

Dell™ Virtual Remote Desktop™  
Solution Reference Architecture:  
Citrix® XenDesktop™ Dell Edition

# Notes, Cautions, and Warnings



**NOTE:** A NOTE indicates important information that helps you make better use of your computer.

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# Introduction

This document describes four validated configurations of Dell|XenDesktop virtual infrastructure for XenDesktop deployments, so you can select the most suitable Dell virtualization solution for your needs. You can customize these configurations to fit your specific system needs.

Dell|XenDesktop provides flexible desktop virtualization that you can optimize for workload or feature requirements through server, network, storage, and software configurations. Dell has validated these configurations using extensive testing. See "Appendix: Testing Methodology" on page 19 for details on how the configurations were tested.

The configurations are:

- **Very Small:** A simple configuration for very small deployments and satellite offices with up to 100 licenses.
- **Small:** This configuration requires minimal hardware, is designed with simplicity in mind, and focuses on demonstrating functionality. Valid for up to 250 licenses.
- **Medium:** This configuration is designed to meet the production requirements of small and medium businesses, such as economical iSCSI/SAN and backup options, with up to 500 licenses.
- **Large:** This configuration is a full-feature virtualization solution that uses the advanced features of XenDesktop in an expansive environment with up to 1000 licenses.

This document describes the features, benefits, and performance implications of each configuration. The goals of the document are to:

- Introduce you to the architecture of the Dell|XenDesktop configurations.
- Help you understand the factors related to virtualization of particular usage models.
- Help you select the best configuration for your system needs.

This document only covers Dell|XenDesktop Virtual Remote Desktop (VRD) solutions, and defines the configurations using Dell servers, storage, and networking components. Custom configurations for specific customer engagements may have third-party hardware, and, therefore, are out of scope, as are software components from Microsoft® or XenServer™ platforms.

# Recommended Components

The following table describes the recommended components for each configuration.

## Hardware and Software Features of the Baseline Configuration

	Very Small	Small	Medium	Large
<b>Description</b>	Simple, entry-level configuration	Small configuration	Designed for small and medium business	Large enterprise environments
<b>License Alignment</b>	100 license	250 license	500 license	1000 license
<b>Number of VMs with Structured Task Workload</b>		4 VMS per CPU core (1 vCPU per VM)		
<b>Number of VMs with Medium Knowledge Workload</b>		4 VMS per CPU core (1 vCPU per VM)		
<b>Citrix Desktop Delivery Controller — Connection Broker</b>				
<b>XenDesktop Server</b>	Any Dell Server running Windows Server® 2003 (32-bit or 64-bit)			
<b>Memory</b>	4 GB			
<b>Network</b>	2 Gigabit Network Interfaces			
<b>Storage</b>	Minimum of 2 SAS hard drives (RAID 1 recommended)			
<b>Citrix Provisioning Server</b>				
<b>Citrix Provisioning Server™</b>	Dell PowerEdge 2950 III recommended with Windows Server 2003 (64-bit recommended)			
<b>Memory</b>	4 GB			
<b>Network</b>	2 Gigabit Network Interfaces			
<b>Storage Controller</b>	PERC 6/i			
<b>Storage</b>	8 15K RPM SAS drives OS/boot volume - 2 15K RPM SAS drives (RAID 1) Data volume - 6 15K RPM SAS drives (RAID 10)			

	Very Small	Small	Medium	Large
<b>XenServer Configuration</b>				
<b>XenServer Servers</b>	PE2900 recommended. Any servers on the compatibility matrix are supported.	1U/2U servers are recommended for PVS deployments. Tower servers (which may be racked) are recommended for configurations using local storage for VMs. Any servers on the compatibility matrix are supported.		
<b>Number of Servers</b>	1-4	5-8	9-16	17-32
<b>Minimum Memory (Memory varies widely based on VM memory configuration)</b>	16 GB	16 GB	16 GB	16 GB
<b>CPU</b>	2 Sockets Quad Core	2 Sockets Quad Core	2 Sockets Quad Core	2 Sockets Quad Core - or - 4 Sockets Quad Core
<b>Minimum NICs</b>	2 x LAN on Motherboard	2 x LAN on Motherboard+ 1 dual port add-in NIC	2 x LAN on Motherboard + 1 dual port add-in NIC	2 x LAN on Motherboard + 1 dual port add-in NIC
<b>DRAC</b>	No	Optional	Yes	Yes
<b>Local Storage with Shared Storage Present</b>	2x73GB SAS 15K RPM (RAID 1)	2x73GB SAS 15K RPM (RAID 1)	2x73GB SAS 15K RPM (RAID 1)	2x73GB SAS 15K RPM (RAID 1)
<b>Local Storage without Shared Storage Present (based on smallest # of drives available)</b>	10x450GB (RAID 5)	1U servers are not recommended without Provisioning Server because of the limited number of hard drives available.  For local storage, always fully populate the servers with 15K SAS drives in a RAID (5 or 10) configuration.		
<b>Controller/ RAID</b>	PERC 6/E	PERC 6/i/e (RAID 1,5,10)	PERC 6/i/e (RAID 1,5,10)	PERC 6/i/e (RAID 1,5,10)

	Very Small	Small	Medium	Large
<b>Storage Configuration</b>				
Storage Fabric	Local	Local or external storage	Fibre Channel or iSCSI Storage	Fiber Channel or iSCSI Storage
Storage Device	Local Storage	Local Storage or iSCSI	Local Storage, iSCSI, or Fibre Channel	Local Storage, PS5000XV, or Fibre Channel
Storage Enclosures (Maximum configurations - 15K SAS drives recommended)	Local only	<b>PS5000XV</b> - 16x300GB 15K SAS <b>MD3000i</b> - 45x450GB 15K SAS <b>AX150i</b> - 12x750GB 7.2K SATA <b>CX3-10c</b> - 60x300GB 15K FC <b>CX3-20</b> - 120x300GB 15K FC <b>CX3-40</b> - 240x300GB 15K FC <b>CX3-80</b> - 480x300GB 15K FC		
<b>Backup</b>				
Backup Server	N/A	N/A	PE2900	PE2900
Backup Software	N/A	N/A	Backup Exec 11D	Backup Exec 11D
Backup Device	N/A	N/A	PowerVault TL4000	PowerVault ML6000
<b>Software Configuration</b>				
Connection Broker	Citrix Desktop Delivery Controller			
Hypervisor	Citrix XenServer Dell Edition			
Desktop Streaming	Citrix Provisioning Server Dell Edition			
<b>Management</b>				
XenCenter	Yes	Yes	Yes	Yes
ITA	N/A	N/A	Windows 2003	Windows 2003



# General Guidelines

The following guidelines are valid for all four validated configurations:

- **CPUs:** Dell recommends quad core CPUs for XenDesktop deployments, as CPU performance is typically the limiting factor in the number of virtual desktops that can be deployed.
- **XenServer Configuration:** Due to rack space density, rack-mount dual-socket servers are typically best for XenDesktop deployments.
- **XenMotion:** XenMotion allows the seamless migration of a virtual machine from one XenServer to another. This requires that shared storage is available in either iSCSI or SAN types. This migration functionality has been tested on both a Dell MD3000i and Equalogix PS-5000X.

Depending on the XenDesktop package you purchased, XenMotion may be included with XenServer. If XenMotion is part of the package, Dell recommends that you implement the application. A shared storage unit is required to support this functionality: both iSCSI and SAN are supported.

- **RAID Configuration:** RAID 1 is recommended for the XenServer boot volume. For best performance and reliability, Dell recommends RAID 10 for local VM storage.
- **Citrix Provisioning Server:** Citrix Provisioning Server streams the OS to each VM, resulting in a large savings in storage and simplified image management.

# Dell|XenDesktop Reference Architecture Configurations

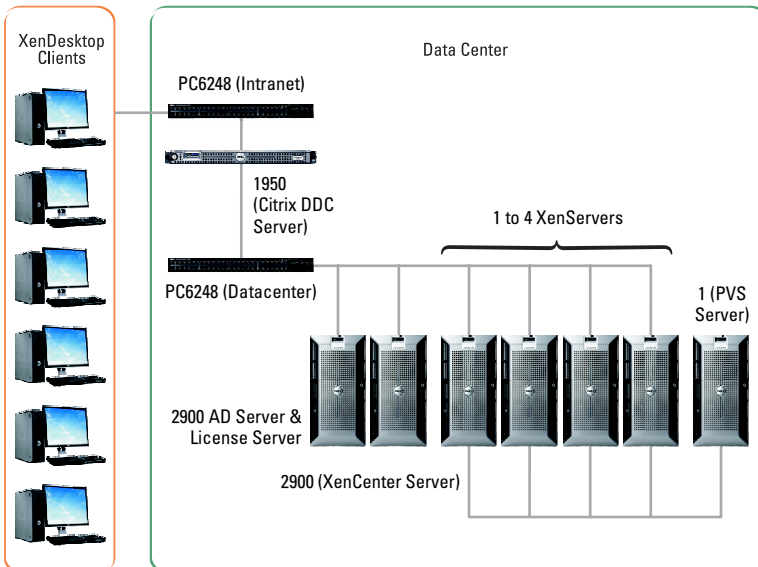
The four configurations listed here are generic deployments that are based on solution size and capability, and are independent of the target application. The recommendations focus on hardware capacity and software features.

## Very Small Configuration

The Very Small Configuration is designed to be a proof-of-concept configuration for approximately 100 Virtual Desktops with knowledge worker loads. It allows customers to get a feel for how their desktops and applications will perform in a XenDesktop environment.

The Very Small Configuration consists of one to four PowerEdge 2900 tower servers, each running XenServer. The minimum recommended memory in this configuration is 16 GB. XenMotion™ is not usually required in a Very Small Configuration, so shared storage isn't included.

### Building Blocks for Very Small Configurations



The components of Very Small Configurations are:

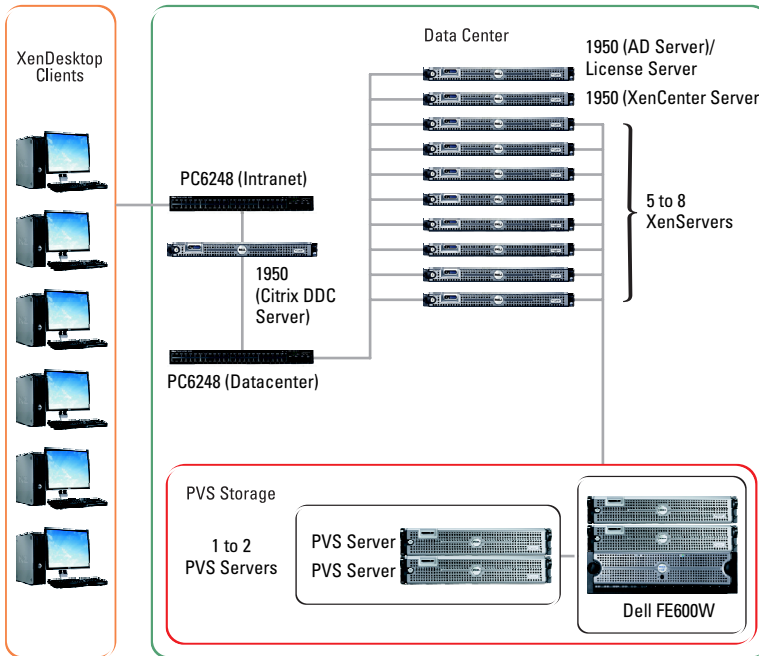
- **Servers:** Because this configuration is intended for a proof-of-concept deployment or a deployment to a small office/satellite office, non-rack mounted servers are available. The Active Directory and License Server roles are combined on one server. Any server on the XenServer compatibility matrix (located in the XenServer Reference Architecture) can be used in place of the XenServer servers.
- **CPU:** Quad core CPUs are recommended in all XenDesktop solutions for maximum virtual desktop scalability.
- **Memory:** 16 GB RAM provides enough memory to deploy many virtual desktops.
- **Network:** The two onboard gigabit NICs provide enough bandwidth to support network traffic. The service console and management are shared on the same NIC. With the exception of the client network (which only requires 10 Mbit for each client), Dell recommends gigabit network switches throughout the solution.
- **Disk:** Local storage is used on the XenServer systems to store the VM configuration only. The virtual machine disk images are stored on the Provisioning Server.

## Small Configuration

The Small Configuration is designed to be a simple configuration of five to eight servers—each running XenServer—that supports up to 256 knowledge worker desktop loads. The minimum memory Dell recommends in this configuration is 16 GB per server. The storage requirements are expected to be low, and local storage may be suitable for some deployments.

Two Provisioning servers are used in this configuration, along with a Dell FE600W failover cluster. This provides redundant and scalable streaming server capabilities, and vastly decreases the storage requirements needed. Shared storage such as a Dell|Equalogix™ PS5000XV will also allow the use of XenMotion to help load balance the XenServer workload. Storage options for Provisioning Server are addressed by the *Provisioning Server Deployment Guide* and *Reference Architecture Guide*.

## Building Blocks for Small Configurations



The components of Small Configurations are:

- **Servers:** The configuration utilizes 1U/2U rack servers. 1U rack servers have low local storage capacity, so they work well with Provisioning Server. If local storage is used, a 2U or larger server is preferred. Network connections on XenServer servers use both of the embedded NICs, typically one for the virtual machines and one for storage and infrastructure connections.
- **CPU:** Quad core CPUs are recommended in all XenDesktop solutions for maximum virtual desktop scalability.
- **Memory:** The 16 GB RAM provides enough memory to deploy 32 384M Virtual Machines per XenServer.

- **Network:** The two onboard and one add-in DualPort gigabit NICs provide enough bandwidth to support VM image streaming and network traffic, while leaving the remaining PCI-e slot(s) available for additional peripherals. The service console and XenServer management are shared on the same NIC. To keep storage traffic isolated, a pair of independent Ethernet switches is recommended to access Provisioning Servers.
- **Disk:** Local storage is used to store the VM configurations only. Provisioning Server is required for storage of the VM disk.



**NOTE:** Using faster disks and/or adding more spindles can improve performance on the Provisioning Server. Refer to the *Provisioning Server Reference Architecture Guide* for more information.

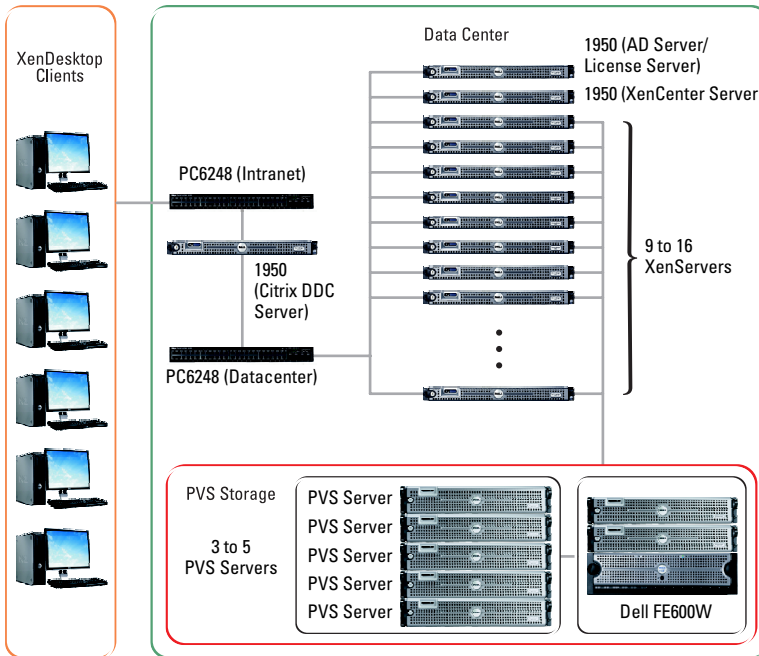
## Medium Configuration

The Medium Configuration is targeted towards medium business customers. It consists of nine to sixteen servers, each running XenServer. Each server should have quad-core processors and at least 16 GB of RAM. This configuration supports up to 512 knowledge worker desktop loads.

Five provisioning servers are used in this configuration, along with a Dell FE600W failover cluster. This provides redundant and scalable streaming server capabilities that can stream an OS image to 500 VMs. Shared storage—such as a Dell | Equalogix PS5000XV—will also allow the use of XenMotion to help load balance the XenServer workload.

Citrix Provisioning Server should be deployed with its own shared storage solution. Refer to the *Citrix Provisioning Server Reference Architecture Guide* and *Deployment Guide* for detailed information on shared storage in this environment.

## Building Blocks for Medium Configurations



The components of Medium Configurations are:

- **Servers:** The configuration utilizes 1U/2U rack servers. 1U rack servers have low local storage capacity, so they work well with Provisioning Server. If local storage is used, a 2U or larger server is preferred. Network connections on XenServer servers use both of the embedded NICs—typically one for the virtual machines and the other for storage and infrastructure connections.
- **CPU:** Quad core CPUs are recommended in all XenDesktop solutions for maximum virtual desktop scalability.
- **Memory:** The 16 GB RAM provides enough memory to deploy 32 384M virtual machines per XenServer.
- **Network:** The two onboard and one add-in DualPort gigabit NICs provide enough bandwidth to support VM image streaming and network traffic, while leaving the remaining PCI-e slot(s) available for additional

peripherals. The service console and management are shared on the same NIC. To keep storage traffic isolated, Dell recommends a pair of independent Ethernet switches to access Provisioning Servers.

- **Disk:** Local storage is used to store the VM configurations only. Provisioning Server is required for storage of the VM disk.



**NOTE:** Using faster disks and/or adding more spindles can improve performance on the Provisioning Server. Refer to the *Citrix Provisioning Server Reference Architecture Guide* for more information.

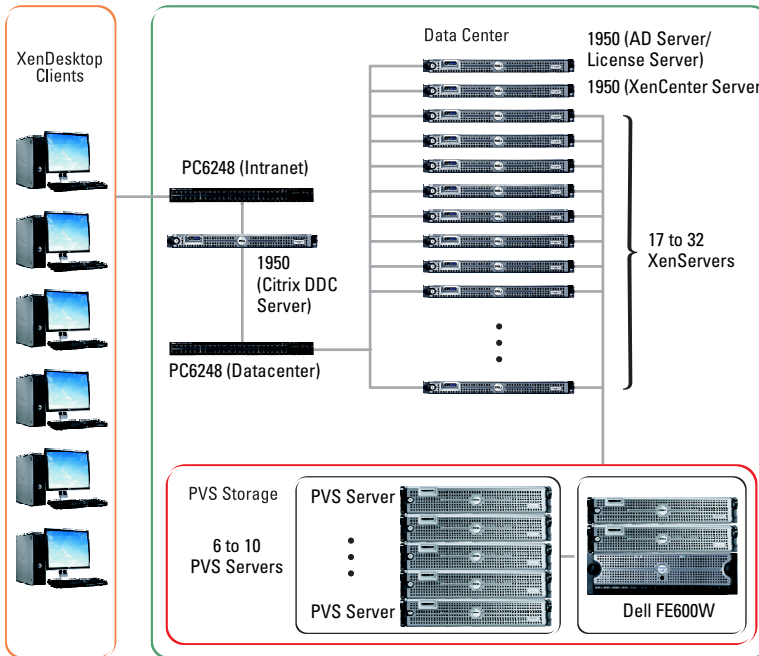
## Large Configuration

The Large Configuration is a full-feature virtualization solution targeted to large enterprises. It consists of 17 to 32 servers, each running XenServer Enterprise Edition. XenMotion enables efficient and dynamic provisioning capabilities to handle peak loads and perform scheduled maintenance on servers.

Ten Citrix Provisioning Servers are required to support streaming to 1000 VMs. A Dell FE600W is required to provide a single shared image to these Provisioning Servers.

Refer to the *Citrix Provisioning Server Reference Architecture Guide* and *Deployment Guide* for detailed information on shared storage in this environment. This requires a shared storage unit to be available, typically a Dell|Equalogix PS-5000XV configuration (not pictured).

## Building Blocks for Large Configurations



The components of Large Configurations are:

- **Servers:** Dell recommends 1U and 2U servers for space and performance reasons. Rack space, expected performance, future expansion, and power/cooling capacity are key factors in selecting the server form factor. Network connections on XenServer servers use both of the embedded NICs—typically one for the virtual machines and one for storage and infrastructure connections. A dual port add-in NIC is expected if iSCSI storage is used for XenMotion.

**NOTE:** The tower server can be rack mounted as a 5U rack server.

- **CPU:** Quad core CPUs are recommended in all XenDesktop solutions for maximum virtual desktop scalability.
- **Memory:** The minimum amount of memory required is 16 GB RAM, which can be expanded up to 64 GB if more memory per VM is needed.



- **Network:** The two onboard and one add-in dual-port gigabit NICs provide enough bandwidth to support iSCSI target and network traffic, while leaving the remaining PCI-e slot(s) available for additional peripherals. The service console and XenServer management are shared on the same NIC. To keep storage traffic isolated, a pair of independent Ethernet switches are recommended to access iSCSI devices.
- **Disk:** Local storage is used to store the VM configurations only. Provisioning Server is required for storage of the VM disk.



**NOTE:** Using faster disks and/or adding more spindles can improve performance on the Provisioning Server. Refer to the *Citrix Provisioning Server Reference Architecture Guide* for more information.



# A

## Appendix: Further Resources

Dell has several resources available for designing and deploying virtualization solutions. For further information about Dell supported virtualization solutions:

- Dell Citrix Virtualization Solutions:  
[http://www.dell.com/content/topics/global.aspx/solutions/xenserver\\_tech\\_docs?c=us&cs=555&l=en&s=biz](http://www.dell.com/content/topics/global.aspx/solutions/xenserver_tech_docs?c=us&cs=555&l=en&s=biz)
- Dell Support and Services:  
<http://www.dell.com/content/topics/global.aspx/services/adi/virtualization?c=us&l=en&s=gen>
- Dell Virtualization Readiness Service:  
<http://www1.euro.dell.com/content/topics/global.aspx/services/adi/virtualization?c=uk&l=en&s=gen>
- Dell Citrix Virtualization:  
[http://www.dell.com/content/topics/global.aspx/solutions/xenserver\\_tech\\_docs?c=us&cs=555&l=en&s=biz](http://www.dell.com/content/topics/global.aspx/solutions/xenserver_tech_docs?c=us&cs=555&l=en&s=biz)
- Dell XenServer Reference Architecture:  
[http://www.dell.com/downloads/global/solutions/dell\\_xenServer\\_reference\\_architecture\\_v1.1.pdf](http://www.dell.com/downloads/global/solutions/dell_xenServer_reference_architecture_v1.1.pdf)



# B

## Appendix: Testing Methodology

The configurations were tested using two defined workloads: knowledge worker and task worker. A base virtual machine (VM) was defined for these workloads, along with the workloads and their associated applications. These were deployed using the XenDesktop's pool feature.

The test objectives were:

- Determine the feasibility of deploying VMs through pools
- Define acceptable response times, throughput, resource utilization, and usability of VMs

The workload generators used to stress the configurations have error checking and handling mechanisms, so if the system became overloaded, errors would appear and the test run would stop. These error checks, along with the defined QoS metrics, were used to validate stability as the number of VMs was scaled up.

Virtual machines are configured with only one Virtual CPU (VCPU). This is done to maximize the number of VMs that can be supported on a single server.

The testing configuration components were:

**Virtual Machines:** All virtual machines used in our scalability and functionality testing were configured with 384M of RAM, 1 VCPU, 4 GB virtual disk, and one network interface.

**Structured Task Worker Workload:** The desktop user entered 900 random numbers into a Microsoft Excel® worksheet (30 rows x 30 columns). The only application running on the desktop was Excel.

**Knowledge Worker Workload:** The operations performed by the knowledge worker were based on the VMware "VDI Server Sizing and Scaling" paper. The operational steps performed by the knowledge worker were:

- 1** Start Microsoft PowerPoint®. Open a 5 MB presentation with automation and page through 50 slides. Close PowerPoint.
- 2** Start Microsoft Internet Explorer®. Browse 3 different web pages. Close Internet Explorer.
- 3** Start Command Prompt and open a directory listing. Close command prompt.
- 4** Start PowerPoint. Open a 5 MB presentation with automation, and page through 50 slides. Close PowerPoint.
- 5** Start Excel. Open an Excel file. Close Excel.
- 6** Start PowerPoint. Open a 5 MB presentation with automation, and page through 50 slides. Close PowerPoint.
- 7** Start Microsoft Word®. Type a 1 page document. Close Word.

Performing a single iteration of these operations took approximately 5-7 minutes, depending on the typing speed of the user. A typing speed of 120 wpm and 200 wpm were used to gather multiple data points. Typical typing speed for experts are in the 60-75 wpm range: therefore, these results represent a worst case scenario for most customers.