Geometric Networks: An Introduction

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Expectations

Presumed knowledge of the Geodatabase

- Features classes
- Tables
- Subtypes
- Domains
- Attachments
- Editor tracking
- Relationship classes
Agenda

• What is the Geometric Network?
• When to use a Geometric Network
• Editing and analyzing
• Validating
• Programming and performance
• Deployment tips
• Future Plans
What is a Geometric Network?

• Why was it developed?
• The network you see in the map
• The logical network behind the scenes
• Features in a geometric network
What is a Geometric Network

Why was it developed?

• Motivation
  - Emerging competitive industry
  - Provide support for utilities and the natural resource sectors
What is a Geometric Network

The network you see in the map

• A way to model common networks and infrastructures found in the real world.

• Definition
  - A network of connected custom point and lines features in a map
  - Supported by a logical network that maintains connectivity relationships
  - Connectivity is based on geometric coincidence
  - Rules and custom features control how things connect
What is a Geometric Network
The logical network behind the scenes

- An index that maintains the connectivity relationships between edges and junctions
  - Geometrically coincident
  - Supporting rule

- Purpose
  - Make things faster

- Use
  - Accessible programmatically
  - Custom analytic tools
  - Maintains weights
What is a Geometric Network

Features in the network

• **Custom features**
  - Type defines how other features can connect to it
  - Store more than just information about that feature

• **Comparison**
  - Non-custom features - store information about that feature
  - Custom features - feature information + connected neighbor
What is a Geometric Network

Features in the network

• **Shape:** junction or edge

• **4 types**
  - Orphan junctions *system maintained*
  - User defined junctions
  - Complex edges
  - Simple edges
What is a Geometric Network

Features in the network

• Shape: junction or edge

• 4 types
  - Orphan junctions
  - User defined junctions
  - Complex edges = midspan connectivity
  - Simple edges
What is a Geometric Network

Features in the network

- Shape: junction or edge

- 4 types
  - Orphan junctions
  - User defined junctions
  - Complex edges
  - Simple edges = no midspan connectivity
What is a Geometric Network

Rules

- Tell the network what is allowed to be connected
- Restrict the number of features allowed to connect

- 2 types
  - Defined at the subtype level
  - Edge-junction
  - Edge-junction-edge

- Analyzed post-process
What is a Geometric Network

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3 lines can connect to the point
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What is a Geometric Network
When you should use a geometric network

- **Model utilities or natural resource systems**
  - Gas, electric, telecommunications, waste water
  - Rivers, stream, watersheds

- **Capabilities**
  - Control how things connect
  - Connectivity on the fly
  - Trace pathways in the network
  - Cost of travel through paths
Creating and Configuring
Demonstration
Editing and Analyzing

- The editing experience
- Editor tips and tricks
- Tracing your network
- Control the direction of flow
- Model the cost of travel
Editing
The editing experience

- Connectivity on the fly
  - Rubber banding
  - Move features logically

- Junction subsumption
  - Orphan junctions
  - Don’t store attributes
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Reshape to stay connected
Editing
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Editing
Editor tips and tricks

• Snapping
  - Ensure connectivity

• Feature Cache
  - Snapshot of geographic locations
  - Hot an ready x, y, z information
Analyzing

Tracing

• **Travel logical paths in the network**
  - Ensure connectivity
  - Find upstream/downstream features
  - Discover loops and paths

• **Trace components**
  - Flags
  - Barriers

• **Weights**
Analyzing
Tracing

• Travel logical paths in the network
  - Ensure *connectivity*
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• Weights
Analyzing
Tracing: Flow direction

- **Direction of flow**
  - Travel a logical path
  - Easily visualized

- **Set direction**
  - Ancillary role - sources and sinks
  - Digitized direction
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![Diagram showing flow direction with points 1, 2, and 3 leading to a sink]
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Analyzing Tracing: Weights

- **Cost of travel**
  - Consider feature attribution
  - Assigned to weights in the index

- **Uses**
  - Least-cost analysis
  - Accumulation trace

- **3 Types**
  - Double, integer, and bitgate
Analyzing Tracing: Weights

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Editing and Tracing Demonstration
Validation and Performance

- Confirm network correctness
- Validation commands and tools
- Programming and the API
- Cache in on performance
Validation
Confirm network correctness

• Rubber banding
  - On the fly connectivity

• Validation commands and tools
  - Checks rules against the network
  - Batch process with GP tools

• Analytics
  - Find connected trace
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Confirm network correctness

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Validation
Command tools

• Verify Connectivity
  - Compares the map with the index

• Repair Connectivity
  - Fixes connectivity
  - Map and index match

• Rebuild Connectivity
  - Rebuilds connectivity
Validation
Geoprocessing tools

• Verify and Repair Connectivity
  - Operate exactly as the tools on the toolbar
  - Can be scripted

• Rebuild Network
  - Drops and recreates an entire versioned Geometric Network
  - Not undoable and can be time consuming

• Batch process
Programing

The API

• Author your own analytic tools
  - Through the ArcObjects API

• Use the logical network
  - Cached information
  - Increased performance
Performance

Working with the network

• Editing
  - Connectivity is maintained on the fly
  - Feature cache

• Data configuration / modeling
  - Make use of subtypes
  - Use optimal structure for your needs
  - Use test environment for development (prototype)

• In a versioned editing environment…
  - Manage your version tree (reconcile, post, compress)
  - Keep your indexes and statistics up to date (rebuild indexes, analyze datasets)
Validation

Demonstration
Deployment and Future Plans

• Preparing your data for a GN
• Understanding the quality of your data
• What you should do today
• What’s coming…
Deployment
Preparing your data

- **Digitized direction**
  - Flow direction consideration

- **Use a topology for cleanup**
  - Geographical assessment

- **Data quality**
  - Understand level
  - Snapping tolerance
Deployment

Preparing your data

• **Script your setup**
  - Archive of rules

• **Prototype**
  - Early and often
  - Performance testing
Deployment

What you should do today if you are using the geometric network model

• Move to or stay on ArcGIS Desktop version 10.2.1

• This is where we prioritize bug fixes through Utility Update patches

• UTU patch 7 is the current release with UTU patch 8 in the works.
Future plans

New framework: Utility Network

• Model complexities and details in network

• Services based architecture
  - Seamless experience across the platform

• Projected release
  - ArcGIS Pro 2.1 and ArcGIS Enterprise 10.6 release