Published paper
Firmin, P.E. (2006) Satellite Navigation Technology Applications for Intelligent Transport Systems: A European Perspective. European Navigation Conference, Manchester, 8th-10th May 2006

Paper (No. 70) presented at the European Navigation Conference – Manchester. 8th – 10th May 2006.

Satellite Navigation Technology Applications for Intelligent Transport Systems: A European Perspective

By
Dr Paul E. Firmin
Institute for Transport Studies, University of Leeds, UK.
Email: P.E.Firmin@its.leeds.ac.uk

Abstract

This paper focuses on real-world applications of Global Navigation Satellite Systems (GNSS) in the field of Intelligent Transport Systems (ITS). The key advantages offered by satellite technology of observation, telecommunications and navigation, are highly suited to the needs of future transport systems of all kinds. The paper will outline the various current European based applications of satellite navigation systems to intelligent transport systems, drawing on recent European telematic research project findings and good case study examples of early system implementation throughout Europe.

With regards to recent EU research, the paper will give an overview of current cutting edge transport research and its implications for the use of satellite navigation technologies and will summarise the key findings from recent test implementation schemes and detail the opportunities for future market exploitation. With regards to the case study examples, a range of full scale and partially implemented Intelligent Transport Systems will be highlighted, with reference made to costs and benefits to society.

The paper will therefore report on a wide range of successful land based transport systems utilising satellite navigation technology which have been brought to the market in recent years, including developments in the following systems: Automatic Vehicle Location for monitoring public transport; Real-Time Passenger Information for public transport users; In-Vehicle Dynamic Route Guidance for car drivers; Road User Charging to better manage the demand for road space in congested networks; Intelligent Speed Adaptation to control the speed of vehicles externally for improved road safety; Demand Responsive Transport to provide a door-to-door service for disabled and elderly travellers; Traveller Information Systems for improved and integrated travel information for travel by all modes; and, Fleet Tracking Systems for better management of freight movements and goods delivery.

Future transport applications will also be considered, with the emphasis being placed on novel and interesting potential developments to aid safety, improve the flow of traffic and provide enhanced travel information services and thus generate an integrated transport system with social, economical and environmental benefits. Potential future applications include: Automated Highways, Remote Sense Parking, Vehicle Access & Control systems, Floating Vehicle Data, Automated Freight Delivery Systems, Personal Navigation, and future transport modes such as Personal Rapid Transit and Cyber-Cars, i.e. driver-less vehicles.

In conclusion the paper will outline some exciting new developments and intriguing future applications for Satellite Navigation Technology in the field of Intelligent Transportation services provision.

Introduction

Traffic congestion is increasing on both road and rail transport networks throughout Europe and scope to build additional network capacity is both limited in terms of land availability and expense. Research indicates that providing more road space leads to further demand, which in turn reduces capacity and increases congestion. New methods for managing the efficient use of road and rail networks and operation of the existing infrastructure are therefore required (Maes & Radia, 2006).

The development, deployment, and continual enhancement of the Global Navigation Satellite System (GNSS) has been of great significance to the design and development of Intelligent Transport Systems (ITS) in recent years. Further enhancements of navigation technology will develop existing and encourage new intelligent transportation systems worldwide. European countries have been at the forefront of research and implementation of ITS technologies over the past decade, to assist with traffic management and provide accurate up to date information to travellers using all modes of transport. ITS applications have been designed and implemented to tackle the growth in traffic congestion, save valuable resources, help protect the environment and provide an equitable and sustainable transport network to aid the mobility of people and goods.

Figure 1: Traffic Congestion

This paper begins with a brief summary of the different satellite navigation systems and will then detail existing and potential land-based intelligent transport systems, which will benefit from and also be enhanced as a direct result of improved satellite navigation technologies. The impacts on the transport networks and influence on travellers will be highlighted for each of the system applications considered.

SATELLITE NAVIGATION TECHNOLOGY

Satellite radio navigation using accurately timed signal emissions from satellites orbiting the Earth is an advanced and already well developed technology. The first system was the Global Positioning System (GPS) developed for use by the US military (Wikipedia website, 2006), but several other systems now exist or are planned. These are briefly described below.

GPS, GLONASS & EGNOS

The American NAVSTAR (Navigation Signal Timing and Ranging) GPS system is well established, initially consisting of a constellation of 24 satellites, which have been in operation since 1993, the same year in which free worldwide civilian use of GPS was sanctioned. Each satellite contains an atomic clock and broadcasts the exact time together with data elements relating to the satellite's precise orbital position. GPS receivers can then calculate their current position and time using trilateration by measuring their distance to at least four satellites and accurately timing the delay of receiving transmitted signals.

The Russian GLONASS system is still in development and although it went through a period of neglect, currently has 16 operational satellites. Meanwhile a hybrid EU system known as EGNOS has been developed as a precursor to the Galileo project. The European Geostationary Navigation Overlay System (EGNOS), is a system of satellites and ground stations which are designed to improve the accuracy of the current GPS and GLONASS systems in Europe (Guida, 2006).

The Galileo Project

The European Commission's Galileo project differs from both the previous GPS and GLONASS systems in that it has been developed wholly for civilian applications. As such the emphasis has been targeted towards civilian needs for navigation systems and services and transport is a prime application for such technology. The GALILEO constellation will consist of 30 satellites in three different orbits and with supporting ground stations (EC-DGTREN, 2006). The first GALILEO satellite, known as GIOVE-A, was launched into orbit in December 2005, became operational in January 2006, and the entire system is hoped to be operational by the year 2010. GALILEO is designed to offer greater precision; improved coverage of satellite signals, especially for northern areas such as Scandinavia; and also improved reliability. The system will also not be subject to selective availability, as with military based systems. Two main services will be offered, an '*Open*' or base service, which will be freely available to anyone with a GALILEO compatible receiver; and an encrypted high bandwidth commercial service offering an improved accuracy, but at an additional cost (Wikipedia website, 2006).

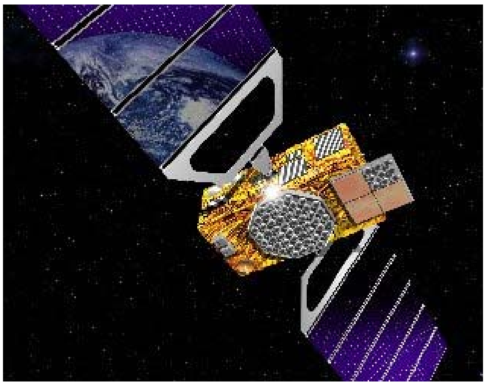

Figure 2: GALILEO Satellite

Global Navigation Satellite Systems (GNSS)

The development and implementation of European satellite technologies, such as EGNOS and GALILEO, in combination with the existing GPS and GLONASS systems, will lead to significant enhancements in the accuracy of global positioning systems and hence assist in the development of further intelligent transport system applications in Europe and world-wide (RIN, 2006). In particular it will be possible to reliably determine the location of vehicles, people and objects precisely in time and space to an accuracy of less than one metre. The combination of existing GPS technology with new systems such as EGNOS and GALILEO will therefore lead to a more robust system, giving better coverage overall, reducing the effect of blocked signal reception due to urban canyons, which in turn will offer better service availability and reliability for a host of transport guidance related and traveller locational applications (Guida, 2006).

INTELLIGENT TRANSPORT SYSTEMS

A definition of Intelligent Transport Systems (ITS) is the integration of modern tele-communications, control and information processing technology to transport systems. The term Transport Telematics as they are known in Europe, are the actual technologies used to deliver such intelligent systems (World Road Association, 2004). The adoption of these technologies will assist with the efficient management of traffic and provide better information to travellers using the various systems.

The main objectives of ITS technologies are to encourage modal shift, reduce traffic congestion, provide safer transport systems and give protection to the environment, as outlined in the European Commission's White Paper on European Transport Policy (EC-DGTREN, 2001a). ITS has been widely accepted by both public and private sectors as the best way of achieving the goal of sustainable mobility, while at the same time improving the quality of life (ERTICO, 2006). The implementation of ITS therefore provides for fast, reliable, safe transport networks, giving European citizens sustainable mobility now and in the future. This paper will now consider satellite navigation based telematic applications for advanced land transport systems.

Private Road Transport Applications

In-Vehicle Route Guidance and Navigation

Estimates indicate that by the year 2010 there will be more than 670 million cars , 33 million buses and trucks and 200 million light commercial vehicles worldwide (EC-DGTREN, 2006). The installation of satellite navigation receivers in new vehicles in the future will provide the potential for a whole range of telematic applications. The application of GPS technology to provide in-vehicle route guidance and navigation is already a well established concept and product growth in this area has rocketed in the last few years. Initially such systems have been predominantly targeted for the hire-car market in the USA, and are often fitted as standard on motor vehicles in Japan, where the in-vehicle telematics market is already well developed. However, motor manufacturers in Europe have been slow to adopt the new technology on their vehicles, with a few notable executive model exceptions, such as BMW. The high price of satellite navigation systems in the late 1990's with a typical kit costing up to £2000 including installation of differential wheel sensors etc., probably was what put most consumers off, other than the rich and early technology adopters.

Figure 3: TomTom in-car navigation device, TomTom.

Now with the advent of affordable portable in-car satellite navigation products, such as TomTom, Navman and CoPilot, which cost a fraction of early high-end systems and which can run their software on a PDA or mobile phone, the term 'SATNAV' has become an in vogue buzzword and such systems were top of the list as presents for the family car driver during Christmas 2005.

Route inefficiency continues to be wasteful of fuel and time resources, hence the need for better and more accurate positioning which will enhance current and new in-vehicle route guidance systems by calculating optimal routes. However, the new breed of in-car navigation device is only going to be of any real use to drivers if it can be matched to perfect data-sets, useful locational information, such as hotels, restaurants, car parks, and can also be linked to current congestion information. Some systems in Europe have been successfully linked to RDS-TMC and the UK TrafficMaster company now offer a personalised dial-up off-board navigation service, called SmartNAV (TrafficMaster, 2005), which can plot alternative routes around congested links.

Traffic Control and Management Applications

Figure 4: Urban Traffic Control Centre – UK Highways Agency

The successful management of traffic in towns and cities and inter-road networks across Europe is of paramount importance to ensure that economic growth is maintained and that quality of life is good. Business depends upon the efficient movement of goods and people within and across borders. The European Commission's White Paper on European Transport Policy (2001), clearly stipulates that satellite technology will play an increasingly important role in providing accurate traffic and incident data and will aid the planning of services and operations in the future (EC-DGTREN, 2001a). Across Europe traffic control centres are appearing, as evidenced with the National Traffic Control and Regional Control entres which have recently been opened by the UK Highways Agency. Although a great deal of information is collected via roadside sensors and CCTV cameras, an increasing opportunity exists to make use of floating vehicle data, by monitoring the position and progress of vehicles in a network using satellite tracking technology. In this manner control and response to changes in flows and incidents can be responded to quickly and effectively.

Road User Charging

Charging for road space usage is a contentious issue, but as the trend in traffic growth increases it may become a necessity soon in many European cities and National road networks within the next ten to twenty years. Already London has adopted a Congestion Charge scheme, although this currently does not rely on GPS technology, the potential for upgrading exists. The benefits of using satellite positioning to apply 'Virtual Tolls' is appealing for many reasons. The system could be inter-operable across borders, it would provide a seamless system, it could be fully automated and tariffs could be easily changed by time of day or location (Lutas, 2006). There are also possibilities to charge different types of vehicles, or charge for use of particular types of roads, for example to charge for entry into an urban or environmentally sensitive area (EC-DGTREN, 2006). Another major benefit of GPS based toll systems are that they do not require lots of fixed roadside equipment. However, enforcement issues are still a major concern with this type of system and remain an issue yet to be successfully addressed.

A recent example of the use of GPS technology to track vehicles for the purposes of charging them for the distance they have travelled is illustrated by the introduction of the German Lorry Road Charging scheme, which became operational in January 2005. Despite initial difficulties in getting the system up and running, it is now performing well and 500,000 on-board units have been installed in trucks (Toll Collect, 2006). Plans for a similar UK based system have currently been put on hold as a National Road Charging Scheme using such tracking technology is considered.

Public Transport Applications

Bus Passenger Transport

Applications of GPS technology to Bus Public Transport is not a new idea. Indeed Automatic Vehicle Location (AVL) systems based on sensors and detectors at major junctions and key network locations have been used by bus operators for several years (DfT-UK, 2005). Real-Time Passenger Information (RTPI) systems are becoming more common place on buses, at bus stops and inside bus stations in major European cities. Two good examples of such are 'Countdown' in London and more recently 'StarTrack' in Leicester, UK. The '*Your-Next-Bus*' system in West Yorkshire is also a good example of the recent application of GPS vehicle tracking of buses for the provision of up-to-date travel information on bus services in the region (WYPTE, 2006). Users simply send via SMS text, a five digit code number, identifying the Bus Stop location, to a special phone number and within seconds receive up to the minute information on the arrival times of the next buses for that particular stop. This removes the unknown time factor that passengers often experience when waiting patiently for buses and also informs them on the progress of services stopping at particular locations. The deployment of more of these travel information services can only enhance public transport and help to encourage mode transfer.

Figure 5: Bendi-Bus in central London, Transport for London

Demand Responsive Transport

These are sometimes known as Bus-Taxi services, but they differ from conventional forms of bus services which have fixed routes, stop locations and arrival times. Such traditional buses are prone to low frequencies, poorly used services and lengthy routes, serving areas where very often nobody wants to travel, which leads to a waste of resources and inefficiency. Demand Responsive Transport (DRT) using smaller scale vehicles, provides a much more flexible service, matching routes and travel times to customers' demands (DRTBUS, 2006). The application of satellite navigation technologies to DRT can provide for an efficient and quick service, by informing of the most direct route to maximise journey payload and efficiency. Customers simply ring up the service and the DRT bus is sent to their location to collect them via an optimal route in consideration of other passengers. Thereby providing a '*door to door*' service, which is both flexible and convenient. Such transport systems are ideal for rural or sparsely populated areas and are also most useful for persons without access to their own personal transport, such as the elderly. However, provision of such services is not cheap. Schemes have none the less been initiated in the UK, Finland and Italy.

Figure 6: Demand Responsive Vehicle, UK.

Taxi Services

The use of satellite navigation in Taxis is already quite common, with taxi drivers being able to plot optimum routes to the client's desired destination. However the application of satellite technology for this type of travel goes further than mere navigation. The possibility of 'Remote Hailing' becomes a viable proposition when the client is also connected to the navigational system via a satellite receiver contained inside a mobile phone. By combining mobile telephony with location based services it becomes possible for a customer to call or 'hail' a taxi remotely to arrive at a specific location simply by the touch of a button. The nearest available Taxi cab can then be directed by the most optimally direct path to the origin location of the request to collect the client (EC-DGTREN, 2006). This represents improved efficiency and also meets customer needs for a personalised car service. It also means that the client need not know precisely where they are when hailing a cab, which is useful for when in unfamiliar surroundings or travelling abroad.

Rail System Management and Control

The integration and harmonization of the rail network in Europe is a key function of the European Rail Traffic Management System (ERTMS). Another rail standard is the European Train Control System (ETCS). These systems give automatic train identification, remote electronic braking and train diagnostics for improved safety, cargo monitoring and improved rail system information, which are all features that could be enhanced through application of satellite positioning (EC-DGTREN, 2001b). Train control and fleet management costs could be significantly reduced with navigation technologies complementing existing ground based systems (Galileo Industries, 2006). Global satellite systems could be applied to monitor individual wagons for cargo control and assist with train signalling, leading to reduced distances between trains and therefore increased train frequencies.

Up to date passenger information about train arrival and departure times and delay notification can be provided to travellers by satellite tracking of trains. Rail track surveying is also an area where accurate positioning data provided by satellite technology will aid repairs, augment track condition data collection and help to maintain service operation.

Freight and Fleet Transport

Freight and fleet transport systems are a major beneficiary of Intelligent Transport System implementation, in order to better co-ordinate freight movements by road or rail and control fleet resources (DfT-UK, 2003).

Fleet Management

Fleet vehicle tracking has been an initial application for satellite navigation systems and has been applied to the public transport, freight and fleet vehicle industries, with more than 500,000 vehicles being equipped with tracking sensors in Europe. Such systems bring a range of benefits, including: optimised fleet usage; optimised services, reduced operational costs, increased driver security and centralised monitoring and control of fleets (EC-DGTREN, 2006).

Automated Freight Transit

The Combi-Road system (Scrase, 1998), which has been developed as a test system for trial in the Netherlands, consists of a completely segregated track for automatic transport control and delivery of container freight cargoes. By applying enhanced satellite navigation technology, it should be possible to operate a system of driver-less, self delivering freight modules, whose routes and destinations may be tracked and plotted automatically via GPS tracking and hence controlled to ensure optimum delivery. Main benefits of such a system are removal of heavy vehicles from Motorways, reduction in traffic congestion, savings in road accidents and improved efficiency of freight deliveries, leading to reduced transit costs for both operators and also consumers.

Figure 7: Combi-Road Demonstration Track, The Netherlands.

Safety of Transport Systems

The total number of road accident fatalities in the EU is extremely high, with 40,000 people being killed on the roads and a total of 1.3 million personal injury accidents recorded per year. Young persons in the age range 15 to 24 are most at risk, with vulnerable road users, such as pedestrians, cyclists and motorcyclists accounting for 40% of all road deaths in the EU (EC-DGTREN, 2006). A major purpose of the GALILEO initiative is to provide improved safety measures and enhanced emergency operations in transportation systems. Satellite navigation systems will bring about new possibilities for improving road users' safety via a range of technical applications. Guidance and information systems will be able to provide the driver with details of hazardous road conditions and static dangers. Filtered traffic information; fleet management could increase the efficiency of rescue operations. Also improvement in the accuracy of logging road accident locational data and statistics will help to provide a better understanding of accident causation and hence potentially lead to accident prevention. It should be noted that guaranteed service continuity and increased availability in urban areas, as will be provided by GALILEO, are both major advantages for transport safety systems (Galileo Industries, 2006).

Advanced Driving Assistance Systems

These systems combine vehicle capabilities with local environmental data to improve mobility and increase safety. Satellite technologies will aid such systems by providing additional data on the vehicle's surrounding environment. Advanced Driving Assistance Systems (ADAS) warn drivers of impending hazards and can take partial control of the vehicle, such as speed reduction in poor visibility, or lane and headway control in heavy traffic. It is anticipated that 50% of vehicles operating in Europe by the year 2020 will have ADAS fitted as standard (EC-DGTREN, 2006).

Intelligent Speed Adaptation

Figure 8: Intelligent Speed Adaptation Car Dashboard

One of the biggest applications of global positioning systems for improved road safety is in the development and deployment of Intelligent Speed Adaptation (ISA) systems to enforce legal speed limits through vehicle speed limiter control (Univ. of Leeds, 2006). This controversial system has the potential to make the largest impact on safety since the introduction of seat belts, and could also render physical traffic calming, such as road humps and chicanes, totally obsolete. Trial systems are currently undergoing testing in the UK with a fleet of Skoda Fabia cars, which cannot exceed the national speed limits of local roads. A similar set of trials have been conducted in Scandinavia. The system is also flexible enough to be linked to remote sensors and used to control speeds due to adverse weather conditions or changes in traffic volume, thus providing for a range of variable speed limits to safely suit the travel circumstances. Predicted savings in the number of accidents have been estimated to be a 36% reduction in personal injury accidents and a 58% reduction in fatalities. The system could be operational by the year 2020, but is subject to public acceptance and appropriate government legislation.

Emergency Call and Incident Response Systems

This represents a very important application of vehicle tracking capabilities to manage and direct emergency and rescue vehicles to the scene of incidents. There are 60,000 ambulances in Europe and with satellite receiver and communications links these will be able to reach target destinations in fast response times. Automatic crash call systems will also automatically signal the location of vehicle accidents and incidents (Galileo Industries, 2006).

By linking satellite tracking with traffic management and control centres, it will also be possible to ensure that incident response vehicles receive a ‘Green Wave’ through control of traffic signals, to speed the arrival of emergency vehicles to road accident locations (EC-DGTREN, 2006).

Hazardous and Valuable Goods Transportation

By tracking of road or rail vehicles carrying dangerous or valuable cargoes, it will be possible to safeguard against risk of terrorism and ensure maximum safety and security at all times. The ability to track single vehicles will aid the transportation of hazardous and valuable goods by selecting routes that avoid built up areas and residential zones. Progress monitoring will allow planning ahead for careful policing of routes at each stage of the journey (EC-DGTREN, 2006).

Travel Information Services

The demand for transport information has dramatically risen over the years, partly due to the fact that people travel more often and further than they ever did in the past. This increased mobility has led to a greater demand for information on transport services, performance and travel options. Satellite navigation technology has an important role to play in providing enhanced information for travellers. The European Commission has set a target for 50% of Europe's major towns and cities to be provided with traffic and travel services by 2010. Providing better travel information is also a key policy of the UK Dept. for Transport (DfT-UK, 2005).

Personal Travel Services

Figure 9: Hand-Held PDA with Personal Route Guidance System

Currently there are 37 million people in Europe with some form of disability making independent travel a real issue of difficulty (EC-DGTREN, 2006). There is a genuine need to improve services and provide usable transport systems for these people. Disabled and blind citizens will benefit from the development of practicable and affordable personalised guidance and locational information systems. The precise matching of personal location with point of interest information becomes essential for successful and usable systems to advise and navigate blind travellers. For those with disabilities requiring access to special transport facilities, such as lifts, escalators and flat or ramped surfaces, careful route planning and notification is required. Indeed through the development of such systems for people with special needs, this will lead to benefits for all travellers, who will be able to obtain navigational advice and guidance when in urban areas and even inside buildings, such as indoor shopping malls and large department stores. Personal navigation systems are already available and will become a great deal more accurate with satellite navigation enhancement in the next few years, as GALILEO will allow for better coverage than has previously been possible.

Figure 10: Mobile GPS – location based services for pedestrian navigation in urban zones

Transport Surveys and Data Collection

This is another potential information source which could benefit from the application of satellite navigation technology. Transport planners and traffic engineers have a real need for accurate data on transport system usage to aid in the planning and design of new services. Traditionally transportation specialists have required to know the following salient details about journeys: points of origin and destination, time of travel, journey duration, average speed, mode choice, ticket type and cost. These items of information are often sourced by conducting of interview, questionnaire or observational surveys, but these are time consuming, costly and difficult to process. In the future it may be possible to utilise global positioning systems to track journeys made via different modes, automatically. This could lead to a wealth of quality data never before feasible for collection. Better quality of data and more of it could lead to better transport system design to meet future travel demands.

One particular application which is ripe for exploitation is that of ‘Floating Vehicle Data’ (FVD), whereby probe vehicles travelling on a busy route are monitored in terms of their performance, e.g. distance travelled, time taken, average speed, and hence journey time between fixed points of reference can be calculated. This is useful data and could also be a source of travel information for travellers too. Portable electronic travel diaries with GPS receivers will also offer the potential for efficient and more accurate travel survey data collection (EC-DGTREN, 2001b).

Future Transport Systems

Automated Highways

Future transportation systems will benefit from enhanced positioning via deployment and operation of a Global Navigation Satellite System. In particular, Automated Highways may become a viable possibility, at least for long distance high speed travelling. Already Co-operative Vehicle Highways Systems (CVHS) have been tested in the USA and Japan, and the concept is also under consideration by the EU (World Road Association, 2004). By tracking lane position and platooning vehicles, a greater efficiency in use of road space via reduced headways may be achieved. This potentially offers increased safety advantages too, although legal aspects if the system were to fail and cause a crash are complex and remain to be resolved.

Figure 11: Automated Highway Vehicle Fleet

Remote Sense Parking

The concept of Tele-parking is already available and being widely installed in the Netherlands and the UK (Parkmobile, 2006), most notably in various west end London boroughs. The advantages of such a system is that it permits payment of parking charges via mobile phone, hence drivers do not need the correct change and save time locating a Pay & Display machine. Users of the system simply SMS text the parking area code, usually a three digit number, to a special phone line and their parking time is automatically logged until they recall to announce their departure. Zonal tariffs can easily be varied by time of day and wardens with hand-held data loggers check the validity of parked vehicles. In future it will be possible to link automatic parking payment to satellite positioning to determine the area charge for vehicles by time of day, a form of location billing (Galileo Industries, 2006). This will also assist with checking the validity of area parking too, since satellite positioning to an on-board unit will determine if the vehicle has been moved or not. In this manner car parking will be remotely sensed and automatically charged, with users receiving a monthly bill for their city centre parking activities.

Vehicle Access and Control

Vehicle access control systems permit access to environmentally sensitive areas, or residential zones by certain vehicle types only, via deployment of automatic barriers and bollards. In this manner access by vehicles and/or pedestrians to restricted areas of neighbourhoods may be carefully controlled to ensure safety, maintain security and protect the local environment. Currently such control systems rely on transponder technology, but a satellite technology based system could work just as well and offers better flexibility.

Another potential application involves access of vehicles to high speed roads via matched merging. By accurately tracking vehicle positions on the approaches to high speed roads, it should be possible to advise the driver of an appropriate approach speed in order to merge safely with the main flow of fast moving traffic on Motorways. Similar advice could be given for when vehicles are exiting the Motorway. Ultimate control would automatically slow the vehicle to permit sufficient gap for a merge to take place, hence leading to improved safety and avoiding the potential for build-up of delay by maintaining traffic flow speeds on the main carriageway.

MODERN MODES OF PUBLIC TRANSPORT

Completely new modes of transport, offering alternative travel options, which are fast, efficient, comfortable and environmentally friendly, are also subject to the influence of satellite based technologies to assist with the navigation and control of such systems. Monorails are currently being implemented as an environmentally attractive solution to mass rapid transit in several cities and countries around the world, although they are as yet to be seriously considered in Europe. These new, green, clean and efficient transport modes provide a level of service and quality of travel so far unattained in public transport. The ability to track such systems using satellite technologies will aid their smooth operation and ensure safety at all times. Other more unusual systems are also envisaged and some of these are described in the final sections below.

Personal Rapid Transit (PRT)

The ULTRA personal rapid transit system being developed in Cardiff by Advanced Transport Systems Ltd, utilises a tracked system of individual computer controlled driver-less vehicles running along a segregated guideway. The system potentially offers a new, low cost, effective, sustainable form of transport (Advanced Transport Systems Ltd, 2006). The application of satellite tracking of PRT vehicles would be advantageous for such a demand responsive system and would also provide data for effective vehicle fleet control. Such systems are ideal for linking terminals at Airports, but are also proposed for providing future transport facilities within city centres.

Figure 12: ULTRA PRT System Test Track, Cardiff, UK.

Automated Buses (Personalised Public Transport – PPT)

The Capoco Design Ltd. company who manufacture traditional bus and coach vehicles have been investigating the design of a brand new concept of public transport system for the future with their PPT design (Ponsford, 2006). The vehicles, which can carry up to 24 passengers, are all driverless and operate via on-board sensors and a link to satellite navigation. Vehicles are designed to operate on track or run on ordinary road space, either individually or as platooned trains, using advanced control telemetrics.

Cyber-Cars

The concept of remote controlled or self-driving robot vehicles may sound like science-fiction, but the concept may not be that far away. With the growing application of telematics to personal vehicle design and inclusion of more and more electronics into the car, the fully electronic vehicle becomes a distinct possibility. A European project known as Stardust has already investigated the potential of Cyber-Cars for use on short distance town centre journeys (Stardust project, 2004). The combination of advanced driver assistance systems and automated vehicle guidance means that such systems are a distinct possibility for cities in the future.

Summary

This paper has outlined the development of satellite navigation technologies, briefly described the systems and given a descriptive over-view of the current and future applications for intelligent transport systems in Europe. Transport telematics represents a huge growth industry and the further enhancement of satellite systems such as GPS, and the on-going development of new systems such as EGNOS and ultimately the full deployment of GALILEO, can only add to that growth. As satellite navigation systems become further developed, more accurate and more reliable, new and exciting opportunities open up in the world of transportation. The next generation of transport telematic applications will see better integration of transport modes, offering more choice, improved efficiency and sustainability. The future currently looks very bright for satellite navigation technology applications to transport, leading to a better quality of life for all the citizens of Europe.

References

• Advanced Transport Systems Ltd (2006).ULTra Website: http://www.atsltd.co.uk/

• Demand Responsive Transport Bus [DRTBUS] (2006). Website: http://www.drtbus.co.uk/

• Department for Transport [DfT-UK] (2005). Intelligent Transport Systems (ITS) – The policy framework for the roads sector. Dept. for Transport. Product Code PPU3617/ES. November 2005.

• Department for Transport [DfT-UK] (2003). Freight Management – Traffic Advisory Leaflet ITS 10/03. DfT Traffic Advisory Unit. December 2003.

• ERTICO (2006). Welcome to ERTICO.com – Making Intelligent Transport Systems and Services part of everyone's daily life. Website: http://www.ertico.com/

• European Commission Directorate General Energy and Transport [EC-DGTREN] (2006). Galileo European Satellite Navigation System Website: http://europa.eu.int/comm/dgs/energy_transport/galileo/index_en.htm

• European Commission Directorate General Energy and Transport [EC-DGTREN] (2001a): White Paper on European Transport Policy. September 2001.

• European Commission Directorate General Energy and Transport [EC-DGTREN] (2001b): Intelligent Transport Systems: Results from the transport research programme. September 2001.

• Galileo Industries (2006). Traffic Management and Transport Website: http://www.galileo-industries.net/galileo/galileo.nsf/pages/CONT-627HCY?openDocument&e

• Guida, U. (2006). GIROADS – Great Enabler. Traffic Technology International magazine. Feb./March 2006 edition. pp. 22-23.

• Lutas, D. (2006). Potential uses of higher res. satellite navigation systems in future transport applications. Traffic Engineering & Control magazine. April 2006. Vol. 47. No.4.

• Maes, W. & Radia, B. (2006). Intelligent Transport Systems (ITS) Activities at the European Union Level. Routes/Roads magazine. No. 330. pp. 74-81.

• Parkmobile (2006). Website: https://www.parkmobile.com/com/index.html

• Ponsford, A. (2006). PPT – Personalised Public Transport: An automated, hybrid electric transport system offering the best of all worlds whilst saving this one. Proceedings of 2nd Conference on Automotive Electronics. The IEE London. 20-21 March 2006. pp. 203-218.

• Royal Institute of Navigation [RIN] (2006). GNSS: Benefits, Risks and Misconceptions. Navigation News - magazine. March/April 2006 edition.

• Scrase, R. (1998). Driving freight forward. ITS International magazine. May/June 1998. pp. 47-50.

• Stardust Project (2006). Towards Sustainable Town development: A Research on Deployment of Urban Sustainable Transport systems. Website: http://www.trg.soton.ac.uk/stardust/

• Toll Collect (2006): Truck Toll System Website: http://www.toll-collect.de/

• TrafficMaster (2005). SmartNAV promotional leaflet.

• University of Leeds (2006). ISA-UK Intelligent Speed Adaptation Project. Institute for Transport Studies, University of Leeds. Website: http://www.its.leeds.ac.uk/projects/isa/

• Wikipedia - The Free Encyclopedia (2006). Website: http://en.wikipedia.org/

• World Road Association – PIARC (2004). The Intelligent Transport Systems Handbook – 2nd Edition. Ed's: J.C. Miles & K. Chen. World Road Association (PIARC). ISBN 2-84060-174-5.

• WYPTE (2006). Your Next Bus – Website: http://wypte.acislive.com/

Filename: EuroNav_2006_PaperNo_70_V09 (Final)