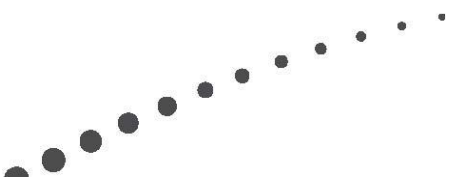




# XenDesktop 5

## Reference Architecture





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## 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, 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. Hosted VDI 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 5 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 and integrates all forms of virtual desktops, including the newest modalities available with a XenDesktop 5 implementation.

## Conceptual Architecture

Physical or virtual, hosted or local are a few of the options organizations must decide upon when embarking on desktop virtualization. At the core, Citrix FlexCast consists of the following base virtual desktop models:

Category	Description
<b>Hosted Shared</b>	Provides 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.
<b>Hosted VDI</b>	Offers a personalized Windows desktop, typically needed by office workers, which can be securely delivered over any network to any device. Hosted VDI desktops can be shared among many users or dedicated, where users have complete control to customize to suit their needs. These virtual desktops can be physical or virtual, but are connected to remotely.
<b>Streamed VHD</b>	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.
<b>Local VM</b>	Delivers a centrally managed desktop image to physical end point devices allowing the user to disconnect from the network. These types of desktops are usually required by sales, consultants, and executives.

Deciding which option is the best aligned with the organization is the responsibility of the user segmentation analysis. This process identifies user requirements and aligns with the most appropriate FlexCast model. Users requiring offline mobility are delivered a Local VM virtual desktop. Remote users who require security receive either a Hosted Shared or Hosted VDI virtual



desktop. User segmentation is critical because users have different requirements that cannot all be met by a single FlexCast model. However, the value of FlexCast is that integrating multiple models into a single architecture helps to simplify delivery and supportability of the overall solution.

The Citrix Modular Architecture, shown in Figure 1, provides the foundation for building a scalable virtual desktop infrastructure.

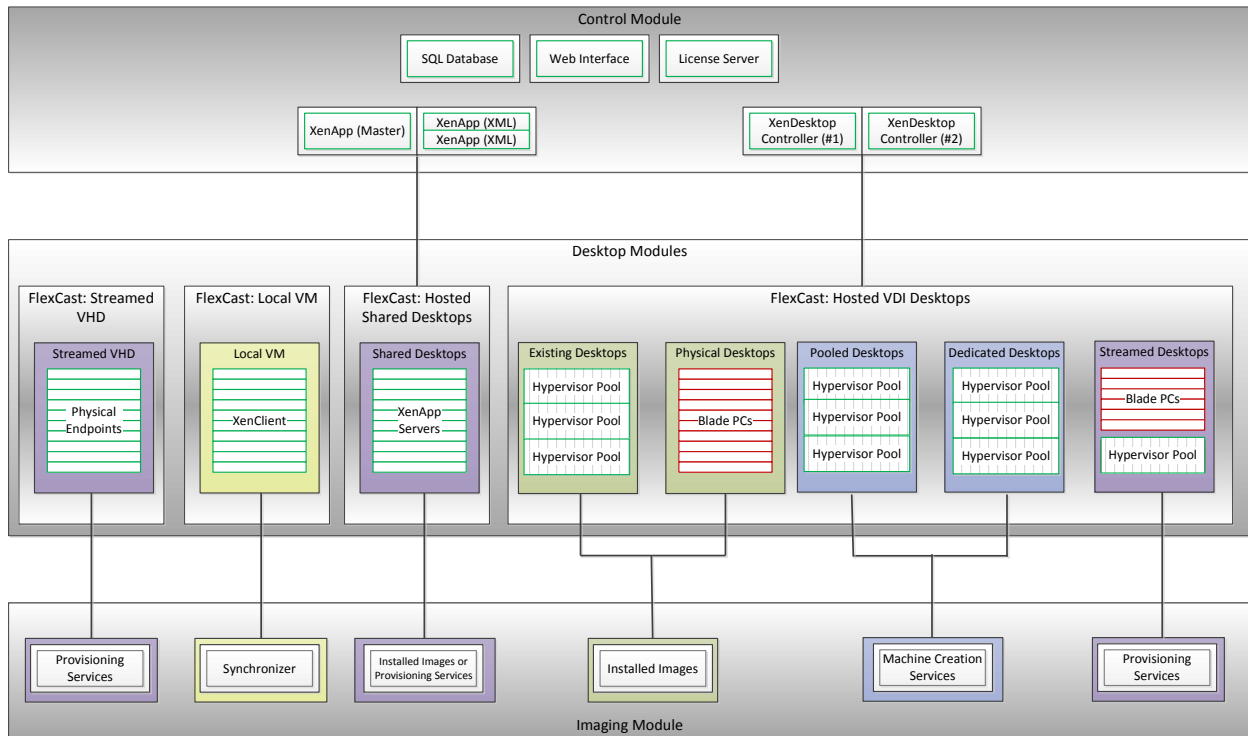


Figure 1: Modular Architecture

The modular architecture creates a single design for a data center, integrating all FlexCast models. The top module (Control Module) manages user access and virtual desktop allocation. The middle module (Desktop Modules) integrates the aforementioned FlexCast models into the modular architecture. The bottom module (Imaging Module) provides the virtual desktops with the master desktop image. Numerous options exist for all three levels because users have different requirements and the technology must align with the user needs.

Although the complete modular architecture covers four different FlexCast models, the remainder of this document focuses only on the Hosted VDI Desktop model, delivered by XenDesktop 5.

## Hosted VDI Desktop Conceptual Architecture

With Citrix FlexCast, there are numerous possibilities for the type of virtual desktops to use within a single implementation and within the Hosted VDI Desktop FlexCast model, organizations must choose between the five options. The similarities between the five is that

- They are all remote from the user's end point device

- They all require the XenDesktop virtual desktop agent
- They all require XenDesktop controller's for connectivity

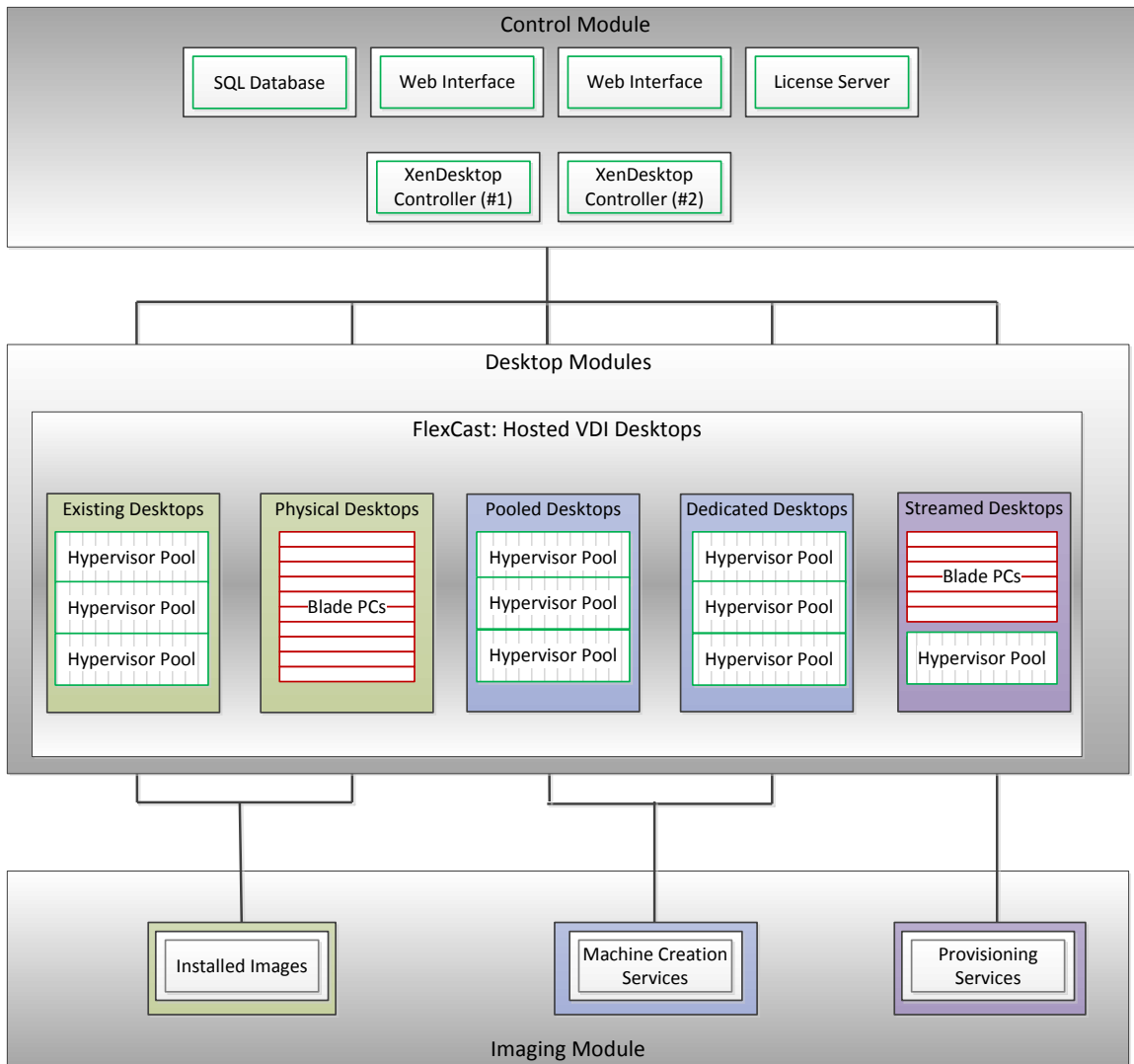
The following table provides a few of the benefits and risks associated with each Hosted VDI Desktop mode

Category	Description	Existing	Physical	Pooled	Dedicated	Stream
<b>Customization</b>	Allows users to have complete control over their environment, including user install applications	●	●		●	
<b>User impact</b>	Provides users with a virtual desktop in same configuration as their traditional desktop	●				
<b>Consolidation</b>	Utilizes a minimal amount of server resources (CPU/RAM) within the data center	●		●	●	●
<b>Common image</b>	Optimizes deployment by basing initial builds on a common, quickly provisioned image			●	●	●
<b>Clean image</b>	Maintains an optimized, clean image upon each reboot			●		●
<b>Managed updates</b>	Simplified desktop management by updating a master image, and all desktops are updated			●		●
<b>Storage space</b>	Reduces the overall amount of storage space required			●	◐	●
<b>Storage IO</b>	Reduces overall IO requirements of the storage infrastructure			●	●	●
<b>Flexibility</b>	Capable of delivering desktops across many different platforms (physical and virtual)					●

Notes:

- **Optimized Storage Space:** Dedicated desktops are initially based off of a common image, which reduces the over storage footprint of the core operating system.
- **Reduce Storage IO:**
  - Read IO activity can be reduced by using XenServer IntelliCache for Pooled and Dedicated desktops.
  - As Provisioning services executes on Windows Server 2008, read IO activity can also be reduced for Streamed desktops by utilizing Windows system cache.

Each of the five XenDesktop 5 Hosted VDI Desktop models can easily be integrated into a modular architecture, as shown in Figure 2: Hosted VDI Desktop Architecture.



**Figure 2: Hosted VDI Desktop Architecture**

Although the five models (Existing, Installed, Pooled, Dedicated, and Streamed) are shown in a single architecture, most organizations will only require a small subset. At the core, each model’s image is managed and maintained by either Machine Creation Services, Provisioning services or installed images. These options provide differing levels of hardware support and user customization ability. Even though organizations will utilize different combinations of virtual desktop models, the control for the environment will be similar, consisting of XenDesktop Controllers, Web Interface servers and a SQL database.

The importance of the modular architecture is each organization can select the most appropriate FlexCast option and easily integrate into the overall architecture. This is accomplished by focusing on the following three core areas, depicted in Figure 2: Hosted VDI Desktop Architecture:

1. Control Module
2. Imaging Module



### 3. Desktop Modules

## Control Module

User access and desktop delivery is the core responsibility of the control module. The module is responsible for managing and maintaining the status of the entire XenDesktop site. User authentication, enumeration, and brokering are all maintained within the control module. The module contains the following infrastructure services:

- **XenDesktop Controller:** Provides the link between the Web Interface and the XenDesktop site. The controllers authenticate users, enumerate resources for the users, and direct user launch requests to the appropriate virtual desktop. The controllers manage and maintain the state of the XenDesktop site to help control desktop startups, shut downs, and heart beats. The controllers constantly query and update the SQL database with site status, allowing controllers to go offline without impacting user activities. It is recommended that at least two controllers be deployed per XenDesktop site to provide high availability. As the site grows, additional controllers might be required if the allocated CPU cannot service the user requests fast enough.
- **Web Interface:** Provides initial user access into the XenDesktop site. Web Interface accepts user credentials and passes them onto the XenDesktop site for authentication and enumeration. Upon acknowledgement from the XenDesktop site, Web Interface presents the user with available resources. Once a selection is made by the user, the XenDesktop controllers manage session initiation. In most implementations, virtualizing Web Interface helps to consolidate resources as they are oftentimes underutilized. Regardless of how the servers are deployed, two Web Interface servers should be utilized and load balanced by an optimized load balancer, like Citrix NetScaler, to provide high availability.
- **SQL Database:** Provides the foundation for the overall XenDesktop site. All configuration information, desktop information and current utilization information is stored within the SQL database. This server is critical to the continuous functioning of the XenDesktop site. If the SQL database fails, no new users can connect to a virtual desktop, although currently connected users continue to function. Because the SQL database is the central repository for site information, the server can be virtualized as long as enough resources are available for the XenDesktop site load.
- **License Server:** Responsible for managing the licenses for all of the components of XenDesktop 5. XenDesktop has a 30 day grace period which allows the system to function normally for 30 days if the license server becomes unavailable. This grace period offsets the complexity involved with building redundancy into the license server. This service is minimally impacted and is a prime candidate for virtualization.

## Imaging Module

The imaging module is responsible for delivering desktop images to the virtual desktops. The goal is to reduce the number of desktop images to the bare minimum to help reduce support requirements, but multiple images are often required in almost every organization. The imaging module must be capable of supporting the number of images and allowing for easy assignment to the correct virtual desktops. The imaging module is responsible for the following services:

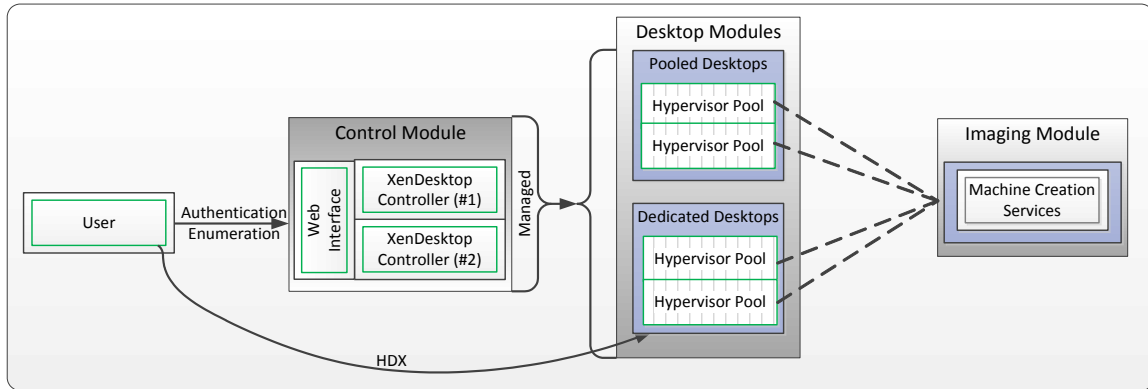
- **Installed Images:** Provides images to remote virtual or physical desktops. Installed images are deployed on a one-by-one basis where the operating system is installed onto the desktop. Users are able to completely modify the desktop once installation has completed. Installed images are deployed manually, so no additional servers are required.
- **Machine Creation Services:** Provides images only to desktops virtualized on a hypervisor. The images are contained within the hypervisor pool and then thin provisioned as needed. The thin provisioned virtual desktops utilize identity management functionality to overcome the new security identity (SID) requirements typical with cloning. Machine Creation Services is managed by the XenDesktop Controllers utilizing the capabilities of the underlying hypervisor, so no additional servers are required.
- **Provisioning Services:** Provides images to physical and virtual desktops. Desktops utilize network booting to obtain the image and only portions of the desktop images are streamed across the network as needed. Provisioning services utilizes similar identity management functionality utilized by the Machine Creation Services. Provisioning Services does require additional server resources, but can be either physical or virtual servers depending on the capacity requirements and hardware configuration. Also, Provisioning services does not require the desktop to be virtualized as Provisioning services can deliver desktop images to physical desktops.

## Desktop Modules

Depending on the size and complexity of the organization, many desktop modules might be required to support all user use cases. However, the integration of the different modules still utilizes the other infrastructure components already maintained within the control and imaging modules. Breaking down the desktop modules into categories helps in creating an appropriate framework for user-desktop alignment.

The first two desktop modules are the Pooled and Dedicated desktops, as shown in Figure 3: Machine Creation Services Desktops.





**Figure 3: Machine Creation Services Desktops**

A user authenticates and enumerates to the Web Interface, which provides an interface for users to enter credentials and select their virtual desktop from a graphical representation. Once the user authenticates to Web Interface, the XenDesktop Controllers manage the desktop groups by building, starting and shutting down the desktops as required. The XenDesktop Controller will rely on Machine Creation Services (MCS) to deliver the appropriate desktop image to the Pooled and Dedicated desktop groups.

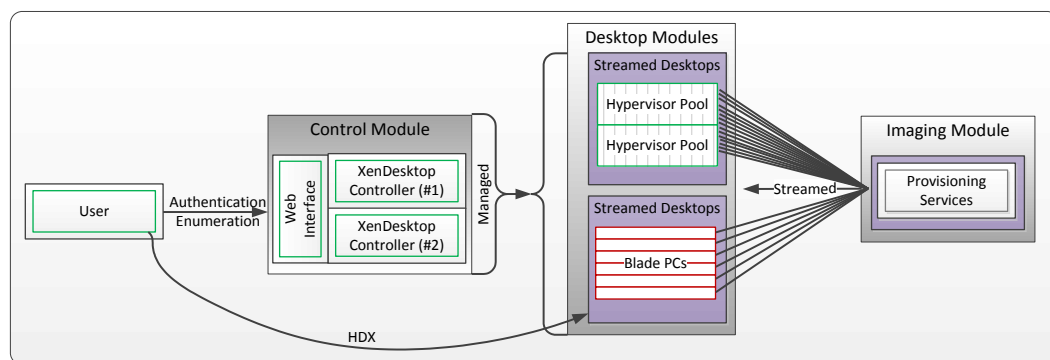
MCS does not require additional servers; it utilizes integrated functionality built into Citrix XenServer, Microsoft Hyper-V and VMware vSphere. As MCS utilizes hypervisor functionality, it is only a viable option for desktops virtualized on a hypervisor. A master desktop image is created and maintained within the hypervisor pool. The XenDesktop Controller instructs the hypervisor to create a snapshot of the base image and then provision new virtual machines through the built-in hypervisor functions. However, thin provisioning images often results in cloning issues as each provisioned desktop has the same identity as the master. MCS utilizes special functionality within the XenDesktop Controller and XenDesktop Agent (installed within the virtual desktop image) to build unique identities for each virtual machine, which is stored within the virtual desktops identity disk. This functionality allows each virtual desktop to be unique even though it is using the same base image.

The pooled and dedicated desktop stores all changes in a differential disk that is layered on top of the thin provisioned image. However, after the initial creation and similar process for storing changes, Pooled and Dedicated desktops operate differently:

- Pooled: When the desktop reboots, the differential disk is deleted and the user starts with a brand new virtual desktop. When the base image is updated, the pooled desktop utilizes the latest snapshot upon next reboot. The pooled virtual desktop also contains two subsets:
  - Pooled-Random: Users connect to random desktops. This is the most common option as virtual desktops are considered disposable after each use, helping to keep a clean and consistent environment.

- Pooled-Static: Users connect to the same virtual desktop upon subsequent reboots. This provides static MAC or IP addresses for users, which is required for certain applications.
- Dedicated: When the desktop reboots, the differential disk is maintained and all user changes persist. Because items persist, users will always be directed to the same virtual desktop. However, when the base image is updated, the dedicated desktop continues to utilize the original, non-updated image. In order to keep the dedicated desktop in line with the master image, desktop management tools should be used.

The second desktop module group is the streamed desktop, which is depicted in Figure 4: Streamed Desktops Module.



**Figure 4: Streamed Desktops Module**

The Streamed Desktop Module is identical to the previously described Machine Creation Services desktop module except that instead of using Machine Creation Services, Streamed desktops receive their images via Provisioning services.

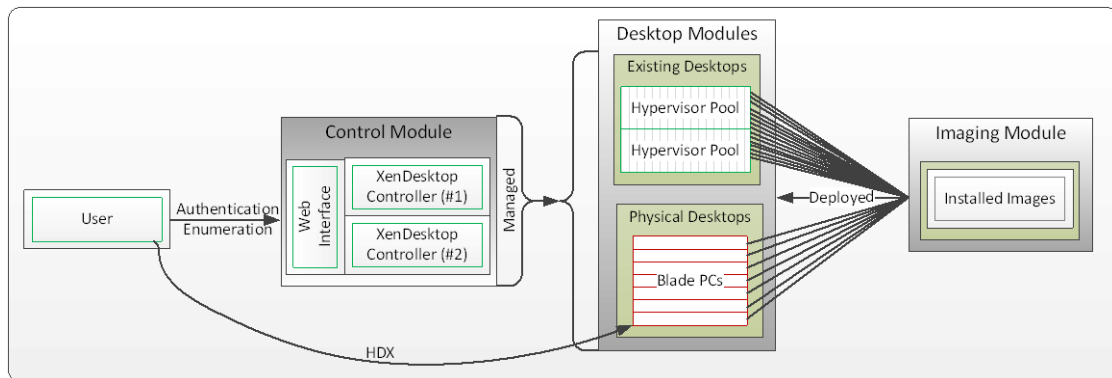
The Streamed desktops utilize network boot (DHCP/TFTP/PXE) to acquire an IP address, TFTP location and a desktop image. Once identified, Provisioning services streams portions of the image to the desktop. As the virtual desktop requires additional portions of the image, Provisioning services delivers as needed across the network. Once the desktop is running, users are directed to the virtual desktop via Web Interface and the XenDesktop controllers.

Because it utilizes network streaming, Provisioning services is not limited to desktops hosted on a hypervisor, like Machine Creation Services desktops. A single image can be used to deliver an image to blade PCs in addition to virtual machines within the data center (other FlexCast options (Streamed VHD) allows the desktop image to be delivered to a user's physical end point located outside of the data center).

However, Provisioning services requires a fast network (1Gbps) as slower networks result in longer times for delivery and slower desktop experiences. Also, because Provisioning services is based on a master image model, changes made during the duration of a session are destroyed upon each reboot.

The decision between utilizing Machine Creation Services desktops or Provisioning services desktops will be based on the overall architecture. If there are plans to utilize other FlexCast options, like Streamed VHD or Hosted Shared Desktops, the Provisioning services infrastructure will already be in place and expanding to include Streamed desktops is inconsequential. However, if the implementation is focused on the use of Hosted VDI desktops only, then Machine Creation Services might be a better option as it requires less infrastructure servers.

The final desktop group focuses on the Existing and Physical desktops, depicted in Figure 5: Installed Desktops.



**Figure 5: Installed Desktops**

Installed desktops are the most similar to a traditional desktop in that the underlying operating system is not based on a single image management solution. Instead, each desktop is unique and deployed a cloned, sysprep'ed or manually installed image. User-level changes and updates are permanent, allowing the user to have complete control of the desktop. However, because the desktop is installed, it does not benefit from the single image management capabilities of Machine Creation Services desktops or Provisioning services desktops. The desktop must be managed on an individual basis or collectively using third-party electronic software distribution (ESD) tools.

Although the installed desktops do not utilize a single image management solution, like Machine Creation Services or Provisioning Services, the virtual desktops are still monitored and enumerated by the XenDesktop controllers. Users, upon successful authentication and enumeration, are directed to the most appropriate virtual desktop utilizing the HDX protocol. Although there are many similarities between the Existing and Physical desktop module, the main differences are as follows:

- Existing: Typically a result of a P2V (Physical to Virtual) process, where a user's physical end point installation is migrated into the data center as a virtual replica.
- Physical: Typically installed onto a set of Blade PCs within the data center to provide greater performance for a group of users requiring complete customization.



## Site Architecture

Based on the conceptual architecture, a more detailed design can be put into place that allows the overall architecture to grow as needed. This is accomplished by building out appropriate hosts, catalogs and assignments.

### Hosts

As many XenDesktop environments will scale beyond the upper boundaries of a single hypervisor pool, organizations must define multiple hosts, which are groupings of hypervisor servers (Citrix XenServer, Microsoft Hyper-V, and VMware vSphere). Each host is the definition of these groupings and is broken down into a few core areas:

- **Hosting Connection:** Includes the hypervisor's master address and administrator credentials. The master address is the XenServer pool master, Hyper-V SCVMM address, or vSphere's vCenter address. This link allows XenDesktop to create, start and terminate virtual machines as needed.
- **Hosting Unit:** The overall definition for the hypervisor pool. It includes the hosting connection, storage definition and networking definition.

Large XenDesktop 5 designs will often include multiple host definitions. And although each host can be on a different hypervisor, this approach will add complexity and administrative challenges as each hypervisor will require different updates from their respective vendors as time progresses.

### Catalogs

In XenDesktop 5, collections of virtual desktops are managed as a single entity called a catalog. Catalogs specify virtual machines (VM) or physical devices that host user desktops, the Active Directory computer accounts assigned to those virtual machines or computers, and, in some cases, the master VM that is copied to create the user desktops.

As the catalog is simply a definition of the virtual desktop, a single catalog can span across multiple Hosts (hypervisor pools). However, having a catalog span across multiple hosts, it is imperative that the hosts have the appropriate templates and required VMs available for cloning and imaging, which is based on the desktop type utilized.

**Note:** *As a general recommendation for ease in management, it is recommended that each catalog should be of the same machine type, although this is not a restriction.*

**Note:** *Catalogs that span multiple hosts must define an operational model that guarantees the base desktop image is updated across all hosts. Having different versions of an image on different hosts will not damage the infrastructure, but it will result in different users having different base configurations.*

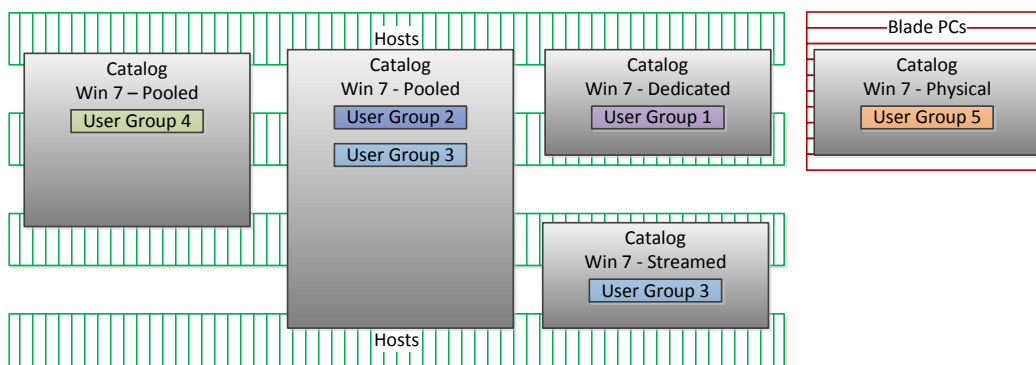
## Desktop Groups

The creation of a Desktop Group within XenDesktop 5 links users to defined catalogs, or even a portion of a catalog. A single assignment can contain desktops from a number of catalogs rather than being limited, as in previous XenDesktop versions, to a single hypervisor pool. Also, a single assignment can be published to users so that a single user may access multiple desktops in the group, and a single desktop may be assigned for use by multiple users. Desktops can also be assigned to client machines (IP address), rather than users, if required.

The process of defining desktop groups within XenDesktop 5 allows organizations to better align their desktop allocations with their unique user requirements.

## Desktop Allocation

To define the desktop allocation, which includes host definitions, catalogs and assignments, organizations need to understand their user requirements through proper analysis. Once complete, the findings can be put together to build a desktop allocation solution.



**Figure 6: Desktop Group Definition**

Based on the example in Figure 6: Desktop Group Definition, the following are some of the possibilities for user to desktop assignments within XenDesktop 5:

- Catalogs can span multiple hypervisor pools
- Users can be assigned to multiple catalogs
- A catalog can be divided between any number of user groups where certain groups are allowed a certain percentage of the maximum size of the catalog



## Summary

XenDesktop 5, when combined with the other Citrix FlexCast models, provides organizations with just about any type of virtual desktop modality required. Whether a user can function in an environment where desktop changes are destroyed every reboot or where a user is allowed to install applications, they are all possibilities. The key challenge for organizations is to determine the most appropriate model for each one of the unique user groups.

Once a proper analysis is complete, the different virtual desktop modalities can be defined and integrated into the modular Citrix architecture, which was defined within this reference architecture.

To help with the additional planning, design and optimization areas, it is recommended to utilize the [XenDesktop Design Handbook Success Kit](#). By logging in and following the kit, all of the content can be available locally via the Citrix Kits To Go tool and synchronized as new items become available.



## Revision History

Revision	Change Description	Updated By	Date
0.1	Document created	Daniel Feller – Lead Architect Tarkan Kocoglu – Sr. Architect	December 8, 2010

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