Introduction – MTEMC

- Distribute electricity to ~200,000 residential & business members
- TN’s largest electric cooperative and 6th largest in U.S.
- Service area ~2,100 sq miles
Introduction – MTEMC GIS Usage

- Esri and ArcFM client for 10 years
- Currently using Esri 10.2.1 / ArcFM 10.2.1a
- GIS used for Engineering (ArcFM Designer), Joint Use (ArcFM Inspector), Outage Management (ArcFM Responder), Vegetation Management (Clearion), Member Services (custom Web Dashboard)
- Every department has GIS users in some capacity
- The number of Applications and Services built off our Esri foundation increases each year
Introduction – MTEMC GIS Landscape

- Environments include Development, Test, Production, and Disaster Recovery
- >40 GIS servers
- Citrix XenApp 6.5 used to deliver most applications
- Database and Application servers clustered
Introduction – MTEMC Physical vs. Virtual

• Historically, GIS Production servers were physical
  - Virtual servers for Development and Test
  - Physical preference for Production due to Performance, ArcFM recommendations, proven technology

• Currently, Production servers moving into virtual realm
  - Cost benefits
  - Easier system provisioning and deployment
  - No need to build from scratch with imaging
  - Monitoring and reviewing information faster
  - Improve disaster recovery/ lower downtime
## Introduction – Esri Hardware Specs

![Hardware requirements table](http://resources.arcgis.com/en/help/system-requirements/10.2/)

<table>
<thead>
<tr>
<th>Hardware requirements</th>
<th>Advanced, Basic, Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU Speed</td>
<td>2.2 GHz minimum; Hyper-threading (HHT) or Multi-core recommended</td>
</tr>
<tr>
<td>Processor</td>
<td>Intel Pentium 4, Intel Core Duo, or Xeon Processors, SSE2 minimum</td>
</tr>
<tr>
<td></td>
<td>Run this <a href="http://resources.arcgis.com/en/help/system-requirements/10.2/">Microsoft utility</a> from your Windows command prompt to check your processor. See <a href="http://resources.arcgis.com/en/help/system-requirements/10.2/">Dual or dual-core support policy</a>.</td>
</tr>
<tr>
<td>Memory/RAM</td>
<td>2 GB minimum</td>
</tr>
<tr>
<td>Display properties</td>
<td>24-bit color depth</td>
</tr>
<tr>
<td>Screen resolution</td>
<td>1024 x 768 recommended minimum at normal size (96 dpi)</td>
</tr>
<tr>
<td>Swap space</td>
<td>Determined by the operating system; 500 MB minimum.</td>
</tr>
<tr>
<td>Disk space</td>
<td>2.4 GB</td>
</tr>
<tr>
<td></td>
<td>In addition, up to 59 MB of disk space may be needed in the Windows System directory (typically, C:WindowsSystem32). You can view the disk space requirement for each of the 10.1 components in the Setup program. If using ArcGlobe, additional disk space may be required. ArcGlobe will create cache files when used.</td>
</tr>
<tr>
<td>Video/Graphics adaptor</td>
<td>64 MB RAM minimum; 256 MB RAM or higher recommended; NVIDIA, ATI, and Intel chipsets supported. 24-bit capable graphics accelerator</td>
</tr>
<tr>
<td></td>
<td>OpenGL version 2.0 runtime minimum is required, and Shader Model 3.0 or higher is recommended. Be sure to use the latest available driver.</td>
</tr>
<tr>
<td>Networking Hardware</td>
<td>Simple TCP/IP, Network Card, or Microsoft Loopback Adapter is required for the license manager</td>
</tr>
</tbody>
</table>
Introduction – ArcFM Hardware Specs

Minimum Responder server hardware required:
- Dual-processors, 2.4 GHz (3 GHz or higher recommended)
- 4 GB RAM
- 60 GB available hard drive space
- Full duplex 100 Mbps LAN port

https://infrastructurecommunity.schneider-electric.com/docs/DOC-2667
Virtual Server Specs – Load Testing & Analysis

• Will describe load testing and analysis tools
  - ArcGIS PerfQA Analyzer
  - SQL Server 2008 R2 Analyses
  - ArcFM TroubleMaker and Telemetry – Load Testing
  - Perfmon
  - Standard Performance Test Steps
  - Transitioning from subjective to objective performance measures
  - Final Specifications
  - Lessons Learned
Virtual Server Specs – Load Testing & Analysis

- ArcGIS PerfQA Analyzer 10.2 Tool
  - Captures render and edit times in ArcGIS
  - User can generate custom scripts
  - Basic ArcMap functions can be listed in script
  - Not able to do advanced ArcFM functions (ex: manage out a Responder incident; create a new job in Designer).
  - Configured on Citrix XenApp servers so that it runs as a “user”
  - Unsupported by Esri Technical Support

Virtual Server Specs – Load Testing & Analysis
Virtual Server Specs – Load Testing & Analysis

- **ArcGIS PerfQA Analyzer Tool**
  - Able to evaluate different components and associated impact on performance (Total Run Time of script)

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
<th>K</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
<td>Time</td>
<td>Script Name</td>
<td>Environment</td>
<td>Total Run Time</td>
<td>CTX CPU’s</td>
<td>CTX RAM</td>
<td>DB CPU’s</td>
<td>DB RAM</td>
<td>SQL Memory</td>
<td># of Steps</td>
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<td>1/14/2015</td>
<td>3:11pm</td>
<td>TOMS_ScriptDes1</td>
<td>TEST</td>
<td>12:08</td>
<td>6 Cores</td>
<td>24GB</td>
<td>4 Cores</td>
<td>32GB</td>
<td>36 GB</td>
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<td>24GB</td>
<td>4 Cores</td>
<td>32GB</td>
<td>36 GB</td>
<td>100</td>
</tr>
</tbody>
</table>

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<th>DB RAM</th>
<th>SQL Memory</th>
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<td>8 Cores</td>
<td>48GB</td>
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<tr>
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<td>24GB</td>
<td>8 Cores</td>
<td>48GB</td>
<td>36 GB</td>
<td>100</td>
</tr>
</tbody>
</table>
Virtual Server Specs – Load Testing & Analysis

- SQL Server 2008 R2
- DBA Analysis using Activity Monitor and traces with SQL Server Profiler
  - Impactful queries and outliers
  - Missing indexes
Virtual Server Specs – Load Testing & Analysis

• DB Findings
  - Rebuild spatial indexes
  - Rebuild spatial extents
  - Update statistics
  - Raise SQL server memory allocation
  - MDOP value = 1
    (http://support.esri.com/cn/knowledgebase/techarticles/detail/38871)
Virtual Server Specs – Load Testing & Analysis

- ArcFM Responder “TroubleMaker” Application
  - Simulation of large scale outages
  - Customizable on devices, call rates, etc
  - Reduces need for extra technicians to assist in testing
Virtual Server Specs – Load Testing & Analysis

- ArcFM Responder “TroubleMaker” Application

![Image of TroubleMaker application]

**Execute Simulation**

- **Number customers affected**: 2660
- **Number calls**: 2660
- **Number hazards**: 6
- **Calculated duration**: 01:19:48
Virtual Server Specs – Load Testing & Analysis

- **ArcFM Responder “Telemetry” Application**
  - Gathers statistical info on the processing of Rx data

**Item Categories**
- **Database**: Metric capturing time to perform an insert, update, delete, or read on the database
- **Detail**: Metric capturing one specific element of a process in the code
- **Service**: Metric capturing service performance on a server machine
- **User**: Metric based on performance of a specific Responder function that an end user would experience
Virtual Server Specs – Load Testing & Analysis

- ArcFM Responder “Telemetry” Application
Virtual Server Specs – Load Testing & Analysis

- PerfMon Analysis: performed under “normal” and “load testing” scenarios
- Responder Explorer – primary Dispatcher application
Virtual Server Specs – Load Testing & Analysis

- **PerfMon Analysis**
  - Citrix Servers - Current Disk Queue Length, Available Mbytes, % Processor Time
Virtual Server Specs – Load Testing & Analysis

- Perfmon Analysis
- Application Servers - Current Disk Queue Length, Available Mbytes, % Usage Peak, % Processor Time
Virtual Server Specs – Load Testing & Analysis

- Perfmon Analysis
- Database servers - TOTAL SERVER MEMORY is the amount of memory SQL Server is consuming, while the TARGET SERVER MEMORY is the amount it thinks is "optimal". In this case, the total consumed is well under the target, meaning that SQL Server is using all the memory that it thinks it should.
Virtual Server Specs – Load Testing & Analysis

- Perfmon Analysis
- Database servers – CPU UTILIZATION
  - ArcFM Designer DB ~less than 25% utilization
  - ArcFM Responder DB ~less than 25% utilization
Virtual Server Specs – Load Testing & Analysis

- Perfmon Analysis
- Database servers – DISK UTILIZATION
  - ArcFM Designer DB ~low with some expected peaks
- ArcFM Responder DB ~low with some expected peaks
Final Specifications: Virtual Production Servers

- 2 HP DL580’s
- Dedicated to GIS servers

<table>
<thead>
<tr>
<th>CPU</th>
<th>GB RAM</th>
<th>Server</th>
<th>CPU</th>
<th>GB RAM</th>
<th>Server</th>
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<td>COR-POMS10WS-02</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Final Specifications: Virtual Production Servers

- SQL Server Memory Allocation set to 36GB out of 48GB available on our DB servers
- Database servers have 8 cores and 48GB RAM.
- Citrix servers have 12 cores and 48GB RAM.

\[
\text{Avg. Virtual Bytes (max 4) } - 1.5\text{GB (shared)} \times \# \text{ of Users} + 2\text{GB (OS)} + 1.5\text{GB shared}
\]

So our equation looked like the following (we are expecting 15 max users per citrix server):

\[
((2.5 - 1.5) \times 15) + 2 + 1.5
\]

\[
((1) \times 15) + 2 + 1.5
\]

\[
15 + 2 + 1.5 = 18.5\text{GB} \ldots \text{start with 24 GB}
\]

- Designer Application servers have 8 cores and 24GB RAM.
- OMS Application servers have 8 cores and 48GB RAM.
Lessons Learned

• There is a need for expertise at each level – DBA, server architecture, application, etc.  TEAM EFFORT
• Stand alone performance testing is not enough, you must do LOAD TESTING
• Application minimum hardware specs are generic, need to CUSTOMIZE YOUR SOLUTION based on size of user group, what custom processes your applications do, network limits, and landscape design
• CONSISTENT TESTING for each variable is necessary to provide proper analysis
• Having and sharing OBJECTIVE METRICS will increase the “buy-in” of functional users
• DOCUMENTATION of functional users’ acceptable performance level
Acknowledgements

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