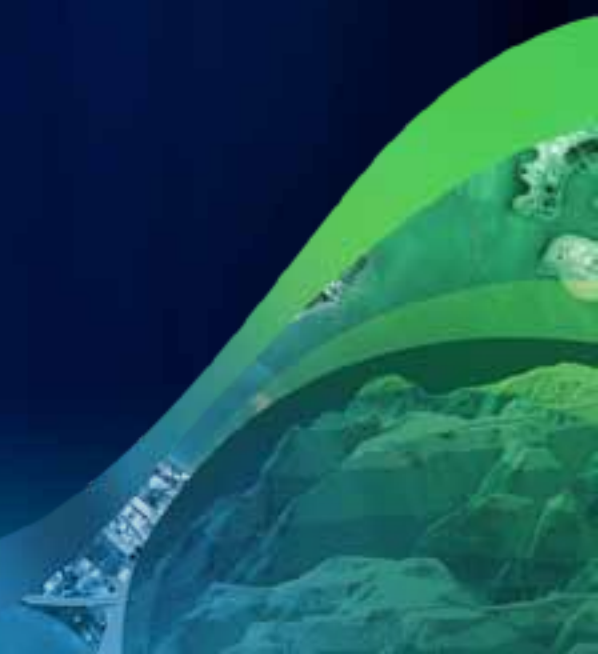
Esri International User Conference | San Diego, CA

Technical Workshops | July 12th and 13th, 2011

ArcGIS Network Analyst – An Introduction

Patrick Stevens

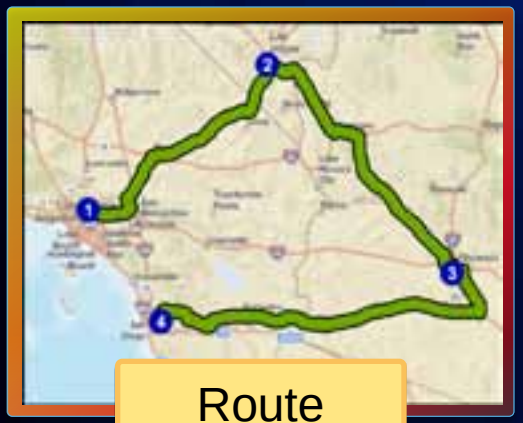
Robert Garrity



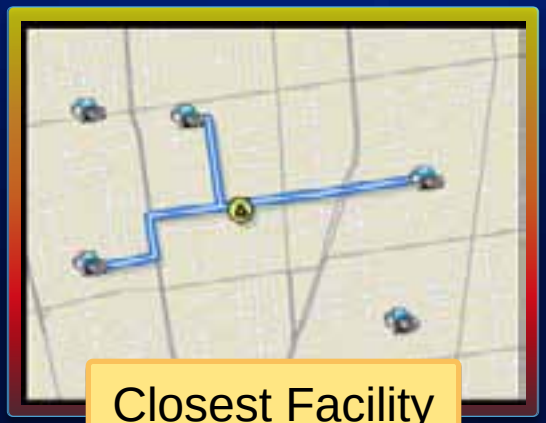
Demo: Example applications

Introduction to Network Analyst

- What is Network Analyst?
- Powerful modeling capabilities of the network dataset
- Analysis demos
- Network Analyst at the User's Conference



Route

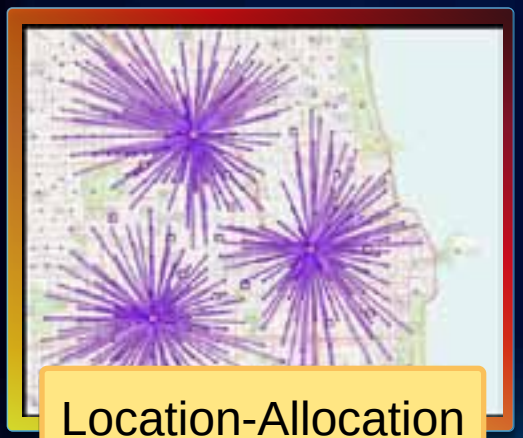


Closest Facility

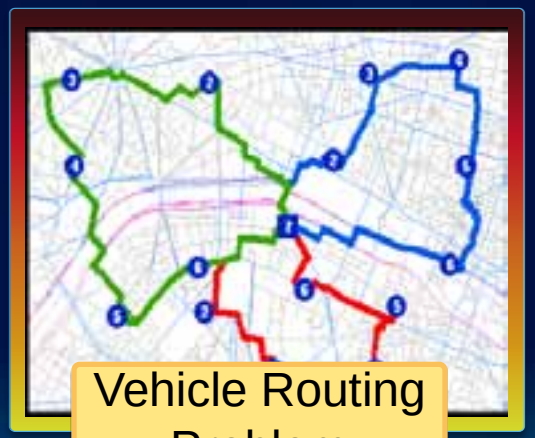
Service Area

ArcGIS Network Analyst Extension

Solving transportation problems



Location-Allocation



Vehicle Routing Problem

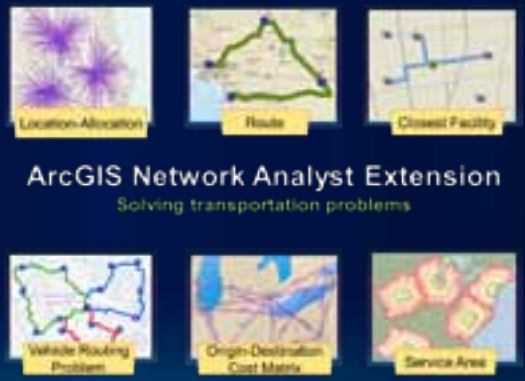
Origin-Destination Cost Matrix

How you work with Network Analyst

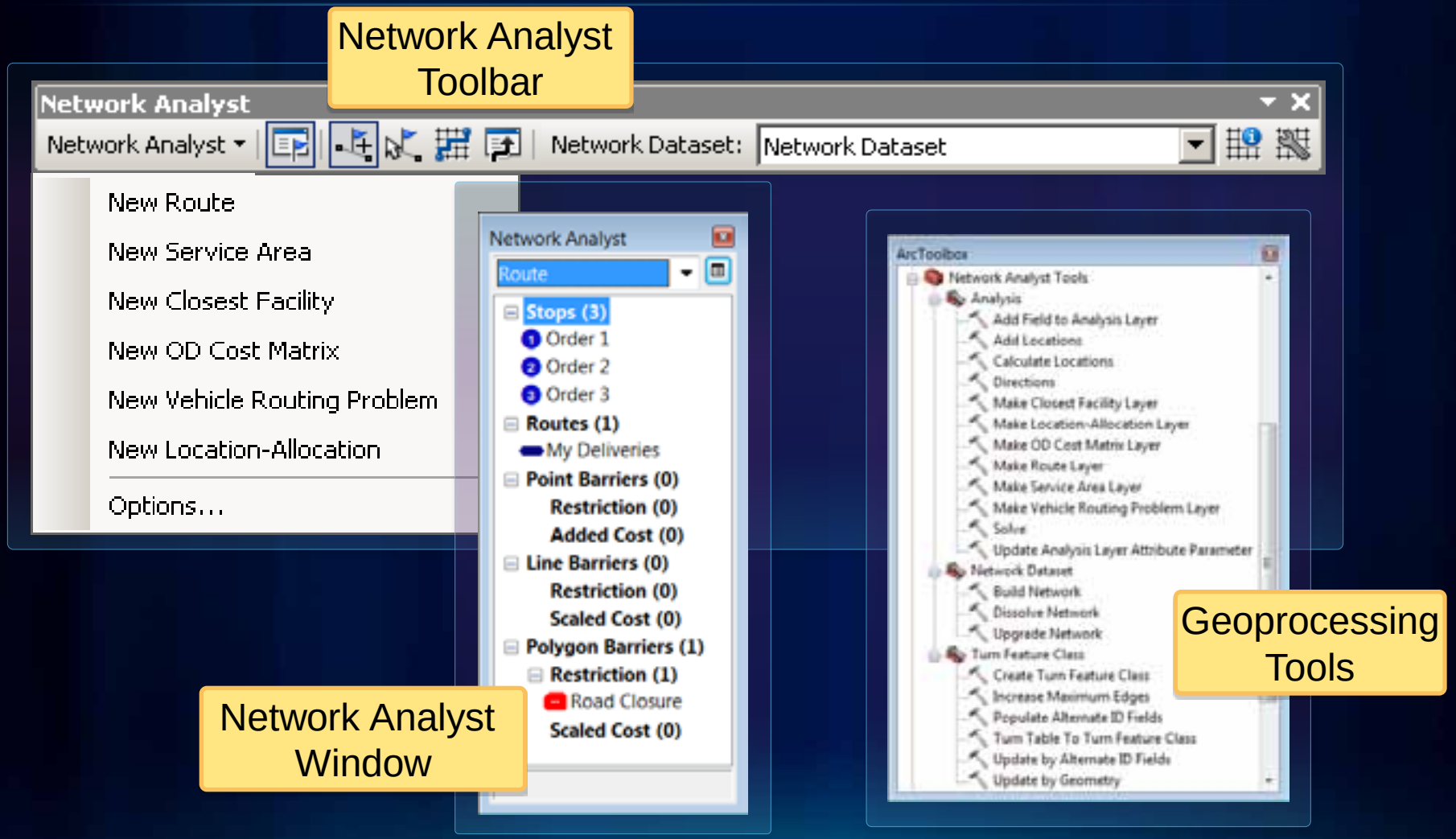
- Enable extension license

- Work with Network Datasets
  - ArcMap
  - ArcCatalog (or ArcMap's Catalog window)

- Perform network analysis
  - ArcMap
  - Geoprocessing
  - ArcGIS Explorer
  - ArcGIS Server
  - ArcScene/ArcGlobe
  - ArcGIS Online

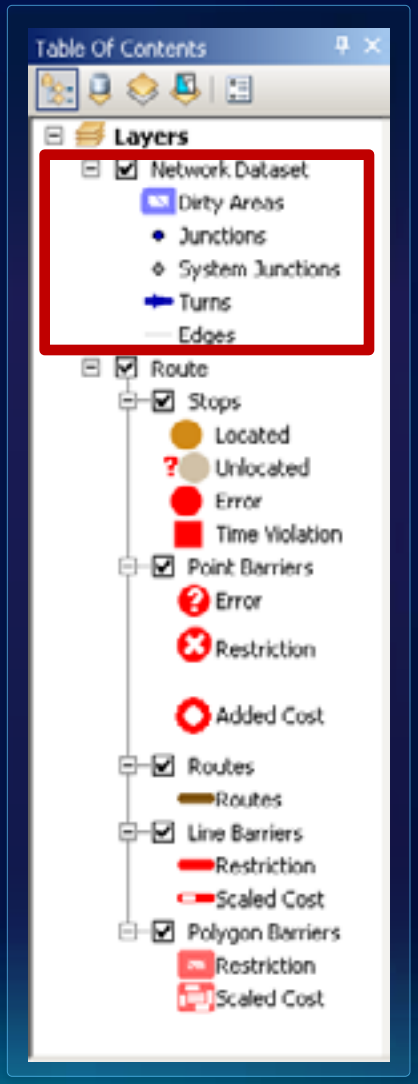


Network Analyst controls in ArcMap



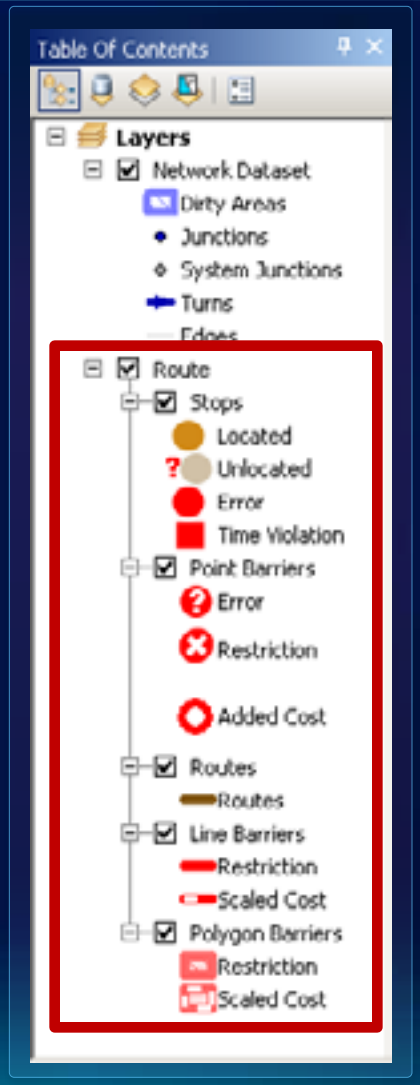
Specialized layers

A Network Layer holds a reference to a network dataset.



Specialized layers

A Network Analysis Layer is a composite layer configured for a specific solver.



Demo: Start working with Network Analyst

Modeling Street Networks with Network Datasets

Where do you get street data?

- **Free data**
  - Data and Maps DVD
  - TIGER
  - ArcGIS Online

- **Community data**
  - OpenStreetMap
- **Your data**
- **Vendor data**

TOMTOM

NAVTEQ

Euclidean vs. Network Path

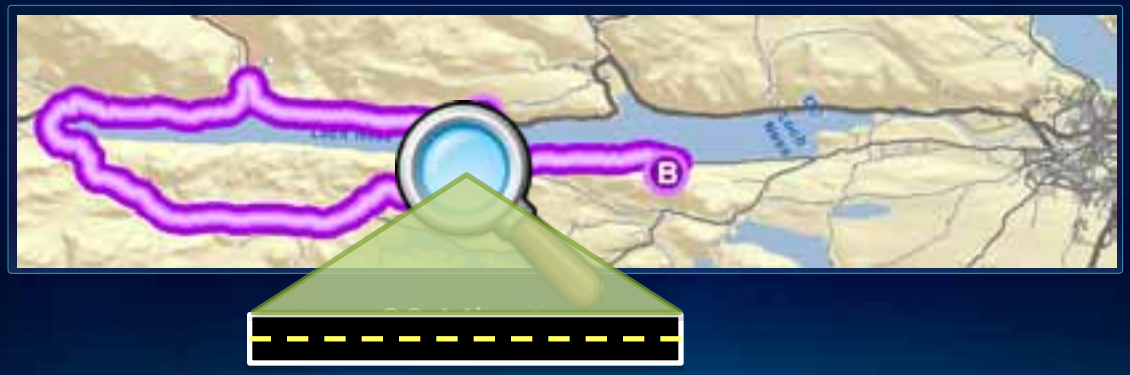
Connectivity

- **How streets connect**

Cost Attributes

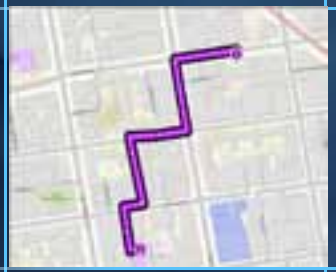
- **Model network cost, such as distance or travel time**

1 mile



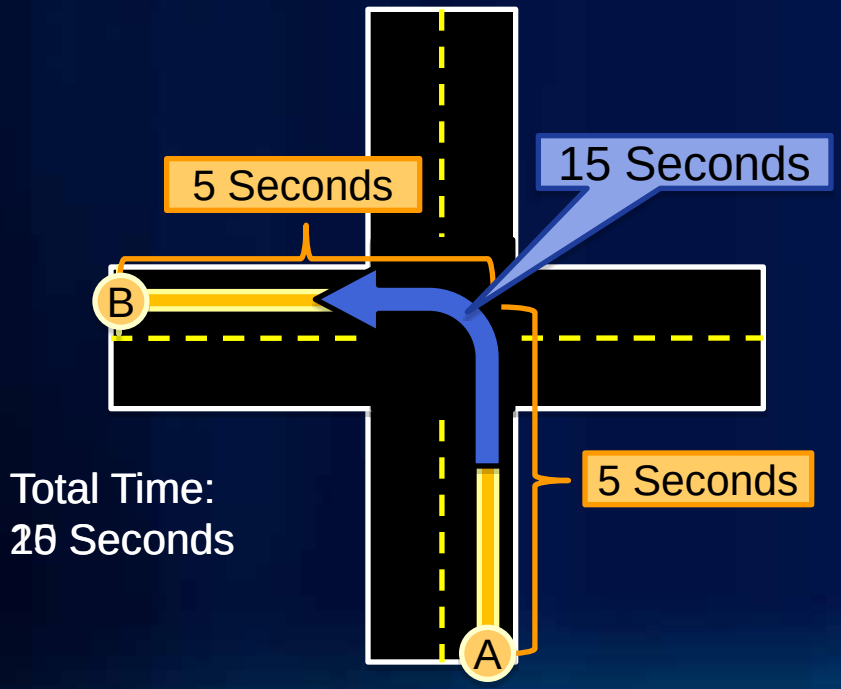
1.2 minutes (driving)

Demo: Start working with network datasets



Cost Attributes

- **Turn Delays**
  - **Add cost to a specific turn**



Cost Attributes

- **Global Turn Delays**
  - **Add a cost to every turn in the network.**
  - **Reduce the number of turn features you need to digitize.**

Cost Attributes

- **Historical Traffic**
  - **Find the best routes given expected traffic delays.**
  - **Get more accurate arrival times.**

Restriction Attributes

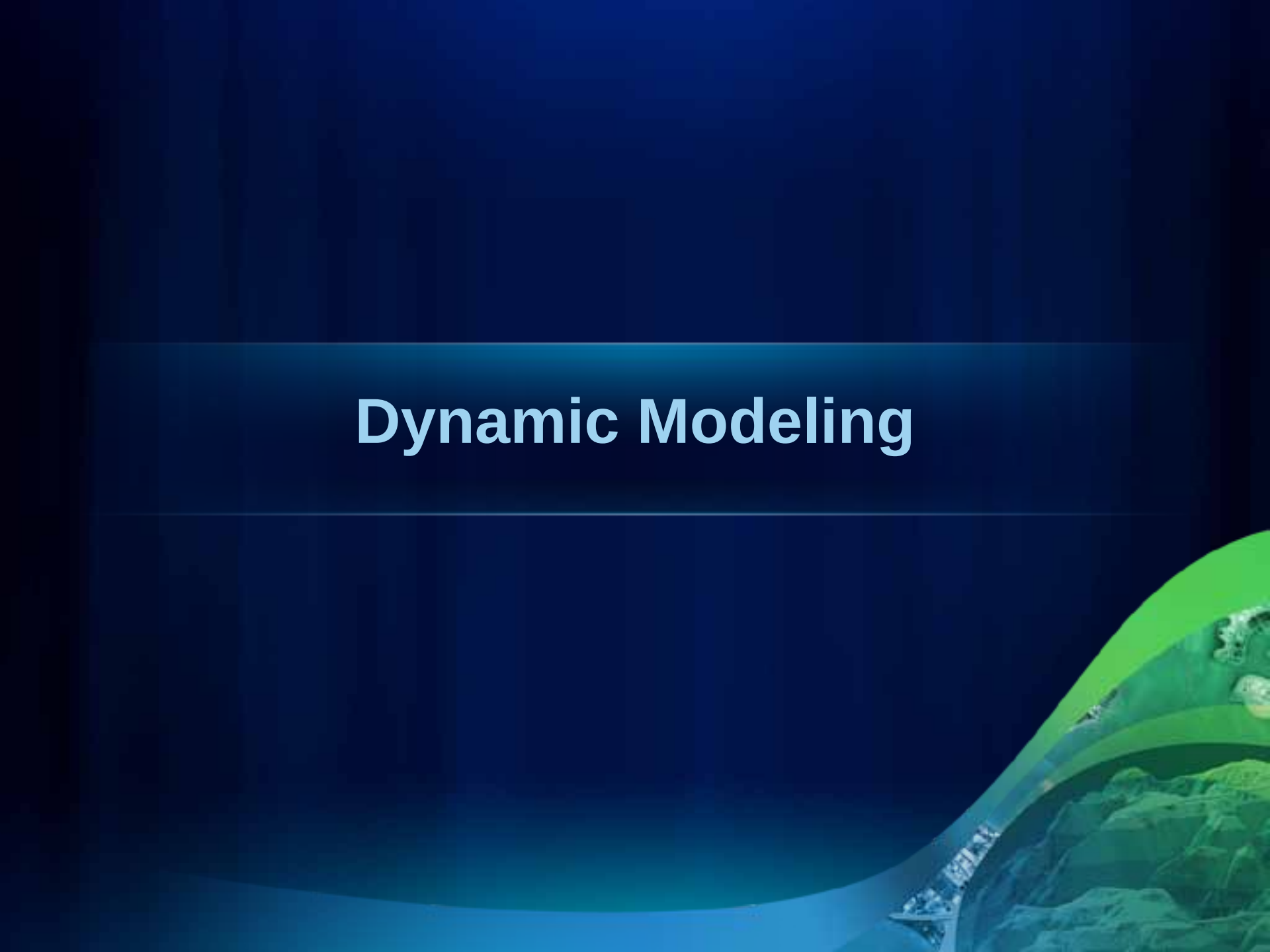
- **Specify which edges, junctions, and turns can't be traversed**

Restriction and Descriptor Attributes

- **Restriction attributes can be derived from descriptor attributes and vehicle characteristics**
  - **Model height, weight, width limits**

Demo: Modeling street networks

Dynamic Modeling



U-Turn policy

- Sometimes the shortest route includes a U-turn
- Restrict U-turns if…
  - you prefer not to make them
  - it's difficult to make them with the vehicle you're driving

Restriction Barriers

- **Model temporary restrictions like…**

Parades

Natural disasters

Territory boundaries

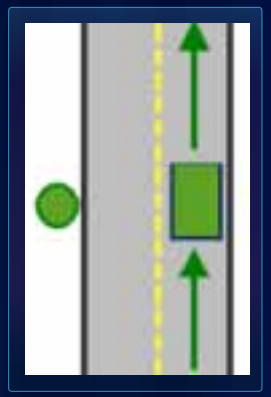
Road closures

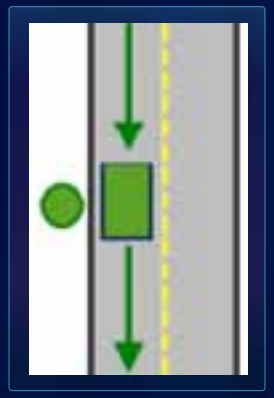
Scaled-Cost Barriers

- **Barriers that model temporary slowdowns like…**
  - **Inclement Weather**
  - **Construction**

Curb Approach

- **Curb approach ensures the vehicle arrives on and departs from a specific side of the road.**





Demo: Dynamic modeling

Solvers

Route solver

- **Find the best route that minimizes travel cost through a series of stops**

- **Variations**
  - **Time windows**
  - **Find best sequence**
  - **Directions**
  - **Start time**

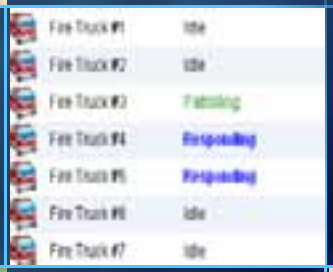
Closest facility solver

- **Finds the best routes and directions to the nearest facilities from each incident**

- **Variations**
  - **Cutoff value**
  - **Number of facilities to find**
  - **Direction of travel**

Demo: Dispatching

Find the nearest emergency vehicle to an incident



Demo: Dispatching – takeaways

- Use the Closest Facility solver to route groups of vehicles to a location.
- Solvers work fast enough to reroute moving vehicles.
- Network Analyst can easily be used as a web service.
- All Network Analyst capabilities are available via ArcGIS Server.

Service area solver

- **Find areas you can reach from one or more locations**
- **Variations**
  - **Multiple break values**
  - **Direction of travel**
  - **Overlapping versus non-overlapping areas**
  - **Output lines or polygons**

Demo: Fire coverage

Visualize deficient fire coverage

Demo: Fire Coverage - takeaways

- Determine your problem type, and pick the most appropriate solver.
- The Service Area solver provides a tool that shows street coverage areas that are easily visualized.

Location-Allocation solver

- **Determine the best location for a facility, based on demand conditions**

- **Analysis Types**
  - **Minimize Impedance**
  - **Maximize Coverage**
  - **Minimize Facilities**
  - **Maximize Attendance**
  - **Maximize Market Share**
  - **Target Market Share**

Demo: Locating Fire Stations

Find the optimal location for a new fire station

Demo: Locating Fire Stations - takeaways

- When the problem type is locating facilities, Location-Allocation is the most appropriate solver.
- Location-Allocation offers many different analysis types appropriate for different situations.

Vehicle routing problem (VRP) solver

- Route a fleet of vehicles

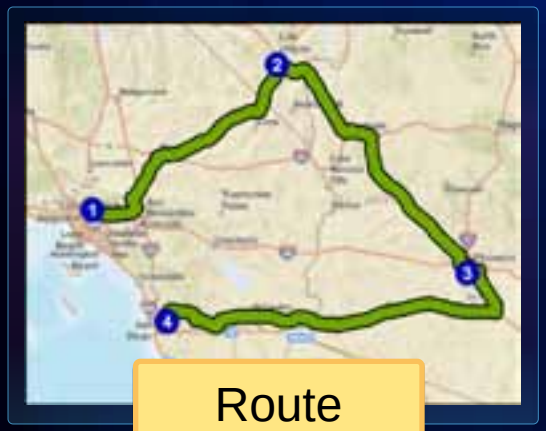
- Variations
  - Capacities
  - Driver Specialties
  - Work Breaks
  - Time Windows

Demo: Appliance Delivery

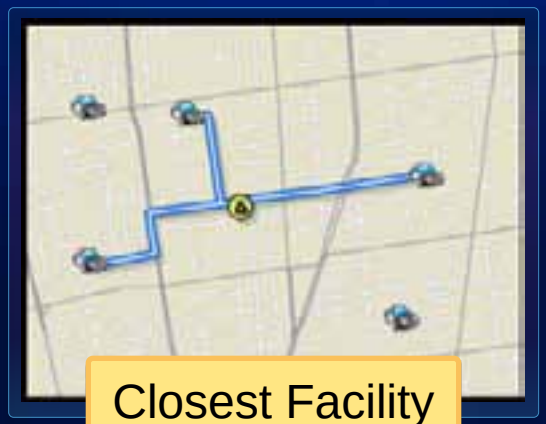
Create optimal routes for four vehicles to deliver appliances to many customers

Demo: Appliance Delivery - takeaways

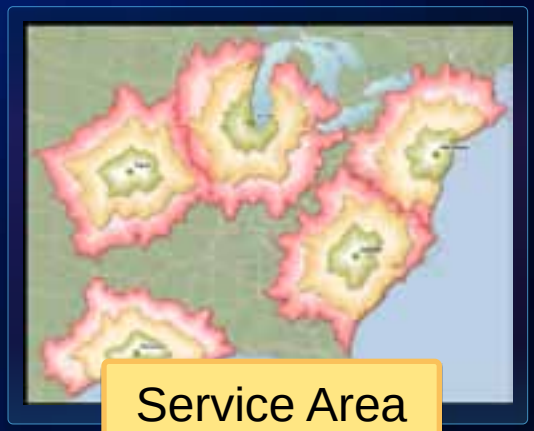
- Route a fleet a vehicles using the vehicle routing problem solver.
- Time windows, capacities, breaks, and other constraints make it a flexible modeling tool.
- Note: ArcLogistics is a VRP-based product geared for non-GIS professionals.



Route



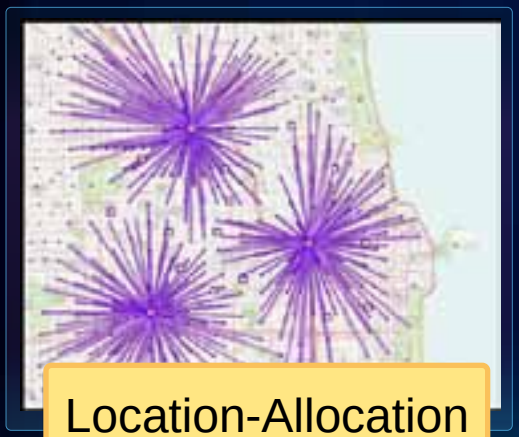
Closest Facility



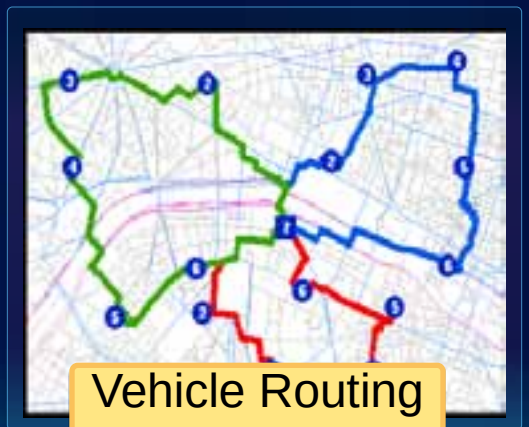
Service Area

ArcGIS Network Analyst Extension

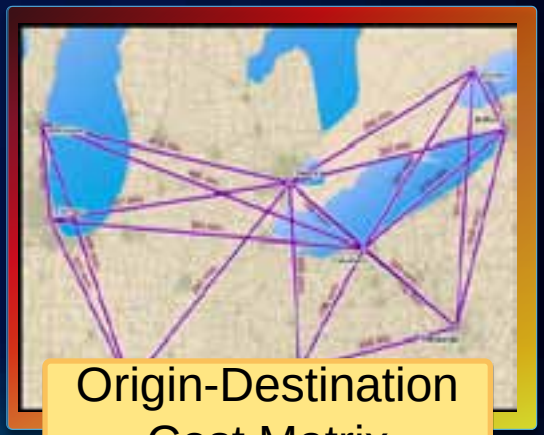
Solving transportation problems



Location-Allocation



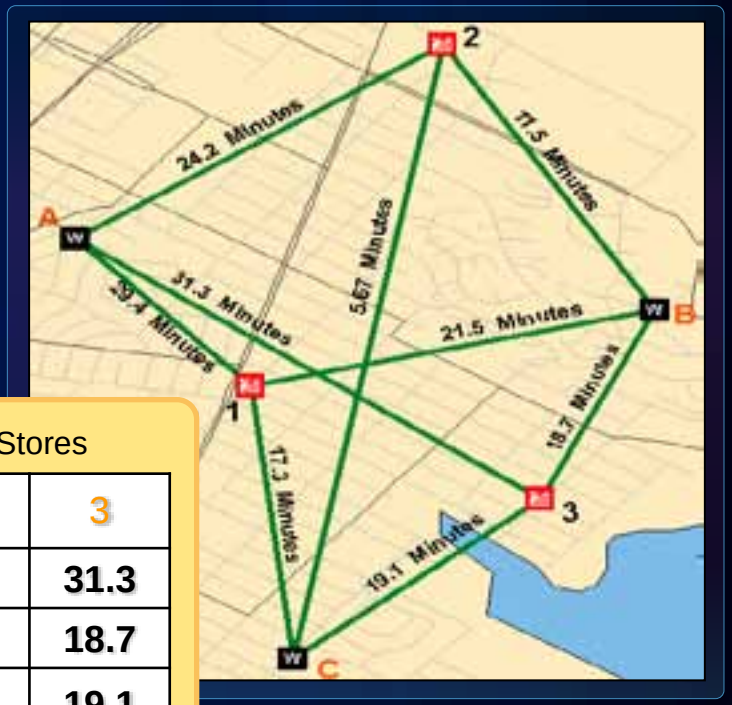
Vehicle Routing Problem



Origin-Destination Cost Matrix

Origin-destination cost matrix solver

- Generates a matrix of the travel costs from origins to destinations
- Variations
  - Cutoff value
  - Number of destinations



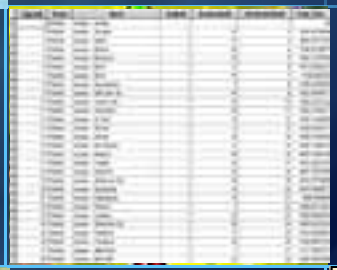
Origins - Warehouses

Destinations - Stores

	1	2	3
A	29.4	24.2	31.3
B	21.5	11.5	18.7
C	17.3	5.67	19.1

Demo: OD Cost Matrix

Find the distances between all of the capital cities in the United States



Demo: OD Cost Matrix – takeaways

- Origin-Destination Cost Matrix solver takes two sets of input locations and produces a table of cost distances.

- Use OD when output geometry is not important. Use Closest Facility when it is.

Benefits of Network Analyst

- Use an accurate model of a transportation network
- Quickly and easy solve complex problems
- Save your company money
  - Shorter routes means less gas, less maintenance, less driver overtime, more customers serviced
  - Find the optimal locations for facilities or remove redundant facilities
- Used across ArcGIS

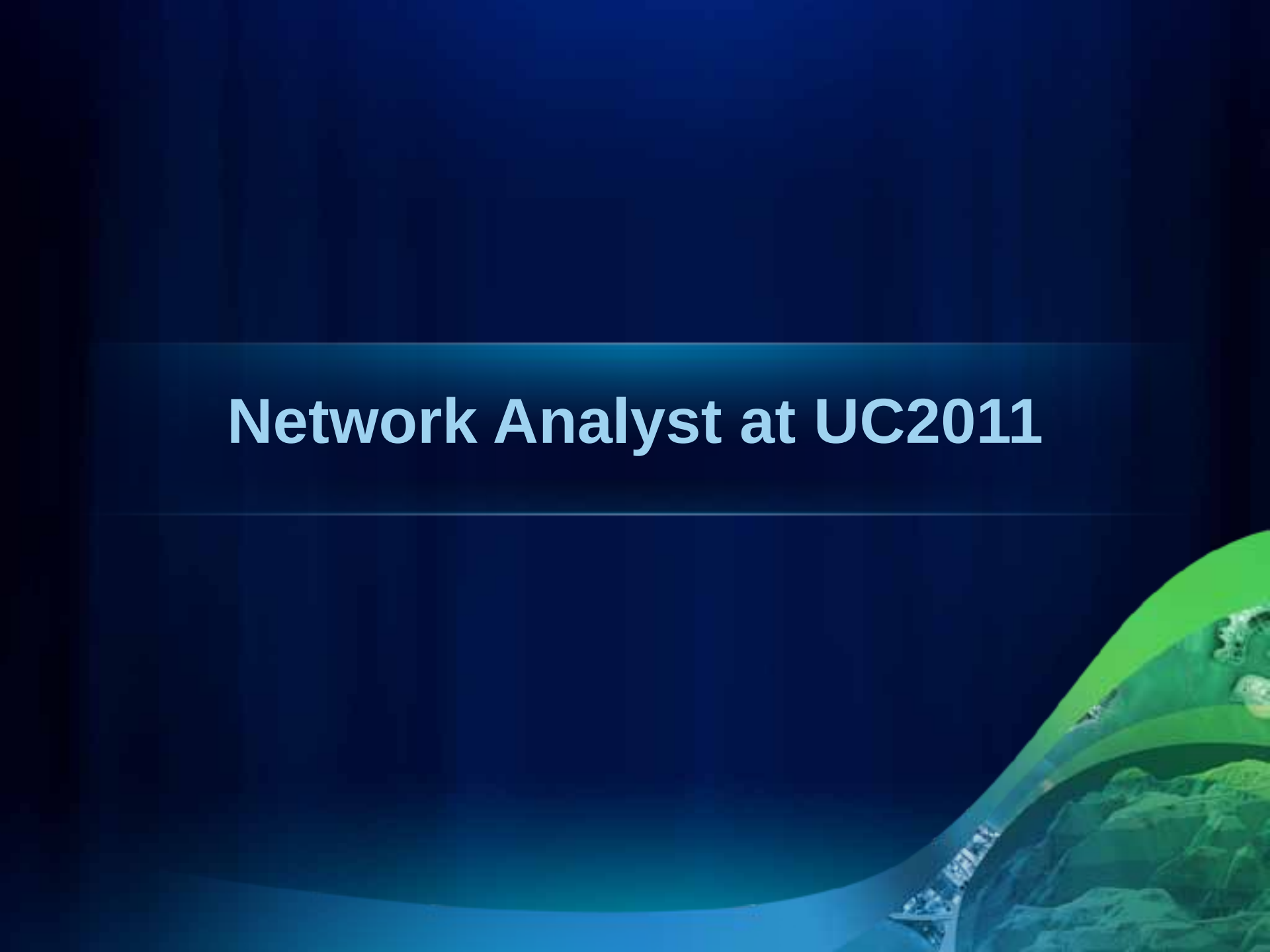
Common Questions

- Does Network Analyst support Arc routing (high-density routing)?
- Can I get alternate shortest paths?
- How do I analyze my utility or natural resource networks?
- Can Network Analyst work with transit schedules?

The road ahead (10.1)

- All solvers will be time aware
- Real-time traffic
- Faster service area
- Geoprocessing improvements
  - arcpy.na site package
  - Copy traversal result tool
  - Simpler publishing story (SA and VRP)
- Speed improvements

Network Analyst at UC2011



Tech Workshops

- ArcGIS Network Analyst – An Introduction
- ArcGIS Network Analyst – Performing Network Analysis
- Performing Network Analysis with ArcGIS Server
- ArcGIS Network Analyst – Creating Network Datasets
- ArcGIS Network Analyst – Automating Workflows with Geoprocessing

Demo Theaters

- Patterns for Measuring and Mapping Access Using Network Analysis
- ArcGIS Network Analyst – Modeling Real-World Problems with the VRP Solver
- What is ArcGIS Network Analyst and Why Should I Use It?
- ArcGIS Network Analyst – Routing Inside Buildings with 3D Networks
- ArcGIS Network Analyst – Location-Allocation and Accounting for Competition in Site Selection

	Tuesday	Wednesday	Thursday
8 am			
9 am	ArcGIS Network Analyst - An Introduction	ArcGIS Network Analyst - Automating workflows with Geoprocessing	ArcGIS Network Analyst - Performing Network Analysis
10 am	ArcGIS Network Analyst - Performing Network Analysis	ArcGIS Network Analyst - Creating Network Datasets	
11 am			
12 pm	Patterns for Mapping Access		
1 pm	Modeling Real-World Problems with the VRP Solver		
2 pm		ArcGIS Network Analyst - An Introduction	ArcGIS Network Analyst - Creating Network Datasets
3 pm	Performing Network Analysis with ArcGIS Server	ArcGIS Network Analyst – Routing Inside Buildings With 3D Networks	Room 3 Room 9 Room 6B Spatial Analyst Island Demo Theater Mapping and Visualization Island Demo Theater
4 pm	What is Network Analyst?	ArcGIS Network Analyst – Location-Allocation in site selection	

Related Tech Workshops

- ArcLogistics
  - Manage Your Mobile Workforce and Improve Efficiency with ArcLogistics
    - Tuesday 1:30 - Room 32A
- Geometric Networks
  - Understanding Geometric Networks
    - Wednesday 1:30 - Room 3

Moderated Paper Sessions

- **Logistics GIS for Optimizing Road and Highway Routing in Adverse Situations**
  - **Tuesday 8:30 – Room 29A**
- **GIS for Logistics**
  - **Tuesday 10:15 – Room 29A**
- **Groundwater Contamination and Watershed Modeling**
  - **Wednesday 8:30 – Room 24C**
- **Accessibility to Health Care and Services**
  - **Wednesday 3:15 – Room 29D**

In Conclusion…

- Please fill out session surveys!
- Questions
- Still have questions?
  - Spatial Analysis Island (Exhibit Hall C)

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