ArcGIS Network Analyst: Network Datasets

Transcript

Welcome. I’m Colin Childs from Educational Services at ESRI in Redlands, California, and I teach a host of ArcGIS classes ranging from geodatabase design to working with Spatial Analyst. Today, I will be exploring the Network Analyst extension, and I'll be giving you an overview of how to create a network dataset. This discussion is tailored to users of Network Analyst who want to learn about how to create a network dataset.

A network dataset is a collection of edges, junctions, and turns through which users can model how resources flow. The network dataset deploys an advanced connectivity model that uses a simple rule-based approach for defining navigation. Network datasets can be used to model the navigation and travel costs of many types of transportation problems. Network datasets, as I mentioned, are a collection of edges, junctions, and turn elements that are derived from network source feature classes. These source feature classes and tables could be in a geodatabase, could be in shapefile, or could be in the smart data compression format, now known as StreetMap Data.

Let’s take a look inside the network dataset. A network dataset consists of one or more network sources combined within the dataset to create a set of network elements, whose connectivity is discovered and stored in a logical network, represented by an internal set of network index tables. Network elements are made from features when the network dataset is built. The network elements and their connectivity are discovered by finding geometric coincidence of the points, poly-line endpoints, and poly-line vertices. The network elements and connectivity information is stored in the logical network (a set of element and index tables inside of the network dataset). Edges are network elements that connect to junctions. Edges are the links over which the resources flow. Each edge has exactly two junctions. Junctions connect edges and facilitate navigation. A junction may be connected to one or to many edges. Turns record information about a sequence of two or more connected edges, and turns model turn restrictions (such as no left turn), or turn impedances (such as an additional 45 seconds of travel time to navigate a turn). Network datasets can therefore have a number of edge sources, junction sources, and turn sources, if you choose.

Let’s take a look at the logical network. So when you build a network dataset, a logical network is calculated. This is a collection of connected junction, edge, and turns, but without any geometry or coordinates. Instead, a logical network is a set of tables that link feature classes and features to the network elements and their connectivity. A logical network is stored in tables, and these tables are regenerated and connectivity rediscovered each time you build a network dataset. The internal details of the logical network are mostly hidden from users. For example, you'll never edit the junctions and edges directly, nor would you work with their IDs in the logical network. Instead, you'll continue to interact with and edit the actual features in the network sources. The junctions and edge elements will be regenerated quickly with any network build in the logical tables. The purpose of the logical network is to provide the data structure necessary to enable network analysis, such as route-finding and service area locations.

Next, we're going to look at creating a network dataset. Making a network dataset is like making a topology. A set of participating feature classes is defined, properties are set, and a graph is made. The properties of a network dataset affect how network elements are discovered, from feature coincidence, refining the connectivity model, and optimizing the solver performance.

Next, let's take the individual steps one at a time. Step one is setting the sources. So first you determine whether your network sources will be from a geodatabase feature dataset or a shapefile. If a geodatabase is used, you can add many point feature classes, line feature classes, and line feature classes with turn attributes, as possible network sources.

Step 2: Setting the connectivity groups and policies. For a set of sources (network sources), you can set whether they should be organized into one or several connectivity groups. Connectivity groups are used to distinguish between different transportation networks (such as subways and streets) that do not connect except at special junctions, such as subway stations. You can also control how edges are built from lines, and you can choose to create junctions whenever two lines have a coincident vertex, or create junctions only at the endpoints of edges. This choice involves whether your source features are planar or not, and how you want to model crossing of objects.

Step 3: Using elevation fields. Elevation fields are used to model crossing objects, such as bridges, tunnels, and overpasses. Elevation does not refer to altitude, but to the logical levels of roadways, analogous to the stories in a building, for example. The elevation fields are commonly provided on street networks from commercial data vendors, if you need to buy some of this data.

Step 4: Adding turns. Turns are added to the network dataset for one of two possible reasons. One, to restrict travel (such as no left turn allowed), or to add an additional travel time to the solver to perform a particular maneuver.

Step 5: Defining network attributes. You can add network attributes to network elements. All junctions, edges, and turns share those same attributes. Applications and network attributes include the option to set a one-way restriction, to define a travel time, to set an accumulative travel distance, or even to apply a road classification.

Step 6: Optimizing your hierarchy. A network dataset can use a feature classification to make three-level hierarchies, such as interstate freeways, major roads, and minor roads. The logical network will use these hierarchies to optimize route-solving on large transportation networks.

Step 7: Building the network dataset (the final step). So once the network dataset sources and properties are set, you can then build the network dataset. This will create the network elements in the logical network. When a network source is edited, the network, remember, must be rebuilt. Because it is quick to (and easy to) rebuild a network dataset, this works well with many organization data flows.

A few tips about the different data sources:

- Use sources from a geodatabase feature dataset if you want greater modeling flexibility and integration with other geodatabase data models, such as topology.
- Use sources from a shapefile workspace for fast, convenient creation of network datasets. Only one edge source is allowed if you do use shapefiles, and multimodal networks are not possible with shapefile sources.
- Use sources from the SDC feature classes if you want to benefit from high data compression. As with shapefiles, only one edge source is allowed.

So in conclusion, network elements are made from features when a network dataset is built. The network elements and their connectivity is discovered by finding geometric coincidence of points, polyline endpoints, and polyline vertices. The network elements and connectivity information are stored in the logical network, which is a set of elements and index tables in the network dataset.

For further resources, please check our instructor-led training courses at www.esri.com. This discussion touched on topics that are covered in our two-day instructor-led class, entitled *Working with ArcGIS Network Analyst*. Thank you for tuning into this session of our ESRI Instructional Podcast Series. Stay tuned for future broadcasts.

