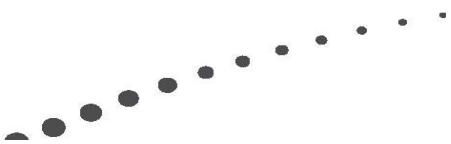
Desktop Transformation Guide

Guidance for transforming to an optimally delivered virtual desktop approach

Citrix Worldwide Consulting Solutions



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Introduction

With any desktop virtualization strategy, one of the simplest ways to get started is by moving the desktop into the datacenter by deploying a 1-to-1, static virtual desktop infrastructure (VDI). This method allows an IT department to quickly get experience with the new technologies involved while realizing a quick win by leveraging existing tools and processes.

However, a 1:1 static VDI model both brings in the existing problems of any desktop environment, and has significant capital costs when scaling up from a proof of concept or small group to tens of thousands of users. As an organization looks to scale up from a small VDI deployment (described in the Desktop Transformation Guide: Centrally Delivered), there are many opportunities to optimize the experience and create a flexible and maintainable environment for the additional groups to utilize virtual desktops. The documents discussing the previous phase (Traditional Distributed Desktops to Centralized) of the Desktop Transformational Model are summarized in the "Previous Documents & Steps" section.

The goal of this paper is to provide IT organizations a guideline for building out an optimally delivered virtual desktop environment, which is characterized by single image management, operating system / application separation, highly available storage, profile management and remote access considerations. This paper assumes that the organization has some experience with VDI, either in pilots or small production deployments. Unlike the previous paper regarding VDI, which leverages existing processes to speed deployment of the virtual infrastructure, this paper looks at changing, updating, simplifying or excluding some of those processes through the use of additional technologies, thereby resulting in operational and capital savings. Such changes allows for reduced management and storage costs while increasing the scalability of the system to much higher levels.

The Desktop Transformational Model Overview

Citrix created the Desktop Transformation Model to illustrate the transition of enterprise desktop computing from the traditional desktop computing model into a completely transformed user-centric, on-demand service model. The following figure provides a high-level overview of the model, for a complete overview please visit http://www.citrix.com/desktoptransformation.

Figure 1: Citrix Desktop Transformation Model

Previous Documents & Steps

In addition to the document that provides an overview of the Desktop Transformation Model, Citrix has provided several other documents to assist in the transformational process that can be used prior to this one.

The First Steps Guide to the Desktop Transformation Model takes a look at identifying three important steps and organization must do prior to implementing the first project: Establish business priorities, establish time to value, and establish a project and technology roadmap. Selecting a user group with desired characteristics can greatly reduce the complexity of an initial project, result in highly visible gains and smooth the path for future groups to be migrated to a desktop virtualization project.

The Desktop Transformation Guide: Centrally Delivered looks at the simplest and quickest way of deploying a basic 1:1 virtual desktop infrastructure solution for a group identified in the previous "First Steps" paper and points out which processes can be leveraged. Additionally, this paper takes a look at some of the factors that need to be considered and steps that should to be taken to complete the analysis, design, build & test and rollout phases.

Characteristics and Considerations of the Optimized Phase

There are several major characteristics of the optimized phase. Not all of these characteristics are required to be considered part of the optimized phase as each environment is different, though equivalently optimized processes should be in place to ease scaling upwards.

These characteristics include:

- **Single Image Management.** Managing and updating hundreds or thousands of desktop images through laborious patch processes and application updates can require significant time, especially considering rollback procedures are difficult in the case of a failed update. Using a single image (or several shared images customized to groups) can greatly reduce update management requirements and prevent help desk calls due to user damaged desktops.

- **Streamed / Remote Applications**. Separating the application layer from the operating system layer greatly reduces the complexity of compatibility testing and single image management. Combining strategies of remote, stream and installed applications into a single environment allows advantages of each method to be utilized fully, resulting in simplified base images, faster application provisioning, and additional benefits such as reduced licensing costs.

- **Profile Considerations**. A more advanced solution than local profiles is recommended for a successful deployment. Roaming profiles with remapped user folders may suffice in some environments, while others may require some more advanced profile management technology to ensure the end user's requirements are met.

- **Storage Considerations**. In line with profile considerations, data should not be stored as part of the local image, but rather on network storage to allow access via any virtual desktop or remote application. Such access will allow SLAs to be set according to company requirements for data backup, and generally allow significant improvements over current data retention and backup procedures.

- **Branch Office & Remote Access**. Having a centralized, optimized environment may greatly simplify access for both branch offices and remote users. Interactions with large documents, data sets and databases will occur as if local as opposed to traveling over high-latency lines. Users will additionally, if permitted, easily be able to access their desktops from outside the organization, resulting in higher productivity and morale, as tasks that may have been impossible to do from home and required a trip to a physical office can quickly be resolved.

Common Image Management

Employing technology to use common images, such as Provisioning (PVS) or Machine Creation (MCS) services, will significantly reduce the time required to manage images and improve rollback possibilities. However, with such a new technology, there are considerations that need to be taken into account.

Pooled vs. Static (Assigned) vs. Dedicated

One decision involves what type of desktop to assign to users. Generally, desktops can fall into three categories: pooled, static (AKA assigned) or dedicated. As a general rule, the best benefits come from having them pooled – the least amount of resources are used, desktops launch nearly instantly, and server, storage and disaster recovery design are greatly simplified. However, there may be some situations where assigned or dedicated desktops are required – a few applications require a unique and static hostname to last in between sessions, or track a user by IP address, or users may have very unique application sets. These may require a small subset of users to have an assigned or dedicated desktop, though the majority can still benefit from a pooled desktop.

- **Pooled**. In a pooled scenario, all desktops in a desktop group are identical. A small set of desktops are online and ready to be used, allowing users to almost instantly access their workspace without waiting for boot-time. Users are always directed to either to an existing session or the first available virtual desktop, so they are not tied to a specific virtual desktop. This allows the bulk of unused virtual desktops to remain powered off, reducing hardware resources and power consumption, and automatically providing desktop high availability in the case of a host server failure.

- **Static (Assigned)**. Statically assigned desktops have the benefit of a user always connecting to the same virtual desktop, though the common image is the same across the board. This allows applications that require the user and the hostname to connected to function, and opens the possibility of customizing the desktop slightly – such as adding an additional static local disk, or modifying the CPU/RAM resources available to the desktop. However, this results in either the virtual desktop having to power on when the user wants to access it (increasing logon time), or having all virtual desktops online, increasing resource requirements and power consumption.

- **Dedicated**. Dedicated machines are similar to static machines, in that users will access the same virtual desktop each time. However, dedicated machines differ in that any changes made to them are persistent. This can either be done by providing each user with a full machine and local disk, or through XenDesktop's Machine Creation Services (MCS), which allows users to build on a common read-only disk. This allows users with very unique application sets or high customization requirements to modify their desktop and install applications as they see fit, though this approach requires that desktops and anti-virus are still updated through traditional methods, and storage is recommended to be highly available, such as SAN, in case of hypervisor failure. This model is also referred to as VDI and is not considered a optimally delivered desktop.

Number of Images

The number of base images can vary greatly from organization to organization depending on applications, requirements, and technologies used. If not using streaming or remote application technology, a master disk image (also referred to as a "vDisk") will have to exist for each unique user group/application set. This will

reduce the number of components by not requiring a XenApp deployment, but will significantly increase the number of vDisks required to manage.

By incorporating XenApp and moving some applications, as appropriate to remote published or streamed, an organization can drastically reduce the number of vDisks. While most organizations will still require more than one vDisk, due to requirements of significant operating system customizations, the number becomes significantly more manageable with the addition of a tool that separates the application layer from the operating system layer.

Using XenApp, by either publishing or streaming applications, not only reduces the number of vDisks necessary to be managed, but also simplifies license management. Whether an organization chooses to implement XenApp or not depends on specific organizational requirements, such as the diversity of user groups and applications, licensing costs around applications, and whether the operating system needs deep application integrations, such as programs that alter the behavior of the file system.

Application Data

Some applications require user-specific settings or allow end users to heavily customize them. Many applications, including legacy, home-grown and small vendor applications, do not use the registry to store this critical data but rather in a configuration file of some sort. This may require that the application is customized with a startup script to copy a configuration from the profile and back to it at logoff. Some profile management tools can be configured to complete these tasks automatically; otherwise, manual scripting may be required.

User Data

User data is a critical issue in a virtual desktop deployment, as users may move from desktop to desktop and server to server. Ensuring that their data is always available is paramount to ensuring productivity and acceptance of the new tool. If users have already been trained to place files in network share, this will simplify the process. However, even untrained users can still use redirected folders such as My Desktop and My Documents, though they will need to know that placing files in the C: root or Program Files will result in those files disappearing. Appropriate Active Directory permission restrictions on these non-redirected folders can prevent data loss issues. It is important to understand user data storage requirements, and provide enough space in redirected folders to store all important user data.

If using roaming profiles or similar technology, it is also important to occasionally check on the size of these profiles to ensure that all folders are being redirected properly and no application is overusing the profile. Some applications may not behave well and may bloat the profile, causing longer logon times to desktops and published applications.

User Personalization & Effects

Allowing users to personalize their desktop and keeping more attractive effects can have slight performance and resource costs, but may greatly increase the user experience. User effects such as having a desktop background or maintaining the look and feel of Windows 7 windows and menus may greatly outweigh the costs and help adopt migration.

Anti-Virus Best Practices

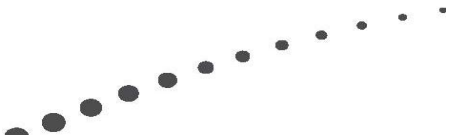
Anti-virus configurations are a common cause of concern in both VDI and common image environments. Having a full scheduled anti-virus scan can negatively impact the storage and performance of an entire environment. In assigned virtual desktop environments, these kinds of scans are necessary, but should be staggered during off hours.

However, in common image environments, full scans are no longer necessary during run-time, as any changes to the image are discarded on power-off, and a clean version of the image comes up upon each logon. It is considered best practice to scan the common image after it is updated for viruses and malware before it is assigned to users.

Despite the benefits of a common image, anti-virus is still an important part of any desktop solution, as there still needs to be protection against self-replicating viruses and users running malicious programs within a session. Some other considerations include whether to scan only on write or on reads as well (generally, writes are enough), and whether to monitor running processes. Things like network drives should most likely be ignored as multiple users scanning the same network drive can have a negative impact on the network drive storage, network utilization, and desktop CPU usage.

As all new information is wiped on a reboot, one common concern is how anti-virus updates work. Since most anti-virus updates are relatively frequent and small in size, allowing updates to occur after boot will have little network or CPU impact. Additionally, during updates of the image, virus definitions can be updated as well.

One newer option that some anti-virus vendors are now providing includes hypervisor-based scanning appliances, simplifying the scanning process and reducing the footprint. Additional information can be provided about these types of appliances from the organization's anti-virus vendor, if they provide one.



Application Deployment

Understanding what applications are required and how to deploy them is a critical, and one of the most time consuming steps in scaling up a large environment.

Gathering Applications & Requirements

Application requirements can be gathered in several ways, and often will require a combination of several methods. End users and business units can be interviewed, or tools such as EdgeSight, PlateSpin Recon and others may provide automated outputs. More detailed information can be found in the Desktop Transformation Guide: Centrally Delivered paper.

Application Deployment Methods

Different deployment methods will be ideal for different applications. Using the best delivery method for each application will greatly improve the environment. Installing applications into the base image or delivering as a remote application via XenApp are the recommended methods, with streaming as a primary fallback and VM Hosted as a last resort. Following this general methodology for application deployment will result in the best balance between reduced overall complexity for management and best resource utilization.

- **Common Image Installed.** These applications are those that are universally licensed or considered birthright applications and used by most or all users (such as Microsoft Office). Alternately, they can be applications that alter the behavior of the operating system, such as WinZip or 7zip.
- **Published Remotely.** Some applications may have concurrent or named licenses requirements, which point towards XenApp as the ideal deployment choice. Generally any less than universally used application with licensing costs should be attempted to be deployed on XenApp.
- **Common Image Streamed.** Some applications may be limited to a few users due to organization requirements or named licensing. These applications can be streamed into the desktop and exist in the same memory space as installed applications. Good applicants for streaming are those that are not multi-user friendly, have large resource requirements or memory leaks, or cannot coexist with base installed applications.
- **VM Hosted.** Some applications may perform poorly in a Terminal Services environment, may have memory leaks, not be friendly to being streamed, or require static hostnames. Such problematic applications may be VM hosted so that multiple users can access over the course of several sessions. Other common issues may include incompatibility with Windows 7 or Internet Explorer 8. Due to resource requirements and management costs, this option should generally be considered a last resort.

Licensing Considerations

Licensing rules may significantly alter the deployment method, as using the best deployment method can greatly reduce costs. Depending on the license type, if an application isn't universally used by a user group, certain methods may be more cost effective than others.

- **Per User (Concurrent):** This licensing type lends itself to be remotely published (or, if necessary, VM Hosted). Installing it locally will likely cause significant additional costs as each user who is assigned to the vDisk will need to be licensed.

- **Per User (Named):** This points toward any option other than common image, as named licenses are easily managed for remotely published, streamed, or, if the other options fail, VM Hosted.

- **Per Machine:** This generally indicates that remote publishing or VM hosted are the best options, as the application will in each case reside on a single machine and be able to serve multiple users. With VM hosted, each VM will be able to serve one user at a time.

Additional licensing methods or caveats may exist depending on the vendor's licensing terms.

Number of Users

The number of users who regularly use the application may also heavily impact the design decision. If all users have access to the application, it points toward being installed into the base image as a primary option. If a significant percentage of users use it, whether publishing it remotely through XenApp or installing it into the base image depends on a number of factors, including licensing costs and performance requirements. If only a few users use it, streaming becomes a preferable option.

Application Complexity

Complex applications may require more testing to determine the best application delivery method. Whether the method to use is installed into the image, published from XenApp, streamed, or hosted in a separate VM can depend significantly on application behavior and requirements.

Additional Considerations

Additional factors play into the centralization of an environment. These include storage & profile architecture, and may include remote access as well.

Storage Considerations

Storage is a critical part of any desktop virtualization deployment. While for most large scale deployments, enterprises tend to go with a SAN, other options exist. Storage is required primarily for three things: profile / redirected folders, common image storage, and a temporary write cache for the vDisk.

For profile solutions, network-attached storage is often employed, though it is very important to ensure that the load on the server and the load on the network does not cause delays, as it can greatly affect the user experience and logon times.

For common image storage, this can generally fall on any type of storage. If using Provisioning Services, the common images are loaded into memory, reducing the requirements for IOPS and fast disks. It is recommended for Provisioning Services to provide ample memory to allow caching of the disks and provide prime performance. A formula for finding the recommended Provisioning server memory is provided in the PVS Planning Guide in the XenDesktop Design Handbook. Reducing the number of active images reduces the recommended size of the Provisioning Server's memory.

For the write cache in Provisioning Services, multiple options exist, including server-side, SAN storage, memory storage and local disk. Redundancy is a consideration, though for most deployments (especially pooled) the data stored in the write cache is not critical and does not need to be backed up. All critical data should be stored in the profile or redirected folders. In most pooled environments, redundancy is built into other architectural components, removing the need for write-cache storage redundancy.

The storage options include, for the delta storage:

- **Stored on the Provisioning Services server**: This option is generally not recommended for large scale environments, as it requires writes and some reads to traverse the network, reducing scalability.
- **SAN storage**. This allows all features, such as migration, to be enabled, though at a fairly high cost. The SAN generally needs to be a high performance device as well to sustain the reads and writes of the workload. While many customers believe that SAN storage is a requirement for high availability, an environment can be designed to be highly available without one. Network storage can be used for profile and user data, and local disks can store both the write cache and synced vDisks across Provisioning servers. If a hypervisor hosting desktops crashes, users will be disconnected and have to reconnect, which they'll be able to do immediately, though any unsaved data will be lost (just as with a regular desktop machine failure). This is the same scenario that would occur with a SAN – as long as user data and profiles are highly available, they'll be able to access their data immediately and without realizing they're on a new desktop. The major advantage of SAN storage is the ability to migrate machines prior to planned hardware downtime.
- **Memory Storage**. Write cache information can be stored directly in memory as well, which can increase security and produce a high performance environment, while requiring less management.

However, this may also be one of the most expensive methods of storing the write cache, as large amounts of additional memory will need to be loaded into servers.

- **Local storage**. Using an array of disks or a single solid state drive (SSD) can be a more cost-effective solution. It is important that the speed of the disks can handle the sustained writes of the environment, and a RAID cache is in place to match bursts of activity. As delta data is non-critical for the most part, SSD drives can be used without a redundant pair, greatly reducing the cost burden. As SSDs come down in price, this will become a more and more viable option.

For both SAN storage and local storage, it is recommended to have a RAID cache to store information in the case of boot storms and temporary increases in activity. Even a small RAID cache can greatly improve performance for end users, and reduce costs by allowing the SAN and local storage to plan for sustained IOPs rather than burst IOPs.

Profile Considerations

Profiles are a critical portion of any desktop virtualization solution. Using a good profile solution can greatly enhance the end user experience and make them feel like they are using a personalized desktop, greatly increasing adoption rates. However, poor profile management can result in things such as large profiles, causing long desktop logon and application launch times, corrupt profiles, lost application settings and general user frustration.

It is strongly recommended to redirect all possible user folders to ensure that user data is not lost. This will help ensure the user experience is identical across desktops and servers.

Desktop logon times and remote application launch times can be heavily affected by the size of the profile, so ensuring that profiles stay relatively clean can be beneficial. While roaming profiles do not have this functionality built in, other tools, such as Citrix's User Profile Manager, AppSense Profile Management, Liquidware Labs Profile Unity and other advanced profile solutions will allow pruning and maintaining the profile to prevent bloat. Please see the Desktop Transformation Model website for additional profile vendors and information.

Additionally, advanced profile managers can help prevent profile corruption, which can be a frequent headache for the help desk and users when using virtual desktops and remote applications. Corruption can occur when users make changes to their profile on multiple desktops, and if the write-backs on logoff conflict with each other, difficult to diagnose issues can occur.

Finally, many applications do not write settings changes to the user registry or profile, and as a result are not captured by Microsoft's roaming profile. Instead, they may write to local configuration files, which will not transfer from device to device.

Finding a profile solution, therefore, is highly recommended.

Branch Offices and Remote Access

With branch offices, additional considerations need to be made. One of the primary concerns is whether the network has enough bandwidth and a low enough latency to have good desktop performance from a centralized location. Ideally, infrastructure should limited to as few locations as possible as this will ease

management. Network optimizers, such as Branch Repeaters, may help in this situation, though if bandwidth is extremely limited, some pieces of infrastructure (the hypervisor, the common image provider), need to be replicated locally. Additional information on bandwidth requirements can be found in the Consulting Solution's document "Performance Assessment and Bandwidth Analysis for Delivering XenDesktop to Branch Offices."

Additionally, providing remote access, from home or while traveling, can greatly increase end-user efficiency and morale by allowing users to access critical documents and perform time-sensitive tasks from wherever they are, without requiring a trip to the office.

Summary

With planning and the proper tools, a basic virtual desktop infrastructure can be built to scale up to a much higher size without a similar increase in management time or similar costs. By implementing new technologies and processes into the environment, flexibility can be increased while reducing both long-term operational and capital expenditures.

Additional Resources

A number of additional resources are available to organizations pursuing a centralized, optimized virtual desktop infrastructure.

Desktop Transformational Model

The Desktop Transformation Model provides a methodology for an organization to move an organization from a traditional desktop approach to desktop-as-a-service model using a phased approach. For more information, please see the Desktop Transformation Model page. *www.citrix.com/desktoptransformation*

Consulting Services

Citrix Consulting has been engaged on hundreds of large-scale XenApp and XenDesktop deployments. Using the expertise of consulting services, either through Citrix Consulting or a partner consulting company, can greatly assist in initial deployments of a virtual desktop infrastructure. *www.citrix.com/consulting*

XenDesktop Best Practices Kit

Using knowledge from internal testing and real-world experiences, Citrix Consulting has organized technical knowledge and best practices for XenDesktop deployments. Subscribing to the XenDesktop kit via an RSS feed will allow for regular updates. *bit.ly/xdhandbook*

Ask the Architect

The Ask the Architect programs offers directed, real-world technical advice through webinars, blog posts, whitepapers and other communication methods. Find more information at the Ask the Architect site. *community.citrix.com/p/ata*

Product Information

Additional information can be found at the following locations:

- XenDesktop. *citrix.com/xendesktop*
- XenApp. *citrix.com/xenapp*
- Provisioning Services. *citrix.com/provisioningserverfordesktops*
- Branch Repeater. *citrix.com/repeater*
- NetScaler. *citrix.com/netscaler*

Revision History

Revision	Change Description	Updated By	Date
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0.4	Document Reviewed	Florian Becker	November 29, 2010
0.5	Revisions Made	Michael Bogobowicz	December 2, 2010
0.6	Document Reviewed	Daniel Feller	December 9, 2010
0.7	Revisions Made	Michael Bogobowicz	December 9, 2010
0.75	Document Reviewed	Jessica Hayner	December 9, 2010
0.8	Revisions Made	Michael Bogobowicz	December 9, 2010
1.0	Marketing Review and final updates	Florian Becker	January 25, 2011

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