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Education

CMB-310-1I:

XenApp, XenDesktop, and Provisioning Services 7.1x
Administration (Fast Track)

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XenApp and XenDesktop Administration

Course Overview

CMB-310-11: v1.1
Exercise Workbook: v1.1
Module 0

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Course Overview

Page 1 of 3

- Explain the Architecture of XenApp and XenDesktop.
- Identify the Initial Requirements of XenApp and XenDesktop and the Lab Configuration.
- Determine How to Install and Configure a XenApp and XenDesktop Site.
- Present How to Provision and Deliver Application and Desktop Resources.
- Describe StoreFront and Receiver Functionality.
- Introduce Citrix Policies and the Functionality.
- Configure Application Presentation.

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Course Overview

Page 2 of 3

- Describe Printing With XenApp and XenDesktop.
- Configure Citrix User Profile Management.
- Describe the Management of a XenApp and XenDesktop Site.
- Present XenApp and XenDesktop Redundancy Considerations.
- Identify XenApp and XenDesktop Basic Network Security Considerations.
- Introduce Monitoring XenApp and XenDesktop.
- Present Supporting and Troubleshooting XenApp and XenDesktop.

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Course Overview

Page 3 of 3

- Explain the architecture of Provisioning Services.
- Identify core Provisioning Services infrastructure components.
- Present how the Provisioning Services boot and streaming process function.
- Describe the role of the target device, and how it handles user and machine data.
- Use Provisioning Services together with XenApp and XenDesktop.
- Introduce Provisioning Services redundancy considerations.
- Perform common Provisioning Services operations.

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Student Introductions

Introduce yourself to the class.
Include the following information:

- Name and company
- Job title
- Job responsibility
- Networking and virtualization experience
- Citrix hardware and software experience
- Class expectations

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Facilities

Review:

- Parking and transportation information
- Class policies
- Break and lunch schedules
- Emergency contact information

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Course Prerequisites

- Knowledge of server, desktop, and application virtualization concepts.
- Familiarity with Windows Server 2016 and Windows 10.

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Day One

Course Outline

- Module 0: Course Overview
- Module 1: Architecture Overview
- Module 2: Initial Requirements and Lab
- Module 3: Installing and Configuring a XenApp and XenDesktop Site
- Module 4: Provision and Deliver App and Desktop Resources

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Day Two

Course Outline

- Module 4: Provision and Deliver App and Desktop Resources (Continued)
- Module 5: Providing Access with StoreFront and Receiver
- Module 6: Understanding and Configuring Citrix Policies
- Module 7: Application Presentation and Management
- Module 8: Printing with XenApp and XenDesktop

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Day Three

Course Outline

- Module 8: Printing with XenApp and XenDesktop (Continued)
- Module 9: Citrix Profile Management
- Module 10: Managing the XenApp and XenDesktop Site
- Module 11: XenApp and XenDesktop Site Redundancy Considerations
- Module 12: XenApp and XenDesktop Site Basic Network Security Considerations
- Module 13: Monitoring the XenApp and XenDesktop Site
- Module 14: Introduction to Supporting and Troubleshooting XenApp and XenDesktop

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Day Four

Course Outline

- Module 14: Introduction to Supporting and Troubleshooting XenApp and XenDesktop (Continued)
- Module 15: Advanced Provisioning
- Module 16: Provisioning Services Infrastructure
- Module 17: Streaming the vDisk
- Module 18: Target Devices

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Day Five

Course Outline

- Module 19: Integrating Provisioning Services with XenApp and XenDesktop
- Module 20: Advanced Architecture
- Module 21: Supporting Provisioning Services

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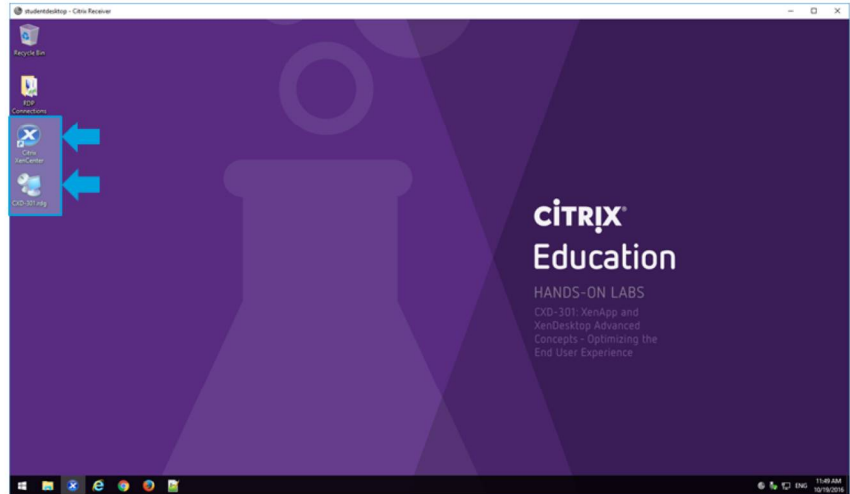
Lab Requirements

- Check connectivity to the environment and report any issues.
- All lab environment details are also provided in the lab guide.

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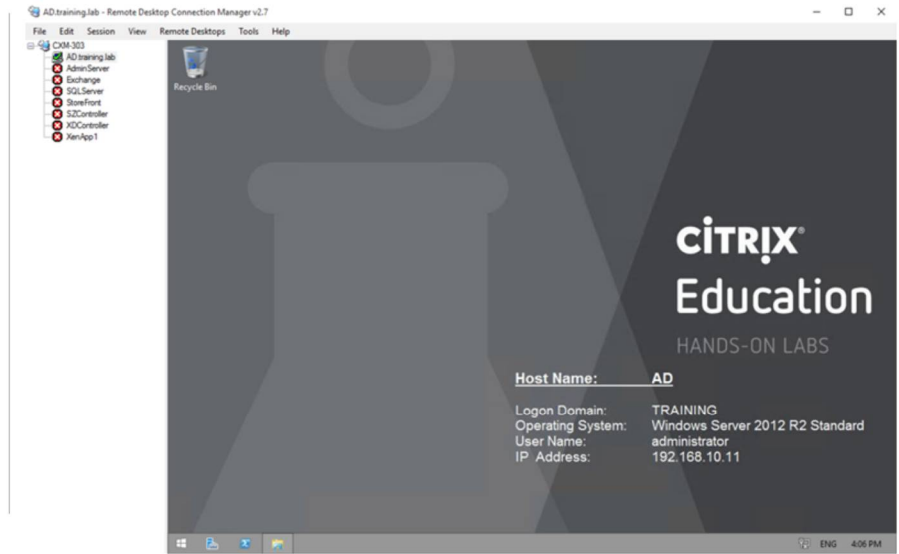
Student Desktop

- Remote Desktop Connection Manager for general management
- XenCenter for virtual machine management and power operations



Remote Desktop Connection Manager

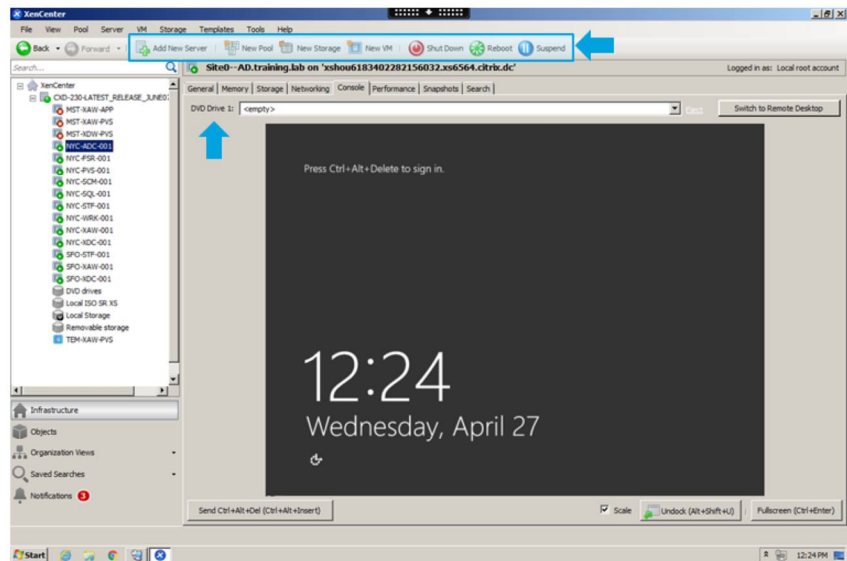
- Preconfigured for your lab environment
- Main access point for lab exercises
- Easy to copy/paste



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XenCenter

- Manage virtual machines.
- Power operations.
- Mount and eject installation media.



Key Notes:

- XenCenter is used to manage the lab environment virtual machines specifically to perform tasks such as mounting/un-mounting an ISO and managing the power state.
- Although XenCenter can be used to connect to the console of a virtual machine and log in, this method of access should only take priority above the Remote Desktop Connection Manager in the event that the lab guide exercise says to do so.

Student Resource Checklist

Visit <http://training.citrix.com/checklist> to learn how to:

- Access your student materials
- Use eCourseware features
- Access your labs
- Redeem an exam voucher
- Complete the course survey

Have more questions?

Browse our FAQ at:

<http://training.citrix.com/cms/education/faq>

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- You can download, save, and print electronic courseware.
- Follow these steps to print to a PDF file:
 - Student Resources > Courseware > Student Manual > Launch

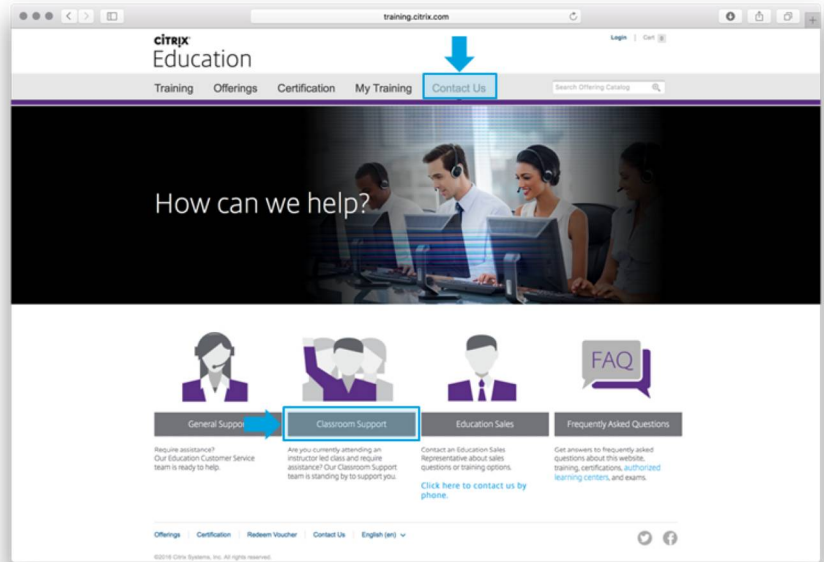
Key Notes:

- It is the responsibility of the student to be able to print the courseware.

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Classroom Support

How do I open a Classroom Support ticket?



Looking ahead – End of Course Survey

Your opinion matters!



Help shape the **next** course.



Tell us what **you** liked!

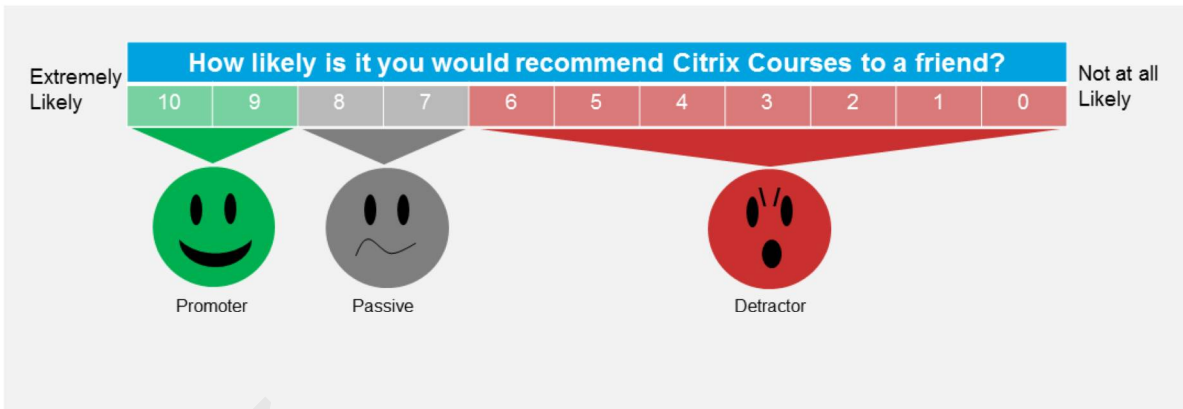


What can **we** do better?

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Citrix Measures your Feedback with NPS

How is Net Promoter Score Calculated?



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XenApp and XenDesktop Administration

Architecture Overview Module 1



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Learning Objectives

- Introduce XenApp and XenDesktop
- Present the architecture in XenApp and XenDesktop
- Determine FlexCast strategy for different use cases
- Present the Connection Flow Process
- Explain the Layered Approach Methodology
- Identify Hosting Platform Considerations

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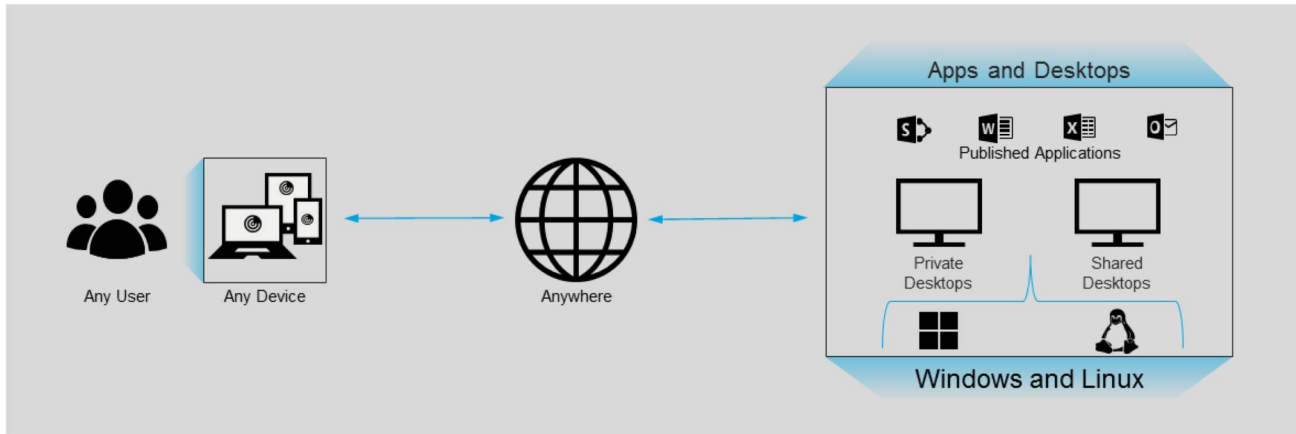


Introduction to XenApp and XenDesktop

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What is XenApp and XenDesktop?



The Citrix XenApp and XenDesktop product line provides secure universal access to applications and desktops, hosted in the datacenter or in the cloud, on Windows or Linux platforms, using Server or Desktop operating systems to any user connecting from any device and network.

Key Notes:

- This access requires software on the user device called the Citrix Receiver.
- Citrix Receiver can be downloaded both using www.citrix.com/products/receiver and mobile AppStores.
- Receiver uses the Citrix connection protocol called HDX to access these apps and desktops.



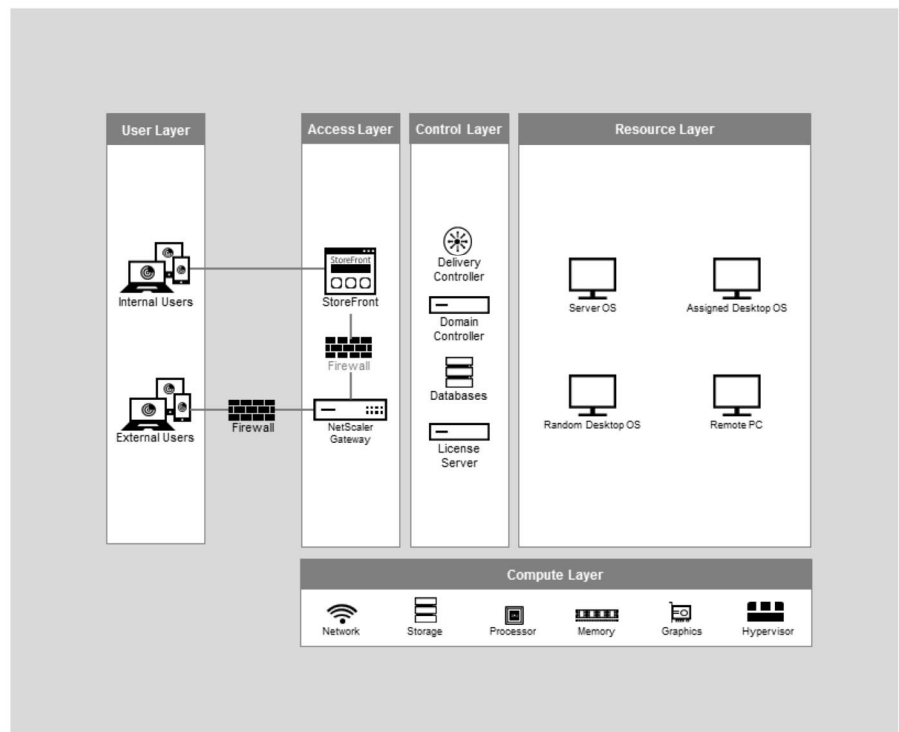
Architecture Overview

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Architecture Overview By Layers

- Internal users access StoreFront directly; external users are proxied by NetScaler Gateway.
- StoreFront presents resources available to end users.
- Delivery Controllers broker connections to resources.



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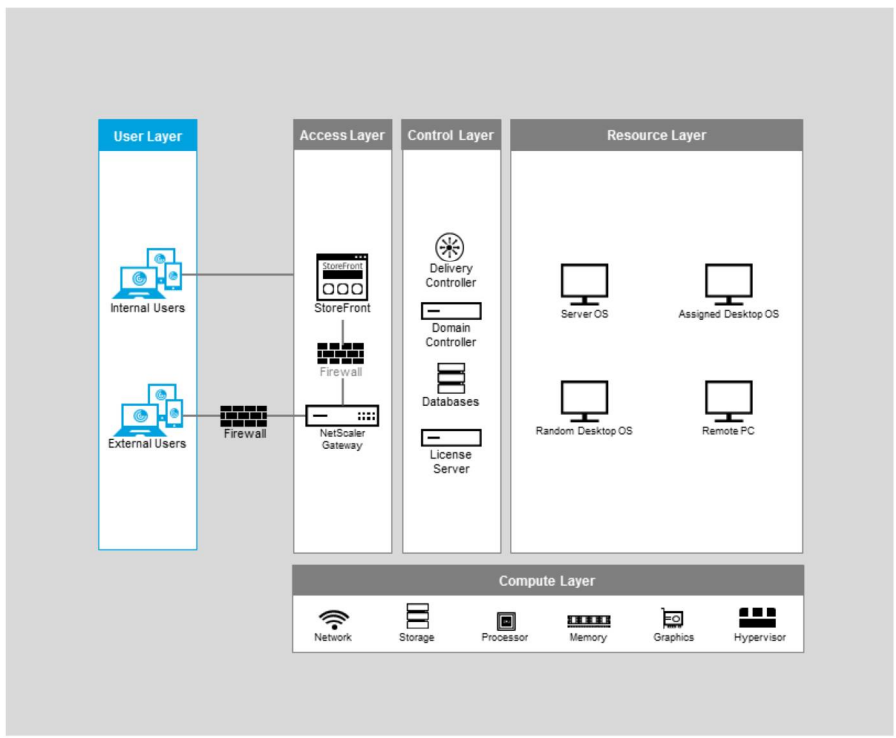
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Key Notes:

- Layer Presentation:
 - External users connect through NetScaler Gateway, located in a DMZ, and then are directed to StoreFront (explain that NetScaler is not covered in this course, but is covered in CNS-222 “Citrix NetScaler Essentials and Unified Gateway”).
 - Internal users connect directly to StoreFront.
 - StoreFront presents the resources that are available to users.
 - Resources include the desktops and apps made available through the different FlexCast models:
 - Published Desktops/Published Apps – Server OS
 - Assigned Desktop OS – Hosted VDI (static/persistent)
 - Random Desktop OS – Hosted VDI (random/non-persistent)
 - Delivery Controller brokers connections to desktop and app resources.
 - Receiver must be installed on endpoint to supply connection to resource.
 - Hypervisor – optional component.

User Layer

- Citrix Receiver running on user device and other endpoints.
- Enables on-demand access to resources made available to end user.



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Key Notes:

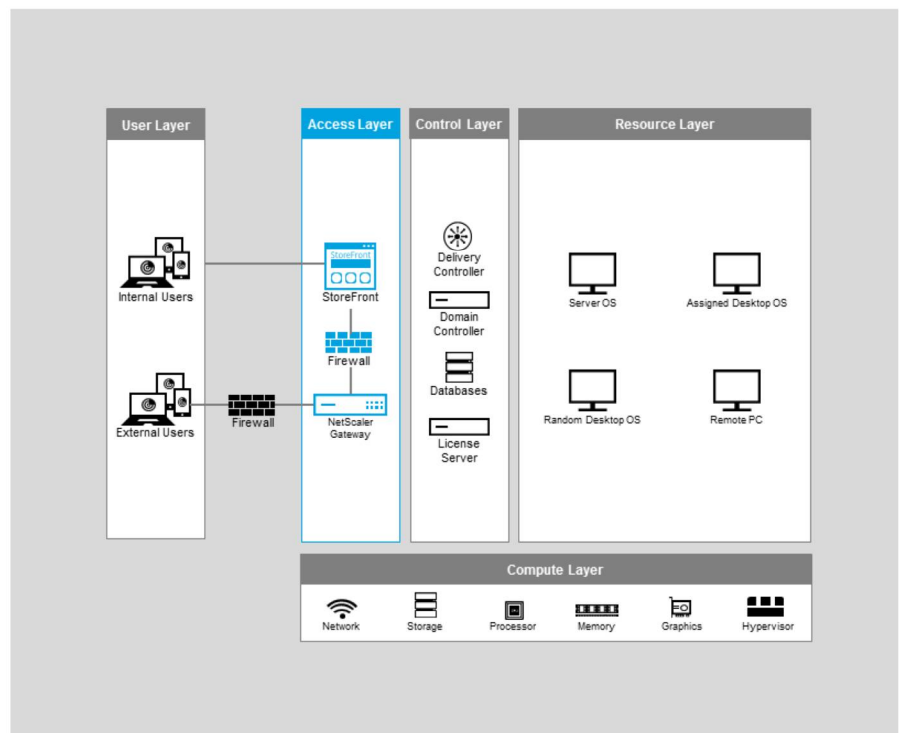
- The User Layer is the grouping presentation of endpoint device architecture that users use to make connections to the XenApp and XenDesktop Environment.
- In this layer the endpoint choices can range from small mobile devices to specialized thin clients and multifunctional devices like notebooks or PCs.
- For devices where admins/users are unable to install Receiver, Receiver for HTML5 can be leveraged. Remember Receiver for HTML5 provides a connection through an HTML5 compatible Web browser; however, it does not have all the functionality that the Receiver clients have.

Additional Resources:

- Receiver download - <https://www.citrix.com/products/receiver>
- Receiver Client Feature Matrix - <http://support.citrix.com/article/CTX104182>
- Citrix Virtual Desktop Handbook 7.x Page 29 - <http://support.citrix.com/article/CTX139331>

Access Layer

- StoreFront displays aggregated resources from multiple sources.
- NetScaler Gateway authenticates and validates user's permission to access resources.



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Key Notes:

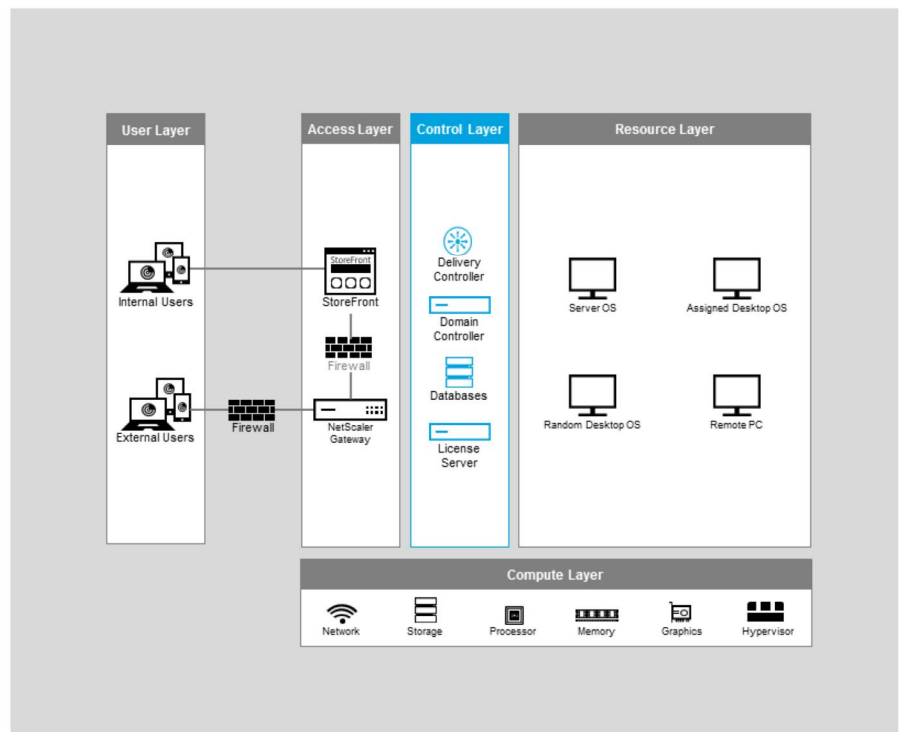
- The Access Layer is the presentation of the technical component(s) that serve as a middle-man between the users with their endpoints and the XenApp and XenDesktop Site with its apps and desktops.
- Typical deployments require external users to make secure encrypted connections through an SSL VPN that supports the HDX protocol, such as a NetScaler Gateway.
- Internal users may bypass the NetScaler Gateway to directly access the StoreFront server.
- These two access methods are typically determined by several factors, such as the location of the users, the types of devices used for access, and company policy.

Additional Resources:

- Citrix Virtual Desktop Handbook 7.x Page 35 - <http://support.citrix.com/article/CTX139331>

Control Layer

- Delivery Controller makes load-balancing decisions and manages availability of devices in the resource layer.



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Key Notes:

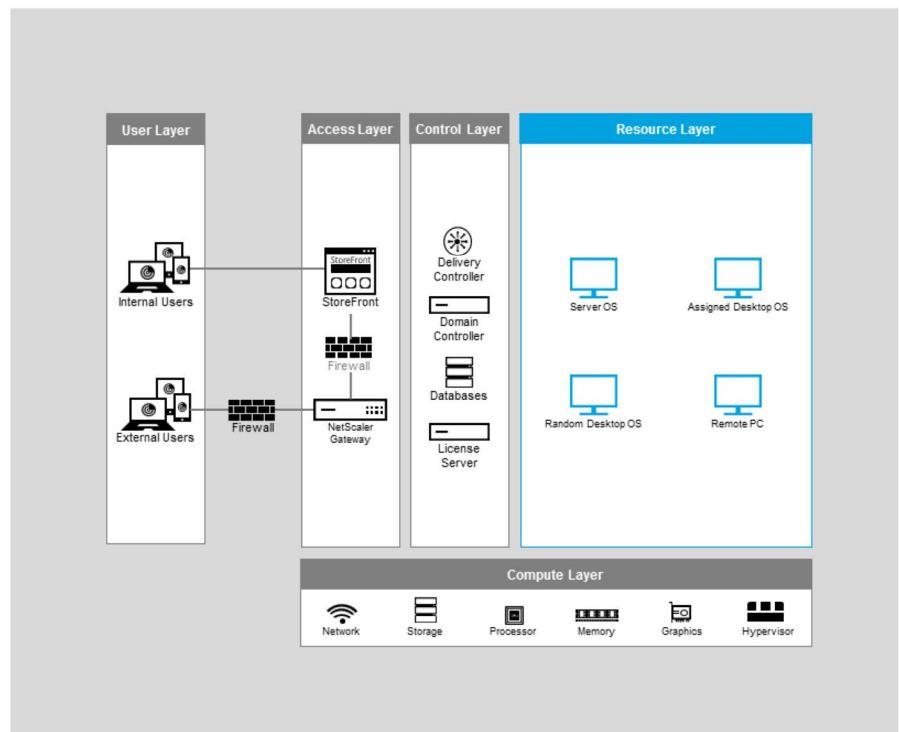
- The Control Layer is used to group and present the core components of the XenApp and XenDesktop implementation.
- The Delivery Controller is the central broker that handles all requests for all user sessions; this includes both apps and desktops, across Server OS and Desktop OS hosts.
- The Delivery Controller also performs load balancing on user requests for apps and desktops on Server OS hosts.
- The XenApp and XenDesktop deployment relies on the SQL platform to host the Site database.
- The Citrix License Server centrally manages and disburses licenses for user connections.

Additional Resources:

- Citrix Virtual Desktop Handbook 7.x Page 70 - <http://support.citrix.com/article/CTX139331>

Resource Layer

- Applications and desktops running on hosted virtual or physical machines.
- Various levels of personalization.



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Key Notes:

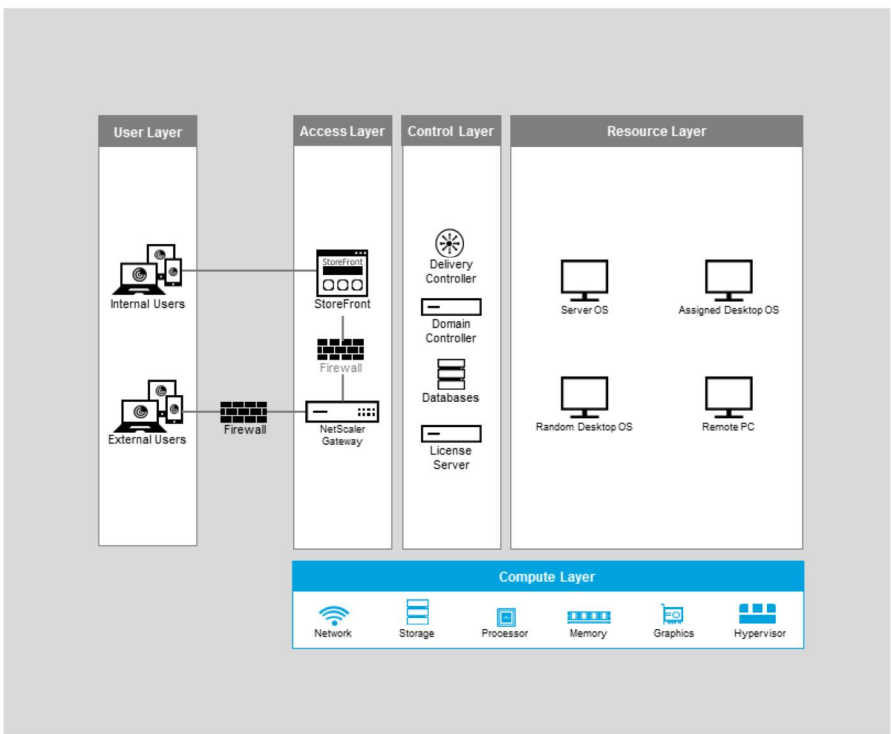
- The Resource Layer is a presentation of all resources that authorized users can gain access to, such as:
 - Apps
 - Desktops
 - User data, like profiles and documents
- The Resource Layer is also the architectural orientation where administrators consider how best to manage and control these above resources, such as through creating policies to grant or restrict features.

Additional Resources:

- Citrix Virtual Desktop Handbook 7.x Page 49 - <http://support.citrix.com/article/CTX139331>

Compute Layer

- Provides the hardware resources for the deployment.
- Influences the scalability and performance of the deployment.



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Key Notes:

- The Compute Layer provides the virtual computing needed by the Access, Control and Resource Layers.
- It's no accident that the Compute layer is presented beneath those three layers, as Compute layer is the "supply channel" for the environment.
- We will expand upon the Compute Layer in a later lesson in this module.

Additional Resources:

- Citrix Virtual Desktop Handbook 7.x Page 97 - <http://support.citrix.com/article/CTX139331>

Lesson Objective Review

Which Layer does the Citrix Delivery Controller belong to?

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Lesson Objective Review

Which Layer does the Citrix Delivery Controller belong to?

The Control layer

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Key Notes:

- What is the role of StoreFront?
 - Enumerating, Aggregating, and Presenting Desktops and Applications
- Which Citrix infrastructure component brokers end user connections to application and desktop resources?
 - Delivery Controller



FlexCast Models

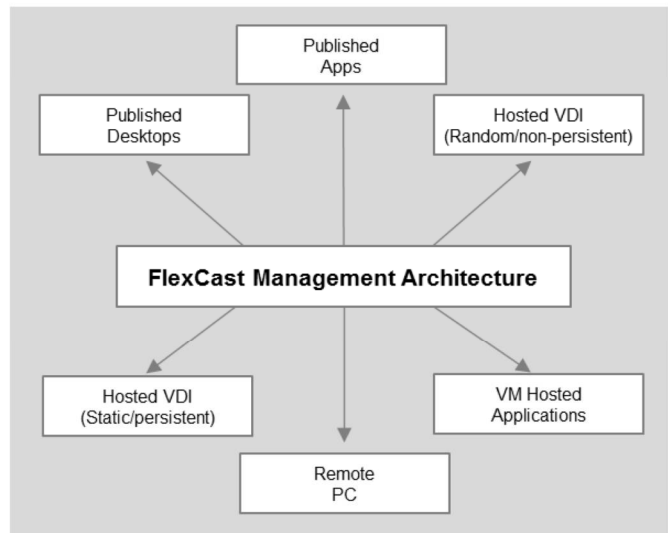
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FlexCast Management Architecture

Understanding the underlying XenApp and XenDesktop architecture

- Provides administrators with a variety of ways to deliver applications and desktops (FlexCast Models).
- Delivers Server OS and Desktop OS workloads from a single console.
- Enables administrators to tailor the method to the specific use case.



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Key Notes:

- XenApp and XenDesktop share a unified architecture called FlexCast Management Architecture (FMA).
- FMA's key features are the ability to manage both Server OS and Desktop OS hosts from a single Site and integrated provisioning.
- The variety of delivery methods are referred to as FlexCast models, such as those depicted above. Although not a comprehensive list, they are the most common.
- One of the advantages of using this FMA platform is that it enables administrators to tailor the delivery method to the business and technical requirements of the end user.

Additional Resources:

- FlexCast Concepts and Components - https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/technical-overview.html#par_anchortitle_a32c
- Technical overview - https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/technical-overview.html#par_anchortitle_2039

Published Desktop

Server OS Desktop

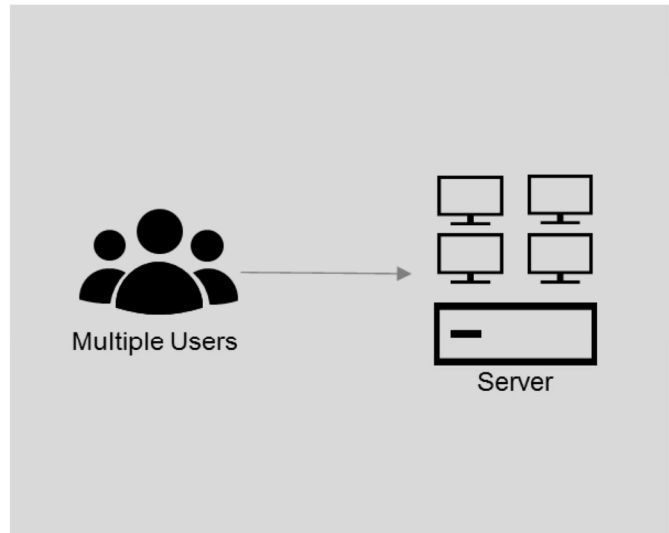
Description: Provides multiple user desktops hosted on a single server-based operating system.

Advantages:

- Higher scalability.
- Lower hardware cost per user.
- Higher user density per physical host.

Considerations:

- Applications must be compatible with a multi-user, server-based operating system.
- Users do not have complete customization.
- A single user's resource consumption can affect other users.



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Key Notes:

- Server OS machines can run multiple desktop or application sessions from a single machine. It is considered an inexpensive server-based delivery mechanism that minimizes the cost of delivering applications to a large number of users, while providing a secure, high-definition user experience.

Additional Resources:

- XenApp published apps and desktops: <http://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/technical-overview/delivery-methods/published-apps-desktops.html>

Published Apps

Server OS Applications

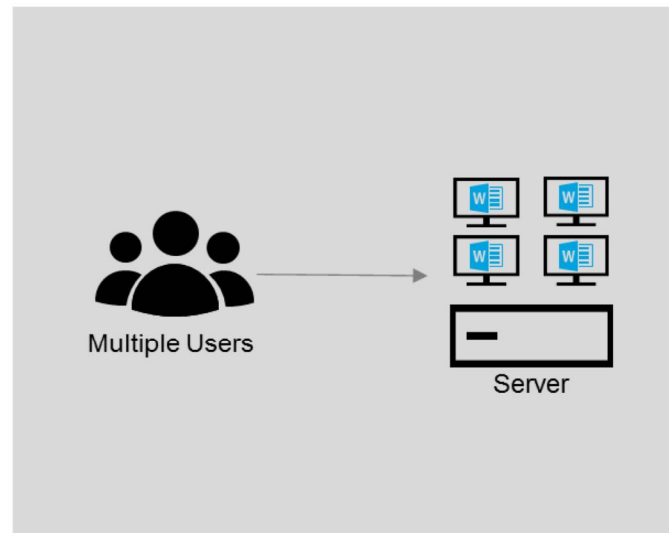
Description: Provides multiple application instances hosted on a single server-based operating system.

Advantages:

- Higher scalability.
- Lower hardware cost per user.
- Higher user density per physical host.

Considerations:

- Applications must be compatible with a multi-user, server-based operating system.
- Users do not have complete customization.
- A single user's resource consumption can affect other users.



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Key Notes:

- Published apps are managed centrally and users cannot modify the application, providing a user experience that is consistent, safe, and reliable.
- Benefits and Considerations:
 - Manageable and scalable solution within your datacenter.
 - Most cost effective application delivery solution.
 - Users must be online to access their applications.
- Example scenario: WWLabs has identified the following requirements for its HR user group:
 - Requires access to standard Microsoft Office applications
 - Does not require personalization
 - Does not engage in resource intensive application work
 - Which FlexCast Model(s) would be an effective solution and why?
 - Answer: Published Apps or Published Desktops.
 - Lead with Server OS apps/desktop if meets the requirements due to scalability and manageability.
 - Applications are Server OS and Remote Desktop Services compatible.
 - Users do not require personalization (non-persistent).
 - Users do not engage in resource intensive application work, so they do not require dedicated resource allocation.

- Does not specify if users require a desktop feel or if published applications would suffice, so either Server OS apps or desktops are acceptable.

Additional Resources:

- XenApp published apps and desktops: <http://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/technical-overview/delivery-methods/published-apps-desktops.html>

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Hosted VDI (Random/non-persistent)

Desktop OS Desktops

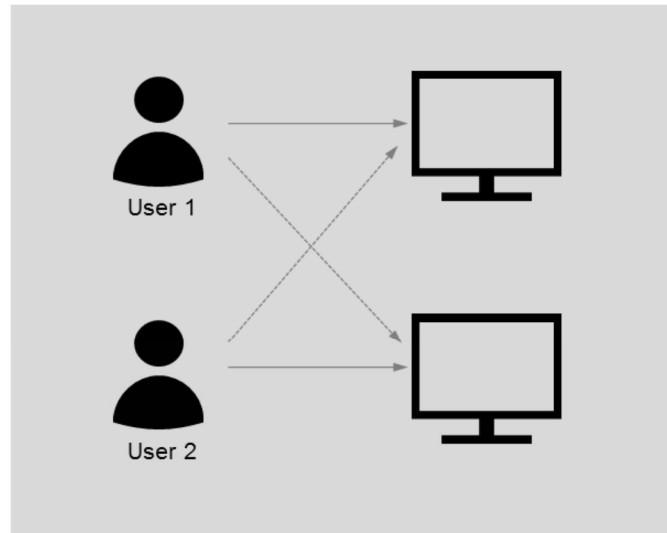
Description: Provides a single desktop operating system to each user randomly.

Advantages:

- Dedicated resource allocation per user.
- Able to use single-image management.

Considerations:

- Higher cost per physical host.
- Lower user density per physical host.
- Limited user personalization.



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Key Notes:

- Use Desktop OS machines to deliver VDI desktops.
- VDI desktops are hosted on virtual machines and provide each user with a desktop operating system.
- VDI desktops require more resources than Hosted Shared Desktops, but do not require that applications installed on them support server-based operating systems. Additionally, depending on the type of VDI desktop you choose, the desktop can be assigned to individual users and allow these users a high degree of personalization.
- Considerations:
 - 1:1 ratio of users to desktop; at logon, user is randomly assigned a desktop. After logging off, changes are discarded and VM returns to pool for another user.
 - A user's resource consumption or action is less likely to affect other users, making it a good use case for those who require a higher level of performance due to resource intensive application work.
 - The overhead of running a complete operating system per user requires more resources on hypervisors.
 - Hosted VDI models also offer the option of dramatically accelerating graphically intensive applications by providing GPUs (or vGPUs) to the VM.
- Example Scenario: WWLabs has identified the following requirements for its Technician user group:
 - Applications are not multi-user compatible

- Does not require ability to install applications
- Engages in resource intensive work
- Which FlexCast Model(s) would be an effective solution and why?
 - Answer: Hosted VDI (random/non-persistent)
 - Applications need to be installed on Desktop OS.
 - No installation of applications means persistence is not required.
 - 1:1 ratio of user:desktop means that a user's resource intensive work will not affect others.

Additional Resources:

- VDI Desktops - <http://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/technical-overview/delivery-methods/vdi-desktops.html>

Hosted VDI (Static/Persistent)

Desktop OS Desktops

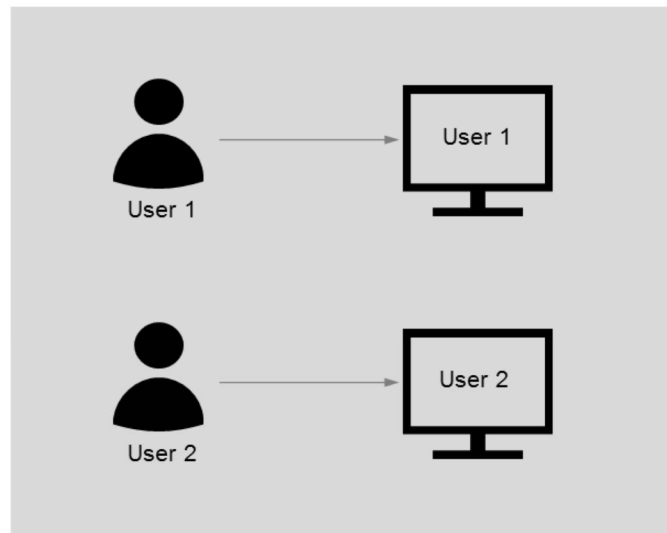
Description: Provides a single desktop operating system to each user that is permanently assigned.

Advantages:

- Dedicated resource allocation per user.
- Ability to install applications.
- Complete customization, personalization, and persistence.

Considerations:

- Higher cost per physical host.
- Lower user density per physical host.
- Increased management and operational overhead.
- Requires additional backup strategy.



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Key Notes:

- The first time a user logs on to use one of these desktops, the user is assigned a desktop from a pool of desktops based on a single master image. After the first use, the user will subsequently connect to the same desktop that was initially assigned. Changes to the desktop are not lost when the machine reboots.
- Considerations:
 - 1:1 ratio of users to desktop; user is assigned the same desktop on each subsequent logon; changes persist and are not discarded on logoff.
 - A user's resource consumption or actions is less likely to affect other users, making it a good use case for those who require a higher level of performance due to resource intensive application work.
- Example Scenario: WWLabs has identified the following requirements for its Engineer user group:
 - Requires ability to install applications
 - Requires personalization and elevated administrator rights
 - Engages in resource intensive work
 - Which FlexCast Model(s) would be an effective solution and why?
 - Answer: Hosted VDI (Static/persistent)
 - Users need to install applications and have them persist.
 - 1:1 ratio of user:desktop means that a user's resource intensive work and use of elevated admin rights will not affect others.

Additional Resources:

- VDI Desktops - <http://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/technical-overview/delivery-methods/vdi-desktops.html>

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Remote PC

Desktop OS Desktop

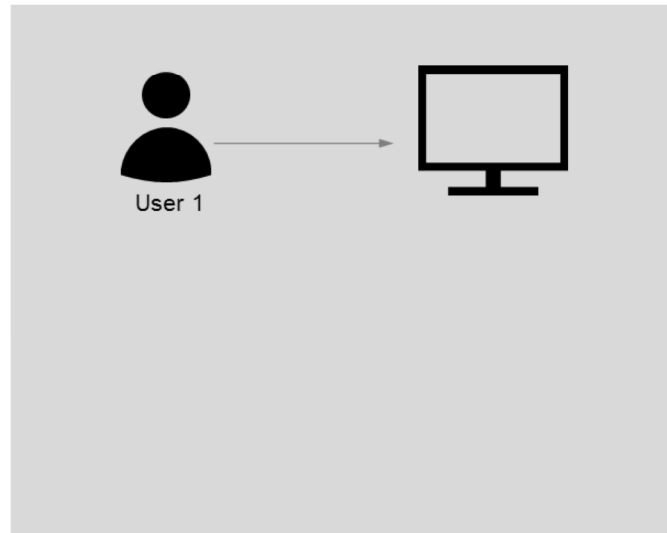
Description: Provides access to a physical desktop already deployed.

Advantages:

- Leverage existing physical desktop investment.
- Lower total cost of ownership.

Considerations:

- Increased management and operational overhead.
- Requires additional backup strategy.



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Key Notes:

- Remote PC Access allows an end user to log on remotely from virtually anywhere to the physical Windows PC in the office. The Virtual Delivery Agent (VDA) is installed on the office PC; it registers with the Delivery Controller and manages the HDX connection between the PC and the end user client devices.
- Remote PC Access supports a self-service model; after you set up the whitelist of machines that users are permitted to access, those users can join their office PC's to a Site themselves, without administrator intervention. The Citrix Receiver running on their client device enables access to the applications and data on the office PC from the Remote PC Access desktop session.
- Remote PC is a great solution for customers that have a great workstation design with a backup solution already in place. These customers would not need to build out additional server infrastructure to get many of the same benefits.
- Remote PC can be a great stop-gap where customers can get benefits quickly while the XenApp and XenDesktop solution is being developed.
- Example Scenario: WWLabs has identified the following requirements for its Designer user group:
 - Needs to leverage existing physical corporate desktops
 - Requires remote access to their applications as soon as possible
 - Engages in resource intensive work
 - Which FlexCast Model(s) would be an effective solution and why?
 - Answer: Remote PC

- Physical desktops that have already been deployed.
- Quicker time to value.
- 1:1 ratio of user:desktop means that user's resource intensive work will not affect others.

Additional Resources:

- Remote PC Access - <http://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/install-configure/remote-pc-access.html>

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VM Hosted Applications

Desktop OS Applications

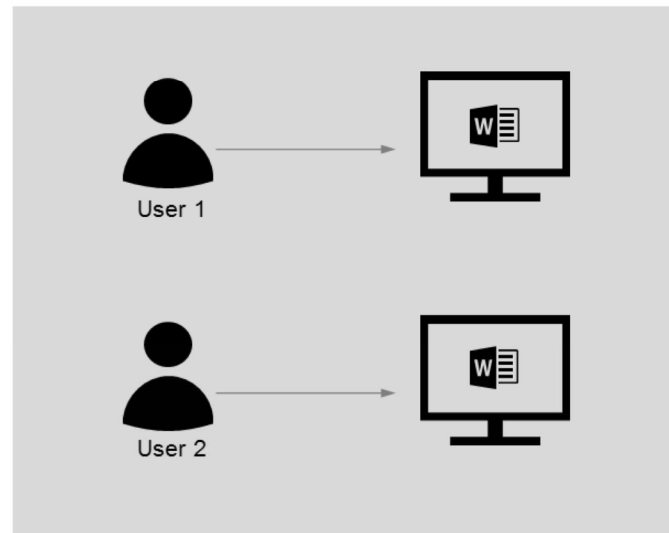
Description: Provides an application instance on a single desktop operating system.

Advantages:

- Deliver hosted applications only compatible with Desktop OS.
- Deliver 16-bit applications.

Considerations:

- Higher hardware cost per user.
- Lower user density per physical host.



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Key Notes:

- Applications and desktops on the master image are securely managed, hosted, and run on machines within your datacenter, providing a more cost effective application delivery solution.
- Considerations:
 - 1:1 ratio of users to desktop for user to access a hosted Desktop OS application.
 - It is not highly scalable as it requires a desktop for each user for a single application

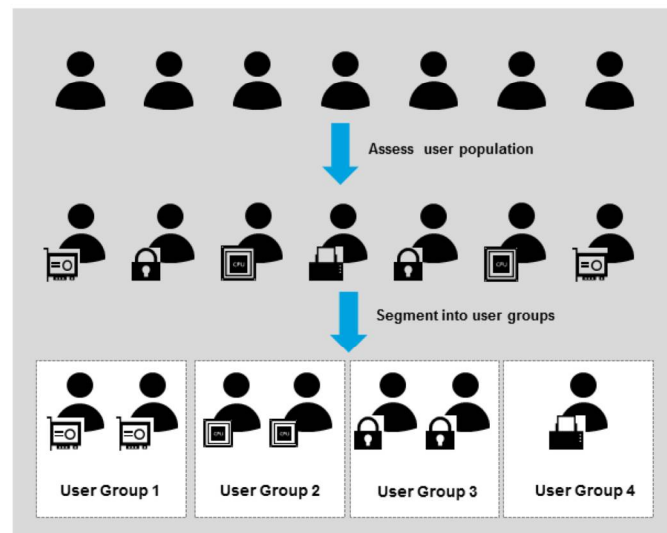
Additional Resources:

- VM Hosted Applications - <http://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/technical-overview/delivery-methods/vm-hosted-apps.html>

User Segmentation Process

Identifying use cases to assign FlexCast Models

- Assess business and technical needs of user population
- Segment into user groups based on common requirements:
 - End user location
 - Mobility
 - Security
 - Personalization, customization, ability to install applications
 - Application set and application usage
 - Desktop loss criticality
- User groups typically map to a role within a department



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Key Notes:

- The diagram depicts the assessment and segmentation of users into groups based on the following criteria: graphic intensive apps, CPU-intensive application work, high security requirements, and printing requirements.
- It is important to the success of the deployment to understand the user requirements and tailor the solution to their specific needs, as this can impact user acceptance and project costs.
- You need to define user groups based on shared common characteristics in order to assign the FlexCast model that effectively addresses the requirements of the user group.
- Mobility – understand where user is connecting from (network speeds, network security, etc.) and how frequently the user is roaming.
- Security - lockdown, audit requirements.
- Personalization – assess if user requires additional personalization that cannot be provided by roaming profiles. Determine if user needs the ability to install apps themselves, or if the admin should install any additional apps required by user.
- Application set/application usage – common applications required; how resource intensive the application work is that users are doing.
 - Have to have an understanding of how users are using applications; not always a clear mapping between app and workload.
 - E.g. Excel for one user may be a light workload, but may have another user who is running reports with thousands of data sets and who therefore is a heavy workload.

- Desktop loss criticality – understand impact to revenue, projects, and product if user is unable to access resources.
- User segmentation is also important for understanding policies that may need to be applied.

Additional Resources:

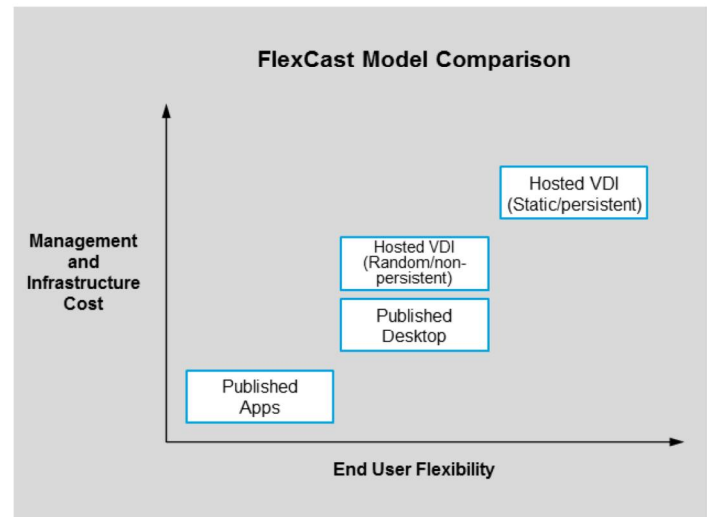
- Citrix Project Accelerator - <http://project.citrix.com/>

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FlexCast Model Strategy Assignment

Assigning FlexCast Models

- Tailor the delivery method to the business and technical needs based on the assessment of a user group
- Lead with scalable, lower cost and higher user density options
- Determine if user groups will require an additional backup strategy



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Key Notes:

- As with physical desktops, it is not possible to meet every user requirement with a single FlexCast model. Different types of users need different types of resources. Some users may require simplicity and standardization, while others may require high levels of performance and personalization. Implementing a single FlexCast model across an entire organization will inevitably lead to user frustration and reduced productivity.
- Citrix FlexCast offers a complete set of application and desktop virtualization technologies that have been combined into a single integrated solution. Because each FlexCast model has different advantages and disadvantages, it is important that the right model is chosen for each user group within the organization.
- There are six FlexCast models available, the advantages and disadvantages of each model are described below:
 - **Published Apps** - The Hosted Apps model utilizes a server-based Windows operating system, where only the application interface is seen by the user. This approach provides a seamless way for organizations to deliver a centrally managed and hosted application into the user's local PC. The Windows app model is often utilized when organizations must simplify management of a few line-of-business applications.
 - **Published Desktop** – With the published desktop model, multiple user desktops are hosted from a single, server-based operating system (Windows 2008, 2012, 2016, Red Hat, SUSE, CentOS). The shared desktop model provides a low-cost, high-density solution; however, applications must be compatible with a multi-user server based operating system. In addition, because multiple users

share a single operating system instance, users are restricted from performing actions that negatively impact other users, for example installing applications, changing system settings and restarting the operating system.

- Hosted VDI (Random/non-persistent) - The Hosted VDI (random/non-persistent) desktop model provides each user with a random, temporary desktop operating system. Because each user receives their own instance of an operating system, overall hypervisor density is lower when compared to the published desktop model. However, pooled desktops remove the requirement that applications must be multi-user aware and support server based operating systems.
- Hosted VDI (Static/persistent) – This model provides each user with a statically assigned, customizable, persistent desktop operating system. Because each user receives their own instance of an operating system, overall hypervisor density is lower when compared to the published desktop model. However, personal desktops remove the requirement that applications must be multi-user aware and support server based operating systems.
- Remote PC – The remote PC access desktop model provides a user with secure remote access to their statically assigned, traditional PC. This is often the fastest and easiest VDI model to deploy as it utilizes already deployed desktop PCs.
- VM-hosted applications – Similar to published apps, the main difference being that the apps are hosted on a desktop operating system. This approach can be used when the seamless app approach is desired, but the application is not compatible with a multi-user Server OS machine. Because each application session is hosted by its own instance of an operating system, overall hypervisor density is lower when compared to the published apps model.

Additional Resources:

- Citrix Virtual Desktop Handbook 7.x - <http://support.citrix.com/article/CTX139331>

Lesson Objective Review

Which FlexCast model typically has the lowest Total Cost of Ownership (TCO)?

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Lesson Objective Review

Which FlexCast model typically has the lowest Total Cost of Ownership (TCO)?

- *Published Apps*

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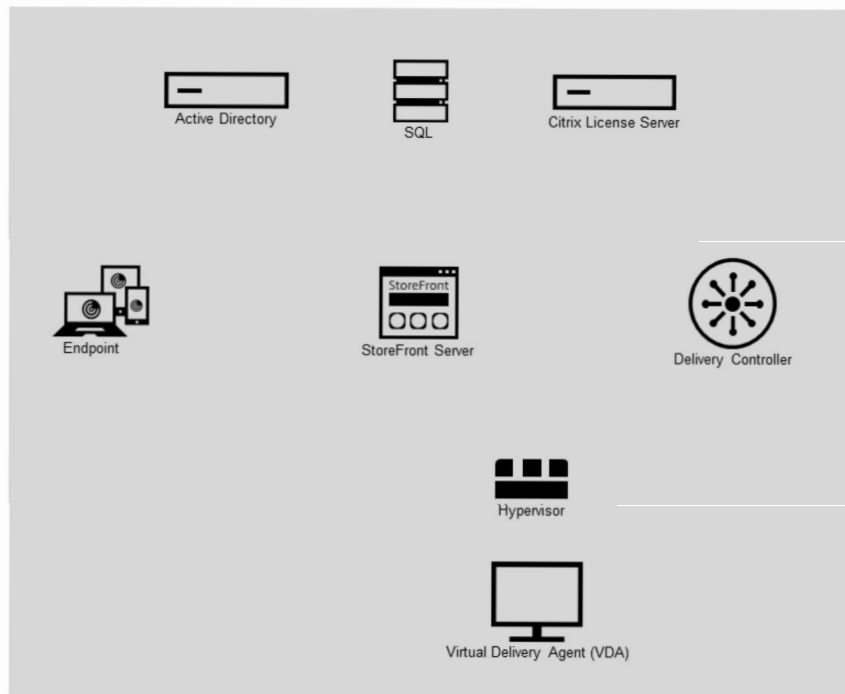
Connection Flow Process

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Connection Flow Process (Three Concepts)

- Authentication
- Enumeration
- Session Launch



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Key Notes:

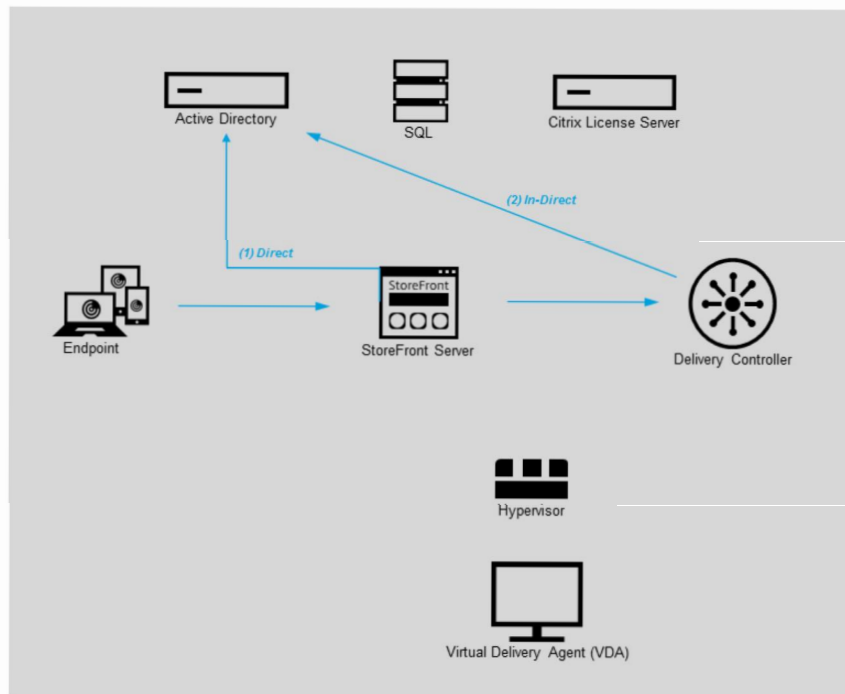
- Previously, the XenApp and XenDesktop Architecture was presented with a layer by layer approach.
- The next few slides will target specific components from all of those layers and group them together.
- This grouping is used to present the basic concepts in one of Three Connection Flow Processes:
 - Authentication
 - Enumeration
 - Session Launch.

Additional Resources:

- XenDesktop Connection Process and Communication Flow - <http://support.citrix.com/article/CTX128909>
- Technical Overview - https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/technical-overview.html#par_anchortitle_2039

Connection Flow Process (Authentication)

- There are two Authentication Flows
- (1) One method relies on StoreFront to authenticate to Active Directory
 - This is default authentication flow (Direct)
- (2) The other method relies on the Delivery Controller to authenticate to Active Directory on behalf of StoreFront
 - This method is called XML service-based authentication



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Key Notes:

- Authentication is the process in which user identity is verified.
- There are two methods for authentication with StoreFront:
 - **Direct:** StoreFront validates credentials against Active Directory. Direct authentication is the default behavior of StoreFront.
 - **XML service-based authentication:** StoreFront passes credentials to Delivery Controller, which validates credentials against Active Directory.
- Both methods are acceptable, and may simply be a choice of preference.
- However some companies don't have the choice. For example, if the StoreFront server is not in the same domain as XenApp and XenDesktop, or if it is not possible to put an Active Directory trust in place, then the only method you can configure is to require the Delivery Controller to authenticate to Active Directory on behalf of StoreFront.
- In order to support this, you have to delegate authentication to the XML server.

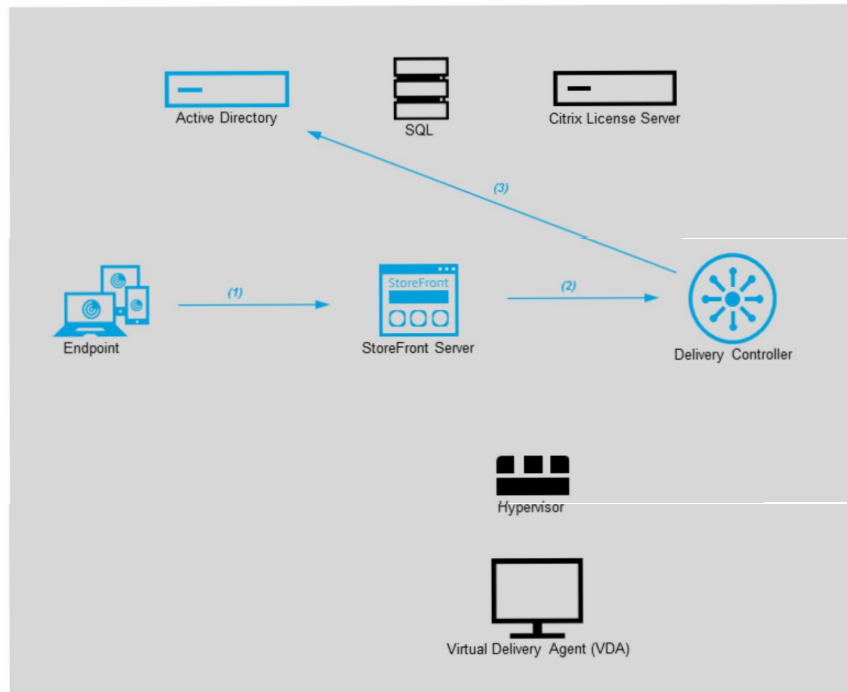
Additional Resources:

- Configuring XML Service based authentication - <http://docs.citrix.com/en-us/storefront/3-8/configure-authentication-and-delegation/xml-authentication.html>
- Configure authentication and delegation - <http://docs.citrix.com/en-us/storefront/3-8/configure-authentication-and-delegation.html>

Connection Flow Process

(Authentication Example)

1. Credentials are submitted to StoreFront.
2. StoreFront passes the credentials to the Delivery Controller.
3. The Delivery Controller validates the credentials received from StoreFront with Active Directory.



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Key Notes:

- The authentication type for a user group is often determined based on security requirements as well as the authentication point used.
- To start a XenApp or XenDesktop session, the user connects either via Citrix Receiver, which is installed on the user's device, or via Receiver for Web (RFW).
- Within Receiver, the user selects the physical or virtual desktop or virtual application that is needed.
- The user's credentials move through this pathway to the Controller, which determines what resources are needed by communicating with a Broker Service. It is recommended for administrators to put an SSL certificate on StoreFront to encrypt the credentials coming from Receiver.

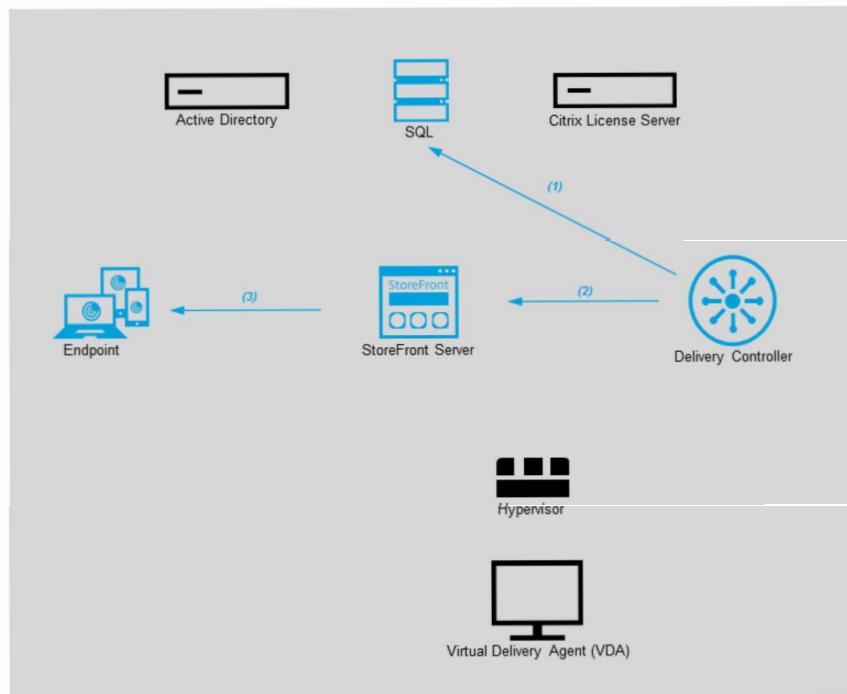
Additional Resources:

- XenDesktop Connection Process and Communication Flow - <http://support.citrix.com/article/CTX128909>
- Technical Overview - https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/technical-overview.html#par_anchortitle_2039

Connection Flow Process

(Enumeration)

1. The Delivery Controller queries the site database for assigned apps and desktops.
2. Available apps and desktops are forwarded to StoreFront.
3. Apps and desktops are presented to the user.



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Key Notes:

- The Broker Service determines which desktops and applications the user is allowed to access.
- Once the credentials are verified, the information about available apps or desktops is sent back to the user through the StoreFront-Receiver pathway.

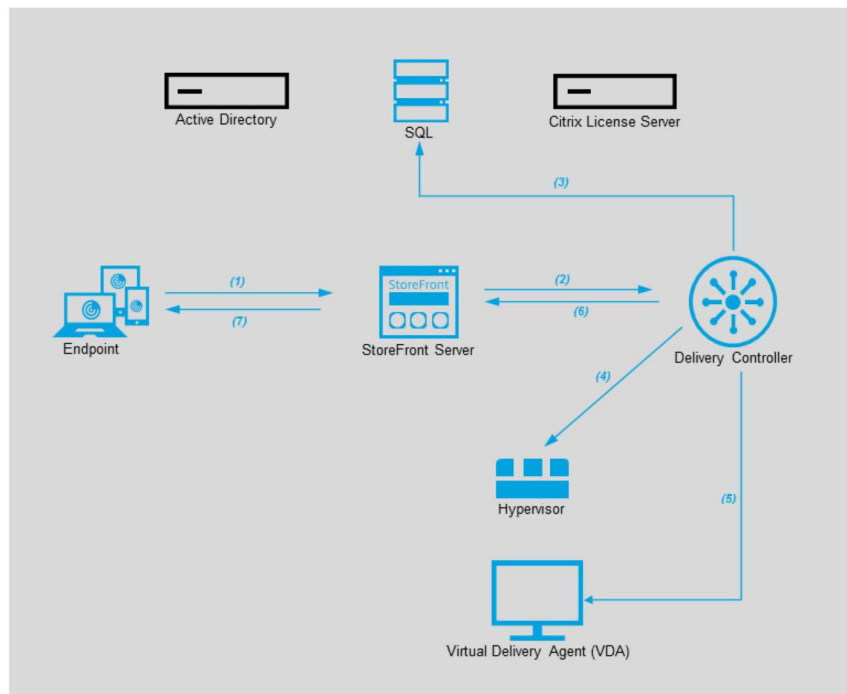
Additional Resources:

- XenDesktop Connection Process and Communication Flow - <http://support.citrix.com/article/CTX128909>
- Technical Overview - https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/technical-overview.html#par_anchortitle_2039

Connection Flow Process

(Session Launch 1/2)

1. User clicks a listed app or desktop. This request is sent to the StoreFront Server.
2. This request is forwarded to the Delivery Controller.
3. The Delivery Controller queries the Site database to determine which VDAs are currently available to host the selected resource, then selects a VDA.
4. The Delivery Controller validates the current status of the selected VDA.
5. Delivery Controller notifies the VDA about the upcoming connection.
6. The Delivery Controller forwards information about the assigned VDA to StoreFront.
7. A launch file (.ICA) is sent to the end user's endpoint.



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Key Notes:

- When the user selects applications or desktops from this list, that information goes back down the pathway to the Controller, which determines the proper VDA to host the specific applications or desktop.
- The Controller sends a message to the VDA with the user's credentials and sends all the data about the user and the connection to the VDA. The VDA accepts the connection and sends the information back through the same pathways all the way to Receiver. Receiver bundles up all the information that has been generated in the session to create Independent Computing Architecture (ICA). file on the user's device, if Receiver is installed locally or on RFW if accessed through the web. As long as the Site was properly set up, the credentials remain encrypted throughout this process.

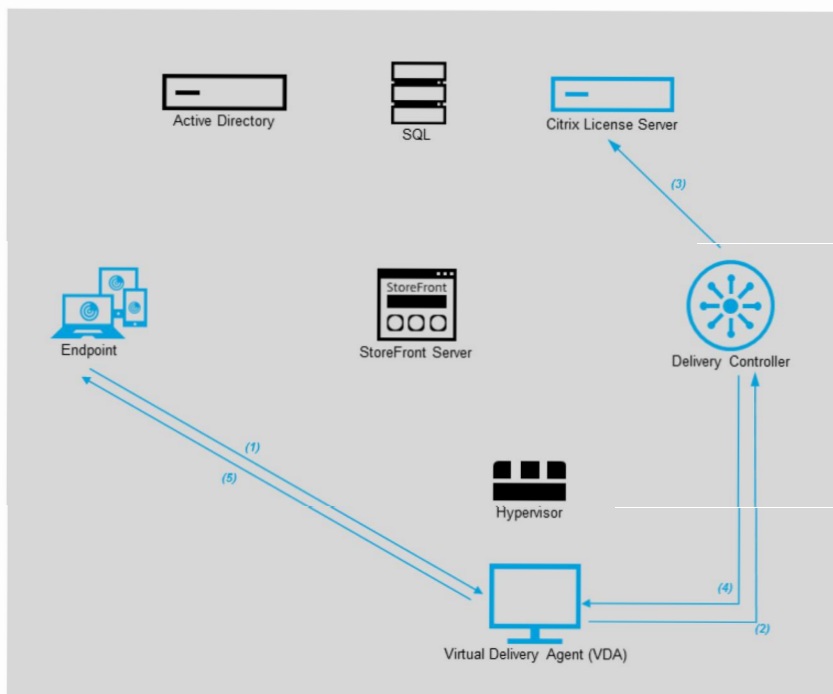
Additional Resources:

- XenDesktop Connection Process and Communication Flow - <http://support.citrix.com/article/CTX128909>
- Technical Overview - https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/technical-overview.html#par_anchor_title_2039

Connection Flow Process

(Session Launch 2/2)

1. Receiver establishes connection with VDA.
2. VDA notifies Delivery Controller about established HDX Session.
3. Delivery Controller queries Citrix License Server and checks out a valid license for the session.
4. Delivery Controller notifies VDA that licensing is qualified.
5. Receiver presents virtual app or desktop to the user.



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Key Notes:

- The ICA file is copied to the user's device and establishes a direct connection between the device and the ICA stack running on the VDA. This connection bypasses the management infrastructure such as StoreFront and the Delivery Controller.
- The connection between Receiver and the VDA uses the Citrix Gateway Protocol (CGP). If a connection is lost, the Session Reliability feature enables the user to reconnect to the VDA rather than having to re-launch through the management infrastructure. Session Reliability can be enabled or disabled in Studio.
- Once the client connects to the VDA, the VDA notifies the Controller that the user is logged on, and the Controller sends this information to the Site database and starts logging data in the Monitoring database.
- In this diagram, the differences between IMA and FMA are apparent. For example, under IMA architecture, each worker was responsible for obtaining the license file. In FMA architecture, this is now centralized and the Delivery Controller checks out the licenses.
- This provides greater flexibility in segmenting the network and also means that the redirection of the license cache on non-persistent machines is no longer needed.

Additional Resources:

- XenDesktop Connection Process and Communication Flow - <http://support.citrix.com/article/CTX128909>

Lesson Objective Review

What are the two methods of authentication with StoreFront?

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Lesson Objective Review

What are the two methods of authentication with StoreFront?

- Direct
- XML service-based authentication

Key Notes:

- Direct: StoreFront validates credentials against Active Directory.
- XML service-based authentication: StoreFront passes credentials to Delivery Controller, which validates credentials against Active Directory. This is the method depicted in the diagram (explicit credentials).
- What software should be installed on an endpoint device to enable user access to their applications and desktops?
 - Citrix Receiver



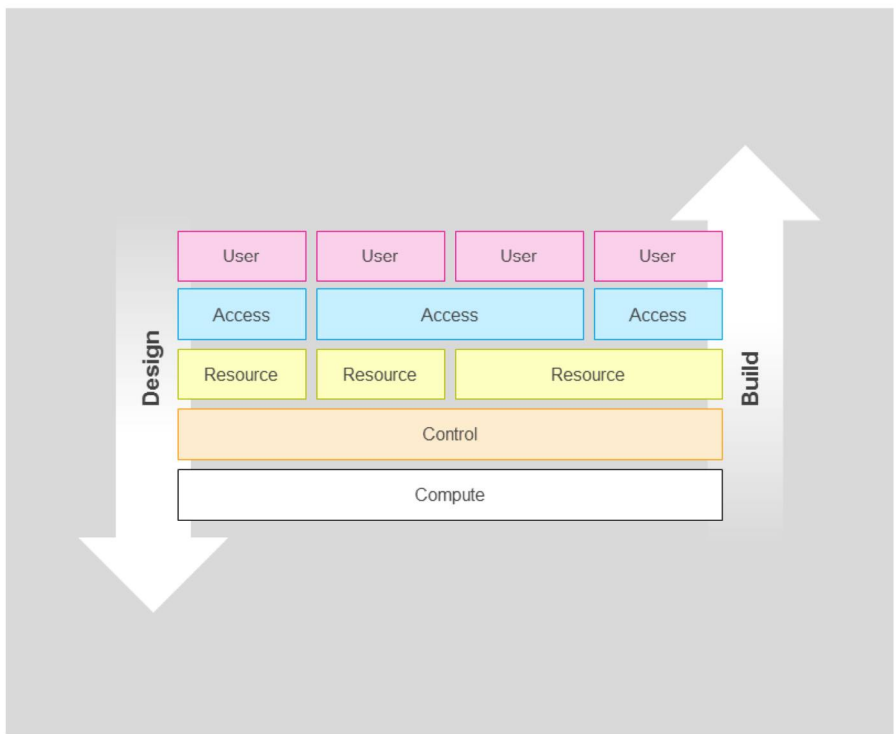
Layered Approach Methodology

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Layered Approach Methodology

Provides an organized, flexible framework for working with Citrix environments



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Key Notes:

- The Layered Approach Methodology was created by Citrix Consulting to provide a standardized approach method for assessments, designs, and builds for Citrix environments.
- This approach is structured, organized, and consistent; and can be flexibly adapted for various scenarios.
- Citrix recommends this approach because it helps to minimize the chance of a missing component or requirement for consideration.
- This approach is flexible, because as you can see above, users/user groups can have different or shared access to resources on one central compute layer.
- User Layer – what are the user groups and their specific requirements?
 - The top layer of the design methodology is the user layer, which is defined for each unique user group.
 - The user layer appropriately sets the overall direction for each user group's virtualized environment. This layer incorporates the assessment criteria for business priorities and user group requirements in order to define effective strategies for endpoints and Citrix Receiver. These design decisions impact the flexibility and functionality for each user group.
- Access Layer – how will users access their resources?
 - The second layer of the design methodology is the access layer, which is

defined for each user group.

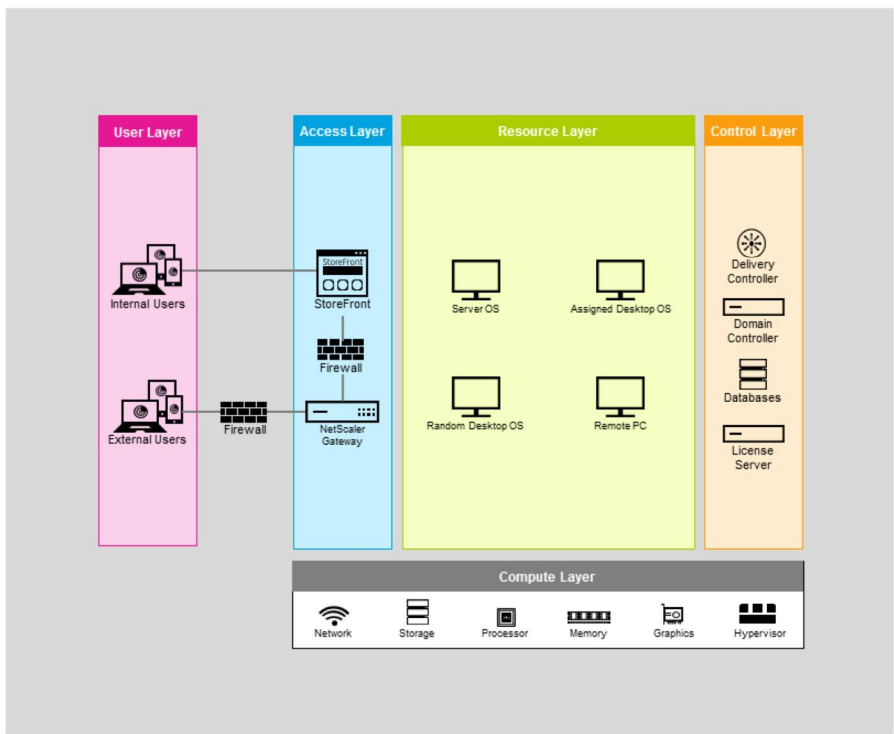
- Creating an appropriate design for the access layer is an important part of the desktop virtualization process. This layer handles user validation through authentication and orchestrates access to all components necessary to establish a secure virtual desktop connection.
- The access layer design decisions are based on the mobility requirements of each user group as well as the endpoint devices used.
- Resource Layer – what is being delivered to users?
 - The Resource Layer contains not only provides desktops and applications for the users, but also their data like user profiles, emails and documents and policies granting or restricting use of features.
 - The resource layer is the third layer of the design methodology and the final layer focused specifically on the user groups.
 - The overall user acceptance of the solution is defined by the decisions made within the resource layer. Personalization, applications and overall desktop image design play a pivotal role in how well the desktop is aligned with the user group's requirements, which were identified within the user data capture and application data capture sections of the assess phase.
- Control Layer – what are the components/configurations necessary to manage the solution?
 - The control layer is the fourth layer of the design methodology.
 - Every major design decision made for all user groups in the upper three layers are used as a whole to help design the control components of the overall solution.
 - The design decisions for each user group are met by incorporating the correct control layer components, which includes access controllers, delivery controllers and infrastructure controllers.
 - Determining capacity, configuration, topology and redundancy for the respective components creates a control environment capable of supporting the user requirements.
- Compute Layer – what is needed to support the above layers?
 - The compute layer is responsible for the physical devices required to support the entire solution including servers, processors, memory and storage devices.
 - This layer is broken into three groups focused on providing the necessary resources for specific parts of the entire solution. One group of servers

will support the XenApp (shared) components (if applicable). A second group of servers will support the XenDesktop (VDI) components (if applicable). A final group of servers will support the underlying infrastructure for the entire environment, which is identified as the Control Layer.

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Layered Approach for XenApp and XenDesktop Environment

Mapping layers to architecture components



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Key Notes:

- User Layer – Receiver version, Receiver deployment method, endpoint devices, peripherals, use cases, business priorities.
- Access Layer – authentication point (StoreFront, NetScaler), authentication policy, security point, resource presentation, access controllers.
- Resource Layer – personalization (user profile solution, folder redirection, policies, printing), applications, VDA image design (OS, delivery, resource allocation).
- Control Layer – delivery controllers, infrastructure controllers, Active Directory, databases, image controllers, licensing (Citrix and Microsoft).
- Compute Layer – hardware or cloud deployment infrastructure required to support solution (sizing), host configuration, CPU, RAM, storage, hypervisor, networking.
- The following layers are defined for each user group: User, Access, and Resource layers.



What approach has your team taken to consider and plan a XenApp and XenDesktop environment?

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Lesson Objective Review

Which Methodology layer would you typically design last and deploy first?

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Lesson Objective Review

Which Methodology layer would you typically design last and deploy first?

Compute Layer

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Hosting Platform Considerations

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XenApp and XenDesktop Hosting Transition

XenApp and XenDesktop supports:

- Running on physical machines
- Several versions ago, admins would typically deploy physical single unit servers to host their Citrix workloads.



Physical Servers

XenApp and XenDesktop supports:

- Using virtual machines
- Since XenApp 6, the industry has been focusing on virtualizing their Citrix workloads, which is still considered a leading practice.



Hypervisors

XenApp and XenDesktop supports:

- Full cloud deployment
- Mixed environments, including hybrid cloud approaches.
- Currently, the trend is moving towards leveraging the cloud.



Cloud

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Key Notes:

- In 1990's and up to mid 2000's Citrix was typically hardware deployed.
- Mid 2000's the focus shifted towards virtual Citrix environments.
- Today the focus is on cloud deployments, either full or hybrid.

Cloud Considerations

What if

- Operating a datacenter is too costly?
- A state-of-the-art security standard is hard to implement in the datacenter?
- The datacenter itself has no redundancy?
- The datacenter needs additional capacity?
- More flexibility is needed within the datacenter?



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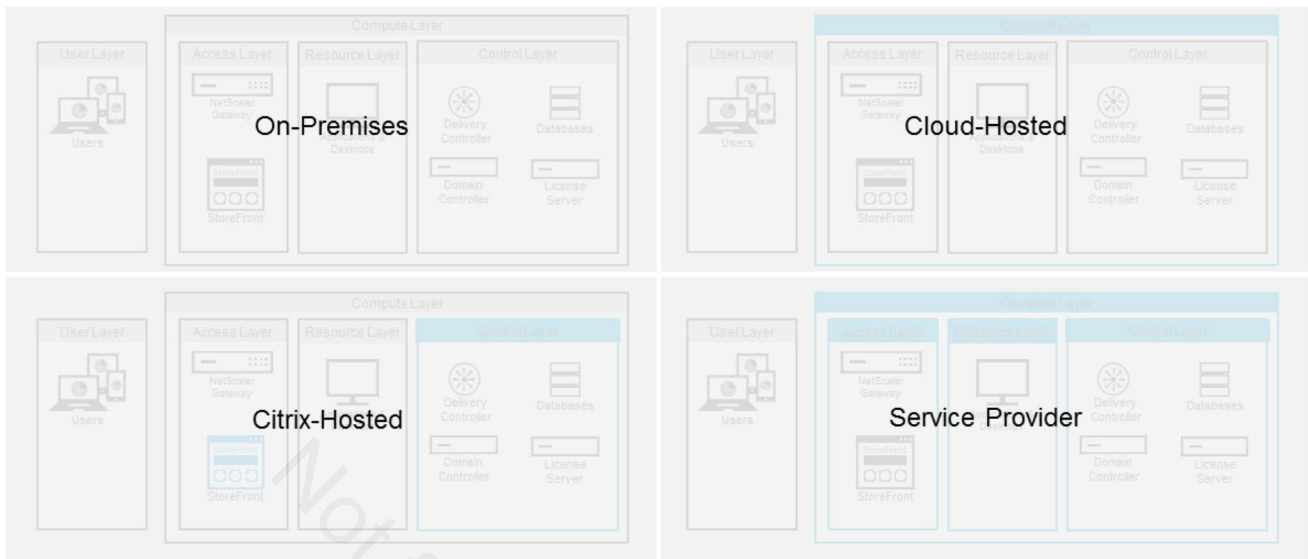
Key Notes:

- Citrix Workspace Cloud simplifies the management of virtual applications, desktops, mobile devices, and data sharing with its cloud-based management platform. You can choose whether you put your resources (hypervisors, VDAs, and StoreFront servers, for example) on premises or in a private or public cloud.
- The biggest drivers for moving to the cloud are flexibility, redundancy, and scalability.
- XenApp and XenDesktop supports on premises, hybrid cloud solutions and full cloud deployments.

Additional Resources:

- Citrix Workspace Cloud Apps and Desktop Services for New Customers Reference Architecture - <http://docs.citrix.com/content/dam/docs/en-us/workspace-cloud/downloads/workspace-cloud-apps-desktop-services-for-new-customers-reference-architecture.pdf>

Citrix Cloud Integration Options



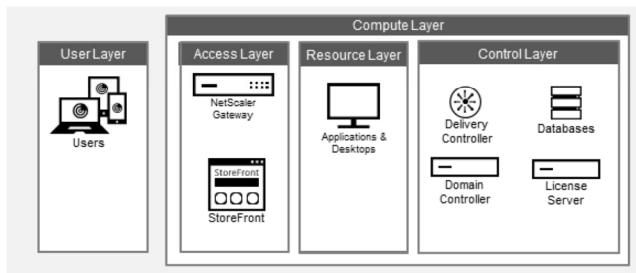
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Hosting Platform: On-Premises



- The Citrix administrator team manages every aspect of the deployment: the infrastructure, rights assignments, resources and hardware.

Key Notes:

- This model offers complete control over every aspect of the deployment, including choice of hardware manufacturer. It also comes with complete responsibility for designing and operating security, climate control, backup, maintenance and updates.
- A typical on-premises configuration consists of one or more XD broker systems. For customers looking to use Citrix Workspace Cloud and have Citrix host the XD broker, consider the following needs:
- All current XD broker systems that are on premises need to use the “ListOfDDCs” option for those VDAs to remain on premises. Otherwise, move the VDAs you want to use with Workspace Cloud into a different OU and change the “ListOfDDCs” option. Currently, there is no support for adding both an on-premises XD broker and Workspace Cloud Connector system to the “ListOfDDCs” in the same OU.
- You need to configure one or more systems with Internet access that are used to host the Citrix Cloud Connector that gets installed on these systems to host multiple services.
- Citrix Cloud Connector requires Windows Server 2012 R2 or newer.
- Port 443 outbound is required to be open and used by the Citrix Cloud Connector system. The Citrix Cloud Connector system will also support the use of IE proxy settings configured for outbound connections. For proxy support, see <https://docs.citrix.com/en-us/citrix-cloud/citrix-cloud-connector/technical-details.html>
- The Citrix Cloud Connector enables access to:
 - On premises Active Directory and provides Protocol Proxy for all STAINFuse connectivity .

- Other services such as XenMobile, ShareFile, Networking, Monitoring, and Lifecycle Management, which can be added at a later time.
- The Citrix Cloud Connector supports multiple AD forests. Windows 2003 and later are supported for AD forest.

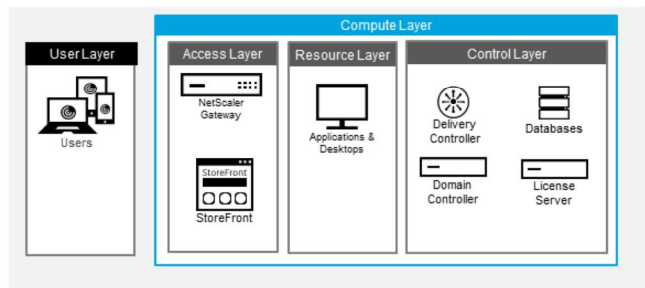
Additional Resources:

- Citrix Workspace Cloud Apps and Desktop Service with an on-Premises Resource Reference Architecture - <http://docs.citrix.com/content/dam/docs/en-us/workspace-cloud/downloads/workspace-cloud-apps-desktop-service-on-premises-resource-reference-architecture.pdf>

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Hosting Platform: Cloud-Hosted

- The Citrix administrator team allows a 3rd party to manage the hardware, for example Microsoft Azure, Azure Resource Manager or Amazon AWS.



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Key Notes:

- Simplify cloud adoption:
 - Ensure a smooth and secure transition when migrating environments to the public cloud.
 - Expand capacity quickly and with less capital cost.
- Manage hybrid and multi-cloud environments:
 - Leverage a common management plane across all Citrix environments.
 - Use multiple disaster recovery locations or manage multiple sites and/or clouds.
- Speed time-to-value:
 - Quickly establish new sites and offices.
 - Rapidly set up test environments and proof-of-concepts.
- Starting with version 7.11, Azure ARM is now supported.

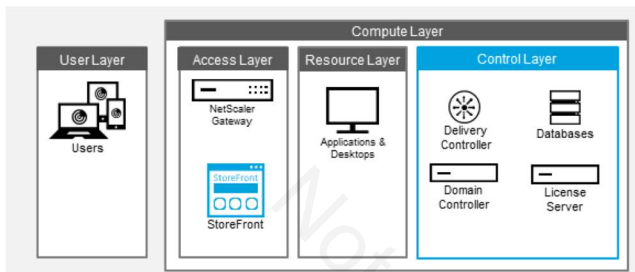
Additional Resources:

Citrix Cloud Overview - <https://www.citrix.com/products/citrix-cloud/>



Hosting Platform: Citrix Cloud

- The Citrix administrator team allows Citrix to manage the necessary infrastructure of the Site.
- The applications and desktops can remain on premises in a private datacenter or hosted in a public cloud of your choosing.



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Key Notes:

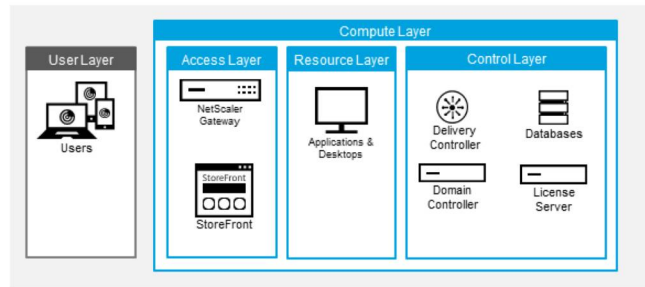
- Explain that new versions of the software in use will automatically be provided for Citrix-managed machines, while on premise machines need to be maintained and updated manually.
- Choice - Host your apps and data on any cloud or virtualization platform as well as across multiple locations.
- Security - Citrix Cloud doesn't handle your apps and data – you control where they reside.
- Experience - An intuitive admin experience keeps management simple, while award-winning Citrix HDX technology delights end users.

Additional Resources:

Citrix Cloud Overview - <https://www.citrix.com/products/citrix-cloud/>

Hosting Platform: Service Provider

- The Citrix administrator team allows a 3rd party to manage everything for them.
- The machines are usually hosted in dedicated or shared datacenters of the 3rd party.



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- How will you leverage the layered approach methodology in assessing, designing, and building your Citrix environment?

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What model of adopting cloud based resources are you currently using or implementing in the near future?

Additional Resources:

- How to Prevent Browser-Borne Malware - <https://www.citrix.com/blogs/2016/07/19/how-to-prevent-browser-borne-malware/>

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Lesson Objective Review

Identify two supported Cloud Providers?

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Lesson Objective Review

Identify two supported Cloud Providers?

- *Microsoft Azure*
- *Amazon Web Services*

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Key Takeaways



- XenApp and XenDesktop provides secure access to user resources across any network from any device.
- The essential architecture for a POC deployment includes a Delivery Controller, Domain Controller, License Server, StoreFront Server, and a NetScaler Gateway.
- XenApp and XenDesktop share a unified architecture called FlexCast Management Architecture (FMA), which allows administrators to tailor Server OS and Desktop OS resources to users from a single console.
- The default method of authentication relies on StoreFront forwarding credentials to Active Directory.
- The Layered Approach provides a strategy for assessing, designing, and building a XenApp and XenDesktop environment.
- XenApp and XenDesktop supports four hosting solutions including On-Premises, Cloud-Hosted, Citrix-Hosted, and Service Provider.

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XenApp and XenDesktop Administration

Initial Requirements and Lab Module 2

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Lab VM Power Management

The following VMs are required to be powered on before beginning the exercises in this module:

- NYC-ADS-001
- NYC-SQL-001
- NYC-FSR-001
- NYC-XDC-001
- NYC-DTP-MST

The remaining VMs need to be powered off.

Note: These VMs are listed in the start-up order.

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Learning Objectives

- Demonstrate Citrix Consulting methodology for XenApp and XenDesktop deployments
- Identify supporting infrastructure requirements for XenApp and XenDesktop build
- Present the supporting Infrastructure Licensing considerations
- Introduce the AppDNA platform and using AppDNA to prepare for Windows 10 and Windows 2016
- Provide overview of training lab environment scenario and architecture

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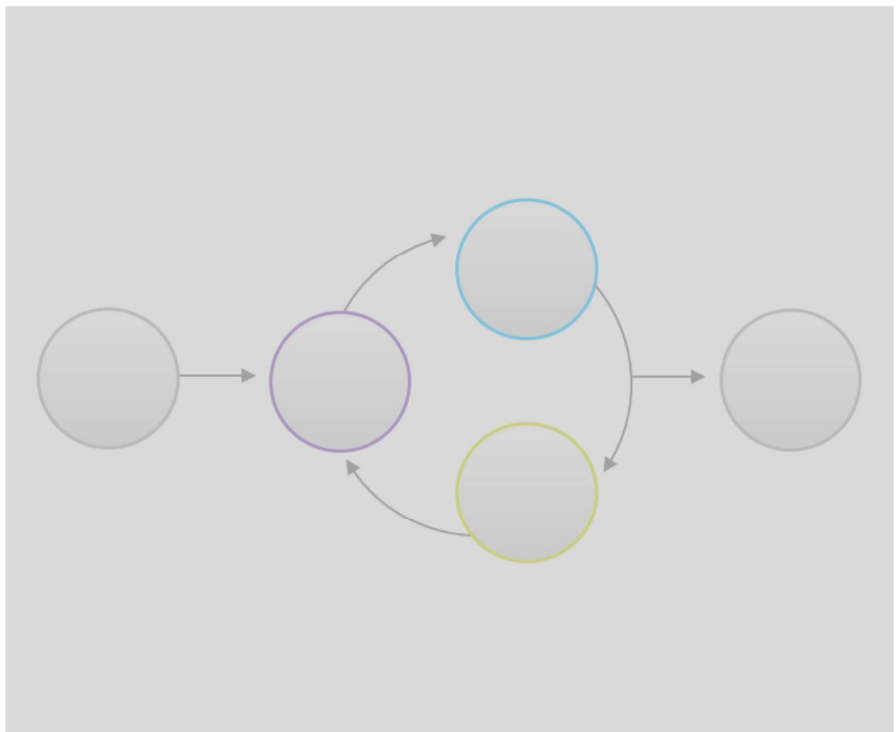
Citrix Consulting Methodology

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Citrix Consulting Methodology

- Apply the proven methodology to Citrix projects to maximize end value
- Complete each phase and obtain signoff from key stakeholders before moving to next phase



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Key Notes:

- With years of successful project implementation experience, Citrix Consulting can help you achieve the highest levels of efficiency, manageability and agility for all of your strategic IT services – from enabling mobile workstyles to delivering cloud services.
- Before starting to build an environment, it is critical to follow the phases of the Citrix Consulting methodology that should be addressed prior to building (define, assess, and design).
- The methodology covered will be an iterative process, meaning that after the completion of each project, or each phase of a larger project, the same steps of the methodology should be leveraged again to improve the environment and/or progress to next steps.
- Applying the proven methodology helps minimize risk and maximize effectiveness and value.

Additional Resources:

- Citrix Consulting Services - <https://www.citrix.com/support/consulting/>

Define

- Identify business and technical objectives
- Determine strategy to achieve goals
- Develop roadmap and strategic plan



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Key Notes:

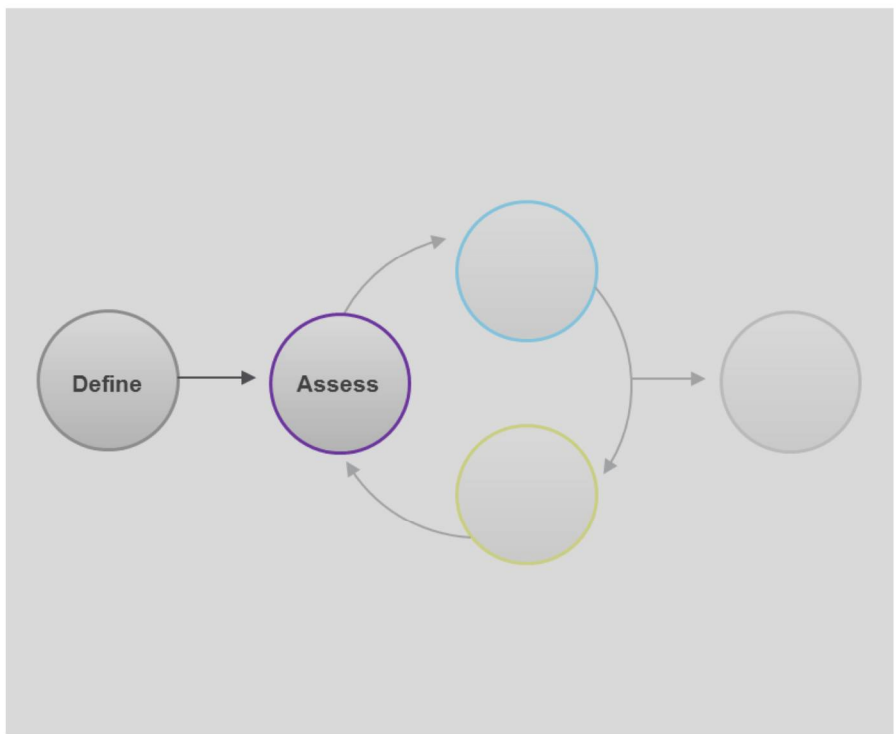
- First step: define the objectives and determine the business goals.
- Develop roadmap and strategic plan to fulfill objectives.
- Citrix Consulting can assist in the definition of the strategy that will help your business take full advantage of these technologies, including solution development, roadmap initiatives and strategic planning, hardware and storage estimation and prioritization.

Additional Resources:

- Citrix Consulting Services - <https://www.citrix.com/support/consulting/>

Assess

- Review the existing environment
- Identify requirements
- Determine use cases



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Key Notes:

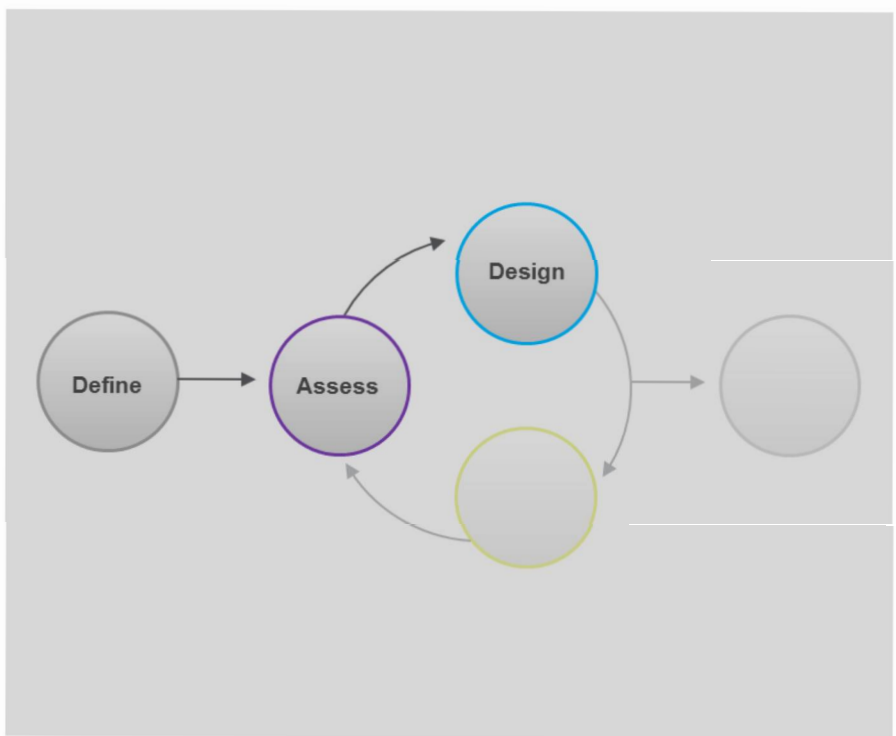
- After objectives are defined, need to assess the existing environment to understand requirements.
- Prioritize business objectives and work streams accordingly.
- Determine use cases and requirements.
- During the Assess phase, Citrix Consulting reviews your current environment, identifies use cases and gathers detailed requirements for the project. This information allows us to define the project success criteria and set the direction for your proposed Citrix deployment, upgrade, or expansion.

Additional Resources:

- Citrix Consulting Services - <https://www.citrix.com/support/consulting/>

Design

- Determine architecture for identified requirements
- Address scalability, redundancy, and high availability



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Key Notes:

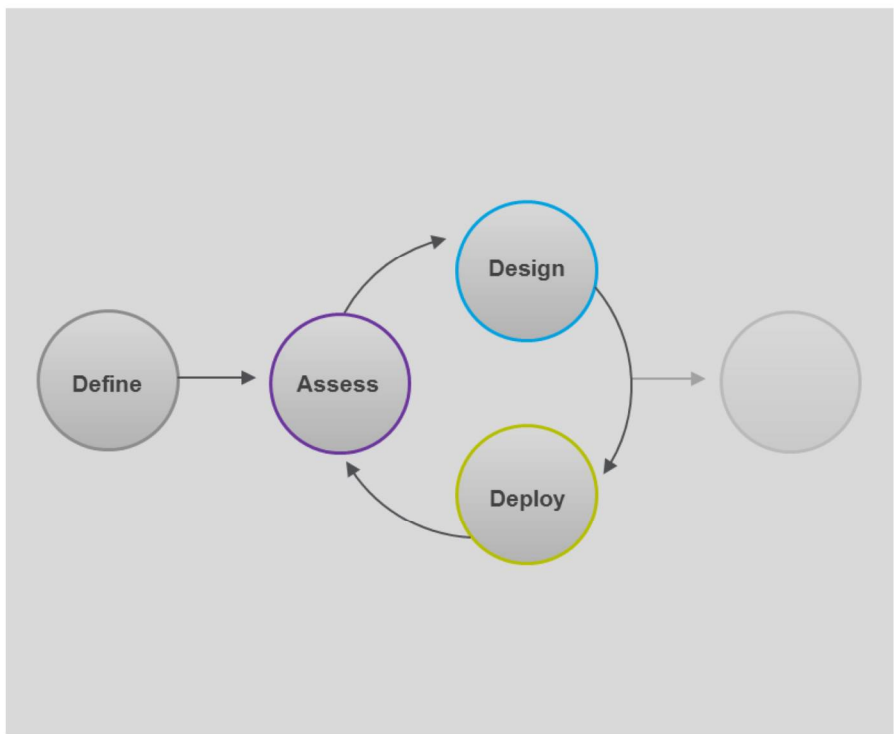
- Design in accordance with leading practices and take into account environment scalability, redundancy, and high availability.
- The design phase defines the architecture and operational processes required to implement and maintain the production environment that will satisfy your success criteria. Topics such as environment scalability, redundancy and high availability are addressed.
- Citrix Consulting will apply leading practices for performance tuning to help your environment perform at its best.

Additional Resources:

- Citrix Consulting Services - <https://www.citrix.com/support/consulting/>

Deploy

- Build the environment according to design
- Perform thorough testing to verify build



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Key Notes:

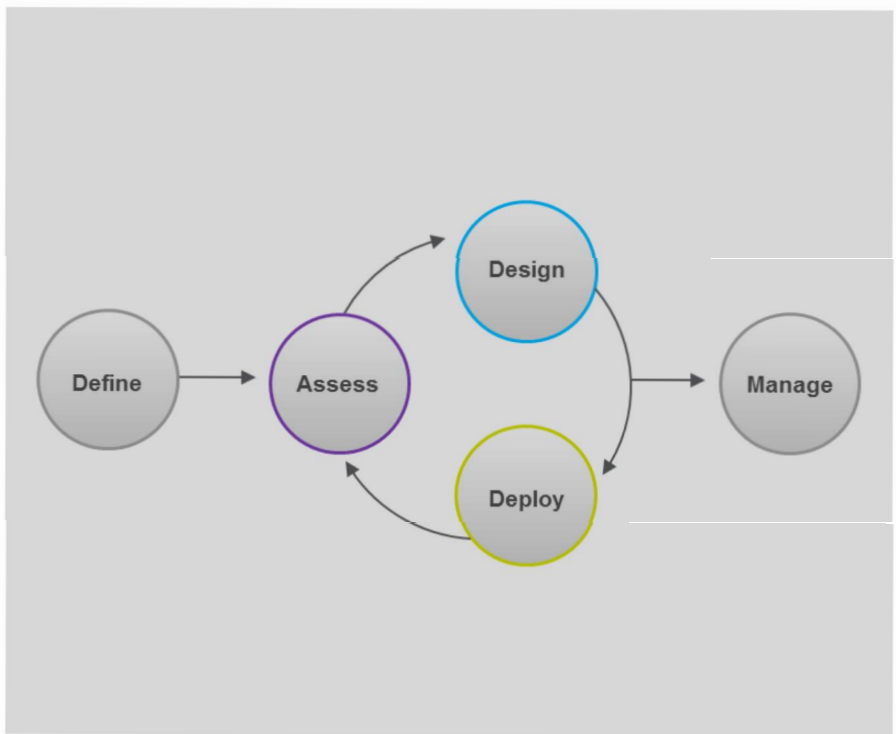
- Build the virtualization environment or integrate components/use cases into existing virtualization environment.
- Integrate testing steps into deploy stage to verify build.
- Stress importance of having a completely separate test environment, where the deployment can be tested prior to production implementation. However, it is still important to integrate testing into the production build as well.
- During the Deploy phase, Citrix Consulting creates and configures the environment to meet the specifications from the Design phase. This includes supporting the integration of any applications that have been identified in the design and performing thorough testing of all infrastructure components. Citrix Consulting will also guide you through a phased rollout approach to mitigate risk and ensure a successful deployment.

Additional Resources:

- Citrix Consulting Services - <https://www.citrix.com/support/consulting/>

Manage

- Develop operational processes to maintain environment
- Implement monitoring solution



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Key Notes:

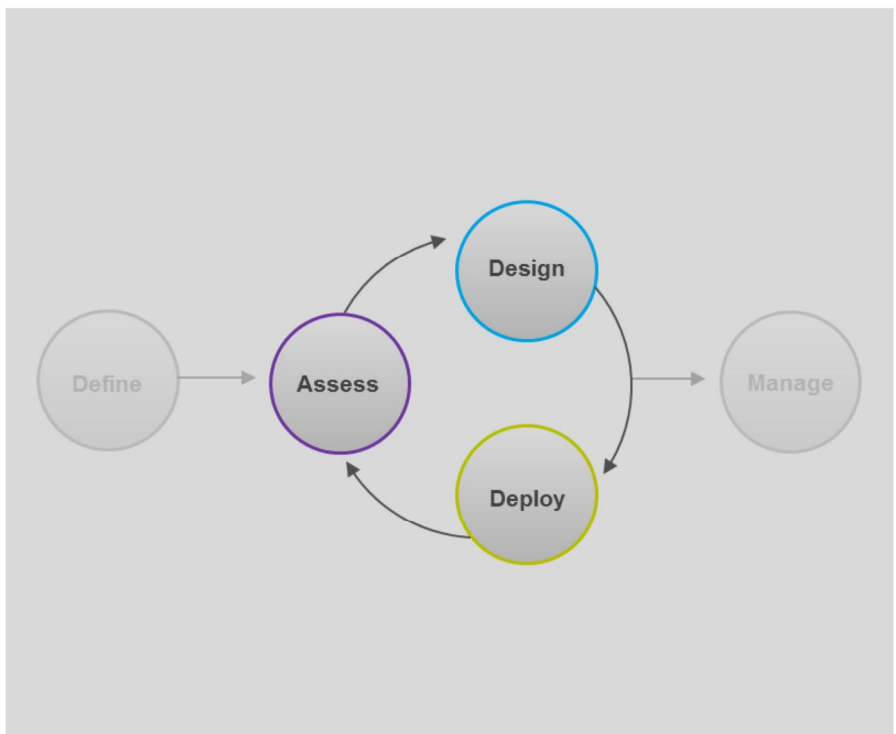
- Implement monitoring processes and maintenance tasks to maintain and stabilize the production environment.
- For the long-term health of your Citrix environment, Citrix Consulting can be engaged to perform the continued monitoring and administrative tasks in several different capacities. With onsite and remote delivery capabilities, Citrix Consulting has the experience to keep your environment stable and your users happy.

Additional Resources:

- Citrix Consulting Services - <https://www.citrix.com/support/consulting/>

Assess, Design, Deploy

- Leverage iterative nature of these phases
- Prioritize the rollout of specific user groups to production



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Key Notes:

- Realize that the assess > design > deploy phases are iterative. For example, these phases can be completed to roll out prioritized user groups to production first (most impact to business and/or quick wins) and the administrator can then later begin the assess > design > deploy phases for the next user groups/FlexCast models at a later point in time.



Scenario: As part of your company's initiative to enable a mobile workforce, you are implementing a XenApp and XenDesktop environment.

- Leveraging your knowledge of Citrix Consulting Methodology, what steps will you take prior to building the environment?

Key Notes:

- Define phase: define the goals of the project and create a roadmap for completion.
- Assess phase: identify the use cases that the Proof of Concept will validate and review the current environment to determine requirements.
- Design phase: determine the infrastructure and components that will be required to meet needs. Design with leading practices in mind.

Lesson Objective Review

What are the five phases of the Citrix Consulting Methodology and in which order are they are used?

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Lesson Objective Review

What are the five phases of the Citrix Consulting Methodology and in which order are they are used?

- Define
- Assess
- Design
- Deploy
- Manage

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Supporting Infrastructure Requirements

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Supporting Infrastructure Prerequisites

Address supporting infrastructure requirements

- Optionally install and configure a supported hypervisor:
 - Citrix XenServer
 - VMware vSphere
 - Microsoft Hyper-V
- Leverage Active Directory for authentication and authorization
- Create DHCP scope for provisioned machines and enable DNS dynamic updates where applicable



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Key Notes:

- A hypervisor is an optional component, as the environment could be entirely physical if only using Remote PC or PVS in certain cases. If leveraging MCS, then a hypervisor will be required.
 - Deployments are also supported in Azure, Amazon Web Services (AWS) and Citrix Cloud.
- Active Directory is required for XenApp and XenDesktop.
 - Kerberos infrastructure ensures authentication of Delivery Controller communication and time synchronization between servers.
 - Time synchronization is particularly important for VDA registration.
- Create a DHCP scope for VMs provisioned via PVS or MCS; DNS dynamic updates are required for VMs that receive addresses dynamically via DHCP (including provisioned VMs).
- Infrastructure servers should be assigned static IP addresses.

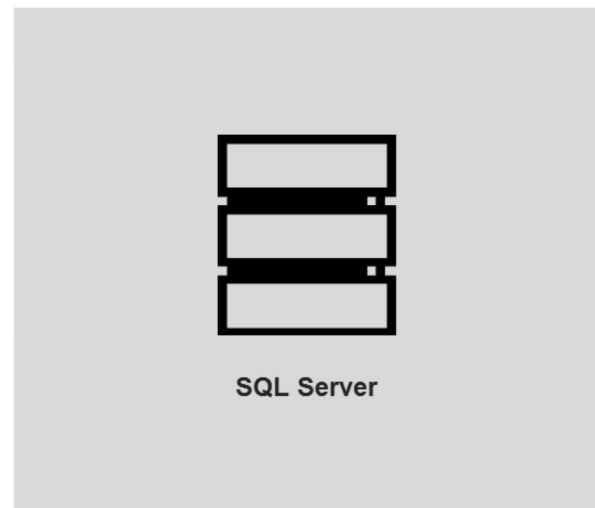
Additional Resources:

- Supported Hypervisors for XenDesktop and Provisioning Services:
<http://support.citrix.com/article/CTX131239>

Supporting Infrastructure Prerequisites

Address supporting infrastructure requirements

- Verify Microsoft Remote Desktop Services Licensing where required for Server OS resources
- Determine the edition and version of SQL to be installed
- Implement a supported SQL high availability configuration:
 - SQL Server Clustered Instances
 - SQL Server Mirroring
 - SQL Server AlwaysOn Availability Groups



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Key Notes:

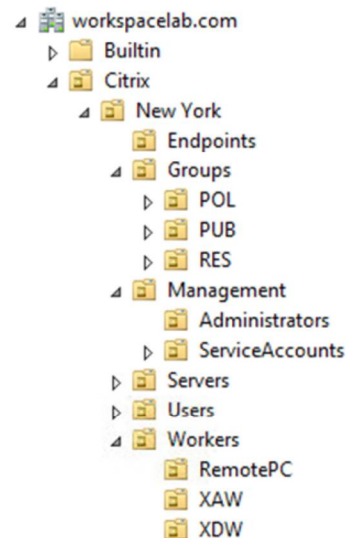
- RDS licensing is required for Server OS-based published apps and desktops, so admins will need to verify that the number of RDS licenses is sufficient for the Server OS workloads delivered.

Additional Resources:

- Supported Databases for XenApp and XenDesktop Components:
<http://support.citrix.com/article/CTX114501>

Organizational Unit (OU) Structure

- Create a separate OU structure for the Citrix environment
- Separate out infrastructure servers from desktops/applications resources
- Build a distinct OU for test Citrix environment



Key Notes:

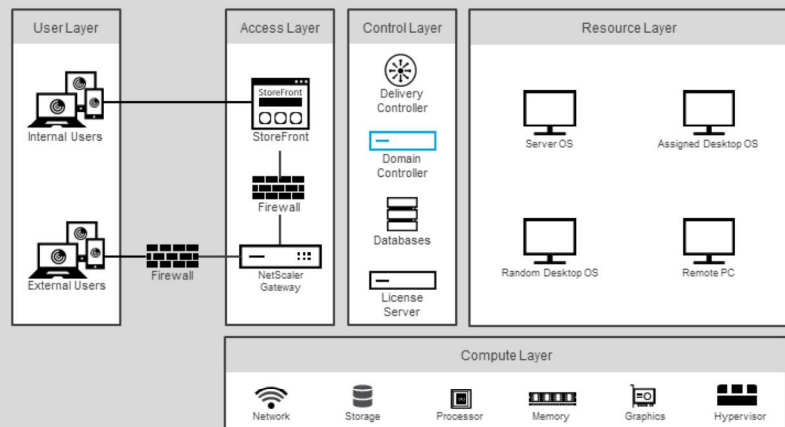
- When you create a Site, a corresponding Organizational Unit (OU) can be created in Active Directory to ease management of the VDAs. As a leading practice, the OU should also contain the Controllers in the Site, but this is not enforced or required. A domain administrator with appropriate privileges can create the OU as an empty container, then delegate administrative authority over the OU to a Citrix administrator.
- Consider the following:
 - Separate Citrix OUs to block inheritance for the Citrix OU and thereby prevent other policies from affecting the Citrix environment.
 - Separate infrastructure servers from resources delivered (VDAs) to prevent VDA policies from affecting infrastructure servers.
 - Further separate out VDAs according to OS, application set, delivery type, etc. where necessary in order to apply more granular group policies to specific machines based on their role in the environment:
 - E.g. Optimization policies based on OS.
 - E.g. Security restrictions for particular resources.
 - If there is a separate AD infrastructure for the test environment, the test OU in the production environment can be leveraged for user acceptance testing (pre-production).
 - If there is no separate AD infrastructure for the test environment, then the test OU can be used to enable administrators to test policies without affecting the production XenApp and XenDesktop deployment.

- The test OU should mimic the production OU as closely as possible.

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Domain Name System (DNS)

- XenApp and XenDesktop relies on DNS to operate correctly at all times
- DNS services are usually installed on Domain Controllers



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Key Notes:

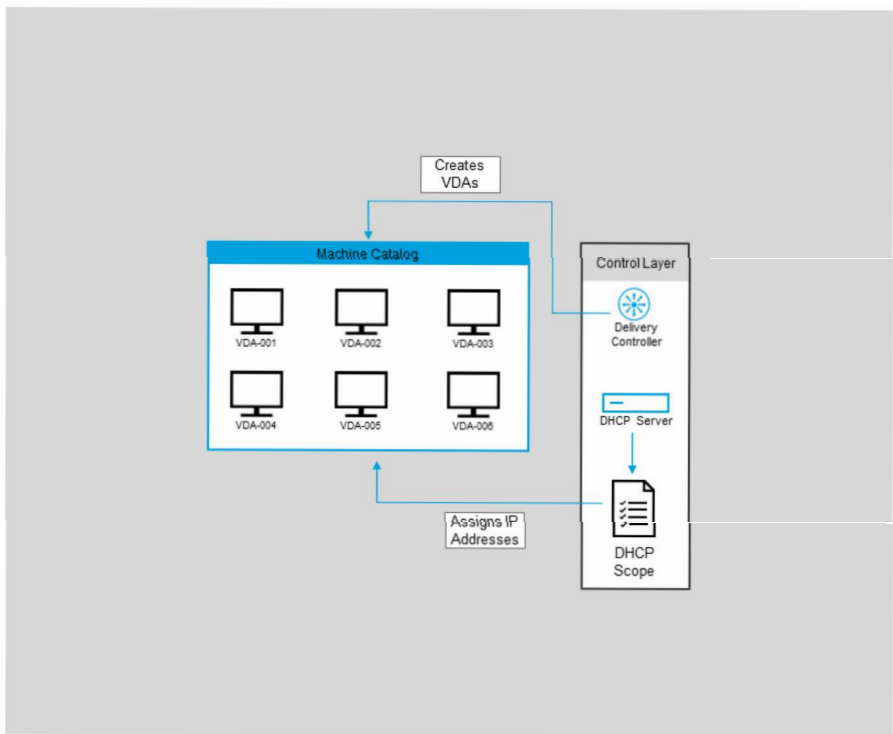
- DNS is a critical component in Microsoft Windows Domains and should be given extra considerations to guarantee availability of the service.
- Most Citrix components need name resolution to function properly. In particular, the VDA registration process can fail if duplicate entries or stale records exist in DNS, so consider enabling “aging and scavenging” on applicable DNS zones.
- For added security, the HDX connection between Receiver and VDA can be encrypted using SSL/TLS. This requires certificates to be present on VDAs, and since certificates are normally issued to names rather than IP addresses, the “XML DNS Address resolution” feature needs to be turned on.
- A reverse DNS Lookup Zone might also be required, especially if the DNS namespace differs from Active Directory Domain names.

Additional Resources:

- Citrix Health Assistant - Troubleshoot VDA Registration - <https://support.citrix.com/article/CTX207624>
- How to Enable DNS Address Resolution in XenDesktop - <http://support.citrix.com/article/CTX135250>
- Understanding Aging and Scavenging - [https://technet.microsoft.com/en-us/library/cc771677\(v=ws.11\).aspx](https://technet.microsoft.com/en-us/library/cc771677(v=ws.11).aspx)

Dynamic Host Configuration Protocol (DHCP)

- XenApp and XenDesktop **Machine Creation Services** and **Provisioning Services** rely on DHCP to issue IP addresses to machines hosting the VDA software
- Confirm DHCP Scope size to match the number of planned VDA machines



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Key Notes:

- DHCP is a service responsible for issuing unique IP addresses (and other information like Gateway servers, Routing information, DNS server location etc.) to devices within a local network. DHCP allocates these IP addresses from a specified range of addresses for a limited time (before these addresses are either returned to the pool or their return date is extended). Sometimes these ranges (scopes) are not large enough or the allocated addresses are not returned fast enough to be available to others.
- The main two dependencies for DHCP are Machine Creation Services (MCS) and Provisioning Services (PVS). While MCS will be covered in an upcoming module, PVS is explained in a different course.
- DHCP normally does not fall under the responsibilities of the Citrix Administration team, but it needs to be monitored / checked because of the dependencies.
- Servers built manually are often using static IP addresses.
- DHCP as a central service can become a single point of failure if no high availability solution is set up.
- Many deployments install the role of the DHCP server on their domain controllers.

Service Accounts

Reduce impact of individual permission and account issues, while increasing security

- XenApp and XenDesktop SQL Service Account
 - Setup and maintenance permissions:
 - dbcreator
 - securityadmin
 - db_owner
 - Install database via Studio permissions:
 - sysadmin
- Hypervisor Service Account
 - Permissions to create and manage virtual machines
 - Permissions to enable communication with hypervisor

Key Notes:

- Leading practice: have a database service account for each Citrix product/each purpose.
- A proper password management procedure should be implemented for service accounts.
- Consider the following:
 - Service accounts reduce impact if there is an issue with an individual administrator's account.
 - Service accounts increase security because it limits the privileges of individual administrator accounts. If an account is compromised, then it will not provide access to the entire environment. Important to note that the service account should not have domain admin privileges, in accordance with the principle of least privilege.
 - The service account permissions for the XA/XD SQL account are required during the initial setup of the database, removing/adding controllers, and updating database schema. During the initial setup, the correct security roles are configured for the services (read, write, and execute only) for runtime. The FMA services utilize the controller's AD machine account for accessing SQL during runtime, so user accounts are not leveraged.
 - "Studio" refers to the XenApp and XenDesktop management console.
 - To configure the site database automatically during site creation through Studio, sysadmin privileges for the service account are required during the

initial configuration. However, these can be removed after the initial setup/configuration if dictated by security. More specifics are covered during Module 3.

- Exact permissions required for a hypervisor account vary according to hypervisor. Refer to the links below for permissions by host resource type.

Additional Resources:

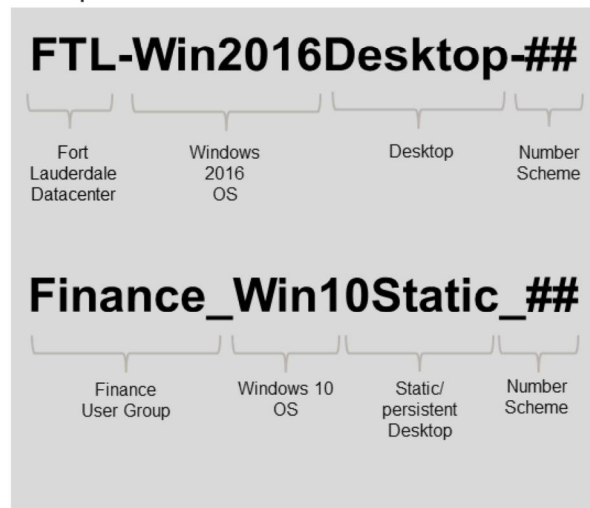
- vSphere: <http://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/install-configure/install-prepare/vmware.html>
- SCVMM: <http://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/install-configure/install-prepare/msscvm.html>
- Azure: <http://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/install-configure/install-prepare/azure.html>
- ARM: <http://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/install-configure/install-prepare/azure-resource-manager.html>

Standard Naming Convention

Establish a standard naming convention for environment components

- Determine a consistent, expandable naming convention during the design phase
- Enables administrators to quickly identify meaningful information:
 - Server role
 - Geographic location
 - Operating system
- Standardize naming conventions for:
 - Servers and desktops
 - Machine catalogs and Delivery Groups
 - Sites
 - Policies

Examples:



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Key Notes:

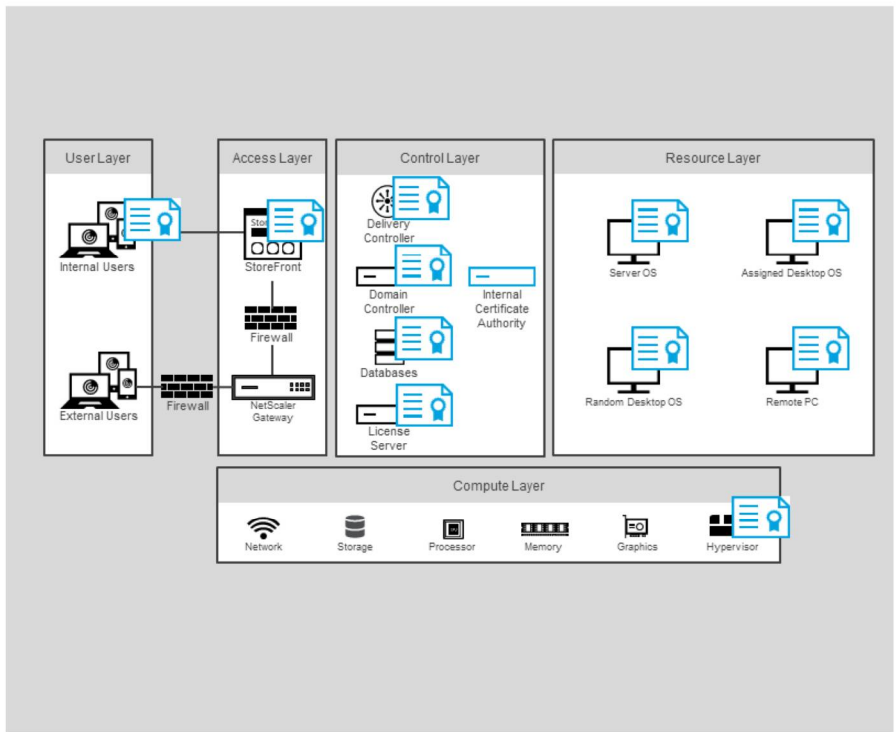
- Considerations:
 - Avoid naming components POC, test, etc. that will eventually be moved into production to avoid confusion and minimize potential issues with changing names, or situations where the name cannot be changed.
 - The naming convention should convey important information so that an admin can quickly identify components (helps streamline management).
 - When creating a naming convention, take into account future expansion. Make sure the naming convention is something that can be built upon so that it can continue to be used if the environment grows.
- Remember renaming components can cause issues, so it is important to delineate naming conventions during the design phase.
- You could include special characters (a hyphen or a dot) used for filtering / tokenizing in scripts later, like "Site-Function-Name-Number". If special characters cannot be used, a fixed number of characters and abbreviations can serve the same purpose, like "SitFunNamNum".

Additional Resources:

- Naming conventions in Active Directory for computers, domains, sites, and OUs - <https://support.microsoft.com/en-us/kb/909264>

Certificate Authority

- Internal CAs can issue certificates for internal computers
- Use certificates to secure network traffic using SSL or TLS



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Key Notes:

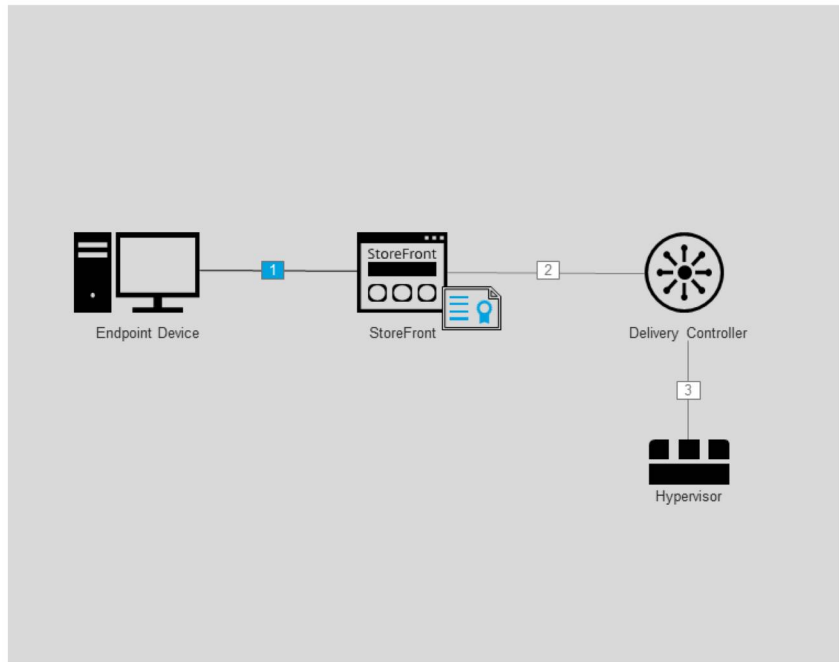
- Configuring a XenApp or XenDesktop Site to use the Secure Sockets Layer (SSL) or Transport Layer Security (TLS) security protocols includes the following procedures: Obtain, install, and register a server certificate on all Delivery Controllers, and configure a port to use the certificate. Optionally, you can change the ports the Controller uses to listen for HTTP and HTTPS traffic.

Additional Resources:

- Transport Layer Security (TLS) - <http://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/secure/tls.html>

Certificates

1. Install server certificate on StoreFront server to secure traffic between endpoints and StoreFront
2. Install server certificate on Delivery Controller to secure communication between StoreFront server and Delivery Controller
3. Install certificate to secure communication between hypervisor and Delivery Controller
 - vSphere – vCenter certificate on Delivery Controllers
 - XenServer – certificate on XenServer host

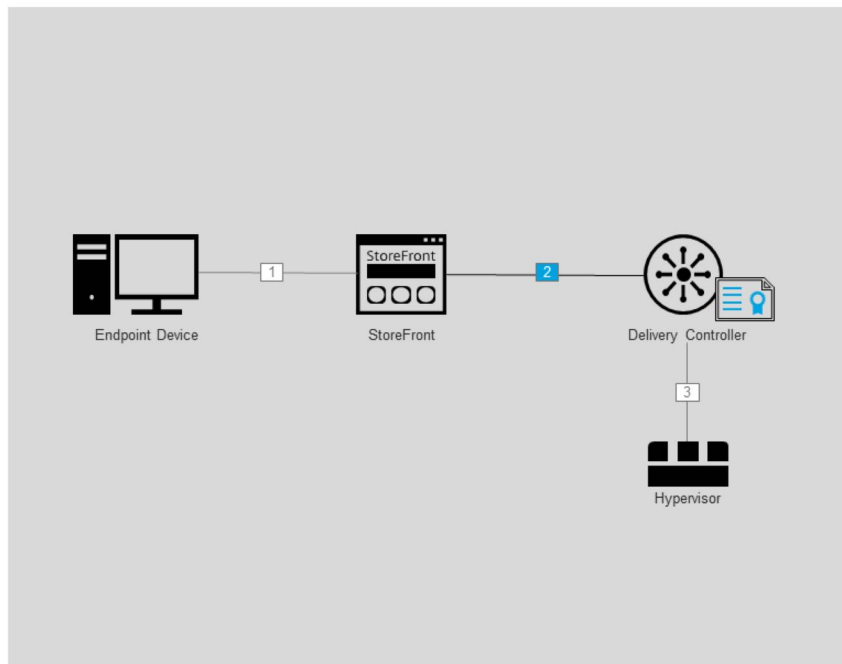


Key Notes:

- The leading practice is to install certificates to secure communication for the connections (#1-3) outlined in the diagram.
- Administrators should be aware that they may need to request these in advance or work with the security team beforehand so they can have the certificates ready when needed for building.
- Considerations:
 - If using the native Receiver to connect directly to StoreFront using the manual configuration of the StoreFront store or email-based account discovery, SSL/TLS encryption is required.
- We will have several hands-on lab exercises in this course addressing certificates.

Certificates

1. Install server certificate on StoreFront server to secure traffic between endpoints and StoreFront
2. Install server certificate on Delivery Controller to secure communication between StoreFront server and Delivery Controller
3. Install certificate to secure communication between hypervisor and Delivery Controller
 - vSphere – vCenter certificate on Delivery Controllers
 - XenServer – certificate on XenServer host



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Key Notes:

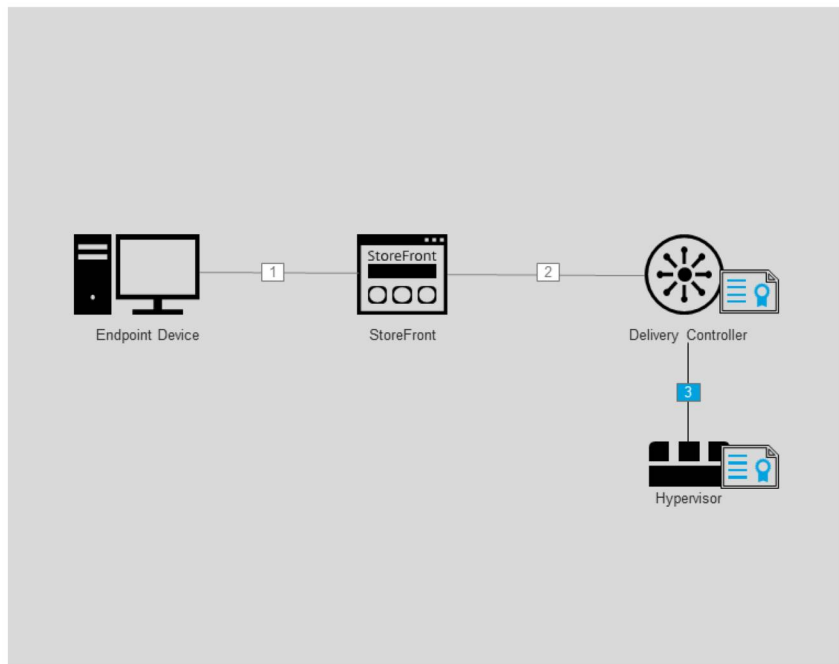
- This certificate is optional, but consider:
 - It is recommended to prevent XML data from being sent in clear text (passwords obfuscated).
 - However, it is a relatively lower security risk because the components are typically on the internal network.

Additional Resources:

- How to Enable SSL on XenDesktop 7.x Controllers to Secure XML Traffic:
<http://support.citrix.com/article/CTX200415>

Certificates

1. Install server certificate on StoreFront server to secure traffic between endpoints and StoreFront
2. Install server certificate on Delivery Controller to secure communication between StoreFront server and Delivery Controller
3. Install certificate to secure communication between hypervisor and Delivery Controller
 - vSphere – vCenter certificate on Delivery Controllers
 - XenServer – certificate on XenServer host



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Key Notes:

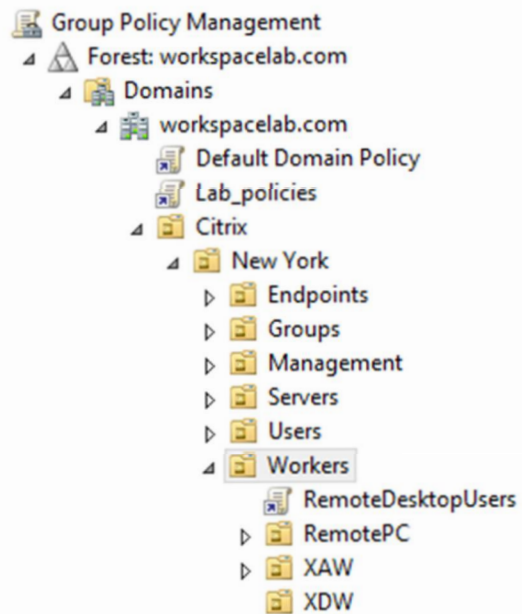
- Installing a certificate is not required for Hyper-V because XenDesktop leverages WCF to automatically secure communications.

Additional Resources:

- Prepare the virtualization environment: VMware - <http://support.citrix.com/article/CTX128617>
- How to Use IIS to Acquire SSL Certificates for XenServer -

Group Policy Management

- Leading practice to manage multiple systems
- Requires delegated permissions on OU level

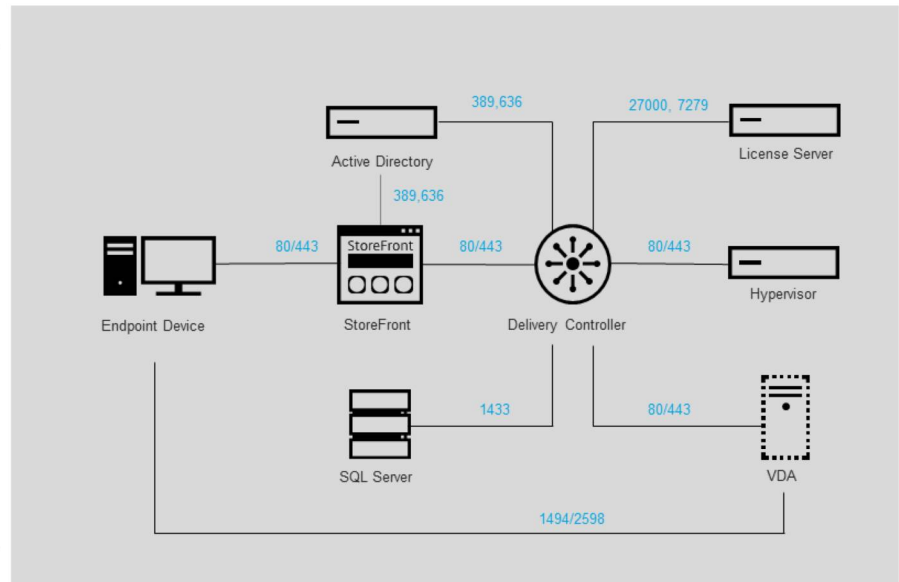


Key Notes:

- In some companies the Citrix Admin has no permissions to manage group policies.
- It is a leading practice to separate all Citrix components into OUs underneath a common Citrix-OU.
 - This OU can then be delegated for management to the Citrix Admin team.

Firewall Ports Overview

Verify ports required for communication are open



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Key Notes:

- This is a succinct overview of the ports required for XenDesktop and the full list of required ports can be found in article under Additional Resources.
- You may need to work with your security or firewall team to determine how the ports will be opened (manually vs. automatically) and these decisions should be made during the design phase to prevent impact to build timelines.
- Port 1494 is for the HDX connection, but port 2598 is used if Session Reliability is enabled.
- Ports 80/443 depends on if the communication has been secured.
- The VDA stands for Virtual Delivery Agent, and refers to the application and desktop resources being made available to users.

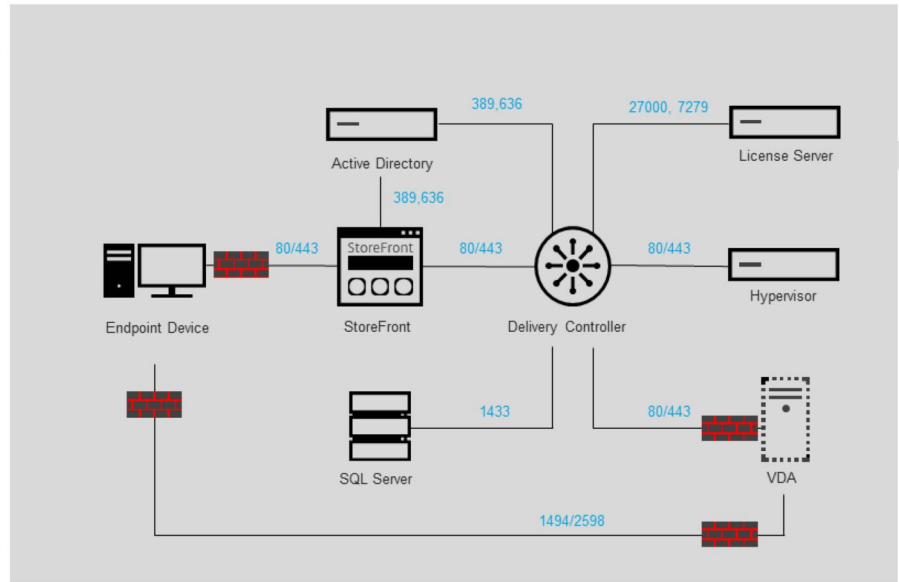
Additional Resources:

- Communication Ports Used by Citrix Technologies - <http://support.citrix.com/article/CTX101810>

Firewall Placement

Firewalls are typically placed to secure traffic to and from:

- Virtual Delivery Agent
- Endpoint Device



Key Notes:

- Keep all endpoint devices in your environment up to date with security patches. One advantage of XenApp and XenDesktop is that you can use thin clients as terminals, which simplifies this task.
- Protect all machines in your environment with antivirus software.
- Protect all machines in your environment with perimeter firewalls, including at enclave boundaries as appropriate.
- If you are migrating from a conventional environment, you may need to reposition an existing perimeter firewall or add new perimeter firewalls. For example, suppose there is a perimeter firewall between a conventional client and database server in the data center. When XenApp and XenDesktop is used, that perimeter firewall must instead be placed so that the Virtual Delivery Agent (VDA) and user device are on one side, and the database servers and Delivery Controllers in the data center are on the other side. You should therefore consider creating an enclave within your data center to contain the database servers and Controllers. You should also consider having protection between the user device and the VDA.
- All machines in your environment should be protected by a personal firewall. When you install core components and VDAs, you can choose to have the ports required for component and feature communication opened automatically if the Windows Firewall Service is detected (even if the firewall is not enabled). You can also choose to configure those firewall ports manually. If you use a different firewall provider, you must configure the firewall manually.

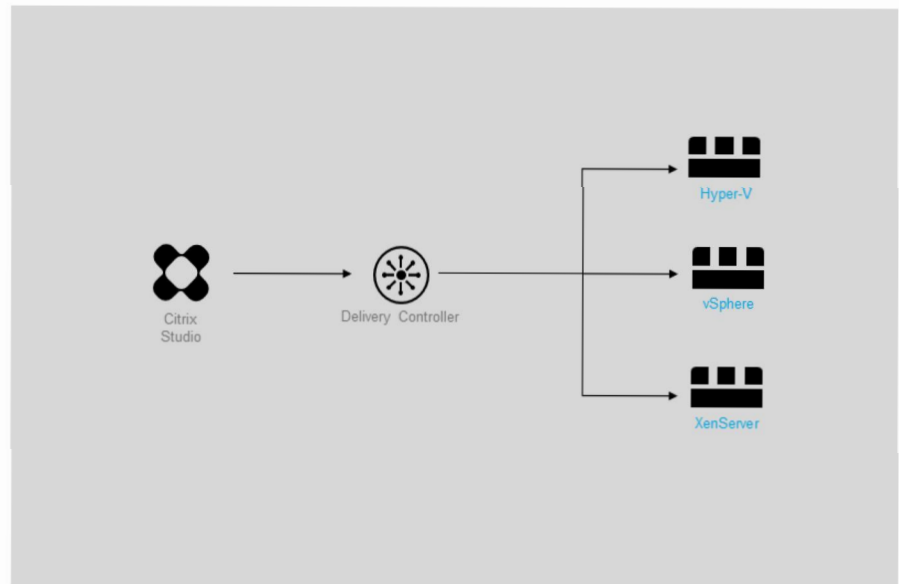
Additional Resources:

- Security Best Practices - <http://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/secure/best-practices.html>

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Hypervisor Agnostic

- XenApp and XenDesktop abstracts complex operations on hypervisors
- Use Citrix Studio or PowerShell to manage hypervisors in a consistent way



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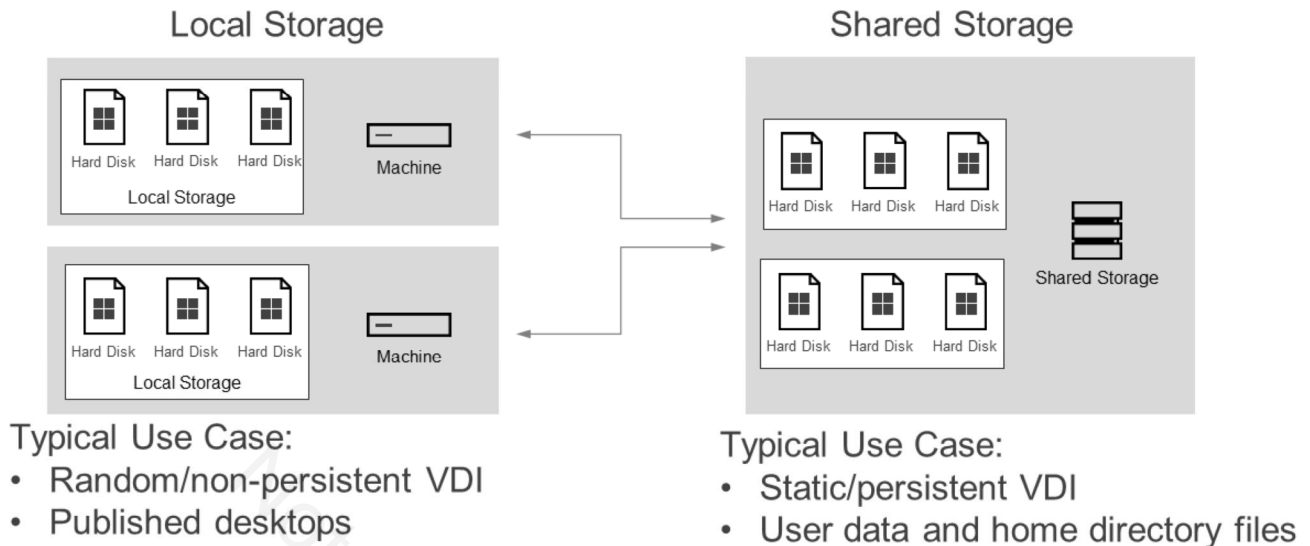
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Key Notes:

- Some XenApp and XenDesktop management tasks performed within Citrix Studio may require several different steps performed on the hypervisor (like creating machines). Such complex tasks are normally combined into a single workflow that Citrix Studio will track and monitor during execution.
- Each hypervisor needs different commands to perform similar tasks – using the abstraction layer from Citrix Studio, the three industry standard hypervisors can be managed using common commands from the same GUI.
- Hypervisors in this context can also be cloud vendors such as Azure and AWS.
- For the purpose of running VDAs, XenApp and XenDesktop does not require special abilities from the hypervisor.
- While differences may exist in performance, cost, scalability or personal preference, the administrative team can freely choose amongst several hypervisors.

Storage

Determine storage architecture solution to leverage for XenApp and XenDesktop environment



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Key Notes:

- Misconception: enterprise companies should use only shared storage.
 - Reality: Enterprise XA\XD implementations are also using local storage.
 - Local storage is typically cheaper and allows for decentralized execution, which makes it easier to guarantee a certain level of performance. Very large environments are aiming for centralized configuration and management with decentralized execution. Local storage based on SSD drives can outperform lower-end SANs and cost only a fraction.
 - Requirements should be reviewed (as well as the existing infrastructure) and a storage solution should be selected based on those needs.
- There are additional storage considerations when determining the supporting storage solution:
 - RAID levels
 - Disk type and tiered storage
 - IOPS requirements
 - Storage bandwidth
- Consider - Local Storage versus Shared Storage:
 - Local storage – stored on the machine and only accessible from a single machine.
 - DAS – block-level, storage sub-system directly attached to server via cable.
 - Shared storage – stored on a separate storage system that is accessible from

multiple machines.

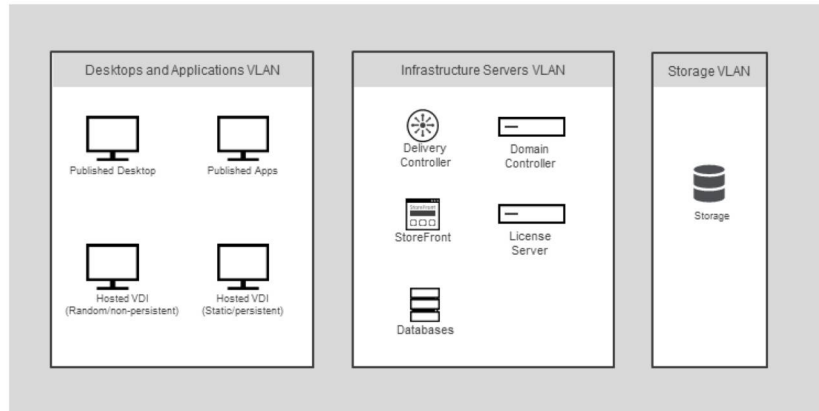
- NAS – file-level storage connected via Ethernet or network file sharing protocol.
- SAN – dedicated storage network for block-level storage connected via HBA.
- For local storage, will have to copy master images and updates to each server if using MCS (will be covered in a later module).
- There is not a one size fits all, the choice of storage type depends on the design of the solution.

Additional Resources:

- Connections and resources - http://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/manage-deployment/connections.html#par_anchor_title_f4be
- Information about connection types: http://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/manage-deployment/connections.html#par_anchor_title_ba4

VLAN Separation

Create VLANS to minimize traffic and increase security



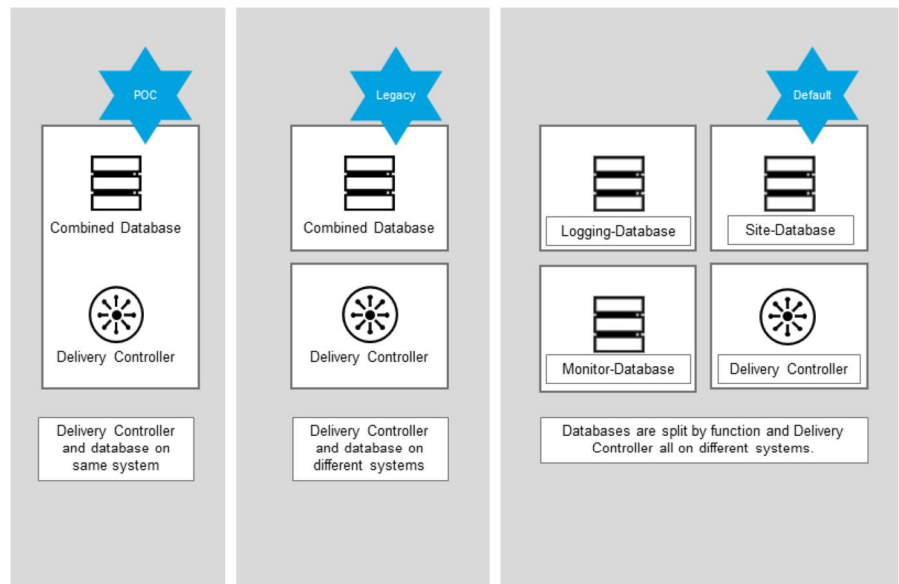
Key Notes:

- VLANs can reduce broadcast traffic, enhance security, and enable complex network configurations.

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Database platforms

XenApp and XenDesktop requires a Microsoft SQL Database



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Key Notes:

- There are different Citrix Components that use databases for different purposes – each one may have different requirements for the version or features of its database.
- In previous versions of XenApp and XenDesktop, the database required for XenApp and XenDesktop would be created as one database by the installer; after install the admin could split it into different databases to enhance performance or comply with backup/security guidelines.
- With the later releases of the product the installer now suggests to deploy three separate databases, although it is still possible to deploy using a single database. However, this is not recommended. This will be covered in detail in a later module.

Additional Resources:

- Supported Databases for XenApp and XenDesktop Components - <http://support.citrix.com/article/CTX114501>

Database sizing

- Database size varies depending on usage of the product
- Refer to the sizing guide for close estimates

Users	Applications	Type	Expected Peak Size (MB)
1,000	50	HSD	31
10,000	100	HSD	198
100,000	200	HSD	752
1,000	n/a	VDI	30
10,000	n/a	VDI	121
40,000	n/a	VDI	426

Key Notes:

- This table serves as a reference and ONLY contains data for the Site Database. The Monitoring and Configuration Logging database are not included. Refer to the XenDesktop 7.x Database Sizing guide (provided below) for more information.
- Most databases grow but normally do not shrink. So, it is best to plan ahead in terms of free space on the storage volume that the database resides on.
- Log files, depending on database settings, can fill up the disk of the database system if they are not truncated (which usually happens after a backup of the database).
- Solid Microsoft SQL knowledge is recommended in order to change settings concerning the database server.

Additional Resources:

- XenDesktop 7.x Database Sizing - <http://support.citrix.com/article/CTX139508>
- Database Sizing Tool for XenDesktop 7 - <http://support.citrix.com/article/CTX209080>



Who does not have access to setup or manage these infrastructure components?

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Lesson Objective Review

Scenario: You are the Citrix Admin and you want to utilize Machine Creation Services to deploy 1000 VDAs on the XenServer environment.

What is the first step to ensure that the communication between the Delivery Controller and XenServer pool master is secure?

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Lesson Objective Review

Scenario: You are the Citrix Admin and you want to utilize Machine Creation Services to deploy 1000 VDAs on the XenServer environment.

What is the first step to ensure that the communication between the Delivery Controller and XenServer pool master is secure?

Ensure certificate is installed on XenServer and edit the hosting connection to ensure https is configured.

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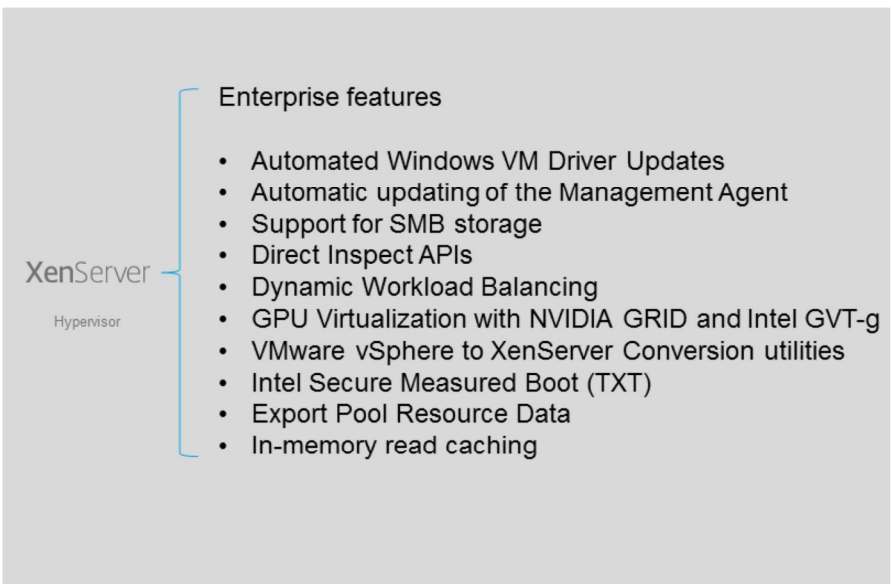
Supporting Infrastructure Licensing Considerations

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Hypervisor

- XenServer is included in XenApp and XenDesktop
- Other vendors may require additional licensing fees and infrastructure



Key Notes:

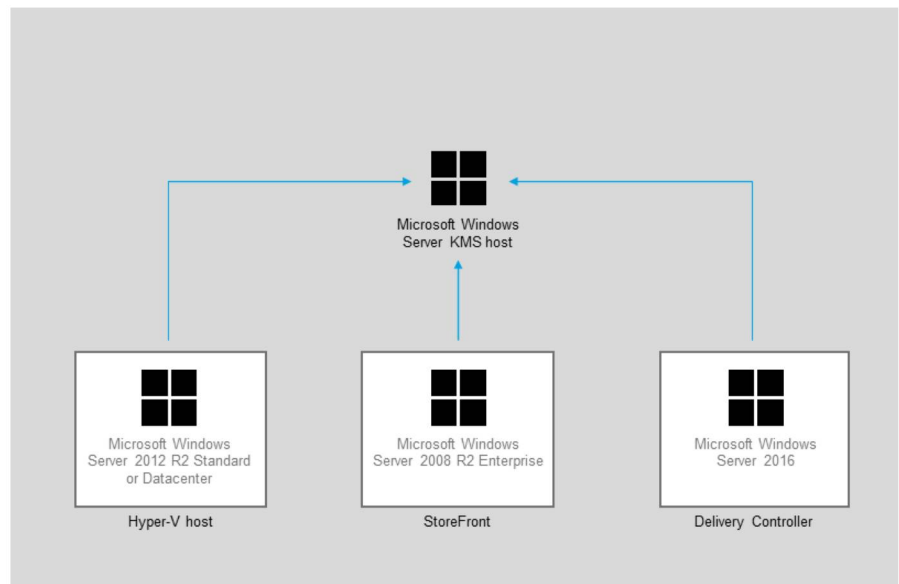
- An Enterprise-level product license to XenServer is included with XenApp and XenDesktop, including unlimited CPU-sockets (XenServer 6.5 onwards is licensed based on the number of CPU sockets, if bought separately).
- The in-memory read caching feature is available only if XenApp or XenDesktop Platinum edition is licensed.

Additional Resources:

- XenServer 7.0: Licensing FAQ - <https://docs.citrix.com/content/dam/docs/en-us/xenserver/xenserver-7-0/downloads/xenserver-7-0-licensing-faq.pdf>

Windows Server for XenApp and XenDesktop Infrastructure Components

- Different editions and versions may be used but require corresponding licenses
- Use KMS to activate volume licenses



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Key Notes:

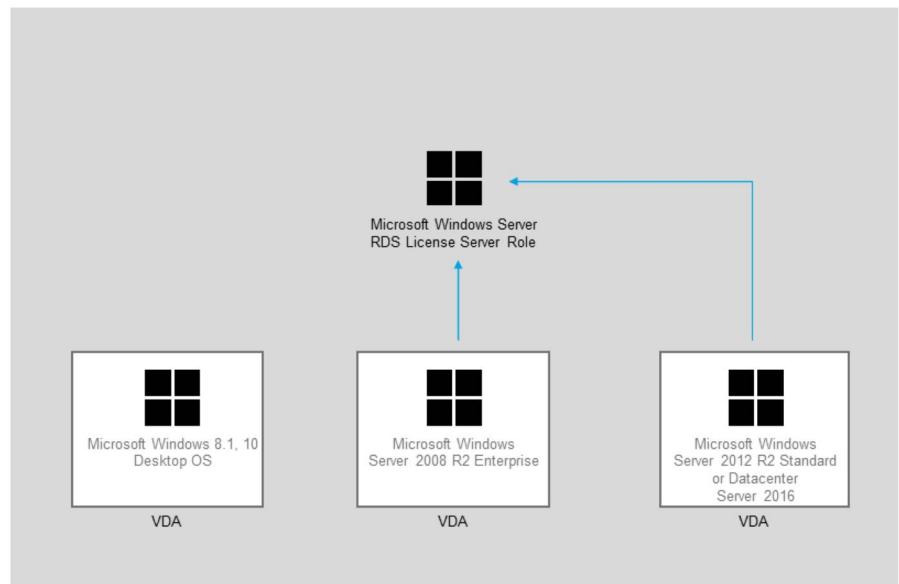
- Microsoft licenses exist in many flavors and a professional consultation of the different license models (OEM, Retail, Volume) and Editions should be done during the conception phase.
- A Key Management Server (KMS) is a special role that can be added to most Microsoft Windows servers to serve the activation requests for other servers, but requires a volume license model.

Additional Resources:

- Windows Server 2012 R2 Licensing Datasheet:
http://download.microsoft.com/download/F/3/9/F39124F7-0177-463C-8A08-582463F96C9D/Windows_Server_2012_R2_Licensing_Datasheet.pdf
- Windows Server 2016 Licensing Datasheet:
<http://download.microsoft.com/download/7/2/9/7290EA05-DC56-4BED-9400-138C5701F174/WS2016LicensingDatasheet.pdf>
- Licensing brief: Licensing Windows Server 2012 R2 for use with virtualization technologies: <https://www.microsoft.com/en-us/Licensing/learn-more/brief-windows-server-virtualization.aspx>

Windows Server for Server OS VDAs

- Windows Server OS machines used for multi-user session hosting require an additional RDS license server



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Key Notes:

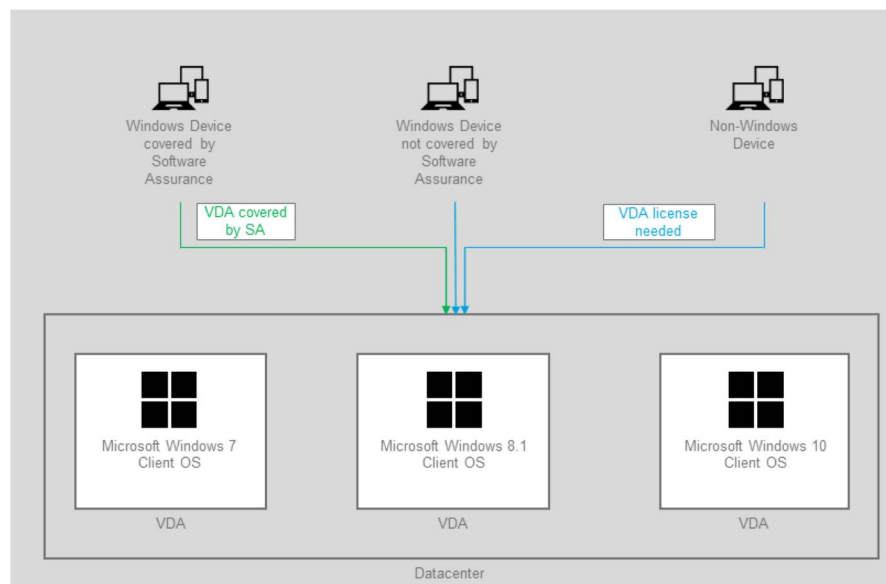
- The VDA install on a Windows Server machine adds the role of Remote Desktop Services (RDS).
 - An RDS server requires connecting to a separate Microsoft license server that needs to be activated, configured and holding appropriate RDS licenses to issue.
 - Each client/user connection to an RDS host requires a separate license to be checked out from the RDS license server to connect.
 - RDS licenses are based on client OR user.
 - As an additional benefit, the RDS license covers the use of App-V.
- The VDA on a Windows Desktop OS does not require contact to the RDS license server.

Additional Resources:

- RDS Licensing Configuration on Windows Server 2012 - <https://blogs.technet.microsoft.com/askperf/2013/09/20/rd-licensing-configuration-on-windows-server-2012/>
- Remote Desktop Services Client Access Licenses (RDS CALs) - [https://technet.microsoft.com/en-us/library/cc753650\(v=ws.11\).aspx](https://technet.microsoft.com/en-us/library/cc753650(v=ws.11).aspx)
- Specify a License Server for an RD Session Host Server to Use - [https://technet.microsoft.com/en-us/library/cc770585\(v=ws.11\).aspx](https://technet.microsoft.com/en-us/library/cc770585(v=ws.11).aspx)

Windows for Client OS VDAs

- A special Microsoft VDA license is required for each Client OS system accessed remotely



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Key Notes:

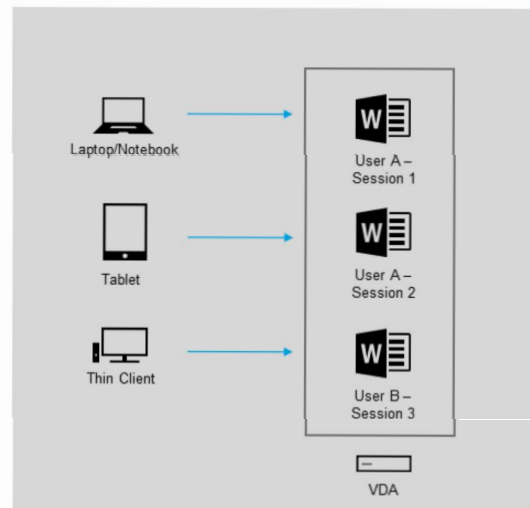
- When accessing Windows Server systems, the RDS license is used, while Client/Desktop OS systems require different licensing.
- Depending on Software Assurance (a Microsoft license model) status, the access to virtualized client systems may already be covered without the need to buy additional VDA licenses from Microsoft. The same can apply to existing Windows Intune licenses.

Additional Resources:

- Using Microsoft VDI to Enable New Workstyles - <https://channel9.msdn.com/series/using-microsoft-vdi-to-enable-new-workstyles/using-microsoft-vdi-to-enable-new-workstyles-07-microsoft-vdi-licensing>

Applications

- XenApp and XenDesktop allow concurrent access to multiple instances of a software program
- Check with vendor for specific license requirements



Key Notes:

- Most software requires a license per device it is installed on (for example Microsoft Office).
- Some software requires extra licensing to run on multi-user systems or prohibits concurrent use altogether.
- Some software uses hardware components (dongle) to verify license compliance – which can pose problems in virtualized deployments.
- Some software requires its own license server in the backend, but may fail if multiple users access the license server with the same IP (from the same system).
- License requirements for specific applications should be clarified before going into production.

Lesson Objective Review

Scenario: You are the Citrix Admin and you just procured XenApp Platinum for hosting your company's mobile sales force.

There are 1500 sales people on staff and each user can access the system using a company laptop and their own personal computer at their home office.

Based on reports from the sales managers there will only be 200 users connected to the system at any time.

How many XenApp and RDS user licenses should you procure?

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Lesson Objective Review

Scenario: You are the Citrix Admin and you just procured XenApp Platinum for hosting your company's mobile sales force.

There are 1500 sales people on staff and each user can access the system using a company laptop and their own personal computer at their home office.

Based on reports from the sales managers there will only be 200 users connected to the system at any time.

How many XenApp and RDS user licenses should you procure?

- 200 XenApp Platinum Concurrent User licenses
- 1500 Microsoft RDS User licenses

Key Notes:

- Which Microsoft licenses are needed to access Windows Server VDAs?
- The license for the Operating System
- RDS CALs for the user or device accessing this server.

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Preparing for Windows 10 and Server 2016 with AppDNA

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Migrating to a new operating system



One of the most common challenges faced by administrators when moving to a new operating system is application compatibility.

By automating application migration testing, an administrator can more accurately predict application behavior on new technology platforms. This allows for a more accurate estimate of project time, cost and resources, thus reducing overall project risk.

Key Notes:

- AppDNA 7.12 helps accelerate application migrations to Windows 10 and Windows Server 2016 by predicting potential issues and showing a clear path to application compatibility on the new operating system.
- AppDNA can be used to analyze application DNA against an image from the specific OS family you are migrating from, and the one you are migrating to. The resulting analysis shows the effects of changes when applications are migrated between OS platforms.
- AppDNA provides a set of default operating system images for each relevant OS family. You can also import your own custom OS images.

What is AppDNA?

Citrix AppDNA is an application testing and management technology that can detect and potentially repair compatibility issues.

This application detection can prevent applications from experiencing issues when being migrated to a new operating system.

AppDNA allows administrators to analyze a high volume of applications at once, rather than manually testing each application one at a time.



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Key Notes:

- AppDNA is included with XenApp and XenDesktop platinum edition.
- AppDNA provides insight into the effect of application issues and proposed implementations on users, workgroups and devices; to help make more informed decisions about their environment.
- AppDNA can help an organization complete application deployment or migration projects more quickly, saving enterprises time, labor and cost while reducing risk.
- AppDNA application management software provides administrators with ongoing application evolution, long after platform migration has been completed. Administrators can use AppDNA to help reduce the risk of deploying new applications, patches and service packs to their enterprise infrastructure.
- Administrators can also automate application remediation and packaging processes to help manage ongoing change.
- Customers have reported that using AppDNA cuts their application testing, remediation and migration time by as much as 90%.

Supported Platforms

AppDNA 7.12

Server OS platforms (64-bit only):

- Microsoft Windows Server 2016
- Microsoft Windows Server 2012 R2
- Microsoft Windows Server 2012
- Microsoft Windows Server 2008 R2 SP1

AppDNA client (32-bit and 64-bit):

- Microsoft Windows 10
- Microsoft Windows 8.1
- Microsoft Windows 8
- Microsoft Windows 7 SP1

Microsoft SQL Server:

- SQL Server 2016 & Express Edition
- SQL Server 2014 & Express Edition (10GB database limit)
- SQL Server 2012 SP2 & Express Edition (10GB database limit)
- SQL Server 2008 R2 SP3

* AppDNA does not support SQL Server AlwaysOn, Clustering or Mirroring.

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Using AppDNA to analyze applications

The AppDNA approach to analysis is simple:
Import - Analyze - Report.



Import



Analyze



Report

Key Notes:

- Application analysis is a dedicated SQL Server database process that combines all of the information AppDNA has about the application, analyzes it against each selected target technology, and generates the report data.
- Import - When applications are imported, they are analyzed by AppDNA and each application's files, registry entries, and API usage are exposed- revealing their application "DNA". This data is then loaded to the SQL server database.
- Analyze - When AppDNA starts the analysis process, it uses the reports that correspond to the platforms against which the application is being tested. AppDNA combines all of the information it has about the application portfolio and runs the report algorithms against the application DNA. It then produces and stores the reporting data.
- Report - After the import and analysis process completes, AppDNA presents the results of the analysis in a set of report views. This information can then be used to help plan, fix, and test your application portfolio.

Additional Resources:

- Importing Apps - <https://docs.citrix.com/en-us/dna/7-12/importing-apps.html>
- Analyzing Apps - <https://docs.citrix.com/en-us/dna/7-12/analyzing-apps.html>
- Reports - <https://docs.citrix.com/en-us/dna/7-12/reporting.html>

Using AppDNA to analyze applications

AppDNA analyzes applications and provides results and guidance based on the **RAG** standard. The RAG status uses Red, Amber and Green output to provide details on any analyzed applications.

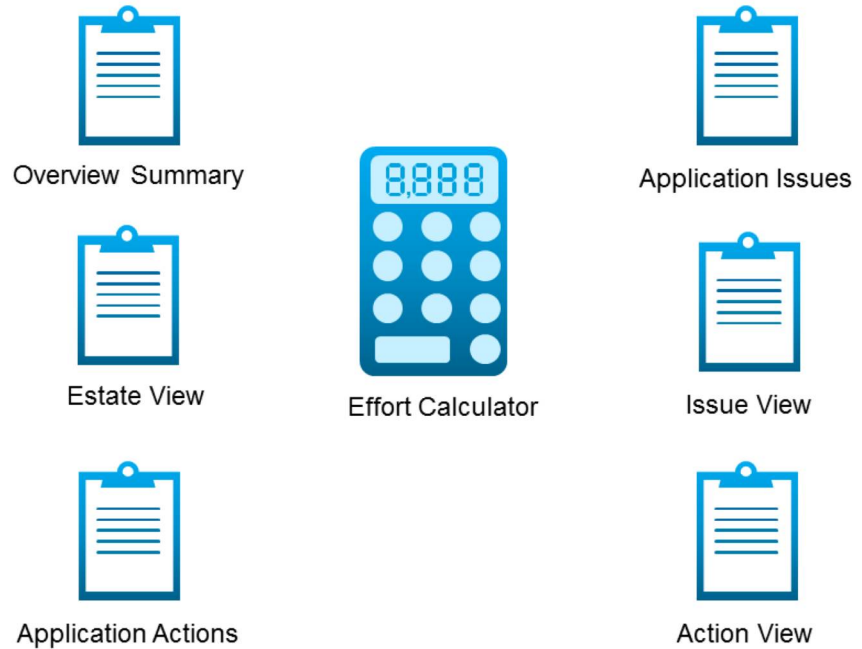


Key Notes:

- RAG icons can sometimes display two outputs: one from the default AppDNA RAG (displayed in the lower right side) of the icon, and an external data source (displayed on the upper left side). The external source is gathered from compatibility lists provided by Microsoft and other IT professionals.
- Red output indicates that some substantial issues were found from the application analysis, and thus the application may experience severe limitations (or not work at all) within the new platform it was tested for.
- Amber output indicates a stronger potential for application capability issues within the new platform it was tested for, and additional application testing may be required.
- Green output indicates that the application is most likely to be fine within the new platform it was tested for. However, it does not mean all is perfect with a given application, and some minor issues could be encountered.

AppDNA Reports

After importing and analyzing applications, several reports are available to assist the migration planning:



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Key Notes:

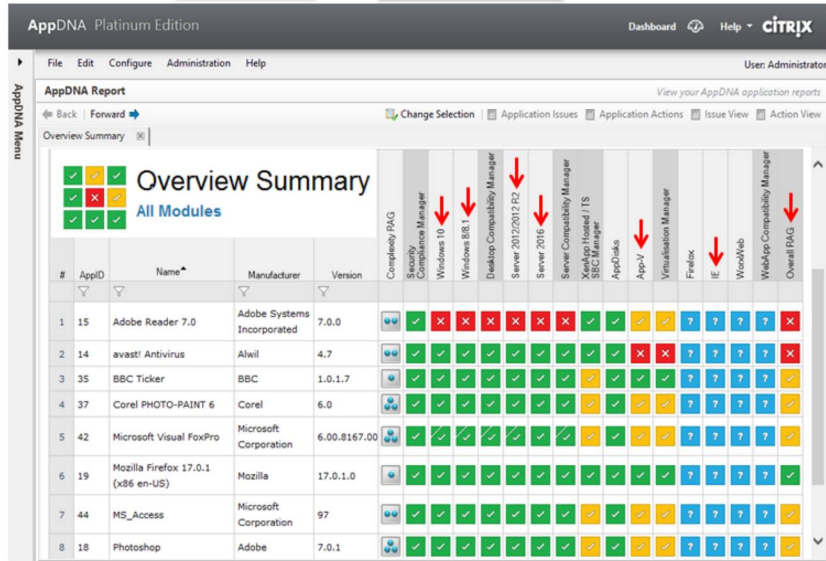
- Overview Summary report view
 - This is a dashboard that provides a high-level view of the state of your application portfolio. For each of the selected applications, it shows the overall RAG (red, amber, green) status for each of the active reports. You can click the RAG icons to go to the Remediation report views for that application. These give the full details of the remediation required along with an MST fix where applicable.
- The Estate View
 - Available for evaluation and trial installations only, this view provides a high-level overview of the consolidated status of the entire application portfolio for a target technology. This report is useful when you are evaluating AppDNA, because it does not rely on individual application licenses. The Estate View starts with a pie chart summary of the standard, custom, and after action RAG status of the applications in the portfolio. (AppDNA does not show the custom RAG pie chart if the custom RAGs are the same as the standard RAGs for all of the report's algorithms.)
- The Application Issues report view
 - This provides a summary of the issues found in the selected applications. The view starts with pie chart summaries of the standard and custom RAG status of the items included in the report.
- The Application Actions report view

- This view starts with a pie chart summary of the RAG status of the selected applications before and after the remediation actions.
- The Issue View
 - This view provides a breakdown of the number of applications that triggered each algorithm within the report. This view starts with a pie chart summary of the standard, custom, and after action RAG status of the applications included in the report. (AppDNA does not show the custom RAG pie chart if the custom RAGs are the same as the standard RAGs for all of the report's algorithms.) Below the pie charts there is a bar chart that shows the number of applications that have triggered one or more algorithms in each algorithm group. The number of applications is shown as a count and a percentage of the portfolio (which here means the applications included in the report).
- The Action View
 - This provides a breakdown of the prevalence of the actions required to remediate the applications in your portfolio. This view starts with a pie chart summary of the standard, custom, and after action RAG status of the applications included in the report. (AppDNA does not show the custom RAG pie chart if the custom RAGs are the same as the standard RAGs for all of the report's algorithms.) Below the pie charts there is a bar chart that shows the number of applications that require each type of remediation. The number of applications is shown as a count and a percentage of the portfolio (which here means the applications included in the report).
- The AppDNA Effort Calculator
 - Use this tool to estimate the time, cost, and effort associated with migrating a portfolio to a new platform – for example, that it will take five people six months and cost \$500,000. Effort Calculator uses a number of variables that define, for example, the cost of a tester per day, the number of working hours in the day, and the time to test an application of a given complexity. You can configure the variables to reflect the specifics of your organization. AppDNA produces a detailed breakdown of the cost and how much time it will take to remediate the applications as well as the potential savings that AppDNA can provide.



AppDNA Overview Summary Report

AppDNA RAG Report provides a quick overview of which applications will need further investigation and remediation.



Key Notes:

- The Overview Summary report view is a dashboard that provides a high-level view of the state of your application portfolio. For each of the selected applications, it shows the overall RAG (red, amber, green) status for each of the active reports. You can click the RAG icons to go to the Remediation report views for that application. These give the full details of the remediation required along with an MST fix where applicable.

Additional Resources:

Understanding RAG Icons - <https://docs.citrix.com/en-us/dna/7-12/reporting/rag-icons.html>



Lesson Objective Review

Scenario: You are the Citrix Admin and you just learned that you will need to migrate all of your existing applications from the current Windows 8\8.1 platforms to Windows 10.

You decide to utilize AppDNA to assist in the migration planning.

What is the first task to complete after installing and configuring AppDNA?

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Lesson Objective Review

Scenario: You are the Citrix Admin and you just learned that you will need to migrate all of your existing applications from the current Windows 8\8.1 platforms to Windows 10.

You decide to utilize AppDNA to assist in the migration planning.

What is the first task to complete after installing and configuring AppDNA?

- Import the applications into AppDNA.

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Lab Environment

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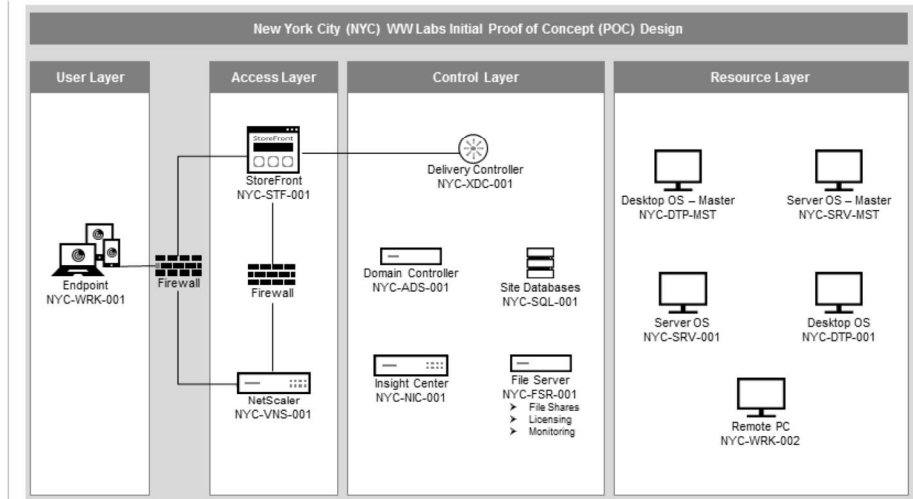
Lab Scenario

- Your company, WWLabs, located in New York City, has purchased XenDesktop Platinum licenses.
- The Lead Citrix Architect has concluded that XenApp and XenDesktop 7.12 meets the company's requirements and has instructed the Citrix Administrator team to validate this XenApp and XenDesktop POC for three specific use cases:
 - HR user group: Published Desktop and On-Demand Applications
 - Technician user group: Hosted VDI (Random/non-persistent)
 - Designer user group: Remote PC
- You are a Citrix Administrator on the WW Labs Citrix Administrator team and you've been tasked to assist with this implementation.

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Lab Environment Overview

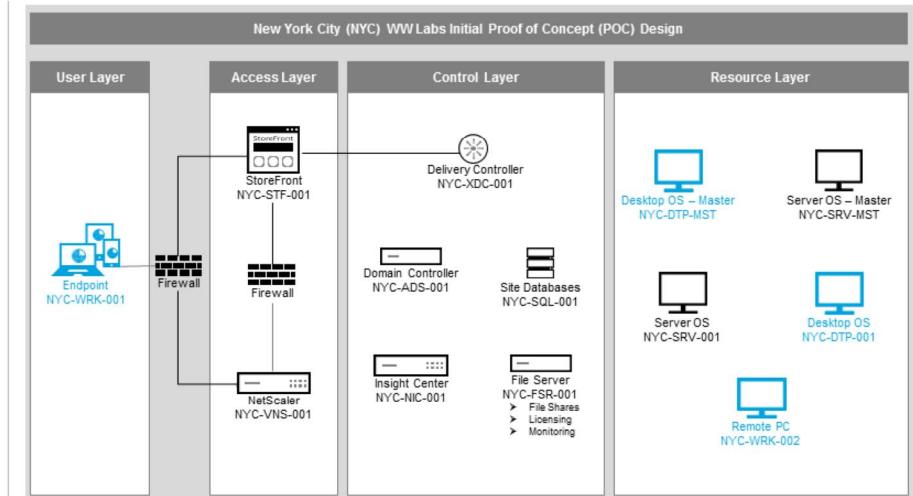
- XenApp and XenDesktop Proof of Concept Architecture
- All Citrix products are the 7.12 release version



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Lab Environment Overview

- Windows 10 devices

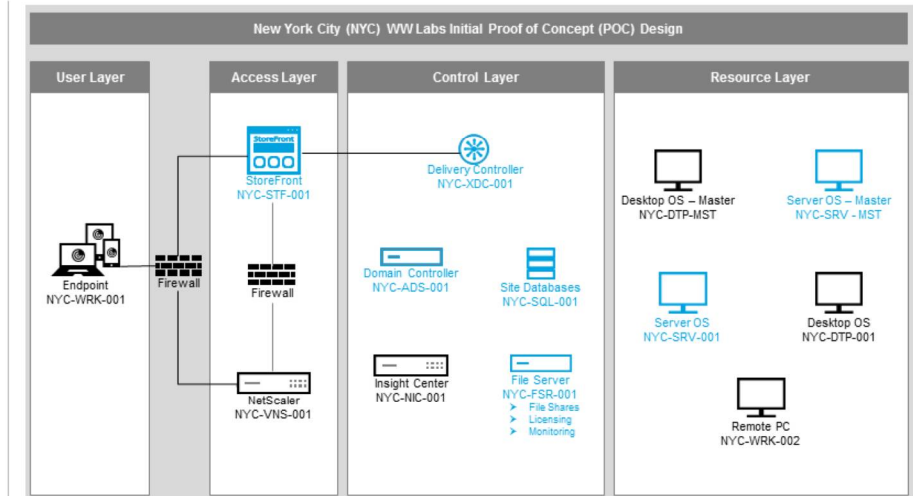


Key Notes:

- NYC-WRK-001 is the virtual machine that is used as the endpoint device for our testing in this POC Deployment.
- NYC-DTP-MST is the virtual machine that is used as a Master for a Desktop OS Catalog.
- NYC-DTP-001 is the virtual machine that will be created in a Desktop OS Catalog.
- NYC-WRK-002 is a simulated (virtual) machine used to create a Remote PC Catalog.

Lab Environment Overview

- Windows Server 2016 machines

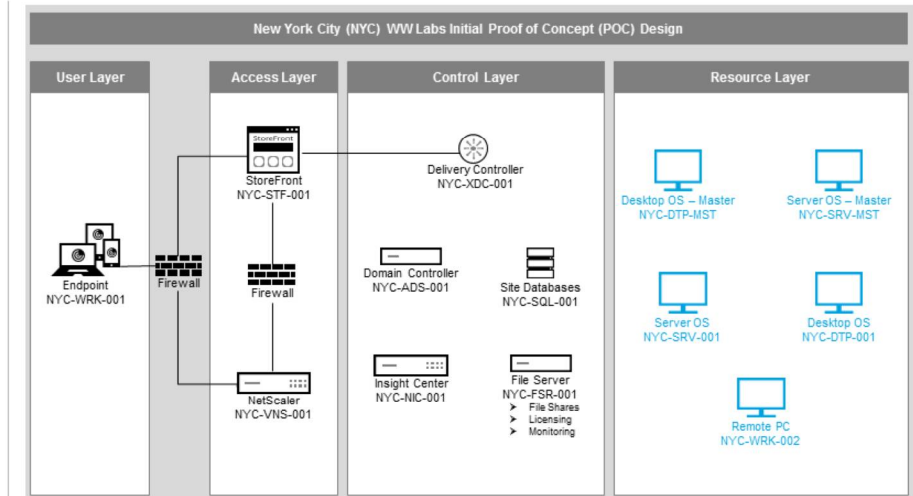


Key Notes:

- NYC-STF-001 is the virtual machine that is used to install the Citrix StoreFront component and host the Store for access to the XenApp and XenDesktop resources.
- NYC-XDC-001 is the virtual machine that is used to install the Citrix XenApp and XenDesktop Delivery Controller component and create the Site.
- NYC-ADS-001 is the virtual machine that is a Domain Controller and hosts Active Directory for this environment.
- NYC-SQL-001 is the virtual machine running Microsoft SQL and will be used to host the XenApp and XenDesktop Site, Monitoring, and Configuration Logging databases.
- NYC-FSR-001 is the virtual machine that is a shared roles server:
 - Hosting the file shares used in the environment, such as user profiles
 - The location where the Citrix License Server is installed and configured
 - The location where the Citrix Director is installed and configured
 - The location where the Citrix Universal Print Server component is installed and configured
- NYC-SRV-MST is the virtual machine that is used as a Master for a Server OS Catalog.
- NYC-SRV-001 is the virtual machine that will be created in a Server OS Catalog.

Lab Environment Overview

- Machines running the VDA

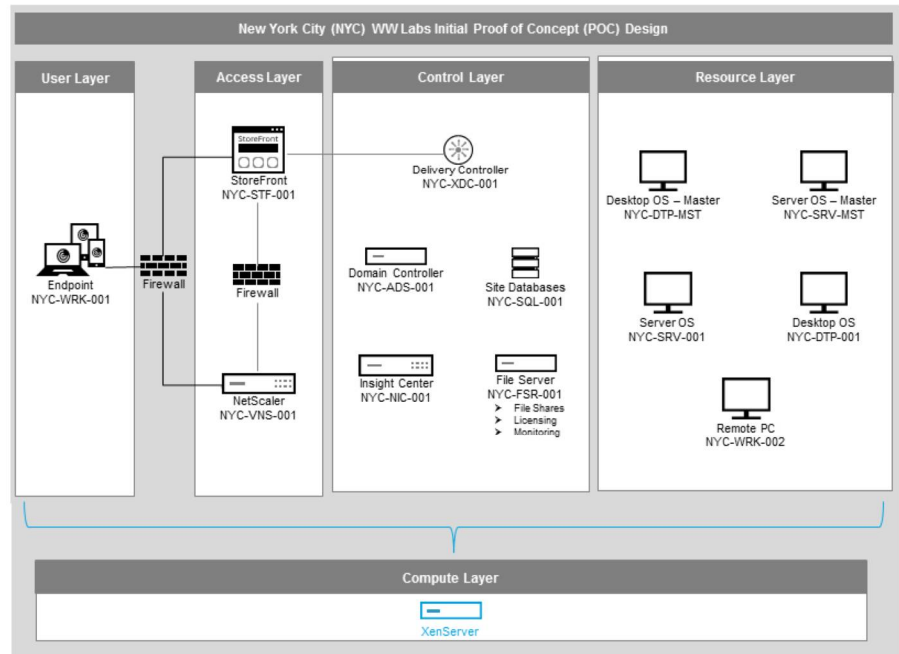


Key Notes:

- The VDA for Desktop OS will be installed on NYC-DTP-MST as the final step in turning this machine into a Master for a Desktop OS Catalog.
- The VDA for Desktop OS will be running on the NYC-DTP-001 because this machine will be created in a Desktop OS Catalog using NYC-DTP-MST as the master.
- The VDA for Server OS will be installed on NYC-SRV-MST as the final step in turning this machine into a Master for a Server OS Catalog.
- The VDA for Server OS will be running on the NYC-SRV-001 because this machine will be created in a Server OS Catalog using NYC-SRV-MST as the master.
- The VDA for Desktop OS will be installed on NYC-WRK-002 as the final step in configuring a Remote PC Catalog.

Lab Environment Overview

- Hypervisor
- Our WWLabs Proof Of Concept (POC) is running on XenServer



Lab Environment Overview

Lab Machine Naming Convention: Location-Role-Designation

- Common Designations:
 - 001: The first machine in that machine type
 - MST: The Master in a Catalog
- View the table to the right for some examples from our Lab Environment

Machine Name	Role
NYC-ADS-001	Active Directory
NYC-SQL-001	SQL Server
NYC-FSR-001	File Server
NYC-XDC-001	Delivery Controller
NYC-STF-001	StoreFront Server
NYC-SRV-MST	Server OS running the VDA
NYC-DVDA-MST	Desktop OS running the VDA
NYC-WRK-001	Proof of Concept endpoint device used to test connections to the Store and published resources
NYC-DTP-MST	Windows 10 Desktop OS
NYC-VNS-001	NetScaler
NYC-NIC-001	NetScaler Insight Center

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Lesson Objective Review

Scenario: Your Citrix Admin colleague is using the XenCenter management console to interact with the desktop of domain joined servers.

Can you recommend another console inside the lab that might be a better choice for day to day operation of the VM's?

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Lesson Objective Review

Scenario: Your Citrix Admin colleague is using XenCenter management console to interact with the desktop of domain joined servers.

Can you recommend another console inside the lab that might be a better choice for day to day operation of the VM's?

The Remote Desktop Connection Manager inside the lab is typically a better console for operating systems that support RDS connections.

Key Notes:

- Which console do you use within the lab to power on VMs?
 - The XenCenter console.

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Key Takeaways



- The Citrix Consulting methodology should be applied to Citrix projects to minimize risk and increase value.
- The requirements for supporting infrastructure; including Active Directory, SQL, certificates, network, storage, and licensing; all need to be addressed prior to the implementation of the core XenApp and XenDesktop components.
- Licensing considerations are important to understand before starting any project.
- AppDNA can analyze applications and operating systems to ensure smooth platform transitions, such as migrating from Server 2008R2 to Server 2016.
- This course uses the lab environment to create a XenApp and XenDesktop Proof of Concept to validate the WW Labs' three use cases.

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XenApp and XenDesktop Administration

Installing and Configuring a XenApp and XenDesktop Site

Module 3



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Additional Resources:

- Create a XenApp and XenDesktop Site - <http://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/install-configure/site-create.html>

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Lab VM Power Management

The following VMs are required to be powered on before beginning the exercises in this module:

- NYC-ADS-001
- NYC-SQL-001
- NYC-FSR-001
- NYC-XDC-001

The remaining VMs need to be powered off.

Note: These VMs are listed in the start-up order.

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Learning Objectives

- Identify licensing considerations
- Examine configuring and managing Citrix Licensing
- Discuss basic License Server troubleshooting
- Explain the role of the Delivery Controller
- Identify the functionality of a XenApp and XenDesktop site
- Determine the value of enabling Local Host Cache

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Licensing Considerations

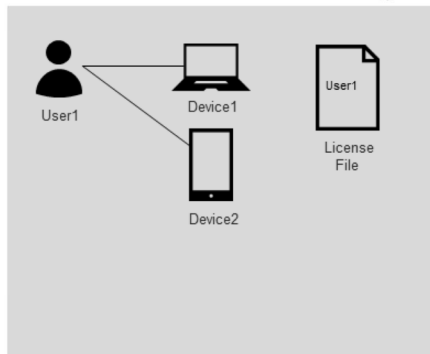
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Licensing Models

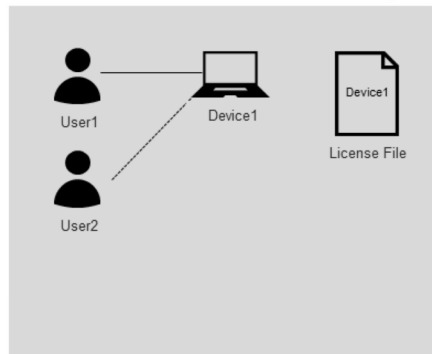
Identify the Citrix Licensing model leveraged

User/Device Licensing



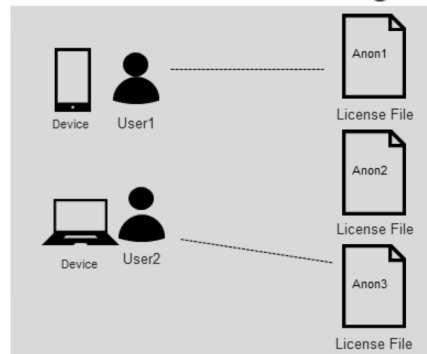
- License is assigned to user ID

User/Device Licensing



- License is assigned to device ID

Concurrent Licensing



- License is assigned to each connection

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Key Notes:

- User Licensing – the license is assigned to a user ID, so the user can launch their resources from multiple devices, and consume only one license. License is assigned to user ID and not able to be re-assigned until after 90 days of user inactivity.
- Device Licensing – the license is assigned to a device ID, so multiple users can launch their resources from one device, and consume only one license. License is assigned to device ID and not able to be re-assigned until after 90 days of device inactivity.
 - Use case: shared workstations in classrooms and hospitals.
- Concurrent Licensing – a license is assigned to an anonymous user and is assigned to each established connection. On disconnection / logoff the license is returned to the pool and available for another user.
- It's the customer that chooses either the (1) User/Device or (2) concurrent type when purchasing licenses. If user/device licenses are used, the License Server assigns either a user or device license optimally based on usage.
- XenDesktop – user/device or concurrent model is available.
 - Keep in mind that in most cases, XenDesktop licenses can be used for both Server OS and Desktop OS workloads, with the exception of the VDI Edition. License editions will be covered in a later slide.
- XenApp – only concurrent model is available, except for Secure Browser edition (user/device).
- XenApp licenses can only be used for Server OS workloads.
- Can release a license assigned to a user ID or device ID using the “udadmin” utility if a

user or device is no longer part of a customer's organization/environment.

- Supplemental Grace Period (SGP) feature – if all purchased licenses are in use, the license policy engine will grant unlimited additional connections for a limited time of 15 days to provide customers with an opportunity to purchase more licenses. After the expiration of SGP, regular license limits are enforced.
- Formula to determine number of user/device licenses to buy:
 - $(\text{Number of total users}) - (\text{number of users that only access via shared devices}) + (\text{number shared devices}) = \text{total number of licenses to buy}$

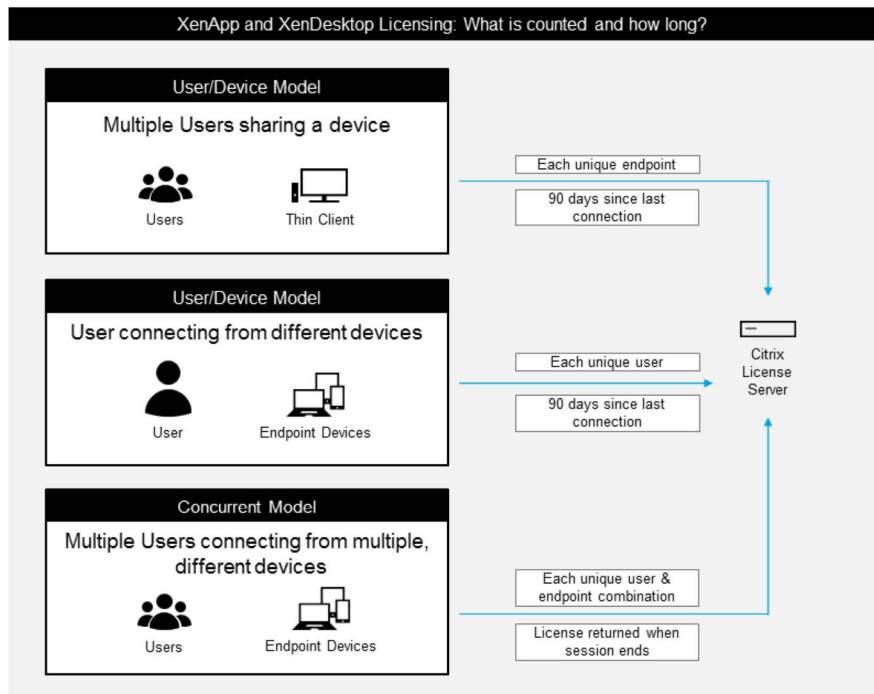
Additional Resources:

- FAQ: XenApp and XenDesktop 7.x Licensing - <http://support.citrix.com/article/CTX128013>

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Concurrent vs. User/Device

- XenApp uses the concurrent licensing model
- XenDesktop uses the concurrent OR user/device licensing models



Key Notes:

- Concurrent licenses are not tied to a specific user. When a user launches a published resource, the Delivery Controller requests the license and it is checked out to the specific user connection. When the user logs off or disconnects from the session, the license is checked back in and is available for another user.
- Per user licenses: A licensed user requires a unique user ID, such as an Active Directory entry. When assigned to a user, the license allows the user to connect to their desktops and applications with multiple devices, such as desktop computer, laptop, netbook, smartphone, or thin client. A licensed user can connect to multiple instances of a product concurrently. When users connect to an application or desktop, they continue to consume the assigned license for the 90 day license assignment period. The assignment period begins when a connection is made, is renewed to the full 90 days during the life of the connection, and expires (allowing reassignment) 90 days after the last connection terminates (logs off or disconnects).
- Per device licenses: A licensed device requires a unique device ID and is authorized for use by any individuals to access instances of a product. Use this type of license for shared devices, such as those used in a classroom or hospital. It allows an unlimited number of users per device. When devices connect to an application or desktop, they consume a license for the 90 day license assignment period.
- For some companies, it might be advisable to upgrade existing XenApp licenses to a XenDesktop edition just to benefit from the user/device licensing model available for XenDesktop.
- Note that it does not matter which or how many VDAs a user is connecting to (sequentially or concurrent) as long as they use the same license server in the

backend.

Additional Resources:

- Types of Licenses - <https://docs.citrix.com/en-us/licensing/11-14/license-types.html>

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Licensing Editions

Determine available features and functionality in a deployment



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Key Notes:

- You should always verify that the desired features are part of the edition of XD or XA that you are deploying. Licensing restricts/enables available features.
- The brackets indicate that all of the features in the preceding edition are also available in the higher edition.
- Some key features by product/edition:
 - XenDesktop Platinum: AppDNA, SmartAccess, SCOM Bundle, Citrix Connector for SCCM, Enhanced Director Monitoring.
 - XenDesktop Enterprise: Remote PC, Linux Dedicated VDI Desktops, PVS for Desktops and Servers, DesktopPlayer, support for 16-, 32-, 64-bit apps, Microsoft App-V integration.
 - XenDesktop VDI: VDI desktops, PVS available for all XD desktops (except physical desktop).
 - XenApp Platinum: AppDNA, SCOM Bundle, SmartAccess, PVS available for all XenApp servers, Enhanced Director Monitoring, Citrix Connector for SCCM, PVS available for all XA servers.
 - XenApp Enterprise: Linux hosted shared desktop, VM hosted apps, HDX RealTime Optimization, PVS only for VM hosted app instances, Microsoft System Center integration, and Hybrid cloud provisioning.
 - XenApp Advanced: published desktops, unified Communications optimization, Support for 32-, 64-bit apps, FIPS compliant, Microsoft App-V integration.

- One license server can contain licenses for multiple editions of a Citrix product (in this case, XenApp and XenDesktop). The type of license checked out corresponds to the edition that is configured for the XenApp and XenDesktop Site. A Site is configured to consume an edition of a license and therefore will check out that edition of a license.
- For example:
 - Site A is configured to checkout Enterprise licenses.
 - Site B is configured to checkout Platinum licenses.
 - LicenseServer1 contains both Enterprise and Platinum licenses.
 - Users who connect to LicenseServer1 from Site A will check out Enterprise licenses only. Once the number of Enterprise licenses on LicenseServer1 is exceeded, new requests from Site A users will cause the Site to enter a Supplemental Grace Period.
 - Users who connect to LicenseServer1 from Site B will check out Platinum licenses only. Once again, if the number of Platinum licenses on LicenseServer1 is exceeded, new requests from Site B users will cause the Site to enter a Supplemental Grace Period.

Additional Resources:

- XenApp and XenDesktop Features:
<https://www.citrix.com/go/products/xendesktop/feature-matrix.html>
- Frequently Asked Questions for Licensing - <http://docs.citrix.com/en-us/licensing/11-14/frequently-asked-questions.html>

Feature Matrix

Depending on the Product and Edition licensed, different options to publish desktops and applications are available.

Product	XenApp Editions			XenDesktop Editions		
Edition / Availability	Advanced	Enterprise	Platinum	VDI	Enterprise	Platinum
XenApp Published Desktop	X	X	X	-	X	X
XenApp Published Apps	X	X	X	-	X	X
VDI - Windows	-	-	-	X	X	X
VM Hosted Apps	-	X	X	-	X	-
Published Linux Desktops	-	X	X	-	X	X
Hosted Physical Desktop	-	-	-	-	X	X
Server VDI	-	-	-	-	X	X

Key Notes:

- XenDesktop offers two license models (concurrent / user-device) while XenApp uses the concurrent model.
- Server VDI refers to using Windows Server OS VDAs without Remote Desktop Session host capability, as mere 1-user-per-server VDAs.
- Linux Desktops are supported for RedHat and SUSE Distributions in multi-user mode (much like Windows Server OS published desktops) only.
- The Citrix License Server manages the entitlements to the following features of XenDesktop: Delivery Controller, Provisioning Services, on-demand application delivery, SCOM Bundle, AppDNA, Session Recording, and enhanced Director monitoring.
- The Citrix License Server manages the entitlements to the following features of XenApp: Delivery Controller, Provisioning Services, on-demand application delivery, SCOM Bundle, AppDNA, Session Recording, and enhanced Director monitoring.
- Secure access (NetScaler Gateway), WAN optimization features (NetScaler SD-WAN) and Desktop Player are licensed individually because licenses can be deployed on an integrated license server on the appliance or on a shared license server in a datacenter.

Additional Resources:

- XenApp and XenDesktop Features - <https://www.citrix.com/go/products/xendesktop/feature-matrix.html>
- FAQ: XenApp and XenDesktop 7.x Licensing -

<http://support.citrix.com/article/CTX128013>

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Group Discussion

What Edition and license model are you currently using?

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Lesson Objective Review

Scenario: You are the Citrix Admin and your manager has just tasked you to include Linux Server Desktops as a shared resource.

Currently you are using XenApp Advanced Concurrent licenses.

What do you tell your manager?

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Lesson Objective Review

Scenario: You are the Citrix Admin and your manager has just tasked you to include Linux Server Desktops as a shared resource.

Currently you are using XenApp Advanced Concurrent licenses.

What do you tell your manager?

The use of Linux VDA's is only supported with Enterprise licenses or above.

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Installation and Management

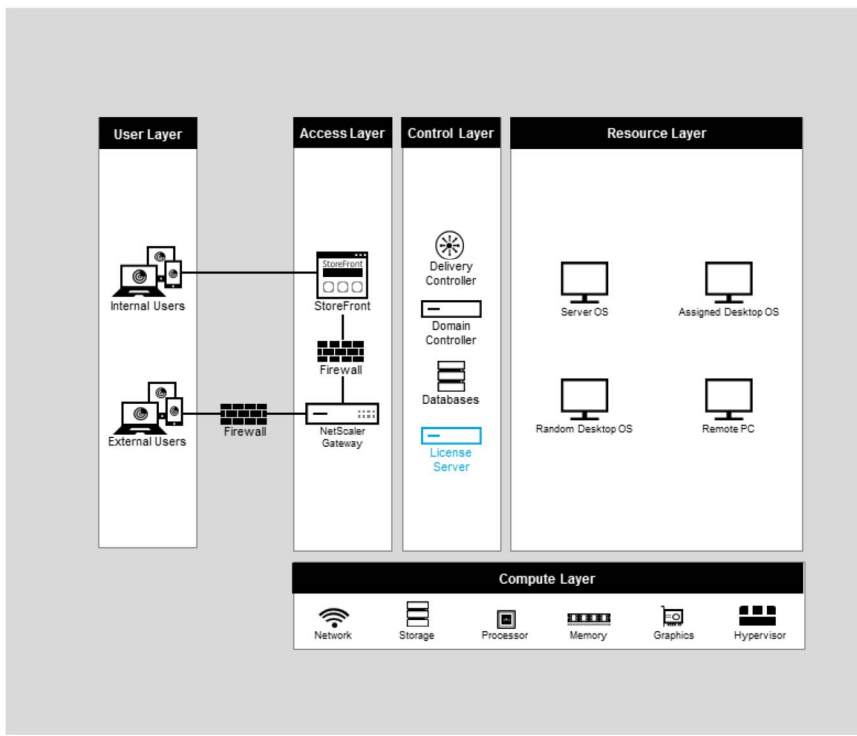
Citrix License Server

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Install Citrix License Server

1. Install Citrix License Server
*Verify minimum supported version
2. Obtain license file
3. Import license file



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Key Notes:

- Leading practice: install/upgrade to latest version of license server when implementing a new product because new products typically need the latest license server in order to correctly check out licenses. License servers are backwards compatible. However, if the latest version is not installed, it is imperative to verify the minimum supported version for a product.
- Determine whether to leverage Citrix License Server for Windows or License Server VPX. VPX does not offer the same functionality, so review the applicable features prior to making a design decision.
- Licensing components can either be installed on a separate, dedicated server or on a server they share with another application. Alternatively, you can use a Web or application server; however, the locations mentioned below are less resource intensive:
 - If you are running fewer than 50 servers or 10,000 licenses on all the environments connecting to the license server, you can install the License Server role on the same server as one of the other XenApp and XenDesktop infrastructure components. You can monitor CPU and Memory load using Performance Monitor to determine if and when you should relocate the License Server to another system.

Additional Resources:

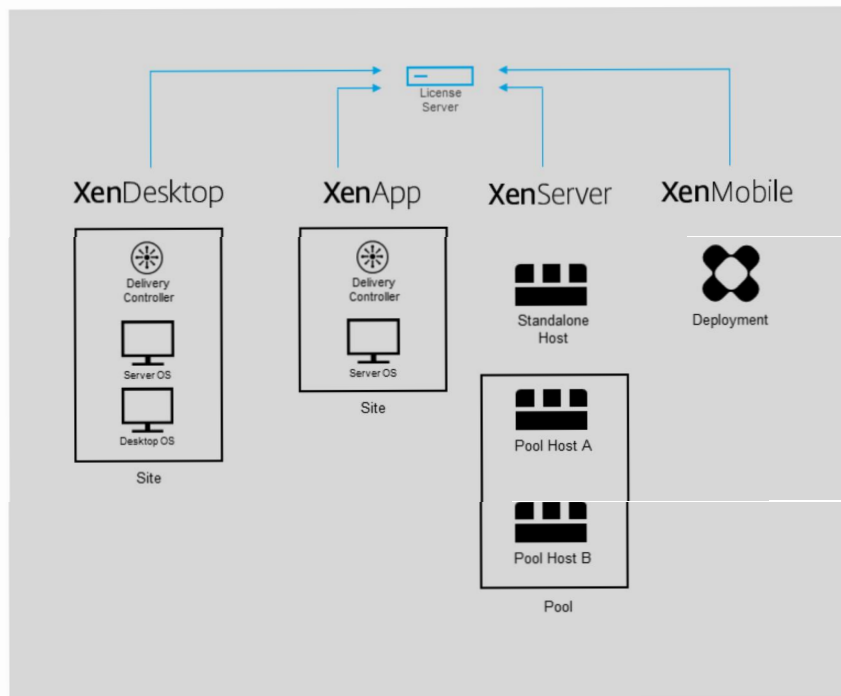
- Licensing 11.14.1 Technical overview: <https://docs.citrix.com/en-us/licensing/11-14/technical-overview.html>

- Licensing 11.14.1 Get started, install, and configure: <https://docs.citrix.com/en-us/licensing/11-14/getting-started.html>

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The License Server role

- Provides central license management for all user sessions
- Is a common resource for different products



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Key Notes:

- Citrix recommends that you upgrade the license server to the latest version when you upgrade or install new Citrix products. New license servers are backward compatible and work with older products and license files. New products often require the newest license server to check out licenses correctly.
- Citrix does not provide hotfixes for license server components and does not support older license servers with newer products. The latest versions of the license server often contain resolutions to issues appearing in earlier versions.
- Citrix also recommends the following security considerations when you configure your environment or use the Licensing Administration Console:
 - Configure the license server environment so that only authorized administrators on a trusted network are permitted to access the Licensing Administration Console port. You achieve this with an appropriately configured network or host-based firewall.
 - When using the Licensing Administration Console, avoid visiting untrusted websites or clicking on untrusted URLs.

Additional Resources:

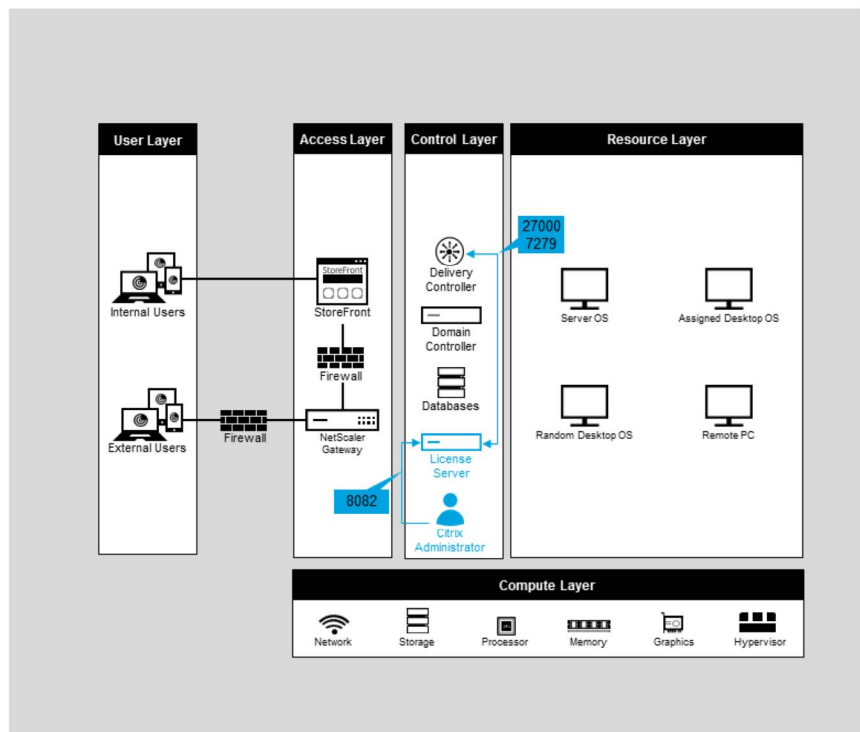
- Frequently Asked Questions for Licensing - <https://docs.citrix.com/en-us/licensing/11-14/frequently-asked-questions.html>
- Licensing 11.14.1 Get started, install, and configure: <https://docs.citrix.com/en-us/licensing/11-14/getting-started.html>

License server communication

To check out licenses:

1. Products contact License Server using port 27000.
2. Products request license using vendor daemon port 7279.

The web based license administration console uses port 8082.



Key Notes:

- Determine if you need to place a firewall between the license server and any product servers. Citrix recommends that you determine if your products will communicate with the license server through a firewall before installing licensing. Where you install the license server can be impacted by firewall considerations.
- Licensing installation sets several port numbers for communications. After installation you can use the License Administration Console to change port numbers.
 - **Console Web Server Port:** The HTTPS TCP/IP port that the Web server uses to listen for communication with clients connecting to the License Administration Console. By default, the port is set to 8082. If you are already using that port number for another application, you can change it to a range between 1 and 65535. If you are upgrading, you will maintain your previous configuration and might not get HTTPS by default. If you change the port, you must stop and restart the Citrix Licensing service.
 - **License Server Manager Port:** This port number is used by the license server manager, which handles the initial communication between the products, starts the vendor daemon, and relays check out and check in requests to the vendor daemon. By default, this port number is 27000. Tip: You can verify which port number is being used from the System Information tab in the Administration area.
 - **Vendor Daemon Port:** This port number is used by the Citrix vendor daemon, which is responsible for the core operations of the license server, including license allocation. By default, this port number is 7279; however, you may need

to change it if you have a firewall or if the number is already in use.

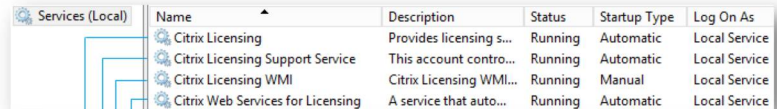
- PowerShell: port 8083 is used to programmatically access the license server from PowerShell, Studio and Director.
- You can verify which port number is being used from the Vendor Daemon Configuration tab in the Administration area.

Additional Resources:

- Technical overview: <https://docs.citrix.com/en-us/licensing/11-14/technical-overview.html>
- Get started, install, and configure: <https://docs.citrix.com/en-us/licensing/11-14/getting-started.html>
- Change port numbers: <https://docs.citrix.com/en-us/licensing/11-14/manage/change-port-numbers.html>

Understanding the services

Citrix License Server consists of four services.



Name	Description	Status	Startup Type	Log On As
Citrix Licensing	Provides licensing s...	Running	Automatic	Local Service
Citrix Licensing Support Service	This account contro...	Running	Automatic	Local Service
Citrix Licensing WMI	Citrix Licensing WMI...	Running	Manual	Local Service
Citrix Web Services for Licensing	A service that auto...	Running	Automatic	Local Service

Uses port 8083 to provide access to programmatic functions like uploading and activating licenses.

Provides access to licensing data for Windows Management Instrumentation (WMI).

Adjusts port specifications within uploaded license files to match the license server's actual port setting.

The main service providing access to the license server via port 27000 and the license administration console via port 8082. This service also launches the vendor daemon hosting port 7279.

Key Notes:

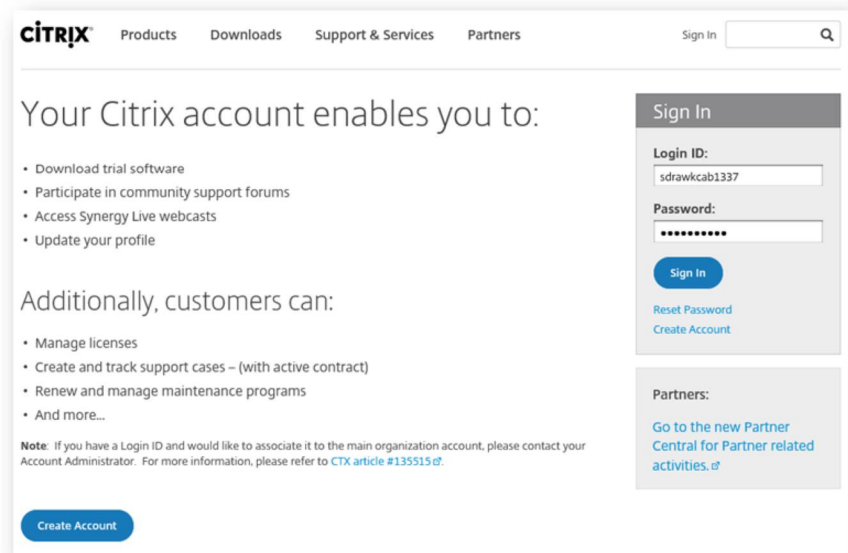
- The main service is “Citrix Licensing” (ladmin.exe) which launches the vendor daemon (citrix.exe).

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Install license files

To install license files:

1. Activate and download the license file from mycitrix.com
2. Upload the license file to the license server
3. Citrix vendor daemon will reread the license files



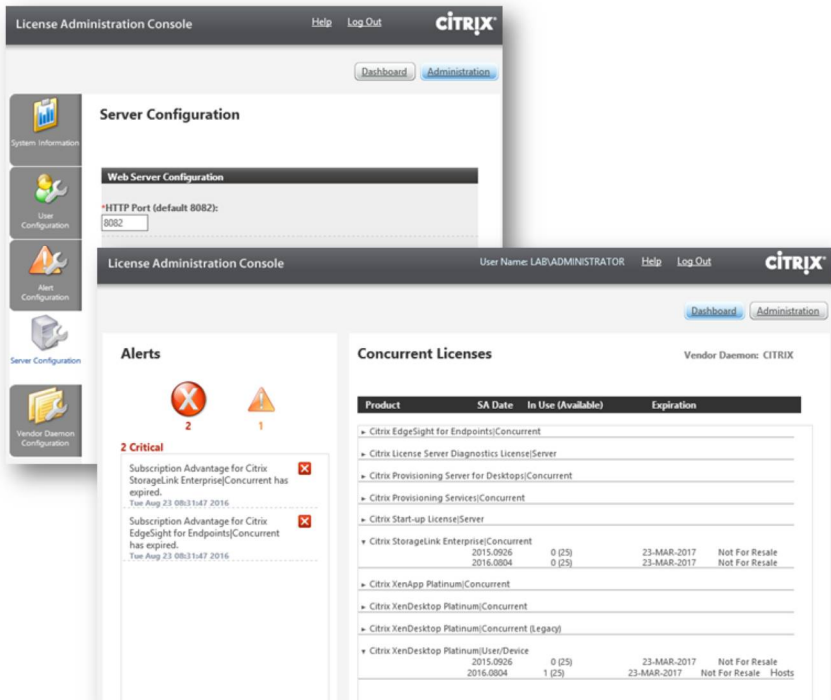
Key Notes:

- A customer's license pool can be issued to a single file or split to multiple license files.
 - Each license file must be issued to the actual license server's hostname.
- Citrix stores the licenses & license files in a database system so they can be downloaded again if needed.

License Administration Console

The License Administration Console offers two main views:

- Use the Dashboard to receive Alerts and see license usage
- Use the Administration board to change license server settings and import licenses



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Key Notes:

- Remember that the License Administration Console is accessible using a browser via port 8082 by default.
- The default administrator with permissions to login to the Administration page is the account that performed the Citrix License Server installation.
- The traffic to the License Administration Console can be secured using a certificate (SSL/TLS) manually, which it is generally considered a leading practice since credentials are exchanged over this connection.

Dashboard Page

The Dashboard provides

- Alerts and Warnings
- An overview of licenses in use - grouped by their respective license contingent

Product	SA Date	In Use (Available)	Expiration
▶ Citrix EdgeSight for Endpoints Concurrent			
▶ Citrix License Server Diagnostics License Server			
▶ Citrix Provisioning Server for Desktops Concurrent			
▶ Citrix Provisioning Services Concurrent			
▶ Citrix Start-up License Server			
▼ Citrix StorageLink Enterprise Concurrent	2015.0926	0 (25)	23-MAR-2017 Not For Resale
	2016.0804	0 (25)	23-MAR-2017 Not For Resale
▶ Citrix XenApp Platinum Concurrent			
▶ Citrix XenDesktop Platinum Concurrent			
▶ Citrix XenDesktop Platinum Concurrent (Legacy)			
▼ Citrix XenDesktop Platinum User/Device	2015.0926	0 (25)	23-MAR-2017 Not For Resale
	2016.0804	1 (25)	23-MAR-2017 Not For Resale - Hosts

Key Notes:

- The thresholds for Warnings and Alerts can be configured on the administration page; for example, when evaluation licenses or subscription advantage periods expire.
- An expired subscription advantage date does not invalidate the license, just the option to use newer products/features.
- The Dashboard page is per default accessible without authentication, but can be made to require a logon first using a setting from the administration page.

Administration Page

The Administration page allows

- Adding groups and users from Active Directory
- Setting thresholds for Alerts and Warnings
- Changing ports, encryption and logging settings
- Importing licenses



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Key Notes:

- Users and groups can be added from Active Directory to delegate administration permission to the license server. Only two administrator roles exist: “read only” and “full administration”.
- The thresholds for Warnings and Alerts can be configured on the administration page; for example, when evaluation licenses or subscription advantage periods expire.
- The license import is essentially an upload of the license file to a specific directory monitored by the license server.
- The License Administration Console can use License Administration users, local Windows users and groups, and Active Directory users and groups. The Citrix Licensing Manager can use local Windows users and groups and Active Directory users and groups. The License Administration Console manages them all. These users are not connected to the computer's local users.
- The Active Directory users and groups are part of an Active Directory/network authentication system. To support Active Directory users and groups, the Windows license server must be a member of a Microsoft Active Directory domain and must be running the License Administration Console. Windows NT domains are not supported.
- You can view system information about the license server and the system running the license server. Administration information is available by clicking the Administration option in the top right corner of the License Administration Console, followed by the System Information tab.

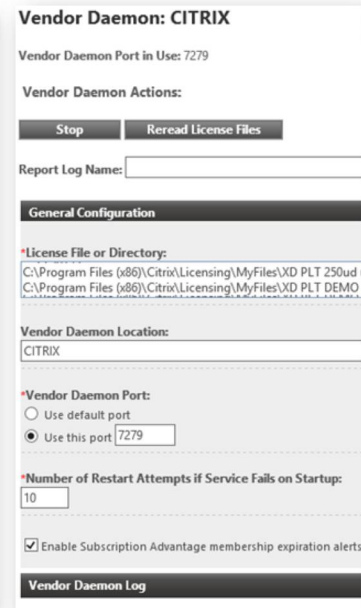
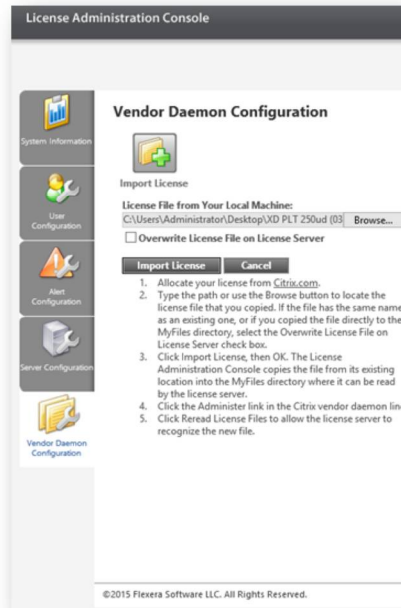
Additional Resources:

- Configure console users and licensing alerts: <https://docs.citrix.com/en-us/licensing/11-14/manage/configure-console-users.html>
- System information and logs: <https://docs.citrix.com/en-us/licensing/11-14/manage/sys-info-logs.html>

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To apply a license

1. Log on to the administration page
2. Select Vendor Daemon Configuration
3. Select Import License
4. Specify the license file and import it
5. Select the Citrix Vendor Daemon
6. Click “Reread License Files”



Key Notes:

- If multiple license files need to be applied (after restoring a license server etc.) it might be easier to copy them to the license directory (“C:\Program Files (x86)\Citrix\licensing\myfiles” by default) and trigger a reread of the licenses manually by restarting the license server service.
- Adding licenses or viewing licenses in use and delegating permissions can also be achieved by using the Licensing node in Citrix Studio.
- After you have imported your license files, they are administered by the Citrix vendor daemon (CITRIX). The Citrix vendor daemon is responsible for the core operations of the license server, such as tracking how many licenses are checked out and who has them. The vendor daemon can manage all of your Citrix license files and is fully backward compatible with any license files you have. Set properties for the vendor daemon on the Vendor Daemon Configuration page of the console.
- The Vendor Daemon Configuration page allows you to import license files, configure the vendor daemon, and view logs about license activity. Only users with Administrator privileges can view this page.

Additional Resources:

- License Administration - <https://docs.citrix.com/en-us/licensing/11-14/manage/vendor-daemon.html>



Lab Exercise

- Exercise 3-1: Install the Citrix License Server and the Citrix License Server Administration Console
- Exercise 3-2: Activate, Allocate and Download a License File
- Exercise 3-3: Upload a License File to the Citrix License Server

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Lesson Objective Review

Scenario: Your colleague has installed the license server for your organization, he reported in sick today but sent you an email asking for you to upload the license file using the License Management Console.

You know the server name is NYC-CTX-LIC01 but what would be the proper URL to navigate to the License Management Console remotely?

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Lesson Objective Review

Scenario: Your colleague has installed the license server for your organization, he reported in sick today but sent you an email asking you to upload the license file using the License Management Console.

You know the server name is NYC-CTX-LIC01 but what would be the proper URL to navigate to the License Management Console remotely?

[HTTP://NYC-CTX-LIC01:8082](http://NYC-CTX-LIC01:8082)

Key Notes:

- Will any license file function on every license server?
 - No. The license file is allocated to the hostname of the license server.
 - The hostname specified in the license file needs to be identical (cApiTAlizaTiON) to the hostname of the license server (not FQDN).
 - Some license files use newer attributes that cannot be interpreted by older license server versions, so the newest license server should be used.



Basic License Server Review

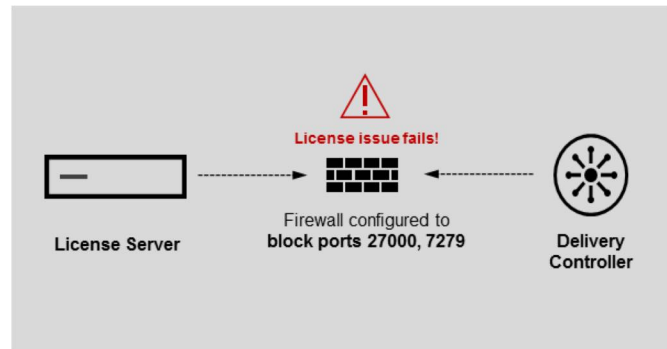
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Basic License Server Functionality

Troubleshoot common license related errors by:

- Validating the hostname of the license server
- Verifying the license file contains the right product and edition
- Checking the firewall ports are open
- Ensuring the version of the License Server is compatible



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Key Notes:

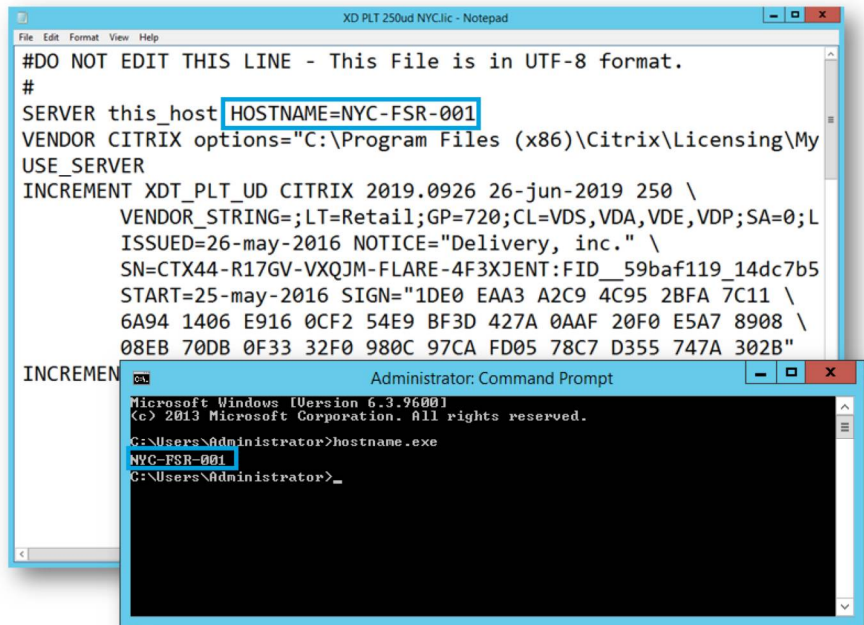
- Log files are stored in:
 - C:\Program Files\Citrix\Licensing\LS\Log on a 32-bit server
 - C:\Program Files(x86)\Citrix\Licensing\LS\Log on a 64-bit server
 - C:\Program Files (x86)\Citrix\Licensing\WebServicesForLicensing\Log on a 64-bit server
 - /opt/citrix/licensing/LS/logs for VPX

Additional Resources:

System information and logs: <https://docs.citrix.com/en-us/licensing/11-14/manage/sys-info-logs.html>

Validate the hostname

- Execute "hostname.exe" on the license server.
- Validate the name against the HOSTNAME attribute within the license file



The image shows two overlapping windows. The top window is a Notepad application titled "XD PLT 250ud NYC.lic - Notepad". It contains a license file with the following text: "#DO NOT EDIT THIS LINE - This File is in UTF-8 format.", "#", "SERVER this_host HOSTNAME=NYC-FSR-001", "VENDOR CITRIX options=\"C:\\Program Files (x86)\\Citrix\\Licensing\\My USE_SERVER", "INCREMENT XDT_PLT_UD CITRIX 2019.0926 26-jun-2019 250 \\", "VENDOR_STRING=;LT=Retail;GP=720;CL=VDS,VDA,VDE,VDP;SA=0;L", "ISSUED=26-may-2016 NOTICE=\"Delivery, inc.\" \\", "SN=CTX44-R17GV-VXQJM-FLARE-4F3XJENT:FID__59baf119_14dc7b5", "START=25-may-2016 SIGN=\"1DE0 EAA3 A2C9 4C95 2BFA 7C11 \\", "6A94 1406 E916 0CF2 54E9 BF3D 427A 0AAF 20F0 E5A7 8908 \\", "08EB 70DB 0F33 32F0 980C 97CA FD05 78C7 D355 747A 302B\"", "INCREMENT". The bottom window is a Command Prompt titled "Administrator: Command Prompt". It shows the command "hostname.exe" being executed, with the output "NYC-FSR-001" displayed.

Key Notes:

- There are many different options to obtain the computer name / hostname of the license server, including powershell (gci Env:\COMPUTERNAME) and several gui & registry related options. Be careful that the hostname within the license file exactly matches the hostname of the license server (the name is case-sensitive).
- The license files are protected against manipulation by a checksum, so they should not be edited to prevent license file corruption.

Verify Product and Edition

- Use a text editor to view the license file.
- The string behind every INCREMENT block is explained at the end of the license file and reveals the product and edition.

```
#DO NOT EDIT THIS LINE - This File is in UTF-8 format.
#
SERVER this_host HOSTNAME=NYC-FSR-001
VENDOR CITRIX options="C:\Program Files (x86)\Citrix\Licensing\My
USE_SERVER
INCREMENT XDT_PLT_UD CITRIX 2019.0926 26-jun-2019 250 \
  VENDOR_STRING=;LT=Retail;GP=720;CL=VDS,VDA,VDE,VDP;SA=0;L
  ISSUED=26-may-2016 NOTICE="Delivery, inc." \
  SN=CTX44-R17GV-VXQJM-FLARE-4F3XJENT:FID_59baf119_14dc7b5
  START=25-may-2016 SIGN="1DE0 EAA3 A2C9 4C95 2BFA 7C11 \
  6A94 1406 E916 0CF2 54E9 BF3D 427A 0AAF 20F0 E5A7 8908 \
  08EB 70DB 0F33 32F0 980C 97CA FD05 78C7 D355 747A 302B"
#
#CITRIXTERM FEATURE XDT_PLT_UD EN Citrix XenDesktop Platinum|Us
#CITRIXTERM FEATURE MPS_PLT_CCU EN Citrix XenApp Platinum|Concur
#CITRIXTERM FEATURE XDT_PLT_CCS EN Citrix XenDesktop Platinum|Co
#CITRIXTERM FEATURE PVS_STD_CCS EN Citrix Provisioning Services|
#
```

Key Notes:

- Most license files contain multiple INCREMENT-blocks and the translation of the “product_edition_licensemodel-tag” is given in several languages. The screenshot has been modified for instructional purposes.

Check network connectivity

Test from the Delivery Controller:

1. Does the FQDN of the license server resolve to the correct IP address?
2. Can the required ports be reached?

```
Administrator: Windows PowerShell
PS C:\Users\administrator.LAB> Test-NetConnection -ComputerName NYC-FSR-001 -Port 27000

ComputerName      : NYC-FSR-001
RemoteAddress     : 192.168.88.1
RemotePort        : 27000
InterfaceAlias    : Ethernet0
SourceAddress     : 192.168.88.2
PingSucceeded     : True
PingReplyDetails (RTT) : 0 ms
TcpTestSucceeded  : True


PS C:\Users\administrator.LAB>
```

Key Notes:

- The nslookup.exe command-line tool can be used to validate that the Delivery Controller can resolve the hostname of the license server to a valid IP address.
- The netstat -bano command can be used on the license server to find listening ports and their corresponding processes.
- It's a good idea to check the Windows Firewall settings on the Delivery Controller (outbound) and on the license server (inbound) as well as any external firewall system that might be blocking traffic.

Check version

1. Log on to the Administration page of the license server
2. Select System Information to retrieve the Release Version



The screenshot shows the Citrix License Administration Console interface. At the top, there is a header with "License Administration Console" on the left, "Log Out" on the right, and the Citrix logo. Below the header, there are two tabs: "Dashboard" and "Administration". The "Administration" tab is active. On the left side, there is a vertical navigation menu with five icons: "System Information" (selected), "User Configuration", "Alert Configuration", "Server Configuration", and "Vendor Daemon Configuration". The main content area displays "System Information" with the following details:

Release Version:	11.13.1 build 16002
License Server Manager Port Number in Use:	27000
Display:	DC01
Host Name:	DC01
Host Domain Name:	DC01.lab.ucit.university
IPv4 Address:	192.168.88.1
Ethernet Address:	000c2980e7bd
Volume Serial Number:	6680c6cb
Local Stop Server Allowed:	No
Remote Stop Server Allowed:	No

Key Notes:

- On a Delivery Controller, the PowerShell cmdlet "Get-BrokerSite" returns the currently configured license server, product edition, and license model. The PowerShell cmdlet "Test-BrokerLicenseServer" can be used to check the accessibility and compatibility of a license server.
- Within the Citrix product documentation, the minimum required version of the license server is specified; however, it is considered a leading practice to use the latest license server version whenever possible.

Lesson Objective Review

Scenario: You are the Citrix Admin and you have just allocated, downloaded and applied some extra licenses to your license server, however they are not shown in the console even after a reboot of the server.

What could be the cause of this behavior?

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Lesson Objective Review

Scenario: You are the Citrix Admin and you have just allocated, downloaded and applied some extra licenses to your license server, however they are not shown in the console even after a reboot of the server.

What could be the cause of this behavior?

The license file may be referencing an incorrect hostname.

Key Notes:

- Additional Scenario: The administrator imported the license file using the License Administration Console. Switching to the Dashboard Page does not show the new licenses. What should the administrator do?
 - Reboot the license server (might conflict with shared use of the license server or monitoring systems causing alerts).
 - Restart the “Citrix Licensing” service (might also conflict with monitoring systems).
 - Log on to the administration page of the license server Administration Console and click “Vendor Daemon Configuration”. Then click the Vendor Daemon named “Citrix” and click the button labeled “Reread license files”.



Delivery Controller Role

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Install the role

Install the Delivery Controller role:

- Using Autorun from the installation media
- Starting XenDesktopServerSetup.exe with parameters
- Using the command line with switches

System requirements:

- Windows Server 2016, Windows Server 2012 R2, Windows Server 2012 or Windows Server 2008 R2 SP1
- Microsoft .NET Framework 3.5.1 (Windows Server 2008 R2 only), Microsoft .NET Framework 4.5.2, Microsoft .NET Framework 4.6.1
- Windows PowerShell 2.0 or 3.0
- Visual C++ 2005, 2008 SP1, and 2010 Redistributable packages

Key Notes:

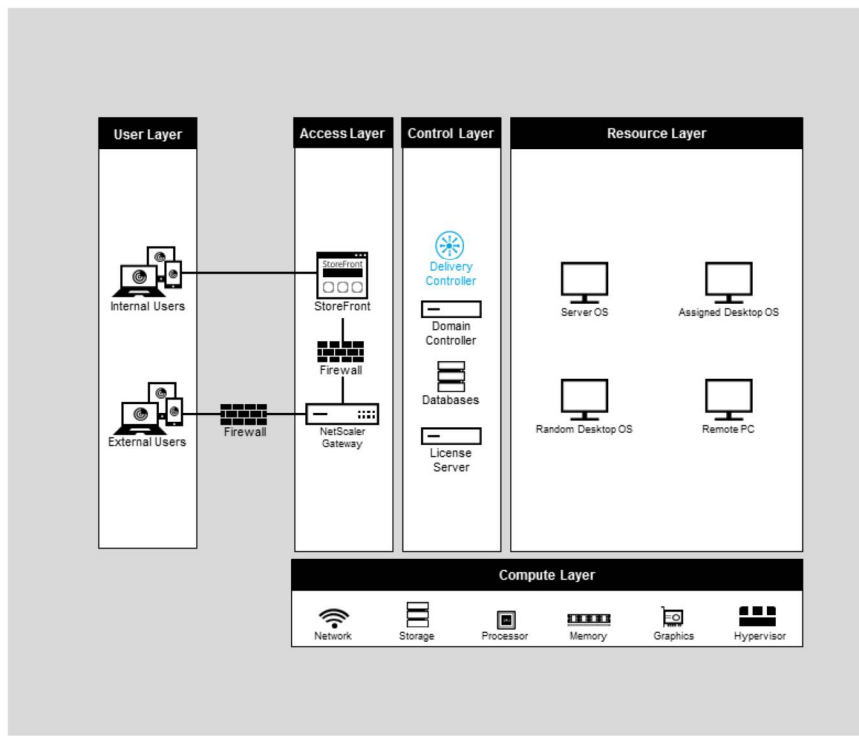
- Unless otherwise noted, the component installer deploys software prerequisites automatically (such as .NET and C++ packages) if they are not detected on the machine. The Citrix installation media also contains some of this prerequisite software.
- The installation media contains several third-party components. Before using the Citrix software, check for security updates from the third party, and install them.
- Standard, Enterprise and Datacenter editions of the Windows Server OS are supported where applicable.

Additional Resources:

- System Requirements - http://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/system-requirements.html#par_anchor_title_42d4
- Install using the command line – <http://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/install-configure/install-command.html>

Delivery Controller

- Brokers connections between users and their desktops and applications
- Optimizes and load balances user connections
- Manages power state and registration of desktops



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Key Notes:

- The Delivery Controller is a core component of a XenApp and XenDesktop deployment.
- The Delivery Controller only manages the power state of the machines for virtualized environments, as it needs to communicate with the hypervisor.
- In a deployment, the Delivery Controller is the server-side component that is responsible for managing user access, plus brokering and optimizing connections. Controllers also provide Machine Creation Services, which can be used to create and manage desktop and server images and machines.
- A Site must have at least one Delivery Controller. After you install the initial Controller and create a Site, you can add additional Controllers. There are two primary benefits from having more than one Controller in a Site.
 - Redundancy — As a leading practice, a production Site should always have at least two Controllers on different physical servers. If one Controller fails, the others can continue to manage connections and administer the Site.
 - Scalability — As Site activity grows, so does CPU utilization on the Controller and SQL Server database communications. Additional Controllers provide the ability to handle more users and more resource requests, and can improve overall responsiveness.
- Supported operating systems:
 - Windows Server 2016, Standard and Datacenter Editions
 - Windows Server 2012 R2, Standard and Datacenter Editions
 - Windows Server 2012, Standard and Datacenter Editions

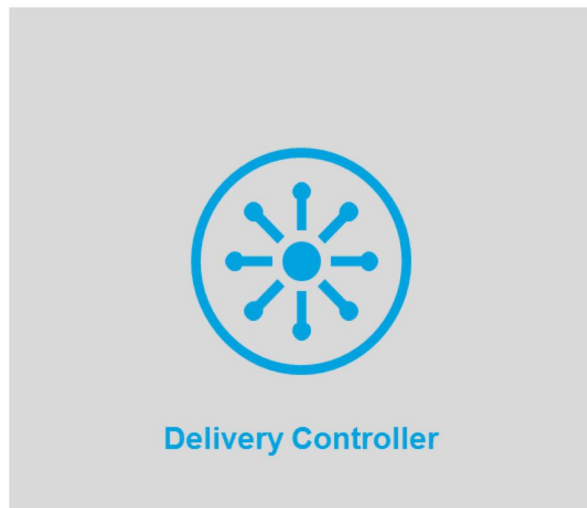
- Windows Server 2008 R2 SP1, Standard, Enterprise, and Datacenter Editions
- Requirements:
 - Disk space: 100 MB. Connection leasing (which is enabled by default) and Local Host Cache (not enabled by default) adds to this requirement; sizing depends on the number of users, applications, and mode (RDS or VDI). For example, 100,000 RDS users with 100 recently-used applications require approximately 3 GB of space for connection leases; deployments with more applications may require more space. For dedicated VDI desktops, 40,000 desktops require at least 400-500 MB. In any instance, providing several GBs of additional space is suggested.
 - Microsoft .NET Framework 3.5.1 (Windows Server 2008 R2 only).
 - Microsoft .NET Framework 4.5.2, 4.6, 4.6.1
 - Windows PowerShell 2.0 (included with Windows Server 2008 R2) or 3.0 (included with Windows Server 2012 R2 and Windows Server 2012).
 - Visual C++ 2005, 2008 SP1, and 2010 Redistributable packages.

Additional Resources:

- Delivery Controller environment - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/manage-deployment/delivery-controllers.html>
- System Requirements - http://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/system-requirements.html#par_anchoritle_42d4

Delivery Controller

- A Delivery Controller is comprised of 20 services that each establish a connection to the Site database
- The Delivery Controller role is the same for a XenApp or XenDesktop deployment
- **Recommended Configuration:** install role on dedicated server to minimize risk and avoid resource contention



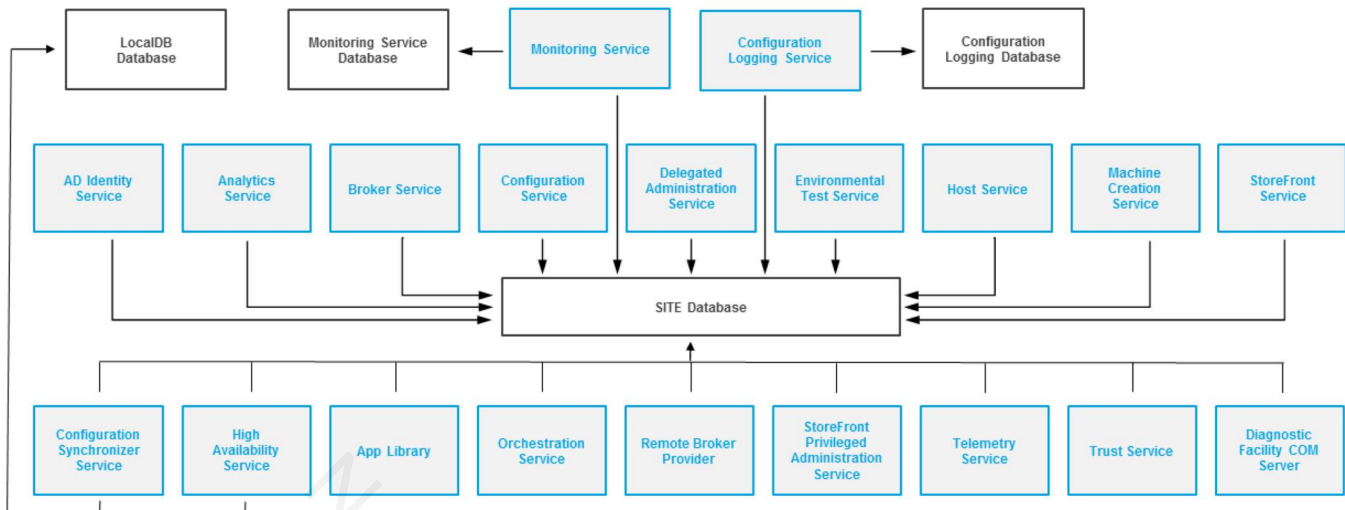
Key Notes:

- The Delivery Controller is comprised of 20 FMA services that are responsible for authenticating users, querying for a user's assigned apps/desktops, brokering connections between end users and their resources, optimizing and load-balancing the connections, and communicating with the hypervisor to determine and manage the power state of the desktops, among other things.
- These FMA Services (Controller) are – Broker Service, Machine Creation Service, Configuration Service, AD Identity Service, Hosting Service, Delegated Administration Service, Monitoring Service, Environment Test Service, Configuration Logging Service, Analytics Service, App Library, Configuration Synchronizer Service, High Availability Service, Orchestration Service, Remote Broker Provider, Telemetry Service, Trust Service, StoreFront Privileged Service and StoreFront Service.
- Each of these services has an independent connection to the Site database.
- Whether the administrator selects XenApp or XenDesktop during the installation process for the Delivery Controller, the same binaries are installed, because XenApp and XenDesktop now share an architecture, called the FlexCast Management Architecture (FMA). The licenses purchased restrict the FlexCast models and features that can be leveraged.
- Leading practice: install the Delivery Controller role on a dedicated server so that resources are not dedicated to other tasks, as this could impact brokering times, thereby decreasing performance/end user experience.
 - This minimizes the risk of a scenario where the other role of the server causes a failure, which could cause end users to be unable to access their resources.

- This installation will also install Citrix Studio (unless deselected), which is the management console for XenApp and XenDesktop deployments, on the Delivery Controller.

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SQL Connections



- Each of the FMA services establishes its own direct connection to the site database. Additionally, some services, such as Configuration Logging, will have an additional separate connection to a secondary database.

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Key Notes:

- Supported Microsoft SQL Server versions for the Site Configuration Database (which initially includes the Configuration Logging Database and the Monitoring Database):
 - SQL Server 2016, Express, Standard, and Enterprise Editions.
 - SQL Server 2014 through SP2, Express, Standard, and Enterprise Editions.
 - SQL Server 2012 through SP3, Express, Standard, and Enterprise Editions. By default, SQL Server 2012 SP1 Express is installed when installing the Controller, if an existing supported SQL Server installation is not detected.
 - SQL Server 2008 R2 SP2 and SP3, Express, Standard, Enterprise, and Datacenter Editions.
- The following database features are supported (except for SQL Server Express, which supports only standalone mode):
 - SQL Server Clustered Instances
 - SQL Server Mirroring
 - SQL Server AlwaysOn Availability Groups
 - Windows authentication is required for connections between the Controller and the SQL Server database.

Additional Resources:

- Database - https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/system-requirements.html#par_anchortitle_384a



Lab Exercise

- Exercise 3-4: Install the Delivery Controller Role

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Lesson Objective Review

Which Operating Systems are supported for hosting the Delivery Controller role with XenApp and XenDesktop 7.12?

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Lesson Objective Review

Which Operating Systems are supported for hosting the Delivery Controller role with XenApp and XenDesktop 7.12?

- Windows 2008 R2
- Windows 2012
- Windows 2012 R2
- Windows 2016

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XenApp and XenDesktop Site

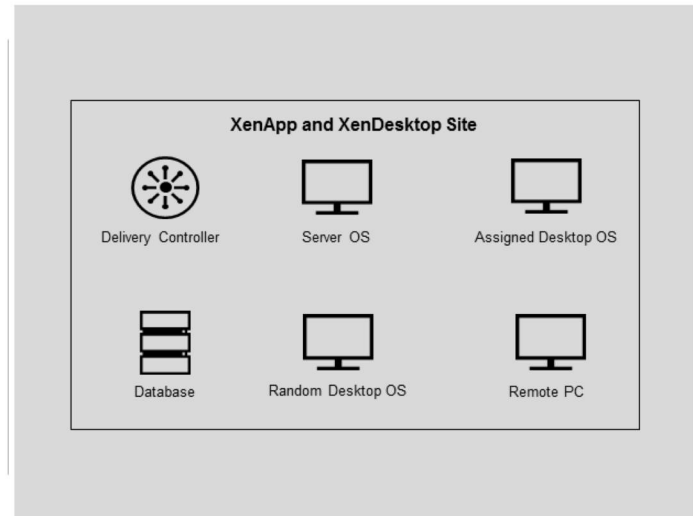
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XenApp and XenDesktop Site

A Site:

- Is a XenApp and XenDesktop deployment
- Consists of the Delivery Controller, the Site databases, and the resources being made available to users
- Requires a minimum of one Delivery Controller, and must be configured prior to joining additional Controllers



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Key Notes:

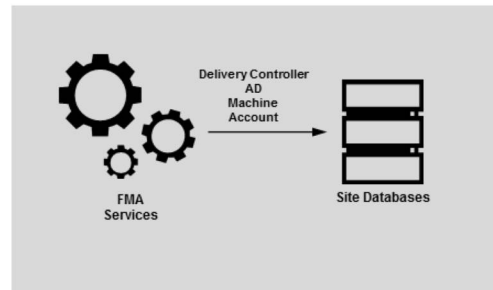
- A Site is the name you give to a product deployment. It comprises the Delivery Controllers and the other core components, VDAs, virtual resource connections (if used), plus the Machine Catalogs and Delivery Groups you create and manage. A Site does not necessarily correspond to a geographical location, although it can. You create the Site after you install the components and before creating Machine Catalogs and Delivery Groups.
- Site creation includes creating the Site Configuration databases. Make sure the SQL Server software is installed before you create a Site.

Additional Resources:

- Create a site - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/install-configure/site-create.html>

XenApp and XenDesktop Site – Database Configuration

- XenApp and XenDesktop Site supports Microsoft SQL databases
 - Three databases store data from each FMA service for the Delivery Controller
 - FMA services leverage the Delivery Controller’s machine account to authenticate against SQL



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Key Notes:

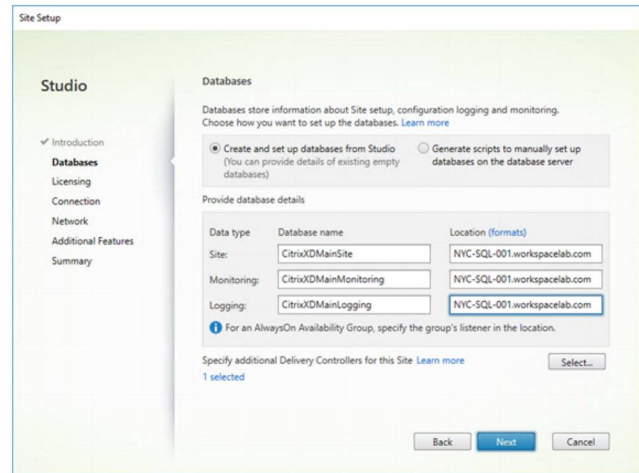
- To review, FMA stands for the FlexCast Management Architecture, which is the architecture used in XenApp and XenDesktop 7.x.
- Data for the Site from the FMA services is stored in the Site databases – this is why a SQL server is required (review Module 2 for details).
- Leveraging the Delivery Controller’s computer AD account for authentication to SQL enhances security by preventing the service account password from being stored and by having the machine password change every 30 days.
- During the Controller installation, if you choose to have the default SQL Server Express database installed, some information is already pre-populated in the wizard. If you use a SQL server that is installed on a different machine, enter the database and server names when prompted.

Additional Resources:

- Create a site - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/install-configure/site-create.html>

XenApp and XenDesktop Site – Database Configuration

- **Option 1:** Create databases automatically through Studio
 - User account requires sysadmin permissions
- **Option 2:** Generate database scripts to create databases manually
 - Create three empty databases
 - Set collation to `_100_CI_AS_KS`
 - Run database script on SQL server using `SQMLCMD`



Key Notes:

- There are two options for configuring the connection to the databases during Site creation to address the fact that not every database team will allow Citrix administrators to have elevated rights to the SQL server.
 - Option 1: user account requires sysadmin privileges on the target SQL server to enable Studio to create the databases automatically. The elevated SQL permissions are not required during runtime, and can be removed after installation/configuration if necessitated by the security team.
 - Option 2: in cases where the security team prohibits the service account from having elevated SQL privileges, during Site creation, click the “Generate scripts” option and provide the resulting scripts to the SQL team/appropriate contact to create the databases manually (generates two scripts – second one is for mirrored database instances). Create the databases, make sure that the collation is correct, and run the script with `SQLCMD`. After it is created, select “Test Connection” to validate that the Delivery Controller can connect to the databases that were created.

Additional Resources:

- Create a site - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/install-configure/site-create.html>



Lab Exercise

- Exercise 3-5: Create and Configure a XenApp and XenDesktop Site
- Exercise 3-6: Install Citrix Director

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Lesson Objective Review

Scenario: Your manager has asked you which service account is used to access the Citrix XenApp and XenDesktop SQL databases.

What would you reply back to him?

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Lesson Objective Review

Scenario: Your manager has asked you which service account is used to access the Citrix XenApp and XenDesktop SQL databases.

What would you reply back to him?

The databases are accessed using the Delivery Controllers Active Directory machine accounts.

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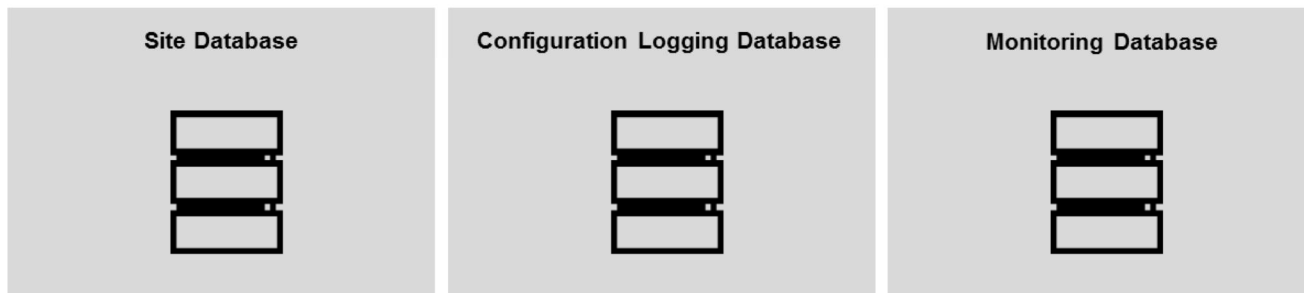


Databases and Local Host Cache

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Databases Overview



- Running Site configuration
- Current session states
- Connection information

- Site configuration changes
- Administrator activities

- Session and connection information
- Data leveraged by Director

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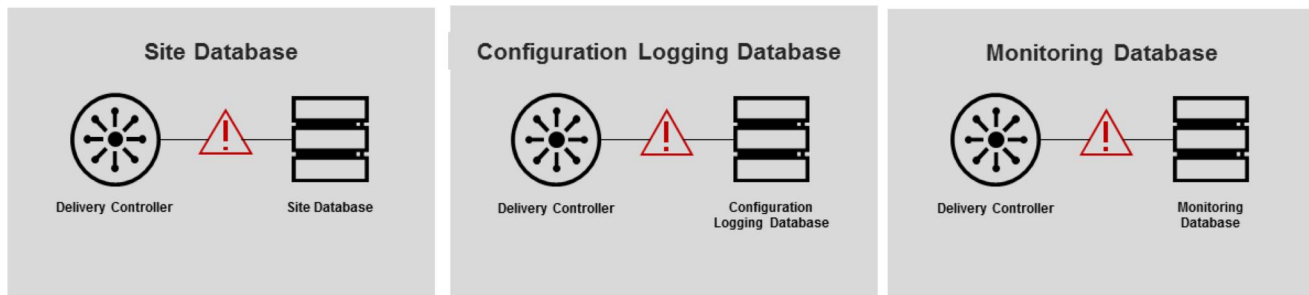
Key Notes:

- The Site Database stores the running Site configuration, plus the current session state and connection information.
- The Configuration Logging Database stores information about Site configuration changes and administrative activities. This database is used when the Configuring Logging feature is enabled.
- The Monitoring Database is used by Director; which is a monitoring tool that is included with XenApp and XenDesktop that displays metrics regarding sessions and enables admins/help desk to perform basic troubleshooting steps (end processes, reset profile, etc.).

Additional Resources:

- Manage Configuration Logging - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/monitor/configuration-logging.html>

Impact of Database Failure



- Users cannot launch certain new sessions
- Administrators cannot leverage Studio or Director
- If logging is mandatory, administrators cannot make changes to the site
- If logging is not mandatory, changes are not recorded
- Administrators cannot view historical data
- Administrators cannot leverage Studio or Director

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Key Notes:

- XenApp and XenDesktop 7.12 introduces a feature called Local Host Cache, which will be the focus of the following slides. This feature will allow users to continuously launch and run most resources even during a database failure. However, it is still recommended to have SQL fault tolerance in place for production environments.
- The failure impact is different for each database.
 - The Site database failure is the most critical - it can cause a production outage because users would not be able to start new sessions to access their resources (connection leasing mitigates some of the impact, but certain new sessions cannot be launched).
 - Logging/Monitoring – primarily affects administrative activities, and does not have an immediate/direct impact on production users.
- Citrix recommends that you back up the databases regularly so that you can restore from the backup if the database server fails. In addition, there are several high availability solutions to consider for ensuring automatic failover:
 - SQL Mirroring — This is the recommended solution. Mirroring the database makes sure that, should you lose the active database server, the automatic failover process happens in a matter of seconds, so that users are generally unaffected. This method, however, is more expensive than other solutions because full SQL Server licenses are required on each database server; you cannot use SQL Server Express edition for a mirrored environment.
 - Using the hypervisor's high availability features — With this method, you deploy the database as a virtual machine and use your hypervisor's high availability

features. This solution is less expensive than mirroring as it uses your existing hypervisor software and you can also use SQL Express. However, the automatic failover process is slower, as it can take time for a new machine to start for the database, which may interrupt the service to users.

- SQL Clustering — The Microsoft SQL clustering technology can be used to automatically allow one server to take over the tasks and responsibilities of another server that has failed. However, setting up this solution is more complicated, and the automatic failover process is typically slower than with alternatives such as SQL Mirroring.
- AlwaysOn Availability Groups is an enterprise-level high-availability and disaster recovery solution introduced in SQL Server 2012 to enable you to maximize availability for one or more user databases. AlwaysOn Availability Groups requires that the SQL Server instances reside on Windows Server Failover Clustering (WSFC) nodes.

Additional Resources:

- High availability- <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/technical-overview/databases.html>

Local Host Cache

Allows connection brokering operations in a Site to continue when a database outage occurs

- Enables Delivery Controllers to leverage a local cache (LocalDB) to provide users with access to resources during a Site database connection failure
- Utilizes two new services
 - Config Synchronization Service
 - High Availability Service
- Must be manually enabled except in certain upgrade scenarios
- Supplements, but does not replace, a SQL high availability configuration

Key Notes:

- With the release of 7.12 we have two options to support a Site during a database outage: Local Host Cache and Connection Leasing. These two solutions cannot be used at the same time.
- To enable Local Host Cache, enter: `Set-BrokerSite -LocalHostCacheEnabled $true -ConnectionLeasingEnabled $false`; this cmdlet also disables the connection leasing feature. Do not enable both Local Host Cache and Connection Leasing.
 - Local Host Cache retains a copy of the site data in a local SQLEXPRESS on every Delivery Controller, and relies on this data during a database outage to continuously support VDA registrations and session brokering requests.
- Connection Leasing was a feature released with 7.6 and is enabled by default. To disable, run PowerShell command: `Set-BrokerSite -ConnectionLeasingEnabled $false`.
 - Retains the local data in a XML file while updating the Site database with information periodically for synchronization amongst Delivery Controllers.
 - Delivery Controllers check for new leases every 10 seconds and sync that information into the XML file, if a new lease exists.
 - The lease expiration period can be changed via PowerShell or the registry, but need to factor in increased storage requirements for longer time periods.
 - With connection leasing, a Controller will cache user connections to resources to its local disk (default location: `C:\Program Data\Citrix\Broker\Cache`) and that the lease generated for the connection is valid for two weeks.
 - Connection Leasing has limitations; it is still a leading practice to require a

highly available SQL solution, as Connection Leasing has limitations.

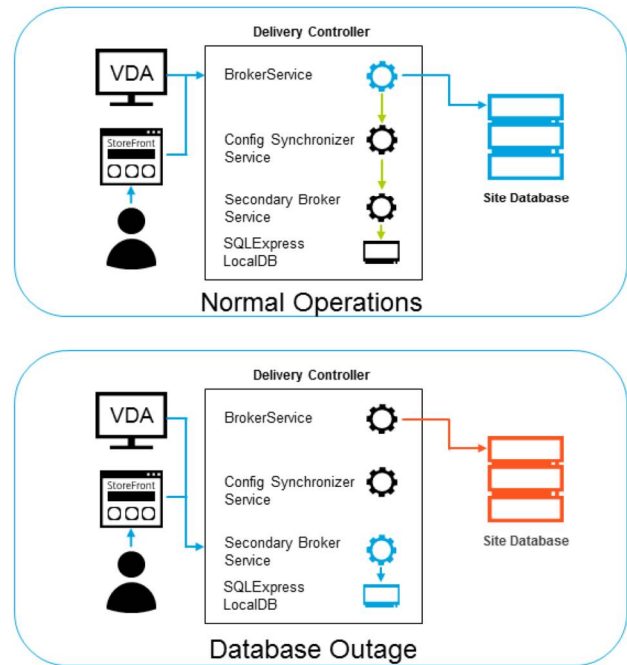
Additional Resources:

- FAQ: Connection Leasing in XenApp and XenDesktop 7.6:
<http://support.citrix.com/article/CTX205169>

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Local Host Cache

- Delivery Controllers synchronize configuration data from the central SQL database to a local SQLExpress database every two minutes if changes have been made
- During a database outage, all Delivery Controllers in a zone will elect a primary Delivery Controller to handle all VDA registration and session brokering, all other Delivery Controllers will reject brokering and registration connections



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Local Host Cache Considerations

During DB outage



- You cannot use Studio or run PowerShell cmdlets.
- No power operations can be issued.
- Anonymous session launch requests are rejected.
- New machine assignments cannot be made during an outage.
- Automatic enrollment and configuration of Remote PC Access machines is not possible.
- An alphabetical election will determine which Delivery Controller will run the Site.
- Pooled VDI desktops cannot be brokered.

Key Notes:

- What is unavailable or changes during an outage:
 - You cannot use Studio or run PowerShell cmdlets.
 - Hypervisor credentials cannot be obtained from the Host Service. All machines are in the unknown power state, and no power operations can be issued. However, VMs on the host that are powered-on can be used for connection requests.
 - Machines with VDAs in pooled Delivery Groups that are configured with "Shut down after use" are placed into maintenance mode.
 - Anonymous session launch requests are rejected.
 - An assigned machine can be used only if the assignment occurred during normal operations. New assignments cannot be made during an outage.
 - Automatic enrollment and configuration of Remote PC Access machines is not possible. However, machines that were enrolled and configured during normal operation are usable.
 - Server-hosted applications and desktop users may use more sessions than their configured session limits, if the resources are in different zones.

Additional Resources:

- Local Host Cache: <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/manage-deployment/local-host-cache.html>

Local Host Cache Considerations

Sizing



- The LocalDB service requires extra RAM on Delivery Controllers.
- LocalDB can use multiple cores (up to 4), but is limited to only a single socket.
- During outages the LocalDB will consume local storage and I/O.
- During an outage, one broker handles all the connections, meaning all Delivery Controllers must be sized accordingly.
- Up to 5,000 VDAs can be handled effectively.
- Local Host Cache is disabled by default on new installations.

Key Notes:

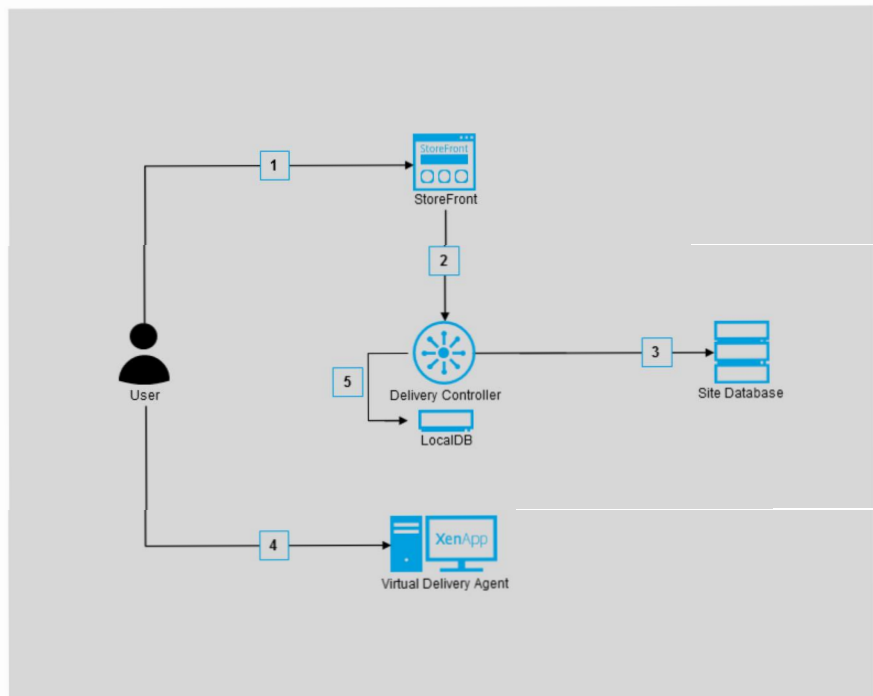
- **New install:** After a new XenApp or XenDesktop installation, Local Host Cache is disabled and Connection Leasing is enabled by default.
- **Upgrade:** The number of VDAs in a Site affects the default Local Host Cache setting after an upgrade. The Connection Leasing setting does not change because of the upgrade.
- If your site has fewer than 5,000 VDAs:
 - Local Host Cache is enabled if Connection Leasing was disabled before the upgrade. Connection Leasing remains disabled.
 - Local Host Cache is disabled if Connection Leasing was enabled before the upgrade. Connection Leasing remains enabled.
- If your site has 5,000 or more VDAs:
 - Local Host Cache is disabled (regardless of the Connection Leasing setting), and Connection Leasing retains the same setting it had before the upgrade.

Additional Resources:

- Local Host Cache: <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/manage-deployment/local-host-cache.html>

Local Host Cache Database Available

1. User authenticates to StoreFront
2. StoreFront forwards credentials
3. Controller authenticates user and enumerates resources via the database
4. Receiver obtains response and starts session
5. Controller synchronizes site data to LocalDB



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Key Notes:

- The *principal broker* (Citrix Broker Service) on a Controller accepts connection requests from StoreFront, and communicates with the Site database to connect users with VDAs that are registered with the Controller.
- A check is made every two minutes to determine whether changes have been made to the principal broker's configuration. Those changes could have been initiated by PowerShell/Studio actions (such as changing a Delivery Group property) or system actions (such as machine assignments).
- If a change has been made since the last check, the principal broker uses the Citrix Config Synchronizer Service (CSS) to synchronize (copy) information to a *secondary broker* (Citrix High Availability Service) on the Controller. All broker configuration data is copied, not just items that have changed since the previous check. The secondary broker imports the data into a Microsoft SQL Server Express LocalDB database on the Controller. The CSS ensures that the information in the secondary broker's LocalDB database matches the information in the Site database. The LocalDB database is re-created each time synchronization occurs.
- If no changes have occurred since the last check, no data is copied.
- To ensure that the Site database is always available, Citrix recommends starting with a fault-tolerant SQL Server deployment by following high availability best practices from Microsoft. However, network issues and interruptions may prevent Delivery Controllers from accessing the database, resulting in users not being able to connect to their applications or desktop.
- The Local Host Cache feature supplements the SQL Server high availability best practices by enabling users to connect and reconnect to their applications and assigned

desktops, even when the Site database is not available.

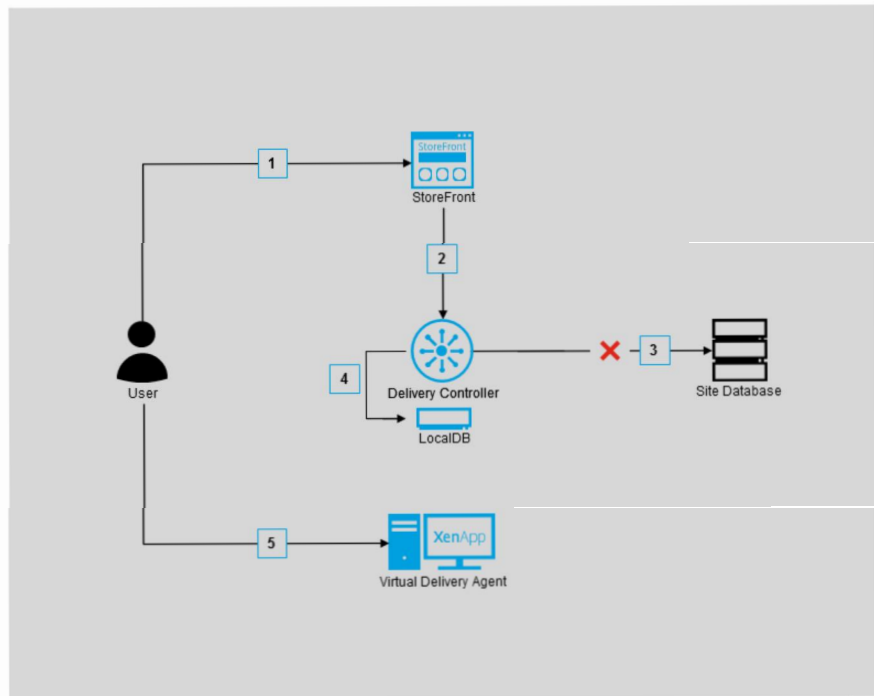
Additional Resources:

- Local Host Cache: <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/manage-deployment/local-host-cache.html>
- Fault tolerance: <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/technical-overview/databases.html>

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Local Host Cache Database Unavailable

1. User authenticates to StoreFront
2. StoreFront forwards credentials
3. Controller authenticates user and fails to enumerate resources as database is offline
4. Controller accesses LocalDB via the High Availability Service and enumerates resources
5. Receiver obtains response and starts session



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Key Notes:

- When an outage begins:
- The principal broker can no longer communicate with the Site database, and stops listening for StoreFront and VDA information (marked X in the graphic). The principal broker then instructs the secondary broker (High Availability Service) to start listening for and processing connection requests.
- When the outage begins, the secondary broker has no current VDA registration data, but as soon as a VDA communicates with it, a re-registration process is triggered. During that process, the secondary broker also gets current session information about that VDA.
- While the secondary broker is handling connections, the principal broker continues to monitor the connection to the Site database. When the connection is restored, the principal broker instructs the secondary broker to stop listening for connection information, and the principal broker resumes brokering operations. The next time a VDA communicates with the principal broker, a re-registration process is triggered. The secondary broker removes any remaining VDA registrations from the previous outage, and resumes updating the LocalDB database with configuration changes received from the CSS.
- In the unlikely event that an outage begins during a synchronization, the current import is discarded and the last known configuration is used.
- Among its other tasks, the CSS routinely provides the secondary broker with information about all Controllers in the zone. (If your deployment does not contain multiple zones, this action affects all Controllers in the Site.) Having that information, each secondary broker knows about all peer secondary brokers.

- The secondary brokers communicate with each other on a separate channel. They use an alphabetical list of FQDN names of the machines they're running on to determine (elect) which secondary broker will be in charge of brokering operations in the zone if an outage occurs. During the outage, all VDAs re-register with the elected secondary broker. The non-elected secondary brokers in the zone will actively reject incoming connection and VDA registration requests.
- If an elected secondary broker fails during an outage, another secondary broker is elected to take over, and VDAs will re-register with the newly-elected secondary broker.

Additional Resources:

- Local Host Cache: <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/manage-deployment/local-host-cache.html>

Lesson Objective Review

Scenario: John has access to the following resources:

- A random/non-persistent Windows 10 desktop that he uses every day
- A Windows 2016 hosted Microsoft Word application that he accesses at least once a week
- An SAP application that he has not used for three weeks

Question: If the Site database is unreachable and Local Host Cache is enabled, which resource(s) will John be able to access and why?

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Lesson Objective Review

Question: If the site database is unreachable and Local Host Cache is enabled, which resource(s) will John be able to access and why?

- Can access Microsoft Word (On-Demand Server OS applications are supported).
- Cannot access Hosted VDI (random/non-persistent desktops are not supported by Local Host Cache).
- Can access SAP application (Local Host Cache is not limited in lease time).

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Key Takeaways

- Citrix licenses can be User/Device or Concurrent and expose different features based on Edition.
- The License Server keeps track of license usage.
- Comprehension of basic troubleshooting of the License Server ensures a stable production environment.
- A Delivery Controller is responsible for brokering connections to resources.
- The deployment of XenApp and XenDesktop through the configuration of one or more Delivery Controllers is called a Site.
- Enabling Local Host Cache reduces the impact of a database outage.

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XenApp and XenDesktop Administration

Provision and Deliver App and Desktops Resources

Module 4



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Lab VM Power Management

The following VMs are required to be powered on before beginning the exercises in this module:

- NYC-ADS-001
- NYC-SQL-001
- NYC-FSR-001
- NYC-XDC-001
- NYC-MAN-001
- NYC-WRK-002
- NYC-DTP-MST
- MCS-DTP-MST
- MCS-SRV-MST

The remaining VMs need to be powered off.

Note: These VMs are listed in the start-up order.

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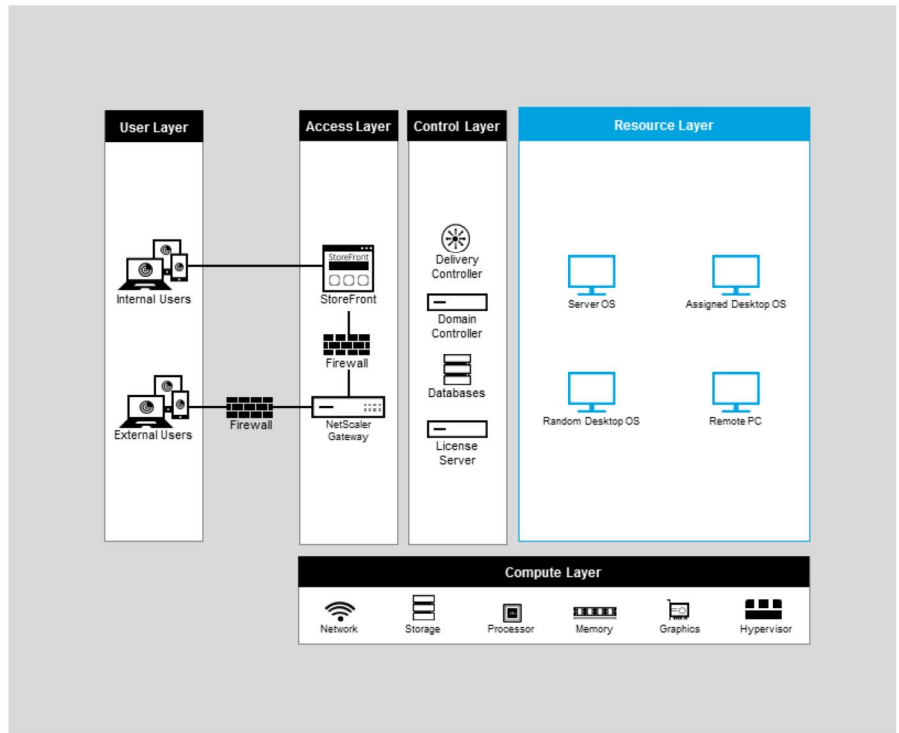
Learning Objectives

- Explain the purpose of the Virtual Delivery Agent installed on each delivered resource.
- Demonstrate roles of machine catalog and Delivery Group in defining and assigning available resources.
- Identify the different provisioning methods and their considerations.
- Illustrate the Machine Creation Services process for provisioning virtual machines.
- Classify machine creation considerations.
- Define the three core steps to creating resources.

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Apps and Desktop Resources

This module will focus on the resources being delivered to users





Virtual Delivery Agent (VDA)

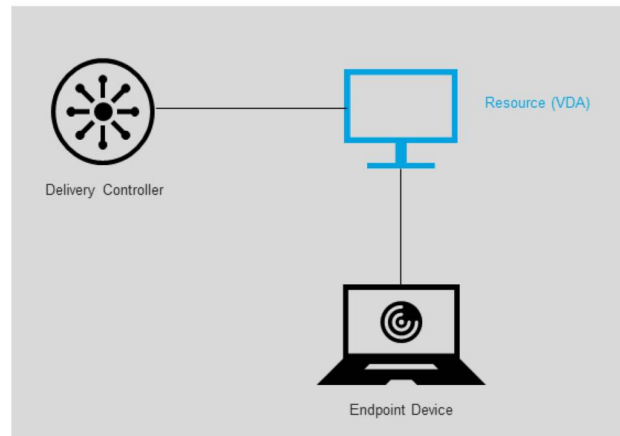
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Virtual Delivery Agent (VDA)

Agent that is installed on each machine used for resource delivery

- Enables user access to the resources being delivered
- Manages the communication between Delivery Controller and Receiver
- Updates the Delivery Controller with session information



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Key Notes:

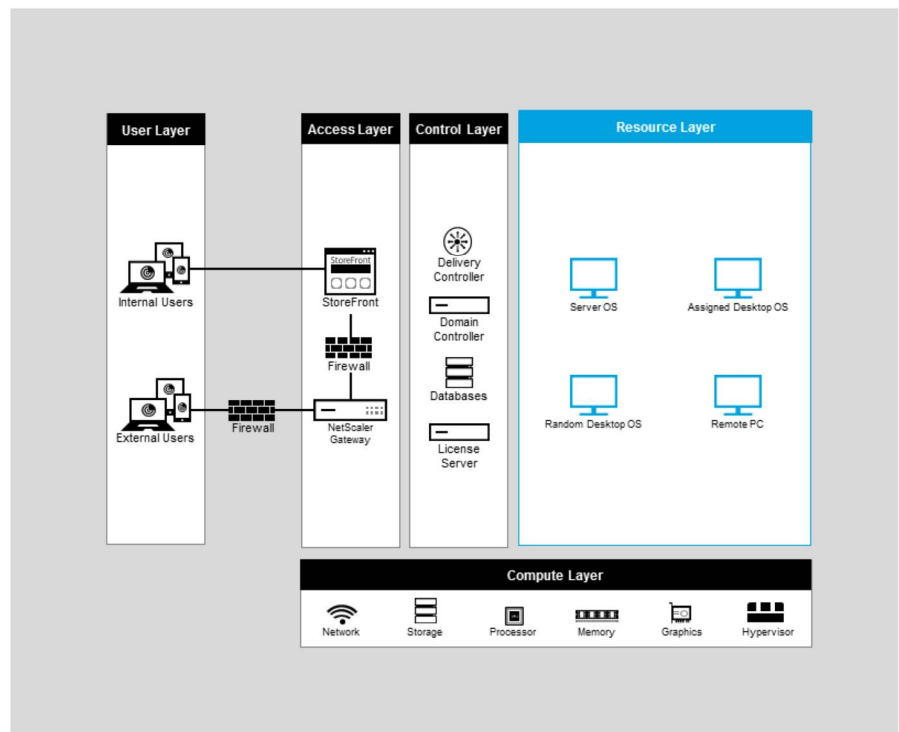
- The VDA is the intermediary between the Delivery Controller and the user's device (Receiver, specifically), as the Delivery Controller will send information regarding the connection to the VDA, and the VDA will send the information to Receiver.
- Note that delivered resources may be referred to as VDA or the VDA machine going forward.
- VDA is an agent that is installed on machines running Windows Server or Windows Desktop operating systems that allows these machines and the resources they host to be made available to users. The VDA-installed machines running Windows Server OS allow the machine to host multiple connections for multiple users and are connected to users on one of the following ports:
 - TCP port 80 or port 443 if SSL is enabled
 - TCP port 2598, if Citrix Gateway Protocol (CGP) is enabled, which enables session reliability
 - TCP port 1494 if CGP is disabled or if the user is connecting with a legacy client

Additional Resources:

- Technical overview - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/technical-overview.html>

Virtual Delivery Agent (VDA)

- Installed on each machine delivering resources
- Distinct install software according to operating system:
 - Windows Server OS
 - Windows Desktop OS
 - Linux
- Comprised of two FMA services
 - Desktop Service
 - PortICA Service (VDI only)



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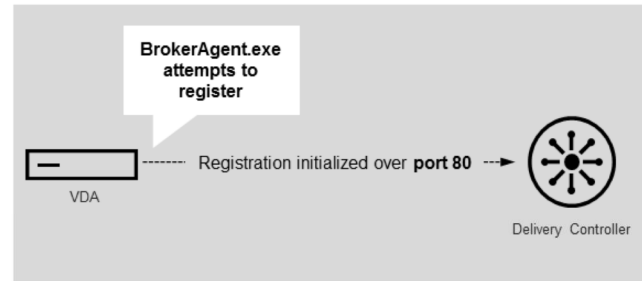
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Key Notes:

- The VDA software is required to be installed on each resource (virtual or physical) that will be delivered to users; otherwise, the Delivery Controller cannot communicate with or direct connections to the resource. If a VDA does not register, it cannot be used.
- Desktop Service: Handles the registration process and the communication with the Controller. Also handles the exchange of pre-logon ticket data and user credentials during the authentication verification process.
- PortICA Service: Handles accepting the initial connection and locking the workstation. Also manages the communication with the display manager for Thinwire display mode changes and manages the communication with the Desktop Service.
- On a Server OS, we do not utilize PortICA but leverage the RDS subsystem instead.

Virtual Delivery Agent – Registration

- Process in which the VDA and Delivery Controller establish a trusted communication
- Registration Configuration Options:
 - Auto update: a Studio policy automatically updates the Delivery Controller list
 - Group Policy Object (GPO): a GPO setting specifies the Delivery Controller list
 - Manual: a registry setting or the VDA wizard configures the Delivery Controller list
 - OU-based Controller discovery: this is a legacy method maintained for backward compatibility.
 - MCS: MCS inserts the Delivery Controller list into the personality.ini file



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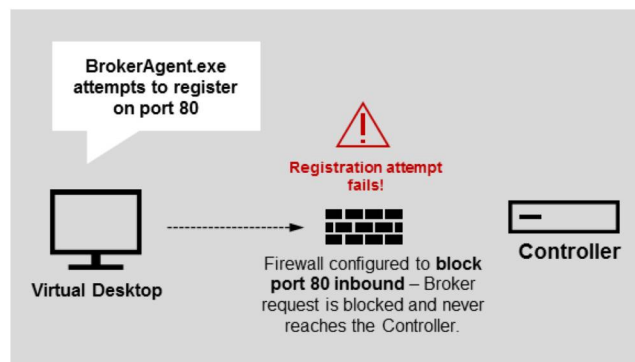
Key Notes:

- The configuration options are in order of priority and the Delivery Controller checks each applicable location for the options in order until it locates the Delivery Controller.

Virtual Delivery Agent – Registration Failure

Basic Troubleshooting Steps for VDA Registration Failure

- Verify that the Delivery Controller is correctly specified
- Test firewall configuration does not block registration port (default: 80)
- Compare time synchronization between Delivery Controller and VDA
- Validate domain membership of VDA
- Check forward DNS lookups for Delivery Controllers and VDA
- Inspect the computer account of the VDA



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Key Notes:

- VDA failed registration with the Delivery Controller results in the Delivery Controller being unable to broker any connection to this resource.
- In other words, if the VDA on a machine fails, then none of the resources on that machine can be accessed.
- VDA registration failure is the most common issue in XenApp and XenDesktop deployments, therefore it is important to note some basic troubleshooting steps:
 - Make sure that the VDA is attempting to register with the correct controller (spelling, etc.).
 - Verify that the firewall is not blocking the registration communication by telnetting over the registration port (Delivery Controller -> VDA and VDA -> Delivery Controller).
 - Compare time between the Controllers and the VDAs (max acceptable difference is 5 minutes).
 - Check the domain membership of the VDA and test removing and rejoining the VDA to the domain.
 - Check forward DNS lookups for Delivery Controllers and VDAs. Reverse DNS lookups are only required in specific scenarios with multiple trusted forests.
 - Inspect the VDA's computer account to verify that the servicePrincipalName attribute includes the computer's fully qualified domain name.
 - If the virtual machine has multiple network adapters, also test disabling

additional network adapters (do not disable the adapter used to communicate with the Controller).

Additional Resources:

- Virtual Desktop Agent Registration with Controllers in XenDesktop:
<http://support.citrix.com/article/CTX126992>
- Virtual Delivery Agent (VDA) Registration Troubleshooting Tips and Flowchart:
<http://support.citrix.com/article/CTX136668>
- Troubleshooting XenDesktop brokering process:
<https://www.citrix.com/blogs/2012/07/23/troubleshooting-xendesktop-brokering-process-2/>

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Lesson Objective Review

Scenario: You are the Citrix Admin and you are working with the network team to identify the ports to be opened between the VDA network and the network hosting Delivery Controllers.

The network team wants to know what port 80 is used for, what do you tell them?

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Lesson Objective Review

Scenario: You are the Citrix Admin and you are working with the network team to identify the ports to be opened between the VDA network and the network hosting Delivery Controllers.

The network team wants to know what port 80 is used for, what do you tell them?

Port 80 is used by the VDAs to register with the Delivery Controller and for the Delivery Controller to gather information about processes, sessions and performance data.

Key Notes:

- This port can be changed to a custom port if needed.
- This can be done via two different methods:
 - Through a Citrix computer policy using the “control registration port” setting. Note that in XenApp and XenDesktop 7.x, this policy setting is only available when configuring Citrix policies with the Group Policy Management Console (GPMC).
 - Through cmd-line using Program Files\Citrix\Broker\Service\BrokerService.exe /VDAPort <port>

Additional Resources:

- Change VDA Registration port - <https://support.citrix.com/article/CTX130002>



Machine Catalogs and Delivery Groups

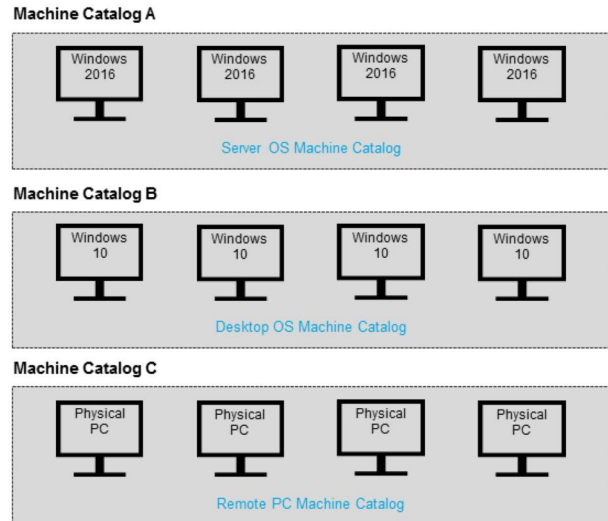
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Machine Catalog

Define the machines that will host the applications and desktops

- Collection of virtual or physical machines managed as a single entity
- Catalogs are separated according to:
 - Machine Type
 - Windows Server OS
 - Windows Desktop OS
 - Remote PC
 - Provisioning method
 - Machine Creation Services (MCS)
 - Provisioning Services (PVS)
 - Existing



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Key Notes:

- The machine type maps to the different FlexCast delivery methods described in Module 1 (e.g. Windows Server OS could be for published desktops and/or Server OS published apps).
- All VMs in a catalog will have the same VDA version and the same apps/desktops. Typically, there is a master image that is used to create all VMs in a machine catalog.
- The existing machines option is for machines that have already been prepared using a non-Citrix technology.
- Since machine catalogs can span hypervisor hosts, it is important to make sure that where applicable, master images are accessible from all hosts.
- During machine catalog creation, the following should also be specified:
 - (1) Power management of machines (“power managed” only permitted if a hypervisor or cloud connection has already been configured)
 - (2) Desktop experience if Desktop OS is selected as the machine type (connect to same or random desktop). If users will connect to the same desktop, select if changes will persist.
- For catalogs containing physical machines or existing machines, select or import existing accounts and assign each machine to both an Active Directory computer account and to a user account.
- For machines created with Provisioning Services, computer accounts for target devices are managed differently; see the Provisioning Services documentation.

Additional Resources:

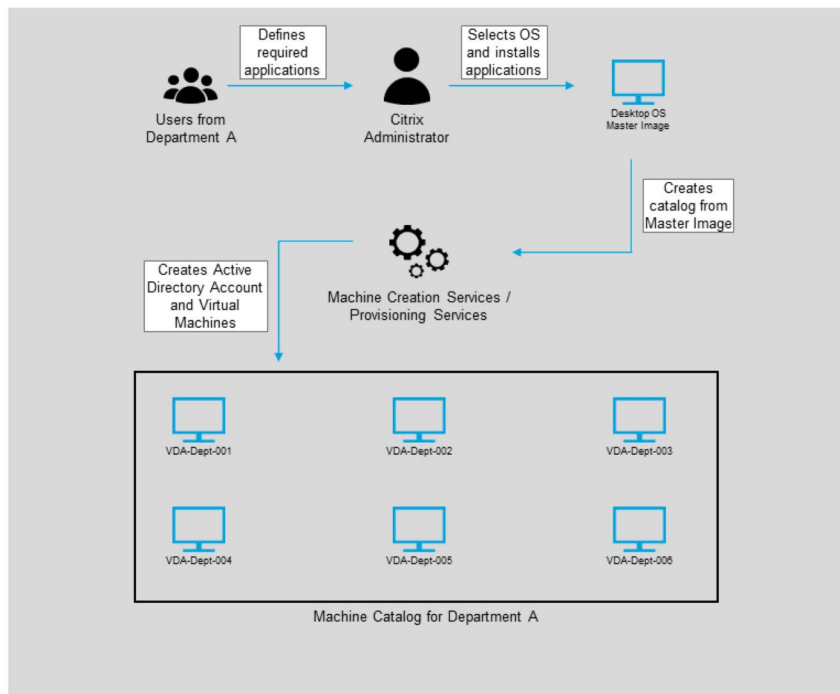
- Create a machine catalog - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/install-configure/machine-catalogs-create.html>

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Master Virtual Machine

XenApp and XenDesktop can create almost identical machines from a single master image.

1. Create the master image with desired OS
2. Add applications
3. Generalize settings
4. Create a catalog from master image



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Key Notes:

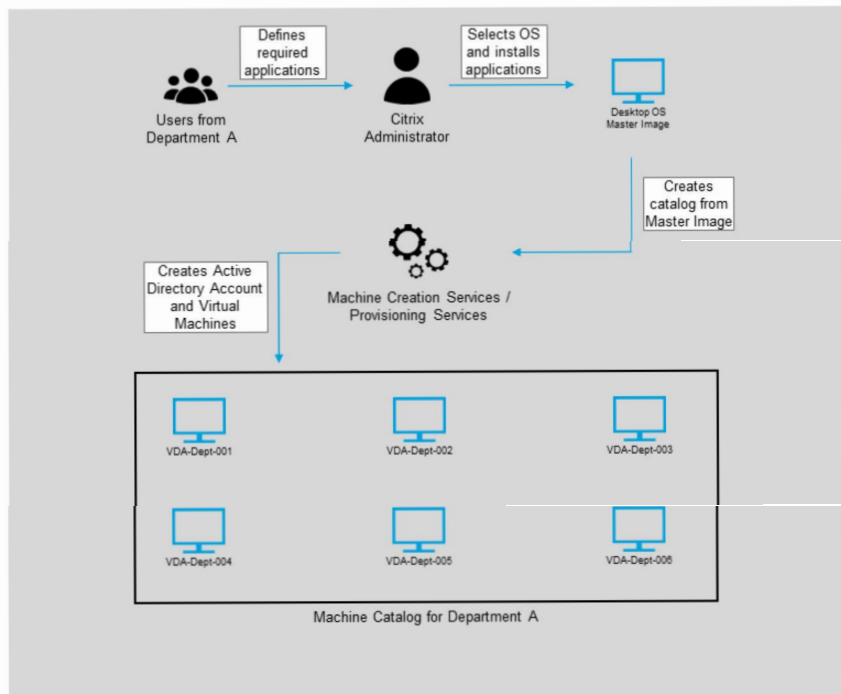
- Windows Server OS and Windows Desktop OS templates can serve as the Master Image for a catalog, but each catalog can only be based on one image at a time.
- Depending on the catalog type, it is possible to update all machines from time to time in order to reflect changes done to a Master Image (like updates or added/removed applications).
- The amount of generalization necessary depends on the application being deployed. While some applications do not require any modification, other applications might need custom settings to avoid conflicts caused by identical settings.
- If you will use Citrix tools (Machine Creation Services or Provisioning Services) to create VMs for your deployment, prepare a master image or template on your host hypervisor. Then, create the machine catalog.
- Make sure the host has sufficient processors, memory, and storage to accommodate the number of machines you will create.
- The master image contains the operating system, non-virtualized applications, VDA, and other software. VMs are created in a machine catalog, based on a master image you created earlier and specify when you create the catalog.

Additional Resources:

- Create a machine catalog - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/install-configure/machine-catalogs-create.html>

Master Virtual Machine Considerations

The Master Image should contain all required applications, patches, and settings required by all users of the production VDAs.



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Key Notes:

- The only necessary differences among the machines created from a master image are usually settings that would otherwise lead to a conflict (like name, AD computer account, SID and IP Address). Machine Creation Services and Provisioning Services take care of this, so the Master Image does not need to be “sysprepped”. If you are using Provisioning Services or Machine Creation Services, do not run Sysprep on master images.
- A master image is also known as a clone image, golden image, or base image.
- When using Provisioning Services, you can use a master image or a physical computer as the initial master target device used to create a vDisk.
- Update a master image to apply changes to all the desktops and applications in a machine catalog that were created with that master image. Managing common aspects through a single master image lets you deploy system-wide changes such as Windows updates or configuration changes to a large number of machines quickly.

Additional Resources:

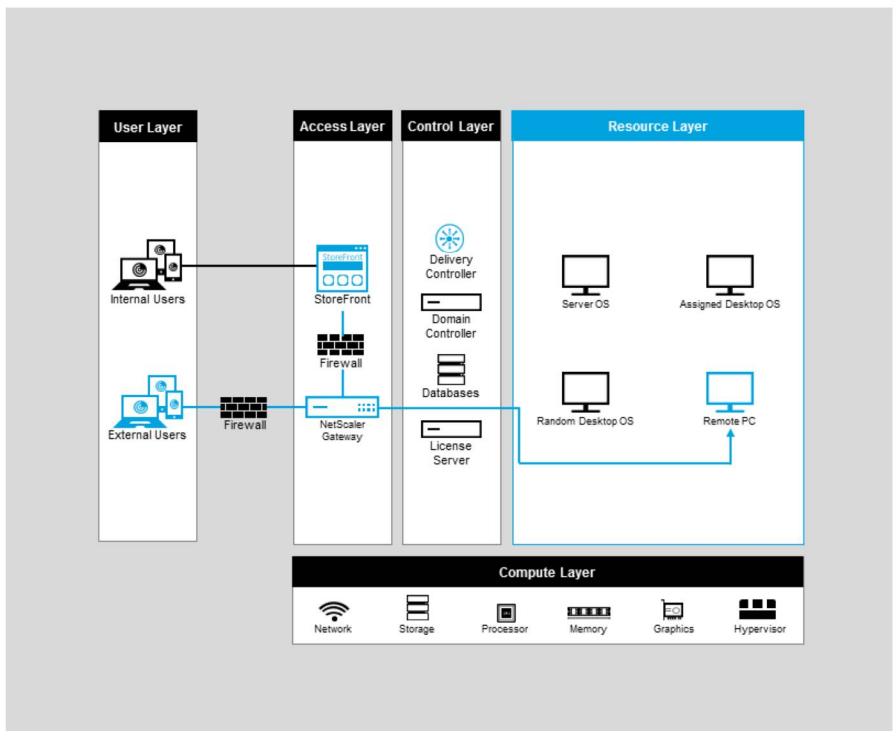
- Create a machine catalog - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/install-configure/machine-catalogs-create.html>
- Manage Machine catalogs - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/install-configure/machine-catalogs-manage.html>

Remote PC Access

Some machine catalogs are based on physical PCs instead of VMs.

Use cases include:

- Leverage existing office PCs
- Access high-powered workstations with specialized hardware



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Key Notes:

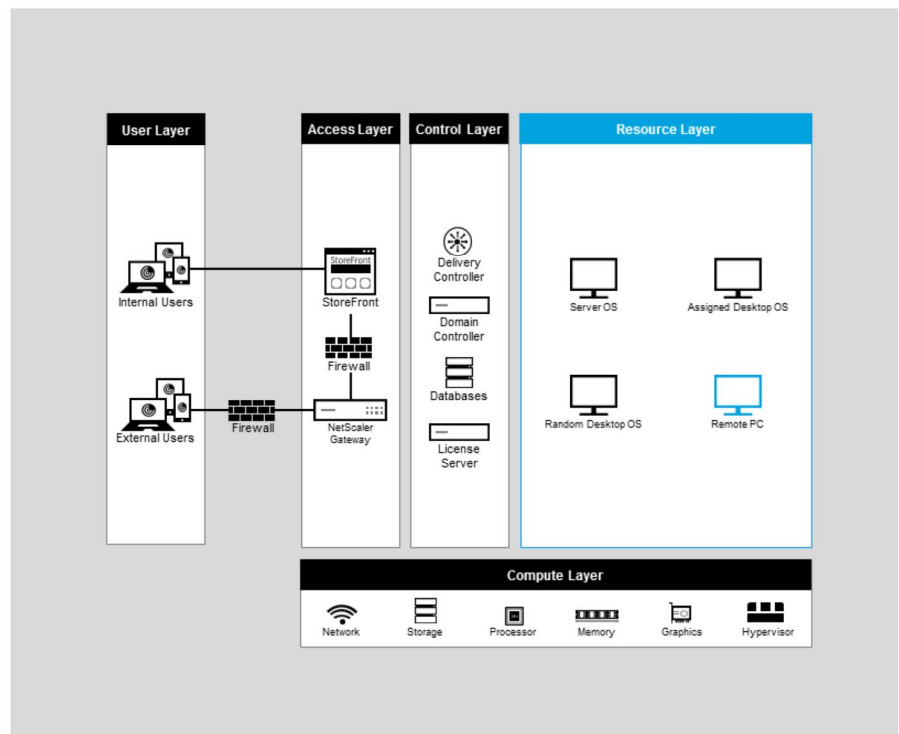
- Remote PC Access allows an end user to log on remotely from virtually anywhere to the physical Windows PC in the office. The Virtual Delivery Agent (VDA) is installed on the office PC; it registers with the Delivery Controller and manages the HDX connection between the PC and the end user client devices. Remote PC Access supports a self-service model; after you set up the whitelist of machines that users are permitted to access, those users can join their office PCs to a Site themselves, without administrator intervention. The Citrix Receiver running on their client device enables access to the applications and data on the office PC from the Remote PC Access desktop session.
- Remote PC Access is a feature of XenDesktop and can be used as an interim stage during migration of physical office PCs to virtual machines.
- Remote PC Access can be a solution for employees to access their documents and applications during roadblocks, quarantine or bad weather.

Additional Resources:

- Create a machine catalog - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/install-configure/machine-catalogs-create.html>
- Remote PC Access - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/install-configure/remote-pc-access.html>

Remote PC Access defined

- Enables existing PCs to be accessed remotely.
- Does not require large changes to the environment.
- Is secure by design.
- Enables mobile device access to office PCs as well.



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Key Notes:

- The value in Remote PC is the access by the HDX protocol.
- The following XenDesktop features are not supported for Remote PC Access deployments:
 - Creating master images and virtual machines
 - Delivering published apps
 - Personal vDisks
 - Client folder redirection

Additional Resources:

- Remote Access Design Guide - https://www.citrix.com/content/dam/citrix/en_us/documents/products-solutions/remote-access-to-enterprise-pc-xendesktop-75-desktop-guide.pdf (this content is based on 7.5 but the design guidelines are still relevant)
- Remote PC Access - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/install-configure/remote-pc-access.html>



Lab Exercise

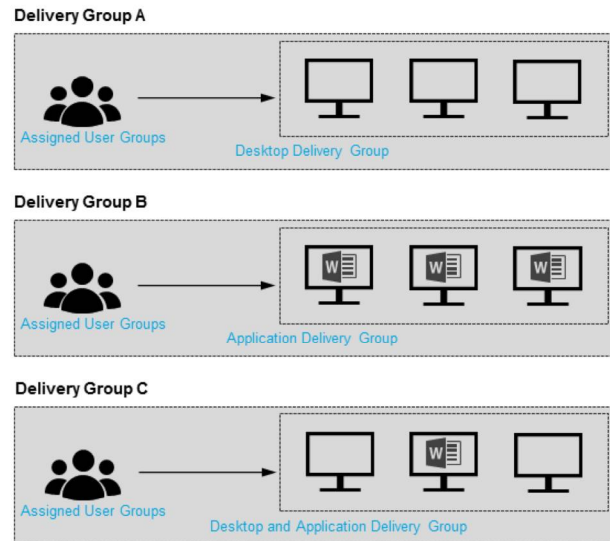
- Exercise 4-1: Prepare the Server OS Image

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Delivery Group

Assign the applications and desktops to the appropriate users

- Collection of machines that specify which user groups can access desktops or applications
- Allocates machines from the machine catalog(s) for user access
- Specifies the delivery type
 - Desktops
 - Applications
 - Desktops and applications
- Assigns user groups or unauthenticated users to resources



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Key Notes:

- A Delivery Group is a collection of machines selected from one or more machine catalogs. The Delivery Group specifies which users can use those machines, and the applications available to those users.
- A machine can only be in one Delivery Group.
- The “desktops and applications” option for delivery type is not available with static Desktop OS desktops.
- Leading practice: assign Active Directory groups (rather than individual AD accounts) to Delivery Groups because it can be easier to add a user to the appropriate AD groups to gain access to the necessary resources when onboarding a user to the environment. This can also reduce the operational complexity involved with removing user access.
- For Delivery Groups containing Server OS machines, you can select a check box that will allow users to access applications and desktops without presenting credentials to StoreFront or Citrix Receiver. For example, when users access applications through kiosks, the application might require credentials, but the Citrix access portal and tools do not. An Anonymous Users Group is created when you install the VDA

Additional Resources:

- Delivery Groups - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/install-configure/delivery-groups-create.html>

Delivery Group – Applications

Publish Applications from Delivery Groups to User Groups

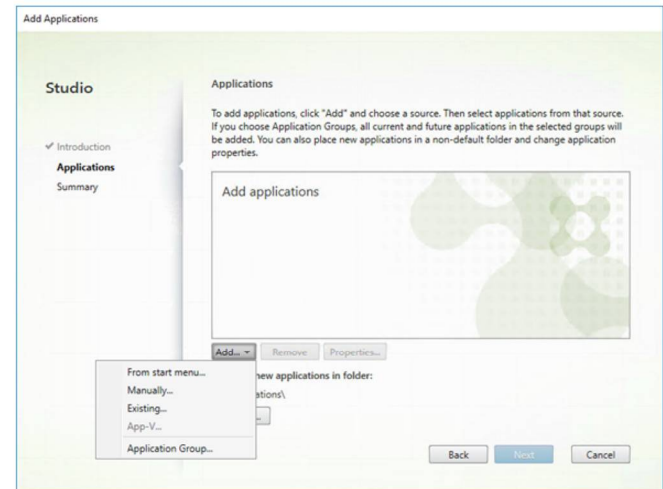
From start menu: select an application that is discovered on one of the machines

Manually: add an application manually by specifying the path to the executable file, working directory, and application name

Existing: add an existing application in the database to a new delivery group

App-V: add a App-V application to a delivery group

Application group: add applications defined in an application group to a delivery group.



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Key Notes:

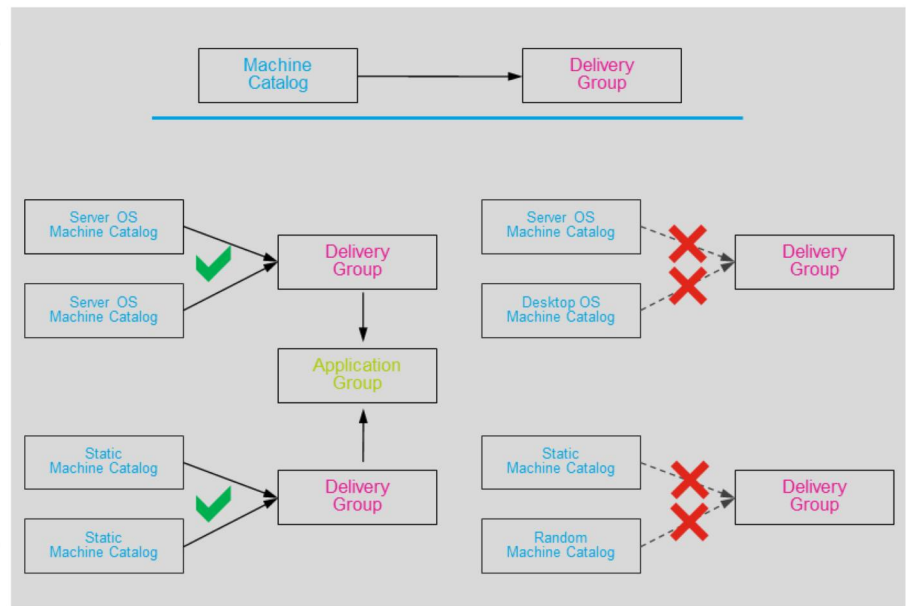
- A list displays the applications that were discovered on a machine created from the master image, a template in the machine catalog, or on the App-V management server. Choose one or more applications to add to the Delivery group.
- You can also add (create) applications manually. You'll need to provide the path to the executable, working directory, optional command line arguments, and display names for administrators and users.
- There are more options for publishing applications that can be accessed by clicking Application properties, including command line parameters, application names, and limiting the visibility of apps. Also, can change the application folder that the application is displayed in by clicking Change under the Place the selected application in folder title. More detail regarding this will be discussed in later module.
- Application Groups let you manage collections of applications. You can create Application Groups for applications shared across different Delivery Groups or used by a subset of users within Delivery Groups. Application Groups are optional; they offer an alternative to adding the same applications to multiple Delivery Groups. Delivery Groups can be associated with more than one Application Group, and an Application Group can be associated with more than one Delivery Group.
 - Application Groups will be covered in module 7.

Additional Resources:

- Delivery Groups - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/install-configure/delivery-groups-create.html>

Machine Catalog and Delivery Group Relationship

- A 1:1 relationship of machine catalogs to Delivery Groups can ease management and administration
- A Delivery Group can contain machines from more than one Machine Catalog, provided that the Machine Catalogs have the same machine type and same desktop experience type



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Key Notes:

- During the creation of a Delivery Group, select a Machine Catalog and specify the number of machines you want to use from the catalog.
 - To use a specific Machine Catalog, at least one machine must remain unused in that catalog.
 - A Machine Catalog can be specified in more than one Delivery Group; however, a machine can be used in only one Delivery Group.
 - A Delivery Group can use more than one Machine Catalog; however, those catalogs must contain the same machine types (Server OS, Desktop OS, or Remote PC Access). In other words, you cannot mix machine types in a Delivery group or in a Machine Catalog.
 - Similarly, you cannot create a Delivery Group containing Desktop OS machines from a Machine Catalog configured for static desktops and machines from a Machine Catalog configured for random desktops.
 - Each machine in a Remote PC Access machine catalog is automatically associated with a Delivery Group.
- Application Groups are optional; they offer an alternative to adding the same applications to multiple Delivery Groups. Delivery Groups can be associated with more than one Application Group, and an Application Group can be associated with more than one Delivery Group. Application Groups will be covered in detail in Module 7.

Additional Resources:

- Delivery Groups - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/install-configure/delivery-groups-create.html>

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Lesson Objective Review

Scenario: You are preparing your company's virtual desktops to be added to the XenApp and XenDesktop Site.

What are the steps that you need to complete to add the desktops to the Site and enable them to register with the Delivery Controller and why?

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Lesson Objective Review

Scenario: You are preparing your company's virtual desktops to be added to the XenApp and XenDesktop site.

What are the steps that you need to complete to add the desktops to the site and enable them to register with the Delivery Controller?

1. Install VDA
2. Create Machine Catalog and add virtual desktops
3. Create Delivery Group and allocate desktops to appropriate users

Key Notes:

Need to install the VDA on the resource so it can register with a Delivery Controller and accept user connections.

Need to create a Machine Catalog and add the machines so that the resources are defined and are ready to be allocated.

Need to create a Delivery Group and add desktops/assign users so that users have permission to access the resources.



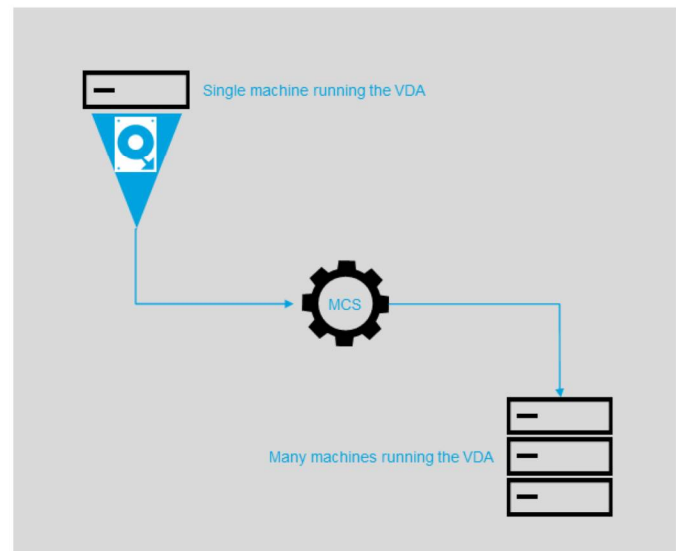
Provisioning Methods and Considerations

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Machine Creation Services (MCS)

A XenApp and XenDesktop included mechanism to create multiple machines as individual clones from a single master image using storage based technologies.



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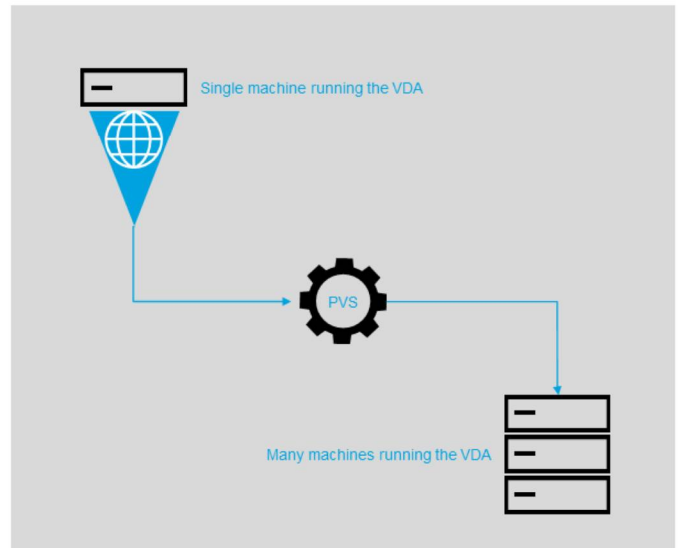
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Key Notes:

- Machine Creation Services is a very simple way of enabling single image management.
- MCS will allow you to create a number of unique machines from one single master machine by utilizing storage level cloning and a number of mechanisms, that will individualize these machines after cloning.

Provisioning Services (PVS)

Provisioning Services is an individual product within XenApp and XenDesktop that can create multiple machines as individual clones from a single master image using network based technologies.



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Key Notes:

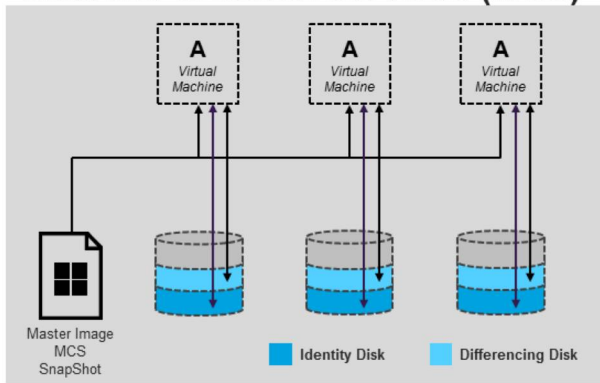
- Provisioning Services is a little more complex to install and configure.
- It will, like MCS, allow you to deploy a number of VDAs all from a single image.
- PVS is typically for larger and more complex environments.
 - Remember our deployment in this course for WW Labs addresses a more simple Proof of Concept.
 - The focus of our deployment is MCS.
- Provisioning Services is an optional component of XenApp and XenDesktop available with some editions. It provides an alternative to MCS for provisioning virtual machines. Whereas MCS creates copies of a master image, Provisioning Services streams the master image to user device. Provisioning Services doesn't require a hypervisor to do this, so you can use it to host physical machines. When Provisioning Services is included in a Site, it communicates with the Controller to provide users with resources.

Additional Resources:

- Concepts and components - https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/technical-overview.html#par_anchor_title_a32c

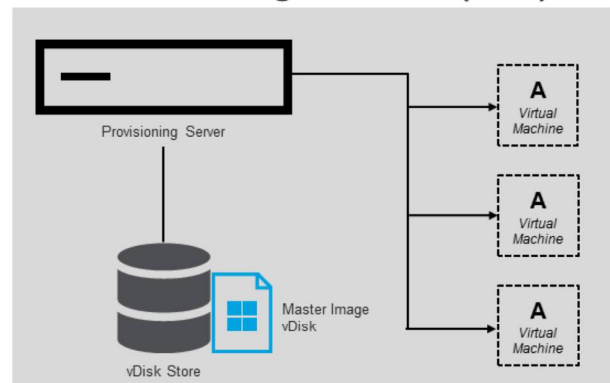
Citrix Preferred Provisioning Methods

Machine Creation Services (MCS)



- Leverages hypervisor APIs through Studio to deploy virtual machines from a single master image snapshot

Provisioning Services (PVS)



- Leverages streaming technology to provision virtual machines from a single shared master image

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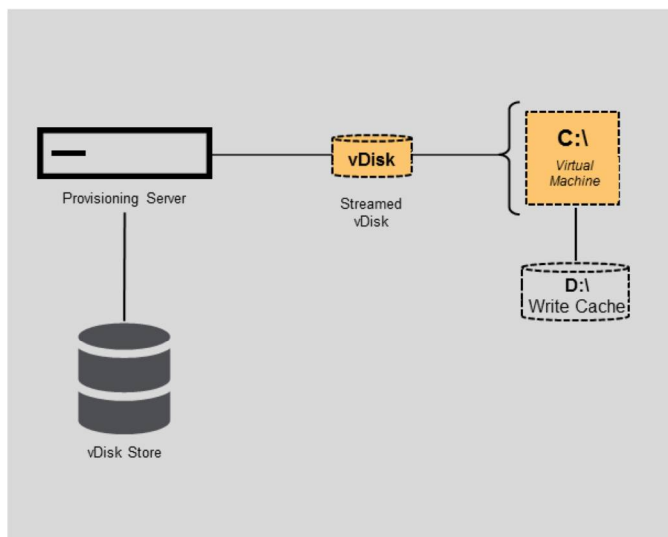
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Key Notes:

- There are two Citrix technologies for provisioning virtual machines that will be discussed in this module.
- This course only covers MCS in depth.

Provisioning Services (PVS) Overview

- Single image management solution that streams read-only vDisk on-demand to machines (target devices)
- A vDisk is created by copying the hard disk contents of the master virtual machine into a VHD file
- Target device requires a write cache to hold the writes for the virtual machine



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Key Notes:

- A vDisk consists of a VHD base image file, a properties file (.pvp), and may also contain a chain of referenced VHD differencing disks (.avhdx). Every time a vDisk is updated using the Provisioning Services versioning method, a new differencing disk file is created.
- Note that the machines that the PVS server streams the vDisk to are referred to as target devices.
- Brief PVS Explanation:
 - Administrator creates a master VM that contains the OS, applications, and other configurations desired.
 - The OS/applications are then captured to a vDisk via the Imaging Wizard.
 - The vDisk is stored in a vDisk store to which the PVS server has access.
 - The PVS server streams the vDisk to the target devices (typically virtual machines), streaming only the bits and bytes necessary for the machine's operation.
 - The vDisk provides the OS for the machine (represented in the diagram by the fact that the vDisk provides the C:\ contents for the target device).
 - Because the vDisk is in read-only mode when available to multiple devices, it is necessary for each target device to have a write cache that handles the writes for the machine (represented in this diagram by a disk attached to the target device).

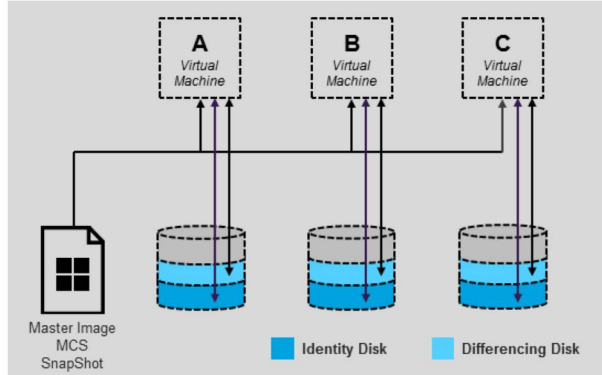
Additional Resources:

- PVS 7.11 overview - <http://docs.citrix.com/en-us/provisioning/7-11/overview.html>

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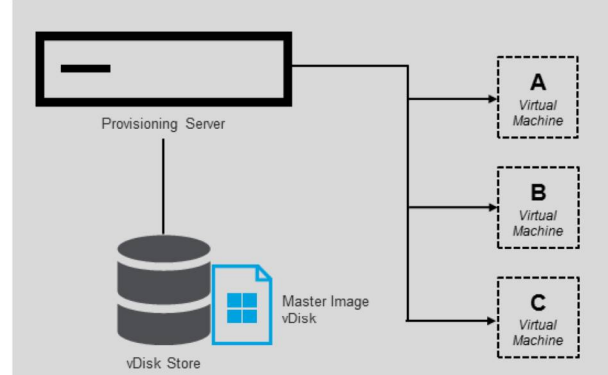
Citrix Preferred Provisioning Methods – Comparison of Advantages

Machine Creation Services (MCS)



- Does not require additional infrastructure
- Provides quick time to value
- Option to enable read and write caching
- Option to utilize full clone

Provisioning Services (PVS)



- Contains versioning feature for testing
- Does not require hypervisor
- Does not require central storage repositories
- vDisk can be synchronized to other datacenters

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Key Notes:

- In previous versions it was easier to choose between MCS and PVS, but the feature gap is much smaller today.
- MCS does not require administrators to build out additional infrastructure or to learn another product, decreasing time and build requirements.
- MCS provides administrators with a quick way to deploy multiple VMs from single shared image, decreasing time to production rollout.
- MCS has added RAM based caching to put performance on par with PVS.
- MCS can now utilize full clones to accommodate backup and storage replication of virtual machines.
- PVS has a unique versioning feature that allows for fast and easy update and roll back of updates.
- PVS can work with physical machines as well as virtual machines.
- PVS can host the images on local storage, reducing the need to plan for SAN capacity.
- PVS maintains the image in a .vhd or .vhdx file (also known as the vDisk), so if we have multiple datacenters, we can simply copy the vDisk image between them using any preferred file sharing mechanism.

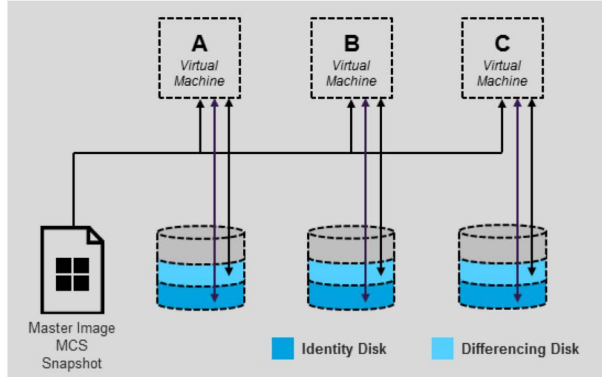
Additional Resources:

- Provisioning Services or Machine Creation Services 2016 Edition - <https://www.citrix.com/blogs/2016/06/28/provisioning-services-or-machine-creation->

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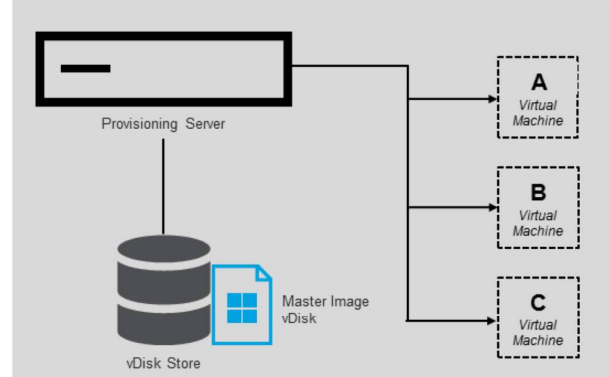
Citrix Preferred Provisioning Methods – Comparison of Considerations

Machine Creation Services (MCS)



- Needs image in each storage repository
- Does not contain a versioning feature
- Will not work with physical machines

Provisioning Services (PVS)



- Depends heavily on network infrastructure
- Needs additional infrastructure and skill set
- No built in deploy to cloud feature

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Key Notes:

- MCS:
 - A copy of the master image needs to be stored in each storage repository configured for the host connection for MCS, increasing storage requirements.
 - MCS does not include a versioning feature that enables the same steady promotion from maintenance -> test -> production as PVS does.
 - MCS cannot be used with physical machines.
- PVS:
 - PVS relies on the networking infrastructure in place, as it streams the image over the network.
 - PVS requires additional infrastructure to be installed and configured for high availability and redundancy. Also, administrators will need to learn how to build, configure, and manage the technology.
 - PVS does not have built in cloud deployment features. To use PVS on AWS or Azure, a separate PVS environment has to be created in the cloud.

Additional Resources:

- Provisioning Services or Machine Creation Services 2016 Edition - <https://www.citrix.com/blogs/2016/06/28/provisioning-services-or-machine-creation-services-2016-edition/>

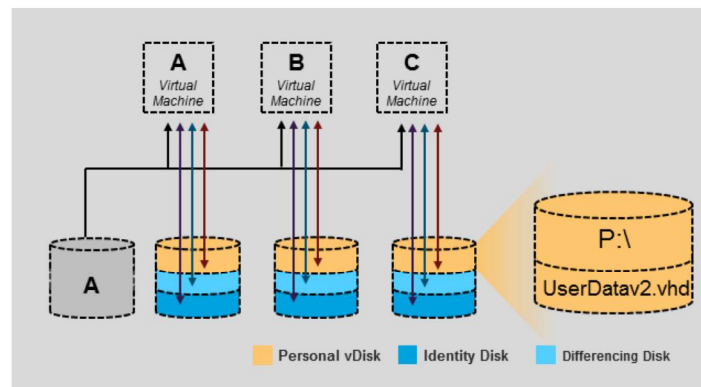


Compare MCS and PVS. What are the advantages and considerations of each image management strategy and why?

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Personal vDisk (PvD) Overview

- Enables single image management for base virtual machine, while allowing users complete user personalization
- Redirects user changes to a separate disk, named the Personal vDisk, that is attached to the virtual machine
- Supports Desktop OS only and can be leveraged with MCS and PVS



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Key Notes:

- The diagram is showing MCS with PvD, but PvD can be leveraged with PVS too. In the case of PVS, the PvDs would be attached to the target devices.
- With PvD, users can install applications and have all their changes persist.
- PvD is not the same as a differencing disk, as differencing disks store changes as block-based differences. PvD stores changes at the object level, enabling files, folders, and registry settings to persist.
- The Personal vDisk has a P:\ drive, which stores the user profile (user data, documents, and user profile) and a UserDatav2.vhd that stores all apps installed on C:\Program Files, etc.
- A PvD is assigned to a pooled static virtual machine (desktop in a machine catalog), which is then assigned to a user on first login.
- The lab will not be covering PvD since it is a limited use case.
- You can manually adjust the automatic resizing algorithm that determines the size of the VHD relative to the P: drive, by setting the initial size of the VHD. This can be useful if, for example, you know users will install a number of applications that are too big to fit on the VHD even after it is resized by the algorithm. In this case, you can increase the initial size of the application space to accommodate the user-installed applications.
- Preferably, adjust the initial size of the VHD on a master image. Alternatively, you can adjust the size of the VHD on a virtual desktop when a user does not have sufficient space to install an application. However, you must repeat that operation on each affected virtual desktop; you cannot adjust the VHD initial size in a catalog that is already created.

- Ensure the VHD is big enough to store antivirus definition files, which are typically large.

Additional Resources:

- Personal vDisk intro - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/install-configure/personal-vdisk.html>

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Personal vDisk (PvD) Considerations

Personal vDisk is for a niche use case and should not be used for all users

- Specific applications can cause issues if installed on the PvD and not on the master image
- Uninstalling or updating applications on a master image can conflict with user-installed applications
- Troubleshooting efforts include determining if the issue is in base image or PvD
- Increased management/operational overhead required affects solution scalability
- Changes are difficult to test prior to rollout as each PvD for a user is different
- The PvDs require an additional backup strategy for disaster recovery purposes

Key Notes:

- PvD is not a solution for every user, it is for a particular niche use case.
 - An example use case would be when a roaming profile does not provide the necessary personalization for a user group and the users require the ability to install applications that administrators do not want to be part of base image or do not want to install/publish.
- You need to determine the applications that have to be installed on the base image due to the fact that they will conflict with the reconciliation process if installed on the PvD. Applications that need to be installed on the master image include applications that modify the Windows network stack or early-boot drivers, agents and clients, and VM tools.
- An administrator uninstalling/updating an application on the base image could cause an issue if a user has installed an add-on for the application onto the PvD or an application that has a dependency on the previous application.
- Because each Personal vDisk is different, administering and managing the solution requires additional time/processes.
- PvD is excluded from LTSR Support because it is still a feature in development.
- Some software might conflict with the way that PvD composites the user's environment, so you must install it on the master image (rather than on the individual machine) to avoid these conflicts. In addition, although some other software might not conflict with the operation of PvD, Citrix recommends installing it on the master image.
- Applications that must be installed on the master image:

- Agents and clients (for example, System Center Configuration Manager Agent, App-V client, Citrix Receiver)
- Applications that install or modify early-boot drivers
- Applications that install printer or scanner software or drivers
- Applications that modify the Windows network stack
- VM tools such as VMware Tools and XenServer Tools

Additional Resources:

- Personal vDisk 7.x Tools - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/install-configure/personal-vdisk/personal-vdisk-tools.html>
- Configuration and management - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/install-configure/personal-vdisk/personal-vdisk-configure-manage.html>
- Personal vDisk intro - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/install-configure/personal-vdisk.html>

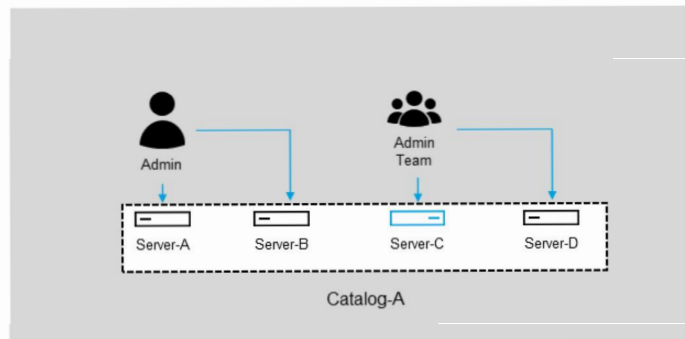


What are some of the considerations that must be taken into account when leveraging the Personal vDisk and why?

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Manual Provisioning

- No central management for deployment/ update
- Risk of inconsistency
- Time-consuming for larger catalogs
- MCS Full Clone can substitute the need for manual provisioning in many cases



Key Notes:

- The graphic demonstrates one server (blue) being inconsistent because it is provisioned manually.
- Manual provisioning is not the Citrix preferred method.
- Some customers are forced to provision VDAs manually. For example:
 - The Citrix Admin Team does not have appropriate permissions to use MCS on the hypervisor or storage.
 - Some applications may need special installation procedures and cannot be installed and cloned via MCS.
- Currently 55% of Citrix customers are using manual creation methods. Although fully supported, manual provisioning has some potential drawbacks:
 - Does not create a central place for updates
 - Does not address and minimize the storage footprint of a catalog
 - Does not address any storage I/O optimization
 - Takes far longer to create larger catalogs
 - Creates potential inconsistencies for the machine within a catalog

Additional Resources:

- XenApp and XenDesktop MCS Full Clone Support -

<https://www.citrix.com/blogs/2016/10/12/xenapp-and-xendesktop-7-11-mcs-full-clone-support/>

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Lesson Objective Review

Scenario: You are the Citrix Admin and you are about to deploy 2000 Virtual Desktops, and having the ability to efficiently change between image versions is important. There is no need for user installed apps or persistency.

Which provisioning method would you start to investigate?

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Lesson Objective Review

Scenario: You are the Citrix Admin and you are about to deploy 2000 Virtual Desktops, having the ability to efficiently change between image versions is important. There is no need for user installed apps or persistency.

Which provisioning method would you start to investigate?

[Provisioning Services](#)

Key Notes:

- MCS relies on snapshots and the whole catalog must be updated at once.
- On the other hand, PVS has the ability to move a vDisk between three stages (Maintenance, Test, and Production) as well as the versioning feature, which allows a single machine to boot on any version without updating the whole catalog.



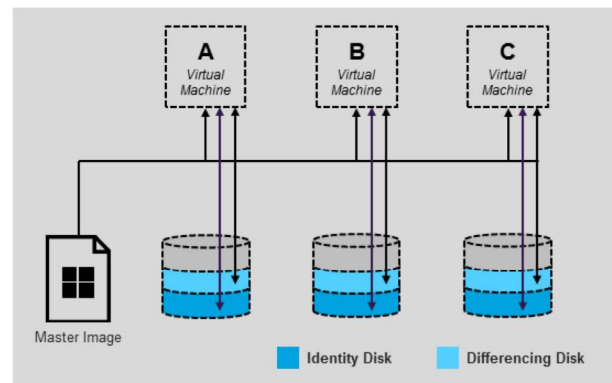
Provisioning Methods: MCS in Detail

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Machine Creation Services (MCS) Overview

- Single image management solution that is built into XenApp and XenDesktop
- Creates virtual machines that are linked to a base, prepped master image
- Attaches an identity disk and differencing disk to each virtual machine created
 - Identity disk: a 16 MB persistent disk that contains hostname and Active Directory machine account
 - Differencing disk: a disk that holds the writes for each virtual machine
- Full Clone copies the entire image to each VM and does not use a differencing disk



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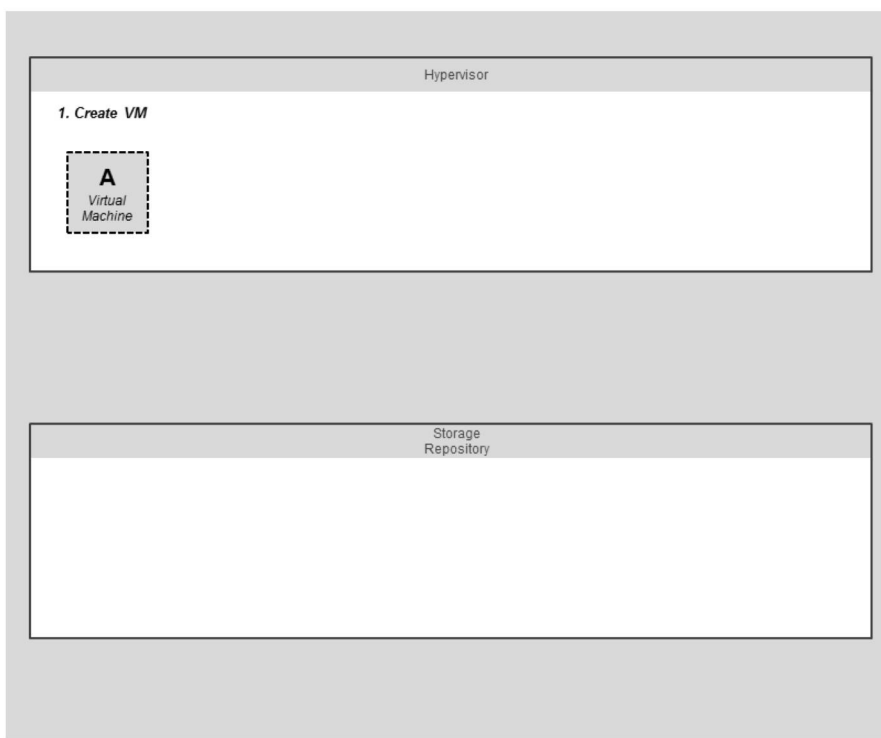
Key Notes:

- MCS leverages a linked-clone approach to provisioning, with virtual machines reading from a read-only master image that has been de-personalized. Each virtual machine is assigned an identity disk that gives the machine a unique identity and a differencing disk that handles the writes for the virtual machine.

Machine Creation Services

Step 1 (Manual):

Create the master virtual machine by installing and configuring the desired OS and applications



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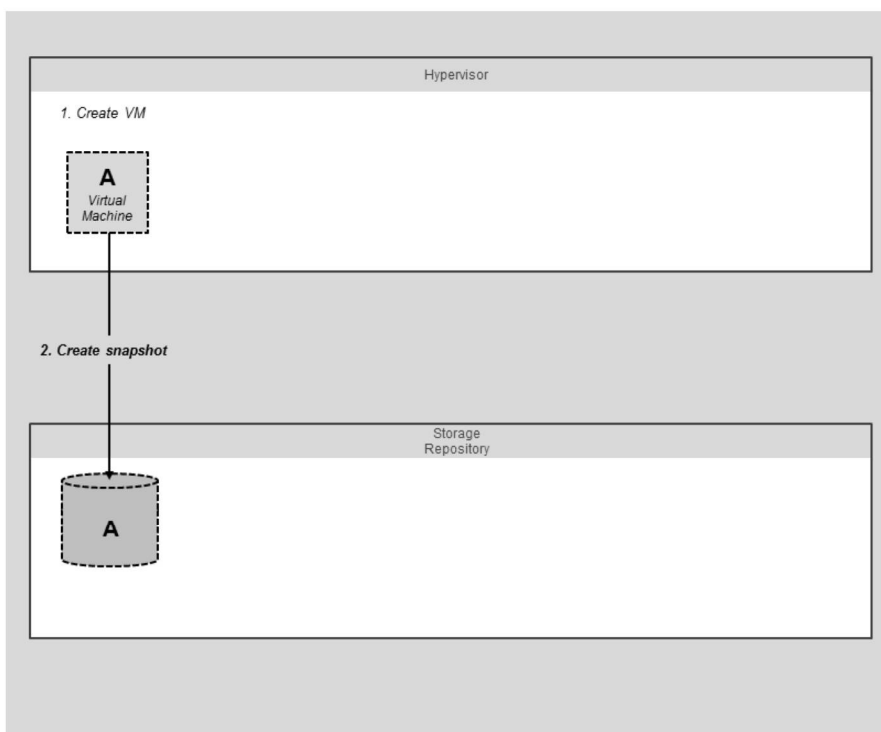
Key Notes:

- In this step, the administrator is creating a virtual machine that has the necessary configurations and applications required for the targeted use case.
- Note that deleting, moving, or renaming master images will prevent administrators from being able to revert a machine catalog if necessary.

Machine Creation Services

Step 2

(Manual or Automatic):
Create a snapshot of the master virtual machine



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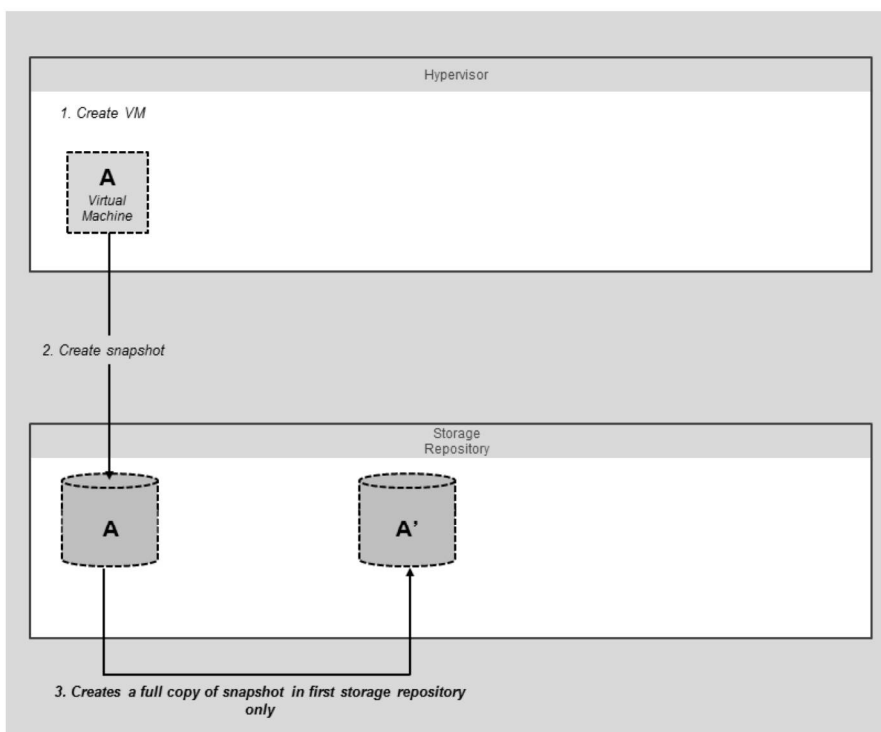
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Key Notes:

- There are two options:
 - **Manual:** the administrator takes a snapshot of the master VM. This option is considered leading practice because it enables the administrator to determine a desired, meaningful naming convention.
 - **Automatic:** if a snapshot is not taken, when the administrator selects the master VM in the MCS wizard, Studio will automatically take a thin snapshot of the VM using an automatic naming scheme and will provide that snapshot to MCS.

Machine Creation Services

Step 3 (Automatic):
MCS creates a full copy of the snapshot and stores it in the first storage repository configured only



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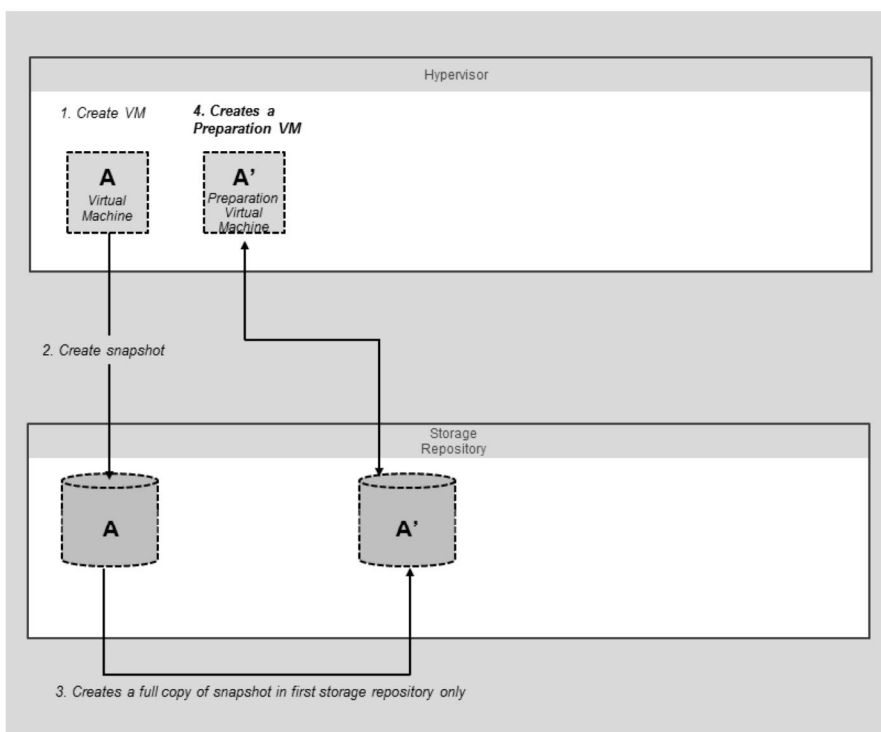
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Key Notes:

- MCS is creating a full copy of the snapshot that was provided so that all machines that will be provisioned will have the same desired properties and configurations from the master VM.
- MCS creates a full copy of the snapshot and stores it so that it can be updated in order to provision multiple VMs, and so that there is no impact if the administrator deletes the original snapshot.

Machine Creation Services

Step 4 (Automatic):
MCS creates a Preparation Virtual Machine to be used for the image preparation process



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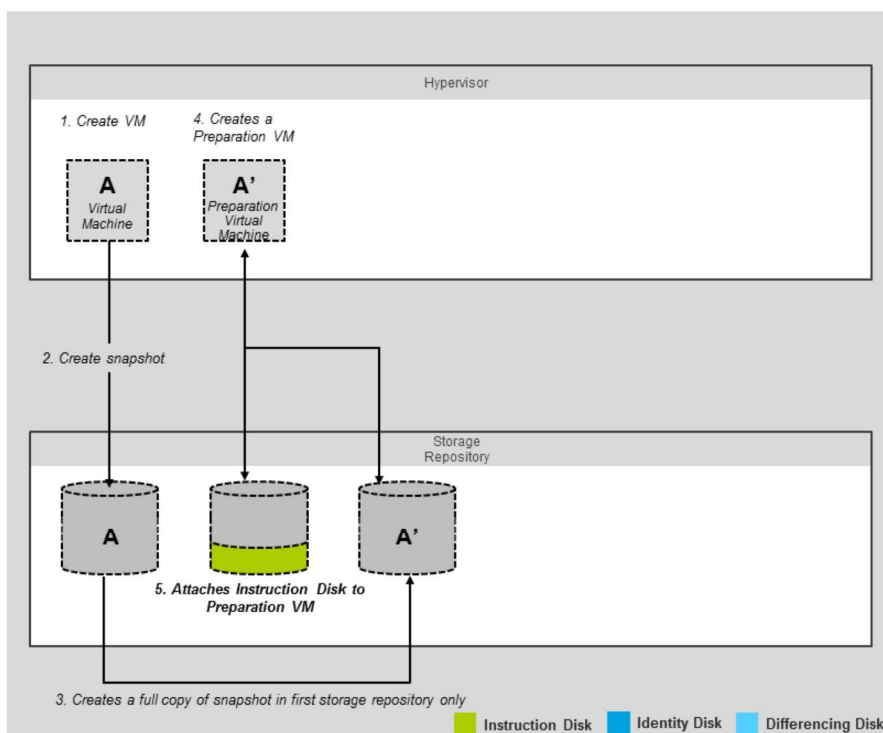
Key Notes:

- A temporary virtual machine is created from the snapshot so that an image preparation process can be run to depersonalize the VM.
- The Preparation VM is created with the network disconnected to prevent any issues with the operation of the original master image.

Machine Creation Services

Step 5 (Automatic):

MCS attaches an Instruction Disk to the Preparation VM that contains the image preparation steps



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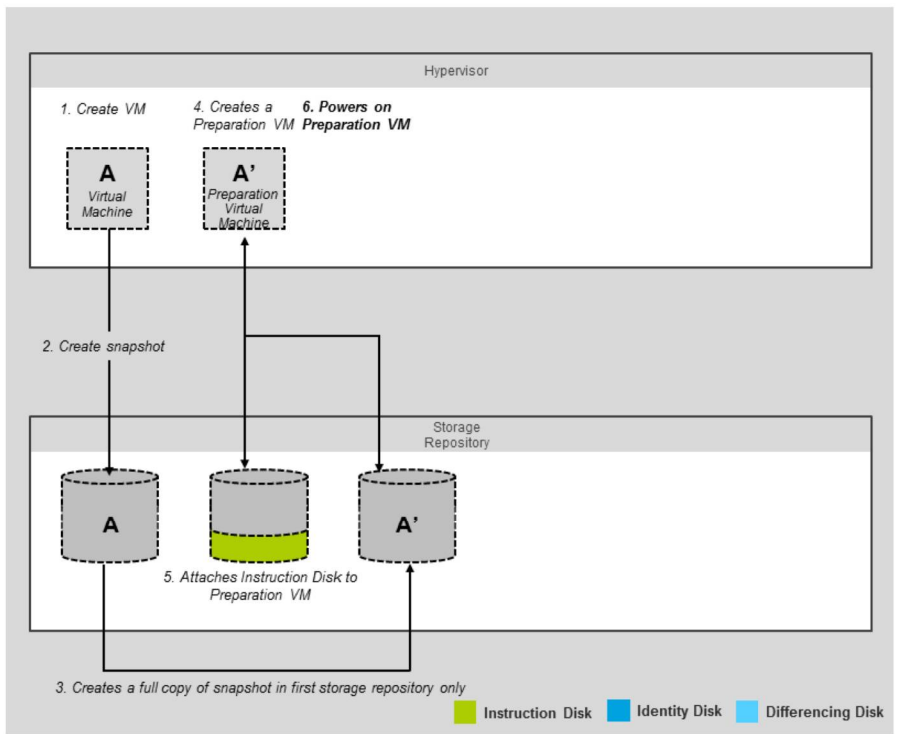
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Key Notes:

- The Instruction Disk will tell the Preparation VM the steps that need to be run in order to depersonalize the VM.

Machine Creation Services

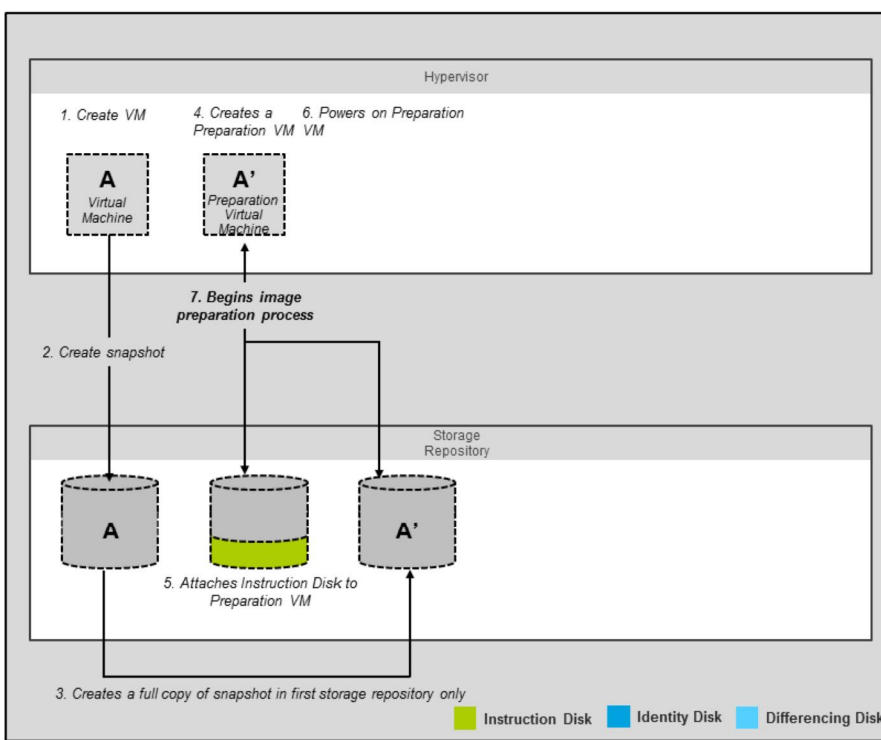
Step 6 (Automatic):
MCS powers on the Preparation VM



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Step 7 (Automatic): MCS begins the image preparation process, which includes rearming KMS, enabling DHCP, and (optionally) performing PvD inventory



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Key Notes:

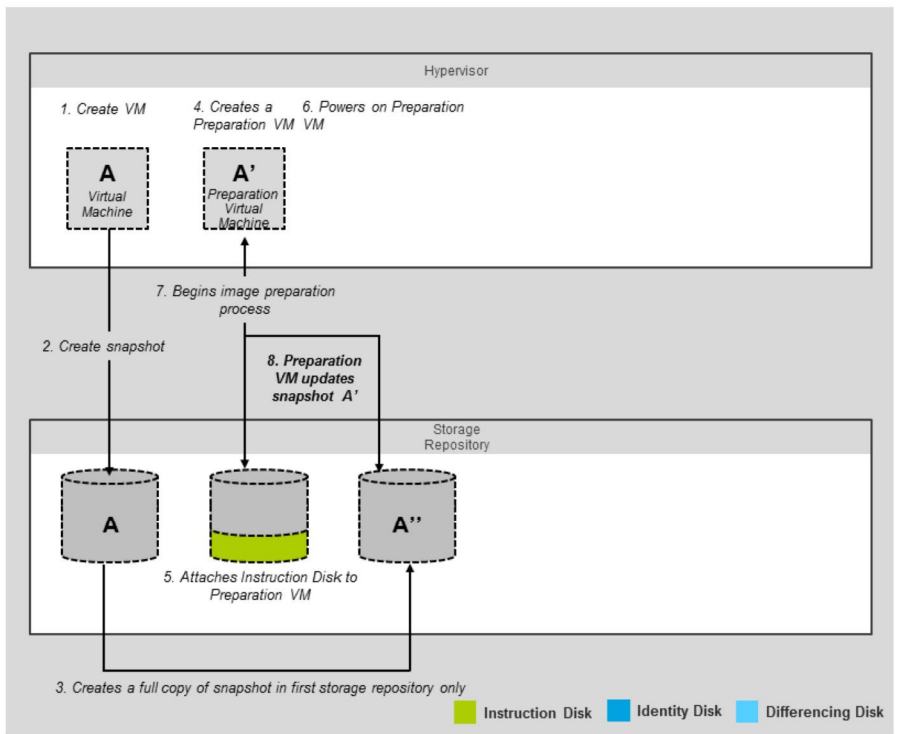
- The PvD inventory step is only applicable if the Personal vDisk feature is being used, which will be discussed later in the module.
- The image preparation process is where the Preparation VM runs through the list of instructions that it obtained from the Instruction Disk. It is depersonalizing the copy of the snapshot to change the base OS so that it can be used to provision multiple machines. This is why sysprep does not need to be run manually when creating a master image with MCS, because the image preparation process automatically performs the necessary de-personalization.

Additional Resources:

- Machine Creation Service: Image Preparation Overview and Fault-Finding: <https://www.citrix.com/blogs/2016/04/04/machine-creation-service-image-preparation-overview-and-fault-finding/>

Machine Creation Services

Step 8 (Automatic): The Preparation VM updates the copy of the snapshot following the completed image preparation process



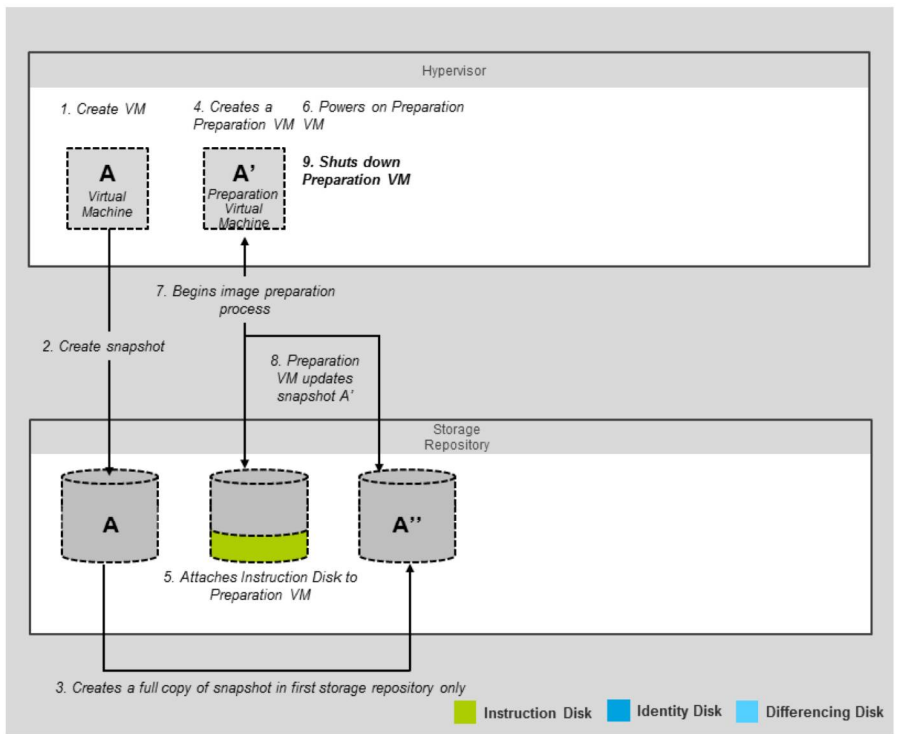
Key Notes:

- The preparation VM updates the copy of the snapshot following the image update process, represented in the diagram by the copy of the snapshot being updated from A' to A''.

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Machine Creation Services

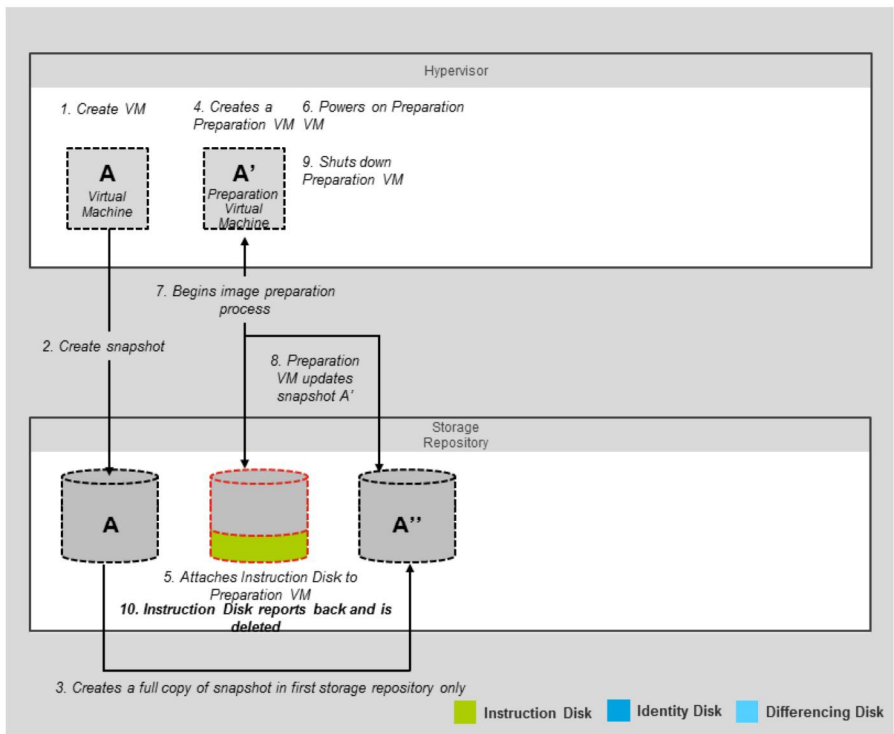
Step 9 (Automatic):
MCS shuts down the Preparation VM



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Machine Creation Services

Step 10 (Automatic): The instruction disk reports the results of the image preparation process and is then deleted



Key Notes:

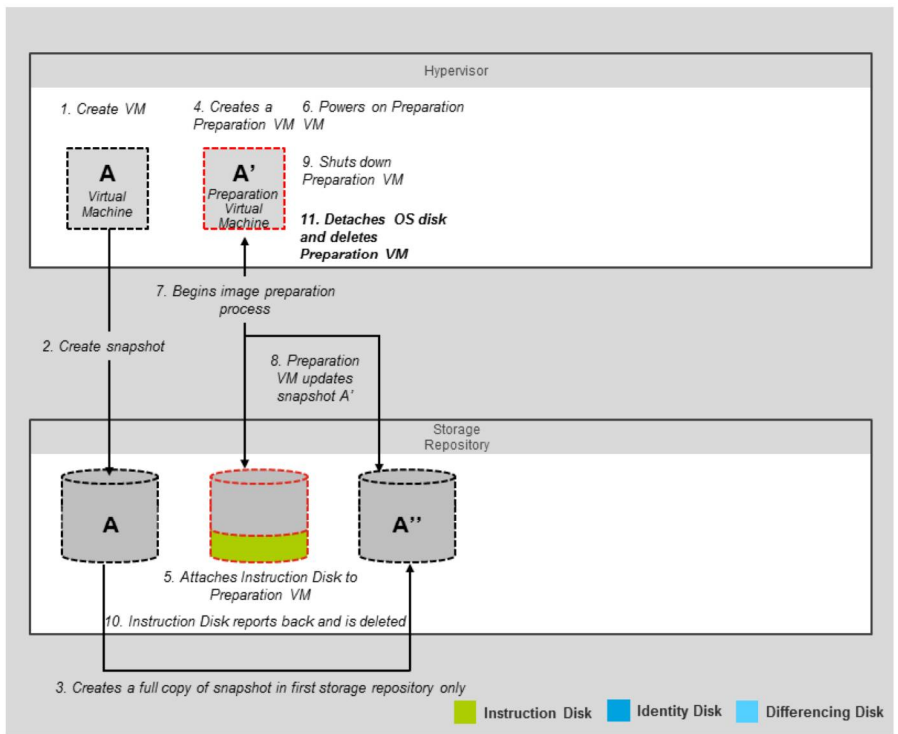
- The instruction disk reports the success/failure of the steps run during the image preparation process and only moves on with the MCS process if the steps were successfully completed. After reading the report back to MCS, the instruction disk is then deleted.

Additional Resources:

- Machine Creation Service: Image Preparation Overview and Fault-Finding: <https://www.citrix.com/blogs/2016/04/04/machine-creation-service-image-preparation-overview-and-fault-finding/>

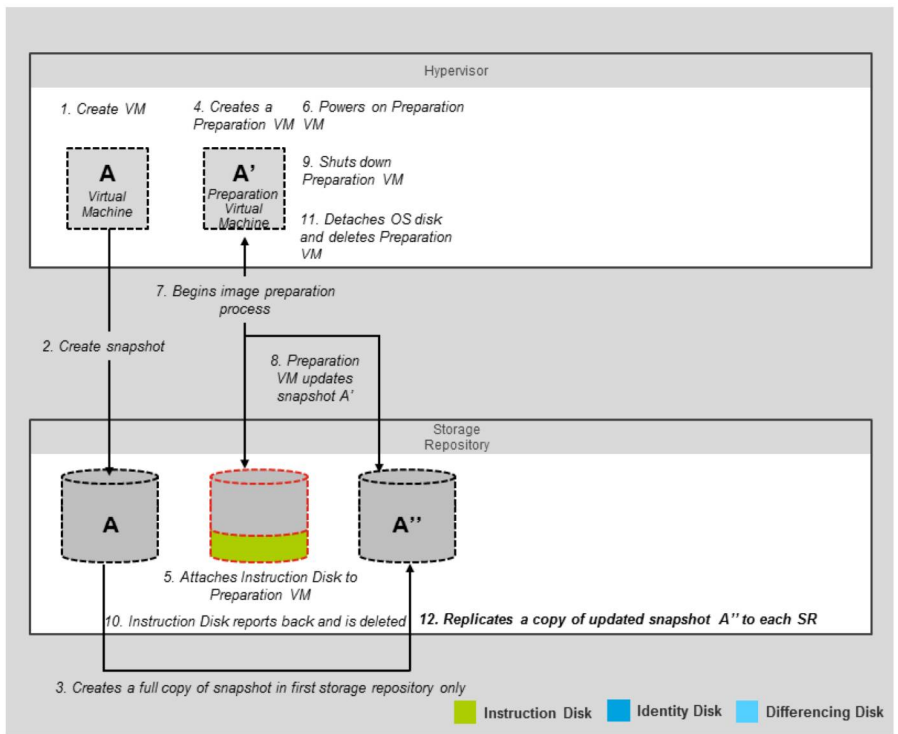
Machine Creation Services

Step 11 (Automatic): MCS detaches the OS disk of the Preparation VM and deletes the virtual machine



Machine Creation Services

Step 12 (Automatic):
MCS replicates the copy of the updated snapshot to each storage repository configured

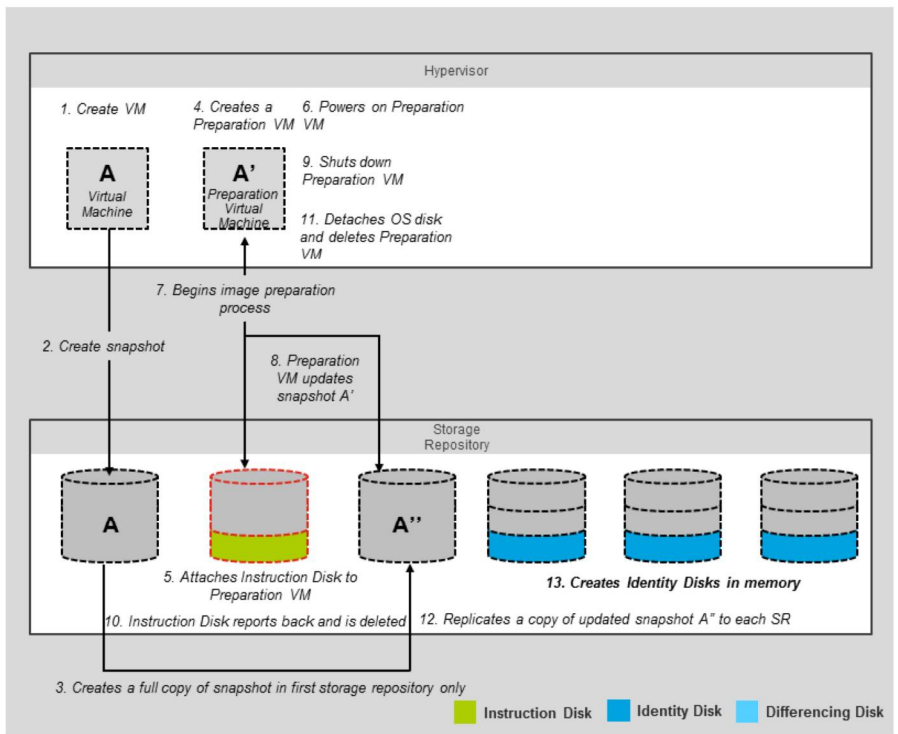


Key Notes:

- Now that the copy of the snapshot has been updated and prepared for use with multiple VMs, the copy can be replicated to each storage repository configured for the host connection. The copy of the snapshot is read-only, and the virtual machines will reference the copy of the snapshot in the applicable storage repository.
- Important to note that because the snapshot copy needs to be placed in each storage repository, the number of storage repositories will affect storage requirements.

Machine Creation Services

Step 13 (Automatic):
MCS creates identity disks in memory for each virtual machine to be created



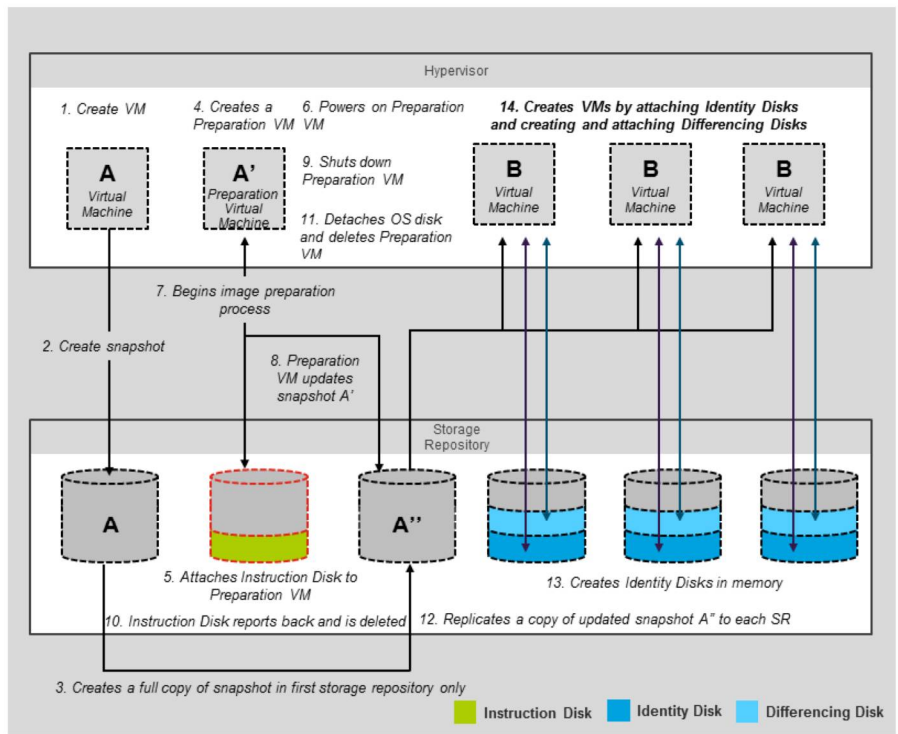
Key Notes:

- The identity disks for each VM are created in memory.

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Machine Creation Services

Step 14 (Automatic): MCS creates the virtual machines by attaching identity disks and creating and attaching the differencing disks

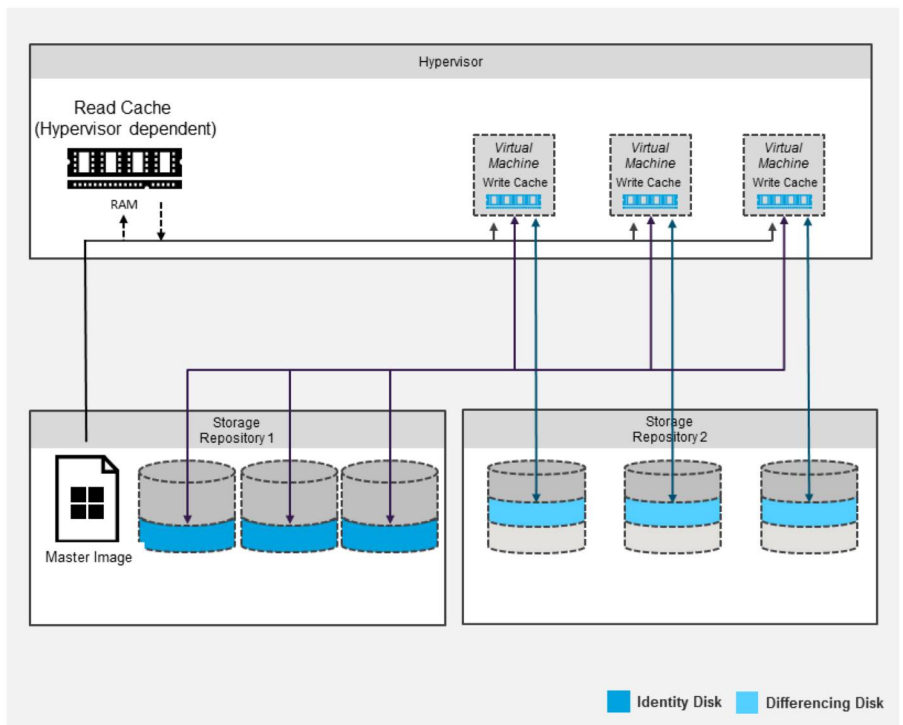


Key Notes:

- MCS creates each VM by attaching the identity disk and creating and attaching a differencing disk. This is done for each VM that needs to be created.
- Since each virtual machine is pointing to the read-only snapshot copy, the virtual machines need a unique identity (provided by the identity disk) and a disk to handle its writes (provided by the differencing disk).

MCS I/O Optimization

- Ability to place differencing disk on separate local storage.
- Ability to leverage virtual machine memory as write cache to reduce I/O.
- XenServer IntelliCache can optimize read IO.



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Key Notes:

- With the release of version 7.9 through 7.12 we have three new features that bring the performance of MCS on par with Provisioning Services.
- We can specify several Storage Repositories per hosting connection, allowing administrators to utilize less expensive local storage, rather than expensive SAN solutions.
- We can configure a Machine Catalog to use RAM to optimize the temporary writes (similar to the PVS option “write cache in memory with offload to disk”).
- We can configure the latest release of XenServer to cache the common Shared OS disk in memory to further minimize central I/O load. (This feature is not supported on any other hypervisor).

Additional Resources:

- Introducing MCS Storage Optimization - <https://www.citrix.com/blogs/2016/08/03/introducing-mcs-storage-optimisation/>
- IntelliCache and In-memory Read Caching - <https://support.citrix.com/article/CTX201887>



- What part will MCS play in your deployment?

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Lab Exercise

- Exercise 4-2: Create a Machine Catalog for Server OS Using MCS
- Exercise 4-3: Create a Machine Catalog for Server OS using Manual Provisioning
- Exercise 4-4: Create Two Server OS Delivery Groups
- Exercise 4-5: Create a Machine Catalog for Remote PC
- Exercise 4-6: Create a Delivery Group for Remote PC
- Exercise 4-7: Create a Snapshot of the Desktop OS VM
- Exercise 4-8: Create a Desktop OS Catalog
- Exercise 4-9: Create Delivery Group for Desktop OS

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Lesson Objective Review

Scenario: You are the Citrix Admin and you are about to deploy 2000 Virtual Desktops using Machine Creation Services.

How much space would you need to allocate for the Identity Disks in your environment?

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Lesson Objective Review

Scenario: You are the Citrix Admin and you are about to deploy 2000 Virtual Desktops using Machine Creation Services.

How much space would you need to allocate for the Identity Disks in your environment?

$$16 \text{ MB} * 2000 = 32 \text{ GB}$$

Key Notes:

- MCS will generate an Identity Disk for each cloned VM, this disk is always 16 MB.
- MCS will also generate a Difference Disk for each VM, the size of this depends on the size of the Master VM disk.

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MCS Environment Considerations

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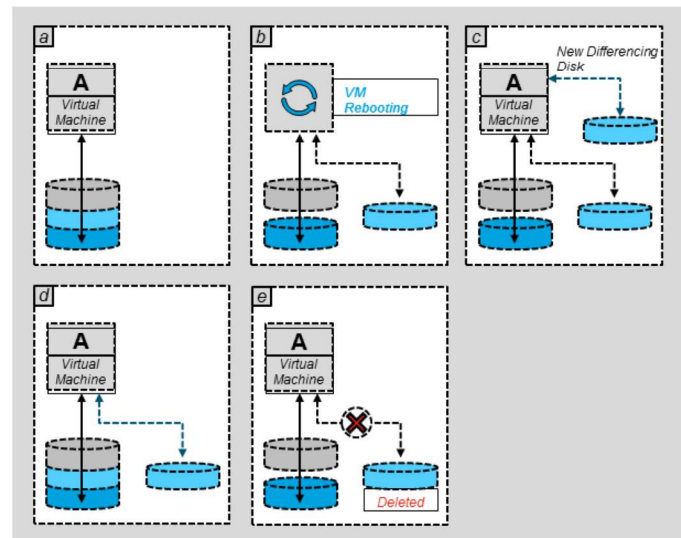
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Reboot Effects – Random/Non-Persistent Desktop

The effects of a reboot on an MCS provisioned random/non-persistent desktop)

Key Takeaway: Differencing disk is deleted following a reboot, discarding user changes

1. If hypervisor supports clone on boot, it resets the differencing disk on reboot
2. If hypervisor does not support clone on boot, then:
 - a) Virtual machine is in steady state
 - b) The virtual machine is rebooted and the differencing disk is disconnected
 - c) A new differencing disk is created
 - d) A new differencing disk is attached
 - e) The old differencing disk is queued for deletion



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Key Notes:

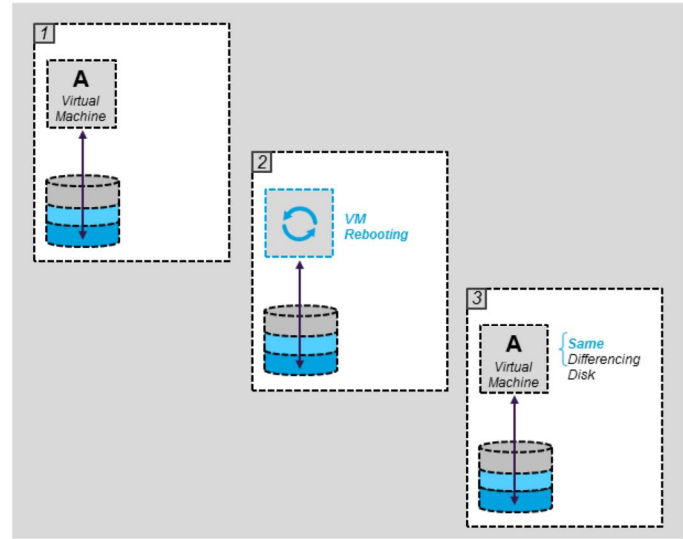
- The differencing disks are discarded because the user changes do not persist for random/non-persistent desktops.
- Since the differencing disks are queued for deletion, this increases the storage consumption and should be taken into account when determining the storage requirements.
- Hypervisors supporting clone on boot include:
 - VMware hypervisors
 - XenServer 6.1 and up
 - Pre-XenServer 6.1 supported for local and iSCSI storage repositories, but not for NFS storage repositories
 - Pre-XenServer 5.6 not supported

Reboot Effects – Static/Persistent Desktop

The effects of a reboot on an MCS provisioned static/persistent desktop

Key Takeaway: Differencing disk is not deleted following a reboot, persisting user changes

1. Virtual machine is in steady state
2. The virtual machine is rebooted
3. The virtual machine completes the startup process and the same differencing disk is still attached



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Key Notes:

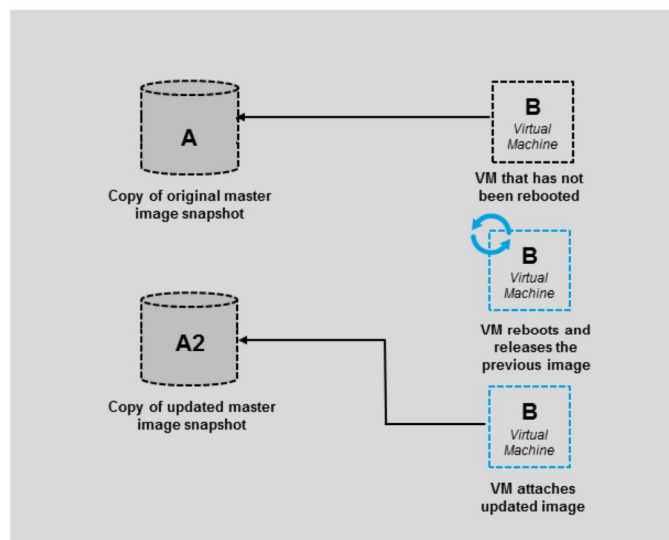
- The differencing disk is not deleted following reboot as user changes are required to persist for the static/persistent desktop.

Updating Master Image – Random/Non-persistent Desktop

The process of updating an MCS master image for random/non-persistent desktop

Key Takeaway: Virtual machines are instructed to boot from latest version following a reboot

- Master VM image is updated
- After the virtual machine reboots, it reads from the latest image



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Key Notes:

- When the administrator updates the master VM and goes into the machine catalog and selects Update Catalog option, this creates a new full copy of the snapshot, which is then updated via the image preparation process.
- The VMs are then instructed on reboot to point to the latest updated image. VMs that have not been rebooted will continue to point to the original image snapshot.
- A2 indicates the new version of the master VM.
- It is leading practice to take snapshots or copies of master image for rollback purposes in the event there is an issue with the update.

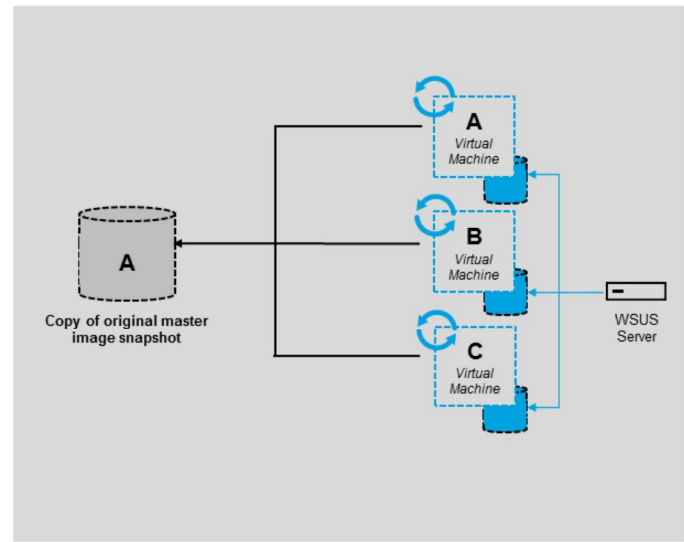
Updating Image – Static/Persistent Desktop

The process of updating a static/persistent desktops

Key Takeaway: When creating a static Machine Catalog using MCS, you lose the ability to update the catalog centrally using MCS.

Updates can be deployed by utilizing central deployment and update solutions such as ESD and WSUS.

Using Personal vDisk instead of persistent differential disks to save changes will enable central MCS updates.



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Key Notes:

- Static/persistent desktops can not be instructed to read from an updated master image on reboot due to the fact that the persistent differencing disks are tied to the original master image.
- Only newly created Catalogs can be instructed to read from an updated master image.
- Updates for existing machines can be done either manually on an individual basis, or collectively through the use of a third party software distribution tools.
- Adding Personal vDisk to the Catalog will enable you to deploy image updates using MCS, however this approach should be tested as it may incur performance and management overhead.



Group Discussion

How often will your base images need updating?

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Lab Exercise

- Exercise 4-10: Update a Machine Catalog for Desktop OS

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Lesson Objective Review

Scenario: You are the Citrix Admin of a large XenDesktop random/non-persistent environment running on XenServer 6.5.

Your manager is now asking you if the XenDesktop design accommodates Clone On Boot

What do you tell him?

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Lesson Objective Review

Scenario: You are the Citrix Admin of a large XenDesktop random/non-persistent environment running on XenServer 6.5.

Your manager is now asking you if the XenDesktop design accommodates Clone On Boot

What do you tell him?

Yes, XenServer has been supporting Clone On Boot since 6.1.

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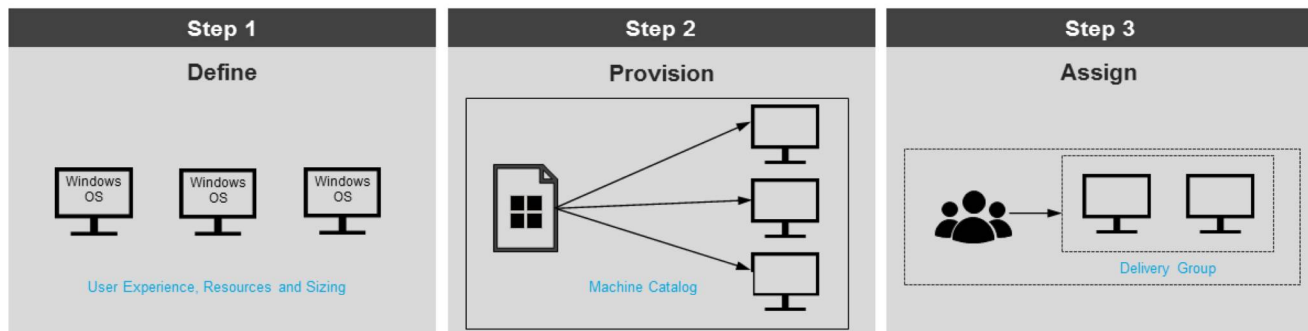


Three Core Steps To Creating Resources

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Three Steps: Define, Provision, Assign



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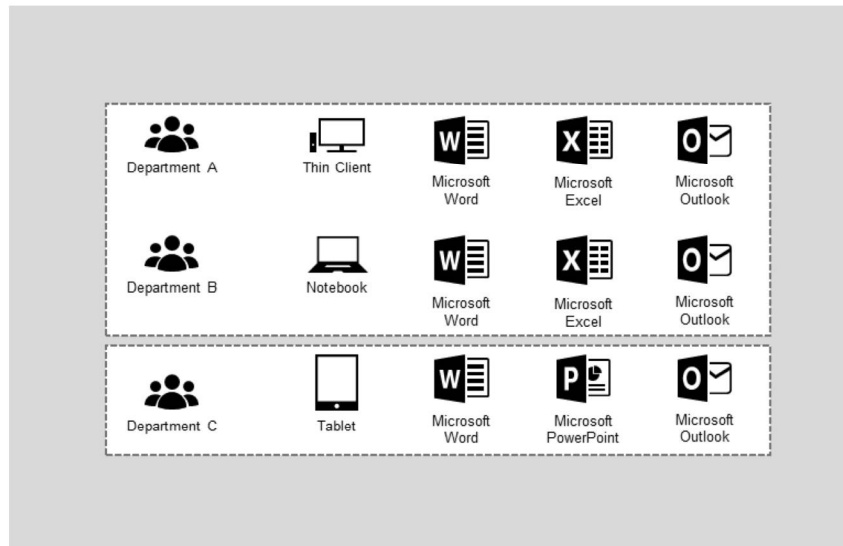
Key Notes:

- There are three high level concepts involved in making a resource available to end users that will be covered in this module:
- (1) the machine needs to be defined (this involves the process of determining user experience, sizing and available resources such as GPU, CPU and RAM, as well as creating the Master Image);
- (2) the correct number of machines need to be provisioned into a Catalog from a master image (typically done through Machine Creation Services or Provisioning Services);
- (3) the resource needs to be assigned to the right users (done through a Delivery Group).

Step 1: Define

Determine the demand per user group:

- Estimated CPU and memory resources
- Applications used
- Mobility requirements



Key Notes:

- Step 1 starts with research and documentation.
- Each group of users has its own requirements in terms of mobility, security, updates & flexibility, provided applications, resource impact, level of personalization, high-availability, and other factors. Grouping users with common requirements together enables them to share a FlexCast model, an image or even a VDA and allows for more accurate planning.
- Once the research is done, a master image must be defined.

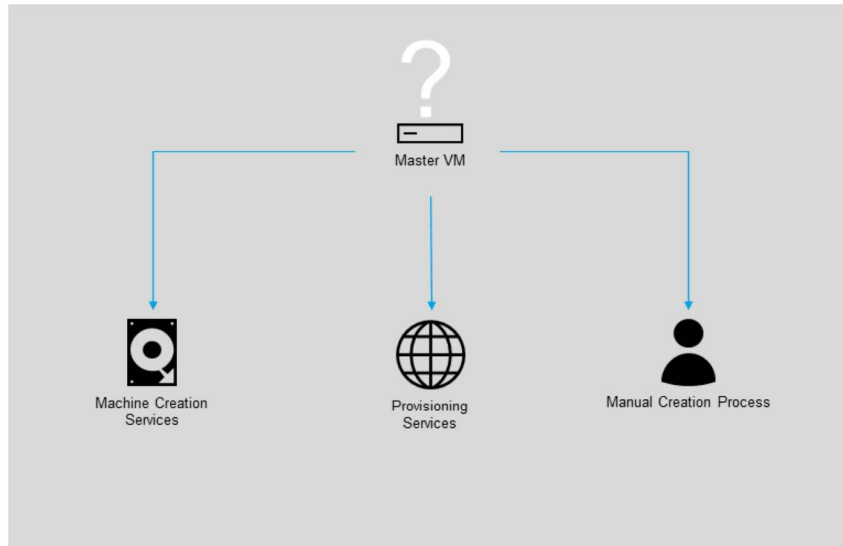
Additional Resources:

- Citrix VDI Handbook – Define the user groups (page 13):
<https://support.citrix.com/article/CTX139331>

Step 2: Provision

Choose the best provisioning model for

- Flexibility
- Performance
- Scalability
- Ease of use



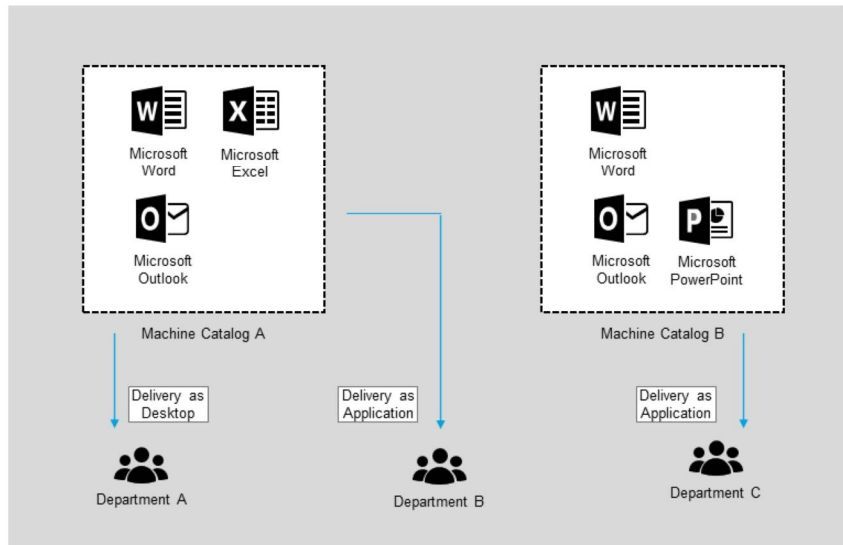
Key Notes:

- During Step 2 the actual resources (and maybe their infrastructure) will be created. The resources can be grouped into Machine Catalogs at this time.
- Choosing the “best” delivery model refers to the “most appropriate” for any given company or resource group. Some companies benefit largely by choosing just one single model to address all requirements, while others prefer to have two different models within the same company for different purposes.

Step 3: Assign

Publish the resources from the catalogs to the user groups.

- Desktops or Apps
- Limited Access
- Instant Availability



Key Notes:

- During Step 3 the actual Delivery Groups are created, providing access for users and groups to their desktops and applications.

Lesson Objective Review

Scenario: You are the Citrix Admin and your manager is chasing you down to get the Sales Team connected to the Citrix environment.

Following what you have just learned, what would be the first step in getting the Sales Team onboarded?

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Lesson Objective Review

Scenario: You are the Citrix Admin and your manager is chasing you down to get the Sales Team connected to the Citrix environment.

Following what you have just learned, what would be the first step in getting the Sales Team onboarded?

Define – The first step is to understand their needs.

Key Notes:

- Can a user access resources from more than one Delivery Group?
 - Yes, one user can have access to resources from several Delivery Groups and catalogs.
 - It is common to have different Delivery Groups for a single user group, based on different machine catalogs. While one Delivery Group provides access to generic applications like MS Office, another Delivery Group adds applications specific to the department (financial, marketing etc.). Applications from both (or more) Delivery Groups are visually aggregated in StoreFront / Receiver.
- Another question: Can a Delivery Group consist of machines from different machine catalogs? Yes – but the type of machine catalog has to be the same.
- Another one: Can machines from a single machine catalog be part of different Delivery Groups? Yes, given that each machine can only be associated with one Delivery Group at a time.

Key Takeaways



- The VDA is required to be installed onto each delivered resource to establish a trusted connection with the Delivery Controller and accept user connections.
- The Machine Catalog is a collection of machines that defines available resources and the Delivery Group is an allocation of those resources assigned to users.
- XenApp and XenDesktop provide two single image management solutions: MCS and PVS.
- MCS comes built in to XenApp and XenDesktop FMA and is used to provision machines from a single image or snapshot.
- The MCS environment considerations depend on the type of catalog machines created.
- The three core steps to creating resources are summarized in Define, Provision and Assign.

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XenApp and XenDesktop Administration

Providing Access with StoreFront and Receiver

Module 5



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Lab VM Power Management

The following VMs are required to be powered on before beginning the exercises in this module:

- NYC-ADS-001
- NYC-SQL-001
- NYC-FSR-001
- NYC-XDC-001
- NYC-STF-001
- NYC-MAN-001
- NYC-SRV-001
- NYC-DTP-001
- NYC-WRK-002
- NYC-WRK-001

The remaining VMs need to be powered off.

Note: These VMs are listed in the start-up order.

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Learning Objectives

- Define the StoreFront architecture and requirements.
- Identify the different Receivers and their functionality.
- Examine methods to configure Receiver.

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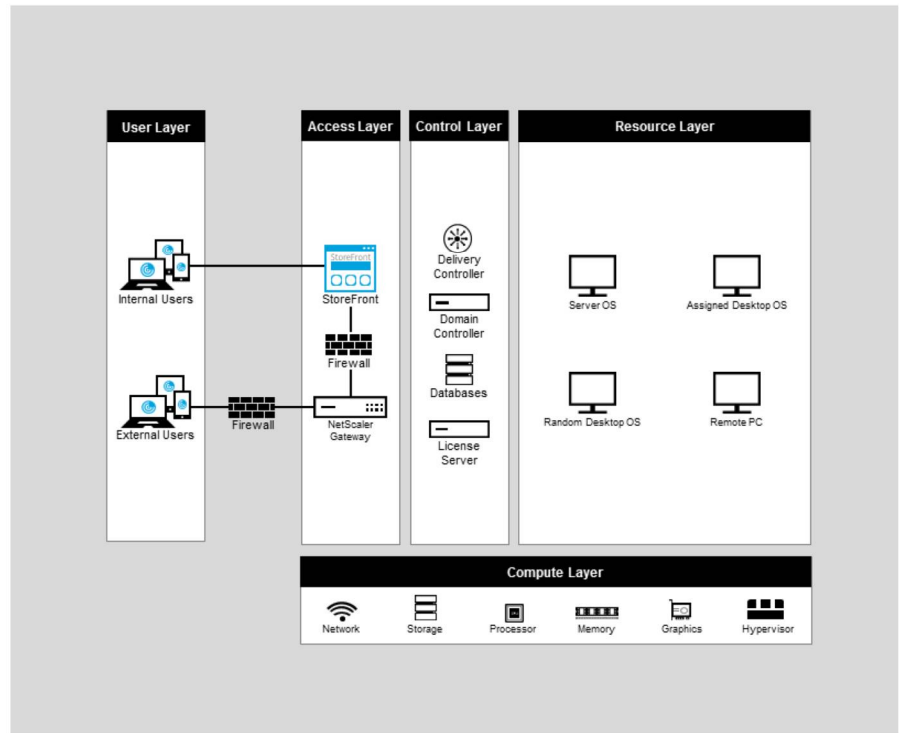
Key Notes:

The Learning Objectives explain what the students can expect to learn and how to learn the concepts presented in this module.

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Providing Access

This module will focus on managing access to resources



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StoreFront Architecture

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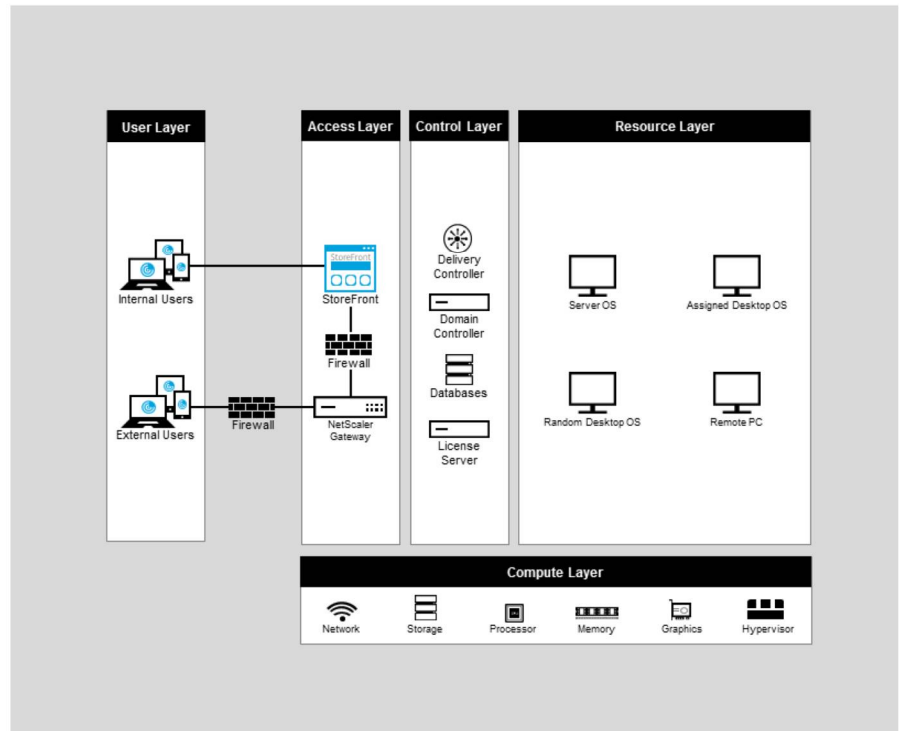
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StoreFront

Web-based Enterprise App Store

StoreFront Responsibilities:

- Authenticates users
- Enumerates resources
- Aggregates resources
- Stores subscriptions
- Deploys Receiver



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Key Notes:

- The function of StoreFront is to authenticate users, then enumerate and aggregate resources for them and provide them with access to these resources.
- StoreFront can be used in parallel to existing Web Interface installations, but both products should not be installed on the same server. NetScaler can be used to divert clients to the appropriate product if necessary.
- StoreFront is the interface that authenticates users, manages applications and desktops, and hosts the application store. StoreFront communicates with the Delivery Controller using XML.

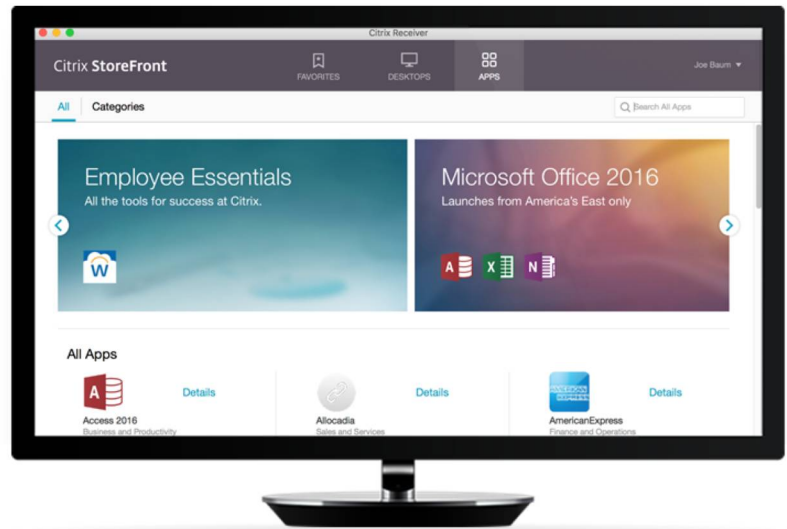
Additional Resources:

- Technical Overview - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/technical-overview.html>

StoreFront - Requirements

Installation Prerequisites

- Required
 - Windows Server 2016
 - Windows Server 2012 R2
 - Windows Server 2012
 - Windows Server 2008 R2 Service Pack 1
 - 2 GB RAM for StoreFront
 - IIS Web Server Role
 - .NET Framework
 - PowerShell
 - Microsoft Management Console
- Recommended
 - Dedicated server
 - SSL certificate



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Key Notes:

- The respective Datacenter, Enterprise and Standard Editions are supported for the Windows Server OS.
- StoreFront installer will install and enable required Windows Roles and Features automatically.
- StoreFront can be set up without a certificate, but doing so puts user credentials at risk and requires additional configuration in Receiver.
- Most deployments are set up using two StoreFront servers and two Load Balancers (e.g. NetScaler) to provide high availability. Special procedures apply and will be taught in a different Citrix training.
- Depending on the size and load of the deployment, up to six StoreFront servers can be grouped together.

Additional Resources:

- StoreFront System Requirements - <https://docs.citrix.com/en-us/storefront/3-8/system-requirements.html>



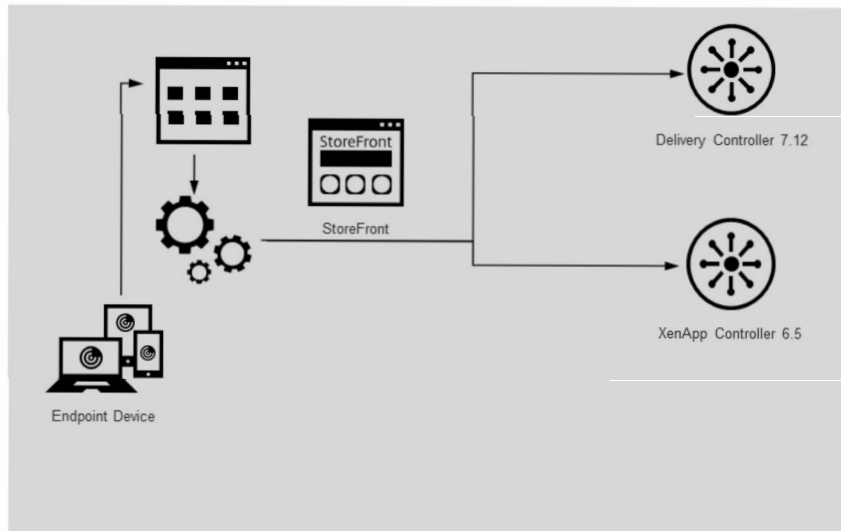
Lab Exercise

- Exercise 5-1: Install the StoreFront Server

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Stores – An Introduction

- Stores are the main configuration unit of StoreFront servers
- Stores aggregate resources from multiple Farms / Sites
- StoreFront can host multiple Stores with different settings
- Receiver for Web sites present the content of a Store in a browser
- Multiple websites per Store supported



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Key Notes:

- Stores are used to retrieve published resources for the user from one or more Controllers via their XML service.
- There are several settings like authentication methods or XML services that are configured per Store.
- Receiver for Web sites are normally used to provide a GUI for the Store in the user's browser, while the "native" Receiver can use its own GUI and access Stores directly to query for published resources or to authenticate.
- Receiver for Web sites can deliver the HTML5 Receiver (embedded into the webpage) and are therefore called "Receiver for Web."
- Multiple Stores are often used during migration of Sites / Farms in the backend, or to separate externally accessible Stores from internal-only accessible Stores. Different websites might be used to incorporate different visual guidelines for users, maybe belonging to different companies within an organization.
- StoreFront Stores aggregate desktops and applications, making them available to users. Store names appear in Citrix Receiver under users' accounts, so choose a name that gives users information about the content of the Store.
- You can configure Stores to provide resources from any mixture of XenDesktop, XenApp, and XenMobile MAM deployments.
- If you require both authenticated and un-authenticated users to log in, then you have to create two separate Stores.

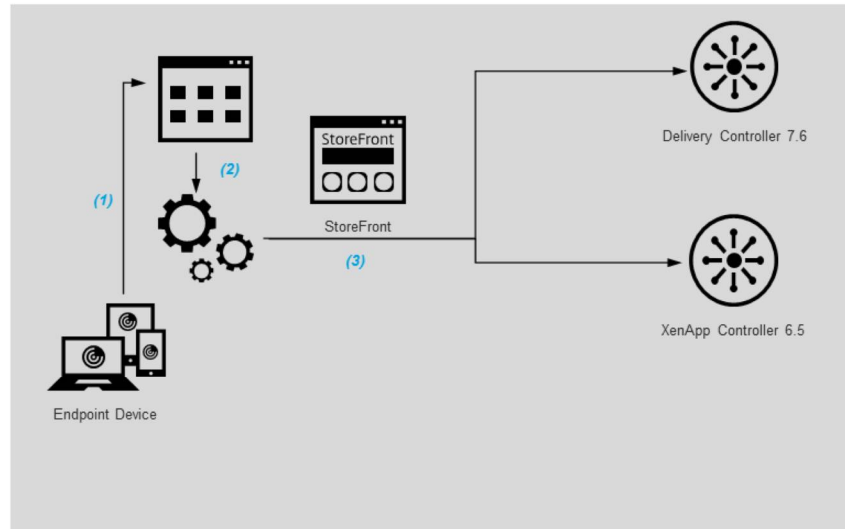
Additional Resources:

- Create new deployment - <https://docs.citrix.com/en-us/storefront/3-8/install-standard/create-new-deployment.html>

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Stores – Access

1. *The Endpoint Device launches an Internet browser and accesses Receiver for Web site*
2. *The Receiver for Web site accesses Store*
3. *The Store hosted on StoreFront accesses the Controllers in parallel*



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Additional Resources:

- Configure and manage stores - <https://docs.citrix.com/en-us/storefront/3-8/configure-manage-stores.html>

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Authentication Options

Two Authentication Options

Direct Authentication

- StoreFront submits credentials to a Domain Controller for validation
- Requires same Domain or Trust Relationship between Storefront and Delivery Controller
- Default authentication option

XML Service-Based Authentication

- StoreFront submits credentials to the XML port of a Delivery Controller
- The Delivery Controller submits the credentials to a Domain Controller.
- Used if no Trust Relationship exists between the StoreFront server and Delivery Controller domains.

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Additional Resources:

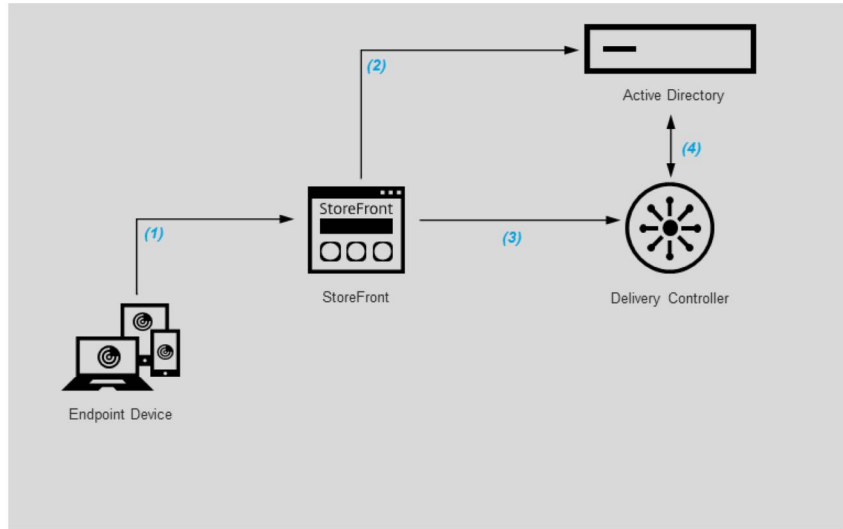
- XML service-based authentication - <https://docs.citrix.com/en-us/storefront/3-8/configure-authentication-and-delegation/xml-authentication.html>

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Authentication Options

Direct Authentication

1. User submits credentials.
2. StoreFront forwards credentials to Domain Controller.
3. StoreFront queries Delivery Controller to list available resources for the user.
4. Delivery Controller enumerates group membership for the user and lists available resources.



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Key Notes:

- Authentication: the process in which user identity is verified.
- Two methods for authentication with StoreFront:
 - Direct: StoreFront validates credentials against Active Directory.
 - Indirect: explained on the next slide.
- Explain that two Windows services are responsible for performing authentication tasks:
 - Default Domain Services = provides AD based account operations (password change, authentication etc.)
 - Credential Wallet Service = stores encrypted passwords in memory
- Use the Create Authentication Service task to configure the StoreFront authentication service. The authentication service authenticates users to Microsoft Active Directory, ensuring that users do not need to log on again to access their desktops and applications.
- You can only configure one authentication service per StoreFront deployment. This task is only available when the authentication service has not yet been configured.

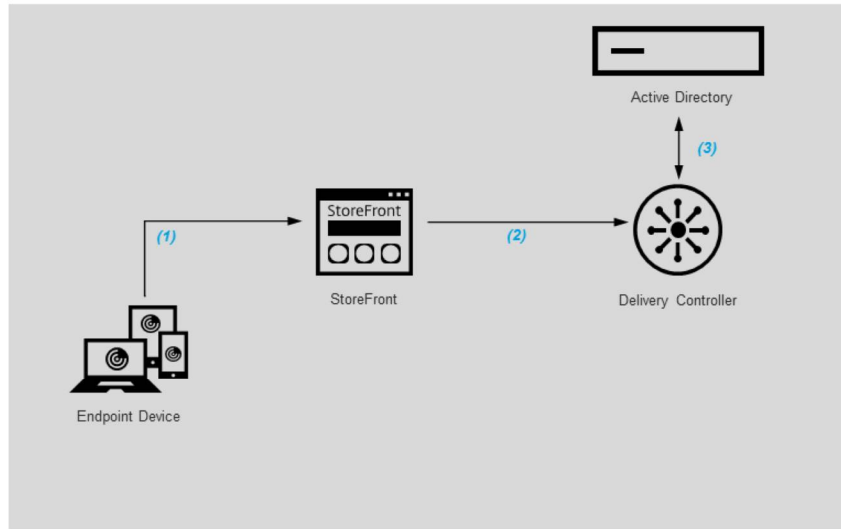
Additional Resources:

- XML service-based authentication - <https://docs.citrix.com/en-us/storefront/3-8/configure-authentication-and-delegation/xml-authentication.html>

Authentication Options

XML Service-Based Authentication

1. User submits credentials.
2. StoreFront forwards credentials to Delivery Controller and requests the list of available resources for the user.
3. Delivery Controller validates credentials received from StoreFront with the Domain Controller, then checks group membership for the user and lists available resources.



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Key Notes:

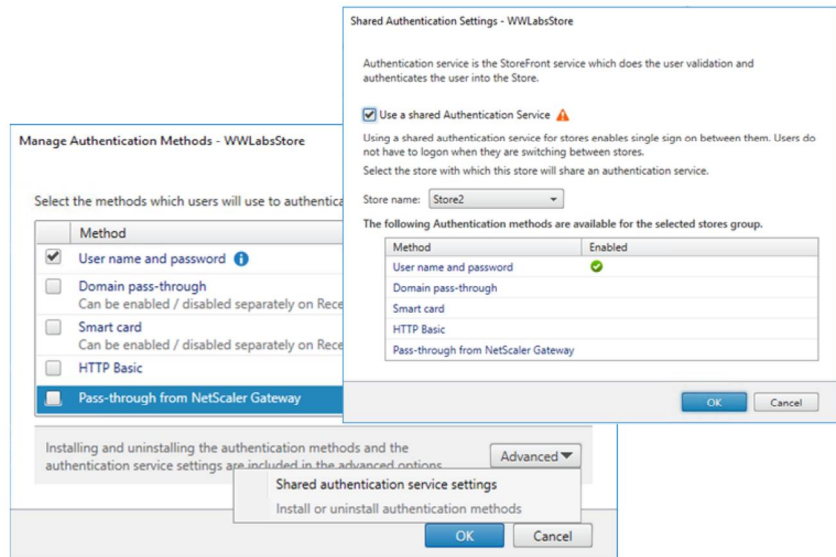
- Indirect: StoreFront passes credentials to Delivery Controller, which validates credentials against Active Directory.
- The authentication service authenticates users to Microsoft Active Directory, ensuring that users do not need to log on again to access their desktops and applications. You can only configure one authentication service per StoreFront deployment.
- You can enable or disable user authentication methods set up when the authentication service was created by selecting an authentication method in the results pane of the Citrix StoreFront management console and, in the Actions pane, clicking Enable Method or Disable Method, as appropriate. To remove an authentication method from the authentication service or to add a new one, use the Add/Remove Methods task.

Additional Resources:

- Create and configure the authentication service - <https://docs.citrix.com/en-us/storefront/3-8/configure-authentication-and-delegation/configure-authentication-service.html>
- XML service-based authentication - <http://docs.citrix.com/en-us/storefront/3-8/configure-authentication-and-delegation/xml-authentication.html>

Authentication Service

- Authentication can be configured:
 - Individually per Store.
 - Or shared between Stores
 - For in-place upgrades, authentication will be shared by default.
- If authentication is not shared, users will have to authenticate to each Store separately.



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Key Notes:

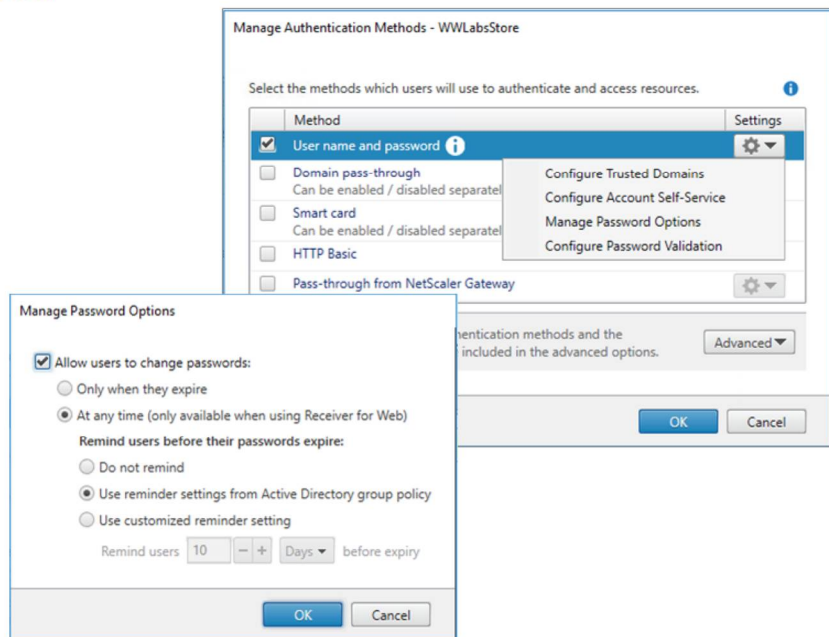
- With the Store Centric paradigm, each store can be configured to have a separate authentication service.
- When upgrading a StoreFront deployment, where multiple stores are configured, all migrated stores will be configured to share the same authentication service located at /Citrix/Authentication.
- If you would like to configure a separate authentication service per store, select the Advanced option to access the shared authentication service settings.
- This will open a dialog box where you can clear the check box to use the shared authentication service. An information message is displayed explaining what steps will be performed, and a new authentication service will be created for the store.

Additional Resources:

- Create and configure the authentication service - <https://docs.citrix.com/en-us/storefront/3-8/configure-authentication-and-delegation/configure-authentication-service.html>

Password Reminder

- StoreFront can remind users when their passwords are about to expire, and also allow them to change their password directly from the StoreFront website.
- The reminder period can be configured under the settings for the user name and password authentication method for the Store.
- Enabling password change via StoreFront can cause more disk space usage.



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Key Notes:

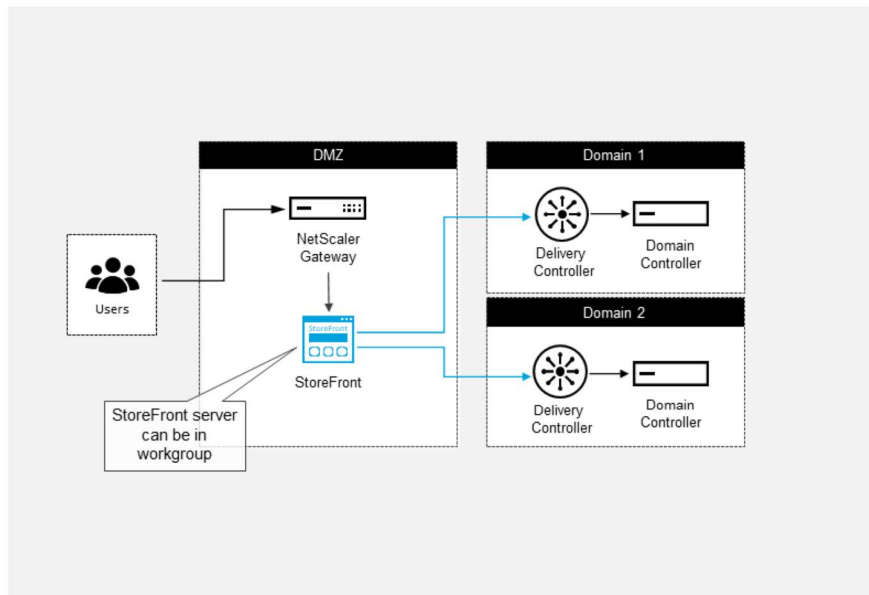
- If you enable Citrix Receiver for Web site users to change their passwords at any time, local users whose passwords are about to expire are shown a warning when they log on.
- By default, the notification period for a user is determined by the applicable Windows policy setting.
- To set a custom notification period for all users, you edit the configuration file for the authentication service.
- StoreFront does not support Fine Grained Password Policies in Active Directory.
- If you enable Citrix Receiver for Web site users to change their passwords at any time, ensure that there is sufficient disk space on your StoreFront servers to store profiles for all your users. To check whether a user's password is about to expire, StoreFront creates a local profile for that user on the server. StoreFront must be able to contact the Domain Controller to change users' passwords.

Additional Resources:

- Enable users to change their passwords - https://docs.citrix.com/en-us/storefront/3-8/configure-authentication-and-delegation/configure-authentication-service.html#par_richtext_5

Non-Domain Joined Deployments

- StoreFront 3.6 and later supports installation and configuration of StoreFront as a non-domain joined server.
- Helpful when deploying StoreFront in DMZ, networks without Active Directory access, or multi-domain scenarios.
- Only Single Server mode supported when not domain joined.
- Authentication must be delegated to Delivery Controllers.



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Key Notes:

- Prior to StoreFront 3.6, you could install StoreFront only on servers that were joined to an Active Directory domain.
- StoreFront 3.6 and later supports installation and configuration of StoreFront on non-domain joined servers.
- Note that in a non-domain joined server deployment, you must delegate authentication to Delivery Controllers and server groups are not supported.



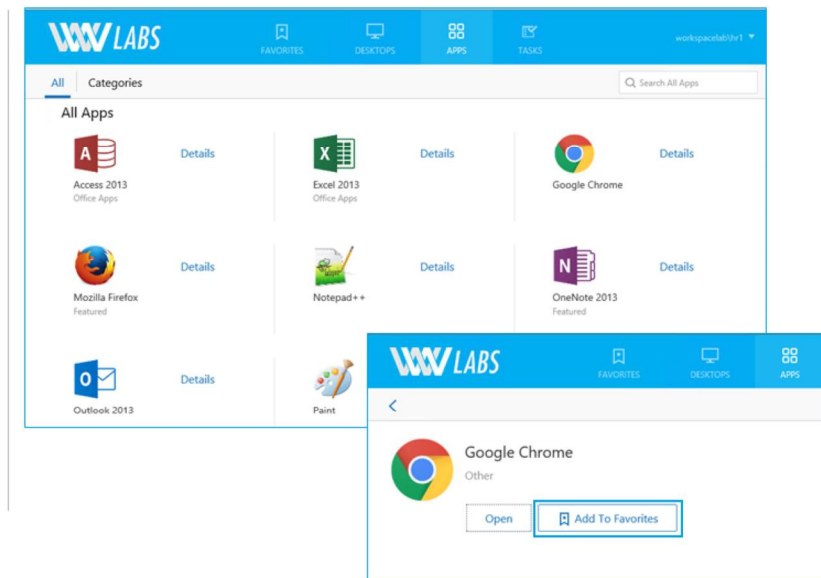
Lab Exercise

- Exercise 5-2: Create StoreFront Store

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Subscriptions

- Users subscribe to selected applications to have easier access to them.
- Each Store saves users' subscriptions in a local database.
- Provides users with same application set across platforms & devices.



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Key Notes:

- Microsoft Extensible Storage Engine (ESE) is used as database backend.
- The database is located in `C:\Windows\ServiceProfiles\NetworkService\AppData\Roaming\Citrix\SubscriptionsStore\<#_Store Name>\PersistentDictionary.edb`
- The database should be backed up routinely to save the users' subscriptions.
- "Add to Favorites" is used to subscribe to an application.
- The entries in the database are not lost if administrator temporarily disables the subscription feature of the store
- Keywords like "auto" or "mandatory" can be used to put published applications automatically in the users' favorite apps.
- The database should be included in a backup routine – otherwise all users might lose their subscribed apps and have to subscribe to them again. Also, make sure your antivirus solution does not interfere with database operations on the EDB file.
- The subscription data for each Store is located in:
 - `C:\Windows\ServiceProfiles\NetworkService\AppData\Roaming\Citrix\SubscriptionsStore\1__Citrix_<StoreName>`
- For two stores to share a subscription datastore, you need only point one store to the subscription service end point of the other store. In the case of a server group deployment, all servers have identical pairs of stores defined and identical copies of the shared datastore.

- The XenApp, XenDesktop and XenMobile servers configured on each store must match exactly; otherwise, an inconsistent set of resource subscriptions on one store compared to another might occur. Sharing a datastore is supported only when the two stores reside on the same StoreFront server or server group deployment.

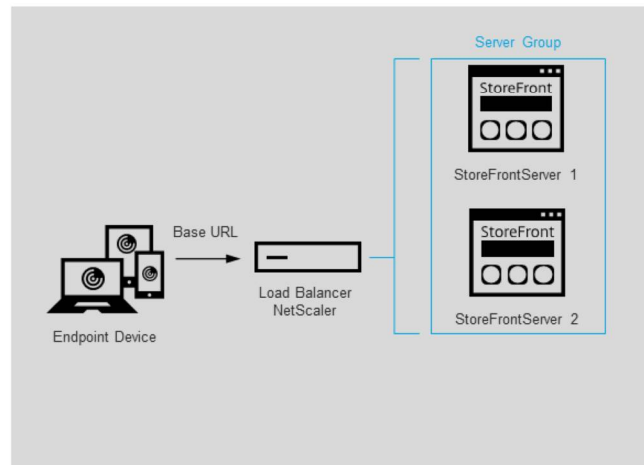
Additional Resources:

- How to Export and Import StoreFront Subscription Database:
<http://support.citrix.com/article/CTX139343>
- Configure two StoreFront stores to share a common subscription datastore -
<https://docs.citrix.com/en-us/storefront/3-8/configure-manage-stores/configure-two-stores-share-datastore.html>

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Server Groups

- A Server Group is a group of StoreFront servers that share a common configuration and provide access to the same resources.
- Group Storefront servers together for high availability.
- Server Groups require external load-balancing.
- All servers in a group share a common base-URL pointing to the load-balancer.
- Subscription Store Database is synced between the hosts automatically.
- Configuration changes need to be manually propagated to other servers.



Key Notes:

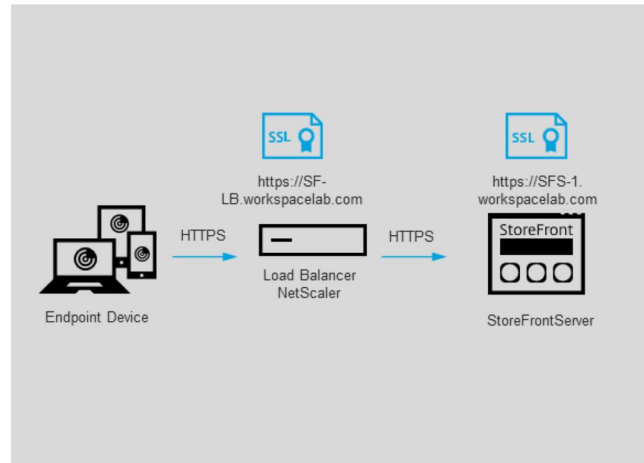
- The main reason for grouping StoreFront servers is to provide high availability.
- Port 808 is used to keep the database containing the user subscriptions in sync between the StoreFront servers of a group.
- Remember each store usually has its own database.
- Propagating servers means “adding” as well as “deleting” objects like stores & Receiver for Web sites from other servers of a group.
- Although not a technical limit, StoreFront performs best when the number of the participating servers in a group is kept to or below six.
- Port 808 is used to keep the database containing the user subscriptions in sync between the StoreFront servers of a group
- To manage a multiple-server deployment, use only one server at a time to make changes to the configuration of the server group. Ensure that the Citrix StoreFront management console is not running on any of the other servers in the deployment. Any configuration changes you make must be propagated to the other servers in the group to ensure a consistent configuration across the deployment.

Additional Resources:

- StoreFront 3.0 Scalability: <https://www.citrix.com/blogs/2015/09/16/storefront-3-0-scalability-2/>
- Configure server groups - <https://docs.citrix.com/en-us/storefront/3-8/configure-server-group.html>

Security

- Per default, users submit their credentials to StoreFront over an unencrypted network connection. To prevent disclosure of the credentials, configure StoreFront to use encryption:
 - Use a SSL/TLS certificate on the Load Balancer that users access.
 - Install a SSL/TLS certificate on each StoreFront Server.
 - Each certificate must match the entered address.
 - The respective client has to trust the issuing Certificate Authority of the certificate or the certificate itself.



Key Notes:

- For internal addresses like “training.lab” or “somewhat.local” only certificates from local / private Certificate Authorities can be used since these domain addresses cannot be validated.
- For external access, multi-factor authentication raises security even more.
- Certificates are prone to expire (depending on their setting, after 1-10 years, shorter validity periods mean more security),
- Authentication services and stores each require certificates for token management. StoreFront generates a self-signed certificate when an authentication service or store is created. Self-signed certificates generated by StoreFront should not be used for any other purpose.
- If your users configure their accounts by entering store URLs directly into Citrix Receiver and do not use email-based account discovery, the certificate on the StoreFront server need only be valid for that server and have a valid chain to the root certificate.
- Citrix recommends securing communications between StoreFront and users' devices using NetScaler Gateway and HTTPS. To use HTTPS, StoreFront requires that the Microsoft Internet Information Services (IIS) instance hosting the authentication service and associated stores is configured for HTTPS. In the absence of the appropriate IIS configuration, StoreFront uses HTTP for communications. Citrix strongly recommends that you do not enable unsecured user connections to StoreFront in a production environment.

Additional Resources:

- Secure your StoreFront deployment - <https://docs.citrix.com/en-us/storefront/3-8/secure.html>

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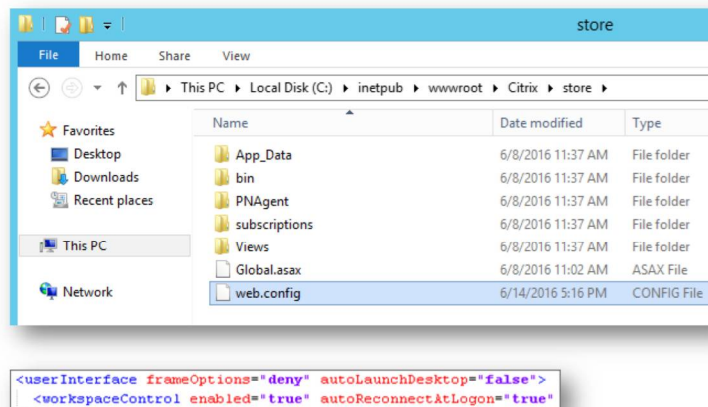
Lab Exercise

- Exercise 5-3: Encrypt StoreFront Store Traffic

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Advanced Configuration

- Advanced settings can be configured in the web.config XML files at
 - C:\inetpub\wwwroot\Citrix\store
 - C:\inetpub\wwwroot\Citrix\storeWeb
- Back up these files before editing them – propagate changes afterwards to other StoreFront servers.
- Settings include changing the visibility of Apps and Desktop views, update behavior of Citrix Receiver and automatic launching of Desktop sessions.



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Key Notes:

- Most options can be configured in the StoreFront Console starting with version 3.5.
- Use caution when editing these files – a single missing character can render the complete website unusable!
- Citrix recommends to backup every file before editing it.
- It is advisable to use a syntax highlighting editor like Notepad++ to manage the XML structure of the file.
- Remember that the edited file needs to be propagated like configuration changes as well.
- When you edit the files, be sure to close the StoreFront Management Console.
- ...\\Store\\web.config contains the primary Store functional settings
 - List of Controllers
 - Advanced XML settings (socket pooling, failure timeouts, etc)
 - Authentication settings
 - Gateway settings
- ...\\StoreWeb\\web.config contains website settings
 - Admin-defined shortcut URL settings
 - Plugin assistant and Receiver download settings
 - App vs Desktop views
 - Desktop auto-launch, workspace control, auto-reconnect

Additional Resources:

- How to Disable Desktop Auto Launch in StoreFront:
<http://support.citrix.com/article/CTX139058>
- How to Enable/Disable Workspace Control in StoreFront:
<http://support.citrix.com/article/CTX200828>
- Advanced store settings: <https://docs.citrix.com/en-us/storefront/3-8/configure-manage-stores/advanced-store-settings.html>
- Configure using configuration files: <https://docs.citrix.com/en-us/storefront/3-8/configure-using-configuration-files.html>

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Group Discussion

Which type of certificates do you plan to implement on StoreFront?

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Lab Exercise

- Exercise 5-4: Set the StoreFront Default Page
- Exercise 5-5: Configure the Default Domain
- Exercise 5-6: Adjust StoreFront Timeout
- Exercise 5-7: Configure StoreFront Store Branding
- Exercise 5-8: Deploy Citrix Receiver through StoreFront
- Exercise 5-9: Configure Email Based Account Discovery
- Exercise 5-10: Configure Delegated Authentication

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Lesson Objective Review

Scenario: Your colleague was tasked with enabling a new authentication method on StoreFront, however since he made the change users have been complaining about intermittent logon failures.

What did your colleague forget?

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Lesson Objective Review

Scenario: Your colleague was tasked with enabling a new authentication method on StoreFront, however since he made the change users have been complaining about intermittent logon failures.

What did your colleague forget?

Propagate changes should be initiated every time a change has been made to ensure all StoreFront servers are in sync.

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Receiver

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Deploying Receiver

Enterprise software deployment	Install Receiver through StoreFront	Manual installation	Receiver for HTML5
Seamless and customizable installation	Supports upgrades	Customizable	Universal support and no installation
Managed devices only	Difficult to customize	No upgrade support	Limited feature set and browser support
Recommended for managed devices	Recommended for unmanaged devices	Advanced users only	Recommended as secondary (fallback) option

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Key Notes:

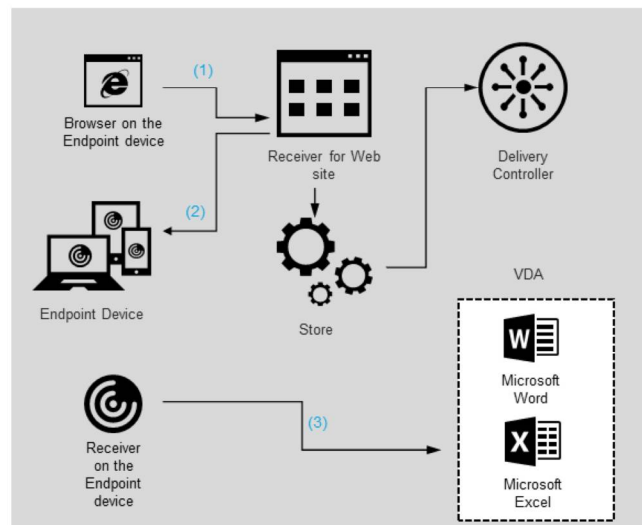
- Receiver exists for all major OS platforms and it can be used to launch a connection to a VDA after the user has used a browser to enumerate the published resources, but also as a standalone program that authenticates the user, enumerates the resources and launches them.

Additional Resources:

- Receiver - Client Feature Matrix: <http://support.citrix.com/article/CTX104182>

Receiver for Web

1. User uses a web browser for authentication and enumeration of resources.
2. StoreFront produces a launch file.
3. Installed local Receiver opens the launch file and launches the session.



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Key Notes:

- Citrix Receiver for Web sites enable users to access stores through a webpage. The tasks below enable you to modify settings for your Citrix Receiver for Web sites. Some advanced settings can only be changed by editing the site configuration files.
- Use the Deploy Citrix Receiver task to configure the behavior of a Citrix Receiver for Web site when a Windows or Mac OS X user without Citrix Receiver installed accesses the site. By default, Citrix Receiver for Web sites automatically attempt to determine whether Citrix Receiver is installed when accessed from computers running Windows or Mac OS X.
- If Citrix Receiver cannot be detected, the user is prompted to download and install the appropriate Citrix Receiver for their platform. The default download location is the Citrix website, but you can also copy the installation files to the StoreFront server and provide users with these local files instead.
- Connecting via Receiver for Web is comparable to the former Web Interface technology.
- This way of connecting can also apply to mobile devices, where a Receiver app is installed, but the user starts application enumeration with the installed browser (for example Safari on iOS devices) and chooses to open the downloaded launch.ica file with the Receiver app.
- This setup can be used to deploy the Receiver application.
- A benefit of this setup is that almost any device can be used, since it requires no configuration – the launch.ica file transmits most session relevant parameters to the client.
- Requirement for Clients:

- User needs to enter the URL manually & authenticate
- SingleSign On / Password passthrough can be established between domain-joined clients and StoreFront web sites
- Pre-launch sessions are not supported.

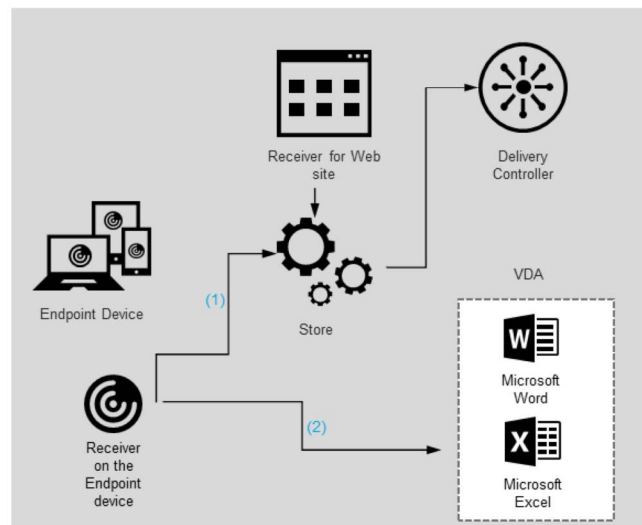
Additional Resources:

- Configure Citrix Receiver for Web sites - <http://docs.citrix.com/en-us/storefront/3-8/manage-citrix-receiver-for-web-site/configure-receiver-for-web-sites.html>
- Citrix Receiver Client Feature Matrix - https://www.citrix.com/content/dam/citrix/en_us/documents/products-solutions/citrix-receiver-feature-matrix.pdf

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Native Receiver

1. Installed local Receiver authenticates user to the store and enumerates resources.
2. Installed local Receiver launches the session.



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Key Notes:

- The Native Receiver setup requires the user to install the Receiver or to have the Receiver pre-installed.
- The Native Receiver requires configuration, either manually by the user or by the IT staff.
- This setup can be used together with single sign-on and prelaunch session support, it offers the most rich feature set available.
- Citrix Receiver attempts to contact beacon points and uses the responses to determine whether users are connected to local or public networks. When a user accesses a desktop or application, the location information is passed to the server providing the resource so that appropriate connection details can be returned to Citrix Receiver. This ensures that users are not prompted to log on again when they access a desktop or application.
- The CitrixReceiver.exe installation package can be installed in the following methods:
 - By a user from Citrix.com or your own download site
 - A first-time Receiver user who obtains Receiver from Citrix.com or your own download site can set up an account by entering an email address instead of a server URL. Receiver determines the NetScaler Gateway (or Access Gateway) or StoreFront Server associated with the email address and then prompts the user to log on and continue the installation. This feature is referred to as "email-based account discovery."
 - Note: A first-time user is one who does not have Receiver installed on the device.

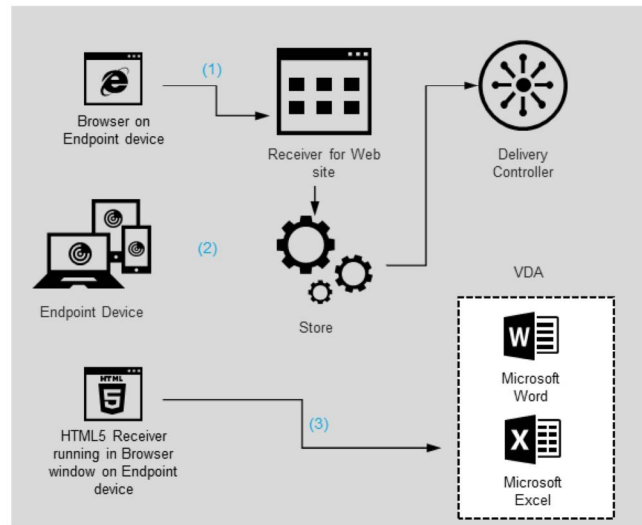
- Email-based account discovery for a first-time user does not apply if Receiver is downloaded from a location other than Citrix.com (such as a Receiver for Web site).
- If your site requires configuration of Receiver, use an alternate deployment method.
- Automatically from Receiver for Web or from a Web Interface logon screen.
 - A first-time Receiver user can set up an account by entering a server URL or downloading a provisioning (CR) file.
- Using an Electronic Software Distribution (ESD) tool
 - A first-time Receiver user must enter a server URL or open a provisioning file to set up an account.
 - Receiver does not require administrator rights to install unless it will use pass-through authentication.

Additional Resources:

- Citrix Receiver Client Feature Matrix - https://www.citrix.com/content/dam/citrix/en_us/documents/products-solutions/citrix-receiver-feature-matrix.pdf
- Create a single Fully Qualified Domain Name (FQDN) to access a store internally and externally - <https://docs.citrix.com/en-us/storefront/3-8/advanced-configurations/configure-single-fqdn.html>
- Receiver Install - <http://docs.citrix.com/en-us/receiver/windows/4-5/install.html>

HTML5 - Receiver

1. User uses a web browser for authentication and enumeration of resources.
2. StoreFront generates launch code and pushes HTML5 Receiver to client.
3. HTML5 Receiver loads inside new browser window and launches the session.



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Key Notes:

- This setup does not require anything to be installed on the client device since the HTML5 receiver will be downloaded to the client as part of the website, much like an image or flash plugin.
- The HTML5 Receiver is missing numerous features compared to the Native Receiver (no file redirection, no bi-directional audio) and other features are implemented using “workarounds” due to platform limitations (clipboard sync, printing).
- The HTML5 Receiver only supports SSL/TLS connections.
- This setup can also be used to provide additional security, but comes with loss of functionality. Also, if incompatible versions of Receiver are installed on the client side, a website can be configured to override the client detection and instead always use the HTML5 Receiver.

Additional Resources:

- Citrix Receiver Client Feature Matrix - https://www.citrix.com/content/dam/citrix/en_us/documents/products-solutions/citrix-receiver-feature-matrix.pdf
- Receiver Internals: How Receiver for HTML5 & Chrome Connections Work - <https://www.citrix.com/blogs/2015/07/08/receiver-internals-how-receiver-for-html5-chrome-connections-work/>

Store Authentication Settings

Starting with StoreFront 3.0 different authentication methods can be used per Store.

Authentication Methods	Description
Unauthenticated	Allows anonymous logon
Username and Password (default option)	Requires users to enter domain, username, and password
Passthrough from NetScaler Gateway	StoreFront relies on NetScaler Gateway to authenticate users
Domain Passthrough	Users are automatically logged on with their domain credentials
SmartCard	Authentication takes place using a physical SmartCard and PIN
HTTP Basic	Provides a method to integrate with 3 rd party software

Key Notes:

- Consider the implications of Domain passthrough:
 - It requires domain joined computers.
 - It does not work with the HTML5 Receiver.
 - It requires Internet Explorer if a browser is to be used.
- The trusted domains setting also restricts other logon methods to adhere to the provided list of trusted domains.
- In short, these are the different authentication methods:
 - Unauthenticated: Useful for providing access to resources that use their own authentication system or where authentication is generally not required.
 - Username and Password: Users logon entering their domain username and the password. This method is enabled by default.
 - Passthrough from NetScaler Gateway: If NetScaler Gateway is used, Storefront just validates that the user has been authenticated and does not authenticate the user itself.
 - Domain Passthrough: Seamlessly passes through the users' authentication from a domain joined windows computer.
 - SmartCard: Enables the use of SmartCards together with the appropriate PKI infrastructure in the backend. Users need to provide the SmartCard and their PIN to logon.

- HTTP Basic: Provides an interface for 3rd party applications to single-sign-on to Storefront using the underlying IIS. Useful when integrating Storefront into portal solutions.
- There are also two options relevant to the authentication methods:
 - Trusted Domains: Restricting all logons to a list of known domains raises security – can also be used to provide a list of domains to choose from to users.
 - Change Password: Provide users the option to electively change a password or change a password on expiry.

Additional Resources:

- StoreFront 3.8 User Authentication - <https://docs.citrix.com/en-us/storefront/3-8/plan/user-authentication.html>
- Manage authentication methods - https://docs.citrix.com/en-us/storefront/3-8/configure-authentication-and-delegation/configure-authentication-service.html#par_richtext_3



Think of scenarios that could benefit from a store allowing unauthenticated access – what are they?

Not for resale or distribution

Lesson Objective Review

Scenario: Your manager has asked you to identify the easiest Receiver type to deploy to 50 task workers in China. The workers do not require any device mappings. Which type of Receiver should you recommend?

Not for resale or distribution

Lesson Objective Review

Scenario: Your manager has asked you to identify the easiest Receiver type to deploy to 50 task workers in China. The workers do not require any device mappings. Which type of Receiver should you recommend?

The HTML5 Receiver is the easiest to deploy; it requires no Citrix components to be installed on the client.

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Receiver Configuration

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Receiver Configuration

- To use the native local Receiver for authentication and enumeration of resources, configure it to use a specific store.
- Receiver can automatically discover Stores that are advertised on configured StoreFront servers.
- Stores that are hidden must be explicitly specified.

```
<?xml version="1.0" encoding="UTF-8"?>
- <Services xmlns="http://www.citrix.com/ServiceRecord" version="1.0">
  - <Service type="store">
    <SRID>451013709</SRID>
    <Name>store</Name>
    <Address>https://nyc-stf-001.training.lab/Citrix/store/discovery</Address>
  - <Gateways>
    - <Gateway RewriteMode="NONE" Auth="Domain" Edition="Enterprise" Default="true"
      Name="NG1">
      <Location>https://nsg.training.lab</Location>
    </Gateway>
  </Gateways>
  - <Beacons>
    - <Internal>
      <Beacon>https://nyc-stf-001.training.lab</Beacon>
    </Internal>
    - <External>
      <Beacon>http://www.citrix.com</Beacon>
      <Beacon>https://www.ucit.university</Beacon>
    </External>
  </Beacons>
</Service>
</Services>
```

Key Notes:

- When delivering applications with XenDesktop or XenApp, consider the following options to enhance the experience for users when they access their applications:
 - Web Access Mode - Without any configuration, Citrix Receiver for Windows provides browser-based access to applications and desktops. Users simply open a browser to a Receiver for Web or Web Interface site to select and use the applications that they want. In this mode, no shortcuts are placed on the user's desktop.
 - Self Service Mode - By simply adding a StoreFront account to Citrix Receiver for Windows or configuring Citrix Receiver for Windows to point to a StoreFront site, you can configure self-service mode, which allows users to subscribe to applications from the Citrix Receiver for Windows user interface. This enhanced user experience is similar to that of a mobile app store. In self-service mode you can configure mandatory, auto-provisioned and featured app keyword settings as needed.
- By default, Citrix Receiver for Windows allows users to select the applications they want to display in their Start menu.
- Include meaningful descriptions for applications in a Delivery Group. Descriptions are visible to Citrix Receiver for Windows users when using Web access or self-service mode.
- Hiding a store does not prevent access to it.
- As shown in the example provisioning file from StoreFront (on the slide), the most

important part of the file is the Address section pointing to a store on a StoreFront server. Most other options pertain to remote access.

- Receiver can access up to 10 different Stores.

Additional Resources:

- Configuring application delivery - <http://docs.citrix.com/en-us/receiver/windows/4-5/configure/receiver-windows-configure-app-delivery-wrapper.html>

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Ways to configure Native Receiver

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Key Notes:

- Citrix recommends using the Group Policy Object method, and provides a template file (receiver.adm or receiver.admx\receiver.adml, depending on OS) to configure settings related to Citrix Receiver for Windows.

Additional Resources:

- Configuring Citrix Receiver for Windows with the Group Policy Object template - <http://docs.citrix.com/en-us/receiver/windows/4-5/configure/ica-import-icaclient-template-v2.html>

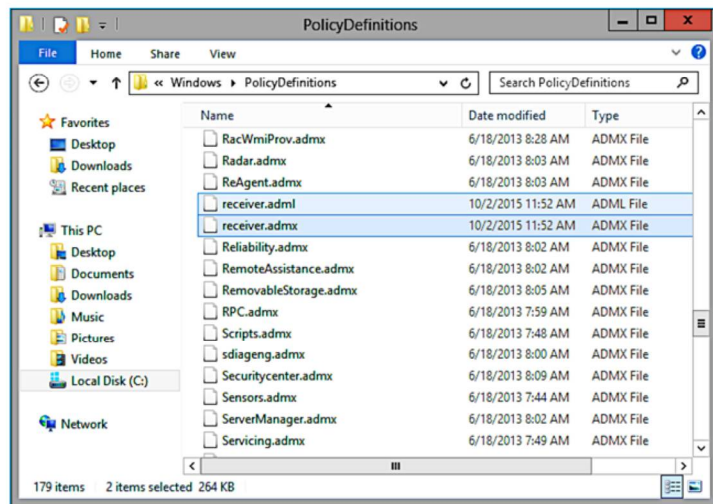
Configuring Receiver with ADMX

Recommended for managed endpoints:

- Easy to configure and apply
- Enforces configuration

Configuration steps:

1. Copy ADMX and ADML files to PolicyDefinitions or central store.
2. Create a policy using the Citrix Administrative Template.



Key Notes:

- If Citrix Receiver for Windows is configured via VDA installation, admx/adml files are found in the Citrix Receiver for Windows installation directory. For example: <installation directory>\online plugin\Configuration.
- You can use adm template files to configure a Local GPO and/or a Domain-Based GPO.
- Citrix recommends you to use the template files provided with the latest Citrix Receiver for Windows. While importing the latest files, the previous settings are retained.
- One of the main benefits of using the new ADMX files is the central store. This option is available to you when you are administering domain-based GPOs, although the central store is not used by default. Unlike the case we discussed earlier with ADM files, the Group Policy Object Editor will not copy ADMX files to each edited GPO but will provide the ability to read from either a single domain-level location on the domain controller **sysvol** (not user configurable) or from the local administrative workstation when the central store is unavailable. You can share a custom ADMX file by copying the file to the central store, which makes it available automatically to all Group Policy administrators in a domain. This capability simplifies policy administration and improves storage optimization for GPO files.
- ADMX files are divided into language-neutral (ADMX) and language-specific (ADML) resources, available to all Group Policy administrators. These factors allow Group Policy tools to adjust their UI according to the administrator's configured language.
- An ADMX file should be used for all managed endpoints. It is the fastest and easiest way of configuring multiple machines in a consistent manner.

Additional Resources:

- Configure Receiver with the Group Policy Object Template - <http://docs.citrix.com/en-us/receiver/windows/4-5/configure/ica-import-icaclient-template-v2.html>

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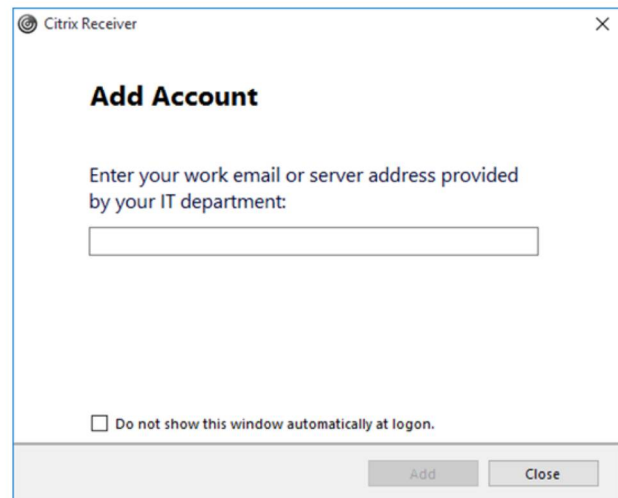
Configuring Receiver with email-based discovery

Recommended for unmanaged endpoints, because while end-users are unlikely to know the load-balanced StoreFront address and site path, all end-users know their email address.

Configuration steps:

Create SRV locator in DNS pointing to StoreFront

- Service = `_citrixreceiver`
- Protocol = `_tcp`
- Port = 443
- Host offering = your StoreFront FQDN



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Key Notes:

- You can configure NetScaler Gateway to accept user connections by using an email address to discover the StoreFront or NetScaler Gateway URL. The process for user connections is:
 - When users connect from inside your network or a remote location and install Receiver for the first time, they enter their email address or the StoreFront URL.
 - Receiver then queries the appropriate DNS server, which responds with the StoreFront or NetScaler Gateway URL. The URL depends on whether users connect from the internal network or they connect from a remote location.
 - Users then log on to Receiver with their user name, password, and domain.
 - If users connect from a remote location, NetScaler Gateway provides the StoreFront URL to Receiver.
 - Receiver gets the account information from StoreFront. If users connect through NetScaler Gateway, the appliance performs SSO to StoreFront. If more than one account is available, users receive a list of accounts from which to choose.
 - When users log on to an account, a list of applications appear in Receiver. Users can then select an app to open.
- End Users cannot be expected to know the load balanced address of the StoreFront server and the site path. The only way they will know this is if they read onboarding documentation or somebody walks them through the process.
- All users know their email address. This provides a much better user experience.

Additional resources:

- Configuring Email-Based Account Discovery for Receiver - <http://blogs.citrix.com/2013/04/01/configuring-email-based-account-discovery-for-citrix-receiver/>
- Connecting to StoreFront by Using Email-Based Discovery - <http://docs.citrix.com/en-us/netscaler-gateway/11/storefront-integration/ng-clg-session-policies-overview-con/ng-clg-storefront-policies-con/ng-clg-storefront-email-discovery-tsk.html>

Not for resale or distribution

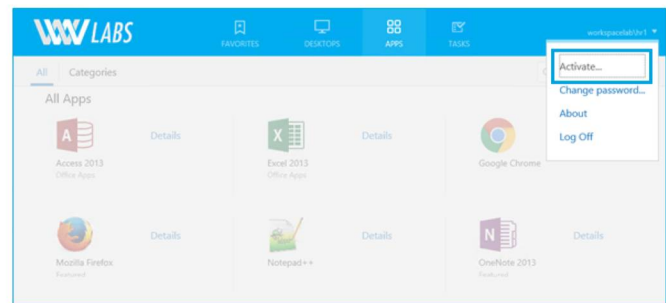
Configuring Receiver with StoreFront activation

Recommended for unmanaged endpoints:

- Only available when connected to Receiver for Web.
- Not recommended as primary configuration method, as end-user might not see the option.

Process:

- User logs on to Receiver for Web and selects Activate from drop-down list box.
- Browser downloads receiverconfig.cf file.
- User is prompted to add the configuration to Receiver.



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Key Notes:

- User logs on to StoreFront and uses the Activate feature to configure Receiver.
- This method is not very intuitive. End-users may miss this feature altogether. They are more likely to find it after using the system for a while.
- Recommended as another option for configuring unmanaged endpoints. Email-based discovery provides a better end-user experience.

Additional Resources:

- Overview of StoreFront's provisioning file - <http://support.citrix.com/article/CTX135919>

Configuring Receiver manually

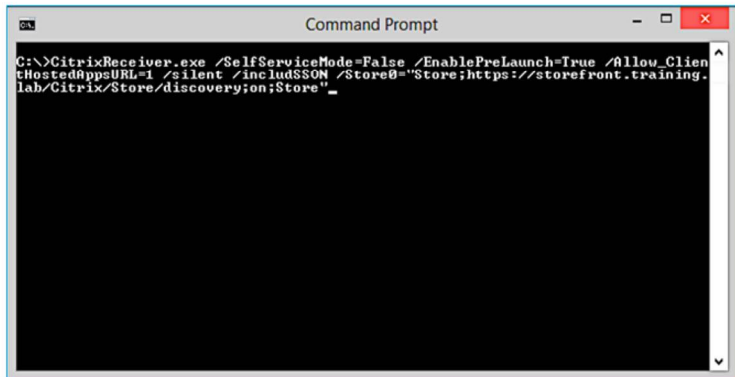
Recommended for advanced users.

Allows for advanced configuration:

- Complicated to configure
- Easy to make a mistake

Configuration steps:

1. Install with command-line switches
2. Configure registry settings



```
Command Prompt
C:\>CitrixReceiver.exe /SelfServiceMode=False /EnablePreLaunch=True /Allow_ClientHostedAppsURL=1 /silent /includeSSON /Store0="Store;https://storefront.training.lab/Citrix/Store/discovery;on:Store"
```

Key Notes:

- Advanced users can use command-line parameters during installation of Receiver.
- Also used when deploying Receiver with a script (which is how an ESD works too).
 - Essentially pre-configuring Receiver as part of the installation process.

Additional resources:

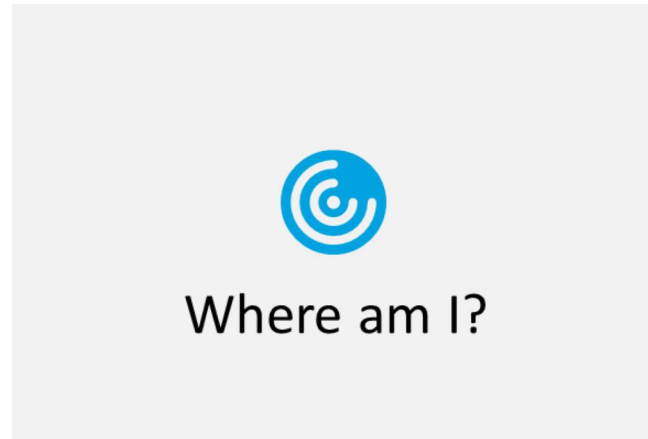
- Configure and Install Receiver for Windows Using Command Line Parameters - <http://docs.citrix.com/en-us/receiver/windows/4-5/install/receiver-windows-cfg-command-line-42.html>

What are StoreFront Beacons?

StoreFront Beacons are URLs defined in the StoreFront configuration, that are downloaded to Receiver upon adding a Store configuration.

Beacons help Receiver detect whether the user is currently inside or outside the trusted network.

Once the location has been established, Receiver will connect to the resources accordingly – either directly to StoreFront or through NetScaler Gateway.



Key Notes:

- Citrix Receiver attempts to contact beacon points and uses the responses to determine whether users are connected to local or public networks. When a user accesses a desktop or application, the location information is passed to the server providing the resource so that appropriate connection details can be returned to Citrix Receiver. This ensures that users are not prompted to log on again when they access a desktop or application.

Additional Resources:

- Documentation on Beacon Points - <https://docs.citrix.com/en-us/storefront/3-8/integrate-with-netscaler-and-netscaler-gateway/configure-beacon.html>

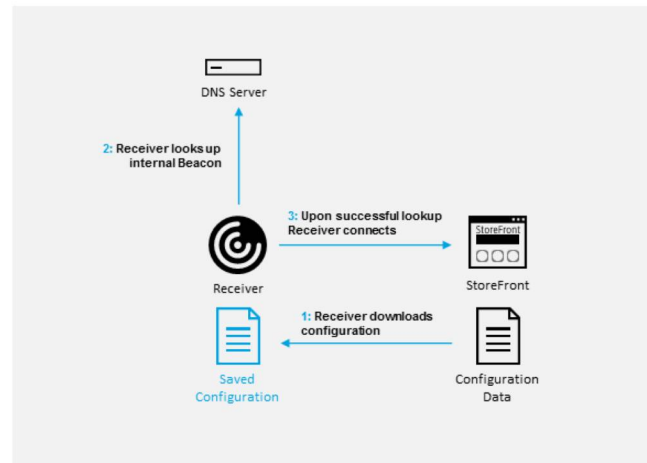
How are StoreFront Beacons used?

Beacons are configured in the StoreFront Console and consist of:

- **Internal Beacon**
 - Typically the URL for the StoreFront server or load balancer
- **External Beacon**
 - Typically the URL for the external NetScaler Gateway logon page

Receiver will attempt to contact the internal beacon first, if this is unsuccessful then Receiver attempts the external.

Internal Beacon should not be registered on the external DNS server.



Key Notes:

- Since StoreFront 2.6, it is supported to use the same internal and external logon point URL, but this is out of scope for this class.

Additional Resources:

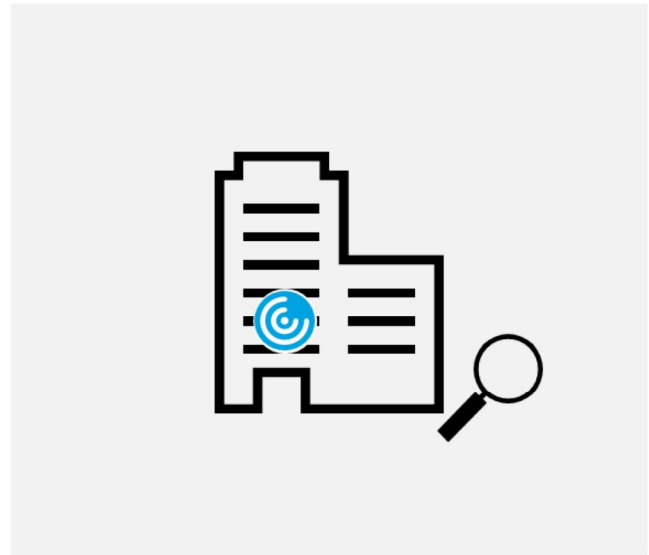
- Configure StoreFront Beacons: <https://docs.citrix.com/en-us/storefront/3-8/integrate-with-netscaler-and-netscaler-gateway/configure-beacon.html>

What is the default internal Beacon Point?

The default internal Beacon Point will be the hostname of the first StoreFront server in a server group.

This should be changed when adding more servers to the server group.

Citrix recommends using the FQDN of the load balancer virtual server as the internal Beacon point.



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Key Notes:

- Internal beacons: You can configure one internal beacon and zero to many external beacons. The default setting for the internal beacon is to use the StoreFront URL. To use your own beacon, you clear the default setting and then enter the URL in the text box. The internal beacon accepts a valid URL format only. You can use one URL and it allows a maximum of 256 characters.

What is the default external Beacon Point?

Before adding a NetScaler Gateway to the StoreFront configuration, an external Beacon will not appear.

When adding a NetScaler Gateway, the Beacon point will be the web address you configure on the Deployment tab, which is typically the NetScaler Gateway FQDN.

The Citrix.com FQDN will also appear under beacons; this is used to ensure the Receiver has an internet connection.



Key Notes:

- External beacons: The default setting for external beacons uses the web address you configure on the Deployment tab, which is typically the NetScaler Gateway FQDN. To use your own beacon, you clear the default setting and enter the URL in the text box. The external beacon accepts comma-separated URLs without spaces after the comma. For example, you can enter `https://ng1.company.com,https://ng2.company.com,https://ng3.company.com`. The maximum length allowed is 1,024 characters.

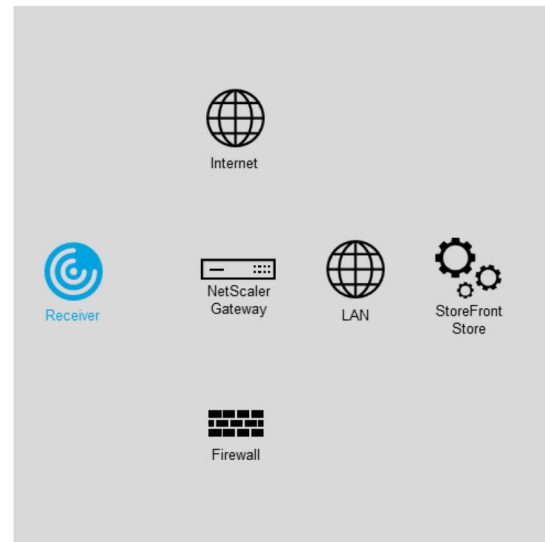
Beacons

Receiver uses beacons to determine location and network availability and request routing information accordingly.

Scenario 1 of 4:

No beacon is reachable.

- If no beacon is reachable, Receiver is offline.
 - Receiver does not prompt user.



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Key Notes:

- Use the Manage Beacons task to specify URLs inside and outside your internal network to be used as beacon points. Beacons are web addresses, typically to StoreFront, XenMobile, or NetScaler Gateway. You can configure the following:
 - Internal beacons. You can configure one internal beacon and zero to many external beacons. The default setting for the internal beacon is to use the StoreFront or XenMobile FQDN. If you have earlier editions of XenMobile, use the App Controller FQDN. If you keep the default setting for the internal beacon, XenMobile disables the text box. To use your own beacon, you clear the default setting and then enter the URL in the text box. The internal beacon accepts a valid URL format only. You can use one URL and it allows a maximum of 256 characters.
 - External beacons. The default setting for external beacons uses the web address you configure on the Deployment tab, which is typically the NetScaler Gateway FQDN. To use your own beacon, you clear the default setting and enter the URL in the text box. The external beacon accepts comma-separated URLs without spaces after the comma. For example, you can enter `https://ng1.com,https://ng2.com,https://ng3.com`. The maximum length allowed is 1,024 characters.
- There is even an additional conclusion for Receiver: If all beacons resolve to the same content, Receiver assumes that it is behind a paywall (catchall-portal / captive portal / a proxy solution commonly found in public / guest Wifi networks redirecting all request to the same website – either to acknowledge terms of service or to buy internet access).

- Storefront sets the default internal beacon to the configured SF address – which should NOT be resolvable outside the LAN.

Additional Resources:

- How to Successfully Test Citrix StoreFront Beacons Inside a Remote Desktop Session - <http://support.citrix.com/article/CTX132037>
- StoreFront Planning Guide - <http://support.citrix.com/article/CTX136547>
- Configure beacon points - <https://docs.citrix.com/en-us/storefront/3-8/integrate-with-netscaler-and-netscaler-gateway/configure-beacon.html>

Not for resale or distribution

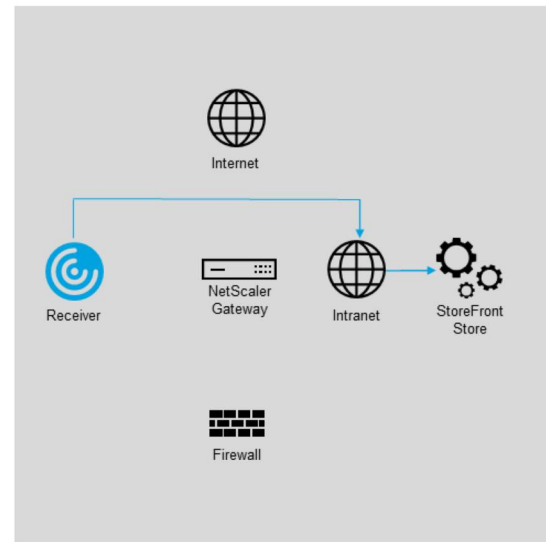
Beacons

Receiver uses beacons to determine location and network availability and request routing information accordingly.

Scenario 2 of 4:

The internal beacon is reachable.

- If the internal beacon is reachable, Receiver is on an internal intranet connection.
 - No NetScaler Gateway is necessary to connect to StoreFront and VDAs.



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Additional Resources:

- How to Successfully Test Citrix StoreFront Beacons Inside a Remote Desktop Session - <http://support.citrix.com/article/CTX132037>
- StoreFront Planning Guide - <http://support.citrix.com/article/CTX136547>
- Configure beacon points - <https://docs.citrix.com/en-us/storefront/3-8/integrate-with-netscaler-and-netscaler-gateway/configure-beacon.html>

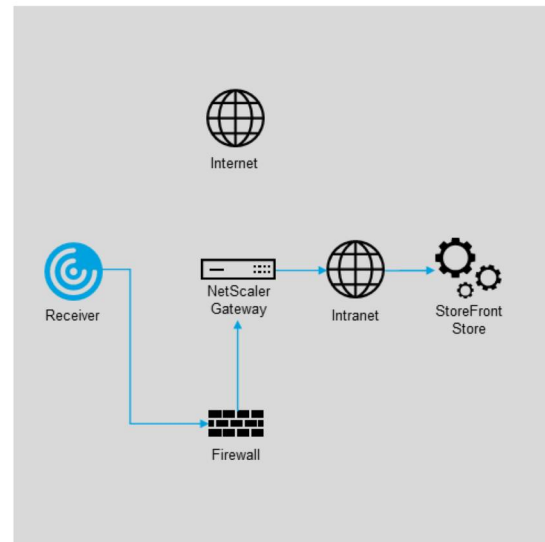
Beacons

Receiver uses beacons to determine location and network availability and request routing information accordingly.

Scenario 3 of 4:

The external beacon is reachable.

- If the external beacon is reachable, but the internal beacon is not reachable, Receiver is online, but outside of the corporate network.
- NetScaler Gateway is necessary to reach Storefront and the VDAs from an external network.



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Additional Resources:

- How to Successfully Test Citrix StoreFront Beacons Inside a Remote Desktop Session - <http://support.citrix.com/article/CTX132037>
- StoreFront Planning Guide - <http://support.citrix.com/article/CTX136547>
- Configure beacon points - <https://docs.citrix.com/en-us/storefront/3-8/integrate-with-netscaler-and-netscaler-gateway/configure-beacon.html>

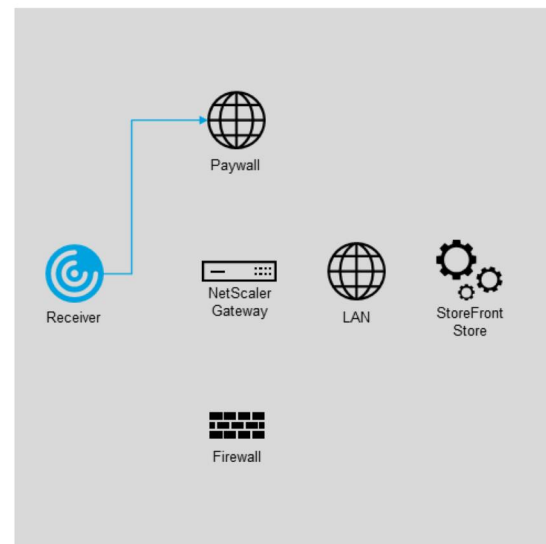
Beacons

Receiver uses beacons to determine location and network availability and request routing information accordingly.

Scenario 4 of 4:

All external beacons resolve to the same website.

- If all external beacons resolve to the same website, Receiver is behind a paywall.
 - Receiver does not offer authentication or starting applications.



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Additional Resources:

- How to Successfully Test Citrix StoreFront Beacons Inside a Remote Desktop Session - <http://support.citrix.com/article/CTX132037>
- StoreFront Planning Guide - <http://support.citrix.com/article/CTX136547>
- Configure beacon points - <https://docs.citrix.com/en-us/storefront/3-8/integrate-with-netscaler-and-netscaler-gateway/configure-beacon.html>



Which Receiver configuration approach would you suggest?

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Lab Exercise

- Exercise 5-11: Add Favorites to the StoreFront Store
- Exercise 5-12: Disable Desktop Auto-launch
- Exercise 5-13: Launch an Application and Desktop on a Server OS
- Exercise 5-14: Launch a Desktop from a Remote PC
- Exercise 5-15: Launch a Desktop on a Desktop OS

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Lesson Objective Review

Scenario: Gary, a regional sales manager, calls you up because he is stuck at the airport and trying to open Receiver. For some reason, it's not behaving like when he is working from home.

What could be the issue?

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Lesson Objective Review

Scenario: Gary, a regional sales manager, calls you up because he is stuck at the airport and trying to open Receiver. For some reason, it's not behaving like when he is working from home.

What could be the issue?

Gary might be sitting behind a paywall, therefore Receiver cannot look up the beacons to determine the right way to connect.

Key Notes:

- Scenario: You are the Citrix Admin and you have recently configured Beacons in the StoreFront servers. When testing this from the outside network you are unable to log on with Receiver. What could be wrong?
 - The internal Beacon could be registered on the external DNS server, causing external Receivers to attempt direct connections to StoreFront.
 - The internal Beacon is resolved first and if this can be resolved in DNS, Receiver will assume that it is internal.
 - Beacons will only do DNS lookup and not actually verify that the service behind the name works.

Key Takeaways



- StoreFront aggregates users' resources and provides access to apps and desktops.
- Citrix Receiver provides access to desktops and applications from any device, including smartphones, tablets, PCs and thin clients.
- Configure Citrix Receiver in the most appropriate way depending on scenario – this even includes not configuring it at all.

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XenApp and XenDesktop Administration

Understanding and Configuring Citrix Policies

Module 6



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Lab VM Power Management

The following VMs are required to be powered on before beginning the exercises in this module:

- NYC-ADS-001
- NYC-SQL-001
- NYC-FSR-001
- NYC-XDC-001
- NYC-STF-001
- NYC-MAN-001
- NYC-SRV-001
- NYC-DTP-001
- NYC-WRK-001

The remaining VMs need to be powered off.

Note: These VMs are listed in the start-up order.

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Learning Objectives

- Determine the role of policies in customizing the end user experience, and the process for configuring policies and determining the resultant set of policy
- Identify how policies can be used to control session management and ensure user connectivity through features such as Load Management, Session Reliability and Auto Client Reconnect

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Policies Introduction

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Policies

Definition

Policies are a collection of settings that define how sessions, bandwidth, and security are managed for a group of users, devices or connection types.

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Key Notes:

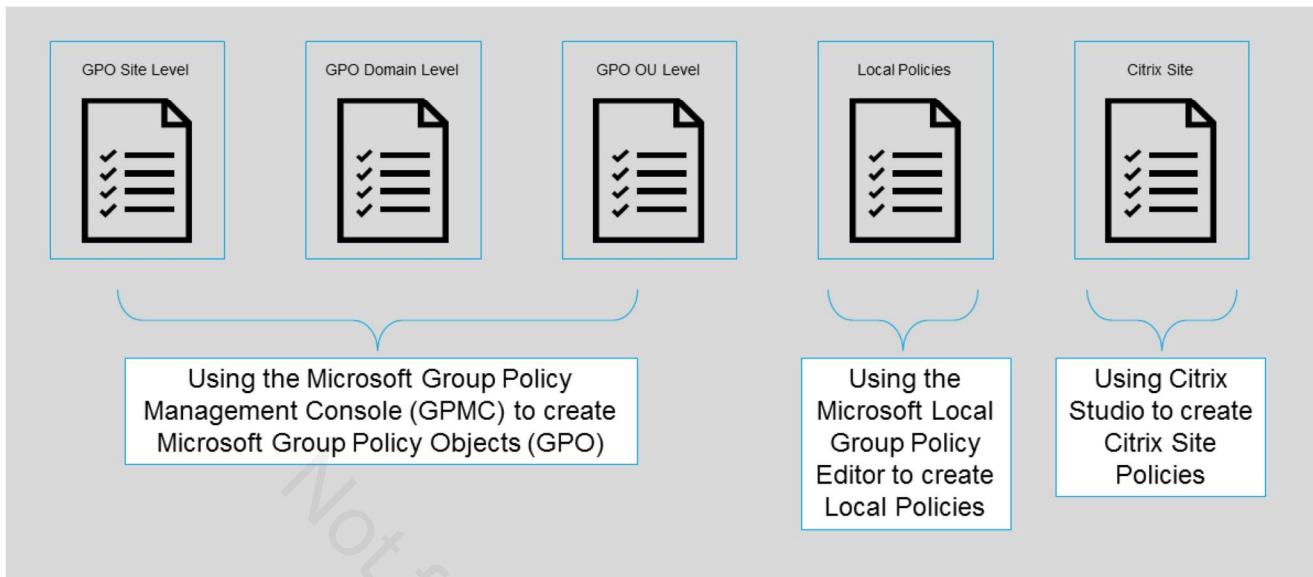
- Policies are a collection of settings that define how sessions, bandwidth, and security are managed for a group of users, devices, or connection types.
- You can apply policy settings to physical and virtual machines, or to users. You can apply settings to individual users at the local level or in security groups in Active Directory. The configurations define specific criteria and rules, and if you do not specifically assign the policies, the settings are applied to all connections.

Additional Resources:

- Policies - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/policies.html>

Policies

There are five different locations where Citrix Policies can be configured



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Key Notes:

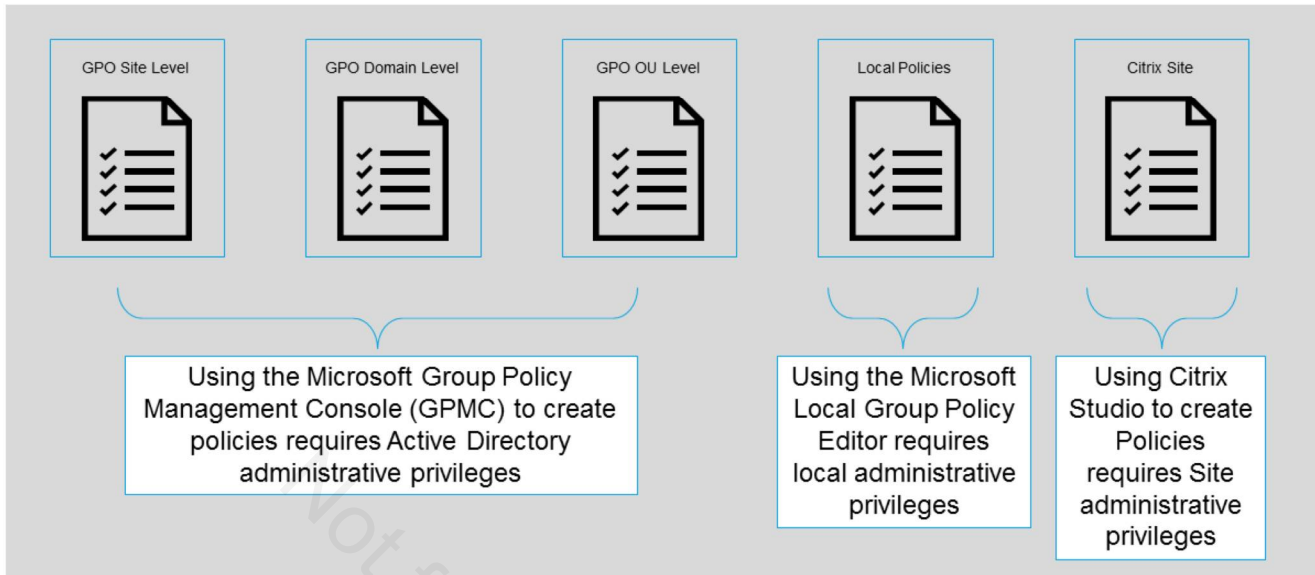
- All Citrix Local Policies are created and managed in the Citrix Studio console and stored in the Site Database; whereas, Group Policies are created and managed with the Microsoft Group Policy Management Console (GPMC) and stored in Active Directory. Microsoft Local Policies are created in the Windows Operating System and are stored in the registry.
- Studio uses a Modeling Wizard to help administrators compare configuration settings within templates and policies to help eliminate conflicting and redundant settings. Administrators can set GPOs using the GPMC to configure settings and apply them to a target set of users at different levels of the network.
- These GPOs are saved in Active Directory, and access to the management of these settings is generally restricted for most of IT for security.
- Settings are merged according to priority and their condition. Any disabled setting overrides a lower-ranked enabled setting. Un-configured policy settings are ignored and do not override lower-ranked settings.
- Local policies can also have conflicts with group policies in Active Directory, which could override each other depending on the situation.

Additional Resources:

- Policies - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/policies.html>
- Group Policy Loopback mode explanation - <https://blogs.technet.microsoft.com/askds/2013/02/08/circle-back-to-loopback/>

Policies

Policy Management Console Permission Considerations



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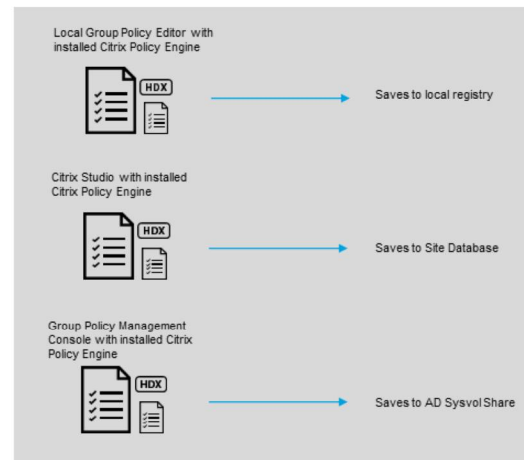
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Key Notes:

- Consider that the permissions to create / modify GPOs are required for Site, Domain, and OU based policies. However, Citrix Site policies can be configured by Citrix Administrators in Studio, so that settings can still be applied to VDAs even though the administrators have no AD permissions.

Citrix Policy Engine

- The Citrix Policy Engine:
 - Can hook into 3 different consoles:
 - Group Policy Management Console
 - Citrix Studio
 - Local Group Policy Editor Gpedit.msc
 - Is installed on all Delivery Controllers by default.
 - Is installed automatically with Studio.
 - Can be installed manually using the installation media on other computers.
- Depending on which console is used to create a Citrix policy, the save location will be different.



Key Notes:

- According to leading practices, Citrix policies should be created either in Active Directory or Citrix Studio, but not both at the same time.
- The Citrix Group Policy management extension is required to actually see and edit the Citrix policies “inside” the Microsoft GPOs.
- These extensions can be installed silently together with Citrix Studio or explicitly from a directory on the XA/XD installation media – both x64/x86 versions exist in separate directories.
- These extensions are only needed on systems that will be used to create or modify the Citrix policies.



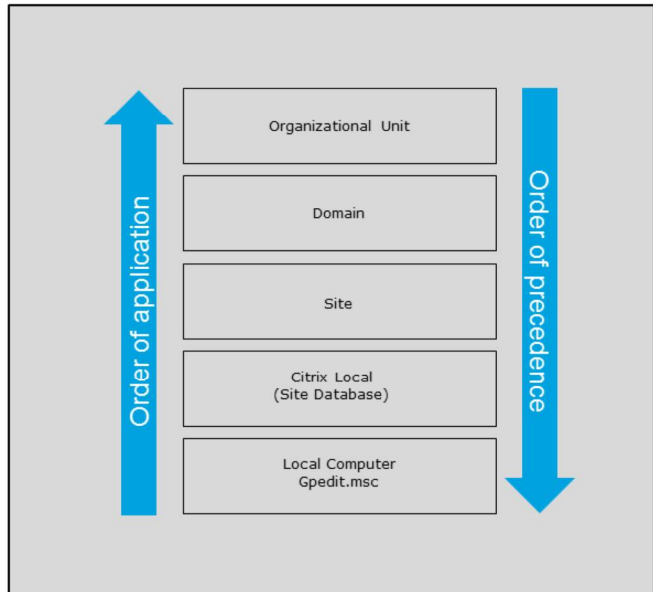
Which way of managing Policies will you most likely use?

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Policies

Precedence

- All Group Policies will be applied in Local, Citrix Local (Site Database), Site, Domain and OU order.
- The last applied policy is the winning policy.



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Key Notes:

- Group policy settings are processed in the following order:
 - Local GPO
 - Citrix local (stored in the Site database)
 - Site-level GPOs
 - Domain-level GPOs
 - Organizational Units
- However, if a conflict occurs, policy settings that are processed last can overwrite those that are processed earlier. This means that policy settings take precedence in the following order:
 - Organizational Units
 - Domain-level GPOs
 - Site-level GPOs
 - Citrix local (stored in the Site database)
 - Local GPO
- Citrix local policies from the Site database are transferred to the VDA and written to the registry upon registration of the VDA and on logon of a user.
- Citrix local policies cannot modify settings on VDAs that have not (yet) registered to the Site or which are registered to a different Site.

Additional Resources:

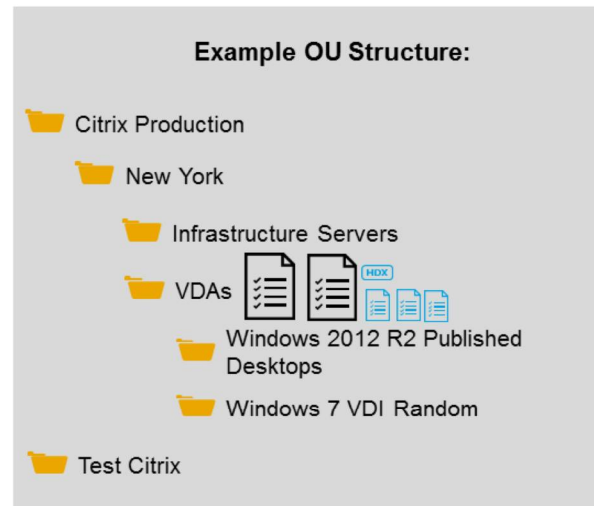
- Work with Policies - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/policies.html>

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Policies

Priorities

- If multiple policies are linked to an OU, the link order decides on their precedence - policies that have lower numbers take precedence over policies with higher numbers.
- If multiple Citrix Policies exist within a single GPO, their priority is used for conflict resolution.
- Policies can be disabled to exclude them from processing.



Key Notes:

- Because it's possible (and even likely) that you may have multiple GPOs to apply, there is always the possibility that these GPOs will have conflicting settings. In this case, how do we know which GPO will win and have its settings applied? The simple rule to remember is that the last GPO applied will overwrite any settings applied earlier. And the GPOs closest to the client location in the directory structure will be applied last. The order goes as follows:
 - Local
 - Site
 - Domain
 - Organizational Unit
- In both Citrix and Microsoft Policies, a lower number means higher precedence. The Local, Site, Domain, OU order still applies – the link order system is used only for conflict resolution inside a single OU, while the Priority system is used for conflict resolution inside a GPO.
- New Citrix Policies are added to the priority list with a higher number – so they would not have much effect and need to be repositioned to their correct rank.
- The priority numbers will be re-numbered automatically, if needed, so no gaps will exist.

Additional Resources:

- Group Policy Basics – Part 2: Understanding Which GPOs to Apply - https://blogs.technet.microsoft.com/musings_of_a_technical_tam/2012/02/15/group-

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Policies

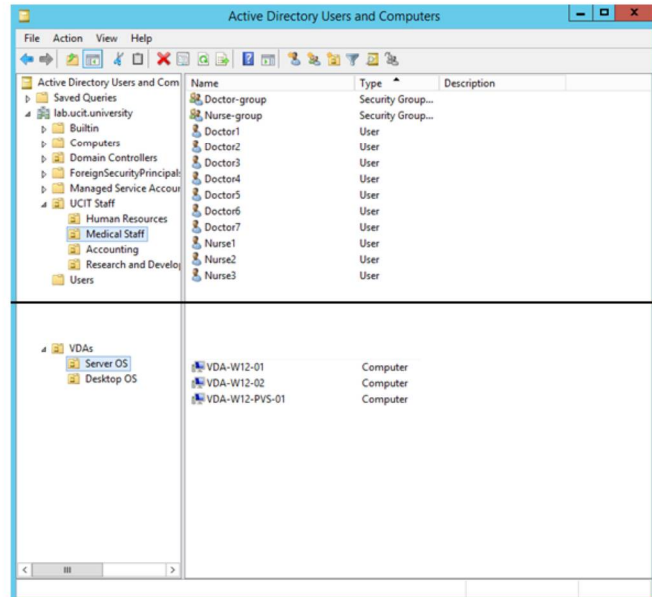
Loopback Example

If Nurse1 logs on to VDA-W12-01, the GPOs would apply in this order:

- Computer settings from Domain
- Computer settings from OU of VDA
- Computer settings from Sub-OU of VDA
- User settings from Domain
- User settings from OU of Nurse1

With Loopback Mode enabled for the Computer, additionally User settings apply:

- User settings from OU of VDA
- User settings from Sub-OU of VDA



Key Notes:

- Group Policy loopback is a computer configuration setting that enables different Group Policy user settings to apply based upon the computer from which logon occurs.
- Administrators use loopback processing in kiosk, lab, and Terminal Server environments to provide a consistent user experience across all computers, regardless of the GPOs linked to the user's OU.
- Loopback mode has to be enabled for a machine, it is a computer setting.
- The screenshot explains the order of policy application and how the computer "loops back" to re-evaluate all User settings from the GPOs that apply to the computer object.
- Loopback mode is useful when permissions restrict attaching a GPO to the users' OU, or more often specific settings for users are required depending on the machine they log on to.

Additional Resources:

- Group Policy Loopback mode explanation - <https://blogs.technet.microsoft.com/askds/2013/02/08/circle-back-to-loopback>

Policies

Loopback modes

Loopback Mode set to Replace:

- No User settings from the Users' OU are applied.
- Only User settings from Computers' OU are applied.

User Setting (User OU)	User Setting (Computer OU)	Resultant Setting for User
A	1	1
B		
C	3	3

Loopback Mode set to Merge:

- All User settings from the Users' OU are applied.
- All User settings from Computers' OU are applied, overwriting conflicting settings.

User Setting (User OU)	User Setting (Computer OU)	Resultant Setting for User
A	1	1
B		B
C	3	3

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Key Notes:

- When you enable loopback processing, you also have to select the desired mode. There are two modes for loopback processing: Merge or Replace.
- During loopback processing in merge mode, user GPOs process first (exactly as they do during normal policy processing), but with an additional step. Following normal user policy processing the Group Policy engine applies user settings from GPOs linked to the computer's OU. The result – the user receives all user settings from GPOs applied to the user and all user settings from GPOs applied to the computer. The user settings from the computer's GPOs win any conflicts since they apply last.
- During loopback processing in Replace Mode, the user settings applied to the computer “replace” those applied to the user. In actuality, the Group Policy service skips the GPOs linked to the user's OU. Group Policy effectively processes as if user object was in the OU of the computer rather than its current OU.
- “Replace” might mean that necessary settings from other GPOs for the user will be missing, like Folder Redirection etc.
- “Merge wins conflicts (1 vs A)”, but settings without conflict will apply. Replace eliminates conflicts by discarding ABC completely”.

Additional Resources:

- Group Policy Loopback mode explanation - <https://blogs.technet.microsoft.com/askds/2013/02/08/circle-back-to-loopback/>

Policies

Filters

- Filtered policies only apply to the filtered targets.
- Policies without filters apply to all users and connections.
- Combine multiple filters for more complex scenarios.
- Filters are AND-combined.
- Available filters are different for User / Computer settings.
- Filters can allow or deny the application of a policy by reversing their expression.



Key Notes:

- In Studio, policies and templates are displayed in a single list regardless of whether they contain user, computer or both types of settings and can be applied using both user and computer filters.
- Studio Policy Filters summary overview:
 - Access Control – use NetScaler EPA scans to detect client scenarios
 - Citrix CloudBridge – detect the presence of the bandwidth saving appliance
 - Client IP address – filter on ranges or specific addresses
 - Client name – filter on client names
 - Delivery Group – apply policies to named Delivery Groups
 - Delivery Group type – apply policies to certain types of Delivery Groups (like shared or private VDAs)
 - Tag – filter policies based on tags from Citrix Studio
 - User or Group – apply the policy to specific domain users or groups
 - Organizational Unit (only within Studio) – filter the policy on the OU of the VDAs
- If multiple Filters are set, they will be AND-combined. Only if each Filter result is true, the policy will apply. (Think of “the more you filter, the less you target”). Example: Filter A set to domain\nurse-group, Filter B set to 192.168.10.20 would only match for specific nurses logging on from a specific address.

Additional Resources:

- Work with Policies - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/policies/policies-processes.html>

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Baseline Policy

Recommendations

- Most settings are enabled by default – this could compromise security.
- Create a policy with settings that apply to most users & scenarios.
- Rank this policy lowest.
- Do not filter the policy.
- Define exceptions in higher ranking policies.
- Do not use the “Unfiltered” policy.

Key Notes:

- Assign policies to groups rather than individual users. If you assign policies to groups, assignments are updated automatically when you add or remove users from the group.
- Do not enable conflicting or overlapping settings in Remote Desktop Session Host Configuration. In some cases, Remote Desktop Session Host Configuration provides similar functionality to Citrix Policy settings. When possible, keep all settings consistent (enabled or disabled) for ease of troubleshooting.
- Disable unused policies. Policies with no settings added create unnecessary processing.
- An unfiltered, lowest-ranking policy with custom settings is basically “a new system default” more suitable for the company.
- Exceptions from the baseline can be defined on a per user / per scenario basis in higher ranking policies that are filtered to specific needs.
- Using the “Unfiltered policy” (which exists in every GPO as well as in Studio) is not recommended, since Director (a Citrix Help Desk web application) and several reporting tools will refer to this name in their reports or charts. It is better to create an alternative unfiltered policy instead and provide it with a meaningful name.

Additional Resources:

- Create Policies - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/policies/policies-create.html>

Policies

Resultant Set

Each Policy Setting can assume different states:

- Enabled / Allowed
- Disabled / Prohibited
- Value
- Not configured

Priority	Policy Name	Filter	Audio Channel	Audio quality	Printing Channel	Drive Mapping
1	Marketing work from Home	Marketing Users External IP	Enabled	-	Disabled	Enabled
2	Marketing work from Office	Marketing Users Internal IP	Enabled	Low quality	Enabled	Enabled
3	Accounting	Accounting Users	Disabled	-	Enabled	-
4	Baseline	No filter	Disabled	-	Disabled	Disabled
-	System default	-	Enabled	High quality	Enabled	Enabled

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Key Notes:

- “Not configured” enables lower ranking policies to get applied for that specific setting.
- Some features have dependencies – Audio quality will be meaningless if the Audio channel is disabled altogether.
- Policy Example:
 - A Marketing User (Jimmy) works from home today – the policy system uses the filters to find policies that apply, in addition to the System default settings, that always apply at a fixed lowest rank but can be modified with higher ranking policies. For Jimmy, the “Marketing work from Home” and “Baseline” policies apply (Jimmy is not member of the accounting group, and Jimmy does not connect from an internal IP address).
 - Next, all settings are processed, where conflicts will be resolved by taking the respective setting’s value from the highest ranking (lowest number) policy.
 - So for “Audio channel” this means “enabled” (since Priority 1 wins over Priority 4), for “Audio quality” this means “High quality” (since the highest ranking policy is not configured, and the lower ranking policies are also not configured, the system default applies. Note that audio quality could be degraded if a future policy introduces a setting of “low quality” for marketing users.
- Use the Citrix Group Policy Modeling Wizard to simulate a connection scenario and discern how Citrix policies might be applied. You can specify conditions for a connection scenario such as Domain Controller, users, Citrix policy assignment evidence values, and simulated environment settings-such as a slow network connection. The report that the

wizard produces lists the Citrix Policies that would likely take effect in the scenario. If you are logged on to the Controller as a domain user, the wizard calculates the Resultant Set of Policy using both Site policy settings and Active Directory Group Policy Objects (GPOs).

- Use Group Policy Results to produce a report describing the Citrix Policies in effect for a given user and controller. The Group Policy Results tool helps you evaluate the current state of GPOs in your environment and generates a report that describes how these objects, including Citrix Policies, are currently being applied to a particular user and Controller.

Additional Resources:

- Compare, prioritize, model, and troubleshoot policies - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/policies/policies-compare-model.html>

Policy Modeling

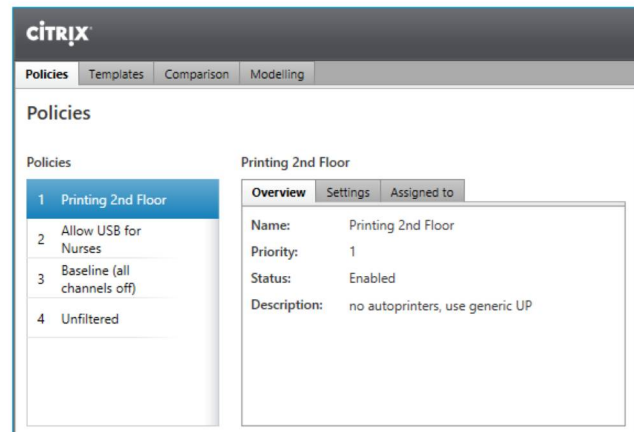
Use Citrix Group Policy Modelling Wizard to find possible results for combinations of filter criteria.

- Helps to clarify which settings are defined if User1 logs on to VDA2 from IP address 10.20.30.40 etc.

Start Wizard from GPMC or Citrix Studio.

Only Wizard within Citrix Studio includes local Citrix policies.

- Use Citrix Studio for Group policy modelling.



Key Notes:

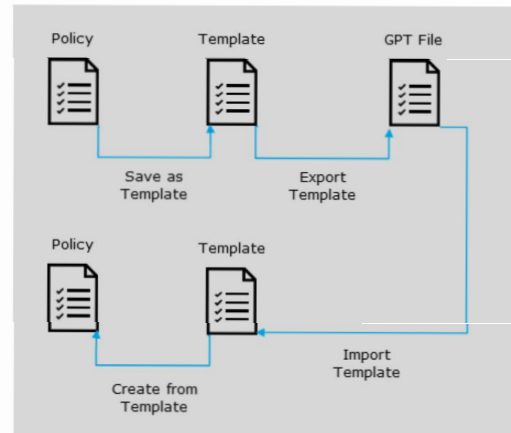
- You can launch the Citrix Group Policy Modeling Wizard from the Actions pane in Studio. You can launch either tool from the Group Policy Management Console in Windows.
- To ensure you obtain the most comprehensive Resultant Set of Policy, Citrix recommends launching the Citrix Group Policy Modeling wizard from Studio, unless you create policies using only the Group Policy Management Console.
 - If you run the Citrix Group Policy Modeling Wizard or Group Policy Results tool from the Group Policy Management Console, local Citrix policy settings created using Studio are not included in the Resultant Set of Policy.
 - The Citrix Studio based Wizard will include local Citrix policies as well as policies created or stored in GPOs within AD.
- The reports can be viewed, printed or saved as HTML files.

Additional Resources:

- Compare, prioritize, model, and troubleshoot policies - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/policies/policies-compare-model.html>

Policy Templates

- Create policies from pre-built templates to quickly adjust many settings for defined scenarios.
- Create templates from converting a configured policy.
- Templates can be imported and exported.



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Key Notes:

- Templates are a source for creating policies from a pre-defined starting point. Built-in Citrix templates, optimized for specific environments or network conditions, can be used as:
 - A source for creating your own policies and templates to share between Sites.
 - A reference for easier comparison of results between deployments as you will be able to quote the results, for example, "..when using Citrix template x or y..".
 - A method for communicating policies with Citrix Support or trusted third parties by importing or exporting templates.
- The import / export function uses Microsoft Group policy template (GPT) as the file format.
- The template functionality exists in the GPMC add-on as well as in Citrix Studio.
- To transfer policies from AD to Citrix local (or vice versa), transform the policy to a template which can then be exported / imported.
- Remember that templates do not have Filters – so saving (copying) a policy as template means that the Filters will get lost for the template (the policy itself keeps the Filters).

Additional Resources:

- Policy Templates - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/policies/policies-templates.html>
- Group Policy Management Template Updates for XenApp and XenDesktop -

<http://support.citrix.com/article/CTX202000>

- Whitepaper: HDX Policy Templates - <http://support.citrix.com/article/CTX202330>

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Lab Exercise

- Exercise 6-1: Create a Group Policy to set Baseline Computer Settings
- Exercise 6-2: Configure Baseline Citrix User Policy Using Group Policy
- Exercise 6-3: Configure Group Policy Loopback Processing
- Exercise 6-4: Creating Citrix Policies from Templates
- Exercise 6-5: Configuring Client Drive Mapping Using Studio
- Exercise 6-6: Run the Policy Modeling Wizard from Studio

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Policy Comparison

- The following items can be compared to each other:
 - Policies
 - Templates
 - Default settings
- Multiple items of each type can be selected.
- Differences are highlighted.

Configured Settings	Defaults	Optimized for WAN
Desktop Composition Redirection	Disabled	Disabled
Desktop Wallpaper	Allowed	Prohibited
Menu Animation	Allowed	Prohibited
Use asynchronous writes	Disabled	Enabled

Key Notes:

- You can compare settings in a policy or template with those in other policies or templates. For example, you might need to verify setting values to ensure compliance with leading practices. You might also want to compare settings in a policy or template with the default settings provided by Citrix.
 - Select Policies in the Studio navigation pane.
 - Click the Comparison tab, and then click Select.
 - Choose the policies or templates to compare. To include default values in the comparison, select the Compare to default settings check box.
 - After you click Compare, the configured settings are displayed in columns.
 - To see all settings, select Show All Settings. To return to the default view, select Show Common Settings.

Additional Resources:

- Compare, prioritize, model, and troubleshoot policies - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/policies/policies-compare-model.html>



Group Discussion

- Will Accounting Users have access to their local drive within the session?
- What unwanted situation could emerge in the future?

Priority	Policy Name	Filter	Printing Channel	Drive Mapping
1	Marketing home office	Marketing Users External IP	Disabled	Enabled
2	Marketing back office	Marketing Users Internal IP	Enabled	Enabled
3	Accounting	Accounting Users	Enabled	-
4	Baseline	No filter	Disabled	Disabled
-	System default	-	Enabled	Enabled

Key Notes:

- Answer 1: No, since only three policies are applied: Priority 3, Priority 4, System default. Since Priority 3 Policy does not configure the Drive Mapping setting, the next Baseline policy's setting is used (any value ranks higher than system default).
- Answer 2: The following unwanted situation could emerge: Accounting users could gain access to their local drives. Reason: A change in the baseline policy or a new policy that is also mapped to the Accounting users, but ranks higher than the Baseline policy enables Drive Mapping.

Lesson Objective Review

Scenario: You are the Citrix Admin and you have recently configured a user setting to hide the server C: drive for all users using Published Desktops.

The setting was configured in the Citrix Baseline GPO linked to the XAW OU, however, the setting does not apply.

What could you be missing?

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Lesson Objective Review

Scenario: You are the Citrix Admin and you have recently configured a user setting to hide the server C: drive for all users using Published Desktops.

The setting was configured in the Citrix Baseline GPO linked to the XAW OU, however the setting does not apply.

What could you be missing?

Loopback processing – by default, user settings will only be applied if the GPO is linked to a user OU.

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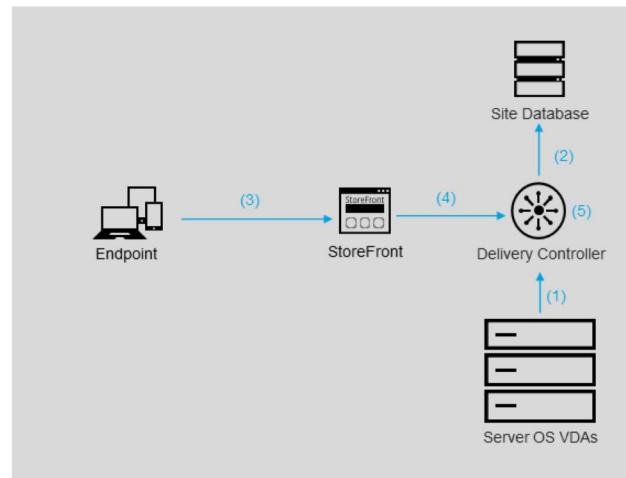
Policies for Session Management

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Load Management

1. Each Server OS VDA reports its load values to the Delivery Controller.
2. The Delivery Controller saves the load values in the Site Database.
3. Requests for Resources come into StoreFront.
4. StoreFront relays the request to the Delivery Controller who for a new session makes a load-balancing decision by using the load values from the database:
 - Load Values range from 0-10000
 - Load Values can be viewed in Studio, Director, and PowerShell
5. The Delivery Controller decides the least busy VDA.



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Key Notes:

- Any value higher than 10000 is usually some warning or error message within the load balancing system (like 20000 = feature not licensed).
- Multiple criteria can be combined to evaluate load on VDAs (memory, CPU etc.), but only the highest value will be reported as load value for this server.
- For Example:
 - A machine is running a task that is consuming 100% of the CPU capacity and reports a load value of 10000. After the administrator ends the task, the load drops to 7000 although the CPU is only 20% loaded. The reason might be, that now a different configured value (memory?) is the “highest value” and thus gets reported as load value.
- Load balancing normally only applies to NEW sessions, so it is best practice to have some spare resources for existing sessions left on the VDA.
- The counters that can be used to report load values:
 - Concurrent logons tolerance
 - CPU usage
 - CPU usage excluded process priority
 - Disk usage
 - Maximum number of sessions (default value of 250)
 - Memory usage
 - Memory usage base load

- Use PowerShell Command “Get-BrokerMachine -SessionSupport Multisession | select machinename,loadindex” to get an overview of the load values.
- Use “select columns” in Studio within the search pane to display “Load index”.
- Use the Load Evaluator Index tab within the Trends section of Citrix Director to display the load values for specific delivery groups. In contrast to PowerShell and Studio, Director can display historical recorded load values, which can be helpful during capacity planning.
- Concurrent logon tolerance:
 - This setting specifies the maximum number of concurrent logons a server can accept.
 - By default, this is set to 2.
- CPU usage:
 - This setting specifies the level of CPU usage, as a percentage, at which the server reports a full load. When enabled, the default value at which the server reports a full load is 90%.
 - By default, this setting is disabled and CPU usage is excluded from load calculations.
- CPU usage excluded process priority:
 - This setting specifies the priority level at which a process' CPU usage is excluded from the CPU Usage load index.
 - By default, this is set to Below Normal or Low.
- Disk usage:
 - This setting specifies the disk queue length at which the server reports a 75% full load. When enabled, the default value for disk queue length is 8.
 - By default, this setting is disabled and disk usage is excluded from load calculations.
- Maximum number of sessions:
 - This setting specifies the maximum number of sessions a server can host. When enabled, the default setting for maximum number of sessions a server can host is 250.
 - By default, this setting is enabled.
- Memory usage:
 - This setting specifies the level of memory usage, as a percentage, at which the server reports a full load. When enabled, the default value at which the server reports a full load is 90%.

- By default, this setting is disabled and memory usage is excluded from load calculations.
- Memory usage base load:
 - This setting specifies an approximation of the base operating system's memory usage and defines, in MB, the memory usage below which a server is considered to have zero load.
 - By default, this is set to 768 MB.

Additional Resources:

- How to Calculate the Load Evaluator Index on XDC - <http://support.citrix.com/article/CTX202150>
- Load Management settings- <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/policies/reference/load-management-policy-settings.html>



Lab Exercise

- Exercise 6-7: Create a Load Management Policy using Studio
- Exercise 6-8: Test the Newly Configured Load Management Settings

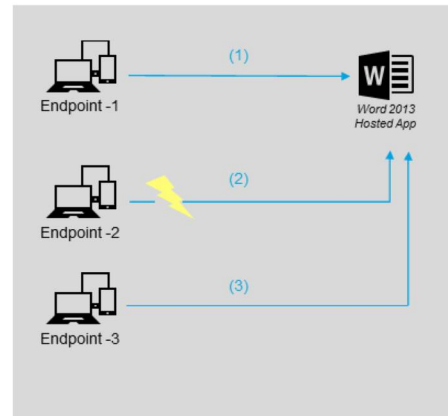
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Session Reliability

Session Reliability Process:

1. User initiates a session from PC001.
2. The network connection is interrupted. Receiver displays a still image and buffers user input for 180 seconds. The VDA is aware of the broken connection, but does not set the session to disconnected for 180 seconds.
3. The network connection is restored and buffered input is sent to the server.

Note: All session data is transmitted on port 2598 when using Session Reliability.



Key Notes:

- By default, Session Reliability is allowed.
- Session Reliability keeps sessions active and on the user's screen when network connectivity is interrupted. Users continue to see the application they are using until network connectivity resumes.
- With Session Reliability, the session remains active on the server. To indicate that connectivity is lost, the user's display freezes and the cursor changes to a spinning hourglass until connectivity is restored. The user continues to access the display during the interruption and can resume interacting with the application when the network connection is restored. Session Reliability re-connects users without re-authentication prompts. If you do not want users to be able to re-connect to interrupted sessions without having to re-authenticate, configure the *Auto client re-connect authentication* setting to require authentication. Users are then prompted to re-authenticate when reconnecting to interrupted sessions.
- The default of 180 seconds is configurable (should not be set too high to compromise security, because re-connects do not require re-authentication).
- Seeing a spinning hourglass icon attached to the mouse pointer within a session is normally an indicator that the session is currently reconnected in the background. Users often describe this behavior as "the session being stuck for a moment" which might be better than having to start a new session again. If this happens a lot, the underlying network connection should be checked.
- This feature is most useful for connections that drop packets frequently or disconnect often (mobile networks, roaming Wi-Fi).

- Takes precedence over Auto Client Reconnect feature (explained in the next slide).
- Some users MUST NOT have still images of their sessions displayed (monitoring systems, healthcare, intraday trading & brokerage), since their decisions would rely on outdated information. This feature can be disabled using a Computer based GPO, but will disable Session Reliability for the entire machine (not for a user or group).

Additional Resources:

- Session reliability policy settings - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/policies/reference/ica-policy-settings/session-reliability-policy-settings.html>

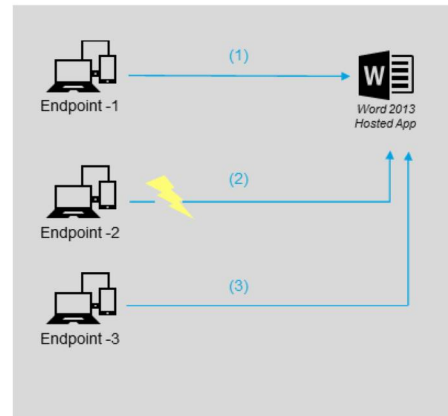
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Auto Client Reconnect

- Setting to control automatic reconnection in case of interrupted connections.
- Can be set to require re-authentication.

Auto Client Reconnect Process:

1. User initiates a session from PC001.
2. The network connection is interrupted.
3. Receiver on PC001 automatically reconnects to the session from PC001.



Key Notes:

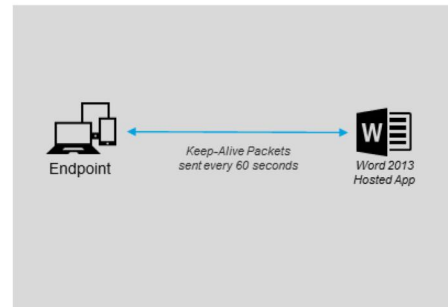
- If you use both Session Reliability and auto client reconnect, the two features work in sequence. Session Reliability closes (or disconnects) the user session after the amount of time specified in the Session Reliability timeout setting. After that, the auto client reconnect settings take effect, attempting to reconnect the user to the disconnected session.

Additional Resources:

- Session Reliability policy settings - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/policies/reference/ica-policy-settings/auto-client-reconnect-policy-settings.html>

ICA Keep-Alive

- Enable to send packets from server to client at configurable interval.
- Enables servers to detect connection failures.
- Can be enabled via policy.
- Session Reliability uses similar mechanism.



Key Notes:

- ICA Keep-Alive is not used for Sessions running CGP / Session Reliability (Port 2598), but only for “plain” ICA Sessions (Port 1494) since Session Reliability uses a similar mechanism by itself.
 - ICA keep-alive does not work if you are using Session Reliability. Configure ICA keep-alive only for connections that are not using Session Reliability.
- By default, the interval between keep-alive messages is 60 seconds.
- Specify an interval between 1-3600 seconds in which to send ICA keep-alive messages. Do not configure this setting if your network monitoring software is responsible for closing inactive connections.
- Normally, the server does not send packets to the client (to save bandwidth). If in a desktop session, the clock is visible, you already have a keep-alive because the updated bitmap needs to be sent to the client every minute.
- If the server does not send packets to the client, network disruptions can go unnoticed – the server might keep the session of the client open and reconnection might fail (the client would have to wait for the session to become disconnected to reconnect again).
- Normally most clients today support automatic reconnection even to sessions that are not (yet) marked as disconnected.
- Ultimately, if Session Reliability is configured ICA Keep-Alive is ignored. Remember that Session Reliability is configured by default.

Additional Resources:

- Keep alive policy settings - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/policies/reference/ica-policy-settings/keep-alive-policy-settings.html>

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Lesson Objective Review

Scenario: You are the Citrix Admin and you have just deployed XenApp and XenDesktop.

However, users are unable to connect to their sessions. In checking with the Networking team, you've learned that port 1494 was enabled for HDX connections.

What are you missing?

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Lesson Objective Review

Scenario: You are the Citrix Admin and you have just deployed XenApp and XenDesktop.

However, users are unable to connect to their sessions. In checking with the Networking team, you've learned that port 1494 was enabled for HDX connections.

What are you missing?

Session Reliability is enabled by default and uses port 2598 for user connections to sessions.

Key Notes:

- If a task consumes 100% of all available CPUs on a VDA - when will the server report “full load”?
 - This counter is evaluated every 30 seconds but the last 10 samples (300 seconds worth of data) are used to build a mean value.
 - Only if a task consumes 100% CPU resources for long enough will the VDA report a full load.
 - This inertia is built in to avoid having servers reporting full load whenever a task “spikes”.
 - For example, when starting Excel or Word 100% of CPU resources are consumed, but only for a very short amount of time.

Key Takeaways



- Policies are a most flexible instrument of controlling most aspects of a Citrix XenDesktop deployment.
- Controlling the session management features can provide users with a better user experience.

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XenApp and XenDesktop Administration

Application Presentation and Management

Module 7



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Lab VM Power Management

The following VMs are required to be powered on before beginning the exercises in this module:

- NYC-ADS-001
- NYC-SQL-001
- NYC-FSR-001
- NYC-XDC-001
- NYC-STF-001
- NYC-MAN-001
- NYC-SRV-001
- NYC-DTP-001
- NYC-WRK-001

The remaining VMs need to be powered off.

Note: These VMs are listed in the start-up order.

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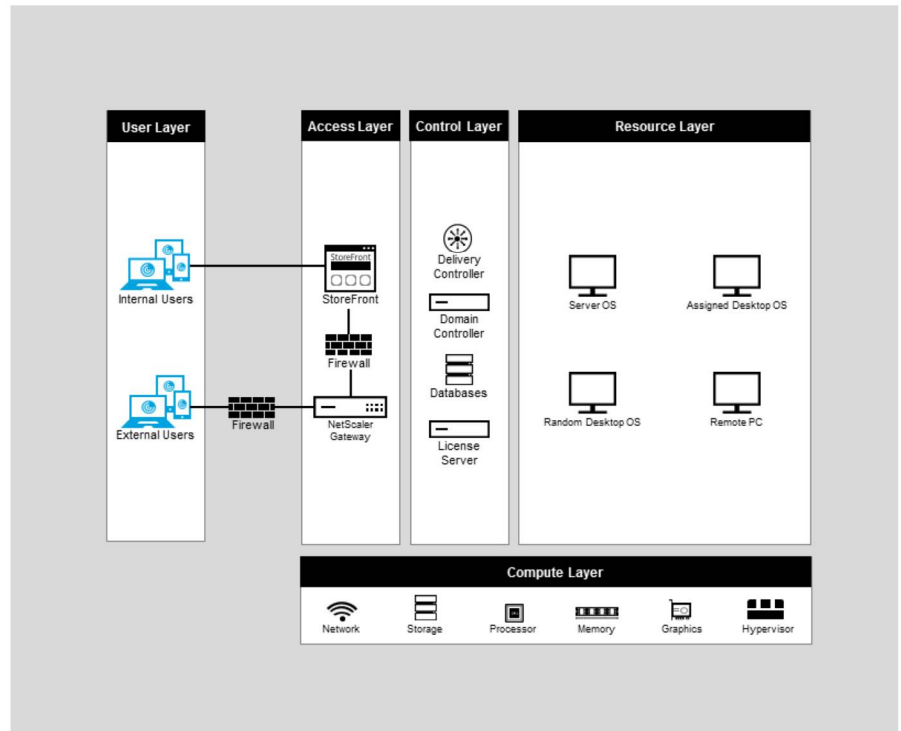
Learning Objectives

- Discover the properties of delivered resources
- Identify the configuration of File Type Association
- Determine shortcut placement options and resource presentation
- Classify the functionality of Application Groups

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User Experience

This module will focus on configuring the user experience



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Application Properties

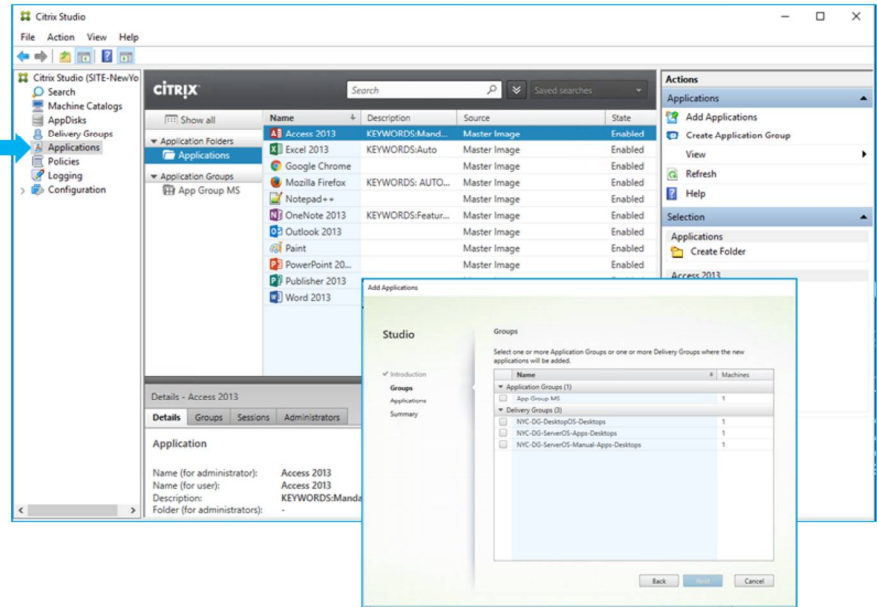
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Applications Node

Features include:

- Viewing, assigning, and editing apps all in one place.
- Option to host apps to multiple Delivery Groups at the same time.
- Ability to add existing apps to a Delivery Group.



Key Notes:

- Under the legacy IMA architecture, XenApp has had an Applications node for years, up through version 6.5.
- When Citrix carved XenApp out of IMA and brought it to FMA and the Site architecture, the individual App node was hidden.
 - It was not completely lost; it was just buried under the Delivery Groups node, in the Applications tab.
- Starting with XenApp and XenDesktop 7.8, the Applications node has been exposed directly in Studio. It's not the same Applications node from the IMA days, because Catalog and Delivery Group considerations now come into play.

Application Properties

- Identification
 - Application Name
 - Description / Keywords
- Delivery
 - Category
- Location
- Groups
- Executable
- Command Line argument
- Working Directory
- Limit Visibility
- File Type Association
- Zone

Application Settings

Studio

Identification

Identify this application.

Application name (for user):
Word 2013

Application name (for administrator):
Word 2013

Description and keywords:

This is the description that will be seen by the user. You can also use this field to enter keywords for StoreFront.
[Learn More](#)

OK Cancel Apply

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Key Notes:

- Each app can use two different names (for user / for administrator) – this makes it possible to offer a program with the same name but different command line parameters or originating from different Delivery Groups to users.
- Within each application folder, the Application Name (for administrator) must be unique.
- To change the properties of an application:
 - Select Applications in the Studio navigation pane.
 - Select an application and then select Edit Application Properties in the Actions pane.

Additional Resources:

- Applications - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/manage-deployment/applications-manage.html>

Keywords

- Auto
 - Applications display automatically as favorite & in start menu
 - User can still remove app from favorites
- Mandatory
 - Like *Auto*, but user cannot remove app from favorites
- Featured
 - Special visual emphasis, depending on client
- Prefer
 - Substitute published app with a local app on the client
- TreatAsApp
 - For virtual desktops to display in the app folder

The screenshot shows the 'Application Settings' window in Citrix Studio, with the 'Identification' tab selected. The left sidebar lists various settings: Studio, Identification (highlighted with a blue arrow), Delivery, Location, Groups, Limit Visibility, File Type Association, and Zone. The main content area is titled 'Identification' and contains the following fields:

- Identify this application.
- Application name (for user): Word 2013
- Application name (for administrator): Word 2013
- Description and keywords: KEYWORDS: Featured Auto

Below the description field, there is a note: 'This is the description that will be seen by the user for StoreFront.' and a link labeled 'Learn More'.

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Key Notes:

- What are Keywords? Keywords are a method that Citrix administrators can use to control or direct how an application is displayed to the user, when that user connects to the Storefront store. The Specific Keywords, as mentioned above, are used to provide this level of control.
- A description and multiple Keywords can be combined in the “Description and keywords:” field, as shown in the screenshot. Everything after “KEYWORDS:” is considered to be a Keyword.
- Multiple Keywords are separated using blank spaces.
- Using Auto or Mandatory does not really subscribe users to applications (no database entry will be made in the StoreFront-based subscription store). Using these Keywords just makes it look as if the user was subscribed to an app. As soon as the Keyword is removed, users will no longer see the app icon within their Favorites in StoreFront & Receiver (or the Start menu).
- Append Keywords to the descriptions you provide for Delivery Group applications:
 - To make an individual app mandatory, so that it cannot be removed from Citrix Receiver for Windows, append the string KEYWORDS:Mandatory to the application description. There is no Remove option for users to unsubscribe to mandatory apps.
 - To automatically subscribe all users of a store to an application, append the string KEYWORDS:Auto to the description. When users log on to the store, the application is automatically provisioned without users needing to manually subscribe to the application.

- To advertise applications to users or to make commonly used applications easier to find by listing them in the Citrix Receiver Featured list, append the string KEYWORDS:Featured to the application description.

Additional Resources:

- Configuring application delivery - <https://docs.citrix.com/en-us/receiver/windows/4-5/configure/receiver-windows-configure-app-delivery-wrapper.html>

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What could be a useful scenario for the “prefer” keyword?

Key Notes:

- Doctor A is using an old PC in the counseling room and Citrix Receiver will start a remote session for Word, Excel, and Outlook since the software is not installed on the old PC due to memory limitations.
- When using his new laptop, Citrix Receiver starts the local installed version of Word, Excel, and Outlook, because the preference was set using a Keyword for these three applications.

Categories

- Provide a hierarchical structure in the client's Start menu and help locate related applications.
- Provide additional words that can be searched for to find an application.
- To nest Categories, use a backslash:
 - Folder\Subfolder1\Subfolder2
 - Note that the Windows 8 start menu only shows the top-level folder.
- Each app can be placed in only one category at a time.
- Multiple applications can share a category.



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Key Notes:

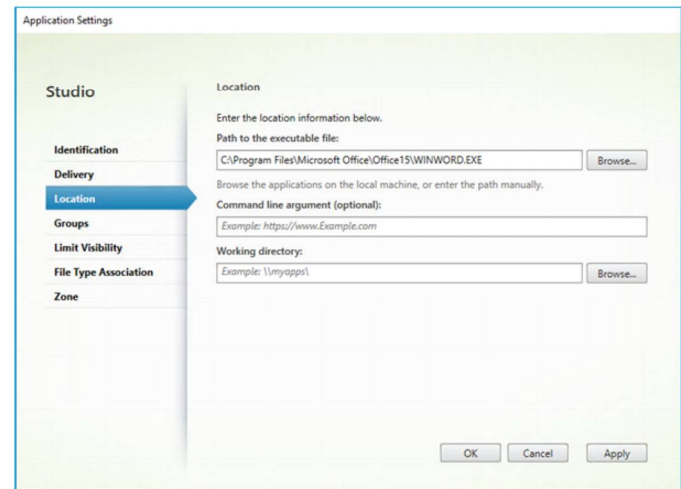
- The screenshot shows several applications that have all been put in the “Office” category – without any subfolders.
- In the Application category field, optionally specify the category in Receiver where the application appears. For example, if you are adding shortcuts to Microsoft Office applications, enter Microsoft Office.
- If you want applications displayed in specific folders use the following options:
 - If you want the application shortcuts Citrix Receiver places in the Start menu to be shown in their associated category (folder) - configure Citrix Receiver with UseCategoryAsStartMenuPath=True.
 - Note: Windows 8/8.1 does not allow the creation of nested folders within the Start Menu. Applications will be displayed individually or under the root folder but not within Category sub folders defined within XenApp and XenDesktop.
 - If you want the applications that Citrix Receiver puts in the Start menu to be in a specific folder - configure Citrix Receiver with StartMenuDir=the name of the Start Menu folder name.
 - Backslash serves as delimiter to create a hierarchical structure.

Additional Resources:

- Configuring application delivery - <https://docs.citrix.com/en-us/receiver/windows/4-5/configure/receiver-windows-configure-app-delivery-wrapper.html>

Location

- Specify local or remote applications in the path field.
 - Use UNC paths instead of mapped drive letters
 - Variables may also be used, like %homedrive%
- Submit special parameters to the program by using the command line argument field .
 - Variables can also be passed to the program, like %username%
- If needed, specify a working directory for the program to use as default when saving or loading files from within the program.



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Key Notes:

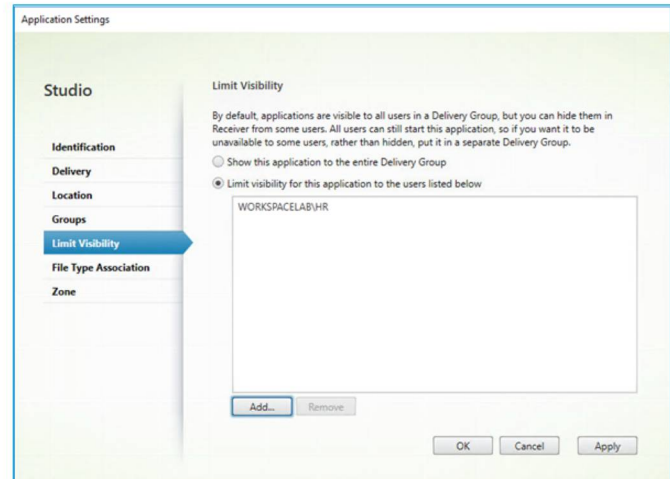
- Mapped drive letters are mapped on a per user basis and might not be available to the FMA subsystem upon the launch of the app. It is therefore a leading practice to use UNC paths instead.
- Most programs do not evaluate the working directory anymore, but instead use different directories for specific functions, usually configurable in the program's menu or via policies.

Additional Resources:

- Applications - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/manage-deployment/applications-manage.html>

Limit Visibility

- Use Limit Visibility to restrict application access to specified groups.
- To limit access to the Desktops delivered on a Server OS Delivery Group that is also hosting applications, use PowerShell, or Studio on version 7.7 and above.
- This will not block users from starting the application itself from another application or a desktop session.



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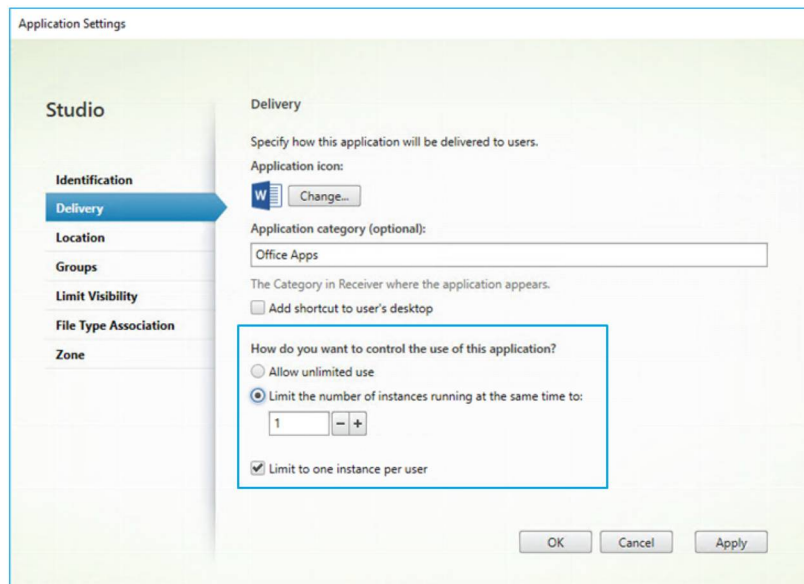
Key Notes:

- This feature functions like a whitelist.
- Every group (or member of the group) needs to be able to access the Delivery Group itself, so allowing access on the delivery group to “doctors” and later specifying the “nurses” group for access to an application hosted from this Delivery Group does not enable the nurses to start the program.
- By default, all applications are accessible to anyone having permissions to access the Delivery Group.
- Starting with XenDesktop 7.7, permissions to access the desktop of a Delivery Group can also be set in Studio (previous to this version, PoSh has to be used).
- This does not prevent access to the app in general for other users – they might still be able to access the app from another app that they are able to launch (for example, starting WinZip by clicking the ZIP-File-Attachment from within Outlook).

App Limits

Use App Limits to:

- Limit the number of resource-intensive apps that can be launched.
- Control licensing of an application.



Key Notes:

- This feature was available in XenApp version 6.5 and earlier, within both the Publishing wizard and the Application Properties Advanced settings.

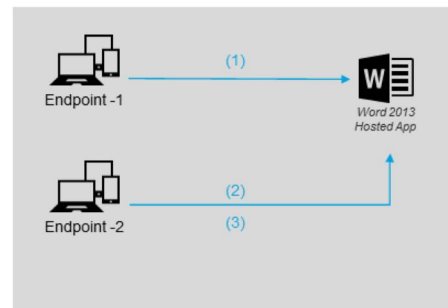
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Workspace Control

- Workspace Control allows roaming of sessions.
- Users can manually initiate reconnection to open or disconnected sessions.
- Policies are re-evaluated upon reconnection.

Process of Workspace Control:

1. User initiates a session from PC001.
2. The same User logs on to PC002.
3. The sessions are disconnected from PC001 and automatically re-connected from PC002.



Key Notes:

- Workspace Control lets desktops and applications follow a user from one device to another. This ability to roam enables a user to access all desktops or open applications from anywhere simply by logging on, without having to restart the desktops or applications on each device. For example, Workspace Control can assist health-care workers in a hospital who need to move quickly among different workstations and access the same set of applications each time they log on. If you configure Workspace Control options to allow it, these workers can disconnect from multiple applications at one client device and then reconnect to open the same applications at a different client device.
- Workspace Control affects the following activities:
 - Logging on – By default, Workspace Control enables users to reconnect automatically to all running desktops and applications when logging on, bypassing the need to re-open them manually. Through Workspace Control, users can open disconnected desktops or applications, as well as any that are active on another client device. Disconnecting from a desktop or application leaves it running on the server. If you have roaming users who need to keep some desktops or applications running on one client device while they reconnect to a subset of their desktops or applications on another client device, you can configure the logon reconnection behavior to open only the desktops or applications that the user disconnected from previously.
 - Reconnecting – After logging on to the server, users can reconnect to all of their desktops or applications at any time by clicking Reconnect. By default, Reconnect opens desktops or applications that are disconnected, plus any that are currently running on another client device. You can configure Reconnect to

open only those desktops or applications that the user disconnected from previously.

- Logging off – For users opening desktops or applications through StoreFront, you can configure the Log Off command to log the user off from StoreFront and all active sessions together, or log off from StoreFront only.
- Disconnecting – Users can disconnect from all running desktops and applications at once, without needing to disconnect from each individually.

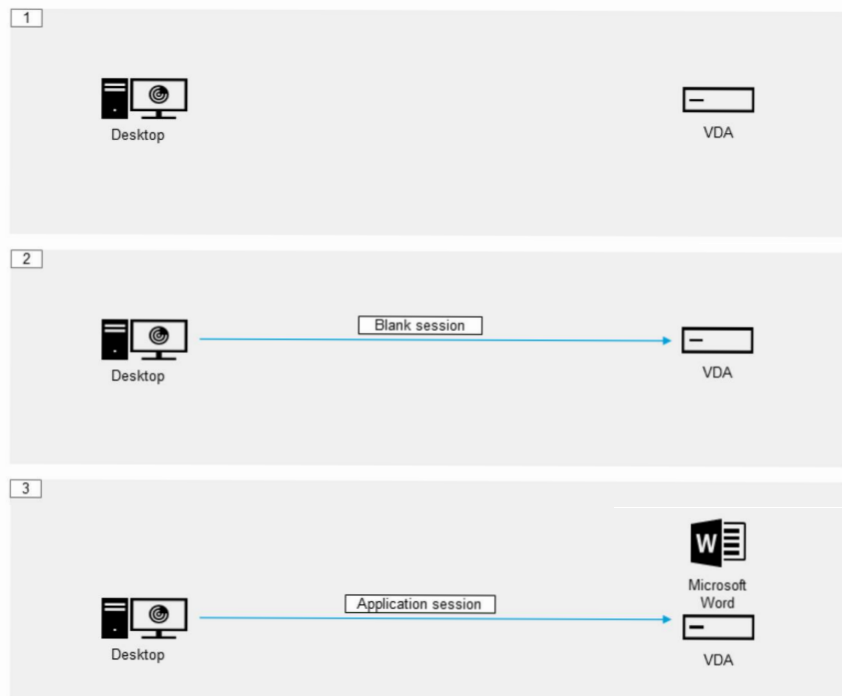
Additional Resources:

- Workspace control - https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/manage-deployment/sessions.html#par_anchortitle_24f8
- Session roaming - https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/manage-deployment/sessions.html#par_anchortitle_d65d

Session Pre-Launch

To save time for the user during application launch, Receiver can re-use existing sessions:

1. Receiver is loaded
2. Receiver starts a blank session
3. User launches application in existing session



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Key Notes:

- The Session Pre-launch and Session Linger features help specified users access applications quickly, by starting sessions before they are requested (Session Pre-launch) and keeping application sessions active after a user closes all applications (Session Linger).
- By default, session Pre-launch and Session Linger are not used: a session starts (launches) when a user starts an application, and remains active until the last open application in the session closes.
- Session pre-launch requires Windows Receiver on the endpoint system.
- Sessions can only be pre-launched for published apps, not published desktops.
- The launch of the session itself is not faster, it just happens in the background before the user is actually requesting a session. When the user requests a session to run a certain application, this application is started almost instantly within the existing session without the need to wait for the session to be fully negotiated between the endpoint and the VDA.
- You can also configure session pre-launch for a scheduled time of day in Receiver.
- Administrators can specify an idle time after which unused blank sessions are terminated to conserve resources on the VDA. Pre-launched sessions also consume a license.
- Session Pre-launch only works with Server-OS published apps, not desktop sessions or applications hosted on Desktop OS VDAs.
- When using session pre-launch:
 - Regardless of the admin-side settings, if an end user's machine is put into "suspend" or "hibernate" mode, pre-launch will not work.

- Pre-launch will work as long as the end user locks their machine/session, but if the end user logs off from Citrix Receiver, the session is ended and pre-launch no longer applies.

Additional Resources:

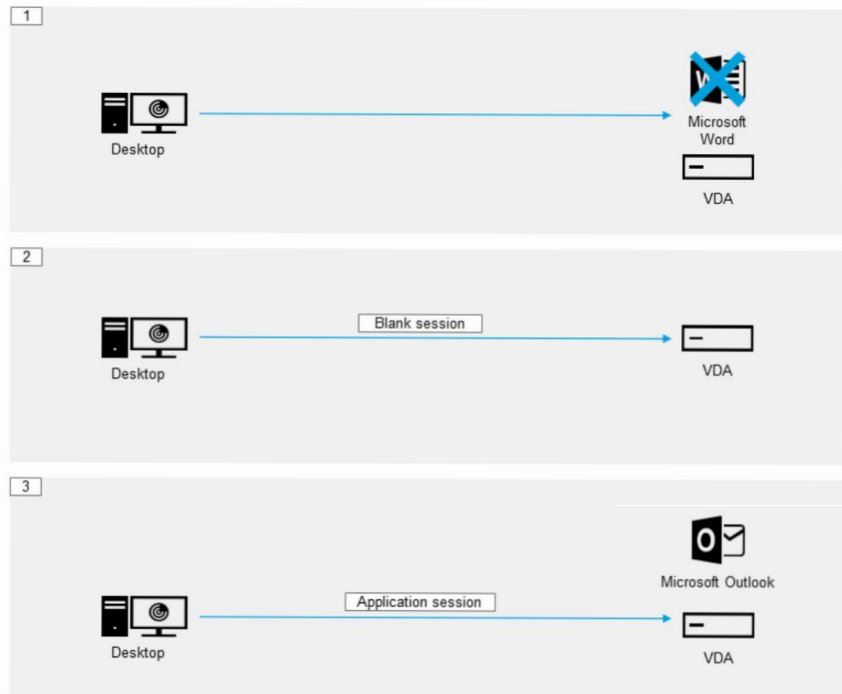
- Configure session prelaunch and session linger in a Delivery Group - https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/install-configure/delivery-groups-manage.html#par_anchortitle_e049

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Session Linger

To save time when starting a new application after closing the last application of a session:

1. A user closes the last application
2. Yet the VDA keeps the session open
3. The VDA re-uses the existing session to launch succeeding applications in it



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Key Notes:

- The Delivery Group must support applications, and the machines must be running a VDA for Server OS, minimum version 7.6.
- Session pre-launch is supported only when using Citrix Receiver for Windows. Session Linger is supported when using Citrix Receiver for Windows and Receiver for Web. Additional Receiver configuration is required.
 - Note: Receiver for HTML5 is not supported.
- Pre-launched and lingering sessions consume a license, but only when connected. Unused pre-launched and lingering sessions disconnect after 15 minutes by default. This value can be configured in PowerShell (`New/Set-BrokerSessionPreLaunch` cmdlet).
- Careful planning and monitoring of your users' activity patterns are essential to tailoring these features to complement each other. Optimal configuration balances the benefits of earlier application availability for users against the cost of keeping licenses in use and resources allocated.
- Roaming of profiles is delayed until the lingering session is finally closed.
- A session can linger in a connected or disconnected state; an administrator can set timers to terminate lingering sessions that are not being used.
- Session Linger is only supported with Server-OS published apps.

Additional Resources:

- Configure session pre-launch and Session Linger in a Delivery Group - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/install-configure/delivery->

groups-manage.html#par_anchortitle_e049

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Scenario: Within a Delivery Group that is delivered only for the Doctor-Group and Nurse-Group, several applications have been delivered with the following settings:

Delivery Group	Application	Limit Visibility
"Office" Doctor-Group Nurse-Group	Word	-no restriction-
	Excel	Accounting-Group
	Outlook	-no restriction-
	Access	Doctor-Group

Question:

Will a member of the Accounting-Group have access to Excel? If not, why?

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Scenario: Within a Delivery Group that is delivered only for the Doctor-Group and Nurse-Group, several application have been delivered with the following settings:

Delivery Group	Application	Limit Visibility
"Office" Doctor-Group Nurse-Group	Word	-no restriction-
	Excel	Accounting-Group
	Outlook	-no restriction-
	Access	Doctor-Group

Answer:

No, the Accounting-Group will not have Access to Excel since it has no access to the Delivery Group itself.

Key Notes:

- In the above example, Nurses and Doctors cannot start Excel, even though the Accounting-Group does not have access to the program either. This is because they are not explicitly included in the Limit Visibility setting.

Not for redistribution



Scenario: Within a delivery group that is delivered only for the Doctor-Group and Nurse-Group, several application have been delivered with the following settings:

Delivery Group	Application	Limit Visibility
"Office" Doctor-Group Nurse-Group	Word	-no restriction-
	Excel	Accounting-Group
	Outlook	-no restriction-
	Access	Doctor-Group

Question:

What will happen, if the Accounting-Group is given access to the Delivery Group "Office"? What applications will they see?

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Scenario: Within a Delivery Group that is delivered only for the Doctor-Group and Nurse-Group, several application have been delivered with the following settings:

Delivery Group	Application	Limit Visibility
"Office" Doctor-Group Nurse-Group	Word	-no restriction-
	Excel	Accounting-Group
	Outlook	-no restriction-
	Access	Doctor-Group

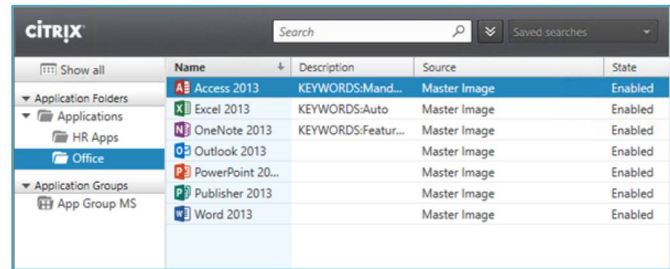
Answer:

If the Accounting-Group is added to the Delivery Group, they would instantly see all applications that are not currently restricted (Outlook, Word) in addition to any App they are entitled to use (Excel).

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Application Folders

- Use Application Folders to organize delivered applications.
- Application Folders are not visible to clients.
- Applications can have the same name if they are in separate folders.
- Maximum depth for nested folders is five.



The screenshot shows the Citrix administrative console interface. On the left, there is a navigation pane with 'Application Folders' expanded, showing sub-folders like 'Applications', 'HR Apps', and 'Office'. The main area displays a table of applications with columns for Name, Description, Source, and State.

Name	Description	Source	State
Access 2013	KEYWORDS:Mand...	Master Image	Enabled
Excel 2013	KEYWORDS:Auto	Master Image	Enabled
OneNote 2013	KEYWORDS:Featur...	Master Image	Enabled
Outlook 2013		Master Image	Enabled
PowerPoint 20...		Master Image	Enabled
Publisher 2013		Master Image	Enabled
Word 2013		Master Image	Enabled

Key Notes:

- Although application folders are technically not a part of application properties it is very helpful to know about the feature.
- These folders are only visible inside the administrative console – not on the client side. They are meant as a means for the administrator to structure the published apps for simpler management.
- These folders often get confused with the “Categories” which are defined in the Application properties. Categories can be made visible on the client side in the web GUI, native receiver or Start Menu of the endpoint.
- Each application can only be in one application folder at a time.
- By default, applications you add are placed in a folder named Applications. You can:
 - Create additional folders and then move applications into those new folders.
 - Folders can be nested up to five levels.
 - Folders do not have to contain applications; empty folders are allowed.
 - Folders are listed alphabetically unless you move them or specify a different location when you create them.
- You can have more than one folder with the same name, as long as each has a different parent folder. Similarly, you can have more than one application with the same name, as long as each is in a different folder.
- Move a folder to the same or a different level. Moving is easiest using drag-and-drop.

- You cannot rename or delete the Applications folder, but you can move all the applications it contains to other folders you create.

Additional Resources:

- Applications - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/manage-deployment/applications-manage.html>
- Citrix XenApp and XenDesktop 7.6 - Studio Application folders - <https://www.youtube.com/watch?v=9ktLbPAoT7k&feature=youtu.be>

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Lab Exercise

- Exercise 7-1: Configure and Test App Limits
- Exercise 7-2: Configure Subscription Keywords
- Exercise 7-3: Test Subscription Keywords
- Exercise 7-4: Configure and Test Application Prelaunch and Application Lingering

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Lesson Objective Review

Scenario: You are the Citrix Admin and you have been tasked with ensuring that only specific employees have access to Publisher as a published app.

Currently Publisher is installed across all Server OS VDAs.

Your manager suggests to implement Limit Visibility, would this be sufficient?

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Lesson Objective Review

Scenario: You are the Citrix Admin and you have been tasked with ensuring that only specific employees have access to Publisher as a published app.

Currently Publisher is installed across all Server OS VDAs.

Your manager suggests to implement Limit Visibility, would this be sufficient?

Limit Visibility only hides the application in StoreFront; the user can still open the application through FTA on the server.

Key Notes:

- Example: If a user is connected to Outlook as a published app and receives an email with a Publisher document attached, opening this document would cause the server to launch Publisher inside the session, disregarding the Limit Visibility setting.



File-type Association (FTA)

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File-type Association (FTA)

To provide a seamless user experience, configuring the File-Type Association feature allows users to leverage Citrix Receiver to open resources on their computer or network with published apps from the XenApp and XenDesktop Site.

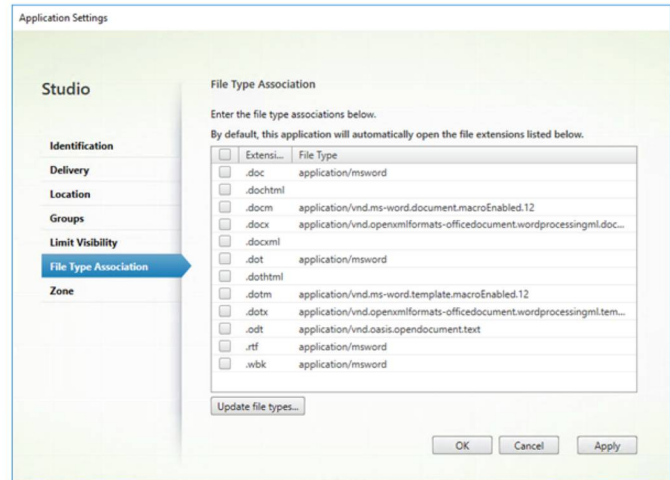
Key Notes:

- FTA launches a published app when a specified file type is launched on the local device, and native Receiver is running. This feature is currently supported for the Windows and ChromeOS Receiver types. To function correctly, the VDA hosting the published app must have access to the file to open it. Therefore, you can only open files that reside on network shares or on client drives (with client drive mapping enabled).

File-type Association

To configure:

- On an endpoint system: Install FTA capable Receiver
- In Citrix Studio: Select all the file extensions for an app that you want to use on an endpoint system



Key Notes:

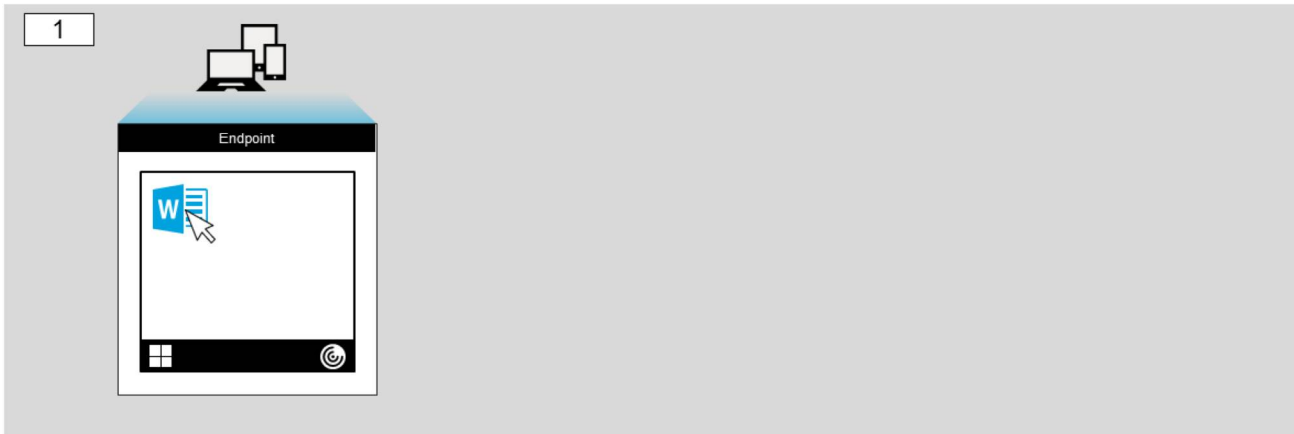
- This feature is also known as FTA (abbreviation), “Client to Server Content redirection”, and “File Open in Receiver.”
- This feature is currently available in Windows (native Receiver) and Chrome OS according to the Receiver client feature matrix. It will not work with Receiver for Web.
- Keep in mind that for FTAs to work, the user must have the target published app as a Favorite in Receiver. Keywords such as “Auto” or “Mandatory” can be used to ensure that this is in place.
- Note the differences between FTA and host to client redirection (also known as URL redirection and Local App Access).
 - Host to client redirection is a different kind of content redirection. It is supported only on server OS VDAs (not desktop OS VDAs).
 - When host to client redirection is enabled, URLs are intercepted at the server VDA and sent to the user device. The web browser or multimedia player on the user device opens these URLs.
 - If you enable Host to Client redirection and the user device fails to connect to a URL, the URL is redirected back to the server VDA.
 - When Host to Client redirection is disabled, users open the URLs with web browsers or multimedia players located on the server VDA.
 - When Host to Client redirection is enabled, users cannot disable it.
- Host to Client redirection was previously known as Server to Client redirection.

Additional Resources:

- Receiver Client Feature Matrix - https://www.citrix.com/content/dam/citrix/en_us/documents/products-solutions/citrix-receiver-feature-matrix.pdf?_ga=1.117297542.1892301207.1409852248

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File-Type Association Process



- Receiver loads the published resources for the user and also retrieves any File-Type Associations for the published apps.
- Receiver associates its own executable as default handler for the specified file-types.
- The user double-clicks file on endpoint.
- File can be local or remote to the endpoint.

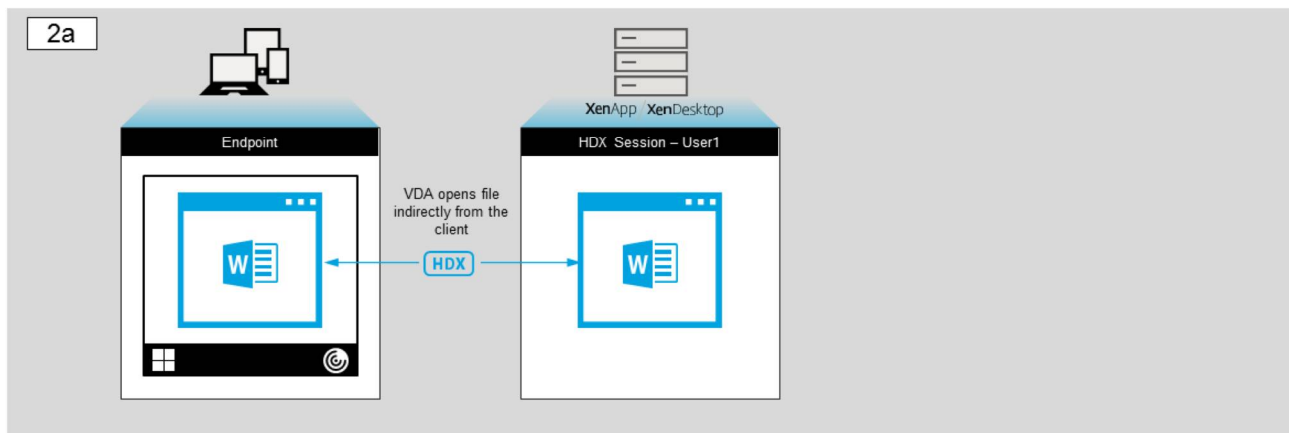
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Key Notes:

- Content redirection allows you to control whether users access information with applications published on servers or with applications running locally on user devices.
- Receiver saves the original File-Type Association and restores it if the user de-favorites the program.
- The files can be on local media or a network share (local or accessible to both VDA and endpoint system).

File-Type Association Process



- Receiver starts a remote session and launches the associated published app in the session.
- Receiver passes a pointer to the file to the published app inside the session.
- The app opens the file through the HDX session from the client drive or network share and displays it to the user in the session.

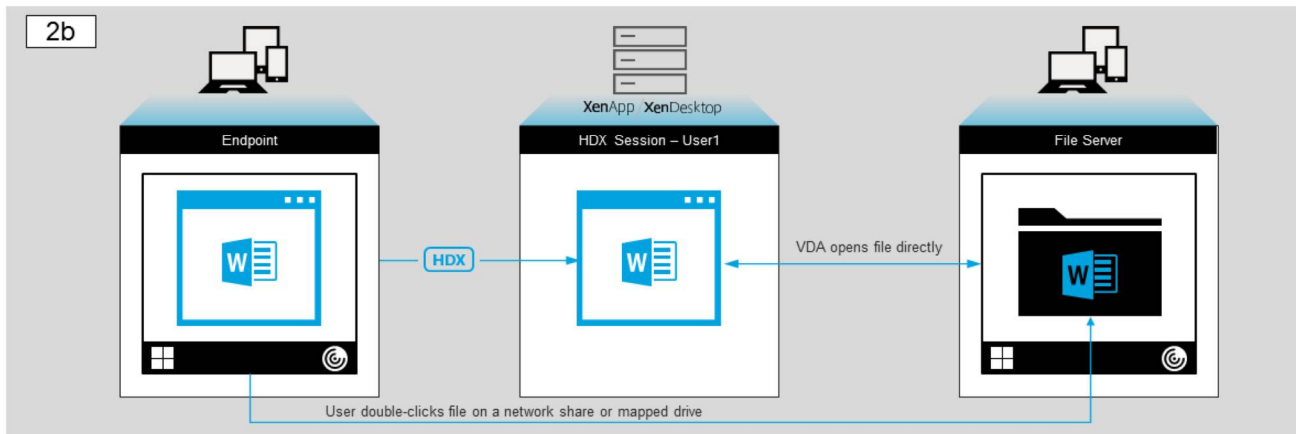
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Key Notes:

- The client drive mapping virtual channel is necessary to open local files on the endpoint. The VDA can only access the file on the endpoint if this channel has not been restricted (via policy).
- With this feature it is not necessary to have applications installed on the endpoint in order to open the file / if an application supporting the file type is installed, Receiver can override the default File-Type Association for this program since it is usually loaded later (last writer wins).

File-Type Association Process



- If the file was located on a file server accessible to both Endpoint and VDA, the VDA would open the file from within the user's session directly.
- The credentials of the user from the session are used on the file server.

Key Notes:

- This is essentially the same situation as the previous slide, however, in this case the user opens a file saved on a network share that is reachable from the VDA. Instead of opening the file through client drive mapping, the session will pick up the file from a network share.
- You can use client to host redirection for an enhanced user experience by creating a seamless workflow to enable users to begin working moments after clicking a target file on their local device or network share.
- Alternatively, it can be implemented for security reasons, for example to prevent users from working on certain types of documents on a managed endpoint.
- Before implementing file-type associations, keep in mind the additional XenApp and XenDesktop hosting resources that may be needed to support the increased number of HDX sessions that would result.



Lab Exercise

- Exercise 7-5: Configure File Type Associations
- Exercise 7-6: Test File Type Associations

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Lesson Objective Review

Scenario: You are the Citrix Admin and you are in the process of implementing FTA for your internal users. Currently, some of the users are using Receiver for Web to connect to their published apps.

Does Receiver for Web support File Type Association?

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Lesson Objective Review

Scenario: You are the Citrix Admin and you are in the process of implementing FTA for your internal users, currently some of the users are using Receiver for Web to connect to their published apps.

Does Receiver for Web support File Type Association?

No, the use of File Type Association requires the native Receiver to be installed and configured.

Key Notes:

- What would happen, if a user in a remote location would open a large document from his local desktop using FTA?
 - The file will be uploaded to the server through client drive mapping, so if bandwidth is limited it may fail.
 - This is why FTA is normally only used in:
 - a) managed environments and
 - b) where ample bandwidth is available.

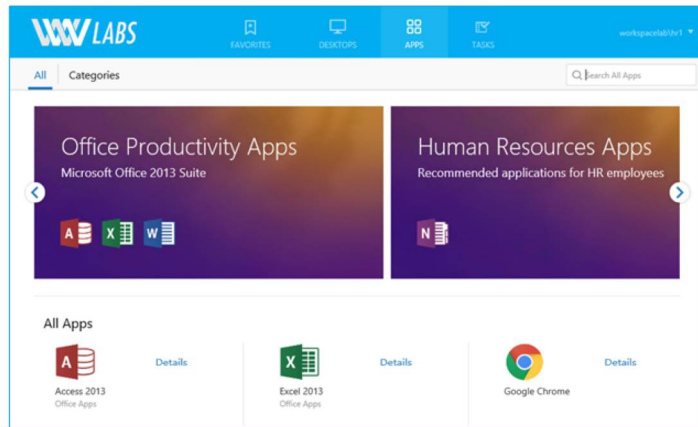
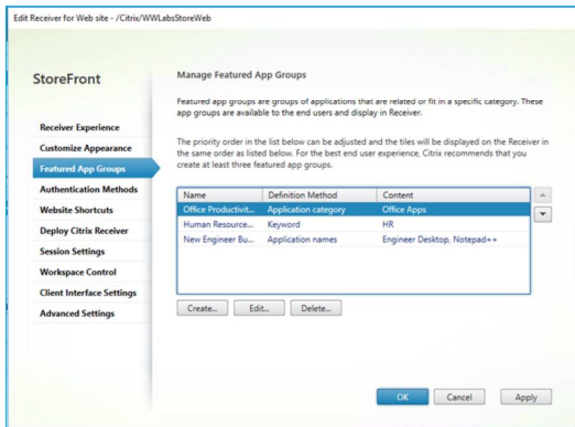


Application Presentation

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Featured App Groups



Displaying applications together as a bundle makes it easier for users to find related applications. Use Featured App Groups by specifying keywords, categories or specific application names to create bundles of related applications.

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Key Notes:

- Featured App Groups are a visual emphasis and a grouping mechanism in addition to the categories.
- Each app can be part of multiple Featured App Groups.
- All applications in a Featured App Group can be favorited / subscribed to at once.

Additional Resources:

- How to display the Featured apps group under the "Category" view than the "All" view on storefront website - <http://support.citrix.com/article/CTX217236>

Shortcut Integration

Start menu integration and desktop shortcut management provide a seamless desktop experience for users.

Control shortcut integration in the following places:

- Receiver ADMX and GPO
- StoreFront – web.config
- PowerShell
- Citrix Studio



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Key Notes:

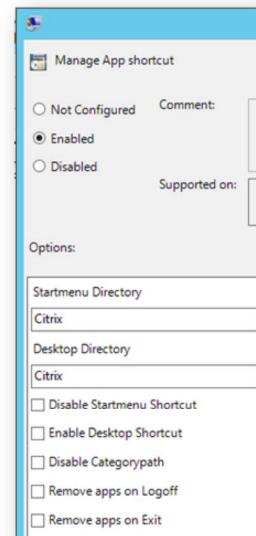
- Start menu integration and desktop shortcut only mode lets you bring published app shortcuts into the Windows Start menu and onto the desktop. In this way, users do not have to subscribe to applications from the Receiver user interface. Start menu integration and desktop shortcut management provides a seamless desktop experience for groups of users, who need access to a core set of applications in a consistent way.
- As a Receiver administrator, you can use command-line install flags, GPOs, account services, or registry settings to disable the usual "self service" Receiver interface and replace it with a pre-configured Start Menu. The flag is called SelfServiceMode and is set to true by default. When the administrator sets the SelfServiceMode flag to false, the user no longer has access to the self service Receiver user interface. Instead, they can access subscribed apps from the Start Menu and via desktop shortcuts - referred to here as shortcut-only mode.

Additional Resources:

- Configuring application delivery - <http://docs.citrix.com/en-us/receiver/windows/4-5/configure/receiver-windows-configure-app-delivery-wrapper.html>
- How to Customize App Shortcuts with Receiver for Windows - <http://support.citrix.com/article/CTX200924>

Shortcut Integration

- Defining a common Start Menu directory to put all shortcuts in makes it easy for users to locate their published apps.
- Tidy up the desktop by specifying a common Desktop directory that shortcuts are placed into.
- Configure Receiver to remove shortcut icons on logoff or exit if the device is shared between users.



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Key Notes:

- The screenshot shows the different settings available in the Receiver Group Policy Template to manage the shortcut integration for native Receiver.
- If no folder is specified and Desktop Shortcut creation is enabled, the icons are placed directly on the desktop.
- Web access mode - Without any configuration, Citrix Receiver for Windows provides web access mode; browser-based access to applications and desktops. Users simply open a browser to a Receiver for Web or Web Interface site and select and use the applications that they want. In web access mode, no app shortcuts are placed in the App Folder on your user's device.
- Self-service mode - By adding a StoreFront or a Web Interface Services Site account to Receiver for Windows, you can configure self-service mode, which enables your users to subscribe to applications through Receiver. This enhanced user experience is similar to that of a mobile app store. In self-service mode you can configure mandatory, auto-provisioned, and featured app keyword settings as needed. When one of your users selects an application, a shortcut to that application is placed in the App Folder on the user device.

Additional Resources:

- How to Customize App Shortcuts with Receiver for Windows - <http://support.citrix.com/article/CTX200924>
- App Shortcuts Where You Want Them - <https://www.citrix.com/blogs/2015/04/29/app-shortcuts-where-you-want-them/>

- Configure Receiver with the Group Policy Object template - <http://docs.citrix.com/en-us/receiver/windows/4-5/configure/ica-import-icaclient-template-v2.html>
- Configure Receiver for Windows - <http://docs.citrix.com/en-us/receiver/windows/4-5/configure.html>

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Self-Service Mode

For the native Receiver

Self-Service Mode	Behavior
Enabled	<ul style="list-style-type: none">- Users can choose which app they favorite and add to the Start Menu or desktop.- Applications can be removed.- Users can add additional stores.- Receiver offers interface to manipulate application subscription & start applications.
Disabled	<ul style="list-style-type: none">- All assigned published apps are automatically subscribed to.- Applications will automatically be placed in the Start Menu.- Categories will be used as Start Menu folders.- Applications cannot be removed / will reappear.- Receiver does not offer interface to manipulate application subscription & start applications.

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Key Notes:

- Self-Service Mode can be configured using the registry, a GPO or the Web.Config file on StoreFront.
- By adding a StoreFront account to Receiver or configuring Receiver to point to a site, you can configure self-service mode, which allows users to subscribe to applications from the Receiver user interface. This enhanced user experience is similar to that of a mobile app store.
- In self-service mode you can configure mandatory, auto-provisioned and featured app keyword settings as needed:
 - To automatically subscribe all users of a store to an application, append the string `KEYWORDS:Auto` to the description you provide when you publish the application in XenApp. When users log on to the store, the application is automatically provisioned without the need for users to manually subscribe to the application.
 - To advertise applications to users or make commonly used applications easier to find by listing them in the Receiver Featured list, append the string `KEYWORDS:Featured` to the application description.
- Disabling subscriptions on a StoreFront store has a similar effect, but will affect also the WebGUI and other variants of Receiver accessing the store.

Additional Resources:

- How to Customize App Shortcuts with Receiver for Windows -

<http://support.citrix.com/article/CTX200924>

- Configure Receiver for Windows - <http://docs.citrix.com/en-us/receiver/windows/4-5/configure.html>

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Lab Exercise

- Exercise 7-7: Configure Featured App Groups and App Categories
- Exercise 7-8: Test the App Group and App Categories
- Exercise 7-9: Configuring Shortcut Placement
- Exercise 7-10: Testing Shortcut Placement
- Exercise 7-11: Disable Self-Service Mode and Test

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What type of shortcut integration will be the best solution for your users?

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Lesson Objective Review

Scenario: You are the Citrix Admin and you are in the process of enabling shortcut integration for all your internal managed PCs.

You have created a new GPO, but you are not able to find the Citrix policy settings to manage the app shortcut feature.

What are you missing?

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Lesson Objective Review

Scenario: You are the Citrix Admin and you are in the process of enabling Shortcut Integration for all your internal managed PC's.

You have created a new GPO but you are not able to find the Citrix policy settings to manage the app shortcut feature.

What are you missing?

The ADMX/ADML files must be added to the policy definitions folder.

Key Notes:

- There is a difference between the Receiver policy settings and the settings covered in the previous module.
- Receiver policies are not using the Citrix Policy engine.
- Receiver policies rely on traditional MS policy templates.

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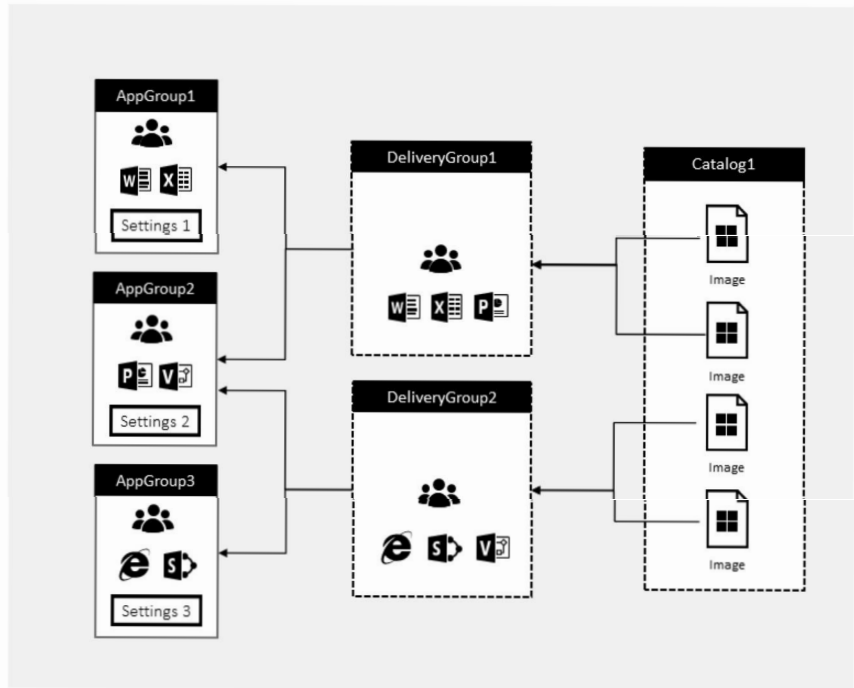
Application groups

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Application Groups

- Application Groups let you manage collections of applications.
- You can create Application Groups for applications shared across different Delivery Groups or used by a subset of users within Delivery Groups.
- To use Application Groups, your core components must be minimum version 7.9.



Key Notes:

- Application Groups is a feature (available for XA/XD 7.9+) that allows admins to group all or some applications from several Delivery Groups to manage and configure them as a single entity.
- Citrix recommends adding applications to either Application Groups or Delivery Groups, but not both at the same time.
- By default, application session sharing between Application Groups is enabled.
 - To review, session sharing means that subsequent application launches on the same server OS will launch within the existing session.
- Configuring unauthenticated user access is available only in Delivery Groups, not in Application Groups.

Additional Resources:

- Introducing Application Groups in XenApp - <https://www.citrix.com/blogs/2016/07/20/xenapp-xendesktop-7-9-introducing-application-groups/>
- Create Application Groups - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/install-configure/application-groups-create.html>

Application Groups - Considerations



- Use either Application Groups or Delivery Groups, but not both.
- Session sharing between Application Groups is enabled by default, and can be disabled.
- Creating Application Groups requires the delegated administration permission of the Delivery Group Administrator built-in role.
- Application Groups can be linked to multiple Delivery Groups and Delivery Group priorities can be used to control failover and load balancing.

Key Notes:

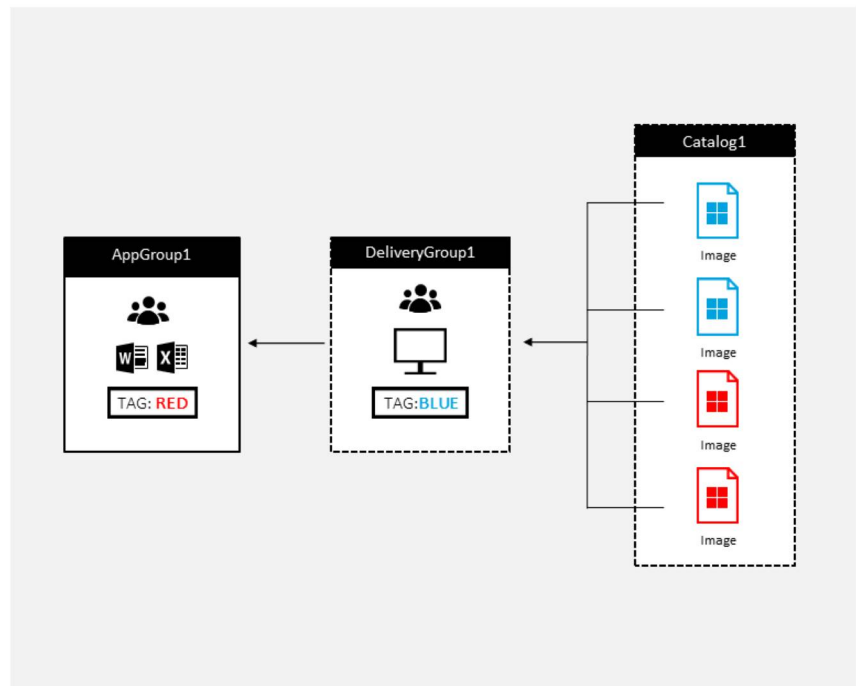
- Using both Application Groups and Delivery Groups at the same time will work, but the administrator will potentially lose track of where published apps are configured as the environment grows.

Additional Resources:

- Create Application Groups - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/install-configure/application-groups-create.html>

Application Groups - Tagging

- With tag restrictions, you can use your existing machines for more than one publishing task, saving the costs associated with deploying and managing additional machines.
- A tag restriction can be thought of as subdividing the machines in a Delivery Group. Its functionality is similar to Worker Groups in XenApp 6.5.



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Key Notes:

- A tag restriction involves several steps:
 - Create the tag and then add (apply) it to machines.
 - Create or edit a group with the tag restriction (in other words, "restrict launches to machines with tag x").
- A tag restriction extends the broker's machine selection process. The broker selects a machine from an associated Delivery Group subject to access policy, configured user lists, zone preference, and launch readiness, plus the tag restriction (if present). For published apps, the broker falls back to other Delivery Groups in priority order, applying the same machine selection rules for each considered Delivery Group.

Additional Resources:

Tag restrictions for a desktop or an Application Group - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/manage-deployment/tags.html>



Lab Exercise

- Exercise 7-12: Create and Test an Application Group

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Lesson Objective Review

Which of the built-in delegated administration roles are required as a minimum to create an Application Group?

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Lesson Objective Review

Which of the built-in delegated administration roles are required as a minimum to create an Application Group?

Delivery Group Administrator.

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Key Takeaways



- Resource properties control the presentation and delivery of resources to users.
- File Type Association allows users to open local files with published apps hosted on XenApp and XenDesktop.
- Shortcut placement options integrate published resources and apps with a user's desktop and Start menu.
- Create Application Groups to manage applications across multiple Delivery Groups and tags to control launch priority between machines in a single Delivery Group.

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XenApp and XenDesktop Administration

Printing with XenApp and XenDesktop

Module 8



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Lab VM Power Management

The following VMs are required to be powered on before beginning the exercises in this module:

- NYC-ADS-001
- NYC-SQL-001
- NYC-FSR-001
- NYC-XDC-001
- NYC-STF-001
- NYC-MAN-001
- NYC-SRV-001
- NYC-DTP-001
- NYC-WRK-001

The remaining VMs need to be powered off.

Note: These VMs are listed in the start-up order.

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Learning Objectives

- Illustrate an introduction to printing
- Identify the functionality of Print Job Routing
- Classify the different types of print drivers

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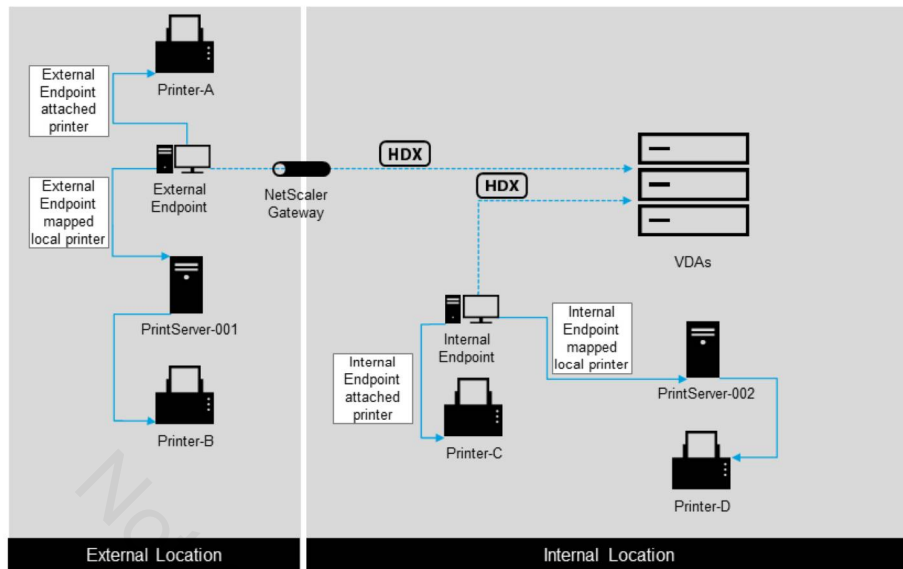
Printing Introduction

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Printing Scenarios

Endpoint Mapped & Attached Printers



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Key Notes:

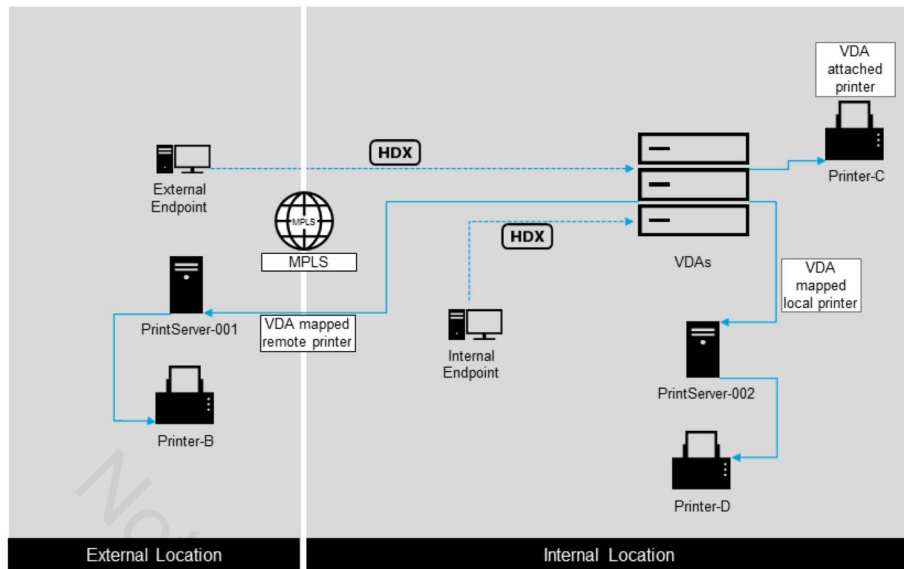
- The diagram illustrates various endpoint attached and mapped printing scenarios. To understand the different printing topologies, the following descriptive names will be used throughout the slide deck :
 - Printer A: External Endpoint attached printer
 - Printer B: External Endpoint mapped local printer
 - Printer C: Internal Endpoint attached printer
 - Printer D: Internal Endpoint mapped local printer
- Every “attached” printer has to use a driver (OS- or manufacturer-provided), in order to be able to print.
- All displayed printers can be used from within the session (e.g. Word 2013 published app).
- Endpoint-based printers may also be referred to as “client printers” in Citrix Studio and some documentation.

Additional Resources:

- Printing - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/printing.html>

Printing Scenarios

VDA Mapped and Attached Printers



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Key Notes:

- Using this mapping method, the print job does not flow inside the HDX protocol; instead, the print job is sent directly from the VDA to the attached printer or mapped print server.
- Printer B: accessed by VDA through site-to-site-VPN or MPLS: VDA mapped remote printer
- Printer C: VDA attached printer (uncommon) (can be used to enable a PDF printer for all sessions)
- Printer D: VDA mapped local printer

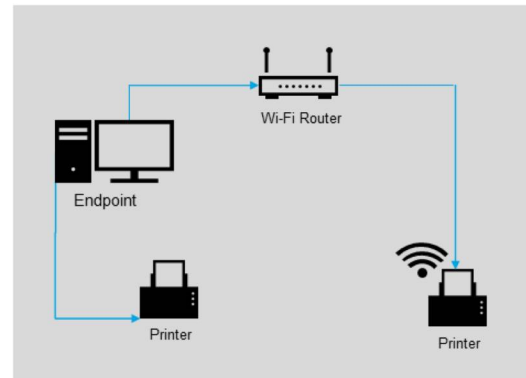
Additional Resources:

- XenDesktop Printing chapter - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/printing.html>

Printer Type: Endpoint Attached

This type of printer is directly connected to the endpoint via:

- A parallel port
- USB
- An IP address



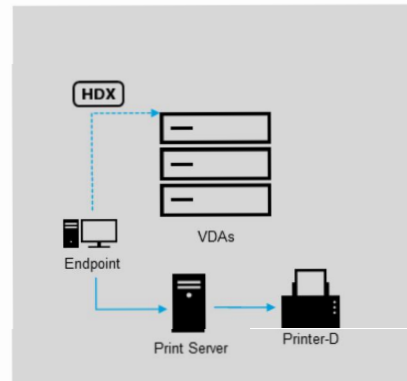
Key Notes:

- This scenario does not require a print server. For this printer type, it is assumed that endpoints are connected to the printer either with a cable or over the network, but without a print server.
- Usually the endpoint has the model specific printer driver installed to print on this printer.
- Some printers have network interfaces (cable / wireless) and can be addressed via TCP/IP directly. Although these printers are often advertised as network printers by their manufacturers, they are directly attached to an endpoint, just using a different method.

Printer Type: Endpoint Mapped

This type of printer requires a print server.

Mapped printers are usually addressed like \\PrnSrv\Printer001



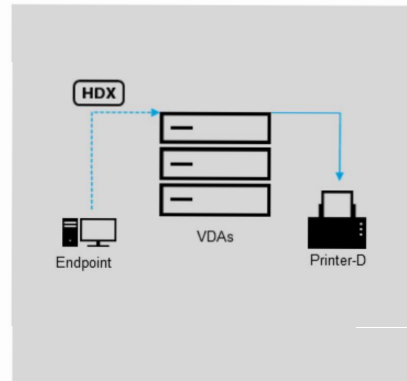
Key Notes:

- A direct connection from the endpoint to the printer is not necessary. The endpoint hands over the print job to the print server, which transfers the print job to the printer or queues it if the printer is busy.
- Print servers enable the central management of printing devices and can also enforce permissions on printers.
- Print servers are typically used when users need to share a printer.

Printer Type: VDA Attached

VDA Attached printers are:

- Installed locally on each VDA
- Available for each session on the VDA
- Typical use case could be a PDF printer



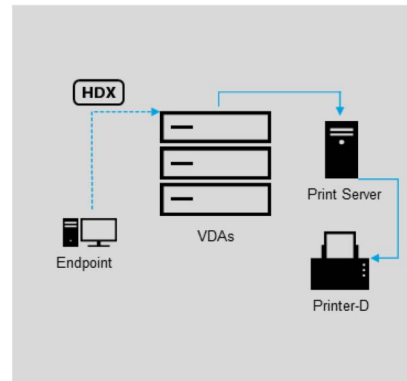
Key Notes:

- Avoid using this method on a large scale with Server OS VDAs. Attaching several printer objects to every VDA is difficult to manage and can cause extra resource usage, essentially turning the VDA into a print server.
- Use mapped printers instead; these can be controlled through policies and login scripts and will cause less resource usage because they offload the print processing to the print server.

Printer Type: VDA Mapped

Network Printers or Session Printers are:

- Used inside the session
- Mapped for each user according to preferences
- Typically mapped using Citrix local policies, login scripts, or GPO Preferences



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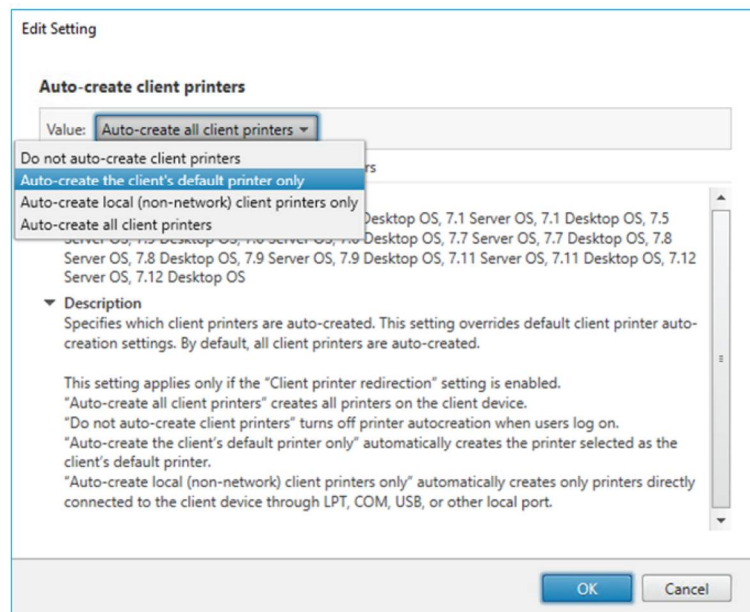
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Key Notes:

- Network Printers (or session printers) usually are connected from the VDA by using a print server.
- These types of printers can be mapped via a logon script, using policies, or manually by the user.

Printer Provisioning

Use the “Auto-create client printers” policy setting to control which endpoint-side printers are automatically made available in user sessions.



Key Notes:

- The process that makes printers available in a session is known as provisioning. Printer provisioning is typically handled dynamically. That is, the printers that appear in a session are not predetermined and stored. Instead, the printers are assembled, based on policies, as the session is built during log on and re-connection. As a result, the printers can change according to policy, user location, and network changes, provided they are reflected in policies. Thus, users who roam to a different location might see changes to their workspace.
- The system also monitors client-side printers and dynamically adjusts in-session auto-created printers based on additions, deletions, and changes to the client-side printers. This dynamic printer discovery benefits mobile users as they connect from various devices.
- Creating all endpoint printers may be time consuming and induces load for the VDA.
- Different options are available to select the printers made available:
 - Auto-create all client printers (default option)
 - Auto-create the client's default printer only
 - Auto-create local (non-network) client printers only
 - Do not auto-create client printers
- “Do not auto-create client printers” does not block users from manually creating printers in their session. To effectively prevent this, the “Client Printer Redirection” Policy has to be set to “Prohibited”, as this will prevent the printing virtual channel within the HDX protocol to get created.

Additional Resources:

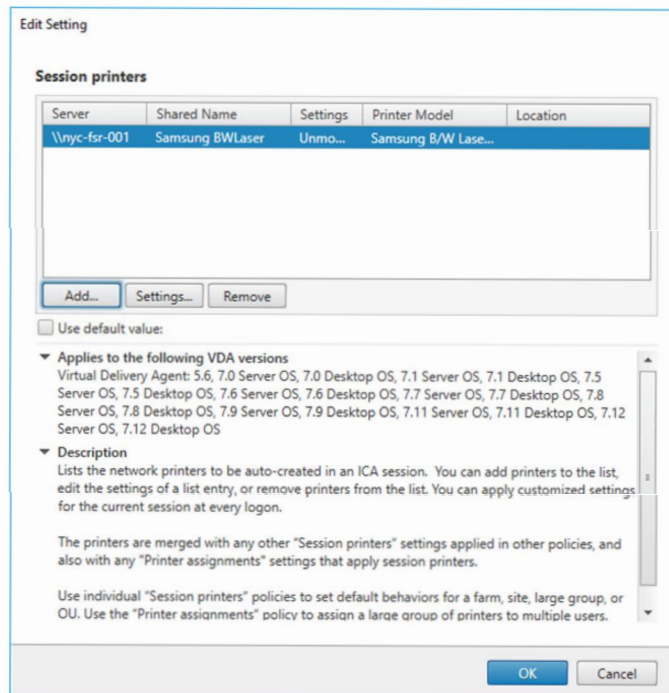
- Printing - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/printing.html>
- Provision printers - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/printing/printing-provision-printers.html>
- Auto-created client printers - https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/printing/printing-provision-printers.html#par_anchortitle_179f

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Printer Provisioning

Use the “Session printers” policy setting to control which network printers are mapped in user sessions.

- All matching policies will be merged for a session.
- Enables the proximity printing feature.
- Combine with “Default printer” policy setting to set a default printer for the session.



Key Notes:

- All session printer policies for a connection will add up to a resultant set of printers that will be mapped into the session. Example: User A is given access to a printer depending on the name of the endpoint device, and in another policy which is filtered on AD-group membership, the user is given access to a different printer. Both printers would be added to the users session in this case. Note, that this is an exception to policy processing, since normally only one policy can set a result (like audio on or audio off).
- Unless the Citrix universal print server is used, an appropriate printer driver for each mapped printer has to be installed on the VDA.
- Instead of creating multiple session printer policies for different user groups, a single “Printer assignments” policy setting can be used. If both “Printer assignment” and “Session printers” settings are used, both types of settings will be merged.
- Normally the endpoint’s main printer is the default printer within the session – which might not always be ideal. Use the “Default printer” setting to set the endpoint’s main printer, a session printer, or a different printer as the default. The last writing policy with the highest priority effectively sets the default printer.
- A similar function exists within MS AD GPOs – although lacking some of the filtering options that Citrix policies provide.
- “Proximity printing” refers to a state of printer provisioning management that always provides users the printer closest to their current location.
 - Example: User A is travelling to two remote offices today. In office A, a policy filtered on the local subnet address maps a local shared printer and sets it as default for the session. In the next office (B), a different printer is mapped and

declared default. Independent of the current location, a printer in the main office where User A normally works is mapped in addition to the respective printers in each location.

- Proximity printing can also be used in a single location that has multiple buildings (campus) or floors – but only if a criteria exists that the policies can be filtered on. A DHCP scope/IP address range that spans an entire building or multiple floors might need to be split first (although a filter based on endpoint names could be used for stationary endpoints).
- Note that policies are only applied on logon or re-connection of a session, so a user that seamlessly roams from one floor to the next floor might not have the policies re-evaluated.
- Universal Print Server - The Citrix Universal Print Server provides universal printing support for network printers. The Universal Print Server uses the Universal print driver. This solution enables you to use a single driver on a Server OS machine to allow network printing from any device. Citrix recommends the Citrix Universal Print Server for remote print server scenarios. The Universal Print Server transfers the print job over the network in an optimized and compressed format, thus minimizing network use and improving the user experience.

Additional Resources:

- Assign network printers to users - https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/printing/printing-provision-printers.html#par_anchortitle_aea0
- Citrix Universal Print Server - https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/printing/printing-provision-printers.html#par_anchortitle_af50



Lab Exercise

- Exercise 8-1: Configure Printer Auto-Creation
- Exercise 8-2: Test that Auto-Creation was Successful
- Exercise 8-3: Configure Session Printers
- Exercise 8-4: Test that the Session Printers mapped to the Session

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Lesson Objective Review

Scenario: You are the Citrix Admin and you are planning to enable remote printing for a branch office that is connected with MPLS but has limited bandwidth available.

Which method of mapping the remote network printers might give the best printing performance?

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Lesson Objective Review

Scenario: You are the Citrix Admin and you are planning to enable remote printing for a branch office that is connected with MPLS but has limited bandwidth available.

Which way of mapping the remote network printers might give the best printing performance?

Mapping printers through the HDX connection via auto-creation allows you to control bandwidth and utilize EMF to compress the print data.

Key Notes:

- Although the same printers could be mapped via policies, the spool data sent to the branch file server could potentially consume all bandwidth and cause the user experience to suffer.
 - Mapping printers through the HDX session allows for more granular control via QoS and compression of the print data.
- A special software has been installed on one of the company's VDAs. This software installs a print driver which can directly output print jobs as PDF documents. What would be the correct name or description for this type of printer?
 - VDA attached printer



Print job routing

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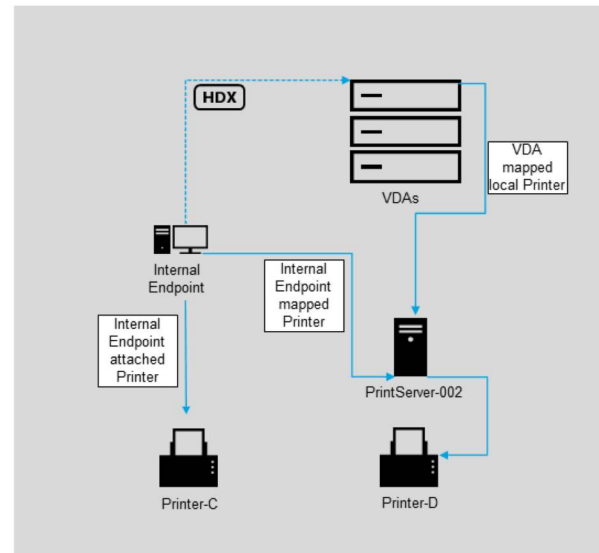
Print Job Routing

For Endpoint attached printers:

- The print job is routed through the HDX protocol from VDA to Endpoint.
- The Endpoint passes the print job on to the printer.

For Endpoint mapped printers:

- Per default, the print job is routed directly from VDA to print server.
 - This can be changed with the “Direct connections to print server” policy.
- As fallback, the print job can be routed through the HDX protocol from VDA to Endpoint.
 - If direct connections to print server fail due to authentication, trust, or accessibility reasons, this fallback is used.
 - If the necessary printer driver or substitute is not available on the VDA, this fallback is used.



Key Notes:

- The internal endpoint connects to the VDA, negotiates Printer-C and Printer-D. While Printer-C can only be used from the VDA by sending pre-spooled print jobs over the HDX protocol to the endpoint, Printer-D is mapped to the endpoint from PrintServer-002. If the same print server can be reached from the VDA and if the user's permissions grant access to Printer-D, then per default, the VDA would just map the printer in the session (if a suitable driver can be installed / has been installed).
- Otherwise, Printer-D is treated like Printer-C, so the print job would be sent over the HDX protocol to the endpoint, which in turn passes the print job on to PrintServer-002 but has to reprocess the print job.
- The term “printing pathway” encompasses both the path by which print jobs are routed, and the location where print jobs are spooled. Both aspects of this concept are important. Routing affects network traffic. Spooling affects utilization of local resources on the device that processes the job.
- Locally attached printers - The system routes jobs to locally attached printers from the Server OS machine, through the client, and then to the print device. The ICA protocol optimizes and compresses the print job traffic. When a printing device is attached locally to the user device, print jobs are routed over the ICA virtual channel.
- Network-based printers - By default, all print jobs destined for network printers route from the Server OS machine, across the network, and directly to the print server. However, print jobs are automatically routed over the ICA connection in the following situations:
 - If the virtual desktop or application cannot contact the print server.
 - If the native printer driver is not available on the Server OS machine.

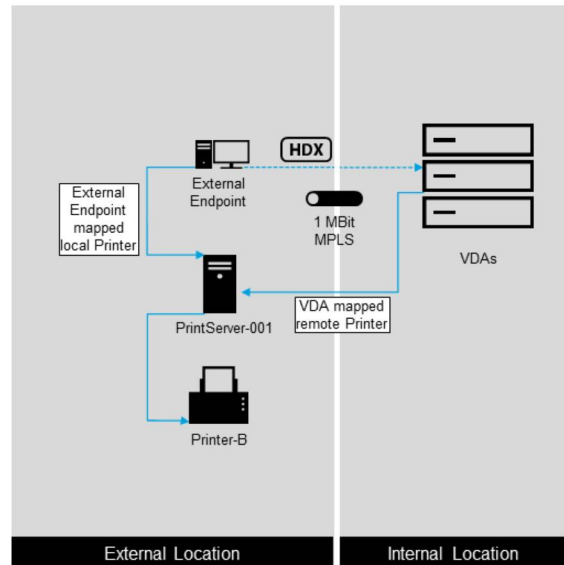
Additional Resources:

- Printing configuration example - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/printing/printing-configuration-example.html>

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Print Job Routing - Example

- PrintServer-001 is on the remote side of a VPN
- PrintServer-001 is accessible from the VDA, but:
 - Print job would not be compressed
 - No bandwidth limit would be applied
 - No caching mechanism would be used
- Use the “Direct connections to print server” policy setting to re-route the print job using the HDX protocol between the endpoint and the VDA.



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Key Notes:

- Scenario: An external endpoint has Printer-B mapped from PrintServer-001 and connects to a VDA. Per default, the VDA tries to connect to Printserver-001 to map the Printer-B in the session of the user, but this time the print server is located on the remote side of a VPN. So if the printer was mapped into the session, the print job would lose all benefits like compression and bandwidth management or caching.
- Depending on the WAN load, the print job might also be blocking other traffic, causing performance issues. In this case, it is recommended to set the “Direct connections to print server” policy to Prohibited, so the VDA connects to the printer only via the endpoint – every print job will now be sent over the HDX protocol and can be further managed with other policies to gain performance and control.



Lab Exercise

- Exercise 8-5: Configure Print Job Routing

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Lesson Objective Review

Scenario: You are the Citrix Admin and you are instructing the help desk team on how to identify the printing pathway being used in a session.

What is the easiest way of identifying if “Direct connections to print server” is enabled or disabled?

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Lesson Objective Review

Scenario: You are the Citrix Admin and you are instructing the help desk team on how to identify the printing pathway being used in a session.

What is the easiest way of identifying if “Direct connections to print server” is enabled or disabled?

From the administrator's perspective, the printers would be labeled:

Direct = Printername on printservername

Indirect = Printername on printservername (from clientname) in session number

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Printer drivers

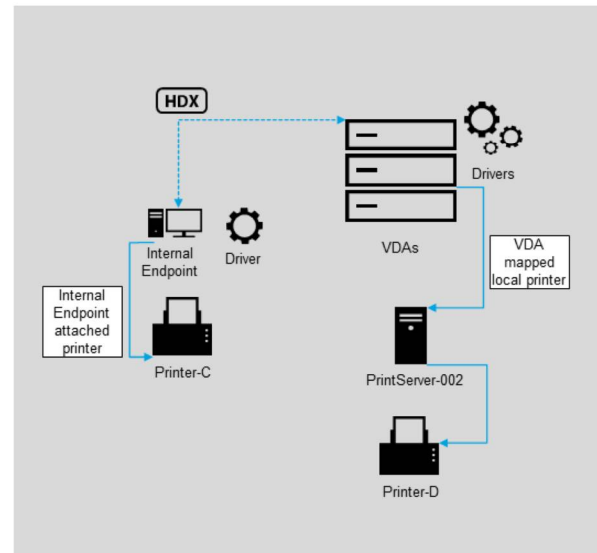
Introduction to drivers, features and tools

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Printer Drivers

- Each endpoint needs the driver for its printers.
- VDAs need all drivers for all printers of the endpoints.
- Drivers can be automatically installed upon connection.
- Installing many drivers can cause system instability.
- Use manufacturer Universal Drivers to reduce number of required printer drivers.



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Key Notes:

- The automatically installed drivers are coming from a repository which is part of the OS – these are mainly stripped down drivers from different manufacturers covering a broad range of common printers. They are supported by Microsoft.
- There is a policy to allow or prohibit the automatic installation of printer drivers on the VDA.
- During logon peaks, installation of drivers can cause slowness/instability. Also, VDAs might be provisioned to lose every change on reboot, including the print drivers, so they would have to be automatically re-installed over and over again.
- Having multiple printer drivers on one system can slow down the logon or logoff process, or cause printing system issues/system instability. Also, drivers can conflict with each other. Having the least amount of printer drivers necessary is therefore recommended.
- Most printer manufacturers offer universal drivers covering multiple printer models with a single driver – this is a good approach to limit the number of drivers to test, implement and maintain.
- Leading practices:
 - Minimize the number of printer drivers installed on Server OS machines.
 - Use driver mapping to native drivers.
 - Never install untested printer drivers on a production Site.
 - Avoid updating a driver. Always attempt to uninstall a driver, restart the print server, and then install the replacement driver.
 - Uninstall unused drivers or use the “Printer driver mapping and compatibility”

policy setting to prevent printers from being created with the driver.

- Try to avoid using version 2 kernel-mode drivers.

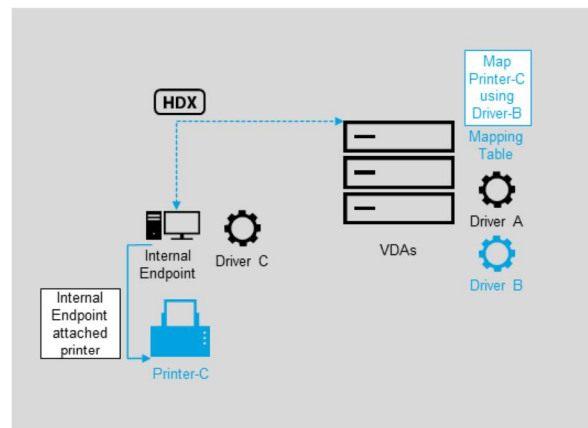
Additional Resources:

- Printing - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/printing.html>

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Printer Driver Mapping

- Use the “Printer driver mapping and compatibility” policy setting to specify substitution rules for endpoint printers.
- Mapping is based on printer model name
 - Example: Canon MX-725
- Printer models can be generalized using wildcards
 - Example: Canon MX*
- The policy can be filtered on different scenarios to substitute accordingly.
- Remember mapping to the printer model name is case sensitive.



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Key Notes:

- Mapping several printers to a single driver can reduce the amount of required printer drivers.
- Mapping can create cross-vendor relationships (mapping Brother Laser printers to HP LaserJet drivers) – if device and driver are compatible.
- The driver mapping table can also be used to prevent the installation of specific drivers while allowing the automatic installation of printer drivers globally.
- The mapping table will be consulted by the system upon session initialization first before resorting to other mechanisms.
- Map client printer drivers - Each client provides information about client-side printers during logon, including the printer driver name. During client printer auto-creation, Windows server printer driver names are selected that correspond to the printer model names provided by the client. The auto-creation process then uses the identified, available printer drivers to construct redirected client print queues.

Additional Resources:

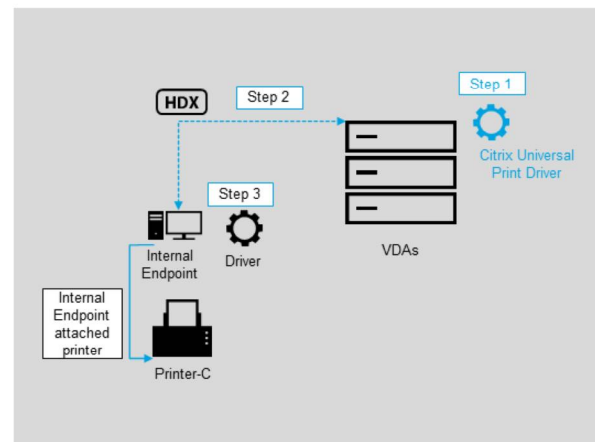
- Maintain the printing environment - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/printing/printing-maintain-environment.html>

Universal Print Driver

The Citrix Universal Print Driver (UPD) is a feature-rich, device independent driver that converts print jobs to a transfer format which can then be printed on the endpoint.

Printing process with UPD:

1. UPD converts the print job from the published app to EMF format.
2. The compressed EMF data is transferred over the HDX protocol to the endpoint.
3. The endpoint prints the EMF file using the installed manufacturer print driver for Printer-C.



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Key Notes:

- UPD can be configured to produce EMF, XPS, PCL or PostScript files.
- UPD is only compatible with Windows-based endpoints where a Receiver has been installed.
- UPD offers a consistent user experience across VDA platforms, but might not offer all options of dedicated manufacturer's printer driver. Special functions like stapling, cutting, punching etc. might require the original driver to be installed instead.
- Per default, UPD is used as fallback in sessions, whenever no suitable driver for a printer can be found.
- UPD consists of two components – a driver on the VDA and a driver on the endpoint which forwards the print job to the local printing system.
- EMF is short for Enhanced Metafile Format and is a newer version of the Windows metafile (WMF) format.
- The EMF format is device-independent, meaning that the dimensions of graphics in the print job is maintained on the printed copy, no matter which resolution the printer uses.
- When determining the best print solution for your environment, consider the following:
 - The Universal Print Server provides features not available for the Windows Print Provider: Image and font caching, advanced compression, optimization, and QoS support.
 - The Universal print driver supports the public device-independent settings defined by Microsoft. If users need access to device settings that are specific to a print driver manufacturer, the Universal Print Server paired with a Windows-

native driver might be the best solution. With that configuration, you retain the benefits of the Universal Print Server while providing users access to specialized printer functionality. A trade-off to consider is that Windows-native drivers require maintenance.

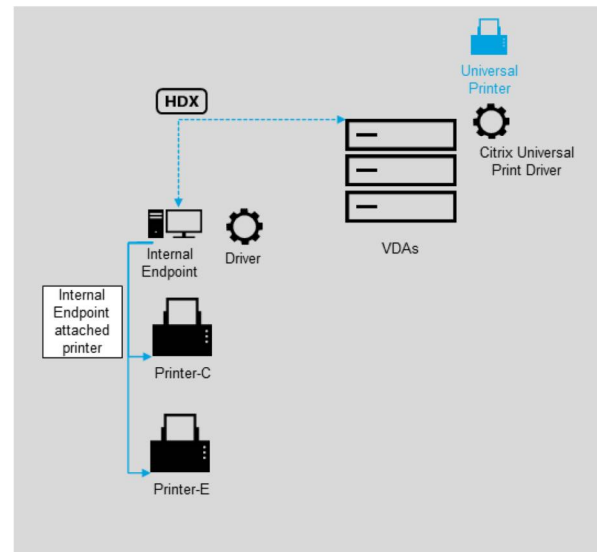
- The Citrix Universal Print Server provides universal printing support for network printers. The Universal Print Server uses the Universal print driver, a single driver on the Server OS machine that allows local or network printing from any device, including thin clients and tablets.
- To use the Universal Print Server with a Windows-native driver, enable the Universal Print Server. By default, if the Windows-native driver is available, it is used. Otherwise, the Universal print driver is used. To specify changes to that behavior, such as to use only the Windows-native driver or only the Universal print driver, update the Universal print driver usage policy setting.
- If the Citrix Universal print driver is not an option for all scenarios, map printer drivers to minimize the amount of drivers installed on Server OS machines.

Additional Resources:

- Provision printers - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/printing/printing-provision-printers.html>

Universal Printer

- The Citrix Universal Printer (CUP) is a single, generic printer in a session on a VDA.
- CUP uses the Universal print driver to transfer print jobs to the endpoint device.
- Users can print to this pseudo-device and can choose to output the print job on any endpoint attached or mapped printer.



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Key Notes:

- Server load can be reduced when only one printer object needs to be created on session launch.
- The Universal Printer is a generic front-end for the Universal Print Driver, so users will not see all their printers created in the session, but only the CUP. When they print to the CUP, per default, they will be asked on the endpoint machine what printer the output should be sent to. This can be configured with policies to omit the dialog and just print to the endpoint's main printer.
- The Citrix Universal Printer requires a Windows environment.
- The Citrix Universal Printer is an auto-created printer object that uses the Citrix Universal Print Driver and is not linked to any specific printer defined on the client. Once implemented, Citrix Universal Printer is available in all sessions that use the 32-bit Windows client. Citrix Universal Printer is independent of any printing policies defined in the management console hence it is possible to implement the Citrix Universal Printer with other auto-created printers, session printers, and/or non-Citrix defined printers. Citrix Universal Printer auto-creates in a standard name "Citrix UNIVERSAL Printer"

Additional Resources:

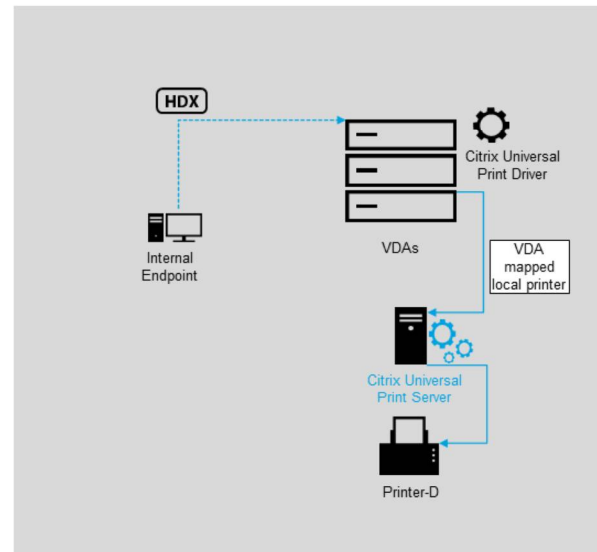
- How to Auto-Create the Generic Citrix Universal Printer in User Sessions - <http://support.citrix.com/article/CTX106812>

Universal Print Server

The Citrix Universal Print Server Component is a service component (CUPS) that can be installed on print servers. It enables the VDAs to map printers using the Universal print driver instead of OEM printer drivers.

Using CUPS:

- Enables UPD features like caching, QoS and compression
- Reduces printer drivers on VDAs
- Is recommended for VDA mapped remote printers
- Load balancing policy included from 7.12



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Key Notes:

- Universal Print Server needs to be installed on (all) print servers that VDAs map printers from. The UPD can then be used to transfer EMF files to the print server, essentially in the same way that UPD is used for endpoint side printing.
- Citrix Universal Print Server consists of two services that use Port 8080 (HTTP/SOAP) and 7229 (CGP) (not to be confused with License Vendor Daemon 7279!) for management and data transfer. A necessary VDA side component is installed with the VDA but can (/needs to be) updated independently.
- Citrix Universal Print Server functionality, per default, is disabled and has to be enabled explicitly using a policy for the VDAs.
- Some options are missing in comparison with endpoint side printing (local settings) and only basic settings of the printer are exposed.
- To use the Universal Print Server with a Windows-native driver, enable the Universal Print Server. By default, if the Windows-native driver is available, it is used. Otherwise, the Universal print driver is used. To specify changes to that behavior, such as to use only the Windows-native driver or only the Universal print driver, update the Universal print driver usage policy setting.
- A new policy called “Universal Print Servers for load balancing” was added in 7.12. This setting lists the Universal Print Servers to be used to load balance printer connections established at session launch, after evaluating other Citrix printing policy settings. To optimize printer creation time, Citrix recommends that all print servers have the same set of shared printers.

Additional Resources:

- Citrix Universal Print Server - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/printing/printing-provision-printers.html>

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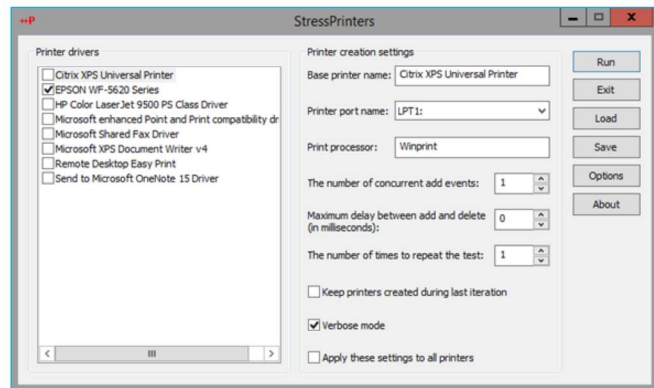
Lab Exercise

- Exercise 8-6: Configure Print Driver Mapping
- Exercise 8-7: Test that the Print Driver Mapped
- Exercise 8-8: Configure the Universal Print Driver
- Exercise 8-9: Test that the Printer Auto-created with the Universal Print Driver
- Exercise 8-10: Configure the Universal Print Server Component

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StressPrinters Tool

- Use the StressPrinters tool to discover printer drivers that:
 - Slow down session launch
 - Issue errors under heavy load conditions
 - Conflict with other drivers
- Can be used to establish a baseline for systems and to simulate load with different configurations



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Key Notes:

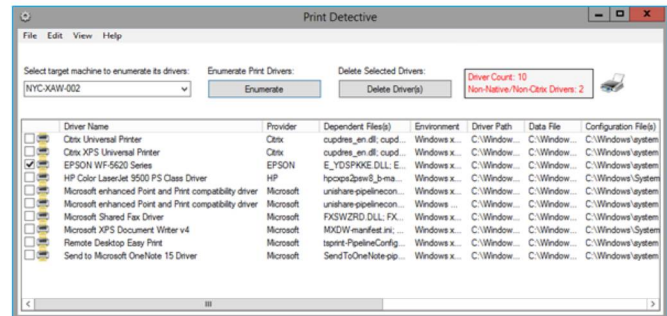
- This tool can be used to simulate multiple sessions auto-creating printers using the same printer driver.
- It can also be used to compare the following among various drivers:
 - CPU load incurred while creating a printer using a particular driver
 - Time required to successfully create a printer using a particular driver
- The tool can be automated using command-line parameters. The produced log files show load times for each printer driver and error messages (if any).

Additional Resources:

- StressPrinters 1.3.2 for 32-bit and 64-bit Platforms - <http://support.citrix.com/article/CTX109374>
- How to Use the Stress Printer Tool - <http://support.citrix.com/article/CTX129574>

Print Detective

- Use Print Detective to gather information for troubleshooting printer drivers.
 - Enumerates all printer drivers from Windows, including driver specific information
 - Can be used to delete specified printer drivers
 - Can output log files
 - Provides command-line interface
- Print Detective is part of the Supportability Pack.



Key Notes:

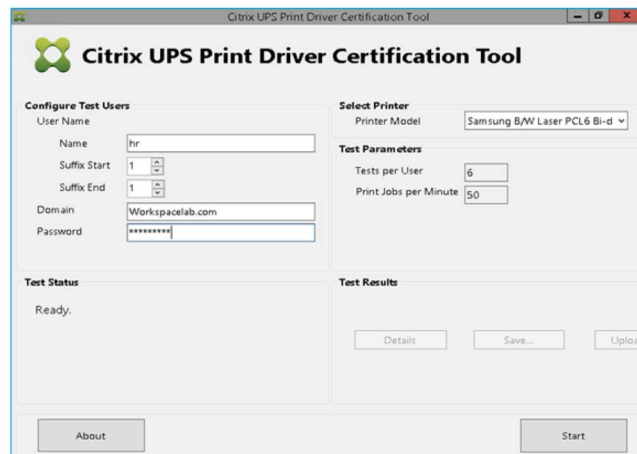
- Print Detective is a tool that can enumerate all printer drivers including version information.
 - Can query local or remote computers.
 - Save the output to log file for comparison.
 - Can be used from command line (i.e. for scripting or documentation purposes).
- To install Print Detective, copy the PrintDetective.exe executable file to the desired location, for the appropriate platform. For example, on a 32-bit system, use the PrintDetective.exe from the x86 directory and on a 64-bit system use the one from the x64 directory. There is no installer required as the application is contained in a standalone executable file.
- The Print Detective package includes the PrintDetective.exe file for the 32-bit and 64-bit versions of Windows (located in the x86 and x64 folders respectively), and the PrintDetective.chm user guide.

Additional Resources:

- Print Detective v1.2.1.5- <http://support.citrix.com/article/CTX116474>

Citrix UPS Print Driver Certification Tool

- Can be used to test the compatibility of a printer driver with the Citrix Universal Print Server.
- The tool checks for compatibility by using the printer driver to simulate load.
- Can determine:
 - If printer driver is capable of handling the load
 - If printer driver meets the Citrix Universal Print Server performance requirement
 - Potential printer driver issues, allowing the administrator to further troubleshoot problem areas



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Key Notes:

- The Citrix UPS Print Driver Certification Tool can be used to test the compatibility of a printer driver with the Citrix Universal Print Server. The tool checks for compatibility by using the printer driver to simulate load, allowing a network administrator or printer driver manufacturer to determine the following:
 - Printer driver is capable of handling the load normally seen with a Citrix Universal Print Server.
 - Printer driver meets the Citrix Universal Print Server performance requirement.
 - Identifies potential printer driver issues, allowing a network administrator or printer driver manufacturer to further troubleshoot problem areas.
- Steps to run a test and view results:
 - Launch UpsCertTool.exe
 - Configure test users
 - Select printer model to test
 - Click Start to begin testing the printer driver
 - Test status is displayed by the tool, including Pass or Fail.
 - To view a summary of the test results, click on Details.
 - To save the test results, click on Save.

Additional Resources:

- Citrix UPS Print Driver Certification Tool - <http://support.citrix.com/article/CTX142119>

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What are some of the key benefits of implementing the Citrix Universal print driver?

Key Notes:

Answers:

- Less number of specific drivers needed on VDA:
 - Resulting in more stable print system
 - Less maintenance (updates of drivers, test of drivers)
- Print job compression (adjustable by policy):
 - Faster output on slow lines
 - Less volume on metered connections
- Bandwidth management:
 - HDX Built-in priority system slows down print jobs when concurring usage (sound, graphics) exist.
 - Throttle/cap can be configured to keep sessions responsive while printing on saturated connections.
- Caching of fonts and images on the endpoint (or universal print server):
 - Faster output and less transferred volume for repetitive print jobs (even if only parts are identical, like printing the same letter to different recipients).

Lesson Objective Review

Scenario: You are the Citrix Admin and currently all your printers are being mapped using the Citrix Universal Print Server.

In the near future, you plan to implement Zebra label printers in the warehouse, but before implementation you decide to test the driver.

Which tool will you use?

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Lesson Objective Review

Scenario: You are the Citrix Admin and currently all your printers are being mapped using the Citrix Universal Print Server.

In the near future, you plan to implement Zebra label printers in the warehouse, but before implementation you decide to test the driver.

Which tool will you use?

Citrix UPS Print Driver Certification Tool.

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Key Takeaways



- Printers in sessions can originate from both endpoints and print servers, and use policies or scripts to control the creation of printers.
- Print job routing controls the flow of the print data, and it is important to consider if WAN bandwidth is limited.
- Use the Citrix Universal print driver as default to keep the number of required printer drivers as low as possible. Rely on manufacturer universal drivers before installing model specific drivers.

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XenApp and XenDesktop Administration

Citrix Profile Management Module 9

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Lab VM Power Management



The following VMs are required to be powered on before beginning the exercises in this module:

- NYC-ADS-001
- NYC-SQL-001
- NYC-FSR-001
- NYC-XDC-001
- NYC-STF-001
- NYC-MAN-001
- NYC-SRV-001
- NYC-WRK-001

The remaining VMs need to be powered off.

Note: These VMs are listed in the start-up order.

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Learning Objectives

- Examine the different profile types from Microsoft and compare them to Citrix Profile Management.
- Identify the features of Citrix Profile Management and how to configure them.

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User Profiles

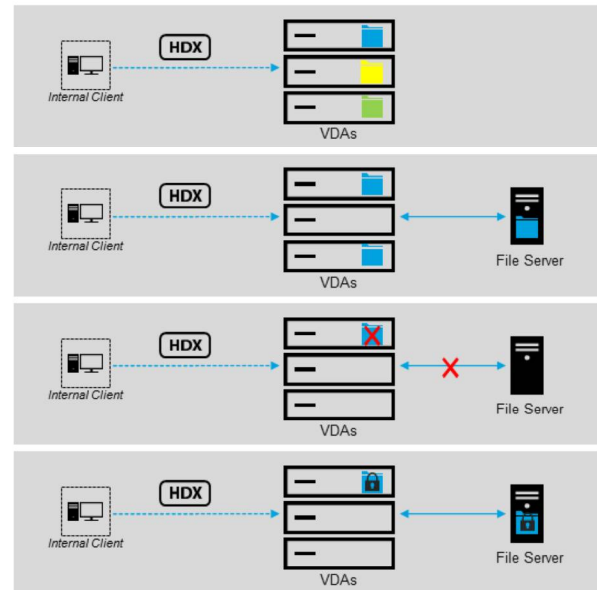
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Profile Types

The following profile types exist:

- **Local**
 - A profile that is created and re-used on a single machine.
- **Roaming**
 - A profile that is stored on a file server and loaded to the actual machine a user logs on to (Client / VDA).
- **Temporary**
 - Used only in error conditions to provide the user with a profile at all – no changes are saved on logoff.
- **Mandatory**
 - A type of pre-configured roaming profile where administrators specify settings for users. Changes are not written back when the user logs off.



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Key Notes:

- A profile is a set of files, including a part of the registry, that together contain all system and application settings for a user.
- Roaming profiles are the main type of profile currently in use.
- The benefit of roaming profiles:
 - Consistent user experience on different VDAs
 - Settings follow the user (printer settings, app specific settings, desktop wallpaper etc.)

Additional Resources:

- About User Profiles - [https://msdn.microsoft.com/en-us/library/windows/desktop/bb776892\(v=vs.85\).aspx](https://msdn.microsoft.com/en-us/library/windows/desktop/bb776892(v=vs.85).aspx)

Citrix Profile Management

Benefits

- Consistent user experience across devices, platforms and sessions
- More control over the profile contents for administrators
- Detailed logging for troubleshooting purposes
- Conflict resolution options and silent migration support
- Easy implementation and support



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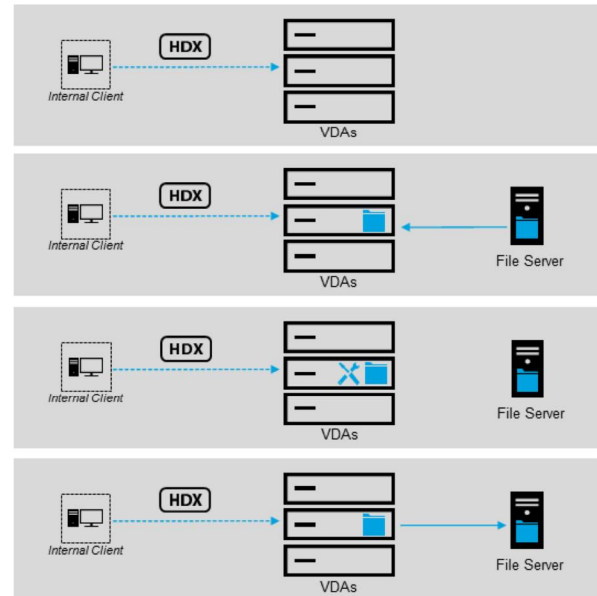
Key Notes:

- Since the release of the FMA, the Citrix Profile Management components have been included in the VDA installer.
- The only two steps required to enable Citrix Profile Management is to create the profile store and enable CPM through policies or by editing UPMPolicyDefaults_all.ini on the VDA.
- By default, Citrix Profile Management is installed silently on master images when you install the Virtual Delivery Agent, but you do not have to use Profile Management as a profile solution.

Citrix Profile Management

How it works:

1. User logs on to VDA.
2. The Profile Management service on the VDA loads profile data from the user store path on a file server.
3. User modifies files and registry settings during the session.
4. At logoff the Profile Management service on the VDA writes profile data to the user store path on a file server.



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Key Notes:

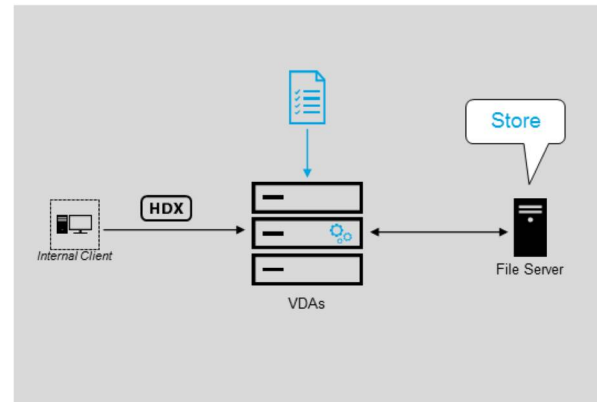
- By default (if Profile Management is enabled) all users are managed and all files & registry settings are included to roam.
- Profile Management can be used on VDA as well as on clients.

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Citrix Profile Management

The following steps are required to use Profile Management:

- Install UPM
 - On any system that the users' profiles should be managed on
 - Remember this agent is included with the VDA install
- Create a user profile store
 - On a location reachable by the managed systems
- Enable / configure with Group Policies
 - Enable Profile Management to start processing user profiles
 - Configure Profile Management for the user store
 - Configure additional settings as needed to fulfill requirements



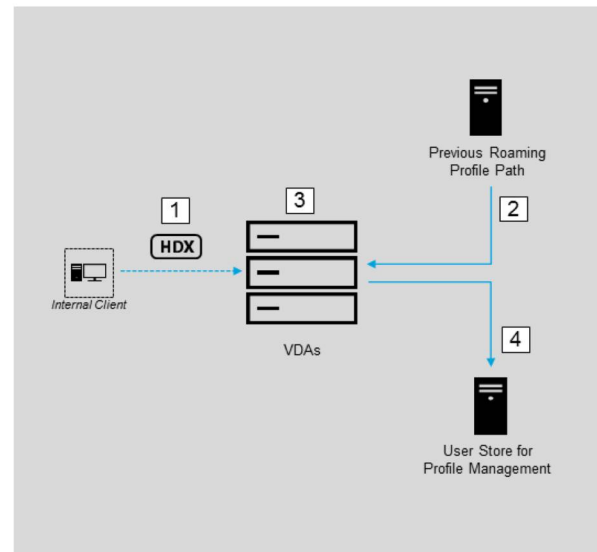
Key Notes:

- UPM is installed together with the VDA software, but might need to be updated separately if a newer version of UPM is to be used.
- By default, UPM does not process user profiles until it is enabled by administrators.

Profile Migration Process

Configure UPM to migrate existing profiles:

1. User logs on to VDA.
2. The Profile Management service detects that a roaming profile exists, but the user store is empty. Windows loads the roaming profile from the defined profile path.
3. User modifies files and registry settings during the session and then logs off.
4. The Profile Management service on the VDA writes profile data to the user store path on a file server and will use this profile for any subsequent logon.



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Key Notes:

- Profile Management offers a smooth transition from MS roaming profiles to UPM based profiles.
- The structure in which the profile contents are saved can even be used to migrate back again.
- Profile Management can migrate existing profiles "on the fly" during logon if a user has no profile in the user store. After this, the user store profile is used by Profile Management in both the current session and any other session configured with the path to the same user store.
 - By default, both local and roaming profiles are migrated to the user store during logon.
- To specify the types of profile migrated to the user store during logon, choose one of the following options:
 - Local and roaming profiles
 - Local
 - Roaming
 - None (Disabled)
- If you select None, the system uses the existing Windows mechanism to create new profiles, as if in an environment where Profile Management is not installed.

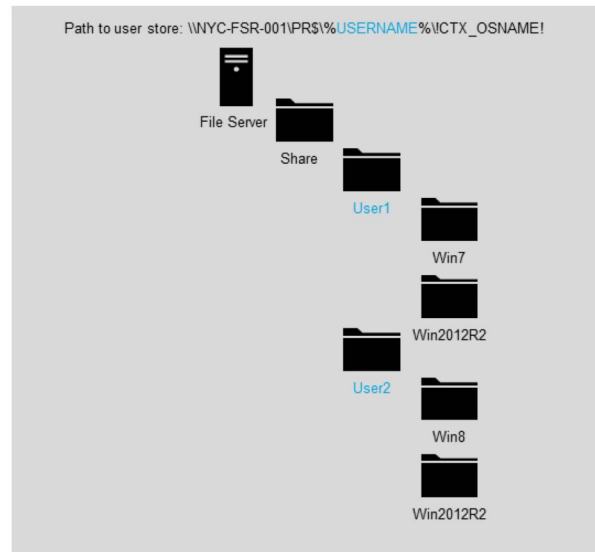
Additional Resources:

- Profile handling policy settings - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/policies/reference/profile-management/profile-handling-policy-settings.html>

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User Store

- Set required permissions to the user store on a file server
- Plan for redundancy
- Variables from the following providers can be used:
 - System (%username%)
 - Active Directory (#department#)
 - UPM (!ctx_osname!)



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Key Notes:

- Variables can be used to separate users' profile folders per platform (OS, bitness, language, purpose).
- Profile Management variables can only be used by UPM, while system and AD variables are accessible to other programs as well. AD variables are a good choice to separate profiles by country or department, provided the according fields on the user object in AD have been filled in.
- For redundancy, a clustered share or DFS-R can be used.
- Normally, administrators should not have access to the files saved in user profiles.
- "Path to user store" specifies the path to the directory (user store) in which user settings, such as registry settings and synchronized files, are saved.
- By default, the Windows directory on the home drive is used.
- If this setting is disabled, user settings are saved in the Windows subdirectory of the home directory.
- The path can be:
 - A relative path. This must be relative to the home directory, typically configured as the #homeDirectory# attribute for a user in Active Directory.
 - An absolute UNC path. This typically specifies a server share or a DFS namespace.
 - Disabled or un-configured. In this case, a value of #homeDirectory#\Windows is assumed.

- Use the following types of variables when configuring this policy setting:
 - System environment variables enclosed in percent signs (for example, %ProfVer%). Note that system environment variables generally require additional setup.
 - Attributes of the Active Directory user object enclosed in hashes (for example, #sAMAccountName#).
 - Profile Management variables. For more information, see the Profile Management documentation.
- You can also use the %username% and %userdomain% user environment variables and create custom attributes to fully define organizational variables such as location or users. Attributes are case-sensitive.

Additional Resources:

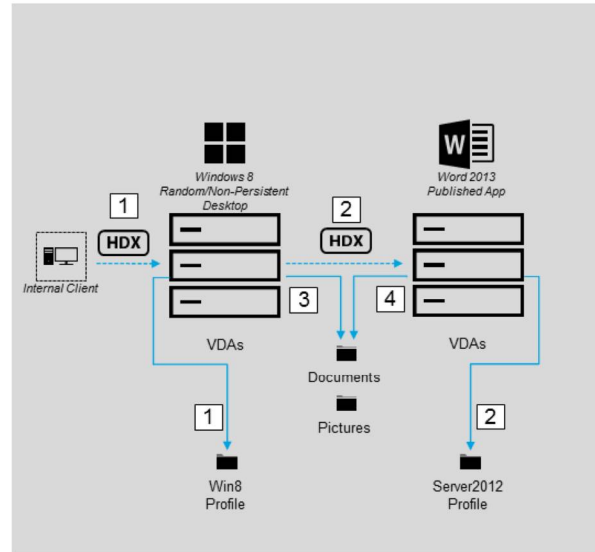
- Basic policy settings - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/policies/reference/profile-management/basic-policy-settings.html>

Folder Redirection

Use folder redirection to enable simultaneous access to common folders.

Example:

1. User starts a session with a random, non-persistent desktop, the profile is loaded the Win8 store.
2. User opens published app from a different VDA, the profile is loaded from the Server2012 store.
3. User uses browser on virtual desktop to save a document from the Internet to the redirected documents folder.
4. User opens the saved document in the published app from the redirected documents folder.



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Key Notes:

- Folder redirection is an excellent addition to most Profile Management solutions.
- Redirected folders do not roam as part of the profile and therefore speed up the logon and logoff process.
- Redirected folders normally require a file share different from the profile share.
- Accessing large files from redirected folders can take more time since they are opened over the network – depending on topology.
- Folder redirection lets you store user data on network shares other than the location where the profiles are stored. This reduces profile size and load time, but it might impact network bandwidth. Folder redirection does not require that Citrix user profiles are employed. You can choose to manage user profiles on your own, and still redirect folders.
- Configure folder redirection using Citrix policies in Studio.
 - Ensure that the network locations used to store the contents of redirected folders are available and have the correct permissions. The location properties are validated.
 - Redirected folders are set up on the network and their contents populated from users' virtual desktops at logon.
- Note: Configure folder redirection using only Citrix Policies or Active Directory Group Policy Objects, not both. Configuring folder redirection using both policy engines may result in unpredictable behavior.
- In Citrix Profile Management (but not in Studio), a performance enhancement allows you to prevent folders from being processed using exclusions. If you use this feature, do not

exclude any redirected folders. The folder redirection and exclusion features work together, so ensuring no redirected folders are excluded allows Profile Management to move them back into the profile folder structure again, while preserving data integrity-if you later decide not to redirect them.

- Grant administrator access: This setting enables an administrator to access the contents of a user's redirected folders.
- By default, this setting is disabled and users are granted exclusive access to the contents of their redirected folders.

Additional Resources:

- Folder redirection policy settings - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/policies/reference/profile-management/folder-redirection-policy-settings.html>

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How many profiles per user would you expect in your company?

Key Notes:

- Answer: Expect one profile per user per platform (and additionally per “silo”).

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Lesson Objective Review

Scenario: You are the Citrix Admin and your manager has just tasked you to configure Citrix Profile Management.

What is the easiest method to ensure configuration is consistent across all VDAs?

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Lesson Objective Review

Scenario: You are the Citrix Admin and your manager has just tasked you to configure Citrix Profile Management.

What is the easiest method to ensure configuration is consistent across all VDAs?

Utilize Citrix policies to configure Citrix Profile Management settings and filter this policy to the VDAs.

Key Notes:

- Although CPM can be configured using a local .ini file, it is recommended to secure the configuration using a policy.
- In the next learning objective we will focus on the different policy settings available.

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Configuring Citrix Profile Management

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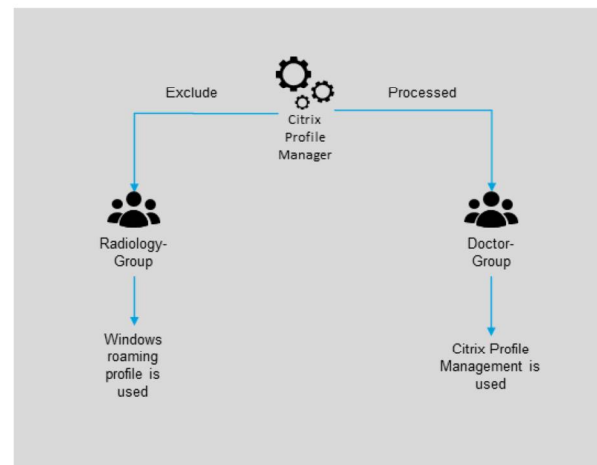
Configure Groups

Select which users' profiles should be managed by Citrix Profile Management:

Policies exist for:

- **Processed Groups**
 - Define which users' profiles are processed
- **Excluded Groups**
 - Exempt users' profiles from being processed
- **Process Logons of local administrators**
 - For users of personal desktops with administrative permissions

The specified groups are matched by their name only!



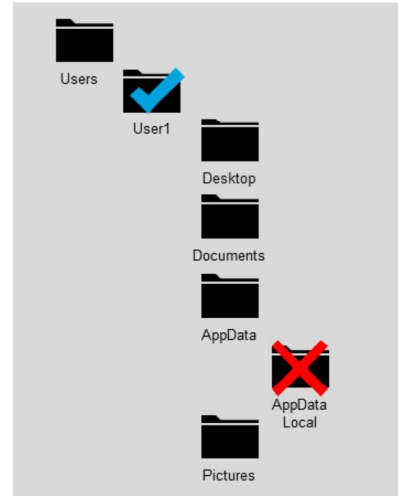
Key Notes:

- By default, all users are managed.
 - If only two groups are specified within the processed group policy setting, then only these two groups are managed.
 - If a single group is specified in the excluded groups policy setting, then all groups except this one are managed.
 - If both settings are used, the resulting set is merged.
- Management of profiles can fail if groups are used for restricting Profile Management and these groups are renamed in Active Directory since they are matched by their name only.
- On static, persistent desktops, users are possibly given local administrator permission (sometimes to solve some software restrictions). Normally Profile Management would not manage these users, unless the according policy is set.

Inclusion / Exclusion

Exclude folders, file patterns and registry hives to speed up profile roaming and conserve space.

- Exclude Directories
 - Like Downloads, Temp, AppData\Local
- Exclude File patterns
 - Like *.mp3 or *.tmp
- Exclude Registry Hives
 - like HKCU\Software\BadlyCoded
- Include Registry Hives
 - Like HKCU\Software\BadlyCoded\Important-Hive



Key Notes:

- If a single entry exists in the Registry-Include-Setting (e.g HKCU\SOFTWARE\Adobe) then this will be the ****only**** registry key that roams. All other keys are implicitly considered to be black-listed and will be excluded from roaming.
- By default, the complete HKCU hive roams and nothing needs to be included.
 - This can be beneficial if designing profiles for an environment (silo) that hosts a single, specialized application. Defining only the printers key and the application keys to be included could result in a fast loading profile that can hardly be corrupted.
- In case exclusion and inclusion are defined, most specific match wins (in the above example, the hive “BadlyCoded” would not roam, but its sub-key “Important-Hive” would).
- Exclusions are processed at logoff. This will not block entries to the registry or filesystem during the session.
- The Exclusions section contains policy settings for configuring which files and directories in a user’s profile are excluded from the synchronization process.
- Exclusion list – directories specifies a list of folders in the user profile that are ignored during synchronization.
- Specify folder names as paths relative to the user profile (%USERPROFILE%).
- By default, this setting is disabled and all folders in the user profile are synchronized.

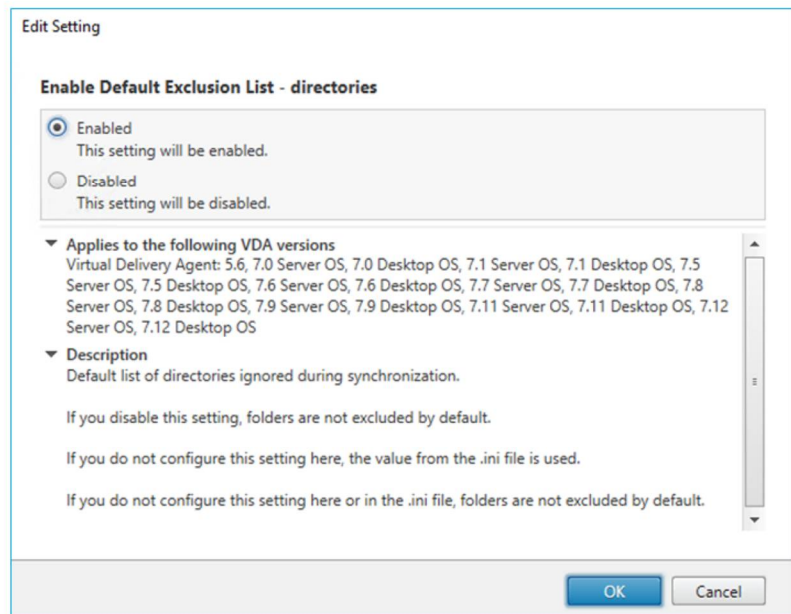
Additional Resources:

- Exclusions policy settings - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/policies/reference/profile-management/file-system/exclusions-policy-settings.html>

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Simplified Configuration

- Profile Management offers predefined, recommended items for inclusion and exclusion. Instead of having to include and exclude items manually, you can use the default policy lists:
 - Enable Default Exclusion List - directories
 - Enable Default Exclusion List



Key Notes:

- In previous versions of Profile Management these settings were either controlled by an .ini configuration file or through manual entry in a policy setting. The pre-defined settings in the .ini file have now been migrated into the policy objects to make configuration and adjustments easier.
- Exclusion list – files : List of files that are ignored during synchronization. File names must be paths relative to the user profile (%USERPROFILE%). Wildcards are allowed and are applied recursively.
- Examples:
 - Desktop\Desktop.ini ignores the file Desktop.ini in the Desktop folder.
 - %USERPROFILE%*.tmp ignores all files with the extension .tmp in the entire profile.
 - AppData\Roaming\MyApp*.tmp ignores all files with the extension .tmp in one part of the profile.
- If this policy is disabled, no files are excluded. If this policy is not configured here, the value from the .ini file is used. If this policy is not configured here or in the .ini file, no files are excluded.
- Exclusion list – directories: List of folders that are ignored during synchronization. Folder names must be specified as paths relative to the user profile (%USERPROFILE%).
- Example:
 - Desktop ignores the Desktop folder in the user profile.

- If this policy is disabled, no folders are excluded. If this policy is not configured here, the value from the .ini file is used. If this policy is not configured here or in the .ini file, no folders are excluded.
- Enable Default Exclusion List - directories - Profile Management 5.5: Default list of directories ignored during synchronization. Use this policy to specify GPO exclusion directories without having to fill them in manually.
- If you disable this policy, Profile Management does not exclude any directories by default. If you do not configure this policy here, Profile Management uses the value from the .ini file. If you do not configure this policy here or in the .ini file, Profile Management does not exclude any directories by default.

Additional Resources:

- What's New in Profile Management 5.x - <https://docs.citrix.com/en-us/profile-management/5/upm-intro-wrapper-den/upm-new-features-den.html>

Profile Caching

By default, profiles are cached locally to be reused on subsequent logons. This is recommended for:

- Hosted VDI – Dedicated, Existing, Physical
- Hosted VDI – Static with PVD
- Hosted VDI – Remote PC
- Non-persistent published desktop environments

Use policy to “Delete locally cached profiles on logoff” for:

- Persistent published desktop environments
- Hosted VDI – Pooled without reboot on logoff



Key Notes:

- Stale profiles could accumulate on published desktop environments where multiple users log on during the day, depending on when the servers are rebooted and if they are set to discard changes on reboot.
- In non-persistent published desktop environments where servers are rebooted every night, this action will clean up the cached profiles.
- Caching the profile and reusing it can speed up the logon process dramatically, but makes sense only on machines where users are expected to return.
- There is also a policy to delay the deletion – this will save storage IO load, especially on random, non-persistent desktops where the machine will be shut down after the user logs off, discarding any change to the machine anyway.

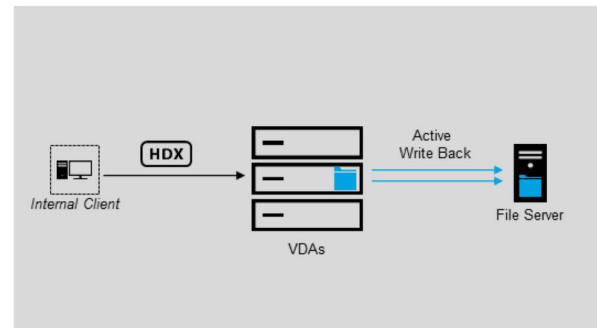
Additional Resources:

- Blog: to cache or not to cache - <https://www.citrix.com/blogs/2012/11/30/to-cache-or-not-to-cache-that-is-the-question>

Active Write Back

Enable the Active Write Back feature to save some profile contents back prior to logging off.

- Changed files are written back to a special folder within the profile directory on the file server (pending)
- This only affects files, not registry hives
- Files are written back every 5 minutes to save bandwidth
- Version 5.6 includes active write back for registry items



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Key Notes:

- A user might work on a document which is saved in a local folder on his VDA. When the VDA crashes (or the user does not log off, but just disconnects...) the profile changes (including the document) has not been saved on the file server and is lost. With Active Write Back, every 5 minutes the latest copy of each changed file is copied back to the file server. When a user logs on again (after crash or from different machine), the saved version of the document will be included in the profile.
- For some applications a certain registry entry must match a certain file, so only saving the files might cause this application's configuration to break.
- Active Write Back enables modified files and folders (but not registry settings) to be synchronized to the user store during a session, before logoff.
- By default, synchronization to the user store during a session is disabled.
- Support for Active Write Back for registry entries - registry entries that are modified on the local computer can be backed up to the user store in the middle of a session, before logoff.

Additional Resources:

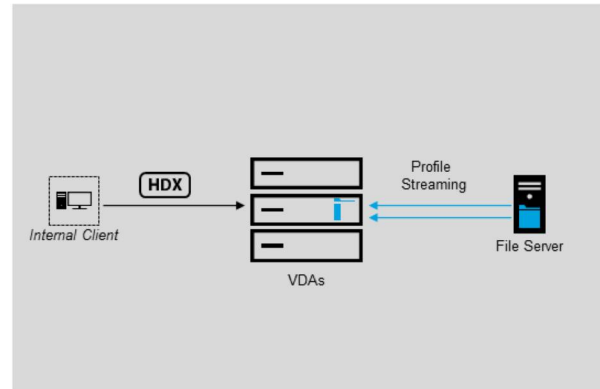
- Basic policy settings - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/policies/reference/profile-management/basic-policy-settings.html>

Profile Streaming

Enable Profile Streaming to create placeholder entries for files from the user profile – files will be loaded on access only.

Use the Always cache policy to:

- Roam all files exceeding a specified size in the background:
 - To reduce the time required when user opens large files
 - Saves some network traffic
- Roam all files of any size in the background:
 - To reduce the time required when user opens any file
 - No network traffic is saved



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Key Notes:

- Profile Streaming typically allows for a much faster logon as the amount of data copied from the file servers will be minimized.
- Profile Streaming can be restricted to a group. So this feature can be tested/enabled only for specific users.
- Creating placeholder files (each 4kb in size) might be a lot faster than downloading larger files or many files from the profile share – especially if the user just logged on to check emails and logs back out afterwards.
- Profile Streaming will automatically be disabled if used together with the Citrix Personal vDisk feature.
- Profile Streaming enables and disables the Citrix streamed user profiles feature. When enabled, files and folders contained in a profile are fetched from the user store to the local computer only when they are accessed by users after they have logged on. Registry entries and files in the pending area are fetched immediately.

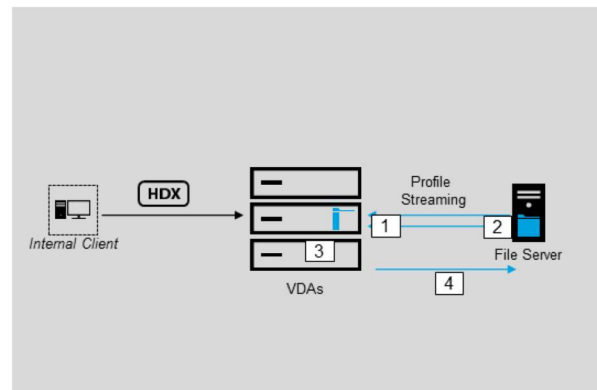
Additional Resources:

- Streamed user profiles policy settings - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/policies/reference/profile-management/streamed-user-profiles-policy-settings.html>

Profile Streaming

How it works

1. User starts session to a VDA, the profile is loaded, but only placeholder files are created on the VDA.
2. User opens a file from his profile using an application on the VDA. Citrix Profile Management downloads the actual file from the user store path and replaces the placeholder.
3. The file now resides locally on the VDA and can be manipulated.
4. On logoff, the file is saved back to the user store path.



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Key Notes:

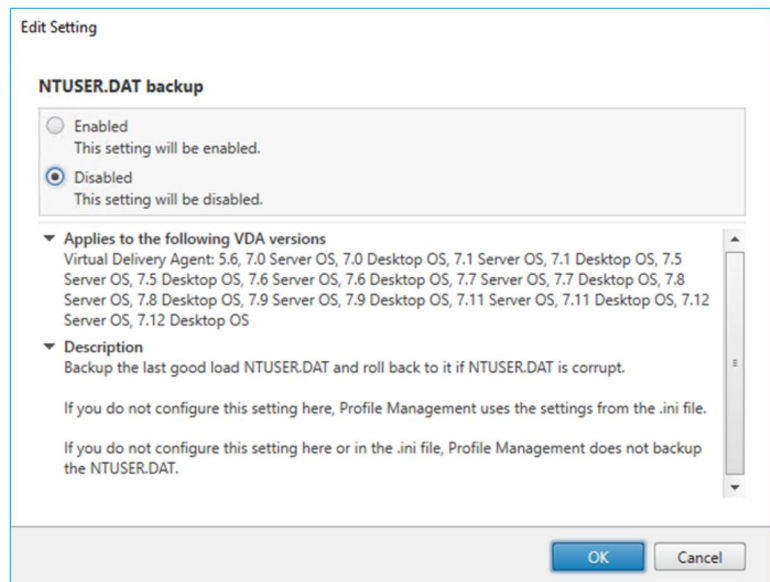
- A special filter driver is used to intercept the access to the placeholder files (reparse points, a special function of NTFS).
- Enabling the “Always Cache” policy but setting the value to “0” enables background downloading of ****all**** files from the user profile.
- Streamed user profile groups specifies which user profiles within an OU are streamed, based on Windows user groups.
- When enabled, only user profiles within the specified user groups are streamed. All other user profiles are processed normally.

Additional Resources:

- Streamed user profiles policy settings - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/policies/reference/profile-management/streamed-user-profiles-policy-settings.html>

Profile Protection

- Profile Management provides profile protection by enhancing the way it handles profiles.
- Profile Management maintains a last known good backup of the NTUSER.DAT file.
- If Profile Management detects corruption, it uses the last known good backup copy to recover the profile.



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Key Notes:

- Enables a backup of the last known good copy of NTUSER.DAT and rollback in case of corruption.
- If you do not configure this policy here, Profile Management uses the value from the .ini file. If you do not configure this policy here or in the .ini file, Profile Management does not back up NTUSER.DAT.

Additional Resources:

- What's New in Profile Management 5.x - <https://docs.citrix.com/en-us/profile-management/5/upm-intro-wrapper-den/upm-new-features-den.html>



- What are some key benefits for Streaming Profiles?

Key Notes:

Answer: less traffic, faster logon times

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Lab Exercise

- Exercise 9-1: Configure Citrix Profile Management Using Group Policy
- Exercise 9-2: Test Optimized Profile
- Exercise 9-3: Configure Profile Protection
- Exercise 9-4: Test Profile Protection

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Lesson Objective Review

Scenario: You are the Citrix Admin and you have recently enabled Citrix Profile Management with the basic profile settings. After doing this you notice that the size of the profiles are starting to grow.

Why are you experiencing this behavior?

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Lesson Objective Review

Scenario: You are the Citrix Admin and you have recently enabled Citrix Profile Management with the basic profile settings to migrate roaming profiles. After doing this you notice that the size of the profiles are starting to grow.

Why are you experiencing this behavior?

With the default settings enabled, Citrix Profile Manager synchronizes more profile data than roaming profiles does. Use the folder and file exclude rules to filter out unnecessary data.

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Key Takeaways



- User Profile Management enables a consistent user experience across multiple sessions.
- Features such as Active Write Back and Profile Streaming offer additional logon and logoff performance gains.

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XenApp and XenDesktop Administration

Managing the XenApp and XenDesktop Site

Module 10



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Lab VM Power Management

The following VMs are required to be powered on before beginning the exercises in this module:

- NYC-ADS-001
- NYC-SQL-001
- NYC-FSR-001
- NYC-XDC-001
- NYC-STF-001
- NYC-MAN-001
- NYC-SRV-001
- NYC-WRK-001

The remaining VMs need to be powered off.

Note: These VMs are listed in the start-up order.

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Learning Objectives

- Identify how Delegated Administration works in Citrix Studio
- Examine Configuration Logging report capabilities within Citrix Studio
- Explore the benefits of PowerShell and the Citrix modules
- Explain why Restart Schedules may be necessary and how to configure them

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Delegated Administration

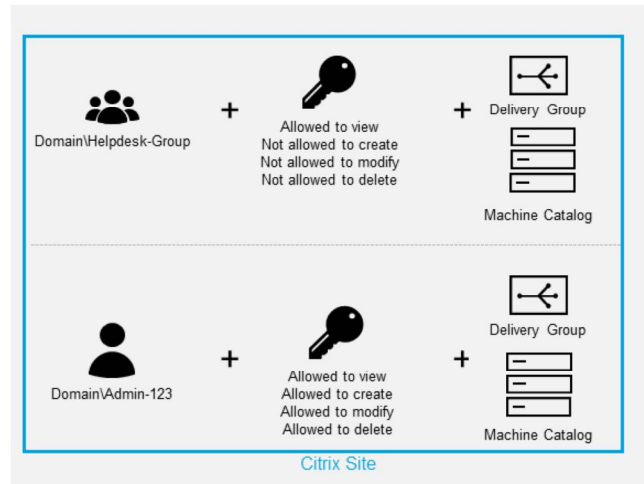
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Delegated Administrators

Explanation

- Delegated Administrators are accounts within a Site that combine:
 - Users or groups
 - A set of permissions
 - Objects in the Site
- Delegated Administrators are Site specific
- The Site database stores the configuration of Delegated Administrators



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Key Notes:

- Delegated Administration now consists of three elements (who gets which permissions on which objects).
- For example, we can give the Junior Admin full admin privileges on the test Delivery Group and the test Catalog while he only has limited permissions on the production resources.
- The Delegated Administration model offers the flexibility to match how your organization wants to delegate administration activities, using role and object-based control. Delegated Administration accommodates deployments of all sizes, and allows you to configure more permission granularity as your deployment grows in complexity. Delegated Administration uses three concepts: Administrators, Roles, and Scopes.

Additional Resources:

- Delegated Administration - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/secure/delegated-administration.html>

Delegated Administrators

Use Case

Group Function	Assigned permissions
First-level User Helpdesk group	<ul style="list-style-type: none">• Allowed to monitor license servers, infrastructure components and access session related data (latency, IP address, status, programs running inside the session).• Allowed to log off or reset user sessions of certain user groups only.
Second-level User Helpdesk group	<ul style="list-style-type: none">• In addition to First level User Helpdesk permissions:<ul style="list-style-type: none">○ Allowed to reset user profiles, sessions and VDAs.○ Allowed to assign users to VDAs.○ Allowed to modify and assign policies to VDAs.
Citrix Administrative Group	<ul style="list-style-type: none">• Allowed to modify every aspect of all objects in the site.

Key Notes:

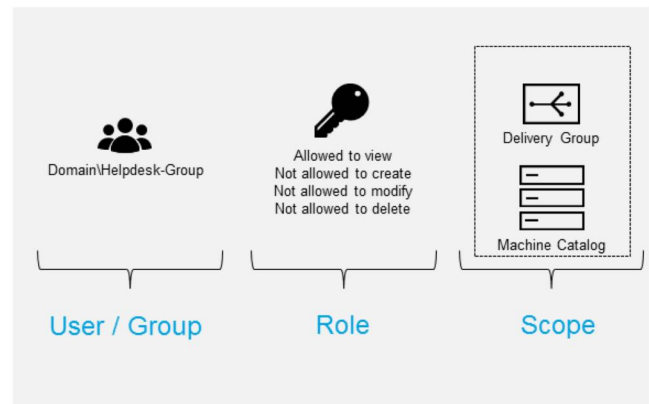
- In this example, we have three different types of administrators, each requiring individual privileges on the same objects.
- We use Roles to create the permission levels.

Delegated Administrators

Requirements

Delegated Administrators require three components to be set up:

- a User or User Group
- a Role
- a Scope



Key Notes:

- In the example on the previous slide, administrators can control the privileges the Helpdesk group has on specific objects or all objects in the database. The Helpdesk group can only view the Delivery Group and three Catalogs that appear in the Scope.
- During the initial Site configuration, an “All” Scope and six different predefined Roles are created.
 - Administrators — An administrator represents an individual person or a group of people identified by their Active Directory account. Each administrator is associated with one or more Role and Scope pairs.
 - Roles — A Role represents a job function, and has defined permissions associated with it. For example, the Delivery Group Administrator Role has permissions such as 'Create Delivery Group' and 'Remove Desktop from Delivery Group.' An administrator can have multiple Roles for a Site, so a person could be a Delivery Group Administrator and a Machine Catalog Administrator. Roles can be built-in or custom.
 - Scopes — A Scope represents a collection of objects. Scopes are used to group objects in a way that is relevant to your organization (for example, the set of Delivery Groups used by the Sales team). Objects can be in more than one Scope; you can think of objects being labeled with one or more Scopes. There is one built-in Scope: 'All,' which contains all objects. The Full Administrator Role is always paired with the All Scope.

Additional Resources:

- Delegated Administration - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/secure/delegated-administration.html>

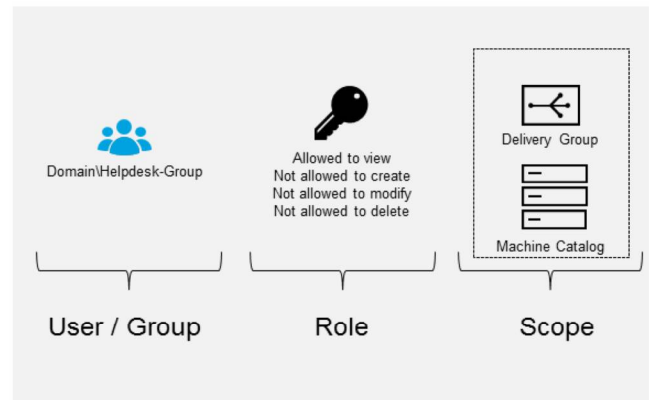
Not for resale or distribution

Delegated Administrators

User and Group Requirements

The following object types qualify for delegated administration:

- Local user
 - Requires management of individual accounts
 - No centralized management
- Local group
 - Better management of multiple accounts
 - No centralized management
- Domain user
 - Requires central management of individual accounts
- Domain group
 - Enables central management of multiple accounts



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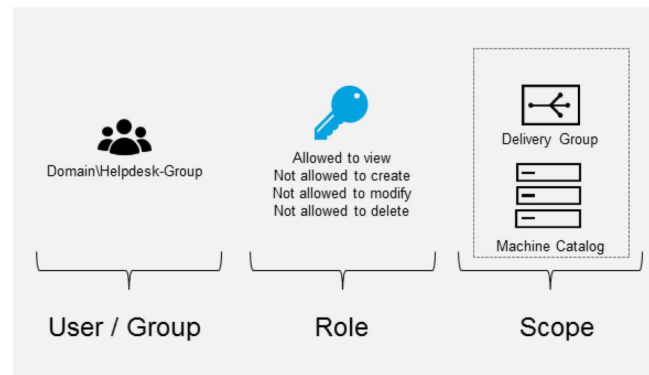
Key Notes:

- Citrix Studio cannot be run using local credentials – a domain account is required!
- Using domain groups is a leading practice for delegating administrative permissions within a Site.

Introduction to Roles

A Role defines a specific set of permissions that a user or group has.

The permissions within a Role typically depend on the job responsibility of the Delegated Administrator.



Key Notes:

- You can create custom Roles to match the requirements of your organization, and delegate permissions with more detail. You can use custom Roles to allocate permissions at the granularity of an action or task in a console.

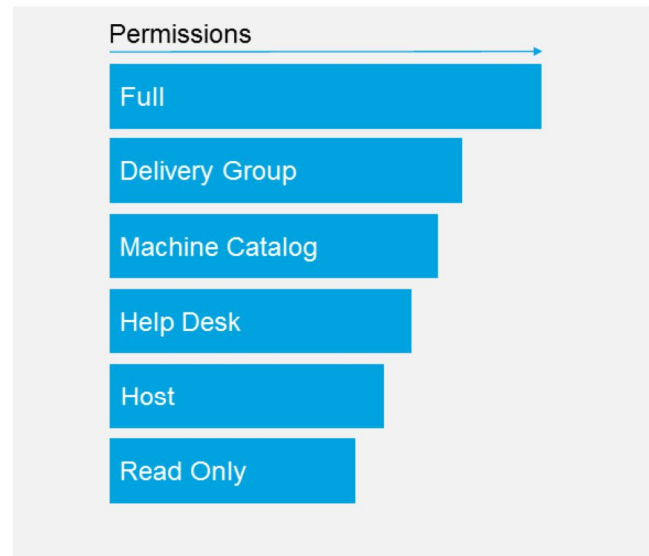
Additional Resources:

- Delegated Administration - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/secure/delegated-administration.html>

Built In Roles

A XenApp and XenDesktop Site offers six built in Roles:

- Full Administrator
- Delivery Group Administrator
- Machine Catalog Administrator
- Help Desk Administrator
- Host Administrator
- Read Only Administrator



Key Notes:

- The account that is used to create the Site is added to the Full Administrator Role automatically.
- It is important to understand the function of the built in Roles and how they relate to typical job functions:
 - Full Administrator
 - Can perform all tasks and operations. The Full Administrator Role only applies to the “All” Scope.
 - Delivery Group Administrator
 - Can deliver applications, desktops, and machines; can also manage the associated sessions.
 - Can also manage application and desktop configurations such as policies and power management settings.
 - Machine Catalog Administrator
 - Can create and manage Machine Catalogs and provision machines into them.
 - Can build Machine Catalogs from the virtualization infrastructure, Provisioning Services, and physical machines.
 - This Role can manage base images and install software, but cannot assign applications or desktops to users.
 - Help Desk Administrator

- Can view Delivery Groups, and manage the sessions and machines associated with those groups.
- Can see the Machine Catalog and host information for the Delivery Groups being monitored; and can also perform session management and machine power management operations for the machines in those Delivery Groups.
- Host Administrator
 - Can manage host connections and their associated resource settings.
 - Cannot deliver machines, applications, or desktops to users.
- Read Only Administrator
 - Can see all objects in specified Scopes as well as global information, but cannot change anything.
 - For example, a Read Only Administrator with Scope=London can see all global objects (such as Configuration Logging) and any London-Scoped objects (for example, London Delivery Groups). However, that administrator cannot see objects in the New York Scope (assuming that the London and New York Scopes do not overlap).

Additional Resources:

- Delegated Administration - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/secure/delegated-administration.html>

Creating Custom Roles

Create Custom Roles from scratch or by copying permissions from an existing Role.

1. Create new Role / Copy Role.
2. Enter a name for the Role.
3. Select all permissions from all sections necessary for the new Role.
4. Save the new Role.

Copy Role

Define a role for this administrator based on the permissions to manage different features.

Name:
Custom Help Desk Administrator

Description:
HelpDesk Level 2

Permissions:

- App-V
- Controllers
- Delivery Groups
- Director
 - No Access
 - Manage
 - Create/Edit/Enable/Delete Alert Policies
 - Create/Edit/Remove Alert Email Server Configuration
 - Dismiss Alerts
 - Edit HDX related Broker machine command properties
 - Edit Kill Application related Broker machine command properties
 - Edit Kill Process related Broker machine command properties

Save Cancel

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Key Notes:

- Creating a Custom Role is very useful since the built in Roles might not meet a customer's specific needs.
- It can be helpful to copy an existing Role instead of creating one from scratch.
- Role names can contain up to 64 Unicode characters; they cannot contain the following characters: \ (backslash), / (forward slash), ; (semicolon), : (colon), # (pound sign) , (comma), * (asterisk), ? (question mark), = (equal sign), < (left arrow), > (right arrow), | (pipe), [] (left or right bracket), () (left or right parenthesis), " (quotation marks), and ' (apostrophe). Descriptions can contain up to 256 Unicode characters.
- You cannot edit or delete a built-in Role. You cannot delete a custom Role if any administrator is using it.
- Note: Only certain product editions support custom Roles. Editions that do not support custom Roles do not have related entries in the Actions pane. At this time, the Enterprise and Platinum editions of both XenApp and XenDesktop support custom Roles. For the latest information, check the XenApp and XenDesktop feature matrix (link provided in Additional Resources).

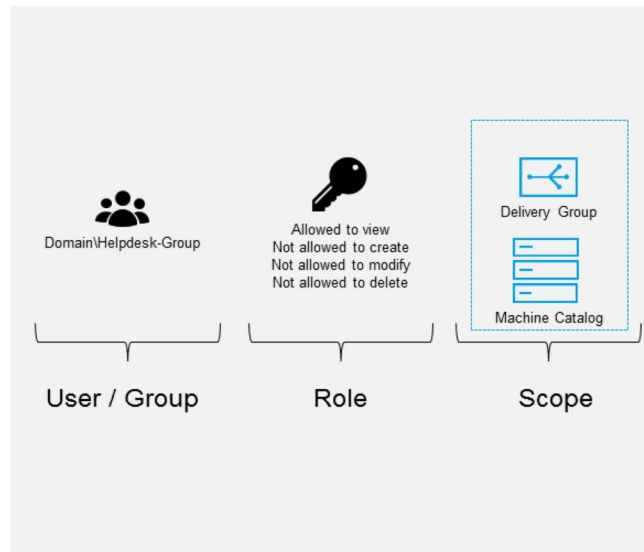
Additional Resources:

- Delegated Administration - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/secure/delegated-administration.html>
- XenApp and XenDesktop features: <https://www.citrix.com/products/xenapp-xendesktop/feature-matrix.html>

Introduction to Scopes

A Scope combines objects from the Site to a unit that permissions (Roles) can be applied to.

- Objects can be part of multiple Scopes.
- Scopes cannot contain other Scopes.
- Only specific objects can be added to Scopes.
 - Examples include Machine Catalogs, Delivery Groups, Hosting Connections and Application Groups.
 - Individual published apps and VDAs cannot be added to a Scope



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Key Notes:

- A Scope is essentially just a partition inside the database that allows for grouping of multiple objects into one single administrative unit.
- Not all objects can be added to a Scope.
- When you create a Site, the only available Scope is the 'All' Scope, which cannot be deleted.
- You can also create Scopes when you create an administrator; each administrator must be associated with at least one Role and Scope pair. When you are creating or editing desktops, machine catalogs, applications, or hosts, you can add them to an existing Scope. If you do not add them to a Scope, they remain part of the 'All' Scope.

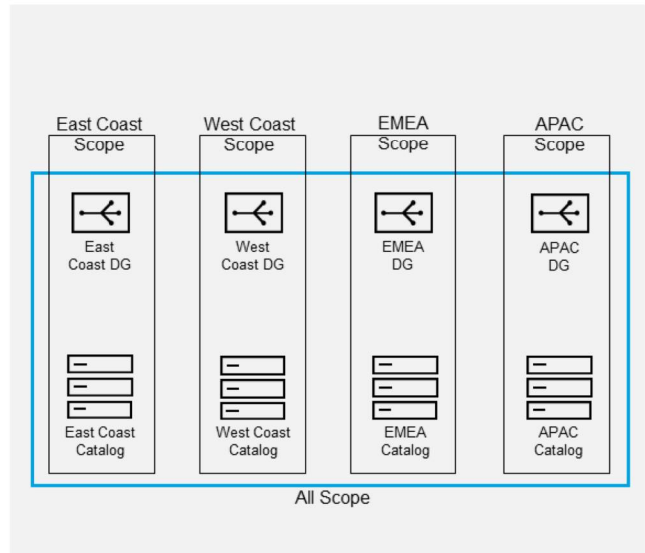
Additional Resources:

- Delegated Administration - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/secure/delegated-administration.html>

Built In Scope

The “All” Scope is the only built in Scope in a new XenApp and XenDesktop Site.

- Contains all objects from the Site.
- New objects are automatically added to this Scope.
- The “All” Scope is always associated with the “Full Administrator” Role.



Key Notes:

- You cannot change the “All” Scope.
- Each new object created in the database will be added to the “All” Scope.
- Site creation cannot be scoped, nor can Delegated Administration objects (Scopes and Roles). However, objects you cannot scope are included in the 'All' Scope. (Full Administrators always have the All Scope.) Machines, power actions, desktops, and sessions are not directly scoped; administrators can be allocated permissions over these objects through the associated machine catalogs or Delivery Groups.

Additional Resources:

- Delegated Administration - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/secure/delegated-administration.html>

Creating Custom Scopes

Create custom Scopes from scratch or by copying an existing Scope.

1. Create new Scope / copy Scope.
2. Enter a name for the Scope.
3. Select all objects from all sections necessary for the new Scope.
4. Save the new Scope.

Create Scope

Define a scope based on the objects in your deployment.

Name:
New York Datacenter

Description: (Optional)
All objects hosted in New York Datacenter

Objects:

- AppDisks
- Application Groups
- Delivery Groups
 - NYC-DG-DesktopOS-Desktops
Windows 10 Desktop

Select all objects of a particular type or specific objects within a type.

Save Cancel

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Key Notes:

- Only objects that have already been created will show up in the Create Scope wizard.
 - A new Site contains no scope-able objects.
- Newer versions of XenApp and XenDesktop have more scope-able objects.
- Scope names can contain up to 64 Unicode characters; they cannot include the following characters: \ (backslash), / (forward slash), ; (semicolon), : (colon), # (pound sign), , (comma), * (asterisk), ? (question mark), = (equal sign), < (left arrow), > (right arrow), | (pipe), [] (left or right bracket), () (left or right parenthesis), " (quotation marks), and ' (apostrophe). Descriptions can contain up to 256 Unicode characters.

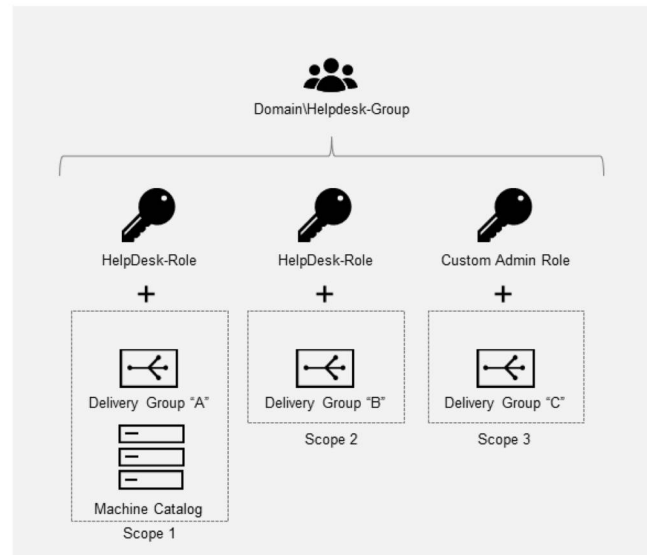
Additional Resources:

- Delegated Administration - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/secure/delegated-administration.html>

Creating Custom Administrators

Create custom Administrators from scratch or by copying an existing Administrator.

1. Create required Scopes and/or Roles.
2. Create new Administrator.
3. Specify user or group for the new Administrator.
4. Select a Scope.
5. Assign a Role that the new Administrator should use for the selected Scope.
6. Save the new Administrator.
7. Edit the Administrator to assign additional Scope & Role pairs.



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Key Notes:

- As the diagram shows, a group of users can have different permissions to different objects at the same time. The diagram shows three Scope & Role pairs. One Scope contains different types of objects (Delivery Group & machine catalog), while other Scopes contain just Delivery Groups.
- When you create a Site as a local administrator, your user account automatically becomes a Full Administrator with full permissions over all objects. After a Site is created, other local administrators have no special privileges.
- The Full Administrator Role always has the All Scope; you cannot change this.
- By default, an administrator is enabled. Disabling an administrator might be necessary if you are creating the new administrator now, but that person will not begin administration duties until later. For existing enabled administrators, you might want to disable several of them while you are reorganizing your object/Scopes, then re-enable them when you are ready to go live with the updated configuration. You cannot disable a Full Administrator if it will result in there being no enabled Full Administrator. The enable/disable check box is available when you create, copy, or edit an administrator.

Additional Resources:

- Delegated Administration - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/secure/delegated-administration.html>



Lab Exercise

- Exercise 10-1: Create a Custom Role
- Exercise 10-2: Create a Custom Scope
- Exercise 10-3: Create Delegated Administrator Accounts
- Exercise 10-4: Create Help Desk Delegated Administrator
- Exercise 10-5: Login and Test the Delegated Administrator

Not for resale or distribution



How will you delegate permissions in your Citrix Team?
Is everyone allowed full administrative access?

Not for resale or distribution

Lesson Objective Review

Scenario: You are the Citrix Admin and you are in the process of adding Joe, a new Junior Admin, as a delegated administrator.

You decide that you want to add him to the Dev and Test Scope only using the Full Administrator Role.

Will this work?

Not for resale or distribution

Lesson Objective Review

Scenario: You are the Citrix Admin and you are in the process of adding Joe, a new Junior Admin, as a delegated administrator.

You decide that you want to add him to the Dev and Test Scope only using the Full Administrator Role.

Will this work?

No, the Full Administrator Role will always be associated with the All Scope.

Key Notes:

- Full Administrator: Can perform all tasks and operations. A Full Administrator is always combined with the All Scope.

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Logging and Reporting

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Delegated Administration Reports

Create reports on delegated administrators to document the following:

- Detailed permissions per administrator on:
 - Delivery Groups
 - Machine Catalogs
 - Hosting Connections and Resources
 - Applications, Application Groups, Director and general functions
- Assigned Scope & Role pairs
- Resulting set of permissions on specific objects
- Which Role is assigned which permission

Delegated Administration Report for WORKSPACELAB\Administrator

Created by: WORKSPACELAB\Administrator
Report created: 1/3/2017 2:11:13 PM

Summary

Administrator Name	User Groups	Scopes and Roles
WORKSPACELAB\Administrator		Scope: All, Role: Full Administrator

System Control

Permissions	Description	Role
AppLib_AddPackage	Add App-V Application Libraries and Packages	Full Administrator
AppV_AddServer	Add App-V publishing server	Full Administrator
Hosts_CreateHost	Add Host Connection or Resources	Full Administrator
Licensing_ChangeLicenseServer	Change licensing server	Full Administrator
Storefront_Create	Create a new Storefront definition	Full Administrator
AppDisk_Create	Create AppDisk	Full Administrator
Applications_Create	Create Application	Full Administrator
AppGroupApplications_Create	Create Application (Application Group)	Full Administrator
Applications_CreateFolder	Create Application Folder	Full Administrator

Key Notes:

- You can create two types of Delegated Administration reports:
 - An HTML report that lists the Role/Scope pairs associated with an administrator, plus the individual permissions for each type of object (for example, Delivery Groups and Machine Catalogs). You generate this report from Studio. To create this report, click Configuration > Administrators in the navigation pane. Select an administrator in the middle pane and then click Create Report in the Actions pane. You can also request this report when creating, copying, or editing an administrator.
 - An HTML or CSV report that maps all built-in and custom Roles to permissions. You generate this report by running a PowerShell script named OutputPermissionMapping.ps1. To run this script, you must be a Full Administrator, a Read Only Administrator, or a custom administrator with permission to read Roles. The script is located in: Program Files\Citrix\DelegatedAdmin\SnapIn\Citrix.DelegatedAdmin.Admin.V1\Scripts\.

Additional Resources:

- Delegated Administration - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/secure/delegated-administration.html>

Delegated Administration Report Options

To create a Delegated Administration Report:

1. Select Create Report in Citrix Studio.
2. Specify a user or group to report on.
3. Name the output file (HTML format).

To create a Role to permission Report:

1. Run the PowerShell-Script OutputPermissionMapping.ps1
2. Specify the output file and format (CSV or HTML).

Role to permission mapping						
Permission	Delivery Group Administrator	Full Administrator	Help Desk Administrator	Host Administrator	Machine Catalog Administrator	Read Only Administrator
Administrators						
Manage Administrators	.	0
View Administrators	.	0	.	.	.	0
AppDisks						
Add AppDisk to Scope	.	0	.	.	.	0
Allow AppDisk to be added to a Delivery Group	0	0	.	.	.	0
Create a new Version of AppDisk	.	0	.	.	.	0
Create AppDisk	.	0	.	.	.	0
Delete AppDisk	.	0	.	.	.	0
Edit AppDisk properties	.	0	.	.	.	0
Install Applications	.	0	.	.	.	0

Key Notes:

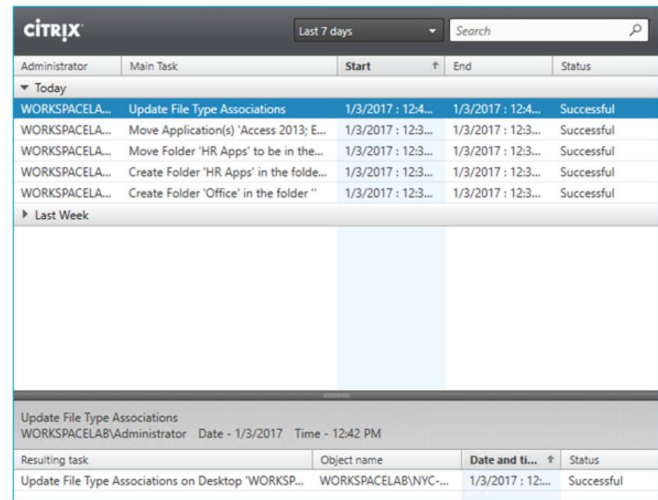
- The script to generate the Role to permission mapping can normally be found at the following location where Citrix Studio is installed: "C:\Program Files\Citrix\DelegatedAdmin\SnapIn\Citrix.DelegatedAdmin.Admin.V1\Scripts\OutputPermissionMapping.ps1"
- The following example writes an HTML table to a file named Roles.html and opens the table in a web browser:
 - &"\$env:ProgramFiles\Citrix\DelegatedAdmin\SnapIn\Citrix.DelegatedAdmin.Admin.V1\Scripts\OutputPermissionMapping.ps1" -Path Roles.html -Show

Configuration Logging Reports

Create Configuration Logging Reports to document changes to a Site.

The built in logging facility tracks all configuration changes within a Site by default including:

- The account used
- Date and time
- Success or failure of the change



The screenshot shows the Citrix Configuration Logging Reports interface. At the top, there is a search bar and a dropdown menu set to 'Last 7 days'. Below this is a table with columns: Administrator, Main Task, Start, End, and Status. The table is filtered to show 'Today' and contains four rows of configuration changes, all marked as 'Successful'. The first row is highlighted in blue. Below the table, there is a section for 'Last Week' which is currently empty. At the bottom, there is a detailed view for the selected task 'Update File Type Associations', showing the resulting task, object name, date and time, and status.

Administrator	Main Task	Start	End	Status
WORKSPACELA...	Update File Type Associations	1/3/2017 : 12:4...	1/3/2017 : 12:4...	Successful
WORKSPACELA...	Move Application(s) 'Access 2013; E...	1/3/2017 : 12:3...	1/3/2017 : 12:3...	Successful
WORKSPACELA...	Create Folder 'HR Apps' in the folde...	1/3/2017 : 12:3...	1/3/2017 : 12:3...	Successful
WORKSPACELA...	Create Folder 'Office' in the folder "	1/3/2017 : 12:3...	1/3/2017 : 12:3...	Successful

Resulting task	Object name	Date and ti...	Status
Update File Type Associations on Desktop 'WORKSP...	WORKSPACELAB\NYC...	1/3/2017 : 12:...	Successful

Key Notes:

- This report will only cover changes that are saved in the Configuration Logging database.
- Both changes from Citrix Studio and PowerShell are tracked.
- Changes to VDA images, such as application installations and Windows updates, are not tracked.
- Policy changes in GPMC are not tracked, however, Studio policies are saved in the database and thus tracked.
- You can generate CSV and HTML reports containing configuration log data.
 - The CSV report contains all the logging data from a specified time interval. The hierarchical data in the database is flattened into a single CSV table. No aspect of the data has precedence in the file. No formatting is used and no human readability is assumed. The file (named MyReport) simply contains the data in a universally consumable format. CSV files are often used for archiving data or as a data source for a reporting or data manipulation tool such as Microsoft Excel.
 - The HTML report provides a human-readable form of the logging data for a specified time interval. It provides a structured, navigable view for reviewing changes. An HTML report comprises two files, named Summary and Details. Summary lists high level operations: when each operation occurred, by whom, and the outcome. Clicking a Details link next to each operation takes you to the low level operations in the Details file, which provides additional information.
- To generate a configuration log report, select Logging in the Studio navigation pane, and

then select Create custom report in the Actions pane.

- Select the date range for the report.
- Select the report format: CSV, HTML, or both.
- Browse to the location where the report should be saved.

Additional Resources:

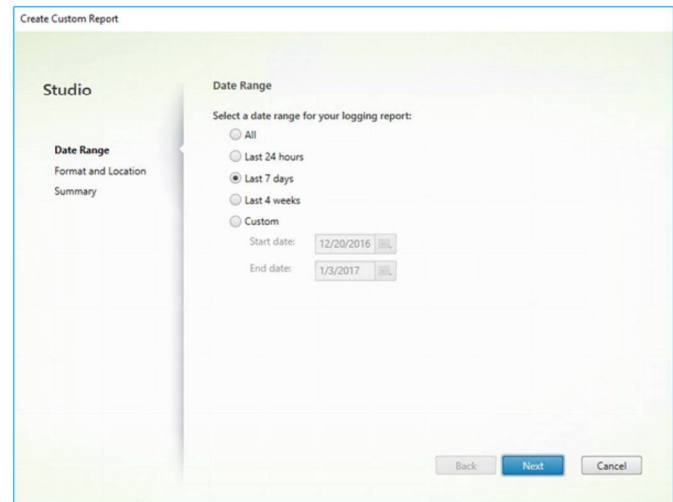
- Manage Configuration Logging - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/monitor/configuration-logging.html>

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Configuration Logging Report Options

To create a Configuration Logging Report:

1. Select **Create Custom Report** in Citrix Studio.
2. Specify a date range to report on.
3. Select the output format (CSV or HTML).
4. Name the output file.



Key Notes:

- CSV is often used for archiving purposes or further processing using data manipulation tools like MS Excel, while HTML output can be included in project documentations and reports.
- To create Configuration Logging reports using PowerShell, leverage the `Export-LogReportHTML` and `Export-LogReportCSV` cmdlets.

Additional Resources:

- Generate reports - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/monitor/configuration-logging.html>



Lab Exercise

- Exercise 10-6: Create a Delegated Administration Report
- Exercise 10-7: Create a Configuration Logging Report

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Lesson Objective Review

Scenario: You are the Citrix Admin and your manager has asked you to provide a report showing every change made within Studio during the last month.

Which report will you use?

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Lesson Objective Review

Scenario: You are the Citrix Admin and your manager has asked you to provide a report showing every change made within Studio during the last month.

Which report will you use?

The Configuration Logging Report.

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Key Notes:

- What output formats does Configuration Logging support?
 - CSV and HTML

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Introduction to PowerShell

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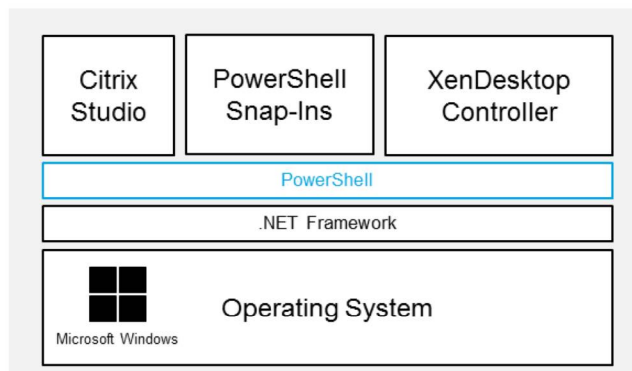
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PowerShell Architecture

Windows PowerShell is a task automation and configuration management framework from Microsoft which is included by default in modern Windows systems.

Commands in PowerShell are called 'cmdlets' and build upon special .NET Framework functions.

To manage specific products like XenApp and XenDesktop, PowerShell can be extended by loading sets of cmdlets (called modules or Snap-Ins) from 3rd party developers like Citrix.



Key Notes:

- PowerShell is object oriented, so almost every command returns not just plain text or tables, but objects with properties that can easily be filtered & manipulated.

Additional Resources:

- PowerShell cmdlet help - <http://docs.citrix.com/en-us/xenapp-and-xendesktop/7-6/cds-sdk-wrapper-rho/xad-commands.html>
- SDK reference (general) - <https://docs.citrix.com/en-us/categories/developer/sdk.html>

PowerShell Benefits

Citrix XenApp and XenDesktop benefits from PowerShell:

- Common language to manage Operating System, Citrix products and other 3rd party products
- Language can be used in a script and interactively on the command line
- Methods available to address .NET, WMI, COM and other executables directly



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Key Notes:

- Each of the FMA services has a corresponding PowerShell snap-in (DLL) that contains the interfaces and objects that can be controlled from the SDK
- Individual service .MSI Snap-in install files can be found on the installation media
 - x86\Citrix Desktop Delivery Controller
 - x64\Citrix Desktop Delivery Controller

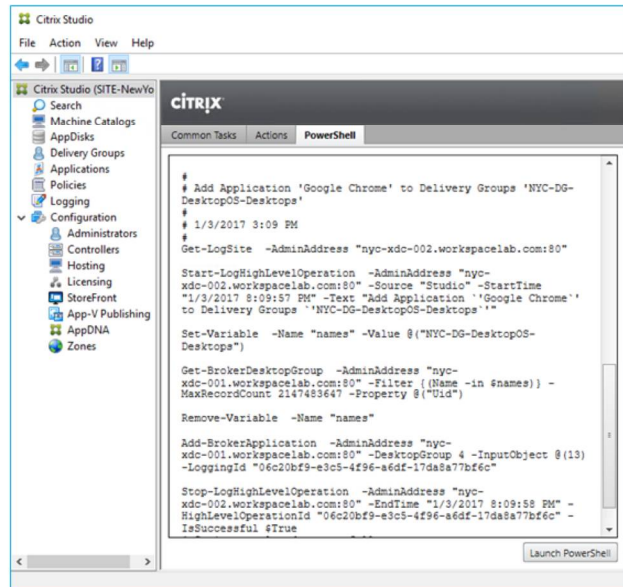
Additional Resources:

- TechEdge Orlando 2015 - Advanced Configuration of XenApp and XenDesktop 7.6 using the PowerShell SDK - <http://support.citrix.com/article/CTX142511>

Citrix Studio – PowerShell Integration

Citrix Studio is a graphical console that uses PowerShell commands for all tasks.

To see a history of issued commands from Studio, click the top node and select the PowerShell tab.



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Key Notes:

- During troubleshooting it is recommended to have a look at the command that is failing since most tasks consist of several necessary cmdlets that are started in a specific order. Often only one of these commands fails and the reason might be visible in the PowerShell pane inside Studio.

Citrix Studio vs. PowerShell

Deciding which management tool to use depends on many factors. Choose the correct tool according to the specific needs of your organization.

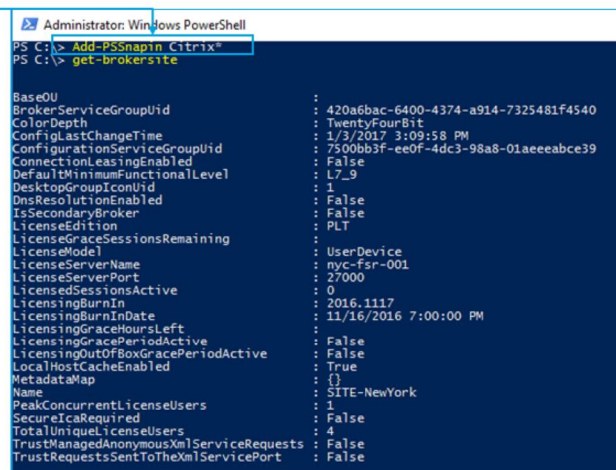
Citrix Studio	PowerShell Commands
Graphical interface	Text based interface
Automatically uses all necessary commands to perform tasks	Requires knowledge of PowerShell syntax and commands
Structure matches common job roles	Automation possible
Manages a single Site only	Management of multiple Sites possible
Offers easy access to common functions and data	Can configure settings not exposed by Studio
Intuitive, easy operation	May require a script editor program or developer tools

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Introduction to Using PowerShell

To manage XenApp and XenDesktop using PowerShell:

1. Install Citrix Studio or the PowerShell SDK
2. Open a PowerShell console window
3. Load the Citrix PowerShell Snap-ins
`Add-PSSnapin Citrix*`
4. Enter the commands needed, for example: `Get-BrokerSite`



```
Administrator: Windows PowerShell
PS C:\> Add-PSSnapin Citrix*
PS C:\> get-brokersite

BaseOU :
BrokerServiceGroupUid : 420a6bac-6400-4374-a914-7325481f4540
ColorDepth : TwentyFourBit
ConfigLastChangeTime : 1/3/2017 3:09:58 PM
ConfigurationServiceGroupUid : 7500bb3f-ee0f-4dc3-98a8-01aecebce39
ConnectionLeasingEnabled : False
DefaultMinimumFunctionalLevel : L7_9
DesktopGroupIconUid : 1
DnsResolutionEnabled : False
IsSecondaryBroker : False
LicenseEdition : PLT
LicenseGraceSessionsRemaining :
LicenseModel : UserDevice
LicenseServerName : nyc-fsr-001
LicenseServerPort : 27000
LicensedSessionsActive : 0
LicensingBurnIn : 2016.1117
LicensingBurnInDate : 11/16/2016 7:00:00 PM
LicensingGraceHoursLeft :
LicensingGracePeriodActive : False
LicensingOutOfBoxGracePeriodActive : False
LocalHostCacheEnabled : True
MetadataMap : {}
Name : SITE-NewYork
PeakConcurrentLicenseUsers : 1
SecureIcaRequired : False
TotalUniqueLicenseUsers : 4
TrustManagedAnonymousXmlServiceRequests : False
TrustRequestsSentToTheXmlServicePort : False
```

Key Notes:

- While typing on the PowerShell command line, commands are often abbreviated. You might have seen the above command before in a shorter version like: “asnp cit*”. Many cmdlets have shorter aliases that can be used instead (get-childitem => gci, add-pssnapin => asnp).
- Depending on manufacturer, Snap-ins or Modules are used to extend the management capabilities of PowerShell. XenApp and XenDesktop uses mostly Snap-ins.
- To list all available Snap-ins, issue the following command: `get-pssnapin –registered`
- To list all available modules, issue the following command: `get-module -listavailable`

Additional Resources:

- TechEdge Orlando 2015 - Automation and troubleshooting of Citrix Group Policy for XenApp and XenDesktop 7.x using PowerShell - <http://support.citrix.com/article/CTX142512>

PowerShell Service Modules

XenApp and XenDesktop uses different services to provide many of its functions.

Manage each service with the cmdlets included in a specific snap-in.

Service	PowerShell Snapin
Citrix AD Identity Service	Citrix.AdIdentity.Admin.V2
Citrix Analytics	Citrix.Analytics.Admin.V1
Citrix Broker Service	Citrix.Broker.Admin.V2
Citrix Configuration Logging Service	Citrix.ConfigurationLogging.Admin.V1
Citrix Configuration Service	Citrix.Configuration.Admin.V2
Citrix Delegated Administration Service	Citrix.DelegatedAdmin.Admin.V1
Citrix Environment Test Service	Citrix.EnvTest.Admin.V1
Citrix Host Service	Citrix.Host.Admin.V2
Citrix Machine Creation Service	Citrix.MachineCreation.Admin.V2
Citrix Monitor Service	Citrix.Monitor.Admin.V1
Citrix Storefront Service	Citrix.Storefront.Admin.V1

Key Notes:

- To demonstrate how many cmdlets are contained inside each PowerShell Snap-in, use the following statement:
`Get-PSSnapin -Registered -name Citrix* | ForEach-Object {write-host $_.name - NoNewline; write-host " contains "(get-command -module $_.name).count "cmdlets."}`

Additional Resources:

- XenDesktop 7.x Services Overview - <http://support.citrix.com/article/CTX139415>

Discovering Citrix cmdlets

- To find appropriate PowerShell cmdlets, use the GET-COMMAND cmdlet.
- To learn about the function, syntax and see examples, use GET-HELP.
- To list available properties of returned objects, pipe the output of a cmdlet to GET-MEMBER.

Command	Result
Get-Command	Returns all cmdlets, functions and aliases from any module and snap-in loaded.
Get-Command -module Citrix*	Only returns cmdlets from Citrix.
Get-Command -module Citrix* *session*	Returns all cmdlets dealing with sessions of any kind.
Get-Command -module Citrix* *application*	Returns all cmdlets dealing with applications of any kind.
Get-Help Get-BrokerSession	Shows the usage and function of the Get-BrokerSession cmdlet.
Get-Help Get-BrokerSession -examples	Shows examples of the use of the Get-BrokerSession cmdlet.
Get-BrokerSession Get-Member	Lists all properties that the objects retrieved by the cmdlet Get-BrokerSession expose (like session start time or Receiver version).

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Key Notes:

- Get-Command and Get-Help are very important to understand if you are new to PowerShell.
- Get-Command will allow you to find commands if you only remember part of the name and will allow you to use wildcards.
- Get-Help will show you more details about a specific command once you know the name.
- If command-line is too advanced, PS ISE can be a bit easier as it has the ability to show inline help and formatting hints.

Lesson Objective Review

What will the following statement most likely do?
(line-breaks have been introduced for readability)

```
Get-BrokerSession |  
Where-Object  
    {$_ .UserName -match "Doctor"  
     -and $_.SessionState -match  
     "Active"  
    } |  
Stop-BrokerSession
```

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Lesson Objective Review

What will the following statement most likely do?
(line-breaks have been introduced for readability)

```
Get-BrokerSession |  
Where-Object  
    {$_ .UserName -match "Doctor"  
    -and $_ .SessionState -match "Active"  
    } |  
Stop-BrokerSession
```

The Statement should immediately logoff all "Doctor"-Users (containing "doctor" in their name, so "SuperDoctor" and Doctor01 would match) out of their active sessions.

Key Notes:

- The first part (get-brokersession) lists all current sessions regardless of user or state.
- The next cmdlet (where-object) filters all sessions with the criteria (both criteria have to apply, they are joined by "-and") and passes the result to the cmdlet which will terminate these sessions (stop-brokersession).
- Scenario: You are the Citrix Admin and the Junior Admin asks you for help running the get-brokersession cmdlet. He reports that PowerShell will not accept the command. What did he likely forget?
 - To load the Citrix PS Snap-ins.
 - There are 3 ways of getting Citrix functionality in PowerShell:
 - Asnp citrix*
 - Add-PSSnapin -Name Citrix.*
 - Start a PowerShell Session from Citrix Studio (Top node, PowerShell Tab, Button: "Launch PowerShell")



Reboot Schedules for Server OS VDA

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Introduction to Restart Schedules

- Server OS VDAs typically host a wide array of both current and legacy applications for many users.
- Over time a Server OS VDA may suffer from application memory leaks or processes not terminating correctly as users log off.
- Restart schedules can be used to power cycle Server OS VDAs at certain non-production hours, ensuring that users experience a well functioning system the next time they log on.

Key Notes:

- Only Server OS VDAs can be scheduled to reboot. Desktop OS VDAs can be configured to either shut down, reboot or suspend when the user logs off. This is configured on the Delivery Group properties and is dependent on the Catalog type.

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How to Configure Restart Schedules

Restart Schedules can be configured within the properties of a Delivery Group.

Studio

Restart Schedule

Do you want to restart machines automatically?

No

Yes

Restart frequency: Daily

Begin restart at: HH : MM

Restart duration: Restart all machines at the same time

Send notification to users: 15 minutes before user is logged off

Notification frequency: Every 5 minutes

Notification message:

Due to system maintenance this server will reboot in %m% minutes - please save your work and log off your session. You can log back in %m% minutes to resume your work.

OK Cancel Apply

Key Notes:

- A restart schedule specifies when to periodically restart all the machines in a Delivery Group.
- You cannot perform an automated power-on or shutdown from Studio, only a restart.
- To configure a restart schedule:
 - Select Delivery Groups in the Studio navigation pane.
 - Select a group and then select Edit Delivery Group in the Actions pane.
 - On the Restart Schedule page, if you do not want to restart machines in the Delivery Group automatically, select the No radio button and skip to the last step in this procedure. No restart schedule or rollout strategy will be configured. If a schedule was previously configured, this selection cancels it.
 - If you do want to restart machines in the Delivery Group automatically, select the Yes radio button.
 - For Restart frequency, choose either Daily or the day of the week the restarts will occur.
 - For Begin restart at, using a 24-hour clock, specify the time of day to begin the restart.
 - For Restart duration, choose whether all machines should be started at the same time, or the total length of time to begin restarting all machines in the Delivery Group. An internal algorithm determines when each machine is restarted during that interval.

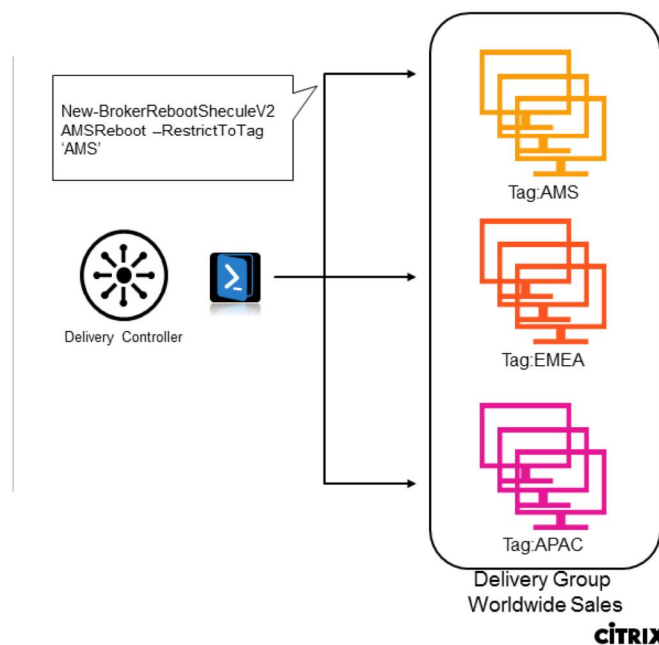
- In the left Notification drop-down, choose whether to display a notification message on the affected machines before a restart begins. By default, no message is displayed. If you choose to display a message 15 minutes before the restart begins, you can choose (in the Repeat notification dropdown) to repeat the message every five minutes after the initial message. By default, the message is not repeated.
- Enter the notification text in the Notification message box; there is no default text. If you want the message to include the number of minutes before restart, include the variable %m% (for example: Warning: Your computer will be automatically restarted in %m% minutes.) If you select a repeat notification interval and your message includes the %m% placeholder, the value decrements by five minutes in each repeated message. Unless you chose to restart all machines at the same time, the notification message displays on each machine in the Delivery Group at the appropriate time before the restart, calculated by the internal algorithm.
- Click Apply to apply any changes you made and keep the window open, or click OK to apply changes and close the window.

Additional Resources:

- Create a restart schedule for machines in a Delivery Group - https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/install-configure/delivery-groups-manage.html#par_anchor_title_4612

PowerShell Configuration of Restart Schedules

- In addition to being able to control restart schedules through Studio, you will need to be familiar with PowerShell in the following two scenarios:
 - Multiple restart schedules
 - Using tag restrictions
- RebootScheduleV2 PowerShell cmdlets were added in XenApp and XenDesktop 7.12.



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Key Notes:

- You can use PowerShell cmdlets to create multiple restart schedules for machines in a Delivery Group. Each schedule can be configured to affect only those machines in the group that have a specified tag. This tag restriction functionality allows you to easily create different restart schedules for different subsets of machines in one Delivery Group.
- For example, let's say you use one Delivery Group for all machines in the company. You want to restart every machine at least once every week (on Sunday night), but the machines used by the accounting team should be restarted daily. You can set up a weekly schedule for all machines, and a daily schedule for just the machines used by the accounting team.
- Multiple schedules might overlap. In the example above, the machines used by accounting are affected by both schedules, and might be restarted twice on Sunday.
- The scheduling code is designed to avoid restarting the same machine more often than needed, but it cannot be guaranteed. If both schedules coincide precisely in start and duration times, it is more likely that the machines will be restarted only once. However, the more the schedules differ in start and/or duration times, the more likely two restarts will occur. Also, the number of machines affected by the schedules can also influence the chances of an overlap. In the example, the weekly schedule that restarts all machines could initiate restarts significantly faster than the daily schedule (depending on the configured duration for each).

Additional Resources:

- Create multiple restart schedules for machines in a Delivery Group -

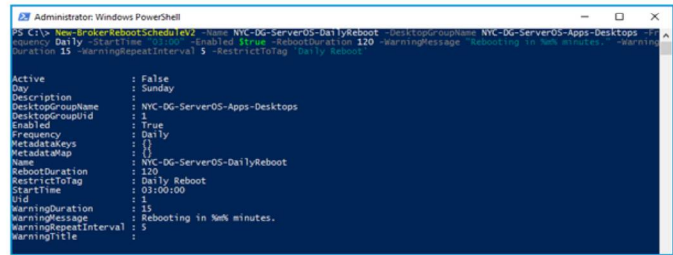
https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/install-configure/delivery-groups-manage.html#par_anchortitle_ceb9

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PowerShell Configuration of Restart Schedules

- New-BrokerRebootScheduleV2
- Get-BrokerRebootScheduleV2
- Set-BrokerRebootScheduleV2
- Remove-BrokerRebootScheduleV2
- Rename-BrokerRebootScheduleV2

* Studio currently uses earlier V1 RebootSchedule PowerShell cmdlets, and will not display schedules that are created with the V2 cmdlets.



```
PS C:\> New-BrokerRebootScheduleV2 -Name NYC-DG-ServerOS-DailyReboot -DesktopGroupName NYC-DG-ServerOS-Apps-Desktops -Frequency Daily -StartTime "03:00" -Enabled $true -RebootDuration 120 -WarningMessage "Rebooting in %m% minutes." -WarningDuration 15 -WarningRepeatInterval 5 -RestrictToTag 'Daily Reboot'

Active           : False
Day              : Sunday
Description      :
DesktopGroupName : NYC-DG-ServerOS-Apps-Desktops
DesktopGroupOID  : 2
Enabled          : True
Frequency        : Daily
MetadataKeys     : {}
MetadataMap      : {}
Name             : NYC-DG-ServerOS-DailyReboot
RebootDuration   : 120
RestrictToTag    : Daily Reboot
StartTime        : 03:00:00
UID              : 1
WarningDuration  : 15
WarningMessage   : Rebooting in %m% minutes.
WarningRepeatInterval : 5
WarningTitle     :
```

Key Notes:

- Sample multiple restart schedule configuration via PowerShell:
 - New-BrokerRebootScheduleV2 -Name NYC-DG-ServerOS-DailyReboot -DesktopGroupName NYC-DG-ServerOS-Apps-Desktops -Frequency Daily -StartTime "03:00" -Enabled \$true -RebootDuration 120 -WarningMessage "Rebooting in %m% minutes." -WarningDuration 15 -WarningRepeatInterval 5 -RestrictToTag 'Daily Reboot'

Additional Resources:

- Create multiple restart schedules for machines in a Delivery Group - https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/install-configure/delivery-groups-manage.html#par_anchortitle_ceb9

Lesson Objective Review

Scenario: You have 20 Server OS VDAs in a Delivery Group. You would like to reboot 10 of these on Tuesdays and 10 on Thursdays and all of them Sunday night.

Will you be using Studio or PowerShell for this task?

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Lesson Objective Review

Scenario: You have 20 Server VDAs in a Delivery Group. You would like to reboot 10 of these on Tuesdays and 10 on Thursdays and all of them Sunday night.

Will you be using Studio or PowerShell for this task?

Currently PowerShell is the only way to create restart schedules based on tags.

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Key Takeaways



- Use Delegated Administration to enhance security and logging capabilities.
- Document Site changes by running Configuration Logging reports with Citrix Studio.
- Use PowerShell to configure settings not exposed by Citrix Studio and automate recurring tasks.
- Reboot schedules can improve the user experience on Server OS VDA's.

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XenApp and XenDesktop Administration

XenApp and XenDesktop Site Redundancy Considerations

Module 11



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The following VMs are required to be powered on before beginning the exercises in this module:

- NYC-ADS-001
- NYC-SQL-001
- NYC-FSR-001
- NYC-VNS-001
- NYC-NIC-001
- NYC-XDC-001
- NYC-XDC-002
- NYC-STF-001
- NYC-STF-002
- NYC-SRV-001
- NYC-WRK-001

The remaining VMs need to be powered off.

Note: These VMs are listed in the start-up order.



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Learning Objectives

- Identify the preface to redundancy
- Examine different redundancy methods

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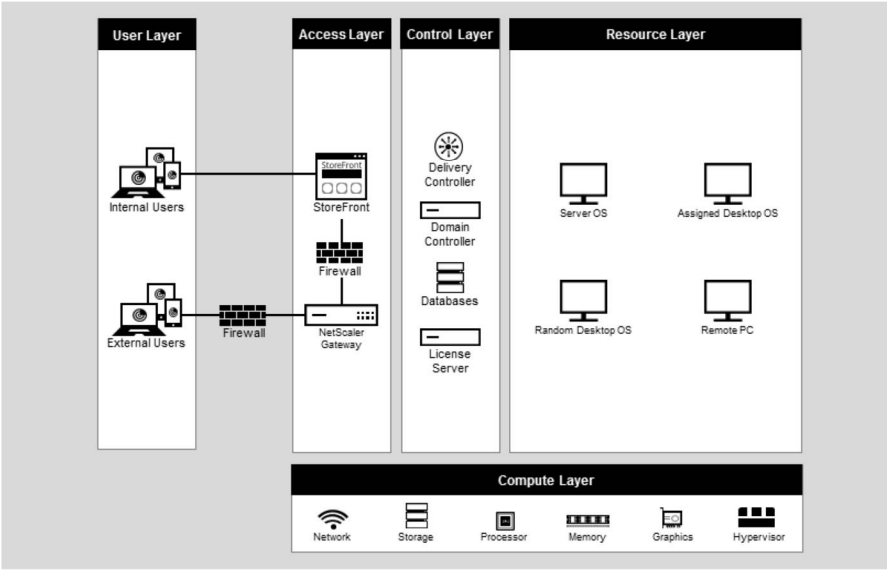
Preface to Redundancy

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Non-Redundant Deployment

Lab Overview

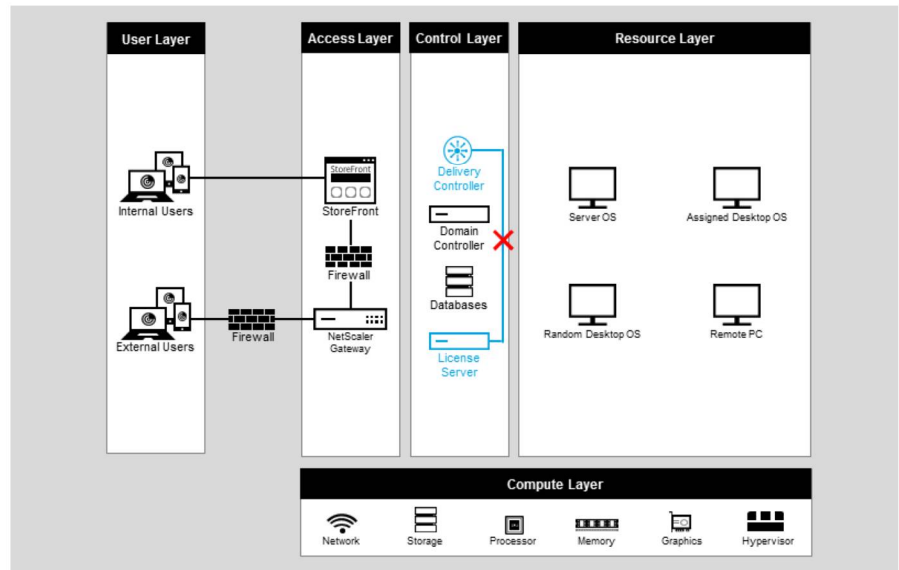


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License Server Failure

When the Citrix License Server fails:

- XenApp and XenDesktop uses a grace period of 30 days if it has communicated with the license server at least once.
- Products that have never communicated with the license server use a built in grace period of 30 days.
- After the grace period expires, XenApp and XenDesktop users will be unable to connect to their resources.



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Key Notes:

- Other licensing components could also fail: Microsoft KMS Server, Microsoft Remote Desktop Licensing Server, AV solution license system etc.
- Failure of the license server can have different reasons:
 - The license server machine or the software crashed / is broken.
 - The license server machine is unable to communicate on the network.
 - All licenses of the requested type are already checked out – in certain scenarios a supplemental grace period can apply (see Additional Resources).
 - The licenses have not been updated to reflect a new subscription advantage date before the site was updated – and now requires a newer SA date.
- Customers are granted a grace period of 90 calendar days post transaction to remove rescinded license file(s) from their license server in order to remain in compliance with Citrix licensing terms and conditions. Please note, at the point of version upgrade, edition upgrade, or trade-up, transaction access to licenses identified for rescission is immediately removed from the secure My Account portal via www.citrix.com. Customers are advised to make a backup copy in case of license server failure during the 90 day grace period.

Additional Resources:

- FAQ: XenApp and XenDesktop 7.x Licensing - <https://support.citrix.com/article/CTX128013>

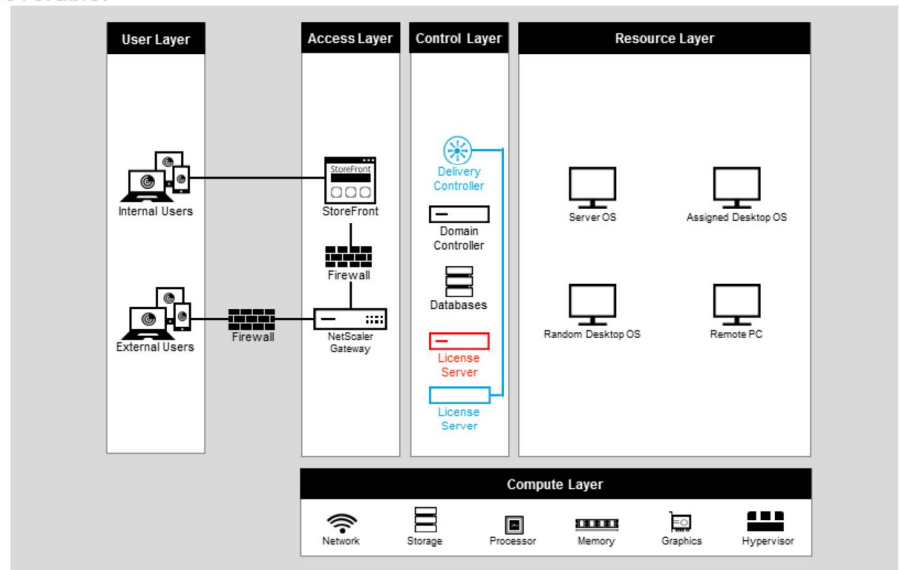
- Citrix License Check Utility - <http://support.citrix.com/article/CTX123935>
- Citrix Director 7.6 Deep Dive Part 1: License Monitoring - <https://www.citrix.com/blogs/2014/10/10/citrix-director-7-6-deep-dive-part-1-license-monitoring/>
- License Server Technical overview - <https://docs.citrix.com/en-us/licensing/11-14/technical-overview.html>

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License Server Failure

When the Citrix License Server is unrecoverable:

- Restore the machine from backup.
- Set up a new license server with the same name and upload the license files.
 - Re-download the license files from MyCitrix
- When the new license server is active, XenApp and XenDesktop exit the grace period and users can connect to their resources again.



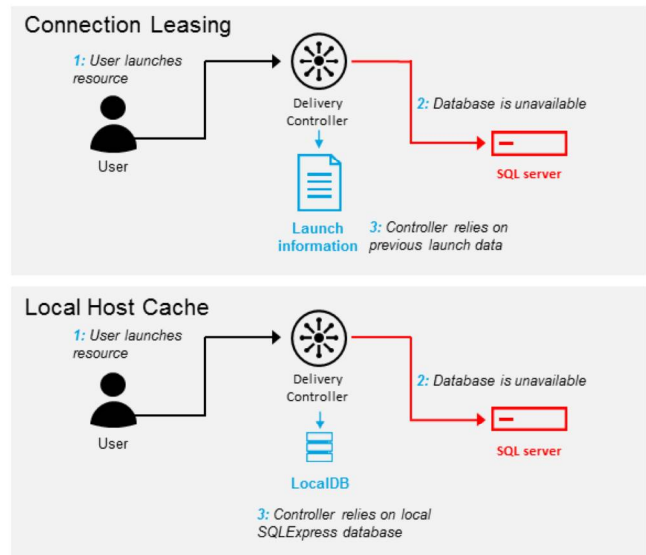
Key Notes:

- Customers who virtualize the Citrix License Server are provided with a redundant solution that allows for mobility between multiple physical servers without the need for down time.

Database Server Failure

When the database server for a site fails:

- The site cannot be managed, Studio and PowerShell cmdlets fail.
- VDAs will not be power managed.
- Established sessions continue to run.
- One of two features can be used to continue brokering:
 - Connection Leasing allows connection to certain resources based on cached launch information.
 - Local Host Cache allows connection to certain resources based on a local SQLExpress replica of the site database.



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Key Notes:

- All information is stored in the Site configuration database; Delivery Controllers communicate only with the database and not with each other. A Controller can be unplugged or turned off without affecting other Controllers in the Site. This means, however, that the Site configuration database forms a single point of failure. If the database server fails, existing connections to virtual desktops will continue to function until a user either logs off or disconnects from a virtual desktop. New connections can only be established if connection leasing or Local Host Cache is enabled.
- The Local Host Cache (LHC) feature allows connection brokering operations in a XenApp or XenDesktop Site to continue when an outage occurs. An outage occurs when:
 - The connection between a Delivery Controller and the Site database fails in an on-premises Citrix environment.
 - The WAN link between the Site and the Citrix control plane fails in a Citrix Cloud environment.
- Local Host Cache is the most comprehensive high availability feature in XenApp and XenDesktop. It is a more powerful alternative to the connection leasing feature that was introduced in XenApp 7.6.
- Local Host Cache has certain limitations when active, when the Site database is inaccessible or otherwise in a failed state:
 - You cannot use Studio or run PowerShell cmdlets.
 - Hypervisor credentials cannot be obtained from the Host Service. All machines are in the unknown power state, and no power operations can be issued. However, VMs on the host that are powered-on can be used for connection

requests.

- Machines with VDAs in pooled Delivery Groups that are configured with "Shut down after use" are placed into maintenance mode.
- Anonymous session launch requests are rejected.
- An assigned machine can be used only if the assignment occurred during normal operations. New assignments cannot be made during an outage.
- Automatic enrollment and configuration of Remote PC Access machines is not possible. However, machines that were enrolled and configured during normal operation are usable.
- Server-hosted applications and desktop users may use more sessions than their configured session limits, if the resources are in different zones.
- Connection Leasing has certain limitations when active, when the Site database is inaccessible or otherwise in a failed state:
 - Desktop Studio and Desktop Director operations are unavailable.
 - Citrix PowerShell cmdlets requiring database access will not work.
 - No VDA load balancing will occur.
 - Users can only connect to the last host they connected to when the site database was available.
 - There is a small window (2 minutes) during which no sessions will be brokered when the site database becomes unavailable or is restored. This is to allow for environments with SQL HA enabled to fail over, such that leasing does not become enabled when there is only a short window where site database connectivity is interrupted.
 - Users must have logged on to the resources within the default 14 day period. This can be configured via a registry setting.
 - Anonymous users are not supported by Connection Leasing.

Additional Resources:

- High availability - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/technical-overview/databases.html>

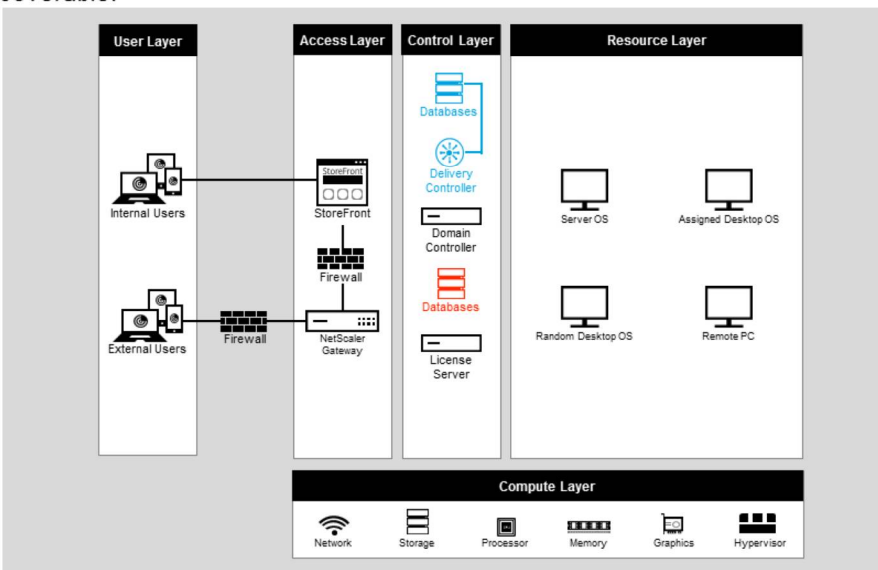
Database Server Failure

When the failed database server is unrecoverable:

- Set up a new database server and restore the database from backup
- Restore all Controller services to point to new database server

If no database backup can be restored:

- Rebuild the site manually
- Create new Catalogs from Master image
- Create new Delivery Groups
- Ensure name consistency



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Key Notes:

- Citrix recommends that you back up the database regularly so that you can restore from the backup if the database server fails. In addition, there are several high availability solutions to consider for ensuring automatic failover:
 - SQL Mirroring — This is the recommended solution. Mirroring the database makes sure that, should you lose the active database server, the automatic failover process happens in a matter of seconds, so that users are generally unaffected. This method, however, is more expensive than other solutions because full SQL Server licenses are required on each database server; you cannot use SQL Server Express edition for a mirrored environment.
 - Using the hypervisor's high availability features — With this method, you deploy the database as a virtual machine and use your hypervisor's high availability features. This solution is less expensive than mirroring as it uses your existing hypervisor software and you can also use SQL Express. However, the automatic failover process is slower, as it can take time for a new machine to start for the database, which may interrupt the service to users.
 - SQL Clustering — The Microsoft SQL clustering technology can be used to automatically allow one server to take over the tasks and responsibilities of another server that has failed. However, setting up this solution is more complicated, and the automatic failover process is typically slower than with alternatives such as SQL Mirroring.
 - AlwaysOn Availability Groups – This is an enterprise-level high-availability and

disaster recovery solution introduced in SQL Server 2012 to enable you to maximize availability for one or more user databases. AlwaysOn Availability Groups requires that the SQL Server instances reside on Windows Server Failover Clustering (WSFC) nodes.

Additional Resources:

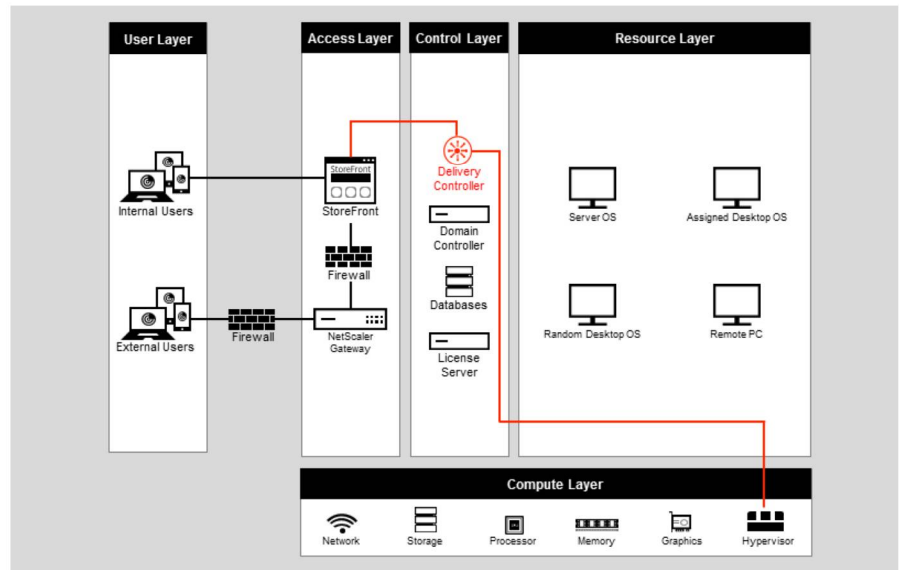
- High Availability - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/technical-overview/databases.html>

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Delivery Controller Server Failure

When the Delivery Controller Server Fails:

- The site becomes unmanageable.
 - No Power Management actions on VDAs
 - Studio and PowerShell cmdlets fail
 - Director cannot be used
- Receiver / StoreFront will not enumerate or launch resources for users.
- Established sessions continue to run.



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Key Notes:

- When the last Delivery Controller in a site fails, no new user connections or reconnections can be made.

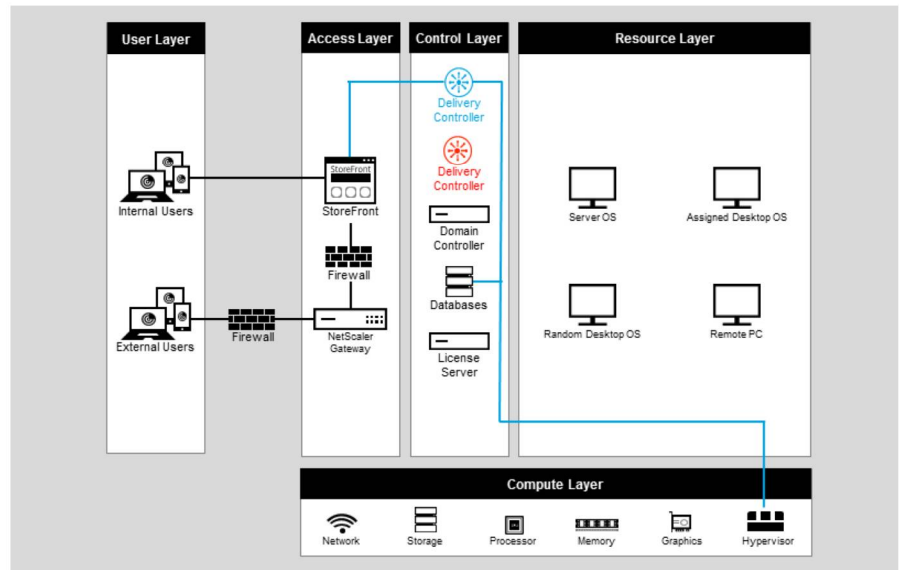
Additional Resources:

- How to Implement Disaster Recovery in XenDesktop and XenApp - https://docs.citrix.com/content/dam/docs/en-us/solutions/assess/downloads/XAXD_Disaster_Recovery.pdf

Delivery Controller Server Failure

When the Delivery Controller Server is unrecoverable:

- Set up a new Controller and use PowerShell to join the existing Site defined in the database.
- Instruct all VDAs to register with the new Controller.
 - If the new Controller reuses the DNS name of the failed machine, the VDAs will register automatically.
- Use Group Policy to direct VDAs to the new Controller's name.



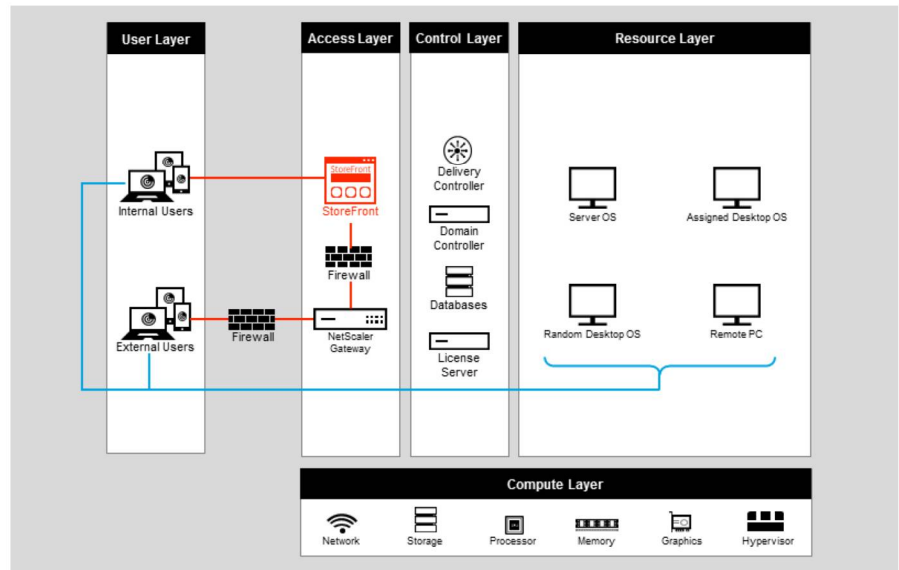
Key Notes:

- When the no operational Delivery Controllers are left in the Site, the only way to recover the Site is to manually add a Delivery Controller through PowerShell.

StoreFront Server Failure

When the StoreFront Server Fails:

- Users are unable to authenticate over the web or Receiver.
- Receiver / StoreFront will not enumerate or launch resources for users.
- Established sessions continue to run.



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Key Notes:

- Although it is likely that a single StoreFront instance could support your XenApp and XenDesktop workload, failover and redundancy are still crucial to maintaining on-demand access. If XenApp and XenDesktop session traffic is routing through a single StoreFront server that suddenly fails, any new connections to the XenApp and XenDesktop applications and desktops will be unavailable. However, it should be mentioned that a StoreFront failure will not impact any existing active XenApp and XenDesktop sessions. Thus, Citrix highly recommends deploying two StoreFront servers to eliminate any possibilities of a single point of failure that may disrupt productivity, and configuring the IP address or DNS name of one Controller in each Site. To streamline the management of multiple StoreFront servers, Citrix has provided a single admin interface from which you can manage all the servers in your StoreFront cluster.
- To make implementation even more robust, Citrix NetScaler can be configured to load balance user requests between the multiple StoreFront instances as well as monitor their availability.

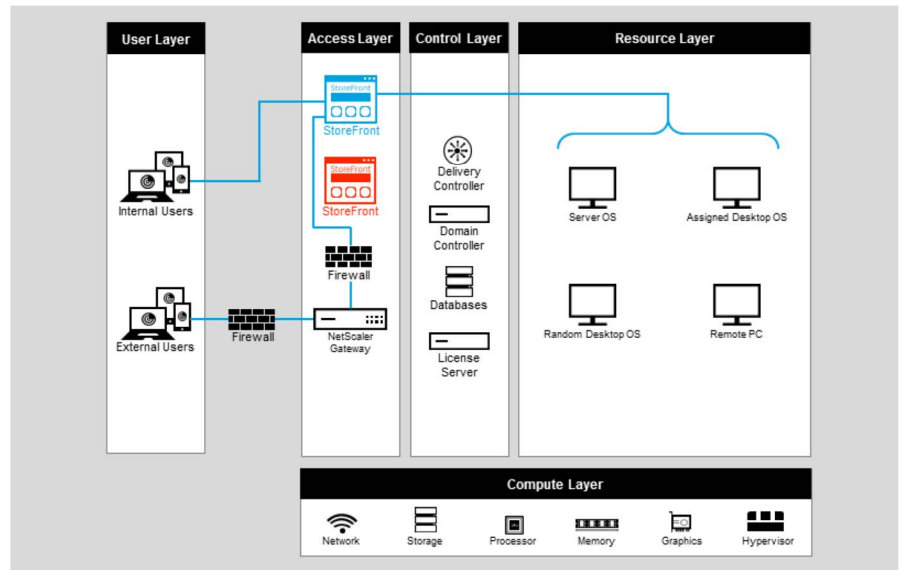
Additional Resources:

- Design considerations for Citrix StoreFront: Responding to challenges in the mobile age - https://www.citrix.com/content/dam/citrix/en_us/documents/oth/design-considerations-for-citrix-storefront.pdf

StoreFront Server Failure

When the StoreFront Server is unrecoverable:

- Set up a new StoreFront server re-using the DNS name of the failed StoreFront server and configure:
 - Base URL
 - Encryption settings
 - Authentication settings
 - Delivery Controller settings
 - Customization settings
 - Remote Access settings

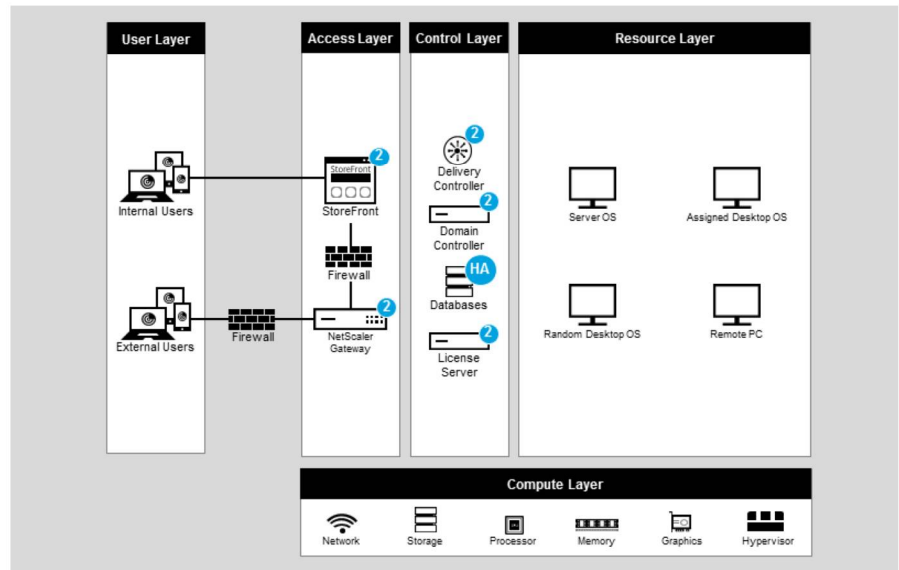


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Redundancy

Depending on the deployment, some components of a XenApp and XenDesktop Site are a “single point of failure”.

To protect against Site-wide outages due to a single failing component, plan for redundancy.



Key Notes:

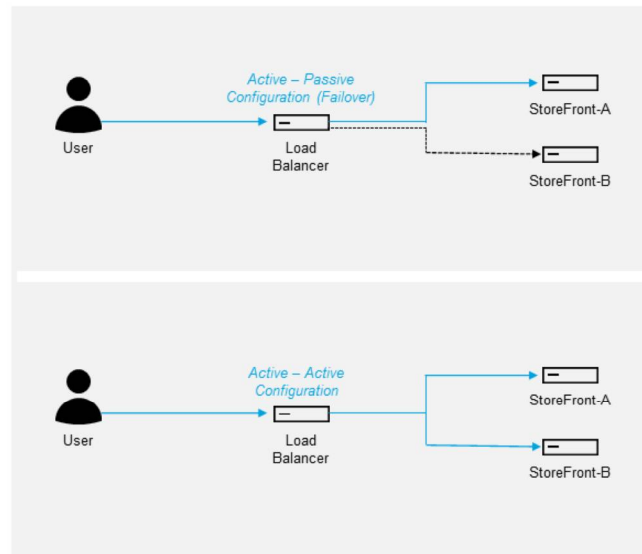
- Redundancy can come in different forms, but mostly means duplicated systems, connections etc. so that the loss of a single component can be compensated without threatening the performance of the complete site.

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Redundancy Performance Gains

Redundancy not only protects from outages, but sometimes offers more performance or better scalability than singular systems.

- Active-passive or failover configurations only protects against loss of functionality.
- Active-active configurations use multiple systems simultaneously or alternating and gain performance by distributing load across available systems.



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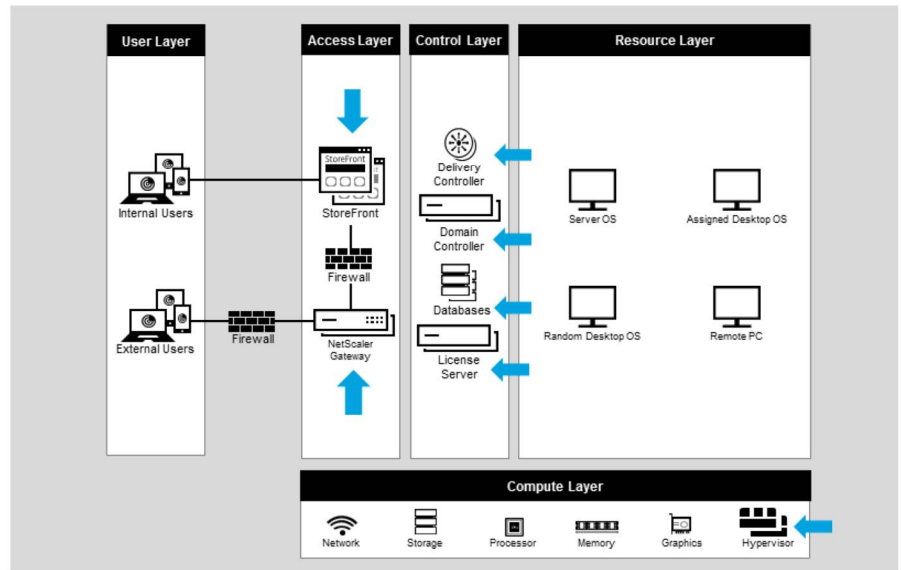
Key Notes:

- Most load balancing systems (like Citrix NetScaler) offer many different load balancing mechanisms as well as some performance gains by eliminating overhead, caching requests etc.
- Although the focus of the slide is on active-passive vs. active-active redundancy configurations, note that the diagram shows only one load balancer, which is a single point of failure. Typically, we would want to address this by adding redundancy to the load balancer as well. For example, Citrix NetScaler can be configured as an HA pair.
- Adding even more redundant systems can offer even more speed but typically offer diminishing returns with each additional machine.

How much Redundancy is needed?

The main components of a Site need to be redundant:

- 2x StoreFront Server
- 2x Controller Server
- HA Database Server
- 2x License Server (if grace period is not acceptable)
- 2x NetScaler (recommended)



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What happens if the Site database is unavailable?

Key Notes:

- The Controllers will either enter Connection Leasing mode or fail over to Local Host Cache, depending on what is configured.
- For Connection Leasing: Only users that have previously launched resources within the last 14 days (by default) can successfully be brokered. Pooled VDI is not supported.
- For Local Host Cache: All brokering will be handled by one single Delivery Controller.
- For both: Studio and Director cannot start and the PowerShell API cannot be used.

Lesson Objective Review

Scenario: You are the Citrix Admin and your manager is asking you to install a single StoreFront server on a Microsoft Failover Cluster to ensure availability of this role.

Would a Microsoft Failover Cluster be the right solution?

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Lesson Objective Review

Scenario: You are the Citrix Admin and your manager is asking you to install a single StoreFront server on a Microsoft Failover Cluster to ensure availability of this role.

Would a Microsoft Failover Cluster be the right solution to host StoreFront?

No. StoreFront is designed to synchronize configuration data between multiple servers. Use NetScaler to ensure the connections are load balanced.

Key Notes:

- StoreFront has scalability built in to the architecture and does not rely on clustering technologies.
- However, StoreFront is relying on NetScaler to distribute the incoming client connections and mitigate in case of failures.

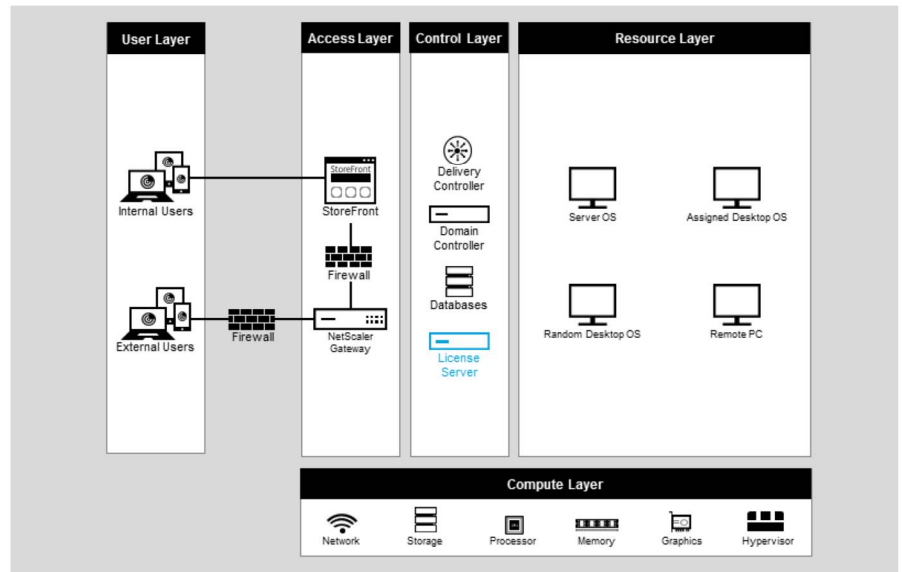


Methods of Redundancy

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Citrix License Server Redundancy

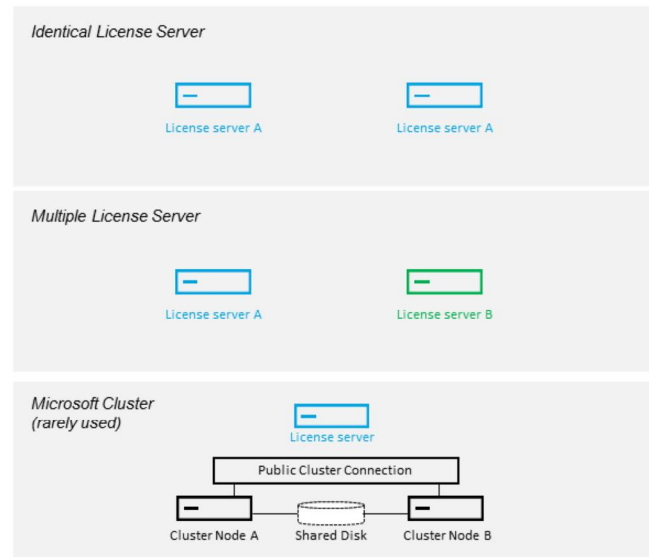


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Citrix License Server Redundancy Options

Depending on deployment and budget, a few options for creating redundancy apply to the Citrix License Server:

- Identical License Server
- Multiple License Servers
- Microsoft Cluster (rarely used)



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Additional Resources:

- Clustered license servers: <https://docs.citrix.com/en-us/licensing/11-14/clustered-license-servers.html>

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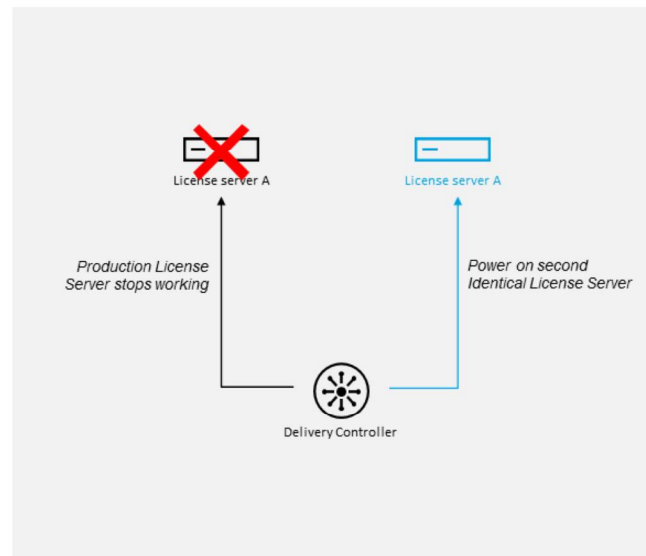
Identical License Server

Create a second identical license server, that will only be powered up if the first license server has failed.

This method incurs some downtime for detection of the failure and startup of the second server.

To create an identical license server, use:

- Cloning technology
- Snapshots
- Scripted installation



Key Notes:

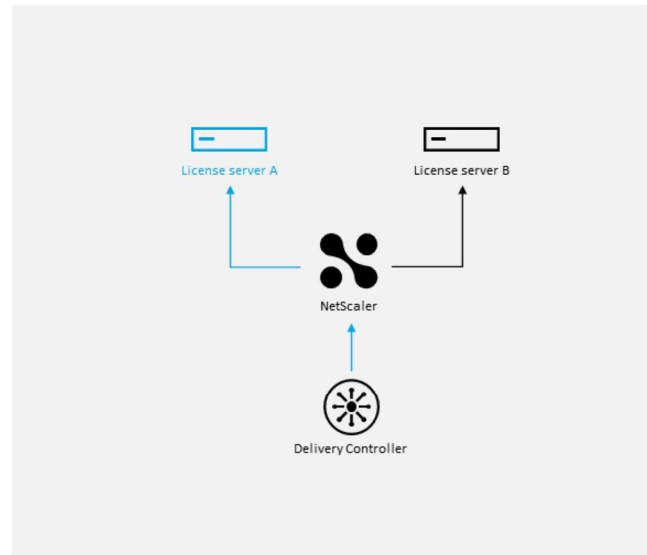
- This might cause problems with the AD account of the “cloned” server. The first server might have changed the AD computer account password in the meantime.
- Two machines claiming the same name or ID will cause a conflict and have to be separated at all times. So, additional caution needs to be applied to ensure the failed machine does not try to resume its original role.

Multiple License Servers

To protect against License Server failures using multiple servers:

1. Create two live license servers with the same name (not domain joined).
2. Use NetScaler to setup active-passive traffic load balancing.

This method usually does not cause any downtime.



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Key Notes:

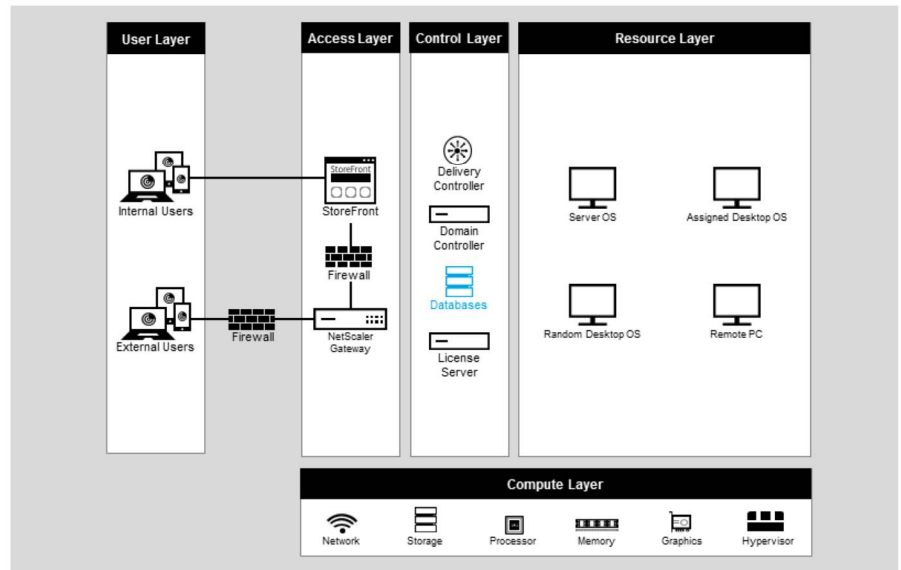
- Both license servers must not be issuing licenses at the same time because of EULA restrictions.

Additional Resources:

- Making the Citrix License Server (Truly) Highly Available - <https://www.citrix.com/blogs/2015/02/12/making-the-citrix-license-server-truly-highly-available/>

Site Database Server Redundancy

Introduction to Database Redundancy

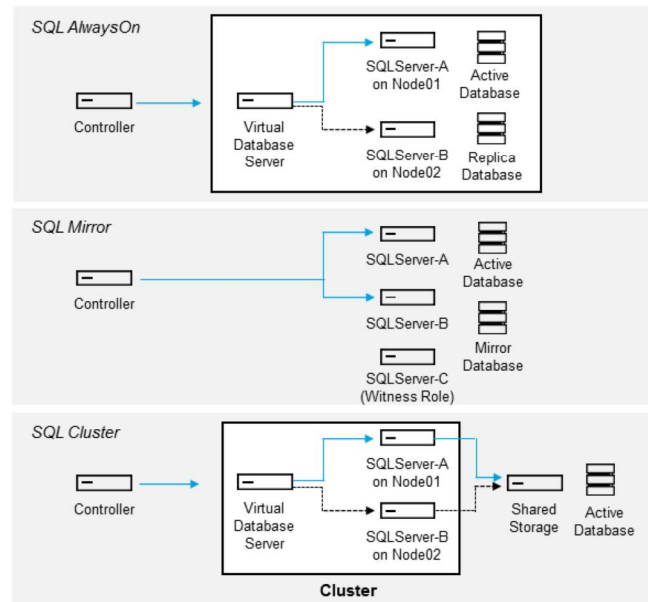


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Site Database Server Redundancy Options

The supported database system for XenApp and XenDesktop is Microsoft SQL Server which offers several redundancy options by design:

- SQL AlwaysOn
- SQL Mirror
- SQL Cluster



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Key Notes:

- This slide shows all three database redundancy options side by side; the next three slides will go into detail about each solution.

Additional Resources:

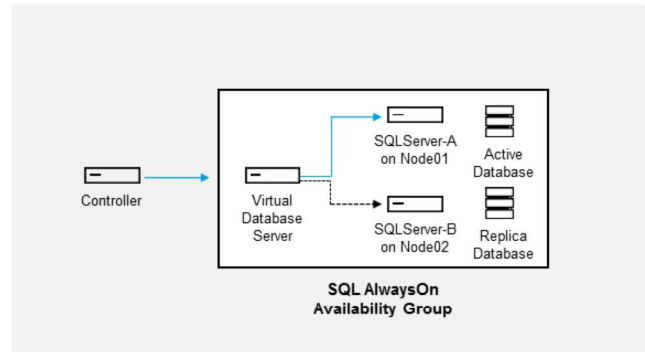
- Supported Databases for XenApp and XenDesktop Components - <http://support.citrix.com/article/CTX114501>

SQL AlwaysOn

Microsoft SQL AlwaysOn is a method of keeping databases in sync across different locations and providing failover capabilities.

This method:

- Relies on Microsoft Failover Clustering components.
- Does not require shared storage (SAN).
- Allows for some performance improvement.
- Uses up to four replica servers (SQL2012).



Key Notes:

- Replica servers have been called mirror servers – some administrators might be more familiar with this term.
- The replica servers can be used to speed up read access to the database, while all write actions have to be performed on the active database.

Additional Resources:

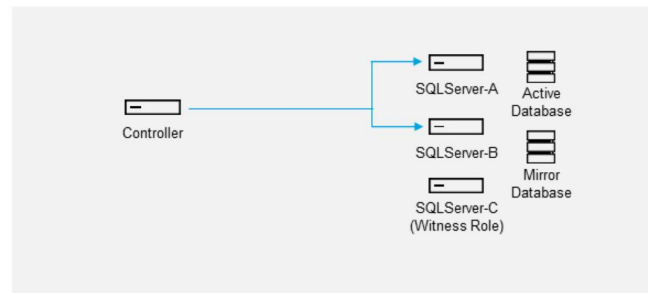
- Always On Availability Groups (SQL Server) - <https://msdn.microsoft.com/en-us/library/hh510230.aspx>

SQL Mirroring

Microsoft SQL Mirroring keeps a database in sync across two servers. Only one server is used for active connections, but the other can assume its role after failure.

This method:

- Requires a Witness server for parity and automatic failover.
- Only uses one mirror to a principal server.
- Does not require shared storage (SAN).



Key Notes:

- The Witness server can be a different SQL Server edition than the principal and mirror servers.
- SQL Server 2016 and the next version still officially support this feature, but since Microsoft deemed the technology deprecated, it will most likely be removed in a future SQL Server version.

Additional Resources:

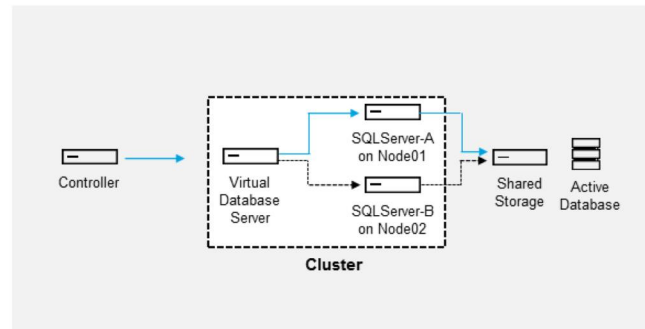
- Deprecated Database Engine Features in SQL Server 2016 - <https://msdn.microsoft.com/en-us/library/ms143729.aspx>

SQL Clustering

A Microsoft Failover Cluster stores the database on a shared storage system which is accessed by a single, active node from the cluster.

This method:

- Requires shared storage (SAN).
- Can cause downtime during failover.



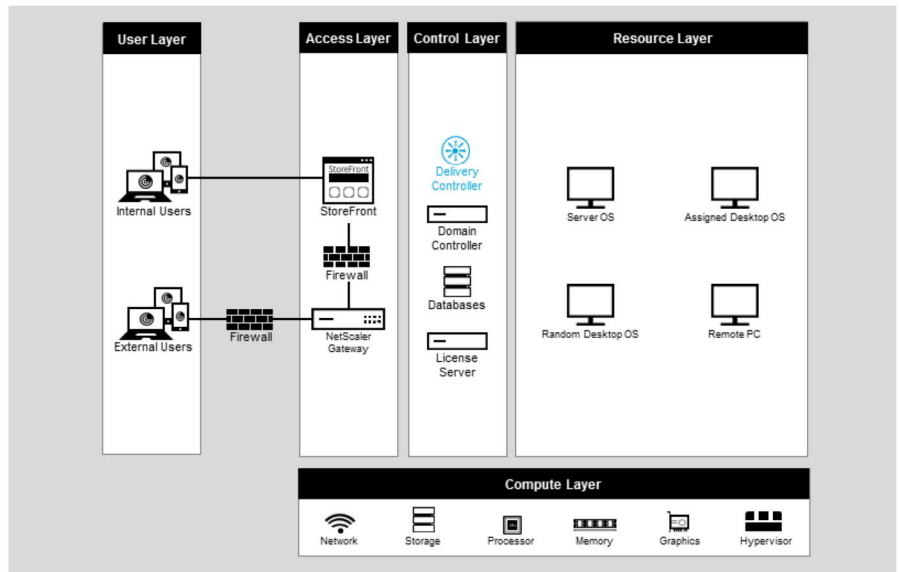
Key Notes:

- The shared storage architecture requires management and redundancy as well – which might make this solution more costly than others.

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Delivery Controller Server Redundancy

Introduction to Controller Redundancy



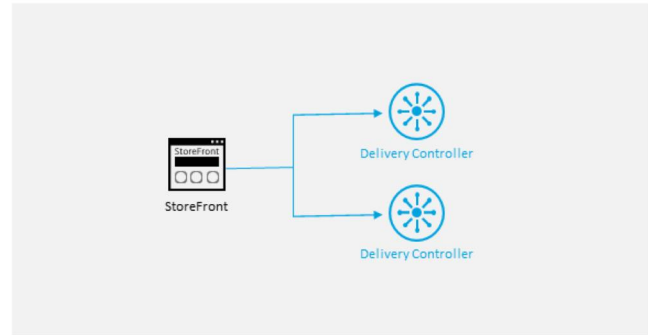
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Delivery Controller Server Redundancy Options

Citrix Delivery Controller servers can assume the required roles within a Site automatically and can be used interchangeably.

To create redundancy for the Controllers:

- Set up a second Controller and join it to the Site of the first Controller.
- Direct dependant systems (Studio, StoreFront, NetScaler, VDAs) to both Controllers.



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Which SQL Server redundancy options are available?

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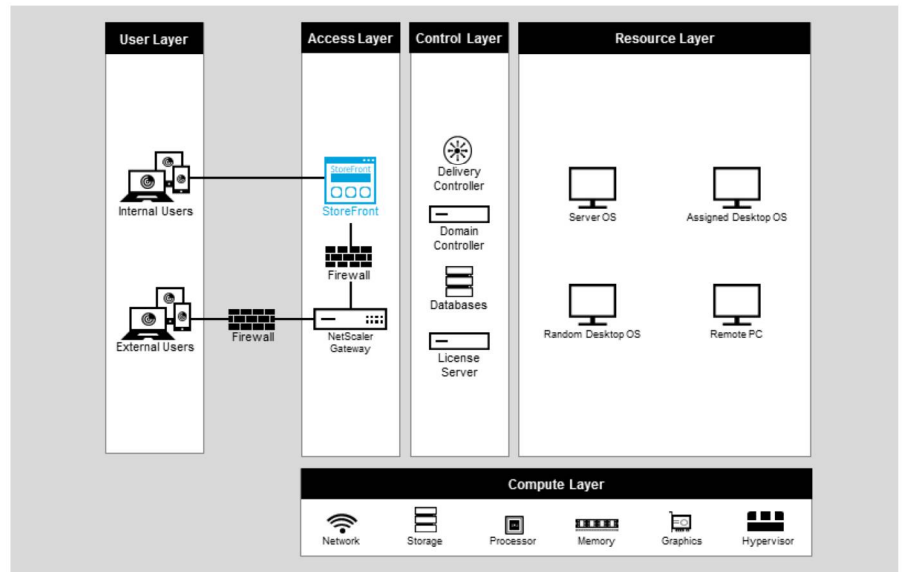
Lab Exercise

- Exercise 11-1: Install the Second Delivery Controller Server
 - Option 1: Step-by-Step using the Command Prompt
 - Option 2: [Step-by-Step using the GUI](#)
- Exercise 11-2: Join the Second Delivery Controller to the Site
 - Option 1: Step-by-Step using Power Shell
 - Option 2: [Step-by-Step using Studio](#)

Choose between [easy](#) or advanced.
- Exercise 11-3: Configure and Test Local Host Cache

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StoreFront Server Redundancy

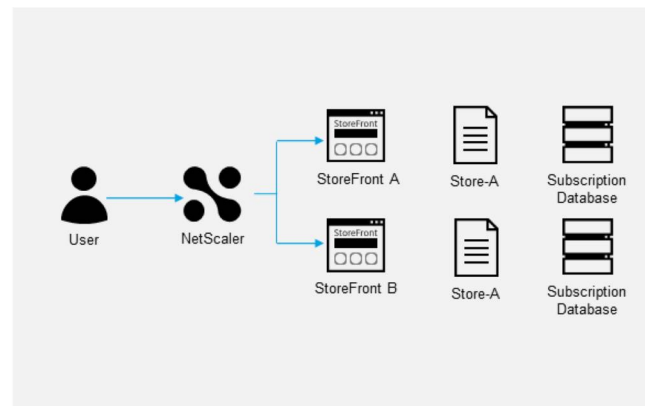


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StoreFront Server Redundancy Options

Aggregate multiple StoreFront servers to a Server Group to provide redundant access to the same stores.

This setup requires the servers to share a common base URL and be load balanced.



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Key Notes:

- Citrix recommends NetScaler as the load balancing solution for StoreFront.

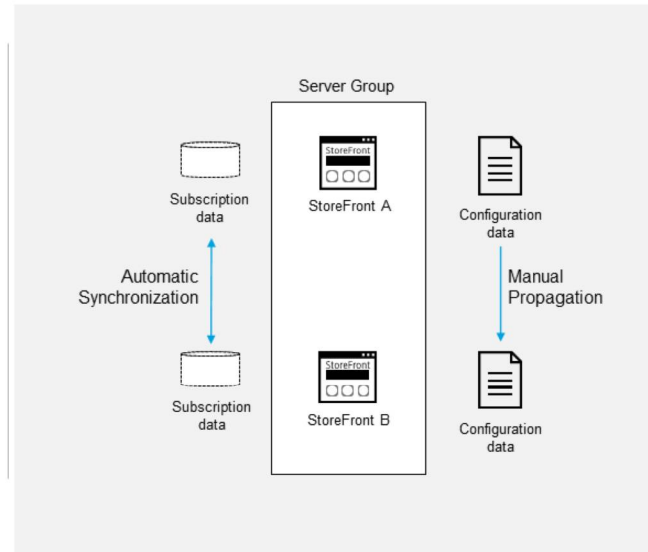
Additional Resources:

- StoreFront high availability - <https://docs.citrix.com/en-us/storefront/3-8/plan/high-availability-and-multi-site-configuration.html>
- Configure server groups - <https://docs.citrix.com/en-us/storefront/3-8/configure-server-group.html>
- Load balancing with NetScaler - <https://docs.citrix.com/en-us/storefront/3-8/integrate-with-netscaler-and-netscaler-gateway/load-balancing-with-netscaler.html>

Server Groups

All servers within a StoreFront Server Group use the same configuration.

- Configuration changes need to be propagated manually.
 - Custom scripts and layout customizations will be replicated.
- Synchronization of the subscription database occurs automatically in the background between all servers.



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Key Notes:

- Whenever a configuration change has been done on a StoreFront server within a server group, the changes must be propagated to the other servers in the group.
- It is recommended to designate one server to making changes and keep the rest of the StoreFront servers “passive partners”.
- Synchronizing changes back and forth might corrupt the configuration.

Additional Resources:

StoreFront high availability - <https://docs.citrix.com/en-us/storefront/3-8/plan/high-availability-and-multi-site-configuration.html>

Configure server groups - <https://docs.citrix.com/en-us/storefront/3-8/configure-server-group.html>

Server Groups Considerations



When enabling multiple StoreFront servers in a server group:

- A load balancer is required
- Manual propagation of configuration data is required
- Base URL must be updated
- Subscription replication uses TCP port 808

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Key Notes:

- Based on simulated activity where users log on, enumerate 100 published applications, and start one resource, expect a single StoreFront server with the minimum recommended specification of two virtual CPUs running on an underlying dual Intel Xeon L5520 2.27Ghz processor server to enable up to 30,000 user connections per hour.
- Expect a server group with two similarly configured servers in the group to enable up to 60,000 user connections per hour; three nodes up to 90,000 connections per hour; four nodes up to 120,000 connections per hour; five nodes up to 150,000 connections per hour; six nodes up to 175,000 connections per hour.

Additional Resources:

StoreFront high availability - <https://docs.citrix.com/en-us/storefront/3-8/plan/high-availability-and-multi-site-configuration.html>

Configure server groups - <https://docs.citrix.com/en-us/storefront/3-8/configure-server-group.html>

Load balancing with NetScaler - <https://docs.citrix.com/en-us/storefront/3-8/integrate-with-netscaler-and-netscaler-gateway/load-balancing-with-netscaler.html>



Which other systems need to be configured for redundancy in your environments?

Key Notes:

- Email system, file server (profiles), telephony, web gateway, remote access, proxy, AV controller, storage, hypervisor, domain controller, backend databases used for line of business applications, print server, etc.

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Lab Exercise

- Exercise 11-4: Install the Second StoreFront Server
- Exercise 11-5: Join the Second StoreFront Server to the Server Group
- Exercise 11-6: Edit the Store to Add the Second Delivery Controller
- Exercise 11-7: Configure Load Balancing of the StoreFront Servers
- Exercise 11-8: Test the Load Balancing of the StoreFront Servers

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Lesson Objective Review

Scenario: You are the Citrix Admin and your manager is asking which SQL HA options Citrix XenApp and XenDesktop support.

What do you tell him?

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Lesson Objective Review

Scenario: You are the Citrix Admin and your manager is asking which SQL HA options Citrix XenApp and XenDesktop support.

What do you tell him?

SQL AlwaysOn

SQL Mirror

SQL Cluster

Key Notes:

- XenApp and XenDesktop offers to install SQL Express during install. This version does not support any form of SQL HA.

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Key Takeaways



- Not accounting for single points of failure can cost downtime and a bad user experience.
- All components in a XenApp and XenDesktop solution support HA either through Microsoft technologies or through the use of NetScaler.

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XenApp and XenDesktop Administration

XenApp and XenDesktop Basic Security Considerations

Module 12



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The following VMs are required to be powered on before beginning the exercises in this module:

- NYC-ADS-001
- NYC-SQL-001
- NYC-FSR-001
- NYC-VNS-001
- NYC-NIC-001
- NYC-XDC-001
- NYC-XDC-002
- NYC-STF-001
- NYC-STF-002
- NYC-SRV-001
- NYC-WRK-001

The remaining VMs need to be powered off.

Note: These VMs are listed in the start-up order.



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Learning Objectives

- Introduce the Citrix Admin security considerations
- Discuss the functionality of the Certificate Authority
- Determine XML service security considerations
- Examine external HDX connection security

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Citrix Admin Security Considerations

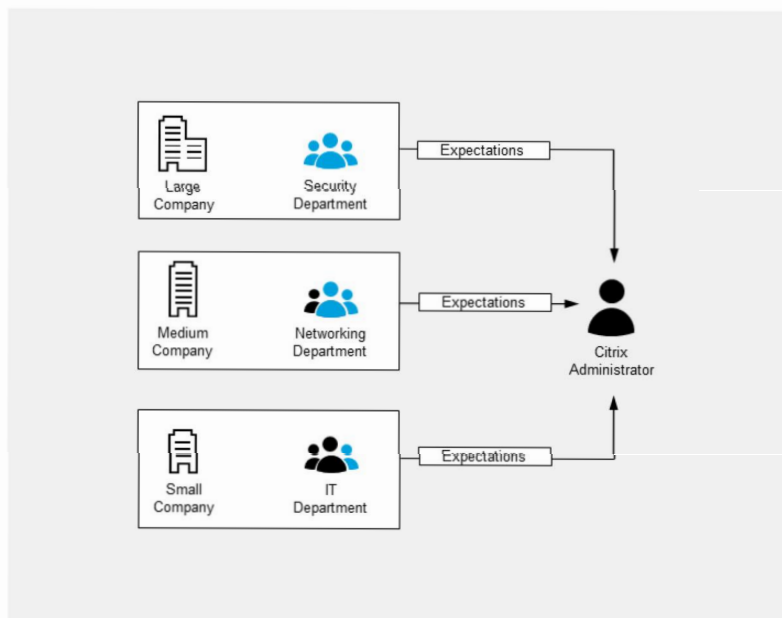
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General Network Security Expectations

While larger companies usually have a dedicated security department, security personnel in smaller companies might have additional roles in the company.

They expect the Citrix Administrator to secure new Citrix components of a deployment.

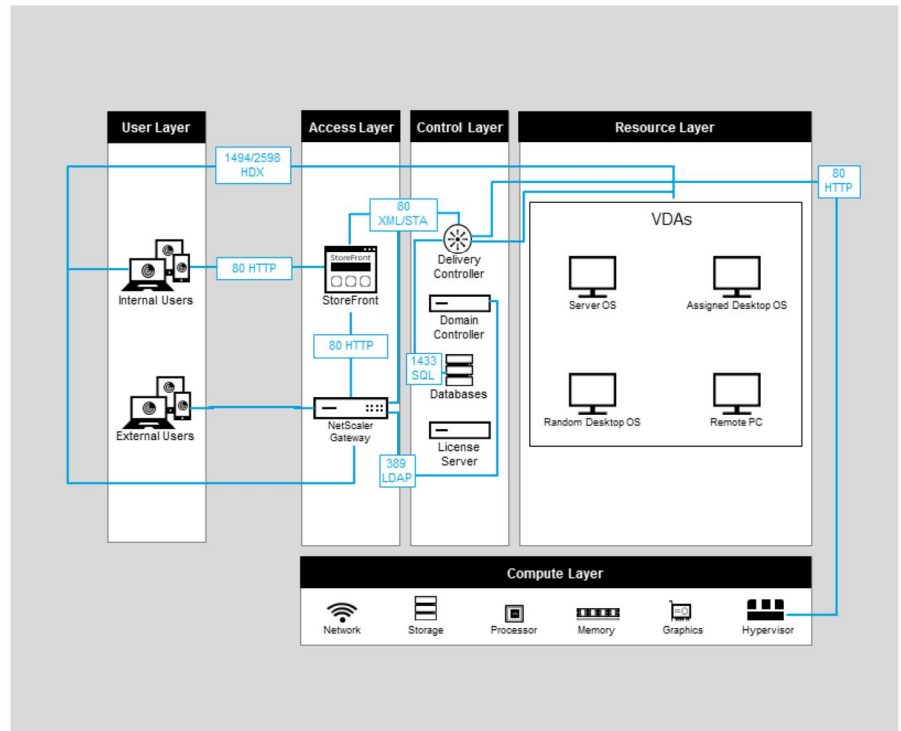


Key Notes:

- While large organizations have a dedicated security team in charge of all security concerns, smaller companies might leave some of these concerns with the individual Citrix Admin.
- As a Citrix Admin, it is important to be aware of the expectations from the organization as well as being aware of the different security mechanisms that can be implemented in the Citrix environment.

Network Topology Security

- XenApp and XenDesktop network communication is not secured by default.
- The network connections in the diagram suggest possible unsecured communication ports in a default XenApp and XenDesktop environment.
- All highlighted network connections can be secured.



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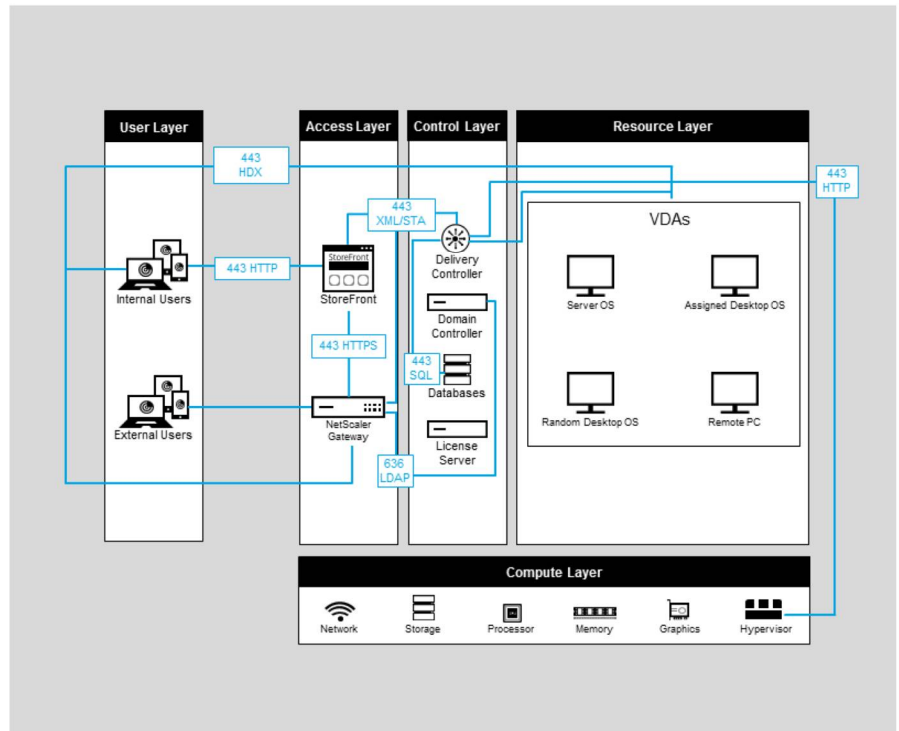
Key Notes:

- The diagram serves as a high level overview; use it to investigate all the possibilities of creating a more secure solution.
- Some companies allow internal access only, so securing internal components also requires blocking external access.
- Some companies require security for all external facing components while only using basic security for internal components.



Network Topology Security

- Network communication is not secured by default.
- The network connections in the diagram suggest possible unsecured communication ports in a default XenApp and XenDesktop environment.
- All highlighted network connections can be secured.



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Key Notes:

- This slide presents the same view as the previous one, but with security measures implemented.

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Lesson Objective Review

Scenario: You are the Citrix Administrator at a large corporation and you have just created a Proof of Concept XenApp and XenDesktop installation without adding SSL/TLS certificates.

Your manager tasks you to secure the solution.

Which team should you contact to obtain assistance for SSL/TLS certificates?

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Lesson Objective Review

Scenario: You are the Citrix Administrator at a large corporation and you have just created a Proof of Concept XenApp and XenDesktop installation without adding SSL/TLS certificates.

Your manager tasks you to secure the solution.

Which team should you contact to obtain assistance for SSL/TLS certificates?

Typically the Security or the Network Department.

Key Notes:

- Typically in larger organizations the Citrix Admin does not have permission to create and obtain certificates needed to secure a deployment.

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Certificate Authority

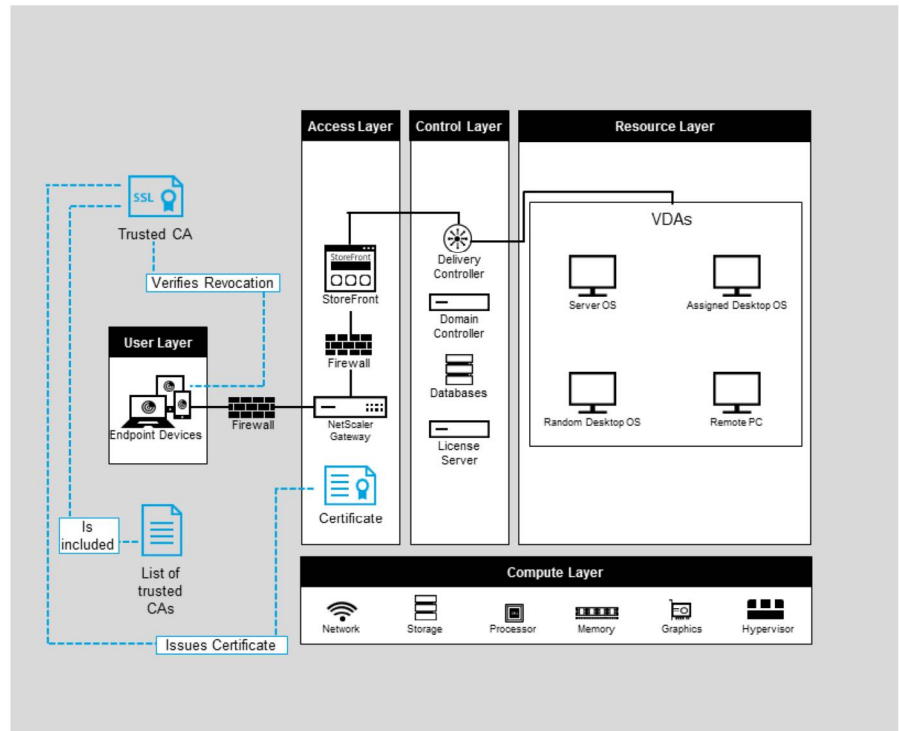
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Public Certificate Authorities

Following general IT leading practices:

- Use certificates from publicly available trusted Certificate Authorities (CA) to secure network connections.
- Keep private key secured.
- Intermediate certificates may be required.



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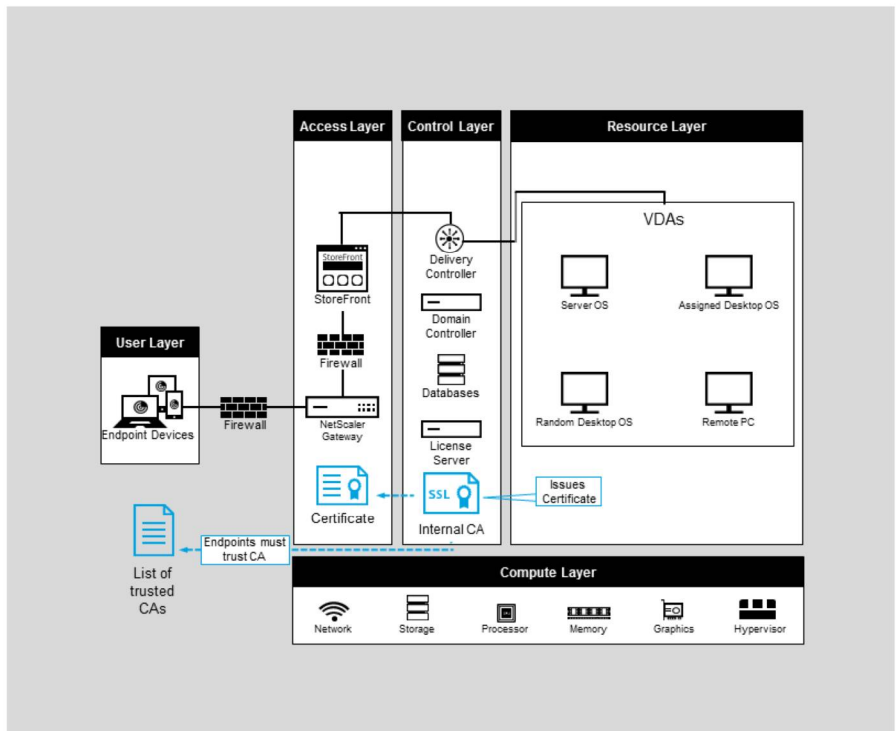
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Key Notes:

- Using certificates from public CAs often does not require additional management on client devices, since the public CAs are already included in their built in list of trusted certificate authorities.

Private Certificate Authorities

- For use within companies or managed environments.
- Use internal or private CAs to issue certificates.
- Add the internal CA to the list of trusted CAs.
- Citrix also supports the use of self-signed certificates.



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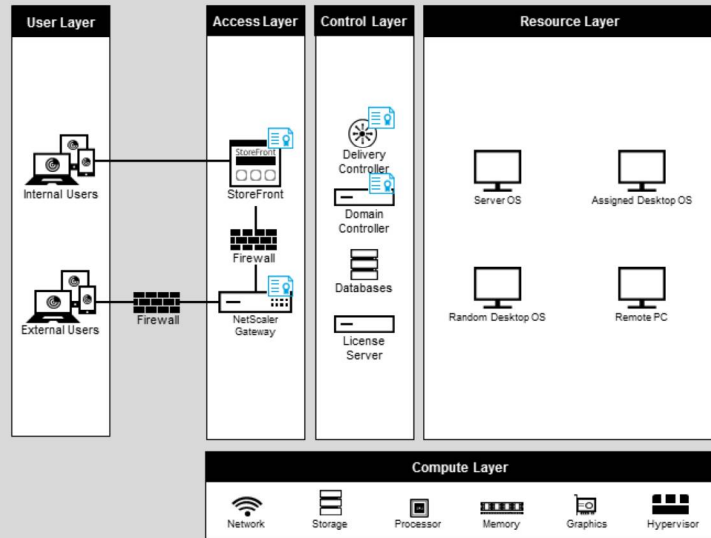
Key Notes:

- Private (or internal) CAs are often used for domains that cannot be verified (company.local or company.intranet) and can reduce the cost compared to certificates from public CAs.
- An additional benefit for hosting a private CA is the complete control over certificate management – but this also comes with the responsibility for protecting the CA against attacks or compromise.
- Self-signed certificates do not require a CA. In fact, the certificate is signed using its own private key. By design, such certificates cannot be revoked if compromised which is a large drawback. Self-signed certificates also lack central management, which is often a requirement for larger organizations.

WW Labs Deployment

The following machines in the lab use certificates:

- Domain Controller
- StoreFront
- Delivery Controller
- NetScaler Gateway



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Key Notes:

- The most common parts of the solution have been assigned certificates within the lab.
- More components could be secured in a production environment.

Lesson Objective Review

Scenario: You are the Citrix Admin and you have decided to implement self-signed certificates from the Domain CA to the StoreFront servers.

Domain joined Windows computers are able to connect to StoreFront but Mac computers receive a certificate error.

What could be wrong?

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Lesson Objective Review

Scenario: You are the Citrix Admin and you have decided to implement self-signed certificates from the Domain CA to the StoreFront servers.

Domain joined Windows computers are able to connect to StoreFront but Mac computers receive a certificate error.

What could be wrong?

The Mac computers do not trust the internal CA.

Key Notes:

- Domain-joined PCs will trust a domain CA based on their membership to the domain.
- Mac computers will need to trust the CA manually or by use of a management system.
- Using a public CA-signed certificate for StoreFront may be a better solution in order to support various device types.



XML Service Security Considerations

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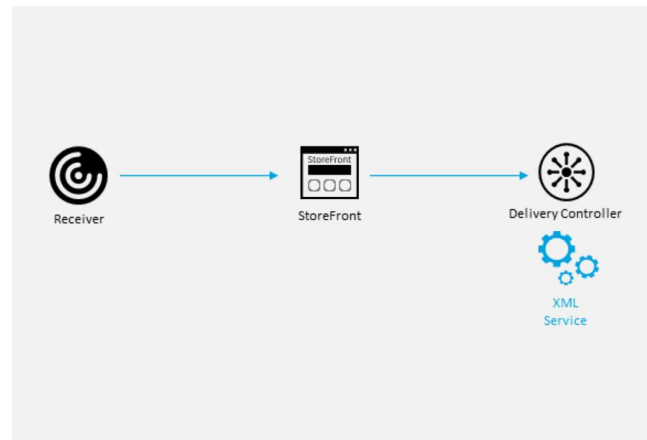
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XML Service Trust Introduction

The Citrix XML Service:

- Is used to exchange information between NetScaler, StoreFront and the Delivery Controller in XML format.
- Hosted on each Controller as a subservice of BrokerService.
- Listens on port 80 and 443 by default.
- Can share its port with Microsoft Internet Information Server (IIS).

Some authentication functions require the XML service to be trusted; this is called the XML Service Trust.



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Key Notes:

- The BrokerService also hosts the Secure Ticket Authority (STA) required for remote access.

Additional Resources:

- Securing the XenApp/XenDesktop XML Service:
<https://www.citrix.com/blogs/2016/11/03/securing-the-xenappxendesktop-xml-service-important-steps-to-prevent-theft-of-user-passwords/>

Features requiring XML Service Trust

The following features require the XML Service Trust to be configured:

- Smart Access
- Pass-Through Authentication
- Smart Card Authentication



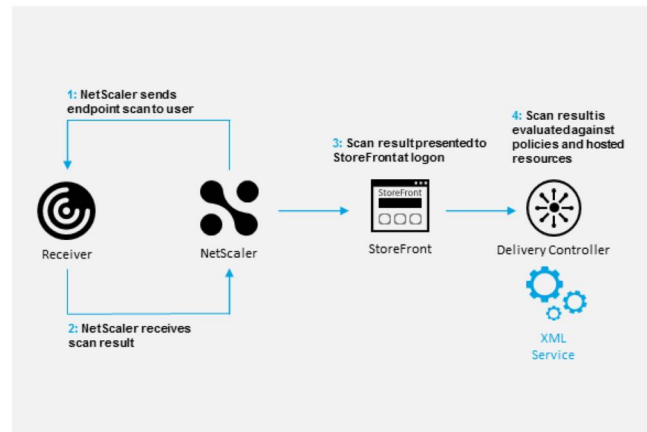
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Smart Access

Smart Access uses NetScaler Gateway Endpoint Analysis to scan endpoint devices.

Based on the results:

- Hosted resources can be restricted to launch.
- Policies can be triggered to adapt to the status of the endpoint device.

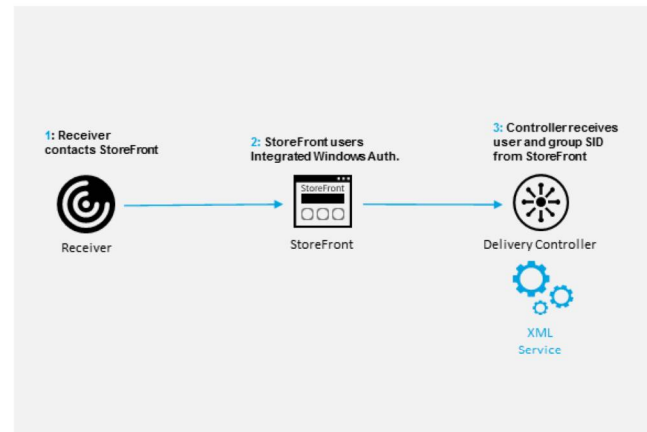


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Pass-Through Authentication

Pass-through authentication enables comfortable logons for users across systems.

Some companies consider this feature to lessen security. Citrix recommends to consult with the persons responsible for company security before implementation.



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Key Notes:

- The slide only covers the first part of the of the Pass-through authentication process.
- At this point, we are only presenting the feature and how it ties in to the XML trust feature.

Additional Resources:

- How to Configure Desktop Pass-Through with Storefront and Receiver: <http://support.citrix.com/article/CTX133855>
- A Comprehensive Guide to Enabling Pass-Through Authentication with XenDesktop: <https://www.citrix.com/blogs/2014/04/11/a-comprehensive-guide-to-enabling-pass-through-authentication-with-xendesktop-7-5/>

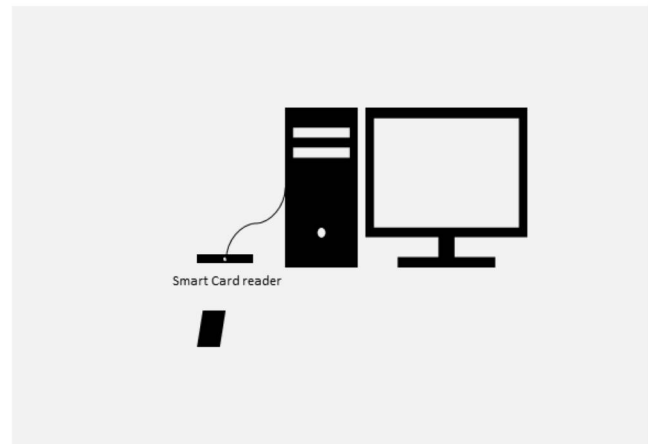
Smart Card Authentication

Smart card authentication is one of many multi-factor authentication types.

Smart cards are typically the same size as a credit card. Some organizations use the same card for physical access to their buildings.

Think of a little plastic card that contains a certificate for a specific user.

This feature requires smart card reader hardware on endpoints and central server configuration.



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How to configure an XML Service Trust

The Citrix XML Service Trust is enabled by using the following PowerShell command:

- Set-BrokerSite -TrustRequestsSentToTheXMLServicePort \$true

```
Administrator: Windows PowerShell
PS C:\> Add-PSSnapin Citrix*
PS C:\> Set-BrokerSite -TrustRequestsSentToTheXMLServicePort $true
PS C:\> get-brokersite

BaseOU :
BrokerServiceGroupId : 420a6bac-6400-4374-a914-7325481f4540
ColorDepth : TwentyFourBit
ConfigLastChangeTime : 1/3/2017 3:30:50 PM
ConfigurationServiceGroupId : 7500bb3f-ee0f-4dc3-98a8-01aeeebce39
ConnectionLeasingEnabled : False
DefaultMinimumFunctionalLevel : L7_9
DesktopGroupIconUid : 1
DnsResolutionEnabled : False
IsSecondaryBroker : False
LicenseEdition : PLT
LicenseGraceSessionsRemaining :
LicenseModel : UserDevice
LicenseServerName : nyc-fsr-001
LicenseServerPort : 27000
LicensedSessionsActive : 0
LicensingBurnIn : 2016.1117
LicensingBurnInDate : 11/16/2016 7:00:00 PM
LicensingGraceHoursLeft :
LicensingGracePeriodActive : False
LicensingOutOfBoxGracePeriodActive : False
LocalHostCacheEnabled : True
MetadataMap : {}
Name : SITE-NewYork
PeakConcurrentLicenseUsers : 1
SecureIcaRequired : False
TotalUniqueLicenseUsers : 4
TrustManagedAnonymousXmlServiceRequests : False
TrustRequestsSentToTheXMLServicePort : True
```

Key Notes:

- Prior to entering the command, the appropriate Citrix PowerShell Snap-In needs to be loaded.
- Use IPsec, firewalls, or any technology that ensures that only trusted services communicate with the XML Service.
- Enable this setting only on servers that are contacted by StoreFront.
- Restrict access to the XML Service to only the servers running StoreFront.

Lesson Objective Review

Scenario: You are the Citrix Admin and your colleague was in charge of enabling an XML service trust.

He reported back to you that he found an easier way to enable it since he is not comfortable with PowerShell.

What might he have done instead?

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Lesson Objective Review

Scenario: You are the Citrix Admin and your colleague was in charge of enabling XML service trust.

He reported back to you that he found an easier way to enable it since he is not comfortable with PowerShell.

What might he have done instead?

The XenApp 6.x policies are still present in the GPMC console but these do not work with 7.x.

Key Notes:

- Using the XML trust policy with FMA will not work.
- An XML trust must be configured with the use of PowerShell in FMA.
- What is the purpose of configuring an XML Service Trust?
 - To enable Pass-through authentication, Smart Card Authentication or SmartAccess.



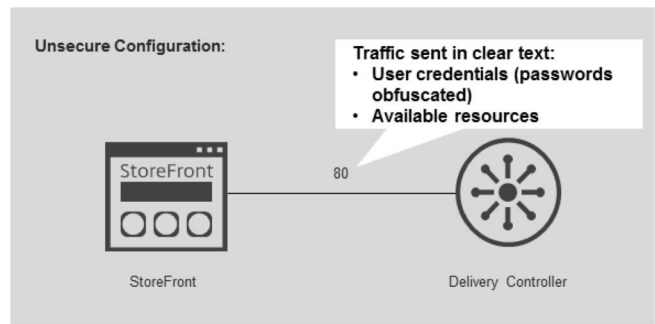
XML Traffic Security

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XML Traffic

- StoreFront and Delivery Controller communicate utilizing XML
- The traffic includes user credentials and available resources for the user
- Default Configuration: The Delivery Controller exposes both a HTTP and HTTPS listener for XML, however, the HTTPS listener cannot be used until a certificate is installed



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Key Notes:

- By using HTTP as the transport type, information is sent in clear text, with passwords obfuscated, posing a security risk.
- By default, the XML service on the Controller listens on port 80 for HTTP traffic and port 443 for HTTPS traffic. Although you can use non-default ports, be aware of the security risks of exposing a Controller to untrusted networks.
- To change the default HTTP or HTTPS ports used by the Controller, run the following command from Studio: `BrokerService.exe -WIPOUT <http-port> -WISSLPOR <https-port>` - where <http-port> is the port number for HTTP traffic and <https-port> is the port number for HTTPS traffic.

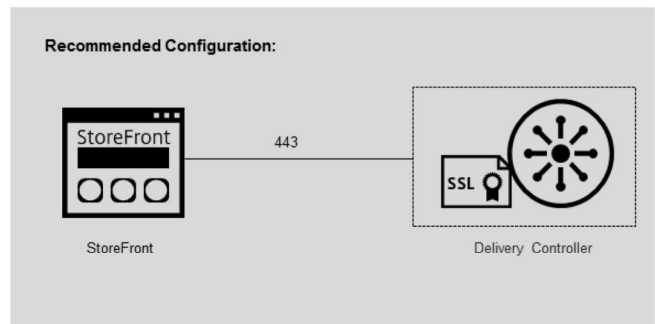
Additional Resources:

- Transport Layer Security (TLS) - <http://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/secure/tls.html>
- How to Enable SSL on XenDesktop 7.x Controllers to Secure XML Traffic: <http://support.citrix.com/article/CTX200415>

Secure XML Traffic

Encrypt communication between Delivery Controllers and StoreFront

- Recommended Configuration: Secure XML traffic over port 443 (https) by installing private server certificate on Delivery Controller
 - Bind certificate to port 443
 - Disable port 80 listener on Delivery Controller
- Prevents credentials from being sent in clear text
- Reduces possibility of Delivery Controller impersonation and the interception of authentication requests



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Key Notes:

- While it is leading practice to secure XML traffic, unsecured XML traffic does not present the same security risk as an unsecured connection to StoreFront, because the XML traffic between StoreFront and Delivery Controller is typically internal with both servers on the same VLAN- unlike a browser connection to StoreFront where the user could be coming in from untrusted/public Wi-Fi connections.
- Steps for configuring SSL/TLS for XML traffic:
 - Install server certificate on each Delivery Controller (private certificate should be used because it is only accessed by StoreFront).
 - Configure correct port (default:443) with SSL/TLS certificate created in above step.
 - Disable the port 80 listener on the Delivery Controller.
 - Later will also have to configure StoreFront to leverage https as the transport type for the Delivery Controller.
- On top of securing the XML traffic, the VDA registration traffic and HDX traffic can also be secured by using the following procedures:
 - Obtain, install, and register a server certificate on all Delivery Controllers, and configure a port with the SSL/TLS certificate. Optionally, you can change the ports the Controller uses to listen for HTTP and HTTPS traffic.
- Enable SSL/TLS connections between users and Virtual Delivery Agents (VDAs) by completing the following tasks:
 - Configure SSL/TLS on the machines where the VDAs are installed. (For

convenience, further references to machines where VDAs are installed are simply called "VDAs.") You can use a PowerShell script supplied by Citrix, or configure it manually. For general information, see About SSL settings on VDAs. For details, see Configure SSL on a VDA using the PowerShell script and Manually configure SSL/TLS on a VDA.

- Configure SSL/TLS in the Delivery Groups containing the VDAs by running a set of PowerShell cmdlets in Studio. For details, see Configure SSL/TLS on Delivery Groups.
- Requirements and considerations:
 - Enabling SSL/TLS connections between users and VDAs is valid only for XenApp 7.6 and XenDesktop 7.6 Sites, plus later supported releases.
 - Configure SSL/TLS in the Delivery Groups and on the VDAs after you install components, create a Site, create Machine Catalogs, and create Delivery Groups.
 - To configure SSL/TLS in the Delivery Groups, you must have permission to change Controller access rules; a Full Administrator has this permission.
 - To configure SSL/TLS on the VDAs, you must be a Windows administrator on the machine where the VDA is installed.
 - If you intend to configure SSL/TLS on VDAs that have been upgraded from earlier versions, uninstall any SSL relay software on those machines before upgrading them.
 - The PowerShell script configures SSL/TLS on static VDAs; it does not configure SSL/TLS on pooled VDAs that are provisioned by Machine Creation Services or Provisioning Services, where the machine image resets on each restart.

Additional Resources:

- Transport Layer Security (TLS) - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/secure/tls.html>
- How to Enable SSL on XenDesktop 7.x Controllers to Secure XML Traffic: <http://support.citrix.com/article/CTX200415>
- Securing the XenApp/XenDesktop XML Service: <https://www.citrix.com/blogs/2016/11/03/securing-the-xenappxendesktop-xml-service-important-steps-to-prevent-theft-of-user-passwords/>



Lab Exercise

- Exercise 12-1: Secure XML Traffic on NYC-XDC-001
- Exercise 12-2: Secure XML Traffic on NYC-XDC-002

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Lesson Objective Review

Scenario: You are the Citrix Admin and you receive a call from the help desk Monday morning that users are not able to log on to StoreFront. You verify the StoreFront configuration and you verify port 443 is not blocked on the Delivery Controllers.

What could be the root cause of this sudden change?

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Lesson Objective Review

Scenario: You are the Citrix Admin and you receive a call from the help desk Monday morning that users are not able to log on to StoreFront. You verify the StoreFront configuration and you verify port 443 is not blocked on the Delivery Controllers.

What could be the root cause of this sudden change?

The certificate on the Delivery Controllers might have expired.

Key Notes:

- What are the high level steps for configuring a XenApp and XenDesktop Site?
 - Answers:
 - Step 1: Install Delivery Controller Role
 - Step 2: Create XenApp and XenDesktop Site
 - Step 3: Secure XML traffic



External HDX Connection Security

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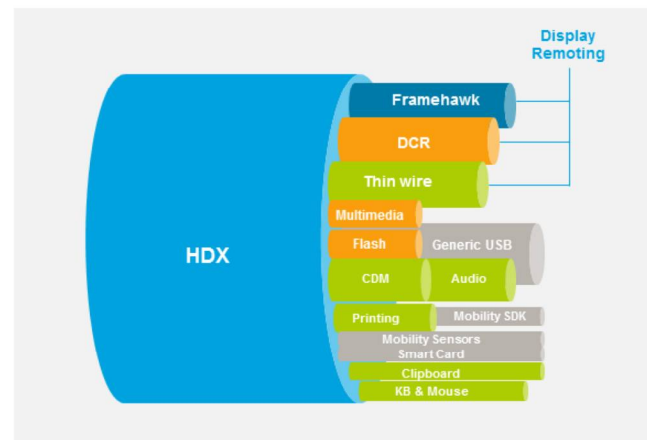
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Why secure HDX traffic?

The HDX protocol consists of 32 virtual channels, all capable of transporting sensitive information, including:

- Client and server capabilities
- Connection information such as username and matching token
- Image data from applications running inside the session
- Clipboard and keyboard data

To prevent disclosure of data, transfer HDX protocol data over encrypted network connections.



Key Notes:

- HDX is the name used for ICA and CGP (Common Gateway Protocol) connections.
- While this module focuses on enabling secure access from external networks using the NetScaler, the HDX protocol can also be encrypted internally using SSL/TLS.
- For more information on internal encryption, refer to the links below.

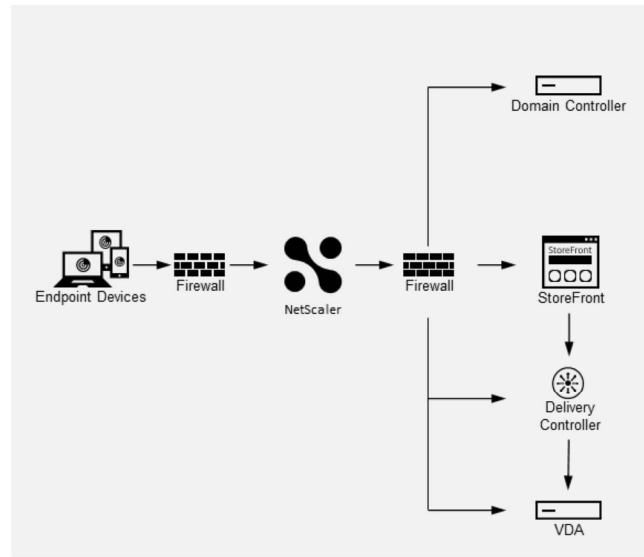
Additional Resources:

- HDX technologies for optimizing application and desktop delivery - <https://www.citrix.com/products/xenapp-xendesktop/hdx-technologies.html>
- TLS settings on VDAs - https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/secure/tls.html#par_anchoritle_53b7
- Configure TLS on a VDA using the PowerShell script - https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/secure/tls.html#par_richtext_5

NetScaler Gateway Introduction

NetScaler Gateway is a security hardened appliance (virtual or physical) which communicates with internal resources on behalf of external users to:

- Authenticate users
- Allow secured external connections to StoreFront (reverse web proxy)
- Allow secured access to internal hosted applications and desktops (HDX proxy)



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Key Notes:

- NetScaler has a huge feature set; this is just a small percentage of what NetScaler can do.
- A proxy server is typically hosted internally to allow users to browse externally-hosted websites without actually having a TCP session to the web servers.
- Reverse web proxy uses the same idea; however, instead it allows external users to browse internal resources without enabling TCP access to the web servers themselves (many customers may be familiar with Microsoft ISA or TMG servers, which have similar functionalities).
- HDX proxy is similar to reverse web proxy; however, instead of protecting webservers, it protects the internal VDAs and converts port 1494/2598 data to encrypted SSL/TLS data in real time.

Secure Ticket Authority Introduction

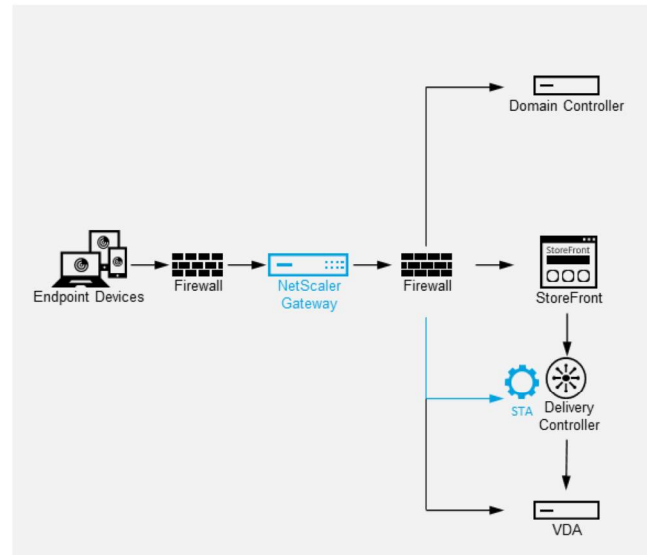
The Secure Ticket Authority (STA) produces Secure Tickets, which can be exchanged for session information.

Every Delivery Controller hosts a Secure Ticket Authority.

The STA must be reachable by StoreFront and the NetScaler Gateway.

The Secure Ticket is used to avoid transporting user-specific data over unsecured networks.

A new Secure Ticket is issued for every resource launch, is only valid inside the current SSL/TLS session, and has a limited lifespan.



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Key Notes:

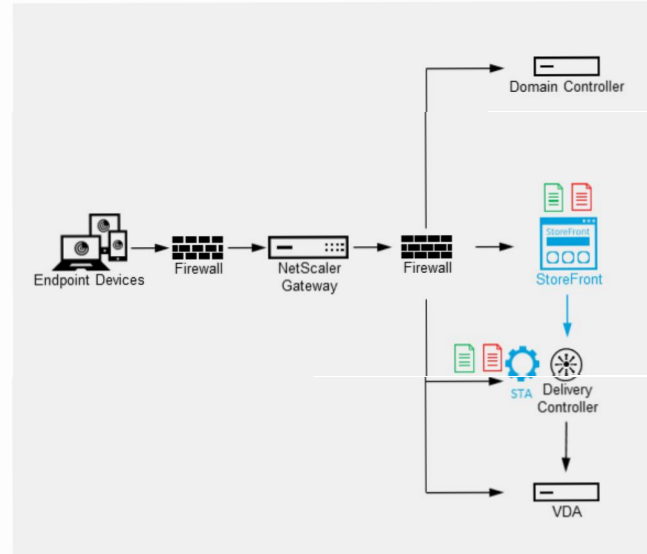
- Like the XML service, the STA service is a sub-service within BrokerService.
- Like the XML service, the STA service is reachable on port 80 by default.
- This service should be secured using SSL/TLS and certificates.
- Think of the STA like a parking valet desk. You turn in your car and receive a randomized number, which can be used to authorize you to pick up your car later without presenting your credentials. The concern in this situation, much like with STA, is you don't want anyone to intercept your randomized number and pick up your car.

Understanding Secure Ticket Authority

Step 1

The STA functions much like a valet parking attendant.

1. StoreFront “parks” session launch information and is issued a “parking token” (the STA ticket).
 - Red document symbolizes the secret information that should not be sent to the untrusted network
 - Green document symbolizes the session specific token (STA ticket)



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Key Notes:

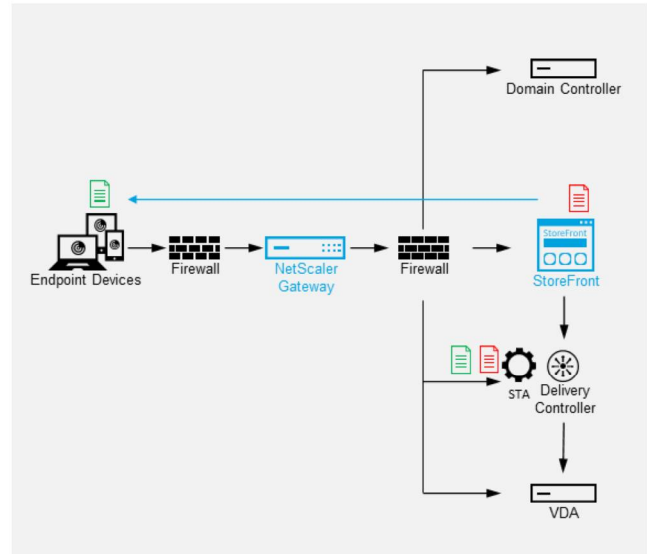
- At the point where this analogy starts, authentication, application browsing, the request to start an application, and load balancing decisions have already taken place.
- The next step would be NetScaler launching the session on the user's behalf.

Understanding Secure Ticket Authority

Step 2

The STA functions much like a valet parking attendant.

1. StoreFront “parks” session launch information and is issued a “parking token” (the STA ticket).
2. StoreFront passes this token back to the endpoint device through the NetScaler, along with the resource launch file.



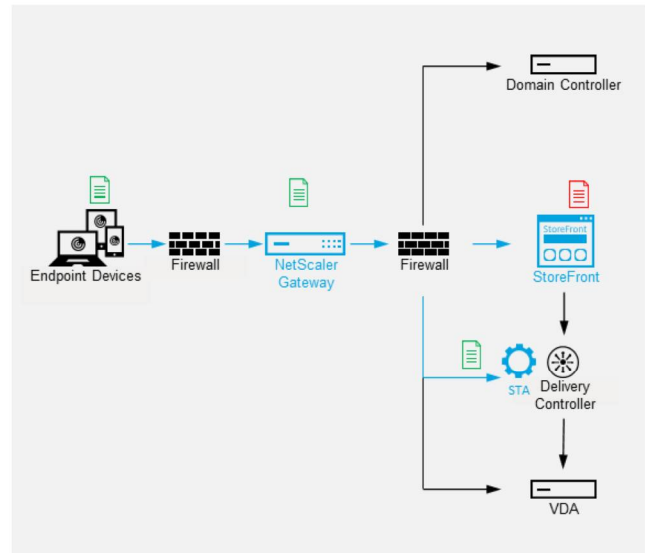
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Understanding Secure Ticket Authority

Step 3

The STA functions much like a valet parking attendant.

1. StoreFront “parks” session launch information and is issued a “parking token” (the STA ticket).
2. StoreFront passes this token back to the endpoint device through the NetScaler.
3. The endpoint device transmits the token to NetScaler which presents it to the STA to access the “parked” session launch information.



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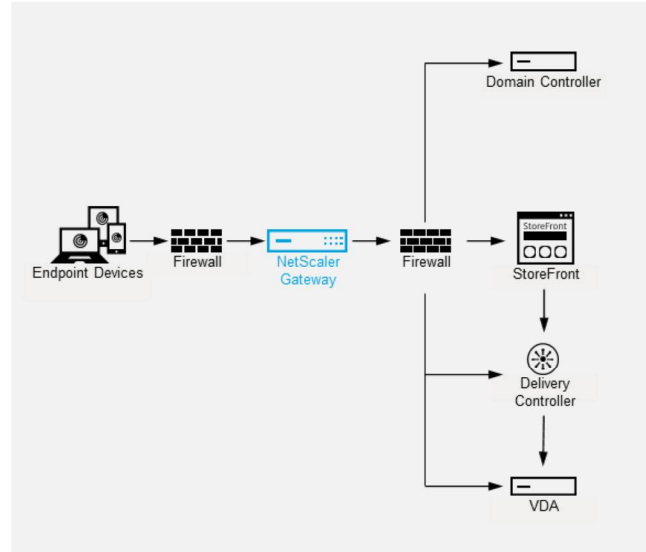
Additional Resources:

- Establishing a Secure Connection to the Server Farm - <https://docs.citrix.com/en-us/netscaler-gateway/11-1/integrate-web-interface-apps/ng-wi-integrate-apps-secure-connection.html> (this document talks about Web Interface but the STA exchange is similar for StoreFront).

HDX Proxy

Citrix recommends NetScaler Gateway as the HDX Proxy component for the following reasons:

- Security hardened SSL VPN appliance
- Single point of contact for vendor support
- Deep integration with all Citrix products and features
- Available as virtual and physical appliance
- NetScaler Gateway can scale and grow on demand



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Key Notes:

- While there are other products on the market that can do “HDX proxy”, NetScaler Gateway is the only product supported by Citrix.
- When new features are added to the HDX protocol, they are immediately supported on NetScaler Gateway.
- Competition does not have the same knowledge about the HDX protocol as Citrix does.

Additional Resources:

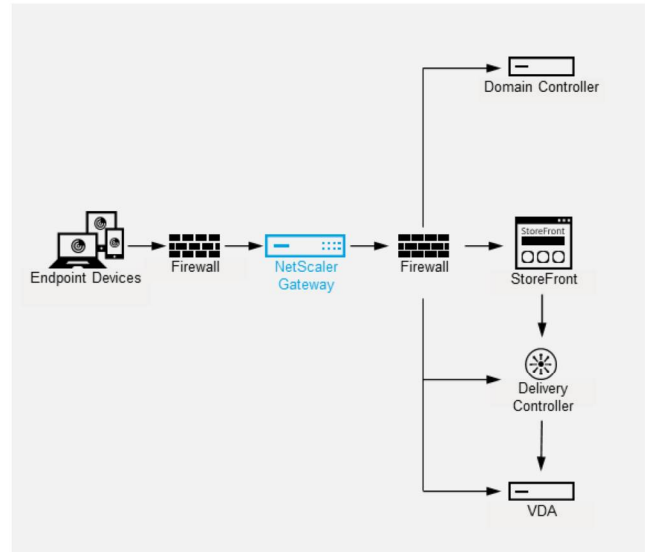
- How to Configure NetScaler Gateway Session Policies for StoreFront - <https://support.citrix.com/article/CTX139963>

HDX Proxy Connection Overview

The HDX Proxy establishes the connection for users on endpoint devices from any place to their hosted resources on the corporate network.

The requirements are:

- An externally accessible internet address (IP & DNS name)
- A certificate that endpoint devices trust
- A firewall rule to allow access to NetScaler Gateway using SSL/TLS and port 443



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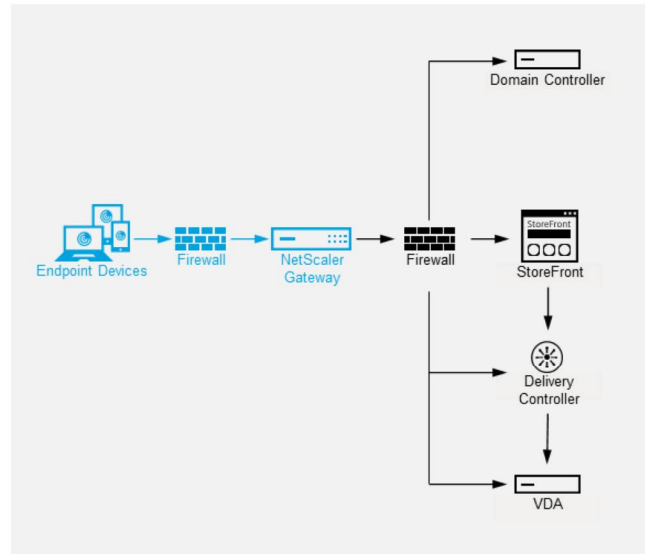
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Key Notes:

- The next slides will highlight the connection flow step by step in more detail; this slide serves only as an introduction and overview of the connection process as such.
- All ports can be changed, but this might complicate troubleshooting and monitoring. Deviating from default ports should be only be done with careful planning.

HDX Proxy Part 1 of 8

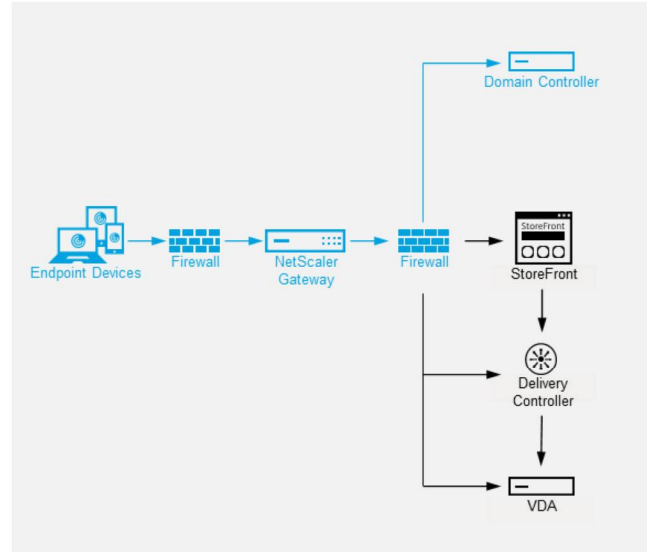
1. Endpoint device accesses company remote access URL; the external firewall passes traffic to the NetScaler Gateway.
2. NetScaler displays the authentication page to the user, optionally running an endpoint analysis scan on the endpoint device.



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HDX Proxy Part 2 of 8

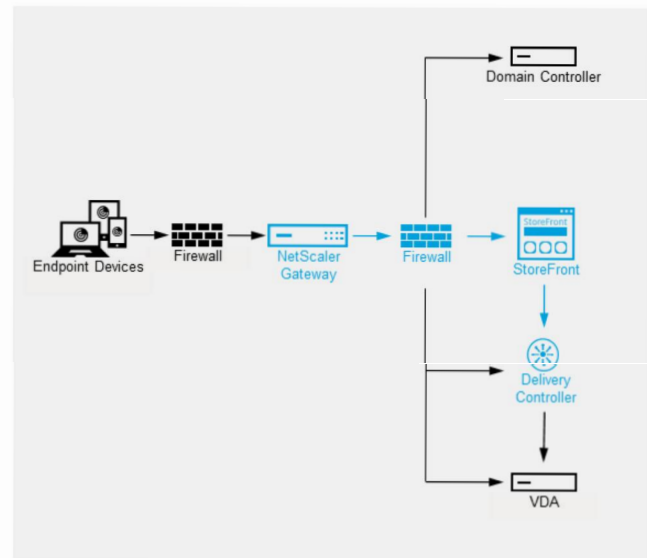
3. The user authenticates to NetScaler.
4. NetScaler authenticates the user via LDAP(S) to the Domain Controller.



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HDX Proxy Part 3 of 8

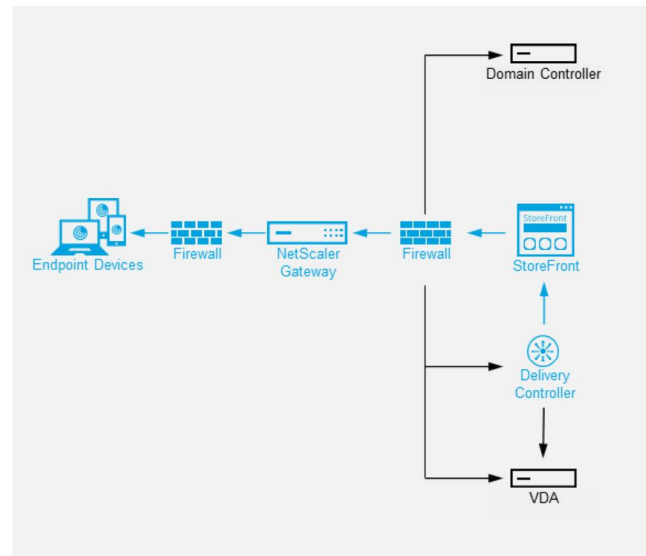
5. If authentication is successful, NetScaler queries StoreFront for available resources on behalf of the user.
6. StoreFront queries the configured Delivery Controllers for available resources accessible to the user.



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HDX Proxy Part 4 of 8

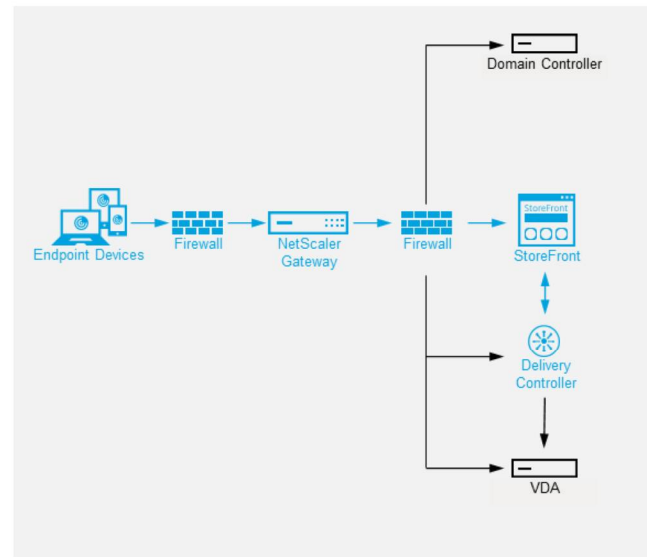
7. The Controller queries the site database and returns a list of all available resources for the user to StoreFront.
8. StoreFront builds a web page with the available resources which is proxied to the endpoint device via NetScaler.



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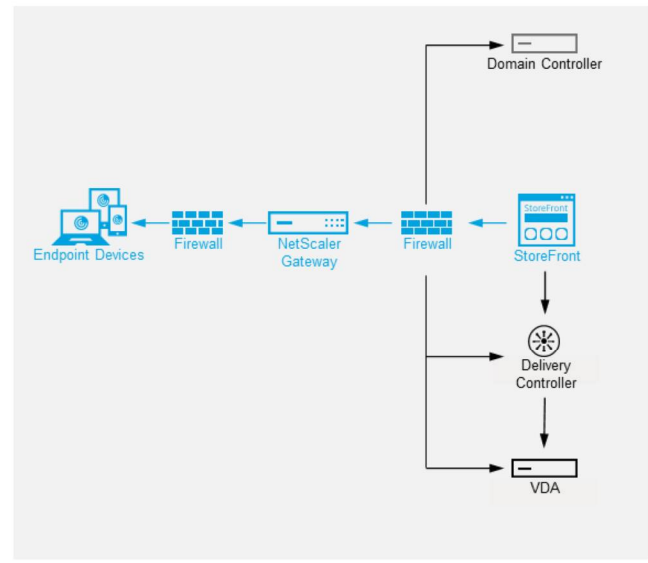
HDX Proxy Part 5 of 8

9. The user clicks on a published resource and NetScaler transmits this launch request to StoreFront.
10. StoreFront forwards the request to the Delivery Controller.
11. The Delivery Controller chooses the appropriate VDA to host the session using load-balancing rules and returns the session information to StoreFront.
12. StoreFront buffers the session information in the STA service of the Delivery Controller and receives a STA ticket in return.



HDX Proxy Part 6 of 8

13. StoreFront generates a launch file including the STA ticket.
14. StoreFront sends the launch file via NetScaler to the endpoint device as the answer to the user's click on a resource.

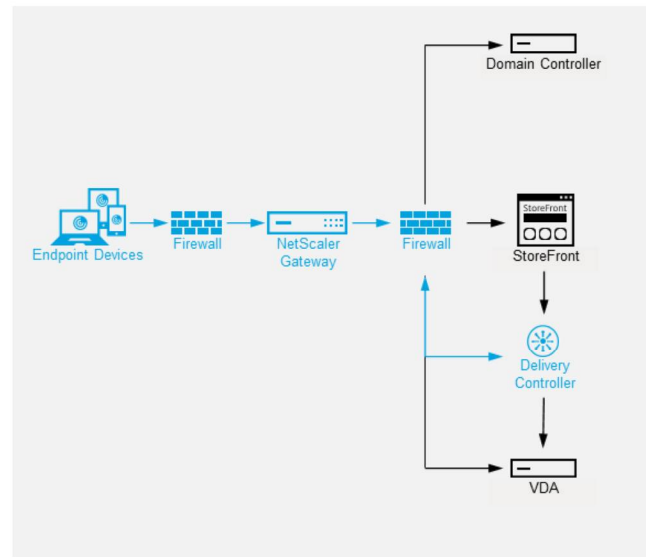


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HDX Proxy Part 7 of 8

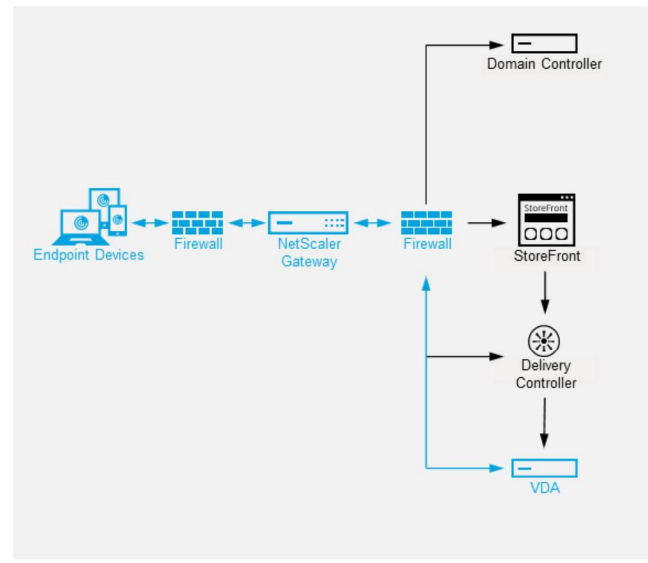
- Receiver on the endpoint device processes the launch file and presents the STA ticket to NetScaler.
- NetScaler validates the STA ticket with the STA on the Delivery Controller.
- If validation is successful, the STA returns the session information to NetScaler.



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HDX Proxy Part 8 of 8

18. NetScaler uses the session information to establish a session to the VDA, and forwards all session traffic between the Receiver on the endpoint device and the VDA.



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What are the benefits of using NetScaler Gateway as the HDX Proxy?

Key Notes:

- Possible Answers:
 - Only one port needs to be opened on the firewall (443). Single vendor to address for support (Citrix). Scalability options (more bandwidth, HA, more processing power, more features (SmartAccess, VPN etc.)

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Lab Exercise

- Exercise 12-3: Configure the Store to Use Secure XML Connections
- Exercise 12-4: Integrate StoreFront with the NetScaler Gateway
- Exercise 12-5: Enable Remote Access to the Store
- Exercise 12-6: Propagate the StoreFront Settings to the Server Group
- Exercise 12-7: Test External Access through the NetScaler Gateway

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Lesson Objective Review

Scenario: You are the Citrix Admin and you have recently configured NetScaler Gateway.

Testing shows that you can log on from outside and see the list of resources, however, you cannot launch resources.

You have identified all options to be configured correctly and you have verified with the Network team that NetScaler can communicate with StoreFront and all VDAs.

What could be missing?

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Lesson Objective Review

Scenario: You are the Citrix Admin and you have recently configured NetScaler Gateway.

Testing shows that you can log on from outside and see the list of resources, however you cannot launch resources.

You have identified all options to be configured correctly and you have verified with the Network team that NetScaler can communicate with StoreFront and all VDAs.

What could be missing?

NetScaler also needs firewall access to Delivery Controllers to verify the STA Ticket.

Key Notes:

- StoreFront has scalability built into the architecture and does not rely on clustering technologies.
- However, StoreFront is relying on NetScaler to distribute the incoming client connections and mitigate in case of failures.
- StoreFront checks out a Secure Ticket for the users session and passes this information back through the NetScaler to the user's device in the form of a ICA launch file. When the Receiver opens the ICA launch file, the Secure Ticket is presented to the NetScaler. The NetScaler will then attempt to validate this ticket with the STA, if this operation fails resources cannot be launched.



Key Takeaways

- Understand default installations and their security considerations to secure new deployments.
- Use certificates from trusted CAs.
- Enable XML service trust to support more authentication options.
- Integrate NetScaler Gateway to securely connect to company resources from unsecured networks.

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XenApp and XenDesktop Administration

Monitoring the XenApp and XenDesktop Site

Module 13



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The following VMs are required to be powered on before beginning the exercises in this module:

- NYC-ADS-001
- NYC-SQL-001
- NYC-FSR-001
- NYC-VNS-001
- NYC-NIC-001
- NYC-XDC-001
- NYC-XDC-002
- NYC-STF-001
- NYC-STF-002
- NYC-SRV-001
- NYC-WRK-001

The remaining VMs need to be powered off.

Note: These VMs are listed in the start-up order.



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Learning Objectives

- Introduce the Citrix Director console
- Examine how to navigate Director
- Identify how to use Director to monitor a session
- Identify how to use Director to interact with a session
- Determine how to use Director and HDX Insight to proactively monitor, troubleshoot and analyze the Site
- Examine the benefits of integrating SCOM monitoring and the Director

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Introduction to Citrix Director

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Citrix Director

Citrix Director is ...	Citrix Director can ...
A web-based management console.	Monitor Sites, infrastructure and sessions.
A user help desk portal.	Help troubleshoot connection and performance issues.
Included in any XenApp and XenDesktop Edition.	Gather data from different sources and integrate with HDX Insight.

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Key Notes:

- Director can access:
 - Real-time data from the Broker Agent using a unified console integrated with Analytics, Performance Manager, and Network Inspector.
 - Analytics includes performance management for health and capacity assurance, and historical trending and network analysis, powered by NetScaler Insight Center or NetScaler MAS, to identify bottlenecks due to the network in your XenApp or XenDesktop environment.
 - Historical data stored in the Monitor database to access the Configuration Logging database.
 - ICA data from the NetScaler Gateway using NetScaler Insight Center or NetScaler MAS.
 - Gain visibility into the end-user experience for virtual applications, desktops, and users for XenApp or XenDesktop.
 - Correlate network data with application data and real-time metrics for effective troubleshooting.
 - Integrate with XenDesktop 7 Director monitoring tool.
 - Personal vDisk data that allows for runtime monitoring showing base allocation and gives help-desk IT the ability to reset the Personal vDisk (to be used only as a last resort).
- Director is an on-premise component, typically hosted on Delivery Controllers or separate

servers depending on scale and use case.

- HDX insight is an appliance that can deliver data from the ICA sessions flowing through NetScaler like latency, bandwidth consumption and packet loss.

Additional Resources:

- About Director - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/director.html>
- HDX Insight at a glance - https://www.citrix.com/content/dam/citrix/en_us/documents/products-solutions/hdx-insight-powered-by-citrix-netscaler-insight-center.pdf

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Citrix Director Installation Requirements

Citrix Director requires the following:

- Operating System:
 - Windows Server 2008 R2 SP1
 - Windows Server 2012
 - Windows Server 2012 R2
 - Windows Server 2016
- Microsoft Internet Information Server
- .NET Framework 4.5.1
- ASP.NET 2.0
- Access to a Delivery Controller

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Key Notes:

- By default, Citrix Director is installed on a Delivery Controller.
- Install Director using the installer, which checks for prerequisites, installs any missing components, sets up the Director website, and performs basic configuration.
- Installer handles typical deployments. If Director was not included during installation, use the installer to add Director. To add any additional components, re-run the installer and select the components to install.
- For information on using the installer, see the installation documentation. Citrix recommends that you install using the product installer only, not the .MSI file.

Additional Resources:

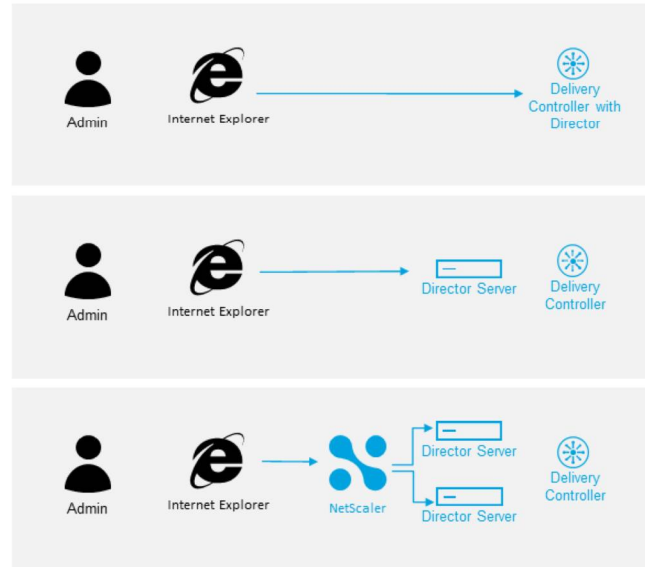
- Citrix Director Documentation: About Director - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/director.html>
- Citrix Director Requirements: https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/system-requirements.html#par_anchortitle_5d4a

Citrix Director Installation Location

For small scale deployments, install Citrix Director on the Delivery Controller.

For enterprise deployments, Citrix recommends a dedicated Director server.

For high-availability, install two Citrix Director servers accessed via a load-balancer.



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Key Notes:

- In smaller environments, the Delivery Controller should have capacity to run Director.
- However, as load starts to increase, Director can take away resources from the Delivery Controller.
- To ensure optimal performance inside Director, and ensure proper session brokering performance, separate the Director role away from Delivery Controller.
- To ensure a highly available Director solution, and to spread load between Director servers, use NetScaler to load balance between multiple servers.

Additional Resources:

- Load Balancing Director with NetScaler: <https://www.citrix.com/blogs/2016/09/06/using-netscaler-to-load-balance-director/>



Who uses Director already?

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Lab Exercise

- Exercise 13-1: Launch and Login to Citrix Director

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Lesson Objective Review

Scenario: You are the Citrix Admin for a large organization. You have implemented Director to run on the Delivery Controller.

After releasing Director to the help desk team, users start complaining about slow performance in StoreFront.

Why is Director having an impact on StoreFront performance?

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Lesson Objective Review

Scenario: You are the Citrix Admin for a large organization. You have implemented Director to run on the Delivery Controller.

After releasing Director to the help desk team, users start complaining about slow performance in StoreFront.

Why is Director having an impact on StoreFront performance?

StoreFront is using the XML service on the Delivery Controller for enumeration and brokering of resources.

If the Delivery Controller is overloaded, StoreFront might appear slow to users.

Key Notes:

- The Delivery Controller's ability to process XML queries from StoreFront has a significant impact in the perceived performance of StoreFront.
- The StoreFront servers might have plenty of available resources, but if the delay is down the stack, then StoreFront performance will suffer.



Navigating Director

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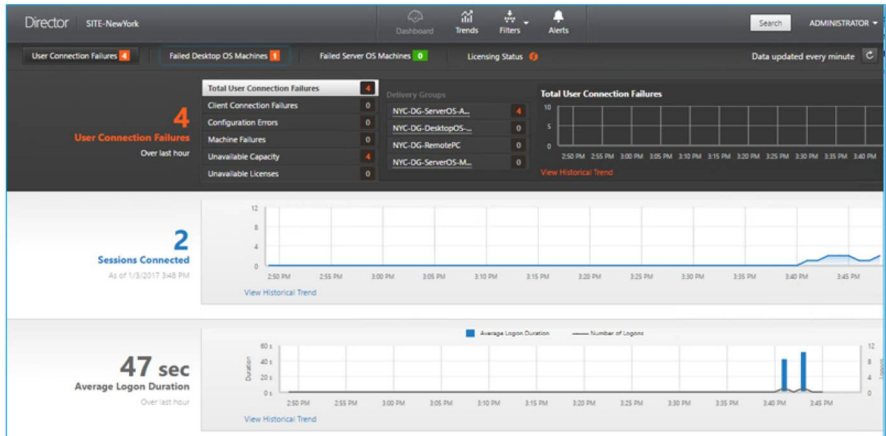
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Basic Navigation

The homepage of Citrix Director is the Dashboard, which shows events and performance data from the last hour.

Most graphs are clickable, and provide additional relevant data if clicked.

Menu items on the top lead to different views of Director.



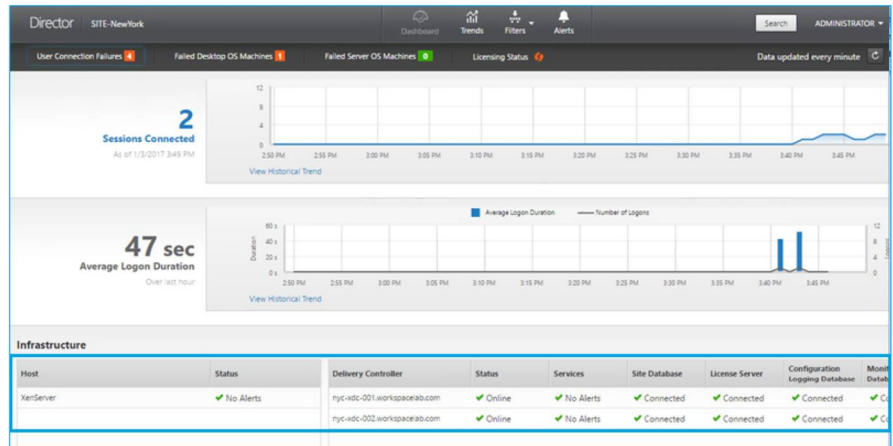
Key Notes:

- The default view when logging on to Director as an administrator is the dashboard. The dashboard contains alerts and a number of clickable graphs. If there are active alerts, the Alerts pane will drop down.

Points of Interest in the Dashboard

The lower area of the Dashboard displays information about the health of required infrastructure services like:

- Hypervisors
- Databases
- License Server



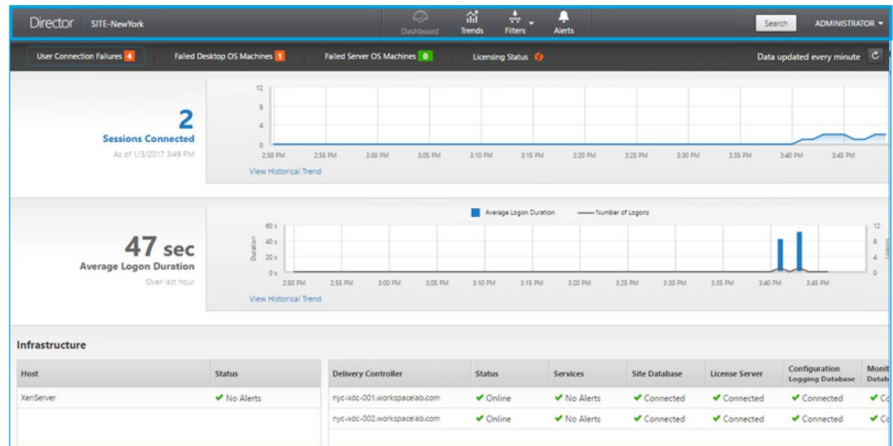
Key Notes:

- The lower part of the dashboard contains the operational status for hypervisors, databases, and the License Server.

Different Views

The different views of Citrix Director are:

- Dashboard
- Trends
- Filters
- Alerts
- Search



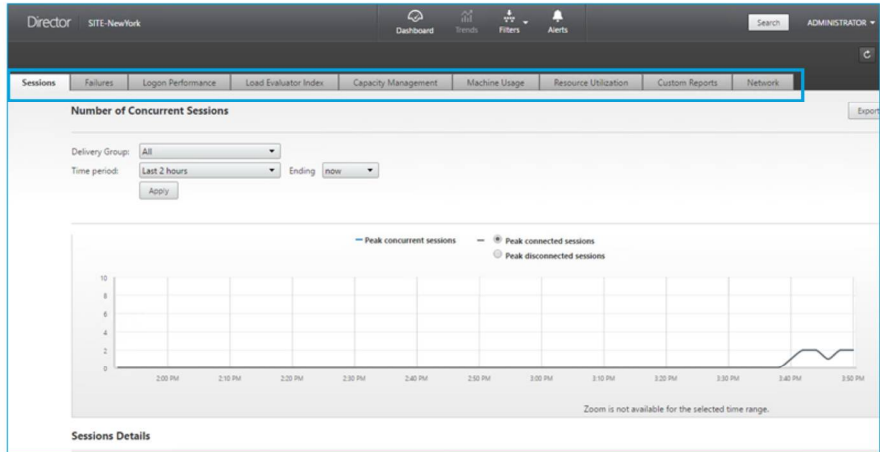
Key Notes:

- **Dashboard** – Provides an overview of performance and failures for the last hour. This self-updating view can be left open, so Citrix administrators can quickly see a change in performance of their Site and react accordingly.
- **Trends** – Provides access to recorded Site metrics for up to a year. Administrators can create a historical report on how many users have used resources from the Site and which applications are used the most.
- **Filters** – Functions much like database queries to find specific information about machines, sessions or connections. Administrators can produce a filtered list of all users with a specific Receiver version or running a certain application from specific networks.
- **Alerts** – An interface to define rules for alert conditions. Administrators of specified Delivery Groups can be notified via email when logon performance drops or a predefined load threshold is exceeded.
- **Search** – Search for sessions by specifying username, VDA name or endpoint. Help desk users can interactively search for sessions to offer remote assistance or begin troubleshooting.

Trends

Use the Trends view to access historical reports on

- Sessions
- Failures
- Logon Performance
- Load Evaluator Index
- Capacity Management
- Machine Usage
- Resource Utilization
- Customized Reports
- Network



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Key Notes:

- Administrators can report on recorded performance metrics of a Site reaching up to a year in the past (depending on the product edition).
- The data can also be exported in PDF, CSV or XLSX format for later processing or archival.
- The different reports available include:
 - Sessions: shows the number of peak concurrent sessions for any Delivery Group. Also displays session start times and duration for selected users.
 - Failures: displays errors relating to VDAs and connections in association with administrative changes made to the Site database.
 - Logon Performance: provides an overview of the duration of each logon for specific Delivery Groups in a set timespan with a breakdown on how much time is spent in different phases of the logon process, like group policy application or running logon scripts.
 - Load Evaluator Index: shows the load management values used to determine session placement on Server OS VDAs and breaks them down.
 - Capacity Management: reveals how many concurrent instances of any published app were running in a set time period.
 - Machine Usage: shows how many VDAs are available and which Delivery Groups they are assigned to.
 - Resource Utilization: Graphs show data for Average CPU, Average Memory, and Peak Concurrent Sessions. The administrator can drill down to the

machine, and view data and charts for the top ten processes consuming CPU.

- Customized reports: The Custom Reports tab provides a user interface to generate Custom Reports containing real-time and historical data from the Monitoring database in tabular format.
- Network: provides deeper insight into HDX performance metrics, like how many times a client automatically reconnected, or what latency applied to what session (and when).

Additional Resources:

- Citrix Director: Trends explained - <https://www.citrix.com/blogs/2014/09/22/citrix-director-trends-explained/>

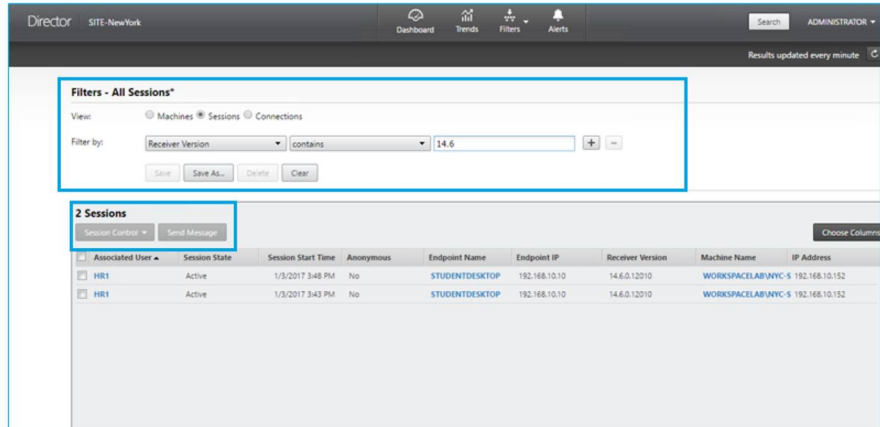
Filters

The Filters view allows filtering based on:

- Machines
- Sessions
- Connections

Filters not only provide a wealth of additional data for each item, but also offer associated actions like:

- Reset / Power down a VDA
- Log off a session
- Send a message to the user



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Key Notes:

- The filtered views can be filtered by many different criteria. These filters can also be saved for easier access.
 - Example: I want to find all sessions that are connected from a Receiver less than version 4.0.
- Pre-defined filters cannot be edited, but you can save a pre-defined filter as a custom filter and then modify it. Additionally, you can create custom filtered views of machines, connections, and sessions across all Delivery Groups.

Additional Resources

- Citrix Director 7.6: Filters explained - <https://www.citrix.com/blogs/2014/12/17/citrix-director-7-6-filters-explained/>
- Filter data to troubleshoot failures - https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/director/monitor-deployments.html#par_anchortitle

Alerts and Notifications

Alerting feature built into Citrix Director from version 7.9:

- Sends an email to a user or distribution list when a pre-configured threshold is reached (requires configuration).
- Prevents support staff from having to manually monitor Director for alerts.
- User Policy and CPU/Memory alerts are 7.11 features.
- Can trigger SNMP traps from 7.12.

The screenshot shows the 'User Policy' configuration page in Citrix Director. At the top, there are navigation tabs: 'Site Policy', 'Delivery Group Policy', 'Server OS Policy', and 'User Policy'. Below the tabs is a 'Back to Alert Policies' link. The main form has three sections: 'Name of Alert' with a text input field, 'Description' with a larger text area, and 'Conditions'. The 'Conditions' section is divided into two columns. The left column lists various conditions: 'Peak Connected Sessions' (highlighted), 'Peak Disconnected Sessions', 'Peak Concurrent Total Sessions', 'CPU' (highlighted), 'Memory' (highlighted), 'Connection Failure Rate', 'Connection Failure Count', 'Failed Machines (Desktop OS)', 'Failed Machines (Server OS)', and 'Average Logon Duration'. The right column is titled 'Number of peak connected sessions' and includes a 'Warning' icon (yellow triangle) and a 'Critical' icon (red circle). Below these icons are two input fields for 'Peak connected sessions' and 'Re-alert interval', each with a 'Warning' icon and a 'Critical' icon. The 'Re-alert interval' fields are set to '60 min'. A 'Reset Values' link is located at the top right of the conditions section.

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Key Notes:

- Citrix alerts are alerts monitored in Director that originate from Citrix components. You can configure Citrix alerts within Director in Alerts > Citrix Alerts Policy. As part of the configuration, you can set notifications to be sent by email to individuals and groups when alerts exceed the thresholds you have set up. Configure the notification as emails to individuals and groups, Octoblu webhooks, and SNMP traps.

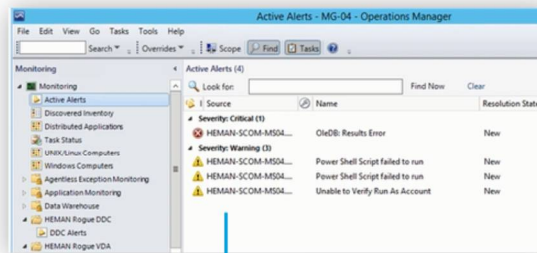
Additional Resources:

- Alerts and notifications - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/director/alerts-notifications.html>
- Configure alerts policies with SNMP traps - https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/director/alerts-notifications.html#par_anchortitle_6b0f

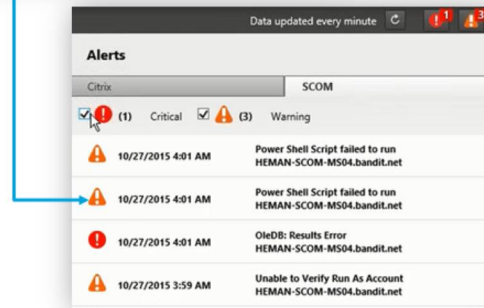
SCOM Integration

Overview

- Citrix Director queries SCOM server for health and performance alerts every 60 seconds.
- Allows for filtering and historical view of SCOM alerts from within Citrix Director.



SCOM
2012 R2



Citrix
Director

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Key Notes:

- SCOM integration with Director lets you view alert information from Microsoft System Center 2012 Operations Manager (SCOM) on the Dashboard and in other high level views in Director.
- SCOM alerts are displayed on-screen alongside Citrix alerts. You can access and drill down into SCOM alerts from SCOM tab in the side bar.
- You can view historical alerts up to one month old, sort, filter, and export the filtered information to CSV, Excel, and PDF report formats.
- The requirements for SCOM integration are:
 - Windows Server 2012 R2
 - System Center 2012 R2 Operations Manager
 - PowerShell 3.0 or higher (PowerShell version on Director and the SCOM server must match)
 - Quad Core CPU with 16 GB RAM (recommended)
 - A primary Management Server for SCOM must be configured in the Director web.config file. You can do this using the DirectorConfig tool.
 - Citrix recommends that the Director administrator account is configured as a SCOM Operator role so that they can retrieve full alert information in Director. If this is not possible, a SCOM administrator account can be configured in the web.config file using the DirectorConfig tool; however, it is not recommended.
 - Citrix recommends that you do not configure more than 10 Director

administrators per SCOM Management Server. This is to ensure that the SCOM Management Server is moderately loaded for optimal performance.

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Do you see the value of using filters to find what you are looking for in Director?

Key Notes:

- Filters work almost like a SQL “Select * from”
- Can be utilized to quickly find the relevant resources or sessions.
- Can be saved for later usage.

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Lab Exercise

- Exercise 13-2: Login to Citrix Director as a Delegated Help Desk Administrator

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Lesson Objective Review

Scenario: You are the Citrix Admin and you are trying to find a report in Director that will show you the number of sessions connected to your environment over the past two hours.

Which section do you go to?

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Lesson Objective Review

Scenario: You are the Citrix Admin and you are trying to find a report in Director, that will show you the number of sessions connected to your environment over the past two hours.

Which section do you go to?

Trends -> Sessions

Key Notes:

- Using the Trends section of Director will give you access to a vast amount of historical data hosted in the Site database.

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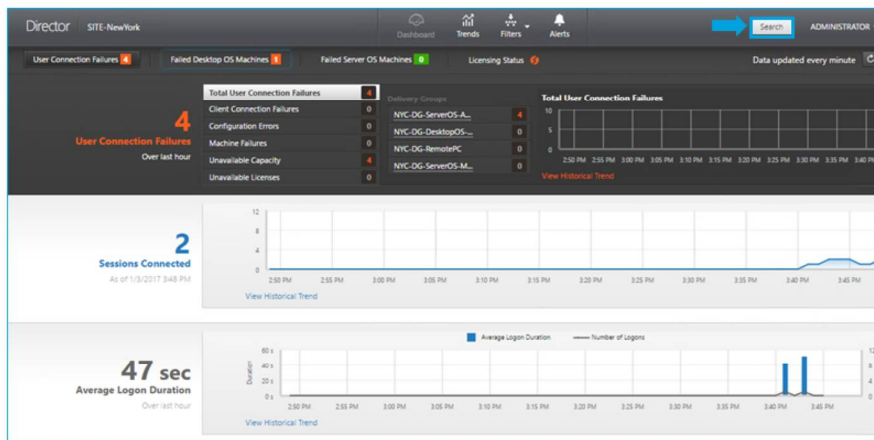
Using Director to Monitor a Session

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Full Administrator Experience

As delegated Full Administrator, click the Search button in the upper right corner.

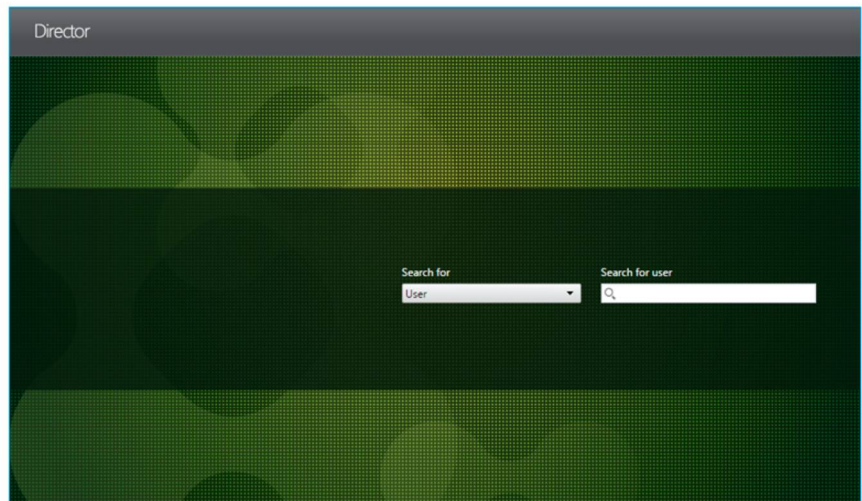


Key Notes:

- For every administrator that has access to the Dashboard view, the Search view is located in the upper right corner.

Help Desk Experience

As delegated Help Desk Administrator, the Search view is the predefined homepage of Director.



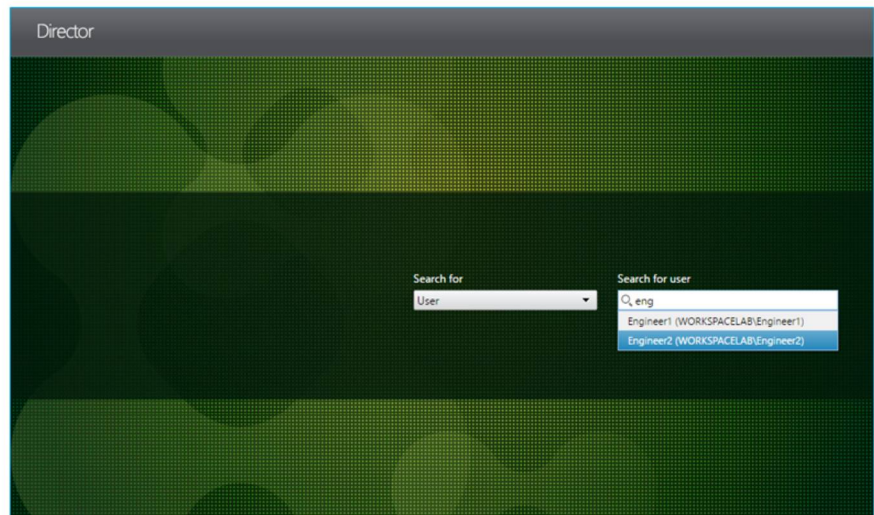
Key Notes:

- For all administrators that do not have access to the Dashboard view (or Trends and Filters), but have access to certain Director functions (view Client/Machine/User details page), the Search view automatically becomes the homepage.

Searching for a Session

To search for a session, the following parameters can be applied:

- User
 - The name of the user
- Machine
 - The name of the VDA
- Endpoint
 - The name of the user's client device



Key Notes:

- The beginning of given name, last name, or logon name can be used to query Active Directory while typing. So the first few characters from a user's name are sometimes sufficient to receive a suggestion from Active Directory.
- Suggestions while typing are also available for the machine and endpoint search.
- Matching is always done from left to right, so entering "Tata" would match "Tatarinov", but "tari" would not.



Lab Exercise

- Exercise 13-3: Use Citrix Director to View Alerts
- Exercise 13-4: View the Session Default View Page

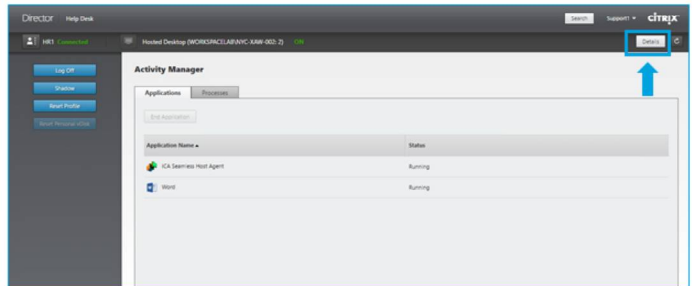
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Viewing a Session

In the default session view, administrators can perform some session management tasks and use the Activity Manager to to:

- Stop an application
- See a program's CPU and memory consumption

To switch to a more detailed view, click on the **Details** button in the upper right corner.



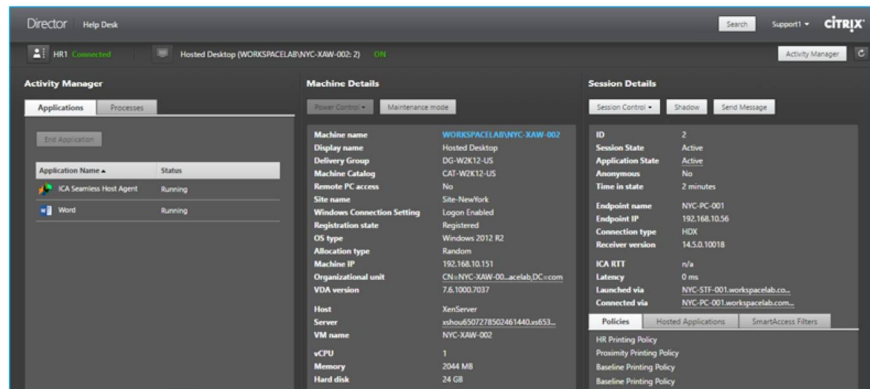
Key Notes:

- Applications are normally visibly running in the user's session, while processes contain tasks running in the background (normally not visible to the user).

Viewing Details of a Session

The detailed session view offers far more information about the session of a user:

- Running applications and processes
- VDA data and performance metrics like disk queue length
- Session status, and Receiver version
- Applied policies



Key Notes:

- The Session view and Detailed Session view are self-updating, but can be updated on demand as well to reflect recent changes to a user's session.
- Meaningful names can help a lot while troubleshooting an issue, as the full name of a policy is displayed in the session details windows.



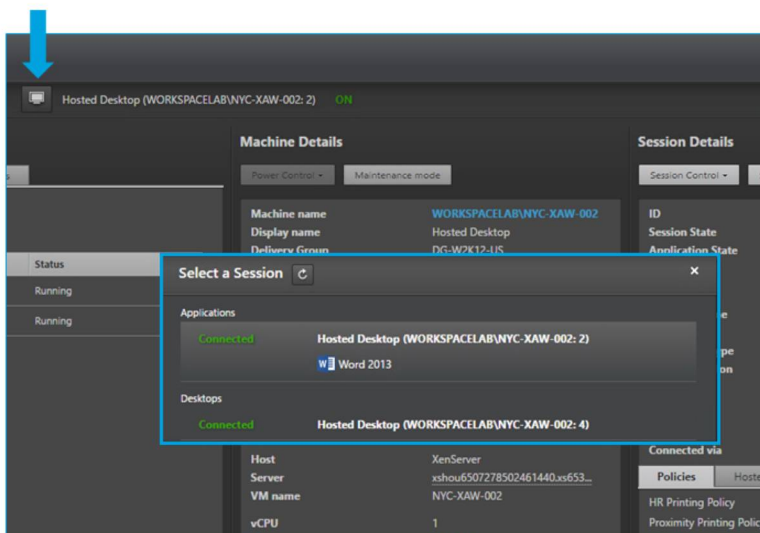
Lab Exercise

- Exercise 13-5: View the Session Details Page

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Switching between Sessions

Use the session selector to switch between multiple running sessions for a user or VDA.



Key Notes:

- Desktop sessions each require their own session, while published apps might run in the same session (depending on configuration). In some deployments, users start off with a single desktop session and start multiple sessions from there to access their published apps.
- Selecting the correct session is key in troubleshooting performance issues, when for example an application performs poorly, while other applications from different sessions expose no issues.

Lesson Objective Review

Scenario: You are the Citrix Admin and you have recently demonstrated Director to your help desk staff. However, after granting them access, they complain that their permissions inside Director are limited.

What could be the issue?

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Lesson Objective Review

Scenario: You are the Citrix Admin and you have recently demonstrated Director to your help desk staff. However, after granting them access, they complain that their permissions inside Director are limited.

What could be the issue?

Delegated Admins with help desk privileges will only be presented a subset of Director features.

Key Notes:

- To change this behavior, the full admin could copy the help desk role and change the permissions accordingly.
- What are the parameters I can use to search for a session?
 - Possible Answer:
 - Username (any of the following: given name, last name, logon name)
 - Machine name
 - Name of the endpoint device



Using Director to Interact with a Session

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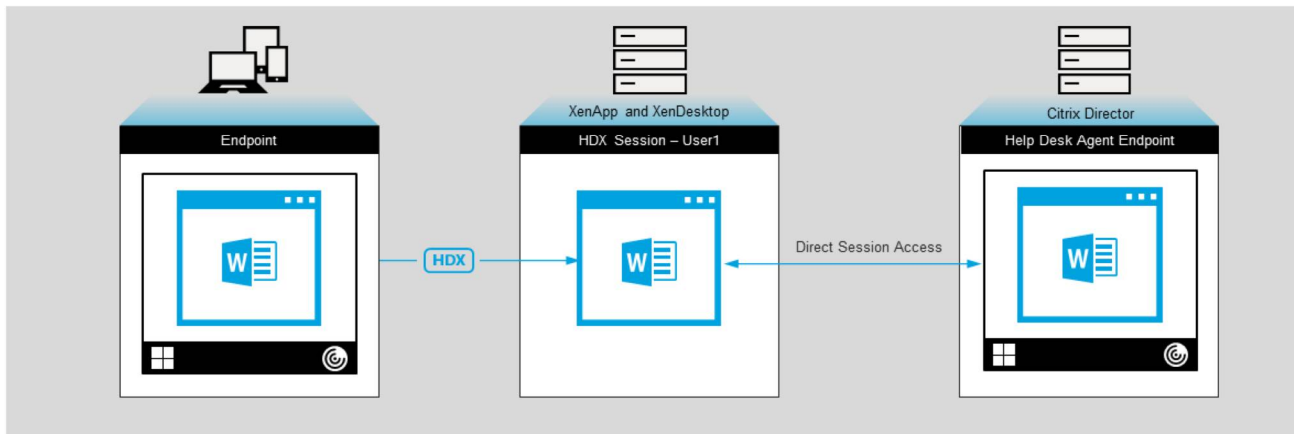
Log Off vs. Disconnect

When a session is logged off:	When a session is disconnected:
Session is no longer visible to the user.	Session is no longer visible to the user.
All applications are stopped.	All applications continue to run .
License (depending on the license model) is set free.	License (depending on the license model) is set free.
User Profile is saved back to the profile share.	User Profile is still in use on the VDA.
Session is shut down.	Session keeps running and can be reconnected.

Key Notes:

- During log off and closure of applications, depending on the OS & application setting, unsaved content might get lost.
- Tasks currently consuming CPU and memory will continue to do so when a session is disconnected.

Shadow



The Shadow feature allows a Delegated Administrator to:

- See the same content from the session as the user.
- Interact with the applications inside the session on behalf of the user.
- Chat with the user of a session.
- Shadowing requires special permissions and network requirements to be met.

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Key Notes:

- Depending on local data and privacy laws, using this feature requires consent of the user.
- Some companies consider shadowing a security vulnerability or an invasion of privacy.
- Shadowing uses Microsoft's Remote Control feature.
- Shadowing requires some configuration before it can be used :
 - The VDA needs to be accessible from the help desk agent's machine via the Remote Control port (default: 3389).
 - The person or group accessing a session needs according permission to do so.
 - The remote control feature needs to be enabled during the setup of Director.

Reset the Personal vDisk

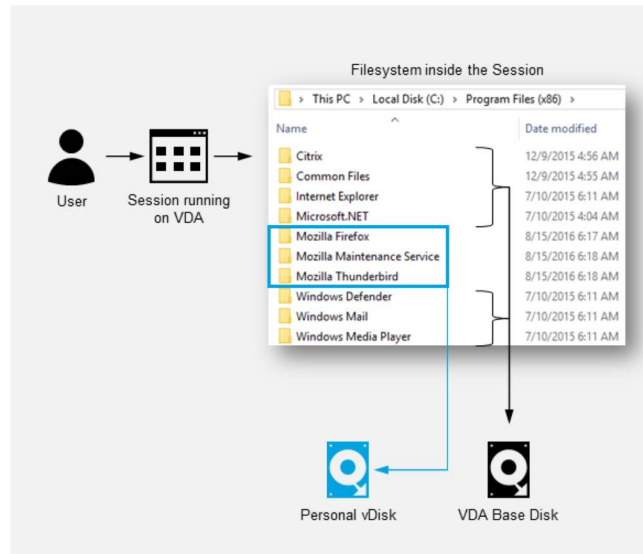
A Personal vDisk retains any changes a user makes, such as:

- User installed applications & plugins
- Windows updates
- Cached profiles

When resetting the Personal vDisk, the VDA will lose all changes and return to its original state.

Delegated Administrators should reset the Personal vDisk if:

- Data on the personal vDisk is no longer required
- The Personal vDisk is corrupt.
- The VDA is assigned to a new user



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Key Notes:

- The VDA needs to be running, but the user will be logged out during the reset procedure.
- Personal vDisks are a very special solution to some problems/scenarios and add an additional layer of management and overhead to the system. Therefore they should be used only where appropriate requirements exist.
- Any data on the personal vDisk will be lost if they are not saved elsewhere or backed up. This function should be used with caution.
- If a Delegated Admin does not have permissions to reset the Personal vDisk, the menu item will be gray in Director. This administrative permission can be found in the delegated role under Director.
- Caution: When you reset the disk, the settings revert back to their factory default values and all data on it is deleted, including applications. The profile data is retained unless you modified the Personal vDisk default (of redirecting profiles from the C: drive), or you are not using a third-party profile solution.

Additional Resources

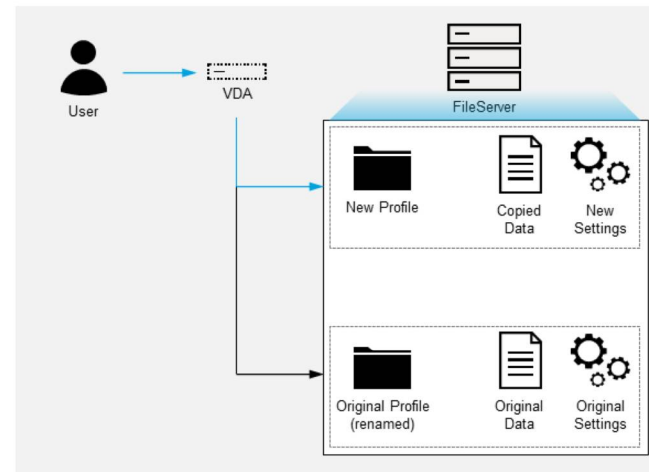
- FAQ: Personal vDisk in XenDesktop - <http://support.citrix.com/article/CTX131553>
- Reset a Personal vDisk: <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/director/troubleshoot/reset-personal-vdisk.html>

Reset the User Profile

User profiles contain all application settings for a user.

To reset a user's profile:

1. Administrator issues user profile reset
2. User logs out of all sessions
 - i. Profile management renames the original profile.
 - ii. Profile management creates a new profile for the user.
 - iii. Profile management copies retained data from the original profile to the new profile.
3. User logs on to new session



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Key Notes:

- The profile reset function is available only for user profiles managed by Citrix User Profile Management or Microsoft roaming profiles.
- It is a leading practice to separate user application settings from user generated data by using folder redirection.
- Citrix Profile Management retains and copies folders like My Documents or Pictures to the user profile after resetting the application settings in the profile. In addition, the original profile is not deleted but just renamed; so, data from this profile can be recovered if needed.
- Folder Redirection is important when resetting a Microsoft roaming profile, without folder redirection enabled the user will lose access to: My Documents, Pictures, Download etc., and it will be a manual process of copying them from the renamed profile into the new profile.

Additional Resources

- Reset a user profile - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/director/troubleshoot/reset-user-profile.html>

End Application or Process

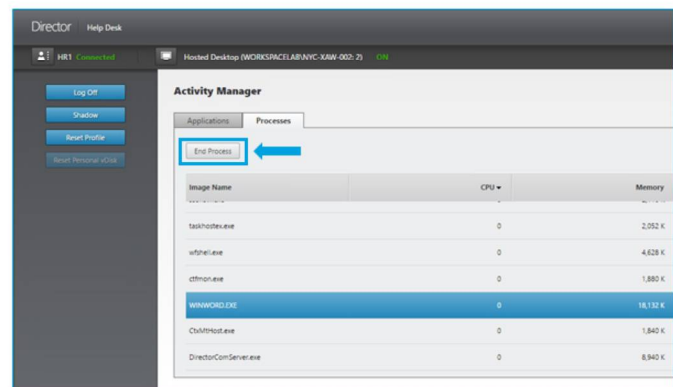
Administrators have the option to terminate a specific application or process inside a session using Director.

This is helpful in the following situations:

- The application has stopped responding
- The process is deadlocked or using 100% CPU consistently
- Terminating the entire session is not desirable

Avoid terminating system specific processes.

Terminating active processes may cause data loss.



Key Notes:

- The option to kill processes is not new, but it is much more accessible since the feature has been exposed to Director.
- Ensure that all Delegated Admins that have access to Director are aware of the consequences of killing a process.

Additional Resources

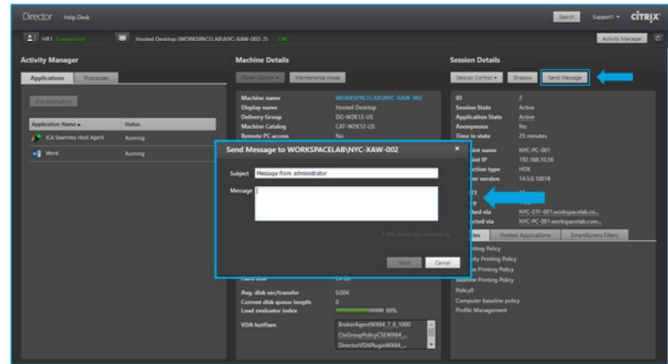
- Restore sessions - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/director/troubleshoot/restore-session.html>
- Resolve application failures - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/director/troubleshoot/application-failures.html>

Sending a Message

Director provides administrators the option to send messages to users.

The message will pop up immediately as a notification inside the session, and will always appear in focus.

Can be useful when doing image maintenance and updates, restarting VDAs, and resolving profile issues.



Key Notes:

- Sending a message to users is extremely helpful when doing maintenance on Citrix environments because it allows us to quickly notify active users of pending actions.

Additional Resources

- Send messages to users - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/director/troubleshoot/send-messages.html>



Lab Exercise

- Exercise 13-6: Log Off a User Session
- Exercise 13-7: Disconnect a User Session
- Exercise 13-8: Shadow a User Session
- Exercise 13-9: Reset the User Profile
- Exercise 13-10: End a Process Within a User Session
- Exercise 13-11: Send a Message to a User Session

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Lesson Objective Review

Scenario: You are the Citrix Admin and are trying to shadow a user using Director.

The VDAs are running a restrictive 3rd party software firewall, but you have verified that all the Citrix communication ports are open.

Which network port might be missing in the firewall configuration?

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Lesson Objective Review

Scenario: You are the Citrix Admin and are trying to shadow a user from Director.

The VDAs are running a restrictive 3rd party software firewall but you have verified that all the Citrix communication ports are open.

Which network port might be missing in the firewall configuration?

Shadowing a user session utilizes Microsoft Remote Assist port 3389.

Key Notes:

- We are integrating with Remote Assist to do shadowing.
- Remote Assist must be allowed in the firewall rules and GPOs.
- Which types of profiles can be reset using Citrix Director?
 - Only profiles managed by User Profile Management or Microsoft roaming profiles can be reset using Director.



Using Director and HDX Insight to Proactively Monitor the Site

Not for resale or distribution

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What is HDX Insight?

HDX Insight is the integration of EdgeSight network analysis and EdgeSight performance management with Director.

HDX Insight consists of several components working together:

- NetScaler Gateway
 - Relaying HDX traffic between endpoint device and VDA
- NetScaler Insight Center
 - A virtual appliance that collects network-related data from NetScaler
- Director
 - A web-based help desk & troubleshooting portal platform

Key Notes:

- HDX Insight is part of the NetScaler Insight Center and is based on the popular industry standard AppFlow. NetScaler Insight Center leverages the NetScaler Application Deliver Controller (ADC) and the NetScaler SD-WAN optimization solution that are uniquely situated in the application 'line of sight' both in the data center and the branch to provide a 360-degree view for applications, including virtual desktop traffic.
- Fast Failure Analysis: HDX Insight allows administrators to dissect the network data from various angles including desktop, application, user groups and at the individual user level. This results in a fast root-cause-analysis for customer issues.
- Real-time Client/Server Latency Measurements: In addition to TCP level jitter and latency information, HDX Insight provides detailed breakdown of ICA session latency by client, ICA RTT, and by server. These are viewed in real-time or historically on simple dashboards.
- Powerful data correlation between application and network data enables reporting and analysis on applications, the network and users.
- When deployed in-line, NetScaler and NetScaler SD-WAN detect and dissect ICA connections to provide complete visibility into the protocol.
- HDX Insight provides the ability to drill down to provide visibility and troubleshooting at the user level. Moreover, HDX Insight can sort issues by a specific application or server that might be impacting a group of users.

Additional Resources

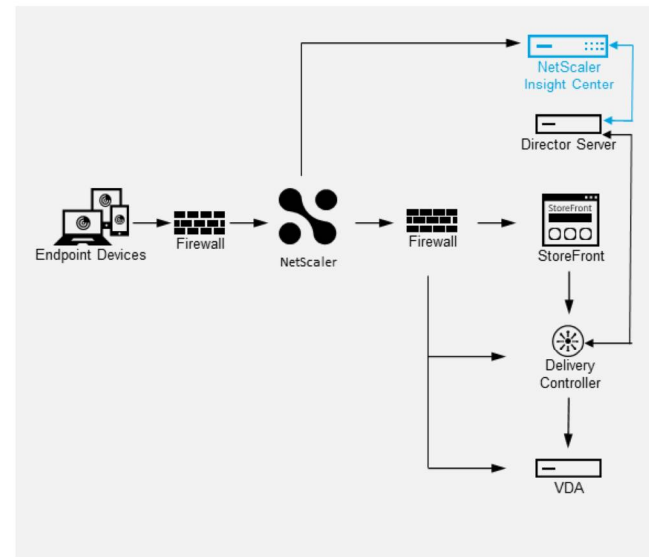
- HDX Insight at a glance -
https://www.citrix.com/content/dam/citrix/en_us/documents/products-solutions/hdx-insight-powered-by-citrix-netscaler-insight-center.pdf

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Appliance Introduction

NetScaler Insight Center is a virtual monitoring appliance offering two main features:

- **Web Insight**
 - Specialized functions to monitor HTTP traffic
- **HDX Insight**
 - Specialized functions to monitor HDX traffic



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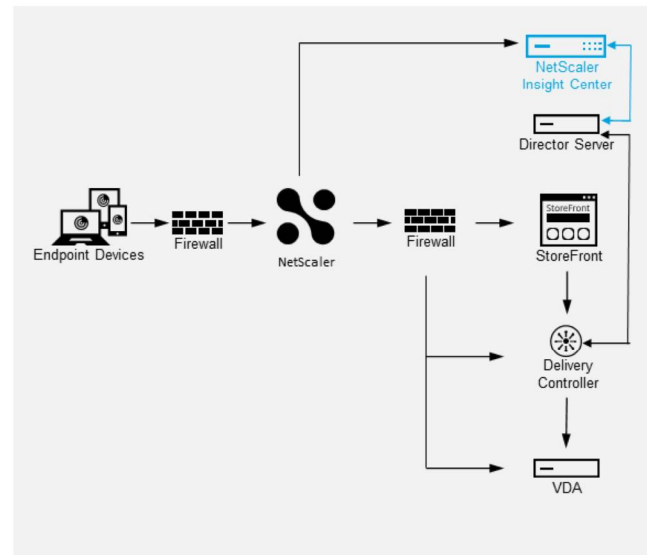
Key Notes:

- Remember HDX/CGP/ICA is a proprietary protocol, based on virtual channels.
- Part of the virtual appliance is a database to store performance data.
- The appliance can be hosted on XenServer, VMWare ESX, Microsoft Hyper-V and KVM.
- The blue line between the Director server and the NetScaler Insight Center is Director querying the NetScaler Insight Server.

HDX Insight Installation

Setting up HDX Insight requires the following steps:

1. Download, import and configure the NetScaler Insight Center appliance.
2. Configure the NetScaler Insight Center appliance to monitor the NetScaler.
3. Configure Director to integrate with the HDX Insight feature (optional).



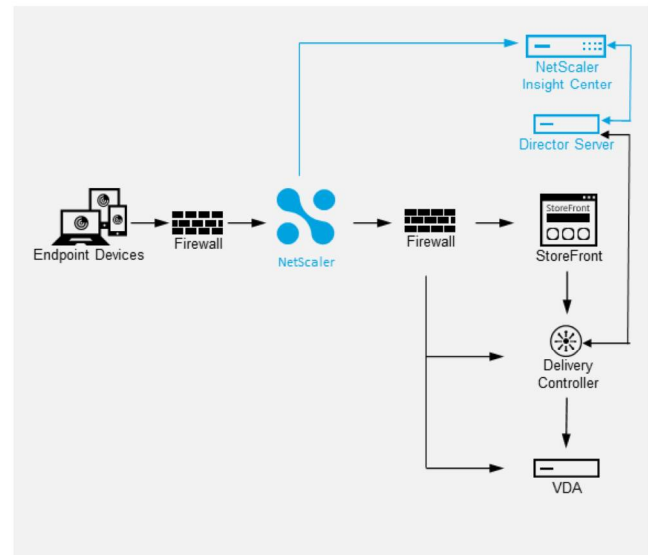
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Key Notes:

- In the Lab, a preconfigured appliance will be used.
- Step 1: encompasses assigning an IP, subnet mask, gateway and DNS address to the appliance.
- Step 2: can be performed in the Web GUI of the NetScaler Insight Center appliance.
- Step 3: requires execution of “C:\inetpub\wwwroot\Director\tools\DirectorConfig.exe /confignetscaler” on the Director server.
- Without step 3, admins would need to pull reports directly from NetScaler Insight Center, and this would not offer the same flexibility as integrating with Director.

HDX Insight: How it Works

1. NetScaler sends AppFlow data for all sessions to the NetScaler Insight Center appliance.
2. The appliance processes and stores the data in the internal database.
3. Administrators use Citrix Director to report on AppFlow data in addition to monitoring data from the Site database.



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Key Notes:

- AppFlow is a UDP-based protocol (similar to NetFlow) for transmitting monitoring data related to so called Collectors. The HDX Insight Box is such a collector.

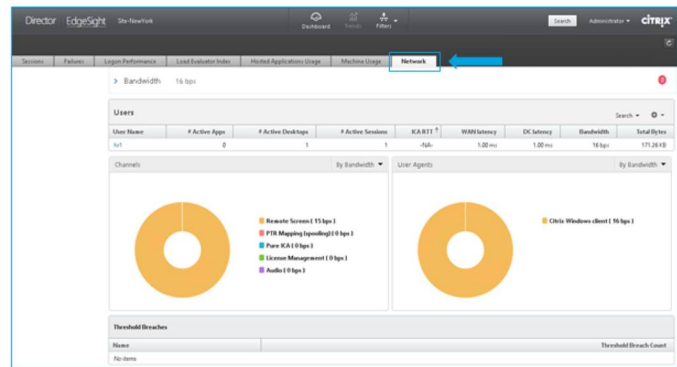
Additional Resources

- How AppFlow works - <https://docs.citrix.com/en-us/netscaler/11-1/ns-ag-appflow-intro-wrapper-con.html>

HDX Insight: Director Integration

Access the network related metrics provided by the HDX Insight feature in the following views:

- Trends view, Network tab:
 - Network statistics per user and location
 - Number of sessions and launch duration
 - Session and network statistics for desktop users
- Search view, Details:
 - Network statistics at the bottom of the page



Key Notes:

- In addition to Director, most statistics are also available from the dashboard within the web GUI of NetScaler Insight Center.

Additional Resources

- HDX Insight Reports - <http://docs.citrix.com/en-us/netscaler-insight/11-1/viewing-reports/ni-viewing-hdx-reports-ref.html>



Has anyone used HDX Insight before?

Not for resale or distribution



Lab Exercise

- Exercise 13-12: Integrate HDX Insight with Director
- Exercise 13-13: View and Interact with the new Trends Page
- Exercise 13-14: View and Interact with the New User Details Page

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Lesson Objective Review

Scenario: You are the Citrix Admin and your company is currently using the NetScaler Gateway product to run HDX Proxy.

Your manager has asked you to set up HDX Insight.

What do you need to complete this task?

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Lesson Objective Review

Scenario: You are the Citrix Admin and your company is currently using the NetScaler Gateway product to run HDX Proxy.

Your manager has asked you to set up HDX Insight.

What do you need to complete this task?

Download and install NetScaler Insight Center and ensure you have the correct licenses.

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Integrating SCOM & Director to Monitor and Troubleshoot the Site

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SCOM Management Packs for XenApp and XenDesktop

Citrix SCOM Management Packs for XenApp and XenDesktop is a software component that can be installed throughout the Citrix infrastructure to allow end to end monitoring using System Center Operations Manager.

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Key Notes:

- Management packs are available for XenApp and XenDesktop (for 7.x versions with FMA architecture), XenApp 6.x, XenServer, StoreFront, Web Interface, Provisioning Services, License Server, NetScaler and CloudBridge (currently, the newer NetScaler SD-WAN versions are not supported).
- SCOM management packs are only available with Platinum licenses.

Additional Resources

- Citrix SCOM Management Bundle Now Available for Platinum Customers: <https://www.citrix.com/blogs/2016/03/17/citrix-scom-management-bundle-now-available-for-platinum-customers/>
- Reference SCOM Packs: <http://docs.citrix.com/en-us/scom-management-packs/scom-management-pack-for-xenapp-and-xendesktop.html>

SCOM Management Packs Features

- **Topology diagram**
 - This view presents all discovered Citrix components including health status.
- **Health Explorer**
 - A view for further investigating health issues and perform troubleshooting.
- **Alerts**
 - The Alert view provides a quick overview of Citrix components that are experiencing problems.
- **Performance reports**
 - Performance reports that show historical trends for performance and usage metrics.
- **SLA dashboards**
 - A multi-site or multi-customer Service Level Monitor that will identify the Quality of Service for each entity.

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SCOM Management Packs Versions

The SCOM Management packs do not follow the XenApp and XenDesktop version numbers. To get 7.12 support, you need:

- Citrix SCOM Management Pack 3.9 for XenApp and XenDesktop

Key Notes:

- Citrix SCOM Management Packs do not ship with a specific release of XenApp and XenDesktop.
- Citrix SCOM Management Packs are backwards compatible, so you can deploy the latest version even if you want to monitor an older XenApp and XenDesktop environment.
- The SCOM Management Packs can be updated to the latest supported release while retaining LTSR status.

Additional Resources

- Citrix SCOM Management Pack for XenApp and XenDesktop version 3.9 - <https://docs.citrix.com/en-us/scom-management-packs/xenapp-xendesktop/3-9/whats-new.html>

SCOM Management Packs Considerations

- Requires XenApp and XenDesktop Platinum licenses
- Requires Microsoft System Center licenses
- Extra Memory and CPU usage

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Key Notes:

- Testing with 10,000 users have found the following:
 - Increasing the session count does not impact the CPU usage of MPXAXDAgent
 - Increasing the session count does not impact the CPU usage of HealthService
 - Average CPU usage of MPXAXDAgent was ~ 24%
 - Average CPU usage of HealthService was ~ 0.2%.
 - Average Memory usage of MPXAXDAgent was ~ 2 GB
 - Average Memory usage of HealthService was ~ 100 MB
- Computers that will host Citrix SCOM Management Pack Machine Agent for XenApp and XenDesktop must meet the following minimum hardware requirements:
 - One physical CPU with two cores (for physical systems), two virtual CPUs (for virtual systems); CPU clock speed of 2.3 GHz
 - 4 GB of RAM (excluding the paging file size)
 - 1 GB of free local storage space

Additional Resources:

- XenApp & XenDesktop Management Packs for SCOM Explained - <https://www.citrix.com/blogs/2016/07/11/scale-and-performance-of-citrix-xenapp-and-xendesktops-management-packs-for-scom-explained-tadej-razborsek/>
- Citrix SCOM Management Pack for XenApp and XenDesktop Performance Overview - <http://docs.citrix.com/content/dam/docs/en-us/scom-management-pack/xenapp-and->

xendesktop-management-pack/3-
8/downloads/Citrix_MPXAXD_PerformanceOverview.pdf

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Lesson Objective Review

Scenario: You are the Citrix Admin and you are planning to upgrade your XenApp and XenDesktop environment to 7.12.

Which version of the Citrix SCOM Management Pack do you download?

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Lesson Objective Review

Scenario: You are the Citrix Admin and you are planning to upgrade your XenApp and XenDesktop environment to 7.12.

Which version of the Citrix SCOM Management Pack do you download?

Version 3.9 supports XenApp and XenDesktop 7.12.

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Key Takeaways



- Citrix Director is an intuitive and easy to use web based administration console.
- Citrix Director offers four main views: Dashboard, Trends, Filters and Alerts.
- Citrix Director provides different functionalities and views based on the delegated permissions.
- Citrix Director allows an administrator to interact with sessions, including shadowing, to provide remote assistance to users.
- Leverage HDX Insight to provide network metrics for HDX sessions.
- SCOM Management Packs provide the ability to monitor and troubleshoot the complete infrastructure through a single pane of glass.

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Looking ahead – End of Course Survey

Your opinion matters!



Help shape the **next** course.



Tell us what **you** liked!

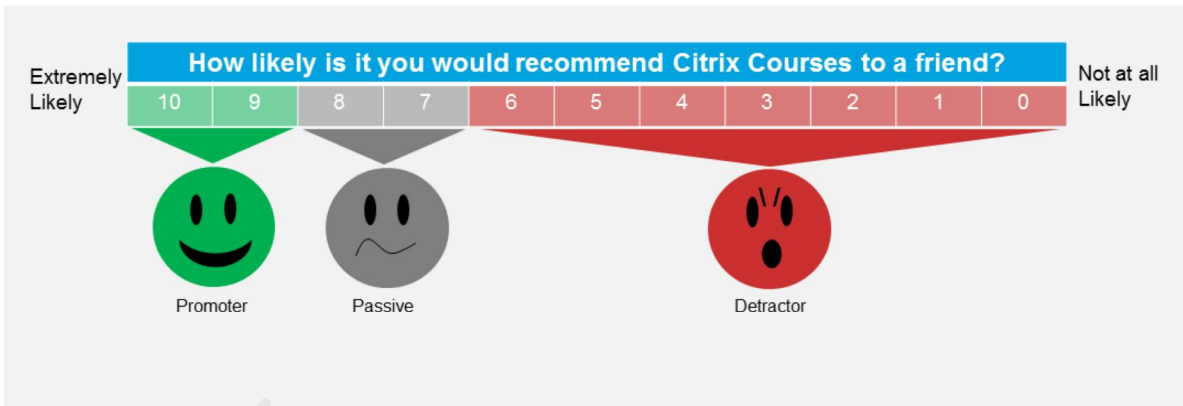


What can **we** do better?

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Citrix Measures your Feedback with NPS

How is Net Promoter Score Calculated?



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XenApp and XenDesktop Administration

Introduction to Supporting and Troubleshooting XenApp and XenDesktop

Module 14



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The following VMs are required to be powered on before beginning the exercises in this module:

- NYC-ADS-001
- NYC-SQL-001
- NYC-FSR-001
- NYC-VNS-001
- NYC-NIC-001
- NYC-XDC-001
- NYC-XDC-002
- NYC-STF-001
- NYC-STF-002
- NYC-SRV-001
- NYC-WRK-001

The remaining VMs need to be powered off.

Note: These VMs are listed in the start-up order.



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Learning Objectives

- Introduce the topic of supporting a XenApp and XenDesktop Site
- Enhance troubleshooting and problem resolution through Known Issue Awareness
- Familiarize the XenApp and XenDesktop hotfixes and the concept of LTSR versus Current Release
- Present a list of common tools for troubleshooting

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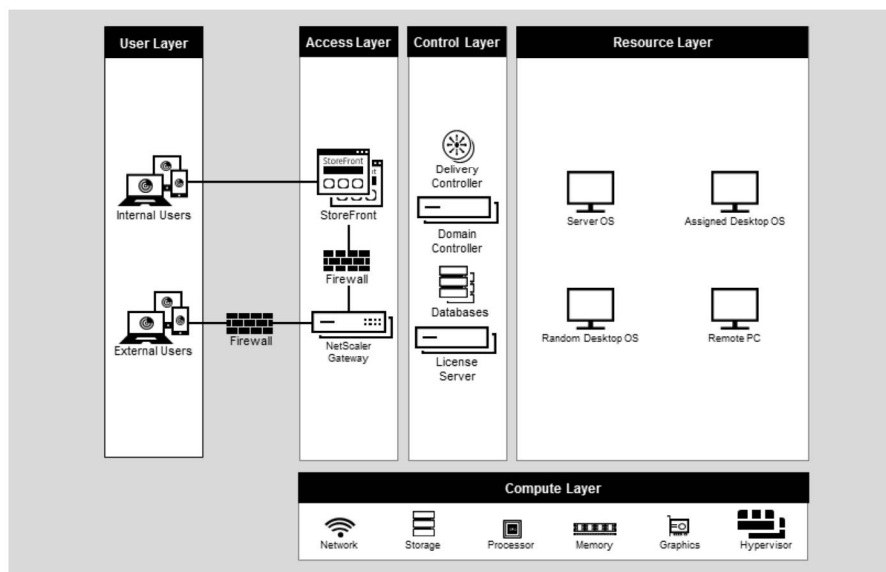
Introduction to Supporting a XenApp and XenDesktop Site

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The Troubleshooting Experience

The XenApp and XenDesktop platform has a lot of components, especially for larger environments, so troubleshooting can be complex.



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Support & Troubleshooting

Finding the right knowledge and tools is key to success when troubleshooting.

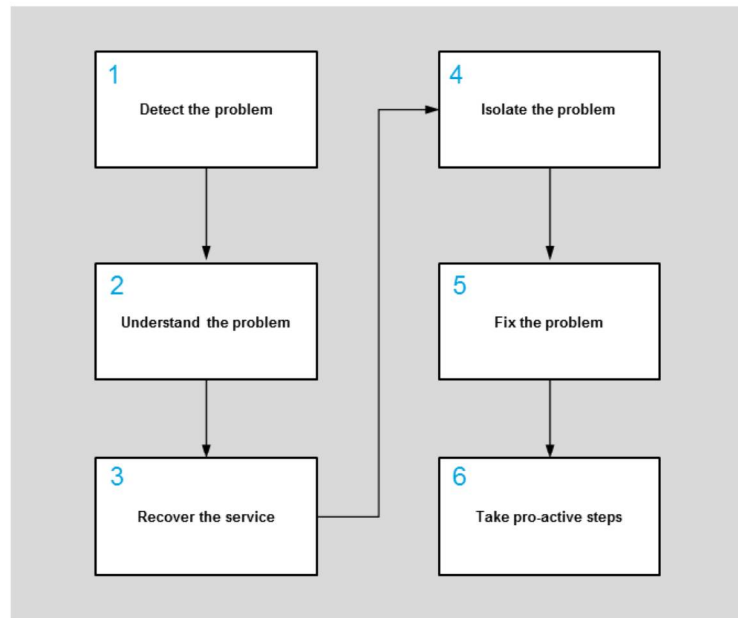
This module is designed to introduce some of these valuable resources:

- Troubleshooting methodology
- Web resources
- Citrix tools
- 3rd party tools

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An Introduction to the Citrix Troubleshooting Methodology

The Citrix recommended approach to troubleshooting XenApp and XenDesktop



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Key Notes:

- CXD-302: XenApp and XenDesktop Advanced Concepts – Troubleshooting is a two day course that focuses on troubleshooting.

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Using the Citrix Troubleshooting Methodology



1. Detecting the Problem

- a. Typically reported through either help desk tickets, monitoring tools or observations by admins.

2. Understanding the Problem

- a. Determine the difference between the expected behavior and the actual behavior.

3. Recovering the Service

- a. Get the service restored as fast as possible through workaround or temporary solution.

4. Isolating the Problem

- a. Narrow the amount of components to troubleshoot.

5. Fixing the Problem

- a. The fix should undergo a test before implementation.

6. Taking Pro-active Steps

- a. By implementing scheduled maintenance or monitoring.

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Key Notes:

- Most IT companies have a troubleshooting methodology in place even if it's not formally defined.
- Issue identification is the first step in the troubleshooting methodology. Issues are typically reported through either help desk tickets, monitoring tools, or observations by admins.
- Understanding the problem is all about understanding the symptoms. This is especially important if you cannot easily reproduce the problem and you need to understand the circumstances under which the problem appears. It is important to determine the difference between the expected behavior and the actual behavior.
- Recovering the service can potentially be one of the first steps in troubleshooting methodology. Sometimes, one part of the team can work on the recovery while the other part of the team tries to identify and fix the issue.
- Isolation of the problem is helpful to narrow the amount of components to troubleshoot. Is the problem related to specific servers or components? Specific times of day? Specific networks? etc.
- The methodology that is commonly used (even if not defined formally) is called DTAP (Development -> Test -> Acceptance -> Production). In most environments, this is spread across two environments (test and production), but some environments can include even more environments.
- After resolving a problem, it is a good practice to ensure the problem does not happen again; this can be done using monitoring tools, by implementing scheduled maintenance or by revisiting the HA and Disaster Recovery plan.



Do you have a defined troubleshooting methodology in your organization?

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Lesson Objective Review

Scenario: You are the Citrix Admin and you have just finished a troubleshooting assignment where the StoreFront servers were down due to lack of local disk space.

You have freed up disk space and users can now log in.

Are you done according to the troubleshooting methodology?

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Lesson Objective Review

Scenario: You are the Citrix Admin and you have just finished a troubleshooting assignment where the StoreFront servers were down due to lack of local disk space.

You have freed up disk space and verified the service to be operational.

Are you done according to the troubleshooting methodology?

No. The last step is to ensure this does not happen again.

Pro-active steps could be to enable disk space monitoring on StoreFront.

Key Notes:

- Taking pro-active steps is more important than troubleshooting.
- If the admin had taken pro-active steps in the first place, he would never have faced the issue in the example.

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Known Issue Awareness

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Identify Known and Resolved Issues

When troubleshooting an issue it can be very helpful to determine if the issue is known or already resolved by a hotfix or a workaround.

Citrix offers a many ways of assisting customers including:

- Citrix Docs
- Citrix Support Knowledge Center
- Citrix Insight Services
- Citrix Support Forum
- Citrix Blogs

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Citrix Docs

The product documentation for a specific version contains two sections that can be valuable in assessing an issue:

- Known issues in this release
- Issues fixed in this release

Additional Resources:

- XenApp and XenDesktop 7.12 Fixed issues - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/whats-new/fixed-issues.html>
- XenApp and XenDesktop 7.12 Known issues - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/whats-new/known-issues.html>

Support

support.citrix.com

The Citrix Support page offers extensive resources to assist in determining and fixing issues:

- Hotfixes
- CTX articles
- White papers
- Security bulletins

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Key Notes:

- All Citrix webpages are fully indexed by Google and it is a great search tool for Citrix resources.
- Use “site: Citrix.com” followed by what you are searching for to get Citrix-only hits.

Additional Resources:

- Support Knowledge Center: <http://support.citrix.com/en/products/xendesktop>



Group Discussion

Which documentation resources are you currently using?

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Lesson Objective Review

Scenario: You are the Citrix Admin and you are just about to update your environment to XenApp and XenDesktop 7.12.

Your manager has asked you whether a specific issue is being fixed by updating to 7.12.

What is the easiest way of finding this information?

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Lesson Objective Review

Scenario: You are the Citrix Admin and you are just about to update your environment to XenApp and XenDesktop 7.12.

Your manager has asked you whether a specific issue is being fixed by updating to 7.12.

What is the easiest way of finding this information?

“Issues fixed since XenApp and XenDesktop 7.11” section in the product documentation.

Additional Resources:

- XenApp and XenDesktop 7.12 Fixed issues - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/whats-new/fixed-issues.html>

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XenApp and XenDesktop Hotfixes & LTSR

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Hotfixes Explained

With the release of XenApp and XenDesktop 7.x the naming and structure of hotfixes has changed.

Currently hotfixes are available per component and are named accordingly on the download page.

Example:

UpsServer	760	WX64	002
DStudio	760	WX86	002
ICAWS	760	WX86	046

Component Version Operating System Hotfix Number

Key Notes:

- Hotfixes on the FMA platform are typically prefixed with a name to identify which component they are designed for; following is a list of some of the names being used and what they are designed for:
 - ICATS - For Server VDA Core Services
 - ICAWS - For Workstation VDA Core Services
 - XDPoshModule - For XenApp & XenDesktop PowerShell Module
 - GPMx - For Group Policy Management Console for Windows
 - DStudio - For Citrix Studio
 - HDXWMIPROV - For HDX WMI Provider
 - UpsServer - For Universal Print Server
 - MISA - For Machine Identity Service Agent
 - GPCSExt - For Group Policy Client side Extension
 - DDirector - For Citrix Director

General Release

What constitutes a hotfix in General Release?

The Citrix Life-Cycle Maintenance (LCM) Team defines and releases hotfixes for Citrix products.

Access to hotfixes depends on the release status.

Hotfixes in General Release have been fully regression tested by the product team and can be implemented by all customers.

Hotfix Status	Customer Impact	Access
General Release	Affects a wide customer base	All customers

Key Notes:

- Installing a hotfix that is in general release is typically “safer” since it has gone through a more strict release process.
- When installing any type of hotfix you should always read the release notes as they contain important information on any adverse effects the hotfix may have, or if the hotfix has any requirements.

Additional Resources:

- Lifecycle Maintenance Hotfixes - Definitions and Examples - <http://support.citrix.com/article/CTX130337>

Limited Release

What constitutes a hotfix in Limited Release?

Hotfixes in Limited Release are typically only meant to solve issues for a small set of customers or a specific usage of the software.

Limited Release hotfixes typically undergo a lighter and more specific Quality Assurance process and should be tested thoroughly before implementation in production.

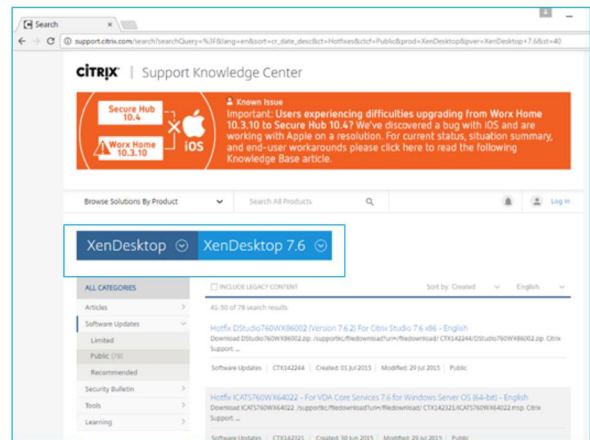
Hotfix Status	Customer Impact	Access
Limited Release	Affects a smaller number of customers	Customers with a Technical Relationship Manager, CTPs, and Partners

Key Notes:

- A Limited Release hotfix should only be installed if experiencing the exact same issue that the hotfix mitigates.
- A Limited Release hotfix should never be part of routine patch management of the Citrix environment; it should always be tested separately in a test environment before release to the production environment.
- Implementing a Limited Release may have unforeseen side effects.
- Be sure to read the release notes.

Where do I Find Hotfixes

- All General Release hotfixes for supported products can be downloaded from the Support Knowledge Center.
- Find specific hotfixes by selecting product and version in the drop-down boxes.



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Key Notes:

- Some MyCitrix accounts may not have permission to download all limited hotfixes; typically Partner accounts have more extensive download permissions.

Additional Resources:

- Citrix Knowledge Center - <http://support.citrix.com/>

What is Long Term Service Release (LTSR)?

Long Term Service Release is a specific support and service option designed for large enterprises and organizations that prefer to retain the same base installation for an extended period.

LTSR benefits:

- Extended Lifecycle with support for 10 years
- Scheduled cumulative updates
- Highest quality product releases

* LTSR does not currently support Windows Server 2016

Key Notes:

- LTSR was created to allow customers to stay on a specific Citrix platform for an extended period of time.
- The support entitlements of the Current Release program states that to be compliant you must continuously keep your platform updated to the latest product release.
- Issue example: Pharma CustomerA has regulations that state that any new environment must undergo regression testing for 18 months before the environment can go into production. After four months of testing XenApp & XenDesktop 7.9, Citrix releases a new version, thus effectively forcing CustomerA to update the environment and reset the test phase.
- Long Term Service Releases (LTSR) of XenApp and XenDesktop are ideal for large enterprise production environments where you would prefer to retain the same base version for an extended period. With LTSR, you will have regular access to fixes typically void of new functionality for predictable on-going maintenance. With each LTSR comes new extended support timelines that let you plan ahead for upgrades at a pace that's right for you and your organization.
- Extended Lifecycle with support for 10 years - Citrix typically announces a five year mainstream support lifecycle for each major release, but with LTSR the clock restarts. For a Long Term Service Release, you will have 5 years of mainstream support and 5 years of extended support (separate contract required).
- Predictable maintenance thanks to scheduled cumulative updates - Citrix will regularly release LTSR cumulative updates – typically containing only fixes devoid of new features – making it easier to schedule on-going site maintenance and lowering risk to your

deployments.

- Reduced IT costs with simplified management - Opting to implement a Long Term Service Release of XenApp or XenDesktop will give you access to the highest quality product releases with the most predictable maintenance schedule to streamline your management efforts, reduce uncertainties and mitigate risks, thereby lowering your total cost of ownership.

Additional Resources:

- Explanation of LTSR: <https://www.citrix.com/support/programs/software-maintenance/xenapp-and-xendesktop-servicing-options.html>

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What is Current Release (CR)?

The Current Release of XenApp and XenDesktop is designed to deliver new features and functionality to customers in the form of a new version rather than through patches and updates.

Current Release benefits:

- Quick delivery of new features
- Less patch management
- Fast turnaround on enhancement requests

Key Notes:

- Current Releases (CR) of XenApp and XenDesktop deliver the latest, most innovative app and desktop virtualization features and functionality allowing you to stay on the cutting edge of technology and ahead of your competition. Ideal for agile environments where you can rapidly deliver the newest app and desktop virtualization features, including both production and test environments. On-going support and maintenance for Current Releases is aligned with the frequent release cycles. Instead of managing new releases and patches independently, with Current Releases you can simply upgrade to the latest release which includes fixes and new functionality side-by-side.

Additional Resources:

- Explanation of CR - <https://www.citrix.com/support/programs/software-maintenance/xenapp-and-xendesktop-servicing-options.html>



Will you implement LTSR or Current Release?

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Lesson Objective Review

Scenario: You are the Citrix Admin and you are asked to build a new environment for hosting a critical pharmaceutical application. Your boss wants you to ensure that the platform used is supported for at least seven years.

Which release will you be using?

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Lesson Objective Review

Scenario: You are the Citrix Admin and you are asked to build a new environment for hosting a critical pharmaceutical application. Your boss wants you to ensure that the platform used is supported for at least seven years.

Which release will you be using?

[Long Term Service Release.](#)

Key Notes:

- LSTR is currently in extended support until January 2026.

Additional Resources:

- Lifecycle Product Matrix table - <https://www.citrix.com/support/product-lifecycle/product-matrix.html>



A List of Common Tools

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Introduction to Citrix Common Tools



Citrix is constantly striving to provide excellent support tools enabling administrators to better troubleshoot their environments, including:

- Custom Event Log views
- Citrix Studio
- Citrix Director
- Citrix Supportability Pack
- Citrix Insight Services
- Citrix Call Home

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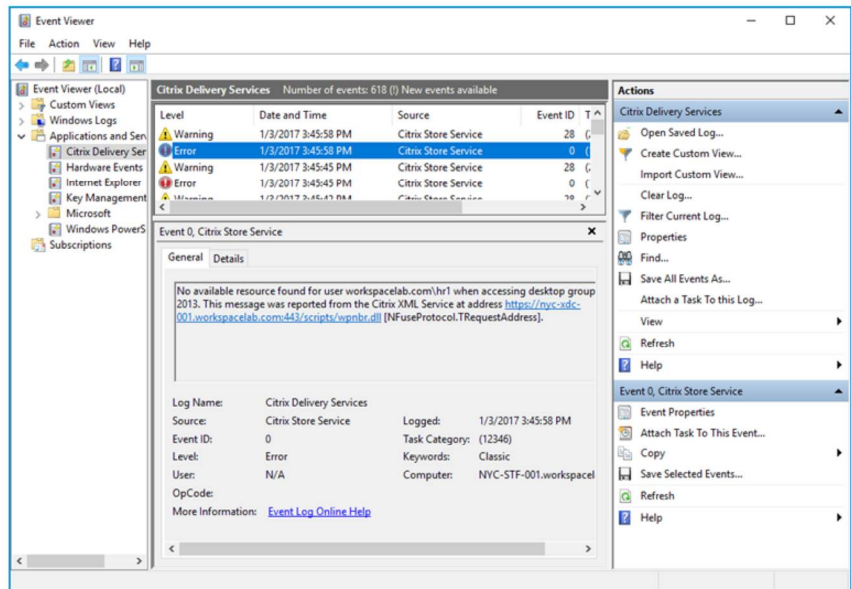
Event Logs

Citrix Views

Event Logs are typically the first place to start basic troubleshooting.

Citrix has created a custom Event Log view on the StoreFront Server that is extremely helpful for Citrix Administrators.

Use this view to gather details on logon and launch issues.



Key Notes:

- Many problems can be addressed by utilizing the StoreFront event log, which is named "Citrix Delivery Services".

Using the XenApp and XenDesktop Management Consoles

Support and troubleshooting session and resource issues usually starts with the use of Director or Studio.

- Studio is focused on setup and task management.
- Director is typically more focused on monitoring and help desk tasks.

Both Studio and Director are essential tools in supporting and troubleshooting the XenApp and XenDesktop Site.

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Using Studio

Citrix Studio can be helpful for the following support and troubleshooting tasks:

- Unregistered VDAs
- VDA load index
- VDA Catalog and Delivery Group assignments
- Citrix Policy modeling

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Using Director

Citrix Director can be helpful for the following support and troubleshooting tasks:

- Ending processes and applications for users
- Resetting profiles and Personal vDisks
- Analyzing applied Citrix Policies
- Analyzing logon duration
- Determining profile size
- Shadowing users

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The Citrix Supportability Pack

53 Popular Tools from Citrix Support

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Tools written and used by Citrix Engineers

Supportability Tool Pack

For XenApp and XenDesktop

All Tools

Features

- Cleanup
- Configuration
- Graphics
- HDX
- IMA
- Install
- Licensing
- Load Balancing
- Miscellaneous
- Monitor/alert
- Policy
- Printing
- Session/Connection
- Tracing/Logging
- USB
- Windows/System

Components

- Controller
- Database
- Endpoint
- Lync
- Multiple
- Other
- Provisioning Service
- Receiver
- StoreFront/Web Interface
- Universal Print Server
- VDI
- XenMobile

All Tools (14/24)

AppDisks Diagnostic Tool NEW

Availability: Public (More Info:CTX120380) | Get to Folder

AppDisks Diagnostic Tool collects logs and metadata files that can be provided to the Citrix Technical Support team, for failures during AppDisks creation or delivery.

Audio Volume Persistence Tool NEW

Availability: Public (More Info:CTX120388) | Get to Folder

This tool restores the volume settings when a user reconnects to a XenApp session and all playback audio devices are reset to 100% volume level.

CDFControl

Availability: Public (More Info:CTX112191) | Get to Folder

CDFControl is an event tracing controller/consumer geared towards capturing Citrix Diagnostic Facility (CDF) trace messages that are output from the various Citrix tracing providers.

CDFMarker

Availability: Public (More Info:CTX124577) | Get to Folder

CDFMarker allows you to send a customizable CDF trace statement into a running CDF trace, on demand, on either XenApp Servers or XenDesktop Virtual Desktop Agents.

CDFMonitor

Availability: Public (More Info:CTX121891) | Get to Folder

CDFMonitor triggers an event or launches a specific command or other tasks based on

Recently Added

- 3rd Party
- Give Feedback
- Submit New Tool
- Back to Home

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Key Notes:

- The Citrix Supportability Pack is downloaded as a .zip file; the .zip file contains an updater function and a web view to get an overview of all the tools. Each section has a link to the online product documentation.
- A sub-folder for each tool is available under the tools folder.
- The Supportability Pack is a collection of popular tools (53 in total as of v1.2.4) written by Citrix engineers to help diagnose and troubleshoot XenApp and XenDesktop products. The tools are cataloged by features and components to make it easier to find and use, and the addition of a Supportability Pack Updater starting with v1.2.0 makes the Pack self-updatable. Early versions of the Pack serve as a launch pad for efforts to raise awareness, improve accessibility, and promote use of internal troubleshooting tools. In subsequent updates of this pack, the spotlight will shift to creation of new tools based on prevalent customer scenarios and your feedback.

Additional Resources:

- Citrix Supportability Pack v1.2.4 - <http://support.citrix.com/article/CTX203082>

How to Download The Citrix Supportability Pack

support.citrix.com/article/
CTX203082



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Key Notes:

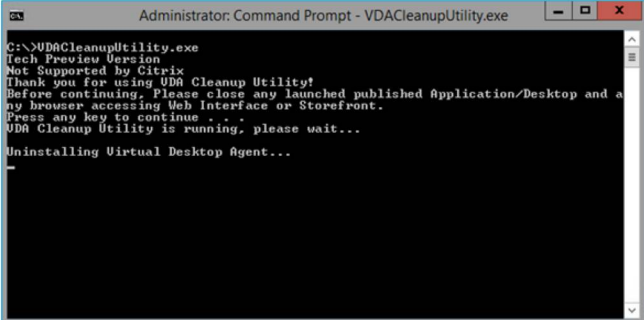
- Installing the Supportability Pack
 - If you have an older version of the Supportability Pack on your system, e.g. v1.1.x, we recommend you completely remove the existing Supportability Pack including all tools and files before downloading the newer version. Since v1.2.x and above provides a new Updater utility, you can use it to keep all tools up to date in the future.
 - Unzip the Supportability Pack .zip package into a local folder of your choice.
 - Open the README.HTML file with any web browser and begin exploring the tools catalog.
 - Each tool is in its individual folder inside the local directory Tools.
 - The Updater SupportabilityPackUpdater.exe is in the same directory as README.HTML. Use "SupportabilityPackUpdater.exe /help" to get more info about how to use it.

Supportability Pack Tool Example

VDA Cleanup Utility

The VDA Cleanup Utility is designed to assist with the following scenarios:

- When errors occur during upgrade from an earlier version of VDA
- When unexpected behavior or performance is experienced after upgrade from an earlier VDA
- If VDA upgrade is not possible due to feature incompatibility and/or a clean uninstall is required
- The VDA Cleanup Utility removes components, files, and registry values of VDA 5.6 onwards



```
Administrator: Command Prompt - VDACleanupUtility.exe
C:\>VDACleanupUtility.exe
Tech Preview Version
Not Supported by Citrix
Thank you for using VDA Cleanup Utility!
Before continuing, Please close any launched published Application/Desktop and a
ny browser accessing Web Interface or Storefront.
Press any key to continue . . .
VDA Cleanup Utility is running, please wait...
Uninstalling Virtual Desktop Agent...
```

Key Notes:

- The VDA Cleanup Utility can be run in unattended mode if desired using the /silent command line option. C:\> VDACleanupUtility.exe /silent
- In silent mode, the tool will reboot system automatically. After the reboot, logon to the machine with the same admin user, the tool will run again automatically.
- Automatic reboot of the system can be suppressed by using /NoReboot command line option. Though it is highly recommended to reboot the machine before attempting to re-install VDA.
- C:\> VDACleanupUtility.exe /noreboot
- C:\> VDACleanupUtility.exe /silent /noreboot
- Log files for VDA Cleanup Utility are created in %TEMP%\Citrix\VdaCleanup folder and can be used to track all uninstall actions and results.

Additional Resources:

- VDA Cleanup Utility - <https://support.citrix.com/article/CTX209255>

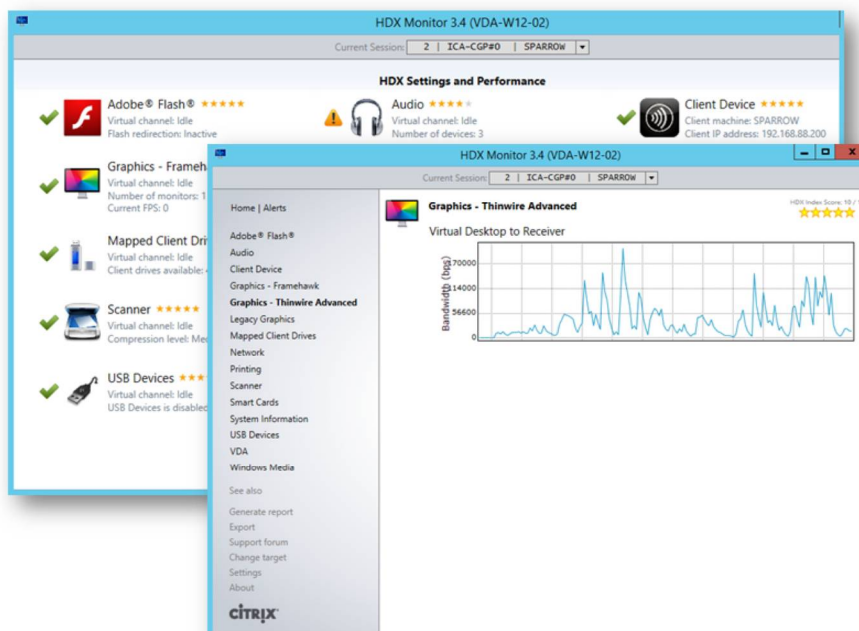
Supportability Pack Tool Example

HDX Monitor

Information about available virtual channels for a running session

Detailed insight into current session settings

Performance graphs for active virtual channels in the HDX protocol



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Key Notes:

- HDX Monitor is a free tool provided for download on the Citrix Insight Services website. Users can run the tool inside a session or admins can use the tool to monitor a session remotely within the domain.
- HDX Monitor does not change the properties of a session and cannot interfere with the session (disconnect, logoff etc.).
- HDX Monitor can export the data to an XML file for later processing.
- Citrix HDX includes a broad set of technologies that provide a high-definition user experience.
- HDX provides a superior graphics and video experience for most users by default, with no configuration required. Citrix policy settings that provide the best out-of-the-box experience for the majority of use cases are enabled by default.
- Use the HDX Monitor tool (which replaces the Health Check tool) to validate the operation and configuration of HDX visualization technologies and to diagnose and troubleshoot HDX issues.

Additional Resources:

- HDX Monitor Tool - <https://cis.citrix.com/hdx/download/>
- HDX - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/hdx.html>
- HDX 3D Pro - <http://docs.citrix.com/en-us/xenapp-and-xendesktop/7-12/hdx/hdx-3d-pro.html>

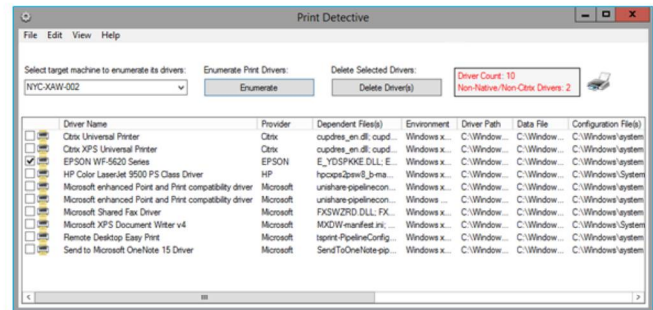
- HDX Monitor 3.x - <https://support.citrix.com/article/CTX135817>

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Supportability Pack Tool Example

Print Detective

Print Detective is a support tool that can scan a local or remote computer for installed printer drivers. The tool can list details either in the console or output the data to a log file.



Key Notes:

- The tool can be very helpful in analyzing driver versions across different VDAs.
- Example: UserA can print when he is logged on to one ServerA, but not when he is logged on to ServerB; use the tool to get a list of printer drivers on both servers and compare these.
- Also, it has the ability to delete specific drivers, but this requires admin rights on the specific computer.
- Print Detective is an information gathering utility that can be used for troubleshooting problems related to print drivers. It enumerates all printer drivers from the specified Windows machine, including driver specific information. It can also be used to delete specified print drivers. It allows for log file capabilities and provides a command-line interface as well.

Additional Resources:

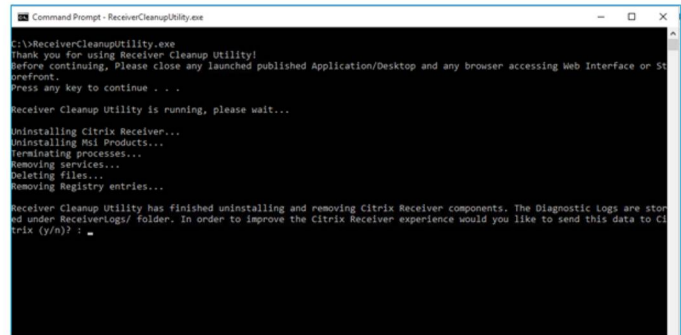
- Print Detective v1.2.1.5: <http://support.citrix.com/article/CTX116474>

Supportability Pack Tool Example

Receiver Clean-Up Utility

Use the Receiver Clean-Up Utility in the following scenarios:

- Errors occur during upgrade from an earlier version of Receiver
- Unexpected behavior or performance is experienced after upgrade from an earlier Receiver
- Upgrade is not possible due to feature incompatibility and/or a clean uninstall is required
- The Receiver Clean-Up Utility removes components, files, and registry values of Online Plug-in 11.x and newer.



```
Command Prompt - ReceiverCleanUpUtility.exe
C:\>ReceiverCleanUpUtility.exe
Thank you for using Receiver Cleanup Utility!
Before continuing, Please close any launched published Application/Desktop and any browser accessing Web Interface or ST interface.
Press any key to continue . . .
Receiver Cleanup Utility is running, please wait...
Uninstalling Citrix Receiver...
Uninstalling MSI Products...
Terminating processes...
Removing services...
Deleting files...
Removing Registry entries...
Receiver Cleanup Utility has finished uninstalling and removing Citrix Receiver components. The Diagnostic logs are stored under ReceiverLogs/ folder. In order to improve the Citrix Receiver experience would you like to send this data to Citrix (y/n)? : -
```

Key Notes:

- The Receiver Clean-Up Utility can be run in unattended mode if desired using the /silent command line option.
- ReceiverLogs folder is created in the location where the utility is run and tracks all uninstall actions and results.
- C:/> ReceiverCleanupUtility.exe /silent
- Although the Receiver Clean-Up Utility will backup Receiver registry keys before deleting them, it is recommended to back up the registry before running this tool.

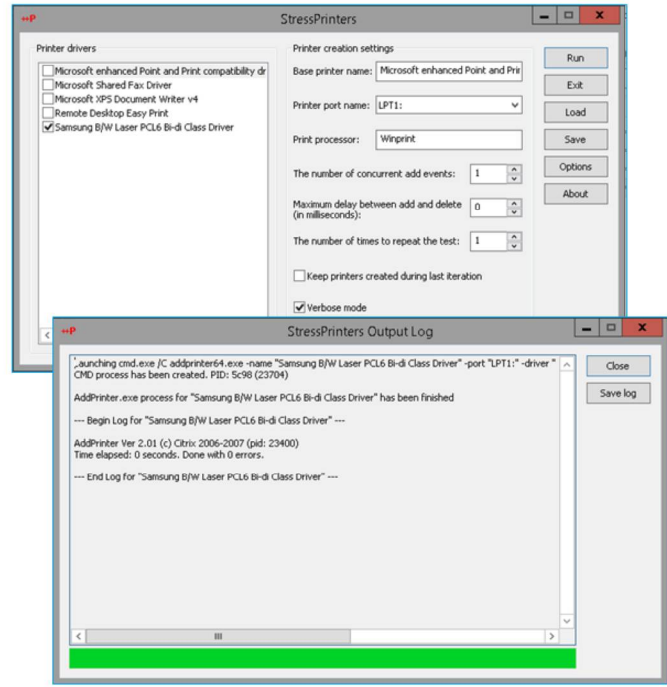
Additional Resources:

- Receiver Clean-Up Utility - <http://support.citrix.com/article/CTX137494>

Supportability Pack Tool Example

Stress Printers

- The StressPrinters tool will perform the action of adding and removing printer objects using a specific driver; this will simulate users mapping and deleting printers during logon and logoff.
- If a printer driver exposes errors or heavy performance impact during StressPrinters testing, the driver should be investigated further.



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Key Notes:

- Most printer driver issues are related to mapping and deleting the printer multiple times in a shared environment.
- Stress printers will simulate this action, use the drop-down selectors to chose how many tests to run.
- This should never be performed on a production environment, as it may cause performance degradation or stability issues.
- Many printer driver problems in Terminal Services/Remote Desktop Services environments revolve around poor multi-threaded performance, which in turn can cause print spooler instability. Problematic multi-threaded performance is usually exposed when multiple users connect to a Terminal Server simultaneously using the same printer driver. Symptoms include the failure to auto-create client printers, increased thread count of the printer spooler and/or Citrix Print Manager services, and possibly the unresponsiveness and/or unexpected termination of these services (stop responding).
- This tool can be used to simulate multiple sessions auto-creating printers using the same printer driver.

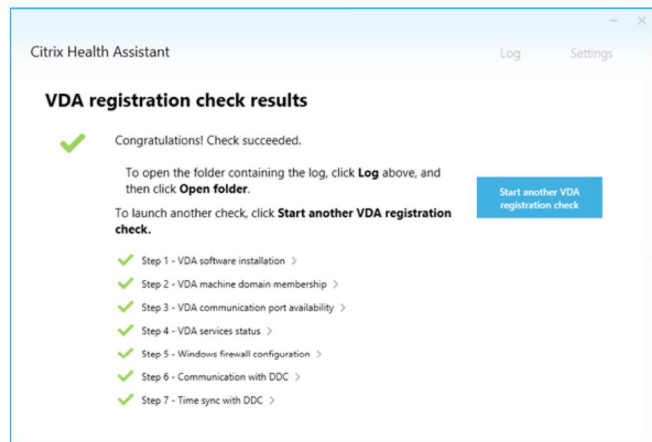
Additional Resources:

- StressPrinters Version 1.3.2 - <http://support.citrix.com/article/CTX109374>

Supportability Pack Tool Example

Citrix Health Assistant

The Citrix Health Assistant is a Windows tool which automates the process of checking for the causes of common configuration issues in a XenApp and XenDesktop environment.



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Key Notes:

- This tool automates a series of health checks to identify possible root causes for common VDA registration and session launch issues. The tool is graphical UI based but also supports command line commands.
- The tool conducts the following health checks on a VDA, and reports results in the UI as well as in the log file:
 - For VDA Registration:
 - VDA software installation
 - VDA machine domain membership
 - VDA communication ports availability
 - VDA services status
 - VDA Windows firewall configuration
 - VDA communication with each Controller
 - VDA time sync with each Controller
 - VDA registration status
 - For Session Launch:
 - Session launch communication ports availability
 - Session launch services status
 - Session launch Windows firewall configuration

- XDPing is an older, command-line based tool that also troubleshoots registration and brokering issues in XenApp & XenDesktop. It has been superseded by the Citrix Health Assistant, but is still available for download if desired.

Additional Resources:

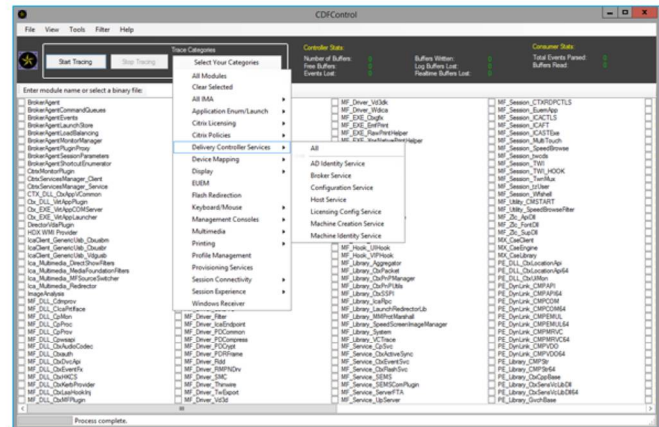
- Citrix Health Assistant - <https://support.citrix.com/article/CTX207624>
- XDPing Tool - <https://support.citrix.com/article/CTX123278>

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Supportability Pack Tool Example

CDF Control

CDFControl is an event tracing controller, geared towards capturing *Citrix Diagnostic Facility* (CDF) trace messages that are output from the various Citrix tracing providers



Key Notes:

- Various Citrix components contain built in debug trace statements, which leverage the Microsoft Event Tracing for Windows (ETW) technology. This means that these components are registered as ETW providers, and can be configured by ETW controllers to start logging their trace statements to a log file.
- CDFControl has been crafted to gather critical troubleshooting data (such as CDF trace and performance data) that should help when troubleshooting complex Citrix related issues. The guide (in the CDFControl Menu under Help) will help you become familiar with all the new features and techniques available to help you maximize your use of this application.

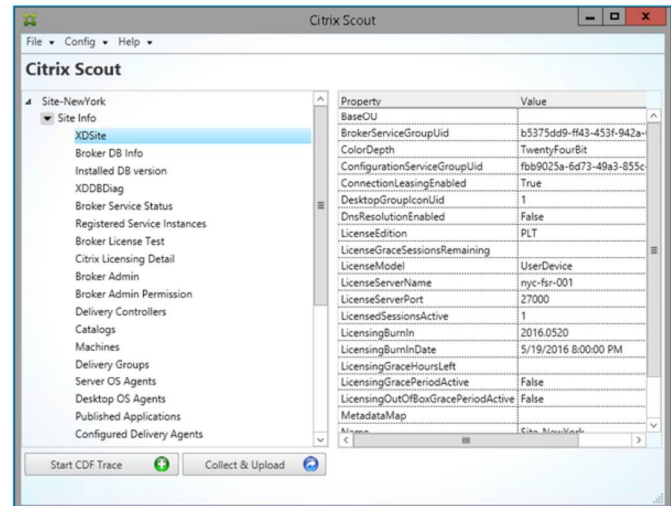
Additional Resources:

- CDFControl v3.2.1.8 - <http://support.citrix.com/article/CTX111961>

Supportability Pack Tool Example:

Citrix Scout

Run Citrix Scout from a single Delivery Controller to capture key data points and CDF traces for selected computers, followed by secure and reliable upload of the data package to Citrix Technical Support.



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Key Notes:

- Scout is a data collection tool that can be used to capture environment data and CDF traces from environments running XenDesktop 5.x, XenApp 6.x and XenApp and XenDesktop 7.x.
- Scout is pre-installed on all Controllers running 7.5 upwards, and can be found in the Citrix Folder on the start menu.
- Scout must run on a Citrix Delivery Controller machine when capturing product information.

Additional Resources:

- Scout v2.23.0.0s - <https://support.citrix.com/article/CTX130147>

Supportability Pack Tool Review

- The Citrix Supportability Pack contains 53 tools from Citrix Support.
- Not all tools are designed for the FMA platform.
- Always read the documentation before implementing a tool in production.

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Group Discussion

Which of the presented tools would you implement in your environment?

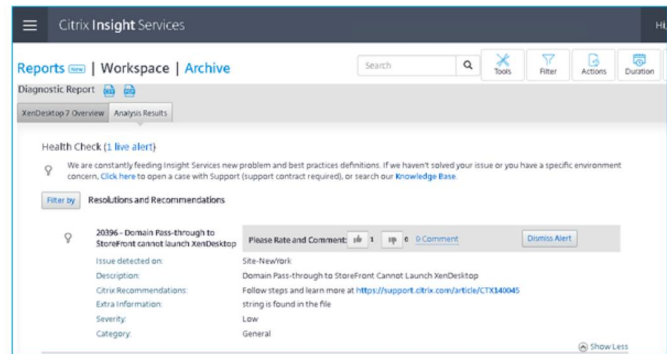
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Citrix Insight Services

“Give us your logs.
We'll give you the insights.”

Citrix Insight Services is a free web based tool

- Analyzes your log files.
- Profiles your environment for known issues.
- Can suggest hot fixes, patches, and updates with red/yellow/green prioritization.
- Can also provide a quick Health Check of your running environment.



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Key Notes:

- Citrix Insight Services (formerly known as TaaS) is an initiative from Citrix focused on making the support of the Citrix environment as easy as possible. Citrix has developed tools and online analysis capabilities to help collect environment information, analyze that information, and receive tailored recommendations based on Citrix environment and configuration. The tools are focused on a single mission (data collection), and their impact.

Additional Resources:

- Citrix Insight Services - <https://cis.citrix.com/>
- Citrix Insight Services FAQ - <http://support.citrix.com/article/CTX131233>.

Citrix Call Home Technology

Citrix Call Home is an opt-in data capturing service designed to give Citrix better insight into product errors and performance issues, allowing Citrix to proactively analyze and solve issues.

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Key Notes:

- Call Home is optional and can be turned off using PowerShell if enabled during install.

Additional Resources:

- About Call Home - <https://www.citrix.com/community/cx/call-home.html>
- Call Home - <https://www.citrix.com/blogs/2015/12/15/citrix-call-home-technology/>



Will you be using Citrix Insight Services for troubleshooting?

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Introduction to Microsoft Common Tools

Since Citrix XenApp and XenDesktop is built on top of a Microsoft platform, we can utilize a number of Microsoft tools for troubleshooting.

- System Monitor
- Performance Monitor
- Network Monitor
- Command line tools
- PowerShell

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Microsoft Sysinternals

Sysinternals is an advanced set of tools from Microsoft to enable IT Professionals to diagnose and troubleshoot a Windows environment.

The Sysinternals Suite consists of more than 70 free tools.

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Additional Resources:

- Sysinternals Suite - <https://technet.microsoft.com/en-us/sysinternals/bb842062>

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Microsoft Sysinternals Example

Process Explorer

Process Explorer will enable administrators to analyze what is going on behind the scenes in Windows:

- **Handle View**

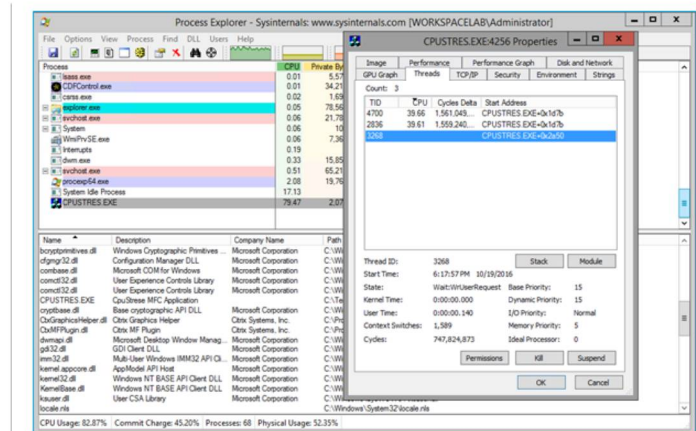
- See the handles that the process selected in the top window has opened

- **DLL View**

- See the DLLs and memory-mapped files that the process has loaded

- **Search View**

- Which processes have particular handles opened or DLLs loaded



Key Notes:

- Process Explorer can be used to analyze processes and applications.
- Especially helpful for tracking down DLL version issues and handle leaks.
- Example: You have an application running in your environment that you suspect of memory leaking. Use Process Explorer to compare a freshly started application against the same application that has been running for a while; compare the amount of handles and memory consumed by the process.

Additional Resources:

- Process Explorer v16.12 - <https://technet.microsoft.com/en-us/sysinternals/procexpexplorer>
- The Case of the Unexplained, 2010: Troubleshooting with Mark Russinovich - <https://channel9.msdn.com/events/teched/northamerica/2010/wcl315>

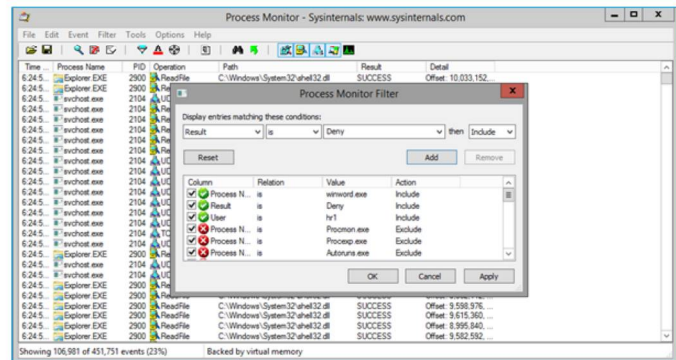
Microsoft Sysinternals Example

Process Monitor

Process Monitor is an advanced monitoring tool for Windows that shows real-time file system, registry and process/thread activity.

Main features include:

- Enhanced filter engine
- Extensive process details
- Process tree tool



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Key Notes:

- Process Monitor is the combination of two older tools from Sysinternals: Regmon and Filemon.
- Process Monitor will monitor and trace any I/O or registry based activity and allow the admin to search for session ID or username, using filters.
- Example: An application is reporting a file system permission issue for a user, and you want to find out where the application is trying to write and which write operation gets denied.
- Process Monitor is an advanced monitoring tool for Windows that shows real-time file system, registry and process/thread activity. It combines the features of two legacy Sysinternals utilities, Filemon and Regmon, and adds an extensive list of enhancements, including rich and non-destructive filtering, comprehensive event properties such as session IDs and user names, reliable process information, full thread stacks with integrated symbol support for each operation, simultaneous logging to a file, and much more. Its uniquely powerful features will make Process Monitor a core utility in your system troubleshooting and malware hunting toolkit.

Additional Resources:

- Process Monitor v3.31 - <https://technet.microsoft.com/en-us/sysinternals/processmonitor>

Microsoft Sysinternals Example

ProcDump

ProcDump is a command-line utility used primarily for monitoring an application for CPU spikes and generating crash dumps during a spike that an administrator or developer can use to determine the cause of the spike.

Automatic dump triggers include:

- Hung window monitoring
- Unhandled exception monitoring
- Custom performance counter monitoring

Key Notes:

- Example: You have implemented a new application that spikes to 100% CPU resources every 15 minutes.
- Use ProcDump to create an automated rule for crash dumping the process when it goes to 100%, analyze the dump with the developers to determine the root cause of the CPU spike.
- Write up to three mini dumps of a process named 'consume' when it exceeds 20% CPU usage for five seconds:
 - `C:\>procdump -c 20 -s 5 -n 3 consume`

Additional Resources:

- ProcDump v8.0 - <https://technet.microsoft.com/en-us/sysinternals/dd996900>



Group Discussion

Have you previously used any of the Sysinternals tools for troubleshooting?

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Introduction to More Tools

There may be several 3rd party tools available that are relevant for troubleshooting.

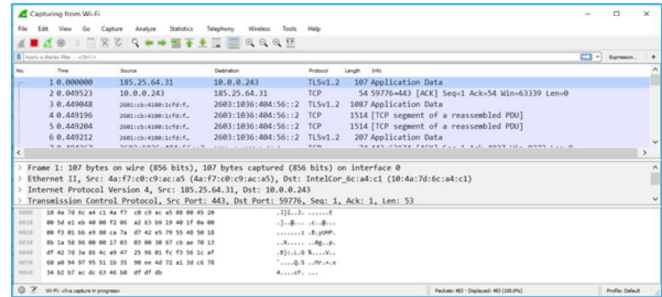
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Wireshark

Wireshark is a free and open source packet analyzer that can be used to capture network data for analysis.

Wireshark offers 3 main views:

- Packet List
- Packet Details
- Packet Data



Key Notes:

- Example: Users on a specific network get randomly disconnected from their sessions. Use Wireshark to trace the network traffic, and apply a filter to look for dropped packets or reset connections.

Additional Resources:

- Wireshark webpage - <https://www.wireshark.org/>

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Do you have experience with other 3rd party tools that have helped you in troubleshooting?

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Lab Exercise

- Exercise 14-1: Leverage the Citrix Supportability Pack and use the Citrix Health Assistant
- Exercise 14-2: Leverage the Citrix Supportability Pack and use the Citrix Receiver Clean-Up Utility
- Exercise 14-3: Leverage the Citrix Supportability Pack and use the HDX Monitor
- Exercise 14-4: Leverage the Citrix Supportability Pack and use the Scout Utility

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Lesson Objective Review

Scenario: You are the Citrix Admin and you are investigating an issue where a user's session does not successfully end after she closes her last published app.

You have used Task Manager to inspect her hanging session but could not find any relevant information.

Which tool would you use to get further details on orphaned processes in the session?

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Lesson Objective Review

Scenario: You are the Citrix Admin and you are investigating an issue where a user's session does not successfully end after she closes her last published app.

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Which tool would you use to get further details on orphaned processes in the session?

Process Explorer

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Key Takeaways



- The Citrix Troubleshooting Methodology can assist you in supporting a XenApp and XenDesktop environment.
- Citrix provides a number of resources to help you identify known issues, either during troubleshooting or when preparing to update the environment.
- Hotfixes are available for many known issues; understanding how to find and apply them is important.
- A number of troubleshooting tools are available from both Citrix, Microsoft, and other 3rd party vendors.

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Provisioning Services 7.1x Administration

Advanced Provisioning
Module 15

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Learning Objectives

- Introduce Provisioning Services.
- Present the core components of Provisioning Services.
- Explain the Layered Approach Methodology.

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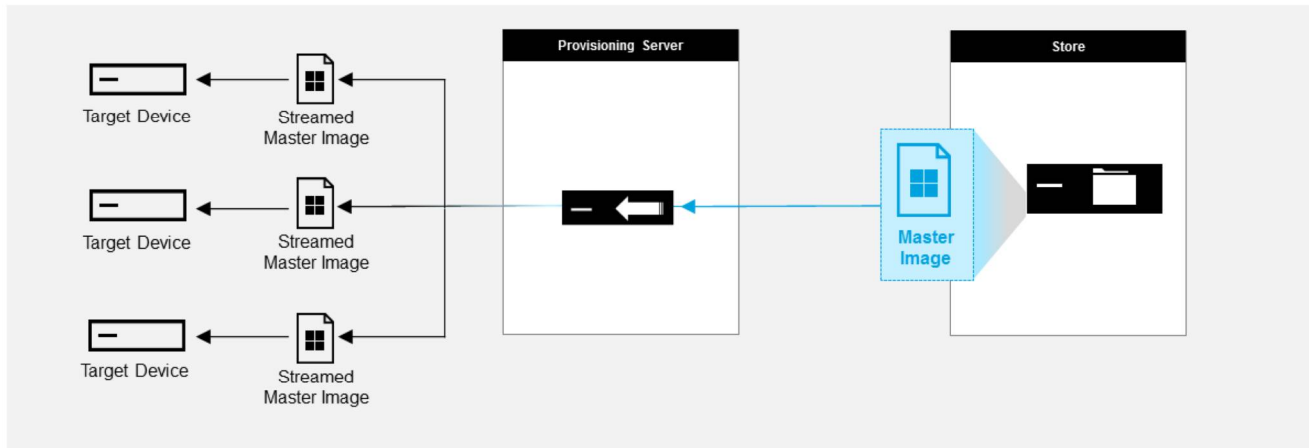


Introduction to Provisioning Services (PVS)

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What is Provisioning Services (PVS)?



Provisioning Services allows computers to be provisioned and re-provisioned in real time from a single shared-disk image, using streaming technology. This enables administrators to completely eliminate the need to manage and patch individual systems. Instead, all image management is done on the master image.

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Key Notes:

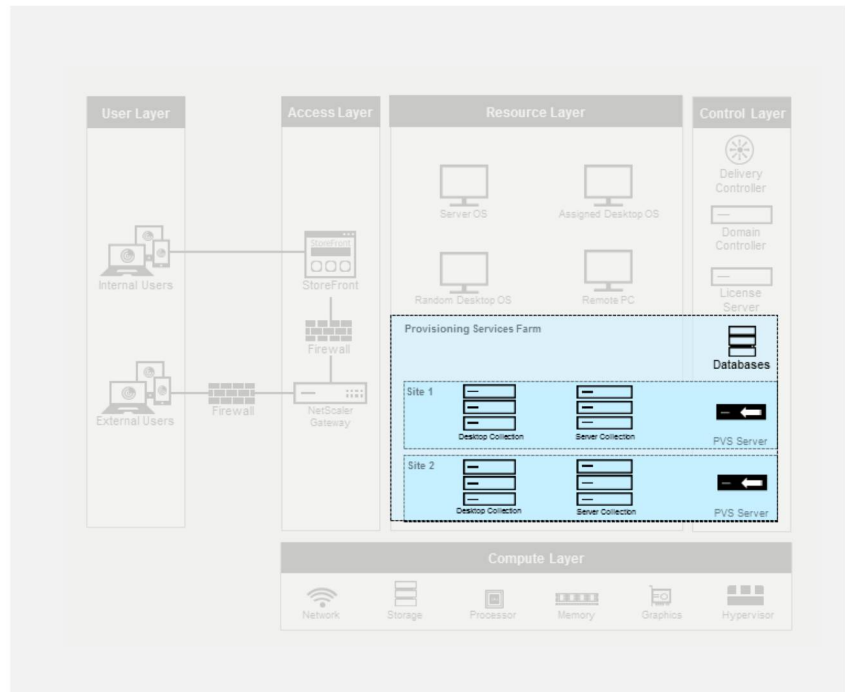
- Provisioning Services is commonly referred to by the acronym “PVS”, which will be used throughout this course.
- By streaming a single shared disk image, called a vDisk, rather than copying images to individual machines, Provisioning Services enables organizations to reduce the number of disk images that they manage, even as the number of machines continues to grow. This gets you the operational benefits of centralized management, while still being able to scale your machines quickly and efficiently.
- In production, the vDisk is in read-only mode, ensuring consistency among a pool of machines receiving that image. All disk writes are sent to a write cache, which can be located in a number of locations which we will discuss later. Updates to a vDisk can be rolled out to a large number of machines simply by rebooting them to use the newer version of the vDisk, or a different vDisk entirely.
- The local hard disk drive of each system can be used for runtime data caching or, in some scenarios, removed from the system entirely, which reduces power usage, system failure rates, and security risks.

Additional Resources:

- Provisioning Services product overview - <http://docs.citrix.com/en-us/provisioning/7-13/overview.html>

Why is Provisioning Services an Advanced Provisioning Method?

Unlike MCS, PVS is not built into a XenApp and XenDesktop Site, and requires additional components to be installed and configured.



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Key Notes:

- Technically, PVS is a separate entity from XenApp and XenDesktop, and they can each be used alone, but work best when integrated with each other.
- As a result of the additional resources, configuration, and maintenance associated with adding the PVS architecture to a XenApp and XenDesktop environment, some organizations may choose to use the built-in MCS provisioning method, especially for proof of concept environments, test environments, and environments with network resource limitations (vs. storage limitations). However, as we will see, the benefits of PVS increase as environments grow larger, more than making up for the increased initial set up time.

Additional Resources:

- Provisioning Services or Machine Creation Services (2016 Edition): <https://www.citrix.com/blogs/2016/06/28/provisioning-services-or-machine-creation-services-2016-edition/>

What are the benefits of Provisioning Services?



Simplify management of enterprise images

- Roll out patches consistently and uniformly
- Easily deploy image updates and rollbacks



Ensure a consistent and secure user experience

- Same image is accessed regardless of which VDA is hosting the session
- Any user-impacting changes can be reset with a reboot



Reduce storage footprint of your deployment

- Especially critical for Desktop OS deployments
- VDAs only need a small local disk for temporary writes and persistent data

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Key Notes:

- Although MCS has been developed and improved greatly over the years, the speed of deploying and rolling back image updates is one area where PVS is demonstrably faster. This can have a great impact in environments with a large number of VDAs.
- VDAs provisioned with PVS all boot from the same “golden” image, which ensures that users are getting the same experience from any machine using that image. Any issues that occur during runtime due to the actions of a single user, or even due to a malicious attack on the operating system, can easily be rolled back by rebooting the machine and discarding any unwanted changes.
- As we will cover later, Provisioning Services is very dependent on the network connectivity between the components of the PVS architecture. However, storage requirements are reduced due to several factors, which can potentially save an organization a lot of money.

Additional Resources:

- Provisioning Services product overview - <http://docs.citrix.com/en-us/provisioning/7-13/overview.html>

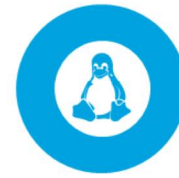
Which operating systems can be provisioned?



- Windows Server 2016
- Windows Server 2012 R2
- Windows Server 2012
- Windows Server 2008 R2 SP1
- Windows Server 2008 R2



- Windows 10
- Windows 8.1
- Windows 8
- Windows 7 SP1



- RedHat Enterprise Linux 7.2
- CentOS 7.2

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Key Notes:

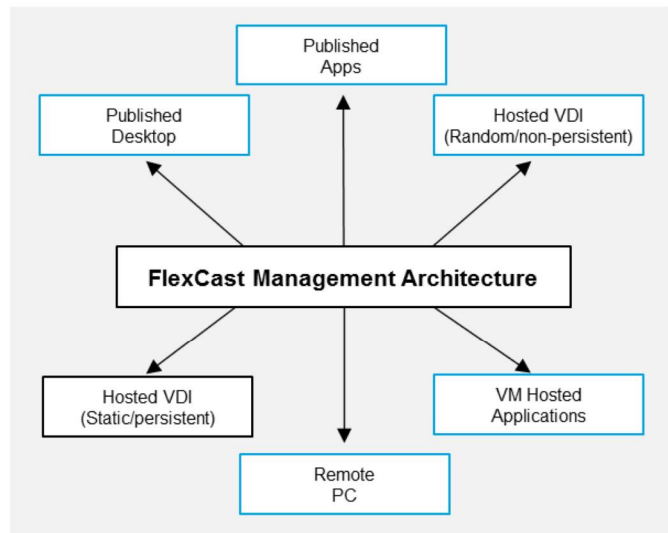
- The listed versions of Windows and Windows Server can be provisioned through PVS. Additionally, selected versions of Linux (RedHat Enterprise Linux 7.2 and CentOS 7.2) can also be provisioned (as of PVS 7.13).
- Refer to the product documentation to verify that your OS edition is supported. For example, the Ultimate edition of Windows 7 is only supported in Private Image mode, which restricts a lot of the benefits and functionality of PVS.
- Windows Desktop operating systems can be 32-bit or 64-bit.
- Older versions of Windows and other Linux distributions may technically work, but would not be supported by Citrix.

Additional Resources:

- System Requirements: <http://docs.citrix.com/en-us/provisioning/7-13/system-requirements.html>

Which XenApp and XenDesktop FlexCast Models are Supported by Provisioning Services?

- The Flexcast models provide administrators with a variety of ways to deliver applications and desktops
- The models highlighted in blue can be used in conjunction with Provisioning Services



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Key Notes:

- The variety of application and desktop delivery methods are referred to as FlexCast models, such as those depicted above; although not a comprehensive list, they are the most common.
- Published Desktops provide multiple user desktops hosted on a single server-based operating system.
- Published Apps provide multiple application instances hosted on a single server-based operating system.
- Hosted VDI (Random/non-persistent) provides a single desktop operating system to each user randomly.
- Hosted VDI (Static/persistent) provides a single desktop operating system to each user that is permanently assigned. Since each desktop image is unique to a specific user, this FlexCast model cannot be deployed with Provisioning Services.
- Remote PC provides access to a physical desktop already deployed. Note that to use this method with Provisioning Services, the physical PCs must stream a Provisioning Services vDisk even when not accessed remotely.
- VM Hosted Applications provide an application instance on a single desktop operating system.

Additional Resources:

- FlexCast Concepts and Components - <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-6/xad-architecture-article/xad-core-concepts.html>

- Technical overview - <http://docs.citrix.com/en-us/xenapp-and-xendesktop/7-6-long-term-service-release/xad-architecture-article.html>

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What are the use case scenarios for Provisioning Services?

Server OS VDA - Healthcare

Description: A healthcare provider streamed Server OS vDisk to VDAs to ensure consistency of mission-critical electronic health record (EHR) application.

Advantages:

- Ensures all Server OS VDAs can be uniformly updated with patches and Citrix/EHR vendor hotfixes.
- Over 10,000 doctors and nurses able to have a consistent and secure experience, often using anonymous accounts tied to devices such as thin clients and nursing stations.



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Key Notes:

- Many healthcare organizations value PVS because it facilitates their deployment of EHR systems to a large number of VDAs, and helps to ensure that doctors and nurses get a consistent experience as they move between different endpoints throughout each day.

Additional Resources:

- More Citrix customers using Provisioning Services:
 - Municipality of Berkelland (Government) - <https://www.citrix.com/customers/municipality-of-berkelland-en.html>
 - Porsche Informatik (Finance) - <https://www.citrix.com/customers/porsche-informatik-en.html>
 - Kriminalvarden (Prison and Probation Services) - <https://www.citrix.com/customers/citrix-xenapp-prison-and-probation-service-delivers-secure-and-flexible-virtual-desktop-environment-se.html>
 - Montefiore Health System (Healthcare) - <https://www.citrix.com/customers/montefiore-health-system.html>

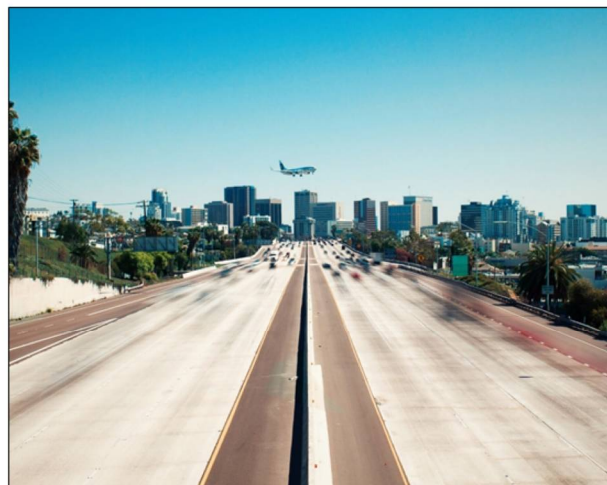
What are the use case scenarios for Provisioning Services?

Desktop OS Random, Non-Persistent Desktop – International airline

Description: An airline streamed a Desktop OS image to random, non-persistent desktops used by thousands of home-based reservations agents.

Advantages:

- Saved significant money due to reduced storage requirements
- Able to deploy image updates to thousands of VMs much more quickly than before



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Key Notes:

- PVS can be extremely valuable for random, non-persistent desktop scenarios which require a Desktop OS, since these tend to involve a relatively high number of 1 to 1 systems that must all be managed.

Additional Resources:

- More Citrix customers using Provisioning Services:
 - Municipality of Berkelland (Government) - <https://www.citrix.com/customers/municipality-of-berkelland-en.html>
 - Porsche Informatik (Finance) - <https://www.citrix.com/customers/porsche-informatik-en.html>
 - Kriminalvarden (Prison and Probation Services) - <https://www.citrix.com/customers/citrix-xenapp-prison-and-probation-service-delivers-secure-and-flexible-virtual-desktop-environment-se.html>
 - Montefiore Health System (Healthcare) - <https://www.citrix.com/customers/montefiore-health-system.html>

What are the use case scenarios for Provisioning Services?

Physical Desktop - Education

Description: A university computer lab streamed several different vDisks to physical PCs.

Advantages:

- Able to present a clean, consistent image for each college class by rebooting the machines between classes
- Different vDisks were created for each department, containing only the applications required by that department's students
- The same vDisks were eventually streamed to virtual machines when the university moved to a virtualized environment, speeding the migration.



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Key Notes:

- It is possible to use PVS in conjunction with physical machines. Although not benefiting from the increased scalability and user density of virtualization, customers streaming disks to physical machines still gain the benefits of single-image management and rapid image updates and rollbacks. Streaming to physical machines can often be used as a stepping stone while a virtualized environment is being developed, since the same vDisks can immediately be streamed to virtual targets, once they are available.

Additional Resources:

- More Citrix customers using Provisioning Services:
 - Municipality of Berkelland (Government) - <https://www.citrix.com/customers/municipality-of-berkelland-en.html>
 - Porsche Informatik (Finance) - <https://www.citrix.com/customers/porsche-informatik-en.html>
 - Kriminalvarden (Prison and Probation Services) - <https://www.citrix.com/customers/citrix-xenapp-prison-and-probation-service-delivers-secure-and-flexible-virtual-desktop-environment-se.html>
 - Montefiore Health System (Healthcare) - <https://www.citrix.com/customers/montefiore-health-system.html>



- Do you use Provisioning Services in your environment?
 - If so, what are the primary benefits you have gotten from it? How do you use it in your environment?
 - If not, what benefits or use cases most interest you?

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**Lesson
Objective
Review**

Which FlexCast models are compatible with Provisioning Services?

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Lesson Objective Review

Which FlexCast models are compatible with Provisioning Services?

Pooled VDI, Published Desktops, Published Applications, VM-hosted apps, and Remote PC (if physical endpoints are streaming targets).

Key Notes:

- Provisioning Services can be used to deliver the operating system to any non-persistent machine, which is compatible with a number of FlexCast models that do not require a high level of personalization or that do not require users to install their own applications.

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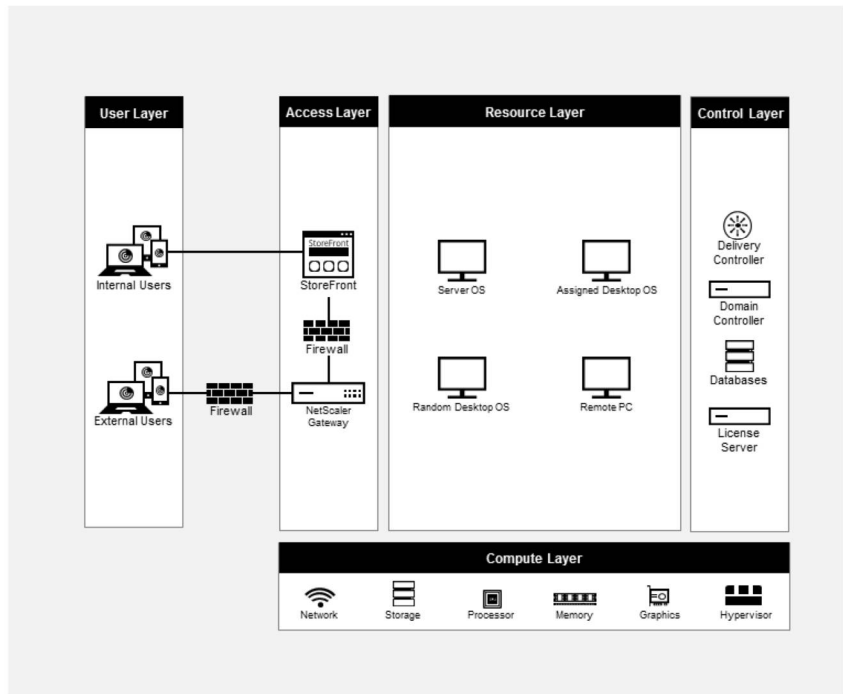
Getting Started with Provisioning Services

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The First Look at Provisioning Services

I have XenApp and XenDesktop deployed, and I'm currently using MCS. I'd like to consider PVS, but what do I need to get started? Where do I go from here?

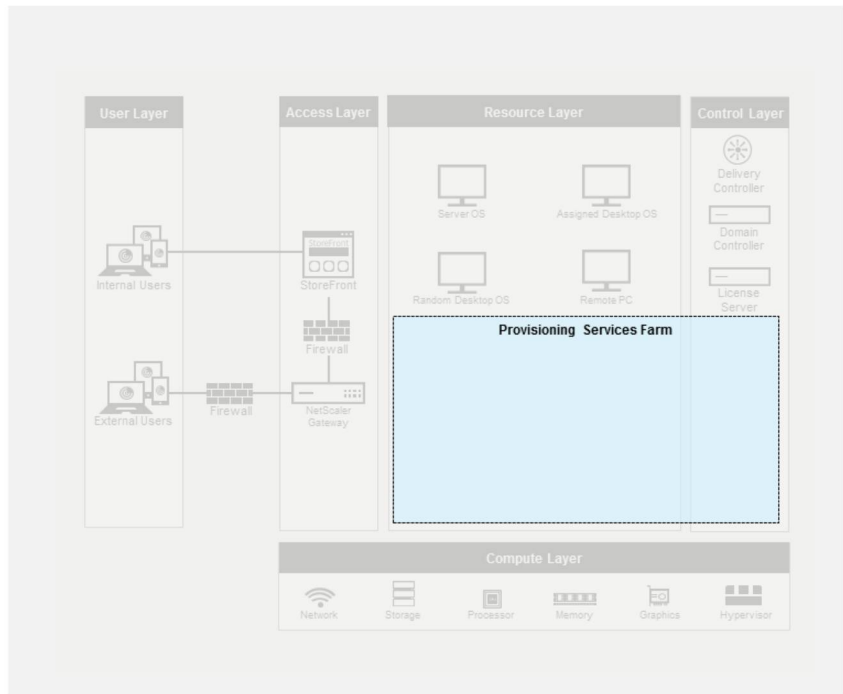


Key Notes:

- Unlike MCS, Provisioning Services requires additional infrastructure components, and introduces new concepts. We will take some time to review the core Provisioning Services components and how they fit into the base XenApp and XenDesktop architecture.

Farm

- To start you have to deploy PVS into what we call a Farm.
- The Farm manages the complete scope of the PVS deployment, including the machines to manage, the image to provide to these managed machines and the infrastructure to support it.



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Key Notes:

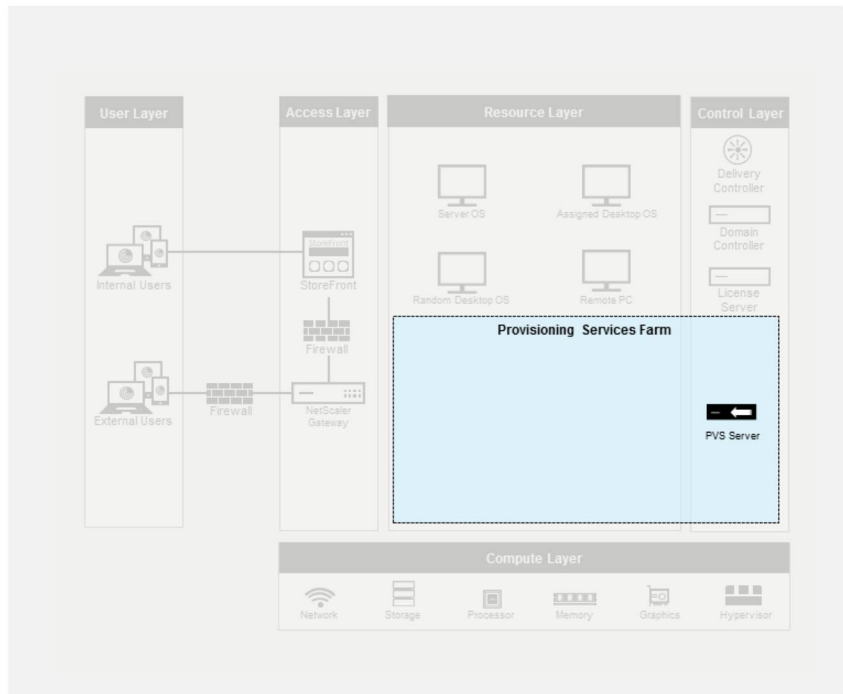
- As an analogy, you can compare the PVS Farm to a XenApp and XenDesktop Site (FMA). It is not a specific component, but rather a logical grouping of components that work together.
- A farm represents the top level of a Provisioning Services infrastructure.

Additional Resources:

- Provisioning Services product infrastructure - <http://docs.citrix.com/en-us/provisioning/7-13/overview/infrastructure.html>

Provisioning Services Server

- To Build a farm you first build a PVS Server.
- A Provisioning Server is any server that has Stream Services installed. Stream Services is used to stream software from vDisks to target devices.



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Key Notes:

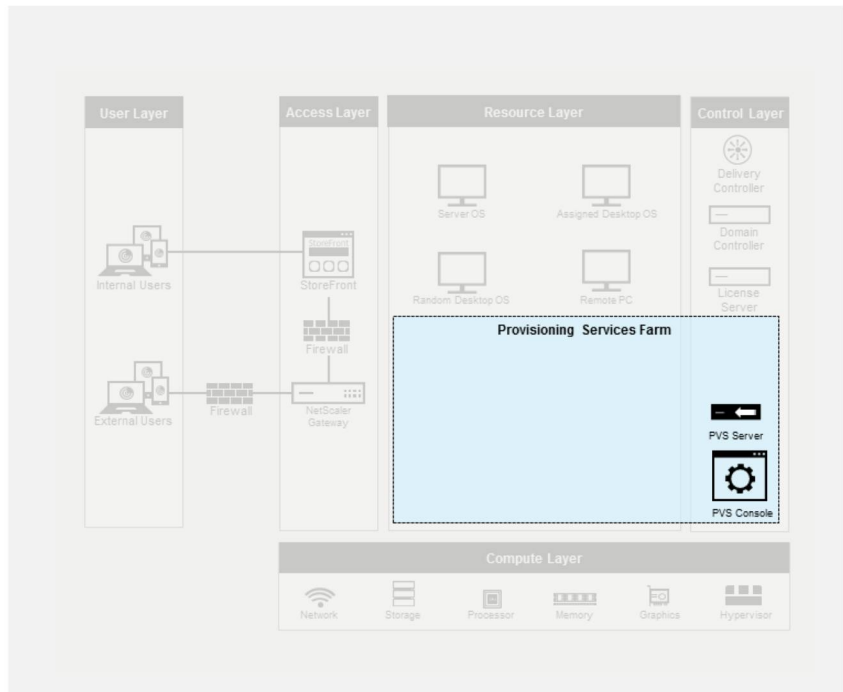
- The farm is created when the Configuration Wizard is run on the first Provisioning Server that will be added to that farm.

Additional Resources:

- Provisioning Services product infrastructure - <http://docs.citrix.com/en-us/provisioning/7-13/overview/infrastructure.html>

Provisioning Services Management Console

- When you build the PVS server, install the management console, so that after the server is setup, you can launch the console to build the farm.



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Key Notes:

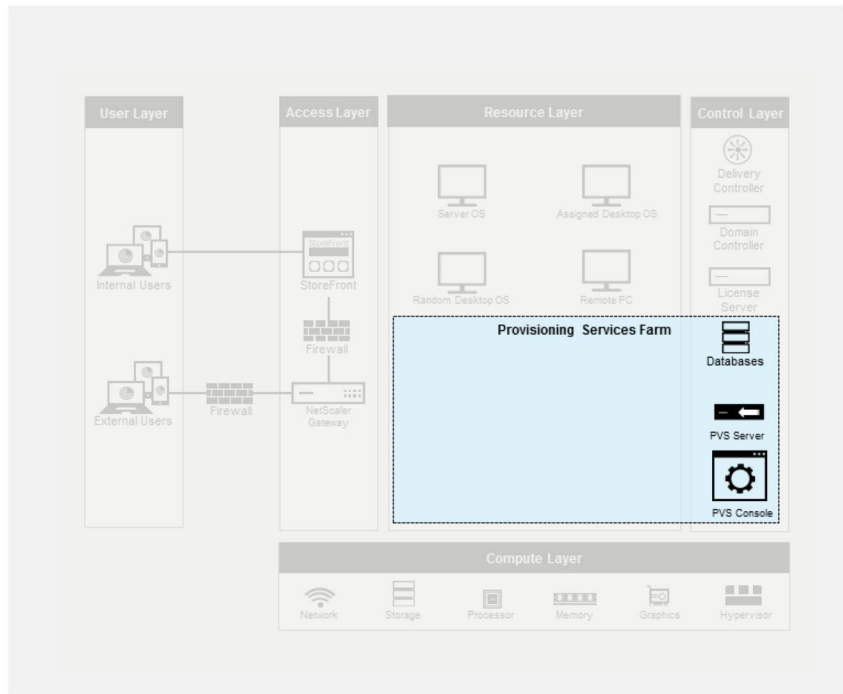
- The Console is a utility that is used to manage your Provisioning Services implementation. After logging on to the Console, you select the farm that you want to connect to. Your administrative role determines what you can view in the Console and manage in the farm.
- The Console does not need to be directly associated with the farm because remote administration is supported on any Console that can communicate with that farm's network.

Additional Resources:

- Provisioning Services product infrastructure - <http://docs.citrix.com/en-us/provisioning/7-13/overview/infrastructure.html>

Farm Database

- During the building of the farm you have to point your deployment to a SQL Server Database.
- The database stores all system configuration settings that exist within a farm.



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Key Notes:

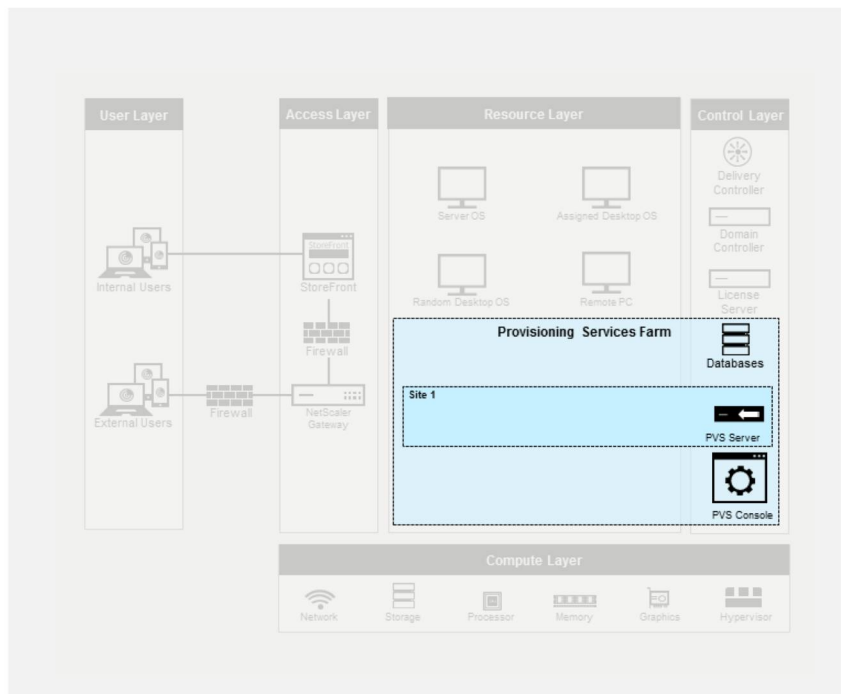
- Only one database can exist within a farm and all Provisioning Servers in that farm must be able to communicate with that database.

Additional Resources:

- Provisioning Services product infrastructure - <http://docs.citrix.com/en-us/provisioning/7-13/overview/infrastructure.html>

Site

- Once the farm is built, your PVS server creates and joins a Site, which is a sub-layer within the farm scope.
- The site is where we manage PVS servers.



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Key Notes:

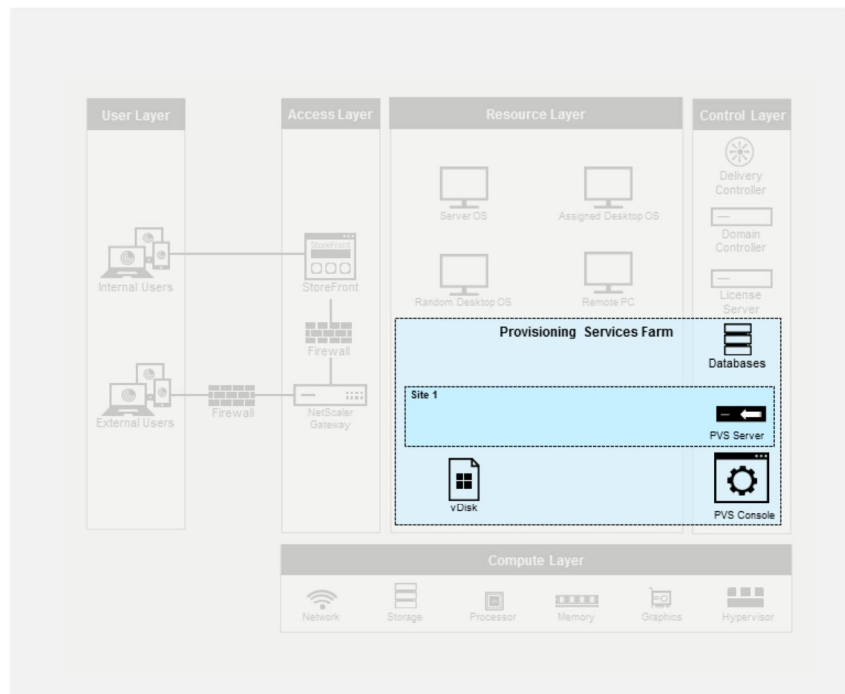
- All sites within a farm share that farm's Microsoft SQL database.
- One or more sites can exist within a farm. The first site is created with the Configuration Wizard and is run on the first Provisioning Server in the farm.

Additional Resources:

- Provisioning Services product infrastructure - <http://docs.citrix.com/en-us/provisioning/7-13/overview/infrastructure.html>

vDisk

- Once the PVS server management is set up, you have to create a virtual disk, also known as a vDisk, which contains an image.
- The vDisk is used to provide an image to the provisioned machines.



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Key Notes:

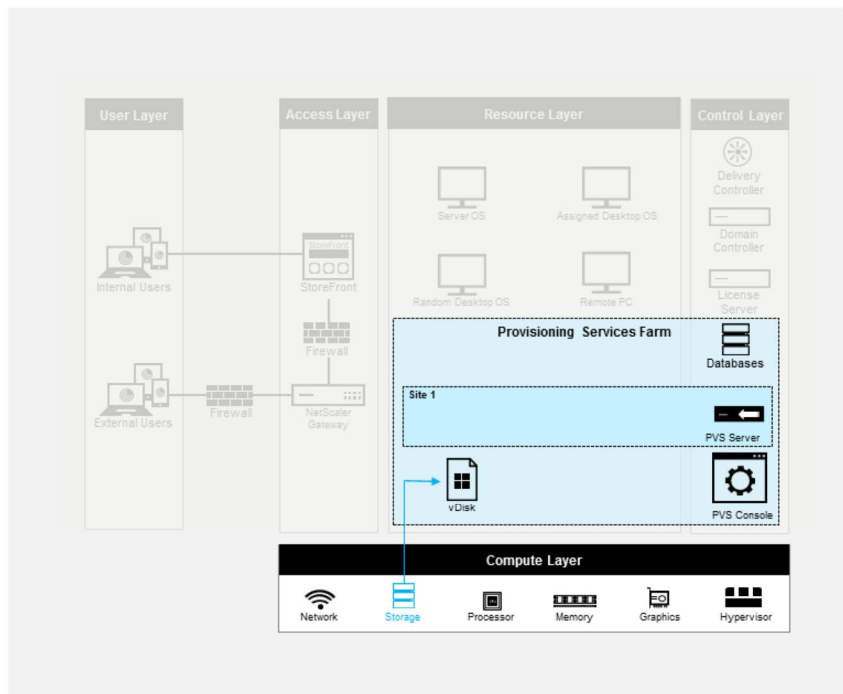
- A vDisk consists of a .vhd or .vhdx base image file, any associated properties files (.pvp), and if applicable, a chain of referenced VHD differencing disks (.avhd or .avhdx).
- In some implementations, vDisks reside directly on the Provisioning Server. In larger implementations, Provisioning Servers may get the vDisk from a shared-storage location on the network.
- vDisk images are configured to be in Private Image mode (for use by a single device, read/write, for maintenance) or Standard Image mode (for use by multiple devices, read-only with various caching options).

Additional Resources:

- Provisioning Services product infrastructure - <http://docs.citrix.com/en-us/provisioning/7-13/overview/infrastructure.html>

Store

- You have to have a place in the farm to store the new vDisk.
- This place is called a Store.



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Key Notes:

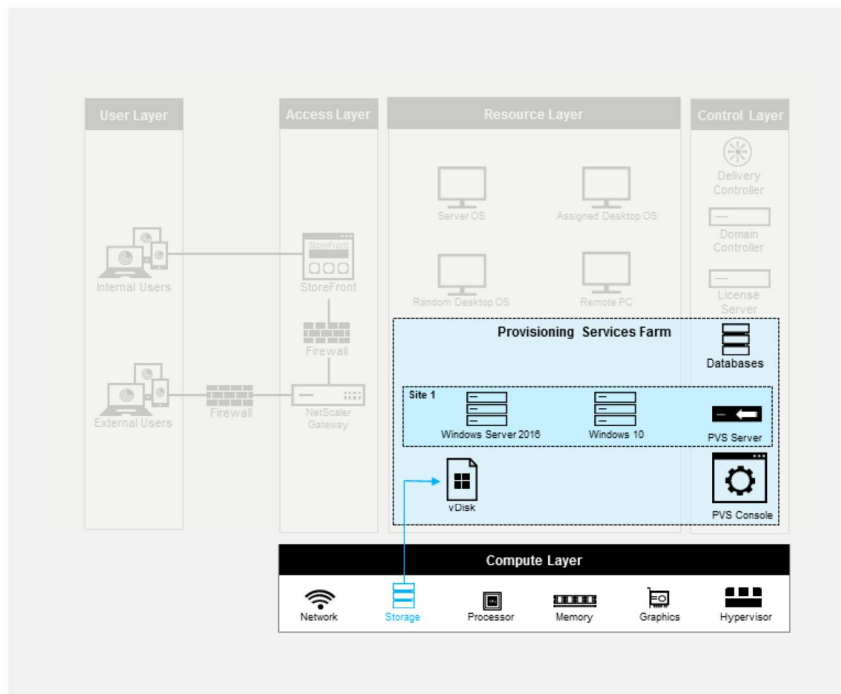
- A farm contains one or more stores. A store is a logical name for a physical or virtual vDisk storage location. The store name is the common name used by all Provisioning Servers within the farm.

Additional Resources:

- Provisioning Services product infrastructure - <http://docs.citrix.com/en-us/provisioning/7-13/overview/infrastructure.html>

Target Devices

- You have to create the machines you wish to image.
- These machines are called Target Devices.



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Key Notes:

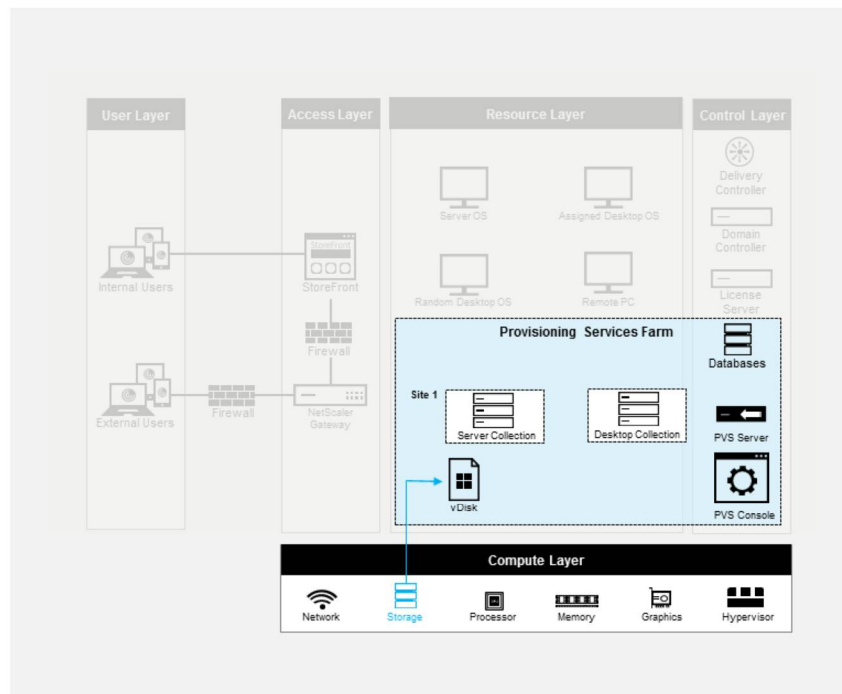
- A target device is a device, such as a desktop computer or a server, that boots and gets software from a vDisk image on the network.
- vDisks are assigned to target devices. Each target device can stream -from- only one vDisk at a given time. However, vDisks can stream -to- multiple target devices simultaneously.

Additional Resources:

- Provisioning Services product infrastructure - <http://docs.citrix.com/en-us/provisioning/7-13/overview/infrastructure.html>

Device Collections

- To manage these Target devices we create Device Collections within each Site.



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Key Notes:

- Device collections are logical groups of target devices. A device collection could represent a physical location, a subnet range, or a logical grouping of target devices.
- Creating device collections simplifies device management by enabling you to perform actions at the collection level rather than at the target-device level.
- A target device can be a member of only one device collection.

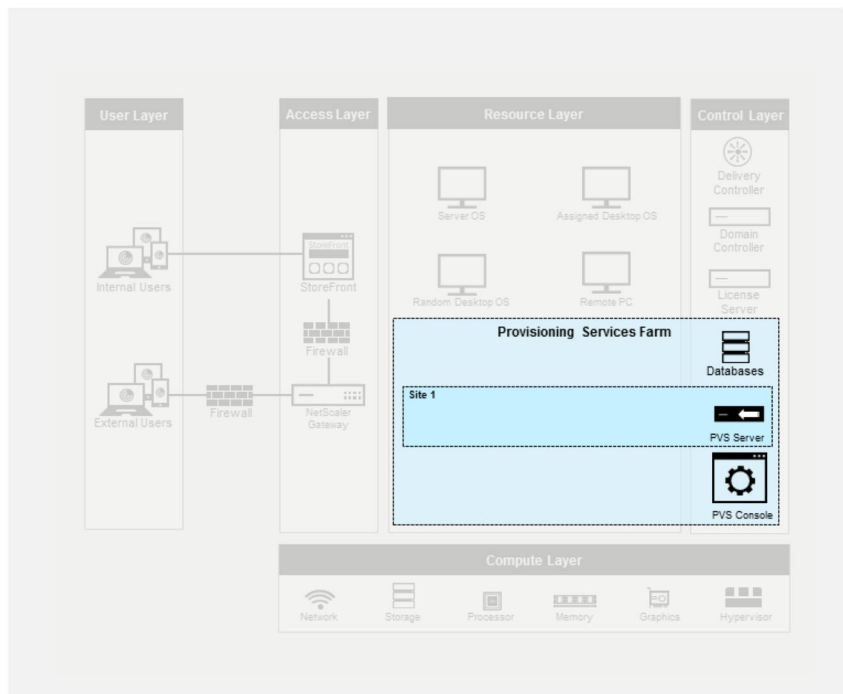
Additional Resources:

- Provisioning Services product infrastructure - <http://docs.citrix.com/en-us/provisioning/7-13/overview/infrastructure.html>

Review

To use Provisioning Services with my XenApp and XenDesktop Site, I need:

- A Provisioning Services Server (PVS) that sits within a Site,
- within a Farm,
- connected to a SQL Database,
- and managed by a Provisioning Services Management Console.



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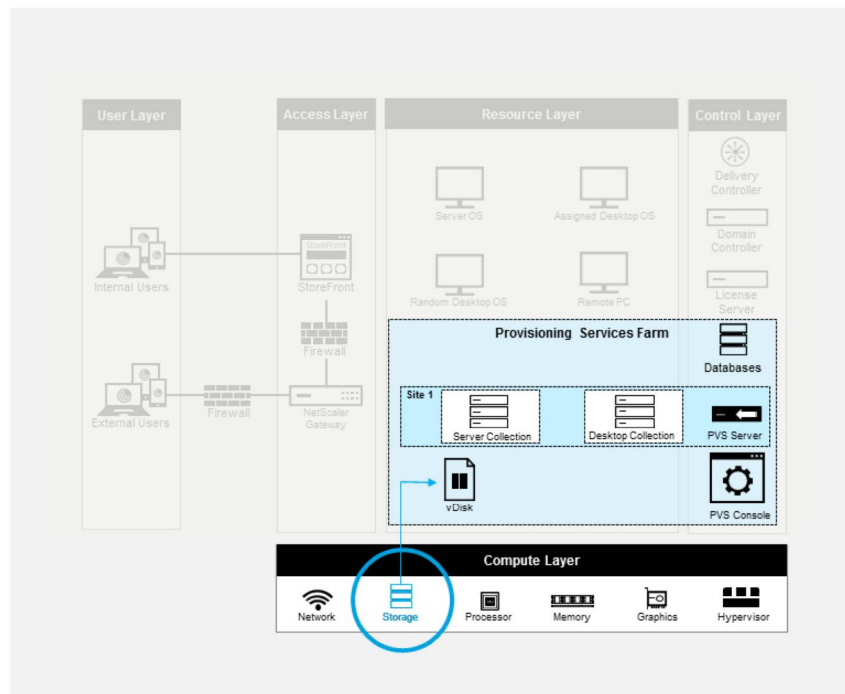
Additional Resources:

- Provisioning Services product infrastructure - <http://docs.citrix.com/en-us/provisioning/7-13/overview/infrastructure.html>

Review

To use Provisioning Services with my XenApp and XenDesktop Site, I need:

- A Store within this Farm,
- hosting a vDisk that is used to provide an image to a target device,
- that is managed within a device collection,
- underneath the Site within the Farm.



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Additional Resources:

- Provisioning Services product infrastructure - <http://docs.citrix.com/en-us/provisioning/7-13/overview/infrastructure.html>



**Lesson
Objective
Review**

Which Provisioning Services component is an operating system image file that is streamed to Target Devices?

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Lesson Objective Review

Which Provisioning Services component is an operating system image file that is streamed to Target Devices?

A vDisk is streamed by a PVS Server from a Store to one or more Target Devices.

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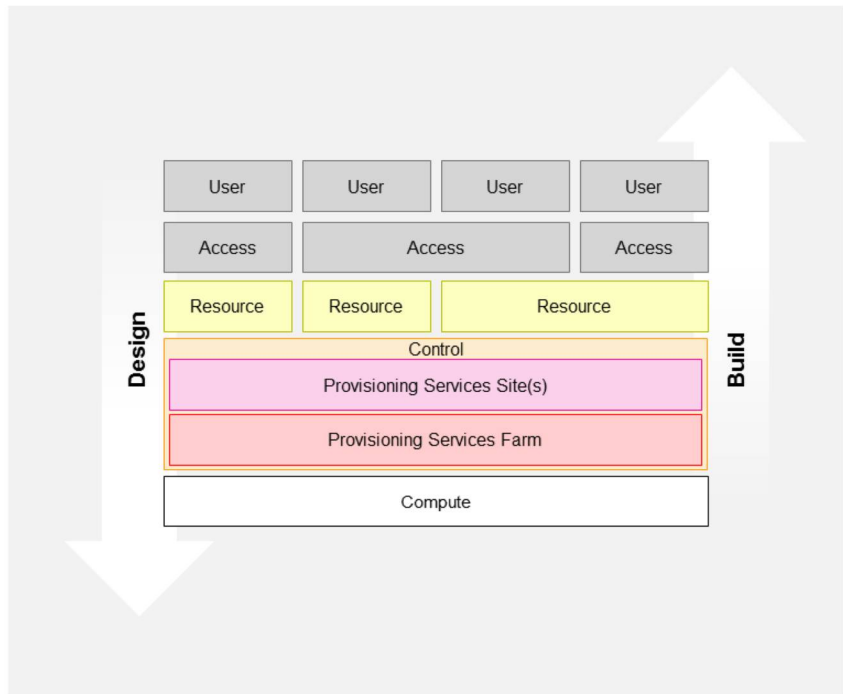
Provisioning Services Architecture

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The PVS Layered Approach

Provides an organized, flexible framework for working with Citrix environments.



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Key Notes:

- The Layered Approach Methodology was created by Citrix Consulting to provide a standardized approach method for assessments, designs and builds for Citrix environments.
- This approach is structured, organized and consistent; and can be flexibly adapted for various scenarios.
- Citrix recommends this approach, because it helps to minimize the chance of a missing component or requirement for consideration.
- This approach is flexible, because as you can see above, users/user groups can have different or shared access to resources on one central compute layer.
 - User Layer – what are the user groups and their specific requirements?
 - The top layer of the design methodology is the user layer, which is defined for each unique user group.
 - Access Layer – how will users access their resources?
 - The second layer of the design methodology is the access layer, which is defined for each user group.
 - The access layer design decisions are based on the mobility requirements of each user group as well as the endpoint devices used.
 - Resource Layer – what is being delivered to users?
 - The Resource Layer contains not only provided desktops and applications for the users, but also their data like user profiles, emails and documents and

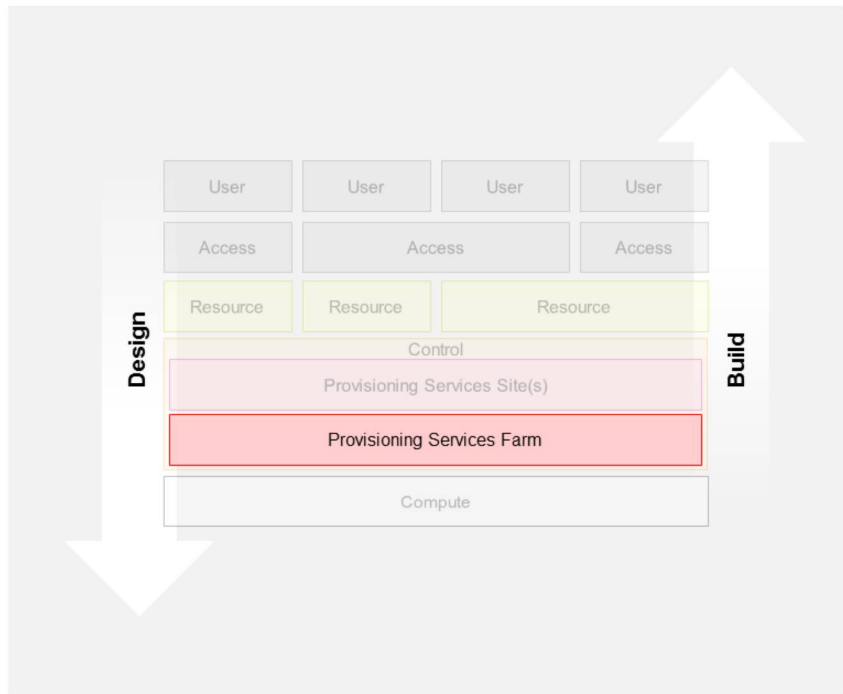
policies granting or restricting use of features. In regard to PVS, this layer determines what will be included in the vDisk image or images to streamed over the network.

- Control Layer – what are the components/configurations necessary to manage the solution?
 - The control layer is the fourth layer of the design methodology.
 - As we will see, most PVS components fall into the Control Layer. Depending on whether the component is tied to PVS Farm or PVS Site will determine which sublayer it belongs to.
- Compute Layer – what is needed to support the above layers?
 - The hardware layer is responsible for the physical devices required to support the entire solution including servers, processors, memory and storage devices.

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Farm Layer

The Farm Layer must be built before one or more Sites are created. Each Farm is tied to a SQL Farm database.



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Key Notes:

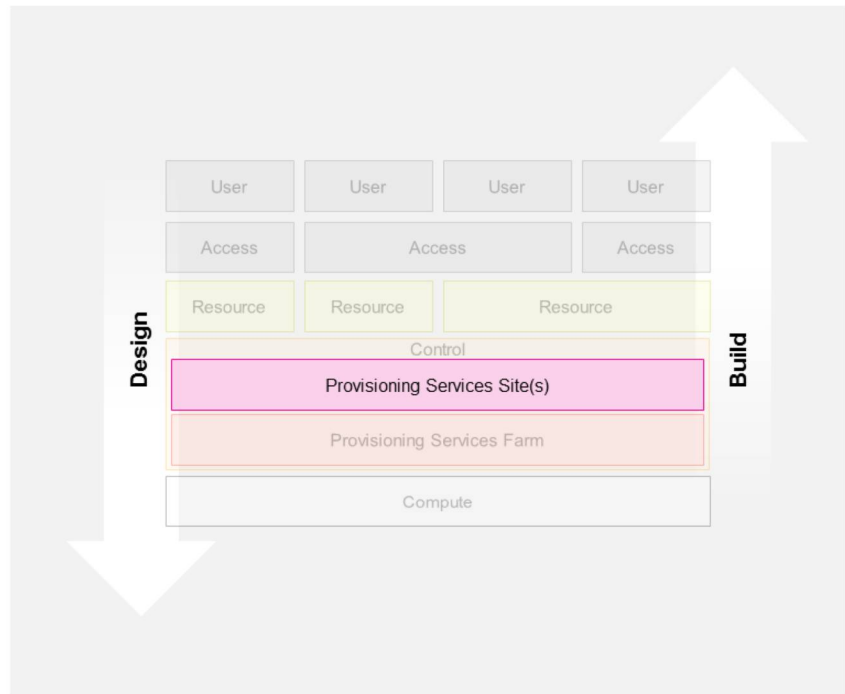
- Some Provisioning Services settings are Farm-wide, while others are Site-wide. So Farm-level settings will apply to all Sites, but Site-level settings will not impact other Sites.

Additional Resources:

- Managing Farms: <http://docs.citrix.com/en-us/provisioning/7-13/managing-farms.html>

Site Layer

The Provisioning Services Site Layer includes one or more Sites which are part of the same Farm.



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Key Notes:

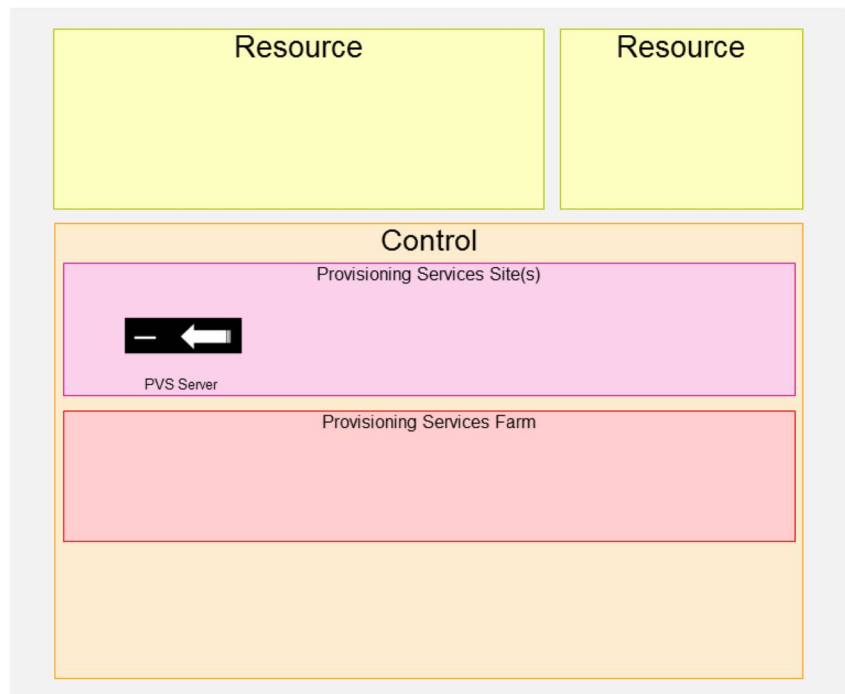
- PVS Sites can be located in different parts of a datacenter, or even in different datacenters, although it is recommended that a Farm not span over a WAN network or any network with over 15 ms of latency.
- In general, it is a leading practice to physically place PVS Servers and Target Devices on the same chassis in order to maximize the network connectivity between them while streaming the vDisk. Using this form of pod architecture can be facilitated by creating a Site for each “pod.”

Additional Resources:

- Managing Sites: <http://docs.citrix.com/en-us/provisioning/7-13/managing-sites.html>

Provisioning Services Server

Provisioning Services Servers belong to a specific Site within the Site sublayer.



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Key Notes:

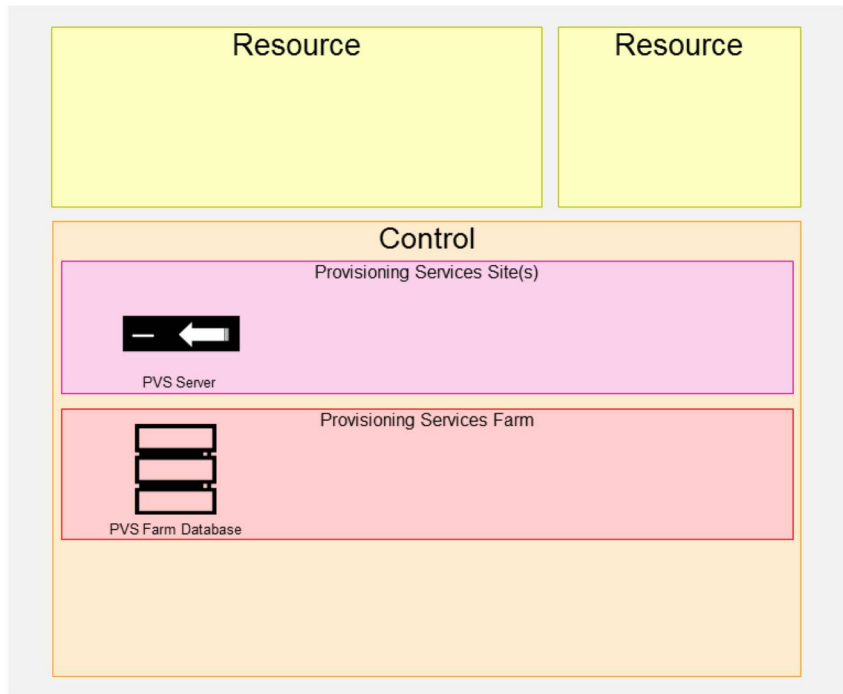
- A PVS Server can only belong to one Site at a time. Different PVS servers can belong to the same Farm, but different Sites, and thus receive differing Site-level settings.

Additional Resources:

- Managing Provisioning Servers: <http://docs.citrix.com/en-us/provisioning/7-13/managing-servers.html>

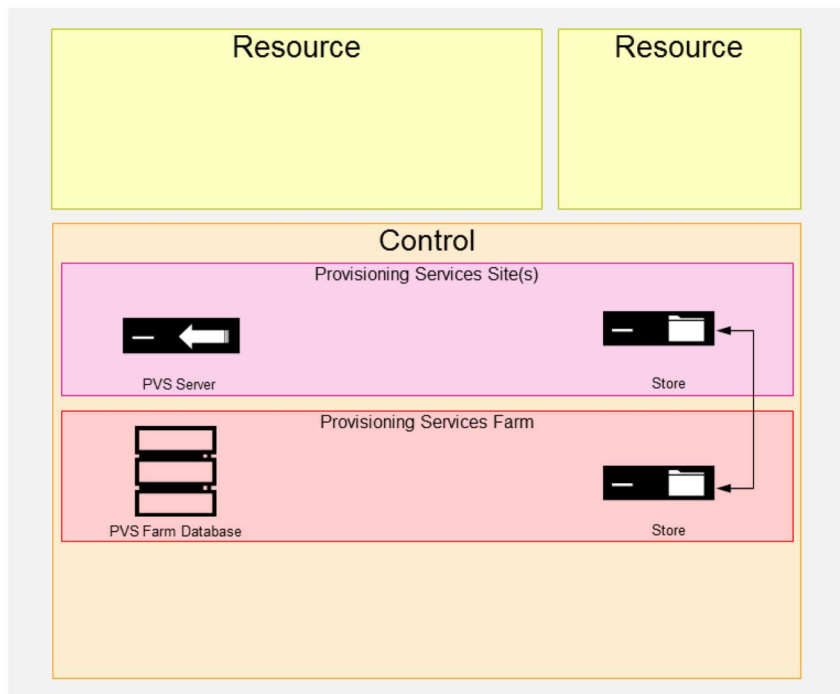
Farm Database

The Farm Database belongs to the Farm sublayer, and stores both Farm-level and Site-level information.



Store

Store can belong to the Farm or the Site Layer based on where it is located.



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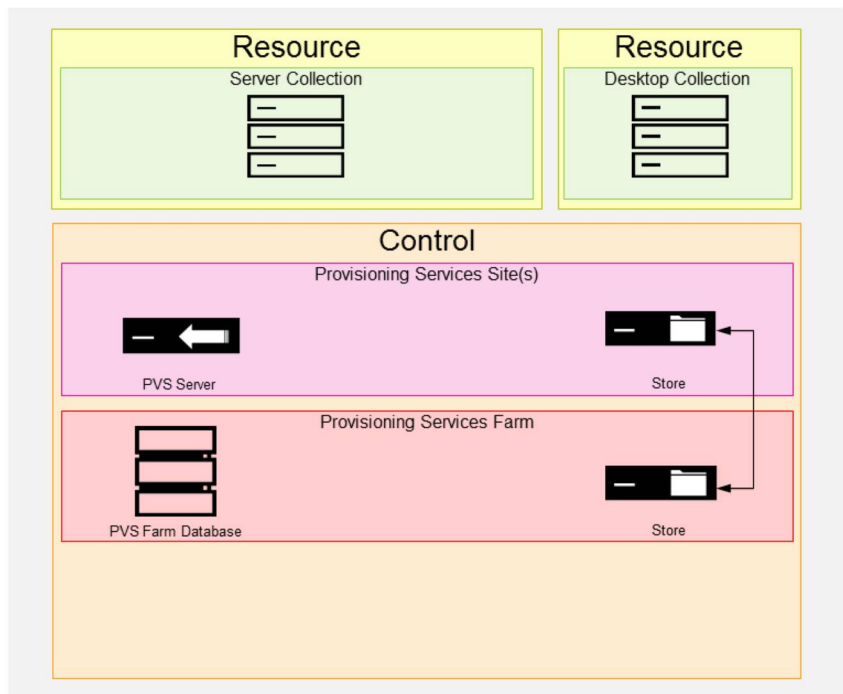
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Key Notes:

- A Store that is configured to use local storage on a PVS Server within a Site will only be accessible from that Site.
- A Store that is configured to use shared storage accessible by PVS Servers from multiple Sites is at the Farm Layer.
- A vDisk pool is a Site-level collection of all the vDisks that are available to that Site. The vDisk pool may include vDisks from one or more Stores, and there is only one vDisk pool per Site.

Device Collection Layer

This is a subset of the Resource Layer, since it includes all the machines which will be streamed the vDisk image(s).

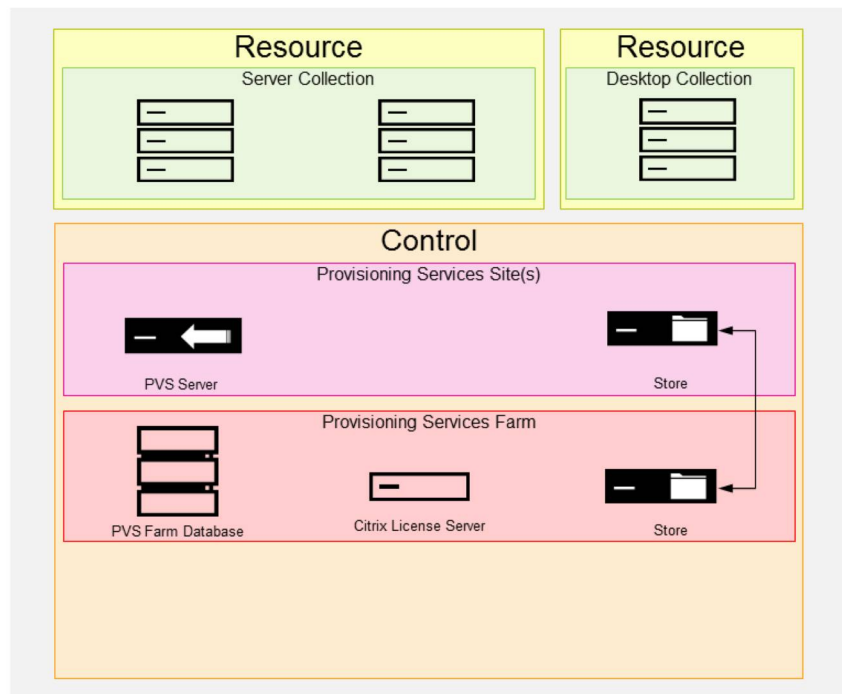


Key Notes:

- When integrated with XenApp and XenDesktop, Target Devices are synonymous with VDAs – they represent the machines that provide applications and desktops to the end users.
- Since Device Collections are the logical groupings of Target Devices within the PVS architecture, the Device Collection Layer falls within the Resource Layer.

Citrix License Server

The Citrix License Server is configured for the entire Provisioning Services Farm.



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Key Notes:

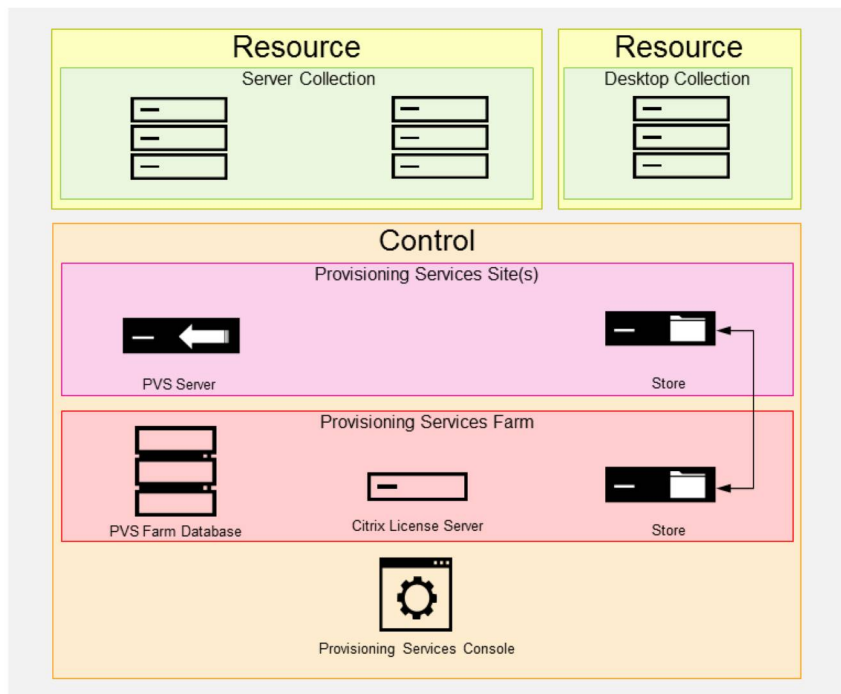
- You can use a pre-existing Citrix License Server that is already used to provide licenses for the XenApp and XenDesktop farm.
- To use Provisioning Services, you must use the entitlement available with XenApp and/or XenDesktop Enterprise or Platinum licenses. Provisioning Services Datacenter Edition refers to standalone licenses that cannot be used in a XenApp or XenDesktop environment. The availability of this edition has been intermittent recently. Please refer to the Licensing Models web link listed in Additional Resources for the most up-to-date information.
- All Provisioning Servers within the farm must be able to communicate with the license server to operate successfully. However, there is an initial 30-day grace period for new PVS installations, as well as a 30-day grace period when connectivity is lost. When a grace period expires, all Target Devices are shut down. Warnings appear on the PVS console when a grace period is in force, and Citrix Director can also monitor the Citrix License Server.

Additional Resources:

- Licensing: <http://docs.citrix.com/en-us/provisioning/7-13/install/license.html>
- Licensing Models: <https://www.citrix.com/buy/licensing/product.html>
- XenApp and XenDesktop Product Feature Matrix: <https://www.citrix.com/products/xenapp-xendesktop/feature-matrix.html>

The Provisioning Services Management Console

The management console is a supporting Control Layer component that can access multiple Provisioning Services farms.



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Key Notes:

- The PVS console can be installed on any machine that can access the farm. In smaller environments, it is often installed on the PVS Servers, but for larger environments, you may want to install the console on a different machine in order to preserve the scalability of the servers.
- Within the Console window, you can access the different PVS components that we discussed. The different exercises in this course will use the console to perform configuration actions.

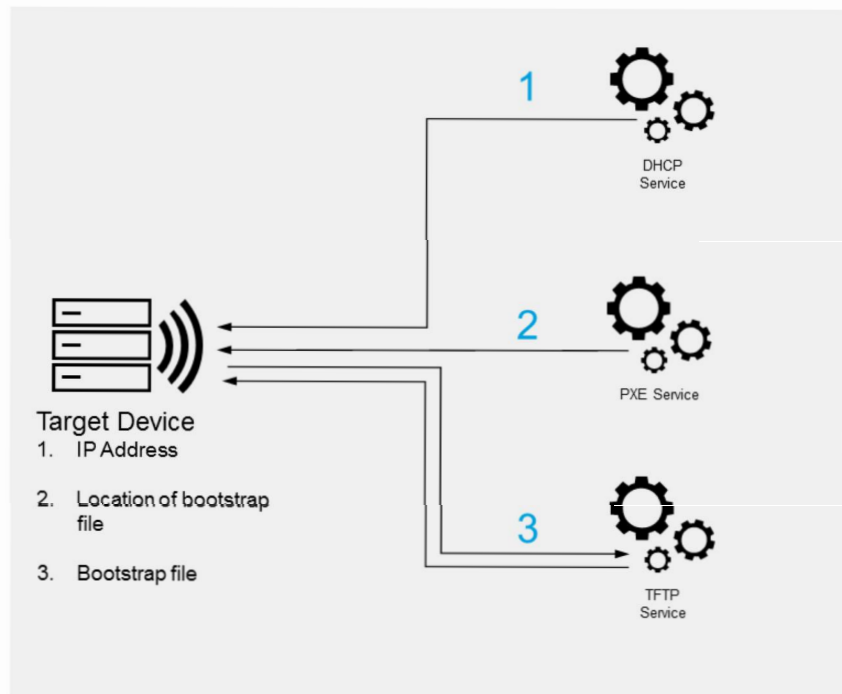
Additional Resources:

- Using the Provisioning Services Console: <http://docs.citrix.com/en-us/provisioning/7-13/administration.html>

The Network Services

The network services provide the following key functions in a Provisioning Services environment:

1. The DHCP service assigns an IP address to a target device.
2. The Preboot Execution Environment (PXE) service can be used to specify the location of the bootstrap file, which is required for vDisk streaming.
3. The TFTP service delivers the bootstrap file to the target devices.



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Key Notes:

- Network services include a DHCP service, Preboot Execution Environment (PXE) service, and a TFTP service. These service options can be used during the boot process to retrieve IP addresses, and locate, then download the boot program from the Provisioning Server to the target device. Alternative boot options are also available.
- These services can be installed during the product installation, but existing network services within your infrastructure can also be leveraged. For example, many organizations use dedicated Microsoft or third-party DHCP servers to host the DHCP service. As a result, the services may either be in the PVS Farm sublayer, or the general Control Layer, depending on where they are hosted.
- The Stream Process, which streams the vDisk to one or more Target Devices, is a core part of the Provisioning Server component, so it is not included in this category. We will examine the full PVS boot and stream processes in depth in a later module.
- There are also other network services considerations and methods to approach streaming, which will also be covered later in the course.

Lesson Objective Review

Based on the Layers methodology, which would be **built** first – the Provisioning Services Farm or Site?

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Lesson Objective Review

Based on the Layers methodology, which would be **built** first – the Provisioning Services Farm or Site?

The Provisioning Services **Farm** would be built first, since it is in the Farm sublayer, which is below the Site sublayer.

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Key Takeaways



- Provisioning Services streaming technology allows computers to be provisioned and re-provisioned in real time from a single shared-disk image. This leads to multiple benefits including easier image management, increased consistency and security, and reduced storage costs.
- To use Provisioning Services with a XenApp and XenDesktop Site, a variety of components are needed in addition to the base XenApp and XenDesktop Site.
- The Layered Approach provides a strategy for assessing, designing, and building the Provisioning Services architecture, and integrating it with XenApp and XenDesktop.

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Provisioning Services 7.1x Administration

Provisioning Services Infrastructure
Module 16



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Lab VM Power Management

The following VMs are required to be powered on before beginning the exercises in this module:

- NYC-ADS-001
- NYC-SQL-001
- NYC-FSR-001
- NYC-PVS-001
- NYC-XDC-001
- PVS-SRV-MST
- PVS-DTP-MST

The remaining VMs need to be powered off.

Note: These VMs are listed in the start-up order.

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Learning Objectives

- Explain the purpose of using a Provisioning Server.
- Demonstrate the role of the farm database.
- Explain the purpose and requirements of the Provisioning Services vDisk Store.

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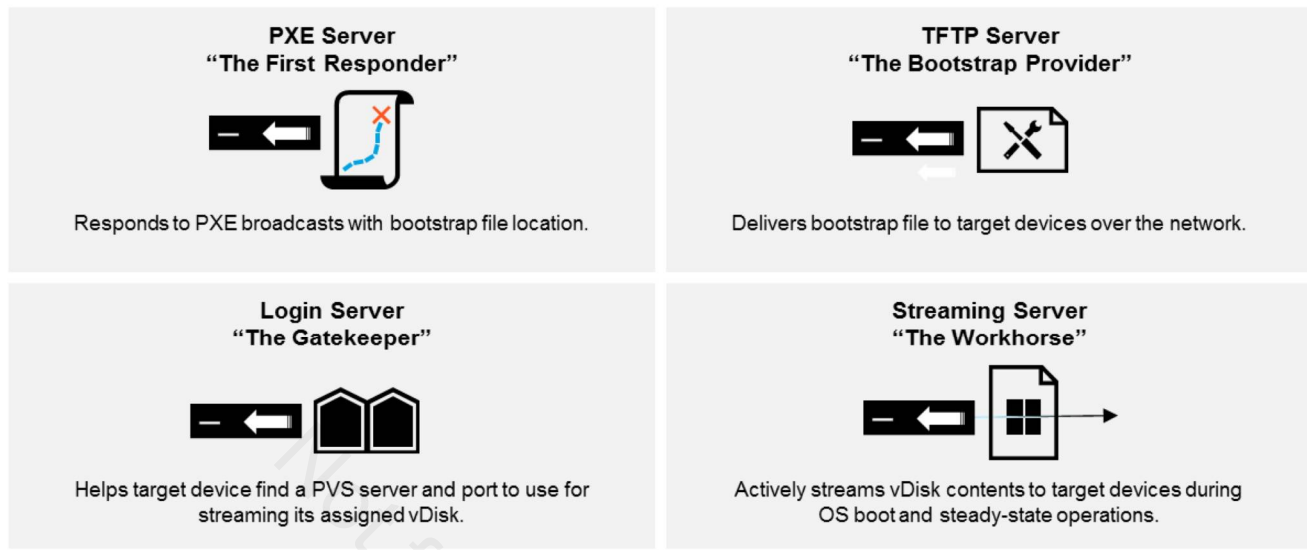


The Provisioning Services Server

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Provisioning Server Roles



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Key Notes:

- A Provisioning Server performs multiple crucial functions, which is why it is considered the core of the Provisioning Services environment. Each of these roles is performed sequentially during a target device's boot process; however, the PVS server can perform all the roles concurrently to meet the needs of various target devices.
- When a target device is turned on, by default it is set to boot from the network and to communicate with a Provisioning Server via PXE in order to learn the location of a bootstrap file which it needs to continue the boot process. As we will learn later, this particular role is optional because there are alternative methods of providing the bootstrap file location.
- After learning the bootstrap file location, the target device downloads the bootstrap file from a Provisioning Server using the TFTP service. TFTP, or Trivial File Transfer Protocol, is a simple high-level protocol for transferring data to or from a remote server. This role is also optional for the PVS Server, since another server or servers can be used to provide the bootstrap file via TFTP.
- The login server role comes into play next. Based on the bootstrap file, the target device is able to contact one of the PVS login servers. The PVS login servers hold a record of all configured target devices, identifiable by MAC address, and use this information to assign an appropriate vDisk, streaming server, and streaming port, as well as inject unique personalization data (machine name, SID, domain computer account password, etc.). This role is required, and typically all Provisioning Servers in the environment will be both login and streaming servers.
- Finally, the streaming server role provides the core functionality of Provisioning Services, which is streaming the contents of a vDisk across a network to one or more target

devices. Instead of immediately pulling all the vDisk contents down to the target device (as in traditional or imaging deployment solutions), the data is brought across the network in real time, as needed. This approach dramatically decreases the amount of network bandwidth required compared to traditional disk imaging tools.

Additional Resources:

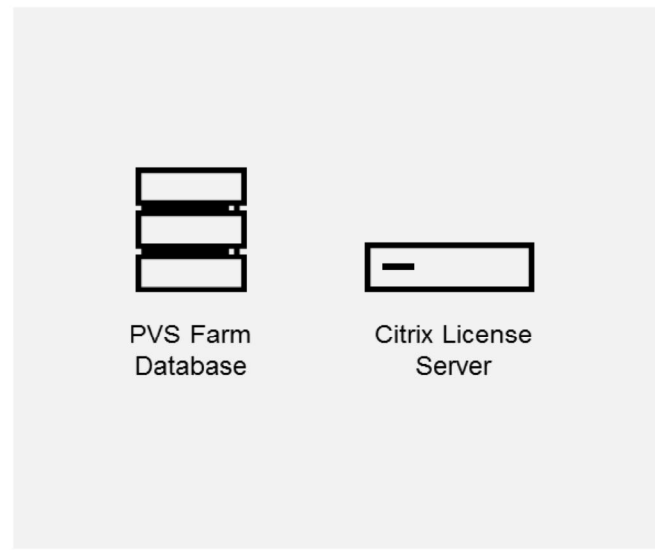
- Provisioning Services Product Infrastructure: <http://docs.citrix.com/en-us/provisioning/7-13/overview/infrastructure.html>
- Getting the bootstrap file: <http://docs.citrix.com/en-us/provisioning/7-13/install/bootstrap-file.html>

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Install Requirements

Supporting Infrastructure

- Database Requirements
 - Microsoft SQL Server 2008 SP3 through 2016 (x86, x64, and Express editions).
- Licensing Requirements
 - Citrix License Server (most recent version)



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Key Notes:

- Database requirements
 - The requirements shown are for Provisioning Services 7.13; for more detail on the requirements per version, refer to the Additional Resources link.
- Licensing requirements
 - The Citrix Licensing Server download for this release is included with the installation media. Refer to Citrix License Server documentation for licensing details and requirements. You should always use the most recent Citrix License server to get the latest features.
 - Provisioning Services servers must be connected to the Citrix Licensing server to operate successfully. Citrix recommends that you upgrade the License Server before upgrading PVS to avoid any licensing conflicts related to grace periods.
 - Consider the following options when deciding which server to use as the license server:
 - Single system: install the license server on the same system as Provisioning Services. This option is suitable for evaluations, test labs, or implementations with one Citrix product.
 - Stand-alone: install the license server on a separate system. This option is suitable for larger implementations or implementations using multiple Citrix products.

- Point to an existing license server.
- If Provisioning Services is installed after the license server or if new licenses are added, you must restart the Stream Service.

Additional Resources:

System Requirements: <http://docs.citrix.com/en-us/provisioning/7-13/system-requirements.html>

Supported Databases for XenApp and XenDesktop Components:
<https://support.citrix.com/article/CTX114501>

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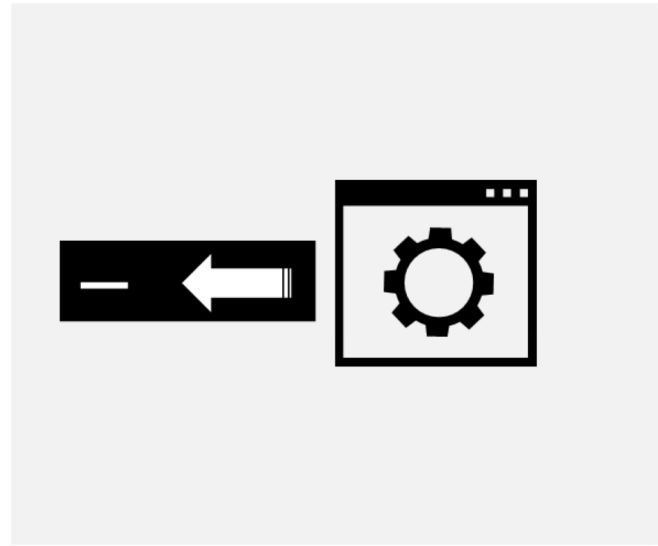
Install Requirements – Provisioning Server & Console

- **Provisioning Server**

- Windows Server 2008 R2 – Windows Server 2016
- Microsoft .NET Framework 4.5.2
- Windows PowerShell 3.0
- Static IP, 100 MB Ethernet NIC at minimum, 1 GB Ethernet preferred

- **Provisioning Services Console**

- Windows 7 – Windows 10; Windows Server 2008 R2 – Windows Server 2016
- MMC 3.0
- Microsoft .NET 4.5.2
- PowerShell 3.0



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Key Notes:

- Requirements are from Provisioning Services 7.13.
- For full requirements, including CPU type, supported languages, and more, check the Citrix product documentation.
- Provisioning Server Requirements
 - Dual 1 GB Ethernet NICs are recommended for more than 250 target devices. Two NICs often perform better than a single dual-ported NIC
- Console requirements
 - The Console can be installed on the Provisioning Servers, but can also be installed on separate systems, including Windows Desktop OS systems.

Additional Resources:

System Requirements: <http://docs.citrix.com/en-us/provisioning/7-13/system-requirements.html>

Services

On a Provisioning Server

Services	Description
Citrix Diagnostic Facility COM Server	Manages and controls Citrix diagnostic trace sessions on the system
Citrix MPPVS Agent	Citrix SCOM management pack agent for provisioning services
Citrix PVS BOOTP Service	Legacy service used to provide IP addresses to target devices. Requires specialized hardware.
Citrix PVS PXE Service	Used to provide location of the bootstrap file to target devices
Citrix PVS Ramdisk Server	Legacy service last developed in PVS 4.x.
Citrix PVS Soap Server	Directs console and management operations
Citrix PVS Stream Service	Monitors Stream Process, which streams vDisk to target devices
Citrix PVS TFTP Service	Hosts bootstrap file, target devices download file over TFTP protocol.
Citrix PVS Two-Stage Boot Service	Used for Boot Device Manager (BDM) boot option

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Key Notes:

- Citrix PVS Soap Server and Stream Services are the main services of Citrix Provisioning Server. However, even if we restart these services, actively streaming target devices will not suffer a disruption because the Stream Process handles I/O communications with the vDisk. However, Citrix always recommends having redundant Provisioning Servers so that target devices can continue to boot successfully. We will examine this more in depth in Module 6.
- Some services, such as the PVS BOOTP Service and the PVS Ramdisk Server Service, are no longer actively used today. They do not interfere with other PVS operations.

Ports

In a Provisioning Services Farm

Source	Destination	Type	Port	Details	
Provisioning Server	Provisioning Server	UDP	6890-6909	Inter-server communication (configurable)	
	Farm Database (SQL)	TCP	1433 (Default)	Adjust as needed if default port is changed.	
	Domain Controller	TCP	389	Communication with Active Directory	
Target Devices	Broadcast/DHCP Server	UDP	67 / 4011	Used to request bootstrap / IP address in PXE Boot method.	
	Broadcast/PXE Service	UDP	69	Trivial File Transfer (TFTP) for Bootstrap Delivery	
	TFTP Server	UDP	6910	Used to initiate target device logon process	
	Provisioning Server	Provisioning Server	UDP	6910-6930 (Default)	vDisk streaming ports used by StreamProcess. Specific ports used are configurable.
			UDP	6969 and 2071	Two Stage Boot (BDM); only used for BDM ISO or BDM Disk Partition.
			TCP	54321-54323	SOAP Service – Used by Imaging Wizard
Provisioning Services Console and APIs (MCLI, PowerShell, etc.)	Provisioning Server	TCP	54321-54323	SOAP Service – Used by Console and APIs (MCLI, PowerShell, etc.)	
	Target Devices	TCP	6901, 6902, 6905	Used to perform power actions on target devices	

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Key Notes:

- Administrator should make sure that the ports are open and that appropriate firewall rules are in place to ensure smooth Provisioning Services operations.
- Each Provisioning Server must be configured to use the same UDP ports in order to communicate with each other using the Messaging Manager. At least five ports must exist in the port range selected. The port range is configured on the Stream Services dialog when the Configuration wizard is run.
- TFTP communication
 - The TFTP port value is stored in the registry: HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\BNTP\Parameters Port
 - The TFTP port defaults to UDP 69
- TSB communication
 - The TSB port value is stored in the registry: HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\PVSTB\Parameters Port
 - The TSB port defaults to UDP 6969.
- Each Provisioning Server must be configured to use the same UDP ports in order to communicate with target devices using the StreamProcess.
 - The port range is configured using the Console's Network tab on the Server Properties dialog. The default ports include UDP 6910-6930. However, the first 3 ports (6910, 6911, 6912) are reserved for Provisioning Services.

- Each Provisioning Server used as a login server must be configured on the Stream Servers Boot List dialog when the Configuration wizard is run. The default port for login servers to use is UDP 6910.
- The SOAP Server is used when accessing the Console. The ports (TCP) are configured on the Stream Services dialog when the Configuration wizard is run.
 - For Powershell: MCLI-Run SetupConnection.
 - For MCLI: MCLI Run SetupConnection.
- The PVS Console and APIs (MCLI, PowerShell, etc.) can communicate with target devices UDP 6901, 6902 and 6905. Unlike Provisioning Servers to target device port numbers, target device to Provisioning Services communication cannot be configured.

Additional Resources:

- System Requirements: <http://docs.citrix.com/en-us/provisioning/7-13/system-requirements.html>
- Communication Ports Used by Citrix Technologies: <https://support.citrix.com/article/CTX101810>

Provisioning Server Optimizations

Disabling Spanning Tree or Enabling PortFast

- The Spanning Tree Protocol (STP) may cause PXE boot requests to time out in larger switched networks, preventing target devices from booting.
- STP can be disabled on edge-ports connected to clients.
- Alternatively, some switch manufacturers have a “PortFast” feature that can mitigate this issue (see examples in chart).

Switch Manufacturer	Fast Link Option Name
Cisco	PortFast or STP Fast Link
Dell	Spanning Tree FastLink
Foundry	Fast Port
3COM	Fast Start

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Key Notes:

- Use these leading practices to help prevent issues such as slow performance, image build failures, lost connections to the streaming server, or excessive retries from the target device. Some of the optimizations will need to be implemented by your organization’s networking team, and it is useful to include these in any planning discussions when designing and building a new environment.
- With Spanning Tree Protocol (STP) or Rapid Spanning Tree Protocol, the ports are placed into a blocked state while the switch transmits Bridged Protocol Data Units (BPDUs) and listens to ensure the BPDUs are not in a loopback configuration. The amount of time it takes to complete this convergence process depends on the size of the switched network, which might allow the Pre-boot Execution Environment (PXE) to time out. This prevents the machine from getting an IP address.
- This optimization is relevant for environments using the PXE boot method; it will have an effect when a different boot method is used. All of the available boot methods will be covered in Module 3.

Additional Resources:

- Best Practices for Configuring Provisioning Services Server on a Network:
<https://support.citrix.com/article/CTX117374>

Provisioning Server Optimizations

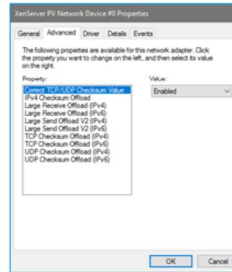
TCP large send offload

- The TCP Large Send Offload feature allows a network interface card (NIC) to re-segment network packets for transmission, which reduces CPU overhead.
- However, in a PVS environment, this process causes latency and timeouts in streaming traffic between PVS servers and target devices.
- As a leading practice, disable Large Send Offload to prevent this from happening.

To disable Large Send Offload (Perform on all PVS Server & Target Devices)

Method 1

Open the machine's NIC properties and select the Advanced tab, then disable Large Send Offload.



Method 2

If the NIC does not offer this setting in the properties page, create the following registry key:

Location:
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\Tcpip\Parameters\
Key: "DisableTaskOffload"
(dword)
Value: "1"

Key Notes:

- The TCP Large Send Offload Feature is enabled by default on modern Ethernet Network Interface Cards (NICs).
- The TCP Large Send Offload option allows the AIX TCP layer to build a TCP message up to 64 KB long and send it in one call down the stack through IP and the Ethernet device driver. The adapter then re-segments the message into multiple TCP frames to transmit on the wire. The TCP packets sent on the wire are either 1500-byte frames for a Maximum Transmission Unit (MTU) of 1500 or up to 9000-byte frames for a MTU of 9000 (jumbo frames).

Additional Resources:

- Best Practices for Configuring Provisioning Services Server on a Network:
<https://support.citrix.com/article/CTX117374>

Provisioning Server Optimizations

Auto-Negotiation

- Auto-Negotiation requires network devices and its switch to negotiate a speed before communication begins.
- This can cause long starting times and PXE timeouts, especially when starting multiple target devices with different NIC speeds.
- Citrix recommends hard coding all Provisioning Server ports (server and client) on the NIC and on the switch.

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Key Notes:

- Be sure to sync-up with your networking team to find out the link speed and duplex settings on the network switches, and then matching those settings on the PVS servers and targets. The method used to configure the NIC speed and duplex settings will vary depending on whether the target devices are physical or virtual, and if virtual, which hypervisor is hosting them.

Additional Resources:

- Best Practices for Configuring Provisioning Services Server on a Network:
<https://support.citrix.com/article/CTX117374>
- How to Modify Network Speed and Duplexing (XenServer):
<https://support.citrix.com/article/CTX117568>

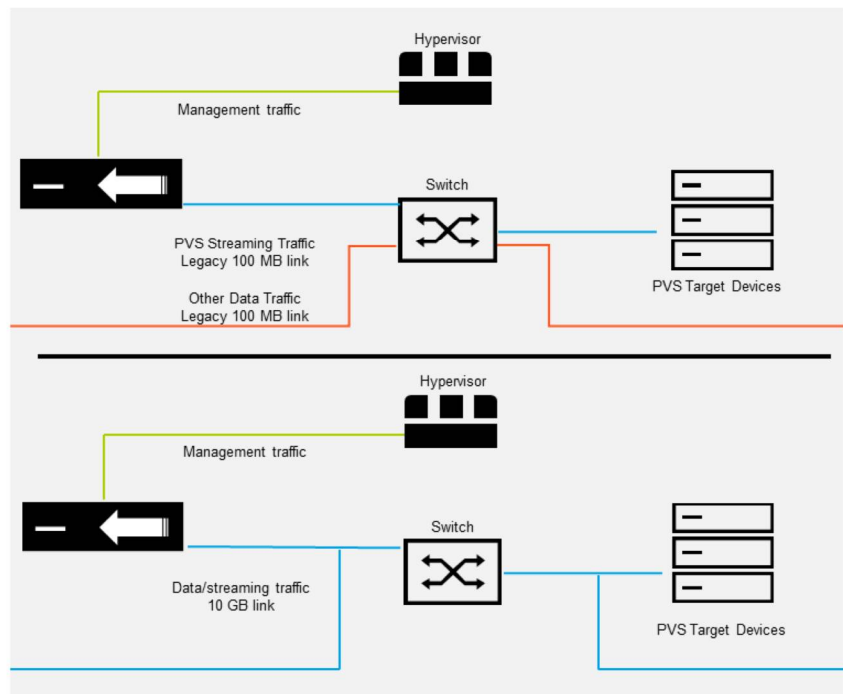
Provisioning Server Optimizations

Stream service isolation

Today, most networks have sufficient bandwidth to accommodate PVS streaming along with other types of traffic on the same network, so it is usually not necessary to isolate streaming traffic.

The primary reason to isolate streaming traffic today is to meet a security requirement.

However, it is still recommended to segment management and storage (e.g. NFS or iSCSI) traffic.



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Key Notes:

- Several years ago, it was recommended to isolate the PVS traffic on its own network in order to ensure optimal performance and ease troubleshooting.
- New advancements in network infrastructure, such as 10 Gb networking, may not require the stream service to be isolated from other traffic. If security is of primary concern, then Citrix recommends isolating or segmenting the PVS stream traffic from other production traffic. However, in many cases, isolating the stream traffic can lead to a more complicated networking configuration and actually decrease network performance in some cases.

Additional Resources:

- Is Isolating the PVS Streaming Traffic Really a Best Practice?:
<https://www.citrix.com/blogs/2012/05/01/pvs-stream-traffic-isolation>
- Best Practices for Configuring Provisioning Services Server on a Network:
<https://support.citrix.com/article/CTX117374>



**Lesson
Objective
Review**

What is the impact if we restart Citrix PVS Stream Service and Citrix PVS Soap Service?

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Lesson Objective Review

What is the impact if we restart Citrix PVS Stream Service and Citrix PVS Soap Service?

Whether you have one PVS server or multiple PVS servers, restarting the stream and soap services doesn't affect active vDisk streaming to target devices.

When there is only one PVS server, for new connections, we will see a TFTP error when restarting those services. And when there are multiple PVS servers, new connections will be pointed to next PVS server.

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The Farm Database

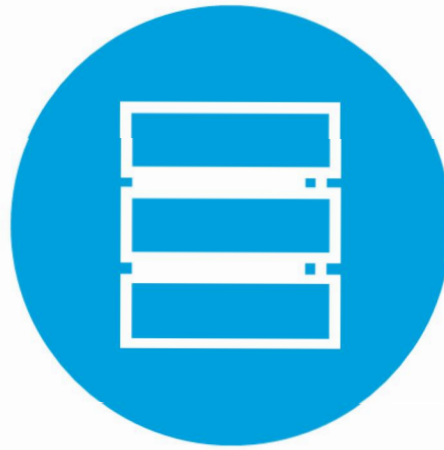
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Role

The database stores all system configuration settings that exist within a PVS farm.

This component that distinguishes one farm from another.



PVS Farm Database

Key Notes:

- The farm database serves as the storage repository for all components within the farm:
 - Farm, Site, Device Collection, Store settings and contents
 - vDisks, vDisk settings and assignments
- Each farm can have only one farm SQL database. This database is completely independent of a XenApp and XenDesktop site database, but it can be co-located on the same SQL server as the site database.
- The farm database is required to successfully enable a target device to boot and begin streaming from a vDisk. As a result, implementing backups and high availability for the farm database are important. We will cover this in Module 6.

Connection Requirements During Farm Creation

- Account performing initial farm installation (if creating farm database via Configuration wizard)
 - DBCreator (for creating the database)
 - Security Admin (for creating SQL logins for Stream and SOAP services)
- Account performing initial farm installation (if database was pre-created by SQL admin):
 - db_owner
 - View any definition
- Account used by Stream and SOAP services during normal PVS operations (assigned during farm creation):
 - db_datareader role
 - db_datawriter role
 - Execute permissions on stored procedures

Key Notes:

- Leading practice: have a database service account for each Citrix product/each purpose.
 - A proper password management procedure should be implemented for service accounts.
 - Consider the following:
 - Security accounts reduce impact if there is an issue with an individual administrator's account.
 - Increases security because limits privileges of individual administrator accounts. If an account is compromised, then it will not provide access to the entire environment. Important to note that the service account should not have domain admin privileges, in accordance with the principle of least privilege.
- The DBCreator and Security Admin service account permissions are required for the PVS service account during the initial setup of the database. Providing sysadmin privileges would also work, but typically database teams will be reluctant to provide that level of access in larger enterprises. Datareader and Datawriter database roles are configured automatically for the Stream and SOAP Services user account using the Configuration wizard. The Configuration wizard assigns these permissions provided the user has securityadmin permissions.
- The database administrator may prefer to create the Provisioning Services database. In this case, provide the MS SQL database administrator with the file that is created using the DbScript.exe utility. This utility is installed with the Provisioning Services software. Once the database administrator has provided an empty database, the user running the

Configuration wizard must be the owner of the database and have the View any definition permission (set by the database administrator when the empty database is created).

- In steady-state operations, Provisioning Services uses Windows authentication for accessing the database. Microsoft SQL Server authentication is not supported except by the Configuration Wizard. The user context for the Stream and SOAP services requires the following permissions: db_datareader, db_datawriter, and Execute permissions on stored procedures. These roles are configured automatically for the Stream and SOAP Services user account using the Configuration wizard. In addition, the service user must have the following system privileges:
 - Run as service
 - Registry read access
 - Access to Program Files\Citrix\Provisioning Services
 - Read and write access to any vDisk location
- The service account used for the initial farm creation can also be assigned as the user account for the Stream and SOAP Services, but permissions should be modified as necessary for the new role. The Stream and SOAP services can also run under a network service account; a minimum privilege local account, which authenticates on the network as a computer's domain machine account; or a specified user account (required when using a Windows Share), which can be a Workgroup or domain user account.
- Provisioning Services support for KMS licensing requires the SOAP Server user account to be a member of the local administrators group. Because authentication is not common in workgroup environments, minimum privilege user accounts must be created on each server, and each instance must have identical credentials.
- During the Configuration Wizard, you will be asked to determine the appropriate security option to use in the PVS farm (only one option can be selected per farm and the selection you choose impacts role-based administration):
 - Use Active Directory groups for security (default); select this option if you are on a Windows Domain running Active Directory. This option enables you to leverage Active Directory for Provisioning Services administration roles.
 - Use Windows groups for security; select this option if you are on a single server or in a Workgroup. This option enables you to leverage the Local User/Groups on that particular server for Provisioning Services administration roles.

Additional Resources:

- Pre-installation tasks: <http://docs.citrix.com/en-us/provisioning/7-13/install/pre-install.html>

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SQL Server/Database sizing

- Sizing starts at 20 MB and grows as needed based on the size of the environment and number of configurations.
- Refer to the sizing guide for close estimates.

Sizing example

Components	Total (KB)
1 Farm	112
10 User groups w/ Farm access	250
5 Sites	20
15 Farm/Site views	10,060
50 total device collections	500
5,000 total target devices	190,000
20 total vDisks (base only)	520
10 total Provisioning Servers	90
5 vDisk Stores	180
10,000 administrative changes (auditing enabled)	10,000
Total:	211,732 KB (~212 MB)

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Key Notes:

- The base amount of space required for the database is 112 KB, which does not change. However, during the PVS farm setup, a database with an initial file size of 20MB is created. Due to the nature of the data in the PVS farm database the transaction log is not expected to grow very quickly, unless a large amount of configuration is performed.
- The database will grow as various farm components are added and activity increases. Some of the relevant categories include:
 - Users, Site, and Device collection records
 - Farm or Site views (custom Console view settings to ease administration)
 - Target device objects and properties
 - vDisks objects, properties, and assignments
 - vDisk update tasks (scheduled tasks for vDisk updates)
 - Provisioning Servers objects, properties, and status
 - Store objects, properties, and assignments
 - Processed tasks (such as vDisk merges)
 - If auditing is turned on, each change made by the administrator in the Console, MCLI, or PowerShell interface will add to the database.

Additional Resources:

Virtual Desktop Handbook (page 75-76): <https://support.citrix.com/article/CTX139331>

Estimate the Size of a Database (MSFT): <https://msdn.microsoft.com/en-us/library/ms187445.aspx>

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Does SQL Need To Be Dedicated?

- Not required, but recommended in order to ensure adequate resources over time.
- Baseline SQL server specification is 4 CPU cores & 4 GB RAM.



Key Notes:

- The SQL server must be sized correctly to ensure the performance and stability of an environment. In addition to static configuration data provisioning servers store runtime and auditing information in the database. Depending on the boot and management pattern, the performance impact of the database can be considered as low to medium.
- It is not mandatory to have a dedicated SQL server for Provisioning Services to function, however it is recommended by Citrix as a best practice to have a dedicated SQL server. However, this could be the same database used for the XenApp and XenDesktop site, monitoring and configuration logging databases. The reason that dedicated SQL is recommended is to ensure that other, non-Citrix databases do not potentially interfere with the functionality of Provisioning Services (and XenApp/Desktop), either by taking up too much space, or hurting SQL server performance. Understanding that each organization has its own needs and constraints, this is not always possible, in which case monitoring should be set up to ensure sufficient storage, CPU and memory is available on the SQL server for Provisioning Services' needs.
- A SQL server specification of 4 Cores and 4 GB RAM is recommended as a good starting point for server sizing. The SQL server should be carefully monitored during the testing and pilot phase in order to determine the optimal configuration of the SQL server.

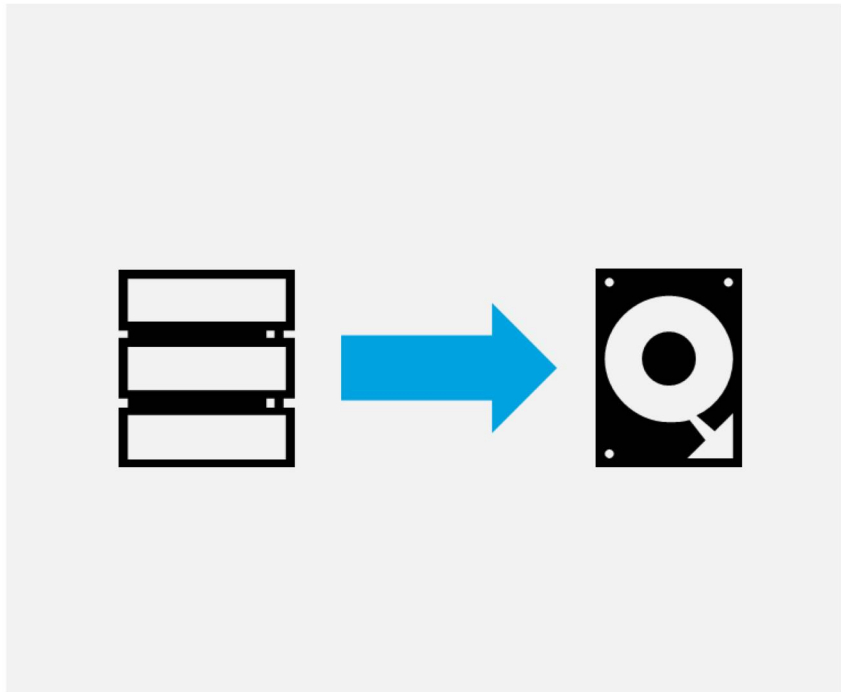
Additional Resources:

- Virtual Desktop Handbook (page 71-72): <https://support.citrix.com/article/CTX139331>

Importance Of Backups

Citrix recommends regularly performing and testing backups of the Provisioning Services database.

If using a virtual SQL instance, perform regular snapshots of the VM.



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Key Notes:

- Citrix recommends to have a backup of the SQL database taken regularly so that the PVS farm can be restored back to its previous state if any major issues occur. Most dedicated database teams will perform these as part of their regular operations, but it never hurts to check, and any databases managed by your team (such as a SQL Server Express instance used in a pre-prod environment) should be backed up as well. Often, a full database backup is taken, and then several differential backups are taken at more frequent intervals to space on backup storage space.
- Beyond simply performing the backups, periodically test the backups by performing a simulated restore from backup. This helps to catch any issues with the backup and restore process before an actual disaster recovery event occurs.
- If using a virtual SQL instance, it is recommended to take a snapshot of the SQL Server as an additional way of providing safeguards for the environment.

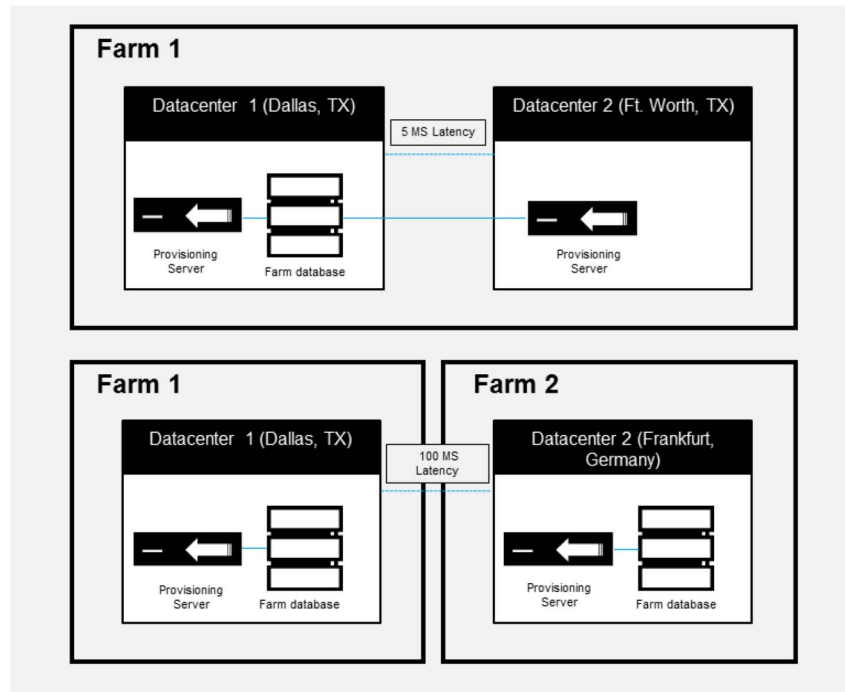
Additional Resources:

- Backup Overview (SQL Server): <https://msdn.microsoft.com/en-us/library/ms175477.aspx>

Optimizing Communications with the Farm Database

For Provisioning Server to farm database communications, performance is good up to a limit of 15-20 milliseconds.

For higher latencies, create an additional PVS Farm.



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Key Notes:

- This estimate was developed from internal Citrix engineering testing and implemented by Citrix Consulting Services in new environment designs.
- As always, be sure to test performance in your environment to confirm that performance is meeting expectations, especially if latency is at the limit of the recommended range.



Lab Exercise

- Exercise 16-1: Install Provisioning Services
- Exercise 16-2: Configure a Provisioning Services Farm

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Lesson Objective Review

Scenario: You meet with your organization's database team to plan for a new Provisioning Services farm. The database team provides two options:

Option 1	Option 2
<ul style="list-style-type: none">• Dedicated, virtual SQL server (SQL Server Express).• 4 CPUs and 4 GB of RAM by default, and a default allocation of 50 GB allocated storage.• Sysadmin privileges available.• DB team does not perform backups on this machine.	<ul style="list-style-type: none">• Shared, physical SQL server (SQL Server 2016 Enterprise).• 8 CPUs and 16 GB RAM.• 4 TBs of available storage.• Sysadmin and securityadmin privileges <u>not</u> available.• DB team performs weekly full backups and daily differential backups of all databases on machine.

Which option would you choose for your production farm? What item or items would you consider negotiating for each option?

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Lesson Objective Review

Option 1	Option 2
<ul style="list-style-type: none">• Dedicated, virtual SQL server (SQL Server Express).• 4 CPUs and 4 GB of RAM by default, and a default allocation of 50 GB allocated storage.• Sysadmin privileges available.• DB team does not perform backups on this machine.	<ul style="list-style-type: none">• Shared, physical SQL server (SQL Server 2016 Enterprise).• 8 CPUs and 16 GB RAM.• 4 TBs of available storage.• Sysadmin and securityadmin privileges <u>not</u> available.• DB team performs weekly full backups and daily differential backups of all databases on machine.

Option 1 may be suitable for a non-production environment, but the team should consider performing occasional backups of the database.

Option 2 is a feasible option for production, especially if the database team can incorporate a form of HA for the database. The Citrix team may wish to ask that the SQL server be monitored to ensure there are sufficient resources over time.

Key Notes:

- Option 1 has two primary drawbacks – it uses SQL Server Express (which limits HA options) and backups would need to be performed by the Citrix team. However, the resources provided would be sufficient for Provisioning Services. Thus, it could be an option for a PoC or test environment.
- Option 2 has one primary drawback, which is that it is a shared instance. Although initial configuration will be more complex due to lack of privileges, it can be completed by providing the database team with a file generated by the DBScript.exe utility.



The Store

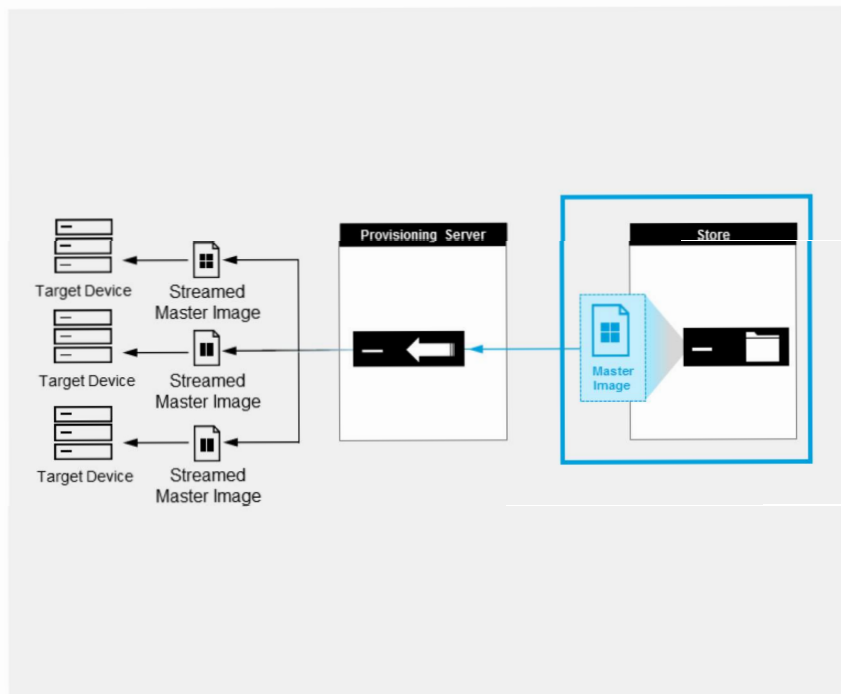
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Role

A Store is a logical name for the vDisk storage location.

Within a site, one or more Provisioning Servers are given permission to access the store in order to serve vDisks to target devices.



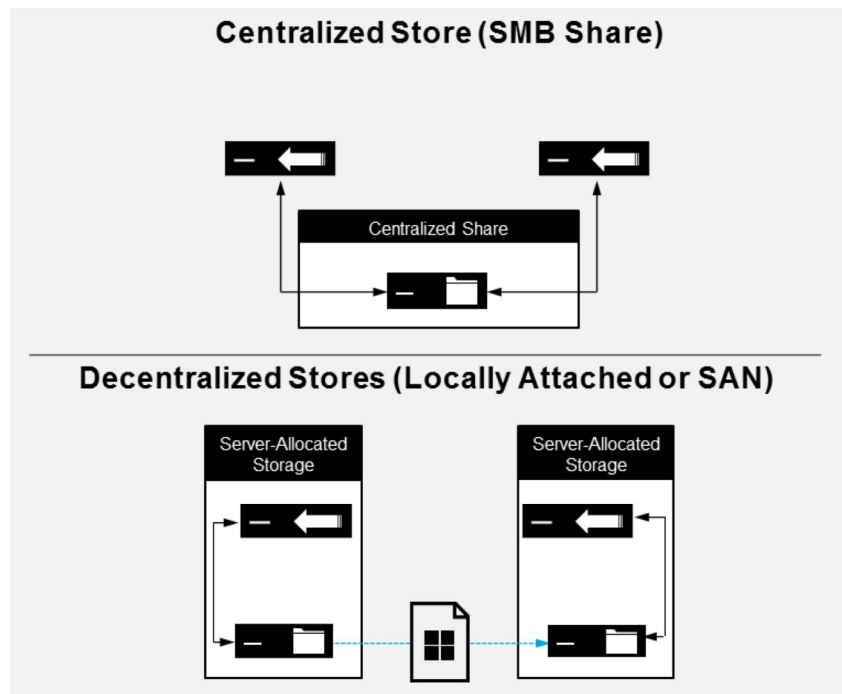
Key Notes:

- A store is the logical name for the storage location of the vDisk folder. This folder can exist on a local server or on shared storage. When vDisk files are created in the Console, they are assigned to a store. Within a site, one or more Provisioning Servers are given permission to access that store in order to serve vDisks to target devices. A Provisioning Server checks the database for the Store name and the physical location where the vDisk resides, in order to provide it to the target device.

Store Locations

Store types:

- Centralized file based storage (SMB/NFS)
- Decentralized network or local storage (SATA, SCSI, iSCSI, Fibre Channel)



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Key Notes:

- In typical deployments, in general, there are two types of configuration:
 - Centralized – File based (SMB\NFS)
 - The centralized approach consists of a single store that is shared by multiple PVS servers. It is usually based on SMB shares with some occurrences of NFS and very few cases of block-based storage. Centralized stores are very common in the U.S., but might require more testing. You need to make sure that the vDisks are being properly cached on all PVS servers and confirm that failover is working as expected. From a performance perspective, the PVS server will offload most of the IOPS from a storage. After all, PVS servers are loading disks from storage only once and serve them from memory. Be aware though that merge operations have a more aggressive IOPS profile and you must size accordingly.
 - Decentralized – Local or Network storage
 - The decentralized solution provides each PVS server with its own storage for vDisks. It can be local disks (in case of physical PVS servers, which is still quite a common scenario in Japan) or disks provisioned on a shared storage that are directly mapped to each PVS server (used with virtualized PVS servers). The challenge with a decentralized solution is that you need to make sure that all stores are synchronized – and while you can do this manually, that's harder to manage in larger environments.
- There is also the option of using multiple shared Stores is using a centralized approach. This could be useful for multi-farm deployments, but it combines the

challenges of both centralized and decentralized Stores.

Additional Resources:

- PVS Internals #3 – Designing vDisk stores:
<https://www.citrix.com/blogs/2016/11/10/pvs-internals-3-designing-vdisk-stores/>

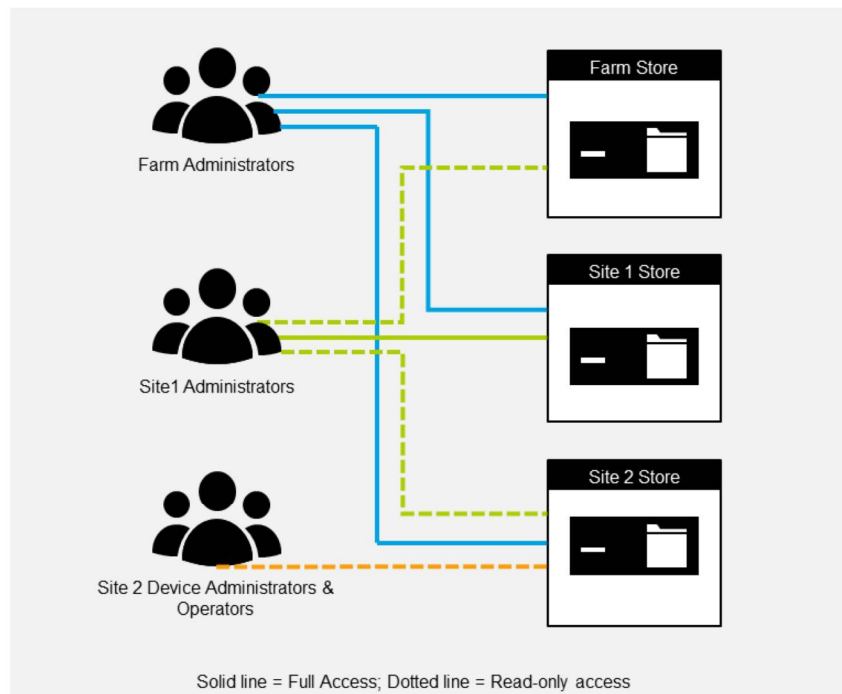
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Store Permissions & Visibility

Farm administrators have full access to all Stores.

Site administrators have full access to Stores owned by the Site, and read-only access to other Stores in the Farm.

Device Administrators and Device Operators have read-only access to Stores in the same Site.



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Key Notes:

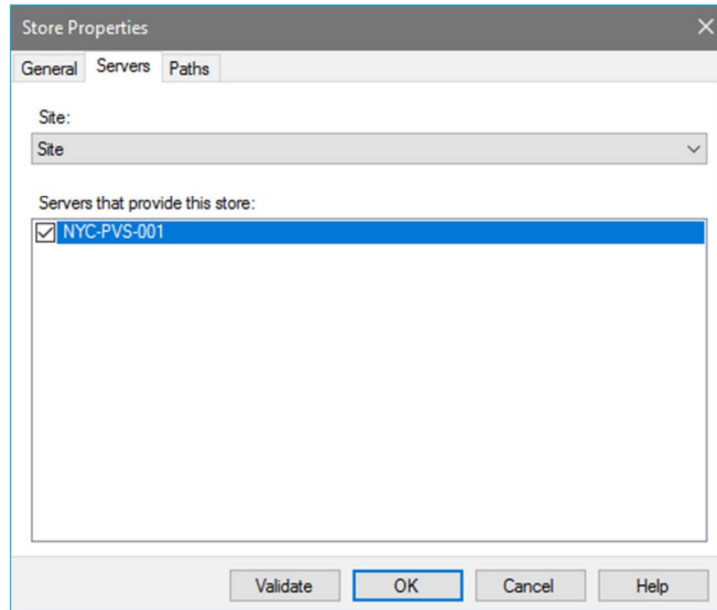
- Stores are defined and managed at the farm level by a farm administrator. Access or visibility to a store depends on the users' administrative privileges.
 - Farm Administrators have full access to all stores within the farm.
 - Site Administrators have access to only those stores owned by the site.
 - Device Administrators and Device Operators have read-only access to stores owned by the Site. Site Administrators may also have read-only access if that store exists at the farm level, or if that store belongs to another site.

Store Permissions & Visibility

Stores can be configured to be accessible from one or more PVS Sites.

Within each Site that has access to a Store, one or more of the member Provisioning Servers can be granted access to that Store.

The best configuration will depend on the location and accessibility of a particular Store.



Key Notes:

- The Citrix PVS Stream Service running on the Provisioning Server uses the Network Service to run, hence the Network Service has to be given full permissions to any vDisk store that should be accessible to the server.
- By default, the path configured in the Store properties will be used by all Provisioning Servers that have been granted access. If the default path is not valid for a selected Provisioning Server, you must define an override path in that server's properties dialog, on the Store tab.
- To check whether a path is accessible to a given Provisioning Server, click the Validate button and validate store path selections from the Validate Store Paths dialog. The validation results display under the Status column.

Additional Resources:

- Managing stores: <http://docs.citrix.com/en-us/provisioning/7-13/managing-stores.html>

Performance Requirements & Planning

- Planning for your Store implementation will depend on the location(s) of your Stores.
- For example, a good network link should connect Provisioning Servers with a centralized Store, while replication is more of a concern for decentralized Store locations.
- A tool such as Performance Monitor (PerfMon) can be used to measure disk reads and writes on the Store.

Key Notes:

- When implementing Provisioning Services using the shared vDisk model where the write cache is not stored on server, the IOPS required by the Provisioning Services server are negligible so long as the proper amount of memory has been allocated to the server.
- As long as the server has enough RAM to cache the frequently requested blocks of data from the vDisks, the server will only generate IOPS one time for each vDisk data block.
- However, if IOPS are a concern within your environment, several tools can be used to measure this metric. Performance Monitor and Process Monitor are free tools that can provide an initial ballpark estimate. However, there are numerous 3rd party tools that can also be used to measure this. Check with your storage team to see how they measure storage performance for the environment.

Additional Resources:

- Provisioning Services and CIFS Stores – Tuning For Performance: <https://www.citrix.com/blogs/2010/11/05/provisioning-services-and-cifs-stores-tuning-for-performance/>
- PVS Internals #3 – Designing vDisk stores: <https://www.citrix.com/blogs/2016/11/10/pvs-internals-3-designing-vdisk-stores/>



Lab Exercise

- Exercise 2-3: Configure the Farm Store

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**Lesson
Objective
Review**

What are the two primary vDisk Store locations, and what are the primary benefits and considerations of each?

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Lesson Objective Review

What are the two primary types of vDisk Stores, and what are the primary benefits and considerations of each?

Stores can be centralized, typically using SMB or NFS shares, or decentralized, using locally attached or shared storage.

Centralized stores reduce operational effort, but must be properly tuned for performance.

De-centralized stores have built-in redundancy and are simpler to build, but require synchronization to keep vDisks consistent between locations.

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Key Takeaways



- The Provisioning Server is the core component of the Provisioning Services environment, and takes on a number of roles during the boot and streaming processes.
- The Farm Database contains all of the configuration, runtime, and optionally, auditing data for the Provisioning Services farm. Databases do not typically grow to a large size, but it is important to ensure that high availability and regular backups are in place.
- The Provisioning Services Store is the location where all vDisk files reside. This location can be centralized or decentralized on a variety of storage types. The type chosen by a given organization will depend on its storage and operational resources and requirements.

Key Notes:

- Memory and storage are critical components that need to be taken into consideration when designing a Citrix Provisioning Services infrastructure that is used to host shared vDisks for target devices.
- As long as the proper amount of RAM has been allocated to both the Provisioning Services server and target devices, read based IOPS from the vDisk are of little concern.
- In summary, here are a few best practices to keep in mind:
 - Provisioning Services Considerations:
 - Use an x64 Edition of Windows.
 - Allocate the proper amount of RAM based upon the formulas discussed in this paper. For most Provisioning Services servers this will be 8 - 32 GB RAM.
 - Use block level storage for the Provisioning Services vDisk Stores (Do NOT use CIFS).
 - Target Device Considerations:
 - Allocate the proper amount of RAM to target devices based upon the formulas discussed in this paper. For a typical Windows desktop operating system this will be total committed bytes + 256 - 512 MB for system cache.



Provisioning Services 7.1x Administration

Streaming the vDisk Module 17

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Lab VM Power Management

The following VMs are required to be powered on before beginning the exercises in this module:

- NYC-ADS-001
- NYC-SQL-001
- NYC-FSR-001
- NYC-PVS-001
- NYC-XDC-001
- The remaining VMs need to be powered off.

Note: These VMs are listed in the start-up order.

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Learning Objectives

- Introduce the vDisk component.
- Prepare a master image.
- Describe the Provisioning Services streaming process.
- Select a boot method for the target devices.

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vDisk Introduction

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Role

A vDisk is a .vhd or .vhdx file that represents a virtual hard disk drive.

In a Provisioning Services environment, a vDisk is used to store and transport an image, which can then be streamed to multiple target devices.



Key Notes:

- Starting with Provisioning Services 7.7 and above, the .vhdx file type became the default for new vDisks. This file type was introduced by Microsoft to support larger VM sizes and Type 2 VMs in conjunction with Hyper-V 2012.
- In Provisioning Services, using .vhdx files can enhance the scalability of your deployment through lower IOPS, lower average disk writes per second, and decreased vDisk merge times.

.VHD versus .VHDX

Disk Type	Avg. Disk Read/Sec	Avg. Disk Write/Sec	IOPS	Merge Time
VHDX	70.105	3.704	73.809	270 seconds
VHD	1275.062	4.371	1279.433	462 seconds

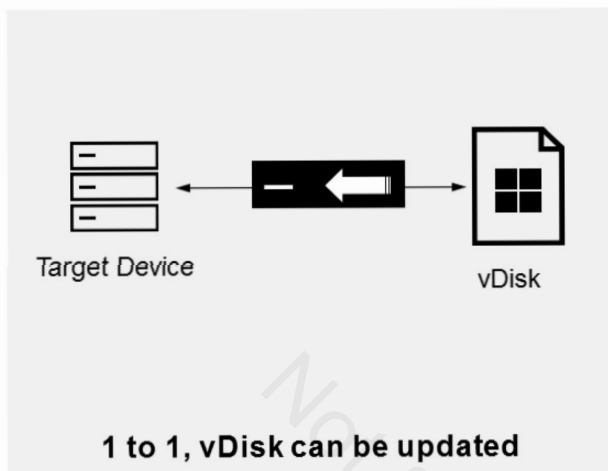
- As the above comparison illustrates, Read IOPS saw nearly an 80% improvement by switching from VHD to VHDX.
- VHDX uses 2 MB sectors versus VHD using 4 KB sectors, leading to better performance and better compatibility with scale-out file servers.

Key Notes:

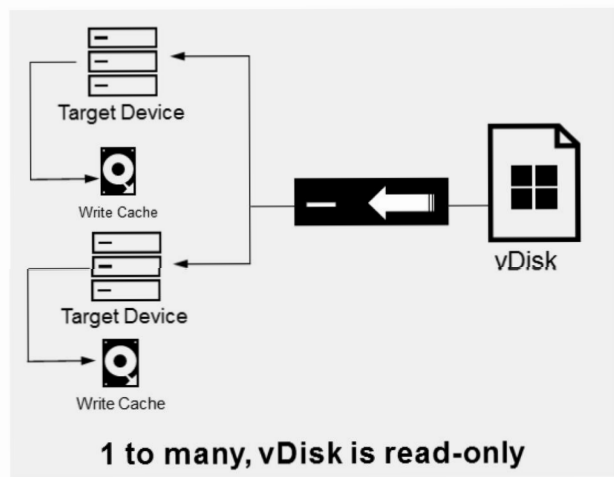
- The VHDX sectors are larger > So it reads a larger block size > So it reads faster > So it performs faster.
- IOPS are international standard used to measure the random read/writes and sequential read/writes of a storage disk.

Type of vDisk Image Modes

Private Image Mode



Standard Image Mode



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Key Notes:

- In private image mode, a vDisk is in read-write mode, which means that any changes made will be permanent. As a result, only one Target Device can be booted to a vDisk in private mode at any time.
- In standard image mode, the vDisk is in read-only mode, and can be streamed to multiple target devices at the same time. Target devices send disk writes to the write cache, where they are discarded after the target device reboots.
- Two additional files are used in combination with the core .vhd/.vhdx file to help manage the movement back and forth between them. A .lok, or lock, file controls read/write permissions to the vDisk. This file will prevent additional target devices from writing to the vDisk while it is in private mode, which would corrupt it. Additionally, a .pvp file, also known as the sidecar file, holds vDisk property information, including which image mode is being used.

Private and Standard Image Mode

Use Case Scenario for Each

Private Image Mode



Perform updates of the vDisk when not streaming to production, or use for vDisk image development in non-production environments.

Standard Image Mode



Stream to production target devices during normal production.

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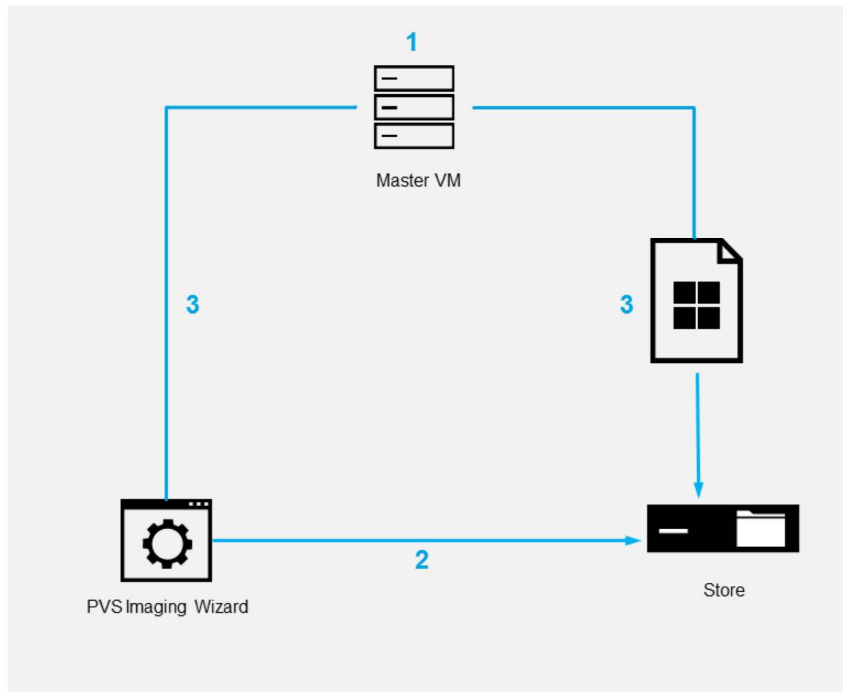
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Key Notes:

- Private mode should only be used when an administrator updates a vDisk or in a non-production environment when developing a new image. Additionally, versioning can be used to facilitate the deployment of updates to a production vDisk. The versioning process will be covered in depth in a later module.
- Any target devices accessed by end users should be accessing a standard mode vDisk. This ensures that the vDisk image is not inadvertently changed by user activity, and that multiple target devices can successfully boot from and stream the vDisk.

How to create a vDisk

1. Prepare Master machine
2. Create vDisk file
3. Use Imaging Wizard to image the Master to the vDisk file



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Key Notes:

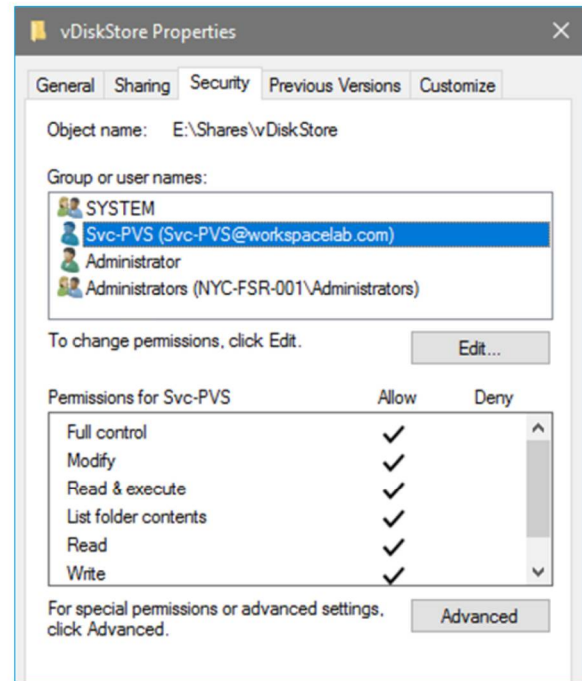
- Preparing the master machine involves installing and configuring the operating system that is desired, as well as installing any applications that should be installed on the base vDisk image, which at a minimum should include the PVS target device software and the Virtual Delivery Agent. OS-specific optimizations should also be applied at this point.
- Creating the vDisk file is a necessary prerequisite before imaging can take place. Prior to imaging, the vDisk file is blank and cannot successfully stream to target devices. The Imaging Wizard can automate this step.
- Finally, the disk information on the Master machine is transferred to the vDisk by using the Imaging wizard. This process is similar to a P2V conversion, where a physical machine's disk is migrated onto a virtual machine.

Additional Resources:

- Creating vDisks: <http://docs.citrix.com/en-us/provisioning/7-12/managing-vdisks/pvs-vdisk-create.html>
- How to Image a Target Device using the Imaging Wizard: <https://support.citrix.com/article/CTX125740>

Permissions on the Store Necessary to Create the vDisk Using the PVS Imaging Wizard

Farm Administrator account with full privileges to the store should be used to run the PVS Imaging Wizard.



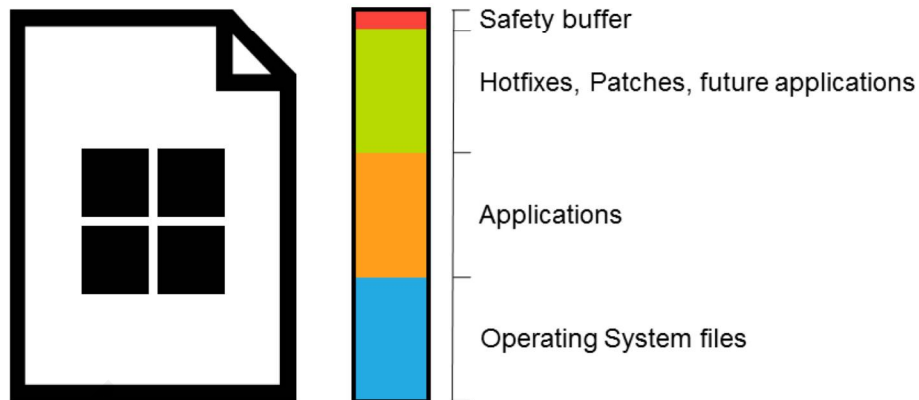
Key Notes:

- The permissions that were configured during the initial Store creation are sufficient to use the Imaging Wizard. This is because a Farm administrator account with access to the Provisioning Services Farm (and Farm database) is required to run the wizard, and this account should already have full access to the Store as well.

Additional Resources:

- Managing stores: <https://docs.citrix.com/en-us/provisioning/7-12/managing-stores.html>.

Sizing Considerations



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Key Notes:

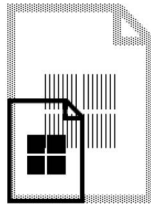
- The vDisk should be sized according to the application requirements of the users, and must accommodate the base OS, any applications included in the base image, and should generally have some additional space available for future growth to occur as hotfixes, patches, and additional applications are added to the vDisk.
- It is generally better to overestimate rather than underestimate the size of the vDisk. If you need to increase the size of the vDisk later, it is possible to do so using *diskpart* commands, but the appropriate steps must be followed carefully to avoid corrupting the vDisk. Always back up the vDisk before attempting the procedure.

Additional Resources:

- How to Expand PVS vDisk Size: <https://support.citrix.com/article/CTX206898>
- How to Expand and Extend to Increase Capacity on a Virtual Hard Disk: <https://blogs.technet.microsoft.com/danstolts/2011/04/how-to-expand-and-extend-to-increase-capacity-on-a-virtual-hard-disk-the-easy-and-fast-waysolve-the-problem-of-out-of-disk-space-on-drive-c-forever/>

Dynamic Versus Static

Dynamic

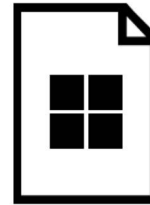


Currently 30 GB, can grow up to 100 GB

Size of vDisk increases as needed, up to a maximum size.

Increases occur in specified block sizes (2 MB or 16 MB).

Static



Always 100 GB

Size of vDisk is pre-allocated during initial creation, and remains static during the life of the vDisk.

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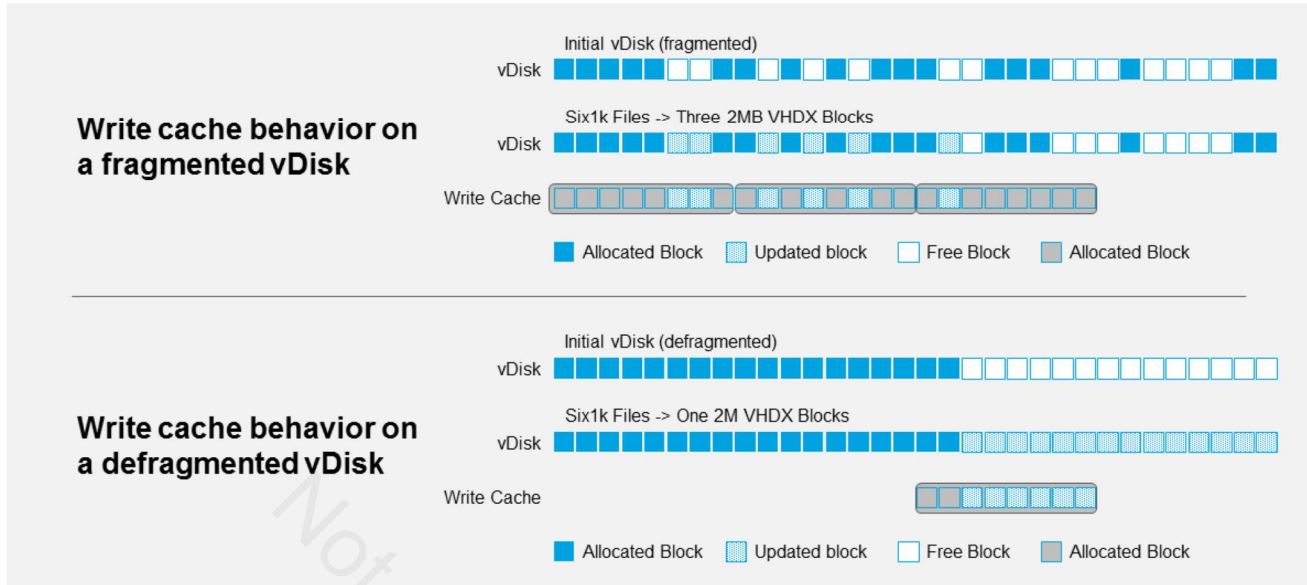
Key Notes:

- vDisks can be fixed or static in terms of how storage is allocated. This is based on the .vhd and .vhdx Microsoft file format that is used for vDisks. The vDisk type is specified during initial creation in the Imaging Wizard.
- In general, static vDisks provide better IOPS performance, while dynamic vDisks save on the amount of total storage in use, since only the amount that is needed is actively reserved in storage.
- The Citrix leading practice is to use dynamic vDisks, for the following reasons:
 - In Standard mode, disk writes do not touch the vDisk, and disk reads are cached in PVS Server RAM, minimizing the amount of disk activity required of the vDisks while in production. So optimizing IOPS performance is not as important in this scenario.
 - Since vDisk sizes will only grow as needed, the average vDisk size will be lower, which saves overall storage costs and saves time on vDisk operations like updates and merges. Beyond lowering the *amount* of storage required, it can also reduce the *type* of storage used, since storage performance is less important when using PVS (for example, vs. MCS).

Additional Resources:

- Clearing the Air: Fixed or Dynamic vDisks?:
<https://www.citrix.com/blogs/2012/02/13/fixed-or-dynamic-vdisks/>

Defragmentation Considerations



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Key Notes:

- As a Citrix leading practice, be sure to defragment the vDisk before initial deployment, as well as after major changes.
 - However, this should not be done on a versioned vDisk, because it will create excessively large versioned disks. If you use versioning, perform defragmentation after merging multiple vDisk versions into a single base.
- Internal Citrix performance testing revealed write cache size was reduced up to 30% after defragmentation was performed on the vDisk. This occurred because disk writes could be made to a consolidated area, reducing the overall size of the write cache.
- For maximum benefits, Citrix recommends defragmenting the vDisk by mounting the .vhd or .vhdx file on a PVS Server and running a manual defragmentation on it, which allows for a more complete defragmentation since the OS is not loaded. This can be initiated through the PVS Console by navigating to a Store, right-clicking the vDisk, and selecting “Mount vDisk.” The vDisk will then be visible in File Explorer of the PVS Server, where a defragmentation can be initiated.

Additional Resources:

- PVS RAM Cache Overflow Sizing: <https://www.citrix.com/blogs/2015/01/19/size-matters-pvs-ram-cache-overflow-sizing/>



Lesson Objective Review

Which should be used in production – a static, private image mode vDisk, or a dynamic, standard mode vDisk?

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Lesson Objective Review

Which should be used in production – a static, private mode vDisk, or a dynamic, standard mode vDisk?

A dynamic, standard image mode vDisk is recommended for use in production.

Key Notes:

- In general, standard mode, dynamic vDisks should be used in production.

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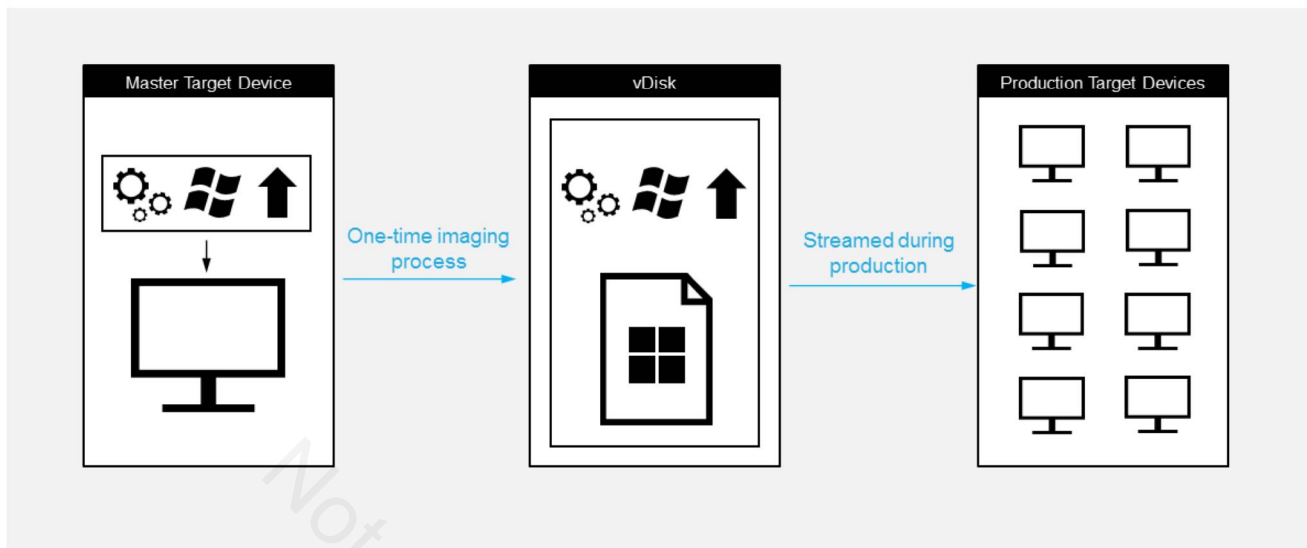


Master Target Device Preparation

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The Role of the Master Target Device



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Key Notes:

- The Master Target Device is a device that is used to build a hard disk image, which is stored on a vDisk for use with Provisioning Services. All application installations, optimizations, and configurations made on the Master will be transferred to the vDisk during the imaging process. Then, Provisioning Services streams the contents of the new vDisk to other target devices.
- The Master Target Device is different from other target devices since it contains its own hard disk during image development. As a result, the desired operating system, device drivers, and applicable service pack updates must be installed on the Master Target Device before imaging occurs.
- It is also important to prepare the Master Target Device with OS-specific optimizations, which will ultimately apply to all target devices using the associated vDisk.

Additional Resources:

- Preparing a master target device for imaging: <http://docs.citrix.com/en-us/provisioning/7-13/install/target-image-prepare.html>

Master Optimizations

Depending on operating system of the Master Target Device, different sets of optimizations are recommended.

Operating System	Optimizations Guidance
Windows 10	https://support.citrix.com/article/CTX216252
Windows 8/8.1	https://support.citrix.com/article/CTX140375
Windows 7	https://support.citrix.com/article/CTX127050
Windows Server 2016	Refer to Windows 10 Guide
Windows Server 2012/2012 R2	Refer to Windows 8/8.1 Guide
Windows Server 2008 R2 / SP1	https://support.citrix.com/article/CTX131577
Linux (Redhat Enterprise Linux 7.2, CentOS 7.2)	http://docs.citrix.com/en-us/provisioning/7-13/install/install-linux-streaming-component.html

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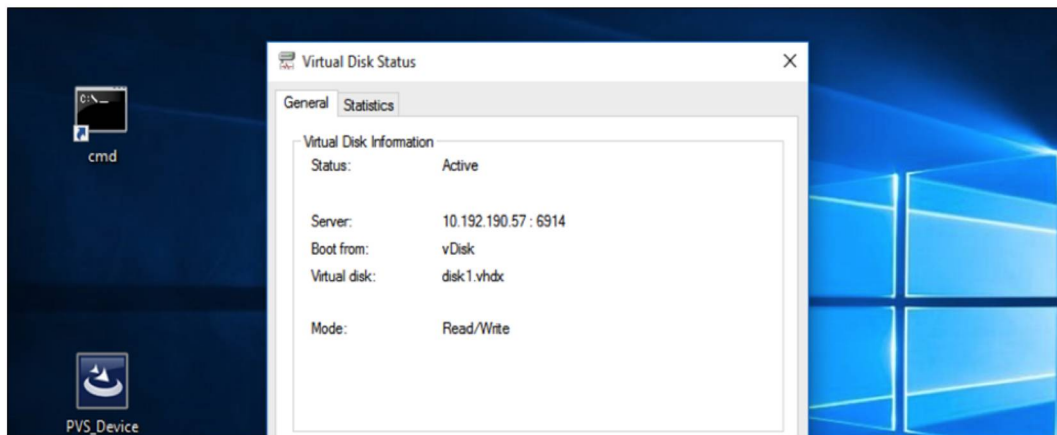


Key Notes:

- Citrix has provided recommended optimizations for VDAs using various operating systems. Although these apply to any VDA, regardless of how it is provisioned, any vDisks which will be integrated with XenApp and XenDesktop should apply them as well.
- Most of the optimizations have the goal of improving the scalability of a XenApp and XenDesktop deployment by tuning a combination of Citrix and Microsoft Group Policy, registry keys, system settings, and scheduled tasks.
- Although the guides are considered leading practices, they do not represent an official endorsement from Citrix or Microsoft, and should always be tested in a non-production environment first.
- As of PVS 7.12, streaming a Linux OS is still in tech preview, and optimizations have not yet been developed. The link provided leads to additional steps that should be taken on a Linux-based Master Target Device to prepare it for imaging.



The PVS Target Device Software



The target device software allows a machine to boot from and stream a vDisk from a Provisioning Server. This software must be installed on the Master Target before it is used to create a vDisk.

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Key Notes:

- Any BIOS-based anti-virus should be disabled during the install of the target device software, since it may block the installation from making required changes.. Be sure to turn the A/V software back on before running the Imaging Wizard.

Additional Resources:

- Preparing a master target device for imaging: <http://docs.citrix.com/en-us/provisioning/7-12/install/pvs-target-image-prepare.html>
- Install the Linux streaming component: <http://docs.citrix.com/en-us/provisioning/7-12/install/install-linux-streaming-component.html>



Lab Exercise

Exercise 17-1: Create a vDisk for the Server OS

Exercise 17-2: Create a vDisk for the Desktop OS

Exercise 17-3: Verify the Store via File Explorer

Exercise 17-4: Verify the Store via PVS Console

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Lesson Objective Review

Scenario: You want to prepare a vDisk image. At minimum, what steps should be performed on the Master Target Device before running the Imaging Wizard?

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Lesson Objective Review

Scenario: You want to prepare a vDisk image. At minimum, what steps should be performed on the Master Target Device before running the Imaging Wizard?

1. Install the operating system, device drivers, and service pack updates on the machine.
2. Optionally, install applications that should be included in the base image.
3. Apply OS-specific and general optimizations.
4. Install PVS Target Device software.

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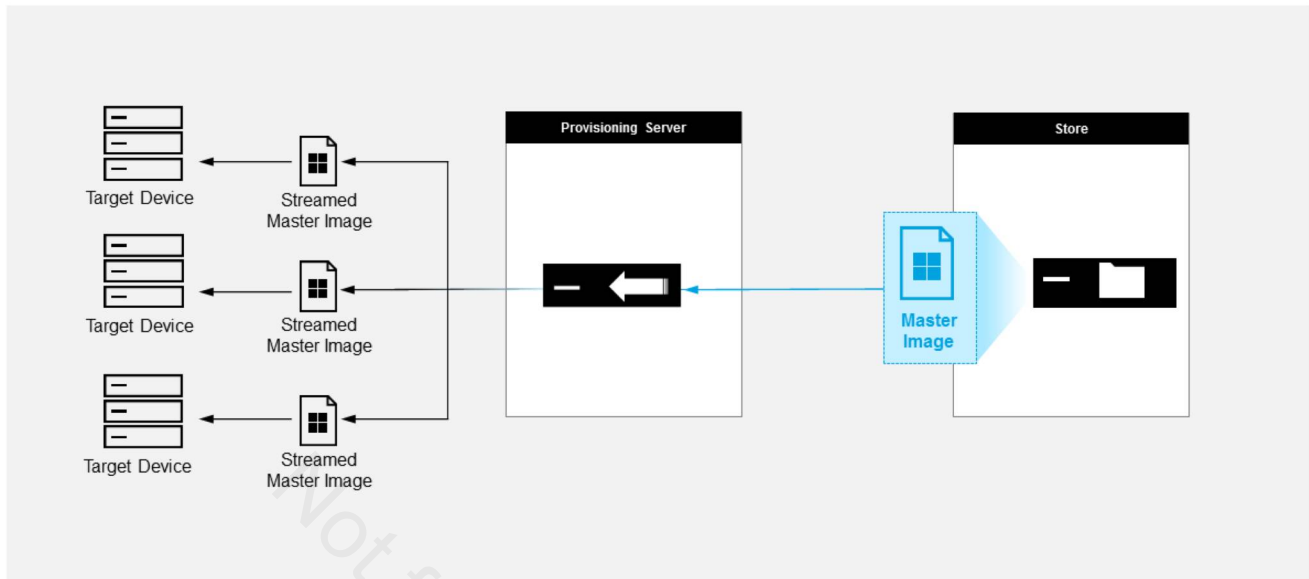


Streaming Introduction

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What is Streaming?



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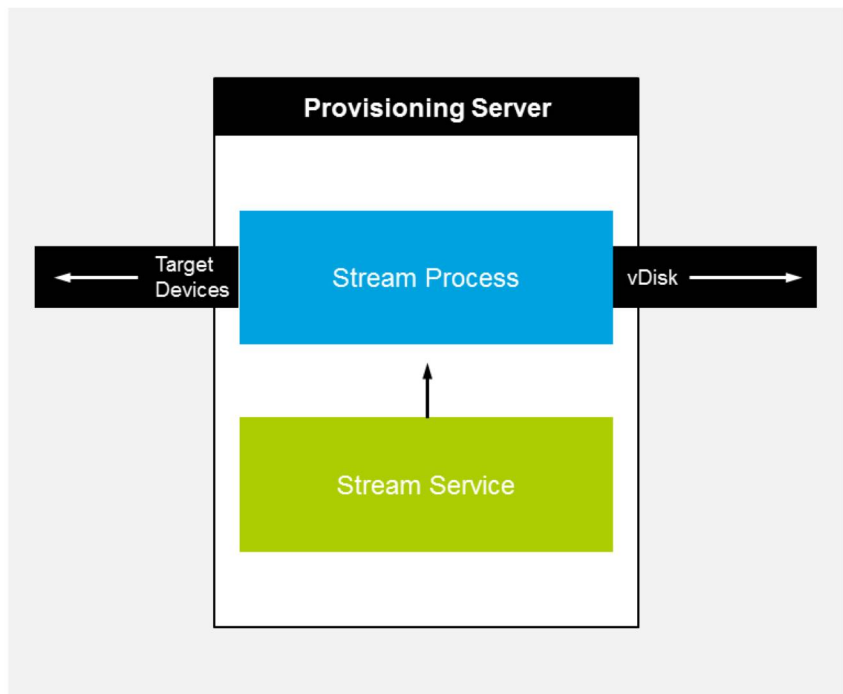
Key Notes:

- At its core, Provisioning Services is a block-level storage protocol that serves as a delivery mechanism for an operating system. Disk reads (and sometimes writes depending on the vDisk mode) are sent over the network from a vDisk to one or more target devices, and this process is brokered by a Provisioning Server.
- In this lesson, we are going to dive into the streaming process and learn what communications must happen for this process to be successful.

Streaming Process

Within the PVS server, the Stream Process brokers disk I/O requests from the target devices.

The Stream Service, also serves as a watchdog on this Stream Process.



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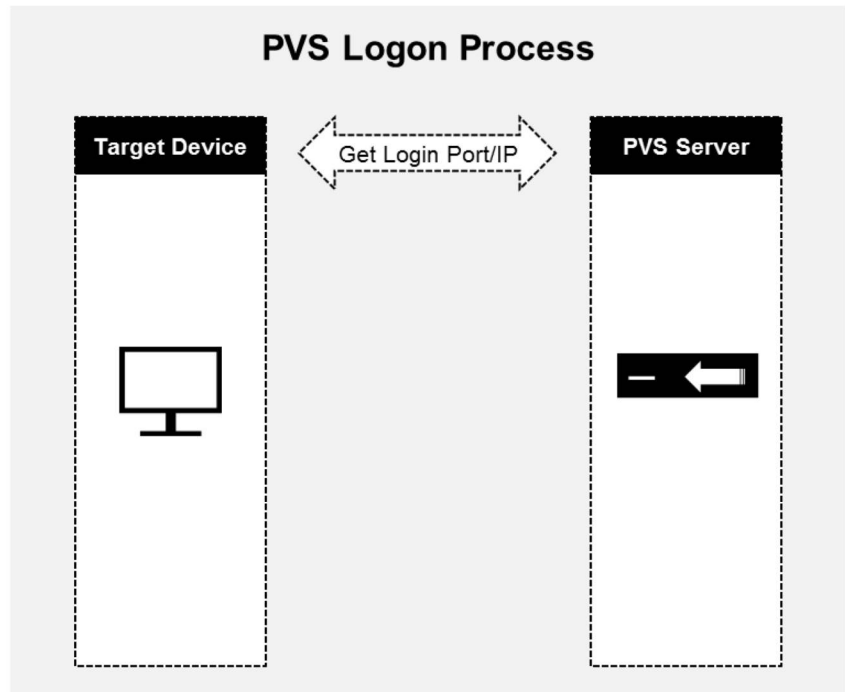
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Key Notes:

- The Stream Service leverages the inter-process communication, or IPC, protocol to monitor the PVS runtime components, including the Stream Process. If any of the components become unresponsive, the stream service will attempt to restart them.

Streaming Process

1. Immediately after downloading the bootstrap file, the target device will connect to the stream process on the server specified in the file.



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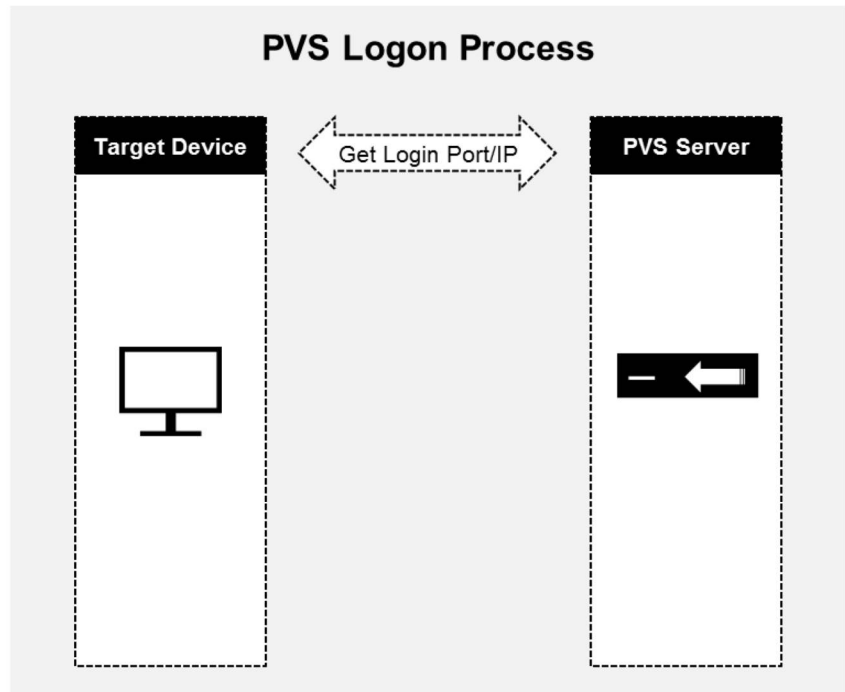
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Key Notes:

- The bootstrap file contains a small program that runs before the operating system is loaded. It initializes the streaming session between the target device and the Provisioning Server. We will cover bootstrap delivery methods in detail later on.
- By default, the target device uses UDP port 6910 to contact the Stream Process on one of the PVS servers. This can be changed in the bootstrap configuration.
- The target device is both checking to see if the server exists at the IP address specified in the bootstrap file and is requesting a login port to continue with the PVS logon process.

Streaming Process

2. The stream service replies with an IP and port where the login process should continue.



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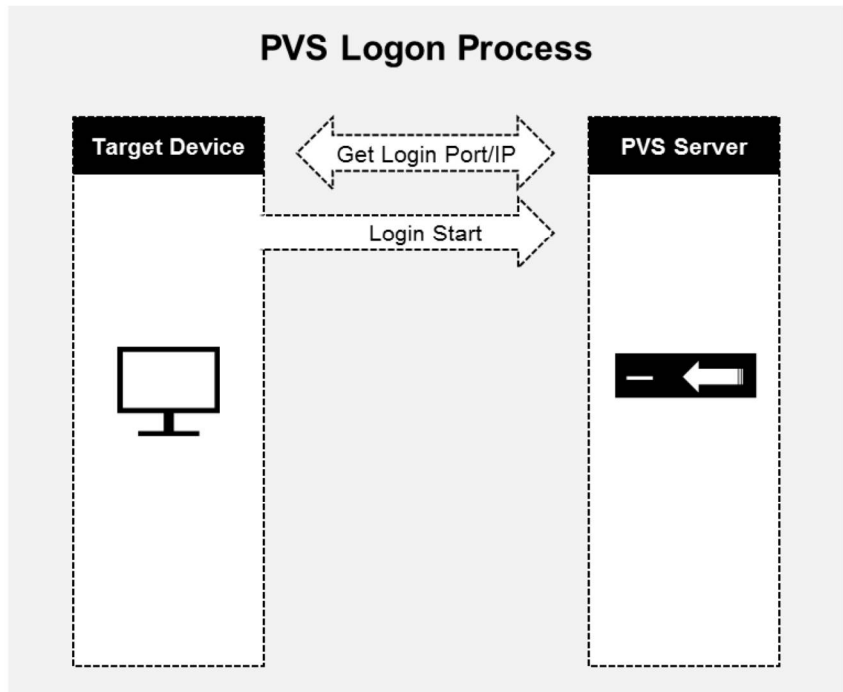
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Key Notes:

- This step is performed so that a PVS server can distribute concurrent target device logon requests over multiple NICs, ports, threads and CPUs, which is important as a PVS farm scales to higher numbers of target devices.
- The range of ports used for streaming is UDP 6910-6930 by default, but this can be changed through the Advanced Server Properties of each PVS Server. As we reviewed in the previous lesson, depending on the number of target devices in the environment, increasing the number of ports available can improve overall boot times.

Streaming Process

3. The target device sends an official login request to the location specified in the previous step.



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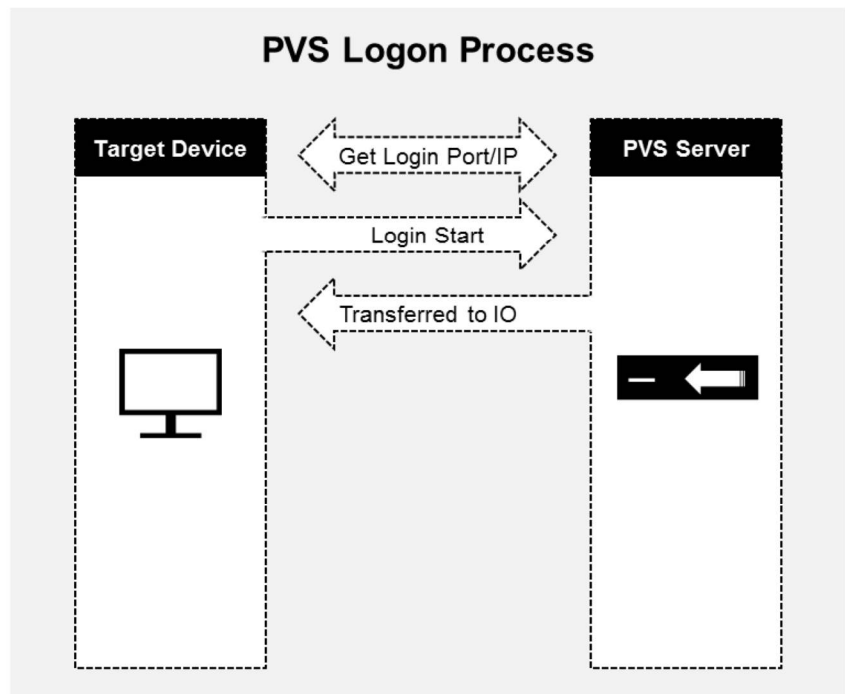
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Key Notes:

- The target will relay its MAC address as means of authentication as part of this communication.
- If communication is ever lost between a target device and PVS Server during normal operations, the target device will attempt to re-initiate a connection by sending a new login request to that server.

Streaming Process

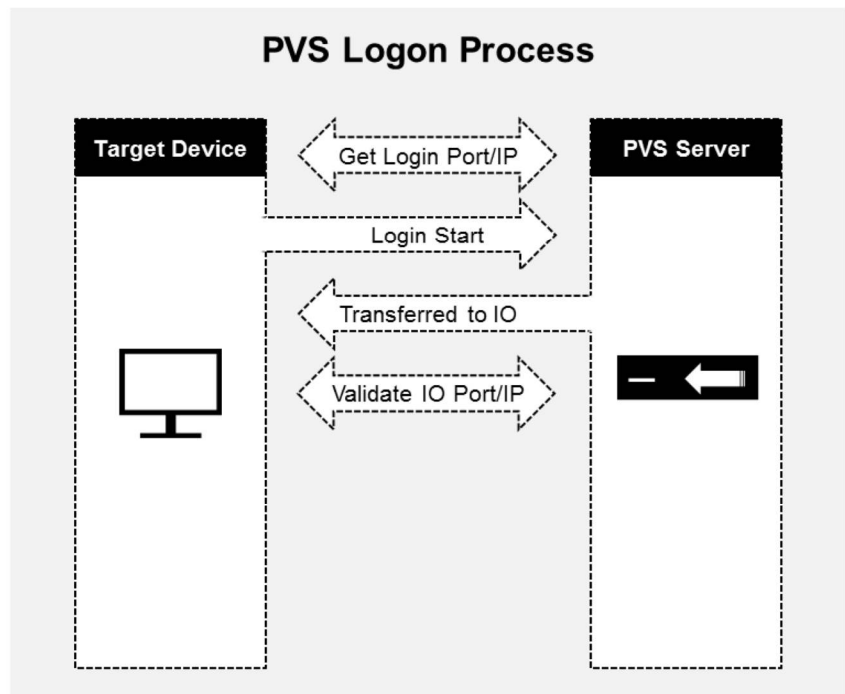
4. The PVS Server replies with the Provisioning server IP and port that the target should contact for regular I/O communications.



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Streaming Process

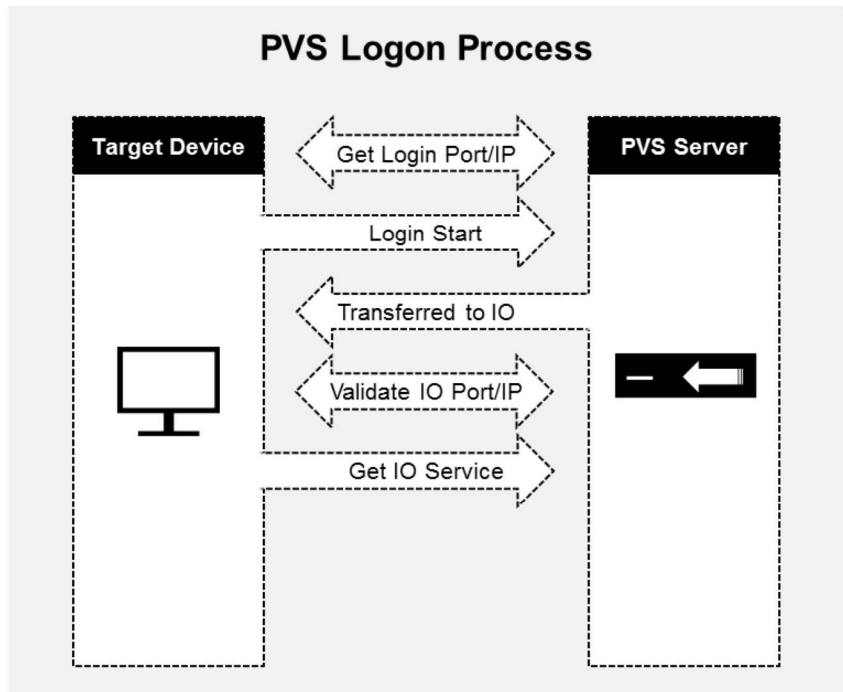
5. Next, the target device validates the I/O IP and Port with the Provisioning Server.



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Streaming Process

6. After validating the I/O IP and Port, the Target Device sends an I/O service request.



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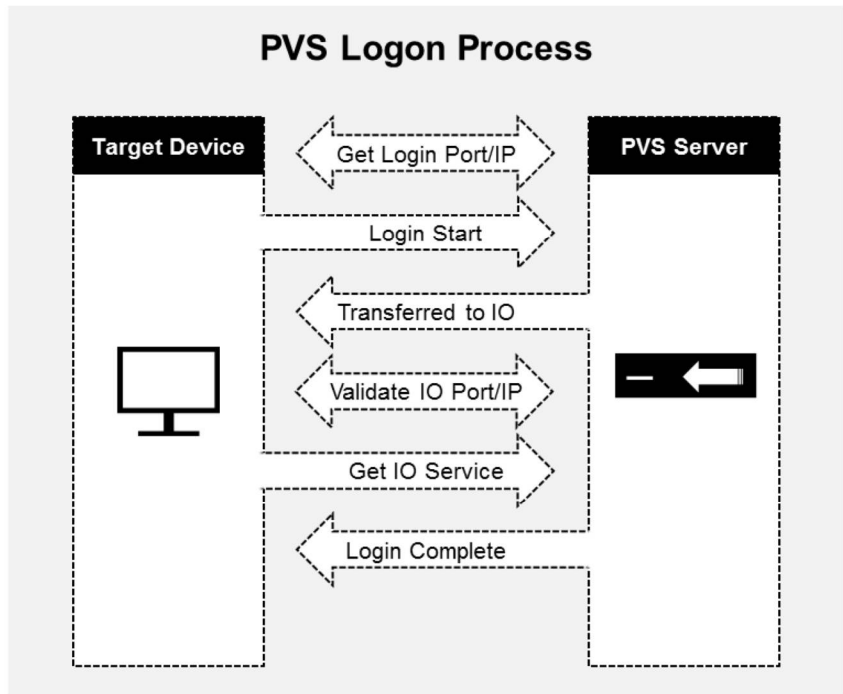
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Key Notes:

- At this stage, the target device is ready to begin input/output (I/O) disk operations.
- The target device also requests information on the vDisk that will be used for streaming.

Streaming Process

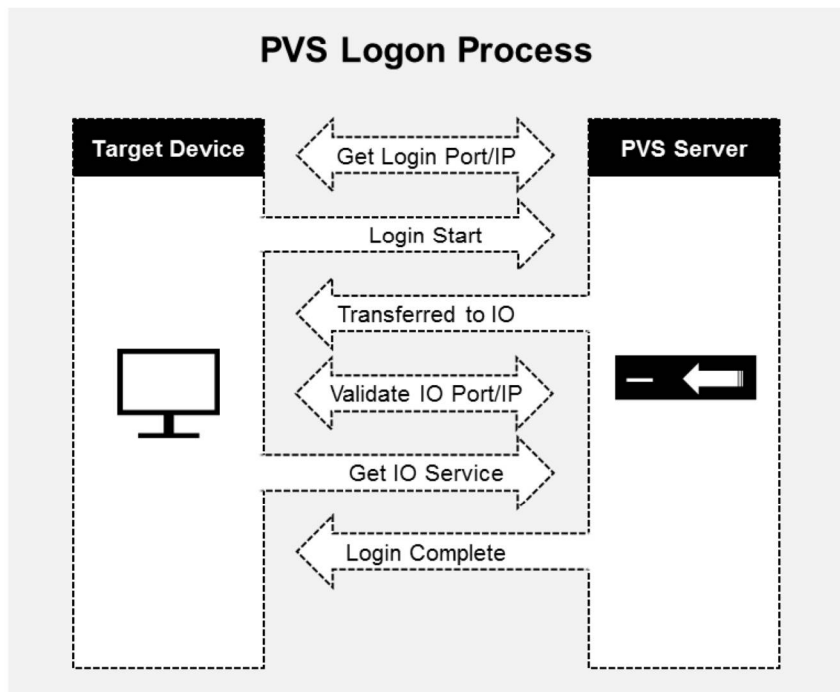
6a. The Stream Process grants I/O access to the target device.



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Streaming Process

6b. In parallel, the Stream Process connects to the Farm Database, retrieves the target's vDisk assignment, and makes a load balancing decision if the vDisk is available on more than one server.



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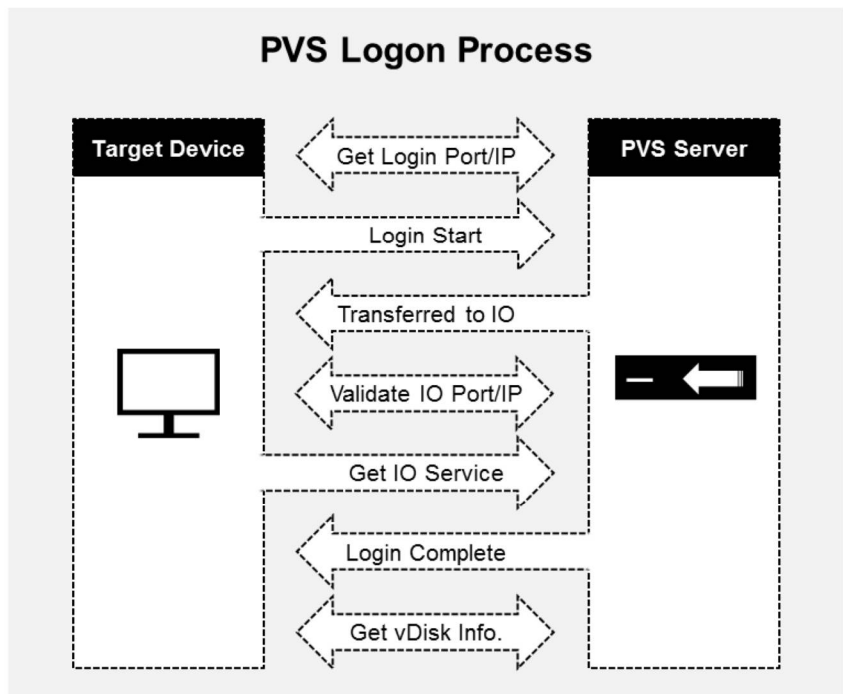
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Key Notes:

- The Stream Process will attempt to use port TCP 1433 to contact the Farm database unless a custom port has been specified in the Configuration Wizard.
- A PVS login server normally attempts to load balance devices between all servers that have access to a given vDisk when the device initially logs in. The login server only bypasses load balancing if the server override property is set for the vDisk locator.
- The load balancing algorithm provides simple connection count balancing. (i.e. the login server attempts to place the same number of devices on each server that has access to a given vDisk.)

Streaming Process

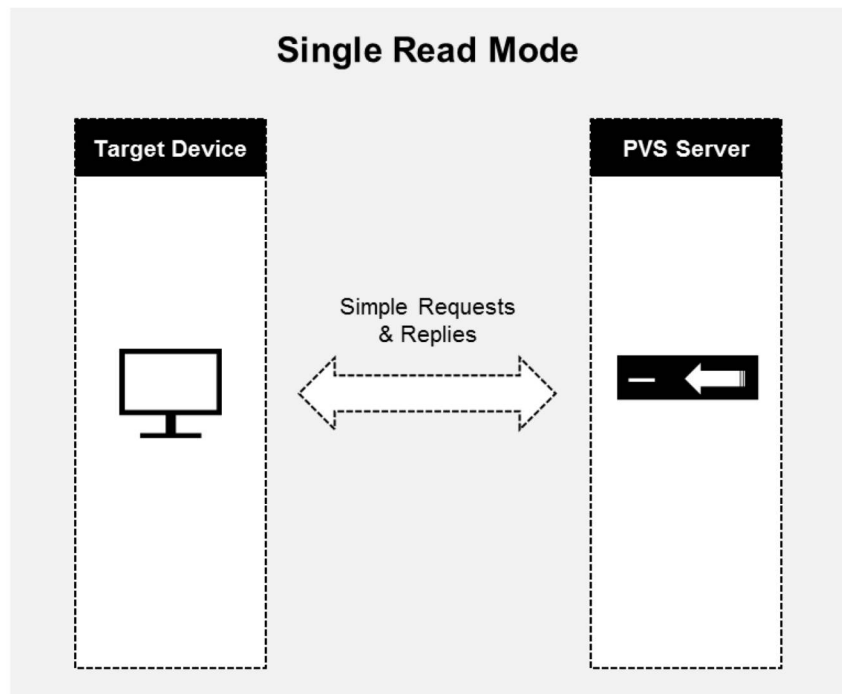
7. Over a series of communications, the Streaming Process communicates the vDisk and Streaming Server assignment to the target device.



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Streaming Process

8. The stream process now begins to send disk read requests to access the vDisk, loads the necessary drivers, and ultimately loads the vDisk operating system.



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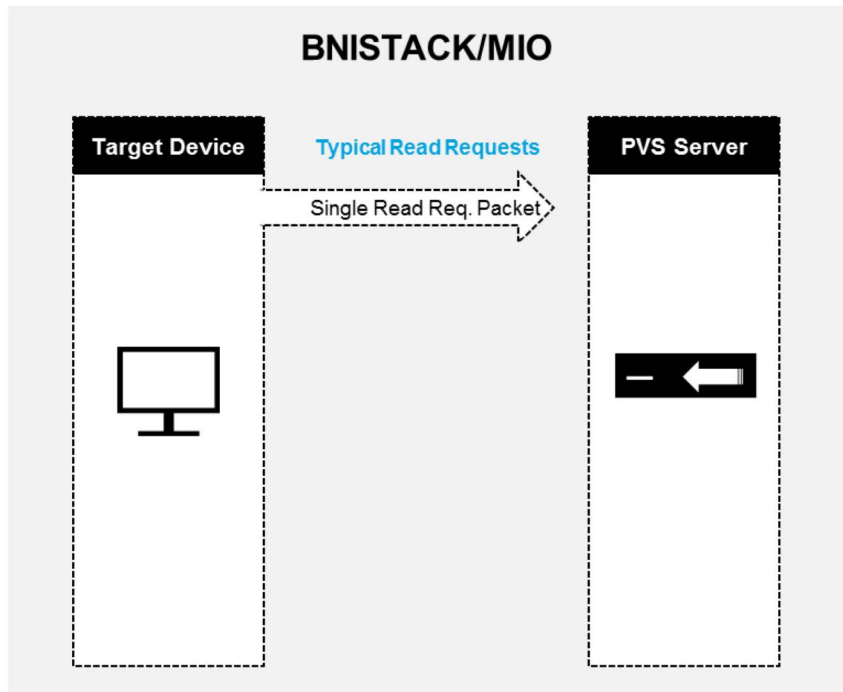
Key Notes:

- This represents the final stage of the target device login process. All PVS servers are capable of acting as both a login server and an I/O server.
- Each read request asks for vDisk sector data that can fit in a single packet UDP response, which is set at a maximum of 1472 bytes (1500 bytes – headers). This is so that responses can fit within the underlying Ethernet MTU, which prevents fragmentation of the packets.
- If the target device does not receive any of the reply packets within five seconds, it retries its request. This will be repeated three times before the target will attempt to reconnect and login to the PVS server again.
- This procedure will repeat until the operating system starts loading drivers and BNISTACK driver is successfully loaded. The BNISTACK driver is responsible for managing steady-state communications between the target device and PVS server.
- BNISTACK communicates information about the client configuration, vDisk info, and Active Directory configuration. At this point, the target device is able to load the operating system of the vDisk.

Streaming Process

During steady-state streaming:

1. The target device sends read request packets to its assigned PVS streaming server.



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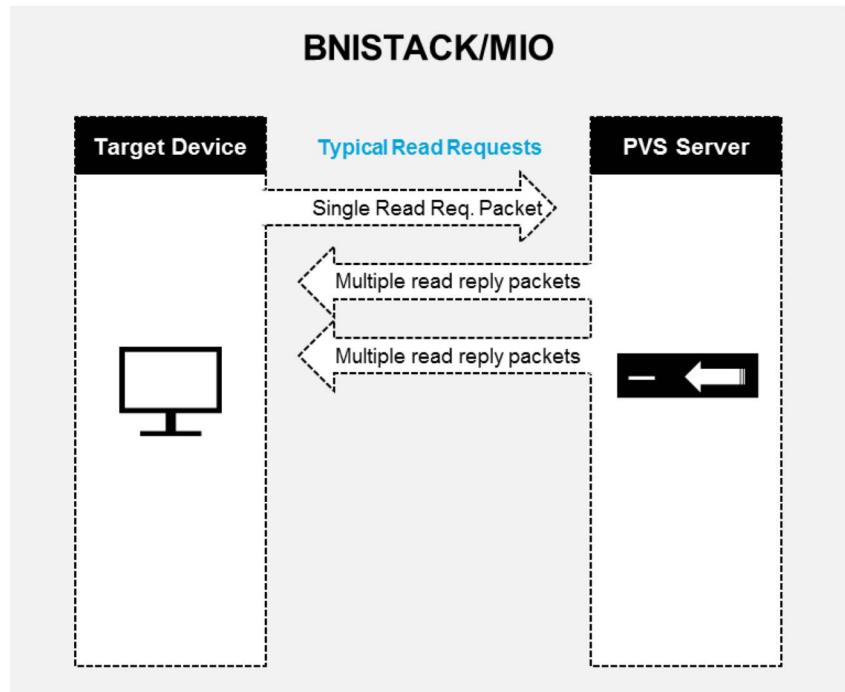
Key Notes:

- To review, the BNISTACK driver is responsible for managing steady-state communications between the target device and PVS server. “MIO” stands for “multiple I/O” since multiple read and response communications can be sent as needed between the provisioning server and the target device during this stage.

Streaming Process

During steady-state streaming:

2. The PVS Server responds with multiple read reply packets.



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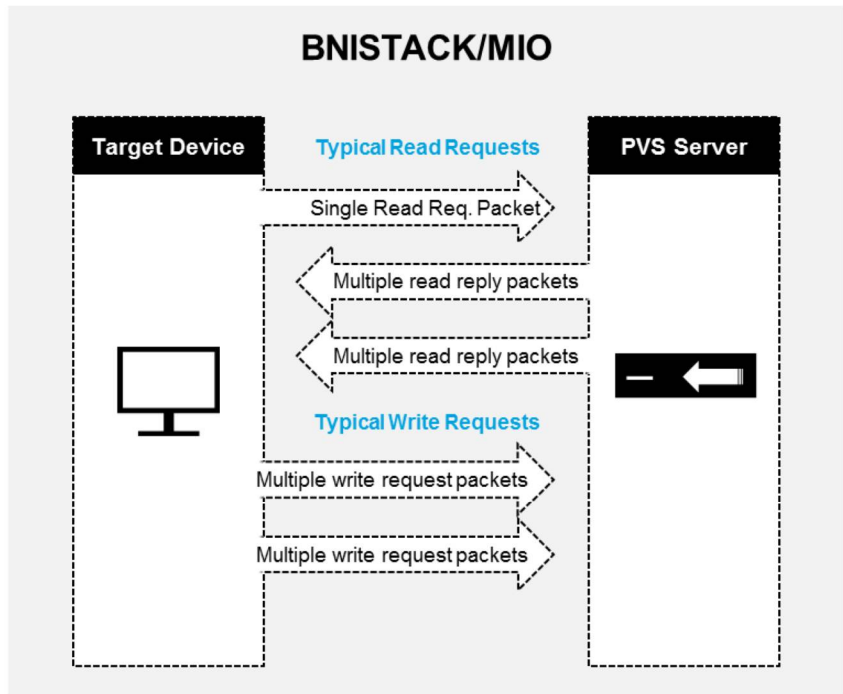
Key Notes:

- Similar to the login stage, if the target device does not receive a read reply packet, it will retry sending a read request.
- Read retries can be viewed in the vDisk Usage window within the PVS Console. A target device with a high number of retries may be an indication of poor network connectivity between the PVS server and the target device.

Streaming Process

During steady-state streaming:

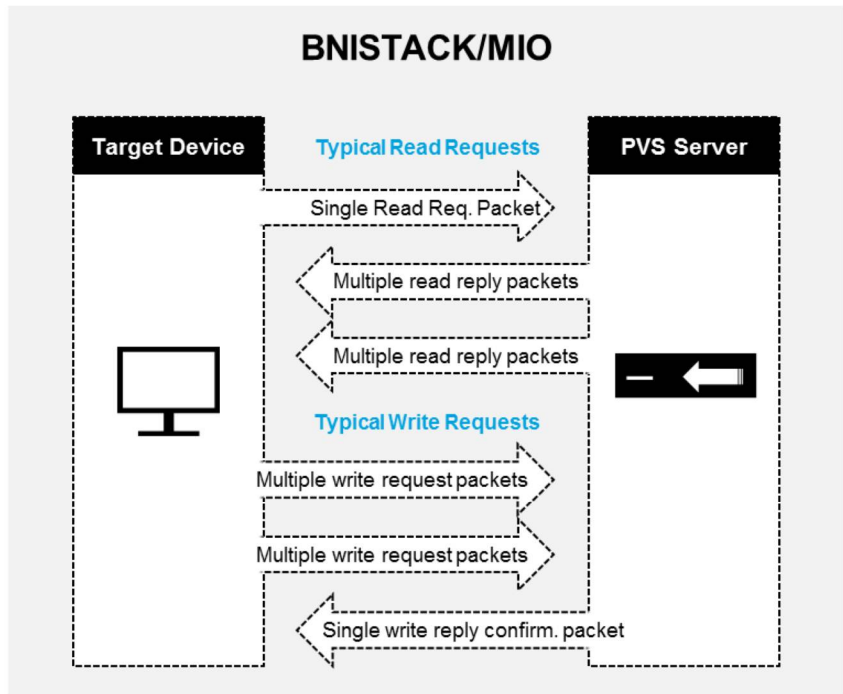
3. If the vDisk is in private mode or a server-side write cache is used, the target device sends multiple write request packets to the PVS Server.



Streaming Process

During steady-state streaming:

- The PVS Server responds with a single write reply confirmation packet.



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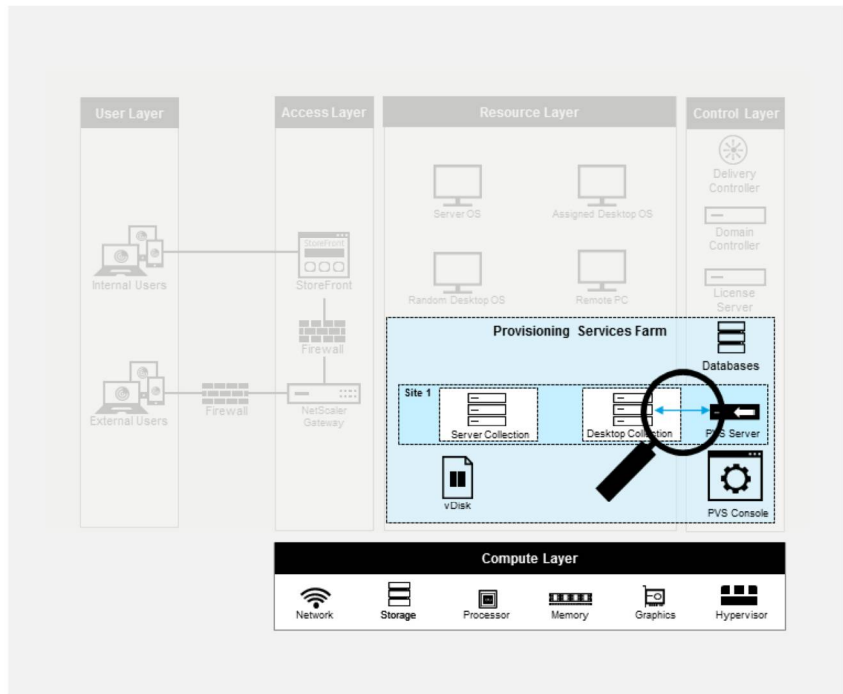
Additional Resources:

- Provisioning Services Boot Process Diagram:
<https://support.citrix.com/article/CTX136378>

Streaming Process

Review:

All of the communications that were just shown occur between a target device and one or more Provisioning Servers.



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Additional Resources:

- Provisioning Services Boot Process Diagram: <https://support.citrix.com/article/CTX136378>

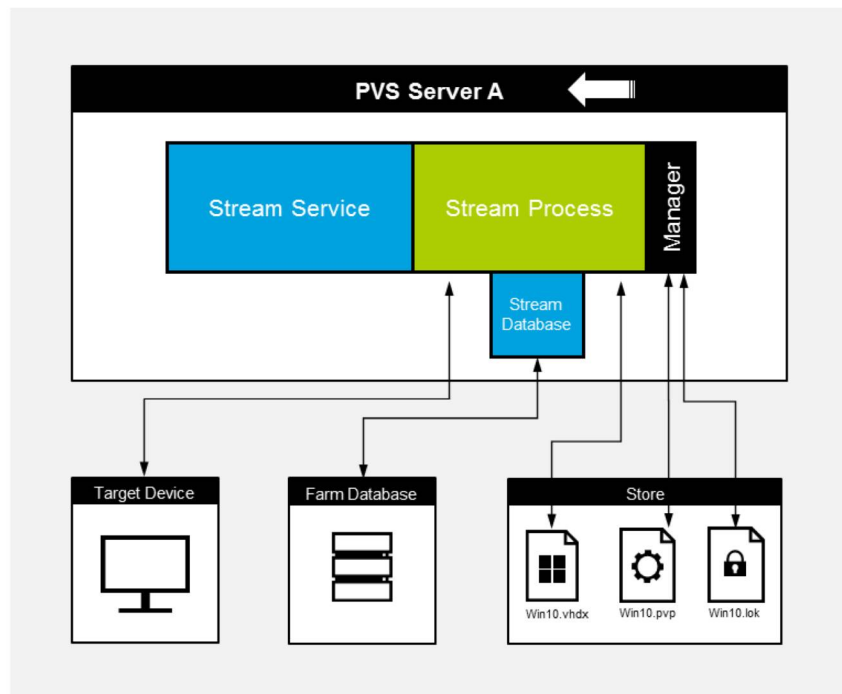
Not for resale or distribution

Streaming Process Management

During steady-state streaming:

The Manager is responsible for locking and unlocking vDisk files, and reading the vDisk properties file (vDiskName.pvp)

The Stream Process continues to communicate with the .vhd(x) file as needed based on target device read requests.



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Key Notes:

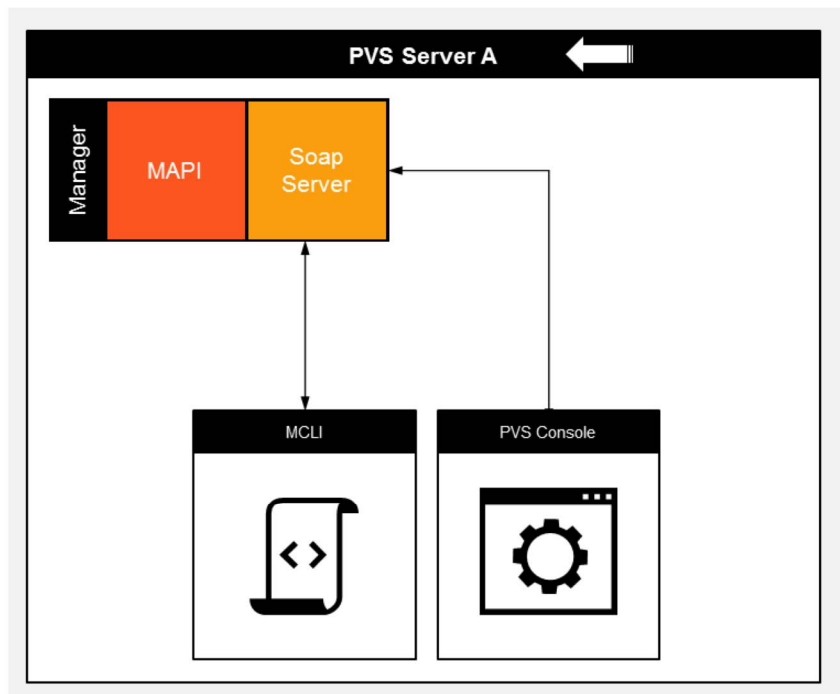
- Keep in mind that all of these components are contained within each Provisioning Server, except for the Target Device and Farm Database. This diagram assumes an external, centralized Store is configured.
- The Manager component is part of the Stream Process, and interacts with the auxiliary vDisk files (.pvp and .lok).
- There are two instances of the Manager running on every Provisioning Server. One instance interacts with the StreamProcess, while the other interacts with MAPI, which in turn coordinates with the Soap Server component.
- The Stream Database sub-component handles communications with the Farm database.
- As reviewed previously, the Stream Service monitors the Stream Process and associated components, and attempts to restart them if any of them fail.

Streaming Process Management

During steady-state streaming:

Connections to the PVS Server via the PVS Console or management command-line interface (MCLI) commands are made to the SOAP Server, not the Stream Process.

All configuration changes to the PVS Server are executed outside of the Stream Process.



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Key Notes:

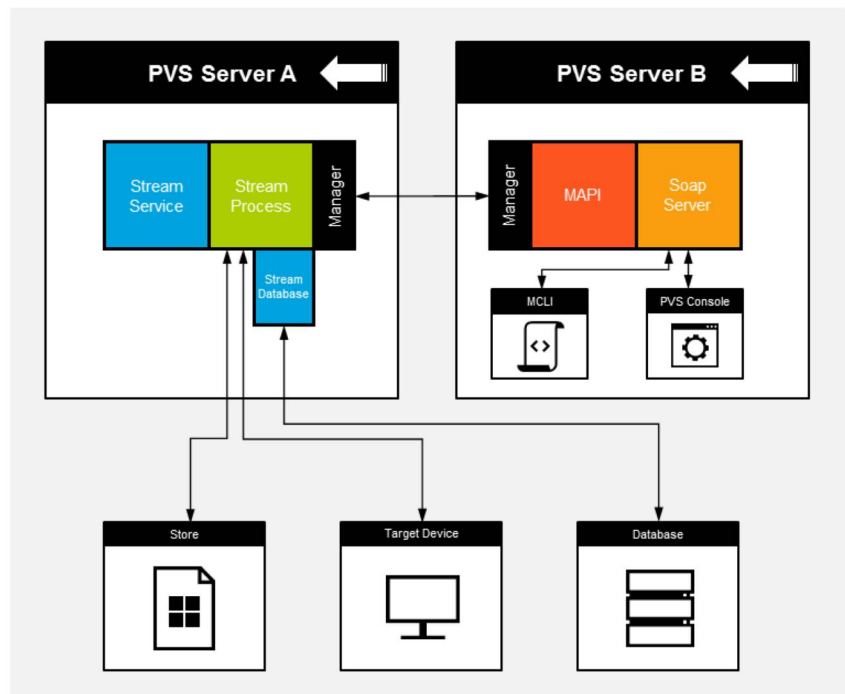
- As mentioned previously, MAPI coordinates communications between the Soap Server service and the Stream Process.

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Streaming Process Management

During steady-state streaming:

If the Provisioning Server that the Console or MCLI is connected to does not have access to the object that is being configured, the Manager on the Provisioning Server that the console/MCLI is connected to will contact the manager of the PVS Server that has the required access to the object to send the command.



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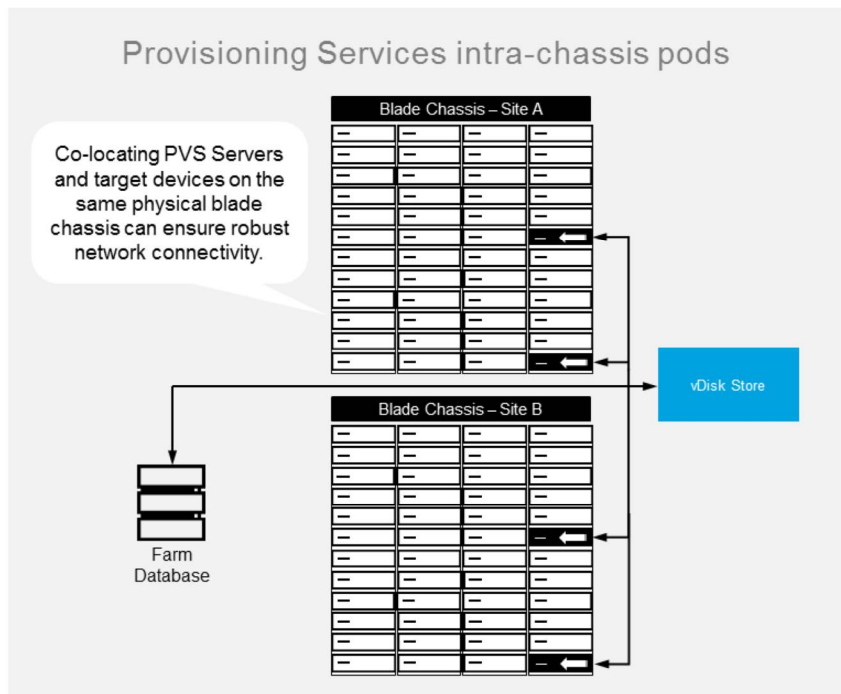
Key Notes:

- Note that all the displayed components are present on each of the Provisioning Servers, but in this scenario, PVS Server B does not have access to a certain component, for example because it is a member of a different Site.

Provisioning Services and Impact to the Network

The PVS boot and stream processes are very network dependent. Citrix recommends for PVS Servers to have high-speed, low latency links with the target devices for best performance.

Based on internal testing, the recommended latency tolerance between Provisioning Servers and target devices is a maximum of 5-10 ms with no firewalls.



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Key Notes:

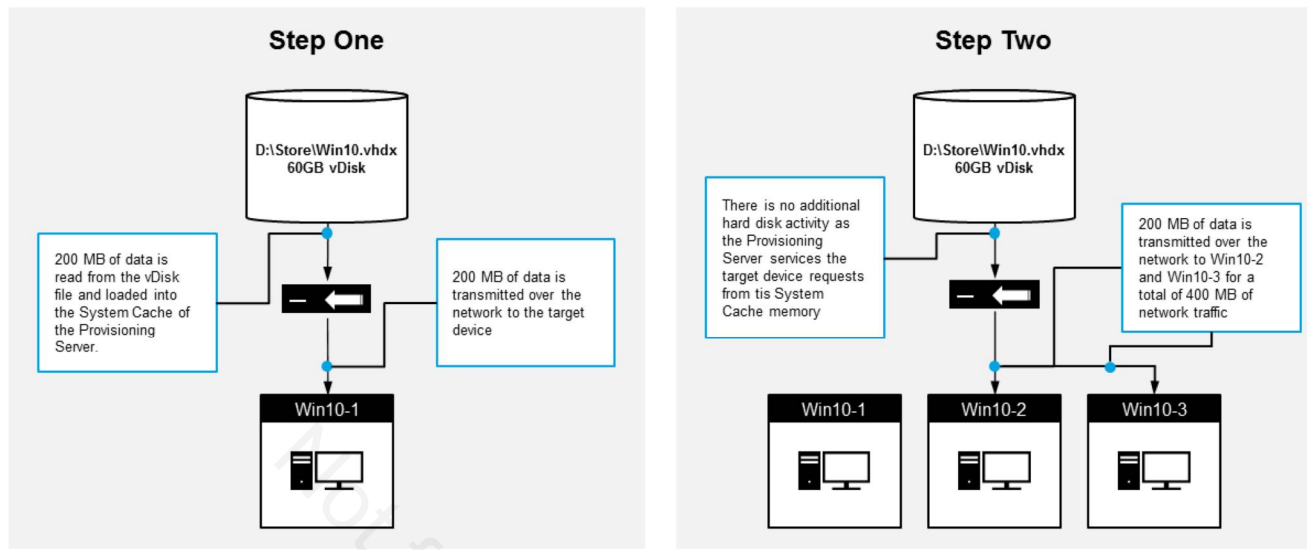
- To facilitate this, some organizations design their PVS environment using a “pod” architecture. What this means is that one or two Provisioning Servers are physically collocated on the same blade chassis as a set number of target devices. When additional target devices are required, an additional “pod” is built out. Beyond making use of the fast, low latency connectivity within a chassis, using a pod architecture also helps to increase resiliency and decrease failure domains.

Additional Resources:

- “New” Citrix Best Practices 2.0: <https://www.citrix.com/blogs/2016/06/08/new-citrix-best-practices-2/>

Optimize Streaming Cache in Memory

Method 1



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Key Notes:

- One of the key benefits of Provisioning Services is the ability to store vDisk information on the system cache of Provisioning Servers. This can dramatically reduce the amount of read IOPS to the PVS Store.
- The streaming cache also helps lower network utilization between the Provisioning Servers and the Store.

Additional Resources:

- Advanced Memory and Storage Considerations for Provisioning Services:
<https://support.citrix.com/article/CTX125126>.

Optimize Streaming Cache in Memory Method 1

- This benefit is built into Provisioning Services because it takes advantage of the system cache that exists on all Windows systems.
- The key consideration here is properly sizing the RAM on the Provisioning Servers.

A baseline formula to use for testing is:

$$2\text{GB} + (\#XA_vDisk * 4\text{GB}) + (\#XD_vDisk * 2\text{GB}) + 15\% \text{ (Buffer)}$$

Number of
Server OS
vDisks

Number of
Desktop OS
vDisks

Used for other
server activities

For example, if you have one Windows 7 vDisk, one Windows 10 vDisk, and one Windows Server 2012 R2 vDisk:

$$2\text{GB} + (1*4\text{GB}) + (2*2\text{GB}) + 15\% \text{ (Buffer)} = 11.5 \text{ GB} \rightarrow \text{round to } 12 \text{ GB}$$

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Key Notes:

- In general, the amount of memory needed will depend on the number and type of vDisks in the environment. From there, adjust as needed based on actual performance. Tools such as Resource Monitor and RamMap can be used to monitor memory usage.
- It is recommended to reboot the PVS servers regularly. This clears the system cache, which may be storing disk information that is no longer needed or used due to vDisk updates, and allows it to rebuild with up-to-date vDisks.

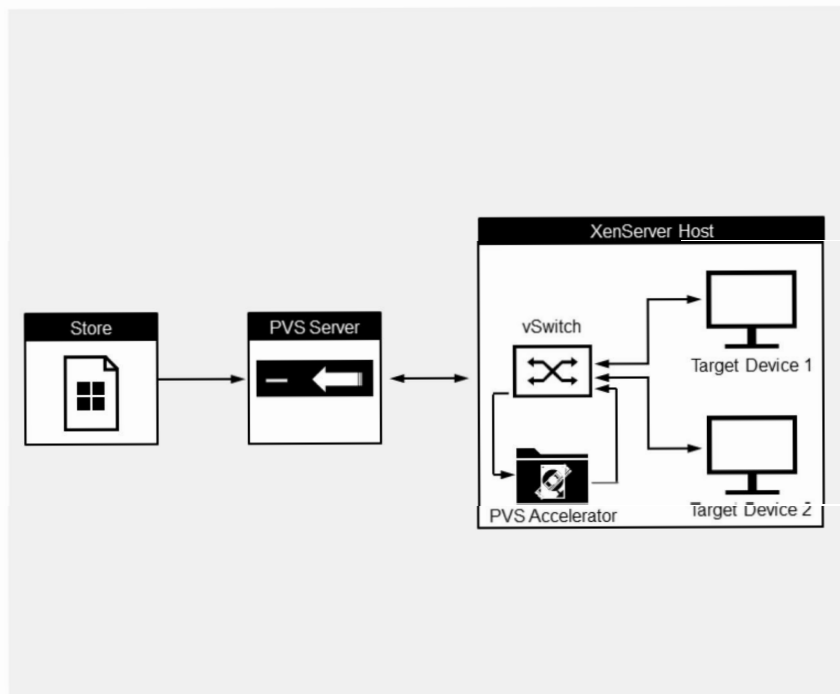
Additional Resources:

- PVS Internals #1 – Cache Manager: <https://www.citrix.com/blogs/2012/10/25/pvs-internals-1-cache-manager/>
- PVS Internals #2 – How to properly size your memory: <https://www.citrix.com/blogs/2013/07/03/pvs-internals-2-how-to-properly-size-your-memory/>

Optimize Streaming Cache in Memory

Method 2

- Starting with XenServer 7.1, the PVS Accelerator feature can provide an additional location to cache vDisk information.
- After being enabled, the cache captures any vDisk reads going through the virtual switch on the XenServer host where target device VMs reside.
- If additional target devices subsequently use the same vDisk, the vSwitch reads the cached information from the PVS Accelerator cache instead of contacting the Provisioning Server.



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Key Notes:

- PVS-Accelerator enables a PVS proxy to reside in Dom0 (XenServer's Control Domain) on a XenServer host where streaming of a PVS vDisk is cached at the proxy before being forwarded to the VM. Using the cache, subsequent booting (or any IO requests) of the VM on the same host can be streamed from the proxy rather than streaming from the server over the network. Using this model, more local resources on the XenServer host are consumed, but streaming from the server over the network saves resources, effectively improving performance.
- It is important to understand that this can act as a supplement to the traditional streaming cache method, since it reduces communications between the Provisioning Server and target devices (compared to the Provisioning Server and the Store in method 1).
- Internal testing has shown that this feature can result in 25% faster desktop boot up times, up to 98% lower network bandwidth usage, and up to 93% reduced PVS CPU usage. Additionally, by providing an additional caching location for vDisk information, it can provide some fault tolerance for PVS Server outages.
- This benefit is available on Provisioning Services 7.13 or above in conjunction with XenServer 7.1 (the first XenServer LTSR version). This is because the XenServer proxy feature is introduced in this version.

Additional Resources:

- Introducing PVS-Accelerator, only available with

XenServer!: https://www.youtube.com/watch?v=l_vhMf3SFks

- Configure PVS-Accelerator: <http://docs.citrix.com/en-us/provisioning/7-13/install/configure-accelerator.html>

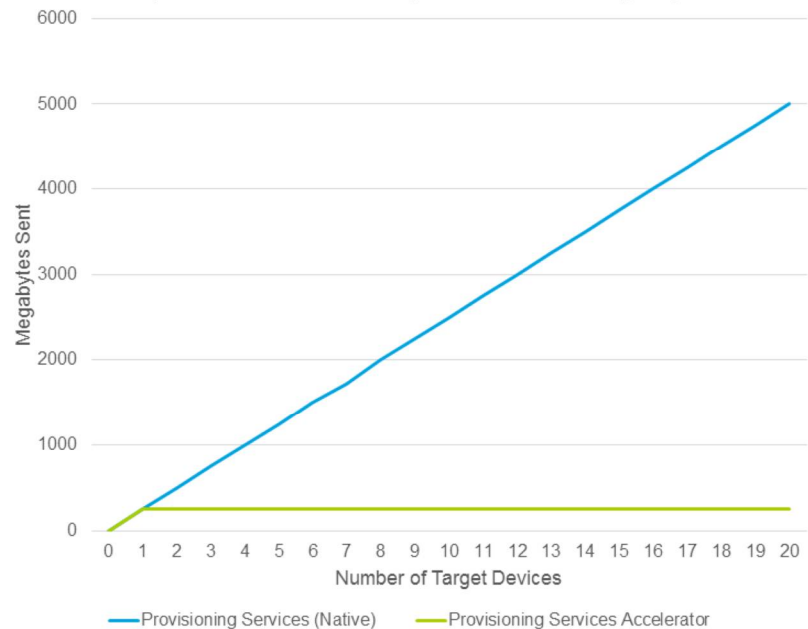
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Optimize Streaming Cache in Memory

Method 2

- Provisioning Services Accelerator is able to decrease network utilization requirements as multiple machines can share the same blocks of vDisk data.
- Enabling this feature involves configuration steps on both the XenServer and Provisioning Services consoles.

Network Bandwidth Utilization
(Between Provisioning Servers and Targets)



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Key Notes:

- To use the PVS-Accelerator feature, an optional package is installed on the XenServer 7.1 hosts where the target devices reside. Next, a PVS Site object would be created using XenCenter (the XenServer console), which defines the storage repositories that will be used when proxying I/O requests.
- On the PVS side, the XenServer proxy is configured for devices using the XenDesktop Setup Wizard and the Streamed VM wizard (which will be reviewed later in the course).
- If implementing this new feature, be sure to refer to the Citrix eDocs, since there are several caveats that can influence the implementation and maintenance.

Additional Resources:

- Introducing PVS-Accelerator, only available with XenServer!: https://www.youtube.com/watch?v=I_vhMf3SFks
- Configure PVS-Accelerator: <http://docs.citrix.com/en-us/provisioning/7-13/install/configure-accelerator.html>



**Lesson
Objective
Review**

How many servers are needed to host the Stream Process, Login Server, Stream Server, BNISTACK, bootstrap file, and Soap Server?

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Lesson Objective Review

How many servers are needed to host the Stream Process, Login Server, Stream Server, BNISTACK, bootstrap file, and Soap Server?

All of these components reside on a Provisioning Server.

Key Notes:

- Although all the necessary components for streaming a vDisk to target devices are contained within each Provisioning Server, it is recommended to use the N+1 principle to have redundancy for all of these roles within the Farm.



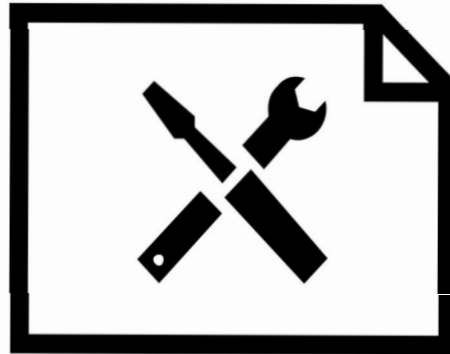
Boot Methods

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What is the bootstrap file?

The bootstrap file provides the information and drivers needed by the target device to begin communicating with Provisioning Servers to stream the vDisk.



Key Notes:

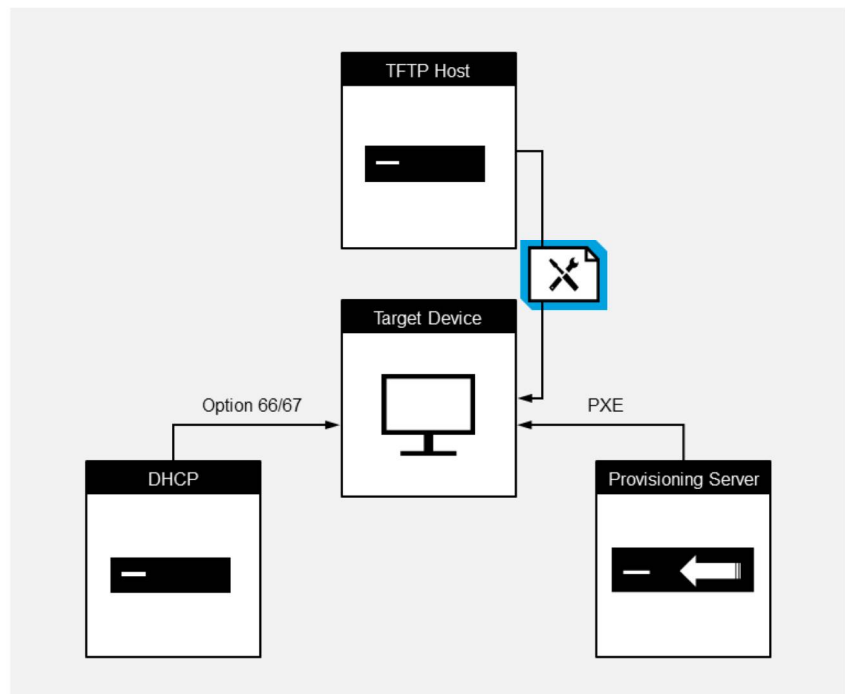
- A target device initiates the boot process by first loading a bootstrap program located within the bootstrap file. A bootstrap program is a small program that runs before the operating system is loaded. Provisioning Services uses a special bootstrap program which initializes the streaming session between the target device and the Provisioning Server. After this session starts, the operating system begins to be streamed and loaded from the vDisk that was initiated.
- The full bootstrap file is named ARDBP32.bin, and helps to handle communications between the target device and Provisioning Server until the target device is ready to boot the operating system contained on the vDisk. The bootstrap file name can be different under certain circumstances, which will be reviewed in this lesson.

Additional Resources:

- Getting the bootstrap file: <https://docs.citrix.com/en-us/provisioning/7-13/install/bootstrap-file.html>

PXE/DHCP Methods - Introduction

- Network-based boot method
- Relies on specifying the bootstrap location via PXE or DHCP,
- Then downloading the bootstrap file using TFTP.



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Key Notes:

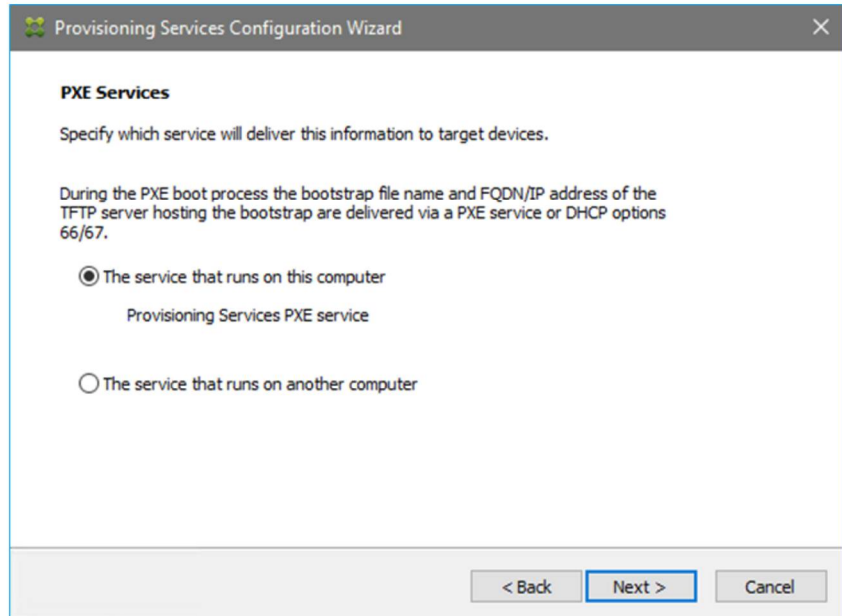
- There are two key stages that must occur before initiating the stream process described in the previous lesson:
 - IP Acquisition
 - Bootstrap delivery
- The PXE and DHCP methods both ultimately deliver the bootstrap file location to target devices, which subsequently download the bootstrap over the network using a TFTP service. A Provisioning Server can serve as the host for the bootstrap TFTP downloads, but another TFTP service provider can also be used.

Additional Resources:

- Getting the bootstrap file: <http://docs.citrix.com/en-us/provisioning/7-13/install/bootstrap-file.html>

PXE Method - Setup

- During the Farm Configuration wizard, the PXE Services location is specified.
- Selecting “The service that runs on this computer” will cause the Provisioning Server to respond to any PXE requests sent over the network.



Key Notes:

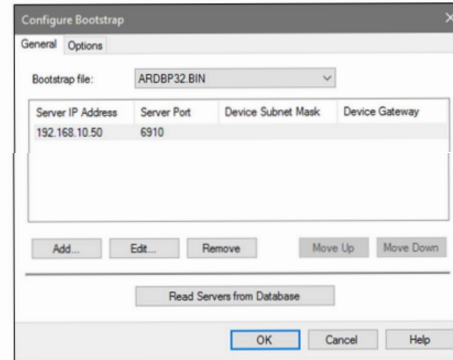
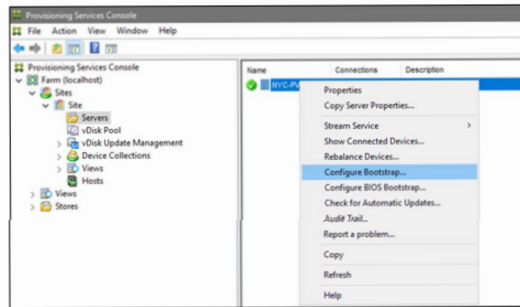
- To set up the PXE method, during the initial farm installation, choose “The service that runs on this computer.” This should be repeated whenever additional PVS servers are added to the Farm.
- At this point, the Provisioning Server will respond to any PXE request broadcasts with the configured bootstrap file location information.
- The PXE Delivery method uses the PXE 2.1 specification originally developed by Intel. The Provisioning Servers can host the PXE service and respond to requests for the bootstrap file location.
- It should be noted that during the Farm Configuration wizard it is possible to designate the Provisioning Servers as DHCP or even BOOTP servers; however, this should not be configured unless building a Proof of Concept or test environment.

Additional Resources:

- Getting the bootstrap file: <http://docs.citrix.com/en-us/provisioning/7-13/install/bootstrap-file.html>

PXE Method - Setup

Bootstrap settings can be configured during initial configuration or later in the PVS Console.



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Key Notes:

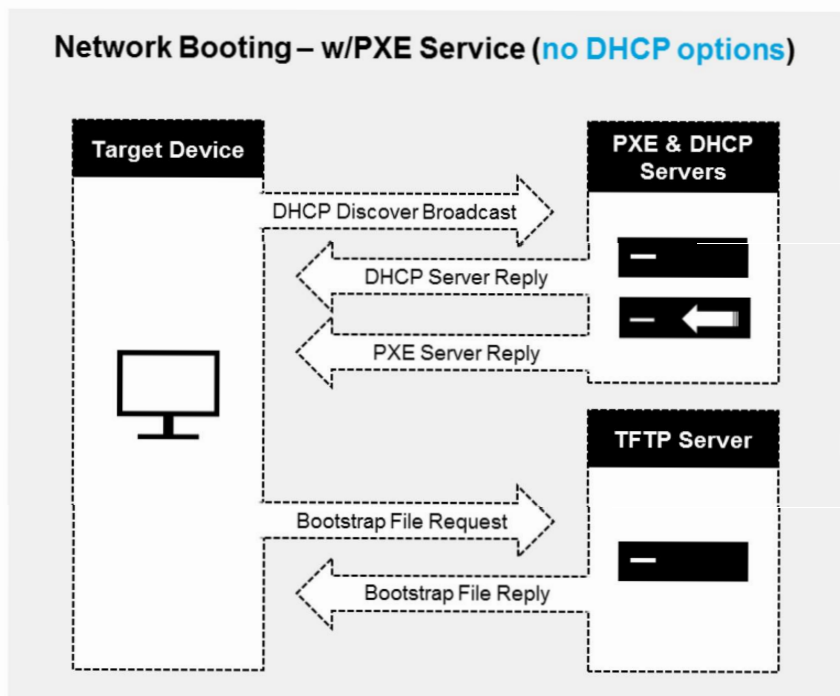
- Beyond specifying the Provisioning Servers to use PXE, the bootstrap file information can be updated in the Provisioning Services Console.
- The target devices should be configured to boot from the network, which will cause them to send a PXE broadcast request when they are powered on or reboot.

Additional Resources:

- Configuring the bootstrap file from the Console: <http://docs.citrix.com/en-us/provisioning/7-13/install/bootstrap-from-console.html>

PXE Method – IP Acquisition / Bootstrap Delivery

1. Target devices are configured for network boot; send DHCP discover packet along with a PXE broadcast.
2. DHCP server replies with IP address.
3. PXE Server replies with bootstrap location.
4. Target device proceeds to request and download bootstrap file from TFTP server.



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Key Notes:

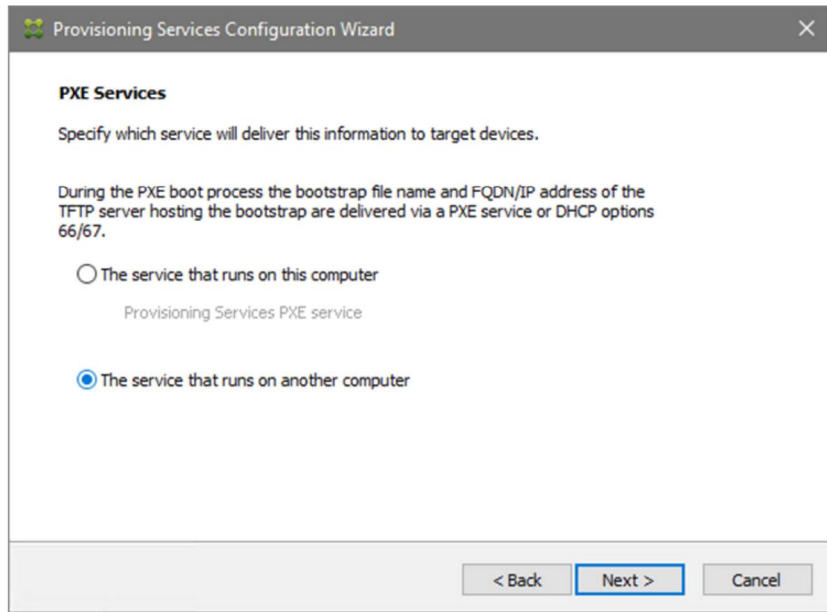
- Because the bootstrap file is delivered dynamically over the network from a TFTP server, static IP addresses cannot be hardcoded into the file; instead, access to a DHCP server is required to provide IP addresses to target devices.
- After requesting and receiving the bootstrap location, the target device will download it via TFTP on port 69.

Additional Resources:

- Provisioning Services Boot Process Diagram: <https://support.citrix.com/article/CTX136378>

DHCP Options Method - Setup

- During the Farm Configuration wizard, the PXE Services location is specified.
- To setup the DHCP Options method, on the PXE Services screen, select "The service that runs on another computer."



Key Notes:

- This option is selected because DHCP, not PXE, will be used to communicate the location of the bootstrap file.

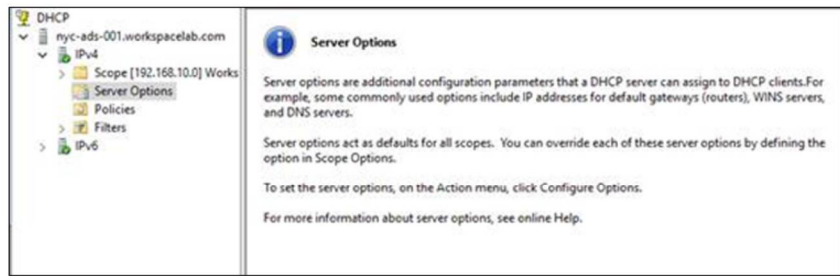
Additional Resources:

- Getting the bootstrap file: <http://docs.citrix.com/en-us/provisioning/7-13/install/bootstrap-file.html>

DHCP Options Method - Setup

On the DHCP Server configure:

- **Option 66:** Name(s) of TFTP Servers hosting bootstrap file
- **Option 67:** Name of bootstrap file (e.g. ARDBP32.bin)



Option Name	Vendor	Value	Policy Name
066 Boot Server Host Name	Standard	192.168.10.50	None
067 Bootfile Name	Standard	ardbp32.bin	None

Key Notes:

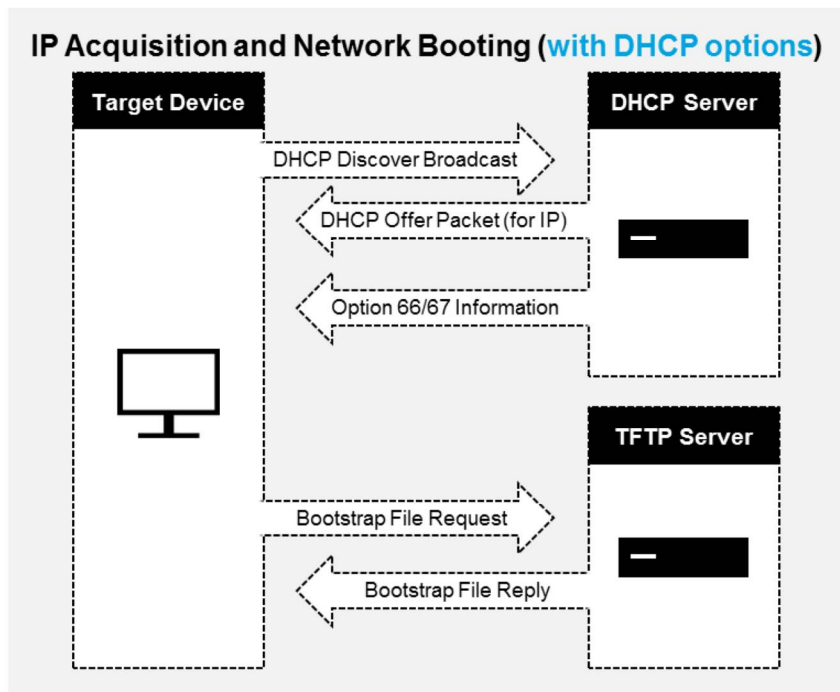
- DHCP options 66/67 must be configured with the TFTP server location(s) and bootstrap file name. When in place, the DHCP server will provide this information to the target device along with its IP address.

Additional Resources:

- Getting the bootstrap file: <http://docs.citrix.com/en-us/provisioning/7-13/install/bootstrap-file.html>

DHCP Options Method – IP Acquisition / Bootstrap Delivery

1. Target devices are configured for network boot; send DHCP discover packet.
2. DHCP server replies with IP address and bootstrap file location and name.
3. Target device proceeds to request and download bootstrap file from TFTP server.



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Key Notes:

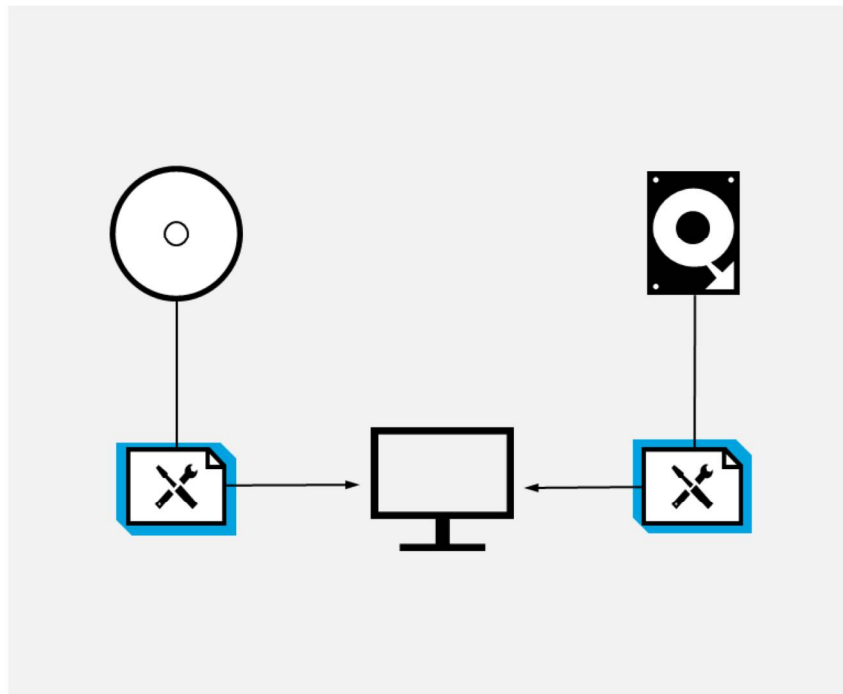
- Because the bootstrap file is delivered dynamically over the network from a TFTP server, static IP addresses cannot be hardcoded into the file; instead, access to a DHCP server is required to provide IP addresses to target devices.
- After requesting and receiving the bootstrap location, the target device will download it via TFTP on port 69.

Additional Resources:

- Provisioning Services Boot Process Diagram:
<https://support.citrix.com/article/CTX136378>

Boot Device / Attached Media Introduction

Instead of being delivered over the network, the bootstrap file is located on attached ISO file or disk partition.



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Key Notes:

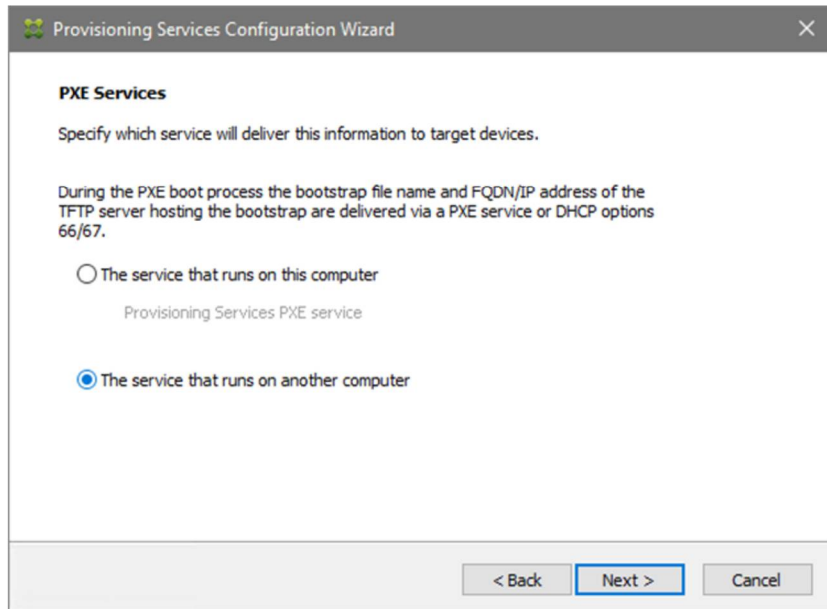
- An alternative way of delivering the bootstrap file to a target device is through the Boot Device Management Utility (BDM). BDM is an optional method for providing IP and boot information to target devices. It is an alternative to using the traditional DHCP, PXE, and TFTP methods. Using this method, when the target device starts, it obtains the boot information directly from the boot device. With this information, the target device is able to locate, communicate, and boot from the appropriate Provisioning Server. After the user is authenticated, the Provisioning Server provides the target device with its vDisk image.
- The BDM utility can be used to place bootstrap information on an ISO file, a hard disk partition, or a USB. The ISO file can be burned onto a CD-ROM, and along with a USB, can be used in conjunction with physical target devices. However, in virtualized environments, the ISO file and disk partition methods are typically used.

Additional Resources:

- Using the Manage Boot Devices utility: <http://docs.citrix.com/en-us/provisioning/7-12/install/pvs-boot-devices-utility.html>

BDM ISO Setup

- During the Farm Configuration wizard, the PXE Services location is specified.
- To setup the BDM ISO method, on the PXE Services screen, select “The service that runs on this computer.”

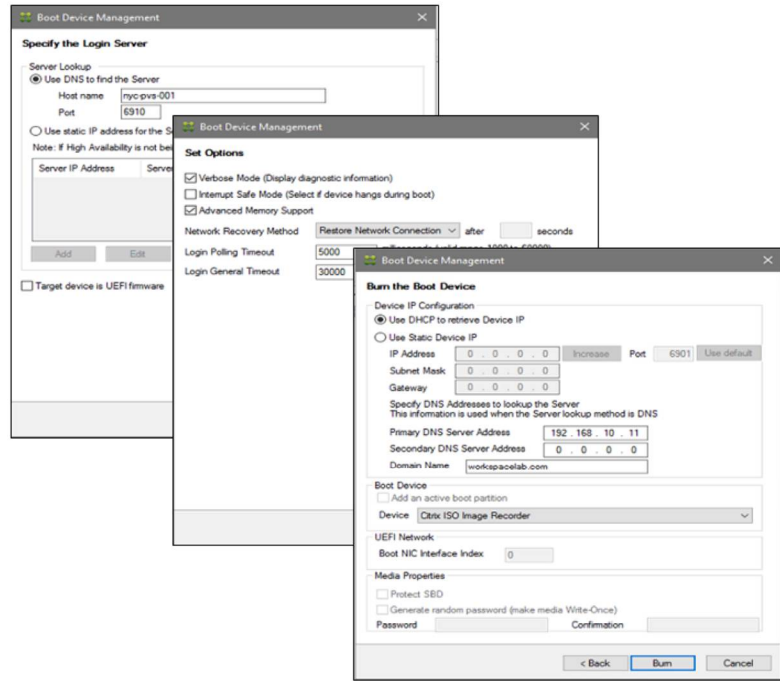


Key Notes:

- To set up the BDM ISO boot method, during the initial farm installation, choose “The service that runs on another computer.” This is because the bootstrap file will be provided by the ISO, not the PXE service on the Provisioning Server.

BDM ISO Setup

1. Configure login servers and options using Boot Device Management wizard.
2. Burn to ISO file
3. Store ISO file on CD-ROM (physical) or hypervisor storage repository (virtual)
4. Set target devices to boot from CD/DVD-ROM



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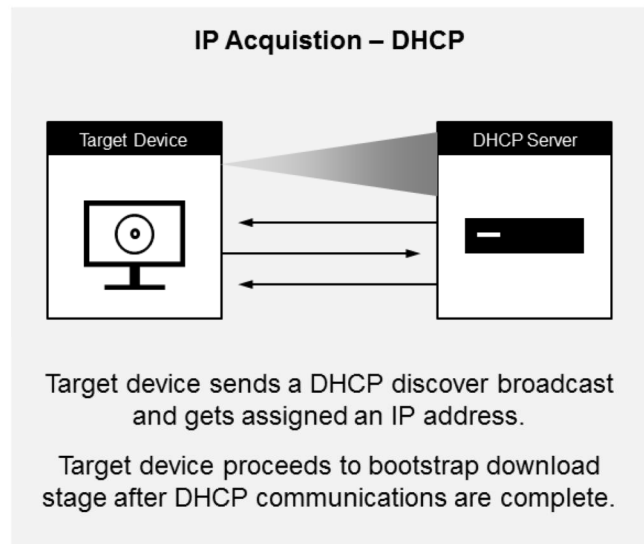
Key Notes:

- Use the Boot Device Management wizard, which is included in the PVS install media, to create the ISO containing the bootstrap file. Once created, this ISO can be placed on physical CD-ROMs (in the case of physical target devices) or more commonly, in an accessible hypervisor storage repository where it can be subsequently mounted on the target device VMs. The wizard is also available from the Provisioning Services Console.
- Remember to set the target devices to boot from CD/DVD-ROM in the BIOS. This process will vary based on the machine type (physical vs. virtual) and hypervisor used, if virtual.

Additional Resources:

- Using the Manage Boot Devices Utility: <http://docs.citrix.com/en-us/provisioning/7-13/install/boot-devices-utility.html>

BDM ISO – IP Acquisition



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Key Notes:

- The IP acquisition method utilized in the BDM ISO boot method is configured in the BDM wizard.
- Using a static IP address removes the need for a reachable DHCP server, but will require a custom ISO file for each target device, which increases deployment and update time.

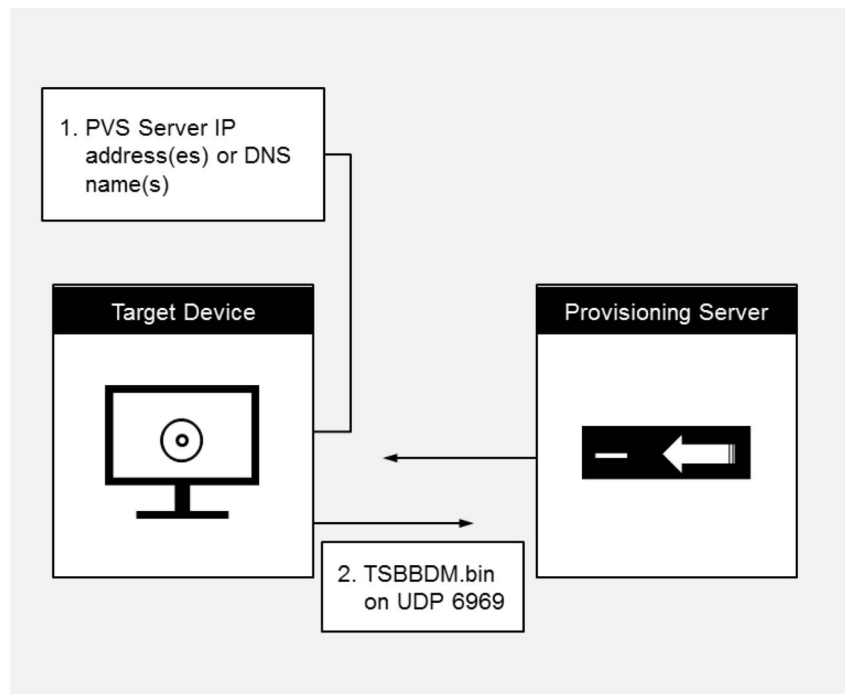
Additional Resources:

- Provisioning Services Boot Process Diagram:
<https://support.citrix.com/article/CTX136378>

BDM ISO Bootstrap Delivery

Two-stage boot process:

1. Bootstrap file in ISO contains the location of the PVS servers in the farm.
2. Target device downloads remaining required boot information, including TSBBDM.bin from a PVS Server using TFTP on UDP Port 6969.



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Key Notes:

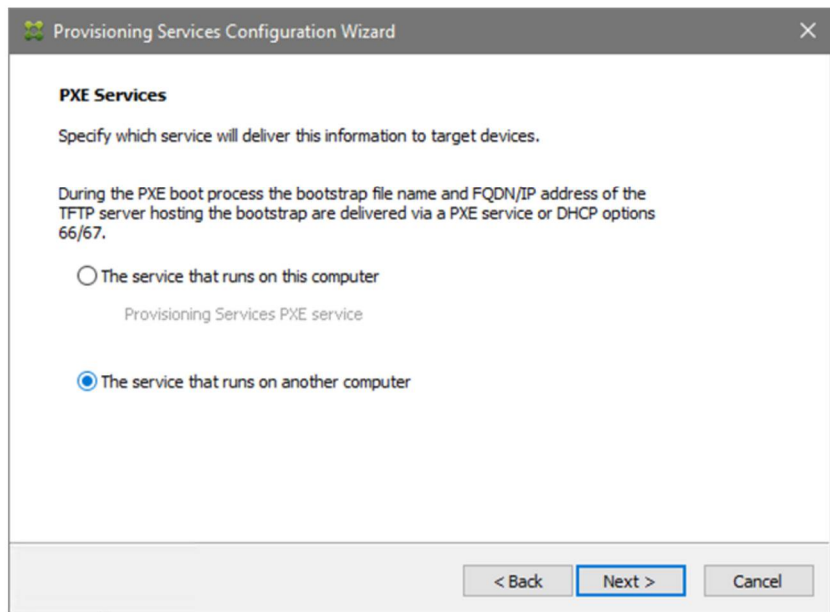
- BDM uses a two-stage boot process where the PVS login server location is hardcoded into the bootstrap generated by BDM.
- Instead of ARDBP32.bin, which is the full bootstrap file that is downloaded in the PXE and DHCP boot options methods, BDM boot methods download TSBBDM.bin, which contains additional required boot information like low level PVS device drivers. TSBBDM.bin is downloaded from a PVS Server using a proprietary download protocol based on TFTP that uses UDP port 6969.
- Once this download has completed, the target device proceeds to the login process covered in the previous lesson.

Additional Resources:

- Provisioning Services Boot Process Diagram:
<https://support.citrix.com/article/CTX136378>

BDM Disk Partition Setup

- During the Farm Configuration wizard, the PXE Services location is specified.
- To setup the BDM Disk Partition method, on the PXE Services screen, select “The service that runs on this computer.”



Key Notes:

- As with the BDM ISO boot method, during the initial farm installation, choose “The service that runs on another computer.” This is because the bootstrap file will be provided by a disk partition, not the PXE service on the Provisioning Server.

BDM Disk Partition

Setup

Traditional Method with the Streamed VM Wizard

1. Create disk partition on Master Target Device.
2. Run BDM Wizard on Master Target Device and burn bootstrap to disk partition.
3. Create a template from Master Target Device.
4. Use Streamed VM wizard to create target devices with BDM partition in place.
5. For updates to the bootstrap, target devices must be deleted and then re-provisioned with new bootstrap.

Newer Method with the XenDesktop Setup Wizard

1. Run XenDesktop Setup Wizard, select "BDM disk" option.
2. XDSW automatically creates a disk partition on each target device.
3. Updates to the bootstrap can be configured and pushed to target devices from the PVS Console.

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Key Notes:

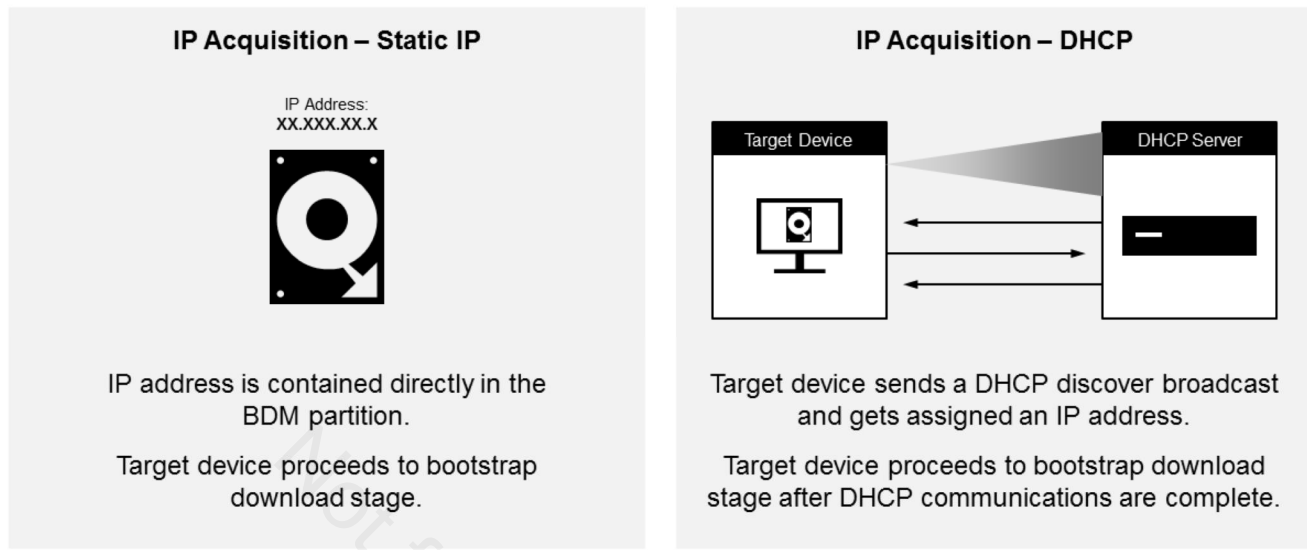
- Traditionally, the disk partition used for BDM was manually created on the write cache drive on the Master Target Device. The BDM wizard was run on the Master Target Device, and the bootstrap file was added to the disk partition. When a copy of the Master Target Device is later made into a template, machines created from that template using the Streamed VM wizard would all have the necessary partition.
- As you can imagine, this method prevented to use of static IPs with BDM. Additionally, prior to PVS 7.9, a BDM partition could not be updated or upgraded, so any changes to the PVS environment, including IP acquisition method, adding or removing PVS servers, hotfixes to the bootstrap, required administrators to delete all BDM partition VMs and provision new VMs to pick up the changes.
- With the introduction of the XenDesktop Setup Wizard, the disk partition can be automatically added to each target device during creation. Additionally, starting with PVS 7.9, updates to a BDM partition bootstrap file can be pushed out from the PVS Console without recreating all the target devices.

Additional Resources:

- Using the Manage Boot Devices Utility: <http://docs.citrix.com/en-us/provisioning/7-12/install/pvs-boot-devices-utility.html>

BDM Disk Partition

IP Acquisition



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Key Notes:

- Similar to BDM ISO, the IP acquisition method utilized in the BDM disk partition boot method is configured in the BDM wizard.
- Using a static IP address removes the need for a reachable DHCP server, but will require a custom ISO file for each target device, which increases deployment and update time, especially for the disk partition method.

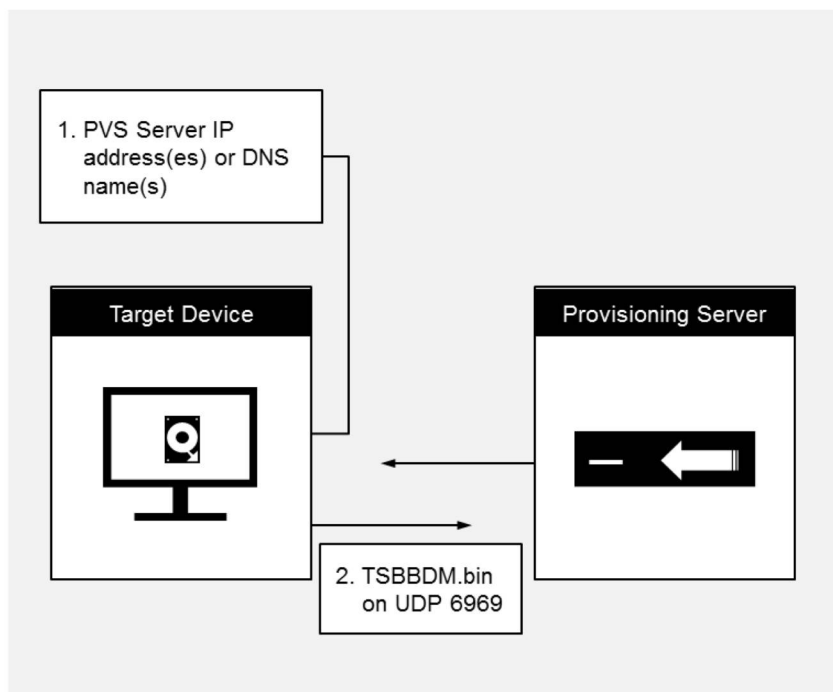
Additional Resources:

- Provisioning Services Boot Process Diagram:
<https://support.citrix.com/article/CTX136378>

BDM Disk Partition Bootstrap delivery

Two-stage boot process:

1. Bootstrap file in disk partition contains the location of the PVS servers in the farm.
2. Target device downloads remaining required boot information, including TSBBDM.bin from a PVS Server using TFTP on UDP Port 6969.



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Key Notes:

- To review, BDM uses a two-stage boot process where the PVS login server location is hardcoded into the bootstrap generated by BDM.
- The boot process is the same as BDM ISO, the only difference being the storage type for the bootstrap file.

Additional Resources:

- Provisioning Services Boot Process Diagram:
<https://support.citrix.com/article/CTX136378>

Bios Embedded Bootstrap Introduction

- The Bootstrap is directly embedded in target device hardware.
- Typically used for physical endpoints such as thin clients.



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Key Notes:

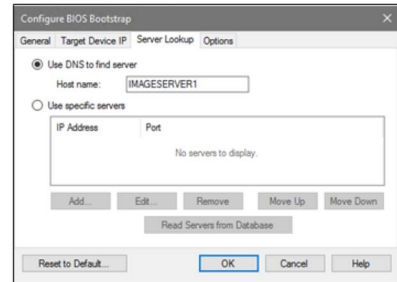
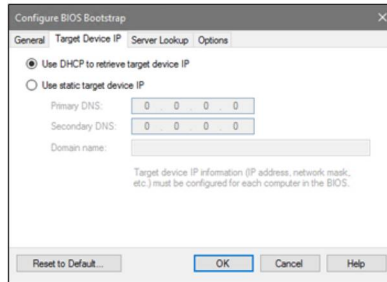
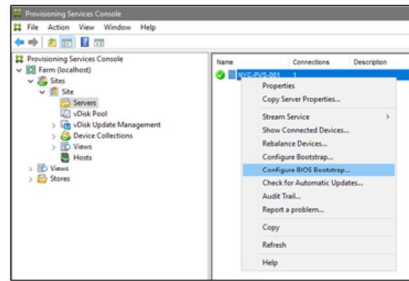
- The BIOS-embedded bootstrap feature is OEM specific and provides end users with systems preconfigured with Provisioning Services, allowing customers to deploy an Provisioning Services-enabled environment with minimal effort. This feature is an alternative to the standard PXE boot method.
- As part of this solution, the OEM embeds the bootstrap within the target device's BIOS at the factory. The OEM also pre-configures the device with product license keys.
- For the BIOS-Embedded Bootstrap feature to work automatically from the factory, the target network must support the following:
 - A DHCP server that is capable of providing the target device's IP, Subnet & Gateway address. Additionally, the DHCP service must provide the default DNS server for the client to use.
 - A DNS server must be active on the network.
 - A DNS entry must be defined which points the name <IMAGESERVER1> to each Provisioning Server's active IP address. This DNS entry is used by the target device to find an active server.

Additional Resources:

- Configuring the BIOS-embedded bootstrap: <http://docs.citrix.com/en-us/provisioning/7-12/managing-target-device/pvs-bootstrap-bios-embedded.html>

Bios Embedded Bootstrap Setup

BIOS embedded bootstrap typically works without additional configuration, but settings can be adjusted in the PVS Console.



Key Notes:

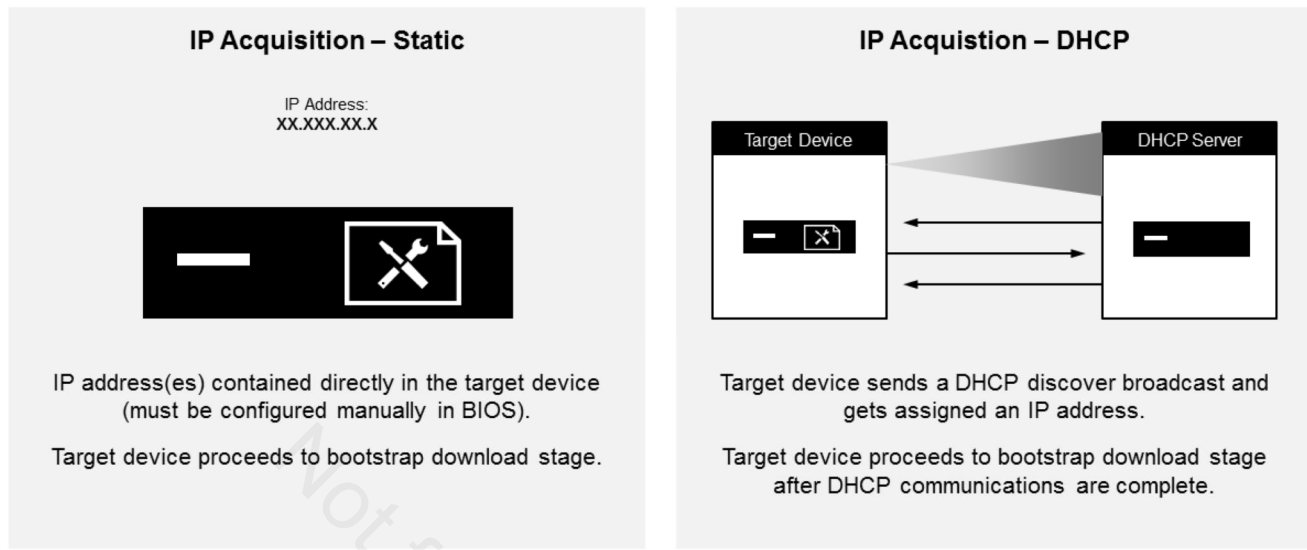
- The OEM configures the BIOS-embedded bootstrap settings so that the bootstrap works 'out-of-the-box'. If the Provisioning Services administrator needs to change settings, use the Configure BIOS Bootstrap feature in the Console. Configuration changes are updated automatically the next time the target device boots. However, only those BIOS settings that differ from the new settings are updated.

Additional Resources:

- Configuring the BIOS-embedded bootstrap: <http://docs.citrix.com/en-us/provisioning/7-13/managing-target-device/bootstrap-bios-embedded.html>

Bios Embedded Bootstrap

IP Acquisition - DHCP



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Key Notes:

- As previously mentioned, to work out-of-the-box, a DHCP server is required for IP acquisition by a target device using a BIOS-embedded bootstrap. However, static IP addresses can be manually added to the bootstrap later on by specifying a specific IP address, netmask, and subnet in the BIOS of each device. Additionally, this option must be specified, and a primary and secondary DNS Server and domain must be configured, in the PVS Console (PVS Server -> Configure BIOS Bootstrap).

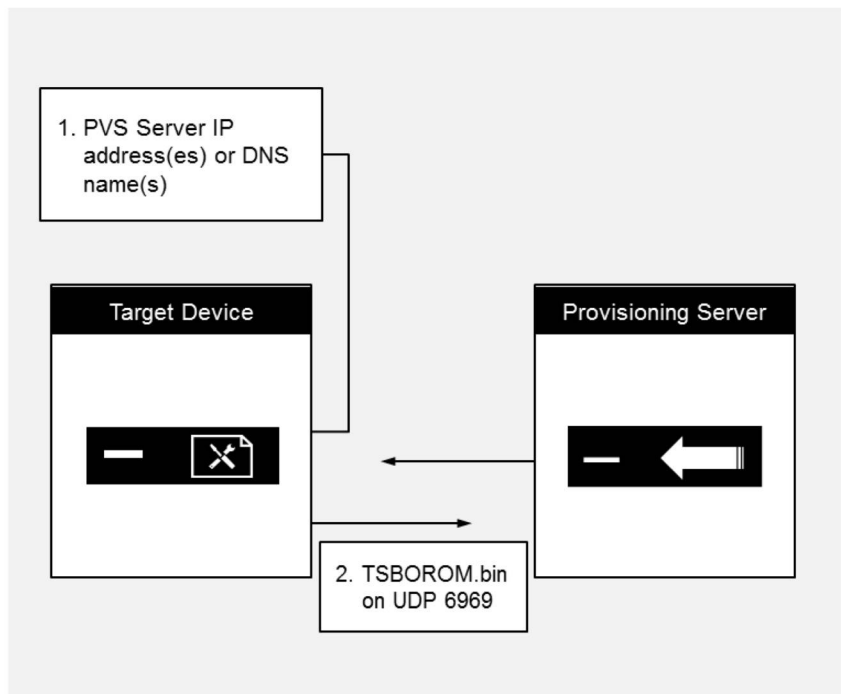
Additional Resources:

- Configure the BIOS-embedded bootstrap: <http://docs.citrix.com/en-us/provisioning/7-13/managing-target-device/bootstrap-bios-embedded.html>

Bios Embedded Bootstrap Bootstrap delivery

Two-stage boot process:

1. Bootstrap file embedded in target device contains the location of the PVS servers in the farm.
2. Target device downloads remaining required boot information, including TSBOROM.bin from a PVS Server using TFTP on UDP Port 6969.



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Key Notes:

- If the target device boots using the BIOS-Embedded Bootstrap, the configuration settings are obtained from the device's BIOS. These BIOS settings may indicate using DHCP with DNS to lookup the IP and server information (dynamic), or it may list up to four server IP addresses in the BIOS (static).
- The first time a target device boots, it reads the product license key and configuration information from the BIOS, locates the Stream Service, and then sends a device registration message to the server. This message contains the information, in addition to the information inherited from the device collection template, necessary to add the device to the Provisioning Services database.

Additional Resources:

- Configure the BIOS-embedded bootstrap: <http://docs.citrix.com/en-us/provisioning/7-13/managing-target-device/bootstrap-bios-embedded.html>

PXE Boot

Use Case

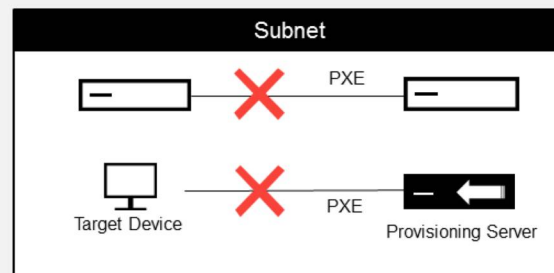
Benefits



Easiest implementation and updates.

Supports booting both BIOS and UEFI based VMs on the same subnet.

Considerations



Can interfere with other running PXE services on the same subnet.

Requires UDP/DHCP helper for targets on different subnets.

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Key Notes:

- PXE booting has the simplest configuration out of all the boot methods. The initial configuration and future updates can all be configured from the PVS Configuration wizard/PVS console, with no configuration needed on the target devices beyond setting them to boot from the network. As a result, this is a very popular option, especially for proof of concepts, non-production environments, labs, and smaller production environments.
- PXE booting may also be the best option for mixed environments of BIOS and UEFI-based target devices. The PXE boot works with both architectures, even if collocated in the same subnet.
- The primary drawback of this method is that there cannot be other PXE services running within the same subnet as the target devices; otherwise, both PVS booting as well as the other PXE service will be disrupted. Especially in larger enterprise environments, this leads to the consideration of alternative boot methods.

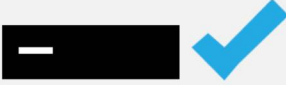
Additional Resources:

Configuring UEFI pre-boot environments: <http://docs.citrix.com/en-us/provisioning/7-13/install/configure-UEFI.html>

DHCP Options

Use Case

Benefits

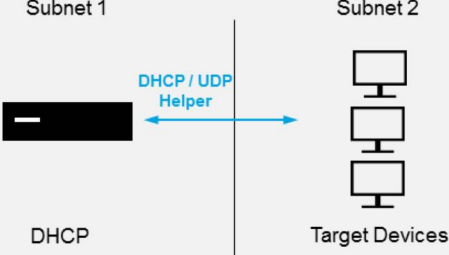


Microsoft DHCP

Relatively easy to implement, especially using Microsoft DHCP server.

Does not require use of PXE services.

Considerations



Subnet 1

Subnet 2

DHCP

Target Devices

DHCP / UDP Helper

Requires UDP/DHCP Helper if DHCP server is not in same subnet as the target devices.

Some caveats for 3rd party DHCP services.

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Key Notes:

- The DHCP boot method has been widely used because it is relatively easy to implement and update, and most customers already have one or more DHCP servers in place. It is a popular option when PXE is already being used for another purpose on a given subnet.
- UEFI-based virtual machines are also supported with DHCP options, although different options must be configured, compared to BIOS-based machines.
- The network architecture in a given environment will play an important factor, and a UDP/DHCP Helper will be necessary if the DHCP server is not in the same subnet as the target devices.
- If using a 3rd party DHCP provider, be sure to check whether they support options 66 and 67, and how to implement it. Although relatively easy to set up and update using Microsoft DHCP, experiences will vary across 3rd party providers. Additionally, some DHCP services may only allow one option 66 entry, presenting a single point of failure for the environment.

Additional Resources:

- Configuring UEFI pre-boot environments: <http://docs.citrix.com/en-us/provisioning/7-13/install/configure-UEFI.html>

Boot Device/Attached Media

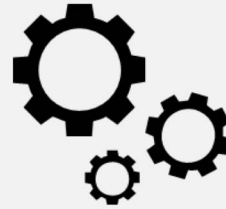
Use Case

Benefits



Does not require PXE or TFTP services.
Able to deploy to targets on multiple subnets.

Considerations



Requires additional effort to set up and maintain.
Not compatible with Hyper-V Generation 2 virtual machines (pre PVS 7.9).

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Key Notes:

- Many customers choose to configure the bootstrap file using BDM because their environment would not support other methods. For example, if PXE is already being used for another function within a given subnet, using it to boot PVS target devices will not work because of interference with the other PXE broadcasts, and you would be hurting the other PXE implementation at the same time.
- Additionally, DHCP option 66 may already be used for another purpose in an environment, or a non-Microsoft DHCP device may be used which doesn't support option 66/67.
- The primary consideration with the BDM method is that additional time will be required to create and update the BDM ISOs or disk partitions. Consider the expected frequency of changes to the Provisioning Servers, which will subsequently require BDM to be updated and deployed after each update.
- However, starting with PVS 7.9, it is now possible to update a BDM disk partition in the PVS Console, greatly increasing the viability of this method in larger deployments.
- Also starting in PVS 7.9, a BDM partition can be configured on a UEFI-based VM, as long as the XenDesktop Setup Wizard is used.

Additional Resources:

- Updating a BDM partition: http://docs.citrix.com/en-us/provisioning/7-9/whats-new.html#par_anchor_title_993a

- BDM support for UEFI through the XenDesktop setup Wizard:
http://docs.citrix.com/en-us/provisioning/7-9/whats-new.html#par_anchortitle_307c

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BIOS Embedded

Use Case

Benefits

Created by vendor



Bootstrap created and embedded by vendor, potentially reducing implementation complexity.

Able to update bootstrap file from PVS Console.

Considerations



Only works for physical target devices offered by third party vendors.

Requires multi-vendor support.

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Key Notes:

- This feature was created to work with specialized server hardware developed by Dell. This collaboration allowed for a simplified PVS setup where a vDisk would be streamed to the specialized Dell targets with little additional configuration.
- However, since streaming to physical targets has become less common, this boot method has become less common. It is still supported in the product for customers who may still be using the specialized hardware that supports the BIOS bootstrap.

Use Case Summary

Delivery Method	Advantages	Disadvantages
PXE	Easy to implement. Compatible with BIOS and UEFI-based VMs on the same subnet.	Can interfere with other running PXE services on the same subnet. Requires UDP/DHCP helper for targets on different subnets.
DHCP Options	Easy to implement Compatible with BIOS and UEFI-based VMs.	Requires changes to production DHCP service. DHCP service may only allow one option 66 entry. Difficulty of implementation on 3rd party services varies. Requires UDP/DHCP helper for targets on different subnets.
BDM ISO	Does not require PXE or TFTP services.	UEFI-based VMs must be provisioned using XDSW on PVS 7.9+. Extra effort required to boot physical target devices.
BDM Disk Partition	Does not require PXE or TFTP services Easier bootstrap update with PVS 7.9+.	UEFI-based VMs must be provisioned using XDSW on PVS 7.9+. Extra effort required to boot physical target devices.
BIOS Embedded	Works "out of the box."	Restricted to specific physical endpoints. Requires multi-vendor support.

Key Notes:

- There is no "best" boot method – each method has advantages and disadvantages, and no one method will fit all environments.

Additional Resources:

- Citrix Virtual Desktop Handbook 7.6 LTSR:
<https://support.citrix.com/article/CTX139331>



- Which boot method do you use, and why? If you haven't implemented PVS yet, which method would work best in your org's environment?

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Lab Exercise

- Exercise 17-5: Configure the DHCP Options (66 & 67)
- Exercise 17-6: Configure and Implement the Boot ISO

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**Lesson
Objective
Review**

Which core functions must be provided by any boot method?

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Lesson Objective Review

Which core functions must be provided by any boot method?

IP acquisition and bootstrap delivery.

Key Notes:

- Regardless of the boot method used, administrators must determine how a target device will be assigned an IP address, as well as how the bootstrap file will be delivered.

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Key Takeaways



A vDisk is used to store and transport an image, which is then used to stream to multiple target devices.

The Master Target Device is a device that is used to build a hard disk image, which is stored on a vDisk for use with Provisioning Services.

The Stream Process forms the core of Provisioning Services, and as such it is important to understand how it communicates with vDisks and Target Devices.

Several boot methods are available for IP acquisition and bootstrap file delivery to target devices.

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Provisioning Services 7.1x Administration

Target Devices Module 18

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Lab VM Power Management

The following VMs are required to be powered on before beginning the exercises in this module:

- NYC-ADS-001
- NYC-SQL-001
- NYC-FSR-001
- NYC-PVS-001
- NYC-XDC-001
- NYC-VNS-001
- NYC-STF-001
- NYC-WRK-001

The remaining VMs need to be powered off.

Note: These VMs are listed in the start-up order.

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Learning Objectives

- Identify the role of a target device.
- Present disk read and write considerations to plan a target device deployment.
- Explain how machine and user data is handled on target devices.

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Target Devices Introduction

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What is Target Device?

A target device is a machine, such as desktop computer or server, that boots and gets software from a vDisk over the network.



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Key Notes:

- There are several types of target devices within a farm.
- For example, while a device is being used to create a vDisk image, it is considered a Master target device. All other devices are configured as a particular device type.
- The device type determines a device's current purpose, and determines if that device can access a particular vDisk version that is in Production, Test, or Maintenance.

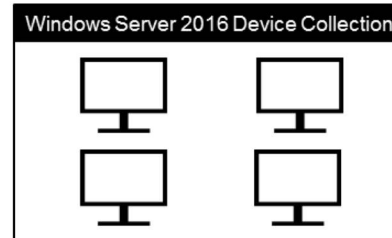
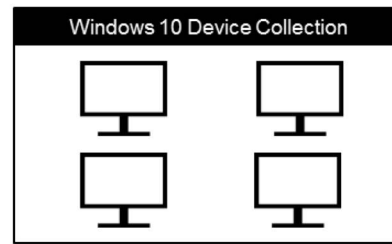
Additional Resources:

- Managing target devices: <http://docs.citrix.com/en-us/provisioning/7-13/managing-target-device.html>

Device collections provide the ability to create and manage logical groups of target devices.

What is a Device Collection?

Creating device collections simplifies device management by performing actions at the collection level rather than at the target-device level.



Key Notes:

- A target device can only be a member of one device collection. A device collection could represent a physical location, a subnet range, or a logical grouping of target devices. For example, a collection could consist of all target devices that use a particular vDisk image, and that target device collection might consist of maintenance, test, and production devices. Alternatively, three device collections could exist for a particular vDisk; one consisting of production devices, one consisting of test machines, and another consisting of maintenance machines. In the proceeding examples, all of the devices in a given collection are assigned to the same vDisk.
- Device collections are created and managed by farm administrators, or site administrators that have security privileges to that site, or device administrators that have security privileges to that collection.

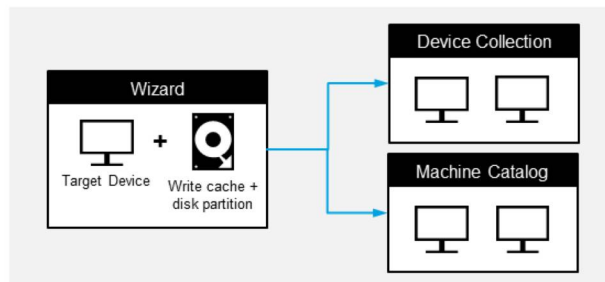
Additional Resources:

- Managing device collections: <http://docs.citrix.com/en-us/provisioning/7-13/managing-device-collection.html>

What are the methods to creating Target Devices?

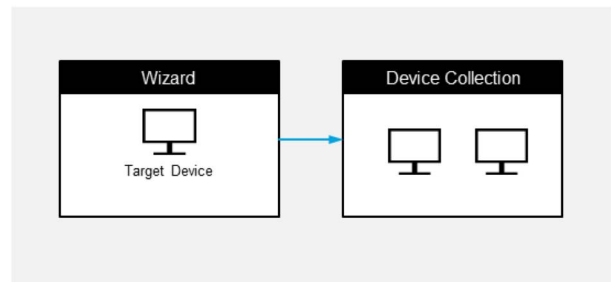
Provisioning Services Wizards

XenDesktop Setup Wizard



Creates target devices, write cache drive, BDM partition (optional), and automatically adds them to a device collection and XenApp/XenDesktop machine catalog.

Streamed VM Setup Wizard



Creates target devices, and automatically adds them to a device collection.

Other steps must be performed manually, but includes fewer prerequisites.

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Key Notes:

- One method used to create new target devices is through the XenDesktop Setup Wizard and the Streamed VM Setup Wizard. Both wizards can create numerous virtual target devices based on a template, assign it a vDisk, and place it in a designated device collection. The XenDesktop Setup wizard can additionally add a write cache drive and BDM disk partition to new target devices, as well as automatically add them to a designated machine catalog within a XenApp and XenDesktop site.
- These methods are useful for creating a large number of identical target devices for use in a XenApp and XenDesktop deployment. The XenDesktop Setup wizard in particular minimizes the amount of manual steps required to deploy target devices, but requires additional permissions to the hypervisor and XenApp/XenDesktop site. We will cover the setup wizards more in Module 5.

Additional Resources:

- Deploying virtual desktops to VMs using the XenDesktop Setup Wizard: <http://docs.citrix.com/en-us/provisioning/7-13/xendesktop-setup-wizard.html>
- Using the Streamed VM Setup Wizard: <http://docs.citrix.com/en-us/provisioning/7-13/streamed-vm-wizard.html>

What are the methods to creating Target Devices?

Manual creation

- Pre-created target devices can be added to the Provisioning Services farm in a few different ways:
 - Manually via the PVS Console or APIs
 - Using the Auto-Add wizard
 - Importing a .csv file with target device information

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Key Notes:

- Target devices do not have to be created via one of the setup wizards. Any machine can become a target device if it has the PVS target device software installed and is set to an appropriate boot method (network, ISO, or disk partition).
- There are a few different ways to add pre-created target devices to a Provisioning Services farm:
 - Individual target devices can be manually added through the Provisioning Services console or APIs. This method works well for test environments or smaller production environments. However, for larger amounts of target devices it becomes time consuming and keeping target device settings consistent becomes more difficult.
 - The Auto-Add wizard can be used to include large numbers of pre-created target devices with consistent settings. This is more appropriate for larger production environment where the setup wizards are not used.
 - A .csv file of target device entries can also be imported into a farm. This may be useful when existing target devices do not all follow the same naming convention, or need to be added to different PVS sites or device collections.

Additional Resources:

- Adding target devices to the database: <http://docs.citrix.com/en-us/provisioning/7-13/managing-target-device/target-database-add.html>
- Using the Auto-Add Wizard: <http://docs.citrix.com/en-us/provisioning/7-13/managing->

[target-device/target-database-add/target-auto-add-wizard.html](http://docs.citrix.com/en-us/provisioning/7-13/managing-device-collection/collections-device-import.html)

- Importing target devices into a collection: <http://docs.citrix.com/en-us/provisioning/7-13/managing-device-collection/collections-device-import.html>

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Is creating a Target Device, streaming?

- No, streaming is the delivery mechanism of the OS to the target device.
- With Provisioning Services, you can create the machines and the image for the machines separately.



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Lesson Objective Review

What is the best way to add a large number of pre-created target devices to a Provisioning Services farm? Assume the target devices have a consistent naming convention and all need to be located in the same device collection.

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Lesson Objective Review

What is the best way to add a large number of pre-created target devices to a Provisioning Services farm? Assume the target devices have a consistent naming convention and all need to be located in the same device collection.

For the given scenario, the Auto-Add Wizard would work best.

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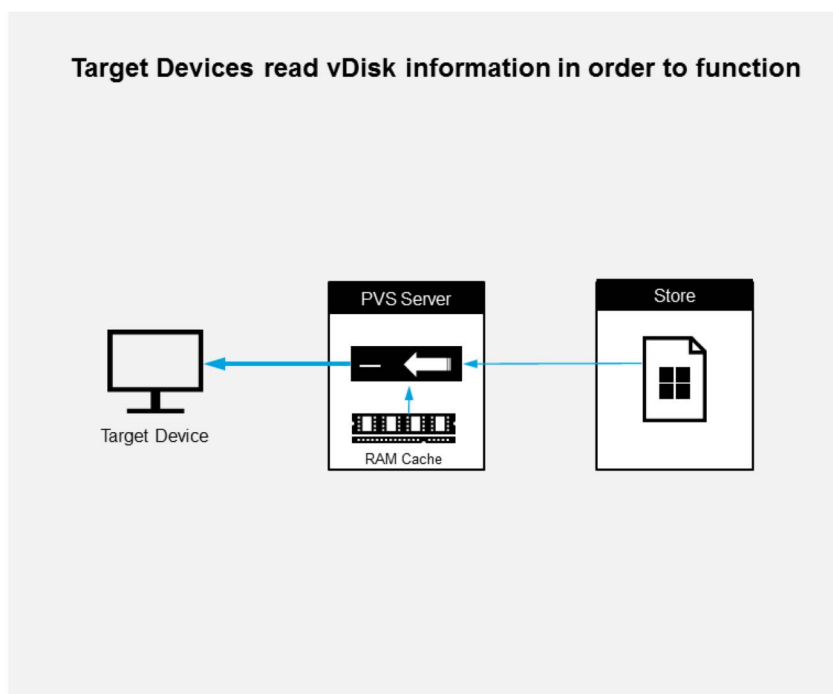
Reads and Writes

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The Target Device Reads the vDisk

- At its core, a target device needs to read vDisk data in order to function.
- The actual data could be retrieved from the vDisk via the Provisioning Server, or it could be cached on the RAM of the Provisioning Server.



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Key Notes:

- To review, sectors of the vDisk are cached in RAM of a Provisioning Server after the first time that server requests that particular disk sector from the vDisk. This process resets after each Provisioning Server reboot, but it is a good idea to regularly reboot the servers because the cache may eventually be filled with out-of-date vDisk information (due to subsequent vDisk updates).

Network Bandwidth

- A relatively large amount of vDisk reads occur when a target device initially boots; this is why a “boot storm” can impact performance if the environment is not sized to accommodate it.
- The amount of data transmitted varies by operating system; the estimates shown here can be used to provide a baseline for testing.

Average Network Impact
(operating system: average data transfer on boot)

Operating System	Data Transfer on Boot (MB)
Windows 7 x86	166
Windows 7 x64	210
Windows 8 x86	178
Windows 8 x64	227
Windows 10 x64	240
Windows Server 2008 R2	251
Windows Server 2012	225
Windows Server 2012 R2	232
Windows Server 2016	TBD

Key Notes:

- The bandwidth available on the network used by Provisioning Services streaming traffic is a major factor in determining overall scalability.
- Windows Server 2016 data has not yet been collected from the field, but should be in the same general range as the other Windows Server operating systems.

Additional Resources:

- Citrix Virtual Desktop Handbook (pages 90-91):
<https://support.citrix.com/article/CTX139331>

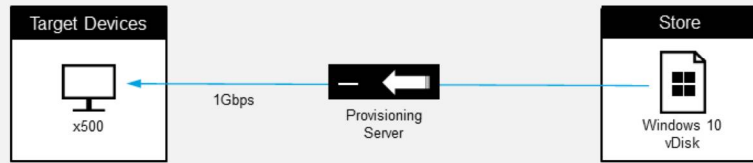
Read Performance Considerations

Calculating target device boot times

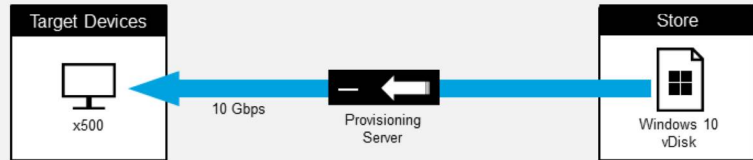
Determining how much time will be required to boot the target devices can be estimated using this formula.

$$\text{Seconds to Boot} = \frac{(\text{Number of Targets} * \text{MB Usage})}{\text{Network Throughput}}$$

Example 1 (Seconds to boot all devices = 960 seconds [16 minutes])



Example 2 (Seconds to boot all devices = 96 seconds [1 minutes, 36 seconds])



Key Notes:

- A 10Gbps network is recommended for use with Provisioning Services. If a 10Gbps network is not available, consider link aggregation to provide additional bandwidth to the provisioning servers, or a dedicated physical streaming network.

Read Performance Considerations

Several other factors should be taken into account to optimize vDisk read performance:

Caching in Provisioning Server memory

As we learned in **Module 3**, a key feature of Provisioning Services is the ability of the Provisioning Servers (and now, XenServer hosts) to cache vDisk reads in RAM. This can dramatically lower the amount of IOPs to the vDisk store during steady-state streaming.

Store availability

vDisk stores that are configured in a centralized SMB or NFS share need to have sufficient network connectivity to Provisioning Servers. And all vDisk stores should be redundant or highly available to eliminate single points of failure. Refer to **Module 6** for more on store availability.

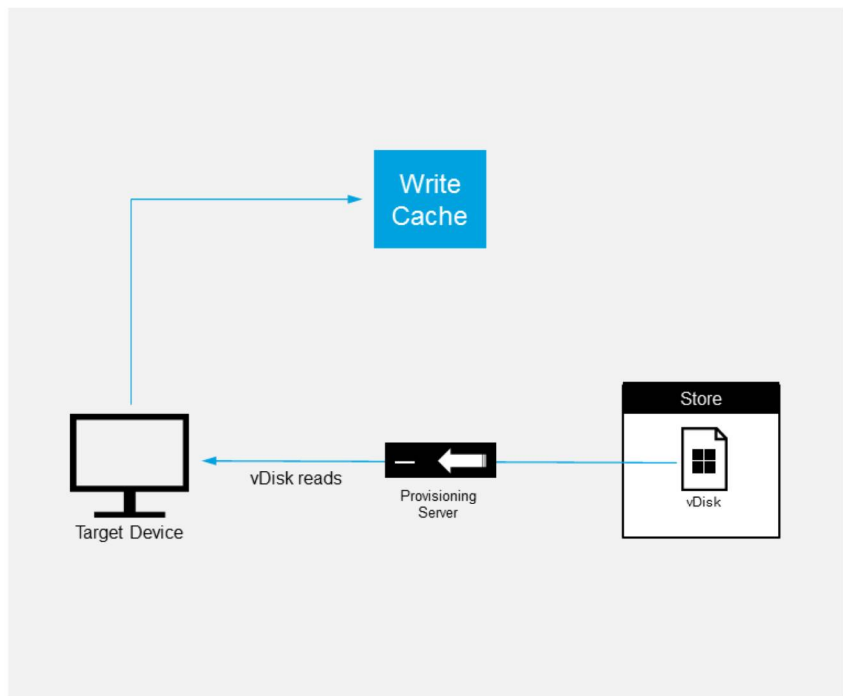
Store IOPs

The storage allocated to the vDisk store should be sufficient to provide adequate performance during boot storms and other periods of heavier than usual activity. Refer back to **Module 2** to learn more about Store performance planning considerations.

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Where do the writes go?

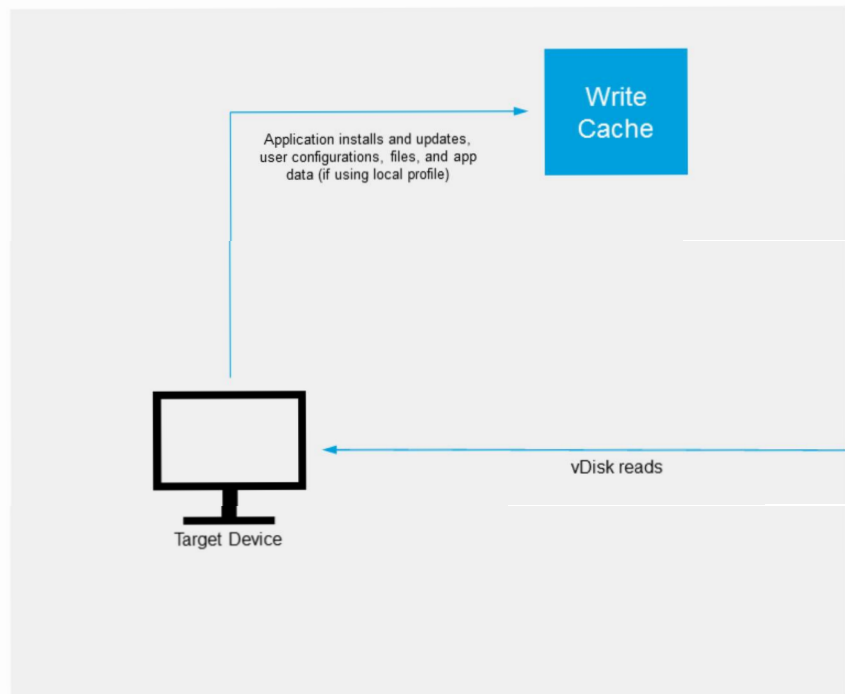
- In Standard mode, disk writes do not go back to the vDisk.
- Instead, disk writes by default will be redirected to the write cache.



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What is a Write Cache?

- A write cache is a designated location to hold the writes for a target device during runtime.



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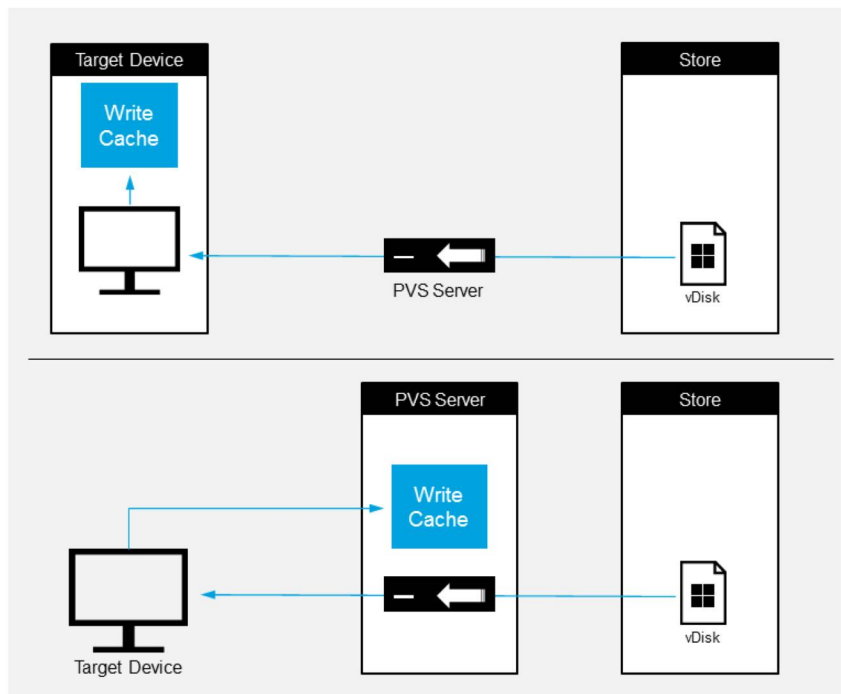
Key Notes:

- The write cache is what enables a vDisk to be streamed to multiple target devices at once. A vDisk cannot handle write requests from more than a single source at a time, and target devices must have a place to store disk writes.

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Where can I store the Write Cache?

- The write cache can be located either on the target device or on a Provisioning Server.
- There are several options for each location.



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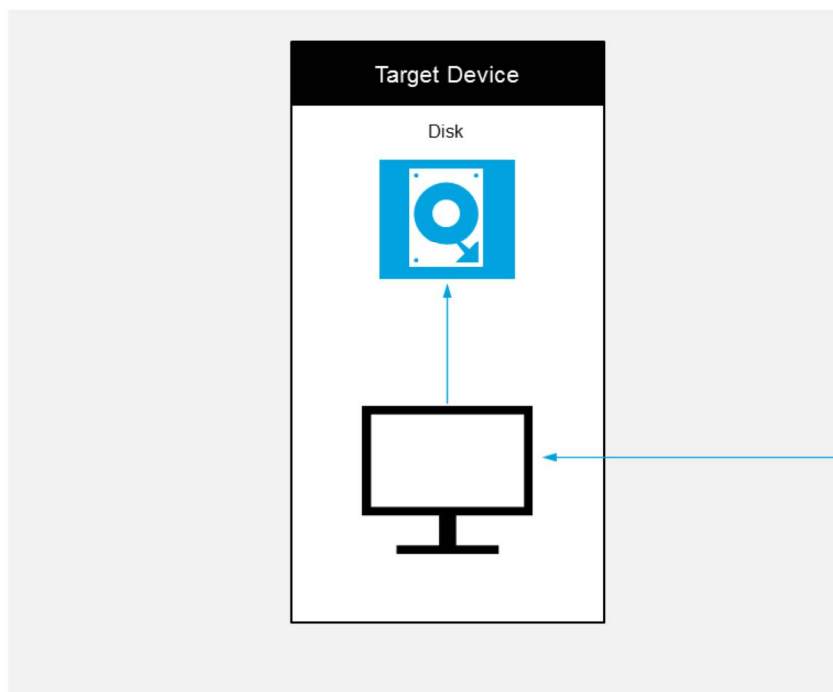
Additional Resources:

Understanding Write Cache in Provisioning Services Server:
<https://support.citrix.com/article/CTX119469>

Write Cache Storage Option

Cache on device hard drive

- All vDisk writes are stored on a disk attached to the target device; writes are erased after each target device reboot.
- A key consideration of this cache method is to appropriately size the write cache hard drive, because the machine will fail if the hard drive runs out of space.



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Key Notes:

- This write cache type creates a write cache file (.vdiskcache) on the target devices' hard drive. It requires an NTFS formatted hard drive on the target device to be able to create this file on the disk.
- Disk space requirements for the write cache will depend on application usage and user behavior. For example, a light user on a Windows 7 machine would only need a 10 GB write cache disk, while a heavy user on Windows Server 2012 R2 may require a 40 GB disk. Use the estimates in the Virtual Desktop Handbook as a baseline, then adjust as necessary during initial testing based on usage in your organization.
- The hard drive used could be located on storage local to the target device, or it could be allocated from a shared storage solution. Local storage will be responsive, but will hamper migration efforts; as a result, this method was traditionally used with physical target devices. Shared storage provide more flexibility for the migration of virtual target devices, but is typically slower than the local method.
- Although this write cache location was widely used in the past, it has been superseded by cache on RAM with overflow to disk. It is slated for deprecation in a future Provisioning Services release.
- To achieve the highest throughput to the write-cache drive, Intermediate Buffering should almost always be used (caution should be used with target devices hosted on Hyper-V where we have occasionally seen adverse effects). Intermediate Buffering allows writes to use the underlying buffers of the disk/disk driver before committing them to disk allowing the PVS disk drive to continue working rather than waiting for the write on disk to finish, therefore increasing performance. By default this feature is disabled.

Additional Resources:

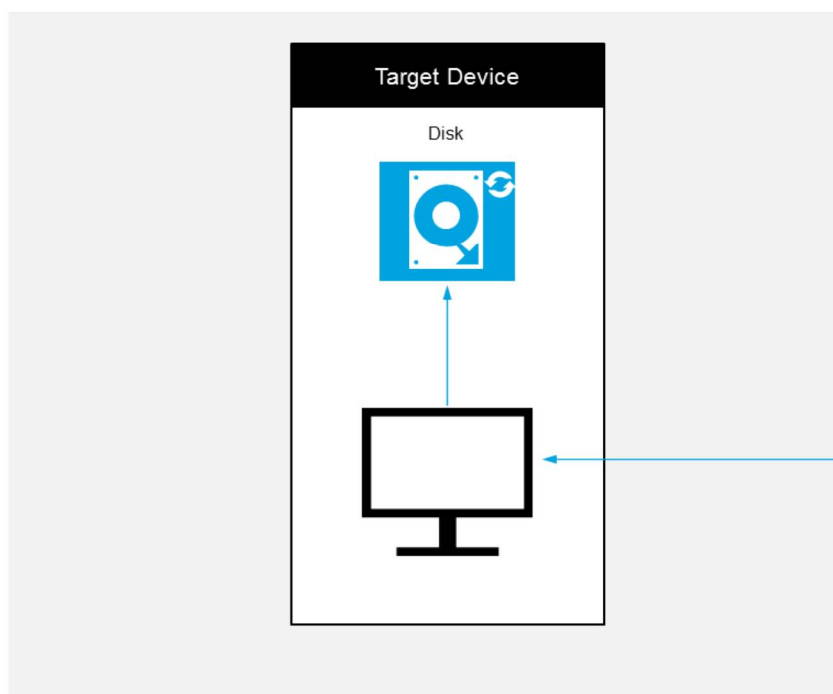
- When to Enable Intermediate Buffering for Local Hard Drive Cache?: <https://support.citrix.com/article/CTX126042>
- Selecting the write cache destination for standard vDisk images: <http://docs.citrix.com/en-us/provisioning/7-13/managing-vdisks/write-cache.html>
- Features removed from future releases: <http://docs.citrix.com/en-us/provisioning/7-13/whats-new/deprecated-features.html>
- Virtual Desktop Handbook (page 68): <https://support.citrix.com/article/CTX139331>

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Write Cache Storage Option

Cache on device hard drive
(persisted)

- All vDisk writes are stored on a disk attached to the target device; writes persist even after a reboot.
- Considered an experimental feature, this cache method requires a custom bootstrap file (CTXBP.BIN).



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Key Notes:

- The same as Cache on device hard drive, except cache persists. This write cache method is an experimental feature, and requires a different bootstrap file.
- Citrix recommends that the local HDD (client side) drive has enough free space to store the entire vDisk, since it is possible that most or all of the vDisk could become cached over time. As a result, this cache method negates the storage savings normally possible through using Provisioning Services. The primary use case for a persisted cache on hard drive is if the target device is intended to be used as a static desktop by a single user. This is considered a niche use case, and could probably be accomplished more easily without involving the Provisioning Services infrastructure. Additionally, this write cache method is scheduled to be deprecated in a future release of Provisioning Services.

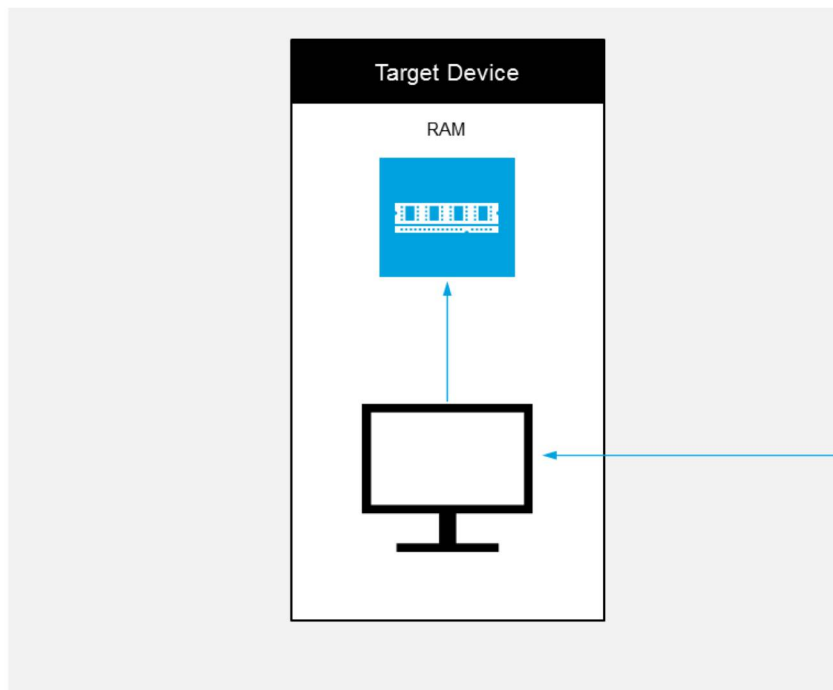
Additional Resources:

- Selecting the write cache destination for standard vDisk images: <http://docs.citrix.com/en-us/provisioning/7-13/managing-vdisks/write-cache.html>
- Features removed from future releases: <http://docs.citrix.com/en-us/provisioning/7-13/whats-new/deprecated-features.html>

Write Cache Storage Option

Cache on device RAM

- All vDisk writes are stored as a temporary file in target device RAM; writes are erased after each target device reboot.
- Faster than cache on disk, but RAM must be sized appropriately to avoid target device crashes.



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Key Notes:

- This write cache type reserves a portion of the target device's memory for the write cache, meaning that whatever portion of RAM is used for write cache is not available to the operating system. The amount of memory reserved for write-cache is specified in the vDisk properties. This option provides better throughput, better response times, and higher IOPS for write cache than the previous types because it writes to memory rather than disk.
- There are some challenges with this option. First of all, there is no overflow, so once the write cache is filled, the device will become unusable (might even blue screen). Therefore, there has to be plenty of RAM available for the target devices to be able to operate and not run out of write cache space, which can be expensive, or just not possible because of memory constraints on the physical host. Second, if there is a need to store persistent settings or data such as event logs, a hard drive will still be required on each target. On the flip side, this hard disk will not be as large or use as many IOPS as when using "Cache on device's hard drive" since the write cache will not be on it. Customers have successfully used this feature when virtualizing Server OS target device hosts, since you do not run as many VMs on a physical host (compared to VDI), so often times there is enough memory to make this feature viable.
- The amount of RAM needed to safely implement this feature will vary by operating system. The Virtual Desktop Handbook has some initial sizing estimates. However, without overflow to disk, the higher end of the suggested ranges should be used as the starting point to reduce the chance of target device failure. Additionally, this amount of RAM should be allocated on top of what is needed by the OS itself.
- This option was used by some customers where performance was a high priority, but it

has been superseded by cache on RAM with overflow to disk.

Additional Resources:

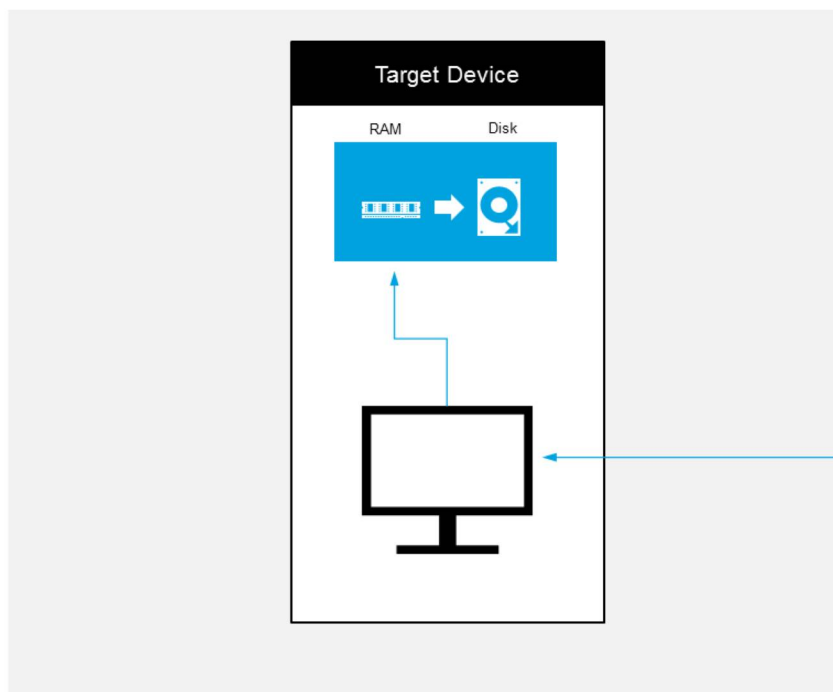
- Selecting the write cache destination for standard vDisk images: <http://docs.citrix.com/en-us/provisioning/7-13/managing-vdisks/write-cache.html>
- Virtual Desktop Handbook (page 68): <https://support.citrix.com/article/CTX139331>
- Turbo Charging your IOPS with the new PVS Cache in RAM with Disk Overflow Feature! – Part One: <https://www.citrix.com/blogs/2014/04/18/turbo-charging-your-iops-with-the-new-pvs-cache-in-ram-with-disk-overflow-feature-part-one/>

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Write Cache Storage Option

Cache on device RAM with overflow to disk

- All vDisk writes are initially stored in the target device's RAM buffer.
- When there is no free RAM available, older writes are moved to the overflow disk.
- Newer writes continue to be stored in RAM to maximize performance.



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Key Notes:

- This is a newer write cache type (available in PVS 7.1+) which provides a write-cache buffer in memory and the overflow is written to disk. However, the way that memory and disk are used is different than with “Cache in device RAM” and “Cache in device’s hard drive” respectively.
- Just as before, the buffer size is specified in the vDisk properties. By default, the buffer is set to 64 MB but can be set to any size. Rather than reserving a portion of the device’s memory, the cache is mapped to Non-paged pool memory and used as needed, and the memory is given back to the system if the system needs it. On the hard drive, instead of using the old “.vdiskcache” file, a VHDX (vdiskdif.vhdx) file is used. On startup, the VHDX file is created and is 4 MB due to the VHDX header. Data is written to the buffer in memory first. Once the buffer is full, “stale” data is flushed to disk.
- Data is written to the VHDX in 2 MB blocks, instead of 4 KB blocks as before. This will cause the write-cache file to grow faster in the beginning than the old “.vdiskcache” cache file. However, over time, the total space consumed by this new format will not be significantly larger as data will eventually back fill into the 2 MB blocks that are reserved.
- This is the recommended write cache method for a majority of Provisioning Services deployments.

Additional Resources:

- Selecting the write cache destination for standard vDisk images: <http://docs.citrix.com/en-us/provisioning/7-13/managing-vdisks/write-cache.html>
- Virtual Desktop Handbook (page 68): <https://support.citrix.com/article/CTX139331>

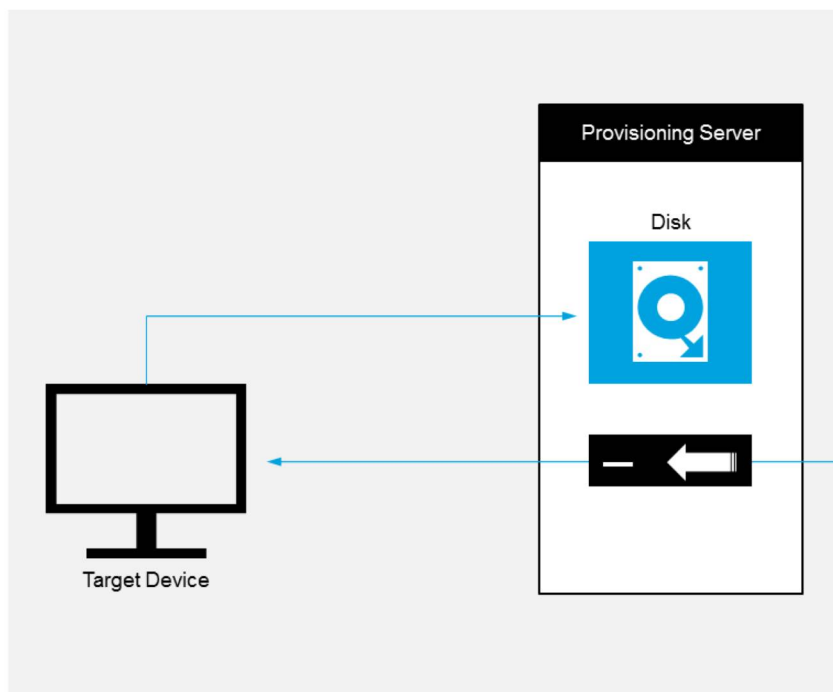
- Turbo Charging your IOPS with the new PVS Cache in RAM with Disk Overflow Feature! – Part One: <https://www.citrix.com/blogs/2014/04/18/turbo-charging-your-iops-with-the-new-pvs-cache-in-ram-with-disk-overflow-feature-part-one/>
- Turbo Charging your IOPS with the new PVS Cache in RAM with Disk Overflow Feature! – Part Two: <https://www.citrix.com/blogs/2014/07/07/turbo-charging-your-iops-with-the-new-pvs-cache-in-ram-with-disk-overflow-feature-part-two/>

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Write Cache Storage Options

Cache on server

- All vDisk writes are stored on a disk attached to the Provisioning Server; writes are erased after each target device reboot.
- Provides poor performance relative to cache on target methods; typically only used when streaming to diskless physical endpoints or thin clients.



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Key Notes:

- The storage used for this cache method depends on what was allocated to the Provisioning Servers.
- The file size grows, as needed, but never gets larger than the original vDisk, and frequently not larger than the free space on the original vDisk.
- It is slower than target device cache methods because all disk writes (and subsequent reads) have to go to the server. The cache gets deleted when the device reboots, so changes remain only during a single boot session.
- The server-side write cache works in a HA environment if all server cache locations to resolve to the same physical storage location. However, this write cache type is not recommended for a production environment due to the performance limitations.
- There is also another server-side write cache type, “cache on server, persistent.” Similar to cache on device hard disk, persistent, a persistent write cache file is created for each target device. The file name uniquely identifies the target device by including the target device’s MAC address and disk identifier. A target device can be assigned to multiple vDisks and therefore has multiple cache files associated to it.
- This cache method requires special attention to be paid to the storage assigned to each Provisioning Server, since its storage could quickly be filled with all the cache files. Additionally, the cache files will become invalid after a vDisk version is placed in maintenance mode, or if the base vDisk is placed in Private Image mode. After a vDisk change, a new cache file will be generated, but the older, invalid ones are not deleted. As a result, these must be periodically removed to save space. As a result of these limitations, this cache method should not be

used in most production environments.

Additional Resources:

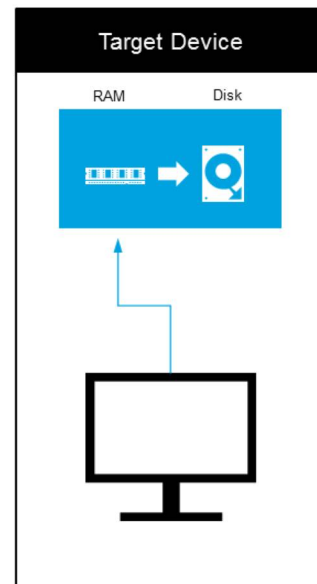
- Selecting the write cache destination for standard vDisk images:
<http://docs.citrix.com/en-us/provisioning/7-13/managing-vdisks/write-cache.html>
- Virtual Desktop Handbook (page 68): <https://support.citrix.com/article/CTX139331>
- Understanding Write Cache in Provisioning Services Server:
<https://support.citrix.com/article/CTX119469>
- Turbo Charging your IOPS with the new PVS Cache in RAM with Disk Overflow Feature! – Part One: <https://www.citrix.com/blogs/2014/04/18/turbo-charging-your-iops-with-the-new-pvs-cache-in-ram-with-disk-overflow-feature-part-one/>

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Leading Practice

Sizing Considerations for Cache on Device RAM w/ overflow to disk

- Cache on device RAM w/ overflow to disk should be used in most production environments.
- By default, the RAM buffer used in this method is 64MB; however, for best performance and to reduce IOPs and size of write cache overflow disk, increase this buffer.
- The disk-based portion of the write cache can initially grow larger than previous methods due to a larger 2 MB blocks being reserved on the write cache.



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Key Notes:

- This cache method provides high performance while also mitigating the risks associated with the cache on RAM write cache method.
- A larger RAM buffer may alleviate the larger write cache requirement for environments that do not have storage capacity. With enough RAM you can even eliminate the need for ever writing to the storage. For desktop operating systems start with 256-512MB and for server operating systems start with 2-4GB.
- Defragment the vDisk before deploying the image and after major changes. Defragmenting the vDisk resulted in write cache savings of up to 30% or more during testing. However, do not perform this on a versioned vDisk, because this will create excessively large versioned disks (.AVHD files). Run defragmentation after merging the vDisk versions.
- The sizing of the overflow disk-based write cache will depend on the RAM allocation provided to each of the target devices. As we will see in the next lesson, you must also take into account other kinds of data you may wish to redirect to this drive so that it can persist between target device reboots. Thin-provisioning the write cache drive is supported, but there may be a small performance penalty associated with doing so. On the other hand, for large environments, the savings in terms of storage requirements justifies the performance hit. And if the RAM buffer is increased from the default value, the number of writes to this overflow disk will be minimal.

Additional Resources:

- The Changing Read/Write Ratio for XenApp: <https://www.citrix.com/blogs/2014/07/01/the->

changing-readwrite-ratio-for-xenapp/

- Size Matters: PVS RAM Cache Overflow Sizing: <https://www.citrix.com/blogs/2015/01/19/size-matters-pvs-ram-cache-overflow-sizing/>
- Clearing The Air (Part 2) – Thick or Thin Provisioned Write Cache: <https://www.citrix.com/blogs/2014/04/02/clearing-the-air-part-2-thick-or-thin-provisioned-write-cache/>
- Turbo Charging your IOPS with the new PVS Cache in RAM with Disk Overflow Feature! – Part One: <https://www.citrix.com/blogs/2014/04/18/turbo-charging-your-iops-with-the-new-pvs-cache-in-ram-with-disk-overflow-feature-part-one/>
- Turbo Charging your IOPS with the new PVS Cache in RAM with Disk Overflow Feature! – Part Two: <https://www.citrix.com/blogs/2014/07/07/turbo-charging-your-iops-with-the-new-pvs-cache-in-ram-with-disk-overflow-feature-part-two/>

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- What caching methods have been used in your org's environment?

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Lab Exercise

Exercise 18-1: Set the Write Cache Location for the Server OS vDisk

Exercise 18-2: Set the Write Cache Location for the Desktop OS vDisk

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**Lesson
Objective
Review**

Which write cache methods allow the target devices to be completely diskless (assuming no persistent data needs to be retained)?

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Lesson Objective Review

Which write cache methods allow the target devices to be completely diskless (assuming no persistent data needs to be retained)?

Cache on device RAM, cache on server, and cache on server (persistent).

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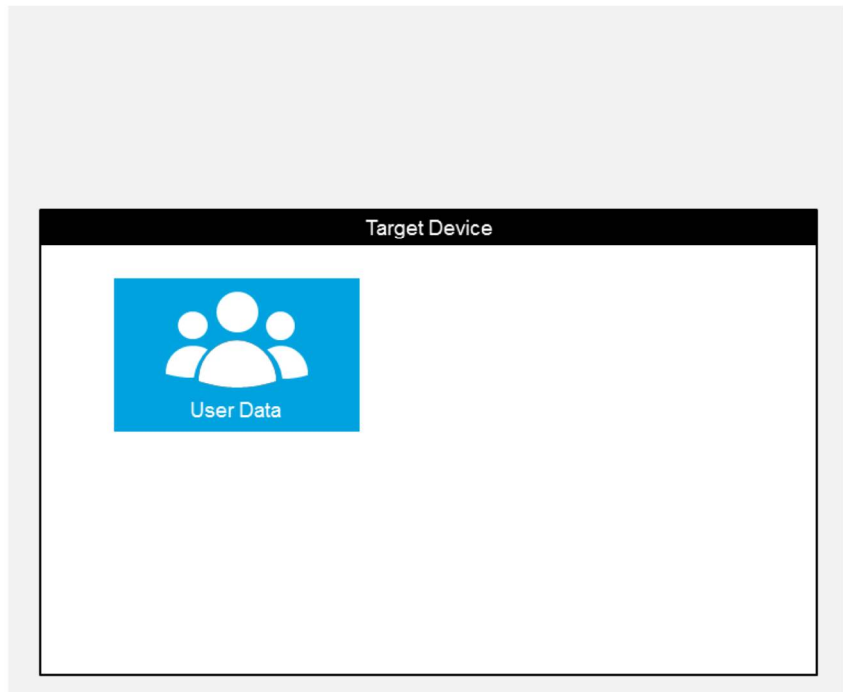
Machine and User Data

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Types of User Data

- It is important to understand the different types of data that are generated on an operating system, and how these data types are handled within a Provisioning Services environment.
- User data includes any user-specific documents, downloads, and settings. These settings are typically stored in the user profile or home drive.



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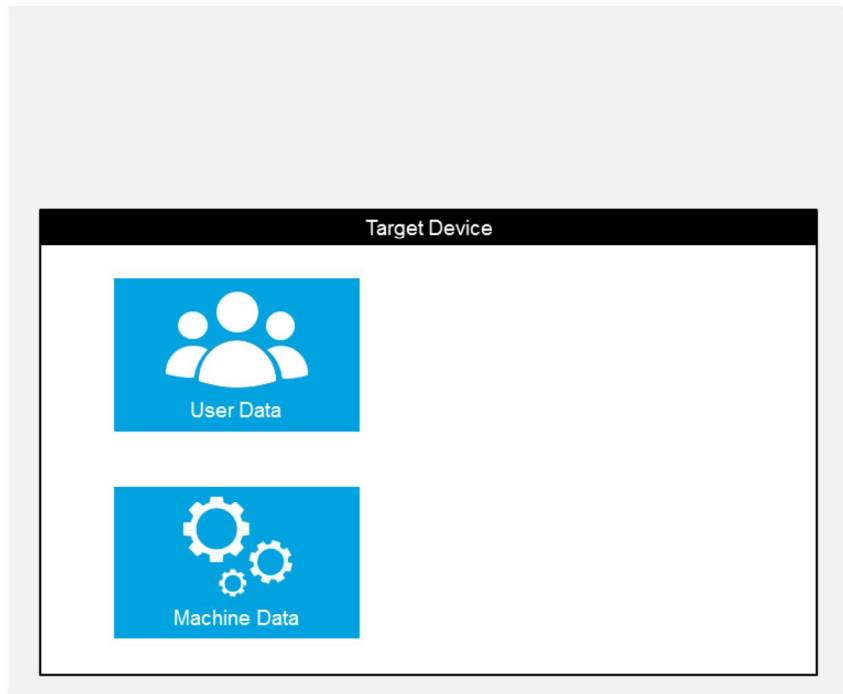
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Key Notes:

- Think of user data as data that is purposefully generated from user activity – files that are opened, modified, and saved; OS and application level settings and preferences, and files downloaded to the downloads folder. The primary exception to this is application installations and upgrades, which generate machine data.

Types of Machine Data

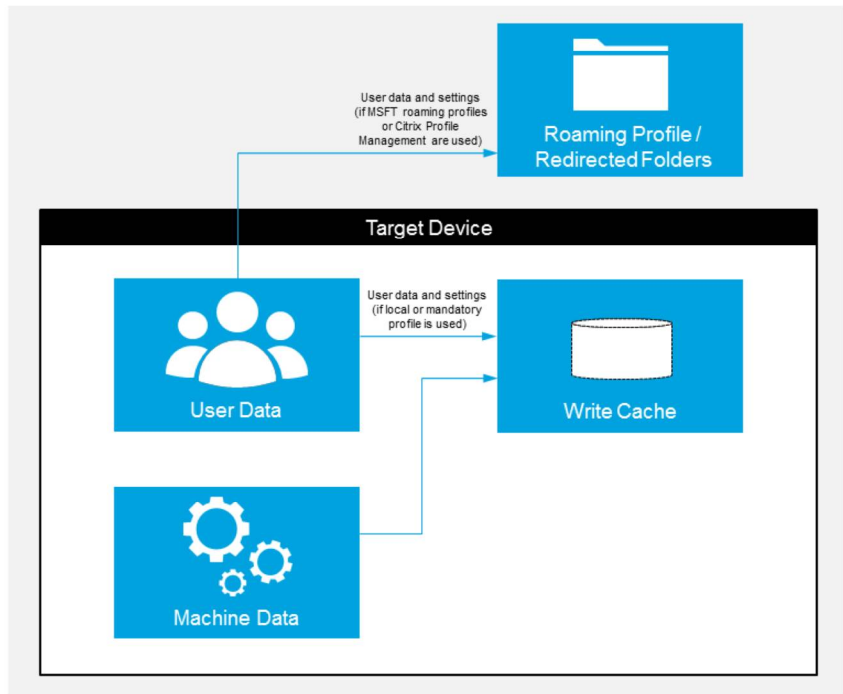
- Machine data includes any information written by the operating system in response to user activities. This can include:
 - Application installations and upgrades.
 - Files and information written to the system folders, including computer hive registry changes, application logs, antivirus definitions, and the page file.



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Types of Data That Goes Into the Write Cache

- By default, all machine data that is generated while a vDisk is in read-only mode will go to the write cache.
- User data will go to the write cache if local or mandatory profiles are configured, since these would typically be stored on a machine's disk.
- If Microsoft roaming profiles or Citrix Profile Management are used, user settings will be preserved in a configured profile or redirected folder location.



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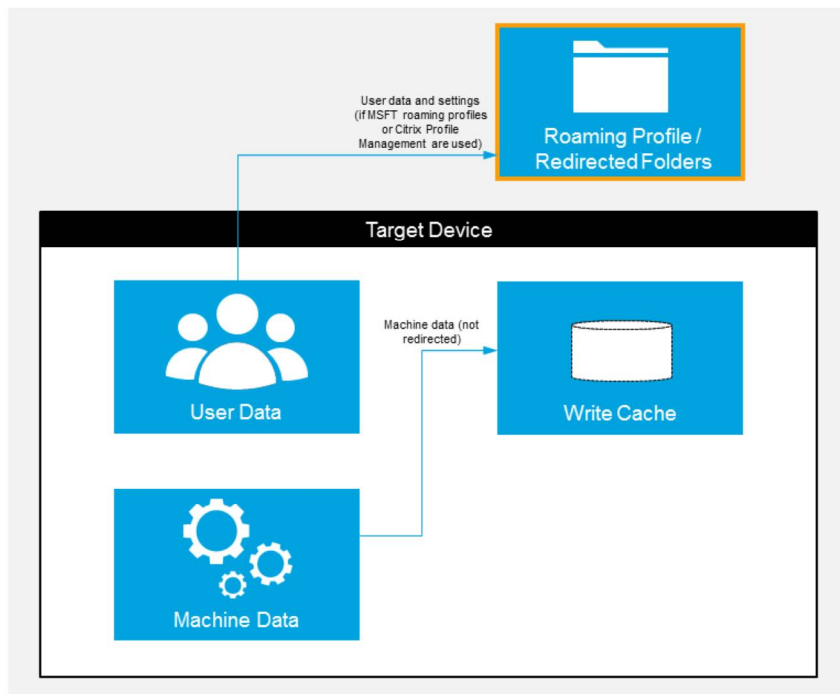
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Key Notes:

- The direct show a device-side write cache, however, the flows remain the same if a server-side cache method is used.

Experience Without a Persistent Drive

- All machine data written to the write cache will be lost after a reboot (unless a persistent caching method is used).
- If antivirus software is used, this can cause performance issues when all definitions must be re-downloaded after each reboot.
- The page file can also cause issues if it is not redirected when a client side cache on disk method is used.



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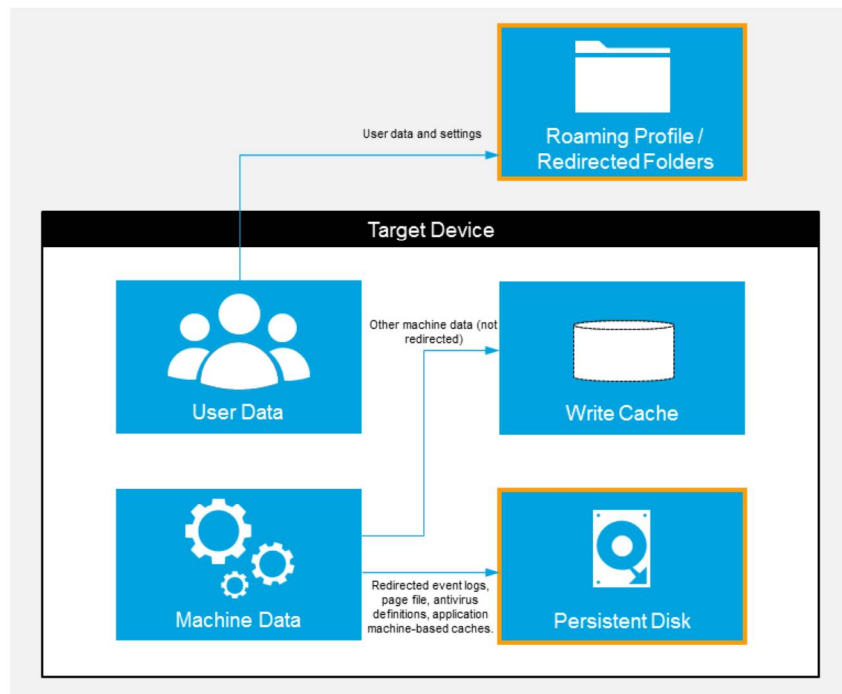
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Key Notes:

- Without a persistent drive on the target device, user data can still be redirected using Folder Redirection and MSFT Roaming Profiles/UPM.
- When a virtual disk is running in standard mode and needs to be restarted, it downloads all of the previously loaded virus definitions. This can cause performance degradation when restarting several target devices at a time, often causing network congestion while the operation persists. In extreme cases, the target device and provisioning server can become sluggish and consume more resources than necessary.
- For a Standard mode vDisk configured with “Cache on device Hard Disk” or “Cache on device RAM with overflow on the Hard Disk”, the page file cannot exist within the cache file itself because of performance lags and potential deadlocking issues. Because the system drive is read-only with standard images, the BNISStack driver (BNISStack.sys for x32 and BNISStack6.sys for x64) places the page file on the next available largest free space local drive. (such as D, E, F). The next local drive can also include the local drive hosting the cache file. This allows the operating system to handle the page file instead of placing it in the write cache. If an available drive with an assigned drive letter is not found, the page file settings cannot be properly allocated.
- Other applications, including Workspace Environment Manager (WEM) also have application-specific settings that are typically stored in their local application folder, and would need to be redirected to a persistent drive in order for the configurations to work as expected.

Experience With a Persistent Drive

- Citrix recommends redirect machine data such as A/V definitions, event logs, and the page file to a persistent drive.
- This can be the same drive that is hosting the write cache, as long as it is sized to support both uses.



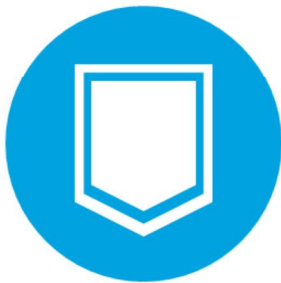
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Key Notes:

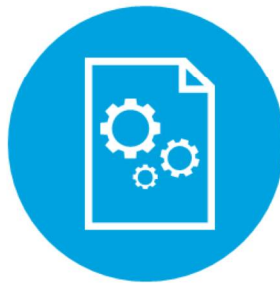
- A persistent drive can be used to store a subset of the machine data that is generated during target device runtime. Based on what is redirected, this can impact sizing considerations for the drive, which may also include the write cache.

Persistent Drive Considerations



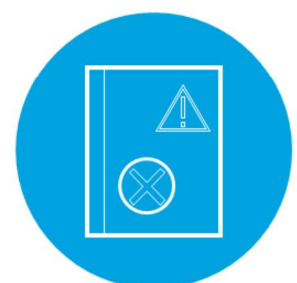
Antivirus

- Redirect a/v definitions to persistent drive or update during vDisk updates.
- Important to implement antivirus exclusions.



Page File

- The page file should be configured to be on the persistent drive instead of the write cache.
- A static page file size should be configured.



Windows Event Logs

- Redirecting core Windows event logs will prevent older entries from disappearing after each reboot.
- The location can be configured in the registry.

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Key Notes:

- The persistent drive can be created manually on the Master Target Device, or it can be created automatically on target devices with the XenDesktop Setup Wizard. Overall, the persistent drive should be protected so that end users cannot inadvertently save files there. This can be accomplished via Group Policy or Workspace Environment Manager.
- It is crucial to plan for implementing antivirus properly with non-persistent machines, since this has been a common source of issues in production Provisioning Services implementations. If the a/v product supports it, consider redirecting the anti-virus definition files to the persistent drive so that they do not need to be re-downloaded after each target device reboot. Alternatively, automatic definition updates can be turned off while the vDisk is in production, and periodic definition updates can be performed while the vDisk is in Private mode or has a maintenance version created.
- In general, most antivirus product defaults are configured to scan all files IO and/or processes on a disk. Like an operating system that runs locally to its hardware, all PVS streaming IO operations are subject to real-time scanning until specified otherwise. If an antivirus program scans the continuously active data stream that consists of and delivers the operating system, then this impedes the normal operation of PVS by causing disk IO delays and read-write failures, HA problems, and so on. In extreme cases, the PVS Target Device and Server can consume more resources than necessary or become inactive. As a result, it is crucial to whitelist or implement exclusions for key PVS files and processes. A list of these is available in the Provisioning Services Antivirus Best Practices webpage.
- To optimally size your paging file, you should start all the applications you run at the same time, load typical data sets, and then note the commit charge peak (or look at this

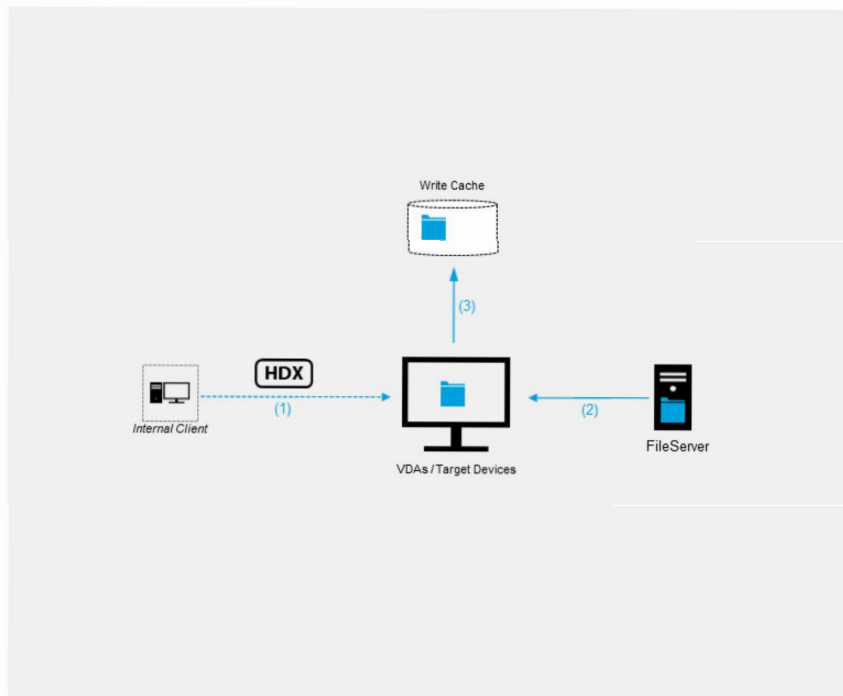
value after a period of time where you know maximum load was attained). Set the paging file minimum to be that value minus the amount of RAM in your system (if the value is negative, pick a minimum size to permit the kind of crash dump you are configured for). If you want to have some breathing room for potentially large commit demands, set the maximum to double that number.

Additional Resources:

- Provisioning Services Antivirus Best Practices:
<https://support.citrix.com/article/CTX124185>
- How to Configure Provisioning Services Page File with Write Cache on a Local Device Hard Disk: <https://support.citrix.com/article/CTX122141>
- The Pagefile Done Right!: <https://www.citrix.com/blogs/2011/12/23/the-pagefile-done-right/>
- Provisioning Services – keeping your data persistent:
<https://www.citrix.com/blogs/2012/05/13/provisioning-services-keeping-your-data-persistent/>

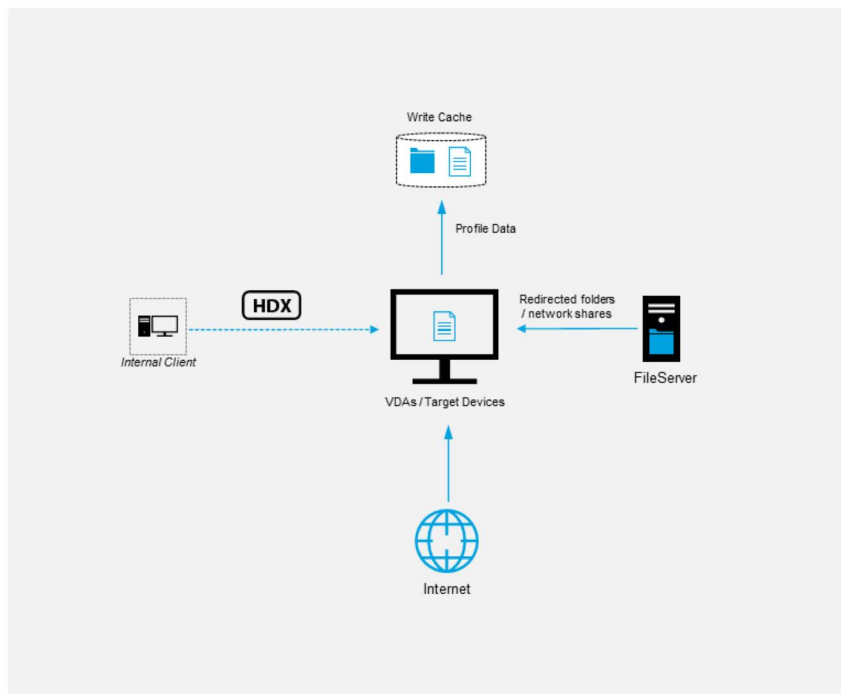
Data Flow When I Log In

1. User logs on to VDA (aka the Target Device)
2. The Profile Management service on the VDA loads profile data from the User Store Path on a File Server.
3. The profile is cached locally on the target device, meaning that it ultimately resides on the write cache. Redirected folders can be accessed from the File Server as needed.



Data Flow When I Download a File from the Internet

- If a user opens an Internet browser and opens a file, the data flow will depend on where the user saves the file.
- If the user saves the file within a system folder or within the locally cached profile, the file will be redirected to the write cache.
- If the user saves the a redirected user folder or network share, the data is immediately sent to the file server hosting the share.



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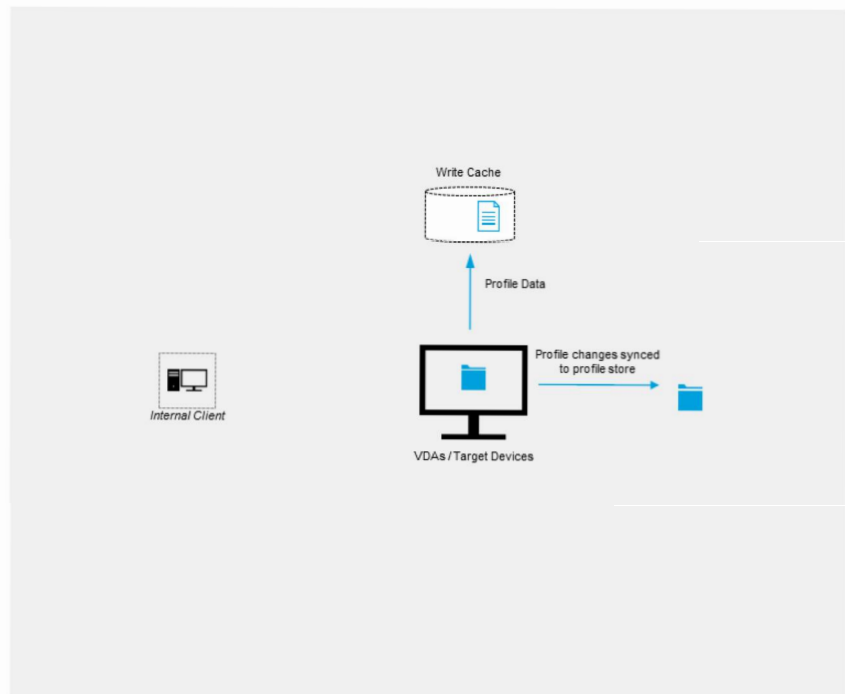
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Key Notes:

- In this example, let's assume that the downloaded file was stored within a folder on the system drive. It is currently residing purely within the write cache.
- While the user is logged on, all changes to the user profile will be stored locally, even if a roaming profile solution is used. The exception is if the Active Write Back feature is enabled, changed files will be synced back to the profile store at regular intervals (not pictured).
- Any network storage locations can be used to immediately place downloaded files in an external location.

What happens when I log off?

- At logoff, the Profile Management service on the VDA writes profile data to the User Store Path on a File Server.
- All other changes remain within the write cache. If the VDA is accessed again during its current runtime, those changes will still be present.



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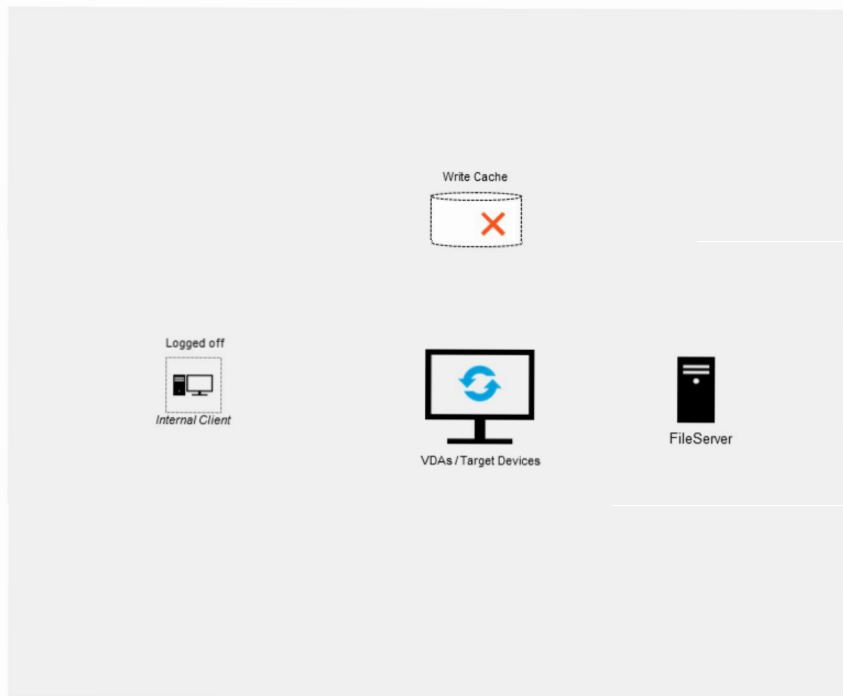
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Key Notes:

- By default, the locally cached user profile will remain in the write cache after a user logs off. However, the “Delete locally cached profiles on logoff” policy can be used to change this behavior. This policy can be enabled if there are resource restrictions limiting the size of the write cache in your environment. Otherwise, it can help speed up subsequent logons from that user until the cache host is rebooted.

What happens when I reboot?

- When the target device is rebooted, all contents of the write cache are erased. The vDisk assigned to the target device will be used to boot up the device in a pristine state.



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Key Notes:

- This behavior assumes the use of a non-persistent write cache. However, this type of write cache should be used in a great majority of use cases in order to gain the full benefits of Provisioning Services.
- It is recommended to restrict end user access to the system drives of a target device. Although any changes made can be reverted simply by rebooting the target device, this will also help prevent users from inadvertently saving important files and documents on the write cache and then subsequently losing them.



Lab Exercise

- Exercise 18-3: Redirect the event logs

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**Lesson
Objective
Review**

Will user data persist across reboots on a Provisioning Services target device?

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Lesson Objective Review

Will user data persist across reboots on a Provisioning Services target device?

It depends on where the user profiles and folders are located:

- If it is located on the local machine, it will not persist.
- If Microsoft Roaming profiles or Citrix Profile Management are used, data will be stored in another location and will persist across reboots.

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Key Takeaways



- A target device is a physical or virtual machine that receives a streamed operating system via Provisioning Services.
- Typically, the target devices continually send read requests to the Provisioning Server for the vDisk information and writes to a write cache, which is wiped clean after each reboot.
- User and machine data can go into the write cache, or it can be redirected to a persistent location.

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Provisioning Services 7.1x Administration

Integrating Provisioning Services with XenApp and XenDesktop

Module 19



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Lab VM Power Management

The following VMs are required to be powered on before beginning the exercises in this module:

- NYC-ADS-001
- NYC-SQL-001
- NYC-FSR-001
- NYC-PVS-001
- NYC-PVS-002
- NYC-VNS-001

The remaining VMs need to be powered off.

Note: These VMs are listed in the start-up order.

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Learning Objectives

- Identify the complete Provisioning Services and XenApp and XenDesktop architecture.
- Use the XenDesktop Setup Wizard to provision new VDAs and place them within the Provisioning Services and XenApp/XenDesktop environments.
- Manage the target devices by creating device collections.
- Publish apps and desktops that use PVS-based VDAs.
- Describe the process flow of a user logging into the XenApp/XenDesktop environment and launching an app or desktop.

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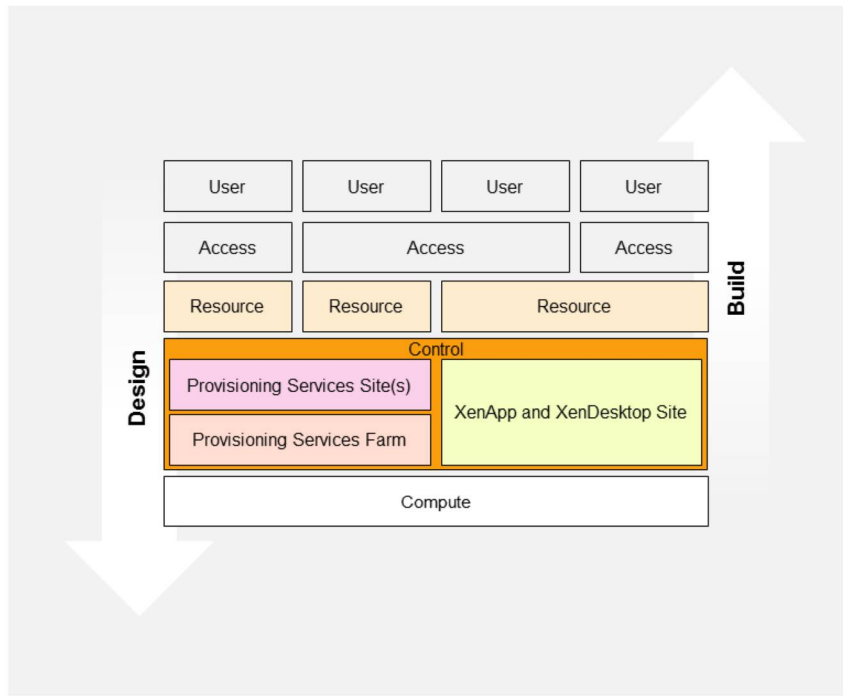
The Complete Architecture Overview

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PVS Layers Review

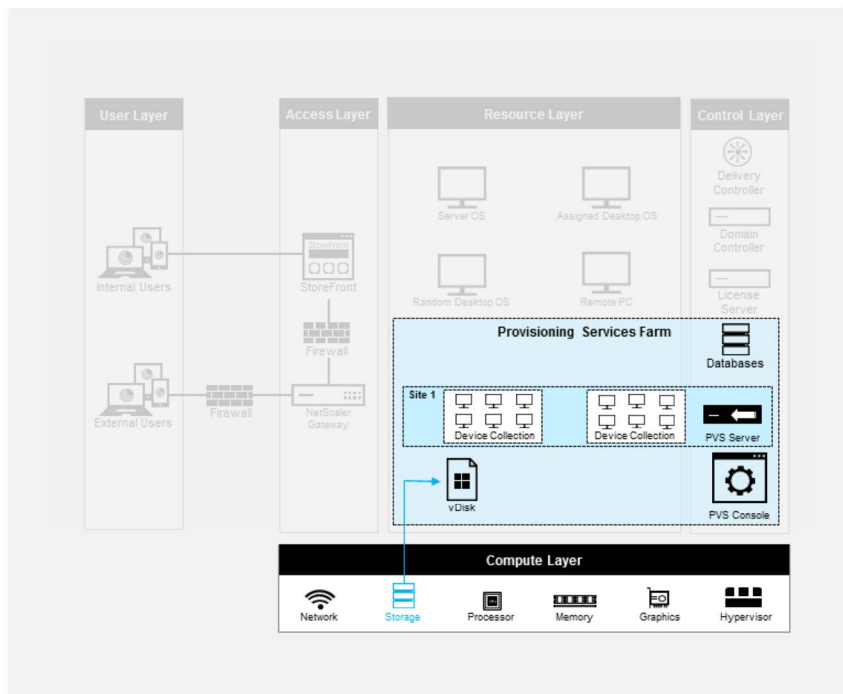
The Provisioning Services and XenApp/XenDesktop infrastructure both belong to the Control Layer of the Layers methodology.



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How much of the XenApp and XenDesktop Site changes when you deploy Provisioning Services?

Nothing changes within the structure of the XenApp and Desktop Site when we deploy Provisioning Services.



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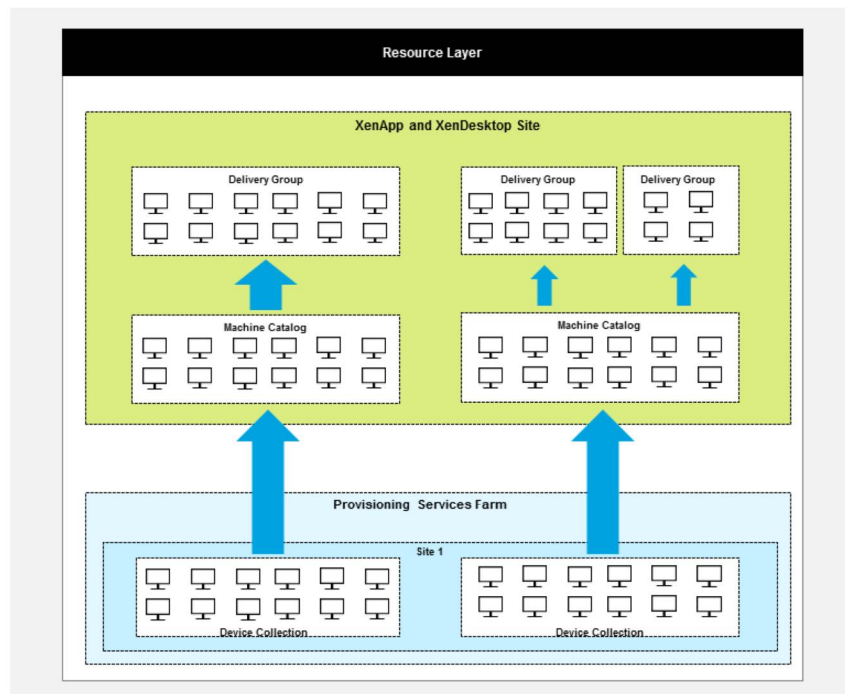
Key Notes:

- The XenApp and XenDesktop components' (StoreFront, Delivery Controller, NetScaler Gateway) core configurations do not have to be changed in any way to integrate with Provisioning Services.

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So Does Anything Change?

- Yes, the primary change is within the Resource Layer.
- A different process can be used to create machine catalogs within a XenApp and XenDesktop Site and add VDAs to the catalogs.



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Key Notes:

- PVS target devices and XenApp/XenDesktop VDAs are two different terms for the same machines (when the two environments are integrated). The name that is used will depend on whether we are working with the PVS or XA/XD environment.
- Ultimately, Provisioning Services is used as a way to manage the images and machines that are ultimately used to provide published app and desktop resources to XenApp and XenDesktop users.

Benefits of integrating PVS with XenApp & XenDesktop



Simplify management of Server OS and Desktop OS VDA images

- Roll out patches and hotfixes consistently and uniformly
- Easily deploy image updates and rollbacks



Ensure a consistent and secure user experience

- Same image is accessed regardless of which VDA is hosting the session
- Any user-impacting changes can be reset with a reboot



Reduce storage footprint of your deployment

- Especially critical for Desktop OS VDA deployments
- VDAs only need a small local disk for temporary writes and persistent data

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Key Notes:

- Although MCS has been developed and improved greatly over the years, the speed of deploying and rolling back image updates is one area where PVS is demonstrably faster. This can have a great impact in environments with a large number of VDAs.
- VDAs provisioned with PVS all boot from the same “golden” image, which ensures that users are getting the same experience from any machine using that image. Any issues that occur during runtime due to the actions of a single user, or even due to a malicious attack on the operating system, can easily be rolled back by rebooting the machine and discarding any unwanted changes.

Additional Resources:

- Provisioning Services product overview - <http://docs.citrix.com/en-us/provisioning/7-13/overview.html>



**Lesson
Objective
Review**

What is one benefit and one drawback of using PVS with XenApp and XenDesktop, when compared to MCS?

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Lesson Objective Review

What is one benefit and one drawback of using PVS with XenApp and XenDesktop, when compared to MCS?

One large benefit is the speed with which updates can be rolled out and rolled back compared to MCS.

One drawback is that MCS is built into the Delivery Controllers, while PVS requires additional infrastructure servers.

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Key Notes:

- Additional advantages for PVS over MCS include:
 - Lower storage footprint
 - Easier to migrate images between sites
 - Can be used for physical devices, while MCS is virtual only
 - Easier to adapt architecture to a dev, test, and production operational framework
- Additional drawbacks of PVS compared to MCS include:
 - Only MCS is supported for use in the Microsoft Azure and Amazon AWS clouds
 - MCS is less dependent on reliable, high-bandwidth networks

Additional Resources:

- Provisioning Services or Machine Creation Services (2016 Edition):
<https://www.citrix.com/blogs/2016/06/28/provisioning-services-or-machine-creation-services-2016-edition/>



The XenDesktop Setup Wizard

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Catalog Creation Methods

- Template Based
 - Machine Creation Services (MCS)
 - Provisioning Services (PVS)
- Manual
 - Manually create a Machine Catalog by using pre-existing VMs or Physical Machines

The screenshot shows the 'Machine Catalog Setup' wizard in Citrix Studio. The 'Machine Management' section is selected in the left-hand navigation pane. The main content area displays the following options:

- This Machine Catalog will use:**
 - Machines that are power managed (for example, virtual machines or blade PCs)
 - Machines that are not power managed (for example, physical machines)
- Deploy machines using:**
 - Citrix Machine Creation Services (MCS)
 - Resources: Internal (Zone: Primary)
 - Citrix Provisioning Services (PVS)
 - Another service or technology
I am not using Citrix technology to manage my machines. I have existing machines already prepared.

Note: For Linux OS machines, consult the administrator documentation for guidance.

At the bottom right, there are three buttons: 'Back', 'Next', and 'Cancel'.

Key Notes:

- In XenApp and XenDesktop, when you create a machine catalog that will contain VMs, you specify how those VMs will be provisioned: you can use Citrix tools supported by Studio, such as Machine Creation Services (MCS) or Provisioning Services (PVS), or you can use your own tools to provide machines.
- All three sources can be used to include machines within a Machine Catalog.

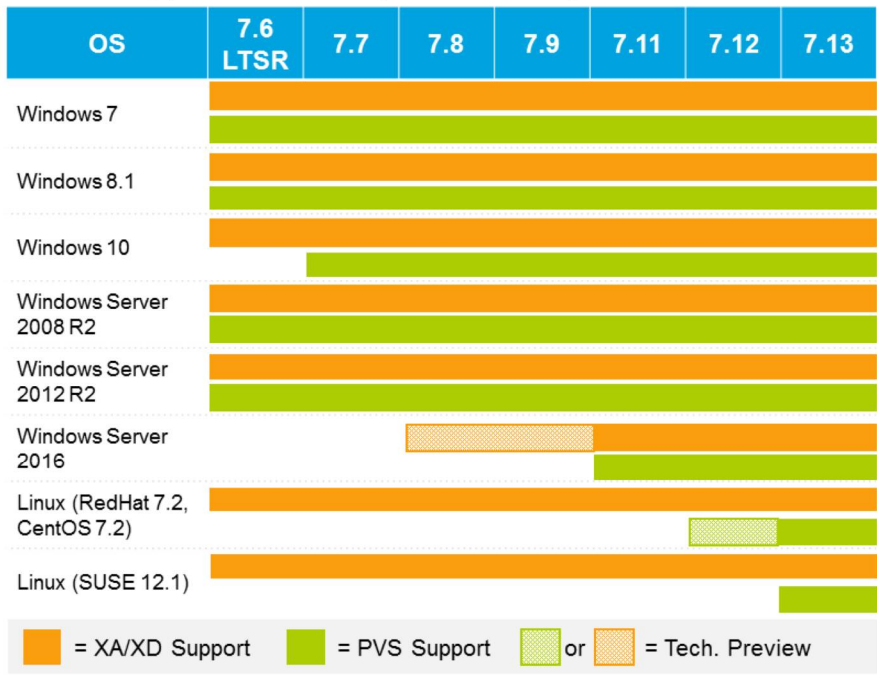
Additional Resources:

- <https://docs.citrix.com/en-us/xenapp-and-xendesktop/7-13/install-configure/machine-catalogs-create.html>

XenApp and XenDesktop / Provisioning Services Version

Supported platforms - OS

- All of the operating systems supported for both Provisioning Services and XenApp/XenDesktop can be placed in a machine catalog.



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Key Notes:

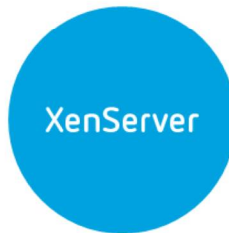
- For the most part, the list of supported operating systems is consistent between like versions of XenApp/XenDesktop and Provisioning Services. However, there are some cases where OS support was added at different times for each product. Use the chart to determine when an OS can be used in an integrated PVS/XA-XD environment. Note that intermediate OS versions such as Windows 8 and Windows Server 2012 are not pictured – please refer to Citrix documentation for information on those versions.
- The Windows 10 VDA had limited functionality in XA/XD 7.6 LSTR – 7.8. This includes lack of support for HDX 3D Pro, Secure Boot, and GPU acceleration, among other things). If your use case requires one or more of these features, use the current release or LTSRv2 (when it comes out) for your deployment.
- Provisioning Services 7.6 included support for Windows XP and Windows Server 2003 machines (not pictured), but only if used separately from XenApp/XenDesktop (the 7.x VDA component does not support these operating systems). In general, Citrix strongly recommends only using operating systems that are currently supported.

Additional Resources:

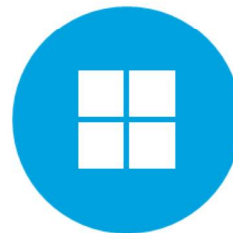
- System Requirements (XenApp/XenDesktop): <http://docs.citrix.com/en-us/xenapp-and-xendesktop/7-13/system-requirements.html>
- System Requirements (Provisioning Services): <https://docs.citrix.com/en-us/provisioning/7-13/system-requirements.html>
- System requirements (Linux VDA): <http://docs.citrix.com/en-us/linux-virtual-delivery-agent/7-13/system-requirements.html>

Supported Hypervisor Platforms

- The “Big 3” all support both XenApp and XenDesktop and Provisioning Services.
 - XenServer
 - Hyper-V
 - vSphere



XenServer



Hyper-V / SCVMM



vSphere

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Key Notes:

- Refer to the link in Additional Resources for a chart showing support based on the version of each hypervisor. Although the Big 3 are generally supported, support varies based on the version of the hypervisor, XenApp and XenDesktop, and Provisioning Services.
- In general, it is recommended to upgrade to a later version of the hypervisor that will be used in these environments prior to imaging a vDisk. This is so that the Master Target Device will have the latest hypervisor tools installed prior to imaging. Otherwise, an alternative vDisk update method must be used to upgrade the hypervisor tools later on (see Module 7).
- Nutanix Acropolis is supported for newer versions of XenApp and XenDesktop, but not for Provisioning Services.

Additional Resources:

- Supported Hypervisors for XenDesktop and Provisioning Services:
<https://support.citrix.com/article/CTX131239>
- Nutanix Acropolis Hypervisor Support in XenApp/XenDesktop:
<https://support.citrix.com/article/CTX202032>



Lab Exercise

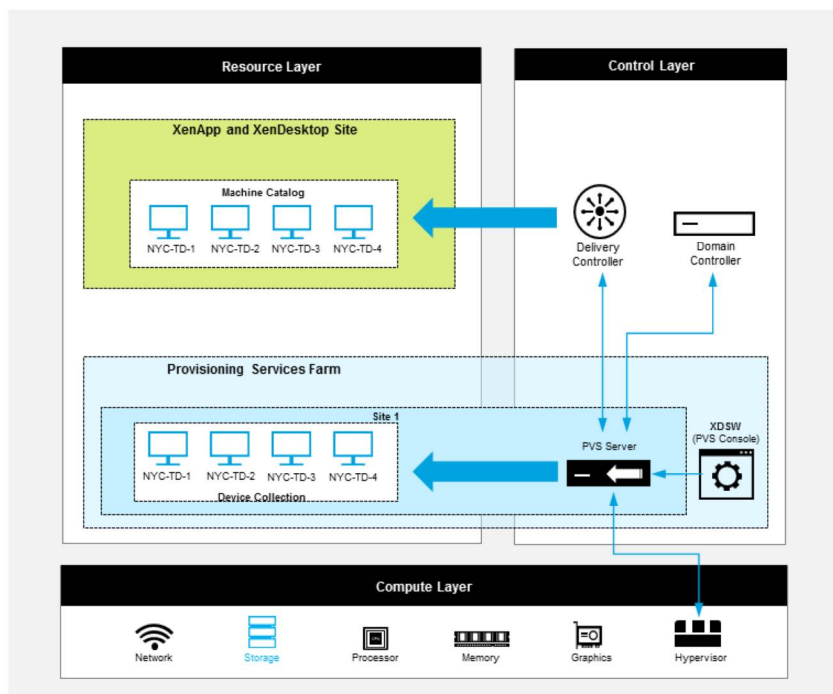
- Exercise 19-1: Copy the Server OS Master and Convert to a Template
- Exercise 19-2: Copy the Desktop OS Master and Convert to a Template

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What is the XenDesktop Setup Wizard (XDSW)?

The XDSW automates several steps of the machine provisioning process, including:

- Creating new VMs based on a template
- Creating a write cache disk for each VM
- Places each VM in a PVS Device Collection
- Places each VM in a XenApp and XenDesktop machine catalog



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Key Notes:

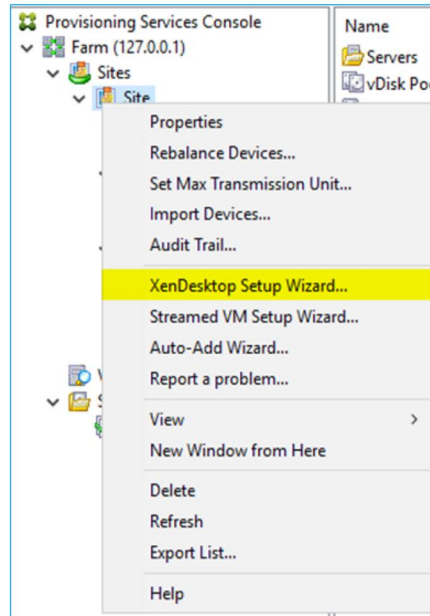
- The XDSW creates Provisioning Services target devices for each new VM within a new or existing Provisioning Services Device Collection matching the XenDesktop catalog name.
- The XDSW assigns a Standard Image vDisk to VMs within the Device Collection.
- The XDSW adds virtual desktops to a machine catalog. Although the name of the wizard only mentions “XenDesktop”, this can be used to create for Server OS and Desktop OS VDAs.

Additional Resources:

- Deploying virtual desktops to VMs using the XenDesktop Setup Wizard:
<https://docs.citrix.com/en-us/provisioning/7-13/xendesktop-setup-wizard.html>

Where is the XenDesktop Setup Wizard (XDSW)?

The XDSW can run from the Provisioning Services console by right clicking on any named Site node

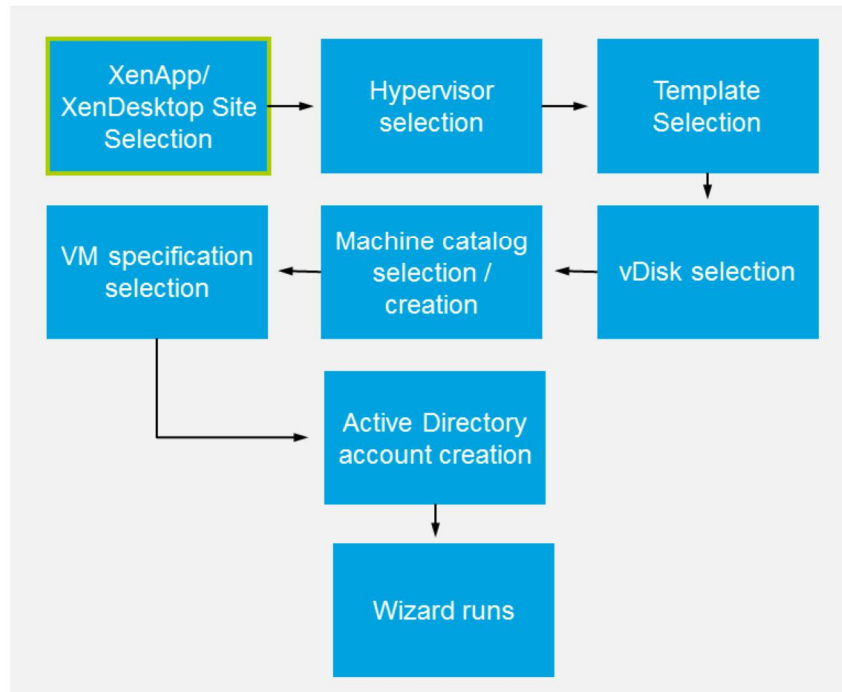


Additional Resources:

- Deploying virtual desktops to VMs using the XenDesktop Setup Wizard:
<https://docs.citrix.com/en-us/provisioning/7-13/xendesktop-setup-wizard.html>

Using the XenDesktop Setup Wizard (XDSW)

- The XDSW includes several items that must be configured in order for the machines to be created.
- Each stage has its own prerequisites that must be addressed.



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Key Notes:

- Review the wizard requirements before attempting to create target devices. Because this wizard must communicate with a few different systems to be successful (PVS, XA/XD, hypervisor resources, Active Directory) the account used to run the wizard must have the appropriate permissions within PVS, XA/XD, and AD. A separate account can be specified for hypervisor access, although the specific permissions needed will vary by hypervisor.
- After the prerequisites are in place, to successfully complete the XDSW, several integration points must be specified:
 - First, a XenApp and XenDesktop Site must be selected by entering the address of a Delivery Controller within that Site.
 - After the Provisioning Server successfully contacts the Delivery Controller, a list of FMA Site resources, or hypervisor hosts, will be shown. These must be configured within Citrix Studio prior to running the wizard. Remember, at this time Provisioning Services is not supported with cloud host resources such as AWS and Azure, so be sure that an on-premises host is selected. You will be prompted for administrative credentials to the hypervisor deployment you select.
 - The wizard will use the hypervisor host credentials to access its storage repository, and will display the VM templates that it finds. Select a compatible template for the target devices. Ideally, it would be based on the Master Target Device that was used to image the vDisk that will be assigned to the target devices – this ensures that the VMs will have the correct pre-boot network drivers.

- Next, based on the PVS Site used to launch the wizard, a list of available vDisks will be displayed. Select the vDisk that will be streamed to the target devices created by this wizard. The wizard will automatically assign the vDisk to each device.
- The wizard proceeds to the machine catalog selection stage. The target devices will be automatically placed in the machine catalog selected here. An existing catalog can be used, or a new one can be created by the wizard. If a new machine catalog is created, you will be prompted to designate it as a Desktop OS or Server OS catalog. Note that a device collection will be created in the PVS site with a name that matches the machine catalog name. Target devices will be automatically placed in that device collection, although they can be moved later.
- Now, you will specify the CPU, RAM, write cache disk size, and boot mode for the target devices. The wizard assumes that a device-side write cache method will be used. It will also remove any disks attached to the template when creating the new machines, and attach a new disk as the write cache instead. If either of these conflicts with your requirements (for example, if a server-side caching method is selected on the target vDisk, the XDSW will create diskless VMs (see Write cache considerations at: <https://docs.citrix.com/en-us/provisioning/7-13/xendesktop-setup-wizard.html>). If you wish to use the BDM disk partition boot method, select that option here to automatically create a partition in the write cache disk. Otherwise, select “PXE boot” to ensure that no partition is created.
- The machines will require Active Directory machine accounts. The Active Directory screen allows you to either create new accounts or import existing accounts. On the following screen, you can also select where the accounts should be located, and the account naming scheme (if creating new accounts).
- Review all configuration settings. After confirming, the following actions take place one at a time across all hosts until configurations are complete:
 - If applicable, create a machine catalog
 - Create VMs on a host's hypervisor using the machine template
 - Create BDM partitions, if specified
 - Create a write cache disk of the specified size
 - Create Provisioning Services target devices then assign the selected vDisk to those devices
 - Add the target devices to the selected Provisioning Services Device Collection

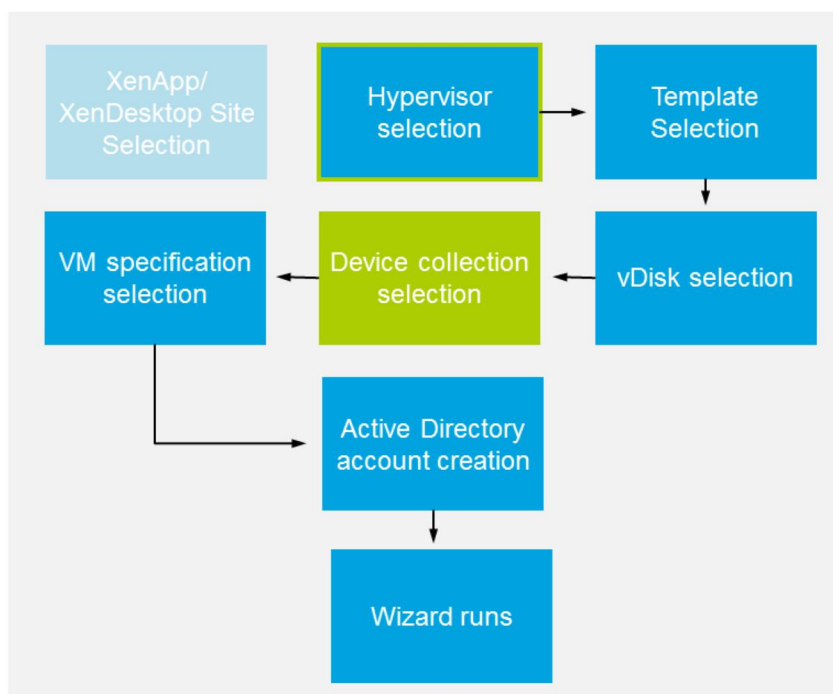
- Add the VMs to the machine catalog
- Boot each VM to format the newly created write cache disk
- It is important to note that if the wizard is cancelled while it is running, it is NOT able to rollback the actions that were already performed. As a result, you must go and do a manual clean-up to delete any VMs, AD accounts, machine catalogs, and device collections that were already created. To avoid this, do not run the final stage of the wizard unless you are sure that everything is configured appropriately!

Additional Resources:

- Deploying virtual desktops to VMs using the XenDesktop Setup Wizard:
<https://docs.citrix.com/en-us/provisioning/7-13/xendesktop-setup-wizard.html>
- System requirements (scroll down to “XenDesktop Setup wizard requirements”):
<https://docs.citrix.com/en-us/provisioning/7-13/system-requirements.html>

What is the Streamed VM Wizard?

- The Streamed VM Wizard also creates PVS target devices, but lacks integration with XenApp and XenDesktop.
- After the devices are created, they must be manually added to a machine catalog.



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Key Notes:

- The Streamed VM wizard predates the XenDesktop Setup wizard, and can also create numerous target devices based on a template. However, the wizard will not automatically place target devices within a machine catalog, and it lacks other automated functions such as attaching a write cache or a BDM disk partition to target devices.
- The Streamed VM wizard may be used if you cannot get the required level of permissions for the service account used to run the wizard, either on XenApp and XenDesktop or on the hypervisor. It can also be used to integrate with XenApp 6.5, which does not support the use of the XenDesktop Setup Wizard.
- Because there is no XenApp and XenDesktop integration, the first stage is skipped in this wizard.
- Instead of a machine catalog selection stage, the Streamed VM wizard asks you to select a PVS device collection where the target devices will reside. The device collection must be manually created prior to running the wizard.
- During the VM specification selection, you will no longer have the option to specify a write cache size. Instead, the wizard detects any disk attached to the template, and displays that disk as the write cache, but you are not able to change its size within the wizard. Additionally, the BDM disk partition must be configured manually on the Master Target Device before making it into a template.
- Review all configuration settings. After confirming, the following actions take place one at a time across all hosts until configurations are complete:
 - Create VMs on a host's hypervisor using the machine template

- Create Provisioning Services target devices then assign the selected vDisk to those devices
- Add the target devices to the selected Provisioning Services Collection

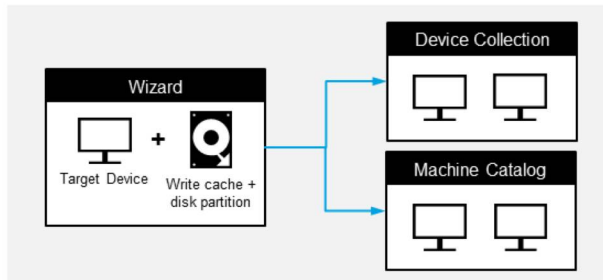
Additional Resources:

- Using the Streamed VM Setup Wizard: <https://docs.citrix.com/en-us/provisioning/7-13/streamed-vm-wizard.html>
- System requirements (scroll down to “Streamed VM Setup wizard requirements”): <https://docs.citrix.com/en-us/provisioning/7-13/system-requirements.html>

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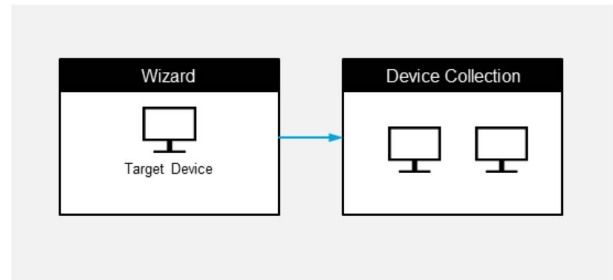
Setup Wizard Considerations

XenDesktop Setup Wizard



- The leading practice is to use the XDSW, as long as the appropriate prerequisites can be met.

Streamed VM Wizard



This wizard is still available in case you have insufficient access to run the XDSW.

Be aware of the differences from the XDSW so that you can adjust your build process accordingly.

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ILT Talking Points:

- This slide is a review from module 4. However, the focus is now on which method should be used by students.

Key Notes:

- Remember that the Auto-Add wizard is also available for integrating target devices that have been created manually or via a provisioning method outside of Provisioning Services. This wizard automatically adds devices to the configured device collection and assigns a vDisk and other settings based on the device name within Active Directory. However, this wizard also does not include integration with XenApp and XenDesktop.



- Which setup wizard do you prefer?
- Which one would work better operationally in your organization?

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Lab Exercise

- Exercise 19-3: Use the XenDesktop Setup Wizard (XDSW) for Server OS
- Exercise 19-4: Use the XenDesktop Setup Wizard (XDSW) for Desktop OS
- Exercise 19-5: Use the Streamed VM Setup Wizard

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Lesson Objective Review

To use the XenDesktop Setup wizard, you will need a administrative account and/or permissions to which environments?

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Lesson Objective Review

To use the XenDesktop Setup wizard, you will need a administrative account and/or permissions to which environments?

You will need to have access to the XenApp and XenDesktop, Provisioning Services, hypervisor host, and Active Directory environments.

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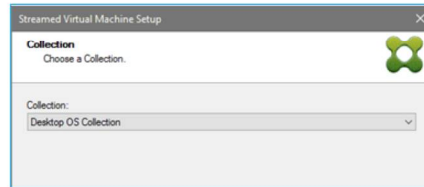
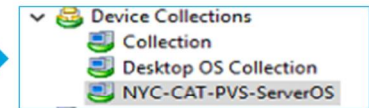
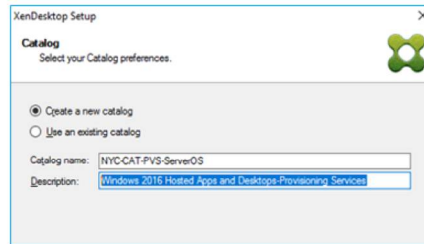
Manage the Target Devices by Creating Device Collections

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How do you identify catalog machines as target devices using the PVS management console?

After running the XenDesktop Setup wizard or Streamed VM wizard, you can view the new target devices in the Device Collections node of the PVS Site.

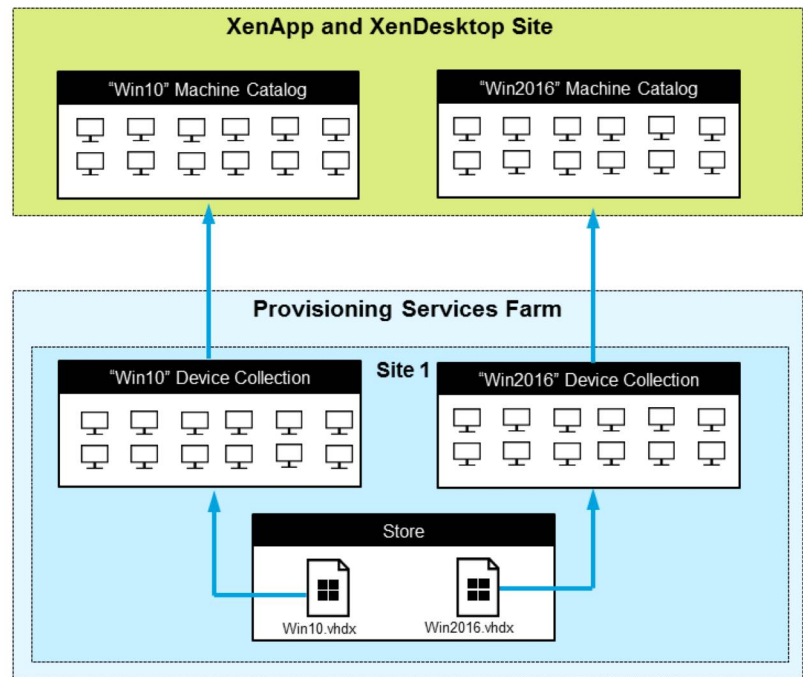


Key Notes:

- If you used the XenDesktop Setup wizard, the device collection will have the same name as the machine catalog that was created in Studio.
- If you used the Streamed VM wizard, the target devices were placed into an existing device collection that was selected in the wizard.
- From an administrative perspective, it is helpful to keep target devices in device collections that match the machine catalogs in XenApp and XenDesktop. However, technically it is possible to organize the target devices in a different way without impacting their functionality. Just make sure that each target device is assigned the appropriate vDisk.

Purpose of the Device Collection

- Provides flexibility in the way that target devices are grouped and managed.
- Most common use case is aligning device collections with machine catalogs.



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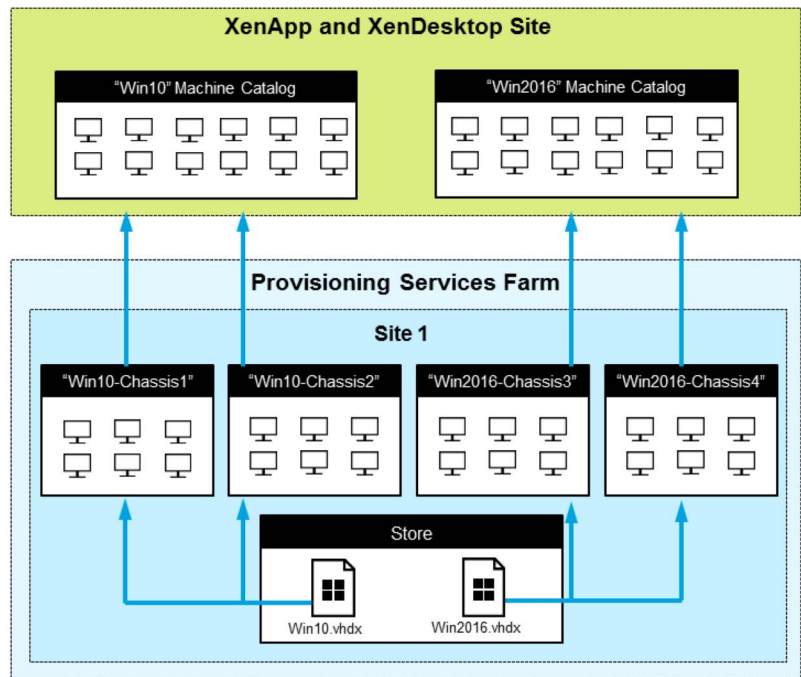
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Additional Resources:

- Managing device collections: <http://docs.citrix.com/en-us/provisioning/7-13/managing-device-collection.html>

Purpose of the Device Collection

- A device collection could also represent a physical location, a subnet range, or a logical grouping of target devices.
- Target devices from separate device collections (or even separate PVS farms/sites) can belong to the same machine catalog, as long as they are streaming the same operating system version



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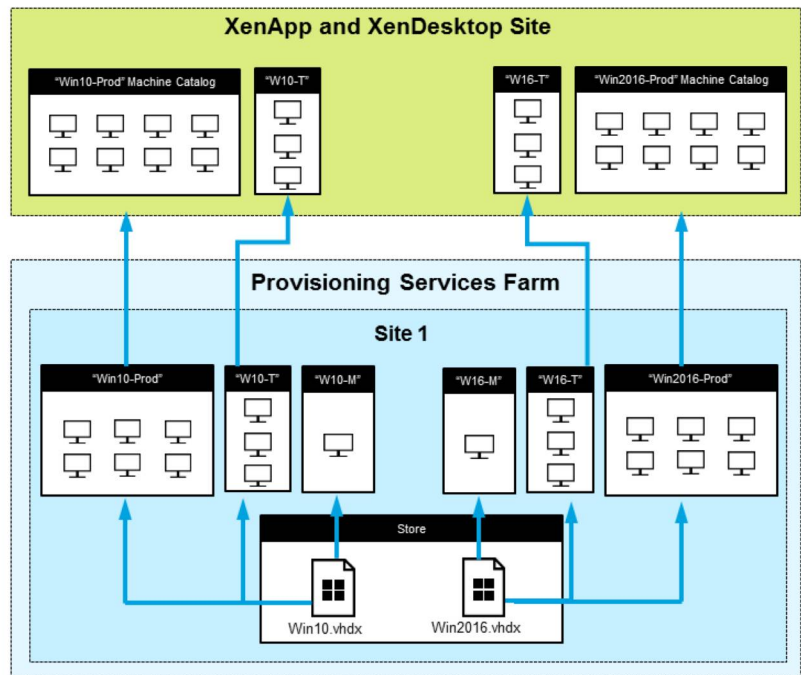
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Additional Resources:

- Managing device collections: <http://docs.citrix.com/en-us/provisioning/7-13/managing-device-collection.html>

Purpose of the Device Collection

- Another example device collection use includes separating maintenance, test, and production target devices into separate device collections.
- Only production and test target devices are present in the machine catalogs within the XenApp and XenDesktop Site.



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Key Notes:

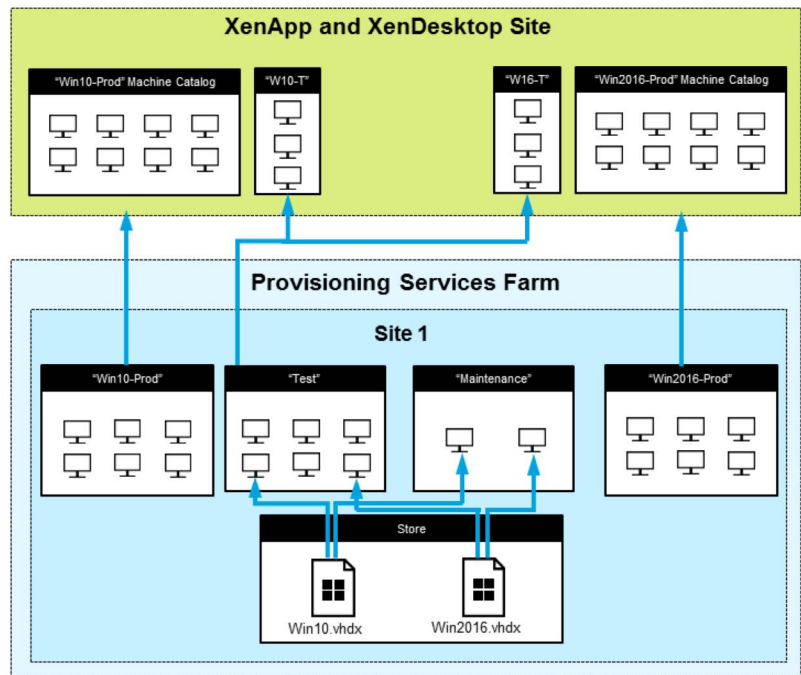
- In this example, the dev, test, and production target devices are all assigned the same vDisk (or different versions of the same vDisk). As we will see in Module 7, this setup could be used to help organize vDisk update activities.

Additional Resources:

- Managing device collections: <http://docs.citrix.com/en-us/provisioning/7-13/managing-device-collection.html>

Purpose of the Device Collection

Development and test target devices could also be consolidated device collections where vDisk assignments are handled individually for each target device.



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Key Notes:

- In this example, the test machine catalogs would most likely be temporary because the target devices would not necessarily run on the same vDisk long-term. A separate non-production XenApp and XenDesktop Site may also be used for the test machine catalogs.

Additional Resources:

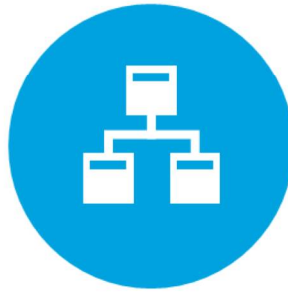
- Managing device collections: <http://docs.citrix.com/en-us/provisioning/7-13/managing-device-collection.html>

Considerations

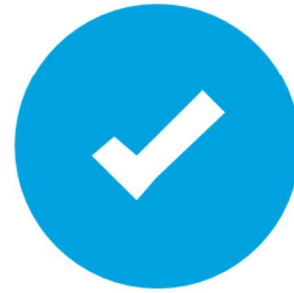
So which device collection setup is best?



No technical requirements – all target devices could be in a single device collection.



Best approach will depend on organization's environment and operations.



In general, start simple. It helps prevent mistakes, and the setup can be adjusted gradually as the team gets used to XA/XD and PVS operations.

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Lab Exercise

- Exercise 19-6: Manually Add Machines to the Device Collection

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Lesson Objective Review

Do all target devices in a device collection need to run off of the same vDisk? Why or why not?

Create Q and A based on scenerios

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Lesson Objective Review

Do all target devices in a device collection need to run off of the same vDisk? Why or why not?

No, vDisks can still be individually assigned to target devices within a device collection. However, when manually adding target devices to a machine catalog, be sure that they are all running on the same OS.

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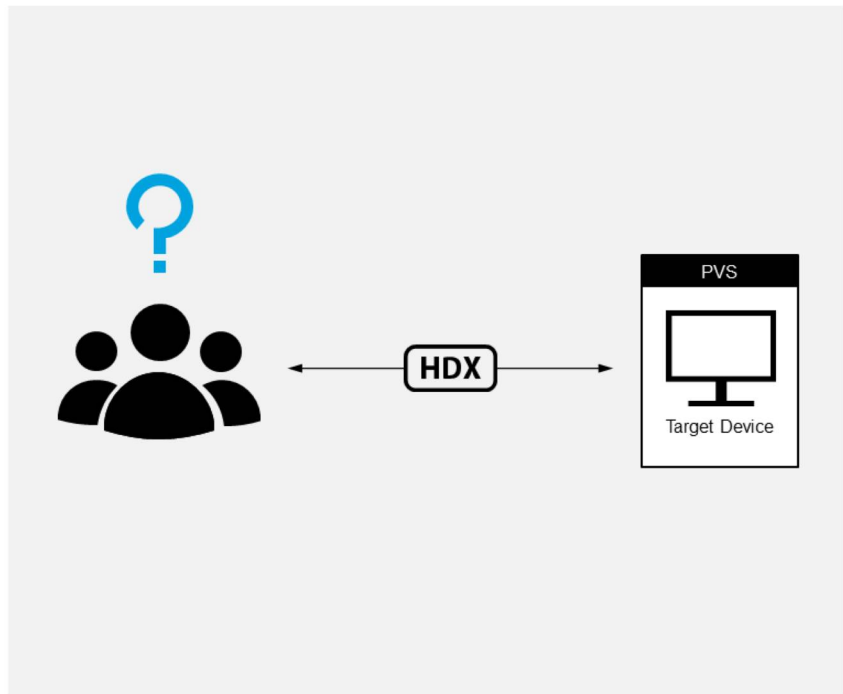


Published Apps and Hosted Desktops

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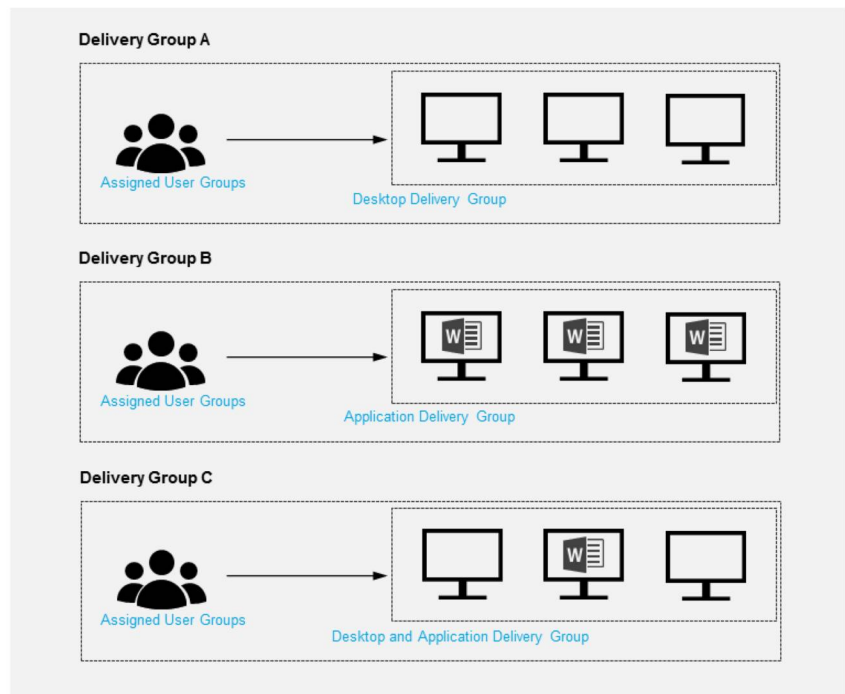
Question:
How do I create
a published app
or desktop,
when the
hosting machine
is a PVS target
device?



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Answer:
No change, I've integrated PVS with the XenApp and XenDesktop Delivery Site.

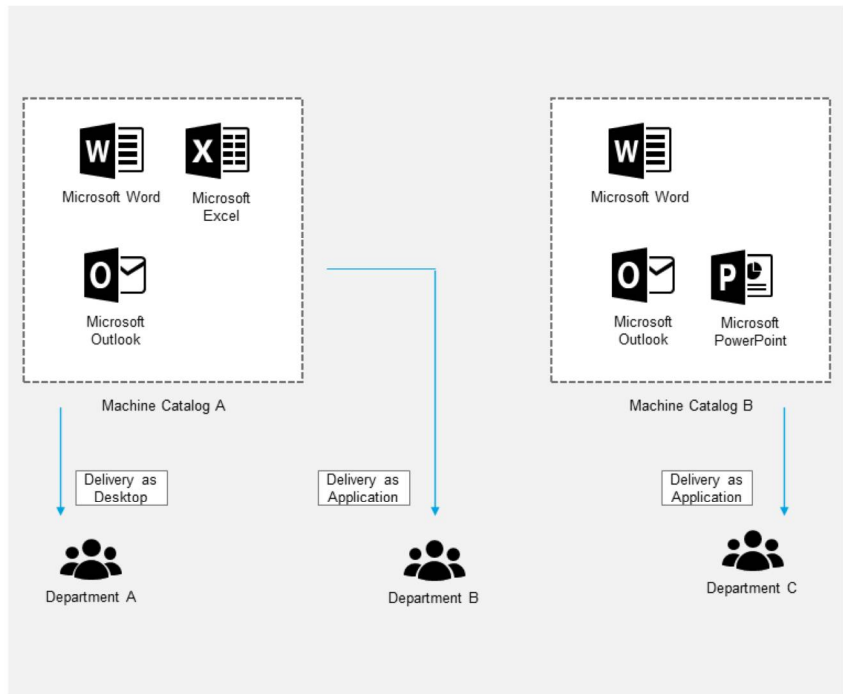
Once the target devices have been imported to a machine catalog, the application and desktop publishing process is the same as with other provisioning methods.



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Use Studio

Use Citrix Studio to publish the resources from the catalogs to the designated user groups.



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Lab Exercise

- Exercise 19-7: Create a Delivery Group For Server OS
- Exercise 19-8: Create a Delivery Group For Desktop OS

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**Lesson
Objective
Review**

What steps need to be taken on the Provisioning Services console in order to publish a resource to a user group?

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Lesson Objective Review

What steps need to be taken on the Provisioning Services console in order to publish a resource to a user group?

None! Publishing applications and desktops to end users is still configured completely within the XenApp and XenDesktop environment.

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Using Provisioned Services with XenApp and XenDesktop

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Connection Flow Process

The process for a user logging in and launching an app or desktop consists of the following phases:

Pre-Login:

1. VDA/Target Device boot
2. VDA registration

Login:

1. Authentication
2. Enumeration
3. Session Launch

Key Notes:

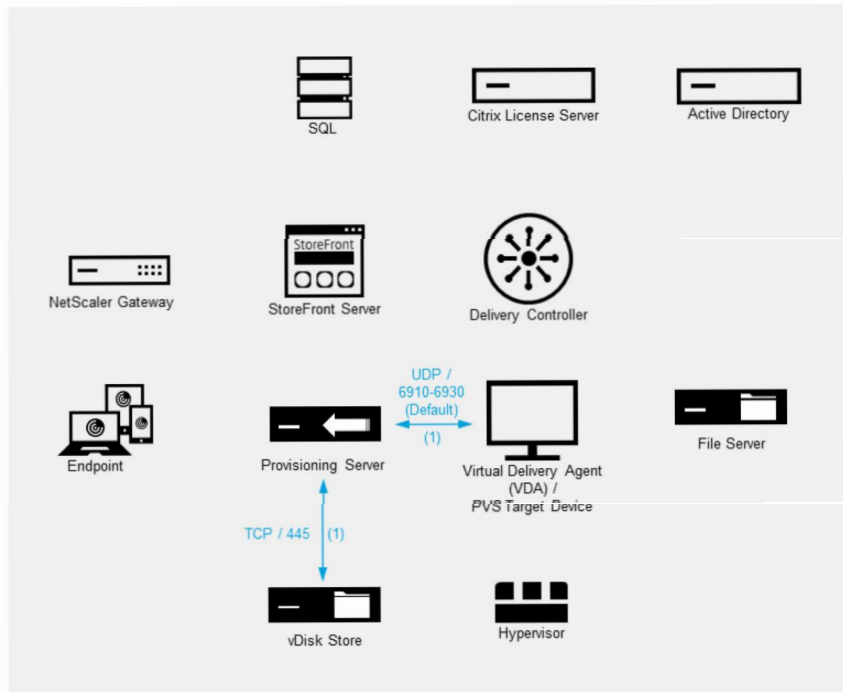
- The next few slides will target specific components from both the XenApp/XenDesktop and Provisioning Services environments and group them together. We will begin by reviewing the Provisioning Services boot, login and streaming processes, then move into the XenApp and XenDesktop session authentication, enumeration and session launch processes.

Additional Resources:

- XenDesktop Connection Process and Communication Flow - <http://support.citrix.com/article/CTX128909>
- Citrix Virtual Desktop Handbook 7.x Page 34 - <http://support.citrix.com/article/CTX139331>
- Technical Overview - <http://docs.citrix.com/en-us/xenapp-and-xendesktop/7-13/technical-overview.html>
- Provisioning Services Boot Process Diagram

Connection Flow VDA/Target Device Boot

- The first stage is booting up Provisioning Services target devices / XenApp/XenDesktop VDAs.
 - For Server OS VDAs, this would typically happen during a change windows after a vDisk update or periodic reboot.
 - For Desktop OS VDAs, this may occur as needed based on the power management settings within the Delivery Group.



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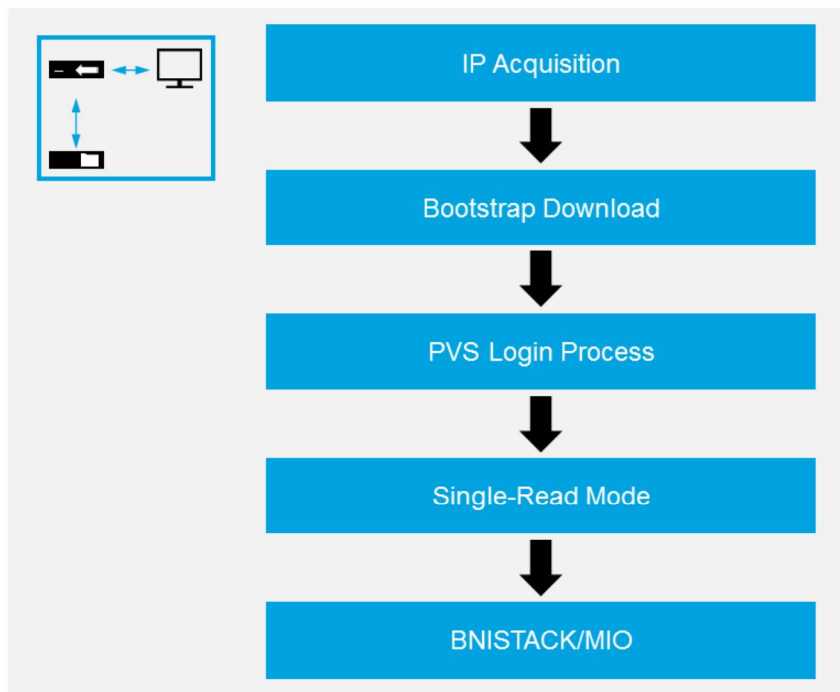
Key Notes:

- In this example, the vDisk Store is located on a centralized SMB share.

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Connection Flow VDA/Target Device Boot

Each PVS-provisioned VDA must go through the displayed stages of the boot process.



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Key Notes:

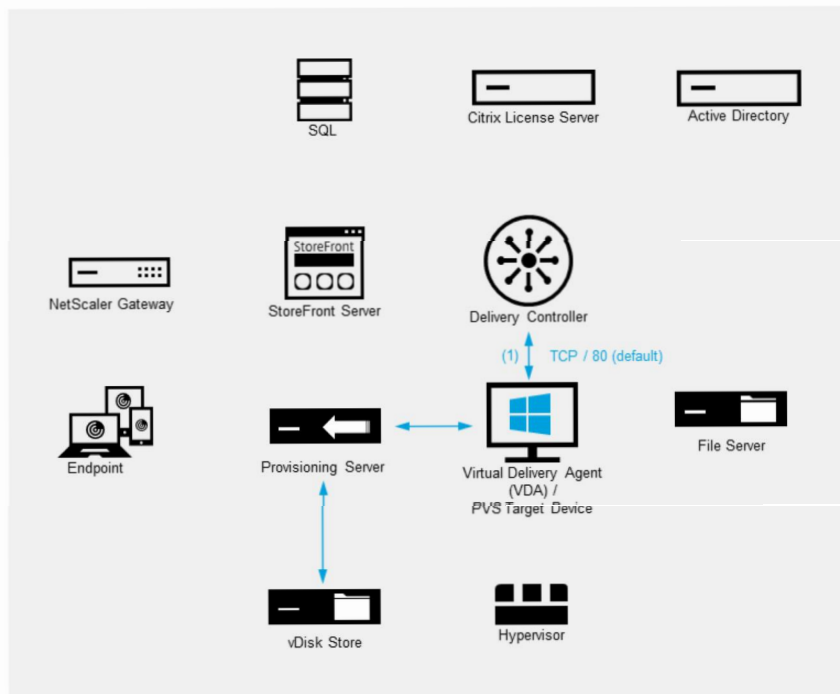
- The target device first gets assigned an IP address, either via DHCP or with a static address embedded in a BDM or BIOS-embedded bootstrap (Module 3, Lesson 4).
- Next, the target device obtains the location of the bootstrap file, and if necessary, downloads it from the TFTP server. The device uses the information in the bootstrap file to contact a PVS login server (Module 3, Lesson 4).
- In the third stage, the target device communicates with the login server to get assigned a streaming server, port, and vDisk (Module 3, Lesson 3).
- In single read mode, the target device sends a series of simple requests to the streaming server. Each request is for a specific sector of the assigned vDisk. The streaming server sends simple replies with requested vDisk data. This process will continue until BNISTACK loads and the OS boot begins (Module 3, Lesson 3).
- In the BNISTACK/MIO phase, the vDisk's operating system boots on the target device, and the device continues to stream the vDisk during runtime (Module 3, Lesson 3).

Additional Resources:

- Provisioning Services Boot Process Diagram:
<https://support.citrix.com/article/CTX136378>

Connection Flow VDA Registration

- Now that the VDA has finished booting it must register with the Delivery Controller.
 - Process in which the VDA and Delivery Controller establish a trusted communication
 - This process is the same regardless of the provisioning method used.



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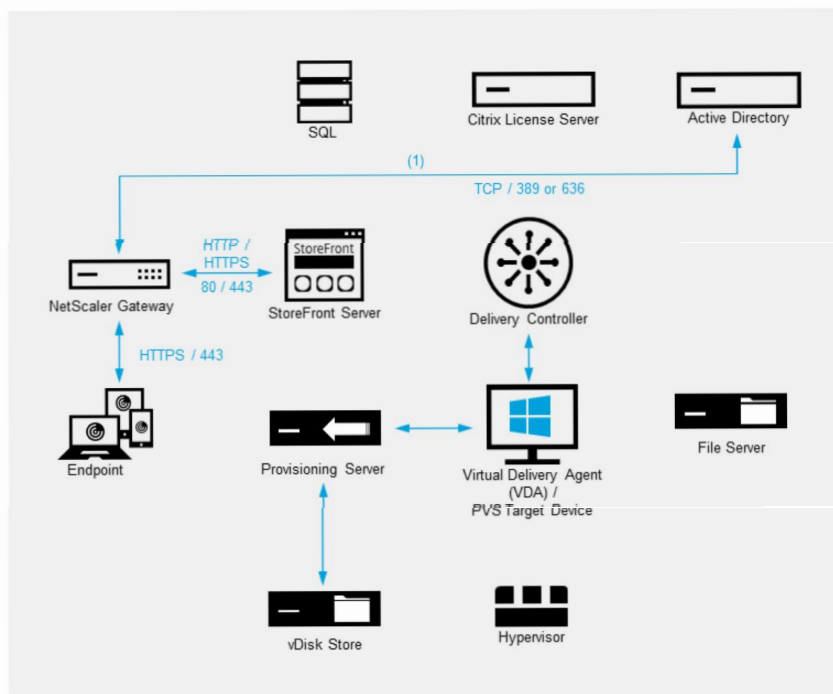
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Key Notes:

- Registration Configuration Options:
 - Auto update: Delivery Controller automatically updates the Delivery Controller list to MCS or PVS provisioned machines
 - Group Policy Object (GPO): a GPO setting specifies the Delivery Controller list
 - Manual: a registry setting or the VDA wizard configures the Delivery Controller list
 - MCS: MCS inserts the Delivery Controller list into the personality.ini file
- The configuration options are in order of priority and the Delivery Controller checks each applicable location for the options in order until it locates the Delivery Controller

Connection Flow Authentication

1. The VDA is now ready to host user sessions. A user begins the logon process by authenticating with Active Directory.
 - The process differs slightly based on whether users are connecting via NetScaler Gateway or directly through StoreFront.
 - Delegated authentication can be used to have the Delivery Controller authenticate users.



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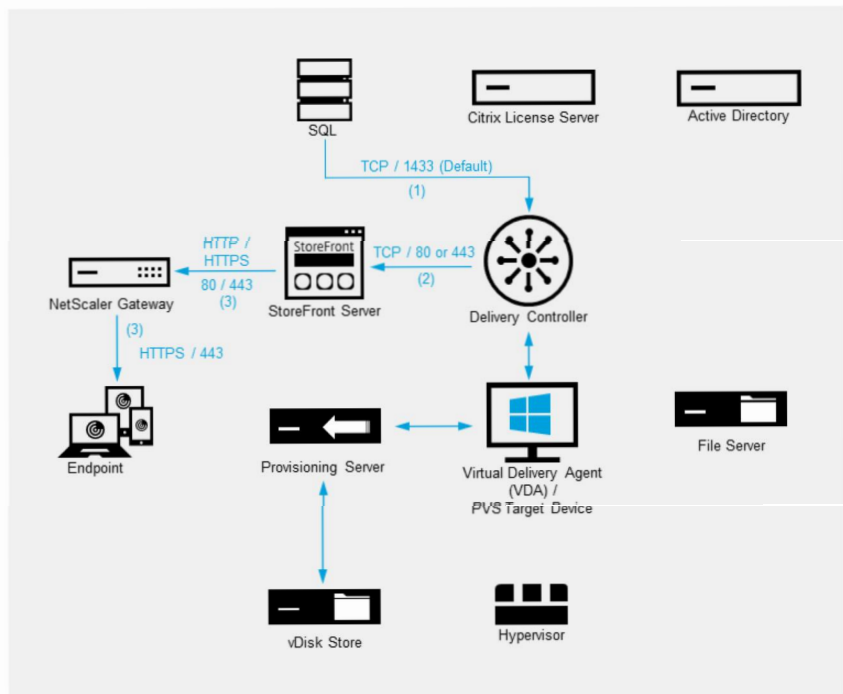
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Key Notes:

- In this example, the user is authenticating from an external network via NetScaler Gateway:
 - Citrix Receiver on the endpoint device contacts the NetScaler Gateway using the remote access URL and the NetScaler displays the authentication page to the user.
 - The user submits their credentials on the authentication page and the NetScaler authenticates the user with a RADIUS Server over the RADIUS access and accounting ports, not shown in the diagram, or with an Active Directory domain controller using LDAP, as shown here.
 - After successful authentication, the NetScaler Gateway forwards the user's credentials to StoreFront and the user is logged into the Store. While HTTP can be used to transmit these credentials to StoreFront, this communication should be secured to protect credential information.

Connection Flow Enumeration

1. Once authentication is complete, the Delivery Controller queries the site database for assigned apps and desktops.
2. Available apps and desktops are forwarded to StoreFront.
3. Apps and desktops are presented to the user.



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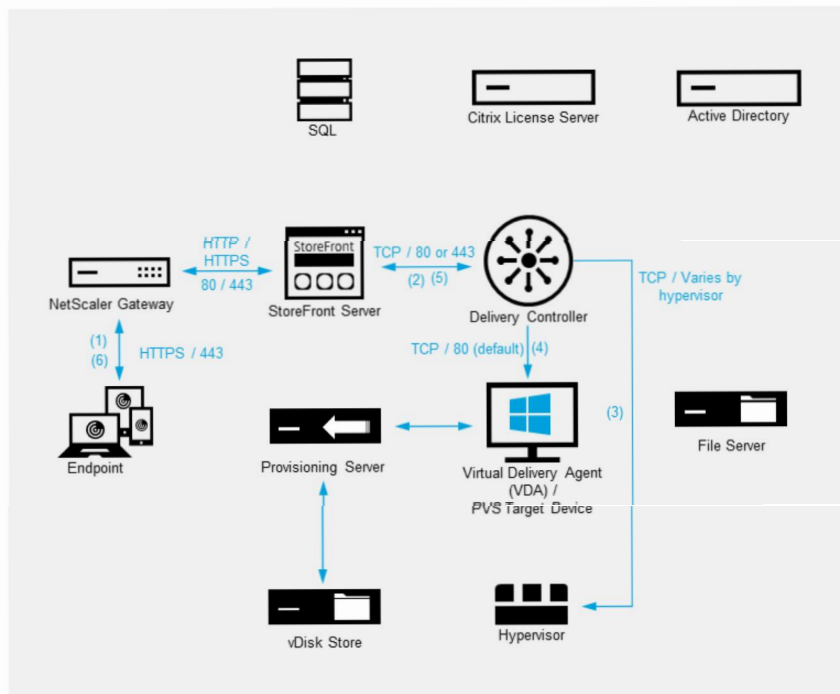
CITRIX

Key Notes:

- The Broker Service determines which desktops and applications the user is allowed to access.
- Once the credentials are verified, the information about available apps or desktops is sent back to the user through the StoreFront-Receiver pathway. When the user selects applications or desktops from this list, that information goes back down the pathway to the Controller, which determines the proper VDA to host the specific applications or desktop.

Connection Flow Session Launch

1. User clicks a listed app or desktop. This request is sent to the StoreFront Server.
2. This request is forwarded to the Delivery Controller.
3. Current status of the VDA is validated.
4. Delivery Controller notifies the VDA about the upcoming connection.
5. The Delivery Controller forwards information about the assigned VDA to StoreFront.
6. A launch file(.ICA) is sent to the end user's Endpoint.



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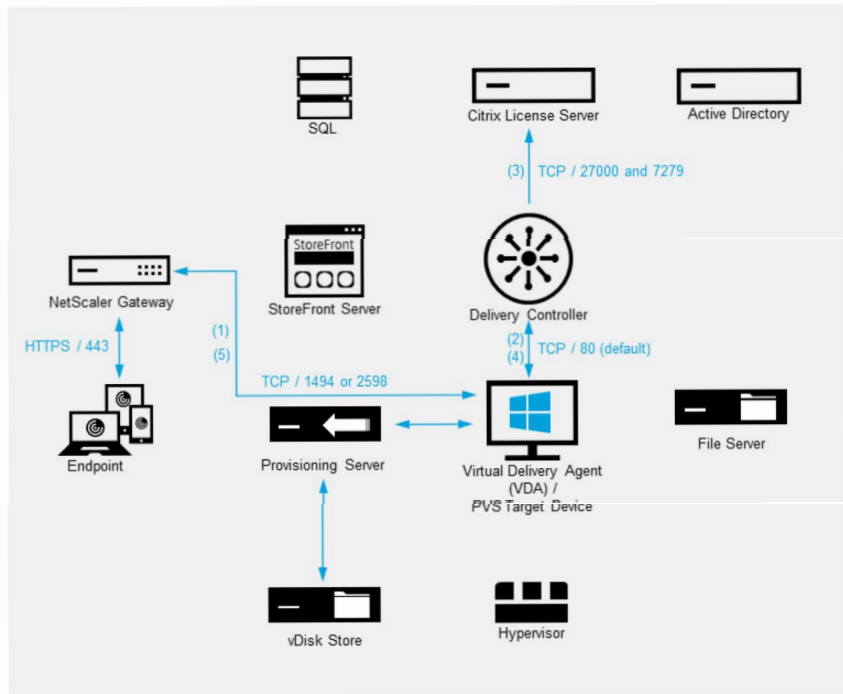
CITRIX

Key Notes:

- When the user selects applications or desktops from this list, that information goes back down the pathway to the Controller, which determines the proper VDA to host the specific applications or desktop.
- The Controller sends a message to the VDA with the user's credentials and sends all the data about the user and the connection to the VDA. The VDA accepts the connection and sends the information back through the same pathways all the way to Receiver. Receiver bundles up all the information that has been generated in the session to create Independent Computing Architecture (ICA). file on the user's device if Receiver is installed locally or on RFW if accessed through the web. As long as the Site was properly set up, the credentials remain encrypted throughout this process.
- The ICA file is copied to the user's device and establishes a direct connection between the device and the ICA stack running on the VDA. This connection bypasses the management infrastructure: Receiver, StoreFront, and Controller.
- The connection between Receiver and the VDA uses the Citrix Gateway Protocol (CGP). If a connection is lost, the Session Reliability feature enables the user to reconnect to the VDA rather than having to relaunch through the management infrastructure. Session Reliability can be enabled or disabled in Studio.
- Once the client connects to the VDA, the VDA notifies the Controller that the user is logged on, and the Controller sends this information to the Site database and starts logging data in the Monitoring database.

Connection Flow Session Launch

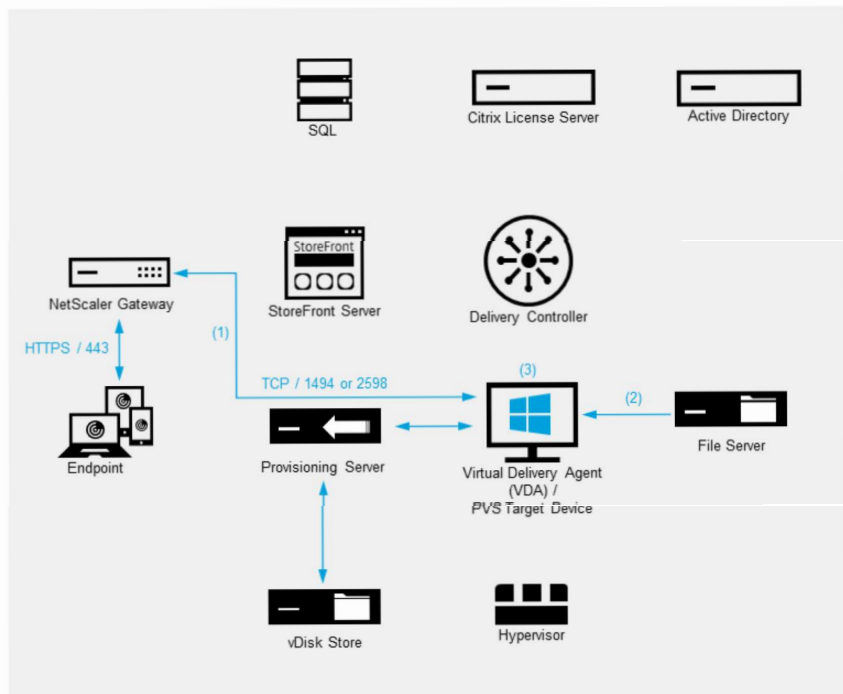
1. Receiver establishes connection with VDA.
2. VDA Notifies Delivery Controller about established HDX Session.
3. Delivery Controller queries Citrix License Server and checks out a valid license for the session.
4. Delivery Controller notifies VDA that licensing is qualified.
5. Receiver presents virtual app or desktop to the user.



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Connection Flow User Login

1. User logs on to VDA.
2. The Profile Management service on the VDA loads profile data from the User Store Path on a File Server.
3. The profile is cached locally on the target device, meaning that it ultimately resides on the *write cache*. Redirected folders can be accessed from the File Server as needed.



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Key Notes:

- At this point, the user is ready to begin working. As you can see, the majority of the logon process remains the same as if MCS or manual provisioning were used, the primary differences being how the VDA boots and runs, and how data is handled.



Lab Exercise

- Exercise 19-9: Launch a Published App and Desktop

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**Lesson
Objective
Review**

How much does PVS change the XenApp and XenDesktop Site?

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Lesson Objective Review

How much does PVS change the XenApp and XenDesktop Site?

None at all. PVS is just the imaging method. It's one of two leading practice methods: MCS & PVS.

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Key Takeaways



- Integrating XenApp/XenDesktop with Provisioning Services provides several benefits to the imaging and provisioning of VDAs.
- The XenDesktop Setup Wizard is recommended as a way to create PVS-provisioned VDAs.
- Device collections can be used in the way that best reflects the operational needs of the organization.
- Publishing apps and desktops is unchanged when integrating with Provisioning Services.
- The overall process for a user logging in and launching an app or a desktop is also unchanged.

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Provisioning Services 7.1x Administration

Advanced Architecture
Module 20



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Lab VM Power Management

The following VMs are required to be powered on before beginning the exercises in this module:

- NYC-ADS-001
- NYC-SQL-001
- NYC-FSR-001
- NYC-PVS-001
- NYC-PVS-002
- NYC-VNS-001

The remaining VMs need to be powered off.

Note: These VMs are listed in the start-up order.

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Learning Objectives

- Plan for Provisioning Services Farm component scalability.
- Implement Provisioning Services Store redundancy.
- Evaluate the Provisioning Services farm database redundancy methods.

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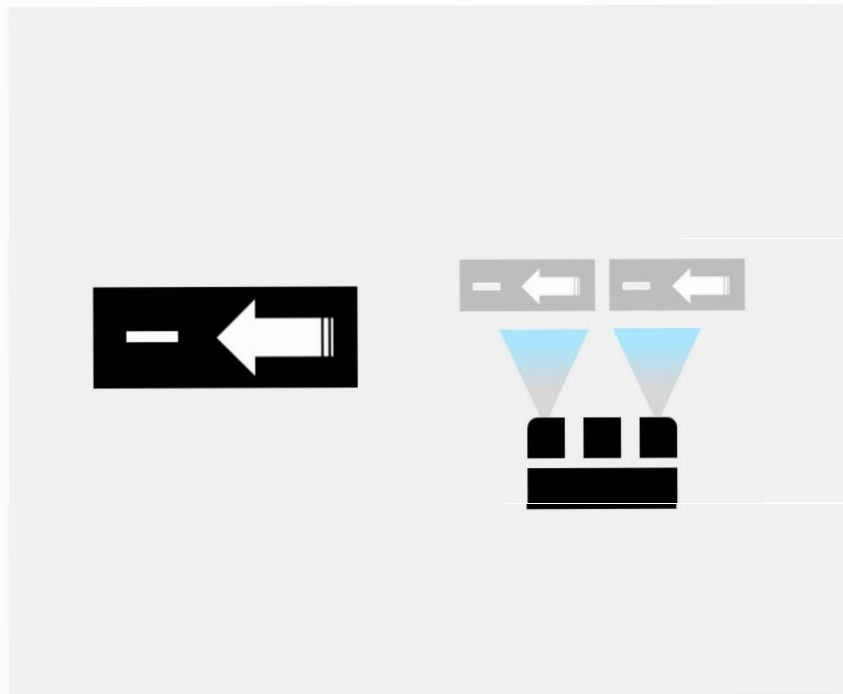
Farm Component Scalability

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Provisioning Servers Physical or Virtual?

- Generally, virtual Provisioning Servers are easier to manage and deploy.
- Take care to assure sufficient underlying hypervisor resources are available.



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Key Notes:

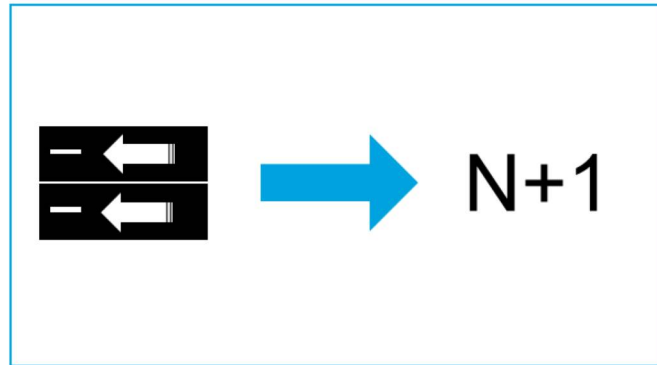
- In general, virtual Provisioning servers offer rapid server provisioning, snapshots for quick recovery or rollback scenarios and the ability to adjust server resources on the fly. Virtual provisioning servers allow target devices to be distributed across more servers helping to reduce the impact from server failure. Virtualization also makes more efficient use of system resources.
- Physical servers offer higher levels of scalability per server than virtual servers, and mitigate the risks associated with virtual machines competing for underlying hypervisor resources.
- Overall, virtual Provisioning servers are preferred when sufficient processor, memory, disk and networking resources can be made available and guaranteed to be available.

Additional Resources:

- Citrix Virtual Desktop Handbook (page 89 for reference specifications):
<https://support.citrix.com/article/CTX139331>

How many Provisioning Servers should be built?

- Deploy a minimum of two Provisioning Servers per Site to provide basic redundancy.
- Based on scalability, follow the N+1 principle for adding more servers.



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Key Notes:

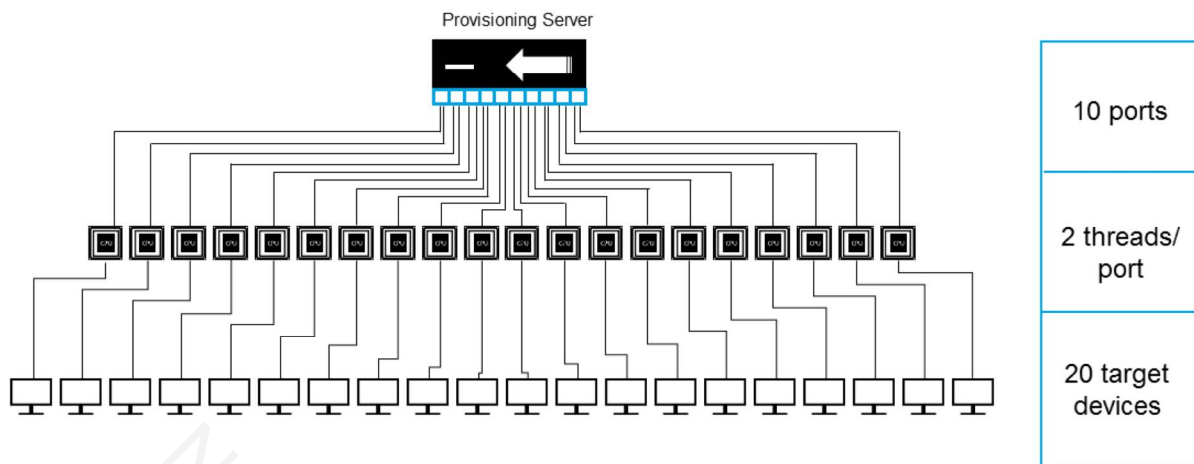
- A minimum of two provisioning servers should always be implemented per site. Sufficient redundancy should be incorporated into the design so that a single server failure does not reduce the total number of target devices that can be supported per site. In a highly available implementation, if the active Provisioning Server in a site fails, the target device can get its vDisk from another Provisioning Server that has access to the store and permissions to serve the vDisk.
- For high availability, ensure that virtual Provisioning Servers are distributed across multiple virtualization hosts. Distributing the virtual servers across multiple hosts will eliminate a single point of failure and not bring down the entire Provisioning Services farm in the event of a host failure.
- The Provisioning Services boot file should be configured for high availability. Up to four Provisioning Servers may be listed in the boot file. Target devices will try to contact the servers in the order that they are listed. The server that responds may not necessarily be the server that will provide streaming services to the target device.

Additional Resources:

- Virtual Desktop Handbook (page 90): <https://support.citrix.com/article/CTX139331>

PVS Ports and Threads

Calculate the number of target devices per Provisioning Server



Max Number of Streams = # of Ports * # of Threads per Port

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Key Notes:

- Provisioning Services is not CPU intensive. However, under-allocating the number of CPUs does impact the optimization of the network streams.
- By default the Streaming Service is configured with 20 sequential network ports, and 8 threads per port. Therefore, by default, a provisioning server can support 160 concurrent targets. If more than 160 streams are required, Provisioning Services continuously switches between streaming different target devices.

Additional Resources:

- Virtual Desktop Handbook (page 90): <https://support.citrix.com/article/CTX139331>

PVS Ports and Threads

Scale Up or Scale Out?

Small/Medium Environments

(Up to 500 target devices)



Allocate up to 4 vCPUs per Provisioning Server, then add more ports or scale out.

Large Environments

(Over 500 target devices)



Allocate up to 8 vCPUs per Provisioning Server, then add more ports or scale out.

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Key Notes:

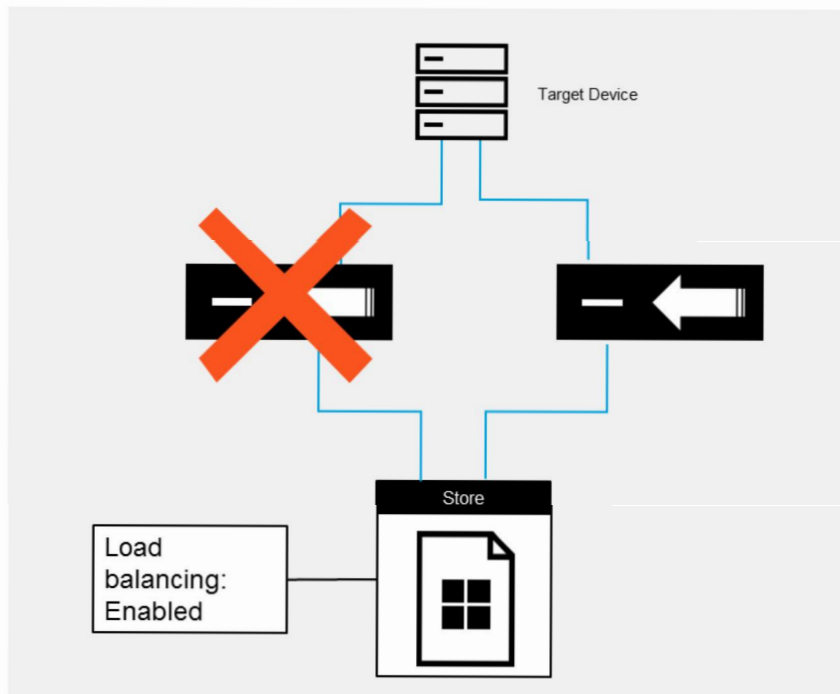
- Ideally, if the environment needs to support more than 160 concurrent targets, the number of ports, and threads per port can be adjusted in the Provisioning Services console. Best performance is attained when the threads per port is not greater than the number of cores available on the provisioning server. If the provisioning server does not have sufficient cores, the server will show a higher CPU utilization, and target devices waiting for requests to be processed will have a higher read latency.
- For example, allocating 2 vCPUs per Provisioning Server will require more contiguous ports to be made available. In general, for smaller environments of up to around 500 target devices, 4 vCPUs per Provisioning Server should suffice. For larger environments, 8 vCPUs are recommended. In general, increasing the number of ports results in better performance compared to increasing threads per port.
- Overall, scaling up Provisioning Servers past 8 vCPUs is not recommended. Scaling out will increase redundancy.

Additional Resources:

- Updated Guidance on PVS Ports and Threads: <https://www.citrix.com/blogs/2016/03/30/updated-guidance-on-pvs-ports-and-threads/>
- Virtual Desktop Handbook (page 91): <https://support.citrix.com/article/CTX139331>

Provisioning Services Failover

- If a Provisioning Server goes offline, all target devices streaming from that server will automatically reach out to another server in the Site if load balancing has been enabled in the vDisk properties.
- If a vDisk has been configured to be accessible from a single server, no failover will occur.



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Key Notes:

- Provisioning Services failover occurs when a Provisioning Server goes offline. All target devices that were streaming from that PVS Server must contact another PVS Server within the Site to continue streaming a vDisk. In older versions of Provisioning Services, this process could take minutes, depending on the number of devices that needed to fail over to another PVS Server. However, testing with PVS 7.x has proven that this is no longer the case, and thus failover is not a scalability consideration for Provisioning Servers.
- A “graceful failover” can be initiated by stopping the Stream Service on a Provisioning Server. This can be done during maintenance windows, for example when a periodic reboot of a Provisioning Server is required. Graceful failovers typically result in a seamless experience for any users accessing affected target devices.
- The failover time for individual target devices can be lessened even more via registry changes.

Additional Resources:

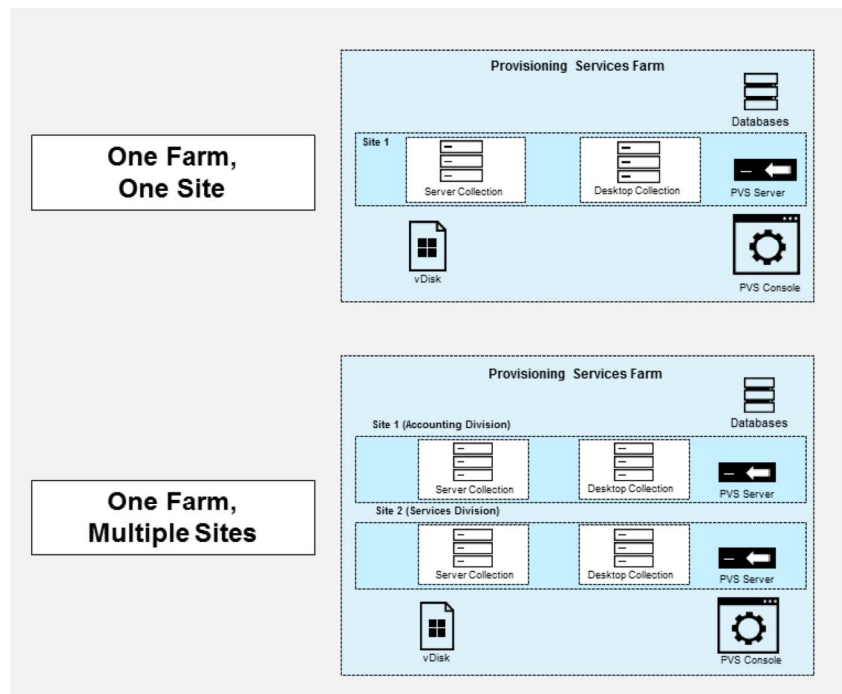
- Provisioning Server Failover: <https://docs.citrix.com/en-us/provisioning/7-13/managing-high-availability/ha-option-intro.html>
- Provisioning Services Failover: Myth Busted!: <https://www.citrix.com/blogs/2014/10/16/provisioning-services-failover-myth-busted/>
- Registry Settings to Improve High Availability Failover Times for Provisioning Services:

<https://support.citrix.com/article/CTX119223>

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How many Sites should I build?

- Target devices can only fail over to other provisioning servers within the same site.
- The primary reason to create additional Sites is to meet organizational requirements; otherwise, one Site per Farm works best.



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Key Notes:

- Although all sites within a farm share the same database, target devices can only fail over to other provisioning servers within the same site.
- A practical reason for building multiple sites is due to organizational changes. For example, two companies may have recently merged through acquisition, but need to keep resources separate while integration takes place. Configuring the organization to use separate sites is one way to keep the businesses separate but managed centrally through the Provisioning Services console. In this scenario, it makes sense to use the Delegated Administration feature to give appropriate access to each of the Sites. We will talk more about Delegated Administration in the next module.
- However, only create additional sites if the business requirements warrant it. A single site per farm is easier to manage and requires no additional configuration.

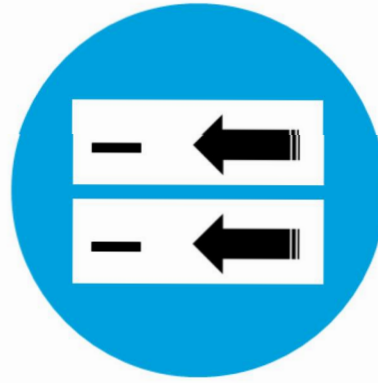
Additional Resources:

- Virtual Desktop Handbook (page 84-85):
<https://support.citrix.com/article/CTX139331>

At Minimum, One PVS Site, Two PVS Servers

To summarize:

- Start with one Site and two Provisioning Servers.
- Scale up and out as needed to support the required number of target devices (and organizations).



Site

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Lab Exercise

- Exercise 20-1: Join a Second PVS Server to the Farm

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Multiple Datacenter Considerations

Scenario 1

- Large enterprise with globally distributed datacenters.
- Multiple Provisioning Services Farms created, each managed by a separate regional team.



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Key Notes:

- Provisioning servers are constantly communicating with the farm database to retrieve system configuration settings. Therefore, separate farms should be created for each physical location where target devices reside, unless they are connected to the database server by a fast and robust connection.
- Organizations may need to maintain the separation of administrative duties at a departmental, regional or countrywide basis. Additional Provisioning Services farms will add some complexity to the management of the environment. However, this overhead is typically limited to initial configuration, desktop creation and image updates.

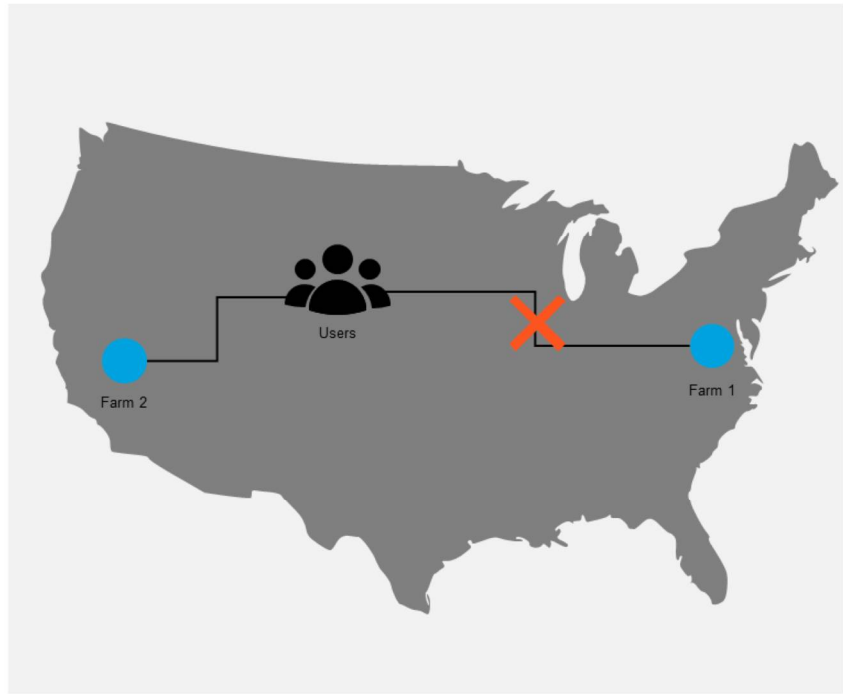
Additional Resources:

- Virtual Desktop Handbook (page 85): <https://support.citrix.com/article/CTX139331>

Multiple Datacenter Considerations

Scenario 2

- Medium-sized government contractor must meet stringent disaster recovery requirements.
- 2nd standby Provisioning Services Farm created in another datacenter to meet requirements.

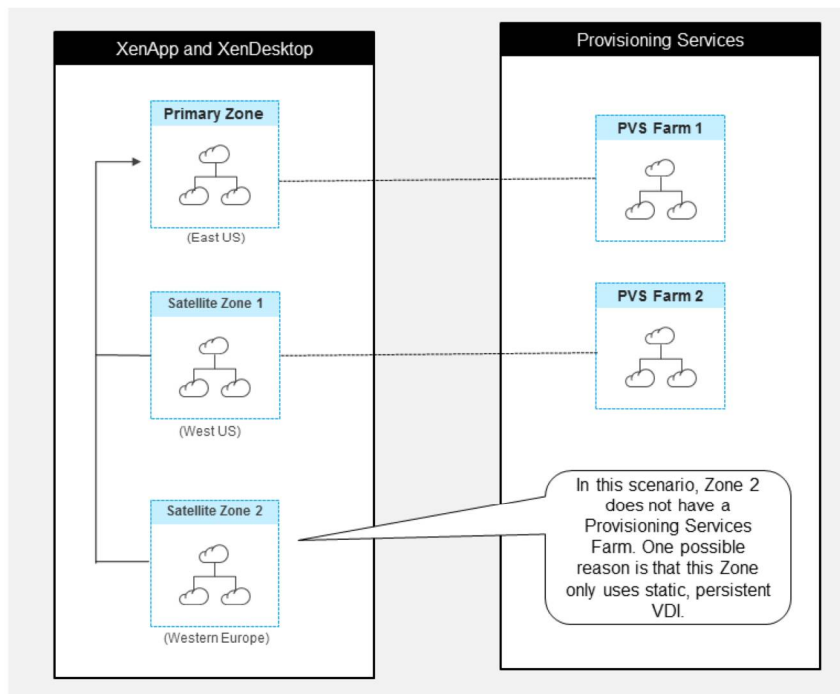


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Multiple Datacenter Considerations

Scenario 3

- In newer XenApp and XenDesktop environments, zones may be used to distribute the FMA Site among several physical locations.
- Separate Provisioning Services Farms may be created to serve each FMA zone separately.



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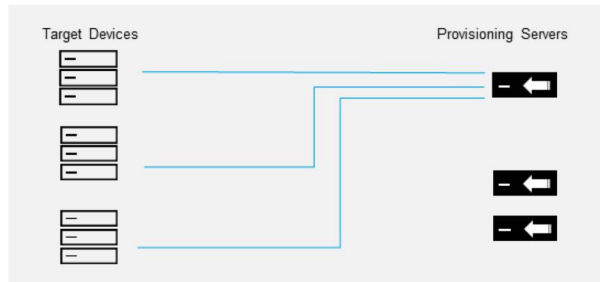
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Key Notes:

- Why wasn't a PVS Farm created in the Satellite Zone 3 location? Perhaps there was not a PVS-compatible use case there (such as persistent, dedicated virtual desktops) or that the team managing the zone decided to use an alternative provisioning method such as MCS.
- The distribution of Provisioning Services Farms should generally mirror that of XenApp and XenDesktop FMA Sites. However, an exception can be made if the zone feature is used, because the Provisioning Services infrastructure should be located physically close to any locations hosting target devices. There is no zone functionality in the case of Provisioning Services, so a new Farm (and Farm database) should be created in each physical location hosting a zone.

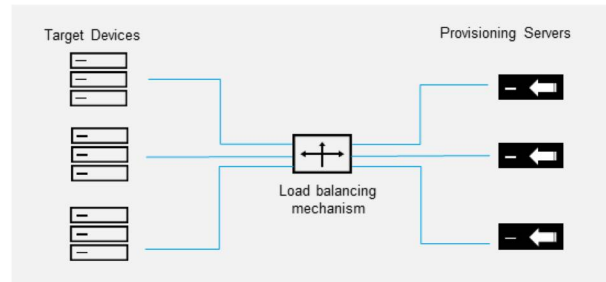
Why load balance TFTP?

Default Behavior



By default, when using the DHCP options boot method, all TFTP requests are sent to the server listed in Option 66.

With TFTP load balancing



Load balancing TFTP can ensure that bootstrap download requests are distributed among multiple Provisioning Servers, which increases the scalability of the Site.

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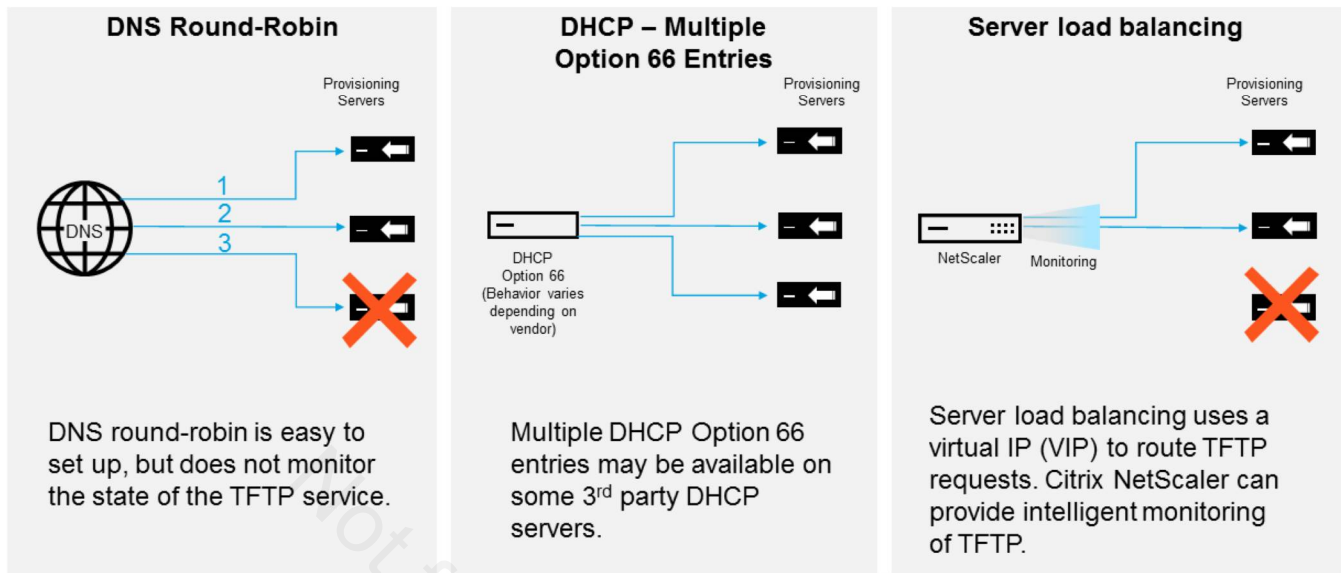
Key Notes:

- As we learned, Trivial File Transfer Protocol (TFTP) is a communications protocol used for transferring configuration or boot files between machines. Provisioning services can use TFTP to deliver the bootstrap file to target devices.
- This is only a consideration if the DHCP options boot method is used. The PXE, BDM and Bios-embedded bootstrap options do not require TFTP load balancing.
 - Although the PXE boot method also requires use of the TFTP service, each PXE service points to its own TFTP service, so TFTP requests are distributed based on which PXE-enabled PVS Server responds to each request.
 - For the BDM and bootstrap embedded options, the bootstrap file is already present on the target device; thus, TFTP is not used in these scenarios.
 - When using the DHCP options boot method, by default, all TFTP download requests are to a single Provisioning Server, which presents a single point of failure. Distributing TFTP requests among all available Provisioning Servers enhances the scalability of the environment.

Additional Resources:

- Load Balancing TFTP – Anything But Trivial:
<https://www.citrix.com/blogs/2011/05/02/load-balancing-tftp-anything-but-trivial/>

How to Load Balance TFTP



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Key Notes:

- There are several options available to make the TFTP service highly available when using DHCP options. Some of the more commonly used methods are:
 - DNS Round Robin – A DNS entry is created for the TFTP service with multiple A records corresponding to the TFTP services running on the provisioning servers in the farm. This method is not recommended since the state of the TFTP service is not monitored. Clients could potentially be sent to a non-functioning server.
 - Multiple DHCP Option 66 entries – This method is easy to implement but requires a DHCP service that supports entering multiple entries in option 66. Microsoft DHCP server allows one option 66 entry so this method would not be feasible in environments with Microsoft DHCP services. If using a non-Microsoft DHCP server or appliance, check with the manufacturer to verify that multiple option 66 entries is supported.
 - Hardware load balancer – Use a hardware load balancer, such as Citrix NetScaler, to create virtual IPs that correspond to the provisioning servers. The NetScaler can intelligently route traffic between the Provisioning Servers. In the event that one of the servers becomes unavailable, NetScaler will automatically stop routing TFTP requests to that server. This is the best method for making TFTP highly available, but can be relatively complicated to setup.
 - Starting with NetScaler 10.1, TFTP support was added to the server load balancing functionality. Load balancing the TFTP service in this way is beneficial because each individual service is configured for availability, and

requests can be intelligently sent only to responsive TFTP servers. Additionally, Provisioning Servers can be added and removed from the load balancing configuration on the NetScaler without affecting the bootstrap configuration. See the Citrix Blog in Additional Resources for detailed implementation guidance.

Additional Resources:

- A Solid Option for the PVS Boot Method: TFTP Load Balancing using NetScaler 10.1: <https://www.citrix.com/blogs/2014/04/01/a-solid-option-for-the-pvs-boot-method-tftp-load-balancing-using-netscaler-10-1/>
- Virtual Desktop Handbook (page 86): <https://support.citrix.com/article/CTX139331>

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Lesson Objective Review

Scenario: You are asked to provide basic sizing for a Provisioning Services environment. The company has two data centers, one in New York, and one in Tokyo. Each data center is managed by a different team. The environment is expected to support 800 target devices, spread evenly between both datacenters. How many PVS Farms, Sites, and Servers should be created, and where should they be located?

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Lesson Objective Review

Scenario: You are asked to provide basic sizing for a Provisioning Services environment. The company has two data centers, one in New York, and one in Tokyo. Each data center is managed by a different team. The environment is expected to support 800 target devices, spread evenly between both datacenters. How many PVS Farms, Sites, and Servers should be created, and where should they be located?

There should be two Provisioning Services Farms, one in New York and one in Tokyo. Each Farm should have a single Site, and two Provisioning Servers.

Key Notes:

- Separate farms were created for each datacenter so that PVS Servers could access a Farm database located in the same datacenter.
- There is only one Site per Farm because there are no listed reasons to create additional Sites.
- Although one Provisioning Server could stream to 400 target devices, we should always provide N+1 capacity.



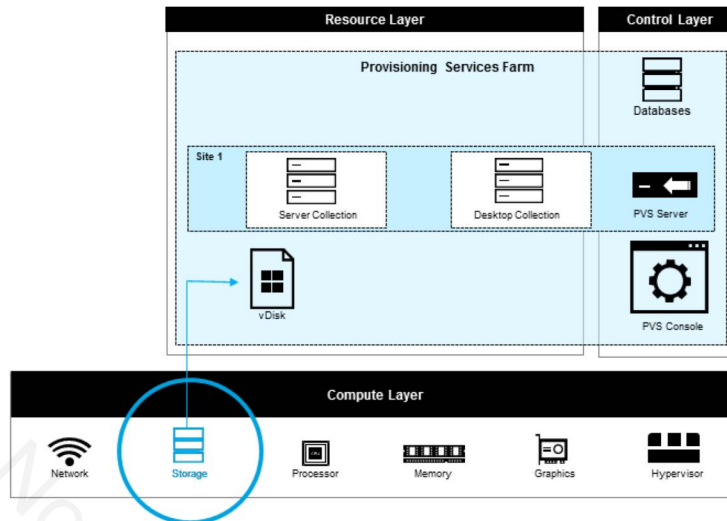
Store Redundancy

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Leading Practice Recommendations

PVS vDisk Store



Citrix recommends some form of redundancy for the Store component.

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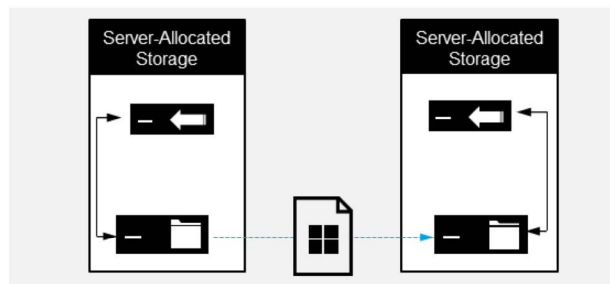
CITRIX

Key Notes:

- Overall, Citrix strongly recommends some form of Store redundancy for a Provisioning Services environment in order to eliminate this as a single point of failure. As the storage location of all the vDisks streamed in the environment, without redundancy, the loss of the Store could result in inaccessible VDAs!

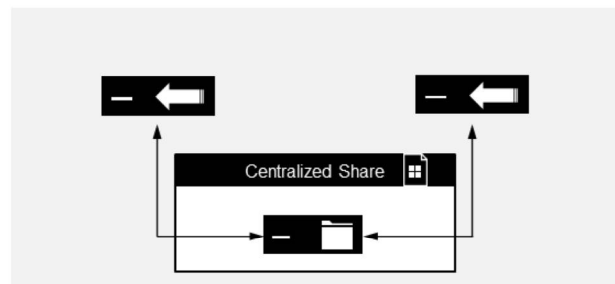
Methods of Redundancy

Decentralized Stores (Locally Attached Storage or SAN)



Each Provisioning Server has its own Store.
vDisks must be replicated among all the Stores.

Centralized Store (SMB Share)



Central location which can be accessed by multiple Provisioning Servers.

No vDisk replication necessary, but must tune share for best performance and ensure HA is in place.

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Key Notes:

- The form of redundancy used for a Store will depend on the type of storage that is used. For vDisk stores hosted on local, Direct Attached Storage (DAS) or Storage Area Network (SAN), replication should be used to synchronize the vDisks. This includes creating one or more local Stores on multiple Provisioning servers, then using robocopy or another method to duplicate the vDisk files from one Store to all the others.
- In general, it is discouraged to use the manual copy function to move vDisk files, because a network interruption during a file transfer could cause the files to become corrupted. Additionally, differences in file time stamps can cause issues with replication and importing/exporting vDisks. By contrast, robocopy can tolerate network disruptions and continue copying, and preserves vDisk time stamps. Many organizations use robocopy scripts to help automate the vDisk replication process. DFS-R is another method that can automate the replication to a great extent, simplifying operations.
- Keep in mind that even though each Provisioning Server has its own Store location, within the PVS Console it is still logically treated as a single Store.
- If using Network Attached Storage (NAS), ensure that the vDisks are hosted on a highly available network share. If using a CIFS share, be sure to optimize the share to maximize your storage's performance. If necessary, copies of vDisks can be maintained on a secondary shared-storage location in the event that connection to the primary shared-storage location is lost. In this case, the default path can be set in the store properties if all Provisioning Servers can use the same path to access the store. If a particular server cannot use the path (the default path is not valid for that server, not because of a connection loss, but because it is simply not valid) then an override path can be set in the store properties for that particular server. Provisioning Servers will always use either the

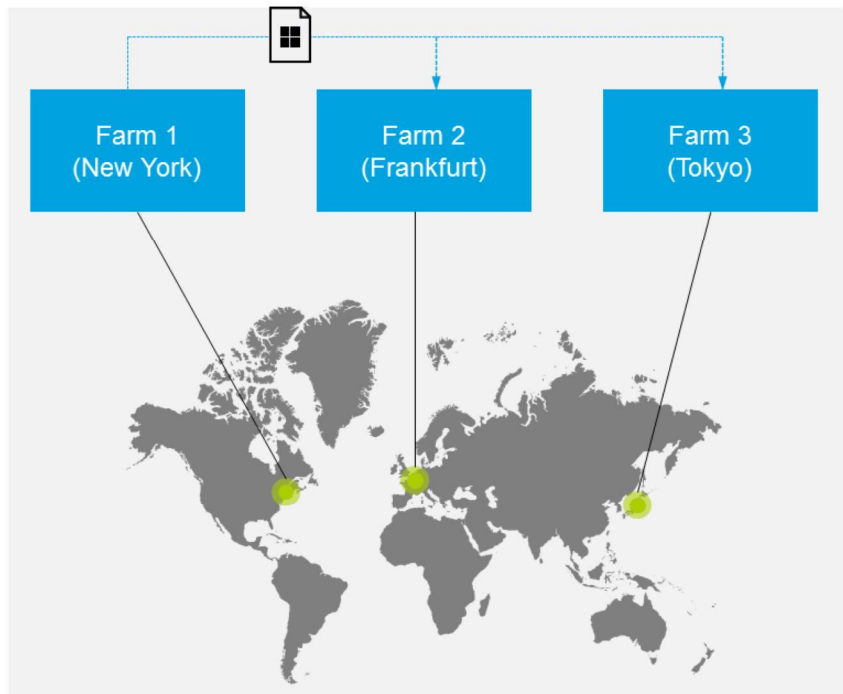
default path (if the override path does not exist in the database) or the override path if it does exist in the database.

Additional Resources:

- Virtual Desktop Handbook (page 86):
<https://support.citrix.com/article/CTX139331>
- PVS Internals #3 – Designing vDisk stores:
<https://www.citrix.com/blogs/2016/11/10/pvs-internals-3-designing-vdisk-stores/>
- Using Microsoft's DFS replication with Provisioning Services HA:
<https://www.citrix.com/blogs/2010/06/25/using-microsofts-dfs-replication-with-provisioning-services-ha/>
- Provisioning Services and CIFS Stores – Tuning For Performance:
<https://www.citrix.com/blogs/2010/11/05/provisioning-services-and-cifs-stores-tuning-for-performance/>
- Robocopy (for vDisk replication between Stores) -
[https://technet.microsoft.com/en-us/library/cc733145\(WS.10\).aspx](https://technet.microsoft.com/en-us/library/cc733145(WS.10).aspx)

Migrate vDisks Between Stores Use Cases

- Share vDisks between farms managed by different teams, in order to have consistent images.



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Key Notes:

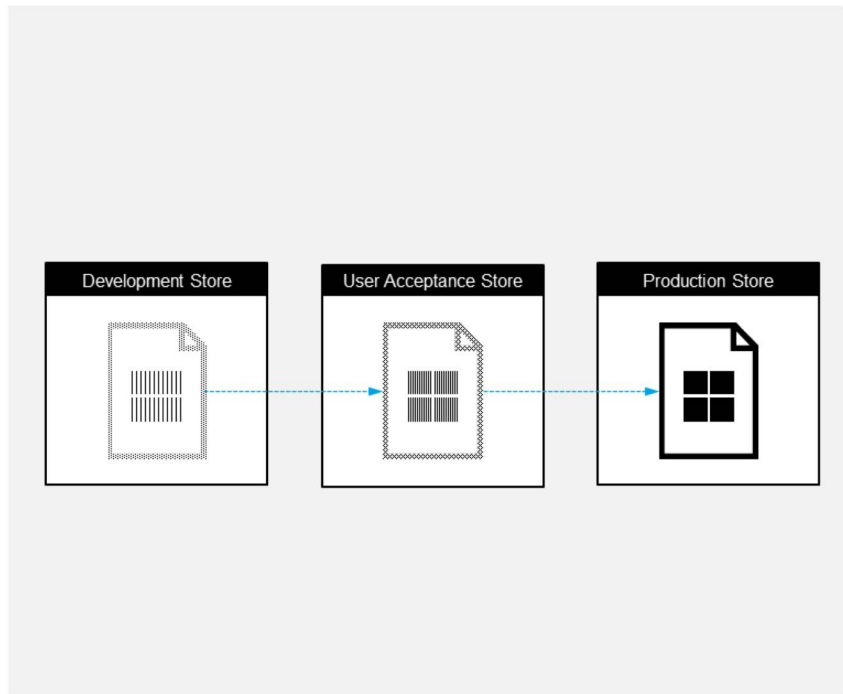
- Provisioning Services allows for the exporting and importing of both versioned and unversioned vDisks, from an existing store to a store in a different farm.

Additional Resources:

- Exporting and importing vDisks: <http://docs.citrix.com/en-us/provisioning/7-13/managing-vdisks/vdisks-versioning-import-export.html>

Migrate vDisks Between Stores Use Cases

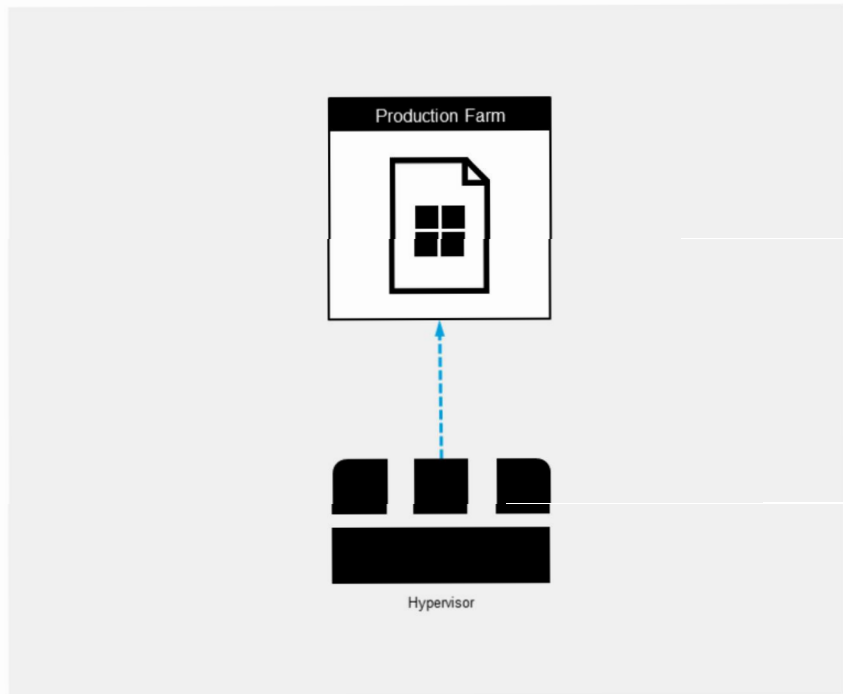
- Perform vDisk updates in a development farm.
- Next, import them into production.



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Migrate vDisks Between Stores Use Cases

- Add a .vhd(x) file created outside of Provisioning Services to a PVS Farm.

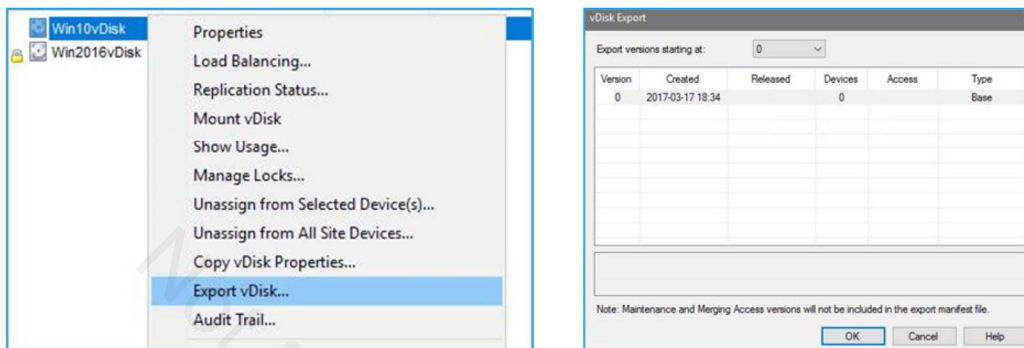


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Migrate vDisks Between Stores

Process to Export a vDisk

- Export a vDisk from the Export menu option when right-clicking a vDisk in the PVS Console.
- You can choose to export a base vDisk or an individual differencing disk or disks.
- After finishing the wizard, a manifest (XML) file is generated.



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Key Notes:

- When deleting a vDisk that will be exported, be sure to export the vDisk first, then copy the resulting XML file to the new location before deleting it from the original location.

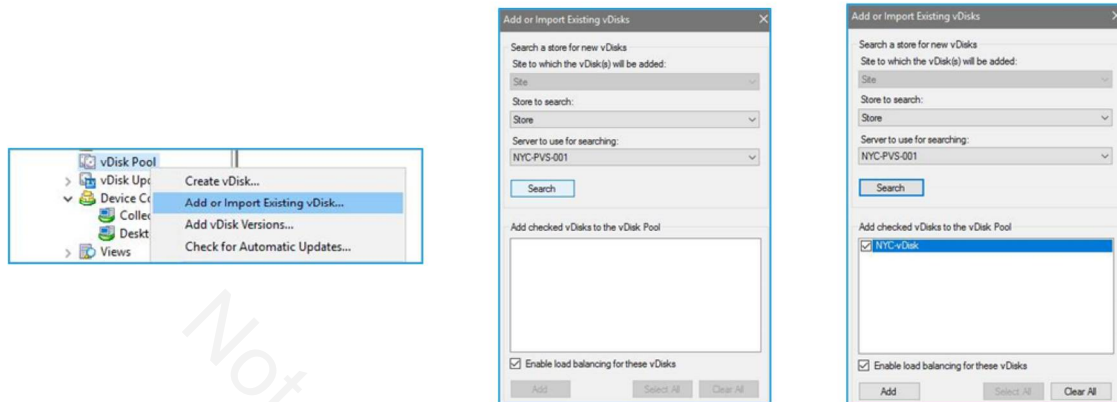
Additional Resources:

- Exporting and importing vDisks: <http://docs.citrix.com/en-us/provisioning/7-13/managing-vdisks/vdisks-versioning-import-export.html>

Migrate vDisks Between Stores

Process to Import vDisk

- To import an existing vDisk to a Site, move the .vhd(x) and manifest (XML) files must be moved into a Store which is accessible from that Site.
- Next, use the “Add or Import Existing vDisk...” menu option from the Store node.



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Key Notes:

- A vDisk or vDisk chain of differencing VHDX files can be imported into a store if:
 - The VHDX being imported does not already exist in the store and both the highest version number of the VHDX and associated manifest files match, and if the VHDX chain includes a base image, and that base image version number matches the base image version in the manifest file.
 - The VHDX does exist in the store but the imported version number in the associated manifest file is greater than the existing VHDX version number.
- The .pvp, or sidecar, file associated with a vDisk can also be moved into a new Store. If it is not moved, a generic .pvp file will be generated during the import process, but some vDisk properties will be lost and must be reconfigured.
- If importing VHDXs that were not exported using Provisioning Services, all differencing disks must first be merged to a base disk using third party tools, then the new VHDX base disk can be imported.

Additional Resources:

- Exporting and importing vDisks: <http://docs.citrix.com/en-us/provisioning/7-13/managing-vdisks/vdisks-versioning-import-export.html>



Lab Exercise

- Exercise 20-2: Reconfigure the Store For Redundancy
- Exercise 20-3: Verify vDisk Replication
- Exercise 20-4: Copy vDisk From One Store to Another
- Exercise 20-5: Import a Pre-Existing vDisk and Create a New .pvp File
- Exercise 20-6: Configure TFTP Load Balancing Using NetScaler

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Lesson Objective Review

Scenario: After a disaster recovery audit, your manager tells you that the Provisioning Services farm was flagged for having no vDisk Store redundancy. Currently, all vDisks are stored locally on one of the Provisioning Servers. What options are available accomplish this?

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Lesson Objective Review

Scenario: After a disaster recovery audit, your manager tells you that the Provisioning Services farm was flagged for having no vDisk Store redundancy. Currently, all vDisks are stored locally on one of the Provisioning Servers. What options are available to accomplish this?

A second Provisioning Server could be configured to have its own local Store, and vDisks could be replicated between locations using robocopy or DFS-R.

Alternatively, if available, a NFS or CIFS share could be set up to serve as a central repository for the vDisks. In this scenario, the share would need to be configured for high availability.

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Farm Database Redundancy

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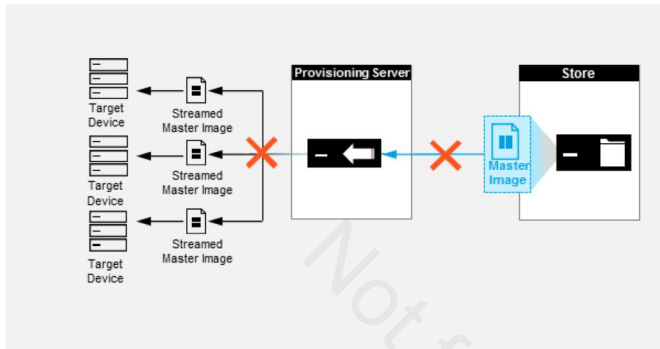
Importance of Farm Database Redundancy

Impact of Farm database outage

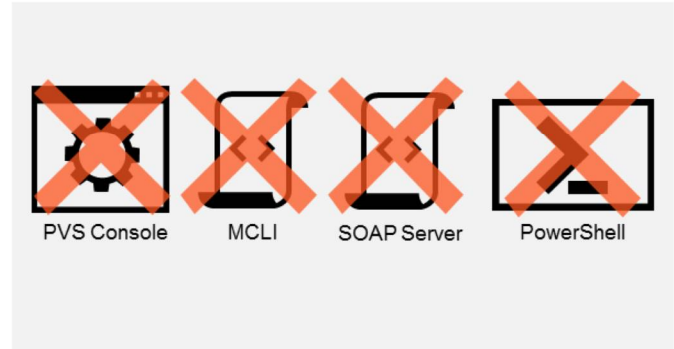
If the Provisioning Services Farm database goes down...



Target devices cannot boot or failover to another Provisioning Server



All management functions become unavailable



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Key Notes:

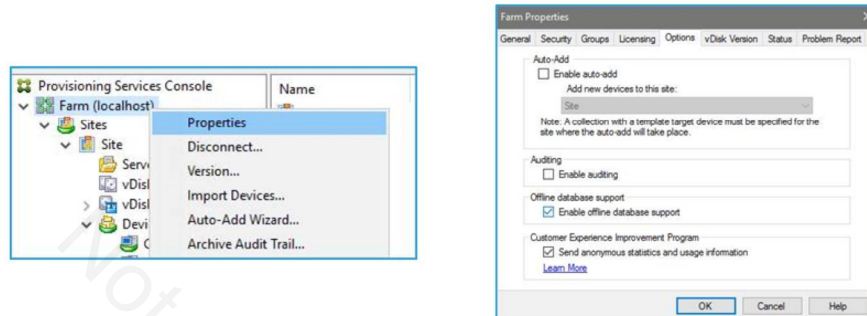
- In a database outage, actively streaming target devices are not affected, as long as other Farm components are still responding normally. However, if it is rebooted or powered off, it will not be able to boot again until database connectivity is restored.

Additional Resources:

- Virtual Desktop Handbook (Page 77): <https://support.citrix.com/article/CTX139331>

Offline Database Support

- Offline Database Support can preserve some of the Farm functionality during a database outage by creating local copies of the database on each of the Provisioning Servers.
- The Stream Process uses this copy to retrieve information about the Provisioning Server and target devices supported by the server, allowing both components to remain operational.



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Key Notes:

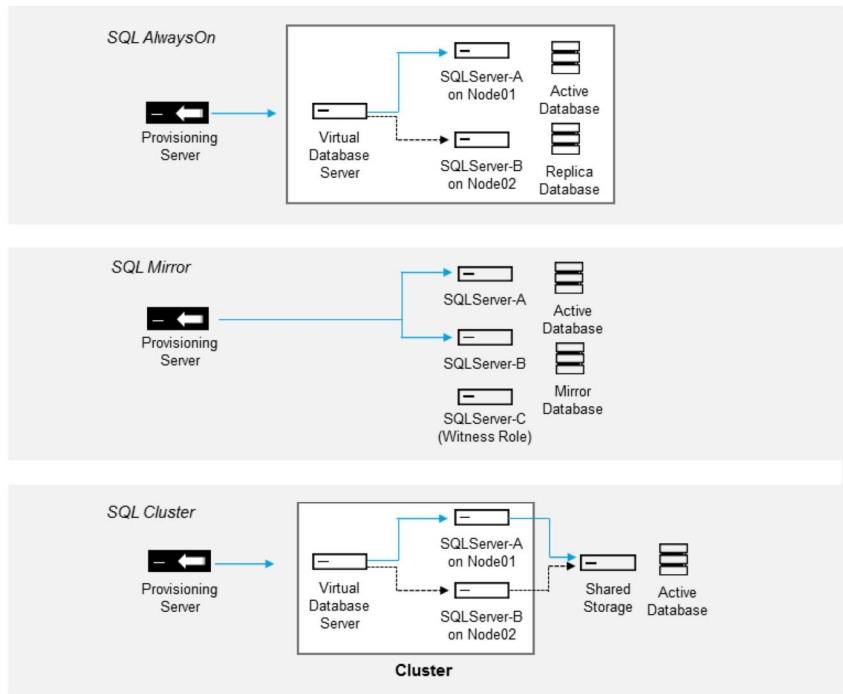
- While Citrix recommends enabling Offline Database Support for production environments to preserve core functionality (i.e. booting and streaming to target devices) in the event of a farm database outage, the following management functions will still become unavailable:
 - AutoAdd target devices
 - vDisk creation and updates
 - Active Directory password changes
 - Stream process startup
 - Image update service
 - PowerShell and MCLI based management

Additional Resources:

- Offline Database Support: <http://docs.citrix.com/en-us/provisioning/7-13/managing-high-availability/ha-offline-db-config.html>
- Virtual Desktop Handbook (Page 77): <https://support.citrix.com/article/CTX139331>

Farm Database Server Redundancy Options

- The supported database system for Provisioning Services is Microsoft SQL Server which offers several redundancy options by design:
 - SQL AlwaysOn
 - SQL Mirror
 - SQL Cluster



Key Notes:

- This slide is to show all 3 database redundancy side by side, the next three slides will go into detail about each solution.

Additional Resources:

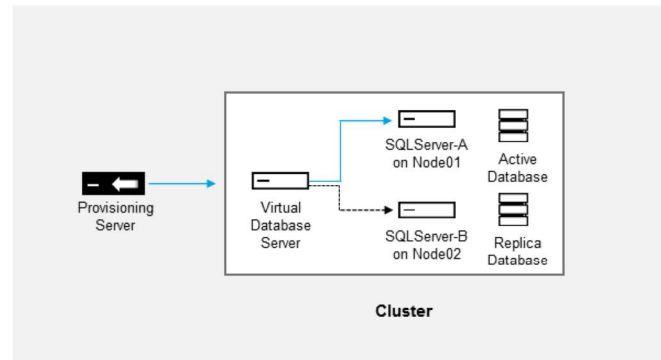
- Supported Databases for XenApp and XenDesktop Components (includes PVS): <http://support.citrix.com/article/CTX114501>

SQL AlwaysOn

Microsoft SQL AlwaysOn is a method of keeping databases in sync across different locations and providing failover capabilities.

This method:

- Relies on Microsoft Failover Clustering components.
- Does not require shared storage (SAN).
- Allows for some performance improvement.
- Uses up to four replica servers (SQL2012).



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Key Notes:

- Replica servers have been called mirror servers – some administrators might be more familiar with this term.
- The replica servers can be used to speed up read access to the database, while all write actions have to be performed on the

Additional Resources:

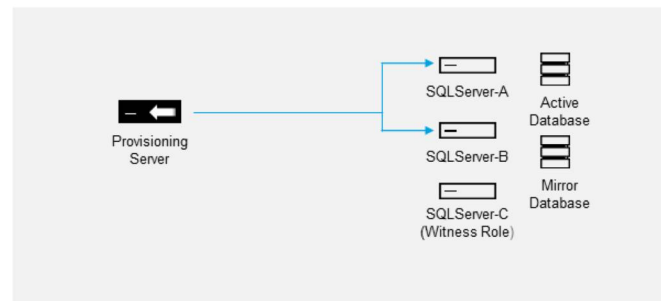
- Always On Availability Groups (SQL Server): <https://msdn.microsoft.com/en-us/library/hh510230.aspx>

SQL Mirror

Microsoft SQL Mirror keeps a database in sync across two servers. Only one server is used for connecting, but the other can assume its role after failure.

This method:

- Requires a Witness server for parity.
- Only uses one mirror to a principal server.
- Does not require shared storage (SAN).



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Key Notes:

- The Witness server can be a different SQL Server edition than the principal and mirror server.
- SQL Server 2016 and the next version still officially support this feature, but since Microsoft deemed the technology deprecated, it will most likely be removed in a future SQL Server version.

Additional Resources:

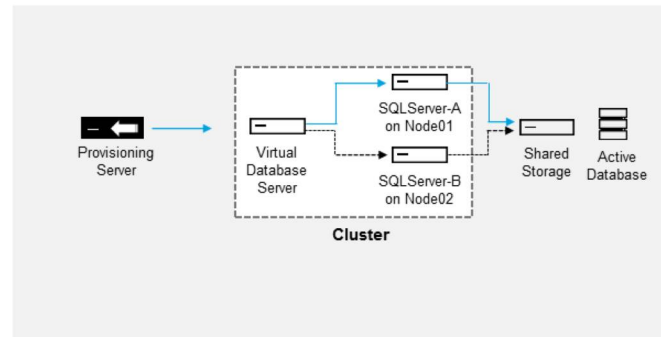
- Features in SQL Server 2016: <https://msdn.microsoft.com/en-us/library/ms143729.aspx> - Deprecated Database Engine

SQL Cluster

A Microsoft Failover Cluster stores the database on a shared storage system which is accessed by a single, active node from the cluster.

This method:

- Requires shared storage (SAN).
- Can cause downtime during failover.



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Key Notes:

- The shared storage architecture requires management and redundancy as well – which might make this solution more costly than others.



Lesson Objective Review

Scenario: You are managing a Provisioning Services Farm, and have enabled Offline Database Support. The standalone SQL server hosting the Farm database goes offline. You had a change window scheduled to install critical OS patches to a new version of one of the production vDisks.

In this scenario, will you be able to perform the update?

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Lesson Objective Review

Scenario: You are managing a Provisioning Services Farm, and have enabled Offline Database Support. The standalone SQL server hosting the Farm database goes offline. You had a change window scheduled to install critical OS patches to one of the production vDisks.

In this scenario, will you be able to perform the update?

No. Unfortunately, without the Farm database, no vDisk versioning updates can be performed. To maintain full Farm functionality when the Farm database goes offline, implement a SQL HA configuration such as Mirroring, Clustering, or AlwaysOn Availability Groups.

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Key Takeaways



- Not accounting for single points of failure can cost downtime and create a negative user experience.
- In general, a separate Provisioning Services farm should be created for each physical datacenter location so that all Provisioning Servers can have a high-quality connection with the farm database.
- All components in a Provisioning Services solution supports HA either through Microsoft technologies, storage technologies, or through the use of NetScaler.

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Provisioning Services 7.1x Administration

Supporting Provisioning Services
Module 21



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Lab VM Power Management

The following VMs are required for this module; all others may be powered down.

- NYC-ADS-001
- NYC-SQL-001
- NYC-FSR-001
- NYC-PVS-001
- NYC-WRK-001

Note: These VMs are listed in the start-up order.

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Learning Objectives

- Present how to update a Provisioning Services vDisk.
- Identify how to Delegate Administration in the Provisioning Services Console.
- Explore the benefits of the Auditing feature.
- Examine alternate vDisk update methods.

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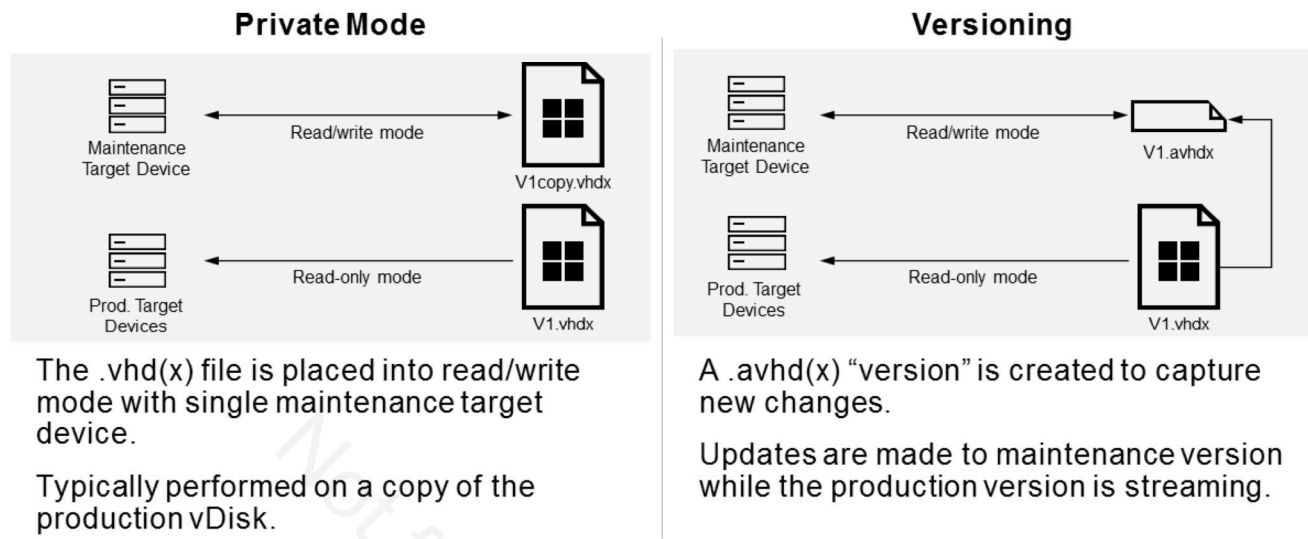


vDisk Updates

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vDisk Updates - Introduction



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Key Notes:

- It is often necessary to update an existing vDisk so that the image contains the most current software and patches. Updating the vDisk can be accomplished in one of the following ways:
 - A vDisk can be put into private mode in order to make updates to it. In production, typically a copy of the production vDisk is made, and the copy is placed into private mode. Then, the new vDisk is eventually placed into standard mode, and the target devices are rebooted to use the new vDisk during a change window.
 - Alternatively, the versioning feature can be used to create a maintenance version of the vDisk. This version can be booted to a single maintenance machine while the production target devices are concurrently running on the production version. When changes are complete, the version is "promoted" to production, and the target devices attached to the vDisk are rebooted to automatically begin using the new version.
 - Versioning can also be used in conjunction with the vDisk copy method. In this process, a full copy of the vDisk can still be made, but versioning is used to deploy updates to the new vDisk. When all updates are complete, the vDisk versions are merged into a single .vhd or .vhdx file, and the production target devices are booted to this new vDisk. This method is recommended by Citrix Consulting, since it combines the benefits of both vDisk copies and versioning.

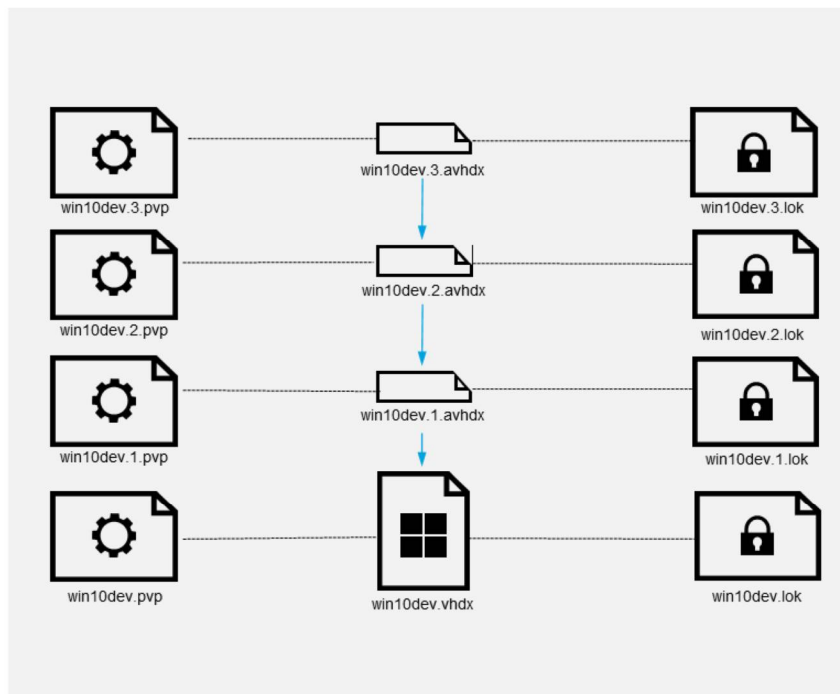
Additional Resources:

- Configuring the vDisk access mode: <http://docs.citrix.com/en-us/provisioning/7-13/managing-vdisks/vdisks-modes-configure.html>
- Updating vDisks: <http://docs.citrix.com/en-us/provisioning/7-13/managing-vdisks/vdisks-update.html>

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Updating the vDisk using Versions

- Each .avd(x) file captures new changes, and has its own .pvp and .lok files.
- Target devices streaming from a vDisk version require access to that version and all earlier versions of the .vhd(x) chain, including the base vDisk.



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Key Notes:

- Versioning simplifies vDisk update and management tasks, providing a more flexible and robust approach to managing vDisks.
- A vDisk consists of a VHDX base image file, any associated side-car files, and if applicable, a chain of referenced VHDX differencing disks. Differencing disks are created to capture the changes made to the base disk image, leaving the original base disk unchanged. Each differencing disk that is associated with a base disk represents a different version. Target devices booting from a vDisk version will request information from that version as well as earlier versions in the vDisk chain and the base vDisk.
- Each time a vDisk is put into Maintenance Mode a new version of the VHDX differencing disk is created and the file name is numerically incremented. It is important to remember that all versions of the vDisk must be kept together in the Store – a missing or corrupted .avd(x) file will cause errors for all target devices attempting to stream that version or any subsequent versions.

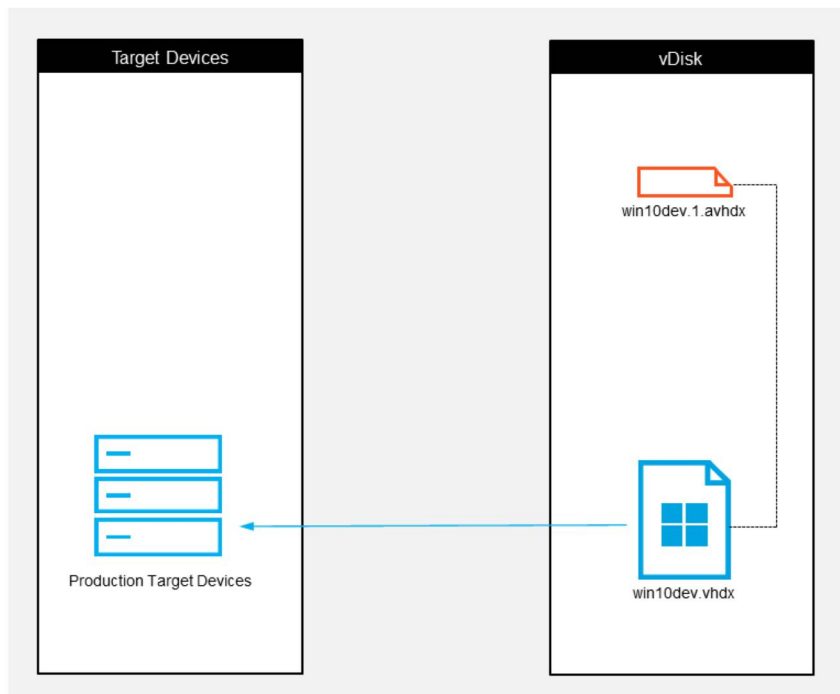
Additional Resources:

- VHDX chain of differencing disk: <http://docs.citrix.com/en-us/provisioning/7-13/managing-vdisks/vdisks-update/vdisks-vhd-chain-overview.html>

Update the vDisk Process

Create a new version

- In the Provisioning Services console, a new version is created for a specific vDisk.
- To make updates, this new vDisk version should be in maintenance mode.



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Key Notes:

- Maintenance mode puts the vDisk version into a read-write state that can only be streamed to a single target device, similar to Private Mode. However, the key difference here is that the base vDisk (or an earlier version of the vDisk) can concurrently be streamed to production devices.
- Some organizations choose to go through this update process on a copy of the production vDisk. Although there is no technical limitation to streaming a production version and a maintenance version of the same vDisk at the same time, some may not feel comfortable working with production vDisks in this way. Additionally, care must be taken with the vDisk base file and version files, since corruption to any of the files in the chain could impact the entire chain.

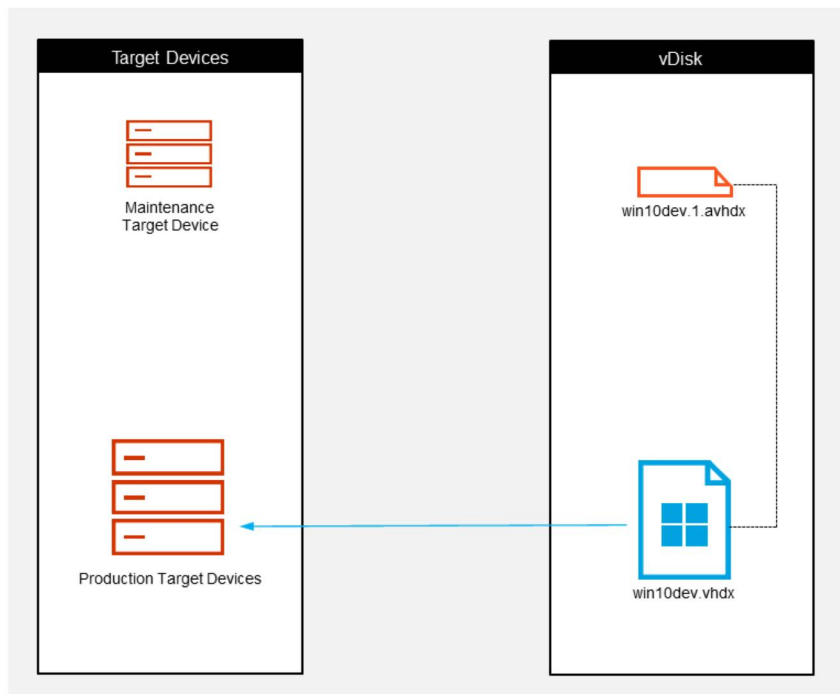
Additional Resources:

- Manually updating a vDisk: <https://docs.citrix.com/en-us/provisioning/7-13/managing-vdisks/vdisks-update/vdisks-updates-manual.html>

Update the vDisk Process

Boot a maintenance target device to new version

- A maintenance target device is set to boot from the new vDisk version.
- At boot, the maintenance version must be selected from a menu.

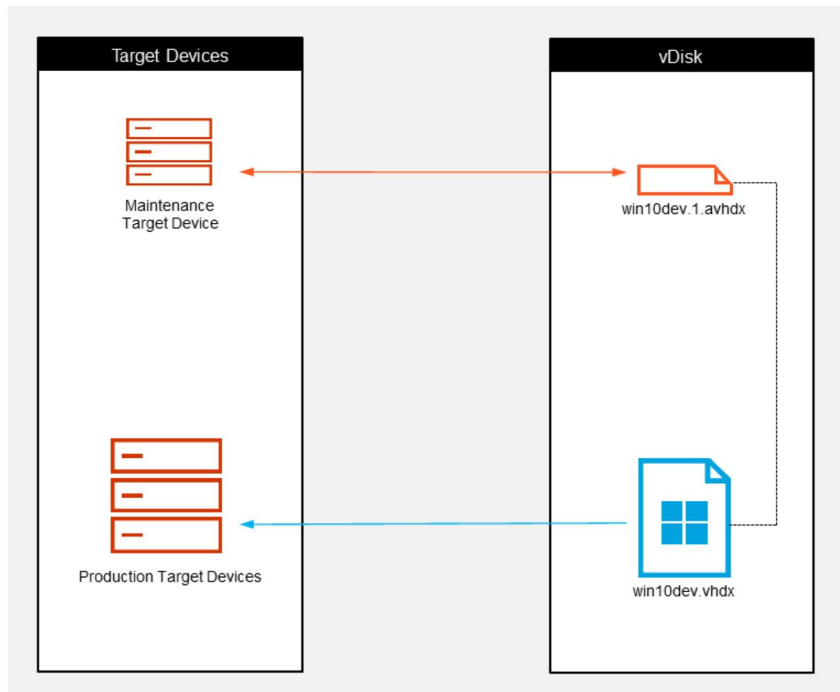


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Update the vDisk Process

Make updates to maintenance version

- While booted to the maintenance vDisk version, any necessary installations or updates can be performed using the maintenance target device.



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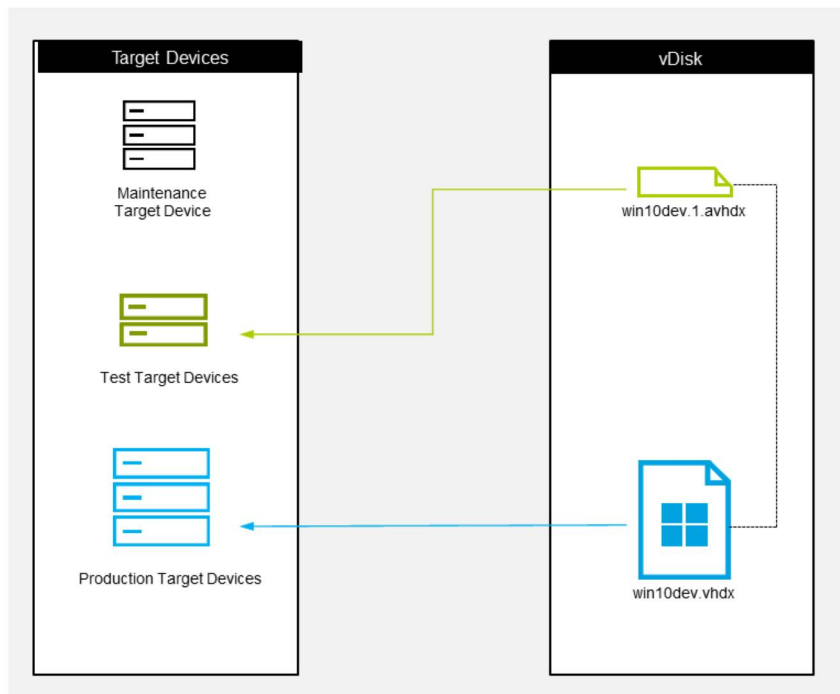
Key Notes:

- Most updates to a vDisk can be applied this way, including upgrades to the PVS Target Device software (starting in PVS 7.6.1 and above). The remaining exception is updates to hypervisor tools or other network-level drivers, which will be covered later in the lesson.

Update the vDisk Process

Test updates

- Once updates have been applied and tested, the maintenance target device should be powered off.
- The vDisk version is promoted to Test, which allows multiple target devices to boot from the new version in read-only mode, but will still not be used by production target devices.



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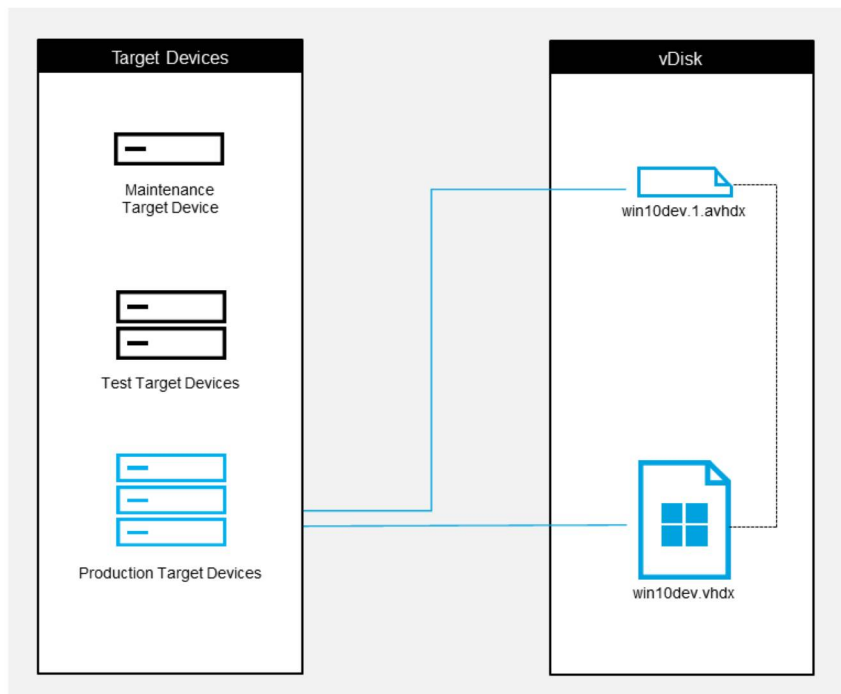
Key Notes:

- The “Test” category is useful for ensuring that updates will work as intended in Standard mode without actually promoting the version to production.
- Remember to power off the maintenance target device before promoting the vDisk version to Test. Otherwise, the promotion will fail because the vDisk is still locked to the maintenance device.

Update the vDisk Process

Promote vDisk version to production

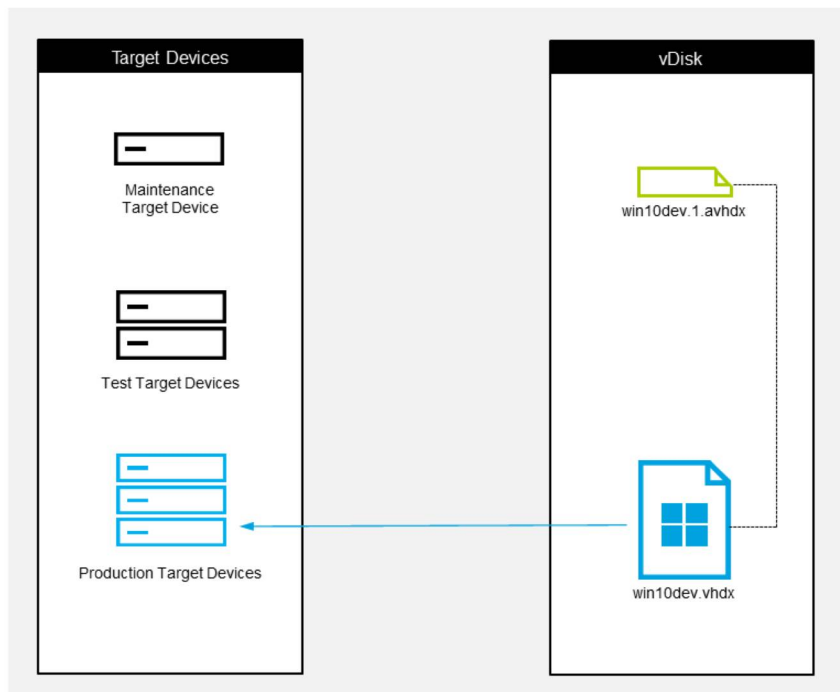
- After the Test target devices are used to perform a shakeout of the updates, the vDisk version is ready to be promoted to Production.
- During a scheduled change window, the version is promoted via the PVS Console, and the production Target Devices are rebooted to use the new version.



Update the vDisk Process

Roll back an update

- To roll back the update, in the PVS Console, the version is reverted to Test or Maintenance, which will designate the previous version as the Production version.
- The production target devices are rebooted to use the earlier vDisk version.



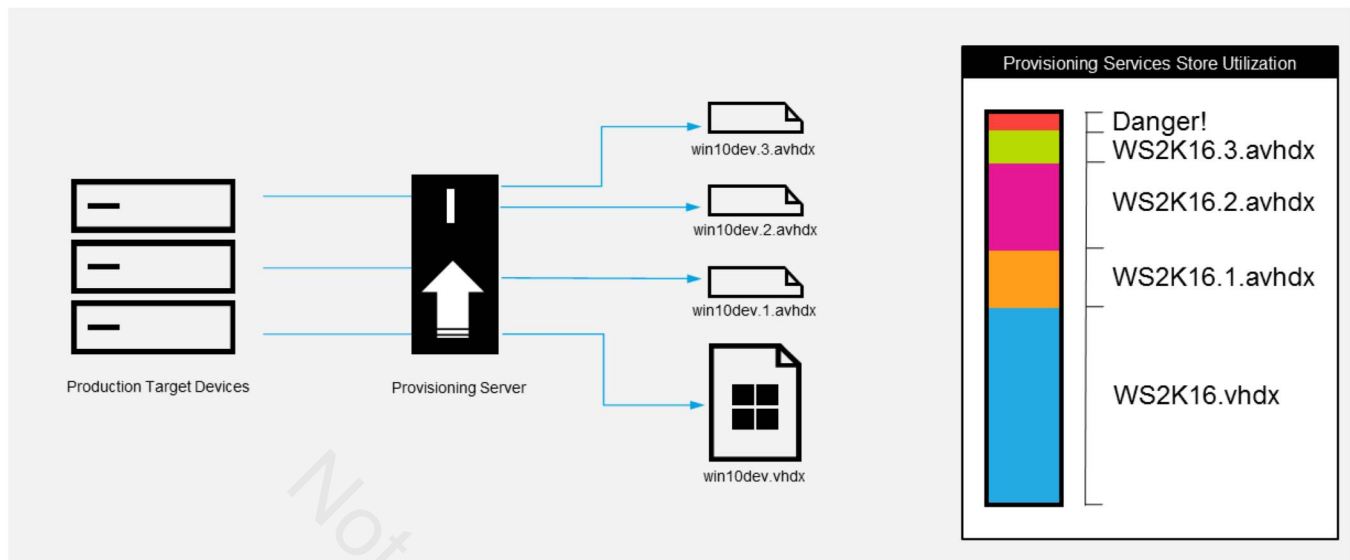
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Key Notes:

- The ease of rolling back updates, if needed, is a key benefit of Provisioning Services, and one that compares favorably with Machine Creation Services. It enables administrators to break down large updates into stages, if desired, and to roll back to the previous version if any update causes issues without restarting from scratch. This technique can also be useful during initial image development.

Version Impact to Storage and Performance



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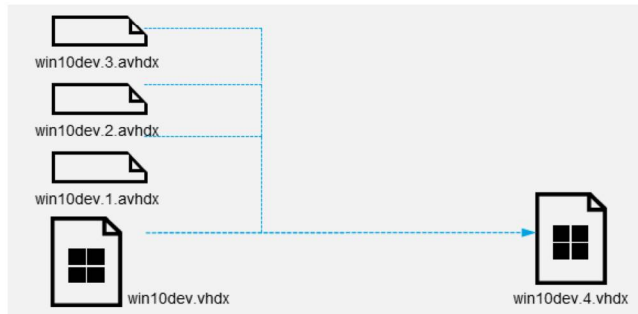
Key Notes:

- Although versioning provides several benefits, there is a storage and performance cost for each additional version created. Although not as large as the base vDisk, each .avd(x) files takes up more space on the Store. The size of each version will depend on the amount of changes made to that version. For example, changing a few system settings will take up less space than installing a new suite of applications or a major OS update.
- Additionally, there is some performance overhead associated with each additional vDisk version. Typically, disk writes will always be directed to a single location (the write cache or a vDisk maintenance version). However, disk reads could come from the base vDisk or any versions attached to that vDisk. As the number of versions increases, the Provisioning Server will need to access multiple files in order to stream the vDisk, hurting disk performance.

What is a Merge?

Two types of vDisk Merges

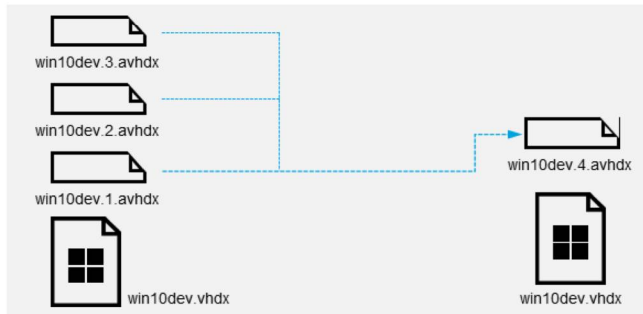
Merging to New Base Image



vDisk merge consolidates vDisk version chain and base vDisk into new single base vDisk.

Allows for fastest access to base image, but takes up more disk space on Store.

Merging to Consolidated Differencing Disk



Partial vDisk merge; combines vDisk version chain into a single consolidated version.

Saves disk space on Store.

Can be automated through PVS Console.

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Key Notes:

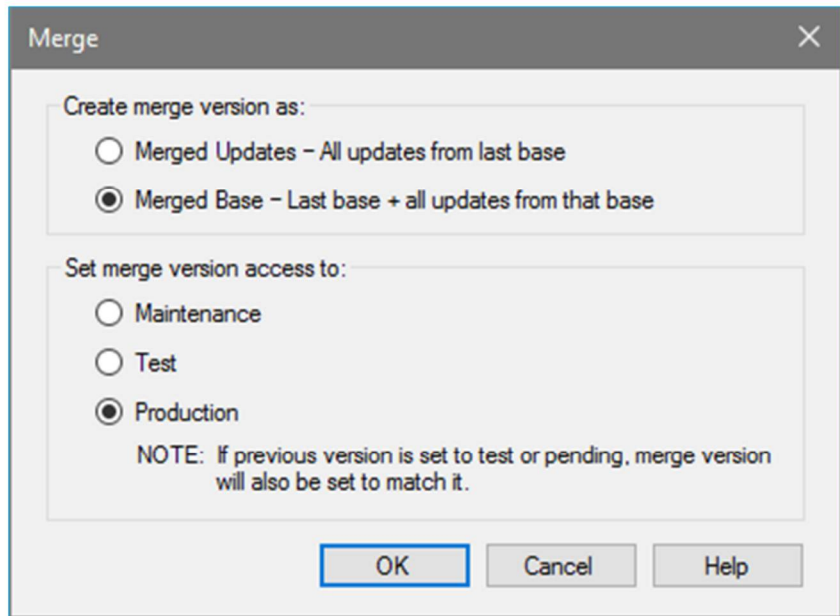
- Merging VHD(X) differencing disk files can save disk space and increase performance, depending on the merge method selected.
- An automatic consolidation of differencing disks can be configured from the Farm Properties dialog's vDisk Version tab. On this tab, a maximum vDisk number is selected. When that number is reached, a merge is automatically performed and the availability of that vDisk depends on the mode selected on the tab (Production, Maintenance, or Test).

Additional Resources:

- Merging VHDX differencing disks: <https://docs.citrix.com/en-us/provisioning/7-13/managing-vdisks/vdisks-update/vdisks-vhd-merge.html>

Merge the Differencing Disks

- When vDisks reach five versions, they should be merged.
- Merging is performed via the PVS Console.
- Be aware that the merging process will increase IOPS to the Store.



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Key Notes:

- Beyond merging if five vDisk versions are reached, it is also recommended to perform a merge at scheduled intervals – the frequency will depend on how often vDisk updates are made. The merge process will temporarily increase the IOPS to the vDisk Store, so for best production performance, the merge should take place during a change window. Other organizations merge versions in a non-production Store, and then migrate the consolidated base vDisk to Production.
- The time it takes to complete the merge process varies based on the merge method selected and the number of differencing disks to merge. After the merge successfully completes, the new version displays in the vDisk Versions dialog. The Type column displays either Merge Base if a full merge was selected, or Merge if a partial merge was selected.

Additional Resources:

- Merging VDHX differencing disks: <https://docs.citrix.com/en-us/provisioning/7-13/managing-vdisks/vdisks-update/vdisks-vhd-merge.html>



- How has your organization updated vDisks in the past?
- If you haven't used Provisioning Services, what image update processes do you currently use?

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Lab Exercise

- Exercise 21-1: Update the vDisk
- Exercise 21-2: Promote the vDisk
- Exercise 21-3: Roll back the vDisk
- Exercise 21-4: Merge the vDisk

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**Lesson
Objective
Review**

True or False: You can move individual .avhd or .avhdx files between Stores and stream them to target devices.

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Lesson Objective Review

True or False: You can move individual .avhd or .avhdx files between Stores and stream them to target devices.

False! Without the base vDisk and other versions in the differencing disk chain, streaming to target devices cannot occur.

Key Notes:

- From an operational perspective, permissions to the Provisioning Services Stores should be restricted to prevent accidental or malicious deletion of .vdh(x), .avhd(x), and associated files. It is also important to be aware of the Provisioning Services files in order to perform vDisk replications and migrations correctly.



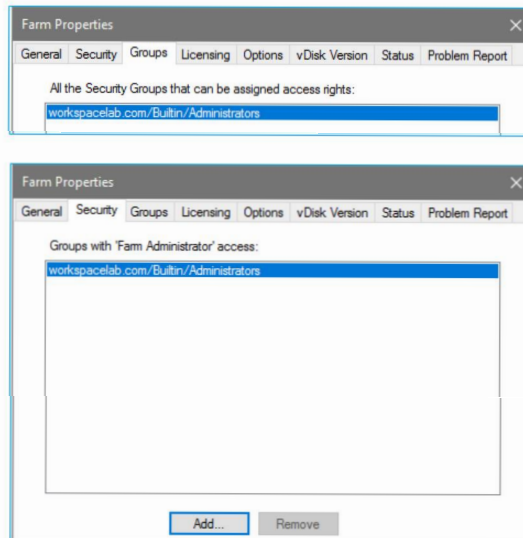
Delegating Administration

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How to Delegate Administration in the Provisioning Services Console

- Use the Provisioning Services console to set administrator roles.
- Each role is set within the Properties of the applicable object:
 - Farm
 - Site
 - Device Collection



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Key Notes:

- The ability to view and manage objects within a Provisioning Services implementation is determined by the administrative role assigned to a group of users. Provisioning Services makes use of groups that already exist within the network (Windows or Active Directory Groups). All members within a group will share the same administrative privileges within a farm. An administrator may have multiple roles if they belong to more than one group.
- After a group is assigned an administrator role through the Console, if a member of that group attempts to connect to a different farm, a dialog displays requesting that a Provisioning Server within that farm be identified (the name and port number). You are also required to either use the Windows credentials you are currently logged in with (default setting), or enter your Active Directory credentials. Provisioning Services does not support using both domain and workgroups simultaneously.
- When the information is sent to and received by the appropriate server farm, the role that was associated with the group that you are a member of, determines your administrative privileges within this farm. Group role assignments can vary from farm to farm.

Additional Resources:

- Managing administrative roles: <https://docs.citrix.com/en-us/provisioning/7-13/managing-administrative-roles.html>

Provisioning Services Administration Roles

Role Name	Assigned permissions
Farm Administrator	<ul style="list-style-type: none">• Can view and manage all objects within a Provisioning Services Farm.• Can create new Sites and manage role memberships throughout Farm.
Site Administrator	<ul style="list-style-type: none">• Can view and manage all objects within a Provisioning Services Site.• Includes Provisioning Servers, Site properties, target devices, device collections, vDisk assignments and vDisk pools.
Device Administrator	<ul style="list-style-type: none">• Manage assigned device collection.• Assign and remove vDisks from a device.• Edit device properties.• View vDisk properties (read-only).
Device Operator	<ul style="list-style-type: none">• Perform limited actions in assigned device collection.• Boot and reboot a target device.• Shut down a target device.• Sending messages to users

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Key Notes:

- The following administrative roles can be assigned to an Active Directory or Windows group:
 - Farm Administrator
 - Site Administrator
 - Device Administrator
 - Device Operator
- In the Console, farm-level tasks can only be performed by farm administrators. For example, only a farm administrator can create a new site within the farm. When the farm is first configured using the Configuration Wizard, the administrator that creates the farm is automatically assigned the Farm Administrator role.
- If a farm administrator assigns a Site as the owner of a particular Store, the site administrator can also manage that Store. Managing a Store includes tasks such as adding and removing vDisks from shared storage or assigning Provisioning Servers to the Store. The Site administrator can also manage device administrator and device operator memberships.

Additional Resources:

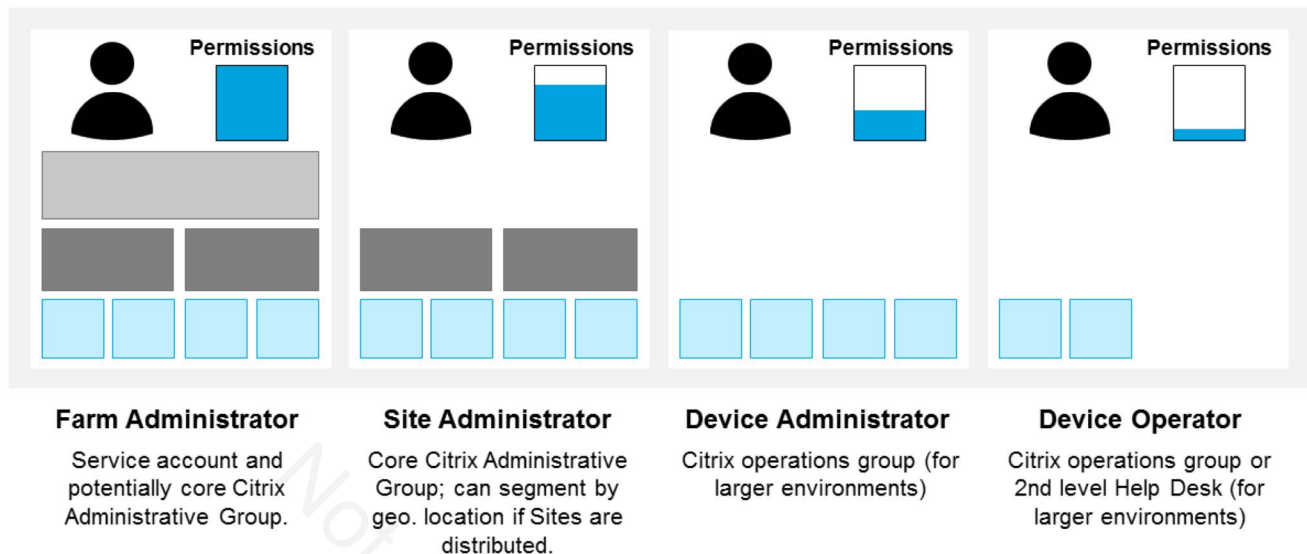
- Managing administrative roles: <https://docs.citrix.com/en-us/provisioning/7-13/managing-administrative-roles.html>
- Provisioning Services administrator roles: <https://docs.citrix.com/en->

us/provisioning/7-13/overview/admin-overview.html

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Provisioning Services Administration Roles

Use Case Scenarios



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Key Notes:

- In smaller organizations or environments, a core team often performs most or all Provisioning Services operations, and only the Farm or Site administrator roles are used. For example, a service account could hold the Farm Administrator role, and the core Citrix team can be assigned the Site Administrator role to various Sites as needed for regular operations.
- In larger organizations or environments, the operational tasks may need to be distributed among a wider team, and not everybody needs to have Farm or Site level access. The Device Administrator and Device Operator roles are ideal for providing access target devices for rolling up periodic vDisk updates, for example after monthly patching, without exposing Farm or Site configurations.



Lesson Objective Review

An administrator with Device Administrator permissions is asked to create a new vDisk version in maintenance mode, assign it to a target device in the Device Collection, and boot the target device to the new vDisk version. Will the Device Administrator be able to complete this task? Why or why not?

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Lesson Objective Review

An administrator with Device Administrator permissions is asked to create a new vDisk version in maintenance mode, assign it to a target device in the Device Collection, and boot the target device to the new vDisk version. Will the Device Administrator be able to complete this task? Why or why not?

No, because a Device Administrator cannot access the vDisk properties in order to make the new vDisk version. If someone with Site Administrator or Farm Administrator permissions performed this action, the Device Administrator could complete this task.

Key Notes:

- It is a good idea to test the expected operational workflow of each administrative role that is used to ensure that permissions are sufficient to complete the workflow.



Auditing and Support

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Provisioning Services Auditing Tool

- The auditing tool can provide a record of all administrative actions made to the PVS Farm.
- Any administrator can use the tool, but the options and information available will vary based on role.



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Key Notes:

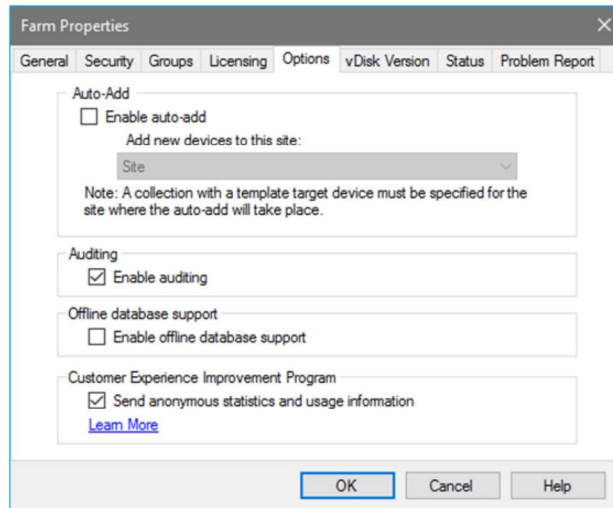
- Provisioning Services provides an auditing tool that records configuration actions on components within the Provisioning Services farm, to the Provisioning Services database. This provides administrators with a way to troubleshoot and monitor recent changes that might impact system performance and behavior.
- The Provisioning Services administrator privileges determine the audit information that can be viewed and the menu options that are visible. For example, a Farm Administrator can view all audit information within the farm, unlike a Device Administrator whom can only view audit information for those device collections they have privileges to.

Additional Resources:

- Auditing: <https://docs.citrix.com/en-us/provisioning/7-13/auditing.html>

Is Auditing enabled by Default?

- Auditing is not enabled by default.
- In the Farm properties menu, auditing can be enabled via the Enable auditing check box.



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Key Notes:

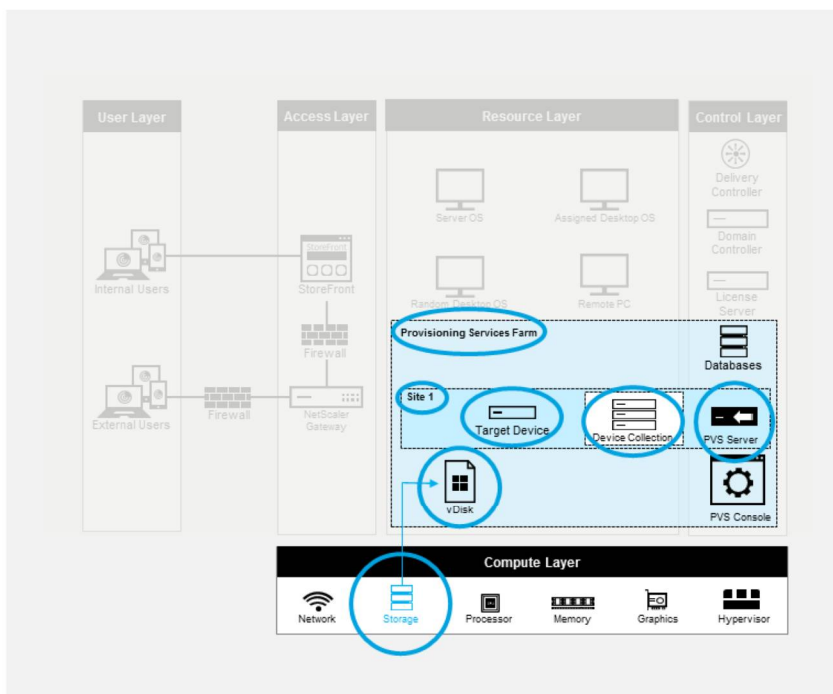
- Note that if the Provisioning Services database is unavailable, no actions are recorded.
- Enabling auditing will cause the Provisioning Services farm database to grow more quickly as auditing data is collected. As we will see, periodically using the archiving feature can keep this growth in check.

Additional Resources:

- Auditing: <https://docs.citrix.com/en-us/provisioning/7-13/auditing.html>.

Identify the objects that can be audited

- The objects shown can be audited within Provisioning Services.



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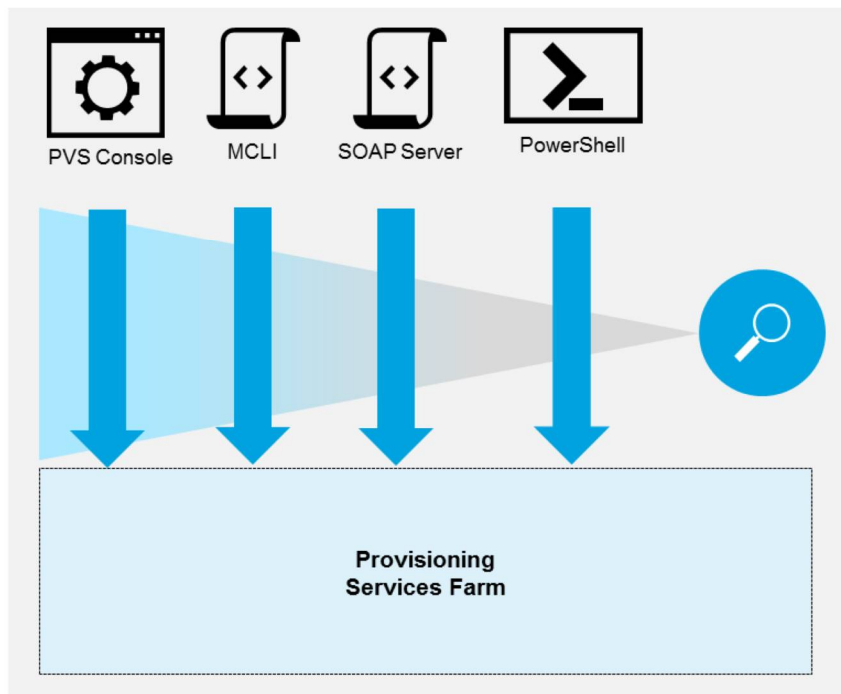
Key Notes:

- The following managed objects within a Provisioning Services implementation are audited:
 - Farm
 - Site
 - Provisioning Servers
 - Collection
 - Device
 - Store
 - vDisks

Identify the utilities in which tasks are recorded

The tasks performed from the following Provisioning Services utilities are recorded:

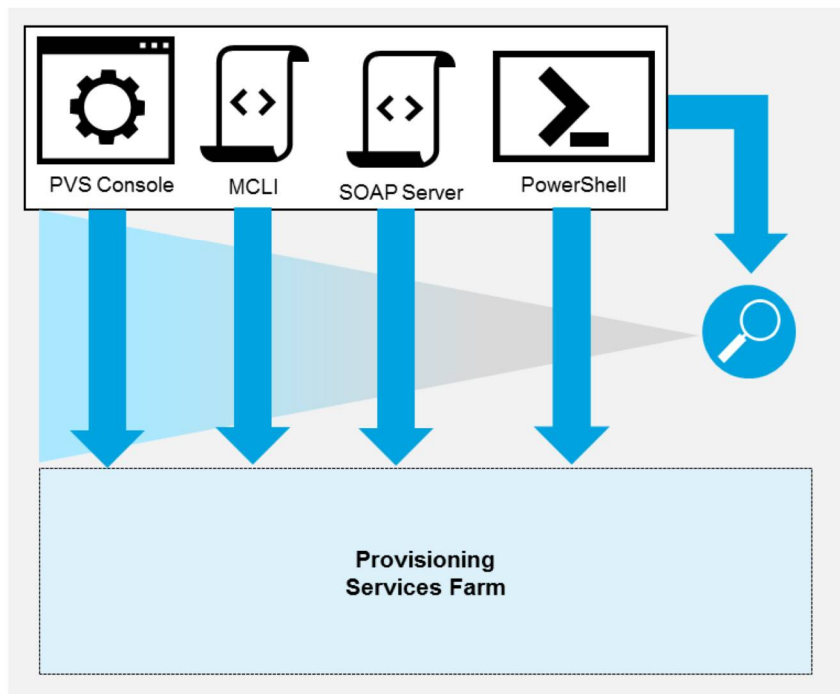
- Console
- MCLI
- SOAP Server
- PowerShell



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Methods to Access auditing information

- Each of the audited configuration sources can also be used to access auditing information.
- To access auditing information from the PVS Console, right-click a managed object, then select “Audit Trail...”



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Key Notes:

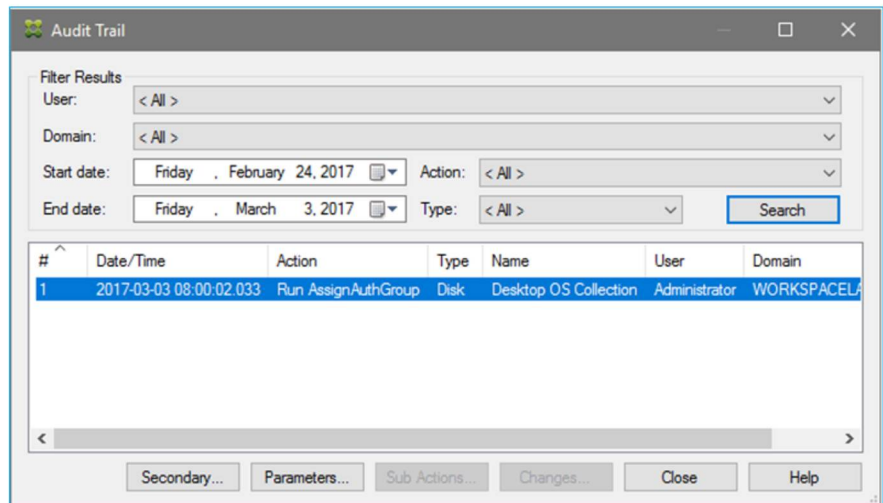
- In the Console, a farm administrator can right-click on a parent or child node in the Console tree to access audit information. The audit information that other administrators can access depends on the role they were assigned.
- Other access methods are command-based. The guides listed below provide the specific commands required to access auditing information.

Additional Resources:

- Auditing: <https://docs.citrix.com/en-us/provisioning/7-13/auditing.html>
- PowerShell with Objects Programmer's Guide: <https://docs.citrix.com/content/dam/docs/en-us/provisioning-services/7-13/downloads/PvsSnapInCommands.pdf>
- MCLI Programmer's Guide: <https://docs.citrix.com/content/dam/docs/en-us/provisioning-services/7-13/downloads/MapiCommands.pdf>
- SOAP Server Programmer's Guide: <https://docs.citrix.com/content/dam/docs/en-us/provisioning-services/7-13/downloads/SoapServerCommands.pdf>

Auditing Display Columns

- In the Audit Trail dialog box, use the Filter Results feature to restrict audit data to a specific category.



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Key Notes:

- The columns include the following information:
 - Action list number
 - Based on the filter criteria selected, in the order the actions took place.
 - Date/Time
 - Lists all audit actions that occurred within the Start date and End date filter criteria.
 - Action
 - Identifies the name of the Provisioning Services action taken.
 - Type
 - Identifies the type of action taken, which is based on the type of managed object for which the action was taken.
 - Name
 - Identifies the name of the object within that object's type, for which the action was taken.
 - User
 - Identifies the user's name that performed the action.
 - Domain
 - Identifies the domain in which this user is a member.
 - Path

- Identifies the parent(s) or the managed object. For example, a Device will have a Site and Collection as parents.

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Additional Details Options

- To view additional details for a particular action, highlight that action's row within the results table, then select one of the displayed options buttons.

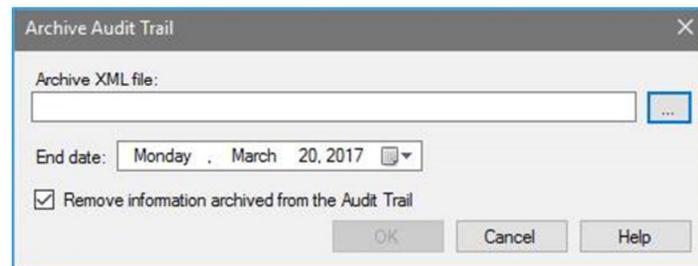
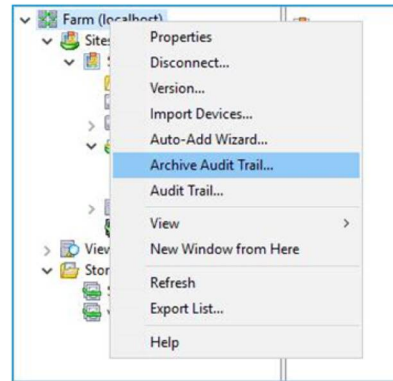
Option	Description
Secondary	Any secondary objects that this action affected. This opens the Secondary dialog, which includes the Type, Name, and Path information. This dialog allows you to drill down to view secondary object actions such as Parameters, Sub Actions, and Changes as described below.
Parameters	Any other information used to process the action. This opens the Parameters dialog, which includes Name (parameter name) and Value (object name) information.
Sub Actions	Additional actions that were performed to complete this action. This opens the Sub Actions dialog, which includes Action, Type, Name, and Path information.
Changes	Any new or changed values (such as 'Description') associated with the object (such as a target device). This opens the Changes dialog, which includes Name, Old, and New information.

Additional Resources:

- Auditing: <https://docs.citrix.com/en-us/provisioning/7-13/auditing.html>

Archiving Audit Trail

- The Farm Administrator determines how long to make audit trail information accessible before it is archived.



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Key Notes:

- The archive audit trail information options are available from the Farm options in the Provisioning Services console.
- In contrast to XenApp and XenDesktop, which also offers the ability to track administrative changes, the related information is not written to a dedicated database but directly to the Provisioning Services farm database. In order to limit the size of the Provisioning Services database it is recommended to archive the audit trail data on a regular schedule.
- Audit information can be archived to an XML file located in an appropriate backup location. It is also possible to remove the archived audit information from the audit trail, but this action is irreversible.

Additional Resources:

- Auditing: <https://docs.citrix.com/en-us/provisioning/7-13/auditing.html>



Lab Exercise

- Exercise 21-5: Enable Provisioning Services Auditing
- Exercise 21-6: Use the PVS Console to view Auditing
- Exercise 21-7: Use PowerShell to view Auditing

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**Lesson
Objective
Review**

Which administrators are able to view audit information?

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Lesson Objective Review

Which administrators are able to view audit information?

Only Farm Administrators can view and archive audit trail information.

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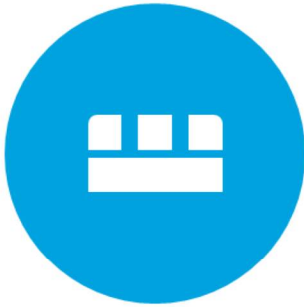


Alternative vDisk update methods

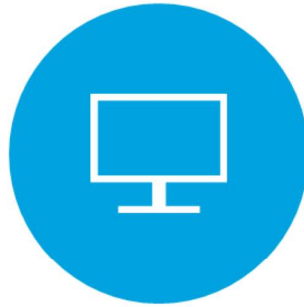
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Use Case for an alternative vDisk update method



Hypervisor tools update



Target device software upgrade
(prior to version 7.6.1)



Other NIC driver update

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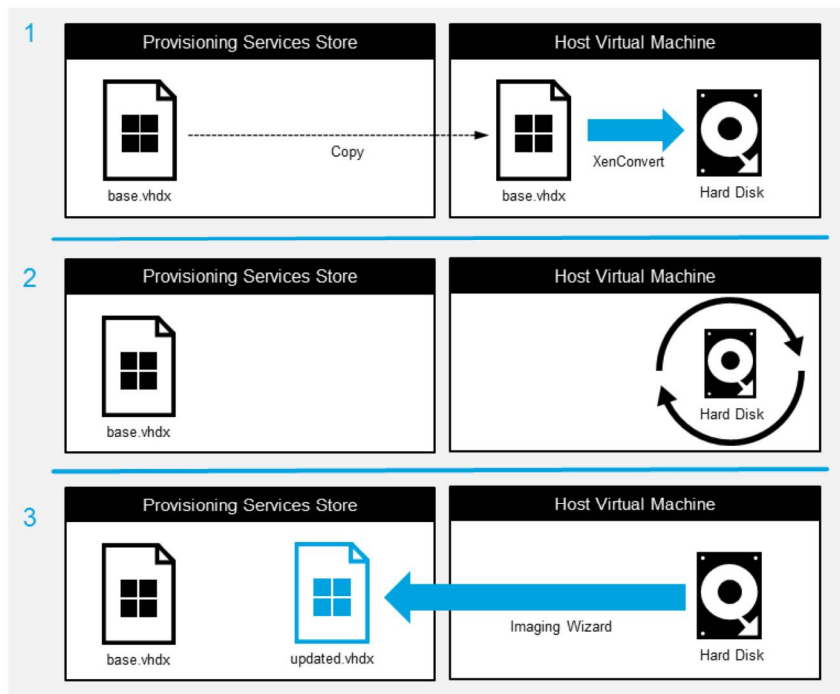
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Key Notes:

- Some kinds of image updates cannot be performed while a vDisk is being streamed, even if it is in a maintenance vDisk version or a private vDisk. This is because the update must update network-level drivers that are actively being used by the target device to stream the vDisk. Attempting to perform the update interrupts the operation of these drivers, causing streaming to fail and preventing the completion of the update.
- Updating the NIC drivers directly would by definition require this approach, but it is also commonly required whenever hypervisor tools are updated.
- Prior to PVS 7.6.1, any target device software upgrades also required an alternate update method. However, newer versions of PVS now allow an in-place target device software upgrade.

Alternate vDisk Update Method Reverse Image

- Traditional method
- Uses P2PVS (XenConvert) or BNImage to transfer vDisk data to a hard disk.
- After updates are completed, hard disk must be re-imaged to a vDisk



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Key Notes:

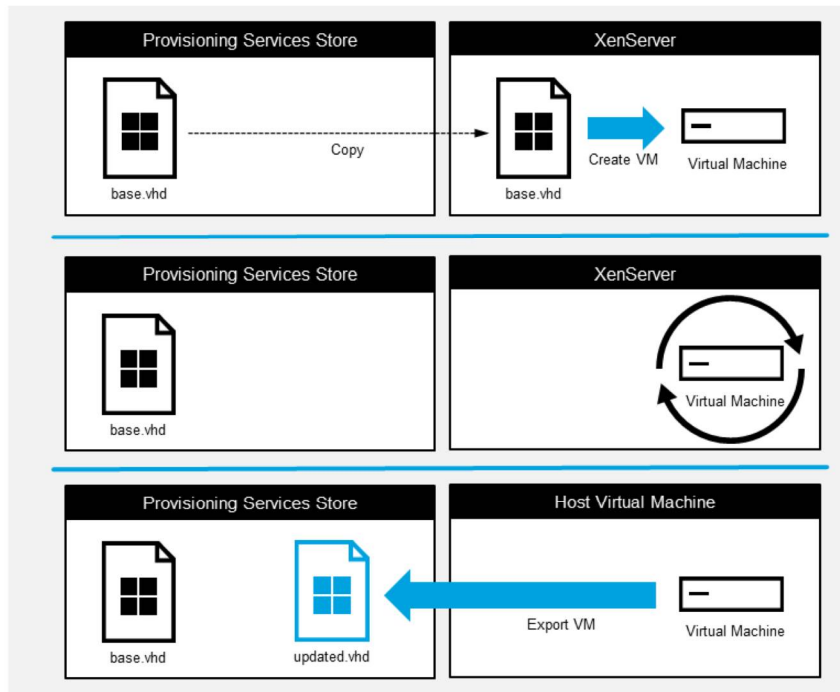
- The reverse image method involves copying vDisk data to a hard disk attached to the same VM. Once the image is booted from the hard disk, necessary NIC driver updates can be applied successfully. After updates are complete, the hard disk must be converted back into a vDisk using the imaging wizard.
- This method is currently supported by Citrix using the tools provided in the product installation. However, performing the reverse image and the re-image is a time consuming process.
- Regardless of which update process is used, create a merged base before starting, since none of the methods support a .vhd(x) chain with multiple versions.

Additional Resources:

- How to Perform Reverse Image in Provisioning Services to upgrade hypervisor tools or Provisioning Services Target Device software version:
<https://support.citrix.com/article/CTX202159>

Alternate vDisk Update Method Direct VHD Boot

- Use .vhd(x) file to create a master VM directly on the hypervisor.
- After necessary changes are completed, VM is imported back to PVS Store.



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Key Notes:

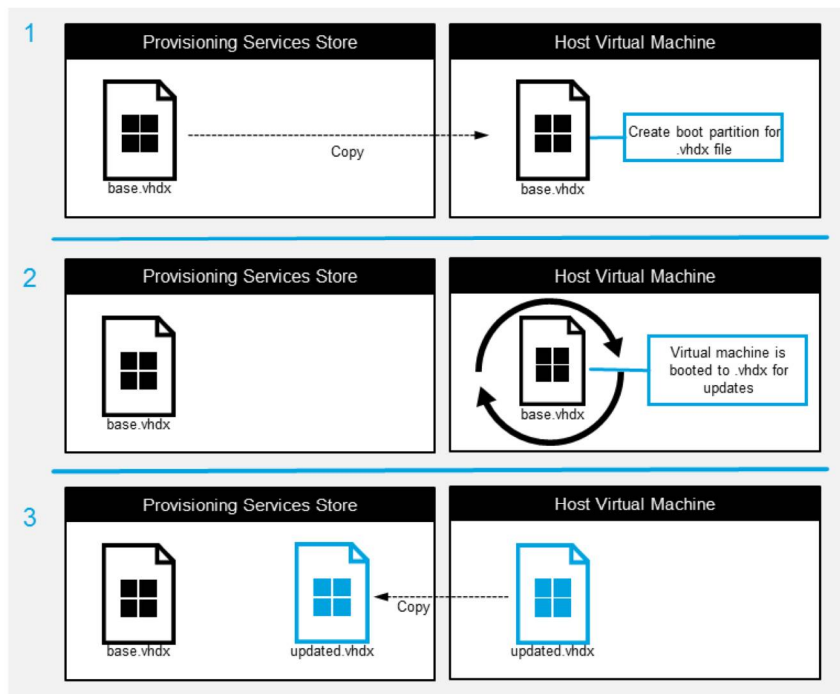
- Direct VHD boot enables NIC driver updates to a vDisk without performing the reverse imaging process, potentially shortening update times. The process involves moving a vDisk file from the Store to a hypervisor storage repository, and then using it to create a VM that can boot from the .vhd or .vhdx file. After changes are completed, the VM is powered off, and the VM's disk is exported back to the PVS Store and re-added to the Farm.
- It is important to note that currently, XenServer can only be used to directly boot .vhd files, not .vhdx files, while Hyper-V is able to directly boot both .vhd and .vhdx formats.
- A version of this method could be used with other hypervisors, but the .vhd(x) file would need to be converted to a compatible format, such as .vmdk, before it could be used to create the master VM. As a result, the process involves more steps and time.

Additional Resources:

- Alternate Method to Reverse Image Provisioning Services vDisks (XenServer Direct VHD Boot): <https://support.citrix.com/article/CTX137253>

Alternate vDisk Update Method Using BCDEdit

- Use BCDEdit command-line utility to add the .vhd(x) file as a native-boot option on the host VM.
- Once booted to the host VM, hypervisor tools and other updates can be performed. Afterwards, the updated .vhd(x) can be re-imported to the Store.



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Key Notes:

- A compatible VM must be used as the “host” for the .vhd(x) file. So for .vhd files, use a Windows Server 2008 R2/Windows 7 or higher VM, while .vhdx files require Windows 8/Windows Server 2012 or higher. Also keep in mind that the host VM should not be a PVS target device, and must have a storage capacity that is roughly two times the size of the vDisk. The .vhd(x) file should be placed at the root of the host VMs system drive (e.g. C:/) so that it can be located as a boot option.
- This method can be the most versatile and efficient method for these kind of updates, but the steps and commands involved require a high level of precision to ensure it is completed correctly.

Additional Resources:

- Add a Native-Boot Virtual Hard Disk to the Boot Menu:
[https://technet.microsoft.com/en-us/library/dd799299\(v=ws.10\).aspx](https://technet.microsoft.com/en-us/library/dd799299(v=ws.10).aspx)



Lesson Objective Review

Assume your environment's Provisioning Services environment is on version 7.6.1. What is the most common reason for using an alternative vDisk update method?

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Lesson Objective Review

Assume your environment's Provisioning Services environment is on version 7.6.1. What is the most common reason for using an alternative vDisk update method?

Updating hypervisor tools.

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Key Takeaways

- The vDisk versioning process can be used to update a vDisk, test the changes, and roll out the new version to production target devices.
- The delegated administration capabilities in Provisioning Services can facilitate the delegation of administrative tasks within larger organizations and/or Provisioning Services environments.
- Auditing is not enabled by default, but can be turned on to track administrative actions within a Provisioning Services Farm.
- Alternative vDisk update methods must be used to update older versions of the target device software, hypervisor tools, or other NIC drivers.

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End of Course Survey

Your opinion matters!

Now is a great time to provide feedback on your experience.



Help shape the **next** course.



Tell us what **you** liked!

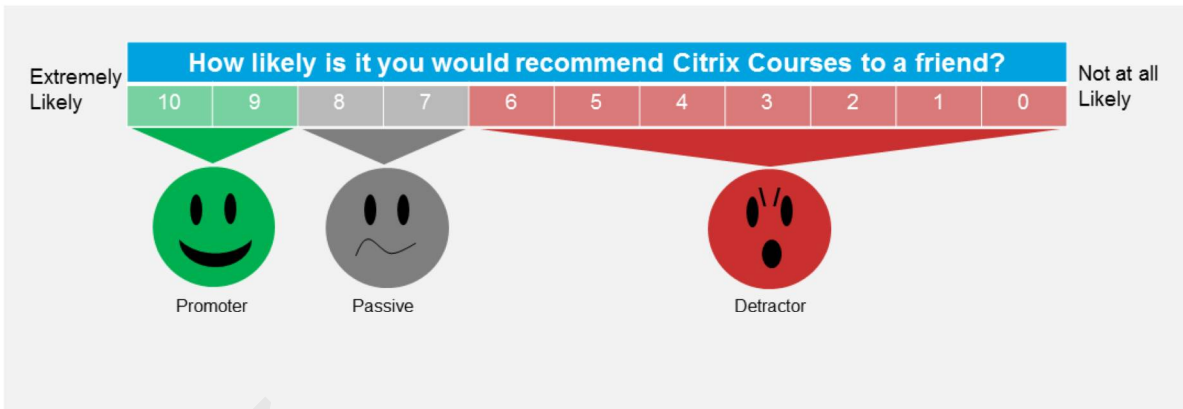


What can **we** do better?

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Citrix Measures your Feedback with NPS

How is Net Promoter Score Calculated?



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