201 Level PowerStore Technical Introduction

99.9999% Availability

Ken Mizuochi
MDC/GTO

2020/5/28 v3

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DELL Technologies PowerStore

Designed for the data decade

Data-centric

Design optimizes performance, scalability and efficiency for any workload

Intelligent

Programmable, autonomous infrastructure that optimizes system resources and simplifies management

Adaptable

Flexible architecture, deployment and consumption models provide choice and investment protection

CONTINUOUSLY MODERN & HIGHLY ADAPTABLE ALL-FLASH STORAGE

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Best of Breed Capabilities in DELL Midrange Portfolio

6,600
Q2/CY17~

Speed
Data Reduction
Modern GUI

55,000
Q2/CY17~

Unified(Block+File)
vVols
Ease of Use

54,300
Q2/CY17~

Never Grow Old
Ease of Use
Federation

IP Storage
Scale-Out

Mainly new developed by using the
long experience from the existing solutions !

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PowerStore - Ready-to-Win

Rigorously Tested

110,000
TEST EXECUTIONS

12,000
UNIQUE TESTS

2,880
PERSON MONTHS TESTING

Extensive Beta

Many
BETA SITES

62
BETA PARTICIPANTS

Multiple
SYSTEMS ONSITE

10/28/19 ---------- **21 Weeks** ---------- 04/03/20

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PowerStore - Positioning

Focus on Storage intensive Workloads

VIRTUAL | PHYSICAL | FILE & OBJECT

Majority of VMs

Remainder of VMs

GENERAL PURPOSE
(COMPUTE INTENSIVE)

DATA INTENSIVE
(STORAGE INTENSIVE)

HCI Opportunity

3 Tier Opportunity

VxRail

"Buy"

+

PowerStore

"Build"

Three-Tier Architecture

PowerOne

"Buy"

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PowerStore - Any Workload

Traditional and modern workloads

RELATIONAL DATABASES | ERP | ELECTRONIC MEDICAL RECORDS | CLOUD NATIVE | CONTENT REPOSITORIES | HOME DIRECTORIES

FC | iSCSI | NVMe-oF* | NFS | SMB

LUN | VM | vVOL

Apps and Databases

Containers

FS | FS | FS

File

*NVMe-oF coming in a future release

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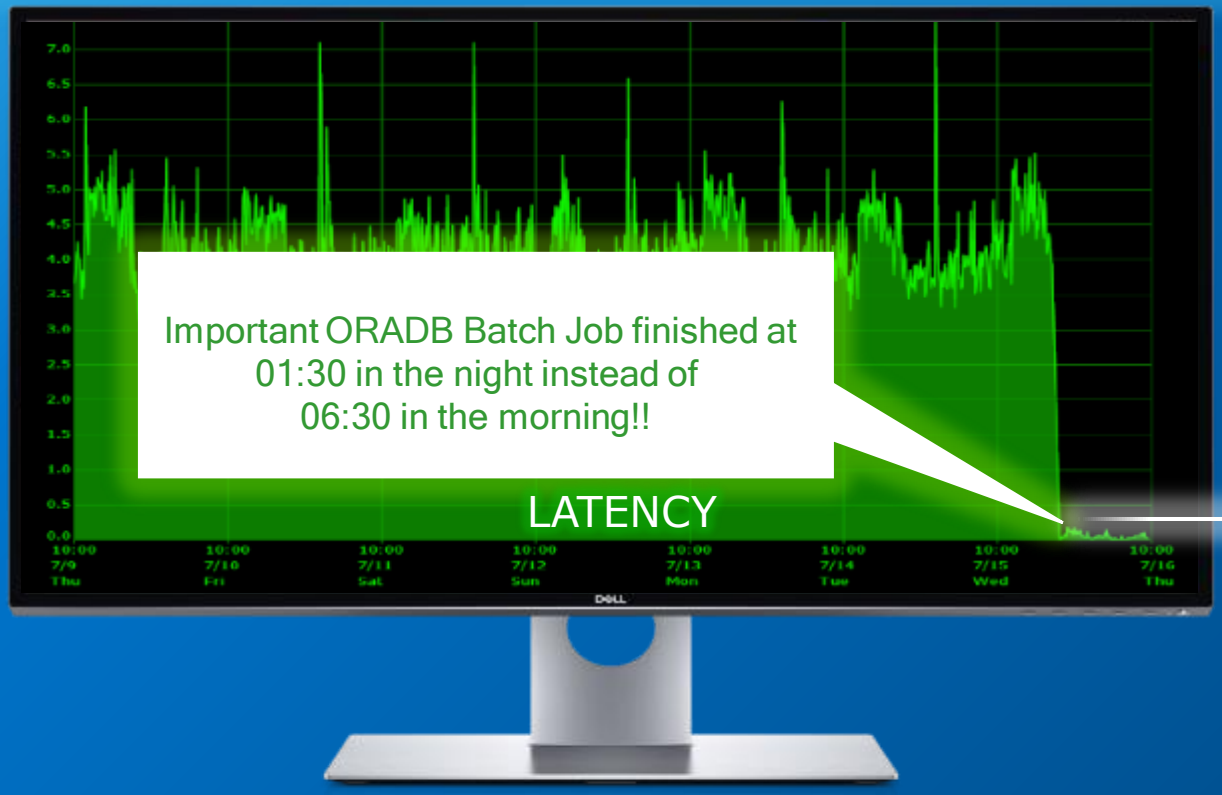
PowerStore - Sudden impact of AFA on Business Application

Before: Hybrid (All HDD+SSD)

5-7ms



Important ORADB Batch Job finished at 01:30 in the night instead of 06:30 in the morning!!

LATENCY

<0.5ms

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PowerStore Family

	PowerStore 1000T/X	PowerStore 3000T/X	PowerStore 5000T/X	PowerStore 7000T/X	PowerStore 9000T/X
CPU (Appliance)	32 Cores/1.8GHz	48 Cores/2.1GHz	64 Cores/2.1GHz	80 Cores/2.4GHz	112 Cores/2.1GHz
Memory (Appliance)	384GB	768GB	1,152GB	1,536 GB	2,560GB
Capacity (Appliance / Cluster)	11.52 – 898TB(Appliance) / 11.52 – 3.59PB(Cluster) RAW / Usable ~78% 28.57 – 2.84PBe(Appliance) / 28.57 – 11.36PBe(Cluster) Effective w/4:1 DRR on Usable				
Max Drives (Cluster)	384(96 per Appliance)				
Drives	NVMe SCM, NVMe SSD, SAS SSD				
Embedded	25/10GbE or 10GBASE-T				
IO Modules	IO Modules: 32/16/Gb FC, 25/10GbE, 10GBASE-T				
Software (Incl.)	Web-based Management, Inline Data Reduction, Thin Provisioning, Snapshots, Thin Clone, Async Replication, SDNAS, NVMe Multicore Optimization, QoS, CloudIQ, Automation-/Management-PlugIns , AppSync StarterPack Licenses				

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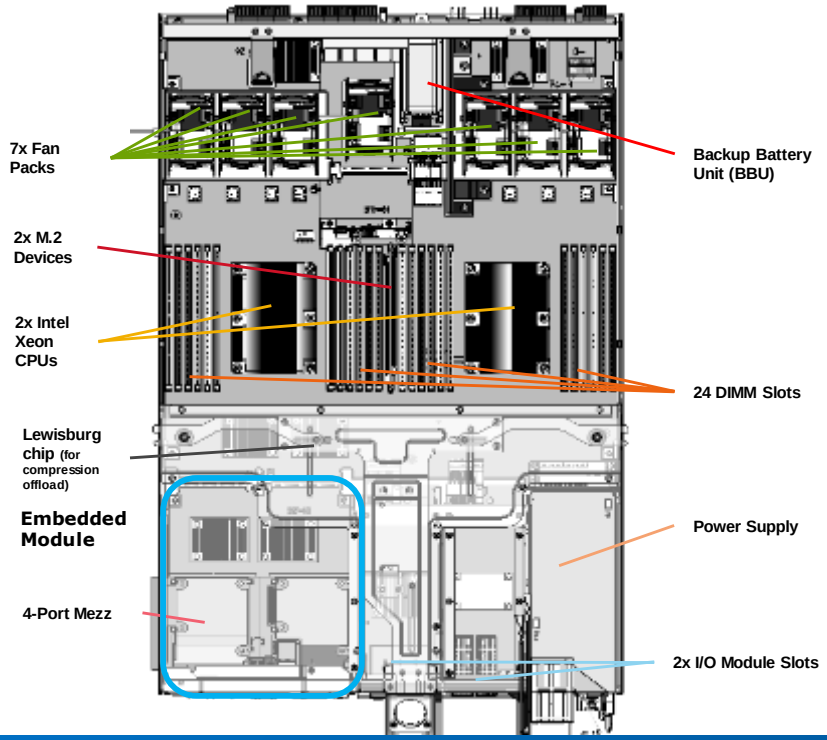
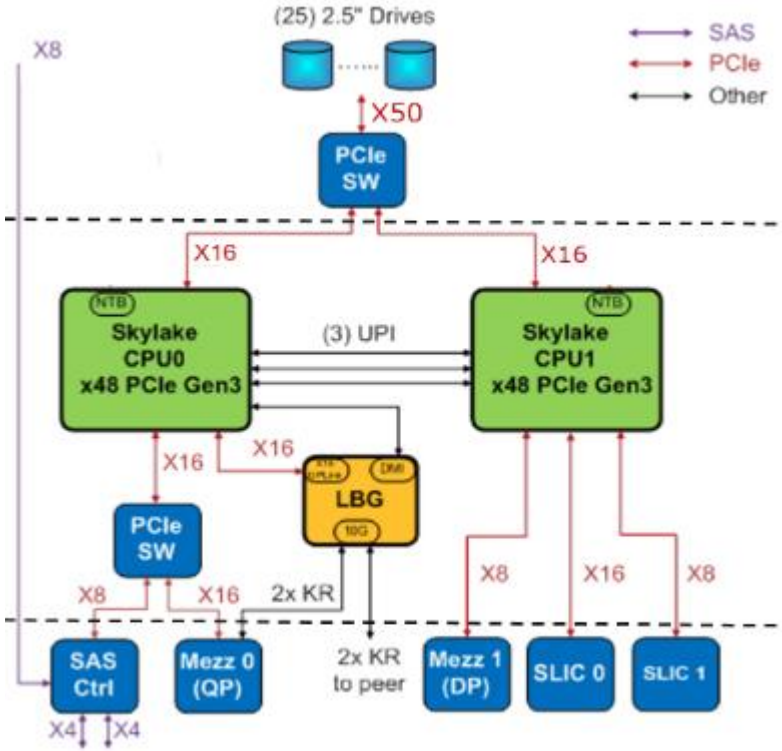
PowerStore - Internal Node View





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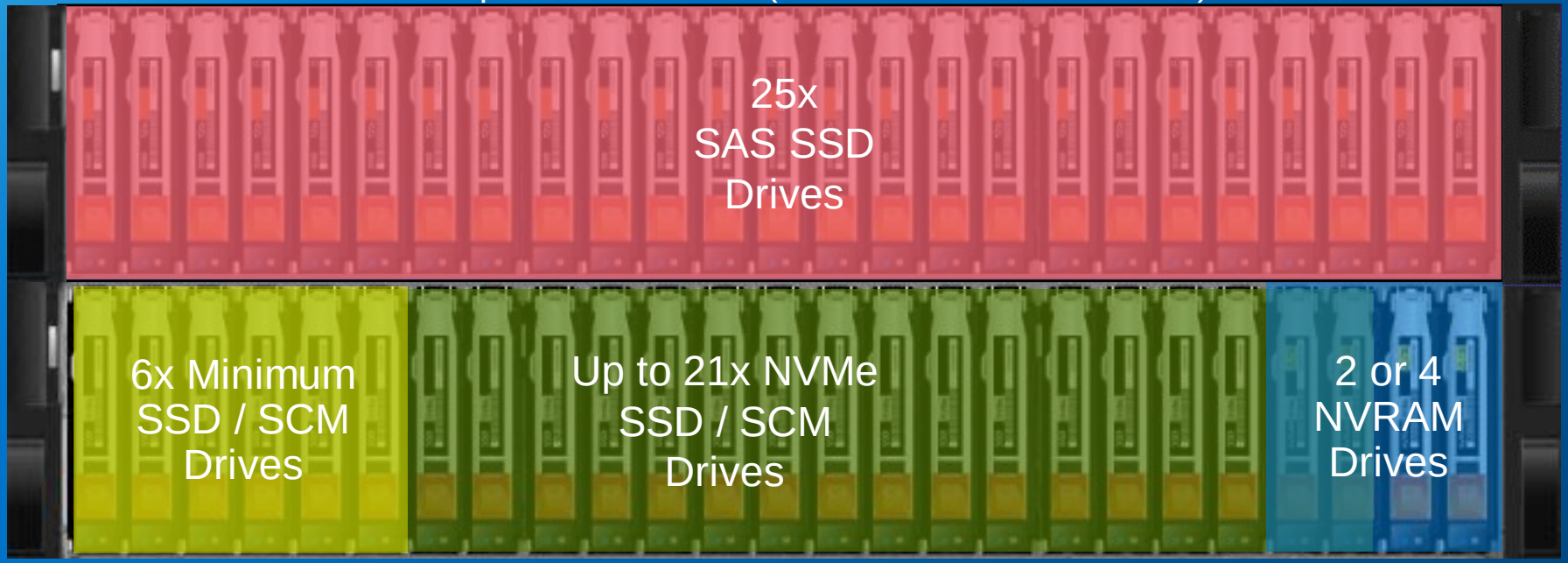
PowerStore - Drive Support/Appliance

Max. 96 drive configuration

1-3x Expansion Enclosure(2U/SAS3.0/75x Drive max.)



Base Enclosure(2U/NVMe/21x Drive max. +2-4x R1-pair NVRAM device),
Need to be filled up before SAS expansion can be used

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PowerStore - Drive Support/Type

Storage Type	Usage, Purpose	Cap.	2.5” Base Enclosure (25 Slot/2U)	2.5” Expansion Enclosure (25 Slots/2U)
SAS SSD	User Data, Metadata	1,920G		✓
	User Data, Metadata	3,840G		✓
	User Data, Metadata	7,680G		✓
NVMe SSD	User Data, Metadata	1,920G	✓	
	User Data, Metadata	3,840G	✓	
	User Data, Metadata	7,680G	✓	
	User Data, Metadata	15,360G	✓	
NVMe SCM	User Data, Metadata	375G	✓	
	User Data, Metadata	750G	✓	
NVMe NVRAM	Write Cache	8G	✓	

All drive offerings are encrypted(SEDs) and offerings are FIPS certified except for NVMe NVRAM drives

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PowerStore - Appliance Connectivity

4-Port Mezz Card(1 per Node)
25GBASE-SR
10GBASE-SR OR
10GBASE-T

(Option)4-Port IO modules(2 per Node)
32/16Gbps FC
25GBASE-SR
10GBASE-SR
10GBASE-T

NODE B

NODE A

Management(1 per Node)

Drive Expansion(2 per Node)

Service Console Port(1 per Node)

Maintenance(1 per Node)

Recovery Boot(1 per Node)

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PowerStore - Appliance Connectivity
Embedded Mezzanine, I/O Modules

4-Port Mezz Card(1 per Node)
25GBASE-SR
10GBASE-SR OR
10GBASE-T

(Option)4-Port IO modules(2 per Node)
32/16Gbps FC
25/10GBASE-SR
10GBASE-T

The **4-Port Base-T** I/O module can interface at speeds of 10Gb/s and 1Gb/s. The I/O module simultaneously supports both IP file and iSCSI Block on the same node. Configuration possible for I/O Module and embedded Mezzanine card

The **4-Port 25GbE SFP-based** module supports the following types of SFP transceivers for I/O Module and embedded Mezzanine Card:

- 10GbE or 25GbE SFP28
- 25GbE passive TwinAx
- 10GbE active or passive TwinAx

The **4-Port 32Gb Fibre Channel** I/O module is used to serve Fibre Channel block protocol via SAN to hosts. The SLIC supports two different types of SFP transceivers per port:

- 32Gb/s SFP
- 16Gb/s SFP
- Both SFP types auto negotiates speeds (4Gb/s lowest)

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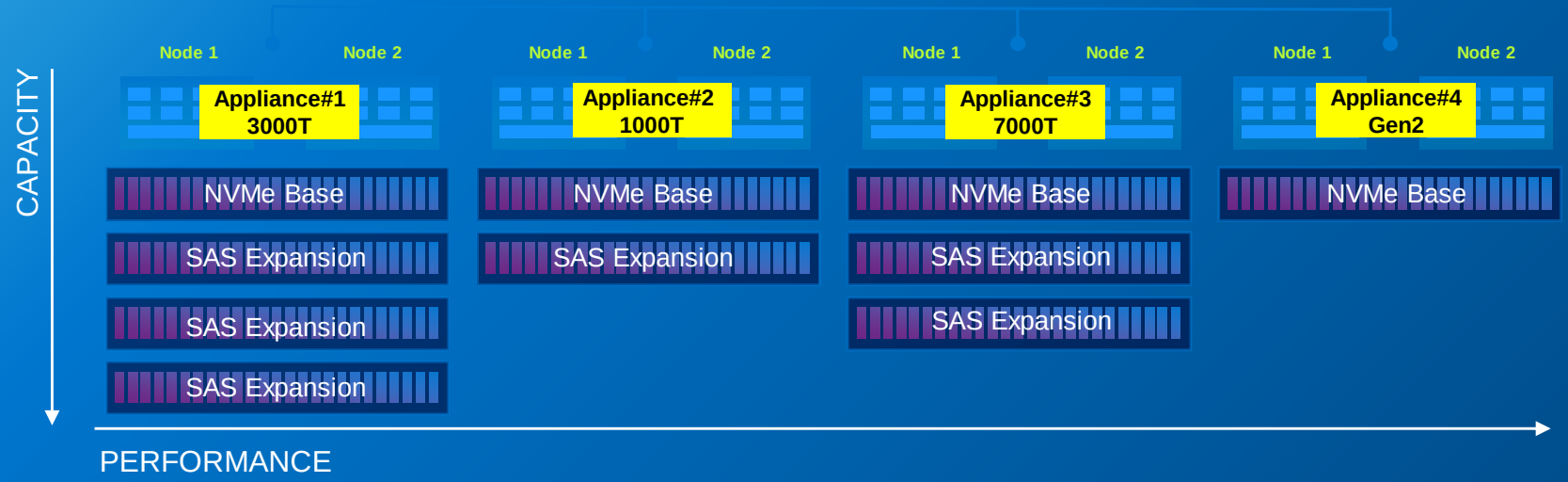
PowerStore - Scale-Up and Scale-Out

to 8x active-active Nodes in 4x PowerStore Appliances



- ✓ Independently scale Performance and Capacity by adding new Appliances or/and Disks
- ✓ You can mix different PowerStore T Models in one PowerStore Cluster
- ✓ First PS Appliance in Cluster is Master Appliances (Mgmt.) and can optionally be Unified (Block+File)
- ✓ “Factory State” PS Appliances can be added non-disruptively (Remove only via service script)
- ✓ Each PS Appliance independently serve Volumes, Filesystems, Storage Container/vVol from each other

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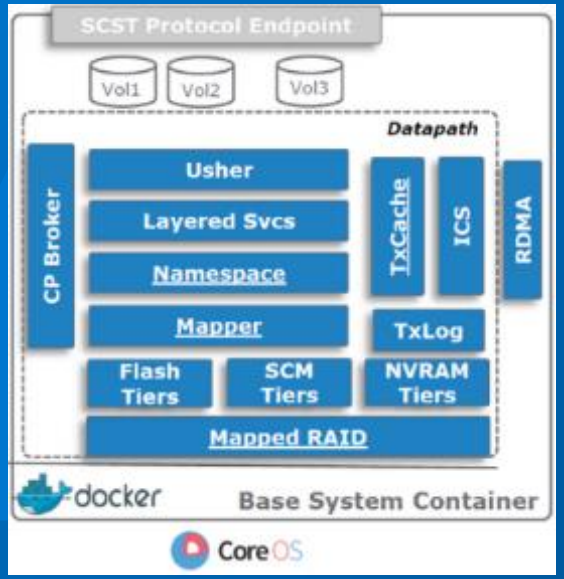
PowerStore - Container-based Architecture

PowerStore OS

Next-generation DELL Technologies storage stack



Flexible **Architecture**

Modular Software Architecture

Faster innovation

Consistent services across platforms

Ultra-high parallelized and scalable

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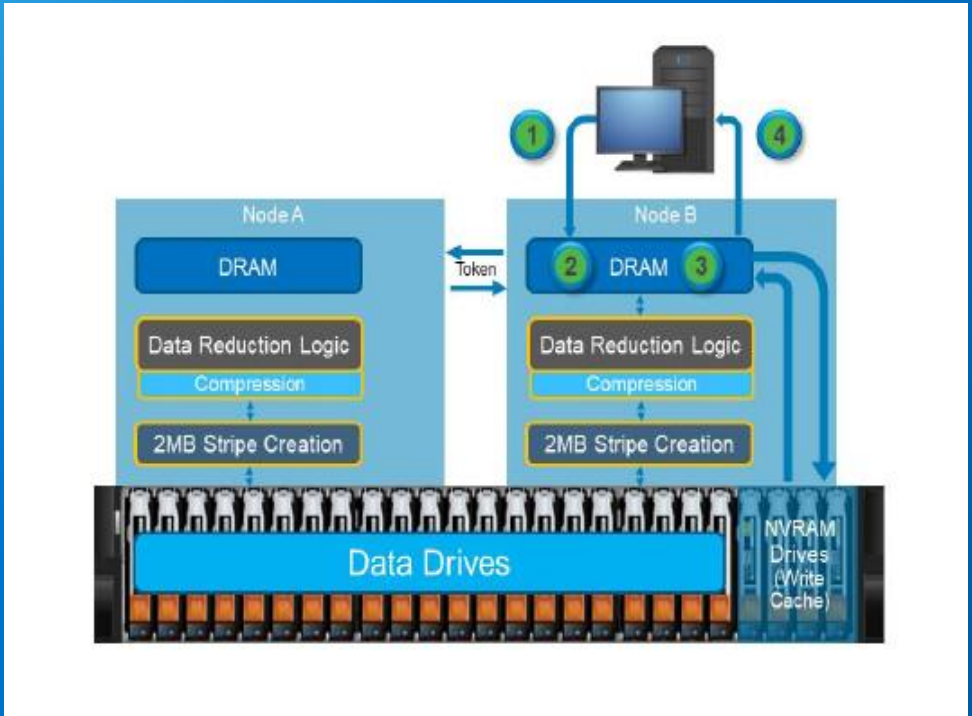
PowerStore - IO Flow with Data Reduction Logic Read Operations



1. The host issues a read.
2. The system locates the current data.
3. Several things can happen here depending on where the data is located:
4. If the data is a pattern, such as all 0's or 1's, the system re-creates the block in DRAM memory. (Go to step 4)
5. If the latest copy is in the Node DRAM memory, the system sends the data to the host.
6. If the latest copy is in NVMe NVRAM drives, the system copies the data to DRAM memory. (Go to step 4)
7. If the requested data resides on the data drives, it has been deduplicated and compressed. The system copies the data from the reference location. The data is decompressed and the page is reconstructed in DRAM memory. (Go to step 4)
8. The system then sends the data to the host.

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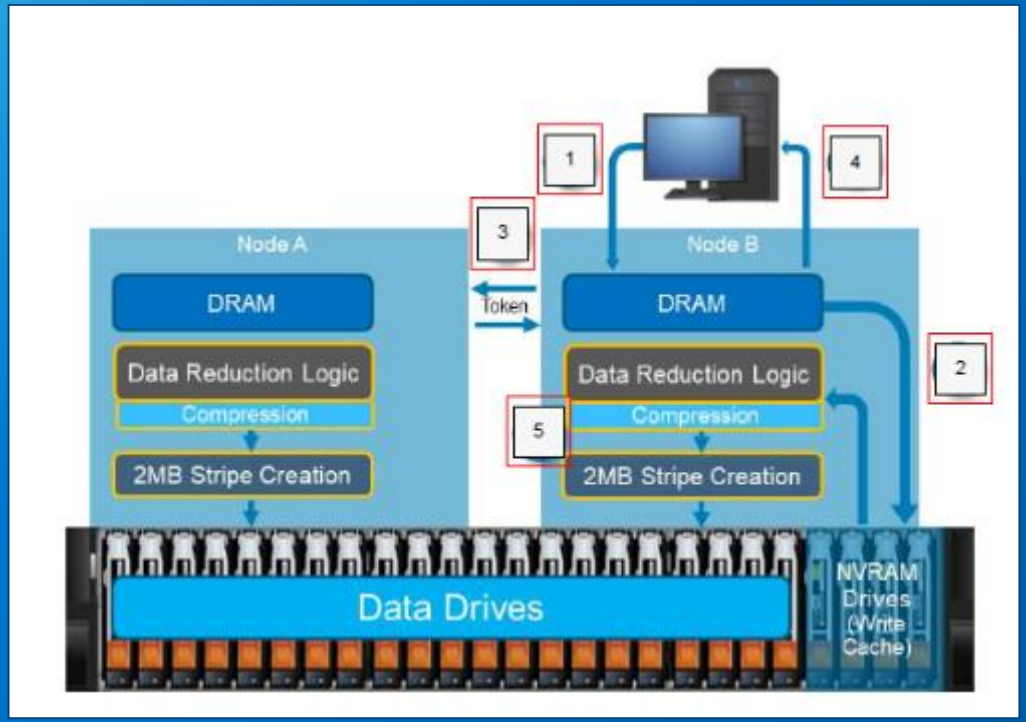
PowerStore - IO Flow with Data Reduction Logic Write Operations



1. The system receives a Write operation
2. The write request is stored in DRAM Cache and is persistently saved in NVRAM Cache
3. The other node is informed via Token (Metadata Sync/Update)
4. The system acknowledges the host.
5. The data will be deduplicated and compressed/packed before written in 2MB stripe sets to the disks

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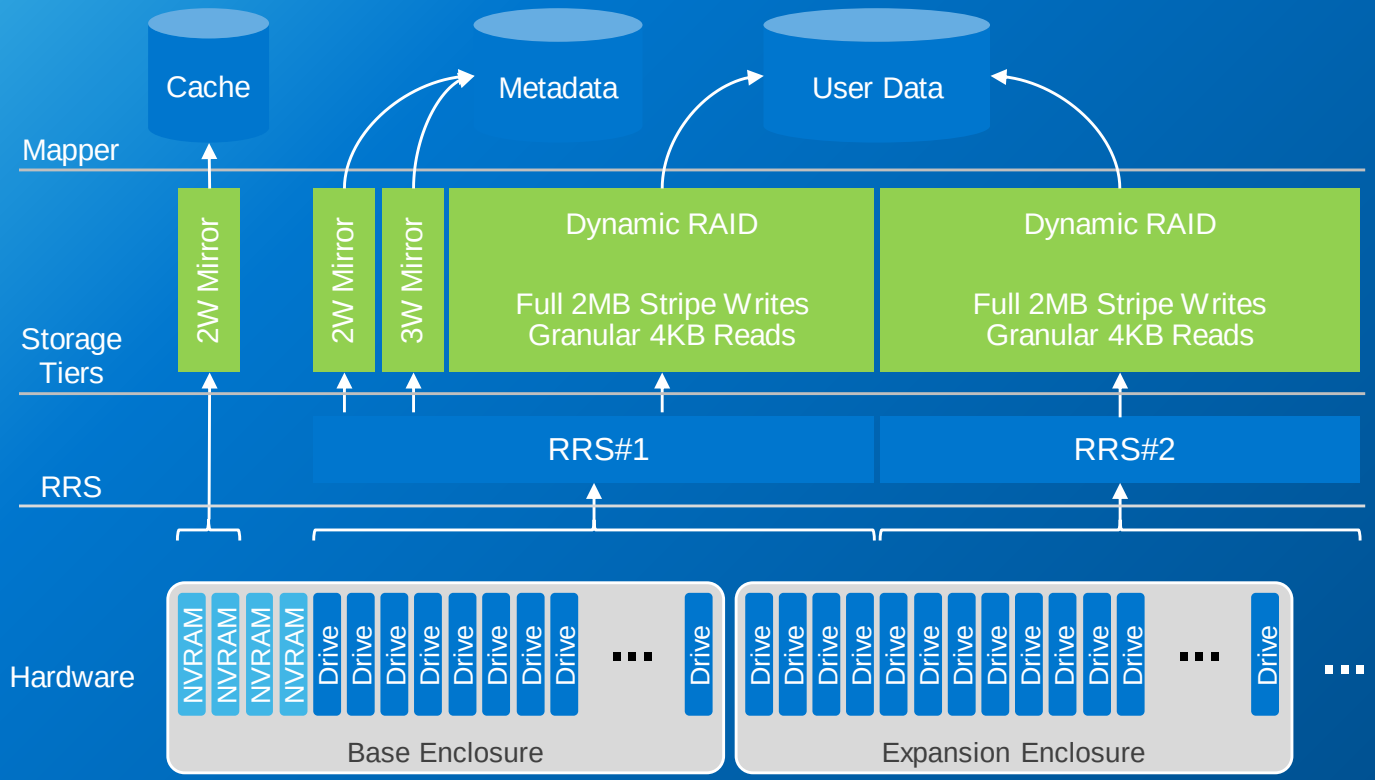
PowerStore - Dynamic RAID Backend

Efficient, full Stripe Writes to minimize Backend I/O



Transactional Cache with DRAM and NVRAM

Host Data in R5 4+1/8+1
Metadata in 2-way Mirror
RAID Map DB in 3-Way Mirror

RAID Resiliency Sets(RRS)
Max. 25 Drives

Distributed Sparing inside the RRS with fast Rebuilds

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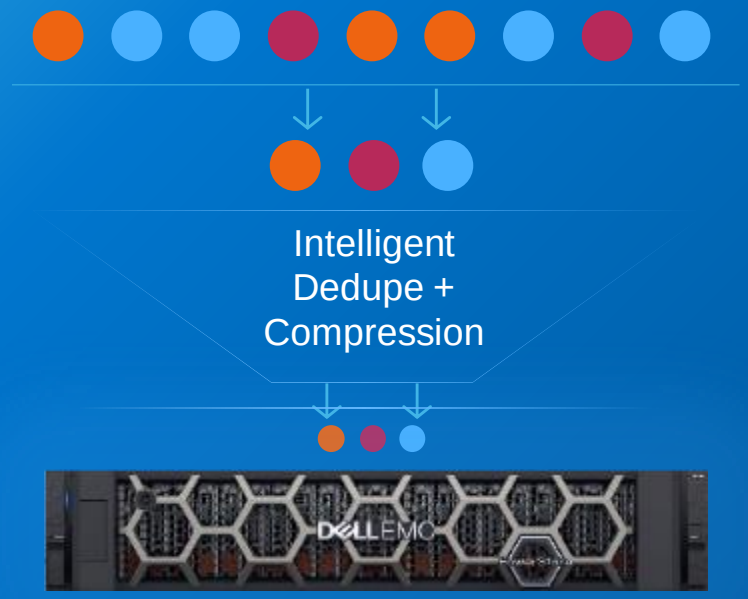
PowerStore - Always-on Inline Data Reduction



Hardware Offloaded by Intel® QAT

Average

4:1

Always-On Data Reduction based on 4K Block size

Intelligent DRR Algorithms assisted by Intel® QuickAssist HW Technology

Large 4K Dedupe Finger Print Cache in DRAM with Read & Compare Validation of the deduplicated Blocks

Fast and efficient Pattern Detection (Blocks with 0s/1s)/Zero Detection

Compression with LZ and Dynamic Huffmann Level 1 (~40Gbps Compress & Verify@4K)

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PowerStore - Effective Capacity

Raw 40TB

x .78 Overhead (R5 8+1)

Usable 31TB

4:1 DRR

Effective: 124TB

/ Price

$/GB

Don't

Raw 40TB

.78 Overhead (R5 8+1)

Usable 31TB

/ Price

$/GB

Do **not** ignore DRR.

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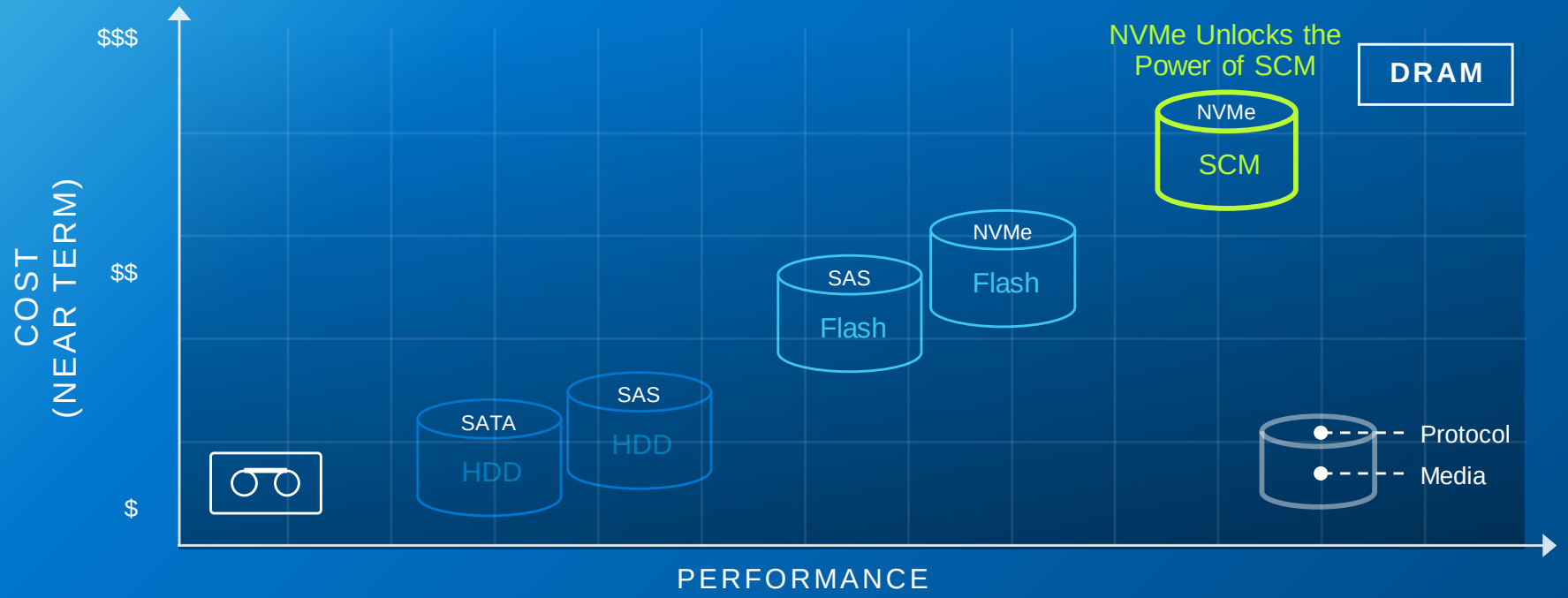
NVMe-Ready: Unlocks new levels of performance



IDC

NVMe-based arrays will be driving over 50% of all primary storage revenues by 2021*

Workload considerations should drive NVMe deployment considerations today*

Note: Chart is estimated at the drive level
**Source: IDC Market Note, June 2018, "A Deluge of NVMe Based Announcements…"*

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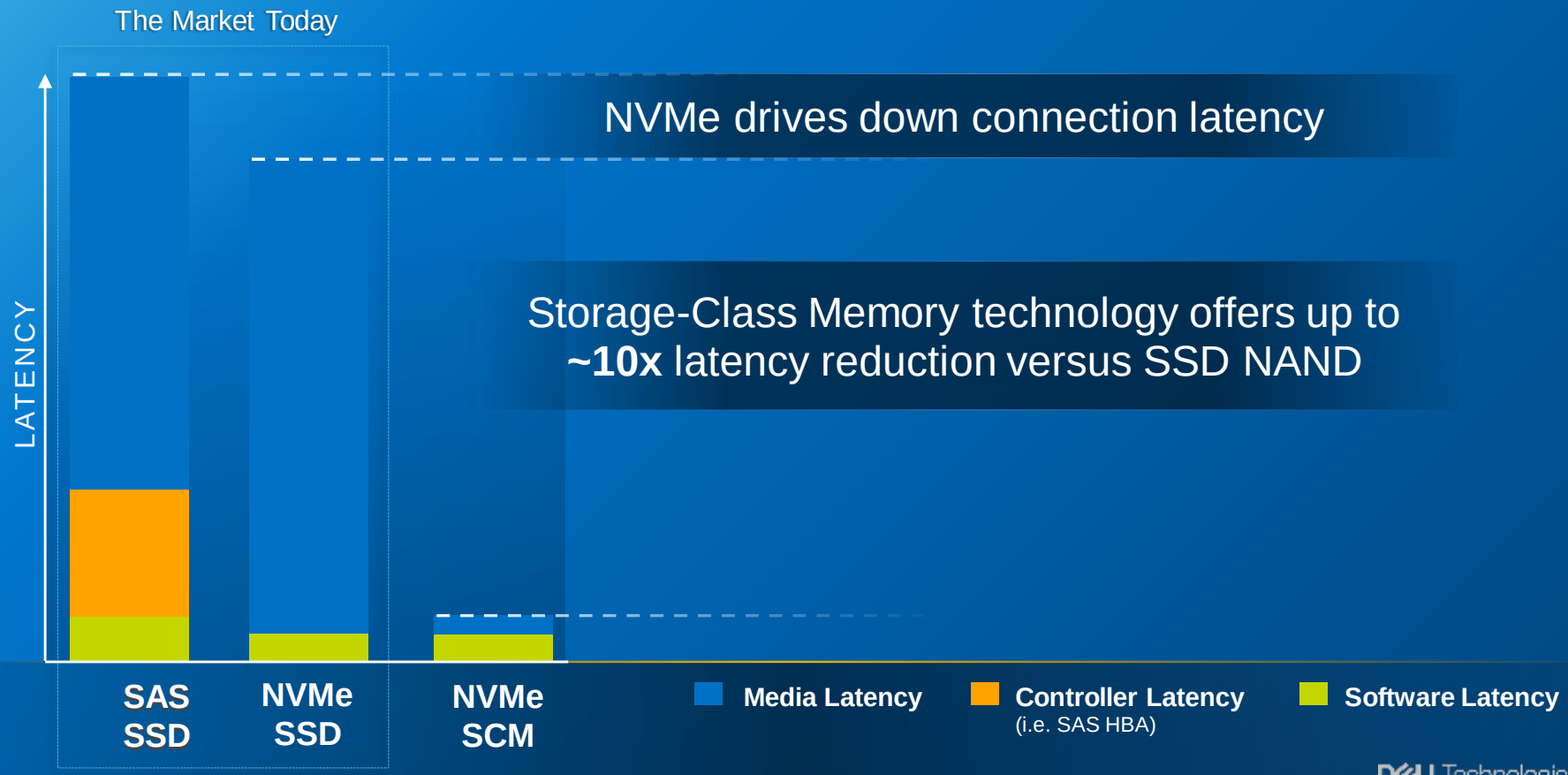
NVMe-Ready: NVMe+SCM together



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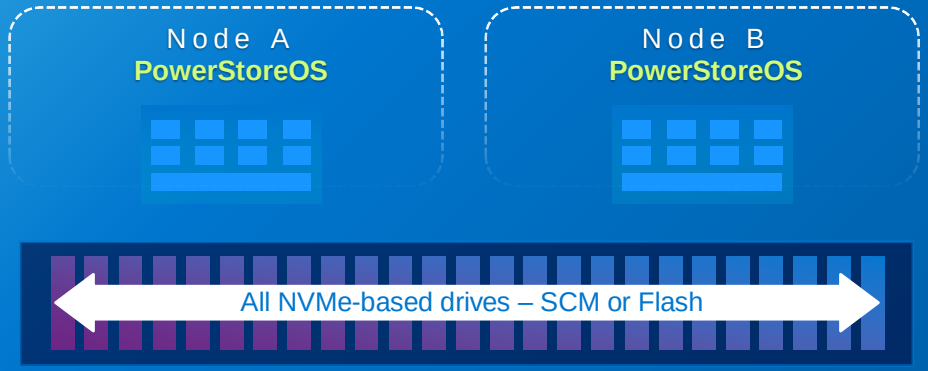
PowerStore - Optimized for Performance

PowerStore



Active-Active HA | End-to-end NVMe | Flash or SCM

7x Faster **3x** Lower Latency

Based on internal testing versus UnityXT880F

Ultra-High Performance and Ultra-Low Latency

10-21 NVMe Drives in Base Chassis can achieve max. IOPS Performance dependent on selected PS Model

Consistent low Latency based on modern, innovative Metadata structure (highly parallelized)

2-4 active I/O-Ports per Node are often enough to reach max IOPS

Only high bandwidth(GB/s) needs require more I/O-Ports or use of 4x NVRAM modules

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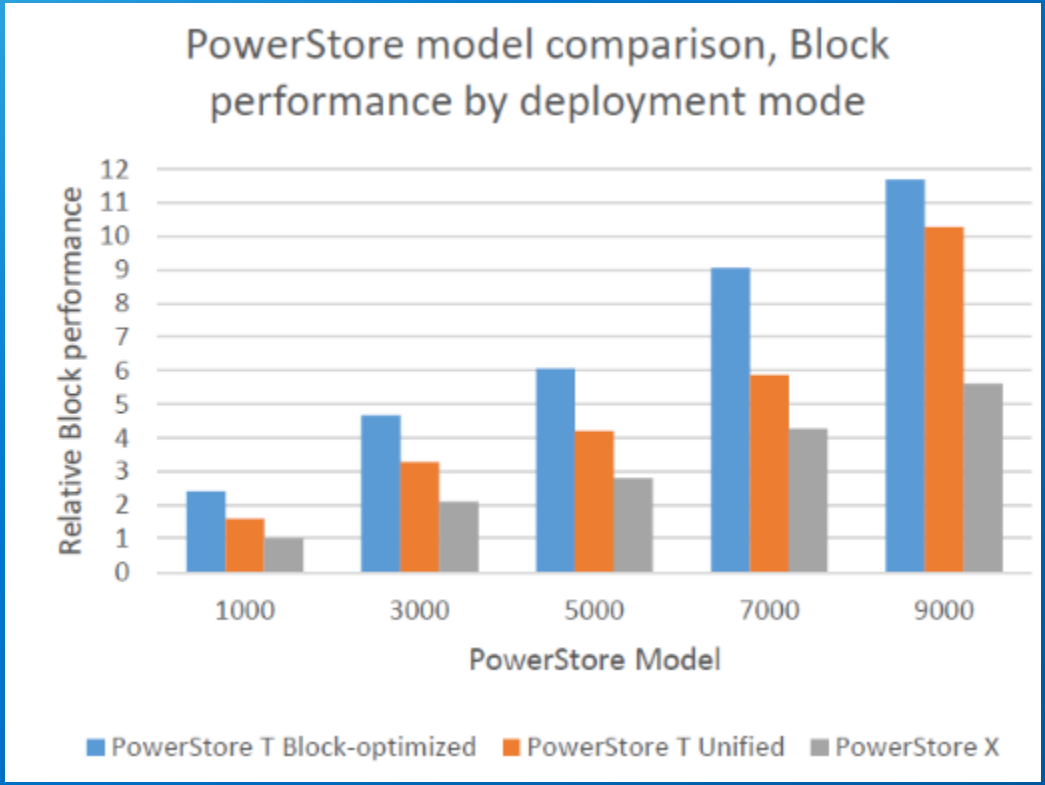
PowerStore - Performance Comparison



PowerStore T Block-optimized offers the highest Performance

PowerStore T Unified with additional SDNAS Container Overhead

PowerStore X has only 50% of Controller Node resources for I/O Performance, other 50% are used for AppsOn VMs

PowerStore 9000T Block-optimized offers the highest I/O Performance

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PowerStore - Go on offense

Set the table with the only storage designed for the data decade

PowerStore 9000T

Vendor A array (NVMe)

Principled Technologies

Source: Principled Technologies

MORE THAN
3x
THE DATA REDUCTION*

Maximize storage efficiency

OVERALL EFFICIENCY 9.6:1

3.3 TB | 32 TB

OVERALL EFFICIENCY 3.1:1

10.1 TB | 32 TB

*Amount of data reduced while running a 256 KB 100% Write test. Lower is better.

UP TO
53%
MORE IOPS*

Satisfy more users with faster storage performance

218,054 IOPS

142.042 IOPS

*Number of input/output operations per second (IOPS) supported while running four different workloads on the Vdbench benchmark.
Higher is better. (4 KB 100% Write)

UP TO
125%
MORE BANDWIDTH*

Process more data with higher bandwidth

25,612 MB/s

11,358 MB/s

*Amount of bandwidth (MB/s) provided while running two Vdbench workloads with 256KB blocks random Read of data. Higher is better.

UP TO
52%
LOWER LATENCY*

Protect users and applications from experiencing wait times

0.70 ms

1.48 ms

*Response time (milliseconds) delivered while producing 360,000 IOPS. Lower is better (32 KB Random Read).

MORE THAN
5x
FASTER PROVISIONING*

Cut provisioning time for IT staff

1 m 25 *s*

8 m 57 *s*

*Time to provision eight storage LUNs on clustered systems to ESXi environments. Lower is better.

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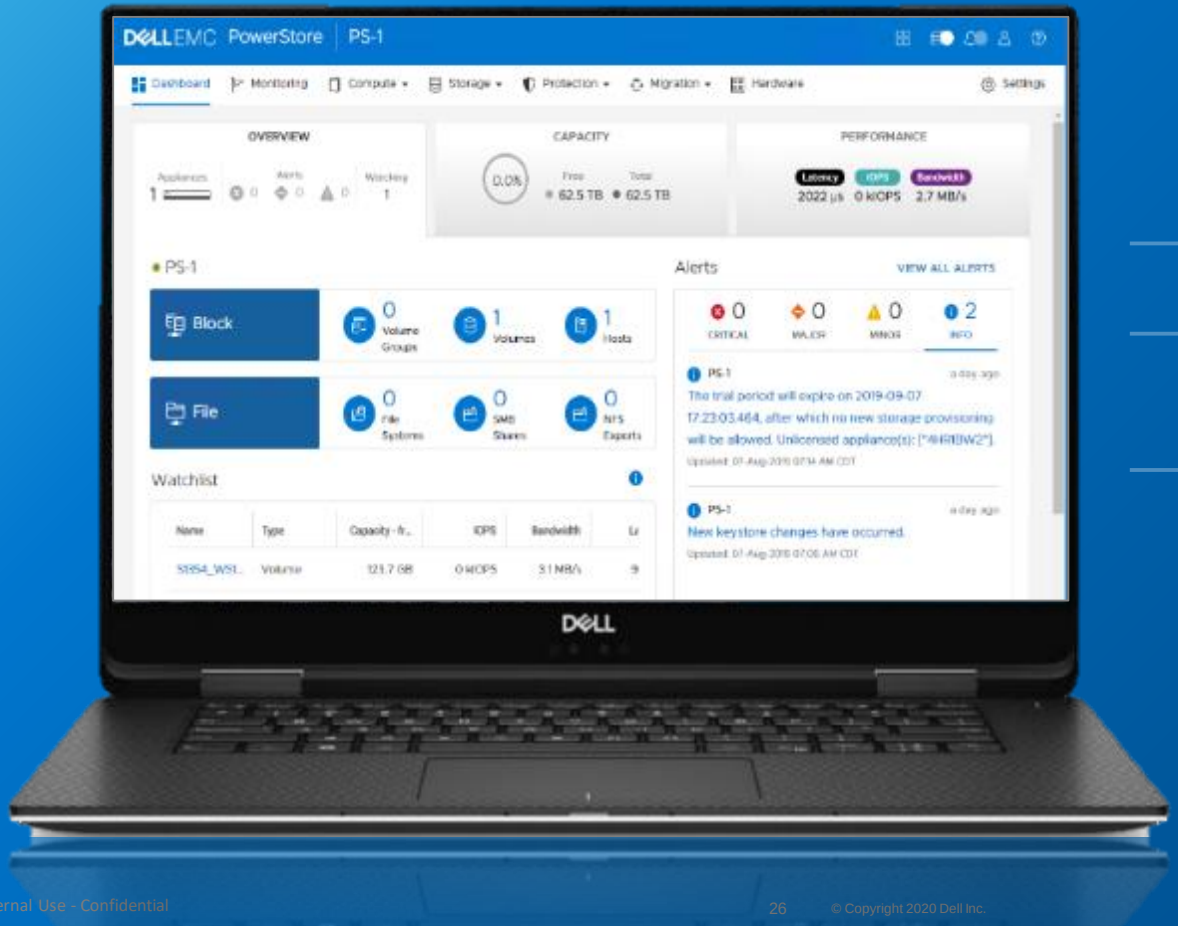
PowerStore Manager - Intuitively, Simply, Modern

Demo



HTML5-based GUI for managing PowerStore Appliance / Cluster

No Java required

Supported with popular Browsers: Chrome, Firefox, IE, Edge, Safari

No Client install required
Connect by HTTPS

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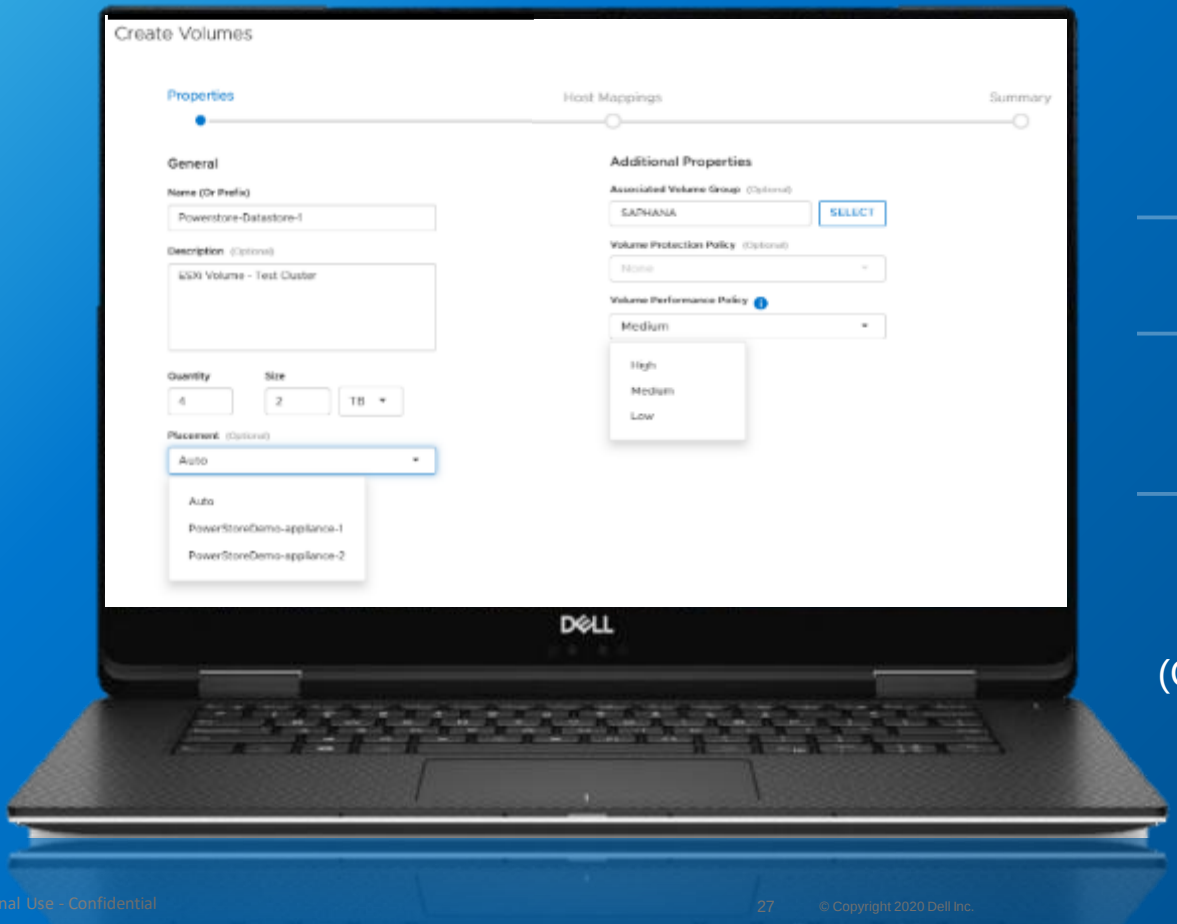
PowerStore Manager - Create Volume

Demo



Easy and Wizard guided Provisioning Process

Name / Description / Quantity / Size

Placement Option for PS Appliance: Auto / Manuel

Volume Performance Policy (QoS): Low , Middle (Default), High

(Only active during resource contention situations e.g CPU/Queues)

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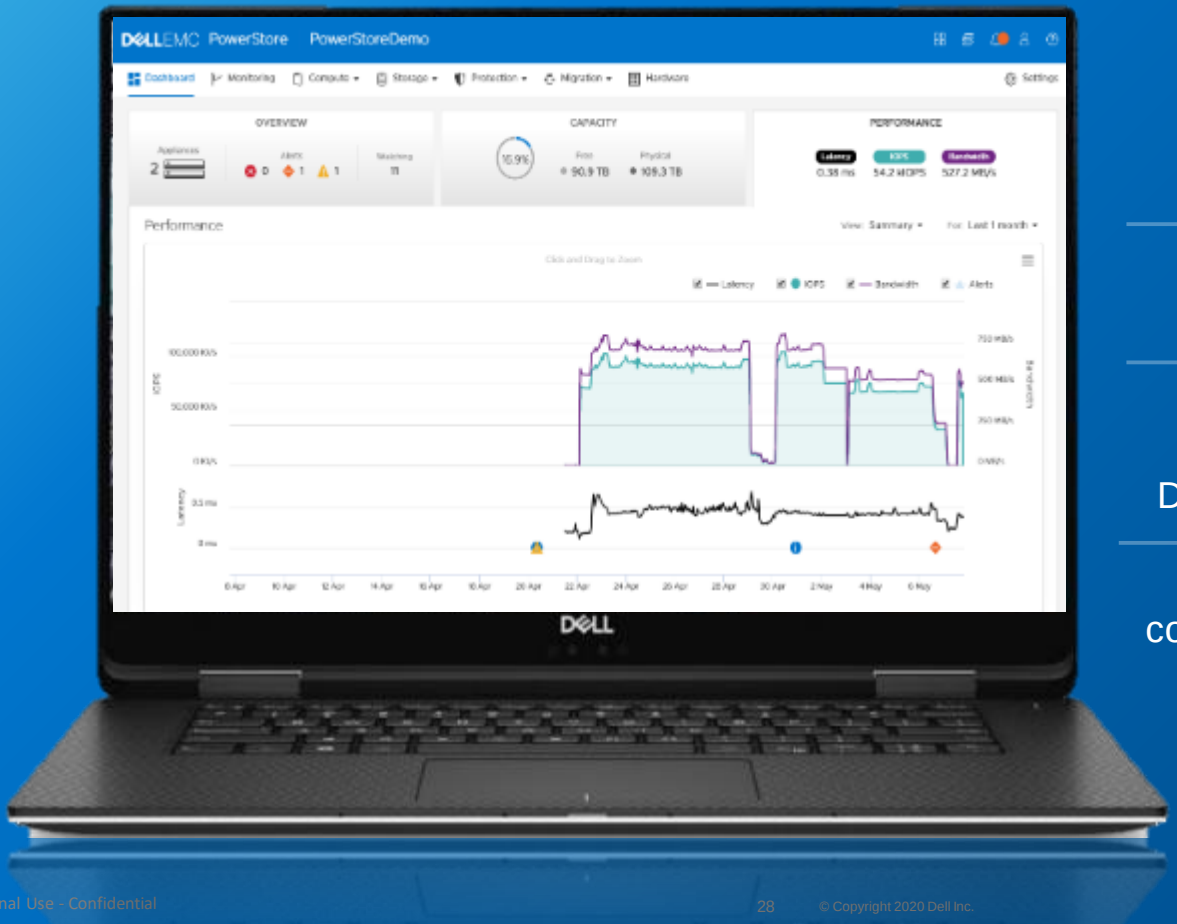
PowerStore Manager - Monitoring Performance

Demo



Near Realtime Performance values for IOPS / Bandwidth / Latency

Modern HTML-5 mouse control for easy value display / zoom in-out

Historical data back from “Last Hour” to “Last 2 Years”
Drill down to Volume / Filesystem level

Detail view for all important metrics correlated with System Alerts to simplify deeper performance analyze

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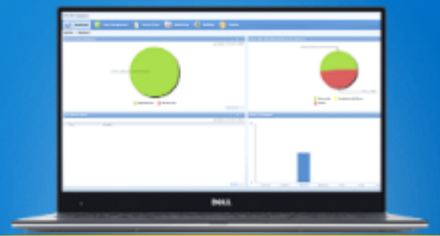
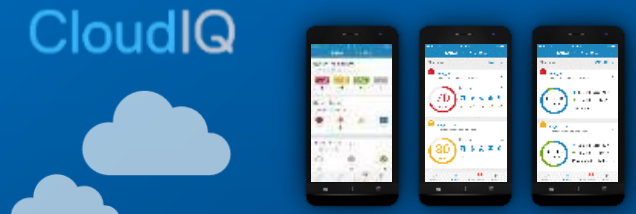
Demo

PowerStore - CloudIQ Proactive Monitoring

Intelligently answering questions about your data center



CLOUD-BASED PROACTIVE INSIGHTS AND PREDICTIVE ANALYTICS TO MONITOR YOUR DATA CENTER



CloudIQ

Data Center

Available with:

PowerStore
PowerMax
Isilon
XtremIO
Unity XT
SC Series
PowerVault
Connectrix
VxBlock
VMware

Reduce Risk

Identify and issues and expedite trouble-shooting

Plan Ahead

Anticipate business needs and avoid outages

Improve Productivity

Single pane of glass view of data center

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PowerStore T - Standard Deployment

Flexible **Architecture**

Block Optimized and
Unified NFSv3/v4v4.1, SMB1/2/3.0/3.02/3.1.1,
FTP/SFTP personality

File Support(SDNAS)
for First Appliance only

PowerStore T Cluster scales
to 4x Appliances

Cluster can have a mix of different PowerStore T
Models between 1000 to 9000

Management/GUI/SRS embedded in First
Appliance

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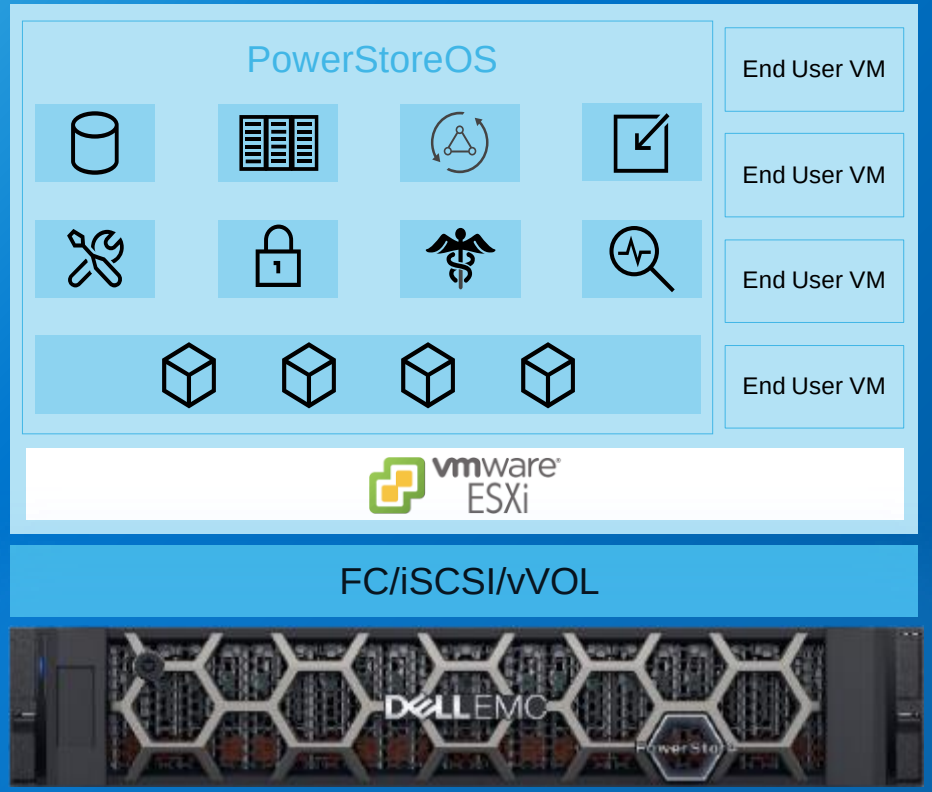
PowerStore X - Hypervisor Deployment

Demo



Flexible **Architecture**

Onboard VMware vSphere
ESXi 6.7U2 on M.2 device per Node

VMware vSphere Enterprise Plus
or higher needed (per Node)

---

vSphere Management with standard
vCenter environment (vSphere HA, DRS ..)

“Controller VM” get static 50% CPU and RAM
resources per Node,
H/W Access via VMDirectPath I/O,
No HA Failover for this “Controller VM “

Actual only one PowerStore X Appliance in a
Cluster allowed,
No File(SDNAS) support yet

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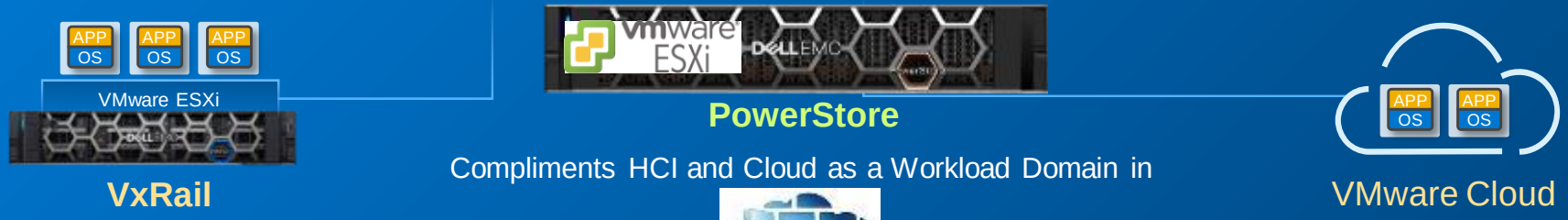
AppsOn - Native VMware Layer as a Differentiator

Move VMs Seamlessly with VMware Storage vMotion

Run ESXi VM's directly on PowerStore & Move them seamlessly between existing VMW Installations



Compliments HCI and Cloud as a Workload Domain in

vmware Cloud Foundation™

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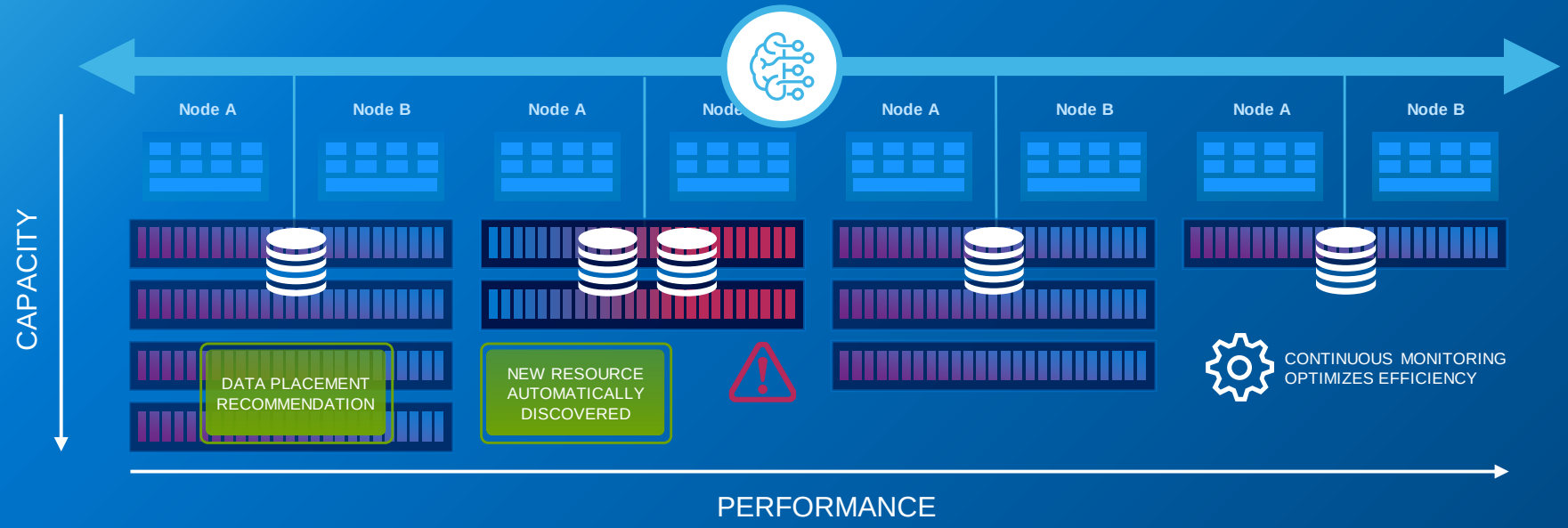
PowerStore Cluster - Autonomous Appliance

Machine Learning engine



Flexible **Architecture**

99% less staff time to rebalance volumes

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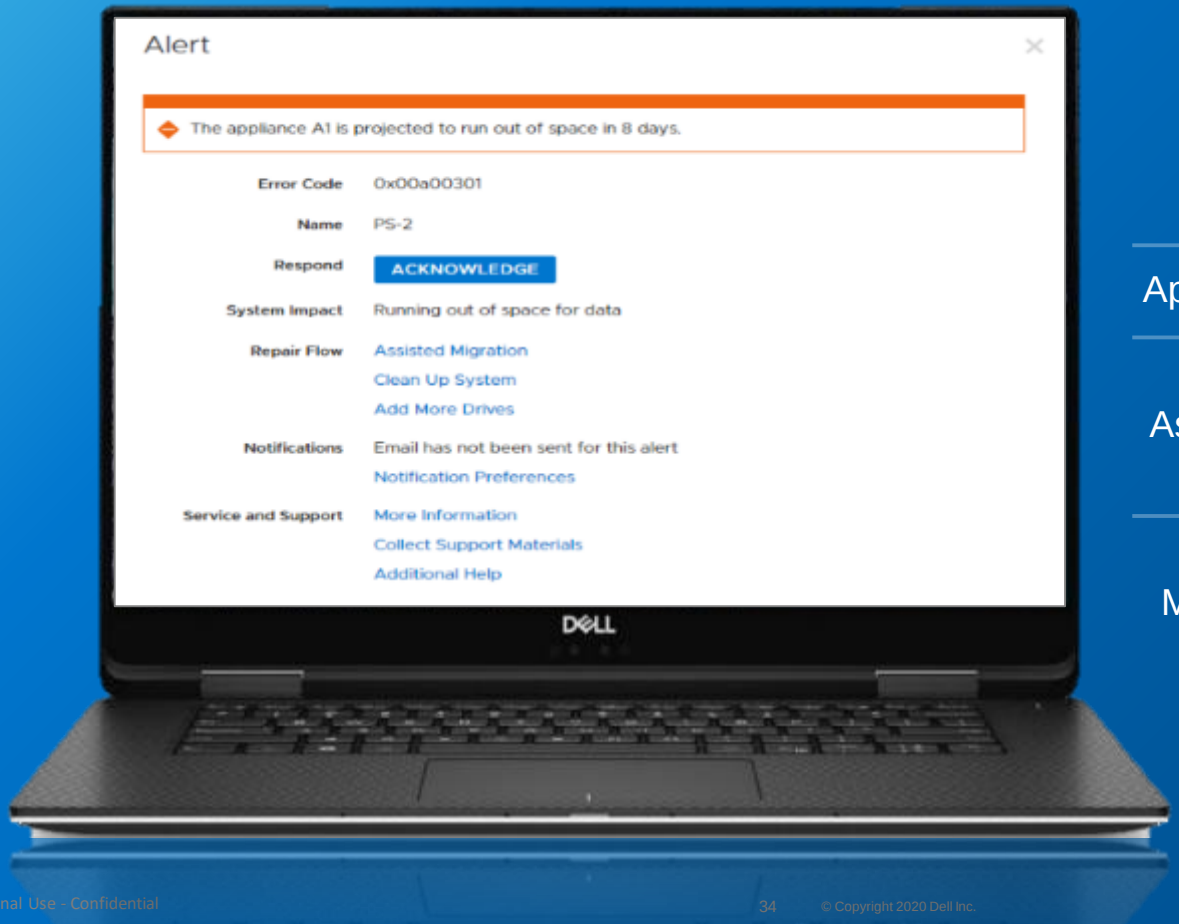
PowerStore Manager - Assisted Volume Migration

Demo



Appliance#1 is forecast to run out of space in 8 days

Appliance#2 has lots of storage capacity

Alert details suggests(Repair Flow) Assisted migration, Clean-up System or Add More Drives

Remediation in this example:
Move volumes with Assisted Migration

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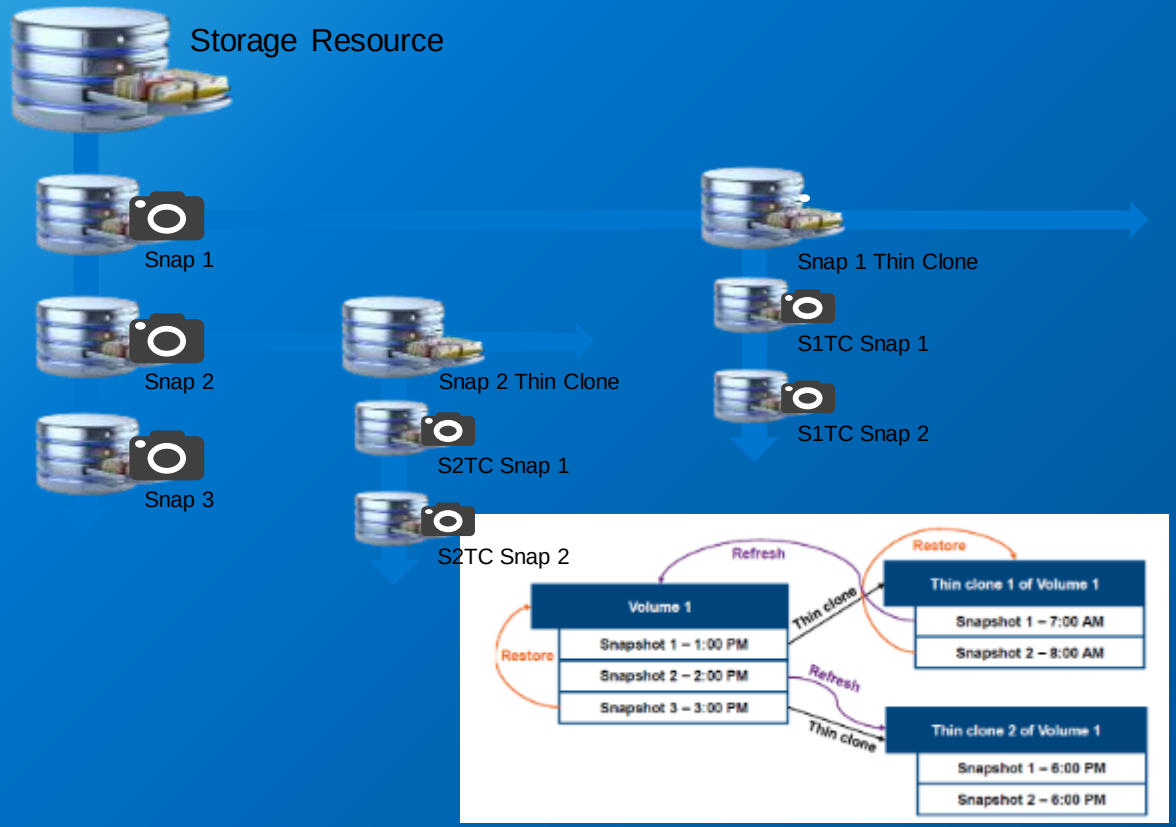
PowerStore - Snapshots/Thin Clone



Supports 256 Snapshots per Volume / Filesystem

Thin Clones are mountable and writeable Copies

Restore from Snapshot and Refresh from related Volume

Assigned via Protection Policies with Snapshot Rules / Scheduler, Frequency 5 Min / 24 hours

For Snapshot Consistency Volumes can be grouped into Volume Groups

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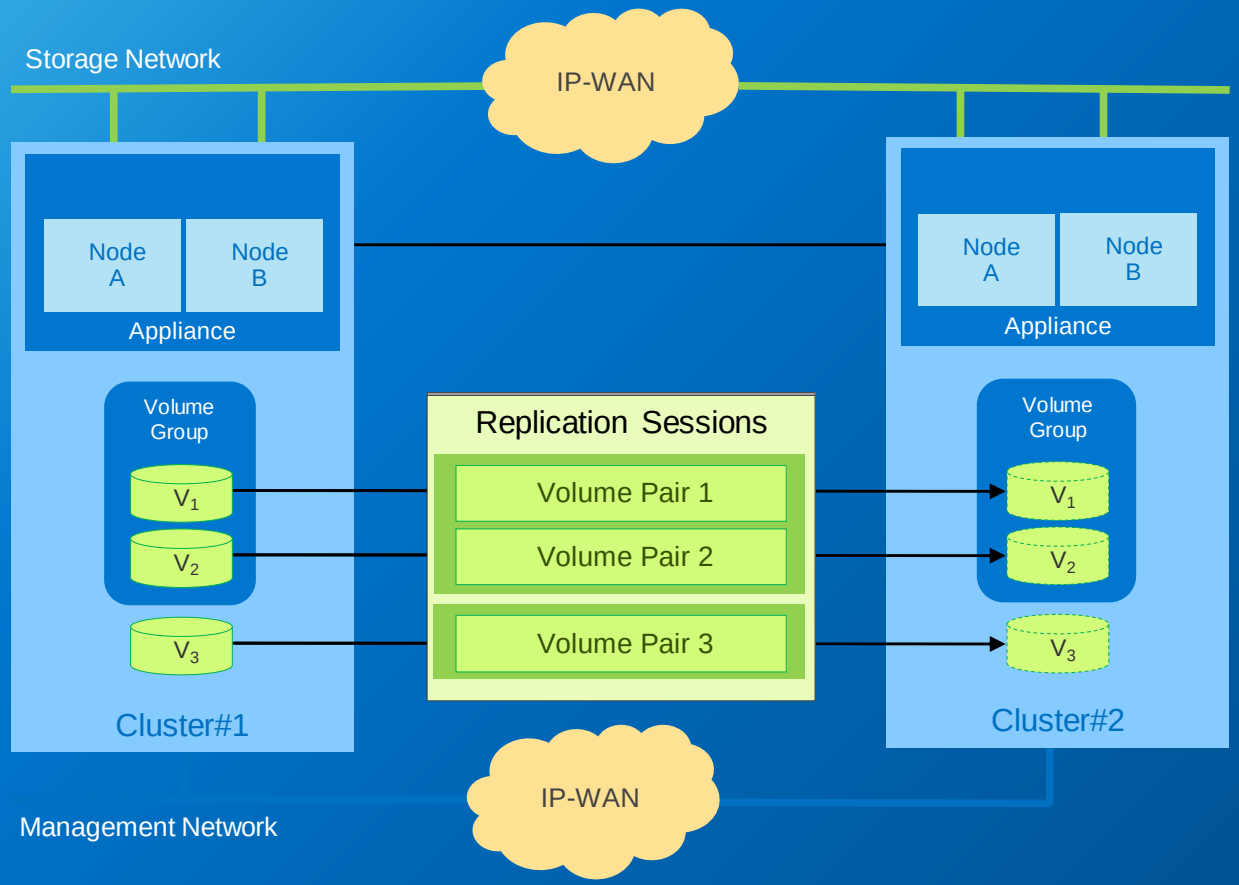
PowerStore - Remote Replication



RPO based asynchronous Remote Replication
(Fixed RPO from 5min - 24hr)

PowerStore Appliances can be different Models(T/X model)

Volumes, Snaps, Thin Clones and Volume Groups

Assigned via Protection Policies with Replication Rules

1:1, 1:N, N:1 Replica topologies are supported

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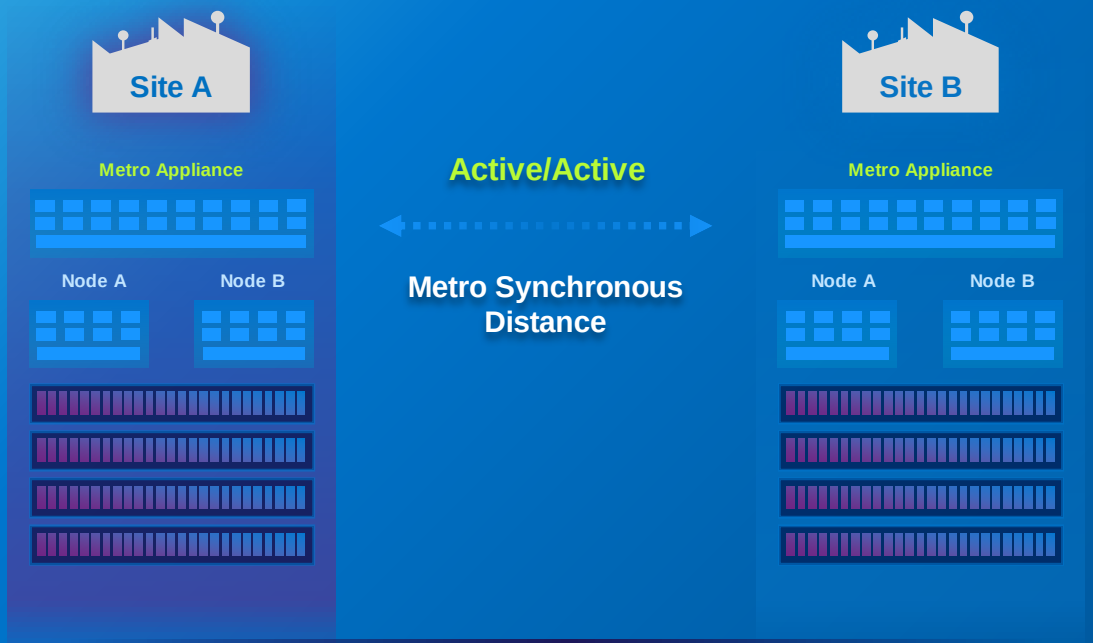
PowerStore - Metro Replication



> Six 9's Consistent Availability

Metro Node Sync Mirrored volumes based on proven VPLEX Technology

Delivers true RTO and RPO equal to zero with instant Failover (active/active)

Enables workload mobility across data centers

Zero impact to PowerStore Array Performance

New HTML5 GUI

VPLEX Innovations(Q3CY20)

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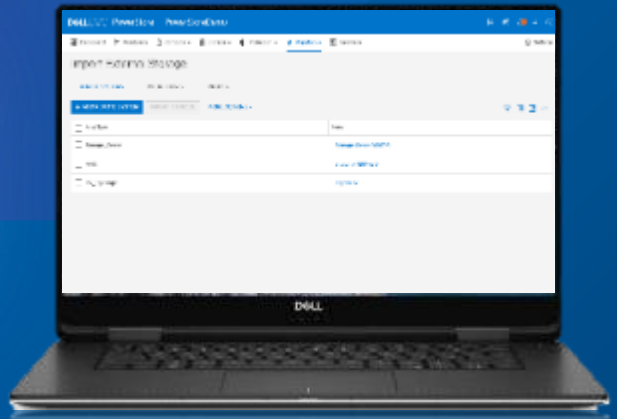
PowerStore - Import External DELLEMC Storage

Demo

Native tools included

Cross-platform solutions

Migrate **without disrupting** your business



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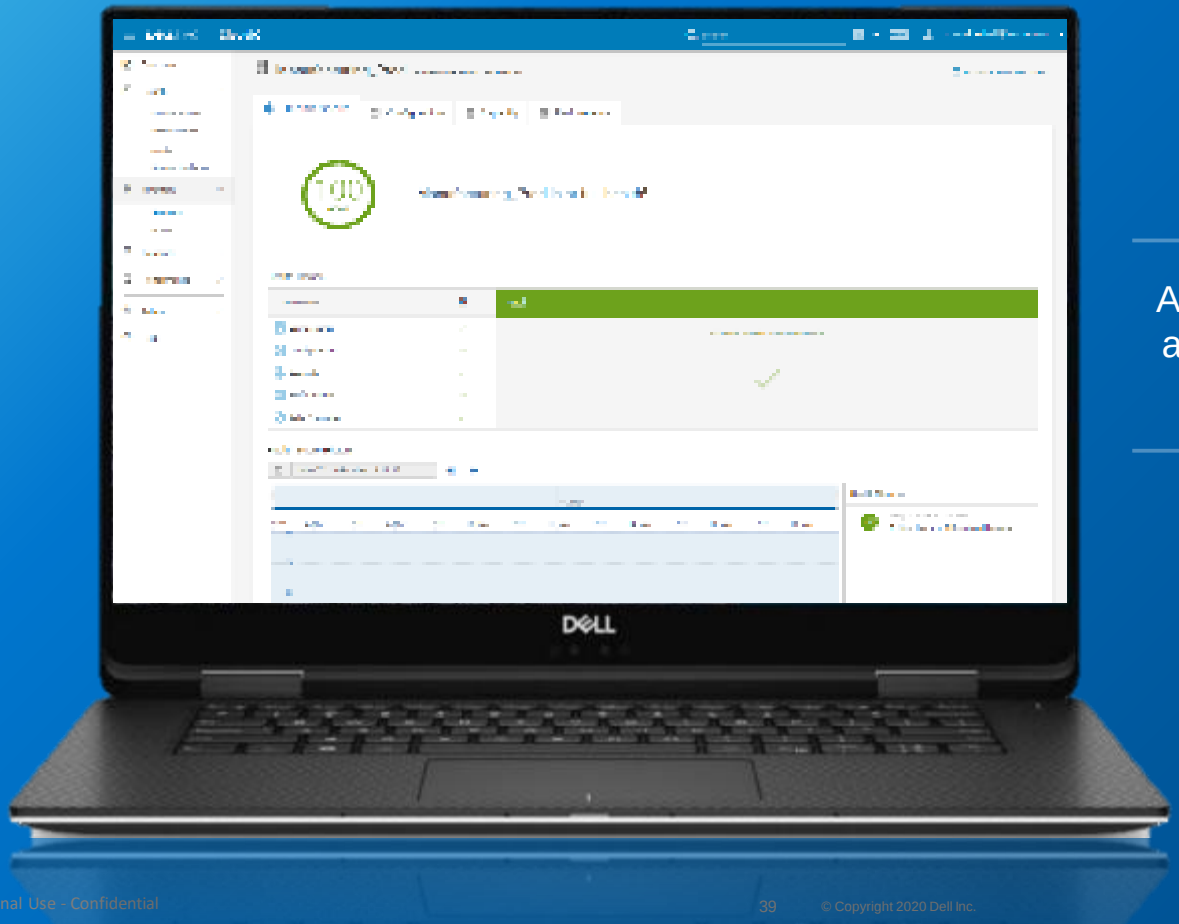
PowerStore Manager - NAS Capabilities

Demo



Multiprotocol Access using
Both SMB/NFS simultaneously

Automatically enabled when Both SMB and NFS protocols are enabled on the NAServer

NFSv3, NFSv4-4.1, Secure NFS
SMB1, SMB2, SMB3-3.1.1
- Standalone or Domain Joined
FTP/SFTP

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PowerStore: Best In Class Technology

Competitive Differentiator

The Best Of The Dell Technologies Storage Portfolio In a ***Single New Next-Gen Data Platform***

The Power of the DELL Technologies Storage Portfolio In A New Data Platform

- ✓ All New Modern Data + Microservices Architecture
- ✓ Fully Engineered for SCM(An Industry First)
- ✓ Built-In Clustering for Scale and Resiliency
- ✓ Unique AppsOn Feature Delivered via Embedded VMware Infrastructure
- ✓ Easily Installed, Easily Managed, Easily Migrated To
- ✓ Unmatched Anytime Upgrade Program

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PowerStore's Platform as a Differentiator

Competitive Differentiator

- ✓ Container-based
- ✓ Extendable & Modern
- ✓ Run VM's Natively
- ✓ Built-In Clustering
- ✓ Extensible Automation
- ✓ Unified Storage
- ✓ NVMe-Ready
- ✓ Active/Active Architecture
- ✓ Inline Data Reduction

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Question & Answer

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