



Hewlett Packard
Enterprise

HPE Converged Architecture 700

VMware vSphere 5.5u3 and 6.0u2 Design Guide

Contents

Executive summary.....	3
Solution overview.....	4
Design objectives.....	7
Components.....	8
Solution hardware.....	10
Storage – HPE 3PAR StoreServ Storage.....	10
Compute/Workload servers – HPE ProLiant Gen9 Blade and Workstation servers.....	11
Management servers – HPE ProLiant DL360 Gen9 Server.....	12
Networking – HPE and Cisco Nexus switches.....	12
Hypervisor.....	14
VMware vSphere.....	14
Management software.....	15
HPE OneView.....	15
HPE OneView for VMware vCenter.....	17
HPE Insight Control Server Provisioning.....	18
VMware vRealize Operations Manager.....	18
VMware vCenter Server.....	18
HPE StoreOnce Recovery Manager Central for VMware.....	19
Solution design and best practices implementation.....	19
Storage.....	19
Network.....	21
Computing.....	23
HPE OneView.....	27
Hypervisor.....	27
Rack infrastructure.....	30
Services.....	30
HPE Proactive Care.....	31
HPE Proactive Care with Personalized Support Option (recommended by HPE).....	31
HPE Critical Service.....	31
HPE Insight Remote Support.....	31
Support considerations for Cisco switches.....	32
Licensing considerations.....	32
VMware licenses.....	32
Microsoft licenses for management servers.....	32
Solution verification.....	32
Appendix A – Solution hardware configuration – VMware 5.5u3.....	32
Appendix B – Solution hardware configuration – VMware 6.0u2.....	36
Resources and additional links.....	41

Executive summary

HPE Converged Architecture 700 delivers a scalable, converged infrastructure platform for virtualization that provides tuned infrastructure to run your workloads and applications. These solutions are delivered through certified channel partners and provide infrastructure your way, delivered as one integrated stack, saving you time and resources.

The HPE Converged Architecture 700 includes Hewlett Packard Enterprise lab-tested infrastructure combining HPE or Cisco network switches, HPE industry-leading x86 servers, HPE 3PAR StoreServ storage, and the VMware® vSphere hypervisor. This foundation can be used to support a wide variety of enterprise workloads such as:

- Data center server consolidation and/or Cloud solutions
- Business critical applications such as Oracle, Microsoft®, SAP databases and applications
- Virtual Desktop Infrastructure (VDI) solutions such as Citrix® and VMware Horizon
- Workforce enablement applications such as Microsoft Exchange Server, SharePoint Server, and Lync Server

The HPE Converged Architecture 700 provides a robust, fault tolerant, scalable, high performance, high availability solution. It has been validated in lab testing to meet these criteria so customers can purchase and deploy these solutions with the confidence and knowledge that stringent design and testing was already done by HPE.

Target audience: The target audience for this design guide is HPE partner solution engineers, distributors, value added resellers, and customer strategic decision makers. Readers can use this document to achieve the following goals:

- Gain insight into the value proposition for the HPE Converged Architecture 700 solution
- Better understand HPE Converged Architecture 700 component requirements
- Better understand the recommended software and features that are part of the HPE Converged Architecture 700 solution
- Leverage design guidance to architect an HPE Converged Architecture 700 to fit a particular set of business cases
- Better understand the design considerations related to fault tolerance, performance, and scalability when architecting the solution

HPE Converged Architecture 700 solution is intended for midsize businesses, large enterprises, and IT service providers who are looking for and understand the value from the combination of consolidation, efficiency, and consistency enabled by the solution.

Document purpose: In the last several years, integrated infrastructures have emerged as a more efficient, less risk-prone method of deploying IT gear. HPE introduces a new best-of-class solution in this space, HPE Converged Architecture 700.

HPE Converged Architecture 700 can be thought of as a solution template whose components have been pre-validated together. The template indicates which families of hardware and software to deploy and how to connect and configure them. The HPE Converged Architecture 700 simplifies and accelerates deployment with a pre-prescribed and validated deployment guide that produces predictable results, and reduces the risk of failure due to the lack of knowledge of the hardware and software interdependencies.

Every HPE Converged Architecture 700 VMware deployment contains the following components:

- Ethernet switches. A pair of verified or allowed HPE or Cisco 10/40GbE networking switches
- Storage. HPE 3PAR StoreServ Storage with OS 3.2.2 leveraging a direct or fabric attached topology
- Computing resources. Industry-leading HPE ProLiant Gen9 server blades in the HPE BladeSystem c7000 chassis form factor, plus a pair of standalone HPE ProLiant Gen9 rack mount servers for solution management
- Hypervisor. VMware vSphere 5.5u3a or 6.0u2a

Solution overview

One of the biggest challenges of IT is to provide a wide variety of software services with the appropriate service levels and performance for the application(s) and/or services needed by their consumers. New workloads and business demands are forcing customers to reevaluate the way they buy and manage infrastructure. Rather than do it yourself or “integrated systems” assembled from components provided by multiple vendors, they want pre-engineered systems and support from a single vendor. They need repeatable and flexible building blocks that are tuned to handle unpredictable workloads. These systems must deliver fast time to value and include software-defined management of servers, storage and networking that automates all layers of the data center and streamlines routine tasks.

HPE Converged Architecture 700 combines HPE industry-leading x86 servers, HPE 3PAR StoreServ storage arrays, HPE 5900/5930 Series network switches and a validated management software stack to provide a highly available, scalable, and high performing virtualization platform from one vendor, HPE. These components are deployed according to HPE best practices, providing a prescriptively defined foundation onto which IT workloads can be deployed.

This section presents the products included in the HPE Converged Architecture 700 solution. For each product, relevant features are described at a high level. HPE Converged Architecture 700 provides choice for compute, network and storage components, so this section focuses on the features that define the minimum equipment characteristics that are appropriate for the architecture. A more detailed discussion is provided in the [Solution design](#) section of this document. Figure 1 and Figure 2 demonstrate two of the infinite possibilities in designing an HPE Converged Architecture 700.

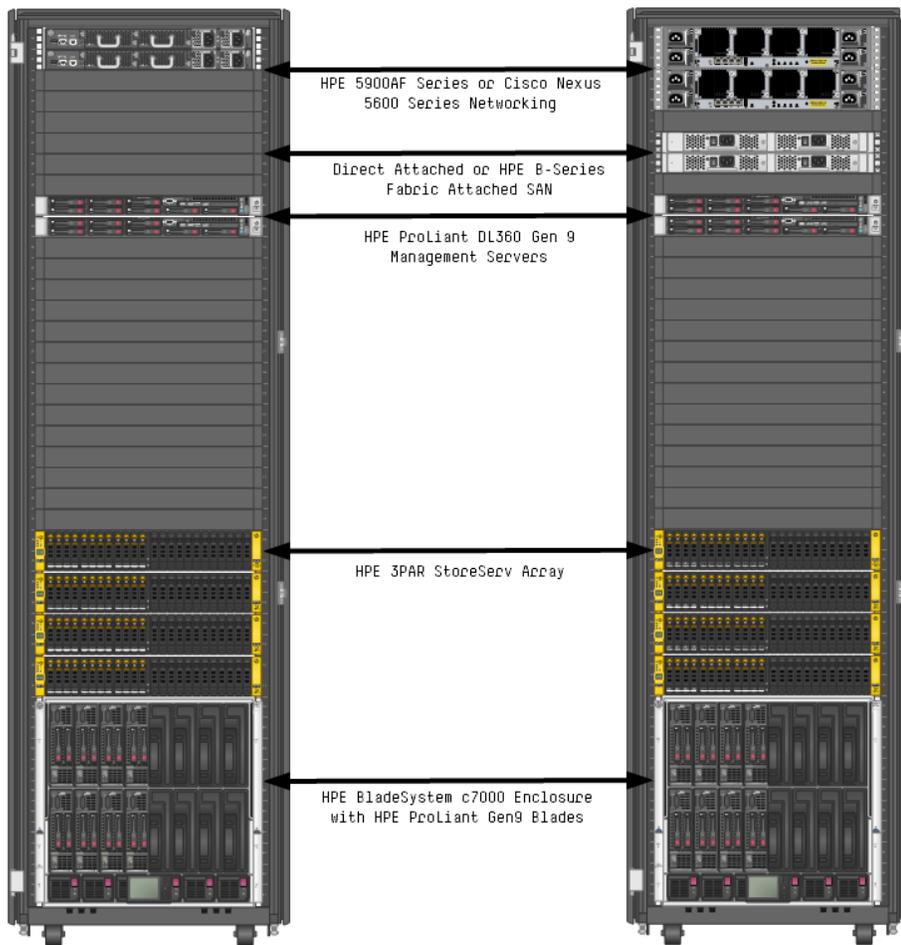


Figure 1. HPE Converged Architecture 700 with HPE Networking and direct attached storage [left] and Cisco Networking with Fabric attached storage [right]

Figure 1 shows two layouts.

The first layout on the left illustrates the following components:

- Two (2) HPE 5900AF-48XG-4QSFP+ network switches configured in an Intelligent Resilient Framework (IRF) configuration.
- Direct Attached Fibre Channel storage, no SAN switches required.
- Two (2) HPE DL360 Gen9 management servers offering a dedicated highly available VMware vSphere cluster to host all of the verified HPE software stack to manage and scale the solution throughout its lifecycle.
- One (1) HPE 3PAR StoreServ 7400c 2 node array to provide storage to the HPE Converged Architecture 700's management and compute clusters.
- One (1) HPE BladeSystem c7000 Enclosure with two (2) HPE Virtual Connect FlexFabric-20/40 F8 Modules and eight (8) HPE ProLiant BL460c Gen9 server blades to host the end users production workloads and applications
- Wiring for Ethernet network, SAN and power are not shown, however everything is wired so there is no single point of failure in the HPE Converged Architecture 700. For an example please refer to the HPE Converged Architecture 700 VMware 5.5u3 Deployment Guide. The Deployment guide is available to Authorized HPE Partners, if you are not an Authorized HPE Partner, please work with your representative HPE Distributor or Value Added Reseller for more information.

The second layout on the right illustrates the following components:

- Two (2) Cisco Nexus 56128P network switches configured in Virtual Port Channel configuration.
- Two (2) HPE SN6000B Fibre Channel switches for a dedicated switched fabric.
- Two (2) HPE DL360 Gen9 management servers offering a dedicated highly available VMware vSphere cluster to host all of the verified HPE software stack to manage and scale the solution throughout its lifecycle.
- One (1) HPE 3PAR StoreServ 7200c 2 Node Storage to provide storage to the HPE Converged Architecture 700's management and compute clusters.
- One (1) HPE BladeSystem c7000 Enclosure with two (2) HPE Virtual Connect FlexFabric-20/40 F8 Modules and eight (8) HPE ProLiant BL460c Gen9 server blades to host the end users production workloads and applications.
- Wiring for Ethernet network, SAN and power are not shown, however everything is wired so there is no single point of failure in the HPE Converged Architecture 700. For an example please refer to the HPE Converged Architecture 700 VMware 5.5u3 Deployment Guide. The Deployment guide is available to Authorized HPE Partners, if you are not an Authorized HPE Partner, please work with your representative HPE Distributor or Value Added Reseller for more information.

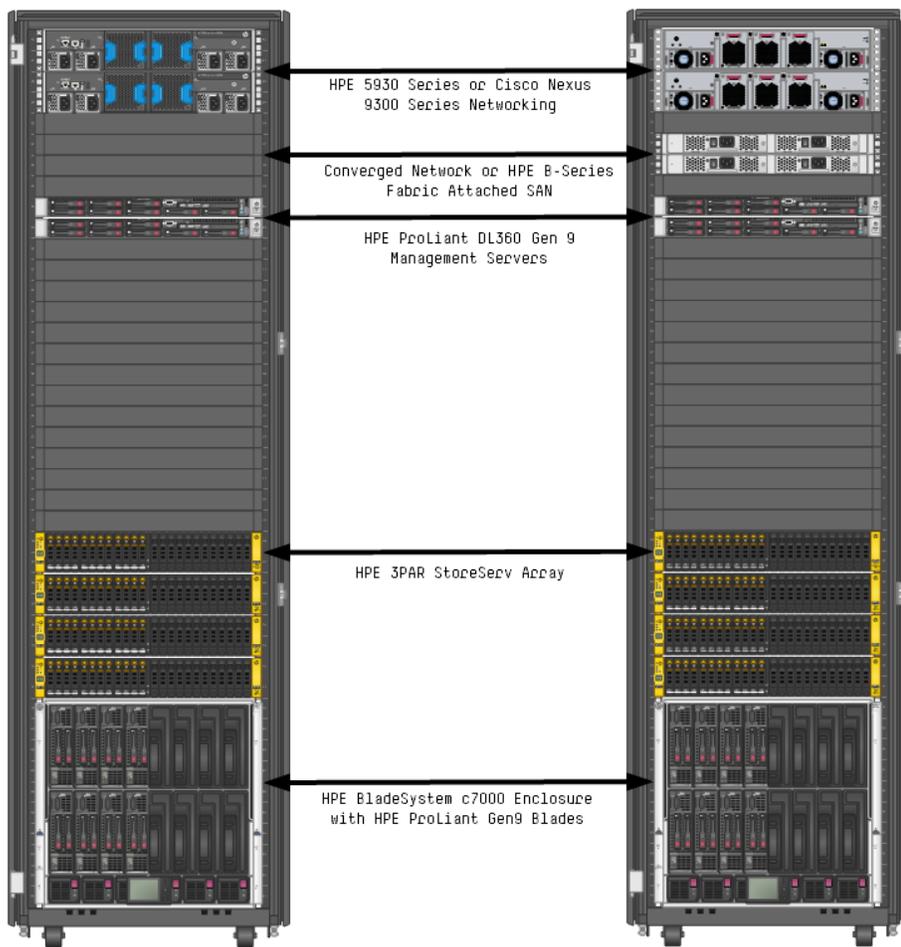


Figure 2. HPE Converged Architecture 700 with HPE Converged Networking (left) and Cisco Networking with Fabric attached storage (right)

Figure 2 shows two layouts.

The first layout on the left illustrates the following components:

- Two (2) HPE FF 5930-4Slot network switches configured in an Intelligent Resilient Framework (IRF) configuration.
- Converged networking using FC and FCoE on the HPE FF 5930-4Slot, no SAN switches required.
- Two (2) HPE DL360 Gen9 management servers offering a dedicated highly available VMware vSphere cluster to host all of the verified HPE software stack to manage and scale the solution throughout its lifecycle.
- One (1) HPE 3PAR StoreServ 8440c 2 node array to provide storage to the HPE Converged Architecture 700's management and compute clusters.
- One (1) HPE BladeSystem c7000 Enclosure with two (2) HPE Virtual Connect FlexFabric-20/40 F8 Modules and eight (8) HPE ProLiant BL460c Gen9 server blades to host the end users production workloads and applications.
- Wiring for Ethernet network, SAN and power are not shown, however everything is wired so there is no single point of failure in the HPE Converged Architecture 700. For an example please refer to the HPE Converged Architecture 700 VMware 6.0u2 Deployment Guide which will be available in the first quarter of 2016. The Deployment guide is available to Authorized HPE Partners, if you are not an Authorized HPE Partner, please work with your representative HPE Distributor or Value Added Reseller for more information.

The second layout on the right illustrates the following components:

- Two (2) Cisco Nexus 9396PX network switches configured in Virtual Port Channel configuration.
- Two (2) HPE SN6000B Fibre Channel switches for a dedicated switched fabric.
- Two (2) HPE DL360 Gen9 management servers offering a dedicated highly available VMware vSphere cluster to host all of the verified HPE software stack to manage and scale the solution throughout its lifecycle.
- One (1) HPE 3PAR StoreServ 8440c 2 Node Storage to provide storage to the HPE Converged Architecture 700's management and compute clusters.
- One (1) HPE BladeSystem c7000 Enclosure with two (2) HPE Virtual Connect FlexFabric-20/40 F8 Modules and eight (8) HPE ProLiant BL460c Gen9 server blades to host the end users production workloads and applications.
- Wiring for Ethernet network, SAN and power are not shown, however everything is wired so there is no single point of failure in the HPE Converged Architecture 700. For an example please refer to the HPE Converged Architecture 700 VMware 6.0u2 Deployment Guide. The Deployment guide is available to Authorized HPE Partners, if you are not an Authorized HPE Partner, please work with your representative HPE Distributor or Value Added Reseller for more information.

The HPE Converged Architecture 700 topology provides full end-to-end redundancy for all hardware and links. Additional storage controllers, storage arrays and servers can be added, up to the scalability limits described in the section [Solution design and best practices implementation](#).

Design objectives

The HPE Converged Architecture 700 solution is architected to address concerns of resiliency, fault tolerance, and high availability without impacting the availability of workloads running on the solution. As a core competency of the architecture of an HPE Converged Architecture 700, no single point of failure can exist in the solution that would affect the workloads running in the environment:

- At the network layer, the solution implements multi-chassis link aggregation groups (MLAG) for the network interfaces of all the components.
- Storage networking, whether it is Direct Attached or Fabric Attached, is designed with redundant paths from multiple HPE 3PAR storage controllers to each device in the solution.
- All components are configured with an N+N power design to ensure the solution can withstand losing one side of a data center's power feed.
- All management and production workloads reside on shared storage hosted on HPE 3PAR StoreServ Storage system(s) with two or more controllers working in an active/active design.

These features allow the environment to continue operating during maintenance activities on the solution or during a failure scenario of components, including network interfaces, power distribution units, cables, switches, and controllers, without causing workloads to fail.

Within the network layer, all components of the infrastructure must be connected to either two or more switches and configured for high availability at the network layer for protection against switch failure. Uplinks must be configured using multi-chassis link aggregation leveraging HPE Intelligent Resilient Framework (IRF) or Cisco Virtual Port Channels (vPCs) if Cisco Nexus Switches are used.

As a core component of the computing infrastructure, the HPE BladeSystem c7000 enclosure is built from the ground up to be a resilient infrastructure component with no active components on the mid planes as well as redundant interconnects for network and SAN connectivity, and redundant Onboard Administrator modules for out-of-band management. Even in the case that a single BladeSystem c7000 chassis is used to create a solution, HPE reports an average availability of 99.9996% and a mean time between failures (MTBF) of 1,899,431 hours. Also within the computing environment, the HPE Converged Architecture 700 solution offers resiliency, fault tolerance, and high availability within the physical servers and the hypervisor. The blade and rack mount servers have redundant power supplies to protect against partial power loss or power supply failure, redundant connections to both the network and SAN, and out-of-band management capabilities to allow remote server diagnostics and troubleshooting. The out-of-band management capabilities significantly improve the administrator's ability to diagnose and recover a server after failure.

Hosted on the computing environment, virtual machines (VMs) can be dynamically migrated across hypervisors, allowing the same kind of zero-downtime hardware maintenance that is provided by the storage system. This capability is further expanded with VMware vCenter's support for HA clustering, which allows VMs to be automatically rebooted on another host if a problem occurs.

Storing the compute and management virtual machines, the HPE 3PAR StoreServ storage also encompasses features that further resiliency and high availability such as persistent technologies, redundant components, and a Mesh-Active backplane technology. The HPE 3PAR Operating System Suite that comes with HPE 3PAR StoreServ Storage arrays includes everything you need to get started, including HPE 3PAR Adaptive Flash Cache, a true extension of DRAM cache that offers lower latency for read-intensive workloads. Optional software suites are also available for advanced data optimization, replication, security, reporting, and application integration—offering enterprise-class features at a price you can afford. It's storage that delivers the performance and flexibility you need to accelerate new application deployment and support server virtualization, the cloud, new service delivery models, data growth, or whatever else your future may hold—effortlessly.

The HPE Converged Architecture 700 topology provides full end-to-end redundancy for all hardware and links. Additional storage (both capacity and additional arrays, servers and networking) can be added up to the scalability limits described in the section [Solution design and best practices implementation](#).

The architecture of the HPE Converged Architecture 700 is based on best practices for all components involved. The requirements listed in this section are approved for use in the HPE Converged Architecture 700 VMware solutions and have been validated to alleviate the worries of any unknown interdependencies or issues with other components in the hardware and software stack. For the exact component models and software validations used in the HPE labs, please refer to the deployment guides.

Note

Each software or hardware component must also be listed on the [HPE OneView 1.20 Support Matrix](#) or [HPE OneView 2.0 Support Matrix](#) (depending on the version of HPE OneView being used) and the [VMware Hardware Compatibility Guide](#).

Components**HPE Converged Architecture 700 VMware 5.5u3**

HPE Converged Architecture 700 VMware 5.5u3 has been verified with the following components. For a full list of the Verified and Allowed components, as well as requirements of each component for compatibility in the HPE Converged Architecture 700, see the [HPE Converged Architecture 700 Architectural Policies](#) document.

Rack and Rack Infrastructure

- HPE 642 1200mm Shock Intelligent Series Rack
- HPE Managed Power Distribution Units (maPDU)

Ethernet Networking (A minimum of two of one type of switch in the following list)

- HPE 5900AF-48XG-4QSFP+
- Cisco Nexus 5672UP
- Cisco Nexus 56128P

Storage Networking (A minimum of two of one type of switch in the following list)

- HPE SN3000B 16Gb Active Fibre Channel Switch
- HPE SN6000B 16Gb Active Fibre Channel Switch
- HPE SN6500B 16Gb Active Fibre Channel Switch

Or Direct Attached SAN (No SAN switches)

Management Servers (A minimum of two)

- HPE ProLiant DL360 Gen9 8SFF Configure-to-order Server

Storage (Running HPE 3PAR OS 3.2.2)

- HPE 3PAR StoreServ 7200c 2-node
- HPE 3PAR StoreServ 7400c 2-node
- HPE 3PAR StoreServ 7400c 4-node

- HPE 3PAR StoreServ 7440c 2-node
- HPE 3PAR StoreServ 7440c 4-node
- HPE 3PAR StoreServ 7450c 2-node
- HPE 3PAR StoreServ 7450c 4-node
- HPE 3PAR StoreServ 7200 2-node
- HPE 3PAR StoreServ 7400 2-node
- HPE 3PAR StoreServ 7400 4-node
- HPE 3PAR StoreServ 7450 2-node
- HPE 3PAR StoreServ 7450 4-node

Compute Infrastructure

- HPE BladeSystem c7000 Enclosure
- HPE Virtual Connect-20/40 F8 Module for c-Class BladeSystem (minimum of 2 per enclosure)

Compute/Workload Servers (Minimum of two)

- HPE ProLiant BL460c Gen9 Server Blade

HPE Converged Architecture 700 VMware 6.0u2

HPE Converged Architecture 700 VMware 6.0u2 has been verified with the following components. For a full list of the Verified and Allowed components, as well as requirements of each component for compatibility in the HPE Converged Architecture 700, see the [HPE Converged Architecture 700 Architectural Policies](#) document.

Rack and Rack Infrastructure

- HPE 642 1200mm Shock Intelligent Series Rack
- HPE Managed Power Distribution Units (maPDU)

Ethernet Networking (A minimum of two of one type of switch in the following list)

- HPE FF 5930-2Slot+2QSFP+
- HPE FF 5930-4Slot
- Cisco Nexus 5672UP
- Cisco Nexus 56128P
- Cisco Nexus 9372
- Cisco Nexus 9396

Storage Networking (A minimum of two of one type of switch in the following list)

- HPE SN3000B 16Gb Active Fibre Channel Switch
- HPE SN6000B 16Gb Active Fibre Channel Switch
- HPE SN6500B 16Gb Active Fibre Channel Switch
- HPE Converged Platform Networking using HPE FF 5930 Series
- Cisco Unified Networking using Cisco Nexus 5600 Series

Or Direct Attached SAN (No SAN switches)

Management Servers (A minimum of two)

- HPE ProLiant DL360 Gen9 8SFF Configure-to-order Server

Storage (Running HPE 3PAR OS 3.2.2)

- HPE 3PAR StoreServ 8200 2-node
- HPE 3PAR StoreServ 8400 2-node
- HPE 3PAR StoreServ 8400 4-node
- HPE 3PAR StoreServ 8440 2-node
- HPE 3PAR StoreServ 8440 4-node
- HPE 3PAR StoreServ 8450 2-node
- HPE 3PAR StoreServ 8450 4-node

Compute Infrastructure

- HPE BladeSystem c7000 Enclosure
- HPE Virtual Connect-20/40 F8 Module for c-Class BladeSystem (minimum of 2 per enclosure)

Compute/Workload Servers (Minimum of two)

- HPE ProLiant BL460c Gen9 Server Blade
- HPE ProLiant WS460c Gen9 Graphics Server Blade

Solution hardware

This section will describe the hardware that can be leveraged in an HPE Converged Architecture 700 and the benefits they provide. The sections will start to touch on some of the key architectural design criteria of an HPE Converged Architecture 700 and how the described solution hardware addresses that criteria. More about the design criteria can be found in the [Solution design and best practices implementation](#) section of this document.

Note

When products are described in this section, features and options that are applicable to the HPE Converged Architecture are discussed. The standard hardware outside of an HPE Converged Architecture 700 may have more functionality or options than can be used in an HPE Converged Architecture. More information on why this is the case can be found in the [Solution design and best practices implementation](#).

Storage – HPE 3PAR StoreServ Storage

HPE Converged Architecture 700 employs the industry-leading HPE 3PAR StoreServ Storage family, which has been designed for virtualization, infrastructure as a service (IaaS), and cloud environments. When building an HPE Converged Architecture 700 system with HPE 3PAR StoreServ Storage, designers can choose from several models that provide the same foundational attributes:

Performance and flexibility. HPE 3PAR StoreServ Storage optimizes capacity utilization without compromising performance, thus reducing the need to add capacity while also reducing storage footprint, power usage, and cooling needs. HPE 3PAR Thin Provisioning Software eliminates capacity waste, allowing you to purchase only the disk capacity you actually need, when you actually need it. In conjunction with powerful storage optimization software, application-specific integrated circuits (ASICs) in the storage controllers monitor traffic and automatically move data and workloads within a particular array or between arrays without impacting services, applications, or users.

Secure multi-tenancy. Consolidate with confidence. Achieve higher service levels for more users and applications with less infrastructure. HPE 3PAR StoreServ Storage is designed to support massive consolidation by supporting mixed workloads and secure administrative segregation of users, hosts, and application data. Deliver higher performance levels, six-nine availability, and next-generation functionality to multiple user groups and applications from a single storage system.

Storage efficiency. HPE 3PAR StoreServ Storage is optimized internally to maximize the efficient use of storage controller resources. Other features designed to enhance storage performance include thin provisioning, thin persistence, system tuning, and virtual copying. Thin provisioning allows unused space to be shared among volumes as well as providing a synchronous view of thin-provisioned LUNs and ensuring their robustness via LUN identification, threshold notification handling, temporary and permanent resource exhaustion, storage space reclamation, and inquiry into the mapping state of logical blocks. Underlining the mantra of *start thin and stay thin*, thin persistence takes this further by reclaiming unused space associated with data deleted from storage volumes. A system tuner automatically detects and eliminates bottlenecks and hotspots without disrupting applications or impacting service levels. To create snapshots for data backup, application recovery, business intelligence, and to expedite development and testing, virtual copy allows point-in-time (PIT) copies of your data.

High availability and fault tolerance. High availability is a critical requirement that is built into the HPE 3PAR StoreServ Architecture providing full hardware redundancy. Controller node pairs are connected to dual-ported drive enclosures owned by that pair. Unlike other approaches, the system offers both hardware and software fault tolerance by running separate instances of the HPE 3PAR Operating System on each controller node, thus facilitating the availability of customer data. With this design, software and firmware failures—a significant cause of unplanned downtime—are greatly reduced.

Data at Rest Encryption enables the encryption for all the data that is stored on the internal drives of the 3PAR StoreServ Storage. The 3PAR StoreServ Data Encryption solution encrypts and decrypts all data written to and read from the media automatically. The 3PAR StoreServ Data Encryption solution encrypts the data so that data cannot be read off a drive that is removed from the 3PAR Storage. In the event of a failure of the drive or the theft of a drive, the proper authentication key is required to be entered to gain access to the data stored within the drive. This method of encryption allows the user the comfort of knowing all data contained on the drive is protected against internal and external risks.

Compute/Workload servers – HPE ProLiant Gen9 Blade and Workstation servers

The HPE ProLiant Gen9 Blade and Workstation servers used in the HPE Converged Architecture 700 solution deliver industry-leading performance, increased over previous generations. Embedded management enhancements include integrated lifecycle automation capabilities that are enabled by innovations such as HPE Intelligent Provisioning for easy system setup, active health checks for agentless hardware monitoring and alerting, and HPE Smart Update for automated firmware and system software maintenance. HPE ProLiant Gen9 Blade and Workstation servers also utilize HPE OneView to automate key management processes, including the system's physical development, configuration, and problem management.

HPE engineered the HPE ProLiant Gen9 Blade and Workstation servers to get the most out of the latest advances in processors, memory, networking technology, and new management solutions through the following features:

- Intel-based blades, with sockets for up to two Intel® Xeon® E5-2600 v3 processors or up to four Intel Xeon E5-4600 v3 processors with up to 18 cores each
- 16 DDR4 DIMM sockets for up to 2TB of HPE SmartMemory and a maximum memory speed up to 2133 MHz
- Connectors for up to two PCI-E mezzanine cards (two x 16)
- Onboard storage with flexible HPE Smart Array controller options
- HPE FlexibleLOM technology with 20Gb adapters
- Onboard Internal USB 3.0 port(s) and a Micro Secure Digital High Capacity (Micro SDHC) card slot for low cost Flash based boot options designed for integrated hypervisor virtualization environments
- Onboard M.2 slot for Solid State M.2 SATA Drives
- HPE Power Regulator for ProLiant
- Unified Extensible Firmware Interface (UEFI) for full configuration and management flexibility

HPE ProLiant Gen9 Blade and Workstation servers also come standard with HPE Integrated Lights-Out 4 (iLO 4), the latest iLO firmware for the iLO management engine. HPE Converged Architecture 700 provides the flexibility to configure each c7000 enclosure with HPE ProLiant BL460c Gen9 Server Blades, HPE ProLiant WS460c Gen9 Graphics Server Blades and/or HPE ProLiant BL660c Gen9 Server Blades equipped with Intel Xeon processors. Additional flexibility is provided by the ability to configure any supported memory configuration as well as local hard drive, SD, M.2, USB or boot from SAN configurations.

Management servers – HPE ProLiant DL360 Gen9 Server

The HPE Converged Architecture 700 solution uses redundant HPE ProLiant DL360 Gen9 servers as management compute infrastructure to deliver exemplary performance and efficiency in a compact 1U size. These servers run the entire HPE Converged Architecture 700 solution management stack and contain many of the same features as Gen9 Server Blades.

HPE engineered the HPE ProLiant DL360 Gen9 servers to get the most out of the latest advances in processors, memory, networking technology, and new management solutions. The HPE Converged Architecture 700 leverages the following of those features:

- Intel-based blades, with sockets for up to two Intel Xeon E5-2600 v3 processors with up to 18 cores each
- 24 DDR4 DIMM sockets with speeds up to 2133 MHz
- Connectors for up to three PCI-E expansion slots (two x 16, one x 8)
- Onboard storage (up to 8 small form factor SAS/SSD drives) with flexible HPE Smart Array controller options
- Embedded 4x1GbE NIC
- HPE FlexibleLOM technology with 10Gb adapters
- Unified Extensible Firmware Interface (UEFI) for full configuration and management flexibility
- HPE Integrated Lights-Out 4 (iLO 4)

Networking – HPE and Cisco Nexus switches

Network connectivity in this solution is provided by a redundant set of 10/40GbE network switches. Because HPE understands customers want choices in vendors especially around the top of rack, two families of switch models have been tested with the HPE Converged Architecture 700:

- HPE 5900AF-48XG-4QSFP+
- HPE FlexFabric 5930-2Slot+2QSFP+
- HPE FlexFabric 5930-4Slot
- Cisco Nexus 9396PX
- Cisco Nexus 56xx (with or without Cisco Nexus 2248PQ Fabric Extenders)

Each switch is configured to meet the following network design goals:

Multichassis link aggregation. Any given compute node has at least one connection to each switch in a pair of switches. The switch pair is interconnected with two or more links as well. The switches are configured in a vendor-specific way to provide chassis-level fault tolerance; if one switch goes down, traffic proceeds uninterrupted.

Link Aggregation Control Protocol (LACP) and NIC Teaming. All compute nodes and infrastructure components have multiple network connections configured automatically by LACP and/or VMware NIC teaming technologies to reduce the opportunity for human error.

VLANs (802.1q). The physical network can be partitioned into multiple VLANs by using the ubiquitous 802.1q networking standard. This configuration allows traffic separation for infrastructure management, back-end storage, and application access from multiple users.

HPE 5900AF-48XG-4QSFP+ Switches

The HPE 5900 Switch Series provides high density, ultra-low latency, top-of-rack (ToR) switches. Designed for HPE FlexNetwork architecture, these switches are ideally suited for deployments at the server access layer of large enterprise data centers and are powerful enough for deployments at the data center core layer of medium sized enterprises.

With the increase in virtualized applications and server-to-server traffic, customers now require ToR switch innovations that can meet their needs for higher performance server connectivity, convergence of Ethernet and storage traffic, the capability to handle virtual environments and low latency in a single device.

Key features include:

- Cut through with low latency and wire speed
- HPE Intelligent Resilient Framework (IRF) for virtualization and two-tier architecture
- High 1GbE/10GbE ToR port density with 40GbE uplinks
- IPv6 support in ToR with full L2/L3 features
- Convergence ready with DCB, FCoE, and TRILL

To accommodate production network traffic, HPE Converged Architecture 700 features redundant HPE 5900AF-48XG-4QSFP+ switches, which are all linked via IRF technology and appear to components in the solution as well as the upstream data center networking switches as one switch. In addition, these switches, in conjunction with the Virtual Connect modules, create a fully redundant active-active network design that can maximize throughput while isolating traffic.

These switches support Link Aggregation Control Protocol (LACP), which allows multiple physical ports to be bundled together to form a single logical channel. With LACP, multiple devices can communicate simultaneously at full single port speed, without permitting any one device to monopolize traffic. In conjunction with IRF, aggregation groups can be connected to both switches in active-active mode without the use of protocols such as spanning tree.

HPE FlexFabric 5930-2Slot+2QSFP+ Switches

The HPE FlexFabric 5930 Switch Series is a family of high-density, ultra-low-latency, top-of-rack (ToR) switches that is part of the HPE FlexNetwork architecture's HPE FlexFabric solution.

Ideally suited for deployment at the aggregation or server access layer of large enterprise data centers, the HPE FF 5930 Switch Series is also powerful enough for deployment at the core layer of medium-sized enterprises.

With the increase in virtualized applications and server-to-server traffic, customers now require spine and ToR switch innovations that will meet their needs for higher-performance server connectivity, convergence of Ethernet and storage traffic.

Key features include:

- Cut-through with ultra-low-latency and wire speed
- VXLAN VTEP support for virtualized environments
- High-density 10GbE and 40GbE spine/ToR connectivity
- IPv6 support with full L2 and L3 features
- Convergence-ready with DCB, FCoE, and TRILL

To accommodate production network traffic, HPE Converged Architecture 700 features redundant HPE FF 5930 Switch Series switches, which are all linked via IRF technology and appear as one switch to the components in the solution as well as the upstream data center networking switches. In addition, these switches, in conjunction with the Virtual Connect modules, create a fully redundant active-active network design that can maximize throughput while isolating traffic.

These switches support Link Aggregation Control Protocol (LACP), which allows multiple physical ports to be bundled together to form a single logical channel. With LACP, multiple devices can communicate simultaneously at full single port speed, without permitting any one device to monopolize traffic. In conjunction with IRF, aggregation groups can be connected to both switches in active-active mode without the use of protocols such as spanning tree.

HPE Intelligent Resilient Framework

HPE Intelligent Resilient Framework (IRF) overcomes the limitations of legacy spanning tree designs by providing rapid failover for delay-sensitive, mission-critical applications and dramatically improving network utilization and performance in the network core. With IRF, up to nine switches can be managed as a single logical device with one IP address.

For decades, enterprises invested in networking infrastructure capacity only to discover that most of the acquired bandwidth must be blocked. Companies using STP are forced to design their networks to adapt to the needs of this aging protocol. With HPE IRF, the network administrator

can build STP-free networks that use all of the available bandwidth. In essence, enterprises are able to take advantage of the investments that they have made in networking capacity.

In addition to freeing strained networking bandwidth, HPE IRF adds link aggregation capability to links that connect physical devices. Link aggregation dramatically enhances network reliability and makes aggregate network bandwidth available to devices in the IRF domain. The result is a network that is ready to support the most demanding business applications. HPE publically demonstrated the superior capabilities of IRF by showing that workload mobility can be improved by more than 80% when VMware vSphere vMotion is used.

For more information, see [Intelligent Resilient Framework](#).

Networking software

HPE VSR1000 Virtual Services Router is an optional component

The HPE VSR1000 Virtual Services Router (VSR1000) is a virtualized application that provides functionality similar to a physical router. The VSR1000 series enables significant operational savings as a result of its agility and ease of deployment. Like other virtual applications, the routers run in a virtual machine on an industry standard x86 server. Resources on the VSR1000 series can be dynamically allocated and upgraded on demand as performance requirements grow. The VSR1000 series is available in one, four, and eight virtual CPU versions that have no expiration date. Robust routing is provided between networked devices using a number of popular routing protocols. In addition, the series provides critical network services associated with today's enterprise routers such as VPN gateway, firewall and other security and traffic management functions.

A variety of deployment models are supported, including enterprise branch CPE routing and cloud offloading for small- to medium-sized workloads.

- Virtualized enterprise class x86 routing software
- Firewall, IPSec, and MPLS VPN security
- Agile deployments across the branch office, data center, and cloud
- Easy to deploy and manage remotely
- VMware and KVM (Kernel-based Virtual Machine) hypervisor support

There are several use cases for the HPE Virtual Services Router in an HPE Converged Architecture 700. The first is to provide NAT in deployments where the management network is isolated to the solution and external access is needed between the customer's data center management network and the solution management network. This allows the customer to access management components from the data center IP space. A second use case for the VSR is to allow multiple solution racks to have identical IP address schemes within the rack but use NAT addresses to communicate to enable replication, high availability, and metro cluster via the data center network enabling customers to create standard deployment procedures and integrate them into a much larger solution.

Hypervisor

VMware vSphere

VMware vSphere is an optimal virtualization platform and enabler for cloud computing architectures. VMware vSphere enables IT to meet service level agreements (SLAs) for the most demanding business-critical applications at the lowest total cost of ownership (TCO). VMware vSphere delivers control over all IT resources with the highest efficiency and choice in the industry, as shown below.

VMware vSphere virtualization solutions provide for:

- **Consolidation.** VMware virtualization allows multiple application servers to be consolidated onto one physical server, with little or no decrease in the overall performance. This helps to minimize or eliminate underutilized server hardware, software, and infrastructure.
- **Manageability.** The live migration of virtual machines from server to server and the associated storage is performed with no downtime using VMware vSphere vMotion, which simplifies common operations such as hardware maintenance, and VMware vSphere Storage vMotion.
- **Availability.** High availability can be enabled to reduce unplanned downtime and enable higher service levels for applications. VMware vSphere High Availability (HA) ensures that, in the event of an unplanned hardware failure, the affected virtual machines are automatically restarted on another host in a VMware cluster.

- **Automation.** VMware automated load balancing takes advantage of vMotion and Storage vMotion to migrate virtual machines among a set of VMware ESXi hosts. VMware vSphere Distributed Resource Scheduler (DRS) and VMware vSphere Storage DRS enable automatic resource relocation and optimization decisions for virtual machines and storage.
- **Provisioning.** VMware virtualization encapsulates an application into an image that can be duplicated or moved, greatly reducing the cost of application provisioning and deployment.

Note

This release of the HPE Converged Architecture 700 architecture uses vSphere 5.5 Update 3a or vSphere 6.0 Update 2a.

VMware vSphere has a range of features at different licensing levels. This solution supports the use of any of these license levels, but it is designed to use the features offered by the vSphere with Operations Management (vSOM) enterprise-level license. This license includes vSphere Enterprise and vRealize Operations Manager (vROps) standard to strike a balance between cost and functionality. Optionally, customers can upgrade vRealize Operations Manager to the advanced or enterprise level.

Management software

HPE Converged Architecture 700 provides holistic management for both virtual and physical environments.

The default configuration of the HPE Converged Architecture 700 solution includes two HPE ProLiant DL360 Gen9 servers running VMware vSphere 5.5u3a or VMware vSphere 6.0u2a, deployed with a number of VMs. These VMs provide all of the management connectivity and software required to administer and manage the solution:

- HPE OneView 1.2 or HPE OneView 2.0 (virtual appliance)
- VMware vCenter Server 5.5u3a or 6.0u2a (virtual appliance)
- VMware Platform Services Controller (VMware vSphere 6 only) (virtual appliance)
- VMware vRealize Operations Manager (virtual appliance)
 - HPE OneView for VMware vRealize Operations
- HPE Insight Control Server Provisioning (virtual appliance)
- HPE Virtual Services Router (optional virtual appliance)
- Solution management VM (Microsoft Windows Server® 2012 R2)
 - HPE OneView for VMware vCenter
 - Insight Control Server Provisioning Media Server
 - HPE 3PAR StoreServ Management Console
 - HPE 3PAR Command Line Interface
- HPE Recovery Manager Central (virtual appliance)

HPE OneView

HPE Converged Architecture 700 utilizes HPE OneView, a comprehensive single platform designed from the ground up for converged infrastructure management. An integrated platform increases the productivity of every member of the internal IT team across servers, storage, and networking. By streamlining processes, incorporating best practices, and creating a new holistic way to work, HPE OneView provides organizations with a more efficient way to work. It is designed for open integration with existing tools and processes to extend these efficiencies.

HPE OneView comes preinstalled with the HPE Converged Architecture 700 solution and is instrumental for the deployment and management of HPE servers and enclosure networking. It collapses infrastructure management tools into a single resource-oriented architecture that provides direct access to all logical and physical resources of the solution. Logical resources include server profiles and server profile templates; enclosures and enclosure groups; and logical interconnects and logical interconnect groups. Physical resources include server hardware blades and rack servers; networking interconnects; and computing resources.

Note

In the current release of the HPE Converged Architecture 700 solution, HPE OneView does not manage HPE or Cisco networking.

The HPE OneView converged infrastructure platform offers a uniform way for administrators to interact with resources by providing a RESTful API foundation. This integrated resource model removes the need for the administrator to enter and maintain the same configuration data more than once and keep all versions up to date. It encapsulates and abstracts many underlying tools behind the integrated resource model, so the administrator can operate with new levels of simplicity, speed, and agility to provision, monitor, and maintain the solution. The integrated resource model is critical for diagnosing problems or determining the risk of making a change because it gives administrators the ability to see affected resources and how they are interconnected before making the change.

HPE OneView also streamlines the process of bringing the enclosures, interconnects, and server hardware under management. When a supported device is added to the solution, HPE OneView automatically detects all the hardware and prepares it for monitoring and management. In HPE OneView, server hardware either has a server profile and is allocated and fully configured or has no server profile and is available as raw hardware in a pool while it awaits a new configuration. This approach supports the most dynamic reconfiguration of hardware possible while preserving the simplicity of provisioning a new server profile with the same settings as existing ones. Server profiles can be deployed successfully to the allocated hardware, based on information about the server hardware type and enclosure group.

Figure 3 shows the high-level HPE OneView architecture.

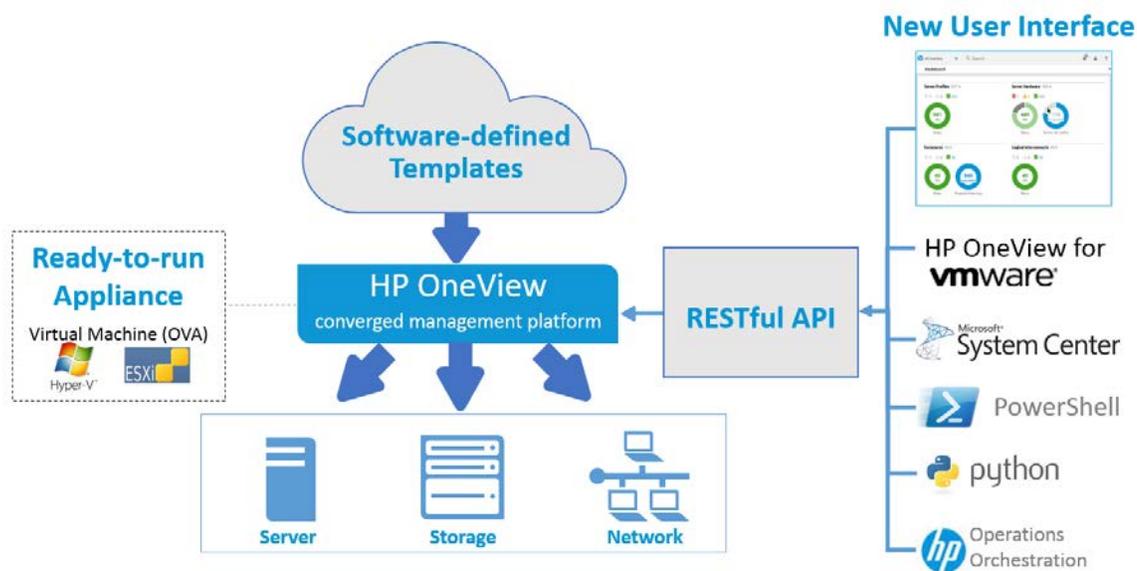


Figure 3. OneView architecture

Designed for automation

A substantial portion of the work of operations teams consists of routine tasks related to infrastructure lifecycle management, including designing, provisioning, monitoring, and updating configurations. HPE OneView is designed to automate day-to-day responsibilities by simplifying time-consuming tasks and leading to increased productivity and reduced operational costs. It is an automated infrastructure provider under any environment (including VMware, Microsoft, Red Hat®, and OpenStack®) that supports traditional, virtualized, and cloud workloads.

Enhanced user experience

The simple, efficient, and consistent UI of HPE OneView is designed to enhance the interaction between IT staff members and match existing work practices in the data center. It features new capabilities inspired by web technology and rethinks them for the data center. Users also have the choice of using programmatic interfaces that are based on REST APIs.

The HPE OneView UI design builds functionality around administrators' work practices and puts resources in the menu while fully embracing the web experience. Users can right-click any of the links in the HPE OneView dashboard to open them in a new tab, copy and paste, browser

bookmarks, easily e-mail links to colleagues, and print diagrams and data. The UI has search capabilities, newsfeeds, and other functions that deliver a web experience. The HPE OneView UI also works on desktops, tablets, and mobile devices.

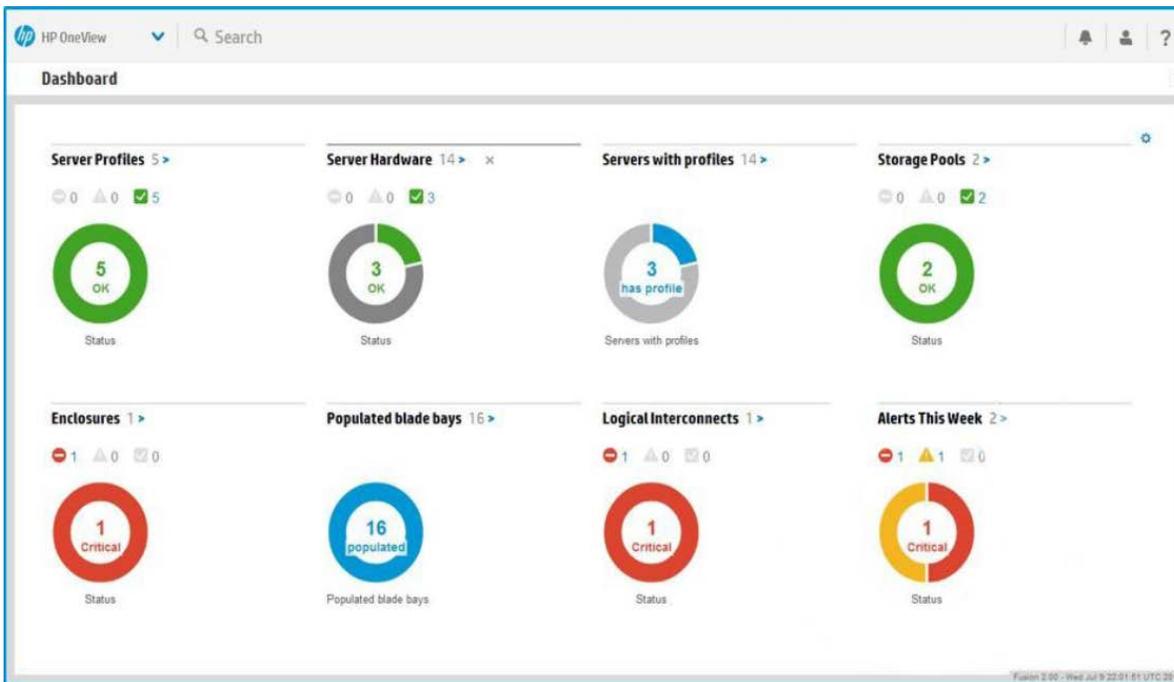


Figure 4. HPE OneView user interface

Software-Defined resources

HPE OneView includes software-defined resources (templates, server profiles, enclosures, and enclosure groups) that provide an innovative way to manage the entire data center. These logical constructs enable administrators to specify the desired configuration of the environment and allow HPE OneView to automate the process of implementing that configuration.

Groups and templates are used to define configurations that are specific to the environment, such as configurations for vSphere virtual hosts. These resources provide flexibility to simplify changes across the data center and control change management. By using these reusable logical constructs, administrators can capture the best practices of experts across a wide variety of disciplines, including networking, storage, hardware configuration, and operating system build and configuration. HPE OneView keeps best-practice approaches intact as the environment grows while allowing customization to maintain ultimate control. This model facilitates faster provisioning, greater consistency, and fewer errors.

Server profiles and enclosure groups make it easier to prepare a bare metal server for operating system deployment because they contain the information necessary to configure the system firmware, BIOS settings, local storage settings, SAN settings, and network connectivity thus defining the complete configuration. Template server profiles can be used to capture best practices once and then roll them out multiple times in an efficient and error-free way.

HPE OneView for VMware vCenter

To extend the capabilities of vCenter to the physical environment, HPE Converged Architecture 700 includes HPE OneView for VMware vCenter. This HPE product integrates the manageability features of HPE ProLiant, BladeSystem, and Virtual Connect with VMware vCenter Server and VMware vRealize Operations Manager to create a holistic, single pane of glass management experience.

HPE OneView for VMware vCenter allows administrators to gain a deeper control of the virtualized environment and reduces the time it takes to make changes, increase capacity, or manage planned and unplanned downtime. When used with the automation power of HPE OneView, best practices for HPE Converged Architecture 700 can be defined once and reused many times to provision an entire cluster with computing and storage resources that can be fully configured in a few steps. New integrations with VMware vRealize Operations Manager are also available to deliver powerful analytics and deeper troubleshooting tools to VMware administrators.

The integration between HPE converged management and VMware vCenter management results in the following capabilities:

- Simplified administration with VMware console access to the HPE infrastructure management
- Automated responses to hardware events
- Ability to take control by launching HPE management tools within the vCenter console
- Ability to manage changes proactively with detailed relationship dashboards
- Ability to leverage on-demand server and storage capacity
- Stability and reliability with online firmware inventory and deployment
- Deep analytics and troubleshooting through integrations with vRealize Operations Manager

HPE Insight Control Server Provisioning

Insight Control Server Provisioning is designed to streamline server provisioning administrative tasks and functions as the common multiserver provisioning capability for HPE Converged Architecture 700. It simplifies the process of deploying operating systems on HPE ProLiant bare metal servers as well as virtual machines and is preinstalled on a VM optimized to run the HPE Insight Control Server Provisioning application.

HPE Insight Control Server Provisioning allows the administrator to perform the following tasks:

- Install Microsoft Windows®, Linux®, VMware vSphere, and Microsoft Hyper-V on HPE ProLiant servers
- Update drivers, utilities, and firmware on HPE ProLiant servers by using the HPE Service Packs for ProLiant (SPPs)
- Configure HPE ProLiant system hardware, iLOs, BIOS, and HPE Smart Array controllers
- Deploy to target servers with, or without, PXE
- Run deployment jobs on multiple servers simultaneously
- Customize HPE ProLiant deployments with an easy-to-use, browser-based interface

VMware vRealize Operations Manager

vRealize Operations Manager on HPE Converged Infrastructure combines a leading software and hardware virtualization platform with robust management capabilities. This combination enables users to gain operational insight into a vSphere environment while optimizing capacity. By providing detailed analysis of the virtual environment, the product enables users to reclaim unused capacity, right-size VMs, improve utilization, and increase consolidation ratios. Users can leverage vRealize Operations Manager on HPE Converged Infrastructure to obtain the following benefits:

Improve application performance and business continuity. vRealize Operations Manager supports even the most resource-intensive applications to meet SLA and availability requirements. It reduces the cost and complexity of managing business continuity and disaster recovery with always-on IT capabilities and layered protection against service outages and data loss.

Simplify IT operations at a lower cost. vRealize Operations Manager lowers operational overhead and simplifies the management of development, quality assurance, and production IT environments that are large and geographically distributed.

Gain operational insight. vRealize Operations Manager enables IT to respond to performance trends proactively. It collects and analyzes performance data, correlates abnormalities, and identifies the root cause of building performance issues.

Optimize capacity. vRealize Operations Manager makes it easier to manage and optimize capacity planning. Unused VMs can be reclaimed, and underprovisioned VMs can be right-sized, to help make the most efficient use of resources.

VMware vCenter Server

VMware vCenter Server offers centralized control and visibility at every level of the virtualized infrastructure. Its single console provides unified management of the entire vSphere environment, allowing for resource management and optimization by giving administrators insight into the status and configuration of clusters, hosts, VMs, storage, guest operating system, and other components to maximize efficiency.

A single vCenter Server instance allows the VM administrator to manage up to 1,000 hosts and 10,000 VMs. For more information about vCenter Server, see the [vCenter Server](#) product page.

HPE StoreOnce Recovery Manager Central for VMware

HPE StoreOnce Recovery Manager Central for VMware allows VMware administrators to create hundreds of VMware consistent snapshots and initiate rapid online recovery directly from within the VMware vCenter Server management console. Using the HPE StoreOnce RMC Express Protect feature, customers can also backup to an HPE StoreOnce directly. The backups are self-contained volumes that can be restored back to the original or different 3PAR StoreServ Storage in the event of a disaster.

Solution design and best practices implementation

This section lays out the required and optional features for each component of the solution and how to best configure them. It also describes how the solution achieves the goals of manageability, security, performance, and integration in the larger data center environment.

Storage

All storage devices verified and approved for use in an HPE Converged Architecture 700 environment must have features that provide resiliency against hardware and cabling failures. They must also be able to be upgraded in an online fashion and provide flexibility to meet the performance and capacity needs of different workloads the customer may place on the HPE Converged Architecture 700.

To meet the architectural guidelines of an HPE Converged Architecture 700, HPE 3PAR StoreServ storage was leverage to eliminate any single point of failure (hardware or software) in the system. To mitigate single points of failure at the hardware layer, the system is designed with redundant components, including redundant power domains. At a minimum, there are two controller nodes and two copies of the HPE 3PAR Operating System even in the smallest system configuration.

To further the resiliency of HPE 3PAR StoreServ Storage, nodes are each powered by two (1+1) redundant power supplies and backed up by a string of two batteries. Each battery has sufficient capacity to power the controller nodes long enough to save all necessary data in memory into the local physical drive. Although many architectures use “cache batteries,” these are not suitable for extended downtimes that are usually associated with natural disasters and unforeseen catastrophes.

To further mitigate downtime due to component failure, HPE 3PAR Persistent Cache is a resiliency feature built into the HPE 3PAR Operating System that allows graceful handling of an unplanned controller failure or planned maintenance of a controller node. This feature eliminates the substantial performance penalties associated with traditional modular arrays and the cache “write-through” mode they have to enter under certain conditions. For any HPE 3PAR StoreServ array with four or more nodes, any node that loses its adjacent node can dynamically form a mirrored cache relationship with another storage controller node.

Another persistent technology, HPE 3PAR Persistent Ports, allows for a non-disruptive environment (from the host multipathing point of view) where host-based multipathing software is not required to maintain server connectivity in the event of a node down or link down condition on any SAN fabric. This applies to firmware upgrades, node failures, and node ports that are taken offline either administratively, or as the result of a hardware failure in the SAN fabric that results in the storage array losing physical connectivity to the fabric.

From a host standpoint, connections to HPE 3PAR StoreServ Storage systems continue uninterrupted with all I/O being routed through a different port on the array. This helps you achieve an uninterrupted service level for applications running on HPE 3PAR StoreServ Storage systems.

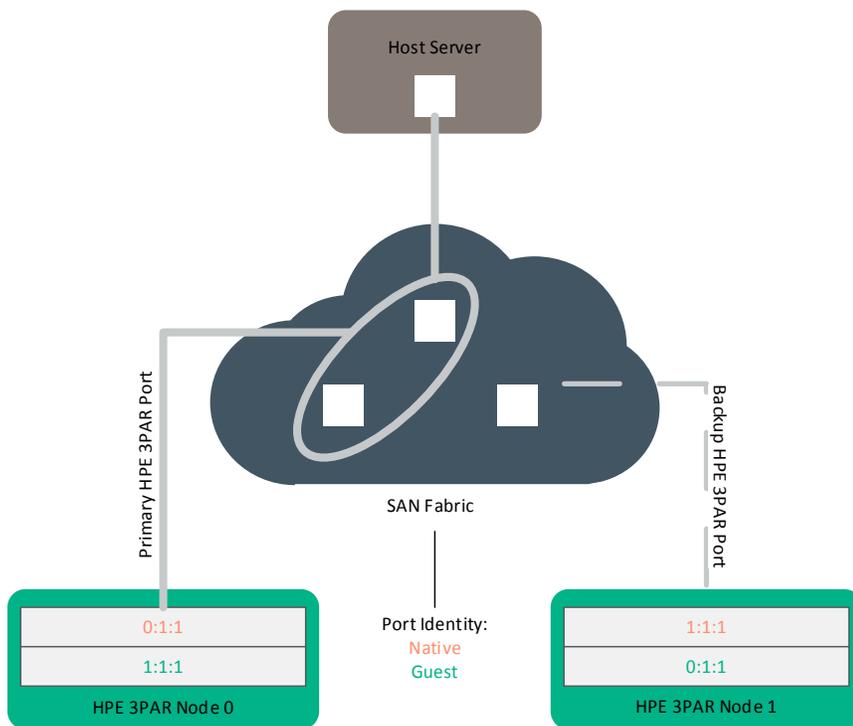


Figure 5. Logical diagram of a Persistent Ports configuration.

Although these storage devices have been tested with a particular firmware version, an HPE Converged Architecture 700 configuration is fully supported by any subsequent version of the firmware unless specifically stated otherwise on HPE SPOCK, the HPE OneView Support Matrix, VMware Hardware Compatibility Guide or the HPE Converged Architecture 700 Architectural Policies document.

At this time only Fibre Channel connectivity via 8Gb or 16Gb ports is allowed.

Storage sizing

HPE 3PAR StoreServ Storage has several sizing options and features. Customers can choose models by matching hardware characteristics to their business needs.

Storage cluster performance

In any deployment of HPE 3PAR StoreServ Storage and in an HPE Converged Architecture, a configuration of one HPE 3PAR StoreServ Storage system with at least two nodes is required. A wide variety of controller options is available, depending on business requirements. A remote office might require a smaller footprint and run lighter workloads; therefore, a 7200c model might be a good fit for the environment. For large data centers that require a substantial amount of horsepower or capacity, a 7440c model might be a better fit. For environments looking to deploy a VDI workload or having a workload optimized for an all flash array, and 7450c model might be best suited. Table 1 lists the hardware specifications for the appropriate controller models for the 7000c series.

Note

In the current release of the HPE Converged Architecture 700 solution, only the HPE 3PAR StoreServ 7000, 7000c and 8000 series have been verified. The HPE 3PAR StoreServ 10000 and 20000 are allowed, but specific guidance on their use is not shown or has not been verified against the verified hardware and software stacks in this design guide.

Table 1. Controller hardware specifications

CONTROLLER MODEL	MAXIMUM RAW HA CAPACITY	MAXIMUM NUMBER OF DISKS	MAXIMUM NUMBER OF SOLID STATE DISKS	PROCESSOR TYPE	MAXIMUM ONBOARD FC PORTS	NUMBER OF PCI-E EXPANSION SLOTS
8200	750TiB	240	120	2 x 6-core 2.2GHz	12 (16Gb)	2
8400	2400TiB	576	240	2-4 x 6-core 2.2GHz	24 (16Gb)	2-4
8440	3000TiB	960	480	2-4 x 10-core 2.4GHz	24 (16Gb)	2-4
8450	1843TiB	N/A	480	2-4 x 10-core 2.4GHz	24 (16Gb)	2-4
7200c	500TiB	240	120	2 x 6-core 1.8GHz	12 (8Gb) or 4 (8Gb)/4 (16Gb)	2
7400c	1600TiB	576	240	2-4 x 6-core 1.8GHz	24 (8Gb) or 8 (8Gb)/8 (16Gb)	2-4
7440c	2000TiB	960	240	2-4 x 8-core 2.3GHz	24 (8Gb) or 8 (8Gb)/8 (16Gb)	2-4
7450c	460.8TiB	N/A	240	2-4 x 8-core 2.3GHz	24 (8Gb) or 8 (8Gb)/8 (16Gb)	2-4

Designing storage involves striking a balance between the throughput and response time needed to support the expected load on the storage subsystems. The following steps review the process of determining the I/O performance and throughput requirements for a customer’s business needs.

- Determine the storage performance (IOPs) and throughput (GB/s) required for business need.
- Determine the disk type (SSD, FC, NL), the capacity required for growth and the protection level of RAID configuration suitable for your mix loads.
- Use the number of IOPs that are required to support the workload to calculate the distribution of disks and the number of controller nodes.

Network

All switches verified and approved for use in an HPE Converged Architecture 700 environment have features that provide resiliency against hardware and cabling failures. In addition, although these switches have been tested with a particular firmware version, an HPE Converged Architecture 700 configuration is fully supported by any subsequent version of the firmware unless specifically stated otherwise on HPE SPOCK, the HPE OneView Support Matrix, VMware Hardware Compatibility Guide or HPE Converged Architecture 700 Architectural Policies document.

Multiple redundant powered switch chassis

The HPE Converged Architecture 700 solution requires a minimum of two independently and redundantly powered switches for production Ethernet networking and SAN networking if a SAN Fabric is used. The architecture of an HPE Converged Architecture 700 requires the connection of all devices in the solution to a minimum of two network switches. For Ethernet networking, it is required to leverage link aggregation and operating system–based load balancing or failover features. For storage, it is required to have a minimum of two independent fabrics so the failure of one fabric does not affect the other. Using a minimum of two switches safeguards against data traffic interruption in the event of a switch hardware or operating system–level failure.

In addition to redundant power supplies, fans must be redundant as well in production Ethernet switches and SAN switches to prevent switch failure caused by power supply failure or fan failure.

Multichassis link aggregation

The HPE Converged Architecture 700 solution requires multichassis link aggregation at the production network level which allows multiple switch chassis to behave like a single network device when interacting with connected devices. The multichassis link aggregation feature enables multichassis link aggregation groups for all components to interact with the network without interruption in the event of a switch failure.

Switches in the HPE Converged Architecture 700 solution must also be configured and support load balancing across multiple links in a multichassis link aggregation group to increase the total throughput available between network-connected devices. Figure 6 illustrates multichassis link aggregation groups using HPE IRF.

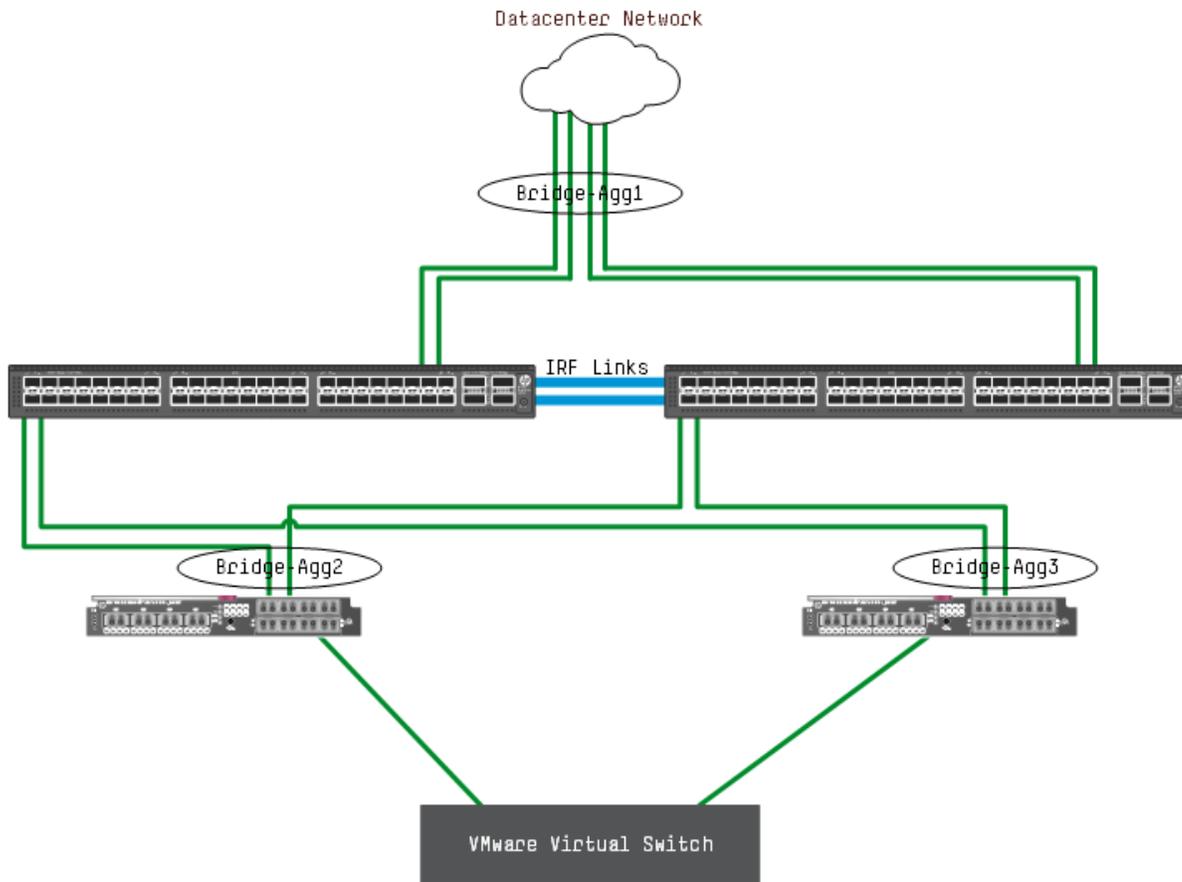


Figure 6. Multichassis link aggregation groups

To facilitate multichassis link aggregation, connectivity (IRF link or Peer-Link) is required between switches that have ports belonging to the same link aggregation group. To reduce the likelihood of split-brain scenarios, a minimum of two links is required between switch groups that participate in multichassis link aggregation to improve interchassis communication.

Multichassis link aggregation is required between the switches and all servers in an HPE Converged Architecture 700 configuration. It is also required for connectivity into the data center network.

Network sizing and planning

When planning or growing the HPE Converged Architecture 700, make sure you take port counts into account to ensure you have the proper Ethernet and SAN networking. As you grow and need to add new switches, switches always need to be expanded in pairs to provide redundancy throughout the infrastructure.

HPE 5900AF and HPE FF 5930 Series switches can be joined to the same IRF domain (up to eight switches). IRF links must use 40GbE connections and be configured in a loop topology. If using the HPE FF 5930 Series switches in a Converged Networking configuration, it is only supported to have a two switches in an IRF domain.

- The HPE 5900AF-48XG-4QSFP+ switch has 48 SFP+ 10GbE ports and four 40GbE QSFP+ ports
- The HPE FlexFabric 5930-2Slot+2QSFP+ supports up to two modules. A 10GbE Module contains 24 SFP+ 10GbE ports and two QSFP+ ports. A 40GbE module contains eight QSFP+ ports. The switch chassis itself has 2 QSFP+ ports built into it.
- The HPE FlexFabric 5930-4Slot supports up to four modules. A 10GbE Module contains 24 SFP+ 10GbE ports and two QSFP+ ports. A 40GbE module contains eight QSFP+ ports.

Cisco Nexus 5600 switches can use Cisco Nexus 2248PQ port extenders to expand the existing capacity of the Cisco Nexus 5600 switches. Two 40GbE or eight 10GbE ports must connect the Cisco Nexus 5600 to the Cisco Nexus 2248PQ fabric extenders.

Additional Cisco Nexus 5600 switches (in pairs) can be added and put into a new vPC domain with redundant links back to the first set of Cisco Nexus 5600 switches in the solution. Multichassis link aggregation must be used to connect the additional pair of switches back to the primary switches in the solution via a minimum of four 40GbE Ports (two per switch) or eight 10GbE ports (4 per switch)

- The Cisco Nexus 5672UP has 48 10GbE ports and six 40GbE QSFP+ ports.
- The Cisco Nexus 56128P has 48 10GbE ports and four 40GbE QSFP+ ports onboard with expansion options of up to 96 10GbE ports and eight 40GbE QSFP+ ports.
- The Cisco Nexus 2248PQ has 48 10GbE ports and four 40GbE QSFP+ ports onboard.

Additional Cisco Nexus 9396PX switches (in pairs) can be added and put into a new vPC domain with redundant links back to the first set of Cisco Nexus 9396PX switches in the solution. Multichassis link aggregation must be used to connect the additional pair of switches back to the primary switches in the solution via a minimum of four 40GbE Ports (two per switch) or eight 10GbE ports (4 per switch).

- The Cisco Nexus 5696PX has 48 10GbE ports and six or 12 40GbE QSFP+ ports depending on the model purchased.

Out-of-band management

It is required to have all of the out-of-band management components, HPE Integrated Lights-Out, HPE Onboard Administrator, SAN switch management ports, HPE 3PAR StoreServ Storage management ports, etc. accessible via the same management network on the production switches. Several pieces of the software stack need to be able to communicate with these out-of-band management components for the solution to function properly.

Although it is not required to purchase dedicated out-of-band management switches for this solution, if an existing out-of-band network infrastructure is not available, you do not have enough open ports on your out-of-band network, or you would like a dedicated out-of-band management network for this solution, the switches below have been verified to work on an HPE Converged Architecture 700:

- HPE 5900AF-48G-4XG-2QSFP+
- Cisco Nexus 3048TP

Please note that while the HPE and Cisco switches have the option for 1Gb RJ45 SFP transceivers, the cost per port may not make using that approach cost affective and those transceivers do not talk to any component that is 10/100Mb, which components in the solution may need.

Computing

Although the storage and network components of this solution are highly redundant and support failover scenarios, an individual server does not. Many typical applications do not provide protection against server failure. Therefore, server failures can create outages that impact business operations. Hypervisor features help mitigate this risk, but server failures should be avoided whenever possible.

Redundant power supplies

All HPE ProLiant rack mounted servers in this solution must be connected to at least two fully redundant power supplies. All HPE BladeSystem c7000 enclosures must be fully populated with power supplies (6) and fans (10) that are designed to accommodate the configuration of the servers in the solution under full load and support N+N power-supply redundancy. The enclosure must be able to lose half of its power supplies and still be able to power all blades in the chassis.

Redundant network connectivity

Each HPE ProLiant rack mounted server and HPE BladeSystem c7000 enclosure Virtual Connect module is connected to at least two of the Ethernet network switches included in this solution. Two ports are required at a minimum for each component to allow continued server operation during the failure of a switch, network cable, or server Ethernet port and to allow for continued operation during a firmware update to the network switches in the solution.

For SAN fabric networking, each HPE ProLiant rack mounted server must be connected to at least two of the SAN switches in two separate fabrics included in this solution. For an HPE BladeSystem c7000 enclosure Virtual Connect module, two connections from each module are required to go to the same SAN fabric. Both ports from the odd numbered interconnect must go to one SAN fabric switch and both ports from the even numbered interconnect must go to another SAN fabric switch included in the solution. It is not supported to have one HPE Virtual Connect module go to separate fabrics, although it is supported to have it go to multiple switches in the same SAN fabric. See Figure 7 for a visualization of this SAN network topology. Two ports are required at a minimum per component to allow continued server operation during the failure of a switch, fibre cable, or server fibre port, and to allow for continued operation during a firmware update to the SAN fabrics in the solution.

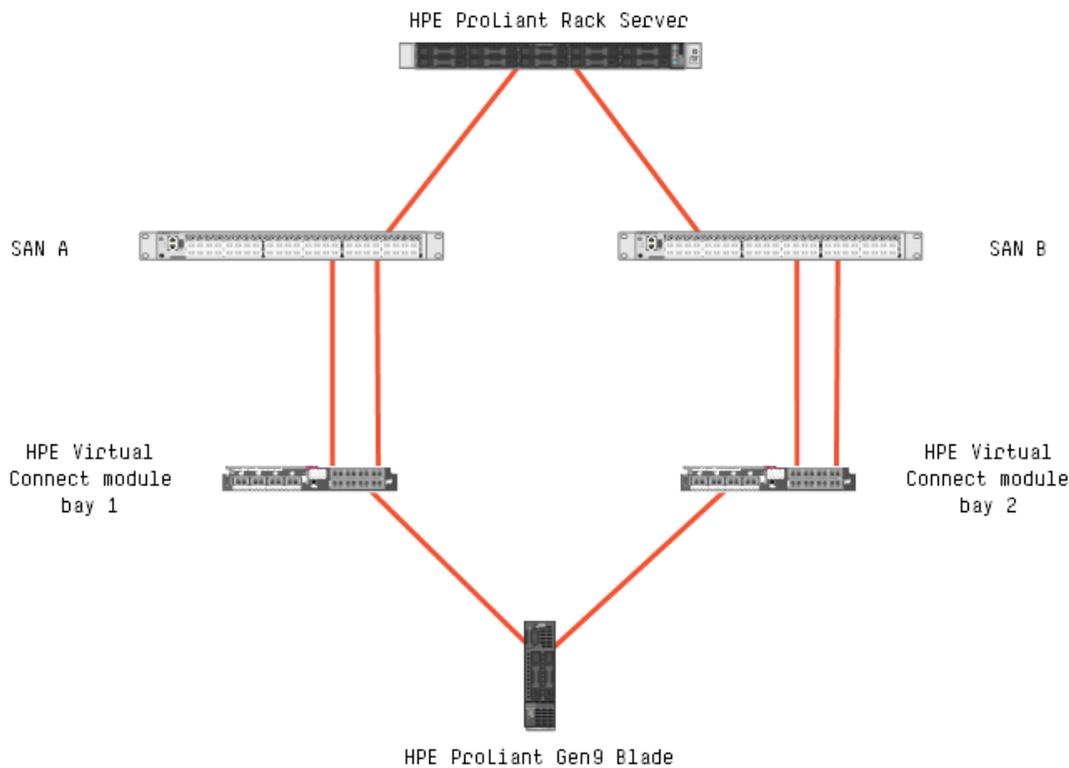


Figure 7. SAN network Topology example

For Direct Attached networking to HPE 3PAR StoreServ Storage, each HPE ProLiant rack mounted server and HPE BladeSystem c7000 enclosure Virtual Connect module must be connected to at least two separate HPE 3PAR controllers in the same array. Two ports are required at a minimum per component to allow continued server operation during a controller, fibre cable or fibre port failure, and for continued operations during a firmware update to an HPE 3PAR storage array.

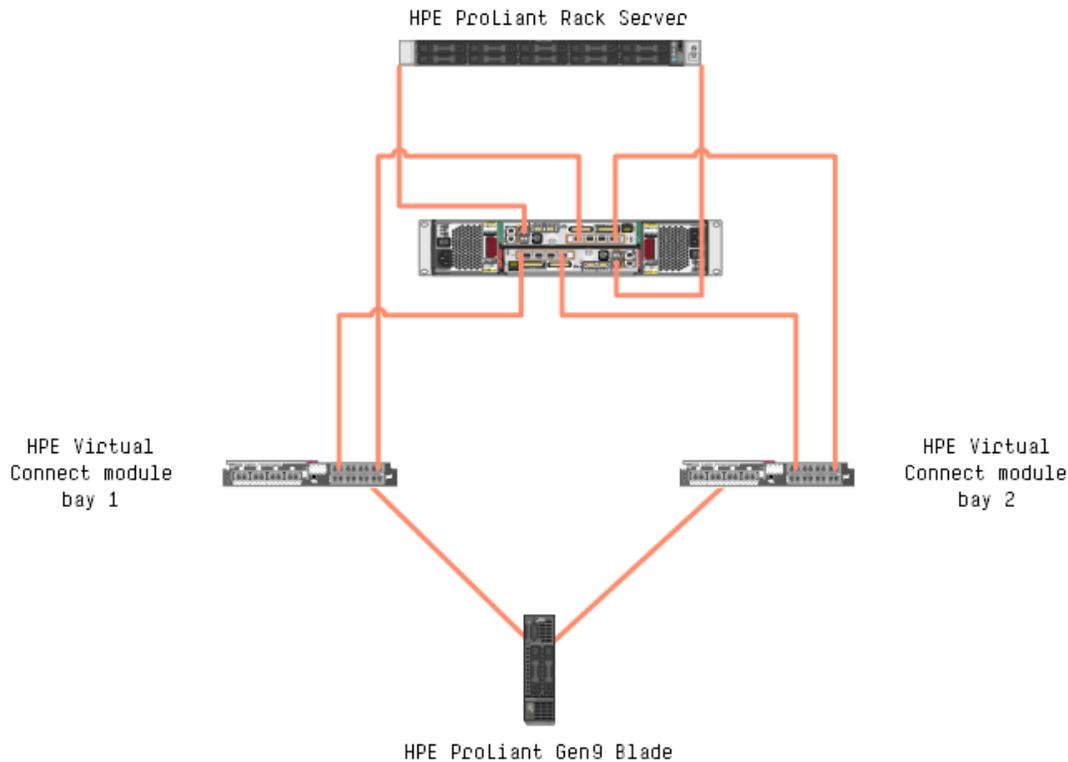


Figure 8. Direct Attached Topology example

CPU and memory requirements

Each computing and management component is required to use multiple processors. Using multiple processors is not only beneficial for raw CPU performance and capacity which is critical and a limiting factor in a virtualized environment, but also to enable full functionality in the servers themselves such as full memory capacity and PCI expansion slots.

For the management servers, it is required to have at least 128GB of HPE SmartMemory and recommended to have at least 256GB. For compute servers, there is no minimum, however ensure you size your compute servers appropriate for the workloads you plan to deploy on them. HPE recommends at least 8GB per core.

Computing options

The requirements for redundant power supplies and redundant network connectivity provide a high degree of resiliency and performance at the server layer. Because this solution is workload independent, it does not require that specific bandwidth or performance requirements be met. If additional performance is required or additional fault tolerance is expected, then the following technologies may be employed.

Add additional network and storage adapters

There are two reasons you might want to add additional network and/or storage adapters. If your workload needs more bandwidth than the dual 20GbE ports the blades provide, you have the option to add up to two additional HPE FlexFabric mezzanine cards. (You also need the appropriate HPE FlexFabric Virtual Connect modules to enable the additional mezzanine card(s) for additional Ethernet and/or storage networking.) This option also exists in the HPE ProLiant rack servers used for management. There are two additional PCI slots free that can accommodate additional dual port network and/or storage adapters.

Although uncommon, it is possible for a server to suffer failure of the Ethernet hardware itself (such as the Ethernet controller on the motherboard or an off-board PCI-E Ethernet card). If all 10/20GbE ports in a server are connected to a single one of these components, that component becomes a single point of failure for data connectivity for the entire server. If a server blade loses network connectivity, it loses both data and storage traffic, effectively resulting in an outage.

As required by the HPE Converged Architecture 700 architecture, each HPE BladeSystem c7000 Enclosure contains at a minimum two HPE FlexFabric Virtual Connect modules to support both LOM ports. Losing one HPE FlexFabric Virtual Connect module will not cause a system failure of the blades in the chassis. If additional network redundancy is needed, additional FlexFabric Mezzanine cards as well as HPE FlexFabric Virtual Connect modules can be added to support that. Although neither of these methods protects against motherboard failure in a server blade, they do protect access to storage and data networks during a component failure.

Operating system disk options

Each server must boot the VMware vSphere operating system. Depending on the configuration of the environment, one of the following boot devices can be used:

- HPE hard drives attached to an HPE Smart Array card (SAS and/or SSD)
- HPE Flash Media Kits for USB Drives
- HPE Enterprise Mainstream Flash Media Kits for Memory Cards
- HPE Solid State M.2 SATA Drives
- Boot from SAN

Note

Verified local boot configurations are demonstrated in the solution deployment guide. All boot options may not be supported in a particular component either for technology or architectural purposes.

Note

The HPE ProLiant servers used for management only support booting from HPE 2.5 inch hard drives attached to an HPE Smart Array card (SAS and/or SSD).

The boot device is a potential point of failure within the server layer. When booting from local storage, HPE recommends using multiple disks configured in a RAID 1 configuration. RAID 1 mirrors the data content on both disks and therefore protects against the failure of a single disk.

Note

HPE highly recommends that only base operating system data reside on local disks if being used and that all business-related or workload-related data reside on HPE 3PAR StoreServ storage. This arrangement provides optimal performance, resiliency, and efficiency.

HPE OneView

Every component in the solution must be managed or monitored by HPE OneView if HPE OneView supports that component. In planning the size of your solution, one must take into account the configuration maximums of HPE OneView. The [HPE OneView 1.20 Support Matrix](#) and [HPE OneView 2.0 Support Matrix](#) contains all the configuration maximums; listed below are the ones most prevalent to the HPE Converged Architecture 700.

Table 2. Hardware configuration maximums

RESOURCE	MAXIMUM
Enclosures	40
Interconnects in all enclosures	240
Total number of servers	640

Table 3. Networking limits configuration maximums

RESOURCE	MAXIMUM
Ethernet Networks	1000
Fibre Channel networks	255
Fibre Channel networks per interconnect	8
Fibre Channel networks per enclosure	48
Total number of network sets	1000
Networks per network set	162
Networks per uplink set	1000
Networks per physical downlink	162
Logical interconnect groups	40
Logical interconnects	40

Hypervisor

Each server in this solution runs VMware vSphere as the host hypervisor. The hypervisor is protected by the resiliency features built into the server as described the [Computing](#) section in the [Solution design and best practices implementation](#) section of this document. Additional configuration is required to protect the VMs within the hypervisor from failures within the physical server.

Number of physical Ethernet network adapters per VMware vSwitch

Within vSphere, multiple virtual switches (vSwitches) can exist. Each vSwitch can have multiple virtual networks and multiple VMkernel ports that act as virtual IP addresses for the vSphere host operating system. Each vSwitch must be associated with at least two physical adapters on the server that go to at least two different switches in a multichassis link aggregation configuration.

The configuration of the management servers (two HPE ProLiant DL360 Gen9 servers) in the HPE Converged Architecture 700 VMware 5.5u3a and 6.0u2a Deployment Guides uses a single vSwitch with two dedicated physical 10GbE NICs. On the compute blades, multiple vSwitches are leveraged because of the FlexNIC capabilities of the 20GbE FlexFabric LOM adapters and HPE FlexFabric Virtual Connect. The NIC teaming feature in vSphere achieves both load balancing and high availability by actively controlling VM traffic. In the event of a NIC failure, traffic from VMs is migrated to the remaining active port(s). Although this process might cause the VMs to operate in a degraded state, it provides an opportunity for the administrator or the system to migrate VMs to other hosts and resolve any underlying physical issues.

For more information on VMware NIC teaming, see the VMware Knowledge Base article [NIC Teaming in ESXi and ESX](#).

For proper configuration of the VMware components in the HPE Converged Architecture 700 VMware solution, see the HPE Converged Architecture 700 VMware 5.5u3a Deployment Guide or the HPE Converged Architecture 700 VMware 6.0u2a Deployment Guide.

Segregated management, migration, high availability and production networks

It is a best practice for any virtualization environment to have separate networks/VLANs for management, production migration (VMware vMotion), and high availability (VMware Fault Tolerance) traffic. The main reason for this architecture is to ensure that one network does not consume the network resources all at once on a server. Having all your networks on one virtual switch can cause VMs to operate less effectively or, in some cases, prevent VMs from operating entirely.

Within the HPE Converged Architecture 700 architecture, it is required that all compute/workload servers (HPE ProLiant Gen9 blades) leverage HPE FlexFabric adapters to enable users to create up to four separate FlexNICs per physical port. The advantage of creating separate FlexNICs is that each FlexNIC can be assigned a preferred (guaranteed) amount of speed (as defined by the OneView administrator) and be allowed to burst up to the full 20GbE if the network has available bandwidth that the other FlexNICs are not using.

The result is that HPE Converged Architecture 700 can be architected with separate vSwitches for management, production, VMware vMotion and fault tolerance as well as support Fibre Channel based storage in a highly available fashion by using a single dual port FlexFabric network adapter.

Data locations

VMware vSphere does not prevent an administrator from putting VM disks on storage that is not highly available. In the event of a server failure VMs may become unrecoverable if not placed on highly available storage. To eliminate local disks or other not highly available storage options as points of failure, this solution requires that all virtual machine data be stored only on shared storage hosted on a highly available storage array.

For the HPE Converged Architecture 700, Fibre Channel based HPE 3PAR StoreServ Storage is required to host all virtual machine data. The Fibre Channel protocol was built from the ground-up to handle storage traffic. In regards to performance, it is difficult to outperform the low latency and high throughput of FC with any other storage protocol in existence today. To support multipathing with FC, the VMware ESXi host has two or more Fibre Channel HBA ports available from which the storage array can be reached. This means that multiple paths connect each server with the HPE 3PAR StoreServ storage array(s) hosting its virtual machine files.

Note

Although the HPE 3PAR StoreServ Storage natively supports file based protocols such as NFS and SMB as well as block protocols such as iSCSI and FCoE, those protocols have not been verified or approved for use in the HPE Converged Architecture 700 at this time. FCoE is only supported when conversion happens in the HPE FF 5930 Series or Cisco Nexus 5600 Series switches. It is not supported to use the CNA/FCoE Adapter in the HPE 3PAR StoreServ array at this time.

VMware High Availability and Distributed Resource Scheduler

Although hypervisor-level high availability does not protect against server failure, it does mitigate the impact of such failures by allowing automatic recoverability. VMware vSphere High Availability automatically restarts a VM on a different server when it detects a server failure. To function properly, the VM data must reside on shared-storage datastores. This feature requires a minimum of two servers as recommended in this HPE Converged Architecture 700 solution.

In addition, the VMware vSphere Distributed Resource Scheduler (DRS) provides additional ease of management and VM protection by automatically distributing VMs across pooled server resources according to server load and capacity. This feature allows the administrator to provision new VMs without having to manually load-balance and risk-impact the performance of other VMs in the pool. Figure 9 illustrates how vSphere DRS redistributes VMs across ESXi servers when a server failure occurs.

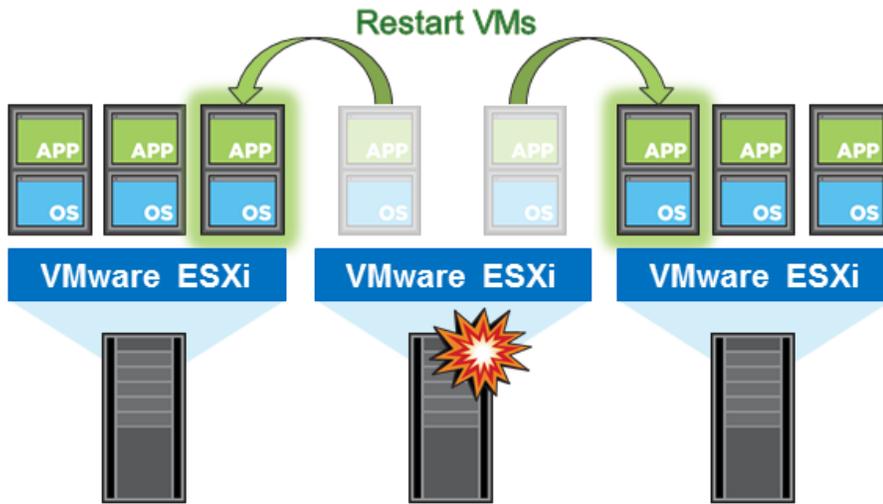


Figure 9. vSphere DRS.

For more information about these vSphere features and benefits, see [VMware vSphere High Availability](#) and the [VMware vSphere Distributed Resource Scheduler](#).

VMware vSphere and vCenter configuration limits

When determining the size and the number of VMware ESXi hosts for your configuration it is important to understand what the maximum configurations for the hypervisor are. Multiple vCenter environments increase complexity and might be better suited to having multiple HPE Converged Architecture 700 instances in place.

Each individual VMware ESXi host and VMware vCenter environment as a whole has limits on the number of physical and virtual components that it can support. Below are some of the most relevant limits to this solution. The rest can be found in VMware’s Configuration Maximums for [vSphere 5.5](#) and [vSphere 6.0](#).

Table 4. VMware configuration maximums

RESOURCE	VSPHERE 5.5	VSPHERE 6.0
RAM per host	4TB	6TB
VMs per host	512	1024
Virtual CPUs per host	4096	4096
Virtual CPUs per core	32	32
vSwitch VM network ports per host	4096	4096
LUNs per host	256	256
LUN size	64TB	64TB
Number of paths to a LUN	32	32
Number of total paths to a server	1024	1024
Physical 10GbE ports	8	8 or 16 (depends on NIC vendor)
Hosts per HA cluster	32	64
Hosts per vCenter server	1,000 (100 if using an appliance with an embedded database)	1,000
Powered-on VMs per vCenter server	10,000	10,000

Rack infrastructure

When planning your rack infrastructure (rack and power) for an HPE Converged Architecture 700, it is important to take into account the serviceability of the solution that is developed in order to ensure that all components in the solution can be replaced in the event of a failure without taking down the solution. Using the right rack and power design is critical.

HPE recommends and used in the HPE Converged Architecture 700 VMware 5.5u3 and 6.0u2 Deployment Guides the HPE 642 1200mm Shock Intelligent Rack and HPE 4.9kVA 208V 30A NA/JP maPDU (HPE Managed PDUs). This allows the solution to have PDUs that are easily replaced without having to take the rack down to remove a zero U PDU or reserving U space in the rack for one U mounted PDUs. It also allows for all the components in the back of the rack such as HPE 3PAR StoreServ PDUs and Controller, as well as the HPE BladeSystem c7000 fans, interconnects and Onboard Administrators to be removed without having to remove power cables and power extension bars for example. HPE Managed PDUs come in several different power configurations to match the data center power needs of the location the solution is being deployed.

Services

Support offerings for HPE Converged Architecture 700 include:

HPE Proactive Care

In converged, virtualized industry standard IT environments, there are many components that need to work together effectively. HPE Proactive Care Service is designed specifically to support these environments, bringing together an enhanced call experience with end-to-end call management, advanced technical expertise for problem prevention, and rapid problem awareness and notification with expedited resolution. Integrating both proactive and reactive elements, customers get superior value out of their IT investments. This support solution is structured on three guiding principles: Personalized, Proactive, and Simplified. Proactive Care helps customers prevent problems and stabilize IT so they can focus on business innovation, growth, and staying competitive. It is cost-effective support covering servers, operating systems, hypervisors, storage, storage area networks (SANs), and networks. Proactive Care includes onsite hardware repair if it is required to resolve the issue. You can choose from a range of hardware reactive support levels to meet your business and operational needs. Hardware reactive support choices:

- HPE Next Business Day Proactive Care Service
- HPE 4-hour 24x7 Proactive Care Service
- HPE 6-hour Call-to-Repair Proactive Care Service

The Proactive Care portfolio also offers the same three service levels with the inclusion of hardware defective media retention (DMR) and comprehensive deflection material retention (CDMR) as additional core features.

HPE Proactive Care with Personalized Support Option (recommended by HPE)

Personalized Support is an optional enhancement to the Proactive Care service that provides an assigned, onsite HPE account support manager (ASM) to help provide operational, technical, and HPE best practice advisory services aimed at helping with the ongoing operation of the customer's IT infrastructure. IT priorities, infrastructure risks, and complexity are identified early in the planning phase with the customer so that the ASM can help build a plan designed to address areas likely to impact infrastructure availability and/or infrastructure performance. The ASM reviews the progress with the customer during the support review meetings so that changes in IT priorities, risks, and complexity can be identified and addressed.

HPE Critical Service

HPE Critical Service keeps up with your changing IT environment, mitigating technology risks to your business. Assigned Mission-Critical support team members understand your IT environment and what it takes to keep your business up and running. We advise you of sudden changes and shifts in technology that could imperil your operations. Proactive remote monitoring and processes fix problems before they affect your business functions. Management tools and tightly coordinated hardware and software/firmware update control keep your environment up to date. Your account team acts as the single point of contact within HPE to reduce the complexity of supporting heterogeneous, multivendor IT environments. HPE offers a portfolio of mission-critical support offerings, so you can choose the most cost-effective support options for your business critical environment.

HPE Insight Remote Support

HPE Insight Remote Support software is a portfolio of infrastructure remote support software. It automatically provides secure remote support for your IT environment for HPE servers, storage, and networking devices 24x7, so you can spend less time solving problems and more time focused on your business. You can have your systems remotely monitoring for hardware failure using industry secure technology to help avoid problems before they occur, with little intervention.

The software provides:

- Remote monitoring so you can gain control all of the time
- Automated notification every time so you can do more with less
- Automatic resolution in less time so your business stays up and running
- Proactive advisories to keep your environment running more reliably

For more information on these support offerings, refer to your Account Manager or Reseller.

Support considerations for Cisco switches

If Cisco switches are used in the HPE Converged Architecture 700, and the customer has an issue, the first call should be to HPE. We will determine the best course of action. HPE will be able to assist the customer with basic configuration support. If the issue falls outside of that, the customer will be directed to contact Cisco.

Licensing considerations

If you elect not to purchase VMware or Microsoft licenses through HPE, you must provide your own Enterprise License Agreement (ELA) licenses when your HPE Converged Architecture 700 solution is being installed.

VMware licenses

Purchasing your VMware software licenses from HPE ensures a single point of contact for all elements of HPE Converged Architecture 700. Many customers already have a VMware ELA, making this purchase redundant. In situations when VMware licenses are not purchased from HPE for use in the HPE Converged Architecture 700, and the initial call comes to HPE for VMware support assistance, HPE will continue to act as the focal point for the system. If the issue is VMware related, HPE will either engage VMware on the customer’s behalf or advise the customer to call VMware directly. HPE will continue to be engaged until the issue is resolved to insure the integrity of the HPE Converged Architecture 700. In situations when VMware is purchased from HPE for use in the HPE Converged Architecture 700, HPE will handle all VMware support issues, from beginning to end, without engaging VMware.

For more information on VMware vSphere licensing, refer to [VMware vSphere: Licensing, Pricing and Packaging](#).

Microsoft licenses for management servers

The management server infrastructure in HPE Converged Architecture 700 for VMware contains one Windows Server 2012 R2 Standard VM. As a result the solution requires two Microsoft licenses (one for each Management server) to support up to two VMs per management server.

Solution verification

To determine whether the HPE Converged Architecture 700 solution can serve as a foundational infrastructure for general-purpose workloads, HPE validated the architecture with a range of tests to check the high-availability features of the environment. Through these tests, HPE has verified that zero data loss occurred in all tested scenarios and no service interruption occurred in any case, except for an unexpected host failure, which resulted in a rapid reboot of the affected VMs.

Appendix A – Solution hardware configuration – VMware 5.5u3

The HPE Converged Architecture 700 solution used the following bill of materials (BOM) for testing and configuration of the HPE verified configuration used in the HPE Converged Architecture 700 VMware 5.5u3 Deployment Guide for its Fabric Attached and Direct Attached storage topology. For more information on the verified and allowed components in this architecture, please refer to the [HPE Converged Architecture 700 Architectural Policies](#) document.

Solution SKU

QTY	PART NUMBER	DESCRIPTION
1	P3R85A	HPE ConvSys700 2x Reference Architecture

Rack infrastructure

QTY	PART NUMBER	DESCRIPTION
1	BW908A	HPE 642 1200mm Shock Intelligent Rack
4	H8B50A	HPE 4.9kVA 208V 30A NA/JP maPDU
1	BW909A	HPE 42U 1200mm Side Panel Kit
1	TK732A	HPE 42U PDU Management Brackets

Management servers (HPE DL360 Gen9 8SFF CTO Server)

QTY	PART NUMBER	DESCRIPTION
2	755258-B21	HPE DL360 Gen9 8SFF CTO Server
2	755258-B21 ABA	U.S. - English localization
2	755394-L21	HPE DL360 Gen9 E5-2680v3 FIO Kit
2	755394-B21	HPE DL360 Gen9 E5-2680v3 Kit
32	726719-B21	HPE 16GB 2Rx4 PC4-2133P-R Kit
16	652583-B21	HPE 600GB 6G SAS 10K 2.5in SC ENT HDD
2	764632-B21	HPE DL360 Gen9 SFF DVD-RW/USB Kit
2	764642-B21	HPE DL360 Gen9 2P LP PCIe Slot CPU2 Kit
2	727060-B21	HPE FlexFabric 10Gb 2P 556FLR-SFP+ Adptr
2	749974-B21	HPE Smart Array P440ar/2G FIO Controller
2	734807-B21	HPE 1U SFF Easy Install Rail Kit
2	764646-B21	HPE DL360 Gen9 Serial Cable
4	720479-B21	HPE 800W FS Plat Ht Plg Pwr Supply Kit
2	766201-B21	HPE DL360 Gen9 High Perf Fan Kit
2	764636-B21	HPE DL360 Gen9 SFF Sys Insght Dsply Kit
2	ESY43A	HPE OV for DL 3yr 24x7 FIO Phys 1 Svr Lic
2	AJ764A	HPE 82Q 8Gb 2-port PCIe Fibre Channel Host Bus Adapter

HPE BladeSystem c7000 Enclosure

QTY	PART NUMBER	DESCRIPTION
1	681844-B21	HPE BLc7000 CTO 3 IN LCD Plat Enclosure
2	691367-B21	HPE BLc VC FlexFabric-20/40 F8 Module
1	733460-B21	HPE 6X 2650W Platinum Hot Plug FIO Power Supply Kit
1	517520-B21	HPE BLc 6X Active Cool 200 Factory Integrated Fan Option
1	456204-B21	HPE BLc7000 DDR2 Encl Mgmt Option
1	433718-B21	HPE BLc7000 10K Rack Ship Brkt Opt Kit
1	413379-B21	HPE BLc7000 1 PH FIO Power Module Opt
1	ESY41A	HPE OneView incl 3yr 24x7 Supp Enclosure Bundle 16 Svr Lic

Compute servers (HPE ProLiant BL460c Gen9)

QTY	PART NUMBER	DESCRIPTION
8	727021-B21	HPE BL460c Gen9 10Gb/20Gb FLB CTO Blade
8	726992-L21	HPE BL460c Gen9 E5-2640v3 FIO Kit
8	726992-B21	HPE BL460c Gen9 E5-2640v3 Kit
128	726719-B21	HPE 16GB 2Rx4 PC4-2133P-R Kit
16	759208-B21	HPE 300GB 12G SAS 15K 2.5in SC ENT HDD
8	700764-B21	HPE FlexFabric 20Gb 2P 650FLB FIO Adptr
8	761871-B21	HPE Smart Array P244br/1G FIO Controller

Storage

QTY	PART NUMBER	DESCRIPTION
1	E7X71A	HPE 3PAR StoreServ 7400c 2N Fld Int Base
2	QR486A	HPE 3PAR 7000 4-pt 8Gb/s FC Adapter
12	K0F23A	HPE M6710 600GB 6G SAS 15K 2.5in HDD
3	E7X64A	HPE M6710 SFF(2.5in) SAS Fld Int Drv Encl
36	K0F23A	HPE M6710 600GB 6G SAS 15K 2.5in HDD
1	BC773B	HPE 3PAR 7400 OS Suite Base LTU
48	BC774A	HPE 3PAR 7400 OS Suite Drive LTU
1	BC781A	HPE 3PAR 7400 Virtual Copy Base LTU
48	BC782A	HPE 3PAR 7400 Virtual Copy Drive LTU
1	BC795B	HPE 3PAR 7400 Reporting Suite LTU
1	BD362A	HPE 3PAR StoreServ Mgmt/Core SW Media
1	BD373A	HPE 3PAR Reporting Suite Media
1	BD454A	HPE 3PAR OS Suite Current Media
1	D4U66A	HPE StoreOnce RMC-V 74xx/84xx LTU
1	D4U76A	HPE StoreOnce RMC Media
8	142257-006	HPE C13-C14 WW 250V 10Amp 1.4m Jumper Crd

Ethernet cabling

QTY	PART NUMBER	DESCRIPTION
6	C7533A	HPE Ethernet Cable 4ft CAT5 RJ45 M/M
4	C7535A	HPE Ethernet Cable 7ft CAT5 RJ45 M/M
2	C7536A	HPE Ethernet Cable 14ft CAT5 RJ45 M/M
4	JG330A	HPE X240 QSFP+ 4x10G SFP+ 3m DAC Cable

Note

Although both HPE Networking and Cisco Networking are shown, only one vendor is needed in the solution. Both have been verified and shown in this BOM to demonstrate the flexibility in top of rack networking options.

HPE Networking

QTY	PART NUMBER	DESCRIPTION
2	JC772A	HPE 5900AF-48XG-4QSFP+ Switch
4	JC680A	HPE 58x0AF 650W AC Power Supply
4	JC680A B2B	INCLUDED: HPE 58x0AF 650W AC Power Supply JmpCbl-NA/JP/TW
4	JC683A	HPE 58x0AF Frt(ports)-Bck(pwr) Fan Tray
2	JG330A	HPE X240 QSFP+ 4x10G SFP+ 3m DAC Cable
2	JG326A	HPE X240 40G QSFP+ QSFP+ 1m DAC Cable

Cisco networking (Cisco part numbers)

QTY	PART NUMBER	DESCRIPTION
2	N5K-C56128P	Cisco Nexus 56128P 2RU Chassis, 48x10G SFP+, 4x40G QSFP+
2	N5596-ACC-KIT	INCLUDED: Cisco Nexus 5596 Chassis Accessory Kit
8	N56128-FAN-F	INCLUDED: Cisco Nexus 56128 Fan Mod with F-B Airflow (Port side exhaust)
4	N56-M-BLNK	INCLUDED: Cisco Nexus 5600 Module Blank Cover
2	N56-BAS1K9	Cisco Nexus 5600 Series LAN Base License
8	NXA-PAC-1100W	Cisco Nexus 1100W Platinum PS, Port side Exhaust airflow
8	CAB-C13-C14-2M	Power Cord Jumper, C13-C14 Connectors, 2 Meter Length
2	QSFP-4SFP10G-CU3M	Cisco 40GBASE-CR4 QSFP+ to four 10GBASE-CU SFP+ direct attach breakout cable assembly, 3 meter passive
4	SFP-H10GB-CU3M	10GBASE-CU SFP+ Cable 3 Meter, passive

Note
 SAN switches are optional in an HPE Converged Architecture 700. Both using a Fabric Attached Topology (using SAN Switches) and a Direct Attached Topology (connecting components directly to the HPE 3PAR StoreServ Storage) have been verified and shown to provide you with the flexibility in SAN topologies to meet your solution’s needs for scalability.

Direct attached topology

QTY	PART NUMBER	DESCRIPTION
4	AJ716B	HPE 8Gb Short Wave B-Series SFP+ 1 Pack
8	AJ835A	HPE 2m Multi-mode OM3 LC/LC FC Cable

HPE SN6000B SAN Switches

QTY	PART NUMBER	DESCRIPTION
2	QK753B	HPE SN6000B 16Gb 48/24 FC Switch
4	QK753B 05Y	2.4m Jumper (IEC320 C13/C14, M/F CEE 22)
56	AJ716B	HPE 8Gb Short Wave B-Series SFP+ 1 Pack
24	AJ835A	HPE 2m Multi-mode OM3 LC/LC FC Cable

Appendix B – Solution hardware configuration – VMware 6.0u2

The HPE Converged Architecture 700 solution used the following bill of materials (BOM) for testing and configuration of the HPE verified configuration used in the HPE Converged Architecture 700 VMware 6.0u2 Deployment Guide for its Fabric Attached and Converged Networking storage topology. For more information on the verified and allowed components in this architecture, please refer to the [HPE Converged Architecture 700 Architectural Policies](#) document.

Solution SKU

QTY	PART NUMBER	DESCRIPTION
1	P3R85A	HPE ConvSys700 2.x Reference Architecture

Rack infrastructure

QTY	PART NUMBER	DESCRIPTION
1	BW908A	HPE 642 1200mm Shock Intelligent Rack
4	H8B50A	HPE 4.9kVA 208V 30A NA/JP maPDU
1	BW909A	HPE 42U 1200mm Side Panel Kit
1	TK732A	HPE 42U PDU Management Brackets

Management servers (HPE DL360 Gen9 8SFF CTO Server)

QTY	PART NUMBER	DESCRIPTION
2	755258-B21	HPE DL360 Gen9 8SFF CTO Server
2	755258-B21 ABA	U.S. - English localization
2	755394-L21	HPE DL360 Gen9 E5-2680v3 FIO Kit
2	755394-B21	HPE DL360 Gen9 E5-2680v3 Kit
32	726719-B21	HPE 16GB 2Rx4 PC4-2133P-R Kit
16	652583-B21	HPE 600GB 6G SAS 10K 2.5in SC ENT HDD
2	764632-B21	HPE DL360 Gen9 SFF DVD-RW/USB Kit
2	764642-B21	HPE DL360 Gen9 2P LP PCIe Slot CPU2 Kit
2	727060-B21	HPE FlexFabric 10Gb 2P 556FLR-SFP+ Adptr
2	749974-B21	HPE Smart Array P440ar/2G FIO Controller
2	734807-B21	HPE 1U SFF Easy Install Rail Kit
2	764646-B21	HPE DL360 Gen9 Serial Cable
4	720479-B21	HPE 800W FS Plat Ht Plg Pwr Supply Kit
2	766201-B21	HPE DL360 Gen9 High Perf Fan Kit
2	764636-B21	HPE DL360 Gen9 SFF Sys Insght Dsply Kit
2	ESY43A	HPE OV for DL 3yr 24x7 FIO Phys 1 Svr Lic
2	AJ764A	HPE 82Q 8Gb 2-port PCIe Fibre Channel Host Bus Adapter

HPE BladeSystem c7000 Enclosure

QTY	PART NUMBER	DESCRIPTION
1	681844-B21	HPE BLc7000 CTO 3 IN LCD Plat Enclosure
2	691367-B21	HPE BLc VC FlexFabric-20/40 F8 Module
1	733460-B21	HPE 6X 2650W Platinum Hot Plug FIO Power Supply Kit
1	517520-B21	HPE BLc 6X Active Cool 200 Factory Integrated Fan Option
1	456204-B21	HPE BLc7000 DDR2 Encl Mgmt Option
1	433718-B21	HPE BLc7000 10K Rack Ship Brkt Opt Kit
1	413379-B21	HPE BLc7000 1 PH FIO Power Module Opt
1	ESY41A	HPE OneView incl 3yr 24x7 Supp Enclosure Bundle 16 Svr Lic

Compute servers (HPE ProLiant BL460c Gen9)

QTY	PART NUMBER	DESCRIPTION
8	727021-B21	HPE BL460c Gen9 10Gb/20Gb FLB CTO Blade
8	726992-L21	HPE BL460c Gen9 E5-2640v3 FIO Kit
8	726992-B21	HPE BL460c Gen9 E5-2640v3 Kit
128	726719-B21	HPE 16GB 2Rx4 PC4-2133P-R Kit
16	759208-B21	HPE 300GB 12G SAS 15K 2.5in SC ENT HDD
8	700764-B21	HPE FlexFabric 20Gb 2P 650FLB FIO Adptr
8	761871-B21	HPE Smart Array P244br/1G FIO Controller

Storage

QTY	PART NUMBER	DESCRIPTION
1	H6Z07A	HPE 3PAR StoreServ 8440 2N Fld Int Base
2	H6Z00A	HPE 3PAR 8000 4-pt 16Gb FC Adapter
12	K2P98A	HPE 3PAR 8000 600GB SAS 15K SFF HDD
3	E7Y71A	HPE 3PAR 8000 SFF(2.5in) Fld Int Drv Encl
36	K2P98A	HPE 3PAR 8000 600GB SAS 15K SFF HDD
1	BD362A	HPE 3PAR StoreServ Mgmt/Core SW Media
1	BD363A	HPE 3PAR OS Suite Latest Media
1	D4U66A	HPE StoreOnce RMC-V 74xx/84xx LTU
1	D4U76A	HPE StoreOnce RMC Media
1	L7B93A	HPE 3PAR 8440 OS Suite Base LTU
48	L7B94A	HPE 3PAR 8440 OS Suite Drive LTU
1	L7C05A	HPE 3PAR 8440 Virtual Copy Base LTU
48	L7C06A	HPE 3PAR 8440 Virtual Copy Drive LTU
8	142257-006	HPE C13-C14 WW 250V 10Amp 1.4m Jumper Crd

Ethernet cabling

QTY	PART NUMBER	DESCRIPTION
6	C7533A	HPE Ethernet Cable 4ft CAT5 RJ45 M/M
4	C7535A	HPE Ethernet Cable 7ft CAT5 RJ45 M/M
2	C7536A	HPE Ethernet Cable 14ft CAT5 RJ45 M/M

Note

Although both HPE Networking and Cisco Networking are shown, only one vendor is needed in the solution. Both have been verified and shown in this BOM to demonstrate the flexibility in top of rack networking options.

HPE networking

QTY	PART NUMBER	DESCRIPTION
2	JH179A	HPE FF 5930-4Slot Switch
8	JC680A	HPE 58x0AF 650W AC Power Supply
8	JC680A B2B	INCLUDED: HPE 58x0AF 650W AC Power Supply JmpCbl-NA/JP/TW
4	JH185A	HPE 5930-4Slit Back-to-Front Fan Tray
2	JH183A	HPE 5930 8-port QSFP+ Module
2	JH184A	HPE 5930 24p Conv Port and 2p QSFP+ Mod
6	JG327A	HPE X240 40G QSFP+ QSFP+ 3m DAC Cable
4	JG326A	HPE X240 40G QSFP+ QSFP+ 1m DAC Cable
4	JD097C	HPE X240 10G SFP+ SFP+ 3m DAC
12	AJ718A	HPE 8Gb Short Wave FC SFP+ 1 Pack Transceiver

Cisco networking (Cisco part numbers)

QTY	PART NUMBER	DESCRIPTION
2	N9K-C9396PX	Cisco Nexus 9300 48p 1/10G SFP+ & additional uplink module req.
2	N9K-C9300-ACK	INCLUDED: Cisco Nexus 9300 Accessory Kit
2	N9K-C9300-RMK	INCLUDED: Cisco Nexus 9300 Rack Mount Kit
6	N9K-C9300-FAN2-B	INCLUDED: Cisco Nexus 9300 Fan 2, Port-side Exhaust
4	N9K-PAC-650W-B	INCLUDED: Cisco Nexus 9300 650W AC PS, Port-side Exhaust
4	CAB-C13-C14-2M	Power Cord Jumper, C13-C14 Connectors, 2 Meter Length
2	N9K-M12PQ	Cisco ACI Uplink Module for Nexus 9300, 12p 40G QSFP
4	SFP-H10GB-CU3M	10GBASE-CU SFP+ Cable 3 Meter, passive
8	SFP-H10GB-CU1M	10GBASE-CU SFP+ Cable 1 Meter, passive

Additional HPE components needed for Cisco Networking option

QTY	PART NUMBER	DESCRIPTION
4	JG330A	HPE X240 QSFP+ 4x10G SFP+ 3m DAC Cable

Note
 SAN switches are optional in an HPE Converged Architecture 700. Using a Fabric Attached Topology (using SAN Switches), and Converged Networking (using HPE FF 5930 Series switches) have been verified and shown to provide you with the flexibility in SAN topologies to meet your solution’s needs for scalability. Direct Attached Topology (connecting components directly to the HPE 3PAR StoreServ Storage) is also supported and verified, but not shown in the HPE Converged Architecture 700 VMware 6.0u2 Deployment Guide.

HPE SN6000B SAN Switches

QTY	PART NUMBER	DESCRIPTION
2	QK753B	HPE SN6000B 16Gb 48/24 FC Switch
4	QK753B 05Y	2.4m Jumper (IEC320 C13/C14, M/F CEE 22)
56	AJ716B	HPE 8Gb Short Wave B-Series SFP+ 1 Pack
4	AJ835A	HPE 2m Multi-mode OM3 LC/LC FC Cable
20	AJ836A	HPE 5m Multi-mode OM3 LC/LC FC Cable

Resources and additional links

This design guide references the following documents and resources:

- Contact Hewlett Packard Enterprise <http://www8.hp.com/us/en/hpe/contact/contact.html>
- HPE Services hpe.com/services
- HPE and VMware hpe.com/partners/vmware
- HPE OneView hpe.com/info/oneview
- HPE Networking hpe.com/networking
- HPE 3PAR StoreServ Storage hpe.com/storage/3par
- HPE Servers hpe.com/servers
- HPE OneView for VMware vCenter <https://h20392.www2.hp.com/portal/swdepot/displayProductInfo.do%3FproductNumber%3DHPVPR>
- HPE Converged Infrastructure Library hpe.com/info/convergedinfrastructure
- VMware vSphere 5.5 Configuration Maximums vmware.com/pdf/vsphere5/r55/vsphere-55-configuration-maximums.pdf
- VMware vSphere 6.0 Configuration Maximums vmware.com/pdf/vsphere6/r60/vsphere-60-configuration-maximums.pdf
- VMware Compatibility Guide vmware.com/resources/compatibility/search.php?deviceCategory=server
- vSphere Availability <http://pubs.vmware.com/vsphere-55/topic/com.vmware.ICbase/PDF/vsphere-esxi-vcenter-server-55-availability-guide.pdf>

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