Bus Priority

Why do buses need priority?

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, eg, consistency of journey times;
- avoiding circuitous routing in traffic management systems;
- maintaining good bus access, eg, 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 (eg, low emission, low floor buses and drivers specially trained in customer care) and high profile marketing. Such Quality Partnerships, to which local authorities and bus companies each contribute are being adopted in many parts of the country.

Options for bus priority

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

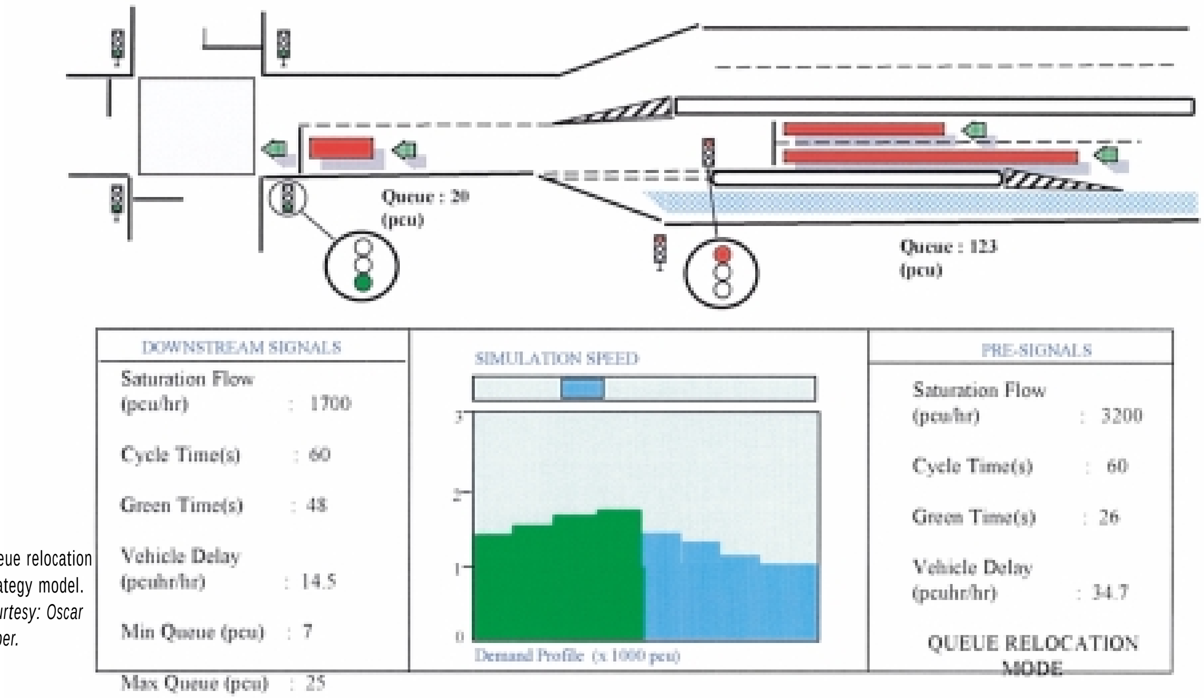
- **full or part time with flow bus lane:** priority access to one lane of a road open to general traffic; full (24 hours/day) or part time (eg, peak hours only);
- **bus only road:** bus only access to a road closed to general traffic. Often features in town and city centres, eg, extensively in the centres of Birmingham and Leeds;
- **contra–flow bus lane:** bus only lane in the opposite direction to the general traffic on a one way street, eg, Piccadilly, London;
- **exemption from banned turn:** to allow buses access denied to other traffic, or to afford them a more direct route;
- **bus gate:** buses use short link closed to other traffic, to travel directly to and across an area not open to general through traffic. May be identified simply by signs, involve activation of a physical measure (eg, traffic signal, barrier, rising bollard or step), or feature a short section of guideway to prevent other traffic from using the route (eg, Ipswich).
- **bus way:** segregated bus corridor, usually purpose built. May be guided (eg, Leeds and Edinburgh's CERT [City of Edinburgh Rapid Transit], currently under development) or non–guided (eg, the long–established Runcorn busway).

Detailed descriptions of the various forms of bus priority and how to implement them are to be found in *Keeping Buses Moving* (Department of Environment, Transport and the Regions, 1997) and *Transport in the Urban Environment* (The Institution of Highways & Transportation, 1997).

Enforcement

If bus lanes are to work effectively, other vehicles must be prevented from driving or – often a more serious obstruction – parking in them. The problem is particularly acute where a bus lane operates part time, which precludes full separation from the rest of the carriageway. The police and other enforcement authorities have insufficient resources constantly to patrol bus lanes, which thus need as far as possible to be self–enforcing. Self enforcement works best when other traffic will not unintentionally tend to stray into the bus lane. Approaches include:

- **colour differentiation of road surface:** red or green surfacing is increasingly being adopted, which reduces unintentional encroachment by other vehicles and encourages enforcement authorities to pay special regard to keeping the bus



Queue relocation strategy model. Courtesy: Oscar Faber.

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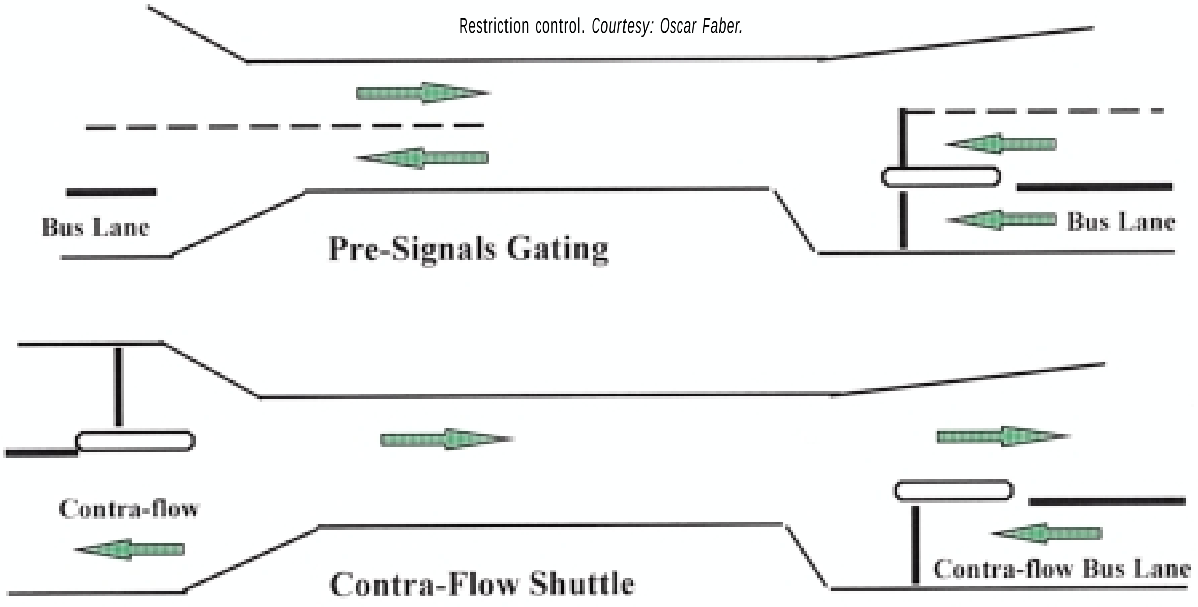
Restriction control. *Courtesy: Oscar Faber.*



lane clear. In Blackpool, the term "red carpet" is used, and of giving buses "red carpet treatment".

❍ **textural differentiation:** eg, rough surfacing material, such as cobble stones, outside the bus's "trackway", to discourage violation. The design for the proposed Leigh Guided Busway in Greater Manchester includes "deterrent paving" along the centre line of each bus way, to prevent violation by other (narrower) vehicles (Greater Manchester PTE *Quality Bus Routes* consultation brochure, 1999);

❍ **partial segregation:** longitudinal ridge, which can be crossed, but not unintentionally. Used in mainland Europe, eg, Brussels and Paris. Being considered for use in Britain, subject to safeguards for two–wheeled vehicles.

❍ **full segregation:** bus lane separated by kerbs from remainder of carriageway: commonly used with contra–flow lanes. Lack of space (carriageway width) and the need for part time access to the lane may preclude widespread use.

❍ **traffic islands:** islands make separation of the bus lane from the rest of the carriageway more obvious and may mean that a conscious driving decision is needed to enter the priority lane.

The role of IT

Advances in information technology make possible "intelligent" traffic management, enforcement, vehicle identification and vehicle guidance, which assists in the provision of effective bus priority and good information. The component elements are discussed below.

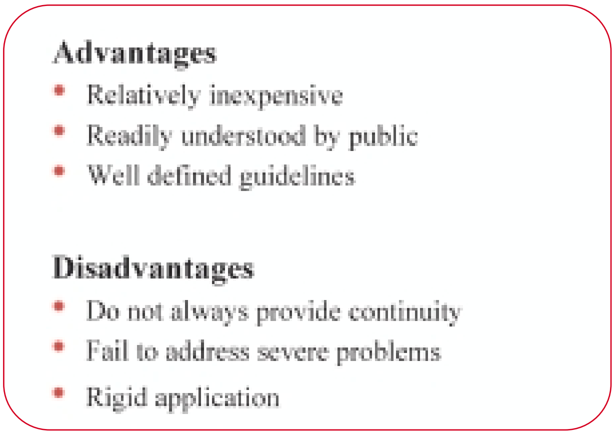
Traffic signal controlled bus priority

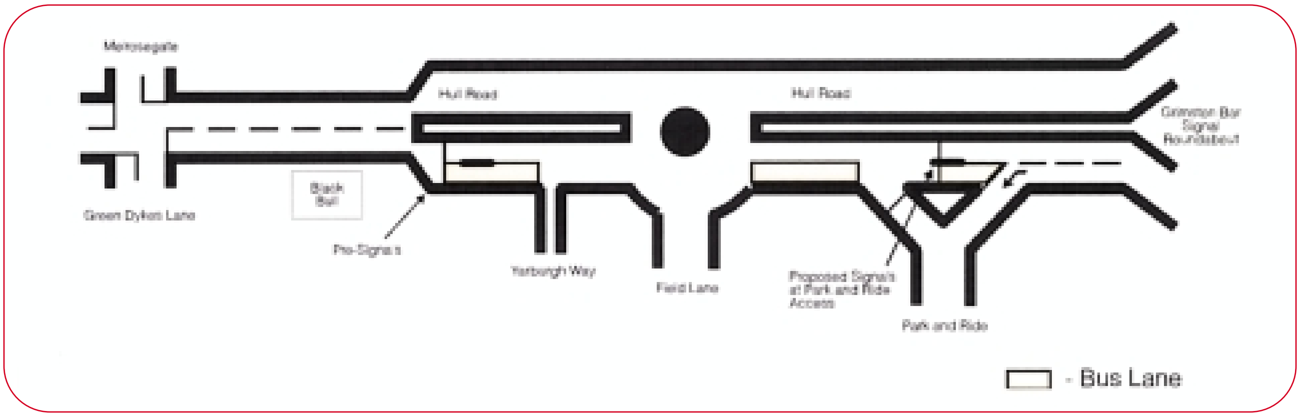
Most traffic signals are now computer controlled and co–ordinated. Earlier systems use pre–determined signal settings, based on historic traffic flows (eg, TRANSYT). Where bus flows are significant, a more sophisticated version (BUS TRANSYT) can be used, to enable a UTC system to bias signal phasing in favour of roads with heavy bus flows.

The main towns and cities increasingly use the fully traffic flow responsive system SCOOT (split cycle offset optimisation technique), in place of former fixed cycle strategies. Version 3.1 of SCOOT includes an inter–active facility to give buses priority, which is activated by bus detectors located upstream of each signal–controlled intersection (Bowen, GT, *Bus priority in SCOOT*. TRL Report 255, 1997).

Priority is given to buses by extension to or early recall of the green phase and by reducing green time for other traffic, for example at entry point to roads with heavy bus flows. The algorithm is usually configured so as to minimise delays and restrictions to other traffic, for a given level of bus priority. In the future, however, bus priority may be implemented in parallel with wider traffic restraint strategies under the Traffic Reduction Act 1997.

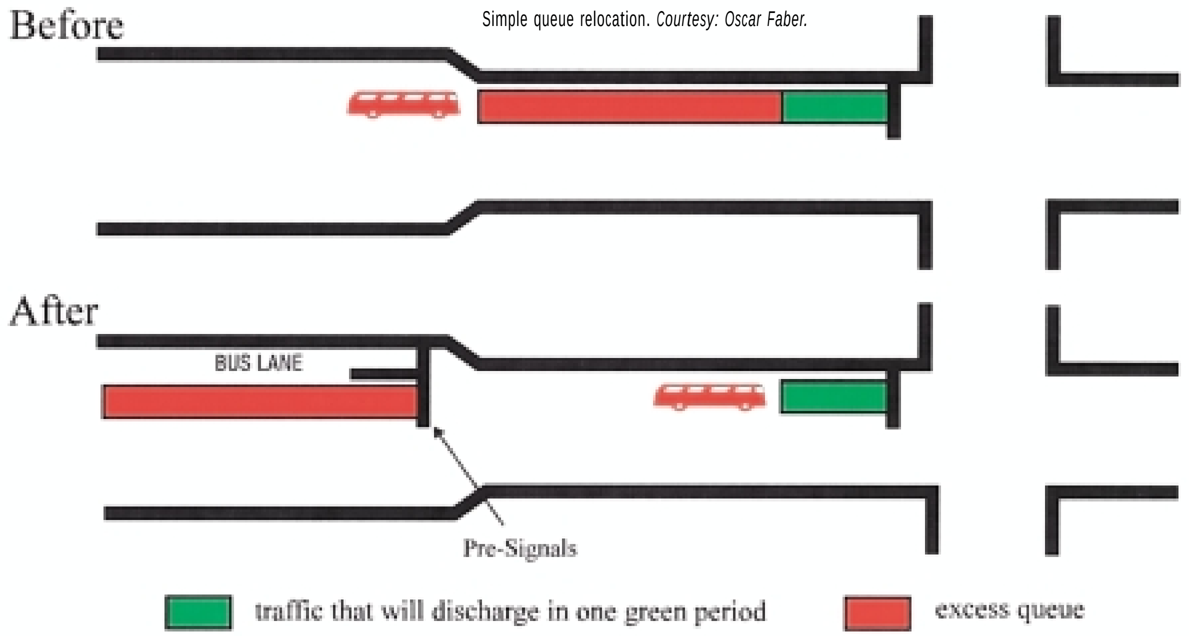
Traditional bus priority techniques. *Courtesy: Oscar Faber.*





Hull Road, York – park and ride management. *Courtesy: Oscar Faber.*

Simple queue relocation. *Courtesy: Oscar Faber.*



Buses may also be given "passive" priority, by controlling general traffic flows so that buses are not delayed in traffic queues:

❍ **Queue relocation** (known also as traffic metering or "gating"): holding excess traffic at locations where it can be "stored", and only released into a potentially congested downstream bottleneck at a level which can be accommodated under free–flow conditions; for example, at an intersection where a dual carriageway ends, or where two main radial routes merge: eg, the junction of Bitterne Road and Bursledon Road, Southampton (Wood, K, *et al*, *UTC Strategies for Congested Networks*. TRL Report 240, 1997) and on Botley Road, coming into Oxford.

❍ **Gap generation:** a technique which allows a bus to rejoin the carriageway from a bus stop lay–by. When the bus is ready to start, it pulls to the head of the lay–by, crossing a buried loop that turns traffic signals up–stream to red and creates a gap in the traffic to let the bus out.

❍ **Advanced stop line:** uses queue relocation or gap generation techniques to allow a bus to bypass a queue of traffic ahead of traffic lights.

Vehicle identification

Intelligent transport systems require vehicle detection and identification (selective vehicle detection [SVD]) as well as IT applications to the infrastructure. Each bus is fitted with an electronic device such as a transponder, which enables it to be identified and its position and status (eg, route, destination, whether it is on time) to be logged. Methods of interrogating buses include:

❍ Fixed equipment, such as a roadside beacon, or an inductive loop beneath the surface, which detect each "live" bus as it passes and inform the real–time traffic signal controller. Global positioning system (GPS) linked to on bus computer to pinpoint the bus's location, direction and speed of travel at any time, with sufficient accuracy to be linked to the SCOOT traffic signal controller and used to advance or retard signal settings. On the system used in Kent, accuracy within three metres is guaranteed, but experience shows that precision as close as one metre can actually be achieved.

Either system allows bus control and priority to be linked to the provision of real time information at bus stops.

Cost profile for satellite and fixed loop/beacon systems

Inductive loop and beacon based systems incur heavy fixed infrastructure costs: fitting 1,000 junctions in London with active bus priority is expected to cost over £20m, or £20,000 per junction (London Transport Buses, Bus Priority and Traffic Unit, Annual Review 1996). On vehicle cost is low, some £20–£50 per vehicle. In London, the first two Bus SCOOT applications, Camden Town and Edgware Road, gave a 72% first year rate of return and 22% cut in delays to buses.

The country's first GPS–based combined vehicle location and bus priority system is in Kent. The pilot system, involving 32 junctions and 44 buses in Maidstone and Ashford, uses the ACIS (Advanced Communications & Information Systems Ltd) Bus Monitoring System, and cost some £200,000 to set up. There are no roadside equipment costs, but at £2,000 per vehicle, the cost of the on bus unit is high. Kent CC met the cost of the pilot scheme, but has reached agreement with the county's main bus operators for them to meet 50% of the cost of fitting additional vehicles. Equipping all 800 buses in the county would cost some £1.6m.

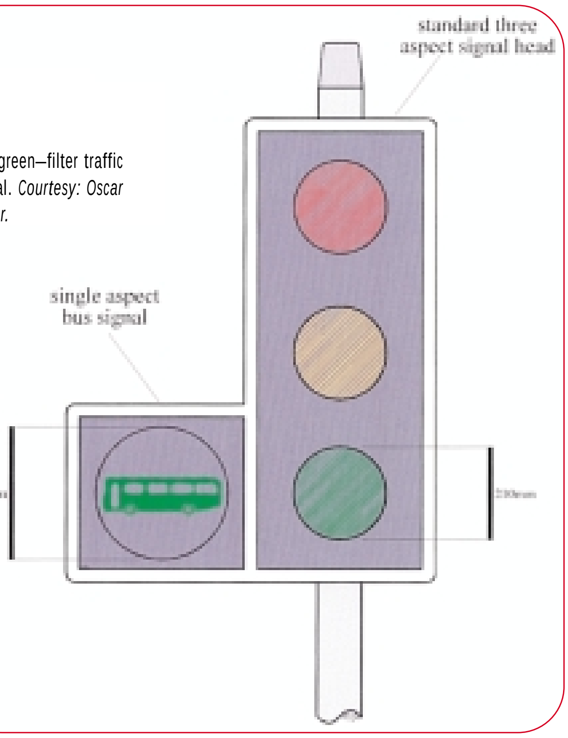
Vehicle guidance

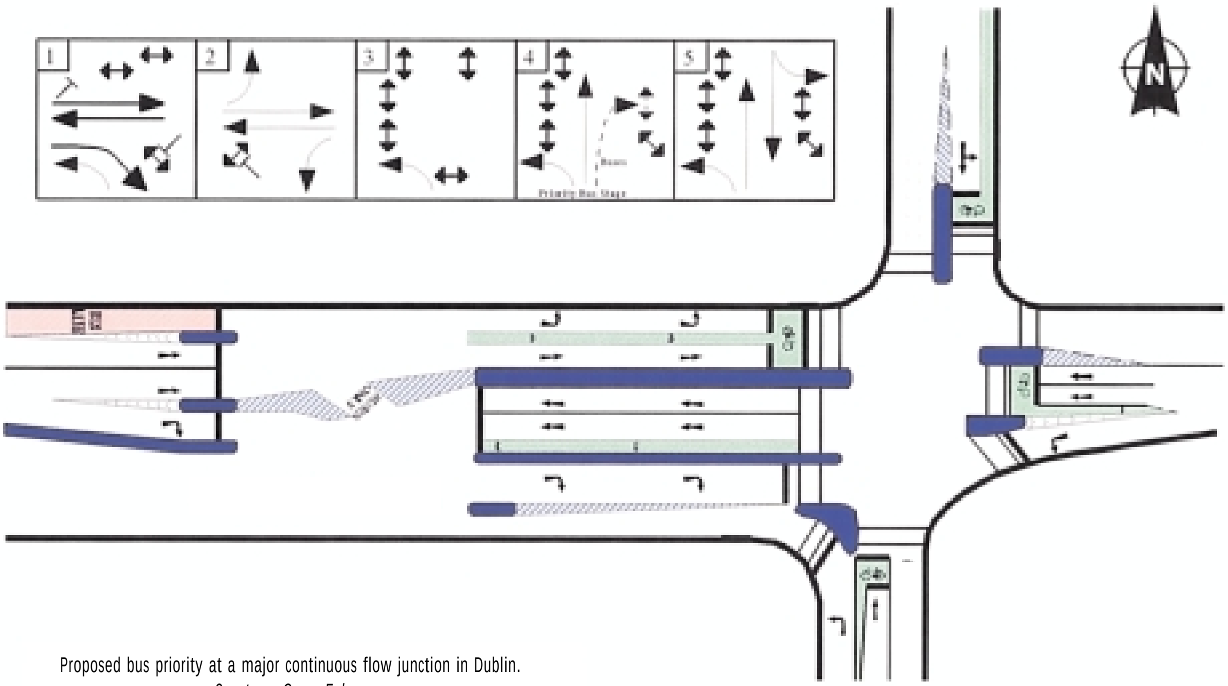
Electronic guidance of buses, with on–board micro processor control linked to buried cables, has potential advantages in the context of bus priority:

❍ ability to penetrate confined zones such as pedestrian areas;

❍ precise repeatability of the vehicle's swept path, despite absence of intrusive physical evidence (track, kerbing) of guidance system, and

Bus green–filter traffic signal. *Courtesy: Oscar Faber.*





Proposed bus priority at a major continuous flow junction in Dublin.
Courtesy: Oscar Faber.

❍ complete flexibility, as guidance can be disengaged by the driver if required.

Guidance is through antennae on the vehicles, which detect the magnetic field from the cables located close to the vehicle's swept path just below the road surface. (CEGELEC AEG Systems and Automation. *Electronic Guidance A New Era in Public Transportation*. 1997).

Although not strictly a bus system, the Eurotunnel service tunnel transit system, with 24 vehicles running on 50km of infrastructure and passing at speed with clearances as little as 100mm demonstrates the technology's success.

Successful trials were conducted at Newcastle–upon–Tyne in 1996 as part of a Tyne and Wear Development Corporation/ERDF project (Buses. September 1996), and new road infrastructure on the Quayside has been built with a view to the later insertion of guidance cables. However, it has been demonstrated that 2.3m wide conventional buses are capable of operating on the route, so the expense of equipping it with a guidance system may not be necessary.

To date the following *Network Management Notes* have appeared in *H&T*.
Real Time Traffic Information Systems by Susan Harvey was published with the March '98 issue.
Urban Safety Management by Chris Lines was published with the April '98. *Camera Enforcement of Traffic Regulations* by Ken Huddart was published in the December '98 issue.
Public Transport Passenger Information, by Martin Higginson was pubished in the January/February '99 issue.

Enforcement

Intelligent systems make enforcing bus priorities simpler, less labour intensive and more effective. Examples include:

❍ Additional use of on–bus equipment to activate gates or rising bollards at the entrance to bus only streets. Successfully applied in Cambridge city centre and in East Ham High Street, London.

❍ **Cameras:** closed circuit television camera monitoring of bus lane infringement was introduced by the Traffic Director for London on the "Red Route" network in 1996 using roadside cameras, and in 1997 with bus–mounted cameras. Each system uses dual cameras; one records the context of the offence, the other takes a close–up picture of the offending vehicle's number plate. The roadside cameras are activated by a vehicle entering the bus lane; those on buses switch on automatically when the bus enters a bus lane. The scheme involves six London boroughs, two bus operators and London Transport Buses (Traffic Director for London. *Annual Report 1996–1997*).

Conclusion

Information technology has much to offer in advancing the science of bus priority, including infrastructure management, vehicle identification and location, enforcement and vehicle guidance. Successful implementation requires that consideration of bus priority starts right at the beginning of the planning of a road or traffic scheme. Different approaches have different cost profiles, but good returns on investment can be earned.

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