

Hewlett Packard Enterprise

Storage portfolio overview

The HPE vision

- Be the industry's leading provider of **hybrid IT**
- Provide secure, next-generation, **software-defined infrastructure** to run your centers today and bridge to multi-cloud environments tomorrow
- Power the emerging **intelligent edge** that will run **campus, branch and Industrial IoT** applications for decades to come
- Support you with our world class **services** capabilities

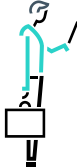


The HPE strategy


 We make **Hybrid IT** simple

Traditional Data Center	Private Cloud
Managed Cloud Services	Public Cloud

Traditional Data Center Software-defined Infrastructure and Private Cloud Multi-cloud Partnerships

 We power the **Intelligent Edge**

Campus & Branch Industrial Internet of Things

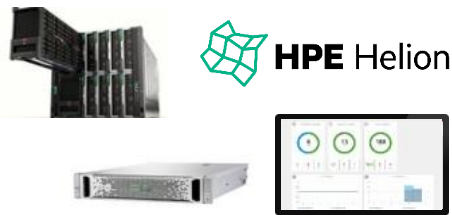
 We have the **expertise to make it happen**

Advisory & Professional Services Technical Services IT Consumption Models

Realizing our vision

Organic Investments

- HPE Synergy
- Hyper Converged 380
- Edgeline
- OneView
- Helion Cloud Platform
- Aruba Mobile First
- All Flash
- The Machine
(Memory-driven, NVM, Photonics)



Targeted Acquisitions

- Aruba Networks
- SGI
- 3PAR
- LeftHand
- Contexstream
- Rasa Networks
- Simplivity
- Nimble



Strategic Partnerships

- Microsoft Azure
- Docker
- Mesosphere
- Chef
- GE Digital
- National Instruments
- Arista
- Scality
- HP Inc.
- Veeam
- DXC technologies
- Micro Focus



Portfolio Optimization

- H3C deal
- Mphasis stake sale
- TippingPoint sale
- DXC technology
- Spin-merge of non-core software assets with Micro Focus¹



Introducing the industry's most complete flash portfolio



MSA and StoreVirtual
Most affordable – storage for the performance needs of small sites



SimpliVity
Hyperconverged – software-defined infrastructure that makes hybrid IT simple



Nimble Storage
Simplest – predictive and cloud-ready all-flash and hybrid flash storage



3PAR
Most flexible – unified storage for the all-flash datacenter



XP7
Extreme availability – lowest in class TCO for enterprise consolidation

The right flash platform at the right economics with the right level of protection for any customer



Introducing HPE MSA 2050/2052 Storage

MSA 205x product portfolio

Budget optimized



MSA 1040 Storage

**Most affordable HPE
entry-level SAN array**

Flash-
ready

Flexible base model



MSA 2050 Storage

**2X more performance than
previous generation for the
same price**

Flash-
ready

Performance optimized



MSA 2052 Storage

**Save 40% with all-inclusive
software and 1.6 TB of flash
capacity included**

Hybrid
flash
model

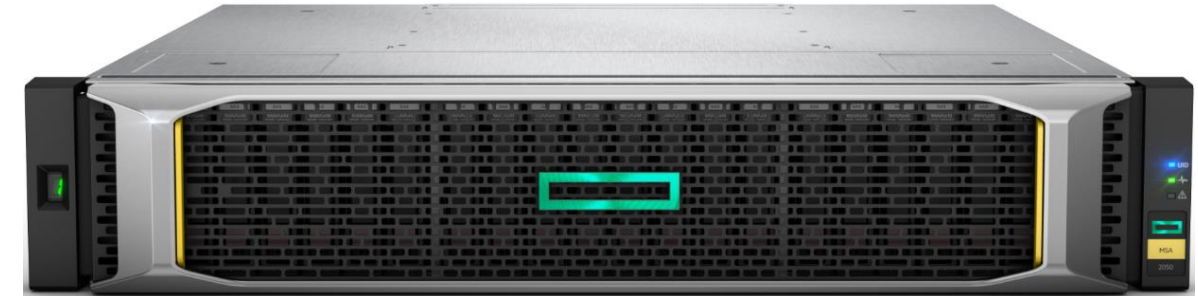
The leading entry FC SAN platform for eight years running*
More than 500,000 HPE MSA Storage systems sold worldwide

* Source: IDC WW Quarterly Enterprise Storage Systems Tracker, 4Q16, based on vendor revenues

Array enclosures

MSA 205x

Front view



Rear view



Large form factor—12 drives



Small form factor—24 drives



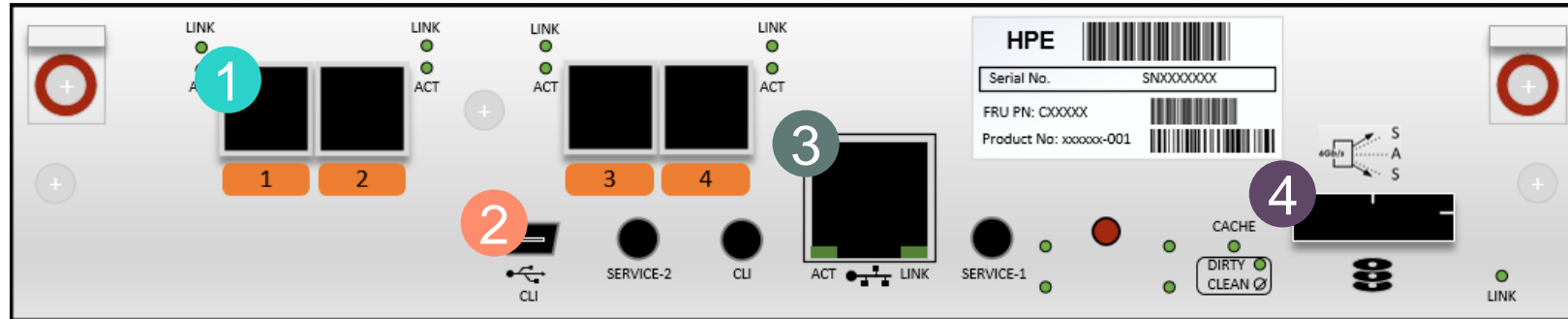
Rear view

MSA 205x



- 1 Dual cooling
- 2 Dual power supply (AC or DC)
- 3 Controller

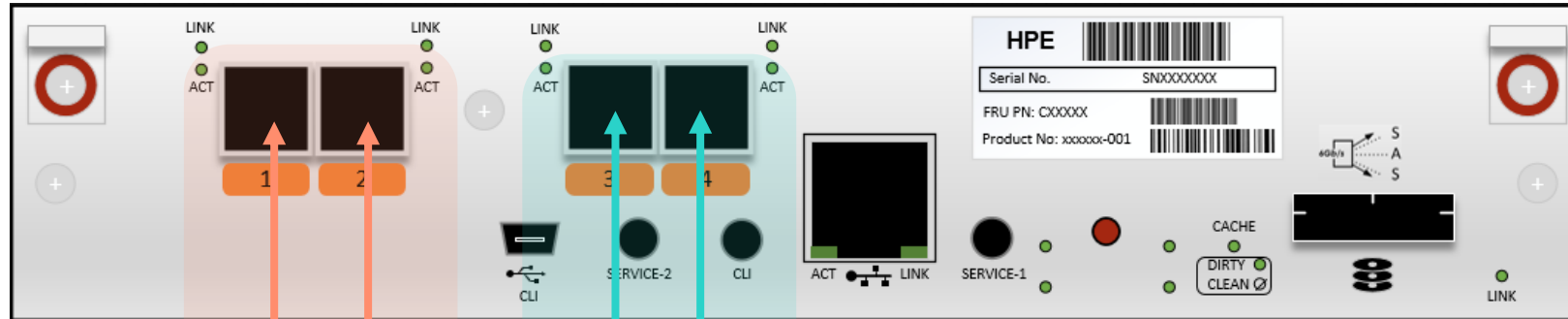
Converged SAN controller (1 of 2)



- 1 Host port (empty SFP bay)
- 2 Micro-USB serial port (CLI)
- 3 Out-of-band Ethernet management port
- 4 6 Gb SAS expansion port

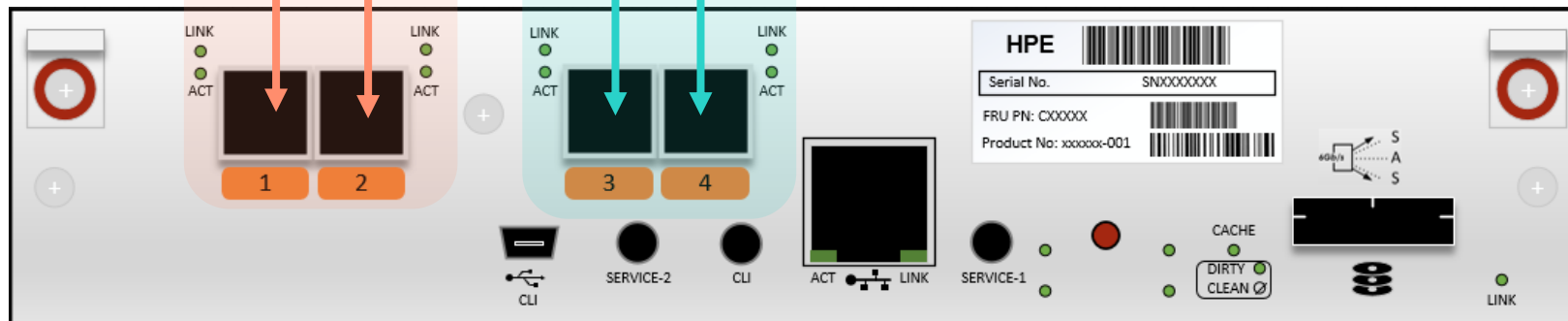
Converged SAN controller (2 of 2)

Controller A



SFP must be the same

Controller B



Scale up



MSA 2050 LFF
96 drives

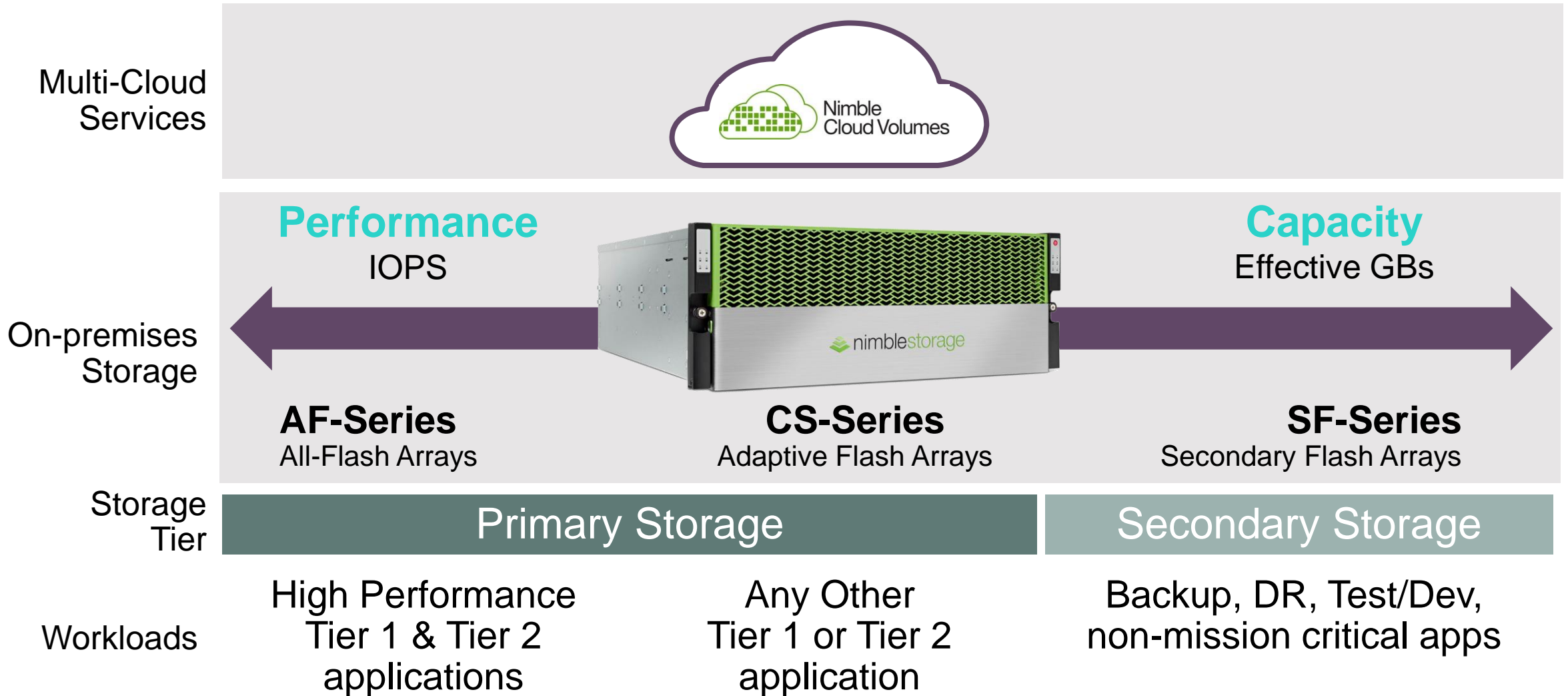


MSA 2050 SFF
192 drives

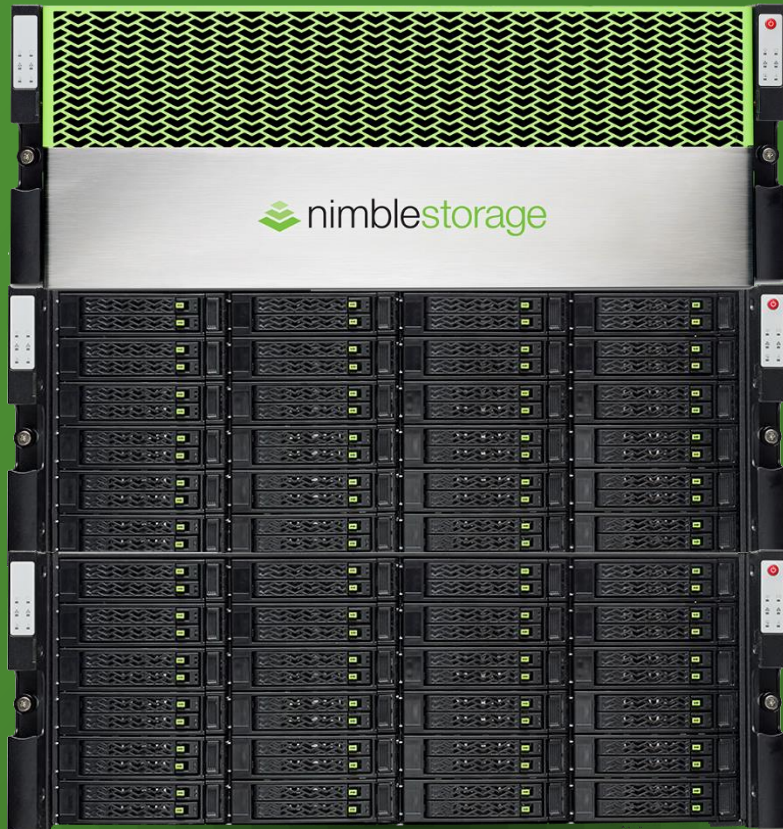


Introducing HPE Nimble Storage

Breadth of Products and Services



Nimble Storage Hardware Overview



4U Chassis

- 4U Height: Up to 48 SSDs with Dual Flash Carriers
- 12Gbps SAS for additional expansion shelves

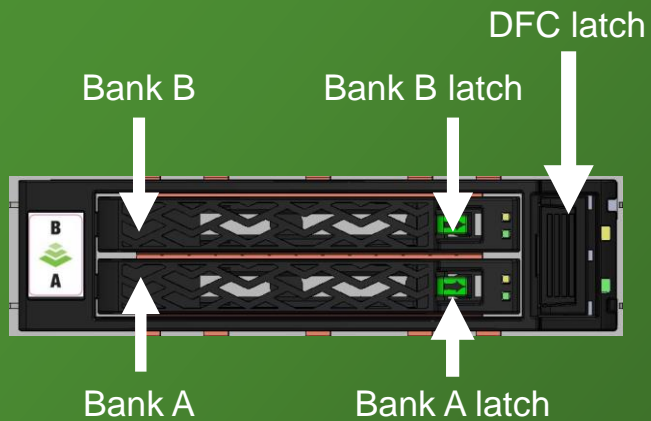
Dual Controllers

- Based on Intel Xeon CPUs
- Interconnect via NTB; NVDIMM-based NVRAM

Nimble Dual Flash Carrier

- Provides built in expandability
- Any SSD can be added/removed with zero disruption

Nimble Storage Dual Flash Carriers



High density

- 2 SFF SSD per LFF slot
- Up to 48 SSD in stand-alone All Flash Array chassis

Non-disruptive upgrades

- Service SSDs in DFC independently
- Add capacity or upgrade flash cache without downtime

First wave of Nimble Storage products

Available through HPE starting in June 2017

	All Flash		Adaptive Flash			Secondary Flash				
	AF1000		CS1000H	CS1000		SF100		SF300		
Initial drive configuration	24		11	21		21		21		
Drive capacities	240GB	480GB	1 TB	1TB	2 TB	1 TB	2 TB	4 TB	6 TB	10 TB
Field upgrades	24 SSD Flash Pack		Flash upgrades, up to 6 expansion shelves			Flash upgrades, up to 2 expansion shelves				
Raw capacity	6 TB	11 TB	11 TB	21 TB	42 TB	21 TB	42 TB	84 TB	126 TB	210 TB
Useable capacity	4 TB	8 TB	7 TB	16 TB	33 TB	16 TB	33 TB	67 TB	101 TB	169 TB
Effective capacity	20 TB	39TB	13 TB	32 TB	66 TB	128 TB	264 TB	536 TB	808 TB	1352 TB
Flash capacities			480 GB or 960 GB	1.44 TB	2.88 TB	1.44 TB	2.88 TB	5.76 TB	9.6 TB	27.87 TB
Data reduction	5:1 (Zero pattern, Compression, Deduplication)		2:1 (Zero pattern, Compression)			8:1 (Zero pattern, Compression, Deduplication)				
Host connectivity	10GbE Optical iSCSI, 10GBASE-T, 16Gb Fibre Channel		1GbE iSCSI, 10GbE Optical iSCSI, 10GBASE-T, 16Gb Fibre Channel			10GbE Optical iSCSI, 10GBASE-T, 16Gb Fibre Channel				
Scale-out	Up to four arrays									

Nimble Storage AF1000

Affordable All Flash Array

- Entry into Nimble Storage All Flash Portfolio
- Multicloud Flash Fabric as single consolidation architecture
- Triple+ Parity RAID for six-nines measured availability
- Effortless Management
- Starting configuration with 6TB or 11TB raw capacity
- Flash upgrades available



Capacity Pack	Raw Capacity (TB)	Usable Capacity* (TB)	Usable Ratio	Effective Capacity** (TB)	Effective Ratio
6TB	5.76	3.7	64.2%	18.5	321%
11TB	11.52	7.9	68.6%	39.5	343%

* No data reduction

** Assumes 5:1 data reduction from deduplication and compression

Comprehensive Data Reduction



Variable block deduplication



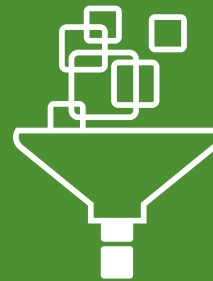
Variable block compression



Zero pattern elimination



Plus more from:
Thin provisioning &
Zero copy clones



5X or more
Data Reduction

Nimble Storage CS1000 and CS1000H

Adaptive Flash Array

- Entry into Nimble Storage Adaptive Flash Array portfolio
- Affordable flash performance with hybrid storage configuration
- Triple+ Parity RAID for six-nines measured availability
- Effortless management
- Starting configuration with 11TB raw capacity
- Upgradable flash cache
- Up to 6 expansion shelves



Comprehensive Data Reduction

Nimble Storage Adaptive Flash Arrays



Variable block
compression



Zero pattern
elimination



Thin provisioning &
Zero copy clones

2–3X or more
Data Reduction

Predictive Analytics Close the App-Data Gap

Millions of Sensors collected every second across installed-base

Cross-Stack Telemetry

Cloud-based Predictive Analytics



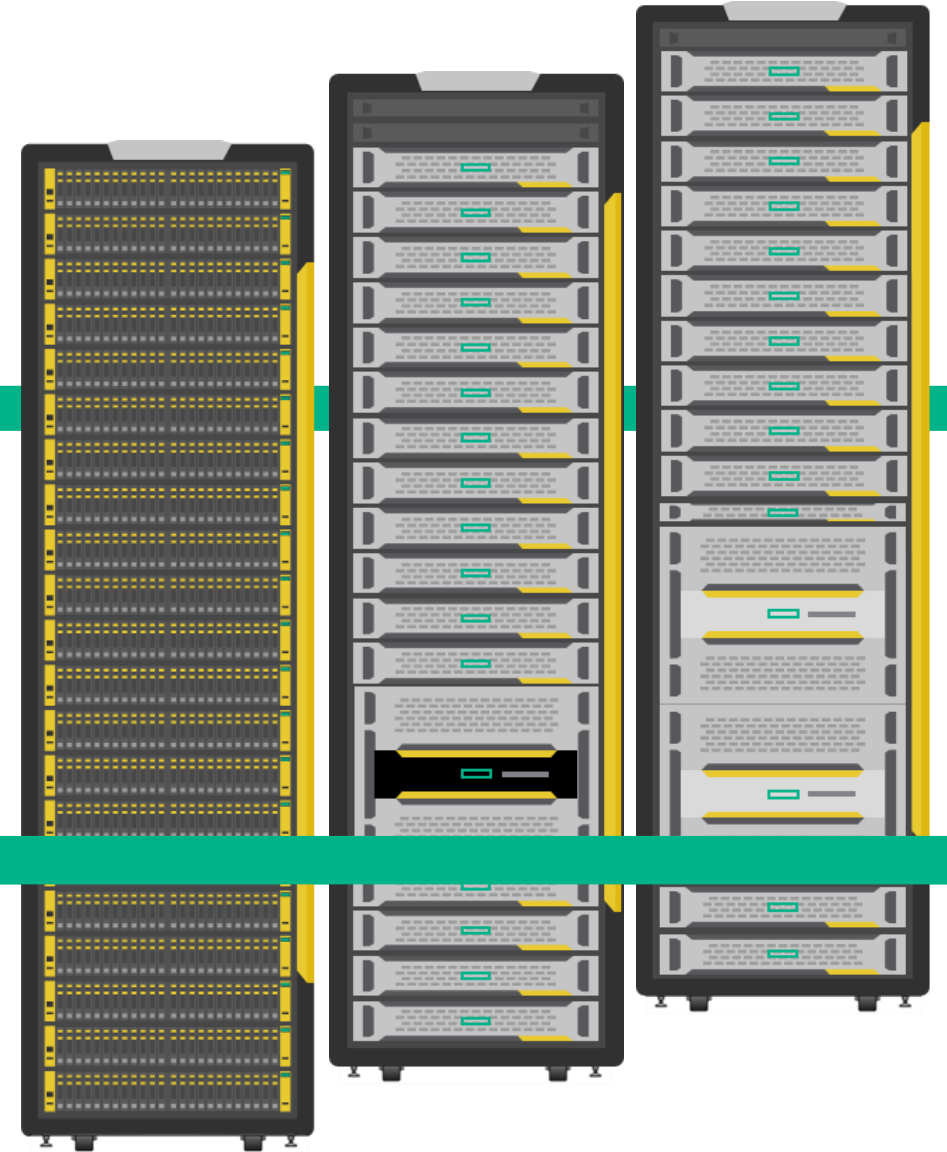
Global Learning

>10,000 customers
Millions of virtual objects under continuous monitoring



**Hewlett Packard
Enterprise**

**HPE 3PAR StoreServ
8000, 9000 and 20000**



Hewlett Packard Enterprise is leading in the next era of storage

NOW

NEXT



Our vision: Polymorphic Simplicity

Adj. Existence in several forms, shapes, & sizes



Store

HPE 3PAR StoreServ

Virtualization, Cloud, Consolidation, Mission-critical Apps

- One Primary storage system architecture
- One Set of common data services low-to-high
- One Approach to block, object and file
- One Architecture optimized for Flash and Hybrid

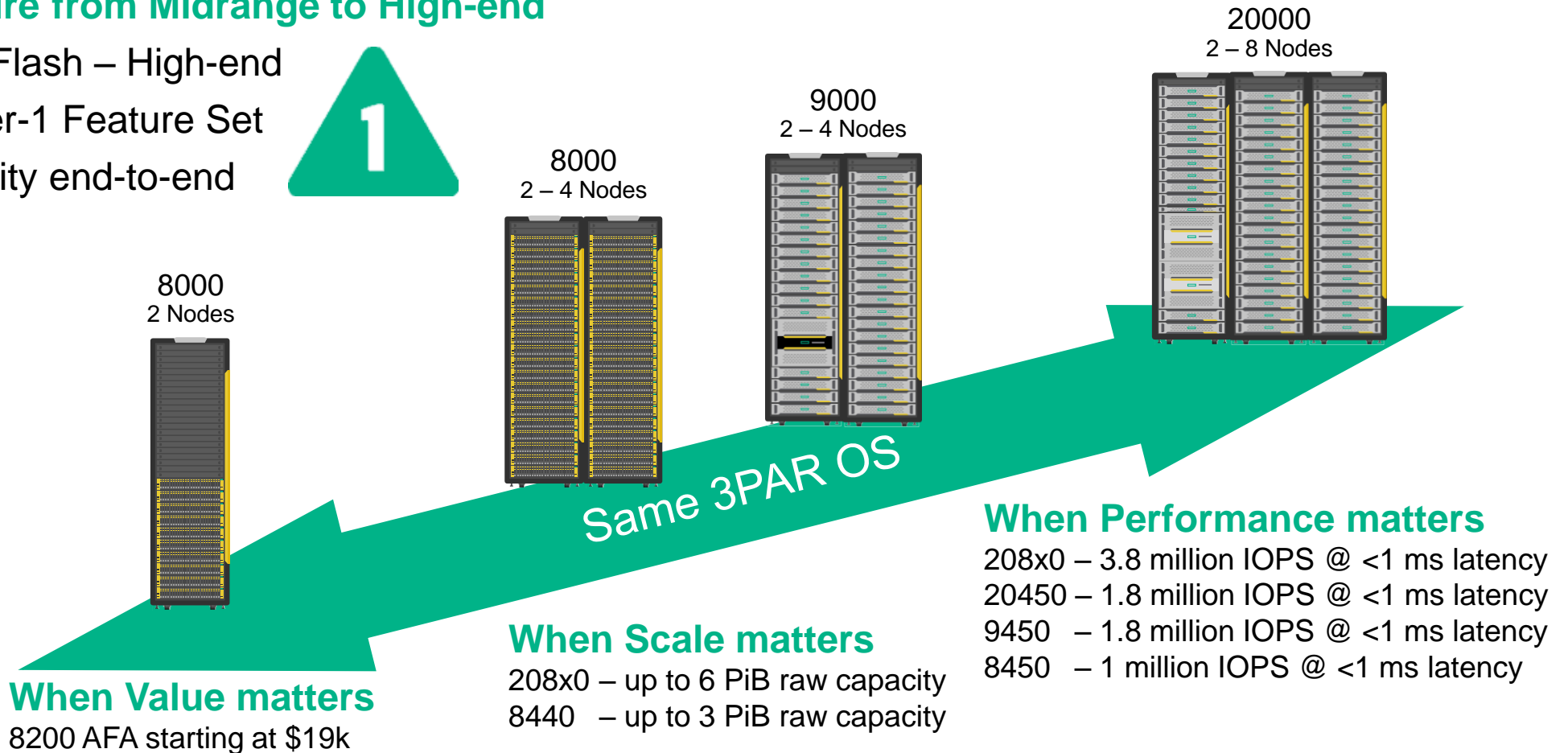
Eliminating distinctions between Midrange and Tier 1

Polymorphic Simplicity – Storage without Boundaries

ONE Architecture from Midrange to High-end

- Midrange – Flash – High-end
- Common Tier-1 Feature Set
- Interoperability end-to-end

Only HPE



3PAR Hardware – Four Simple Building Blocks

8000



Controller Nodes

- Performance/connectivity building block
- | | |
|--------------------|---------------------------|
| 8000: 2 or 4 nodes | 9000: 2 or 4 nodes |
| | 20000: 2, 4, 6 or 8 nodes |

Fast Node Interconnect

- Cache Coherent Interconnects
- Completely passive

Drive Chassis and Drives

- | | |
|--------------------|--------------------|
| 8000: | 9000 and 20000: |
| 2U – 24 SFF Drives | 2U – 24 SFF Drives |
| | 20000 only |
| 4U – 24 LFF Drives | 2U – 12 LFF Drives |

Service Processor

- Physical: 1U Server (default for 20k)
- Virtual: VM on vSphere or Hyper-V (default for 8k and 9k)

9000



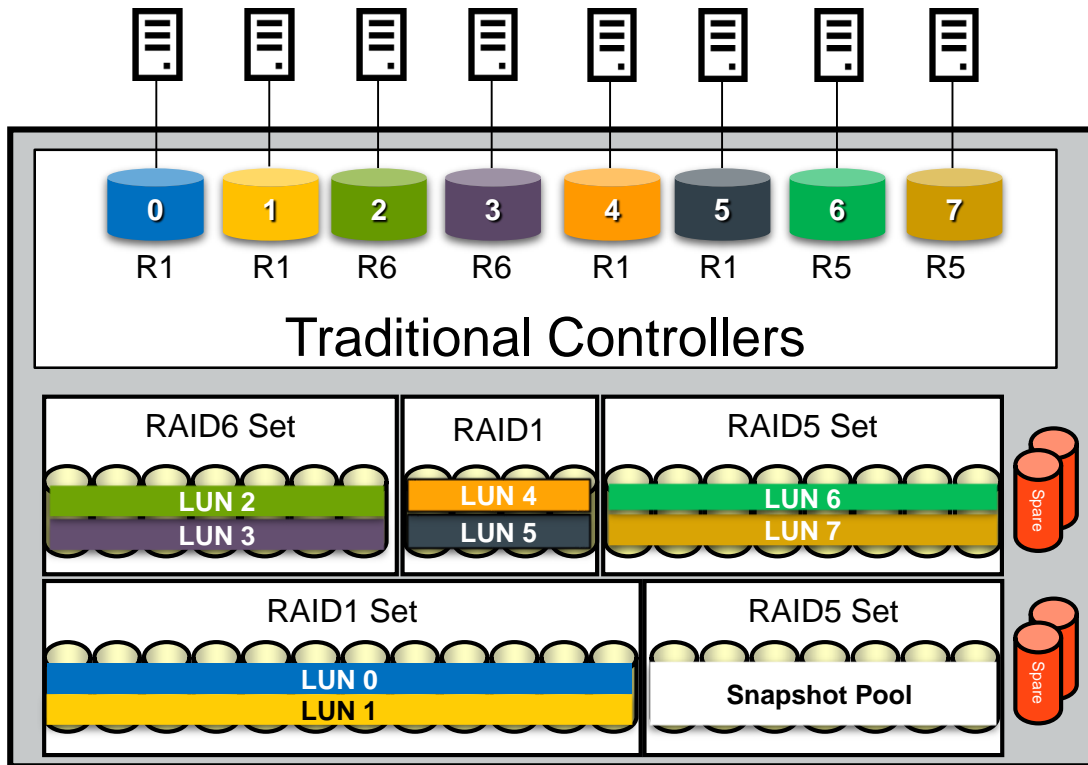
20000



3PAR Virtualization Advantages

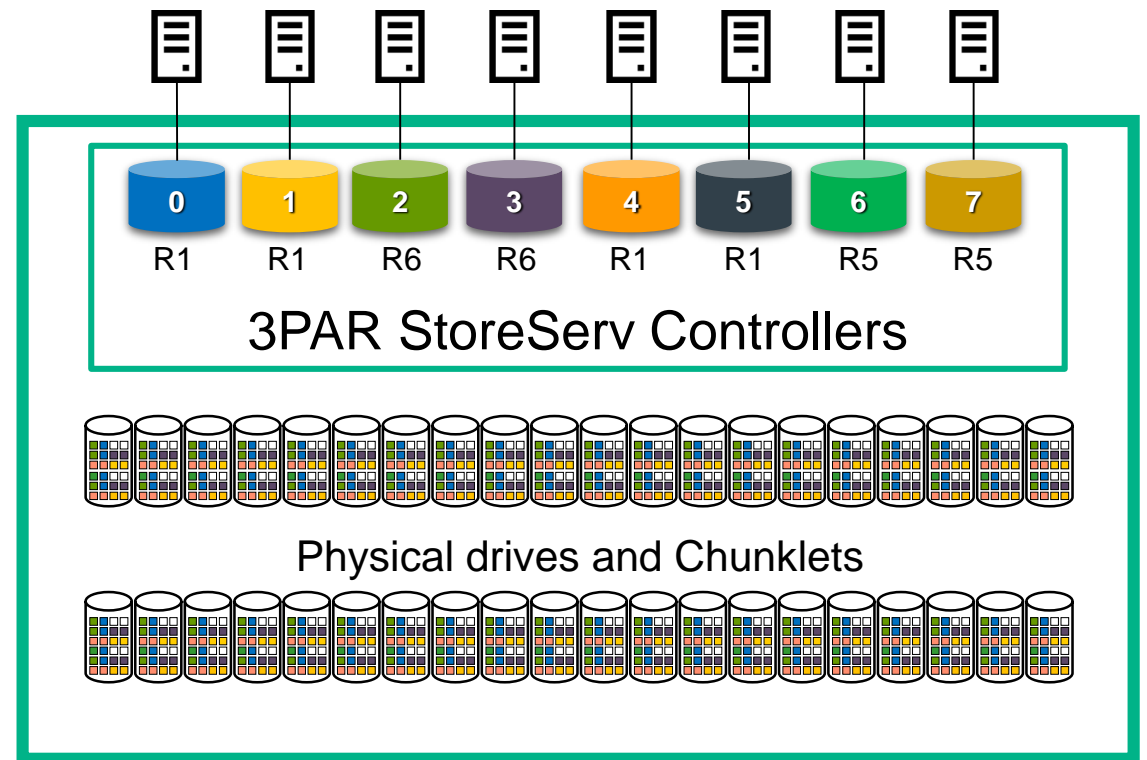
Traditional Array

- Each RAID level requires dedicated drives
- Dedicated spare disk required
- Limited single LUN performance
- Dedicated pool drives



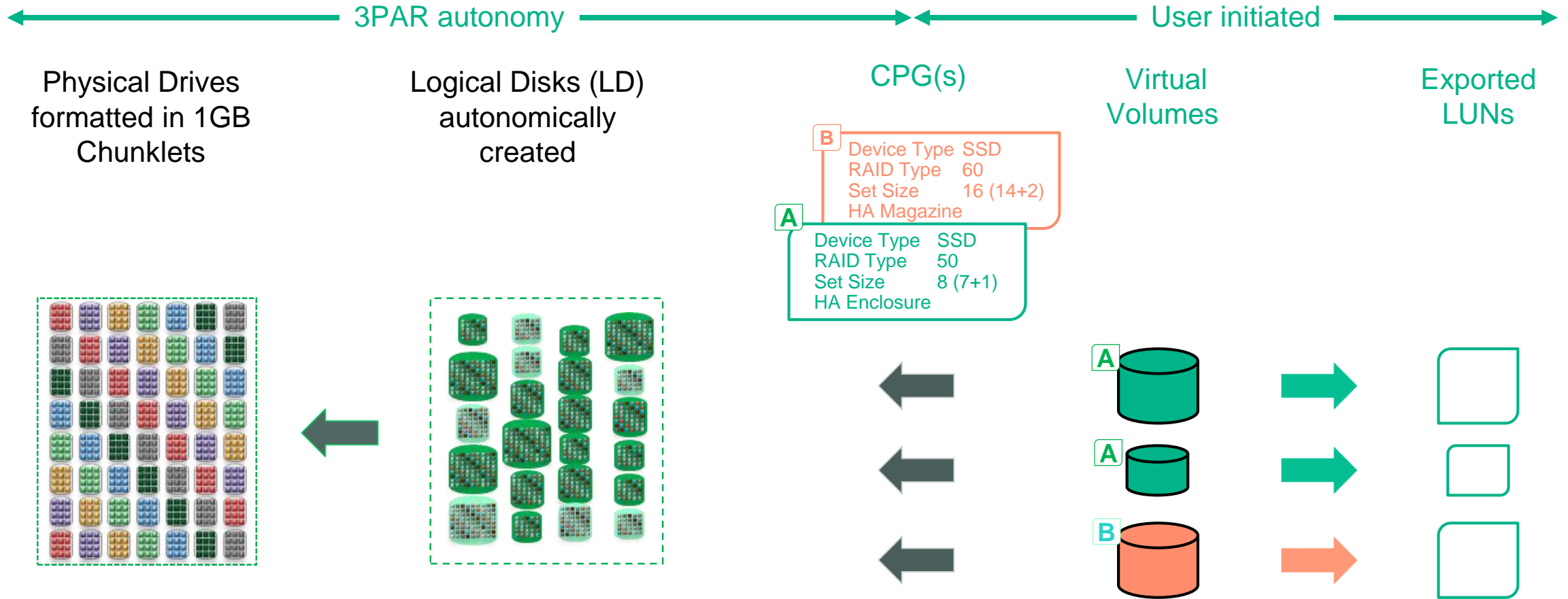
3PAR StoreServ

- All RAID levels can reside on same drives
- Distributed sparing, no dedicated spare drives
- Built-in wide-striping based on Chunklets
- No pools and reservation required



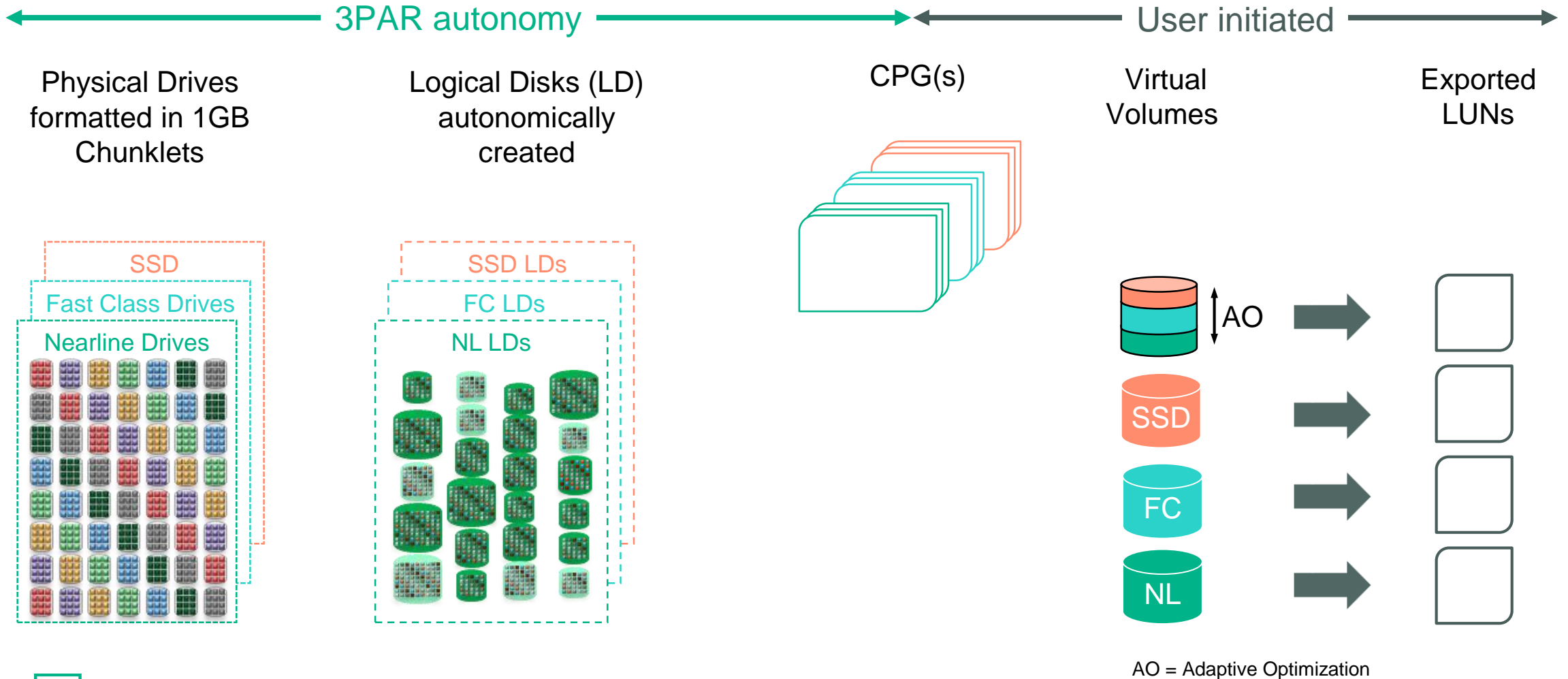
3PAR Virtualization – the Logical View

With one drive type



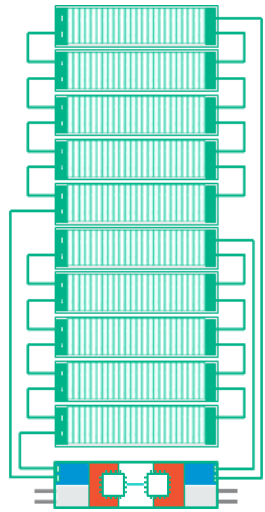
3PAR Virtualization – the Logical View

With three drive types

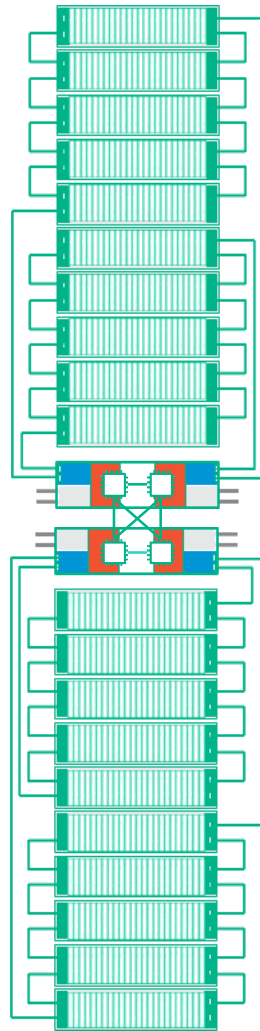


3PAR Hardware Architecture

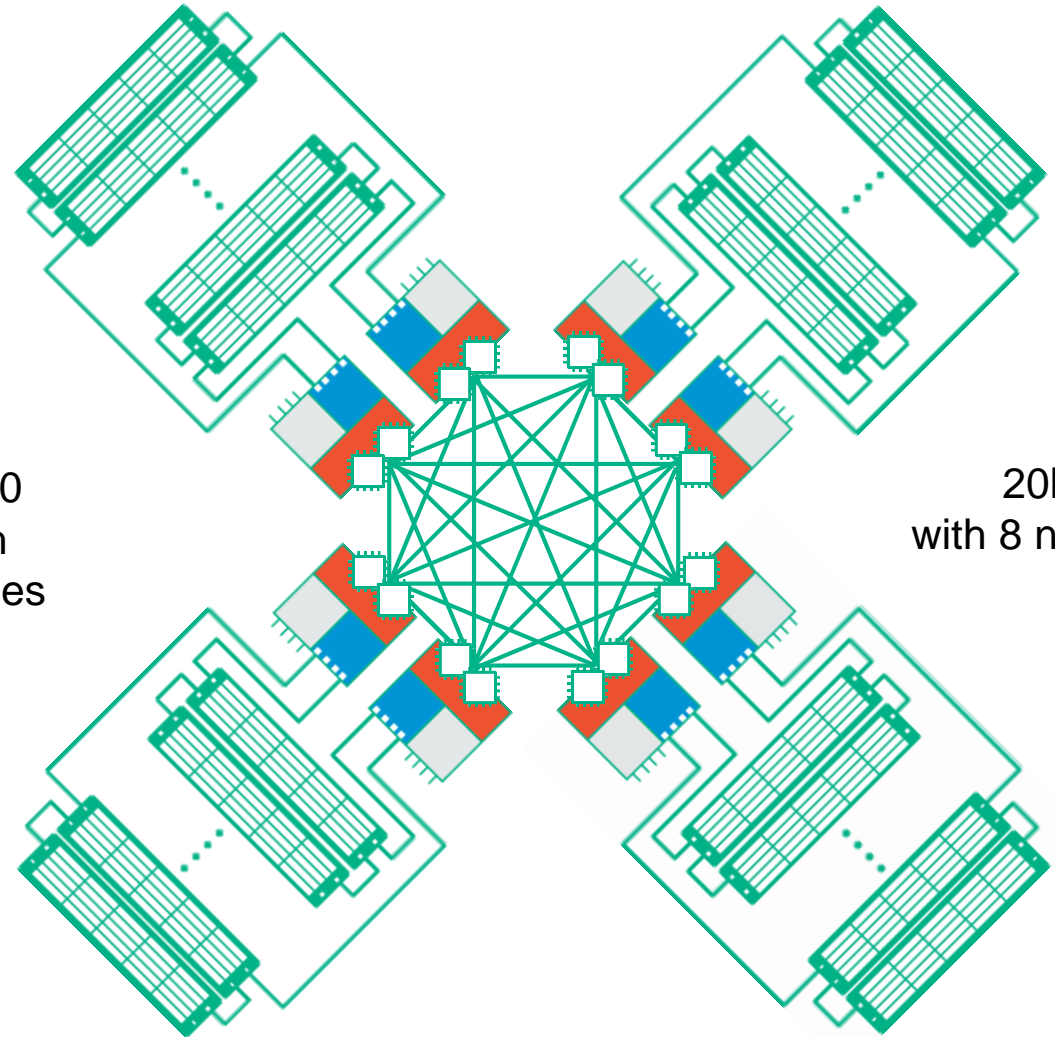
Cost-effective, scalable, resilient, meshed, active-active



8200
with
2 nodes



84x0
with
4 nodes



20k
with 8 nodes

- Host Ports
- Cache
- Disk Ports

All-inclusive 3PAR Software Suites

Frame-based – dramatically simplifies licensing

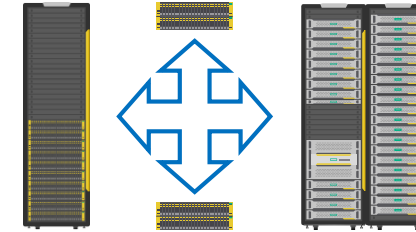
All-inclusive Single-System Software



Frame license bundled with Base Controllers including:

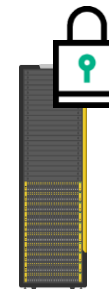
- OS Suite
- Adaptive Data Reduction (ADR)
- File Persona (FP)
- Virtual Copy (VC)
- Dynamic Optimization (DO)
- Adaptive Optimization (AO)
- Priority Optimization (PO)
- Virtual Domains
- Virtual Lock
- Online Import
- Recovery Manager Central (RMC)
- Recovery Manager Central App Suites
- All legacy Recovery Managers
- Smart SAN

All-inclusive Multi-System Software



Optional frame license (1 x per array) including:

- Remote Copy (RC)
- Peer Motion (PM)
- Peer Persistence (PP)
- Cluster Extension (CLX)
- Storage Federation



Data at Rest Encryption

Optional frame license (1 x per array) including:

- Data Encryption
(requires self-encrypting drives – SED)

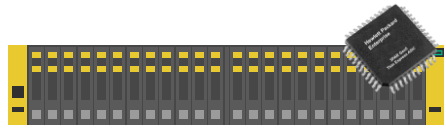
3PAR StoreServ 8000



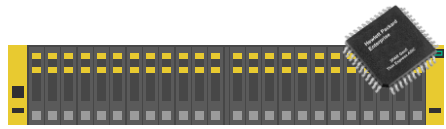
	8200	8400		8440		8450	
Controller Nodes	2	2	4	2	4	2	4
Controller Cache	64 GB	64 GB	128 GB	192 GB	384 GB	192 GB	384 GB
Max Adaptive Flash Cache	768 GB	768 GB	1500 GB	1500 GB	3000 GB	NA	NA
Max local node system IOPS (100% 8KB random read)	400K	400K	800K	500K	1 million	500K	1 million
Max. LUN size for TPVV and CPVV	64TiB						
Max. LUN size for TDVV and compressed VV	16TiB						
Max node-distributed IOPS (100% 8KB random read)	342K	342K	659K	425K	786K	425K	786K
Max drive count total / SSD only	240 / 120	288 / 120	576 / 240	480 / 240	960 / 480	480 / 480	480 / 480
Max raw capacities total / SSD only	1000 / 838	1200 / 838	2400 / 1676	2000 / 1675	4000 / 3351	1675	3352
Built in 16Gbit/s FC ports	4	4	8	4	8	4	8
Built-in 1GbE RJ45 port (Remote Copy/File Persona)	2	2	4	2	4	2	4
PCIe slots for optional port extension	2	2	4	2	4	2	4

HPE 3PAR StoreServ 8000 Hardware Building Blocks

Base Storage Systems



3PAR StoreServ 8200
(2 nodes, 4 FC ports, 24 SFF slots)

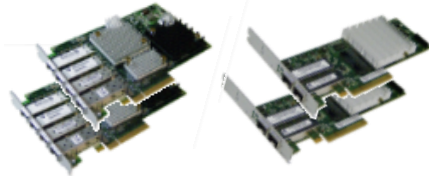


3PAR StoreServ 84x0
(2-node, 4 FC ports, 24 SFF slots)



3PAR StoreServ 84x0
(4-node, 8 FC ports, 48 SFF slots)

Host Adapters



Choice of one Adapter-pair per Node-pair of the following:

- 4-port 16Gb/s FC Adapter
- 2-port 10Gb/s iSCSI/FCoE
- 2-port 10Gb/s IP NIC for File Persona
- 4-port 1Gb/s IP NIC for File Persona
- 4-port FC / IP combo Adapter
 - 2 x 16Gb FC +
 - 2 x 10Gb IP NIC for File Persona or RCIP
- 4-port iSCSI / IP combo Adapter
 - 2 x 10Gb iSCSI +
 - 2 x 10Gb IP NIC for File Persona or RCIP

Expansion Drive Enclosures



3PAR StoreServ 8000
2.5in 2U SAS



3PAR StoreServ 8000
3.5in 4U SAS

DC Power Option



- 48V DC Power Cooling Module
- Only available for field integration
 - 2 PCM per enclosure required (Base and Expansion)
 - 3PAR OS 3.3.1 required

Drives



SFF SAS
HDD & SSD



LFF SAS
HDD & SSDs

Choice of encrypted and non-encrypted drives

Racks

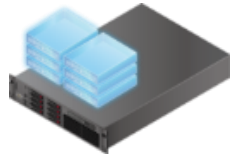


HPE Enterprise
Series Rack



Customer rack
(4-post, square hole, EIA standard, 19 in., rack from HPE or other suppliers)

Service Processor



Virtual (Default)

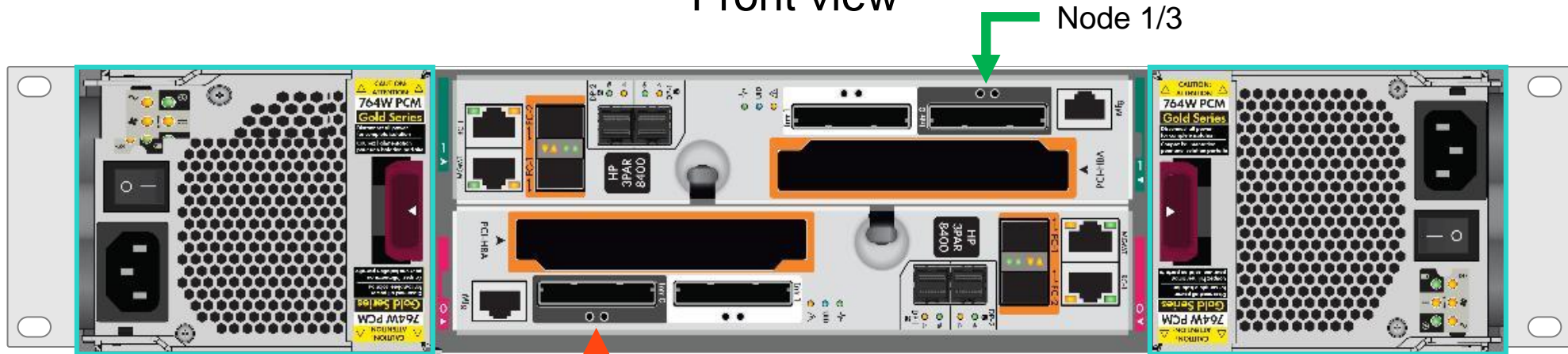


Physical (Optional)

3PAR StoreServ 8000 Controller Enclosure




Front view



Node 1/3

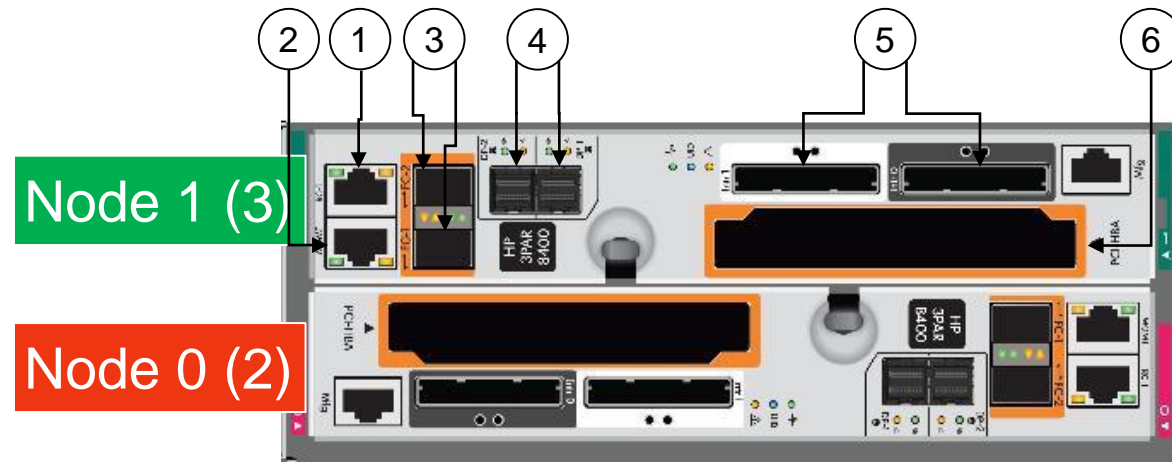
Node 0/2

Rear view

 Power Cooling
Module with Battery
Pack

3PAR StoreServ 8000 Controller Enclosure

Connectivity



- 1 Built-in 1GbE Remote Copy /File Persona Port *
- 2 Built-in 1GbE Management Port
- 3 Built-in 16Gb FC Ports
- 4 4-lane 12Gbit/s SAS drive chassis connections
- 5 4-node Cluster Interconnects
- 6 Optional PCI-e Card Slot (see next slide)

* To be configured for either Remote Copy or File Persona

3PAR StoreServ 8000 Adapter Options

- Optional Adapters must be installed in pairs and must be identical per node-pair
- Optional slot-pairs can be left empty
- Available Adapters
 - 4-port 16Gb FC Adapter for Host, Remote Copy and Peer Motion connectivity
 - 2-port 10Gb iSCSI/FCoE Adapter for Host connectivity
 - 4-port 1Gb Ethernet Adapter (NIC) for File Persona NAS connectivity
 - 2-port 10Gb Ethernet Adapter (NIC) for File Persona NAS connectivity
 - 4-port combo Adapter 2 x 16Gb FC + 2 x 10Gb Eth NIC for Host + File Persona NAS or 10Gb RCIP connectivity
 - 4-port combo Adapter 2 x 10Gb iSCSI + 2 x 10Gb Eth NIC for Host + File Persona NAS or 10Gb RCIP connectivity

incl. 16Gb SW SFP+

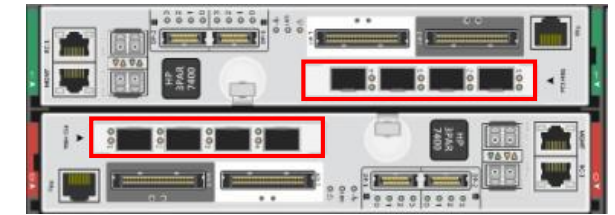
incl. 10Gb SW SFP+

with RJ45 connectors

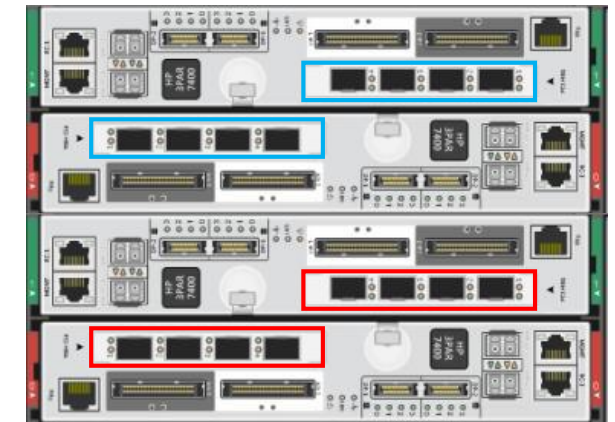
incl. 10Gb SR SW SFP+

incl. 16Gb/10Gb SFP+

incl. 10Gb SFP+



2-node Configuration

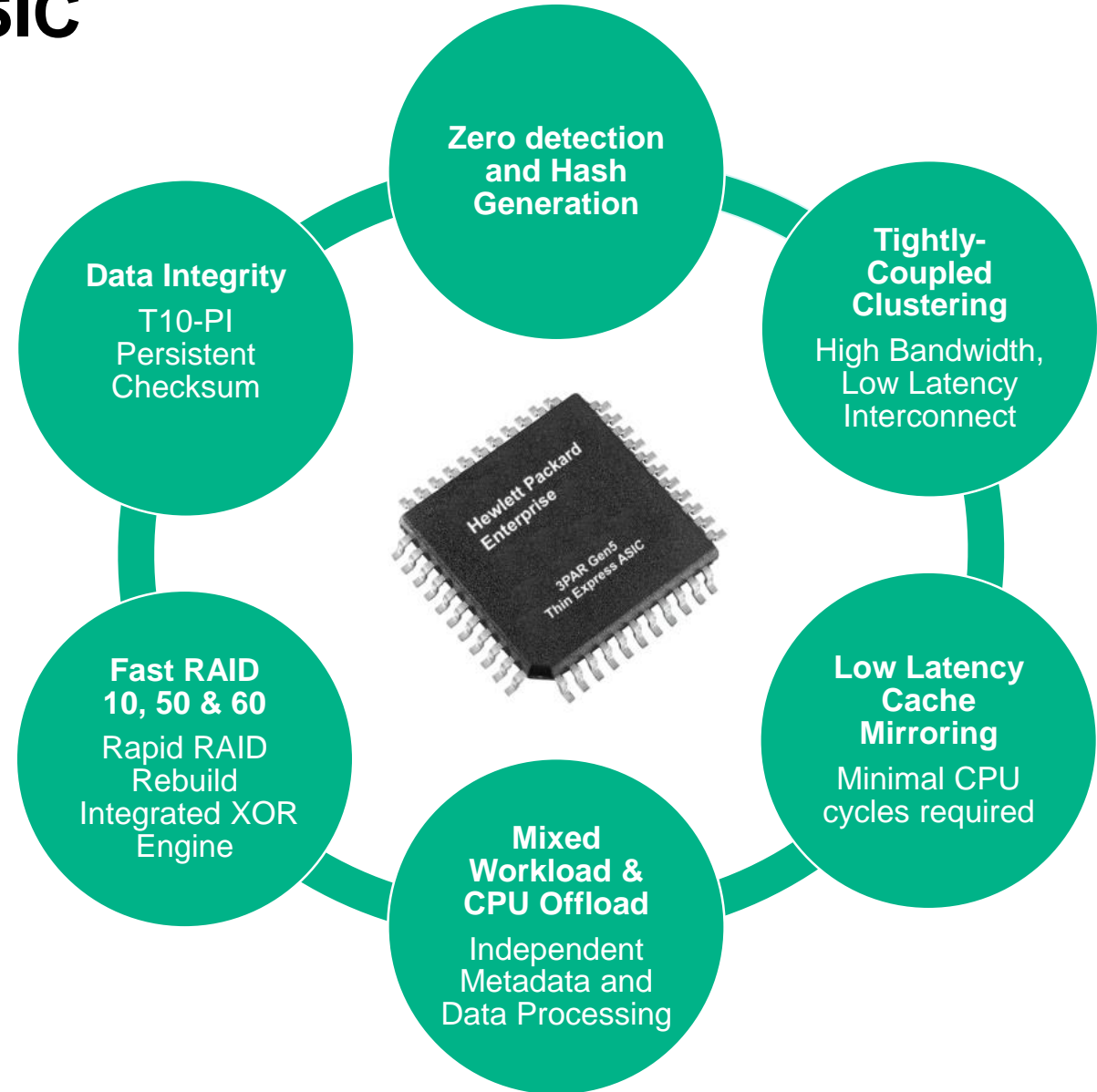
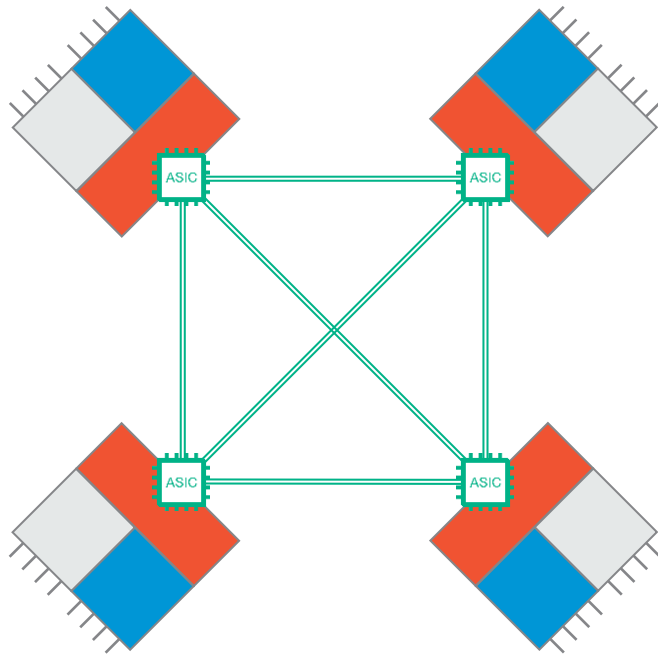


4-node Configuration

- Optional Adapters Node-pair 0/1
- Optional Adapters Node-pair 2/3

3PAR Gen5 Thin Express ASIC

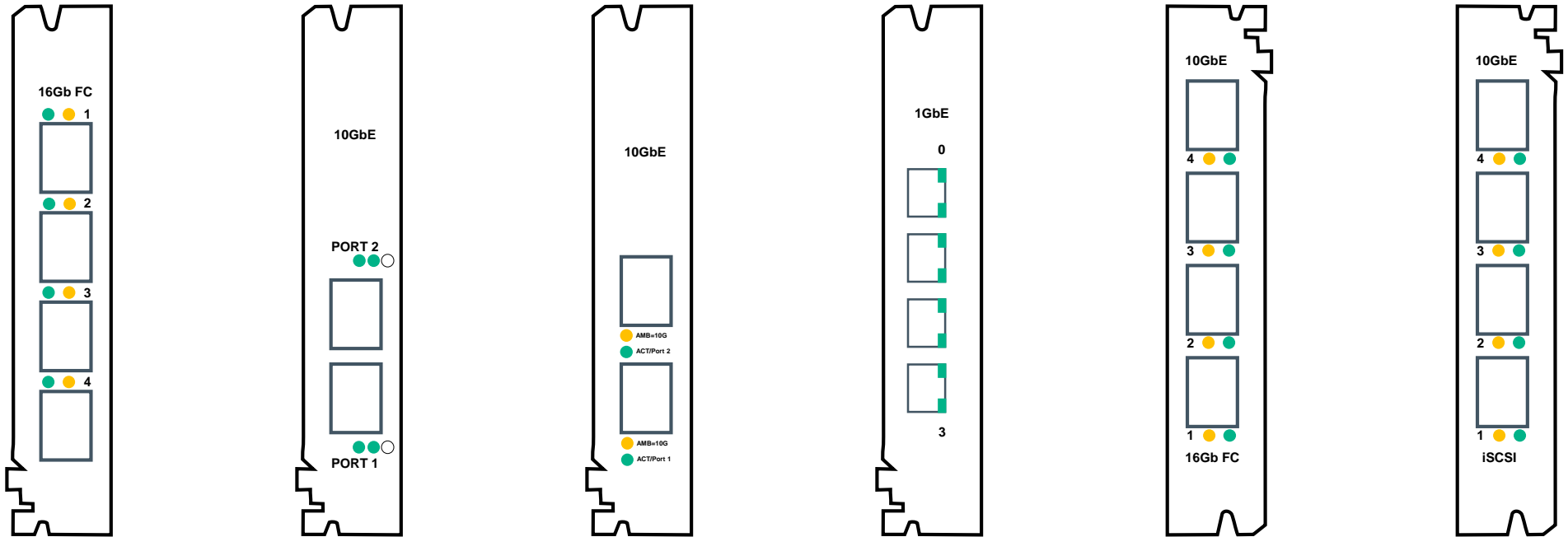
The Heart of every 3PAR



Watch the "Understand the 3PAR ASIC" video: <http://www.youtube.com/watch?v=LmQMqWNGA7E>
and the "3PAR Architecture ChalkTalk": <https://youtu.be/MaTU2xc23NE>

HPE 3PAR 8000 Host Adapters

A variety of adapters to meet your connectivity requirements



HPE Part #	H6Z00A	H6Z10A	E7Y70A	H6Z05A	N9Z18A	N9Z19A
Ports	4 x 16Gb FC (SFP+)	2 x 10Gb iSCSI (SFP+)	2 x 10Gb IP (SFP+)	4 x 1Gb IP (RJ45)	2 x 16Gb FC (SFP+) + 2 x 10Gb IP (SFP+)	2 x 10Gb iSCSI (SFP+) + 2 x 10Gb IP (SFP+)
Connectivity support	Host / Remote Copy / Peer Motion (Federation)	Host only	File Persona only	File Persona only	Ports 1+2: Host / Remote Copy FC / Peer Motion Ports 3+4: File Persona or Remote Copy IP	Ports 1+2: iSCSI Host Ports 3+4: File Persona or Remote Copy IP

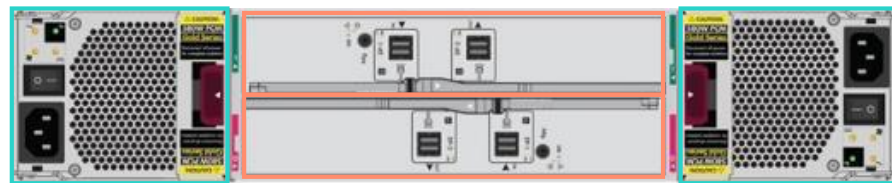
3PAR 8000 12Gb SAS Drive Enclosures



Mix and match drives and enclosures as required

2U with 24 SFF drive slots



4U with 24 LFF drive slots

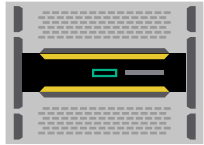


-  Power Cooling Module
-  12Gb IO Module

3PAR StoreServ 9450 Hardware Building Blocks

Base Enclosure

Controller Chassis



2 or 4-Nodes

Backplane
(completely passive)



Adapters



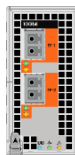
4-port 12Gb/s
SAS drive HBA



4-port 16Gb/s
FC HBA



2-port 10Gb/s
iSCSI/FCoE CNA



2-port 10Gb/s NIC

Drive Enclosures



2U 12Gb/s SAS
shown with bezel



24 drive SFF 2.5"

Drives



2.5" SFF 12Gb
SAS dual-port
SSDs

Rack

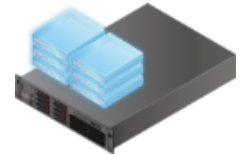


HPE Enterprise
Series Rack



3rd party rack
(4-post, square hole, EIA
standard, 19 in., rack from
HPE or other suppliers)

Service Processor



Virtual (Default)

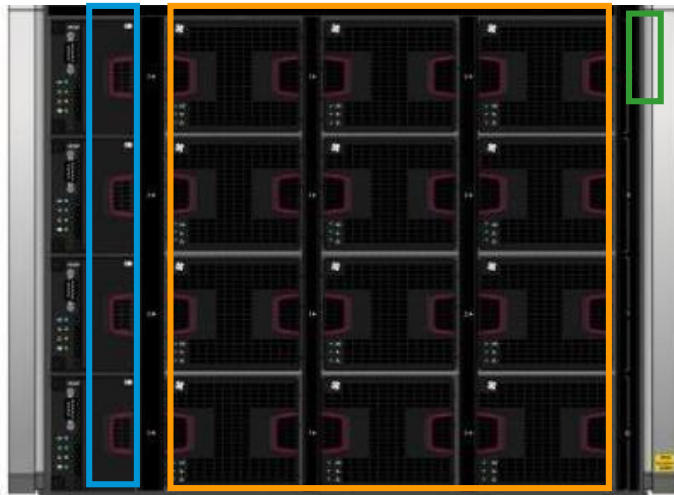


1U Physical SP
(optional for 9k)

3PAR StoreServ 9450 Controllers

Front

Rear

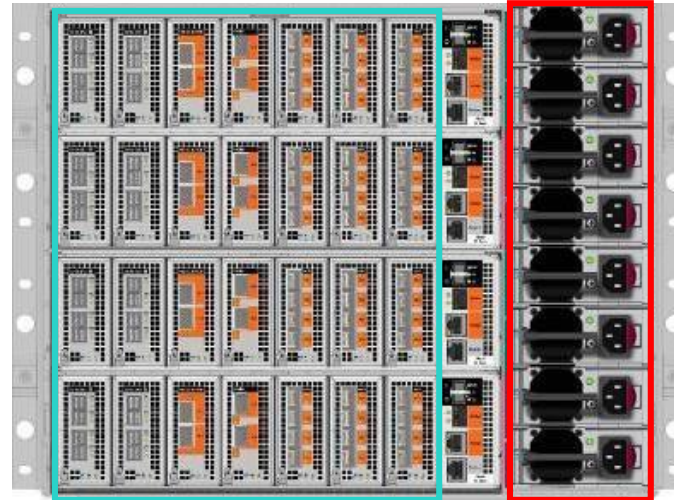


Node 3

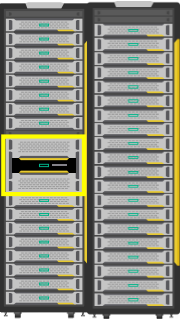
Node 2

Node 1

Node 0



- Fans
- LED Indicators
- Battery Backup Units
- IO Adapters
- Power Supplies



3PAR StoreServ 9000/20000 Controller

Ports Scalability of a single node pair

Allows providing all possible data services like this:

Drive connectivity – 16 x SAS ports – up to 384 drives

FC host connectivity – 16 x 16Gb FC ports

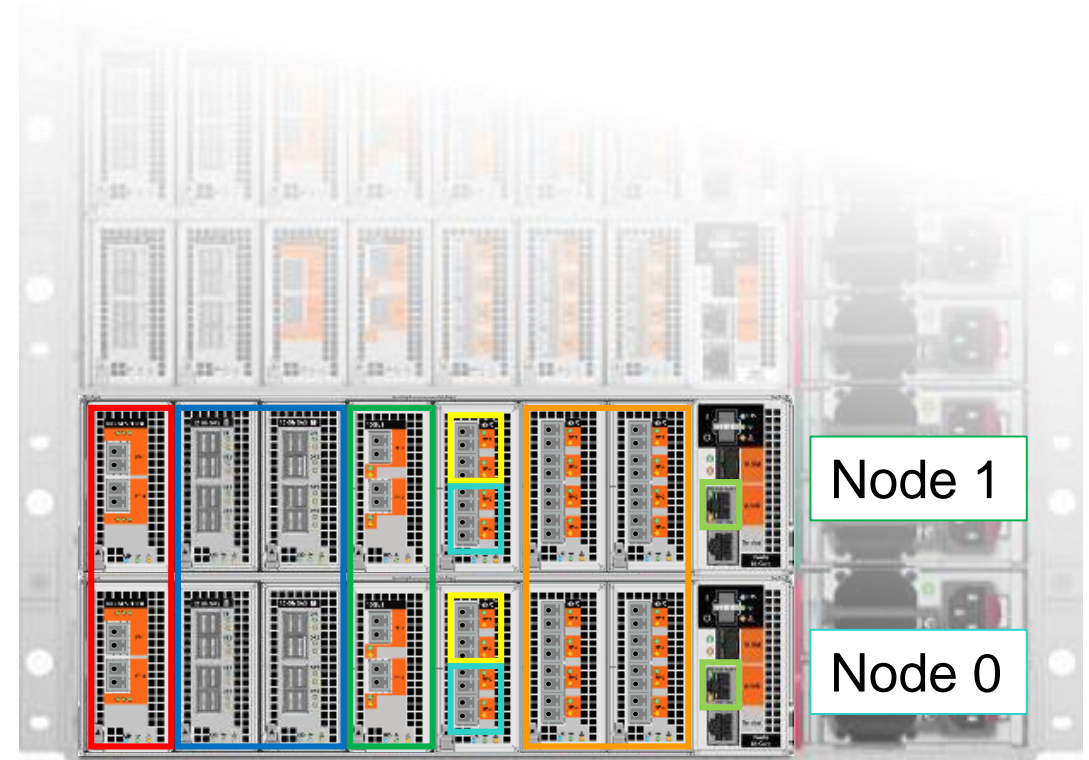
iSCSI/FCoE host connectivity – 4 x 10Gb Eth ports

File Persona Ethernet host – 4 x 10Gb Eth ports

Federation ports – 4 x 16Gb FC ports

Remote Copy FC ports – 4 x 16Gb FC ports

Remote Copy IP ports – 2 x 10Gb IP built-in ports



3PAR 3D Cache Storage Class Memory (SCM)

Technology Preview shown at Discover London 2016

- **Why 3D Cache?**

- In today's all-flash systems performance is limited by the NAND SSD backend

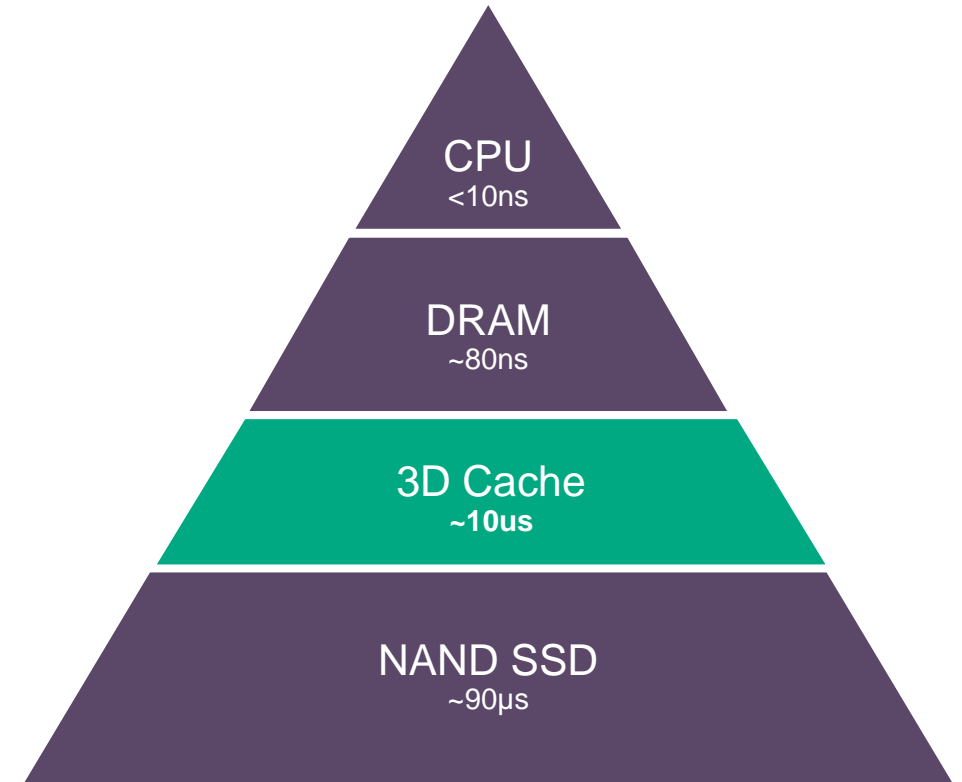
- **What is 3D Cache?**

- New 3PAR read-cache level
- Leverages Storage Class Memory (SCM) as an extension of DRAM cache for extreme performance acceleration
- Introduced as a PCI add-on card using an NVMe interface

- **What SCM technology will be used**

- Intel 3DXpoint technology; the only currently available SCM in the market

All 9000 and 20000 systems are 3D Cache ready



3PAR 3D Cache Storage Class Memory (SCM)

Technology Preview shown at Discover London 2016

- **Shown on a 20000 System**

- 2 nodes
- 16 x 15.36TB SSD
- 2 x 128GB SCM for 3D Cache

- **Results for 100% reads**

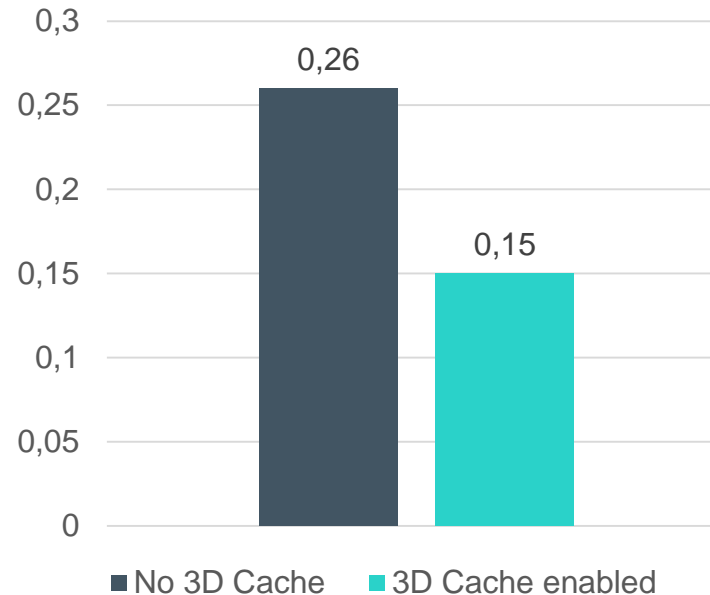
Without 3D Cache

- 45k IOPS
- 0.26ms latency

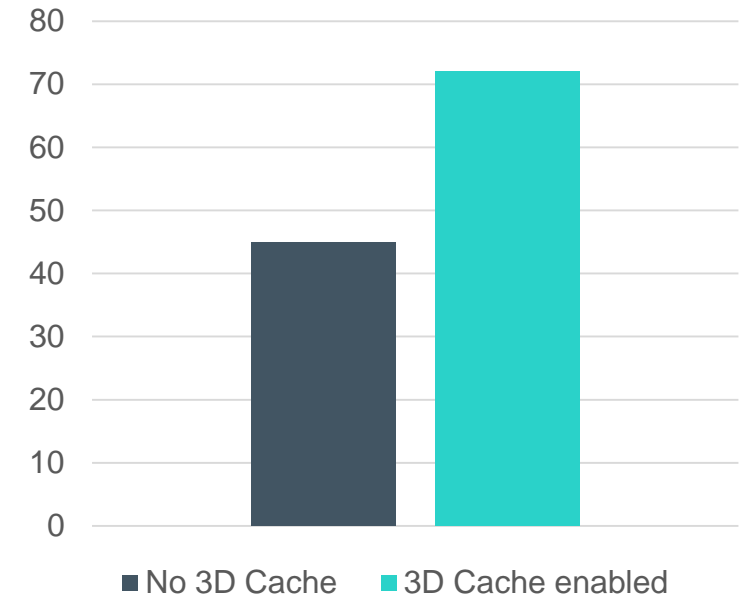
With 3D Cache enabled

- **72k IOPS** **+ 60%**
- **0.15ms latency** **- 42%**

Latency in ms



Performance in kIOPS

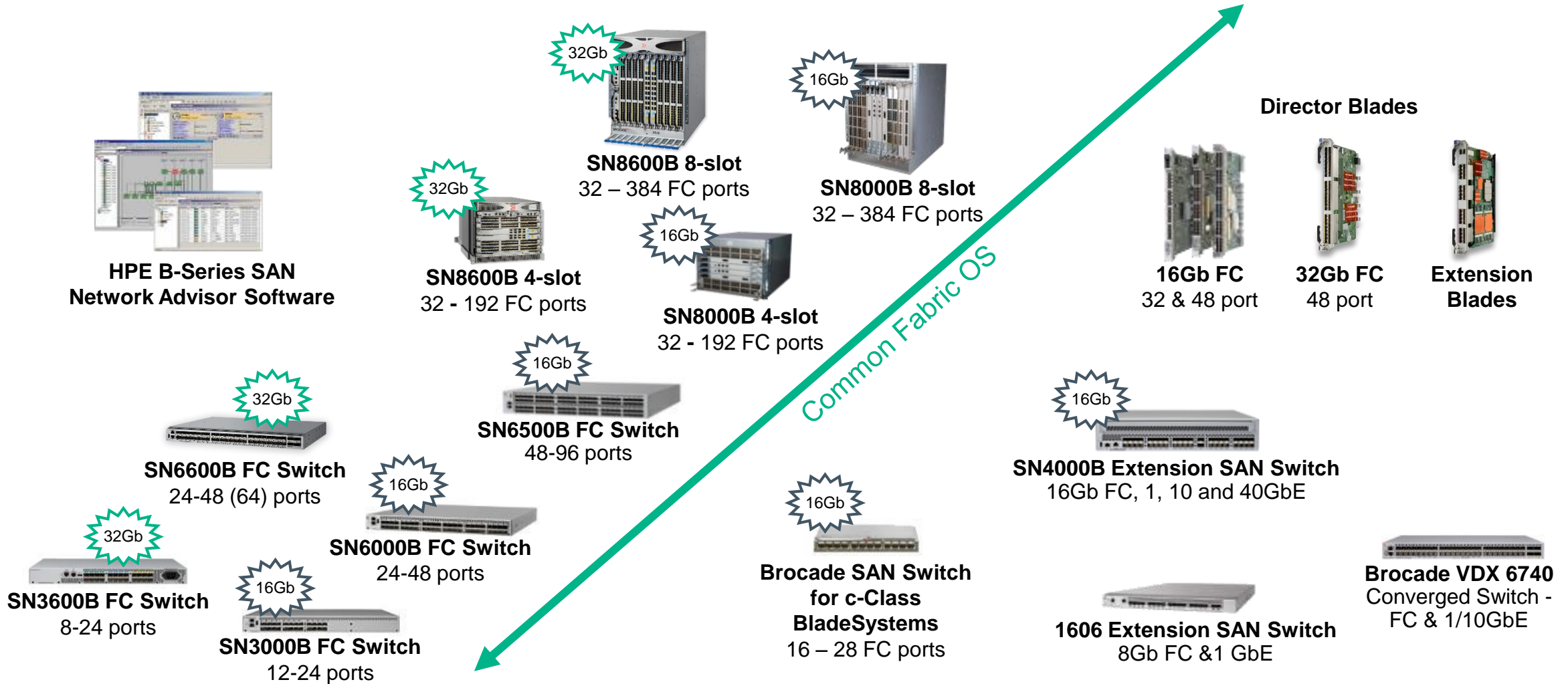




Introducing Storage Networking

HPE B-Series SAN Portfolio

Brocade switch, director and software family



HPE FlexFabric Solution Product Portfolio

Supporting storage access providing DCB and FCoE

Core and Aggregation



12910/16



11900



12500



7904 (HW ready)



7910 (HW ready)

ToR Top of Rack



5900CP
DCB, FCoE, iSCSI and FC



5700 switch series
DCB, FCoE, iSCSI



5900AF
DCB, FCoE, iSCSI



5820 Series
DCB, FCoE, iSCSI



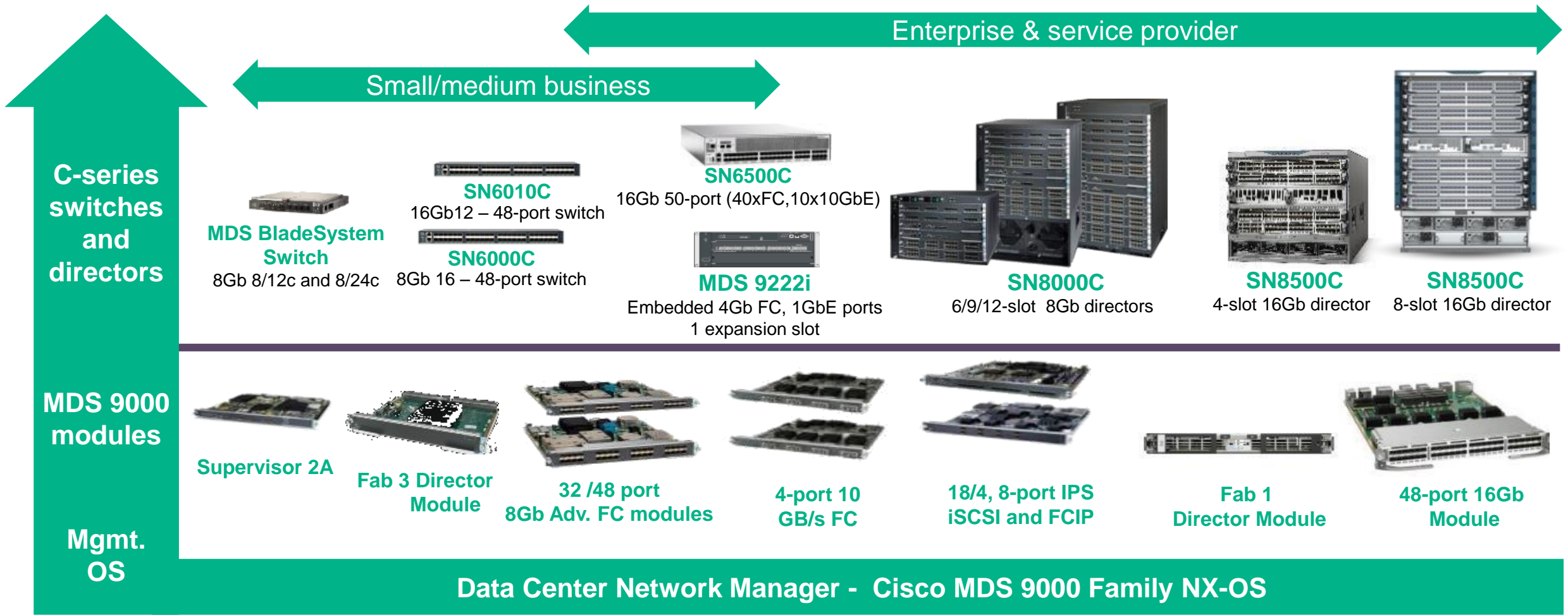
5930 modular switches
DCB, FCoE, iSCSI and FC



5940 modular switches
DCB, FCoE, iSCSI

HPE C-series SAN Portfolio

Industry-leading investment protection across a comprehensive product line





Hewlett Packard
Enterprise

Vielen Dank