Quadstone Paramics V4.2
Modeller User Guide

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1 Before You Begin 4
1.1 Introduction to Paramics 4
1.2 Basic Concepts and Terms 4
1.3 Modeller Development Cycle 5
1.4 How this Manual is Organised 5
1.4.1 Tutorial 6
1.5 Reference 6
1.6 Conventions used in this Manual 7
2 Tutorial 8
2.1 Introduction to the Tutorial 8
3 Introduction to Paramics Modeller 9
3.1 Modeller Start-up 9
3.1.1 Layout of Modeller Window 9
3.1.2 Dropdown Menus 11
3.1.3 Reporter Window 12
3.1.4 Navigation 12
3.1.4.1 Three Button Mouse 12
3.1.4.2 Mouse plus Navigator Panel 13
3.1.4.3 Keypad HotKeys 13
3.2 Paramics Editor 16
3.2.1 Adding a Link 16
3.2.2 Node Editing 17
3.2.3 Link Editing 18
3.2.4 Zone Editing 19
3.3 Exiting Paramics Modeller and Archiving 21
4 Network Build I 22
4.1 Units 22
4.2 Model Area Template 23
4.3 Skeleton Network Coding 25
4.4 Urban Network Junction/Intersection Coding 32
4.4.1 Priority Junction/Intersection 32
4.4.2 Traffic Signal Junction/Intersection 36
4.4.3 Roundabout Junction/Intersection 38
4.4.4 Kerbs and Stop Lines 40
4.5 Infrastructure 41
4.5.1 Annotation 41
5 Traffic Demand I 44
5.1 Zone Specification 44
5.1.1 Zone Areas 44
5.2 Demand Specification 46
5.2.1 Demand Editor 47
5.2.2 Display Demands 48
5.2.3 Sector Editor and Displaying Sector Demands 48
5.3 Vehicles Specification 49
5.3.1 Vehicle Characteristics 49
5.3.2 Vehicle Proportions 51

5.4 Profile Specification 52
5.5 Fixed Demand 53
5.5.1 PT Routes 54
5.6 Run Initialisation 55
5.7 Additional Exercises 56
6 Traffic Assignment I 61
6.1 Introduction 61
6.2 Network Coding 61
6.2.1 Cost Factors 61
6.2.2 Category Cost Factors. 61
6.2.3 Link Cost Factors 62
6.3 Model Parameters 62
6.3.1 Generalised Cost Coefficients 62
6.4 Assignment Methods 64
6.4.1 “All-or-nothing” Assignment 64
6.4.1.1 Major/Minor Links 65
6.4.2 Stochastic 66
6.4.3 Dynamic Feedback 67
6.4.4 Combining Assignment Techniques 67
7 Collecting & Analysing Model Results I 68
7.1 Gathering Statistics 68
7.1.1 Statistics 72
8 Network Build II 74
8.1 Urban/Highway Network 74
8.1.1 Links with Medians 75
8.1.2 Curved Links 76
8.1.3 Ramps and Slips 76
8.1.4 Node Bounding Box 79
8.2 Network Restrictions 79
8.2.1 Turn Restrictions 82
8.3 Infrastructure 82
8.3.1 Loop Detectors 82
8.3.2 Sign Posting 83
8.3.3 Lane Choices 84
9 Traffic Demand II 88
9.1 Zone Specification 88
9.2 Parking 90
9.3 Time Periods and Time Dependent Inputs 95
9.3.1 Time Dependent Demand Files 95
9.3.1.1 Time Dependent Profile File 95
9.3.2 Time Dependent PT Files 99
9.3.3 Time Dependent Vehicles Files 99
9.3.4 Time Dependent Network Files 99
9.3.4.1 Traffic Signals 99
9.3.5 Periodic Link Changes 100

9.4 Multiple Profiles 101
10 Traffic Assignment II 105
10.1 Random Release of Vehicles 105
10.1.1 Modifying the Release of Traffic 106
10.2 Features Affecting Traffic Routing 107
10.2.1 Restrictions 107
10.2.2 Forced Lane Changes 108
10.3 Averaging Feedback Costs 110
10.4 Additional Exercises 113
10.5 Strategic Routes 115
10.6 Generalised Cost Coefficient 116
11 Collecting & Analysing Model Results II 118
11.1 Gathering Loop Detector Data 118
11.1.1 Generated Text Files 118
11.1.2 Interactive Detector Data 119
12 Index 120

1 Before You Begin

1.1 Introduction to Paramics

Paramics is a suite of high performance software tools used to model the movement and behaviour of individual vehicles on urban and highway road networks.

The Paramics Project Suite consists of Paramics Modeller, Paramics Processor, and Paramics Analyser.

Paramics Modeller provides a visualisation of road networks and traffic demands using a graphical user interface (GUI). Geographic and travel data is input to the program which then simulates the lane changing, gap acceptance and car following behaviour for each vehicle. The speed of the simulation is governed by the computer processing power, the size of the network and the number of vehicles on the network at any one time.

Paramics Processor configures and runs the traffic simulation in batch mode without visualisation of the network through the GUI. This dramatically increases the speed of simulation and is used to collect simulation results for the numerous test options and sensitivity tests required.

Paramics Analyser reads output from the simulation model and provides a GUI to compare post processing simulation results to observed data and to contrast and analyse different test results.

This User Guide concentrates on the Paramics Modeller tool and uses examples to describe how the software can be used to build traffic models and extract simulation results.

The Paramics software development is an ongoing process, with additional functionality being created to meet customer needs or to match further developments in ITS or traffic planning processes. If you have any comments on Modeller or on the contents of this User Guide, please access Quadstone's Paramics web site at:

http://www.paramics-online.com

1.2 Basic Concepts and Terms

Modeller, requires two main inputs. The first is the road network data, the second is the travel demand data.

Road network data consists of geometric layout, junction descriptions, lane markings and turning movement information. Junction or intersection descriptions are stored in the model as "node" data where each junction is allocated a node number or name. The road network which connects between nodes, describes the geometry of the road, the lane specification and the distance. The connection between two nodes is called a "link".

The study area can be divided into sub-areas known as "zones" which may be distinct geographical boundaries (e.g. rivers, railways, canals etc.), or socio-economic boundaries (e.g. residential areas, industrial areas, shopping etc.) or boundaries specific to local model conditions (e.g. to accommodate internal screenlines). The travel demand is modelled as zone to zone movements and is represented by an origin/destination matrix of trips.

Zones within the study area are referred to as internal zones while zones outside the study area are referred to as external zones.

The traffic assignment process allocates the journeys (or trips) to appropriate routes through the network. Alternative routes are calculated depending on perception of link costs, on network congestion and on network restrictions such as banned turns.

Additional "fixed demands" such as service bus data can also be coded directly onto the road network with pre-defined specified routes.

To ensure that the model reflects as accurately as possible the existing road conditions, a "base year" model is usually constructed. The current road network and travel demand patterns are modelled and compared to observed traffic data. Where the comparisons are within acceptable guideline criteria (ref. DMRB Vol 12 Traffic Appraisal in Urban Areas) the model in considered to be calibrated and validated.

The process of "calibration" allows for the adjustment of parameters used within the model, fine-tuning the model output to give acceptable matches to observed data. However, the results must be shown to be robust and consistent and any changes to default parameters must be justifiable.

Model "validation" consists of independent checks of the calibrated model. Observed independent data (not used for model calibration) is compared to model output and verified against guideline criteria.

1.3 Modeller Development Cycle

The Modeller development cycle consists of the following seven steps:

1. Creating a new Paramics network and embedding an overlay file.
2. Constructing a road network by adding nodes, links and zones and coding detailed lane and junction description.
3. Constructing demand matrices from origin/destination data, and including fixed demand data such as PT Routes.
4. Assigning traffic using an appropriate assignment technique.
5. Collecting and analysing model results.
6. Calibrating base conditions by comparing model results to observed data
7. Validating the calibrated base model against independent data.

All stages of the network construction and simulation process require checking and validation. Guidelines for good practice are published by the Department of Transport (UK) in DMRB Vol 12: Traffic Appraisal in Urban Areas. Paramics users are recommended to adhere to these practices or to similar national standards when building traffic models.

1.4 How this Manual is Organised

This manual is primarily designed as a tutorial guide to enable user to be come familiar with the core concepts of the Paramics Modeller software. Advanced User guides covering areas such as the use of “3D”, “Junction Analysis”, “Cut and Paste”, “Calibration”, “Incidents”, “Strategic Routing” and “VA Signals” are also available as separate documents.

1.4.1 Tutorial

Modeller is highly interactive and therefore easier to learn by building example models to simulate traffic movements. New users are recommended to read the tutorial section at their workstations and to complete the simple modelling examples. The tutorial gives detailed instructions for the first five stages of the development cycle: creating a new network, building the network, building demand matrices, traffic assignment and collecting model results. The final stages, model calibration and validation, can vary from model to model and may be controlled by published guidelines. For example, in the UK the Department of Transport recommends criteria for model building and validation. The user is advised to follow these recommended criteria or use other national standards where appropriate.

The tutorial is set out in sections corresponding to the development cycle stages, with a first set of examples relating to urban network coding and a second to highway network coding. There is a degree of overlap between these two stages where the coding is applied to both urban and highway networks.

Knowledge of traffic modelling techniques and procedures is an advantage and experienced traffic modellers should recognise and be familiar with a number of the techniques used in Paramics Modeller. However, the programme's intuitive nature means that all users should quickly become comfortable with the development cycle for model building.

1.5 Reference

A full explanation of Modeller commands and a description of associated ASCII output statistics files is contained in the Modeller Reference Manual.

1.6 Conventions used in this Manual

1. Text to be typed at the keyboard is shown in the format:

```
type this exactly
```

2. Messages and ASCII files generated by Paramics are shown as follows:

```
Now using standard demands and zones files, network has also been
Saved/Refreshed.
```

3. Paramics filenames occur in the following bold text:

configuration

4. Paramics commands, selected by clicking with the mouse keys are shown in bold text as follows:

File>>Edit

The **>>** shows the direction of sequence of the commands starting with the left command. All commands to the right will be sub-commands of the previous selected command.

5.Folder names are shown as italic bold

Training/urban

6. "Click" always means to use the mouse buttons. All mouse operations in this User Guide assume that a 3 button mouse is installed.

2 Tutorial

2.1 Introduction to the Tutorial

The tutorial section of this document includes the following chapters:

- Introduction to Modeller
- Network Build I
- Traffic Demand I
- Traffic Assignment I
- Collecting and Analysing Model Results I
- Network Build II
- Traffic Demand II
- Traffic Assignment II
- Collecting and Analysing Model Results II.

It is intended that the user reads the tutorial at their workstation and follows the step-by-step instructions to build simple models.

The model build procedure is divided into two sections. The first section introduces basic model build techniques while the second section introduces additional techniques together with some enhancements to the basic features. In the process you will be introduced to all the major features of Paramics Modeller.

When the tutorial is completed, the Modeller window looks like Figure 1.

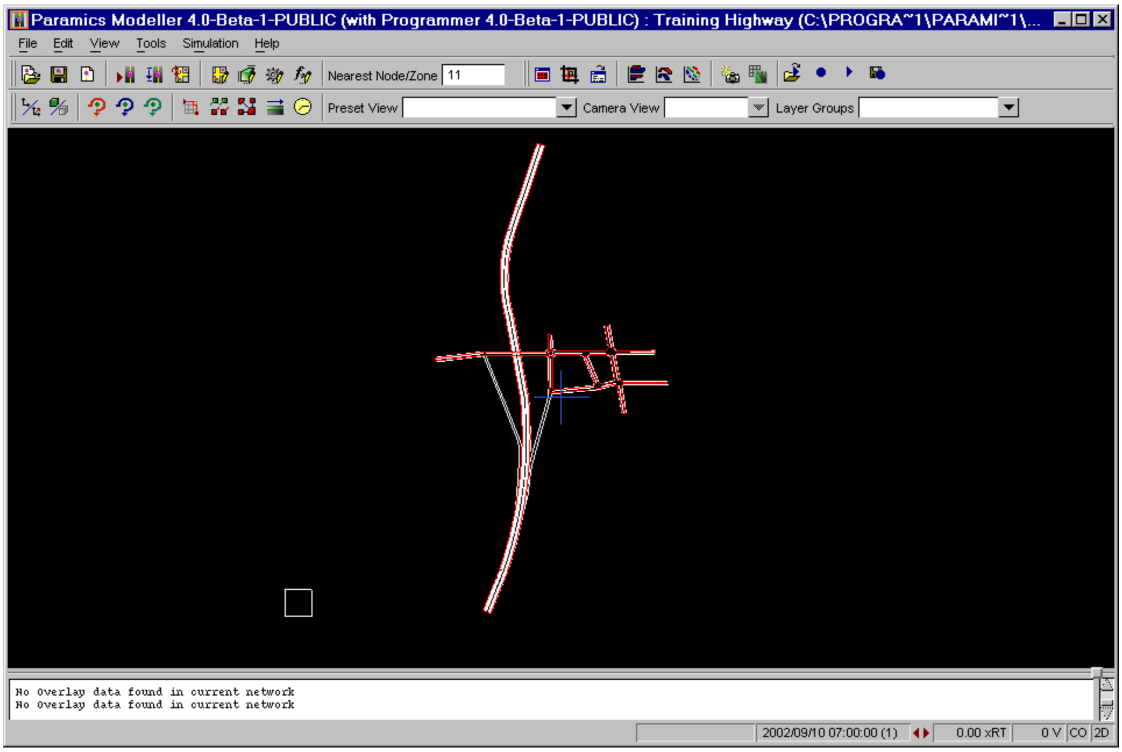


Figure 1: Completed Network

3 Introduction to Paramics Modeller

3.1 Modeller Start-up

Modeller is available for a wide range of systems including Windows NT/95/98/2000/XP Sun Microsystems/Solaris, Linux and Silicon Graphics/IRIX. To install the software please refer to the instructions given in the Paramics Software Installation Guide and ensure the toggle to load Modeller is selected. To run the full version of Modeller a valid licence file is required.

After installing the software a Modeller icon will appear on the monitor screen. To start a Modeller simulation, double click on this icon using the ***left mouse button***. A display window appears similar to Figure 2 below.

If the software is loaded on a Unix workstation, simply type the command "modeller &" in a shell window and press return. The display window will be similar on PC and on Unix but with slight variations depending on the window manager in use.

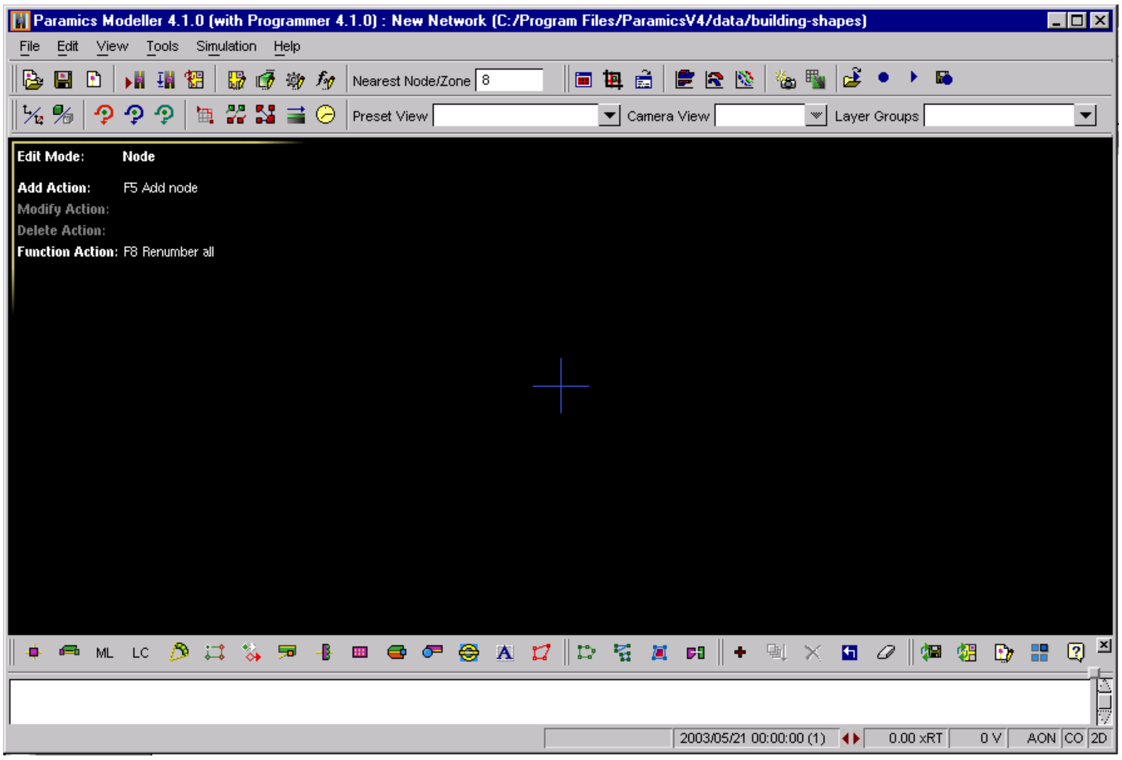


Figure 2: Screen Layout

3.1.1 Layout of Modeller Window

The Title Bar of the Main window displays the name of the current simulation network and is positioned on the top of the Paramics Main window. The Menu Bar is positioned immediately below the Title Bar and comprises of the Paramics dropdown menus: File, Edit, View, Tools, Simulation and Help.

Each menu choice is described in detail in the Modeller Reference Manual. The Icons Toolbars, if selected, are displayed immediately below the Menu Bar and comprises of the shortcut icons.

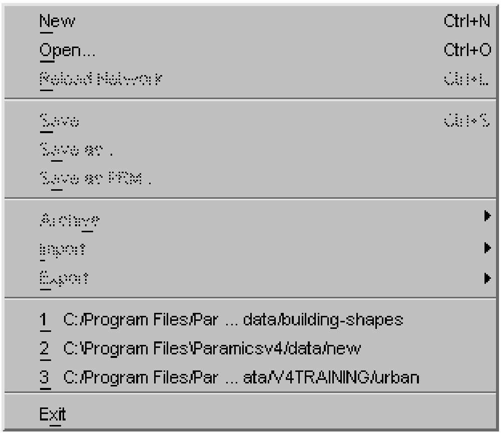
The Paramics Simulation window comprises of the network viewer. This is the major part of the Paramics Modeller software and is used to pan and zoom throughout the simulation network and is also the key to the editing via the Graphical User Interfaces (GUIs).

Below the Simulation window the Network Editor Toolbar will be displayed if the Editor Toolbar is initialised. The Reporter window is located immediately below the Simulation window and is used to display messages and warnings to the user. The Reporter window can be docked, undocked or hidden according to the users preference.

Below the Reporter (from left to right) is the Progress Bar, Simulation Clock, Real Time display, Vehicle display, Mode display and the Dimensional Mode display.

Around the edge of the Simulation window there is a dotted line that defines the area for visualising simulated traffic, this is the Viewport **(View>>Set Viewport)**.

To open a new network select **File>>New** from the Menu Bar. The file browser window allows the user to look at existing directories and select the required one and selecting **Open**.



For example, to create a new network called ***Urban*** select **File>>New**. To name this network simply select **File>>Save as** then select the directory location, in this instance create a folder called ***Training,*** and type the name the network ***Urban*** in the **File Name** field and select **Save**.

This opens a Modeller Main window for a new network called ***urban*** in the directory called ***Training***. In the ***urban*** sub-directory nine default files will be created, namely, **annotation, categories, demands, links, linktypes, nodes, options, vehicles** and **zones**. To view these files minimise the Modeller Main window (click with ***left mouse button*** on the appropriate icon at top right of the window) then use a text editor, such as Notepad, to open any of the eight default files.

Maximise the Modeller Main window (single click with the ***left mouse button*** over the minimised icon). To increase the window size to full screen, click the ***left mouse button*** on the small square icon at the top right of the Modeller Main window.

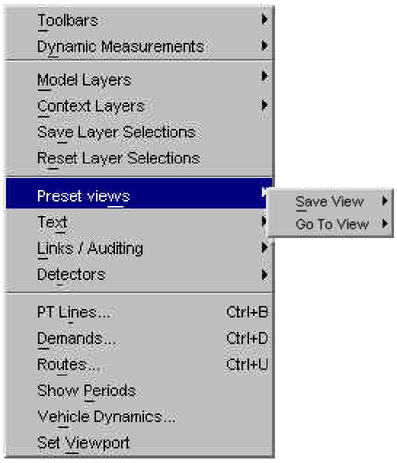
The Modeller Main window shows a basic road network consisting of 4 nodes, 3 connecting links and 2 zones all within a simulation area. The simulation area is marked as a dotted yellow rectangle inside the Simulation window.

An introduction to some of the Menu Bar choices and to a number of the Editor Toolbar icons follows.

3.1.2 Dropdown Menus

By clicking with the left mouse key on Menu Bar choices (**File**, **Edit**, **View**, **Tools, Simulation** etc.) dropdown menus appear. Each menu choice is described in detail in the Modeller Reference Manual and the following simple example will show the general selection procedure for these menus.

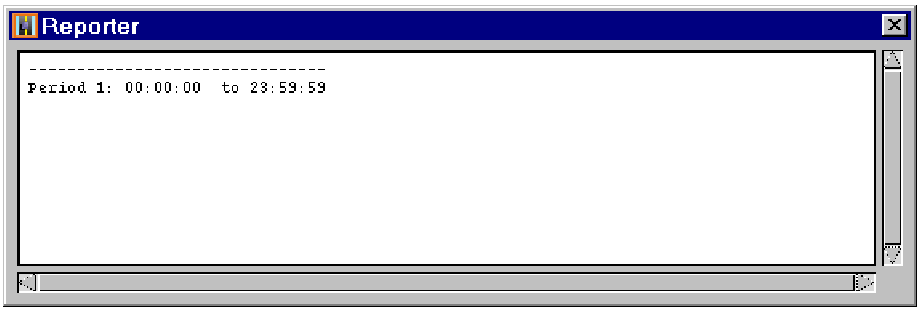
Preset an area by using the dropdown menu **View>>Preset views>>Save View>>0**. The Paramics Input window appears showing a text box with the prompt "Name for Preset View". Click within the text block with the ***left mouse button*** so that the text is activated and type a description such as "full network view" and press **OK**.



This will return the Main window to the predefined area each time the **0** (zero) key is pressed or when **View>>Preset views>>Go To View>>full network view** is selected but only if the mouse arrow is within the Simulation window.

3.1.3 Reporter Window

The Reporter window is "docked" just below the Simulation window, and its size can be controlled using the adjustable pane control. The window displays warning messages and it may be used to output information such as instantaneous data on selected vehicles. If warning messages are displayed these should be read and assessed to see if the warning is critical.



A standalone Status Report window can also be opened using **Tools>>Reporter (Crtl T)** and this window can be dragged to any position on the screen.

3.1.4 Navigation

There are several different methods of navigating within the Modeller Simulation window. The recommended method is to use the mouse buttons on a three button mouse. Alternatively, use a mouse (one, two or three button) together with the Navigator Control Panel or with keypad characters.

3.1.4.1 Three Button Mouse

Within the Simulation window, move the mouse arrow and click the ***left mouse button*** to place the *blue cross hair* at the centre of the area of interest ("point and click"). In addition to "point and click", the left mouse can be held down continuously as the mouse is "dragged" in the Simulation window. The position of the view relative to the Simulation window changes. By releasing the ***left mouse button*** the position is fixed at that point in the Simulation window ("drag and drop").

The "drag and drop" navigation is very sensitive and may therefore be difficult for users who are not familiar with this technique. After some precise this is easily mastered but to start it is probably advisable to use the "point and click" technique.

By clicking the left and centre buttons simultaneously, the Simulation window zooms out from the *blue cross hair* point (referred to as zoom up). The left and right buttons clicked as the same time will zoom in toward the *blue cross hair* (referred to as zoom down). While zooming up and down the *blue cross hair* position remains fixed unless the **Tools**>>**Options>>Zoom and Pan** is toggled on. With this option selected, the *blue cross hair* position can be dragged (i.e. panning) around the Simulation window at the same time as the view is zoomed up or down.

3.1.4.2 Mouse plus Navigator Panel

The Navigator Panel can be toggled on or off using **Tools>>Navigator**.

If the Navigator Panel is displayed and the mouse arrow is positioned over the navigator symbols, a tooltip appears briefly (only if **Options>>Tooltips** is toggled on) on the screen. These tooltips describe the operation of each of the symbols, for example, Pan Left, Pan Up, Zoom Down etc.. Clicking the ***left mouse button*** (or single mouse button) on a symbol will perform the respective operation within the Simulation window. For example, clicking on the symbol Pan Left will reposition the *blue cross hair* to the left of its present position. The incremental step can be changed using the + and – symbols to increase or decrease the sensitivity.

The symbols Snap To, Select (Left) and Select (Right) are used for editing the network and are described in the Modeller Editor section below.

3.1.4.3 Keypad HotKeys

A number of keypad characters have been defined as shortcuts (HotKeys) to navigation operations and for display options. The navigation HotKeys are:

Tab	View Point Height Up
`	View Point Height Down
Right/Left/Up/Down Arrow keys	Focus Point (R/L/F/B)
Ctrl with **Right/Left/Up/Down** Arrow keys	Focus Point (R/L/F/B) (Fine)

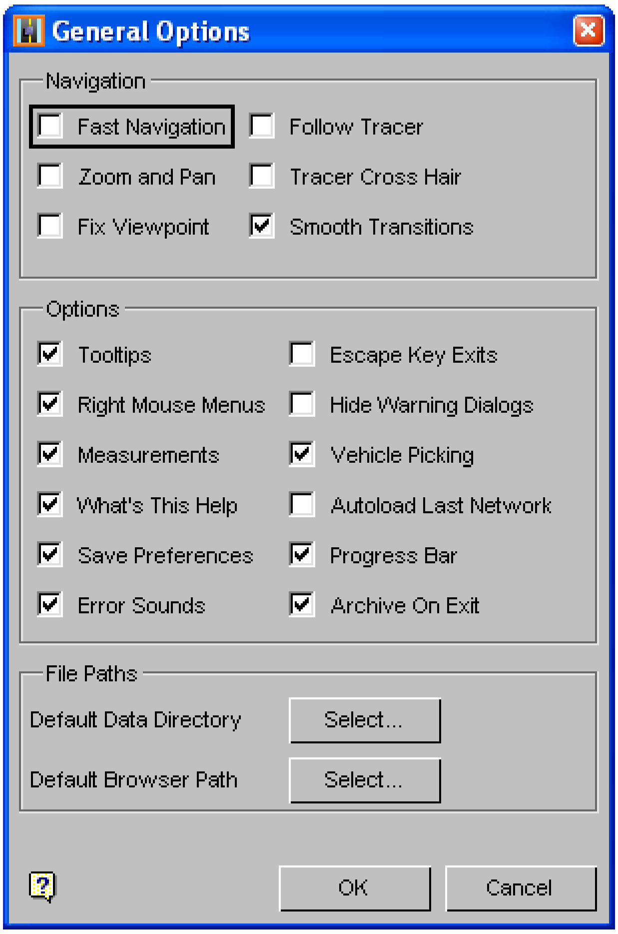
If the mouse arrow is within the Simulation window area then pressing the **<Tab>** key will zoom up while pressing the **<`>** key will zoom down. The keypad arrow keys will pan the view in the Simulation window in each respective direction.

Exercise 1

Use any of the methods described above to centre the *blue cross hair* on Zone 1 and zoom down.

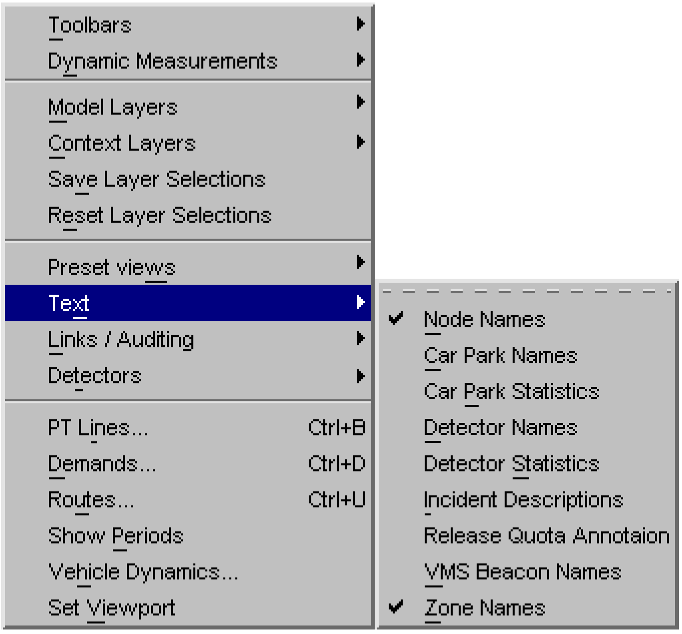
In the **View** dropdown menu click on **model layers** then the dotted line to tear-off this menu. Toggle **Zone Boundaries** on and off by clicking this option using the ***left mouse button***.

Toggle the navigator panel on/off using **Tools>>Navigator**. Toggle the tooltips on/off using **Tools**>>**Options>>Tooltips**.

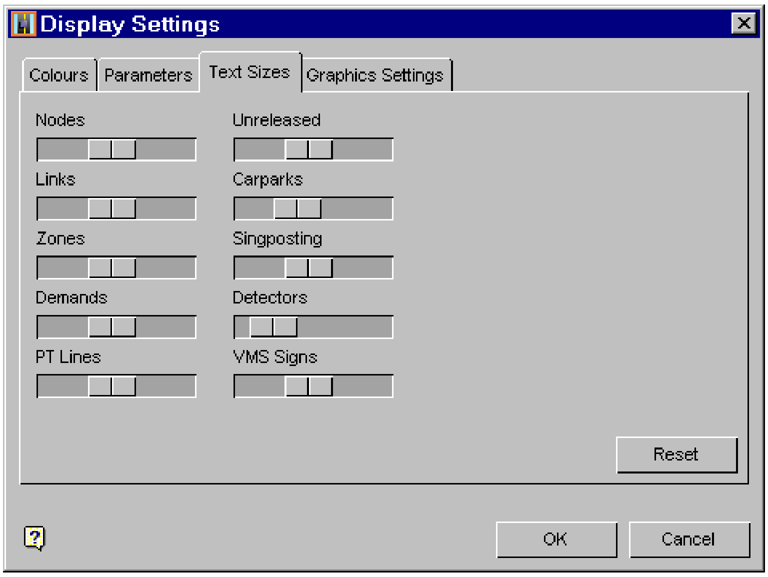


Exercise 2

Click on View>>Text and tear-off the menu for Node Names. Display node names by clicking the left mouse to toggle Node Names on.



Click on Tools>>Display Settings then Text Sizes in the Display Settings window and change the text height by clicking and holding down the left mouse button to move the slider bar.



Click on **Help>>Hotkeys** to show shortcuts to toggling objects.

3.2 Paramics Editor

The Editor Toolbar is used to modify the network data dynamically. Editing can be done at any time, even while the simulation is running.

There are four ways to open the editor. The first two use dropdown menus either **Edit>>Network** or **View>>Toolbars>>Edit**. The third most commonly used method is **<Ctrl E>.**

After opening the editor the Toolbar is conveniently located at the bottom of the window.

Within the Editor Toolbar there are four function groups, namely; **File Options, Network**, **Demand** and **Modification**. The **File Options** group contains the **save and refresh, refresh only, file editor, edit options** and **editor help**.

Save and Refresh - the **Save and Refresh** function executes the edits that have been made to the simulation network, saves the changes and refreshes the screen display.

Note:- If any edits have been carried out but have not been saved then no network changes are applied. Therefore, **File>>Reload** has the effect of undoing any edits since the last **Save and Refresh**.

Refresh Only - the **Refresh** function will not save the network changes but will refresh the screen while.

File Editor - the **Edit** function enables edits to be carried out directly to Paramics files. This is useful for editing user specified files such as **demands**, **categories***,* **profiles** etc.

Editor Options – See Modeller Reference Manual for detailed information on Cut & Paste, Scope, Periodic and Options menus.

Editor Help -. See Modeller Reference Manual for detailed information on this menu.

The edit functions are contained within the Network and Modification groups. By clicking on the icon within these groups specific functions can be undertaken.

The following section concentrates on editing the main network components i.e. nodes, links and zones.

3.2.1 Adding a Link

Open the **Editor Toolbar** and click on **Edit Nodes** then using the ***left mouse button*** select the location of the first node and select **Add Node**. Select the location of the second node and select **Add Node**.

Next select a node using the ***middle mouse button***, when selected the node will be highlighted purple. Select the second node, this time using the ***right mouse button***, the second node will be highlighted as green.

Finally, select **Add Link**, this will launch the **Link Attributes** window enabling the user to select the relevant link category.

Note:- Categories are explained in greater in Chapter 4.

3.2.2 Node Editing

Open the Editor Toolbar and click on the **Edit Node**. In the Modeller Simulation window zoom down to a node and using the ***middle mouse button*** click on the node.

Note:- The modify Toolbar icons; add node, modify node, delete node and modify junction become highlighted.

Using a two button mouse a selection is activated by clicking both buttons simultaneously. Alternatively, in the Navigator Panel click on the symbol Select (Middle) to select the node which is closest to the *blue cross hair* position in the Simulation window.

Next select another node, this time using the ***right mouse button*** (similar for two button mouse) or using Select (Right) from the Navigator Panel. Also, the first node is highlighted as purple while the second node is highlighted as green.

Note:- It is important to be aware that a convention exists where the direction of a link is always from first node to second node i.e. from purple to green.

Next click on **Add Node**.

Note:- If the purple and green nodes were at opposite ends of the same link then the link would be highlighted as grey and the new added node would appear halfway along the link. If the purple and green nodes were on different links then the new node appears at the *blue cross hair* position. The new node becomes the purple node. A node that is not connected to the rest of the network will be highlighted as red.

A node highlighted as purple, is moved by holding down the <shift> key and either clicking the ***middle mouse button*** to reposition the node at the *blue cross hair* or by holding both keys simultaneously to drag the node around the screen. The same functionality is achieved using the Snap To symbol on the Navigator Panel.

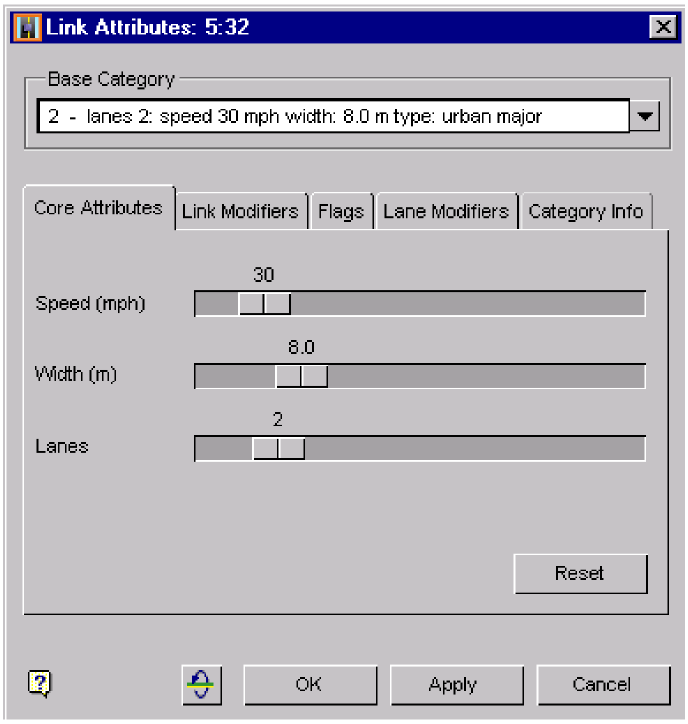
After repositioning the node, select the **Save and Refresh** icon from the save function group.

3.2.3 Link Editing

In the Editor Toolbar window select the **Link** icon (as opposed to **Node** in the above section). Select a link by moving the arrow to the required link and clicking the ***middle mouse button*** (alternatively use Select (Middle) from the Navigator Panel). The edit group keys should read **Modify Link**, **Delete Link, Annotate Link** and **Clear All**.

Note:- Clicking on **Clear All** deselects everything.

Select the **Modify Link** icon to open a new window called **Link Attributes.** Drag this window to a convenient position.



The link attributes of category, speed, width and lanes are automatically shown. To view more link information select one of the following menus; **Flags**, **Devices, Link Modifiers** and **Category Info**.

Use the slider bars to change the category, the speed, the width and number of lanes by clicking and holding down the left mouse key to drag the slider bar. These attributes can also be changed by single clicking the ***left mouse button*** inside the grey slider bar windows.

Make a change to speed, width or lanes and click **Apply**. The changes can be included in the network using the **Save and Refresh** button.

An alternative way to select a link is to use the **Node** function to highlight nodes at either end of a link. Select a node at one end of the required link using the ***middle mouse button*** (or in the Navigator Panel click on the symbol Select (Middle). Then select the node at the other end of the required link using the ***right mouse button*** (or in the Navigator Panel click on the symbol Select (Right)). Remember that the node selected using the Navigator Control Panel will be the one closest to the *blue cross hair* position shown in the Simulation window.

Exercise 3

Use both the **Node** and **Link** functions to include crossroads and T-junctions in the network. **Save and Refresh** changes.

To add a new junction on an existing link, the user is required to firstly select the link and then using the node icon in the editor menu, select the **Add Node** icon. As described previously the new node is added at the mid-point of the selected link.

3.2.4 Zone Editing

Select the function **Edit Zones** icon from the Demands Toolbar and immediately a green dotted rectangle appears in the Modeller Simulation window. The rectangle defines the area of a new zone if one is added to the network.

By clicking with the ***middle mouse button*** in the middle of an existing zone, all vertices of the bounding area of the zone are highlighted. If all the vertices of the zone are marked then the entire zone can be dragged and moved around the screen using the <shift> key together with the ***middle mouse button***. The same functionality can be achieved using the Select (Middle) and Snap To symbols from the Navigator Panel.

To move an individual vertex, use the ***middle mouse button*** to click inside the zone close to the required vertex and move it using the <shift> key and ***middle mouse button***.

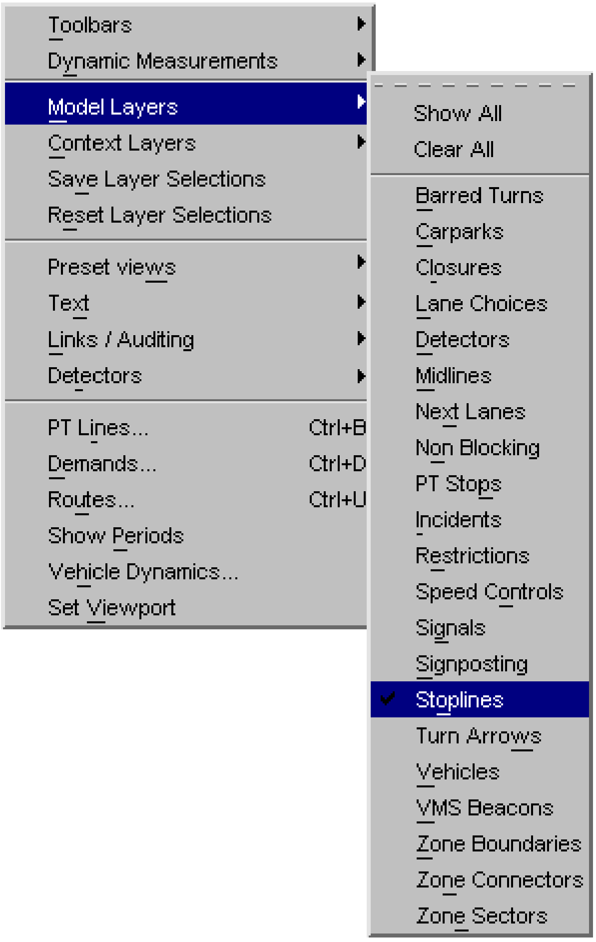
Vertices can be added around the perimeter of the zone. New vertices are shown as a small green dotted square. If a vertex is deleted the unconnected vertices of the zone are automatically joined after **Save and Refresh**.

Exercise 4

Add new zones and position these so that the zone boundary covers a link. **Save and Refresh** changes.

Exercise 5

Start the simulation (two alternative methods – the Start Simulation icon in the main Toolbar or spacebar); change the **Viewport** window; zoom down to the detail of a junction; select the **View** dropdown menu, **Model Layers** and tear off; toggle **Stoplines** on/off.



Note:- If the simulation is running the Start function key changes to Pause. To stop the simulation, select the Pause function or press spacebar.

The **Reporter,** which is docked at the bottom of the Simulation window (or opened by selecting **Tools>>Reporter**) can be used to identify individual vehicle specification. Select a vehicle by positioning the mouse pointer on the vehicles and pressing the ***middle mouse button***. A full description of vehicle types and characteristics in contained on page 49.

Note:- V3.0 compatibility for middle-mouse button selection can be activated within **Tools>>Options>>Vehicle Picking**.

3.3 Exiting Paramics Modeller and Archiving

There are two ways to quit the Modeller program. The first is dropdown menu **File>>Exit** that also allows the user to save snapshots at that point in the simulation and to save the preferred options (e.g. to show **Zone Boundaries** etc.).

The second method is to press the <escape> key. This automatically quits Modeller and saves the options selected at the instant of quitting the program.

> **Warning: It is important to note that if changes have been made to the network without applying Save and Refresh then all changes will be lost.**

Exercise 6

> Quit Modeller and then re-open from the Modeller icon to see the network changes that have been saved.
>
> Use the simulation mode icon to change the mode to single step simulation. Run the simulation in single step mode.
>
> **Note:-** The simulation clock has return to the value set as default. This default simulation start time can be reset to the users requirements in **Edit>>Configuration>>Base Parameters**.

The user may wish to archive material after a specific part of work has been completed. To do this select **File>>Archive>>Backup** and include comments in the box provide e.g. "Changed signal plan at High St / Church St junction". Modeller will archive the data after the user has selected the **Backup** function.

To restore archived data use **File>>Archive>>Restore**.

Note:- Restore will overwrite the network data that exists currently so be careful when restoring from archives that work that has been done is not overwritten. It may be that the user would prefer to use **File>>Save As** in the Editor Toolbar, to save different stages of the network development in separate directories.

Alternatively, use the **File>>Save As PRM** option in the Editor Toolbar window. This option saves the current network as a file with ".prm" filename extension, so that all the network description files are contained in one "PRM" file as opposed to a directory. To load this information the user selects the option **File>>Open**, types the "PRM" filename in the selection box and selects **OK** (See Appendix A of the Modeller Reference Manual - Paramics File System).

Note:- The backup function on the PC will require the Windows operating system to show file extensions for known file types. To change this use the Windows Explorer program or open the 'My Computer' folder. Select the View>>Options… from the dropdown menu and select the View tab. Ensuring that the 'Hide file extensions for known file types' is toggled off.

4 Network Build I

Prior to this stage it is essential that a modelling overview has been completed and decisions have been taken regarding modelling objectives and requirements. This is generally known as the scope of the study or the scoping phase.

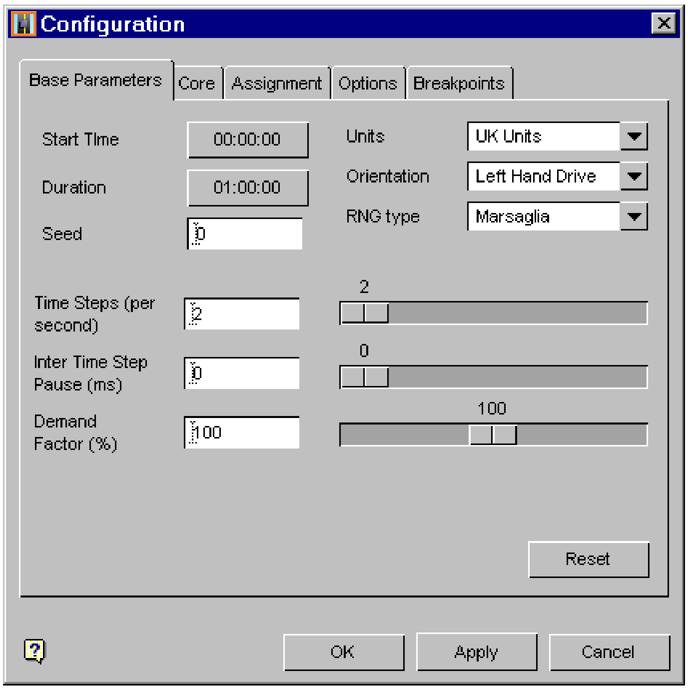
This tutorial assumes that an overview or scope has been completed and the model area, model time periods and data requirements have all been identified.

4.1 Units

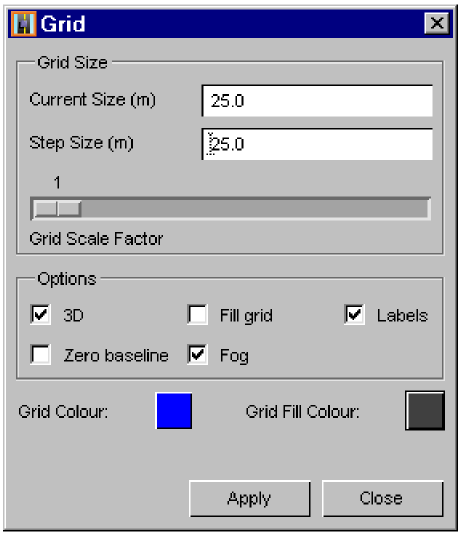
Paramics has three options for displaying speed and distance units, for more details see the **Configuration Manager>>Base Parameters>>Units** in the Modeller Reference Manual, page 22.

Note:- All internal calculations are carried out in metric units therefore minimal conversion and rounding errors can be expected if imperial units are applied.

The user can define the default units used for each network by selecting **File>>Configuration>>Base parameters**. In addition to specifying the units the user can also select whether networks are right hand drive or left hand drive.



Select **Tools>>Grid** and then **100m** if using UK mode or **100ft** if in US mode.



Then click the **edit link** icon and select any link by clicking on the link with the ***middle mouse button***. Using **Modify Link** note the link attributes of category, speed, width and lanes. For UK mode the speed is in miles per hour and the width is in metres. For US mode the speed is miles per hour and the width is in feet. To switch between the modes select **Edit>>Configuration>>Base Parameters** from the main menu bar and select **US Units**, **UK Units or Metric** Units from the Units combo list. The grid automatically changes between 100ft squares and 100m squares. If you select the same link and **Modify Link** you see that the speed remains in miles per hour but the width has changed from metres to feet or visa versa.

4.2 Model Area Template

Detailed road layout plans can be read directly into Paramics and used as a template to build the model road network. This removes the need to measure road geometry manually from plans or from site measurements.

Overlays may be used as a template to build a network model. These can be read into Modeller as Bitmap (bmp), AutoCAD (dxf) of TGA (tga).

For the purposes of this tutorial an AutoCAD file called **overlay.dxf** has been prepared.

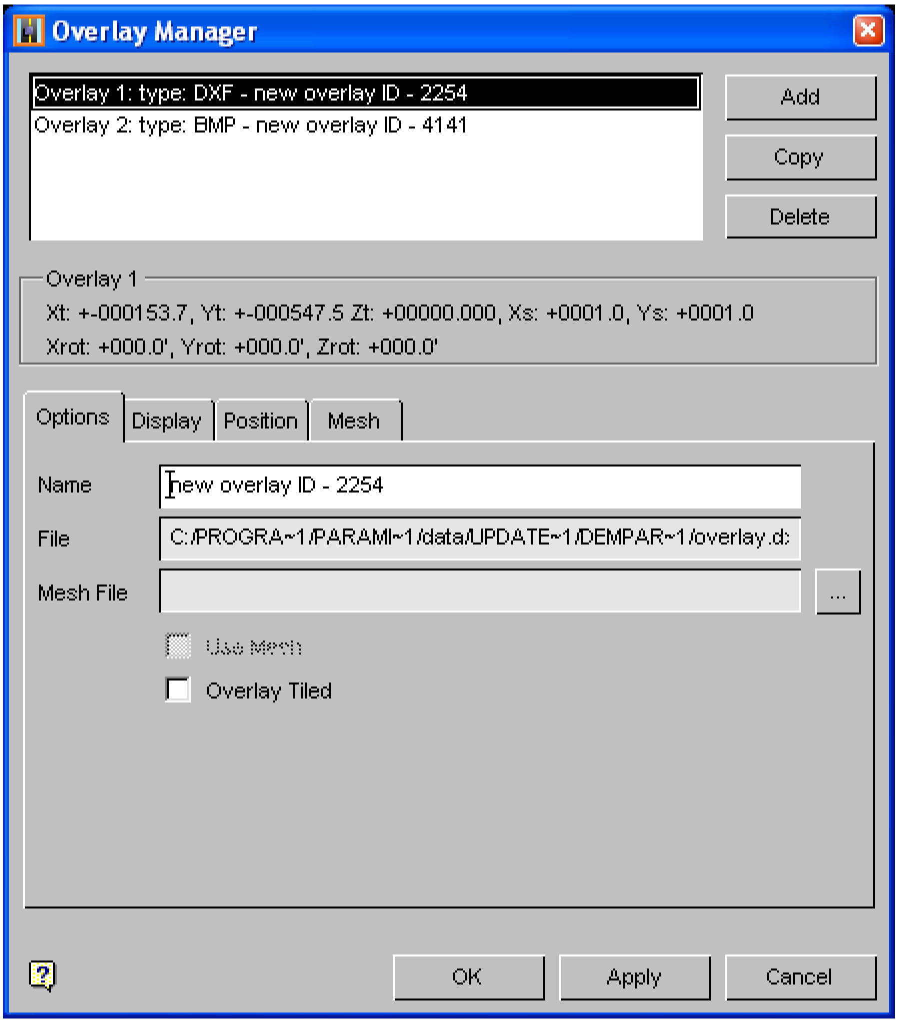
Exercise 7

Copy the file **overlay.dxf** from the media provided (either CD or Floppy Disk) into the training tutorial directory i.e. ***Training/urban***

Open the ***Training/urban*** network by clicking the Modeller icon and selecting **File>> Open** (this is the network which was created in the section Layout of Modeller Window on page 9).

Load the **overlay** file by selecting **Edit>>Overlays or** the **Overlay Manager** icon**.**

This will launch the **Overlay Manager** window that will allow you to manage your overlay(s) within a network. Click the 'Add' button to select an overly file to load for display. The file selector will be shown with the default BMP file filter, change this to dxf. To select a file you navigate to the correct directory icon the left panel and select the overlay file on the right panel. The restrictions on overlay size and dimensions for raster images introduced in V3 remain in V4.



Once the overlay is loaded you can select the entry from the list and position the associated overlay in the Paramics 3D world. The selected overlay will be highlighted in the simulation graphics window in pink. The Position tab for overlays enables the user to translate, scale and rotate the overlay in 3D.

Selecting **OK** commits your changes to file; Cancel discards any changes.

Note:- When nodes are added to the network, or existing nodes are re-positioned the overlay data may need to be reloaded and repositioned. This is due to a non-linier correlation existing between the physical position of nodes and the visual position presented in the 3D Paramics world. This process is necessary to enable 3D graphics.

To avoid this it's best to use a full **Save and Refresh** each time you add a new node to the network while you are using background overlays to aid placement.

It is recommended when coding a new network, using a background overlay, to first position all the key nodes in the network, mapping out the extents of the network before concentrating on the detail and the nodes towards the centre. This will help reduce the potential for physical/visual mismatches in the 3D coordinates.

Exercise 8

Using the **Translation**, **Scaling and Rotation** functions, found in **Edit>>Overlay>>Position**, match the overlay grids to the Modeller Simulation window grids. To help in differentiating between the overlay grid and the Modeller grid, change the colour of the Modeller grid using **Edit>>Overlays>>Options>>Colour**.

4.3 Skeleton Network Coding

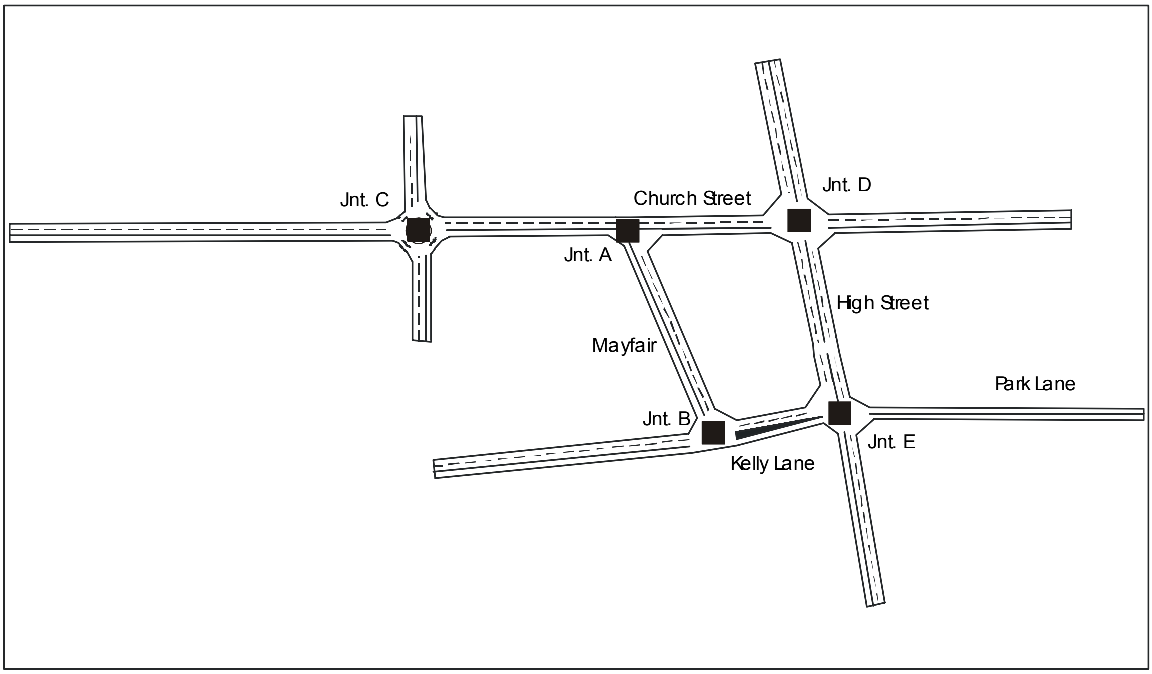
A skeleton network defines the position of the main nodes and links in the model. Before starting to code the skeleton network the user should define units and preferences (refer to Exercise 7).

Match the location of the nodes to the junctions/intersections shown in the overlay. Open the Editor Toolbar and selecting the **Node** icon then select a node by moving the mouse arrow into the Simulation window and selecting the ***middle mouse button***. The node closest to the mouse arrow position will be highlighted in purple. To move the position of the node hold down the <shift> key and press the centre mouse key at the same time.

Note:- The node position will change to the point where the mouse arrow is currently positioned. Alternatively, drag the node position by holding down the <shift> key together with the ***middle mouse button*** and moving the mouse position around the Simulation window.

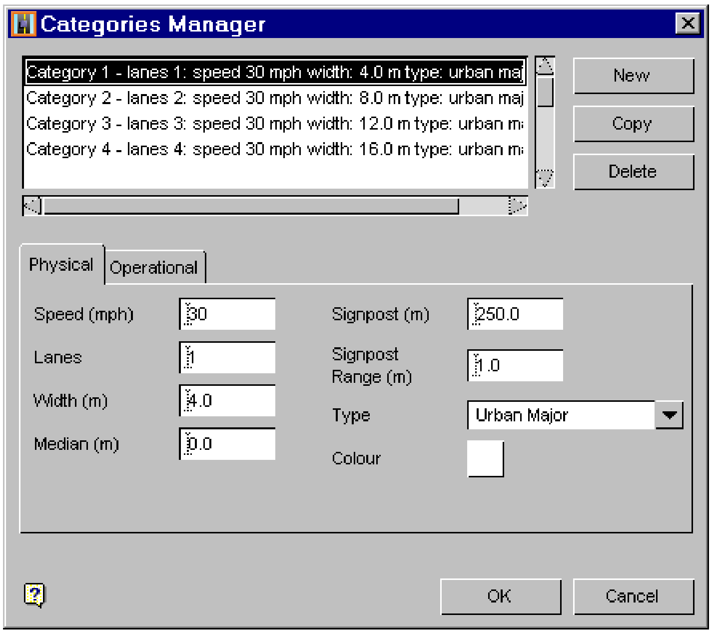
New nodes and links should be added using the methods described on page 16. Initially make all links category 1 and ensure that the node positions match the overlay junction/intersection positions. The resulting network should then be similar to the skeleton road network shown in Figure 3.

Figure 3 : Skeleton Urban Network



Once the skeleton network has been completed change the categories to match those specified in the junction/intersection sketches shown in Figure 4 to Figure 8. At this stage do not try to match the speeds and widths.

To match categories use the drop down menu bar **Edit>>Categories.**



and change the categories based on the following information:

Category	Lanes	Speed (mph)	Width (m)	Type
1	1	30.0	3.7	urban minor
2	2	30.0	7.3	urban minor
3	3	30.0	11.0	urban minor
4	4	30.0	14.0	urban minor
5	1	40.0	3.7	urban minor
6	2	40.0	7.3	urban minor
7	3	40.0	11.0	urban minor
8	4	40.0	14.0	urban minor
21	1	30.0	3.7	urban major
22	2	30.0	7.3	urban major
23	3	30.0	11.0	urban major
24	4	30.0	14.0	urban major
25	1	40.0	3.7	urban major
26	2	40.0	7.3	urban major
27	3	40.0	11.0	urban major
28	4	40.0	14.0	urban major

After all the changes have been made click the **OK** button. The changes will then be saved and reloaded within the network.

Complete the coding of the skeleton network by changing the link categories, speeds and widths to match those specified in the junction/intersection sketches shown in Figure 4 to Figure 8.

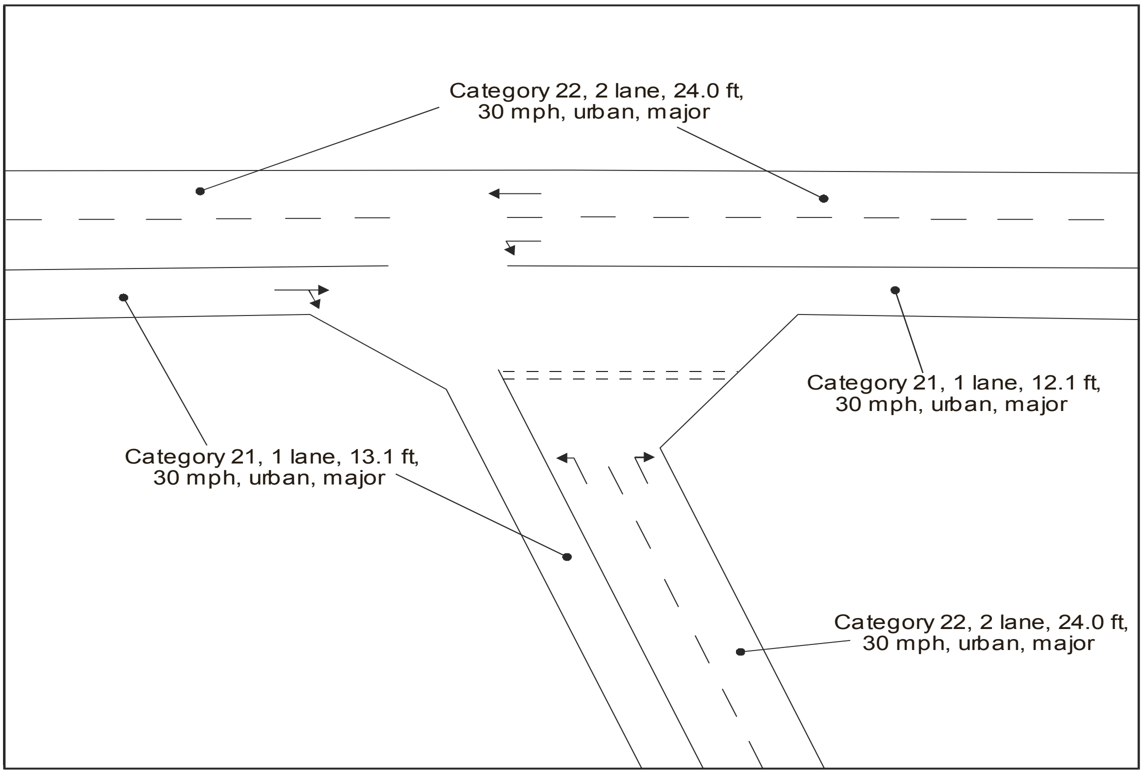
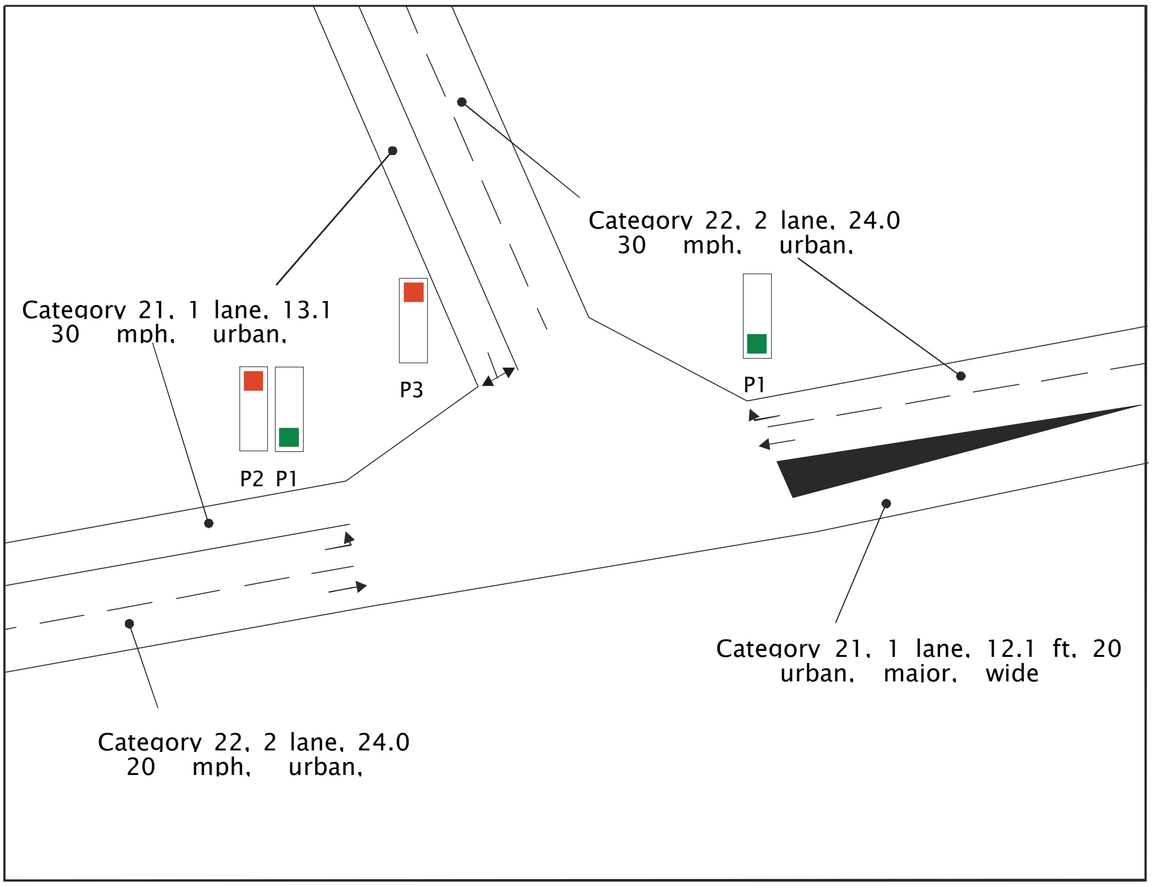


Figure 4: Junction/Intersection A – Priority Junction/Intersection



Phase Diagram

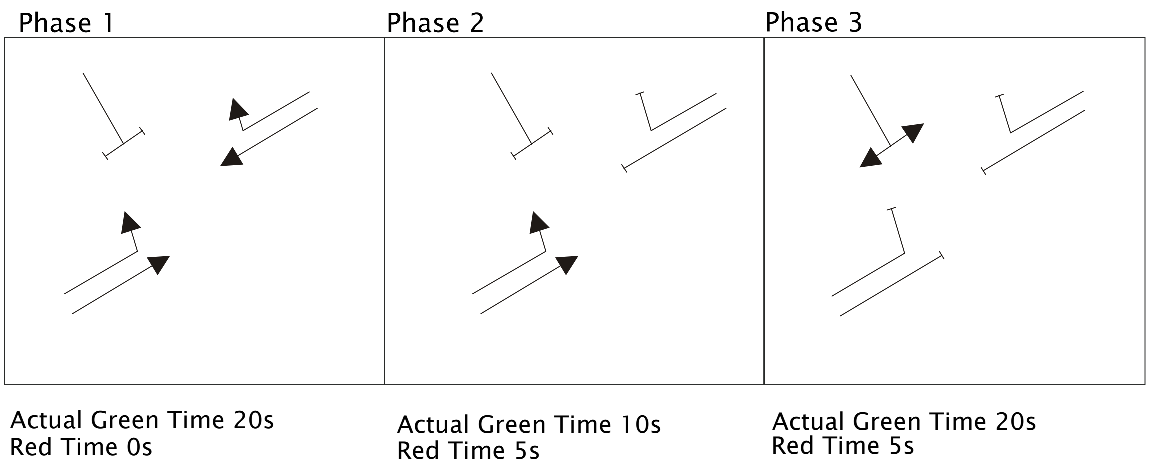


Figure 5 Junction/Intersection B – Traffic Signals

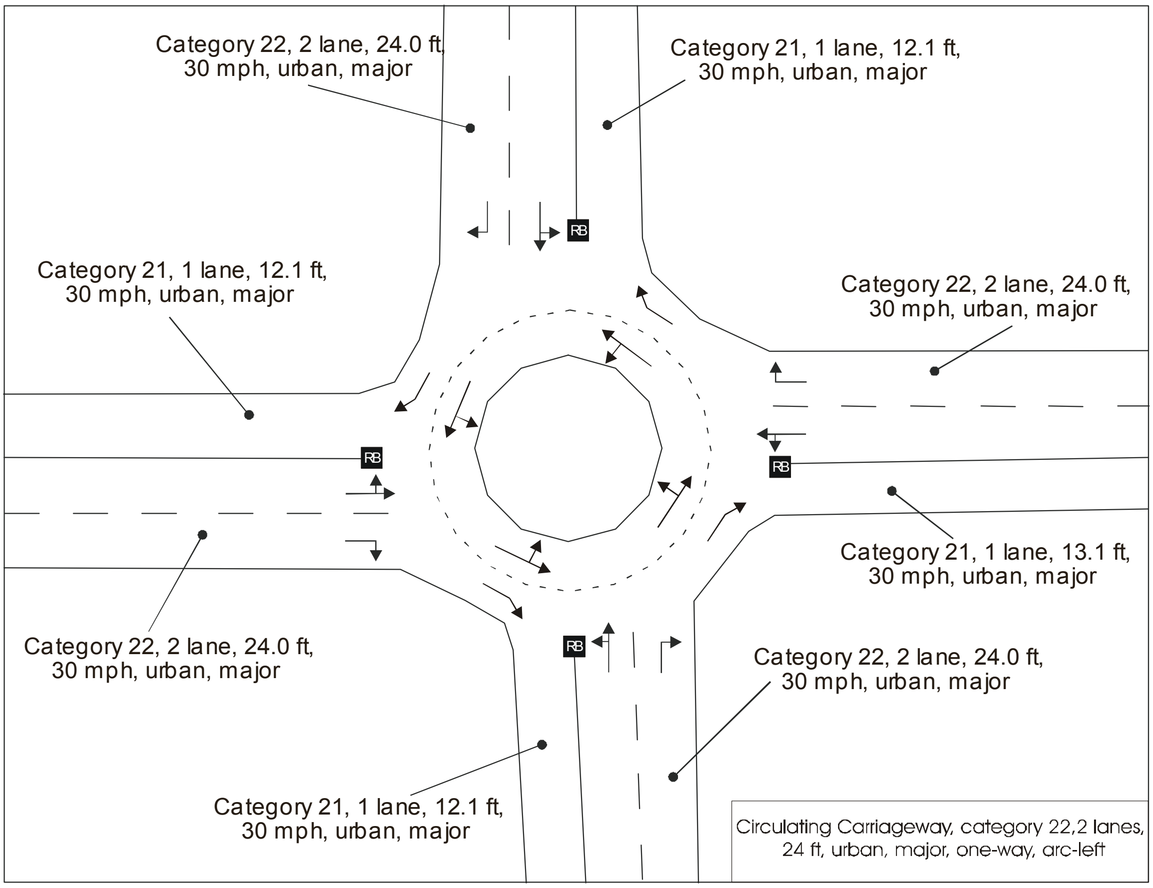
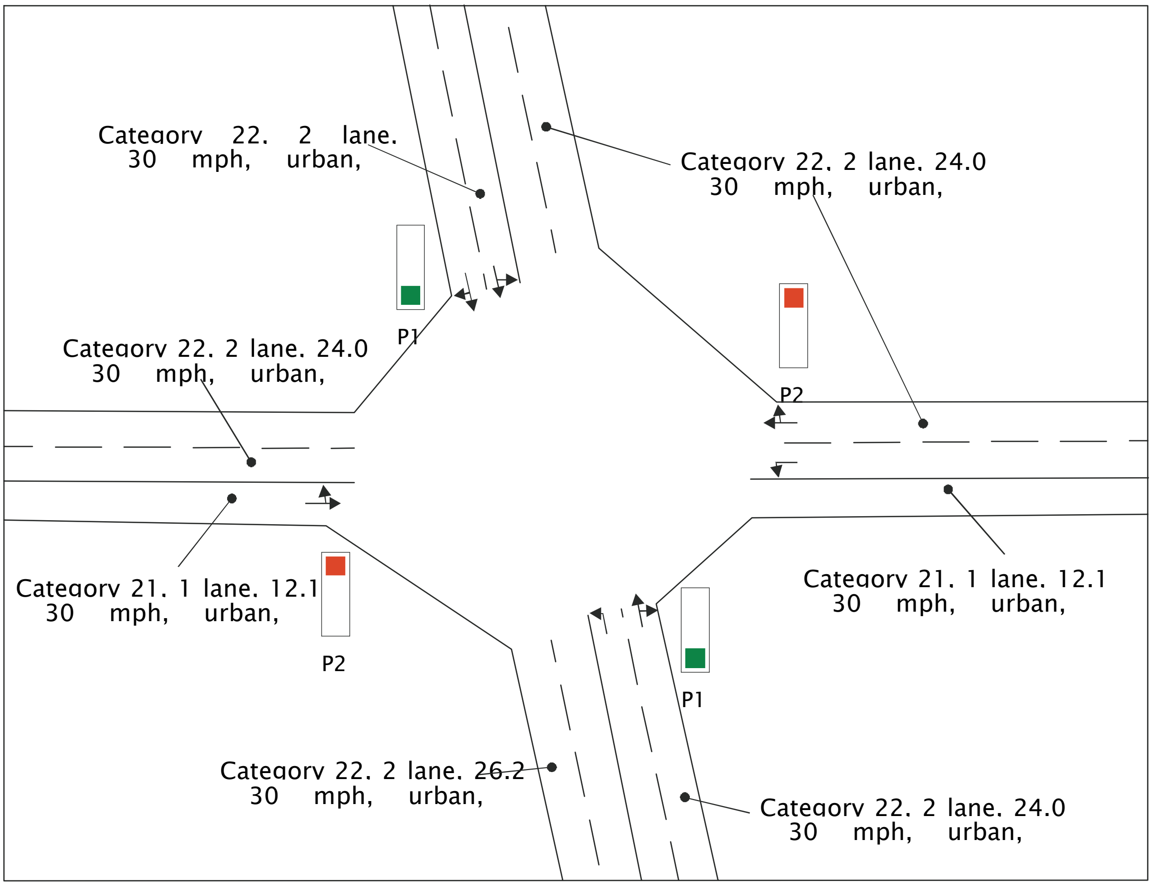
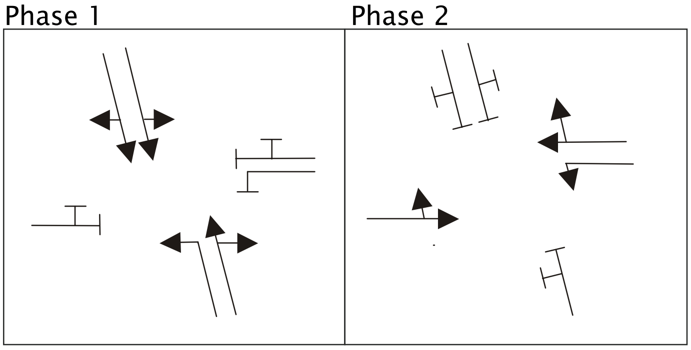


Figure 6: Junction/Intersection C – Roundabout



Phase Diagram

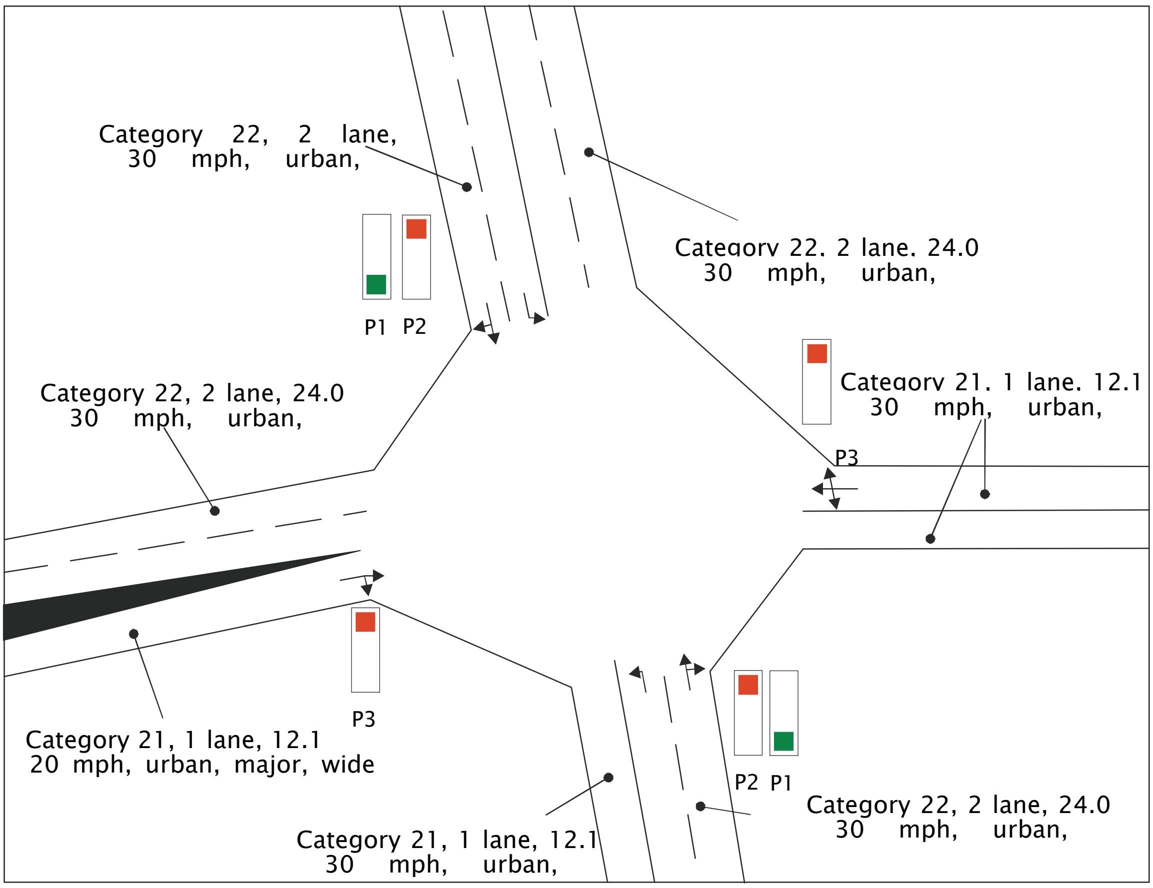
Phase 1 Phase 2



Actual Green Time 25s
Red Time 5s

Actual Green Time 15s
Red Time 5s

Figure 7: Junction/Intersection D – Traffic Signals



Phase Diagram

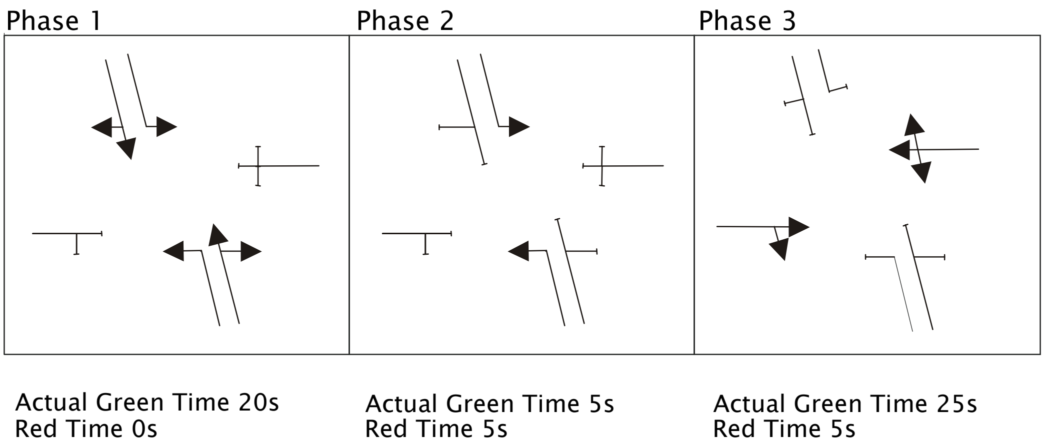


Figure 8: Junction/Intersection E – Traffic Signals

Edit the links using the **Modify Link** icon located on the Editor Toolbar. Select a link by clicking in the Simulation window with the ***middle mouse button***. For the selected link, check the coding specified in Figure 4 to Figure 8 and use the **Modify Link** function to re-code. For example, in Figure 5 Junction/Intersection B the link from the west is defined as category 21, 1 lane, 12.1 ft, 20mph, urban, major, wide start. By changing the category to 21 in the Link Attributes window, the speed is automatically changed to 30 mph. This can be reset by dragging the speed slider to 20 mph. To check the link is urban and to code a wide start select the **Flags** menu and toggle the required buttons on.

Note:- The units displayed for speed and width will be the preferred units coded within the **Configuration Manager**. Paramics converts all units to metric for internal calculation and then applies conversion factors again to convert to US Imperial measurements. The conversion of units can be subject to minimal rounding errors and will not influence the simulation to any extent.

Check the coded widths for all links on the network and correct where necessary (from the Editor Toolbar select **Link** and **Modify Link** as before).

Again, in the Editor Toolbar select **File Editor** to activate the Paramics File Editor window (See the Modeller Reference Manual page 108). Open the **links** file selecting **Network>>links**. At the top of the Paramics Editor window the full path name for the selected file is displayed e.g. C:\Program Files\Paramics\data\Training\urban\links. For some links the codes widths are different from the default category widths and these are stored as individual values in the **links** file.

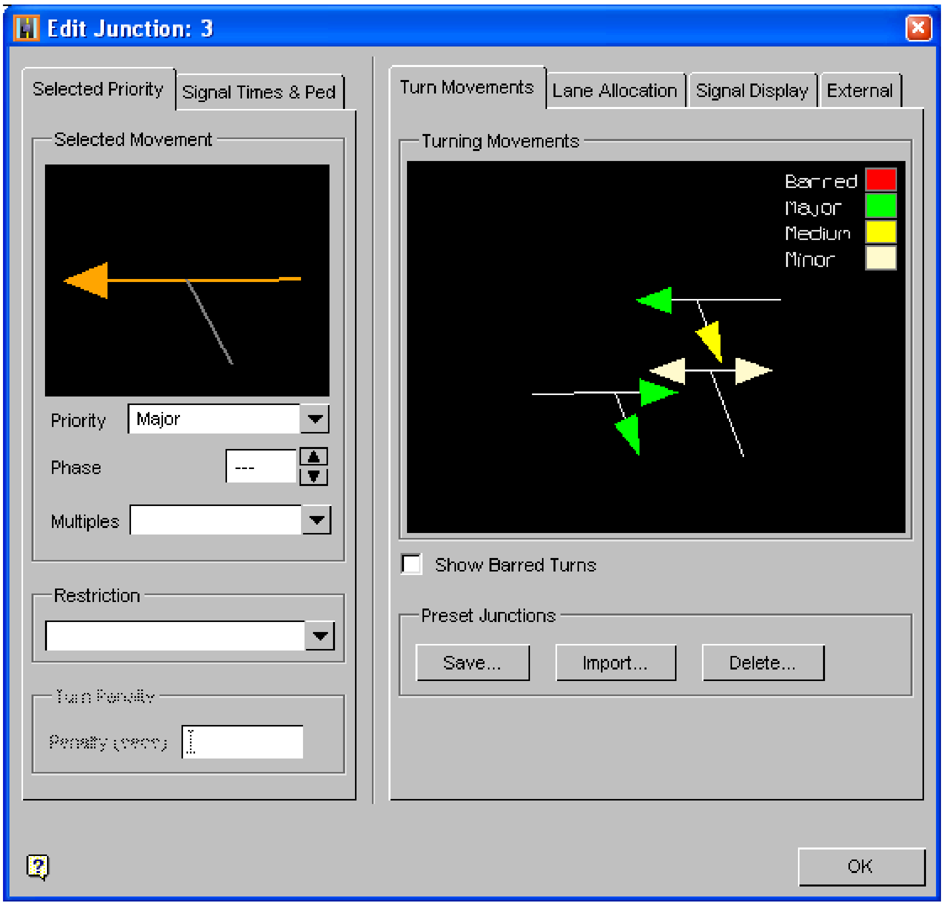
4.4 Urban Network Junction/Intersection Coding

The aim for this section of the tutorial is to code examples of priority junctions/intersections, roundabouts, and signalised junctions/intersections. Figure 4 to Figure 8 should be used as reference for lane markings, turning arrows and traffic signal plans.

4.4.1 Priority Junction/Intersection

Open the Editor Toolbar and select the node shown as Junction/Intersection A in Figure 3. Refer to the junction/intersection details shown in Figure 4.

Select **Modify Junction** to open the Edit Junction window. The Edit Junction window has five sections; Selected Priority, Signal Times, Turn Movements, Lane Allocation, and Signal Display. The Cycle and Phases sections refer to signalised junction/intersection and will be dealt with later in this tutorial.



The **Selected Priority** section contains a skeleton diagram of the priority T-junction/intersection with one movement highlighted with an orange arrow. Along the orange arrow the priority associated with that turn is displayed in the priority combo box. The priority may be MAJOR, MEDIUM, MINOR, or BARRED. To change the priority select the new priority from the combo box and click **OK**.

The display in the turn movements tab will show colour changes to the specific movement in the selected priority window (See Reference Manual page 79).

Note:- Highway links assume all priorities are major as this is one definition of Highway links.

A hierarchy of priorities exists in the order of MAJOR, MEDIUM, MINOR and BARRED. MAJOR priority movements are free flow and not restricted by other streams of traffic (including major movements). A MEDIUM priority gives way (yields) to MAJOR streams of traffic but has priority over MINOR traffic movements. MINOR priority gives way to both MAJOR and MEDIUM traffic flows while BARRED indicates the turn is banned to all vehicle movements.

Note:- Minor priority vehicles will slow down before proceeding even if no conflicting movements exist.

To select a different turning movement click with the left mouse on the approach arm of the turn required (within the diagram). Hold down the left mouse key and move within the diagram area. The turn arrow switches towards the junction/intersection arm closest to the mouse.

Exercise 9

> Edit the junction/intersection priorities so that turns from the southern arm are MINOR i.e. give-way to all traffic; the left turn from east to south is MEDIUM i.e. gives-way to oncoming traffic; and all other turns are MAJOR. **Save and Refresh** all changes.

For reference, the following figure shows the recommended priority coding for a four arm priority junction/intersection.

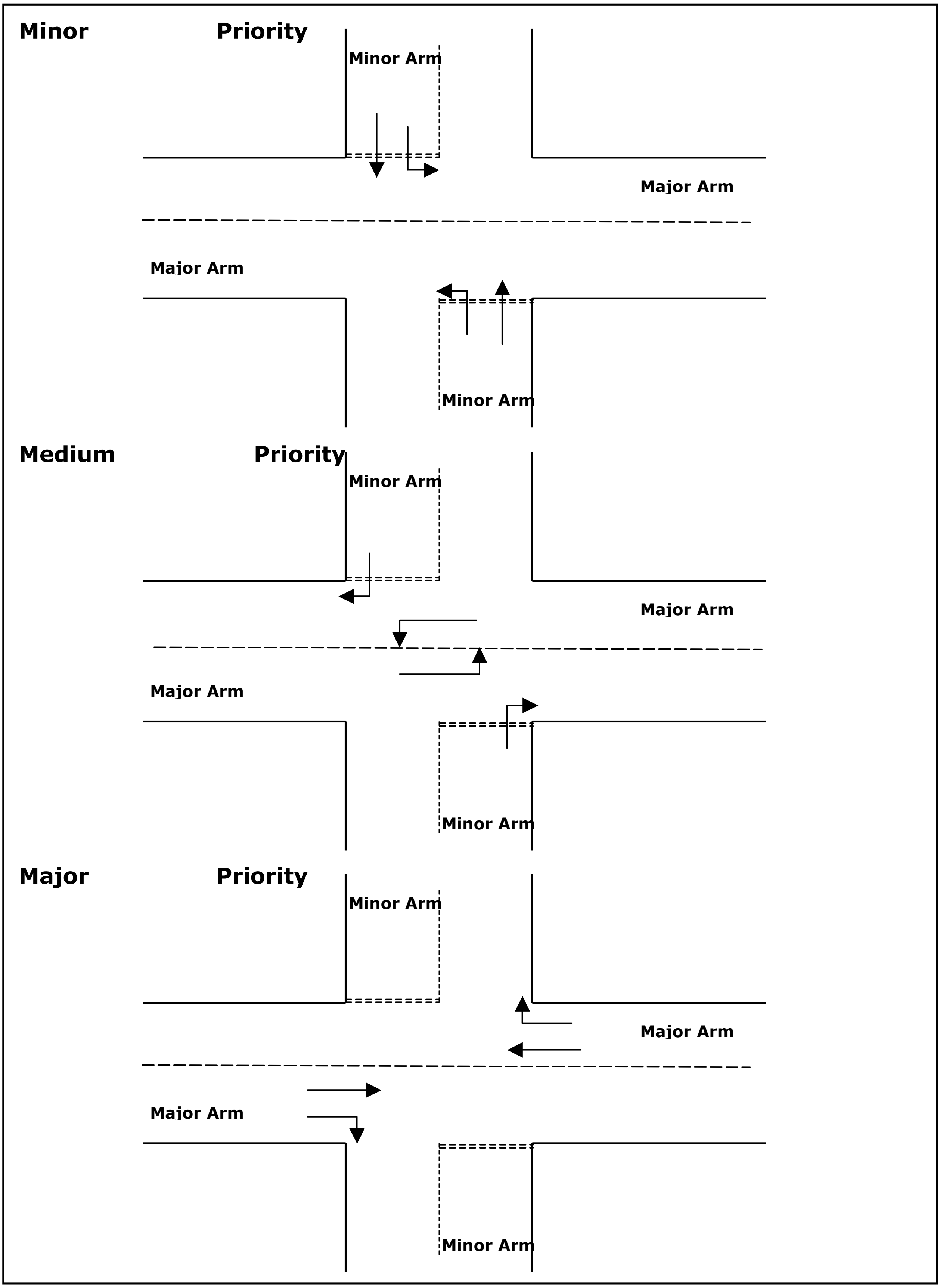
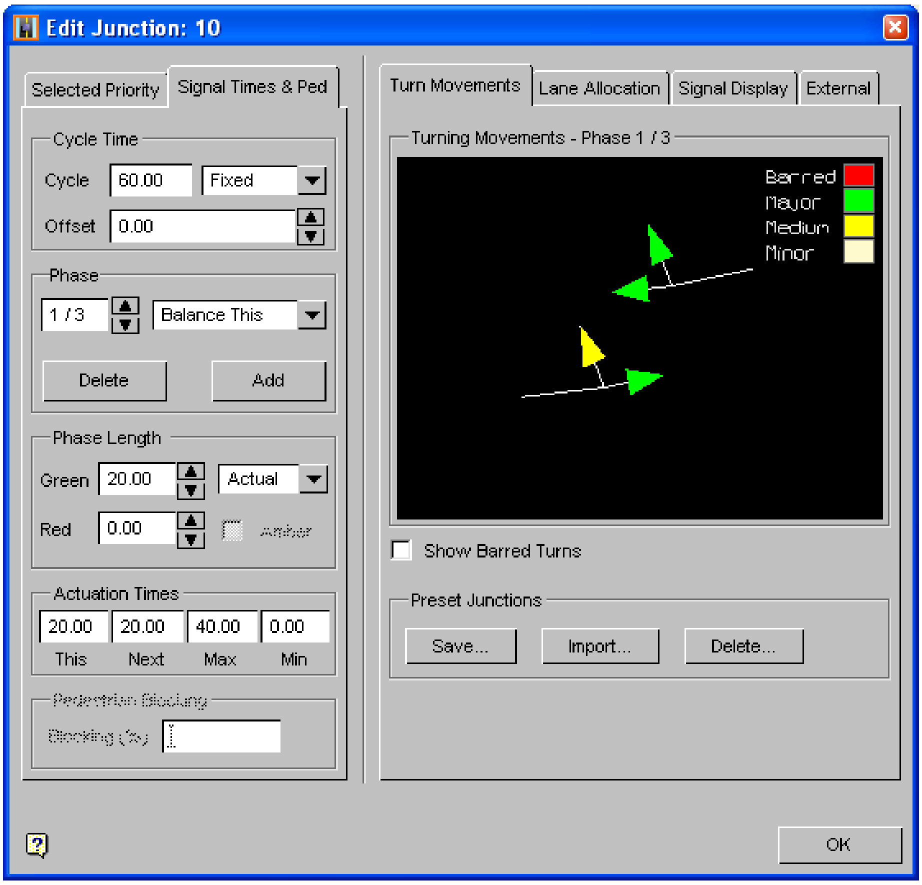


Figure 9: Priority Hierarchy

4.4.2 Traffic Signal Junction/Intersection

Select the node shown as Junction/Intersection B in Figure 3 and refer to the junction/intersection details shown in Figure 5.

Again select **Edit Node** and **Modify Junction** icon from the Editor Toolbar. In this case use the **Signal Times** tab. If a junction is a priority controlled intersection then all functions are greyed out with the exception of **Signalise**. By selecting the **Signalise** function a default signal plan appears in the Signal Display section and all functions in the **Signal Phasing/Signal Times** tab are activated.



The Signal Phasing/Signal Times can be displayed in three different ways. … The display is selected using the **View Style** combo box. Select the **Group/Fixed** display from View Style on the signal display tab.

The default signal plan shows red, green and amber/yellow rectangles to depict the red, actual green and effective green phases of the traffic signal. The dark blue box that borders one set of the green, amber/yellow and red boxes, indicates the phase times shown in the **Signal Times** tab. Select the **OK** button then click **Save and Refresh** to save the changes made to the network. Then, using the ***middle mouse button***, select the same node and **Modify Junction**. To toggle between phases click with the ***left mouse button*** on the blocks of green, amber/yellow and red.

Note:- Node descriptions in the Priority section changes to read Phase 1/2 or Phase 2/2. The green and red times in the Phase Length will also change if the two phase plans are different.

A white line is also displayed in the Signals Display parallel to the Y axis. This indicates the exact point the signal cycle plan is assumed to start. The position of this line changes as the simulation runs in accordance with the simulated time.

The **Phase Length** section of the **Signal Display** window contains functions enabling the user to modify the Green and Red time of individual phases. These values can be modified by the user using arrow buttons located next to the relevant attribute. The total time allocated to each phase and the overall cycle times remain fixed if the **Balance** is set to **This**.

For **Fixed Duration** signals, modifications made to the red and green times of the phase can to compensated for in the selected phase (**Balance – This**), in the phase adjacent to the selected phase (**Balance – Next**) or across all phases (**Balance – All**).

By default the amber/yellow time is set to 3 seconds and is automatically displayed within the **Signal Display**. This can be toggled on/off using the **Amber** check box in the **Signal Times** section. The 3 seconds is subtracted from the red time if the red phase is 3 seconds or more.

Paramics assumes that the amber/yellow time is added to the actual green time to give an effective green time. The user can choose to show the **Effective** or **Actual** green time using the combo box within the **Signal Times** window.

Note:- The 3 seconds default amber/yellow time can also be modified to represent local conditions within **Edit>>Configuration>>Options**.

Exercise 10

Change the cycle time by selecting **Cycle Variable** instead of **Cycle Fix** in the Cycle Time section.

Note the cycle time changes by increasing or decreasing the **Red** or **Green** times.

Code the traffic signal plan shown in Figure 5. Select the **Signal Display** tab, click on the first phase and then click the **Selected Priority** tab. Left click on the northern approach arm and select **Approach Barred** from the **Multiples** combo box. Continue by making the left turn from the west MEDIUM and all other turns MAJOR. Using the Turn Movements tab check that all turning movements have been allocated to the appropriate lanes (refer to Figure 5).

In the **Signal Times** tab set the phase selected to phase 1. Then in the **Cycle Time** section select Cycle Vary, toggle the Amber option off and choose Actual. Then use the arrows beside Red to reduce the red time to zero and on the Green time to set this to 20 seconds.

Repeat the process to code phase 2 and phase 3. **Save and Refresh** when all changes have been completed.

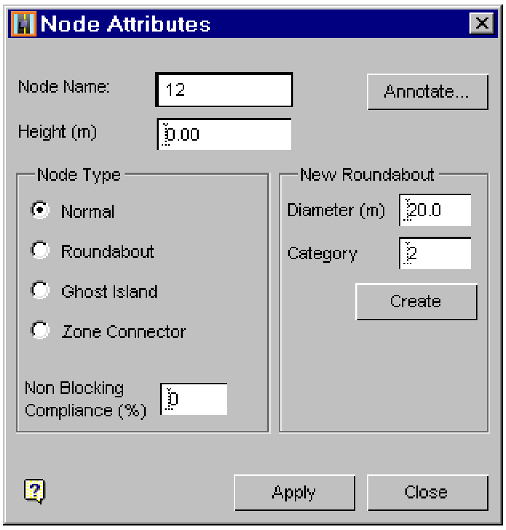
The turn lane specification defines the lanes that different streams of traffic can use on a link entering a junction/intersection. For example, if there is a junction/intersection called Node B and you want to code the lanes for a turn A to B to C, then the turning lane definition should show the lanes on link A:B which the turn A to B to C can use.

If link A:B has three lanes and only lane 2 is used for the turn A to B to C then the **Turn** text box should read "2 – 2". However if all lanes were permitted for the turn then the coding should read "1 – 3".

4.4.3 Roundabout Junction/Intersection

Select the roundabout identified in Figure 3 as Junction/Intersection C (in the Editor Toolbar use **Node** icon and click with the ***middle mouse button*** on Junction/Intersection E in the Simulation window). Refer to Figure 6 for link category details.

In the Editor Toolbar window select **Modify Node** (not **Modify Junction**), the **Node Attribute Modifier** window appears.



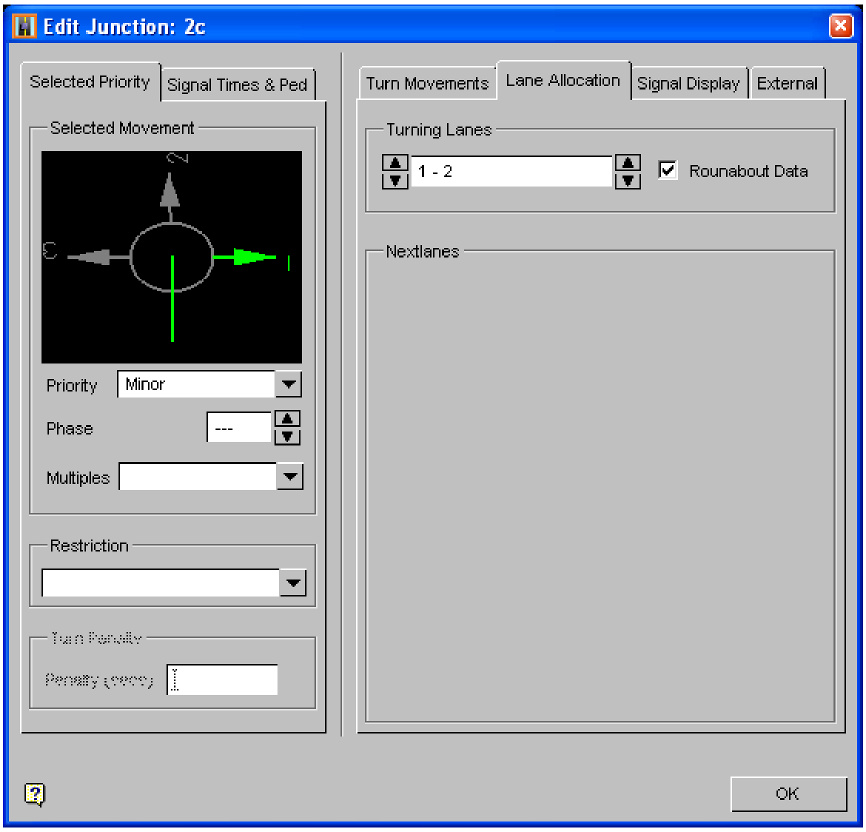
On the right hand side of this window there is a section headed New Roundabout. Click with the ***left mouse button*** in the **Diameter** box and change to 15.0 m (49.2 ft). Similarly change the **Category** to 22 and click on the **Create** function. A roundabout will appear on the screen with the single node expanded to four roundabout nodes (RB) with four roundabout sections.

The centre of the roundabout probably does not match exactly to the overlay. To change the centre of the roundabout, choose the **Edit Curves** function from the Editor Toolbar (the circle representing the centre of the roundabout is now dotted). Edit Mode in the top left hand corner of the Paramics window tells you the current curve editing mode. Select the square at the centre of the circle using the ***middle mouse button*** and change the curve editing mode until this reads Edit Mode: Fixed Radius by selecting the **change curve mode** function. Holding the <shift> key and clicking with the ***middle mouse button***, will reposition the centre of the roundabout. **Save and Refresh** the changes.

The roundabout section links are all coded as category 22. Position the roundabout nodes to match the overlay (marked as **'RB'** positions in Figure 6) using the Node function from the Editor Toolbar.

Edit the turning movements to be similar to the turn arrows shown in Figure 6. This requires the user to modify all the roundabout nodes. Select node a roundabout node and choose the **Modify Junction** icon, then select the **Selected Priority** window and **Lane Allocation** window within the Edit Node.

To switch from normal junction/intersection priority modification it is necessary to toggle **Roundabout Data** in the **Lane Allocation** window, the display window will then change to show a graphical representation of the roundabout. This allows the user to dictate roundabout turning movements for the approach link and circulating carriageway associated with this node.



The **Selected Priority** window displays the relevant approach arm in green, the user can select turning movements to the exit these wish to code by holding down the ***left mouse button*** and releasing it at the exit. The turning lanes can then be modified in the same manner as for other junction/intersection types. This must be repeated for the circulating carriageway then the process must be repeated for all roundabout nodes. After all turning movements have been coded click **OK** and **Save and Refresh**.

An important aspect of coding roundabouts in Paramics is coding approach visibility.

Exercise 11

Choose **Edit Links** from the editor toolbar an approach link, and then select **Modify Link >>Link Modifiers**. The default value for **Visibility** is 0 metres, change this value to 10 metres.

Repeat this procedure for all approaches.

Note:- this is a very important attribute when calibrating roundabouts (See Modeller Reference Manual page 86).

Exercise 12

Select and code the traffic signals shown in

Figure 7 and Figure 8 (Junctions/Intersections D and E, respectively).

4.4.4 Kerbs and Stop Lines

Kerbs and Stoplines can generally be described as 'control points' (See Modeller Reference Manual page 91).

Each link has an inside and outside kerb point at the start of the link and at the end (i.e. 4 kerb points per link, a pair of start kerb points and a pair of end kerb points). By default, locus points (or control points) are defined along a line joining each pair of kerbs so that for each lane on a link a locus point is drawn at the centre of the lane. Vehicles have to pass through these locus points as they move through a junction/intersection. For example, if locus points for the in and out links of a 90 degree turn, are very close to each other then vehicles making that turn are forced to slow considerably. It is therefore important that kerbs are positioned to reflect as accurately as possible the actual road layout.

Kerb points can be edited using the Edit Toolbar select **Edit Kerb points** icon. Each kerb is displayed as a small square with the following associated colours: outside end, white; inside end, grey; outside start, red and inside start, dark red. Specific kerbs are selected by clicking over the required kerb using the ***middle mouse button***. The entire link associated with that kerb point is highlighted in green. This is to clearly identify the kerbs associated with each link. Holding down the <shift> key and clicking with the ***middle mouse button*** repositions the selected kerb. To show that the position has changed from the default position, an **x** is marked inside the square.

In addition, individual locus points can be repositioned and edited using the **Edit Stop Line** function in the Edit Toolbar. Stop lines at the end of a link are shown as white squares while at the start of the link they are drawn as red squares. The position of the stop line may be changed in the same way as described for kerbs, above. Also, the angle of a stop line can be changed by selecting the stop line and using the **Change Stopline mode icon** to toggle between Editor: Stopline Position and Editor: Stopline Angle. Holding down the <shift> key and clicking with the ***middle mouse button*** will adjust the angle.

Note:- Ensure White and Red stoplines are placed consecutively along routes as problems occur in simulation if the same stopline type is placed in this manner.

It is also possible to create a stacking stop line for the outside lane on a link at traffic signals. This is used to simulate traffic turning left that waits in the middle of a junction/intersection before turning. In effect this stream of traffic has two stop lines, one when the vehicles have a red phase, the other during the green phase where they wait for a gap in the opposing traffic movements.

To code a stacking stop line, open the Editor Toolbar and select **Edit Stop Line** icon and select the stop line associated with an outside lane. One of the icons within the Editor Toolbar will show **Make Stacking**. By selecting **Make Stacking** the user can position the stacking stop line close to the centre of the junction/intersection.

Note:- The icon changes to read **Make Normal**. After a **Save and Refresh** select **View>>Model Layers>>Stoplines** to show the locus point positions.

Note:- that stacking stop lines are identified by a blue arrow head.

Exercise 13

Move kerbs at Junction/Intersection B to match as closely as possible the road layout shown in the overlay.

Although some repositioning of these control points can be done before starting a simulation, the detailed operation of each junction/intersection will only become clear when vehicles are loaded onto the network. It is usually best to leave most editing of control points to the calibration stage of the project development cycle.

4.5 Infrastructure

Additional information such as street names, network names etc. can be added to the model to help identify specific locations or model options.

Note:- Although this is background information and does not affect the simulation, it is extremely helpful when demonstrating the simulation and results to non technical people.

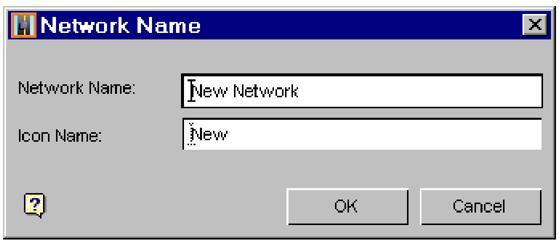
4.5.1 Annotation

The annotation tool is used to add comments and network identifiers such as titles, street names and descriptions of the model options. The following exercise describes how annotation is included in the Modeller title bar and in the Simulation window.

Exercise 14

Code annotation to change the **Network Name**, include a title for model network (underlined) and specify street names etc. Refer to Figure 3 for specific street names.

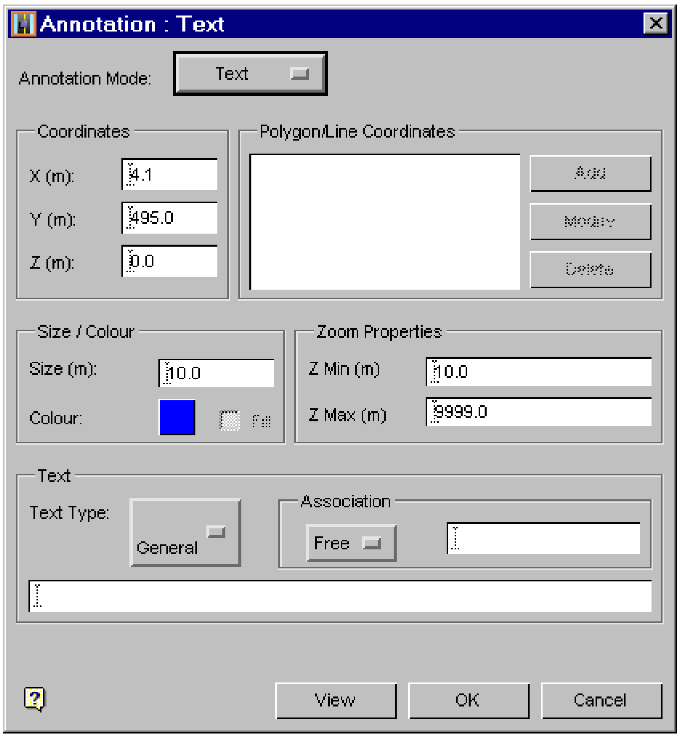
In the Network Editor Toolbar select the **Edit Annotation** icon and the two options **Add** and **Network Name** appear. Click on the **Network Name** icon so a window appears showing Network Name and Icon Name.



Change these by typing the new network and icon names in the appropriate boxes and press **OK**.

The new network name is displayed in the Title Bar at the top of the Paramics Main window. The icon name is displayed when the Modeller Main window is minimised.

When the **Add** option is selected an Annotation window appears. Three modes of annotation exist, **Text**, **Polygon/Line** and **Circle**. Using the **Text** mode, text can be typed in the box at the bottom of the Annotation window. By clicking **OK** the text is added to the Simulation window at the position shown by the x, y, z co-ordinates. The **View** button is used to show the text and the position of the text before applying the change. By zooming in and out in the Simulation window, the annotation will appear and disappear. The limits at which each part of the annotation appears and disappears is set using the **Z Min** and **Z Max** values.



The colour and type of text can also be changed by selecting the appropriate option in the Annotation window.

Note:- There are three text types, namely **General**, **City** and **Road**. The **City** and **Road** types preset the size of the text to 100 point and 10 point, respectively. With **General** text the user can set the size of the text as required.

The text annotation can also be associated to specific nodes, links or zones or can be **Free** i.e. not associated to any part of the network but only to a position in the Simulation window.

In the **Polygon/Line** mode the user can define the co-ordinates of the start and end points of the lines.

Note:- The **Add**, **Modify** and **Delete** options are activated and by default, the *blue cross hair* position is shown in the x, y, z co-ordinate boxes. By clicking **Add** the co-ordinate of the present position of the *blue cross hair* is added to the polygon description box.

In the Simulation window change the position of the *blue cross hair* by clicking the ***left mouse button*** when the mouse arrow is in the required location. The x, y, z co-ordinates in the Annotation window will automatically change. The user can add, change, and delete these co-ordinate positions as required until the polygon or line is completed.

Selecting the **Circle** mode changes the **Size** box to read **Radius**. A circle is drawn with its centre at the x, y, z co-ordinate position and radius as defined in the **Radius** box.

5 Traffic Demand I

Travel demand in Paramics is defined by a matrix of origin to destination trips, specified in the **demands** ASCII Network file. The trips are proportioned into vehicle types (defined in **Vehicles Manager**) and can be profiled by 5 minute time periods for a maximum of 24 hours (defined in the **profile** file). Trips are released from and arrive at geographical areas called zones. Alternatively, car parks can be defined as the start and end points for trips.

Fixed demands such as PT Routes can also be coded. Although these are usually assumed to start at a time specified by the route timetable, the vehicle interaction in the model will reflect the fixed route times as these vehicles interact with road traffic.

5.1 Zone Specification

As described above, zones are defined as geographical areas where trips start from and finish at. The definition and size of traffic zones is critical in determining the realism and accuracy of the traffic model.

The following exercise is used to show zone coding and the specification of link release proportions.

There are two different types of Zones within Paramics: Zone Areas and Zone Links. Zone Areas apply when **Network** is selected in the Scope Menu while Zone Links apply during Junction Analysis when **Junction** is selected in the Scope Menu.

5.1.1 Zone Areas

A Zone Area is a set of points defining the boundary of a region used for categorising origins and destinations within the model, representing the demand side of the network simulation. Each Zone has a unique ID or number and is used in association with the demands to represent the demand for travel in the simulation.

The number of points and the position of each of the points can be modified by the user using the functionality available within the Zone Editing mode of operation. The user may also modify a number of other attributes associated with the selected Zone Area.

A Zone Area is selected using the ***middle mouse button***. However, there are two selection sub-modes: single-point and all-points. A single point on the boundary can be selected by clicking near to that point. All the points defining the Zone Area can be selected by clicking near to the centroid of the Zone Area, where a label describing the Zone Area is displayed.

Exercise 15

Using the methods described on page 19, add zones and change zone boundaries to match the skeleton zone plan shown in Figure 10.

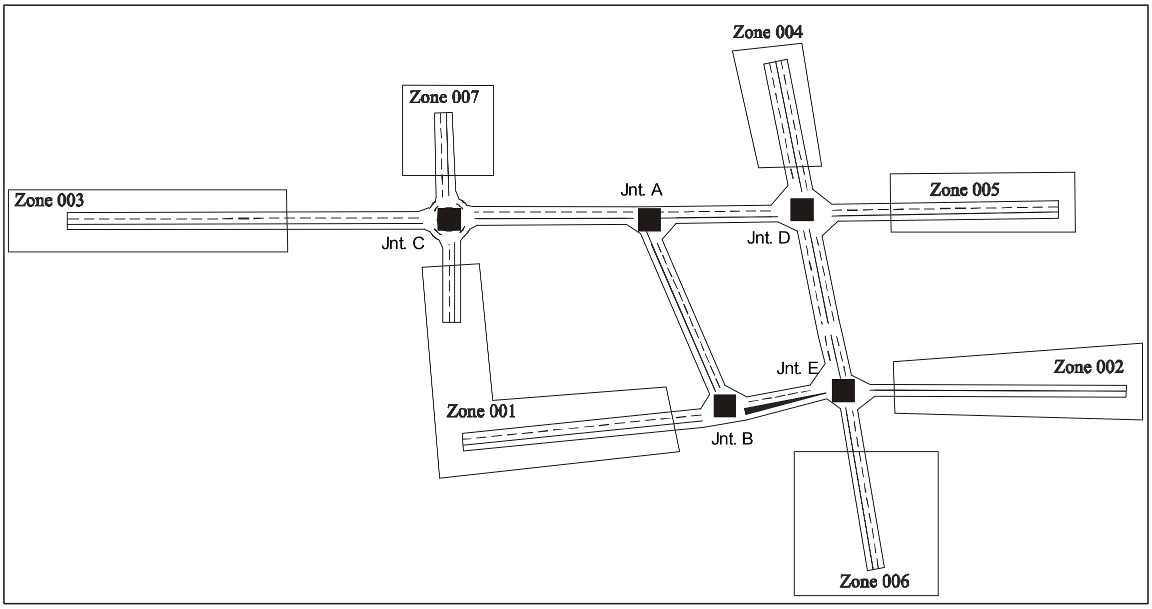


Figure 10: Skeleton Urban Network with Zones

Two links should lie inside Zone 1. In the Editor Toolbar select **Edit Links** and highlight the link which connects from Zone 1 to Junction/Intersection B. **Modify Link** and in the **Link Attributes** window select the **Link Modifiers** tab. The **Vehicle Releases(%)** box will show the percentage of trips released from Zone 1 onto the link. Now select the link northbound from Zone 1 connecting to Junction/Intersection C and note the percentage of trips released onto the link. The total percentage of trips from Zone 1 will equal 100%. Modeller automatically calculates the percentage released in proportion to the length of the links associated with a zone and the number of lanes on each link.

Edit the release rates so that 90% of Zone 1 traffic is released eastbound towards Junction/Intersection B. Do this by opening the **Link Attributes** window (as above) and entering the new percentage in the Releases Rate (%) text box. You should also click the check box to the left of the text box. This fixes the percentage to the value entered. If this toggle is not on, Modeller reverts to the default calculation of percentage released as being proportional to the link length.

The other link associated to Zone 1 will automatically change to have a 10% release, after the next **Save and Refresh**.

Note:- A link is only associated with a zone if the centre point of the link lies inside the zone boundary. If this is not the case then no vehicles will be released onto the link from the zone and a warning error will be displayed in the **Reporter** window 'No suitable links for type *VT* in Zone *OZ* to Zone *DZ* (Matrix *M*)' where VT is the vehicle type, OZ is the origin zone, DZ in the destination zone and M is the demand matrix.

By default vehicles will be randomly allocated a release link where more than one path to the destination exists. To release vehicles onto the link in the origin zone that is part of the least cost path to the destination use the **Configuration>> Options>>Release to Shortest Path** check box.

5.2 Demand Specification

The matrix of trips to and from zones is defined in the **demands** file. There are two methods of changing the demands, one by editing the **demands** file directly or two by using the Demand Editor.

To edit the **demands** file directly, open the Editor Toolbar then use **File Editor** icon in the **Network Options** Toolbar to open the Paramics Editor. In the Paramics File Editor select **Demand>>demands** then type the new values for the matrix cells to match the following. Save file, reload the changes and start the simulation.

```
demand period 1
matrix count 1
divisor 1
Matrix 1
From 1    0  200  150   50  20  100    4
from 2  350    0  100   40  50    5   42
from 3   50  100    0   50  75  150    7
from 4   50  100   10    0  20  100   21
from 5   50   50  100   50   0   50    5
from 6   50   10   70  100  50    0   10
from 7   20   20   10   30  10   20    0
```

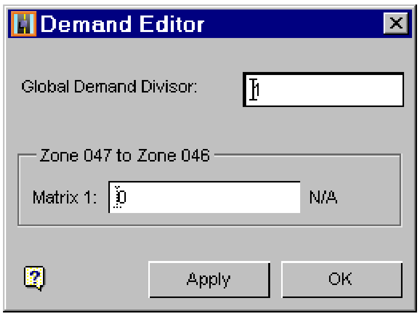
The "demand period" associates the **demands** file to a specific time of day which is defined in the **profile** file. The "matrix count" defines the number of matrices and is associated to the specification of vehicle types in the **Vehicles Manager**. The "divisor" is the value that all matrix elements are divided by while the elements (or cells) in the demand table set the number of trips between each origin and destination.

After saving the demands file and reloading, the software automatically sums the row and column totals and prints these as comments (i.e. with ## to indicate comments).

It is likely that the movement of vehicles through the junctions/Intersections is not accurate, particularly at the small roundabout. As mentioned previously, this is the stage when the positioning of kerbs, stop lines and adjustment of the network description should be considered to improve vehicle movements through these control points. These positions should be changed based on the modellers' local knowledge of the network, through site observations, and from experience of building other networks. For the purposes of this tutorial some of these control points have been adjusted and are contained in the network ***Training/dembuild1***. Load this network using the function **File>>Open** and select the network ***Training/dembuild1***.

5.2.1 Demand Editor

The second method used to adjusted the amount of demand is through the **Demand Editor** function. Open the Editor Toolbar and select the **Edit Demands** icon. In the Simulation window click with the centre mouse on a zone. The zone will be highlighted in purple and the Editor Toolbar window will display the option **Modify Demand**. By selecting **Modify Demand** the **Demand Editor** window appears to show the Global Demand Divisor and the total number of trips from the selected zone to the text box.



To change the demand level type the required value in the text box and press **Apply**.

Note:- The percentage increase or decrease in trips is shown next to the arrow display.

The above procedure changes the total number of trips from a zone (i.e. the row total in the matrix) however, individual element values and column totals can also be changed. The elements are changed using the **Edit Demands** icon and selecting the 'from' zone with the ***middle mouse button*** (as above) and the 'to' zone with the ***right mouse button***. The destination zone is highlighted in green and the Demand Editor window shows the trips for the individual matrix element i.e. from zone to zone. The number of trips is edited as described above.

For column totals (all trips destinating in a zone), the procedure is the same as for all trips originating, with the exception that only the ***right mouse button*** is used to highlight the appropriate destination zone.

Exercise 16

Use the Demand Editor to increase the flow from Zone 3 by 10% and check the increase in individual matrix element values.

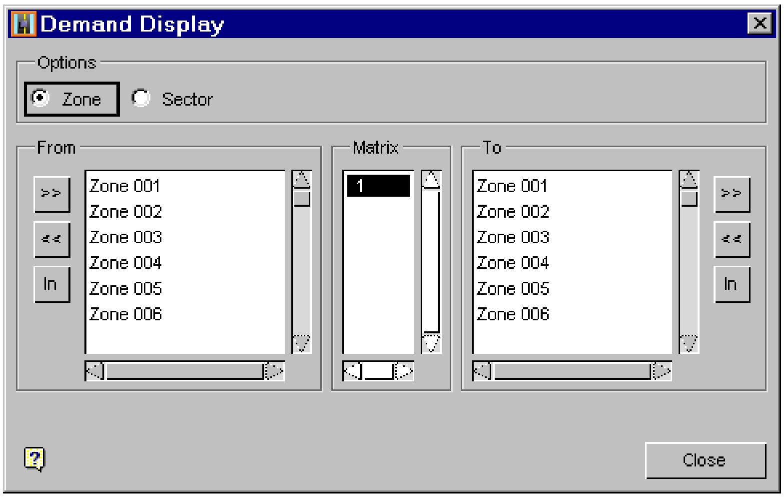
The increase in demand from Zone 3 to all individual zones will be in the region of +10% with some adjustment for rounding within the software. The global demand divisor may also be edited to produce global increases or decreases in demand.

Note:- At present the Demand Editor can only be used to change the existing coding for the demand. For example, it cannot be used to introduce another matrix of trips.

Such changes can only be done by editing the **demands** file directly. The example in Exercise 22 explains how to code more than one demand matrix.

5.2.2 Display Demands

The user can view the levels of demand by selecting **View>>Demands**. The **Demand Display** window will appear.



In the Demand Display window, click with the ***left mouse button*** on a "from" zone, a "to" zone and a matrix number. The demand level will appear as a white bandwidth with an arrow head and associated number. Any combination of from and to zones or matrices can be selected by clicking in the Demand Display window with the left mouse together with the <shift> key or <ctrl> key.

The total demand selected is displayed in the **Reporter** window, **Tools>> Reporter**.

To change the display bandwidth select **Tools>>Display Settings>> Parameters>> Demand Band Width** and drag the slider bar.

This display can be refer to as "desire lines" used to identify the level of desire to travel from origin to destination.

5.2.3 Sector Editor and Displaying Sector Demands

With traffic models that contain many zones it is sometimes necessary to group zones into sectors so that a clearer understanding of major traffic movements can be extracted. For example, Zones 1, 3 and 7 may be combined to form a sector and Zones 2 and 5 to form another section. For the tutorial network, this would give one sector to represent the east and another sector to represent the west.

Open the Editor Toolbar and select **Edit Sector**. In the Simulation window select Zone 1 by clicking over the zone with the ***middle mouse button***. The option **Create Sector** appears. By clicking with the ***left mouse button*** on **Create Sector** the Sector Editor window opens. Select **Sector Colour**, choose red then click **OK** then **Apply** within the Sector Editor window. Now holding the <ctrl> key, click with the ***middle mouse button*** over Zone 3 and Zone 7 then **Apply** then **Close**.

Repeat this process so that sector 2 is green and consists of Zones 2 and 5. Create sector 3 as white with only Zone 4 and sector 4 as blue with only Zone 6, then **Save and Refresh** these changes.

To display these sector totals, select **View>>Demands>>Options>>Sector**. Bandwidths appear in a similar fashion as the zone demand display with the exception that the sector colours are associated with each demand. Again, the bandwidths can be changed using **Tools>> Display Settings>>Parameters >>Demand Band Width**.

This sectoring and demand display option is a very useful way to check the major corridors for trip movements. For example, the tutorial network shows major east/west movements with substantial but less major flows from west to south and from north to east.

5.3 Vehicles Specification

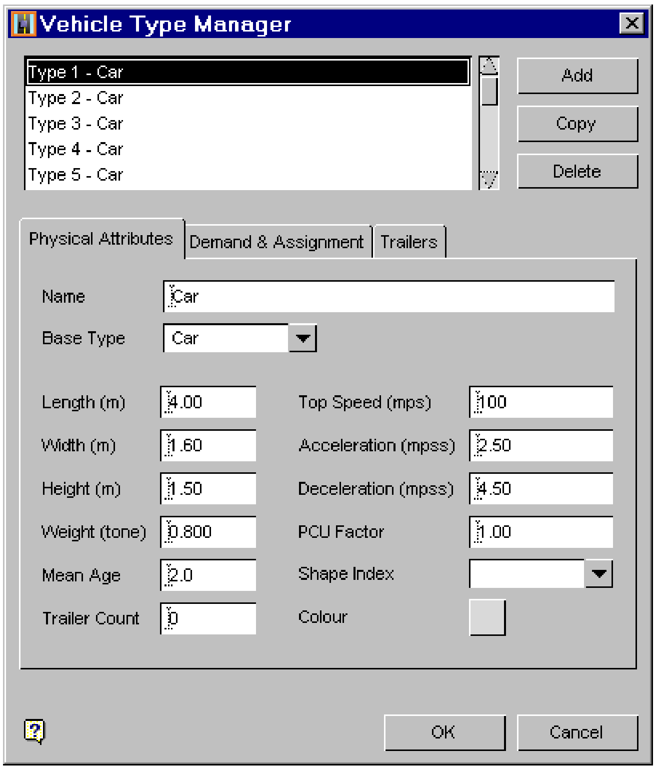
The **Vehicles Manager** defines the characteristics of each vehicle, specifies the demand matrix associated with each vehicle and describes assignment information for each vehicle type. The assignment information is explained in detail in the Traffic Assignment I section, while this section deals with the vehicle characteristics and the association between the **Vehicles Manager** and the **demands** file.

5.3.1 Vehicle Characteristics

Vehicle types may be coded either as default or as user defined vehicle types. The default types are car, lgv (light goods vehicle), ogv1 (ordinary goods vehicle class 1), ogv2 (ordinary goods vehicle class 2), coaches, or as service PT vehicles (large or minibus). Each vehicle has physical attributes associated, such as length, height, width, weight, top speed, acceleration and deceleration. For the default types these are shown in the following table.

Type	Length (m)	Height (m)	Width (m)	Weight (tonne)	Top Speed (km/h)	Maximum Acceleration (m/s^2)	Maximum Deceleration (m/s^2)
Car	4.0	1.5	1.6	0.8	158.4	2.5	4.5
Lgv	6.0	2.6	2.3	2.5	126.0	1.8	3.9
Ogv1	8.0	3.6	2.4	15.0	104.4	1.1	3.2
Ogv2	11.0	4.0	2.5	38.0	118.8	1.4	3.7
Coach	10.0	3.0	2.5	12.0	126.0	1.2	3.7
Minibus	6.0	4.0	2.5	8.0	61.2	1.1	3.2
Bus	10.0	4.0	2.5	12.0	61.2	0.9	3.2

The user can override any physical characteristic by changing the specification within drop down menu **Edit>>Vehicles**. For example, if two specific car sizes were identified with one vehicle being 4.8 m long while the other was 4.0 m long.



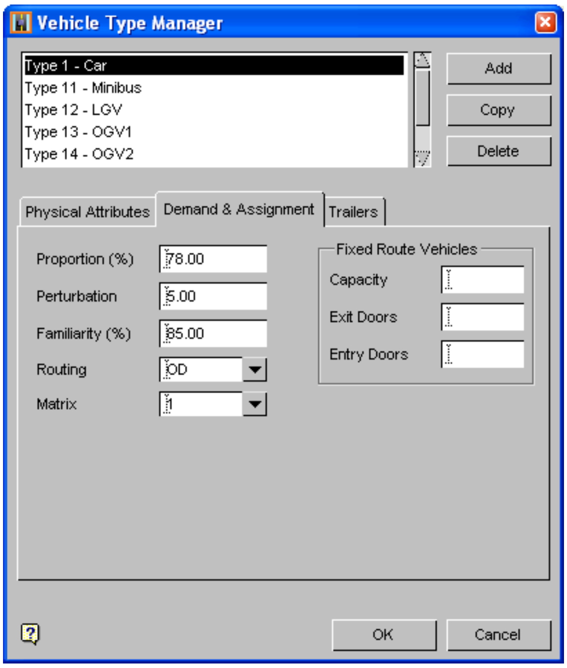
The colours associated with the default vehicle types are cars – white, lgv – green, ogv1 – blue, ogv2 – magenta, coach – pink, service PT vehicles – yellow (large) – white (minibus). These colours can be changed by including a colour specification within **Edit>>Vehicles>>Physical Attributes**.

5.3.2 Vehicle Proportions

Vehicle types are associated to each matrix in **Edit>>Vehicles>>Demand & Assignment**. If a matrix defines only one vehicle type when 100% of that matrix is allocated to the appropriate vehicle type. However, if the demand matrix is built for a combination of vehicle types, for example an all vehicle matrix, then proportions of this matrix are used to disaggregate to individual vehicle classes such as car, lgv, hgv etc..

Exercise 17

Edit the **Vehicles Manager** to divide an all vehicle matrix so that 78% are cars, 10% are lgv's, 6% are ogv1, 3% are ogv2 and the remaining 3% are coaches. Also include vehicle types for miniPT vehicles and PT vehicles. Open **Edit>>Vehicles** and to launch the **Vehicles Manager**.



The **Vehicle Type Manager** should then be modified to include the following vehicle type specification:

Type	Base Type	Proportion	Perturbation	Familiarity	Routing	Matrix
1	Car	78.0	5.0	85.0	OD	1
11	Mini Bus	-	-	-	Fixed	-
12	LGV	10.0	5.0	85.0	OD	1
13	OGV1	6.0	5.0	85.0	OD	1
14	OGV2	3.0	5.0	85.0	OD	1
15	Coach	3.0	5.0	85.0	OD	1
16	Bus	-	-	-	Fixed	-

5.4 Profile Specification

In addition to specifying the demands and vehicles files a **profile** file can be specified to change the demand at 5 minute time intervals. The **profile** file also defines the number of time periods and if required can define more than one profile (refer to multiple profiles in the Traffic Assignment II section).

To change the profile the user should open the Editor Toolbar and then select **File Editor** to open the Paramics Editor window. By choosing **Demand>>profile** a file showing the format of the **profile** file plus an example, appears as comments denoted by ## (See below).

```
## [PROFILE]
##     profile count <NUMBER>
##     <
##       profile <NUMBER>
##         <
##           period count <NUMBER>
##           divisor <NUMBER>
##           interval <NUMBER>
##         > *
##         <
##           period <NUMBER>
##             start
##             "name"
##             start
##           hour <NUMBER>
##             :
##             <NUMBER> : <NUMBER> : <NUMBER>
##           <NUMBER>
##         > +
##     > +
##
## ------ [Example(s)] -----
##
## Demand Profile
## Profile Count 2
## Profile 1
## Period Count 4
## Divisor 10
## Interval 5
## period 1 start 08:15:00
## 200  300  500
## period 2 start 08:30:00
##  80   80   80  120  120  110  110  110  100   90
## period 3 start 14:05:00
##  40   40   40   40   40   40   40   40   40   40   40   40
##  40   40   40   40   40   40   40   40   40   40   40   40
##  40
## period 4 start 16:20:00
## 600  400
##
## Profile 2
##
## 08:15:00
##  0  1000  0
## 08:30:00
##  80   80   80  120  120  110  110  110  100   90
## 14:05:00
##  40   40   40   40   40   40   40   40   40   40   40   40
##  40   40   40   40   40   40   40   40   40   40   40   40
##  40
## 16:20:00
## 600  400
```

Exercise 18

Edit the profile so the demand matrix is for the hour 8am to 9am and 14% of the demand is loaded during the first 10 minutes, 32% loaded for the next 20 minutes, then 54% during the last 30 minutes. The total percentage for each time period must equal 100%. When completed the **profile** file will be similar to the following.

```
Demand Profile
Period Count 1
Divisor 1
Interval 5

period 1 start 08:00:00
7 7 8 8 8 8 9 9 9 9 9 9
```

The start time can be at any 5 minute time step, for example, if the above profile was coded with "period 1 start 08:10:00" then 7% of the demand will load between 08:10 and 08:15 with the last 9% loading from 09:05 to 09:10.

After completing Exercises 16 to 18 there will be a new **demands**, new **vehicles** file and a **profile** file. Click the **Close** button on the Paramics File Editor to save and reload the changes to the profiles. The coded demand periods can be checked by selecting **View>>Show Periods**. The periods will be displayed in the **Reporter** window.

5.5 Fixed Demand

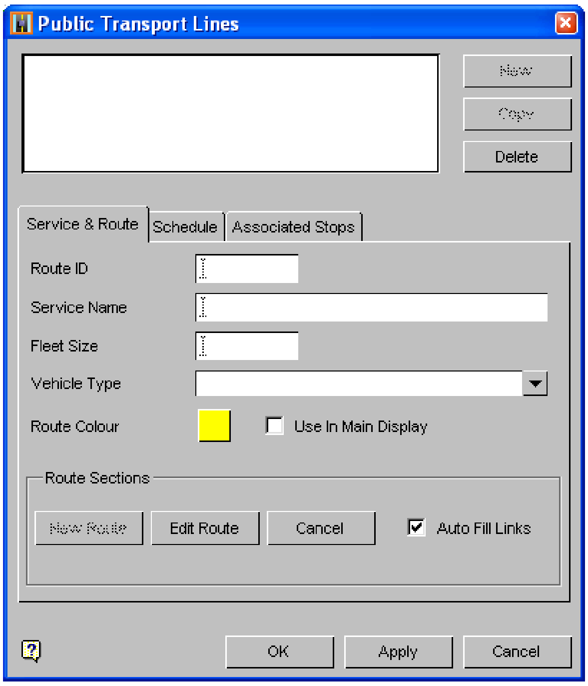
Some types of traffic moving through road networks are defined as travelling along preset routes and are not permitted to choose alternative routes. For example, service PT vehicles, LRT, trams etc. have set routes and defined points that passengers board on exit vehicles. Modeller can be used to define these set routes and the locations where passengers load/unload from the vehicles.

Although the following is referred to bus route coding it can apply to other fixed route demand types such as LRT, trams, guided PT vehicles etc.. This is possible because the specification of vehicle types in the **Vehicles Manager** allows the user to code different vehicle characteristics for trams, PT vehicles, LRT etc. although they may all be defined as fix routes. For example, if the length, acceleration, deceleration, and top speed of LRT are known, then a separate fixed route vehicle type can be defined. The actual route of the LRT vehicle would then be coded using the Bus Route Editor as described below.

Note:- The coding of articulated vehicles (e.g. LRT, trams etc.) is described in the Advanced User section of this manual.

5.5.1 PT Routes

To code PT Routes and PT Stops open the Editor Toolbar and select the **Edit PT lines** function so the Bus Route Editor appears.



In the **PT Lines Editor** there are three modes are shown, **Service & Route, Schedule and Associated Stops.** In the Simulation window click with the ***middle mouse button*** on the link which is to be the first link of the bus route. The option **New Route** will appear. By selecting **New Route** the chosen link will be shown in purple with a cyan circle at the downstream node position. Again, using the ***middle mouse button*** select the next link on the bus route. Continue adding links until the full bus route is defined.

Note:- If a link is added so that it is not on the bus route then it can deleted with the **Delete Last** button. Also, if the links are not consecutive a warning appears in the **Reporter** window.

The user must include data relating to the number, capacity and type of vehicle for each route (i.e. Route ID, Service Name, Fleet Size and Vehicle Type).

Select the **Schedule** menu. Within this menu you have 4 available functions; **New, Edit, Delete and Frequency**. Selecting **New** will launch the New Departure Time window that allows the user to specify a Start Time and an Occupancy at the start of the route. Choose at **Start Time** of 08:00 and an **Occupancy** of 10 then click **OK**.

Within Schedule the **Frequency** function allows the user to modify individual bus route timetables. Selecting **Frequency** opens the Departure Frequency window which allows the user to alter **Start Time, End Time, Release Gap** and **Occupancy**. Select a **Start Time** of 08:00, **End Time** of 09:00, **Release Gap** of 2, an **Occupancy** of 10 and select **OK**. The **Timetable** is updated based on this information. Schedules can be edited and deleted using the appropriate functions.

Although the route has been defined it is now required to specify the PT Stops associated to each bus route. To add, modify and delete PT Stops, select the **Edit PT Stops** icon and in the Simulation window select the link where the PT Stops are required by positioning the *blue cross hair* beside the required link and clicking the **Add PT Stop** icon.

Note: As a shortcut the **Editor Options** icon can be used to check the **Options>>Auto PT Stop Association** box. This will automatically associate the start and end PT stops with the routes.

Once all the PT data has been saved, each bus route then needs a starting point and an end point. The **Associated Stops** mode within the **PT Lines Editor** icon allows the user to do this. Firstly, select a bus route from the **Associated Stops** window using the ***left mouse button***, Toggle **Associate**, select the stop where the route begins and toggle **Route Start.** Repeat this process for **Route End**, **Apply** and **OK** and **Save and Refresh**.

View>>PT Lines is used to select a bus route and identify the associated PT Stops. The selected route will be highlighted and any PT Stop attached to the route will be drawn with a blue box round them.

A network with five PT Routes has been coded and is contained in the directory ***Training/demfix1***. Open this network using **File>> Open** and view the routes using **View>>PT Lines**.

5.6 Run Initialisation

The network and demand are now in place. Start the simulation using either the **Start** simulation function key or the spacebar, as described on page 19.

Note:- The simulation starts at 00:00:00 hrs (refer to simulation clock) and no vehicles appear on the network except for the fix bus demand.

The **Configuration Manager** sets up a list of initialisation parameters used to control a simulation run. Edit the **Configuration Manager**, within the **Edit** dropdown menu select **Configuration>>Base Parameters**. Change the start time to match the following, Then **Apply** and **OK**.

Start Time	Duration	Seed
08:00:00	01:00:00	1.0

The simulation clock should now be set to start at 8 o'clock. Start the simulation and vehicles should now appear on the network.

Note:- The simulation start time can be set to any time, for any day of the week (code time in seconds).

5.7 Additional Exercises

To check vehicle characteristics click in the Simulation window with the ***right mouse button*** over a vehicle and select **vehicle properties**. To ensure that right mouse buttons are available close the editor and check that **Tools>> Option>>Right Mouse Menus** is checked and that **Tools>>Display Settings >>Graphics Settings** is unchecked

The Status Report window will show information similar to the following:

```
Typ Age Len(m) Hgt(m) Wgt(tonne) Wid(m) Top(mph) Acc(mpss) Dec(mpss) Biz Com Lez
  2  3    4.0    1.5      0.8      1.6     98.4      2.5       4.5     0   1   0
Agg Awa   Trip   (Vehicle) Time Stop   Dist(m) Speed(mph) (previous)
 5   2     1-6   (  1-6  )  42  0L  0T  13.08    0.35     (0.28 0.20 0.10)
Lane Lo-Hi Nxt LSec NxO NNO exI Tab Pert Event ATT Tr  Pa  Prt Mat DemP FamP
  1   1- 1   1   0   2   1   8   2    0    0    0   4  31  5.0  0    2.2 85.0
amb stp acc brk wL wR sL mL mR rSt nSt eSt oNo nwT nwV tbk ltI hrd rrt dvt dsP fml dly
                    1  1       1   1   1
```

The first six lines of data give information on the vehicle characteristics, the behaviour, lane allocation and routing of trips. The last two lines are of more interest to programmers concerned with the internal workings of Modeller.

Lines 1 and 2 show the coded characteristics of the selected vehicle, including age. The user can code the mean age of a vehicle type, the actual age of each vehicle being randomly distributed around this mean value. Age is used in the current gradient model to reflect that older HGV's have poorer climbing ability. Biz, Com and Lez are flags that are not used in the standard version of Modeller.

The first four lines of data are self explanatory while Appendix A describes the headings for the last four lines of vehicle parameters.

Exercise 19

> Change the colour of category 21 in the **Categories Manager**. to green.

Do this by opening the drop down menu **Edit>>Categories** and use the **colour** function to change the category colour.

The right hand mouse button can be used to initialise several short cuts to link, node, zone and vehicle functions. It is recommended that these be used when more experience has been gained with Modeller.

Save and Refresh the network. To display the new link colour use dropdown menu **View>>Links>>Category**. This is a useful way to quickly see the category associated with specific links.

Exercise 20

> Show the route or path of vehicles from Zone 1 to Zone 2.

Use the ***right mouse button*** to select outgoing link (West to East) from Zone 1. Next also use the ***right mouse button*** to select Zone 2. Then open **View>>Routes** menu and click to show the routes from Zone 1 to Zone 2. A blue band is displayed in the Simulation window.

Repeat the **View>>Routes** selection to show the paths between different origins and destinations.

Note:- The cost and distances are shown in the **Reporter** window.

Then using the **Edit>>Markings** function, mark all vehicles from Zone 1 to show their routes through the network

Exercise 21

> Renumber the zones so that Zone 2 is now Zone 57, and Zone 5 becomes Zone 30.

To complete this exercise you need to change two files, the **zones** file and the **demands** file. Edit the **zones** file (using the Editor Toolbar select the **File Editor** then **>>Demand>> zones**) to include a lookup table that defines the new names for Zones 2 and 5. Refer to the following example.

```
Zone Count 7

lookup
2 57
5 30

zone 1 6
-1594 ft 651 ft
-1631 ft 1096 ft
-1510 ft 1104 ft
-1481 ft 815 ft
-1116 ft 844 ft
-1088 ft 708 ft
max –1088 ft 1104 ft
min –1631 ft 651 ft
centroid –1403 ft 870 ft

zone 57 4
-633 ft 788 ft
-636 ft 879 ft
-110 ft 936 ft
-110 ft 774 ft
max –110 ft 936 ft
min –636 ft 897 ft
centroid –372 ft 849 ft

etc . . . . . .
```

The zone names should also be changed in the **demands** file so they match the specification in the **zones** file. For example:

```
demand period 1
matrix count 1
divisor 1
Matrix 1
From  1    0  200  150   50  20  100    4
from 57  350    0  100   40  50    5   42
from  3   57  110    0   55  82  165    7
from  4   50  100   10    0  20  100   21
from 30   50   50  100   50   0   50    5
from  6   50   10   70  100  50    0   10
from  7   20   20   10   30  10   20    0
```

After saving and reloading the changed files, the **View>>Model Layers>>Zone Boundaries** menu option can be used to display the new zone names. The Status Report window will show warnings that Zone 2 and Zone 5 are ignored in the **sectors** file. To complete the exercise edit the **sectors** file so that sector 2 includes the new zones names 57 and 30

Exercise 22

> Produce separate demand matrices for cars, lgvs and hgvs for 7-8 am and for 8-9 am.

Firstly revert to the original zone names i.e. remove the references to Zones 57 and 30 from the **zones** file and from the **sectors** file.

The above exercise requires two separate demand files (one for 7-8 am, the other 8-9 am), each with three matrices (matrix 1 for cars, matrix 2 for lgv's and matrix 3 for hgv's). From the Editor Toolbar, open the File Editor window. At the top of this window there is a narrow band text field. Click with the ***left mouse button*** inside this field so that text box is selected and type the filename **demands.1** in this box. After pressing **<Enter>** the Status Report window indicates that a new file has been opened called **demands.1**. Edit this file to match the example shown below and **Close** then reload the network.

demands.1 file

```
demand period 1
matrix count 3
divisor 1.0000

matrix 1
from 1   0 143 113  45  16  83   2
from 2 195   0  31  18  18   0  20
from 3  45  70   0  36  70 133   5
from 4  45  85   9   0  14  77  18
from 5  45  40  98  40   0  47   5
from 6  45   8  55  88  42   0   8
from 7  17  15  10  25  10  16   0
```

```
matrix 2
from 1   0  40  25   0   2  12   0
from 2  14   0  18   2   7   0   0
from 3   2  20   0  10   5  11   1
from 4   3  10   1   0   4  13   2
from 5   3   5   1  10   0   0   0
from 6   3   1  10  10   6   0   0
from 7   3   2   0   3   0   4   0

matrix 3
from 1   0  10   5   2   1   0   1
from 2   6   0   7   0   0   0   0
from 3   3  10   0  10   0   6   1
from 4   2   5   0   0   2  10   1
from 5   2   5   1   0   0   3   0
from 6   2   1   5   2   2   0   2
from 7   2   3   0   2   0   0   0
```

The text box mentioned above, may be used to enter the filename for any file the user wishes to edit. Repeat the above procedure to produce a **demands.2** file that matches the following specification.

demands.2 file

```
demand period 2
matrix count 3
divisor 1.0000

matrix 1
from 1   0 150 120  48  17  88   3
from 2 295   0  53  30  33   2  35
from 3  45  70   0  36  70 133   5
from 4  45  85   9   0  14  77  18
from 5  50  40  97  39   0  46   4
from 6  45   8  55  88  42   0   8
from 7  17  15  10  25  10  16   0
matrix 2
from 1   0  40  25   0   2  12   0
from 2  15   0  30   4  12   1   2
from 3   2  20   0  10   5  11   1
from 4   3  10   1   0   4  13   2
from 5   3   5   1  10   0   0   0
from 6   3   1  10  10   6   0   0
from 7   3   2   0   3   0   4   0
matrix 3
from 1   0  10   5   2   1   0   1
from 2   5   0  10   1   1   0   0
from 3   3  10   0  10   0   6   1
from 4   2   5   0   0   2  10   1
from 5   2   5   1   0   0   3   0
from 6   2   1   5   2   2   0   2
from 7   2   3   0   2   0   0   0
```

The next step is to edit the vehicle categories so that the different vehicle types use the correct matrix. This can be undertaken using the GUI, **Edit>>Vehicles**.

Type	Base Type	Proportion	Perturbation	Familiarity	Routing	Matrix
1	Car	100.0	5.0	85.0	OD	1
11	Mini Bus	-	-	-	Fixed	-
12	LGV	100.0	5.0	85.0	OD	2
13	OGV1	48.0	5.0	85.0	OD	3
14	OGV2	48.0	5.0	85.0	OD	3
15	Coach	4.0	5.0	85.0	OD	3
16	Bus	-	-	-	Fixed	-

Finally, edit the **profile** file so that there are two periods, the first from 7-8, and the second from 8-9. Edit the **profile** file, save it then reload the simulation network.

profile file

```
Demand Profile
Period Count 2
Divisor 1
Interval 5

period 1 start 07:00:00
6  6  6  6  6  6 10 10 10 10 10 14
period 2 start 08:00:00
7  7  8  8  8  8  9  9  9  9  9  9
```

Paramics recognises that there are two demand periods and associated with each period there is a demands file (i.e. **demands.1** for time period 1 and **demands.2** for time period 2). To check, the user should open the Editor Toolbar and select the **Editor Options** icon. The Demands function toggle should automatically be set to the on position.

Change the **Configuration Manager** to start at 7 am and increase the simulation time to two hours, then start the simulation. As the simulation runs past 08:00 hrs the Status Report window indicates that the simulation has switched to the second time period.

6 Traffic Assignment I

6.1 Introduction

Traffic assignment in Paramics applies to all vehicle types except fixed route vehicles. The travel cost for each vehicle to reach its' destination, is calculated at defined time steps (default is one calculation per vehicle every half second). The costs of alternative routes are compared and the best route is taken as the route with lowest or least cost.

The **View>>Routes** and **Edit>>Marking** functions, as described in Exercise 21 are useful methods of checking the routing options. In addition **View>>Context Layers>>Hot Spots** may be used to highlight areas where congestion or major delay is occurring in the network. Once the problems are identified then the traffic assignment model may require adjustment to more accurately reflect actual traffic movements.

In Modeller, route choice flexibility can be achieved by changing:

- network coding e.g. link cost factors, sign posted routes, lane and turn restrictions
- model parameters e.g. generalised cost coefficients, % of familiar drivers, default car park origins/destinations
- assignment methods e.g. Stochastic, dynamic feedback, all-or-nothing.

6.2 Network Coding

For convenience, some network coding issues are described in later sections. For example, route sign posting is detailed in section Sign Posting, on page 83, and the effect of network restrictions in the Network Restrictions section, on page 79. The following describes the use of link and category cost factors.

6.2.1 Cost Factors

Cost factors are multiplication factors that are applied to particular road categories or to individual links in the network.

6.2.2 Category Cost Factors.

The category to which cost factors are to be applied is selected using **Edit>>Categories>>Operational**. The default link cost, calculated as the time taken to travel along the link at free-flow speeds, is multiplied by the cost factor. These factored costs are then used in the routing cost calculations.

For example, roads through residential areas may be a less attractive alternative to district or principle roads. Although these types of road may all have the same speed limit, the user can attach a cost factor to the residential links to change the calculated cost of the residential route.

If a cost factor is associated to a category, all links with that coded category are affected.

Note:- Category cost factors are only seen by unfamiliar vehicles unless the **Assignment>>Category Cost Factor Visible to All** is checked in the Configuration Manager (**Edit>>Confioguration**)

6.2.3 Link Cost Factors

The link to which cost factors are to be applied is selected using **Edit Links>>Modify Link>>Link Attributes**. The default link cost, calculated as the time taken to travel along the link at free-flow speeds, is multiplied by the cost factor. These factored costs are then used in the routing cost calculations.

For example, roads through residential areas may be a less attractive alternative to district or principle roads. Although these types of road may all have the same speed limit, the user can attach a cost factor to the residential links to change the calculated cost of the residential route.

If a cost factor is associated to a category, all links with that coded category are affected.

Note:- Link cost factors are seen by both familiar and unfamiliar vehicles.

For more information regarding cost factors together with explanations of familiar/unfamiliar drivers and major / minor links, refer to the Modeller Reference Manual.

6.3 Model Parameters

A number of model input parameters may be changed to affect model calibration. Most of these parameters are contained in an initialisation menu called **Configuration Manager (Edit>>Configuration).**

Some parameters relate to the behaviour of the vehicles while others such as feedback, perturbation and generalised cost, relate to the route choice model. Changes to generalised cost coefficients are explained in this section while following the sections deal with perturbation and feedback.

6.3.1 Generalised Cost Coefficients

The travel costs, referred to in the above paragraphs, represent a combination of factors that drivers take into account when choosing routes. The most important of these factors are time and distance. Where tolls are charged for the use of specific sections of road, these costs should also be included to allow for drivers' willingness to pay.

In Paramics the base cost for links is calculated using the following generalised cost equation:

$$\text{Cost} = a*T + b*D + c*P$$

where:

a is time coefficient in minutes per minute (default 1.0)
b is distance coefficient in minutes per kilometre (default 0.0)
c is toll coefficient in minutes per monetary cost (default 0.0)
T is free-flow travel time in minutes
D is the length of the link in kilometres
P is the price of the toll in monetary cost units

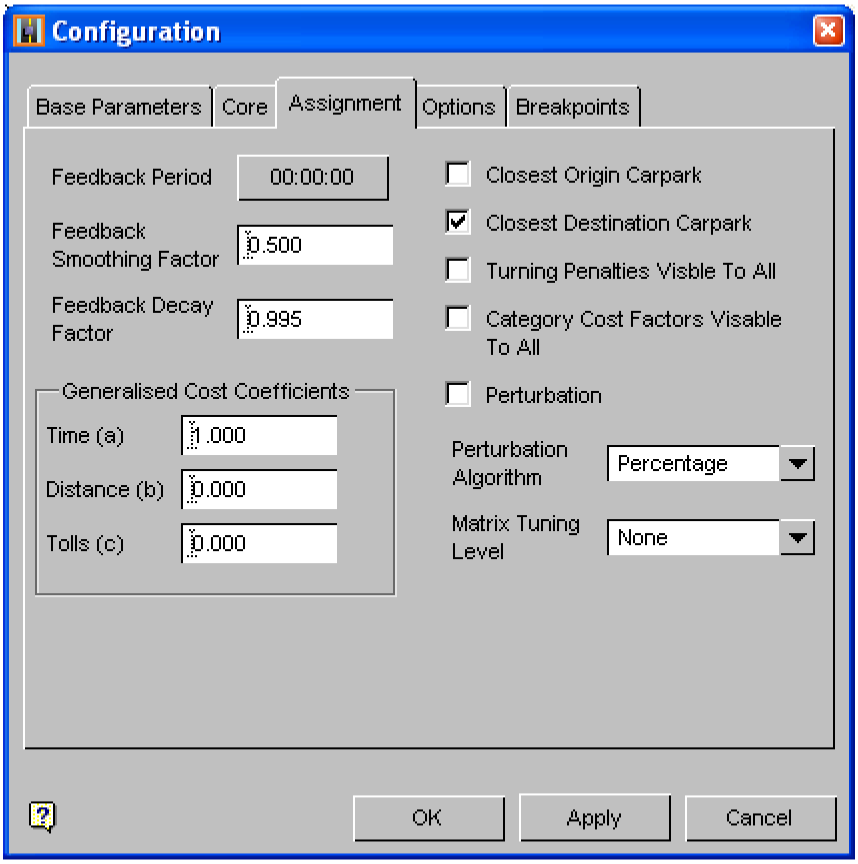
The monetary cost can be in any unit provided it is consistent with the unit used in the **Categories Manager**. For US mode the distance coefficient is in minutes per mile.

The above equation controls the representation of perceived cost by weighting time, distance and toll pricing. The coefficients for time, distance and toll price are changed using the **Configuration Manager**.

Exercise 23

Change the generalised cost coefficients from default (pure time) to pure distance i.e. for the above equation a = 0.0, b = 1.0 and c = 0.0.

Select **Edit>>Configuration>>Assignment** menu and edit the configuration to include the cost coefficients as detailed above. Click **Apply** and **OK**.



For a small network, like the tutorial network, there may be no significant re-routing effects. However, on larger network the route changes are likely to be more marked.

Note:- An additional more detailed exercise on Generalised Cost Coefficients can be found on page 112.

6.4 Assignment Methods

The assignment model predicts the routes drivers will choose between an origin and a destination. The three main assignment techniques used in Paramics are "all-or-nothing" assignment, stochastic assignment and dynamic feedback assignment.

"All-or-nothing" assignment assumes that all drivers travelling between two zones choose the same route and that link costs do not depend on flow levels.

Stochastic assignment methods try to account for variability in travel costs (or drivers perception of those costs). These methods assume that the perceived cost of travel on each network link varies randomly, within predefined limits.

Dynamic feedback assignment assumes that drivers who are familiar with the road network will re-route if information on the present state of traffic conditions is available to them. This is achieved by taking real time information from the Paramics model and using this data to update the routing calculations.

The following sections give examples of coding, applying and analysing these assignment procedures. The example networks used to demonstrate the assignment methods are ***Training/assign1AON***, ***Training/assign1SA*** and ***Training/assign1DF***. All these networks are similar to the tutorial network developed in previous sections of this User Guide.

6.4.1 "All-or-nothing" Assignment

Open the Modeller Main window. Then select the command **File>> Open** to activate the Network Data Selection browser. Select the network ***Training/assign1AON*** and press **OK**.

Change the **Configuration Manager** for this network is as follows:

Start Time	Duration	Seed	Feedback Period	Perturbation
08:00:00	01:00:00	1.0	00:00:00	Toggled Off

Using the ***left mouse button*** click on the **View>>Selections** menu and tear off the dropdown box. Toggle the **Link** button to on and select a link coming from Zone 1. Next toggle the **Zone** button and in the Modeller Simulation window click with the ***middle mouse button*** in the middle of Zone 2. Open the **View>>Routes** menu and toggle the **Show Route (From Link to Zone)** function. Identify the barred turns using the **View>>Model Layers>>Barred Turns** toggle.

Repeat this process to show all routes between each origin and destination zone. The cost and distance for each route is displayed in the Status Report window.

In the **View>>Routes** window, select **Unfamiliar** from the **Driver Type** dropdown menu and repeat to show routes between links and zones. All routes should be similar for familiar and unfamiliar driver types.

The percentage of familiar drivers is specified in the **Vehicles Manager**.

Using the **Edit>>Markings** function, mark all vehicles to Zone 3 and start the simulation. Note vehicles to Zone 3 do not use Kelly Lane.

6.4.1.1 Major/Minor Links

In the **Categories Manager**, links can be described as "major" or "minor". Unfamiliar drivers will use major roads in preference to minor roads akin to using sign posted routes. Familiar drivers are more likely to divert to minor routes as they are assumed to know the road network and possible short cuts or rat runs.

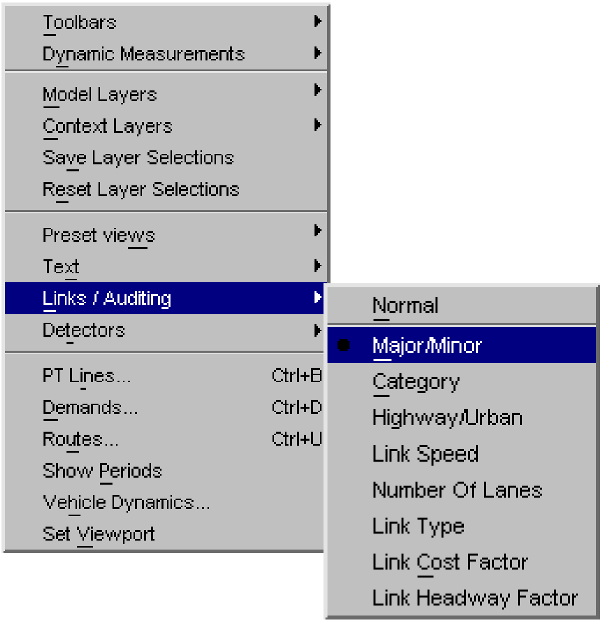
In Paramics the link costs for unfamiliar drivers on minor roads are assumed to be twice the cost of an equivalent major road.

To show the major/minor classification, select **View>>Links>>Major/Minor**. Major links are shown in red while minor links are blue.

Exercise 24

Use the Editor Toolbar to select the High Street links and re-code as category 2 links. Be careful to keep the road widths the same as the original coding. **Save and Refresh** the changes.

The **View>>Links>>Major/Minor** will show High Street links as blue i.e. minor.



Repeating the procedure described above, show the routes for familiar and unfamiliar drivers. For some routes, e.g. from Zone 2 to Zone 3, the familiar and unfamiliar routes will differ.

Again mark vehicles to Zone 3 and start the simulation. Some vehicles to Zone 3 should now be using Kelly Lane. **Pause** the simulation and using the ***right mouse button*** and the **Trace Vehicle** option to mark a vehicle that is using Kelly Lane.

In the Status Report window the traced vehicle can be identified as unfamiliar. The reporter will show either "Tab 1" or "Tab 2" where "Tab 1" is equivalent to routing table 1 (familiar) and "Tab 2" is routing table 2 (unfamiliar). All unfamiliar drivers to Zone 3, from Zone 2 and Zone 6, route via major links including Kelly Lane.

Using major/minor classification of links adds a level of sophistication to all-or-nothing assignments, by allowing the route for a proportion of vehicles, and/or different vehicle types or trip purposes, to be calculated separately.

"All-or-nothing" assignment procedures are unlikely to be appropriate in urban areas where congestion conditions are expected to occur and alternative route choice is available. However, viewing the "all-or-nothing" routes is a useful way to check possible network coding errors such as omitting banned turns.

6.4.2 Stochastic

Use the command **File>> Open** to activate the Network Data Selection browser and select the network ***Training/assign1SA*** and press **OK**. Select **Edit>>Configuration** and edit the following components to enable perturbation costs.

Start Time	Duration	Feedback Period	Perturbation	Perturbation Algorithm
07:00:00	02:00:00	00:00:00	Toggled On	percentage

Check that the perturbation value set in the **Vehicles Manager**, is 10 using **Edit>>Vehicles**. Save file and reload any changes.

Use the **View>>Routes** function to show a sample of origin/destination routes but this time drag the **Perturbation Factor for Display** to 10. If the **Percentage Algorithm** toggle is on, then the value 10 represents a 10% perturbation of costs.

As before, mark vehicles to Zone 3 and start the simulation. Some of the marked vehicles use Kelly Lane. By selecting a sample of the Kelly Lane marked vehicles, the information in the Status Report window should show that these vehicles can be either familiar or unfamiliar.

Link costs are perturbed for each individual vehicle on a random basis. This means that vehicles with exactly the same characteristics, travelling between the same origin and destination, can have different routes. The variation in the routes is controlled by the perturbation factor.

The algorithm for perturbation may be set to **Square Root Algorithm**. The differences between the percentage and the square root algorithms are explained in the Modeller Reference Manual.

6.4.3 Dynamic Feedback

Open the network ***Training/assign1DF*** and select **Edit>>Configuration** and disable perturbation and set the feedback value to 2 minutes, as follows.

Start Time	Duration	Seed	Feedback Period	Perturbation
07:00:00	02:00:00	1.0	00:02:00	Toggled Off

Mark vehicles to Zone 3 and start the simulation. During the first 2 minutes of simulation no marked vehicles use Kelly Lane. However, as the simulation progresses, a number of marked vehicles start to route via Kelly Lane.

Note:- The Report window gives information on the delay feedback calculations, such as, "08:40:00 Delay feedback - recalculating routes".

Select a few vehicles that have re-routed along Kelly Lane. All re-routed vehicles are familiar. Within any given 2 minute time slice, these vehicles will all take the same route for each O/D pair.

Show the routes for familiar and unfamiliar drivers to check how these may change in each 2 minute period.

The dynamic feedback assignment updates the link costs to include a turning delay cost. The turn delays are calculated at defined feedback periods specified by the user, in this case set as 2 minutes. Therefore after each 2 minute period Paramics extracts the turning delays in the network and adds these to the link costs. To damp the fluctuation in route costs, Paramics adds the new turn delay cost to the previous turn delay cost and takes the average of these costs (refer to The Averaging Feedback Costs Section, on page 110).

By default feedback calculations only affect familiar drivers as these drivers are assumed to know the road network and any potential alternative routes. The Averaging Feedback Costs Section, on page 110, describes how to change the default feedback so both familiar and unfamiliar drivers are affected.

Note:- Although damping of feedback costs is carried out, there is no guarantee that large fluctuation in costs will not occur. Therefore it is recommended that checks be carried out to validate the route assignments.

6.4.4 Combining Assignment Techniques

It is possible to run dynamic feedback together with stochastic assignment or with all-or-nothing assignments. This allows the user even more flexibility for route choice. However, as with all assignment techniques extensive checks on routing should be used to validate the alternative routes.

A description of a method to average the feedback costs is contained in the Averaging Feedback Costs Section.

7 Collecting & Analysing Model Results I

7.1 Gathering Statistics

Calibration is an essential stage of the traffic modelling process. This procedure requires comparing model results to observed data and ensuring that these comparisons fall within acceptable guidelines.

As part of model calibration the visualisation of traffic moving through the road network may be compared to junction/intersection video information or to local knowledge of traffic operation. In addition, Modeller can collect and output statistics such as turning counts, journey times, queue lengths etc. for comparison to data observed on site.

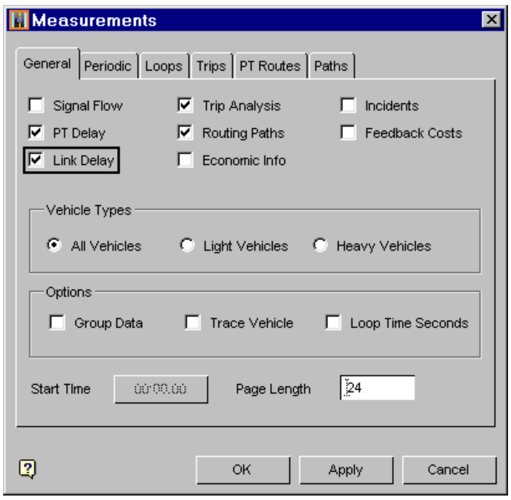
These outputs can be reported to text files and can be displayed using the Paramics Analyser. A full description of how to use the Analyser module is contained in the Analyser User Guide and Analyser Reference Manual.

Paramics output statistics extraction is dictated by two menu options, configuration and measurements. As mentioned previously, the **Configuration Manager** sets up a list of parameters used to control a simulation run, while the **Measurements Manager** defines a list of statistics to be collected. The output data can be collected for the whole of the model network and also at individual sites where loop detectors are located. Data collected from loop detectors is described in the Gathering Loop Detector Data section, on page 118, while the following shows how to collect statistics for the entire simulation network.

To collect network wide data, the user specifies a period over which the data is collected. This data could be Snapshots, Turn Counts, Queue Counts and Release Counts. To collect other data such as Bus Delay, Link Delay, Paths and Trip Info additional specifications are required within the **routes** menu, **trips** menu and **paths** menu.

Exercise 25

Open the network ***Training/modresult1*** and select **Edit>>Measurements>>General.** To collect Link delay, PT delay, Routing Paths and trip analysis toggle the appropriate check boxes.



In addition to this the user must make further inclusions within the Trips, PT Routes and Paths menus. Select **Edit>>Measurements>>Paths,** and check the menu contains the following information:

paths file

```
path count 4
number 1 9 7 17 4 3 2d 2a 2b 1 end
number 2 11 10 3 4 5 end
number 3 8 7 10 3 4 6 end
number 4 11 10 3 2d 2a 2b 2c 2d 3 10 11 end
```

Select **Edit>>Measurements>>Routes**, and check the following PT Routes r1, r2, r3, r4 and r5 are selected.

Finally select **Edit>>Measurements>>Trips**, and add the following:

- Trips from zone 1 to zones 2,3,4,5,6,7
- Trips from zone 2 to zones 1,3,4,5,6,7
- Trips from zone 3 to zones 1,2,4,5,6,7
- Trips from zone 4 to zones 1,2,3,5,6,7
- Trips from zone 5 to zones 1,2,3,4,6,7
- Trips from zone 6 to zones 1,2,3,4,5,7
- Trips from zone 7 to zones 1,2,3,4,5,6

Start the simulation and run for 30 minutes of simulation time and then quit Modeller. The output files will be saved to a sub-directory ***Training/modresult1/Log/run-001*** or equivalent (Modeller will identify where the files are saved).

For example, the checking the **Link Delay** box creates a file called **trips-linkdelay-HH-MM-SS** with the following specification.

```
##-----------------------------------------------------
## Trip          Link       Time    Count
##-----------------------------------------------------
   2->3         7:17       5.00       1
   2->3         17:4      20.00       1
   2->3          4:3      11.00       1
   2->3         3:2d       8.00       1
   2->3        2d:2a       3.00       1
   2->3        2a:2b       1.00       1
   3->2        2b:2c       4.00       1
   3->2        2c:2d       2.00       1
   3->2         2d:3       9.00       1
   3->2         3:10      10.00       1
   3->2         10:7       8.00       1
   2->4         7:17       3.00       1
   2->4         17:4      24.00       1
   4->2         4:17       8.00       1
```

For each vehicle released onto the network, the **links-delay** file identifies the origin /destination, the path in terms of link names, the time taken to travel along each link and the count of vehicles. A full description and specification of files generated by Modeller, is given in the Modeller Reference Manual.

To extract release rates and queuing information select **Edit>>Measurements>>Periodic** and select **Release Counts**. This will launch the 'Set Interval' window that allows the user to choose the time period for which they wish to collect statistics, in this instance it is 5 minutes. Repeat the process for **Queues**.

Some files are time specific and the user can define the intervals the data is collected. For the above, queuing information will be output to files "link-queues-00:05:00", "link-queues-00:10:00" etc..

Note:- Midnight (00:00:00) is always taken as "time 0", regardless of the simulation start time. For example, if the queue data is collected every 10 minutes 43 seconds and the simulation starts at 08:00:00, then the first queue file will be "link-queue-08:02:15".

Examples of the output files for queue counts and release counts are shown below.

File "link-queues-07:45:00"

```
##-----------------------------------------------------------
##   Link Lane Q  Start (ft)   End(ft)  Size   Time   Blocked
##-----------------------------------------------------------
     1:2b   2  1   16.0     376.2       15  07:45:00
    2a:2b   2  1   10.1      31.0        2  07:45:00    *
      4:3   2  1   -0.0     278.6       14  07:45:00    *
     10:3   2  1    0.0     333.4       14  07:45:00
    2b:2c   2  1   13.9      56.6        4  07:45:00    *
    2c:2d   2  1   16.6      42.2        2  07:45:00    *
     2d:3   1  1  160.9     313.2        7  07:45:00
```

File "signal-queues-07:45:00"

```
##-----------------------------------------------------------
##   Link Lane Q  Start (ft)   End(ft)  Size   Time   Blocked
##-----------------------------------------------------------
      9:7   1  1   -0.0      37.8        2  07:40:00
     17:7   1  1    0.0      57.5        4  07:40:00    *
     17:7   2  1   -0.0      20.7        2  07:40:00
     7:10   2  1    0.0      92.7        5  07:40:00
    11:10   1  1    0.6      78.4        4  07:40:00
    11:10   2  1    1.8      25.2        2  07:40:00
      3:4   1  1    0.0     271.2       10  07:40:30    *
      8:7   1  1    0.0      23.0        2  07:40:30
     10:7   1  1   -0.0      65.5        4  07:40:30
     3:10   1  1    0.0     129.2        6  07:40:35
      5:4   1  1   -0.0     101.0        4  07:40:50
```

Two sets of files are produced for queue counts, namely, "link-queues:HH:MM:SS" and "signal-queues:HH:MM:SS" for non-signal and signal junctions/intersections, respectively. Each contains data on queue lengths, locations and indicates if the traffic is blocking back from downstream links.

File "release-07:45:00"

```
07:45:00 Matrix 1

   |   1    2    3    4    5    6    7  Total(Block)Tries
----------------------------------------------------------
  1|   0   15   10    3    0    7    0 |   35 (   0)   35
  2|  15    0    2    1    0    0    3 |   21 (   0)   21
  3|   8    5    0    5    6   17    0 |   41 (   0)   41
  4|   3   13    0    0    0    6    1 |   23 (   0)   23
  5|   3    6    7    3    0    3    1 |   23 (   0)   23
  6|   6    2    9   16    2    0    1 |   36 (   0)   36
  7|   3    1    0    2    1    1    0 |    8 (   0)    8
----------------------------------------------------------
 + |  38   42   28   30    9   34    6 |  187 (   0)  187

07:45:00 Matrix 2

   |   1    2    3    4    5    6    7  Total(Block)Tries
----------------------------------------------------------
  1|   0    3    6    0    0    1    0 |   10 (   0)   10
  2|   3    0    2    0    1    0    0 |    6 (   0)    6
  3|   0    2    0    1    1    3    0 |    7 (   0)    7
  4|   1    1    0    0    0    4    0 |    6 (   0)    6
  5|   0    0    0    2    0    0    0 |    2 (   0)    2
  6|   0    0    2    1    1    0    0 |    4 (   0)    4
  7|   0    1    0    0    0    1    0 |    2 (   0)    2
----------------------------------------------------------
 + |   4    7   10    4    3    9    0 |   37 (   0)   37

07:45:00 Matrix 3

   |   1    2    3    4    5    6    7  Total(Block)Tries
----------------------------------------------------------
  1|   0    2    1    0    0    0    0 |    3 (   0)    3
  2|   1    0    0    0    0    0    0 |    1 (   0)    1
  3|   0    0    0    2    0    1    0 |    3 (   0)    3
  4|   0    0    0    0    0    4    1 |    5 (   0)    5
  5|   0    0    0    0    0    0    0 |    0 (   0)    0
  6|   0    0    0    0    0    0    0 |    0 (   0)    0
  7|   0    0    0    0    0    0    0 |    0 (   0)    0
----------------------------------------------------------
 + |   1    2    1    2    0    5    1 |   12 (   0)   12
```

The release counts show if all the traffic is loaded onto the network. However if some traffic is prevented from loading onto the network because the link(s) associated with the zone become saturated then the second last column "Block" will display the number of vehicles prevented from entering the simulation. Paramics attempts to release these trips when road space is available. However, if links are saturated during the full simulation time then some trips will not be released onto the network.

7.1.1 Statistics

It is also possible to extract summary statistics from Modeller that give network wide information about delay, queuing, number of vehicles on the network, distance travelled and mean speed. This information can be used to assess the overall effectiveness of the model.

Select **Edit>>Measurements>>General** and toggle **Economic Info** by clicking in the associated box. This will produce a number of values to be written to the file named **general** in the current Log/run directory. The column headers are listed and described as follows:

```
## ------------------------------------------------------------------------------------------------------------
##      |   current     |                              all vehicles                               |   bus-specific
## time | nv mean veh   | ave travel tot travel total veh    total   mean veh  VMT    VHT  |
##      |   speed(mph)  |    time(s)    time(s)   dist(ft)      nv  speed(mph)            | stops time  on off
## ------------------------------------------------------------------------------------------------------------
```

- time: each line has a timestamp. The file will be refreshed every minute of simulation, regardless of any other settings.
- current: relating to vehicles that are being simulated at the instant of the timestamp:
  - nv: the current number of vehicles.
  - mean speed: the average speed in either miles/h (US and UK mode) or in km/h (metric mode).
- all vehicles: relating to all vehicles (all trips) released since the simulation began, including those that have not yet reached their destination (the current vehicles):
  - ave travel time (s): mean travel time (seconds) per vehicle in the simulation, up to the current timestamp. Here travel time means the time taken to get from origin to destination (or from origin to where the vehicle is at the present timestamp), zero time would require infinite speed.
  - tot travel time (s):the cumulative total travel time for all vehicles in the network in seconds.
  - total veh dist (m/ft): total cumulative distance travelled up to the current timestamp in the simulation, either in vehiclemetres (UK and metric mode) or in vehiclefeet (US mode).
  - total nv: the total cumulative number of vehicles in the simulation up to the current timestamp.
  - mean veh speed (kph/mph): the average speed for all vehicles up to the current timestamp in the simulation, either in mph (US and UK mode) or in kph (metric mode).
  - VKT/VMT: total number of Vehiclekilometers/Vehiclemiles travelled in the network since the start of the simulation
  - VHT: total number of Vehiclehours travelled in the network since the start of the simulation

- bus-specific: values relating to ALL PT vehicles released since the simulation began:
    - stops: total cumulative number of stops made by PT vehicles at PT Stops.
    - time: total cumulative time (seconds) spent stopped at PT Stops.
    - on: total cumulative number of passengers uplifted.
    - off: total cumulative number of passengers set down

The following file gives an example output from the "gather economic info" option.

```
## ----------------------------------------------------------------------------------------------------------
##      |   current      |                           all vehicles                                  |   bus-specific
## time | nv mean veh    | ave travel tot travel total veh    total   mean veh  VMT    VHT  |
##      |   speed(mph)   |    time(s)    time(s)   dist(ft)      nv  speed(mph)               | stops time  on off
## ----------------------------------------------------------------------------------------------------------
08:01:00  29     11.1          27.3        983       6151       36       22.5  6.15   0.27
BUS        0      ---           0.0          0          0        0        0.0  0.00   0.00      0    0   0   0
ALL       29     11.1          27.3        983       6151       36       22.5  6.15   0.27
08:02:00  42      9.8          42.4       3178      15042       75       17.0 15.04   0.88
BUS        0      ---           0.0          0          0        0        0.0  0.00   0.00      0    0   0   0
ALL       42      9.8          42.4       3178      15042       75       17.0 15.04   0.88
08:03:00  51      9.1          47.3       5490      23843      116       15.6 23.84   1.53
BUS        0      ---           0.0          0          0        0        0.0  0.00   0.00     0    0   0   0
ALL       51      9.1          47.3       5490      23843      116       15.6 23.84   1.53
08:04:00  50     10.7          53.2       8250      34225      155       14.9 34.23   2.29
BUS        0      ---           0.0          0          0        0        0.0  0.00    0.00    0    0   0   0
ALL       50     10.7          53.2       8250      34225      155       14.9 34.23   2.29
08:05:00  47     14.8          59.0      11029      45316      187       14.8 45.32   3.06
BUS        0      ---           0.0          0          0        0        0.0  0.00   0.00     0    0   0   0
ALL       47     14.8          59.0      11029      45316      187       14.8 45.32   3.06
08:06:00  40      9.7          61.5      13705      55906      223       14.7 55.91   3.81
BUS        0      ---           0.0          0          0        0        0.0  0.00   0.00     0    0   0   0
ALL       40      9.7          61.5      13705      55906      223       14.7 55.91   3.81
```

The travel time (vehicle hours) can be calculated from the "all vehicles" section by multiplying the "travel time" and "total nv" columns.

The travel distance (vehicle feet/meters) can be calculated from the "all vehicles" section by converting to the relevant units.

Note:- Explanations and descriptions of all files generated from the measurements menu specification, are contained in the Modeller Reference Manual Appendix B – Descriptions of Generated files.

8 Network Build II

8.1 Urban/Highway Network

In Paramics links in a network can be described as urban or highway. The main distinction is that highway links are not restricted by junction/intersection priorities. In addition, by default trips are prohibited from loading onto highway links.

The option of highway or urban is coded in the categories. menu but can also be associated to individual links. For individual links the **Link Attribute** window (in the Editor Toolbar select **Modify Link**) can be used be selecting the **Flags** menu. One of the flag toggles is for **Urban**, if set to off the link is assumed to be highway.

Exercise 26

Code the highway network shown in the skeleton diagram in Figure 11 and connect to the existing urban network (use the network ***Training/highway***).

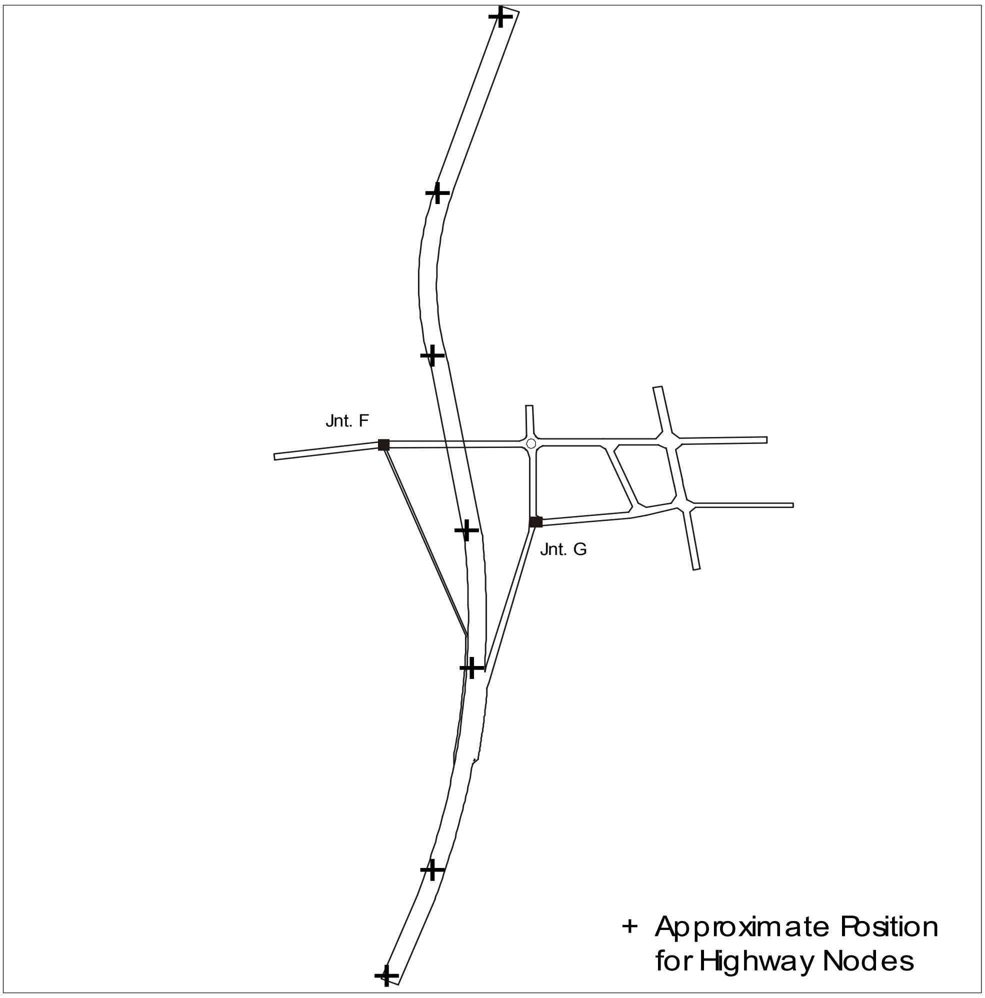


Figure 11: Skeleton Highway Network.

Firstly **Edit>>Categories** to include highway categories as follows:

Category	Lanes	Speed (mph)	Width (ft)	Median Width (ft)	Type
1	1	30.0	12.0	-	urban minor
2	2	30.0	24.0	-	urban minor
3	3	30.0	36.0	-	urban minor
4	4	30.0	48.0	-	urban minor
5	1	40.0	12.0	-	urban minor
6	2	40.0	24.0	-	urban minor
7	3	40.0	36.0	-	urban minor
8	4	40.0	48.0	-	urban minor
21	1	30.0	12.0	-	urban major
22	2	30.0	24.0	-	urban major
23	3	30.0	36.0	-	urban major
24	4	30.0	48.0	-	urban major
25	1	40.0	12.0	-	urban major
26	2	40.0	24.0	-	urban major
27	3	40.0	36.0	-	urban major
28	4	40.0	48.0	-	urban major
31	1	70.0	12.0	-	highway
32	2	70.0	24.0	-	highway
33	3	70.0	36.0	-	highway
34	4	70.0	48.0	-	highway
35	1	70.0	25.1	13.1	highway
36	2	70.0	37.1	13.1	highway
37	3	70.0	49.1	13.1	highway
38	4	70.0	61.1	13.1	highway

Add nodes along the highway to correspond to points where the curvature of the road network changes (refer to Figure 11). Connect the highway nodes by adding links with the appropriate categories. All links along the highway should be coded as category 37.

Do not code ramp (or slip) lanes at present, as the coding of these features is explained later in this section.

8.1.1 Links with Medians

Categories 35 to 38 include median (central reserve) widths of 13.1 ft (4m). For example, category 37 coding will give a carriageway width of 36 ft (11.0m) plus a median width of 13.1 ft (4m). These distances are measured from the centre line of the link, therefore if each side of a link is coded as category 37 then the total central reserve width will be 26.2 ft (8m).

By default, links are drawn as straight lines between connecting nodes with kerb positions for the nearside and centre of the link. Kerbs are drawn at the start and end of each link and are repositioned using the Editor Toolbar **Edit Kerb points** icon (refer to the kerbs and stoplines section on section, on page 40).

8.1.2 Curved Links

In some road networks the alignment of the links are curved so that they fit geometric and topographical constraints. In the Editor Toolbar select **Link** and click with the ***middle mouse button*** in the Simulation window to choose a link. Using **Modify Link** open the Link Attribute window and select the **Flags** menu. Two of the toggles **Arc Right** and **Arc Left** can be used to curve the selected link. Using the convention that the link direction is defined as purple node to green, then **Arc Right** will draw a circle with a centre point to the right in the direction of the link. With **Arc Left** the centre will be to the left.

Select a link that you wish to code as curved and **Arc Right** or **Arc Left** as appropriate. After selecting **Apply** or **Apply** and **OK** a dotted circle is drawn in the Simulation window, representing the arc associated with the selected link. Modeller calculates a default position for the centre of the circle and a default radius. **Save and Refresh** to update the alignment of the link.

To change either the centre position or the radius, in the Editor Toolbar select **Edit Curves**. The correctly selected curve is highlighted in green with three broken lines joining the centre to three points on the circumference. Two of the points on the circumference match the position of the end nodes of the link while the third is drawn halfway between these node points on the circumference of the curve.

In the Simulation window click on the centre point of a curve. The centre point is marked with a yellow square and one point on the circumference will be drawn as a blue square. After selecting the centre, the HUD will show either **Edit Mode: Variable Radius** or **Edit Mode: Fixed Radius**. To toggle between these options click the **change curve mode** icon.

The best way to match the curvature of the overlay with the network curves, is to middle click on the circumference point which does not match the link node positions. Ensure that the edit display reads **Edit Mode: Movable Centre** and then hold the <shift> key and click with the ***middle mouse button*** to change the position of the circumference point. **Save and Refresh** to save the changes. This method fixes the position of the two node circumference points and adjusts the centre and radius of the circle.

Alternatively, the user can select either the circle radius or individual circumference points and switch between movable or fixed radius to adjust the curvature. The user should practise different techniques to find their preferred method.

After completing the coding of curved links save the network and then open a new network called ***Training/ramps***. Use this network to complete the coding for the following section on Ramps and Slips.

8.1.3 Ramps and Slips

Links connecting to highways are described as slips or ramps. In Paramics a slip link is defined as a link where traffic leaves a highway or off-ramp while a ramp is where traffic enters the highway.

For slip lanes or on ramps code a node on the highway link where the roads diverge and then code, a one-way link from that node to represent the slip link. To code the slip lane, the user selects the highway link at the point before the roads diverge (in the Editor Toolbar use the **Link** function).

Then **Modify Link>> Link Modifiers** and in the **Slip Lane** box type the required length for the slip lane. Coding a slip provides an extra lane to the nearside of the road for the specified slip lane length.

To code ramps, the user should firstly code a highway link and a one-way link leading to the highway link. These two links should not be connected. Next in the Editor Toolbar choose the **Edit Ramps** function. The HUD will display either **Edit Mode: Ramp (Node)** or **Edit Mode: Ramp (Link)**. The **Change ramp mode** option toggles between these two options. **Edit Mode: Ramp (Link)**, select the required highway link then toggle **Change ramp mode** (i.e. switch to **Edit Mode: Ramp (Node)** and select the node at the end of the ramp link. This node should now display the mode in orange and the highway link in green. Next select **Add Ramp** so the Paramics Input window appears. The length of the ramp can then be typed in the appropriate box.

Ramp attributes vehicle behaviour for merging and mainline traffic can be modified to represent local conditions associated with ramp behaviour.

Alternatively, ramps can be coded if the network has been built so that the ramp link connects to a node on the highway link. In this case the user selects the ramp link using the **Edit Mode: Ramp (Link)** function and then **Add Ramp**. Paramics automatically adds a disconnected ramp node so that the ramp coding becomes the same as the default specification for ramps.

If the approach ramp link has 2 lanes the user can toggle the **Separate Lane Merging** function in the Paramics Input window, to code two on ramps (i.e. one per lane). Paramics will split the lanes and create two single lane on ramps.

Exercise 27

Code the roads connecting on and off the freeway as ramps and slips. The ramp length is 700 ft and slip length is 400 ft. In addition a minimum ramp time of 1 (s), a headway factor of 0.8 (s) and a ramp aware distance of 150 (ft) should be coded.

Include a new road category in the categories menu as follows:

Category	Lanes	Speed (mph)	Width (ft)	Median Width (ft)	Type
40	1	60.0	12.0	-	Urban

Code one-way links for the slip link and ramp link as category 40. The slip link should connect directly to the highway links. The ramp link may either connect or may be disconnected. Using the methods described above, code the ramp link (length 700 ft) and slip lane (400 ft).

After a **Save and Refresh** you may find that the default position for kerbs does not give a good representation for the road layout at the ramp and slip. These default positions are calculated within Paramics in relation to the intersection of the straight line links. Therefore, when links are curved or at obtuse angles these default positions may not be representative of the actual kerb positions.

Try editing the kerb positions to give a better match with the overlay (in the Editor Toolbar choose **Edit Kerb points** and in the Simulation window select kerb points and reposition).

Remember that the full implications of repositioning kerbs and stop lines may only become clear after traffic has been loaded onto the network. Therefore the bulk of the work in repositioning control points should be carried out during the traffic assignment stage.

Exercise 28

Code the junction/intersection details for Junctions/Intersections F and G shown in Figure 12 and Figure 13, respectively.

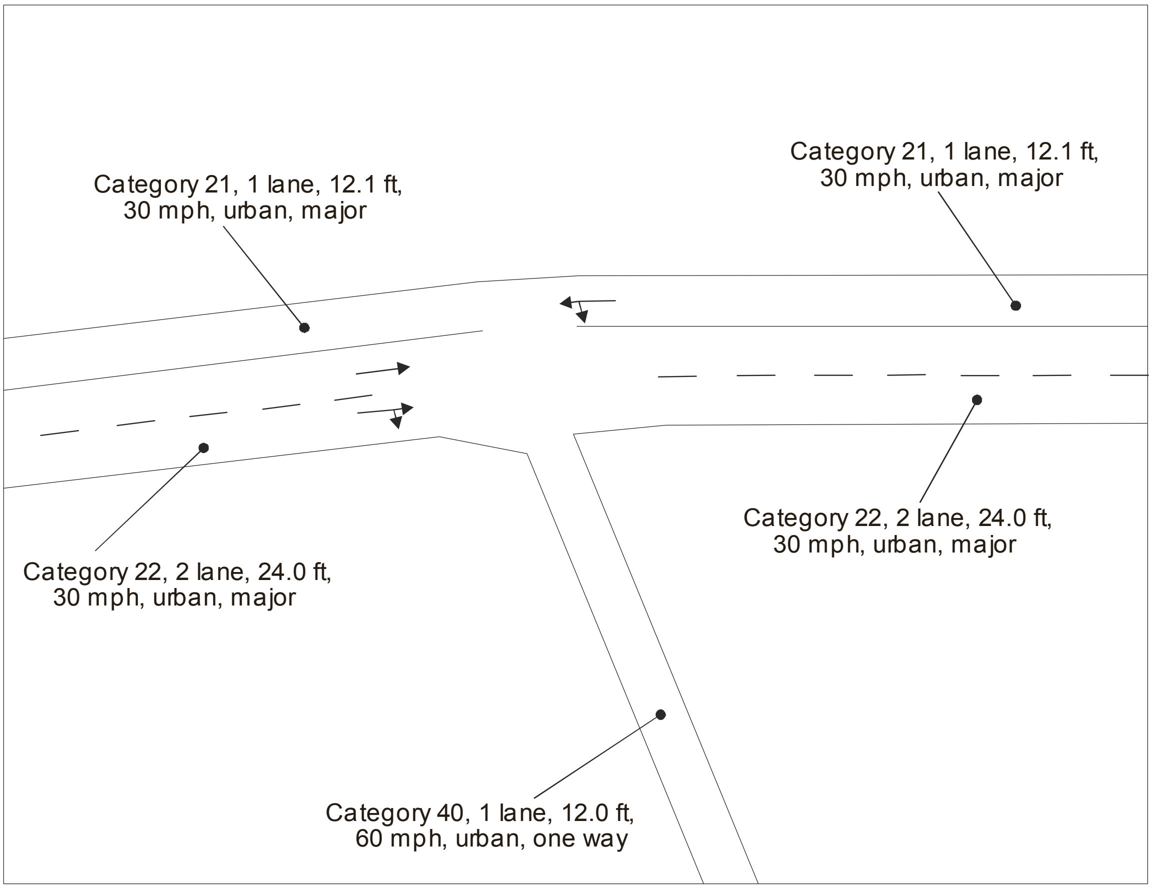


Figure 12: Junction/Intersection F – Priority Junction

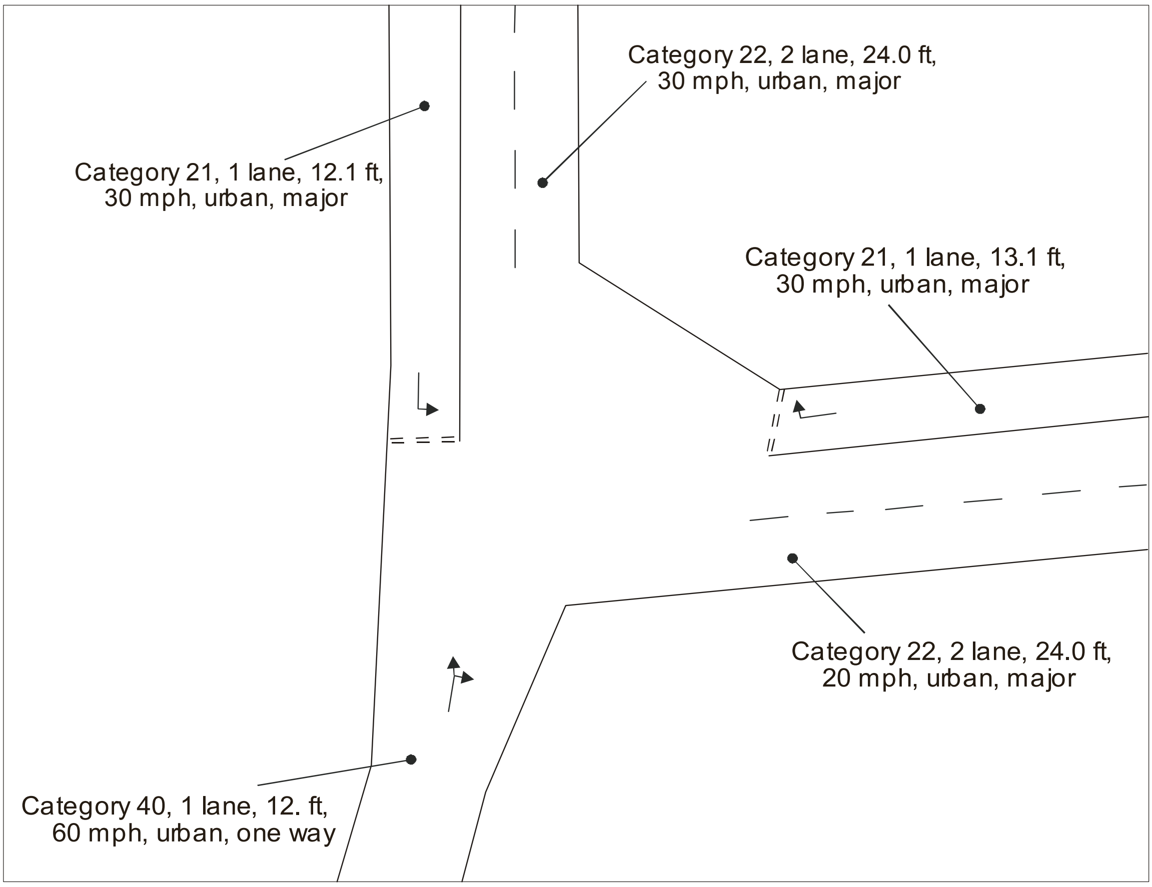


Figure 13: Junction/Intersection G – Priority Junction

8.1.4 Node Bounding Box

Paramics identifies the maximum and minimum grid co-ordinates for all nodes in the network and uses this information to produce a bounding box area. This bounding area is used to define the grid area and the Plan window area.

Exercise 29

> Check the bounding area by selecting the dropdown menu **Tools>>Grid** and the menu **Tools>>Plan**.

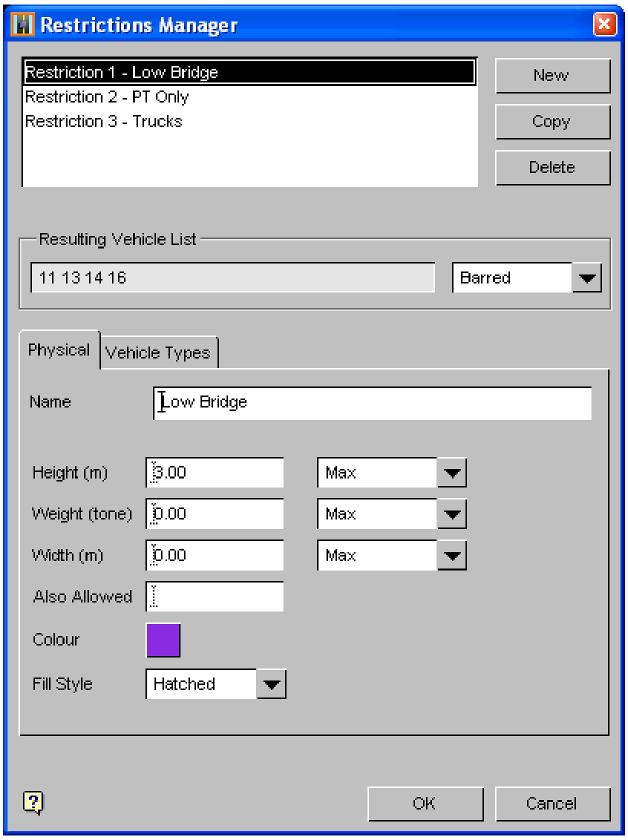
Adding a node that is outside the bounding box and connecting this to the network will prompt Modeller to save the new bounding box area.

8.2 Network Restrictions

Restrictions represent sections of the network that are inaccessible or barred to some vehicles based on the vehicles characteristics.

Paramics network restrictions can be coded for individual links. Restrictions can relate to closures, PT only movements, vehicle type bans, and vehicle characteristic bans (such as weight, height and width).

To code link and lane restrictions open the Editor Toolbar with **Link** selected. Click with the ***middle mouse button*** over the link that is to have a restriction associated with it. The selected lane will be highlighted in blue in the simulation window Then select **Modify Link>> Lane Modifiers** to view the restrictions dropdown menu. This window shows the full range of possible lane restrictions specified as in the **Restriction Manager**. At the top of this window, there are small grey icon squares representing the number of lanes coded for the selected link i.e. 2 squares appear if 2 lanes are coded, 3 if 3 lanes are coded etc. By default the icon for lane 1 will be selected when the window is first opened.



Note:- Lane display icons will show the lane numbers with lane 1 kerbside and the outmost lane, the median lane. Modeller lane numbers are always identified numerically from the kerbside lane to the median lane.

To select the lane that restrictions are to be applied to, single click with the ***left mouse button*** over the square icon representing the appropriate lane. All edits on the restrictions (described below) apply to this currently selected lane only, unless the **'Apply to All'** button is selected.

Below the lane icons there are two toggles to switch the current lane to be **Closed** or **PT Only**. A lane that is closed will not allow any vehicles to enter it, irrespective of the other restriction settings. A PT lane is initially restricted to all vehicles except those that are marked as being PT i.e. fixed demand as specified in the **Vehicle Type Manager**.

Beneath the lane icons and closed/PT lane settings there are is a combo box that contains restrictions created within the **Restrictions Manager**.

The height, weight and width of any restriction may be specified and each may be a maximum or a minimum figure as controlled by the **Restrictions Manager**.

The **Restrictions Manager** can be launched by clicking **New, <Ctrl-R>** or **Edit>> Restrictions.** Within the **Restrictions Manager** it is possible to copy, create, and delete restrictions (See Reference Manual page 36). When creating a new restriction the restriction details within the **Physical** menu are highlighted allowing the user to edit restriction attributes i.e. width, height etc.

The next restriction setting within the **Restrictions Manager** is the **Vehicle Types** tab that specifies which vehicle types are to be barred as part of the restriction.

The selection policy combo box contains the options **Barred** or **Allowed**. The **Except** setting is a convenience function which means that all vehicles EXCEPT those listed in the text box are barred from using this lane. Again a blank box indicates no restriction. Vehicles can be selected to be Barred or Except within a restriction by using the ***left mouse button*** and the <shift> key.

At the top of the section, to help establish complex restrictions, there is a **Resulting Vehicle List**. This list displays the vehicle types actually barred (or allowed) from using (to use) the lane or allowed down the lane (as selected by the combo box selection to the right of the **Resulting Vehicle List**).

The **Vehicle Types** display window in conjunction with the selection policy combo box specifies to which vehicle types the restriction will affect (See Page 20 of the Modeller Reference Manual).

Groups of vehicle types can be specified by using the mouse to drag the selection or the <shift> and <ctrl> keys. Alternatively the cursor keys and the <Enter> or <Return> key can be used to specify vehicle type groups.

After restrictions have been applied the colour of the lane icon changes to show the status of the lane as follows:

- Open grey box - no restrictions on this lane
- Green hashing - lane is a PT lane
- Yellow hashing - lane is closed
- User defined colour/shading – custom restriction

Combinations of purple, yellow and green are possible for combinations of settings. For example, yellow and green hashing represents a closed PT lane. These can be customised by the user if required within the **Restrictions Manager**.

Exercise 30

> Create a new restriction that restricts vehicle types 13 and 14 (i.e. barred to HGV vehicles). Apply the new restriction to the Southbound link of the High Street.

After saving and refreshing the changes show the restriction using **View>>Model Layers>>Restrictions.** Start the simulation to see that no HGV's use lane 2 of the restricted link.

8.2.1 Turn Restrictions

In addition to restricting lanes (or links) Modeller has the ability to restrict vehicles by turn. This is specified in the same manner as link based restrictions, with the exception that the **Node Editor>>Selected Priority>>Restriction** combo box is used to specify the restriction to be applied to the specific turn movement.

Note:- Modeller automatically checks the routing implications due to restrictions and includes additional routing tables specifically for restricted traffic. The section headed Restrictions on Page 107 shows an example of the effect of restrictions in the increasing the number of routing tables.

8.3 Infrastructure

8.3.1 Loop Detectors

Modeller is designed to mirror real-world data collection from induction loops but can also gather statistics not currently collected by on-road detectors.

To collect data the user needs to add a detector to a specific link within a simulation network.

Exercise 31

> Specify loop detectors on the northbound and southbound links of High Street and Mayfair.

In the Editor Toolbar, select a link then the **Edit Loop Detectors icon** then **Add Detector**. The detector attributes window appears allowing a user to type an **ID** name and input the loop length i.e. the distance between the upstream and downstream edges of the loop. Type a loop length of 8 ft and press **OK** and **Save and Refresh**.

A detector has now been specified at a point on the link. The position of the detector can then be moved in the same way as moving a node. That is, click on the detector with the ***middle mouse button*** (highlights the detector in purple), hold down the <shift> key and either drag or click to a new position along the link, **Save and Refresh**.

Note:- Detectors cannot be moved past the ends of the link.

The detector loop will be placed on the link as close as possible to the *blue cross hair*.

Once the loop detectors have been specified and saved, model data can be observed interactively at the loop or can be output to ASCII files for analysis. These options are described in the Collecting & Analysing Model Results II section. To show the detectors select **View>>Model Layers>>Detectors**.

Note:- It is not recommended to place the loop detectors at the extreme edges of a link as this may create inaccuracies in the readings as vehicles transfer between links. It is recommended that a distance equal to double the longest vehicle length be used to separate the end of the link and the loop detector.

8.3.2 Sign Posting

A hazard defined as a network characteristic or feature that may cause a vehicle to change lane, for example a road narrowing (lane drop) or a signalised junction/intersection. The term signpost is used to include hazards as part of the driver behaviour representation of the simulation.

Although hazards exist on nodes they are represented by a set of parameters associated with the link immediately upstream of the hazard node.

By default hazards on urban links are set at 820 ft (250m) from the node while on highway links the default distance is 2461 ft (750m). The assumption is that sign posting on highway links will provide the drivers with information further from the hazard so that they have enough time to react.

To specify a signposting distance for a particular hazard, open the Editor Toolbar and select the **Link** options. Open the Link Attributes window using the **Modify Link** function. Then Link Modifiers and in the box associated with signposting, type the required value, **Apply** then **OK** and **Save and Refresh.**

The sign posting specification has two values. The first is the distance entered in the **Signposting entry box** of the signpost from the end of the hazard node. The second value, **Sign ranges**, is the distance from the signposting distance that vehicles will gradually become aware of the upcoming hazard, in accordance with the vehicles individual awareness parameter.

Note:- Signposts need not represent physical location of a signpost, the term is used to identify to the user, vehicle behaviour that is normally associated with lane choice.

8.3.3 Lane Choices

This feature allows the user to define link/lane specific lane usages rules on approach to a remote intersection. This allows the user to override the default lane use logic provided by the signposting/hazard model used in Paramics giving the user more freedom to deal with complex junctions, short links, complex freeway on-ramp/off-ramp combinations, and special cases.

Exercise 32

Use the command **File>>Open** to activate network data selection browser and select ***Training/lanechoices*** and select **Open**.

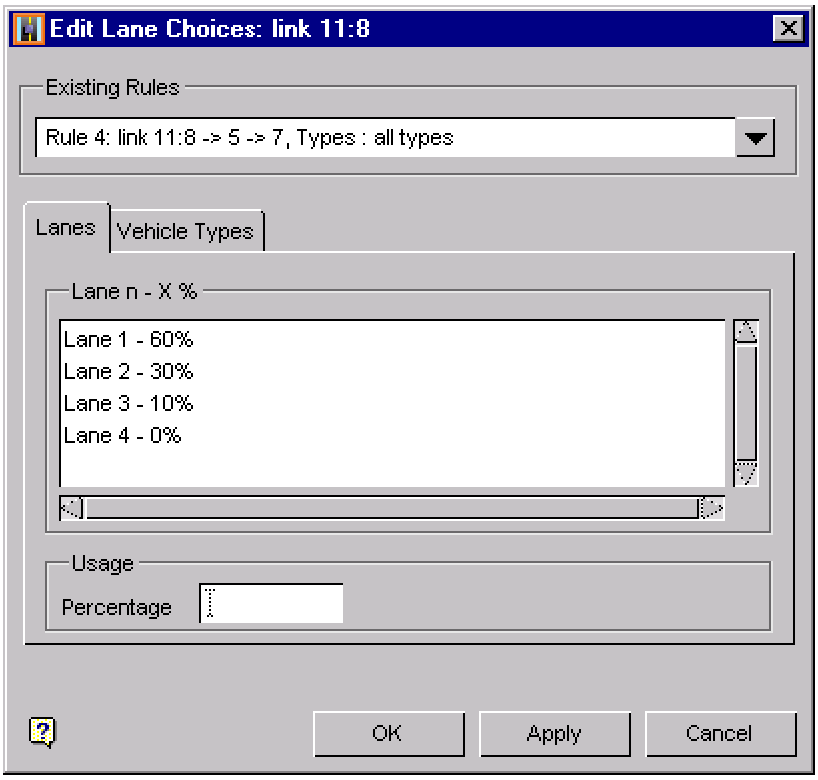
This sample network shows a standard highway junction exit where two oneway slip roads exist a short distance after the initial highway exit slip.

Ensure that signposting is highlighted, select **Model Layers>>Signposting**.

The user will notice the signpost highlighting the Diverge at **Node 5** only extends as far as Node 8, this is due to the architecture of the signposting function. This means that vehicles using either Diverge A or Diverge B can only make their lane choice decisions on link 8:5 which in reality is not necessarily correct. The application of lane choices will enable the signpost to be extended onto link 11:8. To achieve this we will require to apply two 'levels' of lane choices.

Firstly, Select **Lane Choices** from the **Editor Toolbar**. Candidate links, links that have hazards assigned to them, will be highlighted in cyan. The link we select now will be the link where vehicles will receive the necessary information to make a lane choice decision. In this example we Select **link 11:8**, this should highlight **node 11 (A node)** and **node 8 (B.Node)**.

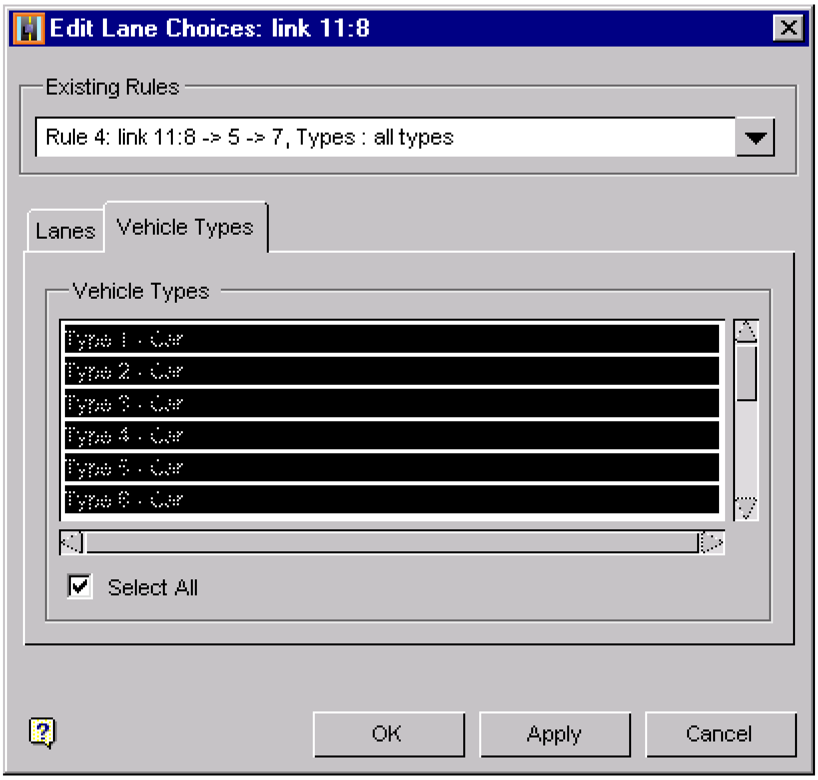
To complete this first stage we need to select the link with the hazard we wish to be extended. Hold **<Crtl>** ***middle mouse button*** and select **node 5 (C Node)**, the node will be highlighted in blue. Then hold **<Crtl>** ***middle mouse button*** select **node 7 (D Node)**, the node should be highlighted in red. Finally select **Add Lane Choice Rule** to launch the **Lane Choices Manager**.



The **Lane Choice Manager** contains two submenus, **Lanes** and **Vehicle Types**. The **Lanes** submenu allows the user to define the proportion of vehicles that uses each lane. Select each lane and apply the following proportions:

- Lane 1 – 60%
- Lane 2 – 30%
- Lane 3 – 10%
- Lane 4 – 0%

Within the **Vehicle Types** submenu the user has the ability to apply the lanes proportions to selective vehicle types. This can be undertaken using the ***middle mouse button*** whilst holding **<Crtrl>** and selecting the relevant types. In this example we will apply the signposting to all vehicle types, this can be implemented by toggling **Select All**.



Selecting **View>>Model Layers>>Lane Choices** will allow the user to observe the signposting at this stage. The layout in its current form ensures that vehicles lane choice decisions are made on the highway well in advance of 5:7.

Exercise 33

In this example we wish to compliment the signposting implemented on **Link 8:11** so that vehicles will be aware of the two upstream off ramps. We can achieve this by applying further lane choices. The first of the complementary lane choices will be applied to exit **Link 5:7**.

Select **Lane Choices** from the **Editor Toolbar**, again candidate links, will be highlighted in cyan. Select **Link 8:5**, this will highlight **Node 8 (A Node)** and **Node 5 (B Node).**

To select the **C Node** for this signpost hold **<Crtl>** ***middle mouse button*** and select **node 7 (C Node)**, the node will be highlighted in blue then select **Add Lane Choice Rule** to launch the **Lane Choice Manager.**

Select the **Lanes** submenu, choose Lane 1 and apply 100% to the lane. In this example we are going to select specific vehicle types. Select the **Vehicle Types** submenu and by holding **<Ctrl>** and ***middle mouse button*** select the following vehicle types:

- Types : 1 2 3 4 5 6 7 8 9

Repeat this exercise for lane 2. Apply 100% to this lane and select the following vehicle types:

- Types : 10 11 12 13 14 15

The second of the complementary lane choice will also be applied to **Link 8:5** however they will be associated to **Node 10**.

Select **Lane Choices** from the **Editor Toolbar**, candidate link will be highlighted in cyan. Select **Link 8:5**, this should highlight **Node 8 (A Node)** and **Node 5 (B Node).**

To select the **C Node** for this signpost hold **<Crtl>** ***middle mouse button*** and select **Node 10 (C Node)**, the node will be highlighted in blue then select **Add Lane Choice Rule** to launch the **Lane Choice Manager.**

Select the **Lanes** submenu, choose Lane 1 and apply 50% to the lane then apply the same percentage to Lane 2. Finally select the **Vehicle Types** submenu and by holding **<Ctrl>** and ***middle mouse button*** select the following vehicle types:

- Types : 10 11 12 13 14 15

Save and Refresh when all changes have been completed.

9 Traffic Demand II

9.1 Zone Specification

Open the network ***Training/dembuild2*** using **File>>Open**. Reposition Zone 3 and Zone 1 to match the locations shown in Figure 14 overleaf. Adjust the boundaries of the zones if required. Also include a new zone (Zone 8) at the north of the highway link (refer to Figure 14). **Save and Refresh** the changes.

Open the Editor Toolbar window and select the **File Editor** icon from the Editor Toolbar. Then click **>>Demand>>demands**, check the **demands** file matches the following.

```
demand period 1
matrix count 3
divisor 1.0000

matrix 1
from 1    0 143 113  45  16  83   2 2500
from 2  195   0  31  18  18   0  20    0
from 3   45  70   0  36  70 133   5    0
from 4   45  85   9   0  14  77  18    0
from 5   45  40  98  40   0  47   5    0
from 6   45   8  55  88  42   0   8    0
from 7   17  15  10  25  10  16   0    0
from 8 3000   0   0   0   0   0   0    0
matrix 2
from 1    0  40  25   0   2  12   0 100
from 2   14   0  18   2   7   0   0   0
from 3    2  20   0  10   5  11   1   0
from 4    3  10   1   0   4  13   2   0
from 5    3   5   1  10   0   0   0   0
from 6    3   1  10  10   6   0   0   0
from 7    3   2   0   3   0   4   0   0
from 8  150   0   0   0   0   0   0   0
matrix 3
from 1    0  10   5   2   1   0   1  12
from 2    6   0   7   0   0   0   0   0
from 3    3  10   0  10   0   6   1   0
from 4    2   5   0   0   2  10   1   0
from 5    2   5   1   0   0   3   0   0
from 6    2   1   5   2   2   0   2   0
from 7    2   3   0   2   0   0   0   0
from 8    9   0   0   0   0   0   0   0
```

Paramics will automatically update the demand matrices by including zero trips for a new added zone.

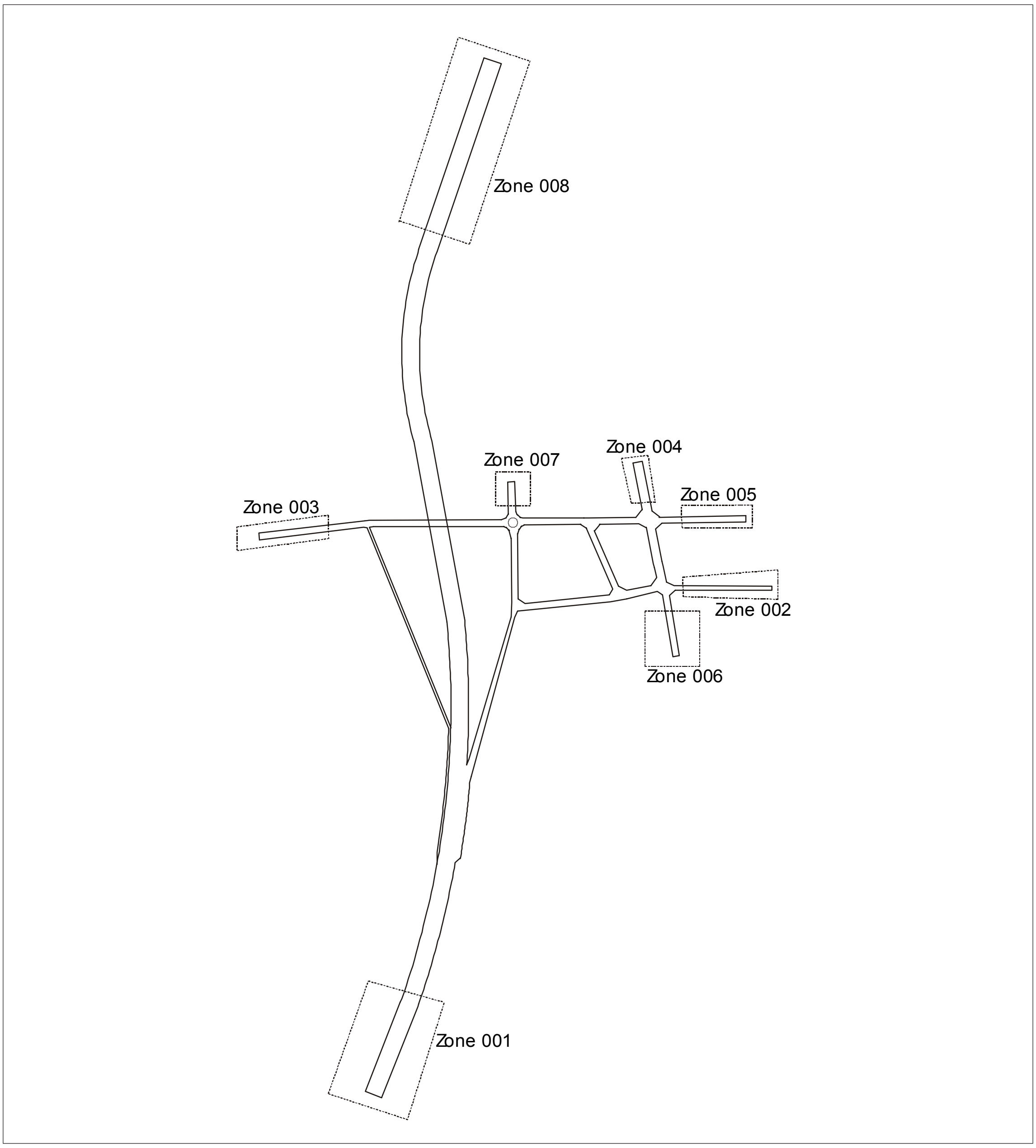


Figure 14: Skeleton Highway Network with Zones

9.2 Parking

Trips start from the origin zone and finish at the destination zone. In some instances this description may be inadequate because the site where vehicles park may be some distance from where the trip end actually starts or finishes.

In Modeller, parking areas can be coded and these can be associated to specific origin and/or destination zones and to vehicle type/purpose. This functionality enables comparison between parking supply and demand to be modelled.

If, for example, a specific trip was described as originating from a shop on the High Street but no parking was available along High Street then the vehicle for this trip may have parked some distance from the shop. It is obviously important that the simulation of traffic movements reflects, as accurately as possible, the starting point and end point of the vehicle trip.

The following example shows how parking areas can be coded in Modeller.

Exercise 34

Open the network ***Training/dempark2*** and add two one-way links as shown in Figure 15. Each link should be coded as category 1, with one lane of 12.0 ft and speed as 30 mph.

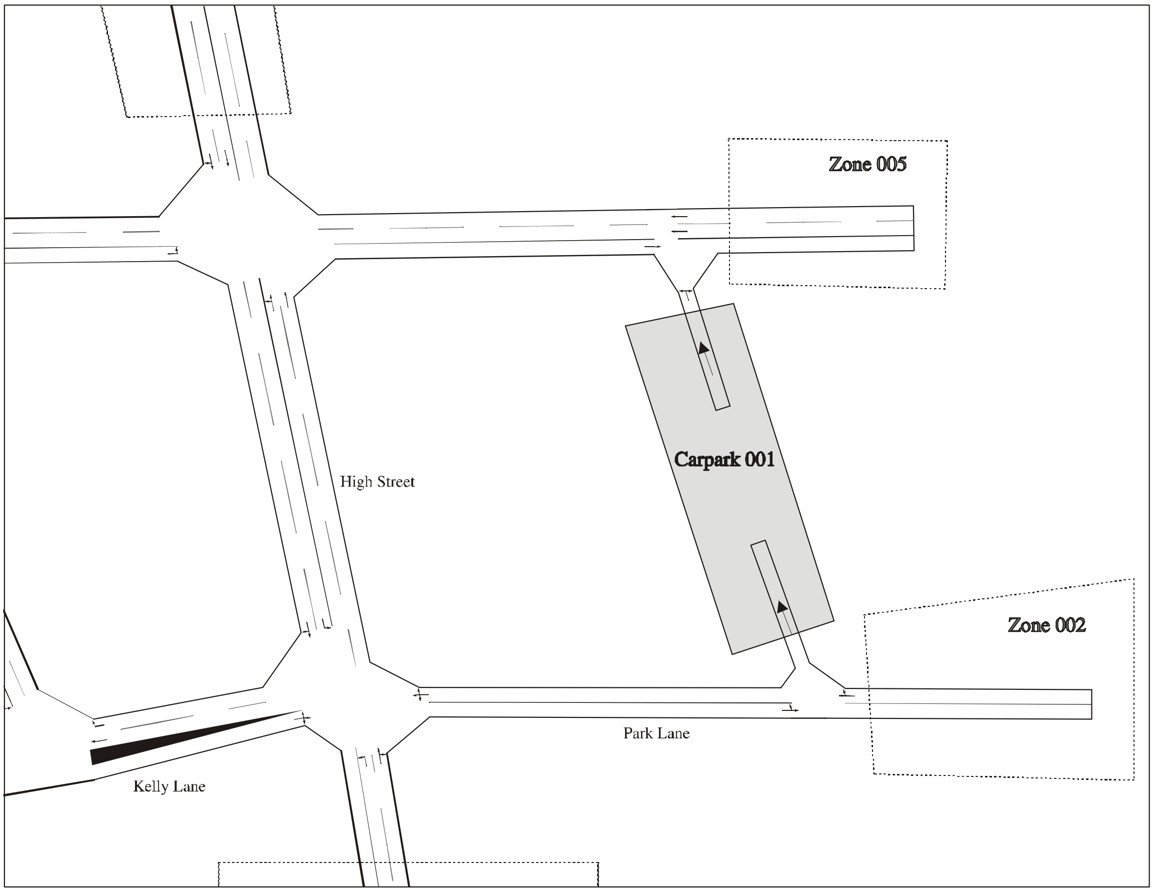
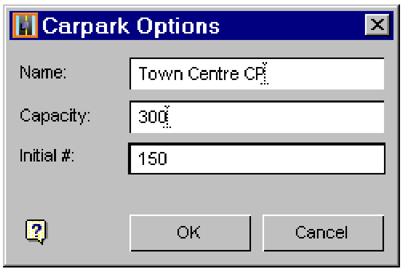


Figure 15: Car Park Coding

Using the Editor Toolbar, select **Edit Carparks** and **Add New Carpark**. Position the car park along the new one-way links as shown in Figure 15. If required reposition the car park vertices in a similar way to editing zone vertices (refer to the Zone Editing section, on page 19).

Select the **Carpark Options** icon to edit the car park name to "Town Centre CP" with a capacity of 300 vehicles and an initial number of 150 vehicles in the car park. Select **OK** and then **Save and Refresh** the changes.



Next in the Editor Toolbar, select the **Edit Zones** icon. Highlight Zone 2 within the Paramics Modeller Simulation window by clicking the ***middle mouse button*** inside the zone boundary. The Modification Toolbar icons should now read **Add New Zone**, **Annotate Zone**, **Delete Zone**, **Zone Options** and **Clear All**. Select **Zone Options**. A pop-up window appears which allows the user to specify the type of parking associated with the selected zone. For details on each option see page 104 of the Modeller Reference Manual.

Select the option **Specify carparks**. This enables the **Edit carpark list..** function. Click on this function with the ***left mouse button*** so the function now reads **Finish editing**. In the Modeller Simulation window select the car park by clicking in the middle of the car park area with the ***middle mouse button***. A further pop-up window appears with the question **Add carpark to zone list?**. Select **Yes**. Return to the Zone Options window and click the ***left mouse button*** on **Finish Editing**. The car park has now been associated with Zone 2.

Repeat this process to associate Zone 5 with the car park then **Close** the Zone Options window and **Save and Refresh** the changes.

Start the simulation and note the arrival and departure of vehicles through the car park. To show the position of the car park select **View>>Model Layers>>Carparks**. Show a selection of routes to/from the parking areas.

The Status Report window will occasionally print a warning message as follows. This message warns that in the demands file a trip has been specified between zone 5 and zone 2 but as these two zones are associated with the same car park, no vehicle is released onto the network.

WARNING: No suitable links for type 1 in zone 5 to zone 2 (matrix 1)

The **zones** file and **carpark** file should be similar to the following examples. This is checked using the File Editor.

carpark file

```
Carpark Count 1

carpark 1 "Town Centre CP" 4
-349 ft 887 ft
-609 ft 887 ft
-609 ft 1147 ft
-349 ft 1147 ft
max -349 ft 1147 ft
min -609 ft 887 ft
centroid -479 ft 1017 ft
Capacity 300
Initial 150
```

zones file.

```
Zone Count 8

zone 1 6
-2291 ft -2059 ft
-2484 ft -2059 ft
-2381 ft -1684 ft
-2280 ft -1482 ft
-2045 ft -1549 ft
-2168 ft -1852 ft
max -2045 ft -1482 ft
min -2484 ft -2059 ft
centroid -2275 ft -1781 ft

zone 2 4
   Carparks: 1
   carpark 1
-337 ft 788 ft
-342 ft 916 ft
-110 ft 936 ft
-110 ft 774 ft
max -110 ft 936 ft
min -342 ft 774 ft
centroid -225 ft 853 ft

zone 3 4
-2495 ft 1084 ft
-3083 ft 1084 ft
-3083 ft 1215 ft
-2497 ft 1215 ft
max -2495 ft 1215 ft
min -3083 ft 1084 ft
centroid -2790 ft 1149 ft

zone 4 4
-788 ft 1310 ft
-920 ft 1307 ft
-976 ft 1553 ft
-829 ft 1570 ft
max -788 ft 1570 ft
min -976 ft 1307 ft
centroid -878 ft 1435 ft

zone 5 4
   Carparks: 1
   carpark 1
-252 ft 1170 ft
-435 ft 1168 ft
-420 ft 1290 ft
-253 ft 1296 ft
max -252 ft 1296 ft
min -435 ft 1168 ft
centroid -340 ft 1231 ft

etc. . . . .
```

Car parks can also be barred to specific vehicle types. Complete the following exercise to bar all vehicles except cars from using the car park.

Exercise 35

Ban all vehicles except cars from the car park.

To do this add two car parks for Zone 2 and Zone 5. Associate one car park to each of these zones and **Save and Refresh** the changes. Edit the **carpark** file to include the following data.

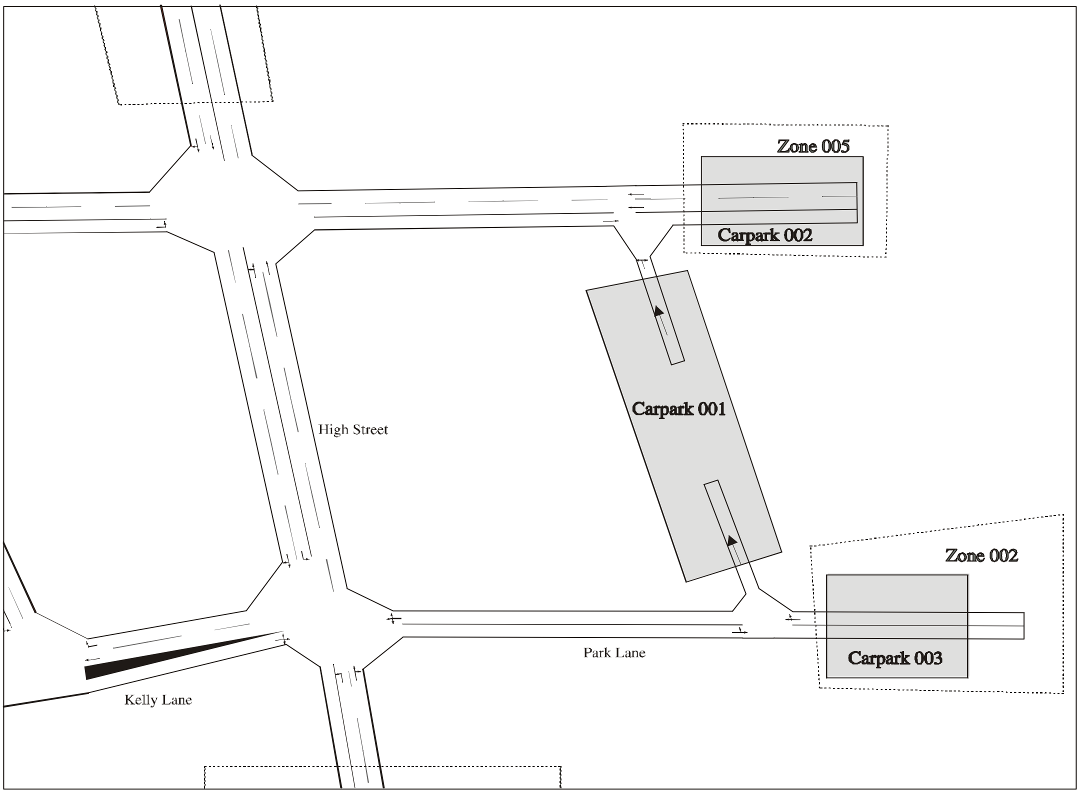


Figure 16: Car Parks- added to Zone 2 and Zone 5

For the "Town Centre CP" add the following line to the **carpark** file to bar LGV, OGV1, OGV2 and coaches.

Note:- This must come after the line that starts with the word "initial".

```
Vehicle types barred : 12 13 14 15
```

For the new car parks add the following line to the **carpark** file to bar all cars.

```
Vehicle types barred : 1
```

After completing this exercise, observe the different routes for cars and all other vehicle types.

The walking time between the parking area and the zonal trip end can be specified in the **walktimes** file. These walk times are included in the calculation of cost for a driver to reach a particular zone (See Reference Manual page 106)

In some circumstances, one car park may be associated with several zones. By default, suitable origin car parks are chosen at random but the destination car park is selected to achieve the least cost trip from origin to destination zone. It is possible to specify in the **Configuration Manager** that the destination car park should be randomised and the closest origin car park chosen, or that both the origin and destination are selected to minimise the trip time.

To specify car park origin and destination criteria, other than default, select **Edit>>Configuration>>Assignment** and;:

Toggle on Closest Origin Carpark
Toggle off Closest Destination Carpark

or

Toggle on Closest Origin Carpark
Toggle on Closest Destination Carpark

or

Toggle off Closest Origin Carpark
Toggle off Closest Destination Carpark

Note:- In Modeller Version 4.1, vehicles continue to be absorbed into the parking area even after the capacity has been exceeded and conversely, vehicles continue to be generated even if the current occupancy indicates that there are no vehicles in the car park.

Exercise 36

Edit the **walktimes** file to include times to walk between the "Town Centre CP" and Zones 2 and 5. Refer to Modeller Reference Manual.

9.3 Time Periods and Time Dependent Inputs

The choice of model time periods is not only governed by the fluctuation in traffic demand through time but also by network changes such as different traffic signal settings by time of day.

Modeller has the flexibility to specify a wide variety of demand changes and network changes through the simulated period. The program reads sets of files for each specified time period, for demand (**demands** files, **vehicles** file and **busroutes** file) and for network (**links** file and **priorities** file).

The breakdown of the time periods is specified within the **profile** file. Care should be taken to ensure all time dependent files are correctly specified by the user.

9.3.1 Time Dependent Demand Files

9.3.1.1 Time Dependent Profile File

The **profile** file is used to define how the total simulation is divided into time periods. Firstly, the periods are defined. For example, 24 hour simulation may be divided in 4 periods as follows:

```
Demand profile

Period count 4

period 1 start 07:30:00
period 2 start 10:00:00
period 3 start 16:15:00
period 4 start 18:45:00
```

For the above periods no vehicle release profile is defined and therefore a flat or uniform profile is assumed for all time periods.

To define a profile for each time period input the percentage of traffic released during each 5 minute time block. Modeller assumes that unspecified values are zero. In the example below, values would be inserted where xxx is shown. The total for all xxx values must add to give 100% for each period.

As with any Modeller file, the layout of the values is not important, but the layout below is used for clarity.

Note:- that periods can start or end at any 5-minute block.

```
Demand profile

Period count 4

xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx
xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx
xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx
xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx
xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx
xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx
xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx
xxx xxx xxx xxx xxx xxx

period 1 start 07:30:00
                xxx xxx xxx xxx xxx xxx
xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx
xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx

period 2 start 10:00:00
xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx
xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx
xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx
xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx
xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx
xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx
xxx xxx xxx

period 3 start 16:15:00
        xxx xxx xxx xxx xxx xxx xxx xxx xxx
xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx
xxx xxx xxx xxx xxx xxx xxx xxx xxx

period 4 start 18:45:00
                        xxx xxx xxx
xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx
xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx
xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx
xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx
xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx
```

The periods defined can be viewed using **View>> Show Periods**. The period, number, the period start time and the period end time will be displayed in the **Reporter** window.

Example: To define four periods 8.15 to 8.30, 8.30 to 9.20, 14.05 to 16.10 and 16.20 to 16.30 with individual profiles, the following profile should be specified. **Note:-** Lines beginning with ## are comments only and are ignored by the program.

```
Demand Profile

Period Count 4

Divisor 10

Interval 5


##  8.15 to 8.30, 8.30 to 9.20, 14.05 to 16.10 and 16.20 to 16.30


period 1 start 08:15:00
200  300  500
period 2 start 08:30:00
 80   80   80  120  120  110  110  110  100   90
period 3 start 14:05:00
 40   40   40   40   40   40   40   40   40   40   40   40
 40   40   40   40   40   40   40   40   40   40   40   40
 40
period 4 start 16:20:00
600  400
```

To demonstrate the effect of time dependent files use the urban network defined in ***Training/demtime2***.

Edit the **profile** file to match the above and code four demand files to correspond to the above period definition. The demand files should be named as **demands.1**, **demands.2**, **demands.3**, and **demands.4**. As a test the demand files may all to coded to have the same cell values as the following.

```
demand period 1
matrix count 1
divisor 1

matrix 1
from 1  0 10 10 10 10 10
from 2 10  0 10 10 10 10
from 3 10 10  0 10 10 10
from 4 10 10 10  0 10 10
from 5 10 10 10 10  0 10
from 6 10 10 10 10 10  0
```

Remember to change the "demand period" for each file so that **demands.1** has demand period set to 1, **demands.2** has demand period set to 2 etc.

Select **Edit>>Configuration>>Base Parameters** and set the start time to "00:00:00" and the simulation time is "23:59:59". Start the simulation.

The simulation clock shows the following information:

00:00:00	(4)	0.00 x RT

The "4" indicates the time period number associated with the simulation time of 00:00:00. By selecting **Editor Options>>Periodic** from the Editor Toolbar window you see that the **Demands** toggle has switched to on.

At the start of the simulation only PT vehicles appear on the network according to their coded start times (at minutes past the hour). The period can be advanced or regressed with the simulation clock by using the period advance/regress icons located to the right of the simulation clock. Set a time just before period 1 i.e. before 8:15, and restart the simulation, more PT vehicles appear on the network almost immediately. This happens because Paramics recognises that the simulation has switched to another hour and is several minutes beyond the start, so calculates that a number of PT vehicles should have been released by this time. All those PT vehicles are immediately loaded onto the network. It is therefore advisable only to use this option to change the simulation clock time when testing the input profiles etc. and not to analyse overall model results.

If you allow the simulation to continue to run, at 08:15 the Status Report window will produce the following message and vehicles start to load onto the network.

```
Switching from period 4 to period 1
```

Note:- That the simulation clock now shows "1" reflecting that period 1 has been activated.

Then at 8:30 the Status Report window shows the message:

```
Switching from period 1 to period 2
```

The report that some files have not been found relates to network files for traffic signals (**priorities**) and time dependent restrictions (**links**). Modeller automatically searches for these files if **demands.1**, **demands.2** etc. have been specified. The program associates **links.1** and **priorities.1** to **demands.1**. However, if no time specific network files exist Modeller reads as default the **links** file and the **priorities** file and displays the warning "File not found" in the **Reporter** window.

By selecting the **View>>Show Periods** option the user can check the times associated with each period. The report will show the following:

```
------------------------------
Period 4: 00:00:00  to 08:14:59
Period 1: 08:15:00  to 08:29:59
Period 2: 08:30:00  to 14:04:59
Period 3: 14:05:00  to 16:19:59
Period 4: 16:20:00  to 23:59:59
```

9.3.2 Time Dependent PT Files

Fixed demands, such as PT links, can also be coded to change at different time periods. As with the **demands** file the **busroutes** file should be coded so that **busroutes.1** refers to the PT Services during period 1, **busroutes.2** for period 2 and so on. All PT Routes must be defined in all files so if a route does not operate during a specific period the frequency for that route should be set to zero.

To test changes in PT Routes by time period, code **busroutes** files for each time period with different frequencies and start times. Start the simulation and observe the bus loading. Check, using the Editor Toolbar **Editor Options>>Periodic** command, that the **PT Lines** periodic toggle is set on.

9.3.3 Time Dependent Vehicles Files

Like **demands** and **busroutes**, the specification for **vehicles** can be defined by time period. This enables the user to change the matrix proportions, familiarity and perturbation. The file names should be consistent with other time dependent files i.e. **vehicles.1**, **vehicles.2** etc.

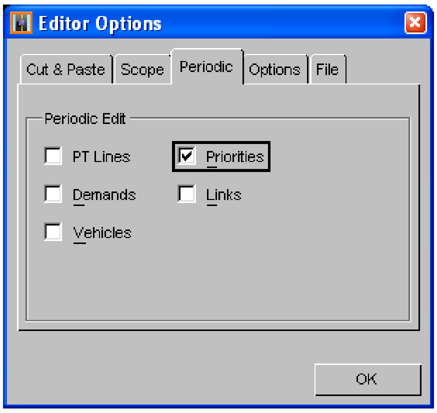
Note:- All vehicle types should be defined in all files.

9.3.4 Time Dependent Network Files

9.3.4.1 Traffic Signals

One of the most frequent changes that occur in urban networks throughout a day, are changes in traffic signal timings. In Modeller the fixed time signal plans are stored in the **priorities** file as actions. It is possible to specify different signal plans for each time period e.g. **priorities.1**, **priorities.2** etc.

To edit the signal settings access the Editor Toolbar **Node>>Modify Junction** window. Select **Show Options>>Periodic** and toggle the priorities check box to on.



Then select a signal node and make changes to the signal timings and **Save and Refresh** these updates. A new **priorities** file will be saved to **priorities.1** if the simulation clock is set to time period 1 or to **priorities.2** if edited in period 2 and so on.

By starting the simulation the user can see the switching of signal plans between different periods.

Note:- All phases must be defined in all periodic priority files. For example if a signalised node operates 4 phases during time period 1 but only activates 3 of these phases during period 2, then both **priorities** files (**priorities.1** and **priorities.2**) must have 4 phases coded. The phase not active in period 2 should be coded to contain zero red and green time.

Once a node has been coded as traffic signals during any time period then the node should be signalised for all time periods. Although this is true, a signal junction/intersection may be coded so that it operates as a priority junction/intersection. To do this, specify all movements as full green time during all phases and code the appropriate turn priorities for major, minor, medium and barred. This method has been used to code "part-time" traffic signal junctions/intersections which, as the name suggests, operate as signals at specific times during the day.

9.3.5 Periodic Link Changes

In addition to signal timing changes, physical restrictions such as street parking, PT Lanes etc. may differ at various times during the day. Modeller enables the user to specify time dependent changes to PT Lanes, lane restrictions, speed limits, cost factors, release rates, stay-in-lane, forced merge/crossing, end stop time and end speed.

Exercise 37

> Using the Editor Toolbar, toggle the **Editor Options>>Periodic>>Links** parameter on. Code lane 1 on the southbound link of High Street with a restriction for LGV during time period 1.

Again in the Editor Toolbar select **Link>>Modify Link>> Lane Modifiers**. Launch the **Restrictions Manager** by clicking 'New' and create a restriction that barrs LGV's. Check that the simulation clock shows that period 1 is activated. After making the changes to the link in the Network Editor, **Save and Refresh** the network.

The updates will be saved to the file **links.1**. To show the restrictions, toggle **View>>Model Layers>>Restrictions** on.

Advance the simulation clock time forward to 8:30, time period 2. The message in the report window should be as follows:

```
Switching from period 1 to period 2
```

Then in the Editor Toolbar select the same southbound link of High Street to show the restriction for LGV's does not exist for period 2. Select **Save and Refresh**. This update will be saved to the file **links.2**. By scrolling between period 1 and period 2 you will see the restrictions appearing and disappear if **View>>Model Layers>>Restrictions** is toggled on.

In a similar way, the link definitions for speed limits, cost factors etc. can also be changed between time periods. However, it is not possible to add extra links or to change physical parameters like the width or number of lanes on a link.

9.4 Multiple Profiles

An enhanced feature of demand loading in Paramics is the ability to specify different profiles for each origin/destination zone. For example, if a new superstore (or mall) development is assumed to produce surges in traffic flows during the modelled period then individual profiles can be defined to reflect these surges in flow.

Exercise 38

In the tutorial network change the release of traffic from Zone 2 so that all vehicles are loaded onto the network in the 5 minute period between 8:20 and 8:25.

The first step is to code a second profile in the **profile** file with 100% of the traffic released in time period 1 as follows:

```
Demand Profile
Profile Count 2
Profile 1
Period Count 4
Divisor 10
Interval 5

##  8.15 to 8.30, 8.30 to 9.20, 14.05 to 16.10 and 16.20 to 16.30

period 1 start 08:15:00
200  300  500
period 2 start 08:30:00
 80   80   80  120  120  110  110  110  100   90
period 3 start 14:05:00
 40   40   40   40   40   40   40   40   40   40   40   40
 40   40   40   40   40   40   40   40   40   40   40   40
 40
period 4 start 16:20:00
600  400

Profile 2

08:15:00
  0 1000    0
08:30:00
 80   80   80  120  120  110  110  110  100   90
14:05:00
 40   40   40   40   40   40   40   40   40   40   40   40
 40   40   40   40   40   40   40   40   40   40   40   40
 40
16:20:00
600  400
```

Alternatively, multiple profiles may be coded as:

```
Demand Profile
Profile Count 2
Profile 1
Period Count 4
Divisor 10
Interval 5

##  8.15 to 8.30, 8.30 to 9.20, 14.05 to 16.10 and 16.20 to 16.30

period 1 start 08:15:00
200  300  500
period 2 start 08:30:00
 80   80   80  120  120  110  110  110  100   90
period 3 start 14:05:00
 40   40   40   40   40   40   40   40   40   40   40   40
 40   40   40   40   40   40   40   40   40   40   40   40
 40
period 4 start 16:20:00
600  400


Profile 2

hour 00:  0    0    0    0    0    0    0    0    0    0    0    0
hour 01:  0    0    0    0    0    0    0    0    0    0    0    0
hour 02:  0    0    0    0    0    0    0    0    0    0    0    0
hour 03:  0    0    0    0    0    0    0    0    0    0    0    0
hour 04:  0    0    0    0    0    0    0    0    0    0    0    0
hour 05:  0    0    0    0    0    0    0    0    0    0    0    0
hour 06:  0    0    0    0    0    0    0    0    0    0    0    0
hour 07:  0    0    0    0    0    0    0    0    0    0    0    0
hour 08:  0    0    0    0 1000    0   80   80   80  120  120  110
hour 09:110  110  100   90    0    0    0    0    0    0    0    0
hour 10:  0    0    0    0    0    0    0    0    0    0    0    0
hour 11:  0    0    0    0    0    0    0    0    0    0    0    0
hour 12:  0    0    0    0    0    0    0    0    0    0    0    0
hour 13:  0    0    0    0    0    0    0    0    0    0    0    0
hour 14:  0   40   40   40   40   40   40   40   40   40   40   40
hour 15: 40   40   40   40   40   40   40   40   40   40   40   40
hour 16: 40   40    0    0  600  400    0    0    0    0    0    0
hour 17:  0    0    0    0    0    0    0    0    0    0    0    0
hour 18:  0    0    0    0    0    0    0    0    0    0    0    0
hour 19:  0    0    0    0    0    0    0    0    0    0    0    0
hour 20:  0    0    0    0    0    0    0    0    0    0    0    0
hour 21:  0    0    0    0    0    0    0    0    0    0    0    0
hour 22:  0    0    0    0    0    0    0    0    0    0    0    0
hour 23:  0    0    0    0    0    0    0    0    0    0    0    0
```

Also, code a **matrix** file to define how the profiles are related to the **demands** file. In the Toolbar Editor select **File Editor>>matrix** The format is shown below:

```
Matrix count 1
Profile matrix 1

##       to:   1    2    3    4    5    6    7

from 1:        1    1    1    1    1    1    1
from 2:        2    2    2    2    2    2    2
from 3:        1    1    1    1    1    1    1
from 4:        1    1    1    1    1    1    1
from 5:        1    1    1    1    1    1    1
from 6:        1    1    1    1    1    1    1
from 7:        1    1    1    1    1    1    1
```

This matrix defines that trips from Zone 2 will use profile 2 while all other trips are related to profile 1.

Coding the above files will produce the required surge in traffic from Zone 2 between 8:20 and 8:25. Check this by running the simulation.

With multiple profiles the user has the flexibility to code many different profiles together with a large number of ways to relate these to the **demands** files and **Vehicles Manager**. It is therefore important that the user checks the coded combination to ensure these are as required.

There are several ways the model can be checked. Firstly from visualisation of the traffic movements, secondly from the demand (or sector) display and thirdly from statistics output from the model runs. A large number of statistics can be collected but in terms of checking the amount of traffic loaded onto the network the "release counts" are particularly useful.

To collect the release counts specify in the measurements menu the following:

```
generate release counts at 5 minute intervals
```

Note:- Statistics can be collected down to 1 minute intervals.

Set the **Configuration Manager** to have a start time 08:15:00 and simulation time 01:05:00, then and start the simulation.

The simulation will run from 8:15 to 9:20 and the statistics will be written to files in a sub-directory of your present working directory ("***Log/run-001***"). The files are automatically named as "release-08:20:00", "release-08:25:00" etc. Typical output for the first 15 minutes of simulation (i.e. time period 1 8:15 to 8:30) are shown below:

```
Seed 5
08:20:00 Matrix 1

   |   1    2    3    4    5    6    7  Total(Block)Tries
----------------------------------------------------------
  1|   0    0    0    1    1    4    0 |    6 (   0)    6
  2|   0    0    0    0    0    0    0 |    0 (   0)    0
  3|   2    2    0    2    0    3    3 |   12 (   0)   12
  4|   1    1    1    0    2    1    2 |    8 (   0)    8
  5|   6    1    2    2    0    0    1 |   12 (   0)   12
  6|   2    1    1    1    1    0    4 |   10 (   0)   10
  7|   8    3    1    2    0    1    0 |   15 (   0)   15
----------------------------------------------------------
 + |  19    8    5    8    4    9   10 |   63 (   0)   63

08:25:00 Matrix 1

   |   1    2    3    4    5    6    7  Total(Block)Tries
----------------------------------------------------------
  1|   0    4    1    2    1    5    2 |   15 (   0)   15
  2|   9    0   13    6   10   10   15 |   63 (   0)   63
  3|   2    3    0    2    5    7    1 |   20 (   0)   20
  4|   0    3    3    0    1    2    4 |   13 (   0)   13
  5|   5    5    2    4    0    2    3 |   21 (   0)   21
  6|   2    0    2    1    2    0    2 |    9 (   0)    9
  7|   5    3    2    5    6    4    0 |   25 (   0)   25
----------------------------------------------------------
 + |  23   18   23   20   25   30   27 |  166 (   0)  166

08:30:00 Matrix 1

   |   1    2    3    4    5    6    7  Total(Block)Tries
----------------------------------------------------------
  1|   0    5    2    6    6    5    8 |   32 (   0)   32
  2|   0    0    0    0    0    0    0 |    0 (   0)    0
  3|   3    5    0    9    5    5    8 |   35 (   0)   35
  4|   3    6    6    0    8    7    4 |   34 (   0)   34
  5|   6    3    8    4    0    8    7 |   36 (   0)   36
  6|   4    5    5    5    3    0    7 |   29 (   0)   29
  7|  11    2    4    4    9    2    0 |   32 (   0)   32
----------------------------------------------------------
 + |  27   26   25   28   31   27   34 |  198 (   0)  198
```

Note:- All the traffic is released from Zone 2 during the 5 minute period from 8:20 to 8:25. Also, for this particular run the total number of vehicles released for time period 1 was 427 as opposed to the **demands** file total of 420.

10 Traffic Assignment II

10.1 Random Release of Vehicles

The difference of 7 vehicles in the above multiple profile example, is due to random release of traffic within the program. As there is no true random generator of numbers, the program can produce exactly the same results if the same network and demand are used together with the same starting point for generating random numbers. This starting point is known as the seed value.

The seed value can be specified in the **Configuration Manager** or can be left blank in which case Modeller will use the cpu internal clock time, as the seed value. Modeller version 4.0 has a choice of two random number generators, either Marsaglia or Merseene Twister.

Split Random Number Seeds & Streams**,** specify the seed splitting option, designed to separate the use of random numbers in different areas of the simulation, with the result that changes in one area of the simulation will not impact on other areas.

Users are recommended to run the model with different seed values to test the sensitivity of the model. A table showing the fluctuation in release rates with different seed values can indicate the stability of model results for a particular run. For example, the following table shows typical release rates generated with different seed values.

Seed Value	Vehicles Released			
	8:15 to 8:20	8:20 to 8:25 to 8:30	8:25	Total
5	63	166	198	427
314	61	161	197	419
120462	66	152	210	428
100000000	57	165	191	413

The above table shows a variation of + or - 3% in total demand levels which is generally acceptable considering hourly and daily fluctuations in traffic flows.

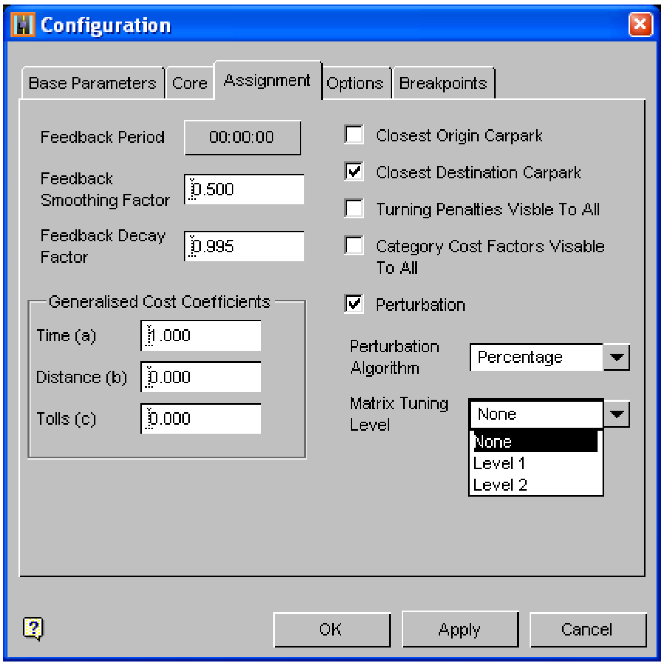
The percentage differences in row and column totals and in individual cell values will be greater than this for two reasons. Firstly the numbers will generally be smaller than the full matrix total (unless the matrix is a single cell value) and secondly the numbers are integers (i.e. complete vehicles). Therefore, it is advisable for the user to assess these variations and decide if they lie within reasonable limits for each particular model.

10.1.1 Modifying the Release of Traffic

By default Paramics produces a random probability of vehicle release, as described above. This method automatically has a built-in fluctuation which may be seen to be representative of daily or hourly changes in traffic flow. This is therefore the recommended procedure for modelling the release of vehicles. It is also advisable to test the sensitivity of the model results using a range of seed values.

In some circumstances these variations in release may be deemed unacceptable therefore two modifications have been incorporated in Modeller to limit the potential departure from input O/D values.

The modifications are activated by selecting **Edit>>Configuration>> Assignment** and using the Matrix Tuning Level combo box to select either Level 1 or Level 2.



Level 1 modifies the probability of release to give a value closer to the stated value but still random. In detail, it factors the probability depending on the previous releases.

Level 2 fixes the release rate to be exactly equal to the specified rate. This level of "fixing" can lead to a sudden rush of vehicles near the end of the period, or alternatively, a total lack of vehicles near the end of the period.

Note:- It is only recommended that Matrix Tuning Level 0 is used in simulating networks

Typical model results with and without matrix tuning are shown below:

Seed Value		Vehicles Released		
5	8:15 to 8:20	8:20 to 8:25	8:25 to 8:30	Total
No Tuning	63	166	198	427
Tuning Level 1	61	170	194	425
Tuning Level 2	62	172	186	420

10.2 Features Affecting Traffic Routing

10.2.1 Restrictions

The section Network Restrictions, on page 79, describes how restrictions for links, lanes and turns are added to the network coding. The network contained in ***Training/demrest2*** has a restriction coded on the southbound link of High Street. Open this network and **View>>Routes** together with selecting the link and zones using the ***Right Mouse Button*** to show the calculated routes for each routing table. Select a link from Zone 3 (link 1:2b) and show the routes from this link to Zone 2.

You may recall that networks with no restrictions only produce two routing tables, one for familiar drivers, the other for unfamiliar drivers. Coding restrictions will, by their very definition, affect the routes calculated for each vehicle type and change the number of routing options available on the network. For this example network four tables are calculated, familiar and unfamiliar for vehicles not affected by the restriction and familiar and unfamiliar for vehicles affected by the restriction.

By showing the routes for each table the Status Report window prints information similar to the following:

```
Link 1:2b -> Zone 2 (table 1): cost = 00:00:47, length = 602 m
Table 1  all types except 13
 -   Familiar
Link 1:2b -> Zone 2 (table 2): cost = 00:00:47, length = 602 m
Table 2  all types except 13
 - Unfamiliar
Link 1:2b -> Zone 2 (table 3): cost = 00:00:49, length = 595 m
Table 3  types 13
 -   Familiar   Restrictions: 1
Link 1:2b -> Zone 2 (table 4): cost = 00:00:49, length = 595 m
Table 4  types 13
 - Unfamiliar   Restrictions: 1
```

Coding more restrictions will increase the number of routing tables. However, Paramics will combine restricts so that the number of tables is kept to a minimum. For example, if lane 2 of the northbound link of the High Street (link 17:4) is restricted to vehicle type 13 and 14 then 6 tables are produced.

```
Table 1  all types except 13 14
 -   Familiar
Table 2  all types except 13 14
 - Unfamiliar
Table 3  types 13
 -   Familiar   Restrictions: 1 2
Table 4  types 13
 - Unfamiliar   Restrictions: 1 2
Table 5  types 14
 -   Familiar   Restrictions: 1
Table 6  types 14
 - Unfamiliar   Restrictions: 1
```

The type restrictions have been split so that tables 3 and 4 relate to vehicles with both restriction 1 and restriction 2 i.e. vehicle type 13. Tables 5 and 6 relate to only type 14 restrictions.

Note:- The greater the number of restrictions the greater the number of routing tables. This can have a significant effect on the processing speed of the simulation as more routing calculations are required.

10.2.2 Forced Lane Changes

Modeller calculates the best lane for a vehicle to be in, by looking several nodes ahead to see the turn definitions at the upstream nodes. This default lane mapping can be overridden by specifying next lanes.

Start the simulation and observe the movement of vehicles travelling north from Zone 6 onto High Street. If the simulation is too fast increase the **Time Steps per second** by either pressing the keyboard minus sign (-) several times or by using **Edit>>Configuration>>Base Parameters** drag the **Time Steps per second** slider bar to the right. The **Time Steps per second** are changed here only for demonstration purposes. It is not advisable to change this value for full model runs as Paramics has been validated for time steps set between 2 and 5 calculations per second. Normally, if you wish to slow the visualisation you are recommended to use the **Inter time-step pause** function (refer to Modeller Reference Manual).

Note:- Altering the Time Steps per second will affect simulation statistics as the random number generator will not follow the same progression as more time steps are specified per second, nullifying the use of a seed value.

Vehicles going north from link 9:7 are in lane 1. As they progress to the High Street link they either go directly to lane 2 on the High Street if they are turning left at the next upstream junction/intersection (node 4) or stay in lane 1 to turn right (or straight ahead). To override this lane mapping open the Toolbar Editor, select node 7 and **Modify Junction**.

Select the **Selected Priority** tab on the left hand side of this window and the **Lane Allocation** tab on the right hand side, the lane allocation and priority are specified for each turn. The **Nextlanes** section is used to define the lane mapping for each specific turn.

Exercise 39

> Change the default lane mapping for the movement from link 9:7 to link 7:17 so traffic leaves lane 1 on link 9:7 and goes directly to lane 2 on link 7:17.

First, from the Editor Toolbar, select node 7 and **Modify Junction**. Then in the **Edit Junction** window **Selected Priority**, select the turn from node 9 to node 7 to node 17. Remember that this turn will be highlighted in yellow once the user has clicked the left hand mouse button on the approach link, then keeping the button pressed move the mouse arrow towards the appropriate exit link and release. For the highlighted movement the Turn allocation will show Turning Lanes "1-1". Below the Lane allocation the "1->" shows that only lane 1 is allowed for this turn and by clicking on the up and down arrows, to the right of "1->", the default lane mapping changes. To check the coded changes to lane mapping ensure that **View>>Model Layers>>Next Lanes** is toggled on.

Click on the arrows until "2-2" is shown beside lane 1 (i.e. "1->"). If **View>>Model Layers>>Next Lanes** is on, then a white line will be drawn in the Simulation window from lane 1 on link 9:7 to lane 2 on link 7:17. This represents the change in lane mapping from program default to the value defined by the user. **Save and Refresh** and start the simulation.

All traffic travelling north from Zone 6 is forced into lane 2 of the northbound link of High Street. However, vehicles turning right or going straight ahead at node 4 weave immediately to lane 1 after entering the High Street link.

The use of next lanes is a flexible alternative to the default lane mapping. For example, coding next lanes can be used to create the effect of spiral road marks on roundabouts and for controlling the weaving of traffic between lanes.

Note:- The default lane mapping for vehicle transferring from the current link to the downstream link is lane 1 to lane 1, lane 2 to lane 2 etc. (See page 48 of the Reference Manual).

It is possible for the user to specify a range for next lanes. For example, with the above turn (9:7:17) the range "1-2" could be specified as opposed to "2-2". This shows that lanes 1 and 2 on the exit link could be used for that turning movement. Also if more than one lane is permitted for the approaching traffic, then next lanes may be specified for each individual lane (select node 3 and turn 4:3:2d to show that next lanes may be coded for lanes 1 ("1->") and 2 ("2->")).

A further option can be used to force traffic to stay in lane. Using the Editor Toolbar select the short link on High Street (link 7:17), north of the Park Lane/Kelly Lane/High Street junction/intersection. Then **Modify Link>>Show>>Flags** and toggle the **Stay in Lane** function to on. **Apply and Close**, **Save and Refresh** and restart the simulation. Note how the traffic is not permitted to change lane over the full length of the link.

10.3 Averaging Feedback Costs

Feedback costs are in affect turning delay costs calculated during a simulation run. In the **Configuration Manager** a feedback time is set, say 5 minutes, and for each 5 minute time step Modeller counts the vehicles making individual turns and the time these vehicles take to turn. The delay per vehicle is then calculated and stored in the program as a cost. In addition, a smoothing function is used to limit the oscillations in costs.

The overall effects are explained in the following example:

Assuming feedback at 2 minute intervals. Then the delay for a particular turn (DT) for 0 to 2 minutes –

$$DT_{(0\ to\ 2)} = \frac{\Sigma_{(0\ to\ 2)}\ \text{times of turning vehicles}}{\Sigma_{(0\ to\ 2)}\ \text{vehicles making the turn}}$$

$$DT_{(2\ to\ 4)} = \frac{[\ \Sigma_{(2\ to\ 4)}\ \text{times of turning vehicles}\ ]}{[\ \Sigma_{(2\ to\ 4)}\ \text{vehicles making the turn}\ ]} *0.8 + 0.2 * [DT_{(0\ to\ 2)}]$$

$$DT_{(4\ to\ 6)} = \frac{[\ \Sigma_{(4\ to\ 6)}\ \text{times of turning vehicles}\ ]}{[\ \Sigma_{(4\ to\ 6)}\ \text{vehicles making the turn}\ ]} *0.8 + (0.2*[DT_{(2\ to\ 4)}])$$

Which can also be expressed as:

$$DT_{(4\ to\ 6)} = \frac{[\ \Sigma_{(4\ to\ 6)}\ \text{times of turning vehicles}\ ]}{[\ \Sigma_{(4\ to\ 6)}\ \text{vehicles making the turn}\ ]} *0.8 + (0.16*[DT_{(2\ to\ 4)}] + 0.04*[DT_{(0\ to\ 2)}])$$

With feedback activated, the averaged and damped turn delay costs are read into Modeller and used to calculate new routing tables. By default, feedback calculations only affect familiar drivers. However, by toggling on **turning penalties visible to all** in **Edit>>Configuration>>Assignment**, the routes for unfamiliar drivers will also include turning delays.

The default smoothing factor of 0.5 can also be changed to 0.7 within **Edit>>Configuration>>Assignment**.

Note:- A feedback smoothing factor of 1.0 will only use the delays from the previous feedback period.

Exercise 40

Select **Edit>>Configuration>>Assignment** and set the feedback value 5 minutes. Paramics will round the feedback value down to the nearest minute i.e. feedback 462 is rounded to 420 seconds or 7 minutes.

Note:- Feedback values 1 to 59 are read as zero minutes, therefore no feedback is calculated.

Before starting the simulation, show the routes from link 11:10 to Zone 4. Select link 11:10 using the ***Right Mouse Button*** and Zone 4 also using ***Right Mouse Button***, and then show the routes (**View>> Routes>>Show Route (From Link to Zone)**) for all 4 routing tables. The Status Report window should give the following information:

```
Link 11:10 -> Zone 4 (table 1): cost = 00:00:38, length = 1353 ft
Table 1  all types except 13
 -   Familiar
Link 11:10 -> Zone 4 (table 2): cost = 00:00:38, length = 1353 ft
Table 2  all types except 13
 - Unfamiliar
Link 11:10 -> Zone 4 (table 3): cost = 00:00:38, length = 1353 ft
Table 3  types 13
 -   Familiar   Restrictions: 1
Link 11:10 -> Zone 4 (table 4): cost = 00:00:38, length = 1353 ft
Table 4  types 13
 - Unfamiliar   Restrictions: 1
```

All tables have the same costs. Start the simulation and run until after the second feedback calculation has been completed (at simulation time 7:05). The Status Report window will display the message "07:05:00 Delay feedback - recalculating routes". Again, show the routes for all tables, from link 11:10 to Zone 4. The Status Report window will display the information shown below:

```
Link 11:10 -> Zone 4 (table 1): cost = 00:00:50, length = 1353 ft
Table 1  all types except 13
 -   Familiar
Link 11:10 -> Zone 4 (table 2): cost = 00:00:38, length = 1353 ft
Table 2  all types except 13
 - Unfamiliar
Link 11:10 -> Zone 4 (table 3): cost = 00:00:50, length = 1353 ft
Table 3  types 13
 -   Familiar   Restrictions: 1
Link 11:10 -> Zone 4 (table 4): cost = 00:00:38, length = 1353 ft
Table 4  types 13
 - Unfamiliar   Restrictions: 1
```

The cost for familiar drivers has been changed from 38 to 50 but unfamiliar costs remain the same.

Toggle on **turning penalties visible to all** in the **Configuration Manager**. If you repeat the above procedure and visualise the route costs at 7:05:00 both familiar and unfamiliar costs have been updated from 38 to 50.

Even though the turning delays are damped, there is no guarantee that large oscillations in turning costs will not occur. As well as viewing the route costs, Modeller outputs these costs to a file if **gather feedback costs** is toggled on in **Edit>>Measurements>>General** menu.

This will save a set of files "feedback-HH:MM:SS" in the statistic run directory for intervals set by the feedback specification in the **Configuration Manager**.

For example, if the Paramics network is in a directory called "***Paramics/data/network***" then by editing the measurements to include **feedback cost** and **Configuration Manager** to include the following :

Start Time	Duration	Seed	Feedback Period
08:15:00	01:05:00	5.0	00:05:00

The statistics directory "***Paramics/data/network/Log/run-001***", will contain files called "feedback-08:30:00" etc..

Note:- The **Configuration Manager** may also include **turning penalties visible to all** if the feedback costs were to be applied to unfamiliar drivers.

The user can analyse the results by loading these feedback files into a spreadsheet or similar tool.

In addition, the averaged list of turning penalties can be put back into the network data directory as a file called **feedback**. This file will be loaded with the network and used to determine the initial turning penalties which normally all start out at zero seconds delay.

One potential use for this option could be to run the model initially to calculate the feedback costs at say 5 minute intervals, for an hour of simulation. These costs could be averaged (using a spreadsheet or similar tool) and then imported back into the model as the initial set of turning costs (using the file called **feedback**). The averaging should damp the effects of oscillating feedback costs and may give a more accurate set of initial costs.

Note:- It should be highlighted that this option has been incorporated to increase the flexibility for changing the routing and has not been included as a recommended procedure. Therefore, this problem should be implemented with caution, as with all models there should be an extensive set of checks on the traffic routings.

10.4 Additional Exercises

A list of further tutorial exercises follows.

Exercise 41

At the traffic signal junction/intersection of Park Lane/Kelly Lane/High Street code the left turn lanes from the south and from the north as "stacking lanes".

Using the Editor Toolbar, select the **Stop Line** editor and select the stop line for the left turn. Select the **Make Stacking** icon and reposition the stack stop line nearer the centre of the junction/intersection (after selecting the stopline, hold the <shift> key and click with the ***middle mouse button*** to move the selected stopline to a new position). Repeat this process with the other left turn lane and **Save and Refresh** the changes. The stop lines are now shown with a little blue arrow to indicate the associated stop line as stacking. Restart the simulation. The left turning traffic should now queue at the new stacking position during the green phase for the associated turn.

Exercise 42

Trace and follow a selected vehicle through the network using the **Tools>> Dashboard Tracer** function.

Select **Tools>> Dashboard Tracer** to open the Dashboard View window and start the simulation. In the Simulation window select a vehicle by clicking over the vehicle with the ***Right mouse button*** and selecting ***Follow Vehicle*** option. The **View** and **Tracers** options within the Dashboard View window can then be used to select "Follow1" (follow vehicle 1) or to destroy different tagged vehicles. The Dashboard View window will display a representation of the vehicle dashboard with speedometer, gear shift etc.

Exercise 43

Describe the information provided when the **View>>Dynamic Measurement Flow, View>>Dynamic Measurements >>Speed**, and **View>> Dynamic Measurements>> Density** functions are activated.

Exercise 44

What does the **Tools**>>**Options>>Fast Navigation** function do?

Detailed explanations for the functions mentioned in the previous two exercises are contained in the Modeller Reference Manual.

Exercise 45

Identify different coded link speeds.

Edit the **Categories Manager** so different colours are associated to different speeds using the following information.

Category	Lanes	Speed (mph)	Width (ft)	Type	Colour
1	1	30.0	12.0	urban minor	green
2	2	30.0	24.0	urban minor	green
3	3	30.0	36.0	urban minor	green
4	4	30.0	48.0	urban minor	green
5	1	40.0	12.0	urban minor	cyan
6	2	40.0	24.0	urban minor	cyan
7	3	40.0	36.0	urban minor	cyan
8	4	40.0	48.0	urban minor	cyan
21	1	30.0	12.0	urban major	white
22	2	30.0	24.0	urban major	white
23	3	30.0	36.0	urban major	white
24	4	30.0	48.0	urban major	white
25	1	40.0	12.0	urban major	yellow
26	2	40.0	24.0	urban major	yellow
27	3	40.0	36.0	urban major	yellow
28	4	40.0	48.0	urban major	yellow

To view different link speeds select **View>>Links>>Category**.

10.5 Strategic Routes

Strategic routes are used to prevent unrepresentative routing of vehicles where multiple routes are possible but unlikely to be taken. For example, strategic routes may be used to prevent a vehicle from leaving the main highway link at an interchange, and then returning to the highway link on the other side of the interchange.

Exercise 46

Use the command **File>>Open** to activate network data selection browser and select ***Training/Strategic*** and select **Open**.

The network is a combination of urban and highway road infrastructure. The interchange of interest in this exercise is located in the centre of the highway.

Mark the vehicles routing between **Zone 2** and **Zone 4** and vice versa using **Edit>>Marking**.

When the simulation is run the user will observe a minority of vehicles between the two zones routing via the on and off ramps.

This phenomenon occurs as a direct result of the assignment criteria applied. Vehicles see this as an acceptable route based on this criteria where in reality it is unlikely to happen. Application of strategic routes removes the local effects of perturbation and dynamic feedback effectively enforcing AON assignment to vehicles between the start and end point of a Strategic Route and therefore solving the problem.

Strategic routes are applied in such a manner that a 'cordon' is created enclosing the chosen junction/intersection

The following links are the entry point to the cordon:

7:8

66:17

132:12

37:31

Open the **Editor Toolbar** and select **Edit Strategic Routes.** Individually select each entry link using the ***middle mouse button***, while holding down **<ctrl>.**

All entry points should be marked as Green.

The blue area highlighted should be minimised to the smallest possible area by placing the exit points as close to the junction/intersection as possible.

The following links are the exit points to the cordon:

35:15

17:66

11:133

31:37

Individually select each exit link using the ***right mouse button***, while holding down **<ctrl>** then **Save and Refresh**.

All entry points should be marked as green and all exit points should be marked as red, the blue area highlighted should be constrained within the marked entry and exit links. This is the area that the AON assignment will be applied.

Select **File>>Reload Network** and run the simulation. The user will observe that vehicles no longer route via the on and off ramps.

10.6 Generalised Cost Coefficient

The Generalised Cost Coefficients can be used to control the way in which perceived cost is represented, by weighting time, distance and toll pricing. This provides the user with a certain degree of control over the base route-choice decisions made by each vehicle in the simulation.

The aim of this exercise is to reiterate the importance of calibrating the correct weighting in the generalised cost equation to key OD pairs prior to assigning demand.

Exercise 47

Use the command **File>>Open** to activate network data selection browser and select ***Training/CostEquation*** and select **Open**.

Ensure that the Highway/Urban links display is toggled on by selecting **View>>Links>>Highway/Urban**.

The network consists of a network with two alternative routes between two zones. The first route (red) is a straight urban road with a speed limit of 30 mph, the second (blue) curved highway with a speed limit of 70 mph.

Firstly, use the ***Right Mouse Button*** to select **Link 1:2**, then also select **Zone 2** in the same way. Finally choose **View>>Routes** and toggle show route in the **Routing Display Control** menu.

The user will observe that the AON route based on the default cost equation coefficient uses the blue route because based on time this route has the cheapest cost.

Change the **Generalised Cost Coefficient** so that the equation favours distance i.e. Time=0, Distance=1 and Tolls = 0 using the **Configuration Manager**.

Repeat the selection of the link/zone combination using the ***Right Mouse Button*** and then **View>>Routes**.

The user will now observe that the AON route now uses the red route because based on distance this route has the cheapest cost.

In addition, combinations of the different costs can be applied. It is good practice to try 3 or 4 Generalised Cost Equations so the user can establish the sensitivity of the base costs. Alterations maybe required to category cost factors (See Modeller Reference Manual page 34) to stabilize the base route costs.

11 Collecting & Analysing Model Results II

11.1 Gathering Loop Detector Data

Model statistics can be collected across the entire network and/or at specific points in the network. The section Statistics, on page 72 describes how to collect network wide data. For individual point information, the detector must first be defined where data is to be collected (i.e. code detectors) and then specify what types of data are required. This data can then be output to text files (if requested in the measurements menu) or can be viewed interactively as the model is running.

11.1.1 Generated Text Files

The Reference Manual lists the statistics that may be defined and output from the **Measurements Manager**. This list is quite comprehensive in terms of general model output and has been developed from requests by current Paramics users. However, further statistics can be output if required for specific models. In these circumstances the specification for the data required, should be passed to the Paramics Support Team so any possible program development can be assessed.

To collect loop detector data the user needs to code detectors, as described on page 82. Once the loop detectors have been specified and saved, model data can be observed interactively (refer to the following section) or can be output to ASCII files for analysis. The following exercise provides an example for extracting loop data to ASCII files.

Exercise 48

> Collect output statistics from loop detectors by selecting **Edit>>Measurements>>Loops** and choosing from the two lists, Point Data and Link Data.

The format of the generated ASCII files is described in the Modeller Reference Manual. These files can be imported into an analysis tool or spreadsheet for reporting purposes.

Statistics can be output to the format required for the Analyser Module. To output data for Analyser set the time interval in the **Measurements Manager>>Periodic>>Analyser Date**. A full description of functionality within Analyser is contained in the Analyser User Manual.

11.1.2 Interactive Detector Data

As described above, the first step is to define the location and position of the loop detector. Statistics can be viewed interactively using **View>>Detectors.** The Detectors window is used to switch the value that is displayed for each loop. One value is shown for each lane on the link where a loop is attached. The choices are:

- **Occupancy** - the time that the loop is occupied (incomplete, complete, smoothed)
- **Gap** - the time that the loop is unoccupied between vehicles (incomplete, complete, smoothed)
- **Headway** - the time between leading edges of successive vehicles (complete, smoothed)
- **Flow** - the instantaneous flow calculated from inverting the headway (instantaneous, smoothed)
- **Speed** - for double loops, the speed calculated from the time difference between two rising edges (instantaneous, smoothed)
- **Count** – the cumulated total number of vehicles counted in each lane
- **Edges** - the raw times at which the vehicles' presence or absence is detected.

The option **Tools>>Dynamic Graphs>>Link Statistics** may also be used to display a range of real time graphs both for links and detectors. Instantaneous values can be displayed for the currently selected detector while mean values can be displayed for the currently selected link.

Use the Right Mouse Button to select either a Detector or a Link to display a graph where the user has chosen appropriate X and Y axes. Vehicle type and sample rate can be varied using the pull-down menu.

Further information on gathering and viewing output data can be found in the 'Gathering Output Data' Technical Note.

12 Index

A

Add Node, 17
Adding a Link, 16
All-or-nothing, 64
Annotation, 41

C

Categories, 18, 26, 56, 74
Category Cost Factors, 61
Configuration, 22, 55, 60, 63, 66, 105

D

Demand
  Matrices, 44, 45, 47, 53, 58, 88, 95
Detectors, 68, 82, 118, 119
Devices, 18
Display Settings, 15
Dropdown Menus, 11
Dynamic Assignment, 64, 67

E

Edit Curves, 38, 76
Editor Help, 16
Editor Options, 16
Editor Toolbar, 10, 84, 88, 100, 109

F

File Editor, 16
Flags, 18

G

generalised cost coefficients, 61, 62, 116
Grid, 23

K

Kerbs and Stop Lines, 40, 46, 75, 78

L

Lane Choices, 84
Link Attributes, 18
Link Cost Factors, 62
Link Modifiers, 18

M

Major/Minor, 65
Modeller window, 8
Modeller Window, 9
Modify Junction, 17, 32, 36, 38, 99
Mouse
  Mouse Navigation, 12
Moving objects, 17, 19, 25

N

Navigation, 12
new network, 6, 10, 24, 41, 76
Node Editing, 17

O

Output Statistics, 68, 72
Overlays
  bmp, dxf and tga, 23, 24, 25

P

Preset views, 11

R

Refresh Only, 16
Reporter Window, 12
Restrictions, 79, 82, 100, 107
Roundabout, 29, 38

S

Save and Refresh, 16
Sign Posting, 83, 84
Start Simulation, 20
Stochastic, 64, 66, 67
Strategic Routes, 115

U

Units, 23

V

Vertices, 19
Visibility, 39

Z

Zones, 19, 44, 48, 90

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