ITS Radar Helpdesk Query: The Future of ITS

Query no:	017	Query initiator:	James Hardy
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Query topic areas:	How ITS will develop in the future		

Categories and level of relevance:	Safety	Very Relevant
	Pilots	Very Relevant
	Traffic Management Technology	Very Relevant
	Standards and Policy	Very Relevant
	Monitoring	Very Relevant
	Technology Solutions	Very Relevant

Transferability to Highways Agency:	Meets Policy Objectives	Yes
	Cost/Benefits Information	None
	Development status	Variable, covers pilots through to untested technologies
	Innovative	Yes
	Applicability to UK legal issues	Yes

Summary:

The HA are currently deploying ITS tools to improve network management, enhance safety and inform travellers. Having a picture of current and future network conditions and how they change over time is going to be increasingly important in informing and controlling users, managing infrastructure and planning for the future. Users are going to becoming increasingly demanding of information and high levels of service at a times of pressure on the network.

It is our view, therefore, that research efforts should be focussed, from an ITS perspective, on better understanding and predicting the performance of the network, better understanding the users of the network and their behaviour, and better understanding how to effectively communicate with, inform, influence, manage and control them.

Key areas for future research should include:

- Supporting and developing existing ITS systems for making better use of road space & manage demand;
- Planning new systems that improve the HA's ability to inform travellers;
- Making better use of available data including that from the Private Sector;
- Making sure information disseminated from all sources including the Private Sector is accurate and complete;
- Planning for and assessing the impact of network wide road user charging;
- Planning for and assessing the impact of greater use of in-vehicle systems.

This note is, by intention, a brief overview of the current state of ITS and a short summary of the near, medium and long term outlook. Each of these aspects warrants a more in-depth study which could be produced on request following feedback.

Introduction

What is this report for?

This report provides the Highways Agency with an overview of the broad "state of the art" of Intelligent Transport Systems/Services (ITS) and how we envisage ITS developing in the future. Specific observations and recommendations are made, related to how ITS research can help address current and future issues related to managing costs, congestion and safety.

What are ITS?

Intelligent Transport Systems/Services have been defined as, "A broad range of diverse technologies, which holds the answer to many of transportation problems. ITS is comprised of a number of technologies, including information processing, communications, control, and electronics. Joining these technologies to our transportation system will save lives, save time, and save money." (ITS America)

ITS are, by their very nature varied, ranging from wide area road network management tools, to delivery of in-vehicle driver information, to development of safety schemes. At the root of all ITS activity is the collection and processing of data to provide information on which to make decisions.

In the context of the Highways Agency and its core business objectives, a typical ITS system/service will consist of the following core elements:

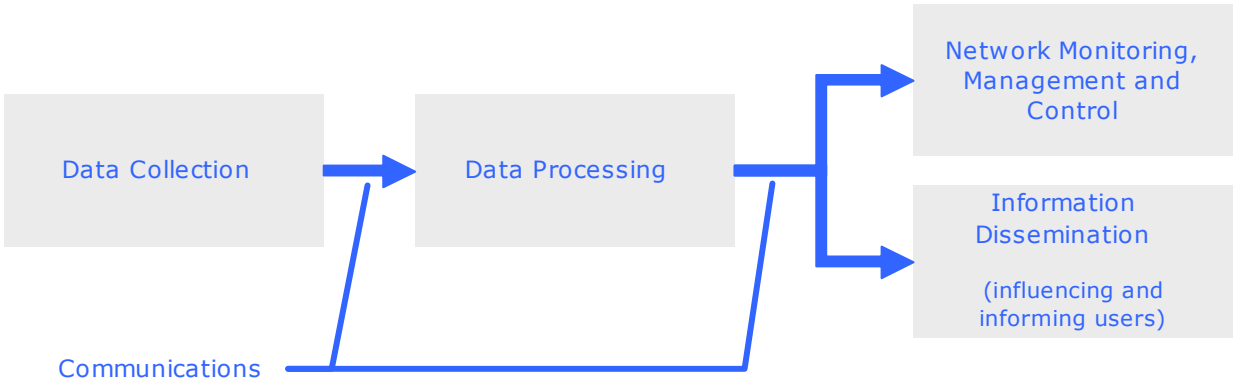

Figure 1 – Typical ITS system or service approach

Structure of this document

The remainder of this document is structured as follows:

- The 'State of the art' section briefly outlines current technology and practice in the field using a broad range of contemporary examples of ITS deployment.
- The 'Near future' section deals with the developments we anticipate over the next 5 years.
- The 'Medium term' section is concerned with tools and technologies whose cost effectiveness and/or practicality are not yet proven, and at present are in an early stage of research and development. This section covers developments between 5 and 15 years into the future.
- The 'Long term developments' section covers the time between 15 and 30 years into the future. As such it is more speculative than the other sections.

In each of the above sections we highlight where ITS research can bring benefits to the HA.

We then look at the implications of the above scenarios on other HA activities that would not necessarily be associated directly with ITS.

Finally conclusions and recommendations are presented.

The State of the art

Typical ITS tools consist of underlying data collection and processing technologies as well as dissemination channels. They can also be used to monitor (and enforce) traffic regulations.

Data Collection

Key data collection technologies in use in ITS tools include:

- Data collection in-pavement/at the roadside; and
- Vehicle based data collection.

In-pavement/roadside data collection methods include: Inductive loops; Microwave & Infra-Red detection; and CCTV image processing including Automatic Number Plate Recognition (ANPR) technologies. These existing technologies are now generally quite reliable, but do require ongoing maintenance to ensure robust operation. In-pavement data collection infrastructure covers much of the core HA network, usually with inductive loops, but coverage is sparse on the All-purpose Trunk Road Network and lighter used sections of the Motorway network. Alternative sensor technologies to inductive loops are often used to reduce installation, running and maintenance costs, depending on the situation and type of data required.

At present in vehicle based data collection, referred to as 'probe vehicle' data, is generally promoted by the Private Sector, although the Government does procure this data for historical analysis.

Communications

ITS tools make heavy use of communications infrastructure to get data back from the roadside or vehicles to a central point and then to disseminate this information to users. Key existing technologies used by the HA include: copper cable (low capacity), fibre optic cabling (higher capacity) and limited use of existing wireless technologies. Highway authorities in the UK and overseas are increasingly using wireless communications, often based on the WiFi technology used by PCs and laptops. This technology can transmit data from a number of sensors a short distance back to a convenient node to reduce the need for laying roadside cables.

Data Processing

The HA takes data from roadside sources and elsewhere and processes it to inform the National Traffic Control Centre and Regional Traffic Control Centres, in particular, about current and likely future road network conditions. Data are also used and stored for many other reasons, including historical data analysis. Some of these systems are automatic, collecting data, processing it and disseminating information or instruction directly to motorists (such as traffic signals and some motorway signal information).

Dissemination Tools

Dissemination Tools are the visible part of ITS and are used to provide a wide variety of services to the user, often tailored to meet the specific users needs. Some examples of the current state of the art include:

Motorway Signals

Dynamic information is delivered to motorists on some of the Motorway network (and small parts of the all-purpose road network) using Variable Message Signs and Signals.

The HA makes extensive use of text based Variable Message Signs. Recently it has introduced the MS4 a pictogram based sign for tactical incident management. Elsewhere in Europe, there is a general migration to greater use of pictogram based variable signs for both tactical and strategic network management[7]. Pictogram information can be absorbed faster that textual information by drivers and when correctly designed, are understood by a higher proportion of motorists. It should be noted that signs currently specified by the HA are very robust and therefore expensive, because they were designed as safety critical systems. The primary function of VMS has been for safety and network management, hence the need for safety critical signs. They were not designed intentionally for the new role of the HA to provide more information to travellers. The HA have recently started trials to include relatively long distance journey time information on VMS. In Europe in particular, predicted journey times for shorter links are displayed on VMS and often used at roadworks to display delays in real time.

In Car Navigation and Traffic Information

In car navigation systems can be overlaid with live traffic information. In the UK the traffic information services are supplied exclusively by the private sector. Elsewhere in Europe this is often provided by the public sector. The HA has previously undertaken research in this area to 'kickstart' the private sector such as the RDS-TMC project. RDS-TMC transmits traffic information via an FM radio signal which can be used by TMC enabled in car radios and to allow TMC enabled satellite navigation systems to route users around incidents.

Pre-Trip Information

At present, there are a limited number of channels that can be used to disseminate information to a road user once they are driving, and these are often limited by the depth of information that can be provided. Pre-trip information from sources such as web sites and information telephone services enable users to plan their routes and be made aware of events that may affect them, before they set off. The HA provides information via the Traffic England and Traffic Map websites. Journey planning tools providing predicted travel times for journeys are being developed, but are only as good as the information available to the prediction algorithm.

Other Initiatives

The HA is currently rolling out a series of ITS tools to help make better use of existing roadspace including:

- Active Traffic Management;
- High Occupancy Vehicle Lanes;
- Ramp Metering;
- Intelligent Road Studs; and associated enforcement.

Coupled with these are developments to link the HA more closely with Local Highway Authorities. Developments include using area travel plans and linking Local Urban Traffic

Management and Control systems (UTMC) with HA systems. Research is required to monitor these systems' impact and effectiveness and reduce their costs of implementation, management and maintenance.

Germany has recently introduced a Lorry Road User Charging system using on-board units that collect data on the position and distance vehicles have travelled. At key locations, infrared beacons are mounted at the roadside and activate a charging mechanism when a vehicle passes the beacon. Where vehicles are not correctly identified by the infrared beacon, automatic number plate recognition software is used as secondary means of vehicle identification and enforcement.

This, along with general charging for road use, as a means to mitigate demand for limited road space will be increasingly important for the Highways Agency in the near future.

The Near Future 2006-2011

Key developments that could be transferred/exploited immediately by the HA:

Roadside detectors

Traditionally, the HA has used inductive loop traffic detectors located within the road surface to monitor traffic conditions. Detectors for monitoring traffic from above the surface are widely available, reliable and do not require closure of carriageway to install or maintain. While the core element of the HA network is relatively well instrumented, the rural network is much less well covered. The HA Detector Technology Steering Group is considering issues such as the use of alternative sensor types. Differing types of non-intrusive detector can offer many advantages, dependent on the type of data and level of accuracy required.

Consideration is also to be given to procuring real-time private sector data where this could complement existing HA data sources in a cost effective way. The HA and Qinetiq have also been undertaking research into Fibre Optic detection systems.

Vehicle based data collection

As noted previously the private sector is now collecting significant volumes of 'floating vehicle data'. Consideration is being given to whether this could cost effectively enhance the HA's existing data sources. The Private Sector also has a significant customer base with in-vehicle information systems. The HA should consider how best to work with the Private Sector to distribute high quality traffic information to these in-vehicle systems.

In the future, any National road user charging system may provide an opportunity to obtain very high quality traffic data of certain types from a 100% sample of vehicles.

There are currently several trials of 'Pay as You Drive' insurance schemes. These systems use a range of technologies depending on their complexity, but they usually rely on GPS for positioning. As the requirements are similar, it is likely that at lease some of the developments with 'Pay as You Drive' insurance will happen in tandem with a national road charging scheme.

Communications

The HA is making a large investment in a new roadside telecommunications system (NRTS) this will use digital transmission of data over a fibre optic network. The extra capacity this will deliver will enable the HA to transmit much more data of different types around the

complete motorway network. Research into how to maximise the benefit of this increased flexibility will be crucial in the near future.

Development of wireless communications continues apace. The HA should consider the merits of these developments of wireless networks derived from PC and laptop WiFi technologies such as MESH. These are useful in urban areas and sites that require a high density of sensors and dissemination devices but where cabling is difficult. These wireless networks can provide a low-cost link back to local communications node a short distance away, such as NRTS connection. If sensors and dynamic signs are not located near a convenient hard-wired communication point, other technologies such as mobile phone based 3G/GPRS communications can be used for telemetry to provide data to and from these 'remote' locations.

Data Processing and Dissemination

To enhance network management, the HA needs to better predict the impact of roadworks and incidents on its network and advise relevant parties about these impacts.

Real time modelling (especially micro-simulation) and predictive tools for assessing the impact of roadworks and incidents in real time are used elsewhere for managing traffic, but in few areas within the HA. Such tools would help inform the HA of when and how to best timetable roadworks and what the likely impact of incidents will be on network performance.

The public has an ever increasing demand for accurate information. This is likely to increase further, and as such the HA needs to consider how accurate information is best disseminated. Mechanisms in use more extensively elsewhere but not so much in England include:

- Highway Advisory Radio (the HA is currently trialling a very localised radio station);
- SMS advice on delays on regular user routes (some trials for delays at roadworks have taken place);
- Providing network performance information on VMS even when network performance is not degraded (as per the current HA Travel Times project);
- Information kiosks & journey time information (the HA is currently trialling information points);
- Providing information via the increasing number of 'smart' mobile phones and other mobile devices; and
- Route specific journey time information.

Elsewhere, specific types of information may be more targeted to specific network users e.g. the freight industry.

The Medium Term 2011-2021

In the next 15 years we believe there will be significant developments in technology available and the legal/institutional framework under which we work. Both the technologies being developed and the legal/institutional framework development are driven by Governmental Policy.

Key Issues

Key issues for the HA that are likely to be hot topics in this timeframe include:

- Measures to address further road traffic congestion including measures to reduce demand;
- Climate change;

- Changing demographics & population distribution;
- Bigger, heavier freight vehicles; and
- Requirements for enhanced road safety.

There have been many road network operator visions covering this period, including the Roads to the Future in the Netherlands project (discussed in the PIARC handbook[5]), which identifies the core values in this period of: safety, sustainability and accessibility.

Our best assessment of the likely situation in the period 2011-2021 is that actions will be taken to combat climate change and manage traffic congestion, which, coupled with a change in demographics, will alter the pattern of road usage significantly. Key changes we anticipate are:

Legal/Institutional Issues

- Nationwide (or at least HA network) road user charging (variable by time of day) will probably be implemented in this timeframe – the intention of road user charging is to change the pattern of road users and is likely to have a radical impact on the demand on HA network at different periods of the day;
- User expectations of network availability and level of service to be provided will increase if they are charged directly for use of the network;
- The HA will need to communicate very effectively with its customers;
- The type and mix of vehicles may alter, with the more price in-elastic customers remaining on the network e.g. business travellers.

Technology Advances

It is likely that there will be key advances in development of systems within users' vehicles in this time period, including:

- Intelligent Speed Adaption;
- Greater use of driver assistance systems including lane departure warning systems;
- eCall; and
- vehicle to vehicle and vehicle to roadside communications.

Long term developments 2021-2036

The HA 2030 vision project looked at a series of socio-economic scenarios and transport visions to meet the requirements of these scenarios. Several other visions cover this timeframe including the Foresight vehicle Intelligent Infrastructures initiative[2].

Within this time period, there is inevitably a great deal of uncertainty. The HA 2030 vision outlined many possible outcomes in this period in terms of infrastructure and vehicle design changes.

Possible developments include:

- Co-operative or Automated Highway Systems;
- New and innovative vehicle fuel systems;
- Much greater use of vehicle to vehicle communications.

Crosscutting Developments

Key ITS developments such as Road User Charging and increased use of communications technology are likely to provide much more information to the Highways Agency. This will enable and require better planning of network maintenance and better and more intelligent use of available road space.

However, increasing use of ITS, including sensors, communications networks and VMS will require more funds to be allocated to maintenance to keep the systems running. As the information that ITS produces is only as good as the input, a higher priority will have to be placed on keeping sensors and detectors functional.

Conclusions

Fundamentally, information is going to be increasingly important to the HA and their customers. Having a current picture of network conditions and traffic on it is going to be vital in informing and controlling users, managing infrastructure and planning for the future. Users are going to becoming increasing demanding of information and high levels of service, at a time, when pressure on limited road space is increasing.

It is our view, therefore, that research efforts should be focussed, from an ITS perspective, on better understanding and predicting the performance of the network, better understanding the users of the network and their behaviour, and better understanding how to effectively communicate with, inform, influence, manage and control them.

We think key areas for future research should include:

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Further Information from ITS Radar

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