Geometric Networks: An Introduction

Christopher Thomas

David Crawford

Expectations

Presumed knowledge of the Geodatabase

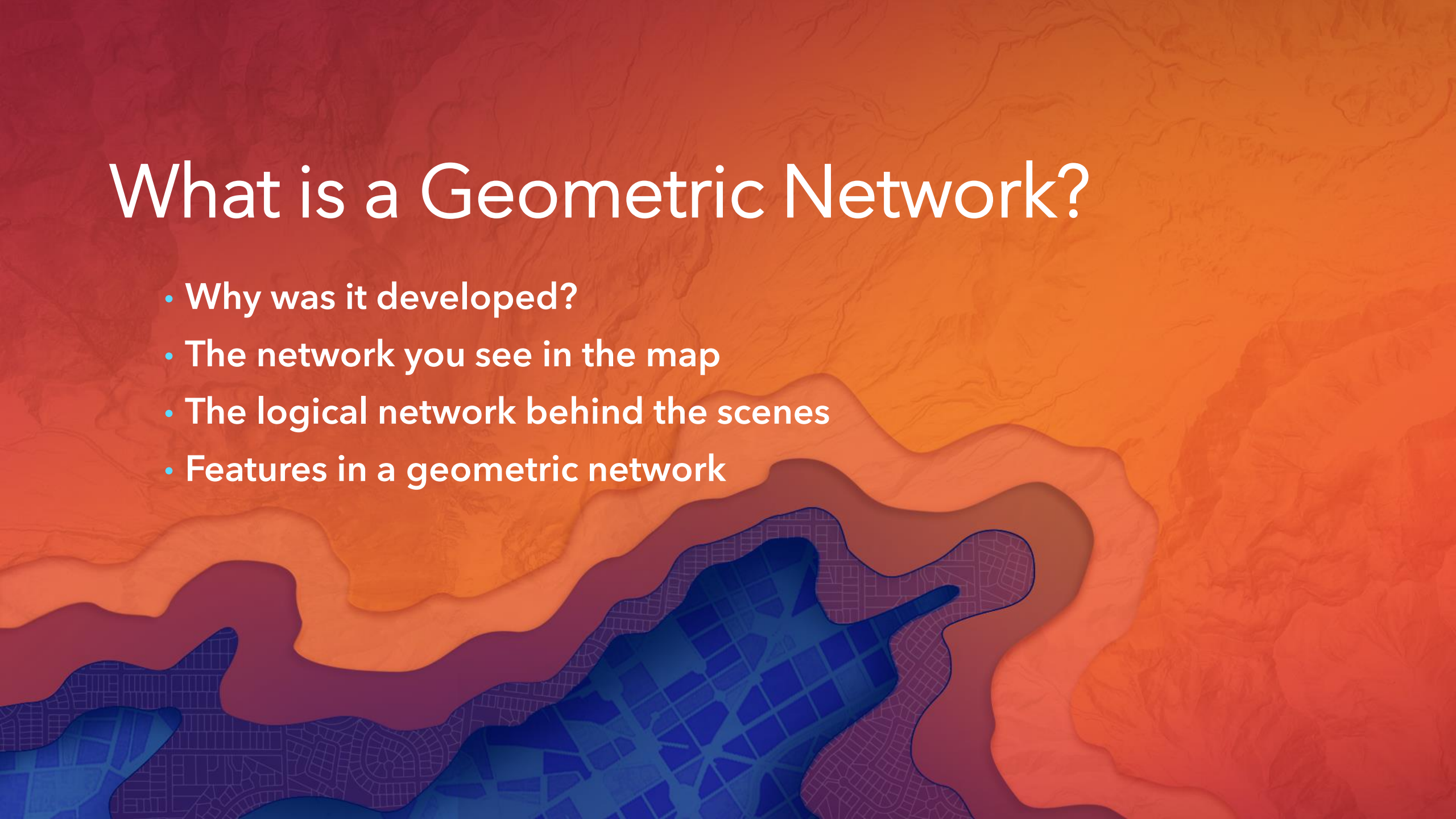
- Features classes
- Tables
- Subtypes
- Domains
- Attachments
- Editor tracking
- Relationship classes

Agenda

- What is the Geometric Network?
- When to use a Geometric Network
- Editing and analyzing
- Validating
- Programing 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**

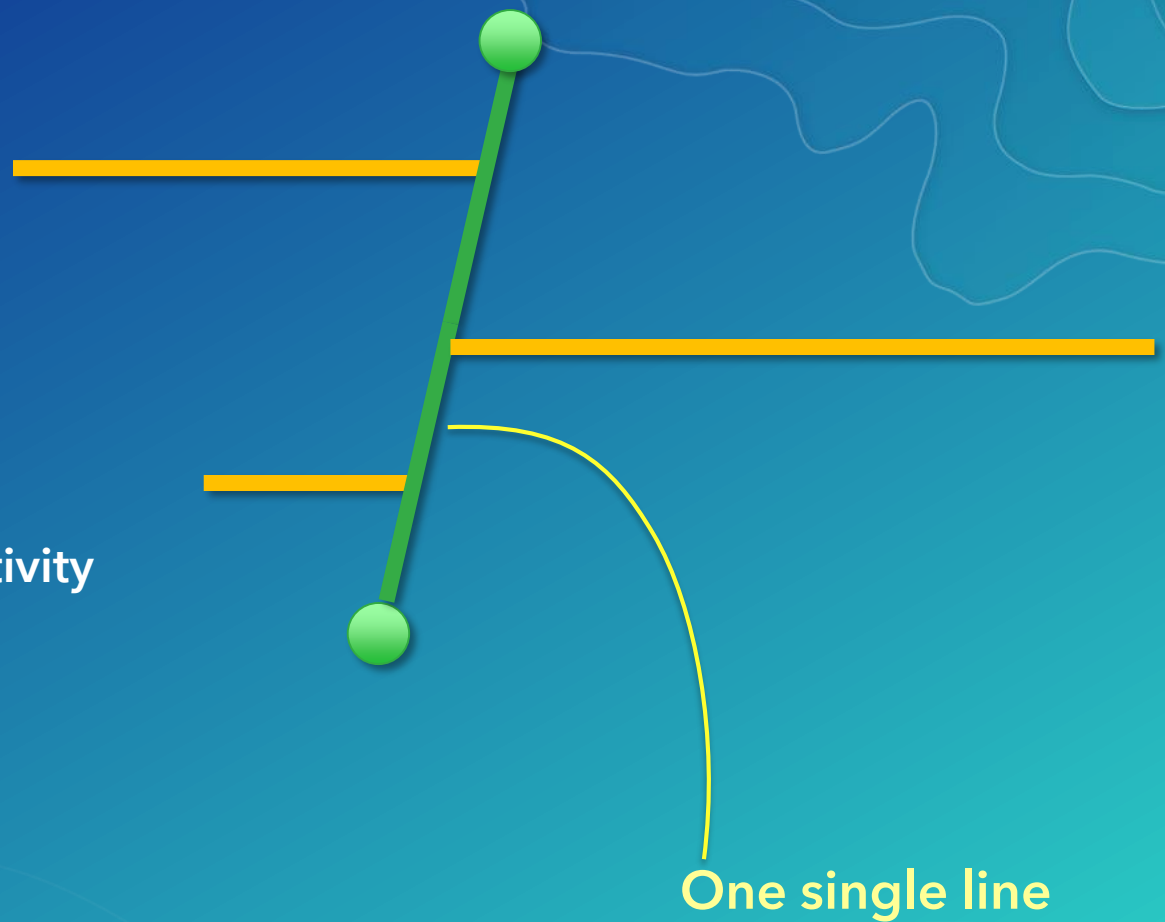
- **4 types**
  - **Orphan junctions *system maintained**
  - **User defined junctions**
  - **Complex edges**
  - **Simple edges**

What is a Geometric Network

Features in the network

- **Shape: junction or edge**

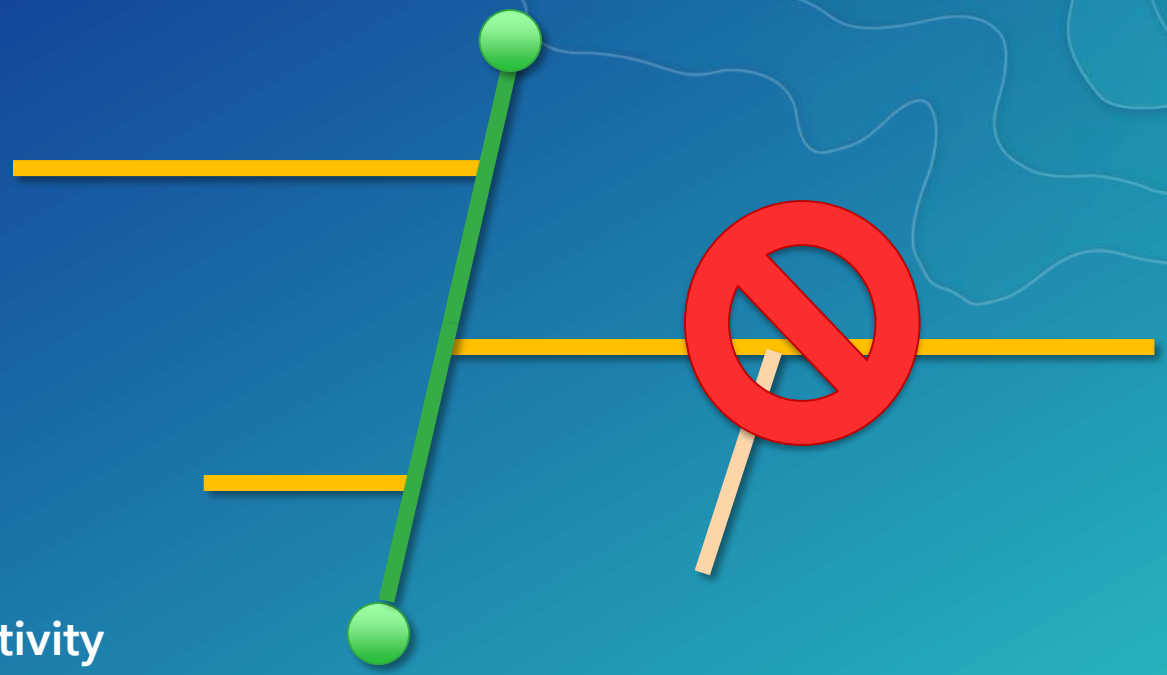
- **4 types**
  - **Orphan junctions**
  - **User defined junctions**
  - **Complex edges = midspan connectivity**
  - **Simple edges**



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**

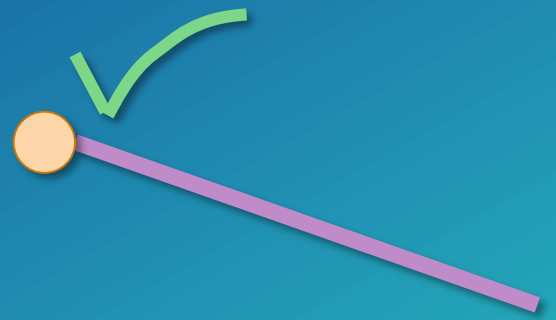


What is a Geometric Network

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

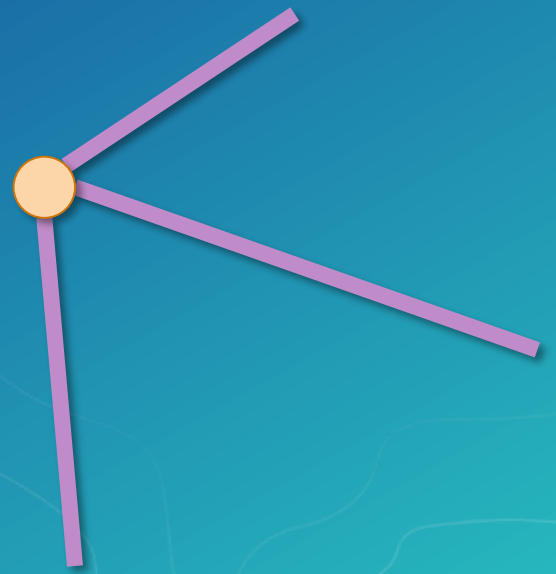
What is a Geometric Network

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



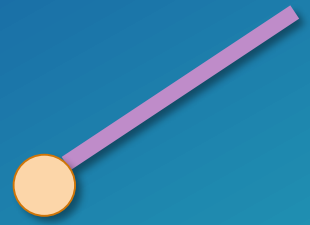
3 lines can connect to the point

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

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

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

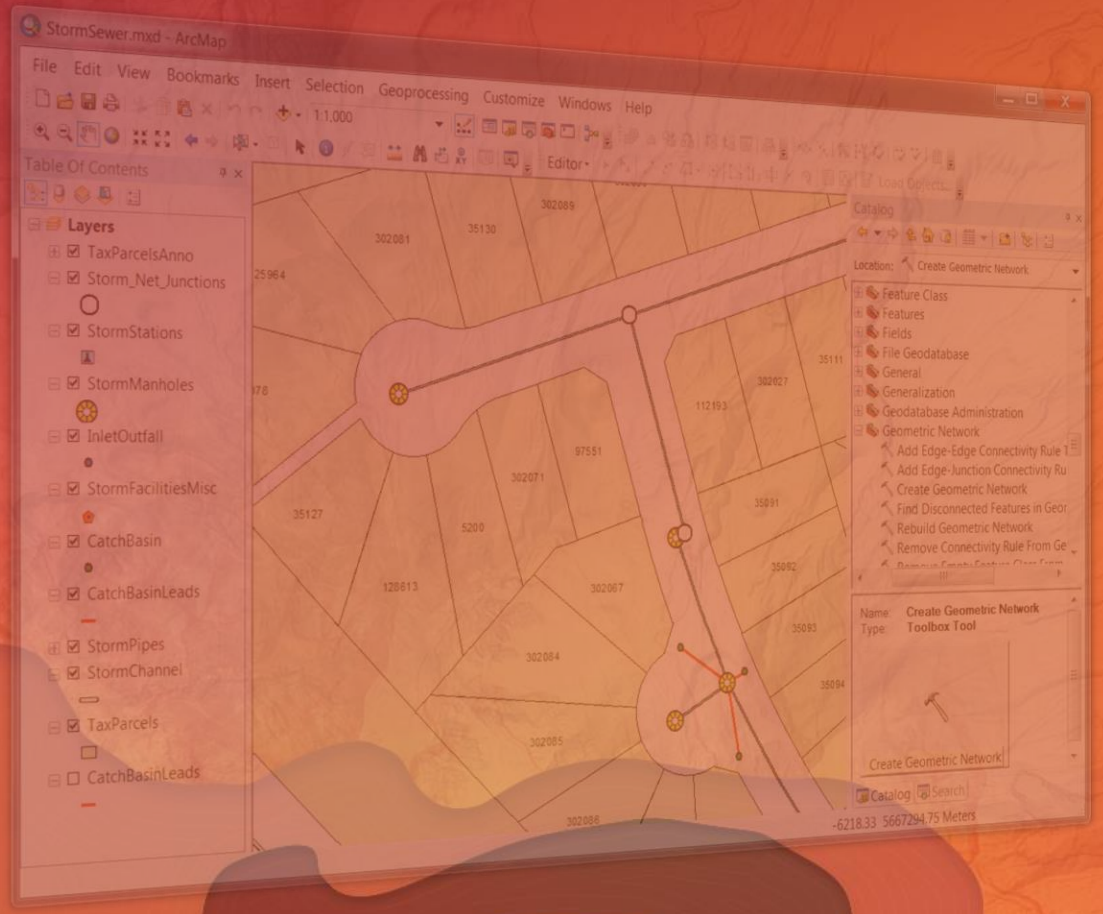
Checking connectivity rules…

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

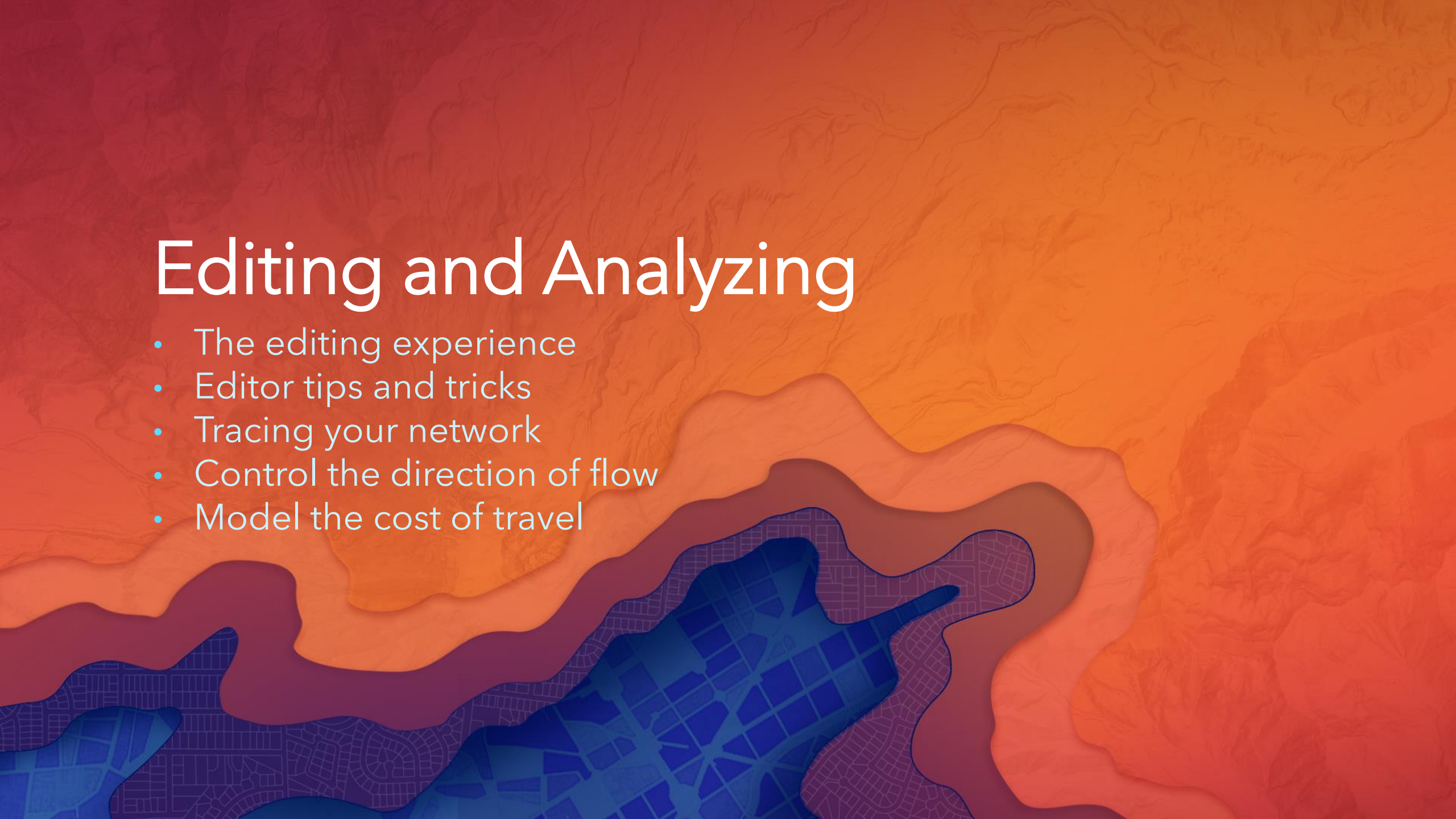


Creating and Configuring

Demonstration

Editing and Analyzing

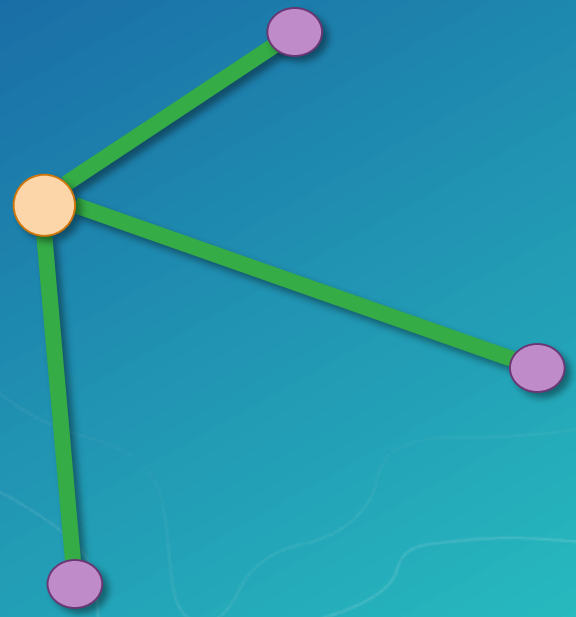
- The editing experience
- Editor tips and tricks
- Tracing your network
- Control the direction of flow
- Model the cost of travel



Editing

The editing experience

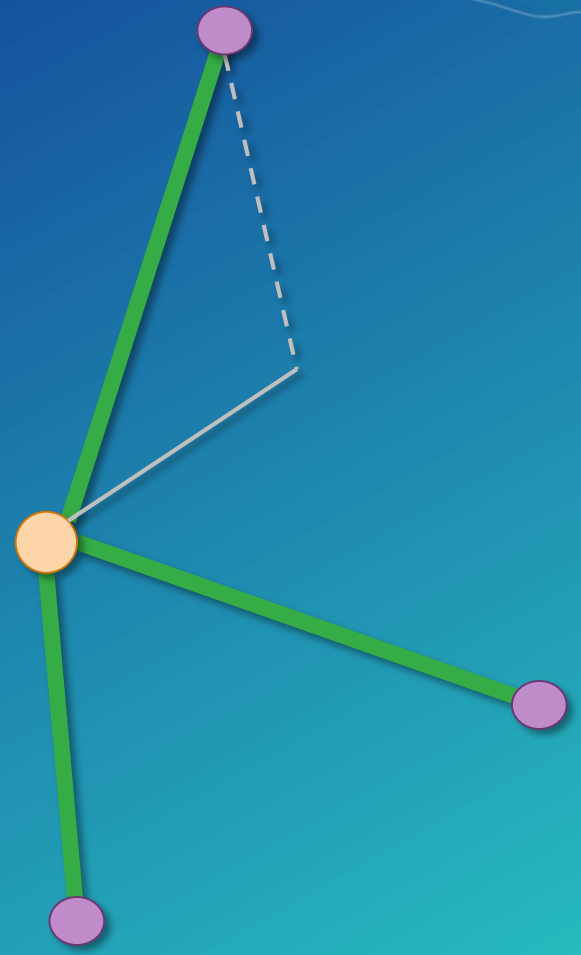
- **Connectivity on the fly**
  - **Rubber banding**
  - **Move features logically**
- **Junction subsumption**
  - **Orphan junctions**
  - **Don’t store attributes**



Editing

The editing experience

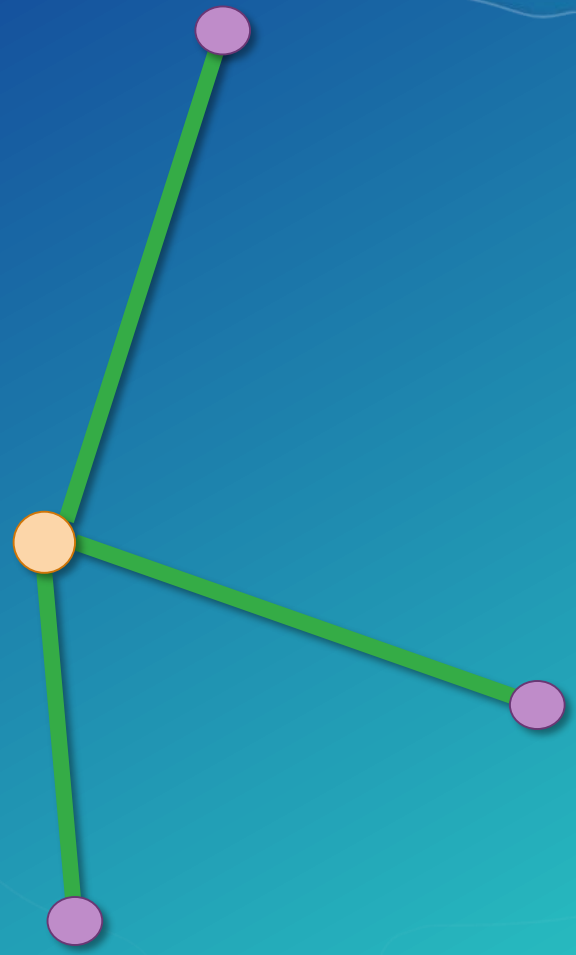
- **Connectivity on the fly**
  - Rubber banding
  - Move features logically
- **Junction subsumption**
  - Orphan junctions
  - Don’t store attributes



Editing

The editing experience

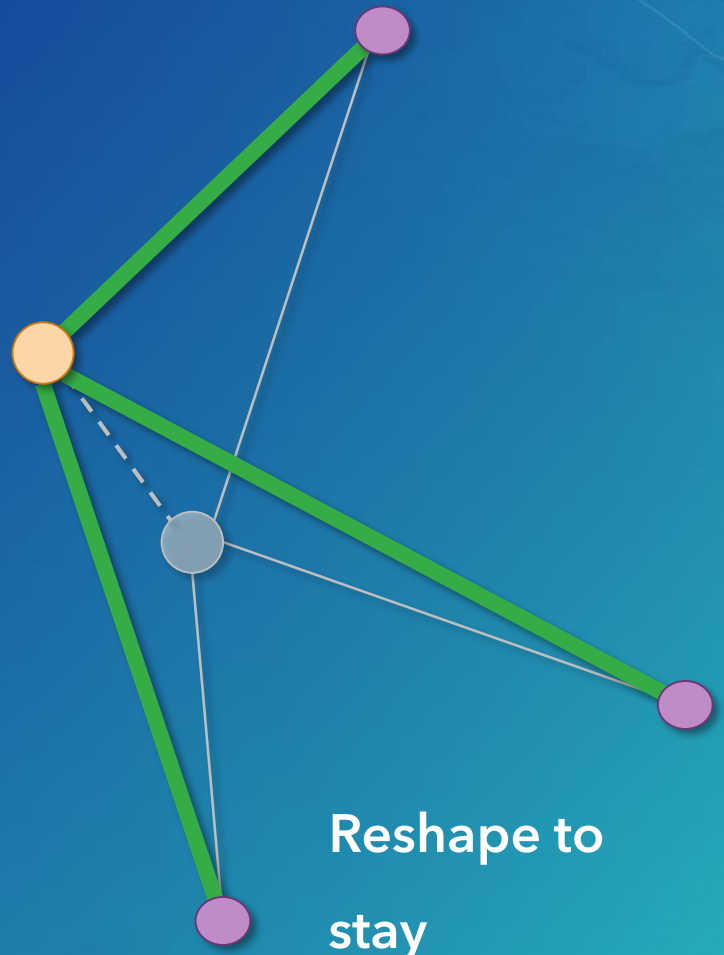
- **Connectivity on the fly**
  - Rubber banding
  - Move features logically
- **Junction subsumption**
  - Orphan junctions
  - Don’t store attributes



Editing

The editing experience

- **Connectivity on the fly**
  - Rubber banding
  - Move features logically
- **Junction subsumption**
  - Orphan junctions
  - Don’t store attributes

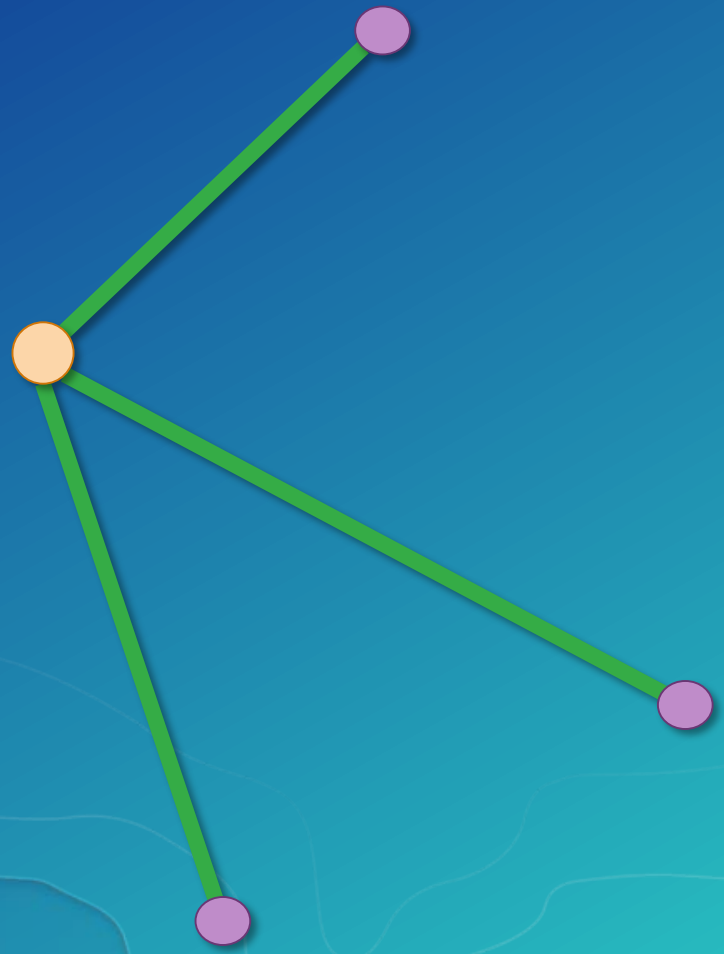


Reshape to stay connected

Editing

The editing experience

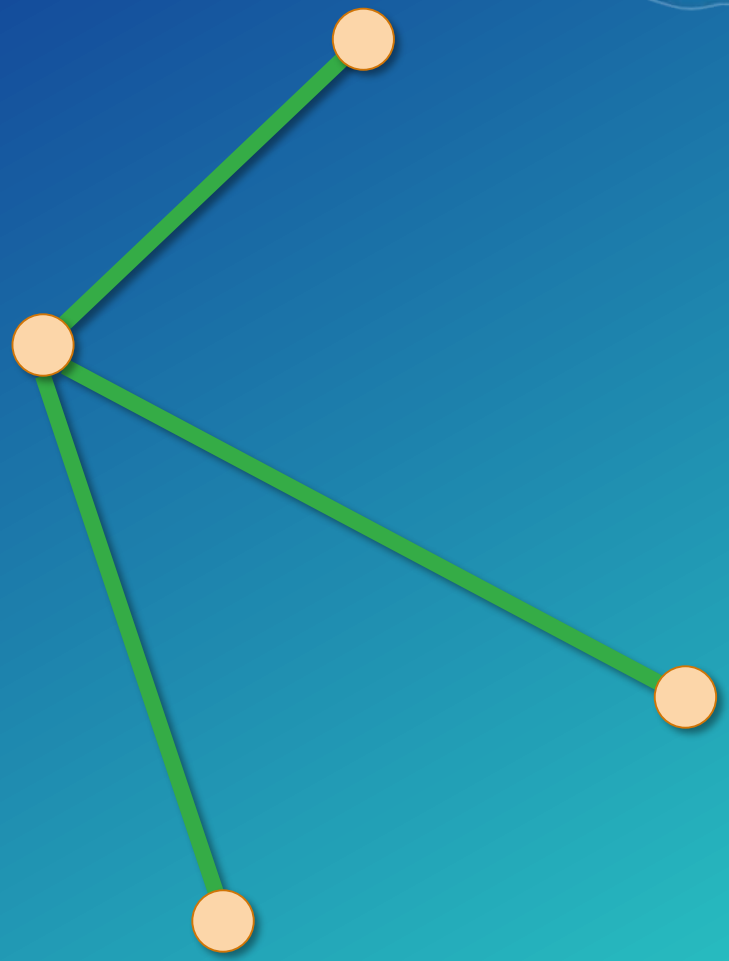
- **Connectivity on the fly**
  - Rubber banding
  - Move features logically
- **Junction subsumption**
  - Orphan junctions
  - Don’t store attributes



Editing

The editing experience

- **Connectivity on the fly**
  - Rubber banding
  - Move features logically
- **Junction subsumption**
  - Orphan junctions
  - Don’t store attributes



Editing

Editor tips and tricks

- **Snapping**
  - **Ensure connectivity**
- **Feature Cache**
  - **Snapshot of geographic locations**
  - **Hot an ready x, y, z information**

Analyzing

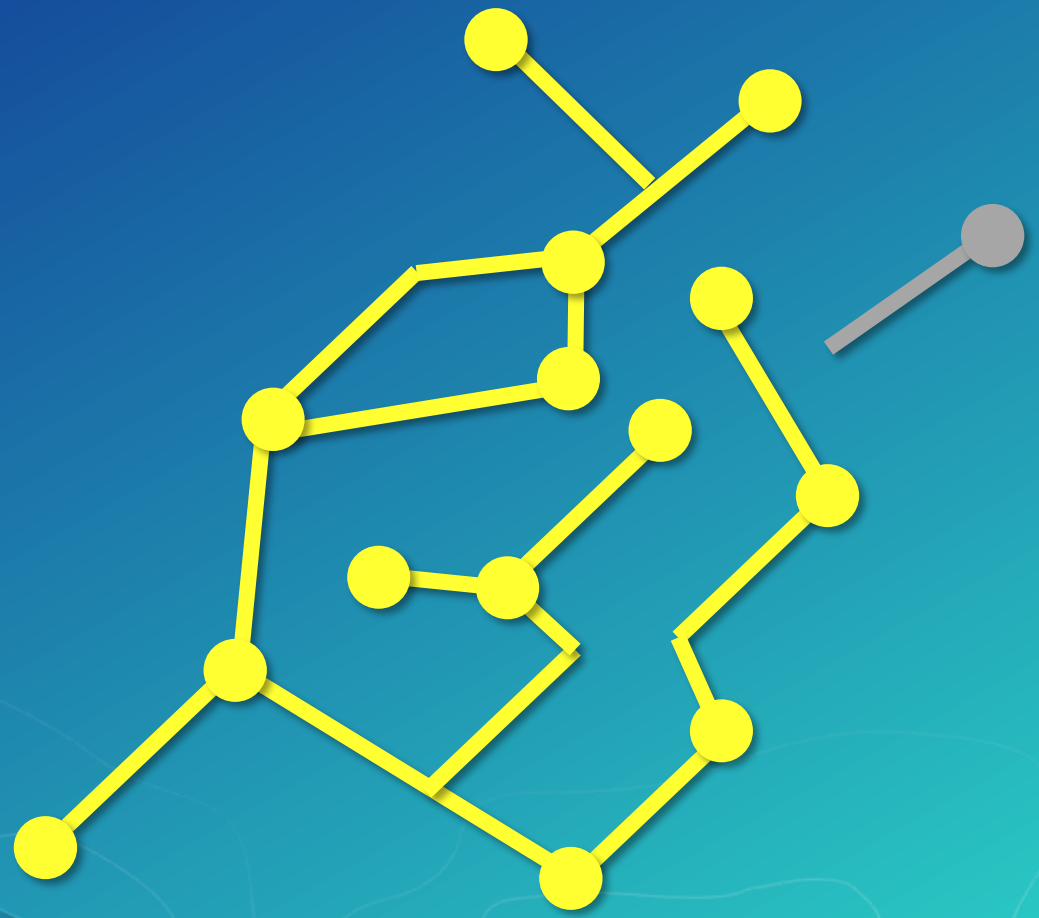
Tracing

- Travel logical paths in the network
  - Ensure connectivity
  - Find upstream/downstream features
  - Discover loops and paths
- Trace components
  - Flags
  - Barriers
- Weights

Analyzing

Tracing

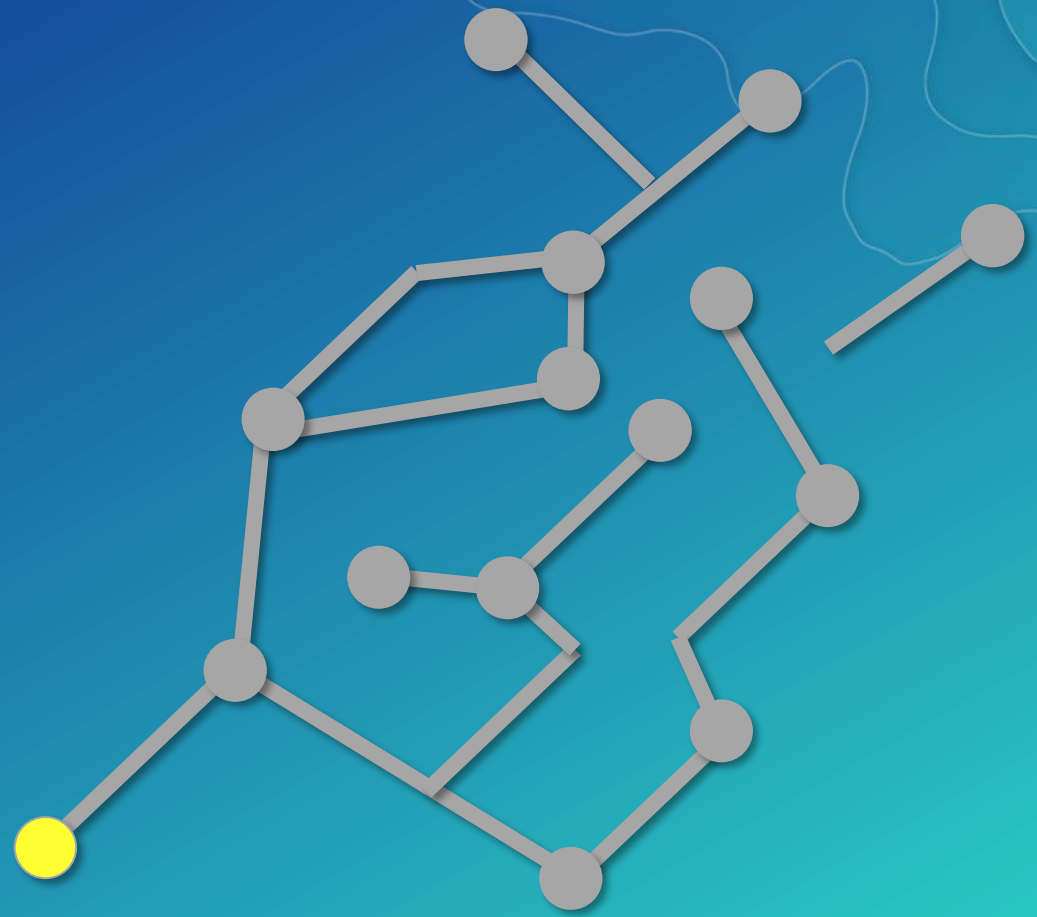
- Travel logical paths in the network
  - Ensure connectivity
  - Find upstream/downstream features
  - Discover loops and paths
- Trace components
  - Flags
  - Barriers
- Weights



Analyzing

Tracing

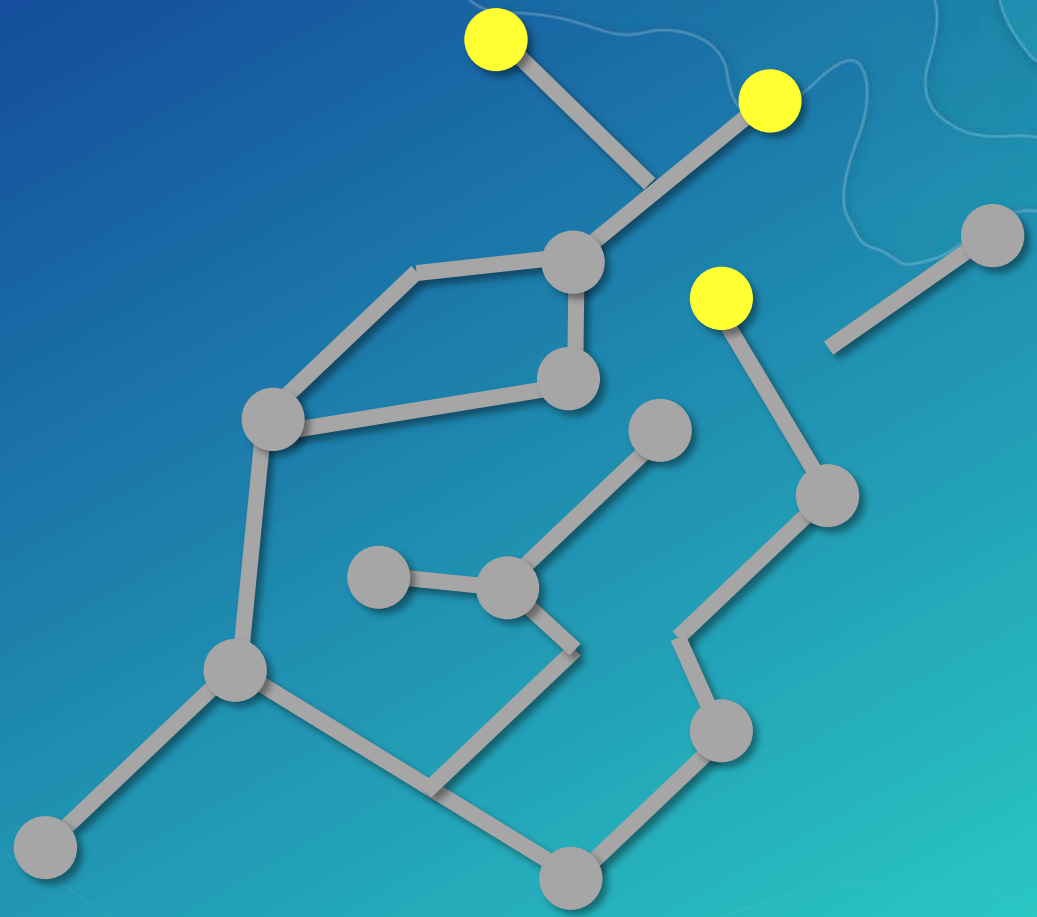
- Travel logical paths in the network
  - Ensure connectivity
  - Find upstream/downstream features
  - Discover loops and paths
- Trace components
  - Flags
  - Barriers
- Weights



Analyzing

Tracing

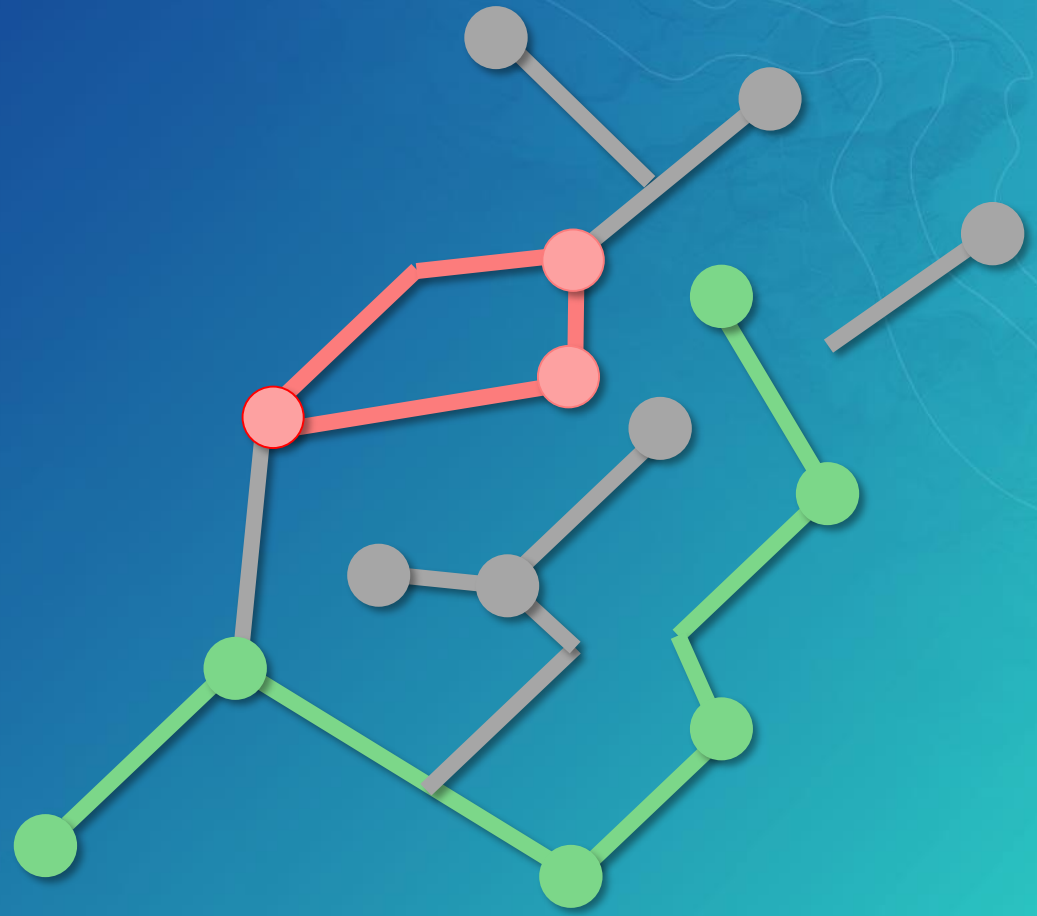
- Travel logical paths in the network
  - Ensure connectivity
  - Find upstream/downstream features
  - Discover loops and paths
- Trace components
  - Flags
  - Barriers
- Weights



Analyzing

Tracing

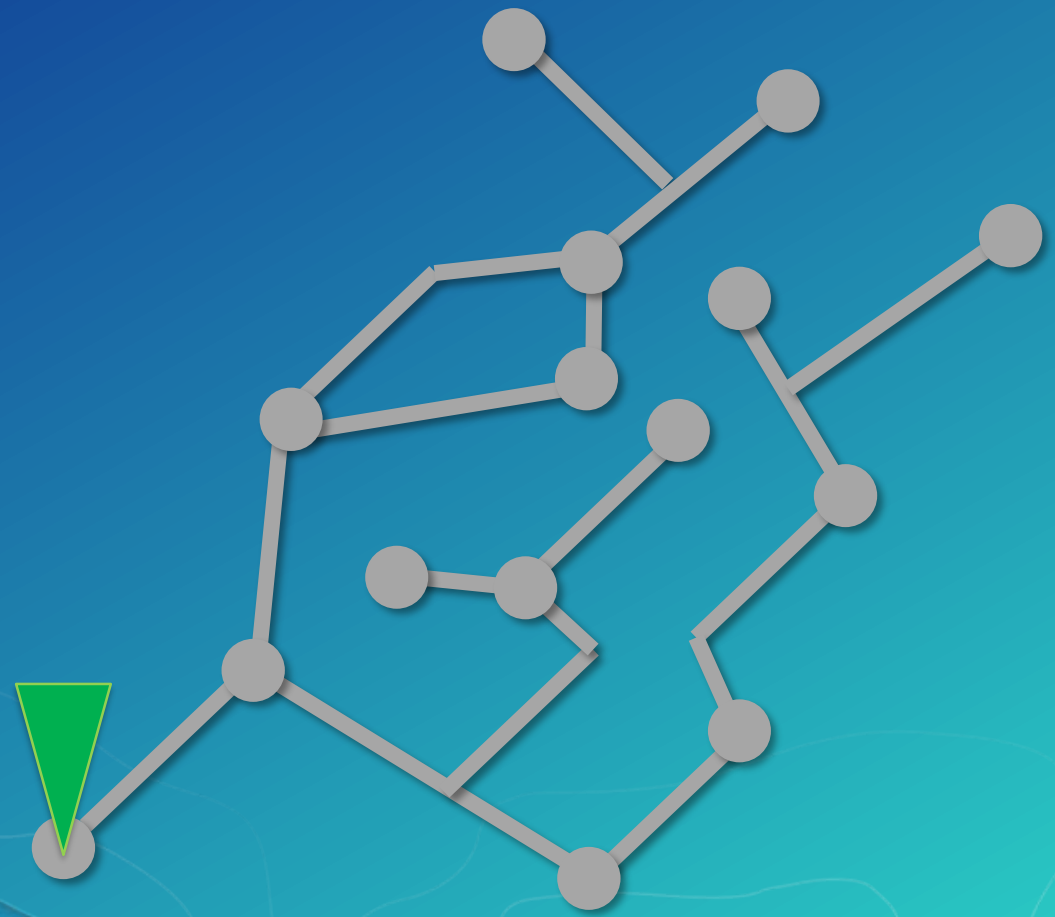
- Travel logical paths in the network
  - Ensure connectivity
  - Find upstream/downstream features
  - Discover loops and paths
- Trace components
  - Flags
  - Barriers
- Weights



Analyzing

Tracing

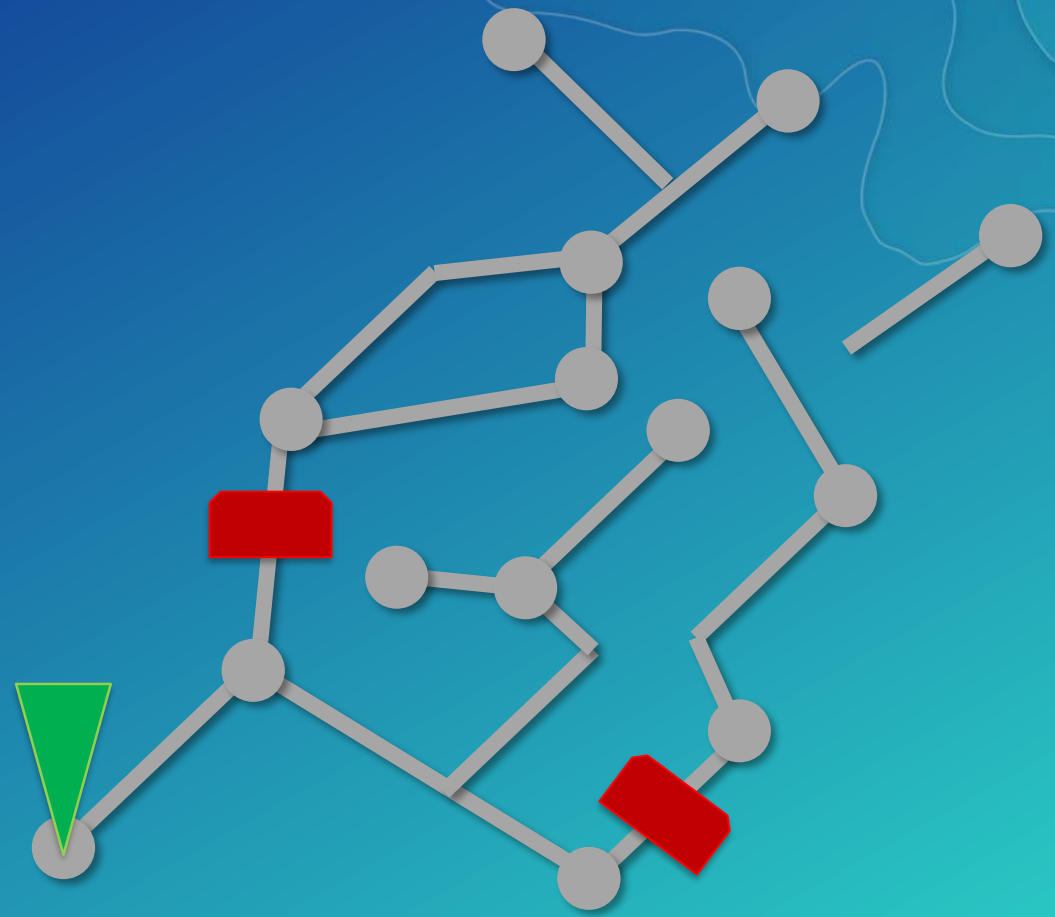
- Travel logical paths in the network
  - Ensure connectivity
  - Find upstream/downstream features
  - Discover loops and paths
- Trace components
  - Flags
  - Barriers
- Weights



Analyzing

Tracing

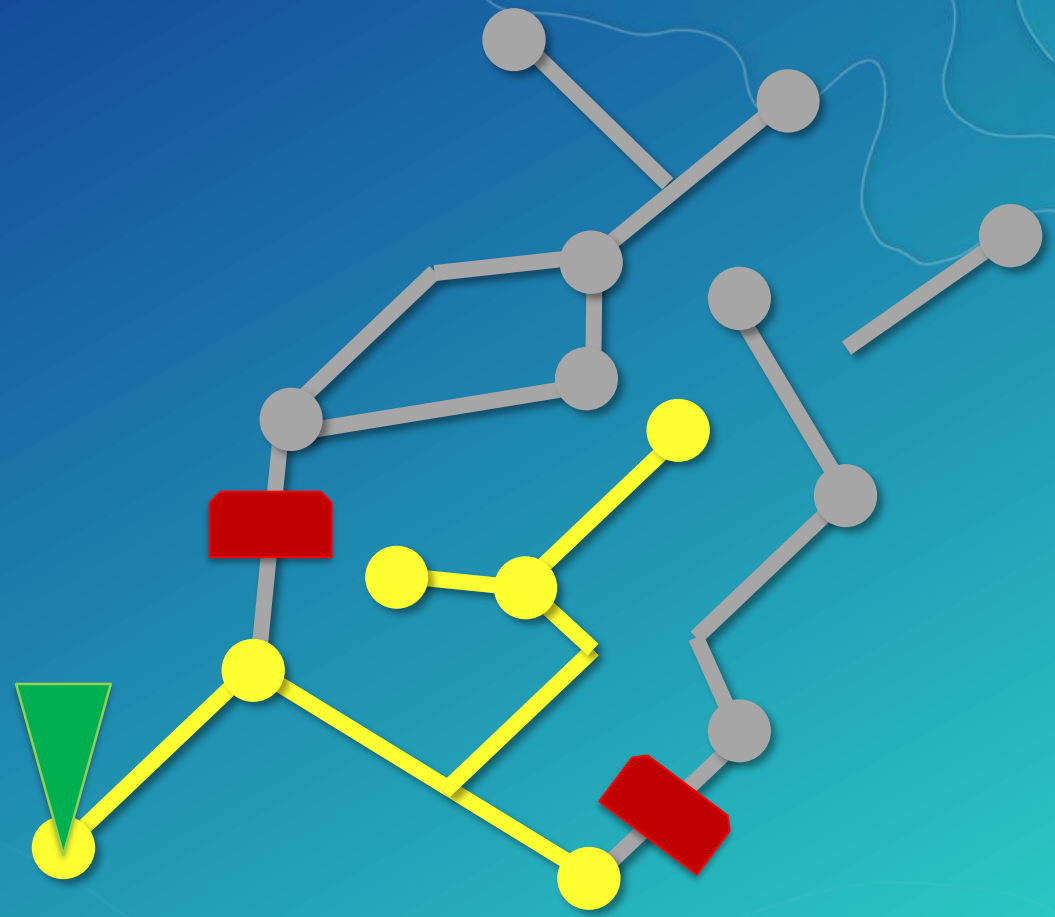
- Travel logical paths in the network
  - Ensure connectivity
  - Find upstream/downstream features
  - Discover loops and paths
- Trace components
  - Flags
  - Barriers
- Weights



Analyzing

Tracing

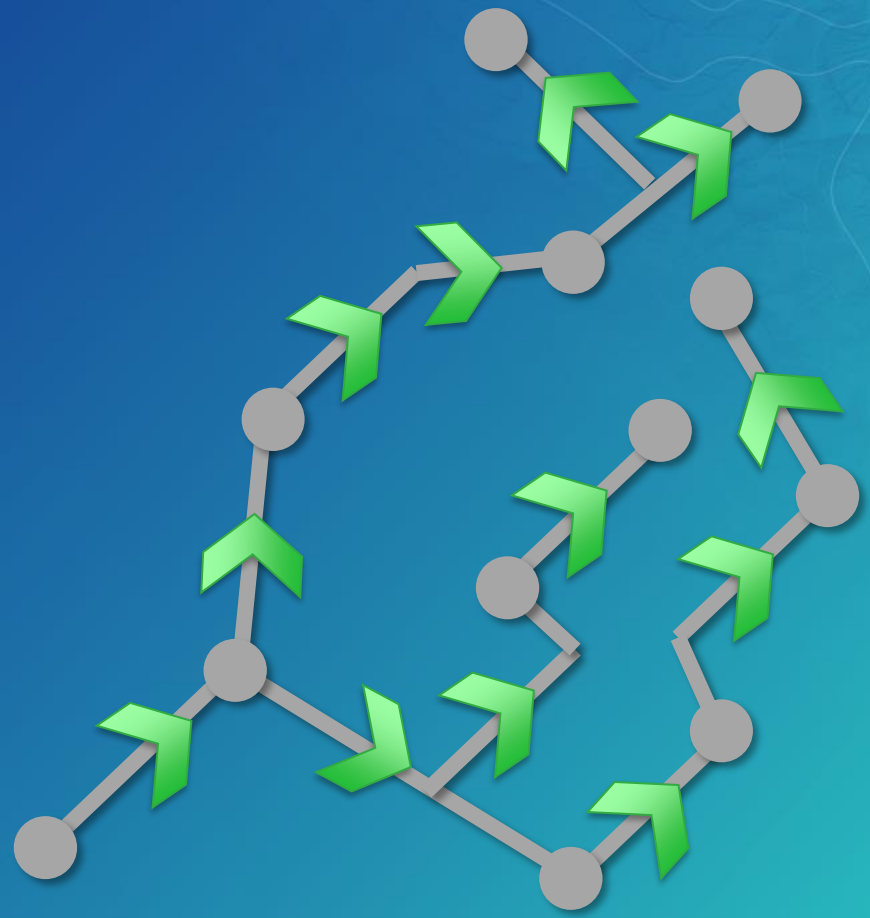
- Travel logical paths in the network
  - Ensure connectivity
  - Find upstream/downstream features
  - Discover loops and paths
- Trace components
  - Flags
  - Barriers
- Weights



Analyzing

Tracing : Flow direction

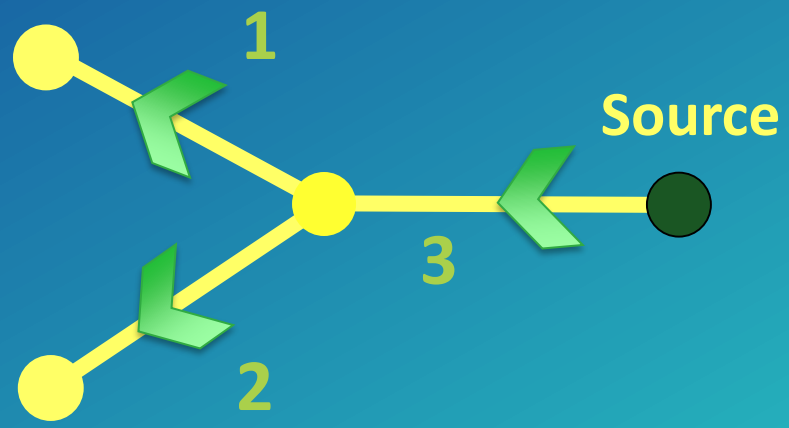
- **Direction of flow**
  - Travel a logical path
  - Easily visualized
- **Set direction**
  - Ancillary role - sources and sinks
  - Digitized direction



Analyzing

Tracing : Flow direction

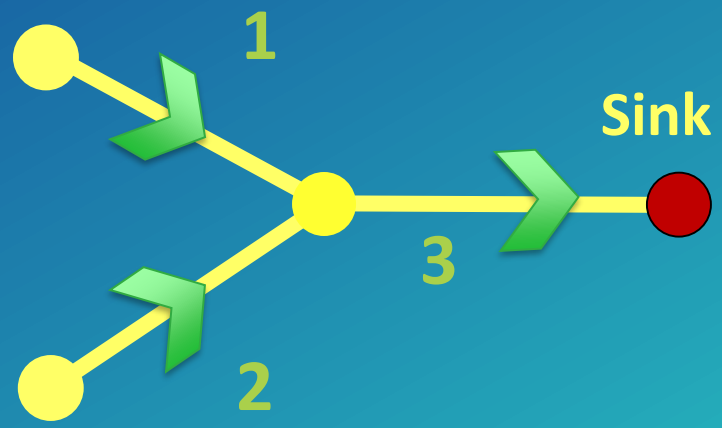
- **Direction of flow**
  - Travel a logical path
  - Easily visualized
- **Set direction**
  - Ancillary role - sources and sinks
  - Digitized direction



Analyzing

Tracing : Flow direction

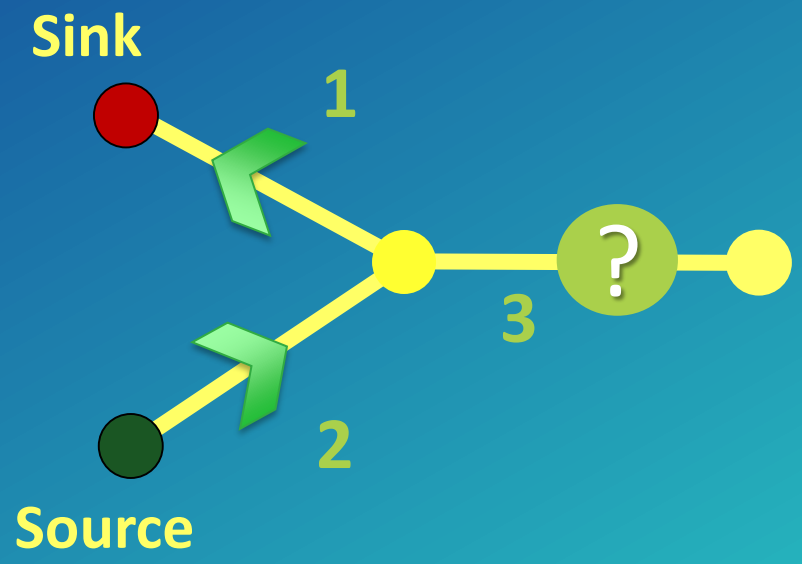
- **Direction of flow**
  - Travel a logical path
  - Easily visualized
- **Set direction**
  - Ancillary role - sources and sinks
  - Digitized direction



Analyzing

Tracing : Flow direction

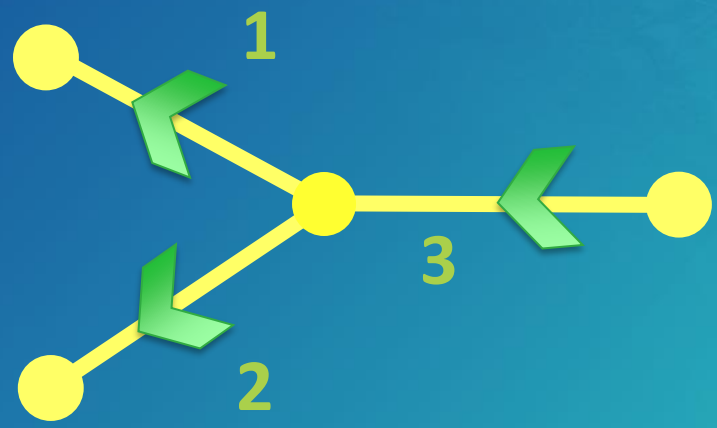
- Direction of flow
  - Travel a logical path
  - Easily visualized
- Set direction
  - Ancillary role - sources and sinks
  - Digitized direction



Analyzing

Tracing : Flow direction

- Direction of flow
  - Travel a logical path
  - Easily visualized
- Set direction
  - Ancillary role - sources and sinks
  - Digitized direction



Analyzing

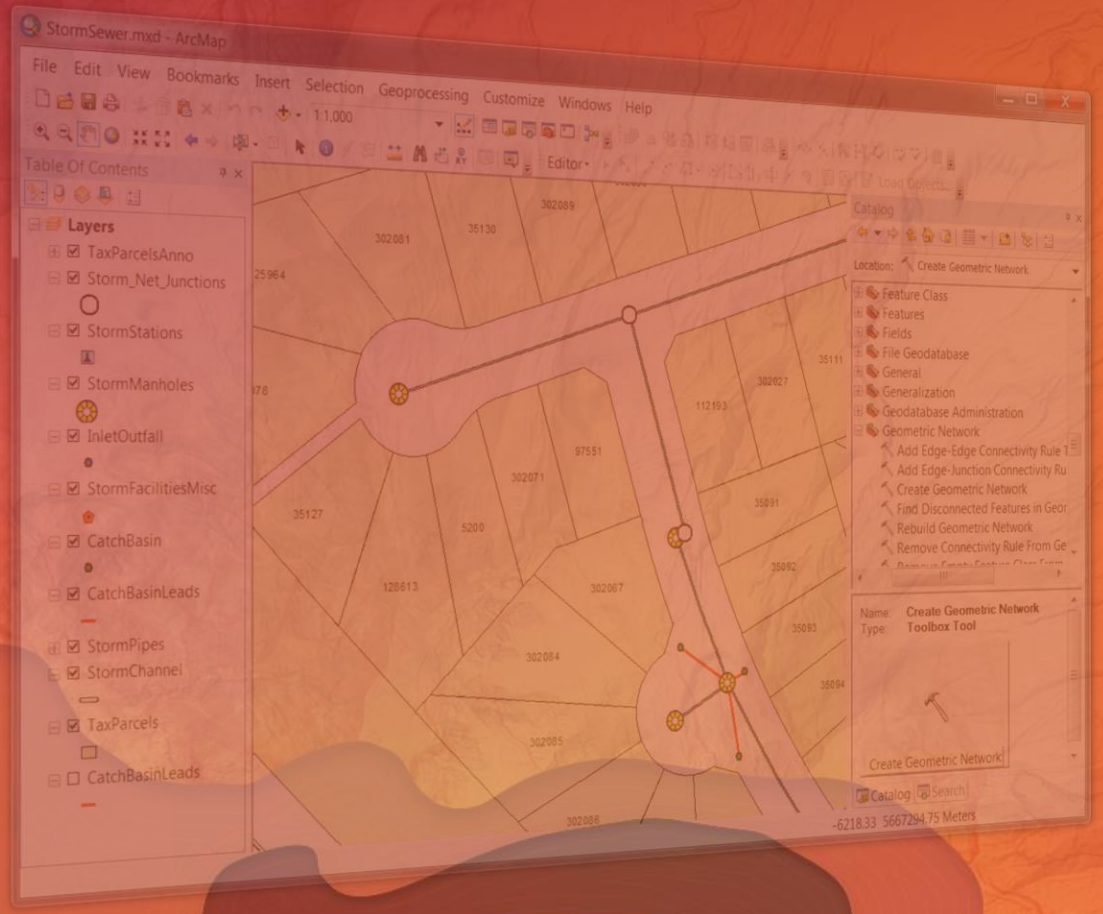
Tracing : Weights

- **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

- **Cost of travel**
  - Consider feature attribution
  - Assigned to weights in the index
- **Uses**
  - Least-cost analysis
  - Accumulation trace
- **3 Types**
  - Double, integer, and bitgate

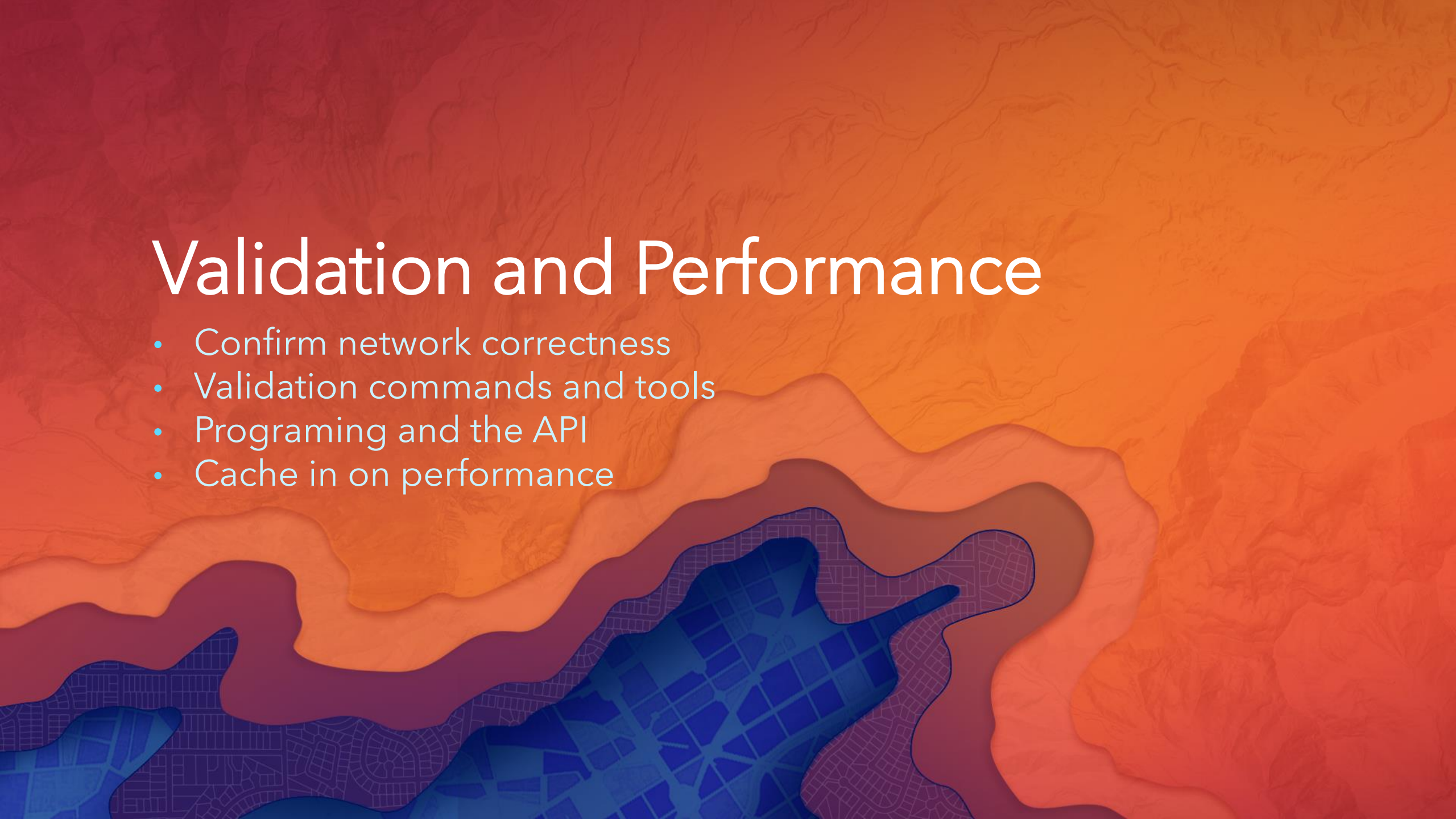


Editing and Tracing

Demonstration

Validation and Performance

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



Validation

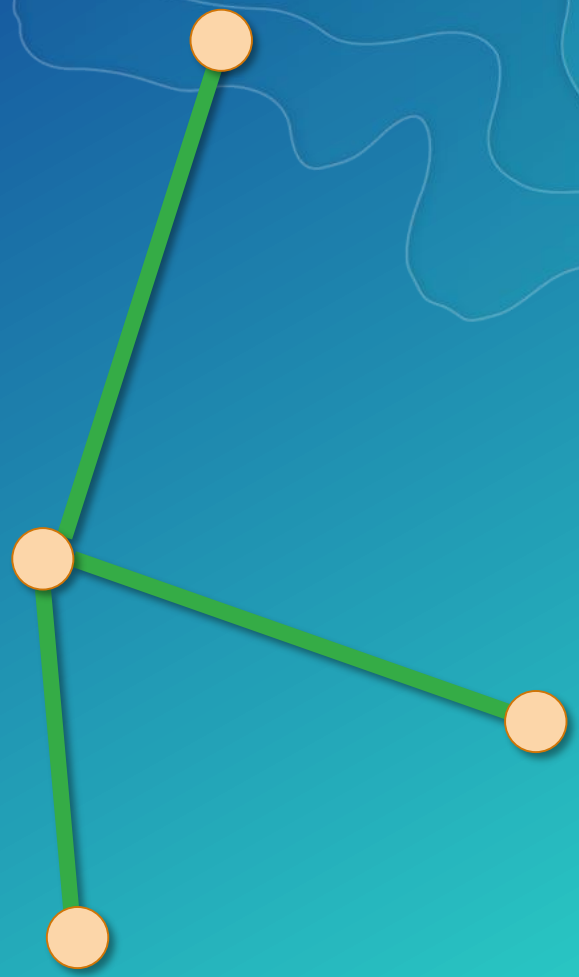
Confirm network correctness

- **Rubber banding**
  - On the fly connectivity
- **Validation commands and tools**
  - Checks rules against the network
  - Batch process with GP tools
- **Analytics**
  - Find connected trace

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



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

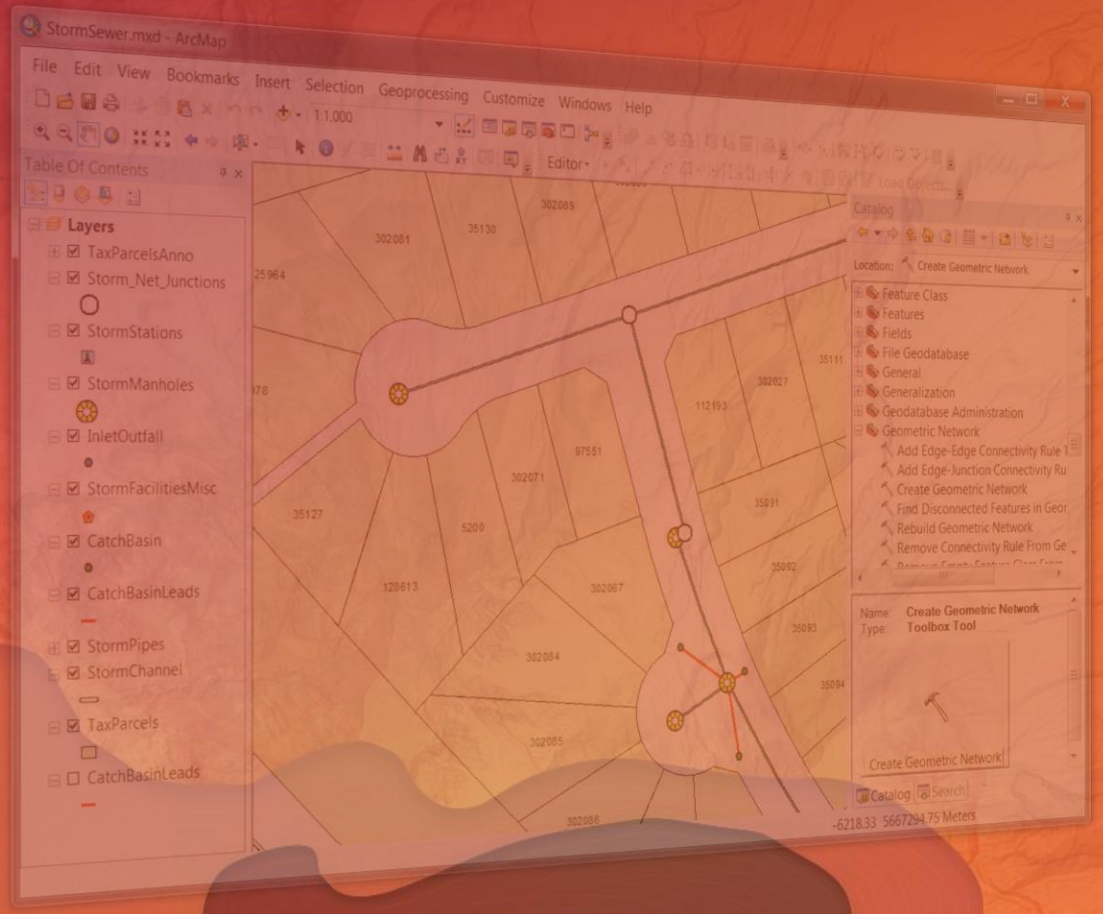
The API

- **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)

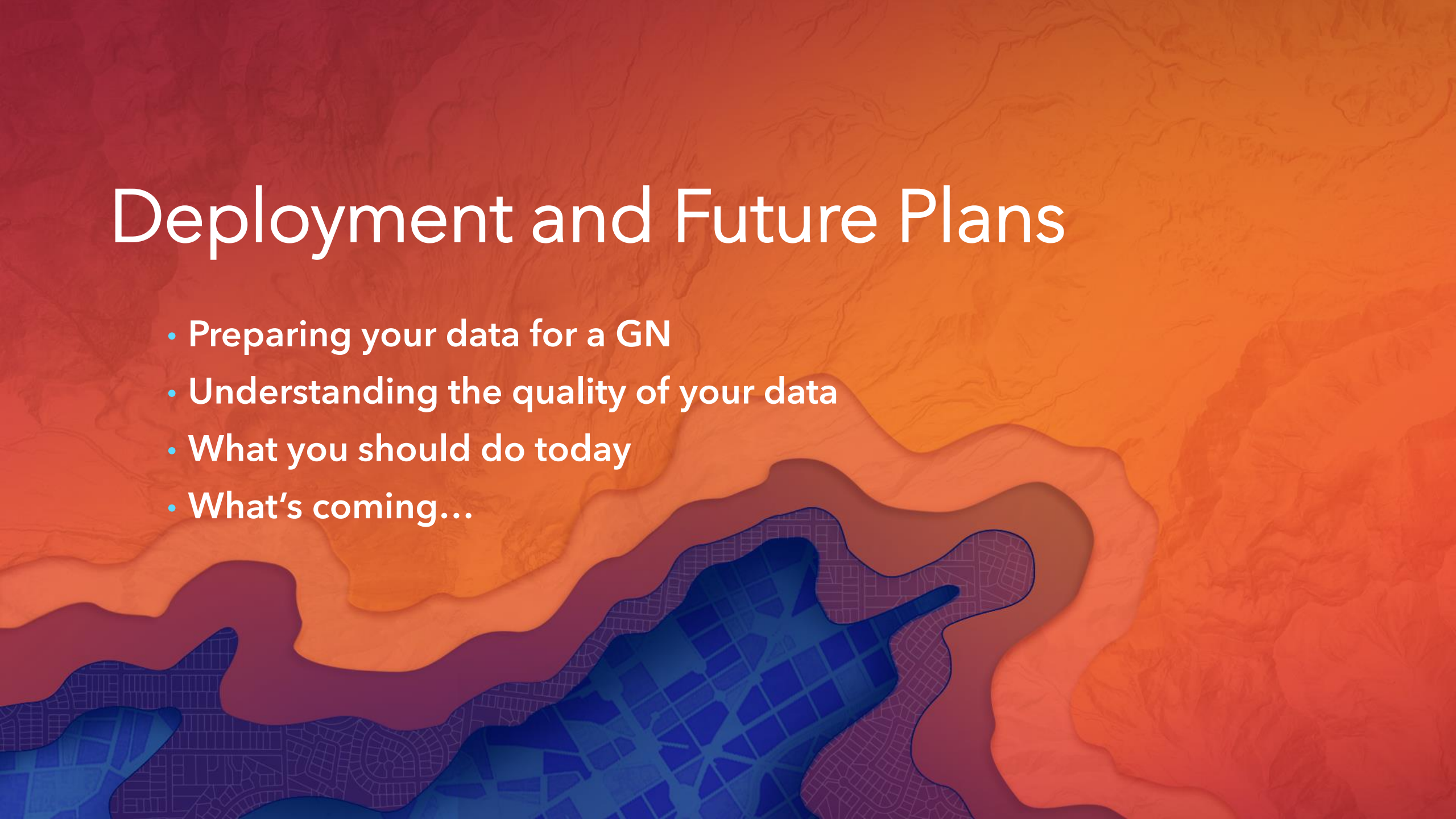


Validation

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**

esri
THE
SCIENCE
OF
WHERE