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Exploring new bus priority methods at isolated vehicle actuated junctions

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Abstract

Bus priority at traffic signals is necessary to improve bus travel time and service regularity especially when buses are late. It can be given by altering signal timings in favour of approaching buses. In usual practice this is achieved by either extending the green period or recalling the green stage early. In this study the usual extension and recall methods at VA signal controller have been developed and evaluated by using VISSIM microscopic simulation tool. Reasons for using VISSIM are also justified. During evaluation bus travel time savings and impact on general traffic has been considered. Performance of these methods on various junction types has been evaluated. New advanced bus priority methods have been developed and their performances have been compared with the existing methods.

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Keywords: public transport; bus priority at traffic signals; extension; recall; bus travel time savings; VA signal controller; VISSIM

1. Introduction

Buses are the predominant form of public transport in most towns and cities in many countries, including the U.K (Hounsell and McLeod, 1999). With their large carrying capacity, buses make effective use of limited road space, and can therefore make a substantial contribution to reducing traffic congestion (Cheney, 1992). However, buses themselves are often affected by congestion, leading to a decrease in speed and an increase in bus travel time variability and service irregularity. Providing priority to buses plays an important role to protect bus services from the effects of traffic congestion and to improve route frequencies, speeds and reliability (IHT, 1997), thus improving levels of

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service for bus passengers and encouraging modal change. 'Keeping buses moving' (DETR, 1997) details a number of bus priority measures that can be considered to assist buses.

Among these methods, bus priority at traffic signals is the most relevant where opportunities for segregated systems are not available and/or where numerous traffic signals exist. At signalised junctions, priority can be given by altering signal timings in favour of approaching buses. In usual practice this is achieved by either extending the green period for an approaching bus or recalling the green stage, if the signals are currently red for the bus. These forms of bus priority have been implemented in many cities in USA, UK, Japan, France, Denmark, Sweden, Switzerland, Finland, Germany, Australia, Austria, Italy, New Zealand (Gardner et al., 2009).

Location of bus detectors could affect the bus priority efficiency. Common practice is to use single detector to avoid costly implementation of physical infrastructure. But the use of multiple detection points becomes more feasible and beneficial with GPS-based systems, known as 'virtual' detectors can be used instead of multiple (and costly) infrastructure installations. Thus this system (for example, iBus in London) eliminates the need of on-street hardware for detecting buses and provides much more flexibility in the number of detectors and their locations (Hounsell et al., 2008). This provides a real opportunity to implement more innovative bus priority methods.

Bus priority at VA junctions started in London in the 1970's with the first major evaluation trial occurring in the SELKENT area of London in 1987-88 (University of Southampton, 1988). The success of the trial led to the expansion of bus priority at 300 more VA controlled junctions in the outer areas of London. Most of the priority detectors were sited at 70m upstream of the stop-line from the consideration of journey time variability.

In this study the usual extension and recall methods considering 70m detection distance at VA signal controller have been developed and evaluated by using VISSIM microscopic simulation tool. Reasons for using VISSIM are also justified. During evaluation bus travel time savings and impact on general traffic has been considered. Performance of these methods on cross junction and T-junction types has been evaluated. Detecting buses early upstream of the stopline was also considered. To deal with the journey time variability issue due to early detection, exit detection near the stopline to cancel priority action was considered. Hence save any time which might be wasted by retaining a green signal after the bus has left the junction. These early and exit detectors could be implemented with no additional infrastructural cost due to the availability of virtual detectors. New advanced bus priority method 'always green for bus' has been developed and its performances has been compared with the existing methods.

2. Bus priority types

Bus priority options available in signalised junctions can be grouped as passive priority and active priority.

2.1. Passive priority

In passive priority signal timings are weighted, or re-optimised, to take account of streams of traffic containing significant bus flows. This is a straightforward form of priority at traffic signals which gives more green time to the approach having higher bus flow than it would have done otherwise (Gardner et al., 2009).

2.2. Active priority

Here priority is given to buses by making the traffic signal responsive to the arrival of each bus detected on the approach. Buses can be given active priority implementing different strategies depending on the policy objectives and the availability of the infrastructure to support the implementation (Gardner et al., 2009).

Priority to all buses: All buses are given priority irrespective of whether they are late or not. This strategy known as "maximum speed" strategy, as the aim is to increase the running speed of all buses (PRISCILLA, 2002). However, it should be noted that where bus flows are high, priority to a large number of buses can delay other buses, and so maximum speed is not necessarily achieved. This is one of the simplest strategies to implement, as the only information required about an individual bus is its expected arrival time at the traffic signal.

Differential/conditional bus priority: Buses are given priority according to their individual requirement (e.g. lateness). 'Priority to late buses only' is the most common strategy.