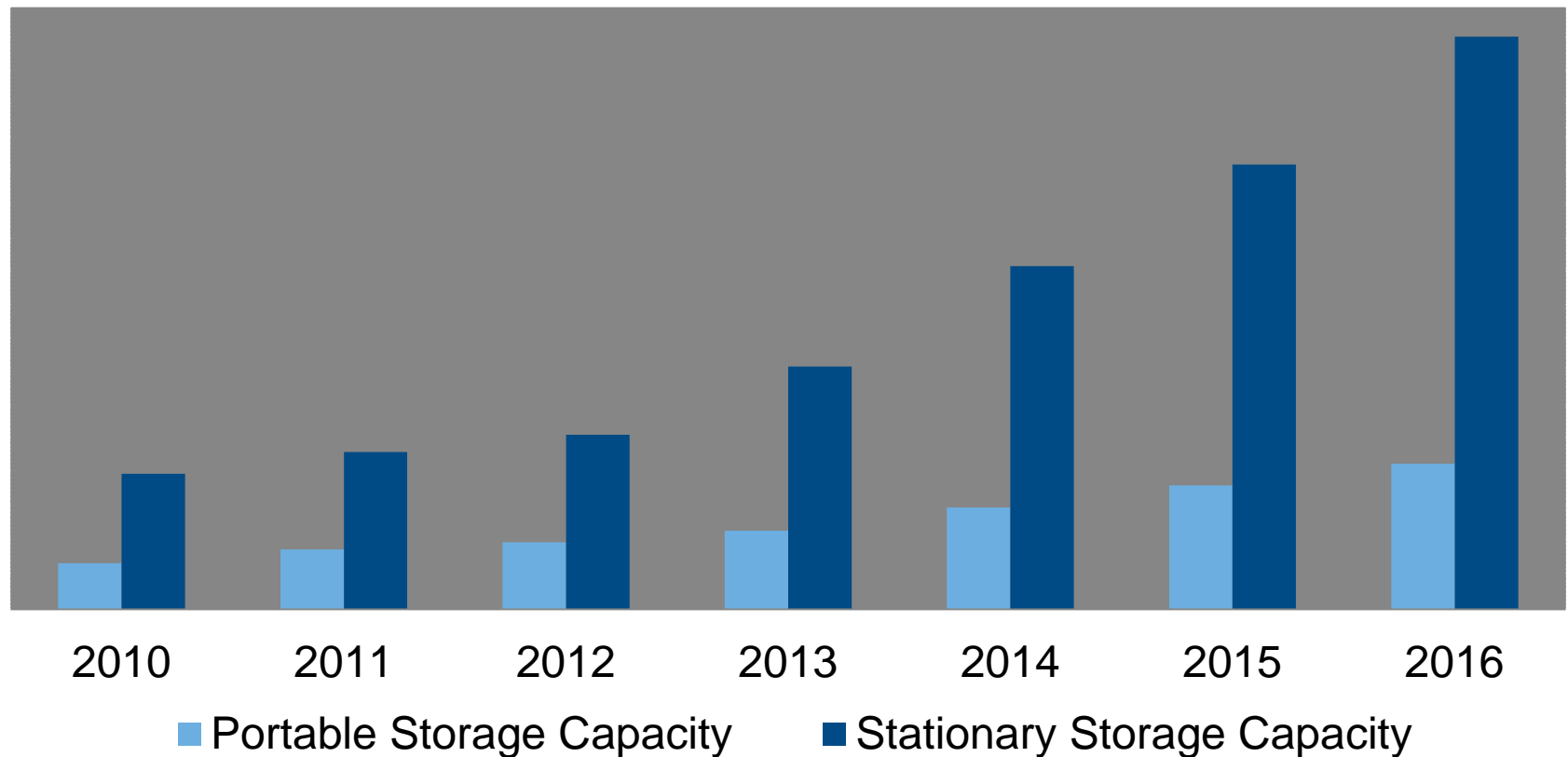
Multi-Devices Era

Client Device Shipments



Stationary vs. Portable Storage Capacity Shipped

Capacity Shipments in TBs



Delivering the Data ... We want ...

Whenever



Wherever



On Any Device



Emergence of Flash Technology in the Enterprise

SSDs



Higher Performance – Need for faster access



Better Efficiency – More intelligent use of assets

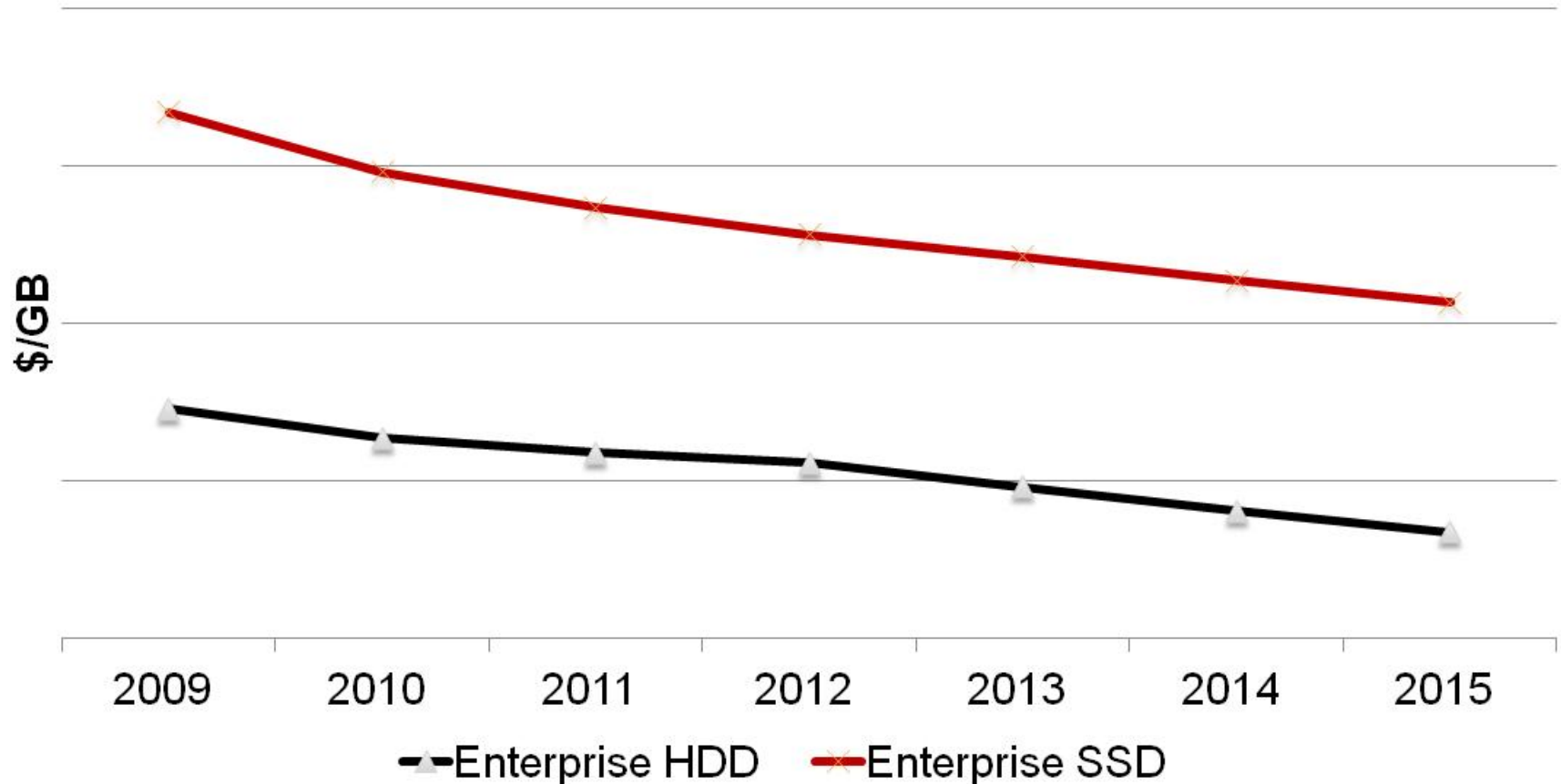


Cost Effectiveness – Lower TCO, \$/IO

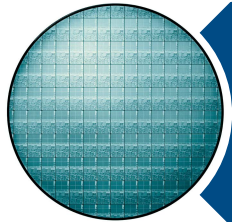


Cost is a Key Driver for Adoption

Worldwide Enterprise Blended Average Price per GB Comparison



It is More than Just \$/GB



Compute



Network

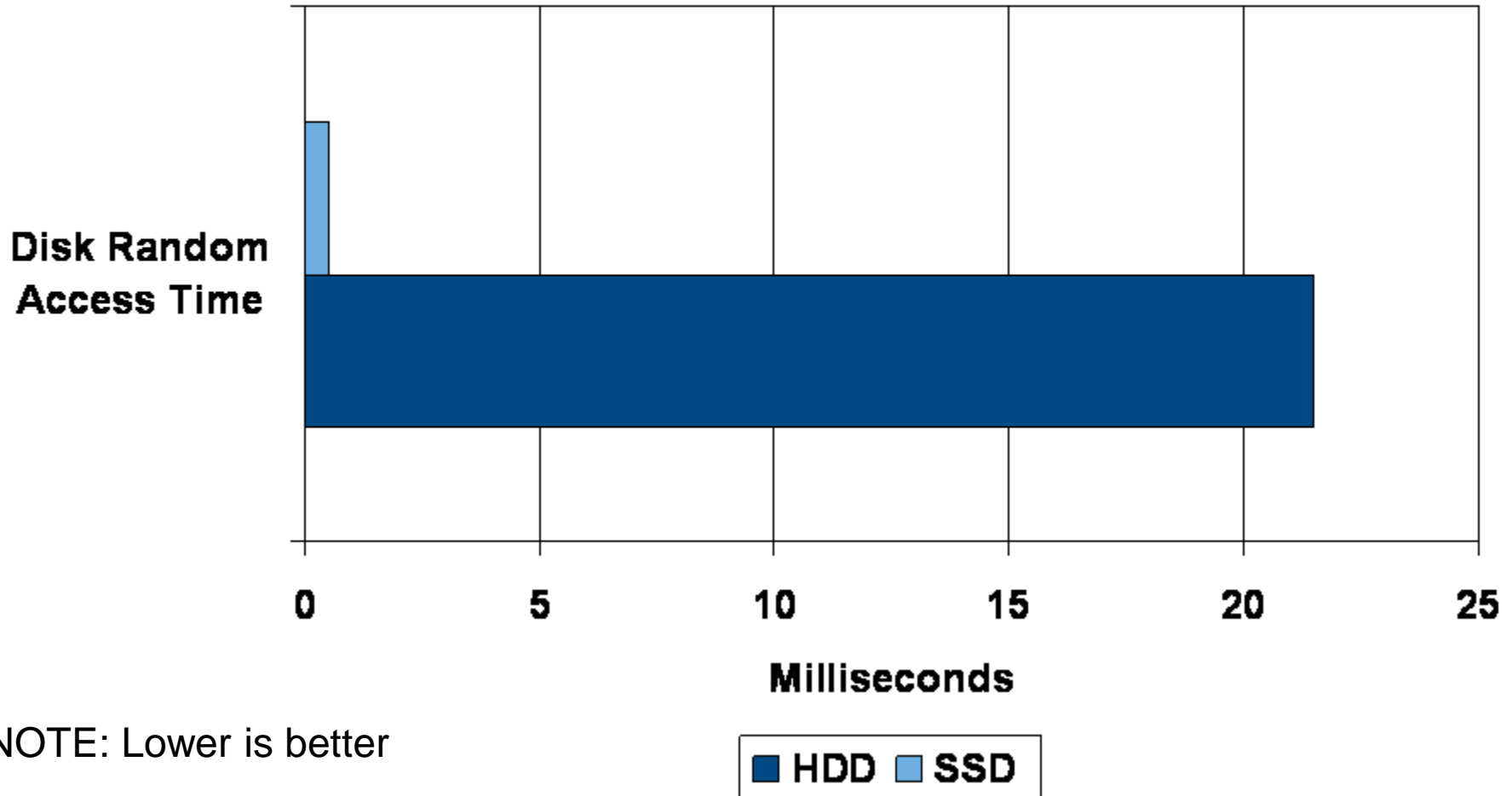


Storage

- Storage Performance is a bottleneck
 - Processors and network performance have grown over the last decade
 - Storage Performance Metrics
 - IOPs
 - Bandwidth
 - Response Time
- Traditional approaches can be inefficient and costly
 - I/O delays cost money and time
- Optimization is key to overcome limitations

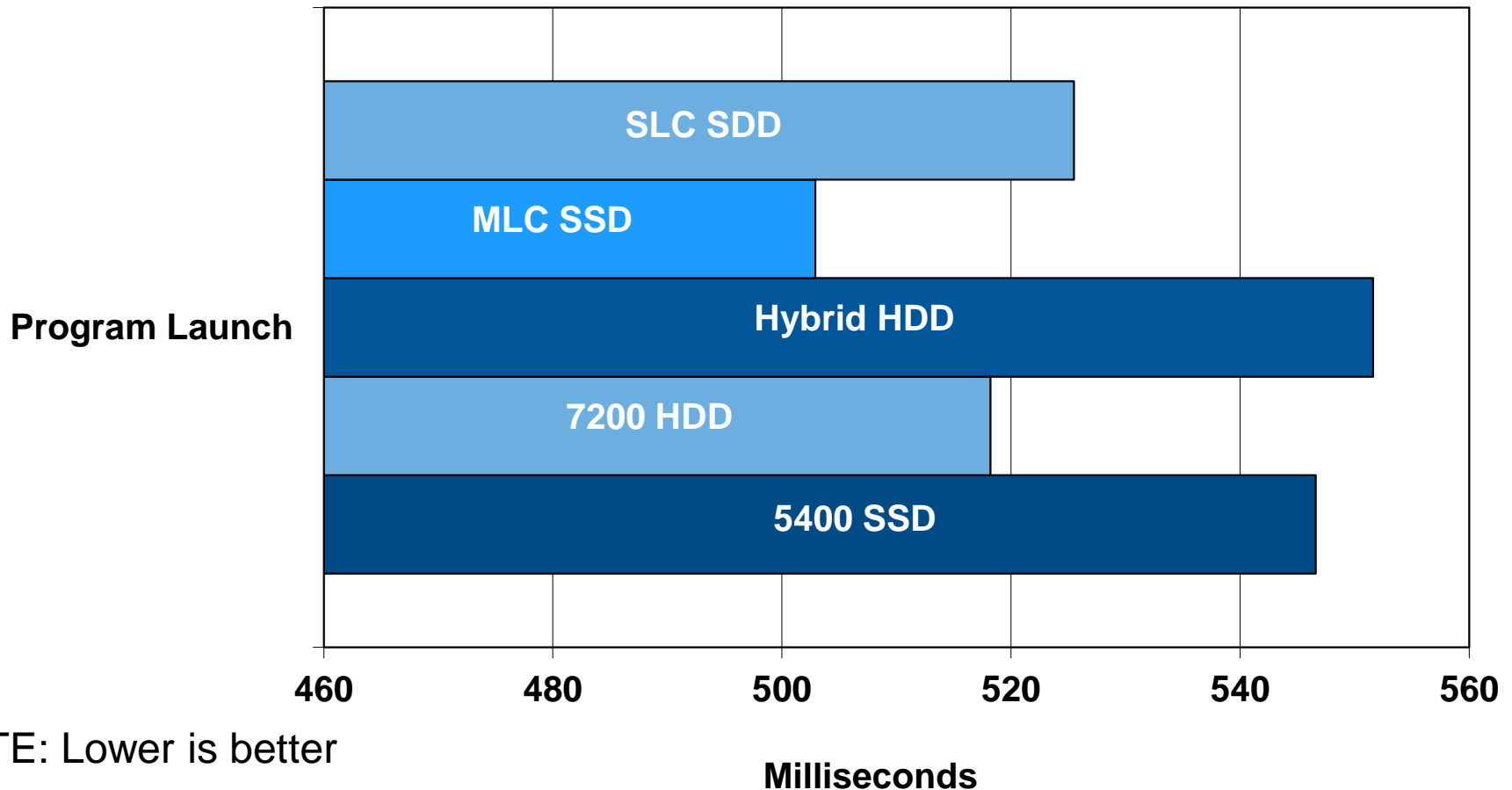
IDC compared and contrasted PCs with different storage devices

HD Tach - Access Speeds



Real-world PC performance

Internet Explorer launch

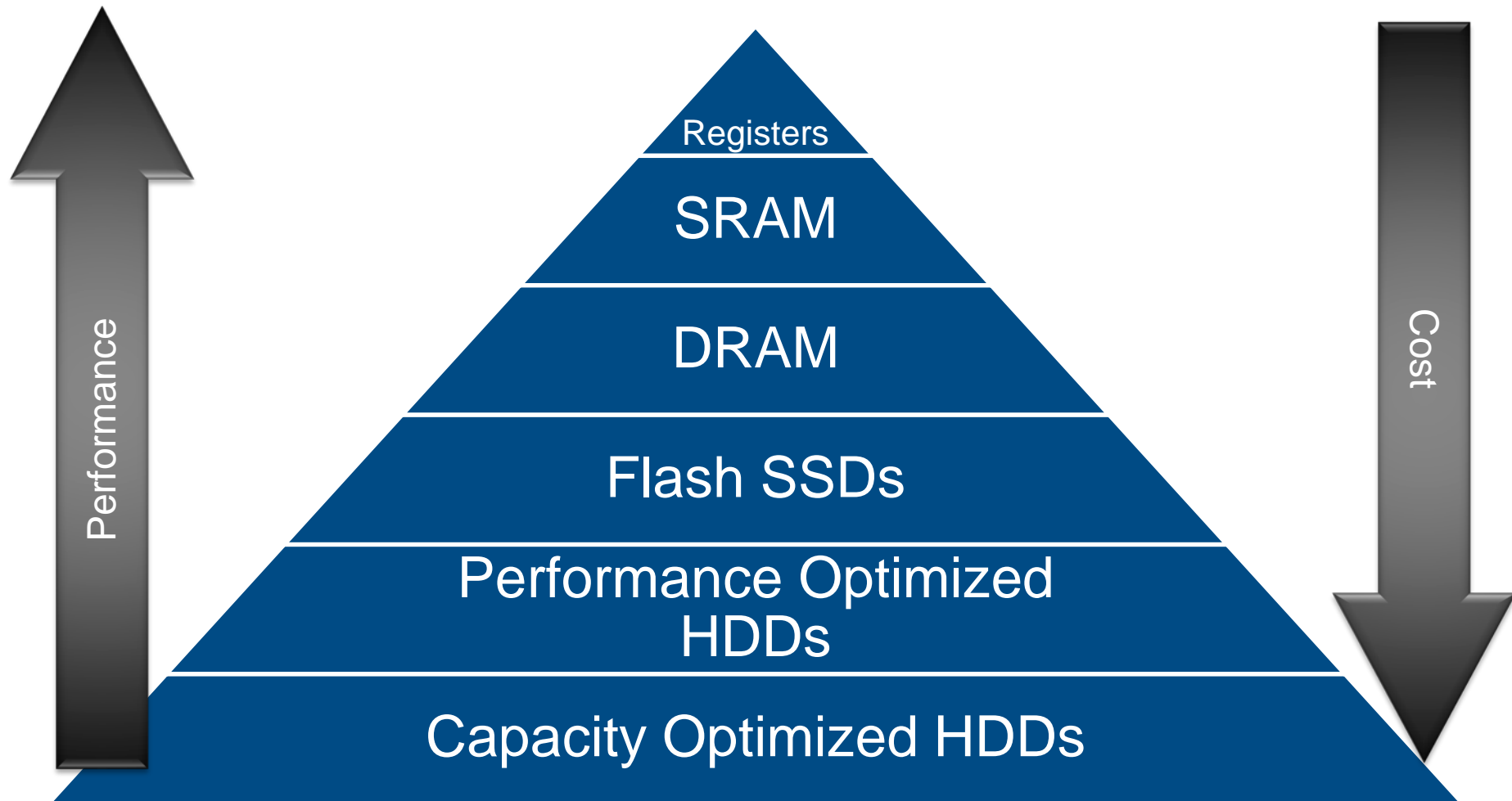


Storage is part of the system

- Today the system is optimized for HDDs
 - Hardware
 - Performance
 - Form Factor
- OS, BIOS, hardware and applications will need to be fine-tuned to exploit inherent advantages
- Smart system design can overcome bottlenecks



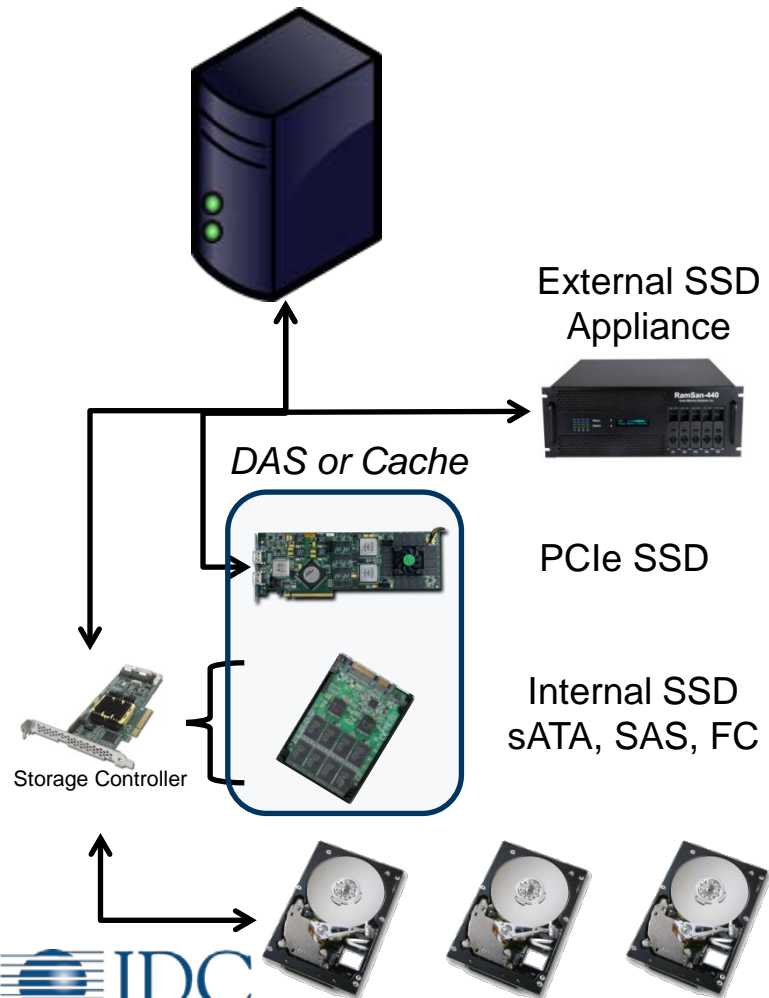
Solid State Technology will complement in system architectures



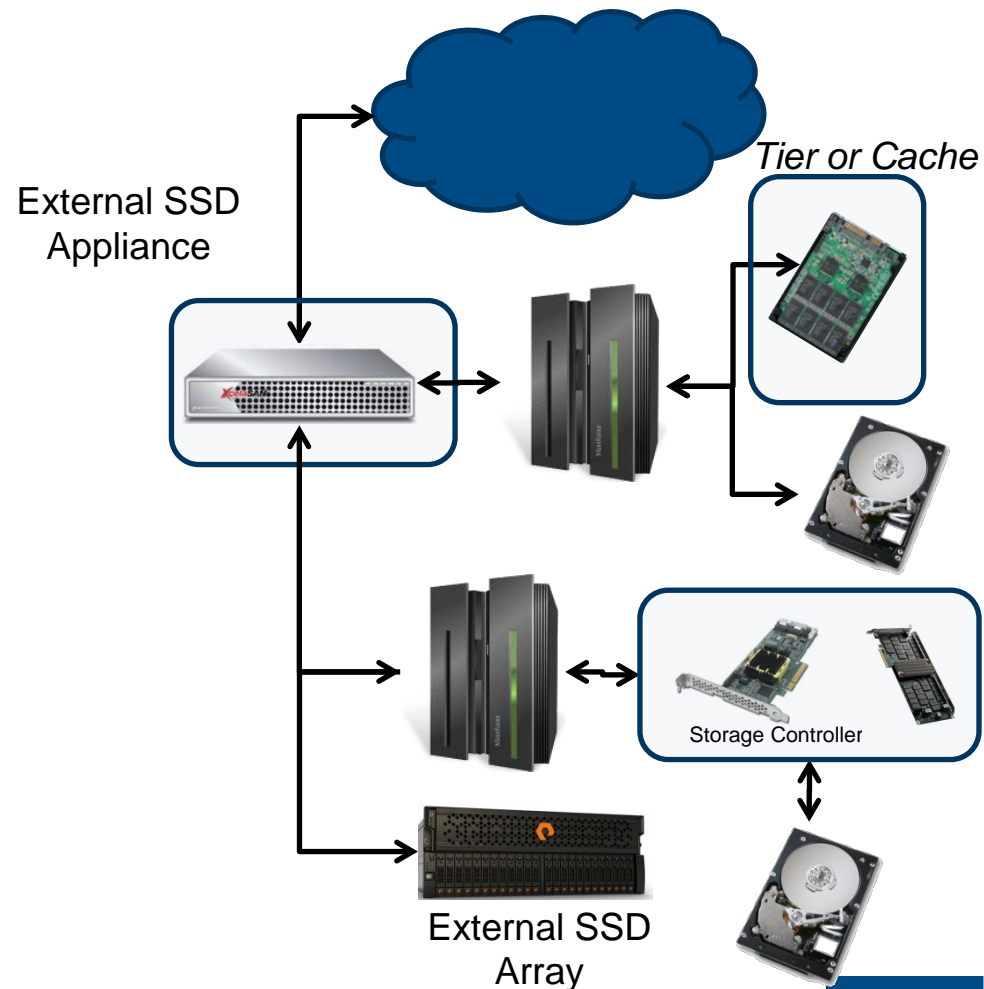
Flash is Everywhere in the Enterprise

SSD Implementations: Persistent and Cached Storage








Direct Attached Storage



Networked Attached Storage



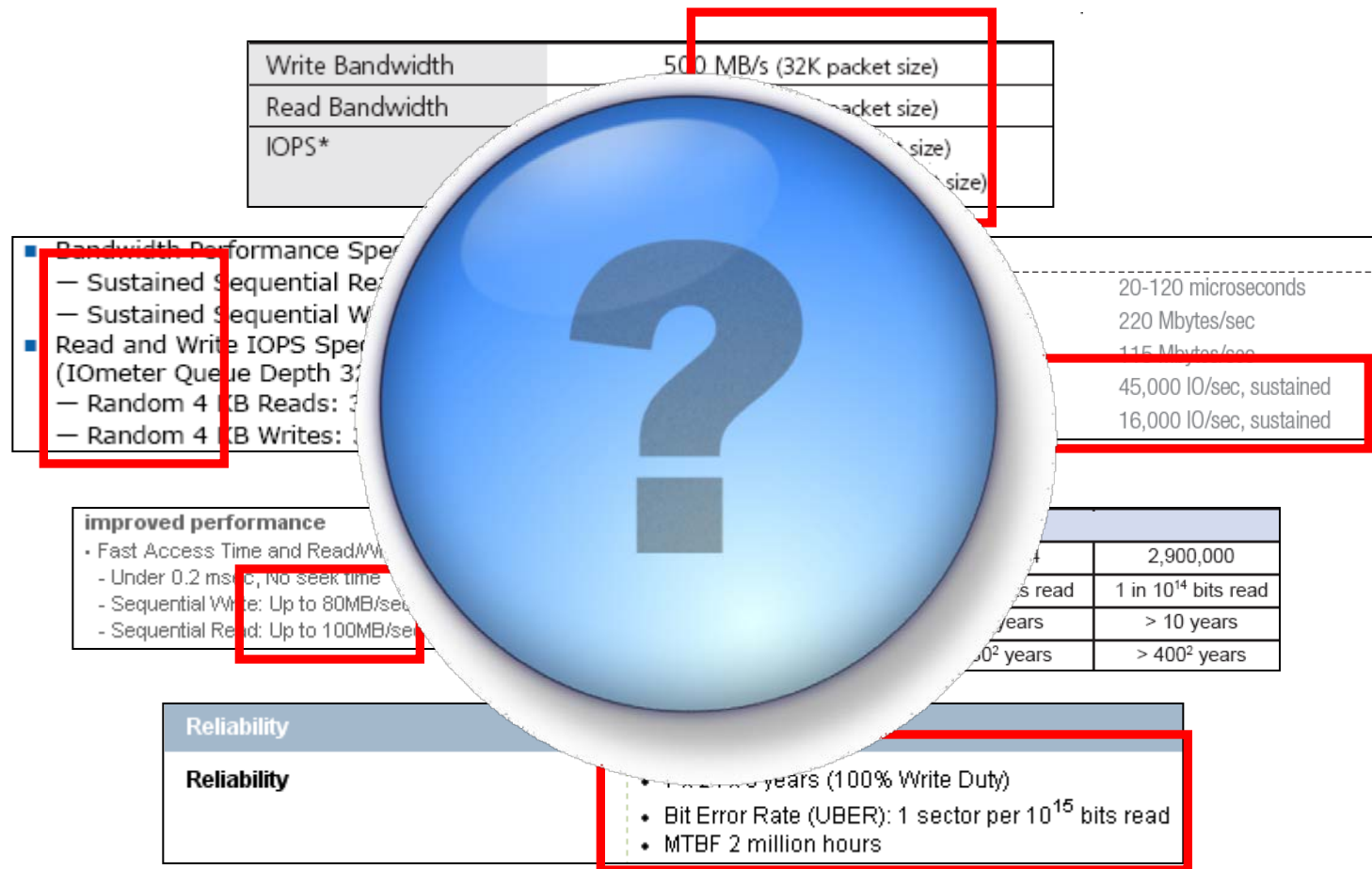
Enterprise SSD Product Diversity

Form Factor	SAS	FC	SATA	PCIe
2.5in				
3.5in				
Module				
Rack				

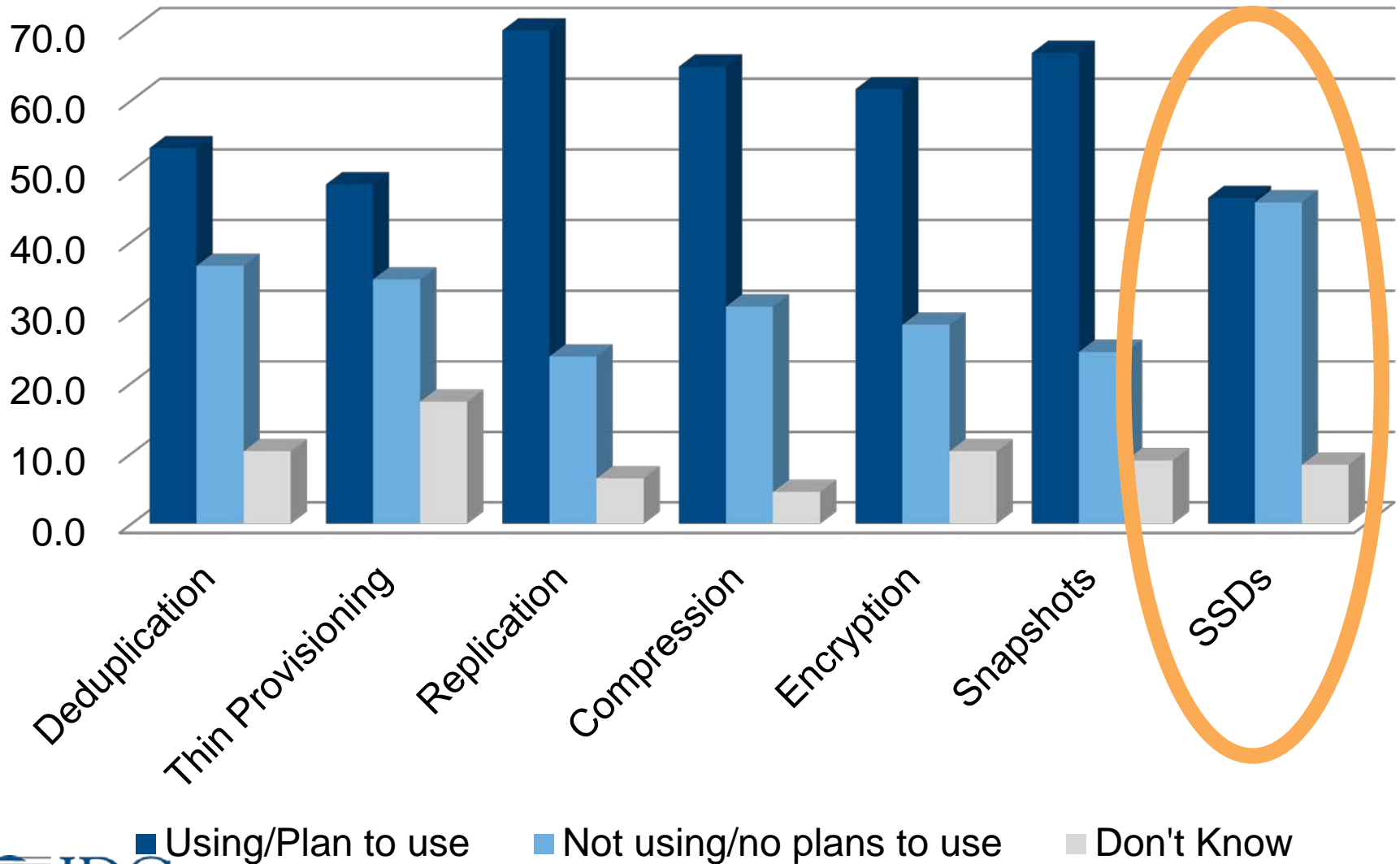
- Multiple Disk Form Factors:
 - 3.5 in, 2.5in, module
 - SSDs are Form Factor agnostic
- Range of Capacities
 - Very low - up to Multi-TB
- Wide Array of Performance Attributes
 - SLC vs eMLC vs cMLC
 - Read / Write speeds
- Many Interfaces:
 - SAS (3Gb/sec → 6Gb/sec)
 - FC (4Gb/sec)
 - SATA (3Gb/sec → 6Gb/sec)
 - PCIe



The SSD Landscape



Storage Functions Demanded in the Transformed Data Center



SSDs Play an Important Role in Accelerating our Data

Quicker Response Time



SSD Deployment Architectures

- Cache & Persistent
- Host based – Local to the server
- All Flash Array – SSD only (No spinning HDD)
- Hybrid Array – utilizes a mixture of SSD & spinning HDD with data placement between media types through defined policy

Emergence of SSDs and SSD-Based Storage Systems

Vendors



Emerging Players ...

violin
MEMORY

 PURE STORAGE

 nimblestorage

XtremIO


 NIMBUS DATA

kaminario.
Simply Faster

A V  R E

 tms

whipTail™
tech

 NexGen
STORAGE

 skyera

 SOLIDFIRE

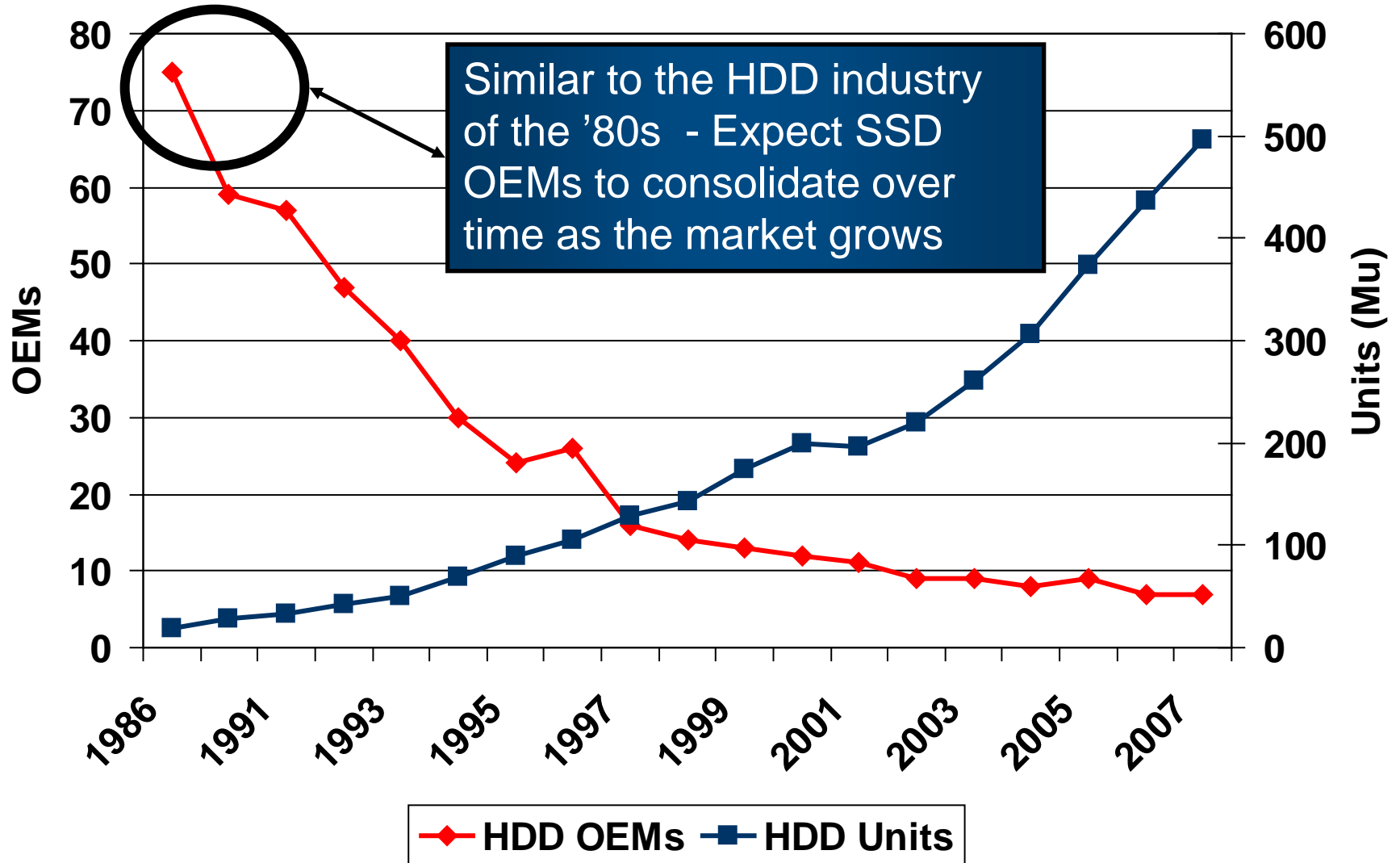
 STARBOARD
STORAGE SYSTEMS

Investments in SSD Technology

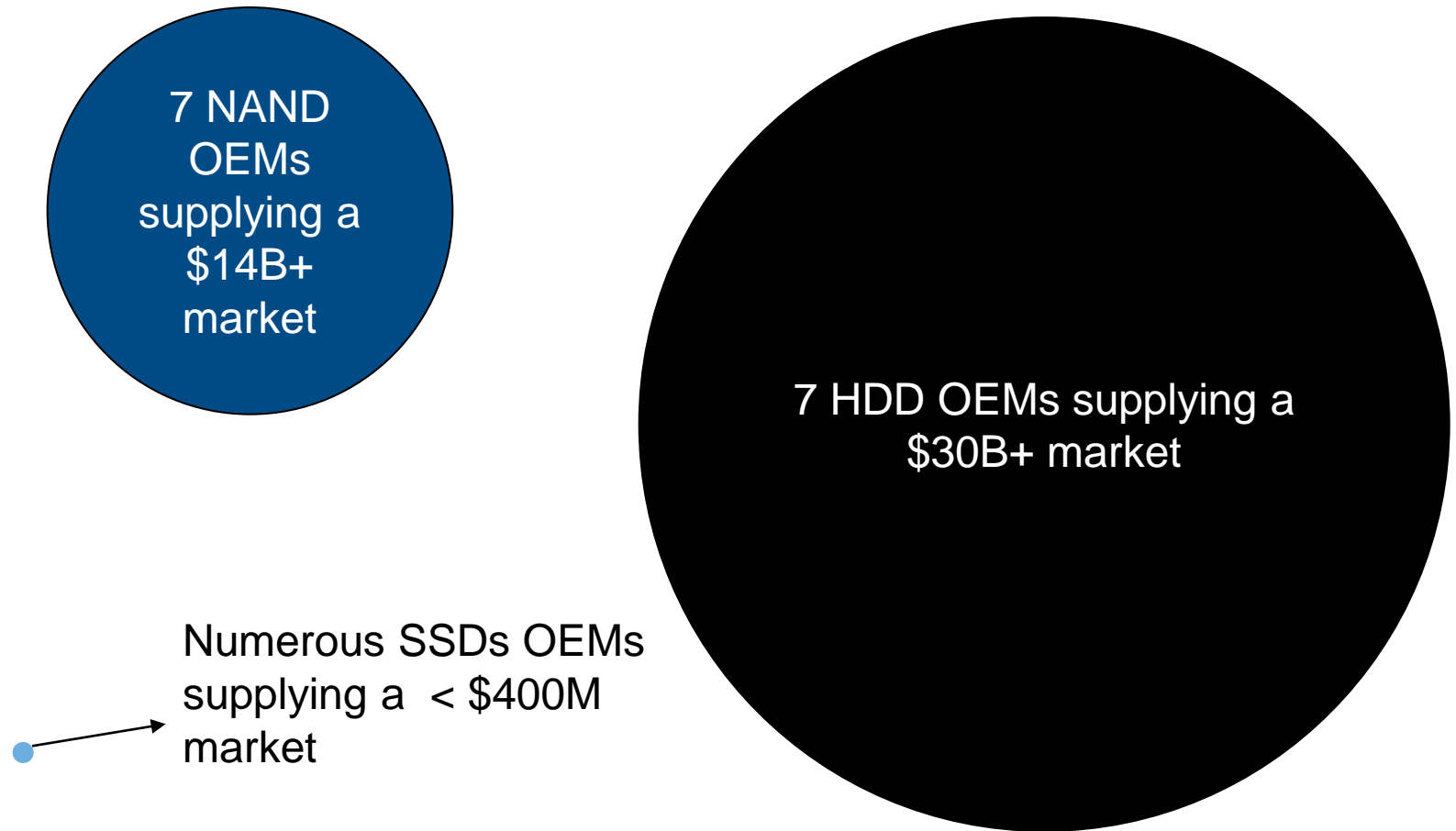
SSD Related Merge and Acquisitions

Date	Acquirer	Target Company	Market Segment
Jan 2013	Violin Memory	GridIron	Storage hardware
Jan 2013	Imation	Nexsan	Storage hardware
Dec 2012	Samsung	Nvelo	SSD caching software
Nov 2012	Intel	Nevex Virtual Technologies,	SSD caching software
Aug 2012	IBM	Texas Memory Systems	Storage hardware
Jun 2012	SK hynix	Link_A_Media	NAND Flash controllers
June 2012	SanDisk	Schooner Information Tech.	Storage hardware
June 2012	BitMicro Networks	QualCore	NAND Flash controllers
May 2012	EMC	XtremIO	Storage hardware
Feb 2012	SanDisk	FlashSoft	SSD caching software
Jan 2012	Micron	VirtenSys	Storage hardware
Dec 2011	Apple	Anobit	NAND Flash controllers
Jan 2012	OCZ	SANRAD	SSD caching software
Oct 2011	LSI	SandForce	NAND Flash controllers
May 2011	SanDisk	Pliant Technology	Storage hardware
Apr 2011	Silver Lake Partners	Smart Modular	Storage hardware
Apr 2011	STEC	KQ Infotech	Storage hardware
Mar 2011	OCZ	Indilinx	NAND Flash controllers

SSD Competitive Landscape




Putting it in Perspective – 2007



Putting it in Perspective – 2012



5 NAND
OEMs
supplying a
\$19B+
market



3 HDD OEMs supplying a
\$37B+ market

Strong Enterprise SSD Growth

2012 Revenue = ~\$2.5B

**2008 Revenue
< \$150M**



Essential Guidance

- Data Growth Continues
 - Improving performance and boosting efficiencies in a cost effective manner are key to managing the data growth
- SSD play an important role
 - SSDs accelerate access to data and will be leveraged in multiple architectures through the datacenter
- The SSD market is here to stay
 - Future hardware & software optimization around solid state technology will be key



Questions



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