

# ITS Radar International

ITS Radar International Ad Hoc Report:  
ITS World Congress, New York - 17th to 20th November 2008

January 2009

# CLIENT PROJECT REPORT

TRL Limited



## CLIENT PROJECT REPORT 273

### ITS RADAR INTERNATIONAL AD HOC REPORT: ITS WORLD CONGRESS, NEW YORK - 17TH TO 20TH NOVEMBER 2008

Version: 3

by Steve Tarry (Faber Maunsell), Jean Hopkin (TRL Limited), David McGuigan (Faber Maunsell) and Monika Pawlak (Faber Maunsell)

**Prepared for:** Project Task Reference 429(387) HTRL  
**Client:** Network Services Highways Agency  
(Graham Seaton)

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Project Manager	Jean Hopkin	28 January 2009
Technical Referee	Peter Vermaat	29 January 2009



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## ITS Radar International Ad Hoc Report: ITS World Congress

### New York (17<sup>th</sup> - 20<sup>th</sup> November 2008)

Date:	27 January 2009	Report initiator	Steve Tarry
Version:	Draft	Compiled by:	Steve Tarry
Report area:	Relevance of projects presented to the Highways Agency at the ITS World Congress.		
Summary:	<p>This document summarises 64 papers relevant to the Highways Agency that were presented at the 15<sup>th</sup> World Congress and Exhibition on Intelligent Transportation Systems and Services held in New York.</p> <p>The 15th World Congress and Exhibition on Intelligent Transportation Systems and Services presented work on the latest developments, policies and practices in the ITS industry from all over the world. Vehicle-to-vehicle and vehicle-to-roadside communication technologies and applications were particularly highlighted. Live demonstrations showcased new ITS technologies for management of transport networks and enhancing and expanding mobility options.</p> <p>Key themes included managing the environmental impacts of transport and the role of ITS in reducing transport related green house gas emissions. Infrastructure and Traffic management was the dominant application area. Vehicle systems and electronics, particularly wireless communications, were also covered extensively, with a focus on Vehicle-Infrastructure Integration (VII) developments over the 3 years since the last world congress was held in the US.</p>		
Instructions:	<p>The Papers Index is a table of papers from the congress that were of relevance to the Highways Agency. The table contains the paper title, a short description and a categorisation against key types of ITS. In the left column is the paper reference. This links to the paper's abstract - press the 'Ctrl' key and left click the mouse on the reference to move to the abstract later in the document.</p> <p>The Paper Extracts section contains full referential details of the papers listed in the index, along with their abstracts.</p> <p>To obtain papers from the ITS World Congress, HA staff should contact Chris McManus or Steve Crosthwaite.</p>		

**Papers Index:**

**ITS Radar Ad-hoc Report: 15<sup>th</sup> World Congress and Exhibition on ITS, New York - Papers of Particular Relevance to the HA**

Reference	Paper Title	Subject	Relevance to the HA	County of Origin																		
					Traffic Control Centres	Traffic Management Technology	Pilots	Driver Behaviour	Tolling	Modelling	Traffic and Travel Information	Freight and Fleet Management	Technology Solutions	Enforcement	Standards and Policy	Monitoring	Safety	GPS/Satellites	European Developments	Driver Information	Environmental Issues	
TS07-20097	Optical Remote Road Surface State and Temperature Sensors: Survey of Functionality and Usability	Remote weather monitoring	Testing new optical remote road surface state and temperature sensors on main roads	Finland			✓							✓			✓	✓				✓
TS34-20273	Development of an Algorithm for Using Weather-Dependent Dynamic Speed Limits to Enhance Safety	Variable speed limits	The development of an algorithm that determines speed limits relevant to weather conditions - expected to be operational at the beginning of 2009	Netherlands		✓	✓										✓	✓				✓
TS59-20299	Traffic Management and ITS for Weather Problems	Weather alerts	Traffic management used associated with weather problems, strategies for integrating weather and traffic information, and coordination between authorities	Spain	✓	✓					✓		✓				✓	✓	✓			✓
TS110-30119	Phase I of Smart Park – Real Time Information on Truck Parking	Lorry parking	Demonstrating how information on parking availability can be disseminated and used in real time to divert truckers to parking areas that have space	Germany	✓		✓					✓	✓			✓	✓		✓		✓	
IS02-10123	A Far Infrared Vehicle Sensor for a Traffic Signal Control	Vehicle sensing	A far infrared vehicle sensing system that detects vehicles based on temperature differences	Japan			✓				✓						✓					
IS01-10193	Millimeter-Wave Radio Sensor for Pedestrian Detection	Pedestrian and vehicle detection	Development of a millimetric radio radar to detect obstacles on railroad crossings and a sensor to detect pedestrians crossing roads	Japan			✓						✓				✓	✓				

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SC05-20156	The Use of Smart Wireless Sensors for ITS Applications and Services	Smart-dust applications	This paper outlines experience in smartdust devices (a processing unit, some memory, and a radio chip) and illustrates the role that smartdust technology can play in future ITS	UK									✓			✓						
20160	Millbrook – An Example of Joined up Control and Modelling	Micro-simulation	Linking of a micro-simulation model to a junction controller emulator has allowed control strategies to be optimised at faster than real time operation and novel ideas and solutions to be assessed at the desk	UK	✓	✓	✓			✓			✓									
TS91-20203	Image Recognition and Incident Detection - A Progress Report	Image processing	Evaluation of 'smart camera' deployment and suitability of such systems in a dense urban environment. Investigating topics such as Digital video compatibility	UK			✓		✓					✓	✓	✓						
IS01-20215	The Mare Nostrum VMS Group: Enlarging the Long Distance Corridor	VMS harmonisation	Development of recommendations for VMS usage, based on the application of "working book" guidelines developed in the Mare Nostrum project	Europe-wide		✓					✓				✓			✓	✓			
IS03-20240	Compliance Strategy: Enforcement and the Provision of Accurate and Relevant Information	Compliance	The relationship between technology, compliance and the type and amount of information provided to motorists is considered through an example compliance strategy for an ITS scheme	UK				✓						✓	✓		✓					
IS03-20266	Highways Technology - Providing Management and Capacity	Managed networks	This paper discusses a series of operational regimes and interventions that could be deployed on existing highways to increase capacity and reduce congestion	UK		✓					✓		✓		✓							
TS92-20305	Traffic Control through Smart Sensors Cooperation	Traffic monitoring	Review of existing sensing technologies, providing them with knowledge sharing capabilities to improve the quality of information whilst minimising additional investment	Spain		✓							✓			✓						

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TS19-20306	Towards the Concept of Smart Infrastructure	VII technologies	Review of Vehicle-Infrastructure Integration (VII) technologies and smart infrastructure. Also, research in progress on combining smart infrastructure with goods movements in order to further improve the efficiency of transport networks	Sweden		✓							✓		✓							
IS02-20318	Operational Benefits of Advanced Detector Technology	Vehicle monitoring	Reviews some of the ways in which new and existing detector technology can be used to assist the operators by presenting data in a format that allows informed decisions to be made quickly and efficiently	UK	✓	✓							✓		✓	✓						
IS03-20338	Improving Incident Detection for Regional Control Centre Operator Support	Incident detection / alerts	Presents an approach to improve incident detection, by combining different data sources and historic data to determine relevance of incidents to operators	UK	✓	✓	✓									✓	✓					
TS58-20368	The Future of Automated Enforcement in the United States and Europe – Compare and Contrast	Automated enforcement	Comparison of automated enforcement in Europe and the United States. It looks at both the similarities and differences in deployment and operation and lessons that can be learnt / challenges for the future	UK / USA									✓	✓		✓	✓					
TS123-20382	Use of Simulation-Based Forecast for Real Time Traffic Management Decision Support: The Madrid Case	Simulation modelling	Describes the use of simulation-based forecasting for real time traffic management decision support in Madrid	Spain	✓					✓												
IS02-20459	Self-Organising Traffic Control for Congestion Avoidance and Traffic Flow Improvement	Use of probe vehicle data	Presents an approach for using probe vehicle data to control traffic flow by using a complex micro simulator capable of simulating real city networks	Austria	✓					✓						✓						

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IS02-20472	An Investigation on the Approaches and Methods Used for Variable Speed Limit Control	Variable Speed Limits	A critical review of different approaches and methods for VSL, an assessment of performance and suggestions for further improvements to the existing rule-based systems	Iran		✓		✓							✓							
TS122-30075	Reversible Managed Lanes Coupled with Time Managed Shoulder Lanes	Reversible and time managed lanes	Reversible Managed Lanes coupled with Time Managed Shoulder Lanes to create a flexible driving environment with increased capacity and reliability for motorists, HOV vehicles, and Bus Rapid Transit (BRT) vehicles	USA		✓			✓				✓		✓							
TS128-30105	Performance Envelope of Cellular-Based Technology for Incident Detection and Traffic Management	Traffic monitoring	Combining cellular-based probe vehicle data with information derived from road sensors (such as inductive loops) for cost-effective traffic monitoring	USA	✓								✓			✓						
IS03-30139	An Integrated Off-Ramp Control Model for Freeway Traffic Management	Ramp metering performance	A study of the benefits of a Cell Transmission Model to capture the traffic propagation on both freeway and surface streets, and the interactions between these, to improve performance of ramp metering	USA		✓				✓												
TS101-30196	Work Zone Traffic Management Systems in Nebraska	Work zone management	The system consists of several vehicle detection devices, speed sensors, CCTV cameras, portable dynamic message signs, and a communication system so that constant monitoring of the system is achievable from any device with a web-based connection	USA		✓										✓	✓					
IS04-30203	Analysis of Freeway Incident Duration for Advanced Traveller Information System (ATIS) Applications	Incident management	This paper presents a methodology for developing a model for estimating and predicting incident duration and identifying variables influencing the incident duration	USA	✓					✓						✓						

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TS100-30234	The First Full Scale Deployment of Active Traffic Management (ATM) System in the United States	Active Traffic Management	The I-80 ICM is the first full scale implementation of Active Traffic Management (ATM) in the United States for a very highly congested corridor	USA		✓	✓						✓		✓	✓						
30250	Rapidly Deployable Low Cost Traffic Data and Video Collection Device	Video-based traffic monitoring	In this paper, the development and demonstration of a low cost, practical, rapidly deployable video recording and data extraction device is presented along with the design, deployment, and data extraction process	USA			✓						✓			✓						
SC20-30260	Primary and Secondary Incidents: Management Strategies	Incident detection	The overall objective of the study is to understand the occurrence of primary and secondary incidents and relevant incident management strategies, as well as to understand how primary incident duration and secondary incident occurrence are related	USA	✓										✓	✓	✓					
IS03-30265	Empirical Evaluation of Adaptive Ramp Metering Along Two Freeway Corridors in Portland, Oregon	Ramp metering	This paper reports on the results of a “before” and “after” evaluation of the performance of two freeway corridors to measure the benefits of system wide adaptive ramp metering compared with pre-timed system operation	USA		✓	✓						✓		✓							
TS18-30294	Using Archived ITS Data to Automatically Identify Freeway Bottlenecks in Portland, Oregon	Operator support tools	This paper describes the development of an automated tool for identifying recurrent bottlenecks on freeways from historical data, which could be used to help prioritise freeway improvement works.	USA	✓		✓			✓						✓						
TS52-30304	Reforming Ramp Meter Queue Override	Ramp metering	A traditional queue override approach for ramp metering is introduced, with reasons why it does not perform effectively. A new type of queue override threshold value, based on the number of vehicles, is proposed with the benefits outlined	USA		✓	✓								✓							

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IS05-30344	A CORSIM Testbed for Ramp Metering Algorithms	Ramp metering	Presents an effort to develop a simulation test-bed for the evaluation of ramp metering algorithms	USA		✓	✓			✓					✓							
TS123-30417	Advanced Mathematical Models as Simulated Traffic Data Collectors	Traffic monitoring	Describes the use of a virtual traffic analysis sensor for integration into existing sensor infrastructure. The specific data collection monitor described is created by formulating mathematical models based on live traffic sensors	USA						✓			✓			✓						
IS01-30426	Video: the Ultimate Sensors	Video monitoring	Compares the potential the benefits of using digital video to improve performance, increase safety, assist traffic enforcement and criminal investigations, and reduce fuel consumption and travel times			✓							✓	✓	✓	✓	✓					
IS03-30428	Irris® Technology: A Data Integration, Analysis, and Visualisation Tool to Support ITS Operations	Data fusion for transport management	IRRIS is an innovative geo-spatial web portal that supports data integration and sharing, transportation operations, freight mobility, logistics, asset tracking, collaboration, transportation security, and incident management	USA	✓		✓				✓											
IS01-30453	Integrated Corridor Management	Integrated corridor management	Analyses the methodologies and technologies appropriate to corridor management applications and provides technical guidance for transportation agencies	USA		✓							✓		✓							
TS56-20051	An Integrated Approach to the Urban / Inter-Urban Interface	Urban / inter-urban traffic management	Provides background and context through a brief description of current inter-urban and urban traffic management systems in the UK with examples of operational data exchange across the urban/inter-urban interface	UK	✓										✓							

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IS01-20159	COOPERS Project: Development of an ITS Architecture for Co-Operative Systems on Motorways	System architecture	Explains the development of a high-level architecture for cooperative systems using the FRAME method and the European ITS Framework Architecture as part of the EU-funded R&D project COOPERS	Austria								✓	✓		✓		✓	✓	✓			
TS104-20268	Working Smarter – An Information Strategy for Real-Time Traffic Operations	Information strategy	Highlights a comprehensive system and data audit, an intelligence requirement capture exercise, and a network analysis methodology developed by TfL	UK											✓							
TS05-20329	New Framework for Evaluating Preventive Safety Functions: Focusing on Human Factors Evaluation	Human factors	PReVAL is a subproject of the PReVENT Integrated Project, in which different preventive safety applications have been developed and demonstrated. This paper discusses the human factors evaluation aspects of the framework in more detail					✓									✓	✓				
TS136-20437	The Norwegian Vision Zero Did it Work?	Traffic Safety	Presents the evaluation results of measures related to the roads, vehicles and different groups of transport users within Lillehammer with a focus on measures to avoid the most serious accidents or reduce their effects	Norway		✓							✓		✓		✓					
IS01-20355	The Use of Data Warehouses and Information Brokers in Crossborder ITS	Data fusion /warehousing	Discusses the use of third party information brokers/data warehouse operators for data collection and data fusion, and further distribution to end service providers	Sweden	✓						✓				✓							
TS76-20439	Evaluation of Pictorial Messages for Variable Message Signs to Enhance Comprehensibility	Driver information	Presents the results achieved from an iterative design and evaluation process by relating the cognitive and technical requirements of information to what is displayed on VMS and conventional road signs	Austria				✓			✓				✓							

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TS27-20441	Study of Traffic Performance and Safety Impacts of the Stockholm Motorway Control System (MCS)	Variable speed limits	Study of the impacts of variable speed limits (VSL) on individual traffic characteristics is reported on the basis of different statistical tests on data of before and after application of the VSL on E4 motorway in Stockholm	Sweden		✓							✓		✓							
TS76-30232	Development of a Dynamic Message Sign Specification for Caltrans	VMS	Describes current progress in development of a new dynamic message sign (DMS) specification for the California Department of Transportation (Caltrans)	USA		✓					✓		✓									
TS53-20190	Road Operators' Manual and MMT for ITS Applications	Control Room Operations	A manual and a Multimedia Training Tool (MMT) targeting the awareness creation and on-the-job training of Road and Traffic Management Centre (TMC) operators, providing operators with essential information on newly emerged applications or those which are under development	Greece	✓										✓			✓				
SC27-20478	The Workplace of Traffic Management Operators - What Changes do Experts Foresee until 2020?	Control Room Operations	This paper aims to understand the dynamics of the Traffic Management Centre operator workplace, with an expansion of the tools, tasks and traffic volumes the operator has to handle	Germany	✓										✓			✓				
IS03-10142	A Web-Based Traffic Information System Using Statistical Data	Traffic information	A new web-based traffic information system is presented that provides more traffic information by using statistical data, also providing an accurate route search function	China			✓				✓		✓									
IS03-10211	Development and Validation of Internet-Based Personalised Travel Assistance System for Mobility Management	Travel planning	For this study, the authors developed a Personalised Integrated Travel Assistance System, working with a Mobility Management programme, which is designed to reduce the number of cars used for commuting In the Nagoya Metropolitan Area	Japan			✓				✓		✓									

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TS85-10350	A Real-time Traffic Information System (RTIS) based on GPS Floating Vehicle Technology in Hangzhou	Floating Vehicle data	Introduces a Real-Time Traffic Information System (RTIS) based on Global Positioning System (GPS) floating vehicle technology in Hangzhou, China	China			✓				✓		✓									
IS04-20045	GPS vs. Wireless Probe-Based Systems for Real-Time Road Traffic Monitoring and Traveller Information	Traffic monitoring	This article compares the advantages and limitations of both GPS and wireless based traffic monitoring, methods based on field trials and simulations	Israel							✓		✓									
TS125-20436	Common Information Platform for Traffic Data Merging Data from Different Sources	Data warehousing	Mobile ICT solutions, telecommunication and next generation positioning techniques provide a considerable market for new and improved products and business opportunities. An important premise for realising this business opportunity is to establish a common database which provides required input data. This paper presents an initiative for achieving this	Norway							✓											
TS85-30146	Parallel Developments in Customer Information Demand and Intelligent Transportation Systems	Traffic information	This paper presents parallel developments in customer information demand and intelligent transportation systems, as Transit Agencies extend services delivered to include real-time information for customers	USA	✓						✓		✓		✓							
SC10-30180	Utilisation of Automated Number Plate Recognition (ANPR) for Travel Time Data Collection	Travel times	Travel times for the freeway systems in Houston, Texas are computed using information from automatic vehicle identification sensors which read Radio Frequency Identification (RFID) tags issued by the local tolling authority	USA					✓		✓		✓									

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SC28-30272	Managing Travel Time Data	Travel times	This paper explores the issues with managing travel time data and looks at information technology and statistical methods to address the key challenges in this area	USA	✓						✓					✓						
IS02-30301	Advanced Travel Information: Making Travel Faster, More Efficient, More Cost-Effective, Safer and More Environmentally Friendly	Data fusion	The goal of this paper is to illustrate how a consortium based approach to the collection and processing of traffic impact data, can improve both information and communications to private and commercial drivers as well as public agencies and yield a range of benefits	USA	✓						✓				✓	✓				✓		
TS125-30314	Analysis of Speed Data Derived from Cellular Probes	Floating vehicle data	The particular system evaluated, TrafficSense from Cellint, uses cellular signals to assess a phone's location and speed, with travel times or spot speeds displayed on a web-based map or delivered to a transportation agency	Norway	✓		✓				✓					✓						
TS84-20102	ITS and Driver Behaviour: Effects and Challenges	Driver behaviour	The present study asks if safety-related ITS are addressing the real threats to safety in road traffic. Critical issues are addressed and core problem statements are discussed.	Norway				✓					✓				✓	✓		✓		
TS93-20271	Evaluation of Intelligent Vehicle Safety Systems – A State-of-the-art Example	Vehicle safety systems	This paper presents both the traffic effects of selected Intelligent Vehicle Safety Systems and the safety parameters as they result from micro simulations	Germany				✓		✓			✓		✓		✓	✓	✓			
TS93-20402	Testing and Evaluation Methods for ICT-based Safety Systems	Vehicle safety systems	This paper presents objective testing and evaluation methods for active safety systems in modern vehicles developed within the recently started European research project eVALUE	Germany				✓									✓	✓	✓			

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TS39-20125	Cooperative Systems for Road Traffic Safety: Functionality Design and Implementation	Co-operative vehicle systems	The paper presents a preliminary results of the EU-funded project COOPERS (CO-Operative SystEms for Intelligent Road Safety). The paper introduces the business case for COOPERS and provides an overview of the architecture of the COOPERS system, and of the determination and implementation of ITS services	Netherlands		✓					✓		✓				✓	✓	✓			
TS50-20262	Cellular Communication Based Mechanism for Road Traffic Information Distribution	Traffic information	This paper presents an approach for Road Traffic Information distribution using cellular communication technologies in existing 3G networks	Germany							✓		✓									
TS50-20444	State of the Art Survey of Wireless Vehicular Communication Projects	CVHS Communications	This paper presents a state of the art review of projects that include wireless communication - vehicle-to-vehicle and vehicle-to-infrastructure	Sweden							✓		✓									
TS121-30375	Rural TMC-TMS Communications – An Evaluation of Alternatives	Communication technologies	In cooperation with the California Department of Transportation, Montana State University's Western Transportation Institute has conducted an evaluation of communication technologies for application to TMC-TMS (Traffic Management Centre to Traffic Management Site) communications	USA	✓								✓									

## **Papers Extracts:**

<b>Paper Reference</b>	<b>Extract</b>
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TS07-20097	Pilli-Sihvola, Y.; Kaakkois-Suomi (2008) <i>“Optical Remote Road Surface State and Temperature Sensors: Survey of Functionality and Usability”</i> , ITS World Congress
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In Finland, the weather conditions are the main cause for most of the traffic problems. The Finnish Road Administration (FINNRA) has used many ways to improve the safety of winter traffic. Nowadays the weather and road conditions are being recognised with the aid of Road Weather Information System (RWIS), road weather cameras and also with weather radars and satellite pictures. Special road weather forecasts are produced for the winter maintenance operators. FINNRA has tried for several decades to find an easy way to determine skid-resistance. During the winters 2004-2008 FINNRA tested new optical remote road surface state and temperature sensors on the main roads of Southern Finland.

TS34-20273	Jonkers, E.; Klunder, G.; Van der Horst, R.; De Rooy, R. (2008) <i>“Development Of An Algorithm For Using Weather-Dependent Dynamic Speed Limits To Enhance Safety”</i> , ITS World Congress
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This paper describes an ongoing research project in the Netherlands for lowering the speed limit, depending on the weather conditions (in particular rain) to enhance traffic safety. The research in this project consists of three main parts. In the first part, research has been conducted on the strategy of speed limits to be displayed: in what situations should the speed limit be lowered and how will these limits be shown to the drivers? Second, the usefulness and accuracy of a weather radar system for the prediction of showers on a motorway is verified. The last part is the development of an algorithm that determines the speed limits. The algorithm is expected to operate on the A12 motorway at the beginning of 2009.

TS59-20299	Rodríguez, M. A.; Fernández, F.; Belda, E., Esteve, S. A.; López, V. R. T. (2008) <i>“Traffic Management and ITS for Weather Problems”</i> , ITS World Congress
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The main purpose of this paper is to present a system that alerts traffic managers when there is a weather incident on the roads. Also, the paper shows the traffic management used associated with weather problems, the strategies for integrating both weather and traffic information, and the coordination between different national and international authorities.

TS110-30119	Kwan, Q. Y. (2008) <i>“Phase I of Smart Park – Real Time Information on Truck Parking”</i> , ITS World Congress
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The Federal Motor Carrier Safety Administration (FMCSA) is carrying out a two-phase project called SmartPark to demonstrate commercial technologies for conveying information about parking availability in real-time to truck drivers on the road 24 hours per day, seven days per week. During Phase I, two technologies (i.e., video imaging and magnetic sensor) will be field tested for their capability to collect data to determine whether a truck parking area is full. One of the two technologies will be continued for Phase II, which will be demonstrating how information on parking availability can be disseminated in real time and used in real time to divert truckers on the road from areas that are full to areas that have space.

- IS02-10123 Hayama, K.; Minakata T. (2008) *"A Far Infrared Vehicle Sensor for a Traffic Signal Control"*, ITS World Congress

This paper describes a far infrared vehicle sensing system that detects vehicles based on temperature differences. Consuming less electrical power, it can be powered by a solar cell battery. Also, it can detect vehicles from oblique directions, and therefore it can be mounted on a shorter mounting arm and is more aesthetically acceptable.

- IS01-10193 Imaizumi, S. *"Millimeter-Wave Radio Sensor for Pedestrian Detection"*, ITS World Congress

Fujitsu are trying to apply technology based on millimeter-wave radio radar, focusing on reducing the number of traffic accidents involving pedestrians. In this paper, the structure and characteristics of the sensor and ITS applications are presented. They have developed a pedestrian-detection sensor by improving the isolation capability of the radar. As future applications for this sensor, they describe a next-generation system to detect obstacles on railroad crossings and a sensor to detect pedestrians crossing roads. Both systems will contribute to the safety of operating trains, driving vehicles and for pedestrians.

- SC05-20156 Blythe, P.; Arief, B.; Bryan H.; Fairchild R.; Selvarajah K.; Tully A (2008) *"The Use of Smart Wireless Sensors for ITS Applications and Services"*, ITS World Congress

The last few years have seen the emergence of many new technologies that can potentially have major impacts on Intelligent Transportation Systems (ITS). One of these technologies is a micro-electromechanical device called smartdust. A smartdust device (or a mote) is typically composed of a processing unit, some memory, and a radio chip, which allows it to communicate wirelessly with other motes within range. These motes can also be augmented with additional sensors – such as those for detecting light, temperature and acceleration – hence enhancing their features and making their application areas virtually limitless. It is generally perceived that smartdust will become the low-cost, ubiquitous sensor of the future, especially once its size shrinks dramatically to merit its name. In particular the formation of a number of these wireless sensors into a mobile adhoc network (MANET) will deliver the opportunity to explore the development of a more pervasive communications environment in which a new range of ITS systems and services can be delivered. This paper outlines experience in these projects and provides an illustration on the important role that the smartdust technology can play in future ITS. It presents encouraging results obtained from experiments in investigating the feasibility of utilising smartdust in real ITS applications.

- 20160 Pleydell, M.; Wylie, M. (2008) *"Millbrook – An Example of Joined up Control and Modelling"*, ITS World Congress

Micro-simulation modelling of road networks is a mature technology, but as with any modelling tool there is continuous work to ensure that the correlation between model and reality is high. The human factors of driver behaviour mean that there is always uncertainty in the traffic model, however, this paper shows how the uncertainty of the control strategy can be eliminated through linking the micro-simulation model to a junction controller emulator. The combination allows control strategies to be optimised at faster than real time operation and novel ideas and solutions to be assessed at the desk.

- TS91-20203 Cracknell, M.; McCarthy, J. *"Image Recognition and Incident Detection - A Progress Report"*, ITS World Congress

This paper introduces the work Transport for London has been doing in the field of Image Processing (or Video Analytics). TfL has been evaluating the technology and the market to determine the suitability of such systems in a dense urban environment. Investigating topics such as Digital video compatibility, "Smart Camera" deployment and developing a Test Library to evaluate systems in a repeatable and robust manner. A key part of the work undertaken has been a deployment of a small scale congestion detection system to the London Traffic Control Centre (LTCC), extending their monitoring capability.

- IS01-20215 Arbaiza, A. *et al* (2008) *"The Mare Nostrum VMS Group: Enlarging the Long Distance Corridor"*, ITS World Congress

This paper focuses on recent changes concerning the European Project on VMS harmonisation *Mare Nostrum VMS* (MN-VMS) now re-named *European Study 4* (ES-4) in the new frame of European ITS studies and implementation EASYWAY 2007-2013. Late in 2006, MN-VMS welcomed the incorporation of Portugal, Republic of Ireland, Slovenia, Sweden, and United Kingdom. New members within this larger group were then required to update, completing the so-called "working book" (where VMS signing practices of the all group are gathered), and performing the empirical tests done by the original members (see 14th World Congress on ITS 2007). Finally, the group is now focused on the elaboration of the ES-4 Guidelines, bringing the experience on the "working book" to a set of recommendations. This paper focuses on this new work.

- IS03-20240 Pickworth, J.; Marsh, P. (2008) *"Compliance Strategy: Enforcement and the Provision of Accurate and Relevant Information"*, ITS World Congress

This paper builds upon previous work which discussed how a comprehensive compliance strategy can provide benefits on the network where there are known or expected issues surrounding safety and/or network performance. The paper considers whether it is necessary to enforce a scheme to obtain an acceptable level of compliance and how accurate and reliable information contributes to the process. Having discussed the link between the level of enforcement and the level of compliance, the paper then considers how this can be managed along with how the provision of information can be used to manage this relationship. The relationship between technology, compliance and the type and amount of information provided to motorists is considered through an example compliance strategy for an ITS scheme.

- IS03-20266 Pengelly, I. J.; Conquest, J.; Patey, I. (2008) *"Highways Technology - Providing Management and Capacity"*, ITS World Congress

Congestion is a serious problem on many road networks around the world and its extent and severity are expected to increase significantly. Environmental impact and financial constraints make conventional widening and the construction of new roads much less appropriate. Interventions are therefore required that help to reduce congestion in an economic and sustainable way. A combined approach of demand management and using existing assets more efficiently - 'Sweating the Asset' - is needed to 'manage movement' in a sustainable way. This paper discusses a series of operational regimes and interventions that could be deployed on existing highways to increase capacity and reduce congestion.

- TS92-20305 Marqués, A.; Rodríguez, P.; Serrano, M. (2008) "*Traffic Control Through Smart Sensors Cooperation*", ITS World Congress

One of the strategic goals for existing traffic control systems is to develop new systems for cooperative sensing and predicting flow, infrastructure and environmental conditions surrounding traffic, with a view to improving road transport operations safety and efficiency. In order to achieve this objective, there is a need to improve existing sensing technologies, providing them with knowledge sharing capabilities to share information. Transforming the existing sensors into knowledge sharing sensors makes it possible to obtain added value information with the minimum investment from the authorities concerned.

- TS19-20306 Sternberg, H.; Andersson, M.; Lumsden, K. (2008) "*Towards the Concept of Smart Infrastructure*", ITS World Congress

A lack of access to information is a hindrance to the development of dynamic transportation systems. In an effort to further understanding of what an increased access to dynamically updated information could mean pertaining to efficiency gains in transport networks, this paper presents findings from a research project demonstrating the concept of *smart infrastructure*. Additionally, research in progress is introduced on combining smart infrastructure with goods in order to further improve the efficiency of transport networks.

- IS02-20318 Pengelly, I. J.; Barton, P. T. (2008) "*Operational Benefits of Advanced Detector Technology*", ITS World Congress

Control room operators are faced with the challenge of sifting through ever increasing amounts of data provided to them by the systems they use on a day to day basis to manage the motorway and trunk road network in the UK. As the deployment of technology continues, this situation will only get worse. This will hinder the ability of operators to differentiate between incidents and congestion. This paper reviews some of the ways in which new and existing detector technology can be used to assist the operators by presenting data in a format that allows informed decisions to be made quickly and efficiently.

- IS03-20338 Thomas, D. *et al* (2008) "*Improving Incident Detection for Regional Control Centre Operator Support*", ITS World Congress

Automated Incident Detection (AID) Systems for traffic management based on processing Closed-Circuit Television (CCTV) images have been in development for over 20 years. However, such systems have not previously been widely deployed in England for operator support in traffic control rooms. This has largely been because the false alert rates of such systems are considered to result in unreasonable additional workload for control room operators. This paper presents an approach which mitigates this difficulty in three ways. Firstly, probabilistic methods are used to achieve improved incident detection by combining a number of data sources, including CCTV images and inductive loops. Secondly, historic data on likely congestion and incident locations are taken into account when assessing alerts for their relevance to operators. Finally, the resulting alerts are presented to control room operators in a minimally intrusive fashion. An initial implementation based on this approach is currently being developed for evaluation in the Highways Agency's West Midlands Regional Control Centre. Preliminary results confirm that while installing a commercial CCTV AID system on existing Pan-Tilt-Zoom (PTZ) cameras can result in a high false alert rate, careful system design can deliver benefits despite this.

- TS58-20368 Wilson, C.; Hansen, C. G. (2008) *“The Future of Automated Enforcement in the United States and Europe – Compare and Contrast”*, ITS World Congress

This paper relates to improving the effectiveness of the enforcement of road traffic laws by automating the capture and recording of evidential data at the roadside through the use of camera-based technology. Automated enforcement has a proven impact on road safety by reducing the number and severity of collisions. It also encourages greater compliance with road traffic laws at a time when there are competing demands on law enforcement officials. This paper gives a brief comparison of how automated enforcement has been implemented in Europe and in the United States. It looks at both the similarities and differences in deployment and operation. It also explores what, if anything, law enforcement officials can learn from each other and highlights some of the challenges for the future of automated enforcement on both sides of the Atlantic.

- TS123-20382 Torday, A *et al* (2008) *“Use of Simulation-Based Forecast for Real Time Traffic Management Decision Support: The Madrid Case”*, ITS World Congress

This paper describes the use of simulation-based forecasting for real time traffic management decision support in Madrid. Being able to forecast the evolution of traffic in a network is a basis on which many traffic management strategies and multiple ITS applications should ideally rely. Real time prediction capabilities are therefore becoming an important requirement for the management of networks, both for urban and interurban environments, and today's road operator expectations drive increasingly complex and exacting requirements.

- IS02-20459 Narzt, W. (2008) *“Self-Organising Traffic Control for Congestion Avoidance and Traffic Flow Improvement”*, ITS World Congress

Social insects perform complex, self-organising tasks in the collective by using pheromone based indirect communication. Following the example of nature, this concept could also be a paradigm for controlling traffic, for recognising and avoiding traffic congestions, where vehicles act like individual insects by depositing digital pheromones in order to indirectly benefit from their trail. Vehicles equipped with emerging positioning and communication technology virtually annotate their local environment and form a collective with decentralised, self-organising capabilities. This paper presents an approach for a technical implementation of a pheromone-based traffic system and tries to prove that this concept from nature is also valid for controlling traffic flow by using a complex micro simulator capable of simulating real city networks.

- IS02-20472 Tafti, M. F. (2008) *“An Investigation on the Approaches and Methods Used for Variable Speed Limit Control”*, ITS World Congress

In the light of increasing demand for further application of Variable Speed Limit (VSL) Control Systems, it is essential to ensure that these systems are robust enough to produce the impacts required to meet the specific objectives set for their implementation. The extent of success of VSL Systems largely depends on the underlying approaches and methods used in their algorithm's logic. In this article, first a critical review of different approaches and methods for VSL with emphasis on those currently implemented in real world is made. Then based on an assessment of the performance of existing systems, especially the UK system (known as Controlled Motorways), a number of suggestions for further improvements to the existing rule-based practical systems is made. Considering the limitations inherited in the currently used practical systems, merits for the development and application of new network oriented VSL systems based on robust theoretical control models and/or artificial intelligence techniques are highlighted.

- TS122-30075 Marcuson, J. (2008) *“Reversible Managed Lanes Coupled with Time Managed Shoulder Lanes”*, ITS World Congress

Reversible Managed Lanes coupled with Time Managed Shoulder Lanes incorporate two concepts into one to create a flexible driving environment that results in increased capacity and reliability for motorists, High Occupancy Vehicles (HOV), and Bus Rapid Transit (BRT) vehicles. It couples the use of reversible flow lanes and utilisation of shoulders for additional roadway capacity that can be used in times of high traffic volumes or during times with traffic incidents. The use of this concept will provide an additional 25% of (total) roadway capacity on the same roadway width.

- TS128-30105 Heikes, J. S. *et al* (2008) *“Performance Envelope of Cellular-Based Technology for Incident Detection and Traffic Management”*, ITS World Congress

Cellular-based probe technologies (Cellular Floating Car Data, CFCD) can be used to support both road traffic management activities and traveller information systems. However, traffic information that can be derived from these systems is different from traffic information derived from road sensors (such as inductive loops). Furthermore, different cellular detection systems provide different types of data, since their core method and technology differ significantly. Some utilise statistical analysis and predictions which have at least a 30-40 minute delay in incident detection, while others provide only a short 2-5 minute delay in comparison with road sensors. Smart planning can use the benefits of each technology and generate optimal value for money.

- IS03-30139 Li, Z. *et al* (2008) *“An Integrated Off-Ramp Control Model for Freeway Traffic Management”*, ITS World Congress

This study presents a mixed integer model for an integrated control between off-ramp and arterial traffic flows. The proposed study intends to minimise the queue spillback from off-ramp to the freeway mainline that may significantly degrade the performance quality of the entire freeway system. In this study, the Cell Transmission Model is employed to capture the traffic propagation on both freeway and surface streets, and to capture the interactions between those two types of flows within the target control boundaries. An efficient solution method based on Genetic Algorithm is provided along with a numeric case study to demonstrate the benefit of this proposed model.

- TS101-30196 Burklund, L. J. (2008) *“Work Zone Traffic Management Systems in Nebraska”*, ITS World Congress

Iteris, Inc. in association with Traffic Technologies, LLC is assisting the Nebraska Department of Roads (NDOR) with the design, deployment and maintenance of a leased temporary work zone traffic management system along the Interstate 80 corridor. The work zone system brings real-time traveller information to NDOR-owned roadside signs for display to the motoring public. The system consists of several vehicle detection devices, speed sensors, CCTV cameras, portable dynamic message signs, and a communication system so that constant monitoring of the system is achievable from any device with a web-based connection. It is the intent that NDOR District 1 operations staff, NE State Patrol, and others have access to monitor and operate the system. On-going field verification and any necessary maintenance of equipment are also conducted for the system as part of this contract.

- IS04-30203 Kim, W. (2008) *et al* "Analysis of Freeway Incident Duration for Advanced Traveller Information System (ATIS) Applications", ITS World Congress

This paper presents a methodology for developing a model for estimating and predicting incident duration and identifying variables influencing the incident duration in the state of Maryland. The incident information from years 2003 to 2005 from the Maryland State Highway (MDSHA) database is used for model development, and year 2006 for the model validation. Classification Trees (CT) were used for a preliminary analysis to understand the influence of the variables associated with an incident. Based on the findings from CT, this study employed the Rule-Based Tree Model (RBTM) to develop the primary prediction model. The overall confidence for the estimated model was over 80% with several remarkable findings regarding the associations between factors and incident duration. Although the estimated results from RBTM are quite acceptable, supplemental models along with a better quality database are required to improve the prediction accuracy for the duration of a detected incident.

- TS100-30234 Minoofar, C. (2008) "The First Full Scale Deployment of Active Traffic Management (ATM) System in the United States", ITS World Congress

The Interstate-80 (I-80) corridor from the Bay Bridge to the Carquinez Bridge is the worst congested corridor in the Bay Area. This corridor has ranked as the most congested corridor in the entire San Francisco Bay Area during the last six years, with traffic volumes reaching 312,000 vehicles per day, with an average of 20,000 hours of delay daily. Currently, the demand on the freeway far exceeds the roadway capacity, causing unreliable travel times, erratic operating speeds, breakdowns, as well as diversion to the local arterials. The congestion on the roadway network contributes to an increase in incident rates, including rear-end accidents on both freeway and local arterials. These contribute to delays for transit services operating along the corridors. The combined effect of the incidents and the congestion hinders efficient incident response times and creates additional secondary incidents. The primary goal of the I-80 ICM Project is to enhance the current Transportation Management System along the I-80 corridor to build a balanced, responsive, and equitable integrated system that will monitor and maintain optimum traffic flow, through speed harmonisation, along the network to improve the safety and mobility for all users, including transit customers. The I-80 ICM is the first full scale implementation of Active Traffic Management (ATM) in the United States for a very highly congested corridor.

- 30250 Schwach, J. A. *et al* (2008) "Rapidly Deployable Low Cost Traffic Data and Video Collection Device", ITS World Congress

Transportation practitioners, planners and researchers lack the availability of an easily deployable, non-intrusive, portable, low cost device for traffic data collection and video recording at intersections and arterials as well as temporary remote surveillance. The necessary data usually includes volumes, speeds, classification, turning movements, queue size and length, conflicting movements, and time headways. They also include recording of traffic characteristics, accidents and other special situations. A visual record of traffic characteristics at intersections, arterials, or other locations can also be used for extensive analysis and research leading to improved safety and control practices. In this paper, the development and demonstration of a low cost, practical, rapidly deployable video recording and data extraction device is presented along with the design, deployment, and data extraction process. Its major advantage is that only one unit can cover an entire intersection up to 5 lanes per incoming approach wide (20 incoming lanes total); this should be sufficient for the overwhelming majority of intersections. In addition it has the potential of extracting turning movements at optional lanes (through plus turning), a rather elusive task for sensing or measuring devices.

- SC20-30260 Khattak, A. J. *et al* (2008) *“Primary And Secondary Incidents: Management Strategies”*, ITS World Congress

The overall objective of the study is to understand the occurrence of primary and secondary incidents and relevant incident management strategies, as well as to understand how primary incident duration and secondary incident occurrence are related. Specifically, secondary incidents are more likely to occur if the primary incident lasts long; at the same time, the durations of primary incidents are expected to be longer if secondary incidents occur. The work will allow State Departments of Transportation to estimate the chances of a secondary incident based on the characteristics of the primary incident, evaluate associated delays, and aid in identifying incident management strategies to mitigate the impacts of both primary and secondary incidents. Freeway incident and roadway inventory data from the Hampton Roads area in Virginia were used in this study. Modelling and simulation techniques were applied to develop primary incident duration and secondary incident occurrence/duration prediction models. Models for primary incident durations and whether or not a secondary incident occurs are estimated. The interdependence is modelled by using the incident duration as endogenous variable in secondary incident occurrence models. The results show statistical evidence for interdependence, but when it is taken into account, no substantial differences in the magnitudes and statistical significance for the estimated independent variables are found (compared to when the interdependence is not accounted for). Statistically significant correlations are found between secondary incident occurrence and other variables, leading to recommended aggressive incident clearance procedures on qualifying high-volume roadways to avoid secondary incidents.

- IS03-30265 Monsere, C. M. *et al* (2008) *“Empirical Evaluation of Adaptive Ramp Metering Along Two Freeway Corridors in Portland, Oregon”*, ITS World Congress

A System-Wide Adaptive Ramp Metering (SWARM) system has been implemented in the Portland, Oregon metropolitan area, replacing the previous pre-timed ramp-metering system that had been in operation since 1981. SWARM has been deployed on six major corridors and operates during the morning and afternoon peak hours. This paper reports on the results of a “before” and “after” evaluation of the performance of two freeway corridors as part of ongoing efforts to measure the benefits of the new SWARM system as compared to the pre-timed system. The study benefited from using the existing regional data, surveillance and communications infrastructure in addition to a regional data archive system and revealed mixed results when comparing the selected performance metrics to pre-timed operation. The development of an ongoing ramp metering performance reporting system is recommended.

- TS18-30294 Bertini, R. L. *et al* (2008) *“Using Archived ITS Data to Automatically Identify Freeway Bottlenecks in Portland, Oregon”*, ITS World Congress

Bottlenecks are key features of any freeway system and their impacts are of increasing importance as congestion worsens in urban areas. In Oregon, a freeway data archive known as PORTAL records measured count, occupancy, and speed data from over 600 locations at 20-second intervals. This archive has enabled development of online freeway performance and reliability analysis tools. This paper describes the development of an automated tool for identifying recurrent freeway bottlenecks using historical data within the PORTAL framework. Efforts have focused on the selection of optimal variables to enable identification and display of active bottleneck features using graphical tools. This research also aims to detect bottleneck activation in real time and to expand the use of reliability techniques. Ultimately the results of this research will aid in the prioritisation of freeway improvements.

- TS52-30304 Wu, J.; Jin, X. (2008) *"Reforming Ramp Meter Queue Override"*, ITS World Congress
- A traditional queue override approach for ramp metering is introduced, with reasons for why it does not perform effectively. A new type of queue override threshold value, based on the number of vehicles, is proposed with the benefits outlined.
- IS05-30344 Zhan, C. (2008) *"A CORSIM Testbed for Ramp Metering Algorithms"*, ITS World Congress
- This paper presents an effort to develop a simulation test-bed for the evaluation of ramp metering algorithms using CORSIM's Run-Time Extension (RTE), which provides exported functions and shared structures to communicate between the CORSIM micro simulator and the algorithms. A simulation network with 12 metered on-ramps for an 11-mile stretch of the I-95 corridor in Miami-Dade County, Florida was used to compare the results from three alternatives: fixed-time ramp metering control, Seattle fuzzy logic ramp-metering control, and no ramp metering. Results show that ramp meters are generally beneficial and that the Seattle fuzzy logic algorithm with only globally configured parameters outperforms a well-calibrated fixed-time control strategy especially under congested conditions. The simulation test-bed developed in this research also makes possible the evaluation of additional ramp metering algorithms in a widely used simulation model in the United States.
- TS123-30417 Benhammou, D. (2008) *"Advanced Mathematical Models as Simulated Traffic Data Collectors"*, ITS World Congress
- The paper describes the use of a virtual traffic analysis sensor for integration into an existing sensor infrastructure. The specific data collection monitor described is created by formulating mathematical models based on live traffic sensors. This technology complements existing vehicle sensors be it radar, microwave or video, resulting in an affordable solution to increasing data resolution and improving the accuracy of travel time predictions. These virtual traffic monitor sensors also have the ability to calculate the predicted estimated variance (PEV) which provides a quantitative metric of the quality of the data.
- IS01-30426 Kotscher, C. (2008) *"Video: The Ultimate Sensors"*, ITS World Congress
- The richness of video data makes the camera in many ways the ultimate sensor. The potential for gaining so much contextual information makes camera networks a compelling solution to today's traffic management needs. Network managers and operators are most effective when they can see the full extent of what is happening, so they can prioritise actions and react with the most efficient use of limited resources. This paper assesses the current uses for traffic data and projects its potential to effectively mitigate congestion and improve performance. The paper compares this potential to the benefits of using digital video to improve performance, increase safety, assist traffic enforcement and criminal investigations, and reduce fuel consumption and travel times.

- IS03-30428 Pollack, J. (2008) *"Irris® Technology: A Data Integration, Analysis, and Visualisation Tool to Support ITS Operations"*, ITS World Congress
- IRRIS® is an innovative geo-spatial Web portal that supports data integration and sharing, transportation operations, freight mobility, logistics, asset tracking, collaboration, transportation security, and incident management. With these capabilities, IRRIS can be used to support ITS operations and activities and to perform a number of tasks for users in all areas of state and federal government, as well as the private sector. IRRIS' core functionality is its ability to integrate and visually display, on an intelligent map, information from nearly 400 different sources. These sources include current transportation infrastructure data (such as data on roads, bridges, and tunnels); near-real-time information (including weather, traffic, and construction reports); along with data on assets critical to security (such as airports, dams, water plants, commuter rail lines, and nuclear power plants). IRRIS integrates the data into one interface to enable users to perform a variety of functions, such as visualising critical infrastructure data, creating reports and charts to proactively manage and coordinate logistics, and tracking the movement of goods and assets.
- IS01-30453 Berkeley Transportation Systems, Inc. (2006) *"Integrated Corridor Management"*
- Integrated corridor management is an emerging approach to managing mobility by integrating the management of multiple transportation networks within a single corridor. This paper analyses the methodologies and technologies appropriate to corridor management applications. It provides technical guidance for transportation agencies seeking to understand options for corridor management as they prepare to embrace this new approach.
- TS56-20051 D'Arcy, J. (2008) *"An Integrated Approach to the Urban / Inter-Urban Interface"*, ITS World Congress
- The criticality of the urban/inter-urban interface to traffic management operations in the UK and Europe has long been recognised. This paper provides background and context through a brief description of current inter-urban and urban traffic management systems in the UK. A number of case studies are described that provide examples of operational data exchange across the urban/inter-urban interface. A theoretical scenario is used to demonstrate the potential benefits of integrating existing technologies, prompting discussion regarding the barriers to implementation and associated conclusions.
- IS01-20159 Frötscher, A. (2008) *"COOPERS Project: Development of an ITS Architecture for Co-Operative Systems on Motorways"*, ITS World Congress
- The paper explains the development of a high-level architecture for cooperative systems using the FRAME method and the European ITS Framework Architecture as part of the EU-funded R&D project COOPERS. The resulting system will be specified, tested and demonstrated on 5 European motorways until the end of 2009.
- TS104-20268 Westhuizen, P. (2008) *"Title: Working Smarter – An Information Strategy for Real Time Traffic Operations"*, ITS World Congress
- This paper summarises some of the achievements of information strategy work currently conducted in the Directorate of Traffic Operations (DTO) of Transport for London (TfL). In particular the paper highlights a comprehensive system and data audit, an intelligence requirement capture exercise, and a network analysis methodology.

- TS05-20329 Scholliers, J. (2008) *“New Framework for Evaluating Preventive Safety Functions: Focusing on Human Factors Evaluation”*, ITS World Congress

PREVAL is a subproject of the PReVENT Integrated Project, in which different preventive safety applications have been developed and demonstrated. The major aims of the PReVAL project are to assess the safety potential of functions developed and demonstrated in the PReVENT integrated project and to develop a harmonised framework for the assessment of preventive safety applications and advanced driver assistance functions. The framework builds on the experiences gained in the PReVENT project and other related projects. The framework integrates different procedures for technical and human factors evaluation and safety impacts assessment in one holistic approach. This paper discusses the human factors evaluation aspects of the framework in more detail.

- TS136-20437 Wahl, R.; Giæver, T. (2008) *“The Norwegian Vision Zero Did it Work? ”*, ITS World Congress

Vision Zero is an image of a future situation where nobody is killed or seriously injured in road accidents. In the time period 2003 – 2006, the Norwegian Public Roads Administration carried out a national traffic safety project in Lillehammer based on the Vision Zero principles. The focus was on measures to avoid the most serious accidents or reduce their effects. The project covered measures related to the roads, vehicles and different group of transport users. This paper presents the evaluation results of these measures.

- IS01-20355 Sundberg, J. (2008) *“The Use of Data Warehouses and Information Brokers in Crossborder ITS”*, ITS World Congress

Access to high quality information is a prerequisite for efficient transport systems. Current architectures are mainly based on public authority service providers engaged in the full chain of the service; from data collection to distribution of information to end users. As transport demand becomes more complex, information needs become more complex. The paper discusses the use of third party information brokers/data warehouse operators for data collection and data fusion, and further distribution to end service providers. All operations will be made on commercial conditions, and examples are provided where this is operational. Such organisations will also be natural hosts for standards, a role that is not suitable for public authorities.

- TS76-20439 Siebenhandl, K. *et al* (2008) *“Evaluation of Pictorial Messages for Variable Message Signs to Enhance Comprehensibility”*, ITS World Congress

This paper presents the results achieved from an iterative design and evaluation process by relating the cognitive and technical requirements of information to what is displayed on VMS and conventional road signs. According to ISO 9186 “Test methods for judged comprehensibility and for comprehension” altogether 2,977 symbol/pictogram variants have been elaborated for submission to an iterative process of testing and redesign. Four tests were conducted in the Czech Republic, in Hungary, Spain, and in Austria, involving 2,667 individual test participants. The close cooperation of designers and researchers turned out to be very effective in terms of integrating shortcomings and taking study results into account. The evaluation of the pictograms tested within the subsequent four test series lead to the “Proposal on unified pictograms, keywords, bilingual verbal messages and typefaces for VMS on the TERN”.

- TS27-20441 Nissan, A. *et al* (2008) “*Study of Traffic Performance and Safety Impacts of the Stockholm Motorway Control System (MCS)*”, ITS World Congress
- Dynamic Motorway Traffic Management and Control has been developed and implemented worldwide with the aim of increasing efficiency, reliability, safety and reducing environmental impacts, without necessitating major physical changes in the road infrastructure. The impacts of these systems are difficult to observe and evaluate. In this paper a study of the impacts of the recommended variable speed limits (VSL) on individual traffic characteristics is reported on the basis of different statistical tests on data relating to before and after application of the VSL on E4 motorway in Stockholm. VSL contribute to more even traffic flow distribution between lanes. Better speed distribution between vehicles and a sharp decrease of speed variance in all lanes are observed. Time headway is equal and less than 1 second is reduced by 43% and frequency of lane changing is reduced by 50%.
- TS76-30232 Galarus, D. *et al* (2008) “*Development of a Dynamic Message Sign Specification for Caltrans*”, ITS World Congress
- This paper describes current progress in development of a new dynamic message sign (DMS) specification for the California Department of Transportation (Caltrans). The project team is soliciting user needs, surveying current practice, and seeking comments from vendors. Included in the specification is a design of an internal sign module protocol. This effort may also help to produce a specification that, in part or entirety, could be adopted industry-wide.
- TS53-20190 Bekiaris, E. (2008) “*Road Operators’ Manual and MMT for ITS Applications*”, ITS World Congress
- Training curricula for a manual and a Multimedia Training Tool (MMT) have been developed, within the IN-SAFETY EC co-funded project, targeting the awareness creation and on-the-job training of Road and Traffic Management Centre (TMC) operators. The aim is to provide the operators with essential knowledge on ITS issues, most notably on newly emerged applications or those which are under development. Extensive research has been undertaken, identifying existing schemes and gathering the views of stakeholders and the relevant content. The systems are described in detail, in terms of their functionalities, application areas and examples, together with cost – efficiency issues and basics on transport engineering. Moreover, selected results of the IN-SAFETY project, as well as standardisation issues and a list of existing standards, are also included, thus providing an holistic approach on ITS technologies in the service of road safety.
- SC27-20478 Hinkeldein, D. (2008) “*The Workplace of Traffic Management Operators - What Changes do Experts Foresee until 2020?*”, ITS World Congress
- This paper aims to understand the dynamics of the Traffic Management Centre operator workplace, with an expansion of the tools, tasks and traffic volumes the operator has to handle. Using expert interviews and Mayring's Qualitative Content Analysis, 20 interviews were conducted and analysed. Experts were drawn from four different ITS working fields in Germany: research, operation, engineering, administration. Results indicate that experts expect a massive change in job characteristics mainly due to technical and organisational influences. Conclusions are drawn for today's selection and training procedures.

- IS03-10142 Liu, B. (2008) *“A Web-Based Traffic Information System Using Statistical Data”*, ITS World Congress
- A new web-based traffic information system is presented that provides more traffic information of roads by using statistical data, and also realises an accurate route search function. Statistical data are generated from accumulated historical traffic data, and a route search function has been implemented based on the combination of real-time data and statistical data. Compared with systems without statistical data, this system increases the coverage of traffic information on roads and provides more reasonable route searching results for users.
- IS03-10211 Usui, T. *et al* (2008) *“Development and Validation of Internet-Based Personalised Travel Assistance System for Mobility Management”*, ITS World Congress
- For this study, the authors developed a Personalised Integrated Travel Assistance System, working with a Mobility Management programme, which is designed to reduce the number of cars used for commuting in the Nagoya Metropolitan Area. The system has three subsystems: the *iMM* sub-system for automatically diagnosing travel behaviour, the *PP* sub-system for collecting accurate travel behaviour information including route choice based on GPS data, and the *PRONAVI* sub-system for providing multi-mode route information about the environmentally optimal route. These systems are integrated and support the efforts of drivers to make environmentally sound decisions about their driving behaviour.
- TS85-10350 Wu, J. *et al* (2008) *“A Real-time Traffic Information System (RTIS) based on GPS Floating Vehicle Technology in Hangzhou”*, ITS World Congress
- This paper introduces a Real-time Traffic Information System (RTIS) based on Global Positioning System (GPS) floating vehicle technology in Hangzhou, China. With GPS-based Floating Vehicle Data (FVD) from 3300 taxis and 1200 buses, the RTIS system can provide real-time traffic information of the urban road network both to traffic police for traffic management and to the public, in a cost effective way. The RTIS system is one of the key projects in China’s ITS Showcase Programme and it is validated to be effective and reliable. This paper introduces its framework, main functions and key technologies and finally outlines plans for the future.
- IS04-20045 Avni, O. (2008) *et al* *“GPS Vs. Wireless Probe-Based Systems for Real-Time Road Traffic Monitoring and Traveller Information”*, ITS World Congress
- GPS can provide very accurate vehicle locations. As a result, many companies have tried to utilise it for collecting road traffic information, both for historical information as well as for real-time traveller information. However, there are several limitations of this method such as low sampling rate, cost of collecting the data, and anomalies of fleet vehicle driving patterns, to name a few. An alternative method for metro-wide data collection is wireless based traffic monitoring, which has its limitations as well. This article compares the advantages and limitations of both methods based on field trials and simulations which show that GPS data can be very useful for collecting historical information with relatively low cost. However GPS data isn’t relevant for real-time traffic information, since it usually entails delays in detecting slowdowns, even over major urban highways, while a wireless based solution can generate very good real-time data but only between 6am and 11pm.

- TS125-20436 Giæver, T. *et al* (2008) “*Common Information Platform for Traffic Data Merging Data from Different Sources*”, ITS World Congress

There are numerous and growing numbers of ICT based products and services available for road users. Such products could be supplied by the car manufacturer. However, an increased amount of products are supplied by small and medium sized enterprises, competing in small niche markets. Mobile ICT solutions, telecommunication and next generation positioning techniques provide a considerable market for new and improved products and business opportunities. An important premise for realising this business opportunity is to establish a common database which provides required input data. This paper presents an initiative for achieving this.

- TS85-30146 Kaufman, S. M. (2008) “*Parallel Developments in Customer Information Demand and Intelligent Transportation Systems*”, ITS World Congress

As transit agencies worldwide strive to deploy customer-oriented Intelligent Transportation Systems, their labours are often the result of greater information demand by the public, who have become accustomed to the availability of data anytime, anywhere. Stemming from the pervasiveness of mobile phones, the ever-enhancing web services of e-commerce sites and an increase in available “pushed” information, government entities have responded to public demand for parallel developments using creative approaches to information distribution. In turn, transit agencies are pressured into providing not just transportation services, but now also information delivery in a real-time “pushed out” format. ITS, therefore, has augmented its focus from transportation management to include real-time information for customers.

- SC10-30180 Puckett, D. D. *et al* (2008) “*Utilisation of Automated Number Plate Recognition (ANPR) for Travel Time Data Collection*”, ITS World Congress

Travel times for the freeway systems in Houston, Texas are computed using information from automatic vehicle identification sensors which read Radio Frequency Identification (RFID) tags issued by the local tolling authority. Demonstrations were conducted to determine the feasibility of utilising automated number plate recognition as an alternative to RFID readers for the determination of link travel times on an urban arterial where tag penetration of the overall traffic might not be as great as on freeways. This paper is the result of the demonstration with multiple vendor products.

- SC28-30272 Richardson, J. K. *et al* (2008) “*Managing Travel Time Data*”, ITS World Congress

There is currently a robust field of research dedicated to measuring travel time on road networks. Nearly all of this work has focused on the task of deriving travel time from loop detector data and various probe monitoring approaches. However, there has been little effort devoted to effectively and efficiently managing travel time data originating from multiple sources. Archived Database Management Systems (ADMS) emerged as a response to the need to manage and store the massive amounts of data being generated by “traditional” ITS technologies (in most cases, point detector data). Yet, while ADMS systems have been successful in storing vast amounts of well-defined data such as speed, occupancy, and volume, there is currently no consensus on the best approach to storing and managing travel time data. This paper explores the issues with managing travel time data and looks at information technology and statistical methods to address the key challenges in this area.

- IS02-30301 Kiernan, N. (2008) *“Advanced Travel Information: Making Travel Faster, More Efficient, More Cost-Effective, Safer and More Environmentally Friendly”*, ITS World Congress

Comprehensive travel information is a critical factor in tackling traffic congestion in the U.S. and other countries, where bottlenecked roads and extraordinary delays often approach crisis conditions. The goal of this paper is to illustrate how a consortium based approach to the collection and processing of traffic impact data, which integrates and coordinates existing, independent data systems and delivery platforms, can improve both information and communications to private and commercial drivers as well as public agencies and yield a range of benefits. These include more efficient travel, enhanced road safety, lower pollution and fuel conservation.

- TS125-30314 Meyer, E. (2008) *“Analysis of Speed Data Derived from Cellular Probes”*, ITS World Congress

The particular system evaluated, TrafficSense from Cellint, uses cellular signals to assess a phone's location and speed, and then data from all cell phone probes on a given segment are aggregated and stripped of personal information. The travel times or spot speeds are displayed on a web-based map or delivered to a transportation agency. Cellint and the Kansas Department of Transportation (KDOT) agreed to conduct a pilot project in the Kansas City area. From June 20 to August 20, 2006, Cellint logged speed data for both directions of traffic on I-435 from Pflumm on the west end to the intersection of I-435, I-470, and US-71 on the east end. The Cellint data were compared with analogous data logged by Scout's vehicle detector stations (VDS), which at that time were all inductive loop detectors. Following the completion of the evaluation period, several performance measures were investigated to determine their utility in comparing the two data sets. It should be noted that while Cellint can provide point to point travel times, the Scout VDS array on I-435 was too sparse at the time of the test to accommodate the calculation of travel times.

- TS84-20102 Vaa, T. (2008) *“ITS and Driver Behaviour: Effects and Challenges”*, ITS World Congress

The development of road safety-related ITS raises a number of questions regarding their effects on driver behaviour and accidents, especially how drivers will adapt to ITS and whether risk compensation mechanisms will take place. While effects of ITS on accidents have been evaluated in real traffic for some 13 systems, 20 other systems have only been evaluated on driver behaviour and/or accidents by surrogate methods. The paper addresses systems which have not yet been fully implemented in real traffic and where the effects on accidents are scarce or missing. The present study asks if safety-related ITS are addressing the real threats to safety in road traffic. Critical issues are addressed and core problem statements are discussed. The mobile phone is termed a threat disguised as a “Trojan horse” because of its increasing number of new applications finding its way to the driver behind the wheel.

- TS93-20271 Benz, T. (2008) *“Evaluation of Intelligent Vehicle Safety Systems – A State-of-the-art Example”*, ITS World Congress

The EU funded project eIMPACT included the evaluation of traffic effects of Intelligent Vehicle Safety Systems (IVSS). Such effects directly turn into monetary effects in terms of economic assessment. They can support or counter-weigh the safety benefits of such systems. For deeper insight into the safety effects the traffic simulations carried out also indicated so-called surrogate safety measures. They can supplement the dedicated safety evaluations. This paper presents both, the traffic effects of selected IVSS and the safety parameters as they result from micro simulations.

- TS93-20402 Lesemann, M. (2008) *“Testing and Evaluation Methods for ICT-based Safety Systems”*, ITS World Congress

With the massive introduction of active safety systems in modern vehicles, it becomes more and more difficult for the customer to understand the effectiveness of those systems. Objective testing and evaluation methods are necessary to support this and are being developed within the recently started European research project eVALUE. They will also foster the development of new and advanced safety systems for future applications. This paper gives an overview of the systems which will be regarded and a scientific approach for the development of assessment procedures for those systems.

- TS39-20125 Linssen, J.; Lu, M. (2008) *“Cooperative Systems for Road Traffic Safety: Functionality Design and Implementation”*, ITS World Congress

The paper presents a preliminary result of the EU-funded project COOPERS (CO-Operative SystEms for Intelligent Road Safety). The paper introduces the business case for COOPERS and provides an overview of the architecture of the COOPERS system, and of the determination and implementation of ITS services. Especially the paper studies the functionality and the implementation of the Automotive PC (APC) and the COOPERS Service Centre (CSC). The APC is one of the main components of the COOPERS system, which hosts the COOPERS services that are provided to the drivers of the COOPERS demonstration vehicles. The CSC is a server system, which collects traffic related information from various sources, aggregates the information, prepares COOPERS service messages and sends these to connected client systems. In addition, the demonstration plan of the COOPERS services in one of the test sites (Rotterdam-Antwerp corridor) is addressed in the paper.

- TS50-20262 Jodlauk, G. (2008) *“Cellular Communication Based Mechanism for Road Traffic Information Distribution”*, ITS World Congress

This paper presents an approach for Road Traffic Information (RTI) distribution using cellular communication technologies in existing 3G (UMTS) networks. In particular the Multimedia Broadcast Multicast Service (MBMS) provides high flexibility in defining regional services from network wide areas down to single cell areas. It was standardised for 3G networks to provide geo-scalable and geo-specific broadcast, but they also imply some challenges to support broadcasting of safety related information.

- TS50-20444 Strandén, L. *et al* (2008) *“State of the Art Survey of Wireless Vehicular Communication Projects”*, ITS World Congress

In this paper the results of a state of the art survey, using publicly available information, are presented. The scope of the survey concerns projects that include wireless communication - vehicle-to-vehicle and vehicle-to-infrastructure. Since there is a vast amount of information available, a specific methodology has had to be developed and applied. This paper presents such a methodology which is based on a matrix representation that enables the definition of specific metrics. These metrics can then be used for further evaluation. The objectives of this work are threefold; to gather relevant project information, to define and apply a methodology for handling this information, and to compare and draw some general conclusions about the nature of projects carried out in Europe, USA and Japan.

TS121-30375 Galarus, D. *et al* (2008) "*Rural TMC-TMS Communications – An Evaluation of Alternatives*", ITS World Congress

In cooperation with the California Department of Transportation, Montana State University's Western Transportation Institute has conducted an evaluation of communication technologies for application to TMC-TMS (Traffic Management Centre to Traffic Management Site) communications in Caltrans District 1. Wireless and wired technologies have been evaluated for prospective use, with pros and cons presented in general as well as site-specific analysis. The results of this study are applicable to other Districts and DOTs, for both rural and urban use.