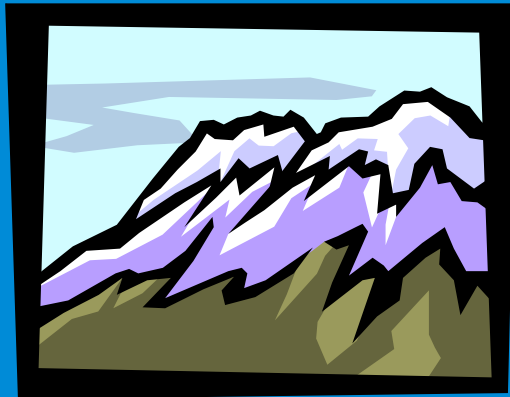




GeoDatabase Topology

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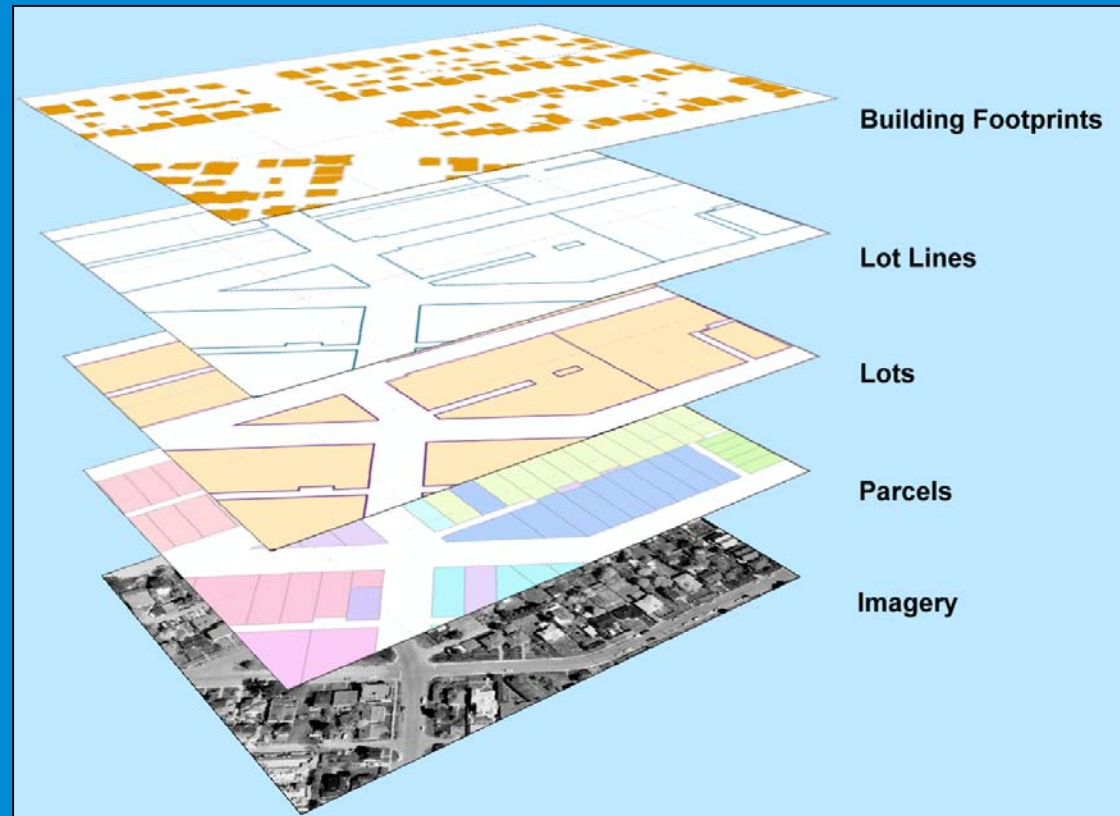
What Is Topology?

- Mathematical way to model feature types that share geometry
 - Features are the GIS representations of real world objects
- Set of spatial relationships
 - Adjacency (polygons)
 - Connectivity (lines)
 - Containment (points, lines, & polygons in other polygons)



What is Topology

- How to model spatial relationships
 - Parcels cannot overlap one another
 - Lot lines must cover the boundary of lot polygons
 - Parcel lines cannot have dangles





Requirements of Topology

- Define how features and feature classes share geometry
- Create features from unstructured geometry
- Edit features that share geometry and support the management of topological constraints



Understanding How It Works



How Does It Work?

- Very little information is written into the geodatabase
 - Topology has properties that are stored in geodatabase
- Topologic relationships are determined and maintained in the edit environment (“on the fly”)



Geodatabase Topology

- A collection of feature classes in a container called a feature dataset
 - **Flexible data model** – multiple polygon, line, and/or point feature classes *in the same feature dataset*
 - All feature classes are simple features classes – lines are like routes, polygons are like regions
 - Feature geometry is always explicit - data is always usable
- **Flexible set of integrity rules**
 - You set up the rules you want
- **YOU “define” topology**



How Do You Create Topology?

- Define properties in the Geodatabase
 - Cluster tolerance
 - Which feature classes participate
 - Relative ranks for each feature class
 - Rules



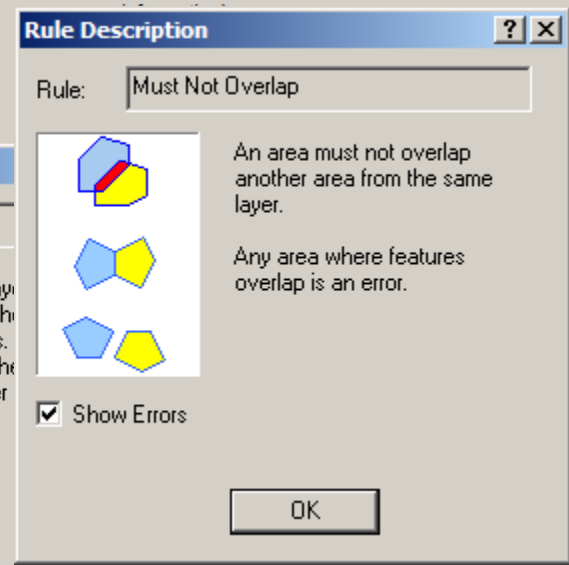
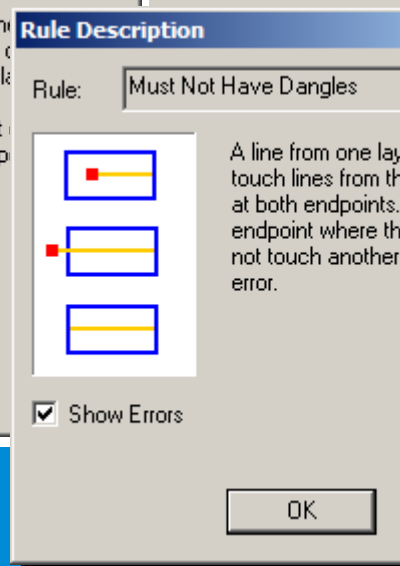
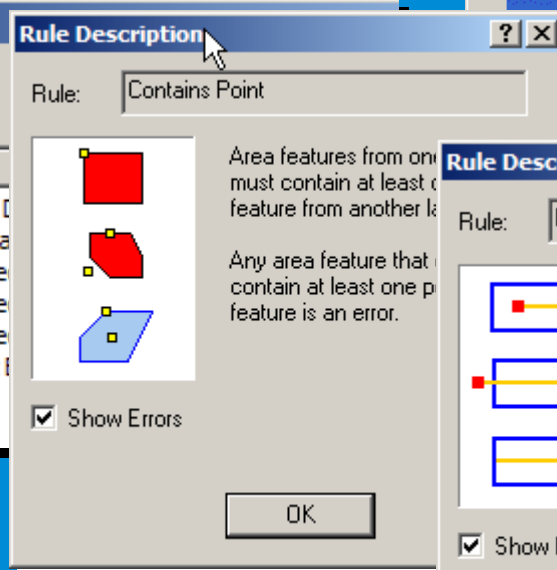
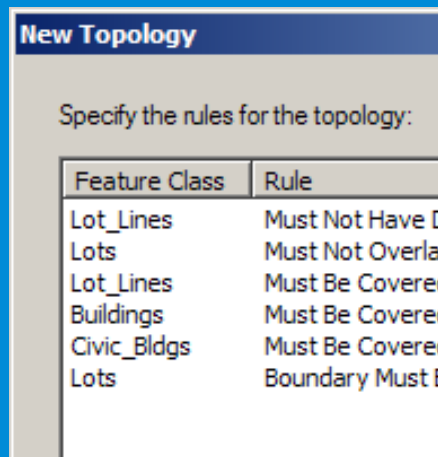
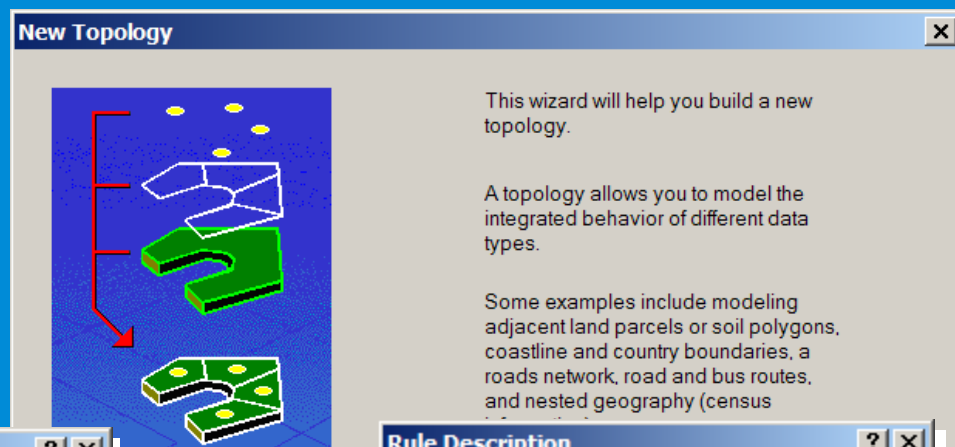
Defining A Topology

- ArcCatalog – New Topology Wizard:
6 steps
 1. Name the topology
 2. Apply a cluster tolerance
 3. Select participating feature classes
 4. Set coordinate accuracy ranks
 5. Apply integrity rules
 6. Validate the topology



Defining Topology

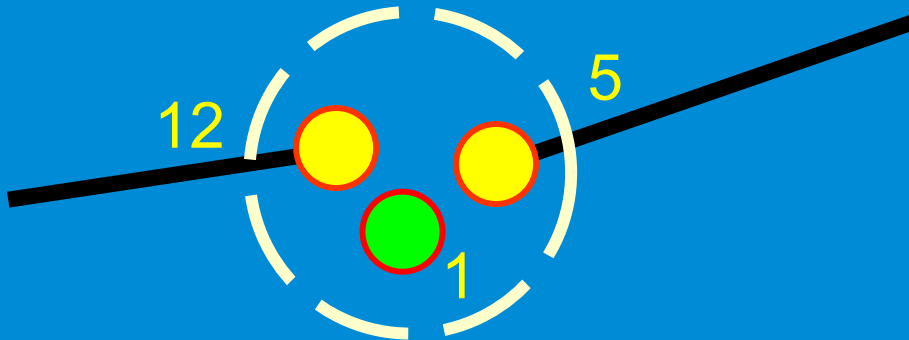
- Topology Wizard in ArcCatalog





Cluster Tolerance

- Range in which all vertices and boundaries are considered identical or coincident
- Default / minimum is based on the precision of the feature dataset
 - Applied during the initial validate process
 - *Features will never move again* (unless new features are added that fall within the cluster tolerance of other features)



New Topology

Enter a name for your topology:

Enter a cluster tolerance:

The cluster tolerance is a distance range in which all vertices and boundaries are considered identical, or coincident. Vertices and endpoints falling within the cluster tolerance are snapped together.

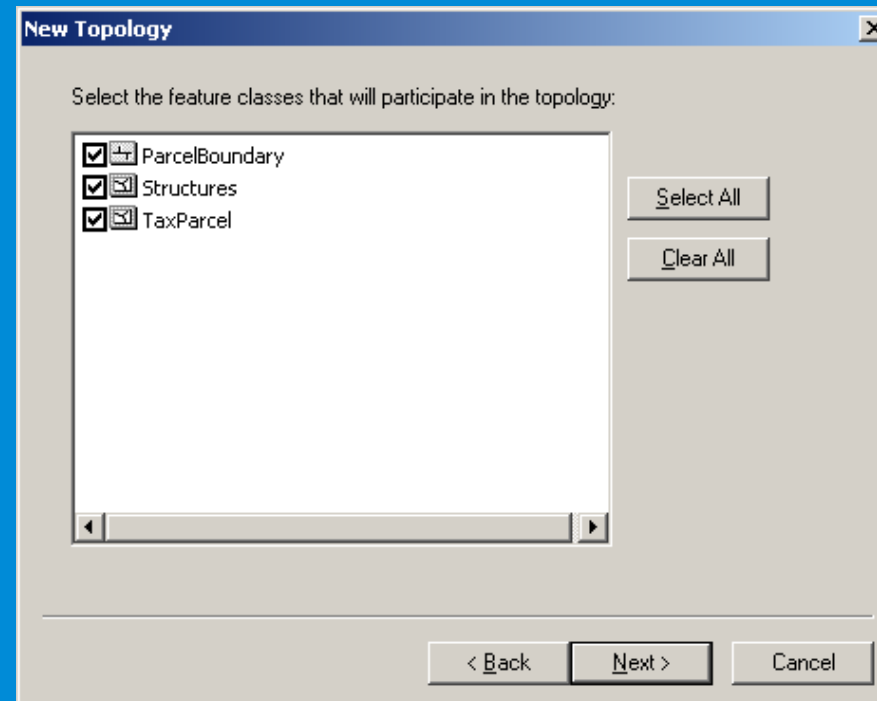
The default value is based on the precision defined for the spatial reference of the feature dataset.

< Back Next > Cancel



Feature Class Participation

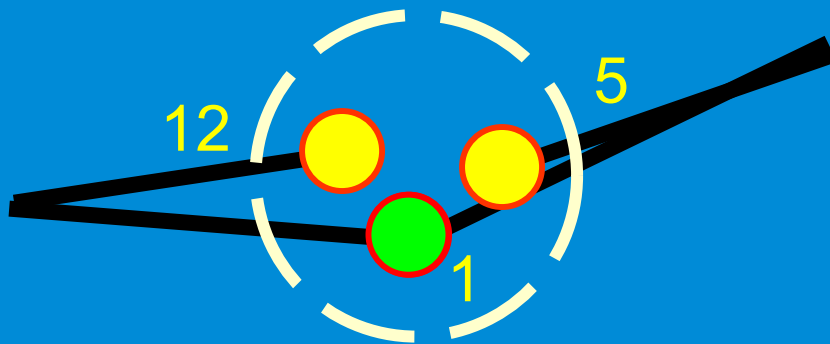
- Define which feature classes participate in the topology
- Can have multiple points, lines, and polygons





Coordinate Accuracy Ranks

- Define how vertices move during validate topology
 - Ranks defined at feature class level
 - By feature class
 - Higher the rank, the less probability that the feature may move



New Topology

Each feature class in a topology must have a rank assigned to it to control how much the features will move when the topology is validated. The higher the rank, the less the features will move. The highest rank is 1.

Enter the number of ranks (1-50):

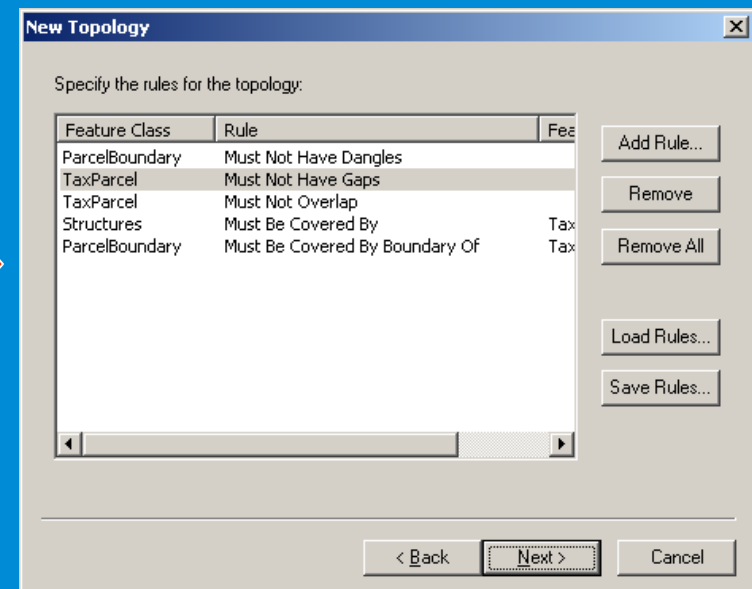
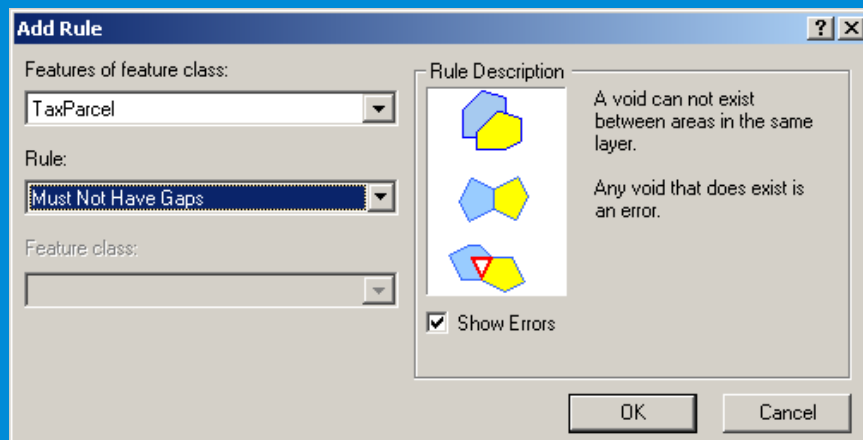
Specify the rank for a feature class by clicking in the Rank column:

Feature Class	Rank
<input checked="" type="checkbox"/> ParcelBoundary	1
<input checked="" type="checkbox"/> Structures	1
<input checked="" type="checkbox"/> TaxParcel	2

< Back Next > Cancel

Rules

- Define spatial relationships between features within a feature class or features between feature classes
- Rules do not guarantee the topology will never be violated





Topology Validation

- Defining the properties of the topology does not validate the feature geometry and rules
- Entire dataset is considered “Dirty” when topology is first created
- Last step in wizard is to validate the topology
 - operation to snap features together and test for rule violation



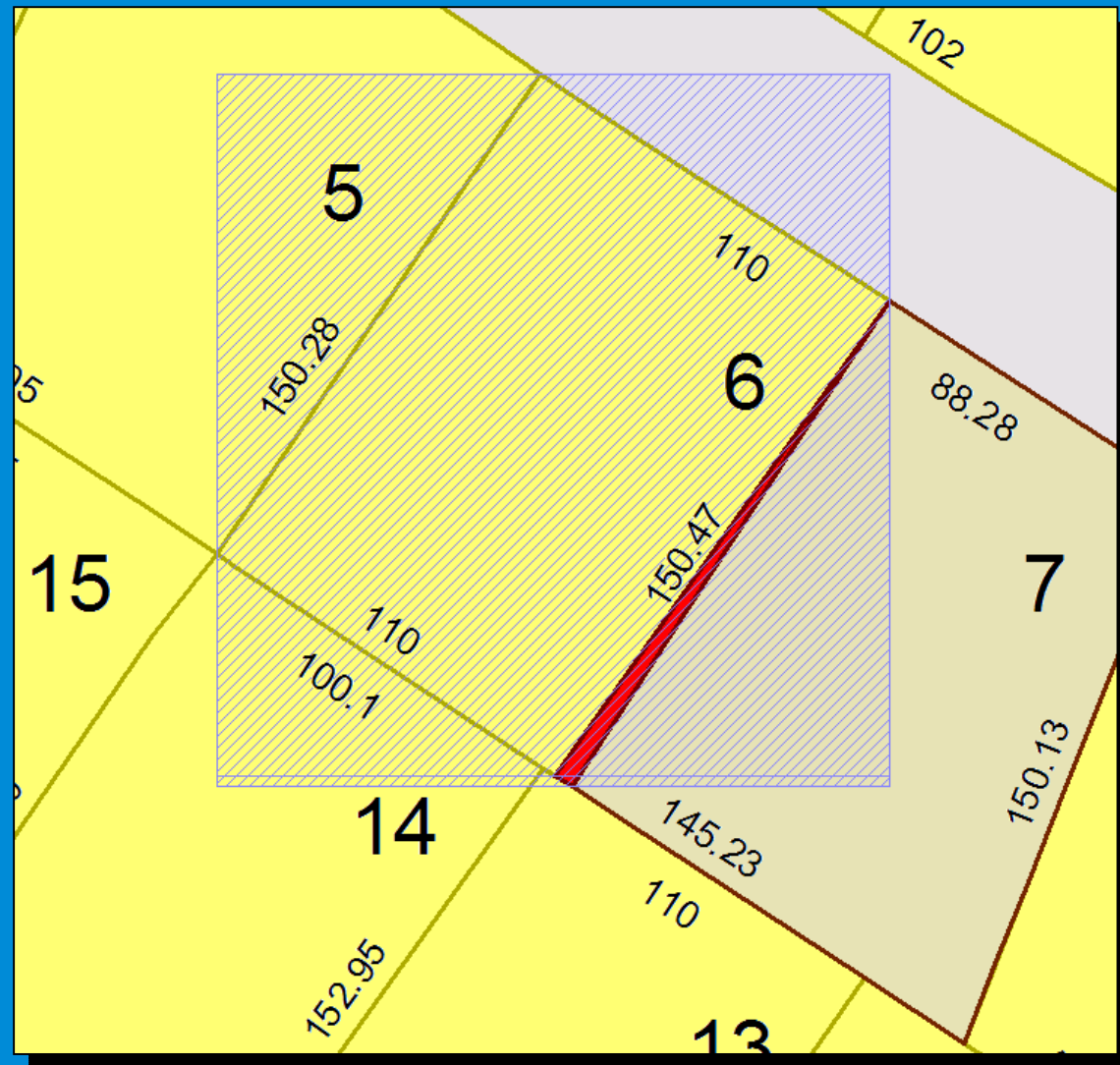
Dirty Areas

- Represent areas where spatial integrity of the topology has not been validated
 - Vertices are not snapped within cluster tolerance
 - Rules have not been tested
- Dirty areas may contain existing or undiscovered errors inside the topology
- Dirty areas are allowed to persist in the database



Dirty Areas

- An area in the topology that has been changed and not yet validated.
- Can be symbolized just like any other layer in the map





What “Validate” Does

- Snaps vertices within cluster tolerance
 - Accounts for rank
 - Adds vertices where features intersect and there isn't already a vertex
- **Limit feature movement by using a small cluster tolerance**
- Rules are verified with the features
 - Violations are denoted as errors
 - Errors are stored as a property of the topology



What “Validate” Does Cont.

- Dirty areas are created anytime feature geometry has been modified
- Can validate topology in ArcMap on dirty areas
- Allow users to define own workflow
- Topology can have one of three states:
 - Not validated
 - Validated with errors
 - Validated without errors

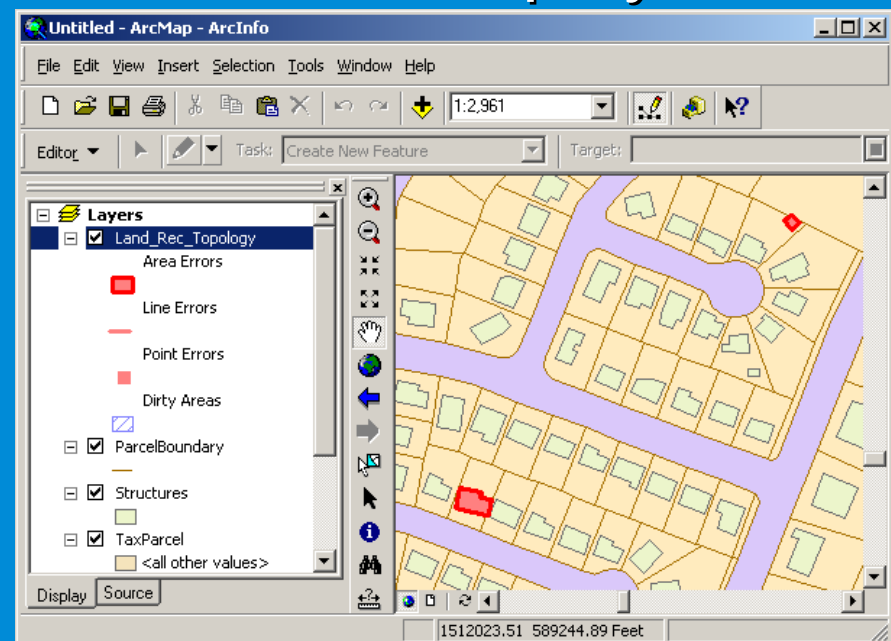


Errors and Exceptions

- Occur where rules are violated in dirty areas during a validate topology
- Errors are persisted and stored in the database
- Can be viewed in an error sheet or displayed

The screenshot shows the 'Topology Properties' dialog box with the 'Errors' tab selected. It displays a table of topology rules, the number of errors found, and the number of exceptions. Buttons for 'Generate Summary' and 'Export To File...' are visible above the table.

Rule	Errors	Exceptions
Must Not Have Gaps TaxParcel	1	0
Must Not Overlap TaxParcel	0	0
Must Be Covered By Structures, TaxParcel	2	0
Must Be Covered By Boundary Of ParcelBoundary, TaxParcel	0	0
Must Not Have Dangles ParcelBoundary	0	0
Total	3	0





Editing Errors in a Topology

Errors cannot just be deleted

- You have three options:
 - Leave the error in the database
 - Fix the error
 - Mark it as an exception
 - E.g. The rule applies everywhere except here
 - Error management based on work flow

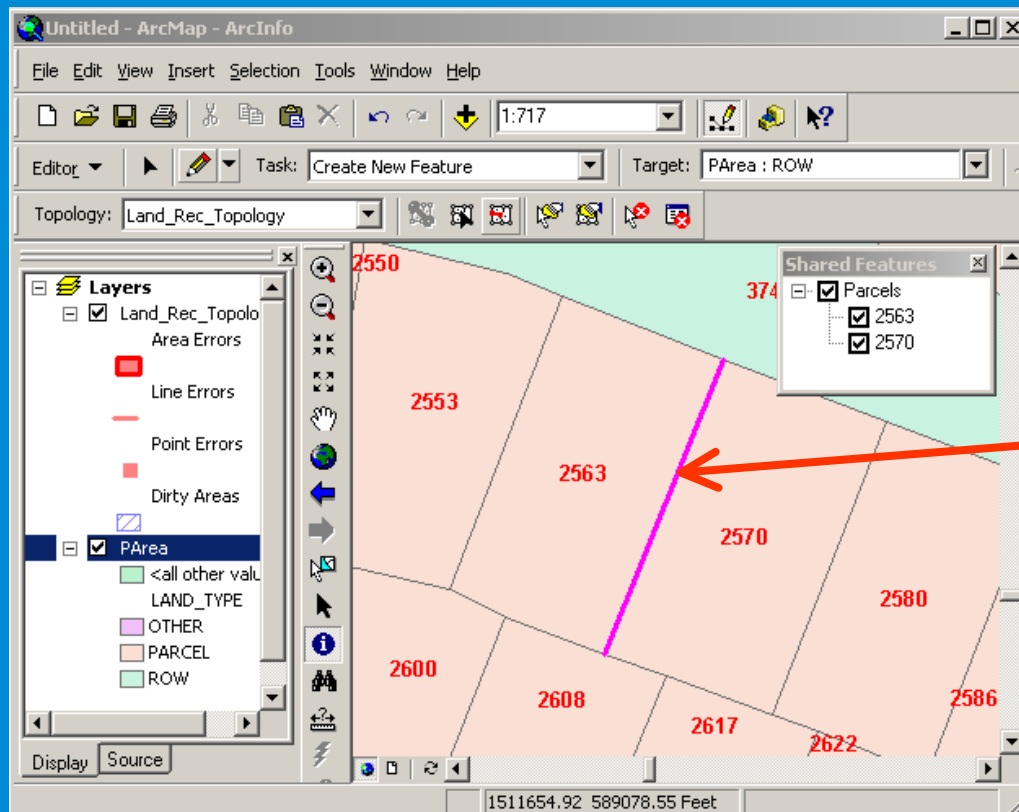


Editing Features in a Topology



Shared Geometry

- Shared geometry consists of features, or part of features that are coincident (share the same space)

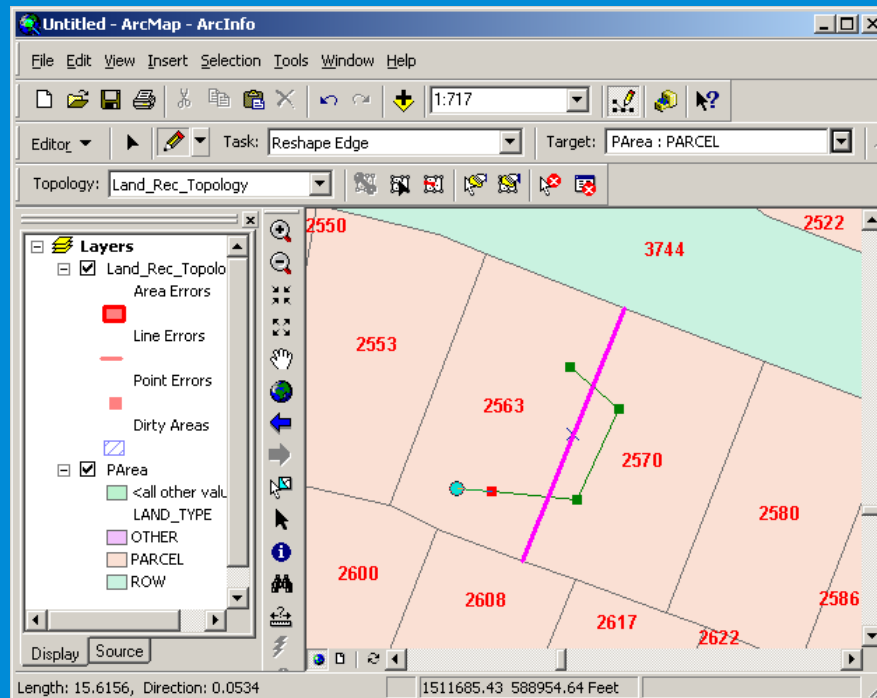


Ex. This shared edge consists of the edges of two polygons



Shared Geometry

- Topology edit tool is used to determine, or “discover” the features that share geometry
- Features that share geometry all become part of the edit
 - User can control which features will be updated

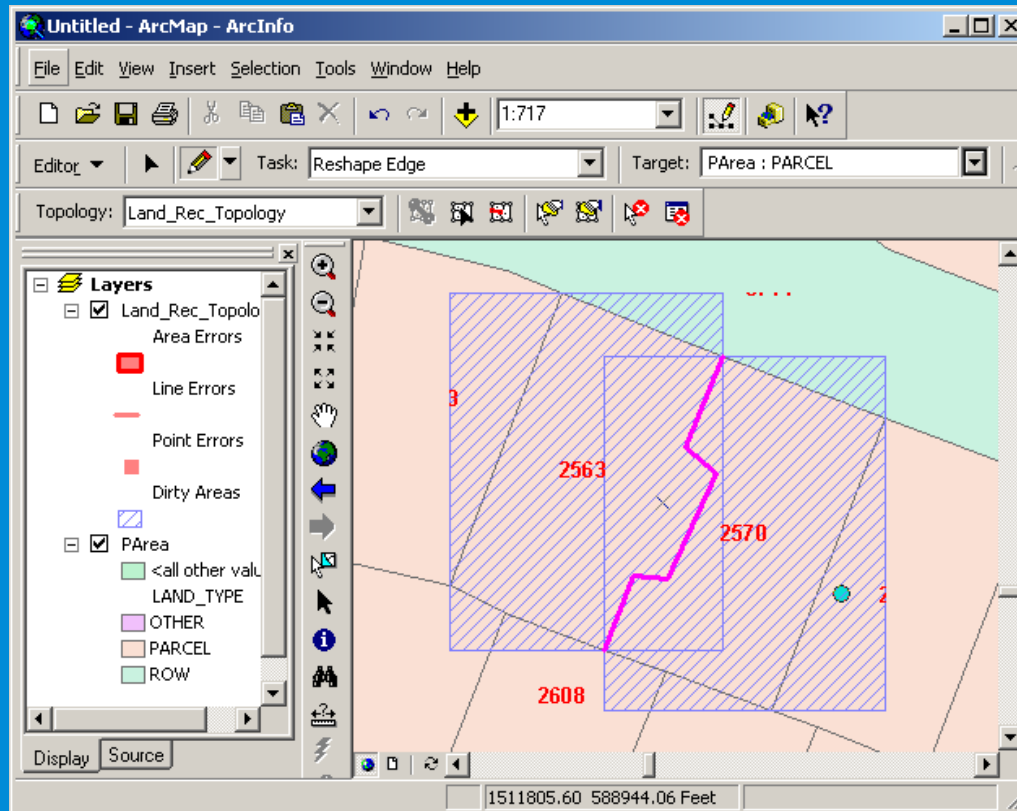


Ex. User can use the edit tools to reshape the existing boundary of these two parcels



Shared Geometry

The boundary between the two parcels has been changed.

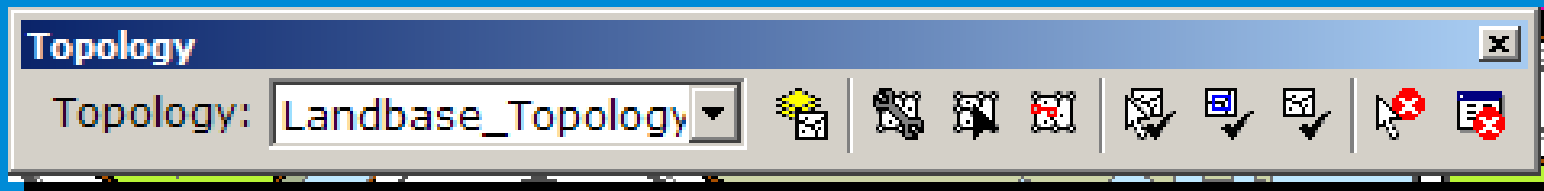


Note that the two polygons that have been modified are now “dirty”.



Editing Shared Geometries

- Topological Editing Tools
 - Fix Topology Tool
 - Error Inspector
 - Validate selected dirty areas, portions of a dirty areas, OR the entire topology
 - Construct polygons from lines
 - ArcMap (with or without a topology)
 - ArcCatalog
 - Show Shared Features Dialog
 - Integrated layers command





Summary

- ArcGIS topology stores little information in the GeoDatabase
 - Participating feature classes, cluster tolerance, relative ranks, and rules
 - Dirty areas, errors, and exceptions
- Shared geometries are discovered on the fly during the manipulation of the topology
 - Between features and/or between features in different feature classes



Advantages of Geodatabase Topology

- Better data modeling of real world features
 - Simple data model
 - Inside a DBMS (pGDB or multi-user)
 - Data is always usable
- **YOU “define” topology**
 - Greater range of integrity rules to apply
 - More flexibility - multiple polygon and point and line feature classes can participate in a Topology



Advantages of Geodatabase Topology

- Improved data integrity
- Take advantage of ArcSDE and multi-user editing environment
- Extremely large continuous data layers stored in a single database
- Can establish topology in any data model
- Excellent editing tools



Questions?



Migrating Coverages to the Geodatabase

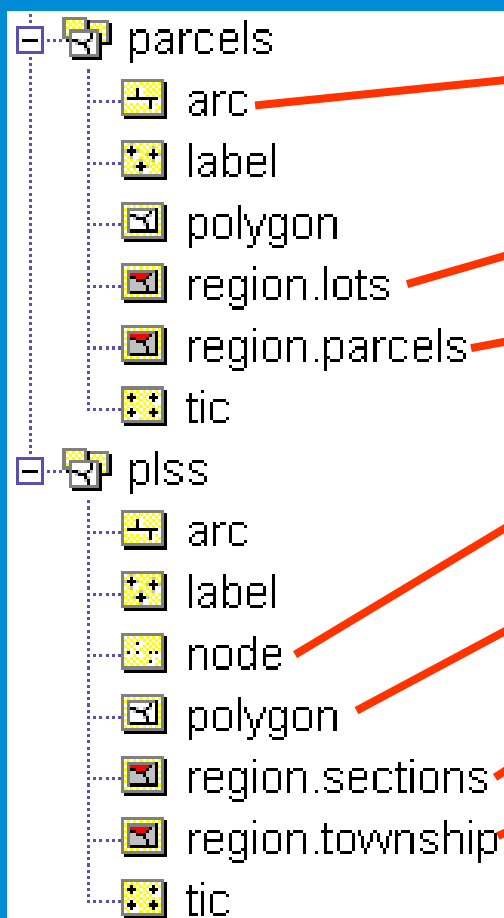
- Start with the coverage model
 - You already know what feature classes represent what
 - *If you have converted from coverages to shapefiles, you've already done this!*
- Choose the feature classes that have spatial relationships
- Apply integrity rules you want



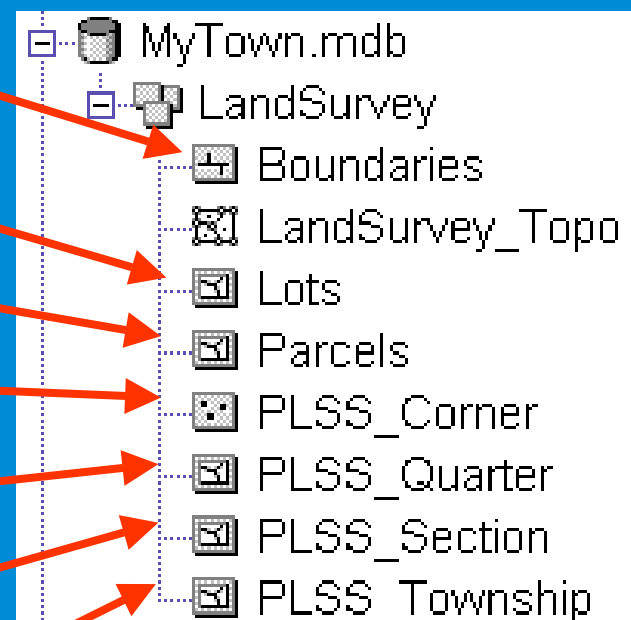
Migrating Coverages to Geodatabase

geography sustaining our world

Coverage(s)



Geodatabase



Boundaries hold COGO information

Coverage parcel polygons only existed to support regions



Coverage Topology

- A collection of feature classes in a container called a coverage
 - **Fixed data model:** 1 polygon, 1 arc, 1 node feature class
 - Regions, and Routes feature classes are based on core feature classes
 - **Fixed set of integrity rules**
 - Label points must be covered by polygons
 - Polygon boundaries must be covered by arcs
 - Arcs must close to form polygons
 - Polygons cannot overlap (only regions can)
 - **Build and Clean create topology**
- **ArcInfo “defined” Topology**



Coverage Model vs GDB Model

- Similarities

- Both are collection of feature classes
- Both offer the ability to share geometry (through the use of different approaches)
- Both employ an evaluation process (clean/validate) with integrity rules/flags for maintaining topology



Comparing Coverage and GDB Topology

- Coverages
 - Topological relationships are stored in the database
 - Fixed set of topology rules
 - Needed topology to use polygons
 - Errors needed to be resolved before topology construction
 - No good way to locate errors



Comparing Coverage and GDB Topology

- Geodatabase
 - Stores little in the database (discovered relationships on-the-fly)
 - You define the topology rules
 - Polygon features exist without topology
 - Errors can exist in topology
 - Nice tools for locating and fixing errors



Coverage Model vs GDB Model

- Coverages
 - Used composite feature classes (regions/routes) to model multiple feature classes that share geometry
 - Required to maintain atomic polygons (for regions)
 - Topological rules are hardwired and unavoidable
- GDB
 - Do not use composite feature classes (each sub class would be a standalone feature class)
 - Do not need to maintain atomic feature classes
 - Define rules you want to enforce
- Topological relationships are still supported and maintained, they just aren't stored in a table you can see