Improving App Performance and Protection for VMware: NVMe, Cloud and Beyond

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| Agenda |
|------------------|------------------|------------------|
| **Introduction to NVMe** | **Benefits of NVMe on VMware environments** | **Data protection advances for VMware environments** |
| **• NVMe** | **• Converged** | **• Cloud** |
Introduction to NVMe
**INTRODUCTION TO NVMe**

What is NVM and NVMe

**NVM**

is non-volatile memory media

- NAND-based flash
- Storage Class Memory (SCM) media technologies such as 3D XPoint™

**NVMe**

(Non-Volatile Memory Express)

- A set of standards which define a PCI Express (PCIe) interface used to access data on NVM
- Takes advantage of modern CPUs and SSDs
- Replaces older storage protocols
- NVMe unlocks up to 65536 queues, up to 65536 commands per queue

**Standard**

developed by an open industry consortium

Directed by a 13 company promoter group which includes Dell

**Core design**

objective to achieve high levels of the following

- Parallelism
- Concurrency
- Scalability
Conceptualizing NVMe

**HDD + SCSI/SAS**
- HDD: varying speed conveyor belts carrying data blocks (faster belts = lower seek time & latency)
- SCSI / SAS: pick & place robot with tracked, single arm executing 1 command at a time, 1 queue

**Flash + SCSI/SAS**
- Flash: all data blocks available at the same seek time & latency
- SCSI / SAS: pick & place robot with single arm executing 1 command at a time, 1 queue

**Flash + NVMe**
- Flash: all data blocks available at the same seek time & latency
- NVMe / PCIe: pick & place robot with 1000s of arms, all processing & executing commands simultaneously, over 64K queues

**Introduction to NVMe**

- Flash + SCSI/SAS: all data blocks available at the same seek time & latency
- NVMe / PCIe: pick & place robot with 1000s of arms, all processing & executing commands simultaneously, over 64K queues

*Concept attribution: J Metz, “The Data Robot Parable”*
Storage technology transitions

**MEDIA**
- Transitions
  - HDD: 7K, 10K, 15K
  - NAND FLASH: SLC, MLC, TLC
  - SCM: e.g. 3D XP

**DRIVE INTERFACE**
- Transitions
  - PARALLEL: SCSI & ATA
  - FIBRE CHANNEL
  - SAS & SATA
  - NVMe

**HOST INTERFACE**
- Transitions
  - SCSI
  - FIBRE CHANNEL
  - NVMeoF
SCM FILLS THE GAP, NVME IS THE PATH TO GET THERE

Addresses latency / capacity gap between DRAM and NAND SSDs

<table>
<thead>
<tr>
<th>Relative capacity</th>
<th>Access Latency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1ns</td>
<td>Processor SRAM</td>
</tr>
<tr>
<td>10ns</td>
<td>DRAM</td>
</tr>
<tr>
<td>100ns</td>
<td>Storage Class Memory (e.g., 3D XPoint)</td>
</tr>
<tr>
<td>1us</td>
<td>SSD (NAND Flash)</td>
</tr>
<tr>
<td>10us</td>
<td></td>
</tr>
<tr>
<td>100us</td>
<td></td>
</tr>
<tr>
<td>1ms</td>
<td>HDD</td>
</tr>
<tr>
<td>10ms</td>
<td></td>
</tr>
</tbody>
</table>

NVMe unlocks the power of SCM

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Maximizing the Performance of a Multi-Controller Architecture

NVMe Unlocks the Power of Next Gen Media

SAS DISK ERA

- Multi-controller Architecture with Multi-core CPUs
- SAS Protocol
- SAS NAND Flash Drives

NVMe MODERN ERA

- Multi-controller Architecture with Multi-core CPUs
- NVMe Protocol
- NVMe NAND Flash Drives
- Storage Class Memory*

*SCM Drive coming soon
Flash becomes mainstream storage

- Flash/SSD lowered cost ($/GB) over time make AFA mainstream data center solution
- SSDs true potential not exposed because legacy protocols were designed based on older technology single core CPU, slow HDD + fast volatile memory (DRAM)

Emergence of NVMe

- NVMe designed from ground to use flash. Protocol exposes the parallel nature of NAND in SSD to increase performance and lower latency
- Common NVMe protocol & driver allow adoption of NVMe from multiple SSD suppliers and across multiple OS
**NVMe host connectivity**

**Simplest** - an NVMe card in a server, direct access to storage on the server or directly to array

**NVMe** over Fabric (NVMeoF)

**Fabric** can be any of the following:
- FC (most popular)
- Ethernet
- RoCE (RDMA over Converged Ethernet)
- iWARP
- InfiniBand
- Next Gen Fabrics
Why NVMe over Fabric

**BENEFITS**
End to end performance optimization
Enabler for high performance shared storage

**IMPLEMENTATION**
Thin encapsulation, no translation
Uses existing Fibre Channel (32Gb/s) and co-exists with FC SCSI

**USE CASES**
IO parallelization and low latency
Investment protection and increased scale

![Diagram of NVMe HBA, NVMe SSDs, NVMe Array Controller, and FC Fabric connections with PCIe Connections.](image)
Future Proof NVMe

✓ MULTI-CONTROLLER

✓ END TO END NVMe
  • NVMe over Fabric Ready*
  • NVMe based drives (dual ported)
  • NVMe based DAE

✓ INDUSTRY STANDARD TECHNOLOGY

*Coming early 2019
ENTERPRISE STORAGE STATE OF THE ART – 2012

Slide credit: Intel and NVM Express
Source: Storage Technologies Group, Intel. Comparisons between memory technologies based on in-market product specifications and internal Intel specifications.
Slide credit: Intel and NVM Express
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Slide credit: Intel and NVM Express
Source: Storage Technologies Group, Intel. Comparisons between memory technologies based on in-market product specifications and internal Intel specifications.
RANDOM READS: POWERMAX 8000 VS. VMAX 950F

8K Random Read Hit
ONE Engine 950F
ONE Brick PowerMax 8000

50% More RRH IOPs!

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DSS WORKLOAD: POWERMAX 8000 VS. VMAX 950F

128K DSS ONE Engine 950F ONE Brick PowerMax 8000

25% More Throughput

ms Response Time vs. IOs/sec

VMAX 950F
PowerMax 8000

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NVMe VMware benefits

- **vSAN**: NVMe controllers available
- **Virtual Volumes**: Higher VM Density
  - Consolidation
- **Virtualized Databases**: Backup & Recovery
Where NVMe makes sense

- Highly virtualized environments requiring high IOPS and low latency
- Large Oracle / SAP deployments
- Real time data processing and analytics
  - Factory control / SCADA systems
  - Data warehousing
  - High end trading applications
  - Oil and Gas
- Large scale web services
- Less applicable
  - Cache friendly workloads (higher % of read hit / write hit)
  - Workloads which don’t tax backend storage such as Microsoft Exchange
ADVANCES IN DATA PROTECTION TO MAKE YOUR LIFE EASIER

NVMe and converged
State of data protection today

CHALLENGES

- Increase in data volumes, users, apps
- Cloud extensibility
- Do more with less

REQUIREMENTS

- Simplicity for quick time-to-value
- Efficient cloud enablement
- Low cost-to-protect
- High performance
Higher performance

**Instant Access and Restore of Virtual Machines**

**Use of backup storage appliance for test dev**

**Faster with NVMe™ flash**

Spinoff VMs directly in backup storage
INTEGRATED DATA PROTECTION APPLIANCE DP4400

Simplicity in a Converged Solution

2U and 10x\(^1\) faster to deploy

Easy to deploy & upgrade

Lower total cost to protect

Easier to manage

Backup servers & storage

24TB–96TB

+192TB with

without additional HW

Highest density 2U

Backup software

System management

NVMe flash

Search & analytics\(^2\)

Cloud DR + LTR

Simpler to deploy

Days

Easier to manage

Hours

Simpler to deploy

INTEGRATED DATA PROTECTION APPLIANCE DP4400

24TB–96TB

+192TB with

without additional HW

Highest density 2U

1Based on Dell EMC internal testing. May 2018, compared to traditional deployments. Actual results will vary.

2Search feature only for file system backup data, not VMs or databases
### Integrated Data Protection Appliance DP4400

**Power is Performance & Efficiency**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Powered by</td>
<td>14G PowerEdge Server</td>
<td>Up to 2X faster backups&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>Source-side deduplication</td>
<td></td>
<td>98% less bandwidth required&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>NVMe flash for instant access &amp; restore</td>
<td></td>
<td>7X more backup streams&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>Boosted application-direct protection</td>
<td></td>
<td>55:1 Avg dedup&lt;sup&gt;3&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

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<sup>1</sup> ESG Lab Review commissioned by Dell EMC, February 2018, versus a competitive Vendor A. [Additional information](#) on the testing environment.

<sup>2</sup> Based on Dell EMC internal analysis as of June 2018.

<sup>3</sup> Based on Dell EMC internal analysis of customer data as of May 2018.
INTRODUCING

Integrated Data Protection Appliance DP4400

Simply Powerful.

@ Lowest cost-to-protect.¹
Guaranteed.²

Ideal for mid-size organizations and remote/back office environments

¹Dell EMC internal analysis using publicly available competitive pricing, May 2018. Lowest cost-to-protect is based on $ per logical GB. Actual cost will vary.
²3 year satisfaction guarantee, hardware investment protection, clear price framework and up to 55:1 data protection deduplication guarantee under the Dell EMC Future Loyalty Program
What about Cloud
Data Protection to Cloud

Current State

**COMPLEXITY**

- Multiple data siloes
- Multiple solutions/management consoles
- Multiple vendors/support organizations

**EVOLUTION OF DATA PROTECTION TO THE CLOUD**

Backup to Cloud

- Clients
- S3/https
- VMs

LTR to Cloud

- Policy
- S3/https

DR to Cloud

- Clients
- S3/https
- VMs

Protect in Cloud

- Public/
- Private/Hybrid/
- DPaaS
- Applications
- Databases
- Files
Transformed Data Protection

Ideal State

SIMPLICITY

Single solution that can span data protection from on-premises, direct to cloud, and workloads in the cloud
Integrated and optimized for in-cloud data protection
One vendor and support organization

SINGLE MANAGEMENT INTERFACE

Backup to Cloud

Clients ➔ S3/https ➔ VMs

LTR to Cloud

Policy ➔ S3/https ➔ VMs

DR to Cloud

Clients ➔ S3/https ➔ VMs

Protect in Cloud

Public/Private/Hybrid/DPaaS

Applications Databases Files
DELL EMC DATA PROTECTION

Transform through the Cloud

Backup/Long Term Retention
Disaster Recovery
VMware Cloud on AWS
In Cloud Workloads

Support for all phases of your journey to the cloud

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VMware Cloud on AWS

**Solution**
- Enterprise-grade data protection for hybrid cloud workloads
- Increased resiliency for VMware workloads running on AWS cloud

**Benefits**
- Integration with on-premises data protection simplifies administration
- Best-in-class deduplication lowers cloud consumption costs
- Deep management tool integration automates operations
- Dell EMC Data Protection Bundle (DP Software + DD VE) makes it easy to add on to your VMware Cloud subscription

**1st Data protection solution for VMware Cloud on AWS**

VMware Cloud on AWS

vSphere integrated

Deduplication

Amazon S3 cost optimized

Up to 96 TB with DD VE

DELL EMC DATA PROTECTION

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Application consistent recovery to the cloud

On-Premises Production

AWS as DR Site

Orchestrated DR
- Test and failover to AWS
- Failback on-premises
- Recovery in minutes
- Multiple VMs DR Plans

Advanced Capabilities
- Eliminate DR Data center costs
- Application recovery to the cloud
- Deduplication to the cloud
- Up to 96 TB

Simple to operate
- Existing on-prem UI
- Direct in-cloud access
NEW - CLOUD DR TO VMWARE CLOUD ON AWS

Extend your DR to VMware Cloud on AWS

Efficient with End-to-End Orchestration

- Minimal cloud cost & footprint
- Simple to operate

Orchestrated DR
- Recover to VMware Cloud on AWS
- Recovery in minutes
- Multiple VMs DR Plans

VMware Cloud on AWS as DR Site
Protect to S3, Recover to VMware Cloud on AWS

- Protect directly to S3
- Deduplication to the cloud
- Up to 96 TB

- Existing on-prem UI
- Direct in-cloud access
- Recover to VMware Cloud on AWS
Software and Data Domain
Efficient, reliable and low cost backup

On Premises
- Optimized for virtual environments
- Provides application consistent backup
- Reduces backup time and network load
- Variable-length deduplication
- Daily full backups and one-step image recovery

In Cloud
- Reduce backup storage 10 to 30x
- Reduce network traffic by up to 98%
- Reduce backup times by up to 50%
- Incremental forever backups
- Instant access for VM recovery
GROWTH OF DATA PROTECTION AS A SERVICE (DPAAS)

In Cloud Data Protection

The market is ACCELERATING

27% CAGR growth rate*

24% 2018 year-over-year growth rate est*

Top managed services

58% Backup & recovery
44% Disaster/site recovery
44% 24 x 7 support
40% Mobile services
40% Archiving

*Technavio market research global backup as a service 2018-2022
Source: IDC’s Cloud and AI Adoption Survey, January 2018, N=400, Percent of Sample
vCloud Director Data Protection Extension

Simple, self-service data protection through an integrated tenant portal UI

Seamless Integration
• End-users can manage Data Protection for their virtual datacenters directly from the VCD Tenant Portal, without the need to login to a separate interface

Cost effective
• Industry leading deduplication minimizes backup storage costs for service providers

Performance and scale
• A scale-out architecture provides unparalleled levels of service performance
vCloud Director Data Protection extension

**vCloud Director Organization**
- Virtual Data Center
- Virtual Data Center Services

**vDC-Ohio**
- vApp 2
  - Exchange
- vApp N

**vDC-Iowa**
- VM 1
  - Client Access Svr
- VM 2
  - DB Available Group Svr
- VM 3
- VM N

**Cloud Admin**
- Define policy templates, publish to tenant catalogs
- Configure granular quotas on protected capacity
- Tenant repository assignment
- Configure backup replication

**Tenant Admin**
- Apply policies from catalog to vApps / VMs
- In-place restore of vApps or VMs
- Re-directed restore of vApps or VMs
- Self-service file-level recovery
- Monitor Backups
Seamlessly integrated tenant portal UI

Data Protection Service tab for embedded Data Protection (extension of vCD Client UI)
Seamlessly integrated tenant portal UI

vApp Restore Workflows
- Restore to new
- Restore to original

VM Restore Workflows
- Restore to new
- Restore to original
- File-level restore
Power is Built For VMware

Comprehensive Data Protection Integration with VMware

- vSphere Web Client
- vSphere vCenter
- VMware Cloud on AWS
- vCloud Director
- vRealize Log Insight
- vRealize Operations Manager
- vRealize Automation

Protect more VMs
- Simple, cost effective to scale to more VMs
- Faster backups and recoveries
PLEASE FILL OUT YOUR SURVEY.

Take a survey and enter a drawing for a VMware company store gift card.
POSSIBLE BEGINS WITH YOU

THANK YOU!

#vmworld
#HYP37059US