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// Competitiveness
Building Competitive Business Clusters
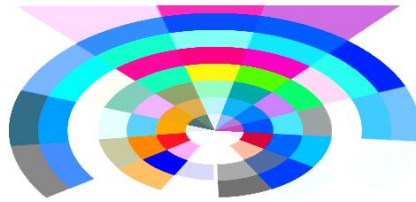
Title

Intelligent Traffic /
Transport systems

Document prepared by
The Cluster Competitiveness Group

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regional development

Table of contents

Sources

This report has greatly benefited from the observations and insights provided by the following documents, white papers, brochures and websites:

- Draft Business Plan of ISO/TC 204 - Intelligent Transport Systems (www.sae.org)

- Deployment of intelligent transport systems in urban transport, by Gražvydas Jakubauskas, Vilnius Gedimino Technical University, Faculty of Transport Engineering, Transport Management Department (www.tsi.lv)

- Intelligent transport systems in the future (by ERTICO (ITS Europe), ITS Asia-Pacific and ITS America, supported by ITS organizations including ITS Australia) and their websites.

- Other Brochures from Ertico (www.ertico.com)

- Innovation in automotive telematics services: characteristics of the field and management principles, Sylvain Lenfle, University of Cergy-Pontoise

1.   About ITS

What is ITS

> Intelligent Transport Systems and Services is the integration of information and communications technology with transport infrastructure, vehicles and users.

By sharing vital information, ITS allows people to get more from transport networks, with greater safety and with less impact on the environment. ITS helps the whole transport system to work most effectively and efficiently. ITS integrates users, transport systems, and vehicles through state-of-the-art information and communications technologies. ITS can dramatically improve travellers' safety, efficiency and comfort. ITS helps shippers and carriers move freight to its destination reliably and efficiently. ITS helps the people who run transport systems provide better service to their customers. ITS helps get the best value from the road and rail systems we already have. ITS helps traffic flow more smoothly, reducing delays, fuel consumption, and air and noise pollution. ITS helps make public transport more convenient and affordable.

ITS often works behind the scenes. When emergency vehicles get to a crash site more rapidly than before, ITS is detecting the crash, notifying emergency services, and getting the nearest response unit rapidly to the site. Technology in a vehicle prevents skidding and helps the vehicle to stop safely; the driver may not even realize that assistance was provided, but ITS is at work.

ITS and mobility and access

ITS provides travel opportunities and additional travel choices for more people in more ways, wherever they live, work and play, regardless of age or disability:

- ITS will help travelers and take trips that use the best and most convenient combination of travel modes: private car, public transport, passenger rail – and walking and cycling, too. ITS will open new employment and recreation opportunities and help make travel time more productive.
- ITS will help all travelers get where they need to go regardless of age or disability and regardless of where they live. ITS will provide better information on available services to travelers who cannot or choose not to drive including those who are mobility- or sight-impaired.
- ITS will also help make it easier to pay for transport services. The future will include a single electronic payment mechanism to pay for fuel, tolls, public transport fares, parking, and a variety of other charges that busy travelers encounter every day. ITS will help convey the needs and interests of transport system customers to the people who manage the system, helping to ensure a transport system that is responsive to those needs and interests. ITS will help managers of the transport system to make services safer and simultaneously available for motorists, cyclists, pedestrians, and users of public transport.
- ITS will help focus the transport system on meeting the needs of all its customers. Better meeting customer needs means a renewed focus on customer service and effective operations.

2.   Implications of ITS systems

ITS for safety

More than 40,000 people die on Europe's roads each year[1]. Road accidents cost the European economy around €200 billion each year[2].

While in-car safety systems have greatly improved the chances of surviving an accident, more attention now needs to be given to systems that can actually prevent accidents from happening.

ITS can help reduce injuries and save lives, time and money by making transport safer:

- ITS will help the drivers of cars, trucks and buses avoid getting into crashes and help keep them from running off the road. ITS will help maintain safe distances between vehicles and safe speeds approaching danger spots. ITS will help improve visibility for drivers, especially at night and in bad weather.
- ITS will provide information about work zones, traffic congestion, road conditions, pedestrian crossings and other potential hazards.
- ITS will help detect the crashes that do occur, determine the severity of the crash and likely injuries, and help emergency management services provide assistance. ITS will help select the closest and most appropriate rescue unit to respond. ITS will adjust traffic signals to clear the way for emergency vehicles.
- ITS will connect responding units to medical care facilities to help provide initial care for the injured and help medical care facilities prepare to deliver more complete treatment when injured people arrive.

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[1] Source: Commission Communication on European Road Safety Action Programme – "Saving 20,000 Lives On Our Roads", COM (2003) 311 final, 22/02/2006

[2] Source: Communication from the Commission on the Intelligent Car Initiative – "Raising Awareness of ICT for Smarter, Safer and Cleaner Vehicles", COM (2006) 59 final, 15 February 2006

ITS for efficiency and economy

Congestion costs the EU 1% of its GDP – around €100 billion – each year[3]. There are around 300 million drivers in the EU today, while in the past 30 years the distance travelled by road has tripled[4] and is set to increase further.

With funding and space for large-scale road building becoming increasingly scarce, governments, infrastructure operators and pubic authorities are turning to ITS solutions to ease congestion.

Ramp metering, traffic and incident detection and variable message sign systems are already being used across Europe. ITS can save time and money for travelers and the freight industry:

- ITS will deliver fast, accurate and complete travel information to help travelers decide whether to make a trip, when to start, and what travel modes to use. ITS will provide his information both prior to a trip and as the trip proceeds.
- ITS will help drivers select and follow safe, efficient routes to their destination. ITS will let drivers pay tolls without having to stop.
- ITS will help freight move swiftly and reliably using the right combination of ship, truck, train and plane.
- ITS will help track freight, enabling its owners to know where it is at all times and when it is due to arrive at its destination, and allowing for better planning and scheduling of critical processes.
- ITS will enable more reliable and timely commercial vehicle management. ITS will automatically keep track of safety-related information about the vehicle, its driver and its cargo. ITS will help communicate this information to the authorities so that, as appropriate, vehicles can be cleared through checkpoints without stopping.
- ITS will help the people who build, manage and maintain the transport system. ITS will help the transport system carry more traffic safely and efficiently by keeping traffic flowing, clearing

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[3] Source: Communication from the Commission: "Keep Europe moving – Sustainable mobility for our continent." (Mid-term review of the European Commission's 2001 Transport White Paper), COM (2006) 314 final, 22 June 2006

[4] Source: Communication from the Commission on the Intelligent Car Initiative – "Raising Awareness of ICT for Smarter, Safer and Cleaner Vehicles." COM (2006) 59 final, 15 February 2006

incidents quickly, and managing construction and maintenance to minimize disruptions. ITS will help schedule road management vehicles and help them work more precisely and efficiently.

The next generation of ITS solutions will:

- Give public transport users real-time service information, as well as smart and seamless ticketing solutions.
- Enable freight operators and customs authorities to share information about consignments and keep track of their position and status, as well as provide information on the most efficient, economical and secure routes for freight.
- Allow vehicles to communicate directly with the infrastructure around them and with one another – enabling drivers to make better decisions about their route and respond to warnings of congestion and accidents.

ITS for environment

Transport accounts for 30% of total energy consumption in the EU[5]. Despite increasing air travel, the vast majority of this energy is still consumed by road transport.

Since ITS systems can improve the efficiency of passenger and goods transport and reduce the time caught in traffic congestion, they will obviously have secondary benefits for the environment and in terms of use of space:

- ITS will keep traffic flowing on urban freeways, on toll roads, at commercial vehicle checkpoints and elsewhere. Reducing delays due to congestion and incidents means that energy waste, wear–and–tear, and the pollution caused by stop–and–go driving are also reduced.
- ITS will help vehicles operate more efficiently. ITS will provide location–specific information about weather and road conditions. ITS will help vehicles to anticipate danger spots and hills, and to smoothly adopt appropriate peeds.
- ITS will help to plan efficient routes and guide drivers along these routes. This helps to reduce fuel consumption and emissions.
- ITS will help make public transport more reliable, effective and attractive, thereby accelerating its use. ITS will provide better information on schedules and connections. ITS will help public transport users stay in touch with their employers and their families while in transit.

In the future there may also be opportunities for ITS systems to provide traffic and topographical information to vehicle management systems. This will enable drivers and vehicles to operate more efficiently.

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[5] Source: Communication from the Commission: "Keep Europe moving – Sustainable mobility for our continent." (Mid-term review of the European Commission's 2001 Transport White Paper), COM (2006) 314 final, 22 June 2006

ITS for security

Recent events have shown that the transport system is under threat from terrorism, whether as a target in itself or a means of attacking other targets. The need to protect travellers, transport facilities and transport workers against security risks has never been greater. However, this must be balanced with the need to make sure transport continues to operate effectively and efficiently.

ITS systems are key to striking this balance. In fact, ITS will help prepare for, prevent and respond to disaster situations, whether from natural causes, human error, or attacks:

- ITS will help keep watch over transport facilities.
- ITS will help provide personal security for people using the public transport system.
- ITS will monitor freight, especially hazardous materials, through the entire supply chain.
- ITS will help transport and safety/security agencies coordinate their activities and their information so they can respond more effectively to incidents of all kinds.
- ITS will help identify the best routes for evacuating people at risk and for directing emergency services to incidents and disaster sites.
- ITS will help the transport system, and all the other parts of the economy that depend on transport, to return to normal as rapidly as possible following a crisis, through better management of the transport system, more efficient interagency communications, and better and more timely information to the public.
- Intelligent Vision Systems can automatically spot suspicious behaviour at transport hubs, while automatic tracking and alarm systems can speed the response to threats.

The remaining major challenge in this area will be to reconcile the need for individual private data protection with public security requirements.

3.   The ITS global market

The U.S

The following table shows the size of U.S. In-vehicle ITS Market[6]

	Units Shipped (000)	Revenues (US$ million)
1999	161	$165
2002	339	261
2005	443	283

The worldwide investment in electronic toll collection (ETC) will top US$11 billion over the next ten years as more than 23,000 toll lanes become equipped. Today's marketplace is US$3.9 billion. Rapid growth is expected to continue well into the next decade, with the number of equipped lanes growing by an average of 10.3% per year.[7]

Over the next 20 years, the US market for ITS products and services is expected to grow and cumulate to approximately US$420 billion.[8]

Selected Private-Led Market Projections[9]:

Category	Market Projections, 1997-2005, US$ Billions
Mayday Systems	$21
Fleet Tracking	17
Route Guidance and Information	12
Obstacle Warning Systems	5

A projected $209 billion will be invested in ITS between now and the year 2011 – with 80% of that investment coming from the private sector in the form of consumer products and services.[10]

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[6] Source: *Global Positioning & Navigation News*, Sept. 22, 1999

[7] Source: *Electronic Toll Collection: Market Analysis and Update,* reported in *Inside ITS, Sept. 6, 1999*

[8] Source: *ITS National Investment and Market Analysis, Executive Summary, page 2* ITS America and U.S. DOT (prepared by Apogee Research and Wilbur Smith Associates, 1997

[9] *ibid, adapted from Table E.3, page 13*

Europe

The potential annual market for ITS equipment and services by 2015 in France, Germany, Greece, Italy, the Netherlands, Spain, Sweden, and the UK is € 56.6 billion[11]. This can be divided into the following categories:

Category	Share (%)	Euros Billions
Advanced Traveler Information Systems (including navigation)	46.0	€ 26.0
Advanced Vehicle Control Systems	29.0	16.4
Advanced Commercial Vehicle Applications	11.7	6.6
Electronic Fee Collection	5.6	3.2
Urban Advanced Traffic Management Systems (ATMS)	4.6	2.6
Advanced Public Transport Systems and Inter-Urban ATMS	3.1	1.8
TOTAL		**€56.6**

An EC study of the Fifth Framework Programme concluded that by the year 2005, "the total potential transport-related market (equipment, systems, services) in Europe will be substantially in excess of € 300 billion at full penetration."

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[10] Source: *ITS America Web Site, http://www.itsa.org*

[11] Source : 1997 Isfort SpA Study

Japan

A *Financial Times* report in 1998 estimated that the overall Japanese market for ITS will grow from US$4.5 billion in 2000 to US$57.0 billion by 2015.

The "Economic Effect Forcast of ITS" by the Telecommunication Technology Council of Japan estimates the following economic effect regarding ITS.

ITS corresponds to three markets within the Japanese Info-Communication field: "Info-Communication Services", "On-board Equipment" and "Telecommunications Infrastructure". The market in these areas is estimated to be ¥900 billion in FY 2000, ¥2,600 billion in FY 2005, ¥4,700 billion in FY 2010, and ¥7,400 billion in 2015. The total market for FY 2000 through 2015 is ¥60,300 billion yen as shown in the table below.

Estimated Market Size of ITS in the Field of Info-Communication
(Unit: Hundred Million Yen)

CLASSIFICATION OF MARKET	2000	2005	2010	2015	Total 2000-2015
Info-communication Services Annual Growth Rate 2000-2015	768	9,449	24,950	47,729	309,903 31.6%
On-board equipment Annual Growth Rate 2000-2015	4,452	10,182	15,068	17,417	186,705 9.5%
Telecommunications Infrastructure Annual Growth Rate 2000-2015	3,594	6,500	7,470	8,470	106,546 5.6%
TOTAL Annual Growth Rate 2000-2015	8,814	26,131	47,488	73,616	603,154 15.2%

The rest of the world

Figures for the rest of the world are more difficult to estimate, but there is significant activity in Latin America (especially Mexico, Brazil, and Argentina), and in additional Asia-Pacific countries such as Australia, China, Korea, Malaysia, New Zealand, and Thailand. It would be reasonable to assume that these additional markets would add 25% to the figures above.

4.   The Market Structure

Major categories of products and services

The following list should be taken as representative, subject to change, and not necessarily exhaustive.

1. Traveler information and advisory systems; Wireless vehicle products and services

   a. Support equipment for in-vehicle functions (for detection and transmission of environmental, road condition, traffic, etc. information for use by on-board safety and control devices)

   b. Surveillance and monitoring equipment

2. Traffic management and control systems; Roadside Infrastructure

   a. Electronic signs, signals, and their controllers

   b. Surveillance and monitoring equipment

   c. Commercial vehicle credentials readers

   d. Support equipment for in-vehicle functions (for detection and transmission of environmental, road condition, traffic, etc. information for use by on-board safety and control devices)

3. In-vehicle products[12]

   a. In-vehicle safety, efficiency, and control products (collision warning and avoidance, adaptive cruise control, throttle/transmission optimisations based on road geometry and conditions, vision enhancement, emergency notification and roadside assistance systems)

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[12] Note: standards for technology completely self-contained in the vehicle is generally the responsibility of ISO/TC 22

b. In-vehicle and mobile/portable multimedia products (navigation and route guidance, traffic displays, office-in-the-car, backseat entertainment, etc.)

c. Transponders and other communications devices for commercial vehicle tracking, automated border crossing and credential checking, and other commercial vehicle operations

4. Freight and passenger fleet management systems including, as applicable, rail, bus, ferry, etc.

   a. Load management
   b. Logistics
   c. Routing, including intermodal connections
   d. Dispatch and surveillance
   e. Emergency management
   f. Interfaces with regulatory authorities

5. Public Transport management systems

   a. Specific Public Transport functions: schedule adherence, driver and passenger safety surveillance and alert, fare collection systems, etc.

6. Emergency response systems

7. Electronic Payment

   a. Transponders for electronic toll collection and road use charging ("toll tags")
   b. Readers for electronic toll collection / road use charge

8. System integration of transportation facilities (traffic management, public transport management, emergency response, etc.)

9. Map databases

The annex contains a summary of the major technologies used in the production and delivery of these products and services.

Agents in the value chain

Design and exploitation of ITS services involve various actors in complex cooperation processes.

- *Service providers* generate the information needed for the service (for example traffic information) and operate the service platform (for example the emergency call center);
- *Telecom operators* develop and maintain the communication systems that connect the car to the service operators;
- *Automotive equipment suppliers* develop the onboard systems needed for the service (for example integrated radio, GPS and GSM equipment);
- *Automotive manufacturers,* which specify, integrate and market the new services and onboard equipments.
- *Software companies and other equipment manufacturers*

The following is a graphic representation of the relationships between agents in the value chain:
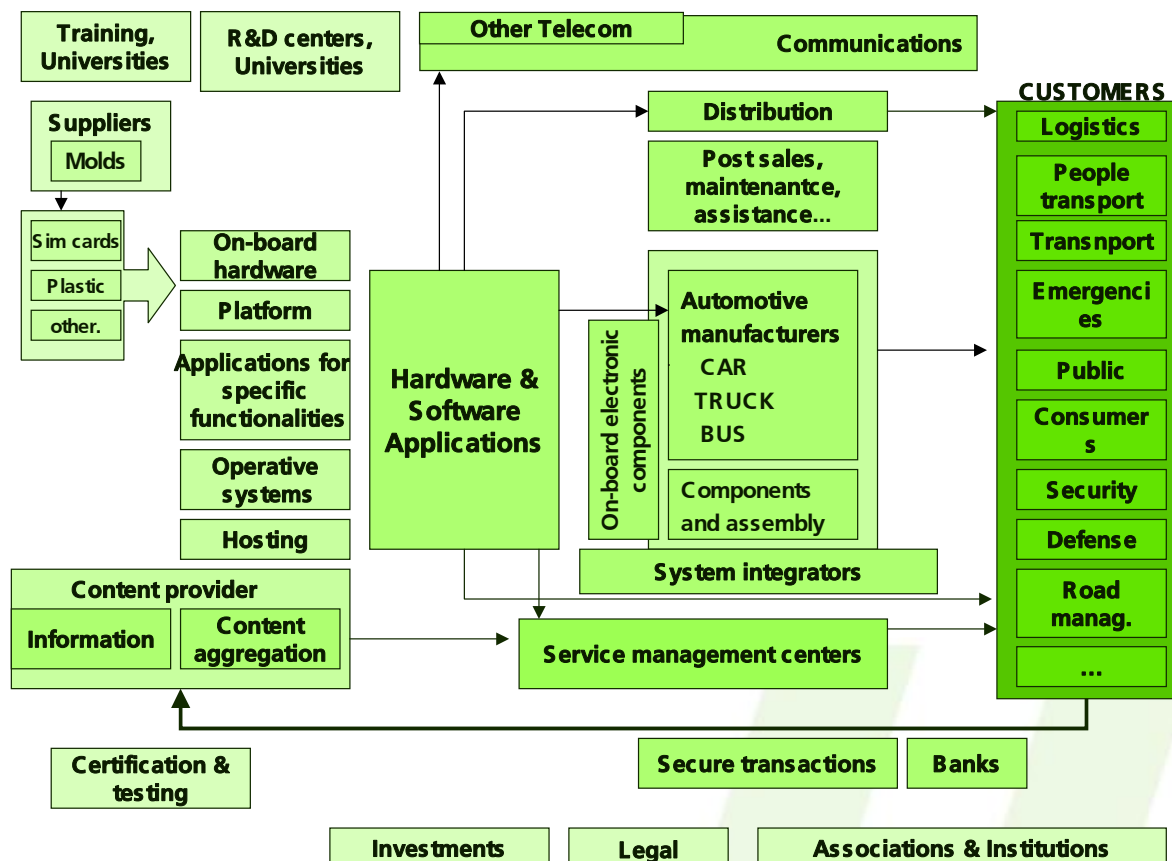
Major suppliers in the market

Market share is difficult to determine in a rapidly changing, highly proprietary environment. However, major suppliers include:

- *Automotive manufacturers*, including BMW, Ford, Daimler-Chrysler, Fiat, General Motors, Honda, Mitsubishi, Nissan, PSA, Renault, Toyota, Volkswagen, Volvo

- *Automotive electronics manufacturers*, including Alpine, Bosch, Delphi, Denso, Magneti-Marelli, Mannesmann, Mitsubishi, Motorola, Panasonic, Pioneer, Siemens, Sumitomo, VDO, Visteon

- *Multiple providers of digital map databases*, including NavTech and TeleAtlas/Etak

- *Wireless equipment manufacturers* including Ericsson, Mannesmann, Motorola, Nokia, and Siemens

- *Major manufacturers of traffic signal and control equipment*, including Automatic/Eagle Signal, Siemens, Image Sensing

- *ITS-specific manufacturers*, including International Road Dynamics, Mark IV, Q-Free, Siemens, SIRIT, TransCore/Amtech

- *Major ITS service providers*, including Ford Wingcast, GM OnStar, Mannesmann Passo, Mediamobile, Tegaron, Toyota/Monet, VW Gedas

- *Major automobile clubs*, including AA, AAA, ADAC, RAC

- *Major telephone and wireless network operators*, including AT&T, Deutsche Telecom, France Telecom, Vodaphone

Generally speaking, in the countries where ITS has significant volume or growth, there are multiple market entrants and enthusiastic competition. Mergers and consolidations are accelerating, creating a volatile and challenging marketplace.

Customers

There are five primary market targets for ITS:

- Builders and operators of the roadway, public transport, rail, and ferry infrastructure. This is predominantly the public sector, but with a growing private sector presence, especially for toll roads.
- Vehicle manufacturers, who incorporate ITS technology into the automobiles, trucks, and buses they sell
- Commercial fleet operators (passenger and freight) who use ITS to better manage vehicles, loads, and routing
- End users, as consumers of ITS products and services
- Public sector regulators of transportation and enforcement entities

These markets are frequently linked. Vehicle manufacturers, for example, incorporate the technology that they feel will appeal to and be bought by their own customers. The electronic toll collection / road use charging technology deployed by the public sector will be successful only if the general public acquires and uses toll tags in sufficient numbers.

In addition, manufacturers of in-vehicle devices and suppliers of ITS information services and content are themselves customers for ITS products and services. For example, manufacturers of in-vehicle route guidance products, who sell both to consumers and vehicle manufacturers, are themselves customers for GPS units, sensors, LCD displays, etc.

Public sector agencies, which organize and deploy much of the ITS infrastructure, have been the largest initial investors in ITS. However, commercial opportunities are rapidly developing as technically and commercially viable products and services become available. Within the next 25 years, the private sector market is expected to become four times larger than the public sector market.

5.   ITS in urban public transport system

Introduction

> Intelligent transport systems in urban public transport might be described as a combination of information and communication technologies integrated into urban public transport system. These technologies might be integrated into the infrastructure of transportation system and/or in urban public transport vehicles themselves.[13]

At present, public sector infrastructure, including electronic toll collection and road use charging, still represents the largest ITS market segment.

In the future, private sector purchases of ITS products and services (either from commercial and consumers) are expected rapidly to overtake the public sector market, with emphasis on communications-enabled in-vehicle products and services, reflecting rapid growth in the wireless internet. Japan is furthest advanced in this market, followed by Europe, and then North America, but this effect is accelerating in all world regions.

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[13] Source: Intelligent Transport Systems and Services. ITS – Part of Everyone's Daily Life (ERTICO – ITS Europe Navigation Technologies, Brussels, 2002, pp. 8, 43–55).

Benefits of ITS in urban public transport systems

Application of ITS in urban transport can lead to an improvement of urban transport performance through:

- Reductions in transport time, cost, and congestion
- Reductions in pollution
- More effective monitoring and management of traffic flows
- Greater safety and security in stations, streets, roads and vehicles
- Facilitation of multimodal journey planning
- Provision of real time traffic information, alternate routes, etc. to passengers
- Creation of appropriate travel conditions for disabled people[14].

The pace of Technological development is so rapid that decisions taken regarding public investment may seem incorrect or outdated even before their implementation is complete. The limitations of current applications may therefore delay companies' deployment of certain ITS. Given this reality, public transportation officials prefer re-programmable, durable ITS.

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[14] Some difficulties are encountered by people with reduced mobility who use public transport, for whom changing from one mode to another can sometimes be a real obstacle

Overview of ITS solutions in urban public transport

Today, the following approaches to intelligent transport systems in urban public transport are widespread:

1. Information dissemination in real-time regarding traffic routes, ticket prices, timetables, announcements on traffic conditions, and other passenger information services (including displaying vehicles' locations, walk distances between stops, parking information) and special information for passengers with functional disabilities or limited mobility. Media used include:

   a. The Internet, phone or mobile services: wireless application protocol services (WAP), short message services (SMS) or similar.

   b. Electronic displays installed in stops or stations, electronic information signs.

   c. On – board screens in urban public transport vehicles

2. Electronic tickets, e-ticketing

3. Security systems (security cameras in vehicles, stations and terminals to avoid crime enabling quick reaction from police offices).

The application of these – and other – solutions might not necessarily facilitate the process of sustainable and qualitative urban public transport improvements; if introduced and used without comprehensive analysis of the specific urban traffic situation, the ITS might instead the already complex and sophisticated urban transport system more complicated. Therefore, the application of intelligent transport systems must be also intelligent. If applied systematically, the intelligent transport systems can significantly facilitate and increase attractiveness of public urban transport, as well as reduce damage to environment, save time and health. Nevertheless, if applied indiscriminately, ITS might lead to even worse situation of public transport – high price of implementation requires high results – better comfort, less wasted time, less congestion, minimized pollution, better social integration of disabled people, increased competitiveness with private cars to contend with growing congestion phenomena, etc.

Many of those solutions are not expensive to introduce, but are in danger of being rejected by society. For instance, the solutions based on SMS do not require large investments, it is more a matter of awareness or technological literacy and willingness to use them – people need to be ready for innovations.

Phases of ITS

Intelligent transport systems represent a huge step toward the creation of a sustainable and modern urban transport system.

The following are the main phases related to public transport in which introducing ITS:

- Planning phase
- Parking phase
- Boarding phase
- Transport phase
- Connection phase

>ITS in the planning phase

During the planning phase, the most effective use of intelligent urban transport systems relates to providing information prior to the planned journey: where to go, how to go, what ticket to buy, where to park a bike/car, when to arrive, etc. Wireless technologies can be used, for instance, to get information on tickets, travel time, distances through SMS or Internet, calculating routes and any other information that might be necessary.

>ITS in parking phase

Information on vacant parking lots is very important: the park and ride approach can reduce car traffic and eliminate bottlenecks in city centres. Real time information reduces congestion on the parking areas, and fast payment (for instance, by SMS or charged smartcards) facilitates processes in the parking phase.

>ITS in boarding phase

The most innovative solutions of ITS applications in this stage of journey are related to use of state-of-the-art ticketing technology. One of today's most sophisticated approaches is e-ticketing. Notwithstanding the fact that this system is not widely deployed, the potential of it is obvious – it is a very fast-track solution. The most effective and convenient is a payment over cell phones. The potential of e-ticketing through portable devices (approx. 90 per cent of passengers carry cell phones) has also been explored in other transport services – for example, to pay for motorway tolls, parking fares,

bridge tolls, or ferry services. The e-ticket can be checked by inspectors simply by reading an SMS message to prove the payment and validation of ticket via portable device.

During this phase, it is important also to provide information about the arrival of the vehicle. This can be done through automatic vehicles location systems (AVL),that enable the continuous monitoring and control of all vehicles, thereby making it possible to improve schedule adherence, vehicle spacing and vehicle usage efficiency.

Two other important functions of ITS at this stage are providing accessibility for passengers with wheelchairs or with reduced mobility and providing sightless support for the blind. In the first case, many practical solutions have already been implemented. In the second case, the blind have significant difficulty using public transport services in cities. A very practical solution has been deployed in the Czech Republic: the "command rig system" has been introduced to help the blind access public transport. It comprises a set of portable, mobile and static technologies, providing acoustic and vocal information to help orient the sightless in urban areas, urban public transport, on crossings, in underpasses, etc. This system is based on a radio transmitter, which provides a variety of information. The public transportation infrastructure is equipped with a receiver connected to an integrated information system. In practice, a blind individual at an urban public transport stop must either rely on a built-in transmitter and command buttons or carry an independent, boxed transmitter. When a vehicle arrives at the stop, the sightless passenger presses the appropriate button to activate the outer loudspeaker of the arriving vehicle, which then announces the number of the bus, trolley-bus or tram line, route direction, and the name of the end stop. If the passenger wants to board, another button then activates an internal speaker and display, which alerts the driver[15]. The same process occurs when disembarking.

>ITS on transport phase
The use of ITS at this phase is mostly related to technologies aimed at providing information to passengers. Equipment is installed in vehicles which allows retrieval of information from traffic centers to in-

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[15] Source: *Intelligent Transport Systems and Services. ITS – Part of Everyone's Daily Life* (ERTICO – ITS Europe Navigation Technologies, Brussels, 2002

form passengers of route conditions, real-time information for those who planned multimodal journeys that require connections, estimate time delays, etc.

For drivers and operators, ITS simplifies and enhances control of the vehicle. For example, visual aid systems (VAD) have been deployed for vision enhancement. One of the practical solutions is an infrared camera installed in the headlights that enables drivers to better identify what is coming ahead of the bus or tram, even in the worst weather conditions.

>ITS on connection phase

In a multimodal urban public transport approach, the ITS at this phase are aimed at facilitating connections. Vehicle delays interfere with the need for fast and simple connections and lead to wasted time. At this phase, passengers must be provided with real time information on traffic situation. Vehicles are therefore equipped with global positioning systems (GPS) devices, calculation units and antenna. The bus or tram terminals are equipped with a radio data system (RDS) reception card, a display module and an antenna. The shape of displays vary from square or rectangular two-lined displays to sophisticated multifunctional screens that provide not only real-time information on waiting time, but also other commercial or public information.

Annex

Major technologies used in the production/delivery of major products and services

With a few notable exceptions, ITS has mostly used off-the-shelf technology, although it sometimes combines items of this technology in novel ways.

The following is a survey of major technologies used in ITS. Stars H precede technologies which are unique to ITS or which require special adaptation for ITS-related use.

1. Traveler information and advisory systems; Wireless vehicle products and services

- Computers
- Information feeds from public and private sources
- Display devices at passenger terminals and on buses and passenger cars
- Traveler information kiosks
- Two-way data connections between communications services and users
- One- and two-way data connections connecting communications services with vehicles, the internet, kiosks, dial-in users, wireless PDA users, etc.
- Software and communication protocols
- Wireless access to the internet for travelers

2. Traffic management and control systems; Roadside Infrastructure

- Architecture, specifying the interfaces between the different functions/subsystems, security management in multi-operator/multi-service road toll and public transport fare collection systems, and in other public and private services using the same devices (e.g., same smart card or DSRC transponder)
- Computers

- Displays
- Information feeds from field equipment and other public and private sources
- Two-way data connections to adjoining systems and centers
- Outbound data feeds to controllers and field equipment
- Software and communication protocols
- Dynamic message signs
- Traffic signals
- Vehicle detectors
- CCTV and other video surveillance devices
- Wired and fiber networks
- Field equipment controllers
- Commercial vehicle tag readers/transmitters

3. In-Vehicle Products

- In-vehicle multimedia and communications products use:
  - Microprocessors
  - Communications devices, including cellular telephone, for voice, data, and internet access
  - Flat panel displays
  - Speakers and tone generating devices; microphones, sometimes combined with cellular telephone
  - Map databases
  - On-vehicle sensors for location and speed/direction of travel, typically GPS receiver, compass, odometer feed, enabling the vehicle to serve as a data probe for itself and others ("floating car data")
  - In-vehicle multimedia data bus [TC 22, SC3/WG1]
  - Software and communication protocols

- In-vehicle control, efficiency, and safety products use:
  - Yaw, pitch, roll, velocity, acceleration sensors [TC 22, SC9]
  - Wheel rotation sensors [TC 22?]
  - Radar and other ranging technology
  - Infrared, video, and other visual sensors
  - Communications devices, including cellular telephone

        Brake, steering, throttle, and transmission actuators
        Map databases
        Specialized control and data buses [TC 22]
        Software and communication protocols

- Commercial vehicle tracking and border crossing (in-vehicle)
          Transponder
          Interface to on-board computer
          Software and communication protocols

4. Freight and passenger fleet management systems

- GPS and other location sensing technologies
- Cellular, satellite, and/or other communications between base station and fleet
- Computers
- Displays
- Software and communication protocols

5. Public Transport Management Systems

- Databases
- Onboard databus
- Fare collection system elements
- Software and communications protocols
- Dedicated User information systems (onboard, at stops)
- Passenger and driver safety surveillance and alarm systems

6. Emergency response systems

- Mayday devices
- Public service answer points
- Links from other service providers
- Computers and displays
- Links to traffic management centers for signal priority
- Two-way voice and data communications to emergency fleet
- Software and communications protocols
- Identification and monitoring of hazardous materials / dangerous goods

7. Electronic Payment

- Electronic toll collection / road use charge (in-vehicle)
  - Toll tags
  - Carriers/transponders for smart cards / electronic purse
  - Transparent masks in metal coated windshields [TC 22, SC11]
  - Software and communication protocols

- Electronic toll collection / road use charge (infrastructure)
  - Toll tag readers/transmitters

- Electronic fare collection (public transport)
  - Fare collection devices
  - Fare media (cards, etc.)
  - Carriers/transponders for smart cards / electronic purse

8. System integration of transportation facilities

- Architecture, specifying the interfaces between the different functions/subsystems
- Computers
- Displays
- Wide area data network
- Software and communication protocols

9. Map Databases
As well as being components of various systems, these are consumer products themselves

- Software, including physical and transfer data formats, access software, application program interfaces