APPENDIX H

Simulation Network Coding – Guidance Note

H. Simulation Network Coding – Guidance Note

INTRODUCTION

H.1 The G-BATS3 (2006) network is an updated and extended version of BATS2 network with: (i) extension of the simulation network to Bristol Airport; (ii) updating the junctions around the Broadmead redevelopment, (iii) alterations to centroid connectors based on the new zoning system and (iv) updates to signal timings. The coding for the extended simulation network was based on the standards adopted for BATS2 model.

H.2 The generic standards adopted in the previous BATS2 models are detailed below – these may be modified to suite local operating conditions and characteristics.

NETWORK CODING STANDARDS

H.3 The coding of the BATS1.1 model simulation network was based on providing a robust estimate of junction capacity related to the physical layout of the intersection. This process was based on the calculation of SATURN saturation flows (capacities) using the ARCADY, TRANSYT and PICADY formula in the following TRL reports:

- Signalised junctions – TRL Research Report 67;
- Roundabout junctions – TRL Research Report 36;
- Priority Junctions, Opposed movements – TRL Research Report 35; and
- Priority Junctions, Unopposed movements – TRL Research Report 67.

H.4 To illustrate the coding of various junction types a typical example is given below for the following junction types:

- Traffic Signals
- Roundabout
- Signalised Roundabout
- Motorway On-Slip
- Priority Junctions

H.5 These formulae are used in spreadsheets specifically designed for calculating SATURN saturation flows.

H.6 In addition to SATURN Saturation Flows, the definition of junctions within SATURN is based on understanding how SATURN represents the interaction of traffic at junctions. A brief overview of the main parameters is detailed below (further details can be found in the SATURN manual).

- SATURN Saturation Flows
  - Defined as ‘the maximum number of pcu’s per hour which could undertake a movement provided there were no other vehicles on the road, no red lights to oppose it etc.’;
  - Calculated on a Turn basis;

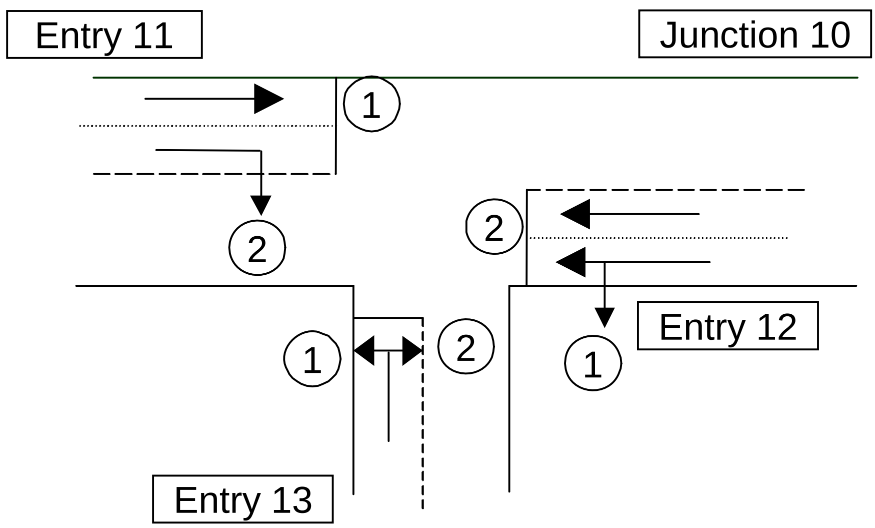
- Lane Allocation
  - Lane usage is allocated by turns;
  - More than one lane can be allocated to a single turn;
- Turn Allocation
  - A SATURN Saturation must be allocated to each turn;
  - Multiple adjacent lanes can be allocated to a single turn;
- Gap Acceptance
  - Applies to roundabouts, priority junctions, merges and right turns in traffic signals which cross opposing traffic;
  - Reflects geometric alignment of junction and driver perception of available 'Gaps' in traffic flows;
  - SATURN gaps are accepted to be approximately half the driver perceived gap;
- Stacking Capacity
  - Reflects the available road space to store a queue
  - Default calculation in SATURN = (Number Lanes * Link Length)/5.75;
  - Can be defined by users to reflect flaring at junctions, or stacking capacity reductions due to Box Junctions;
  - Can be used to reflect locations where traffic may be queue with more/less average pcu queue length of 5.75 metres. Typical examples include motorway queuing, which generally have lengths of 7 to 9 metres between the front of one car to another. Values of less than 4 metres should be avoided since the average length of cars in the UK is about 4 metres;
- Speed Flow
  - Defined by link characteristics – Rural, Sub-Urban, Urban-Non-Central or Urban-Central;
  - Used in simulation coding to reflect delays along the link due to turns onto minor roads (or parking activities) and congestion due to heavy traffic;

H.7 Examples of SATURN Simulation Network Coding:

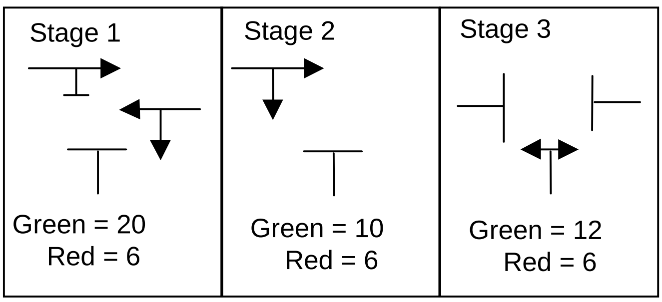
Traffic Signals

H.8 The definition of traffic signals in SATURN requires the definition of both the saturation flows and signal timing information. The following example considers a simple three arm signalised T-junction.

Junction Plan



Signal Stage Diagram



Cycle Time = 60

H.9 The junction plan illustrates a typical signalised junction located on a main road (entry 11 and 12) with a minor road (entry 13). The main road has two lanes on both entries, with entry 11 having lane 1 allocated to the straight across movement and lane 2 to the right turn into the minor road. The main road entry again has 2 lanes with the left turn allocated to lane 1 and the straight allocated to lanes 1 and 2. The minor entry 13 has a single lane, which allows both left and right turns onto the main road.

H.10 The calculation of SATURN Saturation flows is shown in the following table which is extracted from the spreadsheet developed for these calculations:

H.11 Calculation of SATURN Saturation Flows

Node Number			10					
Entry Node Number	Turn	Slope	Lane Width	Turn Prop'n	Turn Radius	Lane Factor	Saturation Flow	Multiple Lanes
11	1	0	2.5	0	0	1	1865	
	2	0	2.5	1	25	0	1892	
12	1	2	2.5	1	20	1	1657	
	2	2	2.5	0	0	1	1781	
	2	2	2.5	0	0	0	1921	3702
13	1	0	3	1	20	1	1781	
	2	0	3	1	25	1	1807	

H.12 The SATURN network coding to represent this signalised junction is given below.

```
10     3    3    3    0   60          25         Line 1
      11*   2   55  100 1865  1 1 1892  2 2      Line 2
           55   25 1650           1.65   35      Line 3
90    12*   2   55  275 1657  1 1 3702  1 2      Line 4
           55   25 1650           1.65   35      Line 5
      13*   1   55  500 1781  1 1 1807  1 1      Line 6
           55   25 1650           1.65   35      Line 7
           20    6    4   12    0   11   12      Line 8
           10    6    2   11    0                Line 9
           12    6    2   13    0                Line10
```

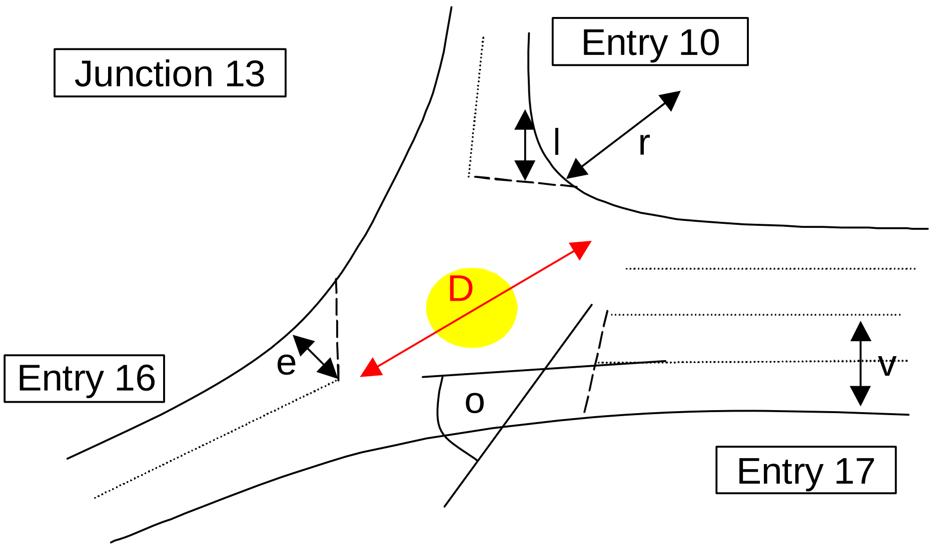
H.13 Line 1 defines the node number, and associated data relating to number of entry links, junction type, signal stages, signal cycle length and gap acceptance. Lines 2, 4 and 6 define the number of lanes, entry data, link speeds, link lengths, and turn saturation flows and lane usage. Lines 3, 5 and 7 define the link speed-flow curves. Lines 8,9 and 10 define the signal timing data for the three stages giving green and inter-green times and the turns to which the stage applies.

H.14 Traffic signals in the BATS1.1 model had signal timing data based on the control method, either UTC or vehicle actuated. The UTC based signals had initial times based on data supplied by BCC extracted from the UTC system. This provided average green stage lengths over the model time period for each of the signals in the UTC system (Bristol City Centre). The remaining signals are primarily vehicle actuated and are based on demand responsive system which senses queue lengths to determine signal timings. The initial signal timings for these signals were based on the maximum green times allowed for in each stage of the signal cycle. The final calibrated signal timings in the BATS1.1 model adjusted the signal settings to best reflect the observed journey time and traffic count data used in the model development.

Roundabouts

H.15 The coding of roundabouts in SATURN is based on defining the entry and circulating saturation flows and gap acceptance. These three parameters can be determined by the geometry of the junction. The following example considers a three arm roundabout.

Junction Plan



H.16 The plan shows entries 10 and 16 as single lane entries with some flaring on the approaches to the roundabout. Entry 17 is from a dual carriageway and has minimal flaring on the entry. The geometric parameters are shown on the plan and are as follows:

D = Inscribed Circle Diameter

V = Approach Half Width

E = Entry Width

L = Flare Length

O = Entry Angle

R = Entry Radii

H.17 These six parameters provide the geometric input data used to calculate entry and circulating saturation flows and the gap.

JUNCTION		**GEOMETRICS**							**CALCULATIONS**		
									SATURATION FLOWS		
		No.of lanes	app width	entry width	flare length	entry angle	curve radius	inscribed diam	Entry	Circulation	GAP
No	Entry	*(NL)*	*(v)*	*(e)*	*(l)*	*(o)*	*(r)*	*(D)*	*(QE)*	*(QC)*	*(g)*
13	10	1	3.5	5	7	35	20	40	1307	2342	1.5
	17	2	7.3	7.5	1	35	200	40	2309	2993	1.2
	16	1	3.5	4.5	15	35	20	40	1287	2323	1.5
		Circulation time =						11		2323	1.5

H.18 The SATURN network coding for this roundabout is given below:

```
13     3     2    11  2323              15        Line 1
          10*    1    55   500 1307   1 1 1307   1 1  Line 2
                55    25 1650              1.65    35  Line 3
          17*    2    68   500 2309   1 2 2309   1 2  Line 4
                68    35 3450              3.47    32  Line 5
          16*    1    55   100 1287   1 1 1287   1 1  Line 6
                55    25 1650              1.65    35  Line 7
```

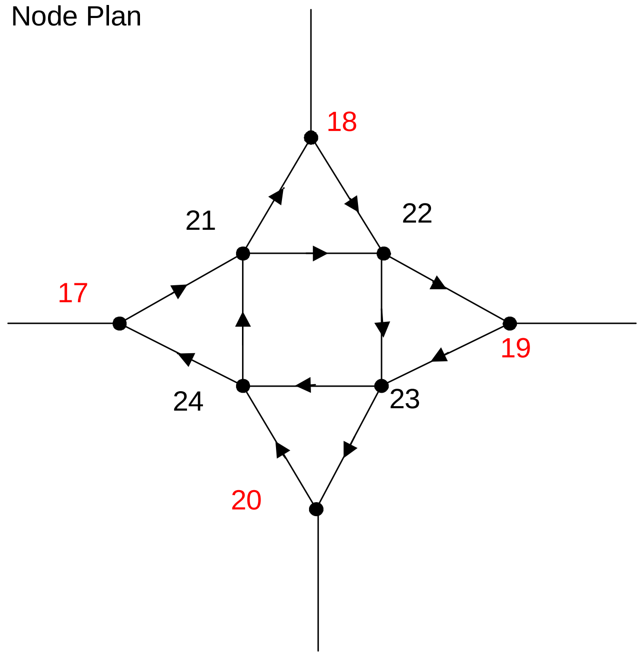
H.19 Line 1 defines the junction node data. Lines 2, 4 and 6 define the entry data and lines 3,5 and 7 define the speed flow curves.

Signalised Roundabouts

H.20 The coding of signalised roundabouts in SATURN is based on coding of traffic lights, with the entries and circulating lanes defined separately. The usual approach is to code the signalised roundabout as a 'square-about' with the central square forming the circulating lanes of the roundabout and the corners being the location of the signal on each of the entries. Usually the entry/exit arms to the roundabout are represented with a triangular formulation linking to the sides of the square.

H.21 This approach can be generalised from four arm roundabouts to 3 to 6+ arm roundabouts. The method also allows for partially signalised roundabouts to be represented with the non-signalised arms acting as priority junctions with entry / circulating saturation flows and gap acceptance defined in line with values for a normal roundabout.

H.22 The following example considers a four entry signalised roundabout with a signalised entries.



H.23 The nodes 21 to 24 are signalised nodes, and nodes 17 to 20 are priority nodes, which link the two elements of the triangular elements to the junction representation.

H.24 The SATURN network coding for this signalised roundabout is given below:

```
17     3    1                                                            Line 1
      13*    2    68   500 3450   1 2     0   0 0                         Line 2
            68    35 3450              3.47    32                         Line 3
      21     0                                                            Line 5
      24*    2    68   100 3450   1 2     0   0 0                         Line 6
            68    35 3450              3.47    32                         Line 7
 21     4    3     2     0    60          25    25                        Line 8
      24     2    45    75     0   0 0 1900   1 1 3820   1 2              Line 9
      17     3    45   100 3720   1 2 3720   2 3                          Line 10
      18     0                                                            Line 11
      22     0                                                            Line 12
            16     6     2    24     0                                    Line 13
            24     6     2    17     0                                    Line 14
```

H.25 The coding example above illustrates the coding for node 17 (lines 1 to 7) and node 21 (lines 8 to 14). The calculation of the saturation flows for the signalised elements are based on the same approach as for a standard signal junction. The main difference in a signalised roundabout is the specification of turn radii which needs to be considered in the context of both the approach and exit movements. On the entry arms into the roundabout the left turn is as a standard signal and as a measurable turn radii, the straight and right turn are usually considered together and are both effectively straight on movements with no turn radii. The circulating lanes are always turning with a circular radii based on the centre of the roundabout (or effective centre if an oval shape).

H.26 The flaring of lanes on the approaches at signalised roundabouts (and some signals) can have a significant impact on the capacity of the junction. The current versions of TRANSYT have the impact of flares incorporated into its calculation of signal times. However, the method employed in TRANSYT is not directly applicable to SATURN, but can be accounted for using the following estimated method.

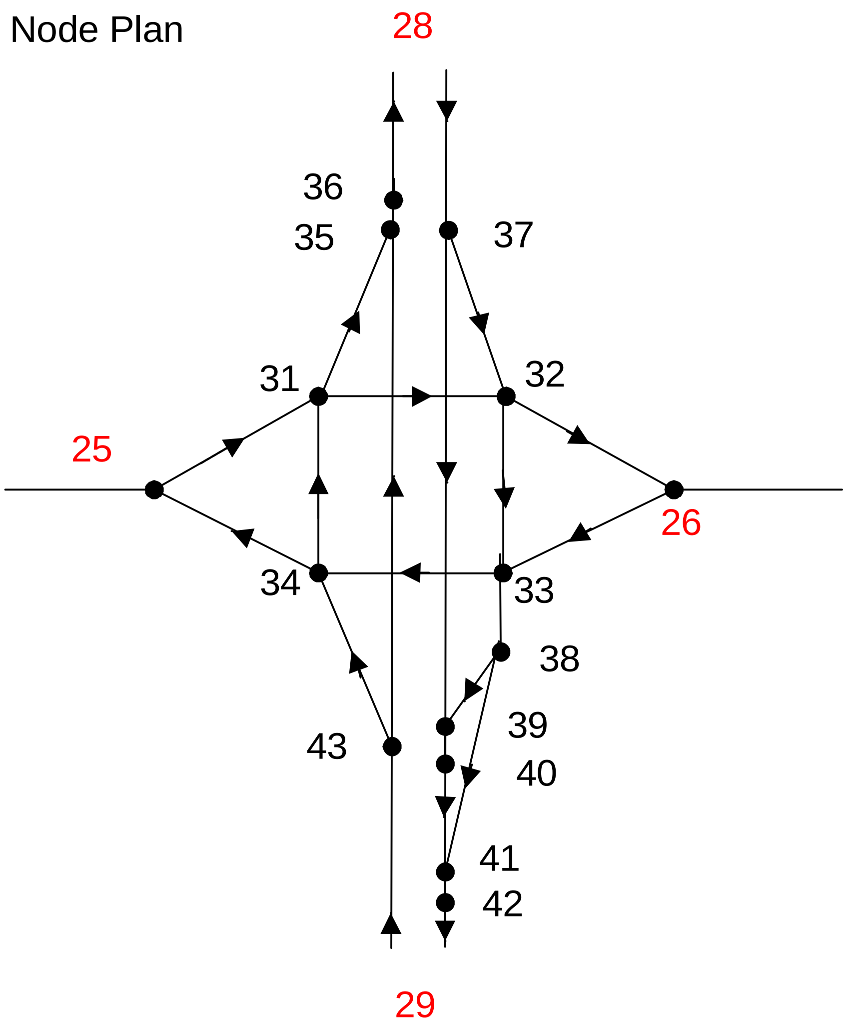
H.27 The main impact of flaring is to reduce the effective saturation capacity across a stop line. This is because the flare is effectively used for only part of the green time in a signal stage, when the flare is able to provide a source of traffic equivalent to the flares storage capacity. The steps for estimating flare impact are as follows:

- Calculate saturation flow as normal = S
- Estimate the flare capacity in pcus = (length of flare in metres)/ 5.75 = A;
- Estimate flare clearance time = A*2 (seconds), assumes one pcu can clear the flare per 2 seconds;
- Obtain the green stage length over which the flare can discharge = B
- If A*2 > B then effective saturation flow S' = S;
- If A*2<B then effective saturation flow S'' = S*((A*2)/B).

Motorway Junctions

H.28 Motorway junctions often consist of a two level junction with a roundabout/signalised junction configuration linking the motorway to the main road network and then a series of on/off-slips connecting to the motorway carriageway. The motorway system is best represented as a series of one-way links since this improves the representation of merge and diverge movements.

H.29 The following example considers multi-level junctions with a signalised roundabout located above/below the motorway with a set of two on-slips and two off-slips. The southbound on-slip has two distinct merge locations which would usually be equivalent to the use of separated merge markings painted onto the merge slip roads ('tiger tales').



H.30 This plan shows the use of 'stopper nodes' on the end of the merges, located at nodes 36 for the northbound merge and 40/42 for the southbound merge. Stopper nodes were developed by Atkins to improve the representation of queuing at merges that occurs at high flow levels.

H.31 The basis of operation is that the stopper node is located some 50m to 100m down stream of the on-slip (merge) and has a capacity limit set to the speed flow capacity of the main motorway link. When traffic flows exceed this capacity a queue begins to form at this node, which then blocks back along the motorway. Once the queue reaches the on-slip node it then interacts with the slip lane and the main carriageway to generate queues long each link on an equal basis. This models the type of queuing that occurs at motorway on-slip merges, which result when traffic flows begin to exceed the capacity of the motorway links.

H.32 If stopper nodes are not used the merge and main line traffic flows may then significantly exceed the capacity of the link downstream of the on-slip merge. The next location where capacity of the link is defined is likely to be at the next diverge. The consequence would then be the generation of a queue at this diverge node. Queuing at diverges does occur, but usually has a consequence of queue forming on the off-slip first, rather than at the diverge itself.

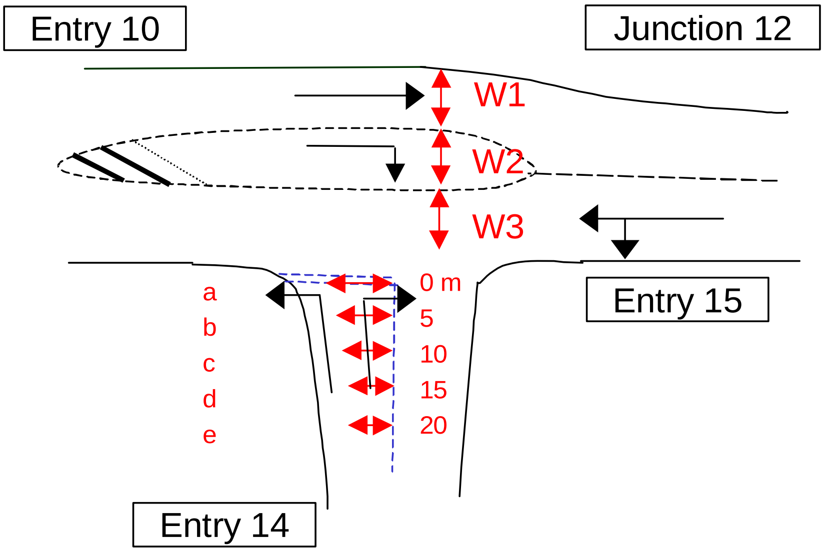
H.33 The SATURN coding for a selection of the nodes in the example is listed below:

```
38     3    1
       33*    2  105   200 2180   1 1 2180   2 2
          105   45 4360            3.68     4
       41    0
       39    0
39     3    1
       37*    2  116   850    0   0 0 5040   1 2
          116   45 5040            3.81     1
       38*    1  105   150 2180   1 1    0   0 0
          105   45 2180            3.68     4
       40    0
40     2    1
       39*    2  116    50 5040   1 2
          116   45 5040            3.81     1
       41    0
41     3    1
       40*    2  116   100    0   0 0 5040   1 2
          116   45 5040            3.81     1
       38*    1  105   275 2180   1 1    0   0 0
          105   45 2180            3.68     4
       42    0
42     2    1
       41*    3  116    50 7560   1 3
          116   45 7560            3.81     1
       29    0
```

Priority Junctions

H.34 Priority junctions represent the give-way movement of a minor road onto a major road and the movement from the major road to the minor. The calculation of saturation flows is key to the junction plus the allocation of lanes and the use of SATURN priority markers. The following example considers a three arm T-junction with a two major arms and a single minor arm.

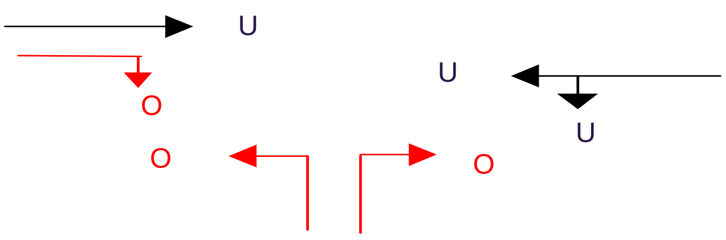
Junction Plan



H.35 The junction plan shows the various measurements that are undertaken to estimate the saturation capacities on both the major arms and minor arms. The major road measurements are carriageway widths W1, W2 and W3. The minor are measurements 'a,b,c,d and e' which are used to estimate the road width on the minor approach. The road width on the minor approach = (a+b+c+d+e)/5. The other measurements relate to length of sight lines, which need to be estimated from a wider plan of the junction, and are usually in the range of 50m to 250 m

H.36 The movements at a priority junction are classified into un-opposed and opposed movements, which determine the formulae used in calculating saturation flows. The un-opposed and opposed movements for a T-junction are as follows:

Un-Opposed/Opposed Definition



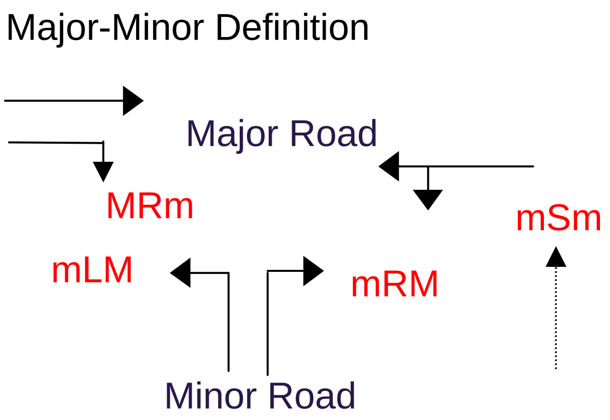
H.37 The definition of movements from major to minor arms of the junction and minor to major are also required to calculate saturation flows. The definitions are as follows:

MRm = Major Right minor

mSm = minor Straight minor (X-roads)

mLM = minor Left Major

mRM = minor Right Major



H.38 The geometric calculation of saturation flows for un-opposed and opposed turns in the T-junction example are listed below:

Priority Un-Opposed

MOVEMENT			GEOMETRICS						CALC
Jctn			Lane	Slope	Lane	Turn	Radius	Lane	Saturation
A node	B Node	C node	no.		width	prop'n	mtr	factor	Flow
10	12	15	1	0.5	3.2	0	0	1	1914
15	12	14	1	0.5	3.2	1	25	1	1806
15	12	10	1	0.5	3.3	0	0	1	1924

Priority Opposed

MOVEMENT				GEOMETRICS				CALC
				lane	vis	vis	central	Saturation
A node	B node	C node	Type	width	right	left	resvn	Flow
10	12	14	MRm	2.2	150	50	2.2	647
14	12	10	mLM	2.5	120	100	0	645
14	12	15	mRM	2.5	120	100	0	542

H.39 The SATURN coding for this priority T-junction is listed below.

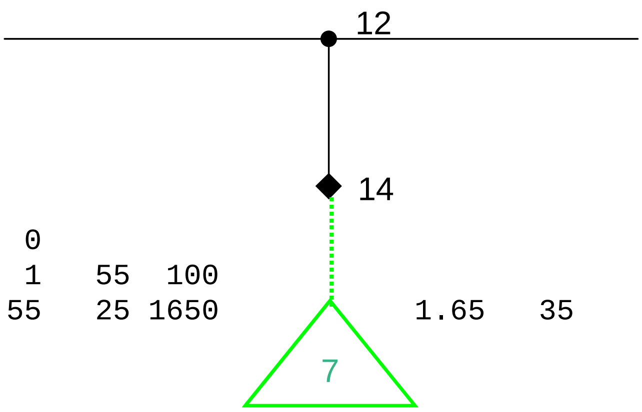
H.40

```
12     3    1                        20
 90    10*   2    55   275 1914  1 1  647X 2 2
            55    25 1650           1.65   35
       15*   1    55   275 1806  1 1 1924  1 1
            55    25 1650           1.65   35
 20    14*   2    55   100  645G 1 1  542G 2 2
            55    25 1650           1.65   35
```

Zone Connectors

H.41 The coding of zone connectors in the simulation network is based on the creation of a minor junction, which represents the minor road access from residential and commercial premises onto the main model highway network. These minor accesses are often described as centroid connector ‘sticks’ and are used in the BATS1.1 model network for the loading of the majority of zones located in the simulation network. A plan showing the network coding is given below:

Zone Connector




```
22222

   14     1     0
         12*    1    55   100
               55    25 1650           1.65    35
99999
33333
C         7          14    30           2S      50          88
99999
```

H.42 Node 12 is a priority junction and takes the same form as the method previously described. Node 14 is a simulation external node. The zone is connected using the zone connection coding employed in SATURN buffer as specified in the 33333 section of a SATURN network. The SATURN coding for this process is detailed below.

Guide SATURN Saturation Flow Values

H.43 During the development of traffic models it is worth undertaking a reality check of the saturation flows that are being coded into the network. This allows the capture of erroneous values at any early stage of the model development or updating process.

To aid this process a set of typical saturation values (10%/15%) by junction types has been compiled and are given in the following tables.

Signalised Junction

H.44 Signalised junctions typically have saturation flows per lane of between 1600 and 2000 depending on the lane width and the turn radii of left/right turns. As a guide the following table considers typical lane widths for single, two and three lane highways.

Entry Arm Type	Left Turn	Straight	Right Turn
Single Lane Narrow <3m	1650	1900	1700
Single Lane Normal ~ 3.5m	1750	1950	1800
2 Lanes Narrow <6m	3500	3950	3600
2 Lanes Normal ~7m	3600	4100	3700
3lanes ~10m	N/A	6200	N/A

Roundabouts Junctions

H.45 Roundabouts have entry and circulating saturation flows defined in the SATURN coding. The main factors determining the values of these are entry lane approach width / degree of flaring and the inscribed circle diameter. The typical entry saturation flows for single and dual lane approaches to a roundabout against roundabout size are shown below:

Entry Arm Type	Mini	Small	Medium	Large	Very Large
Inscribed Diameter	~20m	~40m	~60m	~80m	~100m
Single Lane Narrow <3m, No Flare	900	950	1000	N/A	N/A
Single Lane Narrow <3m, Flare To 2 Lanes	1225	1325	1400	N/A	N/A
Single Lane Normal 3.5m, No Flare	1050	1075	1150	1200	1250
Single Lane Normal 3.5m, Flare To 2 Lanes	1475	1550	1625	1700	1800
Dual No Flare	N/A	2325	2400	2475	2525
Dual Flare To 3 Lanes	N/A	2725	2850	2950	3075

H.46 The circulating saturation flow is largely based on the inscribed circle diameter but is also influenced by the entry saturation flow. The circulating saturation flow and the roundabout gap are given in the following table:

Entry Arm Type		Mini	Small	Medium	Large	Very Large
All Single	Cir	1950	2100	2500	N/A	N/A
	Gap	1.8	1.7	1.5	N/A	N/a
Mixed Single/Dual	Cir	N/A	2300	2650	3100	3300
	Gap	N/A	1.6	1.4	1.2	1.1
All Dual But No Flares To 3 Lanes	Cir	N/A	N/A	3550	4200	4500
	GAP	N/A	N/A	1.0	0.9	0.8
All Dual And Flared To 3 Lanes	Cir	N/A	N/A	3850	4500	4800
	GAP	N/A	N/A	0.9	0.8	0.8

H.47 In addition to the saturation flows, the calculation of circulating times can be based on the inscribed diameter and are of the following order:

Geometry	Mini	Small	Medium	Large	Very Large
Inscribed Diameter	~20m	~40m	~60m	~80m	~100m
Circulation Time (Seconds)	6	11	17	23	28

Priority Junctions

H.48 The coding of priority junctions is split into un-opposed and opposed movements in the junction. The unopposed movements are largely dependant on the road widths of the main road, while opposed movements relate more closely to the geometry of the junction and visibility lengths.

H.49 Unopposed Movements:

- Straight ahead 1700 to 1950;
- Left Turn 1650 to 1800;

H.50 Opposed Movements:

Visibility	Right Major	Left Minor	Straight Minor	Right Minor
Poor (<50m)	575	600	500	500
Average (50-120m)	615	625	575	575
Good (120-240m)	675	700	675	675

H.51 Gap acceptance at priority junctions is usually of the order of 1.5 to 2.5 seconds depending on the junction geometry. As a rule lower gaps relate to open high visibility junctions, while high gaps relate to poor visibility junctions.

REVIEW AND RECODING OF KEY JUNCTION

H.52 The review and recoding of junctions is required to ensure that the model network along the MSB corridors of the Showcase PT corridors is represented in a robust and suitable manner. The Showcase PT corridors are as follows:

- M32
- A4018 Cribbs to City Centre
- A4 Bath to Bristol
- Gloucester Road / Bradley Stoke
- A432 Yate
- A37 Norton Radstock
- Avon Ring Road
- A370 WSM
- A369 Portishead

H.53 The review of these corridors should identify significant improvements in the representation of network and should include the following:

- Review of network coding of major junctions along each corridor;
- Review of speed-flow curves;
- Link Lengths

H.54 The review of network coding encompasses the following elements:

- Number of Lanes at Stop/Give-way Lines;
- Allocation of Lanes to turns;
- SATURN Saturation Flows;

H.55 To aid this review, the 'Guide SATURN Saturation Flow Values' in section 2 should be used to provide a reality check on the coded values along the MSB corridor.

BUS PRIORITY CODING

H.56 The coding of bus priority measures within the SATURN network needs to be accessed by EMME2 to ensure that travel time improvements from such measures are incorporated into the mode choice model. The coding of bus priority is based on the 'B-Code' method used in SATURN which allocates lanes on the main carriageway to exclusive bus usage. This method allows the bus lane to be allocated to either adjacent to the kerb or adjacent to the centre line.

B-Code Example

H.57 An example of the 'B-Code method is given below:

```
3619     4     1     0     0             15    15
     1487*   B1    60   180 1800   1 1     0   0 0      0   0 0
             60    25 1750           2.01    34
     4043     0
     4042*   B1    60   130 1600   1 1 1800   1 1      0   0 0
             60    25 1750           2.01    34
     2089*    1    55   155   750G 1 1     0   0 0      0   0 0
             55    25 1650           1.65    35
```

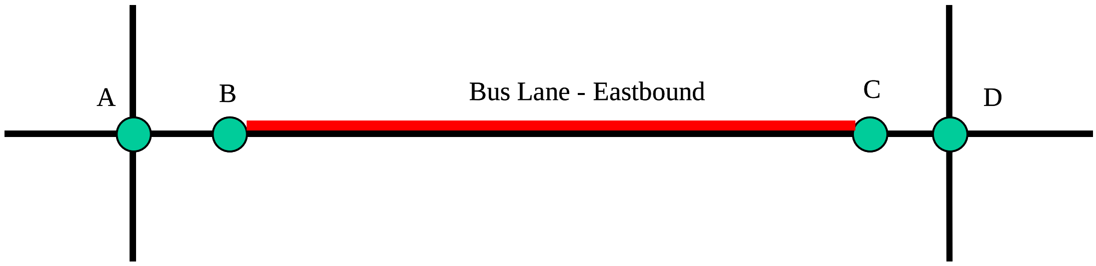
H.58 This allocates a bus lane into junction 3619 on links 1487 and 4042. The B1 following the entry link node number indicates the bus lane is on the kerb side of the road, with 1 lane of traffic for other vehicles. If the 'B-code' was coded as '1B' it would indicate that the bus lane was in the centre with the other vehicle lane located adjacent to the kerb.

Bus Lane Stop-Backs

H.59 The treatment of bus lanes as they approach major junctions in the model is crucial in determining the overall impact of the bus priority measure on other vehicles. There are two main types of bus lanes in operation in the UK. These relate to the location where the bus stop terminates in relation to the stop/give-way lines on a junction.

H.60 A bus lane with no 'Stop-Back' relates to the situation when the bus lanes runs up to the stop/give-way lines on a junction, and the lane remains exclusively for the use of buses. In this case the bus lane is coded into the junction and it is assume the bus can undertake all movements from the lane to the exit nodes.

H.61 A bus lane with 'Stop-Backs' relates to the situation where the bus lane terminates prior to the stop/give-way lines on a junction. The road between the end of the bus lane and the junction becomes available for all traffic including buses. This is represented in SATURN by coding an additional node into the network as a priority node with the bus lane terminating at this node prior to the junction where appropriate. The figure below illustrates this situation.



H.62 The figure shows a bus lane to be between nodes B and C located along a link A to D. The bus lane starts several meters after junction A and terminates prior to junction D. This is the most common arrangement of bus lanes in the UK with stop-backs at the start and end of each section of bus lane.

H.63 In addition to 'B-Code' in SATURN bus priority can be represented using other coding specific to the situation which may include:

- Bus only roads - other traffic is banned from the link in either the 4444 card in SATURN or by using negative saturation flows on the turns into and out of the road;
- Bus only turns - other traffic is banned from a turn using negative saturation flows on the turn.
- Bus only lane – where the bus lane exists at the stop line (as signified by the 'B' marker).

EMME2 –SATURN Linkage for Bus Lanes

H.64 The EMME2 suite extracts travel times on links form SATURN for use in the mode choice mode. The representation of the impacts of bus priority and bus lanes in SATURN needs to be transferred into the EMME2 processes.

H.65 The relevant travel time data which can be extracted from SATURN are as follows:

- Free Flow Time (DA 1803)
- Cruise Time (DA 4003)
- Turn Delay (DA 1633)

H.66 The calculation of speed on a link in SATURN is as follows:

- speed on a link = (Cruise Time) + (Turn Delay)*Flow Weighted by turn

Where Flow Weighted by turn = DA code 4513 = Actual Flow

H.67 This is suitable for all roads except those with bus lanes coded with the B-Code. Since SATURN gives no speed specifically for the bus lane but assumes the buses use it with free flow times/speeds. The speed on the 'B-code' elements of the network for buses is as follows:

- speed on B-Coded links = (Free Flow Time) + (Turn Delay)*Flow Weighted by turn;

H.68 Thus the 'B-coded' will need to be identified for EMME2 to be able to calculate the two respective speeds.