VMware vCloud Director with VMware Cloud Foundation for Cloud Providers
# Table of Contents

**Overview**........................................................................................................................................................................... 3

**Introduction to VMware Cloud Foundation for Cloud Providers**................................................................. 5
  - VMware Cloud Foundation - Features and Benefits......................................................................................... 7
  - VMware Cloud Foundation and VMware vCloud Director........................................................................ 8

**Introduction to HCX**................................................................................................................................................................. 9
  - Deploying HCX with VMware Cloud Foundation and vCloud Director ...................................................... 10

**Introduction to VMware vCloud Director**.................................................................................................................. 12

**Solution Architecture – vCloud Director with Cloud Foundation**................................................................. 17

**Life Cycle Management**...................................................................................................................................................... 23
  - VMware Cloud Foundation.............................................................................................................................. 23
  - vCloud Director .................................................................................................................................................... 23

**Deploy VMware Cloud Foundation**............................................................................................................................... 24
  - Management Domain ........................................................................................................................................... 24
  - Virtual Infrastructure Workload Domains......................................................................................................... 25
  - Key Steps to Deploy VMware Cloud Foundation ............................................................................................ 25

**Deploy vCloud Director**.................................................................................................................................................... 28
  - Deploying vCloud Director .............................................................................................................................. 28
  - Deploy the vCloud Director Appliance ........................................................................................................... 29

**VMware Cloud Provider Pod and Cloud Foundation Interoperability**.......................................................... 31

**Conclusion**.......................................................................................................................................................................... 32
  - References............................................................................................................................................................... 33
  - Acknowledgments................................................................................................................................................... 33
Overview

VMware vCloud Director enables cloud providers to build secure, multi-tenant clouds by pooling virtual infrastructure resources into virtual datacenters and exposing them to users through Web-based portals and programmatic interfaces as a fully automated, catalog-based service.

VMware Cloud Foundation for Cloud Providers provides an integrated cloud infrastructure (compute, storage, networking, and security) to deploy, run and manage the life cycle of virtual infrastructure resources in both private and public environments.
Leading cloud providers use vCloud Director and VMware Cloud Foundation to provide flexible Infrastructure as a Service (IaaS) environments for their tenants. VMware Cloud Foundation is used to deploy and manage the life cycle of the underlying virtual infrastructure and carve out pieces of that infrastructure. It is also used to upgrade and patch the virtual infrastructure on an on-going basis. vCloud Director has a catalog-based self-service system and policy controls, enabling granular control of resource allocation to tenants and their virtual data centers, virtual machines, and vApps.

Cloud providers who integrate VMware vCloud Director and VMware Cloud Foundation mention the following benefits:

- Increased business agility. Rapid deployment, management, and operationalization of shared and dedicated cloud resources.
- Greater security and policy-based control in managing multiple tenants.
- Reduced capital and operational costs resulting from a more efficient way of delivering and allocation of resources.
- Reduced operations costs for deploying and managing the life cycle of underlying virtual infrastructure resources.

This technical white paper discusses the solution architecture of VMware Cloud Foundation for Cloud Providers, the high-level steps to deploy it, and integration options with VMware vCloud Director.
Introduction to VMware Cloud Foundation for Cloud Providers

VMware Cloud Foundation for Cloud Providers enables an integrated software stack that bundles compute virtualization (VMware vSphere), storage virtualization (VMware vSAN), and network virtualization (VMware NSX for vSphere and NSX-T) with intrinsic security into a single platform that can be deployed on premises as a private cloud or run as a service within a public cloud. Cloud Foundation runs on any server on the VMware Hardware Compatibility List that is compatible with the selected storage type.

VMware Cloud Foundation for Cloud Providers is available to VMware Cloud Provider Program (VCPP) partners in three editions:

- Basic
- Standard
- Enterprise

<table>
<thead>
<tr>
<th>VMware Cloud Foundation for Cloud Providers</th>
<th>BASIC</th>
<th>STD</th>
<th>ENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>SDDC Manager</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>HCX ADV</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>NSX DC ENT+</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSX DC ADV</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSX DC PRO</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VSAN ENT</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VSAN ADV</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>vSphere ENT+</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
The detailed capabilities enabled by each edition are as follows:

<table>
<thead>
<tr>
<th>Management</th>
<th>Basic</th>
<th>Standard</th>
<th>Enterprise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automated lifecycle management</td>
<td>SDDC Manager</td>
<td>SDDC Manager</td>
<td>SDDC Manager</td>
</tr>
<tr>
<td>NETWORK OPS - 3rd Party Firewall Visibility, VM-2-VM Path Analysis</td>
<td></td>
<td></td>
<td>vRNI ADV</td>
</tr>
<tr>
<td>NETWORK OPS - Flow Analysis, M-Seg Planning</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Networking</th>
<th>Basic</th>
<th>Standard</th>
<th>Enterprise</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCX Advanced (large scale workload migration)</td>
<td>HCX ADV</td>
<td>HCX ADV</td>
<td>HCX ADV</td>
</tr>
<tr>
<td>Context aware micro-segmentation (app ID)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multi-Site &amp; container networking and security</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSX Edge load balancing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Micro-segmentation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Integration with CMP/NSX Cloud</td>
<td>NSX DC PRO</td>
<td>NSX DC ADV</td>
<td>NSX DC ENT+</td>
</tr>
<tr>
<td>VPN (L2-L3)</td>
<td>vSAN ADV</td>
<td>vSAN ADV</td>
<td>vSAN ENT</td>
</tr>
<tr>
<td>Distributed switching, routing and firewalling</td>
<td>vSphere ENT+</td>
<td>vSphere ENT+</td>
<td>vSphere ENT+</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Storage</th>
<th>Basic</th>
<th>Standard</th>
<th>Enterprise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data-at-rest Encryption</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stretched Cluster with Local Failure Protection</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Erasure Coding (All Flash only)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deduplication &amp; Compression (All Flash only)</td>
<td>vSAN ADV</td>
<td>vSAN ADV</td>
<td>vSAN ENT</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Compute</th>
<th>Basic</th>
<th>Standard</th>
<th>Enterprise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distributed Resource Scheduler</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cross-VC vMotion, and Long Distance vMotion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Availability, and Fault Tolerance</td>
<td>vSphere ENT+</td>
<td>vSphere ENT+</td>
<td>vSphere ENT+</td>
</tr>
</tbody>
</table>

Summary of Options:
- VMware Cloud Foundation for Cloud Providers deploys VMware’s Software Defined Data Center (SDDC) stack of Compute, Storage, and Networking
- All editions include HCX ADV to enable hybrid cloud
- Deployment and lifecycle management of HCX and vRNI is not included
- Cloud management and automation (vRealize Suite) is not included
- Add-on or standalone SKUs are needed for additional products (for example, vCloud Director and vRealize products)
- Deploying VMware Cloud Foundation for Cloud Providers requires a qualification process and PSO engagement
VMware Cloud Foundation helps to break down the traditional administrative silos in data centers, merging compute, storage, and network provisioning with cloud management, to facilitate end-to-end support for application deployment. By automating both complex and mundane lifecycle management tasks, Cloud Foundation reduces the time to derive value from your software investments and to reconfigure these investments in response to new business needs. In addition, Cloud Foundation automation and validated system blueprints replace manually created deployments, which often differ, with standardized deployments that are easier to manage.

Cloud Foundation offers the following core features and benefits:

- **Automated initial server and software instantiation.** The Cloud Foundation Builder Appliance deploys a complete SDDC platform consisting of software and hardware in a fully automated way that requires only minimal user input. The Cloud Foundation Builder Appliance orchestrates the deployment and configuration of an SDDC platform that adheres to the blueprint set out by VMware Validated Designs and typically takes less than 3-hours to deploy.

- **Simplified resource provisioning.** Cloud Foundation creates and maintains logical pools of compute, storage, and network resources from the underlying physical hardware resources. These physical resources can be allocated and decommissioned dynamically “on the fly.”

- **Automated lifecycle management.** VMware Cloud Foundation automates the lifecycle management operations for the SDDC products it deploys. It provides fully automated patch and upgrade management, which includes installing only explicitly tested product-version combinations, downloading and marshalling of the updates, and orchestrating their application. VMware Cloud Foundation also automates password and machine SSL certificate replacements, which reduces the effort of periodically replacing these critical system resources and meeting corporate security policies.
• **Scalability and performance.** Cloud Foundation delivers a private cloud instance, which can easily be integrated into an existing network.

To manage the logical infrastructure in the private cloud, Cloud Foundation augments the VMware virtualization and management components with a new component, SDDC Manager. SDDC Manager automates the bring up, configuration, and provisioning of the entire SDDC stack. SDDC Manager also automates the lifecycle management of the stack. From this interface, the IT administrator can provision new private cloud resources, monitor changes to the logical infrastructure, and manage life cycle and other operational activities.

Cloud Foundation introduces a new abstraction – workload domain – for creating logical pools across compute, storage, and networking. A workload domain consists of one or more vSphere clusters, provisioned automatically by SDDC Manager.

There are two types of workload domains - the management domain and Virtual Infrastructure (VI) workload domains.

The management domain is created during the bring-up process. It contains the Cloud Foundation management components. This includes an instance of vCenter Server and required NSX for vSphere components (NSX Manager and three NSX Controller VMs) for the management domain. The management domain uses vSAN storage.

Cloud Foundation implements Virtual Infrastructure (VI) workload domains for user workloads.

**VMware Cloud Foundation and VMware vCloud Director**

VI domains are an ideal backing for the vCloud Director provider SDDCs. When setting up a domain, you can choose vSAN or NFS storage, and NSX for vSphere or NSX-T. A workload domain can consist of one or more vSphere clusters. Each cluster starts with a minimum of three hosts and can scale up to the vSphere maximum of 64 hosts. SDDC Manager automates creation of the workload domain and the underlying vSphere cluster(s).
Introduction to HCX

HCX is included with VMware Cloud Foundation for Cloud Providers to enable a hybrid cloud that connects an on-premises datacenter to the cloud provider.

- Abstraction layer between on premises and cloud providers
- L2 network extension to cloud
- WAN optimized, compressed, de-duped connectivity
- Secure, automated overlay over WAN or Internet.
- High performance - 5Gbps+ speeds
- Migrate VMs without configuration changes (IP, DNS, MAC)

HCX within VMware Cloud Foundation for Cloud Providers enables:

- App mobility between vSphere versions across on-premises and cloud providers.
- Best-in-class migration, VMware Cloud Motion with vSphere Replication, with zero downtime for large scale migration.
- Multisite, bi-directional, SD-WAN optimized, secure, traffic engineered, network extension with auto VPN creation.
Deploying HCX with VMware Cloud Foundation and vCloud Director

HCX with VMware vCloud Director is available to Cloud Providers that adhere to the following deployment considerations.

- HCX can support 1:1 site pairings between end-customer on-premises environments and end-customer Organization Virtual Datacenters.
- HCX can support a maximum site-pairing of 25 tenants per vCloud Director instance.
- HCX can support up to a maximum of 25 service mesh instances.
  - A service mesh is required for every Provider VDC.
HCX currently does not support the following vCloud Director features:

- NSX-V Distributed Routing (DLR) Backed Org VDC Edge Gateway
- NSX-T backed Provider VDCs
- Flex VDCs and Compute Profiles
- Central Point of Management (CPOM)

Note: Providers that exceed these deployment maximums or want to utilize currently unsupported vCloud Director features require a design partnership for additional HCX with vCloud Director support.

For the latest HCX deployment considerations, see the HCX product documentation at [https://docs.vmware.com/en/VMware-HCX/index.html](https://docs.vmware.com/en/VMware-HCX/index.html).
Introduction to VMware vCloud Director

VMware vCloud Director (vCD) is a platform for delivering cloud services that enables providers to operate and manage cloud-service businesses. Cloud Providers can easily create isolated and secure virtual data centers from a shared pool of resources and deploy additional services for use within these virtual data centers such as containers and application catalogs.

Using a policy-based approach, service providers can carve up the shared compute resources (VMware vSphere), storage resources (VMware vSAN and vSphere storage), and network resources (VMware NSX for vSphere and NSX-T) into virtual data centers for each organization.

Additional services can be deployed and managed by leveraging vCloud Director’s deep integration with leading automation tools (Terraform, PythonSDK, vRO). Multi-tenancy is maintained by isolating the data center services at all virtual layers.
This is extremely important for scalable, isolated architectures. Moreover, by using vCloud Director with NSX, a tenant can consume private IP segments that may overlap with other organizations.

VMware vCloud Director enables cloud providers to efficiently offer the VMware SDDC capabilities to their tenants while maintaining isolation between these tenants and managing them from a single pane of glass. It reduces operational costs by allowing service providers to share resources between tenants, easily repurpose available resources, and automate the tasks of allocating these compute, storage, and networking resources from instances of vSphere, vSAN, and NSX.
The following are some of the important additional features of vCloud Director:

- **VMware vSphere vApp™ catalog.** Tenants can create multi-VM configurations called vSphere vApps and store them as vApp templates in their own vApp catalog. This catalog is isolated from all catalogs of other tenants hosted on the same physical platform. The vApp templates are then used for repetitive deployment of vApps.

- **Automated Virtual Networking and Security Services.** Software-defined NSX networking and security services (such as overlay logical segments, distributed switching based on VXLAN, and distributed firewalls) and VMware NSX Edge™ services (such as routing, NAT, VPN, and load balancing) are consumed by vCloud Director — during vApp deployments, for example — in a fully automated way.

- **Self-service Web Portal.** End users of the tenants using the vCloud Director platform have direct access to their vApp catalogs and deployed vApps through a modern, self-service Web portal.

- **vCloud API.** Tenants and providers can consume vCloud Director services with a comprehensive REST-based API using XML or JSON. For example, providers can develop their own Web portal for consumption by their tenants.

- **Multisite Capabilities.** Multisite capabilities allow an organization user to log in to the vCloud Director UI hosted at any of the sites where they have an Organization and Organization VDC. Upon login, the UI displays distinct sites that allows the end user to seamlessly switch to other sites for manageability. All of this is done from a single login.

- **Central Point of Management (CPoM).** With vCloud Director 9.7 introduces new functionality that allows tenants to access dedicated private vCenters through vCloud Director. Cloud providers can now deliver vCenters with a branded cloud portal experience, without the need to set up VPNs. vCloud Director acts as proxy to API calls to the vCenters.
vCloud Director is built on four (4) resource abstractions: resource groups, resource pools, provider virtual datacenters, and organization virtual datacenters, which are illustrated in the diagram below.

Starting at bottom, the base layers compose a resource group consisting of a vCenter Server and NSX Manager pair along with managed ESXi hosts and associated storage. Each resource group makes available one or more resource pools, which are the capacity vCloud Director divvies up to end users. Typically, each resource pool is a vCenter Server cluster, the storage attached to the cluster, and provisioned virtual networking.
Moving up the stack, provider virtual datacenters (pVDC) are the abstraction that vCloud Director uses to manage the resource groups and allocate the resource pools to tenants. A provider virtual datacenter is configured with the resource pools of a single resource group. While each resource pool can be used exclusively by one provider virtual datacenter, a single resource group can supply resource pools to multiple provider virtual datacenters.

The next resource layer provides the resources consumed by the end users. Users are grouped into organizations. An organization is the unit of multitenancy that represents a single logical security boundary. Each organization is presented with virtual datacenters and services.

**NOTE:** In vCloud Director architectural discussions, the terms “tenant” and “organization” are used interchangeably. The vCloud Director UI uses the term “Organization”.

Within an organization, one or more organization virtual data centers are configured. Each one carves out resources from exactly one provider virtual data center. Multiple organization virtual data centers can carve out resources from a single provider virtual data center. But, in contrast, a single organization virtual data center cannot carve out resources from multiple provider virtual data centers.
Solution Architecture – vCloud Director with Cloud Foundation

Designing and implementing a vCloud Director environment has traditionally been a time-consuming and potentially challenging task. Although VMware Cloud Foundation itself does not eliminate these design and implementation challenges, it dramatically reduces the level of effort required to deploy, scale, and maintain the underlying SDDC platform stack. VMware Cloud Foundation can fully automate the deployment of vSphere, vCenter, NSX-V and NSX-T, and vSAN, all of which can serve as the foundational platform for vCloud Director. Additionally, VMware Cloud Foundation orchestrates patch and upgrade management of these underlying SDDC software components in a fully automated way. The diagram below provides a high-level view of all the typical components of vCD and VCF.

To understand a comprehensive Solution Architecture, let’s start with a simple scenario. The diagram below depicts a single tenant utilizing multiple Cloud Foundation workload domains. Each workload domain and subsequent resource pool and cluster is mapped to a Provider Virtual Datacenter (pVDC). While both have ESXi and vSAN for storage, they differ in NSX backing types with one being NSX-T and the other NSX-V. Since vSAN is used for storage, the solution administrator can further customize the storage offerings by utilizing different vSAN policies. This
means the same storage backing can deliver different services to different tenants even in the same cluster.

Here we also introduce some of the upstream management components and automation from Cloud Foundation. The entire SDDC stack can be instrumented upon instantiation by being configured automatically to send logs to the pre-configured vRealize Log Insight cluster running in the management domain of Cloud Foundation. Additionally, vRealize Operations can be deployed to provide operations management across the solution. Finally, Cloud Foundation simplifies and automates patching and upgrading of the full SDDC stack with workload domain-level lifecycle management.

The diagram below depicts a single tenant utilizing a single Cloud Foundation workload domain. However, there are two very important characteristics of this workload domain. First, there are multiple clusters and secondly it is backed by NSX-T.
You’ll notice that this workload domain is also a PKS workload domain. VMware PKS is a container services solution to put Kubernetes in operation for multi-cloud enterprises and service providers. PKS simplifies the deployment and management of Kubernetes clusters with Day 1 and Day 2 operations support. PKS manages container deployment from the application layer all the way to the infrastructure layer according to the requirements for production-grade software.

PKS supports high availability, autoscaling, health-checks, self-repairing of underlying virtual machines, and rolling upgrades for the Kubernetes clusters. VMware Cloud Foundation automates the installation of the PKS control plane, which makes it incredibly easy to deploy and manage VMware Enterprise PKS. Lastly, you can see that there is an “SDDC” box on top of the K8 Cluster vCenter, which is attached to the SDDC Proxy box. While this isn’t a true Provider VDC it spans both Provider VDC and Org VDC placement. vCloud Director can act as an HTTP proxy server between tenants and the underlying vSphere environment in VMware Cloud Foundation.
A vCloud Director “Software-Defined Data Center (SDDC)” encapsulates the infrastructure of an attached vCenter Server instance. You can dedicate the resources of a vCenter Server instance to a single tenant by publishing the corresponding SDDC only to its organization. The tenant does not share these resources with other tenants. An SDDC proxy is an access point to a component from an SDDC, for example, a vCenter Server instance, an ESXi host, or an NSX Manager instance.

The following diagram depicts a single tenant utilizing a single Cloud Foundation workload domain. The workload domain is an NSX-V backed domain and would be representative of the majority of vCloud Director deployments today. Each cluster has a single resource pool, mapped in turn to a discrete Provider VDC to separate production and development resources.
Finally, let’s put it all together. In the following diagram, we can see that different tenants (organizations) are sharing resources from a single pVDC – this is abstracted at the organization virtual datacenter layer (oVDC). We can also see that resources from a single vCenter can be split across different provider virtual datacenters.
VMWARE VCLOUD DIRECTOR WITH CLOUD FOUNDATION FOR CLOUD PROVIDERS
Lifecycle Management

Currently, the life cycle of the VMware Cloud Foundation and vCloud Director are carried out independently while adhering to VMware’s Interoperability Matrix.

VMware Cloud Foundation

SDDC Manager automates upgrade and patch management for the SDDC software stack. VMware provides update bundles for the SDDC stack, ensuring compatibility of all patches with installed components in your Cloud Foundation environment. You can apply an update to the management domain or VI workload domains independent of the other workload domains. This makes the process non-disruptive to tenant VMs.

vCloud Director

There are two components from a lifecycle management perspective with vCD upgrades: cell state and database schema. During an upgrade, there is not a modification to the existing relationships between servers, the database, and vSphere.

Follow the steps outlined in the product documentation to upgrade vCloud Director.
Deploy VMware Cloud Foundation

The document is to provide high level steps to deploy Cloud Foundation as a pre-requisite before you look at deploying VMware vCloud Director. The [VMware Cloud Foundation Planning and Preparation Guide](#) provides detailed information about the software, tools, and external services that are required prior to using VMware Cloud Foundation to implement a Software-Defined Data Center (SDDC). Review this document prior to the start of the deployment in order to provide enough time to realize all the requirements.

VMware Cloud Foundation can be deployed in one of two different architecture models - Standard or Consolidated.

- In the standard architecture model, the SDDC management workloads are separated from the tenant workloads by using multiple workload domains.
- In the consolidated architecture model, only one workload domain containing both the management and tenant workloads is created and resource pools are used to isolate workloads.

Although this document focuses on the [standard architecture model](#), the requirements provided are applicable to vCloud Director use case. This topic provides general guidance on the minimum requirements for a management domain and a virtual infrastructure workload domain(s) in a Cloud Foundation system.

In this paper, we will discuss the approach of using VCF to deploy the management domain for vCD. Once instantiated, the provider will deploy vCloud Director (manually) along with any necessary dependencies on the newly created management cluster. This can be achieved by using the appliance or Linux platform option, which we will review in a later section.

**Management Domain**

In the standard architecture deployment model, the infrastructure workloads contained within the management domain are kept isolated from tenant workloads through the creation of additional workload domains. In the consolidated architecture model, both infrastructure and tenant workloads are contained within the management domain.
Virtual Infrastructure Workload Domains

A virtual infrastructure (VI) workload domain is used in the standard architecture deployment model to contain the tenant workloads. A VI workload domain consists of a minimum of one cluster consisting of three or more servers. Additional clusters can be added to a VI workload domain as required. A Cloud Foundation solution can include a maximum of 15 workload domains, in accordance with vCenter maximums.

Key Steps to Deploy VMware Cloud Foundation

1. Deploy Cloud Builder VM
2. Install ESXi software on Cloud Foundation servers
3. Download and complete the deployment parameter sheet
4. Initiate the Cloud Foundation bring-up process

Based on the design described in this white paper, we will pre-populate VI workload domains to be used as an endpoint for vCloud Director, or a pVDC object.
Pros

- Easy and straightforward – The Cloud Foundation management domain already exists in a Cloud Foundation installation.
- Minimal planning required – The management cluster already exists as a mandatory component of Cloud Foundation.
- Starting in Cloud Foundation 3.0, VSAN Stretched Cluster is available for the management domain and the workload domain. Both the management domain and the workload domain can reside in two datacenters. If you need disaster resiliency for your vCloud Director deployment, you can use VSAN Stretched Cluster to provide a higher level of availability.
- Better resource efficiency – The Cloud Foundation management domain starts with 3 or more hosts and it is usually bigger than the resource required for Cloud Foundation management instances.
- Placing vCloud Director Management Cluster will consume the surplus resource of the Cloud Foundation Management Workload and brings better resource efficiency.
- One can utilize the new vCloud Director appliance form factor – this simplifies the deployment and operational state of vCD.

Cons

- Limited architectural flexibility regarding Platform Services Controller high availability – Cloud Foundation currently does not offer a load balancer option for this. If a vCloud Director instance integrates into a vCenter Single Sign-On or Platform Services Controller instance, a dedicated registration to one of the two Cloud Foundation Platform Services Controller instances is required with no automated failover.
- This approach requires thought into designing and deploying vCloud Director, even if using the appliance, to ensure the provider is adhering to the VMware Validated Design for Cloud Providers. The provider will need to ensure an NFS share, AMQP broker, and other necessary items are accounted for to achieve a successful deployment.
Once the required workload domains are ready, the following instructions will help you deploy VMware vCloud Director in the VMware Cloud Foundation management domain and then configure or create various pVDC or oVDCs to achieve multi-tenancy.
Deploy vCloud Director

There are two options for deploying vCD:

1. Standalone deployment on a supported Linux platform. The provider will be responsible with selecting a supported database instance, along with necessary dependencies.
2. vCD appliance. With version 9.7, this includes PostgreSQL as the embedded database along with availability capabilities.

For additional deployment steps, see the vCloud Director Installation, Configuration, and Upgrade Guide.

Deploying vCloud Director

Prepare your environment.

- The vCloud Director Database
  - The vCloud Director cells use a database to store shared information. You must install and configure the vCloud Director database before you create the vCloud Director server group. Regardless of the database software you decide to use, you must create a separate, dedicated database schema for vCloud Director to use. vCloud Director cannot share a database schema with any other VMware product.

- Transfer Server Storage
  - To provide temporary storage for uploads, downloads, and catalog items that are published or subscribed externally, you must make an NFS or other shared storage volume accessible to all servers in a vCloud Director server group.
  - The vCloud Director appliance supports only NFS type of shared storage. See http://kb.vmware.com/kb/2086127.

- RabbitMQ AMQP Broker
  - vCloud Director uses the RabbitMQ AMQP broker to provide the message bus used by extension services, object extensions, and notifications.

- SSL Certificates
• vCloud Director uses SSL to secure communications between clients and servers.

• VMware Public Key
  • The installation file is digitally signed. To verify the signature, you must download and install the VMware public key.

• VMware Cloud Foundation VI (NSX-V or NSX-T) workload domain
  • vCloud Director creates VXLAN network pools to provide network resources to Provider VDCs. If VXLAN support is not configured in the associated NSX Manager, Provider VDCs show a network pool error, and you must create a different type of network pool and associate it with the Provider VDC.

• NSX Data Center for vCloud Director configuration steps
  • After you install vCloud Director, you can register the NSX Manager instance with your cloud along with correlating it to a specific vCenter instance (if applicable).

Deploy the vCloud Director Appliance

You can create a vCloud Director server group by deploying one or more instances of the vCloud Director appliance. Deploy the vCloud Director appliance as an OVF template by using the vSphere Web Client (Flex). VMware Cloud Foundation will provide compute/storage and networking as required for the vCloud Director environment in the form of workload domains.

Prerequisites

• Verify that you have access to the vCloud Director .ova file.
• Install and configure the target vCloud Director database.
• Prepare an NFS shared transfer service storage.
• Install and configure a RabbitMQ AMQP broker.

After you create the vCloud Director server group, you can perform following steps:

• Perform additional SSL configurations on the PostgreSQL database
• Customize public endpoints
• Install Microsoft sysprep files on the servers
• Install and configure a Cassandra database for storing historic metric data
• Update DNS settings of the vCloud Director appliance

For additional deployment steps, please follow the vCloud Director Installation, Configuration, and Upgrade Guide.
VMware Cloud Provider Pod and Cloud Foundation Interoperability

VMware Cloud Provider Pod is the fastest way for a cloud provider to build a multi-tenant cloud architecture. Cloud Provider Pod deploys an instance of vCloud Director and additional products in the cloud provider’s datacenter.

The deployed products include the latest versions of the core Cloud Provider Platform that align to the VMware Validated Design for Cloud Providers. The solutions that are included are: vCloud Director, vSphere, NSX, and Usage Meter. Optionally, a provider can also deploy vSAN, vRealize Operations, and other components using Cloud Provider Pod.

As of today, Cloud Provider Pod acts independently of Cloud Foundation as a deployment solution. Previously, we discussed an option that utilizes VCF to deploy the necessary management domain (please see Key Steps to Deploy VMware Cloud Foundation section).

If the cloud provider wants to consume Cloud Foundation with vCloud Director, VMware recommends deploying using Cloud Foundation as outlined in section Deploy VMware Cloud Foundation. While this is a recommendation based on testing as of today, our goal is to have both solutions complement one another in the near future.

Looking to the future, one can think of these two distinct automation layers as the following:

1. Cloud Provider Pod is responsible for the Cloud Management Platform stack which is multi-tenant.
2. Cloud Foundation is responsible for the underlining payload/resource environments that will be exposed as Provider VDC’s to vCloud Director.

VMware will update this white paper when there are further capabilities between Cloud Provider Pod and Cloud Foundation.
Conclusion

Tests internally conducted at VMware have clearly demonstrated the technical feasibility of implementing a pairing of VMware vCloud Director with VMware Cloud Foundation. This technical white paper describes the benefits to a cloud provider, along with providing manual guidance on available architectural options.

With its unique capabilities to provide automated Software-Defined Data Center (SDDC) hardware and software, instantiation services, and automated lifecycle management, Cloud Foundation is an excellent choice for cloud providers who are using vCloud Director and want a way to quickly and efficiently spin up SDDC resources ready for consumption with vCloud Director.

Customers and cloud providers can avoid going through iterative, time-consuming design and architecture cycles to deploy and maintain an SDDC stack consisting of VMware vSphere, VMware vSAN, and VMware NSX. Cloud Foundation “consumption-ready” units of SDDC deploy resources in an automated, repeatable, and quality-assured manner.

Cloud providers can face the requirement of hosting VMware vCloud Director-managed resources onsite at their customers’ datacenters for data security and compliance reasons. Cloud Foundation enables them to achieve efficient integration into these data centers because it is a fully self-contained configuration that provides clear and easy interfaces with an existing data center, greatly simplifying deployment and reducing overall complexity.

In closing, this white paper is part of the initial collateral that provides guidance on how VMware vCloud Director and the VMware Cloud Provider Platform can be in harmony with VMware Cloud Foundation. We believe that there is significant value for cloud providers and consumers of a VMware Cloud Platform.
References

VMware Cloud Foundation

- VMware Cloud Foundation - Product Overview
- VMware Cloud Foundation Documentation
- Walkthrough Videos on YouTube

VMware Cloud Providers

- VMware vCloud Director - Product Overview
- VMware Validated Design for Cloud Providers
- VMware vCloud Architecture Toolkit for Service Providers Documentation Center
- VMware Cloud Provider Pod - Product Overview
- VMware HCX - Product Overview
- VMware Cloud Verified - Overview
- VMware Cloud Verified - Application

Acknowledgments

Executive Sponsors: Wade Holmes, Krish Sivakumar, and Arif Altalib
Architects: Steve Dockar, Tomas Fojta, Ben Sier, Josh Townsend, Keith Farkas, and Girish Manmadkar
Field Architects: Yuichi Yoshiara, Alex Tanner, Greg Kaffenberger, and Daniel Paluszek
Product Management: Simon Genzer and Ranjit Sawant
Product Marketing: Luis Ayuso and Nimish Vora