

ArcGIS for Desktop Best Practices in a Citrix XenApp Environment

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Primer - How Compute Intensive is GIS?

- **Processing Intensive (CPU)**
 - Analysis and geoprocessing
- **Memory Intensive (RAM)**
 - Complex applications and MXDs
- **Network I/O Intensive**
 - Data query and analysis
- **Disk I/O Intensive**
 - Data loading and conversion
- **Graphics Intensive (GPU)**
 - Fly-through and 3D



Desktop Key Deployment Considerations

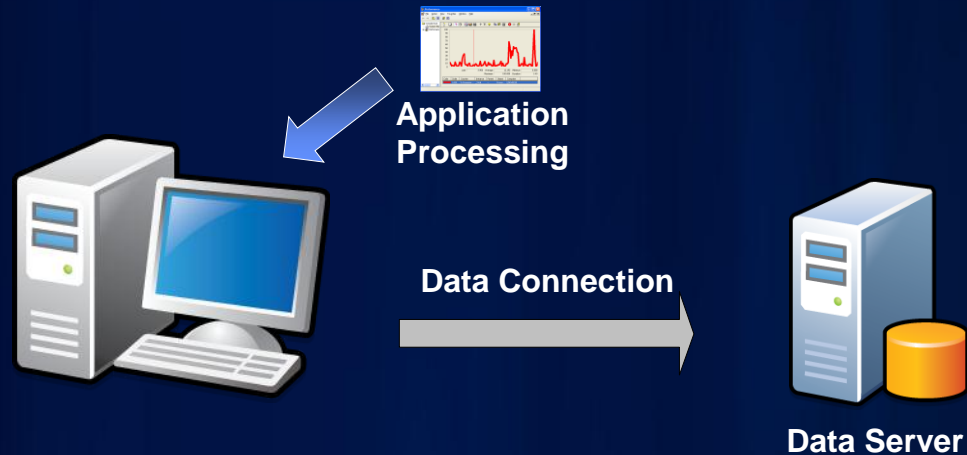
- Before a desktop deployment option can be considered, several factors must be considered.
 - *Desktop processing requirements*
 - *User type and application pattern*
 - *User location relative to the data*
 - *Available network bandwidth*
 - *IT standards / constraints*



Two Traditional Desktop Deployment Options

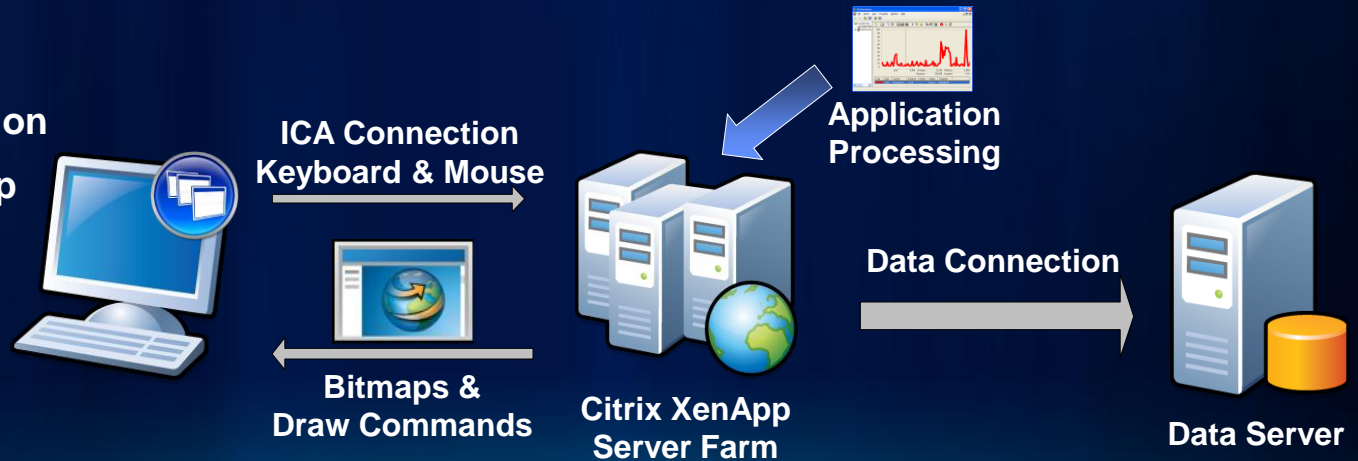
Thick-Client

Classic client/server



Thin-Client

Session Virtualization
via Remote Desktop
Services / Citrix
XenApp



What is XenApp?

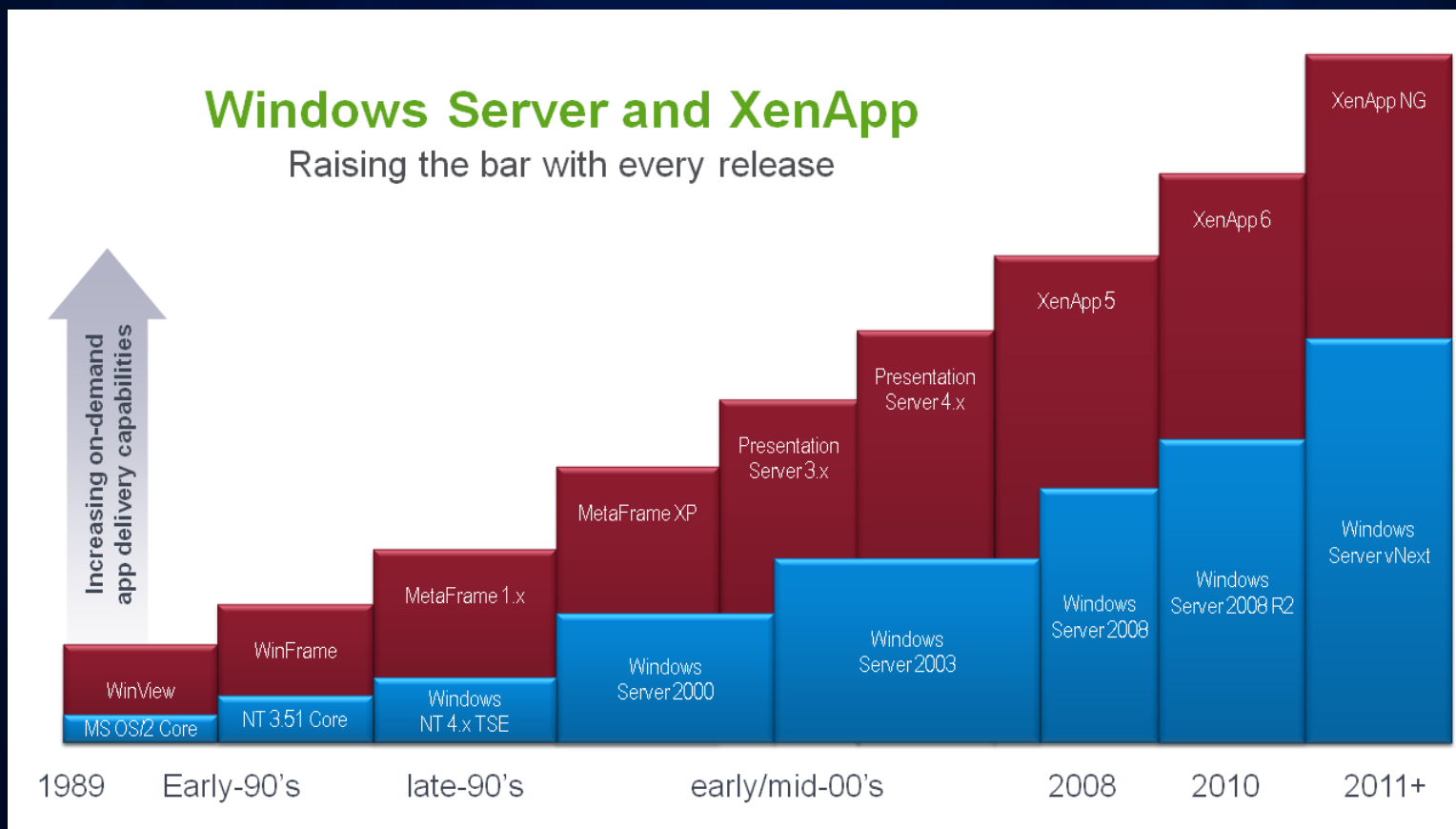
- “Citrix XenApp is the on-demand application delivery solution that enables any Windows application to be virtualized, centralized and managed in the datacenter and instantly delivered as a service to users anywhere on any device.”
- XenApp provides three primary benefits
 - Reduces Application Management Costs
 - Ensures Secure Access
 - Improves Performance
- It provides two methods for delivering application to users
 - Session Virtualization (i.e., thin-client computing)
 - Application Virtualization (i.e., streamed to client computing)

Video – 2.5 min.: How
XenApp Works:
<http://www.citrix.com/tv/#videos/632>

Citrix & Esri History

- **Esri has been working with Citrix and Esri customers deploying Citrix since at least 1998.**
- **Esri has a large deployment base for ArcGIS for Desktop on Citrix.**
- **Original performance testing with Data General in 1998 established thin-client capacity metrics. Various joint testing projects over the years including:**
 - **Scalability testing with 8-core systems**
 - **NetScaler performance testing**
 - **WanScaler (now called Branch Repeater) performance testing**
 - **Graphics enhancement performance testing (which led to SpeedScreen Progressive Display)**
 - **EdgeSight for Load Testing**

Citrix XenApp Release History



XenApp was previously WinFrame, MetaFrame, and Presentation Server

XenApp 6.5 is the current release

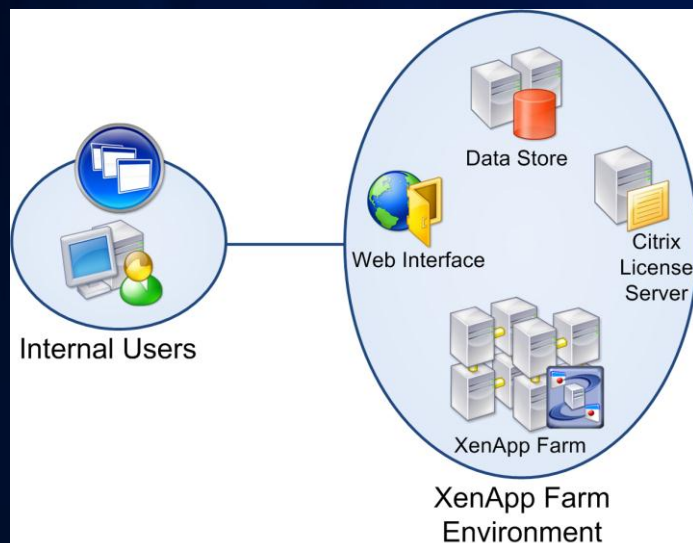
Top 10 Benefits of a GIS Citrix Farm

1. **Supports any device anywhere deployment**
 - **Deploy XenApp based applications on a variety of devices and client operating systems**
2. **Provides Self-Service Applications**
 - **Access applications from portal interfaces based on user credentials**
3. **Consumes less traffic and provides greater stability across WAN connections (i.e., latency tolerant)**
 - **Enables remote GIS users to access GIS desktop across slower / latent WAN connections**
4. **Leverages the power of enterprise class servers**
 - **Fast cores, large memory, 64-bit, Gbit connectivity, cache disk controllers, etc.**
5. **Extends the useful life of user workstations**
 - **No need for costly high-end workstations upgrades for each GIS user**

Top 10 Benefits of a GIS Citrix Farm

6. **Easy to scale over time**
 - **Add additional servers to the farm as user demand grows**
7. **Results in decreased system administration**
 - **Centralized management / configuration of Client GIS software / Upgrades & Patches**
8. **Provides easier detection and resolution of software bugs and performance issues**
 - **Multiple user environment can be monitored more frequently**
9. **Faster turn-a-round for development & QA integration testing**
 - **GIS users can access multiple environments concurrently from their local workstation**
10. **Is secure by design**
 - **User sessions and data are kept in data center**

Citrix XenApp Essential Components



- XenApp Servers
- Data Store
- Data Collector
- License Server
- Web Interface



Data Store (DS)

- Core farm configuration & settings
- Published apps
- Load evaluators
- Citrix administrators
- Server groups



Data Collector (DC)

- Connected sessions
- Disconnected sessions
- Load balancing



License Server

- License file
- Licenses in use
- Licenses available

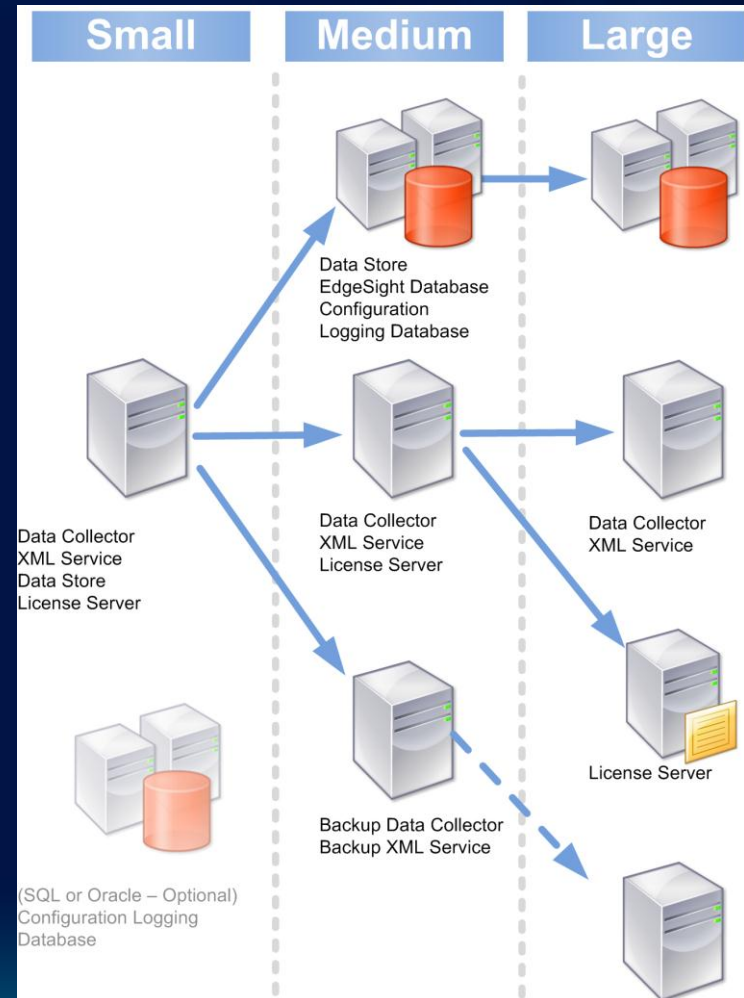


Web Interface

- Portal for Citrix Apps
- Web Plug-In Client
- Customizable

XenApp Farm Design

- XenApp components can be installed all on one server or multiple servers depending upon the size of the farm
- Video – 18 min: Understanding and Designing Presentation Server Farms
<http://www.citrix.com/tv/#videos/1364>
- Video – 28 min: Fundamentals of the Presentation Server Architecture:
<http://www.citrix.com/tv/#videos/1369>



Citrix XenApp Support



- Which XenApp Version is “Supported” by Esri?
 - All versions are known to “work”
 - XenApp 4.5 or higher is recommended primarily due to HDX 3D technology (discussed later)
 - Esri has certified **ArcGIS 10 SP2** as a hosted application with Citrix XenApp 6 and Windows 2008 R2 using the Citrix ICA Online Plug-in for Windows 12.1.
 - Esri has certified **ArcGIS 10.1** as a hosted application with Citrix XenApp 6 and XenApp 6.5 with Windows 2008 R2 using the Citrix ICA Online Plug-in for Windows 13.1.
 - ArcGlobe, ArcScene, and any other 3D application generally will not work well over Remote Desktop or other Windows Terminal Services clients, because these clients do not support 3D graphics acceleration.

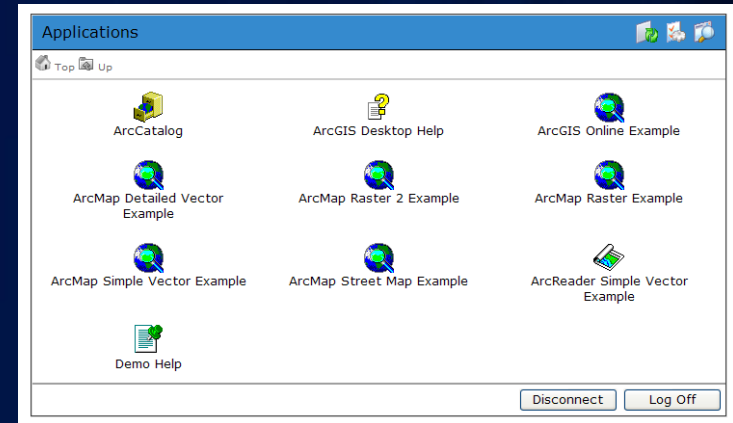
ArcGIS for Desktop Installation on Citrix



- **Installation process is identical as a local workstation**
- **Follow best practices for application installation in a RDS environment (i.e., use “install mode”)**
 - Install applications on Terminal Server via Add/Remove Programs with Windows 2003
 - Install applications on Terminal Server via Control Panel with Windows 2008
- **Install the 32-bit DBMS client on the XenApp servers for Direct Connect support**
 - SQL Server native client needed at 9.3.1 only if using new Spatial Data Types which requires SQL Native Client
 - SQL Server native client is included with 10 install and is required for Direct Connect at 10

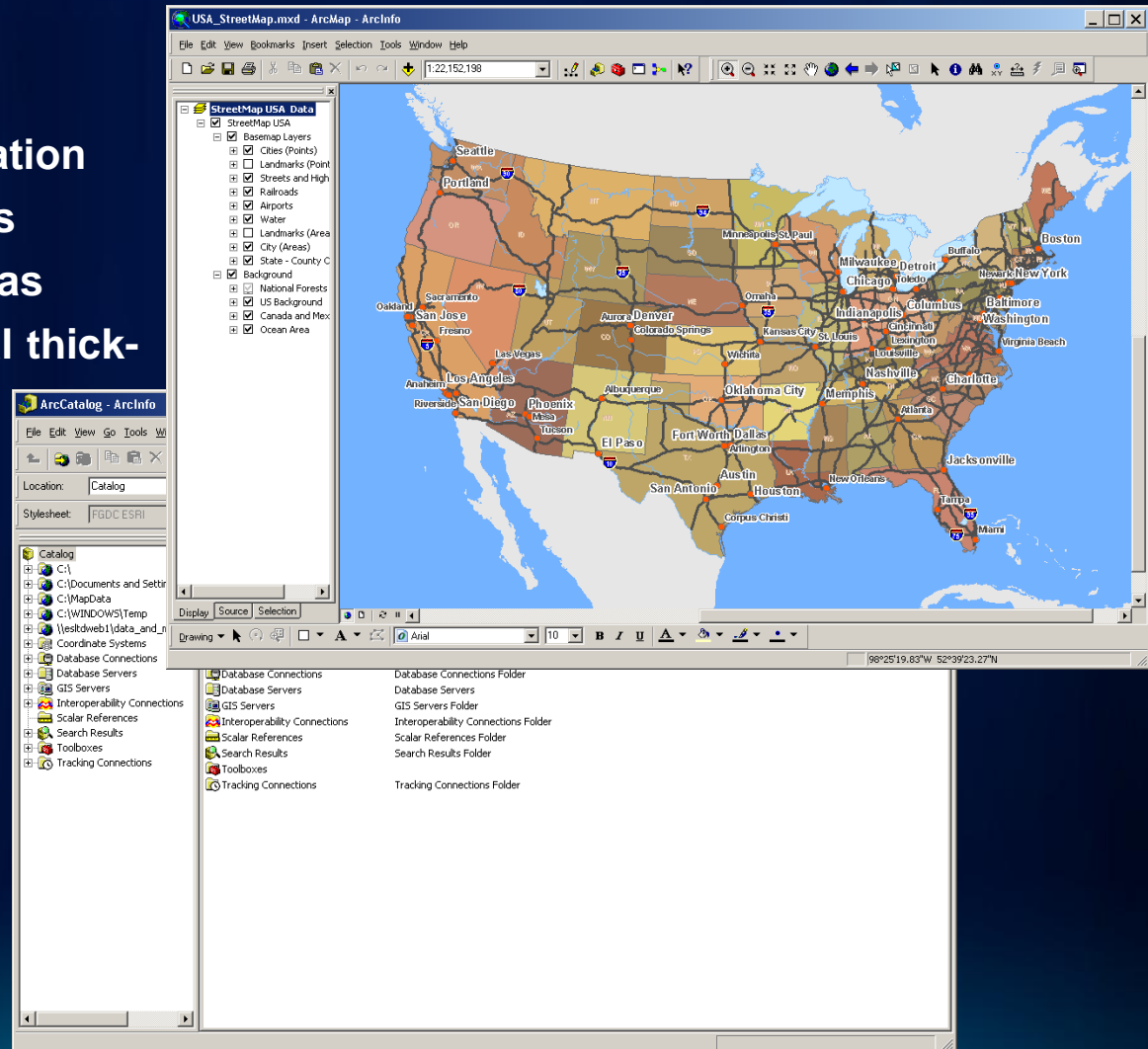
Application Publishing and Access

- GIS applications are published like any other application
- Different icons can be published representing ArcMap, ArcCatalog, etc.
- Applications can be accessed using web client via Citrix Web Interface or directly via plug-in client
- Application access is managed by the publishing tools and application icons are only visible to those users that require access



GIS Application “Look and Feel”

- “Seamless” application publishing provides similar experience as compared to typical thick-client access

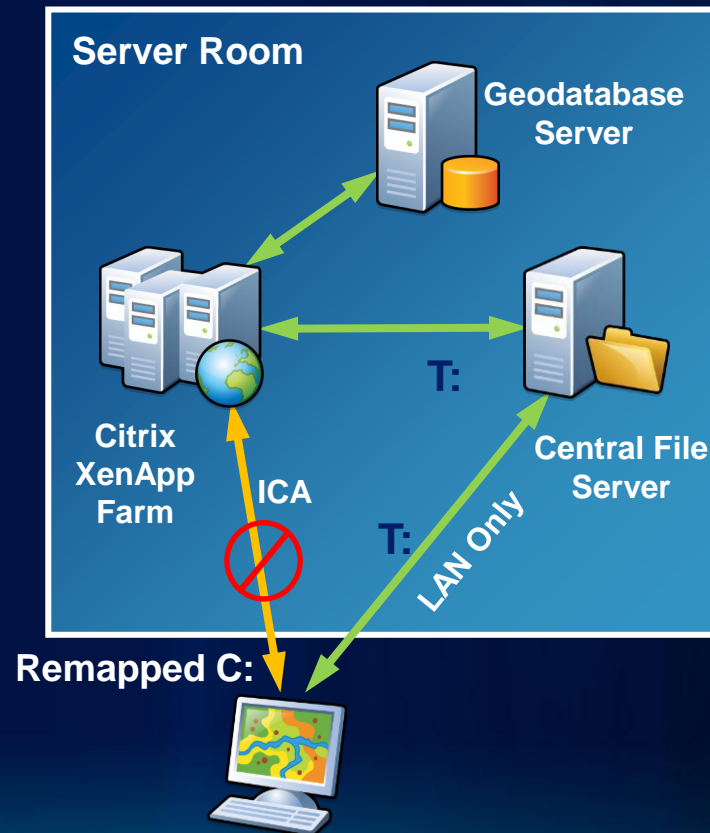


Managing Esri Licenses

- Default Terminal Server behavior is utilize existing session for additional application launches which results in single Esri license checked
- Environment Variables for Supporting Multiple ArcGIS License Sessions on Same Citrix Terminal Server:
 - ArcInfo: ESRI_SOFTWARE_CLASS=Professional
 - ArcEditor: ESRI_SOFTWARE_CLASS=Editor
 - ArcView: ESRI_SOFTWARE_CLASS=Viewer
 - **Note: The environment variables are case sensitive**
- Example Two-Line Batch File for Launching Specific ArcMap Published Applications (.MXD) with a Viewer License
 - Set ESRI_SOFTWARE_CLASS=Viewer
 - ArcMap.exe <local_machine>:\ <PublishedApp.mxd>

Managing Central File Server Access

- Minimize use of “remapped” client drives
- Utilize central file server for project files, data, profiles, etc. (critical for WAN)
- Optional similar mapping directly from client (LAN environments only)

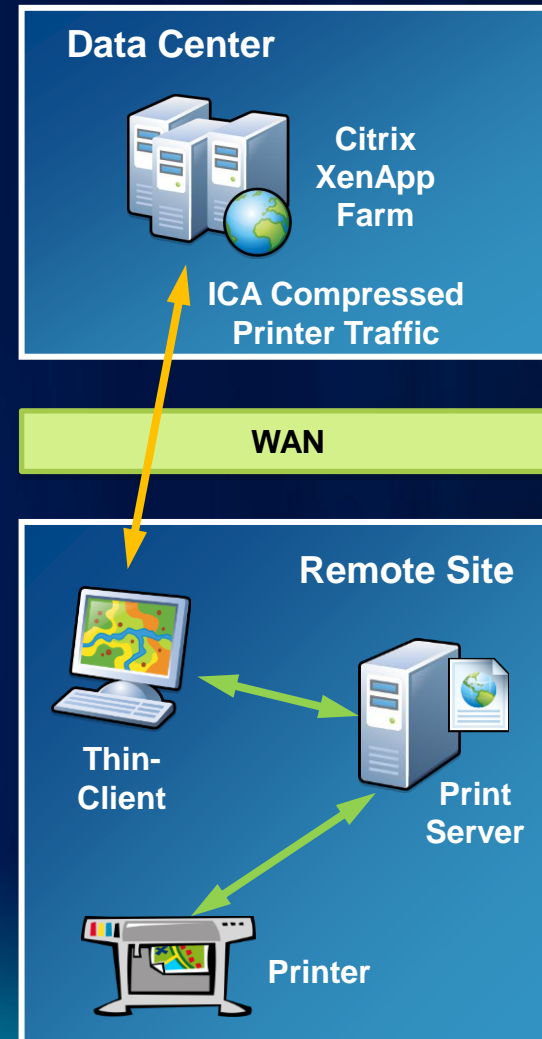


Managing Central Profiles

- Utilize roaming profiles vs. local server profiles to ensure same experience regardless of which server a user lands on
- Hybrid approach (copy in/out portions of profile that are updated including normal.mxt, etc.) and use folder redirection
- Investigate use of Citrix Profile Management
- Profile options: <http://support.citrix.com/article/ctx120285>

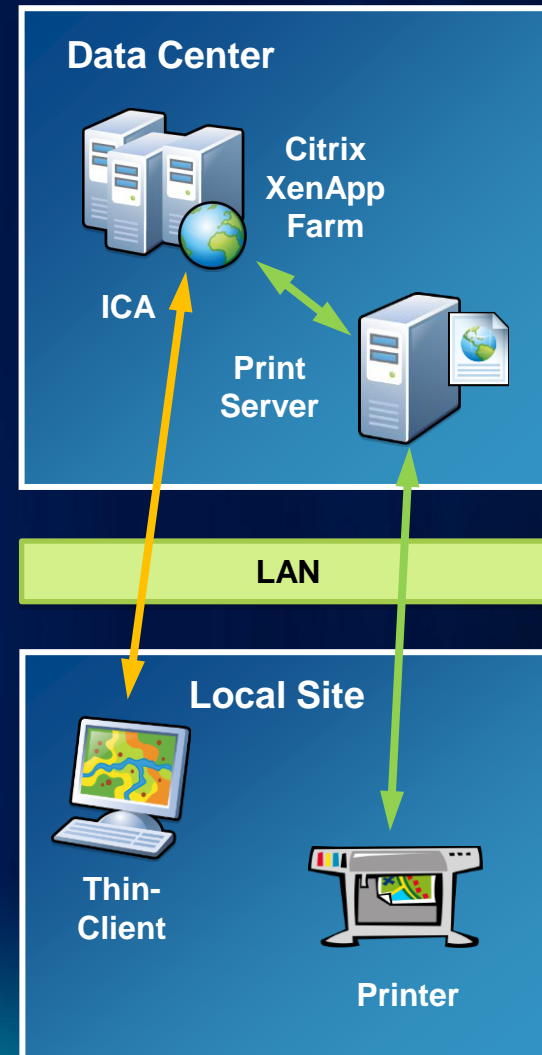
Printing with Citrix XenApp

- When printing jobs cross a network with limited bandwidth (i.e., WAN), Citrix recommends routing jobs through the client device so that the ICA protocol compresses the jobs and enables the administrator to limit the maximum consumable bandwidth.



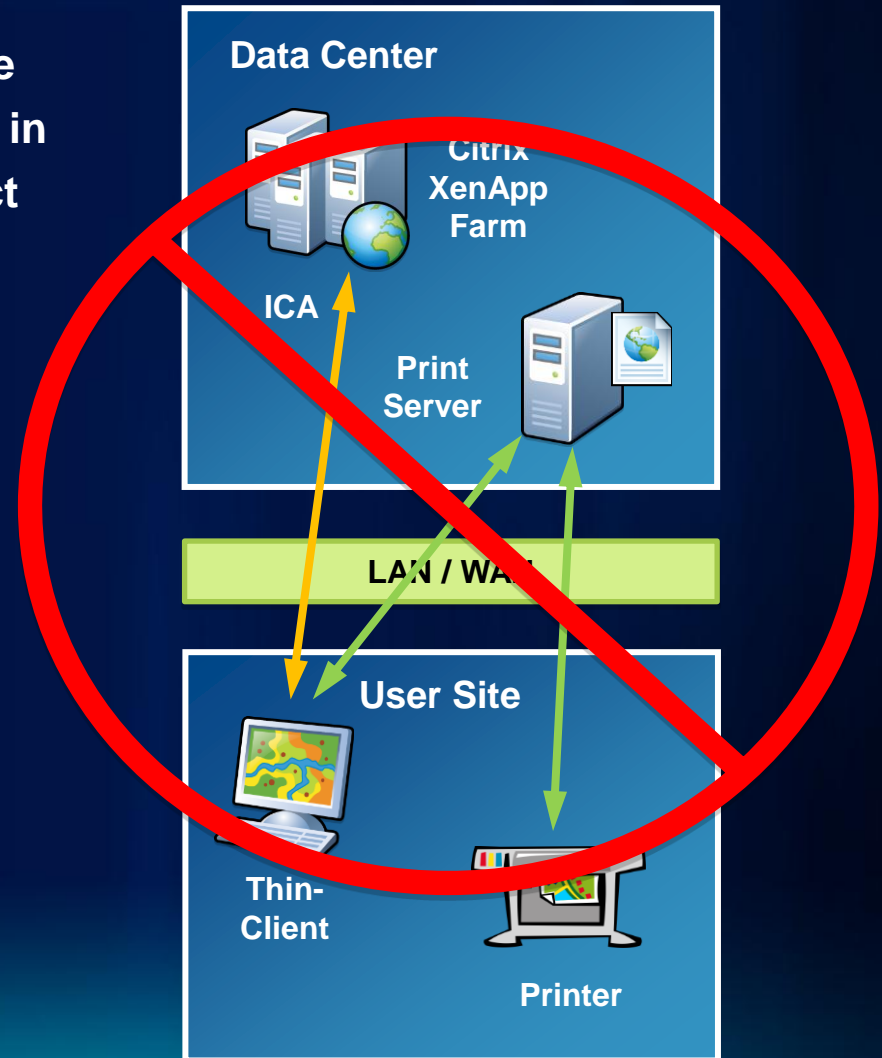
Printing with Citrix XenApp

- For LAN environments, it is not necessary to print through the ICA channel and print jobs can be sent directly from the XenApp server, across the network, and directly to the print server.



Printing with Citrix XenApp

- Avoid traversing network three times when the Print Server is in the Data Center (via the “Direct connections to print servers” policy).



Printing with Citrix XenApp

- In environments with a large number of printers per user, Citrix recommends to auto-create only one default printer.
- The automatic installation of print drivers should be disabled to ensure consistency across the XenApp servers to simplify support and troubleshooting.
- It is Citrix Best Practice is to keep the number of print drivers installed on a XenApp server to a minimum to help reduce management and potential stability issues. Therefore the Citrix Universal Printer Driver should be used whenever possible to reduce the number of print drivers required.
- Consider optimized workflows or third-party printing solutions to help with printer administration and bandwidth management
 - Export to PDF then download to client for local printing
 - 3rd-Party Solutions (ThinPrint / UniPrint / Screwdrivers)

HDX Technologies

Delivering a high definition user experience



HDX Broadcast

HDX MediaStream

HDX RealTime

HDX Rich Graphics

HDX Plug-n-Play

HDX SmartAccess

HDX WAN Optimization

HDX 3D Progressive Display

- Up to 15X faster performance for 2D and lightweight 3D graphics
 - Medical Picture Archiving & Communication Systems (PACS)
 - Geographic Information Systems (GIS)
 - Business Intelligence (BI)
 - 2D image editing
- Reduces cost of delivering graphics-intensive apps
 - **Lowers bandwidth consumption by up to 93%**
 - Supports any ICA client device



Introduced in XenApp PS 4.5 and XenDesktop 2

HDX 3D Progressive Display

- **Ensure the HDX Progressive Display policy (graphics policy in XA 6.5) has been configured and applied to reduce network traffic for raster data displays.**
- **Best performance will be provided by using maximum compression while in process (i.e., while display is in motion) and high compression while at rest.**
 - **Default ICA compression is set to medium without the policy**
 - **Progressive compression is not used without policy in place**
 - **Need to balance quality and performance needs to determine settings for your organization**
- **The heavyweight compression is optional. It will provide additional compression while panning, etc., but at the cost of slightly additional CPU consumption on the client and server.**

Citrix HDX 3D Recommendations

Recommended configuration

LAN Connections

Low compression
Progressive Display **medium compression**
Extra color compression **Off**
Visually lossless

WAN Connections

Medium compression
Progressive Display **high compression**
Extra color compression **On**
Balanced image quality and interactivity



HDX Progressive Display ArcMap 10 Demos

- Pan Test – No Compression
 - 336 KB downloaded
- Pan Test – Ultra High Compression / Heavyweight
 - 261 KB downloaded
- Start Up with MXD Test – No Compression
 - 2.2 MB downloaded
- Start Up with MXD Test – Ultra High Compression / Heavyweight
 - 500 KB downloaded

Known ArcMap on Citrix Issues / Fixes

- **Memory Allocation Patch Hot Fix for 9.3 and 9.3 SP1**
 - Available by request from 93_931memory_allocation@Esri.com
 - Fixed in ArcGIS 9.3.1 SP1
- **Printing large images (Fragmented memory issue)**
 - Workaround available for 9.3.1
 - <http://support.esri.com/en/knowledgebase/techarticles/detail/20294>
- **Default to “default” printer under certain conditions with session remapped printing when loading ArcMap**
- **Help in ArcMap on 64-bit servers does not launch**
 - Workaround: Publish Help as a separate Citrix application
 - C:\WINDOWS\SysWOW64\hh.exe "C:\Program Files (x86)\ArcGIS\Help\ArcInfoMain.chm"
 - Fixed in ArcGIS 10

Known ArcMap on Citrix Issues / Fixes

- **File-based Data Performance / Attribute Table Opening and Feature Selection is Slow**
 - <http://resources.arcgis.com/content/kbase?fa=articleShow&d=34906>
 - Introduced by XenApp 4.5 RP2
 - Fixed in XenApp 4.5 RP3
 - Citrix Windows 2003 32-bit PS 4.5 Hotfix:
<http://support.citrix.com/article/CTX125004>
 - Citrix Windows 2003 64-bit PS 4.5 Hotfix:
<http://support.citrix.com/article/CTX125005>
- **Unable to Hide Server C: Drive from User Sessions**
 - Operating system permissions are used to “lock down” the C: drive from user sessions but the C: drive still appears in ArcCatalog, etc.
 - Known issue for many years (NIM000206 recently created)
 - Fixed in ArcGIS 10
- **A single MXD and normal.mxt file can only be opened approximately 20 times (concurrently)**
 - Primarily impacts load test environments

Troubleshooting and Problem Isolation

- ***Fact vs. Fiction: Most of the time, issues classified as “Citrix issues” turn out to be application or environment related. Very few issues have turned out to be Citrix specific.***
- **Logical Tests to Isolate Source of Problem**
 - **Does the issue occur via Terminal Services?**
 - Isolates if strictly related to XenApp....which is rarely the case
 - **Does the issue occur on a stand-alone workstation?**
 - Helps to isolate if general application issue or in fact specific to server based computing environment
 - **Does the issue occur outside of a seamless window?**
 - Certain display issues, typically with custom applications, have been shown to be sometimes sensitive to seamless window environments
 - **Does the issue occur using an Administrator account?**
 - Often the issue is permissions related and testing with an admin account can help determine if the issue is permissions related

RDS / Citrix Server Capacity Planning

- **The number of users a XenApp server can support depends on several factors, including:**
 - The server hardware technology
 - The applications deployed (CPU and memory requirements)
 - The user application workflows
 - The maximum target resource usage on the server (for example, 80% CPU peak utilization)
- **Recommendations**
 - Leverage modern CPU technology to optimize scalability and performance
 - Use RAID technology for internal drives (typically RAID-1 for OS/Apps)
 - Utilize separate disks for applications and OS with separate disk controllers
 - Use SAS or SCSI drives (i.e., SATA may become a bottleneck)
 - Deploy 64-bit operating systems to avoid 32-bit memory bottlenecks

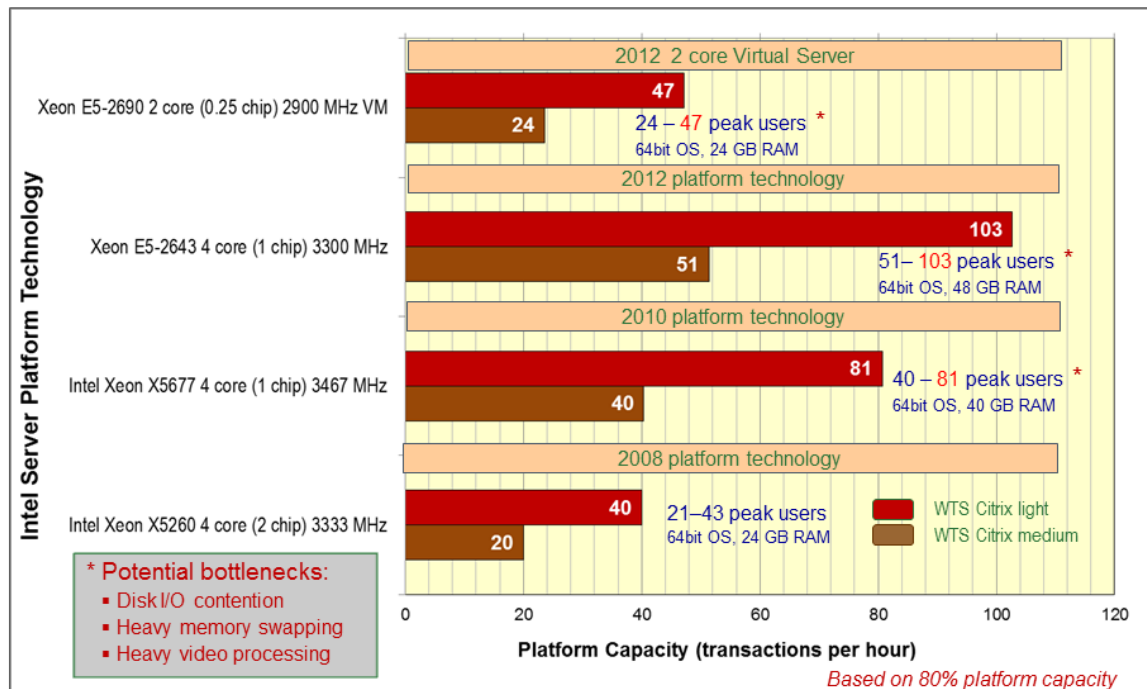
RDS / Citrix Server Capacity Planning

- System Design Strategies Wiki – RDS Platforms

- http://www.wiki.gis.com/wiki/index.php/Platform_Performance#Windows_Terminal_Server_Platform_Sizing

Windows terminal services

- Platform capacity is changing

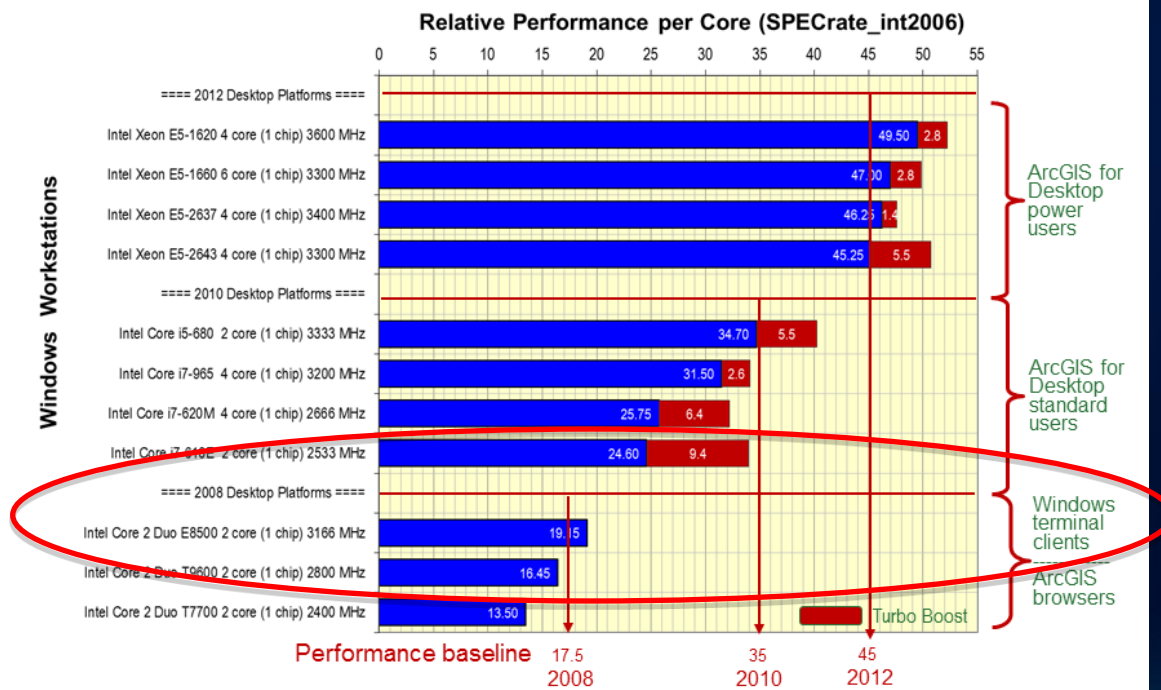


RDS / Citrix Workstation Capacity Planning

- System Design Strategies Wiki – Workstation Platforms

- [http://www.wiki.gis.com/wiki/index.php/Platform_Performance#ArcGIS Desktop Platform Sizing](http://www.wiki.gis.com/wiki/index.php/Platform_Performance#ArcGIS_Desktop_Platform_Sizing)

Workstation platform recommendations



ArcGIS memory = 3 GB minimum (recommend 64bit Windows Operating System)
6 GB may be required to support large file-based data sources

Turbo boost improves performance during light loads

RDS / Citrix Network Planning Factors

- System Design Strategies Wiki – Network Communications

- http://www.wiki.gis.com/wiki/index.php/Network_Communications#Network_Design_Guidelines

Client Platform	Data per display		Traffic per display		Kbps Traffic per user	
	KBpd	Adj KBpd	Kbpd	Mbpd	6 dpm	10 dpm
File Server Client	1,000	5,000	50,000	50	5,000	8,333
Geodatabase Client	1,000	500	5,000	5	500	833
Terminal Client (vector)	100	28	280	0.28	28	47
Terminal Client (raster)	100	100	1,000	1	100	167
Web Browser Client (light)	100	100	1,000	1	100	167
Web Browser Client (medium)	200	200	2,000	2	200	333
Web Desktop Client (light)	200	200	2,000	2	200	333
Web Desktop Client (medium)	400	400	4,000	4	400	667

KBpd = Kilobytes per display

Kbpd = Kilobits per display

Mbpd = Megabits per display

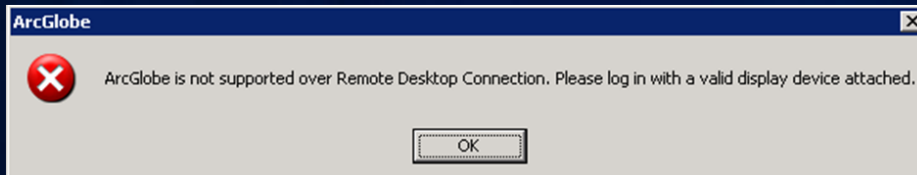
dpm = Displays per minute

ArcGIS General Best Practices

- **Avoid use of application streaming (i.e., application isolation) technology for ArcGIS for Desktop due to software complexity which results in poor performance.**
- **Avoid deploying XenApp servers with server virtualization in production environments due to performance degradation. This is subjective though and there are several variables to consider.**
- **Deploy GIS applications to dedicated servers within the Citrix farm.**
- **Utilize HDX 3D (Progressive Display) policy with Imagery. However, publishing 3D or graphic intensive applications via XenApp (ArcScene, ArcGlobe, ArcGIS Explorer) is not recommended.**
 - **Note: ArcGIS Explorer 1200 will not launch via remote interface, 1700 will launch**
 - **Note: ArcGlobe 10 will not launch via remote interface**

Changes at ArcGIS for Desktop 10

- ArcGIS 10 will leverage the LARGEADDRESSAWARE compile option for 64-bit environments which will allow a process (ArcMap.exe, ArcSOC.exe, etc.) to utilize up to 4 GB of memory on a 64-bit server.
- ArcGlobe 10 now utilizes the same switch/check that ArcGIS Explorer uses and does not launch via remote connections (RDS and Citrix).



- Windows that utilize WPF technology can result in “flickering” with the remote displays on Windows 2003. This is already fixed in Windows 2008. Fix is to install a patch from Microsoft and looks like it is scheduled to be part of Windows 2003, SP3: <http://support.microsoft.com/kb/955692>. There is also information on our beta resource center for the WPF issue: <http://blogs.Esri.com/Dev/blogs/arcgisdesktop/archive/2010/03/01/Windows-Terminal-Server-and-Citrix-Patch.aspx>

Changes at ArcGIS for Desktop 10

- ArcMap is starting to utilize WPF windows (attribute table window, view item description window, etc.). WPF windows are treated as bitmaps by RDP/ICA as opposed to rendering via draw commands and may result in increased network traffic.
- At ArcGIS 10 user templates are stored separately based on version (e.g., C:\Documents and Settings\<user>\Application Data\Esrri\Desktop10.0). This should help situations where a Citrix farm is supporting multiple ArcGIS versions with the same user profiles (i.e., template files, etc., are not compatible between ArcGIS releases).
- The SQL Server Native Client is installed as part of the core ArcGIS installation (required for Direct Connect with SQL Server using ArcGIS 10).

Changes at ArcGIS for Desktop 10

- Background geoprocessing is the default configuration and launches an ArcSOCP.exe process on the server. This new functionality will allow parallel geoprocessing and interactive user processing. Need to consider this when doing capacity planning, etc.
- ArcGIS for Desktop 10, Service Pack 1 added a registry switch to disable WPF based dockable windows. Moving these windows within a thin-client environment can result in large amounts of network traffic (due to constant display refreshes).

<http://resources.arcgis.com/content/kbase?fa=articleShow&d=38474>

Citrix Reference Sites

Reference Sites...

- **What are the best practices for running ArcGIS for Desktop in a Citrix XenApp environment?**
 - <http://support.esri.com/en/knowledgebase/techarticles/detail/39490>
- **Top 10 items found by Citrix consulting**
 - <http://support.citrix.com/servlet/KbServlet/download/18928-102-19722/Top%2010%20Items%20Found%20by%20Citrix%20Consulting%20on%20Assessments%20v2.pdf>
- **Enterprise GIS Resource Center**
 - <http://resources.Esri.com>
- **Esri Terminal Server Printing Whitepaper**
 - <http://resources.arcgis.com/content/white-papers?fa=viewPaper&PID=43&MetaID=1190>

Reference Sites...

- **Change the ArcGIS for Desktop License Type in a RDS/Citrix environment**
 - <http://resources.arcgis.com/content/kbase?fa=articleShow&d=24633>
- **Citrix SpeedScreen Progressive Display Demo**
 - <http://www.youtube.com/watch?v=RMTM7vaMnI>
- **Esri Citrix Alliance Site**
 - <http://www.Esri.com/partners/alliances/citrix/>
- **Citrix Farm Hardware Considerations**
 - <http://support.citrix.com/proddocs/topic/xenapp65-planning/ps-planning-hardware-v2.html>

Reference Sites...

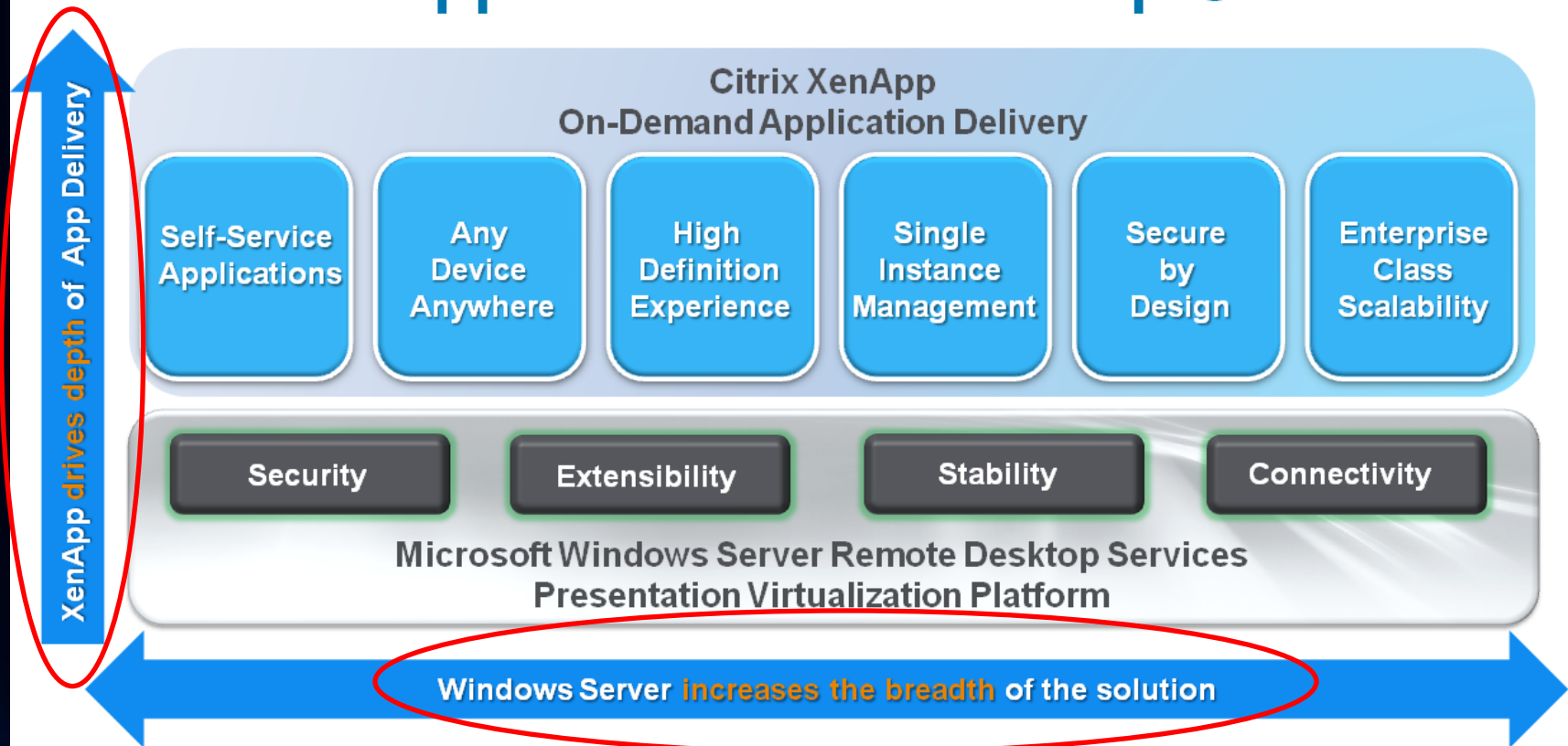
- **XenDesktop and XenApp Best Practices**
 - <http://support.citrix.com/article/CTX132799>
- **XenApp Planning Guide - Virtualization Best Practices**
 - <http://support.citrix.com/article/CTX129761>
- **Best Practices for Citrix XenApp Hotfix Rollup Pack Installation and Deployment**
 - <http://support.citrix.com/article/CTX120842>
- **Best Practices for XenApp Administrators**
 - <http://support.citrix.com/article/CTX127574>

Reference Sites...

- **XenDesktop and XenApp Printing - Planning Guide**
 - <http://support.citrix.com/article/CTX134943>

Bonus – “Why Do I Still Need Citrix XenApp in Addition to Windows Terminal Server?”

Citrix XenApp on Remote Desktop Services



Bonus – “Why Do I Still Need Citrix XenApp in Addition to Windows Terminal Server?”

Citrix XenApp extensions to Remote Desktop Services*

Self-Service Applications

- Unified Application Delivery
- Application Scheduling
- Proactive Performance Monitoring

Single Instance Management

- Content publishing
- Centralized Publishing
- Single Image Provisioning
- Single, Auto-updating client

Secure by Design

- Application password management
- Session recording and activity logging
- Centralized Access Policies
- Adaptive User Access
- Active Directory Federation Services Support
- Anonymous Access
- Integrated SSL VPN

Any Device, Anywhere

- Heterogeneous Client Support

Enterprise-class Infrastructure

- Comprehensive load management
- >1,000 server scalability
- Simplified Graphic Workflow development Environment
- Centralized Client Plug-in Management
- Delegated Administration
- Administrative Logging
- Advanced Server Health Monitoring
- Integration with Desired Configuration Management
- Integration with Multiple 3rd Party Management Systems
- Centralized Resource Monitoring
- Application Performance Monitoring
- Custom Branding Support in Web Interface
- Broad Server Platform Support for Web Services
- Support for Novell® eDirectory
- Policy-Based Control of Bandwidth Usage
- Policy-Based Control of Audio
- Policy-Based Control of TWAIN Device Support
- Policy-Based Control of Application Delivery
- Comprehensive Server Configuration
- Zone Preference and Failover
- Broad Database Engine Support
- Preferential Load Distribution
- Virtual Memory Optimizations

High Definition Experience

- User Self-Provisioning
- Retention of Printer Properties
- Controlled Security Rights for Client Printers
- Client Printer Provisioning
- Network Printer Provisioning
- Generic Universal Print Driver
- Driver Replication
- Driver Compatibility Control
- Printer Bandwidth Limit
- Print Traffic Routing
- SmoothRoaming
- Server to Client URL redirection
- Microsoft ActiveSync® Support
- Scanner Support
- Profile Management
- Click-To-Call
- Application Folder Management
- Automatic Reconnection
- Disconnect or Close All Applications
- User Controlled Network Optimizations
- Priority Packet Tagging
- High-Latency Network Support
- Web Browser Performance Optimizations
- Adobe® Flash® Performance Optimizations
- WAN Performance Optimizations
- Session Reliability
- Graphics Display Optimizations