

RouteWare Studio 1.06

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Part I

Introduction

1 Introduction

RouteWare Studio 1.06

This application has two key functions: Importing GIS files into RouteWare format (RW Net 4 and FleetEngine) and doing topological checks of the data.

Depending upon license files, more or less functionality is enabled.

- [Cleaning data](#) ⁷
- [Calculating attribute](#) ⁹
- [Import](#) ¹¹
- [Manage networks](#) ¹⁴
- [Statistics](#) ¹⁶
- [Topology checking](#) ¹⁸

Licensing

This table shows how many links (records in your input data) you are able to use in the various functions:

Product	Filename	Import	Topology Checking
(unlicensed)		1,000	1,000
RW Net 4 Basic	rwnet4.lic	50,000	1,000
RW Net 4 Standard	rwnet4.lic	500,000	10,000
RW Net 4 Pro	rwnet4.lic	1,000,000,000	1,000,000,000
FleetEngine	fleetengine.lic	1,000,000,000	Full: 500,000 (1) Full SP: 1,000,000,000 (1)
Topology Checker	topologychecker.lic	1,000,000,000	1,000,000,000

In reality you will be limited to working with up to 100 million links at a time with 64-bit windows and plenty of RAM (+6 GB).

These functions are unrestricted, no matter the license file: Cleaning data, Calculating attribute, Manage networks and Statistics.

You should store the license files in the same folder as the application. Multiple license files can be used at one time.

(1) Not for test licenses valid < 90 days.

Settings

The menus allow you to select output format (TAB, MIF, SHP, KML, GML). You should only select KML if working with Lat/Long WGS84 coordinates.

You can also choose between Km or Miles as distance unit.

This affects output in the [statistics](#) ¹⁶ output and a few of the [topology checking](#) ¹⁸ functions.

Settings are stored in this file:

c:\Documents and Settings\All Users\Application Data\routewarestudio\routewarestudio.ini

(or similar depending upon OS)

Be careful if editing on your own.

Part II

System Requirements

2 System Requirements

Operating System

FleetEngine runs on 64 bit Windows only.

Hardware

A fast CPU and hard disk is a good idea, but there are no specific requirements.

Networks require appr. 55 bytes per link. An example: A network with 1 million links uses 55 MB. This is when opening spatial index, but not caching coord3 file.

See [performance](#)^[24] for a more detailed example.

Additional software

A GIS viewer is required to easily view the output:
ArcGIS, MapInfo, Google Earth, QGIS and many more can be used.

Part III

Cleaning Data

3 Cleaning Data

Before importing data, it is a good idea to clean them from the most obvious issues.

We have created two applications, which does this for MapInfo and ArcGIS. It performs these steps:

1. Test for ungeocoded records and delete them
2. Delete objects which are not LINE or PLINE (mapinfo script only)
3. Disaggregate multi-part objects
4. Remove duplicate and consecutive nodes
5. Delete Polylines with 0 or 1 node
6. Split loops / circular links in two - required if you want to do routing in RW Net 4 & FleetEngine

You can adapt the scripts if you want to - full source code is included.

MapInfo (TAB files)

Compile and run "fix_object_issues.mb" application. Read comments first.

ArcGIS 10 (SHP files)

Open ArcToolBox and add "routeware.tbx". Then start the "fix_object_issues" script and select your data source.

Part IV

Calculating Attribute Fields

4 Calculating Attribute Field

The attribute field is key to defining oneway restrictions etc. in RW Net 4. Full information about the field can be seen in RW Net 4 [documentation](#).

We have provided a simple mapinfo script "calculate_attribute.mb", which you can adapt to your needs.

If you don't want to set it up properly at first, just create a field with all 0's and use that as attribute field.

Part V

Import

5 Import

This first tab allows you to import TAB / SHP / MIF files into RW Net 4 format.

Select one or more TAB / SHP / MIF files.

All files should have the same structure (fields) and coordinate system.

Only one type of files are allowed at a time.

If you choose SHP, remember to include a PRJ file for at least the first file on the list.

Click the button "Scan files"

You should now specify which fields in your dataset hold which kind of information:

Field	Valid range	Required?
Z-level from / to	-9 to 9	No - but skip when doing topology checking
Attribute	0 to 65535	Yes
Road name	Text	Only required if you want to create driving directions output
Limit (scalar / bitpattern)	0 to 255	No
External ID	0 to 2147483647 for	Only required if you use turn restrictions which

	numerical fields	references external ID
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Further information about the fields can be seen in RW Net 4 [documentation](#).

Coordinate information is required depending upon which output formats you plan to use:

- MapInfo coordsys string is required for TAB / MIF output (auto detected, if input is also TAB / MIF)
- PRJ file is required for SHP output (auto detected, if input is also SHP)
- EPSG code is required for GML output

Two predefined coordinate systems are included.

You can leave *Autodetect codepage selected*, if you are importing from TAB / MIF or from SHP files, where the language ID has been set in the DBF. This is byte 29 in the header. If that byte is not set, please select a codepage from the list.

Allow loops should be left unchecked since loops are not allowed when doing routing in RW Net 4 and FleetEngine.

- If unchecked and loop links in data: They will be reported as errors in `network_report.txt`
- If checked and loop links in data: They can be exported in one of the topology checking functions.

Max Nodes Per Cell can be left unchanged for all normal purposes.

Encryption Key can be set if you want the generated set of files encrypted (0 = not encrypted).

Finally set output folder, before:

Click the GO!-button

After you have imported a network, it gets automatically added to the list of [Manage Networks](#)¹⁴.

If you started by [cleaning the data](#)⁷, there should be no issues listed in the file "network_report.txt", which has been generated in the output folder.

Part VI

Manage Networks

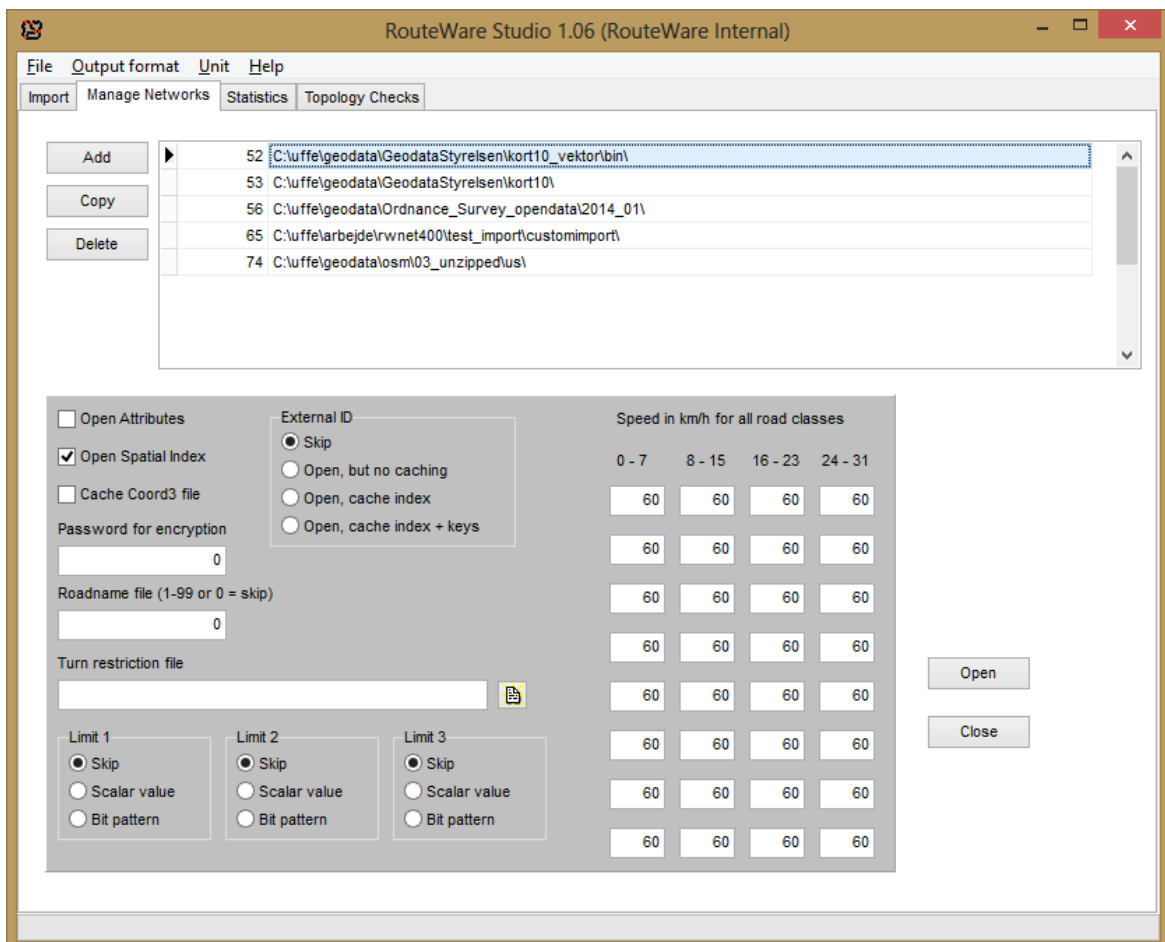
6 Manage Networks

This is a list of networks and the settings you have defined.

The same network can exist multiple times with different settings. Use the Copy button to make a duplicate.

Pressing Delete removes a network from the list, but not from the hard disk.

Click "Open" to get [statistics](#) ^[16] or run [topology checks](#) ^[18]. Only one network can be open at a time.

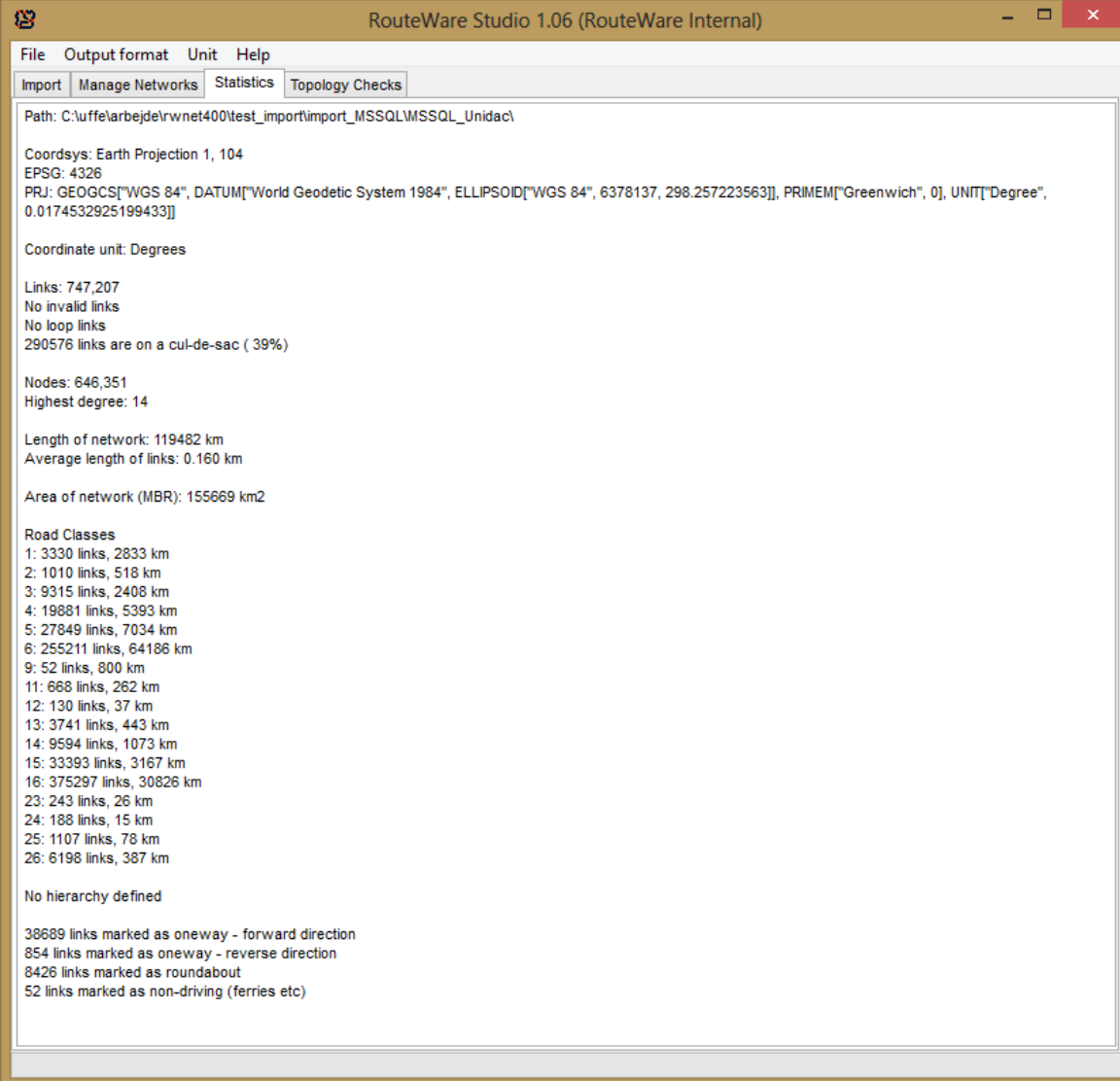


Part VII

Statistics

7 Statistics

After you have opened a network, this page shows lots of useful statistics about the data. Use it for checking if something looks wrong.



RouteWare Studio 1.06 (RouteWare Internal)

File Output format Unit Help

Import Manage Networks Statistics Topology Checks

Path: C:\uffe\arbejde\rvnet400\test_import\import_MSSQL\MSSQL_Unidac\

Coordsys: Earth Projection 1, 104
EPSG: 4326
PRJ: GEOGCS["WGS 84", DATUM["World Geodetic System 1984", ELLIPSOID["WGS 84", 6378137, 298.257223563]], PRIMEM["Greenwich", 0], UNIT["Degree", 0.0174532925199433]]

Coordinate unit: Degrees

Links: 747,207
No invalid links
No loop links
290576 links are on a cul-de-sac (39%)

Nodes: 646,351
Highest degree: 14

Length of network: 119482 km
Average length of links: 0.160 km

Area of network (MBR): 155669 km2

Road Classes

1:	3330 links,	2833 km
2:	1010 links,	518 km
3:	9315 links,	2408 km
4:	19881 links,	5393 km
5:	27849 links,	7034 km
6:	255211 links,	64186 km
9:	52 links,	800 km
11:	668 links,	262 km
12:	130 links,	37 km
13:	3741 links,	443 km
14:	9594 links,	1073 km
15:	33393 links,	3167 km
16:	375297 links,	30826 km
23:	243 links,	26 km
24:	188 links,	15 km
25:	1107 links,	78 km
26:	6198 links,	387 km

No hierarchy defined

38689 links marked as oneway - forward direction
854 links marked as oneway - reverse direction
8426 links marked as roundabout
52 links marked as non-driving (ferries etc)

Part VIII

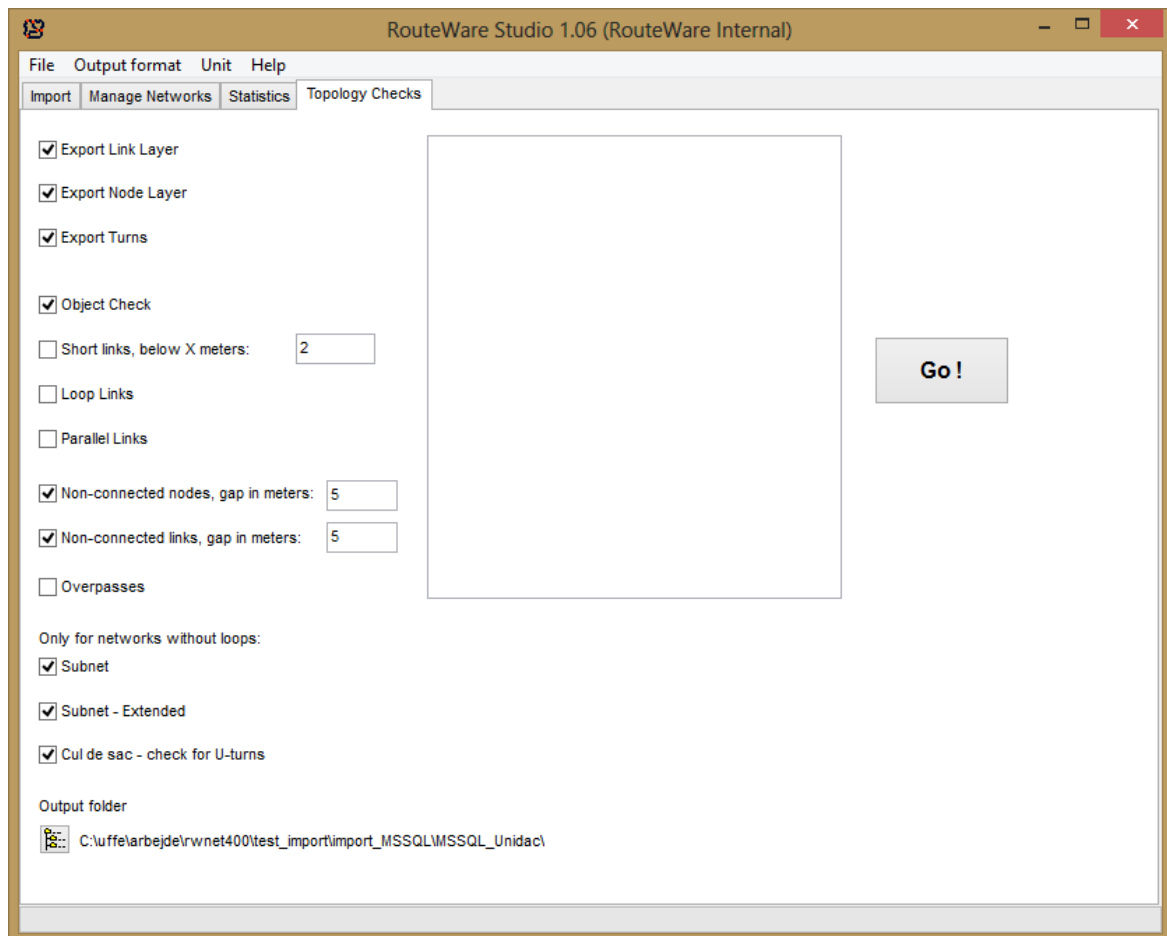
Topology Checking

8 Topology Checking

This tab gives you access to two primary groups of functions:

- Exporting from *.bin files back to GIS format
- Run topological checks

Normally a street network is connected by having exact snap between links, but the data is typically entered through a manual digitization process and this leads to many errors. The functions here shall help you pointing out most of these, but will NOT change your data.



Export functions

- Link

This closely matches the original input data, except information from the attribute field is stored as individual pieces of information and is easier to use for thematic mapping. Information about Cul-De-Sac is also included as true / false.

- Node

The node layer simply returns a new layer with all nodes in the network and their degree. Degree is the number of links connected to the node. Creating a thematic map on the degree can be helpful in locating problems.

Degree = 1 means a dead-end. Make sure they are where you expect them.

- Turns

If you have any turn restrictions, this allows you to export them in a format, which makes it easier to check them visually.

Topology Checking functions

- Object check

These are possible issues related to single objects.
Sharp turns > 45° and self-intersections.

- Short links

Very short links (< 1 meter) is typically an indication of errors.

- Loop links

If checked and the network has loops, these shall be output as a separate layer.

- Parallel links

Parallel links are two or more links that all start and end at the same two nodes.
Especially when `samelength = true` it indicates an error.
Typically due to double digitalization of the same link.

- Non-connected nodes

This will locate pairs of nodes within a short distance of each other, that are not directly connected with a link.

This is typically a result of missing snap.

- Non-connected links

This locates links within short distance of nodes, but without being connected.
Here the link typically need to be split in two and then snapped together.
A Mapinfo application has been supplied for making that process easier.

Use a value of 1-10 meters depending on the level of detail in the data.

Don't use Z-levels during import when checking for non-connected.

- Overpasses

This will generate a list of pairs of links that intersect at other places than the start / end.
This should normally only occur where there is a bridge / tunnel.

- SubNet

These are isolated links, not connected with the rest of the network.
Route calculations between different subnets will fail, so subnets should be avoided.
In case of islands, add a ferry for instance.

- SubNet - Extended

These shouldn't occur at all since it means it is only possible to go from A to B, not from B to A.
It is usually due to errors in oneway settings. It can be a bit tricky to locate exactly where the problem is,
since a single error may highlight several links.

- Cul-de-sac - check for U-turns

When driving down a cul-de-sac you have to make a U-turn somewhere to get back again.
This function identifies additional links with the same problem as normal cul-de-sacs (already marked in layer "link").
Not errors as such, but may point to errors with oneway restrictions.

Strategy

Choose a different folder for output and then click "Go !".

With large datasets it may take a while. Especially "non-connected" and "overpasses" take a long time to run, so do the first runs without these, fix as much as possible and then include them at some point.

For easy viewing of the output, we have supplied these files:

mapinfo: topocheck.wor - see [sample screen-dump](#)^[22]

arcgis: topocheck.mxd - see [sample screen-dump](#)^[21]

Once you have made a significant amount of edits due to some of the first elements on the list, re-import the network and start over.

As you move along, there should be less and less issues left.

It is very normal that the same error can trigger several of the checks above.

Performance

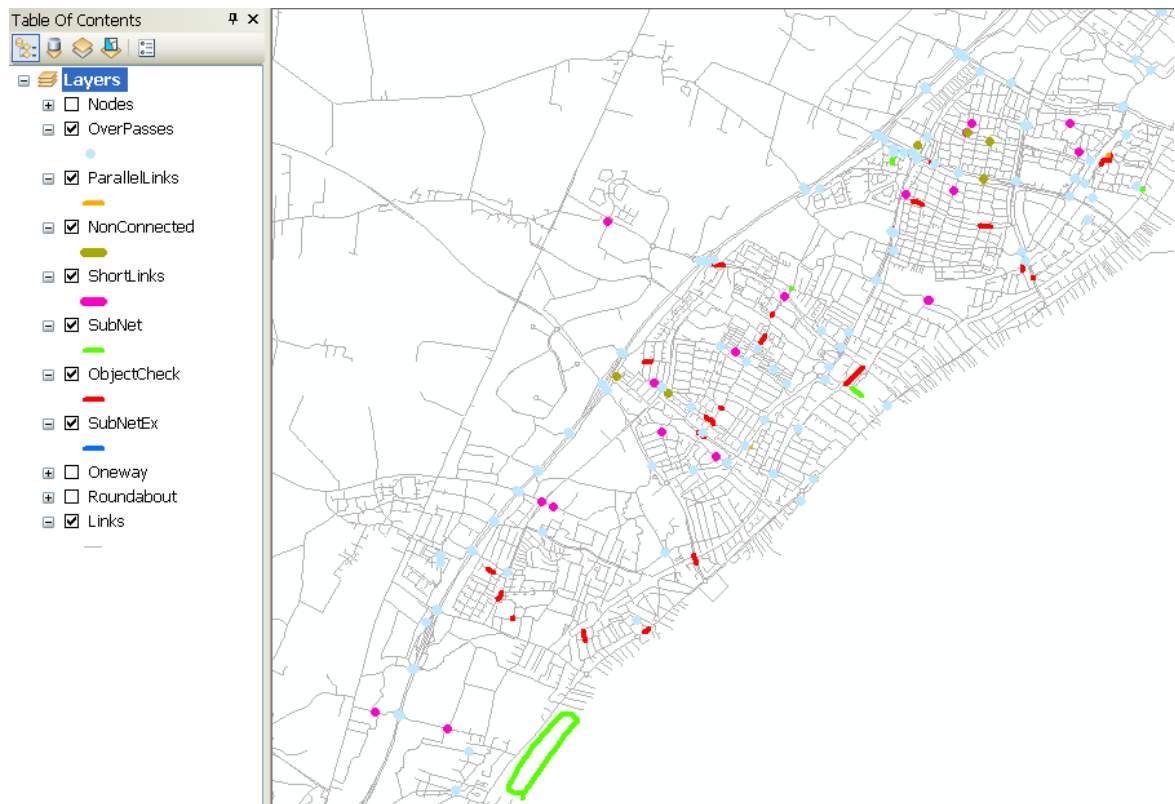
Checking for overpasses is the single most time consuming procedures, so start with the other tests.

Example network with 725000 links:

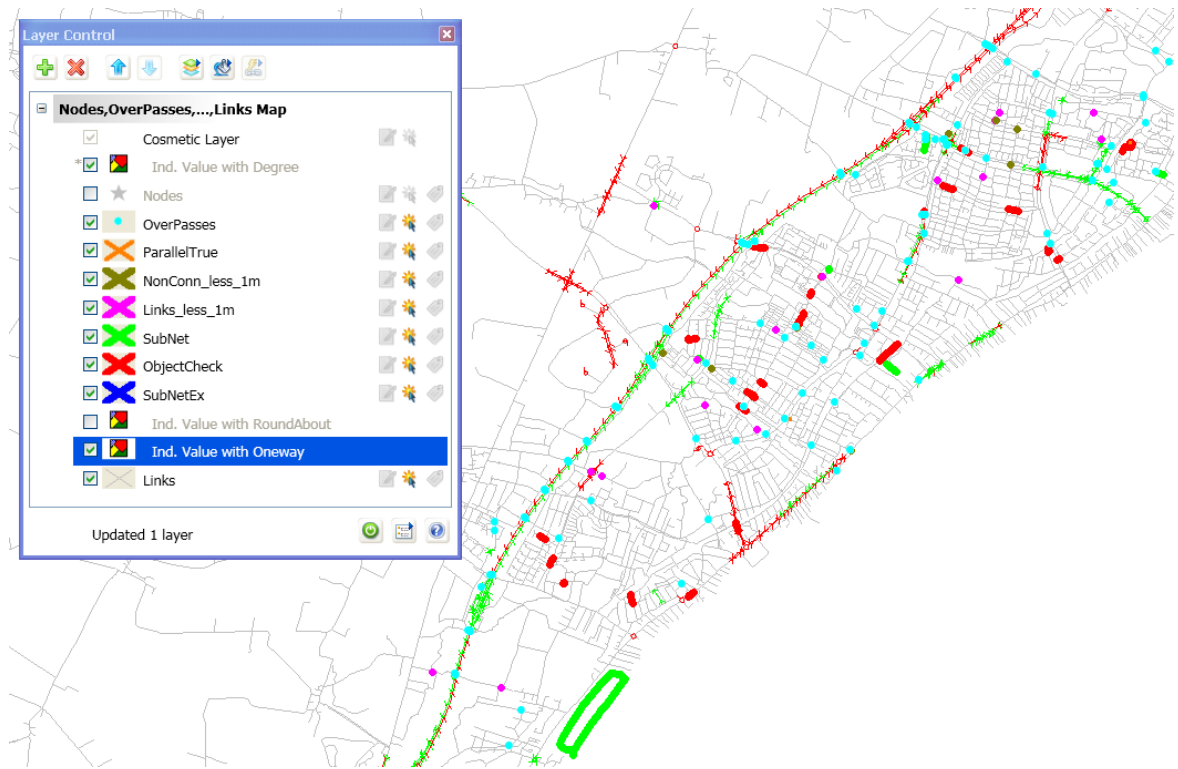
- without overpasses check: 50 seconds

- with overpasses check: 120 seconds

8.1 ArcGIS



8.2 MapInfo



Part IX

Performance

9 Performance

We did a test with OpenStreetMap data for North America (USA + Canada).

This has 39 million records and was stored as a 7 GB MIF/MID file, generated by our free [OSM converter](#).

It took 67 minutes to import using 64-bit Windows. It used 1.6 GB RAM while doing so.

The process included the base network, attribute field, external ID field and road name field.

Output was 6 GB of *.bin files.

Opening the network took 45 sec and required 2 GB of RAM.

This is with opening attributes and spatial index, but skipping other options.

Part X

History

10 History

Version 1.06 (18. Jan 2016)

Topology checking for non-connected, split into node-node and node-link checks.

Version 1.05 (12. Oct 2015)

Fix for import/export of turn restrictions

Extended TAB file format from MapInfo 15.2 are also supported for import.

Recompilation with all the latest engine updates.

Version 1.04 (30. Apr 2015)

32-bit version removed.

Recompilation with all the latest engine updates.

Version 1.03 (14. May 2013)

64-bit version added.

Version 1.02 (31. Mar 2013)

Much improved performance: Faster import, opening and less required RAM.

Version 1.01 (21. Nov 2012)

Accessible to RW Net 4 users

Checking for Cul-de-sac, U-turns

Version 1.00 (24. Oct 2012)

Codepage selection

Version 0.08 (24. Sep 2012)

Added loops as topology check output.

Version 0.07 (8. Sep 2012)

Fixed issues with visual appearance of application.

Version 0.06 (1. Sep 2012)