TIDE

Transport
Innovation
Deployment
for Europe

GUIDELINES FOR IMPLEMENTERS

Advanced priority systems for public transport

TIDE is a Coordination Action funded by the European Commission's DG Research and Innovation under the 7th Framework Programme for Research and Development.

SEVENTH FRAMEWORK PROGRAMME

What is it about?

Helsinki's bus priority system

Source: Airaksinen and Kuukka–Ruotsalainen, 2008

Helsinki, Finland

Helsinki's public transport telematic system — HeLMi (Helsinki Public Transport Signal Priority and Passenger Information) provides several public transport telematic functions including bus and tram priority at traffic signals.

In this system, the exact locations of buses are determined using the combination of GPS navigation, bus door opening sensor and odometer technologies. Once a bus arrives upstream of a traffic signal, the bus requests priority. The signal controller gives priority to the bus if it is running late and is not given to buses which are ahead their time–table.

The system uses wireless communication to: poll buses by the central equipment to locate the exact position of each bus along the route and to request priority at traffic signals.

Characteristics

This measure focuses on giving traffic signal priority to public transport (buses/trams) according to needS, e.g. priority to late buses or to buses with a headway bigger than the scheduled headway. In such a measure, real time locations of buses are tracked "continuously" using an Automatic Vehicle Location (AVL) system (e.g. using the Global Positioning System (GPS)).

Using this location information, the delays or regularity of buses can be calculated at any point in time, and priority requirements can be determined accordingly. The priority can be given at the downstream traffic signal(s) according to the traffic signal control strategy in operation.

As a result, it allows a higher level of priority to be given to the buses that are in greater need while making less disruption to general traffic because there are few priority actions overall .

Key benefits

Advanced priority systems for public transport:

- improve regularity/punctuality of buses;
- reduce waiting time at bus stops for passengers;
- encourage modal change to buses;
- reduce overall emissions and energy consumption from road transport.

Check list

City size	No maximum size. Minimum size related to scale of bus operations.
Costs	• A comparatively medium–cost measure that can be expanded from a route–based scheme to a city–wide scheme. • Mainly capital cost of AVL system.
Implementation time	Planning of scheme and preparation of materials within a couple of years.
Stakeholders involved	• Local authorities; • Public transport operators. • Traffic signal engineers. • Public transport passengers. • Society.
Crucial factors	• Properly designed and installed system. • Skills needed to maintain the benefits from the system. • Cooperation between road and Public transport operators and authorities.

"London has been at the forefront of the development and implementation of bus priority at traffic signals in the UK since 1970's.

To overcome the constraint of fixed detectors, London has upgraded its bus priority facility at traffic signals utilising the recently procured GPS–based AVL system known as iBus.

These facilities provide the opportunity for enhancement of bus priority at traffic signals to give significant additional benefits for buses."

Kevin Gardner,
Recent Head of Bus priority team,
Transport for London,
London

Source: Transport Research group

Benefits & Costs

Benefits

Advanced priority systems for public transport allows a higher level of priority to be provided to the vehicles which are in the need (e.g. late buses). As a result the measure has following benefits:

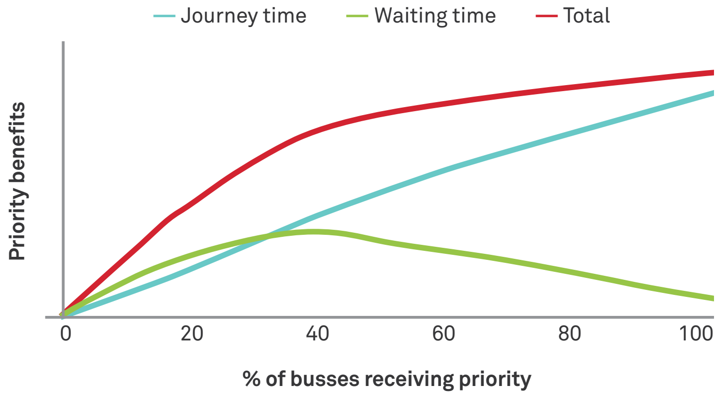
- optimises the movement of people, not vehicles;
- improves service regularity (or adherence to schedule), which reduces passengers waiting times;
- targets buses with a higher occupancy, because late buses typically have to pick up more passengers;
- can provide a higher level of priority for vehicles which are more in need;
- can reduce effects on general traffic, because fewer buses are awarded priority;
- allows a flexible response according to policy;
- Encourages modal change in favour of buses/trams, increases revenue, provides environmental benefits and contributes to sustainable transport

Costs

Provided the existing traffic signal control system has the facilities to give priority to a detected vehicle, the main cost relates to the software upgrade, detection technologies and communications technologies.

- Software upgrade is needed to include a defined algorithm to give priority.
- Detection technology is another main cost component in implementing this measure.
- Communication technology(ies) are needed to communicate between the various components of the system (AVL centre, buses, traffic signal and UTC centre).

Apart from these capital costs at the beginning, the measure also needs regular maintenance cost to continue securing the benefits achievable from the measure



Theoretical benefits of advanced bus priority at traffic signals
Source: Transport research Group, 2008

Users & Stakeholders

Users and target groups

The main users and target groups of this measure are public transport passengers and public transport operators.

Public transport passengers: public transport passengers are the end–user of the system. Improved regularity of public transport reduces their waiting time and hence improves passenger satisfaction and overall travel time.me and hence improve user satisfaction.

Public transport operators: public transport operators are users as well as a key stakeholder. They benefit from any increase in patronage as a result of the advanced priority given to public transport.

Transport Research Group

Source: Transport Research group

Key stakeholders for implementation

The successful outcome from this measure is influenced by the active involvement of different stakeholders including: local authorities; public transport operators; traffic controller; and public transport passengers.

Local authorities: the local authority is a main stakeholder for this measure. The local authority is responsible for implementing the key infrastructure and system as a whole and hence needs to consider costs and benefits of the measure.

Traffic control manager: traffic control managers are the key stakeholder in the smooth operation of the system. They need to be fully convinced to get the best outcome and hence need to be consulted on every aspect and stage of the project (preparation, implementation and operation).

Public transport operators: public transport operators are another key stakeholder. Their active participation in operating buses to achieve the goal is very important. If they operate different way than is assumed in the priority algorithm, the benefits would be significantly reduced. Hence involvement from the beginning is recommended.

Technology supplier: these are the contractors proving all or part of the system (including supply, installation and testing).

Brighton and Hove, UK

The number of bus journeys made in Brighton & Hove has doubled in 20 years. Increase in popularity is attributed to the successful partnerships between the council and bus operators in the city.

The strong partnerships have put the city in a good position to win government funding for transport, most recently being awarded £3.4 million for the 'Better Bus Area'.

The City Council has provided a number of features that aid bus services including: Real Time Information signs at bus stops and bus priority at traffic signals

Assessing the potential for your city

Is this something for us?

Public transport is a key requirement for sustainable transport in the most cities across the world. With their higher passenger carrying capacity, they are very efficient in utilising the available road space.

Being a technology–led measure not requiring any extra road space, this measure is suitable for urban areas with high density of traffic signals and limited road space availability.

An advanced priority system allows priority to be given to public transport addressing a particular goal (e.g. improving regularity/ punctuality, delays or partly both). This enables the city authority to have more control over which bus should get priority depending on its performance.

Pre–assessing the costs and benefits

The cost of implementing advanced priority systems involves the costs of detection technologies, communication technologies and upgrade of traffic signal control software.

The benefits from this measure are measurable and could be converted to economic values to carry out conventional CBA. The most common benefits reported from earlier implementation (as shown in the table below) include: travel time savings, improved regularity/punctuality and patronage. Improved regularity/ punctuality could be assessed in terms of the improved passenger waiting time as a result.

City	Priority benefits and impacts		
	Delay/Travel time savings	Regularity/punctuality	Patronage
Cardiff	3–4% reduction	Improved	
Gothenburg	13–15% decrease		
Helsinki	11% reduction	Improved	11% increase
London	3–5 sec/bus/jun		
Toulouse	5–24% decrease		
Turin	12% reduction		
Zurich			42% increase

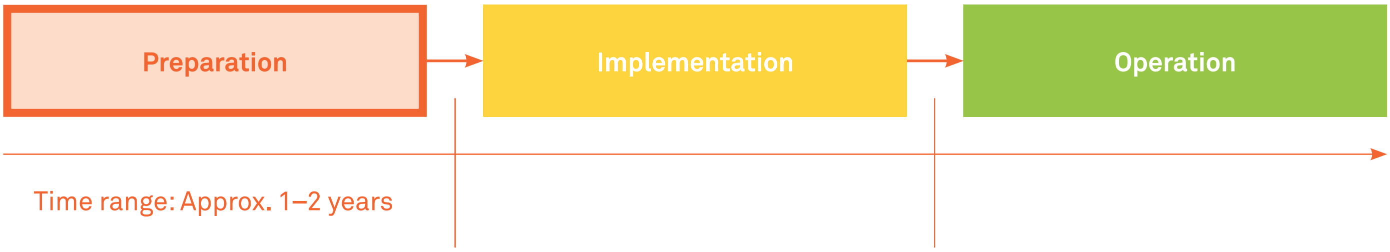
Reported benefits of bus priority at traffic signals around Europe

Source: Gardner et al, 2009


BAHNHOF

From plan to reality

Preparation



In the preparation phase, it is necessary to carry out activities that help create the right pre–conditions and involve the necessary stakeholders for putting the measure successfully into practice.

Key aspects at this stage

Context conditions

Context conditions of the city needs to prepared to assess the existing conditions; organizational control of traffic and bus operational systems; traffic conditions; etc.. The number of public transport vehicles and the density of traffic signal installations are of key importance.

Stakeholder interactions

At this stage, interaction with stakeholders is very important to identify the issues to be addressed to ensure successful implementation and operation phases. Important interactions include those between the local authority and the public transport operator(s). The interaction will also help identify the technology available to support this measure.

Identification of issues

The adaptive nature of coordinated traffic signal infrastructure is needed for bus priority implementation. The way priority is implemented also depends on the capabilities and flexibility provided by the existing traffic control system.

Hence, adaptive traffic control systems using online traffic information is usually required for this measure to be most successful.

Field experience shows that the priority system implemented is dictated by the existing traffic signal control infrastructure as the cost of replacing such an infrastructure would be very expensive compared to the priority measure itself.

Technology selection

Advanced priority at traffic signals is a technology-led measure and hence the selection of the appropriate technology is critical. This should allow the system to be upgraded as technology evolves. The selection of the technology should encompass all aspects of the system (e.g. detection, communication and priority architecture). Care should be taken to select technology that is compatible with the exiting infrastructures.

The budget needs to be considered at this stage. Along with the technology selection, implementation size depends on the budget available. It shapes the whole implementation process.

Combined approach

Combining implementation of advanced bus priority with other public transport applications using AVL data (e.g. Real time passenger information, real time fleet management) improves the effectiveness of the system while reducing the cost burden.

Ready for implementation?	✓
Context conditions	
Stakeholders interactions	
Infrastructure assessment	
Technology selection	
Budget	
Combined approach	

Success factors and barriers at this stage

Success factors

- Public transport policy.
- Adaptive traffic signal control.

Barriers

- Cost.
- Perception of green time wasted due to the priority.

The cost of implementation is a main issue at this stage. This issue could be addressed if a city has a policy that strongly supports public transport. To support the argument for funding, economic justifications could be made in terms of bus journey time savings and passenger waiting time savings.

Being more technical in nature this measure, does not need publicity and the support from general public to be successful.

The perception of green time being wasted when giving priority to a bus and junction efficiency being worsened as a result could be a barrier for implementation of this measure. A proper design and implementation could reduce the wasted green time and not affect junction efficiency adversely.

London's iBus

Bus priority at traffic signals is a part of Automatic Vehicle Location (AVL) system, also known as iBus.

iBus system provides locational information to various public transport applications such as Real Time Passenger Information, bus fleet management and bus priority at traffic signals.

By combining various applications that could utilise the information provided, the cost burden of implementating bus priority at traffic signals could be reduced.

iBus system, London

Source: www.tfl.gov.uk, 2011

From plan to reality

Implementation

Preparation → Implementation → Operation

Time range: Approx. 1–2 years | Time range: Approx. 1–2 years

As the measure takes shape in the field during the implementation phase, a range of activities take place. For the success of the measure, it is necessary to involve stakeholders, ensure good quality of data and address user needs.

Key aspects at this stage

Stakeholders involvement

It is a critical phase in which stakeholders need to be involved to make the implementation phase a success. The priority algorithms need to match the implementing authority's aim and the public transport operator's expectation.

As the operators control all the vehicles, their cooperation is crucial in achieving the defined goal. For example, if the authority is aiming to improve regularity (by giving priority at traffic signals) and operators run buses according to different criteria, then the main performance objective may not be achieved. Hence, positive engagement with public transport operators to agree on the best course of action is crucial for the success of this measure.

Site selection

Not all the sites in a city will be installed with priority facility due to the budget constraint or due to the field characteristics. For example, very little or no benefits at all could be realised from a site with very heavy traffic flows and hence a very limited capacity for priority. Hence a system of selecting sites and prioritising them for installation is needed for an efficient installation programme.

Installation

Correct installation is very important to realise the full potential of the measure. The installation should follow the implementation guidelines and standards available. The infrastructure needs to be correctly set up (e.g. detectors) and appropriate parameters associated need to be used.

Testing

All the installations need to be rigorously tested to make sure that the system is working as intended and giving the expected benefits. The testing should include individual components as well as the complete system.

Success factors and barriers at this stage:

Success factors

- Adaptive traffic signal control.
- Proper design and installation of the required accessories.

Barriers

- Complexity of the junctions.
- Non–optimal installation.

This measure needs an adaptive traffic signal control to give different levels of priority to buses according to their need. Having such a traffic control system is a success factor. In addition, the proper installation of the priority system as a whole is needed to get the best outcome from the measure.

It needs to be noted that in some cases, the complexity of the junction in terms of the flows and geometric characteristics make it difficult to realise the full potential of the measure. Again, non–optimal installation of the system would lead to a non–optimal outcome.

Bus priority module inside a roadside traffic signal controller

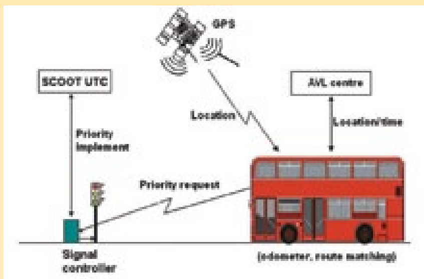
London's bus priority at traffic signals

London has implemented a GPS–based Automatic Vehicle Location (AVL) system known as iBus for various public transport applications. This system includes bus priority at traffic signals and signalised pedestrian crossings for London's fleet of 8000 buses.

In this system, buses are detected as they approach traffic signals using 'virtual' detectors which are the locations programmed onto the on–bus unit. When the location obtained from GPS matches a 'virtual' detection position, a priority request is sent from the bus to the downstream traffic signal controller.

Once the signal controller receives the request for bus priority, priority is implemented mainly by extending the present green time if it is expected that the bus detected would otherwise just miss the present green period or by recalling the green time more quickly if the bus is detected in the red period and is expected to arrive at the stop line before the start of the next green period.

In this process, there is a facility to give different levels of priority (high, medium, low or no priority) according to the needs of the bus. These needs are determined from the iBus information on the adherence to frequency or timetable.

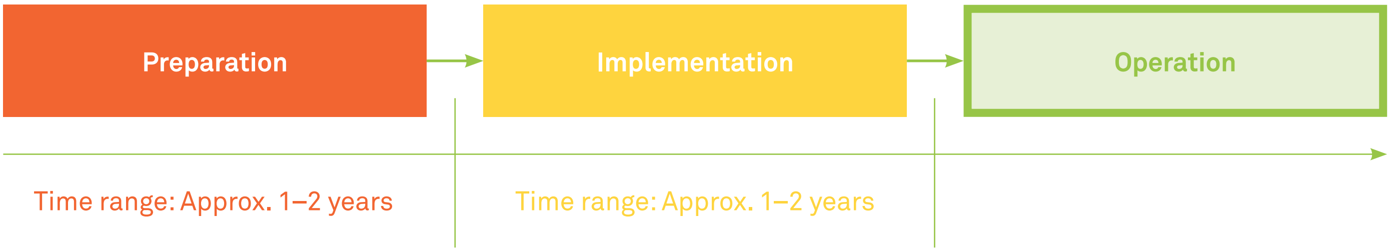


Bus priority using iBus

Source: Hounsell et al, 2008

From plan to reality

Operation



Following successful implementation and testing, operations are largely automated. However, one should be ready for any problem that may arise as a result of the roll out of the measure.

Key aspects at this stage

The cooperation of the bus operators is needed for the success of an advanced priority system where a particular category of bus receives priority (instead of all the buses). This could be a key barrier if the bus operators are operating on a free market scenario without direct control of the local authority.

Maintain stakeholder relations

As the ultimate success of the measure depends on the increased public transport patronage, the authority needs to maintain regular engagement with the bus operators.

Monitoring of the system

Monitoring of the system to maintain initial benefits from the measure is essential. Regular maintenance of the system may be integrated with monitoring.

Regular maintenance

Regular maintenance needs to be carried out to ensure that the system is working to its potential.

Future update

Regular appraisal of the system will be beneficial to assess whether the system is still working in an optimal way, given potential changes in traffic conditions and bus operations. Advances in information technology are very likely and should be regularly reviewed for their potential contribution to the measure.

Other uses

In addition to the real time application, the data from such system could be used for other off–line applications (e.g. performance monitoring).

Success factors and barriers at this stage

Success factors

- Proper implementation.
- Skilled staff for monitoring the system.

Barriers

- Cooperation of private transport operators.

Further information & contacts

Further information

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Further TIDE training on this measure:

Webinars and e–learning courses

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Photo on title page: Transport Research group

Contacts

Birendra Shrestha
Transportation Research Group
b.p.shrestha@soton.ac.uk

Nick Hounsell
Transportation Research Group
n.b.hounsell@soton.ac.uk

Prepared for the European Commission by:

Transportation Research Group, University of Southampton: Birendra Shrestha and Nick Hounsel

Peter Brett Associates: Mike McDonald

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About TIDE — Transport Innovation Deployment for Europe

The European TIDE project aims to foster a more favourable climate for cities and regions to integrate innovations in their urban mobility policies. This should lead to increased acceptance and take–up of new urban transport solutions and technologies. TIDE will help cities and regions to address common challenges in a collaborative and integrated way.

Why should you care about innovation?

On several occasions, European cities have indicated that innovation can help to tackle challenges resulting from the economic crisis. Innovation can save costs as well as contribute to reaching urban policy goals. Still, cities lack resources to conclude a full innovation cycle.

Innovative ideas usually start in one or just a few places before they reach wider coverage. TIDE will help cities and regions across Europe to shorten the path towards the implementation of innovative measures by showing that it is not necessary to re–invent the wheel and much more effective to exchange on innovation and transfer successful solutions from one European region to another. TIDE thus offers a cost–efficient way of spreading innovation throughout Europe

Our mission — Guided by your needs!

TIDE will enhance the broad take–up of 15 innovative urban transport and mobility measures throughout Europe and will make a visible contribution to establishing them as mainstream measures. The TIDE partnership is making a range of new and feasible solutions more easily accessible, to address key challenges of urban transport such as energy efficiency, decarbonisation, demographic change, safety, access for all, and new economic and financial conditions.

TIDE focuses on fostering awareness, advancing expertise via tried and new tools, practical work with cities, and costs and benefits. The needs of practitioners in European cities are thereby a guiding principle. TIDE is actively supporting 15 committed cities to develop implementation scenarios for innovative urban transport measures, setting the example to an even wider group of take–up candidates. These measures cover the following five TIDE themes: new pricing measures, non–motorised transport, advanced network and traffic management to support traveller information, electric mobility, and public transport organisation.

The TIDE innovative transport measures

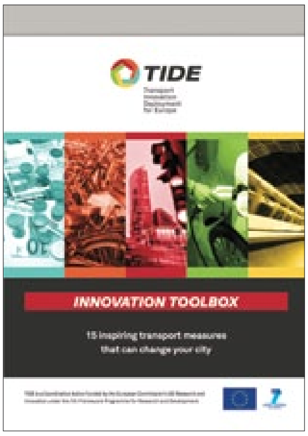
TIDE covers fifteen innovative measures across the five TIDE–themes.

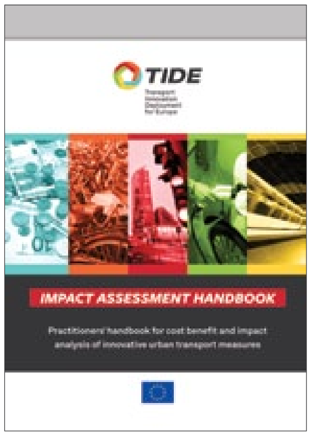
New pricing measures	• Road user charging in urban areas • Parking charge policies • Efficient and convenient pricing and charging for multimodal trips
Non–motorised transport	• Bicycle parking schemes • Creating people–friendly streets and public spaces • Fast cycling lanes
Advanced network and traffic management to support traveller information	• Open data server for applications–based traveller information • User–friendly human machine interface for traveller information • Advanced priority systems for public transport
Electric mobility	• Clean city logistics • Financing schemes for charging stations • Inductive charging for public transport
Public transport organisation	• Creation of public transport management bodies for metropolitan areas • Contracting of services focused on improving passenger satisfaction and efficiency • Marketing research as optimisation tool in public transport

The TIDE Innovation Toolbox brochure highlights these fifteen inspiring transport measures and illustrates them with good practice examples, listing characteristics and benefits, key aspects for implementation, and useful references.

The TIDE Practitioner Handbooks on Transferability and Impact Assessment provide methods and examples to help understand the local potential for innovative measures in urban transport.

The Guidelines for Implementers are ten individual implementation guideline brochures addressing the full implementation process of ten of the fifteen TIDE innovative measures, as well as their costs and benefits, stakeholders to be involved, etc., illustrated with good practice examples.





The mission of the TIDE project

is to enhance the broad transfer and take–up of 15 innovative urban transport and mobility measures throughout Europe and to make a visible contribution to establish them as mainstream measures.

TIDE focuses on 15 innovative measures in five thematic clusters: financing models and pricing measures, non–motorised transport, network and traffic management to support traveller information, electric vehicles and public transport organisation. Sustainable Urban Mobility Plans are a horizontal topic to integrate the cluster activities.

The TIDE team

The TIDE consortium is composed of a variety of experts in the field of urban transport, bringing in the knowledge of the academic sector, the experience of cities, the expertise of consultants and the multiplier effect of European networks.

For more information on TIDE, contact the project coordinator at Polis:

Ivo Cré
Phone: +32 (0)2 500 56 76
Email: icre@polisnetwork.eu

Karen Vancluysen
Tel: +32 (0)2 500 56 75
Email: kvancluysen@polisnetwork.eu

Or visit the project website: **www.tide–innovation.eu**

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