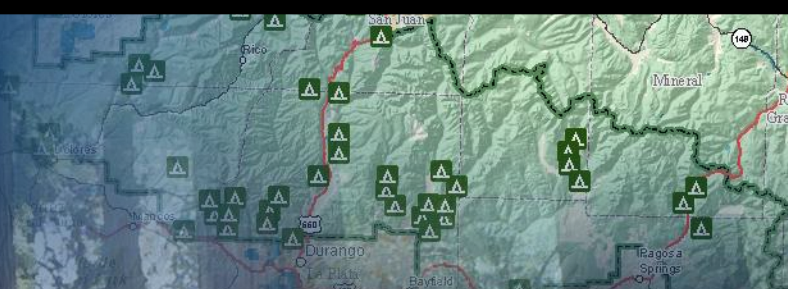




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A map of the Durango, Colorado area, showing various geographical features and locations. The map includes labels for Durango, San Juan, Mineral, and Pagosa Springs. It also shows a network of roads and several green triangular markers with white 'A's inside, likely representing specific resource locations or data points.

Geodatabase Essentials An Introduction to the Geodatabase

Tim Clark
ESRI Federal
Land and Natural Resource Team



Session Path

The Geodatabase

What is it?

Why use it?

What types are there?

Geodatabase Demo

Inside the Geodatabase

Advanced Behavior

Editing Geodatabases

Geodatabase Potpourri



What is the Geodatabase?

- **Core ArcGIS data model**
 - A comprehensive model for representing and managing GIS data
- **A physical store of geographic data**
 - Scalable storage model supported on different platforms
- **A transactional model for managing GIS workflows**
- **Set of COM components for accessing data**



Geodatabase Data Management Approach

- **The geodatabase is built on an extended relational database.**
 - Base relational model
 - Base short transaction model
 - Relational integrity
 - Reliability, Flexibility, Scalability
 - Supports continuous, large datasets
- **Built on the simple feature model**
 - Open access (OGC, C, COM, SQL)



Geodatabase Data Management Approach ...

- **Simple features + logic**
 - All geographic data stored as tables in a DBMS
 - Extend functionality and data integrity
 - Functionality is consistent across DBMS'
- **Application logic (software)**
 - Works on standard DBMS tables
 - Implements GIS integrity and behavior
 - Business rules, topology, networks
 - Data Integrity



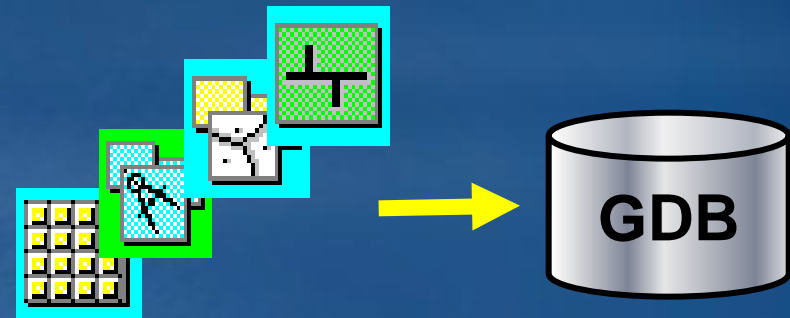
Geodatabase Data Management Approach ...

- **Editing and data compilation**
 - Rich set of editing tools
 - Maintain spatial and attribute integrity
 - Undo and redo edits
 - Multiple users editing the same data
- **Versioning work flows**
 - Long transactions
 - Distributed data management
 - Archiving
- **Robust, customizable framework**
 - Build and manage your own specific GIS solution



Geodatabase Data Management

- **Schema is defined in ArcCatalog**
 - Define feature classes, datasets, relationships, etc
- **Import and convert data from other formats**
 - Shapefile
 - Coverage
 - CAD
 - Raster
- **Copy and Paste**
- **Geodatabase XML Export / Import**
 - For transferring Schema or Features and Schema
- **Use an ESRI Data Model**
 - Industry specific data models available
 - Copy geodatabase template



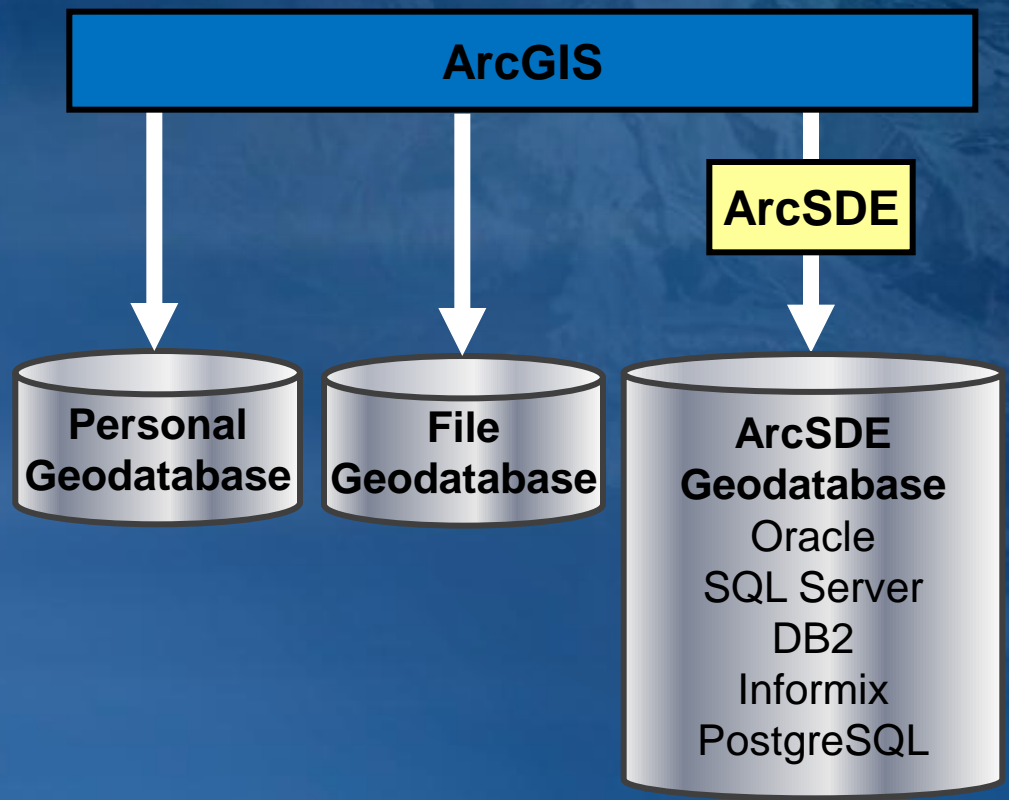


3 Types of Geodatabases

- **Personal Geodatabase**
 - Single user editing
 - Stored in MS Access
 - Size limit of 2 GB




- **File Geodatabase**
 - 1 TB per table
 - Reduced storage requirements

- **ArcSDE Geodatabase**
 - Stored in an enterprise DBMS
 - Supports multiuser editing via versioning
 - Requires ArcEditor or ArcInfo to edit








3 Types of Geodatabases...

	Personal GDB 	File GDB 	ArcSDE GDB (3 editions) 
Storage format	Microsoft Access	Folder of binary files	DBMS
Storage capacity	2 GB	1 TB per table*	Depends on edition
Supported O/S platform	Windows	Any platform	Depends on edition
Number of users	Single editor Multiple readers	Single editor Multiple readers	Multiple editors & readers
Distributed GDB functionality	Check out/check in and One-way replication	Check out/check in and One-way replication	Replication (all types) & versioning

* By default; option to have 256 TB per table






3 Types of Geodatabases...

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Session Path

The Geodatabase

Inside the Geodatabase

Object class, Feature class, Raster dataset

Feature datasets

Validation rules

Domains, Subtypes, Relationship classes

Annotation, Dimensions

Exploring a Geodatabase DEMO

Advanced Behavior

Editing Geodatabases

Geodatabase Potpourri





Inside the Geodatabase

- A geodatabase contains datasets
- Datasets represent collections of information with a real-world interpretation
- Types of geographic datasets:
 - Tables
 - Object classes, feature classes, relationship classes
 - Feature datasets
 - Networks, Topologies, Raster and cadastral datasets
- Datasets have associated information to help manage integrity, behavior, and interpretation
 - Domains, Relational integrity, Topology, Metadata










Inside the Geodatabase...


Table 


Feature dataset 


Feature class


 Polygon	 Annotation
 Line	 Dimension
 Point	 Route

Relationship class 

Topology 

Geometric network 


Network dataset 



Terrain 


Raster dataset 




Raster catalog 

Schematic dataset 

Survey dataset 

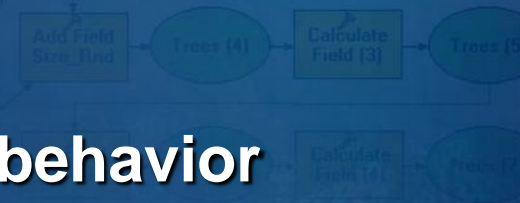
 Project folder  Project

Toolbox 

 Tool  Model  Script

Behavior

Attribute domains Relationship rules
Attribute defaults Connectivity rules
Split/merge policy Topology rules



Objects and Object Classes

- Objects are entities with properties and behavior
- An object is an instance of an object class
- All objects in an object class have the same properties and behavior
- An object can be related to other objects via relationships

Attributes of customers

OBJECTID *	NAME	ADDRESS	ZIP	TYPE	SALES
10	Central Petroleum	1100 CENTER ST NW	30318	Service Station	55130.41
11	Charlie Cota Inc.	400 EIGHTH ST NW	30318	Restaurant	45468.801
12	City Food Market	501 ETHEL ST NW	30318	Store	55686.898
13	Clamerty's	421 SPRING ST NW	30308	Store	55305.93
14	Crossroads Theater	120 MEMORIAL DR SE	30312	Movie Theater	30117.699
15	Damar Sales	388 7TH ST NE	30308	Service Station	55518.012
16	Dan's Taco Emporium	1032 CENTER ST NW	30318	Restaurant	55243.43
17	Darby's Market	1001 CENTER ST NW	30318	Store	55369.801
18	Dream Ice Cream	77 MILLS ST NW	30308	Restaurant	55260.5
19	Eastern Express	150 6TH ST NE	30308	Cafe	55574.148

Record: 0 Show: All Selected Records (0 out of 50 Selected) Options

A row stores an Object
A table stores an ObjectClass



Features and Feature Classes

- Builds on the Relational Model
- A feature is a spatial object
- A feature is an instance of a feature class
- Extended the relational model with
 - Geometry attribute types

A feature class is a table of rows, where each row has a geographic column



Attributes of Parcels						
	OBJECTID*	SHAPE*	PARCEL_ID*	ZONE_CODE*	SHAPE_Length	SHAPE_Area
	4513	Polygon	67970	W	544.053559	9259.209935
	4514	Polygon	67971	W	158.545394	774.602847
	4515	Polygon	67973	R60M	400.003008	7499.965473
	4516	Polygon	67974	B1	236.126101	2905.890606
	4517	Polygon	67982	B1	550.458538	17499.011493



Field data types

- The geodatabase supports **eight** field data types

Data type	Bytes	Range / format / notes
Short Integer	2	-32,768 to +32,767
Long Integer	4	-2,147,483,648 to +2,147,483,647
Float	4	About $-3.4e38$ to $+1.2e38$ (~7 significant digits)
Double	8	About $-2.2e308$ to $+1.8e308$ (~14 significant digits)
Text	varies	Up to ~64,000 characters
Date	8	mm/dd/yyyy hh:mm:ss am/pm
BLOB	varies	Store large binary content or other multimedia
Raster	varies	Store images

- Supported field data types are generic
 - Data types specific to an RDBMS are not supported



Geodatabase Supports Advanced Geometry

- Points, lines, polygons
 - Single and multipart features



Feature with many parts

OBJECTID*	Shape*	STATE_NAME
48	Polygon	Florida
44	Polygon	Georgia
50	Polygon	Hawaii
8	Polygon	Idaho

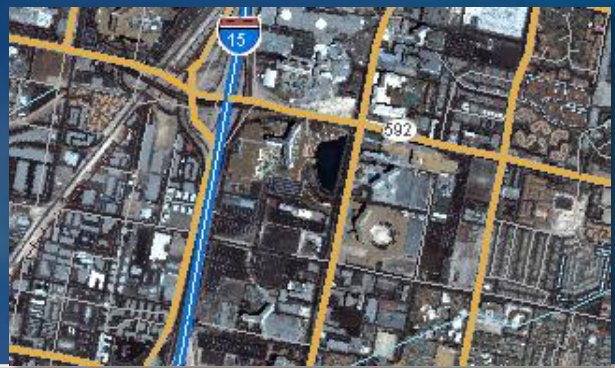
One record in feature class table

- Text and surfaces
- Flexible coordinates
 - XY, Z, M



Geodatabase Raster Data

- Support for many formats
 - tiff, bmp, GRID
- Raster dataset
 - Separate rasters
 - Mosaicking
- Raster catalog
 - A collection of raster datasets
 - Accessed as one entity
 - Each member can be accessed as a raster dataset
 - Each member can have its own storage properties
 - Managed/Unmanaged



Rensselaer_County_Catalog : Table

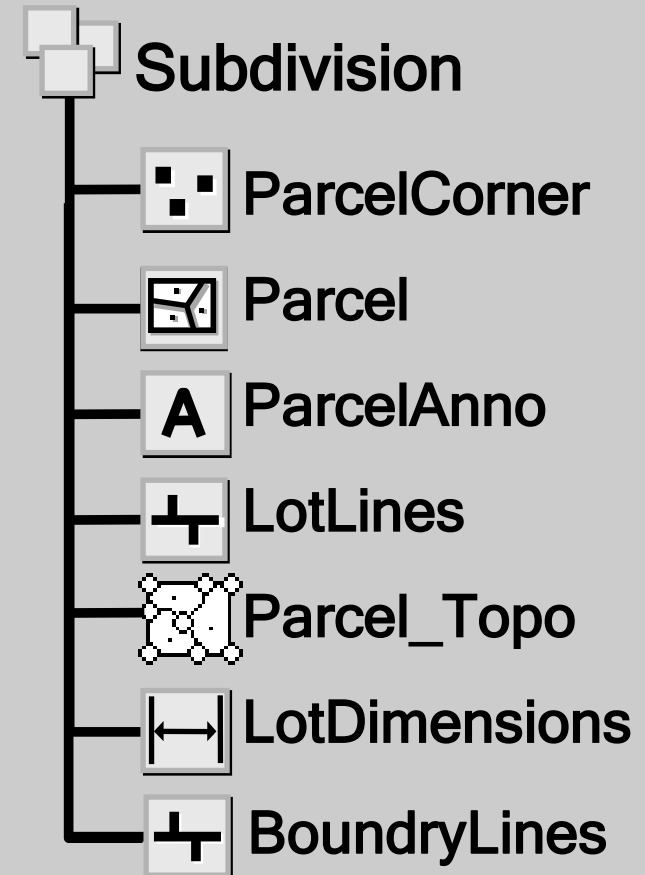
OBJECTID	Shape	Name	Shape_Length	Shape_Area
1	Long binary data	e_07351426.tif	10000	6000000

NAME	OBJECTID
3198373a_sld	16463
3198374a_sld	16464
3198381a_sld	16465
3198382a_sld	16466
3198383a_sld	16467
3198384a_sld	16468
3198391a_sld	16469
3198392a_sld	16470
3198393a_sld	16471
3198394a_sld	16472
3198401a_sld	16473
3198402a_sld	16474
3198403a_sld	16475
3198404a_sld	16476
3198411a_sld	16477
3198412a_sld	16478
3198413a_sld	16479
3198414a_sld	16480
3198421a_sld	16481
3198422a_sld	16482
3198423a_sld	16483
3198424a_sld	16484
3198431a_sld	16485
3198432a_sld	16486



Feature Datasets

- A container object for other datasets
 - Same spatial reference
- Analogous to a coverage
 - Less restrictive
- Contain geometric networks and topologies
 - Optionally relationship classes





Validation Rules

- Store attribute, connectivity, and relationship rules on objects as part of the geodatabase
- Predefined, parameter driven
 - Attribute range rule
 - Attribute set rule
 - Connectivity rule
- On demand
- Perform custom validation by writing code



Domains

- Describe the legal values of a field type
 - Used to ensure attribute integrity
- Defined at the geodatabase level
- Types of domains:
 - Range
 - A tree can have a height between 0 and 300 feet
 - A road can have between one and eight lanes
 - Coded Value
 - A tree can be of type oak, redwood, or palm
 - A road can be made of dirt, asphalt, or concrete

SiteID	PoleHeight	Parcel_ID	Landuse
17	34	2234975	Commercial
18	75	2234976	Industrial
19	40	2234977	

Selected Records (0 out of 3 Selected.) Options



Subtypes

- Partition the objects in a class into like groups
- Defined at the class level
- Defined by the value of a subtype field
 - Have the same attribute\behavior schema
 - Can have different default values and domains for each field
 - Can define topology rules between subtypes

Codes

Descriptions

Parcel

ZoneCode

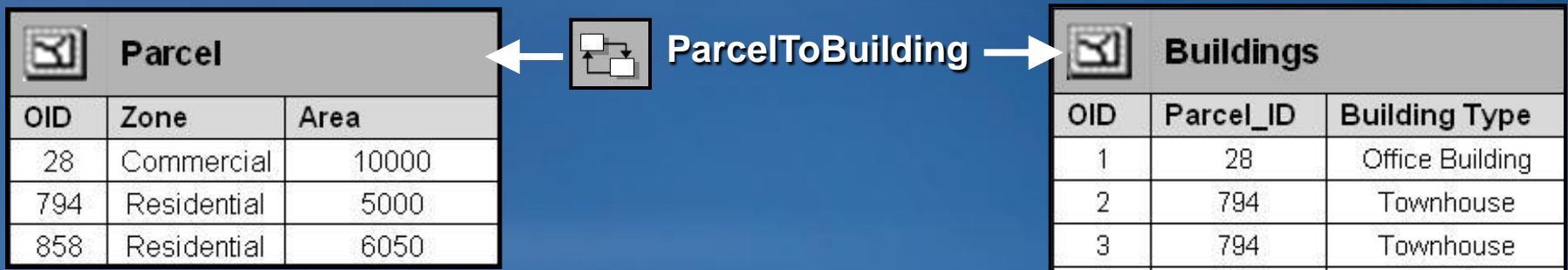
- Residential
- Commercial
- Industrial
- Agricultural

OBJECTID*	SHAPE*	APN	ZoneCode
213	Polygon	70605	201
218	Polygon	70611	201
228	Polygon	70621	201
231	Polygon	70668	201
363	Polygon	70860	202
429	Polygon	70745	202
430	Polygon	70746	202
435	Polygon	70751	203
1278	Polygon	70473	203
1279	Polygon	70474	203



Relationship Classes

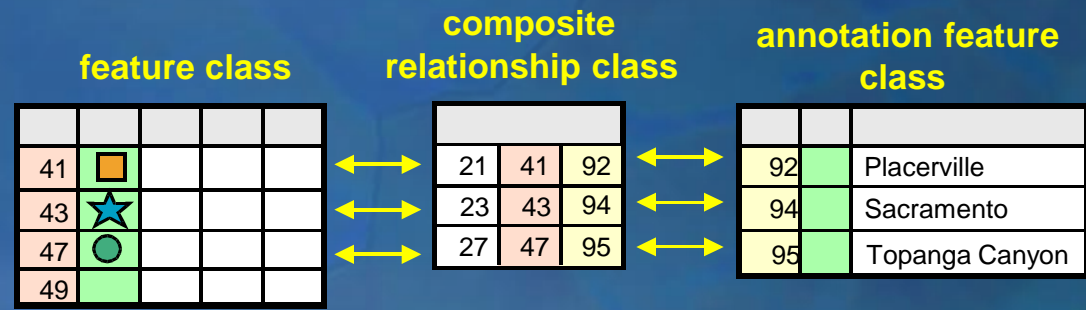
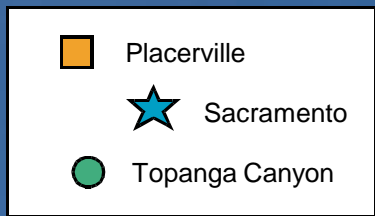
- An association between two object classes
 - A class may participate in multiple relationship classes
- Simple relationships
- Composite relationships
 - Related objects can message each other
 - Can trigger behavior (cascade delete, move to follow, custom, etc.)
- Associate rules with relationship classes
 - Each Parcel can have between 1 to 3 Buildings





Annotation

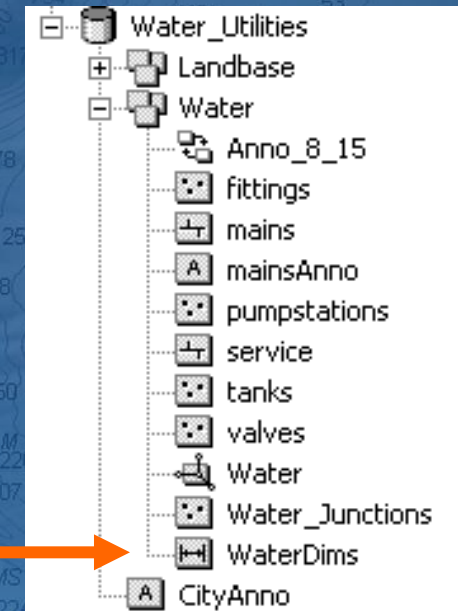
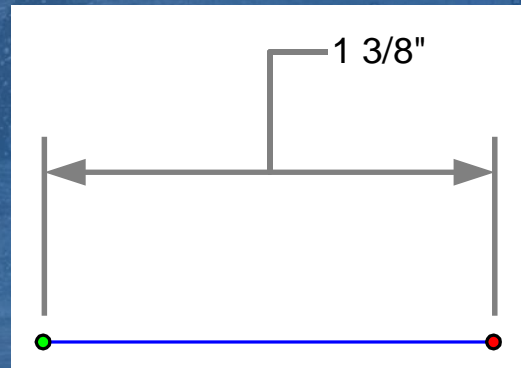
- Annotation feature classes may be
 - Feature linked or Non-feature linked
- Composite relationship manages link
- Can store text as well as other graphics
 - Lines, arrows, boxes, etc...





Dimension Features

- Type of annotation that displays specific distances on a map
- Graphic features stored in a dimension feature class
- “Smart” feature
 - Special drawing
 - Special editing





Object Behavior

- You can:
 - Instantiate classes with predefined behavior. (**Dimensions and Annotation**)
 - Control the default value and acceptable values for any attribute in a class. (**Domains and Validation**)
 - Partition the objects in a class into like groups. (**Subtypes**)
 - Control the general and network relationships in which an object can participate. (**Relationship Classes**)
- Out of the Box in ArcGIS!
 - Configurable, no programming required



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- **Exploring a Geodatabase Demo**
 - **Tables**
 - **Feature Classes**
 - **Subtypes**
 - **Domains**
 - **Relationship Classes**



Session Path

The Geodatabase

Inside the Geodatabase

Advanced Behavior

Geometric Networks

Network Datasets

Geodatabase Topology

Advanced behavior DEMO

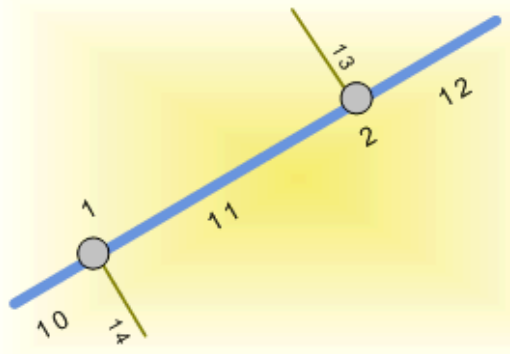
Editing Geodatabases

Geodatabase Potpourri



Geometric Networks

- Used to model network systems
- Connectivity relationships between feature classes
 - Can associate connectivity rules with the network
 - Connectivity is based on geometric coincidence, **always live**
- Each feature class has a role in the network
 - A network may have multiple feature classes in the same role



Water junction fittings (Points)

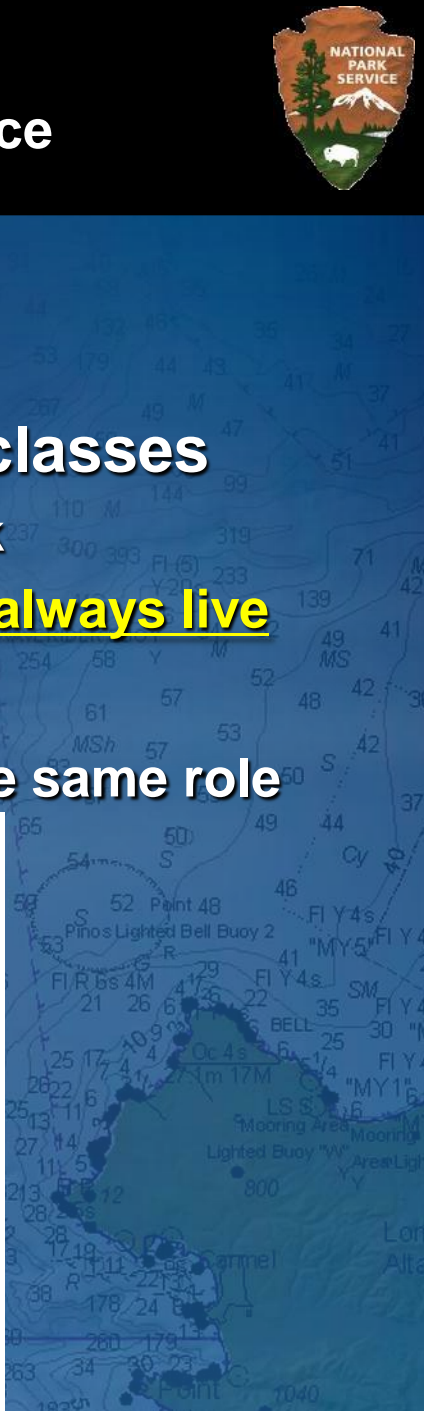
OID	Shape	Equip ID	Valve Type
1		816-32	T203
2		816-45	Y53

Water mains (Lines)

OID	Shape	Diameter	Material
10		8	Concrete
11		10	PVC
12		8	Concrete

Water services (Lines)

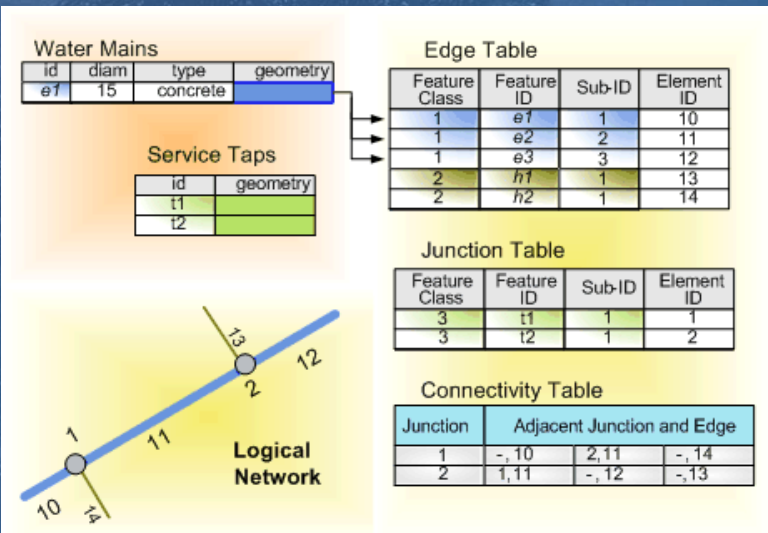
OID	Shape	Service ID	Material
13		1001	Cast iron
14		1002	Copper



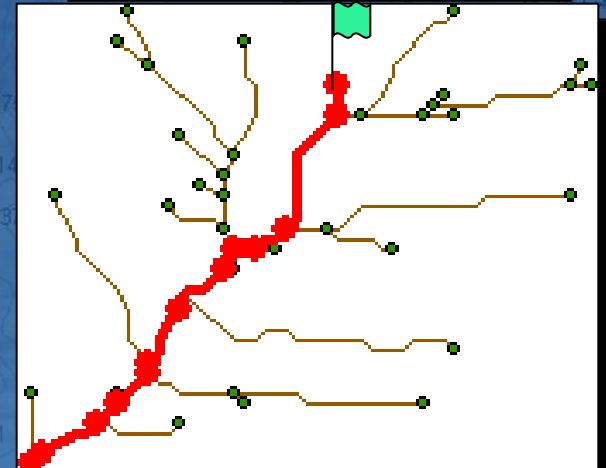


Geometric Networks

- A geometric network is associated with a logical network
 - Each network feature is associated with one or more elements in the logical network
- Trace solvers on the logical network provide
 - Connectivity tracing, cycle detection, flow directions
 - Upstream/downstream tracing, Isolation tracing



Downstream Trace





Network Datasets

- Network designed for the transportation industry
- Does not replace the Geometric Network
- Multimodal
- Edges, Junctions & Turns
- Attributes
 - On-the-fly calculation of costs
 - Improves analysis
 - Cost, restriction, descriptor

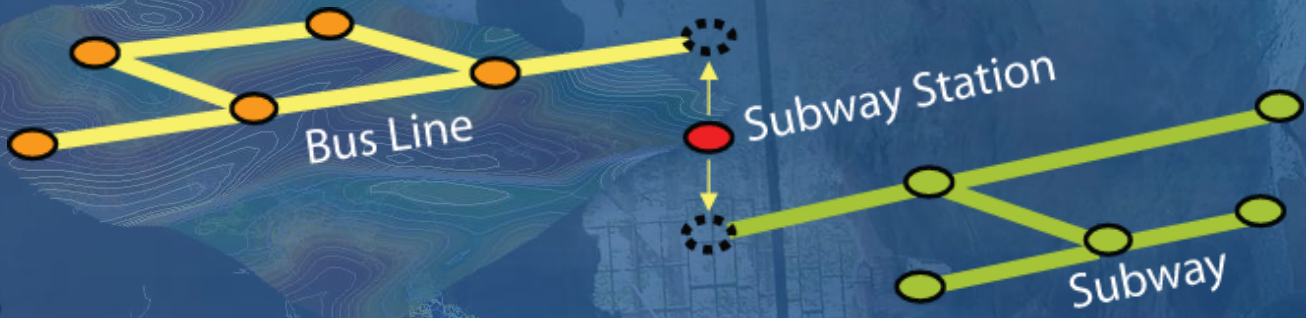




Network Dataset Functionality

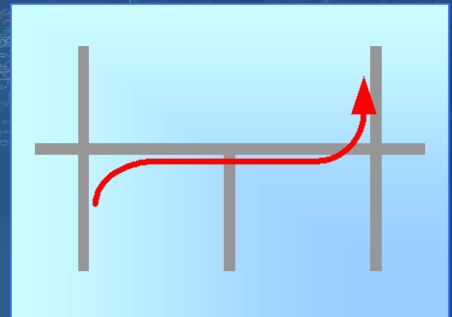
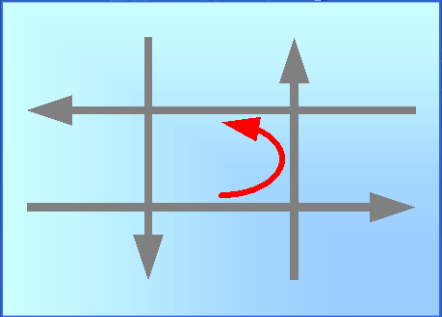
- **Multimodal**

- Points span multiple connectivity groups
- used to create connectivity between lines in different groups



- **Turns**

- Turns do not alter connectivity, but traversability (e.g. U-Turn restriction)





Geodatabase Topology

- **A topology manages a set of simple feature classes that share geometry**
- **Topology is used to**
 - **Integrate feature geometry**
 - **Validate features**
 - **Control editing tools**
 - **Define relationships between features**
 - **Ensure the quality of your data**



Topological Integrity

- **Topology defines integrity rules for associated feature classes**
 - Participating feature classes / subtypes
 - Cluster tolerance, ranks and rules
 - Cluster Tolerance for XY and Z
- **Rules are evaluated during Validation**
 - Define rules when creating the Topology
- **Violations of these rules are expressed as error features managed in the database as a part of the topology**
 - Error and Exceptions
 - Examine and Fix errors in ArcMap



Topology Error Examples

- Rules enforced to maintain topological integrity
 - 25+ topology rules in ArcGIS

Must not overlap

Polygons must not overlap within a feature class or subtype. Polygons can be disconnected or touch at a point or touch along an edge.



Polygon errors are created from areas where polygons overlap.

Must be properly inside polygons

Points in one feature class or subtype must be inside polygons of another feature class or subtype.



Point errors are created where the points are outside or touch the boundary of the polygons.

Must not have dangles

The end of a line must touch any part of one other line or any part of itself within a feature class or subtype.



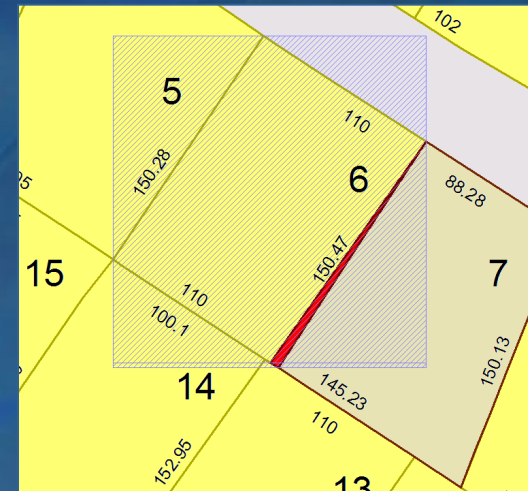
Point errors are created at the end of a line that does not touch at least one other line or itself.



Editing with a Topology

- Editing creates a **dirty area**
 - Area has been edited and may contain errors
 - Can be symbolized
- Errors are found during **validation**
 - Errors have properties
 - What rule was violated
 - Which feature(s) created the error
- Your options:
 - Ignore the error
 - Mark as exception
 - Fix the error

Parcels overlap





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- **Geodatabase Behavior Demo**
 - **Topology**
 - **Geometric Network**



Session Path

The Geodatabase

Inside the Geodatabase

Advanced Behavior

Editing Geodatabases

Transaction model

**Geodatabase editing
solutions**

Versioning

Geodatabase Potpourri



Editing Geodatabases

- **ArcGIS datasets stored in the geodatabase are editable**
 - Merge adjacent parcels in a topology
 - Add water mains to a network
 - Update land owners in a relationship class
 - Etc...
- **There is a rich transaction model for editing in ArcGIS**
 - Edits are performed in an edit session
 - Open session – edit – save edits / don't save edits
 - A series of edit operations constitutes a transaction
 - Unit of work performed against the database
 - The transaction is either committed or rolled back



Editing Geodatabases...

- **Personal Geodatabases**

- Single user, cubicle editing on small datasets
- Multiple readers
- Editing locks at geodatabase level
 - Two editors cannot edit within the same geodatabase at same time

- **File Geodatabase**

- Single user , Workgroup editing on small to very large datasets
- Multiple readers
- Editing locks at the feature level
 - Two editors cannot edit the same object/feature class at same time



Editing Geodatabases...

- **ArcSDE Geodatabases**
 - Extend the transaction model with Versions
 - Enterprise level editing
 - Multiuser editing without locking
 - Unique isolated view of the geodatabase
- **Benefits of versioned editing**
 - Long Transactions
 - Undo / Redo
 - Archiving
 - Replication / mobile GIS



Session Path

The Geodatabase

Inside the Geodatabase

Editing Geodatabases

Advanced Behavior

Geodatabase Potpourri

Terrains

**Cartographic
representations**

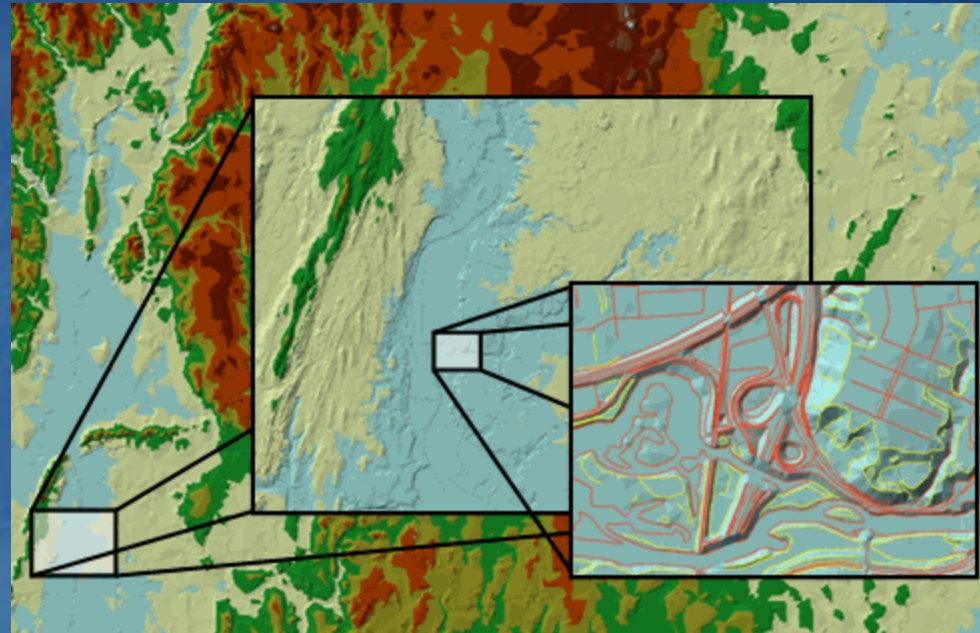
Cadastral

Demo



Terrains

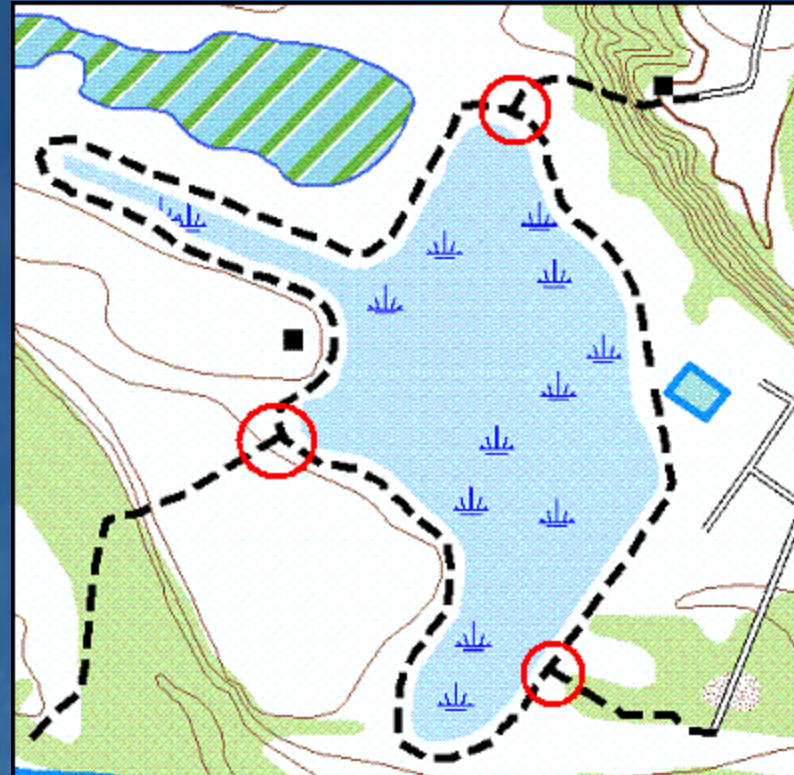
- **Massive point datasets in a multi-resolution, on-the-fly generated TIN**
 - Dataset for modeling 3D surfaces
 - Modeled within a feature dataset
 - User defined terrain (pyramid) levels
 - Different resolutions & vertical tolerances
- **Requires 3D Analyst**
 - Extension to define & edit
 - No license needed to view





Representations

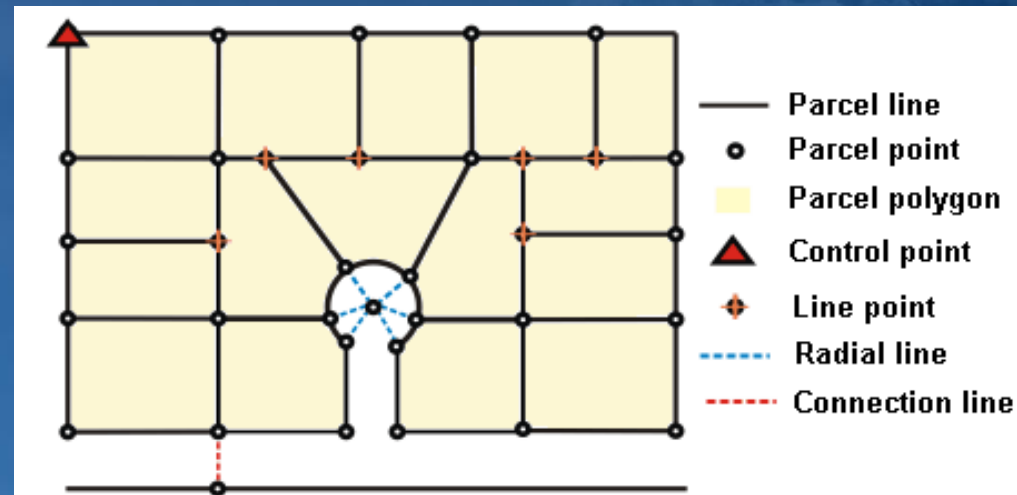
- Property of a feature class
 - Stores info about feature symbology
- One feature class - multiple representations
- Rules and overrides
- Representation Management Toolset





Cadastral Editor

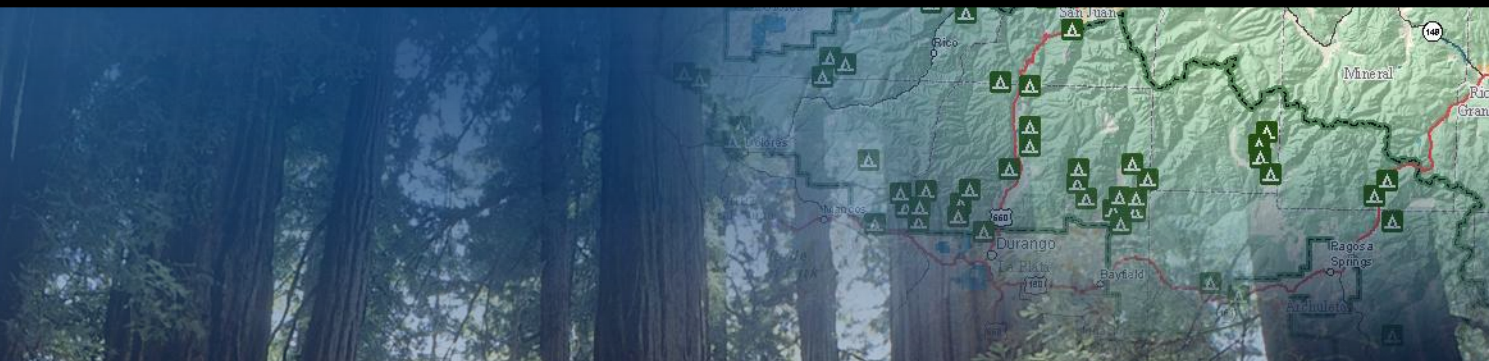
- Solution for parcel data management
 - Survey Analyst extension
- Uses COGO attributes and survey control to improve spatial accuracy
- Cadastral editing
 - Cadastral editor toolbar
 - Cadastral fabrics
 - Group layer with sublayers
 - Jobs



Cadastral fabric data model



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Geodatabase potpourri Demo



Summary

- **The Geodatabase**
 - Data model, Storage, Transaction model, COM components
- **Inside the Geodatabase**
 - Datasets, Validation rules, data behavior and integrity
- **Advanced Behavior**
 - Geometric Networks, Network Datasets, and Topology
- **Editing Geodatabases**
 - Transaction model, Editing solutions, Versions
- **Geodatabase Potpourri**
 - Terrains, Representations, Cadastral



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Geodatabases Essentials Part II

An Introduction to ArcSDE Geodatabases



Session Path

- **Introduction to ArcSDE Geodatabases**
 - What is the Geodatabase?
 - The Geodatabase Management Approach
 - Different types of Geodatabase
 - What is an ArcSDE Geodatabase and what are its benefits?
- **Versioning**
- **Editing**
- **Archiving**
- **Distributed Geodatabase**



Geodatabase Data Management Approach ...

- **Editing and data compilation**
 - Rich set of editing tools
 - Maintain spatial and attribute integrity
 - Undo and redo edits
 - Multiple users editing the same data
- **Versioning work flows**
 - Long transactions
 - Distributed data management
 - Archiving
- **Robust, customizable framework**
 - Build and manage your own specific GIS solution



3 Types of Geodatabases

- **Personal Geodatabase**

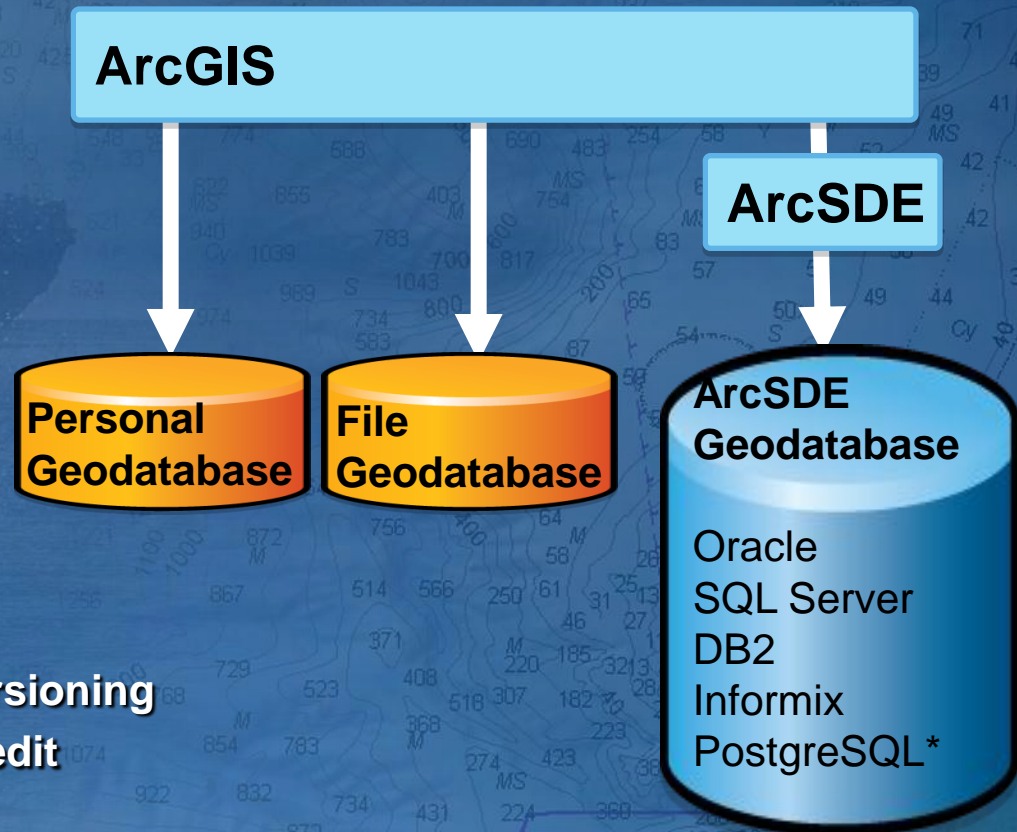
- Single user editing
- Stored in MS Access
- Size limit of 2 GB

- **File Geodatabase**

- 1 TB per table
- Reduced storage requirements

- **ArcSDE Geodatabase**

- Stored in an enterprise DBMS
- Supports multiuser editing via versioning
- Requires ArcEditor or ArcInfo to edit



* PostgreSQL support at 9.3

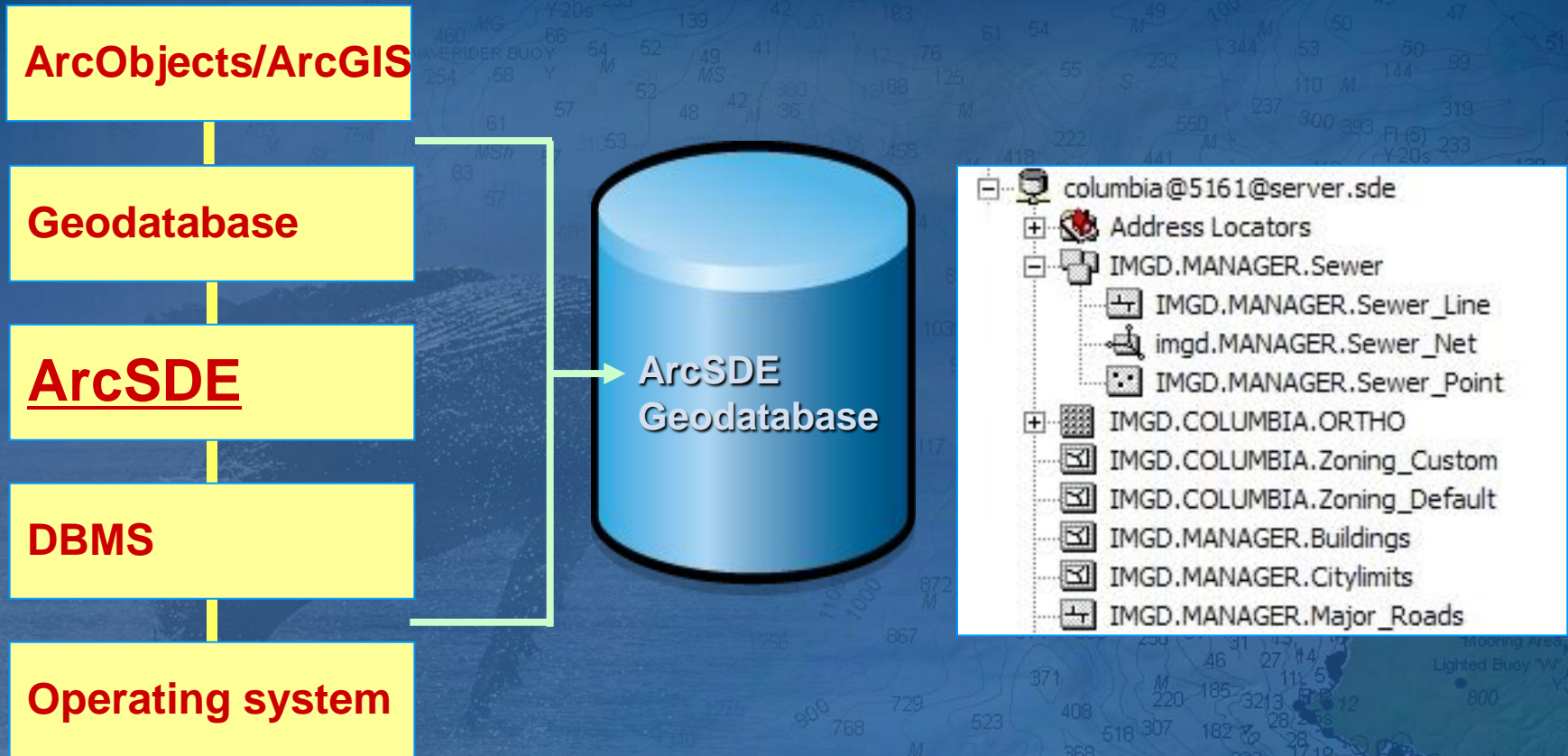


What is an ArcSDE Geodatabase?

- **ESRI's technology for accessing and managing geospatial data in relational databases**
- **ArcSDE Geodatabases are unique in their support of the following capabilities:**
 - **Open and interoperable across many supported DBMSs**
 - **Standards based, using as its native data structure the OGC binary simple features standard and the ISO spatial type (for Oracle, IBM DB2, IBM Informix, and PostgreSQL only).**
 - **Offers support for full, open SQL access to geodatabases stored in Oracle, IBM DB2, IBM Informix, and PostgreSQL.**
 - **Full support of the Oracle format for feature storage (using Oracle Spatial and Oracle Locator).**



How is ArcSDE technology included in ArcGIS?





When do you need an ArcSDE Geodatabase?

- Users need to edit and use their data simultaneously
- Need to manage long transactions and version-based workflows
- Leverage your existing relational databases
- Require high performance and the ability to scale to a large number of users.
- Require the ability to storage extremely large amounts of data



What are the benefits of using an ArcSDE Geodatabase?

- **Leverage the underlying DBMS architecture to support:**
 - Extremely large, continuous GIS databases
 - Many simultaneous users
 - Long transactions and versioned workflows
 - Distributed and archiving based workflows
 - Relational database support for GIS data management (providing the benefits of a relational database such as scalability, reliability, security, backup, and integrity)
 - Standards-based SQL Types for Spatial when the DBMS supports this capability



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Which ArcSDE Geodatabase edition?

	ArcSDE for ArcGIS Desktop	ArcSDE for ArcGIS Server Workgroup	ArcSDE for ArcGIS Server Enterprise
ArcGIS Product	ArcGIS and Desktop Engine*	ArcGIS Server Workgroup	ArcGIS Server Enterprise
Number of users	Max 3 users, 1 editor at any one time	Max 10 clients at one time No limit to the number of connections	Unlimited
Supported DBMS	SQL Server Express 2005	SQL Server Express 2005	Oracle, SQL Server, DB2, Informix, PostgreSQL
Database limits	Max database size 4 Gig 1 GB RAM on a single cpu	Max database size 4 Gig 1 GB RAM on a single cpu	No limits
Administration	ArcGIS Desktop (ArcCatalog)	ArcGIS Desktop (ArcCatalog)	ArcGIS Desktop (ArcCatalog), ArcSDE Commands, DBMS admin software,

Scale from small, personal systems up to workgroups and very large enterprises



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Which ArcSDE Geodatabase edition?

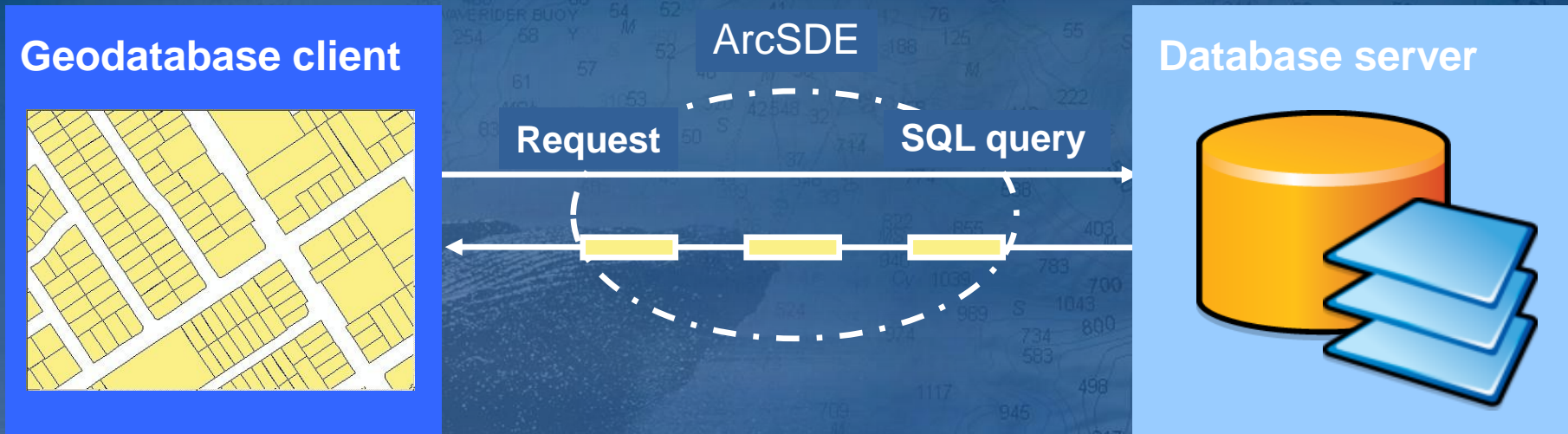
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ArcSDE and the Geodatabase

Client server model



- All data accessed over a network
- All data retrieved through SQL queries
 - ArcSDE technology translates
 - Spatial and attribute filters limit rows returned
- ArcSDE technology performs spatial filtering

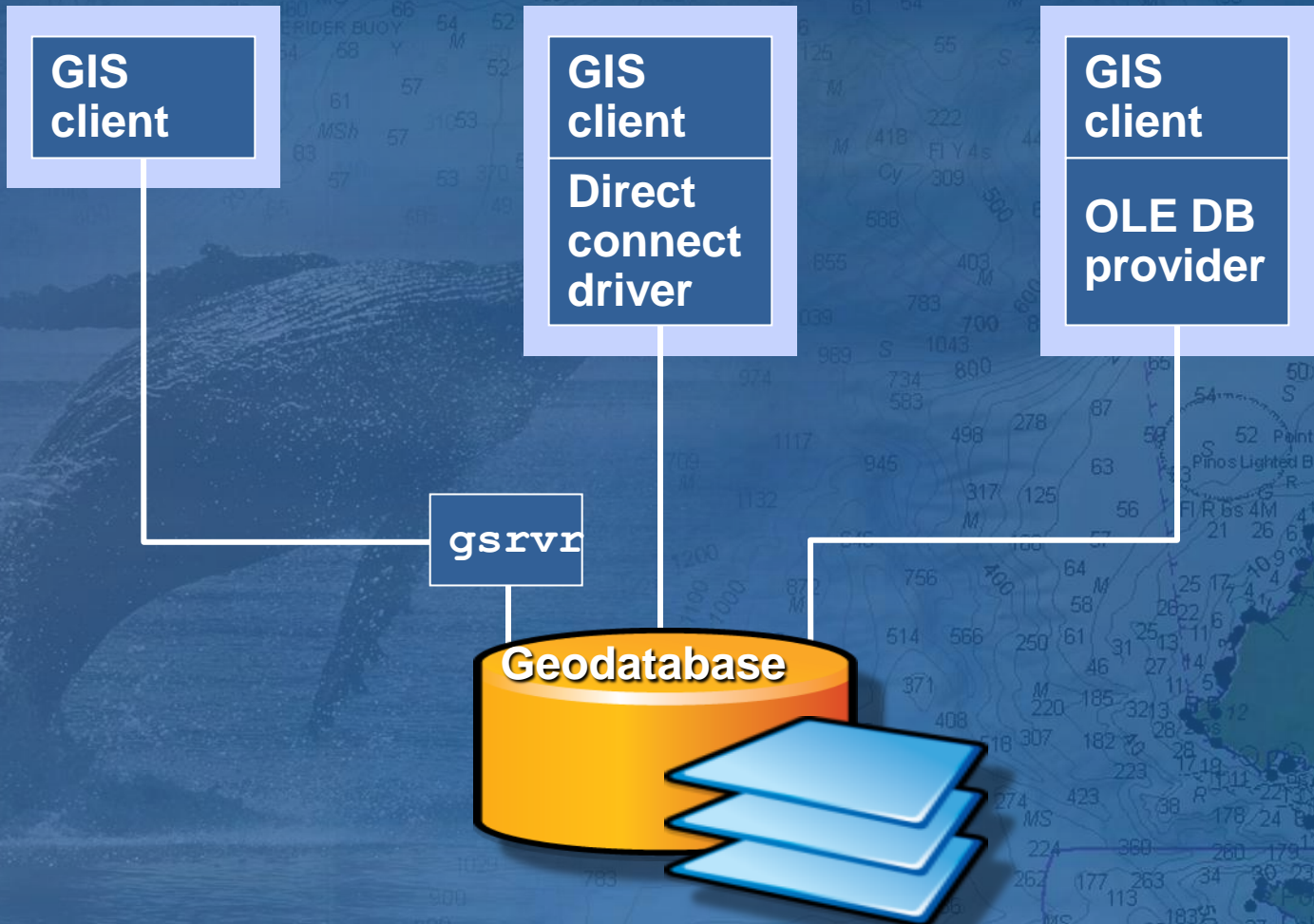


ArcSDE and the Geodatabase - Connection types

Application server

Direct

OLE DB





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Session Path

Introduction to ArcSDE Geodatabases

Versioning

- What is it?

- How is it used?

Editing

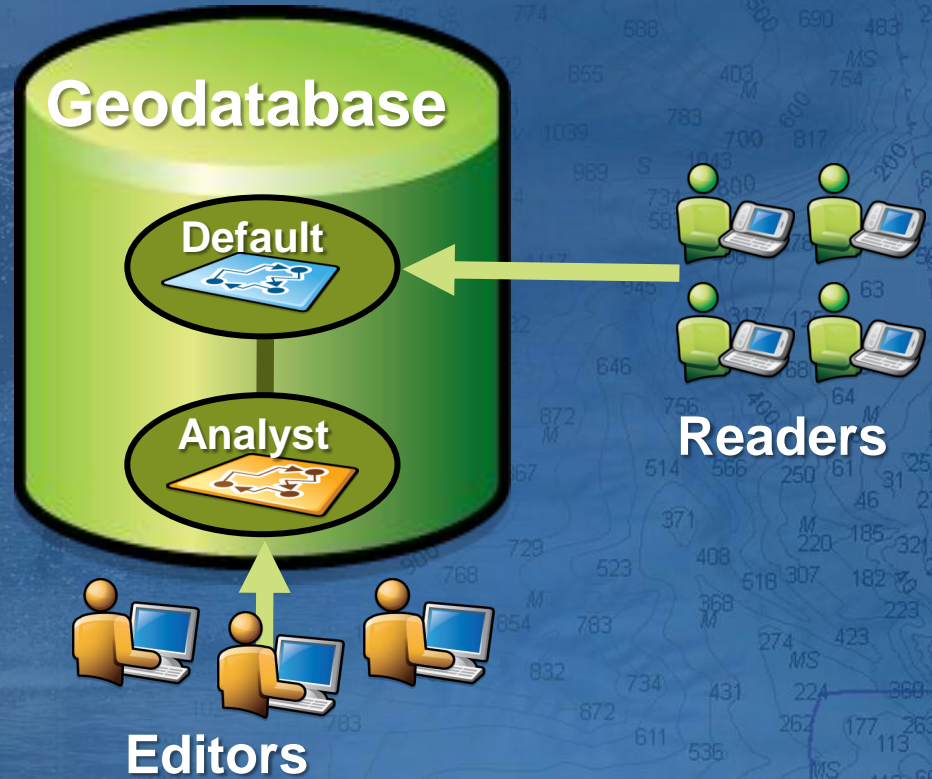
Archiving

Distributed Geodatabase



Versioning - What is it?

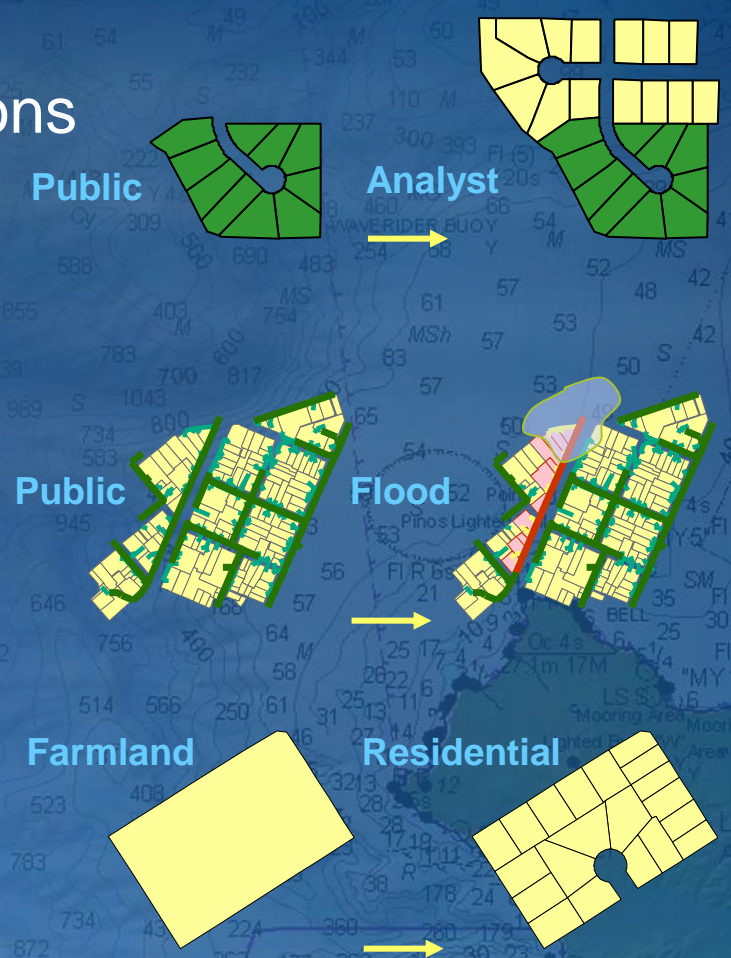
- Technology that allows multiple users to edit and view data at the same time
 - Appears to users as if they have their own copy of a table
 - without applying locks or duplicating data





Versioning Workflows – How is it used

- Editing with long transactions
 - Isolate work across multiple sessions
 - Edits do not impact others
 - Example: Parcel editing
- Model what-if scenarios
 - Simulate situations with versions
 - Example: Disaster event planning
- Workflow management
 - Create versions for project stages
 - Example: Land development





What is a Version?

- An alternate representation of the data in a geodatabase
- A connection to a geodatabase is made through a version
- You can not create a version of a feature class
 - Geodatabases are versioned

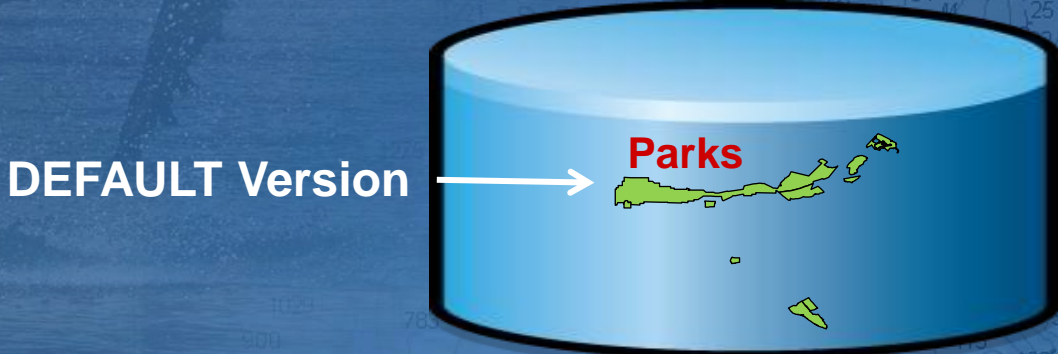


What is a Version?

- An **alternative view** of the geodatabase that has:
 - an owner
 - a description
 - a permission
 - a parent version

Name	Owner	Access	Last Modified
QA	GDB	Public	7/26/2008 1:48:32 PM
New Pipeline	BRENT	Public	6/16/2008 11:12:11 AM
Housing Dev 4...	BRENT	Private	6/16/2008 11:12:11 AM
WO-88966	BRENT	Private	6/16/2008 11:12:11 AM
WO-25346	BRENT	Private	6/16/2008 11:12:11 AM
DEFAULT	sde	Public	7/26/2008 1:48:17 PM

- Versions are not affected by changes occurring in other versions of the database





What is a Version?

- An **alternative view** of the geodatabase that has:
 - an owner
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WO-25346	BRENT	Private	6/16/2008 11:12:11 AM
DEFAULT	sde	Public	7/26/2008 1:48:17 PM

QA Version





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Session Path

Introduction to ArcSDE Geodatabases Versioning

Editing

- Versioned Editing
- Reconcile and Post
- Non-Versioned Editing
- Editing through SQL

Archiving

Distributed Geodatabase



Editing Databases

- Database editing relies on transactions
- Database transactions often conform to the **ACID** standards
- Transactions have “**ACID**” standards
 - **A**tomic — A transaction exhibits "all or nothing" behavior.
 - **C**onsistent — A transaction leaves the database in a consistent state.
 - **I**solation — Changes are isolated from other transactions is committed.
 - **D**urable — Once a transaction commits, its results are persistent.



Editing Geodatabases

- **Short Transactions**

- Small number of operations completed quickly
 - E.g. ATM transactions, Library records, Timecards
- ACID requirements through DBMS Locking mechanisms
- Concurrent transactions are isolated

- **Long Transactions**

- Large number of operations over a long time period
 - E.g. Parcel updates, General geographic editing
- Geodatabases extend the transaction model with Versioning
- Multiuser editing without locking or data duplication
- Editors work with unique isolated view of the geodatabase

- **GIS editors need both long and short transactions**



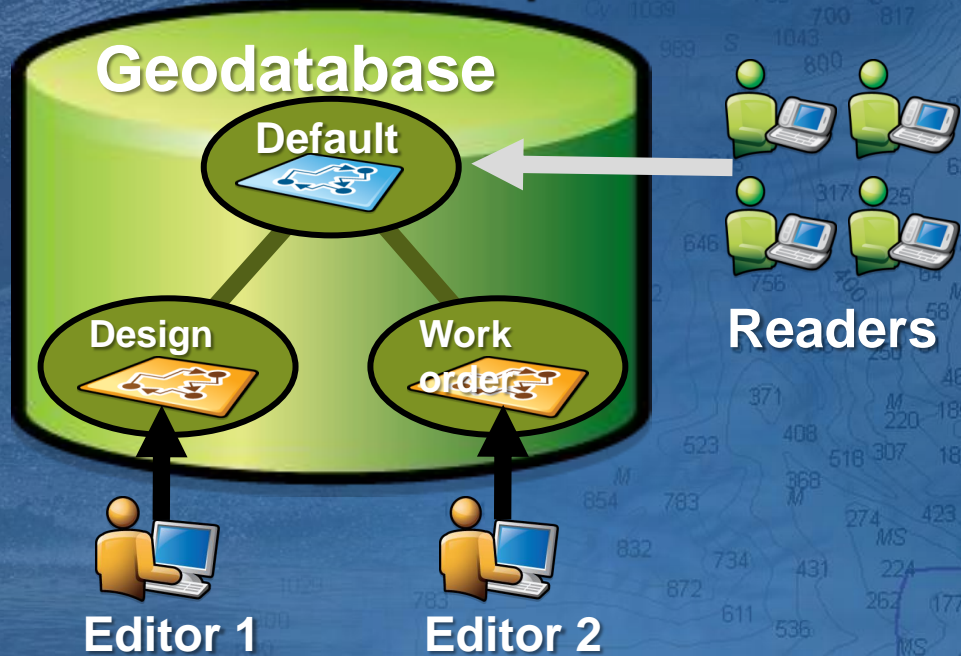
Three different ways of editing Geodatabases

- **Versioned Editing (Long Transactions)**
 - Editing in a version through ArcGIS
- **Non-Versioned Editing (Short Transactions)**
 - Editing the data directly through ArcGIS
- **Editing through SQL (Short Transactions)**
 - Editing the data directly through SQL



Versioned Editing

- **Versioned Edit Sessions**
 - Editing done through a version
 - Changes tracked on delta tables
 - Support concurrent editing with long transactions (hours/days).
 - Undo/redo editing experience.
 - No locking or data extraction required.





Versioned Editing – How It Works

- Class must be registered as Versioned
 - Creates Adds and Deletes tables for tracking edits

Registering data as versioned
This creates the delta tables

1	2	
3	4	5

ObjectID	Perimeter	Bldg_Code
1	10105.15	02
2	10105.15	02
3	11348.31	02
4	10827.18	02
5	11348.31	02

ObjectID	Perimeter	Bldg_Code	SDE_State_ID

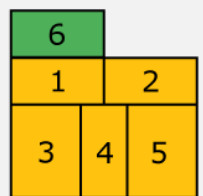
Deleted_At	Deletes_Row_ID	SDE_State_ID



Versioned Editing – How It Works

- Adding Features
 - Record added to the Adds Table
 - Version will be referenced (**SDE_State_ID Field**)

Adding a Feature
Inserts a row in the Adds table



Base Table

ObjectID	Perimeter	Bldg_Code
1	10105.15	02
2	10105.15	02
3	11348.31	02
4	10827.18	02
5	11348.31	02

Adds Table

ObjectID	Perimeter	Bldg_Code	SDE_State_ID
6	10105.15	02	27505

Deletes Table

Deleted_At	Deletes_Row_ID	SDE_State_ID



Versioned Editing – How It Works

- **Deleting Features**
 - Record added to Deletes Table
 - Version will be referenced (**Deleted_At** field)

Deleting a Feature
Inserts a row in the Deletes table

Base Table

ObjectID	Perimeter	Bldg_Code
1	10105.15	02
2	10105.15	02
3	11348.31	02
4	10827.18	02
5	11348.31	02

Adds Table

ObjectID	Perimeter	Bldg_Code	SDE_State_ID
6	10105.15	02	27505

Deletes Table

Deleted_At	Deletes_Row_ID	SDE_State_ID
27506	5	0



Versioned Editing – How It Works

- **Updating Features**
 - Record added to both Adds and Deletes table
 - Version will be referenced (**SDE_State_ID Field**)

Updating a Feature
Inserts a row in both the Adds and Deletes tables

Base Table		
ObjectID	Perimeter	Bldg_Code
1	10105.15	02
2	10105.15	02
3	11348.31	02
4	10827.18	02
5	11348.31	02

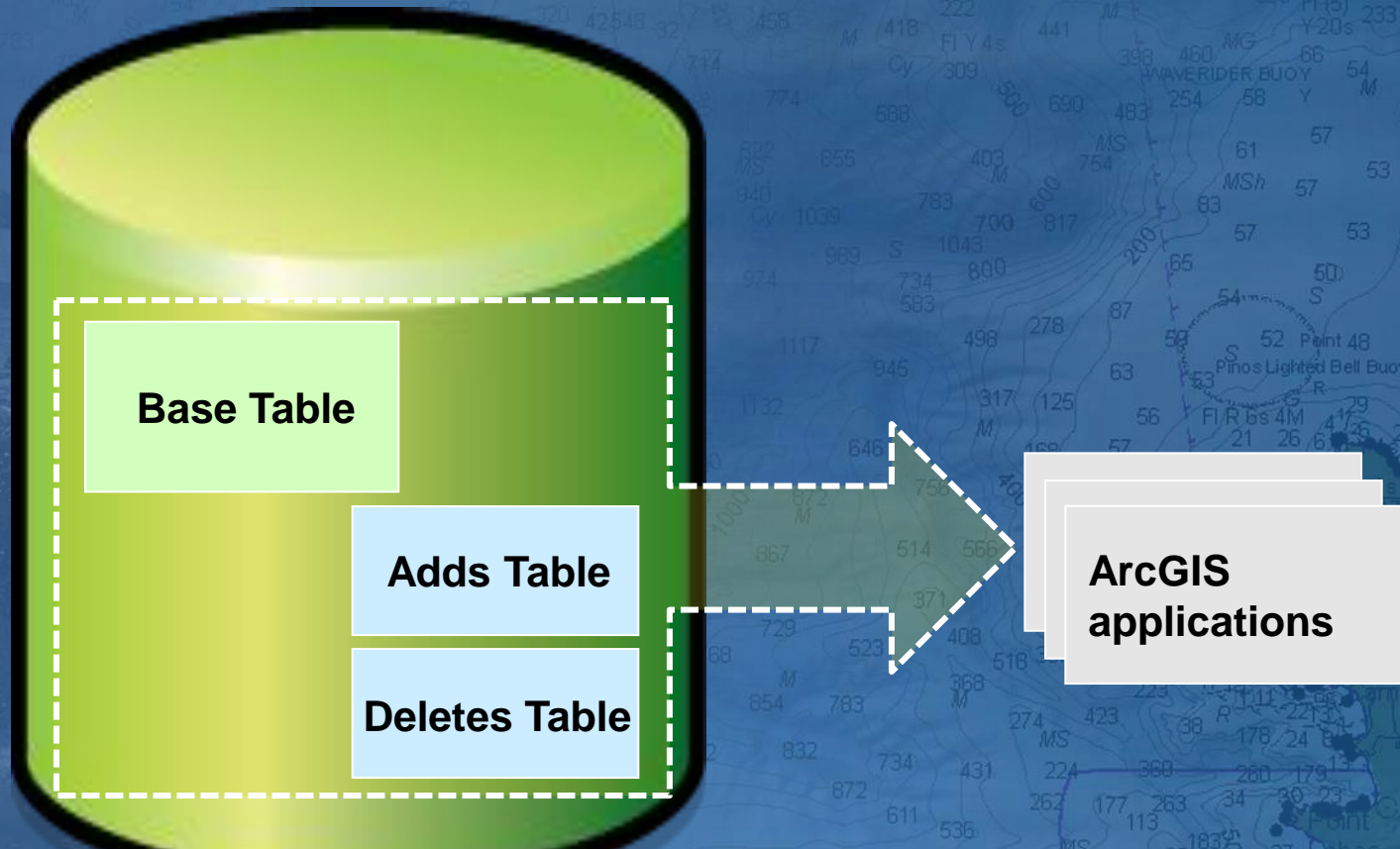
Adds Table			
ObjectID	Perimeter	Bldg_Code	SDE_State_ID
6	10105.15	02	27505
2	20210.30	02	27507

Deletes Table		
Deleted_At	Deletes_Row_ID	SDE_State_ID
27506	5	0
27507	2	0



Versioned Editing – How It Works

- Versioned representation of a feature class
 - combination of records in:
 - Base Table, Adds Table & Deletes Table





Version Changes Viewer

New at 9.3

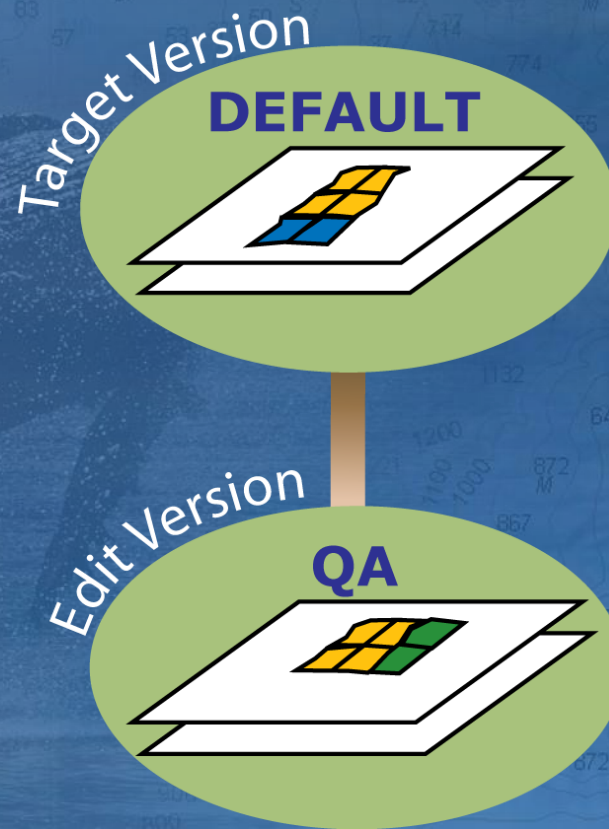
- Ability to see what has changed in a version
 - View changes without having to do a reconcile
 - Displays all changes in version with respect to ancestor version

Property	DBO.Child Version	DBO.Parent Version	Common Ancestor
OBJECTID	24244	24244	24244
Riverside_History.DB...	2560,18324999	2560,18324999	2560,18324999
PERIMETER	244,11286732	244,11286732	244,11286732
BLD_DISS_	24245	24245	24245
BLD_DISS_I	24245	24245	24245
BLPYTYPE	1	1	1
PHASE	<Null>	<Null>	<Null>
Shape			
SHAPE.area	1432.46655332111	2768.48396778275	2206.77413273815
SHAPE.len	157.178987990984	253.504502742158	210.847143953756



Versioned Editing – Reconcile and Post

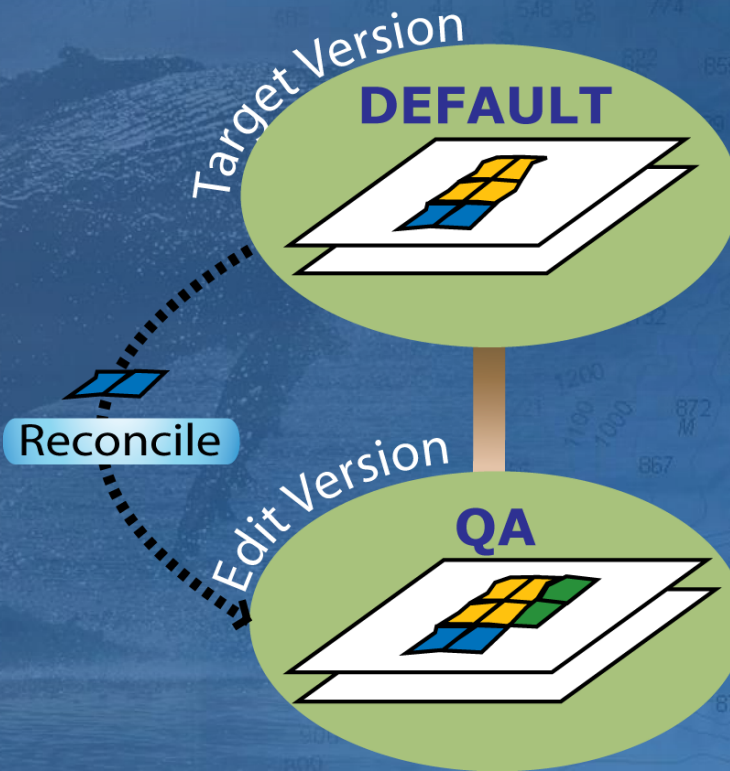
- How can versions be merged?
- Through a process called reconcile and post





Versioned Editing – Reconcile

- Reconcile pulls any changes from the target version into the edit version
- Any conflicts will be detected





Reconcile and Conflicts

- Versioning does not lock data when it is edited
 - Because of this we must make sure data is not overwritten
 - We do this through conflict detection during a reconcile
- A feature will be in conflict any time it has changed on both versions
- Conflict Resolution Dialog

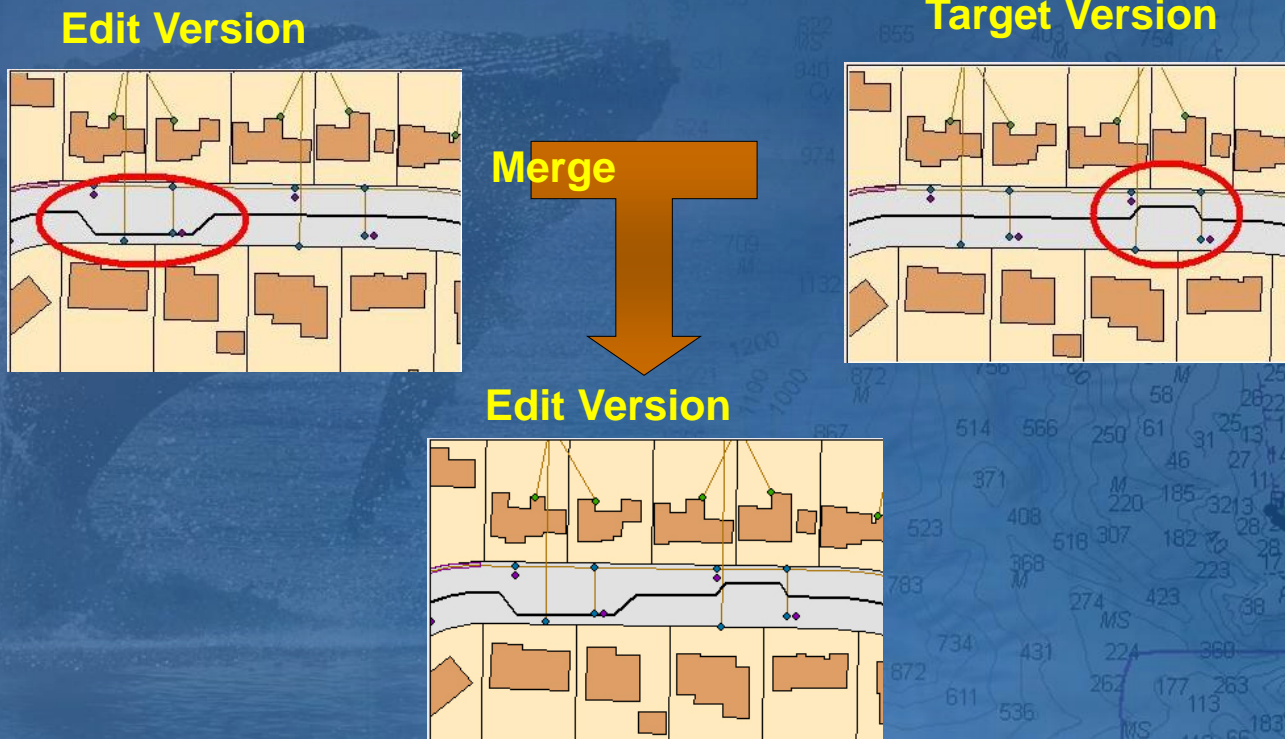
Property	Current	Pre-Reconcile	Conflict	Common Anc...
OBJECTID	24267	24267	24267	24267
Riverside_...	2881.37084996	2881.37084996	2881.37084996	2881.37084996
PERIMETER	270.28373985	270.28373985	270.28373985	270.28373985
BLD_DISS_	24268	24268	24268	24268
BLD_DISS_I	24268	24268	24268	24268
• BLPVTTYPE	1	2	1	1
PHASE	<Null>	<Null>	<Null>	<Null>
• Shape				
• SHAPE.area	2370.35933...	2881.37002...	2370.35933...	2881.37002...
• SHAPE.len	213.728725...	270.284107...	213.728725...	270.284107...



Reconcile and Conflicts

New at 9.3

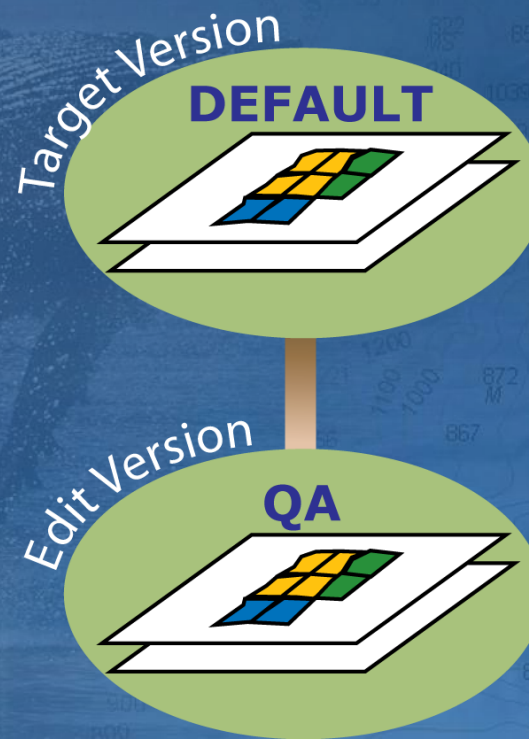
- Merge Geometry option for conflict management
 - Improves the conflict management experience for:
 - large polygon and polyline features





Versioned Editing – Post

- Posting versions merges any changes in the edit version into the target version
 - After a post versions are identical





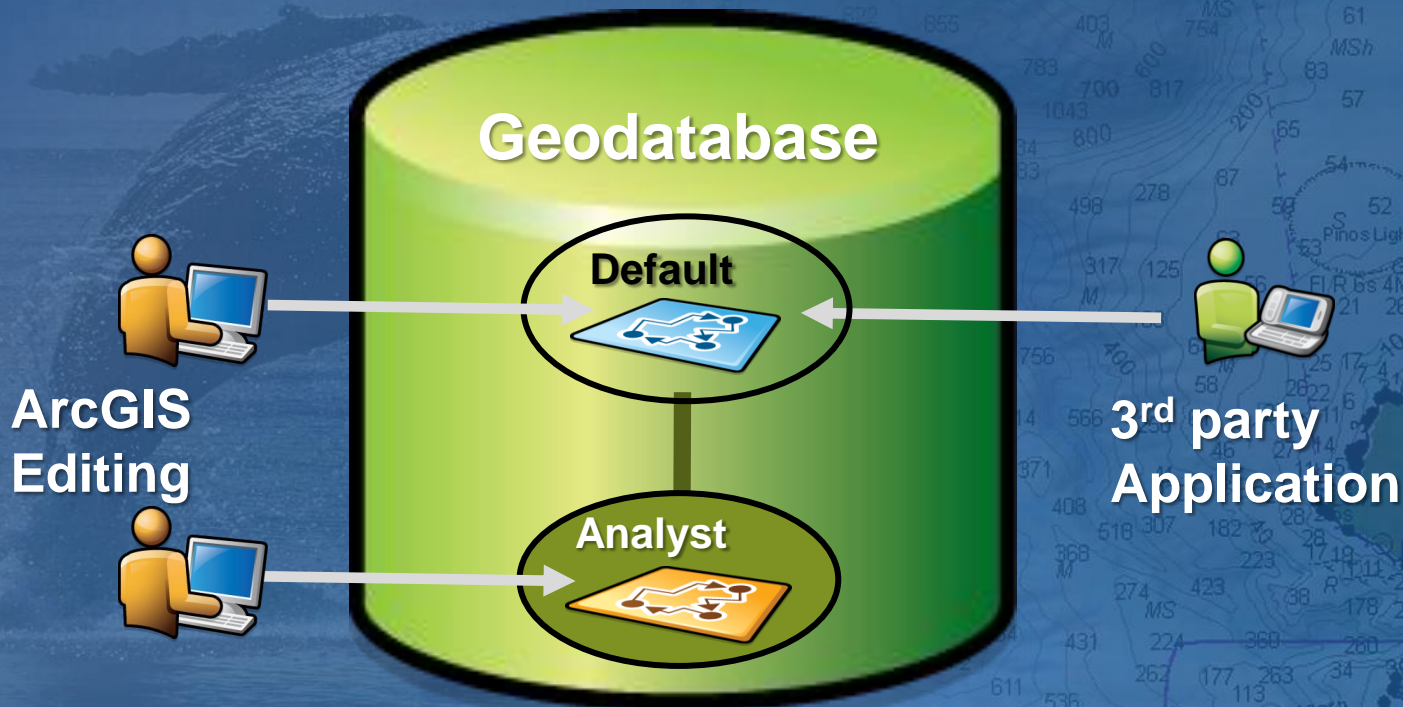
Versioned Editing - Move to Base Option

- **What is it?**
 - Versioned editing with the ability to move changes made in the Default version into the base tables
 - Changes made in non-Default versions are still stored in the delta tables
- **Designed for IT integration**
 - Edits visible to 3rd part applications as soon as they are saved
- **Simple data only**
 - Points, lines, polygons, annotation, relationship classes
 - No Topology, Geometric Networks...etc



Versioned Editing - Move to Base

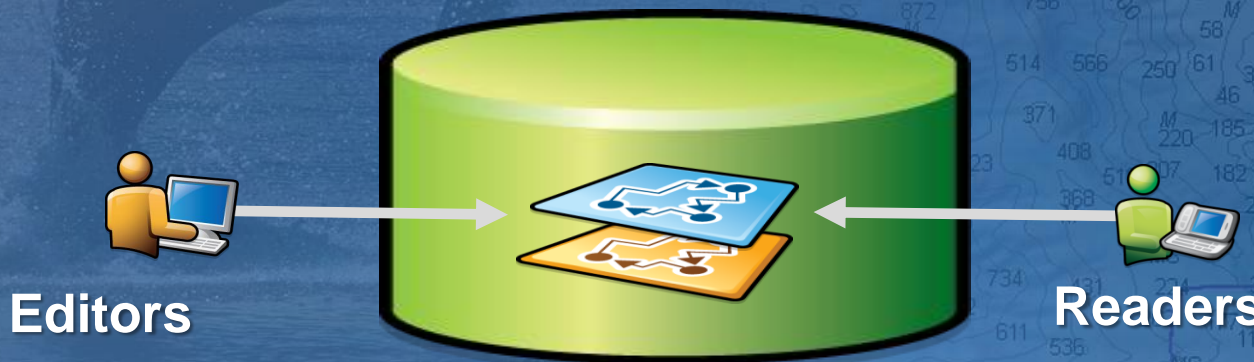
- Why would I use the move to base option?
 - Want version editing experience but...
 - Need to integrate with 3rd party applications
 - Use of database constraints when editing DEFAULT version





Non-Versioned Editing

- **Directly editing the database tables**
 - Not editing in a version
 - Uses a database transaction (short transaction)
 - Edits immediately available upon save
 - Designed for IT integration
 - Suggested for Non-ESRI client interaction
 - Database integrity rules
 - Simple data only
 - Points, lines, polygons, annotation, relationship classes
 - No Topology, Geometric Networks...etc





SQL Editing

- **SQL can be used to update data directly**
- **Geometry editing possible through spatial types**
- **What is a spatial type?**
 - A database data type that stores spatial data
- **Why are they useful?**
 - ESRI Client not necessary to edit data
 - SQL access to geometries
- **Databases with spatial types**
 - Oracle, SQL Server, Informix, DB2, PostgreSQL



Geodatabase Editing Summary

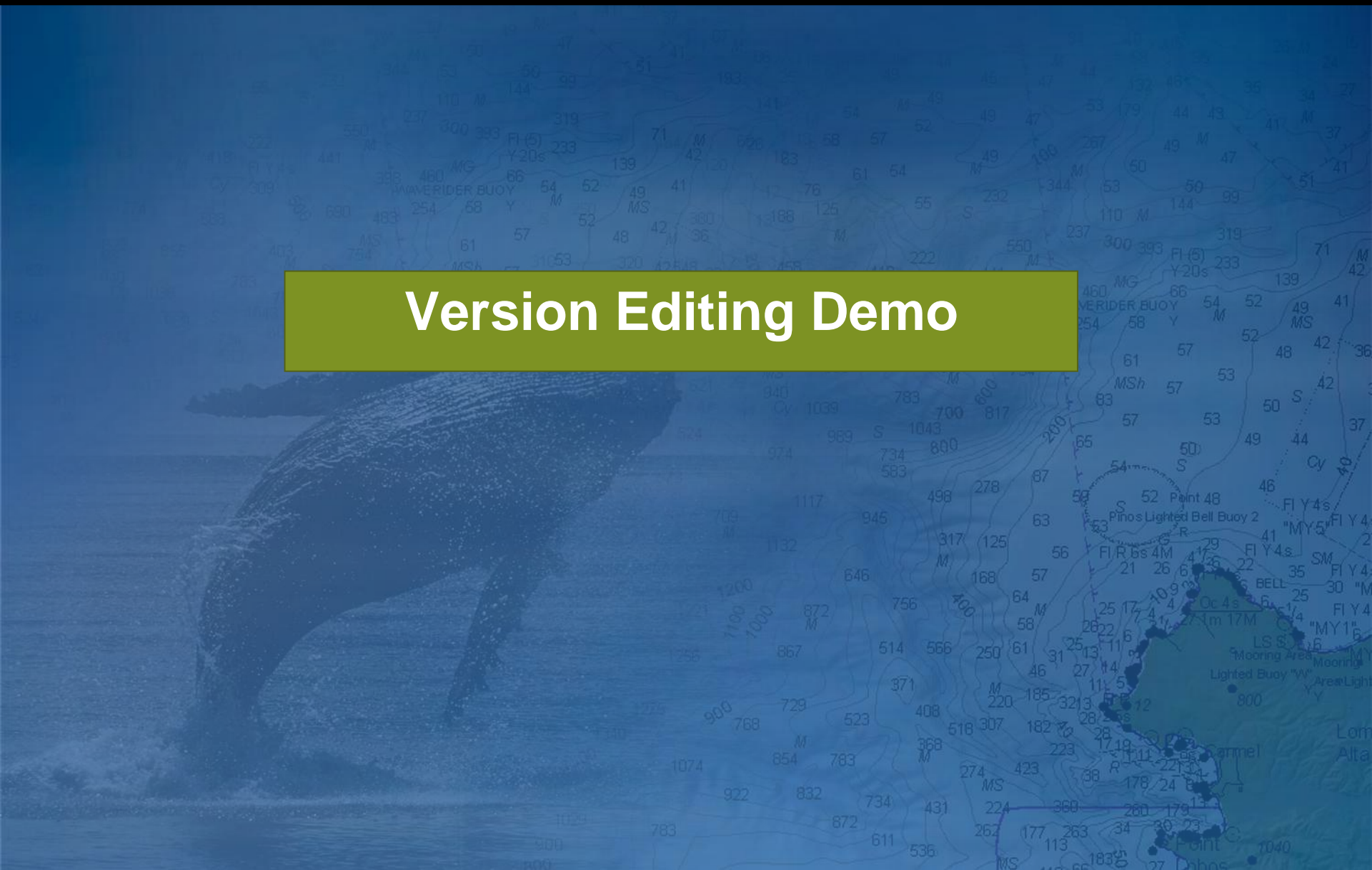
- **Three ways to edit data**
 - **Versioned Editing (Long Transactions)**
 - **Non-Versioned Editing (Short Transactions)**
 - **Editing through SQL (Short Transactions)**
- **Which one do I use?**
 - **Depends on behavior desired**
 - **Short vs Long Transactions**
 - **Is data being accessed by non-ESRI applications?**
 - **Are many editors editing the same data?**



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Version Editing Demo





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Session Path

Introduction to ArcSDE Geodatabases

Versioning

Editing

Archiving

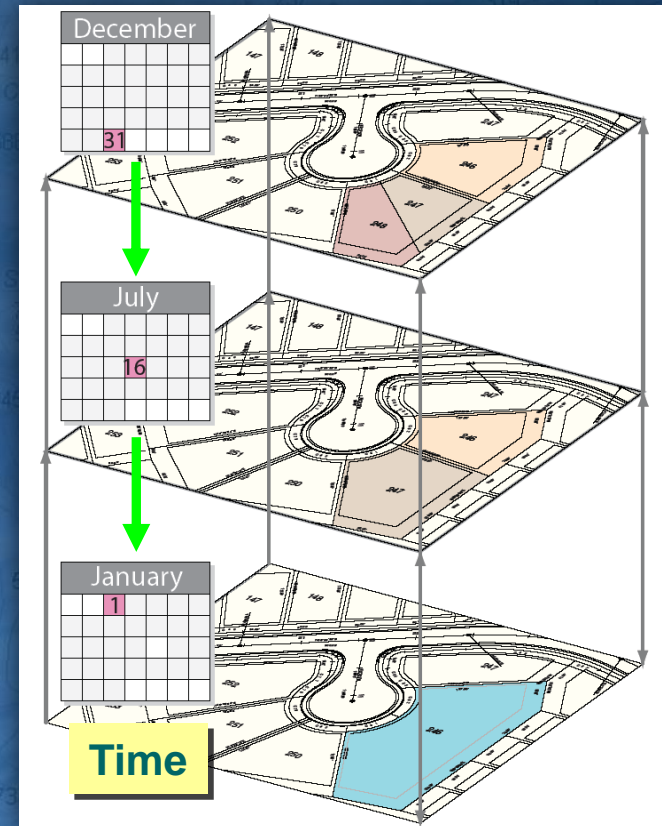
- What is it?
- How is it used?

Distributed Geodatabase



Geodatabase Archiving: What is it?

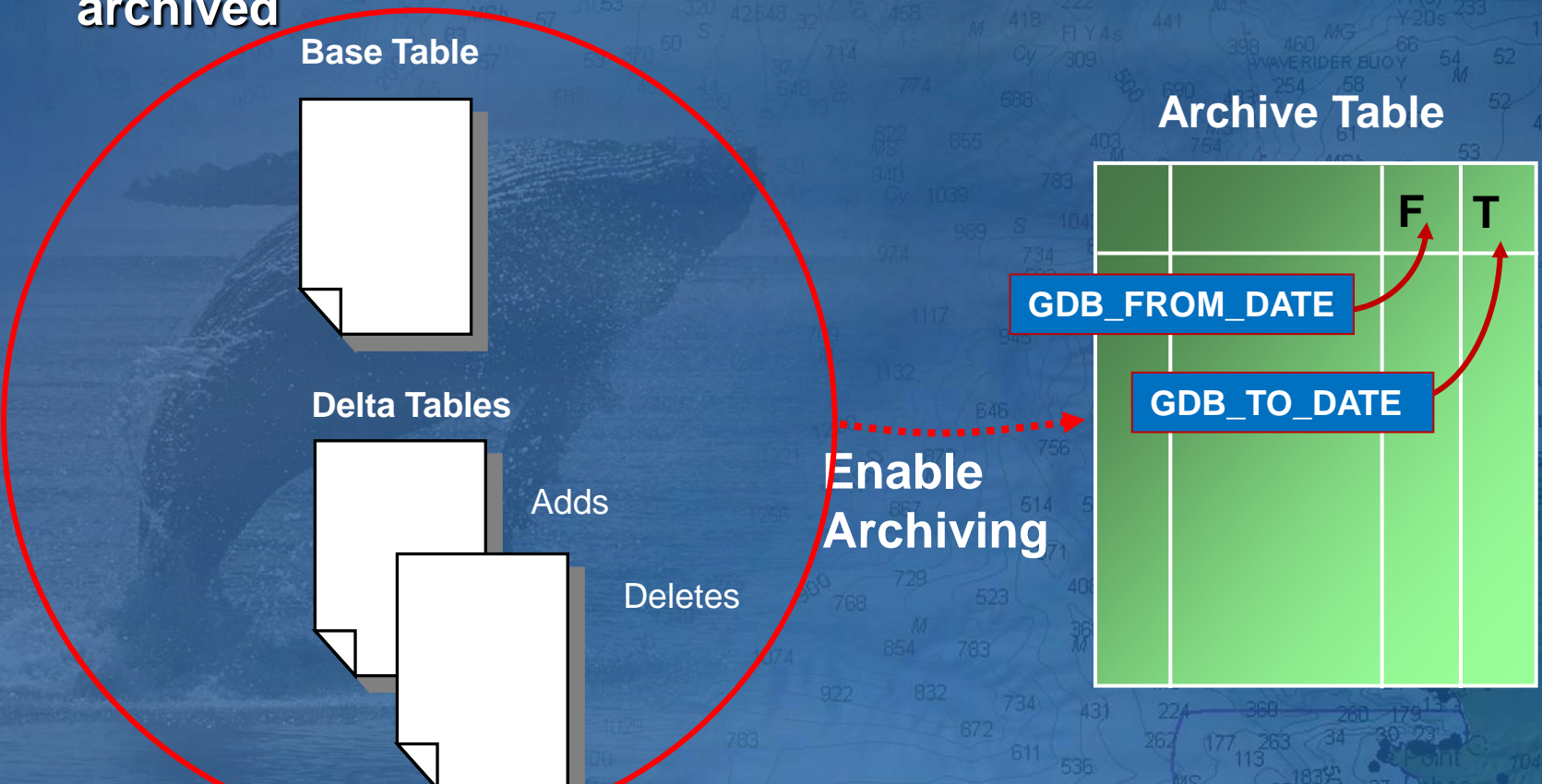
- **Historical archiving of all edits made to the Default version**
 - Maintain a record of a feature classes representation over time
- **Ability to query historical representations of a feature**
 - Archives can be queried based on date information
- **Extends versioning**
 - Classes must be versioned before they can be archive enabled





Geodatabase Archiving: How it works

- Class must be enabled for archiving
 - This creates an archive table in the geodatabase
 - Size of archive table depends on size of class being archived

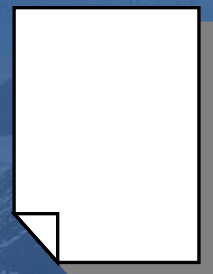




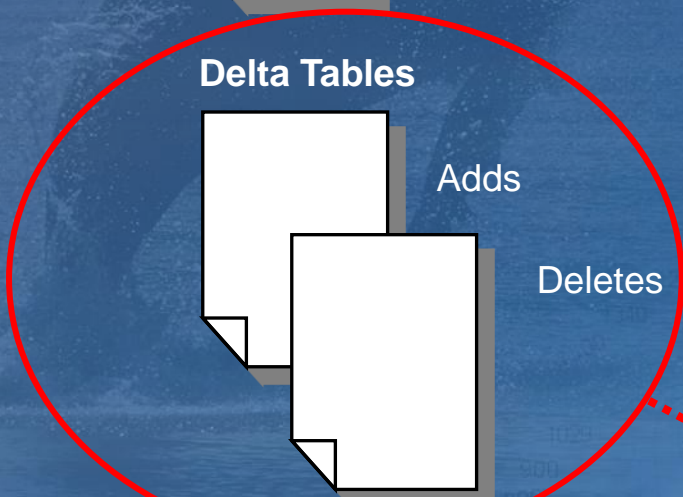
Geodatabase Archiving: How it works

- When edits are made on the Default version
 - These changes are added to the archive table

Base Table



Delta Tables



Archive Table

		F	T



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Geodatabase Archiving: How it works

- Archive table is used to satisfy historical queries
- Can navigate through history in two ways
 - Through specific date query
 - Through historical marker

Historical Marker Manager

Historical Markers

Name	Timestamp
Phase 0 - Orange Grove	1/15/2000 4:00:00 PM
Phase 1 - Sold for Development	2/16/2000 10:41:31 AM
Phase 2 - Lot Subdivided	3/16/2000 10:41:52 AM
Phase 3 - Underground Primary - Phase I	4/16/2000 11:18:21 AM
Phase 4 - Housing - Phase I	5/16/2000 11:19:01 AM
Phase 5 - Underground Primary - Phase II	6/16/2000 1:04:06 PM
Phase 6 - Housing - Phase II	7/16/2000 1:04:42 PM
Phase 7 - Housing - Phase III	8/16/2000 1:18:54 PM
Phase 8 - Development Completed	9/16/2000 1:19:32 PM

New... Edit... Remove Done

Historical Date and Time

Change using a historical marker

DEFAULT

Change using a specific date and time

Tuesday, July 22, 2008 6:13:05 PM

Auto Apply

July, 2008

Sun	Mon	Tue	Wed	Thu	Fri	Sat
29	30	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	1	2
3	4	5	6	7	8	9

Today: 7/22/2008



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Archiving Demo
Archiving in a nutshell





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Session Path

Introduction to ArcSDE Geodatabases

Versioning

Editing

Archiving

Distributed Geodatabase

- **Data Distribution and Geodatabase Replication**



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Geodatabase Replication

- **Allows you to distribute copies of data across 2 or more geodatabases**
- **You can edit the databases independently and synchronize them as needed.**
- **Released at 9.2 - Builds upon disconnected editing from earlier releases (8.3)**



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Replication – Use Cases

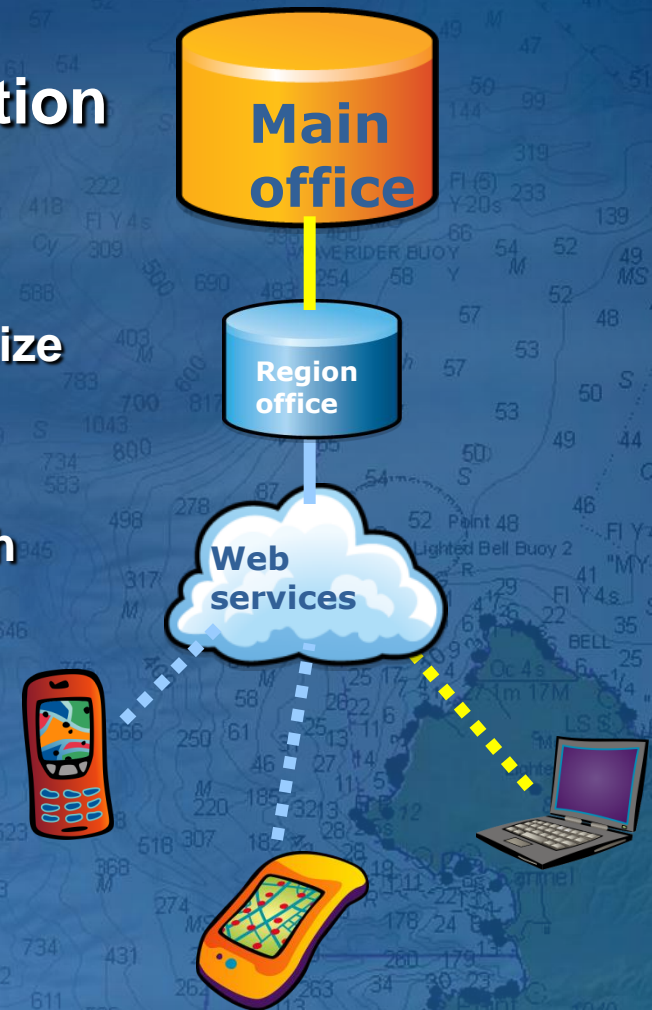
- **Mobile Users and Field Crews who need to be disconnected from the network.**
- **Users who need to maintain copies of data at different organizational levels (city, county, state)**
- **Users who want to maintain copies of data at different geographic facilities.**
- **Users who need to distribute work to contractors.**
- **Production and publication geodatabases**



Data distribution in Enterprise systems

- Geodata services can be used in conjunction with other data distribution techniques

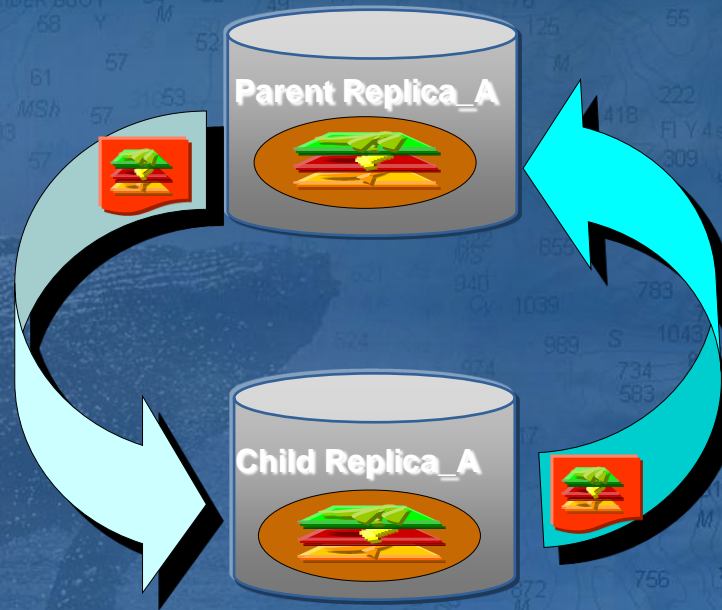
- Use geodatabase replication to synchronize changes between offices
- Use Mobile services for field workers with lightweight mobile devices
- Use geodata services for field workers who need ArcGIS Desktop or ArcGIS Engine in the field





Geodatabase Replication - Concepts

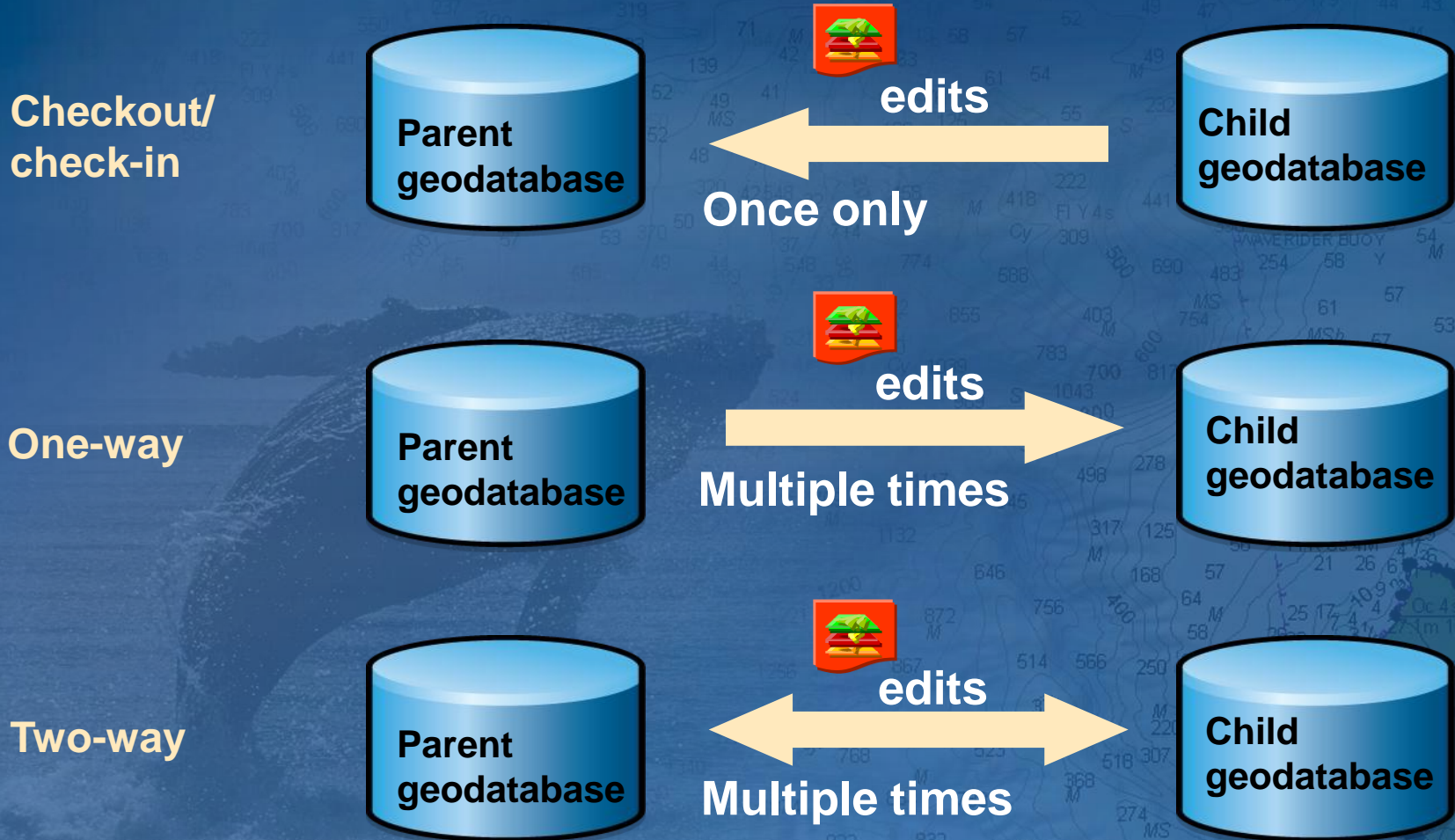
- A Child Replica is created from a Parent Replica.



- You can replicate :
 - A specific version.
 - Specific datasets.
 - A subset of features in the chosen datasets



Geodata Services: replica types





Replication - Concepts

- Works in a connected and a disconnected environment
- Replicas can be Synchronized in either both directions or just a single direction
- Synchronization is based on exchanging messages and is fault tolerant
- You can Create and Synchronize Replicas using Wizards and GP Tools
- Supports applying schema changes across replicas
 - Subset of schema changes are supported
- Developers have a high level object model and API



Geodatabase Replication - LAN and WAN

- **LAN - Use connections to your local geodatabases**
- **WAN - Use ArcGIS Server and geodata web services to access remote geodatabases**
- **All geodatabase replication workflows are supported in both environments**



9.3 Geodatabase Replication

- Enhanced one way replication to support replicating to file geodatabases and personal geodatabases
- Added logging to improve trouble shooting
- User defined global ID's (API)
- Make it easier to generate updategrams (API)



Geodatabase Replication – Getting Started

- Anticipate future needs when defining the data to replicate
- Have a well defined data model before creating replicas
- Choose the right replica type
 - Consider 2 way replicas with ArcSDE for Microsoft SQL Server Express instead of check-out replicas
 - Use 1 way replicas over 2 way replicas when possible



Geodatabase Replication – Getting Started

- **Use models or scripts for replicas you plan to create on a regular basis**
 - You can use the create replica and create replica from server geoprocessing tools to build models
- **Consider using the following replica creation options**
 - Re-use schema (check-out replicas) – uses existing schema
 - Register only – replicates pre-copied data
 - Relationship classes processing is optional
- **Schedule Synchronizations**
 - You can use geoprocessing models exported to python and the windows scheduler
 - Consider synchronization order



Geodatabase Replication – Getting Started

- **Integrate synchronization with version management strategy**
 - Synchronize before running reconcile and compress services
 - Reconcile service should cover replicas with a manual reconcile policy
- **Network speed**
 - Use geodatabases directly over fast networks (LAN)
 - Use ArcGIS server and geodata services on slower networks (WAN
 - i.e. DSL)
 - Use disconnected synchronization techniques over very slow networks (slow dial-up modem) or where there is no network connectivity



DBMS Replication with Geodatabases

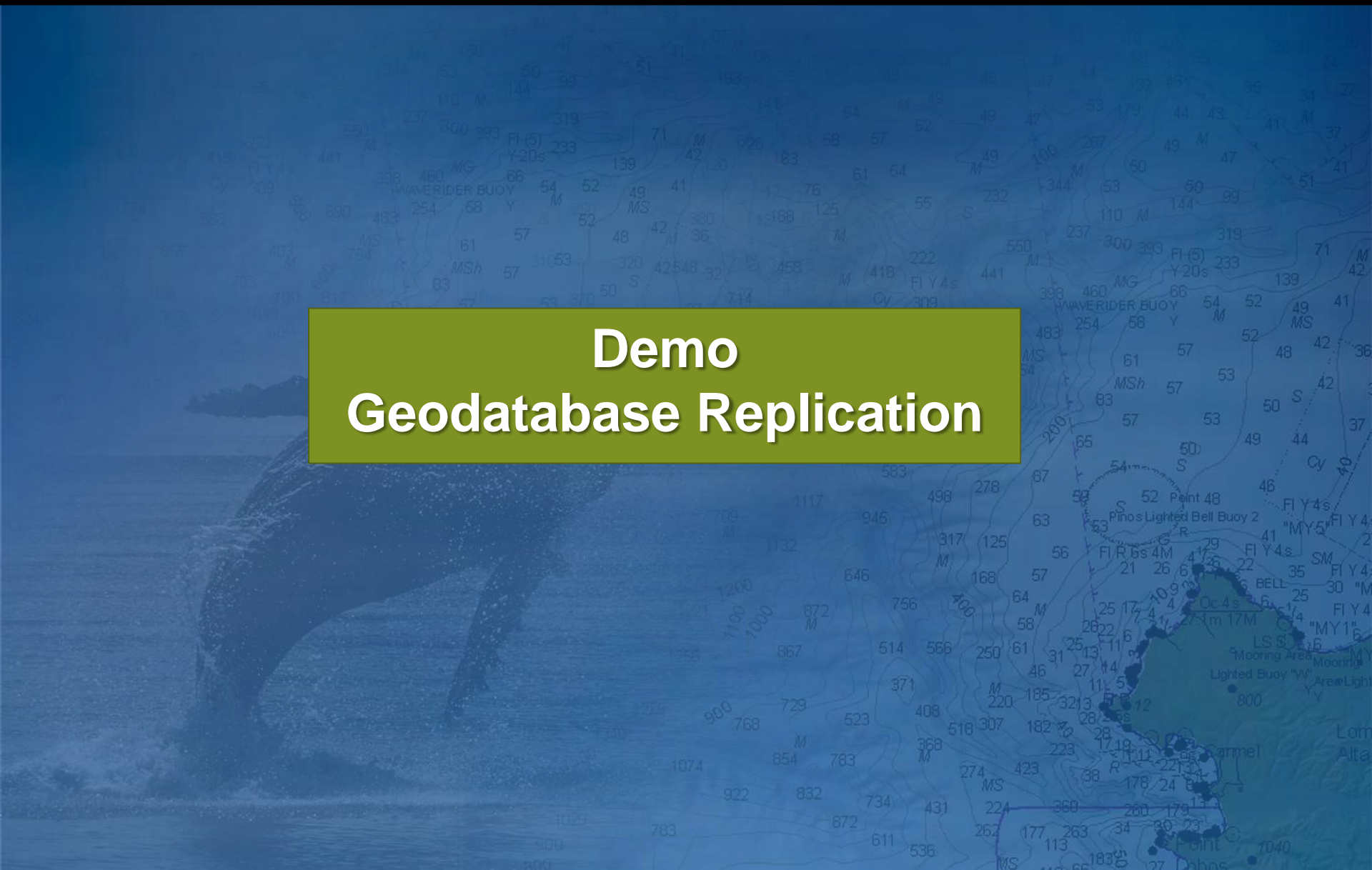
- Geodatabase replication does not use DBMS replication
- DBMS Replication - Requirements and limitations
 - Requires knowledge of how the geodatabase/ArcSDE system tables work
 - No tools provided in ArcGIS to support it
 - Limited support for cross DBMS replication
 - Does not support or has limited support for complex geodatabase data types and limited filters to define the data to replicate
- DBMS Replication - Advantages
 - Can work with non-versioned data
 - Can replicate entire database
 - Can be configured to provide synchronous replication
 - Ideal for systems requiring high availability



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Demo Geodatabase Replication





Geodatabase Summary

- **ArcSDE Geodatabases allow you to:**
 - Manage geographic information
 - Work with rich data models that go beyond simple features, rasters, and attributes
 - Openly manage transactions, archives, and replicas across organizations
 - Openly edit in any application using simple features interchange