EMC DESKTOP-AS-A-SERVICE

EMC VNX, EMC SYMMETRIX VMAX, VMWARE VCLOUD DIRECTOR, VMWARE VSPHERE 5, AND VMWARE VIEW 5

- Deploy virtual desktop services in cloud environments
- Support virtual desktops in multi-tenant environments
- Simplify management and decrease TCO

EMC Solutions Group

Abstract

This Proven Solution Guide describes a Desktop-as-a-Service (DTaaS) platform that supports virtualized desktops for enterprise, multidepartment enterprise, hosted virtual, and multitenant hosted virtual cloud environments. The solution uses EMC® VNX™, EMC Symmetrix® VMAX™, VMware® vCloud™ Director, VMware vSphere™ 5, and VMware View™ 5.

April 2012
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Executive Summary

This chapter summarizes the proven solution described in this document and includes the following sections:

- Business case
- Solution overview
- Key results and recommendations

Business case

With today's widely distributed workforce, IT organizations can find it is difficult to deliver a consistent end-user desktop experience while maintaining security, providing business continuity, and keeping costs down. With Desktop-as-a-Service (DTaaS), customers can extend the useful life of their current assets, accommodate growth, and lower the cost of managing their desktop environment.

Service providers can offer Desktop-as-a-Service as an alternative to building and provisioning dedicated, stand-alone VDI environments for each customer deployment. EMC® DTaaS leverages VMware® vCloud™ Director to provide trusted multitenancy, enabling service providers to better leverage their data center assets while lowering their cost to serve.

EMC DTaaS also allows service providers to support different end-user devices such as tablets, smart phones, and other mobile devices; and eases the transition to new OS releases and upgrades.

The combination of leading technologies from EMC and VMware allows companies to:

- Maximize their investment
- Increase tenant density and unit scaling while maintaining higher customer SLAs than typical VDI solutions
- Easily maintain virtual desktop infrastructure and security across organizations and locations
- Improve end-user productivity with a consistent experience around the globe

Service providers who already offer Compute-as-a-Service, Storage-as-a-Service, and Backup-as-a-Service are ideally positioned to provide DTaaS for customers to round out their other service offerings.
Solution overview

This solution demonstrates the functionality, performance, and scalability of a cloud computing services platform that provides virtualized desktops as a service for multiple types of customers in public, private, or hybrid cloud environments including:

- Enterprise desktops
- Multidepartment enterprise desktops
- Hosted virtual desktops
- Multitenant hosted virtual desktops

This EMC DTaaS solution enables service providers to provide a carrier-class, scalable, multitenant platform for offering desktop services to their customers. EMC DTaaS supports flexible deployment on public, private, and hybrid clouds with full benefits, including:

- Data security
- Business continuity
- Lower total cost of ownership (TCO)
- Consistent, available user experience

This solution incorporates the following components:

- EMC VNX™ and EMC Symmetrix® VMAX™ storage
- VMware technology including vCloud Director, vSphere™ 5, View™ 5, vCenter™ Orchestrator™, and VMware ThinApp®
- 5000 Microsoft Windows 7 virtual desktops, including a mix of standard and premium desktops
- Storage tiering (EFD SAS and NL-SAS)
- EMC FAST™ Cache
- EMC FAST VP
Key results and recommendations

VMware View 5 virtualization technology meets the needs of users and service providers, providing compelling advantages compared to traditional physical desktops and terminal services. Service providers and enterprises can take advantage of the features found in VMware vCloud Director to host virtual desktops in a multitenant environment.

While testing this solution, we found that the EMC DTaaS solution:

- Supported 5000 virtual desktops, including a mix of premium and standard desktop configurations
- Maintained secure separation between multiple customers using the same cloud infrastructure
- Simplified the deployment and management of a VMware-based multitenant desktop environment through the use of vCO
2

Introduction

This chapter introduces the solution and its components, and includes the following sections:

- Document overview
- Technology overview
- Solution diagram
- Configuration

Document overview

This document provides a detailed summary of the tests performed to validate an EMC infrastructure for virtual desktops offered as a service, enabled by VMware vCloud Director and VMware View 5, with EMC VNX5700 and EMC Symmetrix VMAX unified storage platforms.

By integrating EMC VNX unified storage and the new features available in the EMC VNX series and VMware View 5, service providers are able to reduce costs by simplifying storage management and increasing capacity utilization.

Purpose

The purpose of this use case is to demonstrate the functionality, performance, and scalability of a cloud computing services platform that provides virtualized desktops as a service for multiple types of customers in public, private, or hybrid cloud environments.

This solution includes all the attributes required to run this environment, such as hardware and software and the required VMware View configuration.

Information in this document can be used as the basis for a solution build, white paper, best practices document, or training. It can also be used by other EMC organizations (for example, the technical services or sales organizations) as the basis for producing documentation for a technical services or sales kit.

Scope

The paper contains the results of testing the EMC Desktop-as-a-Service enabled by EMC VNX, EMC Symmetrix VMAX, VMware vCloud Director, VMware vSphere 5, and VMware View 5 solution. Throughout this paper, we assume that you have some familiarity with the concepts and operations related to virtualization technologies and their use in information infrastructure.

This paper discusses multiple EMC products as well as those from other vendors. Some general configuration and operational procedures are outlined. However, for detailed product installation information, refer to the documentation for those products.
The intended audience of this paper includes:

- EMC customers
- EMC partners
- EMC internal personnel

Table 1 defines some terms frequently used in this Proven Solutions Guide.

**Table 1. Terminology**

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Block Data Compression</td>
<td>EMC unified storage introduces Block Data Compression, which allows customers to save and reclaim space anywhere in their production environment with no restrictions. This capability makes storage even more efficient by compressing data and reclaiming valuable storage capacity. Data compression works as a background task to minimize performance overhead. Block Data Compression also supports thin LUNs, and automatically migrates thick LUNs to thin during compression, freeing valuable storage capacity.</td>
</tr>
<tr>
<td>EMC FAST Cache</td>
<td>This feature allows customers to use Flash drives as an expanded cache layer for their array. FAST Cache is an array-wide feature that you can enable for any LUN or storage pool. FAST Cache provides read and write access to the array.</td>
</tr>
<tr>
<td>EMC FAST VP</td>
<td>EMC has enhanced its Fully Automated Storage Tiering for Virtual Pools (FAST VP) technology to work at the sub-LUN level on both file and block data. This feature works at the storage pool level. It supports scheduled migration of data to different storage tiers based on the performance requirements of individual 1 GB slices in a storage pool.</td>
</tr>
<tr>
<td>Linked clone</td>
<td>A virtual desktop created by VMware View Composer from a writeable snapshot paired with a read-only replica of a master image.</td>
</tr>
<tr>
<td>Replica</td>
<td>A read-only copy of a master image used to deploy linked clones.</td>
</tr>
<tr>
<td>Unisphere</td>
<td>The centralized interface of the unified storage platforms. EMC Unisphere includes integration with data protection services, provides built-in online access to key support tools, and is fully integrated with VMware.</td>
</tr>
<tr>
<td>VDI platform</td>
<td>Virtual desktop infrastructure. The server computing model enabling desktop virtualization, encompassing the hardware and software system required to support the virtualized environment.</td>
</tr>
</tbody>
</table>
### Technology overview

#### Component list

This section identifies and briefly describes the major components of the validated solution environment. The components are:

- EMC VNX platform
- EMC Symmetrix VMAX platform
- EMC FAST VP
- EMC Symmetrix Management Console
- VMware vCloud Director
- VMware vSphere 5
- VMware View 5

#### EMC VNX platform

The EMC VNX family delivers industry-leading innovation and enterprise capabilities for file, block, and object storage in a scalable, easy-to-use solution. This next-generation storage platform combines powerful and flexible hardware with advanced efficiency, management, and protection software to meet the demanding needs of today’s enterprises.

The VNX series is designed to meet the high-performance, high-scalability requirements of midsize and large enterprises, delivering leadership performance, efficiency, and simplicity for demanding virtual application environments.

#### EMC Symmetrix VMAX platform

Built on the strategy of simple, intelligent, modular storage, EMC Symmetrix VMAX with Enginuity version 5875 incorporates a highly scalable Virtual Matrix Architecture™ that enables Symmetrix VMAX arrays to grow seamlessly and cost-effectively from an entry-level configuration into the world’s largest storage system. Symmetrix VMAX supports EFDs, FC drives, and SATA drives within a single array, as well as an extensive range of RAID types.

The EMC Enginuity™ operating environment provides the intelligence that controls all components in the Symmetrix VMAX array, ensuring the highest efficiency, scalability, and security.

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual desktop</td>
<td>Desktop virtualization (sometimes called client virtualization), that separates a personal computer desktop environment from a physical machine using a client/server model of computing. The model stores the resulting &quot;virtualized&quot; desktop on a remote central server, instead of on the local storage of a remote client; thus, when users work from their remote desktop client, all of the programs, applications, processes, and data used are kept and run centrally. This scenario allows users to access their desktops on any capable device, such as a traditional personal computer, notebook computer, smartphone, or thin client.</td>
</tr>
<tr>
<td><strong>EMC FAST VP</strong></td>
<td>EMC Fully Automated Storage Tiering for Virtualized Pools (FAST VP) expands and extends the capabilities of virtualized provisioning to provide a new form of FAST for Symmetrix at the sub-LUN level. FAST VP automatically implements non-disruptive changes to storage allocations and optimizes the use of a storage configuration composed of different drive technologies. These optimizations take full advantage of the fast response time of Flash drives and provide the most cost-effective use of a mixed drive type configuration while providing the best performance.</td>
</tr>
<tr>
<td><strong>EMC Symmetrix Management Console</strong></td>
<td>EMC Symmetrix Management Console (SMC) is a simple, intuitive, browser-based user interface for the configuration and management of Symmetrix arrays. Along with storage provisioning functions SMC also provide the ability to view, monitor, and report on Symmetrix arrays.</td>
</tr>
<tr>
<td><strong>VMware vCloud Director</strong></td>
<td>VMware vCloud Director (vCD) is a cloud computing management platform for private and hybrid cloud-computing infrastructures. vCD manages a cloud infrastructure using the virtual resources provided by VMware vSphere. It helps you manage as-a-service offerings by monitoring and controlling cloud components such as security, virtual machine provisioning, billing, and self-service portal access.</td>
</tr>
<tr>
<td><strong>VMware vSphere 5</strong></td>
<td>VMware vSphere 5 is a virtualization platform that can transform or virtualize computer hardware resources including CPU, RAM, hard disk, and network controller, to create a fully-functional virtual machine that runs its own operating systems and applications just like a physical computer.</td>
</tr>
<tr>
<td><strong>VMware View 5</strong></td>
<td>VMware View 5 is the leading desktop virtualization solution that enables desktops to deliver cloud computing services to users. VMware View integrates effectively with VMware vSphere to provide performance optimization, tiered storage support, and thin provisioning support. VMware View supports <em>persona management</em>, which dynamically associates a user persona with stateless floating desktops. View persona management provides end users with a consistent, personalized experience while enabling IT administrators to more easily deploy and manage desktops for more use cases while supporting user personalization to persist between sessions.</td>
</tr>
</tbody>
</table>
Solution diagram

Figure 1 depicts the physical architecture of this solution.

![Solution Architecture Diagram]

Figure 1. Solution architecture
Figure 2 shows the logical architecture of the solution.

![Logical solution architecture](image-url)

**Figure 2. Logical solution architecture**
Configuration

**Hardware resources**

Table 2 lists the hardware used for this solution.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Quantity</th>
<th>Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMC Symmetrix VMAX</td>
<td>2</td>
<td>195 × 450 GB FC, 30 × 1 TB SATA, 15 × 200 GB SSD</td>
</tr>
<tr>
<td>EMC VNX5700</td>
<td>2</td>
<td>440 × 600 GB SAS, 90 × 2 TB NL-SAS, 60 × 200 GB SSD</td>
</tr>
<tr>
<td>Cisco B200 servers</td>
<td>26</td>
<td>Dual six-core Xeon X5680: 3.33 GHz, 96 GB RAM</td>
</tr>
<tr>
<td></td>
<td>18</td>
<td>Dual quad-core Xeon E5540: 2.53 GHz, 48 GB RAM</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>Dual quad core Xeon E5540: 2.53 GHz, 96 GB RAM</td>
</tr>
<tr>
<td>Cisco B440 servers</td>
<td>4</td>
<td>Quad ten-core, E7-4860: 2.27 GHz, 256 GB RAM</td>
</tr>
<tr>
<td>MDS switches</td>
<td>2</td>
<td>MDS9509</td>
</tr>
<tr>
<td>Nexus switches</td>
<td></td>
<td>Nexus 5K, 7K</td>
</tr>
</tbody>
</table>

**Software resources**

Table 3 lists the software used with this solution

<table>
<thead>
<tr>
<th>Software</th>
<th>Version</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMC VNX5700</td>
<td>Release 31</td>
<td>Operating environment for the block</td>
</tr>
<tr>
<td>EMC VNX5700</td>
<td>Release 7.0</td>
<td>Operating environment for the file</td>
</tr>
<tr>
<td>EMC Symmetrix VMAX Enginuity</td>
<td>5875</td>
<td>VMAX operating environment</td>
</tr>
<tr>
<td>VMware View 5</td>
<td>5.0</td>
<td>Software hosting virtual desktops</td>
</tr>
<tr>
<td>VMware vCloud Director</td>
<td>1.5</td>
<td>Cloud computing management</td>
</tr>
<tr>
<td>VMware vSphere 5</td>
<td>5.0.0 build 504890</td>
<td>Server hypervisor</td>
</tr>
<tr>
<td>VMware vShield Manager</td>
<td></td>
<td>VMware security</td>
</tr>
<tr>
<td>EMC PowerPath®</td>
<td>5.7/VE</td>
<td>Multipathing and load balancing for block access</td>
</tr>
<tr>
<td>EMC Unisphere™</td>
<td></td>
<td>Management tool for EMC VNX series</td>
</tr>
<tr>
<td>EMC Symmetrix Management Console</td>
<td>7</td>
<td>VMAX storage management tool</td>
</tr>
<tr>
<td>Cisco Intelligent Automation for Cloud</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cisco Fabric Manager</td>
<td>4.1</td>
<td>Cisco MDS FC switch management tool</td>
</tr>
<tr>
<td>Cisco UCS Manager</td>
<td>1.4.3(q)</td>
<td>Cisco unified compute system management tool</td>
</tr>
<tr>
<td>VMware View Planner</td>
<td>2.1</td>
<td>Workload validation tool for View desktop deployment</td>
</tr>
</tbody>
</table>
3

Solution Infrastructure

This chapter details the major infrastructure components of the Desktop-as-a-Service environment, and includes the following sections:

- VMware View infrastructure
- VMware vCloud infrastructure
- Orchestrating workflows with VMware View
- VMware View Persona Management configuration
- VMware vSphere 5 infrastructure
- Configuring VNX file for multitenant
- vSphere network configuration
VMware View infrastructure

Overview

VMware View enables enterprises to host virtual desktops to offer their users a secure, versatile desktop environment accessible from various platforms including HTML5-based browsers, tablets, and smart phones.

VMware View supports the virtual desktop infrastructure for the enterprise. If multiple tenants are from the same organization, VMware View can create multiple virtual desktop pools and use administrative roles and permissions to restrict access to the pools.

If the tenants are from different organizations (which implies different Active Directory domains), then multiple instances of the VMware View environment need to be deployed using VMware vShield Edge devices to create a secure multitenant environment and resource pools to segregate the resources.

This section covers the following topics:

- Design considerations
- Using VMware View folders
- Designing for multitenancy

Figure 3 shows a VMware View infrastructure.
Figure 3. VMware View infrastructure

The VMware View environment consists of Active Directory for authentication, and a Connection Server for managing secure access to virtual desktops. Multiple Connection Servers can be installed for load balancing and fault tolerance. VMware View Composer installs on a vCenter server to provide a linked-clone feature that reduces the storage costs for the virtual desktop. VMware View Transfer Servers are required to provide Local mode support for View Client, which allows users to work on the desktops even when disconnected from the network. VMware View Security Server resides in a DMZ zone and runs a subset of the View Connection Server to provide an additional layer of security between the Internet and the desktop network. The ThinApp repository uses a CIFS share for distributing the package to the View desktops.

A VMware View environment typically consists of at least two vSphere High-Availability/DRS clusters. One cluster hosts the View servers, domain controllers, and so on. The other cluster hosts the virtual desktop pools and View Transfer Server (if required).
Designing VMware View for multiple tenants follows the same principles as designing for a single organization, and then deploying it for multiple organizations while making sure that it does not exceed the maximum resources supported by VMware.

Design the VMware View environment cluster with the number of virtual desktops that it can support based on the template virtual desktop IOPS requirement and the host compute, storage, and network resources. A linked clone pool supports only eight hosts per cluster.

Ensure the template virtual desktop is configured according to the guidelines to turn off unnecessary services and tasks to optimize resource utilization. Make sure the template virtual desktop is configured to access the correct network port group.

For more information, refer to *EMC Infrastructure for Virtual Desktops Enabled by EMC VNX, VMware vSphere 4.1, VMware View 4.5, and VMware View Composer 2.5*.

If the tenants are from the same organization or have a mutual trusting relationship, VMware View folders with custom roles and permissions can be used to delegate the access. This option can also be used in a multitenant environment to create subtenants for different departments within an organization.

View folders are generally intended for departmental enterprise desktop use, where the departments in an enterprise need to manage their own desktop pools. In the cloud environment, folders can represent subtenants. The roles and permissions are applied to the View folder level. Desktop pools are deployed based on the desktop template. For example, an HR desktop administrator can manage the desktop pools of the HR assistants, HR kiosks, and HR managers.

VMware View allows the creation of separate folders for the deployment and management of desktop pools (see Figure 4). This option might be helpful for organizations that need each department to manage its own desktop pools. The following screens show a sample of multiple folders created with VMware View.
The desktop pools can be deployed to the View folders as shown in Figure 5.

Figure 5. Add desktop pools

View folders can also be used to change existing desktop pools, as shown in Figure 6.

Figure 6. Change existing desktop pools
Chapter 3: Solution Infrastructure

You can use the predefined roles and their privileges to restrict access, as shown in Figure 7. You can define custom roles and privileges to secure the View folders.

Figure 7. View folder roles

For our solution, we highlight four use cases:

- Enterprise desktops
- Departmental enterprise desktops
- Hosted virtual desktop infrastructure
- Multitenant virtual desktop infrastructure

The first three use cases typically target a single Active Directory domain, or have a trusted relationship between the Active Directory domains where the View Servers reside and the users. For the fourth use case, the multitenant VDI is where multiple instances of Active Directory domains are deployed for the View Servers.

Using View folders might be good enough for enterprises in the same forest and that have a two-way trust between the View Connection Server domain and the virtual desktop users domain. This is one concern of service providers who want to provide Desktop-as-a-Service to tenants who want to use their own Active Directory domains and prefer not to have the two-way trust.
One way to address this concern is to deploy a connection server in every domain and provide an account for View Composer to use to join the virtual desktops to its corresponding domain.

The View Connection Server is the broker that manages the desktop pools. It is part of the View architecture. The View connection needs to be available for all of the four use cases.

To have secure separation of compute and storage, separate resource pools are used. For the networks, VMware vShield Edge devices are used. If additional security is needed, VMware vShield App can be used to restrict access by applying policies at the VM NIC level.

The View Composer Server is part of VMware View and provides the linked clone functionality. View Composer saves storage space by linking the parent VM disk to the desktop pools. The View Composer service resides on the vCenter server that hosts the desktop pools. In our solution, we target the multitenant VDI use case and we show how to use one View Composer between all the tenants.

In a multitenant environment there will be multiple View Connection Servers for each tenant. However, those tenants can share the same View Composer Server regardless of whether they are in the same, or different, Active Directory domains.

In a multitenant View environment the compute and storage components will be separated between the tenants using the resource pools. Their virtual networks are separated by using vShield Edge. Because each tenant has their own View Connection Servers, they can manage their own desktop pools. The desktop pools are deployed using the templates that the tenants create.

Each tenant can have their own View events database where the logs are available for the desktop pools. For any shared resource such as resource pools and the networks, users can collect the details from vCenter and filter them according to their needs.
VMware vCloud infrastructure

Overview

VMware vCloud Director provides multitenant cloud infrastructure. VMware vCloud automates the creation of resource pools and vShield Edge devices for each organization. VMware vCloud abstracts the underlying virtual infrastructure and allows tenants to deploy the virtual applications (vApps) to their virtual data centers.

As shown in Figure 8, each tenant has the following elements:

- View Connection Servers
- Active Directory domain controllers
- Security servers deployed as part of vApps
- Resource pools
- Networks needed for the desktop pools

This section covers the following topics:

- Provider virtual data center
- Organization virtual data center
- VMware View vApps
- vCloud network design considerations
- Desktop pool connection server access restrictions
- RSA two-factor authentication
- Consideration for multitenancy
Chapter 3: Solution Infrastructure

EMC Desktop-as-a-Service—Proven Solutions Guide

EMC VNX, EMC Symmetrix VMAX, VMware vCloud Director, VMware vSphere 5, VMware View 5

Figure 8. Multitenant virtual data center architecture

The provider virtual data centers (vDCs) are created based on the costs associated with the resources and the provider’s service level agreements. The organization vDCs are created from the provider vDC for each organization to host the organization’s vApps. See Figure 9.

As shown in Figure 9 multiple vDCs are created in a DTaaS environment based on the service level agreement (SLA). Gold-, Silver-, and Bronze-level vDCs are created based on various SLAs.
We recommend having at least one provider vDC for each View administration environment for each tenant, and to have additional vDCs for deploying the desktop pools. In our environment, we created four provider vDCs, one for the administration environment and the other three for desktop pools. See Figure 10.

VMware View does not support deployment of desktop pools to vDCs. VMware vCloud Director abstracts the virtualization layer and deploys vApps on the virtual data centers. VMware View does not recognize these virtual data centers and so it needs virtualization resources for the deployment of desktop pools through the use of resource pools, datastores, and so on.

VMware View keeps track of the resource pool and datastore information in its database. Thus, VMware does not support Storage vMotion for desktop virtual machines that are managed by VMware View.
An organization virtual data center is a container for the deployment of vApps. It is created using the resources taken from a selected provider vDC and is a description of the way resources are allocated and used by a vCloud Director organization when deploying their vApps.

We created one organization vDC for each provider vDC that was created for the desktop pools, as shown in Figure 11.

Figure 11. Organization vDCs

For each organization, we deployed the vApps for the View administration environment, as shown in Figure 12. The VDM vApp consists of domain controllers and View Connection Servers. The DMZ-VDM consists of View Security servers and a load balancer.

Figure 12. View administration environment vApps

VMware View does not support deploying desktop pools to the virtual data centers; it needs vSphere hosts and clusters, resource pools, and data stores. So, the desktop pools are not visible as vApps and need to be managed separately with the View Servers.
To enable the integration of vCloud Director and View, while deploying the desktop pool, select the resource pool that was created by the vCloud Director for the organization vDC. See Figure 13.

![Resource Pool Selection](image)

**Figure 13. Organization vDC resource pool**

The View Connection Servers, domain controllers, virtual desktops in that domain, and the View Composer vCenter server all need to be in a network so that they can communicate with each other. Figure 14 shows the organization networks.

**Figure 14. View organization networks**

The network for the VDM vApp is shown in Figure 15. It is on same VLAN as the Composer vCenter server and the desktop pools.
Figure 15. VDM vApp network

Figure 16 shows the network for the DMZ-VDM vApp.

Figure 16. DMZ VDM vApp network
The VMware View Security Server resides in a DMZ, with firewalls between the internal network and the external networks that communicate with the Internet (see Figure 17).

Figure 17. Multitenant network infrastructure
The users at remote locations can use the vCloud Director site-to-site VPN feature to connect directly to the View Connection Server as if they are in the same location. The site-to-site VPN feature is provided by VMware vShield Edge, and the VMware vCloud Director GUI uses that feature.

That feature can be used for the hosted VDI and multitenant VDI use cases to connect the network between the users at the enterprise to the service provider network. Site-to-site VPN allows the users to simulate that they are on the same network. See Figure 18.

![Site-to-site VPN](image)

**Figure 18.** Site-to-site VPN
In a large VMware View environment that has multiple connection servers, and with some connection servers using two-factor authentication, it is possible to control which desktop pools are allowed based on the connection server tags. Figure 19 shows a sample of how tags are defined on the View Connection Server Settings screen.

Figure 19. View Connection Server tags

These tags can be selected for the pool to restrict which connection the servers are allowed to use as shown in Figure 20.
The View Connection Servers can be configured to use smart cards or RSA two-factor authentication for additional levels of desktop access security. See Figure 21.

Figure 20. Connection Server restrictions

Figure 21. View Connection Server authentication
The Composer vCenter server needs to communicate and resolve the DNS with the tenant's domain controller to deploy virtual desktops in that domain. In our testing, we added an additional virtual NIC to the VM to connect to the tenant's network VLAN. Then we provided the authentication information for View Composer to join the desktop to the domain, as shown in Figure 22.

A separate NIC was used because the View Composer server, View Connection Server, Active Directory domain controller, and the desktop pools should be connected to each other. If the View Composer vCenter server has network connectivity with a routed network, make sure the DNS resolution works by adding the conditional forwarder for each tenant domain.

In our use case, we added a virtual NIC to each VLAN where the tenant resides and defined the DNS configuration for each domain. Note that a virtual machine can have only ten virtual NICs. If you need more, consider using a VLAN based on guest tagging. To use VLAN guest tagging, you must use the E1000/E1000e virtual NIC.

**View Composer Settings**

<table>
<thead>
<tr>
<th>Enable View Composer</th>
<th>Port: 18443</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domains:</td>
<td>cie.emc.net(Administrator)</td>
</tr>
<tr>
<td></td>
<td>org1.local(org1\Administrator)</td>
</tr>
<tr>
<td></td>
<td>Org2.local(<a href="mailto:Administrator@Org2.local">Administrator@Org2.local</a>)</td>
</tr>
</tbody>
</table>

**Figure 22.** View Composer virtual NIC

**Note:** Even though we used the administrator account, the account only needs to create computer objects, delete computer objects, and write all properties to the organization unit (OU) in which the desktop computers will reside.

If you share the View Composer vCenter server with multiple tenants and each tenant provides the authentication information for joining the computer to domain, all those domains will be visible during the deployment (see Figure 23). But if they are not on that domain network, choosing other domains might fail. To address this issue, the service provider can create a custom portal for deploying the desktop pools.

The View Composer server is part of VMware View and provides the linked clone functionality. View Composer saves storage space by linking the parent VM disk to the desktop pools. The View Composer service resides on the vCenter server that hosts the desktop pools. In our solution, we target the multitenant VDI use case and we show how to use one View Composer between all the tenants.
Figure 23. Desktop Pool guest customization

**Note:** For information about additional design considerations, refer to *EMC Compute-as-a-Service—Design Principles and Considerations for Deployment.*
Orchestrating workflows with VMware View

Overview

Whenever VMware View Composer is shared across multiple tenants, the administrators are able to view the other tenant's domain name. To avoid this, the service provider can create a custom portal and restrict the views that are inappropriate for each tenant.

In our solution, we used the VMware vCenter Orchestrator web view to demonstrate this functionality. This section covers how to set up the VMware vCenter Orchestrator to automate the tasks with VMware View.

VMware Orchestrator is part of VMware vCenter, and allows you to automate many tasks. Orchestrator interacts with external systems using appropriate plug-ins. Traditionally, VMware View automation is handled using the View PowerCLI commandlets. Recently, VMware vCenter Orchestrator released a PowerShell Plug-in to integrate vCenter Orchestrator workflows with PowerShell (see Figure 24).

![Plug-ins installed in the server](image)

<table>
<thead>
<tr>
<th>Plug-In Name</th>
<th>Version</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>XML</td>
<td>1.0.3</td>
<td>XML Plug-in</td>
</tr>
<tr>
<td>SSH</td>
<td>1.0.3</td>
<td>SSH Plug-in</td>
</tr>
<tr>
<td>REST</td>
<td>1.0.0</td>
<td>REST plug-in for vCenter Orchestrator</td>
</tr>
<tr>
<td>AMQP</td>
<td>1.0.0</td>
<td>AMQP Plugin</td>
</tr>
<tr>
<td>WebOperator</td>
<td>2.1.2</td>
<td>vCO WebOperator</td>
</tr>
<tr>
<td>VC</td>
<td>4.2.0</td>
<td>vCenter Server 4.1</td>
</tr>
<tr>
<td>vCloud</td>
<td>1.0.2</td>
<td>vCloud</td>
</tr>
<tr>
<td>Library</td>
<td>1.0.0</td>
<td>vCO Library</td>
</tr>
<tr>
<td>Database</td>
<td>1.0.5</td>
<td>Database (SCL) Plug-in</td>
</tr>
<tr>
<td>PowerShell</td>
<td>1.0.0</td>
<td>PowerShell Plug-in</td>
</tr>
<tr>
<td>Mail</td>
<td>1.1.1</td>
<td>Mail Plug-in</td>
</tr>
<tr>
<td>Net</td>
<td>1.4.1</td>
<td>Wrapper to Jakarta Apache Commons net library</td>
</tr>
<tr>
<td>Enums</td>
<td>2.1.1</td>
<td>Common enumerated types</td>
</tr>
</tbody>
</table>

Figure 24.  PowerShell plug-in for vCenter Orchestrator

This section covers the following topics:

- PowerShell remoting
- vCenter Orchestrator configuration for the PowerShell plug-in
- Sample vCO workflow
- Sample vCO web view
To use VMware View PowerCLI commandlets in a vCenter Orchestrator workflow, first install the plug-in on the vCenter Orchestrator Server. Then, enable PowerShell remoting on the View Connection server.

Execute the following PowerShell commandlets on the View Connection Server that the workflows need to interact with (see Figure 25):

- Enable-PSRemoting -Force
- CD WSMan:
- Set-Item Client\AllowUnencrypted True
- Set-Item Client\TrustedHosts 10.110.75.150 -force
- Set-Item Client\Auth\Basic True
- Set-Item Service\AllowUnencrypted True
- Set-Item Service\Auth\Basic True
- C:

![PowerShell commandlets](image)

In the Trustedhosts, add the IP address or DNS name of the VMware vCenter Orchestrator server.
Later, on the vCenter Orchestrator server, add a PowerShell Host workflow under PowerShell\Configuration. This needs to be executed to add the VMware View Connection Server as a PowerShell host target (see Figure 26).

**Figure 26. Add a PowerShell host**

After execution, the PowerShell Host is added to the vCenter Orchestrator Inventory. You can then see what PowerShell snap-ins are installed on the PowerShell Host Remote (see Figure 27).

**Figure 27. PowerShell host remote inventory**
The VMware View Broker snap-in can be expanded to see which View commandlets are available. As shown in Figure 28, right-click to run a workflow against that commandlet to add that workflow as an action item in vCenter Orchestrator.

**Figure 28.** View commandlets
Once you execute the workflow, the vCenter Orchestration Action item is added, as shown in Figure 29.

![vCenter Orchestration Action](image)

**Figure 29.** vCenter Orchestration Action
These actions can now be used in workflows to automate the tasks. Figure 30 shows a sample workflow for deploying the VMware View desktop pools.

Figure 30. View Orchestration Action in workflows

A web view is a feature of vCenter Orchestrator for creating custom portals that can use the workflows and actions from vCenter Orchestrator. Figure 31 displays a sample web view with links to the vCO workflows.

Figure 31. Workflow web view
The web view in Figure 31 was created using the default web view template with an updated image and default HTML file. The updated HTML file is shown in Figure 32.

![Figure 32. Updated web view HTML file](image)

The workflow is defined as the attribute of the web view as shown in Figure 33.

![Figure 33. Web view attributes](image)

This makes it flexible to modify the workflows without affecting the web views.
VMware View Persona Management configuration

Overview
View Persona Management preserves user profiles and synchronizes them with a remote repository. Persona Management does not require you to configure Windows roaming profiles, and you can bypass Windows Active Directory in the management of View user profiles.

Each tenant has their own Active Directory domain and file share for hosting the View Persona Management.

Persona Management downloads only the files that Windows requires at login, such as user registry files. When the user or application opens other files from the desktop profile folder, these files are copied from the stored user persona to the View desktop.

We followed these steps when configuring our test environment. For detailed information on how to configure Persona Management refer to the *VMware View Administration Guide*.

Group policy
We created the GPO, then edited it and imported the ViewPM.adm template. Figure 34 shows the GPO for a user-created organizational unit (OU, or View-desktops).

![Figure 34. Group policy organization](image-url)
Figure 35 shows the Persona Management Policy manager.

Figure 36 shows the folder redirection and the location of the network share used for the persona repository. In a multitenant environment, each tenant needs to have their own file share. We used the EMC VNX platform to create file shares for each tenant.

Figure 36. Persona repository location
VMware vSphere 5 infrastructure

Overview
VMware vSphere 5 is the market-leading virtualization hypervisor used across thousands of IT environments around the world. VMware vSphere 5 can transform or virtualize computer hardware resources, including CPU, RAM, hard disk, and network controller, to create a fully functional virtual machine that runs its own operating system and applications just like a physical computer.

The high-availability features in VMware vSphere 5, along with VMware Distributed Resource Scheduler (DRS) and Storage vMotion, enable the seamless migration of virtual desktops from one ESXi server to another with minimal or no impact to customer use.

This section discusses the two specific vSphere 5 environments that are used in this solution:
- View Composer and desktop pools environment
- View administrative environment

View Composer (which is used for desktop pools) is shared by all the tenants. The tenant administrator has access to that vCenter server. Within that environment, vCenter security roles are used to restrict access to only that tenant’s environment.

The View administrative environment is deployed as vApps in the vCloud environment. The tenants do not need access to this vCenter server. VMware vCloud Director abstracts the virtual resources and creates the virtual data centers for the tenants to consume for deploying the vApps.

It is possible to merge both environments, and they could be managed by the same vCenter server. In that case, the tenants’ access to the resources of the virtual data center would need to be restricted.

View Composer

Each tenant has their own View Connection Server on their virtual data center. The View Composer server is shared among all tenants. The resource pools created for the organization vDC need to be used for the View Desktop pools.
Figure 37 shows the cluster configuration from the View Composer vCenter server. The T1-Cluster1 hosts 500 desktops, while the rest host 4500 virtual desktops.

Figure 38 shows the resource pools that are created by the VMware vCloud for the organization virtual data centers. The desktop pools are deployed to this resource pool.

Figure 37. Cluster configuration from vCenter Server

Figure 38. Organization resource pools
Figure 39 shows the port groups of the distributed switch on the View Composer vCenter server. We used a VLAN to separate multiple tenants. But, you can also use VMware vCloud Director to create the networks.

![dvSwitch]
- dvSwitch
  - dvSwitch-DVUplinks-961
  - 46 Network (346)
  - 47 Network (347)
  - 75 Network (375)
  - 76 Network (376)
  - dvDesktopNetwork
  - dvMgmt-network 372
  - VMotion-700

**Figure 39. Distributed switch port groups**

**View Cloud vCenter** VMware View administration servers are deployed for each tenant as vApps on their organization’s vDC. Figure 40 shows the View administration environment for two tenants.

You can see the vApps are deployed to their corresponding organization virtual data center resource pools. Even though each organization deploys the VM with the same name, VMware vCloud allows them to use the same name and still be separated.

![Org1vDC (ca12c4bf-8e7d-4406-b565-91cebe995e05)]
- Org1vDC (ca12c4bf-8e7d-4406-b565-91cebe995e05)
  - CB01 (829f09f9-479e-4f73-9ef4-2fbae0f7238)
  - DC01 (426e3ead-eeed-47f1-bda9-bf37b46074c6)
  - DCC2 (3706ed3b-43c-4c31-944f-6bbf4a1fb2be)

![Org2vDC (7a37151c-7e5-40ca-8a51-5abds8e5d742)]
- Org2vDC (7a37151c-7e5-40ca-8a51-5abds8e5d742)
  - DCC01 (916e4d6-3d5d-1e4f-9c9a-ba4fe933d9a9)
  - DCC1 (f5088036-7214-4c85-86b7-40594293f7d4)
  - VCM01 (4b66c37d-9004-4c1e-a647-7f504b96259f)
  - VCM01 (bfbe314a-93b3-4848-8079-ba5ebe9eb0cd)

**Figure 40. Infrastructure cluster**
Figure 41 shows the network port groups for the distributed switch on our View vCloud vCenter server. We kept the View Connection Servers, desktop pools, and View Composer server communicating on their own VLAN for each tenant.

Figure 41. Distributed switch network port groups
## Configuring VNX file for multitenancy

### Overview
This section provides the details of how to configure VNX File for creating the CIFS share on multiple domains.

### Data Mover ports
VNX5700 consists of two Data Movers, which can be configured in an active/active or active/passive configuration. In this solution, the Data Movers operate in the active/passive mode. In the active/passive configuration, the passive Data Mover serves as a failover device for the active Data Mover.

The VNX5700 Data Mover is configured with two UltraFlex™ I/O modules, each consisting of four 1-Gb interfaces. Data Mover is configured to use Link Aggregation Control Protocol (LACP) with all Data Mover ports as shown in Figure 42.

### LACP configuration
Figure 42 shows the configuration of four network interfaces into a single LACP device.

---

### Figure 42. Network interfaces aggregated into one LACP

<table>
<thead>
<tr>
<th>Name</th>
<th>Data Mover</th>
<th>Type</th>
<th>Speed/Duplex</th>
<th>Devices</th>
</tr>
</thead>
<tbody>
<tr>
<td>cge-2-0</td>
<td>server 2</td>
<td>port</td>
<td>auto</td>
<td></td>
</tr>
<tr>
<td>cge-2-1</td>
<td>server 3</td>
<td>port</td>
<td>auto</td>
<td></td>
</tr>
<tr>
<td>cge-2-2</td>
<td>server 2</td>
<td>port</td>
<td>auto</td>
<td></td>
</tr>
<tr>
<td>cge-2-3</td>
<td>server 2</td>
<td>port</td>
<td>auto</td>
<td></td>
</tr>
<tr>
<td>cge-2-4</td>
<td>server 3</td>
<td>port</td>
<td>auto</td>
<td></td>
</tr>
<tr>
<td>cge-3-0</td>
<td>server 2</td>
<td>port</td>
<td>auto</td>
<td></td>
</tr>
<tr>
<td>cge-3-1</td>
<td>server 2</td>
<td>port</td>
<td>auto</td>
<td></td>
</tr>
<tr>
<td>cge-3-2</td>
<td>server 2</td>
<td>port</td>
<td>auto</td>
<td></td>
</tr>
<tr>
<td>cge-3-3</td>
<td>server 2</td>
<td>port</td>
<td>auto</td>
<td></td>
</tr>
<tr>
<td>cge-3-4</td>
<td>server 3</td>
<td>port</td>
<td>auto</td>
<td></td>
</tr>
<tr>
<td>fkg-1-0</td>
<td>server 2</td>
<td>port</td>
<td>10000FD</td>
<td></td>
</tr>
<tr>
<td>fkg-1-1</td>
<td>server 3</td>
<td>port</td>
<td>10000FD</td>
<td></td>
</tr>
<tr>
<td>LACP-0</td>
<td>server 2</td>
<td>lACP</td>
<td>auto</td>
<td>cge-2-0,cge-2-1,cge-3-0,cge-3-1</td>
</tr>
</tbody>
</table>
We used the LACP-0 device to support virtual machine traffic and Persona Management access for roaming profiles.

**Multiple VLANs**

We created the virtual interface devices on the same LACP for each VLAN that requires access to the Data Mover interfaces, as shown in Figure 43.

---

Figure 43. VLAN network interfaces
Virtual data movers

We used Virtual Data Movers (VDMs) to isolate the CIFS servers from the different domains required in multitenant environments. For more information, see Configuring Virtual Data Movers on VNX.

Figure 44 shows the three different VDMs.

CIFS servers

Figure 45 shows the three CIFS servers used for Persona Management and associated VDMs.
vSphere network configuration

Overview

This section describes the network configuration for the View Composer vCenter server. For additional information, see VMware vSphere 5 infrastructure.

vSphere NIC teaming

All network interfaces in this solution use 10 GbE connections. The server Ethernet ports on the switch are configured as trunk ports and use VLAN tagging at the port group to separate the network traffic between various port groups. Figure 46 shows a sample network that was configured for vSphere NIC teaming for the vSwitch configuration in vCenter Server.

![vSwitch configuration in vCenter Server](image)

**Figure 46.** vSwitch configuration in vCenter Server

vSphere port groups

For our test environment, we established four 10 Gigabit Ethernet uplinks per host across all clusters in a vSphere distributed switch configuration. Each port group has its own VLAN ID to segregate network traffic, as shown in Figure 47.
Figure 47. VLAN port groups
Installation and Configuration

This chapter describes how to install and configure this solution and includes the following sections:

- Installation overview
- Installing VMware components
- Installing storage components

Installation overview

This section describes how to configure both the VMware and storage components in this solution, including:

- Desktop pools
- Storage pools
- FAST Cache
- Auto-tiering (FAST VP)
- VNX Home Directory
- PowerPath/VE

The installation and configuration steps for the following components are available on the VMware website (www.vmware.com):

- VMware View Connection Server
- VMware View Composer 2.7
- VMware ESXi 5
- VMware vCenter Server 5

The installation and configuration of the following components are not covered:

- Microsoft Active Directory, DNS, and DHCP
- VMware vSphere 5 and its components
- Microsoft SQL Server 2008 R2
Installing VMware components

Introduction
This section describes how to configure VMware components in this solution.

The installation and configuration steps for the following components are available on the VMware website (www.vmware.com):

- VMware View Connection Server
- VMware View Composer 2.7
- VMware ESXi 5
- VMware vSphere vCenter Server 5

VMware View installation overview
The *VMware View Installation Guide* available on the VMware website has detailed procedures to install View Connection Server and View Composer 2.7. There are no special configuration instructions required for this solution.

The *ESXi Installable and vCenter Server Setup Guide* available on the VMware website has detailed procedures to install vCenter Server and ESXi and is not covered in further detail in this paper. There are no special configuration instructions required for this solution.

VMware View setup
Before deploying the desktop pools, ensure that the following steps from the *VMware View Installation Guide* have been completed:

- Prepare Active Directory
- Install View Composer 2.7 on vCenter Server
- Install View Connection Server (standard and replica)
- Add a vCenter Server instance to View Manager

VMware View desktop pool configuration
As described in *VMware vSphere 5 infrastructure*, 500 desktops are deployed on Tier 1 and 4500 desktops are deployed across both Tier 2 and Tier 3. Two desktop pools were created for the vSphere Tier-1 cluster, each hosting 250 desktops.

We used persistent automated desktop pools in this solution because persistent desktop pools are more complicated than other types. By demonstrating that our solution works with persistent desktops, we support the implication that it can easily work with non-persistent desktop pools also.

We divided our users into groups of 500 and 4500 users to test the heavy work load on the 500 users group. Tiers can be defined according to the needs of the service provider. In our solution we used Tier-1 compute along with Tier-1 storage, Tier-2 compute with Tier-2 storage, and Tier-3 compute with Tier-3 storage.
Figure 48 shows how the persistent automated desktop pools were used.

![Persistent automated desktop pools](image)

**Figure 48. Persistent automated desktop pools**

**User assignment**

As shown in Figure 48 and described in Create desktop pools, we configured User assignment as Dedicated and Enable automatic assignment. You can configure a desktop pool so that users have dedicated assignments or floating assignments to the desktops in the pool. You must choose a user assignment for automated pools that contain full virtual machines, automated linked-clone pools, and manual pools.

With a dedicated assignment, View Manager assigns each entitled user to one desktop in the pool. When a user connects to the pool, the user always logs in to the same desktop. The user's settings and data are saved between sessions. No other user in the pool can access the desktop.

With a floating assignment, View Manager dynamically assigns desktops in the pool to entitled users. Users connect to a different desktop each time they log in. When a user logs off, the desktop is returned to the pool.

You can configure floating-assignment desktops to be deleted when users log off. Automatic deletion lets you keep only as many virtual machines as you need at one time. You can use automatic deletion only in automated pools that you provision with a desktop-naming pattern and a total number of desktops.

Floating-assignment desktops can help you reduce software licensing costs.

**Create desktop pools**

To create a persistent automated desktop pool as configured for this solution, complete the following steps:

1. Log in to the VMware View Administration page, which is located at [https://server/admin](https://server/admin), where “server” is the IP address or DNS name of the View Manager server.
2. Click the Pools link in the left pane.
3. Click Add under the Pools banner.
4. In the Type page, select Automated Pool as shown in Figure 49 and click Next.
5. In the User assignment page, select Dedicated and select the Enable automatic assignment checkbox as shown in Figure 50 and click Next.
6. In the vCenter Server page, select View Composer linked clones and select a vCenter Server that supports View Composer, as shown in Figure 51. Click Next.

![Figure 51. Select View Composer linked clones](image)

We recommend the use of View Composer linked clones. Linked clones provide storage savings by sharing the parent disk. The [VMware View Administration Guide](#) contains more information on this topic.
7. In the **Pool Identification** page, enter the required information as shown in Figure 52 and click **Next**. The pool **ID** is used by the View administrators and the **Display name** is what the users will see in the View Client.
8. In the Pool Settings page, make any required changes as shown in Figure 53 and click Next. We chose to change the State to Disabled.

![Pool Settings](image)

**Figure 53. Pool settings**

Pool Settings has many different settings including remote desktop power policies, auto logoff, allowing users to reset their desktops, and so on. For more information on the various options and the implications of selecting them, refer to additional View documentation available from VMware.
9. In the **View Composer Disks** page click **Next**.

![View Composer Disks](image)

**Figure 54. View Composer Disks**

We chose to configure **View Composer Disks** to redirect disposable files to non-persistent storage in a 4-GB disk because we are only showing a sample workflow for desktop pool creation. The disposable disk contains the paging file and temporary files for the virtual desktop, and it is easier to dispose of them rather than bloating the data disks and requiring a refresh operation to gain the space back. Refer to the following URL for additional View information:

For more information, refer to additional View documentation available from [VMware](https://www.vmware.com/).
10. In the **Provisioning Settings** page, select a name for the desktop pool and enter the number of desktops to provision, as shown in Figure 55. Click **Next**. `{n:fixed=3}` increments the desktop numbering with 3 digits padded. We used the pool ID at the end to easily associate the desktop name to its pool. Also, we unchecked **Enable provisioning** and **Stop provisioning on error** to delay provisioning until a later time, and to ignore errors during provisioning.

![Figure 55. Provisioning settings](image)

We configured the VMware **Provisioning Settings** to provision all desktops up-front to avoid a provisioning delay. We recommend that service providers use the best practices defined by VMware. Typically service providers would need to balance up-front and on-demand provisioning. If you provision all up-front, it uses those resources. If you provision on demand, it will cause delay to the users.
11. In the vCenter Settings page, browse to select a default image, a folder for the virtual machines, the cluster hosting the virtual desktops, the resource pool to hold the desktops, and the data stores that will be used to deploy the desktops as shown in Figure 56, Figure 57, and Figure 58. Then click Next.

*Figure 56. vCenter Settings VM folder location*
Chapter 4: Installation and Configuration

Figure 57. vCenter Settings resource pool selection

Figure 58. vCenter Settings
12. On the Select Datastores page, select the datastores for linked clone images, and then click OK. We used Aggressive as the Storage Overcommit option to allow more desktops for each virtual provisioned datastore as shown in Figure 59. Also, we selected the Use different datastore for View Composer replica disks option to put the replica disk in a separate datastore.

![Select Datastores](image)

**Figure 59. Select the datastores for linked clone images**

We configured Select Datastores for Aggressive Storage Overcommit as well as using a different datastore for the View Composer replica disks. For additional details about the implications of this setting, as well as VMware’s recommendations, refer to the VMware website.
13. In the **Guest Customization** page, select the domain and AD container, and then select **Use QuickPrep**. Click **Next**.

![Guest customization](image)
14. In the **Ready to Complete** page (shown in Figure 61), verify the settings for the pool, and then click **Finish** to start the deployment of the virtual desktops.

![Figure 61. Verify your settings](image)

15. If you chose to disable the pool and disable provisioning during the pool configuration, select the pool and click **Enable Pool** and **Enable Provisioning** as shown in Figure 62.

![Figure 62. Enable Pool and Provisioning](image)
Installing storage components

Overview

In a multitenant environment, it is possible to have multiple storage arrays to meet the unique needs of the environments for specific tenants. In our solution, we used a combination of EMC Symmetrix VMAX and EMC VNX to provide the storage needs of the desktop pools.

This section describes how we installed and configured the storage components used in our solution test scenarios, including:

- EMC Symmetrix VMAX configuration
- EMC VNX configuration

For sizing guidelines and other recommendations, refer to the appropriate EMC documentation.

In this use case we separated our 5000 users into a group of 4500 for normal workload testing, and a group of 500 for heavy workload testing. Service tiers can be assigned as needed for a service provider’s environment. For our solution, we used Tier-1 compute along with Tier-1 storage, Tier-2 compute with Tier-2 storage, and Tier-3 compute with Tier-3 storage.

EMC Symmetrix VMAX configuration

We used a building block approach when configuring the Symmetrix VMAX/SE array. The initial building block was designed to deploy 1000 desktops, with expected usage of 9 IOPS per desktop and corresponding capacity. However, because of compute resource limitations we only deployed 500. The remaining storage can be used to meet any future growth. The remaining desktops were provisioned using VNX.

For additional information on the per-desktop IOPS number and configuration, refer to EMC VDI Proven Solutions Guides.

VMAX details

Table 4, Table 5, and Table 6 list the VMAX configuration details.

Table 4. Tier-1 disk, device and thin pool configurations

<table>
<thead>
<tr>
<th>Drive Capacity and Technology</th>
<th>Spindle count</th>
</tr>
</thead>
<tbody>
<tr>
<td>2TB SATA</td>
<td>16</td>
</tr>
<tr>
<td>450G FC</td>
<td>72</td>
</tr>
<tr>
<td>200G EFD</td>
<td>16</td>
</tr>
</tbody>
</table>

Table 5. Data device configuration

<table>
<thead>
<tr>
<th>Disk type</th>
<th>TDAT size/cylinders</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>SATA</td>
<td>163G / 178039</td>
<td>172</td>
</tr>
<tr>
<td>FC</td>
<td>5.25G / 54886</td>
<td>276</td>
</tr>
<tr>
<td>EFD</td>
<td>11.43G / 12492</td>
<td>128</td>
</tr>
</tbody>
</table>
Table 6. TDEV configuration

<table>
<thead>
<tr>
<th>TDEV pool</th>
<th>Capacity/cylinders</th>
<th>Meta members</th>
<th>Volume size</th>
<th>Total meta volumes</th>
</tr>
</thead>
<tbody>
<tr>
<td>VDI-SATA-P1</td>
<td>217G / 237114</td>
<td>24</td>
<td>5.21TB</td>
<td>5</td>
</tr>
<tr>
<td>VDI-FC-P1</td>
<td>217G / 237114</td>
<td>24</td>
<td>5.21TB</td>
<td>4</td>
</tr>
<tr>
<td>VDI-EFD-P1</td>
<td>50G / 54886</td>
<td>na</td>
<td>450G</td>
<td>4</td>
</tr>
</tbody>
</table>

Creating thin devices

We used the following steps to create the thin devices in our deployment.

1. Create thin pools.

For more information on how to create thin pools, see *Simple Capacity Allocation with EMC Symmetrix Virtual Provisioning Technical Notes*.

Figure 63 shows the three thin pools we created for the desktop deployment.

![Thin pools](image)
2. Create thin devices, build metavolumes and bind them to the thin pool.

Figure 64 shows the 24-member metavolume bound to the thin pool.

Note: The largest Symmetrix VMAX device we can create is 240 GB, which means we needed to build metavolumes to achieve the desired size of 5.5 TB. You must build the metavolume first, before binding the thin devices to a thin pool.

We selected the 5.5 TB size based on previous solutions, and used it as a sample in this environment. For design considerations for your environment, refer to previous EMC VDI-related Proven Solutions Guides.

3. Configure autoprovisioning groups.

For a more detailed description see Storage Provisioning with EMC Symmetrix Autoprovisioning Groups Tech Notes.

Figure 65 shows the Masking View we created and its associated storage, port, and initiator groups.
4. Enable and configure FAST/VP.

For more information see *Implementing Fully Automated Storage Tiering for Virtual Pools (FAST VP) for EMC Symmetrix VMAX Series Arrays*.

Figure 66 shows the FAST policy, associated tiers, and storage group associated with the policy.
This section describes how we configured the VNX storage used in the test environment.

**Tier-2 storage configuration**

We configured four storage pools as described in Table 7. Each pool was on a separate bus and contained seven 2560GB thin LUNs.

<table>
<thead>
<tr>
<th>Drive capacity and technology</th>
<th>Spindle count</th>
<th>RAID type</th>
</tr>
</thead>
<tbody>
<tr>
<td>2TB SATA</td>
<td>16</td>
<td>RAID1/0</td>
</tr>
<tr>
<td>450G FC</td>
<td>56</td>
<td></td>
</tr>
</tbody>
</table>

**Table 7. Tier-2 storage configuration**

**Tier-3 storage configuration:**

We configured two storage pools as described in Table 8. Each pool was on a separate bus and contained four 2560GB thin LUNs.

<table>
<thead>
<tr>
<th>Drive capacity and technology</th>
<th>Spindle count</th>
<th>RAID type</th>
</tr>
</thead>
<tbody>
<tr>
<td>2TB SATA</td>
<td>16</td>
<td>RAID1/0</td>
</tr>
<tr>
<td>450G FC</td>
<td>56</td>
<td></td>
</tr>
</tbody>
</table>

Table 8. Tier-3 storage configuration

We selected our storage sizing and RAID levels based on previous solutions and used the configuration as a sample in this environment. For design considerations for your environment, refer to previous EMC VDI-related Proven Solutions Guides.

**Configuring VNX**

1. Enable FAST CACHE.

Click **Create** on the **FAST Cache** tab of **Storage System Properties** as shown in Figure 67.
Figure 67. Enable FAST Cache

Note: Figure 67 shows that FAST Cache was already enabled on this array, leaving the Create button grayed out.

2. Create storage pools in the EMC VNX OE that supports heterogeneous drive pools. In this solution, we constructed Tier-2 pools using 72 disks with RAID 10 from 56 SAS disks and 16 near-line SAS drives. We created seven thin LUNs, each 2,560 GB in size, from this storage pool.

Figure 68 shows the creation of a storage pool and manually selecting the desired drives for the pool.
Figure 68. Storage pool drive selection

Note: Ensure that FAST Cache is enabled at the storage pool level as shown in Figure 69.

Figure 69. Enabling FAST Cache

3. Create LUNs

Ensure the Thin option is enabled within the General tab and Highest Available Tier is selected in the Tiering Policy within the Advanced tab as shown in Figure 70.
Verify that the host initiator failover mode is set to **Active-Active mode (ALUA) failover mode 4** as shown in Figure 71.

For additional information on ALUA refer to this [EMC VNX technical note](#).
5. Create the storage group and add the newly-created LUNs and registered hosts, as shown in Figure 72 and Figure 73.

---

**Figure 72. Creating the storage group**

**Figure 73. Adding LUNs and hosts**
Testing and Validation

This chapter describes how we set up and ran our solution testing. We used VMware View Planner 2.1 as a validation tool to verify the View Desktop design including storage configuration, network implementation, and workload to make sure the View desktops and pools met the design expectations.

The major topics for this chapter are:

- View Planner 2.1 overview
- View Planner test modes
- Desktop-as-a-Service workload test environment
- Results for the various tests

The View Planner tool is available to consultants from the VMware Professionals Services Organization and to VMware Partners as a download from Partner Central. For more information about evaluating your View deployment with this tool, contact a VMware partner or the VMware Professional Services Organization.

For an introduction to View Planner see the VMware View Planner community forum and the View Planner datasheet.

For complete instructions on using View Planner, see the View Planner Installation and User Guide and Using Custom Applications in View Planner.

View Planner 2.1 overview

Introduction

VMware View Planner is a tool designed to simulate a large-scale deployment of virtualized desktop systems and study its effects on an entire virtualized infrastructure. The tool scales from a few virtual machines running on one VMware ESXi host up to hundreds of virtual machines distributed across a cluster of ESXi hosts. View Planner assists in the setup and configuration of the testing infrastructure, runs a set of application operations selected to be representative of real-world user applications, and reports data on the performance of those operations.

VMware View Planner consists of the following components:

- A number of desktop virtual machines running on one or more ESXi hosts
- A number of client virtual machines running on one or more ESXi hosts (only used in the case of remote mode or passive client mode tests; not used for local mode tests)
- A single controller appliance running on an ESXi host
Figure 74 shows a conceptual overview of a typical View Planner layout.

View Planner is highly flexible and accommodates many testing and usage scenarios. There are three different run modes to test the workload.

- **Remote mode** pairs one desktop virtual machine to each client virtual machine for a fully-representative usage scenario.
- **Passive mode** pairs multiple desktop virtual machines to each client virtual machine, thus reducing hardware requirements while still providing some of the benefits of remote mode.
- **Local mode** minimizes required hardware by using no client virtual machines.

For more information about test modes see View Planner test modes.
The standardized View Planner workload consists of nine applications:

- Microsoft Word
- Microsoft Excel
- Microsoft PowerPoint
- Microsoft Outlook
- Microsoft Internet Explorer
  - Document browse
  - Picture album browse
- Mozilla Firefox
- Adobe Acrobat Reader
- Archiving software
- Video playback software

The applications combine to perform 44 user operations. These user operations are separated into three groups, shown in Table 9. The operations in Group A are used to determine Quality of Service (QoS), while the operations in Groups B and C are used to generate additional load.

**Table 9. View Planner 2.1 user operations**

<table>
<thead>
<tr>
<th>Group A (QoS)</th>
<th>Group B (load)</th>
<th>Group C (load)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AdobeReader: Browse</td>
<td>AdobeReader: Open</td>
<td>7-Zip: Compress</td>
</tr>
<tr>
<td>AdobeReader: Close</td>
<td>Excel_Sort: Open</td>
<td>PowerPoint: SaveAs</td>
</tr>
<tr>
<td>AdobeReader: Maximize</td>
<td>Excel_Sort: Save</td>
<td>Video: Play</td>
</tr>
<tr>
<td>AdobeReader: Minimize</td>
<td>Firefox: Open</td>
<td></td>
</tr>
<tr>
<td>Excel_Sort: Close</td>
<td>IE_ApacheDoc: Open</td>
<td></td>
</tr>
<tr>
<td>Excel_Sort: Compute</td>
<td>IE/WebAlbum: Open</td>
<td></td>
</tr>
<tr>
<td>Excel_Sort: Entry</td>
<td>Outlook: AttachmentSave</td>
<td></td>
</tr>
<tr>
<td>Excel_Sort: Maximize</td>
<td>Outlook: Open</td>
<td></td>
</tr>
<tr>
<td>Excel_Sort: Minimize</td>
<td>PowerPoint: Open</td>
<td></td>
</tr>
<tr>
<td>Firefox: Close</td>
<td>Video: Open</td>
<td></td>
</tr>
<tr>
<td>IE_ApacheDoc: Browse</td>
<td>Word: Open</td>
<td></td>
</tr>
<tr>
<td>IE_ApacheDoc: Close</td>
<td>Word: Save</td>
<td></td>
</tr>
<tr>
<td>IE/WebAlbum: Browse</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IE/WebAlbum: Close</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outlook: Close</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outlook: Maximize</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group A (QoS)</td>
<td>Group B (load)</td>
<td>Group C (load)</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>----------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Outlook: Read</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outlook: Restore</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PowerPoint: AppendSlides</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PowerPoint: Close</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PowerPoint: Maximize</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PowerPoint: Minimize</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PowerPoint: ModifySlides</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PowerPoint: RunSlideShow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Video: Close</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Word: Close</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Word: Maximize</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Word: Minimize</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Word: Modify</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
View Planner test modes

Overview

View Planner tests can run in the following three modes:

- Remote
- Passive
- Local

Remote mode

In this mode there is a remote client virtual machine for each desktop virtual machine. The client controls the workload and views the desktop. This mode requires the most hardware, but it is also the most representative of real-world VDI deployments.

Figure 75 shows the logical operation of VMware View Planner remote test mode.

![Figure 75. VMware View Planner operation (remote mode)]
Passive mode

In this mode the number of client virtual machines can be less than the number of desktop virtual machines. The desktop controls the workload; the client is a passive viewer. This intermediate mode can use less hardware than the remote mode, but it can be more representative of real-world VDI deployments than the local mode.

Figure 76 shows the logical operation of VMware View Planner passive test mode.

![Figure 76. VMware View Planner operation (passive client mode)]
Local mode

This mode uses no client virtual machines. The tests are initiated and run entirely on the desktop virtual machines. Because this mode doesn’t generate the network traffic of a real-world VDI deployment, it is less representative of such deployments than the passive or remote modes. However, local mode uses less hardware than either of the other modes to run the same number of desktop virtual machines.

The local mode is designed to validate the storage design for the VDI deployment.

Figure 77 shows the logical operation of VMware View Planner local test mode.

![VMware View Planner operation (local mode)]
Desktop-as-a-Service workload test environment

In our test environment we deployed the View desktop pools using View 5 Composer. Connection Servers connected with vCenter though View Planner 2.1 provided a provisioning capability to deploy desktops.

On vCenter, there are different ESXi 5 clusters configured on each tier. As shown in Figure 78, the T1-Cluster1 has four ESXi 5 hosts which hosted 500 premium View desktops.

Figure 78. vCenter Tier 1 clusters

Figure 79 shows the View desktop pool configuration for the Org1.local domain.

Figure 79. View Desktop pool configuration
Figure 80 shows the View desktop properties and status.

Figure 80. View Desktop properties

View Planner 2.1 provides a web interface to configure the workload, provision the desktop, run the workload, and create the test report. Figure 81 shows the View Planner 2.1 vCenter configuration.

Figure 81. View Planner vCenter configuration
Figure 82 shows the workload profile we used for the testing. As shown, for the multimedia application, we selected FAST mode to play video for achieving higher IO per virtual desktop.

Figure 82. Workload profile

Figure 83 shows the example run profile for passive client mode testing. In this case, we used 12 Windows XP client machines to run 500 remote desktop sessions against 500 premium View desktops in the Org1.local domain.

Figure 83. Passive client mode run profile
Test results: 5000 View Desktops in local mode

We tested 5000 View desktops which consisted of 4500 standard VMs and 500 premium VMs with normal workloads (slow video play) to verify the storage design. With the workload running on all VMs across eight ESXi 5 clusters and 52 CISCO UCS blades, the datastores and their associated VNX/VMAX LUNs passed the workload test, as shown in the following report:

Test Name: Test-5000-New
Test Mode: local

QoS Summary
----------
Group A : PASSED
The 95th percentile was: 0.654565 seconds
(To pass, this must not be more than 1.5 seconds)

Workload Summary
-----------------
Users: 4996
Iterations (Total): 5 (to pass, this must be at least 5)
Iterations (Scored): 3

Workload Status: PASSED
Figure 84 shows the operational latencies found in the 5000 View desktops local mode test.

![Mean operational latencies for 5000 desktop local mode test](image)

**Figure 84. Mean operational latencies for 5000 desktop local mode test**

These are latencies, in seconds, for each operation with the different workloads across 5000 desktop VMs. Among all latencies for each application, the highest one (about 17 seconds) is the PPTx-Save As operation for 5000 Windows 7 desktops. This is equivalent to 3.4 ms latency for each VM during the Microsoft PowerPoint Save As operation, which is fully acceptable from the end-user perspective.
As shown in Figure 85, during the workload test the average disk write IOs per second on each disk is about 100 IOPS. For this specific host, it correlates to an average of 10 IOPS per Windows 7 VM.

**Figure 85.** Average disk IO per second
Test results: 5000 View Desktops with mixed workload in local mode

In this test, we used two View Planner appliance instances to run two different workloads on two different View desktop pools in local mode to validate the storage design:

- View Planner Appliance 1: 4500 View desktops with normal workload
- View Planner Appliance 2: 500 View desktops with heavy workload

Both workload tests passed.

Figure 86 shows the View Planner Appliance 1 run profile.

![View Planner Appliance 1 run profile](image1)

Figure 87 shows the View Planner Appliance 2 run profile.

![View Planner Appliance 2 run profile](image2)
The operational latencies for the 4500 VMs are shown in Figure 88.

![Graph showing mean operational latencies for 4500 View Planner users in local mode](image)

**Figure 88.** Mean operational latencies for 4500 View Planner users in local mode

The operational latencies for the 500 VMs are shown in Figure 89.

![Graph showing mean operational latency for 500 View Planner users in local mode](image)

**Figure 89.** Mean operational latency for 500 View Planner users in local mode
Test results: 500 View Desktops with heavy workload in local mode

In this test, we used the normal workload plus video play in fast mode to simulate a heavy workload on 500 View desktops. Figure 90 shows that the highest latency is also on the Microsoft PowerPoint Save As operation. This indicated that among 500 heavy workload VMs, the average latency for each VM running Microsoft PowerPoint Save As can be as high as 24 ms when the mean operational latency is 12 seconds.

The workload test passed, as shown in the following summary report:

Test Name: Test-500
Test Mode: local

QoS Summary
-----------
Group A :  PASSED
The 95th percentile was: 0.527169 seconds
(To pass, this must not be more than 1.5 seconds)

Workload Summary
-----------------
Users: 500
Iterations (Total): 5 (to pass, this must be at least 5)
Iterations (Scored): 3

Workload Status: PASSED

Figure 90.  Mean operational latencies for 500 View Planner users in local mode
Figure 91 shows the average disk IOPS on the ESXi 5 host.

**Figure 91. Average disk IOPS for 500 user heavy workload local mode test**

**Test results: 500 View Desktops with heavy workload and persona management in passive mode**

With the View Persona Management feature, a user's remote profile is dynamically downloaded when the user logs in to a View desktop. In the test environment, we configured View to store user profiles in a secure, centralized repository as a CIFS file share on EMC VNX5700 storage array.

View Persona Management is an alternative to Windows roaming profiles. View Persona Management expands functionality and improves performance compared to Windows roaming profiles. A user profile is independent of the virtual desktop. When a user logs in to any desktop, their same profile appears.

We tested 500 View desktops which consisted of two View Server pools. The test was run in passive client mode. We enabled persona management and used 12 Windows XP clients to push the workload. Each client VM is configured to launch multiple remote desktop sessions to connect 500 View desktops with unique login IDs.
We ran the test with heavy workload (fast video play) running on all VMs across four ESXi 5 cluster nodes and four CISCO UCS blades. We used Symmetrix VMAX storage for this test, and placed the VMs on fast EFD and FC drives. The workload passed with the following summary report:

Test Name: Test 500 ORG1
Test Mode: Passive

QoS Summary
------------
Group A : PASSED
The 95th percentile was: 0.815619 seconds
(To pass, this must not be more than 1.5 seconds)

Workload Summary
-----------------
Users: 492
Iterations (Total): 5 (to pass, this must be at least 5)
Iterations (Scored): 3

Workload Status: PASSED

Figure 92 shows the operational latencies for each application.

Figure 92. Mean operational latencies for 500 View Planner users in passive mode
Figure 93 shows the host CPU utilization during the workload test.

![CPU utilization during passive mode test](image1)

**Figure 93.** CPU utilization during passive mode test

Figure 94 shows the disk IOPS for all disks connected to one of the ESXi 5 hosts housing View desktop VMs.

![Disk IOPS for all disks](image2)

**Figure 94.** Disk IOPS for all disks
6 Conclusion

This section summarizes our test results and includes the following sections:

- Summary
- Findings
- References

Summary

EMC VNX and EMC Symmetrix VMAX unified storage handle the requirements for block and file storage in multitenant environments. VMware View with VMware vCloud Director lets service providers offer virtual desktop pools to multiple tenants. RSA SecurID provides the additional authentication security for the virtual desktop environment.

Findings

We confirmed the following key results during the testing of this solution:

- Solution is scalable to at least 5000 virtual desktops
- Maintained secure separation between multiple customers using the same cloud infrastructure
- Integrated VDI deployment with an existing CaaS infrastructure for both the service provider and the customer to manage their resources
Chapter 6: Conclusion

References

White papers
Refer to the following white papers, available on the EMC online support website, for information about solutions similar to the one described in this paper:

- **EMC Compute-as-a-Service**
- **EMC Desktop-as-a-Service Enabled by EMC VNX, EMC Symmetrix VMAX, VMware vCloud Director, VMware vSphere 5, and VMware View 5—Reference Architecture**
- **EMC Infrastructure for Virtual Desktops Enabled by EMC VNX Series, VMware vSphere 4.1, VMware View 4.5, and VMware View Composer 2.5—Proven Solution Guide**
- **Deploying Microsoft Windows 7 Virtual Desktops with VMware View—Applied Best Practices Guide**
- **EMC Performance Optimization for Microsoft Windows XP for the Virtual Desktop Infrastructure—Applied Best Practices**

If you do not have access to this content, contact your EMC representative.

Other documentation
The following documents are available on the VMware website:

- **Introduction to VMware View Manager**
- **VMware View Manager Administrator Guide**
- **VMware View Architecture Planning Guide**
- **VMware View Installation Guide**
- **VMware View Reference Architecture**
- **Storage Deployment Guide for VMware View**
- **VMware View Windows XP Deployment Guide**
- **VMware View Guide to Profile Virtualization**