lucity™

System Design and Tuning

Lucity 2016 R2

- Overview
  - Lucity Specifications 2016 R2
  - Web
  - Identity Server
  - Document Server
  - File Server
  - Database Server
  - Service Server
  - Citizen Portal
  - Mobile Server
  - Android Devices
  - Apple Devices
  - Lucity Network Architecture
  - Infrastructure Considerations
  - SQL Server Tuning
  - Backups
  - GIS Maintenance
  - Budget and Planning

Lucity Specifications 2016 R2

Lucity 2016r2 for SQL Server

OPERATING SYSTEM AND SOFTWARE REQUIREMENTS

|	Windows 10 (32/64 bit) [2]	Windows 8.1 (32/64 bit) [3]	Windows 7 SP1 (32/64 bit)	Windows Server 2012r2	Windows Server 2012	Windows Server 2008 R2 SP1	.NET 4.5.2 Full	Internet Explorer 11.0+	Microsoft Silverlight 5.1 (min. 5.1.50428)	ArcGIS 10.2.2+, ArcGIS 10.3.x, ArcGIS 10.4.1+
Lucity Web User	✓	✓	✓					✓	✓	
Lucity Desktop	✓	✓	✓				✓			✓
File Server				✓	✓	✓				
Services Server				✓	✓	✓	✓			
Database Server				✓	✓	✓				
Web Servers [3]				✓	✓	✓	✓			
GIS Web Server							✓			✓

Lucity 2016 R2

HARDWARE REQUIREMENTS

Minimum and Recommended Hardware Specifications					
	CPU	Cores	RAM	Storage Space [1]	Minimum Video
Lucity Web User	1 GHz	1	1GB	50 MB	1024x768
Lucity Desktop	1 GHz	1	1GB	500 MB	1024x768
File Server	2 GHz	2,2[3]	2GB, 2GB[3]	2 GB	N/A
Services Server	2 GHz	2,4[3]	2GB, 2GB[3]	2 GB	N/A
Lucity Database Server	2 GHz	2,4[3]	4GB, 8GB[3]	20 GB	N/A
Lucity Web Server	2 GHz	2,4[3]	4GB, 8GB[3]	2 GB	N/A
Lucity Mobile Server	2 GHz	2,4[3]	4GB, 8GB[3]	2-20 GB[2]	N/A
Lucity REST API Server & Lucity Document Server	2 GHz	2,2[3]	2GB, 4GB[3]	1 GB	N/A
Lucity Citizen Portal Server	2 GHz	2,2[3]	2GB, 4GB[3]	1 GB	N/A

Lucity 2016 R2

- 2016 R2 Solutions
  - Database Server
  - Desktop
  - Service Server
  - Web, Web Rest API, Rest API and WebMap(Microsoft IIS)
  - Citizen Portal and Rest API (Microsoft IIS)
  - Mobile Server (Microsoft IIS: For Android and iOS)
  - Document Server (Microsoft IIS)
  - Identity Server

Lucity Scheduler

Lucity 2016 R2

- 2016 R2 GIS Integration
  - Feature Services (Redlining, Edit and Offline)
  - Image Services
  - Geocoding Services
  - Map Services
  - Inspection Integration for ArcGIS Online Apps
  - Geometry Services
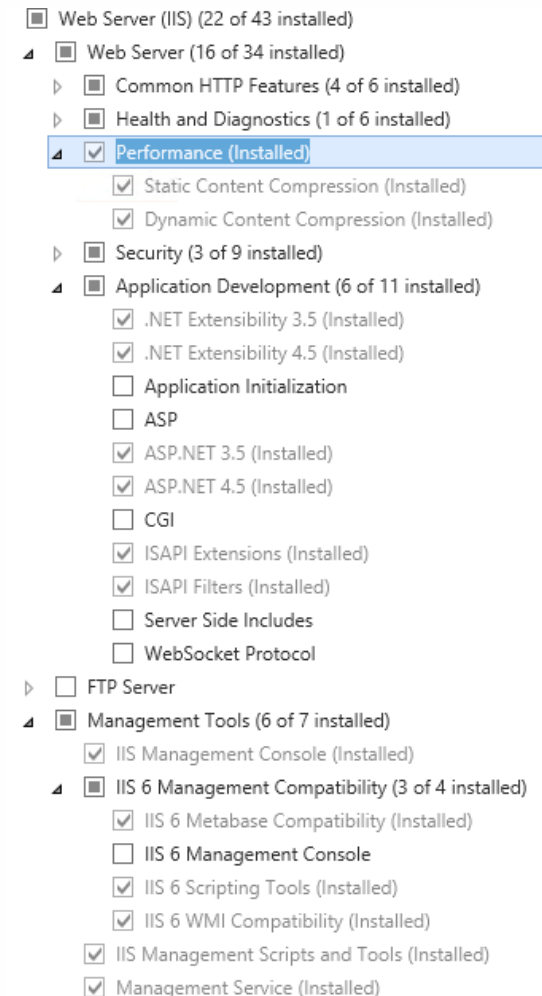 - Collector for ArcGIS and other ArcGIS Online Apps

Web

Lucity Web

- It's a Web application installed on IIS Web Server
  - Clients must have Silverlight installed on local workstation
  - Browser Based using IE11 (Compatibility View not Supported)
  - Should be **internal** only
  - Recommend 2Ghz, 4 cores and 8GB of RAM
  - If stand alone, consider RAID 1 10k SAS or better
  - Consider newer VMWare or 2012 R2 hyper-V for VM core support
  - Recommend Windows 2012 R2 for new servers

Lucity Web

- Software requirements
  - .NET framework 4.5.2 and higher (full)
  - ASP.net 4.5 enabled in IIS
  - IIS 6 Metabase Compatibility
  - IIS 6 WMI Compatibility
  - Windows Authentication
  - WCF HTTP Activation feature
  - For performance, enable Dynamic Content Compression in IIS

Web Server (IIS) (22 of 43 installed)
 ◢ ■ Web Server (16 of 34 installed)
   ▷ ■ Common HTTP Features (4 of 6 installed)
   ▷ ■ Health and Diagnostics (1 of 6 installed)
   ◢ ☑ Performance (Installed)
       ☑ Static Content Compression (Installed)
       ☑ Dynamic Content Compression (Installed)
   ▷ ■ Security (3 of 9 installed)
   ◢ ■ Application Development (6 of 11 installed)
       ☑ .NET Extensibility 3.5 (Installed)
       ☑ .NET Extensibility 4.5 (Installed)
       ☐ Application Initialization
       ☐ ASP
       ☑ ASP.NET 3.5 (Installed)
       ☑ ASP.NET 4.5 (Installed)
       ☐ CGI
       ☑ ISAPI Extensions (Installed)
       ☑ ISAPI Filters (Installed)
       ☐ Server Side Includes
       ☐ WebSocket Protocol
 ▷ ☐ FTP Server
 ◢ ■ Management Tools (6 of 7 installed)
       ☑ IIS Management Console (Installed)
   ◢ ■ IIS 6 Management Compatibility (3 of 4 installed)
       ☑ IIS 6 Metabase Compatibility (Installed)
       ☐ IIS 6 Management Console
       ☑ IIS 6 Scripting Tools (Installed)
       ☑ IIS 6 WMI Compatibility (Installed)
       ☑ IIS Management Scripts and Tools (Installed)
       ☑ Management Service (Installed)

Lucity Web

- Lucity Web Rest API
  - Installed on the same IIS instance as Lucity Web, it is used by Lucity Web to perform necessary functions
    - Provides Data to Lucity Web (HTML5)
      - Dashboards
      - Filters
      - Reports
      - Documents
    - Does not provide data to views or detailed forms as this is still in Silverlight
      - Future Versions will convert these functions into the Web Rest API

Lucity REST API

- Lucity's Application Programming Interface for developers who want to extend the capability of Lucity
  - Can be placed on the same server as Lucity Web

Identity Server

Lucity Identity

- Used to identify, authenticate, and track Lucity user logins.
  - Token based security
  - OAuth 2.0
  - Installed on the same server as Lucity Web and Lucity Mobile Server
  - Please make sure Mobile Server can see the URL for Lucity Identity Server so it can authenticate to Identity Server
    - In a DMZ, the Windows hosts file is one of the ways to assign the internal IP address of the DMZ web server to the Identity Server URL.

    (Example: 36.78.22.124->mobile.Lucity.com)

Document Server

Document Server

- It's a file management system that allows users to upload files as an attachment to Lucity records and places the files on a network share usually on a file server (example…\\fileserver1\LucityDocs)
  - Used in Lucity Web and Lucity Mobile for (iOS and Android)
  - Should be on internal server; can be on same server as Lucity Web
  - Uses Microsoft IIS Web Server
  - Recommend 2Ghz, 2 cores and 4GB of RAM
  - If stand alone, consider RAID 1 10k SAS or better
  - Consider newer VMWare or 2012 R2 hyper-V for VM server support
  - Recommend Windows Server 2012 R2 for new server

File Server

File Server

- Not an application but rather a server to store Lucity Attached documents and sometimes used to store the Lucity configuration files
  - At least 2Ghz CPU, 2 cores, 2GB of RAM is recommended
  - Storage location for Lucity Document Server
  - RAID 1 or higher
  - At least 2GB of Storage Space
  - For CCTV, Documents, and media at least 1TB of space
  - **Case study**: 14TB of available space on a RAID 5 Array; less than $2,000
    - Backup files on a fireproof device

Database Server

Database Server

- Lucity Database uses SQL Server or Oracle
  - Unified Database Architecture excluding GIS

Microsoft SQL Server 2014 (All Editions)
Microsoft SQL Server 2012 (All Editions)
Microsoft SQL Server 2008 R2 (All Editions)
Microsoft SQL Server 2008 [A]

Oracle 11g Server
Oracle 11g Client
Oracle 10g Server
Oracle 10gR2 Client with Latest ODP.NET patch (Client)
Oracle 9i, 10g (Server)

Database Server

- Lucity Database Specifications
  - Recommend at least 2 Ghz, 4 cores and 8GB of RAM
  - Recommend RAID 1 or Higher (RAID 5 or 10 for medium to large organizations)
  - At least 20GB of Space minus GIS
  - Consider other databases like GIS, Financials, Permitting, CCTV and more
  - Consider newer VMWare or 2012 R2 hyper-V for VM server support
  - Not on the same server as ArcGIS for Server
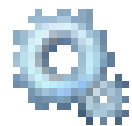 - Recommend Windows Server 2012 R2 for new server

Service Server

Service Server

- Lucity Service Server is a service that runs in Windows

Service Server

- Generates work orders based on a Preventative Maintenance schedule and performs varied other nightly recalculations of data within Lucity like:
  - Fleet calculations at 3:30am
  - Purges temporary data from database tables
  - Process PMs at 2:30am
  - Work Nightly Tasks at 3am
  - Nightly Cleanup Tasks at 2am
  - Update current asset values for server construction records
  - Removes stale availability records
  - Updates work order calculations
  - More details found at **help.lucity.com** under Services, Lucity PM services

Service Server

- Initializes every minute to run processes
  - Polls InMemory
- There are four processes within this service
  - Request Generator
  - Send E-mail Notifications
  - Spatial Indexer
  - GIS Scheduled Tasks

Service Server

- Request Generator
  - Allows for e-mails to be sent to a specific e-mail address. This process will convert the e-mail into a Lucity Work Request.
    - You can setup multiple e-mail accounts linked to a specific problem code.
    - Service logs events into Lucity database, table WKREQEMAIL
    - Generate Requests from Email 7am-8pm

Service Server

- Send E-mail Notifications
  - This process allows Lucity to generate e-mails through a notification trigger configurable in the Desktop or the Web
  - Send Emails every minute 7am-8pm

Service Server

- Spatial Indexer
  - Process generates work order/request, and assets spatial attributes in SQL Server Spatial or Oracle Spatial so users can view live data in ArcMap or Lucity Web Map
    - X, Y location stored in database
    - Ability to control maximum days to process records
    - Must have SQL Server 2008 or higher
  - Every 5 minutes from 7am-8pm

Service Server

- GIS Scheduled Tasks
  - Process is designed to run GIS Scheduled Tasks. These tasks push changes made in inspections for Lucity to GIS and from inventory for GIS into Lucity. Inventory Lucity to GIS changes are synchronized immediately through the feature service.
  - Every minute from 7am-8pm

Service Server

- Hardware Specifications
  - Recommend at least 2 Ghz, 4 cores and 2GB of RAM
  - Recommend RAID 1 or Higher (RAID 5 or 10 for medium to large organizations)
  - At least 2GB of Space
  - Consider newer VMWare or 2012 R2 hyper-V for VM server support
  - Consider increasing RAM and CPU availability as services are using more resources based on functionality enabled in Lucity.
  - Recommend installing Lucity Services on File Server
  - Do not install on Lucity Web Server or Lucity Mobile Server.

Citizen Portal

Lucity Citizen Portal

- Web interface that allows customers to create work requests
  - Can be installed on internal application servers depending on your workflow
  - At least 2Ghz, 2 cores, 4GB of RAM recommended
  - RAID 1 or higher
  - At least 1 GB of Storage Space
  - Citizen Portal Rest API is available as well

Mobile Server

Lucity Mobile Server

- Mobile server allows for Android and iOS devices to connect to Lucity Databases and business logic
  - Rest Services
  - Two Security Architectures for Lucity Mobile Server Deployments
    - Installed on an internal application server for organizations using VPN
    - Installed on an external application server for organizations using DMZ
      - HTTPS and a signed TLS 1.2 recommended
      - Self-Signed SSL does not work
- Lucity Mobile Server (on the server itself) needs to access the Map Services Rest Endpoints that is configured in Lucity Administration Tools/GIS/Map Services

Lucity Mobile Server

- Hardware Specifications
  - At least 2 Ghz CPU, 4 cores, 8GB or RAM Recommended
  - RAID 1 or higher
  - At least 2GB of Storage Space
  - 20GB minimum for offline Mobile caches

Android Devices

Android Devices

- Lucity Mobile 2.x Version
  - Samsung Galaxy Tab S2 or S3
    - 8 and 9.7 inch models
    - At least 32GB internal storage for offline mode
  - Nexus 7 2016 or 9
    - At least 32GB internal storage for offline mode

Android Devices

- Mobile Device Requirements
  - At least 1.5 Ghz CPU
  - For offline storage, at least 2 to 3 times the offline cache size.
    - GIS Offline uses this number could grow substantially
  - At least 2GB RAM
  - At least 720p (usually 960x720 resolution)
  - At least Android 4.0.3 version

Android Devices

- Lucity Mobile Work Phone Specs
  - At least 50MB disk space
  - Small Screens: 426x320 resolution
  - Xlarge Screens: 960x720 resolution
  - At least Android 2.2 version

Apple Devices

Apple Devices

- Lucity 2.x Version
  - For offline storage, at least 2 to 3 times the offline cache size.
    - GIS Offline uses this number could grow substantially
  - At least 2GB RAM
  - At least 720p (usually 960x720 resolution)
  - At least iOS 8 version

Apple Devices

- iPad Pro
  - 9.7 or 12.9 inch multi-touch display
  - Antireflective coating
  - Fingerprint-resistant oleophobic coating
  - 12 and 8 megapixel cameras
  - 4K HD Video recording on the 9.7 inch model
  - 4GB RAM
  - 32GB internal storage or higher for offline mode

Apple Devices

- iPad Mini 4
  - 7.9 inch Retina and with anti-reflective Display
  - 8 megapixel rear camera
  - 2 GB RAM
  - Get 64GB or Higher of storage space if using offline mode

Apple Devices

- iPad Air 2
  - Faster Processor
  - 64 GB Storage or higher if using offline mode
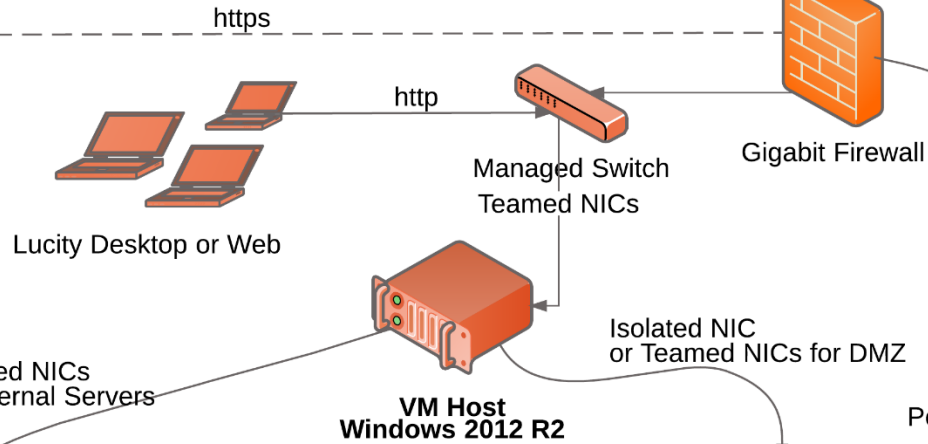 - 9.7 inch Display

Apple Devices

- iPhone 5s,6,6+,6s,SE
  - Recommend purchasing iPhone 5s or higher for offline capability.
    - 32GB internal storage and higher for offline mode

Lucity Network Architecture

Lucity Mobile (Android, iOS)
Citizen, ArcGIS Online
3rd Party
Applications

https

http

Managed Switch
Teamed NICs

Gigabit Firewall

Lucity Desktop or Web

Teamed NICs
for Internal Servers

Isolated NIC
or Teamed NICs for DMZ

Port 443

**VM Host
Windows 2012 R2**

Virtual Switch for Internal VM Servers

Virtual Switch for DMZ

SQL Server Port 1433
or non-standard port

HTTP for Document Server (80)

<u>Lucity Server</u>
SQL Server
Lucity Database
ArcGIS Databases
Lucity Web
Lucity Web REST API
Lucity Identity Server
Lucity Document Server
Lucity REST API
Lucity Service Server
Crystal Reports, License, Lucity Config,
Internal and Citizen Documents

<u>External IIS Web Server</u>
Lucity Mobile Server
Lucity Identity Server
Lucity Citizen Portal
Lucity Citizen Rest API
ArcGIS for Server Web Adapter

Port 6443

<u>ArcGIS for Server</u>
SQL Native Client 2012 or ODBC
Drivers

Lucity/Esri Minimum
Configuration Example
Using a DMZ

Lucity Mobile (Android, iOS)
Citizen, ArcGIS Online
3rd Party
Applications

https

http

Managed Switch
Teamed NICs

Gigabit Firewall

Lucity Desktop or Web

Teamed NICs
for Internal Servers

Isolated NIC
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**VM Host
Windows 2012 R2**

Port 443

Virtual Switch for Internal VM Servers

Virtual Switch for DMZ

HTTP Port for Document Server (80)

Port 1433
or non-standard port

Internal IIS Web Server
Lucity Web
Lucity Web REST API
Lucity Identity Server
Lucity Document Server
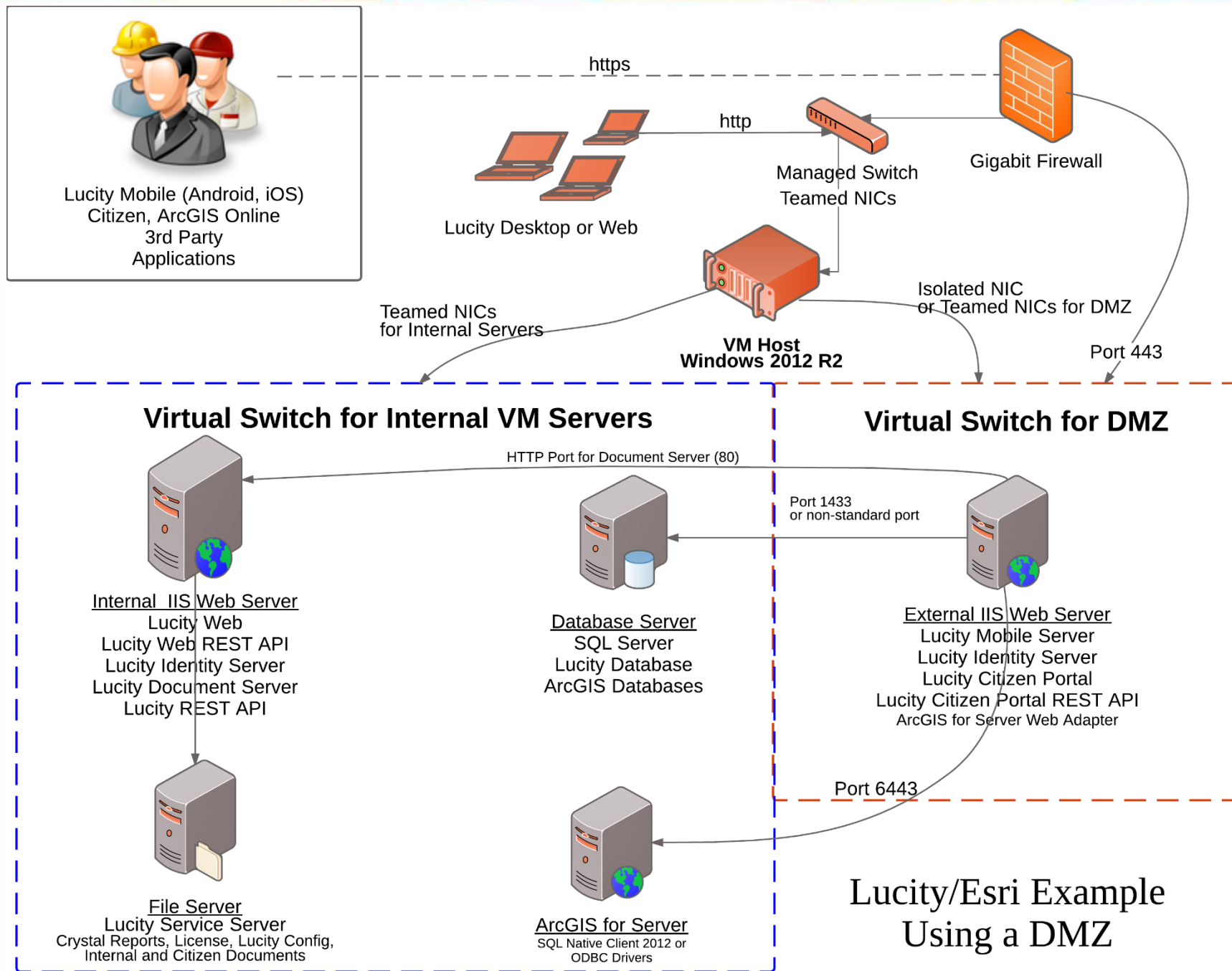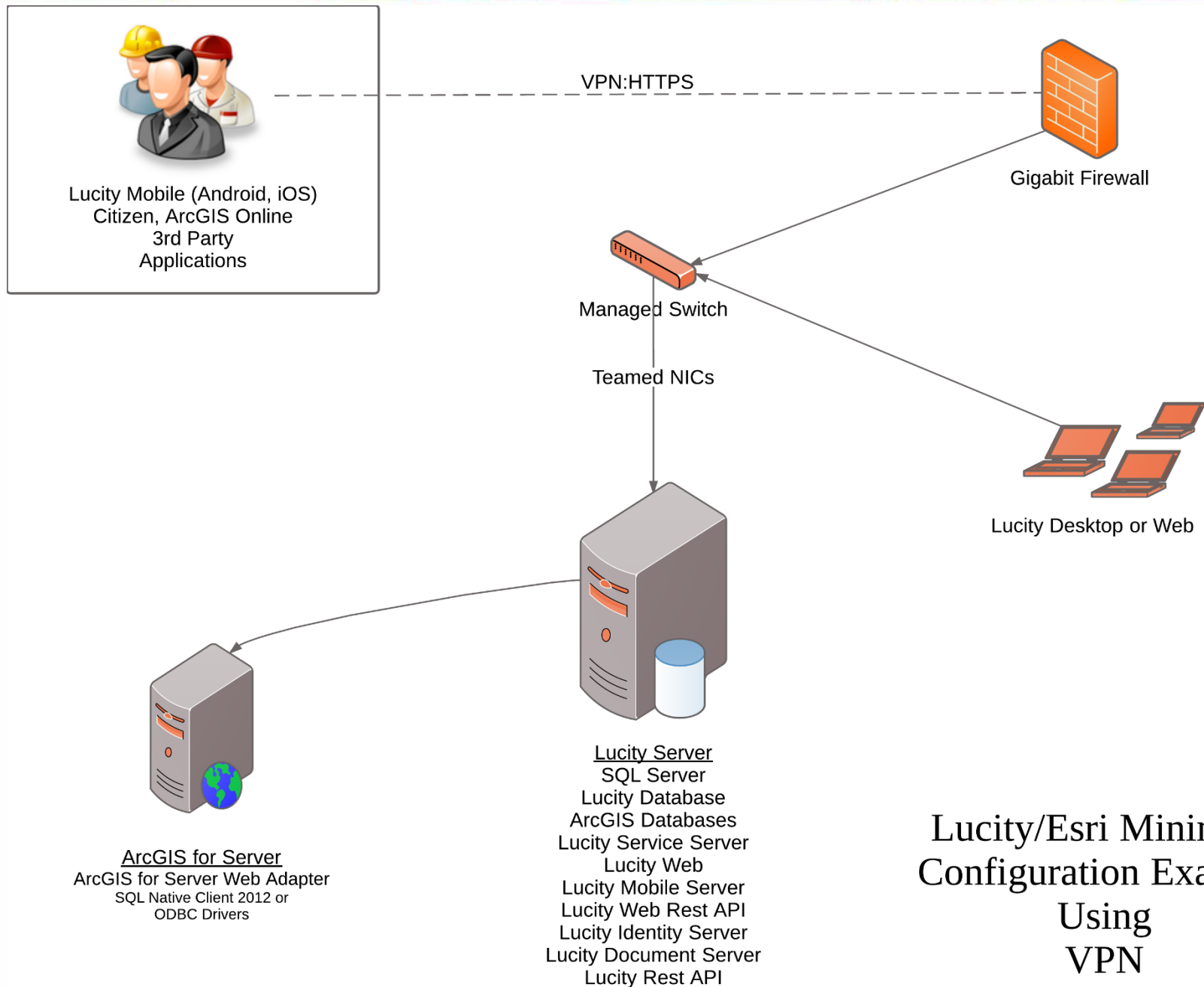Lucity REST API

Database Server
SQL Server
Lucity Database
ArcGIS Databases

External IIS Web Server
Lucity Mobile Server
Lucity Identity Server
Lucity Citizen Portal
Lucity Citizen Portal REST API
ArcGIS for Server Web Adapter

Port 6443

File Server
Lucity Service Server
Crystal Reports, License, Lucity Config,
Internal and Citizen Documents

ArcGIS for Server
SQL Native Client 2012 or
ODBC Drivers

Lucity/Esri Example
Using a DMZ

VPN:HTTPS

Gigabit Firewall

Managed Switch

Teamed NICs

Lucity Mobile (Android, iOS)
Citizen, ArcGIS Online
3rd Party
Applications

Lucity Desktop or Web

Lucity Server
SQL Server
Lucity Database
ArcGIS Databases
Lucity Service Server
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Lucity Document Server
Lucity Rest API
Crystal Reports, License, Lucity Config, Internal and Citizen Documents

ArcGIS for Server
ArcGIS for Server Web Adapter
SQL Native Client 2012 or
ODBC Drivers

Lucity/Esri Minimum
Configuration Example
Using
VPN

Lucity Mobile (Android, iOS)
Citizen, ArcGIS Online
3rd Party
Applications

VPN: HTTPS

Gigabit Firewall

Managed Switch

Teamed NICs

Lucity Desktop or Web

Database Server
SQL Server
Lucity Database
ArcGIS Databases

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ArcGIS for Server
ArcGIS for Server Web Adapter
SQL Native Client 2012 or
ODBC Drivers

Lucity/Esri Example
Using
VPN

DMZ Considerations

- Be strict with firewall rules from DMZ to Internal LAN.

- Add host record for the internal alias to database server on the DMZ server hosts file

- For Internal LAN, add NAT from external IP DMZ Web Server so inside can route to the DMZ Web Server *example*

  - 74.95.78.22 (External Static IP) -> 10.0.12.34 (Internal DMZ IP)

DMZ Considerations

- Lucity Mobile Server, Citizen Portal and Citizen Portal Rest API needs to be able to talk to Lucity Document Server through http.

DMZ Considerations

- For Map Service Rest URLs configured in Lucity, you need to able to connect to the URLs through the servers that have Lucity Web, Lucity Mobile Server and Lucity Services installed.
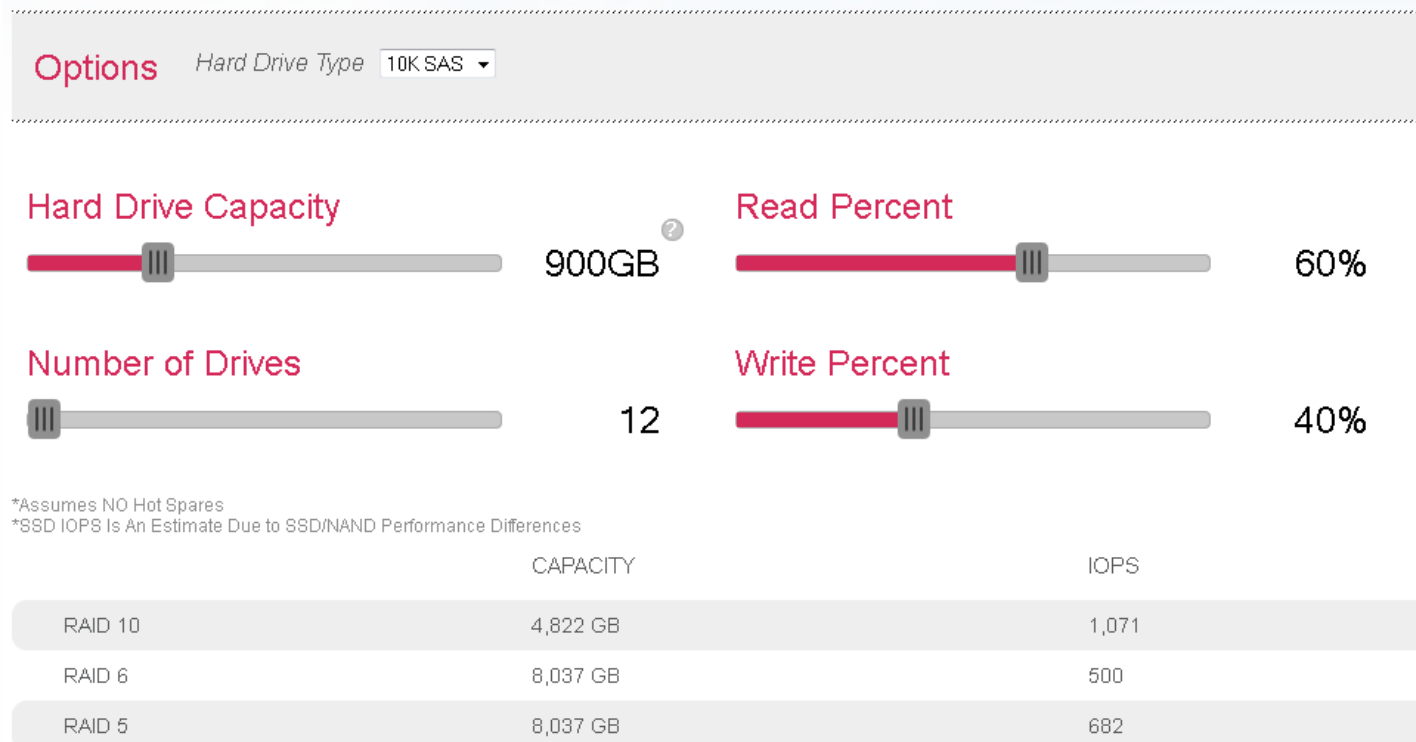 - Also, you need all devices to be able to connect to the Map Service Rest URLs

Infrastructure Considerations

Hyper-V Considerations

- IOPS (Input/Output Operations Per Second
  - [Calculations of Max Concurrent Users](#)
    - Hyper-V RAID Array: 15 IOPS per max concurrent user

Options	Hard Drive Type	10K SAS ▾

Hard Drive Capacity   900GB   **Read Percent**   60%

Number of Drives   12   **Write Percent**   40%

*Assumes NO Hot Spares
*SSD IOPS Is An Estimate Due to SSD/NAND Performance Differences

	CAPACITY	IOPS
RAID 10	4,822 GB	1,071
RAID 6	8,037 GB	500
RAID 5	8,037 GB	682

Hyper-V Considerations

- RAM Overhead using Hyper-V
  - 32MB for the first GB of each VM
    - 8MB for each GB after the 1st GB used

RAM Calculations in Hyper-V		
Test Server		
Description	RAM (MB)	RAM VM Allocation (GB)
Hypervisor	300	
VM RAM (first 1GB)	128	4
VM RAM (after first 1GB)	182.4	22.8
OS Manager	4000	
Overhead	4610.4	
Total	31410.4	26.8
South Placer		
Hypervisor	300	
VM RAM (first 1GB)	256	8
VM RAM (after first 1GB)	1024	128
OS Manager	4000	
Overhead	5580	
Total	141580	136

# of VM Servers X 1GB
Rest of the RAM utilized between all of the VM Servers
Dedicated RAM for OS

Hyper-V Considerations

- CPU
  - Hyper-V uses logical cores
    - Example: Intel 12 core will allow for up to 24 logical cores in Hyper-V
    - **Case Study**: 2 x Intel e5-2695v2
      - Total logical cores = 48
        - » 8 logical cores to SQL Server
        - » 4 logical cores to ArcGIS for Server
        - » 4 logical cores to Tyler Incode Web
        - » 4 logical cores to Lucity Web

Hyper-V Considerations

- Plan system for less than 40% initial utilization for future scalability.
- Consider multi-processes for each user connection (15 IOPS per user times processes per user). Better to have too much than too little. VMWare uses 25 IOPS per user.
- Consider HDD spindle latency (3ms versus 5ms).
- Make sure DAS or SAN is expandable for future growth.

Network Connections

- Check your network connectivity
  - Connections: Cat 5 over ballasts or anything that could impede frequency
    - Recommend CAT 6 insulated or higher
  - Switches: Are they Gigabit?
    - Unmanaged versus Managed?
    - Switch Redundancy for failover in Server Farm?
  - Firewall: Can you configure VPN or DMZ?
    - Does it have Gigabit ports?
    - What's the max user count for VPN connections?
    - What's the total bandwidth/throughput?

System Environment

- Does your servers have an independent climate control?

- Does your server room have air purification system?

- Is there ample power to scale your server room in the near future?

- What is the maximum amount of time for UPS (uninterrupted power supply) in case of a power failure?

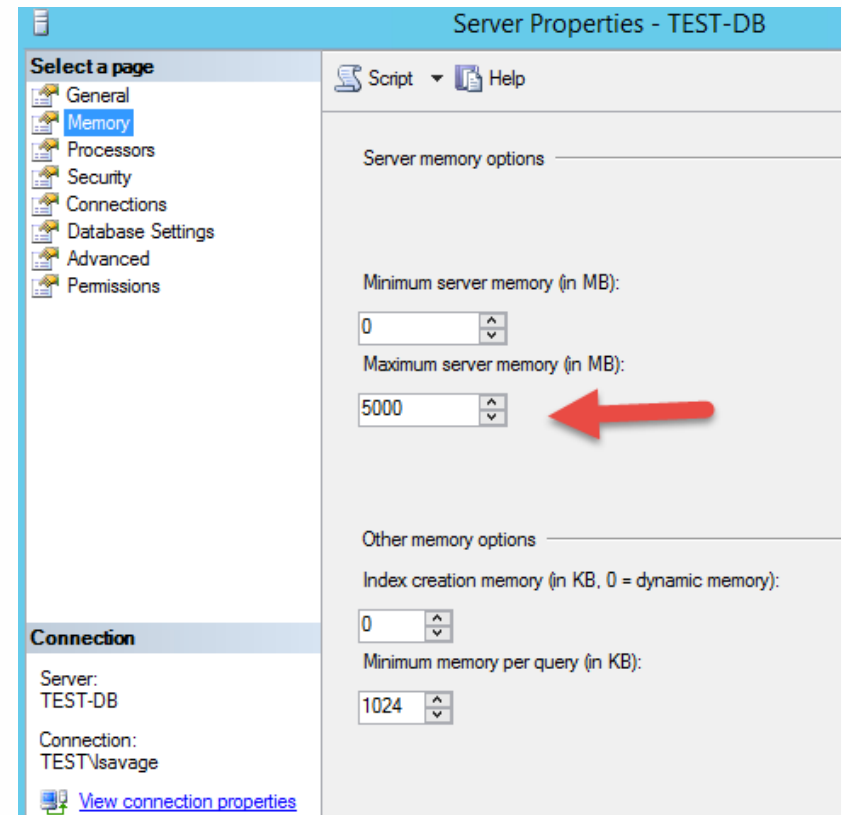- Are you using non-Corrosive Fire Protection Systems like inert Gas that is environmental friendly.
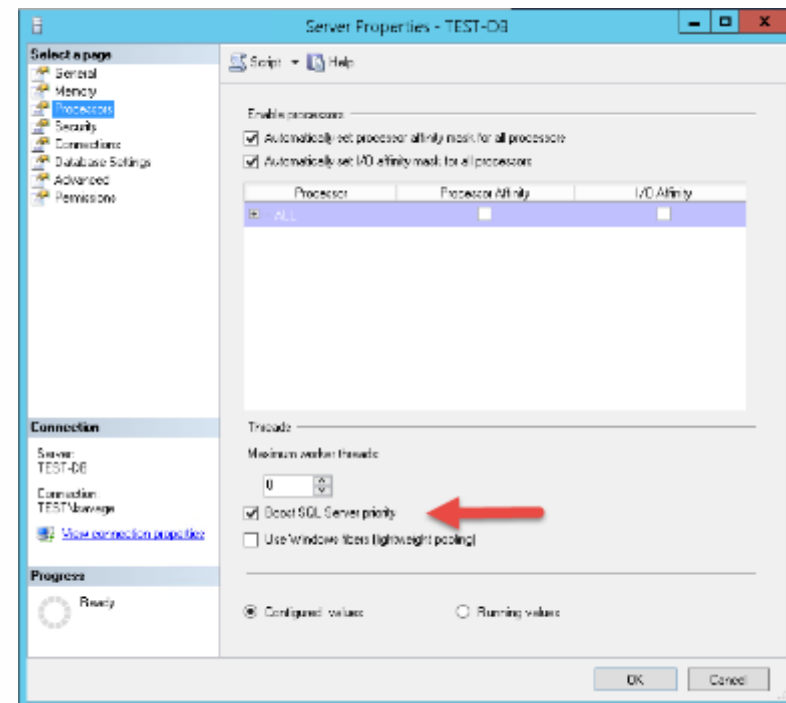
SQL Server Tuning

SQL Server Tuning

- SQL Server 2012+ RAM Caching
  - SQL Server utilizes RAM more efficiently for data that is used frequently for faster queries
 - Keep at least 512MB of RAM for OS

SQL Server Tuning

- SQL Server Tuning for CPUs
    - Recommend using default unchecked 'Boost SQL Server Priority'. However for applications like ArcGIS for Server on the same OS, 'Boost SQL Server priority' will ensure resources will be available for SQL Server.
    - If using Microsoft Server 32bit or older versions of Server, change the processor nodes so the OS can use core 0 and possibly core 1 if many applications exist on the database server. In newer versions of Microsoft Server, VMware, Hyper-V, keep everything automatic for node spanning.
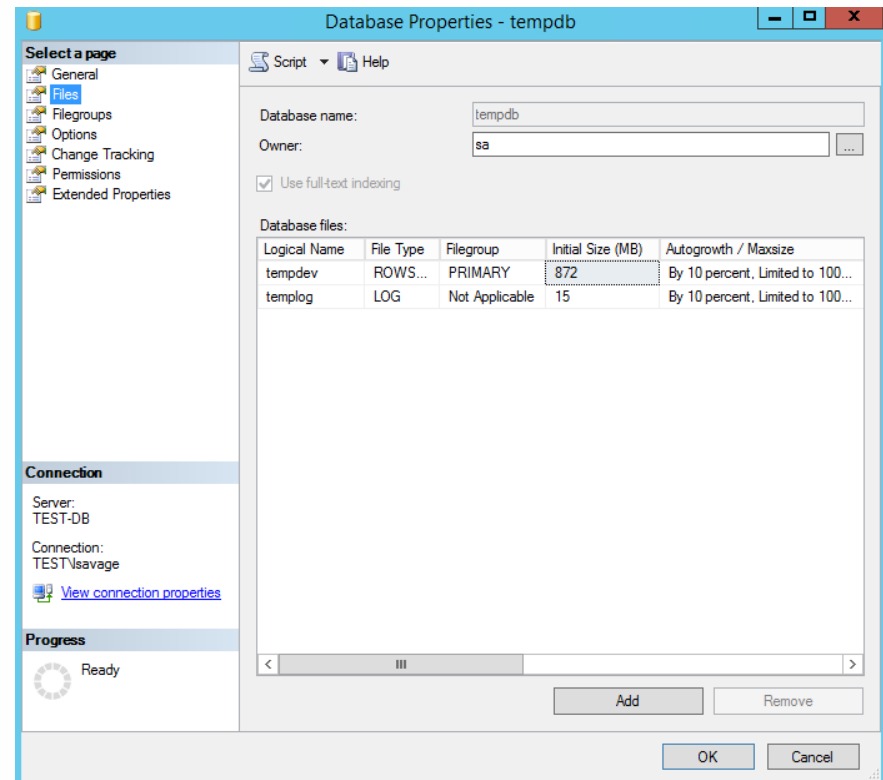
SQL Server Tuning

- Network Packet Size
  - For Lucity, keep the default 4096 for network packet size. However, Increase the network packet size to 8192 for Enterprise Geodatabases if on the same instance as Lucity
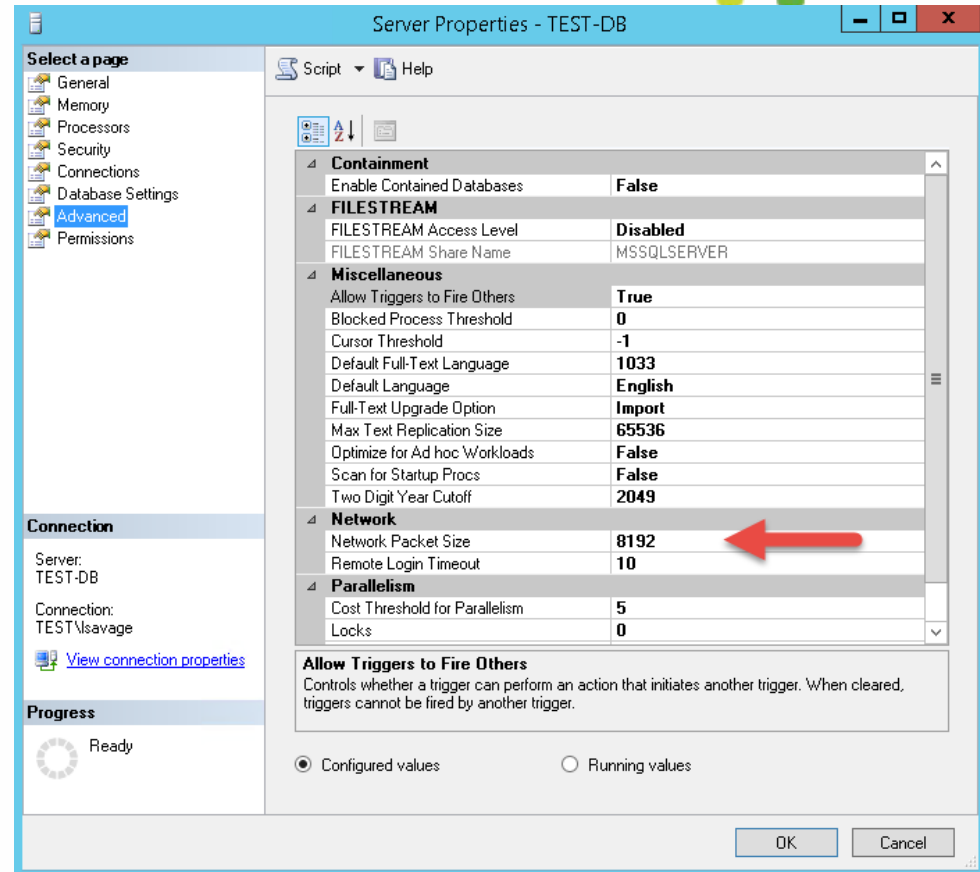
SQL Server Tuning

- TempDB
  - For Lucity, make sure the TempDB database datafile is set to 500MB and logfile to 100MB. It may grow if more databases other than Lucity is inside of the SQL Instance.
    - At minimum, set datafile autogrow to 10% limit to 2GB
    - At minimum, set logfile autogrow to 10% limit to 1GB

SQL Server Tuning

- Consider migrating to DBO Schema instead of SDE Schema
    - Allows SQL Server DBAs to manage SDE
    - Backdoor for SA
    - Integrate with Active Directory Groups and Users
    - Flexible deployment
    - Easier to move the database
    - SDE Schema has limited life

SQL Server Tuning

- Raster data should have it's own database separated away from vector databases
  - Different backup needs
  - Has different maintenance routines
  - Can configure the sde dbtune table to be raster specific and exclude vector storage
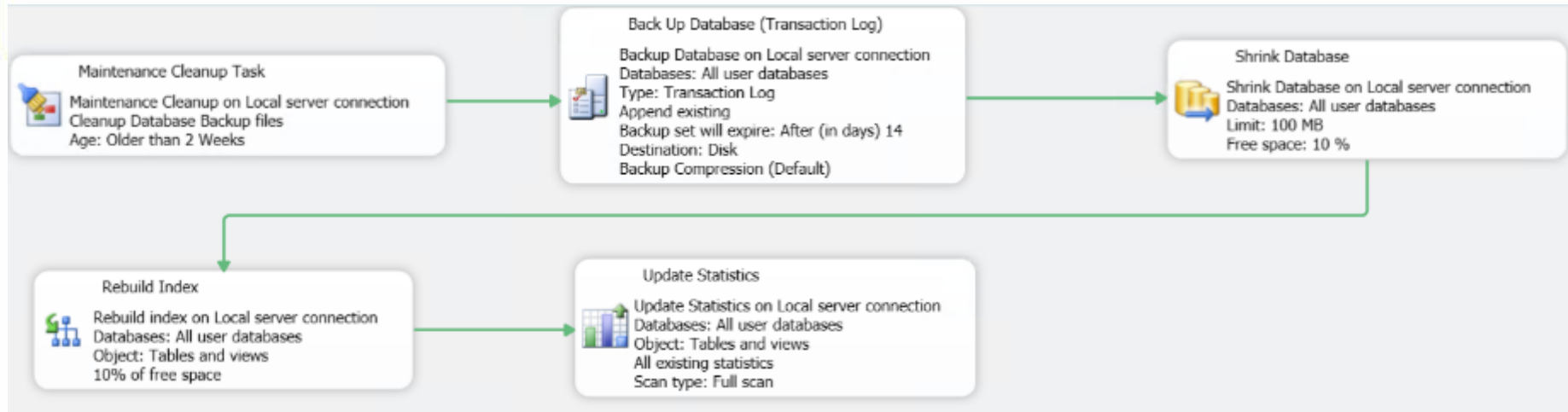 - Security and Access of data are different

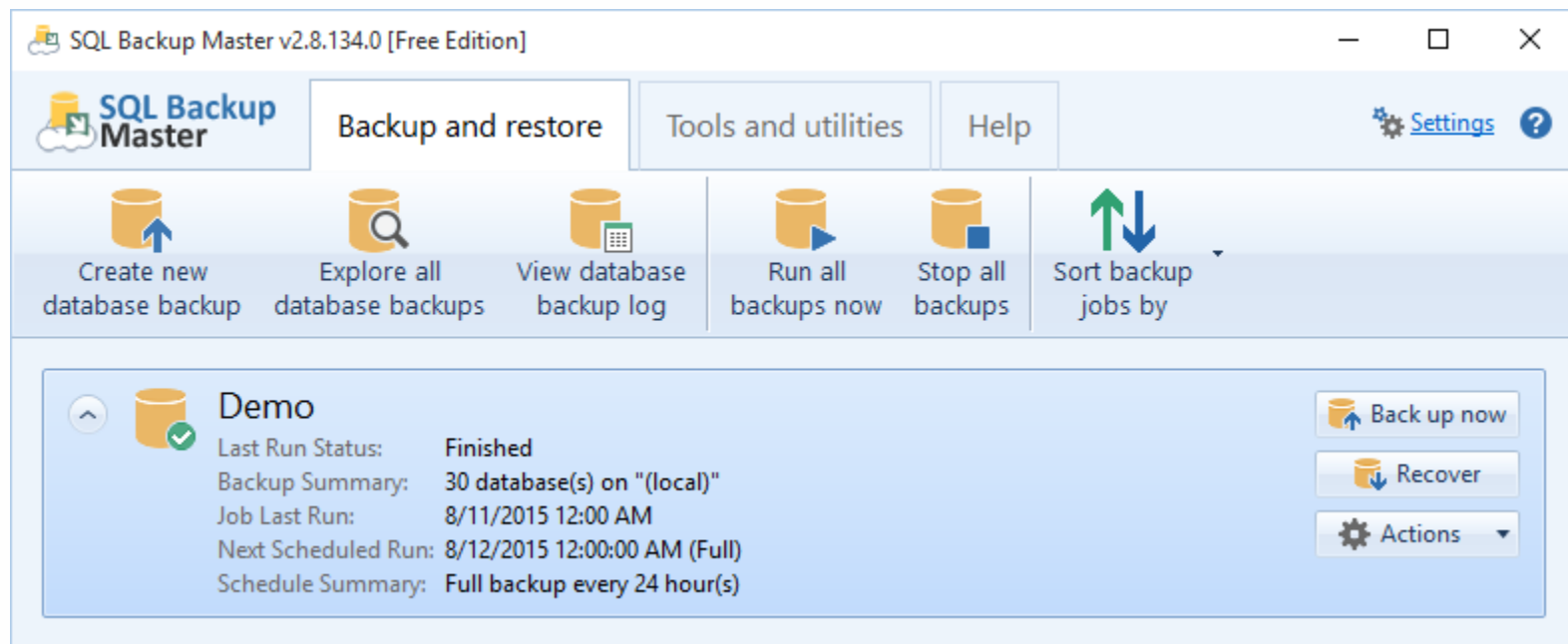# Backups

SQL Server Backup

- Create a Maintenance Plan for SQL Server
  - Lucity Database (simple versus full recovery)
  - Consider backup (.bak) backups rather than backing up mdf and ldf files. Backup to local drive then copy or backup to offsite area.
  - Analyze, Index and Update Statistics
  - Shrink Logfiles only when necessary
  - Consider Full, Intermediate and Transaction Log backups
  - Consider encrypting backups (not available in SQL Express)

Maintenance Cleanup Task
Maintenance Cleanup on Local server connection
Cleanup Database Backup files
Age: Older than 2 Weeks

Back Up Database (Transaction Log)
Backup Database on Local server connection
Databases: All user databases
Type: Transaction Log
Append existing
Backup set will expire: After (in days) 14
Destination: Disk
Backup Compression (Default)

Shrink Database
Shrink Database on Local server connection
Databases: All user databases
Limit: 100 MB
Free space: 10 %

Rebuild Index
Rebuild index on Local server connection
Databases: All user databases
Object: Tables and views
10% of free space

Update Statistics
Update Statistics on Local server connection
Databases: All user databases
Object: Tables and views
All existing statistics
Scan type: Full scan

SQL Server Backup

- Optional SQL Server Backup Software for all SQL versions
  - SQL Backup Master which is easy to use

Lucity Files to Backup

- Document Share Location
- Document Report Share Location
- Lucity Configuration
- Lucity License XML File
- Lucity VM Servers
- Lucity Database

GIS Maintenance

GIS Maintenance

- Make sure you compress per week at least
  - Analyze, index and update statistics during the compression routine
  - Recommended: Zero State compress at least once a year
- Backup your Enterprise Geodatabase
  - Recommend: At least once a year backup into a File Geodatabase in addition to RDBMS backups

Budget and Planning

Budget and Planning

- Plan for Migration to new technologies
  - Infrastructure every 3 to 5 years
  - Warranty and Support for hardware considerations
  - Recommend updating Mobile devices every 18 – 30 months
- Should be a part of your operating costs
- Constant feedback from the field on how the system is operating is a plus
  - Are they using the products?
  - What are they having problems with?
  - Involve your Lucity support staff or Regional Manager to help
  - Be proactive instead of always reactive