VMware vCloud® Architecture Toolkit™ for Service Providers

Dedicated Hosted Cloud with vCloud Director®

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Introduction

As customers research Cloud Providers for hosted infrastructure, some of these customers require dedicated infrastructure for their workloads. Whether customers are looking for additional separation for security or more predictable performance of hosted workloads, Cloud Providers need the tools that provide dedicated hardware services for customers while reducing their operational overhead.

In some scenarios, Cloud Providers will implement managed vSphere® environments for customers to satisfy this type of request and then manage the individual vSphere environments manually or with custom automation and orchestration tools. However, in some cases, it is also possible to leverage vCloud Director® to provide dedicated hardware per customer while also providing a central management platform for Cloud Providers to manage multiple customers.

This document explores the ways in which VMware Cloud Providers leverage vCloud Director out-of-the-box functionality to accomplish dedicated hosted cloud environments for customers.
1.1 Acronyms and Abbreviations

Table 1. Acronyms, Abbreviations, and Full Term

<table>
<thead>
<tr>
<th>Term</th>
<th>Full term</th>
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<tbody>
<tr>
<td>AMQP</td>
<td>Advanced Message Queuing Protocol</td>
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<tr>
<td>API</td>
<td>Application Programming Interface</td>
</tr>
<tr>
<td>CMP</td>
<td>Cloud Management Platform™</td>
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<tr>
<td>DN</td>
<td>Distinguished Name</td>
</tr>
<tr>
<td>DNS</td>
<td>Domain Name Service</td>
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<tr>
<td>FQDN</td>
<td>Fully Qualified Domain Name</td>
</tr>
<tr>
<td>HTTP</td>
<td>Hypertext Transfer Protocol</td>
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<tr>
<td>HTTPS</td>
<td>Hypertext Transfer Protocol Secure</td>
</tr>
<tr>
<td>Org</td>
<td>Organization</td>
</tr>
<tr>
<td>OrgVDC</td>
<td>Organization Virtual Data Center</td>
</tr>
<tr>
<td>PVDC</td>
<td>Provider Virtual Data Center</td>
</tr>
<tr>
<td>REST</td>
<td>Representational State Transfer</td>
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<tr>
<td>SDDC</td>
<td>Software-Defined Data Center</td>
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<tr>
<td>UI</td>
<td>User Interface</td>
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<tr>
<td>URL</td>
<td>Uniform Resource Locator</td>
</tr>
<tr>
<td>vApp</td>
<td>VMware vCloud Director® VM Container™</td>
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<tr>
<td>VM</td>
<td>Virtual Machine</td>
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Overview

In some VMware based cloud environments, Cloud Providers responds to their customer needs for hosted virtualized infrastructure. Cloud Providers deliver these environments with managed services and provide self-service features so that customers can perform day-to-day tasks without the need to open service tickets. To provide this type of service to customers, Cloud Providers often deploy dedicated VMware vCenter® “pods” to each customer. This solution allows for isolation from a hardware and management layer and enables interactions by the customer with a familiar GUI. Using dedicated vSphere for dedicated hosted infrastructure comes additional management points for each customer that is onboarded using this model.

Cloud Providers typically accommodate these demands using the built-in functions of the vSphere® Web Client combined with network controls at the physical layer, allowing the customer the necessary access to management functions and isolation of customer or customer workloads. Cloud Providers also create custom backend and CMP tools to manage these environments. The CMP tools have a management and maintenance overhead as well.

Figure 1. Dedicated Hosted Cloud with vSphere

The benefits from this approach include:

- Leverage of vSphere GUI and API functions that the Cloud Provider and their customer are familiar with
- Clear isolation of management between customer workloads
- Implicit hardware (compute and memory) isolation

Another approach to this use case is to leverage VMware vCloud Director for dedicated hosted clouds. In this solution, Cloud Providers and their customers use vCloud Director for management and consumption of dedicated cloud resources.

Each customer’s cloud resources map to a cluster on dedicated, isolated hardware that one or more common vCenter Server® products manage. Customers access their dedicated cloud resources through a secure, isolated portal that vCloud Director provides.

Using this method for dedicated hosted cloud allows for more streamlined management of customer accounts and workloads and allows for greater economies of scale. Cloud Providers have fewer points of management and provide the dedicated hardware and isolation that customers require in a hosted environment.
Conceptual Design

Conceptually, a dedicated hosted cloud will provide access via a shared portal, with each customer only being able to see their respective dedicated resources and workloads. Shared external networks can be provided for Internet connectivity for workloads, while providing connectivity for external users, applications and remote access via virtual private network (VPN) (L2VPN (Layer 2 VPN), Internet Protocol Security (IPSEC) VPN, or Security Socket Layer (SSL) VPN).

At the next level, each customer is provided with a dedicated space that can be further subdivided by business units or project-based teams within the customer’s actual organizational structure. Customers can create networking constructs to segment workloads and provide their own security configurations between workloads and the respective groupings within the cloud.

At the hardware level, each customer has dedicated hardware resources with physical separation at the compute, networking and storage layer.

The following diagram shows a conceptual overview of this model.

**Figure 2. Dedicated Hosted Cloud Conceptual Design**
2.1 Site Design

The high-level site design for a dedicated hosted cloud offering can exist in single site and multi-site topologies. This section describes some considerations between the two deployment topologies.

2.1.1 Single Site Topology

A single site topology is a suitable configuration option in a dedicated hosted cloud scenario in which Cloud Providers position secondary facilities for customers to host workloads. In this topology, customers can leverage the dedicated hardware in the Cloud Providers’ data center to operate development, test or production workloads. Customers can also leverage the dedicated resources as Disaster Recovery as a Service (DRaaS) endpoints to recover workload in the case of a site failure at the on-premises location. With the use of vCloud® Availability for vCloud Director, Cloud Providers can give customers the option to manage self-service disaster recovery of workloads between on-premises data centers and the dedicated hosted cloud.

Figure 3. Single Site Diagram

2.1.2 Multi-Site Topology

In use cases where Cloud Providers plan to provide cloud resources across regions, the cloud infrastructure can be configured across two sites that are ideally separated by the distance required to meet customer Service Level Agreements. Separate instances or installations of the cloud management portal (in this case vCloud Director) are deployed at each site. Customers have the option of accessing their dedicated infrastructure at each location through the vCloud Director Multi-site portal feature, a third-party ISV portal, or a custom portal.
Figure 4. Multi-Site Diagram

Architecting vCloud Director in a multi-site topology provides Cloud Providers with a foundation to offer their customers further value-added services.
Logical Design

Observing the logical details of this use case, customers consume the same vCloud Director portal that Cloud Providers maintain. vCloud Director provides the necessary isolation of customers using a logical tenancy construct called an “Organization”. Each customer Organization can subdivide the consumption of dedicated cloud resources to provide separation between different groups or business units using OrgVDCs.

Reviewing the vSphere layer, compute and storage are isolated, providing each customer with dedicated resources.

Network separation is provided from a logical perspective using NSX® logical networks (VXLANs). This approach can configure new networks individually within each customer as needed without the intervention by the Cloud Provider administrators.

Storage isolation can be provided by using vSAN™ as part of a Hyper-Converged Infrastructure, or by using traditional access methods such as Fiber Channel (FC), Internet Small Computer System Interface (iSCSI) or Network File System (NFS) protocols. These protocols have dedicated storage devices or logical separation of datastores based on Logical Unit Number (LUN) masking. With the compute clusters, each customer’s cluster is presented with one or more dedicated datastores based on the agreed capacity.

From a cloud component standpoint, the cloud management layer consists of one vCloud Director instance paired with one or more resource groups. A resource group is a logical grouping of a vCenter Server – NSX Manager™ pair and associated vSphere clusters. An initial deployment for a dedicated hosted cloud typically consists of one resource group with additional resource group clusters as customers are onboarded.

Figure 5. Dedicated Cloud Logical Diagram
2.2 vCloud Director Component Design

From a cloud management platform standpoint, all cloud management components reside in a dedicated management cluster for separation from customer workloads. The key components for a vCloud Director deployment include:

- **vCloud Director Cells** – CentOS or Red Hat Enterprise Linux based servers with the vCloud Director software installed. For increased availability and performance, two or more vCloud Director cells can be configured with a load balancer.

- **vCloud Director Database** – The database associated with the vCloud Director instance. vCloud Director version 9.1 supports PostgreSQL, Microsoft SQL Server® and Oracle®. Note: vCloud Director version 9.1 is the last release to support the Oracle database.

- **Platform Services Controller** – Provides Single Sign-On (SSO) functions for VMware components.

- **Management vCenter Server** – The vCenter Server that is designated for the cloud management components.

- **Resource Group vCenter Server** – The vCenter Server that is designated for resource (customer) workloads.

- **NSX Manager** – The management plane for VMware NSX. Is used for management of NSX® Edge™ components and creation of logical networks used with customer workloads.

- **RabbitMQ** – Messaging service (AMQP) used for extensibility options with vCloud Director and other external services such as vRealize® Orchestrator™.

- **Cassandra™ Database** – Optional database used to store historical metrics data for workloads in vCloud Director.

- **vRealize Orchestrator** – Workflow orchestration component used for extensibility and orchestration of common tasks and services.

The configuration of the vCloud Director components follows the recommendations in the "Architecting a VMware vCloud Director Solution" whitepaper.

2.3 Allocation Model

vCloud Director provides three allocation models:

- **Pay as You Go (PAYG) Model** – Commitment of resources only when users create workloads within the organization virtual data center.

- **Allocation Pool Allocation Model** – A percentage of the resources that have been allocated from the Provider Virtual Datacenter is committed to the Organization Virtual Datacenter.

- **Reservation Pool Allocation Model** – Full commitment and management of allocated resources are provided to the OrgVDC.

For the purposes of this use case, the most suitable allocation models are the Reservation Pool Allocation Model and the Pay as You Go Allocation Model. Both models can provide dedicated compute and storage resources for each customer and provide centralized management of customer organizations, catalogs and related components.

Of these three allocation models, the Reservation Pool Allocation Model and the Pay as You Go Model are the most suitable for use with Dedicated Hosted Cloud with vCloud Director. The Reservation Pool Allocation Model can be used when Cloud Providers maintain a fixed host count per customer with little expectations of scaling out the cluster after initial onboarding. The Pay as You Go Model is best used to reduce Cloud Providers’ overhead when customers are expected to request manual scale-out and scale-in of compute resources (ESXi™ hosts) in the cluster.
vSphere Logical Design

The vSphere infrastructure supports a dedicated private cloud and its design is a key factor of providing the necessary isolation for the overall solution. vCenter resource groups are the key management point for virtual workloads in the dedicated private cloud, and the associated vSphere clusters represent the tenancy boundary from a hardware standpoint. Each vSphere cluster is dedicated to a customer and is mapped to a single PVDC in vCloud Director. These PVDCs are consumed by OrgVDCs of a single organization. In a dedicated service offering, there is no sharing of the PVDCs between OrgVDCs in separate organizations.

Because of the mapping of one cluster per PVDC to one OrgVDC, if a customer requires multiple tiers of compute, it is necessary to provide this tiering via a separate cluster mapped to additional PVDC and OrgVDC. Initial cluster host sizing depends on the customer’s compute requirements. It is beneficial to standardize cluster sizing across customers for better manageability.

This use case also supports a design in which one customer requires dedicated resources for different business units within the organization.

2.4 Resource Group Design

A resource group consists of a vCenter Server paired with an NSX Manager for the purpose of managing customer workloads in a dedicated private cloud.

vSphere resource group clusters are configured for management by the vCenter Server and vCloud Director resource groups. Cluster size can vary with customer workload requirements.

Storage options have an impact on cluster sizing as well. If Cloud Providers leverage traditional storage solutions, VMware recommends using a minimum of two to three hosts per cluster based on workload requirements and maintaining a minimum redundancy of N+1. If Cloud Providers consider vSAN as the underlying storage for the solution and a minimum of three hosts in a cluster is supported, however, VMware recommends four hosts. For manageability of the solution, VMware recommends Cloud Providers standardizing minimum host size of clusters.
Networking Logical Architecture

2.5 NSX Design

Each resource group that vCenter deploys for use with vCloud Director requires the following items:

- An associated NSX Manager
- NSX Controllers™ that will be deployed into a Shared cluster or a dedicated Edge Cluster within the Resource Group

A shared cluster can be used for NSX controllers and Edge Gateways. NSX controllers facilitate logical switch and DLR management. Edge Gateways are deployed per customer and provide North-South access from the OrgVDC for Internet and WAN traffic. The Shared Cluster can also be leveraged by the Cloud Provider for other functions such as testing or cloud operation workloads as well as the location of Public Catalogs for consumption by customers. If Cloud Providers use a shared cluster, resource pools must be implemented, one for the NSX Controllers and a second or more for backing the Provider VDC that the Cloud Provider organization consumes in vCloud Director. It is important to configure Anti-affinity rules for NSX Controllers to ensure that controllers run on separate hosts in the cluster.

2.5.1 NSX Controllers

As mentioned in the preceding section, NSX Controllers must be deployed in the cluster that the respective resource group vCenter and NSX Manager manage. As the vCloud Director resource groups are scaled out, additional vCenter-NSX manager pairs are required. More NSX Controllers (and therefore an additional dedicated Cluster for the NSX controllers and Edge Gateways) are required.

One way to minimize the need for additional NSX Controllers is to configure all resource group vCenter-NSX pairs under one management domain and to use a universal NSX Controller cluster. This reduces the need for an additional cluster or resources from clusters when new resource groups are added to the environment.

Note: vCloud Director does not support universal NSX objects in this release.

Although this way reduces the need for additional resources during normal operation, in the case of a failure of the Primary NSX Manager and NSX Controller Cluster, Cloud Providers need to make a recovery plan for the promotion of a secondary NSX Manager to Primary and the deployment of new NSX Controllers with the new Primary NSX Manager in one of the remaining resource groups.
Storage Logical Design

Although service levels of compute performance are fixed in this model, Cloud Providers can present different storage tiers to customers via Storage Profiles based on the storage policies that Cloud Providers configure in the underlying vCenter Server.

2.6 Traditional Storage

When Cloud Providers plan the storage type for a Dedicated Hosted Cloud solution, the use of traditional storage solutions in this model is a viable option. The benefits of this are the ability for the Cloud Provider to leverage existing storage platform investments. Although iSCSI, FC, or NFS can be used, NFS is preferable for the flexibility in managing growing storage needs. For the presentation of different storage tiers to consumers in the dedicated cloud environment, Cloud Providers create the necessary storage profiles in vSphere. These storage profiles can then be assigned in vCloud Director for consumption.

2.7 vSAN

vSAN is another option for dedicated cloud. By using vSAN, Cloud Providers can provide storage with compute capacity that is dedicated to each customer. This extends complete hardware isolation down to the storage as well. vSAN can also be used in the management clusters. When planning to use vSAN for the management cluster, Cloud Providers provide an appropriate external storage target for backup and recovery of the data stored on the vSAN cluster. For more information about Cloud Provider use cases, see the whitepapers: Architecting VMware VSAN 6.2 for VMware Cloud Providers and Leveraging VMware vSAN for Highly Available Management Clusters.
Sizing Considerations

When Cloud Providers plan for the scalability of this use case, it is important to consider the additional components or objects that the solution includes.

The first step is to review the respective configuration maximum guides of the vCloud Director, vSphere and NSX products. Although these documents reference maximum configurations for different components and features, it is important to remember that all maximums in one product or feature may limit the maximums in another product or feature.

For example, vCloud Director version 9.1 supports the cluster maximums that vSphere supports. However, NSX supports a maximum of 64 clusters per NSX Manager (that is paired to a vCenter). Each cluster essentially corresponds to one customer in the Dedicated Hosted Cloud environment. With this NSX maximum in mind, if a Cloud Provider looks to support more than 64 customers on their Dedicated Hosted Cloud platform with vCloud Director, the provider needs to deploy an additional resource group (vCenter–NSX Manager pair) to support more customers under one vCloud Director instance.

The key point is to make sure that the necessary configuration maximums are evaluated for all key components to determine the scalability impacts on the deployment. For more information about configuration maximums, see VMware vCloud Director Configuration Maximums, VMware vSphere Configurations Maximums and VMware NSX Configuration Maximum guides.
Conclusion

VMware Cloud Providers can leverage vCloud Director as a platform to provide physically dedicated compute and storage IaaS offering to customers. By using vCloud Director as the Cloud Management Platform, Cloud Providers have a solution that allows centralized management of resources and catalog offerings while maintaining physically isolated compute storage resources. vCloud Director can be used as the service portal for customers and the Cloud Provider while laying the foundation for additional services such as migration, DRaaS, and monitoring to name a few.
## References

This section provides additional information pertinent to this document and its topics.

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