VMware Horizon View

Best Practices for Deploying VDI with VMware Horizon View™ and Tintri VMstore™

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TECHNICAL WHITE PAPER
# Table of Contents

Intended Audience ...................................................................................................................................... 1  
Introduction ................................................................................................................................................ 1  
  The Virtual Desktop Infrastructure VDI, HVD Delivery Model ................................................................. 1  
  Tintri VMstore and vSphere Best Practices ............................................................................................. 1  
Consolidated List of Practices ..................................................................................................................... 2  
VMware Horizon View Overview ................................................................................................................ 4  
  Physical Architecture Overview .............................................................................................................. 5  
    Host (vSphere ESXi) Servers .................................................................................................................. 5  
    Networking Hardware (Networking routers and switches) ................................................................. 5  
    Shared Storage .................................................................................................................................... 5  
VMware Horizon View Server Components ............................................................................................ 8  
  VMware Horizon View Desktop Pools (collections of desktop VMs) ...................................................... 9  
    Desktop Pools and Cloning with Tintri VMstore .................................................................................. 9  
Stateful or Stateless VMs? ............................................................................................................................ 10  
Horizon View Clients .................................................................................................................................... 10  
Best Practices ............................................................................................................................................ 11  
  Key Factors that Influence Design and Scale .......................................................................................... 11  
Core Practices ........................................................................................................................................ 12  
  General Network Support Services ....................................................................................................... 12  
  vSphere vCenter ................................................................................................................................ 12  
  Load Balancing Services for Horizon View Connection Servers ......................................................... 13  
Network Infrastructure ............................................................................................................................ 14  
  Network Switches and VLANs ................................................................................................................ 14  
  Virtual Networking (vSphere) ................................................................................................................ 15  
Server Sizing Considerations ..................................................................................................................... 16  
  Server Processor Considerations .......................................................................................................... 17  
  Server Memory Considerations ............................................................................................................. 17  
Tintri VMstore ....................................................................................................................................... 18
Intended Audience

This Tintri Best Practices Guide for VMware Horizon View on Tintri VMstore will assist IT administrators who are responsible for the design and deployment of Hosted Virtual Desktop (HVD) VDI infrastructures using VMware Horizon View. This guide supplements the VMware Horizon View documentation.

Introduction

VMware Horizon View provides robust VDI capabilities and has exceptionally tight integration with vSphere. Built for virtualization, Tintri VMstore deploys quickly and provides an unparalleled combination of performance and density for VDI in a compact data center footprint.

The Virtual Desktop Infrastructure VDI, HVD Delivery Model

The term “VDI” and the Hosted Virtual Desktop (HVD) desktop delivery model are synonymous in this paper. Administrators use VMware Horizon View management tools to create pools of desktop VMs, which run on vSphere servers that use Tintri VMstore as their underlying datastore.

Tintri VMstore and vSphere Best Practices

Please configure the vSphere Hypervisor (ESX) servers at the heart of your VDI infrastructure according to Tintri’s best practices. Please see the Best practices for deploying Tintri VMstore™ in VMware vSphere environments document available on the Tintri website for the latest updates and information.
## Consolidated List of Practices

The table below includes the recommended practices in this document. Click the text in the “Recommendation” column or see the section later in the document that corresponds to each recommendation for additional information.

<table>
<thead>
<tr>
<th>Tags</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core, scaling, front-end acceleration</td>
<td>Do: Consider front-end web acceleration solutions for high-volume infrastructures supporting large numbers of clients.</td>
</tr>
<tr>
<td>Core, vCenter</td>
<td>Do: Implement vCenter according to its requirements; back up the database regularly and have provisions in place in case of an outage. vCenter is very important.</td>
</tr>
<tr>
<td>Core, Active Directory, DNS, DHCP, Load Balancing</td>
<td>Do: Consider front-end web acceleration solutions for high-volume infrastructures supporting large numbers of clients.</td>
</tr>
<tr>
<td>Net, VMkernel 10GbE for Tintri VMstore, uplinks, dedicated storage net</td>
<td>Do: Always use dedicated (non-shared) VMkernel ports with redundant 10GbE uplinks for connecting each vSphere server to Tintri VMstore.</td>
</tr>
<tr>
<td>Net, Connection Servers, Load Balancing</td>
<td>Do: Implement more than one Horizon View Connection Server VM to provide high availability of the desktop VM logon services.</td>
</tr>
<tr>
<td>Net, uplink (NIC) redundancy</td>
<td>Do: Assign multiple physical uplinks (network interfaces) to each VMkernel port and VM Port Group to avoid an outage related to a network interface card failure in the server.</td>
</tr>
<tr>
<td>Net, VLAN tagging</td>
<td>Do: Consider using VLAN tags for VMkernel and VM Port Groups to reflect VLANs defined within your network infrastructure.</td>
</tr>
<tr>
<td>Net, infrastructure (e.g. switch, etc.) redundancy</td>
<td>Do: Deploy a fully redundant networking infrastructure to reduce the likelihood of an outage resulting from a failed networking switch or other component.</td>
</tr>
<tr>
<td>Net, VLANs, management</td>
<td>Do: Consider using VLANs to simplify the management of the physical network.</td>
</tr>
<tr>
<td>Net, utilization and threshold monitoring</td>
<td>Do: Monitor Ethernet port and switch utilization to help reduce the possibility that an overloaded switch causes performance problems.</td>
</tr>
<tr>
<td>Net, storage network, Tintri VMstore, 10 GbE</td>
<td>Do: Use high-speed 10GbE Ethernet switches between the ESXi hosts and Tintri VMstore.</td>
</tr>
<tr>
<td>Net, Dedicated VMkernel ports and uplinks for Tintri VMstore/storage</td>
<td>Do not: Create VMkernel ports for other purposes (e.g. Fault Tolerance Logging), or VM Port Groups on the same vSwitch (and its uplinks) designated for Tintri VMstore.</td>
</tr>
<tr>
<td>Net, VLANs, bottlenecks, proper use/design</td>
<td>Do Not: Use VLANs to simplify the network at the expense of creating network bottlenecks.</td>
</tr>
<tr>
<td>Net, 1 GbE, VMstore, bottlenecks</td>
<td>Do Not: Use 1GbE Ethernet switches for the connections between the vSphere hosts and Tintri VMstore.</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Server, testing, scaling, carefully consider last minute changes</td>
<td>Do not: Make significant last-minute changes or substitutions to the successfully tested server equipment and desktop VM configurations without considering the potential impact to performance and user acceptance.</td>
</tr>
<tr>
<td>Server, vSphere Host, CPU cores</td>
<td>Do: Always ensure that the vSphere hosts have the adequate number of cores and CPU performance required by the desktop VMs.</td>
</tr>
<tr>
<td>Server, vSphere Host, installed memory (RAM)</td>
<td>Do: Always ensure that the vSphere hosts have the adequate amount of memory (RAM) to run the desktop VMs and their applications efficiently.</td>
</tr>
<tr>
<td>Server, user acceptance testing, end-to-end (endpoint) performance</td>
<td>Do: Always perform end-to-end user acceptance testing as early as possible in a deployment cycle to exercise the servers, as well as the entire environment from the servers to remote users and their endpoint devices (e.g. smart phones, PCs, laptops, tablets, etc.).</td>
</tr>
<tr>
<td>Server, parent images, preparation</td>
<td>Do: Test and verify the design of the proposed parent VM(s) to determine the resources they will need, such as virtual CPUs, memory assignments, storage IOPS, etc.</td>
</tr>
<tr>
<td>Server, parent images, testing, validation</td>
<td>Do: Test and validate the proposed VM images with users and incorporate their feedback as much as possible before starting a full pilot process.</td>
</tr>
<tr>
<td>Tintri VMstore, storage, best practices</td>
<td>Do: Always start with the latest Best practices for deploying Tintri VMstore™ in VMware vSphere environments.</td>
</tr>
</tbody>
</table>
VMware Horizon View Overview

Virtual desktops and desktop management can take on many forms to achieve the right balance between IT efficiency and user acceptance, with the latter ultimately determining success.

VMware Horizon View consists of a straightforward set of architectural components that are deployable as manageable scale units of up to 10,000 desktop VMs based on pre tested vSphere and VMware Horizon View limits. Conceptually, you may plan and construct architectures of virtually any size from these known limits, from a small number of VMs, up to 10’s of thousands of VMs.

The diagram below highlights the relationship between the implementation of VMware Horizon View’s VM components and the rest of the vSphere infrastructure.

*Figure 1: VMware Horizon View overview diagram*
Physical Architecture Overview

The physical components that comprise your VDI environment will generally fall into one of the three categories:

- **Host (vSphere ESXi) Servers**
- **Networking Hardware (Networking routers and switches)**
- **Shared Storage**

**Host (vSphere ESXi) Servers**

The host servers run all of the virtual machines in the VDI environment. This includes both the VMware Horizon View server management components deployed within Windows Server virtual machines, as well as the desktop VMs themselves.

Largely, the scalability of the individual VMware Horizon View Nodes, measured by the number of host virtual desktop VMs each node can support, has a significant effect on the entire physical infrastructure.

**Networking Hardware (Networking routers and switches)**

For greater clarity, Figure 1 does not specifically represent the physical network infrastructure that connects the VDI infrastructure to the rest of the network. While the details of the network infrastructure is beyond the scope of this paper, it is important to factor in the VMware Horizon View infrastructure server-to-server and storage networks, as well as the networks that allow users to access their desktop VMs.

The network devices and topologies supporting VMware Horizon View will vary from datacenter to datacenter.

**Shared Storage**

Dedicating storage to each individual server for desktop VMs limits system wide performance and the space efficient deduplication of the parent VM images used to create VM clones – one of the hallmarks of VDI and virtualization efficiency. Instead, a server’s internal storage is “stranded”, inaccessible by other servers and their VMs. Furthermore, VMware high availability clusters require shared storage to enable servers to failover during unplanned outages, and to facilitate non-disruptive server maintenance operations. Therefore, shared storage is required for maximum efficiency and high availability for vSphere and VMware Horizon View.
Tintri VMstore -- designed and purpose built to power virtualized infrastructures.

**Tintri VMstore Features:**

- Each VMstore deploys quickly as a datastore to vSphere over 10GbE Ethernet.
- Low latency performance, high storage I/O bandwidth
- Designed for virtual workloads
- High VM density (large numbers of VMs) drives down $/VM costs
- Inline deduplication and compression
- Per VM snapshots and rapid cloning
- Unique server, network and per VM statistics and correlations (Tintri Bottleneck visualization)
- A unique, well designed and modern UI
- Tight vSphere and vCenter integration

Tintri is a VMware Horizon View Rapid Desktop Program (RDP) partner. Please see the “VMware Horizon View Rapid Desktop Appliances” section of the VMware Compatibility Guide for information on some of the tested configurations: [http://www.vmware.com/resources/compatibility/vcl/poc.php#Tintri,Inc](http://www.vmware.com/resources/compatibility/vcl/poc.php#Tintri,Inc)
Review of dedicated server (non-shared) storage and SAN storage

Direct Attached Storage, or “DAS”, refers to disks installed within each vSphere server, or connected externally to each server. Directly attached disk shelves are often referred to as “JBOD” storage, which stands for Just a Bunch Of Disks. DAS or JBOD storage is “owned” by its host server for running VMs, making it impossible to “pool” storage resources together for maximum performance and efficiency. Load imbalances on a given server and its directly attached disks can asymmetrically stress the infrastructure and create an almost irrecoverable, poorly performing situation that can be very difficult to diagnose and resolve. When that happens and users cannot work productively, the inevitable cost overruns and unnecessarily stormy weather for the IT staff follows closely behind.

SAN devices share certain aspects of the server attached storage experience from a vSphere perspective, even though SANs are a type of shared storage. From a deployment and configuration point of view, the “slicing and dicing” of disk RAID groups, storage volumes, and LUNs required when configuring SAN devices for use by vSphere can be considerably complex and costly to manage.

Server-attached DAS storage and SANs do not naturally align with virtual infrastructures.

Server internal or DAS/JBOB storage:
- Does not support vSphere HA configurations
- Relatively inexpensive to acquire
- Owned exclusively by each server (non-shared)
- VMs cannot be migrated between vSphere servers without copying entire images over a network (10’s or 100’s of gigabytes each in size)

SAN storage (shared):
- Requires the configuration and “carving” up of the SAN device’s storage resources into discrete storage units, which are presented to vSphere or other servers
- The most prevalent SAN Fabric (specialized storage networking) devices, HBAs and other components are costly and complex
### VMware Horizon View Server Components

The three main components central to VMware Horizon View are VMware Virtual Center (vCenter), Horizon View Connection Server, and Horizon View Composer. They all work in concert with one another to deliver the VMware Horizon View desktop environment to end users. VMware vCenter is the heart of any vSphere deployment, and the VMware Horizon View Connection Server and View Composer components are common to VDI infrastructures. VMware Horizon View Transfer Server is for streamed (vs. HVD) desktops and is not included in this paper.

*Figure 4: Key VMware Horizon View entities as VMs*

<table>
<thead>
<tr>
<th>Windows VM running VMware Virtual Center (vCenter)</th>
<th>vCenter server’s role with VMware Horizon View:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top-end maximum of 1,000 Hosts and 10,000 Powered-On Virtual Machines for each vCenter instance.</td>
<td>VMware Horizon View depends on vCenter for infrastructure operations to locate and discover resources, and to register, unregister, create, destroy and modify desktop VMs.</td>
</tr>
<tr>
<td><strong>Detailed information on configuring vCenter server.</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Windows Server VM running VMware Horizon View Connection Server</th>
<th>VMware Horizon View Connection server’s role:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 2,000 connections per server (VM) instance.</td>
<td>Connection server authenticates users through the infrastructure’s Microsoft Active Directory DC’s, and then brokers or “directs” their connections to the desktop VMs and resources to which they are entitled. Enforces policies, manages sessions, and entitlement assignments.</td>
</tr>
<tr>
<td>Multiple instances with load balancing can increase scalability and provide high availability for brokering client connections.</td>
<td><strong>Detailed information on the configuration and limits of View Connection server instances.</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Windows Server VM running VMware Horizon View Composer</th>
<th>VMware Horizon View Composers server’s role:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create, provision or recompose up to 1,000 desktops per pool, per Horizon View Composer instance.</td>
<td>Creates <em>linked-clone</em> desktop pools from VMware snapshots of shared “parent” base images, where each <em>clone</em> operates like its own independent desktop VM.</td>
</tr>
<tr>
<td>Optionally, you can install Horizon View Composer alongside vCenter server within the same VM.</td>
<td><strong>Detailed information on the configuration and limits of View Composer server VM instances.</strong></td>
</tr>
</tbody>
</table>

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1 For detailed information on the various VMware Horizon View server components, please visit the [VMware Horizon View Documentation](https://www.vmware.com/support/horizon/view/doc.html) section on VMware’s website.
VMware Horizon View Desktop Pools (collections of desktop VMs)

VMware Horizon View presents desktops and applications to client devices via Desktop Pools. Each pool defines the type and number of desktop VMs it offers to client devices and users, the user-to-desktop assignment methods, and the settings for the group of VMs that belong to a pool.

For the purposes of this paper, VMware Horizon View Manager or VMware Horizon View Composer automatically provision pools of desktop VMs. Administrators may also manually provision desktop VMs using any other method of their choosing. Examples of “manual” methods include using the Tintri VMstore UI, using the vSphere client, writing PowerShell scripts, or using other custom software.

Desktop Pools and Cloning with Tintri VMstore

When creating desktop pools, the type of procedure used calls upon VMware Horizon View Composer’s storage agnostic linked-clone functionality, or Tintri VMstore’s powerful, built-in VM cloning. The best method for a given pool will depend on how you plan to use and manage the VMs.

The simple flowchart below reveals the cloning mechanism employed depending on whether you choose to instruct VMware Horizon View to provision the VMs, or use a “manual” method instead. Note that when choosing an automatic pool type, VMware Horizon View always drives the provisioning process. If you wish to create VMs using other methods such as the Tintri VMstore UI or PowerCLI, you would create manual pools and then import those VMs into those pools as desired.

*Selecting “Full virtual machines” in this example invokes the rapid VM cloning built into Tintri VMstore. Tintri VMstore creates the VM clones, and then adds them to vCenter inventory. The tight vCenter integration built into Tintri VMstore and Tintri’s VAAI (VCAI) provider makes this possible.

Irrespective of the cloning techniques used by VMware View, Tintri VMstore incorporates inline deduplication into its core design, yielding highly optimized working-set performance and space utilization.
Stateful or Stateless VMs?

Deciding on stateful or stateless VMs requires an analysis of how the VMs are going to be used, whether or not they will be updated, if they will or will not persist (retain and store) any user or other data.

Generally:

- Stateless VMs are for non-permanent use-cases, where the VMs do not gather and store any data. Typically, once a user or process is finished using a stateless VM, the infrastructure deletes the VM and any data associated with its session.
- Stateful VMs are either semi-permanent or permanent in nature. They preserve their “state”, and usually their data, after a user logs off, and after a shut down or reboot. For VDI, these VMs are typically part of desktop pools where the specified user assignment is “Dedicated.”

Horizon View Clients

Users can access the desktop VMs and applications in one or more VMware Horizon View pools from a variety of endpoint devices. VMware software clients, known as Horizon View Clients, are available for virtually any device to gain access to the resources made available through VMware Horizon View.

2 To obtain documentation for VMware Horizon View Clients, visit the following URL: https://www.vmware.com/support/viewclients/doc/viewclients_pubs.html
Best Practices

This section divides best practices information into 4 key areas:

- **Core:** The overall infrastructure
- **Networking:** Physical and virtual networking configurations
- **Servers:** vSphere (physical) hypervisor server considerations
- **Storage:** Tintri VMstore

**Key Factors that Influence Design and Scale**

- The configuration of the desktop VM parent images from which desktop pools are created
- Whether or not VMs are persistent (save users’ settings) or non-persistent or “stateless”
- The total number of desktop VMs managed through vSphere
- The cloning and deployment methods which are used (linked clones, Tintri VMstore)
- User activity loads per-desktop

Under load, the VMware Horizon View infrastructure must support the workloads generated by desktop VM provisioning, maintenance operations, and user activity. The end user experience is entirely dependent on the dynamic capabilities of the underlying infrastructure. Consequently, the deployment process should incorporate learning’s from user pilot and acceptance testing into the planning and deployment cycle as early as possible.

**Performance and Acceptance Testing**

Do: Test with pilot users as much as possible during each phase of the development cycle to ensure that the experience meets the expectations of the desktop VM objectives.
Core Practices

VMware Horizon View and vSphere vCenter rely on access to common shared support services such as the Microsoft Active Directory and DNS when provisioning and deploying desktop VMs.

General Network Support Services

Table 1: Core Network Support Services

<table>
<thead>
<tr>
<th>Service</th>
<th>General purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microsoft Active Directory (AD)</td>
<td>Security, identification and authentication</td>
</tr>
<tr>
<td>Domain Name Services (DNS)</td>
<td>Host or service name to IP Address resolution</td>
</tr>
<tr>
<td>Dynamic Host Configuration Protocol (DHCP)</td>
<td>Assigning IP addresses to VMs</td>
</tr>
<tr>
<td>File and Print Services</td>
<td>User Profile and persistent data storage</td>
</tr>
</tbody>
</table>

These services collectively allow a user to establish a session to a desktop VM:

- The Microsoft Active Directory provides authentication and single sign-on services
- Active Directory and vSphere all depend highly on DNS to locate network services
- Usually, when VMs are provisioned, DHCP is used to dynamically assign the VMs valid IP addresses from the DHCP scopes and settings created by the administrator
- General file and print services can be used to store settings and persistent data and profiles for desktop VM users, which are loaded when they boot or logon to their VM

These general services are not unique to VMware Horizon View and need not be dedicated to its operations. However, it is important to consider the additional demands the VMware Horizon View environment may impose on key services. If needed, you must fortify the capacities of these services prior to deploying VMware Horizon View. This will ensure that when users begin to access their desktops, these key services are not overly burdened trying to process workloads that their original design did not account for.

vSphere vCenter

The availability of vCenter is a critically important in all vSphere environments. VMware Horizon View and Tintri VMstore both communicate directly with vCenter to orchestrate all of the underlying operations that support the VMware Horizon View infrastructure. vCenter in turn relies on Active Directory and DNS.

- Do: Fortify key network support services to meet the needs of vSphere and VMware Horizon View prior to deployment.
- Do: Implement vCenter according to its requirements\(^3\), back up the database regularly and have provisions in place in case of an outage. vCenter is very important.

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\(^3\) For best practices information for vCenter, see the [vCenter Server 5.0 Best Practices](https://www.vmware.com/support/pa.html) on VMware’s website.
Load Balancing Services for Horizon View Connection Servers

It is important to ensure that Horizon View Connection server instances are available to authenticate users and broker the connections to their VMs and resources. If you have two connection servers, you always have the opportunity to direct users to the specific Horizon View Connection server instances. That is not however the most manageable option.

Load balancing functionality allows you to provide a single address (name, setting) for users to initiate the logon process. Behind that single address, you can have multiple Horizon View Connection Servers. If one were to go offline, load balancing ensures that the user can still get to another connection server without having to worry about “which one”, or the technical details about the environment.

Industrial strength acceleration solutions such as Citrix NetScaler or the F5 Networks BIG-IP can increase the scalability and responsiveness of the environment when clients are connecting to their desktops.

For test and smaller environments, it is also possible to enable and configure the Microsoft Network Load Balancing (NLB) feature in your Horizon View Connection Server VMs. Since VMware Horizon View runs in Windows, it is easy to take advantage of the functionality that is already there.

Note: Generally, it is a best practice to keep the load balancers on the network. This is true particularly in large environments. That way, a rebooting of your vSphere or other servers (which may be running the NLB VMs), do not impact load balancing for the overall environment.

Enabling and configuring Microsoft NLB in VMs is straightforward:

1. In each Horizon View Connection Server VM (minimum of 2), enable Microsoft NLB
2. Create an NLB “cluster” on the first Horizon View Connection Server VM (a “node” in NLB terms)
3. Configure NLB in each server VM to join the NLB cluster created in step 2
4. Point the Horizon View Clients to the cluster IP address (from Step 2)

For detailed information on Microsoft NLB, please see the following link on Microsoft’s website: http://technet.microsoft.com/en-us/library/hh831698.aspx

Load Balancing and Connection Server Availability

- Do: Implement more than one Horizon View Connection Server VM to provide high availability of the desktop VM logon services
- Do: Consider front-end web acceleration solutions for high-volume infrastructures supporting large numbers of clients.
Network Infrastructure

The hallmarks of VDI center on the centralized management, security and control of virtual desktop resources. The list below summarizes the essential network pathways:

- VMware Client access to the virtual desktop infrastructure
- Server-to-server communication
- Virtual desktop to user profile data transfers
- Storage I/O between the physical servers (vSphere hosts) and Tintri VMstore (storage)

Network Switches and VLANs

The networking components deployed to support the VDI environment must provide the port counts and core backplane bandwidth necessary to support communications between user endpoints and their VMs, as well as the “back end” server-to-server and server-to-Tintri VMstore (storage) traffic loads.

Defining and using VLANs can greatly simplify the physical networking components (e.g. switch ports, network interfaces, cabling) and offer a lot of management flexibility, but it is always vitally important to avoid overwhelming networks or interfaces with too much traffic. Driving more traffic over a physical network than it can handle will always result in a performance bottleneck.

With or without VLANs, it is important to segregate the storage network such that the vSphere servers have a high-speed, dedicated network path to Tintri VMstore. The flow of data between the servers and Tintri VMstore should be free from external user/client or other traffic. Otherwise, performance may be affected. Always provide a “clean” path between the servers and storage.

Network Switches and VLANs

- **Do:** Use high-speed 10GbE Ethernet switches between the ESXi hosts and Tintri VMstore.
- **Do Not:** Use 1GbE Ethernet switches for the connections between the vSphere hosts and Tintri VMstore. Use 10GbE networking for the dedicated storage network.
- **Do:** Monitor Ethernet port and switch utilization to help reduce the possibility that an overloaded switch causes performance problems.
- **Do:** Consider using VLANs to simplify the management of the physical network.
- **Do Not:** Use VLANs to simplify the network at the expense of creating network bottlenecks.

Note: The bottleneck visualization features of Tintri VMstore reveal at-a-glance if there are any VMs experiencing network or other latencies (e.g. host, storage, network, etc.). These powerful per-VM visual (graphed) correlations can save hours, days or weeks of time trying to track down environmental bottlenecks.
Virtual Networking (vSphere)

Virtual Switches in vSphere can be associated with VMkernel Ports or Virtual Machine Port Groups. "Uplinks" refer to the physical network interfaces that facilitate the flow of network traffic between virtual switches and physical networks. Both port group types can be associated with VLANs.

Relating VMware Horizon View Networking to vSphere and Physical Networking

The table below lists the three logical networks in VMware Horizon View, along with their corresponding virtual networking port type.

<table>
<thead>
<tr>
<th>Horizon View Network</th>
<th>Purpose</th>
<th>VMkernel Port or VM Port Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management</td>
<td>vSphere and VMware Horizon View management communications</td>
<td>Management (VMkernel)</td>
</tr>
<tr>
<td>User/Infrastructure</td>
<td>Supports VMware client endpoints, file and print services, and other infrastructure services.</td>
<td>VM Port Group</td>
</tr>
<tr>
<td>Storage</td>
<td>Supports communication with Tintri VMstore</td>
<td>VMkernel</td>
</tr>
</tbody>
</table>

- Do: Assign multiple physical uplinks (network interfaces) to each VMkernel port and VM Port Group to avoid an outage related to a network interface card failure in the server.
- Do: Consider using VLAN tags for VMkernel and VM Port Groups to reflect VLANs defined within your network infrastructure.
- Do not: Create VMkernel ports for other purposes (e.g. Fault Tolerance Logging), or VM Port Groups on the same vSwitch (and its uplinks) designated for Tintri VMstore.
- Do: Always use dedicated (non-shared) VMkernel ports with redundant 10GbE uplinks for connecting each vSphere server to Tintri VMstore.
- Do: Deploy a fully redundant networking infrastructure to reduce the likelihood of an outage resulting from a failed networking switch or other component.

For additional information concerning the best practices for configuring the networking between vSphere and Tintri VMstore, please see the Best practices for deploying Tintri VMstore™ in VMware vSphere environments.

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4Appendix A has additional information concerning the differences between VMkernel and Virtual Machine Port Groups
Server Sizing Considerations

The key answers to distill during a vSphere hypervisor (physical) server sizing exercise are as follows:

- How many desktop VMs will “fit” on each physical vSphere host server?
- What are the configuration details of each server?
- How many servers do I need?

More desktop VMs per-server results in greater server density. Greater density reduces the number of servers required, as visualized in Figure 7 below:

Figure 7: VDI HVD desktops per vSphere host server (simplified example)

Key factors affecting vSphere server scalability (density):

- The number of virtual CPUs relative to the vSphere server’s available CPU resources
- The total amount of installed server memory and the amount assigned to virtual desktop VMs
- Each VM’s internal configuration (e.g. desktop VM optimizations, page file settings, etc.)
- The disk I/O bandwidth of the datastores, such as Tintri VMstore, that underpin the servers

VMware provides some excellent sources of information for architectural sizing and deployment in the Horizon View Architecture Planning, VMware Horizon View Installation and VMware Horizon View Administration documents. Visit http://www.vmware.com/support/pubs/view_pubs.html for access to these documents, and more.

Vendor-neutral software tools such as Login VSI can simulate and measure desktop VM performance. Be aware however that many tools measure performance at the servers and not at the user client/receiver endpoints, so it is important to run pilots with small groups of users to verify end-to-end performance.

Do: Always perform end-to-end user acceptance testing as early as possible in a deployment cycle to exercise the servers, as well as the entire environment from the servers to remote users and their endpoint devices (e.g. smart phones, PCs, laptops, tablets, etc.).
**Server Processor Considerations**

Consider as a simple example, a server that has a dual-socket, octa-core architecture (2*8 = 16 cores):

If you knew for example that a given physical vSphere server could efficiently run 10 desktop VMs (each assigned 1 virtual CPU) per physical CPU core, the number of VMs that you could run per-server would be 10 times the number of cores. In this simple example, the virtual CPU to core ratio is 10:1, and you could then assert that each server is capable of running 160 VMs. 

Do: Always ensure that the vSphere hosts have the adequate number of cores and CPU performance required by the desktop VMs.

**Server Memory Considerations**

Continuing with the example above, assume that 160 VMs are going to be running on each vSphere host at any given time. From there, the memory requirement calculations generally depend on the following factors:

- The Operating System running in the VM (e.g. Unix/Linux, Windows XP, Windows 7, Windows 8)
- The page file settings within each VM
- The requirements of the applications that users must run in the VMs

The most important single goal is to ensure that VMs do not run low on memory, resulting in a lot of paging to their virtual disks. Excessive paging across groups of VMs can bog down the vSphere servers and generate a lot of unnecessary disk I/O.

Do: Always ensure that the vSphere hosts have the adequate amount of memory (RAM) to run the desktop VMs and their applications efficiently.

**Tintri VMstore Tip:** The bottleneck virtualization features of Tintri VMstore can help quickly identify and sort VMs which are “going to swap” (writing excessively to their swap vDisks due to low memory conditions), but it is always best to avoid potential issues with desktop VM configurations prior to a wide scale deployment.

Do: Test and verify the design of the proposed parent VM(s) to determine the resources they will need, such as virtual CPUs, memory assignments, storage IOPS, etc.

Do: Test and validate the proposed VM images with users and incorporate their feedback as much as possible before starting a full pilot process.

Do not: Make significant last-minute changes or substitutions to the successfully tested server equipment and desktop VM configurations without considering the potential impact to performance and user acceptance.

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5 This is a simplified example. The optimal VM CPU to ESXi host CPU core ratios vary across server models, etc.
Tintri VMstore

Tintri VMstore is a powerful storage appliance that embodies virtualization and the software-defined datacenter. Tintri VMstore “sees” VMs, and intrinsically maps each I/O to its corresponding VM in real-time. VMs are truly first class citizens.

The unique VM-awareness between Tintri’s purpose-built file system and Hypervisors such as vSphere allows Tintri VMstore to monitor and optimize the performance of all of the VMs running on the system. Tintri VMstore provides administrators powerful, at-a-glance per-VM visualizations with built-in flexible graphing tools and helpful insights into how the network and hosts connected to Tintri VMstore are performing.

Tintri VMstore deploys very quickly, and requires minimal if any specialized configuration or tuning across the vSphere servers to achieve best-in-class performance, with maximal efficiency and density.

Tintri VMstore Deployment Fundamentals

The core requirements for setting up and configuring Tintri VMstore are the same for all virtual environments, from general-purpose server VMs, to enterprise and database applications to VDI and VMware Horizon View.

Overview of deploying Tintri VMstore:

- Rack the system and make all of the necessary power and networking connections
- Configure the system’s IP addresses, DNS, etc., and provide it with a login to vCenter
- Add the system as a network file system storage device to your vSphere ESXi server(s)
- That is it – Tintri VMstore is 100% ready

Note: Optimizations and best practices are available at http://www.tintri.com/resources/

Do: Always start with the latest Best practices for deploying Tintri VMstore™ in VMware vSphere environments.

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6 For cloning operations Tintri VMstore must be configured with a vSphere login that has both “read and write” permissions in order to add Tintri-cloned VMs to the vCenter inventory. Basic operation of the VMstore only requires read access to vCenter so that it can “see” and auto-correlate all of the VMs statistics, etc.
Summary

The flexibility and known scale units for VMware Horizon View make it unusually easy to plan for the requirements and deployment of your VDI architecture, at virtually any size.

There are three main components to VMware Horizon View, for typical VDI (Hosted Virtual Desktop) infrastructures. Those are VMware vCenter, VMware Horizon View Connection Server, and VMware Horizon View Composer. VMware Horizon View Composer provisions linked-clone desktop pools, and VMware Horizon View Administrator works very cleanly with vSphere when creating full virtual machine pools. In all cases, make sure the core services such as Active Directory, and DNS, are ready for the deployment launching the environment. Lastly, be sure to implement multiple Horizon View Connection Servers to help provide high availability to the connection brokering facilities of VMware Horizon View.

Starting with the fundamental best practices concerning the deployment of Tintri VMstore with VMware vSphere ESX/ESXi servers, the best practices for VMware Horizon View follow in turn. Test the vSphere server configurations and storage sizing prior to a full deployment. Monitor smaller pilot deployments and incremental user acceptance testing early and while approaching a full-scale deployment, to ensure the environment is performing as expected.

Tintri VMstore uniquely incorporates powerful VM awareness and installs transparently into vSphere environments like a natural part of the system. The snapshots, fast cloning, vCenter and VAAI integration, as well as powerful VM, server, network and storage bottleneck visualization (correlation) features, along with the per-storage system density of 1,000 high-performance desktop VMs per 3U VMstore appliance, make Tintri VMstore the best choice for VDI environments of any size.
Appendix A

Virtual Networking

*VMkernel ports* literally operate using an ESXi hosts TCP/IP kernel stack, and are generally for ESXi server operations. Kernel ports are configured with an IP address that maps to a *vmknic*, which operates over 1 or more physical uplinks (physical network interfaces), and an optional VLAN ID. The list below provides some examples of where VMkernel ports are used:

- For ESXi management networking traffic
- For vMotion to move VMs from one ESXi host to another
- Fault Tolerance logging traffic is directed over VMkernel ports
- To define a path between ESXi server(s) and a storage network (e.g. to Tintri VMstore)

*VM Port Groups* are for VMs to communicate with the resources they need, whether it is with VMs on the same ESXi server, other ESXi servers, or other devices and resources elsewhere across the physical network. Unlike VMkernel ports, VM Port Groups are akin to unmanaged, (aka “dumb”) switches, and they do not have IP addresses. Instead, a VM Port Group connects via the ESXi server’s uplinks (as assigned) to a physical network, and the VMs use their own IP addresses to communicate with the rest of the network.

Microsoft Image Preparation Tools

The following kit from Microsoft can be instrumental when creating consistent, standardized settings and profiles for large groups of desktop VMs.

The Windows Assessment and Deployment Kit (ADK)

References

VMware vSphere 5 Documentation

VMware Horizon View Documentation
http://www.vmware.com/support/pubs/view_pubs.html

VMware Horizon View Architecture Planning

vSphere vCenter Operations Manager Documentation

Best Practices for running VMware vSphere on Network Attached Storage

Performance Best Practices for VMware vSphere 5.0

vSphere 5 Storage Guide

VMware Windows 7 Optimization Guide for Horizon View