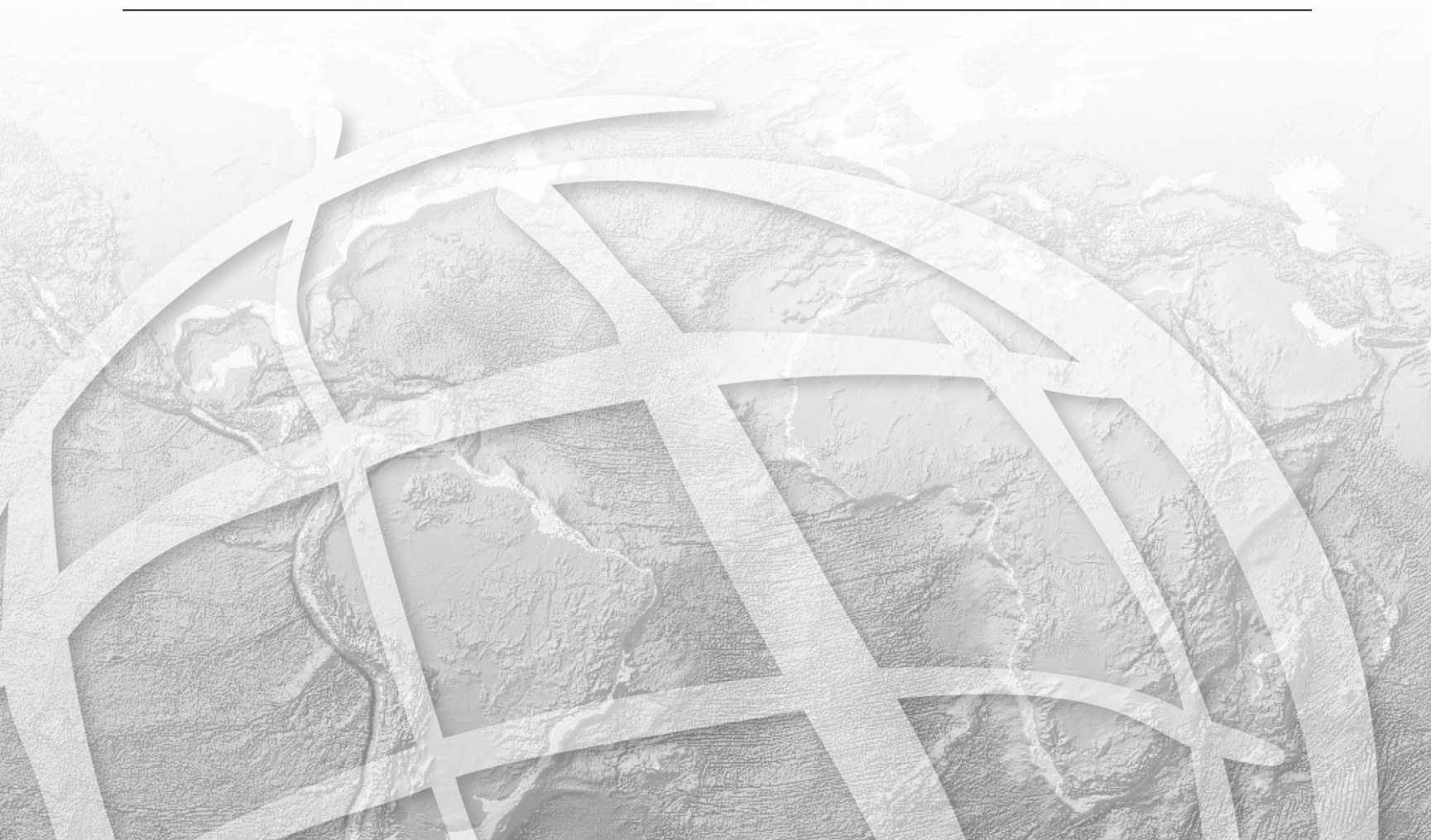


# ArcGIS® 9

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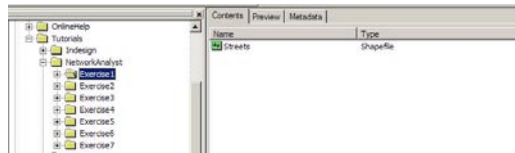


# Exercise 1: Creating a Shapefile based Network Dataset

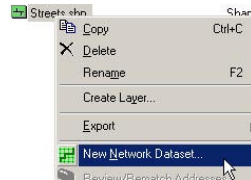
In this Exercise you will create a simple shapefile based network dataset from a single line feature class and a turn feature class.

## Creating a network dataset

1. Start ArcCatalog by either double-clicking a shortcut installed on your desktop or using the programs list in your Start menu.
2. Navigate to the C:\arcgis\ArcTutor\Network\_Analyst folder in the Catalog Tree. (This is the default install location for this data.)
3. Click the Exercise1 folder to show its contents.



4. If the Network Analyst Extension is not enabled, on the Tools menu, click Extensions and in the Extensions dialog, click Network Analyst.
5. Right-click the Streets shapefile and choose New Network Dataset. This shapefile contains street data for downtown San Francisco.

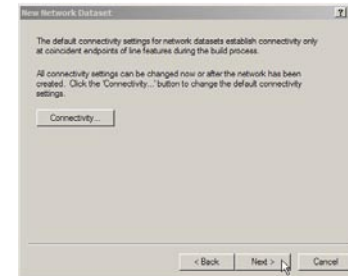


6. The name of the network dataset is set to Streets\_ND by default. Click Next to continue.



Network Connectivity defines how features that participate in a network connect to each other. The default connectivity for a network dataset places all sources in one connectivity group and assigns all edge sources endpoint connectivity. In a shapefile based network there is only one edge source, hence there is no need for multiple connectivity groups. Also, we wish to model streets with endpoint connectivity. (To see how this is modeled, you may click the Connectivity button.)

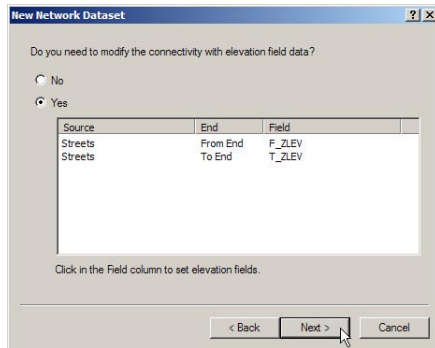
7. You will accept the default connectivity, therefore Click Next to continue.



Earlier versions of ArcView GIS and ARC/INFO support optional elevation fields to establish connectivity. Each feature in a shapefile or a coverage would be assigned two Z-elevation values, one for each endpoint. If the endpoints of line features have the same Z-elevation value, connectivity is established. If the values are different, they do not connect (e.g. in the case of bridges or tunnels).

The elevation field contains logical elevation values for establishing connectivity only and does not provide height information for the feature. ArcGIS Network Analyst can use this data to modify the connectivity settings established in the previous step. ArcGIS Network Analyst automatically searches and maps the relevant fields.

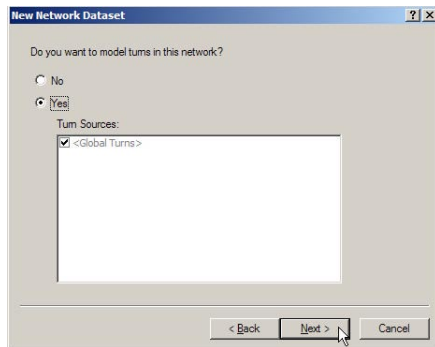
8. Click Next to accept the default elevation fields settings. If ArcGIS Network Analyst finds elevation fields data in your shapefile, it automatically chooses the Yes radio button and assigns the appropriate fields.



ArcGIS Network Analyst supports turns in a shapefile based network. Turn information (such as turning restrictions and delays) enhance the quality of network analysis. Earlier versions of ARC/INFO and ArcView GIS used turn tables. These turn tables can be converted into turn features and used in the network dataset. You will use turn features in Exercise 2.

In addition, by default Global Turns are selected. Global Turns are rules that can be set, such as all left turns have a delay of 15 seconds. Such a rule gives preference to right turning movements. The advantage of Global Turns is that you do not need to create individual turn features for rules that apply to every turn in the network.

9. Click Yes to model turns in the network.
10. Click Next to continue.

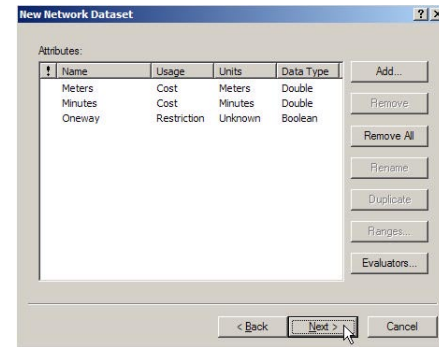


Network attributes are properties of the network that are used to control navigation. Common examples are costs that function as

impedances over the network. Restrictions like oneway traversal are also examples of network attributes.

The ArcGIS Network Analyst analyzes the source shapefile and looks for common fields like Meters, Minutes (FT\_Minutes and TF\_Minutes, one for each direction), and Oneway. Once it finds these fields, it automatically creates the corresponding network attributes and assigns the respective fields to them. (This can be viewed by clicking the Evaluators button.)

11. Since the attributes are automatically defined and assigned values, click Next to continue.

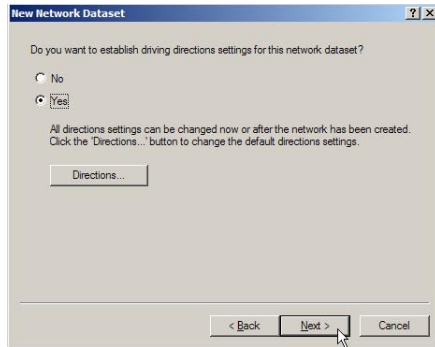


To use driving directions in a network analysis, they should be set in the network dataset.

12. Select Yes to establish driving directions settings for this network dataset.

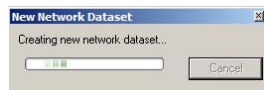
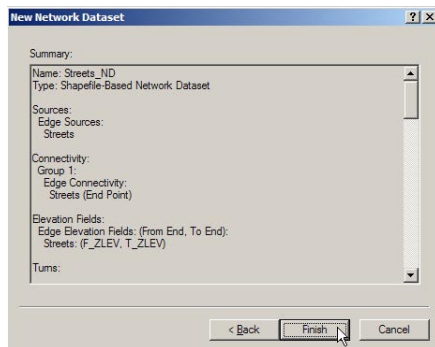
The Network Analyst automatically finds and maps the field in the streets source that will be used to report street names. Additionally Length and Time fields are automatically mapped as well.

13. Click Next to continue.



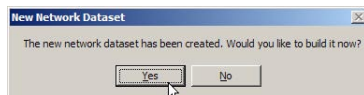
14. A summary of all the settings that have been chosen is displayed in the following window for your review.

Click Finish to create the new shapefile based network dataset.

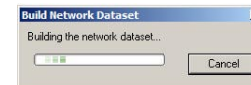


Once created, the system prompts for the network to be built.

15. Click Yes to build the network.



The network dataset has been built when the progress bar disappears.



The shapefile based network, Streets\_ND, is added to ArcCatalog along with the system junctions shapefile Streets\_ND\_Junctions.

16. Select Streets\_ND and click on the Preview tab to see the built network dataset.



17. Close ArcCatalog.



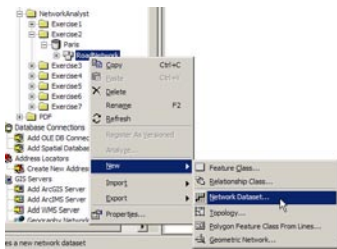


## Exercise 2: Creating a geodatabase network dataset

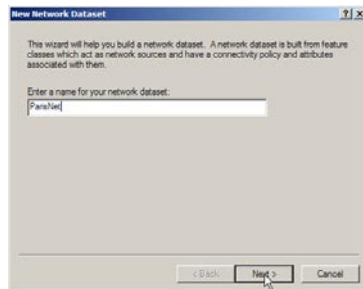
In this Exercise you will create a geodatabase based network dataset using the streets feature class for Paris.

### Creating a network dataset

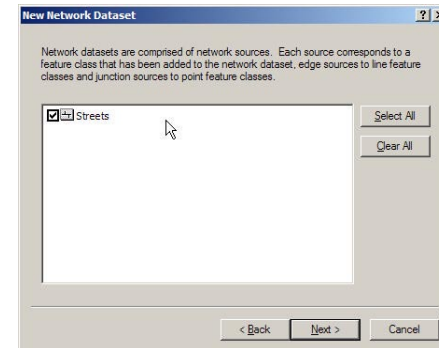
1. Start ArcCatalog by either double-clicking a shortcut installed on your desktop or using the programs list in your Start menu.  
If the Network Analyst Extension is not enabled, on the Tools menu, click Extensions and in the Extensions dialog, click Network Analyst.
2. Navigate to the C:\arcgis\ArcTutor\Network\_Analyst folder in the Catalog Tree. (This is the default install location for this data.)
3. Double-click the Exercise2 folder to expand it.
4. Click the plus sign on Paris.mdb. This will expand the connection tree to show you the contents of the geodatabase.
5. Click the RoadNetwork feature dataset. The contents will be listed in the Contents tab.
6. Right-click the RoadNetwork feature dataset, click New, then click Network Dataset. This will open the New Network Dataset Wizard.



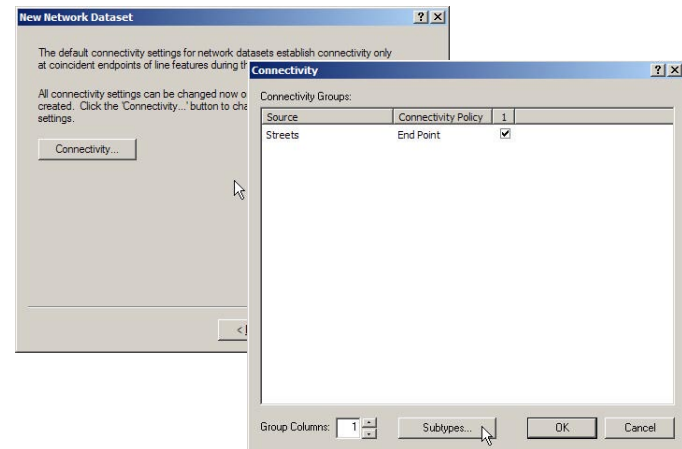
7. Type "ParisNet" as a name for your network dataset.



8. Click Next.
9. Check the Streets feature class to use it as a source for the network dataset.

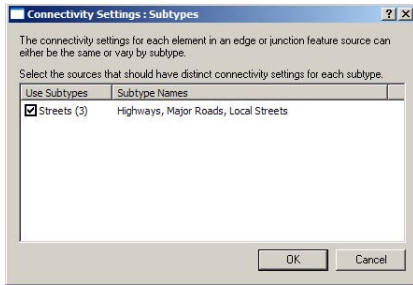


10. Click Next.
11. Click Connectivity to set up the connectivity model for the network.

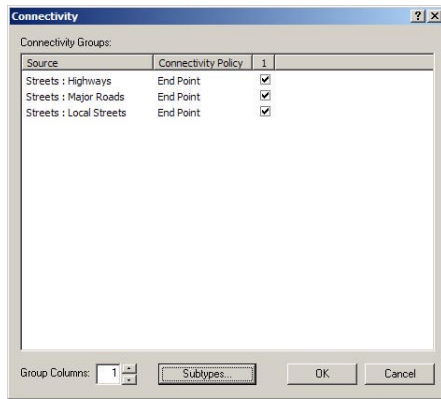


The Streets feature class has three subtypes that we wish to use to set up the connectivity - Highways, Major Roads and Local Streets.

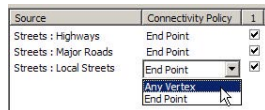
12. Click the Subtypes button to bring up the Connectivity Settings: Subtypes Dialog. Check the Box next to Streets (3) to use the three subtypes of Streets.



- Click OK to return to the Connectivity dialog. There are now three rows, one for each subtype.



- For this network, Highways and Major Roads connect to each other at end points. Local Streets connect at any vertex of geometric coincidence. Change the connectivity policy of Streets: Local Streets to Any Vertex.

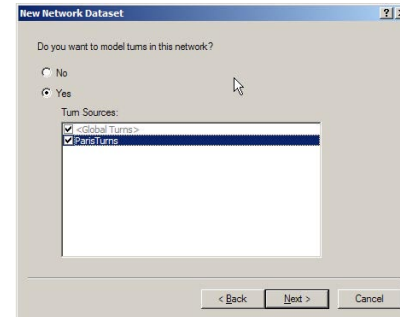


- Click OK to close the Connectivity Group dialog box.
- Click Next.
- There is no elevation field data for this dataset, therefore make sure No is selected.

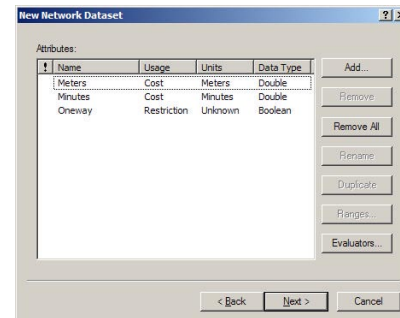
Elevation fields have been used since the earlier versions of ARC/INFO and ArcView GIS to model connectivity. ArcGIS Network Analyst supports this connectivity model. Each feature in a shapefile

or a coverage would be assigned two Z-elevation values, one for each endpoint. If the endpoints of line features have the same Z-elevation value, connectivity is established. If the values are different, they do not connect (e.g. in the case of bridges or tunnels). The elevation field contains logical elevation values for establishing connectivity only and does not provide height information for the feature.

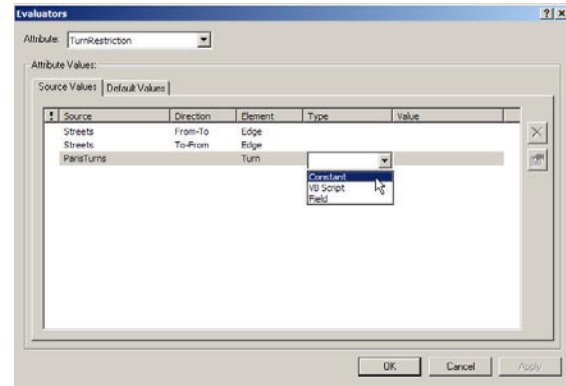
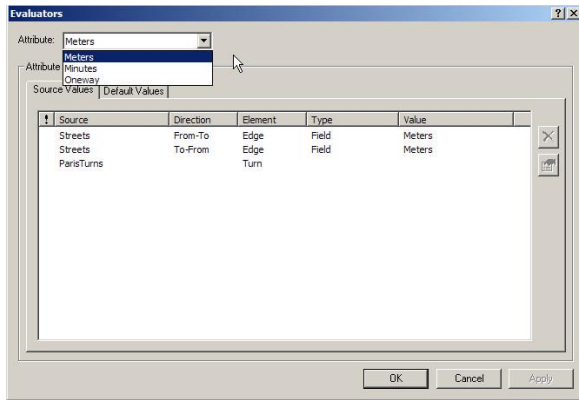
- Click Next.
- Select Yes for modeling turns in the network. Check the box by ParisTurns to select the turn feature source.



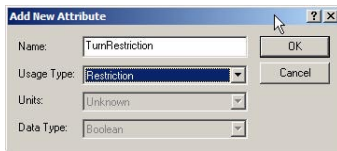
- Click Next.
- There are three attributes that are added by default, Oneway, Minutes and Meters.



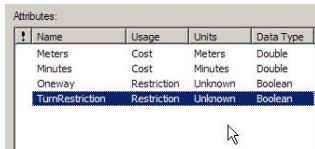
- ArcGIS Network Analyst inspects all sources and tries to automatically assign values for these three attributes.
- Click Evaluators to inspect the evaluator assigned by source for each attribute.



23. Click OK to return to the New Network Dataset Wizard.
24. You will add a new attribute that will restrict movement over the turn elements created from ParisTurns. Click Add to bring up the Add Attribute dialog. Type TurnRestriction as the name of the attribute and select Restriction as the Usage type.

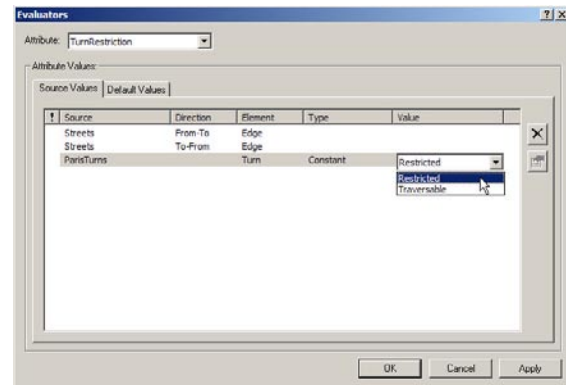


25. Click OK. A new attribute called TurnRestriction is added to the list.



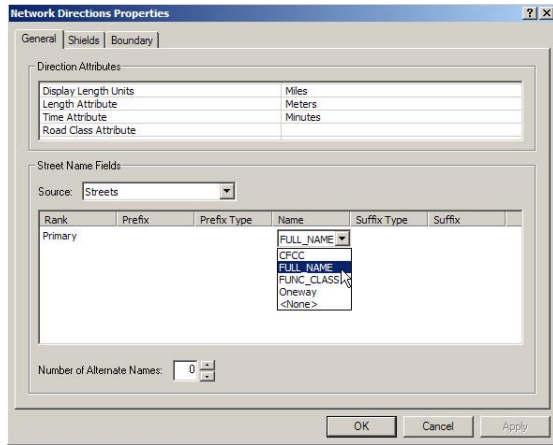
26. Click Evaluators to assign values by source.
27. Set the Type of Evaluator for ParisTurns to Constant by clicking in the Type column, for the ParisTurns row and selecting Constant from the dropdown box.

28. Change the Value for ParisTurns to Restricted. The evaluators for other sources are set automatically to Traversable under Default Values.

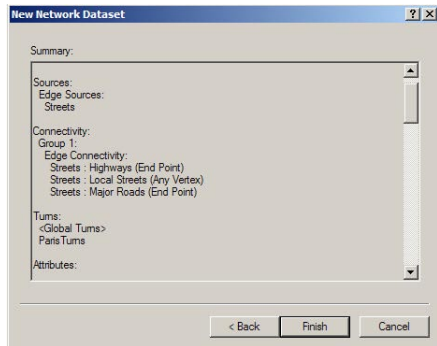


29. Click OK to return to the New Network Dataset Wizard.
30. Click Next to continue.
31. Click Yes to set up directions. Click Directions to open the Directions Properties Page. Here, you will set up the fields used to report directions after network analysis.
32. In the General tab, click under the Name column for the Primary row

and select FULL\_NAME from the dropdown list. In the Paris streets data, this field contains the street names that will be used to generate directions.



- 33. Click OK to return to the New Network Dataset Wizard.
- 34. Click Next to see a summary of the settings defined.



- 35. Click Finish to create the new network dataset.
- 36. Click Yes to build the network dataset.



Once the network dataset is built, you should see a new network dataset called ParisNet along with the system junctions feature class ParisNet\_Junctions. Preview the network dataset by selecting it and clicking on Preview.

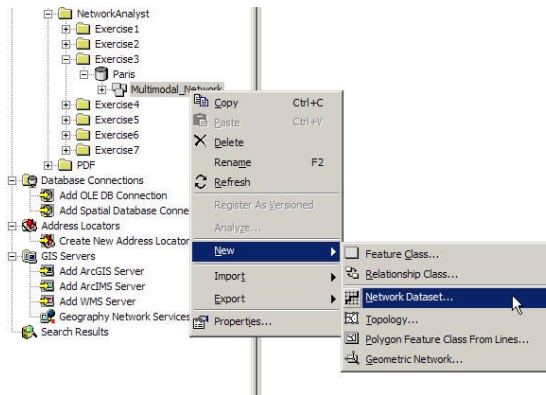
- 37. Close ArcCatalog.

## Exercise 3: Creating a multimodal network dataset

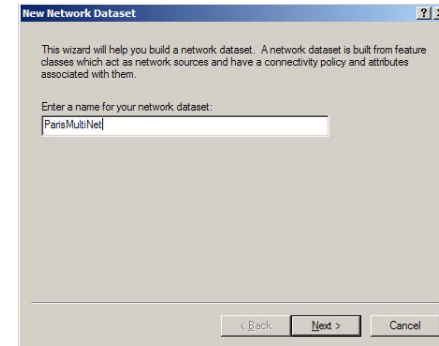
In this Exercise you will create a multimodal network dataset from multiple feature classes within a feature dataset in a geodatabase.

### Creating a network dataset

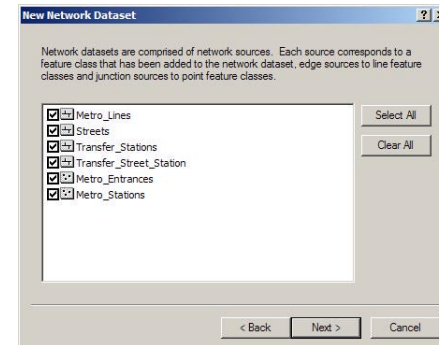
1. Start ArcCatalog by either double-clicking a shortcut installed on your desktop or using the programs list in your Start menu.  
If the Network Analyst Extension is not enabled, on the Tools menu, click Extensions and in the Extensions dialog, click Network Analyst.
2. Navigate to the C:\arcgis\ArcTutor\Network\_Analyst\Exercise3 folder in the Catalog Tree. (This is the default install location for this data.)
3. Double-click the Exercise3 folder to expand it.
4. Click the plus sign on Paris.mdb. This will expand the connection tree to show you the contents of the geodatabase.
5. Click the Multimodal\_Network feature dataset. The contents will be listed in the Contents tab.
6. Right-click the Multimodal\_Network feature dataset, click New, then click Network Dataset. This will open the New Network Dataset Wizard.



7. Type “ParisMultiNet” as a name for your network dataset.

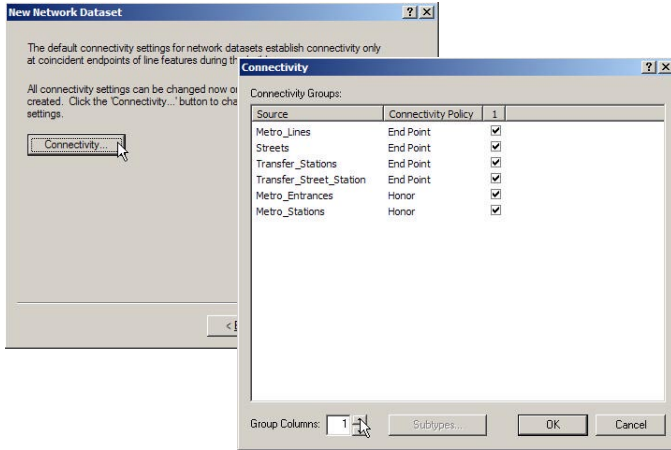


8. Click Next.
9. Click Select All to select all the feature classes to participate as sources in the network.



10. Click Next.

11. Click Connectivity to set up the connectivity model for the network.



12. Click the Group Column up-arrow once, to increase the number of connectivity groups to 2. Connectivity group 1 represents the metro system and connectivity group 2 represents the street network.

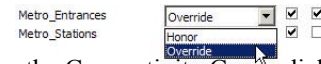


13. Check the boxes under the Connectivity Group numbers to assign each source to the group they belong to. Click under the column labeled 2 for the Streets row to move Streets to connectivity group 2, as shown in the graphic below. Click under the column labeled 2 for the Metro\_Entrances row to assign Metro\_Entrances to both groups 1 and 2. They are the points of transfers between the two networks.

Source	Connectivity Policy	1	2
Metro_Lines	End Point	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Streets	End Point	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Transfer_Stations	End Point	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Transfer_Street_Station	End Point	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Metro_Entrances	Honor	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Metro_Stations	Honor	<input checked="" type="checkbox"/>	<input type="checkbox"/>

14. Click under the Connectivity Policy column for Metro\_Entrances and select Override from the dropdown list.

Each feature of Metro\_Entrances is coincident with a vertex of the streets feature class. However the streets feature class has a policy of endpoint connectivity. Since the Metro\_Entrances are to be connected to the streets at the coincident vertex, you have set the Metro\_Entrances to override the default endpoint connectivity of the streets.

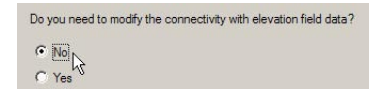


15. Click OK to close the Connectivity Group dialog box.

16. Click Next.

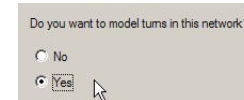
17. There is no elevation field data for this dataset, therefore be sure No is selected.

Elevation fields have been used since the earlier versions of ARC/INFO and ArcView GIS to model connectivity. ArcGIS Network Analyst supports this connectivity model. Each feature in a shapefile or a coverage would be assigned two Z-elevation values, one for each endpoints. If the endpoints of line features have the same Z-elevation value, connectivity is established. If the values are different, they do not connect (e.g. in the case of bridges or tunnels). The elevation field contains logical elevation values for establishing connectivity only and does not provide height information for the feature.



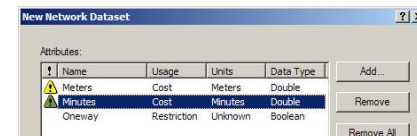
18. Click Next.

19. Select Yes for modeling turns in the network. Although you have no turn feature classes for this network, selecting yes allows the network dataset to support turns. Turn information can be added to an existing network dataset, if it supports turns. If you choose no here, you will not be able to add turns to this network on a later date.



20. Click Next.

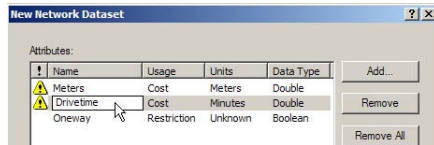
21. There are three attributes that are added by default, Oneway, Minutes and Meters.



Since this is a multimodal network you will add different time attributes based on mode. For automobiles, you will have an attribute called Drivetime and for pedestrians, you shall have a Pedestrian\_Time attribute.

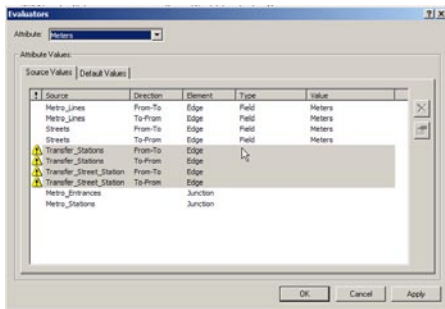
The attribute Minutes is added by the Network Analyst by default. We can rename this attribute to be called Drivetime.

22. Select the Minutes row, click Rename, then type “Drivetime”.



The Meters and Drivetime attributes have a yellow warning symbol that represents a potential problem with the evaluators.

23. Select Meters and click Evaluators to inspect values for the Meters attribute for each source in the network.

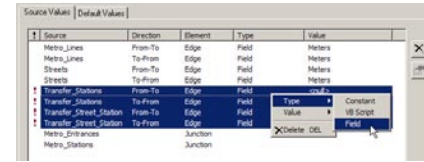


ArcGIS Network Analyst inspects all sources and tries to automatically assign values for the Meters attribute. The Metro\_Lines source and the Streets source have a field called Meters, therefore this field is automatically assigned to the sources.

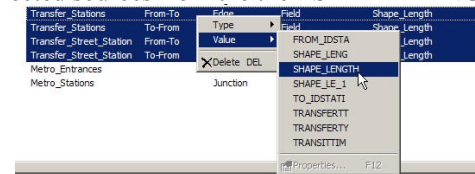
For each edge source in the network, attributes need to be assigned for each direction of travel. Since the length does not depend on direction of travel, the same values are assigned for both directions of a source. Network Analyst attempts to assign values for each cost attribute for each edge source that participates in the network. In this case, Network Analyst was unable to find values for Transfer\_Stations and Transfer\_Street\_Station sources. Hence a warning symbol is present to indicate that there is a problem.

24. Select all four rows with the yellow warning symbol (two sources in both directions), right-click, choose Type, and click Field. The yellow warning sign changes to a red exclamation mark indicating an

incomplete assignment of values.



25. The four rows, now with the red exclamation mark, should still be selected. Right-click the selected rows, choose Value and click SHAPE\_LENGTH. This will assign values for the Meters attribute for the selected sources from their SHAPE\_LENGTH field.



26. Click Apply.
27. From the Attributes dropdown box, select Oneway. The attribute Oneway has been assigned values automatically by the ArcGIS Network Analyst for the Streets source. Since all other sources are related to the metro system, they have no oneway restrictions.
28. From the Attributes dropdown box, select Drivetime.

The values for the street network are populated automatically by Network Analyst. Other edge sources have no values assigned and have the warning symbol.

The attribute Drivetime will be used to model the travel time using automobiles. Since automobiles travel on streets only (and not on Metro\_Lines or transfers between stations), a valid value of Drivetime can exist only for streets (which has been automatically set up).

29. Select all the other edge sources that belong to the metro system

(Metro\_Lines, Transfer\_Station, and Transfer\_Street\_Station). Click on the column heading named Type and select Constant.

Source	Direction	Element	Type
Metro_Lines	From-To	Edge	Constant
Metro_Lines	To-From	Edge	Constant
Streets	From-To	Edge	Field
Streets	To-From	Edge	Field
Transfer_Stations	From-To	Edge	Field
Transfer_Stations	To-From	Edge	Field
Transfer_Street_Station	From-To	Edge	Field
Transfer_Street_Station	To-From	Edge	Field
Metro_Entrances		Junction	
Metro_Stations		Junction	

- The same rows should still be selected. Hit the F12 key on the keyboard to bring up the Constant Value Input box. (Alternately, you can also right-click the selected rows, point to Value and select Properties to bring up the same input box.) Type -1 and press Enter.

By assigning a constant of -1, the system will treat the sources as restricted when the attribute Drivetime is used as an impedance.

Source	Direction	Element	Type	Value
Metro_Lines	From-To	Edge	Constant	-1
Metro_Lines	To-From	Edge	Constant	-1
Streets	From-To	Edge	Field	FT_Minutes
Streets	To-From	Edge	Field	TF_Minutes
Transfer_Stations	From-To	Edge	Constant	-1
Transfer_Stations	To-From	Edge	Constant	-1
Transfer_Street_Station	From-To	Edge	Constant	-1
Transfer_Street_Station	To-From	Edge	Constant	-1
Metro_Entrances		Junction		
Metro_Stations		Junction		

- Click OK to return to the New Network Dataset Wizard.
- Click Add to add a new attribute.
- In the Add New Attribute dialog box, enter “Pedestrian\_Time” for the Name. Set the Usage Type as Cost, the Units as Minutes and the Data Type as Double.

- Click OK.
- Select Pedestrian\_Time and click Evaluators.

The Pedestrian\_Time attribute in the network represents the time a pedestrian takes on the network. In this case it has two components because a pedestrian can utilize the metro system in addition to walking on the street network. In the Evaluators dialog, the

following six sources should already be selected. Metro\_Lines (in each direction), Transfer\_Stations (in each direction) and Transfer\_Street\_Station (in each direction). If not, you can use the CTRL key and select each of them.

- Right-click, choose Type, and click Field.

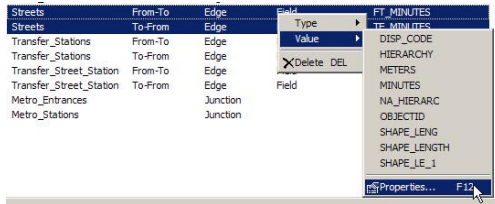
- The same rows should still be selected. Right-click, choose Value, and click TRANSITTIME.



- To set up the Pedestrian\_Time for Streets, click the row for Streets in the From-To direction. Hold the CTRL key and click the row for Streets in the To-From direction, to select both rows for the Streets source.

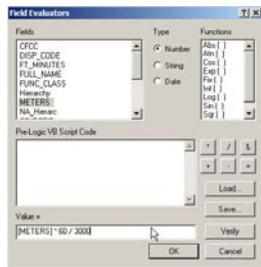
Streets	From-To	Edge	Field	FT_MINUTES
Streets	To-From	Edge	Field	TF_MINUTES

- Right-click on the selected sources, point to Value, and click Properties to bring up the Field Evaluators dialog box.



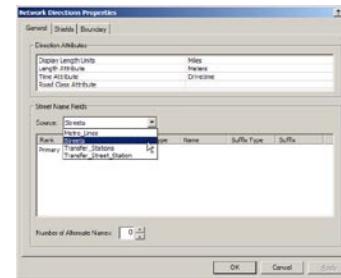
On the street network a pedestrian can walk. Hence for the streets source, the value of Pedestrian\_Time is the walk time for a pedestrian. Assuming that a pedestrian walks at 3 km/h, walk time in minutes will then be  $[Meters] * 60 / 3000$  where  $[Meters]$  is the attribute containing length of the edge in meters.

- Enter  $[METERS]*60/3000$  in the Field Evaluators Dialog as shown below.

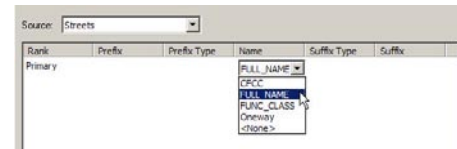


- Click OK to close the dialog and to return to the Evaluators dialog.
- Click OK to save the attribute assignment.
- Click Next.

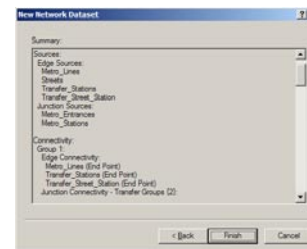
- Click Yes to set up directions. Click Directions to open the Directions Properties Page.
- On the General tab, click the Source dropdown arrow and click Streets.



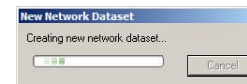
- Click on Primary in the Street Name Fields list.
- Click under the Name field and click FULL\_NAME from the dropdown list.



- Click OK.
- Click Next to see a summary of the settings defined.



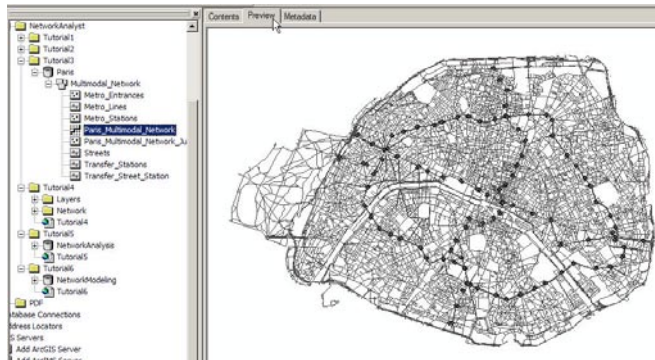
- Click Finish to create the new network dataset.



- Click Yes to build the network dataset.



Once the network dataset is built, you should see a new network dataset called ParisMultiNet along with the system junctions feature class ParisMultiNet\_Junctions. Preview the network dataset by selecting it and clicking on Preview.



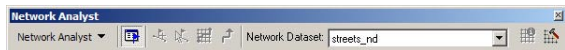
52. Close ArcCatalog.


## Exercise 4: Finding the best route using a network dataset

In this Exercise you will find the best route for the given order of stops based on travel time.

### Preparing your display

1. If you have Exercise4.mxd open in ArcMap, skip steps 2 to 5.
2. Start ArcMap by either double-clicking a shortcut installed on your desktop or using the programs list in your Start menu.
3. Click File on the Main menu and click Open.
4. In the Open dialog box, navigate to C:\arcgis\ArcTutor\Network\_Analyst\Exercise4\Exercise4.mxd. (This is the default install location for this data.)
5. Double-click Exercise4.mxd.
6. If the Network Analyst Extension is not enabled, on the Tools menu, click Extensions and in the Extensions dialog, click Network Analyst.
7. If the Network Analyst toolbar is not already present, on the Main menu, click View, point to Toolbars, and click Network Analyst.



8. If the Network Analyst Window is not already open, click the Network Analyst Window button  on the Network Analyst toolbar.

This is a dockable window which you can dock within the ArcMap window or leave undocked. In this Exercise the window is docked below the Table of Contents.



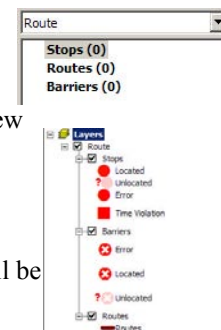
### Creating the Route analysis layer

1. On the Network Analyst toolbar, click the Network Analyst dropdown menu and click New Route.




The Network Analyst Window now contains empty lists of Stops, Routes and Barriers categories.

Additionally, the table of contents contains a new Route analysis layer.



### Adding a stop

Next, you will add the stops between which you will be creating the best route.

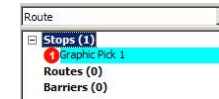
1. Click Stops(0) on the Network Analyst Window.
2. On the Network Analyst Toolbar, click the Create Network Location tool .
3. Click anywhere on the street network in the map to define a new stop location.

The program then calculates the nearest network location and symbolizes the stop with the located symbol. The stop will remain selected until another stop is placed or until it is unselected.

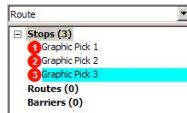


The located stop also displays the number 1. The number represents the order in which the stops will be visited by the calculated route.

You will also notice that the Stops category on the Network Analyst Window now lists 1 stop.





4. Add two more stops on the map. The stops are numbered 2 and 3. The order of stops can be changed on the Network Analyst Window. The first stop is treated as the origin and the last, as the destination.

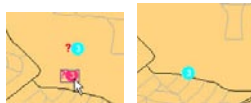


If a stop is not located on the network, it will appear with an unlocated symbol.



An unlocated stop can be located on the network by moving it, closer to any edge that belongs to the network. On the Network Analyst Toolbar, click Select/Move Network Location tool .

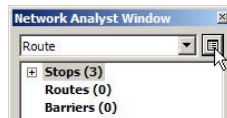
Using the Select/Move Network Location tool , click and drag the unlocated stop closer to an edge on the network.



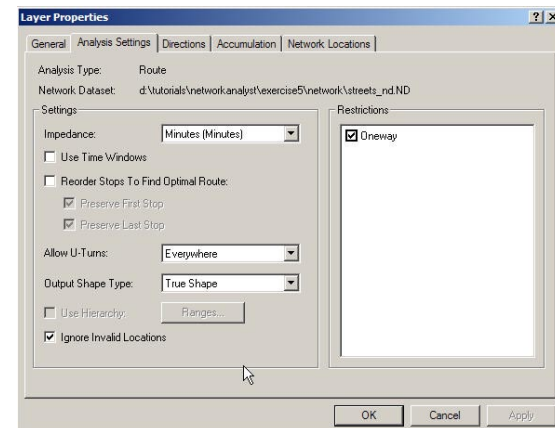
## Setting up the parameters for the analysis

Next, you will specify that your route will be calculated based on time (minutes), that U-turns are allowed everywhere, and that one-way restrictions must be followed.

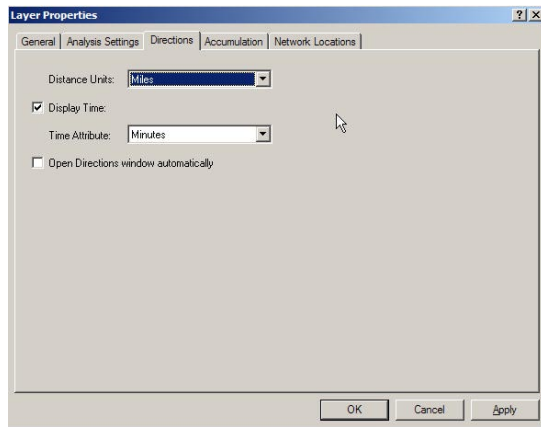
1. Click the Analysis Layer Properties button next to Route layer on the Network Analyst Window to bring up the Layer Properties dialog for Route.



2. In the Layer Properties dialog, click the Analysis Settings tab. Make sure the impedance selected is Minutes (Minutes).
3. Do not use time windows. (Leave the box unchecked). Time windows are used when certain stops can only be visited at certain times.
4. Do not reorder stops. (Leave the box unchecked). This preserves the order of stops as decided by you, when you created the stops.
5. Choose Everywhere from the Allow U-turns dropdown box.
6. Choose True Shape from the Output Shape Type dropdown box.
7. Check the box labeled Ignore Invalid Locations. This will let you find the best route using located stops. Stops that were not located on the network will be ignored.
8. Check Oneway in the Restrictions list.




9. Click the Directions tab.
10. Make sure the Distance Units are set to Miles, the Display Time box is checked and the time attribute is set to Minutes.

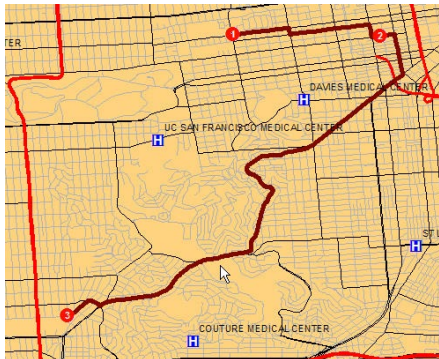


11. Click OK.

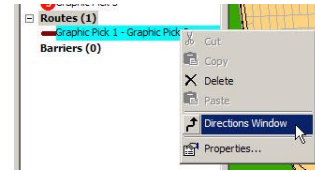
### Run the process to compute the best route

1. Click the Solve button  on the Network Analyst toolbar.

The route polyline appears in the map and in the Route category of the Network Analyst Window.



2. Click the plus (+) sign next to Routes on the Network Analyst Window to show the Route.
3. Right-click the new route called 'Graphic Pick 1 - Graphic Pick 3' and click Directions Window to display driving directions.



4. The Directions Window can also be displayed with turn-by-turn maps that can be shown by clicking on the Map link.




5. Close the Directions Window.

### Adding a barrier


In this section, you will add a barrier on the route, that represents a road block and will find an alternate route to the destination, avoiding the road block.

1. In the Window menu, click Magnifier to bring up the Magnifier window.
2. Click on the title bar of the Magnifier window and drag to reposition the Magnifier window.
3. Move the Magnifier window over the route, to a point where you want to add a barrier. The Magnifier window shows a part of the map where you can add a barrier at a zoom of 400%.



4. On the Network Analyst Window, click Barrier (0).
5. On the Network Analyst Toolbar, click the Create Network Location tool .
6. In the Magnifier Window, click anywhere on the route, to place a barrier.



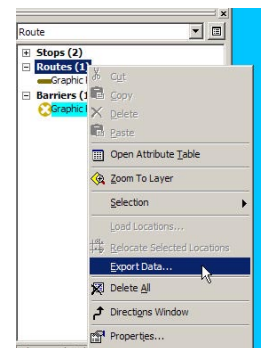
7. Click the Solve button  on the Network Analyst toolbar. A new alternative route is computed, avoiding the barrier.



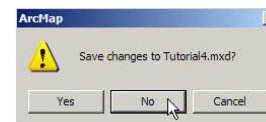
8. Close the Magnifier Window.

### Saving the best route

1. Right-click Routes (1) on the Network Analyst Window and click Export Data.



2. Type C:\arcgis\ArcTutor\Network\_Analyst\Exercise4\Exercise4\_Route.shp in the Output shapefile or feature class field.
3. Click OK. The best route generated is saved to the specified shapefile.
4. Click NO when prompted to add the exported data to the map as a layer.
5. If you do not plan to work on any other Exercise, close ArcMap. Click No to discard all changes.




# Exercise 5: Finding the closest fire stations

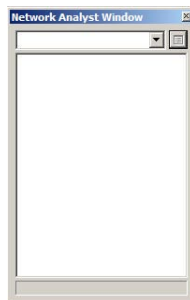
In this Exercise you will find the closest four fire stations that can respond to a fire at a given address. You will also generate the fastest route from each of these fire stations that will be provided to each driver of the fire engine.

## Preparing your display

1. If you have Exercise5.mxd open in ArcMap, skip steps 2 to 5.
2. Start ArcMap by either double-clicking a shortcut installed on your desktop or using the programs list in your Start menu.
3. Click File on the Main menu and click Open.
4. In the Open dialog box, navigate to C:\arcgis\ArcTutor\Network\_Analyst\Exercise5\Exercise5.mxd. (This is the default install location for this data.)
5. Double-click Exercise5.mxd.
6. If the Network Analyst Extension is not enabled, on the Tools menu, click Extensions and in the Extensions dialog, click Network Analyst.
7. If the Network Analyst toolbar is not already present, on the Main menu, click View, point to Toolbars, and click Network Analyst.



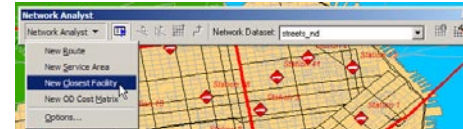
8. If the Network Analyst Window is not already open, click the Network Analyst Window button  on the Network Analyst toolbar.



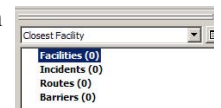
This is a dockable window which you can dock within the ArcMap window or leave undocked. In this Exercise the window is docked below the Table of Contents.

## Creating the Closest Facility analysis layer

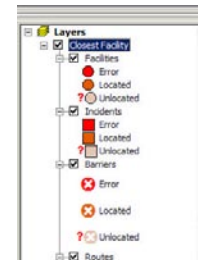
1. On the Network Analyst toolbar, click the Network Analyst dropdown menu and click New Closest Facility.



The Network Analyst Window now contains an empty list of Facilities, Incidents, Routes, and Barriers categories.



Additionally, the Table of Contents contains a new Closest Facility analysis (group) layer.

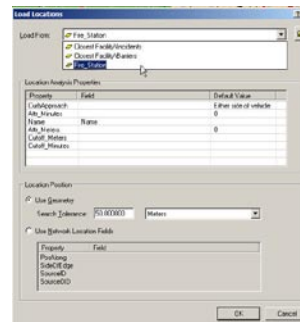


## Adding facilities

Next you will add facilities from a point file for which a layer file has been created.

1. Right-click Facilities (0) in the Network Analyst window and click Load Locations.
2. Select Fire\_Station from the Load From dropdown list.
3. Click OK.

40 fire stations are listed in the Network Analysis window and are displayed as facilities on the map.



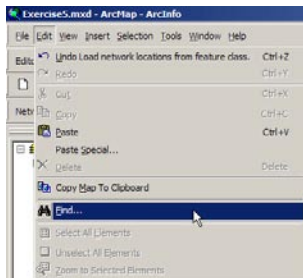
## Adding an incident

Next, you will find a street address (1202 Twin Peaks Blvd) and add it as an incident for Closest Facility Analysis.

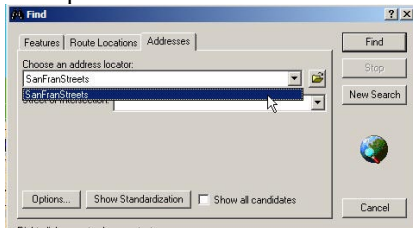
1. Click Incidents(0) on the Network Analyst Window to select it as the feature layer to which you will add the street address as a network location.



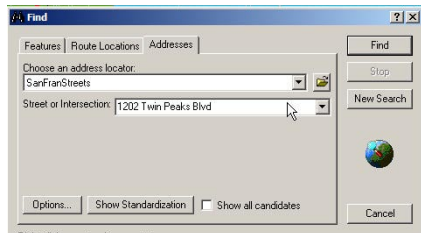
2. Select Find from the Edit menu to bring up the Find Dialog



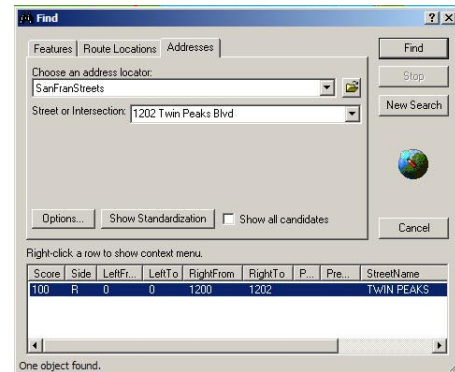
3. In the Addresses tab, Select "SanFranStreets" from the Choose and address locator dropdown list.



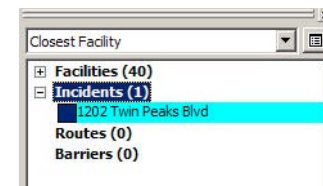
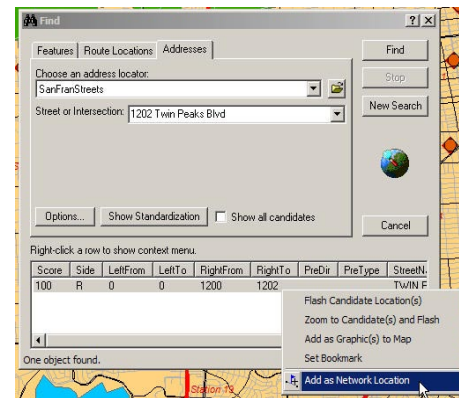
4. Enter "1202 Twin Peaks Blvd" in the text box labeled Street or Intersection.



5. Click Find. One location is found with that street address and is listed as a row in the table in the Find Dialog.



6. Right-click the row and click "Add as Network Location". This adds the located address as an incident on the Network Analyst Window and on the map.



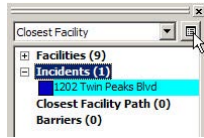
7. Close the Find Dialog.



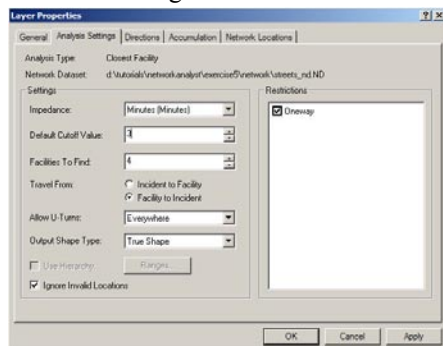
## Setting up the parameters for the analysis

Next, you will specify the parameters for your Closest Facility analysis.

1. Click the Analyst Layer Properties Button next to Closest Facility on the Network Analyst Window to bring up the Layer Properties dialog.



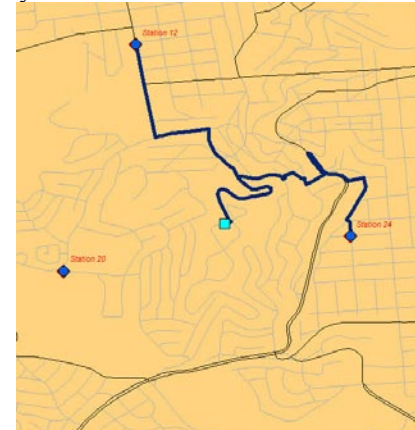
2. In the Layer Properties dialog, click the Analysis Settings tab.
3. Click the Impedance dropdown arrow and click Minutes (Minutes).
4. Set the Default Cutoff value to 3. ArcGIS will search for fire stations that are within three minutes of the fire. Any fire station outside of three minutes drive time will be ignored.
5. Increase the Facilities to Find from 1 to 4. ArcGIS will attempt to search for four fire stations from the fire site, within the three minute cutoff. If there are only three fire stations within the three minute cutoff, then the fourth fire station will not be found.
6. Under Travel From, select Facility (fire station) to Incident (fire).
7. Select Everywhere from the Allow U-Turns dropdown box.
8. Select True Shape from the Output Shape Type dropdown box.
9. Check the box labeled Ignore Invalid Locations. This will let you find the best route using located stops. Stops that were not located on the network will be ignored.
10. Check Oneway in the Restrictions list.
11. Click OK to save the settings.




## Run the process to identify the closest facility

1. Click the Solve button  on the Network Analyst toolbar.

The routes appear in the Map and in the Route Category on the Network Analyst Window.



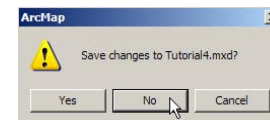
Note that only 2 fire stations were found to be closest to the fire within the three minute cutoff. You can optionally, increase the cutoff value to 4 minutes and see how many fire stations are found.

2. Click the Directions Window button  in the Network Analyst Toolbar to generate directions for routes from each fire station.



If you do not plan to work on any other Exercise, close ArcMap.

3. Click No to discard all changes.






## Exercise 6: Calculating service area and creating a OD Cost Matrix

In this Exercise you will create a series of polygons representing the distance that can be reached from a facility within a specified amount of time. These polygons are known as service area polygons. You will calculate 3-, 5-, and 10-minute service area polygons for six warehouses in Paris. You will also find out how many stores lie within each of these service areas. You have to identify one warehouse that should be relocated to better service the stores. Additionally, you will create an Origin-Destination Cost Matrix for delivery of goods from the warehouses to all the stores within a 10-minute drive time. Such a matrix is used as an input for logistics, delivery, and routing analyses.

### Preparing your display

1. If you have Exercise6.mxd open in ArcMap, skip steps 2 to 5.
2. Start ArcMap by either double-clicking a shortcut installed on your desktop or using the programs list in your Start menu.
3. Click File on the Main menu and click Open.
4. In the Open dialog box, navigate to C:\arcgis\ArcTutor\Network\_Analyst\Exercise6\Exercise6.mxd. (This is the default install location for this data.)
5. Double-click Exercise6.mxd.
6. If the Network Analyst Extension is not enabled, on the Tools menu, click Extensions and in the Extensions dialog, click Network Analyst.
7. If the Network Analyst toolbar is not already present, on the Main menu, click View, point to Toolbars, and click Network Analyst.



8. If the Network Analyst Window is not already open, click the Show/Hide Network Analyst Window button  on the Network Analyst toolbar.

This is a dockable window which you can dock within the ArcMap window or leave undocked. In this Exercise the window is docked below the Table of Contents.



### Creating the Service Area analysis layer

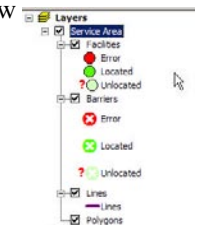
1. On the Network Analyst toolbar, click the Network Analyst dropdown menu and click New Service Area.



The Network Analyst Window now contains an empty list of Facilities, Barriers, Lines, and Polygons categories.



Additionally, the table of contents contains a new Service Area analysis layer.



### Adding facilities

Next, you will add warehouses as facilities for which the service area polygons will be generated.

1. Right-click Facilities(0) on the Network Analyst Window and select Load Locations. Select Warehouses in the Load From dropdown list and click OK.




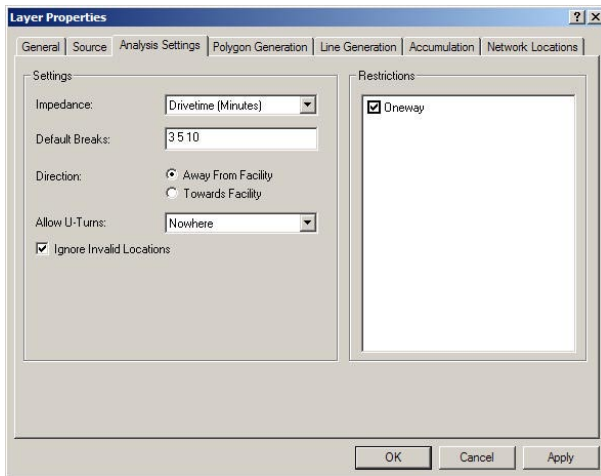
Click the plus (+) sign next to Facilities(6) in the Network Analyst Window to show the list of six facilities. The facilities are also visible on the map.



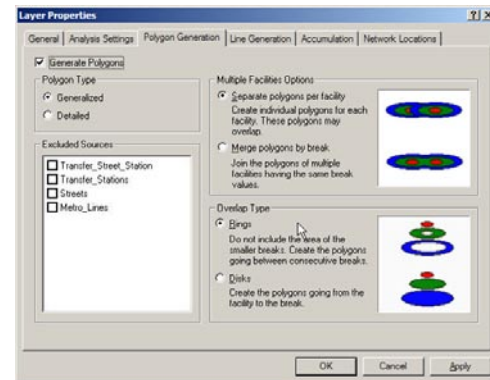
## Setting up the parameters for the analysis

Next, you will specify that your service area will be calculated based on Drivetime (minutes). Three service area polygons will be calculated for each facility, one at 3 minutes, one at 5 minutes, and another at 10 minutes. You will specify that the direction of travel will be from the facility, not towards the facility, that no U-turns are allowed, and that one-way restrictions must be followed.

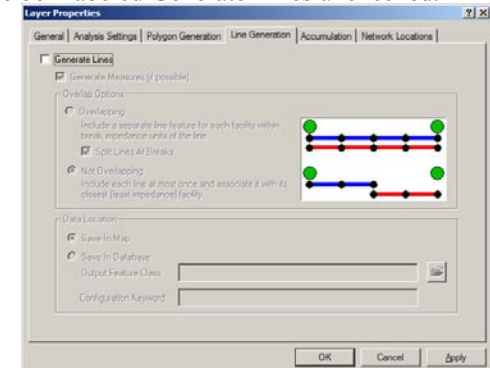
1. In the Network Analyst Window, click the Analysis Layer Properties Button  to bring up the Layer Properties dialog box
2. Click the Analysis Settings tab.
3. Click the Impedance dropdown list and select Drivetime (Minutes).
4. Type “3 5 10” in the Default polygon breaks text box. (Enter this as 3 5 10, the three numbers are separated by a space, without the quotes.)
5. Under Direction, click Away from facility.
6. Click Nowhere from the Allow U-turns dropdown list.
7. Check Oneway in the Restrictions list to honor one way restrictions.
8. Check the Ignore Invalid Locations checkbox.



9. Click the Polygon Generation tab.
10. Make sure that Generate Polygons is checked.
11. Click Generalized for Polygon Type. This results in faster analysis. Detailed polygons are much more accurate, but need more time to be generated.
12. Click Separate polygons per facility under Multiple Facilities Options. This results in individual polygons per facility that may or may not overlap.
13. Click Rings for the Overlap type. This excludes areas of smaller breaks from the polygons of a bigger break.
14. Click Apply to save the settings.




15. Click the Line Generation tab.
16. Leave the box labeled Generate Lines unchecked.



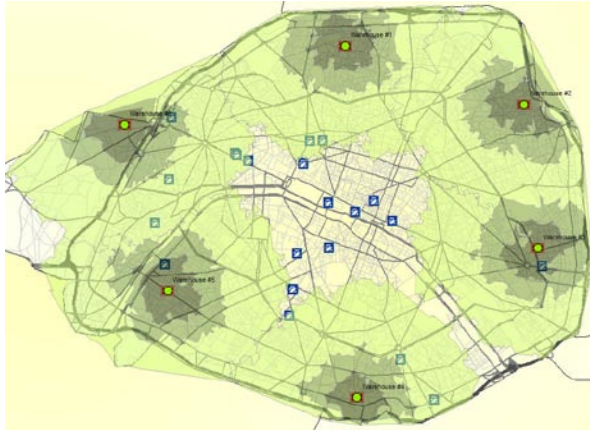
17. Click OK to save your settings.

## Run the process to compute the Service Area

1. Click the Solve button  on the Network Analyst toolbar.

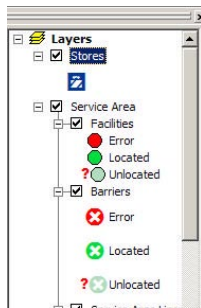
The service area polygons appear on the map and on the Network Analyst Window.

There is a transparency set by default for the Polygons layer. This shows the underlying layers and gives an idea of the area under the polygons with respect to the street network.

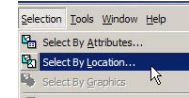


## Identifying stores that do not lie within any polygon

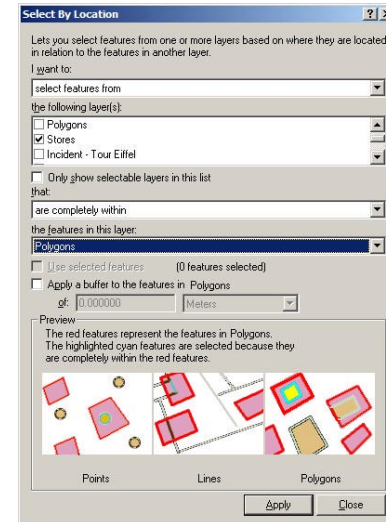
1. In the table of contents select and move the Stores feature layer to the top to improve visibility.



2. Choose Select by Location from the Selection menu.



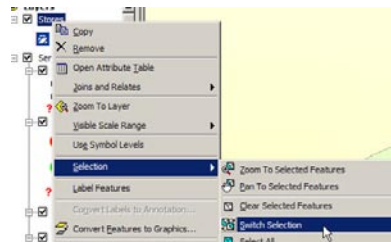
3. Create the selection query in the Select by Location to select features from Stores that are completely within Polygons, as shown below.



4. Click Apply. This will select all stores that lie within service area polygons.
5. Click Close.

You want to select stores that are not within the service area polygons, which is the inverse of the current selection. To get the selection of stores that are not within the service area polygons, you can switch the selection.

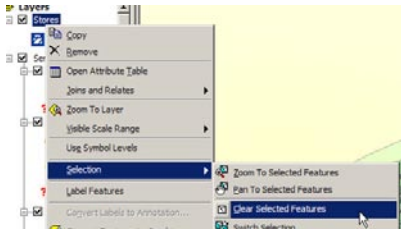
6. Right-click Stores in the Table of Contents, point to Selection and choose Switch Selection.



- The selection now shows the distribution of stores not contained in any service area polygon. You use this selection to identify the area to which you will relocate a warehouse. This area appears to be in the center of the map.




- Right-click Stores in the Table of Contents, point to Selection and choose Clear Selected Features.

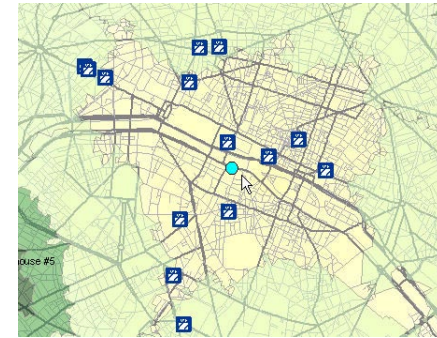


## Relocating the least accessible warehouse


- Look at the service area polygons of Warehouse #2. There are no stores that lie within the 3-, 5- or 10-minute service areas of Warehouse #2. Hence, you will relocate Warehouse #2 to better service the stores.
- On the Network Analyst Window, select Warehouse #2 under Facilities (6).

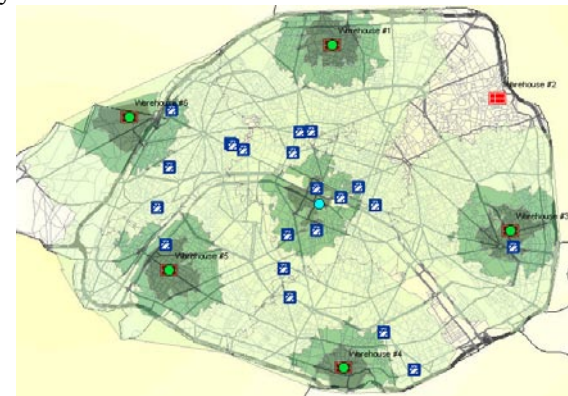


- Use the Select/Move Network Location Tool  to move Warehouse #2 to the center of the map, as shown in the figure below.



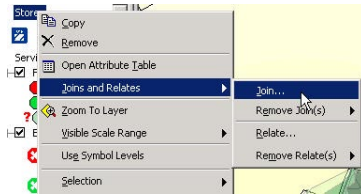
## Run the process to compute the Service Area

- Click the Solve button  on the Network Analyst toolbar. The service area polygons appear on the map and on the Network Analyst Window.



## Identifying the service area polygon that each store lies within

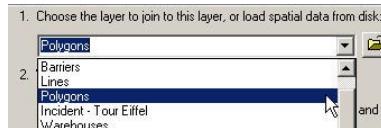
- In the table of contents, right-click Stores feature layer, point to Joins and Relates and select Join...



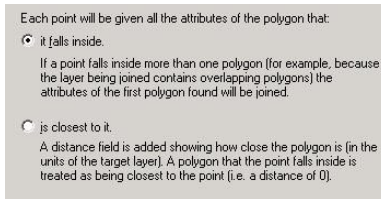
2. Choose Join data from another layer based on spatial location



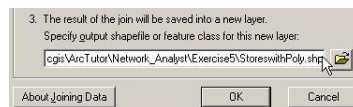
3. Select Polygons as the layer to join to this layer.



4. Select the first radio button labeled “it falls inside” to add the attributes of polygon to all points that fall inside the polygon.



5. Specify the output shapefile to save the result of the join as StoreswithPoly.shp.



6. Click OK to perform the join.

7. Right-click the newly added StoreswithPoly feature layer and select Open Attribute Table. Each row displays the name of the store and polygon it falls under. You can use this table to generate other useful

categories such as the number of stores within 0-3 minute service area of warehouses.

FID	Shape	OBJECTID_1	OBJECTID_2	POI	NOM	ObjectID_2	FacilityID	Name	FromBreak	ToBreak
0	Point	2	6	CENTRE COMM AU PRINTEMPS HALUSMANN		19	2	Warehouse #2: 5-10	5	10
1	Point	3	7	CENTRE COMM GALERIES LAFAYETTE HALUSMANN		19	2	Warehouse #2: 5-10	5	10
2	Point	4	8	CENTRE COMM ARCADES DULIDO		19	2	Warehouse #2: 5-10	5	10
3	Point	5	9	CENTRE COMM GALERIE DU CLAUDRE		19	2	Warehouse #2: 5-10	5	10
4	Point	6	10	CENTRE COMM ELYSEE 26		19	2	Warehouse #2: 5-10	5	10
5	Point	7	11	CENTRE COMM GALERIE DES TROIS QUARTIERS		19	2	Warehouse #2: 5-10	5	10
6	Point	9	14	CENTRE COMM ESPACE EXPANSION FORUM DES HALLES		19	2	Warehouse #2: 5-10	5	10
7	Point	12	17	CENTRE COMM BAZAR DE L'HOTEL DE VILLE		19	2	Warehouse #2: 5-10	5	10
8	Point	10	23	CENTRE COMM MARNE-MONTFARNASSE		19	2	Warehouse #2: 5-10	5	10
9	Point	19	24	CENTRE COMM GATTE		19	2	Warehouse #2: 5-10	5	10
10	Point	13	18	CENTRE COMM GALERIE COMMERCIALE PASSY PLAZA		20	5	Warehouse #5: 5-10	5	10
11	Point	8	12	CENTRE COMM GALERIE SAINT DIDIER		21	6	Warehouse #6: 5-10	5	10
12	Point	20	25	CENTRE COMM ITALE 2		24	4	Warehouse #4: 5-10	5	10
13	Point	21	28	CENTRE COMM CENTRE COMMERCIAL MASSENA 13		24	4	Warehouse #4: 5-10	5	10
14	Point	11	16	CENTRE COMM SAMARITAIN		27	2	Warehouse #2: 3-5	3	5
15	Point	14	19	CENTRE COMM LE MARCHE SAINT GERMAIN		27	2	Warehouse #2: 3-5	3	5
16	Point	15	20	CENTRE COMM LE BON MARCHE		27	2	Warehouse #2: 3-5	3	5
17	Point	1	6	CENTRE COMM LES BOUTIQUES DU PALAIS DES CONGRES		28	6	Warehouse #6: 3-5	3	5
18	Point	17	22	CENTRE COMM S.C.I. BEAULOURENELLE		31	5	Warehouse #5: 0-3	0	3
19	Point	16	21	CENTRE COMM PRINTEMPS NATION		33	3	Warehouse #3: 0-3	0	3
20	Point	10	15	CENTRE COMM GALERIE CARROUSEL DU LOUVRE		36	2	Warehouse #2: 0-3	0	3

8. Close the attribute table.

You can optionally export your facilities (including the one you moved to a new location) as a feature class.

9. Right-click Facilities (6) on the Network Analyst Window and click Export Data

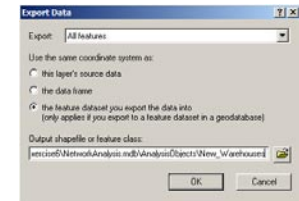
10. In the Export dropdown list, click All features.

11. Set the coordinate system to be used by choosing the third radio button labeled “the feature dataset you export the data into”

12. Type “C:\arcgis\ArcTutor\Network\_Analyst\Exercise6\NetworkAnalysis.mdb\AnalysisObjects\New\_Warehouses” as the output feature class.

13. Click OK.

14. Choose No when prompted to add the feature class to the map. You will not be using this feature class for the remaining exercise.



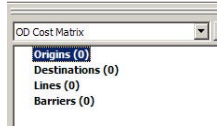
Optionally, you can create an Origin-Destination cost matrix for deliveries from the new warehouses to each store. The results of this matrix can be used to identify the stores that will be serviced by each warehouse within a 10-minute drive time. Also, you would like to find the total drive time from each warehouse to its stores.

## Creating the OD Cost Matrix analysis layer

1. In the table of contents, uncheck Service Area analysis layer to improve readability of the map.
2. On the Network Analyst toolbar, click the Network Analyst dropdown menu and click New OD Cost Matrix.



The Network Analyst Window now contains an empty list of Origins, Destinations, Lines, and Barriers categories.



Additionally, the table of contents contains a new OD cost matrix analysis layer.

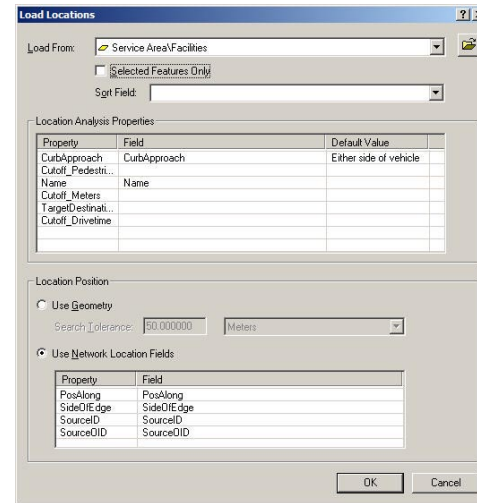


## Adding origins

You can use the facilities from Service Area Analysis (in the previous section) as origins. If you have not completed the section on Service Area Analysis, you can alternately use the Warehouses feature layer.

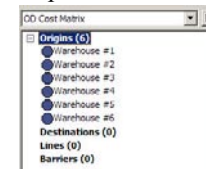
1. Right-click Origins (0) on the Network Analyst Window and click Load Locations.
2. Select ServiceArea\Facilities in the Load From dropdown list. (If you did not complete the previous section on service area analysis, you can use Warehouses instead. Note that your results will not resemble the results in this exercise.)
3. Make sure the Selected Features Only check box is unchecked.

4. Click Use Network Location Fields radio button under Location Position. Using network location fields will allow ArcGIS to use the located position of Service Area facilities to locate the origins again. This is much faster than using search tolerance to locate them again. (If you are loading Warehouses, you will need to click the use Geometry radio button and set the Search Tolerance to 50 meters.)



5. Click OK.

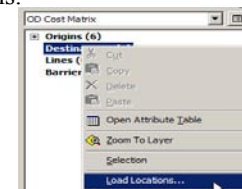
The Network Analyst Window now shows six origins under the Origins list and on the map.



## Adding destinations

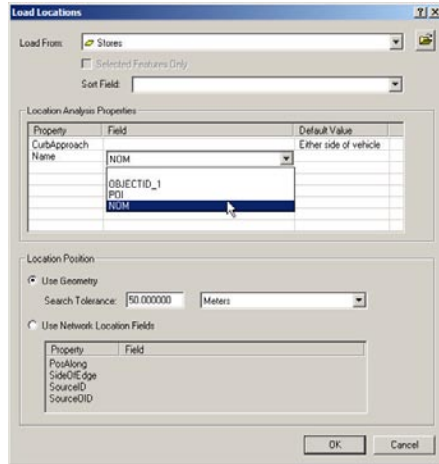
Next you will add the stores as destinations.

1. Right-click Destinations(0) on the Network Analyst Window and click Load Locations.



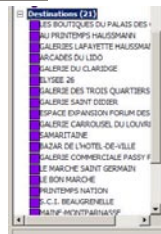


2. Choose Stores in the Load From dropdown list.
3. Under Location Analysis Properties, for the property Name, select the field “NOM” from the dropdown list. Since the field name is in French, ArcGIS Network Analyst was unable to map the field name automatically.

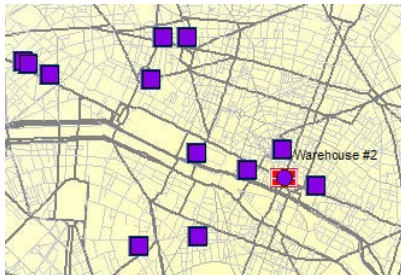


4. Click OK.

The Network Analyst Window now lists 21 destinations under the Destinations list.




These destinations are also displayed on the map.



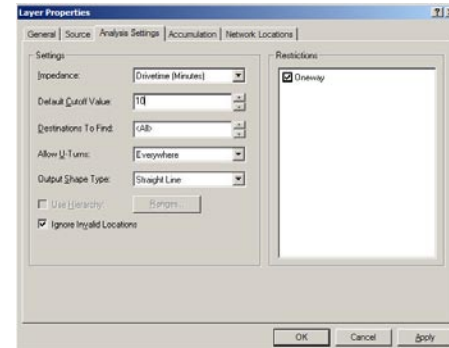
## Setting up the parameters for the analysis

Next, you will specify that your OD Cost Matrix will be calculated based on time (Drivetime). You will set a default cutoff value of 10 minutes and will ensure that all destinations are found within the specified cut off. Additionally, you will specify that U-turns are allowed everywhere and the output Shape type should be a straight line. Since all these trips are on roads, one-way restrictions must be followed. All invalid locations (locations that were not located) will be ignored.


1. Click the Analysis Layer Properties Button  next to OD Cost Matrix on the Network Analyst Window.

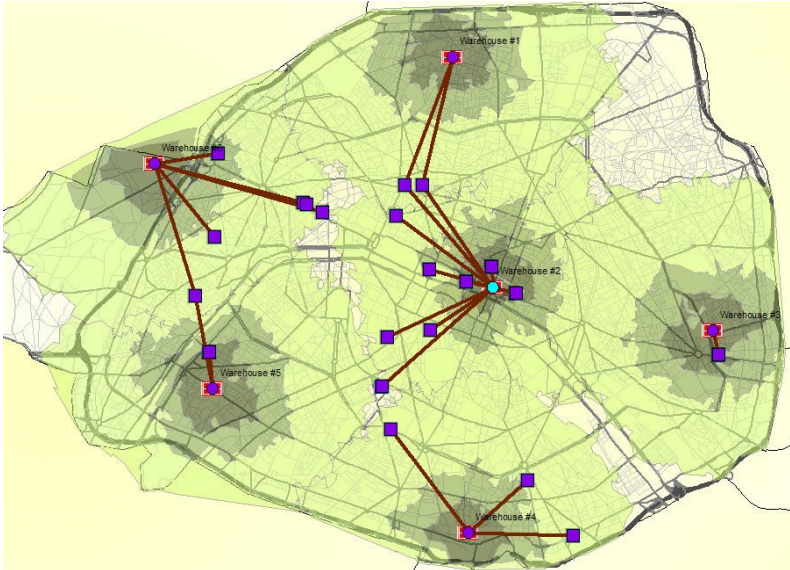


2. Click the Analysis Settings tab.
3. Click the Impedance dropdown list and click Drivetime(Minutes).
4. Input 10 in the Default Cutoff Value dropdown list. This will create origin-destination paths from each warehouse to all stores that can be reached within 10 minutes.
5. Select <All> from the Destinations to Find dropdown list.
6. Select Everywhere from the Allow U-turns dropdown list.
7. Select Straight Line from the Output Shape Type dropdown list.
8. Check Oneway in the Restrictions list.
9. Check Ignore Invalid Locations
10. Click OK save the parameters.



## Run the process to create the OD Cost Matrix

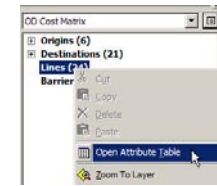
1. Click the Solve button  on the Network Analyst toolbar.  
The OD lines appear on the map. The number of lines in this tutorial are 24. These may be different for you depending on where you relocated Warehouse #2.
2. Turn on the Service Area Layer, and display the Lines on top of the service areas of the warehouses.



## Allocating stores to warehouses

Based on the OD Cost Matrix, you can now identify the stores that would be served by each warehouse.

1. Right-click on Lines(24) on the Network Analyst Window and click on Open Attribute Table to open the OD cost matrix.



2. The Attributes of Lines represents the origin destination cost matrix from each warehouse to stores within a 10 minute drive time in Paris. The OriginID column contains IDs of warehouses. The DestinationID column contains IDs of stores. The DestinationRank is a rank assigned to each destination that is served by a store based on the total drive time. For example, in the table below, for Warehouse #1, DestinationID 23 has a rank of 1 and DestinationID 24 has a rank of 2. This is because it takes less time to go from Warehouse #1 to DestinationID 23. (This may be different for you, as your analysis results are dependent on the source feature class of the origins and destinations.)

ObjectID	Shape	Name	OriginID	Destination	DestinationRank	Total_Drivetime
233	Polyline	Warehouse #1 - AU PRINTEMPS HAUSSMANN	1	23	1	8.502172
234	Polyline	Warehouse #1 - GALERIE LAFAYETTE HAUSSMANN	1	24	2	8.816077
245	Polyline	Warehouse #1 - AU PRINTEMPS HAUSSMANN	6	23	9	8.356675
249	Polyline	Warehouse #2 - BAZAR DE L'HOTEL-DE-VILLE	6	33	3	3.684713
248	Polyline	Warehouse #2 - ESPACE EXPANSION FORUM DES HALLES	6	30	2	2.846918
250	Polyline	Warehouse #2 - GALERIE CARROUSEL DU LOUVRE	6	31	4	4.415114
252	Polyline	Warehouse #2 - GALERIE DES TROIS QUARTERS	6	20	6	7.563005
254	Polyline	Warehouse #2 - GALERIE LAFAYETTE HAUSSMANN	6	24	8	8.679630
253	Polyline	Warehouse #2 - LE BON MARCHÉ	6	36	7	8.527717
251	Polyline	Warehouse #2 - LE MARCHÉ SAINT GERMAIN	6	35	5	6.942032
256	Polyline	Warehouse #2 - MARE-ANTRARIBASSE	6	39	10	9.874308
247	Polyline	Warehouse #2 - SAMARITAIN	6	32	1	2.283397
235	Polyline	Warehouse #3 - PRINTEMPS NATION	2	37	1	4.442888
237	Polyline	Warehouse #4 - CENTRE COMMERCIAL MASSENA 13	3	42	2	6.300414
230	Polyline	Warehouse #4 - GAITE	3	40	3	8.578204
236	Polyline	Warehouse #4 - ITALIE 2	3	41	1	5.628731
240	Polyline	Warehouse #5 - GALERIE COMMERCIALE PASSY PLAZA	4	34	2	7.840005
229	Polyline	Warehouse #5 - S.C.I. BEAUGRENELLE	4	38	1	2.426299
243	Polyline	Warehouse #5 - ARCADES DU LIGO	5	25	3	8.049053
246	Polyline	Warehouse #5 - ELYSÉE 28	5	27	6	9.772601
245	Polyline	Warehouse #5 - GALERIE COMMERCIALE PASSY PLAZA	5	34	5	8.857623
244	Polyline	Warehouse #6 - GALERIE DU CLARIDGE	5	28	4	8.793894
242	Polyline	Warehouse #6 - GALERIE SAINT DIDIER	5	29	2	6.088853
241	Polyline	Warehouse #6 - LES BOUTIQUES DU PALAIS DES CONGRES	5	22	1	3.868477

The OD cost matrix displays the stores serviced by each warehouse along with the total drive time for each route. Some stores are within a 10 minute accessibility zone of more than one warehouse and can be served by any one of them. The OD cost matrix can also be used as an input in logistics routing models, that use origin destination matrices to allocate goods and services.

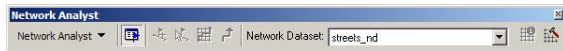
3. Exit ArcMap and do not save any changes to the Exercise6.mxd.


# Exercise 7: Creating a Model for Route Analysis

In this Exercise you will create a model for finding the fastest delivery route connecting 21 stores in Paris.

## Preparing your display

1. If you have Exercise7.mxd open in ArcMap, skip steps 2 to 7.
2. Start ArcMap by either double-clicking a shortcut installed on your desktop or using the programs list in your Start menu.  
If the Network Analyst Extension is not enabled, on the Tools menu, click Extensions and in the Extensions dialog, click Network Analyst.
3. Click File on the Main menu and click Open.
4. In the Open dialog box, navigate to C:\arcgis\ArcTutor\Network\_Analyst\Exercise7. (This is the default install location for this data.)
5. Double-click Exercise7.mxd.
6. If the Network Analyst toolbar is not already present, on the Main menu, click View, point to Toolbars, and click Network Analyst.




7. If the Network Analyst Window is not already open, click the Network Analyst Window button  on the Network Analyst toolbar.



This is a dockable window which you can dock within the ArcMap window or leave undocked. In this exercise, the window is docked below the table of contents.

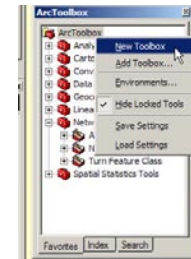
8. In the table of contents, check the check boxes by the Stores layer to show it on the map.
9. In the table of contents, uncheck the check box by the Metro System group layer to hide it on the map.

## Creating the Model

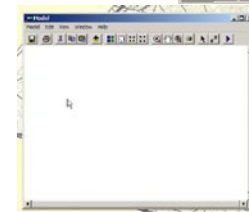
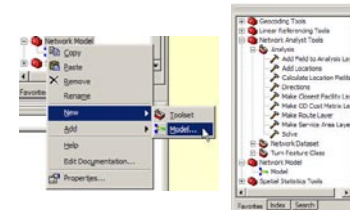
1. On the Standard toolbar, click the Show/Hide ArcToolbox Window Button  to show the ArcToolbox Window.



2. Right-click ArcToolbox in the ArcToolbox window and select New Toolbox.



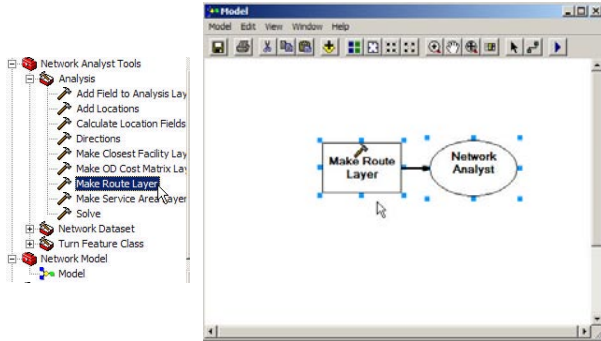
3. Name the newly added toolbox "NetworkModel".
4. Right-click on NetworkModel toolbox, select New and then Model. A new model appears in the NetworkModel toolbox and in the map window.



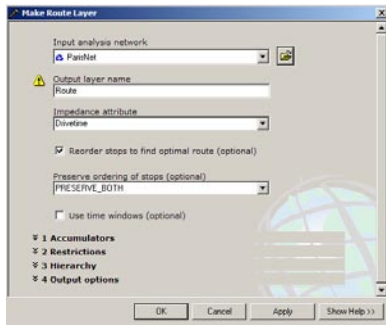
## Creating the Route Layer in the model


Next you will create the route layer within the model. The workflow for using Network Analyst in a model is the same as the workflow for using Network Analyst in ArcMap. First, you create a route layer and set properties. Next, you add the network locations (stops) to be used as inputs. Last, you solve and display the results.

1. Select the Make Route Layer tool in the Analysis Toolset of the Network Analyst Tools toolbox and drag it into the model.



2. Double-click the Make Route Layer Tool in the model, to set its properties.
3. Click the ParisNet as the Input Analysis Network in the dropdown list.
4. In the Impedance dropdown list, click Drivetime.
5. Check the Reorder stops to find optimal route checkbox.
6. In the Preserve ordering of stops dropdown list, click PRESERVE\_BOTH



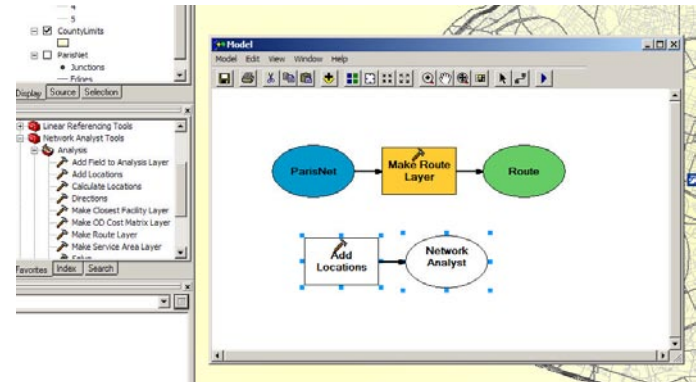
7. Click OK to continue. The Input analysis network is now added to the model. The Make Route Layer tool becomes yellow in color and the output layer becomes green. Click the Full Extent button  to view the entire model.



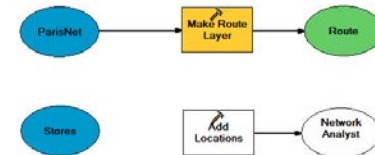
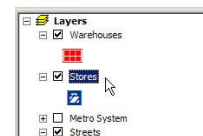
## Adding stops in the model

Next you will add the stores as stops by using the Add Locations tool.

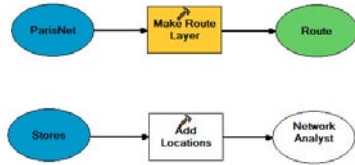
1. Select the Add Locations tool in the Analysis toolset of the Network Analysis toolbox and drag it into the model.






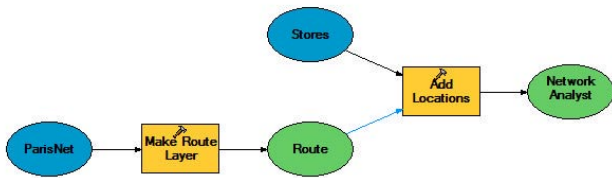
2. Select the Stores feature layer in the table of contents and drag it into the model to the left of the Add Locations tool.



3. Select the Add Connection Tool  and connect Stores to the Add Locations tool.

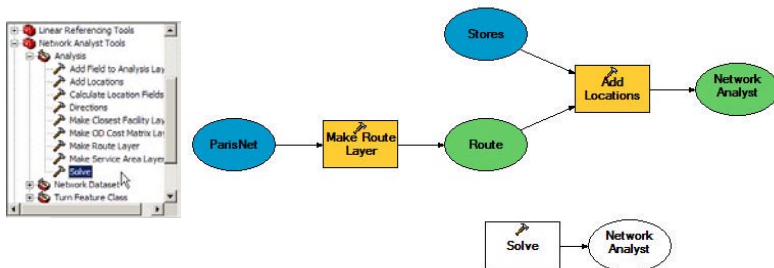





4. Using the Add Connection tool , connect the output layer called Route to the Add Locations tool. The Add Locations tool becomes yellow in color. Click the AutoLayout button  to arrange the model. Click the Full Extent button  to view the entire model.

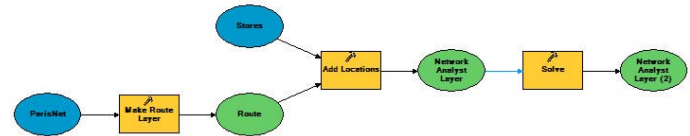



### Adding the solve function and finding the best route

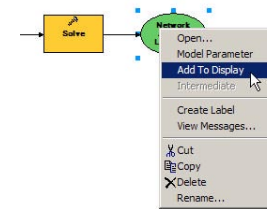
1. Select the Solve tool in the Analysis toolset in the Network Analyst toolbox and drag it into the model.




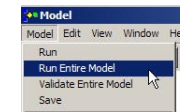
2. Using the Add Connection tool , connect the output layer called Network Analyst Layer to the Solve tool. The Solve tool becomes yellow in color and the output layer becomes green. Click the AutoLayout button  to arrange the model. Also click the Full Extent button  to view the entire model.



3. Using the Select tool  right-click on the output layer of the Solve tool (Network Analyst Layer (2) ) and click Add To Display. This will add the final ou



4. Click on the Save button  to save the model.
5. From the Model menu, choose Run Entire Model to perform the analysis.

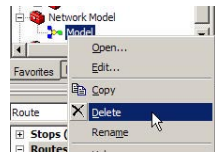


6. Close the model to inspect the results. Click Yes, when prompted to save the model.

A new Route layer is added to the map, the Network Analysis window has all the stops and the resultant route. The route is also displayed on the map.



7. Right-click the Model in the NetworkModel toolbox and select Delete. Click Yes to verify the deletion.



8. Exit ArcMap and do not save any changes to the Exercise7.mxd.