Capacity and Operational Considerations for VDI

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CT CMG Meeting
What is VDI- Virtual Desktop Infrastructure?

- An alternative approach to centralized desktop computing that allows users access to virtualized desktop computing environments running on servers ("virtualization hosts") located in a data center.

- Virtual desktops can provide users with either pooled (shared) or personal (one-per-user) working environments depending on how the VDI solution is implemented.
  - Most common implementation is a “pooled” or shared working environment.

- Citrix XenAPP is one solution which will be discussed supported on VMware but can also be supported on Hyper-V.
Desktop Virtualization and VDI

“Decoupling” the windows desktop environment from the hardware.
- Separate the OS, Applications, and User State information from the PC hardware

Server Hosted- What VDI does
- Desktops are managed on a server using either Hyper-V virtualization or VMware or XenServer
  - XenDesktop supports hypervisor technology and virtualization management from Citrix, Microsoft and VMware

Session Virtualization- Older approach such as Citrix XenApp
- Users either access entire Windows desktops or individual applications which are running remotely on data center servers.
- Good approach for large number of task workers
  - Issue though everyone is sharing same environment and any application issue can impact everyone else in shared environment
  - Java applications with memory leaks can impact other users.
    - Another Microsoft approach is App-V
Traditional Session Virtualization

1. User requests application
2. App sent from hub to hosting server
3. User interacts remotely with app on server

Provisioning Servers

Citrix XenApp Farm
VDI Business Benefits

- Simplify Desktop Management using centralized desktop delivery architecture.
  - Storage, Execution and Management of Windows desktops is performed within the data center.
- Improve Security
  - Provide users with completely isolated work environments
  - All user information/profiles are saved separately from the business data
  - Keep sensitive business data “locked” in the data center.
- Provide Business Continuity in a Disaster and provide flexibility for user access
  - Access can be provided from any connected endpoint device, managed or unmanaged.
    - Standard PC, thin clients, tablets, smart phones, IPAD
  - If device is lost or stolen access can be gained from another device
  - All user information is stored in the datacenter not just on a user’s PC which is not backed up.
VDI Considerations

- User Experience is first and foremost
  - Which users are good candidates
    - What are the decision factors?

- Cost considerations
  - Server and Storage Capacity to support the users
  - WAN Acceleration
ROI with VDI - Benefits

- Savings from OpEx vs CapEx
  - Will not see the same ROI for PC replacement as for server replacement.
  - Each PC will be replaced with a VDI.
  - Will need to purchase Servers and Storage (centralized SAN storage which is expensive)
- Replace expensive PCs with thin clients
  - Fewer upgrades
  - Save on hardware- use “Thin Clients”
    - Hardware can last longer
  - Improve software license management and minimize software procurement
- OPEX Savings from:
  - Quick Provisioning
    - Creating a new desktop VM, customized for each user, literally takes just a few minutes instead of the hours typically consumed in imaging a corporate standard image, patching it, applying the appropriate updates, special software needed,
  - Quick and easy application deployment (standard platform)
    - One of the issues in deploying applications is that they run on a wide variety of hardware platforms which may cause incompatibilities or other issues requiring administrator intervention.
  - Administration and Operational costs
  - Management centrally rather than “desk-side” for traditional PCs
  - Reduces costs for scheduled software maintenance, patch management, OS-support
VDI Assessment Process

- **Interview:**
  - Identify your organization’s business drivers to gain a clear understanding of your current infrastructure, end users, applications and project and technical requirements.

- **Collect Information:**
  - Use a combination of assessment questionnaires to gather information to define user and application candidacy.
    - Not all applications can be “streamed” or supported e.g., Bloomberg terminals
  - Inventory all applications and all desktops
  - Collect performance data on all PCs
  - Gather indications of end user experience on PCs
    - Need tools here or at least create some pilots to “stop watch” and establish baselines for comparison

- **Analyze:**
  - Assess candidacy
    - Classify users as “Good”, “Fair” or “Poor” candidates based on usage
    - Application requirements access to
    - System requirements- e.g., mobile users
    - Number of displays required, USB access etc.

- **Report:**
  - Candidacy and Profiles of Usage
  - Size the hardware to support 80-100 users per server
Planning for VDI - What do you measure and collect?

- Application Inventory Information
  - Application usage by department
    - % of time being used
  - Patching requirements, levels etc.
  - Can the application be virtualized and streamed?

- User Inventory
  - User mapping to departments- AD definitions and LDAP definitions
  - User requirements and SLAs
  - Access requirements – mobile or office only D/R requirements

- PC Inventory:
  - Age of PC, Model, Processor Number of cores, memory etc.

- Target Platforms- e.g., Server Host Configurations
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<tr>
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<th>Description</th>
<th>Department</th>
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Data Collection on the PC and after Virtualization

- **CPU consumption** including system and user, by user, machine, application
- **Memory consumption** including swapping and page faults, by user, machine, application
- **Network consumption and performance** by user, machine, application
- **Disk consumption and performance** by user, machine, application
- **User logon durations** (the time it takes a user logon to complete)
- **Application load times** (the time it takes an application to load and initialize)
- **Graphics intensity** to identify the level of graphics and screen refresh demands by user, machine, application
- **Non-responding applications**
- **Network latency**
- **Network application response times**
- **Failed or dropped network connections**
Determining Candidacy

- For each metric, define thresholds but one must also account for the PC on which the data was gathered.
  - Processor Usage
  - Memory Usage
  - Disk IO usage
  - Network IO load

- Caveats on Thresholds
  - E.g., Intel Pentium 4 3.00 GHz with 2 GB of memory or a Pentium III with 512 MB of memory.
  - Should normalize the data for processor utilization
  - Paging and therefore disk IO will be higher on PCs with reduced memory.

- Which metrics pose the greatest impact on the consolidated host?
What are the thresholds?

- What consolidation ratio are we trying to achieve?
  - What ROI? Savings will not be as much from CAPEX as from OPEX
  - Users with high CPU and memory demands will impact the VDI density that can be achieved on a hosted server.

- Processors are much more powerful on servers and studies show between 6-10 VDIs per core or >100+ VDIs on host based on CPU

- Memory: Can increase memory from 1 GB to 2 GB for memory intensive users and not impact other workloads

- Network IO load-
  - Users accessing servers where they are downloading significant amounts of data or streaming video will impact bandwidth as well as NIC capacity.
  - Need to size based on NIC capacity and network design but network IO thresholds should be <40 Kbytes on average

- Disk IO load-
  - <20-30 IOPS
  - What is SAN throughput capacity and dasd set up to support?
  - Require multi-pathing IO and is much more significant in the VDI-VMware environment with a much higher consolidation ratio.

What is of paramount import? USER EXPERIENCE!
Thresholds

- **Key Indicator: System+User CPU Load**
  - Good $\leq 10\%$; Fair $\leq 40\%$; Poor $> 40\%$

- **Key Indicator: Memory Used**
  - Good $\leq 550\text{K}$; Fair $\leq 1000\text{K}$; Poor $> 1000\text{K}$

- **Key Indicator: Graphics Intensity**
  - Good $\leq 150$; Fair $\leq 300$; Poor $> 300$

- **Key Indicator: Disk Load**
  - Good $\leq 10 \text{ IOPS}$; Fair $\leq 25 \text{ IOPS}$; Poor $> 25 \text{ IOPS}$

- **Key Indicator: Network Load**
  - Good $\leq 5 \text{ KB/s}$; Fair $\leq 20 \text{ KB/s}$; Poor $> 20 \text{ KB/s}$
Additional User Experience Metrics

- **Network Latency**
  - Good <= 80ms; Fair <= 280ms; Poor > 280ms
  - >280 ms typically is indicative of excessive network latency and remote user sites should be considered. In most LAN environments the latency will be small and not of concern but

- **Login Duration**
  - Good <= 4s; Fair <= 10s; Poor > 10s
  - This is the measure of the average duration of each user login, measuring the time from when a user logs in to the time that the login process and login scripts have completed.
  - This is a key indicator of possible design issue particularly related to the implementation of “profiles”
    - Roaming, Mandatory, Local using Appsense, Microsoft or Citrix Profile management

- **Application Load Time**
  - Good <= 3s; Fair <= 5s; Poor > 5s
  - This is the measure of the average time each user application takes to load, measuring the time from when a user launches the application to the time that the application is fully initialized and ready for input.
  - Slow application load times can be a key contributor to poor user experience.
  - VDI design using streaming, published applications from a Provisioning Server or Streaming Server need to ensure that network interfaces are optimized and disk is optimized.
  - Note- In newest release of Xendesktop provisioning servers are eliminated
Other Network Related metrics

- Graphics Intensity: Another measure of network load
  - This is the measure of the average graphics intensity of each application used on a machine or by a user, obtained by examining the number of loaded GDI objects.
  - High Graphics Intensity indicates users and applications that may have extreme graphics needs, and therefore may not be a good fit for VDI where frequent screen refreshes and highly interactive graphics may be compromised by VDI streaming, or could negatively impact network performance.
**Sampling Rates and Measurement Duration**

- **How frequently do you need to sample?**
  - Windows metrics: at least once per 5 minutes
  - data is just a snapshot per the interval that you collect over.

- **For what duration should you spend collecting the data?**
  - Minimum of two weeks per user should suffice
    - But need a longer capture in case users are on vacation to insure that you have captured all users
    - Need to weight the information by % of time user is logged on
    - Discount data outside of normal working hours
Data Summarization

- Capture data for PC users and measure the following by:
  - Entire group, department, each user
    - Average, Max, Min, 75\textsuperscript{th} percentile, 95\textsuperscript{th} percentile for each metric:
    - Processor Usage Total: System+User
    - Processor Run Queue
    - Memory: Available Memory
    - GDI: Count of GDI objects
    - Network: bytes sent+received
    - Disk: IOPS and bytes read+written
    - % login time out of sample
      - use to determine if you have sufficient data for the user
  - Application Load Time
  - Network latency
    - Time between endpoint e.g, PC and server on which metrics will be collected
Application Assessment Summary


Machine group: All
User group: CODA

<table>
<thead>
<tr>
<th>Application</th>
<th>Users</th>
<th>Average Usage Time</th>
<th>Average App Load Time</th>
<th>Average CPU Time</th>
<th>Average System CPU</th>
<th>Average User CPU</th>
<th>Average Memory</th>
<th>Average IO</th>
<th>Average Graphics Intensity</th>
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<td>IBM Lotus Notes/Domino</td>
<td>3</td>
<td>n/a</td>
<td>n/a</td>
<td>50.39ms</td>
<td>0.19%</td>
<td>0.14%</td>
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<td>Microsoft Office Visio Standard 2003</td>
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<td>490.00ms</td>
<td>18.08ms</td>
<td>2.52%</td>
<td>1.83%</td>
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<td>n/a</td>
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<td>693.34ms</td>
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<td>10.14ms</td>
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<td>5.97MB</td>
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<td>24.32MB</td>
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### User Assessment Example

#### User Assessment Summary

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<thead>
<tr>
<th>User</th>
<th>Machines Used</th>
<th>% Time Active</th>
<th>Login Delay Avg(s)</th>
<th>System CPU Avg(%)</th>
<th>User CPU Avg(%)</th>
<th>Memory Avg(MB)</th>
<th>Memory Avg(%)</th>
<th>Disk IO Avg(%)</th>
<th>Disk Used Avg(GB)</th>
<th>Disk使用 Avg(KB/s)</th>
<th>Network Avg(KB/s)</th>
<th>Round Trip Latency Avg(ms)</th>
<th>Graphics Intensity</th>
<th>VDI Fit</th>
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<td>u002646@Local Directory</td>
<td>1</td>
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<td>7.6</td>
<td>7.98</td>
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<td>52.31</td>
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<td>551.77</td>
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<td>Fair</td>
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<tr>
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Note: The data represents user assessment metrics for various users, including login delay, system and user CPU usage, memory usage, disk I/O, and round-trip latency. The VDI fit column indicates the quality of service, with 'Good', 'Fair', and 'Poor' categories.
Process Continued

- Identify “Good Candidates”
  - Good on all metrics

- Identify “Fair Candidates”
  - Determine the importance of the scores
    - Do you want to concentrate more on Network and Disk IO?
    - Change your weights to review an overall score
    - You can grant larger memory sizes and CPU for specific users
    - But your infrastructure has limits in terms of network bandwidth and number of HBAs
What tools are available for measurement before and after?

- Liquidware Labs
  - data is pulled back to a central console
- Quest
- Lakeside Software
- Roll your own perfmon light-weight collection
  - Need to script pull back of data to central location
- Teamquest light-weight collection
  - pull back to central console
- Microsoft Assessment and Planning Toolkit (MAP)
- Professional Services Vendors
  - VMware Desktop Infrastructure Virtualization Assessment Service
  - Microsoft Professional Services
  - Citrix Professional Services and Partners
Free, yes FREE VDI assessment tool from Quest

NicholasPapé
7 Mar 2011 12:41 PM

FREE VDI assessment tool from Quest in the form on an appliance that can be downloaded and can scan your estate hunting out candidates for desktop virtualisation.
- Quest have acquired the code from Liquidware Labs and provide it as a VMware (tut) virtual machine

From the Quest website: -
"Quest VDI Assessment:
- Identifies which users are a best fit for VDI, Terminal Server/RD Session Host, off-line VDI, application virtualization and blade PCs
- Analyzes and reports on your current network, user and application usage
- Assesses the viability of a Windows 7 deployment
- Pre-determines desktop, network, data center and storage needs to help you build a successful plan to migrate and manage your users with virtual desktops and applications"

So
Microsoft Assessment and Planning (MAP) Toolkit for Windows 7 & Windows Internet Explorer 8

- The MAP Toolkit is an inventory, assessment, and reporting tool that assists in inventorying small or large IT environments without agents being installed.
- The MAP Toolkit uses Windows® Management Instrumentation (WMI), Active Directory® Directory Services (AD DS), SMS Provider, and other technologies to collect data in your environment without using agents.
- Windows Management Instrumentation
  - WMI is used to collect hardware, device, and software information from the remote computers.
  - This inventory method is required for all assessment scenarios and must be enabled on all remote computers.
    - The Inventory and Assessment Wizard will not provide an option to enable WMI:
    - You must enable it through Group Policy settings, logon scripts, or manually on each computer.
Map Toolkit Server/PC Discovery

- **AD DS.** Use this method if all computers and devices you plan to inventory are in AD DS.

- **Windows networking protocols.** Use this method if the computers in the network are not joined to an AD DS domain.

- **Microsoft System Center Configuration Manager.** Use this method if you have System Center Configuration Manager in your environment and you need to discover computers that System Center Configuration Manager servers manage.

- **Import computer names from a file.** Use this method if you have a list of up to 120,000 computer names that you want to inventory.
  - **Example:** If you want to review candidacy for a subset of your environment for a specific set of departments

- **Scan an IP address range.** Use this method to target a specific set of computers in a branch office or specific subnets when you only want to inventory those computers. You can also use it to find devices and computers that cannot be found using the Computer Browser service or AD DS.

- **Manually enter computer names.** Use this method if you want to inventory a small number of specific computers.
Citrix BLOG- How many VMs can I get on each box?“.

- “How many VMs per core?”
- “How many IOPS per VM
- It Depends!
Examples

Customer A:
- Stack: XD4 + PVS561 + XS55
- VM Config: Win7 w/ 1 vCPU, 1 GB RAM and 3 GB wC drive (20 GB vDisk)
- Hardware: 2×6 w/ 96 GB RAM
- App Delivery: XA and AppStreaming for 99% of apps (only 2-3 apps installed locally!)
- Profiles: UPM w/ folder redirection
- AV: None
- Monitoring: ES enabled and redirecting monitoring data to the wC drive
- Optimizations: Yes (according to Citrix best practices)
- Other: XS DMC enabled
- Storage: 100 GB LUNs in RAID10 (~33 VDIs/LUN)
- Density: 120 VMs/box (10 VMs/core)
- Bottleneck: Memory
- IOPS: 7 total average IOPS/VM

Customer B:
- Stack: XD5 + vSphere41 (with TP at the VM layer)
- VM Config: Win7 w/ 1 vCPU, 2 GB RAM and 42 GB image (only using ~29 GB on average due to TP)
- Hardware: 2×8 w/ 256 GB RAM
- App Delivery: All apps installed locally
- Profiles: Local profiles
- AV: McAfee (not “optimized” according to Citrix best practices)
- Monitoring: ES enabled
- Optimizations: Some (definitely not all)
- Other: No VMW memory over-commitment features enabled
- Storage: 1 TB LUNs in RAID5 (23-34 VDIs/LUN depending on how you look at it with over-subscription/TP)
- Density: 110 VMs/box (6.875 VMs/core)
- Bottleneck: CPU
- IOPS: 24 total average IOPS/VM
Let’s understand impact of Profiles and Provisioning Servers with Citrix XenApp
XenDesktop Overview

- **Desktop Delivery Controller (DDC).** Installed as an infrastructure component on servers, the controller authenticates users, manages the assembly of users’ virtual desktop environments, and brokers connections between users and their virtual desktops.

- **Virtual Desktop Agent (VDA).** Installed on each virtual desktop, the agent communicates with the DDC and enables a direct ICA (Independent Computing Architecture) connection between the virtual desktop and the users’ endpoint device.

- **Desktop Receiver.** Installed on users’ endpoint devices, the Desktop Receiver enables direct ICA connections from endpoint devices to virtual desktops. The XenApp plug-in can also be used in place of the Desktop Receiver.
XenDesktop Overview

- Desktop Delivery Controller for brokering, remoting and managing the virtual desktop
- Citrix Provisioning Services for OS provisioning
Distribution of roles to 3 virtualized brokers tested to support 5000 sessions:

- **Farm master (DDC1)**
  - Registry configured so that the DDC rejects VDA registrations.
  - Pool Management throttling was configured at 40 desktops, overriding the default of 10% of the pool size (≈160-170 desktops depending on the group).
  - Configured as the preferred Farm Master.

- **VDA registration and XML brokering (DDC2 and DDC3)**
  - The pool management configuration change was made in case pool management failed over to a different VDA.
XenDesktop Controller

- XenDesktop controller is responsible for:
  - Authenticating users against Active Directory
  - Enumerating available resources
  - Creating registrations for newly started virtual desktops
  - Maintaining an active heartbeat with online virtual desktops

- The controller can become a bottleneck during boot or logon storms where hundreds or thousands of users connect to the environment in a short amount of time
  - Creating multiple servers, the overall XenDesktop farm can support more virtual desktops and respond faster.
  - XenDesktop implementations should have redundant controllers to provide fault tolerance.

- Servers can be virtualized
- Functions can be separated
Citrix Provisioning Server Overview

- Provisioning Server’s infrastructure is based on software-streaming technology
  - Using Provisioning Server, administrators prepare a device (Master Target Device) to be imaged by installing an operating system and any required software on that device.
  - A virtual disk (vDisk) image is then created from the Master Target Device’s hard drive and saved to the network (on Provisioning Server or back-end storage device).
  - Once the vDisk is available from the network, a target device no longer needs its local hard drive to operate, as it boots directly from the network.
  - The Provisioning Server streams the contents of the vDisk to the target device on demand, in real time. The target device behaves as if it is running from its local drive.
Performance Considerations with Design

- **Provisioning Server - Needs more memory!**
  - Provisioning services relies on fast access to the blocks within the disk image (vDisk) to stream to the target devices. The faster the requests are serviced, the faster the target will receive.
  - Allocating the largest possible size for the system cache should allow Provisioning services to store more of the vDisk into RAM as opposed to disk.
- **Will improve Read response times**
  - The operating system plays a large role in how large the system cache can become.
    - Windows Server 2003/2008 x32: 960 MB
    - Windows Server 2003/2008/2008 R2 x64: 1 TB
Key benefits of using Profile management

- **Consistent Experience: Increases user satisfaction and improves productivity**
- **Reliable roaming experience:**
  - Ensures that personal settings, documents, shortcuts, templates, desktop wallpapers, cookies and favorites always follow the user across different Windows environments on any device.
- **Faster logon times:**
  - Provides the ability to control and reduce the profile size, which improves the logon times.
- **Better Management: Reduces administrative burden**
- **Profile size control:**
  - Enables administrators to only include specific files and folders or exclude unnecessary ones
    - Reduce data storage and network overhead and improve logon times
- **Easy to implement and simple to maintain:**
  - Enables administrators to automatically migrate existing user settings and choose at a granular level which profile information to keep or discard. It runs as a system service, and does not require any additional servers, services, or databases or changes to logon scripts.
VDI Cluster in VMware
VDIs on VMware

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VDI Configurations and Architecture are not simple

- Configurations are often complex
- Supporting multiple different types of endpoints and streaming applications to these endpoints
- Solutions for streaming the applications and creating VDIs on Hosted Servers is not simple.
  - Hosted solutions from Xenserver, Microsoft Hyper-V and VMware
  - Microsoft and Citrix XenApp for virtualization and streaming
- Performance and Capacity Planning is fairly complex
- Need to review SAN performance, Server performance and measure network latency
- Need to consider the establishment of dashboards to highlight where trouble may lie.
- There are many moving parts in the configuration.
VMware Measurements - Disk Latency

IO Latency is key metric to review for Good user experience
Make sure that read/write times <10-20 msec
VMware Measurements - Processor Usage

Measure processor Usage and evaluate “density” of VDIs/VMs per host.
Is there room for further consolidation?
VMware Measurements - Memory Usage

- Review memory usage by host
- Measure amount of “shared memory” – how much “sharing” exists in VMware allowing for overallocation of memory
- Measure amount of total memory “consumed”
CPU Usage by VM

Review by VM to identify Users/VDIs using high CPU
VDI Trouble-shooting users
Trouble Shooting - Profile Server

![AppResponse Xpert Console](image)

**Project 1**

2012-04-19 09:37

- **Profile Server**
- **VOI, NY**
- **VOI, NJ Provisioning Servers**
- **VOI**

**app: VDI Profile**

- **Mean**
- **Value**
- **Unit**

- Prevention Requests (TCP Clients)
- Prevention Requests (TCP Servers)
- Prevention Failed (TCP Clients)
- Prevention Failed (TCP Servers)
- Mean Response Time (Clients)
- Mean Response Time (Servers)

- **Max**
- **Value**
- **Unit**

- Throughput (Inbound and Outbound)

![Graph showing data](image)
VDI Reviewing Traffic From Provisioning Servers
Response time for Profile Server
Before vs. After VDI Assessment

What is user experience?

- Develop survey/questionnaire and make sure there are no problems with the user’s experience
- Measure network latency, login times, application load times for all users and ensure there are no issues
- Compare their resource usage before vs. after virtualization
  - IO usage, Memory usage, Network usage
  - Is it similar? Is it greater?
  - Processor usage of course will differ and should consider normalizing the data and modeling the expected usage.
- Do some users need more resources?
- What is the capacity on the hosts? Do you need to add more resources?
- Monitor and track usage on the SAN
- Monitor network load and network latency
- Pilot first and roll-out slowly- so you can monitor and “tune” as you go.
References


- Best Practices for Citrix XenDesktop with Provisioning Server

- Getting Started with Citrix XenDesktop 2.1 (CTX118041)
- Desktop Delivery Controller 2.0 Administrator's Guide (CTX116843)
- Citrix Provisioning Server Administrator’s Guide (CTX117916)
- Citrix Provisioning Server 5.0 Installation and Configuration Guide (CTX117917)
- Best Practices for Configuring Provisioning Server on a Network (CTX 117374)

- Delivering 5000 Desktops with Citrix XenDesktop

- Validation Report and Recommendations for a Scalable VDI Deployment using Citrix XenDesktop and Provisioning Services, NetApp Storage and VMWare Server Virtualization