USING SCOOT MULTI-NODES TO REDUCE PEDESTRIAN DELAY AT DUAL CROSSINGS IN BRISTOL

Jackie Davies, Senior Technical Officer (UTC), Bristol City Council Traffic Signals

Synopsis

Bristol City Council has received a number of complaints about pedestrian delay at dual pedestrian crossing facilities in the city. The complaints arise because the pedestrians have to wait twice, and there is little or no progression between the two streams of the crossing. Conventional methods of reducing pedestrian delay were unable to provide sufficient progression for pedestrians and maintain good offsets for traffic. This project therefore used the multi-node facility in the Siemens SCOOT system to create pedestrian progression at the dual crossings that required it.

The use of pelican multi-nodes at the trial sites brought a significant reduction in pedestrian delay, by enabling the SCOOT system to provide progression for pedestrians in both directions across the dual crossings. This reduced pedestrian delay on the central island by over 50%, reducing delay to between 6 & 11 seconds on average. Furthermore, as the SCOOT model was still able to calculate offsets for traffic, the changes did not cause a significant increase in congestion levels.

The success of this trial was due to the fact that the sites selected were well suited to this solution. In order for the use of pelican multi-nodes to be successful, the dual crossing should have only one SCOOT link that needs modelling (if it is configured as a pelican), the model should only need offsets in one direction, and the cycle time required for traffic should be suitable for pedestrian progression.

This trial has demonstrated that in the right circumstances, pelican multi-nodes can reduce pedestrian delay at dual crossings without detriment to traffic. It is therefore worth considering their use when attempting to reduce pedestrian delay at dual pelican crossings.

Introduction

Like many local authorities, Bristol City Council has adopted a hierarchy of transport users, with pedestrians and cyclists at the top, (Joint Local Transport Plan, 2011).

Within the Traffic Control Centre, these priorities have been demonstrated in a number of projects to reduce pedestrian delay at traffic signal controlled pedestrian crossing facilities. The initial projects were fairly conventional, in line with TAL 02/09, such as altering the way sites operate when under SCOOT control by double cycling them, capping the maximum cycle times and moving pedestrian sites into regions with lower cycle times. Also, adopting strategies to bring sites onto SCOOT based on traffic flow levels, and setting up SCOOT MC3 pedestrian priority across the city.

Unfortunately, there are still a number of sites that generate complaints about pedestrian delay. The majority of these sites are dual pelican crossings where delay on each stream of the crossing is not particularly high. The complaints arise because the pedestrians have to wait twice, and there is little or no progression between the two streams of the crossings. The majority of the dual crossings are on important transport corridors, with high levels of congestion and delay during the peaks, so maintaining good offsets for traffic is vital to the road network.

The aim of this trial was therefore to reduce pedestrian complaints by providing progression for pedestrians in both directions across the dual crossings, without losing the offsets for traffic.

Conventional methods for achieving pedestrian progression were explored. For example, the use of artificial demands to assist pedestrians is not used in Bristol due to road safety concerns. It is believed that this type of demand can cause unexpected stage changes for drivers and can ultimately cause drivers to run through the crossings (LTN 02/95). Furthermore, the use of artificial demands can only provide limited progression in one direction for pedestrians.

The use of a UTC fixed time plan was investigated. It provided good pedestrian progression, but involved taking the sites off SCOOT and therefore losing the benefits of SCOOT operation.

The possibility of setting up pedestrian progression using a dummy SCOOT link with an offset was investigated. This option was dismissed, as it was only able to provide pedestrian progression in one direction, and reduced the model's ability to provide good offsets for traffic.

It became apparent that conventional methods were unable to provide progression in both directions, and maintain good offsets for traffic at the same time. Therefore, a less conventional method of achieving the required pedestrian progression at dual pedestrian crossing sites was adopted.

In the Siemens SCOOT system, there is a facility to link junctions together in one node, and to fix offsets between them using the SCOOT plan lines, called multi-nodes (Siemens, 1999). The intended application for this facility is to fix an offset between sets of signals that are very close together. This project used the multi-node facility to create pedestrian progression at the dual crossings that required it.

The Trial Sites

On the main Bath Rd (A4) into Bristol, a busy main road and important public transport corridor, there are three dual pedestrian crossings in close proximity (as shown in figure 1), these are:

P34145/ P34146 – A4/ Grove Park Dual Pelican

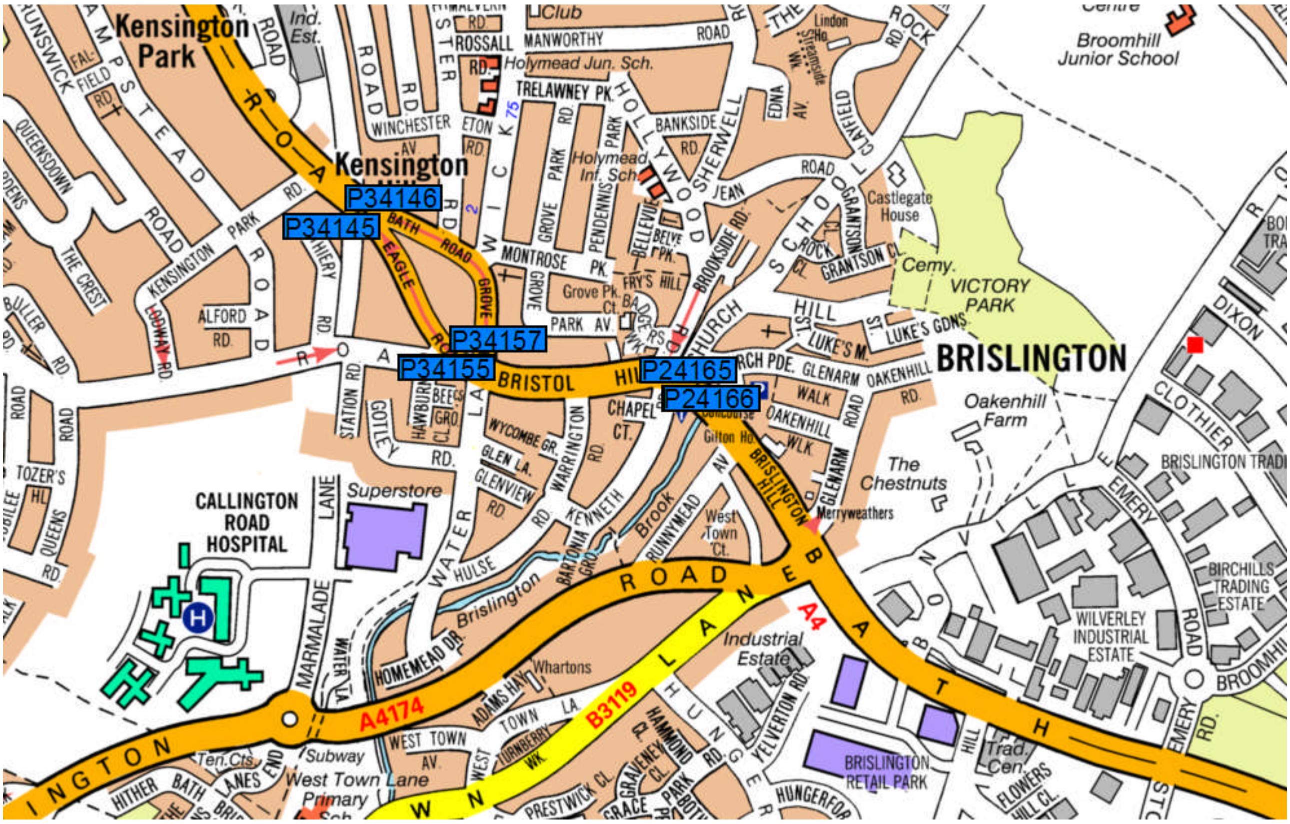
P34155/ P34157 – A4/ Eagle Rd Dual Pelican

P24165/ P24166 – A4/ Brislington Hill Dual Puffin (configured as a Pelican, with GX/NotGX replies)

The Traffic Control Centre receives regular complaints about them from the public, but using conventional methods, has been unable to make any further reductions to pedestrian delay without creating unacceptable levels of congestion and delay.

The three sites selected are far enough from upstream junctions that some platoon dispersion occurs, however, they have always been operated within the same SCOOT region as the upstream junction. Observations show that when pedestrian demand is high, the three pedestrian sites need good offsets between them or they create significant congestion and do exit block the nearby junctions.

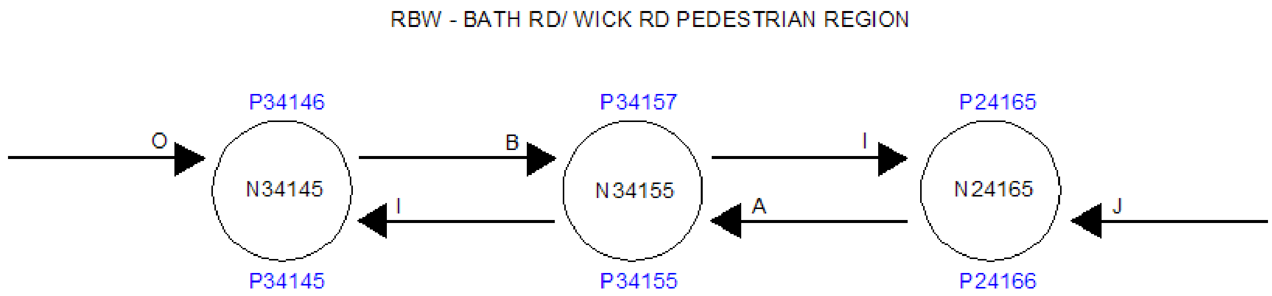
Figure 1 – The Bath Rd Trial Sites



The Process

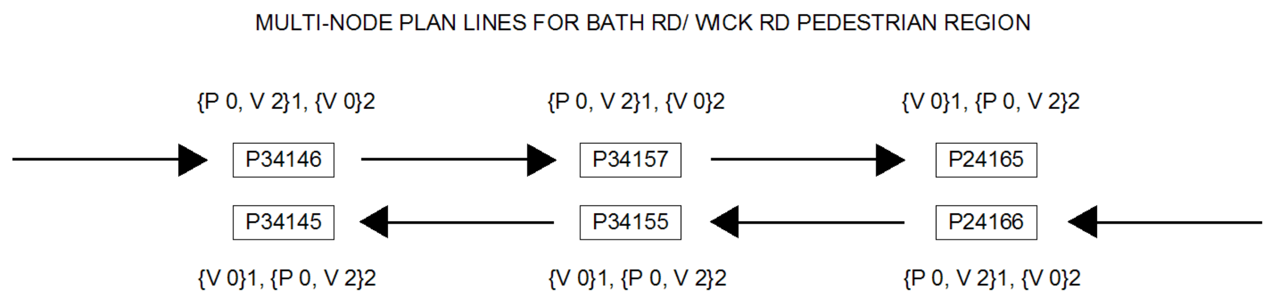
A region was created for the three dual crossings with a minimum cycle time of 44 seconds and a maximum of 60 seconds. Each of the three dual crossings was set up as a separate multi-node with two SCOOT stages for each multi-node, with a minimum stage length of 24 & 20 seconds each.

Figure 2 – The Trial Region



The plan lines for each stream of the dual crossings were set up so that the pedestrian window for the first site on the node was in SCOOT stage 2, and for the second site, in SCOOT stage 1:

Figure 3 – The Multi-Node Plan Lines



These changes mean that the pedestrian windows at each side of the dual crossing appear roughly 24 seconds apart (at a 48 second cycle time). The journey time for pedestrians from the tactile paving at the first crossing, to the push button for the second crossing was between 15 – 20 seconds on average, allowing the pedestrian enough time to get to the second arm of the crossing and enter a demand, just before it changes to green man. So effectively, once the pedestrian has waited for the first green man, they won't wait for the second one. This allows progression in both directions at the same time for pedestrians.

Validating the links enabled the SCOOT model to adjust the cycle time as the saturation level increases and decreases, and to work out the optimum offsets within the region. On the links where there is no detection, default offsets were entered for the traffic movements, to maintain good progression through the region.

Results

This trial aimed to reduce delay for pedestrians primarily by providing progression between the 2 streams of the dual crossing, and therefore reducing the pedestrian wait time on the central island. The project was not expected to make any significant changes to the level of delay at the pedestrian entry point (i.e, the first of the two crossings).

Prior to the trial, the crossings were in a SCOOT region with their upstream junctions and were operating a cycle time of 88 – 120 seconds. The crossings were double cycled for most of the day and also ran SCOOT pedestrian priority. Consequently the maximum average pedestrian delay was around 25-35 seconds on each stream, which was measured by recording the Wait Confirm time. Once the changes had been put into place, the maximum average pedestrian delay was reduced to around 18 – 22 seconds. This small change is because the crossings were moved into a region operating a 44 second cycle time for most of the day. This has helped to reduce the overall delay for pedestrians.

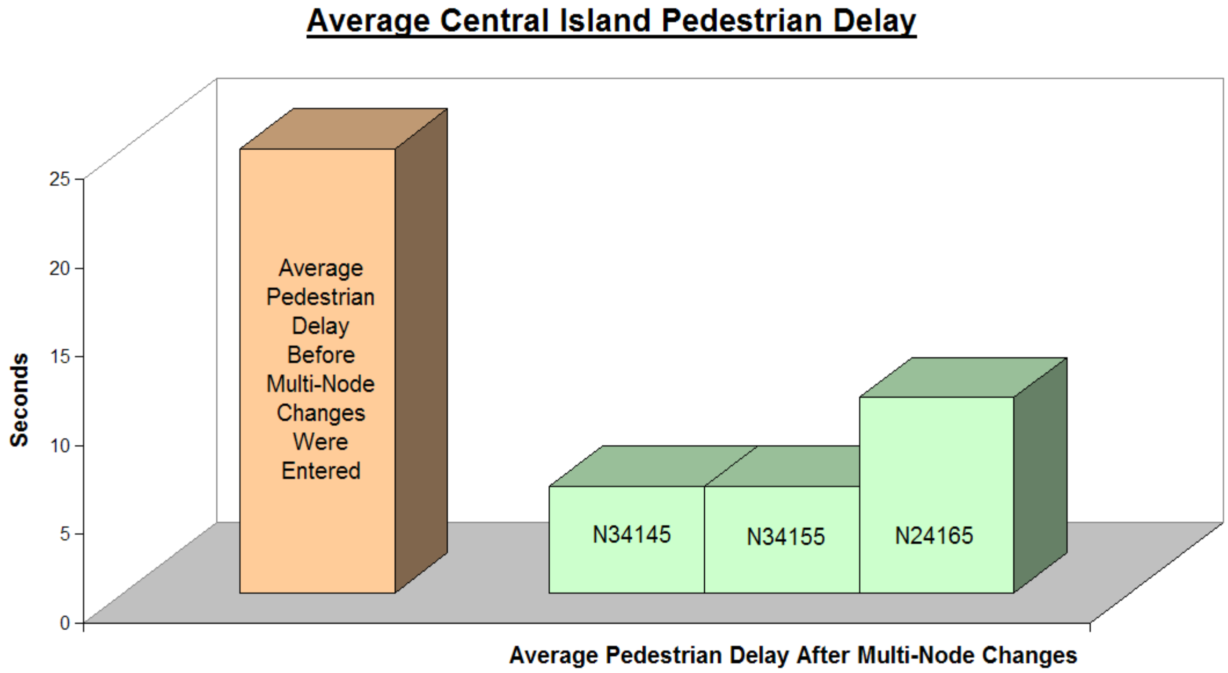
Pedestrian delay on the central island varied greatly before the changes were entered, as there was no linkage between the two streams of the dual crossings. The delay was difficult to accurately measure, but was estimated to be an average of around 25 seconds from entering a demand until beginning to cross the road.

Once the changes had been entered, the Grove Park & Eagle Rd crossings achieved a large reduction in pedestrian delay on the central island in both directions of travel. Over 85% of pedestrians entered a demand for the second crossing within the 20-second window period, and experienced an average delay of only 6 seconds.

The Brislington Hill crossing has a smaller central island, and consequently, a shorter journey time for pedestrians to the second push button. This meant that almost all pedestrians entered a demand for the second crossing within the 20-second window period, but the central island delay was higher than the other two sites, at 11 seconds.

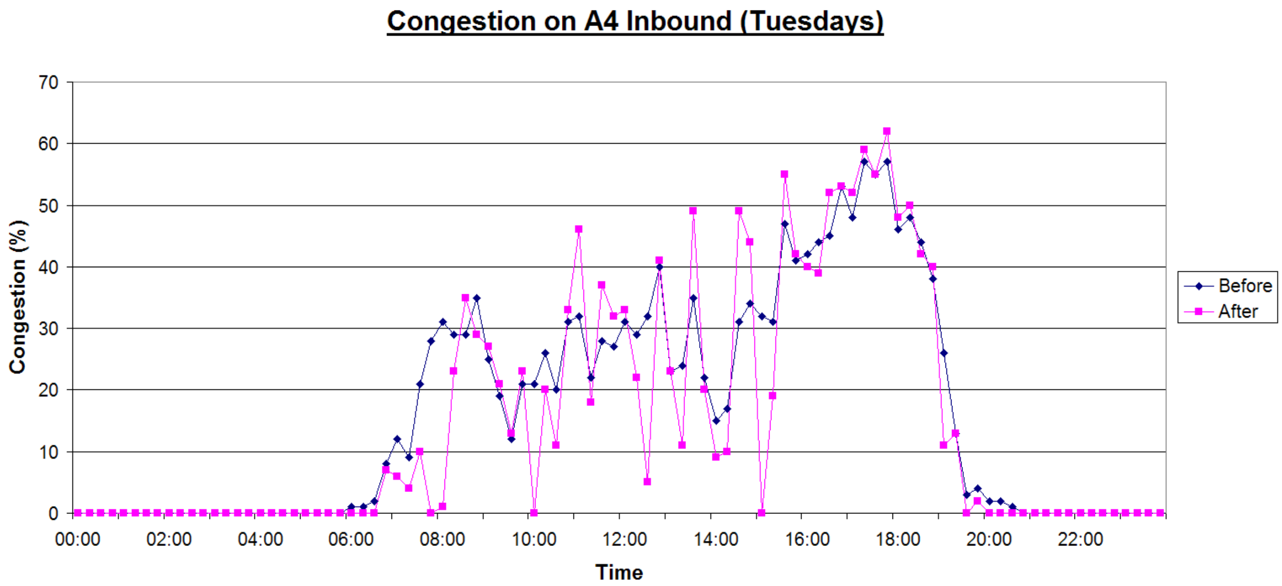
At all three sites, the average pedestrian delay on the central refuge island was reduced by well over 50%, as shown in graph 1, below.

Graph 1 – Average Pedestrian Delay on the Central Refuge Island



The changes have caused a slight increase in congestion on the Bath Rd corridor, as the cycle time for the new region is slightly lower and the model only rarely increases the cycle time to 60 seconds. The main cause of delay seems to be that the pelican crossings are no longer in the same region as the upstream junctions, so the SCOOT model cannot calculate an offset between the junction and the first crossing. However, the offsets within the new region are working well and delay is minimal. The offsets were initially set up to favour the outbound movement, but it was found that the opposing offset for the inbound also works well in the region.

Graph 2 – Congestion on the Bath Rd (A4) Inbound before and after the multi-node changes



Problems Encountered

Three main issues were identified as a result of this trial, these were:

1) Modelling pelican multi-nodes within the Siemens SCOOT system is only partly functional, and not available at all in the Peek SCOOT system. The SCOOT system models pelicans differently than junctions, because it receives only a GX/NotGX reply, rather than GA/GB replies. Because of this restriction, the Siemens system requires the pedestrian window to be in stage 2 to enable SCOOT to 'see' the effective green. Within a multi-node, this is further complicated by the fact that SCOOT is only able to receive stage replies for the first pelican in the multi-node. This means that SCOOT can only model the link associated with the first pelican correctly. The other links on the multi-node will model with the effective green from the first pelican, which is incorrect. To work around this issue, it is necessary to ensure that the first pelican on the multi-node is the one with the link and detector that needs to be modelled. This issue is only a problem on sites that are configured with a GX/NotGX reply, so puffin crossings with GA/GB replies model correctly.

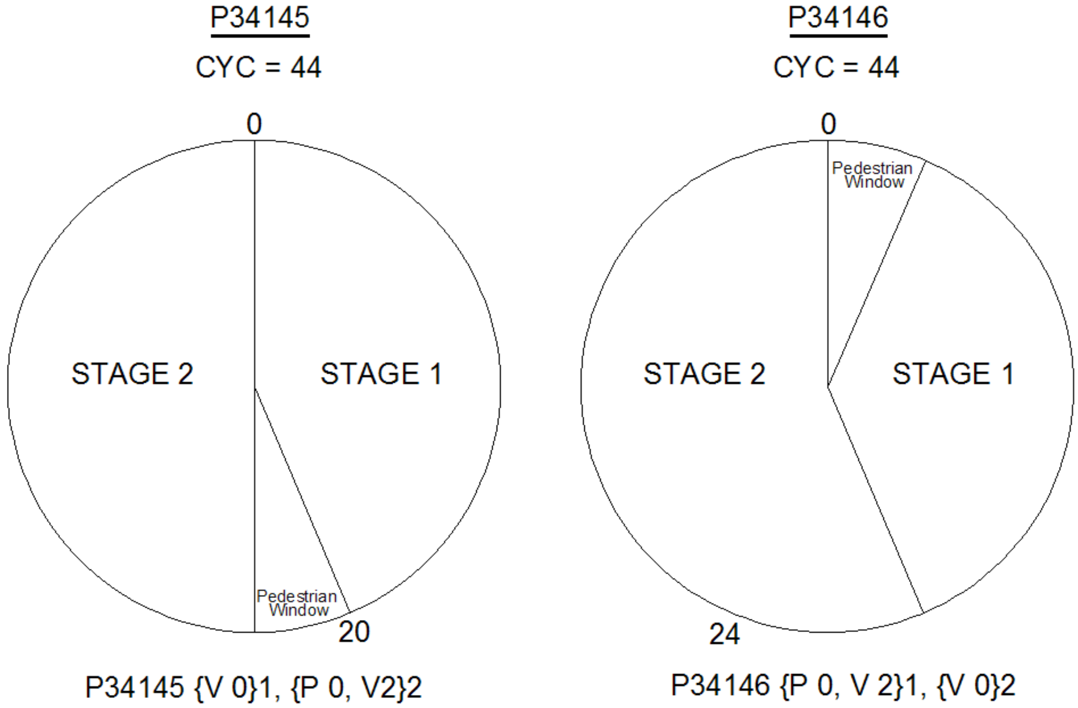
   The issue was raised with Siemens, who advised that resolving it would require some software development, and that it should be proposed as an Enhanced Software Support (ESS) development. Whilst pelican crossings are slowly being replaced by puffin crossings, they can still be configured as pelicans with a GX/NotGX reply, rather than a GA/GB reply. Therefore, it has been proposed under ESS that the SCOOT system be developed so that it can model pelican multi-nodes fully and correctly.

2) Pelican multi-nodes only work well where the cycle time required for traffic is also suitable for pedestrian progression, as increasing the cycle time will directly increase the delay for pedestrians on the central island. For example, at the Grove Park & Eagle Rd sites the ideal cycle time for most of the day is 44 seconds (meaning that the pedestrian windows appear 20/24 seconds apart). As the pedestrian journey time from the tactile paving at the first crossing to the push button for the second was around 18 – 20 seconds, this created very good progression for pedestrians. But increasing the cycle time for traffic to 60 seconds, would create an additional 16 seconds of delay for pedestrians on the central island.

3) The use of pelican multi-nodes causes difficulties with how the SCOOT model creates offsets for traffic. The pedestrian windows have to appear at the intervals within the cycle that are fixed by the multi-node plan lines, as shown in figure 4 below.

The model is able to create an offset between the up node through stage (UNTS) and the pedestrian window for the first pelican in the multi-node, but cannot create an offset in both directions. This is because the appearance of the pedestrian window for the second pedestrian crossing is fixed to the appearance of the first. The use of pelican multi-nodes is therefore only appropriate where an offset is only required in one direction, or where opposing offsets can work.

Figure 4 – The appearance of the pedestrian windows within the cycle



Conclusions

The use of pelican multi-nodes on the Bath Rd in Bristol has enabled us to provide pedestrian progression in both directions at the same time, whilst maintaining offsets for traffic. The method has brought a significant reduction in pedestrian delay at the trial sites, without any significant increase in congestion levels. The success of this trial is due to the fact that the sites selected were well suited to this solution. Therefore this method is now being applied across the city of Bristol at the sites that are considered suitable.

In order for the use of pelican multi-nodes to be successful, the dual crossing should have only one SCOOT link that needed modelling (if it is configured as a pelican), the model should only need offsets in one direction, or the offsets entered for one movement should also work in the other direction. Also, the cycle time required for traffic should be suitable for pedestrian progression.

There are a number of methods available to reduce pedestrian delay in SCOOT, such as double cycling sites, transferring nodes into regions with lower cycle times, or the use of pedestrian priority. This trial has demonstrated that in the right circumstances, pelican multi-nodes can reduce pedestrian delay at dual crossings without detriment to traffic. It is therefore worth considering their use when attempting to reduce pedestrian delay at dual crossings.

Acknowledgements

Thank you to Giles Burrows and Chris Parkes of Siemens for their assistance with understanding the limitations of modelling pelican multi-nodes in the Siemens UTC system. Thanks also to Andrew Kirkham of Transport Research Laboratory (TRL) for assistance with understanding precisely how the SCOOT system models pelican crossings.

References

Department for Transport, (2009) Traffic Advisory Leaflet 02/09, Integration of Pedestrian Traffic Signal Control within SCOOT/ UTC systems, London, HMSO.

Department for Transport, (1995) Local Transport Note 02/95, The Design of Pedestrian Crossings, London, HMSO (Section 5.4.6).

Siemens, (1999) SCOOT User Guide, Issue 30 (Section 6.5).

West Of England Partnership, (2011) West Of England Joint Local Transport Plan 3 2011-2026.