Bespoke Bus Priority – West Yorkshire Priority Project

In 2009, West Yorkshire Passenger Transport Executive (Metro) initiated the implementation of a large scale priority project across West Yorkshire - the 'Traffic Light Priority' (TLP) project – with initially 197 junctions (recently increased to 240). Intelligent priority systems were employed to gain the scheme benefits, with AVL virtual detection the input source of choice (virtual detector outputs are here referred to as 'triggers').

Of the 240 sites in the West Yorkshire scheme, sites deriving priority via STM constitute about 80% of the total. These sites require focused thought leading to a range of strategies which are tailored to the specific circumstances of the individual networks. A minority of the sites in this scheme have priority provided by SCOOT, MOVA or local controller priority.

Monitoring of results

As part of the scheme a monitoring report was produced to demonstrate the effectiveness of the traffic signal priority. The report contained 17% of the original 197 total (34 sites). It examined the tested benefits of sample sites, and drew conclusions regarding the results. In particular, it addressed the key project metric that the scheme Benefit/Cost Ratio (BCR) should exceed a value of **2**.

The results of the report were based on a 'before and after' protocol developed by the Scheme Working Group, which addressed a number of issues including '*use of triggers for monitoring*', '*the sampling rate of junctions*', '*the required number of trigger matches*' and '*comparator before & after periods*'.

NORTHGATE, HALIFAX - STRATEGY EXAMPLE

The bus priority example given here is a group of 3 coordinated junctions in Halifax, operating at a fixed cycle of 80s, and provided with STM priority. This group resulted in an overall bus improvement sufficient to place it around the mid-range of the Benefit/Cost Ratios of the junctions monitored as part of the scheme. However, this was achieved by applying different priority 'tactics' to each junction in the group.

The PM route out of the bus station (northbound from junctions 1 to 3) was seen as a particular delay issue and was specifically targeted in the priority strategy. In the absence of priority, northbound buses frequently fail to coordinate through Junction 3, due to lack of capacity at that junction.

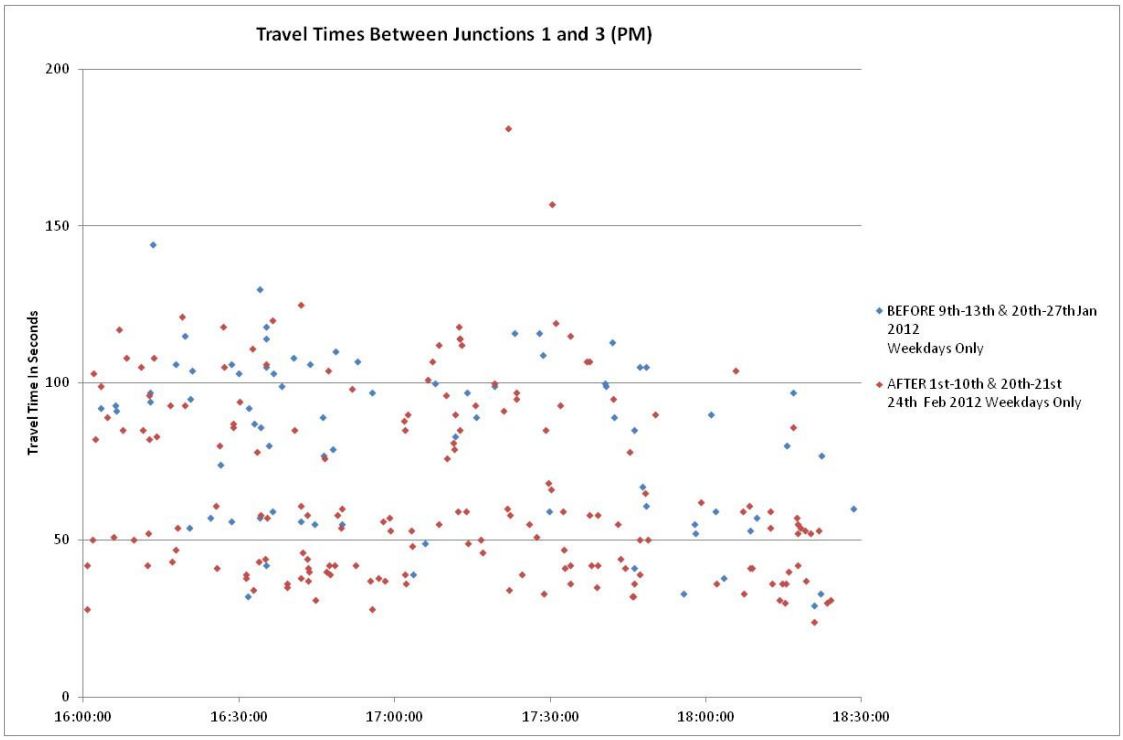
The priority strategy, which provides automatic *compensation* on following cycles, involves:

- ***Junction 3***. Providing a *green extension* to improve the northbound bus coordination
- ***Junction 2***. Providing a *green recall* complementary to the priority at Junction 3 – this increases the use buses can make of the extension at Junction 3, and also reduces the amount of general traffic running in front of buses.
- ***Junction 1.*** No action outbound.

For monitoring purposes triggers were located at the entry to Junction 1 and at the exit from Junction 3. By matching pairs of 'entry' and 'exit' triggers for each bus, it was possible over a period of days to build up a meaningful picture of travel times through this network. The chart below shows the resulting scatter plot of travel times for both the 'before' situation (blue dots), and the 'after' situation (red dots).

The scatter plot generated from the Journey Time Tool tends to indicate two horizontal bands where travel times are clustered – the lower band (close to the 50s line) corresponding to buses being coordinated through the first cycle at Junction 3, and the upper band (close to the 100s line) corresponding to buses which miss the first green and have to wait for the next cycle. There are significantly more 'after' (red) triggers in the lower band - this representing a mean improvement in PM travel time of **17**s. Were it not for the fact that priority has to be limited to cycles when there is no pedestrian demand at Junction 3 (little more than 50% of cycles), the PM benefit would be significantly higher

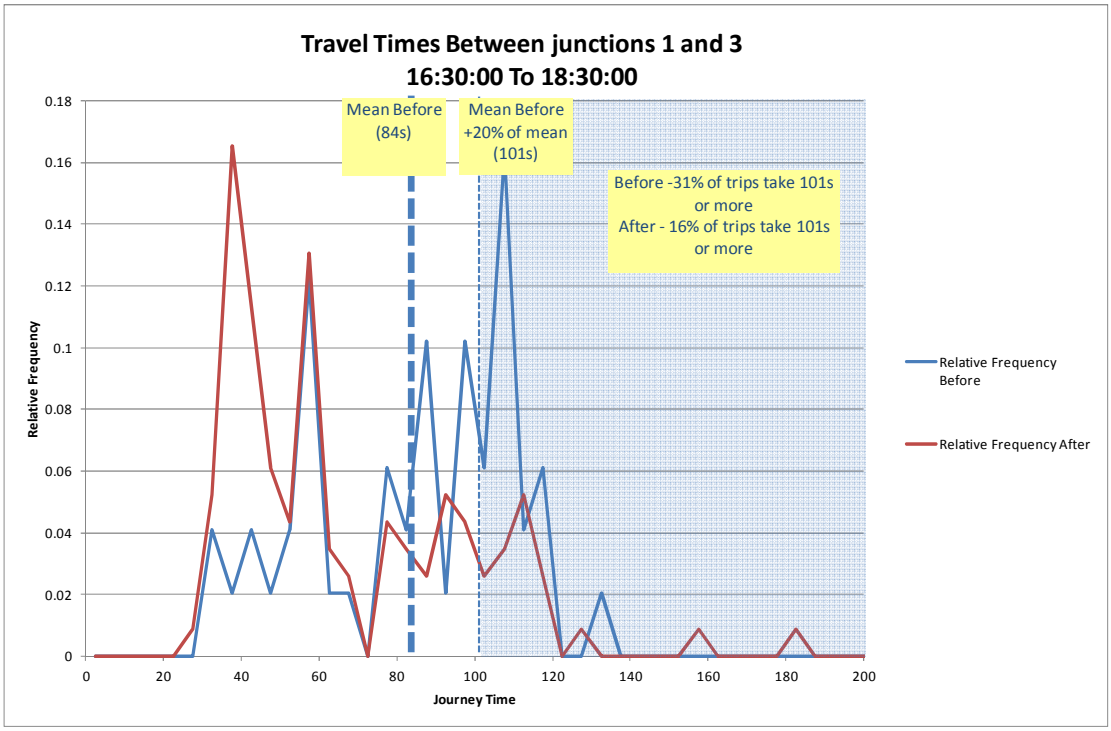
Scatter plot of travel times in the PM peak



This before and after data was further manipulated, to show an alternative representation in the form of a Relative Frequency graph (below). This similarly shows the 'before' travel time frequencies in *blue* and 'after' frequencies in *red*. This graph provides a better understanding of the relative bus travel times, and enables a test to be carried out which gives a measure of the proportion of buses which suffer 'higher' levels of delay (defined here as 'greater than Before Mean plus 20%'), the intention being to provide additional information about the longer bus travel time, not provided simply by the *mean* benefit.

The chart shows that the number of buses suffering 'higher' levels of delay (in excess of 101s in this case), fell from 31% in the 'before' situation to 16% in the 'after' situation.

Relative frequency graph of travel times in the PM peak



This Relative Frequency graph visually illustrates the changes made by the priority strategy. It shows a 'before' situation which has two distinct (blue) 'peaks' – a small one at around 60s and a much larger one at around 110s. This latter peak is an indication that most buses in the 'before' situation failed to get through the first green at Junction 3. In contrast, in the 'after' situation (red) the patterns are now changed – the peak at around 110s is much reduced, and there is a new distinct peak at around 40s, indicating that there are now far more buses being prioritized through the first green. This is a visual indication of a successful strategy outcome.

OVERALL BCR OF THE BUS PRIORITY SCHEME

At the commencement of the scheme the benefits of each junction were estimated, and an overall estimate of Benefit/Cost Ratio (BCR) derived for the scheme as a whole – with a value in excess of 8. Most of the junctions in the monitoring sample gave *actual* benefits greater than the estimated values, and these sampled junctions *alone* gave a BCR in excess of 2. Thus the key project metric has been achieved.

An assessment of the robustness of the scheme BCR shows that the final value is likely to be considerably higher than 2. In the unlikely event of the non-sampled sites ALL yielding under 75% of estimated benefits, there would still be an overall scheme BCR in excess of 7.