NetApp Verified Architecture

NetApp HCI for VMware Private Cloud

NVA Design

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Abstract

This document describes the high-level design criteria for a NetApp® Verified Architecture that uses VMware cloud-enablement products layered on top of NetApp HCI components.

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1 Executive Summary

NetApp® HCI provides compute and storage resources for a data center that can scale in a predictable and easy-to-manage manner. Modular components are combined to meet CPU, memory, capacity, and IOPS requirements for any given environment.

VMware provides a hypervisor and management console to abstractly provision virtual machines (VMs) for practically any purpose. VMware also provides a suite of products to provide cloud-like provisioning and oversight of VMs, allowing customer self-service, centralized operations, debugging capabilities, and departmental or customer bill-back accounting.

Combining NetApp HCI and VMware private cloud products lets an IT department quickly build out hardware resources at the exact required capacity without unused excesses. It further enables an IT department to conduct, troubleshoot, and monitor the environment from several utilities available from a single console.

The combination also allows you to self-deploy VMs, either transiently or long term, using exactly the resources needed for the application. Later, if requirements change, you can alter the resource allocation dynamically to suit your needs without intervention from IT staff.

Finally, the combination allows detailed accounting of how the infrastructure is being used, both in provisioning and in actual use. Discrepancies between requirements and demands can easily be identified, and separate departments and consumers can be accurately assessed for their use of the HCI environment.

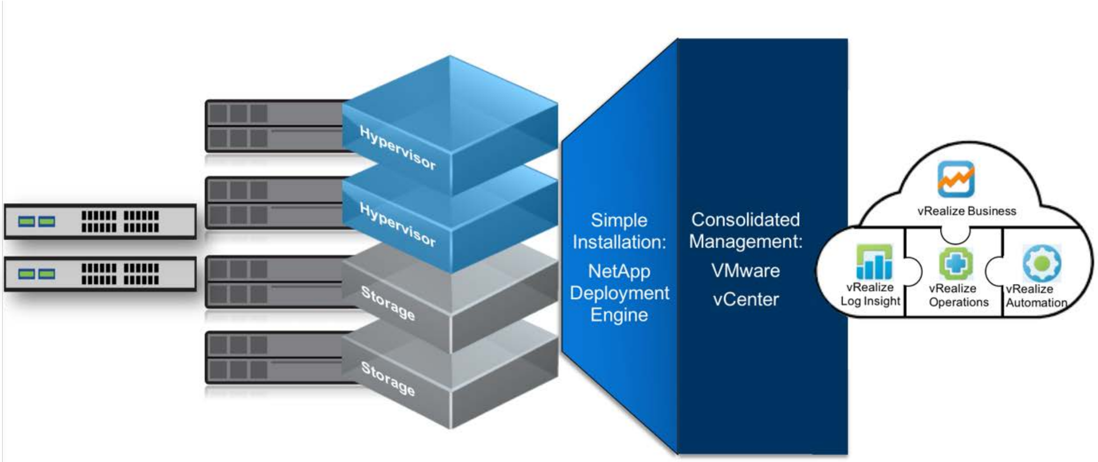
2 NetApp HCI and Private Cloud Architectures

The combination of technologies from NetApp and VMware position customers to take advantage of the benefits of a private cloud ecosystem. This NetApp Verified Architecture (NVA) details the design decisions made to deploy a VMware private cloud architecture on NetApp HCI.

NetApp HCI is a hyper-converged solution capable of transforming and empowering organizations to move faster, drive operational efficiencies, and reduce costs. NetApp HCI is the foundation of a private cloud strategy, running multiple applications with the predictable performance that enterprises and customers demand. NetApp HCI enables the independent scaling of compute and storage resources so that systems are rightsized. NetApp HCI with VMware private cloud can be deployed in minutes with a turnkey cloud infrastructure, which eliminates the complex management of traditional three-tier architectures. Integration into the NetApp Data Fabric means that you can unleash the full power of your applications, with the data services they require, across any infrastructure or cloud.

NetApp HCI frees customers from the limitations of today’s infrastructure solutions that are complex, cannot consolidate all workloads, force customers to scale in ways that strand resources, and throttle the performance required by next-generation applications. With VMware private cloud and NetApp HCI, customers can deploy VMs using the resources needed on an infrastructure that can be deployed quickly and scale as needs change. Figure 1 demonstrates NetApp HCI and VMware private cloud suite of products.

Figure 1) NetApp HCI and VMware private cloud components.



2.1 NetApp HCI Benefits

NetApp HCI offers various benefits to consumers seeking a hyper converged infrastructure offering by combining industry best practices and the VMware vSphere hypervisor. NetApp HCI delivers features and capabilities that first-generation HCI vendors could not offer. NetApp HCI is predictable, flexible, and scalable, provides simple administration and deployment and is integral in NetApp Data Fabric.

Predictable

One of the biggest challenges for anyone managing infrastructure is delivering predictable performance, especially in the face of proliferating applications and workloads. Dedicated platforms and massive overprovisioning are not economically viable. However, when multiple applications share infrastructure, one application might interfere with the performance of another. NetApp HCI alleviates this concern with quality of service (QoS) limits available natively with NetApp Element® software. Element allows the granular control of every application and volume, eliminates noisy neighbors, and satisfies all performance SLAs. All applications can be deployed on a shared platform, predictably and with confidence. NetApp HCI's multitenancy capabilities can help eliminate more than 90% of traditional performance-related problems.

Flexible and Scalable

Previous generations of hyper converged infrastructures required fixed resource ratios, limiting deployments to four to eight-node configurations. NetApp HCI, however, scales compute and storage resources independently. Independent scaling avoids costly and inefficient overprovisioning, eliminates the 10% to 30% “HCI tax” from controller VM overhead, and simplifies capacity and performance planning.

With NetApp HCI, licensing costs are reduced. NetApp HCI is available in mix-and-match small, medium, and large storage and compute configurations. The architectural design choices offered enable customers to confidently scale on their terms, making HCI viable for core data center applications and platforms.

No data center scales linearly, because business needs constantly change, and each application has different requirements from the infrastructure. NetApp HCI enables independent scaling of compute and storage resources, allowing on-demand scaling, avoiding costly and inefficient overprovisioning, and simplifying capacity and performance planning.

NetApp HCI is architected in building blocks at either the chassis or the node level. Each chassis can hold four nodes, made up of storage nodes, compute nodes, or both. A minimum configuration is two chassis with six nodes, consisting of four storage nodes and two compute nodes. Two additional blank spots can be used for expansion. Compute and storage nodes can be mixed if best practices are followed. Resources can be scaled nondisruptively through a simple GUI-driven process.

Simple

A driving imperative within the IT community is to automate all routine tasks, eliminating the risk of user error while freeing up resources to focus on more interesting, higher-value projects. NetApp HCI allows IT departments to become more agile and responsive by simplifying deployment and ongoing management.

The new NetApp Deployment Engine (NDE) eliminates most manual steps involved in deploying infrastructure, such as assigning names, network settings, and IP addresses, and provisioning ESXi hosts and VMware datastores. You can expect the infrastructure be functional in less than 30 minutes.

The VMware vCenter Plug-in simplifies management, and it’s intuitive. Additionally, with NetApp HCI a robust suite of APIs enables integration into higher-level management, orchestration, backup, and disaster recovery tools.

NetApp Data Fabric

Traditional HCI platforms often involved the introduction of a silo of resources into an existing data center. They also had little in common with other infrastructure-consumption choices that consumers might have made already or would like to make in the future. This approach is not efficient long term.

In contrast, NetApp HCI integrates into the NetApp Data Fabric for enhanced data portability, visibility, and protection of workloads whether they reside on premises, in near-cloud storage, or in a public cloud. The NetApp Data Fabric removes lock-in and provides you a new level of choice. It allows the full potential of your data to be unleashed across cloud environments.

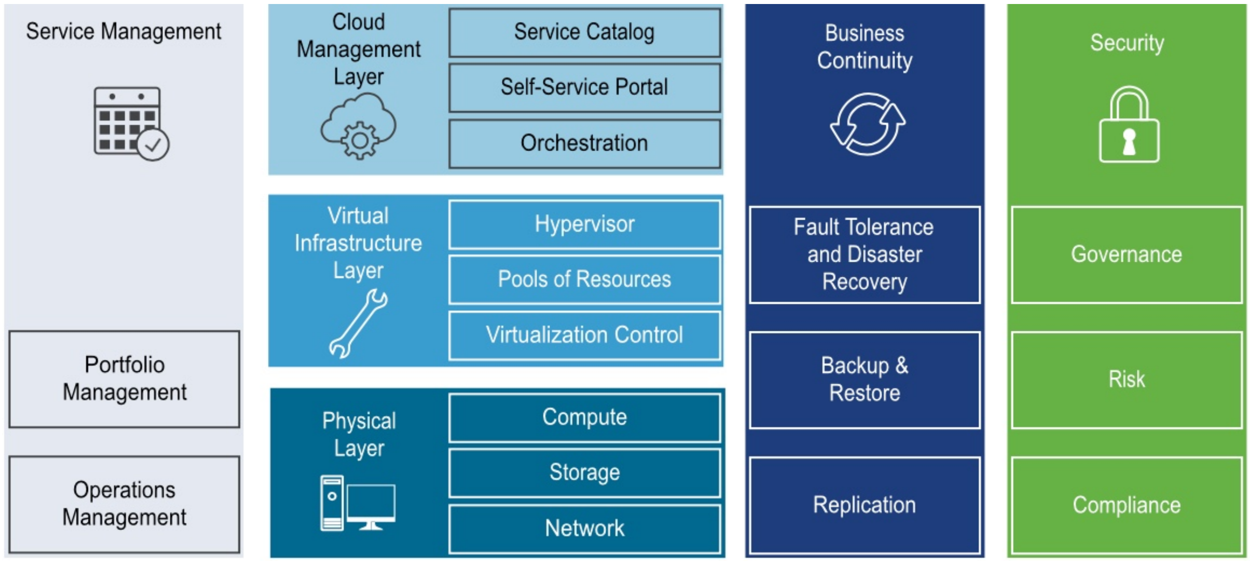
2.2 VMware Private Cloud

VMware private cloud enables IT organizations to automate the provisioning of common repeatable requests and to respond to business needs with more agility and predictability. Traditionally, this was referred to as infrastructure as a service (IaaS). In current terminology, this is referred to as VMware private cloud or the VMware Validated Design for Software-Defined Data Center (SDDC), which extends the typical IaaS solution to include a broader, complete IT solution.

As shown in Figure 2, the VMware private cloud architecture is based on several layers and modules. These modules allow interchangeable components to be part of the end solution or outcome, such as an SDDC. The components of VMware private cloud are:

- **Physical layer**. Contains compute, storage, and network resources in the data center.
- **Virtual layer**. Virtual infrastructure that contains components that provide the compute, network, and storage resources to management and tenant workloads.
- **Operations management layer**. Provides capabilities for performance and capacity monitoring and for backup and restore of the cloud management components.
- **Cloud management layer**. Enables the delivery of tenants with automated workload provisioning through a self-service portal.
- **Business continuity layer**. Includes solutions for data protection and disaster recovery of critical management components.
- **Availability zones**. Provides guidance for deploying VMware private cloud in two availability zones.

Figure 2) VMware vRealize suite.



2.3 NetApp HCI and VMware Private Cloud Design Principles

NetApp HCI and VMware private cloud products provide an integrated system that offers all the benefits of VMware private cloud and the scalability and granularity of NetApp HCI. The underlying NetApp HCI platform allows expanding or resizing a data center according to CPU, memory, storage capacity, and storage IOPS requirements. VMware private cloud architectures let you manage these aspects through a single management console and allocate them to workloads as necessary.

NetApp HCI also lets you add and repurpose compute and storage nodes of various capacities to expand or contract any of the compute or storage parameters according to the data center's needs. This scaling is managed through vCenter and the NDE.

NDE manages the hardware configuration and deployment of the HCI environment. This means that compute and HCI storage nodes can be added or deleted easily in any configuration. Compute nodes can easily be added to the VMware cloud configuration by adding them to the vCenter data center and compute clusters. Storage nodes are added to the NetApp HCI cluster transparently to the VMware cloud management. Capacity and throughput are added or managed this way and simply become available to the VMware private cloud.

VMware management tools are used to add compute nodes to available data centers and compute clusters, and compute resources can be dynamically applied using VMware Distributed Resource Scheduling (DRS).

You can also use VMware management tools to expose additional storage resources. Provisioning additional VMFS datastores allows additional capacity. You can manage IOPS by manipulating VM placement in the datastores and the provisioned IOPS for each datastore.

Optionally, use of Virtual Volumes (VVols) allows more flexible datastore allocation, with capacities matching the capacities of the HCI cluster. Also, you can manage VM throughput and latency requirements with virtual-disk granularity by using VMware Storage Policy-Based Management (SPBM).

3 Solution Overview

This NetApp HCI solution provides customers with a fully integrated VMware private cloud environment that uses all the capabilities of NetApp storage systems. By integrating NDE and VMware, this solution enables organizations to improve productivity of infrastructure engineers and VMware administrators, reduce deployment and provisioning time, and optimize storage space.

3.1 Target Audience

The intended audience for this document includes sales engineers, field consultants, professional services personnel, IT managers, and partner engineering personnel. This document is also intended for customers who want to use NetApp HCI features to accelerate and streamline their application development and deployment methodology.

Two roles that benefit from the features and capabilities of NetApp HCI and VMware private cloud are cloud architects and staff engineers. Cloud architects are responsible for creating a cloud strategy and are interested in data protection, operational costs, and available monitoring and management tools. Staff engineers also benefit from NetApp HCI because of optimized storage and compute resources that facilitate easy scaling and rightsizing of a VMware environment.

3.2 NetApp HCI Use Cases

In addition to the previously mentioned benefits, there are various use cases for which NetApp HCI is ideal. For customers deploying private clouds, designing end-user computing environments, and considering workload consolidation, NetApp HCI is architected to deliver exceptional value.

Private Cloud

NetApp HCI is an optimal foundation for an enterprise private cloud model, whether you choose OpenStack, VMware, or an in-house developed solution. This is because NetApp HCI uses native NetApp Element APIs that allow the on-demand provisioning of workloads through storage drivers and management plug-ins.

As an example, NetApp HCI integrates with VMware VVols, enabling VMware administrators to achieve the most granular control over storage performance on a per-VM basis. With this functionality, you can set minimum, maximum, and burst IOPS levels, confirming exact amounts of capacity and performance for even the most sensitive VMs. You can change capacity and performance dynamically without migrating data or affecting system performance.

End-User Computing

NetApp HCI is optimal for end-user computing (EUC) environments because capacity and performance are allocated independently for every virtual desktop and every application. The allocations can be easily adjusted as workloads shift or needs evolve without complexity. If an application needs more performance, the initial configuration can become a bottleneck, but NetApp HCI eliminates the penalty for underestimating requirements. Modification of the QoS policies can easily change the settings for minimum, maximum, and burst, and the new settings take effect immediately.

Workload Consolidation

NetApp HCI eliminates workload silos, allowing customers to predictably run multiple applications on the same infrastructure. Traditionally, when multiple applications share infrastructure, all performance resources, both IOPS and bandwidth, are freely available to all applications, all the time, across the shared resources. Without a more precise resource allocation, one application or "noisy neighbor" can easily consume an unfair share of the resources, leaving little available for others. This "first-come, first-served" allocation methodology has a huge negative effect on all the other applications on the system.

Performance expectations on an application-by-application basis are erratic and unpredictable. One misbehaving application can cripple the entire system. To keep these variances in check, customers must constantly monitor and manage which applications share resources. Often, alleviating resource contention requires migration of either the “noisy neighbor” or the unhappy customer to a new system.

The NetApp HCI QoS settings eliminate resource contention and variable application performance that is caused by noisy neighbors. Each volume on the system is assigned its own minimum, maximum, and burst settings, enabling predictable performance for each application without incurring the capacity sprawl and low utilization that are common in today’s hyper converged infrastructures.

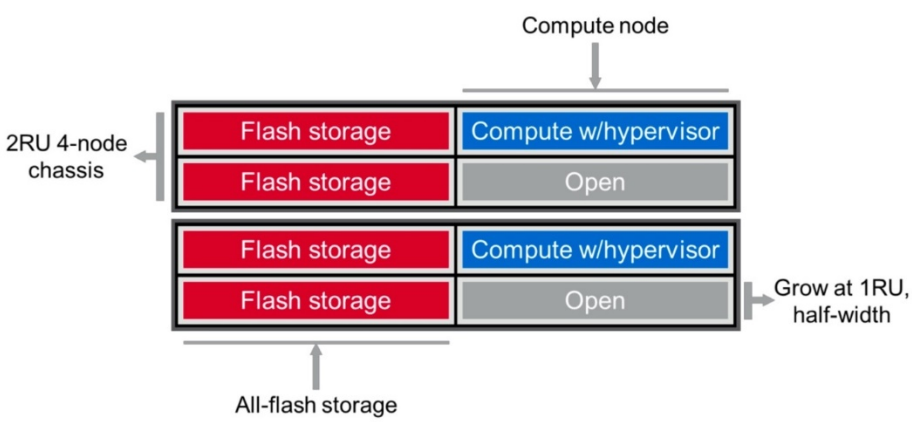
4 Technology Overview

NetApp HCI with VMware private cloud serves as the foundation for various virtualized workloads. By combining NetApp HCI, NDE, NetApp Element, NetApp ONTAP® Select, integration with vSphere, software-defined networking with VMware NSX, and the VMware vRealize suite of products, enterprises can deliver on demands of private cloud infrastructure and lower time to value.

4.1 NetApp HCI

NetApp HCI is available with configuration options of small, medium, or large for both compute and storage. The nodes are similar to a small blade that sits inside a chassis. A minimum starting configuration must have four storage nodes and two compute nodes spread across two chassis (Figure 3).

Figure 3) NetApp HCI minimum configuration.



The Element software component of NetApp HCI 1.4 supports protection domains for storage clusters using shared chassis. When storage is distributed evenly across multiple chassis, Element software automatically heals from certain types of chassis failures, and alerts you when automatic healing is not possible. You can also use the Element API to integrate with third-party monitoring tools to inform you of protection status.

Table 1 and Table 2 list the various compute and storage node options available to scale NetApp HCI. The hardware components that are used in an implementation of the solution might vary according to customer requirements. This solution validation uses H500E and H500S compute and storage nodes.

Table 1) NetApp HCI storage node configuration.

Details	H410S	H610S
RU	1RU, half-width	1RU

Details	H410S	H610S
Base networking	2 x 10/25GbE iSCSI SFP28	2 x 10/25GbE iSCSI SFP28
SSD	6 x 480GB/960GB/1.92TB	12 x 960GB/1.92TB/3.84TB
Effective block capacity	5.5TB - 44TB	20TB - 80TB
Performance per node	50,000 IOPS – 100,000 IOPS	100,000 IOPS

Table 2) NetApp HCI compute node configuration.

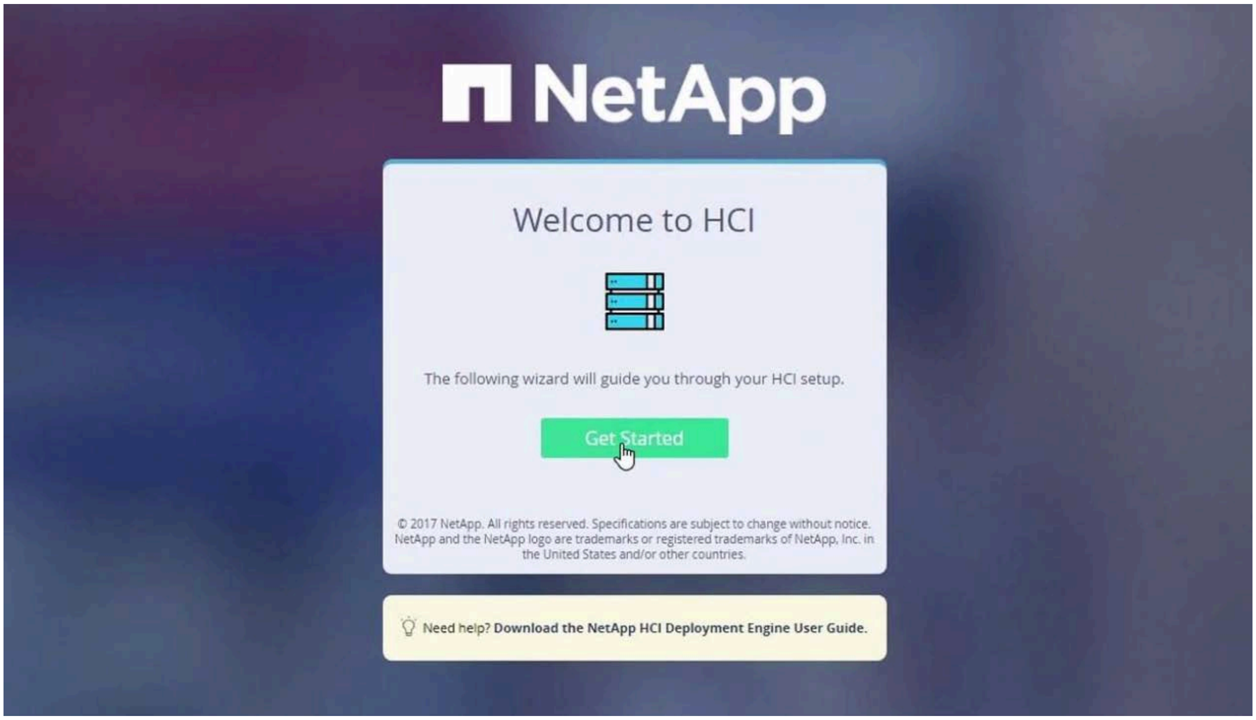
Details	H410C	H610C
RU	2RU, half-width	2RU
Cores for VMs	8-40	32
CPU	2 x Intel Xeon Gold 5122, 4 cores, 3.6GHz 2 x Intel Xeon Silver 4110, 8 cores, 2.1GHz 2 x Intel Xeon Gold 5120, 14 cores, 2.2GHz 2 x Intel Xeon Gold 6138, 20 cores, 2.0GHz	2 x Intel Xeon Gold 6130, 16 cores, 2.1GHz 2 x NVIDIA Tesla M10 GPU cards
Cores for VMs	8-40	32
Memory	384GB-1TB	512GB
Base networking	4 x 10/25GbE (SFP 28); 2 x 1GbE RJ-45	2x10/25GbE (SFP 28); 2 x 1GbE RJ-45
Out-of-band management	1 x 1GbE RJ-45	1 x 1GbE RJ-45

For more information about the technical specifications of NetApp HCI, see NetApp HCI datasheet.

4.2 NetApp Deployment Engine

The NetApp Deployment Engine (NDE), enables the quick deployment of NetApp HCI including the NetApp Element cluster and the VMware virtualized infrastructure. NDE simplifies Day 0 deployment by reducing the number of manual steps from over 400 to less than 30. Because NDE is intuitive and reuses data such as user name and password, you do not have to reenter information or set credentials at varying complexity levels. Likewise assigning IP addresses is taken care of by NDE, allowing you to set a scheme and pool for all resources before actual configuration. Also, preinstallation checklists enable successful deployments because the system automatically checks for user errors, eliminating manual checks.

Figure 4) NetApp NDE welcome screen.



As part of the deployment process, an administrator can optionally deploy VMware vCenter Server and choose simple or advanced networking options. The NDE also makes it easy to configure the 1Gb and 10/25GbE network for compute and storage by using predefined defaults. For many users, this basic network setup is the most convenient option. However, there is also an advanced network setting tab that allows you to enter individual IP addresses, subnets, and host names to conform to existing infrastructure standards.

For more information about the NetApp Deployment Engine, see the HCI NDE User Guide.

For more information about deploying NetApp HCI, see the NetApp HCI Deployment Guide 1.4.

4.3 NetApp Element Software

NetApp Element software is designed for data centers where rapid, modular growth or contraction is a requirement with diverse workloads. Element is the storage infrastructure of choice for service providers, due to its flexible handling of permanent and transient workloads with various throughput and capacity requirements.

Element provides modular, scalable performance with each storage node delivering guaranteed capacity and throughput to the environment. Each Element storage node added to a NetApp HCI environment provides a set amount of IOPS and capacity, allowing predictable, plannable growth.

Because each node provides a set throughput (IOPS) to the storage environment, QoS for each workload can be guaranteed. Minimum SLAs are assured with Element because the total throughput of the cluster is a known, quantifiable amount.

Element provides inline data deduplication and compression, enabling efficiency. Deduplication is performed at a clusterwide scale, improving the overall efficiency as used capacity is increased.

The design of Element is based on ease of use. It has fewer “nerd knobs” because it provides the most efficient use with the fewest of trade-offs. Element uses iSCSI configuration to eliminate the need for elaborate tables of initiators and targets found in FC configurations. The use of iSCSI also provides automatic scaling capabilities and inherent ability to take advantage of new Ethernet capabilities.

Finally, Element was designed for automation. All storage features are available through APIs. These APIs are the only methods used by the UI to control the system. VMware private cloud utilities can consume these APIs to make self-service resources and fully integrated monitoring and debugging available to VMware management tools.

For more information, see the Element product page.

4.4 NetApp ONTAP Select

NetApp ONTAP Select extends NetApp HCI, adding a rich set of file and data services to the HCI platform. ONTAP Select is NetApp's solution for the software-defined storage (SDS) market. ONTAP Select brings enterprise-class storage management features to the software-defined data center and extends the NetApp Data Fabric to standard virtualized environments.

The primary use cases for ONTAP Select on NetApp HCI include departmental file services, VM template storage over NFS, and home directories for midsized virtual desktop deployments. ONTAP Select is not positioned as a primary storage platform for VMs hosted on NetApp HCI.

For more information, see the ONTAP Select product page.

4.5 NetApp Storage Integration with VMware

NetApp has developed integration with VMware that greatly simplifies the management and orchestration of a virtualization environment. The available enhancements with VMware are NetApp Element software integration with vCenter, the NetApp SolidFire vSphere Plug-in for vCenter Web Client, and the NetApp SolidFire vRealize Orchestrator Plug-in.

NetApp Element Integration with VMware vCenter

NetApp Element storage provides several points of integration with vSphere capabilities, through vCenter.

The first point is vCenter plug-in's integration with the management capabilities of Element. This integration enables the creation of datastores, full visibility into Element QoS and access settings. The vCenter plug-in also provides integration with VMware Storage IO Control, allowing Element QoS settings to directly reflect individual VM rates and limits set through Storage IO Control.

The second is Element's tight integration with VMware Storage Policy-Based Management (SPBM) using VVols. When VVols is enabled on the NetApp HCI cluster, VMware SPBM policies can be set on VMs created on VVols storage. This enables granular, direct manipulation of the QoS settings for each VM and each virtual disk associated with each VM.

NetApp Element Plug-in for VMware vCenter Server Web Client

The NetApp SolidFire Plug-in for VMware vCenter Server Web Client is used to discover, configure, and manage NetApp HCI systems or NetApp Element all-flash array storage system clusters. Cluster activity can also be monitored with real-time reporting, including error and alert messaging for any event that might occur while performing various operations.

The Plug-in UI can be used to set up, monitor, and allocate storage from cluster capacity to configure datastores and virtual datastores (for VVols). A cluster appears on the network as a single local group that is represented to hosts and administrators by virtual IP addresses.

For more information, see the NetApp Plug-in for VMware vCenter Server Web Client User Guide.

NetApp Element vRealize Orchestrator Plug-In

The NetApp SolidFire vRealize Orchestrator Plug-in provides a convenient way to use the Element API to administer your Element storage system with VMware vRealize Orchestrator. Each Element API method is modeled as a workflow in the plug-in, enabling you to combine the inputs and outputs of these workflows to schedule and automate complex storage administration tasks. The plug-in provides more than 120 workflows and actions for controlling your Element storage system. The NetApp SolidFire vRealize Orchestrator Plug-in integrates with higher-level VMware management software such as VMware vRealize Automation and vCloud Director, to provide storage orchestration across the VMware ecosystem.

For more information, see the NetApp Element vRealize Orchestrator Plug-in page.

4.6 Software Defined Networking with VMware NSX

VMware NSX Data Center delivers a new operational model for networking defined in software, forming the foundation of the Software-Defined Data Center (SDDC). Data center operators can now achieve levels of agility, security, and economics that were previously unattainable when the data center network was tied to physical hardware components. NSX Data Center provides a complete set of logical networking elements and services, including logical switching, routing, firewalling, load balancing, VPN, QoS, and monitoring. These services are provisioned in virtual networks through any cloud management platform leveraging the NSX Data Center APIs. Virtual networks are deployed nondisruptively over any existing networking hardware.[1]

The following are the key features of NSX Data Center:

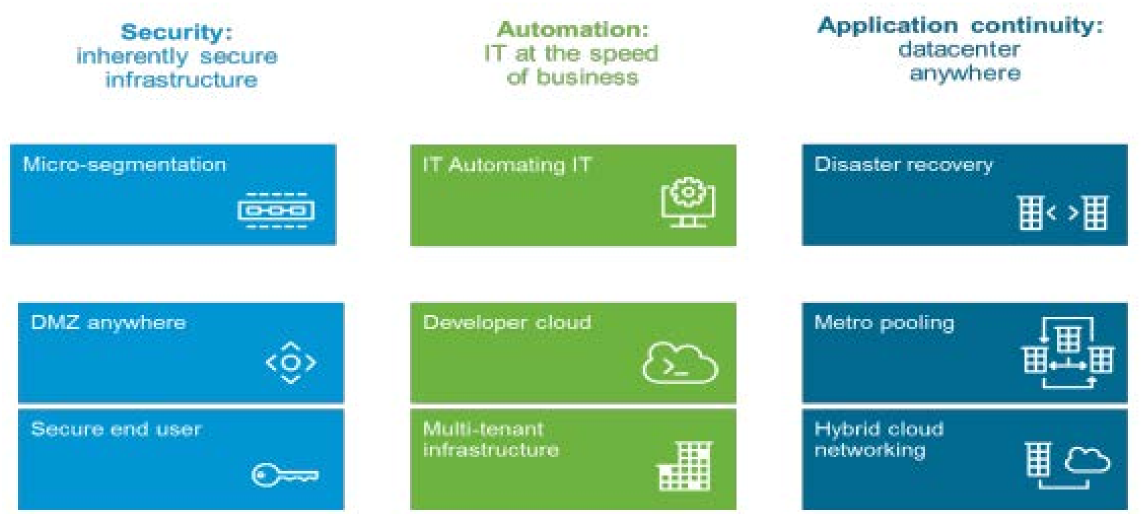
- **Switching**. Enables logical Layer 2 overlay extensions across a routed (Layer 3) fabric within and across data center boundaries. Support for VXLAN-based network overlays.
- **Routing**. Dynamic routing between virtual networks performed in a distributed manner in the hypervisor kernel, scale-out routing with active-active failover with physical routers. Supports static routing and dynamic routing (OSPF, BGP) protocols.
- **Distributed firewalling**. Distributed stateful firewalling, embedded in the hypervisor kernel for up to 20 Gbps of firewall capacity per hypervisor host. Support for Active Directory and activity monitoring. Additionally, NSX Data Center can also provide north-south firewall capability through NSX Edge.
- **Load balancing**. L4–L7 load balancer with SSL offload and pass-through, server health checks, and application rules for programmability and traffic manipulation.
- **VPN**. Site-to-site and remote-access VPN capabilities, unmanaged VPN for cloud gateway services.
- **NSX gateway**. Support for VXLAN to VLAN bridging for seamless connection to physical workloads. This capability is both native to NSX Data Center and delivered by top-of-rack switches from an ecosystem partner.
- **NSX Data Center API**. RESTful API for integration into any cloud management platform or custom automation.

[1] Source: https://www.vmware.com/content/dam/digitalmarketing/vmware/en/pdf/products/nsx/vmware-nsx-datasheet.pdf

- **Operations**. Native operations capabilities such as central CLI, traceflow, SPAN, and IPFIX to troubleshoot and proactively monitor the infrastructure. Integration with tools such as VMware vRealize Operations and vRealize Log Insight for advanced analytics and troubleshooting. Application Rule Manager and Endpoint Monitoring enable end to end network traffic flow visualization up to Layer 7, allowing application teams to identify both intra and inter data center endpoints, and respond by creating the appropriate security rules.
- **Context-aware micro-segmentation**. NSX Data Center enables the creation of dynamic security groups and associated policies to be based on factors beyond just IP address and MAC, including VMware vCenter objects and tags, operating system type, and Layer 7 application information to enable micro-segmentation based on the context of the application. Identity-based policy using login information from VMs, Active Directory, and Mobile Device Management integration enables security based on the user including session level security in remote and virtual desktop environments.
- **Cloud management**. Native integration with vRealize Automation and OpenStack.
- **Third-party partner integration**. Support for management, control plane, and data plane integration with third-party partners in a wide variety of categories such as next-generation firewall, IDS/IPS, agentless antivirus, application delivery controllers, switching, operations and visibility, and advanced security.
- **Multisite networking and security**. Extend networking and security across data center boundaries irrespective of underlying physical topology—enabling capabilities such as disaster recovery and active-active data centers.

VMware NSX platform creates a software-defined networking and security solution that addresses many of the challenges of deploying a virtualized infrastructure in the cloud. It helps build a myriad of logical networking services, including firewalls and advanced networking, independent of the underlying physical network infrastructure. Figure 5 details the primary use cases of VMware NSX.

Figure 5) VMware NSX primary use cases.



For more information, see the [VMware NSX] product page.

4.7 VMware vRealize Suite

vRealize Suite is an enterprise-ready, cloud management suite that enables managing cloud-like environments.

- **Intelligent operations.** Proactively detect and remediate issues and ensure performance and availability, from applications through the entire infrastructure stack and across multicloud environments.
- **IT automation.** Automate the delivery of production-ready infrastructure across a cloud environment through automation and policy-driven governance, reducing the time it takes to respond to requests for IT services.
- **Developer cloud.** Accelerate application delivery across traditional and container-based applications by letting developers use the tools that make them most productive while still ensuring that applications can be moved seamlessly from developer laptop to production.

For more information, see the VMware vRealize Suite product page.

vRealize Lifecycle Manager

Accelerate Time to Value

vRealize Suite Lifecycle Manager delivers complete lifecycle and content management capabilities for vRealize Suite products. It helps customers accelerate time to value by automating the deployment, upgrades, and configuration, while bringing DevOps principles to the management of vRealize Suite content.[2]

vRealize Automation

Automation for VM and Container-Based Applications

vRealize Automation is a cloud automation tool that accelerates the delivery of IT services through automation and pre-defined policies, providing high level of agility and flexibility for developers, while enabling IT teams to maintain frictionless governance and control.[3]

vRealize Operations

Self-Driving Operations

Run production operations hands-off and hassle-free with VMware vRealize Operations, delivering continuous performance optimization based on intent, efficient capacity management, proactive planning,

[2] Source: https://www.vmware.com/products/vrealize-lifecycle-manager.html

[3] Source: https://www.vmware.com/products/vrealize-automation.html

and intelligent remediation. Optimize, plan, and scale SDDC and multicloud deployments, from apps to infrastructure, with a unified management platform.[4]

vRealize Log Insight

Intelligent Log Management and Analytics

vRealize Log Insight delivers heterogeneous and highly scalable log management with intuitive, actionable dashboards, sophisticated analytics, and broad third-party extensibility. It provides deep operational visibility and faster troubleshooting across physical, virtual, and cloud environments.[5]

5 Technology Requirements

This section details the technical requirements of the validated solution. Individual customer requirements may vary.

For more information about the technical requirements and installation guidance for NetApp HCI, see the NetApp HCI Resource collection.

For more information about the technical requirements and installation guidance for VMware vRealize Suite, see the vRealize collection.

5.1 Hardware Requirements

Table 3 lists the hardware components that are required to implement the validated solution. The components that are used in any particular implementation of the solution might vary according to customer requirements.

Note: Specific switch infrastructure is not included in the required hardware, because there are various deployment options available. See the section “Network and Switch Requirements”.

Table 3) NetApp HCI hardware requirements.

Hardware	Quantity
Compute node: NetApp H500E	4
Storage node: NetApp H500S	4

5.2 Software Requirements

Table 4 lists the software components that are required to implement the solution. Because of the layering aspect of VMware private cloud, the components that are used in any particular implementation of the solution might vary according to customer requirements.

[4] Source: https://www.vmware.com/in/products/vrealize-operations.html

[5] Source: https://www.vmware.com/in/products/vrealize-log-insight.html

Table 4) Software requirements.

Product Family	Product Name	Product Version
VMware vSphere Enterprise Plus	ESXi	6.5 U1
	vCenter Server Appliance	6.5 U1
VMware NSX for vSphere Enterprise	NSX for vSphere	6.4
VMware vRealize Automation Advanced or higher	vRealize Automation	7.5
	vRealize Orchestrator	7.4
VMware vRealize Operations Manager Advanced or higher	vRealize Operations Manager	6.6.1
	vRealize Operations Management Pack for NSX for vSphere	3.5.1
	vRealize Operations Management Pack for Storage Devices	6.0.5
	vRealize Operations Management Pack for Site Recovery Manager	6.5.1.1
VMware vRealize Log Insight	vRealize Log Insight	4.7.0
	vRealize Log Insight Content Pack for NSX for vSphere	3.6
NetApp	Element	10.3.0.157
	NDE	1.4
	ONTAP Select (file services)	9.4

5.3 Environmental Requirements

Make sure that the power for the rack used to install NetApp HCI is supplied by AC power outlets, and that the customer data center provides adequate cooling for the size of your NetApp HCI installation.

For detailed capabilities of each component of NetApp HCI, see the section "NetApp HCI Specifications" in the NetApp HCI datasheet.

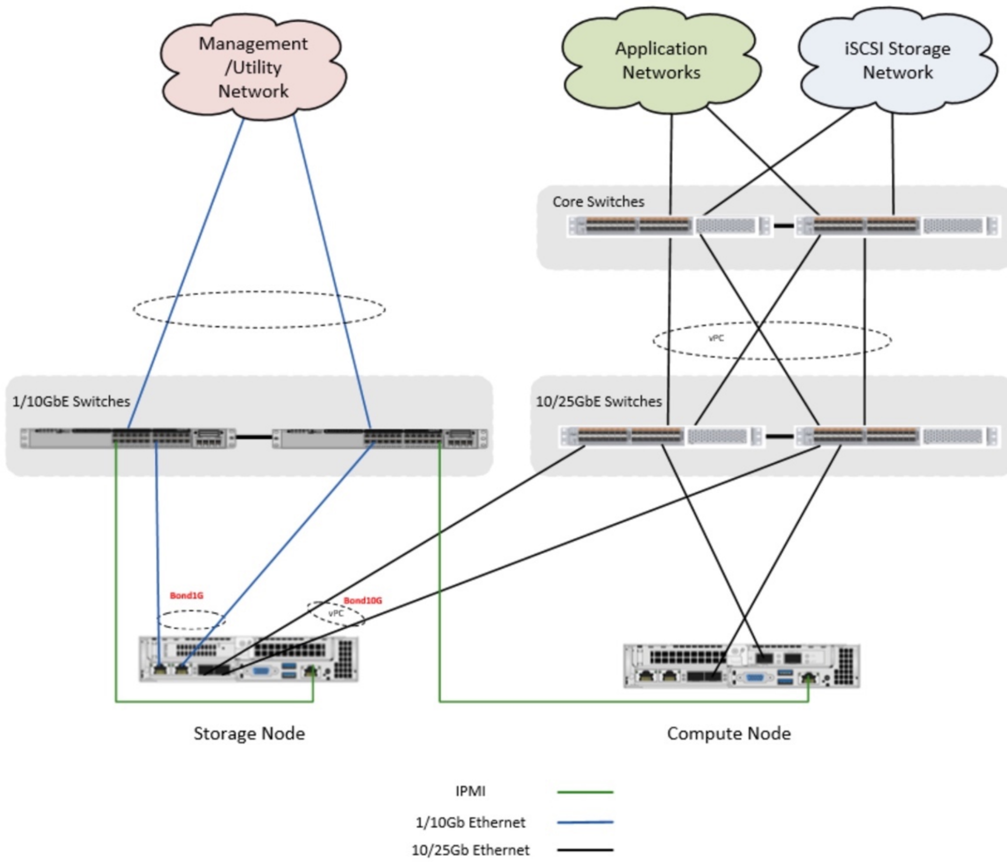
5.4 Network and Switch Requirements

The switches used to carry NetApp HCI data and management traffic require specific configuration for successful deployment. There are several methods for connecting a NetApp HCI system to an existing network infrastructure, depending on the features and capabilities in the customer's data center.

Beginning with NetApp HCI release 1.4, users can reduce the cables required for compute nodes. This design uses the two-cable compute node configuration which requires each compute node must be connected to a 10/25GbE network using two SFP+/SFP28 cables (one extra RJ-45 cable is optional for out-of-band management). Each storage node must be connected to a 10/25GbE network through two SFP+/SFP28 cables and to a 1/10GbE network using two RJ-45 cables (one additional RJ-45 cable is optional for out-of-band management).

Figure 6 illustrates an example connection topology of NetApp HCI.

Figure 6) NetApp HCI network topology.



NetApp HCI deployment requires multiple logical network segments. Each logical network segment uses its own VLAN, for each of the following types of traffic:

Table 5) NetApp HCI sample network VLANs used.

Network Segment	Details	ID Used in this Validation
In-band management network	Network for accessing management interfaces of nodes, hosts, and guests	3496
Out-of-band management network	Network for HCI terminal user interface (TUI)	16
VMware vMotion	Network for live migration of VMs	3495
SAN storage	Network for iSCSI storage traffic	3494
NAS storage	Network for NFS storage traffic	3493
VM network	Network for VM traffic	3490

NetApp HCI has the following switch requirements:

- All switch ports connected to NetApp HCI nodes must be configured to allow the Spanning Tree Protocol (STP) to enter the forwarding state immediately. On Cisco switches, the STP functionality is called PortFast. Ports connected to NetApp HCI nodes should not receive STP Bridge Protocol Data Units (BPDUs).
- The switches handling storage, VM, and vMotion traffic must support speeds of at least 10GbE per port (up to 25GbE per port is supported).
- The switches handling management traffic must support speeds of at least 1GbE per port.
- The maximum transmission unit (MTU) size on the switches handling storage traffic must be 9216 bytes end-to-end for a successful installation. The MTU size is automatically configured on the storage node interfaces.
- Cisco Virtual Port Channel (vPC) or the equivalent switch stacking technology for your switches must be configured on the switches handling the storage network for NetApp HCI. Switch stacking technology eases configuration of Link Aggregation Control Protocol (LACP) and port channels and provides a loop-free topology between switches and the 10GbE or 25GbE ports on the storage nodes.
- The switch ports connected to the 10GbE or 25GbE interfaces on NetApp HCI storage nodes must be configured as an LACP port channel.
- The LACP timers on the switches handling storage traffic must be set to “fast mode (1s)” for optimal failover detection time. During deployment, the Bond1G interface on all NetApp HCI storage nodes is automatically configured for active-passive mode.
- Round-trip network latency between all storage and compute nodes should not exceed 2ms.

Implement the following best practices to prepare your network for NetApp HCI deployment:

- Install as many switches as needed to meet high-availability (HA) requirements.
- Balance 1GbE or 10GbE port traffic between at least two 1/10GbE capable management switches.
- Balance 10GbE or 25GbE port traffic between two 10GbE capable switches.

5.5 Routable Subnets

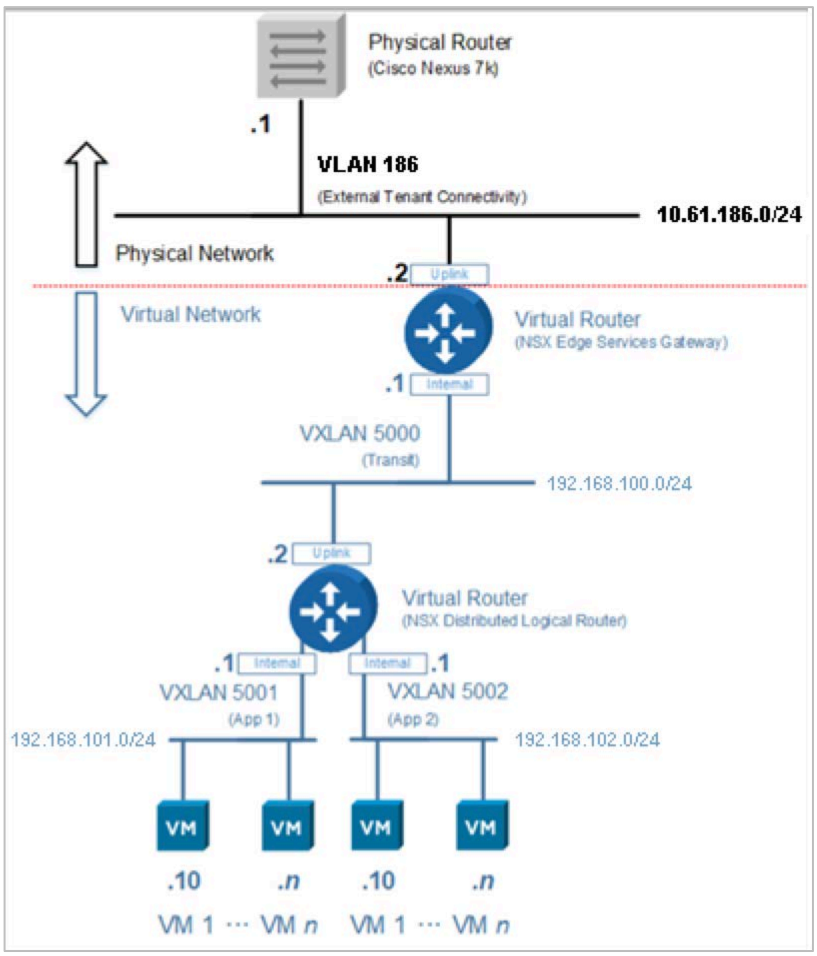
Before deploying the SDDC, you must allocate VLANs and IP subnets in the SDDC to the different types of traffic such as ESXi management and vSphere vMotion. For application virtual networks, you must plan separate IP subnets for these networks. Table 6 and Figure 7 provide example VLAN IDs and subnets for system traffic and an overview of connectivity.

Table 6) Example VLAN IDs and IP subnets for system traffic.

Cluster	Type	Purpose	VLAN	VNI	Subnet	Gateway
Management	VM Network	Management VMs	3496	N/A	172.21.240.0/24	172.21.239.1
Management	VMkernel	ESXi management	3496	N/A	172.21.240.0/24	172.21.240.1
Management	VM Network	NFS/ONTAP appliance	3493	N/A	172.21.237.0/24	172.21.238.1
Management	VMkernel	vMotion	3495	N/A	172.21.239.0/24	172.21.239.1
Edge & compute	VMkernel	ESXi management	3496	N/A	172.21.240.0/24	172.21.240.1

Cluster	Type	Purpose	VLAN	VNI	Subnet	Gateway
Edge & compute	VMkernel	NFS/ONTAP appliance	3493	N/A	172.21.237.0/24	172.21.238.1
Edge & compute	VMkernel	vMotion	3495	N/A	172.21.239.0/24	172.21.239.1
Edge & compute	VMkernel	NSX VXLAN VTEPs	3492	N/A	172.21.236.0/24	172.21.235.1
Edge & compute	VM Network	External tenant connectivity	3490	N/A	172.21.234.0/24	172.21.236.1
Edge & compute	VM Network	Tenant VXLAN (transit)	N/A	5000	192.168.100.0/24	192.168.100.1
Edge & compute	VM Network	Tenant VXLAN (app 1)	N/A	5001	192.169.101.0/24	192.168.101.1
Edge & compute	VM Network	Tenant VXLAN (app 2)	N/A	5002	192.168.102.0/24	192.168.102.1

Figure 7) Example networking topology.



5.6 IP Address Requirements

NetApp HCI has specific IP address requirements that depend on the size of your deployment.

In addition to the networks described in section 5.5, “Routable Subnets,” the storage network and the management network each use separate contiguous ranges of IP addresses for the NetApp HCI hardware nodes.

Table 7 lists the number of IPs that are required for each function. This represents a minimum configuration. Additional IPs on each subnet might be required if your deployment exercises certain options. For instance, adding HA capabilities to vCenter or vRealize Suite components would double the number of IPs needed on that subnet from 10 to 20.

Table 7) HCI IP address requirements.

IPs Required	Purpose	Example VLAN	Example VNI	Example Subnet
1 per storage node	NetApp HCI storage nodes	3496	N/A	172.21.240.0/24
1 per storage cluster	Storage cluster	3496	N/A	172.21.249.0/24
10 total for vRealize Suite	Management VMs	3496	N/A	172.21.240.0/24
1 per edge and compute host	ESXi management (EC)	3496	N/A	172.21.240.0/24
1 per management host	ESXi management (MGMT)	3496	N/A	172.21.240.0/24
2	NFS/ONTAP appliance	3493	N/A	172.21.237.0/24
1 per edge and compute host	vMotion (EC)	3495	N/A	172.21.239.0/24
2	NFS/ONTAP appliance	3493	N/A	172.21.237.0/24
1 per management host	vMotion	3495	N/A	172.21.239.0/24
1 per edge and compute host	NSX VXLAN VTEPs	3491	N/A	172.21.235.0/24
1	External tenant connectivity	3492	N/A	172.21.236.0/24
2 (usually .1 and .2)	Tenant VXLAN (transit)	N/A	5000	192.168.100.0/24
1 (usually.1)	Tenant VXLAN (app 1)	N/A	5001	192.168.101.0/24
1 (usually.1)	Tenant VXLAN (app 2)	N/A	5002	192.168.102.0/24

5.7 DNS and Timekeeping Requirements

DNS is a critical dependency of a properly functioning NetApp Verified Architecture deployment. All IPs associated with command and control components must have properly configured A records and PTR records. Further, NetApp strongly recommends that you use fully qualified domain names (FQDNs) when referencing various components during setup activities wherever possible.

Access to a valid Network Time Protocol (NTP) server is required for timekeeping; publicly available time servers can be used if one is not available in a customer’s environment. However, unless it is a complex deployment, most organizations use their Active Directory domain controllers for both DNS and NTP. Regardless of the NTP server chosen, **all** components **must** specify the same NTP server during configuration activities. Even a small amount of time drift between subcomponents of the vRealize Suite can create serious problems.

Table 8 lists an example of DNS records to create before configuration begins. The list is not comprehensive; it depends on design choices specific to your deployment. For instance, if you have a large vRealize Automation deployment, multiple UI and IaaS VMs might be involved. However, this example presents a baseline.

Table 8) Example DNS records.

IP	A Record	PTR Record	Purpose
172.21.239.100	vmpc-rtp-vc.sddc.netapp.com	100.239.21.172.in-addr-arpa.	VCSA
172.21.239.101	nsx-manager. .sddc.netapp.com	101.239.21.172.in-addr-arpa.	NSX Manager
172.21.240.141	vmpc-vra-01.sddc.netapp.com	141.239.21.172.in-addr-arpa.	VRA UI appliance
172.21.240.136	vmpc-sql-01.sddc.netapp.com	136.239.21.172.in-addr-arpa	VRA IaaS SQL Server
172.21.240.137	vmpc-iaas-01.sddc.netapp.com	137.239.21.172.in-addr-arpa.	VRA IaaS server
172.21.240.138	vmpc-iaas-02.sddc.netapp.com	138.239.21.172.in-addr-arpa.	VRA IaaS server
172.21.240.139	vmpc-iaas-03.sddc.netapp.com	139.239.21.172.in-addr-arpa.	VRA IaaS server
172.21.240.142	vmpc-vrli-01.sddc.netapp.com	142.239.21.172.in-addr-arpa.	LI appliance
172.21.240.132	vmpc-lcm-01.sddc.netapp.com	132.239.21.172.in-addr-arpa	Lifecycle Manger Appliance
172.21.240.143	vmpc-vrops-01.sddc.netapp.com	143.239.21.172.in-addr-arpa.	VROPS appliance
172.21.240.101	vmpc-rtp-esx-01.sddc.netapp.com	101.240.21.172.in-addr-arpa.	MGMT Host 1 Mgmt
172.21.240.102	vmpc-rtp-esx-02.sddc.netapp.com	102.240.21.172.in-addr-arpa.	MGMT Host 3 Mgmt
172.21.240.103	vmpc-rtp-esx-03.sddc.netapp.com	103.243.21.172.in-addr-arpa.	Compute Host 1 Mgmt
172.21.240.104	vmpc-rtp-esx-04.sddc.netapp.com	104.243.21.172.in-addr-arpa.	Compute Host 2 Mgmt

6 HCI Deployment

After completing the rack and stack and network configuration of the switches, you can prepare the environment for NDE. Before deploying NDE on a NetApp HCI system, you need to meet the minimum hardware, software, and networking requirements. NetApp HCI Prerequisites Checklist lists the essential steps to complete before installing and configuring NetApp HCI. You must complete this checklist before you use the NetApp HCI NDE.

Each HCI node has a terminal user interface (TUI) that enables out-of-band management. There are three ways to prepare the nodes for deployment with NDE:

- Set up DHCP in the environment to assign addresses to each of the nodes.
- Manually assign two IP addresses for each storage node and compute node.
- Set the management address of a single storage node and allow NDE to automatically configure all addresses during deployment.

Regardless of the method used, the first step is to connect to the management IP address of a single storage node. Then the deployment of NDE is a GUI-driven operation, simplifying installation.

This validation uses the automatic assignment of management and storage addresses.

For more information about HCI deployment guidelines, see the NetApp HCI Documentation Center.

6.1 Requirements for HCI Deployment

Before executing NDE, complete the following final items before you deploy NetApp HCI:

- Gather all relevant information about your network, current or planned VMware Infrastructure, and planned user credentials.
- Rack, cable, and power on the NetApp HCI installation.
- If you plan to use an existing VMware vCenter Server deployment:
  - If the vCenter Server deployment is at version 6.0, make sure that it is at version 6.0 update 3a or later.
  - If the vCenter Server deployment is at version 6.5, make sure that it is at version 6.5 update 2 or later.

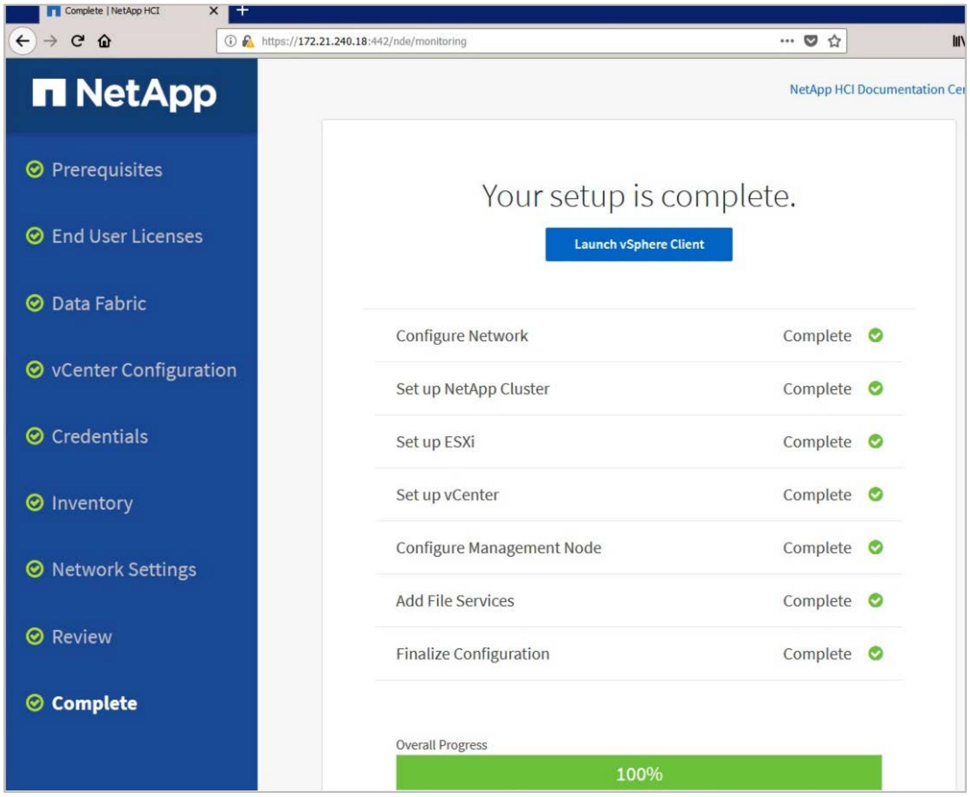
6.2 NetApp HCI Post-Deployment Process

NDE does the following to bring an HCI system online:

1. Installs the storage node (NetApp Element software) on a minimum of four storage nodes.
2. Installs the VMware hypervisor on a minimum of two compute nodes.
3. Installs VMware vCenter to manage the entire NetApp HCI stack.
4. Installs and configures the NetApp storage management node and NetApp Monitoring Agent.

Figure 8 details a successful completion of NDE.

Figure 8) NetApp NDE setup.



After the successful deployment of HCI, log in to vCenter and review the configured components. The direct integration of NetApp HCI with VMware vCenter enables you to easily manage day-to-day tasks such as:

- Viewing of event logs and report overviews.
- Creating a datastore or a volume with individualized minimum, maximum, and burst QoS per application.
- Managing your accounts, data protection, clusters, and even VVols.
- Receiving alerts about the health of NetApp HCI. The integration with the monitoring system means that you never need to leave vCenter to receive alerts. The alerts are conveniently displayed in the alarm section.

7 Private Cloud Component Deployment

This section describes the state of the NetApp HCI system after the NDE completes and the preparations that are required to install VMware private cloud. Details for the environment can be found in the vSphere Web Client. For this validation, a new installation of vCenter was deployed.

7.1 Licensing

NDE installs a 60-day trial license so that customers can provide their own Enterprise license. NetApp HCI does not require premium licensing. From a VMware perspective, a customer installs 6.5u1 for this validation. VMware environments can vary greatly in complexity and license levels. NetApp HCI does not dictate a license level or require additional VMware license costs if the customer has an existing license.

7.2 Hosts

NDE identifies and deploys the hosts for a vSphere cluster according to best practices. As shown in Figure 9, the hosts are deployed in a NetApp HCI data center and vSphere cluster according to the naming convention used.

Figure 9) Hosts deployed by NDE.

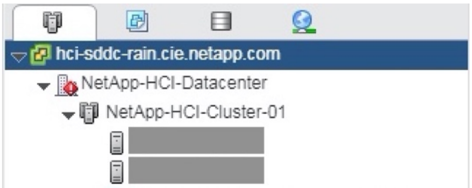
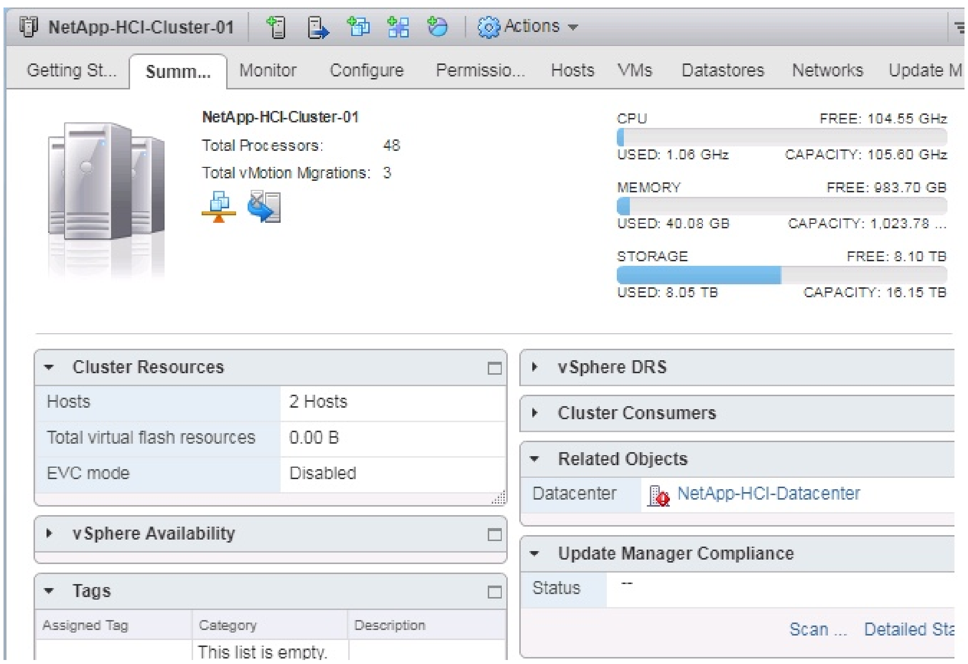


Figure 10 shows an overview of the properties of the H500E compute node used as part of this solution.

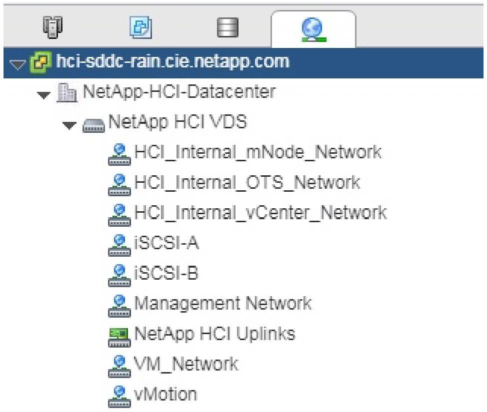
Figure 10) Compute node overview.



7.3 Networking

NDE provisions a standard vSphere Distributed Switch (VDS) according to best practices. As shown in Figure 11, the VDS is provisioned under the NetApp HCI data center and includes multiple predefined port groups to prepare the VMware administrator for a general-purpose virtualized environment.

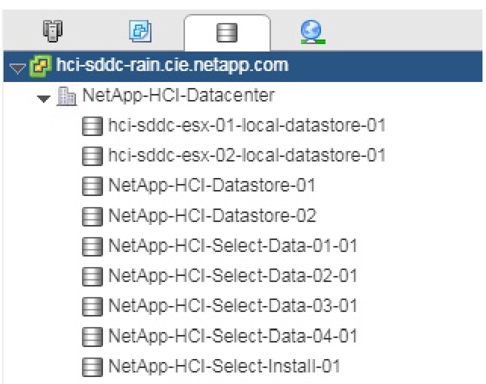
Figure 11) VDS and port groups provisioned by NDE.



7.4 Storage

NDE provisions several datastores according to best practices. As shown in Figure 12, the datastores are provisioned under the NetApp HCI data center. The resources provisioned include local datastores for each host for the ESXi instance, two VMFS HCI datastores that are hosted on the HCI storage cluster for iSCSI traffic, and multiple NetApp ONTAP Select datastores for NFS files.

Figure 12) Datastores provisioned by NDE.



NDE always deploys at least two datastores for ONTAP Select. This is done to separate the write workload from the vNVRAM device and the persistent data. The small configuration has two datastores. For every additional 2TB of licensed capacity, this verification deploys another datastore up to the maximum supported configuration of 8TB.

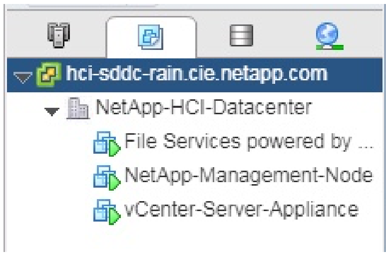
Each datastore has a VMDK file mapped to it that shows up as a VMDISK object in NetApp OnCommand® System Manager, which can be added to an aggregate.

After the aggregate is created, the normal workflow of creating an SVM, enabling file services, and creating an export can follow.

7.5 Virtual Machine

NDE provisions three VMs in the HCI data center: the ONTAP Select virtual instance, management node, and vCenter Server Appliance.

Figure 13) VMs provisioned by NDE.



ONTAP Select VM

When you enable file services, you are required to provide a valid capacity license file before continuing. The NDE handles provisioning the ONTAP Select VM during the HCI system deployment by automating the following tasks:

- Installation of the ONTAP Select appliance
- Application of the license file
- Application of the node and cluster management IPs
- Provisioning of capacity to the ONTAP Select VM for file services

After the system is deployed, the ONTAP Select VM requires execution of some post-configuration tasks. This ONTAP Select VM is deployed as a VM on iSCSI VMFS storage.

HCI Management Node (mNode)

The NetApp HCI management node enables centralized monitoring and upgrades of NetApp HCI. If you joined an existing VMware vCenter environment when you deployed NetApp HCI, you need to install a management node before you can use NetApp HCI in production. For this validation, a new vCenter environment was created. This mNode is deployed as a VM on iSCSI VMFS storage.

vCenter Server Appliance

NetApp HCI uses VMware vCenter Server to manage and monitor the VMware ESXi hypervisor installed on each compute node. The NDE provides you with the choice of either deploying a new vCenter Server or using a vCenter Server that you have already configured. This vCenter Server Appliance is deployed as a VM on iSCSI VMFS storage.

8 Preparing HCI for VMware Private Cloud

NetApp HCI and NDE facilitate a rapid configuration of a virtualized infrastructure. Additional customization steps are required before deploying VMware private cloud. These steps include:

1. Adding customer VMware licenses.
2. Scaling compute or storage resources.
3. Adding licenses for NSX.
4. Setting up NSX.
5. Installing vRealize.

8.1 vSphere Licensing

Customers can provide their own VMware Enterprise license as NDE installs a 60-day trial license. NetApp HCI does not require premium licensing. To enable NSX and vRealize features and capabilities, you must add the required licenses. You can add licenses by navigating to Home > Administration > Licensing.

For more information, see the VMware Licensing Help Center.

8.2 Scaling Storage and Compute Nodes with EasyScale

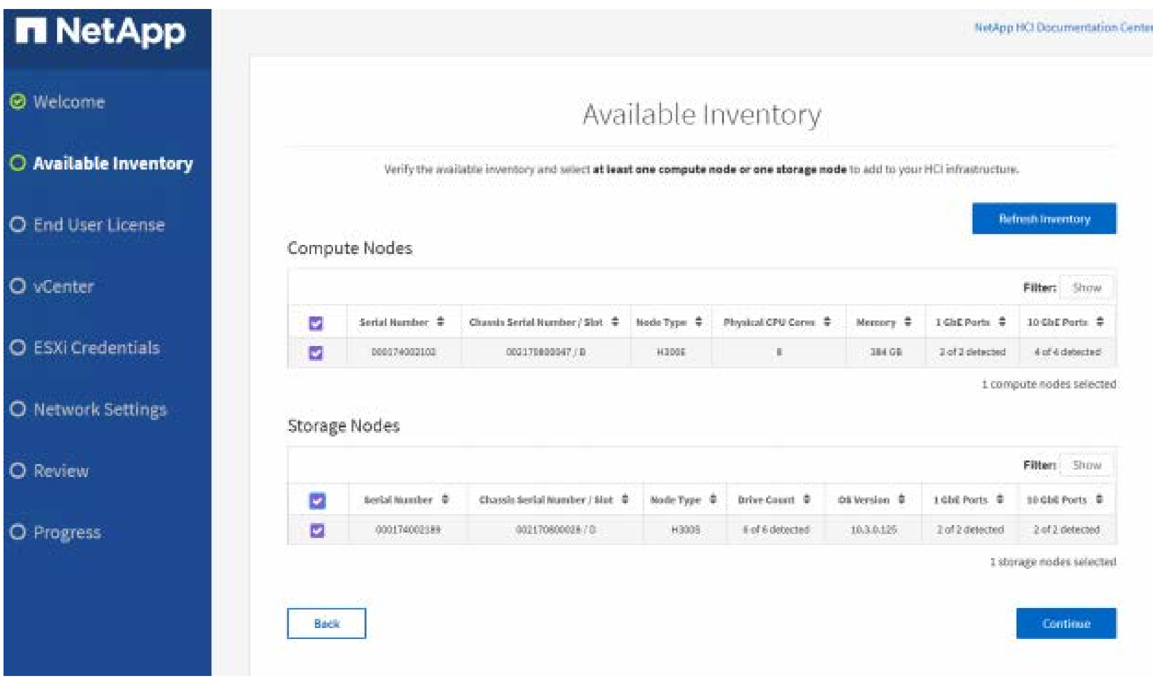
The smallest configuration that can be deployed with NDE is 2 compute nodes and 4 storage nodes. The largest configuration is 64 compute nodes and 40 storage nodes. Usually, the installation ranges from approximately 35 minutes for the small configuration to approximately 1 hour for the largest configuration.

The EasyScale feature enables you to expand your NetApp HCI system by adding compute and storage nodes to the cluster up to the maximum configuration. You can use any combination of compute and storage nodes if basic requirements are met. You can access EasyScale by navigating to https://NDE_IP:442/scale where is NDE_IP is the management IP (MIP) for any of the storage nodes in the existing HCI system.

Adding Nodes

Before you add new nodes to the cluster, the nodes must be configured with management and storage IPs, which are reachable from the existing cluster. You can then add the node to the HCI system through EasyScale as shown in Figure 24.

Figure 14) Adding nodes with EasyScale.



The number of compute nodes can be expanded to a maximum of 64 nodes.

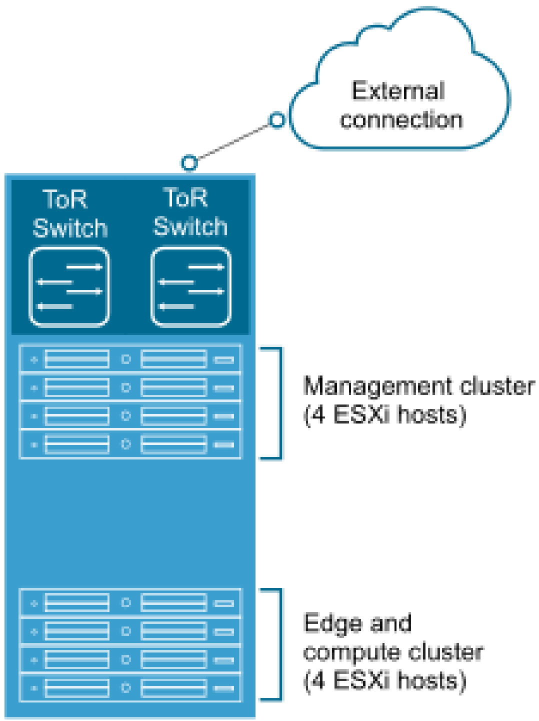
The number of storage nodes can be expanded to a maximum of 40 nodes. You can mix storage node types if a single node does not compose more than one-third of the available capacity of the cluster.

For example, consider an initial system built with four H300S (small) storage nodes, each of which has a capacity of 2.4TB. The total cluster capacity is 9.6TB (2.4TB * 4). You can expand the cluster with H700S storage nodes with a capacity of 9.6TB per node or any sized node to meet your needs.

8.3 Separating Management and Workload Clusters

The SDDC differentiates between different types of clusters, such as management clusters and shared Edge and Compute clusters. You must divide resources into these separate clusters after NDE. You can accomplish this separation by simply creating a cluster dedicated to either compute clusters, edge clusters, or shared edge. Figure 15 details the different clusters that must be created as part of a single availability zone in the VMware SDDC.

Figure 15) Clusters in a single availability zone in the SDDC.



Management Cluster

The management cluster resides in the management workload domain and runs the VMs that manage the SDDC. These VMs host vCenter Server, vSphere Update Manager, NSX Manager, NSX Controller, vRealize Operations Manager, vRealize Automation, vRealize Log Insight, and other management components. Because the management cluster contains critical infrastructure, consider implementing a basic level of hardware redundancy for this cluster.

Management cluster components must not have tenant-specific addressing.

Shared Edge and Compute Cluster

The shared Edge and Compute cluster is the first cluster in the virtual infrastructure workload domain and hosts the tenant VMs (sometimes referred to as workloads or payloads). This shared cluster also runs the required NSX services to enable north-south routing between the SDDC tenant VMs and the external network, and east-west routing inside the SDDC. As the SDDC expands, you can add more compute-only clusters to support a mix of different types of workloads for various SLAs.

Compute Cluster

Compute clusters live in a virtual infrastructure workload domain and host the SDDC tenant workloads. An SDDC can contain different types of compute clusters and provide separate compute pools for different types of SLAs.

External Storage

External storage provides non-VSAN storage using NFS, iSCSI, or FC. Different types of storage can provide different levels of SLA, ranging from JBODs using IDE drives with minimal to no redundancy, to fully redundant enterprise-class storage arrays.

8.4 NSX Setup

After adding all required licenses, scaling compute and storage resources, and modifying ESXi cluster switching, you are ready to set up VMware NSX on your NetApp HCI cluster. This validation considers the vCenter environment to be a new installation. With additional planning, these same considerations can be applied to existing vCenter environments. NetApp HCI is a flexible environment, compatible with the SDN provided by VMware NSX.

VMware NSX is VMware's SDN that provides network virtualization, network function virtualization (NFV), and a security platform. NSX decouples the network functions from the physical devices, similar to decoupling virtual servers (VMs) from physical servers. To decouple the virtual network from the traditional physical network, NSX natively recreates the traditional network constructs in virtual space; these constructs include ports, switches, routers, firewalls, and so on.

As mentioned in the section "Software Defined Networking with VMware NSX," NSX offers several features and capabilities, including the following:

- **Security.** Every virtualized workload can be protected with a full stateful firewall engine at a granular level. Security can be based on constructs such as MAC, IP, ports, vCenter objects and tags, and Active Directory groups. Intelligent dynamic security grouping can drive the security posture within the infrastructure.
- **Application continuity.** NSX enables you to easily extend networking and security up to eight vCenter Servers either within or across data centers. Along with vSphere 6.0, customers can easily use vMotion to move a VM across long distances, and NSX makes sure that the network is consistent across the sites and that the firewall rules are consistent. This essentially maintains the same view across sites.
- **Automation.** IT automation tools such as vRealize Automation, which can provide a one-click deployment option for an entire application, and includes the compute, storage, network, security, and L4–L7 services.

The NSX platform includes several components that are deployed in this solution. These components are responsible for platform management, traffic control, and service delivery. The following table briefly details their functional and operational specifics for this guide.

NSX software defined networking planes	• Data plane • Control plane • Management plane
NSX deployment components	• NSX Manager • Controller cluster • VXLAN primer • ESXi hypervisors with VDS • NSX Edge services gateway • Transport zone

Logical network service components	• Switching • Routing • Connectivity to physical networks
Logical network and Edge services	• Edge firewall services (part of the NSX Edge services) • Gateway (Edge services gateway, or ESG) • VPN • Logical load balancing • DHCP and NAT services • Distributed firewall

For more information, see the VMware NSX for vSphere (NSX) Network Virtualization Design Guide.

8.5 vRealize Operations Manager and Log Insight

The vRealize Suite provides a pair of products to simplify operations and monitoring.

vRealize Operations Manager presents a single dashboard with drill-down abilities to examine many of the components in the private cloud environment. vRealize Operations Manager is delivered as an OVA file from VMware and is deployed as a single instance or highly available cluster of instances.

Management plug-ins allow vRealize Operations Manager to best understand and display the environment. Management packages exist for vCenter and NSX, and agents are available to install on guest operating systems to allow complete integration with vRealize Operations Manager.

Specifically, NetApp HCI provides a management pack for NetApp Element nodes, integrating operational oversight for HCI storage components in vRealize Operations Manager.

vRealize Log Insight gathers log information from data center software components and aggregates logged information, speeding analysis of potential issues. There are vRealize Operations Manager content collector packs for most services in a private cloud, including vCenter instances, ESXi hosts, and individual guest operating systems.

vRealize Log Insight correlates events from various sources, allowing administrators to quickly identify and resolve problems by tracing them to their source.

vRealize Log Insight is an OVA file from VMware and is deployed as a single instance or highly available cluster of instances. vRealize Operations Manager directly accesses vRealize Log Insight to seamlessly go from operations oversight to debugging.

8.6 vRealize Automation Appliance

vRealize Automation is a product in the vRealize Suite that allows easy, self-service deployment of VMs from a predefined catalog. vRealize Automation is used in cloud environments to quickly provision VMs using a service catalog of blueprints and resources.

vRealize Automation requires an external SQL Server and an IaaS server. vRealize Automation also relies on vRealize Orchestrator to develop custom workflows. vRealize Orchestrator, by default, is provided with vRealize Automation.

vRealize Automation requires a minimum of one VM to work as the deployment engine. The VM is delivered as an OVA file from VMware to be deployed in your vSphere environment. vRealize Automation appliance includes an internal Orchestrator server and requires external SQL and IaaS servers be provisioned.

Blueprints are one of the most important constructs within vRealize Automation. Blueprints dictate how resources are provisioned, and how long they exist. Blueprints also dictate the security parameters associated with resources and their associated network configuration. To aid administrators, vRealize Automation offers predefined blueprints and provisioning methodology templates.

After the vRealize Automation service is running and configured, a blueprint is designed that allows the creation of vRealize Automation Catalog Services and Items. Active Directory groups or users are imported, and detailed infrastructure roles can be defined in the Service Catalog. Custom company branding for site headers/footers and login pages can be configured for the Service Catalog as shown in Figure 16 and Figure 17.

Figure 16) vRealize Service Catalog.

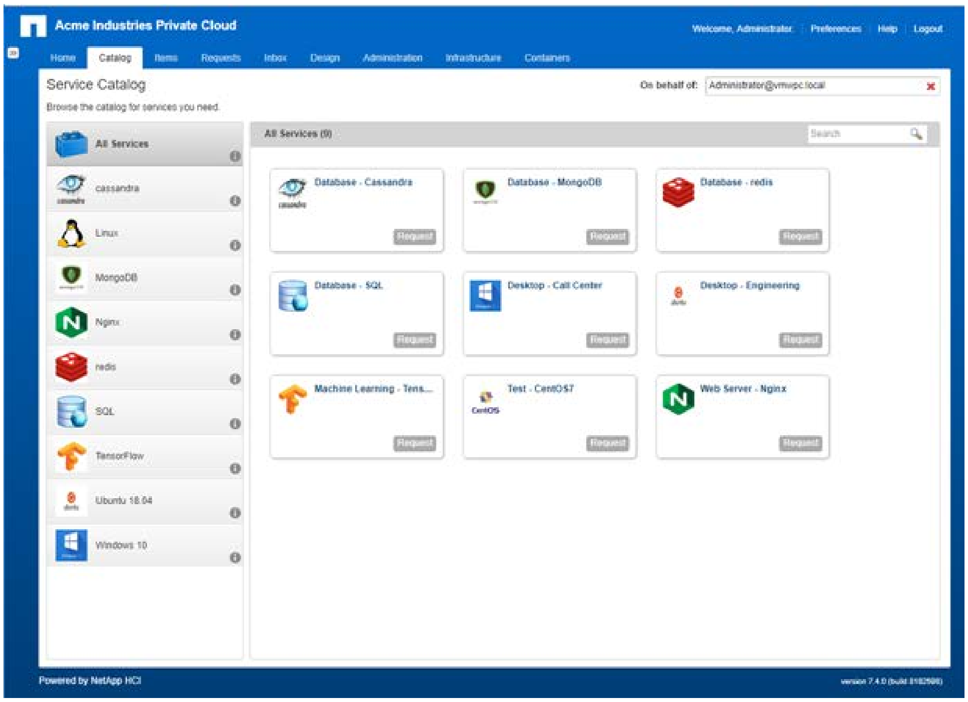
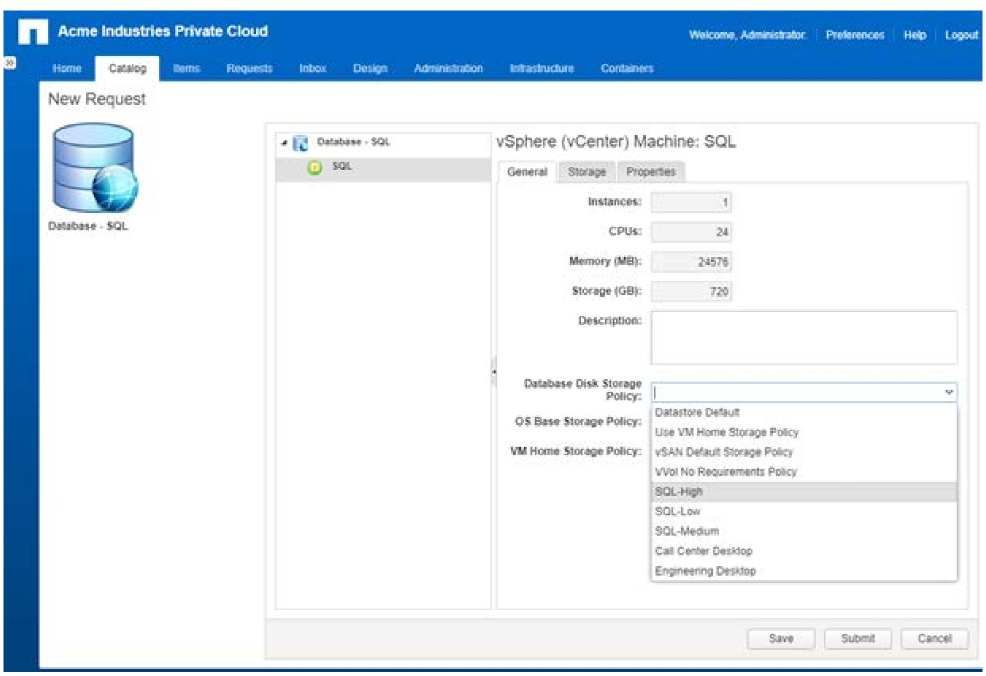


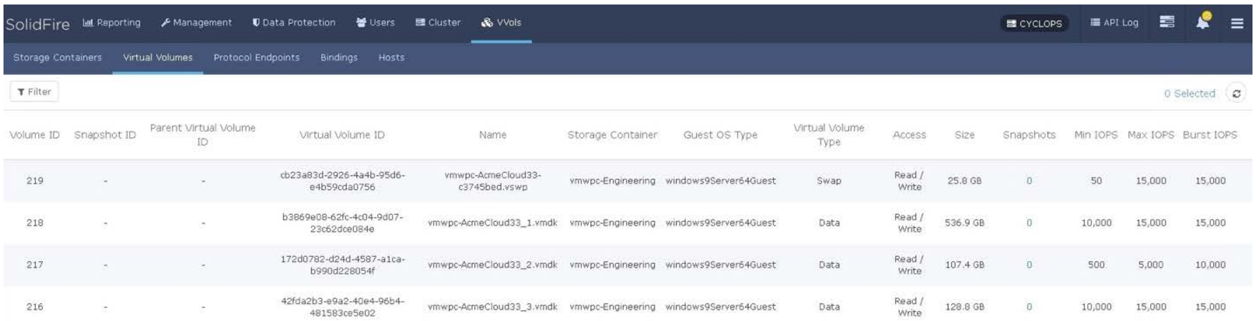
Figure 17) vRealize Service Catalog new request.



This architecture defines the SPBM integration through a plug-in, allowing you to create and assign vRealize Automation property definitions for single or multiple disks for VMs created through the Blueprint and Catalog Services. This allows the selection of your predefined storage policies defined in vCenter.

vRealize Automation is useful when certain VMs are repeatedly deployed on NetApp HCI. Also, vRealize Automation uses Element software's VVols integration and VASA capabilities to adjust QoS defined in the custom storage policies by using the SPBM. It's enabled using an integration plug-in and the NetApp vCenter plug-in. Figure 18 shows the settings made using these plug-ins for VVols as displayed in the Element UI.

Figure 18) vRealize Service Catalog new request.



For more information about the SPBM plug-in, see [vRealize Automation and Storage Policy-Based Management Framework Integration on the VMware Solution Exchange](#).

9 Solution Verification

The following integrations were validated during solution verification:

- NetApp HCI and SPBM
- NetApp HCI and vRealize Automation and vRealize Orchestrator
- NetApp HCI and vRealize Operations Manager
- NetApp HCI and vRealize Log Insight

10 Conclusion

By delivering compute and storage resources in an efficient form factor, NetApp HCI scales in a predictable and easy-to-manage manner. VMware vSphere and vCenter use NetApp Element software plug-ins to enable provisioning of VMs for several use cases, with granular control. VMware also provides a suite of products to provide cloud-like provisioning and oversight of these VMs. By combining NetApp HCI and VMware private cloud products, this solution enables self-serviced, centralized operations, and debugging capabilities. Additionally, departmental or customer bill-back accounting is achieved with a resilient and easily scalable hyper converged system. This solution enables an IT department to quickly scale hardware resources to match the dynamic needs of the business. The VMware Private Cloud on NetApp HCI NVA enables a single console from which an IT department can conduct, troubleshoot, and monitor an environment that includes data from several utilities.

Where to Find Additional Information

To learn more about the information that is described in this document, review the following documents and/or websites.

NetApp Documents

- NetApp Product Documentation
  docs.netapp.com
- HCI Resources page
  https://mysupport.netapp.com/info/web/ECMLP2831412.html
- NetApp Data Fabric
  https://www.netapp.com/us/info/what-is-data-fabric.aspx
- NetApp HCI
  https://www.netapp.com/us/products/converged-systems/hyper-converged-infrastructure.aspx
- DS-3881: NetApp HCI Datasheet
  https://www.netapp.com/us/media/ds-3881.pdf
- NetApp HCI Technical docs
  http://docs.netapp.com/hci/index.jsp
- NetApp HCI Deployment Guide
  https://library.netapp.com/ecm/ecm_download_file/ECMLP2844053
- TR-4679: NetApp HCI Network Setup Guide
  https://www.netapp.com/us/media/tr-4679.pdf
- WP-7261: NetApp HCI Theory of Operations
  https://www.netapp.com/us/media/wp-7261.pdf
- NetApp Element software
  https://www.netapp.com/us/products/data-management-software/element-os.aspx
- NetApp ONTAP Select
  https://www.netapp.com/us/products/data-management-software/ontap-select-sds.aspx
- NetApp Element Plug-in for VMware vCenter Server Web Client
  https://www.netapp.com/us/media/solidfire-vcenter-plugin-user-guide.pdf
- NetApp Element vRealize Orchestrator Plug-in
  https://github.com/solidfire/vrealize-orchestrator-plugin

VMware Documents

- VMware licensing
  https://www.vmware.com/support/support-resources/licensing.html
- VMware vSphere Hypervisor
  https://www.vmware.com/products/vsphere-hypervisor.html
- VMware vCenter Server
  https://www.vmware.com/products/vcenter-server.html
- VMware NSX
  https://www.vmware.com/products/nsx.html
- VMware NSX Datasheet
  https://www.vmware.com/content/dam/digitalmarketing/vmware/en/pdf/products/nsx/vmware-nsx-datasheet.pdf
- VMware NSX design considerations
  https://www.vmware.com/content/dam/digitalmarketing/vmware/en/pdf/products/nsx/vmw-nsx-network-virtualization-design-guide.pdf
- VMware vRealize Suite
  https://www.vmware.com/products/vrealize-suite.html

- VMware vRealize Automation
https://www.vmware.com/products/vrealize-automation.html
- VMware vRealize Log Insight
https://www.vmware.com/products/vrealize-log-insight.html
- VMware vRealize Operations
https://www.vmware.com/products/vrealize-operations.html
- VVD (VMware Validated Design)
https://docs.vmware.com/en/VMware-Validated-Design/index.html

Refer to the Interoperability Matrix Tool (IMT) on the NetApp Support site to validate that the exact product and feature versions described in this document are supported for your specific environment. The NetApp IMT defines the product components and versions that can be used to construct configurations that are supported by NetApp. Specific results depend on each customer's installation in accordance with published specifications.

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