

Network Analyst

ArcGIS advanced training

Advanced Geoprocessing Tools

What's the use of Network Analyst tool?

- Calculate fastest road from point A (MSF office) multiple points
- Create service areas (Accessibility buffers around a point)
- Calculate the best itinerary to visit multiple destinations
- Create table of distances from point A to multiple points

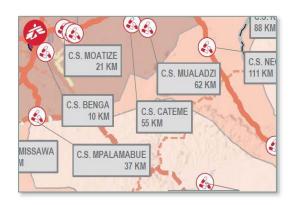
In this tutorial the Network Analyst Tool will be used to calculate the fastest road from the MSF Office to each Health facilities. As a result, a road shapefile with the attributes of road length, name of origin and destination will be obtained.

Main Steps

- 1. Getting software & data ready
- 2. Build the road network
- 3. Create the analysis
- 4. Symbology

Example of products







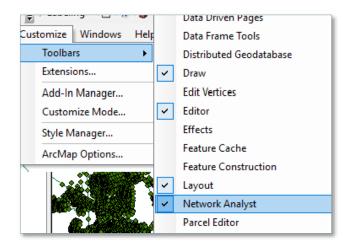
1. Getting software & data ready

Activate extension

>In Customize / Extensions check « Network Analyst »

Add the toolbar

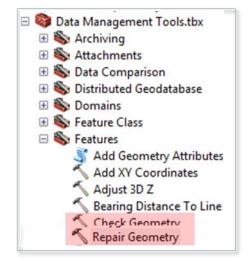
>In Customize / Toolbars check « Network Analyst »



Road layer

- > Export AOI roads only (faster processing)
- > Check/Repair geometry
- > Add a new field in the attribute table
 - o « hierarchy » as an integer
 - classify roads by categories:
 - 1 main roads (osm: trunk+ primary),
 - 2 secondary roads (osm: secondary + tertiary),
 - 3 tertiary roads (osm: other roads)

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Select the extensions you want to use.									
?	3D Analyst	1							
	ArcScan								
	Geostatistical Analyst								
····· 🖌	Network Analyst								
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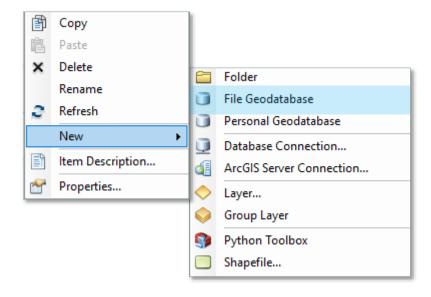
name	type	hierarchy
	trunk	1
Avenida Ho Chi Min	residential	3
Rua John Issa	residential	3
Avenida Patrice Lumumb	residential	3
Rua José Sidumo	residential	3
Avenida Amílcar Cabral	secondary	1



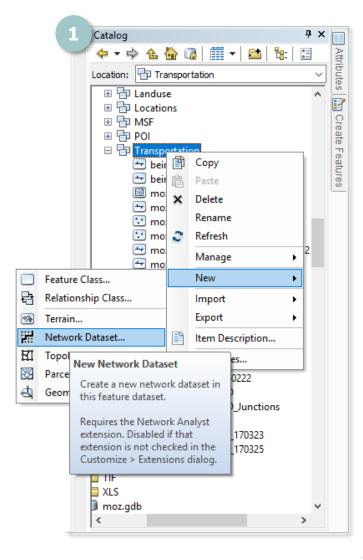
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Database

- > Ensure you have a gdb
- > Else create one



2. Build the road network



Network dataset

This step is the longest and the number of parameters will depend on your data and its quality.

You can create a complex model based on many inputs (speed, hierarchy, bridges, one way, elevation...) or, as in this example, a very simple one (based only on hierarchy and length) as it is a network build remotely – no accurate knowledge of the field and with open source data.

- In the gdb add a « new network dataset »
- 2. Select transportation feature class
- 3. Model turns

(i) cartong	ArcGIS advanced Training
2 New Network Dataset	
Select the feature classes that will participate in the network	dataset:
beira_rds_l_msf_wgs84_clip	New Network Dataset
moz_GAACsAccess_I_osm_msf_231215 moz_rds_I_cenacarta_161027 moz_rds_I_dcw	Do you want to model turns in this network?
 moz_rds_l_msf moz_rds_l_osm_160912_selection moz_rdsGAACs_l_osm_msf_231215 	 Yes Tum Sources:
moz_rlw_l_cenacarta	Global Turns>

Here it is a simple analysis so I select only one layer but you can mix railway with several road layers, foothways...

Next,	ew Network Dataset						
 Connectivity (any vertex) Use elevation as a cost 	The default connectivity settings for network datasets establish connectivity only at coincident endpoints of line features during the build process. If you want to use different connectivity settings, click the Connectivity button below. You can change the connectivity settings now, or you can change them after the network dataset has been created.						
Connectivity: We advise you choose "any vertex" so that two crossing lines can connect even if they don't have an "end point" at this location.	Connectivity Connectivity Groups: Source Moz_rds_l_osm_160912_selection Any Vertex End Point						
How would you like to model the elevation of your r None Using Z Coordinate Values from Geometry Using Elevation Fields	network features? You can add elevation as a cost if you have a corresponding field in your attribute table.						



Additional parameters

Depending on your data quality and your knowledge of the field of study you can also:

- > Add "Length" as a cost
- > Add "road classification" as a hierarchy
- > Add "speed limit" as a cost
- > Add "one way" as a restriction

Here length from origin to arrival is a "cost" (analysis will choose the shortest path) and the road classification is a "hierarchy" so the analysis will favor a primary road over a pathway. You can also choose some parameters as "restriction", for example if you have a field about bridge presence on the road, you can add "no bridge" as a restriction. That way the model will not choose road with bridges.

0	Name		Usage	Units	Data Type	Add
0	Length		Cost	Meters	Double	Remove
						Remove All
		Add New Attribute				Rename
		Name:	road_classification		ОК	Duplicate
		Usage Type:	Hierarchy	~	Cancel	Ranges
		Units:	Unknown	~		Parameters
		Data Type:	Integer	\sim		Evaluators
		Restriction Usage:	Prohibited	~		
			✓ Use by Default	Add New Attribut	te	
	_			Name:	road_classification	0
				Usage Type:	Hierarchy	✓ Can

6. Add « Hierarchy » parameter



7. Check "hierarchy" ranges

Based on the field you added as the hierarchy at the beginning, choose which numbers will be considered as "primary roads", "secondary" or "tertiary". Notice only three categories are accepted by the software, you could have in your original data source 10 categories and choose:

- 1-4 are to be considered as "Primary roads" for the model, 5-7 "secondary roads" and 8-10 "local roads.

- 1-2 "Primary roads", 3-4 "secondary" and 5-7 "local road" and 8-10 not need for the model.

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	l	°	o	o		Ranges
	l	Primary Roads	Secondary Roads	Local R	pads	Parameters
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- 8. Check evaluators
 - > For Length make sure the evaluator is length (by default it can be shape)
 - > For road_classification make sure the evaluator is hierarchy

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۰	roa	d_classification		Hierarchy	Unknown	Integer		Remove
_							X	Remove All
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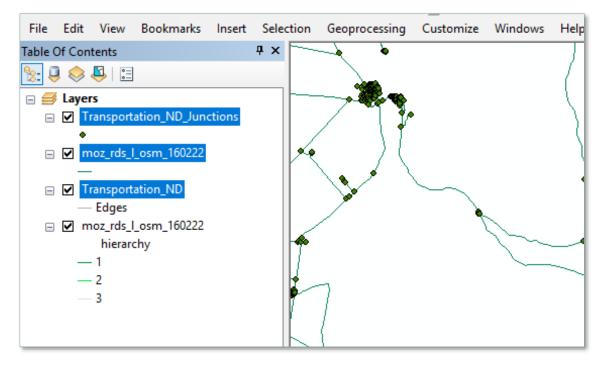
9. Final steps Name the model and check the summary

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Result

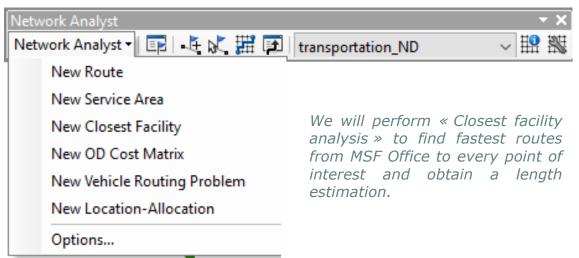
You can see three new layers on your map: junctions, roads, edges. You won't use them so you don't have to answer "yes" when ArcGIS asks if you want them to be added on the map.



3. Create the analysis

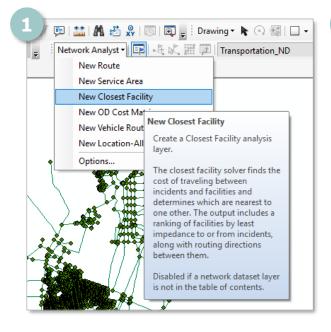
Analysis possible:

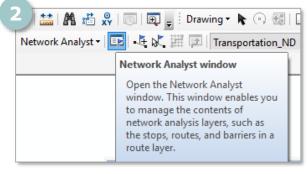
> Open your Network analyst toolbar





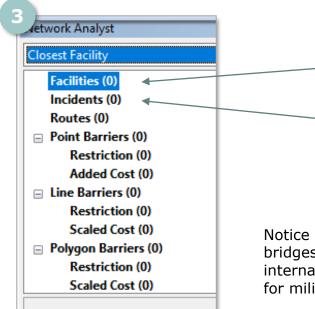
1. Select "New Closest Facility", and we will define the starting point as the MSF Office, and the many destination points as the "health facilities" MSF team is interested in.





2. In the "Network Analyst Toolbar", open the "Network Analyst Window" to access the menu where you can input starting and ending points.

3. The Network Analyst Window is composed as follows:



"Facilities": Starting point of the analysis. All distance and routes will start from this point(s).

"Incidents": Ending points of the analysis. All distance and routes will be calculated individually from starting point to each ending point.

Notice you can also input "Point barriers" like bridges, checkpoints, "Line barriers" such as international borders, rivers or "Polygon barriers" for military zones, deep forests...

Those default names can be changed to better suits your needs.



- 4. Load "Facilities": MSF Office (starting point)
 - > Right-clic on "Facilities" in the "Network Analyst Window"
 - > Select "Load locations" in the menu
 - > Select the layer containing your MSF Office in "Load From"
 - > Check the field containing the name of the office is the one mention below

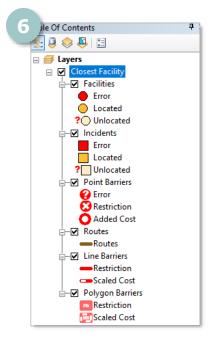
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Adde	Delete All	Property Field Default Value
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Kestr	Zoom To Layer	my layer to have only one
		point
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o 1 and the r	name of the office is mention	ed. Routes (0)
		Point Barriers (0)
		Restriction (0)

- 5. Load "Incidents": Health facilities (ending points)
 - > Right-clic on "Incidents" in the "Network Analyst Window"
 - > Select "Load locations" in the menu
 - > Select the layer containing your Health facilities of interest (make a definition query on your layer if needed) in "Load From"
 - > Check the field containing the name of the Health facilities is the one mention below



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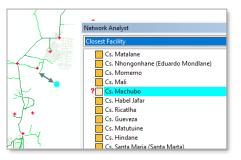
6. Check in the Table of Content



In the "Table of Content" you can see a symbology for "Error", "Located" and "Unlocated" features you just input.

Check how many "Unlocated" features you have in both "Facilities" and "Incidents". One way to diminish this number is to use the "Use Geometry" functionality while loading "Facilities" and/or "Incidents".

It will use the "search tolerance distance" you mention to consider the feature is connected to the road if the distance between the unlocated feature and the road is inferior to this distance.



Of course the distance you will obtain from the MSF Office to this point will be a very rough estimation as it will only take into account the distance from the MSF Office to the end of the road, then it will be missing from the end of the road to the Health facility. The choice is yours to use or not this option.

7. Solve the analysis



Back on the "Network Analyst Toolbar" click on "Solve".





Result

You will obtain the "Routes" connecting the starting point to every ending point (in brown here). You can see them on your table of Content under "Routes" and we strongly advise to register this data in a layer so you can edit it.

Opening the « Route » attribute table have information on:

- The length of the total path,
- The name of the road,

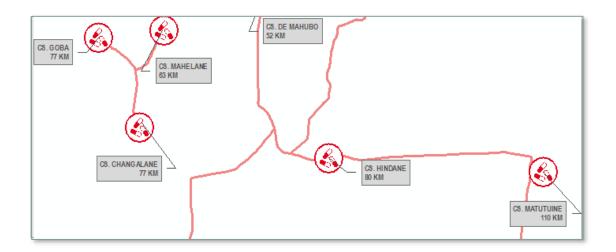
And you visualize it on the map.

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4. Symbology

The symbology can be tricky after a network analysis. This last part is to give you tips and tricks about one way of making the symbology.

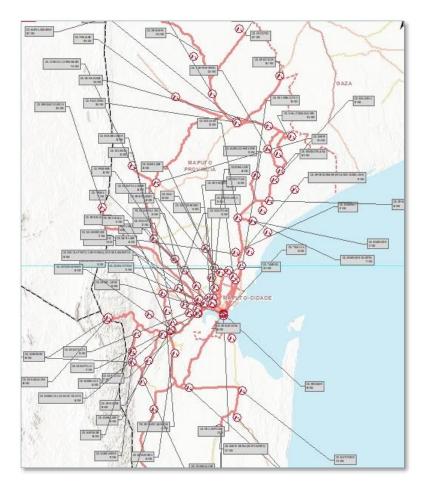


In this example we want to label each "Health facility" with information contained in two fields: the name of the health facility and its distance to the MSF Office, each on a different line (vbnewline function in maplex).

Layer Properties					Label Expression		
Hatches Joins & Relater		Joins & Relates	Time		Expression Maplex		
General Source	e Selection	Display Symb	ology Fields	Definition Query	Fields Double-click to add a field into the expression Show Type •		
✓ Label features in this layer Method: Label all the features the same way.					OBJECTID FacilityID FacilityRank Name InddentCurbApproach		
All features will be labeled using the options specified. Text String Label Field: <expression> Expression</expression>					Append Show Values Display coded value description		
Text Symbol	AABBYYZZ	Arial N		Expression Write the expression in the language of the selected parser.			
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But the result is very messy!



What is proposed is to convert label to annotations.

Be careful when using this functionality. We advise to use it only if in a database, never on the replica.

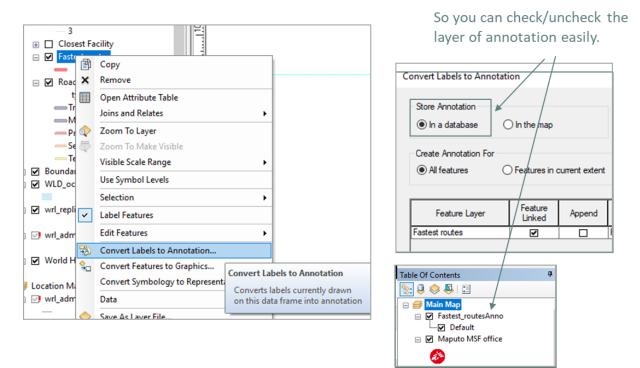
You can either store annotations in the gdb or in the map itself. The second option is not to be advised as if you need to change your symbology, the label expression or modify a label you have to start again as it is not dynamic. Saving the annotations in the gdb is dynamic, so if you modify you label in the annotations it will also change in the attribute table, and if you decide to change colours or to align text differently it is working.

You should not use this functionality on a replica layer, as it will be considered as a change in its data model and won't be able to perform synchronization anymore.

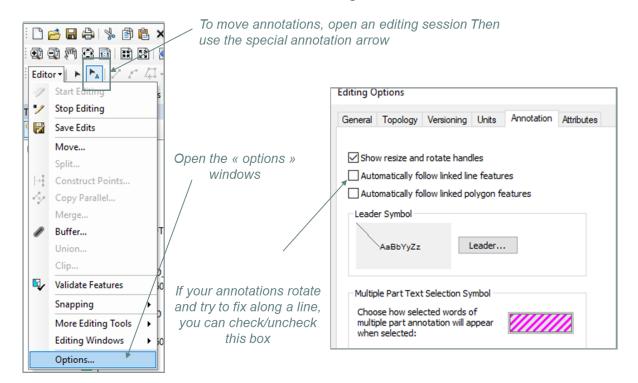
1. The first step is to save the "route" layer from the analysis result into a database layer so you will be able to make modifications on it.



2. Then, right-clic on the layer and select "Convert Labels to Annotations..." and select "Store Annotations in a database". You will see them appearing as a new layer into the table of content.



3. Move annotations by editing the layer, and use the arrow with "blue A" so the line linked to the feature will move along.





Results

