Minnerva

Networked Wisdom

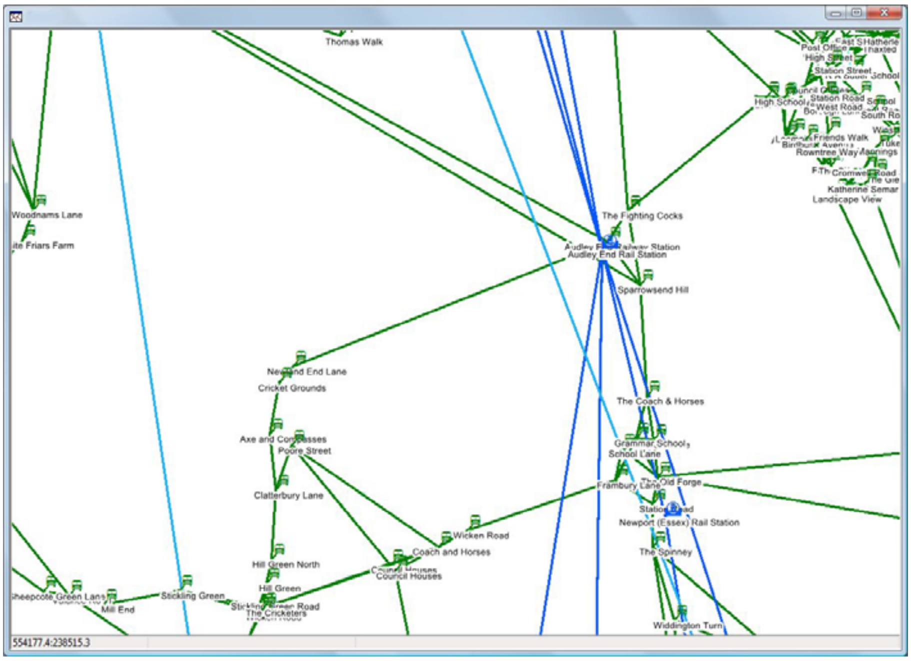
Building Public Transport Networks in OmniTRANS

Traditionally, building a Public Transport network in any software package has been a laborious, costly and error prone task.

No longer the case when using OmniTRANS! Now that Public Transport time table data* is freely available for services operating in the UK, we have developed some innovative tools which takes this information and constructs a Public Transport network suitable for modelling, monitoring and reporting

Two forms of network build are available:

- Where there is no underlying network: In this case, the network is built topographically on a stop-to-stop basis
- Where there is an underlying network: In this case, the transit services are mapped on to the appropriate underlying network structure. The network is then topographically correct.

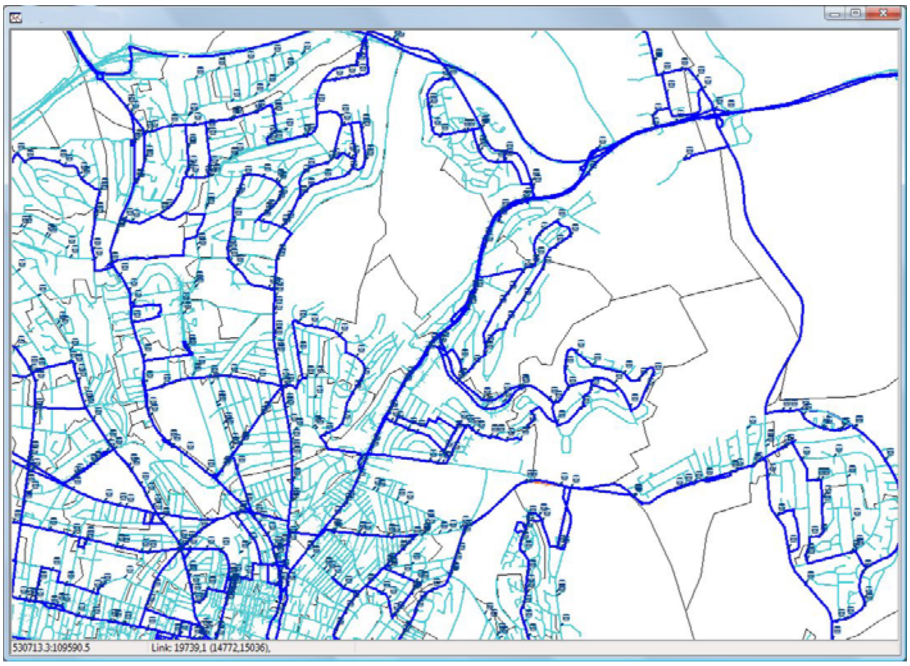


Extract from a Public Transport network built on a stop-to-stop basis. Bus routes (green) follow a 'crude' topography; rail routes (blue) are expressed as straight lines given the distance between stations.

For either option, the input data is both voluminous and complex, but primary controls are provided to filter:

- Dates of operation of the services to be included
- The day(s) of week for the services to be included
- How route 'instances' should be 'merged' - data is available for each timed departure of a service but for modelling purposes these are grouped to give frequencies for the user defined modelling time periods

Data is available* for 142 Local Authority areas and is supplied by mode. These are commonly Bus, Coach, Rail and Metro, and where relevant, for Air and Ferry.



Extract from a Public Transport network where the bus routes (dark blue) have been mapped to the underlying road network

Building a Public Transport network where there is no underlying network

This is the easier of the two methods of network build as there is no network mapping to be done. All required stops, nodes and links are generated using the information associated with the routes, and the network is constructed on a 'stop-to-stop' basis.

* National Public Transport Data Repository (NPTDR) - data.gov.uk

In its 'purest form', the individual stops as defined by the input route data are used.

This can lead to a very detailed network being generated where, for example, each stop (or bay) in a bus or coach station is identified, whereas for modelling a single stop point would perhaps suffice.

Similarly, where there are bus stops on either side of a road serving a route running in both directions, both stops will be generated. As the generated network is 'stop-to-stop' based, each direction of the route will generate its own (one way) set of links. Again this may be too detailed for modelling, where a single two way link with 'single common' bus stops serving the route in each direction is all that is required..

To allow for this, a 'best estimate' of Stop Grouping' is made, and the user has the choice of building the network with either 'Ungrouped' or 'Grouped' stops.

Building a Public Transport network where there is an underlying network

This is a more complex process as the Public Transport stop-to-stop services have to be mapped to the underlying infrastructure, and in so doing obey the 'rules' of Public Transport coding in OmniTRANS. In short, these are:

- Transit stops are attached to nodes
- There cannot be more than one stop attached to the same node
- A route cannot traverse the same link twice in the same direction (circular route)

The process is summarised below, noting that it is repeated for each mode being imported :

1. Identify the stops used by the routes which have passed the filtering process and are to be included in the build.

2. Build a correspondence table between these stops and existing nodes in the underlying network, using a user defined 'search space'

   It is likely that there will be many unmatched stops on this first pass, so then an attempt is made to match to 'shape nodes' in the links. If a match is found, the shape node is upgraded to a node.

   Remaining unmatched stops are then examined to see if they 'lie' on or close to a link where thus far there are no corresponding nodes (or upgraded shape nodes). If yes, the link is split at that point to generate a node which in turn is associated with the stop.

   Any remaining unmatched stops have no relationship with the underlying network and nodes are generated to accommodate them. It is also possible that multiple stops will have been associated with the same node; this is dealt with in the next step.

3. Once this stop-node correspondence table has been built, the stops in each route are translated to their corresponding network nodes. The network is examined to see if a single link connects each node-node pair; if not a 'shortest path' is built to find the set of links between these nodes. In this manner, a 'Link Equivalence' table is built and routes are 'mapped' to the network

All of these steps are automated, but the outputs need to be reviewed, specifically for the incidence of Circular Routes. These may genuinely exist in the data, in which case the user must take a decision on what to do with them.

But it is also possible that they may have been generated by this process, and corrections have to be made. A common issue is where a bus stop is on a dual carriageway, but *purely because of the way in the underlying network has been coded,* it may have associated itself with a node on the 'wrong side' of the carriageway. This leads to incorrect paths being built when seeking the linkage between stops, and so 'phantom' circular routes are generated.

Tools are provided to identify these occurrences and they are dealt with by defining a 'Stop Exception' file in which explicit stop-node associations are stated. The process is re-run, using this file in step 2 noted above, and these irregularities are corrected.

This is the only 'intervention' required by the user; just how much is needed depends on the how the underlying network has been coded.

Connecting the Modes - Generating Walk Links for Modelling

For modelling purposes, there must be connectivity between the modes so paths can be built through the network. This is provided by introducing Walk Links to the network where needed.

Again, an automated procedure is provided to generate these using a set of rules. For example:

"Generate walk links between stops which serve rail and stops which serve bus, providing they are not more than 250m apart"

Of course, zone centroids and centroid connectors are required for model building (tools are available for generating these as well), and once added, the network is in state ready for thorough checking and validation.

Benefits

A Public Transport network built using the processes described here is likely to be more accurate in detail than one built 'manually', and is less likely to have 'coding' errors associated with it. Quality will be higher, leading to better models being built.

Most importantly, the time required to construct a detailed Public Transport network is substantially less than using 'conventional' methods, making it very cost efficient process.

Improved quality at a lower cost.

Of course there are other uses for these networks other than modelling, for example simply monitoring and understanding the characteristics of a Public Transport system.

For more information

Martin Bach
Minnerva
mbach@minnerva.co.uk
01763 837376
.minnerva.co.uk
omnitrans-international.com