



VMware View™ Backup Best Practices

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DEPLOYMENT AND TECHNICAL CONSIDERATIONS GUIDE

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Executive Summary

VMware View is a cost effective, “best of breed” virtual desktop solution. It that allows businesses to deliver office systems, applications, and infrastructure to users as a high performance, highly scalable centralized managed service. View also provides the capabilities needed to protect the systems and applications it supports and the associated user data. It enables archived data to be backed up and restored conveniently.

Typically, businesses initially protect their virtual desktop environment using the backup methodologies they have already deployed to support their physical infrastructure. In some cases, this standard practice is sufficient. In other situations, businesses implement solutions for backing up and restoring View that are designed specifically for the virtual environment.

This white paper describes a VMware best practices approach businesses can use to build View data backup and recovery solutions for the datacenter including a reference architecture that can be used to develop these solutions. It also describes backup and restore scenarios for View storage components and procedures for implementing these scenarios. Note that this paper does not address disaster recovery procedures for the View environment.

This paper is written as a deep-dive for experienced architects and engineers who are responsible for developing backup solutions for the VMware View environment. This paper assumes that the reader has an advanced knowledge of virtualization, VMware vSphere and View, and Microsoft Active Directory and Active Directory Lightweight Directory Services (AD LDS), also called ADAM.

It is written as a companion to other published materials about VMware View. The Resources section at the end of this paper provides a complete list of reference documents for VMware View.

View Architecture Overview

VMware View enables IT departments to run virtual desktops in the datacenter and deliver desktops to the user's client device as a managed service. View enables authorized end users to use a familiar, personalized environment that they can access on demand from any number of devices anywhere, and at any time. View allows administrators to maintain centralized control, operational efficiency, and the security of their desktop systems, applications, and the associated data from the datacenter, rather than from the user's PC.

View is used to configure the virtual desktop environment, create administrators, provision and deploy View desktops, set up user authentication, configure policies, and manage virtualized applications. See the Resources section at the end of this paper for more information.

Understanding View Architecture

A typical VMware View deployment with each of its key components is shown in the figure below.

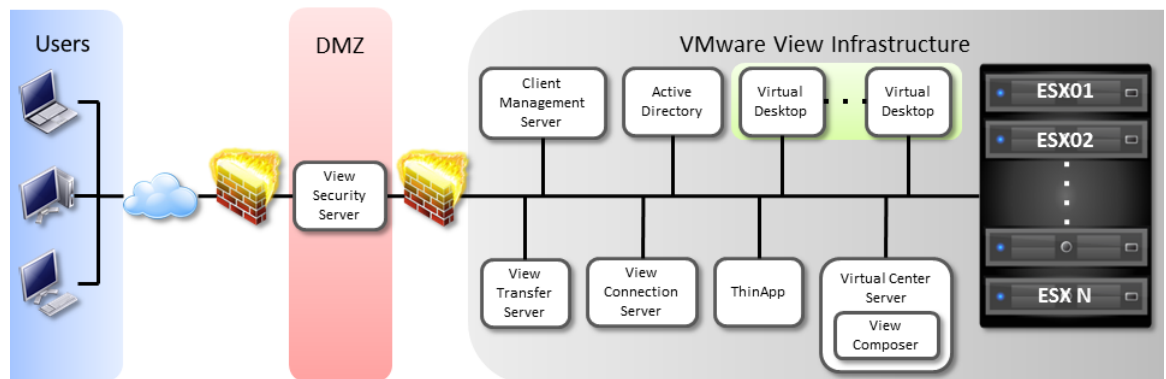


Figure 1. High level example of a VMware View deployment

View Components

The key components of View include View Client, View agent and guest, View server, other VMware product components, and vendor components that can be used with View, as described in the following sections.

View Client Components

The View Client components are described in the table below.

Table 1. VMware View client components

VIEW COMPONENT	DESCRIPTION
View Client	<p>The types of View Clients include:</p> <ul style="list-style-type: none"> • Zero client. Hardware device that is built for presenting View desktops. This device has no operating system. It is simple to use and requires little maintenance. • Thin client. Hardware device that is built for presenting View desktops. This device runs a custom-built operating system and it has View Client software pre-installed.

VIEW COMPONENT	DESCRIPTION
	<ul style="list-style-type: none"> • Thick client. Windows PC or Mac computer that has View Client installed locally for accessing View desktops. • Tablet client. Tablet device that has the VMware Client software preinstalled. <p>Note that View Client with Local Mode (formerly called Offline Desktop) has been extended to allow end users to download or “check out” virtual machines and use them on their local systems, either with or without a network connection.</p>

View Agent and Guest Components

The View agent and guest components are described in the table below.

Table 2. VMware View agent and guest components

VIEW COMPONENT	DESCRIPTION
View Agent	Service that is installed on all virtual machines, physical systems, and Terminal Service servers that act as sources for View desktops. This agent communicates with View Client to provide features such as connection monitoring, virtual printing, and access to locally-connected USB devices.
View Composer Agent	Service that is active when recomposing or provisioning the machine. If linked-clones are not enabled, this agent does not get installed.
View Guest	This virtual machine serves as a View desktop for thin client users.

View Server Components

The View infrastructure components including View Connection Server, View Security Server, View Composer, and View Transfer Server are described in the table below.

Note that all View servers run on the Microsoft Windows Server operating system.

Table 2. VMware View server components

VIEW COMPONENTS	DESCRIPTION
View Connection Server	<p>This server acts as a broker for client connections. View Connection Server authenticates and manages users through Active Directory, and directs the request to the appropriate virtual machine, physical or blade PC, or Windows Terminal Services server.</p> <p>It uses AD-LDS to store configuration data. Inside the corporate firewall, a group of two or more View Connection Server instances can be installed and configured. In this case, View configuration data is stored in an embedded AD-LDS directory and replicated among members of the group.</p> <p>View Connection server communicates with vCenter in order to manage the virtual desktops.</p>

VIEW COMPONENTS	DESCRIPTION
View Security Server	View Security Server can optionally be installed outside the corporate firewall, in the DMZ, and configured as a Security Server (using Security Server mode). The Security Server offers a subset of View Connection Server functionality and it is not required to be in an Active Directory domain.
View Composer	When installed on a vCenter Server instance, View Composer can rapidly create linked-clone desktop pools (desktop images) that share virtual disks with a specified parent virtual machine using a single, centralized master image. Unlike View Connection server, View Composer uses a separate database server to store its configuration. The View Composer database backup and control procedure can be manually controlled from the Administrator console.
View Transfer Server	This server manages and streamlines data transfers between the datacenter and View Local Mode enabled clients that have the Desktop checked out. View Transfer Server is required to support desktops that run View Client with Local Mode.

Other VMware and Vendor Products Used with View

View deployments are typically used with VMware products including VMware ThinApp, VMware ESX server, and VMware vCenter, as well as other compatible vendor products.

Table 3. VMware and vendor products used with View

COMPONENTS	DESCRIPTION
VMware ThinApp	ThinApp decouples an application from the underlying operating system and its libraries and framework, and it bundles the application into a single executable file called an application package.
VMware vSphere (ESX server hosts)	vSphere is the platform for virtual desktop provisioning, hosting, and high availability services. It also hosts View components including View Connection Server instances, Active Directory servers, and vCenter instances.
VMware vCenter	vCenter manages the assignment of virtual machines to physical servers and storage, as well as CPU and memory resources to virtual machines. It provides the central point for configuring, provisioning, and managing virtual machines, and for managing all VMware ESX/ESXi servers connected on a network. When installed on a vCenter server instance, View Composer enables View to communicate with the vCenter host. View Composer can then rapidly create linked-clone desktop pools. See View Composer above for more details.
Microsoft Active Directory	VMware View relies on Active Directory for user authentication and management.
Microsoft AD-LDS	VMware View uses AD-LDS to store virtual desktop infrastructure configuration information. On View Connection Servers, AD-LDS is an embedded LDAP directory that is provided as part of the installation.

COMPONENTS	DESCRIPTION
Vendor Client Management Servers	Most of the client vendors have their own client management servers. These servers can provide remote configuration, firmware updates, and power control functionality. Please check the vendor information for your client management server for more information.

View Operation Workflow

The workflow within a typical VMware View deployment performs as follows:

1. User connects to the View environment using View Client as a zero, thin, thick, or tablet client.
2. In scenarios where the View user connects, the user initially connects to View Security Server. The Security server acts as the external network gateway to View and it is typically placed in the DMZ. The Security server forwards all session requests to the internal View Connection Server.
3. View Connection Server acts as the session broker between virtual desktop and user's View Client. It authenticates and manages users through Active Directory. It connects the end point device with the appropriate virtual machine, physical or blade PC, or Windows Terminal Services server. All View settings are stored on an AD-LDS store.
4. In scenarios where View Composer is used, View communicates with View Composer and pre-provisions the linked-clone desktops from a single master image.
5. Once View Connection Server authenticates the user, the virtual desktop session is initiated. In this case, View Connection Server retrieves the virtual desktop virtual machine resource for the user.
6. In scenarios where Local Mode is enabled, View Connection Server uses View Transfer Server to create, track and transfer local mode virtual machine images. All virtual machine images on View Transfer Server are encrypted by default.

Storage Configuration

The storage configuration for a typical VMware View deployment is shown in the figure below.

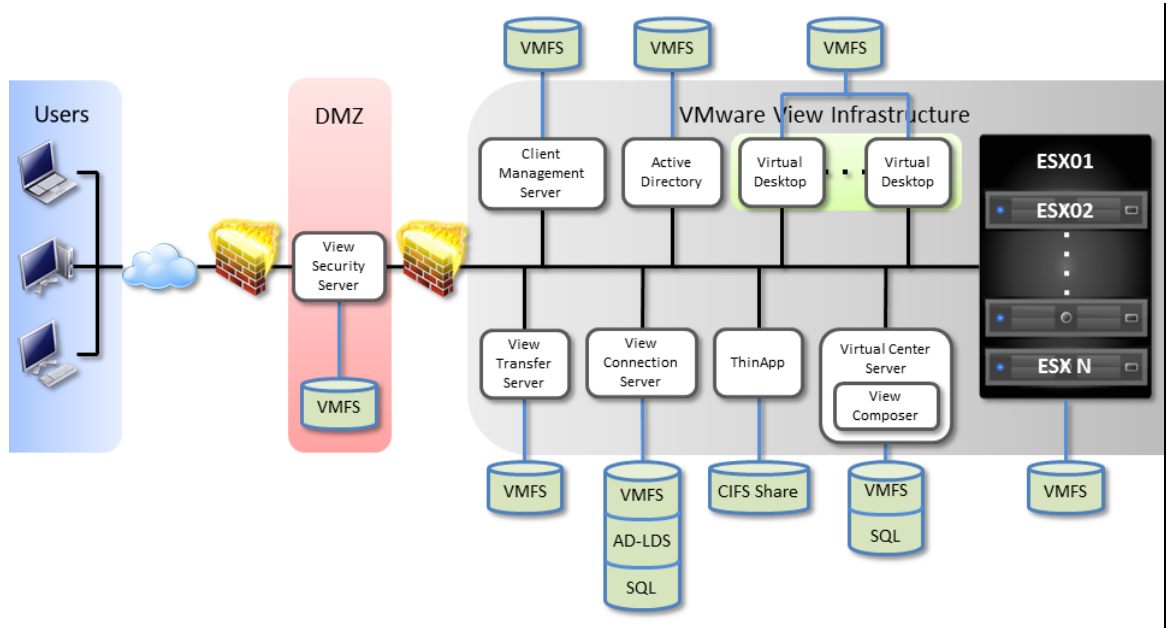


Figure 3. Example of VMware View Storage Configuration

View Storage Components

The View storage components for fully virtualized environments are described in the table below.

Table 4. View storage components

COMPONENTS	DESCRIPTION
VMDK containers for virtual machine storage	vSphere uses the VMware Virtual Machine File System (VMFS) for the storage of virtual machines. This high-performance file system is optimized to store large files such as virtual machine disk images. In the virtual implementation of View, all View components are stored on VMFS volumes and run in VDMK (virtual disk) containers. In addition, vCenter, Active Directory, and AD-LDS servers are installed as virtual machines and run in VMDK containers.
AD-LDS store for View configuration	The AD-LDS service database stored in Active Directory contains configuration data and events/logs. By default, this database resides on View Connection Server.
View Connection Server logs database	View Connection Server can be configured to use the event database hosted on Microsoft SQL Server. The event database holds historical data that is not critical to View functionality.
vCenter and View Composer databases	vCenter and View Composer rely on Microsoft SQL Server or Oracle Database to store configuration and run-time data.
CIFS share for ThinApps	CIFS acts as the primary storage for ThinApp applications. ThinApp can run on any storage appliance or virtual machine hosting a CIFS share.

View Backup and Restore

This section describes the steps needed to perform a complete backup and restore of View components.

View Components Requiring Backup

View back up includes the components and functionality that is needed for the View environment to function properly. The critical View components include:

- View Connection Server
- View Composer (if installed)
- vCenter server and ESX hosts for virtual desktop virtual machines
- Active Directory

In addition, the critical database components include:

- View Connection Server AD-LDS datastore
- View Composer database (if installed)
- vCenter server database

VMware recommends backing up all View components at the same time to avoid data discrepancies.

Note: If the View Composer database is attached to a new installation of the View Composer service, first transfer the RSA key container that was created by the original View Composer service to the new host system. For more information, see the View Manager Administration Guide:

http://www.vmware.com/pdf/view45_admin_guide.pdf, on page 267

View Backup Procedures

Perform a backup of the View environment in the following sequence:

- Back up vSphere
- Back up View Connection Server AD-LDS datastore
- Back up View Composer database
- Back up vCenter database

Each of these procedures is described in the sections below.

Backing Up vSphere

To back up the vSphere

Use the recommended steps to back up and restore vSphere and VMFS volumes in the upgrade guide associated with your version of the product:

http://www.vmware.com/support/pubs/vi_pubs.html

Backing Up the View Connection Server AD-LDS Datastore

To back up the View Connection Server AD-LDS datastore

For more information, see the View Manager Administration Guide:

http://www.vmware.com/pdf/view45_admin_guide.pdf

1. Verify that there are no ongoing create, recompose, and delete operations in progress.
2. Disable provisioning of new virtual machines from all pools to prevent data synchronization problems:
 - a. Click **View Administrator > Pools**.
 - b. Select each Pool and click **Status**.
 - c. Click **Disable Provisioning...** and then click **OK**.

LDIF data is exported from View Connection Server using the vdmexport.exe tool that accompanies each standard and replica of View Connection Server. The path to the executable file is:

C:\Program Files\VMware\VMware View\Server\tools\bin\vdmexport.exe
3. From the command prompt on a standard or replica View Connection Server, create a file called VDMConfig.LDF by executing the command:


```
vdmexport > vdmconfig.ldf
```

VDMConfig.LDF contains the exported View LDAP configuration information.

Backing Up the View Composer Database

To back up the View Composer database

1. Stop the View Composer service to get a clean backup of the database:
 - a. Click **Start > Administrative Tools > Services**.
 - b. Right-click VMware View Composer service.
 - c. Choose **Stop**.

Note: When the View Composer service is stopped, it stops accepting any new requests for linked-clone related operations. Current actions on the View Composer database finish and the service shuts down. Any View Composer operations attempted (recompose/refresh) through the View Administrator fail, which can leave clones in an erred state. This can be fixed by manually recomposing or refreshing the desktop.
2. Back up the View Composer database. Follow the recommended practice for backing up the database with third party utilities.

For quick verification with Microsoft SQL 2005 databases:

- a. Right-click on the database.
- b. Choose **Tasks**.
- c. Click **Backup**. By default, the backup is stored in:


```
C:\Program Files\Microsoft SQL Server\MSSQL.1\MSSQL\Backup\<database_name>.bak
```

Backing Up the vCenter Database

To back up the vCenter database

1. Perform the backup of the vCenter database. See the instructions in the vSphere 4.x Backup Knowledge Base article:

http://kb.vmware.com/selfservice/microsites/search.do?language=en_US&cmd=displayKC&externalid=1023985%20

2. Restart the View Composer service.
3. Enable provisioning of new virtual machines from all pools:
 - a. Click **View Administrator > Pools**.
 - b. Select each Pool and click **Status**.
 - c. Click **Enable Provisioning...** and then click **OK**.

View Restore Procedure

Perform a restore of the View environment from backups as described below.

To restore the View backup

1. Verify that there are no ongoing create, recompose, and delete operations in progress.
2. Stop the View Connection Server service:
 - a. Click **Start > Administrative Tools > Services**.
 - b. Right-click VMware View Connection Server service and select **Stop**.
3. Stop the View Composer Service:
 - a. Click **Start > Administrative Tools > Services**.
 - b. Right-click VMware View Composer service and select **Stop**.
4. Restore the vCenter database. See the instructions in the vSphere 4.x Backup Knowledge Base article: http://kb.vmware.com/selfservice/microsites/search.do?language=en_US&cmd=displayKC&externalid=1023985%20

Note: Stop the VMware vCenter Server service before attempting a restore.
5. Restore the View Composer database. Use the recommended practice for restoring your database with third party utilities.

Note: If the View Composer database is attached to a new installation of the View Composer service, first transfer the RSA key container that was created by the original View Composer service to the new host system. For more information, see the View Manager Administration Guide:

http://www.vmware.com/pdf/view45_admin_guide.pdf, on page 267

For quick verification with Microsoft SQL Server 2005 databases:

- a. Right-click on the database.
- b. Choose **Restore**.
- c. Click **Database**.

Restore the View Manager AD-LDS datastore. see the View Manager Administration Guide.

To uninstall View Connection Server and AD-LDS:

Note: If restoring to a multi-broker environment, uninstall all Connection Server instances.

- a. Click **Start > Control Panel > Add/Remove Programs**.
 - b. Click VMware View Connection Server and click **Remove**.
 - c. Click and AD-LDS (ADAM) Instance VMwareVDMDS and click **Remove**.
6. Reinstall View Connection Server, AD-LDS with View Connection Server. If restoring to a multi-broker environment, install only one instance of the View Connection Server.
 7. LDIF data is imported into View Connection Server using the vdmimport.exe tool that accompanies each standard and replica View Connection Server. The path to the executable file is:


```
C:\Program Files\VMware\VMware View\Server\tools\bin\vdmimport.exe
```

- a. From the command prompt on a standard or replica View Connection Server, import View LDAP backup file VDMConfig.ldf using this command:

```
vdmimport -f vdmconfig.ldf
```
- b. If this is a single View Connection Server environment, proceed to Step c. If restoring to a multi-broker environment, reinstall the remaining View Connection Servers making them replicas of the one that was restored.
- c. Verify that the View Connection Server, View Composer, and vCenter Server services are started.

View Backup Troubleshooting

Reconciliation is required when the View Connection Server environment is out of sync with the current state due to administrator actions taken after the backup. Examples of common situations where reconciliation is required are described below.

Case 1: Missing desktops appear in the View Manager Admin user interface after a restore of the View Connection Server's AD-LDS database. This typically occurs when the administrator takes either of these actions after the backup, but before the restore:

- Deletes pools and/or desktops.
- Recomposes a desktop pool, which results in the removal of unassigned desktops (spare virtual machines).

In this case, the View administrator manually removes missing desktops/pools from the View Manager Admin user interface.

Case 2: Some automated desktops may become disassociated from their pools when a View administrator creates a pool between the time the backup took place and the restore time.

In this case, the View administrator can return them to use by cloning the linked-clone desktop as a full clone desktop through vCenter, creating it as an Individual desktop in View Manager, and assigning the desktop to a specific user.

Case 3: After restoring vCenter, the administrator removes orphaned virtual machines pertaining to View desktop pools using the VMware infrastructure client.

Orphaned virtual machines and templates appear as disconnected in the VMware infrastructure client. In this case, restart the vCenter Server service. Disconnected virtual machines may appear with an erroneous status of READY in the View Server Admin user interface.

Contact VMware Support for instructions for removing orphan sources and replicas under VMwareViewComposerReplicaFolder after a restore from backup. Some orphan replicas and sources are removed by subsequent actions by View Composer.

Virtual Desktop Backup Scenarios

In addition to the View backup procedures described above, virtual desktop backup scenarios might be required, depending on how the virtual machine pools and storage is configured.

These additional backup scenarios can include:

- Linked-clone desktops
- Stateful virtual desktops
- Stateless virtual desktops

Each of these backup scenarios is described in the sections below.

Linked-Clone Desktops

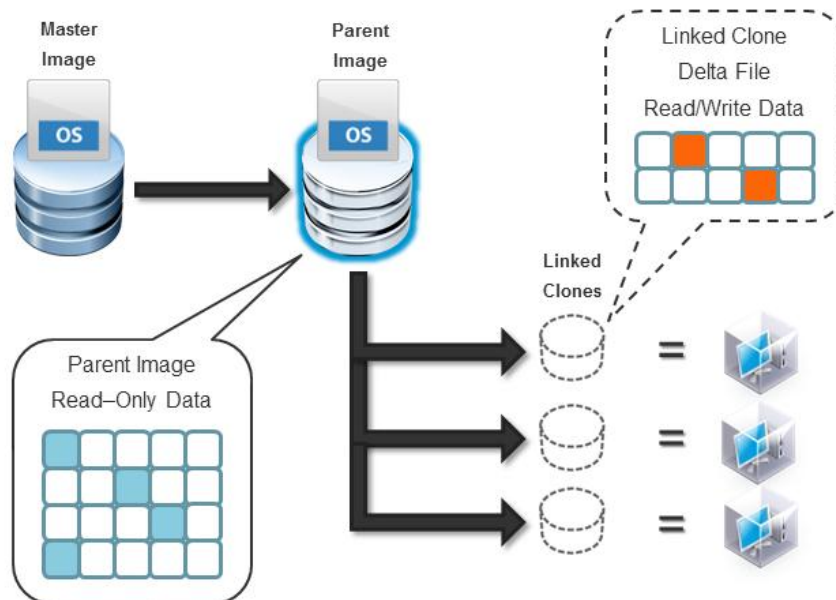


Figure 5: VMware View linked-clone desktops

Linked-clones created using the VMware Storage API generate a single VMDK file for backup. Restoring the virtual machine is challenging since there are no tools to split the backup VMDK image into the original parent and snapshot images. The recommendation is to restore the backed up virtual machine as a separate virtual machine in vSphere. Once the virtual machine is restored, go to View Administrator console and add a virtual desktop in View as a dedicated virtual machine.

Stateful Virtual Desktops

In a stateful desktop pool scenario, all virtual desktops retain user data when the user logs back in to the virtual desktop. In this case, VMware recommends backing up the virtual machines with third party tools as with any other virtual machine in vSphere.

Stateless Virtual Desktops

In the stateless desktop architecture, virtual desktop does not retain the desktop state when the user logs back into the desktop. This architecture relies on ThinApp applications and user data disks configured on a separate volume. In this case, there is no need to back up the virtual machines.

Backup Frequency Recommendations

The frequency for backing up View components and functionality is defined according to the criticality of the component in the View environment. The recommendations described in the table below are provided as a guideline for building a backup strategy. These guidelines may vary in actual practice.

Table 5. Recommendation for minimum backup frequencies

COMPONENT	INCREMENTAL BACKUP FREQUENCY	FULL BACKUP FREQUENCY	DESCRIPTION
View Composer event database	Daily	Daily	The View Composer event database is critical for the View environment to function properly. VMware highly recommends implementing high availability for SQL Server.
vSphere SQL Server database	Daily	Weekly	The vSphere SQL Server database is critical for the View environment to function properly. VMware highly recommends implementing high availability for SQL Server.
Active Directory database	As per Microsoft best practices	As per Microsoft best practices	Active Directory is critical for the View environment to function properly. VMware highly recommends implementing high availability for Active Directory.
AD-LDS database	Daily	Daily	AD-LDS is critical for the View environment to function properly. VMware recommends daily backups for this database.
View Transfer Server	Weekly	Monthly	View Transfer server hosts files are required with Local Mode enabled desktops, thus daily backup is highly recommended.
Stateful View virtual desktops	Daily	Weekly	VMware recommends backing up virtual desktops frequently since user data is stored on the virtual desktops.
ThinApp share repository	Daily	Weekly	Some ThinApps can be configured to store user data on this share. VMware highly recommends keeping files on a highly available share.
View Connection Server	Weekly	Monthly	View Connection Server does not change frequently, thus monthly server backups are adequate to keep your server up-to-date.
View Security Server	Weekly	Monthly	View Security Server does not host any significant data, thus a full backup monthly is sufficient.

COMPONENT	INCREMENTAL BACKUP FREQUENCY	FULL BACKUP FREQUENCY	DESCRIPTION
vCenter server	Weekly	Monthly	vSphere server does not store frequently changing files, thus a full backup monthly is sufficient.
View Composer Server	Weekly	Monthly	Since View Composer server has to reside on the same operating system where vCenter server is installed, the backup frequency is the same as for vCenter server.
View Error Log SQL database	Weekly	Monthly	SQL database can be configured for View Connection Server to log user logins, desktop provisioning information, errors, and similar data. Data in the database changes frequently, but it is not required for View to function properly.
ESX hosts	None	Once	The ESX host typically does not need to be backed up due to the nature of the servers, especially in highly available vSphere configurations.
View replica servers	None	None	Backup is not required for View Security and View Connection replica servers.
Vendor client management servers	None	Once	Vendor client management servers are not required for the View environment to function properly as they do not store historical data.

Other Considerations

View components are considered to be physical when any part of the View server software is running non-virtualized operating systems. In some scenarios, View Connection Servers, virtual desktop blade PCs and View Security Servers can run on dedicated servers in a non-virtualized environment. In this case, VMware generally recommends following the backup procedure for the physical environment that is established within your organization.

Conclusion

VMware View is a cost effective, “best of breed” virtual desktop solution. It that allows businesses to deliver office systems, applications, and infrastructure to users as a high performance, highly scalable centralized managed service. View also provides the capabilities needed to protect the systems and applications it supports and the associated user data. It enables archived data to be backed up and restored conveniently.

This white paper describes a VMware best practices approach businesses can use to build View data protection solutions for the datacenter. The paper provides a reference architecture that can be used to develop VMware View backup and recovery solutions. It also describes backup and restore scenarios for View storage components and procedures for implementing these scenarios. Note that this paper does not address disaster recovery procedures for the View environment.

In particular, a well-planned View backup strategy improves business infrastructure availability. Implementing a stateless desktop architecture removes the need to backup virtual desktop machines, thus removing virtual Infrastructure complexity, which simplifies manageability and can reduce support cost. For highly critical systems, VMware also recommends implementing high availability architecture for virtual desktops.

Resources

For more information about VMware and related products, use the links and references below.

VMware References

- VMware View Administration Guide and release documentation:
http://www.vmware.com/support/pubs/view_pubs.html
- VMware View Architecture and Planning Guide and other documentation:
http://www.vmware.com/support/pubs/view_pubs.html
- VMware Infrastructure 3 Documentation including hardware compatibility list and release notes:
http://www.vmware.com/support/pubs/vi_pubs.html
- VMware Documentation:
<http://www.vmware.com/support/pubs/>
- VMware Licensing:
<http://www.vmware.com/support/licensing/>
- Application Performance Troubleshooting:
<http://www.vmware.com/resources/techresources/10066>
- VMware vSphere 4.1 Performance Best Practices:
<http://www.vmware.com/resources/techresources/10161>
- VMware Proven Best Practices (VIOPS):
<http://communities.vmware.com/community/viops>
- VMware Solutions/Product/Partner Podcasts:
<http://www.vmware.com/technical-resources/podcasts/>
- VMware Global Support KB:
<http://kb.vmware.com>
- VMware Global Support Videos:
<http://blogs.vmware.com/kbtv/>
- VMware TV:
<http://www.youtube.com/user/vmwaretv>
- VMworld TV:
<http://www.youtube.com/user/VMworldTV>
- VMware KB TV:
<http://www.youtube.com/user/VMwareKB>

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Appendix A: VMware View Backup Automation

This paper describes how to back up View directly using the View Administrator and its various backup menus. Appendix A describes how View backups can also be performed through the View API using automation scripts.

View backup automation scripts can be enabled using any of the following tools:

- **Microsoft Windows PowerShell.** This interactive command console and scripting language allows you to manage the latest Windows machines and various applications.
- **VMware View PowerCLI.** The VMware snap-in for Power Shell is installed on View Connection server by default. More information about PowerCLI, go to PowerShell Integration with VMware® View™ 4.5/4.6 at: <http://www.vmware.com/files/pdf/techpaper/PowerShell-Integration-View45-WP.pdf>
- **VMware vSphere PowerCLI.** This snap-in can be installed on Windows servers to provide script automation tools for both vSphere administrators and software developers. For more information, go to: <http://www.vmware.com/technical-resources/script-automation/>

Vendors can also use the VMware VDDK API automation tool for backups. For more information, go to the Virtual Disk Development Kit Documentation at: <http://www.vmware.com/support/developer/vddk/>

Example Backup Automation Scripts

The commands and example scripts described in this section can be used to help create automated backup solutions. Note that the example backup scripts are provided for reference only.

Stop View Manager Service

This command gracefully stops View Manager service to enable an uninterrupted backup.

```
#
# Stop Critical Services to Perform Backup
#
function StopServices
{
    $service = Get-Service -name wsbroker

    if($service.status -eq "Running")
    {
        write-output("wsbroker -- Running")
        write-output("Quescing Services for backup")
        stop-service -name wsbroker -ErrorAction silentlycontinue
    }
    else
    {
        write-output("Services not running - OK to Backup")
    }
}
}
```

Quesce Desktop Pool Status

GetPoolStatus command is used to provide the status of the pools.

```

$poolAuto = 0
$poolLinked = 0
$rem_Count = 0
$loc_Count = 0

function GetPoolStatus
{ param ($pool)
  # Get list of remote and local sessions for specified pool
  #
  $rem_session = Get-RemoteSession -pool_id $pool.pool_id -ErrorAction SilentlyContinue
  $loc_session = Get-LocalSession -pool_id $pool.pool_id -ErrorAction SilentlyContinue

  if ($rem_session) {
    $rem_Count = ([Object[]]($rem_session)).Count
  }
  if ($loc_session) {
    $loc_Count = ([Object[]]($loc_session)).Count
  }

  # Get list of Automatic Pools and Linked clone Pools
  if (($pool.deliveryModel -eq "Provisioned") -and ( $pool.desktopSource -eq "VC")) {
    $poolAuto++
    Write-Output("Pool "+ $pool + "is Automatic")
  }
  elseif (($pool.deliveryModel -eq "Provisioned") -and ( $pool.desktopSource -eq "SVI")) {
    $poolLinked++
    Write-Output("Pool "+ $pool + "is Linked")
  }
}

#
# Start Main
#

$num_pools = get-pool -ErrorAction SilentlyContinue
foreach ($p in $num_pools) {
  getPoolStatus $p
  Write-Output("Number of Remote Sessions: "+$rem_count)
  Write-Output("Number of Local Sessions: "+$loc_count)
}
Write-Output("Number of Automatic Pools: "+$poolAuto)
write-Output("Number of Linked Clone Pools: "+$poolLinked)

```