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Possibilities of ensuring urban public transport priority

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ABSTRACT

Not only the opinions of experts point to the increasing number of cars in central areas of cities, but this fact is also perceived by the city residents themselves. They experience it every day when they move around the city. Congestion at the junctions and sometimes a total collapse of traffic cause substantial problems for urban public transport vehicles. It is not uncommon for an urban public transport vehicle to stand in a slowly moving queue of vehicles, transporting mostly two or three passengers. An urban public vehicle can transport several times more passengers and in this fact it is much more favourable for the city area. Delays of urban public transport vehicles deteriorate the quality of public transport, which is very important for the passengers.

The article deals with the different ways of public transport priority which could be broadly categorised as- physical measures, traffic signal priorities, and integrated measures. These measures are used according to the need and the feasibility to provide them and can include with-flow lanes, contraflow bus lanes, bus only streets, priority at traffic signals and integrated measures such as queue-relocation and virtual bus lanes.

KEYWORDS: bus lanes, priority measures, signal controlled junction

1. Introduction

One of the main aims of all larger cities is address the important issues of traffic congestion and environmental pollution, both of which are serious and growing problems. A key part are measures to encourage provision of more sustainable, environmentally friendly, forms of transport, including the development of more attractive public transport services. Buses already play an essential role in the transport systems of our urban areas and, in most cases, will remain the main means by which improved public transport services will be provided.

Bus priority is needed because there is too much traffic on the network and too little capacity for it all to flow freely. Giving buses priority over cars recognises the bus's greater efficiency in the use of road space. Emphasis is placed on maximising the throughput of people, rather than the number of vehicles.

Bus priority contributes to:

- Ensuring that buses run to time;
- Reducing scheduled running times, to help make buses more competitive with cars;
- Improving reliability, e.g., consistency of journey times;
- Avoiding circuitous routing in traffic management systems;
- Maintaining good bus access, e.g., to town centres, and
- Increasing the bus's modal share of the travel market.

Bus priority is most successful if it is adopted along complete route corridors and accompanied by high vehicle and operational standards (e.g., low emission, low floor buses and drivers specially trained in customer care) and high profile marketing.

2. Physical measures of urban public transport priority

The most common form of bus priority is to give buses exclusive or priority access to a section of road.

Features include:

- With-flow lanes,

- Contra-flow lanes,
- Bus gate,
- Bus way.

2.1. Whit-flow bus lanes

With-flow bus lanes are the most common form of bus priority. With-flow bus lanes are reserved traffic lanes, usually on the nearside (Fig. 1), for the use of buses and may accommodate bicycles. A with-flow bus lane enables buses to bypass traffic queues, usually approaching traffic signals. This will produce substantial time savings to buses and their passengers.

Fig. 1. With-flow bus line [1]

2.2 Contra-flow bus lanes

A contra-flow bus lane is a lane where buses are allowed to travel against the main direction of traffic flow (Fig. 2). This enables buses to avoid unnecessary diversions, to maintain route patterns when new one-way streets are introduced, and to gain better access to business and shopping areas. These contra-flow bus lanes are usually introduced in area-wide one-way traffic systems, where the effect is to create a two-way road with 'buses only' allowed in one direction, and all other vehicles including buses, in the other.

Contraflow bus lanes should be at least 3 metres wide and separated from the rest of the carriageway either by a solid white line, or else physically separated by a continuous upstand or series of long islands. Although physical separation helps to keep the bus lane clear of other traffic, segregated lanes are costly to install, and by confining buses to a precise track can cause tracking of the road surface. Complete segregation also prevents buses from overtaking cyclists, a broken down vehicle or other obstruction, and may create a safety hazard by preventing the bus driver from steering to avoid a pedestrian. For these reasons, separation by white line supplemented by occasional traffic islands and/or solid white lines with hatching between them will usually be preferable to full physical separation.

Fig. 2. Contra-flow bus lane [1]

2.3 Bus gate and bus only street

Short lengths of bus only street are sometimes referred to as "bus gates". Short, standard width, sections of road protected only by signs is commonly used, violation rates are often high at such installations, especially away from central areas. Narrowing the road to the width of one vehicle in the bus gate itself, using a different colour for the road surface in this section, and/or installing traffic calming features such as speed cushions or road-side furniture can often improve the compliance rate. Where more elaborate carriageway constructions designed to deter smaller vehicles from passing through the bus gate are proposed, the highway authority should ensure that suitable powers are available to introduce such measures. They should also be aware that such a construction may make it impossible for some emergency vehicles to pass. Local authorities should also be satisfied that adequate alternative routes are available before introducing such measures. Bus gates and entries to longer lengths of bus only street which are wide enough to accommodate only one vehicle at a time should not exceed 30 metres in length.

Fig. 3. Diagram track-time [7]

A bus only street is a section of road for the use of buses only. It may be a section of road enabling the bus to take a more direct route, for example between a main access road and a residential estate, or it may be a "pedestrianised" street in a town centre where buses are exempt from a prohibition on all, or some types of, vehicles.

Such streets enable buses to:

- maintain route patterns in areas where traffic flow patterns have been changed, long detours which add to bus operating costs can be avoided whilst preventing unwanted short cuts by other traffic;
- gain close access to business and shopping areas at times when it is denied to other vehicles, such arrangements help to make bus services more attractive by providing convenient access for bus passengers, including elderly people and those with mobility handicaps.

2.4 Busways

Busways are substantial corridors or networks of bus-only sections of road constructed specifically for the exclusive use of buses (Fig. 4). Busways are designed to segregate buses from general traffic that protect them from congestion. For reasons of economy and land requirement, automatically guided or tracked busways may be preferred over busways relying on manual steering. Finally, some links/roads may be reserved for the exclusive use of buses and other priority vehicles.

Fig. 4. Busway [8]

3. Traffic signal priorities

Urban public transport priority by light signalling means a possibility of a preferred option and extension of the green signal for a vehicle which come to a junction. It is desirable so that the vehicle can cross signal controlled junction as far as possible without stopping or at least with minimum delay. Character of movement of municipal transport vehicles is significantly different as movement of others vehicles. It is caused by stopping buses at bus stops between junctions and by embarking and disembarking passengers. It means that the speed of municipal transport vehicles is lower than the speed of passenger vehicles. Figure 5 shows a diagram track-time for the movement of municipal transport vehicles and for groups of other vehicles. The lower speed of municipal transport cause that municipal transport vehicles cannot be included in the calculation of coordination which be counted for relative compact clumps of vehicles. We can tell the junctions with traffic lights which are included in the coordination cause the greatest loss of time (delay) of municipal transport. Delays caused by traffic lights reach values at intervals 10-30% of the total delay. By reducing these delays is reduced not only driving time but also is increased speed. It can even reduce the number of vehicles for the same intervals of timetable.

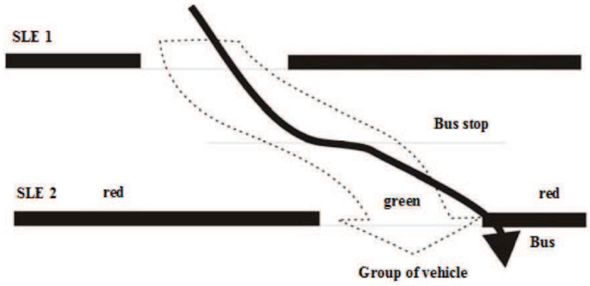

Fig. 5. Diagram track-time [4]

Passive systems apply to those where 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. The other approaches then share the remaining part of the cycle time. Even though no infrastructure is required for such systems, it is believed that these facilities are not widely used as the perceived benefits are modest at best.

In active priority, bus priority is given by making the traffic signal responsive to the arrival of each bus detected on the approach. Most of the development work has been related to such active systems, which is technologically advance and is efficient in giving priority to particular group of buses. Buses can be given active priority implementing different strategies depending on the policy objectives and the availability of the infrastructure to support the implementation.

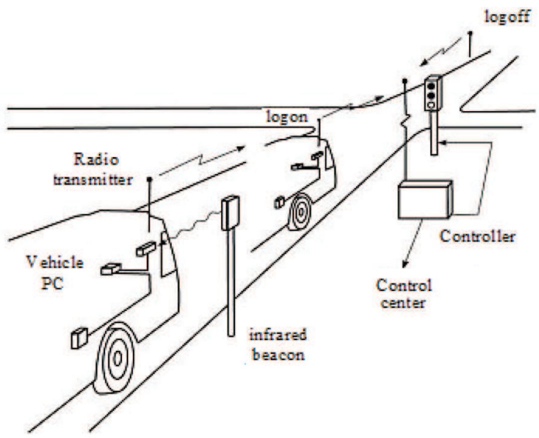

Fig. 6. The scheme of active detection via a radio communication [4]

Figure 6 shows the active detection scheme which is ensured by radio communications through the computer of the vehicle and controller of signal light equipment. A vehicle by using onboard computer evaluates the signal from the infrared beacon and thus determines the location of the vehicle. Subsequently, the vehicle computer sends to controller information which contains the necessary data on the line, direction, distance and direction of the vehicle before junction. Controller will evaluate the submitted information and sets corresponding to the sequence of phases for arriving vehicle.

One of the preference possibilities is a central system preference based on satellite navigation where isn't needed building any other infrastructure at the level of traffic node. In this case is necessary to provide functional communication infrastructure based on radio transmissions. The system works by using satellite navigation unit which must be installed in the vehicle, communication unit, the control computer and control console for the driver. The digital tachograph is used for more accurate measurement data to a preference. Driver before the journey enters basic information about the line which will be transferred to the center. Then the screen displays information about whether the vehicle drives according timetable. Virtual points are following the route of the vehicle from which the vehicle transmits its location to the center and it is then transmitted from the center to the controller. They serve as information to modify the signaling there. To ensure the proper transmission position of the reference point is activated signal approximately 5 km from this point which is based on the measurements of satellite GPS. This signal serves to prepare all the necessary data to transfer. After determining the position of the vehicle a signal is sending to the receiver which issues command to control part of light signal and the green signal light is light up before the arriving of the vehicle at a junction.

4. Integrated measures of urban public transport priority

Integrated measures combine both physical and signal measures (e.g. with-flow bus lanes with the signalling measures). Queue relocation and pre-signals techniques are some the examples of integrated measures utilising physical as well as signal measures to give preferential treatment to buses.

4.1 Queue relocation

Queue relocation (also known as traffic metering) is one such measure in which the flow of traffic is controlled at upstream junctions by adjusting signal timings to reduce capacity, so that this junction becomes more critical than the one downstream. The downstream junction is the main junction whereas the upstream junction is the metered junction. Along with this, the bus lane running up to the upstream stop line enables buses to by-pass the relocated traffic queue.

The theory behind simple queue relocation can be easily understood from Figure 6. In the "before" scenario, queuing traffic builds at the approach to a signalised junction. Given upto- date information on the performance of the junction, it is relatively easy to predict the amount of traffic that will pass through the junction during a green signal. This traffic is represented as the green bar. The red bar represents the excess queue that will not discharge through the junction in that cycle of the signals. An ideal situation would be to relocate all the excess queuing traffic, in such a position in the road network that public transport can pass it and thus be given an advantage. This is shown as the "after" scenario.

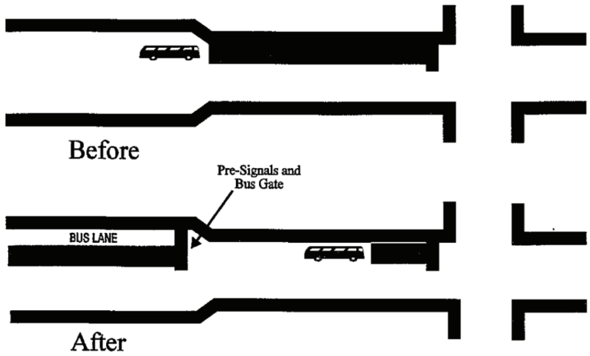

Fig. 7. Queue relocation [7]

4.2 Pre-signals techniques

Pre-signals can be used at a junction to create a bus advance area and in a link to create virtual bus lane. At a signalised junction, a pre-signal can be used to create bus advance area that enables buses to by-pass queues of general traffic (held by pre-signal) and to undertake manoeuvres to make turns ahead of other traffic. In a congested link with insufficient width to provide a physical bus lane, a pre-signal can be used to hold general traffic upstream of this narrow section. This allows buses on the bus lane to bypass the queue and rejoin the main traffic stream ahead of other traffic.

5. Conclusion

Providing of public transport vehicles preference requires constant monitoring of transport development on individual junctions and consequently changes in the organization of traffic on them. All junctions differ from each other, whether it's the location in the city, number of vehicles which cross through them, or the scope of preference which is necessary ensure and so on. Therefore it is necessary to consider each junction specifically and also to adjust the possibilities of preferences and technology that it ensure. In designing the technology we have to consider options of junction for example location and correct choice of detector and controller at the junction, so that is ensured the transfer of information to the controller and subsequently reliable meet the requirements of public transport vehicles.

The positive impacts of preference of urban public transport aren't only beneficial for passengers if is increased the speed and the reliability of transport. But also for carriers if is reduced the consumption, wear of vehicles, smooth observance of the social legislation and so on.

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