



ORDNANCE SURVEY GB

# Guide to Routing for the Public Sector

A guide to the basics of route analysis for Public Sector organisations

## Version History

Version	Date	Description	Authors
1.0	July 2015	First issue	Ian Bennett, GI Consultant
.0	November 2018	Updated to include OS MasterMap Highways	Ian Bennett, GI Consultant

## Purpose of this Document

This is the document is a guide to the basics of route analysis for Public Sector organisations.

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# Introduction

If you've ever searched for the nearest library or the most efficient route for your deliveries, then you've encountered routing analysis. It uses road networks to determine either distances or time between objects and can be used to solve complex problems like these.

The Public Sector Mapping Agreement (PSMA) and One Scotland Mapping Agreement (OSMA) provide access to a rich source of detailed spatial datasets. One of the network datasets available is OS MasterMap Highways, which was introduced in 2016 and has replaced OS MasterMap ITN Layer (ITN) <sup>™</sup>, which was withdrawn in March 2019.

OS MasterMap Highways is a detailed roads dataset suitable for use in routing analysis and incorporates the National Streets Gazetteer (NSG), the definitive reference dataset of streets within England and Wales.

A number of member organisations use network data for optimising refuse collection routes, school transport and reorganisation of the locations of key services. Case studies have been published demonstrating real cost savings through improved planning and optimised utilisation of assets. This has raised awareness of the benefits of using routing analysis and more organisations are seeking to adopt network data to optimise operations. This paper provides a guide to routing analysis by focusing on:

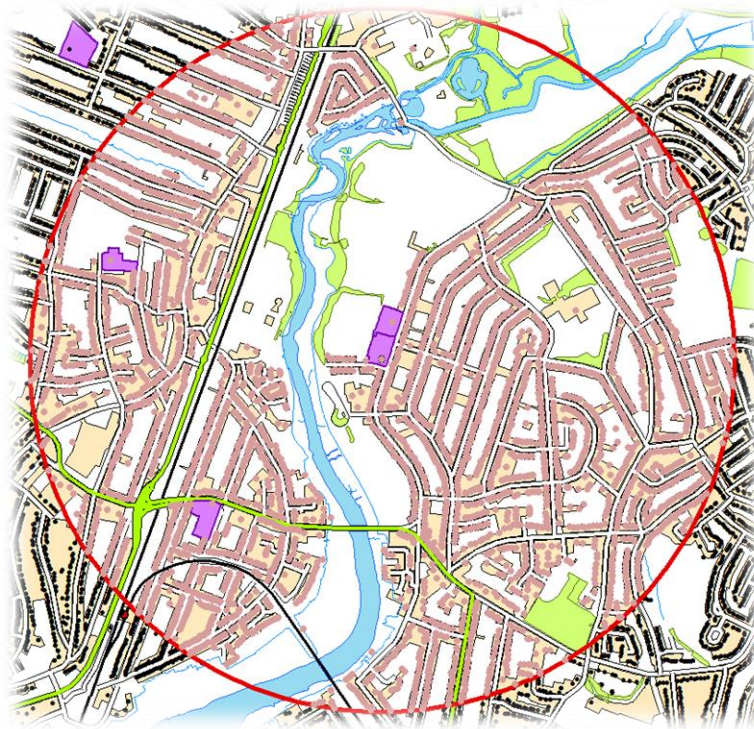
- What routing analysis is.
- The elements needed to create a working network from the Highways data.
- Other sources required to enable analysis.
- How to create a network.
- Examples of routing analysis across the public sector.

## Routing Analysis?

Route analysis can be used to answer questions such as:

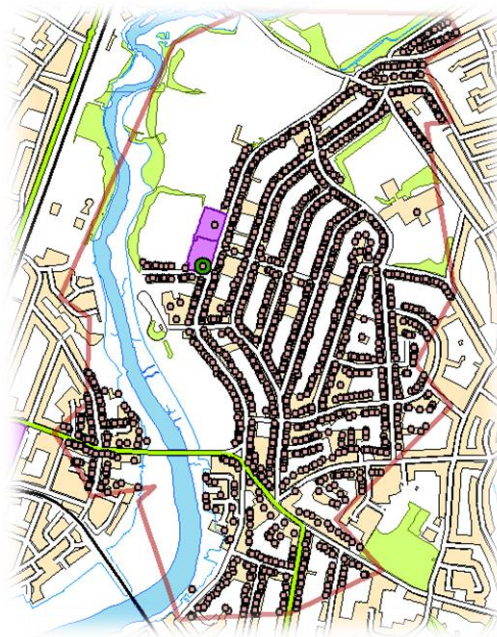
- Where is my nearest library?
- What is the most efficient route for my deliveries?
- Which is the best location to build a new office?

When considering these questions, a simple radius search using a buffer zone can be used to find objects within a set distance of a feature. For example, a school needs to know how many addresses are within a 1km catchment area. The diagram shows all the addresses highlighted within a radius buffer however, addresses on the opposite side of the river are included.



To improve this analysis, we can use the **road network** to give a more accurate picture. By generating a polygon based on 1km driving distance creates a more refined picture, returning fewer addresses. This demonstrates that routing analysis provides a more effective method for defining catchment areas and managing location-based services and answering the questions listed earlier.

The image below provides the more refined results when incorporating road network data.



## Types of Routing Analysis?

Routing analysis uses road networks to determine either distances or time between objects. This can be used to solve complex problems such as where is my nearest facility, what is the optimal location for a new business, what's the most efficient route for customer visits, and many more. In order to solve these problems, analysis needs to be performed on the data. The following types of analysis can be applied:

- A to B route generation
- Travel time
- Closest centre
- Cost matrix



## A to B route generation analysis

*A to B route generation allows you to plan a route between two points.*

How do I get from point A to point B? This is the simplest form of routing and is in common use in web mapping applications giving details of how to travel between two points, the distance and the estimated journey time.

Start and end points could be a grid reference, address, post code or a place name. The example shows a journey between Cardiff and Cwmbran using the quickest route and includes directions.

However, it is also possible to set options to include certain types of road or go via another place on route - this is often referred to as Travelling Sales Person (TSP).



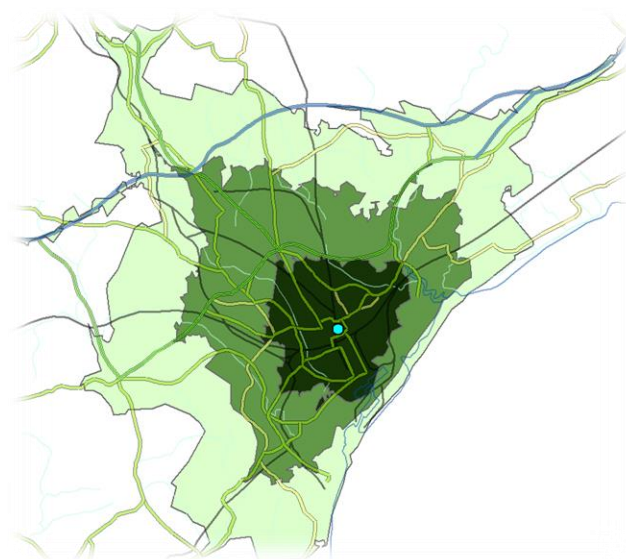
## Travel time analysis

*Travel or drive time analysis is used to define how far can be travelled in either a set time or over a set distance.*

It's used to show what's within a specific distance of a certain point. For instance, a hospital may want to know how many patients live within a certain travel time to the facility to help with service planning.

This method of analysis creates a series of irregular or Voronoi polygons representing either distance or timed travelled. The results are displayed as a series of isochrones, either as polygons or lines.

The image shows how far you can travel from the centre of Cardiff displayed as five, ten and fifteen minute isochrones (road speed and conditions have not been taken into account).

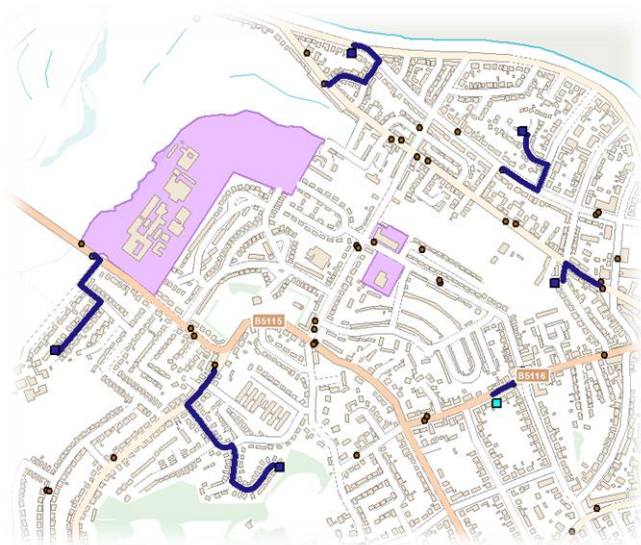


## Closest centre analysis

*Closest centre analysis is used to calculate the cost of travelling between a number of locations from a fixed point (or points) determining which are nearest to each other.*

The resulting analysis includes a rank of the points and corresponding locations based on the time to travel between them. This, for example can be used for assigning the closest resource to an incident, such as emergency responders to an incident.

This analysis can also be used to help plan the location of resources such as bus stops. The example shows the location of people without cars on a housing estate and the closest bus stop to each.



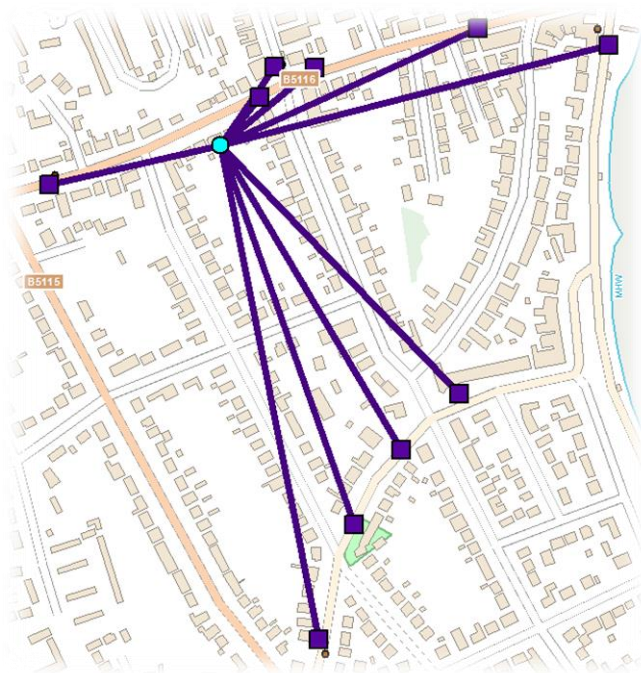
## Cost matrix analysis

*An origin-destination cost matrix measures the distance across a network that costs the least to travel (or least cost path) from either a single or multiple origin to multiple destinations.*

The results are displayed either as a table or a spider diagram linking origin to destinations with a straight line. This type of analysis is useful when large volumes of data need to be analysed.

Continuing our example using bus stops we want to know, for a particular location, the distances to all stops in the area, as we need to understand the impact of changing a route.

The table shows the distance to each location ranked from closest to furthest displayed graphically as series of lines.



Name	OriginID	DestinationID	DestinationRank	Total Length
Graphic Pick 1 - Location 40	1	9	1	58.756287
Graphic Pick 1 - Location 29	1	3	2	109.495438
Graphic Pick 1 - Location 30	1	4	3	123.975483
Graphic Pick 1 - Location 41	1	10	4	181.304054
Graphic Pick 1 - Location 31	1	5	5	300.419468
Graphic Pick 1 - Location 36	1	6	6	497.348709
Graphic Pick 1 - Location 37	1	7	7	515.587285
Graphic Pick 1 - Location 7	1	1	8	523.362933
Graphic Pick 1 - Location 8	1	2	9	584.680914
Graphic Pick 1 - Location 38	1	8	10	639.809181



## Software options

To perform any routing analysis, specialist software is required. There are many solutions available and those described are considered to be the most popular across the public sector. Consideration has also been given to Open Source software although the options are limited and are considered more complex to implement. The traditional solutions for routing analysis have been using desktop GIS software. However, these are reliant on having appropriate hardware available. As an alternative, a number of web-based services are also available.

### Premium software

- **Network Analyst** – Is an extension to ESRI's ArcGIS desktop software and can be used to solve complex routing problems. However, data models used to define network data are often complex and to help users overcome this ESRI has developed additional tools to assist users in creating and building networks. More information about the tool can be found on ESRI's dedicated [webpage](#).
- **RouteFinder for MapInfo** – Produced by [Routeware](#) and distributed in the UK by Dotted Eyes and Higher Mapping Solutions. A tool is available to convert Highways GML into a TAB file suitable for routing. Widely used across the Local Government Community and is incorporated into Capita's One system for school transport planning.
- **Manifold** – Although [Manifold](#) has a routing extension its support for GML is poor although it does read MapInfo TAB files. However, the software does not utilise turn restrictions, and other routing information.
- **TRACC** - Produced by [Basemap](#) and widely used across the Public Sector to look at public transport impacts on service location.
- **CadCorp** – [CadCorp SIS Desktop](#) incorporates a routing engine which supports OS MasterMap Highways and includes tools for loading the data from GML and building a network dataset.

### Open source

A number of routing tools have been developed by the open source community. One of the main differences between these and premium software is that the latter often includes the tools to translate data and convert it into a network dataset. This is not the case with open source and additional work may be required to convert data into a suitable output. One solution to this has been developed by Astun Technologies. Their open source loader can be used with Ordnance Survey data including OS MasterMap Highways. Further details, including instructions can be found on [GitHub](#).

The following are some of the available open source tools that are in common use:

- **pgRouting** – is a routing extension for PostGIS and the PostgreSQL database. It is possible to load and use Highways data, however a good deal of work is required to make it usable and not all the algorithms support all the features within the data. Some desktop software packages have connectivity to PostgreSQL databases, so the functions can be called from these. A QGIS plugin is

also available. Open source software is supported by a community of users who have made resources available on GitHub including - <https://github.com/tmnrs> and <https://github.com/mixedbredie/highways-for-pgrouting> - both have instructions and code for creating a network dataset.

- **SmartVRP** – Is an open source vehicle route planner based on pgRouting and can be used for fleet management and optimising operations such as waste collection. Further details can be found at - <http://openvrp.com/>.
- **Network X** – Is an Open Source Python utility for creating and analysing complex networks. Further details and software downloads can be found on [GitHub](#).

## Web Based

- **ArcGIS online/server** – ESRI's online application which includes the Network Analysis extension.
- **MapInfo Stratus** - Pitney Bowes web mapping portal for creating and distributing maps and data. Support for Highways is uncertain.
- **Network X** – python utilities for use in web applications which can be used with Highways does not support road restriction information.
- **Mapumental** - created by MySociety for generating [travel time maps](#) using Open Street Map.
- **Graphhopper** – Open source [routing library](#).
- **Mapbox** - [Development tools](#) for creating web apps using mapping. Includes routing capability and supports Ordnance Survey data but we are unsure of its ability to use Highways.

## Data Options

To create a routable network the following data types are required:

- **Geometric network** – most commonly this would be road centrelines. However, foot paths, waterways or cycle paths may also be incorporated.
- **Restrictions** – to create a full network, routing restrictions such as no-turns and one-ways are required.
- **Speed limits** – As most networks will not be uniform, differing speeds will need to be applied to network links dependent on various factors. These are important for developing time-based applications.

## Network data

### OS MasterMap Highways Network

Ordnance Survey has a number of datasets available which are suitable for route analysis. The OS MasterMap Highways Network is Ordnance Survey's premium large-scale roads data and contains a network line representing both major and minor roads in Great Britain, along with road names and numbers. In addition, the data contains information on routing restrictions such as one-way streets and banned turns, making it suitable for use in routing applications. Currently this is the preferred option for detailed analysis and further information about [OS MasterMap Highways Network products](#).



Additional path data providing detailed paths and alleyways can be linked to the road network lines to create walking or cycling networks.

## OS Open Roads

In addition to OS MasterMap Highways Network, OS OpenRoads may be considered suitable for some routing applications. OS OpenRoads is a high-level, generalised road network, that includes road names and numbers, which is suitable for more generalised analysis. This is because the data is not as detailed as Highways and does not contain any additional routing restriction information. Furthermore, it does not include one ways and other types of restrictions, and dual carriageways have been collapsed to a single feature. Further details can be found on Ordnance Survey's [OS Open Roads](#) webpage.

## Restrictions

The OS MasterMap Highways Network includes routing and asset management information (RAMI) describing restrictions, permissions and other information relevant to the network. The information is provided in the form of the following rights and restrictions:

- Access Restrictions
- Turn Restrictions
- Restrictions for vehicles, including height, weight, width and length
- Highways dedications, providing information about the type of users who have access to a particular network section, including byways, cycle tracks and bridleways

Additional information is also part of the Path Network and is structured in a similar way, including details of steps and ramps.

Other information that would be useful in creating a network include:

- Cycle crossings
- Pedestrian crossings
- Traffic lights

Although some local authorities make data available for these on their websites, no national datasets are currently available.

## Speed data

In generating a network for analysis, speed limits play an important role. They provide the details for journey-time analysis as the speed one can travel will determine how far can be travelled in a given time.

The three types of speed data are:

- **Legal speed limit** – as defined by road signage maintained by the local authority. However, restrictions within these limits apply to different vehicle types, as detailed on the [DfT website](#).

- **Derived or average road speeds** – these are harder to define and vary depending on time of day.
- **Estimated road speeds** – based on speed limits, road classification and personal interpretation.

Ordnance Survey and Basemap have made speed data accessible through OS Partners. It's available in three variations:

1. OS MasterMap Highways Road Network with Routing and Asset Management Information and Average Speed.
2. OS MasterMap Highways Road Network with Routing and Asset Management Information and Speed Limits.

Combining the two elements:

3. OS MasterMap Highways Road Network with Routing and Asset Management Information and Average Speed and Speed Limits.

## Sources of legal speed limits

Legal speed limits are defined by the local highway authorities as a Traffic Regulation Order (TRO). These are then enforced by both the local authority and Police. Some authorities maintain a copy of the data and may make them available upon request. [Buchanan Computing's Moving Orders Map software](#) is widely used by local authorities for the management of this data.

As mentioned previously Basemap has captured a national set of speed limits which include the unique identifiers for each road link in OS MasterMap Highways. This is available from OS Partners and further details are on [Ordnance Survey's website](#).

## Sources of actual road speeds

A number of satellite navigation companies collect road speed data from mobile devices. The data collection is then used to enhance journey times either for a mobile terminal or web application. Ordnance Survey has partnered with Basemaps to make this data available via its existing partners. This data has been matched to the Highways data. Further details can be found on Ordnance Survey's [OS MasterMap Highways Network with speed data](#) webpage.

Department for Transport publishes various road statistics including information on speeds and congestion. This data can be [downloaded](#) from Data. Another useful resource is their [traffic counts datasets](#).

Further to this, some public sector bodies have captured speed data from in-cab navigation. This information has been processed to create a dataset for their own internal use in routing applications.

An example of this is Nottinghamshire Fire and Rescue that uses the data in mobilisation of fire crews. However, to do this accurately a source of road speed data was required. To create this, they used the GPS tracks from the in-cab satellite navigation system to record the road speeds for each vehicle. This data has been amalgamated to generate average road speeds for both rural and urban locations. The speeds calculated are 'under blue lights' and are therefore not suitable for use in scenarios for non-emergencies.



## Estimated road speeds

The following table has been created from road speed data previously captured by Ordnance Survey as part of a trial survey, although the data has not been maintained. These were originally based on ITN attribution but can be applied to Highways by using a combination of the *route hierarchy* and *form of way* attributes found in the roadlink data.

Route Hierarchy	Form of Way	Primary road	Trunk road	Estimated speed - Urban	Estimated speed - Rural
Motorway	Dual Carriageway			70	70
Motorway	Roundabout			60	60
Motorway	Single Carriageway			60	60
Motorway	Slip Road			60	60
A Road	Dual Carriageway			47.5	52.5
A Road	Dual Carriageway	Y		55	62.5
A Road	Dual Carriageway		Y	50	50
A Road	Roundabout			47.5	47.5
A Road	Single Carriageway			40	42.5
A Road	Single Carriageway	Y		42.5	47.5
A Road	Single Carriageway		Y	40	35
A Road	Traffic Island Link At Junction			40	45
A Road				42.5	45
B Road	Dual Carriageway			45	47.5
B Road	Roundabout			37.5	37.5
B Road	Single Carriageway			37.5	32.5
B Road	Traffic Island Link At Junction			42.5	42.5
B Road				30	30
Local Road	Dual Carriageway			30	25

Local Road	Single Carriageway			30	32.5
Local Road	Traffic Island Link At Junction			27.5	27.5
Local Road				22.5	25
Minor Road	Dual Carriageway			45	52.5
Minor Road	Single Carriageway			40	45
Minor Road	Traffic Island Link At Junction			37.5	37.5
Minor Road				37.5	45
Restricted Local Access Road	Single Carriageway			30	27.5
Restricted Local Access Road				32.5	45
Restricted Secondary Access Road	Dual Carriageway			25	20
Restricted Secondary Access Road	Single Carriageway			27.5	22.5
Restricted Secondary Access Road				30	27.5

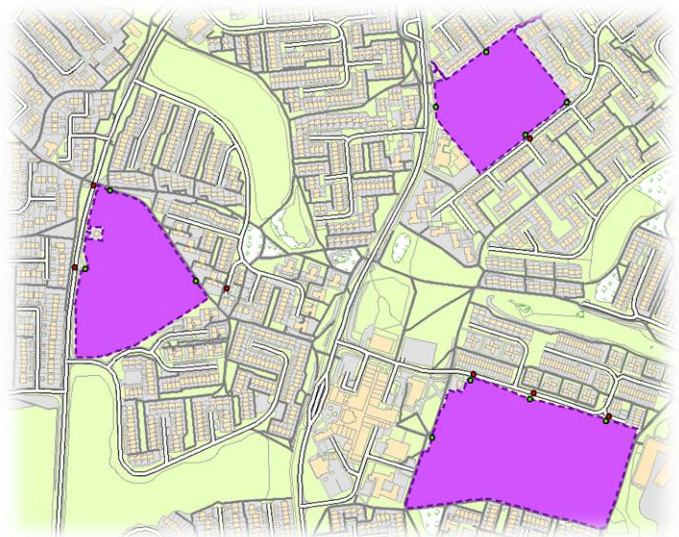
## Local knowledge

Another useful source of information is your own local knowledge. This may be knowledge of travel restrictions at certain times of day, e.g. some schools operate a voluntary one-way system to aid congestion at the start and end of the school day. This information can be stored in a table separate from your network. The Highways data contains a TOID as a consistent identifier and can be used to link between datasets.

## Other useful information

**OS MasterMap Sites Layer** – This is part of the OS MasterMap Topography Layer and provides an outline of features including an educational establishment, medical facility and transport facility (the purple polygons in the image). The data includes the access points for these sites with a link to OS MasterMap Highways. These can be used to further enhance your data in joining the network to addresses and other features across the landscape.

**Urban / Rural areas** – Highways data does not include a definition of whether a link is within a rural or urban area. However, it is possible to use the urban extents from other Ordnance Survey products, such as OS Vector Map Local to add this as an additional attribute. The simplest way to do this is by performing a spatial intersection between the road link and urban extent data. The result can then be used to classify a link as either urban or rural. However, where a link falls within both classifications it can either be spilt into two parts or classified according to which area contains the longest part of the link.



**Creating a network hierarchy** improves network efficiency by allowing routing software to not use the full network when calculating routes. For instance, calculating a journey from London to Glasgow does not need to use all the minor roads along the route. Developing a hierarchy will allow the software to quickly find only the major network and use this to determine when the destination is found. DfT generated a major route network as part of the now defunct Transport Direct web service. This is known as the [Transport Direct Routing Network](#) and can be downloaded from Github. Although the original data is based on ITN, as it comprises a list of TOIDs that are part of the network, this can be used to add an additional attribute to a network.

## Multimodal transport

When reviewing services such as the location of a GP Surgery or specialist health clinic, journeys by different transport modes, such as walking, public transport and cycling are required. By joining the OS MasterMap Highways Network Path data to the Highways Road data, a multimodal network can be generated.

Public transport data can also be added. Railway stations form part of several Ordnance Survey products and Sites layer contains both the outline of a station site and its access points. Bus stations are also part of the transport theme of the sites layer, however bus stops are not. These can be obtained in a geographic form from [DfT's NAPTAN data](#). The data also includes railway stations and airports. The data can also be linked to bus route information from [Traveline](#).

## Building a network

These notes provide a guide to building a network using what are considered to be the three most popular routing software packages used across the public sector. They are not, however, intended to be a comprehensive guide to creating a network, or an endorsement of the packages. Please refer to the documentation for the specific software to be used. Furthermore, a working knowledge of the software is required before starting this type of analysis.

### What to consider before starting?

Before starting to build the network there are a number of options to consider which will determine what data is required and what you will need to build the network.

- **What level of analysis is required?** – This will determine the level of detail in your network. If you want a more strategic overview, then consider using OS OpenRoads data as the basis for a network. If you require more detailed analysis, such as looking at service location and journey times, then you'll require OS MasterMap Highways.
- **What extent of data is required?** - You will need to consider whether you need a network for Great Britain or just your local area. The bigger the area the longer it will take to build the network.
- **What additional data do I need to add?** - Road speeds, bus stops for public transport networks. Note that some networks will be built with speeds attributes set to nominal values which you may need to review and amend.
- **What type of analysis is required?** – Give consideration to what you're hoping to achieve.
- **How to run the analysis?** – Typically, network analysis is memory intensive and it may be more efficient to analyse the data in smaller batches.
- **How will the results be presented?** – Are the results going to be presented graphically in a report or do you just require a spreadsheet of values.

## Network Analyst (ESRI)

### OS MasterMap Highways network

To use Highways in Network Analyst the data needs to be converted from GML into a Geodatabase. ESRI UK's UK Data Loader will do this and create a network in the correct format. This includes incorporating the restriction and qualifiers into the data model. Once the network is built it can be added to either ArcMap or ArcGIS Pro with the Network Analyst Extension enabled for use. This typically creates a national network in approximately two days (depending on hardware setup).

For further details, go to the [UK Data Loader](#) webpage.

## OS OpenRoads

OS OpenRoads is supplied as both GML and Shapefile. To create a network from the data you will first need to convert the Shapefiles into a Geodatabase by using merge from ArcToolbox to create a new Feature Class. This needs to be within a Feature Dataset in the Geodatabase as you can only create networks at this level.

Once completed you can build a network in ArcCatalog by opening your Geodatabase, right clicking on the Feature Dataset and selecting *New* followed by *New Network Dataset*. The wizard will take you through the process, but as OpenRoads only contains geometry you can leave all other settings as default.

As this data contains fewer features than Highways the processing time is significantly reduced and a network can be created in a few hours.

A useful [tutorial](#) is available online explaining how to build a network and the different types of analyses.

## RouteFinder

### OS MasterMap highways network

To convert the Highways GML into TAB format for use with RouteFinder you'll need to download a [translator](#). There are separate tabs for working with both roads and paths which can be either loaded together or individually.

1. Click *Add Files* and select the *GML for translation*.
2. To include the restrictions which are part of Highways, you will need to check *TOID base (turn.txt)* and click *Go!*

This will produce a table of RoadLinks from which a network can be generated.

RouteFinder is a tool which is run within MapInfo. If the tool is not present on the Toolbar it can be found in MapInfo's Tool Manager.

1. Open your translated data in MapInfo and select *Network* and *Create Network from Table*.
2. Choose the road table and click *OK* to create the network. This process will take approximately a day to complete, depending on your hardware setup.

RouteFinder uses a route hierarchy based on road classification which is added to the data as an integer. The import tool will have added an attribute column containing these values to the data.

1. In the *Select Network Attributes* dialog set the *Attribute Column* to *road\_class* and height and width to the columns containing these values if present.
2. Click *OK* to create your network.



## OS OpenRoads

OS OpenRoads is supplied as both GML and Shapefile. If you are using MapInfo v12.5 or newer, the Universal Translator can be used to convert GML directly into TAB files. If you are using an older version then MapInfo can read shapefiles directly, however the data will need to be saved as a TAB file and merged into a single file.

Once a TAB file is created a new attribute, `road_class`, will need to be added to the data to hold integer values for each road classification. The following query and update in MapBasic can be used to populate the new attribute.

```
Select * from RoadLink where roadClassification = "Motorway"
Browse * From Selection
Update Query1 Set road_class = 1
Close Table Query1 Interactive
Select * from RoadLink where roadClassification = "A Road" And formOfWay = "Collapsed Dual
Carriageway" into Selection
Browse * From Selection
Update Query2 Set road_class = 2
Close Table Query2 Interactive
Select * from RoadLink where roadClassification = "A Road" And formOfWay = "Single Carriageway" into
Selection
Browse * From Selection
Update Query3 Set road_class = 3
Close Table Query3 Interactive
Select * from RoadLink where roadClassification = "A Road" And formOfWay = "Roundabout" into Selection
Browse * From Selection
Update Query4 Set road_class = 2
Close Table Query4 Interactive
Select * from RoadLink where roadClassification = "B Road" And formOfWay = "Collapsed Dual
Carriageway" into Selection
Browse * From Selection
Update Query5 Set road_class = 4
Close Table Query5 Interactive
Select * from RoadLink where roadClassification = "B Road" And formOfWay = "Single Carriageway" into
Selection
Browse * From Selection
Update Query6 Set road_class = 5
Close Table Query6 Interactive
Select * from RoadLink where roadClassification = "B Road" And formOfWay = "Roundabout" into Selection
Browse * From Selection
Update Query7 Set road_class = 4
Close Table Query7 Interactive
Select * from RoadLink where roadClassification = "Unclassified"
Browse * From Selection
Update Query8 Set road_class = 6
Close Table Query8 Interactive
Select * from RoadLink where roadClassification = "Not Classified"
Browse * From Selection
```

*Update Query9 Set road\_class = 7*  
*Close Table Query9 Interactive*

Once the road\_class attribute is added the data is ready for network conversation as described previously. No additional attributes will be present in the data.

## pgRouting

### OS MasterMap Highways network

There are many resources for loading data into PostgreSQL for use with pgRouting. The data can be loaded into the database using the [Astun Loader](#) made available on GitHub.

Creating a network for use with pgRouting involves running SQL queries in a PostgreSQL database with the PostGIS extension. Useful resources are available on GitHub such as the guides written for pgRouting by Ross MacDonald ([view here](#)) and Tim Manners ([view here](#)).

Loading the data into pgRouting and building a network can be time-consuming and will take 2 to 3 days to complete. The most efficient way to do this is by creating routines for each element of the build which can then be run overnight, leaving hardware and software free for other tasks during the day.

For further details take a look at [pgRouting](#).

### OS OpenRoads

OS OpenRoads is delivered as Shapefiles which can be loaded directly into PostGIS using the *PostGIS Shapefile Import/Export Manager*. However, once loaded into PostGIS, you will need to append the tables into one table to make the data easier to work with. To use the data in pgRouting you will need to add the following columns to the data:

- source (integer) – Contains the value of the start node for each link
- target (integer) - Contains the value of the end node for each link
- fid (serial) – Unique value for each link, used as a primary key
- cost (double precision) – Cost value for traversing along the link
- rcost (double precision) – Reverse cost value for traversing along the link

As the data contains references to the start and end nodes held in the roadnode table, the source and target columns can be populated using these values by using an update query, removing the OSGB text and recasting the column.

The following SQL has been used to populate these values. Some editing may however be necessary to reflect differences in data structure. An additional column temp\_id has also been added to make the conversion of the references easier.

```
UPDATE roadnode SET temp_id = trim(leading '#osgb' from gml_id) :: Bigint;  
  
UPDATE roadlink set source_temp = trim(leading '#osgb' from l.startnode_xlink_href) :: Bigint  
  
FROM roadlink AS l where l.gml_id = roadlink.fid;  
  
UPDATE roadlink set target_temp = trim(leading '#osgb' from l.endnode_xlink_href) :: Bigint  
  
FROM roadlink AS l where l.gml_id = roadlink.fid;
```

The cost values can be either set to the road length or assigned an integer value dependent on the road classification.

## Examples

With ever tighter financial pressures on Public Services, a number of Authorities have looked to using network analytics to improve services and reduce costs. Ordnance Survey has published use cases demonstrating the use of network data in route optimisation for waste collection and school bus routing. Full details of all Ordnance Survey [case studies](#) can be found on the website.

The following are highlighted as good examples of the use of routing technology.

### Getting there quicker with Geotracker – London Ambulance Trust

London Ambulance has used data captured from vehicles to create a model for the resource redeployment and dispatch. Further details of the research behind this and the resulting model are detailed in the paper, [Towards Smarter Metropolitan Emergency Response](#).

Geotracker is an 'in-house' developed software using this model and is described in the [Getting there quicker with Geotracker case study](#).

### OS data helps keep hospital open for stroke patients

South West Commissioning Support Unit used travel times as a part of a [review](#) of Stroke Services across Somerset.

### Hot Blocking targets crime reduction for safer streets

Combining network data with data from Police, Fire and Ambulance services to locate hotspots and target resources – [Hot Blocking targets crime reduction for safer streets](#).

## Additional Information

- [OS MasterMap Highways Product Guide](#)
- [OS MasterMap Highways Roads Technical Specification](#)
- [OS MasterMap Highways Routing and Asset Management Technical Specification](#)
- [OS MasterMap Highways Paths Technical Specification](#)
- [OS MasterMap Highways Speeds Technical Specification](#)
- [OS Open Roads User Guide](#)
- [IM Data Index](#) – this is a one stop shop for data related to mobility and includes many useful datasets