ArcGIS Network Analyst — An Introduction

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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
ArcGIS Network Analyst Extension

Solving transportation problems

- Route
- Closest Facility
- Service Area
- 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

Network Analyst Toolbar

Network Analyst Window

Geoprocessing Tools
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
Euclidean vs. Network Path
Connectivity

- How streets connect
Cost Attributes

- Model network cost, such as distance or travel time
Demo: Start working with network datasets
Cost Attributes

- Turn Delays
  - Add cost to a specific turn

Total Time: 26 Seconds
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

Modeling Transportation Networks with Network Datasets
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
<table>
<thead>
<tr>
<th>Restriction Barriers</th>
<th>Parades</th>
<th>Natural disasters</th>
<th>Territory boundaries</th>
<th>Road closures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model temporary restrictions like...</td>
<td></td>
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</tbody>
</table>
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
• 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 of 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.
ArcGIS Network Analyst Extension

Solving transportation problems

Route
Closest Facility
Service Area

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

<table>
<thead>
<tr>
<th>Origins - Warehouses</th>
<th>Destinations - Stores</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>A</td>
<td>29.4</td>
</tr>
<tr>
<td>B</td>
<td>21.5</td>
</tr>
<tr>
<td>C</td>
<td>17.3</td>
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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
<table>
<thead>
<tr>
<th>Time</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
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<tr>
<td>8 am</td>
<td>ArcGIS Network Analyst - An Introduction</td>
<td>ArcGIS Network Analyst - Automating workflows with Geoprocessing</td>
<td>ArcGIS Network Analyst - Performing Network Analysis</td>
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<td>9 am</td>
<td>ArcGIS Network Analyst - Performing Network Analysis</td>
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<td>10 am</td>
<td>ArcGIS Network Analyst - Performing Network Analysis</td>
<td>ArcGIS Network Analyst - Creating Network Datasets</td>
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<td>11 am</td>
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<td>12 pm</td>
<td>Patterns for Mapping Access</td>
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<td>1 pm</td>
<td>Modeling Real-World Problems with the VRP Solver</td>
<td>ArcGIS Network Analyst - An Introduction</td>
<td>ArcGIS Network Analyst - Creating Network Datasets</td>
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<tr>
<td>3 pm</td>
<td>Performing Network Analysis with ArcGIS Server</td>
<td>ArcGIS Network Analyst – Routing Inside Buildings With 3D Networks</td>
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<tr>
<td>4 pm</td>
<td>What is Network Analyst?</td>
<td>ArcGIS Network Analyst – Location-Allocation in site selection</td>
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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)