Commission's Expert Group on Urban ITS

Draft Guidelines

"Traffic Management & Urban Logistics"

Version 1

Abbreviations and acronyms

Abbreviation	Description
3G / 4G	3rd / 4th Generation mobile telecommunications
AFNOR	National Standard Body
ANPR	Automatic Number Plate Recognition
ASECAP	European association with tolled motorways, bridges and tunnels
BMM	Business Motivation Model
BPMN	Business Process Model and Notation
BSI	National Standard Body
CBD	Central Business District
CCTV	Closed Circuit Television
CEN	European Committee for Standardisation
CVIS	Cooperative Vehicle-Infrastructure Systems
DATEX II	Standards for information exchange between traffic management centres, traffic information centres and service providers
DIN	National Standard Body
EUROCITIES	Network of major European cities
ERTICO	Intelligent Transport Systems and Services for Europe (public / private partnership)
ETSI	European Telecommunications Standards Institute
GPRS	General Packet Radio Service
GPS	Global Positioning System
HGV	Heavy Goods Vehicle
ISO	International Organisation for Standardisation
IT	Information Technology
ITS	Intelligent Transport System
LEZ	Low Emission Zone

NEN	National Standard Body
OCA	Open Cities Association
POLIS	European Cities and Regions Networking for Innovative Transport Solutions
RTPI	Real Time Passenger Information
SBVR	Semantics of Business Vocabulary and Business Rules
SCATS	UTC-based software
SCOOT	UTC-based software
SMS	Text Message
SoaML	Service oriented architecture Modelling Language
TAM	Traffic and Access Management
TCC	Traffic Control Centres
TM	Traffic Management
TMC	Traffic Management and Control
TMP	Traffic Management Plan
UITP	International Association of Public Transport
UPMS	UML Profile and Metamodel Services
UTC	Urban Traffic Control
UTM	Urban Traffic Management
UTMC	Universal Traffic Management Control
V2I	Vehicle To Infrastructure
V2V	Vehicle To Vehicle
VMS	Variable Message Signs

Content

1 Summary

This document outlines how ITS can add value to traffic management and urban logistics.

Chapter 3 outlines how ITS can aid policy delivery and describes a wide range of ITS applications such as intelligent traffic signal control, satellite tracking of vehicles, CCTV, variable message signs etc. that can be used to manage traffic. Reference is also made to developments such as the contemporary utilisation of vehicle to infrastructure communications and the future potential of vehicle to vehicle communications, which is likely to be a key element in future management of traffic in urban areas.

Chapter 4 lists the stakeholders considered as key players for successful deployment of traffic management and urban logistics schemes. It also highlights those agencies which can act as data providers and how data can be most beneficially used to advance ITS schemes.

Chapter 5 describes the impacts that ITS can make on traffic management and urban logistics within an organisational framework that functions on a number of complimentary and interconnected levels – policy, tactics, measures and operations. ITS impacts directly across each of these levels.

Chapter 6 includes key factors for success with particular emphasis placed on co-operation, partnership and interoperability. Other issues dealt with include productive project management; organisational issues that need to be addressed; how ITS can be used to provide good quality information to individual travellers, which, in turn can help to optimise network performance; minimising human intervention; and the role of standards and harmonisation.

The recommendations for success are the following:

- The need for effective multi agency co-operation is critical in devising an ITS traffic management project. Any organisation wishing to establish a project should seek the active and productive participation of all relevant organisations. Political problems are generally more challenging than technical problems.
- Identify, define and allocate those tasks that are essential to the process of delivering a successful project.
- The most successful ITS traffic management projects and systems are those that are focused on delivering relevant services and information to individual end users. Try to structure projects and channel resources that are bespoke to individual end users. In this way operation of the urban road network will also be optimised.
- The effectiveness of ITS in urban traffic management and logistics can generally be increased by adoption of automated systems which are better equipped than humans to perform operational functions. Try to identify and select those systems which maximise the potential for automated ITS systems to take on functions such as routine data processing and interpretation, which will allow human participation to be concentrated at a more strategic level.

- Usage of standards can be beneficial when implementing ITS traffic management projects. Standards are most productively used when they are not proscriptive but lead to the creation of features such as open platforms for ITS technology, which are central to the successful development and future adoption of ITS based traffic management projects.

2 Introduction

Nowadays, there are a number of challenges lying ahead of the transport system. The idea of a Single European Transport Area, promoted by White Paper for Transport 2011, sets the goals to be achieved by 2050. The transportation has to become more competitive and resource efficient within this time horizon.

The goals for urban transport, in this respect, are to promote the use of cleaner cars and cleaner fuels. The need is also to reduce the number of fatalities and incidents. Yet another challenge is that the amount of traffic in Europe's urban areas has been increasing inexorably during last decades. The task of people involved in urban traffic management is to best allocate the scarce resources of road and kerbside space to potentially competing transport modes, within a network that has finite capacity. A more accessible public transport system has to be prioritized in traffic management.

Smart technologies and **Intelligent Transport Systems (ITS)**, in particular, have a role to play in achieving the aforementioned goals. ITS can significantly contribute to a cleaner, safer and more efficient transport system, especially in urban areas. The ITS Directive (2010/40/EU) gives the legal framework in order to accelerate the coordinated deployment of innovative transport technologies across Europe. It aims to establish interoperable and seamless ITS services while leaving Member States the freedom to decide which specific systems to invest in.

Two recent European Action Plans include complementary actions on the issue of ITS for urban areas:

- The **ITS Action Plan** (2008) foresees the set-up of a specific ITS collaboration platform to promote ITS initiatives in the area of urban mobility.
- The **Action Plan on Urban Mobility** (2009) foresees that the Commission will offer assistance on ITS applications for urban mobility, possibly in form of a guidance document, to complement the ITS Action Plan.

Resulting from these provisions, the Expert Group "ITS for Urban areas" has been set up in December 2010 for 24 months, in order to support the European Commission in its work concerning the aforementioned Action Plans. The Expert Group was multi-modal in its focus, broad in nature and covered the urban region taking into account the interfaces between the urban and inter-urban mobility. Both passenger and freight issues were considered and a dialogue between public and private stakeholders encouraged.

The tasks of the Expert Group have been three-fold: to provide guidance on ITS deployment in urban areas, collect best practices on successful deployment and identify a possible need of standardisation. The group had to develop specific

guidelines to promote and show the benefits of the use of ITS in urban areas along the individual travellers' mobility chain. The Guidelines despite the fact that they do not have mandatory character have the aim to foster interoperability and continuity of services within Europe.

The Guidelines target the organisations in charge of decision making and technical deployment of ITS on local level. For each **key application of urban ITS** a separate document has been issued:

- Traffic and Travel Information
- Smart Ticketing
- Traffic Management and Urban Logistics

3 Application concepts and context

3.1 How can ITS help decision makers with policy delivery

The role of Intelligent Transport Systems (ITS) is generated from the problems caused by traffic congestion and the development of new information technology for simulation, real-time control, and communications networks, offering the opportunity to address issues such as urban traffic management in an innovative manner. Traffic congestion has been growing as a result of increased use of motor vehicles, population growth, and changes in population density.

Ever increasing urbanisation has led to many larger towns and cities experiencing a level of traffic usage that has seen peak hours spreading from the traditional 07.00 – 10.00 and 16.00-19.00 to a situation where roads in the inter peak period of 10.00-16.00 and post peak period after 19.00 are often as congested as traditional peak hours. The result is that road network in many urban areas in Europe are operating at or near capacity throughout many periods of the day and consequently the detrimental effect of congestion becomes greater and the need to mitigate against the consequences of congestion ever more pressing.

Congestion reduces efficiency of transportation infrastructure and has a detrimental impact on travel time and reliability, air pollution, and fuel consumption. Congestion also has a particularly negative effect on the economy of distribution services.

Large increases in vehicle use and urbanisation have put transport policy in the spotlight. Oil will become scarcer in future decades. There is a need drastically to reduce greenhouse gas emissions. Coping with congestion by widely extending road infrastructure is often not a valid option. Promoting independence from oil and creating modern infrastructure and multimodal mobility assisted by smart management and information systems is a challenge. A transport system can be considered as smart if it is capable of dealing with new situations — such as those concerning safety, traffic congestion, obstacles or modal integration — by linking all sources of data to produce valuable information for transport users and operators.

ITS includes a wide variety of applications in the different modes of transport, for both passengers and freight to help realise broader transport policy goals. This is the case not least in road transport, where ITS applications include applications such as electronic tolling, dynamic traffic management (including variable speed limits, parking guidance and reservation, and real-time navigation support), real-time information and other driver-assistance systems such as like electronic stability control and lane-departure warning systems. ITS can also make it easier to link the various transport modes, for example by means of integrated multimodal trip planners or tracking services for co-modal freight transport. Such smart transport solutions are already applied across many urban areas of the EU.

3.2 ITS applications for traffic management

There is no single tool of urban traffic management and a range of applications have been developed over many years. Parking controls, pedestrian zones, traffic signals, public transport provision, freight provision and access controls are just some of the typical management applications found in our towns and cities. How the road network is managed can vary greatly from area to area and there will be local, national and international legislation and policies that influence this. National and international standards do apply to some of the management tools used for traffic management for example traffic signals operate in broadly similar fashion across Europe. However, it is local policy that is likely to have the greatest influence on how urban traffic is managed taking into account the needs and expectations of all stakeholders including residents, businesses and visitors.

ITS have a clear role to play in helping to deliver sustainable transport policy goals at an urban level. Whilst each urban area will have its own transport policies, there is now a considerable degree of uniformity of policy goals to be found in many towns and cities across Europe. The policy goals outlined below are representative of those adopted by many urban areas across Europe;

- i) Reduce congestion
- ii) Reduce energy consumption and traffic emissions
- iii) Improve quality of life in city centres
- iv) Increase market share of clean vehicles in private and public fleets
- v) Increase efficiency of the transport system
- vi) Increase attractiveness of public transport / Encourage modal shift
- vii) Facilitate freight delivery and servicing
- viii) Enhance road safety
- ix) Decrease parking pressure

It is important that ITS is used to support and help deliver clearly thought out and transparent policy goals. ITS can be used to its optimal effect when it is applied within a strategic framework with clear roles distributed among the stakeholders.

Due to an increasing reliance on the private car urban traffic management is as much about managing congestion as it is about reducing vehicle pollutants and promoting sustainable travel modes such as walking, cycling and public transport. Many of these policy objectives can only be effectively delivered through a well-defined urban traffic management strategy supported by an increasing ITS toolbox.

Possibly the oldest ITS application used within then urban environment is **traffic signal control.** Although initially traffic signals did not really include any intelligence with the advancement in computer technologies junction control has become more sophisticated since the 1980s. Rather than just being a tool that typically separates conflicting movements at an individual junction, microprocessor modules enable modal-based, artificial intelligent, ubiquitous control using data from inductive loops and other detector systems. This has enabled the development of features such as prioritisation of public transport (e.g. through systems that recognise buses, trams etc.) and optimisation of traffic throughput at individual arms of junctions.

Within the urban road network it is often the case that there is a concentration of traffic signal controlled junctions. Central computerised control and management systems enable wider area based network management. When urban traffic control (UTC) systems were first introduced they were based on fixed cycle times allowing linking of junctions to improve vehicle journey times. A further consequence of improved detector technologies and data allows the optimisation of urban regions and areas through UTC based software (e.g. SCOOT and SCATS).

Access to floating vehicle data and cellular data is a relatively new concept. **Satellite tracking of vehicles** has existed for some time but mostly used by freight transport operators for their own fleet management purposes. A source of floating vehicle data that may be more accessible to the highway authority is public transport systems such as Real Time Passenger Information (RTPI) and systems designed to give private motorists information based on satellite tracking of their route and location. RTPI systems are fundamentally designed to inform users when their next bus/tram/train is arriving. RTPI and systems aimed at the private motorist typically use some form of tracking either through GPS (satellite) or GPRS (vehicle-to-infrastructure) for positioning that can be used to measure delays and congestion in areas of the road network not otherwise monitored. Where this information is available to the local authority it enhances the view of the urban road network performance. Cellular data (the tracking of mobile phones) can vary greatly across Europe with some countries allowing it whilst others have legislative restrictions. Cellular data has previously required the co-operation of mobile phone companies but where it is made available no additional roadside equipment is required. However, the raw data often needs to be converted so that it can be used by the highway authority. Bluetooth readers can easily be converted for road side use and the data collected in such a way that it can be used by the urban road authority. This technology is evolving rapidly with the advent of 3G and 4G allowing faster and more precise identification of location of individuals based on their electronic devices. **Automatic Number Plate Recognition (ANPR)** systems for journey time monitoring are widely used in some European urban area whilst again local legislation in some area does not allow such systems. Traffic management should use journey time performance as the basis for enacting a set of predefined strategies.

A tool that enables a visual view of the road network is **CCTV**. CCTV has existed for many years and it is typical to find cameras monitoring the highway network, particularly critical junctions, linked back to the highway authority UTC centre. Historically CCTV has enabled the highway authority to view what is happening and intervene through the UTC system based on what is visible. It is often the case that whilst junction specific intervention will help it may not be that easy to benefit the wider road network in times of incidents and accidents. All of the data sources (detectors, ANPR, CCTV, Floating vehicle data) can be gather together and fed into the UTC system where area wide network management can be maintained.

Initiatives such as Universal Traffic Management Control (UTMC) have created open standards and specifications for system to system data exchange. This has led to the creation of an integrated network strategy tool enabling better highway network management and incident detection and response. Open Cities Association (OCA) has created an open specification for traffic signals and detector data exchange with the UTC system which offers similar advantages to UTMC. A key feature of UTMC, which broadly operates in cities in English speaking countries and OCA, which broadly operates in cities in German speaking cities is that they both provide an open platform for progressive traffic signal control. Not only can they each provide a platform for urban traffic control in their own right but urban road and traffic authorities also have the opportunity of interworking the two systems by selecting features of each to meet their own requirements, whilst retaining a common open operating platform.

With a wide range of data sources and central control and management systems and strategies highway authorities are finding it much easier to deal with incidents as they occur. Such developments have also pushed the boundaries on access and control possibilities where congestion and air quality issues continue to persist. **Vehicle detection systems** as already highlighted can be used for a variety of purposes from car park management to dedicated parking for just in-time freight deliveries at the kerbside. **Pollution monitors** help the highway authority understand the impact of vehicle pollution within the urban environment. Such data fed in real-time into the UTC system can be used to develop strategies that can be implemented to specifically change traffic patterns through signal timings in response to poor air quality.

Variable message signs (VMS) are now common place across larger towns and cities in Europe. Whilst these may be considered to be a tool for delivering travel information to the roadside they are also a valuable traffic management tool. VMS can be used to inform and direct drivers of problems and around incidents when they occur reducing their impact on the highway network. VMS can be used to inform on specific reduction in capacity in the network; e.g. when an incident makes it necessary to give priority to commercial transport or when a major event (sports, exhibition or other) requires implementation of a special parking and traffic management strategy.

Through CCTV and ANPR technologies enforcement is quickly becoming easier to achieve regardless of whether it is undertaken by the police or local highway authority. These tools have made congestion or road use charging an option to achieve a policy of reduced congestion and improved air quality within the largest European cities. **Road user charging** can be challenging to introduce politically but has proved to be very effective in its primary objective in cities such as London and Stockholm of reducing traffic volumes and levels of congestion. **Low Emission Zones (LEZs)** generally aim to improve air quality within a given area by targeting the worst polluters have proved easier to implement. LEZs, however, can create a real issue for business where freight operators are likely to be the most affected by such restrictions.

Generally urban traffic management initiatives impact all road vehicles. However the strength of the economy of all cities and towns is dependent on business being able to operate effectively. The cost to the economy of congestion and delays is an increasing trend and there is real pressure to improve road based travel. By contrast heavy goods vehicles are a real target for restricting their use within the urban environment due to air quality issues and road safety concerns particularly the safety of vulnerable users. Freight traffic does need to be managed separately to general traffic with specific routes, access and delivery facilities are likely to be required. ITS should be used to facilitate for city distribution/urban logistics in the Central Business District (CBD).

ITS, by its very nature, is constantly evolving. In the context of urban traffic management development is currently being undertaken on **vehicle-to-infrastructure (V2I)** systems**.** Examples include research work undertaken by BMW in Munich on giving drivers advance notice of the status of traffic signals, which subsequently formed the basis of an on-street trial in London; the 'Spitsmeiden' project in the Netherlands; the CVIS and related projects that have taken place throughout Europe where communication between vehicle and infrastructure has been a key feature in drivers receiving information about parking spaces, traffic disruption, public transport services etc. and trials in the USA involving tracking of vehicles for charging purposes based on time and location of their usage rather than flat payment of fuel tax.

Vehicle-to-vehicle (V2V) technology is at the research stage but certainly has great potential to play a significant role in urban traffic management in the future. The capacity for vehicles to communicate with one another, thereby acting as probes or mobile sensors is an exciting concept. The greatest challenge may well be to ensure that an appropriate level and quantity of information is communicated to the driver to ensure that he/she is neither overburdened nor relinquishes too much control of the vehicle through over pervasive automation.

There is considerable scope for these forms of communication to play an increasingly prominent role in urban traffic management by providing real time information on location and speed of individual vehicles, with this information being communicated to other vehicles and to traffic signals, traffic control centres etc. in order for it to be used in formulating traffic management plans.

It is essential that organisations involved in initiatives such as V2V and V2I establish and develop productive working relationships with those agencies, such as vehicle manufacturers and academic institutions, who are at the forefront of this research. This will be necessary to ensure that traffic management applications flowing from these technologies are to be fully realised.

4 Stakes and public policy

4.1 Identification of stakeholders

The success of transport policies and traffic management strategies depends to a large extent on local cultural background and mobility practices. Traffic management solutions are often not directly interchangeable between different urban areas or regions. It is, therefore, necessary that they are tailored to local requirements and should be reflective of local priorities and sensitivities. Traffic management requirements often have direct political implications. Thus political decision makers will be fully involved in decision making regarding traffic management scheme selection.

The implementation of traffic management measures always requires extensive analysis, an essential feature of which is the requirement not only to identify a range of potential project partners but also to articulate the precise role and function that each partner will perform within a given project.

Successful traffic management in an urban area is dependent on efficient and productive partnership working. This is particularly apposite in relation to traffic management projects which are especially reliant on significant ITS elements. ITS features rarely originate from a single source and, even if they happen to, their application is generally beneficial across a range of agencies directly concerned with traffic management provision.

4.2 Stakeholders / necessary partners

The list below represents those organisations, which could add value to and benefit from direct involvement in ITS related traffic management projects.

- **Traffic and Transport authorities and administrations:** Their direct concern is to manage traffic at a local or regional level and they are generally responsible for formulating, publishing and enforcing traffic regulations. They are also generally responsible for providing traffic data in an accurate, appropriate and timely manner. They generally regulate the usage of traffic signals, CCTV cameras, variable message signs etc. and are responsible for implementing measures to enact key policy areas.
- **Police and enforcement institutions in the region:** They can provide real time or near real time information about traffic accidents and incidents. They generally have expertise in assembling information and data, which can readily inform the decision making processes employed by traffic and transport authorities.
- **Public transport enterprises** at local, regional and even national level. They provide transport services and information about schedules and any perturbations to their published timetables. They can also provide data on their own passenger volumes and sometimes those of complementary modes, e.g. feeder services.
- **Transport industry and transport providers.** These are necessary bodies to make an influence on freight balance, consolidation centre build up. The can provide data that can be used for local area traffic

management, including benefits for the use of cleaner vehicles, e.g. electrical vehicles for last mile distribution, when possible.

- **Road / Car park operators.** They can provide information about the capacity, the degree of utilisation, condition of infrastructure, status of dynamic control functions etc.
- **Background information providers:** Orientation maps, cartographic base maps etc.
- **Meteorological information providers:** Weather can have a great impact on travel behaviour, speed and patterns of traffic movement. Accurate weather forecasts can play an important part in reducing the number and severity of traffic accidents and can help to mitigate their impact.
- **Broadcasting companies:** Radio and television companies can act as a highly effective real time conduit of traffic and transport information.

  These channels are now being supplemented by modes of communication based on electronic devices such as SMS texting, twitter etc., which can provide timely one-to-one and one-to-many communications channels.
- **Public and private traveller information service providers:** Providers of in-vehicle satellite navigation devices are also potentially productive partners in traffic management projects, both as sources of traffic data and as channels of communications to their clients about prevailing traffic conditions.

4.3 Additional discretionary stakeholders

- **Events Organisers** (e.g. sporting events, recreational / leisure events, fairs, exhibitions etc.)
- **Automotive Industry.** It is essential that organisations and agencies promoting ITS focused traffic management retain and develop links with automotive manufacturers to communicate requirements for in-vehicle communications channels. This is particularly relevant for evolving V2V and V2I technology that is likely to form a core element of future ITS based traffic management.
- **Telecommunications operators sector.** For similar reasons as outlined in relation to the Automotive Industry above.
- **Associations representing Freight and Logistics Traffic.** Competition for on-street loading and unloading facilities can often be intense in urban areas. Servicing of retail and business premises needs to be undertaken as efficiently as possible and support from organisations representing the freight industry is beneficial.
- **Emergency Services.** They can be sources of important real time / near real time traffic information but will certainly be users of real time ITS based information to identify locations where emergency intervention is required.

4.4 Other organisations which can be productive partners

- IT infrastructure companies
- Local press
- Organisations with specific expertise in the field of ITS, urban transportation and traffic management: E.g. ERTICO, UITP, EUROCITIES, POLIS, ASECAP
- ITS community, including national contact points
- Research organisations, universities

It will generally be advisable to seek to involve as wide a range of these organisations as possible. This is important not only to broaden the expertise available to the project but often, as importantly, widening the ownership of the project across more organisations can prove exceedingly beneficial from the perspective of broader political acceptance, which is often a key factor in gaining approval for projects to proceed and develop.

Of course, it may not always be possible or practical to gain the active participation of each of these potential partners but even if their involvement is not specifically active, it is worthwhile for as many organisations to have at least have an awareness of and passive acceptance of ITS based traffic management projects.

4.5 Role of partners

4.5.1 Data providers

Data providers include;

- Infrastructure operators and fee collectors
- Traffic and Transportation Authorities
- Police and Enforcement Agencies
- Transport Enterprises
- Public transport operators
- Fleet managers / Fleet operators (e.g. taxis, public transport, city distribution providers' vehicle manufacturers, navigation device providers).
- Private companies (e.g. media, motorist representative bodies etc.)

The main area of expertise of each of the organisations listed above is not necessarily data generation or collection. However each of them does generate or have access to discrete data streams which can help to provide a comprehensive picture of traffic operation in any given area.

4.5.2 Data content and usage

The quality, robustness and appropriateness of data originating from different sources, will vary considerably. There is a clearly defined role for data cleansing and data fusion in order to ensure that data is of the requisite quality and is in a form which can readily be used for (real time) traffic management purposes. Benchmarking and calibration processes are beneficial in helping traffic management practitioners decide on the quality of data that they receive and will facilitate the process of defining the content and form of data presentation that is used in communicating with and informing travellers.

The challenge is to manage the procurement and consequent usage of the data in a co-ordinated fashion. Not only will qualitative decisions have to be made with respect to the choice of data to be procured, there is also a challenge in how this data is then presented to travellers in a way that optimises usage of the network.

As the highway network (and public transport network) in urban areas often operate at or near capacity, any disruption (e.g. an accident) can have a disproportionately significant impact. In the event of an incident or accident it is important that each traveller receives information that is individually targeted as far as possible and is bespoke to their specific circumstances.

It is necessary to evaluate the sources of data available, make a judgement as to their accuracy and pertinence – sometimes traffic volume figures can be extrapolated from data of relatively low observed traffic flows. Data integrity will need to be assessed to allow participating organisations to decide whether and how it can be meaningfully used in managing traffic in an urban area.

5 Impacts of ITS on Urban Management and Urban Logistics

ITS can offer significant added value to urban authorities in the field of traffic management. This ranges from conventional traffic flow management to urban access management, public transport management and urban logistics. The effectiveness and efficiency of conventional traffic management that has been deployed for decades can be augmented and enhanced by ITS, using features such as information and communication technology together with automation, new approaches of modelling and simulation and (technical) interoperability.

Traffic management encompasses several levels (as suggested by the KAREN[1] framework architecture), and ITS based traffic management supports all levels; i.e.

- Transport **policy level**: High level objectives are set that influence the quality of life, living and working conditions, etc.;
- Traffic control **tactical level**: Rules and control scenarios are set according to local conditions;
- Traffic control **measures level**: Explicit measures are defined for each scenario and optimal working points are specified;
- Traffic control **operation**: Defines technical equipment.

For each level the main value provided by ITS can be formulated as follows:

5.1 Support policy objectives

Examples of high level policy objectives are outlined in Section 3.2 above. These objectives can be valid for the whole city area or for specific urban quarters. ITS offers tools and methods that readily facilitate policy goals being realised effectively within a limited amount of time.

5.2 Support the tactical layer

The tactical layer focuses on creating the local framework within which traffic is managed. Scenarios are created in accordance with policy objectives, taking into consideration the capabilities of ITS supported traffic management. The scenarios can be valid for the whole city area or for certain stretches of selected roads only. Examples aiming at the above approaches are:

- **Demand management (i)**: A charge is imposed to access the CBD in order to reduce absolute traffic numbers and shift private car journeys to public transport, reduce congestion, improve the city accessibility and reduce pollution.

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[1] "Keystone Architecture Required for European Networks"; In September 2000, the project delivered the first version of a European ITS Framework Architecture. This represented the effort to produce a European ITS system architecture, requested by the High Level Group on road transport telematics, and approved by the European Council of Ministers and funded by DGXIII as part of the 4th Framework Programme.

- **Demand management (ii):** A low emission zone could be introduced for heavily polluting vehicles; green vehicles will generally be granted easier access to the city centre and to parking facilities; eventually harmonise the scheme with that of adjacent cities.
- **Traffic flow harmonisation**: Introduction of green waves in the event of unsustainable levels of congestion or weather conditions that provoke emission thresholds being exceeded; shift congestion through queue relocation from highly populated areas to less densely populated regions.
- **Commercial delivery services**: Extend the LEZ to trucks; offer loading bay management in order to avoid unnecessary circulating traffic seeking unoccupied loading / unloading facilities.
- **City access alternatives**: Offer bicycle- and pedestrian options in combination with public transport; enhance the attractiveness with inform/book/pay services on interoperable communication platforms.
- **Casualty reduction**: Adoption of tactics aimed to deliver a safer urban road network through increased communication with road users via variable message signs, radio and electronic devices, enhanced real time information and in the future V2V communication.

5.3 Support traffic control measures

Once the scenarios are determined, explicit traffic control measures can be planned and deployed. This is where ITS and supporting technologies play a major role, making the measures effective, efficient and interoperable. Examples relating to the above scenarios are:

- **Traveller advice**: In an urban environment evidence points to journey time reliability being more important than speed. ITS can add value by making the traveller (motorist and public transport user) better informed; giving people journey options, suggesting alternative journeys based on real time situation; for this to happen, the system needs to be able to communicate directly with the individual and be directly relevant to the individual – e.g. potential for using Satnavs, mobile phones etc. as communications devices. In the future this application will be strengthened by the development of V2I and V2V (connected vehicles). Those devices could even be used in a reciprocal manner – as probes or sources of floating vehicle data, making each vehicle a contributor to a common operational traffic picture. ITS offers these capabilities not only for the consumer using private transport but also for public transport, by giving passengers an indication of the arrival time of the next bus/tram/train etc.
- **Enhance performance and frequency of public transport**. ITS can be used to give pre-emption to public transport at traffic signals. Using transponder technology, PT vehicles can reduce brake/acceleration cycles, maintain reliable travel times and generally enhance performance in comparison to ordinary passenger cars.

- **Low Emission Zones**: Restricting the access to urban areas for polluting vehicles can be achieved by driving bans or charges. Both work effectively with fully electronic vehicle registration at the zone boundaries by means of licence plate cameras and/or transponders. Environmentally friendly vehicles can be readily distinguished automatically from conventional vehicles. LEZs can be used to grant incentives as a means to increase their market share. Furthermore, ITS can be used to forward information about eventual dynamic access restriction schemes to travellers.
- **Congestion Charge**: Journeys into or within a designated zone are automatically registered without the need for vehicles to change speed or use dedicated lanes. ITS not only reliably registers accessing vehicles and subsequently classifies vehicles appropriately but also helps to manage the back office procedures such as customer relation management, payment or violation treatment.
- **Green waves**: Co-ordinated traffic signalling can be used to harmonise the traffic flow at pollution hotspots, reducing the stop-and-go-cycles and consequentially the emissions along the harmonised stretch of road. By using actual environmental measurement data, harmonisation could be made dependent on the actual pollution situation and hence does not distort the traffic system.
- **Loading Bay Management**: Registered vans & lorries may book loading bays in advance, ensuring that capacity is available at the desired time-slots. Satnavs can be used for driver notification and roadside sensors to confirm the legal use of the loading bay and to detect violations in a fully automated operation.
- **Parking space management**: Vehicles seeking parking spaces can significantly add to congestion in urban areas. ITS can have a significant role to play in reducing this impact by directing vehicles to unoccupied (off-street or on-street) parking spaces – by use of information and communication technology and satellite technology. This can be used for both informing drivers about available unoccupied parking spaces, booking of spaces and payment of the resulting charges. Authentication and identification technologies can be used to give registered vehicles access to car parks.
- **Incident Detection**: Traffic hot spots can be monitored automatically for early indications of severe disturbances; a common operational picture can be introduced, helping traffic managers to resolve disturbances in a timely fashion. ITS can facilitate vision and real time management of the traffic network for traffic managers. A prime example is CCTV camera coverage which is a key ITS tool. ITS is at its most efficient when it minimises the level of human intervention, which can be expensive and time consuming. ITS systems which automatically recognise unusual patterns of movement and flag these up to traffic managers can be particularly helpful in this respect.
- **Targeting accident hotspots:** E.g. at locations with high cycling accident records: Sensors can be used to detect the presence of cyclists in

cycle lanes who are waiting for a green traffic light. This information can be used at accident hot spots to alert particularly HGV drivers by variable message signs and detector systems to give them better awareness of cyclists near their vehicles.

5.4 Support traffic control operation level

The technological baseline of ITS on the operational level consists of sensors, actuators, communication media (wireless and wired), software, handheld devices, human machine interfaces, data, maps, algorithms, models and many more. Technological innovation takes place at this level; sensors get smarter, algorithms get faster, equipment gets cheaper and less power consuming. Innovations continuously offer new opportunities at the measures level, the tactics level and the policy level. The goals of these levels will determine exactly how the technology is used.

The matrix below summarizes and illustrates the sections 5.0-5.4 and offers a cross-referencing of ITS importance for Transport Policy Objectives, Traffic Control – Tactical Level and Traffic Control – Measures Level.

TRANSPORT POLICY OBJECTIVES	TRAFFIC CONTROL - TACTICAL LEVEL	TRAFFIC CONTROL - MEASURES LEVEL
Reduce Congestion	- Demand management (i) - Traffic flow harmonisation - City access Alternatives	- Congestion Charging - Incident detection - Parking space management
Reduce energy consumption / emissions	- Demand Management (ii) - Traffic flow harmonisation - City access alternatives	- Green waves - Enhance performance and frequency of public transport
Improve quality of life in cities	- Demand management (i) and (ii) - Traffic flow harmonisation	- LEZs - Congestion Charging - Enhance performance and frequency of public transport
Increase market share of clean vehicles	- Demand management (ii)	- LEZs - Congestion Charging
Increase efficiency of transport system	- Traffic flow harmonisation	- Traveller advice - Green waves - Parking space management - Incident detection
Modal Shift / Increase attractiveness of public transport	- Demand management (i) and (ii) - City access alternatives	- Traveller advice - Enhance performance and frequency of public transport
Facilitate freight delivery & servicing	- Commercial delivery services	- Loading bay management -Parking space management
Enhance road safety	- Casualty Reduction	- Incident detection - Targeting accident hotspots
Decrease parking pressure	- Demand management (i) and (ii)	- Parking space management - Loading bay management

NB: In addition to the three levels contained in the table (Transport Policy Objectives; Traffic Control – Tactical Level; Traffic Control – Measures Level), ITS also operates across a 4th level; Traffic Control – Operational Level, where the range of ITS operational tools outlined in Section 5.4 are commonly applied to projects aimed at delivering the full range of policy objectives described in the left column of the matrix.

6 Key factors for success

6.1 Co-operation, partnership and interoperability

A key factor in implementing a successful ITS based traffic management project is actively involving and gaining ownership from as many appropriate partners and stakeholders as possible. It is not desirable to undertake an ITS project in isolation – buy in from a range of stakeholders serves to broaden the political acceptance of the project, adds technical value to it and generally greatly facilitates its implementation.

Urban areas are often too small on their own to use ITS to its optimum effect. The majority of trips do not stop at historically defined city or administrative boundaries. From the user perspective the whole transportation network is considered as one entity. Motorists (and public transport passengers) often travel between different highway / traffic authorities even on relatively local journeys, often without the travellers themselves either knowing or caring that they are crossing administrative boundaries.

Widening the range of stakeholders of a traffic management project can often serve to widen the geographical area to which it applies. Regional / sub-regional traffic management projects are usually preferable to those in single, stand-alone urban areas.

Individual local authorities often do not have the administrative processes in place to procure the necessary ITS services for traffic management projects simply and efficiently. A disproportionate amount of time and staff resources can be spent on the procurement process if an individual authority is acting is isolation. This can be mitigated by partnership working, whereby a number of potential client authorities can combine together to formulate a procurement process, which has currency across a wider geographical area and across a wider range of potential client authorities.

The technical barriers to implementing an ITS traffic management based project tend to be easier to solve than the associated administrative / political barriers. Politicians / decision makers tend to be elected for cycles of four to five years and this timescale tends to set the parameters for the decisions that they take. For this reason it is important that the advocates of ITS based traffic management projects should highlight the short and medium term benefits in addition to longer term benefits.

Against this background one of the main current challenges is not only to overcome historical barriers between "highway" and "urban" road operators, but also between "individual" and "public" transport and between public authorities and private organisations. In this way "cross-border continuity" of ITS services becomes possible, which leads to the intended additional benefit for the conurbational, inter-regional and cross-border intermodal user. The key issue for this desired continuity of ITS-services is **interoperability.**

The concept of technical interoperability across ITS projects in different regions should be encouraged to allow ITS to realise its full potential in delivering traffic management and urban logistics projects.

Annex A outlines a theoretical structure for an ITS based traffic management project, across which interoperability is a key element at all levels.

Recommendation: The need for effective multi agency co-operation is critical in devising an ITS traffic management project. Any organisation wishing to establish a project should seek the active and productive participation of all relevant organisations. Political problems are generally more challenging than technical problems.

6.2 Essential tasks for successful delivery

The tasks outlined below form a template that can be used to formulate a cooperative, regionally focused, ITS based traffic management project.

1. It is not intended to be proscriptive but to indicate those actions that usually need to be carried out when devising an ITS traffic management project; Form a steering group representative of partner bodies to carry out a feasibility study.
2. Select pilot-partners and pilot-projects and create a draft work programme.
   Present it to selected stakeholders.
3. Establish expertise that each selected partner can contribute.
4. Collect basic data
   a) Build a regional, intermodal reference system
   b) Create an urban data set.
5. Design a final programme and present it to stakeholders
6. Gain support and ownership from stakeholders for the programme. Identify funding bodies and raise public awareness.
   a) Include a sustainable business model in programme.
7. Complete the reference system and the basic urban traffic data set.
   a) Make reference system the fundamental information source for all administrative processes.
8. Implement some fundamental administrative and traffic information processes.
9. Add further partners and processes to programme as appropriate.
10. Continuous review, monitoring and refinement of project.

It is generally more practical to work initially with supportive partners and let practice convince the others. Some of the steps outlined above can be undertaken simultaneously.

Recommendation: Identify, define and allocate those tasks that are essential to the process of delivering a successful project.

6.3 Targeting individuals to optimise network performance

In order for an urban ITS traffic management project to be successful, it is critical that accurate information is conveyed to the individual traveller in a timely fashion.

Individual travellers, whether using private or public transport, almost invariably carry electronic devices, which can act as a medium to convey real time traveller information. Feeding real time traffic information to motorists' navigation devices and public transport users' mobile phone type devices is a prime example of a potentially readily available means of communication with individual travellers.

The challenge for those implementing an ITS based traffic management project is not only to tailor travel information to individual travellers but also to ensure that the information that is conveyed to individuals aids the overall management of the network. In urban areas highway networks often operate at or near capacity at peak hours and, in many larger cities, throughout much of the working day. The challenge for ITS providers is to provide bespoke information to individuals, which also takes into account the manner in which the network operates. For example if an incident takes place, which results in a route becoming congested, rather than informing all motorists to take the same alternative diversionary route, which in a urban area could then become very congested itself as a result of the diversion, the most intelligent use of ITS would be to give different messages to different users so that some are advised to take diversionary route 'a', others advised to take diversionary route 'b' and others advised to remain on the original route. In this way ITS will seek to achieve the optimum balance between the needs of the individual traveller and the efficient operation of the network.

Similarly public transport information targeted at individuals in a similar fashion will help to optimise network performance by balancing supply and demand more closely.

Recommendation: The most successful ITS traffic management projects and systems are those that are focused on delivering relevant services and information to individual end users. Try to structure projects and channel resources that are bespoke to individual end users. In this way operation of the urban road network will also be optimised.

6.4 Maximising ITS potential / Minimising human intervention at operational level

A successful ITS traffic management project should aim to limit the amount of human intervention at basic operational level as this tends to be costly and often time consuming.

For example camera coverage of traffic and highway networks in urban areas is often comprehensive with many city authorities having a proliferation of roadside cameras that are used to facilitate management of the road network. The challenge for camera operators and traffic managers is to how to identify which of the often numerous cameras they should view and what action they should take in order to optimise the performance of the network.

ITS techniques such as video analytics are helpful in detecting unusual patterns of movement captured by roadside cameras, sensors, loops etc. These can be used to draw the attention of the camera operator to specific locations where intervention would be beneficial in expediting traffic movement. Currently there is still an element of human intervention inherent within this process but ITS has the potential to offer a wholly automated operational system, which, for example, would introduce a given traffic plan when particular patterns of vehicular movement are detected.

Future development of V2I and V2V systems should also result in the introduction of automated processes, many of which will be carried out in real time or near real time. Their advent will increase the role and relevance of ITS at operational level in urban traffic management.

Recommendation: The effectiveness of ITS in urban traffic management and logistics can generally be increased by adoption of automated systems which are better equipped than humans to perform operational functions. Try to identify and select those systems which maximise the potential for automated ITS systems to take on functions such as routine data processing and interpretation, which will allow human participation to be concentrated at a more strategic level.

6.5 Standards and harmonisation

Standards and harmonisation are important in delivering effective ITS traffic management projects. They serve to improve the quality of a project and enhance the concept of interoperability. However it is important that standards are not used in a proscriptive manner in an urban project, as such an approach could limit technical innovation and undermine the EU subsidiarity principle, which is important in an urban context

Creating interoperability does not mean the specification or even standardisation of components of ITS Services. This is crucial since each modification (enlargement, modification, new procurement etc.) of IT infrastructure should be based on existing (local, national) or market-available products (protection of investment). Furthermore an approach that stipulates adherence to a rigid standards and harmonisation protocol could well be expensive and time consuming. A key element of a productive approach to standards and harmonisation is the creation of an open platform for ITS services. This allows the advantages of technological interoperability to be captured and applied, whilst allowing individual authorities to maintain autonomy in deciding the precise form of technology and services that they wish to use.

Annex C gives more information about specific standards that may be beneficial when implementing ITS based traffic management projects.

Recommendation: Usage of standards can be beneficial when implementing ITS traffic management projects. Standards are most productively used when they are not proscriptive but lead to the creation of features such as open platforms for ITS technology, which are central to the successful development and future adoption of ITS based traffic management projects.

7 Further information and contacts

7.1 Best practices collected within the work of the Urban ITS Expert Group

Nr.	Project name	Country
1	Dusseldorf-Dmotion	DE
2	UK Conurbations-Traffic Management and control	UK
4	Lyon-Urban Traffic Management	FR
5	Oslo-Toll cordon	NO
7	Paris-PassAutocar	FR
8	Berlin-Inner city logistic	DE
9	Munich-Tram and bus priorisation	DE
10	Gothenburg-Motorway control system	SE
11	London-Urban road user charging	UK
12	Rotterdam-Park and Ride pricing strategy	NL
13	Rotterdam-Truck parking management	NL
14	Bristol-Environmental road pricing	UK
16	Austria-GIP:Graphs Integration Platform for Austria	AT
19	London-Low Emission Zone (LEZ)	UK
20	Rotterdam-The Traffic Enterprise (De Verkeersonderneming)	NL
21	Helmond-Freilot: Urban Freight Energy Efficiency Pilot	NL
22	Rotterdam-Port of Rotterdam Authority	NL
24	NL-A12-Avoiding Rush Hour (Spitsmijden)	NL
25	Brabant-Avoiding the Peak in Brabant (Spitsmijden in Brabant)	NL
30	Basel-Messe Basel Logistic Tool (MCH Logistiktool)	CH
36	Trondheim-Real Time Passenger Information and Bus Signal Priority	NO
51	Vienna Parking Control Management	AT
52	Low Emission Zones (in many cities)	various
53	eMobility	various
54	Parking	various
55	Combined bus/freight lanes	various
56	Ease of distribution with TM	various
58	Aalborg: ITS for a Medium Sized City	DK
60	Gothenburg: Urban Freight: Integrated Approach to Enhance Access for People and Freight	SE
64	Leicester: Traffic Information Service Database / Smart Ticketing	UK
65	Rotterdam: Optimising the Usage of Road Infrastructure through ITS	NL
66	Stuttgart: Integrated Traffic Management Centre Focuses on Collaboration and Information Sharing	DE

67	Turin: 5T: Telematic Technologies for Transport and Traffic in Turin	IT
70	Vienna: Traffic Information Pilot Vienna	AT
71	Stuttgart: MOSCA	DE
72	Eindhoven: eDRUL	NL
73	Genoa: M.E.R.ci	IT
74	Hungary: Commercial Vehicle Fleet Management System	HU
75	Munich: VMTL	DE
76	INVENT-VMTL	DE
77	Logistik-V'Info	DE
78	AKTIV	DE
81	Public Transport - IMS Munich	DE
82	Public Transport - itcs Cologne	DE
83	Public Transport - public transport traffic control and passenger information Leipzig	DE
84	Public Transport - Intermodal Transport Control Systems PT-ITCS	DE
87	Implementation of ITCS for 250 light rail vehicles and 80 buses	DE
89	Networking of Intermodal passenger travel information and Realtime in Public-Transport (itcs/RBL/FIS/ABF/RBL-Light etc.)	DE
90	Interconnection of Public Transport travel information system nation- and European wide (DELFI & EU-SPIRIT)	DE
92	RBL light	DE
95	Public Transport - itcs/RBL Dortmund	DE
96	Gothenburg: ITS4Mobility, Providing real time travel information (passengers) and real time management (authorities)	SE
97	Gothenburg's Attractive Commuting Assistant	SE
102	Online Portal for transport data/content management and transportation service provision	GR

7.2 Contact information

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8 ANNEX A - Interoperability at an organisational level

Interoperability is not restricted to technical aspects of a traffic management project. Interoperability must be established on all levels of cooperation and collaboration of co-working organisations and their technical system. The following picture - called ITS-pyramid[2,3] - is helpful, as it represents all layers of an ITS service where interoperability has to be established:

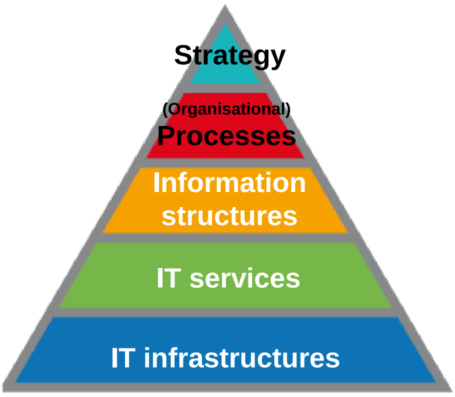

Figure 1: ITS service metamodel

The basic structure of the five layers from top to bottom are described as strategy, processes, information structures, IT services, IT infrastructure.

- The **strategy layer** describes the long-term (visions), and the medium-term objectives (missions) of an ITS service, i.e. the benefits of the ITS service. The strategy is closely related to the business model of an ITS service.

  Interoperability requires: Tailoring the specific strategy of the involved organisations/bodies to the scope of the targeted Traffic Management /Logistics service.

- The **process layer** describes the actions of actors within their business processes and their day-to-day behaviour. Role models enable transferability by providing an abstraction from concrete organisations. Typical ITS service roles are: content owner, content provider, service provider, network provider. Typical role characteristics connected with a specific behaviour are for example public, private, external stakeholders. If networking requirements between actors are defined for the purpose of exchanging information or to act on a common basis (for example as part of a cross-regional or cross-border ITS service), then this is first form of a

[2] FGSV-Forschungsgesellschaft für Straßen und Verkehr 2011, Methodische Empfehlungen zur Entwicklung einer IVS Rahmenarchitektur für Deutschland

[3] EasyWay 2011, EasyWay Deployment Guidelines 2012, Methodological approach to ITS Service harmonization, Version 01-00-01

process description.

Interoperability requires: Development of a cooperation and collaboration model for the involved organisations/bodies.

- The **information structure layer** deals with information that is generated by or processed in (business) processes. The information logistics, i.e. the collection and presentation of information and its distribution to relevant places where they are applicable can only be specified if appropriate information structures are mutually agreed by all stakeholders.

  Interoperability requires: Development and use of uniform ITS service information and domain models (e.g. DATEX II profiles)

- The **layer of IT services** (note: not to be mixed up with ITS services) describes the IT services which have to be available to enable business processes to be "executed" and to implement the agreed information models. It focuses on the question: "How do the functions interact/ communicate with each other (specification of interfaces and data exchange mechanisms)?”. The IT sector has developed proven and robust technologies to provide an abstraction from implementation details, e.g. the Service Oriented Architecture (SOA) approach. Ideally, applications use such an abstract, reusable service mechanism to deliver their functionality.

  Interoperability requires: Development of consistent, harmonised IT service specifications and implementation (e.g. DATEX II protocols)

- The **IT infrastructures layer** describes IT systems needed to ensure the execution of IT services and networking. In the Internet age, the execution of services can happen "somewhere" and is not bound to one specific place. An exception is the IT infrastructure for the delivery and presentation of information to users (terminals).

  Interoperability requires: Networking of the IT infrastructures used to implement ITS Services and the specification of devices that are capable of presenting/displaying information in a harmonised manner to end users. The internal structure of the ITS-service IT infrastructures itself is not part of interoperability considerations, maybe with the one notable exception of the presentation of user information on collective and individual devices (Common Look and Feel).

9 ANNEX B - Inter agency organisational model

In the case of different parties with different roles - both public authorities and private organisations - being involved in providing an ITS-service the development and application of sustainable organisation models becomes crucial. The organisation and the roles of the parties must be clearly defined. That means the service architecture becomes more important:

Traffic management services – beneath the end user - can be deemed to have four main actors necessary for the entire supply chain. These are:

- Data providers
- Content providers
- Service operators
- TCCs - Traffic Control Centres / Service providers

The information and the revenue chain is indicated in the Figure below;

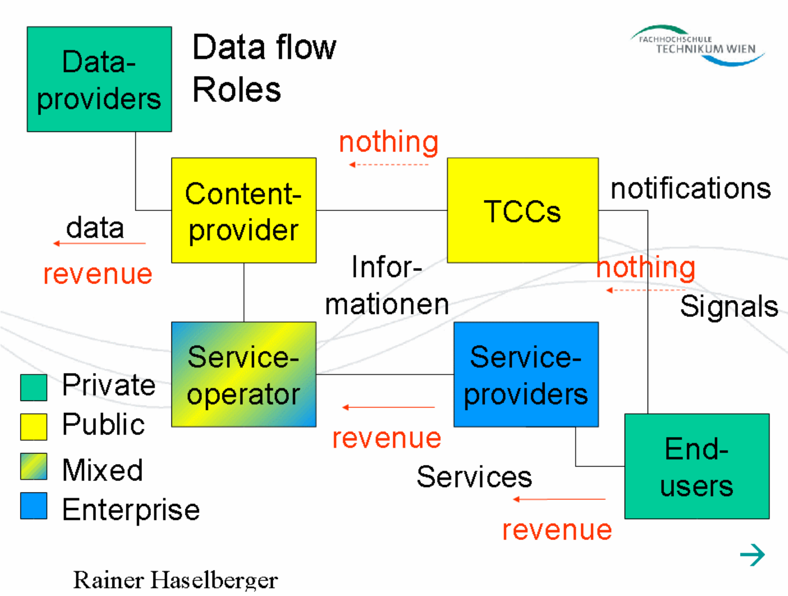

Figure 2: Urban Traffic Management value chain

Addressing key organisational issues

As a general principle, any equipment that is dedicated to a certain partner should be provided and operated by that partner, e.g. roadside equipment by the highway authority; station equipment by the rail operator etc. However there is generally much core equipment which must be jointly procured or towards which the public sector should contribute for shared use.

Key issues for the model to address include;

- What will the implementation cost be? Who will fund which elements?
- Who contributes to procurement of which assets? Who owns the assets – hardware, licences etc?
- Who owns the data? Who may use the data and for what purposes? Can the data be passed on to anyone and, if so, should this be free of charge?
- Who provides the staff, office space and office services? Whose staff contributes time and advice? Is this contribution financially recognised?
- Who will fund long-term operations?
- Who receives income from services and how is this conveyed to the contributors?
- How and in which configuration should the service be generated?
- Which roles are necessary and by which organisation/partners they can be covered?
- How is the division of work organised?
- Which interfaces and which workflows have to be defined?

It is not possible to define a unique organisation model even for similar services, due to the diverse nature of the services, which are usually defined by local political and operational conditions. Every ITS service has to develop an organisational model to suit its own requirements.

10 ANNEX C - Standards and harmonisation (further information).

In order to facilitate the introduction of ITS based traffic management projects, it is recommended that adjustments of existing specifications and already existing ITS service solutions, should be utilised.

This means in detail:

- Creation of a common understanding among the involved parties of:
  - the long term and mid-term objectives as well as the benefit of ITS-Services (strategy)
  - the (rough) functional structure of ITS Services (functional requirements)
  - the (rough) organisational structure of ITS Services (organisational requirements)
- Harmonisation of:
  - the visualisation of information to road users, in some cases also for system operators (Common look & feel)
  - the criteria for assessing the quality of ITS Services from the perspective of road users (level of service quality)
  - technical standards, available or required, beneficial for implementation (technical requirements)

Use of exiting and proven standards can be advantageous

Wherever possible use of existing and proven standards should be encouraged:

- in the service planning and preparation phase → descriptive standards
- in the service deployment and operation and evaluation phase →technical standards

Descriptive standards

The preparation, planning and deployment and operation of traffic management services usually takes place in a situation when completely different organisations and persons from diverse backgrounds have to form a working group which is obligated to cooperate and collaborate for the common strategic goal to create a successful ITS-service.

In this strategically based situation the selection and use of appropriate descriptive standards become crucial. They not only offer well defined linguistic framework but commonly agreed and proven concepts. This helps to provide an objective framework within which projects partners can work.

The following list contains certain standards that could be very useful for strategic considerations.

Title
Business Motivation Model (BMM) Specification; OMG dtc/07-08-03
Business Process Definition MetaModel; Volume 1: Common Infrastructure Version 1.0; OMG Document: formal/2008-11-03; http://www.omg.org/spec/BPDM/20080501
Business Process Model and Notation (BPMN) OMG Document: formal/2009-01-03;
Bon; Service strategy based on ITIL v3- A Management Guide; Van Haaren Publishing, 2008
MDA Guide Version 1.0.1; OMG Document: omg/2003-06-
Information Technology – Open Distributed Processing – Reference Model: Overview ; International Standard ISO/IEC 10746-1:1998(E)
Semantics of Business Vocabulary and Business Rules (SBVR), v 1.0; OMG Document: formal/2008-01-02; http://www.omg.org/spec/SBVR/1.0/PDF/
Service oriented architecture Modelling Language (SoaML) – Specification for the UML Profile and Metamodel for Services (UPMS); Revised Submission; OMG document: ad/2008-08-04
Reference Architecture for Service Oriented Architecture Version 1.0; Public Review Draft 1, 23 April 2008; OASIS Open; http://www.oasis-open.org
Reference Model for Service Oriented Architecture 1.0; Committee Specification 1, 19 July 2006; OASIS Open; http://www.oasis-open.org
Software & Systems Process Engineering Meta Model Specification v.2; OMG Dokument:formal/2008-04-01; http://www.omg.org/spec/SPEM/20070801

BMM and SBVR are suitable for general goals and objectives. The SPEM standard is recommended for the general deliberation of processes. The debate on services is currently subject to great fluctuations, particularly against the Cloud background.

Technical standards

In contrast to linguistic and conceptual standards which aim to improve consensus between organisations and persons, technical standards pursue technical and economic goals. Technical standards[4].

- Enable interoperability of systems/services
- Encourage innovation, foster enterprise and open up new markets for suppliers
- Create trust and confidence in products and services
- Expand the market, bring down costs and increase competition

[4] Johan Hedin, Liaison between CEN/TC278 & Urban ITS Expert Group, presentation in the frame of Urban ITS expert group

- Help to prevent duplication of effort
- Support greater confidence in procurement
- Facilitate interoperability of system component suppliers

Technical ITS standards are very diverse, ranging from ISO TC204 on global level, which is responsible for the overall system aspects and infrastructure aspects of ITS to CEN/CENELEC and ETSI standards on European level, which describe data models, from the abstract to concrete and from simple to complex. The more modern ones form a uniform package of data models or exchange format specifications with an integrated service interface.

The standard bodies for ITS started their work in 1992:

- Global level:
  - ISO/TC 204 – Intelligent Transport Systems
  - ISO/TC 22 – Road vehicles
- European level:
  - – CEN/TC 278 – ITS standardisation.
  - – CEN/TC 224 – Personal Identification
  - – CENELEC/TC 226 – Road equipment
  - – ETSI TC ITS
- National level
  - National standards bodies: NEN, DIN, AFNOR, BSI, etc
- Coordination between CEN/ETSI/EC through ITS-CG
  - Intelligent Transport Systems Coordination Group

For further information see:

- CEN/TC278:
  - http://www.itsstandards.eu
  - CEN/TC278 Brochure
- ISO/TC204:
  - http://www.tiaonline.org/standards/secretariats_tags/iso_tc204/index.cfm
- ETSI TC ITS
  - http://portal.etsi.org/portal/server.pt/community/ITS/317
- Workshop, 6-8 February 2012, Doha, Qatar.