Horizon on VMware Cloud on Dell EMC Architecture
Reference Architecture
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Executive summary
VMware Horizon® on VMware Cloud™ on Dell EMC delivers a seamlessly integrated hybrid cloud for virtual desktops and applications. It combines the enterprise capabilities of the VMware Software-Defined Data Center (SDDC) on Dell EMC with the market-leading capabilities of VMware Horizon for a simple, secure, and scalable solution. This solution allows customers to quickly deploy and support virtual desktop infrastructure (VDI) in core data center, edge, and co-location contexts. It provides a prescriptive and stable digital foundation for VDI that simplifies scalability, alleviating IT administrators of significant infrastructure management burden.

For customers who are already familiar with Horizon or have Horizon environments on-premises, deploying Horizon on VMware Cloud on Dell EMC lets you leverage a unified architecture and familiar tools. This means that you use the same expertise you know from VMware vSphere® and Horizon for operational consistency and leverage the same rich feature set and flexibility you expect. By outsourcing the management of the SDDC to VMware, you can simplify operation of Horizon deployments.

The purpose of this guide is to provide VDI administrators and architects with a set of steps and best practices on how to deploy Horizon on VMware Cloud on Dell EMC. This guide is designed to be used in conjunction with Horizon documentation, VMware Workspace ONE and Horizon Reference Architecture guide, and VMware Cloud on Dell EMC documentation.

Overview
You can deploy Horizon on VMware Cloud on Dell EMC to scale Horizon desktops and applications with the simplicity and agility of the public cloud and the security and control of on-premises infrastructure delivered as a service to data center and edge locations. It is built upon on the latest VMware software defined data center suite, including industry-leading compute, storage, and network virtualization that is optimized for Dell EMC VxRail hyperconverged infrastructure. It’s quick and easy to procure and delivers a cloud-style consumption model for a range of use cases.

VMware provides fully automated lifecycle management and monitors the health of the entire SDDC stack around the clock. The combined software, hardware, and services offering enables customers to focus technology resources on initiatives that differentiate the business, instead of spending time on infrastructure management.

Audience
This white paper is intended for all the architects, engineers, consultants and IT administrators who are responsible for designing, implementing and operating Virtual Desktop Environment on VMware Cloud on Dell EMC.

Business case
Providing data and applications to users anywhere and on any device has become essential to keeping businesses, education, and healthcare running. As a result, we have seen tremendous customer demand for virtual desktop infrastructure (VDI) solutions. Successfully deploying and managing VDI depends on several fundamental requirements:

• Modernizing the underlying infrastructure
• Extending data center capacity
• Limiting the need for staff to work in the office or travel to remote locations
• Centralizing desktop management
• Rapidly provisioning and deploying desktops to both employees and contract workers

VMware Cloud on Dell EMC provides modern infrastructure that easily expands on-premises data center capacity. It does this quickly with minimal need for on-site customer contact. VMware Horizon provides a centralized single-pane-of-glass for deploying and managing virtual desktops to quickly get workers productive without entering the physical workplace.

Key benefits
• Deliver cloud-like experience for Horizon desktop/app platform on-premises
• Onboard and support remote workers quickly and easily
• High performance for workspace density and optimized user experience
• Unify virtual desktop environment management through a single, centralized entitlement layer
• Delivers enterprise-class security and compliance with organizational requirements
Customer examples and use cases
VMware Cloud on Dell EMC and VMware Horizon form a joint offering that is applicable to both data center and edge locations. While not an exhaustive list, some of the most common use cases this solution addresses are:

Retail customers have distributed and often remote infrastructure locations. These locations are business critical but operate under tight margins. This presents a challenge for IT teams to install and support VDI at retail or branch locations while minimizing operational costs. The solution in this paper provides retailers with a way to deploy modern infrastructure for VDI while minimizing the need for IT staff to perform on-site deployments and ongoing maintenance. The result is a reduction in operational overhead which gives the customer a competitive edge.

Manufacturing customers have factory sites that are often located far from administrative offices to take advantage of less expensive real estate or for logistical reasons. Factory workers need access to both local and corporate applications using a wide range of endpoint devices. This solution keeps business-critical production infrastructure performing while also managing remote virtual desktop infrastructure.

Healthcare presents many unique IT challenges. Patient care is often an urgent matter and health services need to reach people in urban centers and rural locations. At the same time medicine is highly dependent on IT systems and endpoint infrastructure that are secure, up-to-date, and constantly monitored to maintain availability and performance. To support this essential mission, IT staff require dependable solutions like those described in this paper to provide critical tools that doctors and nurses need so they can treat patients wherever they are.

Public Sector provides important services to their constituents. The success of these services depends on positive citizen engagement. This mission requires robust and distributed infrastructure that supports VDI to ensure that the needs of citizens are met in their communities. All of this must be done under tight budgets and cost control. These challenges can be addressed.

About VMware Cloud on Dell EMC
VMware Cloud™ on Dell EMC combines the simplicity and agility of the public cloud with the security and control of on-premises infrastructure delivered as a service to data center and edge locations. It is built on the latest VMware software defined data center suite, including industry-leading compute, storage, and network virtualization. This suite is optimized for and built upon Dell EMC VxRail hyperconverged infrastructure. It is easy to procure and it delivers a cloud-like consumption model. This solution provides an excellent digital foundation for customers to host and manage virtual desktops.

VMware Cloud on Dell EMC infrastructure is delivered, installed, maintained and supported by VMware. Additionally, VMware’s hybrid cloud control plane enables the provisioning and monitoring of modern infrastructure that integrates with existing VMware on-premise infrastructures. Furthermore, the consistency VMware Cloud on Dell EMC creates between your VMware-based public cloud and on-premises infrastructure reduces overhead for IT Operations, IT Security, Developers and CIOs/CTOs, enabling these roles to instead focus on accelerating the business.

VMware Cloud on Dell EMC delivers value to any data center or edge location where business is transacted and there exists a need for compute, storage or networking capabilities.

VMware Cloud on Dell EMC seamlessly extends public cloud benefits to workloads in your on-premises data centers and edge locations alike. This is significant because requirements for integrating security, networking and policy management at the edge are just as stringent as those in your data center—if not more so. VMware’s hybrid cloud control plane makes it as easy to configure and monitor core and edge workloads at scale such as virtual desktops.
About VMware Horizon

VMware Horizon is a modern platform for the secure delivery of virtual desktops and applications across the hybrid cloud. Leveraging best-in-class management capabilities and deep integrations with the VMware technology ecosystem, the Horizon platform delivers a modern approach for desktop and app management that extends from on-premises to the hybrid and multi-cloud. The result is fast and simple virtual desktop and application delivery that extends the best digital workspace experience to all applications.

Modern platform for simplicity and speed

You can rapidly deploy full-featured, personalized virtual desktops and apps in seconds by leveraging Instant Clone, VMware App Volumes™, and VMware Dynamic Environment Manager™ technologies. Instant clone desktops retain user customization and persona from session to session and can be destroyed at logout, an agile provisioning approach that can quickly roll out updated images and apps at the next login. One-to-many provisioning and complete API extensibility of the Horizon platform streamlines and automates day 2 management of images, apps, profiles and policies. IT can take advantage of this lightweight, modern approach that simplifies management, saves time, and reduces costs, but not at the expense of user customization and personalization.

End-to-end security from your trusted partner

Horizon delivers secure remote access to corporate resources from bring-your-own or corporate devices and centrally hosted desktops and apps. Intrinsic security that is built into your VMware infrastructure helps provide complete security from the device, across the network, and into the data center and cloud. VMware Workspace ONE® Access establishes and verifies end-user identity with multifactor authentication and serves as the basis for conditional access and network microsegmentation policies for Horizon virtual desktops and apps. Additional security features are woven into VMware technologies across the network and supported by Horizon, such as VMware NSX® Advanced Load Balancer™ (Avi Networks) and VMware SD-WAN by Velocloud®. With next-generation endpoint protection from Carbon Black, IT can further improve security on virtual desktops and apps. These intrinsic elements help provide a Zero Trust access security model across users, apps and endpoints that empowers employees without sacrificing security.

Unique integration with VMware technology

Leveraging VMware’s virtualization heritage and leadership in Software-Defined Data Center (SDDC) and digital workspace technology, Horizon delivers unique benefits across management, networking, security and user experience. Built on VMware Cloud Foundation™, Horizon can leverage the market-leading capabilities of VMware vSphere®, VMware vSAN™, and VMware NSX to deliver real-time desktops and applications, strengthen security, and simplify and automate day 2 operations.

The best digital workspace experience

By providing access to Horizon virtual desktops and apps through Workspace ONE, IT can further extend the best digital workspace experience to all apps and use cases. Horizon features include single sign-on, session collaboration, and support for hundreds of peripherals. Personalized desktops deliver optimal performance and an immersive, feature-rich user experience across devices, locations, media and network connections. Remote and mobile workers enjoy workstation-class performance and rich 2D and 3D graphics with the Blast Extreme protocol, which offers dynamic optimization in non-ideal, high-latency, low-bandwidth network conditions. Our relentless pursuit of the best digital workspace experience is enabled by our enterprise-grade management capabilities and technology ecosystem with user-centric performance metrics and monitoring, advanced load balancing, and SD-WAN optimization that extend from on-premises to the hybrid and multi-cloud.
Horizon on VMware Cloud on Dell EMC Architecture

Architectural overview

There are two design patterns how Horizon can be deployed on VMware Cloud on Dell EMC. Customer has choice to request how the vSphere clusters can be configured within VMware Cloud on Dell EMC on Day 1.

The following figures shows the high-level logical architecture of the Horizon components in VMware Cloud on Dell EMC.

Design #1
- In this design all the nodes are configured as single vSphere cluster in the vCenter.
- In this deployment architecture, all SDDC management components such as VMware vCenter, NSX Manager and NSX Edge are placed under Management Resource Pool. This is fully automated as part of VMware Cloud Dell EMC offering.
- All VMware Horizon management components such as Unified Access Gateways, Connection Servers, Database Servers and App Volumes are placed under Compute Resource Pool along with Virtual Desktops and Load Balancers.

Design justification

A customer can start with a minimum configuration of VMware Cloud on Dell EMC and then scale their VDI environment as needed according to the following architecture and design guidelines. The minimum configuration for VMware Cloud on Dell EMC is currently 3 nodes.

Figure 1: VMware Cloud on Dell EMC Single Cluster Design
**Design #2**

- In this design we have two vSphere clusters as part of VMware Cloud on Dell EMC Day 1 deployment.
- We have one dedicated vSphere cluster with three nodes to run all the SDDC management software along with all the Horizon management software components.
- Second cluster is dedicated for Horizon Desktops and published applications.
- In this deployment architecture, all SDDC management components such as VMware vCenter, NSX Manager and NSX Edge are placed in Cluster-1 under Management Resource Pool. This is fully automated as part of VMware Cloud Dell EMC offering.
- All VMware Horizon management components such as Unified Access Gateways, Connection Servers, Database Servers, App Volumes and Load Balancer are placed under a sub resource pool within Compute Resource Pool of Cluster-1.
- Cluster 2 is dedicated to host all the virtual desktops and published application.

Note: Even though you have configured three node cluster for management, VMware Cloud on Dell EMC reserves a 4th node as dark node to supplement if there is any failure in the management cluster to provide resiliency and high availability to the cluster.

**Design justification**

This deployment architecture design is preferred because it provides the most flexibility, scalability, and workload isolation for customers scaling their VDI environment in production. However, this does require a larger initial infrastructure footprint, and thus cost, to get started.

Note: Please work with your sales contact to request for two cluster deployment option for your VDI environment.
Solution components

The individual server components used for Horizon, whether deployed on VMware Cloud on Dell EMC or on-premises, are the same. See the Components section in the Horizon Architecture for details on the common server components.

The components and features that are specific to Horizon on VMware Cloud on Dell EMC are described in this section.

Software-defined data centers as a service

VMware Cloud on Dell EMC is a complete solution for data center infrastructure, and it is based on industry-leading virtualization software technology from VMware and proven hyperconverged hardware from Dell EMC. The software components include VMware vSphere compute, VMware vSAN™ all-flash storage, and VMware NSX-T® networking and security. Dell EMC foundational elements include VxRail hyperconverged infrastructure appliances and high-performance top of rack network switches.

All services delivery hardware is factory integrated inside a standard data center rack enclosure that can be positioned right alongside other racks in your data center, remote office and edge compute locations. Customers are given the choice of using 110 or 220-volt power circuits. See the following table for specific rack details:

<table>
<thead>
<tr>
<th>RACK SPECIFICATIONS</th>
<th>RACK R1 (24U)</th>
<th>RACK R2 (42U)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of VxRail E560F Nodes</td>
<td>Min. 3 - Max. 5</td>
<td>Single-phase power: Min. 3 – Max 12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Three-phase power: Min. 3 – Max 27</td>
</tr>
<tr>
<td>Spare / Standby Hosts per rack</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Power Requirements</td>
<td>30 amp +UPS</td>
<td>4 x 30 amp single-phase</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 x 60 amp three-phase</td>
</tr>
<tr>
<td>Power Source Location</td>
<td>Floor</td>
<td>Floor or Ceiling</td>
</tr>
<tr>
<td>Top of Rack Switches</td>
<td>2 x 10GbE</td>
<td>2 x 25GbE</td>
</tr>
<tr>
<td>Secure Management</td>
<td>Dual SD-Wan Devices by VeloCloud - (HA pair)</td>
<td></td>
</tr>
</tbody>
</table>

For details on current service infrastructure hardware specifications, see the VMware Cloud on Dell EMC Datasheet.

Management component

The management component for the SDDC and Horizon Infrastructure includes VMware vCenter Server.

Note: For common services, such as Active Directory and DNS, customers can bring their own or they can deploy a new set of those services in VMware Cloud on Dell EMC SDDC infrastructure under Compute Resource Pool. For the validation of this deployment architecture, we have kept Active Directory and DNS outside of this environment.

Compute component

The compute component includes the following Horizon infrastructure components:

• Horizon Connection Servers
• Unified Access Gateway appliances
• App Volumes Managers
• Load balancer
• Virtual machines

Note: While VMware Cloud on Dell EMC is fully managed by VMware, the Horizon infrastructure components listed above are customer managed, similar to that of a regular on-prem Horizon deployment.
NSX-T components
VMware NSX-T is the network virtualization platform for the VMware Cloud on Dell EMC Software-Defined Data Center (SDDC), delivering networking and security entirely in software, abstracted from the underlying physical infrastructure.

- **Tier-0 router:** Handles Internet, route or policy based IPSEC VPN and serves as an edge firewall for the Tier-1 Compute Gateway (CGW).
- **Tier-1 Compute Gateway (CGW):** Serves as a distributed firewall for all customer internal networks.
- **The Tier-1 Management Gateway (MGW):** Serves as a firewall for the VMware maintained components like vCenter and NSX.

Resource pool
A resource pool is a logical abstraction for flexible management of resources. Resource pools can be grouped into hierarchies and used to hierarchically partition available CPU and memory resources.

Within a Horizon pod on VMware Cloud on Dell EMC, you can use vSphere resource pools to separate management components from virtual desktops or published applications workloads to make sure resources are allocated correctly.

After an SDDC instance on VMware Cloud on Dell EMC is created, two resource pools exist:

- A Management Resource Pool with reservations that contain vCenter Server plus NSX, which is managed by VMware
- A Compute Resource Pool within which everything is managed by the customer

When deploying both management and user resources in the same SDDC, it is recommended to create two sub-resource pools within the Compute Resource Pool for your Horizon deployments:

- A Horizon Management Resource Pool for your Horizon management components, such as connection servers
- A Horizon User Resource Pool for your desktop pools and published apps

See Figure 3 for schematics of the recommended architecture. Because the management components of Horizon are shared among all virtual machines, you can avoid having any single virtual machine affect overall performance by deploying the management components in a separate resource pool with reservations. Alternatively, you can use different clusters to separate these components.

Figure 3: Resource Pools for Horizon on VMware Cloud on Dell EMC
Memory reservations
Because physical memory cannot be shared between virtual machines, and because swapping or ballooning should be avoided at all costs, be sure to reserve all memory for all Horizon virtual machines, including management components, virtual desktops, and RDS hosts.

CPU reservations
CPU reservations are shared when not used, and a reservation specifies the guaranteed minimum allocation for a virtual machine. For the management components, the reservations should equal the number of vCPUs times the CPU frequency. Any amount of CPU reservations not actively used by the management components will still be available for virtual desktops and RDS hosts when they are not deployed to a separate cluster.

Virtual Machine-level reservations
As well as setting a reservation on the resource pool, be sure to set a reservation at the virtual machine level. This ensures that any VMs that might later get added to the resource pool will not consume resources that are reserved and required for HA failover. These VM-level reservations do not remove the requirement for reservations on the resource pool. Because VM-level reservations are taken into account only when a VM is powered on, the reservation could be taken by other VMs when one VM is powered off temporarily.

Leveraging CPU shares for different workloads
Because RDS hosts can facilitate more users per vCPU than virtual desktops can, a higher share should be given to them. When desktop VMs and RDS host VMs are run on the same cluster, the share allocation should be adjusted to ensure relative prioritization.

As an example, if an RDS host with 8 vCPUs facilitates 28 users and a virtual desktop with 2 vCPUs facilitates a single user, the RDS host is facilitating 7 times the number of users per vCPU. In that scenario, the desktop VMs should have a default share of 1000, and the RDS host VMs should have a vCPU share of 7000 when deployed on the same cluster. This number should also be adjusted to the required amount of resources, which could be different for a VDI virtual desktop session versus a shared RDSH-published desktop session.

<table>
<thead>
<tr>
<th>RESOURCE POOL RESERVATION</th>
<th>VM RESERVATION</th>
<th>SHARES</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEMORY</td>
<td>CPU</td>
<td>MEMORY</td>
</tr>
<tr>
<td>Management</td>
<td>Full</td>
<td>Full</td>
</tr>
<tr>
<td></td>
<td>(vCPU*Freq)</td>
<td>(vCPU*Freq)</td>
</tr>
<tr>
<td>VDI</td>
<td>Full</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>RDSH</td>
<td>Full</td>
<td>No</td>
</tr>
</tbody>
</table>

Network configuration
When SDDCs are deployed on VMware Cloud on Dell EMC, NSX-T is used for network configuration. After you deploy an SDDC instance, two isolated networks exist, a management network and a compute network. Each has its own NSX Edge Gateway and an NSX Distributed Logical Router for extra networks in the compute section.

Note: Because the Horizon Connection Server must communicate with the vCenter Server, traffic must be allowed on the MGW Edge Firewall.

A load balancer such as Avi load balancer or Dell EMC Elastic Load Balancer (ELB) must be deployed to allow multiple Unified Access Gateway appliances and Connection Servers to be implemented in a highly available configuration. (See figure below)
Virtual Network Segment
The following networks must be configured in VMware Cloud on Dell EMC web portal console in Network Segment section when preparing for Horizon deployment on VMware Cloud on Dell EMC.

- **DMZ network (sddc-cgw-dmz)**
  The DMZ network is the intermediate network between the VMware Cloud on Dell EMC SDDC network and the internet. The incoming interface of the Unified Access Gateway appliances and the DMZ load balancer are connected here.

- **Horizon management network (sddc-cgw-horizon-mgmt)**
  The Horizon management is the network dedicated to the Horizon components. All Horizon VMs (except Unified Access Gateway) must be on this network. All Connection Servers, App Volumes, Dynamic Environment Manager and management interface of the Unified Access Gateway appliances must have IP addresses from this network. In addition, the load balancers deployed by Horizon domain in front of the Connection Servers and App Volumes must be in this network as well.

- **Horizon user workload network (sddc-cgw-horizon-user-workload)**
  This network is dedicated to the Horizon virtual desktops and published applications.

Sizing Horizon on VMware Cloud on Dell EMC
Similar to deploying Horizon in any other hardware platform, you will need to size your requirements for deploying Horizon on VMware Cloud on Dell EMC to determine the number of hosts you will need to deploy. Hosts are needed for the following purposes:

- Your virtual desktop or RDS workloads
- Your Horizon infrastructure components, such as connection servers, Unified Access Gateways, App Volumes managers
- SDDC infrastructure components on VMware Cloud on Dell EMC. These components are deployed and managed automatically for you by VMware, but you will need capacity in your SDDC for running them

The methodology for sizing Horizon on VMware Cloud on Dell EMC is exactly the same as for any other VDI deployments. What is different and simpler is the fixed hardware configurations on VMware Cloud on Dell EMC. Work with your VMware sales team to determine the correct sizing.

Scaling

**Block and pod**
A key concept of Horizon, whether deployed on VMware Cloud on Dell EMC or on-premises, is the use of blocks and pods. See the Block and Pod section in Horizon Architecture.

**Licensing**
A unique cost benefit to this solution is that customers can leverage existing 3rd party licensing agreements such as Microsoft Windows desktop operating system licensing. Because VMware Cloud on Dell EMC is deployed on premises it is not necessary to purchase License Mobility and Software Assurance as is required when migrating desktops to a 3rd party public cloud. This can have a positive impact on a TCO/ROI calculation when considering VMware Cloud on Dell EMC vs other public cloud solutions.

For Horizon licensing options please contact your VMware sales representative.

**Horizon Cloud Connector**
Regardless of whether you are deploying Horizon on-premises or on VMware Cloud on Dell EMC, if you are using any of the subscription licenses you must install the Horizon Cloud Connector to enable subscription license management for Horizon. The Horizon Cloud Connector is a virtual appliance that connects a Horizon pod with Horizon Control Plane features.

A MyVMware account from https://my.vmware.com is required for Horizon subscription license. Once you purchase the subscription license, a record will be created in the Horizon Cloud Service using your MyVMware email address, and your subscription license information will be visible to the Horizon Administrator console.

As part of the subscription license fulfillment process, you will receive an email with a link to download the Horizon Cloud Connector as an OVA (open virtual appliance) file. Follow the instructions in the email to deploy the Cloud Connector, using the vSphere web client, alongside your new or existing Horizon pods. Once deployed, the Cloud Connector is paired with a Connection Server in the Horizon pod, and this pod is connected to the Horizon Cloud Service. The Horizon Control Plane manages the Horizon subscription license of connected Horizon pods.
Unlike the Horizon perpetual license, with a subscription license you do not need to retrieve or manually enter a license key for Horizon product activation. However, supporting component license keys, such as the license keys for vSphere, App Volumes, and others, will be delivered separately, and the administrator must manually enter them to activate the product.

Review Horizon documentation for more details on Enabling VMware Horizon for Subscription Licenses and Horizon Control Plane Services. You will need a separate Cloud Connector for each Horizon pod.

Note: To use Cloud Connector or Horizon Control Plane a subscription license is needed.

Deploying desktops

With Horizon on VMware Cloud on Dell EMC, both Instant Clones and full clones can be utilized. Instant Clones, coupled with App Volumes and Dynamic Environment Manager, help accelerate the delivery of user-customized and fully personalized desktops.

Instant clone

Dramatically reduce infrastructure requirements while enhancing security by delivering a brand-new personalized desktop and application services to end users every time they log in:

- Reap the economic benefits of stateless, nonpersistent virtual desktops served up to date upon each login.
- Deliver a pristine, high-performance personalized desktop every time a user logs in.
- Improve security by destroying desktops every time a user logs out.

When you install and configure Horizon for instant clone for deployment on VMware Cloud on Dell EMC, do the following:

- On the golden image VM, add the domain’s DNS to avoid customization failures.
- When creating Horizon instant-clone pools on VMware Cloud on Dell EMC, use the following settings in the provisioning wizard:
  - Compute-resource Pool resource pool
  - Workloads folder
  - WorkloadDatastore datastore

App Volumes

App Volumes provides real-time application delivery and management, now for on-premises and on VMware Cloud:

- Quickly provision applications at scale.
- Dynamically attach applications to users, groups or devices, even when users are already logged in to their desktop.
- Provision, deliver, update, and retire applications in real time.
- Provide a user-writable volume, allowing users to install applications that follow them across desktops.
- Provide end users with quick access to a Windows workspace and applications with a personalized and consistent experience across devices and locations.
- Simplify end-user profile management by providing organizations with a single and scalable solution that leverages the existing infrastructure.
- Speed up the login process by applying configuration and environment settings in an asynchronous process instead of all at login.
- Provide a dynamic environment configuration, such as drive or printer mappings, when a user launches an application. For design guidance see App Volumes Architecture.

For more information on how to configure, see Configuring App Volumes Manager for VMware Cloud on Dell EMC.

Dynamic Environment Manager

Use VMware Dynamic Environment Manager for application personalization and dynamic policy configuration across any virtual, physical, and cloud-based environment. Install and configure Dynamic Environment Manager on VMware Cloud on Dell EMC just like you would install it on-premises.

See Dynamic Environment Manager Architecture.
Deploying external storage for user data

User data is an important consideration when thinking about deploying Horizon on VMware Cloud on Dell EMC. For storing user profiles and user data, you can either deploy a Windows file share on VMware Cloud on Dell EMC (and use DFS-R to replicate data across multiple sites) or use external IP storage, which is accessible over network.

You can bring your own IP storage into VMware Cloud on Dell EMC environment as long as the network and the storage IP address is routable and reachable.

Validation of design

**Scenario:** Customer has deployed VMware Cloud on Dell EMC at a Data Center as single SDDC and would like to use this environment for VMware Horizon Deployment. Customer can bring existing Active Directory and DNS service to VMware Cloud on Dell EMC.

In this validation, VMware Horizon on VMware Cloud on Dell EMC for an on-premises implementation use case demonstrates the number of virtual desktops could expect to run on VMware Cloud on Dell EMC infrastructure. Testing was conducted using R2 configuration with 11 hosts (node type M1d.medium).

Figure 4 shows how the environment in terms of networking is setup and configured for the validation and scale testing of VMware Horizon on VMware Cloud on Dell EMC:

- VMware Cloud on Dell EMC ToRs are connected to existing data center core network (just for illustration purpose, we are calling it as customer data center).
- L3 network connectivity is established from two Top of Rack (ToR) switches of VMware Cloud on Dell EMC to customer datacenter aggregation/core switch.
- Customer network is routed and appropriate static route has been added to both sides for VMware Cloud on Dell EMC SDDC and Horizon Components to reach to the customer network.
- Appropriate firewall rules have been configured for vCenter and Horizon Connection Server communication.
- Three compute network segments have been created for deployment of VMware Horizon Components such as “cgw-dmz”, “cgw-horizon-mgmt”, and “cgw-horizon-user” with respective IP subnets.
- Common services such as Active Directory and DNS are hosted in customer data center.
- LoginVSI launcher and Horizon Clients are hosted in the customer data center and they are communicating VMware Cloud on Dell EMC SDDC over a layer 3 network communication.

Note:

1. For detailed placement of VMs in correct resource pool, please refer “Resource Pool” section of this document.
2. For more detail on the virtual network segments, please refer “Virtual Network Segment” section of this paper.
Login VSI

We used the Login VSI workload-generation and measurement tool to generate and measure rigorous, realistic desktop workloads. Of the several types of Login VSI tests, two produced the most revealing findings.

Read more about Login VSI

VSImax and Horizon View Session Concurrency

Test #1 (2000 instant clone desktops, 100 percent concurrency with 10 hosts) Validation of this test result shows a VSImax of 1770. At 100% session concurrency, host CPU resources are pushed to the point of CPU saturation and user experience starts to break down. This is not a viable option for sustained level of CPU utilization because little CPU headroom availability is required for bursting capacity or failover. The sustained CPU utilization threshold for most production implementations are 80 percent. Sustained CPU utilization above 80 percent ordinarily causes high CPU usage alarm in VMware vSphere.

Test #1 Highlights
- Desktop access using the blast protocol and knowledge worker with 1920 x 1080 resolution (as shown in Table 1 above)
- Login VSI VSImax of 1770 (as shown in Figure 5)
- Host CPU 100% and Memory 83%
- NSX Edge (Large) CPU 42% and Memory 5%
- vCenter (Medium) CPU 32% and Memory 22%

![Figure 5: Test #1 LoginVSI Score](image)

Test #2 (2000 instant clone desktops, 100 percent concurrency with 11 hosts) As Test-1 result shows, VSImax of 1770, we increased the host count to 11 to see if we can reach 2000 sessions. Validation of this test result shows a VSImax did not reach the maximum. Thus, we consider 11 hosts are sweet spot for 2000 sessions.

Test #2 Highlights
- Desktop access using the blast protocol and knowledge worker with 1920 x 1080 resolution
- Login VSI VSImax not reached (as shown in Figure 6)
- Host CPU 100% and Memory 81%
- NSX Edge (Large) CPU 44% and Memory 5%
- vCenter (Medium) CPU 33% and Memory 22%
Test #3 (2000 instant clone desktops, 80 percent concurrency with 11 hosts)
This validation with 2000 desktops, 80 percent concurrency showed much better host CPU resource utilization. All 2000 sessions demonstrated excellent performance, and host CPU resource remained under 85 percent. All 2000 desktops were powered on and available while LoginVSI workload ran on 80 percent of the available desktops. Typical production VDI environments exhibit concurrent desktop usage of 80 percent of total available capacity.

Test #3 Highlights
• 1600 active sessions, with remaining desktops powered on but not in use
• Desktop access using the blast protocol and knowledge worker with 1920 x 1080 resolution
• Login VSI VSImax not reached (as shown in Figure 7)
• Host CPU – 84% and Memory 73%
• NSX Edge (Large) CPU 42% and Memory 4%
• vCenter (Medium) CPU 27% and Memory 23%
Resource sizing
The sizes we used for the LoginVSI test are listed in the following table.

<table>
<thead>
<tr>
<th>SERVER ROLE</th>
<th>SIZE</th>
<th>VCPU</th>
<th>MEMORY (GB)</th>
<th>STORAGE (GB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>vCenter</td>
<td>Medium</td>
<td>8</td>
<td>28</td>
<td>700</td>
</tr>
<tr>
<td>NSX Manager</td>
<td>Large</td>
<td>12</td>
<td>48</td>
<td>300</td>
</tr>
<tr>
<td>NSX Edge</td>
<td>Large</td>
<td>8</td>
<td>32</td>
<td>200</td>
</tr>
<tr>
<td>Connection Server (x2)</td>
<td>x</td>
<td>4</td>
<td>10</td>
<td>40</td>
</tr>
<tr>
<td>SQL Database Server</td>
<td>x</td>
<td>4</td>
<td>4</td>
<td>40</td>
</tr>
<tr>
<td>Unified Gateway Appliance (x2)</td>
<td>Default</td>
<td>2</td>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td>Avi Load balancer Controller</td>
<td></td>
<td>8</td>
<td>24</td>
<td>128</td>
</tr>
<tr>
<td>Avi Load Balancer Service Engine (x2)</td>
<td></td>
<td>2</td>
<td>4</td>
<td>15</td>
</tr>
</tbody>
</table>

Note: The resource sizing is dependent on your scale and number of desktop sessions.
Technical specification

Hardware
Below table shows the technical specification of this solution validation.

Note: Depending on Node Type your desktop sessions may change.

<table>
<thead>
<tr>
<th>SOLUTION SPECIFICATION (R1)</th>
<th>QUANTITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>VxRail E560N (Node Type M1d.medium)</td>
<td>11</td>
</tr>
<tr>
<td>Intel(R) Xeon(R) Platinum 8260 CPU @ 2.39GHz, 24 Core, 2 Socket per/core</td>
<td></td>
</tr>
<tr>
<td>768 GB RAM,</td>
<td></td>
</tr>
<tr>
<td>3.49 TB NVMe Flash Disk (Capacity) x 6</td>
<td></td>
</tr>
<tr>
<td>1.46 TB NVMe Flash Disk (Cache) x 2</td>
<td></td>
</tr>
<tr>
<td>Disks per vsAN Disk Group – 4</td>
<td></td>
</tr>
<tr>
<td>Disk Groups per host - 2</td>
<td></td>
</tr>
<tr>
<td>Dell EMC Power Switch – s5248</td>
<td>2</td>
</tr>
<tr>
<td>VMware SD-WAN 620s</td>
<td>2</td>
</tr>
</tbody>
</table>

Software
Below table shows the software version which we have tested.

<table>
<thead>
<tr>
<th>COMPONENTS</th>
<th>VERSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>VMware vSphere</td>
<td>7.0.1</td>
</tr>
<tr>
<td>VMware vCenter</td>
<td>7.0.1</td>
</tr>
<tr>
<td>VMware NSX</td>
<td>3.0.2</td>
</tr>
<tr>
<td>Horizon View Connection Server</td>
<td>8.0</td>
</tr>
<tr>
<td>Unified Access Gateway</td>
<td>3.10</td>
</tr>
<tr>
<td>Avi Load Balancer</td>
<td>20.1.2</td>
</tr>
</tbody>
</table>
Conclusion
VMware Horizon on VMware Cloud on Dell EMC eliminates the costly and cumbersome process of refreshing, managing, and maintaining the infrastructure supporting VDI deployments. When deploying Horizon on VMware Cloud on Dell EMC you get the ability to scale Horizon desktops and applications with the simplicity and agility of the public cloud and the security and control of on-premises infrastructure delivered as a service to data center and edge locations.

Built upon on the latest VMware software defined data center suite, including industry-leading compute, storage, and network virtualization that is optimized for Dell EMC VxRail hyperconverged infrastructure, VMware Horizon on VMware Cloud on Dell EMC is quick and easy to procure and delivers a cloud-style consumption model for a range of use cases.

Because VMware provides fully automated lifecycle management and monitors the health of the SDDC stack around the clock, you can take advantage of a combination of software, hardware, and services to focus technology resources on initiatives that differentiate the business, instead of spending time on infrastructure management.

Author
Shree Das is a Technologist and Architect in the OCTO Business Unit. Responsible for architecture and design of various customer reference architecture solutions. Shree’s focus is on the Cloud, Software-Defined Data Center, Hyper-converged Platform, and other emerging technologies like, Edge Computing, IoT, 5G, HPC and AI/ML.

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