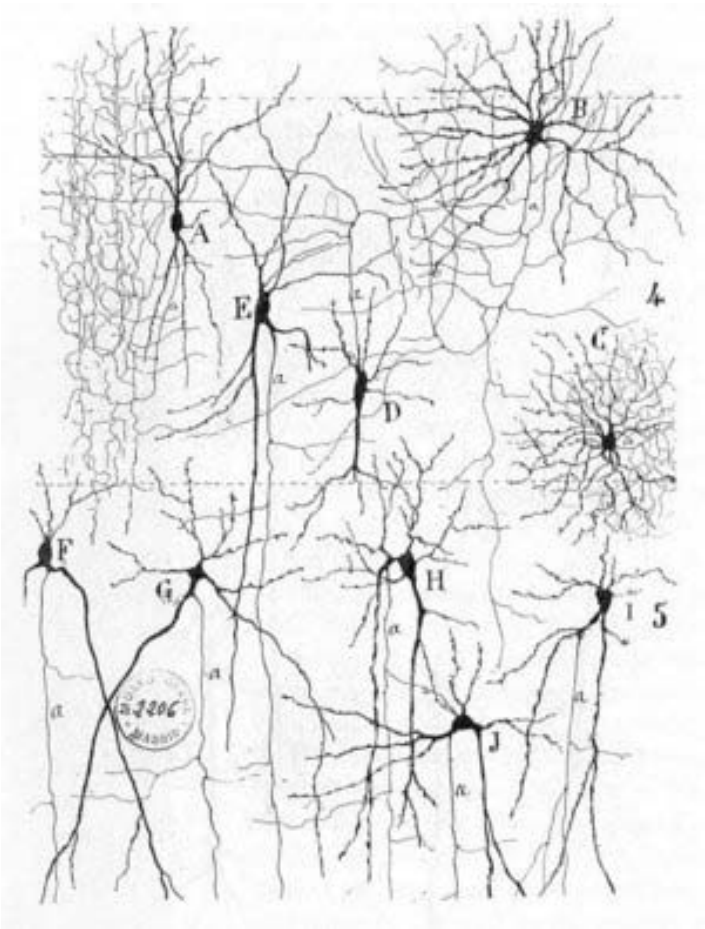
Network Analysis Tools

GIS III: GIS Analysis

Children's Environmental Health Initiative

Learning Objectives

- Introduce basic components of a network
- Understand general network analysis concepts
- Offer a few examples of current application
- Introduce network analysis in ArcGIS

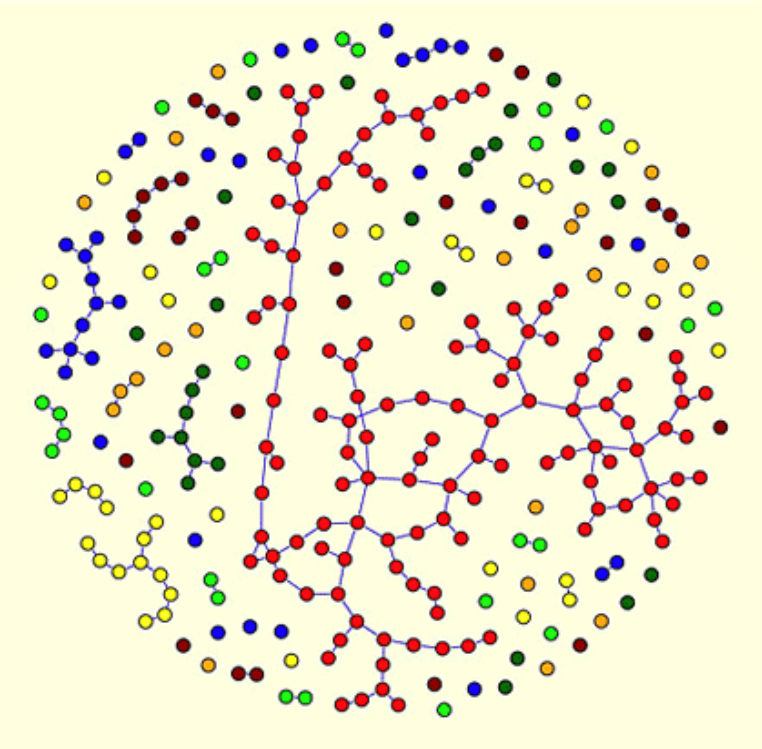


What is a Network?

- Interconnected set of points (nodes) and lines (edges)

- Examples
  - Information networks
  - Social networks
  - Stream networks
  - Transportation networks

- Connectivity allows for analysis/problem solving

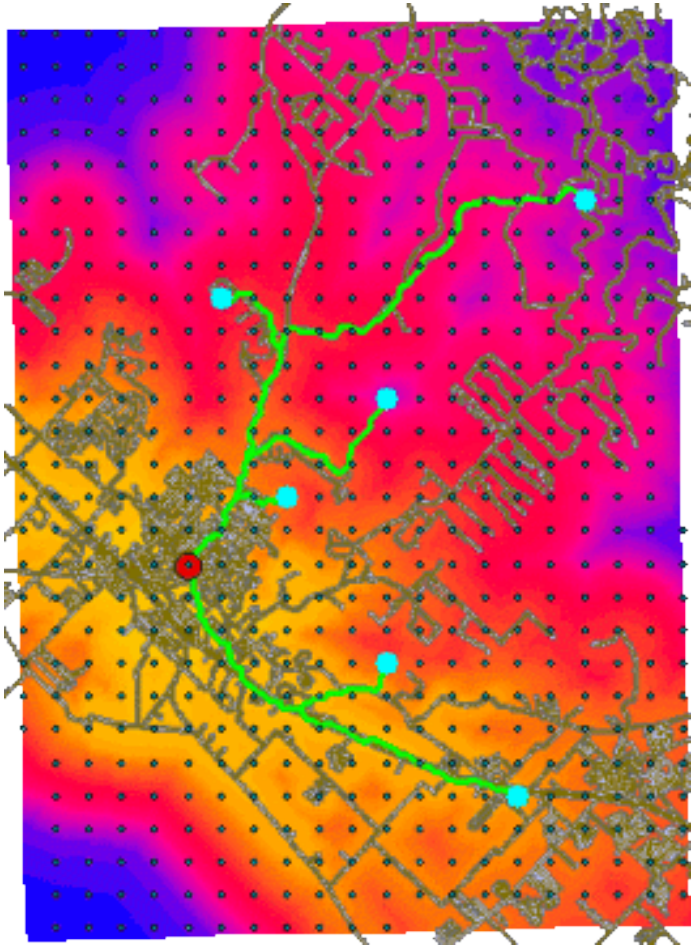


Networks and GIS

- A set of interconnected line entities whose attributes share some common theme primarily related to flow

- Network lines define relationships between nodes

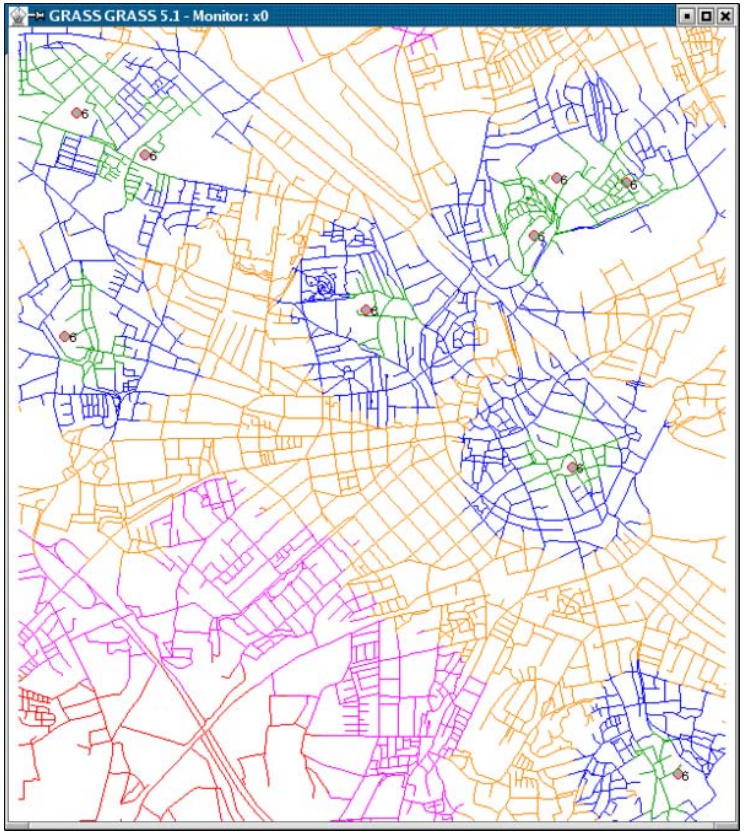
- Flow types:
  - Data
  - Objects
  - Materials



Networks and GIS

- **Rules** dictate how objects can move through the network

- Types
  - Direction – one way streets
  - Barriers
  - Time of day
  - Node restrictions – stroke centers
  - Sequence – stop 1 then stop 2



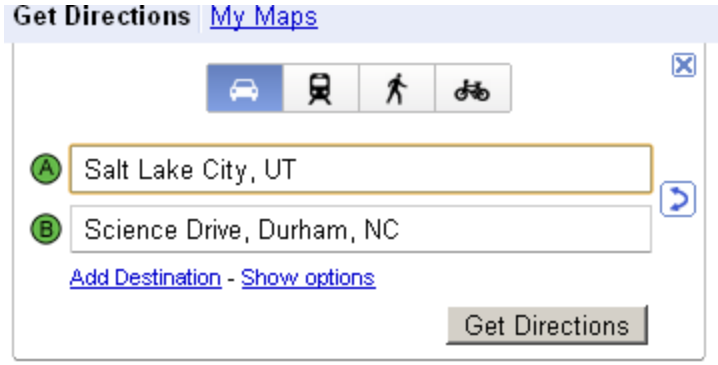
Networks and GIS

- Cost:

What is the impact of an object flowing through the network?

- Types
  - Time
  - Distance

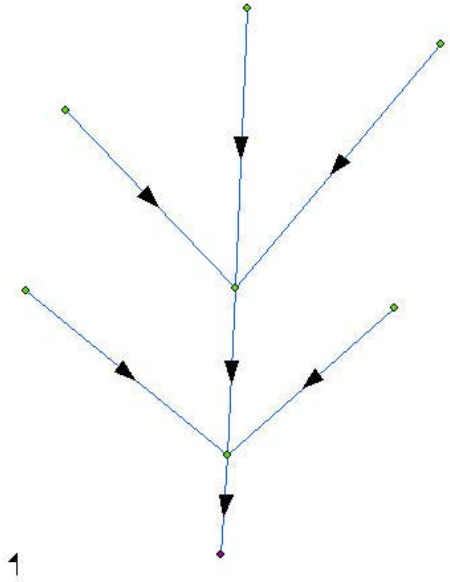
Based on connectivity, flow, and rules



Directions to Science Dr, Durham, NC
2,121 mi – about **1 day 10 hours**

Network Basics

- Set of nodes connected by lines
- Represent some type of flow
- Incorporate flow rules
- Rules determine cost



Network Analyst

- Network analysis is a set of analysis techniques used with networks

- Network Analyst is the ESRI extension that performs network analysis in ArcMap

- Network Analyst uses network datasets

- Types of analysis:
  - Route
  - Service areas
  - closest facility
  - Origin-destination cost matrix

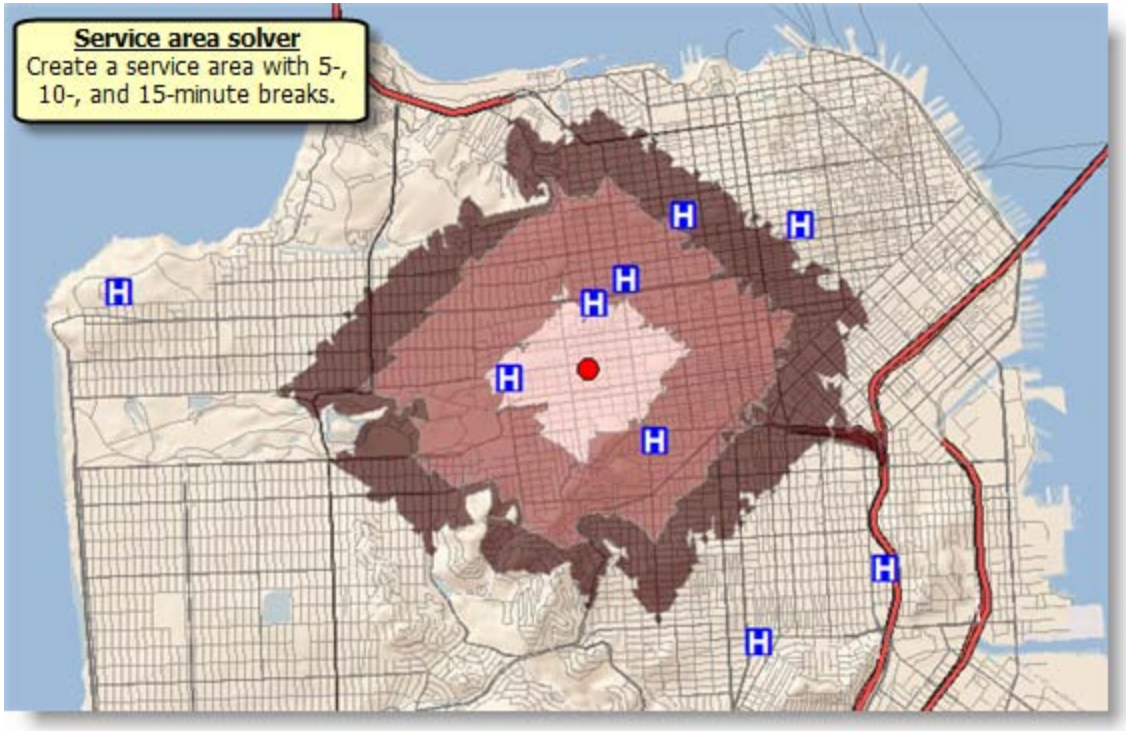
Network Analyst

- Route:
  - Can be simple – finding driving directions between two points
  - More complex – best route between 10 different stops
- “Best” can mean different things:
  - Shortest distance
  - Quickest
  - Most scenic
  - No highways

Network Analyst

Service areas:

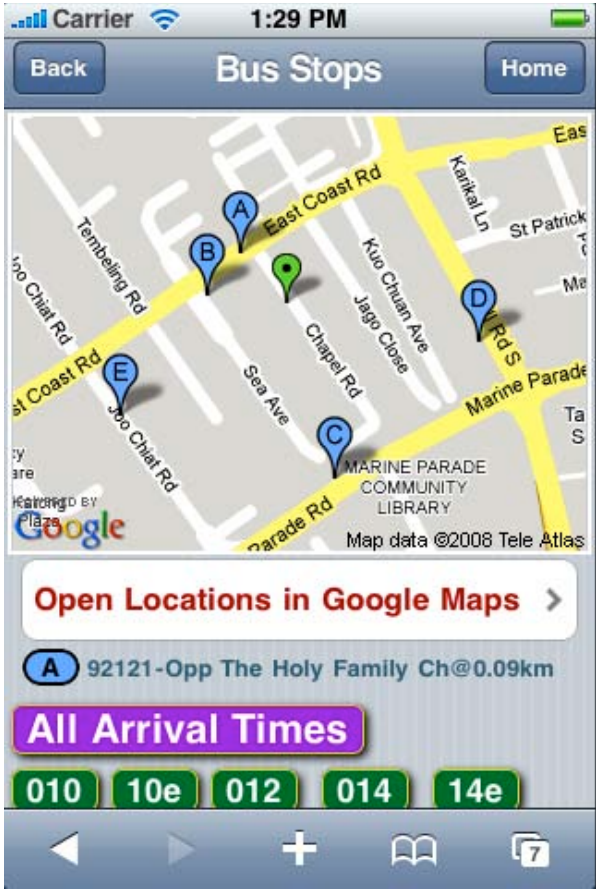
- Calculate an area based on time or distance from an input
- Good for estimating populations
- Different than a simple buffer



Network Analyst

Closest facility:

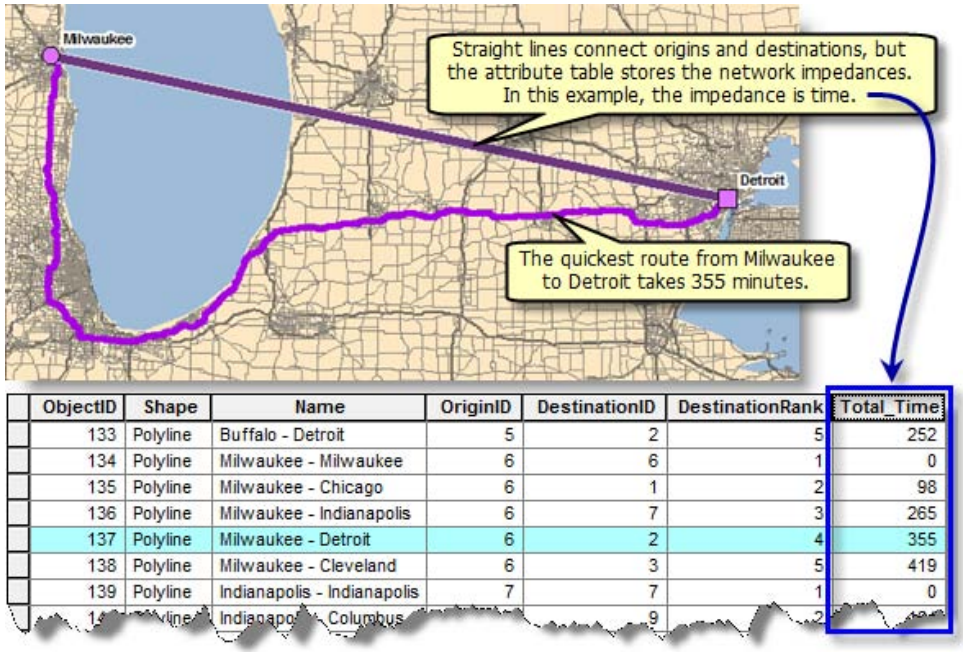
- Calculate the nearest X number of facilities to an incident or point of interest
- Closest can be based on network distance or time
- Set up a cutoff
  - Find all the hospitals within 5 minutes of an accident
  - Find all the clinics within 2 miles of a home address



Network Analyst

Origin-destination cost matrix:

- Creates a cost matrix from multiple origins to multiple destinations
- Good for calculating distance or time between multiple start and end points



ObjectID	Shape	Name	OriginID	DestinationID	DestinationRank	Total_Time
133	Polyline	Buffalo - Detroit	5	2	5	252
134	Polyline	Milwaukee - Milwaukee	6	6	1	0
135	Polyline	Milwaukee - Chicago	6	1	2	98
136	Polyline	Milwaukee - Indianapolis	6	7	3	265
137	Polyline	Milwaukee - Detroit	6	2	4	355
138	Polyline	Milwaukee - Cleveland	6	3	5	419
139	Polyline	Indianapolis - Indianapolis	7	7	1	0
1[illegible]	[illegible]line	Indianapo[illegible] - Columbus	[illegible]	9	2	[illegible]

Useful Examples

Driving times and distances to hospitals with percutaneous intervention in the United States: Implications for prehospital triage of patients coronary with st-elevation myocardial infarction Circulation 2006;113;1189-1195

Brahmajee K. Nallamothu, Eric R. Bates, Yongfei Wang, Elizabeth H. Bradley, and Harlan M. Krumholz

Access to primary percutaneous coronary intervention for ST-segment elevation myocardial infarction in Canada: a geographic analysis Open Medicine 2010;1(1):e21

Alka B. Patel, Jack V. Tu, Nigel M. Waters, Dennis T. Ko, Mark, J.Eisenberg, Thao Huynh, Stéphane Rinfret, Merril Knudtson, and William A. Ghali

Getting Started with NA

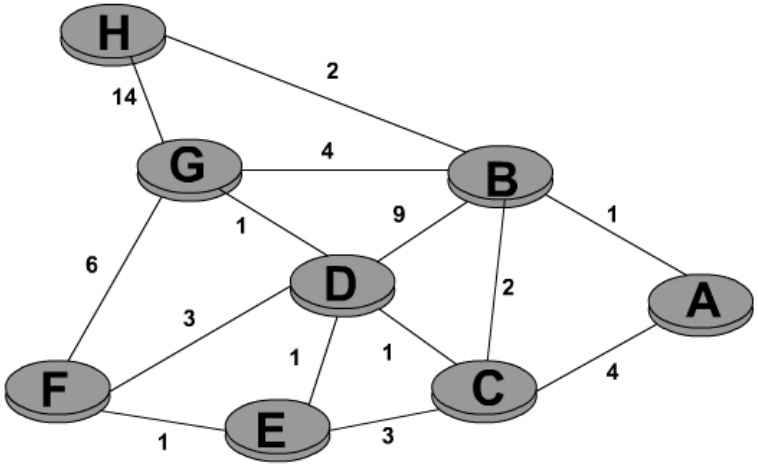
- Network locations
- Network Analyst workflow
- Useful analyses
  - Routes
  - Service areas
  - Closest facility
  - Origin destination cost matrices

Review and New Terms

- A network is made up of edges and nodes
  - Edges are the “lines” of the network
  - Nodes are physical locations

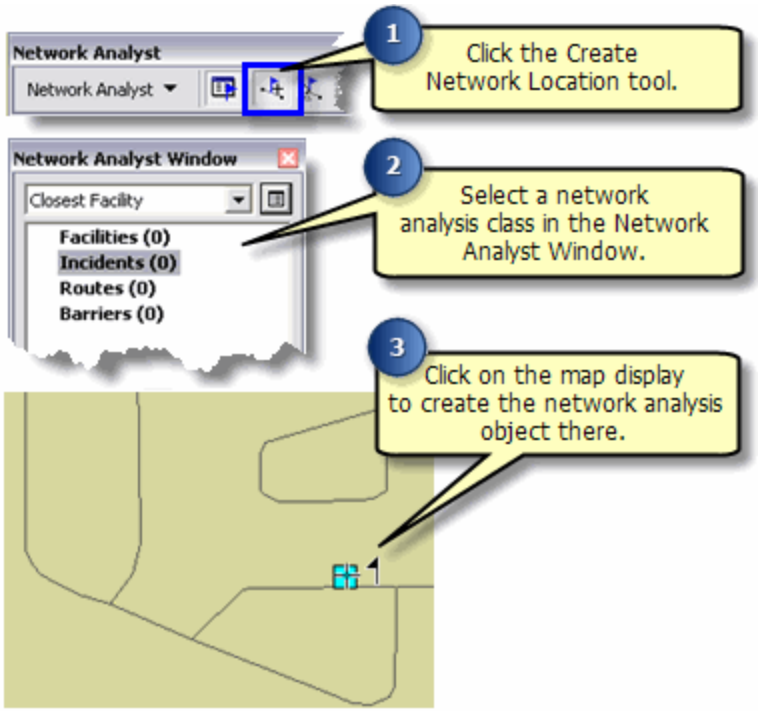
- Edges for all cases discussed in this module will be roads

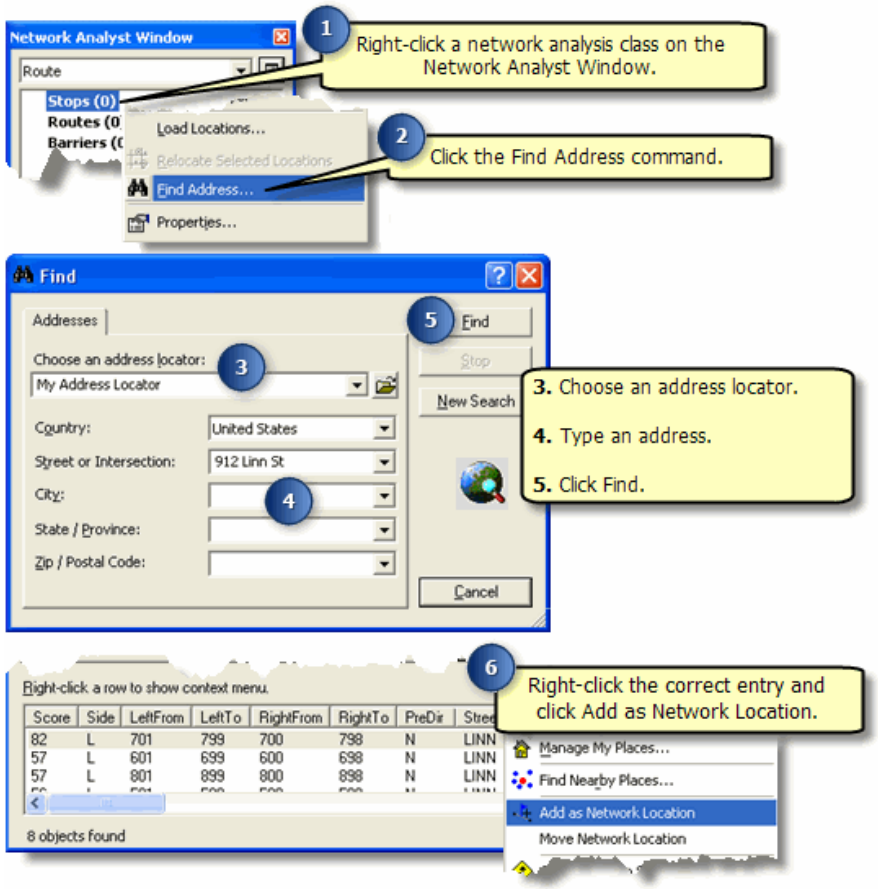
- Types of locations (nodes)
  - Stops
  - Barriers
  - Facilities
  - Incidents
  - Origins
  - Destinations



Network locations

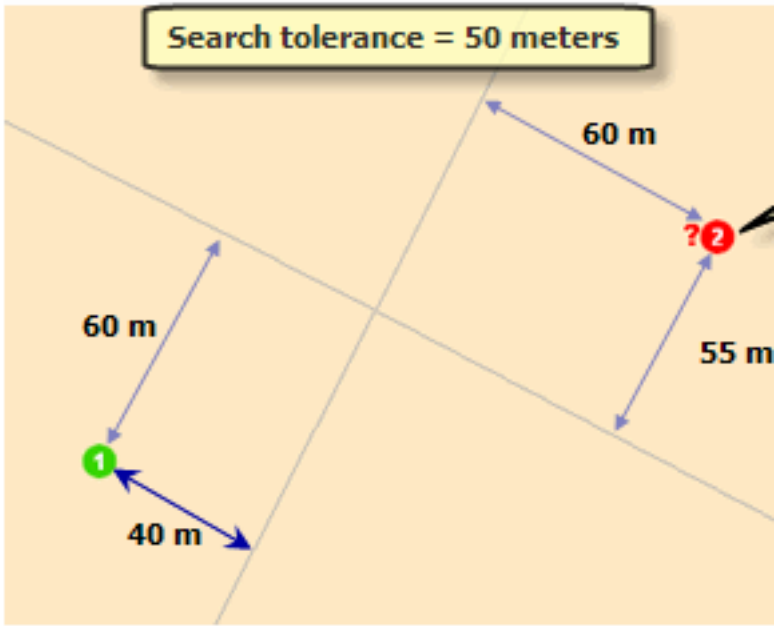
- **Adding your own network locations to a network**
  - **Create Network Location tool**
  - **Load Locations tool**
  - **Find tool**

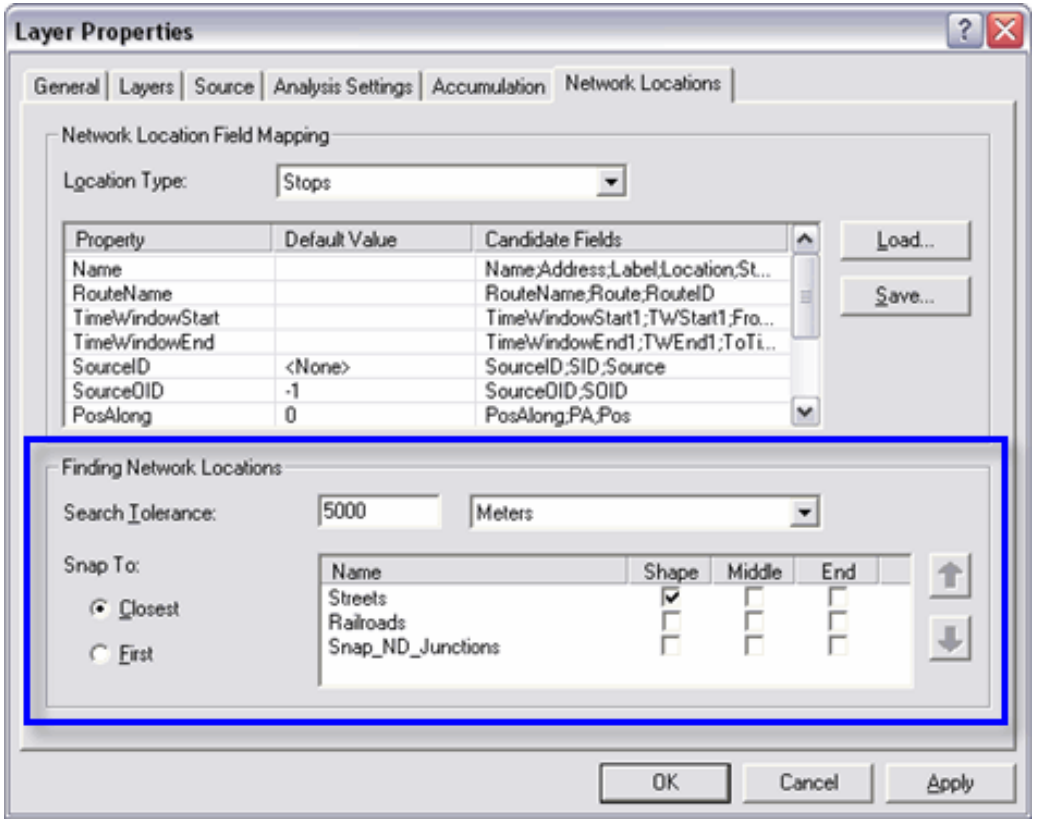




Network locations

- Finding network locations
  - Search tolerance
  - Snapping environment





Network Analyst workflow

1. *Create network analysis layer*
2. Add network locations
3. Set analysis properties
4. Perform analysis and display results