Is FC-NVMe Ready for Prime Time?

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Today's Presenters

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Moderator

About the FCIA

The Fibre Channel Industry Association (FCIA) is a mutual benefit, non-profit, international organization of manufacturers, system integrators, developers, vendors, industry professionals, and end users:

- Promotes the advancement of Fibre Channel technologies and products that conform to the existing and emerging T11 standards
- Maintains resources and supports activities to ensure multi-vendor interoperability for hardware, interconnection, and protocol solutions
- Provides promotion and marketing of FC solutions, educational awareness campaigns, hosting public interoperability demonstrations, and fosters technology and standards conformance
- FCIA provides market direction to the INCITS T11 Task Groups

This presentation is sponsored in cooperation with the FCIA Education Committee

https://fibrechannel.org/

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FIBRE CHANNEL INDUSTRY ASSOCIATION

What This Presentation Is

- A follow on to previous FCIA BrightTalk courses on FC-NVMe
  - Introducing FC-NVMe
  - FC-NVMe Deep Dive
- A review of FC-NVMe industry standards and readiness events
- A high level, vendor neutral report of FC-NVMe products in the marketplace
- A review of various performance findings
- Implementation Considerations

What This Presentation Is *Not*

- **A technical deep-dive on Fibre Channel or NVMe over Fabrics**
  - Please review our other FCIA webcasts
- **A comprehensive list of solutions**
- **A competitive comparison of other technologies**

Agenda

- NVMe over FC overview
  - Previous trainings (Intro to FC-NVMe, FC-NVMe Deep Dive)
  - Review of benefits
- Standards overview – where are we today?
  - Standards timelines
  - Plugfest readiness events
- NVMe/FC Ecosystem
  - OS vendors, HBAs, Switches, Storage
  - Details of availability
- Solution Performance

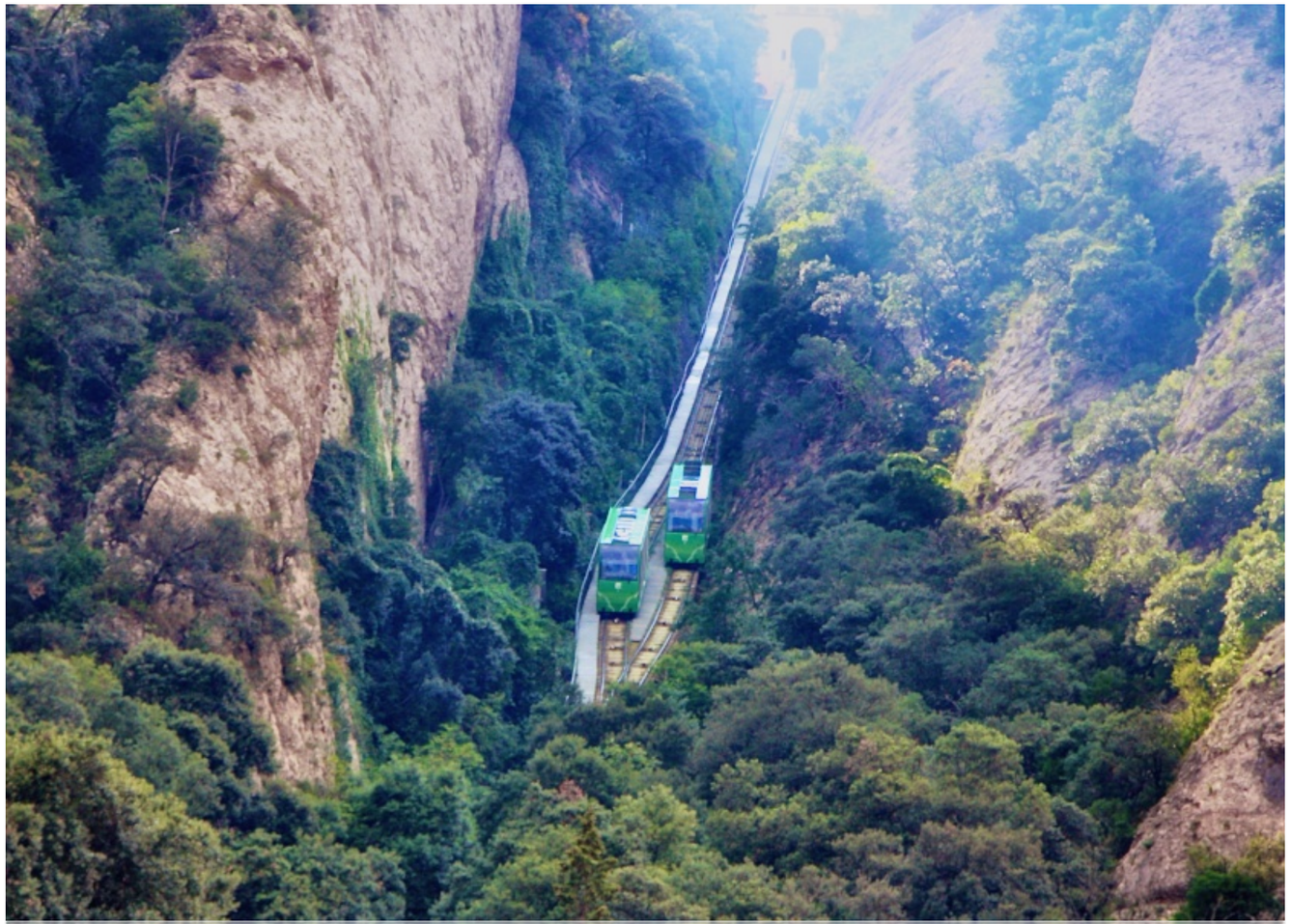
NVMe over Fibre Channel Overview

Top 5 Reasons FC-NVMe Might Be The Right Choice

1) **Dedicated Storage Network**

Top 5 Reasons FC-NVMe Might Be The Right Choice

1) Dedicated Storage Network
2) Run NVMe and SCSI Side-by-Side



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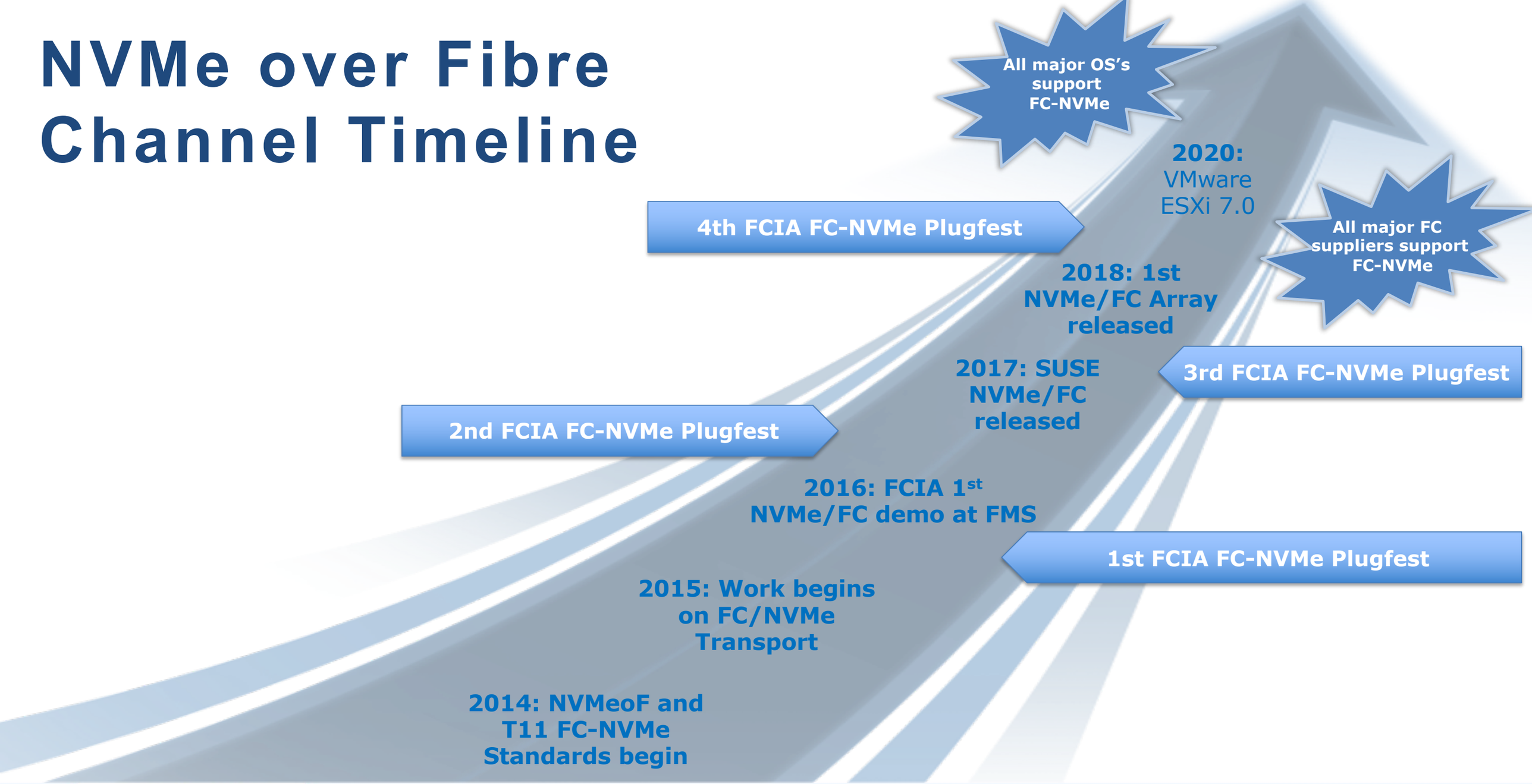
1) Dedicated Storage Network
2) Run NVMe and SCSI Side-by-Side
3) Robust and battle-hardened discovery and name service
4) Zoning and Security
5) Integrated Qualification and Support

Standards Evolution and Preparing for Readiness

NVMe over Fibre Channel Timeline



Plugfests

- FCIA has hosted four FC-NVMe Plugfests
  - Attendance and leadership by all major Fibre Channel vendors
  - Focus on the Fibre Channel aspects of NVMe over Fabrics connectivity
  - Adherence to INCITS T11 FC-NVMe specification
  - Multivendor interoperability
  - FC-NVMe Compatibility of concurrent operation of existing FCP products from multiple vendors at multiple speeds.
  - “Large Build” combining HA fabrics for failover and performance testing

FC-NVMe Ecosystem

NVMe over Fibre Channel Seamlessly Extends Enterprise Storage

Efficient Concurrency (FCP & NVMe packets) on Existing Fibre Channel SANs

Server

- Performance improvement is via a shorter path through the OS storage stack with NVMe™ & NVMe-oF™
- **Latency Improvements**

Front of Storage Array

- Performance improvement is a shorter path through the target stack
- **More performance with same hardware**

Back of Storage Array

- Performance improvement is by moving from SAS/SATA drives to NVMe SSDs
- **Media latency drops from 100us to 10's of us**

FC-NVMe Enterprise-class Storage Services

The only NVMe-oF enterprise fabric to deliver a complete solution

Feature	FC-NVMe
Low latency network	✓
Credit based lossless network[2]	✓
Centralized discovery[2]	✓
Zoning and isolation[2]	✓
State-change notifications[2]	✓
Storage network topology auto-discovery[2]	✓
Fabric Authentication[2]	✓
Sequence level error recovery	✓
Concurrent NVMe and SCSI support	✓
Feature equivalency between NVMe and SCSI	✓
Fabric Notifications	

[2] Documented by NVM Express (NVMe 1.3, TPAR 8006, TPAR 8009)

It Takes a Village to Get FC-NVMe to Prime Time!!

Ecosystem?	Change?
Application	No Change
Operating System - Multi Pathing Interface, NVM over Fabrics Stack, FC HBA Drivers	OS Upgrade
FC HBAs	Software Upgrade
Cables	No Change
FC Switches - Switch Hardware, SAN Management Software	No Change
Storage Arrays	OS Upgrade, New HW

FC-NVMe on the Server

“NVMe” Over Fibre Channel

Non-Volatile Memory “Express”

- Concurrent FCP and FC-NVMe
- New 16GFC and 32GFC HBAs
- Certified and Inbox Drivers
- Leverage Existing Investments in Fibre Channel – Just upgrade HBA SW/FW
- Multi-Pathing Software Available
- All Major Operating Systems NEW

NVMe Over Fibre Channel OS Support

NEW!

- SLES12 SP4 and newer
- RHEL 7.6 and newer
- Non-Native Drivers for Windows
- ESXi 7.0 and newer

NVMe/FC is supported by all the major HBA vendors

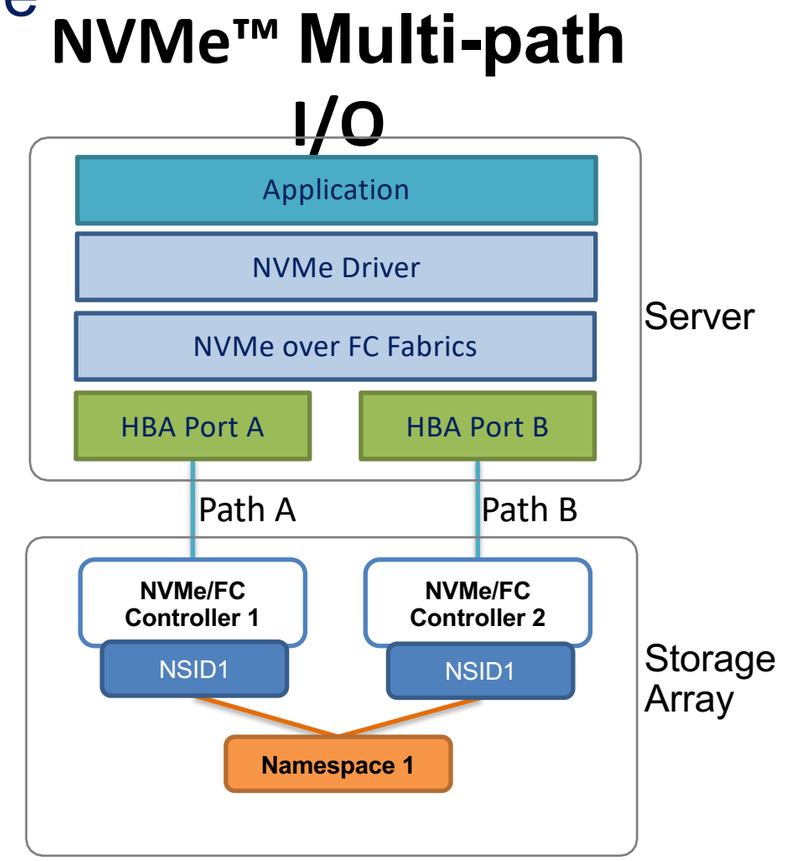
Upgrade to latest Firmware/Driver per HBA vendor requirements

In some cases the NVMe/FC feature may need to be enabled

FC-NVMe High Availability (MPIO)

Architecture used in Linux (SUSE, UEK, RHEL) and VMware

- NVMe™ Standard defines multi-path I/O to the same namespace
  - Optimized submission and completion queues
  - Multi-path is handled in the kernel NVMe driver
  - Applies to any transport supported by NVMe-oF
  - Multi-path I/O is a native and integrated feature of the OS
- NVMe AEN (Asynchronous Event Notifications) – optional feature
  - Enables the storage device to tell the host when things change
  - Such as the size of a name space, or a new name space
- NVMe ANA (Asynchronous Namespace Access) – optional feature
  - Enables the storage array to tell the OS which are the preferred paths to be used for multi-path I/O, and when they change



Reference: https://nvmexpress.org/resources/specifications/

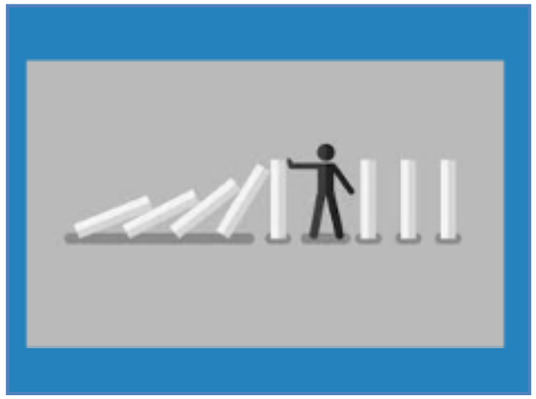
FC-NVMe – Delivers NVMe Natively

Traditional FC SAN Applications

Low Latency FC SAN Applications

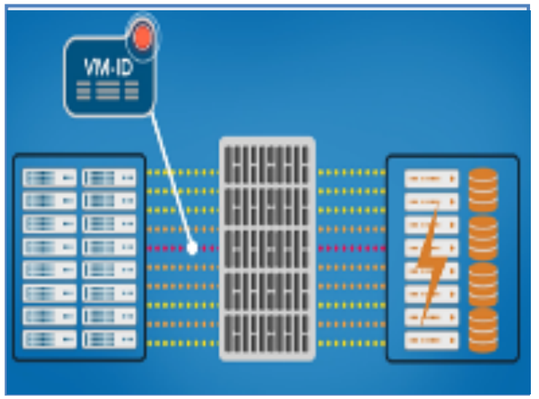
SAN / FC-NVMe E2E Services

Resilience

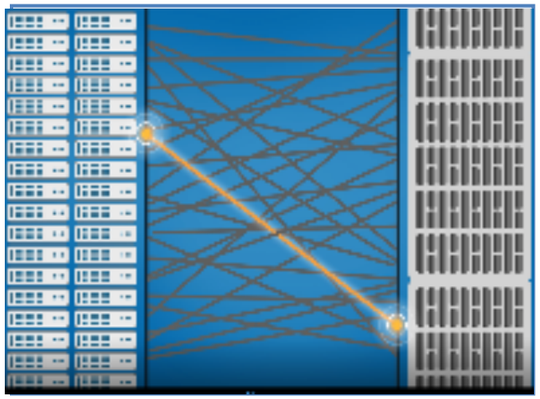


Deployment

Performance



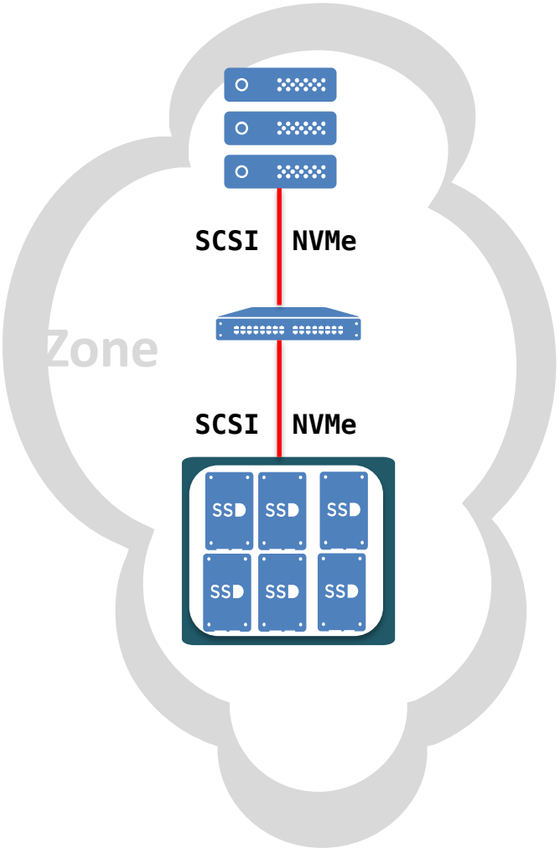
Availability



HBAs ⟷ Switches ⟷ Targets

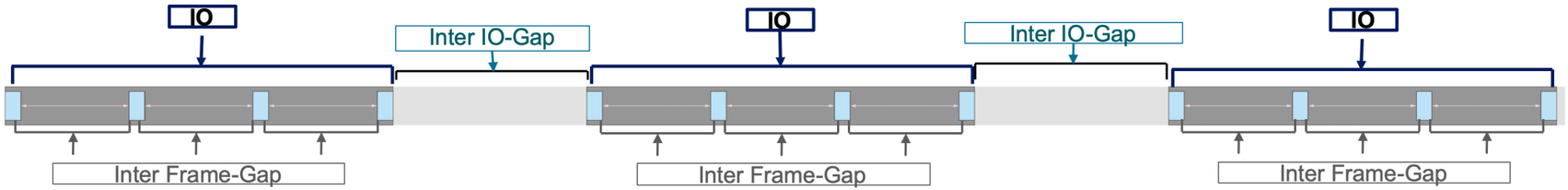
Existing SANs are Ready for FC-NVMe

- ✓ Concurrent Transport of SCSI and NVMe on same ports
- ✓ All Gen 5 and Gen 6 Fibre Channel switches support FC-NVMe
- ✓ Same Provisioning Model
- ✓ Same Monitoring and Analytics Tools
- ✓ Zero Learning Curve and Minimal Risk with FC-NVMe

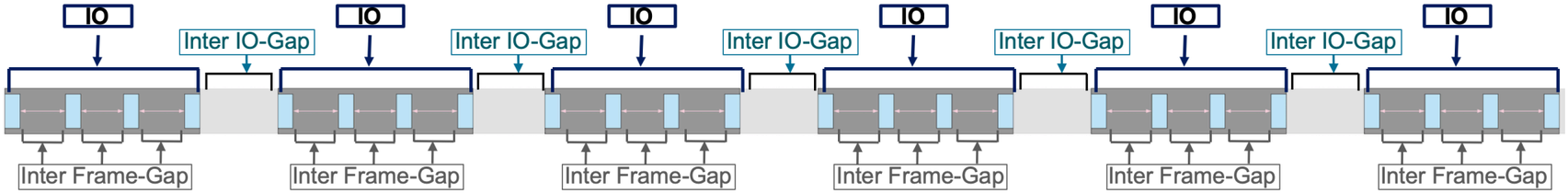


Decreasing Network Idle Times

HDD Array (SCSI)



SSD Array (SCSI)



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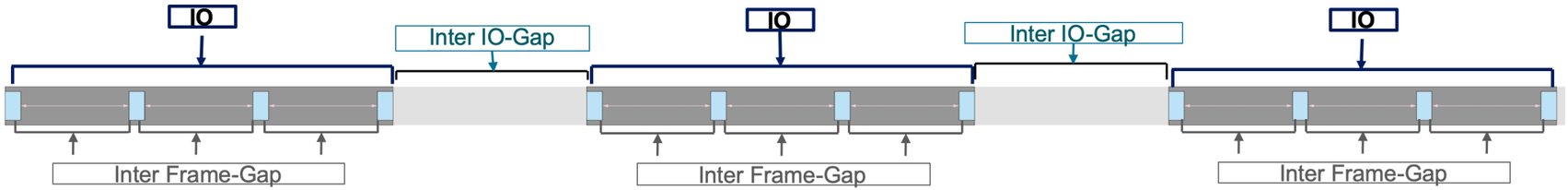

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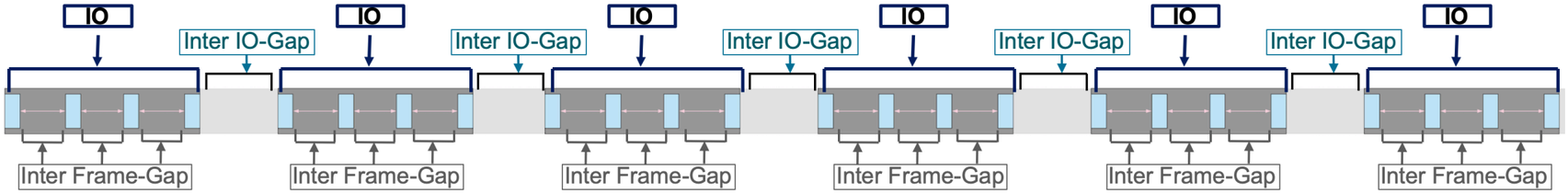
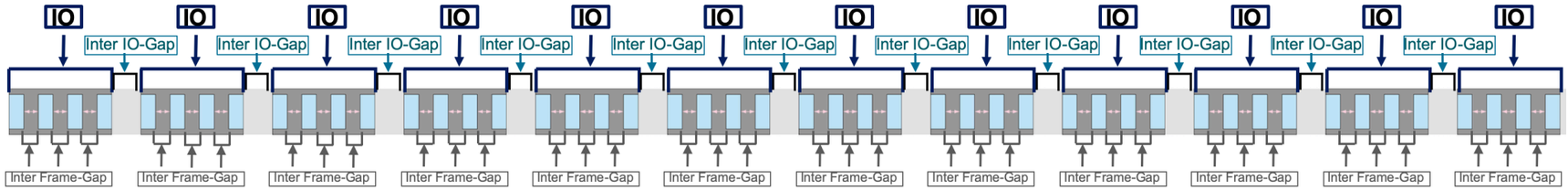
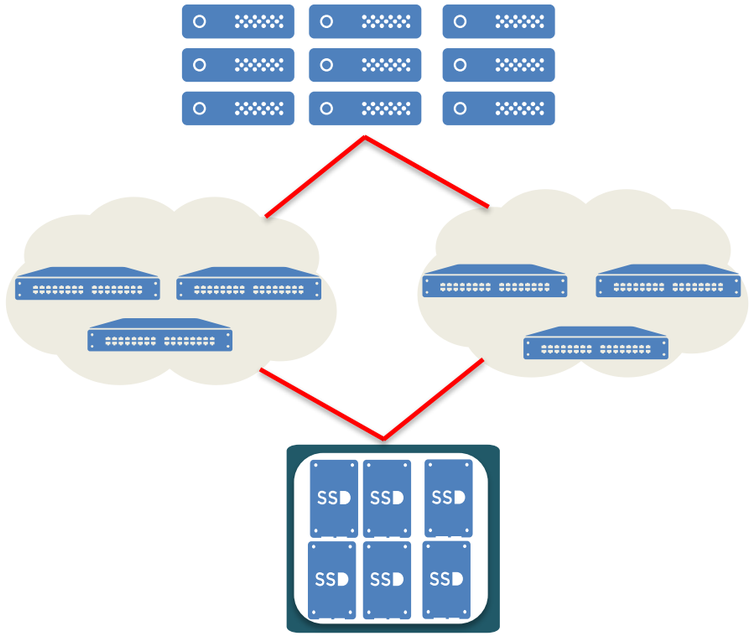


SSD Array (NVMe)



Key Fibre Channel SAN Differentiators

- ✓ Inherently Lossless Network
  - ✓ Purpose built and optimized for storage traffic
- ✓ Redundant Network Deployment Architecture
  - ✓ MPIO adept hosts and storage
- ✓ Complete Fabric Services
  - ✓ OPEX efficient scalability
- ✓ Standards Based Diagnostics and Remediation
  - ✓ End-to-end across hosts, switches and storage



Strong Ecosystem Commitment

Operating Systems

- VMware
- Linux
- Windows Server
- SUSE
- Red Hat

Servers

- Dell Technologies
- Cisco
- IBM
- Hewlett Packard Enterprise
- Lenovo

Host Bus Adapters

- Broadcom
- Marvell

Fibre Channel Switching

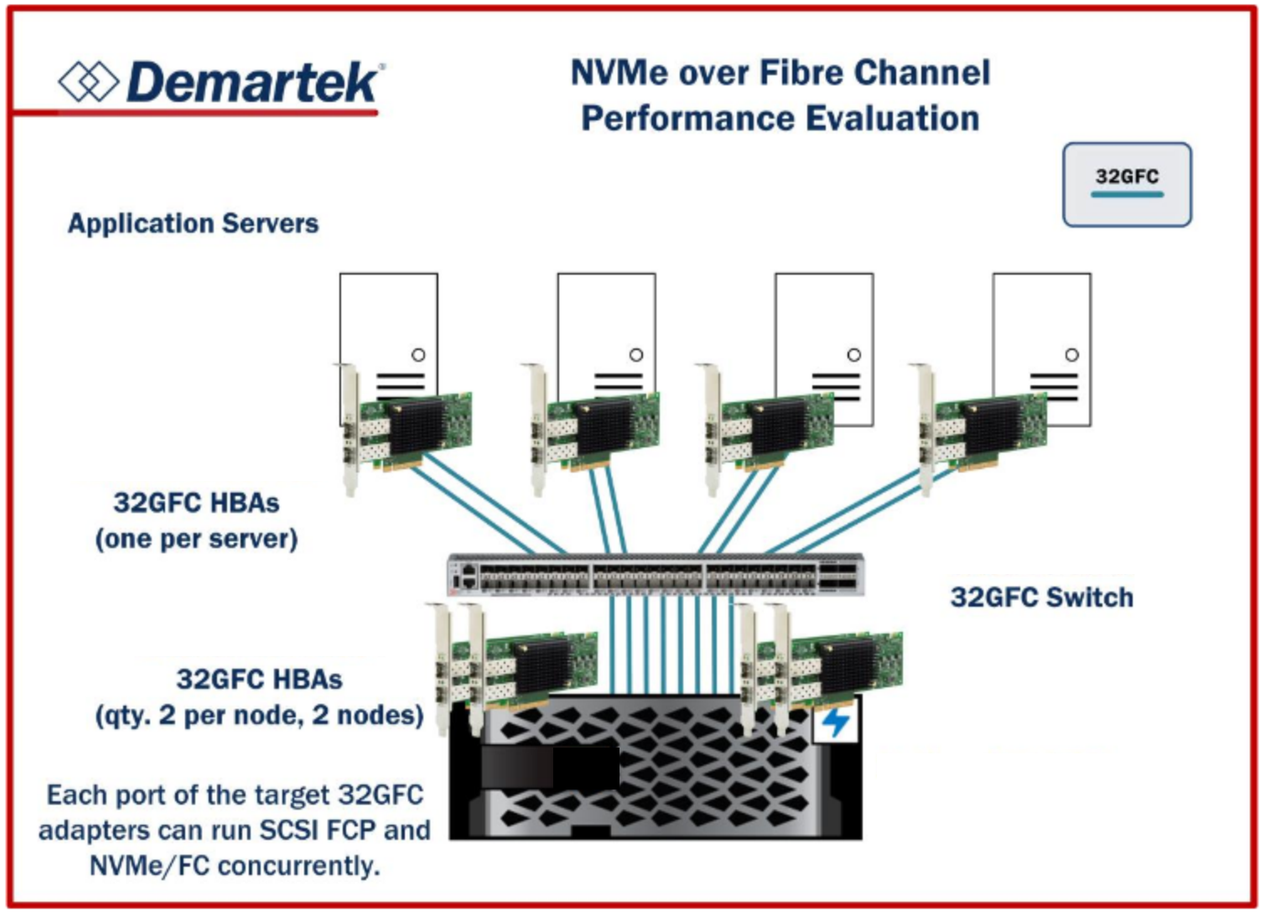
- Cisco
- Brocade (A Broadcom Company)

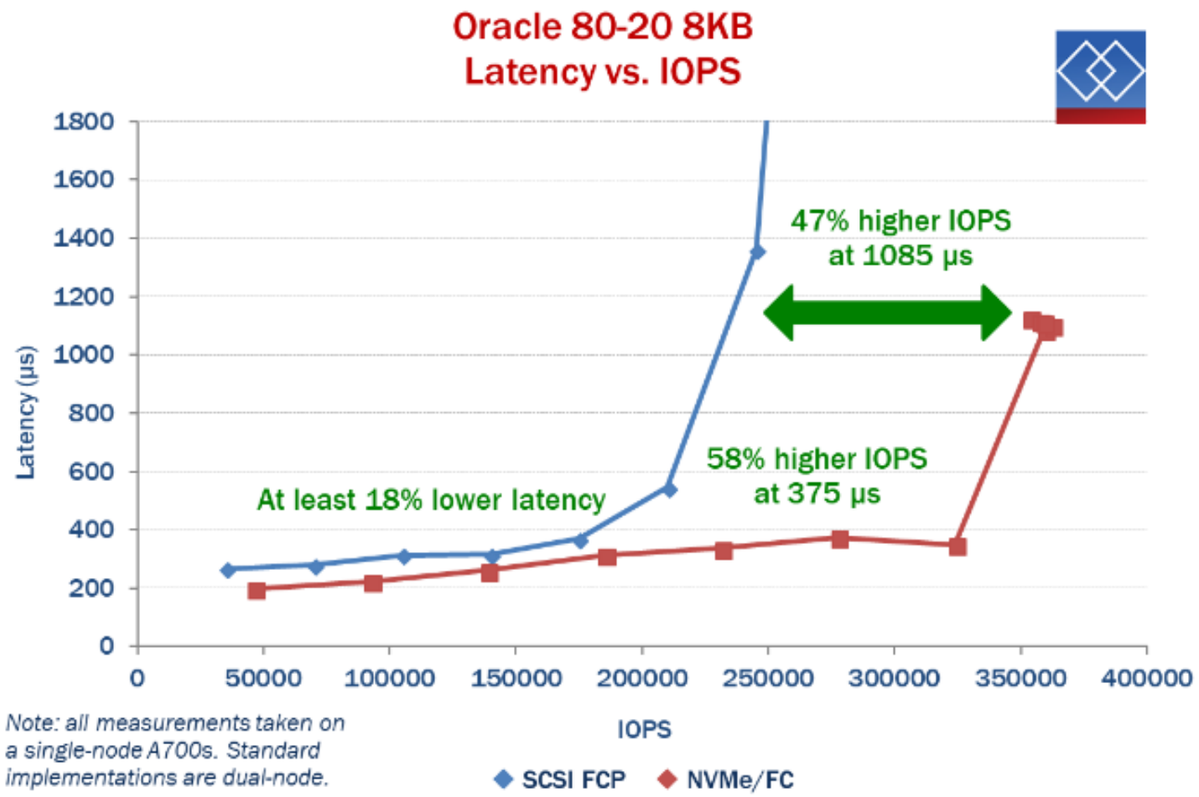
Disk & Flash Storage Arrays

- Dell EMC
- NetApp
- IBM
- Hewlett Packard Enterprise
- Hitachi (Inspire the Next)

FC-NVMe Applications

FC-NVMe Leads in Performance

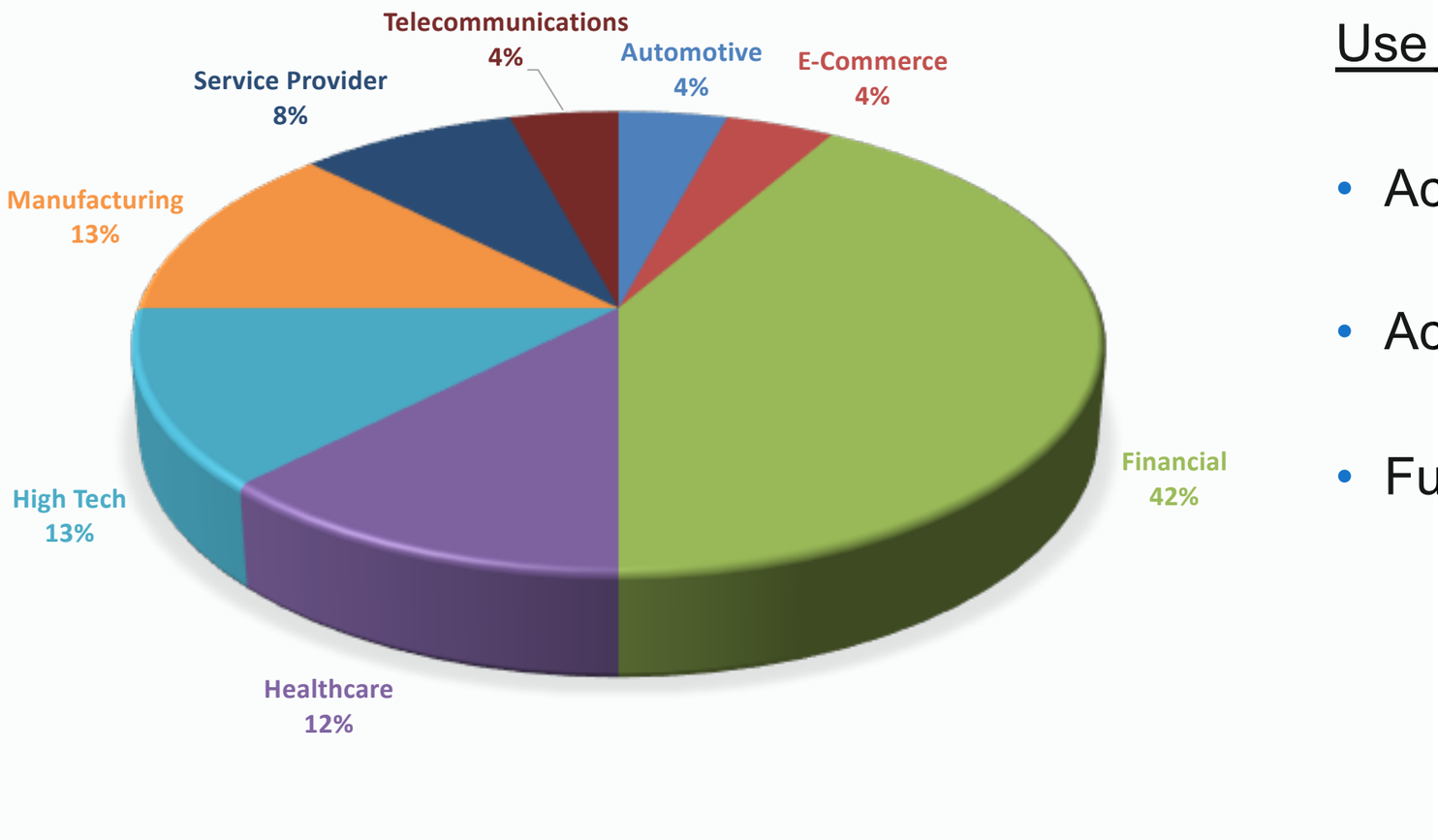




[Performance Benefits of NVMe™over Fibre Channel–A New, Parallel, Efficient, Protocol]

FC-NVMe Adoption

Customers Testing and Deploying FC-NVMe



Use cases:

- Accelerate business critical application
- Accelerate Oracle and SQL application
- Future proofing and Investment protection
  - VM density increase on hypervisor
  - New advanced applications

Webinar: Real World Performance Advantages with NVMe over Fibre Channel June 11, 2019.

NVMe over Fibre Channel Readiness Checklist

- Server Operating Systems
  - All major operating systems supported
- HBAs
  - Available from all HBA vendors
- Switches
  - All switch vendors support FC-NVMe
- Storage
  - Most array vendors offer FC-NVMe today

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  - FC-NVMe
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  - FCIP (Extension): Data Protection and Business Continuity
  - Fibre Channel Performance
  - FICON
  - Fibre Channel Cabling
  - 64GFC
  - FC Zoning Basics
  - Fibre Channel Standards

Thank You