

## Geodatabase Concepts: Setting Topology Rules for ITAM GIS Datasets

A personal geodatabase is an object-oriented data model that allows GIS users to physically store and manage geographic information inside a database management system. In a geodatabase, a feature class stores the geographic information and attributes of a collection of similar features, such as buildings or airfield areas. A collection of feature classes is stored in a feature dataset. Within feature datasets, topology rules define spatial relationships such as adjacency, connectivity, proximity, and coincidence between feature classes. Topology rules can be created to ensure these spatial relationships are maintained, especially during editing sessions. Topology ensures the integrity of the data and the geodatabase. Rules can be created for polygons, points and lines. Rules can preserve relationships within one feature class or between two or more feature classes, such as points and polygons. The user decides which data layers will participate in the topology. Topology rules allow a user to discover and fix errors quickly. Errors occur when data break a rule. There are 25 predefined topology rules established by ESRI in ArcGIS. For example, points must be covered by the boundary of a polygon and lines must not intersect. These predefined topology rules can be utilized in ITAM GIS geodatabases.

There are 45 core ITAM data layers. The basic ITAM personal geodatabase contains the following SDS feature datasets: military operations, boundary, cadastre, hydrography, landform, transportation\_vehicle, buildings, common, cultural, fauna, flora, geodetic, land\_status, and transportation\_air (Fig. 1). These names follow the SDS standard for geodatabases. Please refer to the SDSFIE website (<http://tsc.wes.army.mil/products/TSSDS-TSFMS/tssds/html/>) for information pertaining to SDS standards and nomenclature. For each of these feature datasets, topology rules can be established. This article will only focus on the topology rules of the military operations feature dataset.

Before topology rules can be set for a feature dataset, the topology must be created first. Since topology can only be created within a feature dataset, this limitation may cause some potential problems within a personal geodatabase based on SDS structure. A common topology rule is that contours must not overlap with water bodies. These two feature classes normally fall within two different feature datasets, hydrography and landform. A simple solution for this problem is to create a “junk” feature dataset, move the necessary feature classes into the dataset, create the necessary topology rules, perform edits and move the feature class back to their appropriate datasets.

When creating topology, a few settings must be addressed to maximize the benefits of using topology rules. The cluster tolerance controls how far apart lines, nodes and vertices can be from each other in order to not be considered coincident. If lines, nodes, and vertices are within the cluster tolerance of each other, they will either snap or cluster together. The recommended maximum cluster tolerance is one order smaller than the precision of the feature dataset. For example, if a feature dataset has .25 meter precision, the maximum recommended cluster tolerance would be .025 meter.

In addition to the cluster tolerance, the feature classes used in the topology must be ranked. The rankings of the feature classes control their behavior when the topology is validated. When topology is validated, the features are checked to ensure that none of the rules have been violated. Furthermore, features within the cluster tolerance will snap and cluster together. If two

**Figure 1:** Basic structure of a SDS compliant ITAM personal geodatabase.



feature classes have equal rankings, then vertices will snap to line ends and line ends will cluster to an average location. If one feature class has a higher ranking, then the vertices and line ends of lower ranked feature classes will snap to the higher ranked feature class. The accuracy level of the data will help decide how the feature classes will be appropriately ranked.

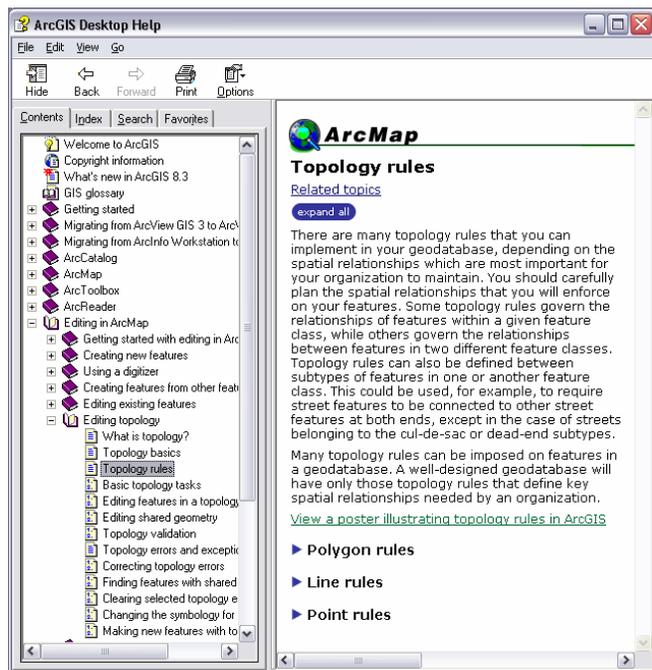
Finally, topology rules can be created when the topology is created, or through the properties of an existing topology. The user retains full control over topology at all times. Features classes can be added and removed, as well as the topology rules that define the spatial relationships of those feature classes. The definitions of the 25 predefined topology rules can be found in the ArcGIS Desktop Help (Fig.2).

The predefined topology rules can help to define many of the spatial relationships that exist among the feature classes of the military\_operations feature dataset. The following topology rules are examples of some of the rules that can potentially be used to help increase the integrity of the feature classes within this dataset. Often times there is more than one way to achieve the same result using topology rules.

- Dudded\_impact\_area ... *must be covered by* ... installation\_area<sup>1</sup>
- Dudded\_impact\_area ... *area boundary must be covered by boundary of* ... dudded\_impact\_buffer\_zone
- Ammunition\_storage\_area ... *must be covered by feature class of* ... mil\_restricted\_access\_area
- Military\_access\_point ... *must be covered by boundary of* ... mil\_restricted\_access\_area
- Military\_drop\_zone\_area ... *must be covered by* ... installation\_area<sup>1</sup>
- Military\_landing\_zone\_area ... *must be covered by* ... installation\_area<sup>1</sup>
- Military\_training\_sub\_area ... *must be covered by feature class of* ... training\_area
- Firing\_line ... *must not intersect*
- Firing\_line ... *must not overlap*
- Mil\_surface\_danger\_zone\_line ... *must be covered by boundary of* ... mil\_surface\_danger\_zone\_area
- Military\_route\_line ... *must not have dangles*
- Tank\_trail\_line ... *must not have pseudo nodes*

After the application of topology rules, the resulting feature classes have higher data integrity because the spatial relationships among them have been validated. Through the proper use of topology and topology rules, the data integrity of any feature data set can be improved. For more information on how to establish topology rules, please refer to the step-by-step instructions following this article.

**Figure 2:** Location of topology rule definitions in ArcGIS Desktop Help.



<sup>1</sup> It may be beneficial to move the installation\_area feature class from the cadastre feature dataset into the military\_operations feature dataset when establishing topology.

## Establishing Topology Rules

1. Right-click on a feature dataset
2. Choose 'New'
3. Choose 'Topology'
4. Select 'Next'
5. Enter a name for your topology
6. Enter in a cluster tolerance for your topology
7. Select 'Next'
8. Check the boxes next to the feature classes participating in the topology
9. Select 'Next'
10. Enter the ranks
11. Select 'Next'
12. Select 'Add'
13. Create a topology rule by selecting participating feature classes and a rule
14. Select 'OK'
15. Select 'Next'
16. Select 'Finish'

### Sources:

Childs, Colin. Kabot, Gary. McGray, Patricia. Simmons, Brenda. *Building Geodatabases 1 (for ArcEditor 8.3 and ArcInfo 8.3)*, ESRI, 2003.