XenDesktop Modular Reference Architecture

Citrix Worldwide Consulting Solutions

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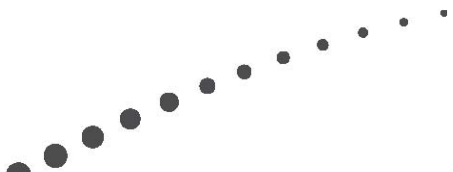

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Executive Overview

Many IT organizations are looking for a better way to manage desktops. The continuous cycle of imaging, patching and upgrading a myriad of physical devices dispersed throughout the organization is costly, time consuming and frustrating. With the ever increasing push to be more agile and flexible IT organizations are increasingly looking to desktop virtualization as an alternative to traditional desktop management solutions.

Hosted Virtual Desktops (HVD), also referred to as Virtual Desktop Infrastructure (VDI), refers to the process of running an end user desktop inside a virtual machine that lives on a server in the datacenter. HVD is only one model of desktop virtualization. Different types of workers across the enterprise have varying performance and personalization requirements. Some require simplicity and standardization while others need high performance or a fully personalized desktop. XenDesktop can meet all these requirements in a single solution with Citrix FlexCast™ delivery technology. With FlexCast, IT can deliver every type of virtual desktop, hosted or local, physical or virtual - each specifically tailored to meet the performance, security and flexibility requirements of each individual user.

With so many options, creating an all encompassing architecture could take years to design and implement. However, this document demonstrates a proven approach that simplifies the design and architecture of the XenDesktop implementation. The different desktop delivery models are discussed and broken out into a series of discrete modules that can be combined as needed to create a solution that's tailored to each environment's unique needs.

The modular approach presented offers the best options for building large-scale deployments, starting with modules and scaling all the appropriate contents with high-availability and best TCO.

A Modular Approach to XenDesktop Architecture

Rather than looking at XenDesktop as one large integrated system it is better to break the system up into a discrete set of structurally independent modules with well-defined interfaces. These modules are combined in a wide variety of configurations to solve an even wider array of business challenges.

A modularized approach to design and architecture is predicated on the notion that each customer is unique but that many share a core set of requirements and objectives. A modularized approach solves for these core requirements by creating a platform that is highly resilient, flexible and scalable. Building upon the platform is a set of discrete modules that are used to customize the platform to suit the customer's individual needs and objectives.

This paper describes the modularized approach and provides a blueprint for the XenDesktop platform and its constituent modules. Pulled from the field, this Reference Architecture is based on information gathered by Citrix's team of worldwide consultants working on a wide array of real XenDesktop implementations of varying scope, size and complexity.

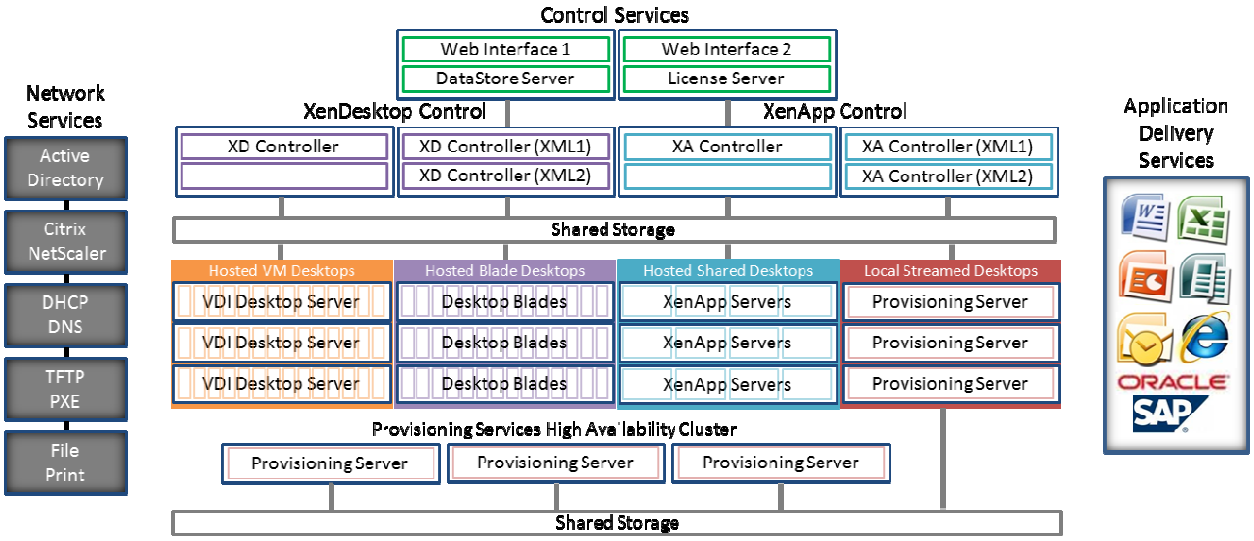


Figure 1 - XenDesktop as a Modular Platform

Building a Modular XenDesktop Environment

Using the modularized approach, build out the initial infrastructure before adding desktop modules. All the service and support modules are built with redundancy and scalability in mind (See Appendix 1).

Stage 1 - Setting up the Platform

Step 0 – Ensure the Supporting Network Services are in place

Active Directory
Active Directory provides a common namespace and a secure method of communication for all servers and desktops in the environment.

Citrix NetScaler
Citrix NetScaler provides load balancing for the Web Interface and XML Broker servers.

Domain Name System (DNS)
DNS provides IP Host name resolution for all infrastructure components.

Preboot eXecution Environment (PXE)
PXE is a BIOS extension that enables target devices to boot from a network card, regardless of the availability of local data storage devices or operating systems. When the PXE extension is initialized at boot time, the firmware sends a DHCP broadcast that identifies the target device as being PXE-compatible. PXE receives data on UDP port 67 and sends data to UDP port 68.

Dynamic Host Configuration Protocol (DHCP)
DHCP is used by the target device to request and obtain an IP address from the DHCP service. DHCP uses Option 66 and 67 to specify the bootstrap file location and filename to a target device. The DHCP service receives requests on UDP port 67 and sends data to UDP port 68 on a target device. Pooled and assigned VDI Hosted Desktops will have their OS's streamed from PVS.

Trivial File Transfer Protocol (TFTP)
Provisioning services (PVS) target devices use the Trivial File Transfer Protocol (TFTP) to request and receive a bootstrap file from the TFTP service. The TFTP service receives the requests on UDP port 69 and sends data to UDP port 69 on a target device.

File & Print Services
File Servers are used to store user profiles and data and Print Servers are used to manage and control shared print resources.

Step 1 - Build The Image Module

Role: The Image Module is responsible for streaming the operating systems (OS) of most components in the environment including servers and desktops. Using Provisioning Services (PVS) to deliver a server's OS image allows for the highest level of consistency in the environment and significantly simplifies ongoing server updating and maintenance. DHCP reservations should be used in environments where server IP address consistency is required.

Server Details

Image Module Configuration	
Physical Server Configuration	Dual Quad-core CPU's, 32 GB RAM
Server OS	Windows Server 2008
Windows Server Roles	None
Software	Citrix Provisioning Server 5.1 SP2

Figure 2 - Image Module Configuration

Provisioning Services

Due to its criticality in the environment it is recommended to leverage a PVS high availability cluster. Comprised of two or more PVS servers sharing read/write access to the same shared storage LUN(s) where the vDisks reside, a highly available PVS cluster offers IT Administrators the following benefits:

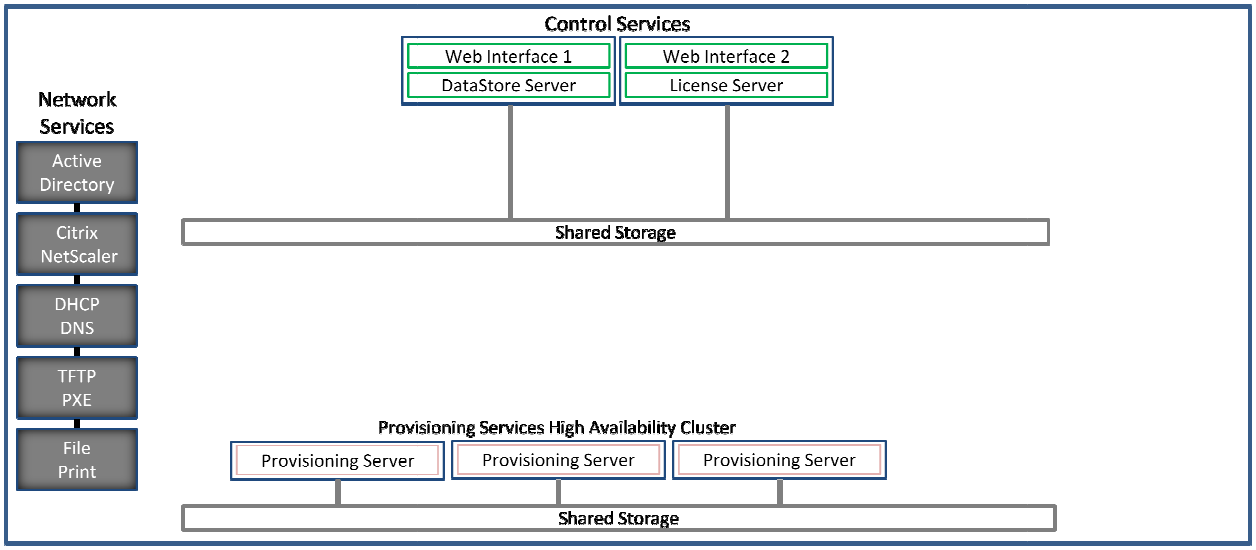
- Facilitates load balancing of I/O (Input/Output) operations by effectively distributing I/O requests from target devices amongst all servers.

- Allows target devices to automatically re-establish connectivity (failover) to the vDisk containing their workload through another PVS server in the event that connectivity to the vDisk through an initial PVS server is lost unexpectedly, i.e. Server hardware failure or loss of network connectivity.

Image Module Communications		
Server	**Protocol**	**Port(s)**
Inter-Server	UDP	6905-6909
Streaming Services	UDP	6910-6930
Console	TCP	54321,54322
Data Store Server	TCP	1443 (SQL)

Figure 3 - Image Module Communications

Step 2 - Build the Control Services Module



Role: Farm support services for the XenDesktop environment.

Overview

Built on two 64bit servers joined together in a highly available resource pool, this layer supports the redundant Web Interface servers and farm backend servers (licensing, configuration databases, etc.). The physical servers are configured with redundant connections to the Storage Area Network SAN and the Local Area Network (LAN) to overcome potential network-layer faults. The Web Interface servers should be imaged and delivered by PVS with the local host cache on either local disk or a SAN based storage repository. The database and license servers should be configured to boot from the SAN to allow the server to be live migrated to the other server in the hypervisor pool in the event of a physical hardware failure.

Web Interface

Web Interface provides the user interface to the XenDesktop environment. Web Interface brokers user authentication, enumerates the available desktops and, upon launch, delivers an .ica file to the Citrix Receiver on the user's local device to initiate a connection.

XenDesktop user roaming ***(New in Web Interface 5.2)*** allows for the association of user groups with specific XenDesktop farms to provide a consistent experience for users, regardless of their current location or the server to which they are logging on. This enables users who travel abroad on business, for example, to log on to a local Web Interface server and automatically receive desktops in their native language from a XenDesktop farm in their home country.

Web Interface Server Configuration	
VM Configuration	2 Virtual CPU's, 2GB RAM
Server OS	Windows Server 2008
Windows Server Roles	IIS, ASP.NET, IIS, ASP.NET, IIS 6 Metabase Compatibility, Windows Authentication
Software	Citrix Web Interface 5.2
Communication	HTTP(S): 80, 443

Figure 4 – Web Interface Server Configuration

License Server

The Citrix License Server is responsible for managing the licenses for all of the components of XenDesktop 4 with the exception of XenServer. XenDesktop has a 90 day grace period which allows the system to function normally for 90 days if the license server becomes unavailable. This grace period offsets the complexity involved with building redundancy into the license server.

License Server Configuration	
VM Configuration	2 Virtual CPU's, 2GB RAM
Server OS	Windows Server 2008
Windows Server Roles	IIS, ASP.NET, IIS 6 Management Compatibility, Windows Authentication
Software	Citrix License Server 11.6.1
Communication	TCP: 27000, 7279

Figure 5 – License Server Configuration

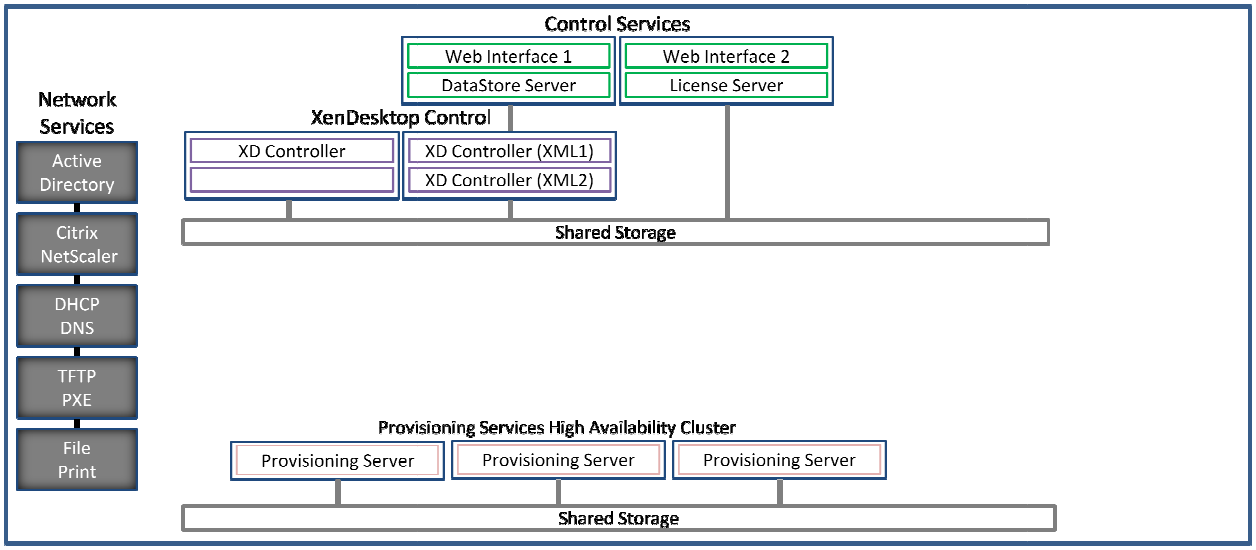
Data Store Server

XenDesktop, XenApp, Provisioning services and StorageLink all store configuration information in the data store database. These databases should all be collocated on a single, centralized database server.

Data Store Server Configuration	
VM Configuration	2 Virtual CPU's, 4GB RAM
Server OS	Windows Server 2008
Windows Server Roles	NA
Software	Microsoft SQL Server 2005 SP3
Communication	TCP: 1433

Figure 6 – Data Store Server Configuration

Step 3 – Build a XenDesktop Control Module



Role: The XenDesktop Control Module is responsible for all of the management, coordination and brokering of the VM hosted and bade hosted desktops in the environment.

Server Details

XenDesktop Controller Configuration	
VM Configuration	4 Virtual CPU's, 4GB RAM
Server OS	Windows Server 2003
Windows Server Roles	NA
Software	Citrix XenDesktop 4

Figure 7 - XenDesktop Controller Configuration

XenDesktop Controller

The XenDesktop (XD) controllers are responsible for maintaining the proper level of idle desktops to allow for instantaneous connections, monitoring the state of online and connected virtual desktops and shutting down virtual desktops as needed. The primary XD controller is configured as the farm master server. In the event the primary farm master becomes unavailable one of the backup farm master servers will be elected to the primary farm master role. For this reason both of the XML servers should be configured as backup farm master servers.

XenDesktop Controller (Dedicated XML Server)

By directing the Web Interface servers to communicate with dedicated XML servers the master XenDesktop controller is allowed to focus on its role of managing the farm. The XML brokers are responsible for user authentication, resource enumeration and resource launching processes. A failure in the XML broker service will result in users being unable to start their desktop. Due to its criticality it is best to have at least two dedicated XML servers. It is also highly recommended to enlist Citrix NetScaler for advanced monitoring and load balancing of the XML servers. For more information please see High Availability for Desktop Virtualization - Reference Architecture (CTX123244)

Communications

XenDesktop Control Module Communications		
Service	**Protocol**	**Port(s)**
Domain Controller	TCP	389,636 (LDAP)
License Server	TCP	27000, 7279
XenServer Infrastructure	HTTP(S)	80,443
Virtual Desktop Agent	HTTP	8080
Web Interface	HTTP(S)	80,443
DataStore Server	TCP	1443 (SQL)

Figure 8 - XenDesktop Control Module Communications

Notes:

- Shared Storage (SAN) does not necessarily need to be split between the control modules and the Image (PVS) Module. It is drawn that way in the diagram for clarity.

- While this infrastructure appears overbuilt for smaller environments it is important to note that the point of a modularized approach is to create architecture that can scale as the organization scales without requiring an extensive redesign. For the small environments (less than 3,000 virtual desktops), the master controller can be decommissioned.

Step 4 – Putting Application Delivery Services in Place

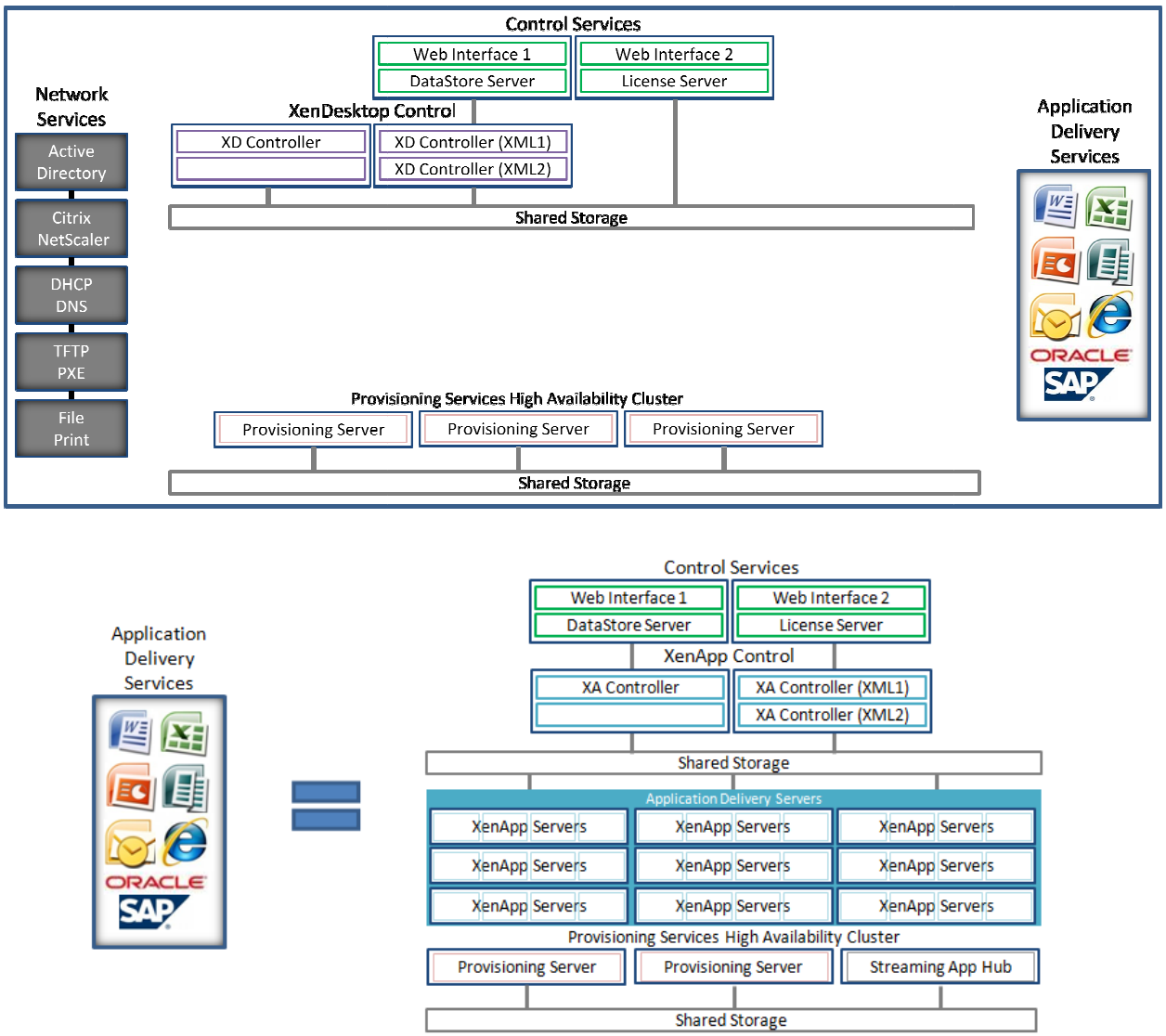


Figure 9 - Application Delivery Services Module

Role

The Application Services Module is responsible for application delivery to all desktop modules as well as any Citrix Receiver compatible endpoint devices.

Description

The desktop is a platform for users to access their applications and data. The quantity, diversity and complexity of a customer's application set will have a significant impact on the virtualized desktop environment. With the addition of XenApp as a component, XenDesktop 4 is capable of delivering both virtualized applications as well as desktops.

Note: Hosted shared desktops are equivalent to XenApp shared server based desktop. While one XenApp Farm is capable of acting as both a desktop and application delivery mechanism the roles are separated here for the purposes of clarity.

Application delivery models

- **Installed on the desktops image** – This is typically the best method for the core set of applications that need to be delivered to all users. Since updating these applications requires updating the desktop image it is best not to use this method for applications that are updated frequently or that require granular access control.

- **"Online" Hosted Applications** – Online hosted applications allow for a high degree of granular access control, provide a fast and efficient method for updating applications and reduce the workload burden on the desktop by moving application execution to the XenApp servers in the Application Services Module.

- **"Offline" Streamed Applications** – Offline streamed applications provide the same level of control and update efficiency that "online" applications offer but are different in that the workload burden is placed on the desktop. "Offline" applications require a local disk cache to store the application package. When using offline applications with Provisioning services streamed desktops ensure that sufficient storage space is available for the write cache and application cache.

Additional Considerations

- **Leverage existing application delivery models** – One of the challenges consistently facing consultants in the field with XenApp engagement is that of operational separation. Management and configuration of XenApp is clearly the role of the Windows Server \ Citrix teams while the management and configuration of the applications that XenApp delivers is more traditionally the realm of the applications or desktop services teams. In cases where there exists a well-defined and effective method of testing and deploying applications and desktop images the best course of action may be to leverage the existing infrastructure to manage and deploy the application set to the desktop images. Alternatively, customers that have already solved their application delivery problems with XenApp should leverage their existing XenApp infrastructure to provide application delivery services to the XenDesktop environment.

- **Managing the application execution burden** - Where applications execute has a significant impact on the resource load in the environment. Installed and streamed applications place the burden on the desktop modules. Application burden is the single most important factor regarding the density of desktops on each physical server. Driving most of the application execution burden to the desktop modules reduces the need for a large or sophisticated Application Services Module. Alternatively, shifting the application execution burden to the XenApp environment provides far more predictable performance from the desktop modules but requires a properly sized Application Services Module. In either case it is advisable to perform comprehensive user acceptance testing to determine the proper sizing and physical configuration of the Desktop and Application Service Modules to ensure the environment is capable of providing an acceptable level of user experience while under load.

* For more information regarding the delivery of applications to virtual desktops please see.
Simplifying Application Delivery to the Virtual Desktop - Reference Architecture (CTX120516)

Stage 2 - Adding a Hosted VM Desktop Module

Hosted VM-based VDI Desktops offer a personalized Windows desktop experience, typically needed by office workers, which can be securely delivered over any network to any device.

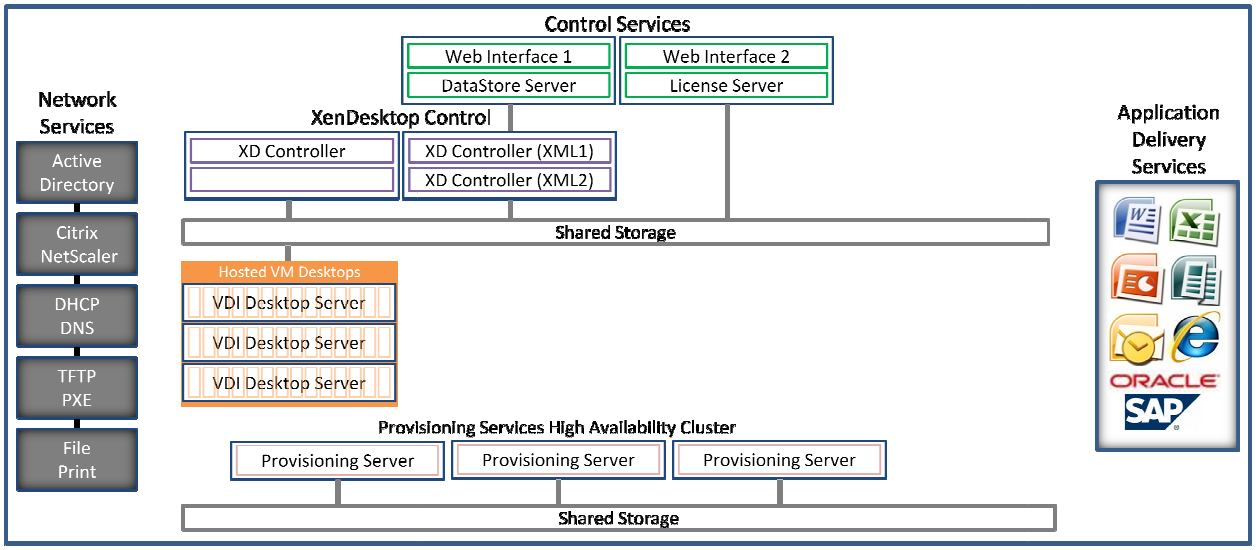


Figure 10 - Adding a Hosted VM Desktop Module

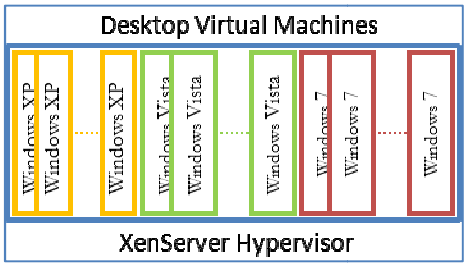


Figure 11 - Desktop Virtual Machines

Description

VDI Desktop Servers are physical servers running a hypervisor and hosting multiple desktop virtual machines.

Architecture and Design Considerations

Virtualization

XenDesktop is hypervisor agnostic and supports Citrix XenServer, Microsoft Hyper-V and VMware vSphere.

Scalability

The number of desktop virtual machines that can be hosted on a single server varies significantly and is influenced by the following factors:

- **Physical Server Capacity** – Number of CPU cores and Memory (RAM)
- **Desktop Operating System** – Windows XP, Windows Vista, Windows 7.
- **Virtual Machine Configuration** – # of virtual CPU's and memory assigned to each VM

- **Application Delivery Model** – Applications can be installed on the desktop image, streamed to the desktop by XenApp or hosted by XenApp and delivered virtually. Installing the applications locally or streaming them from XenApp places the application resource burden on the desktop and will have an impact on the amount of resources required for each desktop.

Resiliency

Provisioning Services supports three types of vDisk modes:

- **Standard Mode** – Provides a read-only desktop image that can be shared by multiple VM's
- **Private Mode** – Creates a one-to-one mapping between the VM and desktop image
- **Differencing Mode** – Provides the same benefits as standard mode but with cache that will persist a desktop reboot.

While all of these modes have their uses, standard mode makes the most sense in the majority of hosted VM desktop situations. Since changes do not persist desktop reboots all user data, settings and profile information must be redirected to a File Server. In the event that a server hosting PVS streamed VM hosted desktops fails users simply logon again and are redirected to another available desktop.

Communications

To provide an optimal and highly available environment, the Hosted VM Desktop Module is built with three teamed groups of networks (NICs):

- **Management network:** Supports communication between the hypervisor and the XenDesktop controllers.
- **User/Infrastructure network:** Supports all ICA\HDX traffic to the endpoints, file and print traffic and local infrastructure communications.
- **Storage network:** Supports communication to the SAN.

Hosted VM Desktops Module Communications		
Server\Module	**Protocol**	**Port(s)**
XenDesktop Controller Module	HTTP	8080
Application Services Module (Online Apps)	TCP	1494, 2598 (ICA)
Application Services Module (Offline Apps)	SMB	445
Endpoints	TCP	1494, 2598 (ICA)
Web Interface	HTTP(S)	80, 443
Citrix License Server	TCP	2700, 7279
Terminal Services License Server	TCP	135

Figure 12 - Hosted VM Desktop Module Communications

Introducing additional Hosted VM Desktop Modules

The boundary of the Hosted VM Desktop module varies and will depend on many factors including desktop OS, user load and the types of applications. Expanding the environment is simply a matter of adding more Hosted VM Desktop modules. As the number of VM Hosted Desktops in the environment grows so will the demand on the PVS servers in the Image module. The hardware allocation for the PVS servers should be aligned with the scale of the Hosted VM Desktop module so when a new desktop module is added, a new PVS server is added.

Notes:

- Hosted VM desktops can be built on a variety of hypervisors including Citrix XenServer, Microsoft Hyper-V and VMware vSphere. Each hypervisor has its own design considerations, which should be taken into account when designing the environment.

- While the size of a module is not limited to one hypervisor pool there may be additional infrastructure required for each pool depending on the hypervisor being used.

Stage 3 - Adding a Hosted Blade Desktop Module

Hosted Blade PC Desktops are best for solving challenges where the end users or applications require special and\or dedicated desktop hardware.

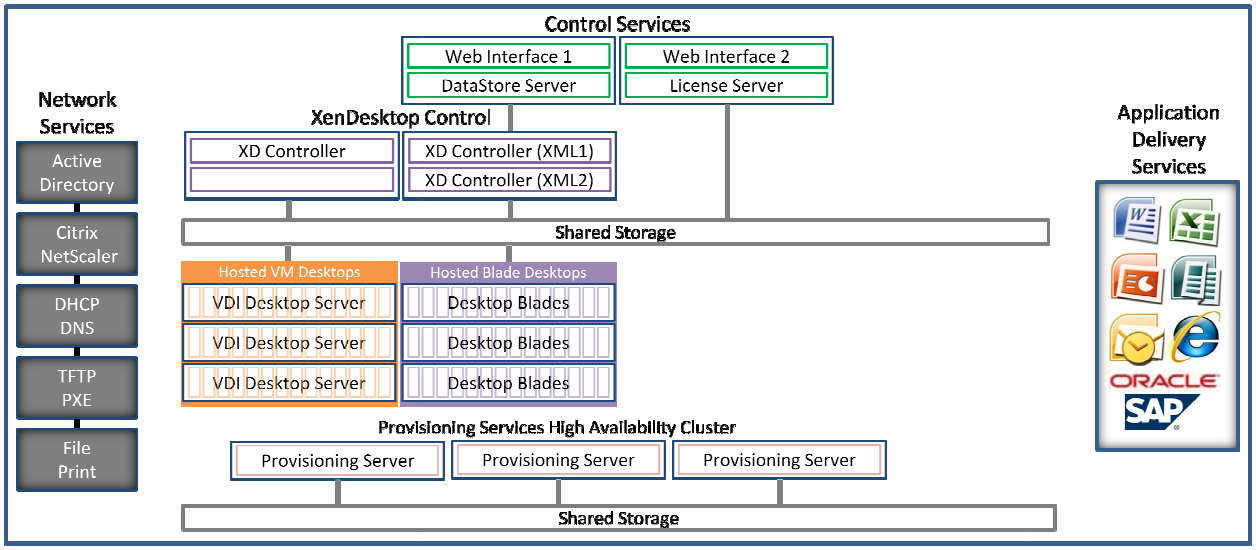


Figure 13 - Adding a Hosted Blade Desktop module

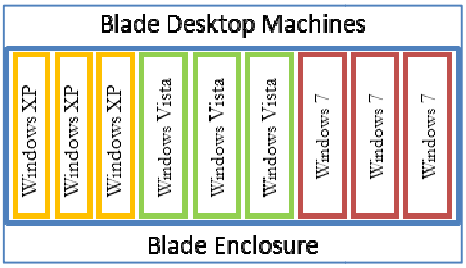


Figure 14 - Hosted Blade Desktops

Description

Hosted Blade Desktops are physical desktop PC's that are designed to fit into a rack mounted blade enclosure in the datacenter. This model creates a one to one ratio of users to desktops.

Architecture and Design Considerations

Scalability

The number of desktops is dictated by the number of physical blades that can be accommodated by the enclosure.

Resiliency

Due to the one to one mapping of this model if a user's desktop should become unresponsive the user can attempt to reboot the physical device through the Web Interface GUI.

Communications

Hosted Blade Desktop Module Communications		
Server\Module	**Protocol**	**Port(s)**
XenDesktop Control Module	HTTP	8080
Application Services Module (Online Apps)	TCP	1494, 2598 (ICA)
Application Services Module (Offline Apps)	SMB	445
Endpoints	TCP	1494, 2598 (ICA)
Web Interface	HTTP(S)	80, 443
Citrix License Server	TCP	2700, 7279
Terminal Services License Server	TCP	135

Figure 15 - Hosted Blade Desktop Module Communications

Notes:

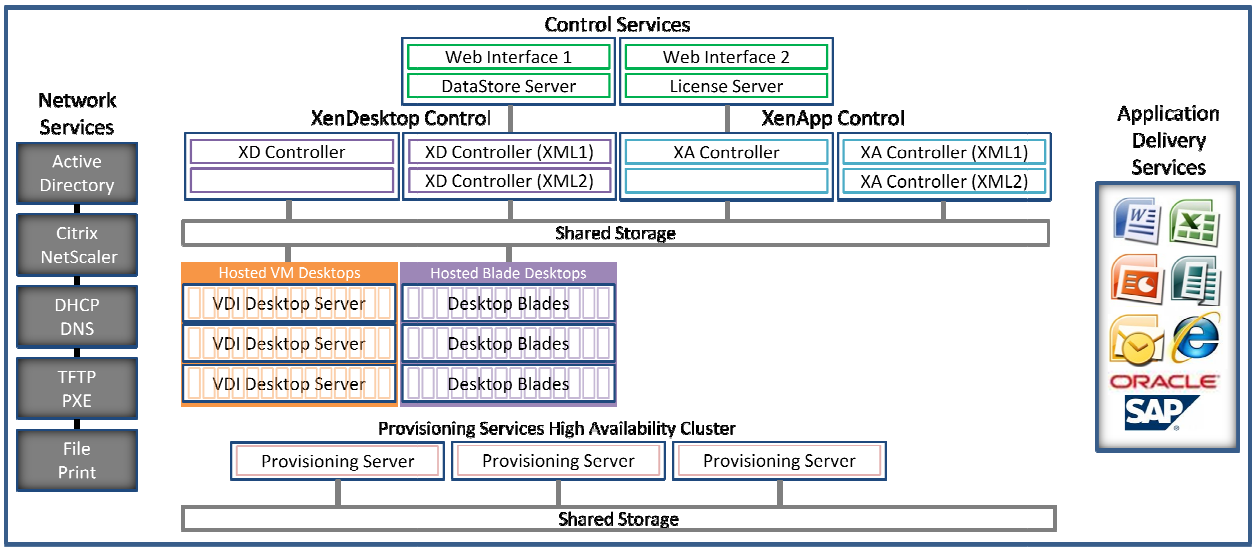
- The need for additional PVS resources is predicated on the use of PVS to stream the OS image to the desktop blades. If the desktop blades are booted from the SAN then the additional PVS resource would not be necessary.

- **Modes of delivering the OS to a Hosted Blade Desktop:**
    - Booting a desktop OS image that is stored on the SAN.
    - PVS streamed desktop using a vDisk in private mode.

Stage 4 - Adding a Hosted Shared Desktop Module

Hosted Shared Desktops provide a locked down, streamlined and standardized environment with a core set of applications, ideally suited for task workers where personalization is not needed – or allowed.

Step 1 - Adding a XenApp Control Module



Role: The XenApp Control Module is responsible for all of the management, coordination and brokering of the hosted shared desktops in the environment.

XenApp Controller Configuration	
VM Configuration	4 Virtual CPU's, 4GB RAM
Server OS	Windows Server 2008
Server Roles	Terminal Services
Software	Citrix XenApp 5

Figure 16 - XenApp Controller Configuration

XenApp Controller

XenApp servers must be load-balanced to ensure a quality user experience. Servers maintain dynamic information on a single XenApp server in each zone, called the Data Collector. The Data Collector or 'XenApp Controller', as it is referred to here, is responsible for load balancing decisions based on the following criteria; server load, session status and user information.

A XenApp Controller is a XenApp server configured as "Most Preferred" in the data collector election process. It is best to dedicate this server as a XenApp Controller by disabling user connection or not adding it to the published desktop load-balancing pool. If the Master XenApp Controller becomes unavailable one of the backup XenApp Controllers will be elected to take on the Master role. For this reason both of the XML servers should be configured as "Preferred" Data Collectors.

XenApp Controller (Dedicated XML Server)

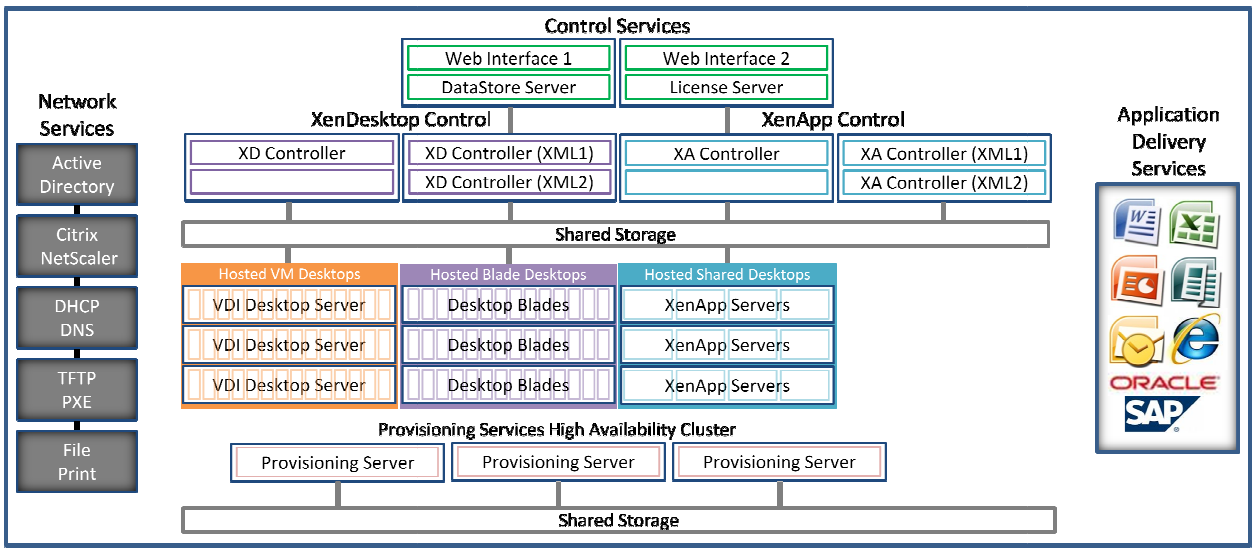
Directing the Web Interface servers to communicate with the XML servers allows the Master XenApp Controller to focus on its role of farm management. The XML broker is responsible for user authentication, resource enumeration and resource launching processes. A failure in the XML broker service will result in users being unable to start their desktop. Due to its criticality it is best to have at least two dedicated XML servers. It is also highly recommended to enlist Citrix NetScaler for advanced monitoring and load balancing of your XML servers. For more information please see Planning for the Web Interface and XML Broker

Communications

XenApp Controller Module Communications		
Server\Module	**Protocol**	**Port(s)**
Inter-Server	TCP	2512,2513 (IMA)
Domain Controller	TCP	3268,3269 (LDAP)
Citrix License Server	TCP	27000, 7279
Terminal Server License Server	TCP	135
Virtual Machine Infrastructure	HTTP(S)	80,443
Virtual Desktop Agent	HTTP	8080
Web Interface	HTTP(S)	80,443

Figure 17 - XenApp Control Module Communications

Step 2 - Adding Hosted Shared Desktop Module



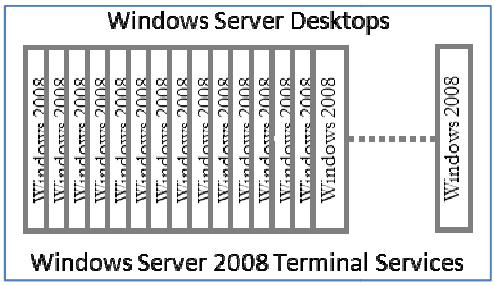


Figure 18 - Windows Server Desktops

Description

Hosted Shared Desktops provide a locked down, streamlined and standardized environment with a core set of applications, ideally suited for task workers where personalization is not needed or allowed. While it is entirely possible to use one XenApp farm to deliver both desktops and applications in this environment the Hosted Shared Desktop Module is dedicated to delivering desktops.

Architecture and Design Considerations

Virtualization

The XenApp servers can and should be virtualized. The number of VM's and their resource allocation varies significantly depending on hardware and the application set. At the time of this writing the price\scalability 'sweet spot' is an 8 core server with 20 GB of RAM hosting 4 virtual XenApp servers each with two virtual CPU's and 4 GB of Memory.

Scalability

There are many factors that will determine how many desktop you are able to support per XenApp server. The best way to determine what this number will be in your environment is to perform scalability tests with actual users.

Resiliency

Since many users will all be working together on a server it is difficult to completely protect users from a server failure. To minimize the impact of a server outage user data, application configuration information and profile data should be redirected to a file server. It is also best to design the

environment with one more server than the scalability numbers dictate (N+1). In this case the additional capacity will allow for users to quickly resume working in the event of a server outage. Since the operating system is being streamed from a read only image delivered by Provisioning services a reboot of the virtual machine will restore the server to a known and stable state.

Communications

Hosted Shared Desktop Module Communications		
Server\Module	**Protocol**	**Port(s)**
XenApp Controller Module	TCP	2512,2513 (IMA)
Application Services Module (Online Apps)	TCP	1494, 2598 (ICA)
Application Services Module (Offline Apps)	SMB	445
Endpoints	TCP	1494, 2598 (ICA)
Web Interface	HTTP(S)	80, 443
Citrix License Server	TCP	2700, 7279
Terminal Services License Server	TCP	135

Figure 19 - Hosted Shared Desktop Module Communications

Stage 5 - Adding a Local Streamed Desktop Module

Local Streamed Desktops leverage the local processing power of rich clients, while providing centralized single-image management of the desktop. These types of desktops are often used in computer labs and training facilities, and when users require local processing for certain applications or peripherals.

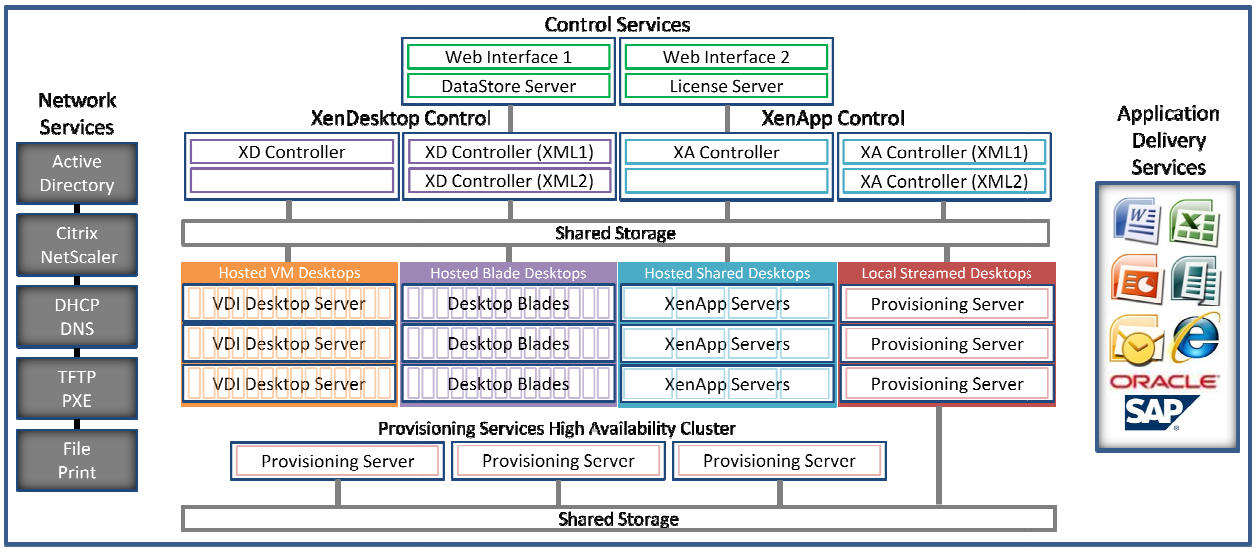


Figure 20 - Adding a Local Streamed Desktop Module

Description

Using Provisioning services (PVS), desktops are configured to boot off the network via PXE (Pre-boot eXecution Environment, part of Intel's Wired for Management (WfM) specification). During the initial stages of the boot process, a target device requests its IP address and boot information, including the name or IP address of the boot server and the name of the bootstrap file, from a DHCP server on the LAN. Upon receipt of this information, the device initiates a TFTP download request for the bootstrap file from the boot server, which instructs the device to connect to the PVS server for the purpose of registration. During the registration process, the PVS server determines which vDisk is assigned to the target device and instructs the device to download its vDisk to complete the boot process. Once the target device has obtained its workload, it is able to operate as a fully-functional desktop, taking full advantage of its local processing capabilities.

Note: New in PVS 5.1 SP2 is the ability to map a vDisk to a user account. When a particular logs on the PVS server will deliver their personal vDisk to whichever desktop they are connecting from.

Architecture and Design Considerations

Virtualization

For maximum performance and scalability PVS servers should be installed on a physical server and not virtualized on a hypervisor.

Scalability

Each PVS server is capable of servicing thousands of physical devices. One of the most relevant factors to PVS scalability is the location and type of the local host cache (LHC). For the best scalability and performance results use the RAM or the hard disk of the local device.

Resiliency

As with the Image Module configuring at least two PVS servers in a high availability cluster is recommended.

Communications

Local Streamed Desktop Module Communications		
Server\Module	**Protocol**	**Port(s)**
Endpoints	UDP	6910-6930
Web Interface	HTTP(S)	80, 443
Citrix License Server	TCP	2700, 7279

Figure 21 - Local Streamed Desktop Module Communications

Appendix 1: Control and Support Modules

Control and Services Modules Host Server Configuration

Allowing for physical server failures

The Control and Service Modules are critical to the operation of the XenDesktop environment. It is best to virtualize these server in a load balanced, highly available resource pool containing at least two physical servers. Both host servers will have redundant connections to high speed shared storage and each server will have enough resources available to handle all server loads in case one of the physical servers should fail.

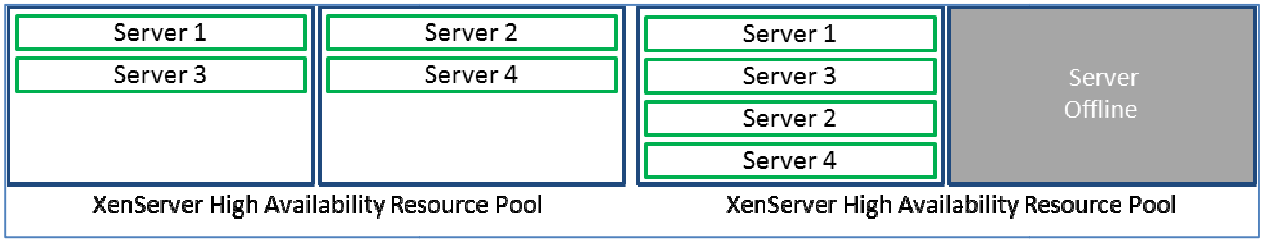
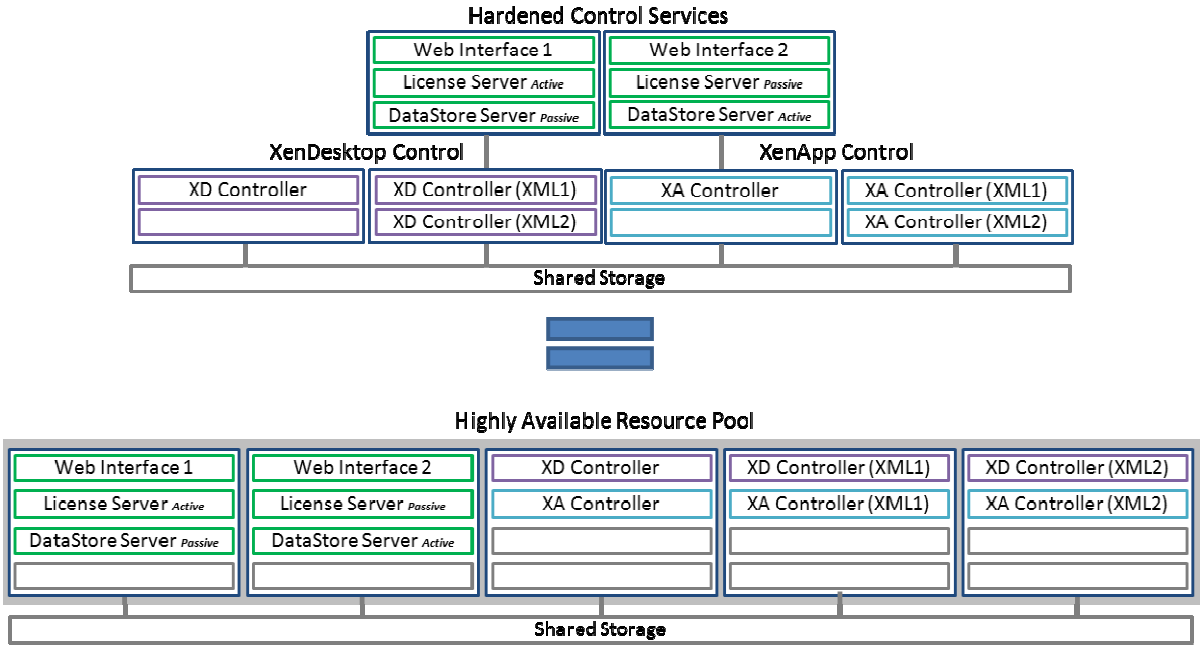


Figure 22 - Highly Available Resource Pool

Building a single Control Services resource pool

In the diagrams found within this document the Control Modules are separated for the purpose of clarity. In an actual application of the methodology it is best to create one large resource pool with the server loads distributed across the entire pool. This provides for the maximum level of resiliency and protection from hardware failure.



Hardened Services Module

Figure 23 - Hardened Services Module

License Server

In the event that the controller modules cannot contact the license server they will enter a 90 day grace period allowing for more than enough time to overcome a server outage should one occur. It is possible to create a two-node Microsoft cluster in an active/passive clustering configuration in order to establish a resilient license server. For more information on how to configure Windows clustering please see How to configure Windows clustering groups for hot spare support. And Citrix eDocs for more detail on managing and configuring a clustered license server.

Data Store Server

The control modules all react differently to an interruption of communication with the data store but all are designed to continue normal system operation in the event of a data store outage. The data store server is critical to the operation of the environment and should be managed accordingly. Provided a data store outage is remediated in short order there will be no obvious interruption of service to the user community. It is possible to create a two-node Microsoft cluster in an active/passive clustering configuration in order to establish resiliency at the data store server application layer. For more information on how to configure Windows clustering please see How to configure Windows clustering groups for hot spare support. and Citrix eDocs for more detail on managing and configuring a clustered SQL data store.

Data Store Outage Impact

- **XenApp –** Each XenApp server stores a subset of the data store in the Local Host Cache (LHC). The LHC performs two primary functions:
    - Permits a server to function in the absence of a connection to the data store.
    - Improves performance by caching information used by the Citrix Receiver plugins for enumeration and application resolution.

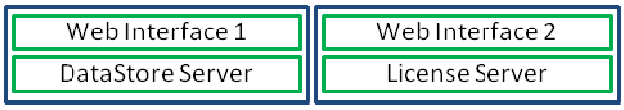
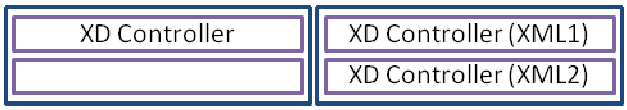
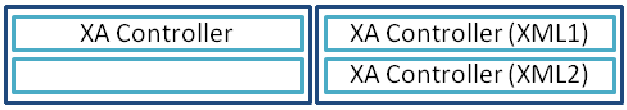
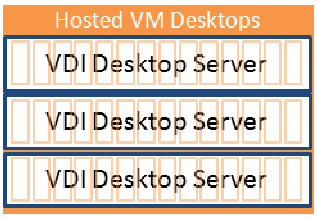
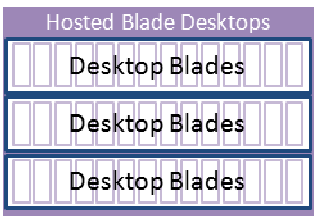
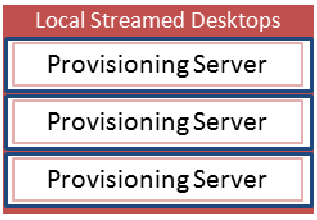
If the data store is unreachable, the LHC contains enough information about the farm to allow normal operations for an indefinite period of time, if necessary. However, no new static information can be published, or added to the farm, until the farm data store is reachable and operational again.

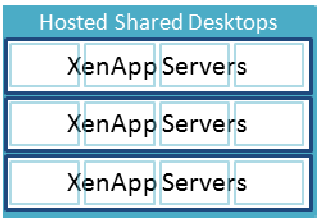
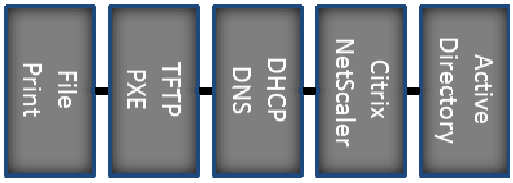
- **XenDesktop** – Similar to XenApp, XenDesktop also keeps a subset of the data store in a Local Host Cache. Although, no desktops that are set to 'assign-on-first-use' can be assigned while the data store is unavailable.

- **Citrix StorageLink Gateway (CSLG)** – Citrix StorageLink is used by XenServer to configure and manage SAN storage. If the CSLG database is offline XenServer will not be able to initiate a connection to any Storage Repositories that are managed by StorageLink. Features like XenMotion and work load balancing will not function, and while started VMs will continue to run, any stopped VMs will not be able to start.

- **Provisioning Services** – With offline support enabled can continue to function with no noticeable impact to the users. While the database is down you will not be able to:
    - Auto Add target devices
    - Create User Groups
    - Auto Update or incremental vDisk updates
    - vDisk creation
    - Active Directory password changes
    - Stream process startup **(If the process is currently stopped)**

Appendix 2: Module Reference

 **Services Module**	**Shared Platform Services:** • Web Interface servers (x2) • License server • Database server
 **XenDesktop Controller Module**	**XenDesktop Farm Services:** • XenDesktop Controller – Master • XenDesktop Controller – Brokers (x2)
 **XenApp Controller Module**	**XenApp Farm Services:** • XenApp Controller – Master • XenApp Controller – Brokers (x2)
 **Hosted VM Desktop Module**	**Hosted VM-based VDI Desktops** offer a personalized Windows desktop experience, typically needed by office workers, which can be securely delivered over any network to any device.
 **Hosted Blade PC Desktops**	**Hosted Blade PC Desktops** enable technical workers and power users to run professional graphics applications such as CAD/CAM, GIS, etc., which typically require more processing resources.
 **Local Streamed Desktops**	**Local Streamed Desktops** leverage the local processing power of rich clients, while providing centralized single-image management of the desktop. These types of desktops are often used in computer labs and training facilities, and when users require local processing for certain applications or peripherals.

 **Hosted Shared Desktops**	**Hosted Shared Desktops** provide a locked down, streamlined and standardized environment with a core set of applications, ideally suited for task workers where personalization is not needed – or allowed.
 **Application Services Module**	**Application Delivery Services:** • XenApp Farm
 **Image Module**	**Provisioning Services Image Delivery:** • Provisioning Services High Availability Cluster
 **Network Services**	**Network Support Services:** • Active Directory • Citrix NetScaler • DHCP\DNS • TFTP\PXE • File and Print

Appendix 3: High Availability

Providing high-availability for the XenDesktop architecture is focused on four distinct layers:

- Virtualization layer
- Provisioning layer
- Desktop delivery layer
- Infrastructure access layer

Virtualization Layer

Virtualizing the XenDesktop environment with XenServer provides three different levels of high-availability.

- Protect: Protected servers automatically restart if there is a physical server failure. The protected virtual machine is started on another XenServer having available resources. Only the most critical systems should be protected.

- Restart if Possible: If a virtual machine is on a failed physical server, the virtual machine only restarts if there are enough resources within the XenServer resource pool. XenDesktop infrastructure components that already have some level of redundancy built in are typically configured with this setting.

- Do Not Restart: If a virtual machine is on a failed physical server, it remains off until restarted by another system or an administrator.

Based on these three high-availability options, the following are the recommended settings for the XenDesktop components.

Component	Protection Level	Justification
XenDesktop Controller(s)	Master: Protect XML Broker #1: Protect XML Broker #2: Restart if Possible	Need to guarantee at least one controller is available. Additional controllers are desirable for scalability and fault tolerance.
Web Interface(s)	Primary: Protect Secondary: Restart if Possible	Need to guarantee at least one Web Interface is available to allow users access to desktops and applications. Additional servers recommended for scalability and fault tolerance
Data Store	Protect	The XenDesktop data store and license server are critical to the proper functioning of the XenDesktop farm. It must be running to allow for the creation of new virtual desktop connections.
Hosted Desktop(s)	Do not restart	If a user's hosted desktop fails, the user can immediately connect to another hosted desktop. While connecting, the XenDesktop Controller(s) starts the appropriate number of hosted desktops based on XenDesktop group idle settings. However, if a virtual desktop is dedicated and not pooled, then the user must wait for the hosted desktop to restart. As part of the organization's design, there are no dedicated hosted desktops defined.
XenApp Controller(s)	Master: Protect XML Broker #1: Protect XML Broker #2: Restart if	Need to guarantee at least one XenApp controller is available. Additional controllers provide a level of fault tolerance to the environment.

	Possible	
Application Hub(s)	Primary: Protect Secondary: Restart if Possible	Need to guarantee at least one Application Hub for application streaming to occur. Redundant hubs are recommended for scalability and fault tolerance.
XenApp Hosts	Restart if Possible	XenApp hosts are critical for delivering hosted applications. Although they are critical, other XenApp hosts can support a temporary increase in user load.

Provisioning Layer

Hosted-VM based desktops, local streamed desktops, XenDesktop controllers, Web Interface and XenApp are delivered by Provisioning services. If one Provisioning services server fails, the connected target devices must be able to reacquire a streaming connection from another available Provisioning Services server. High-availability requires each Provisioning services server have access to the same vDisk as other Provisioning services servers. To simplify maintenance and update activities for the vDisk, a network-attached storage device is used to host the vDisk images, as shown in Figure 24.

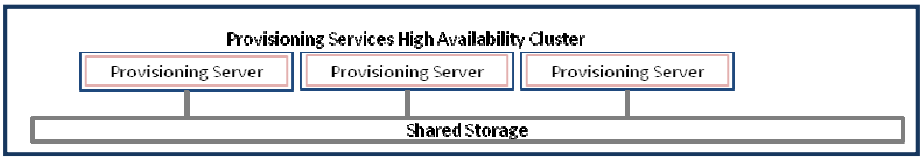


Figure 24: Provisioning Services High-Availability at Data Center

Although high-availability for Provisioning services is possible without a shared storage device, it requires the vDisk images to be located on each server and that the write cache be stored on the local device and not on the Provisioning services server. When a vDisk is updated, the new vDisk images must be synchronized between all Provisioning services servers. As there might be multiple vDisk files for different desktop configurations, XenDesktop controllers, Web Interface servers and XenApp servers, keeping the vDisk images synchronized between all Provisioning services servers will result in an administrative overhead. By using a shared storage device, the management of the environment is simplified.

Secondly, in order to provide redundancy during the boot-up sequence, the bootfile must also include redundant Provisioning services addresses, up to a maximum of four entries. Any four Provisioning services addresses can be used.

Desktop Delivery Layer

The XenDesktop controllers are responsible for

- Maintaining the proper level of idle desktops to allow for instantaneous connections
- Monitoring state of online and connected virtual desktops
- Shutting down virtual desktops as needed
- Connecting a new user to an idle virtual desktop

Without a XenDesktop controller, new users would not be able to connect to virtual desktops. However, the XenDesktop controllers are designed with built-in redundancy and the following configuration provides the highest levels of availability and scalability.

- Master Controller: One controller is the master for the farm and is responsible for maintaining idle desktop levels within the virtualization infrastructure via the Pool Service, starting/stopping virtual machines on demand and handling all user launch requests. By dedicating a server for this role, the scalability of the XenDesktop farm will be increased. If the master controller fails, one of the other controllers takes over the responsibility of maintaining idle desktop levels. For more information on configuring a Master Controller, please see Citrix Knowledge Base Article CTX117477.

- XML Broker Controller: When a virtual desktop starts, the virtual desktop agent must register with a XenDesktop controller. The controller is responsible for maintaining the status of the virtual desktop and directing new requests to newly available virtual desktops. There is also a periodic heartbeat message exchanged between the virtual desktop and the controller. This allows the controller to detect failed virtual desktops, and it also allows the virtual desktop to determine if the controller has failed. If this occurs, the virtual desktop attempts to contact another controller and reregister. This process does not impact an already connected user.

Infrastructure Access Layer

As users continue to be spread across different regions, there is a requirement for many XenDesktop environments to provide business continuity and disaster recovery. Oftentimes, this results in one of the following actions by the administrators:

- Users are told to use a different address in the event of a failure at the main data center

- A manual change is made to the DNS table, which will direct user requests to the backup data center

Of course these items are not automatic based on monitors and they also idle roughly 50% of the hardware stored at the backup data center because these business continuity solutions are configured in an active-passive mode. In the active-passive mode, only one site is active at a time. When a failure occurs, the passive site becomes active, but until this occurs, the backup site is in standby mode. However, in an active-active model where there are multiple data centers, users require a solution that not only provides them access, but also provides them access to their desktop in their preferred data center, which is where the user's data is located. This can be automated through the use of

- NetScaler Global Server Load Balancing

- XenDesktop Roaming User Support

- XenDesktop Farm Failover

For more information, please refer to Citrix Knowledge Base Article CTX123244 High Availability for Desktop Virtualization.

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