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Department for Transport

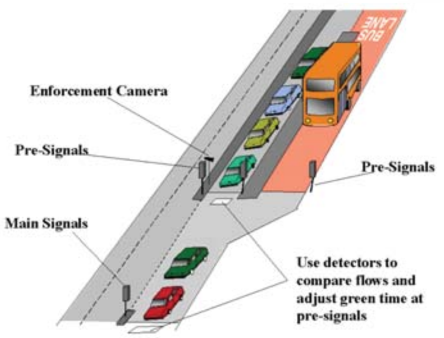
TRAFFIC ADVISORY LEAFLET ITS 5/03

Public Transport Priority

This leaflet is one of a series of documents from the ITS Assist Project. ITS Assist is a Department for Transport (DfT) initiative that aims to encourage and promote across the UK the use of Intelligent Transport Systems (ITS) as tools to implement local transport policy objectives.

Public Transport Priority systems are designed to improve journey times, and the service reliability of public transport vehicles in line with local authority policy objectives. Priority can be provided using physical measures or using technology. Public Transport Priority can improve the quality of bus services and, as a result, can lead to greater patronage.

This leaflet provides an overview of the various components that combine to provide Public Transport Priority, and show how these can be integrated into other traffic management systems.



March 2003

Traffic Advisory Unit

Background

An important policy objective for most local authorities is to increase the use of public transport. One important consideration for potential passengers is the relative journey times by public and private vehicles; public transport priority systems help to improve this in favour of public transport.

PHOTO COURTESY OF FABERMAUNSELL

Priority systems have been provided for buses, light rail and to a lesser extent heavy rail. Priority for public transport has traditionally been provided via physical measures such as bus lanes, to allow priority vehicles to by-pass congestion. Technological improvements have produced systems that can assist public transport vehicles by influencing the operation of signalised junctions, and allow local authorities to manage the road network as a whole.

Engineers can implement priority using a variety of methods. In its simplest form, it influences traffic signal timings to enable a priority vehicle to travel through an intersection more quickly than it normally would have done. More complex systems use information about the service route, timetable and whether the vehicle is late or early to determine the level of priority required. The processing of the data can take place either locally on-street or, more usually, at a central control centre.

Network management tools such as Urban Traffic Control (UTC) systems, including those using SCOOT (Split, Cycle and Off-set Optimisation Technique), have functions to enable priority on receipt of demands from vehicles. The UTC systems can dynamically affect traffic signal timings across a number of junctions in response to a demand, and then compensate other vehicles after the priority vehicle has passed. The ability to compensate means that priority is achieved with little increase in delays for other vehicles

The latest bus priority developments include systems such as SPRINTi for fixed time UTC, and bus priority provided through SCOOT that was developed during the EU's PROMPTii project.

Although the tools can be used discretely, results are improved when combined with a package of quality improvement measures along a whole route or corridor.

Priority systems require knowledge of a vehicle's location to function correctly. Operators can use this location data for other systems such as Real Time Information for public transport users, or for Fleet Management Systems. Therefore, infrastructure can be shared between various systems thus providing better value. Many of the technologies can be added on to existing control equipment, and hence can be installed economically. The DfT's Urban Traffic Management and Control (UTMC) initiative provides a framework for the integration of different traffic management systems through the employment of open system design.

PHOTO COURTESY OF FABERMAUNSELL

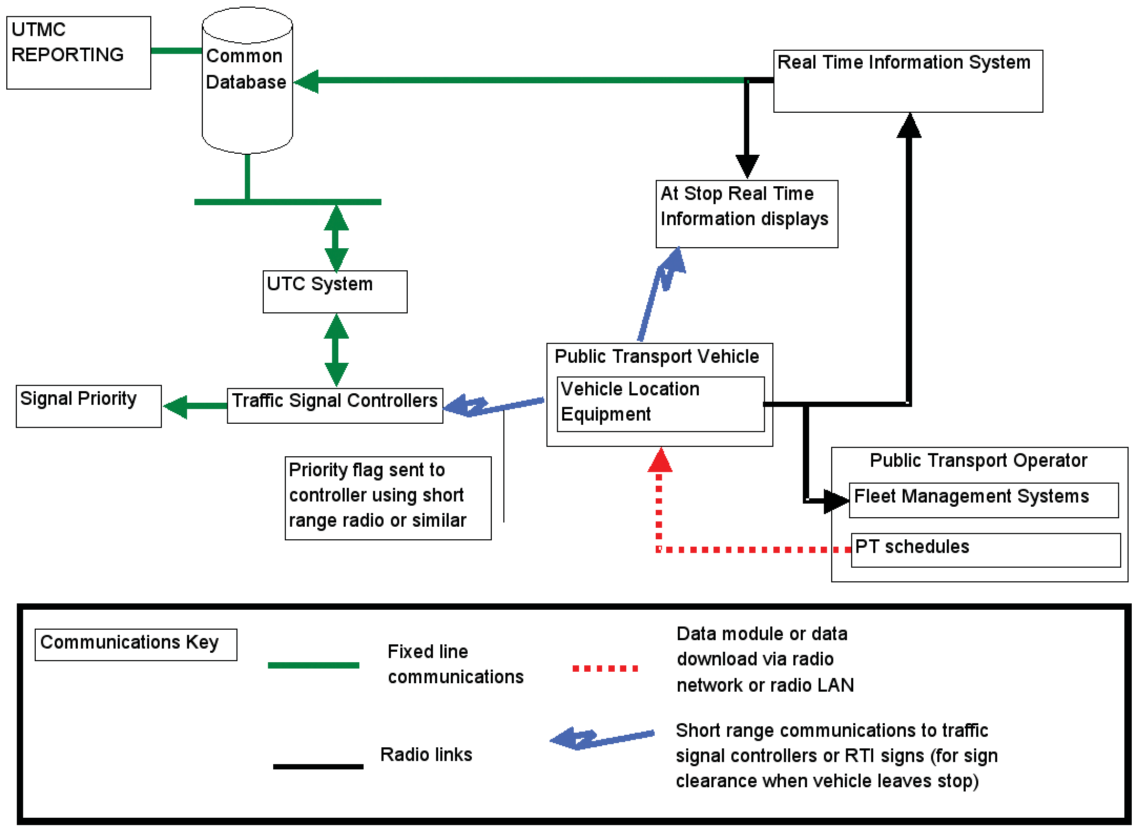
System Design

Public Transport Priority can be installed in isolation or as part of a package of measures along a route. It is therefore important that the technology and physical measures are designed to complement each other.

The key components of a system are:

- Vehicle location equipment;
- Communications;
- Data processor (local or central); and
- Traffic Control Equipment.

The diagram below illustrates a typical arrangement of the key components of a system.



KEY COMPONENTS OF A TYPICAL PUBLIC TRANSPORT PRIORITY SCHEME PREPARED BY FABERMAUNSELL

Vehicle Location Equipment

The location of vehicles on the network can be achieved using a number of technologies, for example:

- Detector Loop;
- Roadside beacon;
- Vehicle profile recognition via inductive loop detection; and
- Global Positioning System (GPS).

Some location systems are based on detector loops, cut into the carriageway surface that interact with a transponder located on a priority vehicle. The loop receives information from the transponder about the vehicle, which is then passed to the central processing unit to determine if priority is to be provided.

A roadside beacon performs a similar function to the detector loop receiving information from a vehicle-mounted transponder.

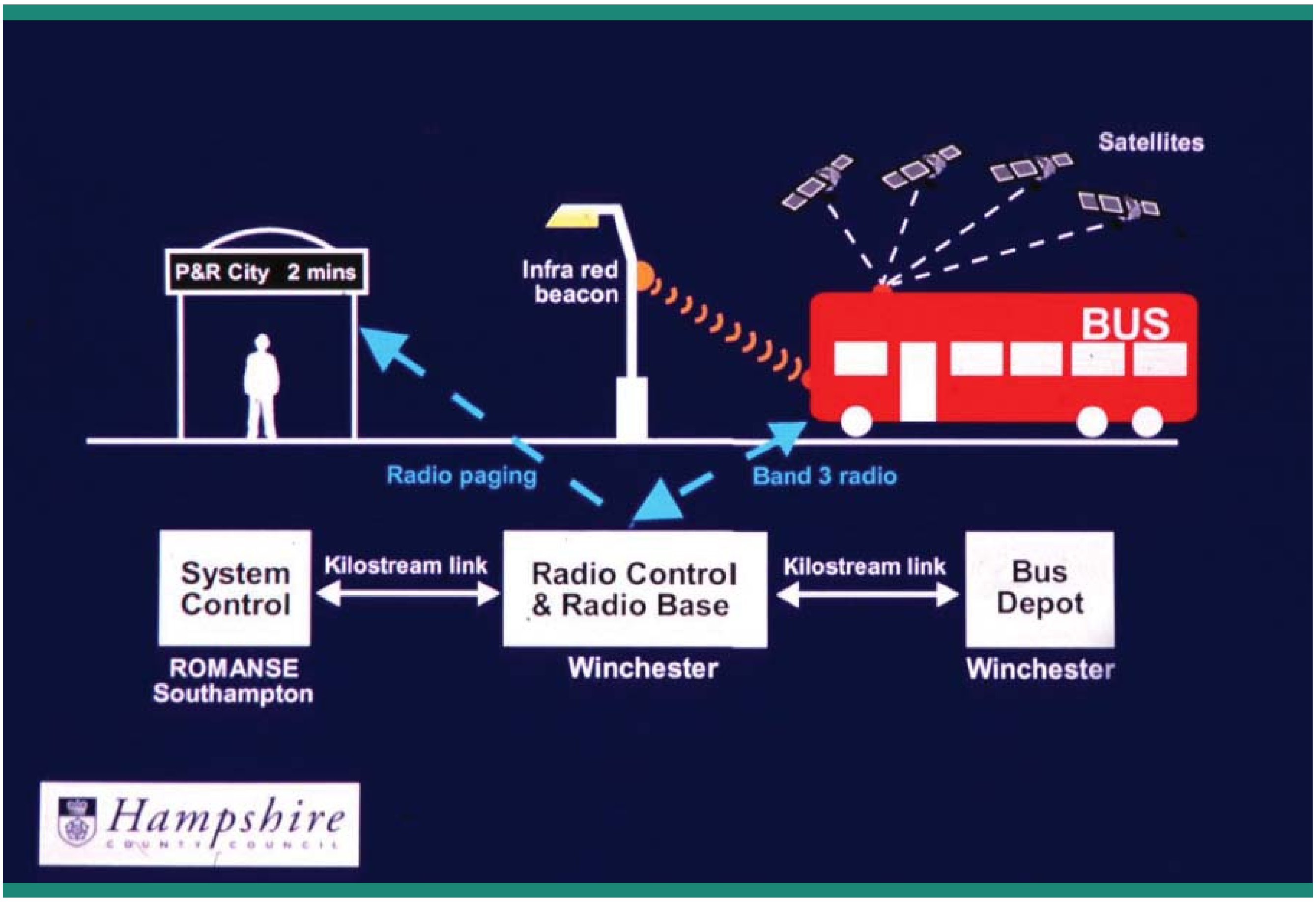
Both the above technologies require vehicles to be fitted with transponders. Even though the cost of transponders can be relatively low, bus operators have not always wanted to equip some or all of their vehicles; in addition, bus operators have been known to move vehicles from one part of the country to another as requirements change. This can result in non-equipped vehicles operating on routes that have bus priority, and means that some buses receive priority while others do not, resulting in poor value for money for the highway authorities investment.

A technology that avoids these problems is a loop detector that can identify different vehicle types by sophisticated signal processing. Systems using this technology learn to recognise the profile of appropriate bus types while ignoring other vehicle types. Although this technology is more expensive than those based on Transponders, no equipment is required on the vehicles.

Transponder or loop based systems are often known as Selective Vehicle Detection (SVD).

The technologies described above are all dependent on equipment located in fixed positions at the roadside. They are therefore relatively inflexible, and require equipment to be relocated, or new equipment to be installed, as the network changes or as the geographical extent of the system expands. The latest systems therefore tend to be based on GPS technology.

Vehicles equipped with this technology can calculate their position to within a few metres using data from a network of 24 satellites orbiting above the earth; the calculated position can then be transmitted by radio to a central



point. Using GPS removes the need to have roadside based equipment, and provides flexible systems that are less expensive to expand geographically.

As the cost of GPS equipment is decreasing, bus operators and local authorities are now beginning to install GPS systems for fleet management purposes and Real Time Passenger Information at bus stops, so that bus priority can be an 'added function' at a relatively low additional cost.

GPS based systems are often called Automatic Vehicle Location (AVL).

The type of detection dictates the information provided to the control system. Detection can be passive or active. Passive systems only notify the in-station of a vehicle presence at a specified location, whereas active systems provide information that can identify individual vehicles, so that details such as route number and adherence to timetable can be determined. Using this data, systems can set different levels of priority.

During design, consultation with the vehicle operators will ensure that the vehicle detection system chosen meets the needs of the network managers and the bus operators.

Equipment fitted to vehicles may be complex and expensive, and therefore, it may not be possible to equip all vehicles in a fleet. Where this is the case, careful management by the vehicle operators is required to ensure that correctly equipped vehicles are used on routes with priority systems.

Communications

The communication media required for transmission of bus priority data are generally determined by the form of technology used. However, the rate at which communications technology is developing means that the following paragraphs may quickly be overtaken.

Open system design can provide some "future proofing"; specifying standard protocols such as Internet Protocol (IP) can make it easier to change system components if a more efficient technology becomes available.

If the system is transponder based, there is a short wireless communication path between the vehicle and detector or roadside equipment. Communications from roadside equipment to the traffic controller or central control room are generally wireline based, although wireless communication paths could be used. Priority data is transported from the roadside equipment either to the traffic signal controller for immediate action, or back to a central UTC computer if an area wide strategy such as SCOOT is being used.

GPS based systems generally communicate by a wireless signal to the traffic signal controller. The data is then either processed for immediate action at the controller, or passed on to the central computer if an area wide strategy is being used. Potential wireless technologies include GPRS (General Pack Radio System) and PMR (Private Mobile System).

Where other functions are provided, such as Real Time Information at bus stops or Fleet Management, data is generally transported from the vehicle to the central control room via a wireless link.

Priority Strategies

Data processing at the traffic signal controller is generally restricted in capability, as the controller has a limited knowledge of traffic conditions on the rest of the network, even if part of a UTC system. Priority actions are therefore limited to the specific intersection. These actions are usually to:

- Extend the green so that the bus can pass before the end of the stage;
- Recall a stage more quickly by terminating other stages early;
- Call a special stage such as an exclusive right turn; and
- Provide compensatory stages to other traffic once the priority vehicle has passed.

Centrally based processing can take into consideration a greater range of factors including the degree of congestion not only at the location where priority is demanded but in other areas of the network. This enables more wide-ranging decisions to be made in progressing the vehicle.

Importance of Integrated Systems

Public transport priority must have accurate detection in order to operate successfully. Other systems can use this data to assist in the management of other services and provide information to users. Therefore, it is important that open systems are used so that data can be easily transferred.

Authorities can gain benefits from the integration of systems by:

- Integrating public transport priority systems and public transport information systems to provide real time passenger information.
- Sharing communications networks between applications to reduce operating and infrastructure costs.
- Providing information to vehicle operators to allow better management of the vehicle fleet.
- Enabling access control to allow only the priority vehicle to gain entry to restricted areas such as pedestrianised town centres.

Reported Benefits

Studies have shown that the benefits of public transport priority systems are more effective where priority is implemented as part of a package of measures for a whole corridor or route.

In SPRINT in fixed time UTC, a reduction in delay of between 2 and 6.4 seconds per priority vehicle per junction was achieved. i

Bus Priority in London using SCOOT UTC resulted in a reduction in delays to buses of between 22% and 33%.ii

Evaluation

Local Authorities should monitor the performance of systems and evaluate their effectiveness in accordance with the Guidance on Local Transport Plans produced by the DfT. Systems should be evaluated on their effect on patronage, on journey time and delay savings through the network.

If systems are part of an Urban Traffic Management and Control environment, performance data collected can be stored in the UTMC common database. A performance evaluation module can then assist in quantifying, monitoring and optimising the priority system performance. The 'UTMC 05a Performance Criteria for UTMC Systems Handbook' and 'Technical Note' provides further advice on this.

Further Information

The following documents provide further information about topics discussed in the text.

LTN 1/97 Keeping Buses Moving (DTLR)

UTMC – www.utmc.dtlr.gov.uk

UTMC 05a 'Performance Criteria for UTMC Systems Handbook' and 'Technical Note': (DTLR)

Guidance about the Local Transport Plan Process can be found at:

www.local-transport.dft.gov.uk/index.htm#ltp

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To find out more about the wide range of ITS-related initiatives and projects supported by DfT, and the development of ITS policies to encourage and promote greater deployment of ITS, please contact Transport Technology and Telematics division of the Department for Transport at: its@dft.gsi.gov.uk

References

i Housell, N B et al: Collaborative Study on Public Transport Priority at Traffic Signals Final Report to ERTICO, University of Southampton Transport Research Group, January 1996.

ii Housell, N: McLeod, F; Bretherton R; Bowen G (1996): PROMPT: Field trial and simulation results of bus priority in SCOOT. IEE, Road Traffic Monitoring and Control, 23-25 April, Conference Publication, No. 422. pp 90-94

DfT website www.dft.gov.uk
Details of Traffic Advisory Leaflets available on the DfT website can be accessed as follows:
From the DfT homepage, click on the Local Transport icon and then on Traffic Advisory Leaflets. Lastly, click on one of the themes to view material.

The Department for Transport sponsors a wide range of research into traffic management issues. The results published in Traffic Advisory Leaflets are applicable to England, Wales and Scotland. Attention is drawn to variations in statutory provisions or administrative practices between the countries.

The Traffic Advisory Unit (TAU) is a multi-disciplinary group working within the Department for Transport. The TAU seeks to promote the most effective traffic management and parking techniques for the benefit, safety and convenience of all road users.

Department for Transport

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