

The PowerStore Experience

Welcome to continuously modern

 **DELL**Technologies

PowerStore Overview

WELCOME TO

The PowerStore Experience

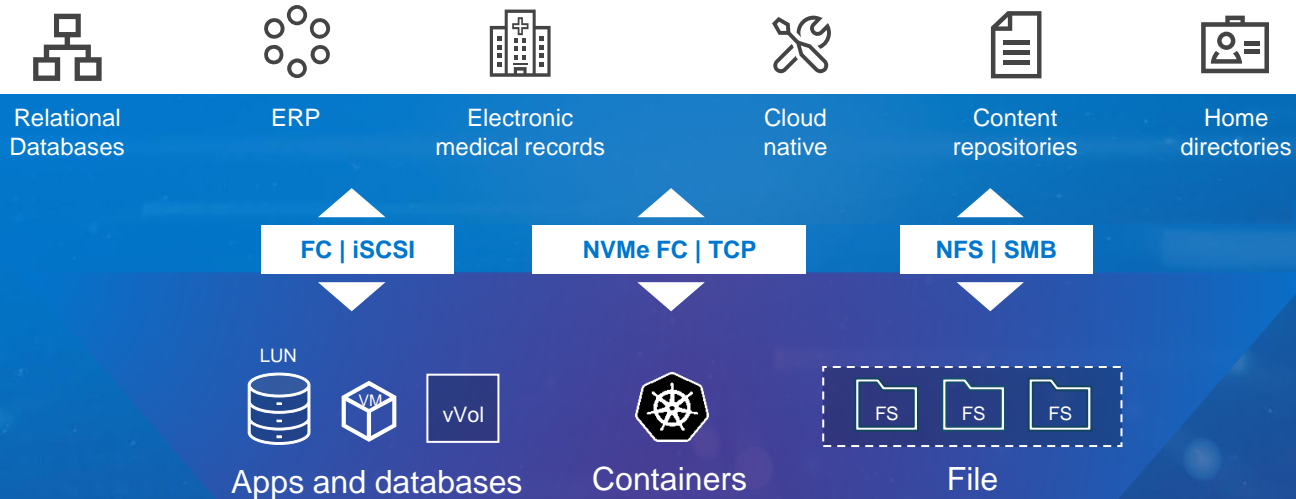


Continuously modern storage

Featuring the **Anytime Upgrade™** advantage

Any workload

Traditional and modern workloads



Modular, container-based OS

PowerStoreOS



Continuously modern design

Microservices architecture helps PowerStore *itself* evolve faster.

Shared capabilities across platforms

Future deployment models

Performance-optimized platform

Expandable appliance

Start with base chassis



Node 1
PowerStoreOS

Node 2
PowerStoreOS



25 NVMe drives

Scale up to 3 expansion enclosures per appliance



24 NVMe drives

24 NVMe drives

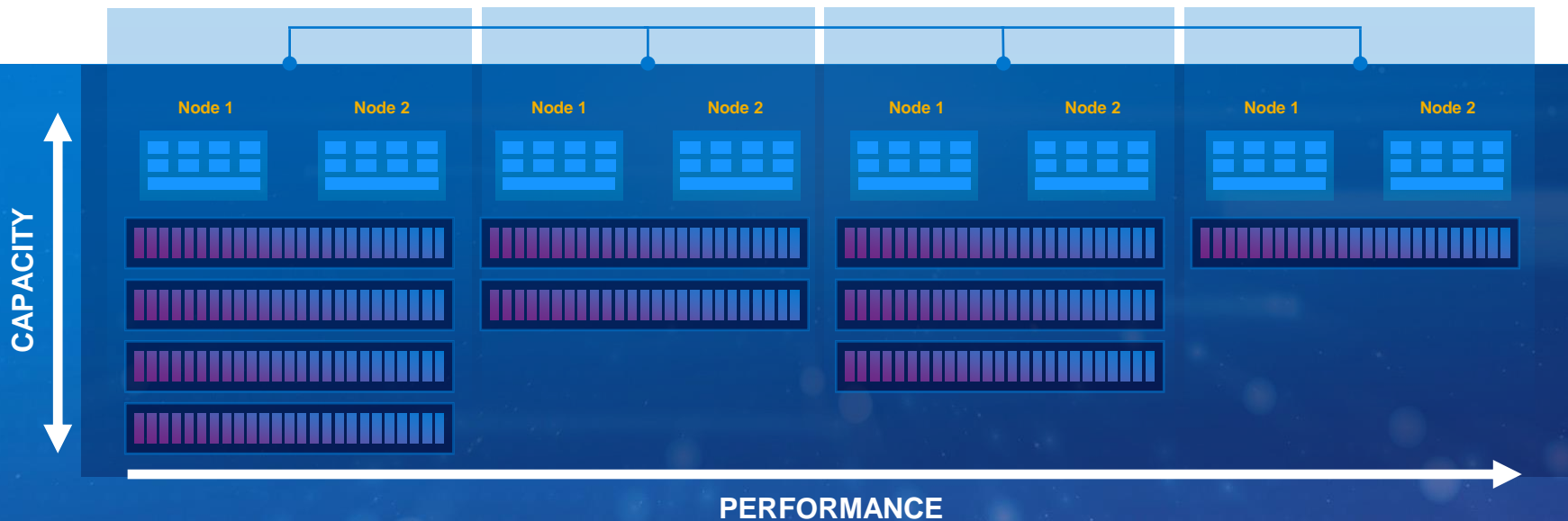
24 NVMe drives

- End-to-end NVMe
- Dual active/active nodes
- High core counts, large system memory configurations
- 4.7 PBe per appliance
- Self-optimizing efficiency

Scale out with multi-appliance clusters

Scale UP
*to 4.7 PBe per appliance**

Scale OUT (4 appliances, 8 nodes)
*to >18 PBe per cluster**

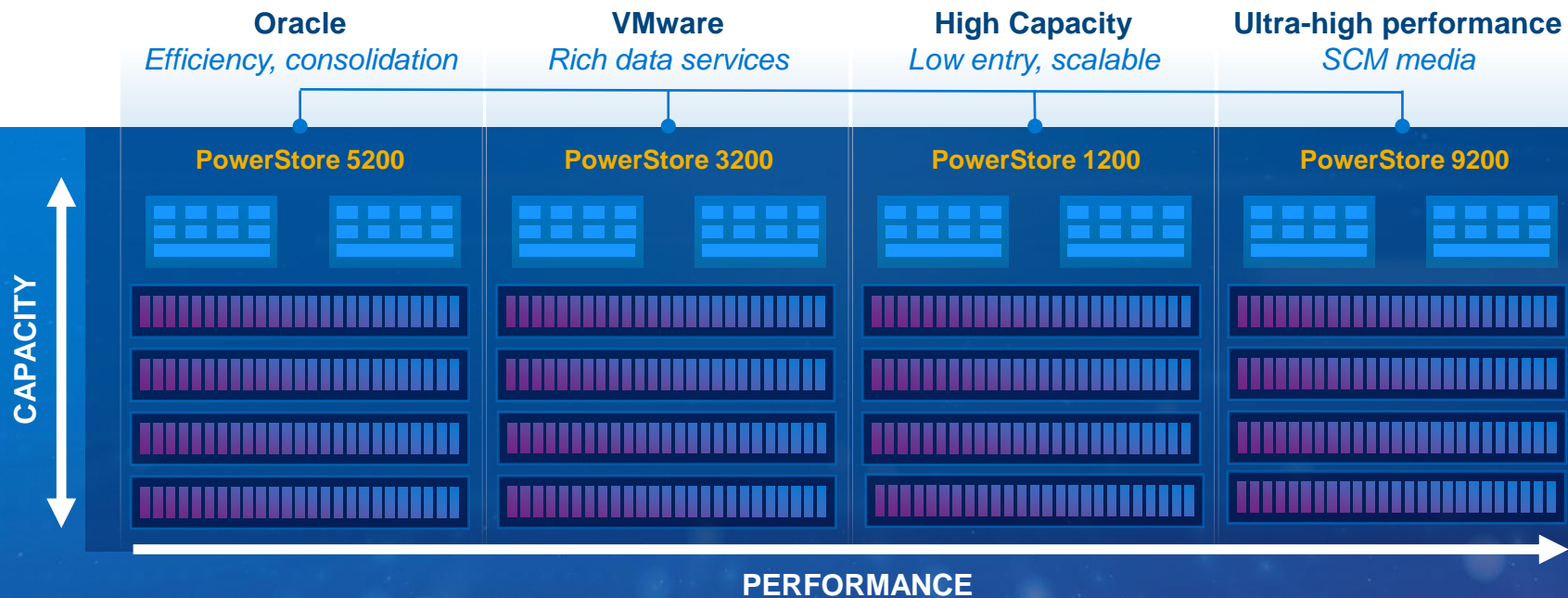


Expand compute and storage independently

*Effective capacity assumes 4:1 DRR

Mixed clusters target specific workload needs

Flexible performance & application segregation



Performance varies by model

Same software features, same max capacity

PowerStore Family (Gen 2)



PowerStore model	500	1200	3200	5200	9200
CPU (appliance)	24 cores 2.2GHz	40 Cores 2.4GHz	64 Cores 2.1GHz	96 Cores 2.2GHz	112 Cores 2.2GHz
Memory (appliance)	192GB	384GB	768GB	1152GB	2560GB
Max capacity (appliance)	4.71 PB Effective <i>(1.49 PB Raw)</i>	4.52 PB Effective <i>(1.43 PB Raw)</i>			
Max capacity (cluster)	18.83 PB Effective* <i>(5.96 PB Raw*)</i>	18.06 PB Effective <i>(5.71 PB Raw)</i>			
Max drives (appliance / cluster)	97 / 388 ²	93 / 372			
Drive types	NVMe SSD/SCM	NVMe SSD/SCM			
Embedded ports ¹	25/10/1 GbE	25/10/1 GbE or 10/1 GbE BaseT			
Expansion (per appliance)	Add up to 3 expansion enclosures per appliance				
Clustering	Up to four appliances (mix and match any model/config ³)				
IO Modules	32/16/8 Gb FC, 100/25/10 GbE, 10/1 GbE BaseT				
Front-end connectivity	FC: 32Gb NVMe/FC, 32/16/8Gb FC; Ethernet: 100/25/10 GbE NVMe/TCP, iSCSI, File				

1 - 500 customers may order without embedded ports

2 - Larger configurations available in mixed clusters with other PowerStore models

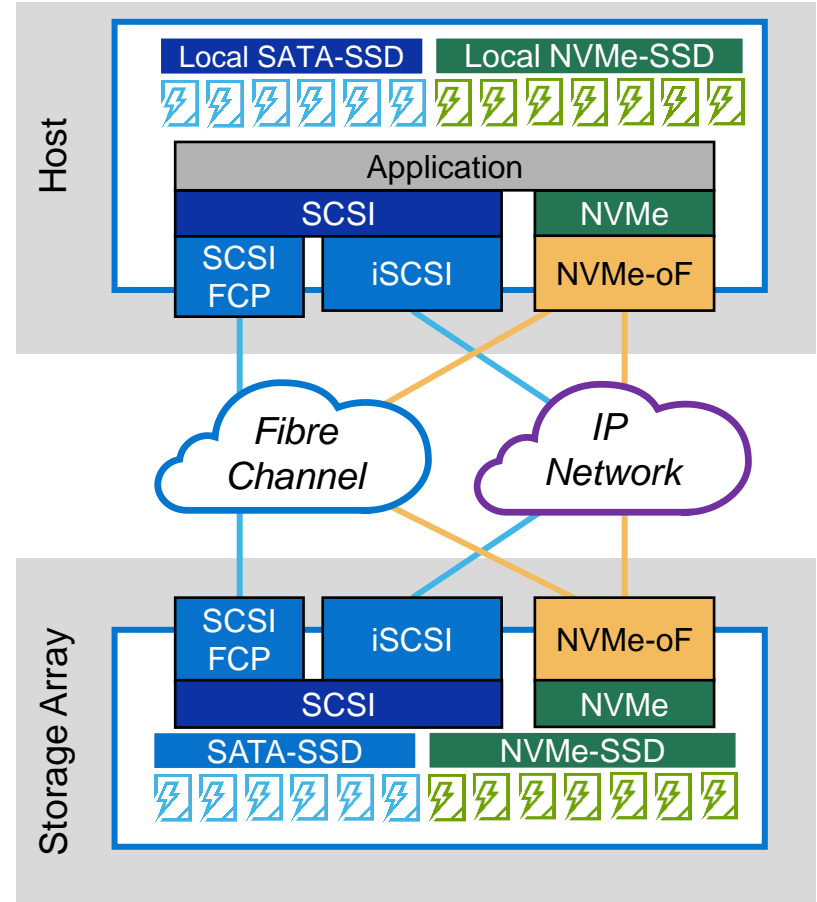
3 - Gen 2 models may be clustered with Gen 1 T models, but not with Gen 1 X models

NVMe/TCP

NVMe-oF™ Evolution

From SCSI to NVMe

- Application running on a host that is accessing external array-based storage via either FC or iSCSI.
- NVMe Drives were first introduced on the host in 2015 and were used mainly for caching and boot drives
- NVMe-SSDs improve storage array **performance** (~35%) locally but using the SCSI protocol can add significant latency.
- NVMe-oF™ can run over either Ethernet or Fibre Channel with **low latency**.



Performance White Paper Summary

NVMe Transport Performance Comparison*

NVMe/TCP (25Gb)

NVMe/TCP has the **Lowest total cost** per IO and the best performance per dollar

IOPS and latency are **similar** to NVMe/FC and FCP for **Writes**, and **within 20%** for **Reads**

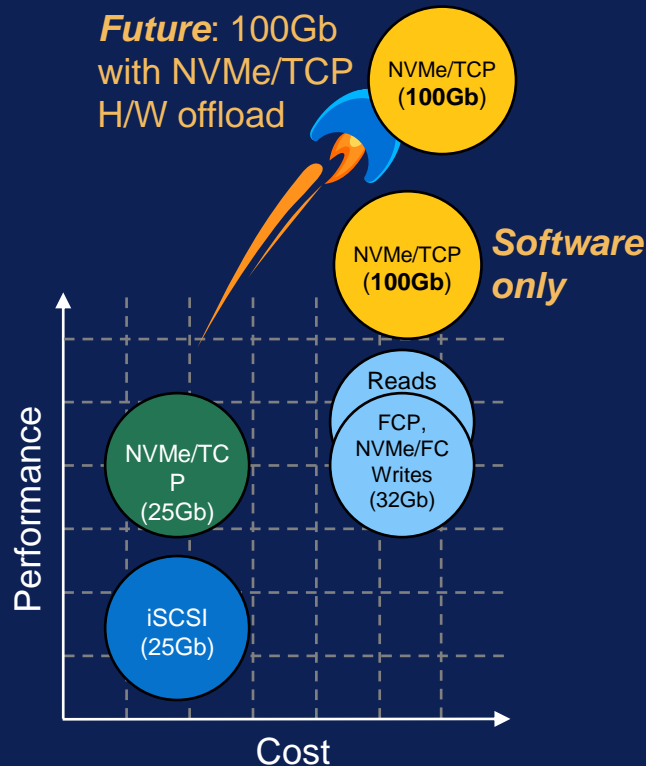
NVMe/FC (32Gb)

NVMe/FC has **higher IOPS and lower latency** than FCP

Provides the **best overall performance**

iSCSI (25Gb)

iSCSI has the **lowest IOPS** and the **highest latency**

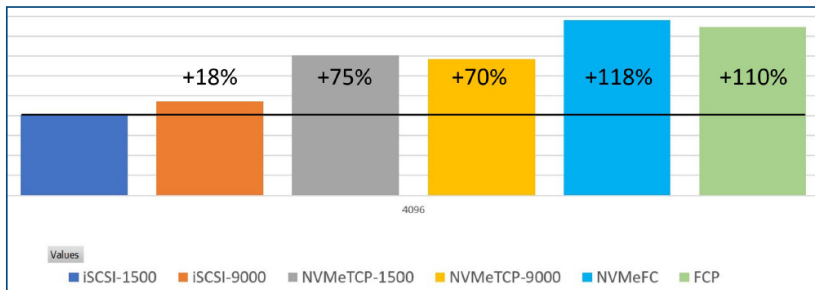


- *Compares 32Gb Fibre Channel (FCP), NVMe/FC and 25Gb NVMe/TCP and iSCSI using Dell PowerStore and ESXi
- [Link: NVMe Transport Performance Comparison](#)

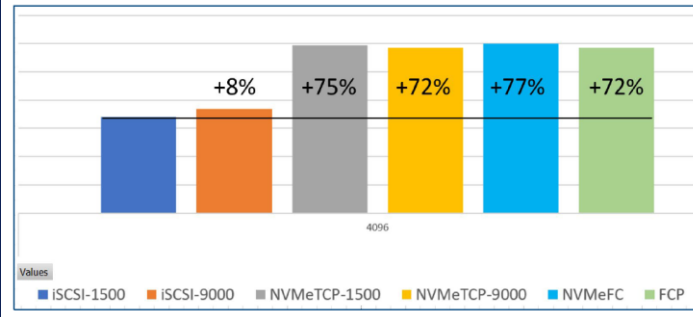
Performance White Paper Summary

NVMe Transport Performance Comparison

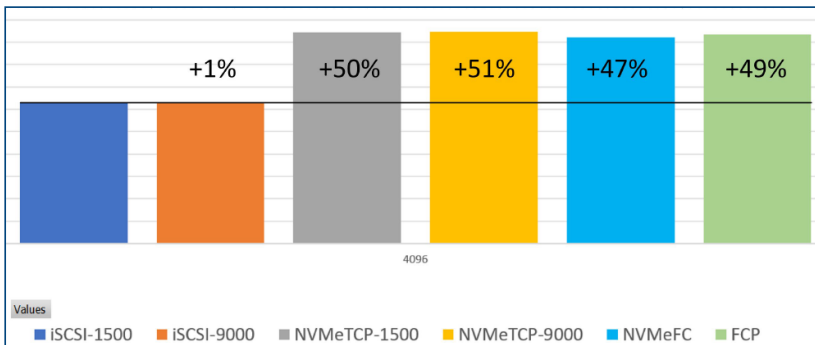
3.1.1 IOPS – 4K - 100% READ



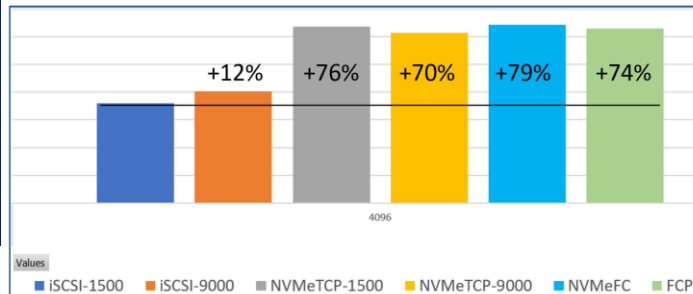
3.1.3 IOPS – 4K - 50% READ / 50% WRITE



3.1.2 IOPS – 4K - 100% WRITE



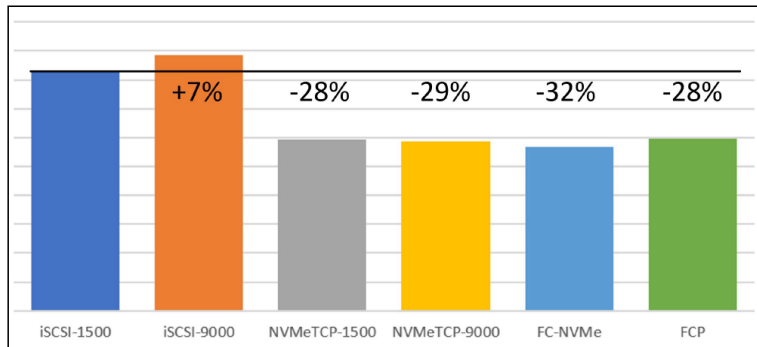
3.1.4 IOPS – 4K - 70% READ / 30% WRITE



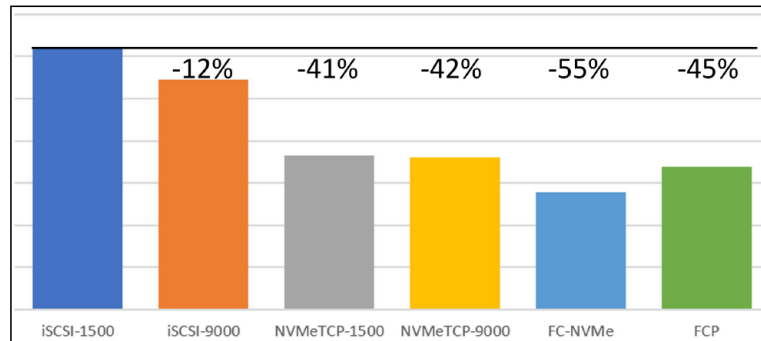
Performance White Paper Summary

NVMe Transport Performance Comparison

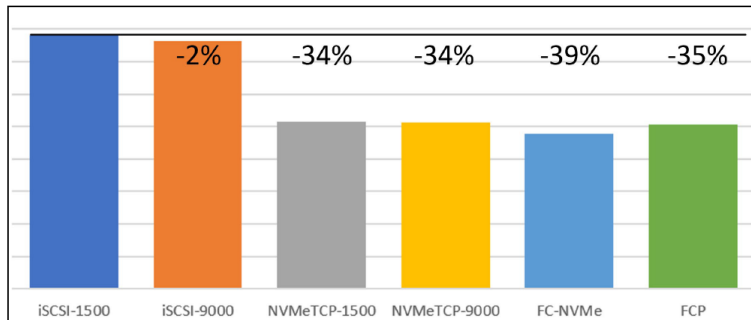
3.3.1 CPU Utilization – 4K - 100% Write



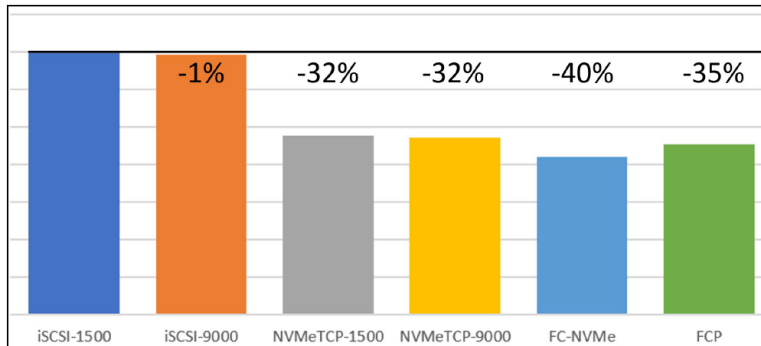
3.3.2 CPU Utilization – 4K - 100% Read



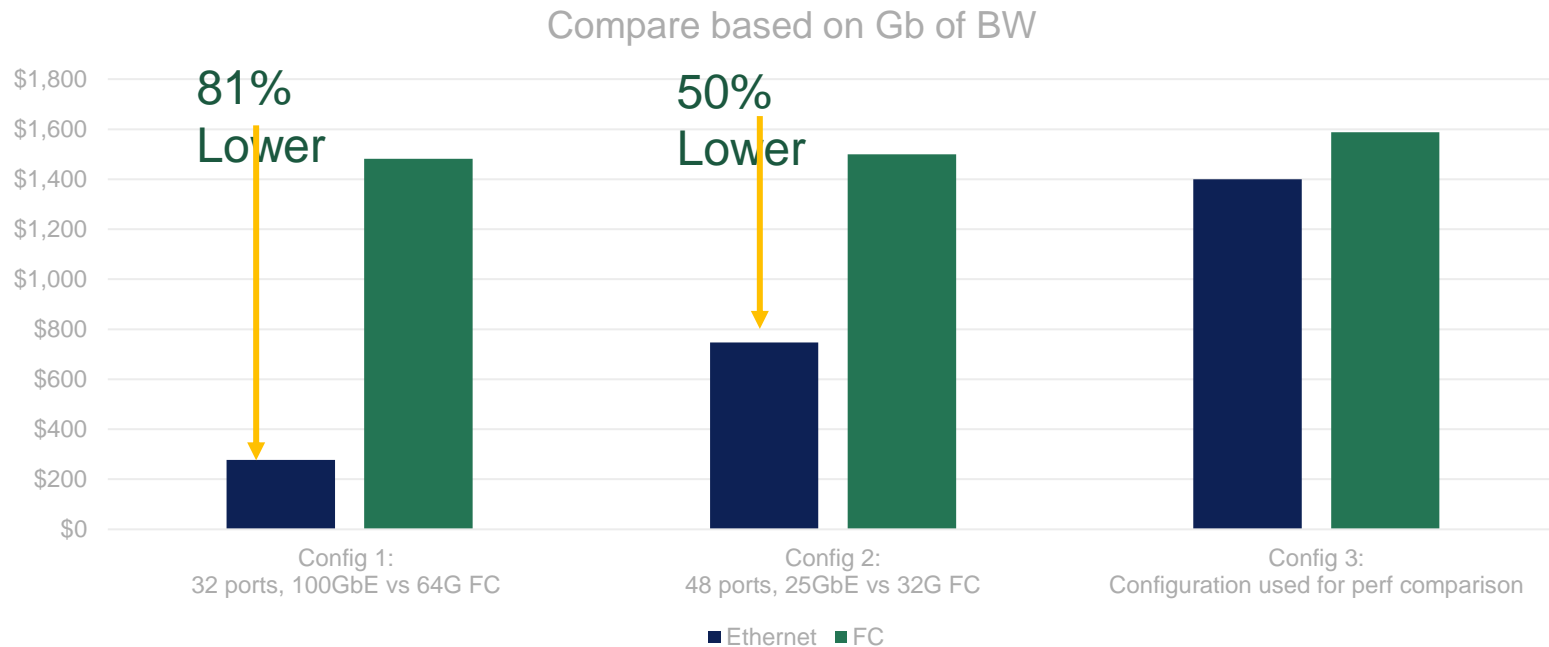
3.3.3 CPU Utilization – 4K - 50% READ / 50% WRITE



3.3.4 CPU Utilization – 4K - 70% READ / 30% WRITE

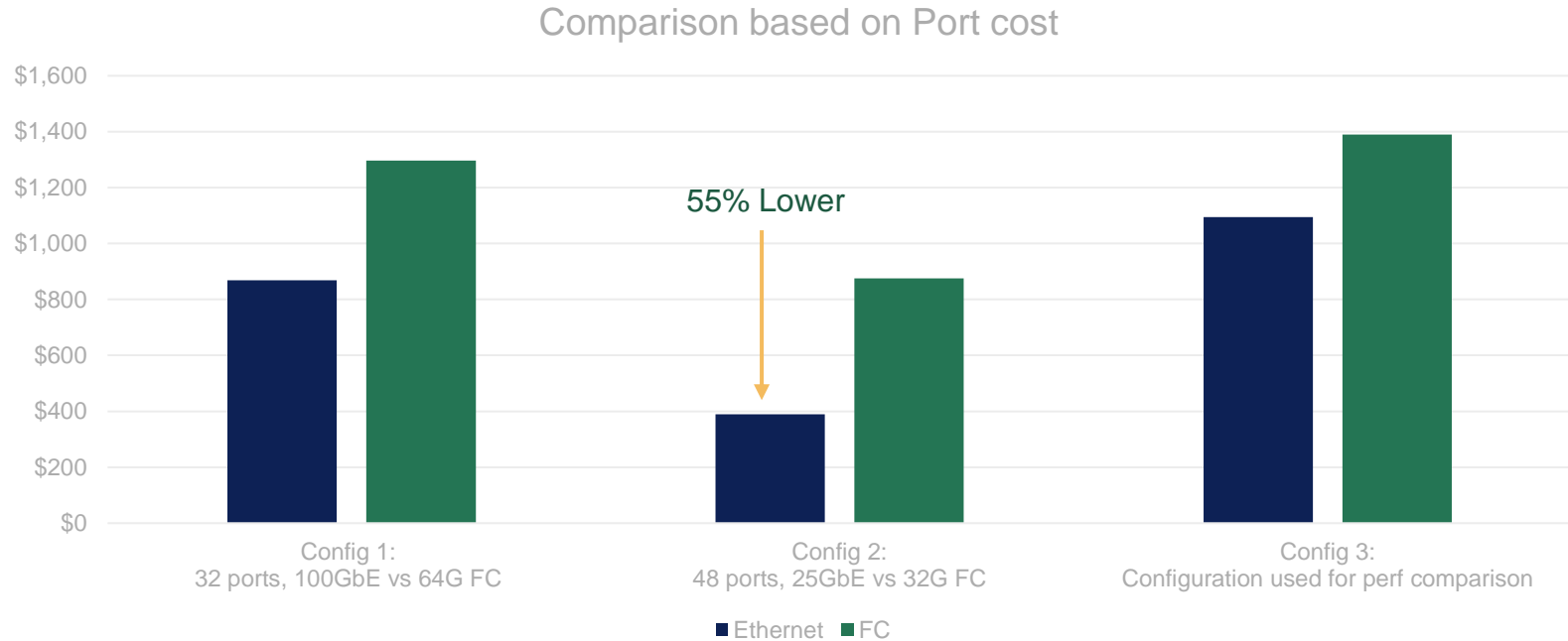


Ethernet cost is up to 81% less per Gigabit of bandwidth than FC in some configs*



*Based on updated information in May 2023, using Dell Technologies' hardware and costs.

Ethernet cost is up to 55% less per port than FC in some configs*



*Based on updated information in May 2023, using Dell Technologies' hardware and costs.

NVMe/TCP – FC Experience for less

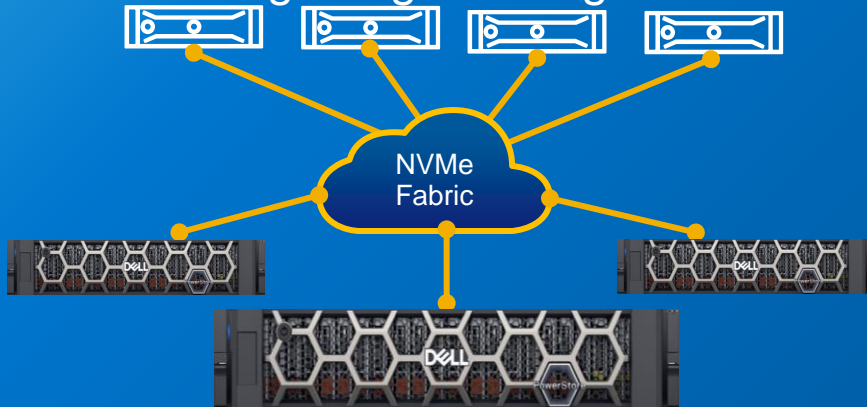
	Fibre Channel	Ethernet iSCSI	NVMe-oF RoCE	NVMe-oF TCP/IP
Low Latency and High IOPS	✓		✓	✓ → ✓
High Speed End-device support (100G+)		✓	✓	✓
HW Offload support (e.g., T10 DIFF)	✓			
Software Defined Storage		✓	✓	✓
Centralized Provisioning	✓		✓	✓
State Change Notifications	✓		✓	✓
Edge/Distributed System at Scale				✓
Cloud Operating Model/Automation				✓
CapEx Cost Advantage		✓		✓

OPEX benefits

NVMe Connectivity Support

End-to-end NVMe Support

Leverages 25Gb/s and/or 100Gb/s IP fabrics to connect servers and storage targets using TCP



New 100GB/s IP Connectivity

- Supports all V1 and V2 Models
- Provides 4 IP ports that can support NVMe/TCP, iSCSI, and File
- Optical or Copper transceiver options

SmartFabric Storage Software

- Optional add on software that provides automation similar to Fibre Channel
- Implements standard NVMe calls to discover and add servers and storage without manual administration

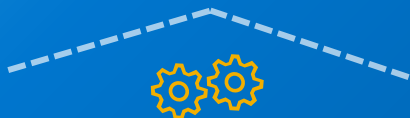
Integrated support for NVMe Fabrics

- Support for NVMe FC/TCP
- Support for vVols over NVMe FC/TCP
- eLab qualified, PowerPath enabled

Dell SmartFabric Storage Software (SFSS)

SFSS

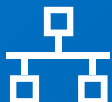
End-to-end NVMe/TCP discovery and auto-config



End-to-end NVMe/TCP discovery and auto-config



Compute



Network



Storage

Makes NVMe/TCP an **easy and cost-effective** IP alternative to Fibre Channel for block SANs.

Industry-first Automation

FC-like services

- Centralized Discovery Controller (CoC)
- End-point registration and query services
- Zoning service access controls
- Asynchronous event requests & notifications

Simplify / standardize your NVMe/TCP transition

- Automated deployment at any scale
- Minimize errors, time to solution
- Fast proof-of-concept trials
- Quick expansion

1 Industry's first software tool for automating NVMe/TCP discovery and configuration. Based on Dell analysis comparing NVMe/TCP discovery and registration with PowerStore using SmartFabric Storage Software vs competitive storage solutions, March 2022.

End-to-end NVMe ecosystem

Treat your workloads to improved IOPS performance, throughput and reduced latency

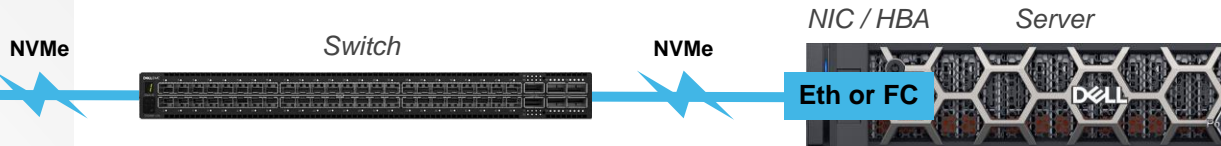
All-NVMe storage



ALL PowerStore models now support NVMe expansion enclosures.

Begin your NVMe network transition More efficient, parallel, scalable than SCSI

- Easy software-only upgrade, using existing hardware.¹
- Run standard SCSI/iSCSI and NVMe over same network.



100/25Gb NVMe/TCP
High-performance IP alternative to FC
Easy deployment w/ SmartFabric software!

32Gb NVMe/FC
Lower latency for block and/or vVols workloads

¹ Assumes compatible 25Gb, 32Gb or 100Gb switches and HBAs. See notes for required firmware levels.

Why is NVMe/TCP Attractive

Cost, Performance, and Management

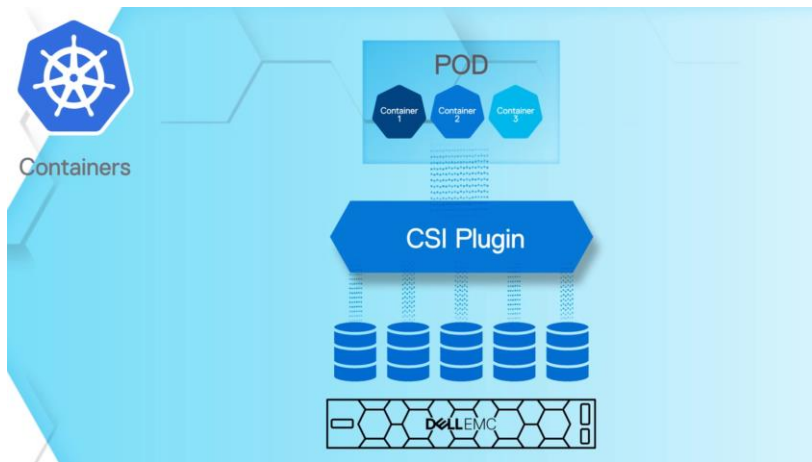
- **Cost**
 - Ethernet is cheaper than FC
- **Performance**
 - 25GbE/100GbE vs 32Gb/64Gb FC
- **Management**
 - NVMe/RoCE network configuration is complex and challenging
 - NVMe/TCP provides FC-like experience with features like zoning
 - Many medium / large enterprise customers are already very familiar with FC zoning

DevOps Integrations

Dell Technologies CSI and CSM Plugins

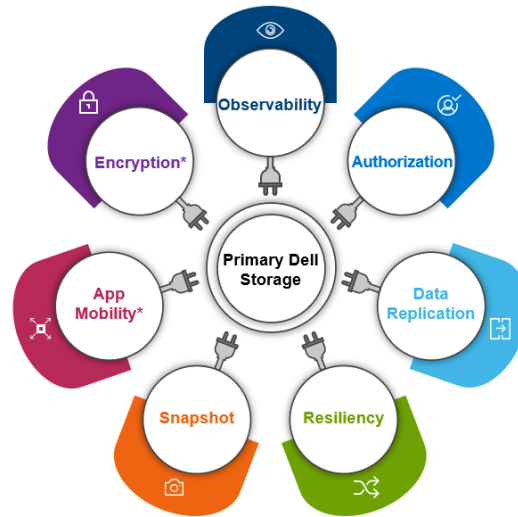
Dell CSI Plugins

Extends existing infrastructure to rapidly deploy modern microservice based applications



Dell CSM Modules

Provides enterprise infrastructure services in K8s Environment



* Currently in tech preview, available on request

PowerScale

PowerFlex

PowerMax

PowerStore

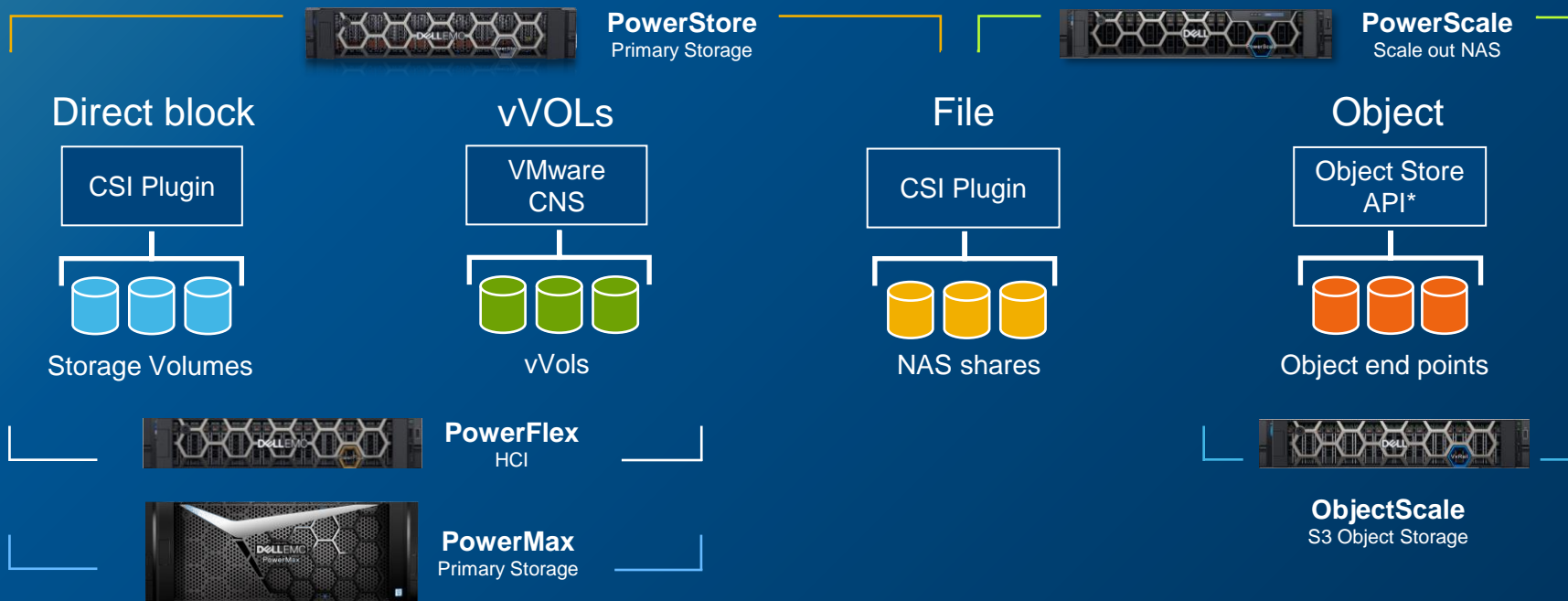
Unity XT

DELLTechnologies

CSI

(Container Storage Interface)

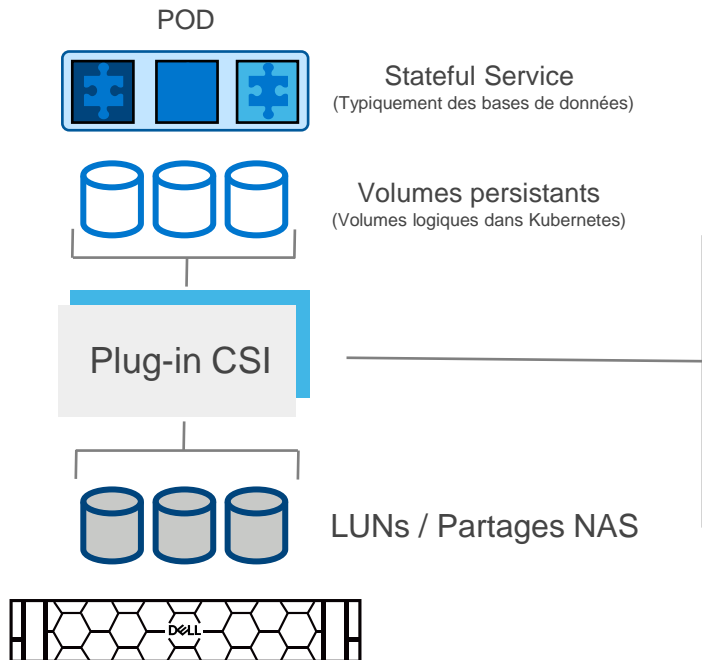
Storage for every Kubernetes workload



Over 5 Million Downloads of PowerScale CSI Driver

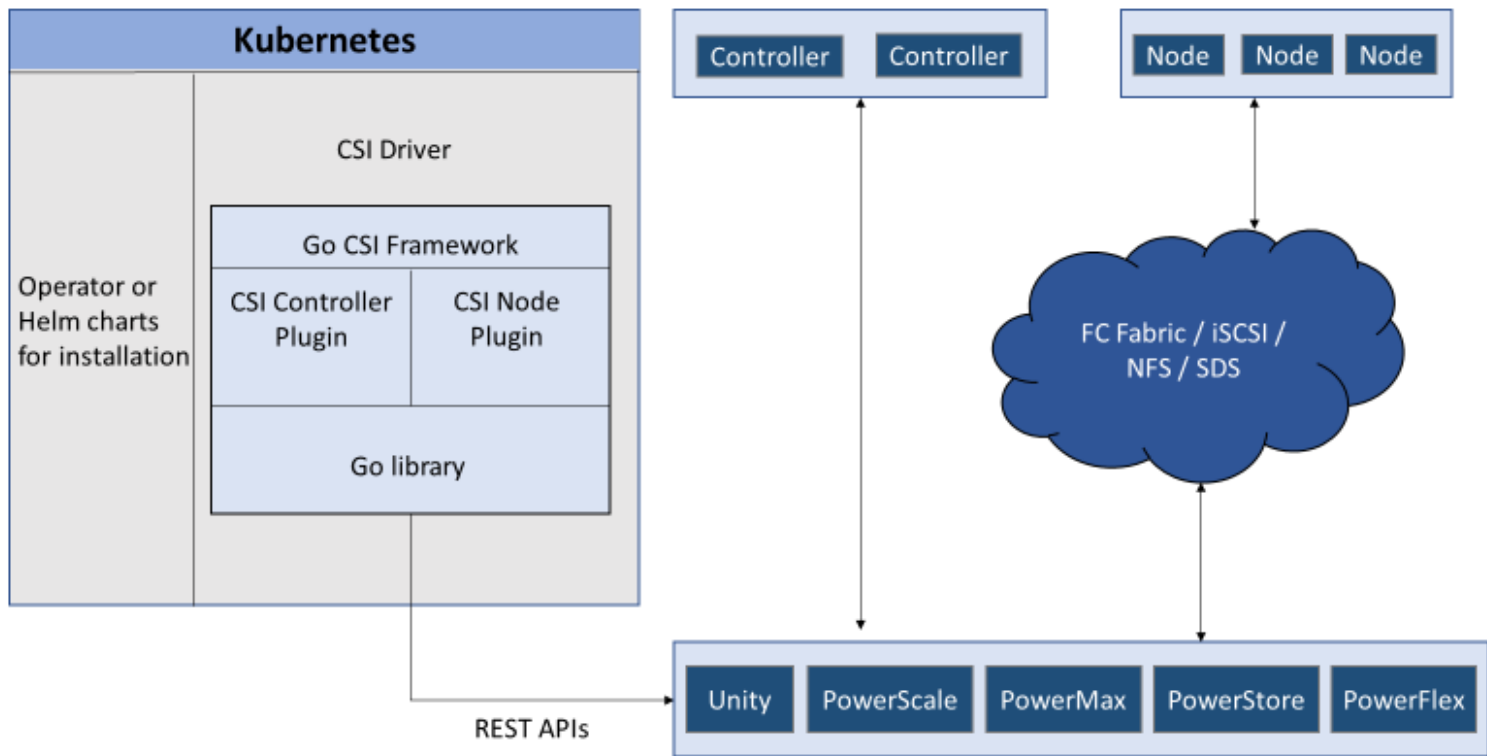
Pilote CSI (Container Storage Interface)

Gestion standard du cycle de vie des volumes et des snapshots pour les charges de travail Kubernetes



- Interface de stockage standard pour les applications conteneurisées
- Interface unique pour n'importe quelle distribution Kubernetes
- Prise en charge de l'ensemble du portefeuille de stockage Dell

Architecture



Internal Use - Confidential

CSM, c'est quoi ?

1

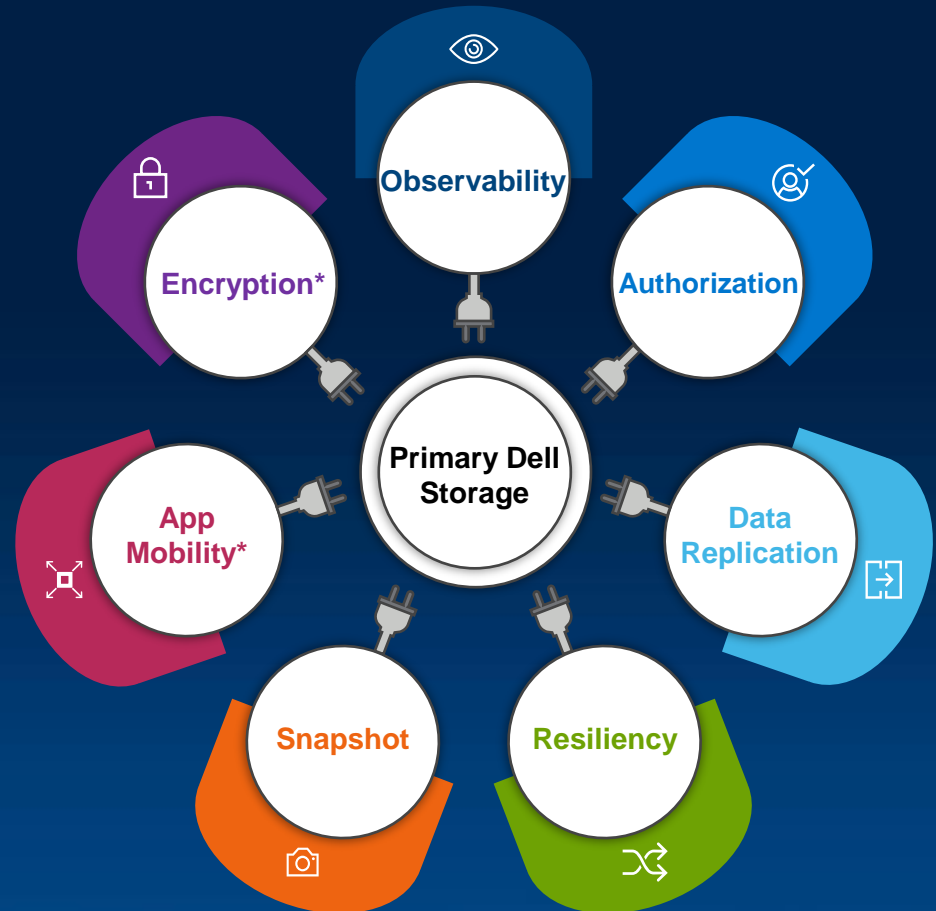
Expérience simple, intégrée et automatisée pour le stockage et les applications cloud natives (stateful)

2

S'appuie sur la base de l'interface de stockage de conteneurs (CSI) pour offrir des capacités de stockage d'entreprise uniques et puissantes

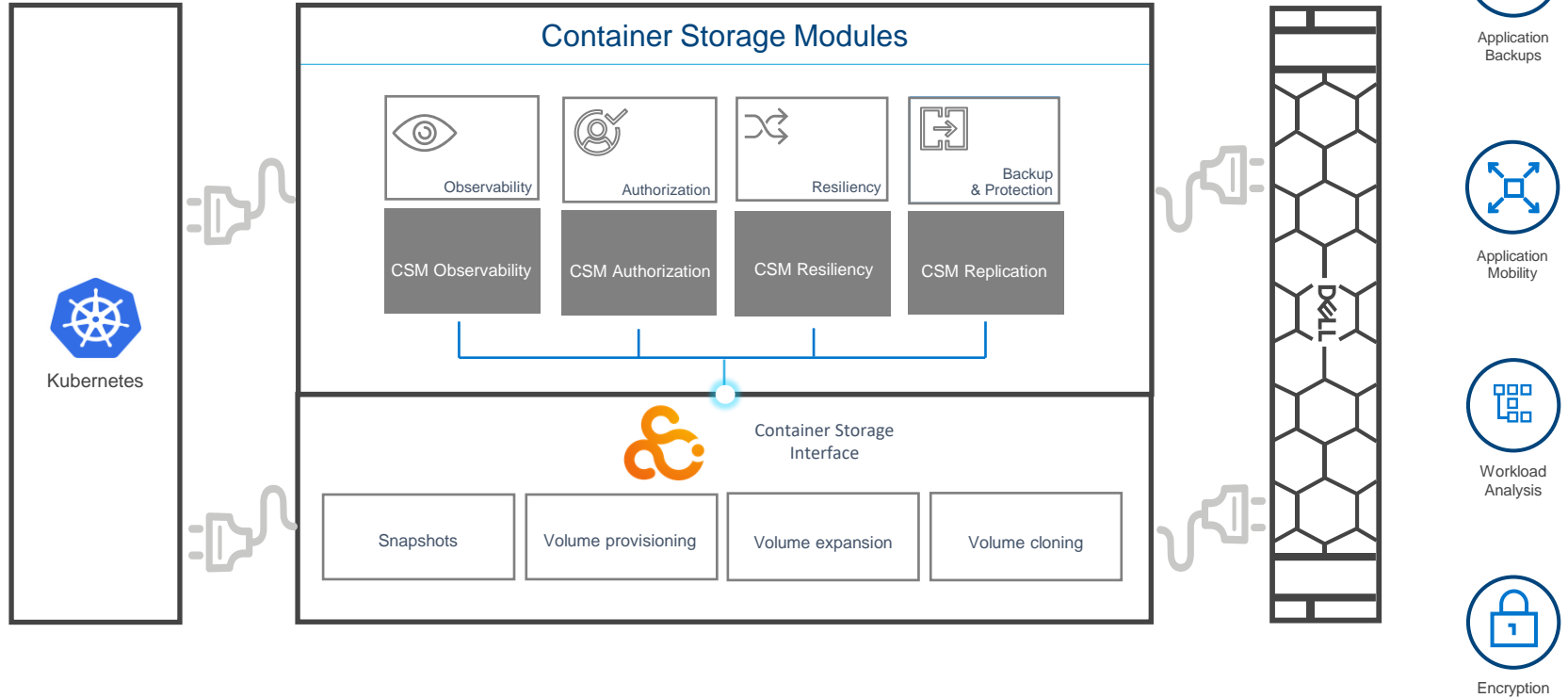
3

Comprend une variété de modules, chacun avec des fonctionnalités spécifiques qui vous permettent de tirer le meilleur parti de votre baie de stockage



* Actuellement en avant-première technique, disponible sur demande

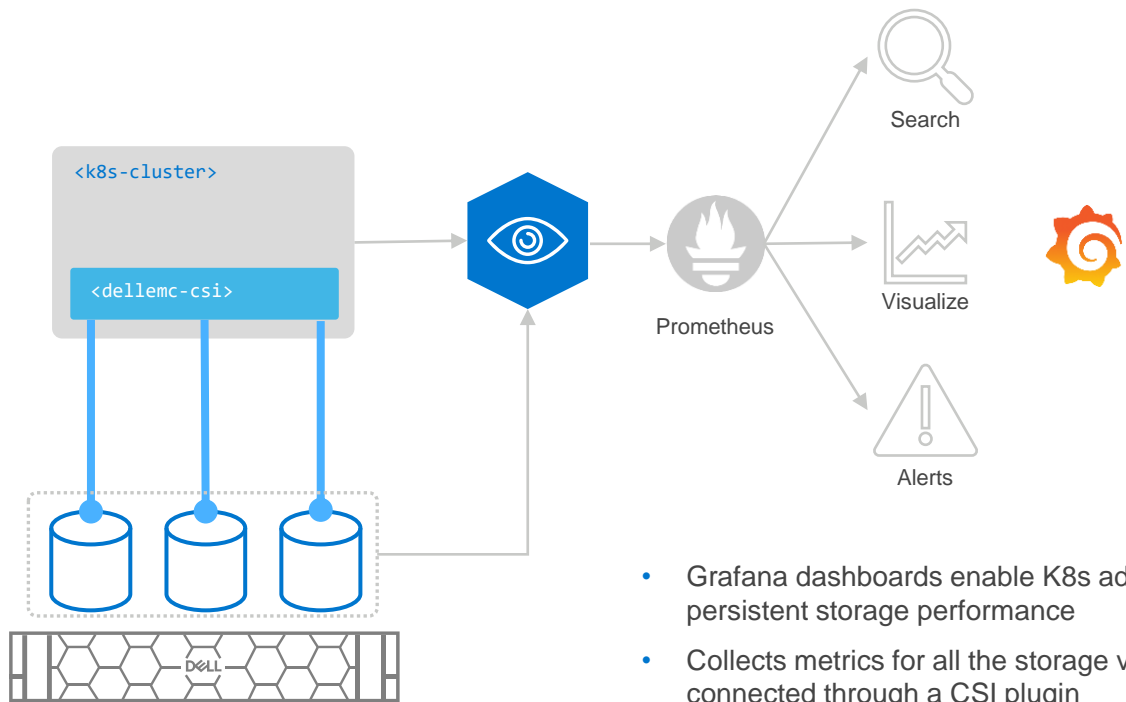
Enabling automation



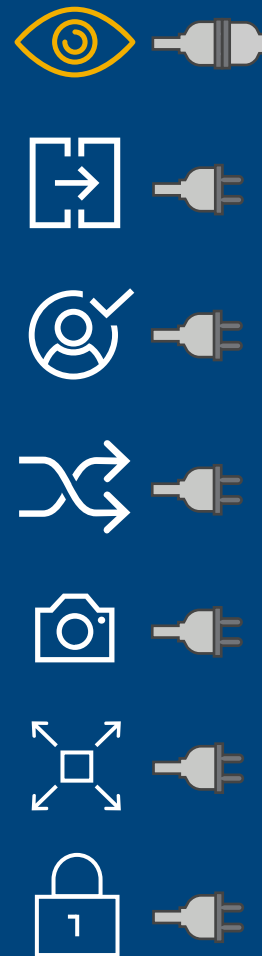
Observability

Observability Module

Access storage metrics in tools like Grafana and Prometheus



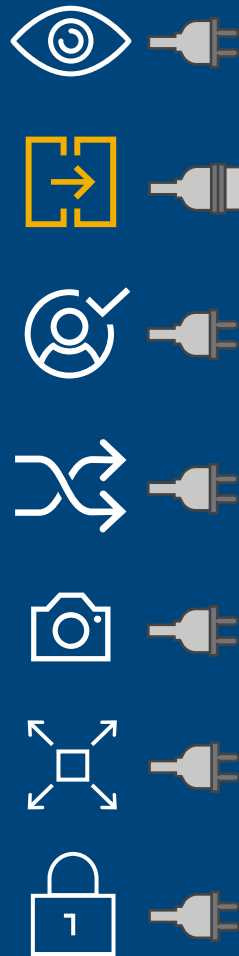
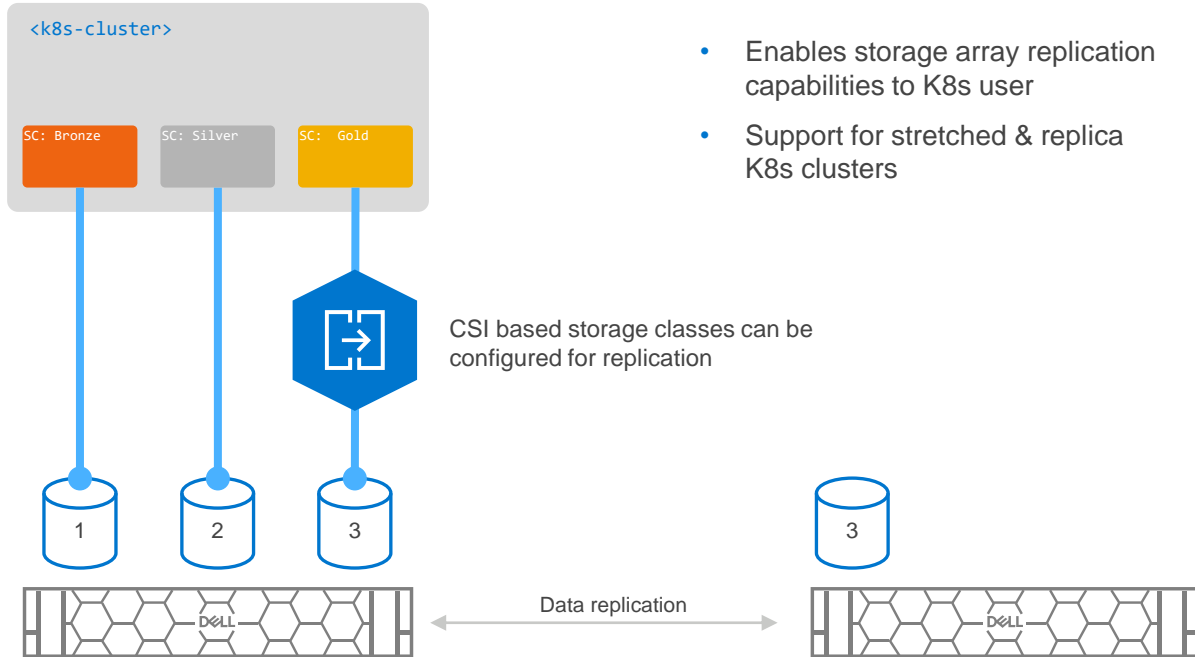
- Grafana dashboards enable K8s admin monitor persistent storage performance
- Collects metrics for all the storage volumes connected through a CSI plugin
- Simple to use, requires no expertise in storage



Data Replication

Data Replication Module

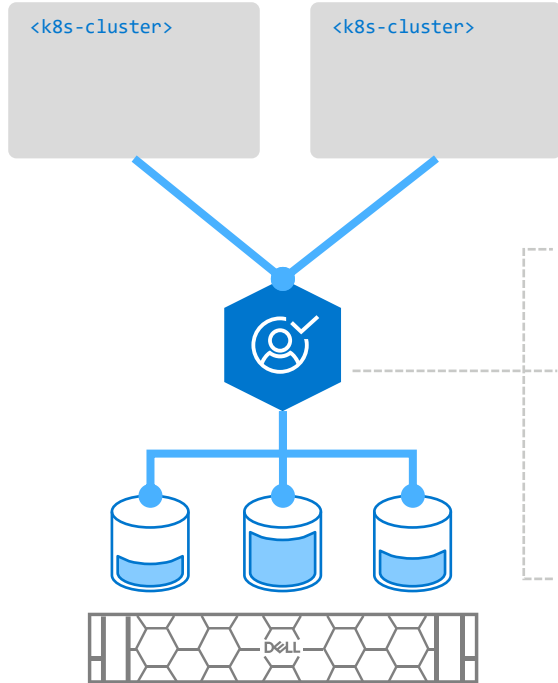
Industry leading replication to extend Kubernetes clusters across datacenters



Authorization

Authorization Module

Access control to storage infrastructure with user group support



- Enables provisioning operations to non-admin users
- Logical resource isolation to enable multi-tenancy



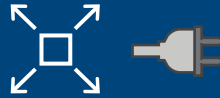
Security token based access to the array at the cluster level



Works for all the apps in a cluster or set of clusters, so developers need not worry about generating and using token

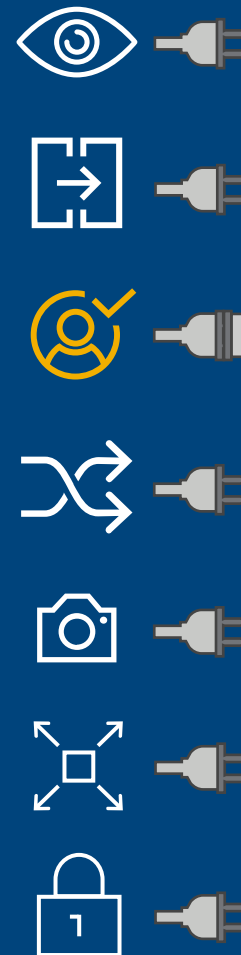
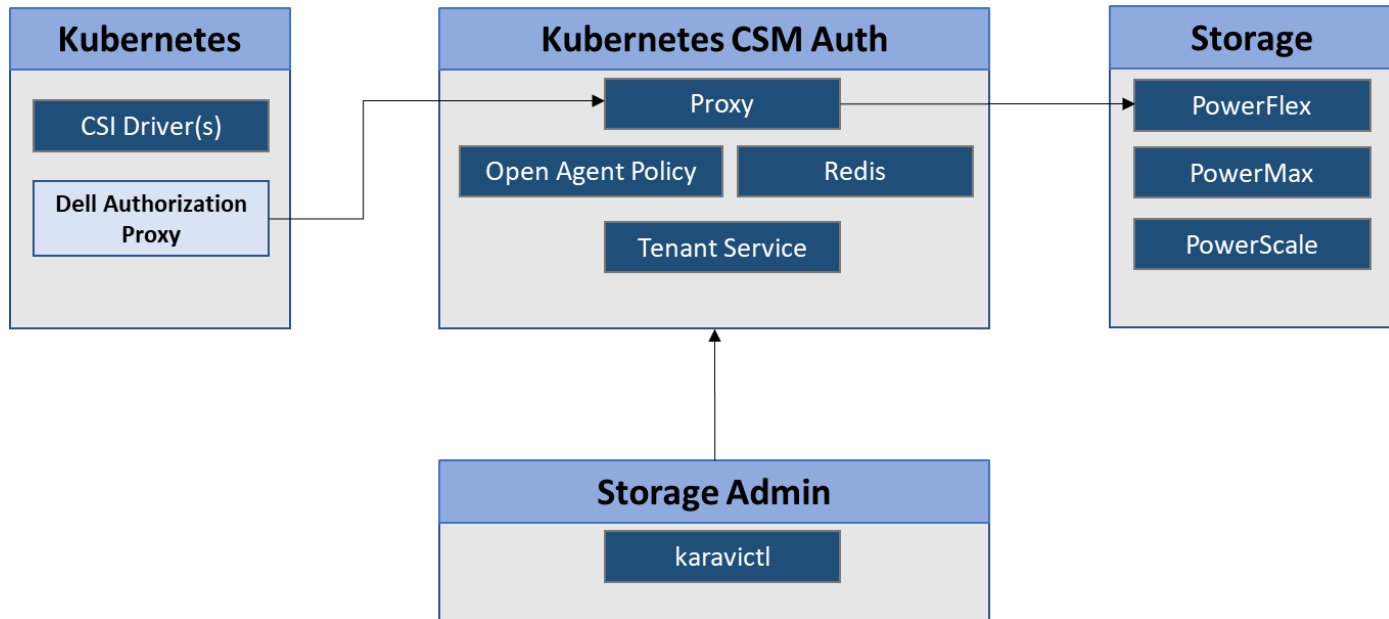


Storage admins can enforce storage quota at the cluster level. Cluster admins can setup additional quotas per application within K8s environment



Authorization Module

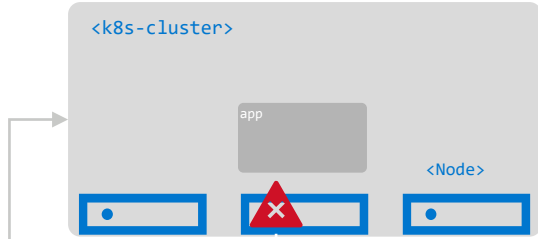
Access control to storage infrastructure with user group support



Resiliency

Resiliency Module

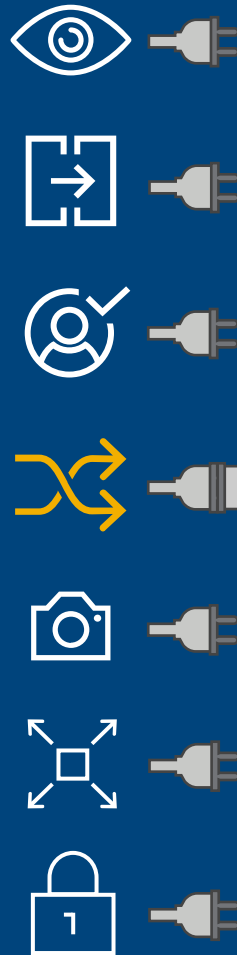
Node failure detection and recovery mechanism



- Enables K8s node failover by monitoring persistent volume health
- Trigger POD failover



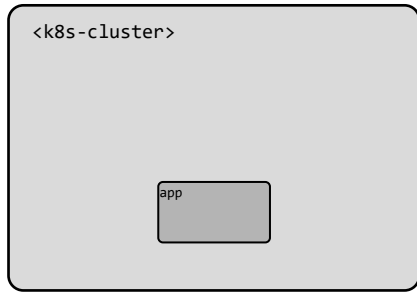
Node failure determination and recovery orchestration with Kubernetes



Snapshots

Snapshots (through CSI)

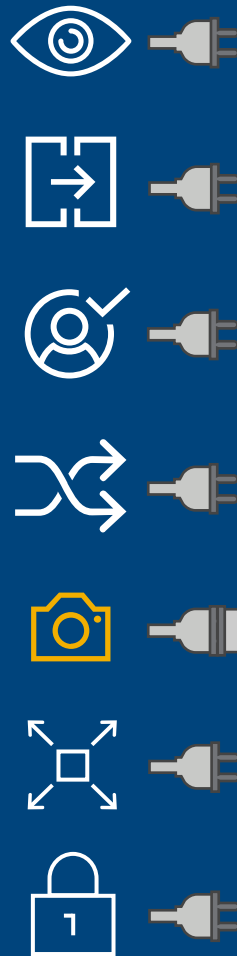
Expanding on existing capabilities delivered through Dell's CSI plugin



CSI based snapshots for operational recovery and data repurposing

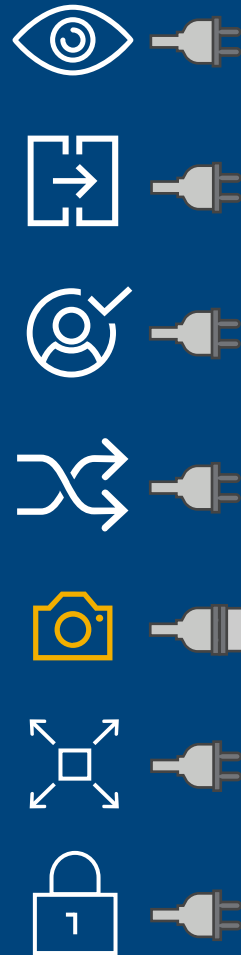
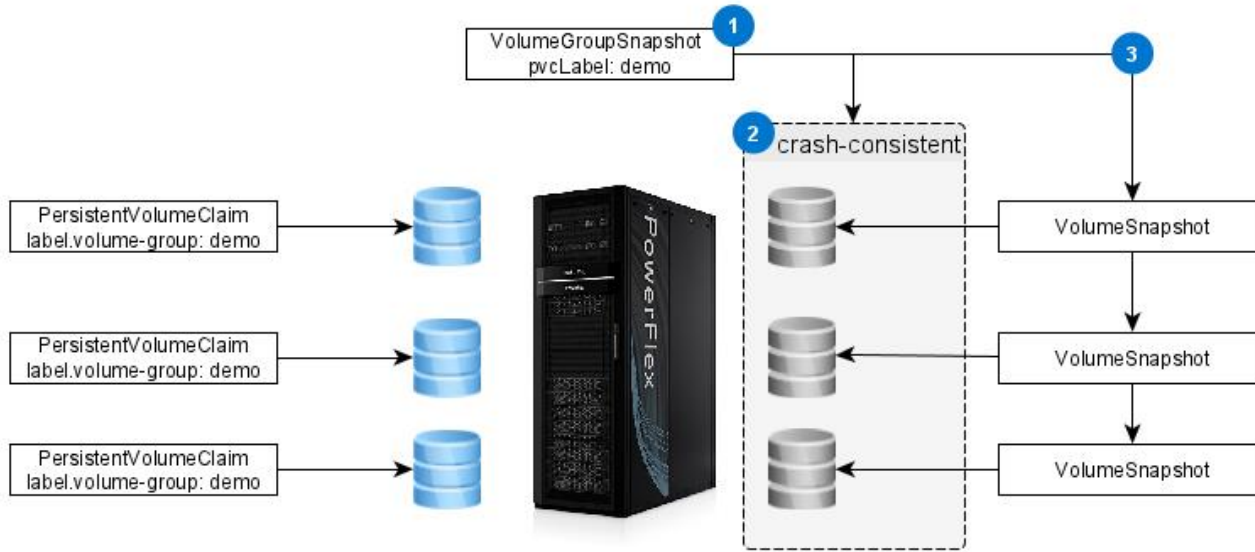


- Build on CSI's point-in-time recovery with additional capabilities such as group/crash consistent snapshots with referential integrity



Snapshots (through CSI)

Expanding on existing capabilities delivered through Dell's CSI plugin



App Mobility

App Mobility Module

Migrate the entire meta data of your applications to meet a variety of use cases

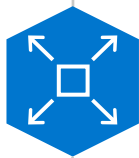
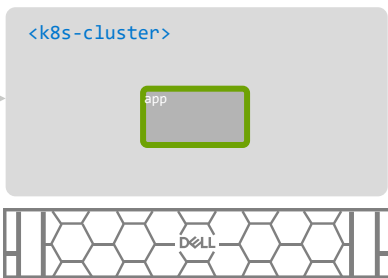
Primary Site



Hybrid Cloud

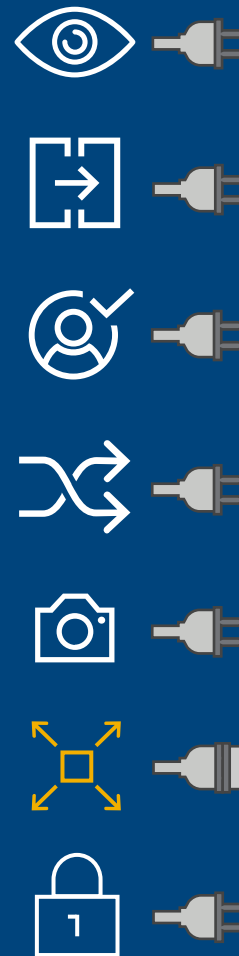


Test/Dev Environment



- Clone stateful application workloads and application data to other Kubernetes clusters using a single command
- Move applications either on-premises or in the cloud to meet repatriation, deployment, migration or test/dev goals

Application Mobility uses [Velero](#) and its integration of [Restic](#) to copy both application metadata and data to object storage.

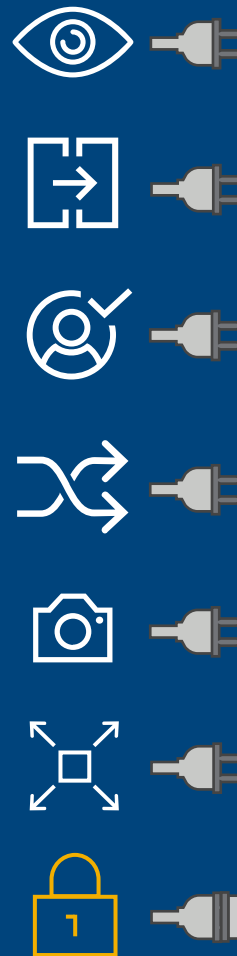
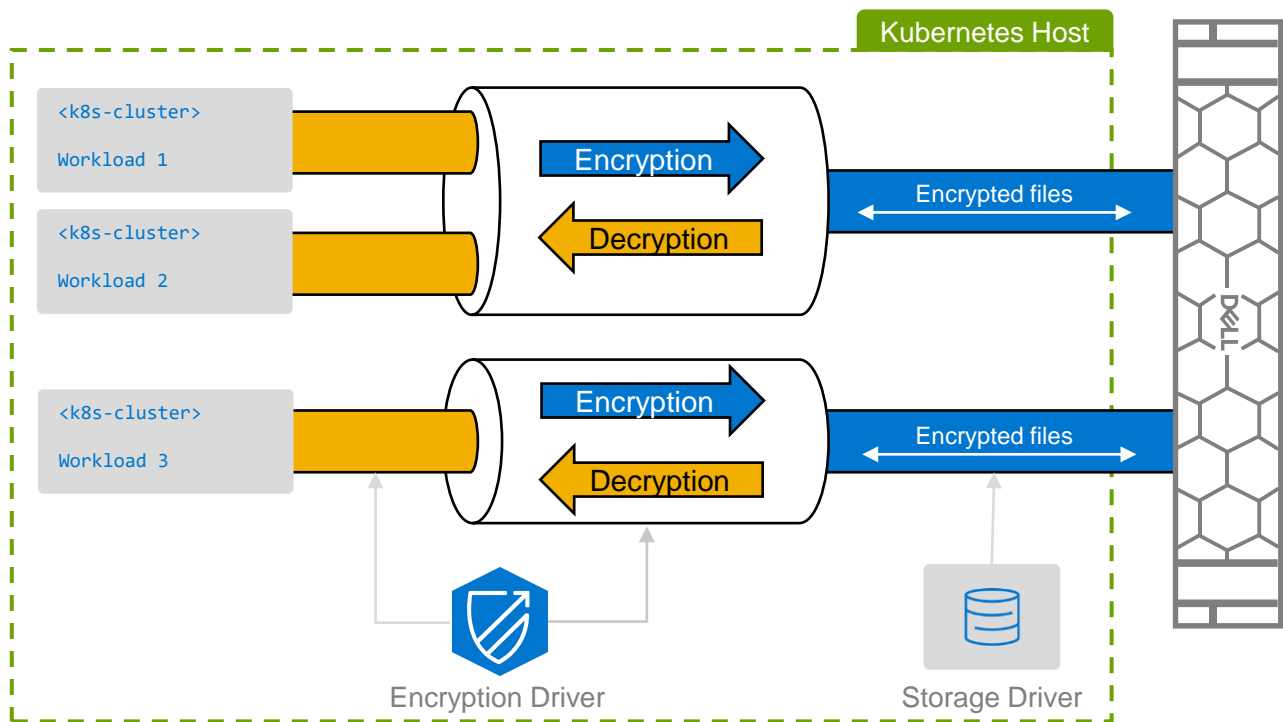


Encryption

Encryption Module

Protect Kubernetes storage environment from malicious attacks with added encryption

- Transparently adds host side encryption to a volume
- Adds encryption in motion (on top of the storage arrays encryption at rest)



Documentation

<https://dell.github.io/csm-docs/>

 Dell Technologies

[Container Storage Modules](#) [GitHub](#) [Releases](#)

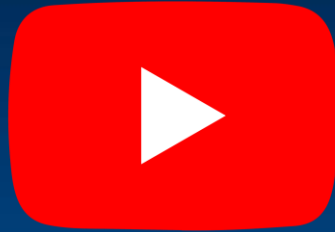
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Demo

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