Summary
This article contains information about the Best Practices for Provisioning Services 5.x and 6.x

General

Provisioning Services Caching

Caution! This fix requires you to edit the registry. Using Registry Editor incorrectly can cause serious problems that might require you to reinstall your operating system. Citrix cannot guarantee that problems resulting from the incorrect use of Registry Editor can be solved. Use Registry Editor at your own risk. Be sure to back up the registry before you edit it.

- Install Provisioning Services as x64 to leverage Large System Cache if Server has enough memory.

- Activate Large System Cache on Provisioning Services:
  HKLM\SYSTEM\CurrentControlSet\Control\SessionManager\MemoryManagement\LargeSystemCache
  Value=1 (DWORD)

Note: This is for Windows 2003 and specifies whether the system maintains a standard size or a large size file system cache, and influences how often the system writes changed pages to disk - [http://technet.microsoft.com/de-de/library/cc784562%28WS.10%29.aspx](http://technet.microsoft.com/de-de/library/cc784562%28WS.10%29.aspx)


Refer to the following Knowledge Center articles for additional information:
CTX119469 - Understanding Write Cache in Provisioning Services Server

Process for Computer Account Password Change
Refer to Citrix Knowledge Center article: CTX125744 - [entryID]CTX125744[/entryID]

High Availability Timeouts

Configure High Availability Server FailOver TimeOuts – Registry Settings to Improve Failover Times for Citrix Provisioning Services on target machine - CTX119223 - [Regi ...](https://technet.microsoft.com/de-de/library/cc784562%28WS.10%29.aspx)

- HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\BNIStack\Parameters \losPacketTimeouts <DWORD>

- HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\BNIStack > Parameters > \losRetryLimit <DWORD>
**Note:** Tuning this key can reduce failover from maximum 95 sec. down to 2 sec. Remember that Target Device does not start to toggle between Provisioning Services servers.

**Streamed Targets**
- Provisioning Services Daylight Saving Time problem, 1 hour time difference and impact on Kerberos authentication (impacts all streamed targets)
- For additional information, see the attached pdf.

**Desktops**
- If changes are made to default console port of Provisioning Services, do this for MCLI as well:
  - “mcli.exe run SetupConnection –p Port=PortNumber”
- Same applies to “SetupToolApplication.exe.config” for XenDesktop 4 Setup Wizard
- If your environment is based on MS SMS 2003, you should consider [http://support.microsoft.com/kb/828367](http://support.microsoft.com/kb/828367) to avoid duplicate GUIDS.

**Database**

**SQL Permissions for Provisioning Services Database**
1. To install Provisioning Services, the user must have local administrator privileges. **Note:** This user does not require any permission to access the db.
2. The user running Configuration wizard must have SQL administrator permission (sysadmin) to be able to create and configure the db.
3. The user which Stream/SOAP services run as, must have db_datareader and db_datawriter roles:
   - CTX120080 - [Service Account Configuration for Accessing SQL](http://support.microsoft.com/kb/828367)
   - Use DBSCRIPT.exe to pre-create DB on SQL server.
   - If you cannot connect to SQL2008, then leave the instance empty as well as port while running configuration wizard. You must point to the IP address of the SQL server.

**Network**

**Network Impact**
- Provisioning Services uses an optimized UDP-based protocol to communicate with the target devices
Data is streamed to each target device only as requested by the OS and applications running on the target device.

In most cases, less than 20% of any application is ever transferred.

Network utilization is most significant when target devices are starting as the OS loads, after target devices start, there is minimal network utilization.

Use NIC Teaming whenever possible.

**Network Components**

Configure active network components accordingly:

<table>
<thead>
<tr>
<th>Switch manufacturer</th>
<th>Fast Link option name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisco</td>
<td>PortFast or STP Fast Link</td>
</tr>
<tr>
<td>Dell</td>
<td>Spanning Tree FastLink</td>
</tr>
<tr>
<td>Foundry</td>
<td>Fast Port</td>
</tr>
<tr>
<td>3COM</td>
<td>Fast Start</td>
</tr>
</tbody>
</table>

**Note:** For additional information, check CTX117374 – [Best Practices for Configuring Provisioning Services Server on a Network](#).

**PXE or Network Boot**

1. Create a dummy collection in Provisioning Services console and enable the **Auto-Add** feature in the farm.
2. Create a target device inside the dummy collection and define as template.
3. Assign a small vDisk (that is 100 MB) and select **Boot** from Hard Disk.
4. In site properties, point the **Auto-Add** feature to dummy collection. This ensures that no machines are unresponsive and showing **No vDisk found** if configured to PXE boot and no target device entry is created in the Provisioning Services database.

**TCP Offloading**

1. Set following registry keys in vDisk - Golden Master (Target Device):
   
   ```
   HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\BNNS\Parameters\ DWORD = EnableOffload
   Value "0"
   ```

2. Disable TCP **Large Send Offload** for Provisioning Services driver:
   a. Adds latency as packets re-segmented
   b. Must be set on Provisioning Server and Target Device:
      
      ```
      HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\TCP\Parameters\ 
      ```
Key: "DisableTaskOffload" (dword)
Value: "1"

3. Disable PV NIC (VIF) TCP offload.

4. Try to synchronize all MTUs across your network if possible.
   Do this on Virtual Desktop Agents, Provisioning Services, XenServer to avoid
   network problems when tunneling protocols, adjust MaxICAPacketSize, and all MSS
   accordingly.

**Note:** For additional information about TCP/IP and Large Send Offload, see the
following Knowledge Center articles:
CTX117374 – [Best Practices for Configuring Provisioning Services Server on a Network](http://support.microsoft.com/kb/949589)
CTX117491 – [Excessive Retries Occur when a Provisioning Server Target Device is Deployed on a XenServer Platform](http://support.microsoft.com/kb/949589)

**ARP Cache Changes – Windows 2008 / Vista / Windows 7**
The default lifespan of ARP cache entries was lowered from 10 minutes in Windows
Server 2003 to a random value between 15 and 45 seconds in Vista/W2K8. As a result,
the Provisioning Services bootstraps are 20 times more likely to experience a timeout
during a Vista/W2K8 boot. The workaround is to increase the ARP cache entry lifespan
for Provisioning Services -bound NIC’s: Provisioning Services Server and VDA:

1. Open a command shell window. At the command prompt, enter the following
   command:
   ```
   netsh interface ipv4 show interfaces
   ```
2. To set the ARP cache entry lifespan to 600 seconds, enter the following command:
   ```
   netsh interface ipv4 set interface <PVS interface number>
   basereachable=600000
   ```
3. To verify the new setting, enter the following command:
   ```
   netsh interface ipv4 show interface <PVS interface number>
   ```
   **Note:** The Base Reachable Time should be set to 600,000 ms, and the Reachable
   Time to a value between 300,000 and 900,000 ms.

   For more information, refer to [http://support.microsoft.com/kb/949589](http://support.microsoft.com/kb/949589).

**VMXNet3 and Streaming Issues**
Refer to article CTX125361 - [Target Device Fails to Start with VMXnet3 Drivers](http://support.microsoft.com/kb/949589) to fix
problems with VMXNet3 drivers.

**Boot Sector / PAE / TFTP**

**Boot Sector**
If Target Device would not start with bootloader or NTLDR not found:
• Verify this partition has 0x20 reserved sectors in MBR: run dskprobe.exe, read from PhysicalDrive1 (local disk) sector 0. Verify data offset 0x1c6 is 0x20.

• To verify, this partition has 0x20 reserved sectors in PBR: run dskprobe.exe, read from PhysicalDrive1 (local disk) sector 32. Verify data offset 3 is 'NTFS' and offset 0x18 is 0x20 (when formatting with some SCSI/Raid controllers windows format places a 0x3F in this location which causes the machine not to start).

**PAE**

When Windows 7 does not start, it is likely caused by PAE (Advanced Memory Support). Starting in 5.1.2, this option is enabled by default in the Bootstrap. However, in the BDM and Bios Bootstrap (OROM in DELL FX Series), this option is still disabled by default. Windows 7 and newer always require PAE to start in RAM Cache mode. This is the reason why PXE works and BDM and OROM does not, if not rewritten or configured properly

**Note:** For additional information, refer to:
CTX126107 - Error: "vDisk Not Available" When Creating a New vDisk After Reboot Using BDM ISO

**TFTP**

• Use TFTP32.exe (Freeware) or DHCPExplorer (free from SoftPedia.com) to discover which TFTP/PXE services are already running in the environment.

• In order to bind TFTP Daemon to a specific NIC/Port, configure logging for TFTP Daemon, set the “GET” Directory (server side) and use:
  “%Program Files%\Citrix\Provisioning Services\tftpcpl.cpl”

• In order to bind TFTP Daemon to a specific NIC/Port, configure logging for TFTP Daemon, set the “GET” Directory for the TwoStageBootloader (server side) and use:
  “%ProgramFiles%\Citrix\Provisioning Services\tsbcpl.cpl”

• In order to bind the Stream service to specific NIC (target device side) use:
  “%ProgramFiles%\Provisioning Services\bindconfig.exe”

• If in your environment PXE/TFTP has problems with finding ardbp32.bin or tsbbdm.bin you should check the following registry keys:
  - Default configuration sets the TFTP directory to
    “C:\ProgramData\Citrix\Provisioning Services\Tftpboot”
    HKLM\SYSTEM\CurrentControlSet\Services\BNTFTP\Parameters\GetDirectory)
  - If tsbbdm.bin, for example, is not found during boot:
    Try to copy the file from “C:\Program Files\Citrix\Provisioning
vDisks
Common vDisk Tuning
1. Delete Bitlocker 100 MB Partition during setup of Golden Master using Shift+F10 during first setup screen of the installation > Start “Diskpart” - and inside “Diskpart” tool complete the following steps:
   a. select disk 0
   b. clean
   c. create partition primary
   d. select partition 1
   e. format fs=ntfs quick
   f. exit

2. Disable Last Access Timestamp of Files in vDisk (can be done through XenConvert optimizer)
   “FSUTIL behavior set disablelastaccess 1”

   Note: You can add many customizations through editing optimizations.xml in XenConvert directory (target device side)

3. Prior to building any vDisk Flush the DNS Resolver Cache:
   “ipconfig flushdns”

4. Run chkdsk before starting XenConvert or Imaging Wizard.

5. Use Sysinternals sDelete –c driveletter to zero out empty vDisk areas and reduce storage when creating golden master.


7. Configure redirection of spool directory, virus patterns, RADECache, EdgeSight DB, AppSense Profile, Databases, Event logs, Log files to a persistent CacheDisk or CacheVolume if possible

8. If provisioning hardware, you must use newest BIOS or Firmware to avoid hardware conflicts.

9. If XenConvert throws an error while creating the vDisk, try to exclude directories through XenConvert.ini, which could not be copied.

10. If virtualizing XenApp Server Configuration Tool 1.1 for XenApp 6 Sealing before Provisioning Services image creation (includes preparation for MSMQ):
   CTX124981 - XenApp Server Configuration Tool - Update 1.1.0 for XenApp 6 for Windows Server 2008 R2

vDisk Updates

Provisioning Services 5.x
- Do updates by modifying a copy of the golden master vDisk and assign updated vDisk later.
- If possible, keep golden master machine if you are required to update components, which modify the network stack (xentools, vmwaretools, target device driver)
- Use Hyper-V to upgrade vDisks - refer to the Knowledge Center article CTX124791 - Citrix Provisioning Services 5.6 SP1 Installation and Configuration Guide

Provisioning Services 6.x
- Do updates by creating a new version of the vDisk and modifying the maintenance version. When the update is ready, promote the version to test. After testing, promote the version to production using immediate or scheduled availability.
- Schedule merge of the vDisk versions after a number of versions have been created to save space and increase performance.

Disk Type
- As Virtual Hard Disk (VHD) expands:
  - Disk can become fragmented on physical media
  - Expansion algorithm occurs in 1 MB increments
  - Rapid expansion wreaks havoc on SAN such as first boot or page file creation
- Alignment issues
  - Constructed with extra byte at end of file
  - Dynamic VHD always misaligns disk with storage
- Use only fixed-size VHDs for write-cache drives and Provisioning services vDisk

High Availability per Component
- Use High Availability (HA)-Setup for DHCP and TFTP Services
- Load Balance TFTP (NetScaler VPX is a good option)
- Use multiple DDCs for redundancy (XD-Farm)
• Use multi-server PVS Farms – Target devices can switch to other PVS when streaming PVS gets unavailable

• Use streamed apps - multiple profile shares + NetScaler for Load Balancing

• Use load-balanced XenApp-Farms for best load distribution and user density

• Use HA for License server because in file mps-wsxcia_mps-wsxcia.ini information about licenses + timestamp are stored during contact of license server. In standard image mode this file cannot be updated and 30 days after vDisk creation, there will be no grace period if license server goes down because timestamp is too old

• Use STAs of XenApp Farm, because health checks are available and can be used

• Implement NetScaler VPX for redundancy of TFTP

• Use multiple PVS Servers for high availability and redundancy

• vDisk-images on fast local RAID Disks, SAN or NAS

• Place PVS Servers as near as possible to target devices for high performance and bandwidth

**Note:** For additional information, refer to:
CTX116337 - [How to Load Balance Trivial File Transfer Protocol Servers](#)
CTX119286 - [Provisioning Server High Availability Considerations](#)

**Performance**

**Traffic Bottleneck if only 100Mbit Available**

• Resource bottlenecks are mostly I/O related and hardly ever RAM or CPU dependent, test scalability if write cache on server should be used

• Amount of write cache is related to user activity and applications used (check in PoC or real world scenario)

• Never use power settings like hard disk power savings on Provisioning Services (server disks)

• The following will effectively disable TSO and increase the performance substantially with XenServer 5.5 (it is enabled by default in XenServer 5.6):

  1. Create registry key
     HKLM\System\CurrentControlSet\Services\xenevtchn\Parameters
  2. Create a DWORD value called SetFlags in that key and set it to 30000 hexadecimal
  3. Restart the Virtual Machine and test it
     ▪ Hotfix CPVS51SP2E003 – described in the write cache section
Storage

NFS Storage Usage
Maximum benefit from the Read-Only vDisk Storage feature can be obtained in environments that use SAN for vDisk storage and are using client-side write-back cache (disk or RAM). In these environments, use of this feature eliminates the requirement to deploy shared or clustered file system software, reducing deployment costs and complexity, and maximizing scalability and performance.

Notes
- When running the `mount IP-Address:/vol/vf000/foobar x:` command to mount a NFS share, Windows translates the path into a normal UNC
- Use `\IP\vol\vf000\foobar` when configuring the store (as UNC Path)

VHD and Storage Alignments
The VHDs must be fixed because internal structure of dynamic VHDs is different and can cause alignment problems concerning disk subsystem (that is NetApp- Filer). There is a whitepaper created by NetApp covering alignment considerations (same applies to Hyper-V VHDs).
- For vDisks use RAID 5 (read-intensive), for Write Cache use RAID 1 / RAID10 (write-intensive) enable Write Back Cache /and ensure there is a Battery Backup Unit for RAID Controller/ SAN Systems in place

Additional Information
When using write caching on local device HDs, CPVS51SP2E026 introduces a fix to allow for alignment by default on a 4K boundary. This is particularly applicable in a virtual environment where the local disks attached to the Virtual Machines are actually Virtual Desktop Infrastructures (VDIs) stored on Storage Area Networks (SANs). The hotfix allows for full alignment when reading and writing the cache data thereby improving the performance of the SAN.

Storage Recommendations

<table>
<thead>
<tr>
<th>Disk Speed</th>
<th>Random IOPS</th>
<th>RAID Level</th>
<th>Write Cost</th>
<th>Activity</th>
<th>IOPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>15,000</td>
<td>150</td>
<td>0</td>
<td>1</td>
<td>Startup</td>
<td>26</td>
</tr>
<tr>
<td>10,000</td>
<td>110</td>
<td>1 or 10</td>
<td>2</td>
<td>Logon</td>
<td>12.5</td>
</tr>
<tr>
<td>5,400</td>
<td>50</td>
<td>5</td>
<td>4</td>
<td>Working</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Logoff</td>
<td>10.7</td>
</tr>
</tbody>
</table>
• Quick and Dirty estimates:
   5 simultaneous boot ups per spindle
   12 simultaneous logons per spindle
   14 simultaneous logoffs per spindle
   18 simultaneous users per spindle

• IOPS calculations impacted by:
   Disk speed
   RAID level
   Read/Write % (20/80)
   User Activity

• IOPS calculations:

  \[
  \text{Total Raw IOPS} = \text{Disk Speed IOPS} \times \# \text{ Of Disks}
  \]

  \[
  \text{Total Raw IOPS} = 150 \times 8 = 1200
  \]

  \[
  \text{Functional IOPS} = \left(\frac{\text{Total Raw IOPS} \times \text{Write} \%}{\text{RAID Penalty}}\right) + (\text{Total Raw IOPS} \times \text{Read} \%)
  \]

  \[
  \text{Functional IOPS} = \left(\frac{(1200 \times .8)}{2}\right) + (1200 \times .2) = 720
  \]

• Virtual desktops are WRITE intensive (not READ)
   20% Read
   80% Write

• Requires RAID that supports heavy writes
   RAID 1 for 2 disks
   RAID 10 (1+0) for 4+ disks

• RAID 5 is meant for read intensive operations
   Databases
   Provisioning services vDisk storage

**Write Cache Storage Location**

Virtual Desktops per Spindle

<table>
<thead>
<tr>
<th></th>
<th>Boot</th>
<th>Logon</th>
<th>Working</th>
<th>Logoff</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAID 0</td>
<td>5</td>
<td>12</td>
<td>18</td>
<td>14</td>
</tr>
<tr>
<td>RAID 1</td>
<td>3</td>
<td>6</td>
<td>9</td>
<td>7</td>
</tr>
</tbody>
</table>
Spindles required for 60 desktop loads

<table>
<thead>
<tr>
<th></th>
<th>Boot</th>
<th>Logon</th>
<th>Working</th>
<th>Logoff</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAID 0</td>
<td>12</td>
<td>5</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>RAID 1</td>
<td>20</td>
<td>10</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>RAID 5</td>
<td>60</td>
<td>20</td>
<td>15</td>
<td>15</td>
</tr>
</tbody>
</table>

**Note:** For additional information, refer to CTX122296 - *Provisioning Service and Storage Considerations*

**Write Cache**

1. **Planning**
   - Start with write cache on Provisioning Services Server
   - Start with initial size of 2 GB + swap file

2. **Designing**
   - If **target device write cache** is chosen, available space must be sufficient
   - Minimize network impact (limit number of hops)

3. **Implementing**
   - Do NOT use Provisioning Services server
   - Use RAM with extreme caution (if you run out of RAM you do not have time to restart the machine before it becomes unresponsive and you would not get a warning, just a BSOD).
   - Use local disk (shared/local)

**Note:** If you do not have enough space when using RAM cache, the target device stops. If there is not enough local storage for client side cache (local disk/SAN) then if it fills up, it will degrade performance similar to your local drive filling up on a laptop, but it will not stop.

**Calculating the proper size for the write cache**

1. **Planning**
   - Start with write cache on Provisioning Services Server to get some information on write cache – start with initial size of 2 GB + pagefile.
   - **Note:** Hyper-V requires additional space for the memory save file

2. **Designing**
   - Pagefile is written to target device partition where write cache is located, if **target device write cache** is chosen, available space must be sufficient.
   - **Note:** If there is not enough space on the target device’s local drive while starting, the cache will be sent to the server. This only occurs when it determines where to place the local cache and does not find a suitable sized partition locally.

3. **Implementing**
   - Minimize network impact (limit number of hops)
4. To enable a Target Device leveraging locally attached disk for write caching, it is necessary to enable the Windows Auto Mount functionality. This can be done by completing either of the following options:

**Option 1**
- a. Open up command line, start “Diskpart”
- b. type “automount enable”
- c. exit

**Option 2**
- a. Open command line
- b. Execute Mountvol /E

**Write Cache Considerations**
- R/W ration dependent on the environment/load, usually more writes
  - # of reads likely to go up the longer uptime of the target
- RAID 1 or 10 is ok, RAID 5 or 6 *not* recommended (unless a huge amount of spindles)
- Usually local disk system, and in virtualized environments NFS, iSCSI, or FC
- If using server side caching, use multiple write cache paths to increase performance
- RAID controller with battery backed write cache can help a lot
- Remember to set check registry setting (with streamed server OS only):
  - CTX126042 – [When to Enable Intermediate Buffering for Local Hard Drive Cache](#)
- Losing the write cache will cause a BSOD in most cases (might fail over to server side)
  - Things that causes write cache activity to be high
  - Boot / Shutdown / User logging in or off
  - User starting application (streamed or local, hosted should have minimal effect)
  - Application behavior
  - Windows Perfmon <Physical Disk \ Disk Writes/sec> (\ Disk Transfers / sec gives you the whole picture)
- Hotfix CPVS51SP2E003 describes how to enable file buffering for Write Cache if Write Cache size < vDisk size when using Target Device Cache (it has been noticed performance gain up to 350% for Write Cache throughout)

**Note:** For additional information, refer to:
vDisk Store
- Read-only, unless updating:
  - Provisioning Services 5.x: private mode
  - Provisioning Services 6.x: create a maintenance version
- Create a separate set of disks for write cache to better optimize the I/O load
  - NetApp PAM (Performance Acceleration Module)
- Use a disk subsystem that causes the Windows Server to cache the vDisk
  - Not NFS or Windows 2008 R2

**Note:** For CIFS stores, refer to *Provisioning Services and CIFS Stores - Tuning For Performance*
- Almost any RAID level except RAID 0
- Provisioning Services does not take lightly loosing the vDisk connection, use multipathing
- RAID controller read cache can help, especially in larger Provisioning Services farms:
  - All servers must read at least one time
- Things to ask:
  - How many vDisks will be heavily utilized at one time (how many targets with different vDisks are started at the same time)
  - Windows Perfmon <Physical Disk \ Disk Reads/sec> (This gives an idea on the throughput needed)

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