# Esri Best Practices: Implementing an Enterprise Geodatabase

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esri

SEE
WHAT
OTHERS
CAN'T

THE
SCIENCE
OF
WHERE

# Agenda
## Implementing an Enterprise Geodatabase

- **Overview**
- **Implementation Approach**
- **Architecture**
- **Geodatabase Design**
- **Build**
- **Workflow Design**
- **Testing and Tuning**
- **Maintenance**
- **Monitor**
- **Question & Answers**

*Key Considerations, Best Practices, Recommendations and Lessons Learned!*

# Audience

## Implementing an Enterprise Geodatabase

- **Intermediate**
- **Advanced**

# Overview

# What is an Enterprise Geodatabase (EGDB)?

## Centralized multiuser Geodatabase

- **ArcSDE enables the RDBMS\* for GIS data management**
  - **Oracle**
  - **Microsoft SQL Server**
  - **PostgreSQL**
  - **IBM DB2, Informix**
  - **SAP Hana**
- **Extremely large, continuous and centralized GIS database**
- **Many simultaneous users**
- **Long transactions and versioned workflows**
- **SQL types for spatial in all supported RDBMS**
- **High performance for a very large number of users**

**\*RDBMS – Relational Database Management System**
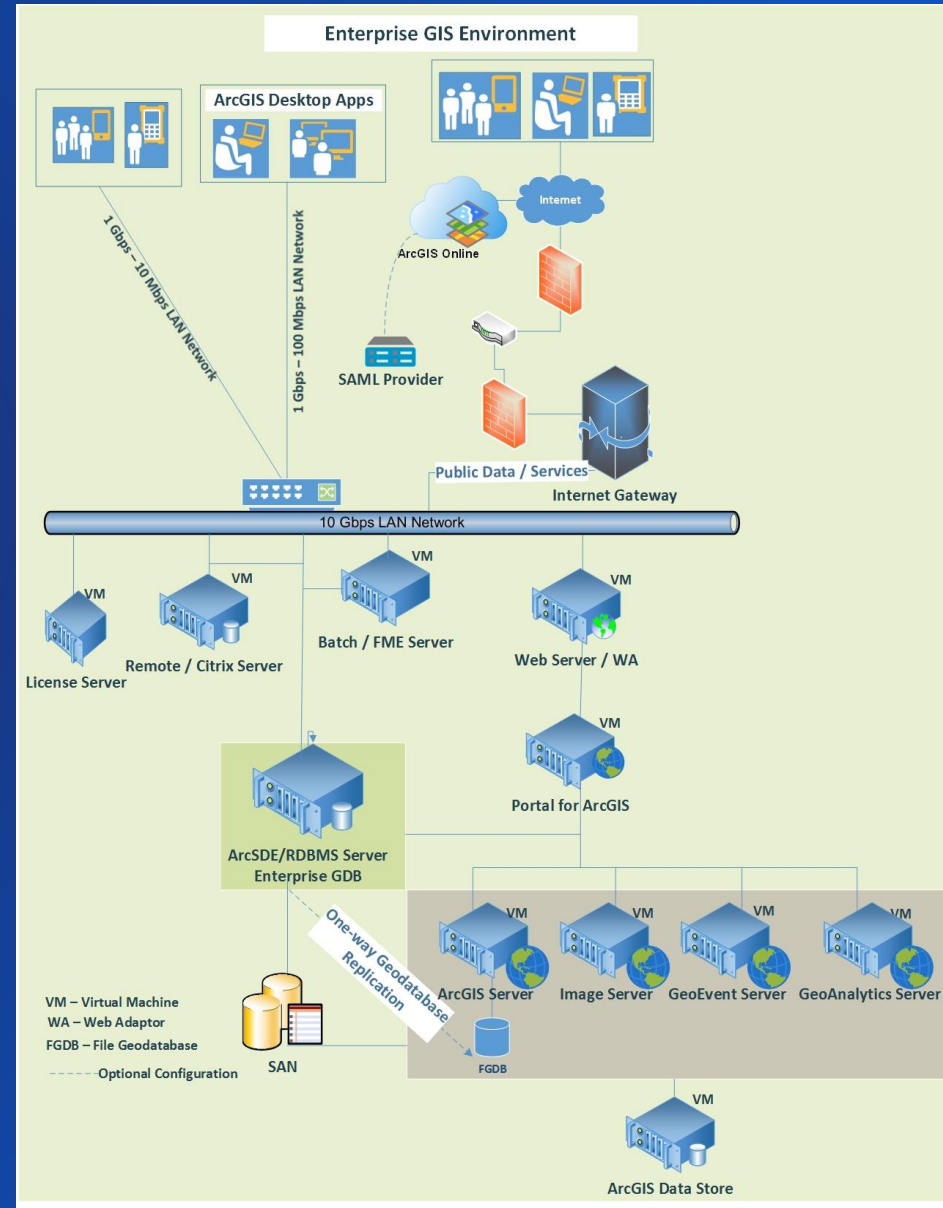
# Implementation Approach

# Implementation Approach
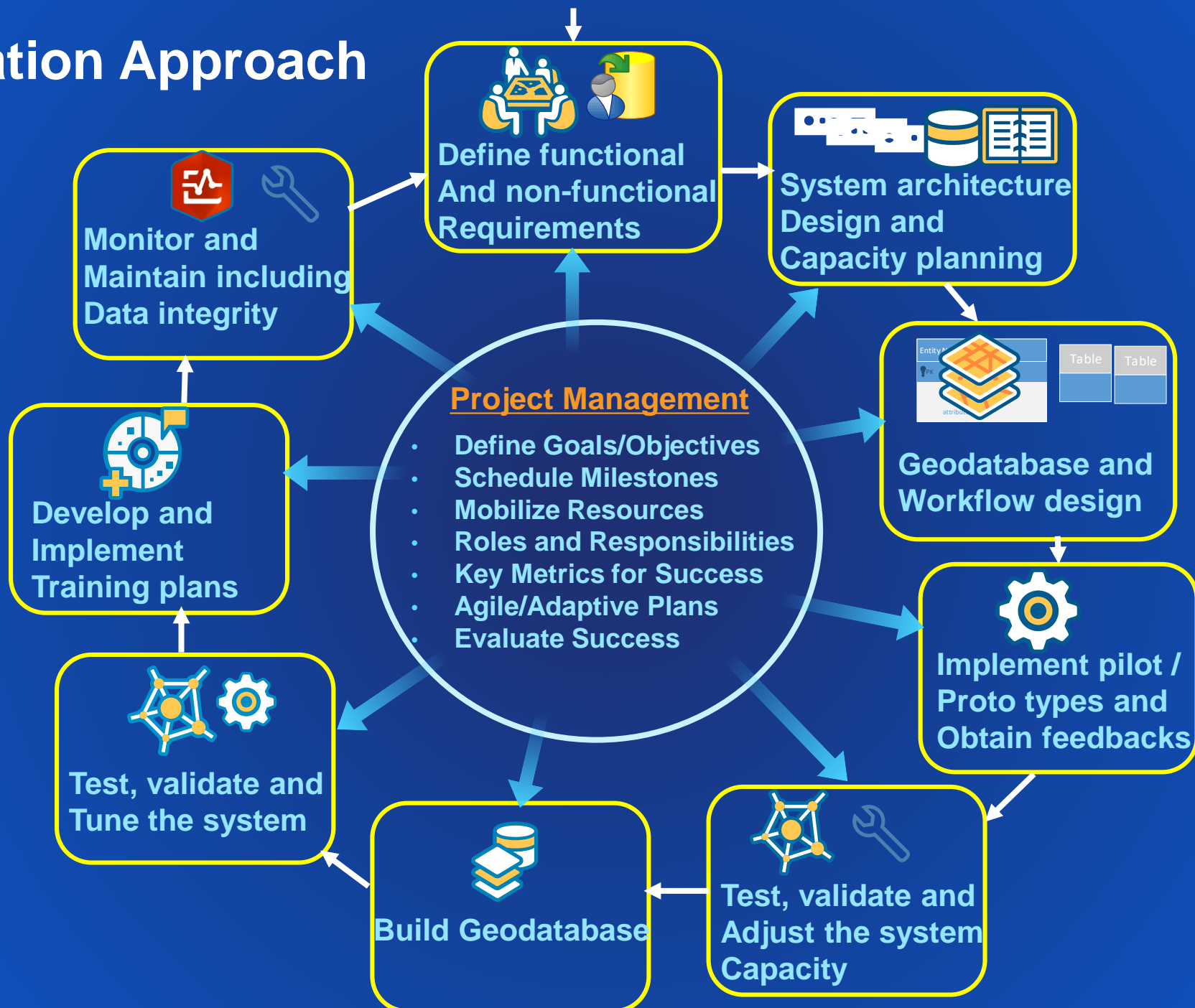
# Architecture

# Efficient Implementation



- **System Architecture and Capacity**
  - **Separation of read and edit data sources**
  - **Faster Processors**
  - **Enough system capacity**
  - **Better storage and network**
  - **etc.**



ArcGIS (Desktop, Engine) Text Performance Patch

Drawing of text when font smoothing is enabled is significantly slower than non-smoothed text. This patch resolves the performance deficit.

Published: 04/30/2019

Read More

- **Software**
  - **Version selection including the patches**
  - **Utility industry ArcGIS Desktop version 10.2.1 (10.2.2) and 10.6.1**
  - **Utility Network in ArcGIS Pro >2.1**

| Annotation Performance | | | | | |
|---|---|---|---|---|---|
| S.No | Display Scale | Layer Name | Before Applying Patch in Seconds | After Applying Patch in Seconds | Performance difference in Seconds | Performance improvement in % |
| 1 | 2000 | ServiceAnno | 1.02 | 0.19 | 0.83 | 436.84% |

*Under-utilized / stable IT Infrastructure helps*

# Capacity Planning

- **Define architecture vision / foundation**
  - **Describe the System and its relationships**
- **Business Architecture**
  - **Define the business usage**
- **Application Architecture**
  - **Plan suitable software solutions / applications**
- **Data Architecture**
  - **Identify data requirements and management**
- **Technology Architecture**
  - **Select proper technology & capacity for IT infrastructure**

*System architecture design reduces cost and improves productivity*

Solution Architecture
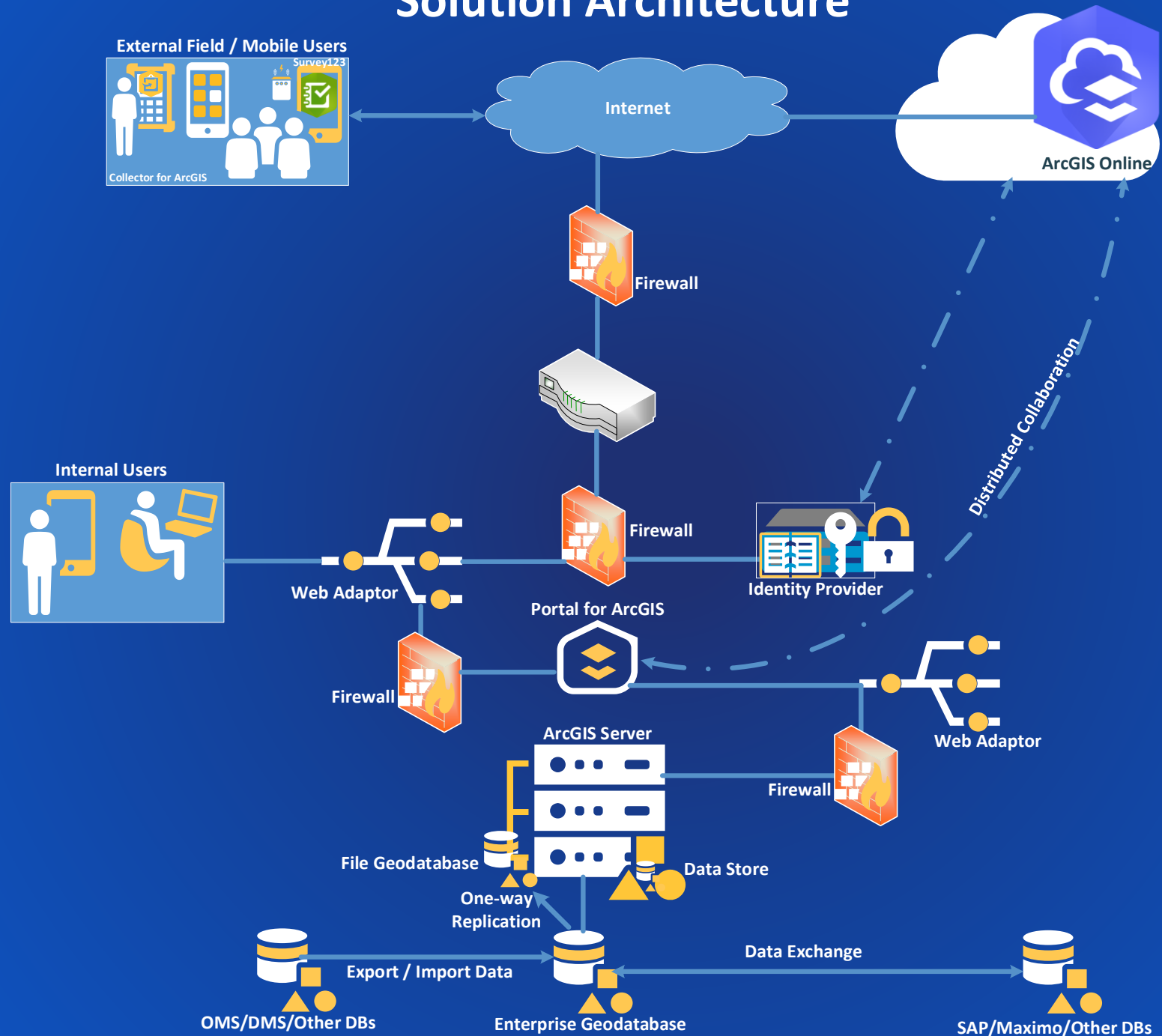
# New / Additional Solution Architecture Options

## Utility Network

- **New network to manage Utility and Telecom network data**
- **Cross platform support**
  - Any device, anytime, anywhere!
- **Services based architecture**
- **Updated network model**
  - **Connectivity associations**
  - **Containment associations**
  - **Structural attachments**
  - **Multiple terminals**
  - **Expanded tracing framework**
  - **Built in support for network diagrams**
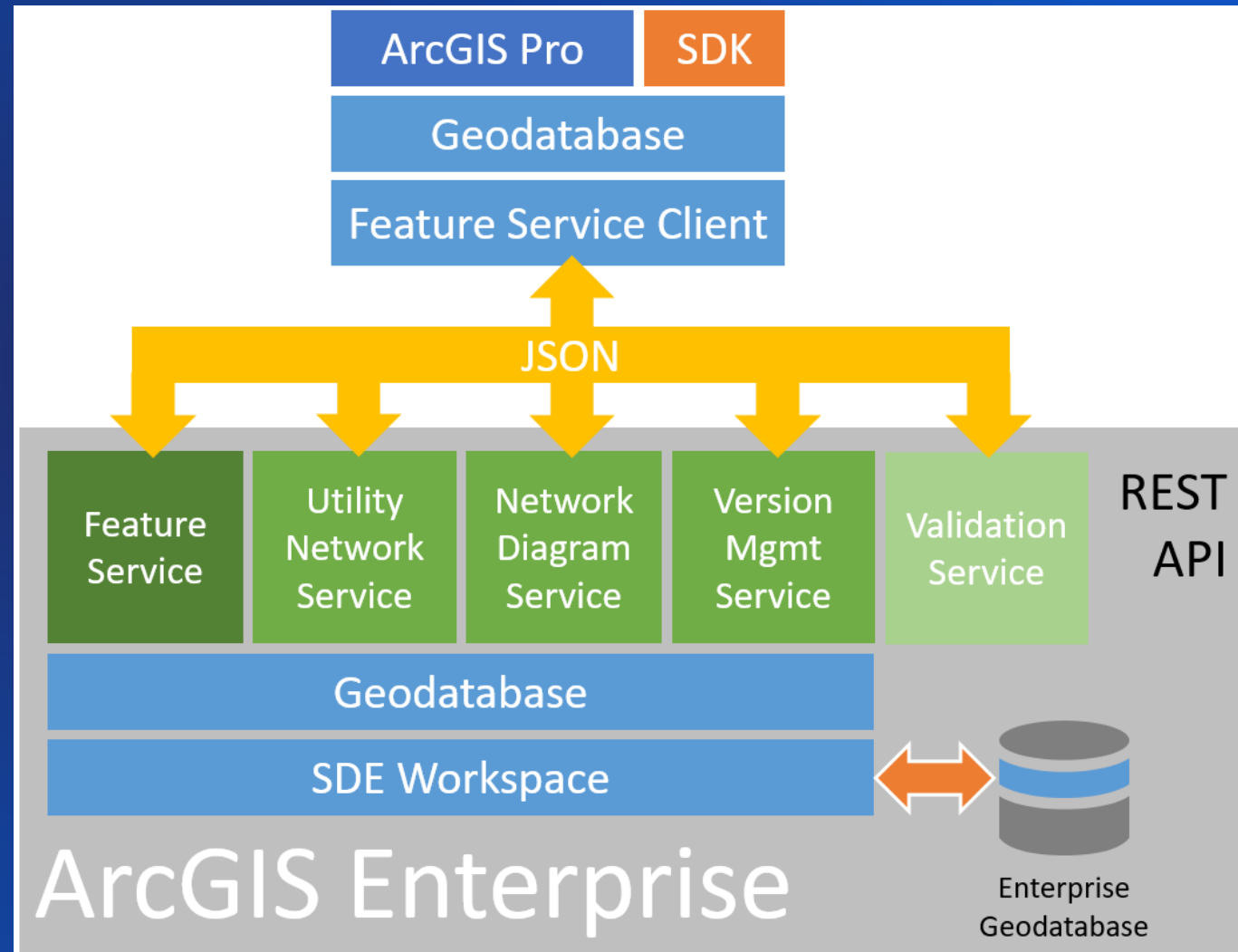
# Business Architecture

- **Business users**
  - **Total and concurrent**
  - **Location**
  - **Internal and / or external**
- **Business workflows and user roles**
  - **Data editors / Managers / Administrators**
  - **Data readers**
  - **Power users**
  - **Web / Mobile users**
  - **etc.**

### Data Centers and User Sites
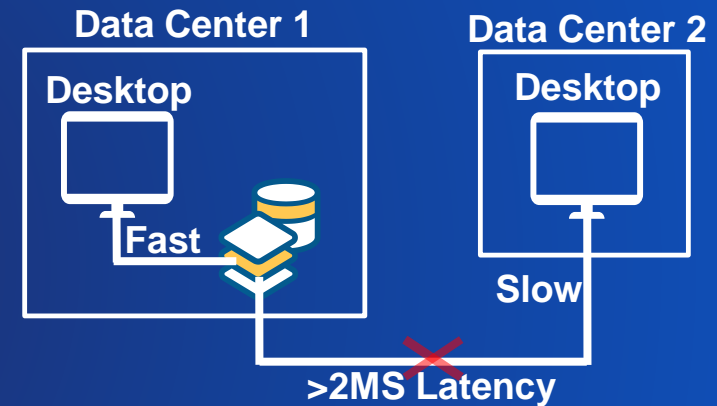


| Electric MXD - DC2 Vs DC1 -  MXDPerfstat Results | | | | | |
|---|---|---|---|---|---|
| Scale | Feature Class/Layer | Display in Seconds at Data Center 2 Server | Display in Seconds at Data Center 1 Server | No of Features | Performance Difference in % |
| 25,000 | Street Centerline | 0.22 | 0.16 | 3,449 | 37.50% |
| 20,000 | ROWEdge | 0.61 | 0.23 | 4,017 | 165.22% |
| 20,000 | Overhead Primary Conductor | 0.34 | 0.28 | 3,403 | 21.43% |
| 15,000 | Street Centerline | 0.23 | 0.09 | 2,745 | 155.56% |
| 15,000 | ROWEdge | 0.25 | 0.14 | 2,461 | 78.57% |
| 15,000 | Overhead Primary Conductor | 0.57 | 0.19 | 1,944 | 200.00% |

# Define Functional and Non-Functional Requirements
**Critical to collect NFRs**

- **High Availability (HA)**
  - **Web application for 24x7 Field / Emergency crew**
  - **Use clusters with one database for editing**

- **Backups**

- **Disaster Recovery (DR)**

- **SLAs (Service Level Agreements)**
  - **RPO (Recovery Point Objective)**
  - **RTO (Recovery Time Objective)**

**HA – Read Only**

**Almost HA- Editing**

**Data Center 1**    DR    **Data Center 2**
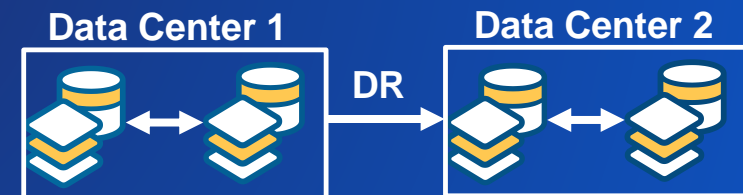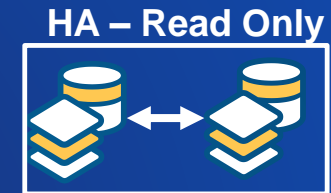
*Relevant and justifiable requirements to keep the cost and complexity checked*

# Application Architecture

- **Desktop and web solutions**

- **Target software versions**
  - **Operating System**
  - **Virtualization**
  - **Partner solutions**

- **Update service pack levels and patches**
  - **ArcGIS Desktop TLS Patch**
  - **ArcGIS (Desktop, Engine) Text Performance Patch**
  - **Utility and Telecom Update (UTU) Patch 9 for 10.2.1**
  - **etc.**

*Check system requirements and GDB client compatibility*

**MXDPERFSTAT – Production Environment**

| S.No | Display Scale | Layer Name | Before tuning - Display in Seconds | After Tuning (Only SDE Direct Connect and DFQ*) - Display in Seconds | Performance Improvement in % |
|---|---|---|---|---|---|
| 1 | 1,000,000 | TRANS LINE | 0.94 | 0.37 | 154.05% |
| 2 | 500,000 | STATION | 0.26 | 0.13 | 100.00% |
| 3 | 50,000 | TRANS LINE | 0.8 | 0.18 | 344.44% |
| 4 | 50,000 | STRUCTURE | 44.62 | 0.72 | 6097.22% |
| 5 | 25,000 | STRUCTURE | 46.38 | 0.49 | 9365.31% |
| 6 | 25,000 | TRANS LINE | 0.83 | 0.16 | 418.75% |
| 7 | 1,000 | STRUCTURE | 42.26 | 0.28 | 14992.86% |
| 8 | 1,000 | TRANS LINE | 0.76 | 0.31 | 145.16% |
| 9 | 500 | STRUCTURE | 41.66 | 0.27 | 15329.63% |
| 10 | 500 | TRANS LINE | 0.74 | 0.21 | 252.38% |

*DFQ (Definition Query) = Objectid is not null

*Impact of an older RDBMS Version bug*

# Technology Architecture
## Quality vs Quantity



- **IT infrastructure**
    - **Availability and policies**
    - **Limitations, preferences and constraints**
- **Processor selection**
    - **Key to optimal scalability and performance**
    - **Save costs by reducing server footprint**
    - **Check spec rate per core**
        - **http://spec.org/cgi-bin/osgresults?conf=cpu2017**
        - **E.g. Intel Xeon Gold 6244 16 cores 3.6GHz = 83.125 SPEC rate per core (April 2019 results)**
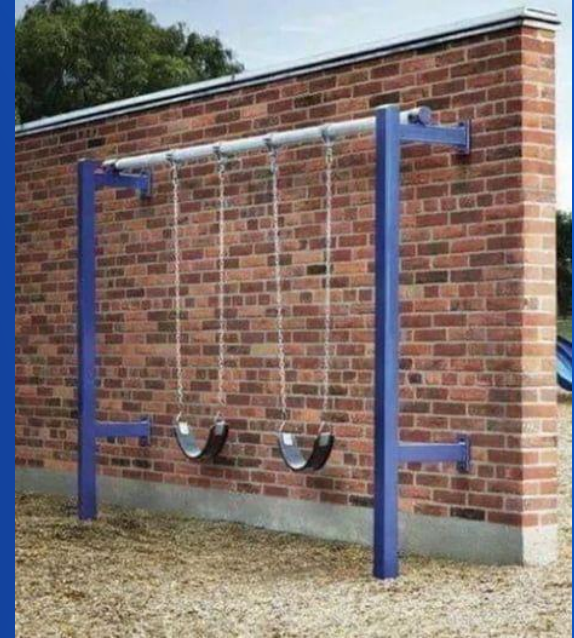
*Select higher SPEC rate per core for speed Vs processor density*

# Server Technology Selection
### Do not compensate poor maintenance with top processing power

- **Processing power is directly proportional to total Delta table records count**



*Intel® Xeon® E5-2637 v4 @ 3.40GHz, 8 Cores, 256GB RAM, ~59.38 SPEC rate/core Physical machine hosting a happy GDB!*

```
SQL>
SQL> prompt 2. STATES
2. STATES
SQL>
SQL> select count(*) from sde.states;

Tue Sep 26


  COUNT(*)
----------
    113,904


SQL>
SQL> prompt 3. STATE_LINEAGES
3. STATE_LINEAGES
SQL> select count(*) from sde.state_lineages;

Tue Sep 26


  COUNT(*)
----------
 106,274,130


SQL>
SQL> spool off
```

```
---ArcSDE A Table Rows

SQL> select sum(num_rows) as


TOTAL_A_TABLE_ROWS
------------------
12,154,746

SQL>


SQL> ---ArcSDE D Table Rows
SQL> select sum(num_rows) as


TOTAL_D_TABLE_ROWS
------------------
      9,338,738

SQL>
SQL> Spool off
```

*GIS Benefits from dedicated and powerful processors*

# Virtualized Database Servers – Key Considerations

**Speed is more important than utilization**

- **Avoid over-commitment**

- **Ensure less number of vMotions**

- **Estimated capacity requirements**
  - **User Load**
  - **Dedicated operations and transactions**

- **Application & database complexity**



**Physical vs. Virtual Server**



General

| | |
|---|---|
| vSphere DRS: | On |
| vSphere HA: | On |
| VMware EVC Mode: | Disabled |
| Total CPU Resources: | 2159 GHz |
| Total Memory: | 12.50 TB |
| Total Storage: | 494.37 TB |
| Number of Hosts: | 25 |
| Total Processors: | 800 |
| Number of Datastore Clusters: | 1 |
| Total Datastores: | 81 |
| Virtual Machines and Templates: | 793 |
| Total Migrations using vMotion: | 392768 |

General

| | |
|---|---|
| vSphere DRS: | On |
| vSphere HA: | On |
| VMware EVC Mode: | Intel® "Sandy Bridge" Generation |
| Total CPU Resources: | 227 GHz |
| Total Memory: | 1.87 TB |
| Total Storage: | 103.92 TB |
| Number of Hosts: | 4 |
| Total Processors: | 88 |
| Number of Datastore Clusters: | 0 |
| Total Datastores: | 42 |
| Virtual Machines and Templates: | 314 |
| Total Migrations using vMotion: | 3928 |

**0.3 CPU/VM**

General

| | |
|---|---|
| vSphere DRS: | On |
| vSphere HA: | On |
| VMware EVC Mode: | Intel® "Westmere" Generation |
| Total CPU Resources: | 184 GHz |
| Total Memory: | 2.16 TB |
| Total Storage: | 61.06 TB |
| Number of Hosts: | 5 |
| Total Processors: | 92 |
| Number of Datastore Clusters: | 0 |
| Total Datastores: | 37 |
| Virtual Machines and Templates: | 176 |
| Total Migrations using vMotion: | 2747 |

*Complex and busy databases need dedicated machines*

# Symptoms of Over-Committed vCPUs

- **vCPU usage Vs MXD display seconds**



**3 Seconds Display**

**Above 25% of CPU usage
8 Seconds Display**
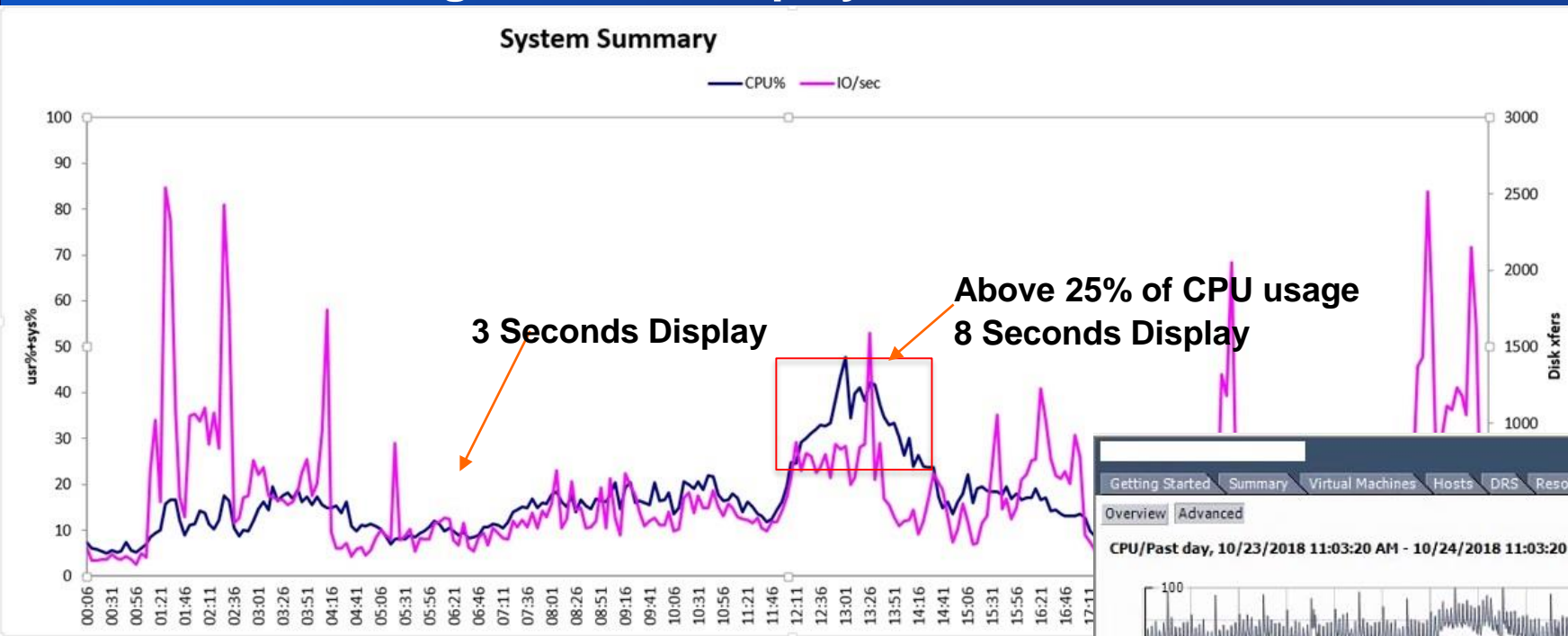
*~100% Virtual cluster utilization!*
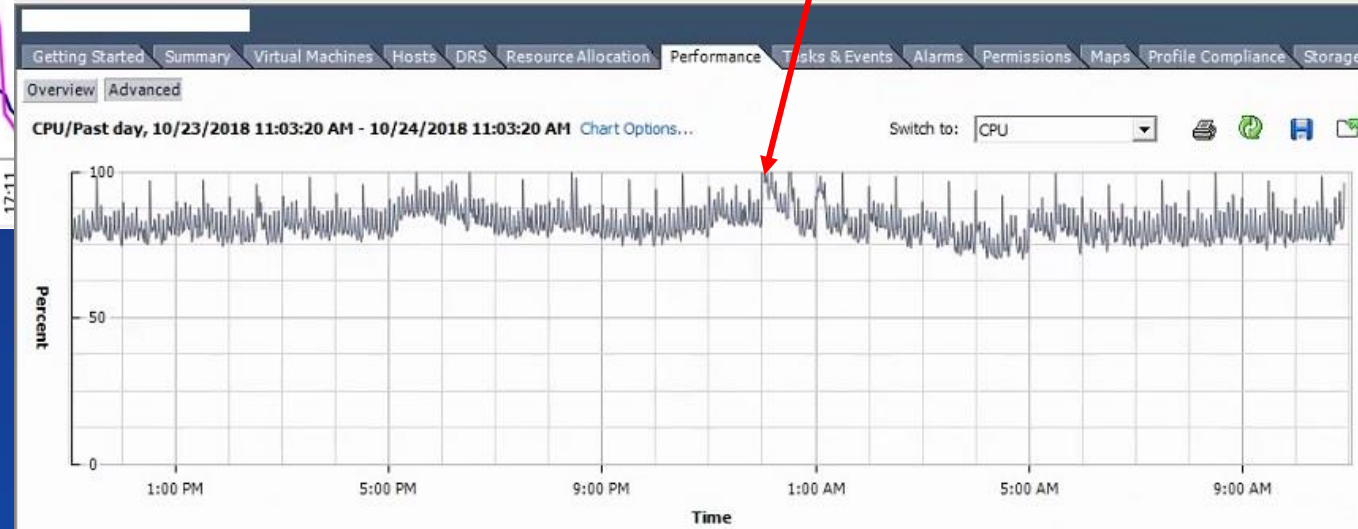
# User load

### Estimated vs actual usage



- **Number of users, operations and transactions**
  - **Expected 130 power users (editors) Vs 200+ Actual Users**

- **Number of outstanding Versions**
  - **Estimated 600 Vs actual 1250 Versions**

- **Estimated total delta table records (A# and D# Tables)**
  - **Designed for 2 Millions Vs 8 Millions records actual**



```
HASH_AJ */ SDE_DELETES_ROW_ID, SDE_STATE_ID FROM NIS.D63 WHERE DELETED_AT
IN (SELECT   l.lineage_id FROM SDE.state_lineages l WHERE l.lineage_name =
:lineage_name2 AND l.lineage_id <= :state_id2) AND SDE_STATE_ID >
:"SYS_B_5") AND a.SDE_STATE_ID = SL.lineage_id AND SL.lineage_name =
:lineage_name3 AND SL.lineage_id <= :state_id3) V__63
```

| call | count | cpu | elapsed | disk | query | current | rows |
|------|-------|-----|---------|------|-------|---------|------|
| Parse | 1 | 0.00 | 0.00 | 0 | 0 | 0 | 0 |
| Execute | 169 | 0.19 | 0.19 | 0 | 0 | 0 | 0 |
| Fetch | 169 | 24.66 | 24.66 | 0 | 123445 | 0 | 0 |
| total | 339 | 24.86 | 24.86 | 0 | 123445 | 0 | 0 |

*Unplanned concurrency overloads Server resources*

# Virtual Environment



- **Dedicate the Virtual environment for a large GIS user base**
  - Provide a decent provisioning ratio

- **Provide GPU\* for GDB clients**
  - Video RAM >256MB Per Virtual Machine

- **Fit Virtual Machine within one CPU NUMA\* node**
  - # of vCPUs <= number of cores in the CPU socket

- **Choose faster CPUs - Spec rate per Core 80+**

**\* GPU – Graphics Processing Unit)**
**\*NUMA - Non-uniform memory access**

| Task | Performance - Before CPU Change (in Seconds) | After Change in CPU Entitlement from 1 CPU to 4 CPU (in Seconds) | Performance improvement in % |
|---|---|---|---|
| Opening ArcMap thru Citrix (ArcGIS Desktop Launcher - for setting the licenses) | 26.01 | 21.37 | 21.71% |
| ArcFM Locator - Zoom to Distribution | 29.45 | 11.15 | 164.13% |
| Zoom to 1000 ft | 8.92 | 7.33 | 21.69% |
| Zoom to 500ft | 4.36 | 3.69 | 18.16% |
| Zoom out to 100ft | 5.02 | 4.3 | 16.74% |
| Zoom out to 50ft | 4.19 | 3.73 | 12.33% |
| Place UG Primary Conductor with Ducts (2) | 13.3 | 6.68 | 99.10% |
| Distribution Pole | 5.46 | 4.19 | 30.31% |
| Split OH Primary Conductor - Custom Split | 21.23 | 15.76 | 34.71% |
| Delete Transformer | 14.05 | 7.8 | 80.13% |
| Place the above transformer and Jumper | 9.85 | 5.24 | 87.98% |
| Place a pole | 2.48 | 0.82 | 202.44% |
| Place Primary OH-ABC Phase | 5.1 | 2.89 | 76.47% |
| No Save Edits | 9.86 | 6.2 | 59.03% |
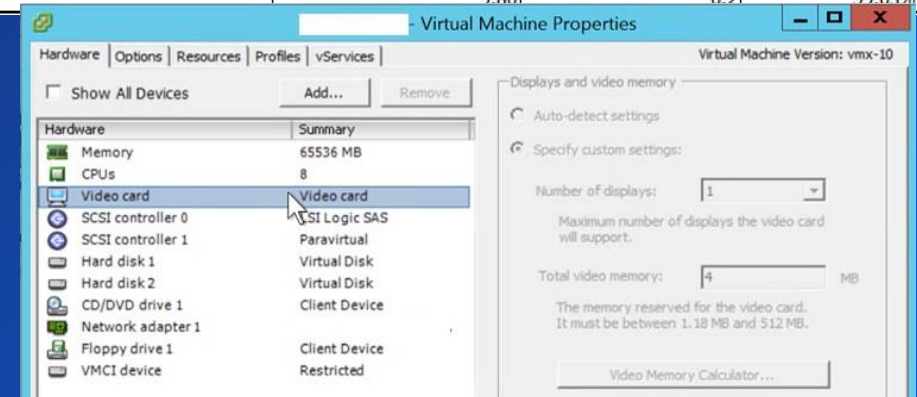


*Tune Virtual environment before deployment*

# Network Planning
## Establish and configure DNS appropriately!

**Trace Route: LA Workstation → Phoenix DNS**
**LA Database Server**



```
C:\Users\          >tracert

Tracing route to
over a maximum of 30 hops:

1    55 ms      55 ms      55 ms
2    55 ms      55 ms      55 ms
3   115 ms      58 ms      62 ms
4   111 ms     111 ms     112 ms
5   110 ms     109 ms     110 ms
6   110 ms     113 ms     110 ms
7   109 ms     109 ms     109 ms
```
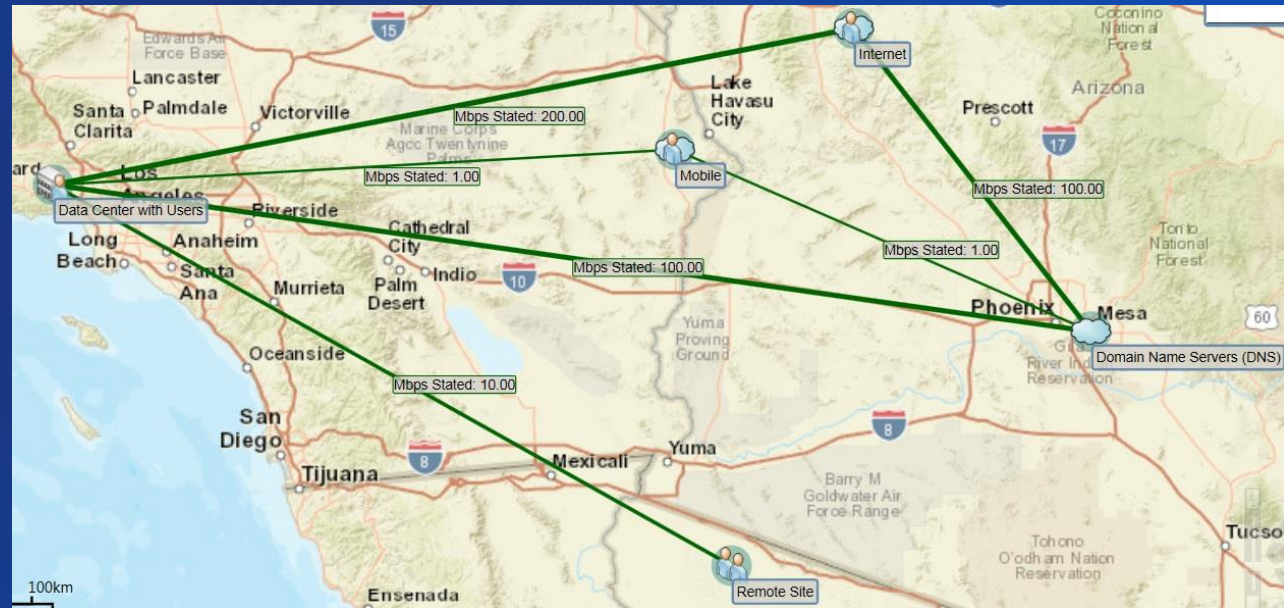
| | Network Latency's impact on performance | | | | |
| S.No | Task | Performance when <1 ms latency (in Seconds) | Performance during latency fluctuation (in Seconds) | Performance difference in Seconds | Performance Difference in % |
|---|---|---|---|---|---|
| 1 | Open ArcMap | 23 | 90 | -67 | -291.30% |

# Network Infrastructure

- **Establish higher Network bandwidth (>1Gbps) and less latency (<1 MS)**
  - ArcGIS Desktop is sensitive to 1 – 2 MS latency
  - Plan for ~ 1.5 Mbps per concurrent GIS User
- **Enable Jumbo Frames between servers**
  - All Switches must support – Otherwise don't enable it!
- **Validate Network path between GIS user and server locations**
- **Upgrade lower bandwidth or move GIS user locations**

*MXDPerfstat Results – 100Mbps Vs 1Gpbs port*

| Scale | Feature Class Name | Response Time in Seconds when the workstation was connected to 100Mbps Phone port | Response Time in Seconds when the workstation was connected to 1Gbps LAN port | Performance improvement in % |
|-------|--------------------|----------------------------------------------------------------------------------|------------------------------------------------------------------------------|------------------------------|
| 50,000 | Centerline | 8.84 | 4.18 | 111.48% |
| 50,000 | Control Boundary (WMX) | 0.17 | 0.14 | 21.43% |
| 2,500 | GasMeter | 0.78 | 0.55 | 41.82% |
| 1,000 | GasMeterQualAnno | 0.21 | 0.12 | 75.00% |

*Higher bandwidth between EGDB and the clients provide better performance*

# Storage
## Disks

- **Use SSDs (Solid-State Drives)**
- **Plan for ~5000 IOPS (Input/output Operations Per Second)**
- **Avoid LUNs* > 2TB size**
  - **Minimum of 4 LUNs that are identical in size**
- **Avoid noac mount option**
- **Distributed File System (DFS) is not supported**

**\*LUN – Logical Unit Number**

*SSD delivers better performance for EGDB*

# ArcSDE Configuration

- **Configure ArcSDE DBTUNE Settings**
  - **Use Default Geometry Storage - St_Geometry / Geometry**
  - **Storage locations**
  - **etc.**
- **ArcSDE initialization parameters**
  - **Limit the connections**
  - **Defaults are good!**

# Geodatabase Design

# Geodatabase Design – Data Modeling

- **Conceptual Design**
  - Identify business requirements
  - Identify thematic layers
  - Identify required applications
  - Document

- **Logical Design**
  - Define tabular database structure
  - Define relationships
  - Determine spatial properties
  - Document

- **Physical Design**
  - Create and implement model design
  - Generate physical schema in the RDBMS / FGDB
  - Test and validate
  - Document
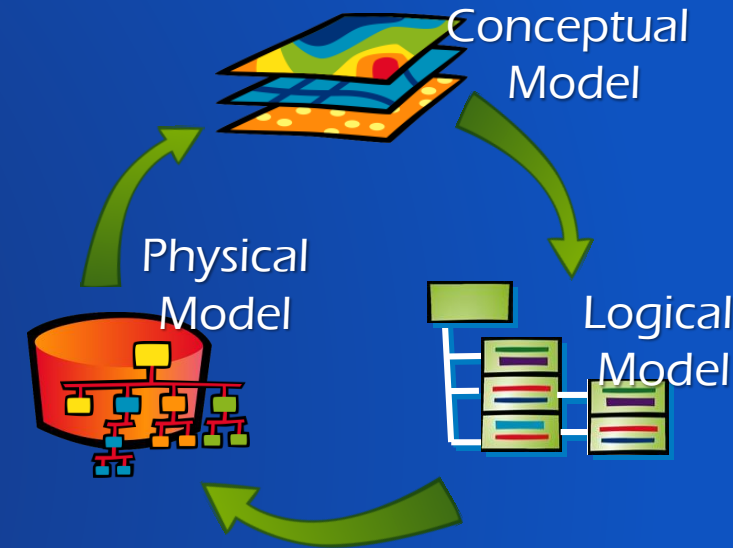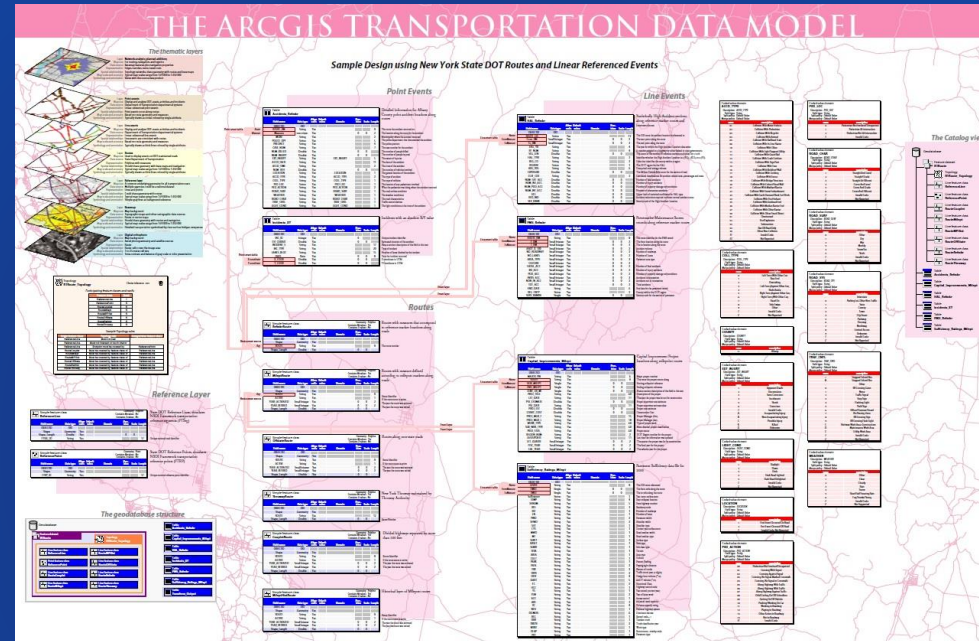


*Leverage the existing data models*

# Geodatabase Design – Tools

- **Tools**
  - **X-Ray Add-In**
  - **Geodatabase Diagrammer**
  - **Sparx Systems' Enterprise Architect**
  - **Geometric Network Configuration Manager**
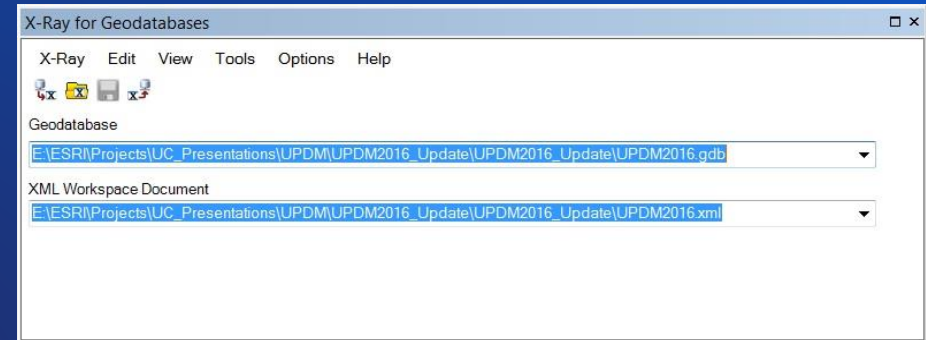
# Geodatabase Design – Key Considerations

**Prevention is better than cure!**

- **Consider single coordinate system**
    - **On the Fly Projection is expensive**
    - **Geometric Network editing does not support "On the Fly Projection"**
- **Column / Domain names and Field lengths**
    - **Avoid >10 characters in Field names**
    - **Apply required text length e.g. Text - 256 Vs NCLOB – 1,073,741,822**
    - **Select appropriate Field type**
    - **Apply only the required Precision and Scale**
    - **Define Not Null Fields**

*Justify every single Geodatabase element*
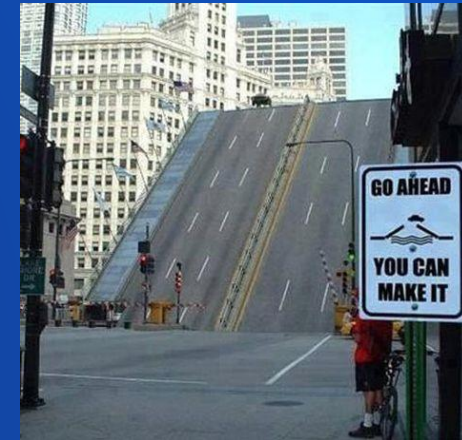
| Field Properties | |
|---|---|
| Alias | CustomerName |
| Allow NULL values | Yes |
| Default Value | |
| Domain | |
| Length | 1073741822 |

# Geodatabase Design – Key Considerations

**Poor Design = Rework, slow performance and bugs**

- **Avoid XY Tolerance modification**
    - **Default = 10x Times of XY Resolution**
    - **Introduces complexity (#NIM090335) for Geometric Network, etc.**
    - **Impacts performance**

*Avoid expensive rework!*



New Feature Dataset

XY Tolerance

The XY tolerance is the minimum distance between coordinates before they are considered equal. The XY tolerance is used when evaluating relationships between features.

0.001    Meter

Z Tolerance

0.001

M Tolerance

0.001    Unknown Units

Reset To Default    About spatial reference properties

☑ Accept default resolution and domain extent (recommended)

< Back    Finish    Cancel

# Geodatabase Design – Best Practices

**Data Model impacts storage and performance**

- **Leverage the existing ArcGIS Data Models**
  - Drop redundant Feature Datasets / Classes, Columns, etc.
  - Stand alone Feature Classes are fine!
  - Possibly split the Feature Classes per scale levels
  - Reduce complex and attributed Relationship Classes
  - Test, refine and tune the Data Models
- **Integrate related Feature Classes using topology**
- **Deploy necessary information models**
  - Geometric Network Vs Utility Network

*Justify every single Geodatabase element*
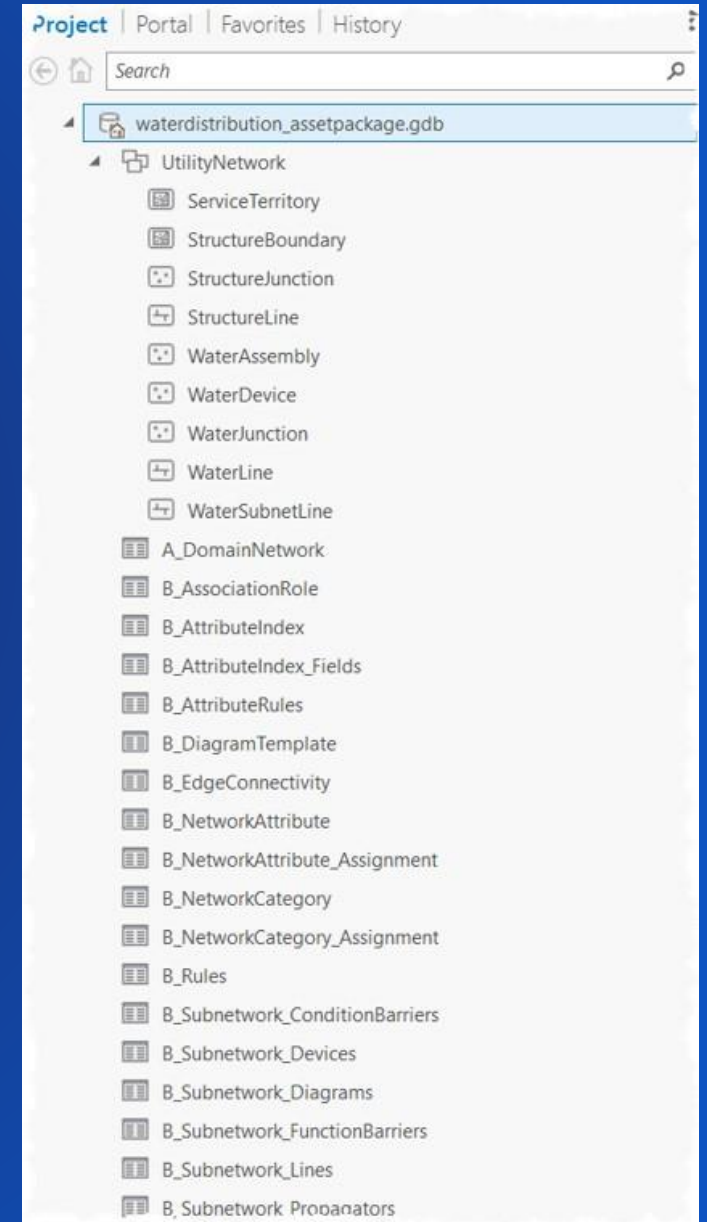
# Geodatabase Design – Best Practices
## Poor Design = Rework, slow performance and bugs
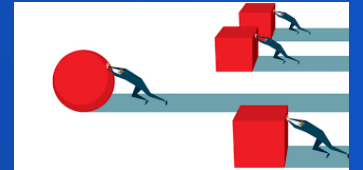
- **Create Feature Datasets or Databases for each LOBs (Line of Businesses)**
  - **Depends on size, access, usage and maintenance**
  - **E.g. Landbase, Gas, Electric, Water GDBs, etc.**
- **No attributed Relationship Classes with no attributes**
- **Use Many to Many Relationship Classes only when necessary**
- **Don't use Objectid as Primary Key for Relationship Classes**
  - **Unexpected Replication behavior**
  - **Additional processing during synchronization**

*Keep common dataset / database for base map / landbase*
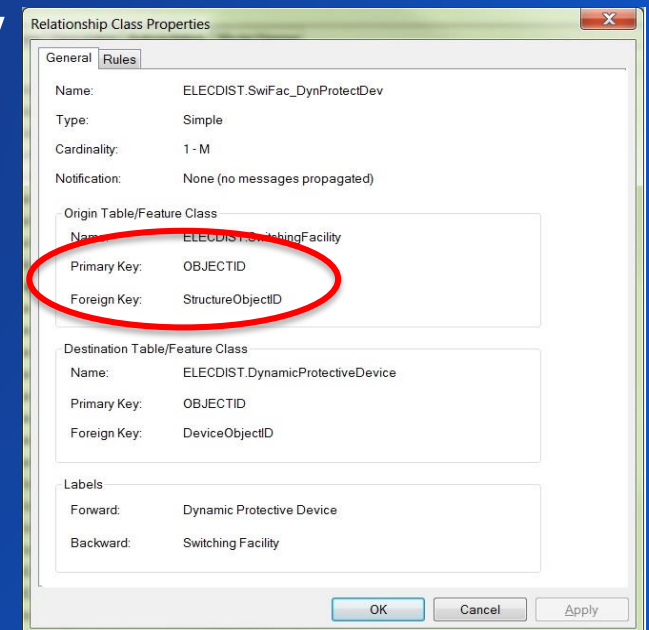
# Geodatabase Design – Best Practices

**Navigate common oversights!**

- **Review the Labeling requirements ahead of time**
  - **For Multi-Field complex Labeling**
    - **Combine them to a new Field and Auto Update**
    - **Convert Labels to Annotations**

- **Less Annotation Classes within Annotation Feature Class**

- **Add Attribute Indexes**
  - **Label Expression**
  - **Definition Queries**
  - **Application Design**



| Indexes | Subtypes | Feature Extent | Relationships | Annotation Classes | Annotation |

Annotation Classes:

CGC
Default
Job
LoadBreak
Size

New...
Delete
Rename...

Label Field: <expression>    Expression...

*Analyze Annotation requirements and choose proper Annotation reference scale*

# Build

# Build Geodatabase

- **Create physical Geodatabase**
  - Separate Data Owner from SDE / DBA user
  - Structure the implementation to Pilot → Phase I → Phase II → Phase III, etc.
  - Enough gap to accommodate the learned lessons
- **Develop Data conversion specification document**
  - Align it with Data Model
- **Team review and demonstration**

*Capture, load and maintain data accurately*

# Geodatabase Access and Management



NOBODY GETS IN,
NOBODY GETS OUT.

- **Create roles / groups based on the access level**
  - Total access will slow connection time!
- **Configure client applications to manage data**

| | | Connection Performance | | | |
|---|---|---|---|---|---|
| S.No | User Name | ArcCatalog Connection in Seconds with all access | ArcCatalog Connection in Seconds with reduced privileges | Performance difference in Seconds | Performance improvement in % |
| 1 | Rasu | 30 | 12 | 18 | 150.00% |
| 2 | Andrew | 21 | 12 | 9 | 75.00% |

*Capture, load and maintain data accurately*

# Key Data Conversion Considerations

- **Extra Vertices introduced by:**
  - **Conversion process involving CAD systems**
  - **Geometric Network creation with Snapping ON option**
  - **Conversion/Update methods**
- **Develop adequate QA/QC methods and procedures**
- **Additional Data Reviewer checks**
  - **Duplicate/invalid geometries**
  - **Orphan related records**
  - **Connectivity check**
  - **etc.**
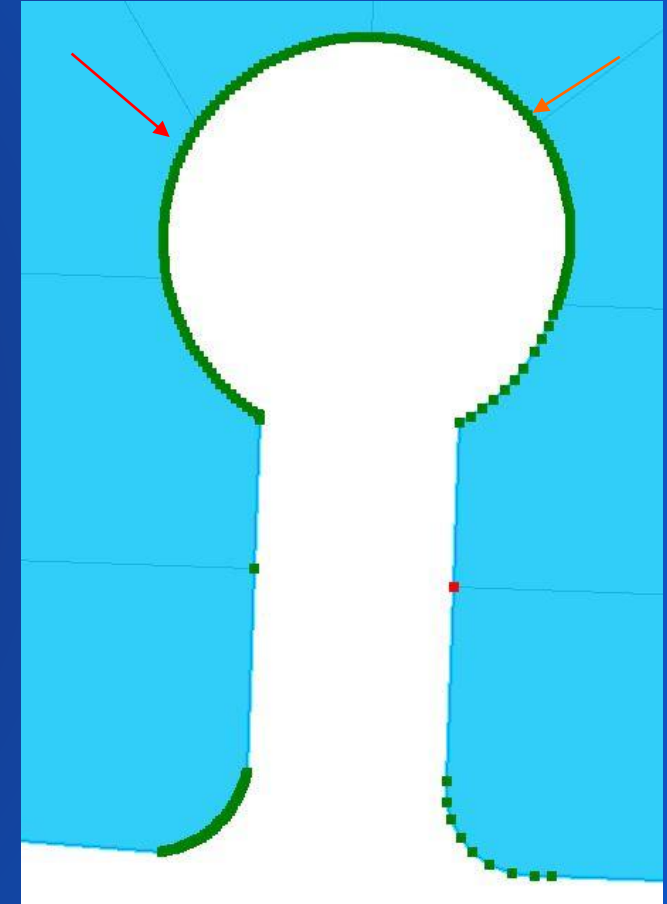
| Feature Class/Layer | Total Number of Features | Total Number of Vertices with Geometric Network Snapping | Total Number of Vertices without Geometric Network Snapping | Increase in number of vertices % |
|---|---|---|---|---|
| Secondary Overhead Conductor | 3,712 | 12,953 | 7,841 | 65.20% |

*Put additional efforts to get the data conversion right*

# Build Geodatabase – Best Practices

- **Avoid extra vertices**
  - **Use curve tools that insert less vertices**

- **Turn off snapping during Geometric Network (GN) creation**
  - **ArcGIS 10.0 onwards a Vertex is added at every intersection**
  - **Cannot create GN with >15M edges until ArcGIS 9.3.1**

- **Remove additional vertices**
  - **Generalize / Simplify**
  - **Use ArcObjects**

*Provide tips and tricks for editing crew regularly*
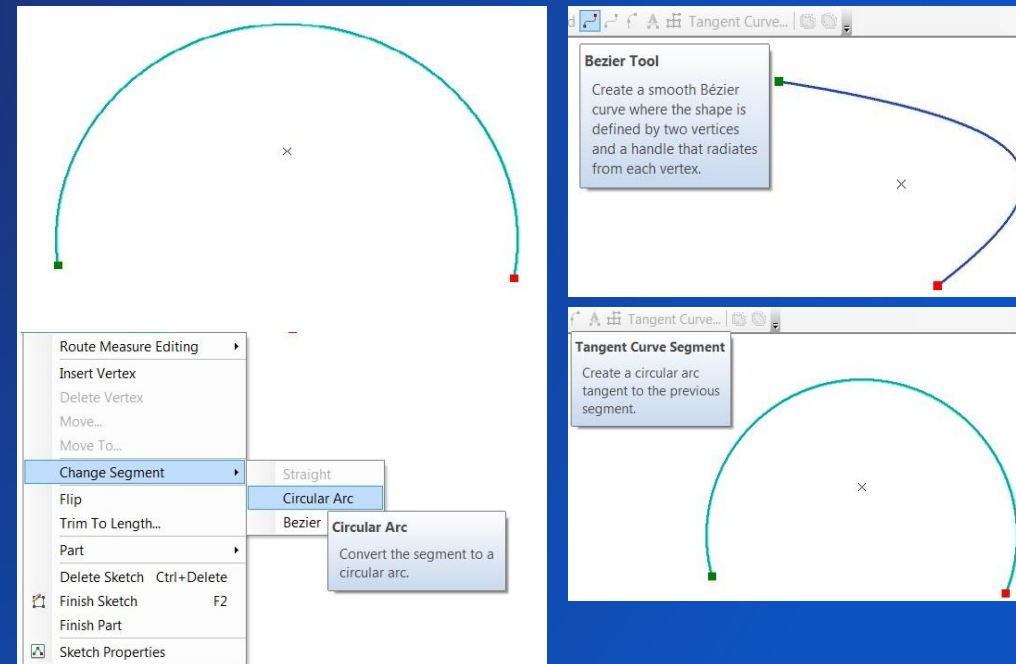
# Build Geodatabase – Best Practices

**Data is the brain of GIS nervous system!**

- **Aim for 100% Data accuracy**

- **Either populate or drop empty Fields**

- **Minimize Data Model / schema changes**

- **Consolidate GDBs**
  - **Avoid creating GDB per Geographic locations / regions**

- **Extra Vertices have performance impact**

| Scale | Feature Class | Display in Seconds - before Simplify Polygon | Display in Seconds - after Simplify Polygon (without any shape change) | Performance gain in % |
|---|---|---|---|---|
| 50,000,000 | Time_Zones | 0.59 | 0.27 | 118.52% |
| 1,000,000 | Time_Zones | 0.06 | 0.02 | 200.00% |
| 10,000 | Time_Zones | 0.05 | 0.02 | 150.00% |
| 1,000 | Time_Zones | 0.05 | 0.02 | 150.00% |

| S.No | Display Scale | Layer Name | # of Displayed Features | Number of Vertices - Before Simplify | Number of Vertices - After Simplify | Before Simplification Display in Seconds | After Simplification- Display in Seconds | Performance Improvement in % |
|---|---|---|---|---|---|---|---|---|
| 1 | 50,000 | Street_1_inch | 35,093 | 105,695 | 101,060 | 2.36 | 0.5 | 372.00% |
| 2 | 50,000 | PARCEL_1_Inch | 7,922 | 645,766 | 188,212 | 0.37 | 0.31 | 19.35% |
| 3 | 25,000 | Street_1_inch | 11,192 | 31,112 | 29,620 | 0.69 | 0.2 | 245.00% |
| 4 | 25,000 | PARCEL_1_Inch | 2,687 | 168,011 | 48,540 | 0.16 | 0.14 | 14.29% |
| 5 | 20,000 | Street_1_inch | 7,590 | 20,494 | 19,574 | 1.59 | 0.16 | 893.75% |

*Unnecessary vertices add significant performance overhead*

# Build Geodatabase – Best Practices

- **Keep the Data clean and simple**
  - **Without any topological errors**

- **No Coincident Complex Edge Features in Geometric Network**
  - **Most common reason for Geometric Network corruption**

- **Unversion the Read Only Feature Classes / Tables**

- **Use Mosaic Datasets for Raster requirements**
  - **No massive imagery loading into EGDB**

```
OWNER                          TABLE_NAME                        NUM_ROWS      BLOCKS AVG_ROW_LEN TO_CHAR(LAST_ANALYZED,'MON/DD/YYHH24:MI:SS')
------------------------------ --------------------------------- ---------- ---------- ----------- -------------------------------------------
ARCFM                          SDE_BLK_3                           1145079    1190598          12 APR/19/16 05:38:10
ARCFM                          BK_SDE_LOGFILE_DATA                 4231223       8773          10 APR/19/16 05:32:14
```

*Static Raster Data does not need to participate in daily RDBMS backup*

# Workflow Design

# Implementation Dependencies

**Understand intrigue challenges**

- **Map the project / data dependencies**
  - Business user groups
  - Application designs
  - System integration requirements
  - etc.

- **Organize cross functional skills/support team**
  - Dedicated / Assigned ArcSDE Administrator

*Talk to the right people to get the right information*

# Requirements and Workflows

**Selection of GDBs drive efficiency**

| | Mobile Data Collection - Offline Workflow Planning | | |
|---|---|---|---|
| | **Data Maintenance Workflow** | **Short duration Project Work** | **Ongoing Project Work** |
| Version from which the feature service is published | Default version | Child version | Child version |
| Offline version is created for each | Downloaded map | User | User |
| Number of versions created | Many | Few | Few |
| Latency between offline edits and updates to Default version | Low | High (1 week) | High (Daily) |
| Maps involved in quality assurance | One map | All maps | All maps |
| Frequency that offline versions are deleted | Daily | At project completion | Never |

- **Number of users and types of users**

- **Workflows**
  - **Multi User editing  -** *Enterprise / Workgroup GDBs*
  - **Single User Editing –** *FGDB*
  - **Replication  -** *EGDB → FGDB / EGDB*
  - **Read Only / Publication –** *FGDB / EGDB*
  - **Mobile User offline editing –** *EGDB*
  - **etc.**

- **Generally more than one Geodatabase is required**

*A goal without a plan is just a wish!*

# Geodatabase Workflows - QA / QC

- **Design and implement QA / QC workflows**
  - **Data requirements for software functions**
  - **Accurate data for business**
  - **Maintain data integrity**

*Capture, load and maintain Data accurately*

# Data Integrity and Validation Strategies

- **Stage 1: Don't allow start editing**
  - Read Only users
  - Without landbase layers

- **Stage 2:  No inserts without pre-requisite checks**
  - Out side of editing areas (Pacific Ocean!)
  - Street light without Poles
  - Equipment without structures
  - Required attribute values (WO Number, Number of Phases, etc.) in attribute columns
  - etc.

*Capture, load and maintain Data accurately*

# Data Integrity and Validation Strategies

- **Stage 3: Reconcile/Save edits only after rules validation**
  - **Domain checks**
  - **Connectivity rules, etc.**
- **Stage 4: Allow to post data with warnings**
  - **Run batch processes to perform additional checks**
- **Tools**
  - **Domains, Subtypes, Topology, etc.**
  - **Attribute Assistant Add-In**
  - **ArcGIS Data Reviewer**
  - **ArcGIS Workflow Manager**
  - **Business Partner Products**
  - **Customization**

*Capture, load and maintain Data accurately*



ArcGIS Data Reviewer Checks

# Geodatabase Multiuser Workflows

**Which Versioning model to choose?**

- **Traditional Versioning Vs Branch Versioning**



Traditional versioning



Branch versioning
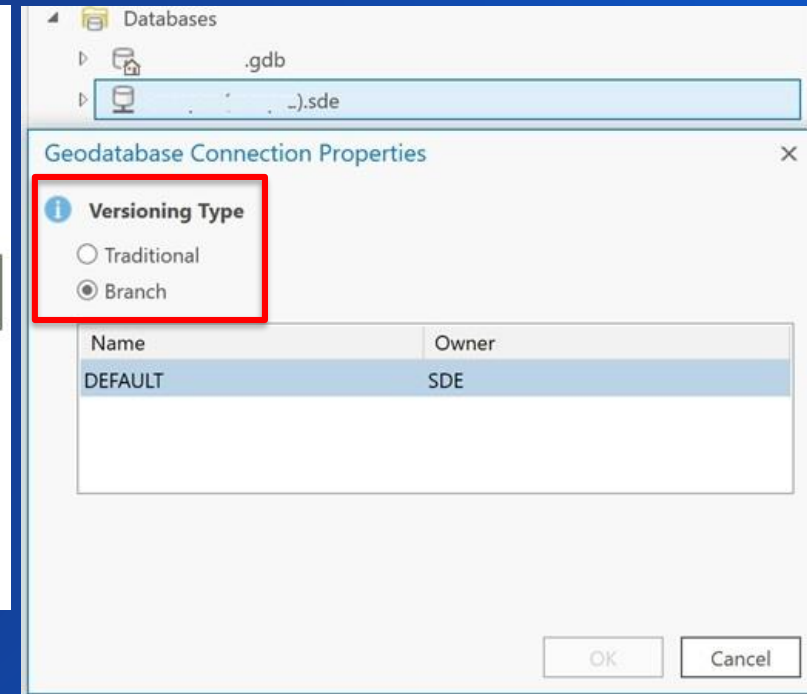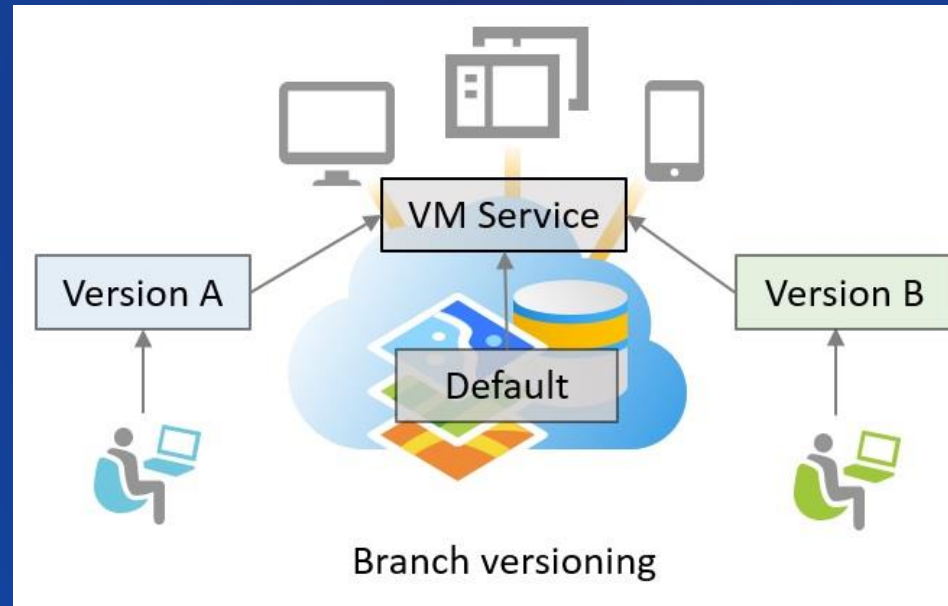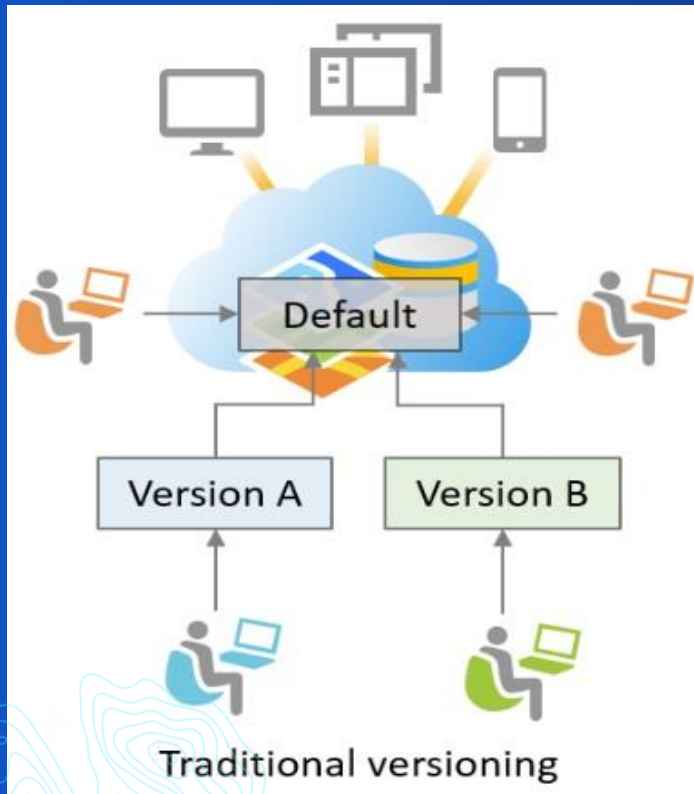
# Geodatabase Multiuser Workflows – Key Considerations

- **Versioning structure**
  - **Move Edits to Base for simple Feature Classes**
  - **Recreate the Version after each Post for 3-level Version tree**
  - *Problem: Unexpected conflict observed during reconcile*
  - *http://support.esri.com/en/technical-article/000012321*
- **Estimate edit volumes and Version durations**
- **Conflict resolution mechanisms**
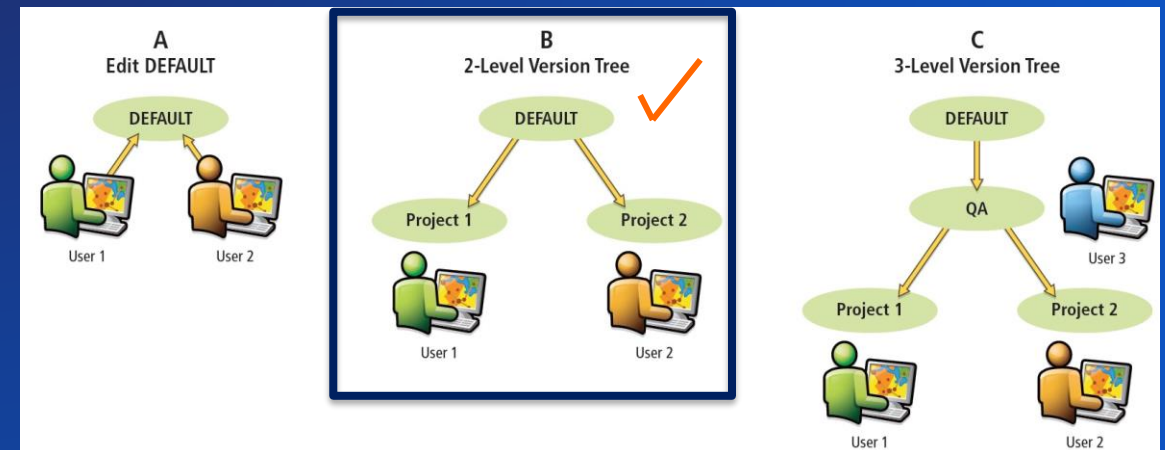


*Avoid 3-level version tree*

# Geodatabase Workflows – Key Considerations

- Conflict for Split operation could introduce duplicate geometry
- Plan bulk loading / mass update
- For regular Data load, consider truncate Vs delete
- Execute batch processes during non-business hours
- Geodatabase Replication - One-Way Vs Two-Way
- Archiving
- Editor tracking

**Overlap**

**Objectid 1**  **2**
**3**
**Default**

**Objectid 1**  **2**
**Version1**  **Split**

**Objectid 1**  **3**
**Version2**  **Split**
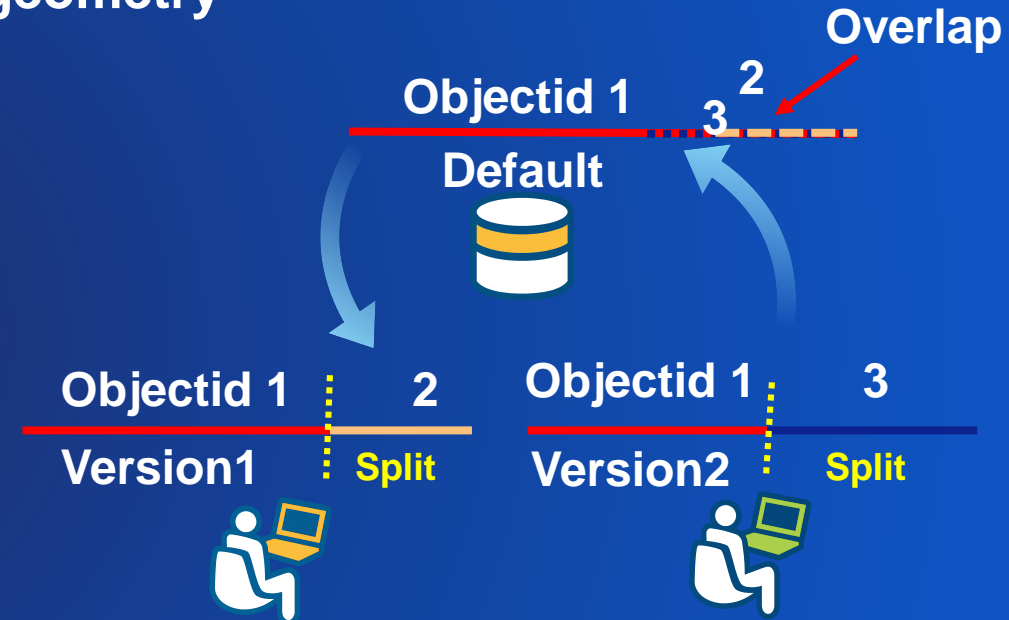
- Conflict on Objectid 1
- Objectid 2 and 3 Overlap

# Geodatabase Workflows – Best Practices

- **Choose the Versioning workflows appropriately**
  - **Key to performance and scalability**
- **Run QA / QC tools regularly**
  - **Avoid duplicate / invalid geometries, etc.**
- **Leverage Geodatabase Replication**
  - **Use One-Way Replication options**
    - **Parent to Child**
    - **Child to Parent**
    - **Create Read-Only / Publication Geodatabase**
  - **Two One-Way Replicas for two separate Datasets/FCs**



Geodatabase replication use cases

Mobile operations

Production/publication

Distributed operations

Hierarchical operations

5-9

System Architecture Design Strategies    10
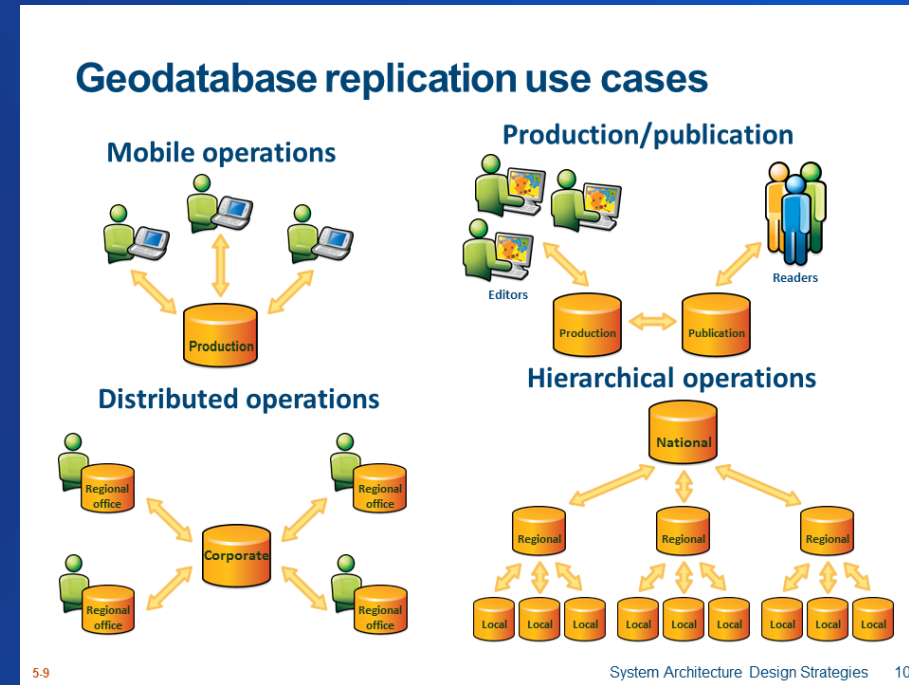
# Geodatabase Workflows – Best Practices
**Archiving**

- **Do not enable Archiving when 100% data update / modification is expected!**
- **Generally mistaken with the below functionalities / purposes:**
  - **GDB Editor tracking**
  - **RDBMS backup and retention**
  - **Security**
  - **Data integrity**

| OWNER | TABLE_NAME | NUM_ROWS | BLOCKS | AVG_ROW_LEN | TO_CHAR (LAST_ANALYZED) |
|-------|-----------|----------|--------|-------------|--------------------------|
| GIS | WSERVICECONNECTION | 117,726 | 12,139 | 584 | APR/10/18 15:32:34 |
| GIS | WSERVICECONNECTION_H | 140,242 | 8,697 | 528 | APR/10/18 15:28:28 |
| GIS | WSERVICECONNECTION_H2 | 118,057 | 12,458 | 605 | APR/16/18 08:12:27 |
| GIS | WSERVICECONNECTION_H1 | 1,653,331 | 155,838 | 784 | APR/10/18 15:30:13 |
| GIS | S4998_IDX$ | 1,653,331 | | 52 | APR/24/18 22:07:53 |

# Geodatabase Workflows – Best Practices

- **Provide only the required privileges to users**
  - Access to large number of tables slows connection performance

- **Arrange workflow training for users**
  - Conduct tips and tricks session

# Testing and Tuning

Important step before going live!

# Testing

- **Test application workflows**
  - Functionality
  - Flexibility and consistency
- **Conduct single user execution test and measure performance**
  - Provides Key Indicators towards scalability

**Mxdperfstat Before Tuning in Production**

mxdperfstat

1/9/2018 2:58:46 PM
Master          .mxd
layerCount= 6
WGS_1984_Web_Mercator_Auxiliary_Sphere
esriMeters
X= -9,233,816.99 Y= 4,869,583.83 width= 1200 height= 1000

Map Display Performance (sec) for each scale

| Scale | Refresh Time(sec) | VisibleLayers |
|---|---|---|
| 1,000,000 | 1.30 | 3 |
| 500,000 | 1.56 | 3 |
| 100,000 | 1.25 | 4 |
| 50,000 | 53.83 | 5 |
| 25,000 | 50.40 | 5 |
| 12,000 | 48.44 | 5 |
| 5,000 | 47.84 | 5 |
| 2,500 | 51.52 | 5 |
| 1,000 | 44.78 | 5 |
| 500 | 48.48 | 5 |

**Mxdperfstat After Tuning in Production**

mxdperfstat

1/12/2018 8:31:01 AM
Master               .mxd
layerCount= 6
WGS_1984_Web_Mercator_Auxiliary_Sphere
esriMeters
X= -9,233,816.99 Y= 4,869,583.83 width= 1200 height= 1000

Map Display Performance (sec) for each scale

| Scale | Refresh Time(sec) | VisibleLayers |
|---|---|---|
| 1,000,000 | 1.24 | 3 |
| 500,000 | 2.10 | 3 |
| 100,000 | .67 | 4 |
| 50,000 | 1.14 | 5 |
| 25,000 | 1.37 | 5 |
| 12,000 | 1.10 | 5 |
| 5,000 | .81 | 5 |
| 2,500 | .92 | 5 |
| 1,000 | .69 | 5 |
| 500 | .83 | 5 |

**Performance Tuning Results for an Editing workflow:**

| S.No | Task | Performance - Before Tuning in Seconds | Performance - Before Tuning in Seconds | Performance Gain in % |
|---|---|---|---|---|
| 1 | Opening ArcMap | 46.22 | 15.41 | 199.94% |
| 2 | Open MXD (Master.mxd) | 28.79 | 28.06 | 2.60% |
| 4 | Zoom to selected features | 8.46 | 5.36 | 57.84% |
| 5 | Zoom to 5000 | 7.25 | 3.46 | 109.54% |
| 6 | Zoom out to 1000 | 4.93 | 2.25 | 119.11% |
| 7 | Zoom out to 500 | 5.32 | 0.91 | 484.62% |
| 8 | Start Editing | 11.95 | 7.66 | 56.01% |
| 9 | Place a Structure (1 Pole with Push brace) | 9.63 | 0.93 | 935.48% |
| 10 | Insert a Trans Line | 7.85 | 1.11 | 607.21% |
| 11 | Stop Edits | 4.73 | 1.50 | 215.33% |

# Tune - Operating System

**Operating System**

- **Adjust and configure**
  - **Kernel parameters**
  - **Settings specific to RDBMS and Network capacity**
- **Enable Large / Huge Memory Pages for Geodatabases**
- **Update patches**

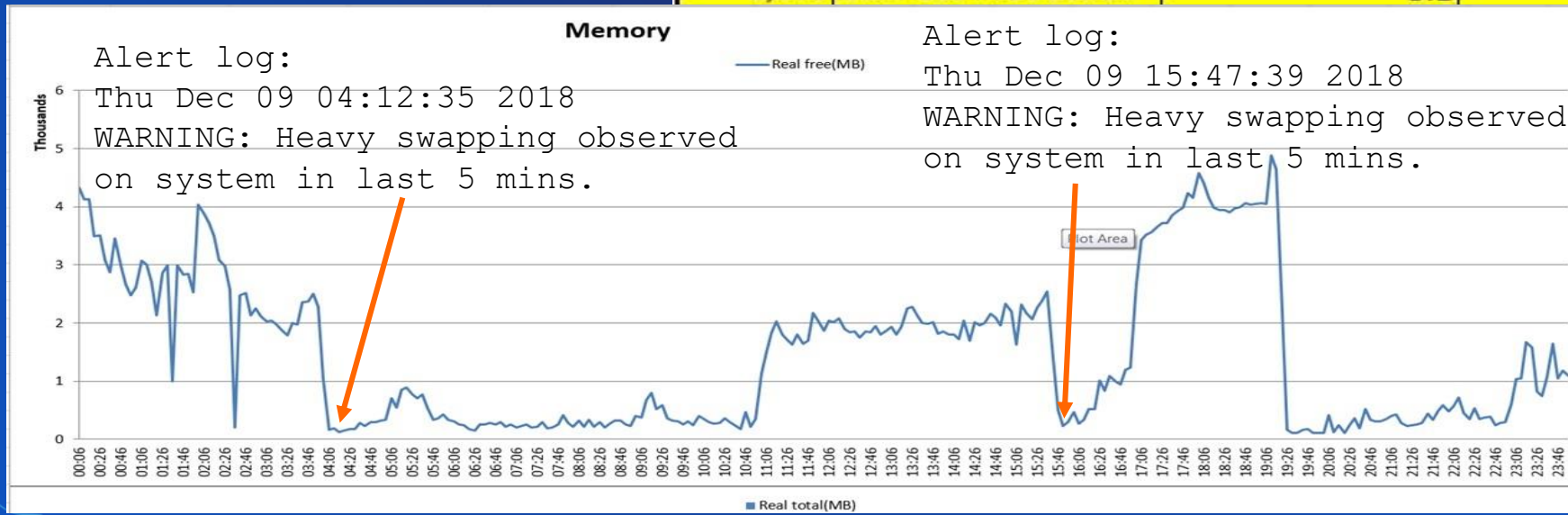| Operation System's Internal Memory Allocation to RDBMS | |
| --- | --- |
| OS Default Memory 4KB/ Page | OS Huge / Large Memory 2MB per Page |
| RDBMS 32GB / 4KB = 8,388,608 Pages | RDBMS 32GB / 2MB = 16,384 Pages |

```
HugePages_Total:   16384
HugePages_Free:     5166
HugePages_Rsvd:     1585
HugePages_Surp:        0
Hugepagesize:       2048 kB
DirectMap4k:    67117056 kB
DirectMap2M:           0 kB
```

# Tune – RDBMS
## RDBMS Configuration and Tuning

- **Tune RDBMS**
  - **Memory allocation from hardware**
  - **Other initialization parameters**
  - **Log file settings**
  - **etc.**
- **Implement the best practices**

## RDBMS Tuning - MXDPerfstat Results

| Scale | Feature Class/Layer | Display in Seconds - before tuning | Display in Seconds - after tuning | Performance gain in % |
|-------|---------------------|-----------------------------------:|----------------------------------:|----------------------:|
| 250,000 | Well Top | 101.83 | 0.2 | 50815.00% |
| 250,000 | Last Gas Prod Rate | 13.06 | 0.94 | 1289.36% |
| 250,000 | Cum Gas Production | 17.18 | 0.9 | 1808.89% |
| 250,000 | Last Oil Prod Rate | 8.78 | 0.2 | 4290.00% |
| 250,000 | Cum Oil Production | 5.71 | 0.2 | 2755.00% |
| 150,000 | Well Top | 94.04 | 0.14 | 67071.43% |
| 150,000 | Last Gas Prod Rate | 9.87 | 0.86 | 1047.67% |
| 150,000 | Cum Gas Production | 9.05 | 0.87 | 940.23% |
| 150,000 | Last Oil Prod Rate | 4.07 | 0.11 | 3600.00% |
| 150,000 | Cum Oil Production | 3.29 | 0.12 | 2641.67% |
| 5,000 | Well Top | 36.71 | 0.03 | 122266.67% |
| 1,000 | Well Top | 37.19 | 0.03 | 123866.67% |
| 1,000 | Last Gas Prod Rate | 5.13 | 0.03 | 17000.00% |
| 1,000 | Cum Gas Production | 5.1 | 0.03 | 16900.00% |



Memory

Alert log:
Thu Dec 09 04:12:35 2018
WARNING: Heavy swapping observed on system in last 5 mins.

Alert log:
Thu Dec 09 15:47:39 2018
WARNING: Heavy swapping observed on system in last 5 mins.

# Maintenance

# Increase Performance and Scalability

**Failing to prepare is preparing to fail!**

- **Workflow estimations**
    - **Number of outstanding versions**
    - **Versioning levels**
    - **Archiving**
    - **Traditional Vs Branch Versioning**
    - **etc.**
- **Maintenance plan**
    - **Mandatory tasks to keep performance**
    - **Delta table records Vs CPUs**
    - **Roles and responsibilities**
    - **etc.**

| S.No | Display Scale | Layer Name | Before Maintenance- Display in Seconds | After Maintenance - Display in Seconds | Performance Improvement in % |
|---|---|---|---|---|---|
| 1 | 50,000 | RoadCL > 10,000 | 0.34 | 0.3 | 13.33% |
| 2 | 15,000 | Water Mains | 0.15 | 0.09 | 66.67% |
| 3 | 10,000 | MapLink | 1.02 | 0.08 | 1175.00% |
| 4 | 10,000 | CH2M_Mains | 1.15 | 0.97 | 18.56% |
| 5 | 10,000 | Leaders | 0.58 | 0.07 | 728.57% |
| 6 | 10,000 | Annotation | 0.69 | 0.15 | 360.00% |
| 7 | 10,000 | Water Mains | 0.96 | 0.6 | 60.00% |
| 8 | 10,000 | CTParcels | 1.2 | 0.42 | 185.71% |
| 9 | 6,000 | CH2M_Mains | 0.68 | 0.56 | 21.43% |
| 10 | 6,000 | Water Mains | 0.88 | 0.52 | 69.23% |
| 11 | 1,000 | SwingTies | 7.74 | 0.05 | 15380.00% |
| 12 | 500 | SwingTies | 6.12 | 0.74 | 727.03% |
| 13 | 500 | Water Mains | 0.72 | 0.24 | 200.00% |
| 14 | 500 | sbDriveways | 0.37 | 0.16 | 131.25% |

*\*Few private and orphan versions induced the bottlenecks*

*Mitigate the risk with proper system capacity & maintenance*

# Geodatabase Maintenance - Strategies

- **Identify a maintenance window and tasks**

- **Categorize**
  - **Nightly, Weekly, Monthly and Yearly.**

- **Classify manual and automated batch processes**
  - **Design scalable batch processes**

- **Assign SDE/GIS administrator role**

- **Monitor**

*Geodatabase needs maintenance – Plan one*

# Geodatabase Maintenance – Key Considerations



- **Reconcile, Post and Compress schedule**

- **Underlying RDBMS requires maintenance other than backup**
  - **Rebuild Index**
  - **Update Statistics**
  - **Logs**

- **Execute automated processes only within maintenance window**

- **Run repair version tables and metadata**
  - **(Previously: SDEGDBREPAIR) every ~3 months**
  - **Fix any inconsistencies**
  - **Schedule the execution around weekends**

*Automate the daily maintenance process*
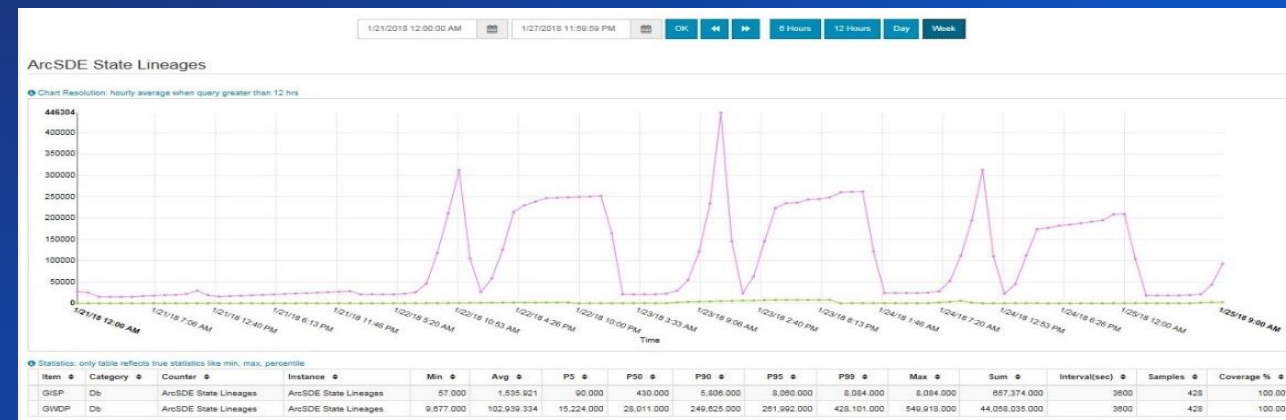
# Versions maintenance

- **Use private Versions for larger versioning environment**
  - **Keep the total number less**
  - **Sync frequently**
  - **Monitor**

- **Complete the batch processes within maintenance period**
  - **Improve Hardware and/or Software design**
  - **Additional CPUs**
  - **Multi threads**
  - **Feature/Schema cache**
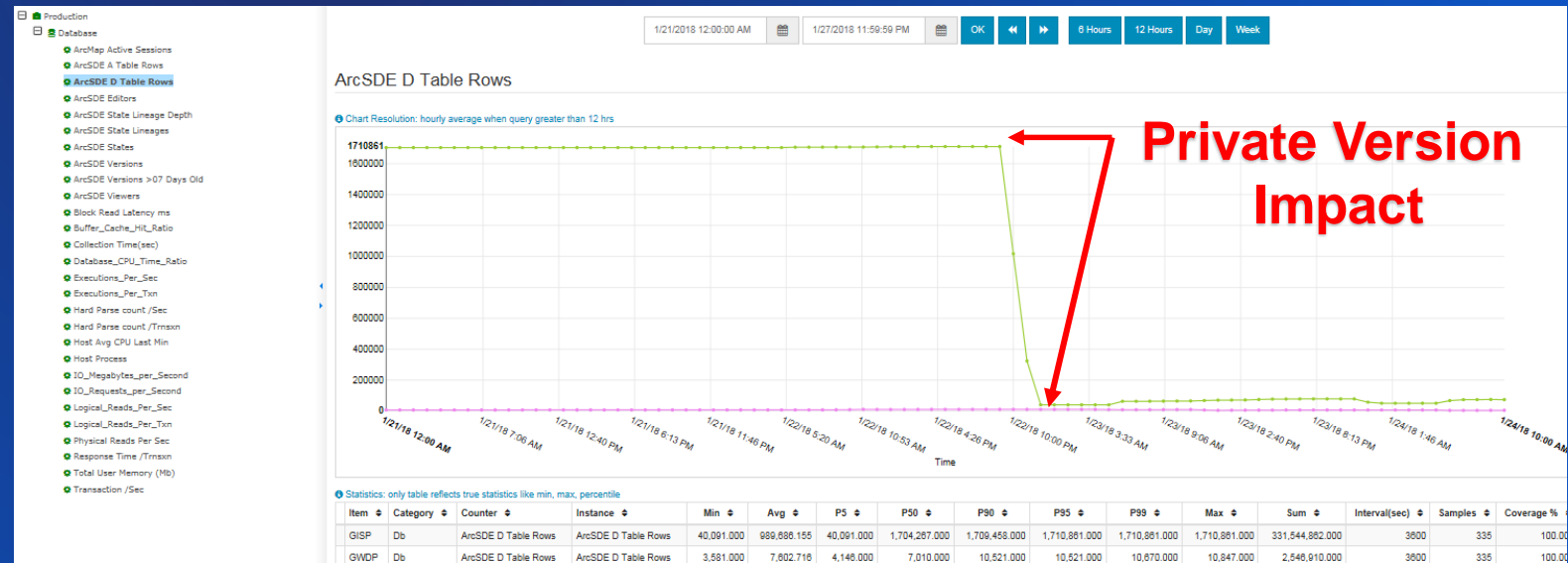
# Geodatabase Maintenance – Best Practices

- **Identify, Reconcile and Post top 5 blocking Versions every day**
  - **Blocking Versions cause inefficient Compress**
  - **Increase in Delta Table records beyond the hardware support level**
  - **Maintain the lineage length <100**

```
                              Versioning statistics
=====================================================
Number of versions: 664
Number of versions blocking DEFAULT: 625
Top 5 blocking versions...
    ANDREW.SN_164022
    ANDREW.SN_162751
    RASU.SN_163090
    RASU.SN_163139
    RASU.SN_164468
Number of states: 4333
Number of state lineages: 86293
DEFAULT versions lineage length: 426
Last compress: JUL-09-2017
```



SQL Server DBs ArcSDE A Table Rows -- ADDS TABLE RECORD COUNT (COUNTER) -- Principle: track record count
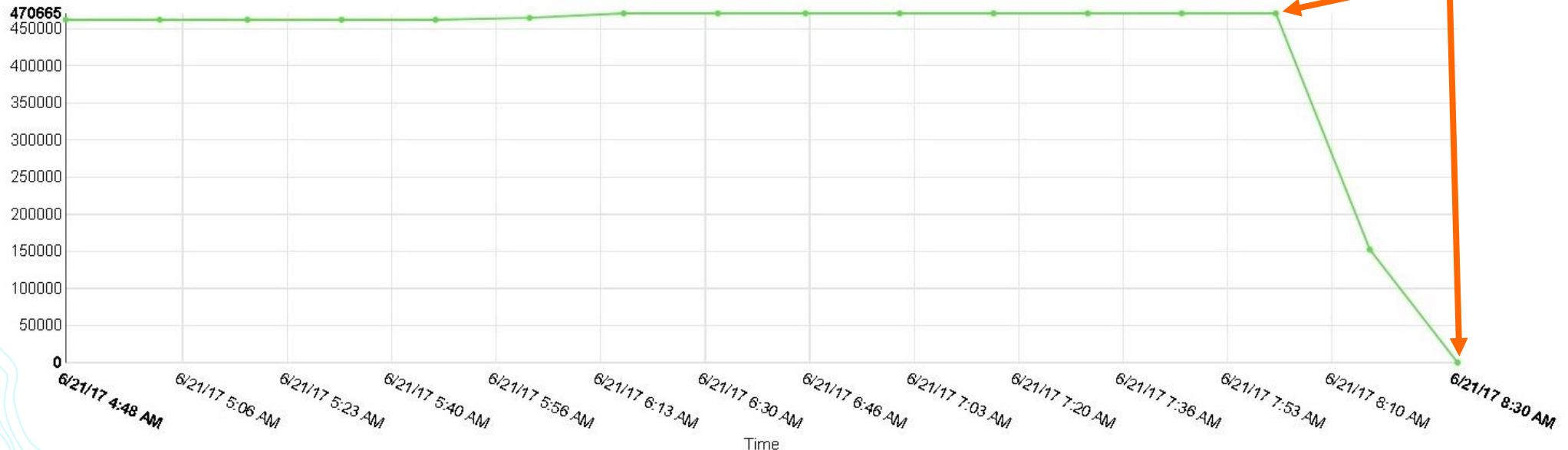
# Geodatabase Maintenance – Best Practices



- **Remove Geoprocessing (GP) history**
  - *How To: Automate the process of deleting geoprocessing history*
  - *http://support.esri.com/technical-article/000011751*
- **Disable (GP) history for scripts**

  *import arcpy*

  *arcpy.SetLogHistory(False)*

| Python Tasks | Before Deleting GP History in Seconds | After Deleting GP History in Seconds | Performance Improvement in % |
|---|---|---|---|
| Create Version | 400.74 | 16.3 | 2358.53% |
| Delete Version | 571.23 | 14.17 | 3931.26% |

| Feature Class Name | Calculating 2 records before GP History Removal in Seconds | Calculating 2 records after GP History Removal in Seconds | Performance Difference in % |
|---|---|---|---|
| Sewer | 58.67 | 8.09 | 625.22% |

# Geodatabase Maintenance – Best Practices



- **Manage auditing / history tables**
  - **Reduce the database**
    - **Backup size**
    - **Storage**
    - **Time**

| OWNER | TABLE_NAME | NUM_ROWS | BLOCKS | AVG_ROW_LEN | TO_CHAR(LAST_ANALYZED,'MON/DD/YYHH24:MI:SS') |
|-------|------------|----------|--------|-------------|----------------------------------------------|
| ARCFM | EDITEDFEATURESTRACKING | 12330909 | 122954 | 140 | APR/23/16 23:44:17 |
| ARCFM | EDITEDGRIDS | 12964827 | 32969 | 32 | APR/23/16 23:47:55 |
| SDE | ARCSDEUSERLOG | 56558633 | 259246 | 62 | APR/24/16 12:28:25 |

| OWNER | TABLE_NAME | NUM_ROWS | BLOCKS | AVG_ROW_LEN | TO_CHAR(LAST_ANALYZED,'MON/DD/YYHH24:MI:SS') |
|-------|------------|----------|--------|-------------|----------------------------------------------|
| SDE | GDBM_RECONCILE_HISTORY | 4759429 | 50484 | 72 | AUG/12/17 12:40:34 |
| ARCFM | USAGEINFORMATION | 6377236 | 221057 | 39 | AUG/10/17 15:59:14 |

# Geodatabase Maintenance – Best Practices
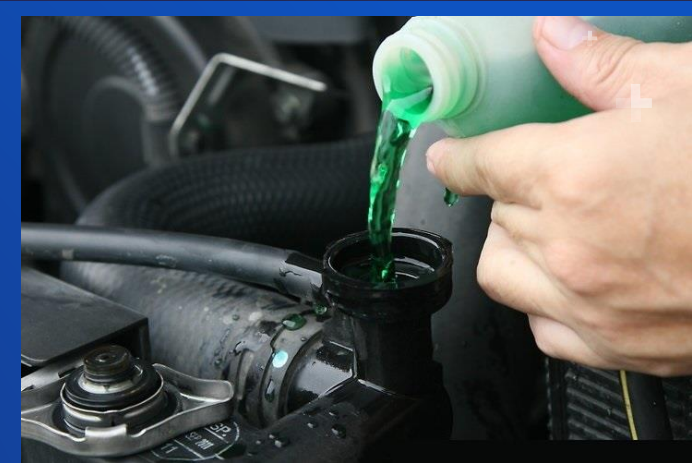
- **Every 3 - 6 months:**
  - **Fix the feature class extent first**
  - **Followed by spatial index rebuild**
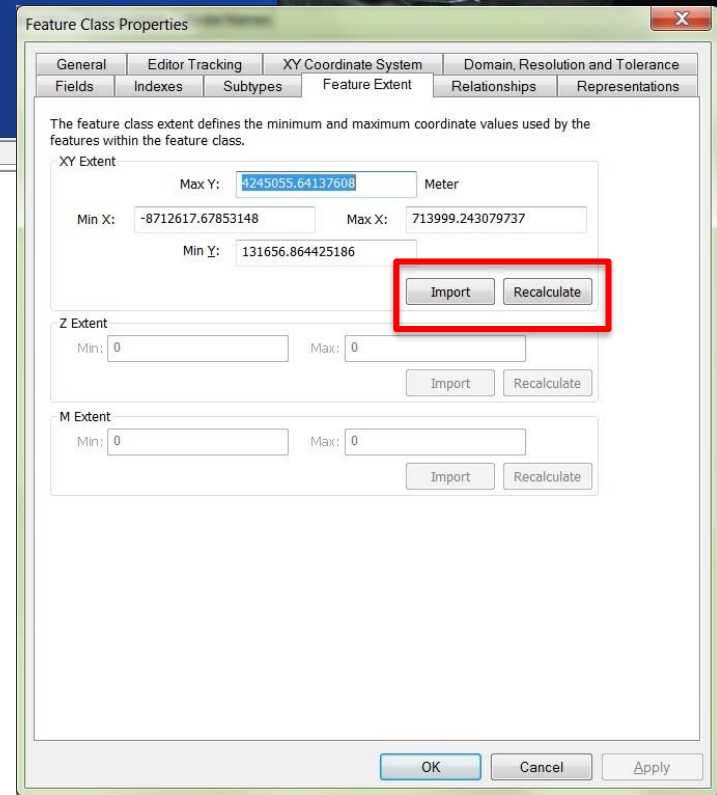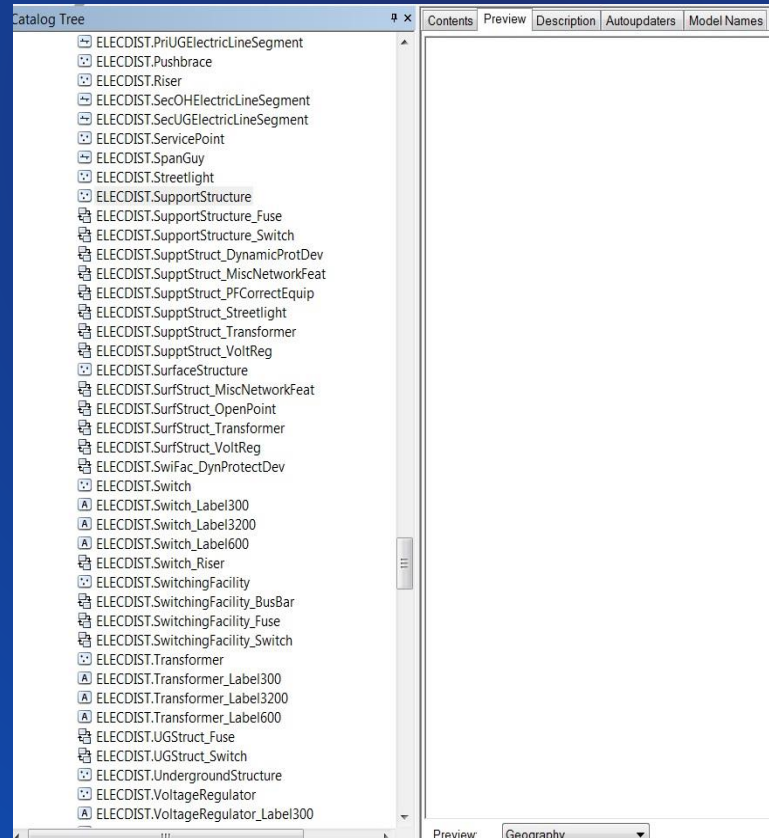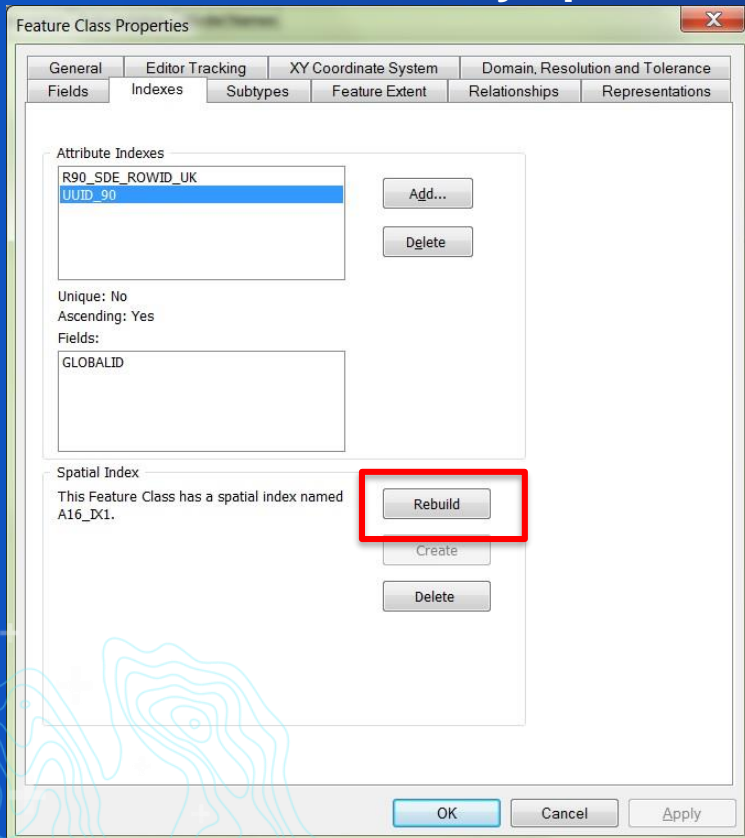
# Geodatabase Maintenance – Best Practices

- **Fix the non-empty Feature Classes with no spatial index**

```
1  Exec DBMS_STATS.GATHER_SCHEMA_STATS ('ARCFM', estimate_percent=>100,
2   DEGREE=> 7, CASCADE=>TRUE, No_Invalidate=>false);
3  select table_name, GSIZE1, GSIZE2,GSIZE3 FROM sde.layers
4      where gsize1=0 and gsize2=0 and gsize3=0 and table_name in
5      (select table_name from all_tables where num_rows > 0);
```

| TABLE_NAME | GSIZE1 | GSIZE2 | GSIZE3 |
|---|---|---|---|
| COATING | 0 | 0 | 0 |
| CPBOND | 0 | 0 | 0 |
| CPCABLE | 0 | 0 | 0 |
| CPGROUNDBED | 0 | 0 | 0 |
| CPANODE | 0 | 0 | 0 |
| LINECROSSING | 0 | 0 | 0 |
| MARKER | 0 | 0 | 0 |
| PIPEEXPOSURE | 0 | 0 | 0 |
| TIEINMETHOD | 0 | 0 | 0 |
| DOCUMENTPOINT | 0 | 0 | 0 |
| INJECTION | 0 | 0 | 0 |
| PIGROUTE | 0 | 0 | 0 |
| PIPEDEPTH | 0 | 0 | 0 |
| RL_SITE | 0 | 0 | 0 |
| PIPEJOIN | 0 | 0 | 0 |
| PIPELENGTH | 0 | 0 | 0 |
| WELL | 0 | 0 | 0 |
| LEAK | 0 | 0 | 0 |
| DOT_CLASS_PREVIOUS_RDETAILS | 0 | 0 | 0 |
| ALIGNMENT_SHEETS | 0 | 0 | 0 |
| EXTERNAL_COATING_RDETAILS | 0 | 0 | 0 |
| MISC_FITTING_DETAILS | 0 | 0 | 0 |
| ALIG_SHT_CROSS_REF_RDETAILS | 0 | 0 | 0 |
| CLOSURE_DETAILS | 0 | 0 | 0 |
| HCA_PREVIOUS_RDETAILS | 0 | 0 | 0 |
| INJECTOR_DETAILS | 0 | 0 | 0 |
| ODORANT_RANGE_RDETAILS | 0 | 0 | 0 |
| OFFLINECOMPSTATIONPOLYGONS | 0 | 0 | 0 |
| PIG_SIGNAL_DETAILS | 0 | 0 | 0 |
| PIR_RDETAILS | 0 | 0 | 0 |
| RIGHT_OF_WAY_RDETAILS | 0 | 0 | 0 |
| RIVER_WEIGHT_RDETAILS | 0 | 0 | 0 |
| SHEET_NOTE_RDETAILS | 0 | 0 | 0 |
| TAP_DETAILS | 0 | 0 | 0 |
| PIPE_SEG_PIR_BUFF | 0 | 0 | 0 |
| MAOP_CALC_RDETAILS | 0 | 0 | 0 |

# Geodatabase Maintenance – Best Practices

- A Sample daily maintenance (batch process) for multi user Geodatabase:

  1. Backup the Database

  2. Synchronize any Replica version.

  3. Delete the orphan / unnecessary versions.

  4. Drop the orphan keyset tables

  5. Reconcile and Post all/eligible Versions – through out the Day

  6. Only Reconcile all versions (>100 versions - parallel reconcile)

  7. Update Database statistics - optional

Continue…..



```
50    END LOOP;
51
52    dbms_output.put_line('Dropped '||cnt||' keyset tables.');
53
54    END;
55    /
Dropped 31038 keyset
tables.
```

```
SDE_VERSION_NAME
--------------------------------------------------------------------------------
HEALTHCOMMENT
--------------------------------------------------------------------------------
RASU.SYNC_SEND_96817_3
Critical: Orphaned replica version (http://support.esri.com/technical-article/00
0010858)

RASU.SYNC_SEND_90803_2
Critical: Orphaned replica version (http://support.esri.com/technical-article/00
0010858)
```

# Geodatabase Maintenance – Best Practices

- Continue…..
    8. **Pause the SDE connections**
    9. **Kill the existing or orphaned user connections**
    10. **Truncate dynamic tables**
        A. **state_locks; table_locks; object_locks; layer_locks; process_information; <user>.SDE_LOGFILE_DATA;**
    11. **Start the Compress process**
    12. **Un-pause the SDE connection**
    13. **Rebuild indexes in RDBMS for all the Schema Owners and SDE**
    14. **Update RDBMS statistics for all Schema Users and SDE.**

| OWNER | TABLE_NAME | NUM_ROWS | BLOCKS | AVG_ROW_LEN | TO_CHAR(LAST_ANALY |
|-------|-----------|----------|--------|-------------|--------------------|
| RASU | SDE_LOGFILES | 7,488 | 244 | 93 | JUN/17/19 22:03:13 |
| RASU | SDE_LOGFILE_DATA | 86,832,159 | 171,379 | 10 | JUN/03/19 22:02:56 |
| ANDR | SDE_LOGFILES | 783 | 13 | 91 | MAY/14/19 22:02:05 |
| ANDR | SDE_LOGFILE_DATA | 28,887,671 | 57,017 | 10 | AUG/26/18 06:04:45 |

# Geodatabase Maintenance – Geometric Network

- **Every 3 – 6 Months run Esri's Verify And Repair Geometric Network connectivity tool**
- **Only GIS Administrator should follow the below steps:**
  - **Create a new Version under SDE.Default.**
  - **Create a SDE connection document with the new Version.**
  - **Run the Verify and Repair tool**
    - **With "Repair network after verify completes" option**
  - **Reconcile, Post and Delete the newly created version.**
  - **Compress the Database.**
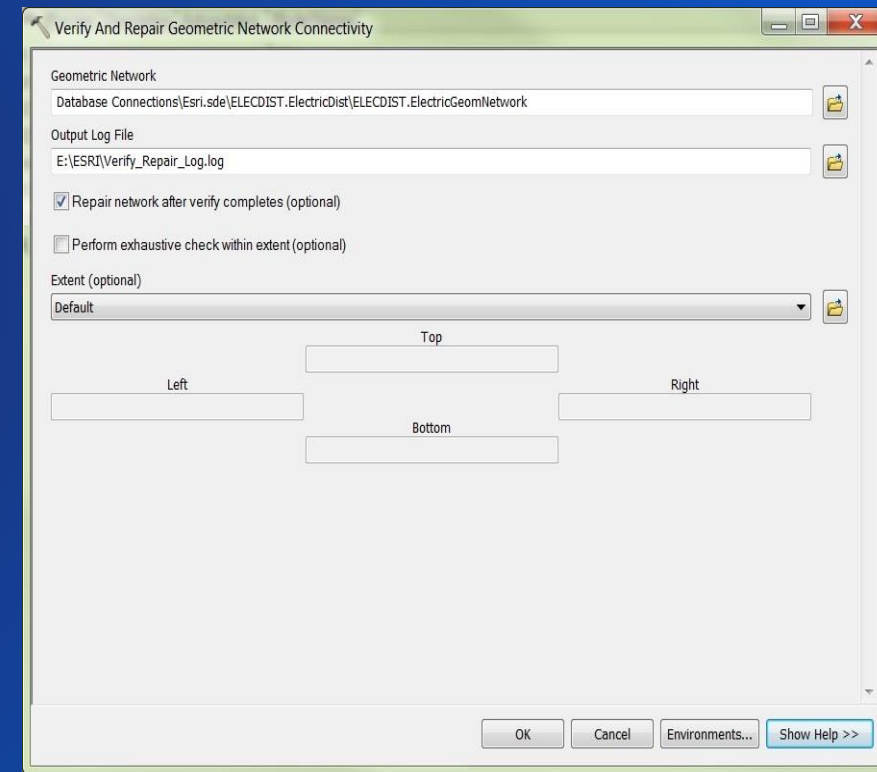


*Caution: Individual users should not run it. Generates larger number of delta table records and it can produce more conflicts when run under SDE.Default version directly.*

# Monitor

# ArcGIS Monitor

- **Add RDBMS Queries**
- **Monitor key performance indicators**
- **Keep 15 minutes sampling interval**

# ArcGIS Monitor – EGDB Add-on

- **Configure EGDB Add-ons per RDBMS**
- **Use EGDB health tool**

| database_name | owner_name | delta_table_name | base_table_name | comment |
|---|---|---|---|---|
| GIS_Common | dbo | a146 | ADDITIONAL_PROPERTY | Critical: Delta tables exist and there is no compress history |
| GIS_Common | dbo | D146 | ADDITIONAL_PROPERTY | Critical: Delta tables exist and there is no compress history |
| GIS_Common | dbo | a147 | ER | Critical: Delta tables exist and there is no compress history |
| GIS_Common | dbo | D147 | ER_ _ _ _ _ _ _ _ _ | Critical: Delta tables exist and there is no compress history |
| GIS_Common | dbo | a148 | FACILITY | Critical: Delta tables exist and there is no compress history |
| GIS_Common | dbo | D148 | FACILITY | Critical: Delta tables exist and there is no compress history |

| | stats_name | table_name | type_desc | owner_name | modify_date | statistics_recompute_setting | statistics_user_created | comment |
|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | |
| 2 | d160_pk | D160 | USER_TABLE | dbo | 42710.54988 | Recompute | Not user created | Warning: No statistics update information available. Review statistics updating procedures. |
| 3 | d160_idx2 | D160 | USER_TABLE | dbo | 42710.54988 | Recompute | Not user created | Warning: No statistics update information available. Review statistics updating procedures. |
| 4 | a160_rowid_ix1 | a160 | USER_TABLE | dbo | 42710.55096 | Recompute | Not user created | Warning: No statistics update information available. Review statistics updating procedures. |
| 5 | a160_state_ix2 | a160 | USER_TABLE | dbo | 42710.55096 | Recompute | Not user created | Warning: No statistics update information available. Review statistics updating procedures. |
| 6 | d189_pk | D189 | USER_TABLE | dbo | 42710.55745 | Recompute | Not user created | Warning: No statistics update information available. Review statistics updating procedures. |
| 7 | d189_idx2 | D189 | USER_TABLE | dbo | 42710.55745 | Recompute | Not user created | Warning: No statistics update information available. Review statistics updating procedures. |

- https://community.esri.com/community/implementing-arcgis/blog/2019/05/10/using-egdbhealth-to-evaluate-a-geodatabase?et=watches.email.blog

*Monitor, interpret and respond*

# Tools for Implementation Assistance
**ArcGIS Monitor**

- **ArcGIS Monitor**
  - **ArcGIS Monitor is a tool for monitoring and analyzing your enterprise GIS system**
  - **https://www.esri.com/en-us/arcgis/products/arcgis-monitor/overview**

- **MXDPerfstat**
  - **An ArcGIS Engine command line tool to diagnose typical mxd performance problems**
  - **https://www.arcgis.com/home/item.html?id=a269d03aa1c840638680e2902dadecac**

- **System Designer**
  - **A comprehensive tool for designing and capacity planning of GIS solutions.**
  - **https://www.arcgis.com/home/item.html?id=8ff490eef2794f428bde25b561226bda**

- **System Log Parser**
  - **A reporting tool specifically designed for analyzing ArcGIS server and service logs**
  - **http://www.arcgis.com/home/item.html?id=a29649a3d87d4cae84374e5d711dc3aa**

# Questions and Answers

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# See us here

| WORKSHOP | LOCATION | TIME FRAME |
|---|---|---|
| • **Enterprise Geodatabase: Automating Administration Tasks Using Python** | • **SDCC - Expo Demo Theater 04** | • **Thursday 7/11/2019 10:00 AM - 10:45 AM** |
| • **Geodatabase: Ensuring Data Quality with Attribute Rules and Contingent Values** | • **SDCC - Ballroom 06 E** | • **Thursday 7/11/2019 4:00 PM - 5:00 PM** |

# Please Share Your Feedback in the App

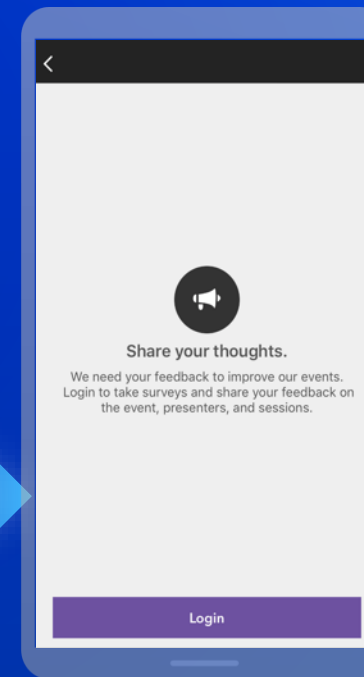Download the Esri Events app and find your event
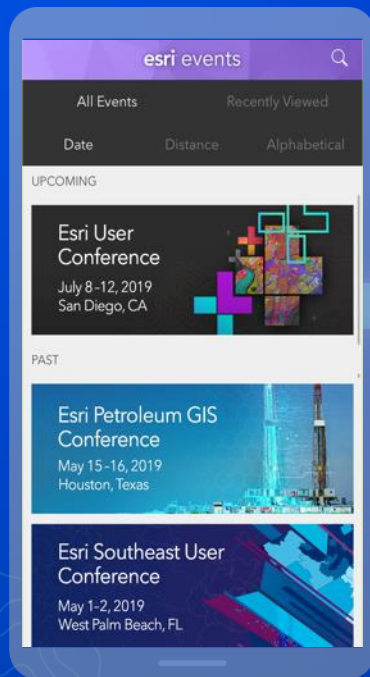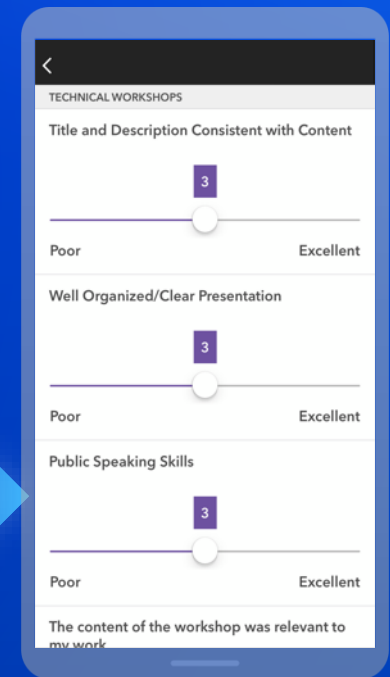
Select the session you attended
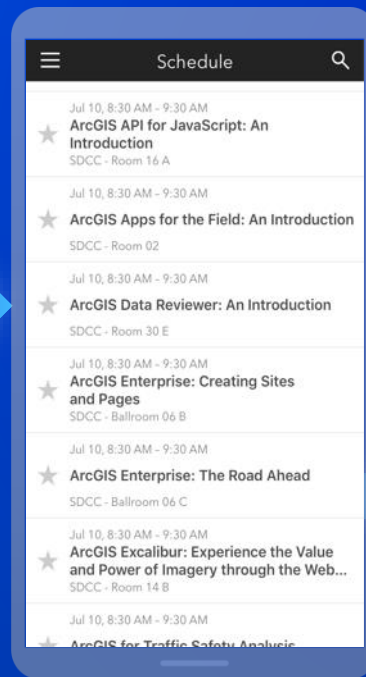
Scroll down to "Survey"
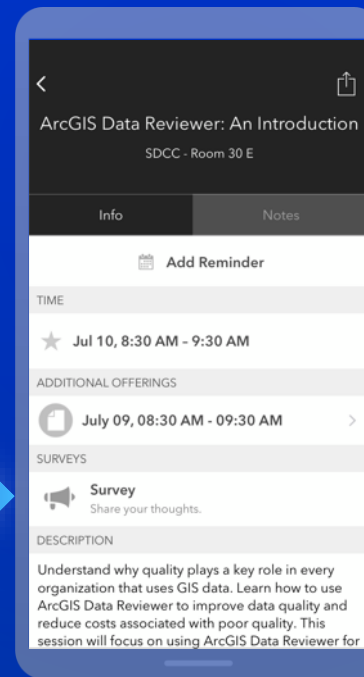
Log in to access the survey

Complete the survey and select "Submit"