Enterprise GIS: Design Using Citrix

Ty Fabling
ESRI Enterprise Architect
History of Citrix Products and Solutions

1995
- WinFrame
- Remote Windows

1998
- MetaFrame XP
- Server-Based Computing

2002
- XenApp (Presentation Server)
- Access Gateway with Advanced Access Control
- Password Manager
- NetScaler System
- Desktop Server
- Application Firewall

2004
- GoToMeeting
- GoToAssist
- GoToMyPC
- Access Essentials
- Application Gateway
- EdgeSight
- XenSource

2007

Microsoft purchases WinFrame and calls it Windows Terminal Server.
Citrix Product Lines Today

1. XenApp (Presentation Server)
2. Access Gateway with Advanced Access Control
3. NetScaler System
4. Desktop Server
5. Password Manager
6. Application Firewall
7. Access Essentials
8. Application Gateway
9. GoToMeeting
10. GoToAssist
11. GoToMyPC
12. EdgeSight
13. WanScaler
14. XenSource *(Acquired August 2007)*
Citrix Product Lines
to be Discussed in this Presentation

Citrix Server Products
- XenApp (Presentation Server)
- NetScaler System
- WanScaler

Citrix Security Products
- Citrix Application Firewall
- Citrix Access Gateway
- Citrix Password Manager

Application Virtualization
Web Application Acceleration
Data Caching / Distribution
Security Products
Citrix Access Infrastructure
Logical Architecture

- Clients Across Internet/WAN
  - Remote GIS User
  - Web Browser User
  - Mobile User

- DMZ
  - Access Gateway
    - NetScaler
    - WanScaler
    - Application FW

- Protected Network
  - Local GIS User
  - Advanced Access Control Option
    - SQL
    - SOAP
    - SMB
    - HTTPS
    - ICA/RDP

- GIS Applications
  - RDBMS
  - ArcSDE
  - ArcGIS Server
  - ArcIMS

- Citrix XenApp
  - (Presentation Server)
  - GIS Applications
NetScaler System Architecture
Optimizing Web Application Delivery

Functional Modules

Core Platform

Application Networking Module Interface
AppExpert™ Policy Engine

NetScaler OS™
Availability
Optimization
Security
Request Switching™
High-Speed Packet Processing Engine
Legacy Network Architecture

Application Delivery Challenges

Remote User → Network(s) → Firewall → Router → Switch → Filtering (DDoS) → Compression 

VPN Concentrator → SSL Accelerator → Caching Device → Application Firewall 

Web / LDAP → RDBMS

Local User

Mobile User
Citrix NetScaler Architecture

Citrix NetScaler Single-Box Solution

Remote User → Network(s) → Firewall → Router → Switch → Citrix NetScaler

Local User

Mobile User

Citrix NetScaler

ArcSDE

ArcIMS

ArcGIS Server

Web / LDAP

RDBMS
Relevant NetScaler Features
Optimizing and Securing Web Application Delivery

- Load Balancing
- Content Switching
- SSL Offloading
- Compression
- Caching
- Application Firewall
- XML API

- Buffer Overflow Exploits
- CGI-BIN Parameter Manipulation
- Form/Hidden Field Manipulation
- Forceful Browsing
- Cookie/Session Poisoning
- Broken ACLs/Weak Passwords
- SQL Injection
- Insecure Use of Crypto
- Server Misconfiguration
- Back Doors and Debug Options
- Well-known Platform Vulnerabilities
- Web Site Defacement
- Zero-Day Exploits

Compliments existing Firewall Systems
Citrix Access Security & Control
Best Fit for Every Scenario

- Single Sign-On
- SSL VPN
- Web Security

Citrix Password Manager
Citrix Access Gateway
Citrix Application Firewall
GIS Architecture Patterns
GIS Business Planning

The three key architecture factors are the location of:

Users  Applications  GIS Data
Enterprise GIS Architectures

Key Components:
- Users
- Applications
- Data

Types of Infrastructures:
- Centralized (Citrix, Web Services, Data Center)
- Distributed (Replication, Regional Offices)
  - Hybrid: New SmartClient / Mobile ADF
Major Elements of an Enterprise GIS
Connectivity is the Key

Three Major Elements:

1. Users
2. Applications
3. Data

- Where do each reside (Data Center, Regions, etc)?
- What is the network connectivity like between these three?
  - LAN vs. WAN
  - Network Bandwidth and Latency
  - Frequency of Outages or Drops
Centralized Infrastructure

Centralized Systems

Centralized Application near Centralized Data (Web Apps or Citrix)

Data Center

Applications

Citrix Server Farm
Web Servers

Data

ArcSDE DB

Regional Office

Field Office

Lab

Program Office

Thin Client Connections

Thin Client Connections

Thin Client Connections
Distributed Systems

Distribute Replicated Data
ArcSDE Replication (9.2)
How does Citrix XenApp (Presentation Server) work?
## Six Segments of Any Application

<table>
<thead>
<tr>
<th>Segments</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presentation Services</td>
<td>Screens, Text, Images</td>
</tr>
<tr>
<td>Presentation Logic</td>
<td>Field Order, Filter, Sort</td>
</tr>
<tr>
<td>Business Logic</td>
<td>Business Rules</td>
</tr>
<tr>
<td>Data Logic</td>
<td>Data Rules (Ref Integrity)</td>
</tr>
<tr>
<td>Data Services</td>
<td>DBMS: Tables, Views</td>
</tr>
<tr>
<td>File Services</td>
<td>Files: Table Space, Index</td>
</tr>
</tbody>
</table>
Segment Distribution

If all you have in a Client Server configuration is two tiers or platforms – Client and Server – then you will have to be creative as to how you distribute the six segments between the two platforms.
Mainframe
Legacy Systems

Dumb Terminal
Presentation Services

9600 Baud

Host
Presentation Logic
Business Logic
Data Logic
Data Services
File Services

DATABASE
File Server
Multi-User LAN Applications

**Workstation PC**
- Presentation Services
- Presentation Logic
- Business Logic
- Data Logic
- Data Services

**Host**
- File Services

**Coverage**
- Shape File
- Personal GeoDatabase
- File-based Geodatabase (9.2)

Network Connections:
- 10 Mbps
- 100 Mbps
Client/Server
Remote Presentation

Thin Client

Workstation
Presentation Services
Presentation Logic

Host
Business Logic
Data Logic
Data Services
File Services

Database Centric Approach

DATABASE

10 Mbps
Client/Server
Remote Data

Thick Client

Workstation PC
- Presentation Services
- Presentation Logic
- Business Logic
- Data Logic

Host
- Data Services
- File Services

ARCObjects

RDBMS

100 Mbps
Client/Server
Distributed-Logic

Workstation
- Presentation Services
- Presentation Logic
- Business Logic

Host
- Business Logic
- Data Logic
- Data Services
- File Services

ArcObjects

100 Mbps

DATABASE

ArcSDE
RDBMS

100 Mbps
Web Applications require that you rewrite your desktop GIS applications for a browser interface.

ArcGIS Server is ArcMap without a user interface.
Client/Server
Three-Tiered (Citrix)

ICA Client Workstation
Presentation Services

Thinner Client

Thick Client / Server

Tier 1

Tier 2

Tier 3

Citrix Server Application Server
Presentation Logic
Business Logic
Data Logic

geoDatabase Server
Data Services
File Services

DATABASE

RDBMS

ArcObjects

100 Mbps
1 Gbps

T1

1 Gbps
Integrated System Architecture

**Tier 3**
- Database Servers

**Tier 2**
- Application Servers

**Tier 1**
- Client Workstations

Legend:
- Blue - WMS DB Connection
- Green - GIS DB Connection
- Red - Designer/WMS XLM Messages
- Violet - Citrix Thin Client Connection

Legend:
- η = Hops

Integration Framework MQ Server

Server Room

UNIX or NT

3

GIS ArcSDE Oracle Server

WMS Oracle Server

2

GIS Designer / WMS
Citrix Server Farm

XML

2.5

Windows 2000 Terminal Servers

ICA Client Workstations

Thinner Client

ICA Client Workstations
Client/Server Protocols

**Tier 1**
Display/Control
- Remote Terminal Clients

**Tier 2**
Applications
- Query Processing on Client
- Typical Data Transfer
  - 100 KB Display Data
- UNIX or Windows Clients
- NFS, CIFS
- SDE, DB APIs
- WTS Server
- Web/IMS Server/ArcGIS Server
- RDP, ICA, HTTP
- 10-28 KB displays
- 10-100 KB Images
- 100-400 KB Images
- Citrix
- Web

**Tier 3**
Data
- File Servers
- RDBMS Server
- Query Processing on Server
- Cache
- Typical Data Transfer
  - 1 MB Spatial Data
- SDE, DB APIs
- Tier 1, Tier 2, Tier 3
- Direct Connect
- Windows Terminals
- Web Browsers
- ArcGIS Desktop
Multiple ArcView Versions on a Single Workstation

Multiple GDBs

GIS User

Workstation
Windows XP
ICA Clients

Thumb Drive

1
ArcView 8.3

Citrix Server 1
Windows 2000
ArcView 8.3

Geodatabase Server
ArcSDE 8.3

2
ArcView 9.1

Citrix Server 2
Windows 2003
ArcView 9.1

Geodatabase Server
ArcSDE 9.1

3
ArcView 9.3

Citrix Server 3
Windows Vista
ArcView 9.3

Geodatabase Server
ArcSDE 9.3
Multiple ArcView Versions on a Single Workstation

Single GDB (Web Service)

1. ArcView 8.3
   - Citrix Server 1
   - Windows 2000
   - ArcView 8.3

2. ArcView 9.1
   - Citrix Server 2
   - Windows 2003
   - ArcView 9.1

3. ArcView 9.3
   - Citrix Server 3
   - Windows Vista
   - ArcView 9.3

- Workstation
  - Windows XP
  - ICA Clients

- GIS User

- WMS

- ArcGIS Server 9.2
  - Web Service

- Geodatabase Server
  - ArcSDE 9.2
Multilevel Security w/ Single Workstation
Single Base Data Sources
Solutions to Known Issues when Using Citrix XenApp (Presentation Server) with ArcGIS Desktop
Recommend a Dedicated File Server to Citrix Farm

Server Room

Geodatabase Server

Dedicated File Server

GIS Citrix Server Farm

GIS Citrix Client

Printer

Plotter
Enterprise Printing Issues w/ Citrix

Server Room

Geodatabase Server

GIS Citrix Server Farm

Dedicated File Server*

Print Server*

*Could be the same Server

GIS Citrix Client

Printer

Plotter

Citrix WanScaler Boxes

Federal User Conference 2008
GIS Printing / Plotting Issues

- Print streams can be very large for plotters 10-400 MB.
- Low-bandwidth connections (T-1 or less) will be more problematic – but it still can work if printing bandwidth is managed properly.
- Printing administration can be an issue with WTS/Citrix especially with large organizations.
- PS4 dynamic printer names do not work with ArcGIS (because the printer name is stored in the mxd map document).
- PS4 Universal Print Driver does not work well with most plotters.
- Printer driver compatibility is very important.
- Printing problems may impact the overall Citrix server performance.
Enterprise Server-based Printing Process

1. Windows Application
2. Print Subsystem
3. Network Printer
4. Metafile (EMF format)
5. Print Job (raw data)
6. Print Spooler
7. Enterprise Server
8. Based Printing Process
9. RDP / ICA Protocol
10. Citrix / Terminal Server

- Server Printers (Locally Attached)
- Terminal Server
- JetDirect
- Print Server
- Client Printers
- RDC Client
- WAN
- User’s Office
- RDC Client
- Network Print Server

Application
Print Subsystem (Router / Spooler)
Print Job (raw data)
Citrix Printing Solutions

- Avoid using client side printing – recommend using a print server in the data center. Offload print driver rendering from TS/Citrix server to a separate print server.
- Try to use a print subsystem that uses compression.
- Test all print drivers – a long driver mapping time reveals a driver specific problem. Tightly control drivers on Citrix application servers.
- Citrix XenApp (Presentation Server) configuration is important to look at.
- Use Universal Print Driver (UPD) for normal (non-plotter) printers or those where native print driver does not work.
- Consider third-party solutions to help with printer administration. (i.e. direct print to plotters, i.e. ThinPrint or ZEH)
- Look at printing bandwidth management. (Citrix Universal Printer Driver & Third-party solutions, i.e. ThinPrint or ZEH)
- Download ESRI’s Enterprise Printing whitepaper on ESRI Project Center web site.
Use Case: Dominion Electric
## GIS Citrix Farm

### Windows 2000 Servers

<table>
<thead>
<tr>
<th>File Server</th>
<th>Database Admin</th>
<th>Terminal Servers</th>
<th>Batch Applications</th>
<th>Citrix Metaframe: Server Groups</th>
<th>WMS Farm</th>
</tr>
</thead>
<tbody>
<tr>
<td>(no Novell)</td>
<td>MS SQL Srvr/Citrix License</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GIS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01F</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>380G2 2x1.2G</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Development**

- GIS 00D
  - Sandbox
  - 380G2 2x1.4G P3

**Test/Instruct.**

- GIS 00T
  - 3.0.x
  - 380G2 2x1.4G P3

**Maintenance**

- GIS 00M
  - 3.0.x
  - 380G2 2x1.4G P3

**Production**

- GIS 00P
  - 3.0.x
  - 380G2 2x1.4G P3

### UNIX Servers

<table>
<thead>
<tr>
<th>Oracle Data Schemas</th>
<th>Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process</td>
<td>GeoDatabase</td>
</tr>
</tbody>
</table>

**Oracle Data Schemas**

- WMSd
  - Dev
  - GDB
  - GISd (9i)

**Environment**

- Development UNIX Server
  - GIS (9i)
- Test/Instruction UNIX Server
  - GIS (9i)
- Maintenance UNIX Server
  - GIS (9i)

**Legend:**

- WMS: Work Management System
- GeoDB: Geodatabase
- WMS: Work Management System
Top 10 Benefits of a GIS Citrix Farm

   - Enables remote GIS users to access GIS desktop system across slower WAN connections
   - Smaller footprint for GIS desktop users on faster Corporate LAN
     - (GIS fat-client comparable to Video Conference footprint on corporate network)
   - Even possible to connect over 56K dial-up connections

2. More stable across WAN connections (latency tolerant)
   - Application can disconnect and then reconnect without losing Citrix session
   - Less affected by latency issues across WAN

3. Lower cost for hardware requirements and system administration
   - No need for costly high-end workstations for each GIS user

4. Easy to scale over time

5. Centralized management / configuration of Client GIS software

6. Easier detection and resolution of software bugs and performance issues

7. Easier to distribute upgrades or bug fixes

8. Faster turn-a-round for development & QA integration testing of custom GIS extensions:
   - Development → Test → Production

9. Any authorized GIS user can access all three environments at the same time from their local workstation

10. Remote Monitoring/Control - Shadowing
Currently only a Citrix solution offers the following:

- **Only Citrix enables published applications within a seamless window**

- **New with XenApp (Presentation Server 4.5):**
  - Improved Performance for Raster Images w/ SpeedScreen: Progressive Display
  - Application Isolation: i.e. 9.0 & 9.1 on same server (PS4)
  - Better Virtual Memory Space Management (PS4)
  - Prevent a Single Application from Consuming a CPU (PS4)

- **Other components:**
  - Web Interface to Launch Published Apps (NFuse)
  - Advanced load management of Citrix servers (LM)
    - TS Load-balancing is network-based and limited to 32 nodes
    - TS Load-balancing requires the Enterprise Edition to really be effective
  - Automated software installation across servers (IM)
  - Server monitoring & statistic collection (SM)
  - ICA Client provides Secure Proxy Connection to the Citrix Servers
  - Advanced session shadowing
  - Centralized license management
  - Centralized printer management
  - ICA Client - Smallest network bandwidth (Win2000 only)
Citrix (WTS) is Required for using GIS Over WAN Connections

County Headquarters

Public Works
GIS Department
Land Records
Assessor
Information Systems

User Locations Requiring Citrix

Fire Station
Utility Site
Water Site

100 Mbps Backbone
T1 WAN
# User Configuration Guidelines

## Local Area Networks

<table>
<thead>
<tr>
<th>Bandwidth</th>
<th>File Servers</th>
<th>SDE Servers</th>
<th>Windows Terminals</th>
<th>Web Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 Mbps LAN</td>
<td>2-4</td>
<td>10-20</td>
<td>350-700</td>
<td>150-300</td>
</tr>
<tr>
<td>16 Mbps LAN</td>
<td>3-6</td>
<td>16-32</td>
<td>550-1100</td>
<td>250-500</td>
</tr>
<tr>
<td>100 Mbps LAN</td>
<td>20-40</td>
<td>100-200</td>
<td>3,500-7,000</td>
<td>1,500-3,000</td>
</tr>
<tr>
<td>1 Gbps LAN</td>
<td>200-400</td>
<td>1,000-2,000</td>
<td>35,000-70,000</td>
<td>15,000-30,000</td>
</tr>
</tbody>
</table>

## Wide Area Networks

<table>
<thead>
<tr>
<th>Bandwidth</th>
<th>File Servers</th>
<th>SDE Servers</th>
<th>Windows Terminals</th>
<th>Web Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>56 Kbps Modem</td>
<td>NR</td>
<td>NR</td>
<td>2-4</td>
<td>1-2</td>
</tr>
<tr>
<td>128 Kbps ISDN</td>
<td>NR</td>
<td>NR</td>
<td>5-10</td>
<td>2-4</td>
</tr>
<tr>
<td>256 Kbps DSL</td>
<td>NR</td>
<td>NR</td>
<td>10-20</td>
<td>5-10</td>
</tr>
<tr>
<td>512 Kbps</td>
<td>NR</td>
<td>NR</td>
<td>20-40</td>
<td>10-20</td>
</tr>
<tr>
<td>1.54 Mbps T-1</td>
<td>NR</td>
<td>1-2</td>
<td>30-100</td>
<td>25-50</td>
</tr>
<tr>
<td>2 Mbps E-1</td>
<td>NR</td>
<td>1-3</td>
<td>75-150</td>
<td>40-80</td>
</tr>
<tr>
<td>6.16 Mbps T-2</td>
<td>1-2</td>
<td>6-12</td>
<td>200-400</td>
<td>100-200</td>
</tr>
<tr>
<td>45 Mbps T-3</td>
<td>10-20</td>
<td>50-100</td>
<td>1,500-3,000</td>
<td>700-1,500</td>
</tr>
<tr>
<td>155 Mbps ATM</td>
<td>30-60</td>
<td>150-300</td>
<td>5,000-10,000</td>
<td>2,500-5,000</td>
</tr>
</tbody>
</table>
Server Platform Performance Makes a Difference
Supported Windows Technology (Intel & AMD Processors)

Performance Baseline

- Intel Xeon 4 Core (2 socket) 3000-4 MHz
- Intel Xeon 4 Core (2 socket) 2666-4 MHz
- Intel Xeon 4 Core (2 socket) 2500-1 MHz
- Intel Xeon 4 Core (2 socket) 2333-4 MHz
- AMD 2 Core (2 socket) 3000-1 MHz
- Intel Xeon 4 Core (1 socket) 2400-8 MHz
- AMD 4 Core (2 socket) 2800-1 MHz
- AMD 2 Core (2 socket) 2800-1 MHz
- Intel Xeon 4 Core (2 socket) 2000-4 MHz
- Intel Xeon 2 Core (2 socket) 3800-2 MHz
- Intel Xeon 4 Core (2 socket) 2000(4) MHz
- Intel Xeon 4 Core (1 socket) 2133-8 MHz
- AMD 4 Core (2 socket) 2600-1 MHz
- Intel Xeon 2 Core (2 socket) 3600-2 MHz
- Intel Xeon 4 Core (2 socket) 3730-2 MHz
- AMD 2 Core (2 socket) 2600-1 MHz
- Intel Xeon 4 Core (2 socket) 1866(4) MHz
- Intel Xeon 8 Core (2 socket) 2333-8 MHz
- Intel Xeon 8 Core (2 socket) 2666(8) MHz
- AMD 4 Core (2 socket) 2400 MHz
- Intel Xeon 2 Core (2 socket) 3200 MHz
- Intel Xeon 8 Core (2 socket) 2000-8 MHz
- Intel Xeon 4 Core (2 socket) 1600-4 MHz
- Intel Xeon 8 Core (4 socket) 3500-4 MHz
- Intel Xeon MP 2 Core (2 socket) 3000-1 MHz
- Intel Xeon 8 Core (4 socket) 3333-4 MHz
- Intel Xeon 2 Core (2 socket) 2800-1 MHz
- Intel Xeon 8 Core (2 socket) 1860-8 MHz
- Intel Xeon 8 Core (2 socket) 1866-4 MHz
- Intel Xeon 8 Core (4 socket) 3166-1 MHz
- Intel Xeon 8 Core (4 socket) 3133-1 MHz
- Intel Xeon 4 Core (2 socket) 2800-1 MHz
- Intel Xeon 8 Core (2 socket) 1600-8 MHz
- Intel Xeon MP 2 Core (2 socket) 2000-1 MHz

2004 and 2005 2006 2007

- Intel Xeon 4 Core (2 socket) 3000-4 MHz
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- Intel Xeon 4 Core (2 socket) 2800-1 MHz
- Intel Xeon 8 Core (2 socket) 1600-8 MHz
- Intel Xeon MP 2 Core (2 socket) 2000-1 MHz
Citrix Management Console

16 Concurrent Users

3 GB Memory Used

Occasional Spike to 90% CPU Utilization

Avg. 40-60%
Compaq DL380G2 2x **1.4 GHz** P3  4G Memory

Avg. 60-70%
Compaq DL380G3 2x 3.2 GHz XEON 4G Memory

3.2 GHz CPU
Avg. 30-40%
### Task Manager Processes on Terminal Server

**Determine ArcMap.exe Application Memory Utilization**

<table>
<thead>
<tr>
<th>Image Name</th>
<th>PID</th>
<th>CPU</th>
<th>CPU Time</th>
<th>Mem Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>ArcMap.exe</td>
<td>3048</td>
<td>00</td>
<td>0:06:10</td>
<td>234,140 K</td>
</tr>
<tr>
<td>ArcMap.exe</td>
<td>3212</td>
<td>00</td>
<td>0:06:07</td>
<td>234,836 K</td>
</tr>
<tr>
<td>ArcMap.exe</td>
<td>3720</td>
<td>00</td>
<td>0:17:29</td>
<td>260,084 K</td>
</tr>
<tr>
<td>ArcMap.exe</td>
<td>4100</td>
<td>00</td>
<td>0:17:24</td>
<td>259,712 K</td>
</tr>
<tr>
<td>ArcMap.exe</td>
<td>4608</td>
<td>00</td>
<td>0:36:06</td>
<td>214,076 K</td>
</tr>
<tr>
<td>ArcMap.exe</td>
<td>4956</td>
<td>00</td>
<td>0:19:14</td>
<td>236,620 K</td>
</tr>
<tr>
<td>ArcMap.exe</td>
<td>5524</td>
<td>00</td>
<td>0:08:41</td>
<td>287,720 K</td>
</tr>
<tr>
<td>ArcMap.exe</td>
<td>6468</td>
<td>05</td>
<td>0:09:05</td>
<td>264,396 K</td>
</tr>
<tr>
<td>ArcMap.exe</td>
<td>6776</td>
<td>00</td>
<td>0:02:55</td>
<td>159,944 K</td>
</tr>
</tbody>
</table>

**Compaq DL380G3 2x 3.2 GHz XEON w/ 4G Memory**

<table>
<thead>
<tr>
<th>Image Name</th>
<th>PID</th>
<th>CPU</th>
<th>CPU Time</th>
<th>Mem Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>ArcMap.exe</td>
<td>2936</td>
<td>00</td>
<td>0:01:11</td>
<td>145,652 K</td>
</tr>
<tr>
<td>ArcMap.exe</td>
<td>2940</td>
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<td>0:14:56</td>
<td>287,404 K</td>
</tr>
<tr>
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<td>05</td>
<td>0:02:51</td>
<td>203,036 K</td>
</tr>
<tr>
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<td>00</td>
<td>0:00:30</td>
<td>140,092 K</td>
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<tr>
<td>ArcMap.exe</td>
<td>4224</td>
<td>00</td>
<td>0:15:20</td>
<td>279,364 K</td>
</tr>
<tr>
<td>ArcMap.exe</td>
<td>4556</td>
<td>00</td>
<td>0:09:07</td>
<td>263,248 K</td>
</tr>
<tr>
<td>ArcMap.exe</td>
<td>5260</td>
<td>00</td>
<td>0:00:44</td>
<td>200,240 K</td>
</tr>
<tr>
<td>ArcMap.exe</td>
<td>5888</td>
<td>00</td>
<td>0:08:25</td>
<td>207,328 K</td>
</tr>
<tr>
<td>ArcMap.exe</td>
<td>6276</td>
<td>00</td>
<td>0:08:48</td>
<td>282,572 K</td>
</tr>
</tbody>
</table>
### ArcMap Memory Utilization

**Unique for Each Implementation**

#### Average

<table>
<thead>
<tr>
<th>GHz</th>
<th>Image Name</th>
<th>PID</th>
<th>CPU</th>
<th>CPU Time</th>
<th>Rank</th>
<th>Mem Usage</th>
<th>Rank</th>
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<tr>
<td>3.2</td>
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<td>207,328 K</td>
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<tr>
<td>3.2</td>
<td>ArcMap.exe</td>
<td>3040</td>
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<td>0:02:51</td>
<td>15</td>
<td>203,036 K</td>
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<td>ArcMap.exe</td>
<td>5260</td>
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<td>0:00:44</td>
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<td>0:00:30</td>
<td>18</td>
<td>140,092 K</td>
<td>18</td>
</tr>
</tbody>
</table>
How many concurrent GIS users can you support on a XenApp server?

32-bit vs. 64-bit Windows Server OS

Today’s Intel servers are so fast and powerful that the primary hardware issue for Citrix servers is the amount of Memory not CPU capacity or speed.

32-bit Windows Server OS

- 15-20 GIS users per Citrix server w/ 4 GB RAM
- 30-40 GIS users per Citrix server w/ 16 GB RAM
  (using Enterprise version of Windows Server OS & /PAE switch)

64-bit Windows Server OS

- 40-60+ GIS users per Citrix server w/ 16+ GB RAM
Other Things to Consider...

- **Raster Images**
  (CPS4.5 – SpeedScreen: Progressive Display)

- **Roaming Profiles**
  - Desktop vs. Terminal Server (TS)
  - Normal.mxt

- **Multiple ArcGIS Sessions on Same Server** *(Case Sensitive):*
  - ArcInfo : ESRI_SOFTWARE_CLASS=Professional
  - ArcEditor : ESRI_SOFTWARE_CLASS=Editor
  - ArcView : ESRI_SOFTWARE_CLASS=Viewer

- **Citrix Digitizer support now available for CalComp**

- **ESRI Support Whitepaper on Citrix**
  - Support for Windows Terminal Server (WTS) and Citrix MetaFrame
  Search Key: Citrix
Questions?

Please fill out your evaluation forms. Thank you for attending.