Server and Storage Sizing Guide for Windows 7 Desktops in a Virtual Desktop Infrastructure

TECHNICAL NOTES

vmware®

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Introduction

Sizing the server and storage resources for a virtual desktop infrastructure (VDI) can be a complex task, and there are no easy answers. This paper provides a high-level overview of the basic steps in sizing the infrastructure, plus additional items to consider.

The discussion is designed to help organizations size their server and storage resources for any VDI implementation with Windows 7 desktops. You can apply these recommendations to a VMware® Horizon View™ environment.

Note: It is assumed the reader is already familiar with VDI and the related benefits of the technology. If an introduction to VDI is necessary, see VMware Horizon View.

In this paper, we focus on a Windows 7 implementation and the first two steps of the sizing process below:

- Establish a baseline of the existing desktop environment
- Estimate VDI hardware needed
- Build proof-of-concept infrastructure
- Validate hardware estimates

References to Windows XP are also included for those looking to migrate their existing environment to Windows 7.

Establish a Baseline of the Existing Desktop Environment

The first step in the process is to gather baseline information on the key user groups that have been identified as good candidates for a VDI environment. The purpose of this step is to understand the performance characteristics of the target users' workload—for instance: What applications do they need? Are the applications more CPU- or memory-intensive? Are there an excessive number of storage operations? What type of network load is being generated by the end users' activities?

Note: These steps are applicable whether you are looking at implementing a new VDI environment or looking at migrating an existing Windows XP VDI environment to a Windows 7 VDI environment.

A performance-monitoring tool will help you gather the necessary baseline information. There are several tools, including third-party tools, which can assist you with this process, such as VMware Capacity Planner, Liquidware Labs Stratusphere FIT, and Lakeside Software SysTrack. In addition, both Windows XP and Windows 7 ship with Performance Monitor (Perfmon), a performance logs and alerts tool. Perfmon allows administrators to capture and graph various performance statistics from both local and remote computers.

Additional information on Perfmon and key attributes to monitor can be found in the VMware Knowledge Base article Collecting the Windows Perfmon log data to diagnose virtual machine performance issues.

Pay particular attention to the application workloads in the desktop estate. Physical-to-virtual hardware mapping is less important and should be considered separately. Ideally, start with the recommended sizing of 2 vCPUs and 4GB RAM, and size larger if necessary.

Estimate VDI Hardware Needed

This section describes the process of estimating the hardware resources needed for a VDI implementation.

CPU

The primary question you need to answer about processing power in your VDI environment is how many virtual machines can be assigned to each CPU, or core, in the host. This calculation depends upon how many virtual CPUs you need per virtual machine. For a typical Windows 7 implementation, use a minimum of 2 vCPUs per virtual machine to ensure a good user experience. Only in the absolute lightest of workloads is 1 vCPU sufficient. You can monitor the PCPU USED, PCPU UTIL, and CORE UTIL esxtop utility counters to monitor the required virtual CPUs.

VMware does not recommend oversubscribing *memory* resources in a VDI environment. However, we almost always oversubscribe CPU resources in order to achieve an optimal density of virtual machines per ESXi host.

Recommended sizing can be as many as 10 virtual CPUs (vCPUs) per physical CPU core (pCPU), depending on the workload.

A good, conservative starting point in the design is 6 vCPUs per pCPU when calculating density. This ratio of vCPU:pCPU is called the *overcommit ratio*.

After you have determined the optimal vCPU:pCPU ratio in your design, your virtual-machine-per-host sizing can follow this simple formula:

```
(Virtual Machines per Server) = ((Cores Available on Server) / (vCPUs Needed
per Virtual Machine)) * (Overcommit Ratio of vCPUs per pCPU)
```

Table 1 provides two examples, both with an overcommit ratio of 6:1.

NUMBER OF vCPUs NEEDED PER VIRTUAL MACHINE	NUMBER OF PHYSICAL CORES AVAILABLE ON SERVER	(CORES AVAILABLE / vCPUs NEEDED PER VIRTUAL MACHINE)* (OVERCOMMIT RATIO)	VIRTUAL MACHINES PER SERVER
1	16	(16/1)*6	96
2	16	(16/2)*6	48

Table 1: Virtual Machines per Server Based on vCPUs Needed per Virtual Machine

Note: Virtual machines possible per server can vary based upon the workload the virtual machines are running, the capacity of the server hardware, the requirements of the guest operating system, and the efficiency of the hypervisor and available storage.

Memory

A typical Windows 7 64-bit enterprise deployment requires 2 vCPUs and 4GB RAM. (For a Windows 7 32-bit virtual machine guest with 2 vCPUs, a minimum of 2GB RAM is recommended.) The native OS alone is approximately 400MB. The goal is to allocate enough memory to hold the set of applications and data while keeping the memory overcommit ratio as low as possible. This prevents Windows from writing data to the paging file because there is not enough RAM available in the guest OS.

As a guideline, for balance between performance and memory utilization, the virtual machine should have approximately 25 percent more RAM allocated than the maximum active load on the virtual machine. This allocation prevents Windows from writing data to its paging file and keeps the active working set (applications and data) for the virtual machine in RAM instead of in virtual memory space.

Memory should not be oversubscribed in a VDI deployment. There should be sufficient RAM in the host, plus 25 percent for vSphere and swap overhead, and potentially more if 3D is being used. For more 3D-overhead numbers, see Storage Considerations for VMware Horizon View 5.2.

Storage

The Windows 7 64-bit version requires an additional 4GB of disk space over the Windows 7 32-bit version. This will decrease the number of virtual machines on your server, unless additional storage can be added.

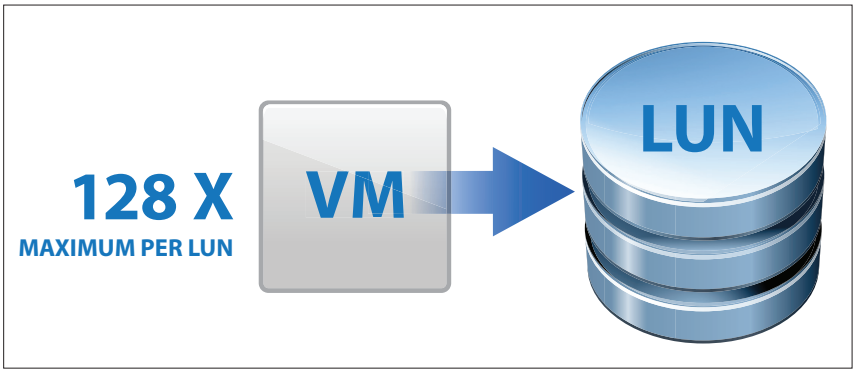

Figure 2: Maximum Virtual Machines per LUN

The maximum virtual machines per LUN is 128 for Fibre Channel, and an unlimited number of virtual machines for NFS and iSCSI.

Depending on the operations performed and applications that are used, Windows 7 could produce additional I/O especially during boot and login, and the first time applications are opened.

It is extremely important that you baseline your existing environment, build a proof-of-concept infrastructure, and run tests to validate your estimates for additional hardware, memory, and storage that will be required.

VMware Horizon View 4.5 and later versions offer a tiered-storage option. You can place View Composer replicas on solid-state disk drives, and linked clones on less expensive drives like SATA. By taking advantage of the new tiered-storage option, intensive operations such as provisioning many linked clones at once can be accelerated.

For more information, consult Storage Considerations for VMware Horizon View 5.2.

Virtual Desktop Configuration

There is no one virtual desktop configuration that will meet everyone's needs. This is why gathering baseline information about your existing environment is so important. Table 2 is based on the information provided in previous sections of this document, Storage Considerations for VMware Horizon View 5.2, and the VMware Horizon View Architecture Planning guide. These configuration guidelines are for standard Windows 7 and XP virtual desktops running in remote mode.

Note: Information is provided on XP is for those looking to migrate their existing VDI environments to Windows 7.

ITEM	WINDOWS 7, 32-BIT	WINDOWS 7, 64-BIT	WINDOWS XP
Operating system	32-bit Windows 7 (with the latest service pack)	64-bit Windows 7 (with the latest service pack)	32-bit Windows XP (with the latest service pack)
RAM	1–2GB, 2 recommended	4GB minimum, 4+ recommended	1GB (512MB low end, 2GB high end)
Virtual CPUs	1–2, 2 recommended	Minimum of 2*	1
System disk capacity	24GB	32GB	16GB (8GB low end, 40GB high end)
User data capacity (as a persistent disk)	5GB (starting point)	5GB (starting point)	5GB (starting point)
Virtual SCSI adapter type	LSI Logic SAS (the default)	LSI Logic SAS (the default)	LSI Logic Parallel (not the default)
Virtual network adapter	VMXNET3	VMXNET3	VMXNET3

Table 2: Desktop Virtual Machine Examples for Windows 7 and XP, Hosted on an ESXi 5.x Server

*See the CPU section for more information.

The amount of system disk space required depends on the number of applications required in the base image. The amount of disk space required for user data depends on the role of the end user and on the organizational policies for data storage. If you use View Composer, this data is kept on a persistent disk.

Virtual Desktop Configuration by User Type

If you have not already classified your user base, you will want to. This step will help simplify your analysis as well as your deployment. Users have been classified into three basic categories:

- Task-based workers – Limited applications and limited performance requirements
- Knowledge workers – Standard office applications and medium performance requirements
- Power users – Compute-intensive applications and high performance requirements

The IOPS listed in Table 3 are guidelines for Windows 7. The IOPS generated will vary based on your definition of the worker types and the applications they use, the environment, storage, and whether or not the virtual machines are optimized.

USER/WORKER TYPE	APPLICATIONS (OPEN SIMULTANEOUSLY)	VIRTUAL MACHINE CONFIGURATION	IOPS
Task-based worker (light)	Limited (1–5 applications, light use)	1 virtual CPU 1GB memory	3–7
Knowledge worker (medium)	Standard office (1–5 applications, regular use)	2 virtual CPUs 2GB memory	8–16
Power user (heavy)	Compute-intensive (5+ applications, regular use)	2 virtual CPUs 4GB memory	17–25
Power user plus (heavy)	Compute-intensive (5+ applications, intense use)	2+ virtual CPUs 4GB memory	26+

Table 3: Virtual Desktop Configuration by User Type

Optimizing Windows 7

Microsoft Windows is a complex operating system incorporating thousands of built-in features. Many of the user-convenience features were designed for a dedicated resource usage model, such as a dedicated physical PC with abundant RAM and CPU resources. When the desktop hardware container moves from a dedicated physical PC to a virtual hosted desktop, it is crucial that each running process provide value to the user experience. It is this point where many of the Windows user-convenience features designed to enhance the user experience actually have the opposite effect by taxing the shared resource pool of physical RAM and CPU from the VMware vSphere® host, causing poor application performance.

To provide a better user experience and enhance the overall scalability and performance of your VMware Horizon View virtual desktop infrastructure, you will want to optimize your Windows 7 image. See the VMware Horizon View Optimization Guide for Windows 7 and Windows 8.

VMware Horizon View Requirements

The following information has been gathered from the VMware Horizon View Installation guide. Consult the latest Installation guide for the most up-to-date information.

You will want to install the following in your Horizon View implementation for Windows 7 virtual desktops:

- The View Agent component assists with session management, single sign-on, and device redirection. You must install View Agent on all virtual machines, physical systems, and terminal servers that will be managed by Horizon View.
- The View Client is used to connect users to their Horizon View desktops. You must install View Client or View Client with Local Mode on the supported operating system of the client machine that is accessing the Horizon View desktop. View Client with Local Mode is supported only on Windows systems and only on physical computers.
- View Transfer Server is an optional component of the View Connection Server and is required for check-in, check-out, and replication of desktops that run in Local Mode. You will need to install and configure View Transfer Server if you deploy View Client with Local Mode on client computers.

Other Design Considerations

This section covers additional topics you should consider for your VDI implementation.

User Profiles

User profiles include all user-specific settings of a user's environment, including program items, network connections, printer connections, mouse settings, window size and position, screen colors, and desktop preferences.

There are three types of profiles available for use in a terminal services environment from Microsoft—local, roaming, and mandatory profiles. Which profile type an organization decides to go with will be dependent on the decision made about the overall environment:

- Local profiles are used when the settings in the profile do not matter as a user roams from desktop to desktop.
- Roaming profiles allow user settings to be persistent across logins and across machines, ensuring a consistent user experience no matter which desktop a user logs in to.
- Mandatory profiles provide groups of users with a single profile, and changes to the profile are discarded upon logout.

In addition to deciding on the type of profile(s), the size of the profile is also important when using roaming profiles. Administrators have the ability to exclude folders from a profile, while redirecting other folders to the network, and to use policies to configure settings such as Temporary Internet Files to minimize the size of the profile. Roaming and mandatory profiles should be measurable in KB rather than MB. A properly designed and implemented profile solution will help to ensure quick login times for users. For further details, see Storage Considerations for VMware Horizon View 5.2.

VMware Horizon View Persona Management preserves user profiles and dynamically synchronizes them with a remote profile repository. Horizon View Persona Management does not require the configuration of Windows roaming profiles, and you can bypass Windows Active Directory in the management of Horizon View user profiles. If you already use roaming profiles, Horizon View Persona Management enhances their functionality.

Third-party solutions are available to help you plan and manage user profiles. One solution is the Liquidware Labs ProfileUnity product, which not only offers profile support and fast logins, but also offers powerful automated desktop configuration and deployment-integrity features such as user profile management, migration, and portability of any Windows XP/2000/Vista/7 session.

Migration from Windows XP to Windows 7

For those organizations that are planning a migration from Windows XP to Windows 7, upgrading hundreds or thousands of desktop devices is costly and time consuming. Windows XP applications will not automatically be compatible with Windows 7. For example, Web-based applications that work well on Internet Explorer 6 may not run on Internet Explorer 8 with Windows 7. Additionally, many organizations have customized applications driving their businesses; recoding and recertifying their applications for Windows 7 is a time-consuming and costly endeavor.

Start the transition to Windows 7 by virtualizing your existing Windows applications with VMware ThinApp™. Application virtualization removes the dependency of applications from the underlying operating system so you can run a single application across multiple supported Windows operating systems. This helps to streamline application migration, ease the burden of cost and complexity for IT organizations, and create a seamless transition for end users.

VMware Horizon Mirage™ is a layered image-management solution that separates the PC into logical layers which are owned and managed by either your IT organization or the end user. You can update IT-managed layers while maintaining end-user files and personalization. And to maximize end-user productivity, snapshots and backups of layered desktop images enable quick recovery or rollback in case of failure. Horizon Mirage enables the two most common approaches to Windows 7 migrations: in-place and hardware refresh. Horizon Mirage can deliver a new IT-provisioned Windows 7 image to upgrade an existing Windows XP device, or migrate an end user's profile and files from that user's previous Windows XP device to a new Windows 7 device. Horizon Mirage can be especially useful if you wish to migrate from physical Windows XP devices to virtual Windows 7 desktops. See VMware Horizon Mirage Streamlines Windows 7 Migration.

VMware ThinApp Application Delivery

VMware ThinApp simplifies application delivery by isolating applications from the underlying operating system and plugging directly into existing virtual and physical desktop management tools and infrastructure. ThinApp encapsulates applications inside a virtual OS that transparently merges a virtual system environment with the real system environment.

ThinApp supports Windows 7. You can now package legacy applications from older versions of Windows such as Windows XP and Windows Vista into ThinApp packages for deployment on Windows 7 if that application is supported on Windows 7. By packaging your current applications with ThinApp, you will avoid costly recoding and regression testing and accelerate deployment of business applications to Windows 7 more quickly and securely.

For additional information, see VMware ThinApp.

Next Steps

After you have completed the first two steps in sizing your server and storage infrastructure, as discussed in this document, the next two steps are

- Build a proof-of-concept infrastructure
- Validate hardware estimates

Summary

Whether you are looking at implementing a VDI environment for the first time with Windows 7 or migrating from an existing Windows XP VDI environment, it is important to take the time to follow the steps outlined in this document. Be sure to take extra care in designing the storage. Depending on the storage you have in your environment, check with the vendor; chances are, the storage vendor has created reference architectures that can provide you with additional guidelines for parameters such as the number of virtual machines. For further details, see Storage Considerations for VMware Horizon View 5.2.

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- Michael Furman, Senior Member of the Technical Staff, Quality Engineering for Storage, VMware
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Resources

VMware Horizon View Optimization Guide for Windows 7 and Windows 8

VMware Compatibility Guides

VMware Horizon View Installation

VMware Horizon View Architecture Planning

VMware View Persona Management Deployment Guide

VMware Horizon Mirage Streamlines Windows 7 Migration

Storage Considerations for VMware Horizon View 5.2

Interpreting esxtop Statistics

Performance-Monitoring Tools

VMware Capacity Planner

Xangati for vSphere

Lakeside Software, Inc. – SysTrack

Liquidware Labs – Stratusphere FIT

Profile Tools

Liquidware Labs ProfileUnity

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