



STORAGE DEVELOPER CONFERENCE

SNIA ■ SANTA CLARA, 2016

NVM Express®

Awakening a New Storage and Networking Titan

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G2M Research

Acronyms and Definition Check Point

Term	Definition
NVMe™	Non-Volatile Memory Express®
NVMe-oF™	Non-Volatile Memory Express® over Fabrics (Ethernet, InfiniBand, Fiber Channel)
NVMe Bay	NVMe connected 2.5” device slot typical installed into servers & arrays
NVMe I/O Block	NVMe based I/O card (Ethernet, InfiniBand, Fiber Channel)
NVMe Accelerator Block	NVMe based CPU, GPU or FPGA based card for analytics or clustering
SSD	Solid State Drive
M.2	A small form factor “mezzanine” SSD for laptops and cloud servers
U.2	The new name for an SFF-8639 connector (primary NVMe Bay connector)
RDMA	Remote Direct Memory Access (Typically RoCE or iWARP)
RoCE	Remote Direct Memory Access over Converged Ethernet
iWARP	internet Wide Area RDMA Protocol
AFA	All Flash Array
Hyperscale	Non-enterprise servers or data center such as OCP, Cloud, Google etc.
PCIe®	Peripheral Component Interconnect Express
SAS	Serial Attached SCSI (Small Computer System Interface)
SATA	Serial AT (Advanced Technology) Attachment
SCM	Storage Class Memory (3D Xpoint, HybriDIMM, ReRAM, and STT-MRAM)
SDS	Software Defined Storage

G2M - Research, Sales Enablement, Marketing



Market Research & Product Validation

- Market Sizing & Reports
- Competitive Analysis
- Benchmarks & Testing
- Thought Leadership
- Webcast & Infographics



Sales Enablement & Technical Content

- Value Prop Stories
- Sales Presentations
- Lead Generation
- Sales Collateral
- Ecosystem Alliances



Strategic Positioning & Digital Marketing

- Branding and Messaging
- Press & Social Media
- Web Design & CRM
- Product Launches
- Digital Campaigns

NVMe – The Awakening a New Storage and Networking Titan

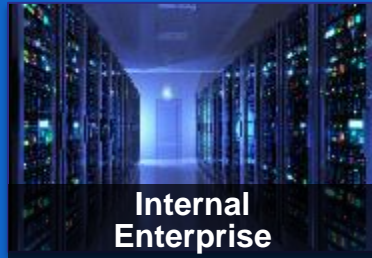
NVMe – Moving Data & CPUs Closer Together

Virtualized

Software Defined

Orchestration

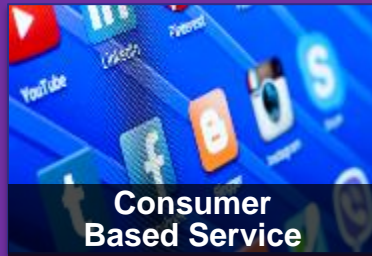
Enterprise



Enterprises have a Role
Cost to Scale
Time to Deployment
Balance Business & Regulatory



Cloud



Gen “C”loud is now Running IT
More Business Driven (AWS)
Attacking Latency (Google, Azure)
MSFT Sells More Office via Cloud



Telco
IoT



IoT drives “NanoData”
Driver of 5G, WIFI
Edge Networking
Fan-In Data and Networking



SAS

Flash

SDS

NVMe

NVMe-oF

Market Drivers of the NVMe Market



1

NVMe is driven by the move to Flash & SCM

2

Intel is making NVMe pervasive and cost effective

3

Latency is the “value commodity” for applications

4

Faster apps need storage aligned with the CPU

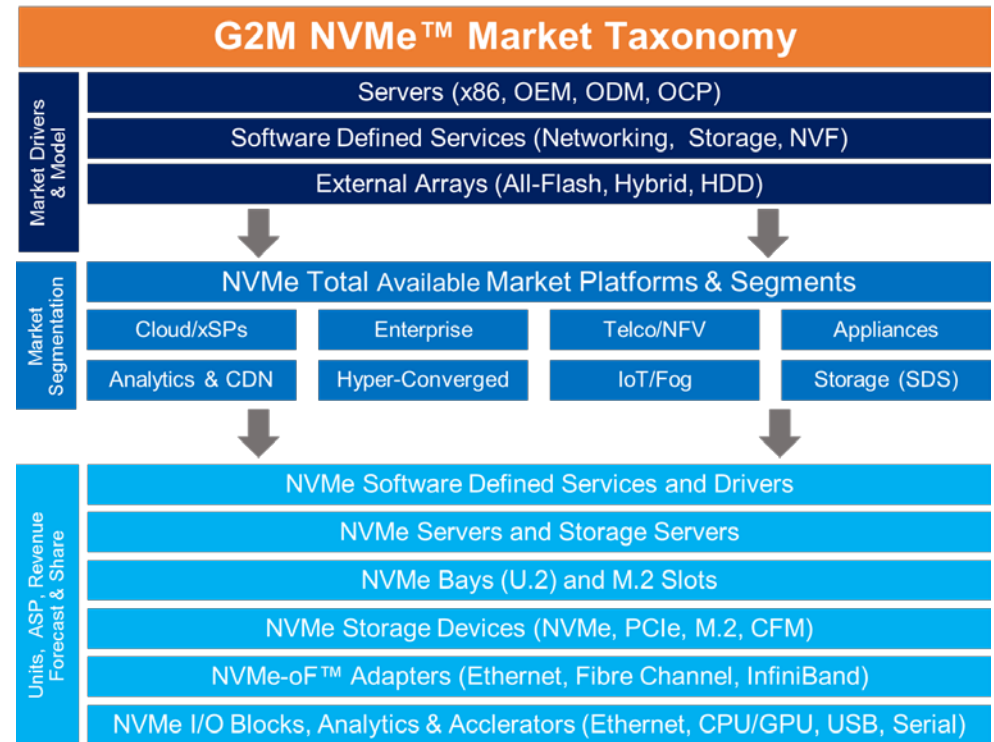
5

Legacy connectivity always wins in the market

Over 80 Companies Are Delivering NVMe Enabled Solutions

NVMe - Ecosystem

- ❑ Over 80 NVMe Players
 - ❑ Servers
 - ❑ Storage server
 - ❑ Storage arrays
 - ❑ ASICs & controllers
 - ❑ SSD (U.2 and M.2)
 - ❑ NVMe-oF adapters
 - ❑ GPU & I/O adapters
 - ❑ Test equipment
 - ❑ NVMe software

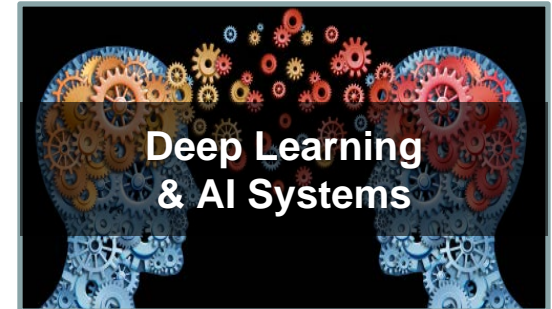


NVMe Application Drivers

Enterprise



Cloud/xSP

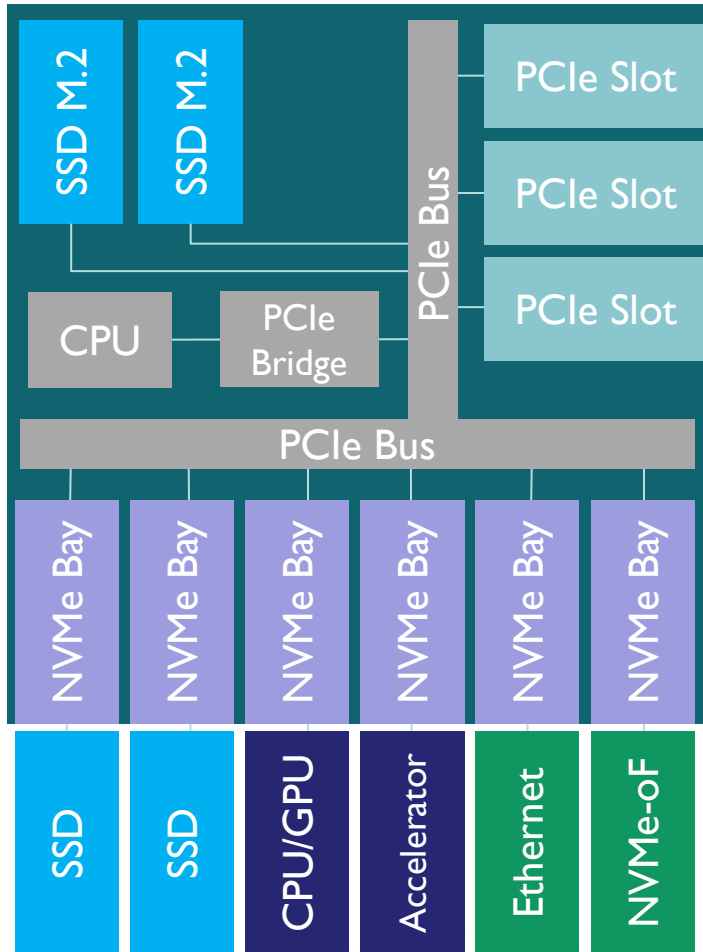


Vertical



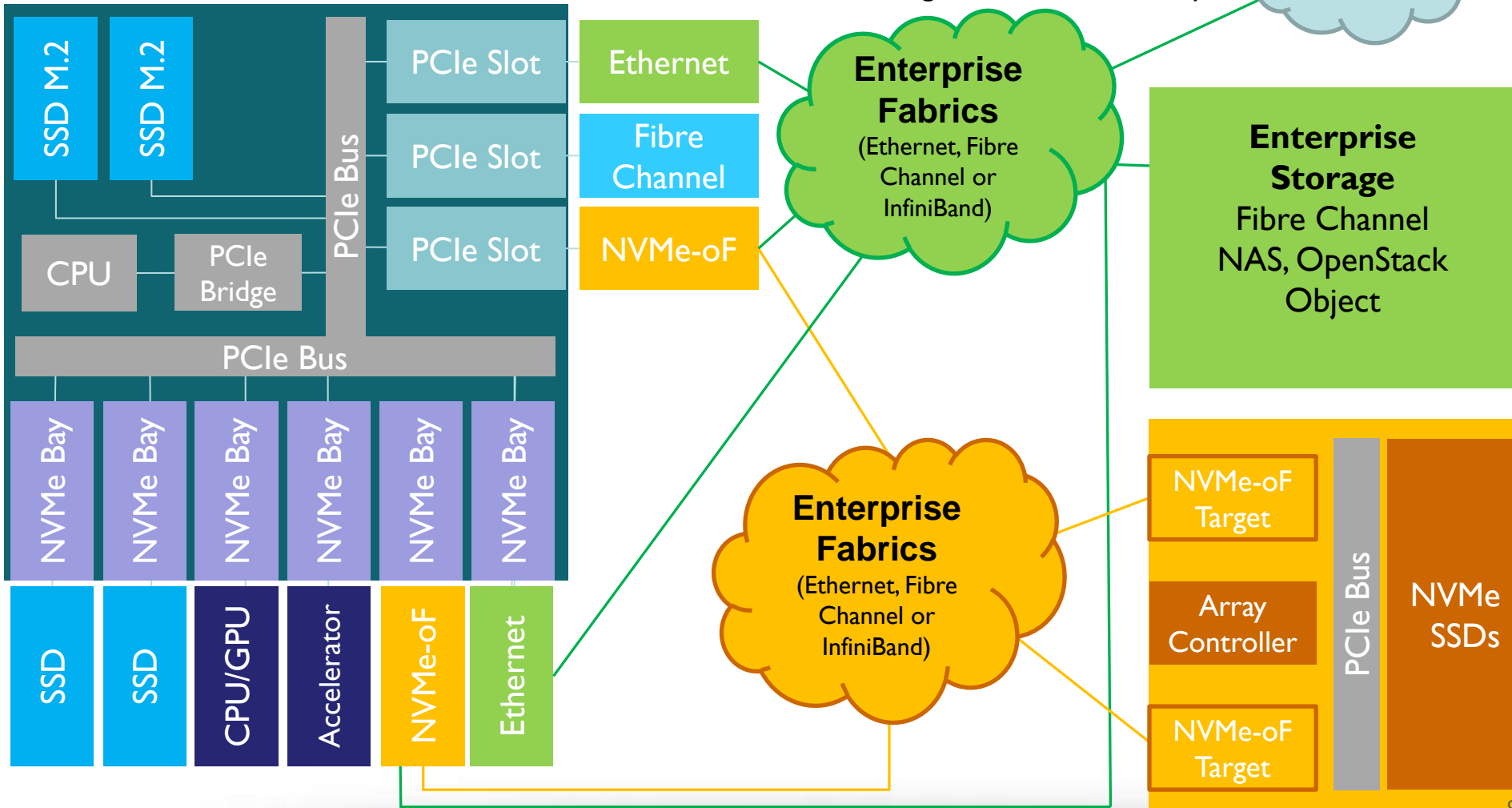
NVMe – Intra-Chassis

NVMe Enabled Server or Storage Server



NVMe-oF – Inter-Chassis

NVMe Enabled Server or Storage Server



Top Predictions for the NVMe Market



**NVMe
Market
Size**

The NVMe market will be over \$57 Billion by 2020

(servers, software defined storage servers, external arrays, connectivity and I/O)



**NVMe SSD
U.2 & M.2
in Servers**

Over 50% of servers will ship with NVMe drives by 2020

(The average server will have 5.5 NVMe devices)



**SDS
Storage
Servers**

Over 60% of storage servers drives are NVMe by 2020

(The average storage server will have 29 NVMe devices)



**NVMe-oF
Networking**

NVMe-oF adapter shipments exceed 740K units by 2020

(Over 75% of these will be RDMA enabled Ethernet Adapters)



**AFA
Moves to
NVMe**

Over 40% of AFAs arrays will NVMe based by 2020

(This will grow faster than the AFA transition vs HDD SAS arrays)



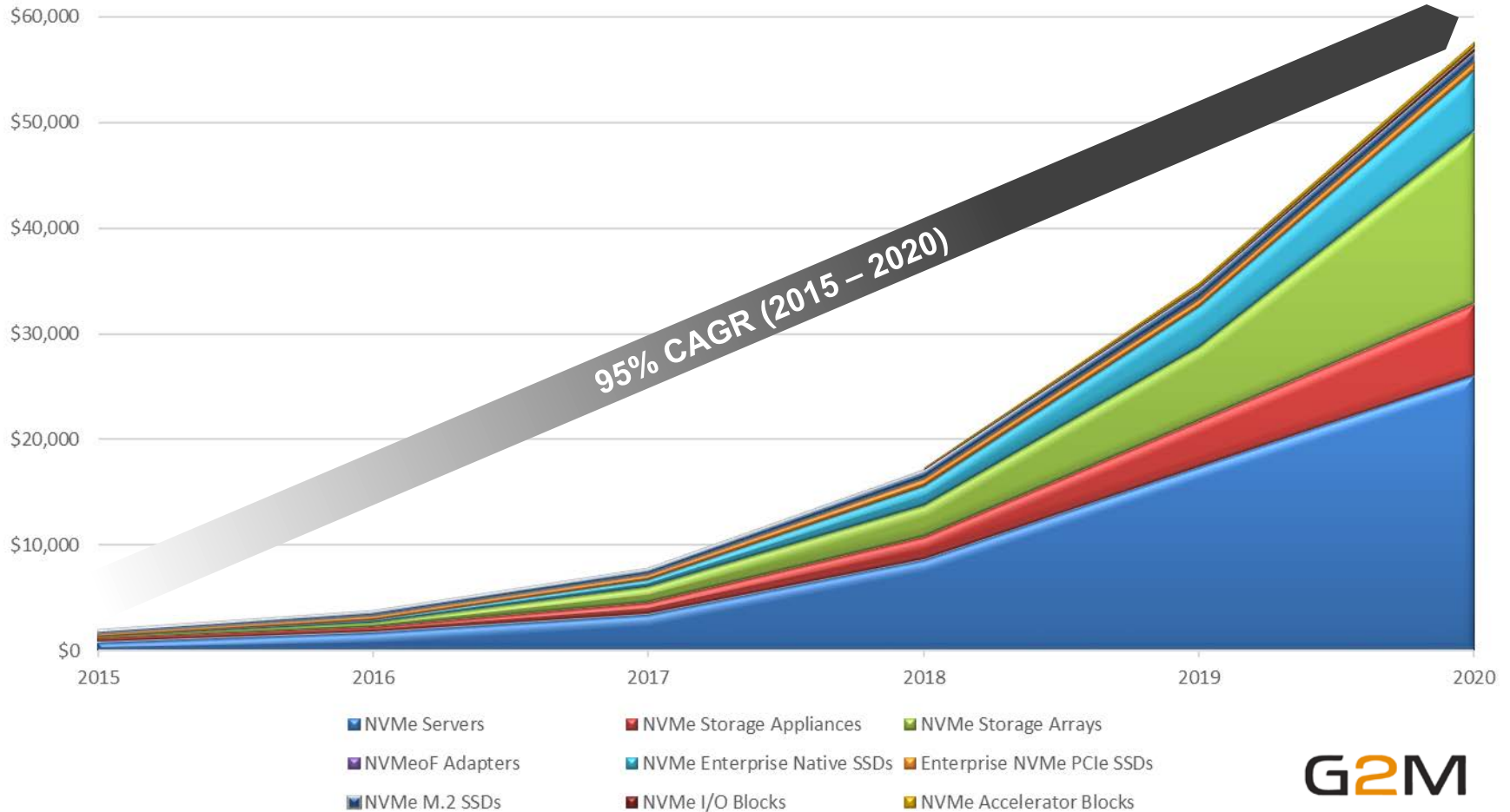
**NVMe SSD
& SATA
Parity**

NVMe SSD will reach price parity with SATA SSD by 2018

(The Intel push on NVMe integrated infrastructure and SCM will drive cost down)

Total NVMe Ecosystem \$57B by 2020

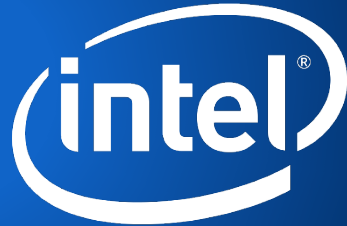
G2M NVMe Ecosystem Market Report 2016



The Evolution of NVMe in Servers

Intel Driving NVMe

- 3D NAND SSD
- NVMe integrated into systems
- 2017 will be a pivotal year for NVMe



NVMe to be 50% of Drive Bays

- Closer to the CPU reduces latency
- Applications demanding the performance

50%

Of Server & appliance drive bays will be NVMe by 2020

5.5 Bays/Server Chassis

- By 2020, servers and storage servers will have 5.5 drive bays per chassis
- Capacity growth will keep this number flat through 2020



Top OEMs & ODMs Driving NVMe



Lenovo



SUPERMICRO

NVMe Based Software Defined Storage

- ❑ 60% of Software Defined Storage servers will have NVMe bays by 2020
- ❑ RDMA support for OpenStack and other SDS platforms will push SDS server growth
- ❑ OS and Hypervisor vendors are leading the charge to native SDS solutions
- ❑ Hyper-Convergence and NVMe-oF will challenge the performance leadership of external arrays

vmware®

Microsoft

redhat


SUSE

openstack™

NUTANIX

simplivity™

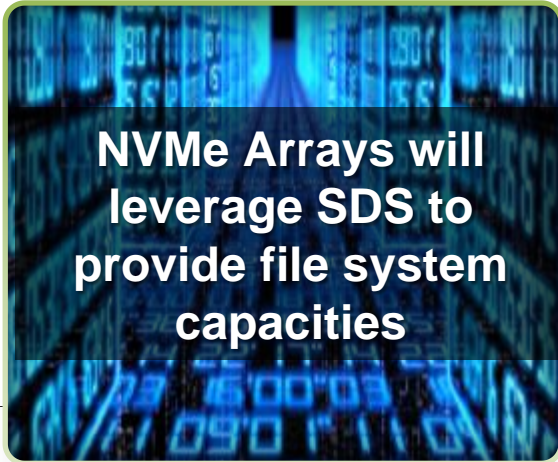
The Evolution of NVMe Storage Arrays



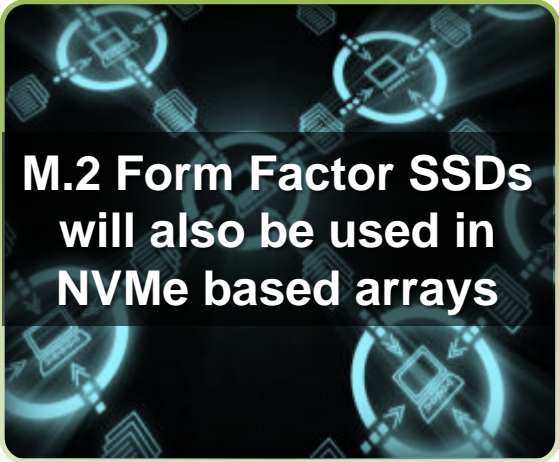
**40% of All-Flash
Arrays will ship
NVMe by 2020**



**30% of NVMe Array
Vendors will deploy
custom flash modules**



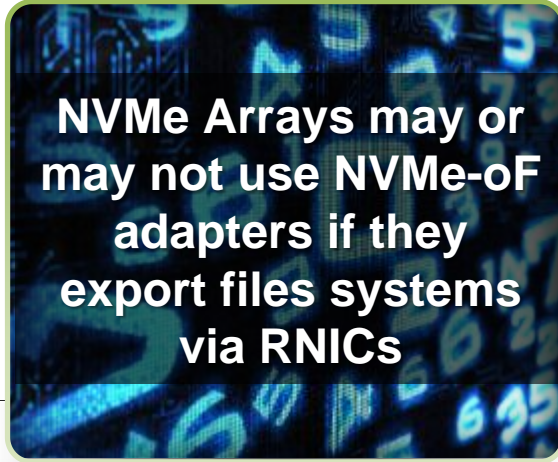
**NVMe Arrays will
leverage SDS to
provide file system
capacities**



**M.2 Form Factor SSDs
will also be used in
NVMe based arrays**



**NVMe Flash Arrays
will set the new
standard for high
performance and low
latency**



**NVMe Arrays may or
may not use NVMe-oF
adapters if they
export files systems
via RNICs**

NVMe – Accelerating SSD Apps & Adoption



**30M NVMe SSD Devices
will be shipped in 2020**

25M NVMe U.2 based NVMe drives will ship in 2020 enterprise & HCI

5M NVMe M.2 based drives will ship in 2020 driven by cloud & embedded

NVMe will be the same prices and SATA SSD by the end of 2017

New SCM and Flash options promise to lower price and increase speeds

NVMe-oF – Ethernet, Fibre Channel & InfiniBand



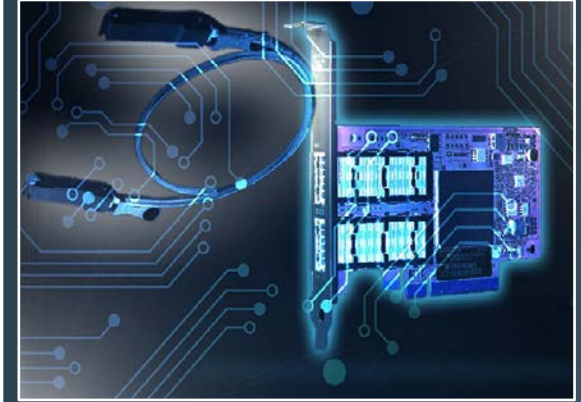
Ethernet NVMe-oF

- Ethernet with RDMA will be over 70% of shipments
- Scale-out SDS will use NVMe to challenge arrays
- Mellanox is leading right now with RDMA/RoCE
- Broadcom, Chelsio have announced products



Fibre Channel NVMe-oF

- Life extension for Fibre Channel & legacy Storage
- Broadcom, Brocade and Cavium look to 2017 GA
- Target array changes will be 2018/19 time frame



InfiniBand NVMe-oF

- Mellanox has not announced a product
- Given their storage cluster inter-connect business this could be interesting
- Wait and see right now

NVMe – Life Finds A Way

- ❑ A New World of Options
 - ❑ Ethernet networking
 - ❑ Storage I/O port
 - ❑ NFV & SDx
 - ❑ Fan-In ports
 - ❑ Edge analytics (IoT)
 - ❑ Network monitoring
 - ❑ Security
 - ❑ GPU clusters
 - ❑ Console management
 - ❑ Embedded applications
 - ❑ Military



Don't Bet Against Innovation

- Never underestimate creativity
- NVMe Bays moving to x8
- Aggregate Multiple NVMe Bays
- Legacy Lives On...

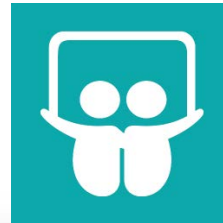
Final Thoughts

- ❑ NVMe adoption in servers, storage appliances, and storage devices will be rapid.
 - ❑ It is driven by the economics of the consumer and hyperscale markets; the enterprise will rapidly follow.
 - ❑ NVMe adoption in AFAs will also be rapid but will lag storage appliances, which will drive AFA adoption.
- ❑ NVMe will become the dominant interface for flash storage devices well before 2020.
 - ❑ Simpler and higher performance than SAS or SATA
 - ❑ Again, driven by the consumer and hyperscale markets.
- ❑ NVMe-oF will be dominated by Ethernet-based adapters.
 - ❑ Fibre Channel will pick up NVMe as a way to stay relevant (at least for a little while more).
 - ❑ InfiniBand NVMe-oF will be limited to the upper end of the HPC market.
- ❑ New devices will emerge that will plug into NVMe 2.5” drive bays (“NVMe bays”)
 - ❑ I/O “blocks” where front-panel, hot swappable I/O is critical.
 - ❑ Accelerator “blocks” to provide functions such as classification, filtering, and encryption.

Contact Information

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