Identifying ITS Opportunities for the HA

Incident management: the role of technology Fact Sheet

Summary

Incident Management is the detection and identification of abnormal traffic situations (including accidents), implementation of responsive actions and handling traffic until normal conditions have been restored.

Technology has a part to play in: incident detection and handling, traffic management and provision of travel information to road users, and assisting with incident investigation.

This Fact Sheet summarises current incident management technologies used throughout the world and highlights recent Research and Development and advances in this field. This Fact Sheet will inform the Highways Agency on the state of current and developing incident management technology around the world.

Key Words

Automatic Incident Detection, Monitoring, Project, Traffic centre, Traffic management

Date of Preparation

February 2010.

The authors of this Fact Sheet are employed by TRL. The work was carried out under a contract placed on 11 March 2008 by the Highways Agency. Any views expressed are not necessarily those of the Highways Agency.

What is Incident Management Technology?

In order to create a more efficient and effective incident management system, various ITS technologies are usually incorporated into the system. The role of the technology is to assist organisations responsible for incident management with:

- Incident detection – Technology used for incident detection can typically be divided into monitoring of roads, identification of abnormal traffic situations and automation of an alert following a potential detection

- Incident handling – Primarily deals with gathering data, either on road through data terminals or, in the control centre where more detailed information can be collected
- Traffic management – Technology that helps to manage speed of traffic approaching the incident, indicate lane closures and helps to determine the most efficient re-routing of traffic
- Traveller information – Technology that is able to notify road users of an incident in close proximity, notify of likely delay and provide information on alternative routes
- Incident Investigation – Aims to analyse the causes of the incident and investigate the outcomes (e.g. investigation of fatalities). Technology can be deployed to speed up the investigation process and thus help to re-open roads sooner.

This Fact Sheet describes what current technologies exist for each of the areas described above and what research and developments are likely to be introduced in the near future. Examples of technologies from the UK, Europe and elsewhere are included.

Incident Detection

Fast incident detection is one of the main priorities for traffic managers; the key steps in an efficient incident detection procedure are:

- Speedy initial detection of the incident
- Validation of the alert
- Identifying the precise location, including which carriageway
- Identifying the type of incident and resources required.

The number of secondary incidents can be reduced if Variable Message Signs (VMS) give approaching drivers sufficient warning of queues ahead. Incident detection techniques can be grouped into three general categories:

1. Electronic / ITS techniques – video-based incident detection and inductive loops with incident detection algorithms
2. Professional reports – police patrols, aerial surveillance, service patrols and traffic reporting services
3. Citizen reports – mobile phones and emergency roadside phones.

This Fact Sheet concentrates mostly on category 1, as this is the category which is the most relevant to the application of technology solutions.

Monitoring

Most incident detection systems rely on algorithms to identify a situation that is unusual for a given environment. This requires the system to be aware of the baseline conditions on the road in order to be able identify when traffic conditions change suddenly. Data on the baseline conditions is typically collected by monitoring of roads and motorways.

Monitoring of the network is usually performed by the network operator through a number of means. CCTV cameras and/or inductive/virtual road loops are usually used in both urban and interurban environments for traffic monitoring. Increasingly, radar technology is being trialled for monitoring traffic conditions in tunnels and on interurban routes due to its relatively low requirement for maintenance and high reliability. Monitoring is an important part of incident detection as it allows for comparison of the current situation with a recent history of the traffic conditions. If a sudden and unexpected change in traffic conditions is detected then it could potentially be a sign that an incident has occurred.

Typically a number of parameters are monitored; depending on the system these can be either parameters of the overall flow or, of each individual vehicle. Monitored parameters are typically:

- Individual vehicles
  - Time
  - Speed
  - Vehicle shape factors (changing shape factors can be used to distinguish between vehicles and people or animals)
  - Lane.
- Stream of vehicles
  - Average velocity
  - Flow rate
  - Occupancy.

The parameters are measured at each detection point, which can be a loop, radar or a camera.

Identification and provision of detailed information

Various systems can identify a potential incident using a number of different techniques. Although many Automatic Incident Detection (AID) systems are capable of detecting vehicles which have stopped or debris on the road, sudden changes in vehicle velocities, changes in the flow of traffic speeds, some systems are better suited for one or more of those tasks. Events of potential interest are identified and selected by comparing the data with the baseline obtained during monitoring. Information gathered can help to determine the severity and scale of the detected incident. Information such as location, time, number of vehicles, affected lanes and surrounding traffic conditions is collected. The nature and detail of the data collected is dependant on the type of detection system used.

Automatic Alerts

Most Automatic Incident Management systems have the capability to issue automatic alerts to an operator who can then take appropriate action based on the information provided by the AID system. AID systems generally rely on algorithms to determine when a traffic situation is determined to be unusual and warrants an alarm to be raised to attract the attention of the operator.

SAPN

The SAPN system is an example of how a typical AID system creates alerts to inform the operators of a detected incident. The SAPN AID system in France raises a visual alarm to inform an operator when an incident has been detected and the changes to the VMS that have been automatically applied. The operator can then either confirm or change the VMS based on information made available by the SAPN system and take further appropriate action if necessary, such as inform emergency services of the incident.

> The average interval of time between the moment the SAPN AID detects an incident and the posting of a message on the VMS is less than 5 seconds. The first results showed that the rate of false alarms remained low at approximately 10% (Centrico briefing note: Automatic Incident Detection and Fast Alert).

Traficon

This automatic system is capable of detecting an accident in its observation area, raising an alarm and providing video and other supporting data for the operator.

Video-Based Automatic Incident Detection

Video-based AID systems use one or more CCTV cameras to identify abnormal traffic situations. CCTV-based systems offer the flexibility of pan and zoom cameras that can be used to manually gather more information on the incident. However, use of pan and zoom cameras can lead to higher false alarm rates. Camera-based AID systems are also susceptible to bad weather conditions and poor lighting conditions.

Traficon

An example of video-based AID system is the Traficon system (traficon.com). This type of technology is based on a Video Image Processing (VIP) module, which digitises the video input from a camera(s), analyses the image and extracts the most important data based on programmed parameters. This type of system is capable of detecting an incident by recognising a stopped vehicle in a fixed detection zone, for example a junction or a tunnel, and by detecting the presence of large debris on the road. Systems installed in tunnels are also capable of detecting smoke.

The main advantage of video-based AID is that there is a combination of numerical data with immediate visual feedback, enabling the operator to make informed decisions and deploy appropriate resources.

Traficon systems are deployed throughout Europe and other parts of the world.

> The City of Oslo has installed Traficon video detection technology to monitor the traffic inside the Bjørvika and Festning tunnel. Incidents like smoke, pedestrians and fallen objects are detected within seconds and transmitted to the traffic control centre where immediate actions can be taken to clear

the incident.

A few months after installation of the Traficon AID system in Belgium on E313 between Antwerpen and Hasselt, the Flemish government's 1998 yearbook published statistics showing a 60% reduction in accidents (Roadtraffic-technology.com, August 2008).

Videotrak 900

Another example of a video-based AID is based on Peek Traffic's Videotrak 900 software deployed in the Heysen Tunnels in Australia. It analyses existing CCTV footage from the tunnels. A number of detection zones, or tracking strips, are established within the various cameras' field of view. Alarm generation is based upon object dwell time within each, or across a number of, tracking strip segments and the object's direction of movement through these segments. The system works in tandem with the tunnels' lane use signals, which can close lanes if a vehicle is stranded.

A13 France (SAPN system)

A video camera monitoring system is in place on the entire section of the A13 west of Paris between Poissy and Mantes. The 20-mile section of motorway has very dense traffic conditions, with a high accident rate and recurrent traffic problems.

This AID system is compatible with the existing CCTV network, which consists of each camera monitoring both directions. The AID technology is capable of detecting the following:

- Unusual deceleration
- Stopping in congestion situations
- Stopping in free flow situations
- Pedestrians.

The system includes both fixed cameras and rotating cameras. For the rotating cameras, it is possible to transform the camera images to a pre-determined position using the "automatic repositioning function". However, tests on the mobile cameras have revealed a worse level of event detection and more false alarms.

Automatic Incident Detection using inductive/virtual loops

Instead of using data from various CCTV cameras and defined "corridors", data on traffic flows from inductive loops is used. The Integrated Incident Detection (INGRID) system is a real time automatic incident detection system for use in urban areas, which works with Split Cycle Offset Optimisation Technique (SCOOT) to compare the current traffic situation with that expected from the historic reference data in the Automatic SCOOT Traffic Information Database (ASTRID) database (http://www.scoot-utc.com/INGRID.php).

INGRID uses two algorithms to detect incidents. One algorithm examines current traffic data for sudden changes in flow and occupancy. The other algorithm uses historic reference data from ASTRID, which contains the expected flow and occupancy for each 15 minute period at each SCOOT detector. Both algorithms require data on the flow and occupancy over loops on consecutive links to detect an incident in the road space between them. Incidents are indicated during the following conditions:

- Downstream detector – decrease in occupancy and decrease in flow;
- Upstream detector – increase in occupancy and decrease in flow.

The algorithms use standard deviations and mean values to determine a confidence level against which to assess the current data. An incident is indicated if the conditions are satisfied for one minute. When the conditions are satisfied for three consecutive minutes, more weight is given to the incident report.

Once an incident has been detected, it is important to establish the extent to which the incident will alter traffic flow around the network. There are two main effects to be considered - the area affected by the spread of congestion due to the incident and the additional delay to vehicles travelling through the affected area.

RAID algorithm, (Remote Automatic Incident Detection) designed to detect abnormal periods of traffic congestion existing over single inductive loop detectors, was trialled along the A33 and A35 in Southampton. The RAID detection rate for verified incidents was 69% and 92% respectively. The low detection rate on the A33 was due to five incidents during off-peak periods which caused no congestion and therefore could not be detected by RAID (Cherrett, T., Waterson, B. and McDonald, M. (2005)).

Automatic Incident Detection using radar

Using radar for AID is an emerging concept that that could have a number of advantages over other AID systems. Navtech Radar have developed a radar-based ('Millimetric') incident detection system "ClearWay" based on 77GHz millimetre wave (MMW) radar technology. The system is capable of detecting incidents from 2 to 800 metres radius from the radar installation. Radars can be positioned at the roadside to enable coverage of all lanes of motorway or in tunnels (Clearway).

The radar AID technology can be used to detect:

- Stopped vehicles
- Slow moving vehicles
- Vehicles moving in the wrong direction
- Presence of pedestrians on the carriageway
- Presence of debris on a road.

Once a potential incident has been detected, an alarm is raised and an operator is informed and provided with the necessary data to decide on an appropriate action. The advantage of the radar - based AID system is that, unlike camera based systems, it is not affected by varying light conditions and/or weather conditions. In addition, radars also require less maintenance than other AID.

Clearway™ TS 350-X detection system has been successfully trialled in the Southwick Tunnel on the A27 in Sussex, UK (Thinking Highways, Volume 4, No. 4). The system is to be installed in the Hindhead Tunnel on the A3 in the South East of England.

Automatic Incident Detection – summary

The table below is from Martin (2001) and gives a summary of the performance of various video based incident detection methods.

Table 1 Performance of various incident detection methods (Martin, 2001)

Detection Method	Name	Detection Rate (%)	Mean Time to Detection (min)	False Alarm Rate (%)
Algorithm	California	82%	0.85	1.73%
Algorithm	TSC #7	67%	2.91	0.13%
Algorithm	TSC #8	68%	3.04	0.18%
Algorithm	APID	86%	2.50	0.05%
Catastrophe Theory	McMaster	68%	2.20	0.002%
Statistical Methods	ARIMA	100%	0.40	1.50%
Statistical Methods	SND	92%	1.10	1.30%
Statistical Methods	DES	92%	0.70	1.87%
Statistical Methods	Filtering	80%	4.00	0.30%
Statistical Methods	Bayesian	100%	3.90	0%
Statistical Methods	SSID	100%	not reported	0.20%
Neural Networks		89%	0.96	0.01%
Video-based	France, 1993	90%	0.37	3.00%

The video-based detection results quoted in this table are from a trial along a 1.7km corridor in France in 1993 (Bloseville, 1993). Video Image Processing technology has since improved, and the table below gives the summary of the performance of a more advanced video detection system (Versavel, 2000) compared to other methods as evaluated by ARRB in report ARR327 (Chung, 1999).

Table 2 Performance of various incident detection methods (Chung, 1999 and Versavel, 2000)

Detection Method	Name	Detection Rate (%)	Mean Time to Detection (min)	False Alarm Rate (%)
Algorithm	California	80%	2.82	0.55%
Algorithm	Delos	78%	3.15	0.29%
Neural Networks		83%	3.40	0.03%
Video-based	Traficon	95%	0.2	0.01%

N.B The results quoted here for California, Delos and Neural Networks have the time to detection limited to 5 minutes; this means that incidents detected more than 5 minutes after the incidents occurred are considered undetected.

Video image processing was found to be the quickest detection method in both studies. The Traficon system has a mean time to detection of 12 seconds, whereas many other methods take more than two minutes. The quickest of the other methods are ARIMA, California, DES and Neural Networks, all with detection times under one minute. The methods with lowest false alarm rate are Bayesian, Catastrophe Theory, video (Traficon) and Neural Networks. Martin (2001) says that "No matter how complex or evolved an incident detection algorithm is, it can never fully mimic and comprehend the dynamic nature and changes associated with traffic flow".

Incident Handling

Once an incident has been detected and an alarm raised by the AID system, an operator has to respond appropriately. Based on the information provided to the operator by the AID system, a decision has to be made regarding what emergency services need to be informed and what information they will require. All AID systems will as a minimum provide the following information:

- Location of incident
- Time of incident.

Some systems can also provide additional information such as number of vehicles involved, debris present on the road and surrounding traffic conditions.

In the case of dangerous goods, incident handling can be assisted if data from cargo tracking systems can be used to identify the nature of the cargo rapidly, thus enabling the appropriate incident response to be deployed sooner. For example the EC Good Route project has developed a cooperative system for dangerous goods vehicles which includes, among other functions, real time monitoring and an on-board automatic data retrieval and storage system.

Incident handling can involve dissemination of data either directly to or amongst the personnel involved in handling the incident, and via the traffic control centre.

Codespear

"Federal Signal Codespear" is a joint incident management communications platform, which is currently used to connect various agencies in the U.S. on any communications device regardless of existing infrastructure, hardware or frequencies. According to the FS Corporation website, the technology enables live communications and alert notifications across multiple devices, including: 2-way radios, landline and mobile phones, computers, pagers and hybrid cell phone / radio devices, such as Nextel Direct Connect. Technology such as this allows incidents to be handled quickly and efficiently.

The "SmartMsg" software package contains the alert notification and secure messaging options. Scenario Manager is an additional module used for creating incident management plans, so that depending on the incident scenario, the program produces a step-by-step list of pre-programmed procedures in an "if-then / decision tree" fashion.

> Codespear has been implemented in Omaha, Nebraska, USA, enabling over 2,500 incident management and first responder personnel to communicate on a common platform, regardless of the type of their existing individual communication device (Federal Signal deploys Codespear SmartMsg for Hamilton County, OH, Federal Signal, January 2010).

SHARE

An advanced communication and data system for emergency rescue teams was developed as part of a European 6th Framework project, 'SHARE'. The system includes audio, video, text, graphic and location information, and will log voice and text communications and video transmissions creating a record of the operation and its development. Further information can be found at the project web site http://www.ist-share.org.

FIRST

The Freeway Incident Response Services Tracking (FIRST) project is a computer system that provides data on freeway incidents in Los Angeles County to allied agencies, first responders and the media (Grey, 2000). The system facilitates two-way communication between the California Highway Patrol (CHP) and the responders that are involved in clearing the roadway. By providing interfaces to the system for on-scene incident management and incident responders, the system allows data to be accurately entered into the system once and then disseminated instantly to all parties that need it.

The FIRST system links the CHP's computer-aided dispatch system bi-directionally with other agencies and their systems, such as the LA County Metropolitan Transport Authority, Freeway Service Patrols and LA County Coroner. It is Intranet-based and all operations are accessible, with familiar windowing technologies. The system is designed using open-systems technologies, which allows integration with any type of computer system.

VSAT

Philadelphia's Traffic and Incident Management System uses Very Small Aperture Terminal (VSAT) technology to provide simultaneous video and data links between roadside stations, the control centre and a mobile communications platform (Jehanian, 1995). A mini-hub is located at the control centre, which serves as the focal point for all communications. There are four fixed earth stations which verify and monitor incidents within range. Upon arrival at an incident, the mobile response vehicle acquires a satellite connection for communication with the control centre. The operator in the control centre can then control the camera, which has 360 degrees pan rotation and +90 degrees tilt.

eCall

eCall is a European initiative that is developing a system for automatic notification of emergency services when a vehicle has been involved in an accident. This technology is expected to improve response times as the information will not have to go through a traffic control operator, instead going directly to an emergency operator who will dispatch the appropriate emergency services as well as be able to access vital data about the incident.

In addition to notifying the emergency service operators about the incident, eCall will also provide them with data leading up to the incident. This will help with determining the severity of the incident and what emergency services will be best placed to deal with it. The European Commission is expecting eCall implementation by 2014.

Traffic Management and Traveller Information

In order to minimise congestion and number of secondary incidents following a previous incident, various traffic management techniques are implemented with the help of AID systems.

Many AID systems are linked to a VMS interface that can automatically change the signs to warn drivers of an incident up ahead. This is done in order to encourage the drivers to slow down to avoid any further incidents, and offer advice on possible re-routing to avoid the incident.

Drivers can also be warned by Traffic Radio on DAB Radio and the internet, and by mobile phone services, enabling them to plan their journeys and avoid incidents and congestion. For example a version of the Highways Agency traffic information web site is available for viewing on mobile phones and a free Highways Agency iPhone app is available; this pinpoints the user’s location, provides live traffic updates and tunes in to Traffic Radio, broadcasting updates from the National Traffic Control Centre.

Companion

Various studies suggest that 20% to 30% of all road crashes are related to previous incidents. The COMPANION system, which has been developed by BMW, is a roadside hazard warning system designed for use on inter-urban roads (Tarry, 1999). Its main objective is to reduce the number of “shunt” style accidents, by warning drivers in advance of stationary vehicles in front of them. This is done through roadside electronic guide markers, which emit yellow or orange signals to indicate that there are incidents ahead. The system has been trialled in Munich, Verona and Dunfermline and the key results show that, on activation of the system, traffic speeds are reduced by between 10% and 20% and average headway between vehicles is increased. VMS can also be used, where available, to provide motorists with warning messages of queues and incidents ahead

The accident rate at the COMPANION site, pre implementation, was 0.10 Personal Injury Accidents per million vehicle kms. After the implementation in 2000, the rate was estimated to be 0.06, UK- M90 COMPANION Hazard Warning System (TABASCO project & subsequent Scottish Executive research), Steve Tarry, Martin Pyne (Faber Maunsell), February 2003. An example of deployment of COMPANION is provided in the EasyWay guidelines on deployment of incident warning systems (EasyWay 2009).

Gensym G2

Real-time computer systems can be used in traffic management centres to minimise disruptions by quickly diagnosing problems, taking corrective actions and automating procedures (Vacca, 1995). The G2 package developed by Gensym is used as the software platform in various industries, such as aerospace, power utilities and government. It is also used by several European and US organisations as the software platform in their traffic management centres.

The G2 system guides operators in handling emergency situations, as well as monitoring equipment and enforcing procedures. The software can be adapted to the specific requirements of the organisation, enabling operators to focus on the most critical information.

DRIPS

Variable Message Signs (VMS), also known as Dynamic Message Signs (DMS), are large text panels located above or alongside the roadway that contain 2 or 3 lines of text providing informative messages to motorists. VMS are used for daily traffic information, but are also especially useful during traffic incidents. VMS are used extensively throughout Europe and the rest of the world.

VMS that provide information on alternative routes are also known as Dynamic Road Information Panels (DRIPs). Information provided by a DRIP can influence driver route choice and control traffic flows. Drivers in the immediate vicinity of the incident will be informed by several lines of text on the nature and location of the incident, the likely delay and any driving instructions. Drivers further upstream of the incident will be advised and provided with alternative routes to avoid the incident congestion. The DRIPs are installed near incident hot-spots, where viable alternative routes exist.

In the Netherlands, in addition to DRIPs, there are Graphical Road Information Panels (GRIPs). These provide an easy-to-read graphical display of road links, which indicate levels of congestion and estimated delay times.

Future developments – Cooperative systems

There is much work that is currently concentrated on developing vehicle co-operative systems that will communicate between vehicles themselves and vehicles and the infrastructure. Projects such as the European COOPERS and CVIS projects are aiming at developing platforms for ITS that will enable vehicles to transfer information about their speed and location to other vehicles, either directly or via infrastructure. Such cooperative systems will speed up the distribution of traffic information to other vehicles within the affected area.

■ Incident Investigation

The ability to commence and complete investigations of incidents quickly can reduce delays that occur as a result of road closures following an incident. The objective is to capture all relevant information from the incident site and enable the road to be re-opened as soon as possible. Currently various technologies are used to capture evidence and layout of an incident site.

Photogrammetry

Photogrammetry is the method of taking multiple digital images of the scene, then piecing together overlapping images with computer software, in order to determine the distances between and dimensions of objects (Cooner, 2000). Evidence markers are placed in the scene and included in the images. Some advantages of photogrammetry include:

- The technology involved, digital cameras and computer software, is relatively cheap compared to Total Station and laser-based technologies
- Only one person is required
- It is significantly quicker than manual mapping methods, the average time for a standard investigation is 20 to 30 minutes
- Digital images also contain qualitative data, such as surface colour, texture and general condition
- Accuracy is to within +/- 15 to 30 mm
- Training courses are generally two or three days, whereas training for Total Station is typically a five-day course.

Photogrammetry has some disadvantages as well: even though the process is very quick on-scene, the processing of measurements in the office takes longer than other methods; skid marks and other evidence may need to be enhanced, particularly at night; and long incident scenes can be difficult to photograph and process.

Total Station

The Total Station survey method uses infra-red technology to record the distance between a point of reference and a prism that is placed on the object of interest (Dunn, 2003). The Total Station equipment consists of: an infra-red electronic distance meter; a rod-mounted prism, which is placed on the object of interest; a theodolite or electronic transit, which measures the horizontal angle to an object; and an internal level, which measures the vertical angles. The data is electronically stored and a computer drawing can be produced recreating the crash scene. Some of the advantages of the Total Station method are:

- It can be used off the roadway, with measurements being taken across open lanes of traffic
- The technology provides a high level of accuracy and detail
- It is quicker than manual mapping methods, but not as quick as photogrammetry.

Some limitations of the method are that it has difficulties in dense fog and extremely hot weather.

3D Laser Scanning

Expensive laser technology exists that can record the details of the evidence quickly, very accurately and in great detail (Hillier, 2003). In December 2000, the Investigations and Risk Management Group at the Transport Research Laboratory (TRL) acquired a 3D laser scanning unit, in order to assess the potential for the technology to be used in incident investigation.

Data is collected by emitting a range finding laser beam via a rotating mirror system. The beam hits objects in the scanned field of view and is reflected back into the unit. The unit computes the location of objects in the scene from the transit time between emitting the beam and receiving the reflection. Data is also collected on the colour of the object. The unit can measure data at a rate of approximately 6000 points per second and the user can set the required level of detail of the scan. The unit is capable of scanning 340 degrees horizontally and 80 degrees vertically (+/- 40 degrees), but the user sets the boundaries of the field of view to scan what is required. It is recommended to perform the scan approximately 50 metres from a target object. Once the initial scan is completed, it is necessary to move the unit to scan the scene from a different angle, since it can only record what is in its line of sight. If vehicles and pedestrians pass in front of the scanner, it will record their location instead of the incident scene, but these points can be filtered out by conducting multiple scans. Simulated 3 dimensional views of the scene and dynamic simulation of the track of a vehicle involved in an incident from the evidence captured, can be constructed by exporting the scans to various software packages.

> The 3D laser scanning unit has been used in the investigation of major transport incidents, such as the road/rail crash near Selby in the UK. However, it is considered to be relatively expensive when compared to other available technologies.

CCTV Recording, VICCOM

VICCOM is a technology developed by a private company, Traficon, that records CCTV images of an incident (Boucké, 1999). It is used around the world and works with video image processing technology, storing images not only of the incident, but also of what happened immediately before and after the incident. The technology is primarily designed for use in automatic incident detection and to aid traffic control centre operators in the detection of incidents. However, CCTV recordings could also have applications in incident investigation in establishing the cause of the incident.

■ Incident Detection - Recent and Future Developments

UK Technology Strategy Board research

In line DfT's strategy for a sustainable transport system, the UK Technology Strategy Board is prioritising five key areas of research, one of which is Informed Incident Management.

In 2010 the Board will focus on how to provide integrated and tailored information services that will enable a more effective and better-coordinated response to incidents in a disrupted transport network. This activity will affect all those involved in responding to incidents and will consider how to deploy reliable and credible information to manage traffic disruption as a result of the incident.

The aim of this research is to address the issues and barriers that prevent integrated systems and services being deployed for effective recovery from incidents. Various models will be produced to see how human behaviour and system architecture technologies can be balanced to reduce the time of recovery and impacts to congestion after an incident (Technology Strategy Board, Intelligent Transport Systems and Services, 2010).

Independent technologies already exist for AID and are in use in various countries throughout the world. However, most of those systems have shortcomings that can limit their application and reliability. The focus in the near future is to use software and algorithms to combine data received from various sources simultaneously and in real time make an assessment based on the best available information. For example, camera-based AID systems are susceptible to decreased reliability in poor weather conditions and visibility as well as varying levels of light, when used independently. However, by combining camera, floating car data, radar and even loop based AID information, the most reliable set of data can be used to detect an incident based on the conditions at the time and environment in which the incident took place.

Currently, multi source AID has been trialled in the UK in the form of HASMOS (Hard Shoulder Monitoring System). The project used software to combine data from various sources such as CCTV cameras, inductance loops and radar, and used algorithms to determine optimum detection of slow or stopped vehicles from the information gathered (Hard Shoulder Monitoring System – HASMOS, www.sea.co.uk).

In addition, project MESA is aiming to produce the specifications for an advanced digital mobile broadband standard much beyond the scope of currently known technologies. Technology developed under MESA standards will be independent of public infrastructures and/or radio frequencies. MESA based technology will provide users with fast broadband communications. This will enable those attending incident scenes to be able to have access to data and communications irrespective of what communication provisions are available in that location (www.projectmesa.org). For more information on Project MESA see the articles and Fact Sheet on the ITS Radar International web site.

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Glossary

AID	Automatic Incident Detection systems
ASTRID	Automatic SCOOT TRaffic Information Database is a database designed to take information from SCOOT and to process and store it for later retrieval and analysis
CCTV	Closed Circuit television – cameras used for monitoring of environments
COOPERS	Cooperative Systems for Intelligent Road Safety is an EC project on the development of innovative telematics applications on the

	road infrastructure with the long term goal of a "Co-operative Traffic Management
CVIS	Cooperative Vehicle-Infrastructure Systems is a European research and development project aiming to design, develop and test the technologies needed to allow cars to communicate with each other and with the nearby roadside infrastructure.
DMS	Dynamic Message Signs
DRIP	Dynamic Road Information Panel
EC	European Commission
GRIP	Graphical Road Information Panel
HASMOS	HArd Shoulder Monitoring System
INGRID	INteGRated Incident Detection is a system operating in real time that uses information from the SCOOT detectors together with historic data from ASTRID to automatically detect incidents
ITS	Intelligent Transport Systems
MMW	Millimetre Wave radar
SCOOT	Split Cycle Offset Optimisation Technique is a tool for managing and controlling traffic signals in urban areas
VIP	Video Image Processing
VMS	Variable Message Sign