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About This Guide

The VMware Cloud Provider Stack (VCPS) Architecture Guide provides an overview of the architecture and design of the VCPS solution.

The VCPS architecture and design is based on the VMware Validated Design (VVD) and the similarities to the VVD architecture and design are listed where applicable. This document includes links to the VVD content wherever the details are applicable as is to VCPS also.

Intended Audience

This information is intended for VMware partners and Cloud Providers (CPs) who want to deploy the VCPS as an SDDC solution for their customers. The information in this guide will also be of interest to VCPS and SDDC cloud architects, cloud solution engineers, and infrastructure administrators. You must be familiar with virtual machine technology, Windows or Linux system administration, and data center operations.
Introduction

This document provides the architecture and design overview of the following areas of the VMware Cloud Provider Stack solution.

- Physical Infrastructure
- Virtual Infrastructure
- Workload mobility
- HCX design

Note the following considerations for the VCPS design:

- It is based on NSX-T.
- Cloud management, Business Continuity, and Disaster Recovery are not part of the design.
- The design meets the minimum requirement of four ESXi hosts. As a result, having a dedicated management or edge cluster is not considered.
The VCPS architecture is based on the VMware Validated Design (VVD) for Consolidated Software Defined Data Center (SDDC).

However, there are many differences and exceptions between the architecture and design for VVD for Consolidated SDDC and the VCPS design. The differences in design are discussed in the respective sections.

You must also note the following exceptions:

- In this release of the Single Workload Domain SDDC design, there is a strong focus on the physical layer and the Virtual Infrastructure layer.
- Service Management and Cloud Management is not covered in this design.

Special Annotations: Use existing third-party solutions to provide backup and restore capabilities using the framework provided by VMware. See the Business Continuity Architecture for Consolidated SDDC and the Data Protection and Backup Architecture for Consolidated SDDC for information and guidelines that apply to the VCPS solution as well.

Physical Infrastructure Architecture

The architecture of the data center physical layer is based on logical hardware domains and the physical network topology.

The following diagram provides an overview of the physical infrastructure architecture:

The generic guidelines listed in this physical infrastructure architecture topic are applicable here.

This chapter includes the following topics:
- Workload Domain Architecture
- Cluster Types
- Physical Network Architecture
- Availability Zones and Regions

Workload Domain Architecture

Workload domains refer to a set of common building blocks that are used in SDDC.

See the VVD workload domain architecture for detailed information applicable to VCPS architecture also.
The following exception is applicable to layer-2 networks:

**Note** If layer-2 networks are terminated at the ToR-level, then the consolidated single workload domain design cannot span multiple racks, as management VMs with VLAN-backed networks require the same layer-2 connectivity when it gets migrated to another rack using vMotion.

### Cluster Types

The Single Workload Domain SDDC for Cloud Providers consists of only two cluster types, a consolidated cluster and optional workload clusters.

![Cluster Types Diagram](image)

The Consolidated cluster runs the following services:

- Virtual machines to manage the SDDC such as vCenter Server, NSX-T Managers, and NSX-T Edge Nodes.
- Required NSX services to enable north-south routing between the SDDC and the external network, and east-west routing inside the SDDC.
- Virtual machines running business applications supporting different Service Level Agreements (SLAs).

The optional Workload Cluster runs the following services:

- East-west routing inside the SDDC.
- Virtual machines running business applications supporting different Service Level Agreements (SLAs).
Physical Network Architecture

This section provides a generic description of the physical network architecture for the Single Workload Domain SDDC for Cloud Providers.

Network Transport

You can implement the physical layer switch fabric for a VCPS SDDC deployment by offering Layer 2 or Layer 3 transport services.

See the Network Transport for Consolidated SDDC section for detailed information.

Physical Network Interfaces

To provide physical NIC redundancy for all network services, a minimum of four uplinks or physical NICs must be dedicated per ESXi host.

Two virtual switch types are required per host, each connecting to a set of two physical NICs.

The physical NICs should connect to a pair of Top-of-Rack switches (ToR-switches). All required VLANs must be trunked to the physical NICs of the ESXi hosts through 802.1Q network trunks.

Availability Zones and Regions

In an SDDC, availability zones are collections of infrastructure components. Regions support disaster recovery solutions and allow you to place workloads closer to your customers. Typically, multiple availability zones form a single region.

The VCPS SDDC design uses a single region with one availability zone.

See Cluster Types for Consolidated SDDC for detailed information.

Availability Zones

In a region, each availability zone is isolated from the other availability zones to prevent reproducing failure or outage across zone boundaries.

The VCPS design supports only a single availability zone.

See the Availability Zones and regions for Consolidated SDDC for more information.

Regions

Multiple regions support placing workloads closer to your customers, for example, by operating one region on the US east coast and one region on the US west coast, or operating a region in Europe and another region in the US.

This VCPS design supports only a single region.

See the Regions for Consolidated SDDC section for more information.
Virtual Infrastructure Architecture

The virtual infrastructure is the foundation of SDDC. It contains the software-defined infrastructure, software-defined networking and software-defined storage. The virtual infrastructure layer runs the operations management layer.

The following diagram shows the virtual infrastructure layer in the Consolidated SDDC:

See Virtual Infrastructure Architecture for Consolidated SDDC in the VMware Validated Design for Consolidated SDDC guide for detailed information.

This chapter includes the following topics:

- Virtual Infrastructure Overview
- Network Virtualization Components

Virtual Infrastructure Overview

The virtual infrastructure consists of a single region with a consolidated cluster.
The consolidated cluster runs the virtual machines that manage the Consolidated SDDC.

The management components include vCenter Server, NSX-T Manager, NSX-T Edge Nodes and other shared management components.

All management, monitoring, and infrastructure services are provisioned to the consolidated vSphere cluster which provides high availability for these critical services.

NSX Services enable North-South routing between the SDDC and the external network, and east-west routing inside the SDDC.

The consolidated cluster also hosts the SDDC tenant virtual machines (sometimes referred to as workloads or payloads). Workloads run customer business applications supporting varying SLAs.
Network Virtualization Components

VMware NSX-T Data Center, the network virtualization platform, is a key solution in the VCPS SDDC architecture. NSX-T Data Center network virtualization programmatically creates, deletes, and restores software-based virtual networks.

The VCPS solution uses the NSX-T platform which consists of several components that are relevant to the network virtualization design.

The following diagram shows the different components of NSX-T.

See NSX-T Data Center Overview in the NSX-T Data Center Installation guide for an overview of NSX-T Data Center.
VCPS Hybridity Services

Hybridity Services includes all services that you can offer your customers to connect the on-prem data centers to their cloud data centers.

A few examples of the Hybridity services are listed below.

- Migration of vSphere VM workloads between an on-prem and a cloud data center.
- Temporary or permanent stretching of Layer-2 networks between an on-prem and a cloud data center.
- Disaster Recovery (DR) to protect on-prem vSphere workloads to fail over to a cloud data center and conversely, if there was a disaster or a planned maintenance.
- Provide a single view between cloud and on-prem vSphere resources to provide seamless management of on-prem and cloud data center resources.

**Note** The above Hybridity services are just a few examples and do not provide the complete listing of services which might be offered with the VCPS solution.

This chapter includes the following topics:

- HCX Overview
- HCX Components
- HCX Services Overview

**HCX Overview**

VMware HCX abstracts on-premises versus cloud notions and presents capabilities to virtual machines as a continuous hybrid cloud.

**Business Use Cases**

- Modernization of mission-critical application infrastructure with a minimal operational overhead, without requiring a retrofit of your legacy infrastructure.
- Coherent migration of hundreds of virtual machines, bi-directionally, in parallel, on a secure high-performance overlay, over an existing WAN, VPN, or private lines.

**Technical Capabilities**

- Secure interconnection of vSphere-based SDDCs on-premises and in the cloud by providing encrypted tunnel connections.
- Metro-stretching of vSphere-based L2 networks across interconnected SDDCs.
- Optimizing SDDC interconnection network traffic by providing techniques like deduplication and compression.
- vMotion of VMs across SDDCs.
- Scheduled bulk migrations of VMs between HCX-connected SDDCs.
- Scheduled data center failover/migrations with vSphere Replication as an enabling technology.

**HCX Components**

The suite of HCX technologies are delivered through three distinct service components, which can be enabled from the HCX Manager’s interface. The HCX interface is added as a vCenter Server plugin during the HCX Manager OVA deployment. The HCX enabled sites are paired and then service components are deployed simultaneously at the source and destination sites whenever services are enabled for the selected site pair.

**HCX Enterprise or Cloud Manager**

The HCX manager component is deployed as an OVA, integrates HCX with the vSphere environment, and enables it to deliver HCX services. HCX Manager is deployed one to one with each vCenter Server.

HCX Enterprise Manager is deployed at the source site. HCX Cloud Manager is deployed at the target site by the HCX Cloud Services provider. The HCX cloud manager automates the deployment of peer appliances when a service is enabled at the source site within the HCX plugin. Services cannot be enabled using the HCX Cloud interface.

An HCX Site Pair always consists of one HCX Enterprise source site (tenant site) and one HCX Cloud destination site (Cloud Provider site). The components listed in the following sections are always deployed in the context of a site pair.

**HCX WAN Interconnect (HCX-IX)**

This service appliance is deployed when migration and/or Data Recovery (DR) services are enabled. This component automatically tunnels to its peer at the remote site and provides an encrypted service path for migration services.

**HCX WAN Optimization (HCX-WAN-OPT)**

This service appliance is deployed when WAN Optimization services are enabled for a site pair. The WAN Optimization component only communicates with the HCX-IX, it does not make direct connections to its peer.

**HCX Extension Appliance (HCX-NET-EXT / L2C)**

This is deployed when Network Extension services are enabled. This component automatically tunnels to its peer at the remote site and provides an encrypted service path for migration services.
HCX Services Overview

HCX provides infrastructure abstraction, high performance network extension with advanced services like proximity routing, virtual machine mobility, and disaster recovery services with data reduction and WAN line conditioning built in.

HCX Network Extension

HCX connects networks (VLANs or VXLANs) at the source site to an NSX logical switch at the destination site. This service expedites the consumption of remote resources by allowing virtual machines to be migrated, while using the Layer 3 gateway and security policies at the source site.

HCX Virtual Machine Mobility

Virtual machines can be moved to and from HCX-enabled vSphere private and public cloud environments using multiple HCX migration technologies. HCX provides version compatibility across legacy and modernized sites.

A few migration methods are listed below:

- **HCX Bulk Migration** - Uses the vSphere Replication protocol to transfer multiple virtual machines in parallel. Virtual machines are “rebooted” into the target site and can be transformed to the latest VM Hardware/VM Tools available. With the Bulk migration option, virtual machines can have their vNIC IP addresses updated as part of the migration operation.
- **HCX vMotion** - Uses the VMware vMotion protocol to transfer individual virtual machines. Used with HCX Network Extension for zero-downtime migrations of applications that are sensitive to downtime.
- **HCX Cold Migration** - Uses the VMware NFC protocol. This migration type is automatically selected when transferring powered-off virtual machines.
- **HCX vMotion with vSphere Replication** - Combines Bulk and vMotion to deliver zero downtime failover for virtual machines prepared in parallel.

HCX WAN Optimization

The HCX WAN Optimization service improves the performance characteristics of private lines or Internet path by applying WAN optimization techniques such as data reduction (compression, deduplication) and WAN line conditioning (Error Correction / Packet Order Correction).

HCX Disaster Recovery

VMware HCX uses advanced WAN Optimization to protect on-premises applications by replicating the data to an HCX- enabled provider or private cloud deployment. In the event of a disaster, VMware HCX recovers the networking layers. Traffic routes are maintained as it was before the disaster, resulting in high-speed disaster recovery with low downtime. There is no reconfiguration of IPs, which removes complexity and enables either partial or full site recovery.