Position Paper on Intelligent Transport Systems

Introduction

Intelligent Transport Systems (ITS) comprise several combinations of communication, computer and control technology developed and applied in the domain of transport to improve system performance, transport safety, efficiency, productivity and level of service, environmental impacts, energy consumption, and mobility. ITS represent the next step in the evolution of the entire transportation system.

ITS can be applied to the vast transportation infrastructure of highways, streets, bridges, tunnels, railways, port and airport infrastructures, as well as to a growing number of vehicles, including cars, buses, lorries and trains, as well as aircraft and waterborne vessels. They can be used for both passenger and freight transport. Moreover, ITS apply to all transport modes and can facilitate their interlinking or multimodality.

ITS vary in the technologies they apply, from basic management systems such as car navigation, traffic signal control systems, container management systems, variable message signs, enforcement systems for monitoring applications (security CCTV systems), through to more advanced applications that integrate live data and incorporate feedback from other sources, such as parking guidance and information systems or weather information.

Scope and background

This position paper aims to define the applicability of the NEM technologies to the ITS sector and the technical challenges that should be targeted in the near future. On the one hand, the range of possible applications from the NEM sector should improve the information available to transport users and operators, to make them more aware of the implications of their use and operation of the transport system, and thus to support transport policy objectives. This information helps travellers make more informed decisions about how, when, where and whether to travel. In this case, the ubiquitous and immersive use of audiovisual information and the provision of reliable ITS information is key to satisfy the needs and expectations of travellers.

On the other hand, road traffic congestion and road fatalities have been identified as major challenges that Europe's transport system needs to overcome. Conventional approaches such as the development of new infrastructure have not provided the necessary results to meet the scale of these challenges. Innovative solutions are therefore clearly needed.

NEM technologies can contribute to the implementation of ITS based solutions, as they will gradually provide a range of new services to citizens and also allow improved real-time management of traffic movements. Additionally, there will be obvious benefits for transport operators and clients, since the new systems will provide public administration with rapid and detailed information on infrastructure and maintenance needs. Furthermore, NEM technologies will provide new and more comfortable services to passengers, and increase safety and security.

Strategic importance

One of the main pillars of the European Transport Policy is to stimulate technological innovation in order to address transport problems. In September 2001, the "European transport for 2010: time to decide" White Paper, recognising the growing importance of transport in modern economies, identified several policy objectives aiming to achieve better efficiency in transport systems by the application of ICT. The main policy objectives arising from the identified challenges for transport and travel are for transport to become cleaner, more efficient and safer.

Innovative solutions are clearly needed and it is time for ITS to play their role. For example, intermodality is crucial to develop competitive alternatives to road transport. Although there have been several achievements in freight transport, a greater effort is required to ensure fuller integration of the modes, and here ITS could have a considerable impact. The same applies to multimodal passenger journeys, where ITS needs to help overcome issues like the lack of information (or sometimes the overload of information), complexity of booking and payment, and lack of reliability of connections between transport modes and operators. Existing applications have clearly demonstrated the need for reliable, real-time, ubiquitous availability of information for travellers and transport operators to efficiently exploit the services and the available infrastructures.

Furthermore, intelligent mobility solutions and transport demand management based on smart charging will alleviate congestion. In the future, there is no reason why ships, trains and cars should not have as sophisticated communication and navigation systems as aircraft. New technologies will improve real-time management of traffic movements and capacity use.

Current applications and challenges related to NEM technologies

This section presents a first draft of a possible matching between the technologies defined in the SRA of the NEM platform and some of the current applications and challenges in the transport sector.

Media-related applications and business models

- Social networking and media sharing

Social networking encourages people to collaborate in media sharing, commenting, content mining and new content creation. The user paradigm is evolving from the traditional consumer model towards a much more proactive role (the *prosumer* model). Social media is helping users to interact with the real world, from figuring out the best route to get from point A to point B, to helping people avoid speeding tickets.

There are many social media tools that enable and apply social solutions in order to improve transport efficiency. Innovative initiatives such as *RideSharing, CarSharing, CarPooling Bycicle Rentals, Space availability at parkings lots or on-road Parking Spaces ,* are based on user interaction to dynamically cover daily or occasional transportation needs by private car sharing and therefore, increasing travel efficiency. Moreover, an increasing number of departments of transport are using popular web-based social networking sites to enhance traveller information. Further, many public transport agencies have provided Google with data that allows Google users to obtain public transport itineraries via Google Transit.

Enhancing traveller information using hosted social networking is another innovative application. Transport operators own infrastructures that provide accurate and reliable information, although they are often very costly. Also, they are far from ubiquitous and generally have a limited geographic coverage. Furthermore, they tend to offer paid services, preventing wide public acceptance and use. On the other hand, the social networking approach solves the market penetration problem and enhances wider adoption of information services. They lower the costs of the services by combining data obtained from proprietary infrastructure with the vast amount of information voluntarily shared among users, even though this may be less reliable and accurate. However, combining the two approaches together, i.e. supplementing fixed infrastructure data with content from social networks would allow validation of the free content against reliable proprietary data.

However, progress towards the introduction of Web 2.0 applications in the transport sector is less advanced that in the private sector. It is commonly accepted that social media has the capacity to become a powerful marketing channel, Several airlines (Southwest, JetBlue, Delta, Qantas and Virgin) are already using social media sites such as Twitter, Facebook or YouTube to get the online community involved, motivate them to travel and to get them spreading the word of what airline they should be travelling.

- User satisfaction and quality of experience

The value perceived by the user is a critical parameter for most of the passenger transport carriers. One clear example is the growing concern about personal security, which is becoming a big impediment to public transport use, especially to women and the elderly. In this case, ITS technologies do not eliminate the need for security personnel, but can make them much more efficient and effective.

Additionally, on-board infotainment systems and services involving broadband access and video/TV content delivery to mobile devices can substantially improve the added value and the QoE perceived by public transport users. Therefore, it is vital to evaluate the value of the services from the point of view of the users.

Content creation

- New forms of content

Common and harmonised driver training and assessment procedures should be implemented across Europe through the use of multimedia tools. This would lead to novice drivers being involved in fewer accidents and also to more experienced drivers being identified and recognised for their skills.. Social benefits can be expected from the potential application of serious games applications for education and training, such as the ongoing eco-driving experiments to provide eco-route guidance and improve drivers' behaviour by means of probe traffic data and IT-based monitoring systems, which are expected to significantly improve travel time and fuel consumption.

- Tools for content creation and manipulation

Travel and traffic information systems are evolving rapidly due to several factors: new sensors can provide even more accurate information about an increasing number of events, creating needs for new tools to analyze the consequences of what is happening on the road and in public transport.

ITS based operation and control centres are being progressively implemented in major corridors and urban areas, and interconnections between them are being developed. The development of on-board and nomadic devices in vehicles and in the pockets of pedestrians opens opportunities to create new services: intermodal comparisons, navigation to the “last mile”. In this context, there will be a clear need for advanced information processing and analysis tools in order to support integrated mobility management systems, especially in relation to the traffic infrastructure and control centres.

Networking and delivery infrastructure

- Network architecture

Vehicle-to-Infrastructure (V2I) and Vehicle-to-Vehicle (V2V) mobile communications have driven ITS development for a significant period of time. There are many examples of successful ITS technologies that have been proved in practice in cell phones, broadcasting, GPS, DSRC and now further technical innovation and expansion is strongly expected, such as Wi-Fi, 802.11p and next generation cell phones systems. Several leading edge technological deployments for the connected vehicle and connected traveller are now penetrating the ITS market, expanding financial opportunities, creating new jobs, and addressing transport complexities and issues in society through new paradigms of “intelli-drive” and “intelli-travel”.

Moreover, cooperative V2V and V2I safety support systems can inform drivers about dangerous situations in order to avoid collisions. Drivers will be well informed about the prevailing conditions ahead. These technologies will be useful not only in urban areas, but also in rural areas with applications like hazard warning, slippery road warning based on floating car data, emergency call, and systems to improve safety for pedestrians and other unprotected road users. Therefore, standards and architectures for V2V and V2I communication are an important element for the evolution of new transport systems providing safety and mobility services.

Next generation WLAN and cellular based V2V and V2I communication systems are expected to also enable other key ITS services such as traffic management; electronic tolling; or on-board infotainment with different impacts on the requirements of the infrastructure and underlying technologies.

Content search and media presentation

- Automatic semantic annotation

Integrated and real-time door-to-door information systems are a key tool in developing workable and attractive long-distance and European passenger intermodality. Well promoted, accessible real-time information is necessary to smoothly plan for, and negotiate transfers. For the key issue of fusion of heterogeneous databases, more advanced metadata are emerging, which make it easier and cheaper to combine data sources. Several attempts to develop transportation ontologies have been made worldwide. The use of available ontology data models can guide the design of new transportation data models to maximize the potential of transportation ontology.

- User-system interaction

Over the last decade, Passenger Information Systems (PIS) have evolved from standalone simple audiovisual displays to multimodal integrated systems that keep passengers informed and entertained during their journey in public transit systems (metro trains, commuters, station platforms, busses or bus shelters). Current information systems include multiple technologies, for example advanced visual displays, public address systems, emergency intercom, IP networks, wireless networks or video streaming. These systems deliver real time information seamlessly in vehicles, directly to personal mobile devices and in stations while being controlled and managed from a single control centre.

On the other hand, the use of interaction technologies such as speech and gesture recognition when driving or travelling is important in order to combine driving and service access without reducing safety, as well as making mobility agile and comfortable.

- Effective recommendation systems

Transportation management involves solving diverse decision making problems, which are basically related to the appropriate route and carrier selection. Such issues mainly arise due to the variety of the preferences of the customer (e.g. cost limitations, loading preferences, delivery dates) and the service resources of the carrier (e.g. transportation media, available itineraries, capacity). The matching between the above preferences and offered services cannot be easily handled manually, as in most cases, there are a lot of alternative options, while time and money limitations are ubiquitous. The customer should be assisted in order to properly evaluate the proposed alternatives and make his/her final decision. Effective recommendations will be based on specially developed algorithms for retrieving optimal and sub-optimal solutions.

Technology drivers and enabling technologies

- Security, privacy and trust

The widespread deployment of in-vehicle telematics and applications will imply the storage and exchange of a huge amount of personal data. It is important that these services ensure an adequate compliance to the privacy regulations, and include security mechanisms that the misuse of this data from external unauthorised parties. Otherwise, users may lose trust in these services, which may lead to a lack of demand. Adequate privacy enhancement technologies and security mechanisms at the design phase may solve these issues. There is an urgent need to design secure ITS, respecting privacy and data protection regulation.

- Contextual awareness

The implementation of information technologies with ubiquitous networks, using a wide range of sensors, mobile and nomadic devices, can enhance multimedia services offered to the transport systems users. A primary benefit from the user perspective is that interconnected services for public transportation minimise delays for transit after the information is provided to users. Several innovative technologies should be analysed, such as location tracking of users and transportation modes, real time traffic management, and geographic information required to develop user-based services on demand for public transport users.

Already existing examples include air travel, where in-flight entertainment systems are commonly installed on the long-haul aircraft to improve the satisfaction of the passenger. Moreover, real-time mobility and traffic information can benefit from context-aware services

like real time updatable Local Dynamic Maps. This technology is based on the integration of standard digital maps with dynamic and local information collected by the infrastructure or by the vehicles.

However, current available systems are not context-aware, so the entertainment services do not necessarily improve the comfort level of the passenger. New approaches are being developed to provide personalized services based on his/her personal demographic information, activity and even physical and psychological state.

- Charging and paying

It is agreed that e-ticketing is a crucial component for improving transport, enabling multimodality and gaining a better knowledge of the customer. However, passenger information is also a major factor, so local government and transport operators should coordinate their approaches regarding ticketing and passenger information. This management implies a common approach between different actors: integrators, hardware providers, application suppliers (Internet, NFC), telco operators.

Actors in the transport industry can generate new revenue streams and increased traveller satisfaction by strategic deployment of NFC (Near Field Communications) enabled mobile phones. Therefore, there could be an interesting convergence between the telecom and the transportation information, payment and advertisement markets.

On the other hand, electronic tolling systems are expected to expand throughout Europe and to conform to a common standard at EU level. Motorway operators will need electronic tolling systems that are easily operated by both the users and the concessionaires, in combination with adding value.

Conclusions

The main contributions and challenges that should be targeted by the NEM Initiative related to the ITS sector can be summarized as follows:

- Technology, systems and services that contribute to safety, security, on-board entertainment, traffic management or efficient passenger transport to fulfil the ITS requirements.
- Interoperability of content and services is essential to provide ITS services at European level. Therefore, information exchange standards should be developed and implemented among public authorities, transport operators and ITS providers.
- The NEM Initiative should foster regulation policies and standards for Vehicle-to-Infrastructure and Vehicle-to-Vehicle communications as a key element to provide safety and mobility services.
- Codes of Practice for the design of secure ITS covering privacy and data protection should be developed in order to ensure and adequate compliance to the privacy regulations.
- Leading edge technological deployments of connected vehicles and travellers are expected to expand business opportunities for the NEM sector through new paradigms such as “intelli-drive” or “intelli-travel”.

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