

**User Guide for NeXTA-GIS:**  
**Conversion between SHAPE file and CSV file**

**Table of Contents**

<b>1. Introduction.....</b>	<b>2</b>
<b>2. Step-by-step process for converting shape file to csv file .....</b>	<b>4</b>
<b>3. Step-by-step process for converting csv file to shape file, using 2-corridor example ....</b>	<b>7</b>

## 1. Introduction

- (1) Shape files are commonly used in different GIS and transportation planning tools.
- (2) GMNS uses CSV for representing network information in node.csv and road\_link.csv format.
- (3) Two-way conversion allows users to easily use Excel to edit field names and field values, e.g. using VLOOKUP functions to batch-process the values based on link attributes, and then GIS to display the network geometry in a standard way.
- (4) General Travel Network Format Specification (GMNS) is a product of Zephyr Foundation, which aims to advance the field through flexible and efficient support, education, guidance, encouragement, and incubation. <https://github.com/zephyr-data-specs/GMNS>
- (5) Well-known text (WKT) is a text markup language for representing vector geometry objects on a map. WKT format used in coding node and link geometry fields, see in Figure 1.1. Coordinates for geometries may be 2D (x, y), 3D (x, y, z), 4D (x, y, z, m) with an m value that is part of a linear referencing system or 2D with an m value (x, y, m). For the point in Figure 1.1, the coordinates of the point is [30,10], and the coordinates of the three points in the line string are [30,10], [10,30], [40,40].

[https://en.wikipedia.org/wiki/Wellknown\\_text\\_representation\\_of\\_geome](https://en.wikipedia.org/wiki/Wellknown_text_representation_of_geome)

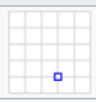

Geometry primitives (2D)		
Type	Examples	
Point		POINT (30 10)
LineString		LINESTRING (30 10, 10 30, 40 40)

Figure 1.1 WKT format

The tools used in this user guide is summarized in Table 1.1.

Table 1.1 Tools used in this user guide

Number	Tool	Address or format
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1	Nexta	GitHub\NeXTA-GMNS\releases
2	Nexta_GIS	GitHub\NeXTA-GMNS\tools\GIS_shape_file_CSV_file_conversion\NEXTA_GIS
3	Excel	
4	QGIS/ArcGIS	
5	CSV files	node.csv, road_link.csv
6	Shape files	*.dbf, *.shp, *.shx  The shapefile format is a geospatial vector data format for geographic information system (GIS) software. It is developed and regulated by Esri as a mostly open specification for data interoperability among Esri and other GIS software products.  <a href="https://en.m.wikipedia.org/wiki/Shapefile">https://en.m.wikipedia.org/wiki/Shapefile</a>

The procedure of converting shape file to csv file and converting csv file to shape file are illustrated in Figure 1.2 and Figure 1.3. The numbers in Figure 1.2 and Figure 1.3 are corresponding to the numbers in Table 1.1.

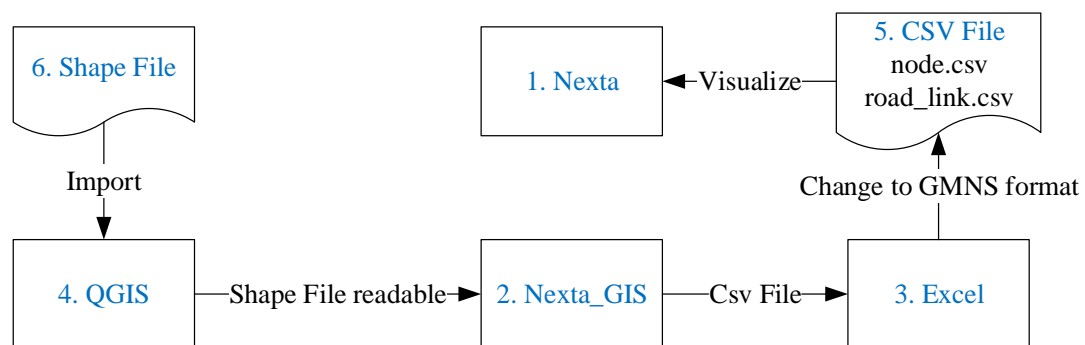


Figure 1.2 illustration of converting shape file to csv file

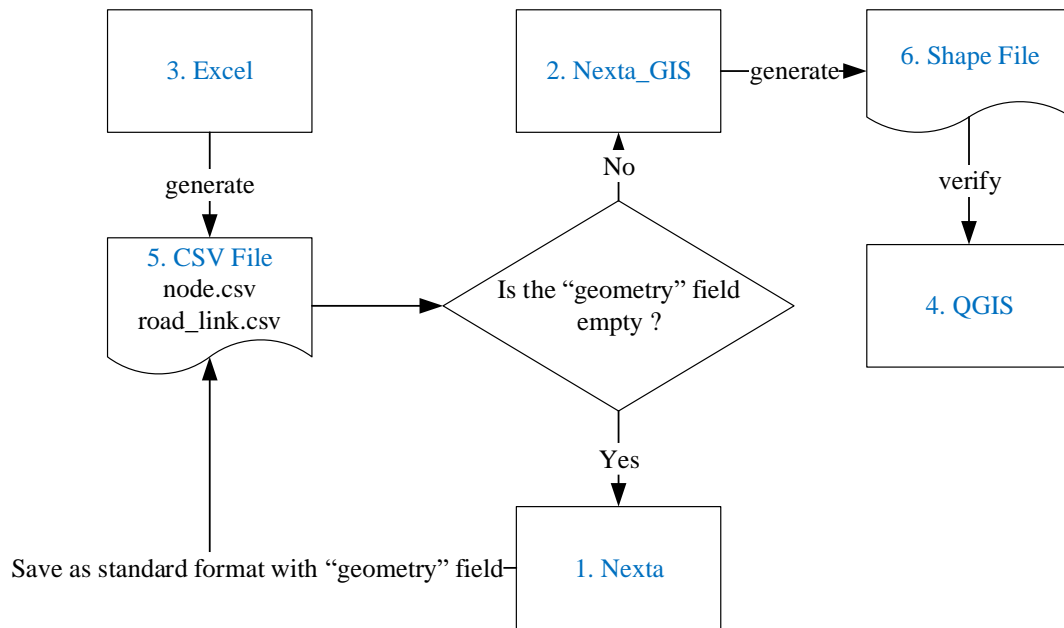


Figure 1.3 illustration of converting csv file to shape file

## 2. Step-by-step process for converting shape file to csv file

First, please download the NEXTA-GIS tool package, NEXTA\_GIS.zip at

[https://github.com/xzhou99/NeXTA-GMNS/tree/master/tools/GIS\\_shape\\_file\\_CSV\\_file\\_conversion](https://github.com/xzhou99/NeXTA-GMNS/tree/master/tools/GIS_shape_file_CSV_file_conversion)

Second, please unzip the package to find 1) NEXTA-GIS.exe executable and 2) three sets of sample GIS files. Note that, there are a large number of DLL files in the same folder, which are required as part of GIS SHAPE file reading utility.

<https://en.wikipedia.org/wiki/QGIS>

<https://en.wikipedia.org/wiki/Shapefile>

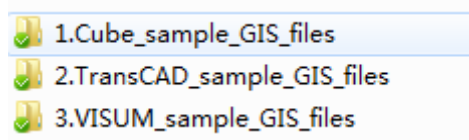


Figure 2.1

### Step 1: Ensure GIS Shape file is readable.

Open Q-GIS, go to menu->layer->add layer-> add vector layer, and open a GIS shp file, e.g. in data folder "1.Cube\_sample\_GIS\_files". For more information about Q-GIS, one can refer to

the user guide for Q-GIS at: [https://docs.qgis.org/3.10/en/docs/user\\_manual/](https://docs.qgis.org/3.10/en/docs/user_manual/)

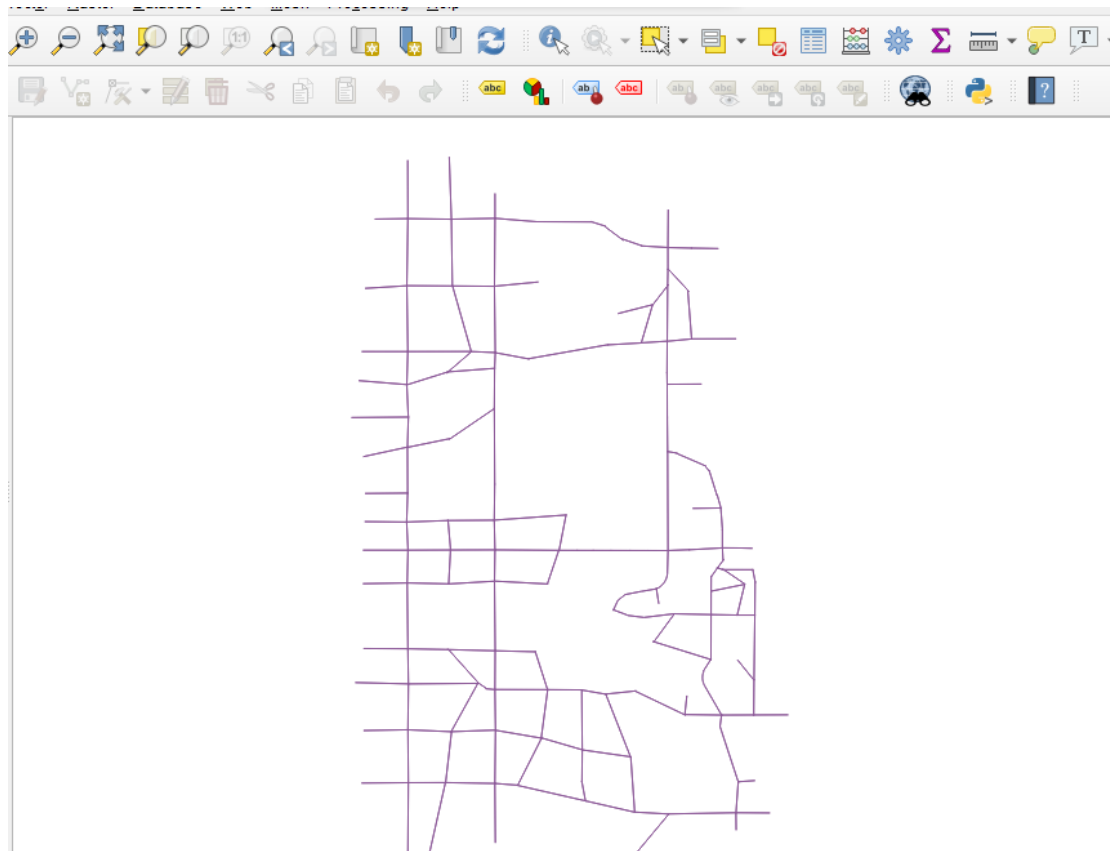


Figure 2.2

**Step 2:** Click on NEXTA-GIS.exe, Select menu Tools→Shapefile to CSV two-way converter,

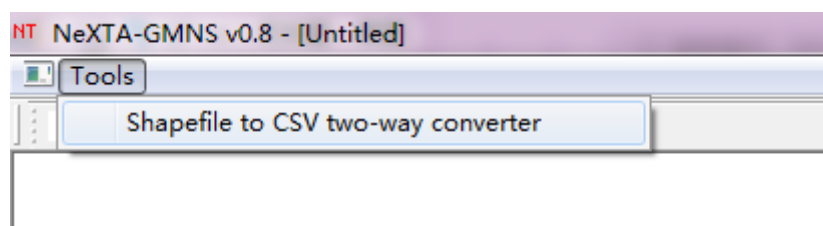


Figure 2.3

Now one can find the dialog of Import/Export Data File. Click the “...” to choose the Shape file, then click “Export to CSV File”.

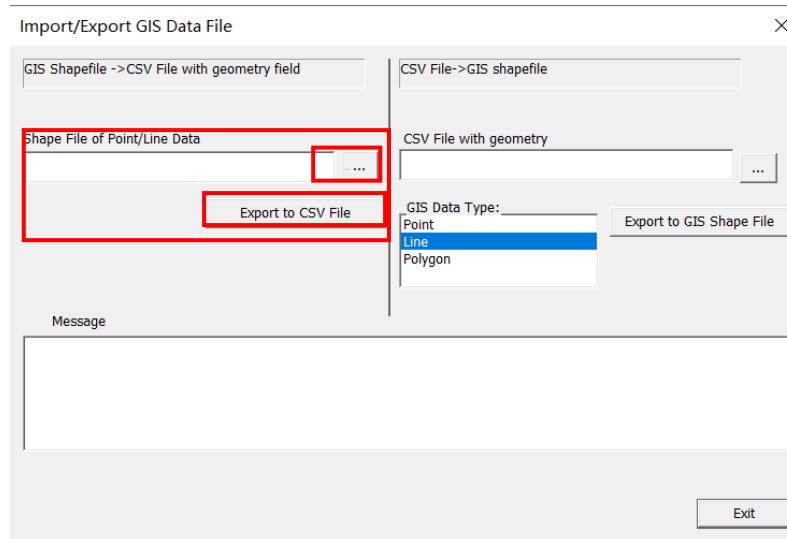


Figure 2.4

**Step 3: Export Shape file to CSV file:** On the left side of Import/Export Data File dialog, you can select a GIS Shape file (e.g., SLC\_Network\_Link.shp) and then click on the button “Export to CSV File” to save the shape file data into a new CSV file (e.g. road\_link.csv).

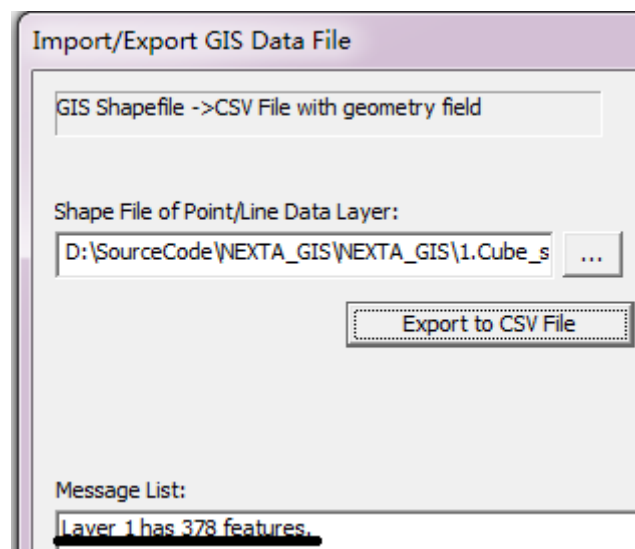


Figure 2.5

As shown above, the sample file has 378 links. The user can check the saved/converted csv file road link in Excel, where the true shape coordinate information has been stored in the required field for representing “geometry” in GMNS.

LINESTRING (-111.943375 40.616454 ,-111.938855 40.616737)										
D	E	F	G	H	I	J	K	L	M	N
REET	ONEWAY	TAZID	LINKID	LANES	FT	SFF	SFF_TIME	CAP1HR1LN Length		geometry
ent	2	1285	1285_5018	7	1	21.17647	0.67547	10000		LINESTRING (-111.943375

Figure 2.6

One can also use the similar step to convert a node shape file to node.csv.

	A	B	C	D	E
1	N	TAZID	geometry		
2	1285	32	POINT (-111.943375 40.616454)		
3	1286	18	POINT (-111.934202 40.630776)		
4	1289	17	POINT (-111.933868 40.616707)		
5	1290	35	POINT (-111.924502 40.617134)		

Figure 2.7

**Step 4:** One can carefully change the field name for required fields in GMNS, such as from\_node\_id or to\_node\_id in Excel. If the shape file does not consist of the “from\_node\_id” and “to\_node\_id” messages, the csv file will not have this field. Note that, the node.csv file requires x\_coord and y\_coord fields, which can be converted from the field of geometry, manually using the “text to column” feature in Excel.

#### **Step 5: Convert two-way links to one-way links.**

In a common shape file for the link layer, a link can be coded as a two-way link. Note that, GMNS requires one-way directional links.

- (1) One can first add a field of “direction” with a value of 0 in road\_link.csv, then use standard NEXTA tool to open the network, and then a two-way link will be automatically split to two one-way links in the interface, but without offset (so that two links are displayed as overlapping links).
- (2) Then continuously click on the NEXTA toolbar highlighted in yellow below, increase and decrease link offset to make two related being displayed separately.
- (3) The user can further save the project through menu file->save project, then the saved road\_link file will have one-way links with offset geometry coordinates and the field of “direction” = 1. This “direction” field is not required in GMNS but convenient for distinguishing two-way links and one-way links.
- (4) In some cases, original fields such as AB\_speed, or BA\_speed are coded to represent different speed limits for different directions of a two-way link, then user needs to manually transfer the information carefully.

### **3. Step-by-step process for converting csv file to shape file, using 2-corridor example**

Now we use a simple two-corridor example (with 4 nodes and 4 links) to illustrate the conversion process. For any CSV files with a “geometry” field following the WKT format, one can seamlessly generate a shape file based on the CSV files.

If the CSV files do not have “geometry” field, you can use NEXTA to first open the CSV file and save the project, to generate “geometry” messages. The two-corridor data can be downloaded at [https://github.com/xzhou99/STALite/tree/master/dataset/1\\_two\\_corridor](https://github.com/xzhou99/STALite/tree/master/dataset/1_two_corridor).

The descriptions of node.csv and road\_link.csv are illustrated in Table 3.1 and Table 3.2

Table 3.1 description of node.csv

Field Name	Description	Sample Value
name	Optional for visualization only	Main street @ Highland Dr.
node_id	Node identification number	1001
x_coord	Longitude or horizontal coordinate in any arbitrary geographic coordinate system.	100
y_coord	Latitude or vertical coordinate horizontal coordinate in any arbitrary geographic coordinate system	200
node_type	Optional text label for visualization and identifies of node	1
zone_id	Indication of node’s physical location	1

Table 3.1 description of road\_link.csv

Field Name	Description	Sample Values
name	Optional for visualization purposes	Main Street



road_link_id	Link identification number of the road	1003
from_node_id	Upstream node number of the link, must already defined in <i>node.csv</i>	1
to_node_id	Downstream node number of the link, must already defined in <i>node.csv</i>	3
link_type_name	Optional text label for visualization and data checking purposes	1
dir_flag	Indication of directions of the link (=0, bi-direction; =1, single direction)	1
length	The length of the link (between end nodes), measured in units of miles or km.	10
free_speed	Free-flow speed on defined link. Suggested Unit: mph or kmph	60
lanes	The number of lanes on the link	1
capacity	The number of vehicles per hour per lane	4000
link_type	Index of link type name	1
toll	Optional generalized toll cost of the link, which could also be the cost of fuel	0
VDF_cap1	Capacity used in the volume-delay function	4000
VDF_alpha1	Coefficient used in the volume-delay function	0.15
VDF_beta1	Coefficient used in the volume-delay function	4
VDF_theta1	Coefficient used in the volume-delay function	1

	associated with free-flow travel time time.	
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### Step 1: Open the CSV file in Excel to check the “geometry” field

In this example, the “geometry” field in node.csv and road\_link.csv is empty, so you can turn to step 2 to generate “geometry” messages, if the CSV file has a “geometry” field, you are able to turn to step 4.

name	node_id	zone_id	node_type	control_type	x_coord	y_coord	geometry
	1	1			0.017882	-0.12518	
	2	2			40.25393	0.053648	
	3				19.77825	14.80687	
	4				19.68884	-9.69242	

Figure 3.1

### Step 2: Use standard NEXTA to generate “geometry” field in both node and link files

Use the standard NEXTA\_GMNS executable, then click menu “File”->Open Traffic Network Project-> choose node.csv, and finally click on the menu item “Save Project” or the related toolbar button.

After this step, one can open the files node.csv and road\_link.csv again, to check the generated geometry field as shown below.

node_id	name	x_coord	y_coord	node_type	ctrl_type	zone_id	geometry
1		0.017882	-0.12518			1	POINT (0.017882 -0.125179)
2		40.25393	0.053648			2	POINT (40.253933 0.053648)
3		19.77825	14.80687			0	POINT (19.778254 14.806867)
4		19.68884	-9.69242			0	POINT (19.688841 -9.692418)

Figure 3.2

from_node	to_node	ic	facility_type	link_type	dir_flag	length	lanes	free_speed	capacity	agent_type	geometry
1	3		Freeway	1	1	20	1	60	4000		LINESTRING (0.017882 -0.125179 ,19.778254 14.806867 )
3	2		Freeway	1	1	24.39613	1	60	4000		LINESTRING (19.778254 14.806867 ,40.253933 0.053648 )
1	4		arterial	2	1	30	1	60	3000		LINESTRING (0.017882 -0.125179 ,19.688841 -9.692418 )
4	2		arterial	2	1	24.39613	1	60	3000		LINESTRING (19.688841 -9.692418 ,40.253933 0.053648 )

Figure 3.3

### Step 3: Use NeXTA\_GIS to convert CSV file to SHAPE file

Open the NeXTA\_GIS executable. On the right side of the Import/Export Data File dialog, please load a CSV file, choose the type (point/line/polygon) of geometry field, and then click on the button “Export to GIS Shape File”.

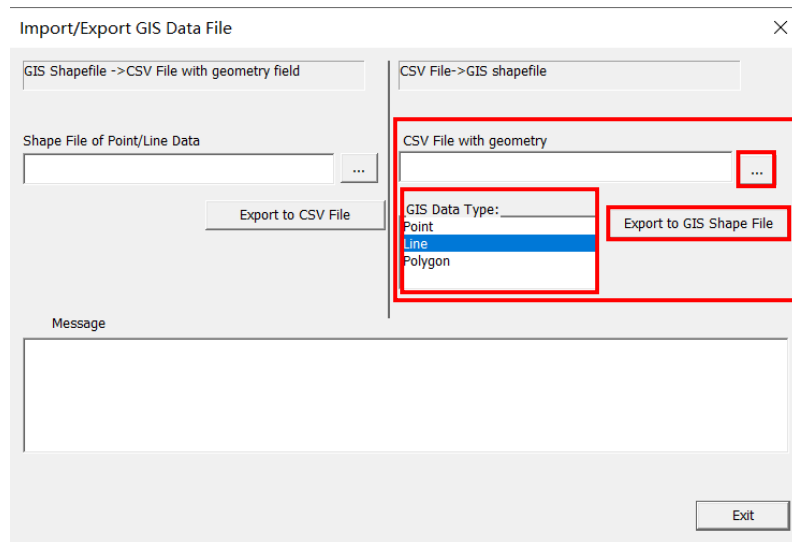


Figure 3.4

Step 4: use Q-GIS to verify and display node.shp and link.shp. From Figure 3.5 and Figure 3.6, the shape files are generated successfully.



Figure 3.5

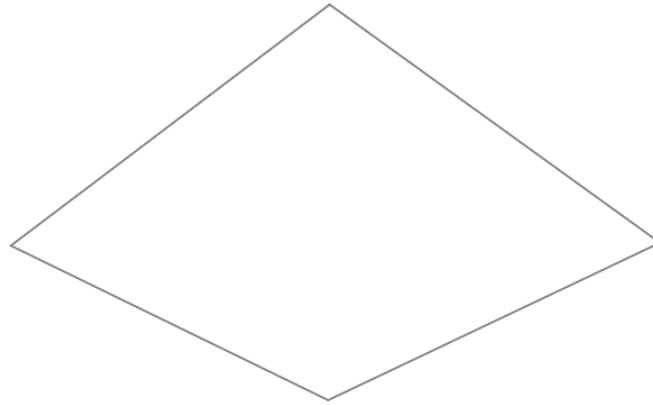
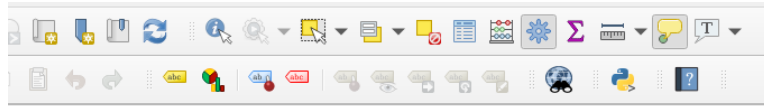


Figure 3.6