
**VOLUME 9 NETWORK – TRAFFIC
CONTROL AND
COMMUNICATIONS**

**SECTION 1 DETECTION
TECHNOLOGY**

PART 2

TD 45/17

AMENDMENT NO. 1 MAY 2018

**DETECTION ON THE MOTORWAY AND
TRUNK ROAD NETWORK**

Contents

1. Introduction
 2. Business Need for Detection
 3. Business Drivers for Detection
 4. Business Requirements for Detection
 5. Functional Performance Requirements
 6. Interface Requirements
 7. Environmental Requirements
 8. Safety
 9. Related Business Unit Requirements
 10. References
 11. Approval
- Annex A Detection Performance Requirements for
MIDAS Incident Detection
- Annex B Detection Performance Requirements for
Congestion Management (MIDAS)
- Annex C Detection Performance Requirements for
Operational Traffic Information (MIDAS)
- Annex D Detection Performance Requirements for
Traffic Data Dissemination (MIDAS GOLD)
- Annex E Detection Performance Requirements for
Traffic Statistics (MIDAS)
- Annex F (England Only) Detection Performance
Requirements for Stopped Vehicle Detection
(SVD)

1. INTRODUCTION

1.1 Background

- 1.1.1 Detection systems traditionally comprise traffic sensors, detection equipment or outstations connected via communications services to an instation that can either directly, or indirectly, operate motorway signalling systems. However, some detection functions can be performed using data derived from mobile sources that have no fixed highway equipment.
- 1.1.2 Detection systems have been deployed on parts of the Motorway and Trunk Road Network (MTRN) to support services such as incident detection and traffic information. MIDAS was initially developed to identify the formation of traffic queues, which are used as indicators that incidents have occurred. When queues are detected, signals are subsequently set automatically to warn approaching motorists and protect the queues from secondary incidents. This provides speed, accuracy and efficiency in queue protection to a level that is unattainable under manual control. Such systems can be integrated with variable message signs (VMS), satellite navigation (sat nav) systems and mobile apps to provide traffic information by offering advanced warning of queues and incidents, enabling travellers to seek alternate routes.
- 1.1.3 Preceding this version of TD45, Motorway Incident Detection and Automatic Signalling (MIDAS) provided the core detection functions on the MTRN using inductive loop, radar and magnetometer-based sensors. These technologies provided inputs for a variety of services, including incident detection and traffic information. The development of operational requirements for detection placed increased demands on technology (e.g. for smart motorways control). Also, the improvement of performance and efficiency of detection solutions provided new opportunities for detection. TD45 has been revised to remove technology dependency and create a viable mechanism for innovation in detection.
- 1.1.4 Detection facilities need to be designed to meet the operational requirements of each service. TD45 provides the performance requirements for detection on the MTRN.

1.2 General

- 1.2.1 Detailed detection performance requirements for each service are described in annexes; one annex for each service. Detection data is used as inputs to systems, or subsystems that process it to derive particular outputs. The output might be to populate a traffic database, for example, or to set a warning sign, depending on the processes performed by the system and their functions.
- 1.2.2 Technology suggestions in this document and any associated annexes do not imply acceptance of solutions, technology or products, nor that performance has been assessed, or is consistent with relevant regulations.
- 1.2.3 The annexes are identified in Table 1 below. Other annexes will be added as requirements for detection are identified.

Table 1 List of Annexes for services currently supported by TD45

Annex A	Incident Detection (MIDAS)
Annex B	Congestion Management (MIDAS)
Annex C	Operational Traffic Information (MIDAS)
Annex D	Traffic Data Dissemination (MIDAS GOLD)
Annex E	Traffic Statistics (MIDAS TDAS)

1.3 Scope and Purpose

- 1.3.1 This document provides advice and requirements for the implementation of detection on the MTRN (including conventional motorways, all-purpose trunk roads (APTR), smart motorways and expressways). TD 71 (Technology Overview and General Requirements) provides general requirements (including performance-based requirements) for detection data, although it does not provide technology requirements.
- 1.3.2 Detection functions and typical sensor technologies are identified in the annex for each service. However, this document does not limit detector technologies that may be deployed. Any new detector technologies are viable as long as they meet the detection performance requirements described in the annex for the appropriate service.
- 1.3.3 The annex for each service outlines the relevant system functions that are used to support the service. However, this document and its annexes do not specify system requirements, which are described for context only.

1.4 Definitions, Acronyms and Abbreviations

- 1.4.1 The following defined terms are used in this document:

Acoustic	A type of detector that measures vehicle presence and speed by detecting sound produced by traffic from a number of sources from within vehicles and from the interaction of the vehicle's tyres with the road surface.
Alarm	An indicator normally provided to an operator that an event or incident has occurred. The alarm can be audible, or visual, and is normally raised in reaction to the receipt of an alert.
Alert	A type of detection data that identifies when a threshold has been exceeded. Examples include detection of an over-height vehicle, when a speed threshold has been exceeded, or when occupancy levels increase above a pre-set level.
Algorithm	A process that is normally expressed as a set of rules in a calculation that is performed in an operational situation. For example, the High Occupancy (HIOCC) algorithm.
All Lane Running (ALR)	An operational description of a type of smart motorway where the hard shoulder is converted to a permanent running lane.
All Purpose Trunk Road (APTR)	A trunk road that is open for use by all classes of traffic (unless local exclusions apply).
Anemometer	A sensor for measuring wind speed.
Automatic Number Plate Recognition (ANPR)	A process, system and detector that uses image processing to identify text characters on vehicle identification number plates to identify the vehicle.
Availability	A measure of the time that an item of equipment, system, component, service or facility is available for use. Availability is normally expressed as a percentage of total time.
Availability Period	An indication of the proportion of total time for which detection data is required by a service. This is normally expected to be 100% (i.e. 24/7/365). However, some services might only be needed during weekdays, for example, or during normal office hours, or during hours of darkness.
Big Data	A generic term to describe the processing of large amounts of data from a variety of sources to produce outputs that would otherwise not be available.

Business Rules Coverage	Conditional criteria such as speed or flow limits (e.g. speed detection accuracy between 20 and 70 mph)
Calculation Period	The time period after which the event or measurement occurs before it is reported (a measure of data currency).
Calculation/Estimation Method	The means by which detection data is derived from sensor inputs (e.g. arithmetic average over time).
Classification	Classification is the process of fitting various vehicles into categories, by length, width, height, weight, axle load, axle number, number of wheels, trailers and load, and some detectors will do this.
Collection Method	The means by which detection data is obtained (normally “calculated” e.g. at a MIDAS outstation), but sometimes “raw” (e.g. counts of pulses from a sensor).
Common Highways Agency and Rijkswaterstaat Model (CHARM)	New generation of traffic management centre systems, which supersedes HATMS.
Connected Vehicles	A generic term to describe the exchange of data between vehicles and between vehicles and fixed infrastructure.
Control Centre	An operational building where a facility is monitored and controlled. A control centre normally has an operations room, an equipment room, administrative facilities and staff facilities. Highways England control centres are normally referred to as Regional Control Centres (RCCs).
Conventional Motorway	A motorway with an operational regime that is not included in the smart motorways suite of traffic management measures.
Count	The number of vehicles identified by a detector passing a particular point. Count is normally time-related and it identifies the number of vehicles passing a point in a known period, unlike “flow”, which is identified as vehicles passing a point per unit time.
Data Correctness	See “False detection rate”. This is difficult to assess with confidence other than as part of long term trials.
Data Reliability	An indicator of “reliable” or “unreliable” subjectively determined by the detection facility (e.g. this could be derived from a sensor’s fault monitoring system)
Detection Data Source (or data source)	Data source is a generic term to identify where detection data is obtained from. It includes roadside detectors, CCTV cameras, communication services providers who process mobile-sourced data, operator reports, highway maintainers, police and members of the public.
Data Time Stamping Regime	Normally when a detection event occurs (allowing for calculation time if necessary).
Data type	The general type of detection data that is provided by a detector or detection facility (e.g. loops provide count for traffic flow monitoring and speed, flow and occupancy for incident detection (MIDAS)).
Data Update Interval	The time period between detection events or detection data updates (relevant if “periodic” data update mode is used).
Data Update Mode	The general arrangement for revising or updating the detection data (e.g. occurrence, periodic, snapshot).
Data Validity Period	The time period after the detection data time stamp during which the data can be used.

Detection	The process of obtaining data about changing conditions or measuring particular parameters. This is associated, for example, with traffic, vehicles, highway, weather or assets.
Detection Accuracy	Detection accuracy refers to the accuracy in measuring the quantity that is being detected, the location of the detection event and the time stamp of the detection event. Detection accuracy is often described using tolerances (e.g. +/- 10%, +/- 10m, or +/- 10s).
Detection Data	Detection data is the data that is created by, or from, a data source. Detection data is the record of a detection event or the unprocessed data available from a sensor.
Detection Delay	Detection delay is the lag between a detection event occurring and the detection data relating to that event being made available for transmission to a system. Note that this excludes communications delays.
Detection Equipment	Detection equipment is a generic term that refers to any equipment that is used to obtain detection data.
Detection Event	The detection event is an occurrence that generates detection data. It is normally identified through a detector, but it can be derived by processing data from other sources, including mobile-sourced data.
Detection Facilities	Detection facilities is a collective term to describe equipment or associated services that are used to provide detection data.
Detection Function	Detection function describes the activity that a detector is performing, which may not be fully described by the sensor. For example, a loop sensor (which detects changes in inductance) can be connected to a detector pack to produce a number of functions, including count, speed, length, occupancy and headway.
Detection Performance	The set of characteristics that describe the required performance of detection data, the operational constraints that detector equipment is required to perform in and relevant interface requirements.
Detection Products (or detector products)	Sensors, detectors and associated equipment that are marketed by suppliers.
Detection Rate	The detection rate is the percentage of detection events identified by a detector compared to the actual number of detection events (normally relevant to threshold trigger events such as HIOCC outputs).
Detection System	A detection system normally comprises all of the components that are needed to perform a detection function. The components of a system generally include hardware and software, instation and outstation equipment, communications and data. It should be recognised that some of the system components might be shared with other systems (e.g. communications or operator interfaces). Some components of a system are packaged into a subsystem. A detection system such as MIDAS uses the detection data gathered by detection facilities as inputs required by a service.
Detection Technology	Detection technology is a generic term to describe the detection equipment and associated systems, communications, interfaces and processing.
Detection Zone	The detection zone is the area of the highway surface that detection data for a detection event relates to. This can be restricted by the size and shape of a sensor (i.e. for inductive loops), by configuration (e.g. for image processing), by orientation or physical constraints (e.g. for microwave-radar sensors), or by data processing (e.g. for mobile-sourced data).

Detector	Detectors are the devices that are installed on the MTRN as part of a detection system to provide detection data to other roadside devices or a control centre. Detectors include sensors, but they perform additional functions to sensors. In particular, detectors convert inputs from sensors into detection data that is useful for a detection system. A detector pack is often combined with a sensor to create a detector that is a single unit.
Detector Pack	A detector pack is one element of detection equipment that is used to convert outputs from sensors into detection data. Some sensors are integrated with a detector pack such that the detector and sensor are provided as a single unit.
Downstream	A position trailing a reference point, measured in the direction of travel.
Emissions Monitoring	Emissions monitoring is a service that refers to the monitoring of pollutants and products normally derived from road vehicle usage (e.g. nitrogen oxide and Nitrogen dioxide and carbon dioxide and particulates).
Equipment Type	Equipment type describes the detection or sensor technology. This may be defined by the service (e.g. loop, CCTV, automated weather station).
Error Probability	Error probability is a measure, or assessment, of the probability of high level data objects (e.g. event or information records) that are delivered as part of the service being erroneous within the bounds of the accuracy and timeliness defined.
Error Standard Deviation	Error standard deviation is normally related to a value detection, such as counts (e.g. vehicles per unit time).
Estimation/Simulation Model Identity	A specific algorithm or process normally used to calculate detection data output (e.g. HIOCC algorithm).
Expressway	A type of highway where technology is applied to a high quality, grade separated dual carriageway.
False Detection Rate	The false detection rate is a measure of the number of times that alert detection data is transmitted incorrectly (i.e. when there is no relevant detection event). The false detection rate is normally expressed as a percentage when describing detection equipment, or detection data attributes (i.e. the number of incorrect detection events reported as a percentage of the number of actual detection events). However, operational requirements for false detection may be expressed as a number of false alarms per control room per shift, or per system per day, etc. False detection might not represent a technical fault. For example, a flapping tarpaulin might create an over-height alert when the lorry it is on is actually not over-height (which is not apparent when the stationary vehicle is measured).
Floating Vehicle Data (FVD)	Floating vehicle data is processed from the position data that is reported from vehicles in the general population. The performance of this data is dependent on a variety of factors, most notably, the penetration rate of the vehicles (i.e. how representative the FVD sample is of the whole population).
Flow	The total number of vehicles passing a given point per unit time. Flow data is often classified according to particular vehicle characteristics (e.g. length).
Gap	See "Headway"
Headway	Headway is the distance between the rear of one vehicle travelling in a lane and the front of the following vehicle.
HIOCC	The HIOCC and HIOCC2 algorithms are used to generate alert detection data that is used by the MIDAS subsystem for an incident detection service.
Incident	An incident is an event that restricts the capacity of the highway.

Incident Detection	Incident detection is an operational service that provides detection of incidents for the benefit of operational staff and to enable information to be presented to road users. MIDAS provides an incident detection service by detecting when a queue is formed after an incident has occurred.
Inductive Loop	An inductive loop is a type of sensor technology that uses a loop of cable buried in the highway surface. The inductance of the loop changes under certain conditions, in particular, the presence or passage of ferrous material and the change in inductance can be monitored to detect a vehicle.
Infra-red (or infrared)	Infra-red is a type of sensor technology that relies on the transmission or reception of electromagnetic waves in the infra-red part of the spectrum (700 nm (430 THz) to 1 mm (300 GHz)). Infra-red can be used as part of image processing sensing technology or for sensing thermal heat sources.
Instation	An instation is a general term for the systems and equipment that form the parts of a system located in a control centre (as opposed to outstation equipment, which is located externally – normally at the roadside).
Interface	An interface exists where two objects, components, systems, processes or bodies meet and it is necessary to ensure that they are described in a way that they are compatible with each other. An interface description can include various elements, such as data, communications, electrical, power, foundations, fixings and environmental.
IP Code	Degrees of protection provided by enclosures.
LIDAR (Light Detection and Ranging)	LIDAR is a detector technology measures vehicle position, speed and class across multiple lanes.
Magnetometer	A magnetometer is a road surface-mounted sensor technology that monitors the earth's magnetic field and identifies changes in it that indicate the presence, or passage of a vehicle.
Mean Absolute Error	The mean absolute error is the difference between the means of forecast and measured quantities.
Mean Error	The mean error is the average error of a number of measurements of a quantity that is calculated by taking the mean value of the magnitude of the positive and negative errors. Normally, mean error is related to a value detection, such as counts (e.g. vehicles per unit time).
Mean Time Between Failures (MTBF)	MTBF is the mean period between failures of one item of equipment, system, technology or facility.
Mean Time to Repair (MTTR)	MTTR is the mean time that is required to repair an item of equipment, system, technology or facility. For repair service contracts, this is normally taken from the arrival on site (or arrival at the point at which the repair can be performed). For operational purposes, the MTTR is normally measured from the time at which the fault is reported.
Meteorological Monitoring	Meteorological monitoring is a general term to describe the monitoring of a variety of environmental quantities that help to describe weather or weather-related events. This includes wind speed/direction, temperature, ice, fog, rainfall and flood.

Microwave	Microwave is a type of sensor technology that relies on the transmission or reception of electromagnetic waves in the microwave part of the spectrum (1 mm (300 GHz) to 1 m (300 MHz)). Microwave detectors can be used to detect the presence of vehicles and by taking advantage of the Doppler effect, it is used in speed detectors. Microwave is normally associated with radar technology and the terms are commonly interchangeable. Some microwave detectors are identified by qualifying terms such as “millimetric”, which refers to the shorter wavelengths in the microwave spectrum.
Mobile App (or “Apps”)	A mobile app (abbreviated from “application”) is a program that runs on a mobile device. Mobile apps exist for a multitude of purposes, including travelling. They can be used for providing travel and traffic information, navigation and for location reporting.
Mobile-Sourced Data	Some apps enable data about a traveller’s journey to be collected as mobile-sourced data, which subsequently can be processed into useful detection data.
Mobile Device	A mobile device is a generic term for a mobile phone, tablet or other similar portable device.
Motorway and Trunk Road Network (MTRN)	The MTRN is the highway network for which the Secretary of State is the highway authority.
Motorway Incident Detection and Automatic Signalling (MIDAS)	MIDAS is a detection system that provides detection data for incident detection, traffic information, congestion management and traffic data services. It was initially deployed for incident detection. MIDAS uses vehicle presence and flow detectors to detect speed, flow and occupancy of lanes, with categorisation by length. As well as being a system, the part of MIDAS that is implemented in the RCC is the MIDAS subsystem. The MIDAS subsystem performs processing functions so that other systems and subsystems can deliver their services using the processed detection data (e.g. set speed limits and associated messages on VMS to warn approaching travellers).
National Roads Telecommunication Services (NRTS)	The service contract that Highways England uses to obtain its operational telecommunications services. NRTS2 is the second generation of the service contract.
Number of Data Points	The number of locations at which data is collected to obtain the detection data. Normally, this will be one, but some services might require more than one data point (e.g. OD monitoring).
Occupancy	Occupancy is the percentage of time that a detector’s detection zone is occupied by a vehicle (or vehicles) as a proportion of total time. Note that this refers to detectors that detect the presence or passage of vehicles.
Operator	An operator is a person who is responsible for monitoring and controlling remote equipment and for communicating with relevant service providers to achieve a specific objective (such as incident resolution). An operator is also an organisation, entity or service provider that is responsible for the operational management of the highway network.
Operator Interface	An operator interface is a control room device that presents information to operators and enables them to interact with the relevant systems to control or monitor remote equipment.
Origin/Destination (OD)	Origin Destination is a type of detection data that describes the starting and ending points of a journey. This is commonly used to create an OD matrix, which can be used for transport planning.

Outstation	An outstation includes detection equipment that is mounted externally from the control office (normally in cabinets at the roadside). An outstation can include different types of equipment, depending on the purpose, complexity and system architecture. For example, a MIDAS outstation includes the detector packs, communications interface equipment and related power supplies and connections.
Percentage occurrence coverage	See “Detection rate”
Piezo	Piezo detectors are pressure sensors that are mounted in the highway surface that rely on the piezoelectric effect to identify the presence of a wheel, or to measure the force that is being carried by that wheel. They are commonly used for vehicle classification (e.g. in a road charging situation) or for enforcement (e.g. weigh in motion).
Pneumatic	Pneumatic sensors normally consist of sealed flexible tubes that are mounted in or on the road surface to detect the presence of wheels. Pneumatic sensors are not normally used in fixed installations, but they are used for temporary traffic counting sites.
Presence	Presence is a detection function that refers to the existence of a vehicle in a detector’s detection zone without reference to the vehicle’s speed.
Quantity	Quantity is a general term for an item, characteristic or feature being measured by a detector. For example, speed, flow, occupancy.
Queue Detection	Queue detection is a detection function that is achieved by detecting when traffic is stationary or moving slowly. Queue detection is commonly used as a means of detecting that an incident has occurred (by detecting the secondary effect of the incident). As such, queue detection provides the detection function for an incident detection service.
Radar	(see microwave)
Radio Frequency Identification (RFID)	RFID is a generic term to describe how objects can be identified using radio communications. In the highway context, RFID is used as a means by which vehicles communicate with roadside infrastructure. RFID normally relies on the use of vehicle mounted devices to provide the communications interface (sometimes referred to as a tag). It is normally used in any service that requires identification of a vehicle, for example road charging.
Redundancy	Redundancy is an engineering design technique that increases the availability of a product, system, component, infrastructure or service by ensuring that the failure of one element does not have an immediate impact on the performance. For example, standby generators and uninterruptable power supplies protect against power failures or radar detectors might be used in addition to loop detectors to perform the same detection function at the same location in case one or the other fails.
Reliability	See “Availability” (Note that this does not relate to data reliability.)
Sensor	A sensor is a device that monitors a physical attribute (e.g. light or inductance) that is processed by a detector to create detection data. A sensor might register a reduction in received light from a transmitter, which is used to generate alert data relating to an over height vehicle detection if the transmitter and sensor are arranged to perform that function.
Service	A service is an activity that supports operational functions and processes by making particular use of detection data. Services include incident detection, congestion management, operational traffic information, traffic data dissemination and traffic statistics.

Service Grade	Service Grade is a measure of the importance of the detection data according to a separately defined categorisation e.g. 0 – Not Applicable 1 – Safety Related 2 – High Quality 3 – Normal Quality 4 – Low Quality 5 – Special Quality
Signal	A signal is an output device that is mounted over, or next to, a highway to communicate with motorists, normally to provide simple warnings and instructions (such as speed advice and speed and lane control).
Signalling	Signalling is a general description of the process, technology and operations associated with the presentation of instructions and advice on signals.
Smart Motorways	Smart motorways are motorways where the traffic is managed using a suite of traffic management measures that facilitates the dynamic control of traffic for congestion and incident management. The measures include: – All Lane Running (ALR) – Hard Shoulder Running – Variable Mandatory Speed Limits (VMSL) – Queue Protection – Lane Specific Signalling – Ramp Metering
Subsystem	A subsystem is a Highways Agency Traffic Management System (HATMS)-compatible system element that performs a particular control or monitoring function. Subsystems cannot act independently and they need to be connected to a Control Office Base System (COBS), which is the core of HATMS. Subsystems include signal, meteorological, MIDAS and message sign. Note that CHARM is an alternative control system that does not have the same architecture as HATMS, with no subsystems or COBS.
System	A system identifies various items of equipment, technology, interfaces, communications and data that are arranged to deliver a particular process, function or output in support of operational activities.
Telemetry	Telemetry is the measurement of a quantity remotely.
Time Precision	See also “Detection Accuracy”. Time precision is a measure of how exact the reporting of time is on a time stamp for a detection event (e.g. to the nearest second, minute, hour).
Traffic Control	Traffic control is a generic term to describe systems, technology, processes and operational interventions that are used to actively influence or manage traffic on the network.
Traffic Information	Traffic information is an operational function that delivers information relating to traffic conditions to third party organisations and to travellers.
Trunk Road	See “MTRN”
Ultrasonic	Ultrasonic detectors operate in the frequency range 20kHz to 65kHz. They use sensors to detect reflected ultrasonic waves that are emitted from a source and to identify the presence of vehicles.
Upstream	A position in advance of a reference point, measured in the direction of travel.

Vehicle Classification	The process by which the type of vehicle being detected is placed in category. Vehicles can be classified by their dimensions (length, width and height), weight, axle load, number of axles, number of wheels and their load or purpose. Subsequently, they can be compared with a list of vehicle categories. For example motorcycles, cars, buses and lorries are in different categories. Vehicle classes can also be further categorised by technical features such as weight, axle weight, height, length, width and load.
Veracity	A set of attributes that determine the correctness, truthfulness or error rate in the detection data.
Weigh-in-Motion (WIM)	WIM is a detection function that measures the axle weight of a vehicle whilst the vehicle is moving.

1.4.2 A list of abbreviations used in this document is given in Table 2 below.

Table 2 Abbreviations used in this document

Abbreviation	Description
ALR	All Lane Running
APTR	All Purpose Trunk Road
CCTV	Closed Circuit Television
CHARM	Common Highways Agency and Rijkswaterstaat Model
CPR	Construction Products Regulations
DMRB	Design Manual for Roads and Bridges
FVD	Floating Vehicle Data
GSM	Global System for Mobile Communications
HATMS	Highways Agency Traffic Management System
HIOCC	High Occupancy Algorithm
LIDAR	Light Detection and Ranging
IP	Ingress Protection
IP	Internet Protocol
MD	MIDAS Detector
MET	Meteorological Subsystem
MIDAS	Motorway Incident Detection and Automatic Signalling
MTRN	Motorway and Trunk Road Network
NMCS2	National Motorway Communications System, Second Generation
NRTS	National Roads Telecommunication Services
RCC	Regional Control Centre
RFID	Radio Frequency Identification
RIS	Roads Investment Strategy
SHW	Specification for Highway Works
TSP	Telecommunications Service Provider
VMS	Variable Message Sign(s)
WIM	Weigh in Motion

1.5 Equality Impact Assessment

1.5.1 Where there is a requirement within this document which means the resultant design falls within the scope of the Equality Act, an equality impact assessment shall be carried out by the designer.

1.6 Mutual Recognition

1.6.1 Where there is a requirement in this document for compliance with any part of a 'British Standard', technical specification or quality mark, that requirement may be met by compliance with GD 01 (Introduction to the Design Manual for Roads and Bridges (DMRB)).

1.7 Safety

1.7.1 The design shall be in accordance with the overseeing organisations published policies on designing for maintenance and the Construction (Design and Management) (CDM) Regulations 2015.

- 1.7.2 Risk Assessments shall be performed in accordance with GD 04 (Standard for Safety Risk Assessment on the Strategic Road Network).

1.8 Application in Devolved Administrations

- 1.8.1 Contract-specific additional requirements and substitute requirements may be included for contracts where the overseeing organisation is not Highways England (or its successor). Where required, these will be issued by:

Scotland:

Transport Scotland, 8th Floor, Buchanan House, 58 Port Dundas Road, Glasgow, G4 0HF.

Wales:

The Welsh Government, Transport Department, Cathays Park, Cardiff, CF10 3NQ.

Northern Ireland:

Director of Engineering, Department for Infrastructure, Clarence Court, 10–18 Adelaide Street, Belfast BT2 8GB.

- 1.8.2 The overseeing organisation may also issue an initial list of alternative requirements/departures.

1.9 Implementation

- 1.9.1 Implementation shall be in accordance with GD 01.
- 1.9.2 This document shall be used on all schemes for the provision of detection facilities. This includes installation of detection equipment on the highway (and schemes where this is being considered). This document also applies where such activities are being prepared, provided that, in the opinion of the overseeing organisation, this would not result in significant additional expense or delay. Design organisations should confirm its service to particular schemes with the overseeing organisation. The relevant advice note in the design manual for roads and bridges (DMRB) gives further interpretation of this document and guidance for scheme design.
- 1.9.3 This standard shall be used on all projects for the assessment, design, construction, operation and maintenance of conventional and smart motorways, APTR and expressways (and roads designated by the overseeing organisation in Northern Ireland) except where the procurement of works has reached a stage at which, in the opinion of the overseeing organisation, its use would result in significant additional expense or delay in progress (in which case the decision must be recorded in accordance with the procedure required by the overseeing organisation).

1.10 Feedback and Enquiries

Users of this document are encouraged to raise any queries and/or provide feedback on its content and usage to the dedicated Highways England team. The email address for all enquiries and feedback is: Standards_Enquiries@highwaysengland.co.uk

2. BUSINESS NEED FOR DETECTION

2.1 General

2.1.1 Detection is an operational function that provides input data to systems, which process the data to deliver particular outputs. For example, anemometers are used to monitor wind speed and direction and to raise alerts when thresholds are exceeded. The alert information that is generated by a system (e.g. the meteorological subsystem (MET)) can then be used by operators, for example, to allocate resources to bridge closure procedures, or to set warning messages on VMS.

2.2 Detection as a Function

2.2.1 In this context, detection is the first operational intervention that Highways England performs to achieve its business objectives. The path from detection to business outcomes is outlined in the examples in Figure 1 below. This shows how requirements (that are derived from business needs) are met through the combined performance of technical and operational activities. This document relates most closely to the “data source” and “detection technology” in Figure 1.

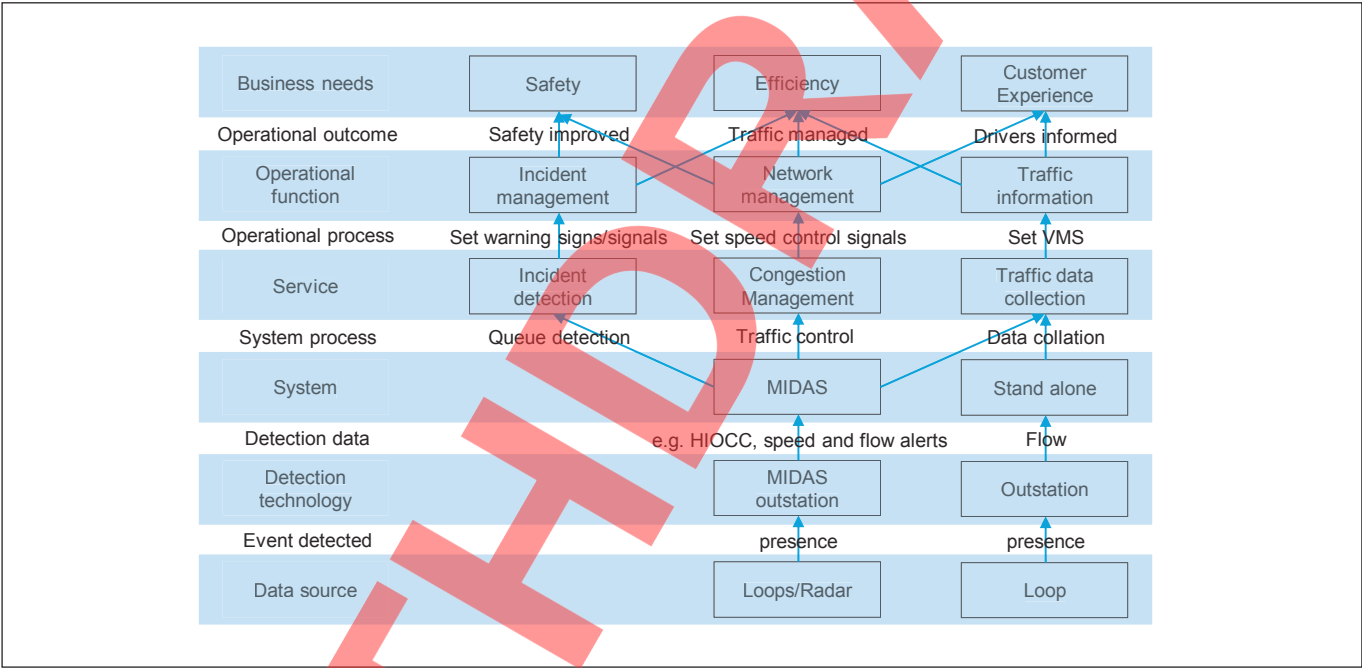


Figure 1 Examples of using detection to achieve business needs

2.2.2 Business needs are provided through operational functions that are delivered using services. Detection facilities shall be matched to a service (e.g. incident detection). The input requirements of the service shall be met by the detection facilities delivered by a scheme. For example, smart motorways is a network management function that is delivered using a congestion management service that is delivered using a detection system. Detection data shall be provided by detectors and associated equipment and services that are delivered by the scheme.

2.2.3. Section 4.5 below highlights how some detection technologies are identified with particular services. The detection performance requirements for each service are described in the annexes to this document.

WITHDRAWN

3. BUSINESS DRIVERS FOR DETECTION

3.1 Business Functions

3.1.1 Figure 1 above highlights the key requirement that the detection function needs to deliver: highway detection shall meet the operational input data needs of the business. This shall be achieved by delivering the event and monitoring data to relevant systems that are deployed to meet particular services' needs. Services will meet operational needs through appropriate system processes and operational procedures, so that business objectives are achieved.

3.2 Business Outcomes

3.2.1 Figure 1 provides examples of how detection helps to deliver business outcomes. The overseeing organisation will identify specific business requirements that are related to detection. The business requirements that relate to detection are expected to include the following, but other business drivers might also be relevant;

- Safety (early and accurate detection of incidents and weather that triggers appropriate operational responses);
- User satisfaction (early detection of events enables communication of issues affecting network performance to travellers, with appropriate alternative advice);
- The smooth flow of traffic (incident resolution and network availability is enhanced by early and accurate incident detection).

3.2.2 Detection shall be designed to meet business needs as expressed by the overseeing organisation.

3.2.3 The overseeing organisation's policies shall be applied with regard to detection, which are expected to include a variety of issues, for example:

- Business unit policies
- Equality, diversity (e.g. standard text to use in documents)
- Health and safety
- Operations and Maintenance (including maintenance services)
- Communication services (e.g. NRTS - National Roads Telecommunication Services)
- Procurement/commercial
- Data (e.g. privacy, security, dissemination)

3.3 Business Case Issues

3.3.1 Business case issues (e.g. provision criteria) that affect detection provision are identified for specific services in the annexes.

WITHDRAWN

4. BUSINESS REQUIREMENTS FOR DETECTION

4.1 General

- 4.1.1 Detection facilities shall be deployed to meet the needs of detection system processes in the delivery of operational services. The design shall ensure that the combination of sensors, detectors and detection systems meet the requirements of the overseeing organisation and integrate seamlessly into the existing facilities. Each annex identifies the detection performance requirements of a service.
- 4.1.2 Services normally rely on systems. Designs of detection facilities shall ensure that detectors deliver inputs so that the system processes can create the required outputs. For example, the MIDAS subsystem uses inputs from traffic detectors to generate outputs for:
- The automatic setting of appropriate signals and messages in response to incidents affecting the MTRN
 - Providing traffic flow data and statistics
 - Informing drivers of the prevailing network conditions
- 4.1.3 Sensor connectivity shall be specified either for connection to roadside detector equipment in a standalone mode (e.g. for overheight vehicle warnings), or roadside detector equipment can be connected directly to a control centre (such as one of Highways England's Regional Control Centres (RCCs)), or to a data centre for processing. The design shall specify how connections shall be achieved by using an appropriate communications service, which shall be NRTS wherever appropriate.
- 4.1.4 The control, or data centre systems will process and analyse data derived from detection facilities. Depending on the process being undertaken, the design shall ensure that detection systems are able to interact with other systems and subsystems to set signals, trigger pre-set alarms, warn or inform road users and provide traffic flow data and statistics.

4.2 Operations and Maintenance

- 4.2.1 Acceptance of detection technology into maintenance and operation shall be determined by applying MCH1349 (Technology Maintenance Instruction - Operational and Maintenance Requirements for Technology Systems and Equipment).

4.3 Detection Functions

- 4.3.1 The design shall ensure that detection functions specified by the overseeing organisation for the detection system are met by sensors /detectors that provide the raw data from the highway, or the environment. This will allow the detection systems to process this data into usable functions. These functions include, but are not limited to, the following:
- Vehicle presence (moving and stationary)
 - Vehicle count
 - Vehicle speed
 - Vehicle gap or headway

- Lane occupancy
- Vehicle classification (e.g. using weight, axle weight, height, length, width, load)
- Vehicle identification (e.g. using ANPR)
- Meteorological monitoring (e.g. wind speed/direction, ice, fog, rainfall, flood, ambient light)
- Emissions monitoring (e.g. NOx, CO2, particulates)

4.3.2 The most effective method for delivering the required detection performance shall be chosen. For example, detection facilities can be deployed either as individual sensors, or combined (depending on the requirements of the service, system or process that the detection facilities are supporting and the type of detection technology employed).

4.3.3 Where physical detectors are used, they may be deployed in combination with other detectors (of the same or different technology) or with separately sourced data to achieve the particular detection performance requirements. Where necessary, detectors shall be deployed in pairs for specific functions (e.g. two inductive loops are required for speed measurement, whereas one radar sensor can be deployed for this).

4.3.4 The detection technology specified shall be compatible with the existing facilities at the location for that scheme. The selection of detection technology shall be dependent upon the functionality of the system and performance requirements of the service for which the detection data is required. Existing system, or outstation equipment, will not be modified to accommodate new detection technology other than in exceptional circumstances and with full business case approval from the overseeing organisation.

4.3.5 Sensors and detectors specified shall be appropriate to the location and that they are arranged to take into account local environmental effects and conditions. Where local conditions preclude the use of specific sensor types or configurations, these shall be excluded from the design or the environmental effects shall be mitigated at that location. For example, light beam overheight vehicle detectors with an east-west orientation may be susceptible to poor performance in low angle sunlight, which might be mitigated with shielding or altered alignment.

4.3.6 Detector locations might not be fixed for some solutions (e.g. using mobile-sourced data). However, where accurate detection location reporting is required, the needs of the system or service shall be met (e.g. using pseudo detector locations).

4.4 Detection Data

4.4.1 Detectors provide data about the presence or passage of vehicles, traffic related conditions or other features that are relevant to the operation of the MTRN. Subsequent to the acquisition of the data, it is used by the systems and services that rely on it to perform their control or information functions to support safe, efficient, informative highway operations.

4.4.2 Detection data is derived from processed sensor inputs, or it can be processed from data that is collected for other purposes (for example, traffic information from mobile-sourced data.). Detection data has various quality attributes. These can be expressed as the detection data requirements of the service, which enables the performance of the components of the systems to be determined (e.g. communications and sensors). Parameters such as detection rate, false detection rate, detection delay and detection accuracy (of measured quantity, time and location) are of particular importance.

4.4.3 Detection data can be grouped into two generic types: alarms/alerts and telemetry. Alerts typically provide reports of specific events, whereas telemetry provides information about a measured quantity. Alarms are generally unpredictable and ad-hoc, but telemetry commonly requires continuous, or regular reporting. Alerts can be processed wherever it is appropriate to do so (including at the roadside), whereas telemetry data is often transmitted as raw data.

4.4.4 Sometimes alerts and telemetry are derived from the same detection data source. For example, wind speeds can be monitored as they rise and fall, but if they exceed a certain level, an alert can be created. In the same way, traffic counts can be monitored continuously for traffic information purposes, but alerts can be transmitted if a queue develops.

4.5 Detection Technology

4.5.1 Detection data is derived from roadside sensors or processed data. Some common sensor technologies that are currently used to create detection data are listed below and examined in more detail in the ensuing paragraphs. It should be noted that this is not an exclusive list and innovations in detection technology shall be considered if they meet the detection performance requirements identified in the annexes:

- Inductive loops
- Infra-red/LASER motion detectors
- Microwave RADAR detectors
- Light sensors
- Magnetometers
- Video processing detection
- Automatic Number Plate Recognition (ANPR)
- Acoustic detection
- Pressure sensors (e.g. piezo devices)
- Environmental/meteorological sensors (e.g. wind, rain, visibility, temperature, rainfall, water level, smoke, fire, gases, particulates)

4.5.2 Detection technology has been analysed by the US Department of Transportation Federal Highways Administration and a description of detector performance is available from Publication No. FHWA-HRT-06-108 (Traffic Detector Handbook). This provides a general performance review that shall be considered in discussion with suppliers when designing detection technology.

4.5.3 Inductive loops can be deployed in a variety of designs to satisfy a range of services. The technology is well-understood and mature, with a large experience base. Inductive loops can be used to provide basic traffic parameters (e.g. flow, presence, occupancy, speed, length, and gap). In particular, they provide high accuracy for count data and algorithms are available for obtaining accurate occupancy measurements. High frequency excitation models provide classification data. Inductive loops are insensitive to inclement weather such as rain, fog, and snow. However, installation of inductive loops requires pavement disruption and improper installation risks pavement life reduction and poor performance. Installation and maintenance require lane closures and loop cables are subject to the stresses of traffic and temperature. Multiple sensors

are usually required to monitor a location and detection accuracy may decrease when the design requires detection of a large variety of vehicle classes.

- 4.5.4 Magnetometer technology is less susceptible than inductive loops to stresses of traffic. Some types of magnetometer can be used where inductive loops are not feasible (e.g. bridge decks) and some models are installed under the roadway without need for pavement cuts (if boring under the highway is used). Magnetometers are insensitive to inclement weather such as snow, rain, and fog and some models transmit data over a wireless link. However, where installation requires slot cutting, pavement disruption occurs and improper installation decreases pavement life (but to a lesser extent than for inductive loops). Installation and maintenance require lane closures and models with small detection zones require multiple units for full lane detection. Magnetometers tend to be 'point' detectors and may need extra detectors to ensure coverage or to calculate speed and possibly vehicle length.
- 4.5.5 Microwave radar detectors are typically insensitive to inclement weather at the relatively short ranges encountered in traffic-related services. They provide a direct measurement of speed and they can operate across multiple lanes. However, Continuous Wave (CW) Doppler sensors may not detect stopped vehicles and some models' performance is influenced by nearby large steel structures (e.g. gantries) and overhead conductors within the beam cone. Also, target position information provided by radar technologies become less accurate at distance as the beam diverges.
- 4.5.6 Millimetric radar detectors operate in the 30-300GHz range and they are relatively insensitive to inclement weather. They are highly directional, which reduces the risk of false detection and of infrastructure interference. Antennae are compact and lightweight and there is a greater Doppler shift than for CW radar, which improves the accuracy of velocity measurement. The comparatively high attenuation in air reduces interference when two systems are installed close together. Millimetric radar is better for stopped vehicle detection (SVD) than CW radar.
- 4.5.7 Active infrared (LIDAR) detectors transmit multiple beams for accurate measurement of vehicle position, speed and class across multiple lanes. Their performance may be affected by dense fog or blowing snow. Installation and maintenance requires lane closures for gantry-mounted sensors (e.g. for periodic lens cleaning).
- 4.5.8 Passive infrared detectors with multi-zone passive sensors measure speed. Their performance might suffer from reduced vehicle sensitivity in heavy rain, snow and dense fog, so some models are not recommended for presence detection.
- 4.5.9 Light sensors using any appropriate wavelength can be used to monitor changes in light input levels. The light input can be derived from a lantern (e.g. beam-breaking for overheight vehicle detection), or a natural source (such as the sun) for use in light level monitoring.
- 4.5.10 Ultrasonic detectors can be used for multiple lane operation for overhead vehicle detection. Environmental conditions such as temperature change and extreme air turbulence can affect ultrasonic detector performance. This is mitigated by temperature compensation in some models. Large pulse repetition periods may degrade occupancy measurement on higher speed roads.
- 4.5.11 Acoustic detectors measure vehicle presence and speed by detecting sound produced by traffic from a number of sources from within vehicles and from the interaction of the vehicle's tyres with the road surface. As the vehicle passes the detector, a change in sound energy is detected and a vehicle presence signal is generated. When the vehicle has passed, the sound energy level drops below the detection threshold and the vehicle presence signal is terminated. Sounds outside the detection zone are attenuated. Acoustic sensors provide passive detection that is insensitive to precipitation and it can be applied across

multiple lanes for some models. Colder temperatures may affect vehicle count accuracy. Other influences on performance include the speed and nature of traffic (e.g. stop-and-go) and noisy environments.

- 4.5.12 Video image processors provide multiple lane monitoring across multiple detection zones for each lane. Detection zones can be easily added to existing sites to provide a rich array of data and detection sites can be aggregated to create cost-effective wide-area detection. Installation and maintenance might require lane closures if cameras are mounted over the carriageway (e.g. for lens cleaning). Performance can be affected by poor visibility, vehicle shadows, lane straddling, obscuration, day/night transition, low angle sunlight and the presence or movement of structures, cables, water, salt grime, icicles and creatures in the sensor. Optimum presence detection and speed measurement generally requires minimum camera mounting heights. Some models are susceptible to camera motion caused by strong winds or vibration of the camera mounting structure, which can be mitigated with image stabilisation. Image processing of different wavelengths (e.g. infra-red and ultra violet) is available from some models, which can improve detection performance for some services.
- 4.5.13 ANPR applies image processing techniques on still images to perform optical character recognition on the registration numbers of vehicles. Images are taken from video, or still cameras mounted above or alongside the carriageway. ANPR can perform some detection functions because it treats each vehicle as a unique item. Ultra violet illumination can be used to improve image processing for ANPR performance, particularly at night, but this requires careful filtering (or consideration of this at design stage to ensure suitable installation) to mitigate problems with daytime glare.
- 4.5.14 Image processing techniques can also be used to identify vehicle characteristics, including orange plate detection for hazardous loads.
- 4.5.15 When they are operating in the infra-red spectrum, image processing techniques can be used to identify unusual heat sources (e.g. tyres running hot) to enhance safety, particularly with appropriate sunlight filters to reduce excessive glare.
- 4.5.16 Piezo detectors use the piezoelectric effect to measure the pressure exerted by a vehicle's wheel on the road surface, which is converted into an electrical current. Piezo detectors are most suitable for services that require weight to be detected (e.g. for weigh-in-motion or vehicle classification). Permanent piezo sensors are disruptive to the road surface for installation.
- 4.5.17 Pneumatic detectors measure pressure and provide similar detection to piezo detectors, but they are not considered to be viable for permanent detection because they are very disruptive to the highway surface and they impose significant maintenance burdens. They are used for temporary traffic counting.
- 4.5.18 Bluetooth® and Wi-Fi tracking of devices can be used to detect vehicles, but the detection range can be short and detection times can be unreliable. Also, it is difficult to classify vehicles from the passage of devices without additional information. Mitigation of these challenges can be achieved through multiple detectors, with increased complexity and cost.
- 4.5.19 Connected vehicle detection (including RFID – Radio Frequency Identification) depends on communication between roadside and vehicle-mounted equipment. RFID solutions have been developed for road user charging services that depend on vehicle-installed technology. Connected vehicle technology is developing to accommodate automation (and future vehicle autonomy). The ability to acquire data directly from vehicles provides opportunities for high quality detection data. However, its value is limited by the penetration rates of the vehicle technology.
- 4.5.20 Environmental and meteorological detectors use a variety of sensor technologies to monitor gases, particulates, temperature, visibility, wind speed and direction, rainfall, water levels and emissions.

4.6 Combining Sensors

- 4.6.1 Designs should take into account whether detection performance can be improved through the appropriate combination of detection technologies or data. The detection rate shall be maximised and the false detection rate shall be minimised as demanded by the service.
- 4.6.2 Redundancy shall be used where high reliability requirements make it viable. In such circumstances, sensors of the same or differing technologies perform the same detection functions individually at the same location. If one fails, the other continues to operate (assuming that there are no common mode failures, such as power). Redundancy is used to improve reliability and availability, rather than to increase detection rates, or reduce false detection rates, but these might be delivered as secondary outcomes, depending on how the detection data is processed.
- 4.6.3 The use of multiple, or combined, sensors for improved reliability/availability shall be subject to approval by the overseeing organisation.
- 4.6.4 Future developments in detection approaches shall be considered in order to achieve performance requirements with efficiency savings. (E.g. combining data inputs actively using big data approaches).

5. FUNCTIONAL PERFORMANCE REQUIREMENTS

5.1 General Requirement

5.1.1 Detailed performance requirements for detectors are identified in the annexes. This section provides general performance requirements that apply to all detection facilities. This section shall apply unless otherwise stated in the relevant detection annex.

5.2 Design Requirements

5.2.1 This section identifies the requirements for designing detection on the MTRN. The requirements are identified by reference to the annexes, which describe how detection data inputs are to be provided for different services. Each annex addresses one service.

5.2.2 Detection functions for different operational processes that are relevant to the overseeing organisation includes, but not limited to:

- Motorway traffic control (speed, flow, headway, occupancy, classification)
- Coordination of Urban and Motorway control (speed, presence, flow, occupancy, origin/destination)
- Work zone traffic management (speed, presence)
- Traffic information dissemination (speed, flow, occupancy, count)
- Incident monitoring and confirmation e.g. MIDAS (speed, flow, headway, occupancy)

5.2.3 Different services might have different detection performance requirements for the same function. For example, detection performance requirements for congestion management might be different to traffic information dissemination. Detection performance requirements shall be matched to the needs of the most onerous service inputs they are serving.

5.2.4 This means that the design of the detection service should apply the following generic steps:

- i. Identify the business needs (from policy and strategy commitments and business case statements)
- ii. Determine the operational requirements (from documents such as “Concept of Operations”)
- iii. Decide which services are required (by examining the annexes to this document)
- iv. Identify which systems and subsystems are being used (e.g. HATMS, CHARM)
- v. Develop the detection design to meet the most onerous of the system, service and operational requirements served (including technology and product selection, location selection and design, interfaces, installation, testing, operational and maintenance arrangements)

5.2.5 Subsequently, the detection design should be deployed through schemes or works. During the ensuing operational phase, the service might be optimised, which is dependent on detection performance, network requirements and operational experience.

5.2.6 Iterations in the detection design process outlined in 5.2.4 above shall progress by validating design changes against the preceding steps. For example, if a new technology solution is identified as part of the detection design development (step 5), it shall be considered by identifying how its performance affects the preceding 4 steps.

5.3 System Requirements

- 5.3.1 Detection technology shall be selected to meet the detection performance requirements of the system for which it is providing detection data. For example if an incident detection service is required to provide a queue detection function, detection data shall be consistent with the control system requirements. Inductive loop and radar sensor technologies are expected to have performance profiles that meet the detection requirements identified in the incident detection annex and other detection facilities might also be viable.

5.4 Detection Performance Requirements

- 5.4.1 The detection performance requirements are described in annexes to this document by reference to PD ISO/TR 21707:2008 (Intelligent transport systems - Integrated transport information, management and control – Data quality in ITS systems). PD ISO/TR 21707:2008 provides definitions of data quality attributes that can be applied to detection performance.
- 5.4.2 The attributes described in PD ISO/TR 21707:2008 provide a standard approach for detection data requirements for services. The subset of attributes that are available for selection to describe a service's detection requirements are shown in Table 3 below. These are selected for each service in annexes.

Table 3 PD ISO/TR 21707:2008-related detection performance parameters

Data Quality Object	Short form	Attribute
Measurement Source	CA	Calculation/ Estimation Method
	CM	Collection Method
	CP	Calculation Period
	EM	Estimation/ Simulation Model Identity
	ET	Equipment Type
	NP	Number of Data Points
Precision	DP	Number of Decimal Places
	SF	Number of Significant Figures
	TP	Time Precision
Service Availability	AP	Availability Period
	TF	Mean Time Between Failures (MTBF)
	TR	Mean Time to Repair (MTTR)
Service Completeness	BC	Business Rules Coverage
	DT	Data Type(s) Covered
	PC	Percentage Occurrence Coverage
Service Grade	SG	Service Grade
Timeliness	DV	Data Validity Period
	TS	Data Time Stamping Regime
	UM	Data Update Mode
	UI	Data Update Interval
Veracity	DC	Data Correctness
	EP	Error Probability
	AE	Mean Absolute Error
	ED	Error Standard Deviation
	ME	Mean Error
	RL	Data Reliability

5.5 Maintenance

- 5.5.1 Maintenance performance requirements that are relevant to the scheme shall be applied to detection equipment that is deployed by the scheme. This relates, for example to maintenance access arrangements, including remote access and MTTR.

5.6 Resilience

- 5.6.1 Detection equipment shall be designed to provide continuous operation for a minimum service life of 15 years.
- 5.6.2 Detection equipment shall have a minimum MTBF of 5 years calculated in accordance with PD IEC TR 62380 (Reliability data handbook – Universal model for reliability prediction of electronics components, PCBs and equipment). Using the criteria of:
- Ground; stationary non-weather protected
 - Permanent working

5.7 EU Compliance

- 5.7.1 Products and services shall be described within the constraints of the Public Contracts Regulations 2015 (Statutory Instrument 2015 No.102). Particular attention should be paid to section 2, paragraph 18 and section 5, subsection 5, paragraph 42. The Public Contracts Regulations implement the Public Contracts Directive (2014/24/EU).
- 5.7.2 Where a product or service falls within the scope of the Construction Products Regulations (305/2011/EU) (CPR), requirements must be expressed in terms required by the CPR and by reference to a relevant harmonised standard. The essential requirements of the CPR shall be met by describing the performance requirements as outlined in the harmonised standard.
- 5.7.3 Where a product or service falls within the scope of any new approach directive, the product requirements must be expressed by identifying the directive, an associated harmonised standard and specific performance requirements that are described in the harmonised standard.

5.8 Sustainability

- 5.8.1 Sustainability requirements will be identified by the overseeing organisation.

WITHDRAWN

6. INTERFACE REQUIREMENTS

6.1 General

- 6.1.1 Detailed interface requirements for detectors are identified in this document's annexes. This section provides general interface requirements that apply to all detection facilities. This section shall apply unless otherwise stated in the relevant detection annex.
- 6.1.2 Existing telecommunications services and control systems (e.g. NRTS and HATMS) need to be accommodated in any detection provision.
- 6.1.3 Account shall be taken for future planned telecommunication services and control systems (e.g. NRTS2 and CHARM) where possible.

6.2 Operator Interface

- 6.2.1 Operator interfaces with detection facilities are defined by the system that is providing the service as described in the annex (e.g. MIDAS/HATMS).

6.3 System Interface

- 6.3.1 The system interface for the detection facilities is identified in the annexes.

6.4 Communications Hardware Interface

- 6.4.1 The network interface shall comply with the requirements of MCE1126 (NMCS Internet Interface Specification).
- 6.4.2 The overseeing organisation shall be consulted to confirm whether any communications adapters are required (e.g. between the highway-located detection equipment interface and existing TIA/EIA 485 (Electrical Characteristics of Generators and Receivers for Use in Balanced Multipoint Systems) NRTS/ NMCS2 infrastructure). If so, it shall be powered from the same source and securely mounted in the same equipment cabinet as the detection equipment.
- 6.4.3 Network link access shall be achieved using a socket interface identified by the overseeing organisation.
- 6.4.4 Detection technology shall achieve certification before connecting to the NRTS network in accordance with MCH1514 (Code of Connection - application process for agency project sponsors, suppliers and maintainers).
- 6.4.5 TD72 (transmission infrastructure) provides requirements for the provision of telecommunications services and associated roadside infrastructure on the highways in England.

6.5 Environmental Interface

- 6.5.1 Detection equipment shall be consistent with the environmental requirements described in section 7 below.

6.6 Installation

- 6.6.1 Installation shall be subject to manufacturers' recommendations and the approval of the overseeing organisation. Also, installation of detection equipment shall be performed in accordance with the Specification for Highways Works 1500 series – Motorway Communications where applicable.

6.7 Site and Location Issues

- 6.7.1 Site and location requirements for detection are dependent on the needs of the service and system that is being served by the detection data. These are described in the annexes.

6.8 Support Structures

- 6.8.1 If detection equipment is to be mounted on support structures, the support structures shall be subject to structural design requirements. For example, where detectors are to be gantry mounted, the requirements of BD 51/14 (Design Manual for Roads and Bridges, Portal and Cantilever Sign/Signal Gantries) shall be applied to the structural design.
- 6.8.2 Any reduction in detection performance that is caused by the presence of any highway infrastructure shall be mitigated or avoided so that it meets the needs of the service. This applies to all infrastructure, including the support structures that the detection equipment is mounted on.

6.9 Power Supply Interface

- 6.9.1 Detection equipment shall comply with TR1100 (General Technical Requirements for Motorway Communications Equipment) section 5 with regard to electrical performance and connections.

7. ENVIRONMENTAL REQUIREMENTS

7.1 General

- 7.1.1 Detection functions can be performed through deployment of sensor and detector technology (e.g. using induction loops or radar detectors). Alternatively, it can be achieved through data analysis. Where equipment is installed on the highway, the environmental performance requirements outlined in this section apply.

7.2 Ingress Protection

- 7.2.1 Ingress Protection (IP) tests shall be carried out in accordance with BS EN 60529 (Degrees of protection provided by enclosures (IP code)) with the detection equipment unpowered, but with all normal configuration items, or representative DUMMY, connectors in place. At the conclusion of each test the detection equipment shall be examined for evidence of the ingress of dust or water in accordance with BS EN 60529.

7.3 Environmental Testing

- 7.3.1 Detection equipment shall be subject to the testing requirements of TR2130 (Environmental Tests for Communications Equipment and Portable and Permanent Traffic Control Equipment for use on Trunk Roads) and the tests that the equipment should pass shall be determined as part of the design process (see section 5.2.4 above).

WITHDRAWN

8. SAFETY

8.1 General

- 8.1.1 Detection shall be deployed so that the need for staff to visit the highway is minimised in accordance with the Construction Design and Management Regulations 2015 (CDM Regulations).
- 8.1.2 Risk assessments shall be performed in accordance with GD 04 (Standard for Safety Risk Assessment on the Motorway and Trunk Road Network).
- 8.1.3 The essential safety requirements for detection equipment are embodied in TR1100.

WITTHDRAWN

9. RELATED BUSINESS UNIT REQUIREMENTS

9.1. Procurement

- 9.1.1 The designer's selection of equipment or systems in meeting the requirements of the technology service shall not be limited to detection items issued through the overseeing organisation's supply system.
- 9.1.2 Where a technology service design employs detection equipment that is not issued through the overseeing organisation's supply system, the designer shall provide a non-supplier specific performance based functional requirements definition document to the overseeing organisation's purchasing and supply organisation to enable competitive procurement in accordance with Cabinet Office rules.
- 9.1.3 Any functional requirements definition document for the supply of equipment that is not routinely issued by the overseeing organisations supply system shall include reference to the overseeing organisations interfaces used to connect to the existing service infrastructure sufficient to achieve confidence that all respective interfaces are compatible or can be configured to be compatible or that adaptors will be available to achieve designed functional performance requirements.
- 9.1.4 Where relevant, any functional requirements definition document for the supply of equipment that is not routinely issued by the overseeing organisations supply system shall establish – as part of the procurement process - the minimum requirements for any warranty agreements or service agreements.
- 9.1.5 Definition of any applicable service agreements shall include the minimum requirements for scope of service agreement, duration of service agreement, roles and responsibilities and requirements that are essential for inclusion in those service agreements as part of the procurement process.
- 9.1.6 Any functional requirements definition document for the supply of equipment that is not routinely issued by the overseeing organisations supply system shall include all necessary safety notices, maintenance and operational documentation for the safe installation, operation and maintenance of the equipment including identification of any specialist roles that may require restricted access or additional competencies in order to install, operate or maintain the equipment.
- 9.1.7 Where relevant, any functional requirements definition document for the supply of equipment that is not routinely issued by the overseeing organisations supply system shall include requirements identifying (as part of the procurement process) negotiated or agreed (including third party) partnership agreements needed to ensure equipment can be installed safely according to the risk assessments of the contractor and also installed according to any requirements to protect manufacturer warranties associated with correct installation.
- 9.1.8 Any functional requirements definition document for the supply of equipment that is not routinely issued by the overseeing organisations supply system shall ensure that equipment has not been customised or modified in a way that invalidates the CE mark.
- 9.1.9 Any functional requirements definition document for the supply of equipment that is not routinely issued by the overseeing organisations supply system shall include any optional minimum requirements that need to be included as part of any Declaration of Conformance or Declaration of Performance accompanying the equipment CE mark.
- 9.1.10 Any functional requirements definition document for the supply of equipment that is not routinely issued by the overseeing organisations supply system shall include – as part of the procurement process – identification of any additional equipment, service or licence agreements (such as – and not limited to – installation tools, maintenance terminals, Sim cards, internet connections or software including mobile apps for example) including quantities and durations.

WITHDRAWN

10. REFERENCES

10.1 Normative References

1. Construction (Design and Management) (CDM) Regulations 2015 (SI 2015 No. 51)
2. GD 01 Introduction to the DMRB
3. GD 02 Quality Management Systems for Highways Design
4. GD 04 Standard for Safety Risk Assessment on the Motorway and Trunk Road Network
5. MCH1349 Technology Maintenance Instruction – Operational and Maintenance Requirements for Technology Systems and Equipment
6. PD IEC TR 62380 Reliability data handbook – Universal model for reliability prediction of electronics components, PCBs and equipment
7. TIA/EIA 485 Electrical Characteristics of Generators and Receivers for Use in Balanced Multipoint Systems
8. MCH1514 Code of Connection - application process for agency project sponsors, suppliers and maintainers
9. Specification for Highways Works 1500 series – Motorway Communications
10. BD 51/14 Design Manual for Roads and Bridges, Portal and Cantilever Sign/Signal Gantries
11. TR1100 General Technical Requirements for Motorway Communications Equipment
12. MCE1126 NMCS Internet Interface Specification
13. BS EN 60529 Degrees of protection provided by enclosures (IP code)
14. TR2130 Environmental Tests for Communications Equipment and Portable and Permanent Traffic Control Equipment for use on Trunk Roads
15. BS EN 50293 Electromagnetic Compatibility Road Traffic Signal Systems Product Standard.
16. TR2174 NMCS2 MIDAS System Performance Specification
17. TR2144 NMCS2 MIDAS Subsystem Specification
18. TR2169 NMCS2 MIDAS Outstation Specification
19. TR2173 NMCS2 MIDAS Message Specification
20. TR2177 MIDAS Outstation Algorithm Specification

21. BS ISO 8601:2004 Data elements and interchange formats – information interchange – representation of dates and times
22. Public Contracts Regulations 2015 (Statutory Instrument 2015 No.102).
23. Construction Products Regulations (305/2011/EU).

10.2 Informative References

1. Traffic Detector Handbook: Third Edition US Department of Transportation Federal Highways Administration Publication No. FHWA-HRT-06-108
2. PD ISO/TR 21707:2008 Intelligent transport systems – Integrated transport information, management and control – Data quality in ITS systems.
3. TD 71 Technology Overview and General Requirements (DMRB 9.3.1).
4. Equality Act 2010
5. Specification for Highways Works: Volume 1 of the Manual of Contract Documents for Highway Works
6. The Traffic Signs Regulations and General Directions 2016 (SI 2016 No 362)
7. MCH 1696 “NMCS MIDAS System Overview”
8. PD ISO/TR 21707:2008 (Intelligent Transport Systems – Integrated transport information, management and control – Data quality in ITS systems
9. MCH 1529 Guidance Notes for the Performance Assessment of Detector Technology/Systems
10. MCE1060 MIDAS Traffic Data Analysis System Requirement Specification
11. TD72 transmission infrastructure
12. Public Contracts Directive (2014/24/EU).

11. APPROVAL

Approval of this document for publication is given by:

Highways England
Temple Quay House
The Square
Temple Quay
Bristol
BS1 6HA

M WILSON
Chief Highway Engineer

Transport Scotland
8th Floor, Buchanan House
58 Port Dundas Road
Glasgow
G4 0HF

R BRANNEN
Chief Executive

Welsh Government
Transport
Cardiff
CF10 3NQ

S HAGUE
Deputy Director
Network Management Division

Department for Infrastructure
Clarence Court
10-18 Adelaide Street
Belfast
BT2 8GB

P B DOHERTY
Director of Engineering

All technical enquiries or comments on this Document should be sent to
DMRB_Enquiries@highwaysengland.co.uk

WITHDRAWN

**VOLUME 9 NETWORK - TRAFFIC
CONTROL AND
COMMUNICATIONS**

**SECTION 1 DETECTION
TECHNOLOGY**

PART 2

TD 45/17 Annex A

**DETECTION PERFORMANCE REQUIREMENTS
FOR MIDAS INCIDENT DETECTION**

Contents

1. Summary of Detection Requirements for a MIDAS-based incident detection service
2. Introduction
3. Business Need for Incident Detection
4. Functional Performance Requirements
5. Interface Requirements
6. Approval

1. SUMMARY OF DETECTION REQUIREMENTS FOR A MIDAS-BASED INCIDENT DETECTION SERVICE

1.1.1. Figure 1 below outlines general data flows from sensor to outputs for an incident detection service using a variety of approaches. This Annex describes the required performance of detection inputs to a MIDAS subsystem that provides incident detection. This can be achieved in a variety of ways and Figure 1 suggests some of them. Figure 1 also indicates where this annex has most influence; it describes the input requirements for a MIDAS subsystem.

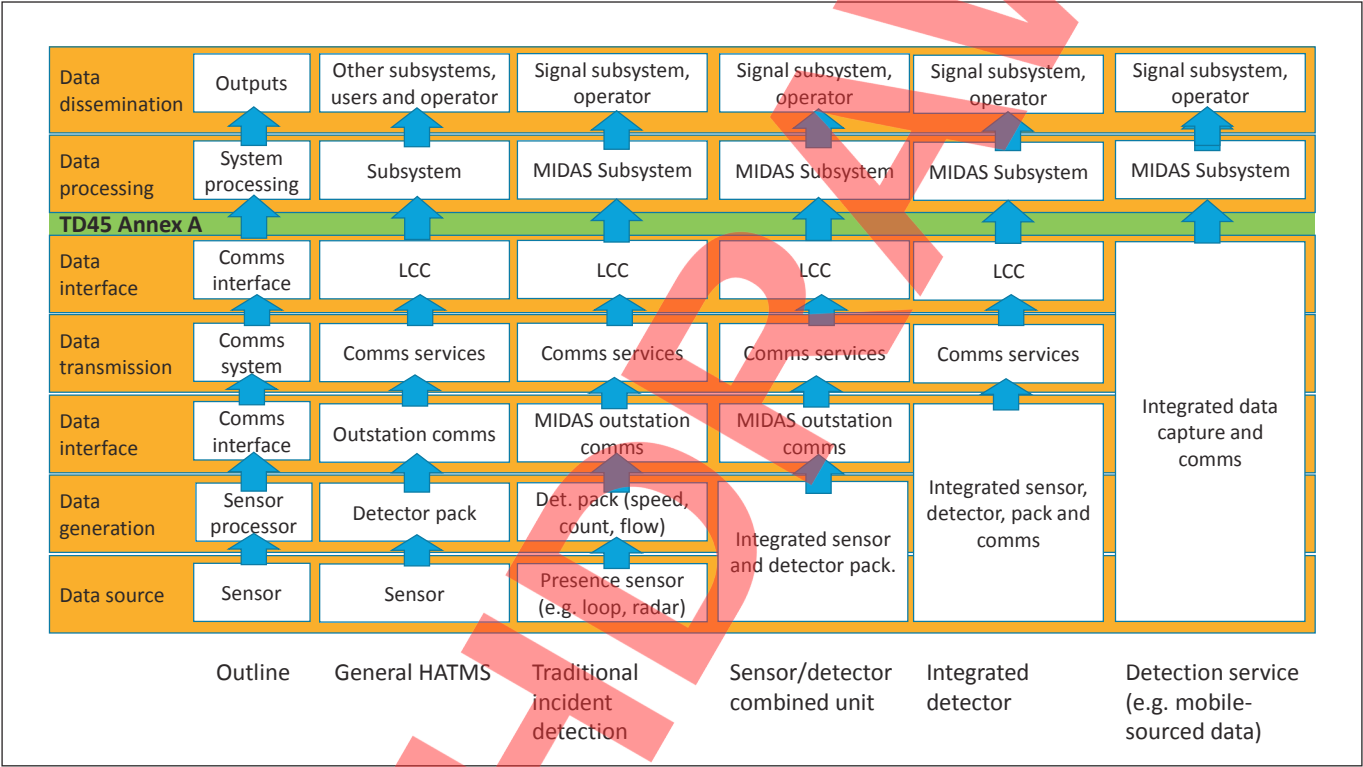


Figure 1 Outline of incident detection data flows showing some examples of data capture, generation and transmission arrangements for a MIDAS-based solution.

1.1.2 Table 1 below provides a summary of the detection requirements for a MIDAS-based incident detection service. This is described in section 4 below and the clauses identified in the “Detailed requirement reference” column should be examined for further information.

Table 1 Summary of detection requirements

General requirement criteria	Criteria	Requirement	Detailed requirement reference
Measurement Source	Calculation/Estimation Method	Calculated from occupancy and speed inputs	4.2.1
	Collection Method	Algorithm	4.2.2
	Calculation Period	<20 ms	4.2.3
	Estimation/ Simulation Model Identity	HIOCC/HIOCC2	4.2.4
	Equipment Type	No restriction	4.2.5
	Number of Data Points	One per lane per site	4.2.6
Precision	Number of Decimal Places	Not relevant	
	Number of Significant Figures	Not relevant	
	Time Precision	Hours, minutes and seconds	4.3.3
Service Availability	Availability Period	(24/7/365)	4.4.1
	Mean Time Between Failures (MTBF)	>5 years. (> 3 years to first failure)	4.4.2
	Mean Time to Repair (MTTR)	<15 minutes after attendance	4.4.3
Service Completeness	Business Rules Coverage	3 - 120 mph, tested at 1,800 vehicles per lane per hour, average 100 km/h traffic speed and 5m vehicle length, all weather and lighting conditions	4.5.1
	Data Types Covered	HIOCC/HIOCC2 alerts	4.5.2
	Percentage Occurrence Coverage	90% detection rate	4.5.3/4.5.4
Service Grade	Service Grade	None	4.6.1
Timeliness	Data Validity Period	None	4.7.1
	Data Time Stamping	Accurate to +/-100ms	4.7.2
	Data Update Mode	“Occurrence”	4.7.3
	Data Update Interval	Zero	4.7.4
Veracity	Data Correctness	+1.0m/-5.0m detection location. False detection rate N/A.	4.8.1
	Error probability	1 in 10	4.8.2
	Mean Absolute Error	Not relevant	
	Error Standard Deviation	Not relevant	
	Mean Error	Not relevant	
	Reliability	At least 90% confidence in detection accuracy and timing performance.	4.8.6

2. INTRODUCTION

2.1 Background

- 2.1.1 This annex of TD45 is supplementary to the main text and it should not be read in isolation. It provides the input detection requirements for an incident detection service that is delivered using the MIDAS subsystem. It should be combined with the main body of TD45 to complete the detection requirements. Requirements in the main body of TD45 shall be met unless more onerous ones are identified in this annex. Under such circumstances, the requirements in this annex shall apply.
- 2.1.2 Successful incident detection depends on receipt of data from the highway that indicates when an incident has occurred. The nature of incidents varies, but generally, they are events that restrict the capacity of the highway. Some incidents are difficult to detect automatically (e.g. animals on the motorway) and incident detection is dependent on secondary effects of the incident. This means that incident detection is often achieved using queue detection, for which sensors (or other detection data sources) need to be monitored to detect changes in the characteristics of traffic. The features of traffic that can be monitored for the incident detection service include speed, flow, headway, vehicle length and occupancy. Of those, speed and occupancy are used to create the HIOCC/HIOCC2 alerts that the MIDAS subsystem uses.
- 2.1.3 The primary aim of this annex is to identify the performance requirements of detection inputs to a MIDAS-based incident detection service. It also provides performance requirements for a supply specification for detection facilities. Detection facilities can then be designed to meet the needs of the service. The aim of incident detection is to identify that an incident has occurred as soon as possible after it has started. This is necessary to deliver and improve safety, customer experience and network performance.
- 2.1.4 The performance requirements in this annex identify the input requirements for an incident detection service that uses the MIDAS subsystem to process the inputs. The HIOCC/HIOCC2 alerts that the MIDAS subsystem uses provide a queue detection function to determine that there is an incident. One output of the MIDAS subsystem is a request to the signal subsystem to automatically set warnings upstream of the detected queue.
- 2.1.5 It is recognised that any relevant technology solutions should be considered as a means of providing the detection inputs to the MIDAS subsystem as long as performance requirements for the incident detection service are met.
- 2.1.6 Locations for MIDAS-based incident detection are identified to support the system operation.

2.2 General

- 2.2.1 Whilst the primary aim of MIDAS is incident detection, it achieves this by identifying high occupancy events to detect stationary, or near stationary, traffic. This is taken as evidence of queues that form as a result of an incident. The function that the MIDAS system performs, therefore, is queue detection and when it is combined with signal setting, it provides queue protection.

2.3 Scope and Purpose

- 2.3.1 Incident detection systems use the detection data gathered by detectors or detection services to create an output. The output might be in the form of an operator alert, a log record, the collection of data or the provision of warnings to highway users that there might be incidents ahead of them.

- 2.3.2 For incident detection, the detection aim is therefore to identify that an incident has occurred as soon as possible after it has started. For MIDAS, this is achieved by detecting the stationary, or near stationary, vehicles that are a result of the incident, which is identified using HIOCC/HIOCC2 alerts.
- 2.3.3 The objective of detection in this annex is to deliver detection data according to the performance requirements of a MIDAS-based incident detection service.

WITHDRAWN

3. BUSINESS NEED FOR INCIDENT DETECTION

3.1 General

- 3.1.1 Incident detection supports the operational processes for incident management. This includes detection, alert, warning, recovery and resolution.
- 3.1.2 The primary business requirement for incident detection is to provide a safe highway. HIOCC/HIOCC2 alert detection data facilities and the MIDAS subsystem support incident management processes to improve safety, customer satisfaction and network performance. This is achieved by the early and accurate detection of traffic queues and the triggering of warning signals. Early event detection enables traffic information dissemination and advice and quick incident resolution.
- 3.1.3 The earlier an incident is detected, the sooner that warnings can be presented to approaching motorists. This reduces the risk of subsequent incidents. It also means that traffic officers can be alerted and the incident can be resolved quickly. Subsequently, rescue can be achieved promptly, which reduces delay for medical intervention and the associated risk to injured people. These benefits contribute to safety.
- 3.1.4 Early resolution of incidents also returns the highway to its operational capacity promptly, which improves the customer experience and ensures that the highway network operates effectively and efficiently. So early incident detection contributes to safety, effectiveness, efficiency and customer experience.
- 3.1.5 It is important for the business efficiency that incident detection is as accurate as possible because late, or wrongly-located incorrect, incident detection can result in delays to resolution. False detection can result in unnecessary reductions in highway capacity to deal with “phantom” incidents or incorrect allocation of scarce resources (e.g. Traffic Officers), leading to inefficiency.

3.2 Business Case

- 3.2.1 A MIDAS-based incident detection service is an inherent part of smart motorways, so the decision to deploy smart motorways includes an assumption that incident detection will be deployed.
- 3.2.2 The decision to specify the requirement for a section of conventional motorway, expressway or APTR to be equipped for incident detection will be made by the overseeing organisation based on a variety of criteria, such as:
- Accident rate
 - Abnormal highway design (e.g. tunnels or steep gradients)
 - Junction spacing
 - Traffic flow density
 - Length of road section
 - Signalised junctions
- 3.2.3 Incident detection systems provide their primary benefits in any situation where traffic anomalies may cause traffic queues to form. These occur most frequently in areas of heavy traffic flow, but any of the following conditions may increase these occurrences, making provision of incident detection even more beneficial:

- Areas having at least 20% higher than the national annual average accident rate for motorways
- Sections of motorway having abnormal design standards (e.g. tunnels, crawler lanes, steep gradients)
- Closer than normal interchanges, with a high density of joining and leaving traffic
- Special instances where a very small self-contained system might be appropriate (e.g. at a junction that has already been provided with part-time signals but queues form back onto the motorway on a daily basis). These shall only be considered on an individual basis and shall not be joined together to form a system.

3.3 Incident Detection Functions

- 3.3.1 MCH 1696 (NMCS MIDAS System Overview) provides the background to the MIDAS incident detection system.
- 3.3.2 Detection technology for incident detection shall provide detection data that meets the needs of the MIDAS subsystem as described in TR2144 (NMCS2 MIDAS Subsystem Specification) and the performance requirements of the MIDAS subsystem as described in TR2174 (NMCS2 MIDAS System Performance Specification).
- 3.3.3 The MIDAS incident detection system uses alerts generated by the HIOCC algorithm (modified by HIOCC2) as described in TR2177 (MIDAS Outstation Algorithm Specification). Detectors shall ensure that the HIOCC/HIOCC2 alerts are generated according to the performance requirements in section 4.1 below.

3.4 Incident Detection Data

- 3.4.1 Data structures and standards shall be consistent with the MIDAS Message Specification (TR2173). MIDAS incident detection data shall consist of HIOCC/HIOCC2 alerts.
- 3.4.2 Data quality shall be described by the requirements for detection in section 4 below.

3.5 Incident Detection Technology

- 3.5.1 Various technology options exist for incident detection. Inductive loops are a mature technology that has been used for incident detection. Radar and magnetometer-based solutions have also been deployed. Alternative options might provide easier access for maintenance or repair or improved performance. Detection based on alternative data sources might also be considered (e.g. mobile phones). All options have strengths and weaknesses that should be analysed to determine their suitability for incident detection in a particular location. Attention should be paid to assessing the detection performance, capital and maintenance costs, reliability and network disruption when selecting the detection technology option.
- 3.5.2 Privacy issues are likely to be relevant for some solutions (e.g. mobile and big data). Any solution shall be compatible with the overseeing organisation's obligations under the data protection act.

4. FUNCTIONAL PERFORMANCE REQUIREMENTS

4.1 Incident Detection Performance Requirements

- 4.1.1 The performance requirements for incident detection are associated with HIOCC/HIOCC2 alerts, which are described using detection quality object descriptions derived from PD ISO/TR 21707:2008 (Intelligent Transport Systems – Integrated transport information, management and control - Data quality in ITS systems).

4.2 Measurement Source

- 4.2.1 **Calculation/Estimation Method:** HIOCC/HIOCC2 alerts shall be used to identify queuing as an indicator that an incident has occurred. Alerts shall be derived from occupancy and speed calculated from traffic detector inputs.
- 4.2.2 **Collection Method:** An algorithm shall be used to generate alerts for a MIDAS incident detection service in response to traffic conditions.
- 4.2.3 **Calculation Period:** An alert message shall be transmitted within 20 ms of the event that triggers the alert. This is the time delay between occurrence and the completion of processing of an alert condition at the roadside (i.e. excluding transmission and system processing time).
- 4.2.4 **Estimation/ Simulation Model Identity:** The HIOCC/HIOCC2 algorithm shall be used to generate the alerts as described in TR2177.
- 4.2.5 **Equipment Type:** There is no restriction on the equipment type that can be used to deliver the HIOCC/HIOCC2 alert detection data performance requirements.
- 4.2.6 **Number of Data Points:** There shall be one detection location for each site on the SRN that needs HIOCC/HIOCC2 alert detection data (section 5.3 below provides location information). Each lane shall form a detection location point at each site. However, the number of data points and the number of installed detectors might not be identical, depending on the solution adopted (see section 5.3 below).

4.3 Precision

- 4.3.1 **Number of Decimal Places:** The number of decimal places is not relevant to the existence of HIOCC/HIOCC2 alerts.
- 4.3.2 **Number of Significant Figures:** HIOCC/HIOCC2 alerts are not relevant to the number of significant figures.
- 4.3.3 **Time Precision:** Time stamp information relating to HIOCC/HIOCC2 alerts shall be identified using hours, minutes and seconds.

4.4 Service Availability

- 4.4.1 **Availability Period:** HIOCC/HIOCC2 alerts shall be provided on a full-time basis (24/7/365).
- 4.4.2 **Mean Time Between Failures (MTBF):** The MTBF for HIOCC/HIOCC2 alert detection data equipment shall be at least 5 years. The minimum period before the first failure shall be 3 years.

- 4.4.3 **Mean Time to Repair (MTTR):** The MTTR for HIOCC/HIOCC2 alert detection data equipment technology shall be at most 15 minutes after attendance.

Note that the MTTR and MTBF figures identified above relate to detection technology only (i.e. they exclude communications and system failures).

4.5 Service Completeness

- 4.5.1 **Business Rules Coverage:** Detection shall be achieved according to the performance requirements identified in this annex, subject to the following conditions:

- Vehicles travelling at speeds between 4.8 km/h (3 mph) and 193 km/h (120 mph) shall be included in the calculation of a HIOCC/HIOCC2 alert condition.
- Representative traffic conditions shall be adopted for performance testing, including a mean traffic density of 1,800 vehicles per lane per hour, a mean traffic speed of 100 km/h and a mean vehicle length of 5m.
- Detection performance requirements shall be delivered under all weather and lighting conditions unless otherwise stated in the environmental performance requirements (for example, temperature).

- 4.5.2 **Data Types Covered:** The detection input data for MIDAS incident detection shall be provided in the form of HIOCC/HIOCC2 alerts.

- 4.5.3 **Percentage Occurrence Coverage:** The detection rate for traffic events that trigger a HIOCC/HIOCC2 alert shall be at least 90%.

- 4.5.4. The HIOCC/HIOCC2 algorithm shall perform with at least 99.9% accuracy (that is, 99.9% of the detection events that should be triggered by the algorithm shall be triggered – assuming perfect input data).

4.6 Service Grade

- 4.6.1 **Service Grade:** No service grade is identified for the incident detection service.

4.7 Timeliness

- 4.7.1 **Data Validity Period:** There is no data validity period for detection data associated with MIDAS incident detection. The HIOCC/HIOCC2 condition shall remain at “alert” until the alert condition no longer exists. TR2173 section 9.9.2 (requirement M:1352) shall take precedence over this requirement if it is different.

- 4.7.2 **Data Time Stamping Regime:** Time stamping of HIOCC/HIOCC2 alert detection data shall be based on the time that the alert is first processed and subject to the precision requirements identified in paragraph 4.3.3 above. Time stamping shall be in accordance with BS ISO 8601:2004 (data elements and interchange formats – information interchange - representation of dates and times).

- 4.7.3 **Data Update Mode:** Alerts associated with an incident detection service shall be updated as an occurrence of a change in the alert condition.

- 4.7.4 **Data Update Interval:** The data update interval for MIDAS HIOCC/HIOCC2 alert detection data is zero. This means that the alert status of the detection represents a snapshot “occurrence”.

4.8 Veracity

- 4.8.1 **Data Correctness:** The false detection rate for the detection inputs for an incident detection service is not defined.
- 4.8.2 **Error probability:** The error probability for HIOCC/HIOCC2 alert detection data shall be 1 in 10 (see paragraph 4.5.3 above).
- 4.8.3 **Mean Absolute Error:** There is no mean absolute error requirement associated with MIDAS HIOCC/HIOCC2 alert detection data inputs.
- 4.8.4 **Error Standard Deviation:** There is no error standard deviation requirement associated with MIDAS HIOCC/HIOCC2 alert detection data inputs.
- 4.8.5 **Mean Error:** There is no mean error requirement associated with MIDAS HIOCC/HIOCC2 alert detection data inputs.
- 4.8.6 **Reliability (i.e. reliability of detection data):** There shall be at least 90% confidence that the detection location accuracy shall be +1.0/-5.0 metres or better for any individual detection point (for vehicle speeds between 40 km/h (25 mph) and 112 km/h (70 mph)).
- 4.8.7 There shall be at least 90% confidence that the detection timestamp accuracy shall be +/-100ms or better.

WITHDRAWN

5. INTERFACE REQUIREMENTS

5.1 Operator Interface

5.1.1 Operator Interfaces for incident detection are defined by MIDAS/HATMS.

5.2 System Interface

5.2.1 Data structures and standards for MIDAS incident detection shall be consistent with TR2173 (NMCS2 MIDAS Message Specification). Data flows associated with MIDAS incident detection shall be consistent with TR2173. Sections 9.9.2 and 9.9.5 of TR2173 provide message structures for the HIOCC/HIOCC2 alerts.

5.2.2 HIOCC/HIOCC2 alert detection data facilities shall support the MIDAS subsystem in accordance with TR2144 (NMCS2 MIDAS Subsystem Specification).

5.3 Site and Location Issues

5.3.1 Initial detection locations shall support MIDAS-based incident detection as described in Table 2 below for motorways, smart motorways and all-purpose trunk roads (APTRs).

5.3.2 Once the initial detection locations have been established, other detection locations shall be based on requirements for the spacing between detection locations for all types of highway shall be 500m +100/-200m, with a scheme average tolerance of +50/-100m.

5.3.3 Any gaps between detection locations of less than 4 signal sites shall be equipped and detection shall extend to at least one signal site before the divergent signal site at an interchange. This is needed in order to avoid anomalies in signal setting.

5.3.4 Data points can be formed using “logical”, or “pseudo” detectors (e.g. if mobile-sourced data is used). This might result in the number of data points being larger than the number of installed detectors, particularly if some of the logical/pseudo detectors’ outputs are calculated from a small number of installed detectors. The location of the logical/pseudo detectors needs to be fixed, consistent with the needs of the MIDAS subsystem as outlined in Table 2 below, even if no installation actually occurs.

5.3.5 Where loop detection technology is not the designed solution, the detection system shall include 1 mainline counting site per link using inductive loop detectors. This site shall be aligned across all lanes on both the A and B carriageways. This shall provide an audit or self-check function using a known legacy system as a reference point.

Table 2 Detection location positions for MIDAS-based incident detection

Highway type	Motorway	Smart Motorway	APTR	Preferred detection location	Detection location	
					Upstream limit	Downstream limit
Main line (reference signal separation >1000m)	Y	Y	Y	10m upstream of reference signal	50m upstream of reference signal	10m downstream of reference signal
Motorway to motorway links (reference signal separation >1000m)	Y	Y	N	Between upstream and downstream limits	100m downstream of the diverge nose tip	100m upstream of the merge nose tip
Main line and motorway to motorway links (reference signal separation 600m - 1000m)	N	Y	N	Between upstream and downstream limits	100m downstream of the diverge nose tip	100m upstream of the merge nose tip
Main line and motorway to motorway links (reference signal separation 600m - 1000m)	Y	N	N	Between upstream and downstream limits (and midway between upstream and downstream limits for "mid-link" detection position)	100m downstream of the diverge nose tip	100m upstream of the merge nose tip
Exit slip with 1 running lane	Y	N	Y	10m upstream of exit slip signals	12m upstream of exit slip signals or 50m upstream of the adjacent main line detection point (whichever is closest to (and upstream of) the preferred detection position)	8m upstream of exit slip signals or 50m upstream of the adjacent main line detection point (whichever is closest to (and downstream of) the preferred detection position)
Exit slip with 2 or 3 running lanes	Y	N	Y	Adjacent main line detection position	20m downstream of diverge-tip of nose or 50m upstream of the adjacent main line detection point (whichever is closest to (and upstream of) the preferred detection position)	50m downstream of diverge-tip of nose or 50m upstream of the adjacent main line detection point (whichever is closest to (and downstream of) the preferred detection position)

Highway type	Motor-way	Smart Motor-way	APTR	Preferred detection location	Detection location	
					Upstream limit	Downstream limit
Exit slip with 4 or more running lanes	Y	N	Y	Adjacent main line detection position	10m upstream of confirmatory gantry or 50m upstream of the adjacent main line detection point (whichever is closest to (and upstream of) the preferred detection position)	50m downstream of diverge-tip of nose or 50m upstream of the adjacent main line detection point (whichever is closest to (and downstream of) the preferred detection position)
Entry slip	Y	Y	Y	Adjacent main line detection position	Entry slip signal location or 50m upstream of the adjacent main line detection point (whichever is closest to (and upstream of) the preferred detection position)	50m downstream of the adjacent main line detection point, or at the final lane gain or merge information sign or 100m from Merge tip of nose (whichever is closest to (and downstream of) the preferred detection position)
Diverge connector road (without diverge connector signals)	N	Y	N	Between upstream and downstream limits	Stopping distance from diverge-tip of nose	>100m from end of connector road
Diverge connector road (with diverge connector signals)	N	Y	N	Between upstream and downstream limits	10m upstream of diverge connector signal location	10m downstream of diverge connector signal location

WITHDRAWN

6. APPROVAL

Approval of this document for publication is given by:

Highways England
Temple Quay House
The Square
Temple Quay
Bristol
BS1 6HA

M WILSON
Chief Highway Engineer

Transport Scotland
8th Floor, Buchanan House
58 Port Dundas Road
Glasgow
G4 0HF

R BRANNEN
Chief Executive

Welsh Government
Transport
Cardiff
CF10 3NQ

S HAGUE
Deputy Director
Network Management Division

Department for Infrastructure
Clarence Court
10-18 Adelaide Street
Belfast
BT2 8GB

P B DOHERTY
Director of Engineering

All technical enquiries or comments on this Document should be sent to
DMRB_Enquiries@highwaysengland.co.uk

WITHDRAWN

**VOLUME 9 NETWORK – TRAFFIC
CONTROL AND
COMMUNICATIONS**

**SECTION 1 DETECTION
TECHNOLOGY**

PART 2

TD 45/17 Annex B

**DETECTION PERFORMANCE REQUIREMENTS
FOR CONGESTION MANAGEMENT (MIDAS)**

Contents

1. Summary of Detection Requirements for a MIDAS-based Congestion Management Service
2. Introduction
3. Business Need for MIDAS Congestion Management
4. Functional Performance Requirements
5. Interface Requirements
6. Approval

1. SUMMARY OF DETECTION REQUIREMENTS FOR A MIDAS-BASED CONGESTION MANAGEMENT SERVICE

1.1.1 Figure 1 below outlines general data flows from sensor to outputs for a congestion management service using a variety of approaches. This Annex describes the required performance of detection inputs to a MIDAS subsystem that is providing incident detection. This can be achieved in a variety of ways and Figure 1 suggests some of them. Figure 1 also indicates where this annex has most influence; it describes the input requirements for a MIDAS subsystem.

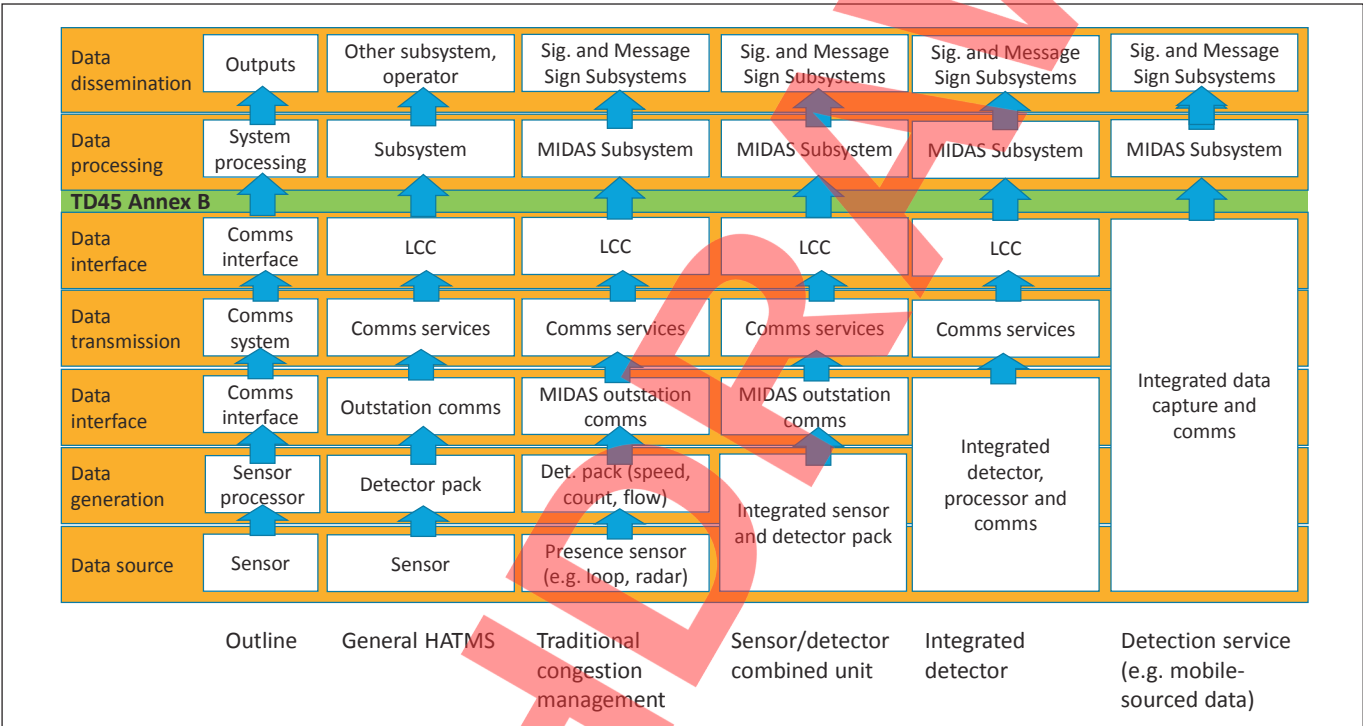


Figure 1 Outline of congestion management data flows showing some examples of data capture, generation and transmission arrangements for a MIDAS-based solution.

1.1.2 Table 1 below provides a summary of the detection requirements for a MIDAS-based congestion management service. This is described in section 4 below and the clauses identified in the “Detailed requirement reference” column should be examined for further information.

Table 1 Summary of detection requirements

General requirement criteria	Criteria	Requirement	Detailed requirement reference
Measurement Source	Calculation/Estimation Method	Calculated from Speed and Flow	4.2.1
	Collection Method	Algorithm	4.2.2
	Calculation Period	<20 ms	4.2.3
	Estimation/ Simulation Model Identity	Speed and flow algorithms (described in TR2177)	4.2.4
	Equipment Type	No restriction	4.2.5
	Number of Data Points	One per lane per site	4.2.6
Precision	Number of Decimal Places	Not relevant	
	Number of Significant Figures	Not relevant	
	Time Precision	Hours, minutes and seconds	4.3.3
Service Availability	Availability Period	24/7/365	4.4.1
	Mean Time Between Failures (MTBF)	>5 years (>3 years to first failure –)	4.4.2
	Mean Time to Repair (MTTR)	<15 minutes after attendance	4.4.3
Service Completeness	Business Rules Coverage	3 - 120 mph, tested at 1,800 vehicles per lane per hour, 100 km/h and 5m vehicle length, all weather and lighting conditions	4.5.1
	Data Types Covered	Speed and flow alerts	4.5.2
	Percentage Occurrence Coverage	90% detection rate	4.5.3
Service Grade	Service Grade	Not relevant	
Timeliness	Data Validity Period	None	
	Data Time Stamping	Accurate to +/-100ms	4.7.2
	Data Update Mode	“Occurrence”	4.7.3
	Data Update Interval	Not relevant	
Veracity	Data Correctness	+1.0m/-5.0 metres detection location. False detection rate N/A	4.8.1
	Error probability	1 in 10	4.8.2
	Mean Absolute Error	Not relevant	
	Error Standard Deviation	Not relevant	
	Mean Error	Not relevant	
	Reliability	At least 90% confidence in detection accuracy and timing performance.	4.8.6

2. INTRODUCTION

2.1. Background

- 2.1.1 This annex of TD45 is supplementary to the main text and it should not be read in isolation. It provides the input detection requirements for a congestion management service that is delivered using the MIDAS subsystem. It should be combined with the main body of TD45 to complete the detection requirements. Requirements in the main body of TD45 shall be met unless more onerous ones are identified in this annex. Under such circumstances, the requirements in this annex shall apply.
- 2.1.2 Smart Motorways and expressways provide congestion management using speed control that depends on receipt of data from the highway. This data indicates when traffic conditions are deteriorating to the point where speed control intervention is needed. The data consists of speed and flow threshold alerts that are processed from sensor inputs through algorithms.
- 2.1.3 Speed and flow alert data can also be collected from other sources (including mobile data), which can be processed to identify the required traffic characteristics. However, the same performance requirements apply to the detection data irrespective of its source.
- 2.1.4 The primary aim of this annex is to identify the detection performance requirements of a MIDAS-based congestion management service. It also provides performance requirements for a supply specification. Detection facilities can then be designed to meet the needs of the service.
- 2.1.5 The aim of congestion management is to ensure that the risk of incidents is reduced and that the traffic throughput is maximised. This is necessary to improve safety, customer experience and network performance.
- 2.1.6 The performance requirements in this annex identify the input requirements for a MIDAS-based congestion management service. The MIDAS subsystem uses speed and flow alerts as inputs that are generated by algorithms. One output of MIDAS is the automatic setting of speed control signals.
- 2.1.7 It is recognised that any relevant technology solutions should be considered as long as performance requirements for the congestion management service are met.
- 2.1.8 Locations for MIDAS congestion management detection are identified to support the system operation.

2.2 General

- 2.2.1 Whilst the primary aim of MIDAS is incident management, it also responds to speed and flow threshold alerts to regulate traffic speed so that flow is not subject to disruption and traffic throughput is maximised. The detection function that is performed in this context, therefore, is speed and flow detection, which are used to create alerts using an algorithm.

2.3 Scope and Purpose

- 2.3.1 Congestion management systems use the detection data gathered by detectors or detection services to create an output. The primary output is normally the delivery of speed control instructions and advice to drivers using signals and Variable Message Signs (VMS). Operator alerts, log records and data collection are also available outputs.

- 2.3.2 For congestion management, the detection aim is therefore to identify when traffic conditions require intervention to regulate speed. For MIDAS, this is achieved by monitoring speed and flow and raising alerts when they reach thresholds (separate thresholds are used as the congestion reduces).
- 2.3.3 The objective of detection in this annex is to deliver detection data according to the performance requirements of a MIDAS-based congestion management service.

WITHDRAWN

3. BUSINESS NEED FOR MIDAS CONGESTION MANAGEMENT

3.1 General

- 3.1.1 Congestion Management supports the operational processes for traffic control, which also includes ramp metering and lane control. The operational processes employed for congestion management can be automatic (as performed by the MIDAS subsystem), or manual intervention can be used to set signals.
- 3.1.2 The primary business requirement for congestion management is to improve network management by maximising the throughput of a section of highway. Traffic flow disruption and the resultant stop/start traffic conditions are avoided by reducing traffic speed. The risk of incidents is also reduced, so safety is improved. It also means that traffic officers can be alerted as congestion forms so that they can take any necessary actions.
- 3.1.3 Early detection of congestion and the use of appropriate interventions also ensures that the disruption to drivers' journeys due to congestion is minimised, which improves customer experience. So early congestion management contributes to safety, effectiveness, efficiency and customer experience.
- 3.1.4 Incorrect speed and flow alert detection can result in unnecessary speed restrictions if the detection is late, inaccurate or wrongly located or no speed reduction when it is needed. False detection can result in unnecessary interventions that reduce traffic speed to deal with non-existent congestion.

3.2 Business Case

- 3.2.1 A MIDAS-based congestion management service is an inherent part of smart motorways, so the decision to deploy smart motorways includes an assumption that congestion management will be deployed.
- 3.2.2 The decision to specify the requirement for a section of conventional motorway, expressway or APTR to be equipped for congestion management will be made by the overseeing organisation based on a variety of criteria, such as:
- Accident rate
 - Abnormal highway design (e.g. tunnels or steep gradients)
 - Junction spacing
 - Traffic flow density
 - Length of road section
 - Signalised junctions

3.3 Congestion Management Functions

- 3.3.1 MCH 1696 (NMCS MIDAS System Overview) provides the background to the MIDAS congestion management.
- 3.3.2 Detection technology for congestion management shall provide detection data that meets the needs of the MIDAS subsystem as described in TR2174 (NMCS2 MIDAS System Performance Specification).

- 3.3.3 For congestion management on Smart Motorways and expressways, MIDAS automatically sets 60mph, 50mph and 40mph speed limits to delay the onset of flow breakdown, which improves the traffic throughput and journey time reliability. Traffic flows and speeds are monitored and the controlled motorways algorithm sets speed limits accordingly.
- 3.3.4 The appropriate threshold levels for both speed and flow (rising and falling) are influenced by factors such as road geometry, percentage of HGVs, link lengths between junctions, traffic patterns and movements. Thresholds need to be determined specifically for each link by appropriate modelling so that they can be included in site data. For dynamic hard shoulder running, detection data also assists in determining when the hard shoulder should be opened and closed to traffic.

3.4 Congestion Management Data

- 3.4.1 Data structures and standards shall be consistent with the MIDAS Message Specification (TR2173). MIDAS congestion management data shall consist of speed and flow alerts.
- 3.4.2 Data quality shall be described through the performance requirements for detection in Section 4 below.

3.5 Congestion Management Technology

- 3.5.1 Various technology options exist for congestion management. Inductive loops are a mature technology that has been used for speed/flow detection. Radar and magnetometer-based solutions have also been deployed. Alternative options might provide easier access for maintenance, repair or improved performance. Detection based on alternative data sources might also be considered (e.g. mobile phones). All options have strengths and weaknesses that should be analysed to determine their suitability for speed/flow detection.
- 3.5.2 Privacy issues are likely to be relevant for some solutions (e.g. mobile and big data). Any solution shall be compatible with the overseeing organisation's obligations under the data protection act.

4. FUNCTIONAL PERFORMANCE REQUIREMENTS

4.1 Congestion Management Detection Performance Requirements

- 4.1.1 Flow and speed alerts shall be generated in accordance with the performance requirements in this section. The performance requirements are described using detection quality object descriptions derived from PD ISO/TR 21707:2008 (Intelligent Transport Systems - Integrated transport information, management and control - Data quality in ITS systems).

4.2 Measurement Source

- 4.2.1 **Calculation/Estimation Method:** MIDAS speed and flow alerts shall identify that particular traffic conditions exist. Alerts shall be calculated from detection inputs for speed and flow.
- 4.2.2 **Collection Method:** An algorithm shall be used to generate speed and flow alerts for a MIDAS congestion management service in response to traffic conditions.
- 4.2.3 **Calculation Period:** An alert message shall be transmitted within 20 ms of the event that triggers the alert. This is the time delay between occurrence and the completion of processing of an alert condition at the roadside (i.e. excluding transmission and system processing time).
- 4.2.4 **Estimation/ Simulation Model Identity:** Speed and flow algorithms shall be used to generate the alerts as described in TR2177.
- 4.2.5 **Equipment Type:** There is no restriction on the equipment type that can be used to deliver the speed and flow alert detection performance requirements.
- 4.2.6 **Number of Data Points:** There shall be one detection location for each site on the SRN that needs speed and flow alert detection (section 5.3 below provides location information). Each lane shall form a detection location point at each site.

4.3 Precision

- 4.3.1 **Number of Decimal Places:** The number of decimal places is not relevant to the existence of speed and flow alerts.
- 4.3.2 **Number of Significant Figures:** Speed and flow alerts are not relevant to the number of significant figures.
- 4.3.3 **Time Precision:** Time stamp information relating to speed and flow alerts shall be identified using hours, minutes and seconds.

4.4 Service Availability

- 4.4.1 **Availability Period:** Speed and flow alerts shall be provided on a full-time basis (24/7/365).
- 4.4.2 **Mean Time Between Failures (MTBF):** The MTBF for speed and flow alert detection equipment shall be at least 5 years. The minimum period before the first failure shall be 3 years.
- 4.4.3 **Mean Time to Repair (MTTR):** The MTTR for speed and flow alert detection equipment technology shall be at most 15 minutes after attendance.

Note that the MTTR and MTBF figures identified above relate to detection technology only (i.e. they exclude communications and system failures).

4.5 Service Completeness

4.5.1 **Business Rules Coverage:** Detection shall be achieved according to the performance requirements identified in this annex, subject to the following conditions:

- Vehicles travelling at speeds between 4.8 km/h (3 mph) and 193 km/h (120 mph) shall be included in the calculation of a speed/flow alert condition.
- Representative traffic conditions shall be adopted for performance testing, including a mean traffic density of 1,800 vehicles per lane per hour, a mean traffic speed of 100 km/h and a mean vehicle length of 5m. Detection performance requirements shall be delivered under all weather and lighting conditions unless otherwise stated in the environmental performance requirements (for example, temperature).

4.5.2 **Data Types Covered:** The detection input data for MIDAS congestion management shall be provided in the form of speed and flow alerts.

4.5.3 **Percentage Occurrence Coverage:** The detection rate for traffic events that trigger a speed or flow alert shall be 90%.

4.5.4 The speed and flow algorithms shall perform with 99.9% accuracy (that is, 99.9% of the alerts that should be triggered by the algorithm shall be triggered, assuming perfect input data).

4.6 Service Grade

4.6.1 No service grade is identified for the congestion management service.

4.7 Timeliness

4.7.1 **Data Validity Period:** There is no data validity period for detection data associated with MIDAS speed and flow alert detection. Speed and flow alerts shall be raised when the algorithm that generates them identifies that a threshold has been exceeded. TR2173 section 9.9.2 (requirement M:1352) shall take precedence over this requirement if it is different.

4.7.2 **Data Time Stamping Regime:** Time stamping of speed and flow alert detection shall be based on the time that the alert is first processed and subject to the precision requirements identified in paragraph 4.3.3 above and reliability requirements in paragraph 4.8.6 below.

4.7.3 **Data Update Mode:** Alerts associated with speed and flow alert detection shall be updated as an occurrence of a change in the alert condition.

4.7.4 **Data Update Interval:** The data update interval for MIDAS speed and flow alert detection is zero. This means that the alert status of the detection represents a snapshot “occurrence”.

4.8 Veracity

4.8.1 **Data Correctness:** The false detection rate for the detection inputs for the congestion management service is not specified.

4.8.2 **Error Probability:** The error probability for speed and flow alert detection shall be 1 in 10 (see paragraph 4.5.3 above).

- 4.8.3 **Mean Absolute Error:** There is no mean absolute error requirement associated with MIDAS speed and flow alert detection inputs.
- 4.8.4 **Error Standard Deviation:** There is no error standard deviation requirement associated with MIDAS speed and flow alert detection inputs.
- 4.8.5 **Mean Error:** There is no mean error requirement associated with MIDAS speed and flow alert detection inputs.
- 4.8.6 **Reliability (i.e. reliability of detection data):** There shall be at least 90% confidence that the detection location accuracy shall be +1.0m/-5.0m or better for any individual detection point (for vehicle speeds between 40 km/h (25 mph) and 112 km/h (70 mph)). There shall be at least 90% confidence that the detection timestamp accuracy stamp shall be +/-100ms or better.

WITHDRAWN

5. INTERFACE REQUIREMENTS

5.1 Operator Interface

- 5.1.1 Operator interfaces for congestion management are defined by MIDAS/HATMS.

5.2 System Interface

- 5.2.1 Data structures and standards for MIDAS speed and flow alert detection shall be consistent with TR2173 (NMCS2 MIDAS Message Specification). Sections 9.9.3 and 9.9.4 of TR2173 provide message structures for the speed and flow alerts.
- 5.2.2 Speed and flow alert detection facilities shall support the MIDAS subsystem in accordance with TR2144 (NMCS2 MIDAS Subsystem Specification).

5.3 Site and Location Issues

- 5.3.1 MIDAS speed and flow alert detection locations shall be the same as for incident detection (See TD45 Annex A) unless additional or alternative locations are confirmed by the overseeing organisation.

WITHDRAWN

6. APPROVAL

Approval of this document for publication is given by:

Highways England
Temple Quay House
The Square
Temple Quay
Bristol
BS1 6HA

M WILSON
Chief Highway Engineer

Transport Scotland
8th Floor, Buchanan House
58 Port Dundas Road
Glasgow
G4 0HF

R BRANNEN
Chief Executive

Welsh Government
Transport
Cardiff
CF10 3NQ

S HAGUE
Deputy Director
Network Management Division

Department for Infrastructure
Clarence Court
10-18 Adelaide Street
Belfast
BT2 8GB

P B DOHERTY
Director of Engineering

All technical enquiries or comments on this Document should be sent to
DMRB_Enquiries@highwaysengland.co.uk

WITHDRAWN

**VOLUME 9 NETWORK – TRAFFIC
CONTROL AND
COMMUNICATIONS**

**SECTION 1 DETECTION
TECHNOLOGY**

PART 2

TD 45/17 Annex C

**DETECTION PERFORMANCE REQUIREMENTS
OPERATIONAL TRAFFIC INFORMATION
(MIDAS)**

Contents

1. Summary of Detection Requirements FOR A
MIDAS-based Operational Traffic Information
Service
2. Introduction
3. Business Need for MIDAS Operational traffic
information
4. Functional Performance Requirements
5. Interface Requirements
6. Approval

WITHDRAWN

1. SUMMARY OF DETECTION REQUIREMENTS FOR A MIDAS-BASED OPERATIONAL TRAFFIC INFORMATION SERVICE

1.1.1 Figure 1 below outlines general data flows from sensor to outputs for an operational traffic information service using a variety of approaches. This Annex describes the required performance of detection inputs to a MIDAS subsystem that provides operational traffic information. This can be achieved in a variety of ways and Figure 1 suggests some of them. Figure 1 also indicates where this annex has most influence; it describes the input requirements for a MIDAS subsystem.

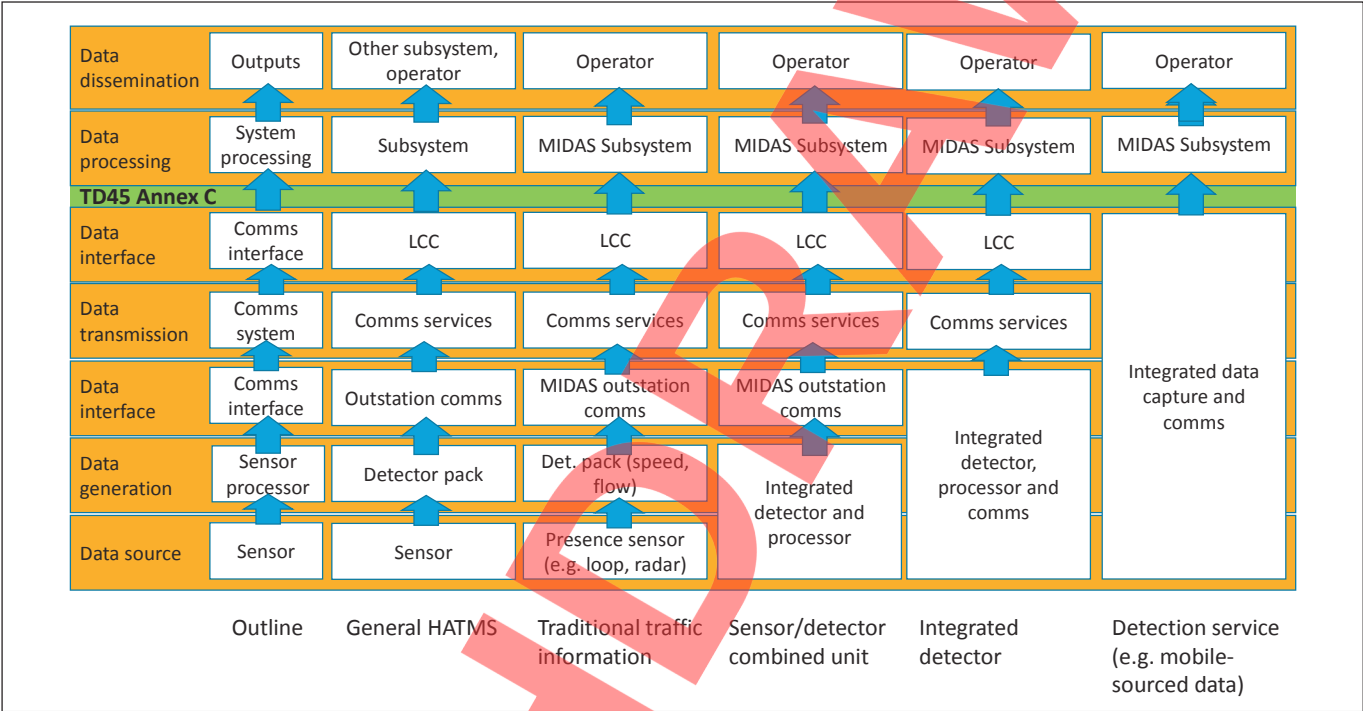


Figure 1 Outline of operational traffic information data flows showing some examples of data capture, generation and transmission arrangements for a MIDAS-based solution.

1.1.2 Table 1 below provides a summary of the detection requirements for a MIDAS-based operational traffic information service. This is described in section 4 below and the clauses identified in the “Detailed requirement reference” column should be examined for further information.

Table 1 Summary of detection requirements

General requirement criteria	Criteria	Requirement	Detailed requirement reference
Measurement Source	Calculation/Estimation Method	Calculated from speed and flow	4.2.1
	Collection Method	Averaging	4.2.2
	Calculation Period	<20 ms	4.2.3
	Estimation/ Simulation Model Identity	Not relevant	
	Equipment Type	No restriction	
	Number of Data Points	1 data point per lane per site	4.2.6
Precision	Number of Decimal Places	Vehicle category (length in m – 1 decimal place) (TR2144 takes precedence) Average speed (km per hour – 0 decimal places) (TR2173 takes precedence) Flow data (vehicles per minute – 0 decimal places) (TR2173 takes precedence)	4.3.1 to 4.3.3
	Number of Significant Figures	3 (TR2144 takes precedence)	4.3.4
	Time Precision	Hours, minutes and seconds	4.3.5
Service Availability	Availability Period	(24/7/365)	4.4.1
	Mean Time Between Failures (MTBF)	>5 years (> 3 years to first failure –)	4.4.2
	Mean Time to Repair (MTTR)	<15 minutes after attendance	4.4.3
Service Completeness	Business Rules Coverage	3 - 120 mph, tested at 1,800 vehicles per lane per hour, 100 km/h and 5m vehicle length, all weather and lighting conditions	4.5.1
	Data Types Covered	Speed and categorised flow data	4.5.2
	Percentage Occurrence Coverage	100% speed and flow calculations	4.5.3
Service Grade	Service Grade	Not relevant	
Timeliness	Data Validity Period	Valid for the averaging period (configurable). TR2177 takes precedence	4.7.1
	Data Time Stamping	+/-100ms	4.7.2
	Data Update Mode	“Occurrence”	4.7.3
	Data Update Interval	0	4.7.4
Veracity	Data Correctness	Not relevant	
	Error probability	1 in 10	4.8.2
	Mean Absolute Error	Not relevant	
	Error Standard Deviation	Not relevant	
	Mean Error	Not relevant	
	Reliability	At least 90% confidence in detection location accuracy and timing performance.	4.8.6

2. INTRODUCTION

2.1 Background

- 2.1.1 This annex of TD45 is supplementary to the main text and it should not be read in isolation. It provides the input detection requirements for an operational traffic information service that is delivered using the MIDAS subsystem. It should be combined with the main body of TD45 to complete the detection requirements. Requirements in the main body of TD45 shall be met unless more onerous ones are identified in this annex. Under such circumstances, the requirements in this annex shall apply.
- 2.1.2 Operational traffic information is dependent on the receipt of data from the highway for operators to access via an operator interface. Operators have access to traffic statistics generally and in particular, speed and flow detection data, categorisation by vehicle length.
- 2.1.3 Speed and flow data can be collected from highway sensors or obtained from other sources (including mobile data), which can be processed to identify the required traffic characteristics. However, the same performance requirements apply to the detection data irrespective of its source. Vehicle length data is generally not available from mobile data sources, so other detection tools will need to be employed to deliver categorised data using mobile sources.
- 2.1.4 The primary aim of this annex is to identify the detection performance requirements of a MIDAS-based operational traffic information service. It also provides performance requirements for a supply specification. Detection facilities can then be designed to meet the needs of the service.
- 2.1.5 The aim of operational traffic information is to provide operators with the information they need to take decisions. This supports effective network management by improving network performance and enhancing customer experience.
- 2.1.6 The performance requirements in this annex identify the input requirements for a MIDAS-based operational traffic information service. The speed and categorised flow data that MIDAS uses is collected from detection facilities.
- 2.1.7 It is recognised that any relevant technology solutions should be considered as long as performance requirements for the operational traffic information service are met.
- 2.1.8 Locations for MIDAS operational traffic information detection are the same as those identified for incident detection in TD45 Annex A.

2.2 General

- 2.2.1 Whilst the primary aim of MIDAS is incident detection, it also provides traffic data to operators so that network management can be improved. This is achieved through an operational traffic information service. The function that the MIDAS subsystem performs in this context, therefore, is speed and categorised flow detection.

2.3 Scope and Purpose

- 2.3.1 Operational traffic information systems use the detection data gathered by detectors or detection services to create an output. The primary output is normally provided through operator access to stored data for operational support and decision making.

- 2.3.2 For operational traffic information, the detection aim is therefore to provide traffic data for subsequent presentation to operators. For MIDAS, this is achieved by monitoring speed and categorised flow and delivering this data to operators on request.
- 2.3.3 The objective of detection in this annex is to deliver detection data according to the performance requirements of a MIDAS-based operational traffic information service.

WITHDRAWN

3. BUSINESS NEED FOR MIDAS OPERATIONAL TRAFFIC INFORMATION

3.1 General

- 3.1.1 The primary business requirement for operational traffic information is to support operator decision making for network management. Effective operator decisions ensure that network disruption is minimised so that the highway asset is used effectively and efficiently and customer experience is maintained or improved.
- 3.1.2 Incorrect speed and categorised flow detection can result in incorrect operator decisions if the detection is wrongly located or incorrectly time-stamped.

3.2 Business Case

- 3.2.1 The decision to specify operational traffic information for a smart motorway, conventional motorway, expressway or APTR will be made by the overseeing organisation based on a range of criteria, such as:

- Accident rate
- Abnormal highway design (e.g. tunnels or steep gradients)
- Junction spacing
- Traffic flow density
- Length of road section
- Signalised junctions

3.3 Operational Traffic Information Functions

- 3.3.1 MCH 1696 (NMCS MIDAS System Overview) provides the background to MIDAS operational traffic information.
- 3.3.2 Detection technology for operational traffic information shall provide detection data that meets the needs of the MIDAS subsystem as described in TR2144 (NMCS2 MIDAS Subsystem Specification) and the performance requirements of the MIDAS subsystem as described in TR2174 (NMCS2 MIDAS System Performance Specification).
- 3.3.3 Link flow information is displayed for all links on an operator interface when it enters “MIDAS” mode. Also, speed and categorised flow detection data will be displayed at previously selected MIDAS sites and the alert/fault status will be displayed at all other MIDAS sites.
- 3.3.4 The operator can choose the location of speed and categorised flow detection data to be displayed on an operator interface, which is updated as the data changes.
- 3.3.5 An operator can choose to display the total flow for each vehicle category and the average speed at the selected site for each hour of the day and for each day of the preceding week.

- 3.3.6 The flow and average speed data is obtained over a configurable averaging period. The averaging period is in the range 1 to 60 minutes, the vehicle category lengths are in the range 0 to 25.5 metres in units of 0.1 metres.

3.4 Operational Traffic Information Data

- 3.4.1 Data structures and standards shall be consistent with the MIDAS Message Specification (TR2173). MIDAS operational traffic information data shall consist of speed and categorised flow.
- 3.4.2 Data quality shall be as described by the requirements for detection in section 4 below.

3.5 Operational Traffic Information Detection Technology

- 3.5.1 Various technology options exist for operational traffic information detection. Inductive loops are a mature technology that has been used for speed and categorised flow detection. Radar and magnetometer-based solutions have also been deployed. Alternatives might provide easier access for maintenance or repair or improved performance. Detection based on alternative data sources might also be considered (e.g. mobile phones). However, length data is unlikely to be available from mobile data sources. As well as inductive loop technology, vehicle length might also be available from laser scanning sensors or image/video processing detection.
- 3.5.2 All options have strengths and weaknesses that should be analysed to determine their suitability for speed and categorised flow detection. The quality of detection data that can be derived from alternative sources shall meet the needs of the overseeing organisation. The detection performance, capital and maintenance costs, reliability and network disruption when selecting the detection technology option.
- 3.5.3 Privacy issues are likely to be relevant for some solutions (e.g. mobile and big data). Any solution shall be compatible with the overseeing organisation's obligations under the Data Protection Act

4. FUNCTIONAL PERFORMANCE REQUIREMENTS

4.1 Operational Traffic Information Detection Performance Requirements

- 4.1.1 The performance requirements for speed and categorised flow data are described using detection quality object descriptions derived from PD ISO/TR 21707:2008 (Intelligent Transport Systems - Integrated transport information, management and control - Data quality in ITS systems).

4.2 Measurement Source

- 4.2.1 **Calculation/Estimation Method:** MIDAS speed and categorised flow data shall be calculated from detection inputs for speed and categorised flow detection.
- 4.2.2 **Collection Method:** Averaging shall be used to generate speed and flow data for vehicle types categorised by length for a MIDAS operational traffic information service.
- 4.2.3 **Calculation Period:** A traffic data message shall be transmitted within 20 ms of the end of the averaging period (which can be between 1 and 60 minutes).
- 4.2.4 **Estimation/ Simulation Model Identity:** No model is used to calculate speed and flow data.
- 4.2.5 **Equipment Type:** There is no restriction on the equipment type that can be used to deliver the operational traffic information performance requirements.
- 4.2.6 **Number of Data Points:** There shall be one detection location for each site on the SRN that needs operational traffic information (section 5.3 below provides location information). Each lane shall form a detection location point at each site.

4.3 Precision

- 4.3.1 **Number of Decimal Places:** Vehicle category lengths shall have a precision of 0.1 metres. If TR2144 indicates a different number of decimal places, TR2144 shall take precedence (see TR2144 Section 4.3.3, M:434.9).
- 4.3.2 **Average Speed Data:** Shall have a precision of 1 kilometre per hour (i.e. zero decimal places). If TR2173 indicates a different number of decimal places, TR2173 shall take precedence (see TR2173 section 9.8, M:1285).
- 4.3.3 **Flow Data:** Shall have a precision of 1 vehicle per minute (i.e. zero decimal places). If TR2173 indicates a different number of decimal places, TR2173 shall take precedence (see TR2173 section 9.8, M:1286).
- 4.3.4 **Number of Significant Figures:** Speed and categorised flow detection data shall have 3 significant figures. If TR2144 indicates a different number of significant figures, TR2144 shall take precedence (see TR2144 Section 4.3.3, M:434.9).
- 4.3.5 **Time Precision:** Time stamp information relating to speed and categorised flow detection data shall be identified using hours, minutes and seconds.

4.4 Service Availability

- 4.4.1 **Availability Period:** Speed and categorised flow data shall be provided on a full-time basis (24/7/365).

4.4.2 **Mean Time Between Failures (MTBF):** The MTBF for speed and categorised flow detection equipment shall be at least 5 years. The minimum period before the first failure shall be 3 years.

4.4.3 **Mean Time to Repair (MTTR):** The MTTR for speed and categorised flow detection equipment technology shall be at most 15 minutes after attendance.

Note that the MTTR and MTBF figures identified above relate to detection technology only (i.e. they exclude communications and system failures).

4.5 Service Completeness

4.5.1 **Business Rules Coverage:** Detection shall be achieved according to the performance requirements identified in this annex, subject to the following conditions:

- Vehicles travelling at speeds between 4.8 km/h (3 mph) and 193 km/h (120 mph) shall be included in the calculation of a speed/flow data. (Note the speed range for detection location accuracy requirements in paragraphs 4.8.1 to 4.8.6 below).
- Representative traffic conditions shall be adopted for performance testing, including a mean traffic density of 1,800 vehicles per lane per hour, a mean traffic speed of 100 km/h and a mean vehicle length of 5m. Detection performance requirements shall be delivered under all weather and lighting conditions unless otherwise stated in the environmental performance requirements (for example, temperature).

4.5.2 **Data Types Covered:** The detection input data for MIDAS operational traffic information shall be provided in the form of measured speed and categorised flow data.

4.5.3 **Percentage Occurrence Coverage:** 100% of speed and categorised flow calculations shall be reported.

4.6 Service Grade

4.6.1 **Service Grade:** No service grade is identified for the operational traffic information service.

4.7 Timeliness

4.7.1 **Data Validity Period:** Categorised flow and speed data shall be valid for the averaging period. TR2177 section 4 (requirement M.59) shall take precedence over this requirement if it is different.

4.7.2 **Data Time Stamping Regime:** Time stamping of speed and categorised flow data shall be based on the time that the data is calculated and subject to the precision requirements identified in paragraph 4.3.5 above and the reliability requirements in paragraph 4.8.6 below.

4.7.3 **Data Update Mode:** Categorised flow and speed data shall be updated as an occurrence of a change in the available data, which is calculated for every averaging period.

4.7.4 **Data Update Interval:** The data update interval for categorised flow and speed data is zero. This means that the data represents a snapshot “occurrence” and updated as “unsolicited data”.

4.8 Veracity

4.8.1 **Data Correctness:** The false detection rate is irrelevant for speed and categorised flow data (see paragraph 4.8.6 below).

- 4.8.2 **Error Probability:** The error probability for speed and categorised flow data shall be 1 in 10 (see paragraph 4.5.3 above).
- 4.8.3 **Mean Absolute Error:** There is no mean absolute error requirement associated with MIDAS speed and categorised flow data inputs.
- 4.8.4 **Error Standard Deviation:** There is no error standard deviation requirement associated with MIDAS speed and categorised flow data.
- 4.8.5 **Mean Error:** There is no mean error requirement associated with MIDAS speed and categorised flow data.
- 4.8.6 **Reliability (i.e. reliability of detection data):** There shall be at least 90% confidence that the detection location accuracy shall be +1.0/-5.0 metres detection location. metres or better for any individual detection point (for vehicle speeds between 40 km/h (25 mph) to 112 km/h (70 mph)). There shall be at least 90% confidence that the detection timestamp accuracy stamp shall be +/-100ms or better.

WITHDRAWN

5. INTERFACE REQUIREMENTS

5.1 Operator Interface

5.1.1 Operator interfaces for operational traffic information are defined by MIDAS/HATMS.

5.2 System Interface

5.2.1 Data structures and standards for MIDAS operational traffic information shall be consistent with TR2173 (NMCS2 MIDAS Message Specification). Data flows associated with MIDAS operational traffic information shall be consistent with TR2173. Section 9.7.3 of TR2173 provides the message structure for the speed and categorised flow detection data.

5.2.2 Speed and categorised flow data collected for operational traffic information shall support the MIDAS subsystem in accordance with TR2144 (NMCS2 MIDAS Subsystem Specification).

5.3 Site and Location Issues

5.3.1 Speed and categorised flow detection locations shall be the same as for incident detection (See TD45 Annex A) unless additional or alternative locations are confirmed by the overseeing organisation.

WITHDRAWN

6. APPROVAL

Approval of this document for publication is given by:

Highways England
Temple Quay House
The Square
Temple Quay
Bristol
BS1 6HA

M WILSON
Chief Highway Engineer

Transport Scotland
8th Floor, Buchanan House
58 Port Dundas Road
Glasgow
G4 0HF

R BRANNEN
Chief Executive

Welsh Government
Transport
Cardiff
CF10 3NQ

S HAGUE
Deputy Director
Network Management Division

Department for Infrastructure
Clarence Court
10-18 Adelaide Street
Belfast
BT2 8GB

P B DOHERTY
Director of Engineering

All technical enquiries or comments on this Document should be sent to
DMRB_Enquiries@highwaysengland.co.uk

WITTHDRAWN

**VOLUME 9 NETWORK – TRAFFIC
CONTROL AND
COMMUNICATIONS**

**SECTION 1 DETECTION
TECHNOLOGY**

PART 2

TD 45/17 Annex D

**DETECTION PERFORMANCE REQUIREMENTS
FOR TRAFFIC DATA DISSEMINATION (MIDAS
GOLD)**

Contents

1. Summary of Detection Requirements for a MIDAS-Gold-Based Traffic Data Dissemination Service
2. Introduction
3. Business Need for MIDAS Traffic data dissemination
4. Functional Performance Requirements
5. Interface Requirements
6. Approval

WITHDRAWN

1. SUMMARY OF DETECTION REQUIREMENTS FOR A MIDAS-GOLD-BASED TRAFFIC DATA DISSEMINATION SERVICE

1.1.1 Figure 1 below outlines general data flows from sensor to outputs for a traffic data dissemination service using a variety of approaches. This Annex describes the required performance of detection inputs to a MIDAS subsystem that provides traffic data dissemination. This can be achieved in a variety of ways and Figure 1 suggests some of them. Figure 1 also indicates where this annex has most influence; it describes the input requirements for a MIDAS subsystem.

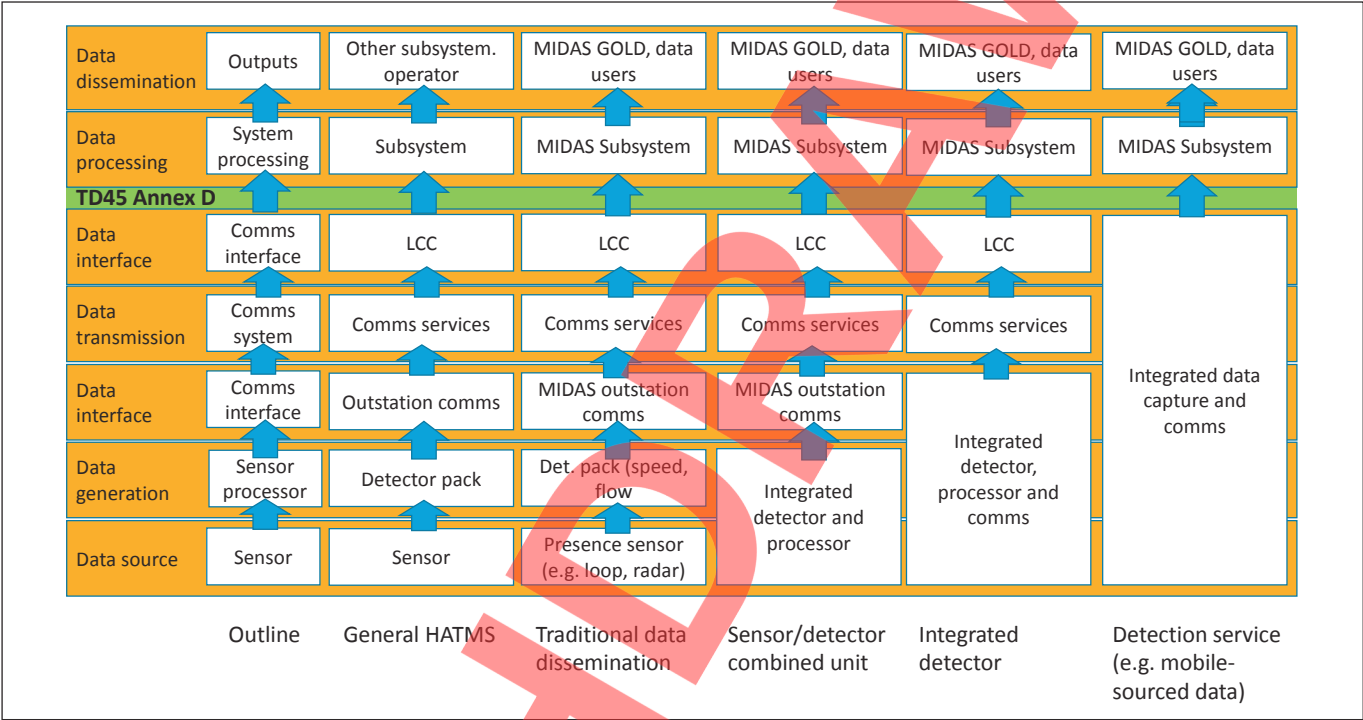


Figure 1 Outline of data flows for data dissemination showing some examples of data capture, generation and transmission arrangements for a MIDAS-based solution.

1.1.2 Table 1 below provides a summary of the detection requirements for a traffic data dissemination service. This is described in section 4 below.

Table 1 Summary of detection requirements

General requirement criteria	Criteria	Requirement	Detailed requirement reference
Measurement Source	Calculation/Estimation Method	Calculated	4.2.1
	Collection Method	Averaging	4.2.2
	Calculation Period	<20 ms	4.2.3
	Estimation/ Simulation Model Identity	Not relevant	
	Equipment Type	No restriction	4.2.5
	Number of Data Points	One per lane per site.	4.2.6 to 4.3.3
Precision	Number of Decimal Places	Vehicle category by length (m – 1 decimal place) (TR2144 takes precedence) Average speed (km per hour – 0 decimal places) (TR2173 takes precedence) Flow data (vehicles per minute – 0 decimal places). TR2173 takes precedence	
	Number of Significant Figures	3 (flow data). Not relevant for alerts	4.3.4
	Time Precision	Hours, minutes and seconds	4.3.5
Service Availability	Availability Period	(24/7/365)	4.4.1
	Mean Time Between Failures (MTBF)	>5 years (>3 years to first failure)	4.4.2
	Mean Time to Repair (MTTR)	<15 minutes after attendance	4.4.3
Service Completeness	Business Rules Coverage	3 - 120 mph, tested at 1,800 vehicles per lane per hour, 100 km/h and 5m vehicle length, all weather and lighting conditions	4.5.1
	Data Types Covered	Speed and categorised flow data and speed and flow alert data	4.5.2
	Percentage Occurrence Coverage	100% for speed and categorised flow calculations. 90% for speed and flow alerts	4.5.3
Service Grade	Service Grade	Not relevant	
Timeliness	Data Validity Period	Averaging period	4.7.1
	Data Time Stamping	+/-100ms	4.7.2
	Data Update Mode	Occurrence	4.7.3
	Data Update Interval	0	4.7.4
Veracity	Data Correctness	Not relevant	
	Error probability	1 in 10 for alerts	4.8.2
	Mean Absolute Error	Not relevant	
	Error Standard Deviation	Not relevant	
	Mean Error	Not relevant	
	Reliability	At least 90% confidence in detection accuracy and timing performance.	4.8.6

2. INTRODUCTION

2.1 Background

- 2.1.1 This an annex of TD45 provides the input detection requirements for a traffic data dissemination service that is consistent with the MIDAS subsystem. It is supplementary to the main text and it should not be read in isolation. It should be combined with the main body of TD45 to complete the detection requirements. Requirements in the main body of TD45 shall be met unless more onerous ones are identified in this annex. Under such circumstances, the requirements in this annex shall apply.
- 2.1.2 Traffic data dissemination is dependent on the receipt of data from the highway for onward distribution to third parties, including alerts and speed and flow data, categorisation by vehicle length. Speed and flow statistics are also made available.
- 2.1.3 Alerts, speed and flow data can be collected from highway sensors, or obtained from other sources (including mobile data), which can be processed to identify the required traffic characteristics. However, the same performance requirements apply to the detection data irrespective of its source. Vehicle length data is generally not available from mobile data sources, so other detection tools will need to be employed to deliver categorised data using mobile sources.
- 2.1.4 The primary aim of this annex is to identify the detection performance requirements of a MIDAS-based traffic data dissemination service. It also provides performance requirements for a supply specification. Detection facilities can then be designed to meet the needs of the service.
- 2.1.5 The aim of traffic data dissemination is to provide third party data providers with the opportunity to access Highways England traffic data so that customers can be informed about the status of the network. This improves customer experience and it supports network management by encouraging alternative journey decisions during incident situations.
- 2.1.6 The performance requirements in this annex identify the input requirements for a MIDAS-based traffic data dissemination service. The alert, speed and categorised flow data that MIDAS uses is collected from detection facilities.
- 2.1.7 It is recognised that any relevant technology solutions should be considered as long as performance requirements for traffic data dissemination are met.
- 2.1.8 Locations for MIDAS traffic data dissemination detection are the same as those identified for incident detection in TD45 Annex A.

2.2 General

- 2.2.1 Whilst the primary aim of MIDAS is incident detection, it also provides traffic data to third parties so that customer experience can be improved. The detection function that the MIDAS subsystem performs in this context, therefore, is alert, speed and categorised flow detection.

2.3 Scope and Purpose

- 2.3.1 Traffic data dissemination systems use the detection data gathered by detectors or detection services to create an output. The primary output is normally traffic data for the provision of traffic information.

- 2.3.2 For traffic data dissemination, the detection aim is therefore to provide traffic data for subsequent processing by third parties and onward dissemination to travellers. Logging of traffic data is also available. For MIDAS, this is achieved by monitoring alert, speed and categorised flow and delivering this data to a gateway for external access.
- 2.3.3 The objective of detection in this annex is to deliver detection data according to the performance requirements of a MIDAS-based traffic data dissemination service.

WITHDRAWN

3. BUSINESS NEED FOR MIDAS TRAFFIC DATA DISSEMINATION

3.1 General

- 3.1.1 The primary business requirement for traffic data dissemination is to improve customer experience. When travellers have information and knowledge relating to their journey, they can make effective route, mode and timing choices. This helps to mitigate the worst impacts of incidents and congestion, which improves network performance.
- 3.1.2 Incorrect alert, speed and categorised flow detection can result in poor quality traffic data, which leads to incorrect traveller decisions if the detection is inaccurate or wrongly located.

3.2 Business Case

- 3.2.1 The decision to specify the requirement for a smart motorway, conventional motorway, expressway or APTR to be equipped for traffic data dissemination will be made by the overseeing organisation based on a range of criteria such as:

- Accident rate
- Abnormal highway design (e.g. tunnels or steep gradients)
- Junction spacing
- Traffic flow density
- Length of road section
- Signalised junctions

3.3 Traffic Data Dissemination Functions

- 3.3.1 MCH 1696 (NMCS MIDAS System Overview) provides the background to the MIDAS traffic data dissemination.
- 3.3.2 MCH1986 (NMCS2 MIDAS GOLD an overview) provides a description of how traffic statistics are collected and redistributed via the MIDAS gateway for on-line data (GOLD).
- 3.3.3 MCE0127 (MIDAS GOLD System Requirement Specification) provides a description of the MIDAS GOLD system.
- 3.3.4 Detection technology for traffic data dissemination shall provide detection data that meets the needs of the MIDAS subsystem as described in TR2144 (NMCS2 MIDAS Subsystem Specification) and the performance requirements of the MIDAS subsystem as described in TR2174 (NMCS2 MIDAS System Performance Specification).
- 3.3.5 The MIDAS data gateway provides access to real-time alert and traffic data that is updated on a minute-by minute basis. The data gateway does not process the data other than by making it available to other software applications that may be connected.

- 3.3.6 Interfaces that obtain live traffic or alert data should not be connected directly to a live MIDAS Subsystem because it is operational. Instead, they should be connected to a buffering system providing a traffic data dissemination service. This ensures that MIDAS is not compromised by external systems. MIDAS GOLD provides that buffering.
- 3.3.7 The MIDAS GOLD system also provides current traffic data information at regular intervals to the HALOGEN data service. This is used to update a real time traffic information web site.
- 3.3.8 The flow and average speed data is obtained over a configurable averaging period. The averaging period is in the range 1 to 60 minutes, the vehicle category lengths are in the range 0 to 25.5 metres in units of 0.1 metres.

3.4 Traffic Data Dissemination Data

- 3.4.1 Data structures and standards shall be consistent with the MIDAS Message Specification (TR2173). In particular, section 6 of TR2173 shall apply (CI=B6H and B8H). MIDAS traffic data dissemination data shall consist of alerts, speed and categorised flow.
- 3.4.2 Data quality is described by the requirements for detection in section 4 below.

3.5 Traffic Data Dissemination Technology

- 3.5.1 Various technology options exist for traffic data dissemination. Inductive loops are a mature technology that has been used for alert, speed and categorised flow detection. Radar and magnetometer-based solutions have also been deployed. Alternative options might provide easier access for maintenance or repair or improved performance. Detection based on alternative data sources might also be considered (e.g. mobile phones).
- 3.5.2 All options have strengths and weaknesses that should be analysed to determine their suitability for alert, speed and categorised flow detection. Detection performance should be assessed against the needs of the overseeing organisation with regard to a variety of issues, such as the quality of detection data, capital and maintenance costs, reliability and network disruption.
- 3.5.3 Privacy issues are likely to be relevant for some solutions (e.g. mobile and big data). Any solution shall be compatible with the overseeing organisation's obligations under the Data Protection Act.
- 3.5.4 Length data is unlikely to be available from mobile data sources. Vehicle length might also be available from laser scanning sensors or image processing.

4. FUNCTIONAL PERFORMANCE REQUIREMENTS

4.1 Traffic Data Dissemination Detection Performance Requirements

- 4.1.1 The performance requirements for alert, speed and categorised flow data are described using detection quality object descriptions derived from PD ISO/TR 21707:2008 (Intelligent Transport Systems - Integrated transport information, management and control - Data quality in ITS systems).

4.2 Measurement Source

- 4.2.1 **Calculation/Estimation Method:** MIDAS alert, speed and categorised flow data shall be calculated from detection inputs.
- 4.2.2 **Collection Method:** Averaging shall be used to generate speed and flow data for vehicle types categorised by length for a MIDAS traffic data dissemination service. An algorithm shall be used to generate speed and flow alerts.
- 4.2.3 **Calculation Period:** A message shall be transmitted within 20 ms of the event that generated an alert or the end of the averaging period (which can be between 1 and 60 minutes).
- 4.2.4 **Estimation/ Simulation Model Identity:** No model is used to calculate speed and flow data. Alerts shall be generated by algorithms as described in TR2177 section 5.
- 4.2.5 **Equipment Type:** There is no restriction on the equipment type that can be used to deliver the traffic data dissemination performance requirements.
- 4.2.6 **Number of Data Points:** There shall be one detection location for each site on the SRN that needs traffic data dissemination (section 5.3 below provides location information). Each lane shall form a detection location point at each site.

4.3 Precision

- 4.3.1 **Number of Decimal Places:** Vehicle category lengths shall have a precision of 0.1 metres. If TR2144 indicates a different number of decimal places, TR2144 shall take precedence (see TR2144 Section 4.3.3, M:434.9).
- 4.3.2 **Average Speed Data:** Shall have a precision of 1 kilometre per hour (i.e. zero decimal places). If TR2173 indicates a different number of decimal places, TR2173 shall take precedence (see TR2173 section 9.8, M:1285).
- 4.3.3 **Flow Data:** Shall have a precision of 1 vehicle per minute (i.e. zero decimal places). If TR2173 indicates a different number of decimal places, TR2173 shall take precedence (see TR2173 section 9.8, M:1286).
- 4.3.4 **Number of Significant Figures:** Speed and categorised flow detection data shall have 3 significant figures. The number of significant figures is not relevant to alerts.
- 4.3.5 **Time Precision:** Time stamp information relating to alert, speed and categorised flow detection data shall be identified using hours, minutes and seconds.

4.4 Service Availability

- 4.4.1 **Availability Period:** Alert, speed and categorised flow data shall be provided on a full-time basis (24/7/365).
- 4.4.2 **Mean Time Between Failures (MTBF):** The MTBF for alert, speed and categorised flow detection equipment shall be at least 5 years. The minimum period before the first failure shall be 3 years.
- 4.4.3 **Mean Time to Repair (MTTR):** The MTTR for alert, speed and categorised flow detection equipment technology shall be at most 15 minutes after attendance.

Note that the MTTR and MTBF figures identified above relate to detection technology only (i.e. they exclude communications and system failures).

4.5 Service Completeness

- 4.5.1 **Business Rules Coverage:** Detection shall be achieved according to the performance requirements identified in this annex, subject to the following conditions:
- Vehicles travelling at speeds between 4.8 km/h (3 mph) and 193 km/h (120 mph) shall be included in the calculation of a speed/flow alert condition. (Note the speed range for detection timing and location accuracy requirements in paragraphs 4.8.1 to 4.8.6 below).
 - Representative traffic conditions shall be adopted for performance testing, including a mean traffic density of 1,800 vehicles per lane per hour, a mean traffic speed of 100 km/h and a mean vehicle length of 5m.
 - Detection performance requirements shall be delivered under all weather and lighting conditions unless otherwise stated in the environmental performance requirements (for example, temperature).
- 4.5.2 **Data Types Covered:** The detection input data for MIDAS traffic data dissemination shall be provided in the form of measured speed and categorised flow data and speed and flow alert data.
- 4.5.3 **Percentage Occurrence Coverage:** 100% of speed and categorised flow calculations shall be reported. The detection rate for traffic events that trigger a speed or flow alert shall be 90%. This is the percentage of the number of detected occurrences compared to the total number of actual occurrences during a given time period.
- #### 4.6 Service Grade
- 4.6.1 **Service Grade:** No service grade is identified for the traffic data dissemination service.
- #### 4.7 Timeliness
- 4.7.1 **Data Validity Period:** Categorised flow and speed data shall be valid for the averaging period (i.e. data is valid until the next averaging period is complete).
- 4.7.2 **Data Time Stamping Regime:** Time stamping of alert, speed and categorised flow data shall be based on the time that the data is calculated and subject to the precision requirements identified in paragraph 4.3.5 above and the reliability requirements identified in paragraph 4.8.6 below.

4.7.3 **Data Update Mode:** Categorised flow and speed data shall be updated as an occurrence of a change in the available data, which is calculated for every averaging period. Also, alerts shall be treated as occurrences.

4.7.4 **Data Update Interval:** The data update interval for categorised flow and speed data is zero. This means that the data represents a snapshot “occurrence” and updated as “unsolicited data.”

4.8 Veracity

4.8.1 **Data Correctness:** The false detection rate is irrelevant for alert, speed and categorised flow data (see also paragraph 4.8.6 below).

4.8.2 **Error Probability:** The error probability for alerts shall be 1 in 10 (see paragraph 4.5.3 above).

4.8.3 **Mean Absolute Error:** There is no mean absolute error requirement associated with MIDAS alert, speed and categorised flow data inputs.

4.8.4 **Error Standard Deviation:** There is no error standard deviation requirement associated with MIDAS alert, speed and categorised flow data.

4.8.5 **Mean Error:** There is no mean error requirement associated with MIDAS alert, speed and categorised flow data.

4.8.6 **Reliability (i.e. reliability of detection data):** There shall be at least 90% confidence that the location detection shall be +/- 0.5 metres or better for any individual detection point (40 km/h (25 mph) to 112 km/h (70 mph)). There shall be at least 90% confidence that the detection timestamp accuracy shall be +/- 100ms or better.

WITHDRAWN

5. INTERFACE REQUIREMENTS

5.1 Operator Interface

- 5.1.1 The external systems that access alert, speed and flow data provide their own operator interfaces, which is not relevant to the detection data.

5.2 System Interface

- 5.2.1 Data structures and standards for MIDAS traffic data dissemination shall be consistent with TR2173 (NMCS2 MIDAS Message Specification). Data flows associated with MIDAS traffic data dissemination shall be consistent with TR2173. Section 6.24 of TR2173 provides the message structure for the alert, speed and categorised flow detection data.

- 5.2.2 Alert, speed and categorised flow data collected for traffic data dissemination shall support the MIDAS subsystem in accordance with TR2144 (NMCS2 MIDAS Subsystem Specification).

5.3 Site and Location Issues

- 5.3.1 Alert, speed and categorised flow detection locations shall be the same as for incident detection (See TD45 Annex A) unless additional or alternative locations are confirmed by the overseeing organisation.

WITTHDRAWN

6. APPROVAL

Approval of this document for publication is given by:

Highways England
Temple Quay House
The Square
Temple Quay
Bristol
BS1 6HA

M WILSON
Chief Highway Engineer

Transport Scotland
8th Floor, Buchanan House
58 Port Dundas Road
Glasgow
G4 0HF

R BRANNEN
Chief Executive

Welsh Government
Transport
Cardiff
CF10 3NQ

S HAGUE
Deputy Director
Network Management Division

Department for Infrastructure
Clarence Court
10-18 Adelaide Street
Belfast
BT2 8GB

P B DOHERTY
Director of Engineering

All technical enquiries or comments on this Document should be sent to
DMRB_Enquiries@highwaysengland.co.uk

WITHDRAWN

**VOLUME 9 NETWORK – TRAFFIC
CONTROL AND
COMMUNICATIONS**

**SECTION 1 DETECTION
TECHNOLOGY**

PART 2

TD 45/17 Annex E

**DETECTION PERFORMANCE REQUIREMENTS
TRAFFIC STATISTICS (MIDAS)**

Contents

1. Summary of Detection Requirements for a
MIDAS-Based Traffic Statistics Service
2. Introduction
3. Business Need for MIDAS Traffic Statistics
4. Functional Performance Requirements
5. Interface Requirements
6. Approval

1. SUMMARY OF DETECTION REQUIREMENTS FOR A MIDAS-BASED TRAFFIC STATISTICS SERVICE

1.1.1 Figure 1 below outlines general data flows from sensor to outputs for a traffic statistics service using a variety of approaches. This Annex describes the required performance of detection inputs to a MIDAS subsystem that provides traffic statistics. This can be achieved in a variety of ways and Figure 1 suggests some of them. Figure 1 also indicates where this annex has most influence; it describes the input requirements for a MIDAS subsystem.

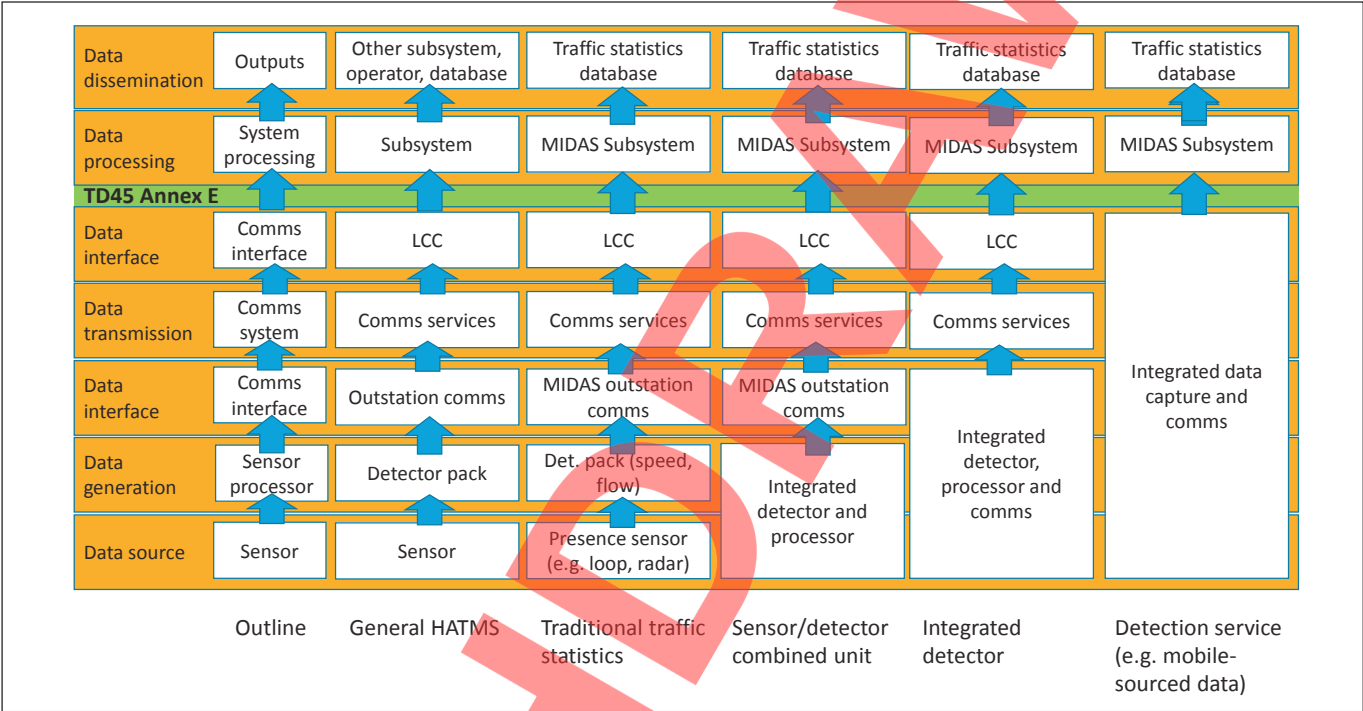


Figure 1 Outline of traffic statistics data flows showing some examples of data capture, generation and transmission arrangements for a MIDAS-based solution.

1.1.2 Table 1 below provides a summary of the detection requirements for a MIDAS-based traffic statistics service. This is described in section 4 below.

Table 1 Summary of detection requirements

General requirement criteria	Criteria	Requirement	Detailed requirement reference
Measurement Source	Calculation/Estimation Method	Calculated from speed, categorised flow, occupancy and headway data inputs. Count data is raw data for each averaging period	4.2.1
	Collection Method	Averaging (for speed, categorised flow, occupancy and headway)	4.2.2
	Calculation Period	<20 ms	4.2.3
	Estimation/ Simulation Model Identity	Not relevant	
	Equipment Type	No restriction	4.2.5
	Number of Data Points	One per lane per site	4.2.6
Precision	Number of Decimal Places	Vehicle category by length (m – 1 decimal place) (TR2144 takes precedence) Average speed (km per hour – 0 decimal places) (TR2173 takes precedence) Flow and count data (vehicles per minute – 0 decimal places) (TR2173 takes precedence) Occupancy (percentage – 0 decimal places) (TR2173 takes precedence) Occupancy data shall have 0 decimal places	4.3.1 to 4.3.6
	Number of Significant Figures	3 (speed, categorised flow, count and headway) 2 (occupancy)	4.3.7
	Time Precision	Hours, minutes and seconds	4.3.8
Service Availability	Availability Period	(24/7/365)	4.4.1
	Mean Time Between Failures (MTBF)	>5 years (>3 years to first failure)	4.4.2
	Mean Time to Repair (MTTR)	<15 minutes after attendance	4.4.3
Service Completeness	Business Rules Coverage	3 - 120 mph, tested at 1,800 vehicles per lane per hour, 100 km/h and 5m vehicle length, all weather and lighting conditions	4.5.1
	Data Types Covered	Speed, categorised flow, count, occupancy and headway	4.5.2
	Percentage Occurrence Coverage	100% of speed, categorised flow, count, occupancy and headway detection events shall be reported	4.5.3
Service Grade	Service Grade	Not relevant	

General requirement criteria	Criteria	Requirement	Detailed requirement reference
Timeliness	Data Validity Period	Not relevant	
	Data Time Stamping	Accurate to +/-100ms	4.7.2
	Data Update Mode	“Occurrence”	4.7.3
	Data Update Interval	0	4.7.4
Veracity	Data Correctness	Not relevant	
	Error Probability	1 in 10 (speed, categorised flow and count). 1 in 20 (occupancy and headway).	4.8.2
	Mean Absolute Error	Not relevant	
	Error Standard Deviation	Not relevant	
	Mean Error	5% (count, average speed and flow). 10% (headway and occupancy).	4.8.5
	Reliability	At least 90% confidence in detection accuracy and timing performance.	4.8.6

WITHDRAWN

2. INTRODUCTION

2.1 Background

- 2.1.1 This annex of TD45 provides the input detection requirements for a traffic statistics service that is consistent with the MIDAS subsystem. It is supplementary to the main text and it should not be read in isolation. It should be combined with the main body of TD45 to complete the detection requirements. Requirements in the main body of TD45 shall be met unless more onerous ones are identified in this annex. Under such circumstances, the requirements in this annex shall apply.
- 2.1.2 Traffic statistics are captured by the MIDAS Traffic Data Analysis System (TDAS), which receives data from the highway to populate a database in the MIDAS subsystem. Users can then access the data for analysis.
- 2.1.3 The MIDAS Subsystem creates daily binary traffic counting data files that contain an account of the traffic speeds and counts throughout a Regional Control Centre (RCC) area. The files also contain headway and occupancy per lane and flow classification by vehicle length. Users can view and analyse the traffic data from database tables.
- 2.1.4 Speed, categorised flow, count, occupancy and headway data can be collected from highway sensors, or obtained from other sources (including mobile data), which can be processed to identify the required traffic statistics. The same performance requirements apply to the detection data irrespective of its source. Flow data is categorised by vehicle length, which is generally not available from mobile data sources, so other detection tools might need to be employed to deliver length-categorised data using mobile sources.
- 2.1.5 The primary aim of this annex is to identify the detection performance requirements of a MIDAS-based traffic statistics service. It also provides performance requirements for a supply specification. Detection facilities can then be designed to meet the needs of the service.
- 2.1.6 The aim of the traffic statistics service is to provide users with data for subsequent use (for example in operational, scheme and network planning). This supports strategic decision making so that planned disruptions are minimised or mitigated. This means that network performance is improved and customer experience is enhanced.
- 2.1.7 The performance requirements in this annex identify the input requirements for the TDAS MIDAS-based traffic statistics service. The speed, categorised flow, count, occupancy and headway data that MIDAS uses is collected from detection facilities.
- 2.1.8 It is recognised that any relevant technology solutions should be considered as long as performance requirements for a traffic statistics service are met.
- 2.1.9 Locations for MIDAS TDAS detection are the same as those identified for incident detection in TD45 Annex A.

2.2 General

- 2.2.1 Whilst the primary aim of MIDAS is incident detection, it also provides traffic statistics to users so that planning can be improved. The function that the MIDAS subsystem performs in this context, therefore, is speed, categorised flow, count, occupancy and headway detection.

2.3 Scope and Purpose

- 2.3.1 Traffic statistics systems use the detection data gathered by detectors, or detection services, to create an output. The primary output is normally data for network and operational planning support.
- 2.3.2 For traffic statistics, the detection aim is therefore to provide traffic data for subsequent analysis. For TDAS, this is achieved by monitoring speed, categorised flow, count, occupancy and headway and delivering this data to operators on request.
- 2.3.3 The objective of detection in this annex is to deliver detection data according to the performance requirements of a MIDAS-based Traffic statistics service (TDAS).

3. BUSINESS NEED FOR MIDAS TRAFFIC STATISTICS

3.1 General

- 3.1.1 The primary business requirement for traffic statistics is to support network planning for strategy, schemes and operations. Effective planning decisions ensure that network disruption is minimised so that the highway asset is used effectively and efficiently and customer experience is maintained or improved.
- 3.1.2 Incorrect speed, categorised flow, count, occupancy and headway detection can result in poor planning decisions if the detection is inaccurate or wrongly located.

3.2 Business Case

- 3.2.1 The decision to specify the requirement for a smart motorway, conventional motorway, expressway or APTR to be equipped for TDAS will be made by the overseeing organisation based on a variety of criteria, such as:

- Accident rate
- Abnormal highway design (e.g. tunnels or steep gradients)
- Junction spacing
- Traffic flow density
- Length of road section
- Signalised junctions

3.3 Traffic Statistics Functions

- 3.3.1 MCH1696 (NMCS MIDAS System Overview) provides the background to MIDAS.
- 3.3.2 MCE1060 (MIDAS Traffic Data Analysis System Requirement Specification) provides a description of TDAS.
- 3.3.3 Detection technology for traffic statistics shall provide detection data that meets the needs of the MIDAS subsystem as described in TR2144 (NMCS2 MIDAS Subsystem Specification) and the performance requirements of the MIDAS subsystem as described in TR2174 (NMCS2 MIDAS System Performance Specification).
- 3.3.4 The MIDAS TDAS system allows users to view and analyse traffic statistics in the form of tables and graphs. It is designed to allow rapid presentation of traffic data from selected MIDAS detection locations. The traffic statistics are read directly from binary files and stored in a user database. This logically separates the application and the data, giving a more flexible environment.
- 3.3.5 The MIDAS TDAS system supports traffic counting, flow (by vehicle category; length) and average speed, flow, occupancy and headway (by lane) on a minute-by minute basis.

- 3.3.6 A user can choose to display the traffic statistics or to import them into a proprietary database for further analysis.
- 3.3.7 The flow and average speed data is obtained over a configurable averaging period. The averaging period is in the range 1 to 60 minutes, the vehicle category lengths are in the range 0 to 25.5 metres in units of 0.1 metres.

3.4 Traffic Statistics Data

- 3.4.1 Data structures and standards shall be consistent with the MIDAS Message Specification (TR2173). MIDAS TDAS data shall consist of speed, categorised flow, count, occupancy and headway.
- 3.4.2 Data quality is described through the performance requirements for detection in section 4 below.

3.5 Traffic Statistics Detection Technology

- 3.5.1 Generally, TDAS might be able to use the same input data that other MIDAS-based services use (for example, incident detection). This approach can provide cost savings, but, the detection technology options for those services should be examined to confirm that they are appropriate for TDAS. These are described in other TD45 annexes.
- 3.5.2 Various technology options exist to collect TDAS detection data. For traffic statistics, inductive loops are a mature technology that has been used for speed, categorised flow, count, occupancy and headway detection. Radar and magnetometer-based solutions have also been deployed. Alternatives to these might provide easier access for maintenance or repair or improved performance. Detection based on alternative data sources might also be considered (e.g. mobile phones). All options have strengths and weaknesses that should be analysed to determine their suitability. Detection performance should be examined against a variety of criteria established by the overseeing organisation (for example, capital and maintenance costs, reliability and network disruption).
- 3.5.3 Flow data is categorised by vehicle length, which requires physical detectors to measure it in most circumstances. Length data is unlikely to be available from mobile, or nomadic data sources. As well as inductive loop technology, vehicle length might also be available from laser scanning sensors or image processing.
- 3.5.4 Sensors can also be combined to provide mitigation for low performance, but without detecting the same quantity. For example, inductive loop and radar.

4. FUNCTIONAL PERFORMANCE REQUIREMENTS

4.1 TDAS Detection Performance Requirements

- 4.1.1 The performance requirements for speed, categorised flow, count, occupancy and headway data are described using detection quality object descriptions derived from PD ISO/TR 21707:2008 (Intelligent Transport Systems - Integrated transport information, management and control - Data quality in ITS systems).

4.2 Measurement Source

- 4.2.1 **Calculation/Estimation Method:** Speed, categorised flow, count, occupancy and headway data shall be calculated from detection inputs. Count data shall be raw for a defined period (the averaging period).
- 4.2.2 **Collection Method:** Averaging shall be used to generate speed and categorised flow, occupancy and headway data. Count data shall be calculated by incremental tally over the averaging period.
- 4.2.3 **Calculation Period:** A traffic data message shall be transmitted within 20 ms of the end of the averaging period (which can be between 1 and 60 minutes).
- 4.2.4 **Estimation/ Simulation Model Identity:** No models are used to calculate speed, flow, count, occupancy and headway data.
- 4.2.5 **Equipment Type:** There is no restriction on the equipment type that can be used to deliver the TDAS performance requirements.
- 4.2.6 **Number of Data Points:** There shall be one detection location for each site on the SRN that needs TDAS (section 5.3 below provides location information). Each lane shall form a detection location point at each site.

4.3 Precision

- 4.3.1 **Number of Decimal Places:** Vehicle category lengths shall have a precision of 0.1 metres.
- 4.3.2 **Average Speed Data** shall have a precision of 1 kilometre per hour (i.e. zero decimal places). If TR2173 indicates a different number of decimal places, TR2173 shall take precedence (see TR2173 section 9.8, M:1285).
- 4.3.3 **Flow Data** shall have a precision of 1 vehicle per minute (i.e. zero decimal places). If TR2173 indicates a different number of decimal places, TR2173 shall take precedence (see TR2173 section 9.8, M:1286).
- 4.3.4 **Flow and Count Data** shall have a precision of 1 vehicle per minute (i.e. zero decimal places). If TR2173 indicates a different number of decimal places, TR 2173 shall take precedence. See section 9.8, M:1286.
- 4.3.5 **Occupancy data** shall be reported as a percentage, with a precision of 1(%) (i.e. zero decimal places). If TR2173 indicates a different number of decimal places, TR 2173 shall take precedence. See section 9.8, M:1276 and M:1289.
- 4.3.6 **Headway data** shall be reported in seconds with 0.1s increments. If TR2173 indicates a different number of decimal places, TR 2173 shall take precedence. See section 9.8, M:1684.

- 4.3.7 **Number of Significant Figures:** Speed, categorised flow, count and headway detection data shall have 3 significant figures. Occupancy data shall have 2 significant figures. If TR2173 indicates a different number of decimal places, TR2173 shall take precedence. See TR2173 section 9.8, M:1276.
- 4.3.8 **Time Precision:** Time stamp information relating to speed, categorised flow, count, occupancy and headway detection data shall be identified using hours, minutes and seconds.
- 4.4 Service Availability**
- 4.4.1 **Availability Period:** Speed, categorised flow, count, occupancy and headway data shall be provided on a full-time basis (24/7/365).
- 4.4.2 **Mean Time Between Failures (MTBF):** The MTBF for speed, categorised flow, count, occupancy and headway detection equipment shall be at least 5 years. The minimum period before the first failure shall be 3 years.
- 4.4.3 **Mean Time to Repair (MTTR):** The MTTR for speed, categorised flow, count, occupancy and headway detection equipment technology shall be at most 15 minutes after attendance.

Note that the MTTR and MTBF figures identified above relate to detection technology only (i.e. they exclude communications and system failures).

4.5 Service Completeness

- 4.5.1 **Business Rules Coverage:** Detection shall be achieved according to the performance requirements identified in this annex, subject to the following conditions:
- Vehicles travelling at speeds between 4.8 km/h (3 mph) and 193 km/h (120 mph) shall be included in the calculation of a speed/flow data. (Note the speed range for detection timing and location accuracy requirements in paragraphs 4.8.1 to 4.8.6 below).
 - Representative traffic conditions shall be adopted for performance testing, including a mean traffic density of 1,800 vehicles per lane per hour, a mean traffic speed of 100 km/h and a mean vehicle length of 5m.
 - Detection performance requirements shall be delivered under all weather and lighting conditions unless otherwise stated in the environmental performance requirements (for example, temperature).
- 4.5.2 **Data Types Covered:** The detection input data for MIDAS TDAS shall be provided in the form of measured speed, categorised flow, count, occupancy and headway data. Other detection input data might also be available from the same detection facilities to provide alerts. These detection data inputs can be used for services other than traffic statistics (as described in other annexes of TD45), but they are not used by MIDAS TDAS.
- 4.5.3 **Percentage Occurrence Coverage:** 100% of speed, categorised flow, count, occupancy and headway calculations shall be reported.
- 4.6 Service Grade**
- 4.6.1 **Service Grade:** No service grade is identified for the traffic statistics service.

4.7 Timeliness

- 4.7.1 **Data Validity Period:** Traffic data is recorded as it is reported. The data validity period is irrelevant in this context.
- 4.7.2 **Data Time Stamping Regime:** Time stamping of speed, categorised flow, count, occupancy and headway data shall be based on the time that the data is calculated and subject to the precision requirements identified in paragraphs 4.3.8 above and 4.8.5 below.
- 4.7.3 **Data Update Mode:** Categorised flow and speed data shall be updated as an occurrence of a change in the available data, which is calculated for every averaging period (which is configurable).
- 4.7.4 **Data Update Interval:** The data update interval for speed, categorised flow, count, occupancy and headway data is zero. This means that the data represents a snapshot “occurrence” and updated as “unsolicited data”. However, data shall be available to cover traffic statistics for every minute.

4.8 Veracity

- 4.8.1 **Data Correctness:** The false detection rate is irrelevant for speed, categorised flow, count, occupancy and headway data for traffic statistics.
- 4.8.2 **Error Probability:** The error probability for speed, categorised flow and count data shall be 1 in 10. The error probability for occupancy and headway data shall be 1 in 20. (See paragraph 4.5.3 above).
- 4.8.3 **Mean Absolute Error:** There is no mean absolute error requirement associated with speed, categorised flow, count, occupancy and headway data inputs.
- 4.8.4 **Error Standard Deviation:** There is no error standard deviation requirement associated with MIDAS speed, categorised flow, count, occupancy and headway data.
- 4.8.5 **Mean Error:** The reported count, average speed and flow data shall be within 5% of the actual quantities. The reported headway and occupancy data shall be within 10% of the actual quantities.
- 4.8.6 **Reliability (i.e. reliability of detection data):** There shall be at least 90% confidence that the detection location accuracy shall be +1.0/-5.0 metres or better for any individual detection point (40 km/h (25 mph) to 112 km/h (70 mph)). There shall be at least 90% confidence that the detection timestamp accuracy shall be +/-100ms or better.

WITHDRAWN

5. INTERFACE REQUIREMENTS

5.1 Operator Interface

5.1.1 User interfaces for MIDAS TDAS are described in MCE1060 section 4.

5.2 System Interface

5.2.1 Data structures and standards for MIDAS TDAS shall be consistent with TR2173 (NMCS2 MIDAS Message Specification). Data flows associated with MIDAS TDAS shall be consistent with TR2173. Section 9.8 of TR2173 provides the message structure for the speed, categorised flow, count, occupancy and headway detection data.

5.2.2 Speed, categorised flow, count, occupancy and headway data collected for TDAS shall support the MIDAS subsystem in accordance with TR2144 (NMCS2 MIDAS Subsystem Specification) and MCE1060.

5.3 Site and Location Issues

5.3.1 Speed, categorised flow, count, occupancy and headway detection locations shall be the same as for incident detection (See TD45 Annex A) unless additional or alternative locations are confirmed by the overseeing organisation.

WITHDRAWN

6. APPROVAL

Approval of this document for publication is given by:

Highways England
Temple Quay House
The Square
Temple Quay
Bristol
BS1 6HA

M WILSON
Chief Highway Engineer

Transport Scotland
8th Floor, Buchanan House
58 Port Dundas Road
Glasgow
G4 0HF

R BRANNEN
Chief Executive

Welsh Government
Transport
Cardiff
CF10 3NQ

S HAGUE
Deputy Director
Network Management Division

Department for Infrastructure
Clarence Court
10-18 Adelaide Street
Belfast
BT2 8GB

P B DOHERTY
Director of Engineering

All technical enquiries or comments on this Document should be sent to
DMRB_Enquiries@highwaysengland.co.uk

WITHDRAWN

**VOLUME 9 NETWORK - TRAFFIC
CONTROL AND
COMMUNICATIONS**

**SECTION 1 DETECTION
TECHNOLOGY**

PART 2

TD 45/17 ANNEX F (ENGLAND ONLY)

**DETECTION PERFORMANCE REQUIREMENTS
FOR STOPPED VEHICLE DETECTION (SVD)**

Contents

1. Summary of Detection Requirements for a Stopped Vehicle Detection Service
2. Introduction
3. Functional Performance Requirements
4. Interface Requirements
5. Approval

1. SUMMARY OF DETECTION REQUIREMENTS FOR A STOPPED VEHICLE DETECTION SERVICE

1.1.1 Figure 1 below outlines general data flows from sensor to outputs for a stopped vehicle detection (SVD) service using a variety of approaches. This Annex describes the required performance of detection inputs to a HATMS/CHARM SVD application.

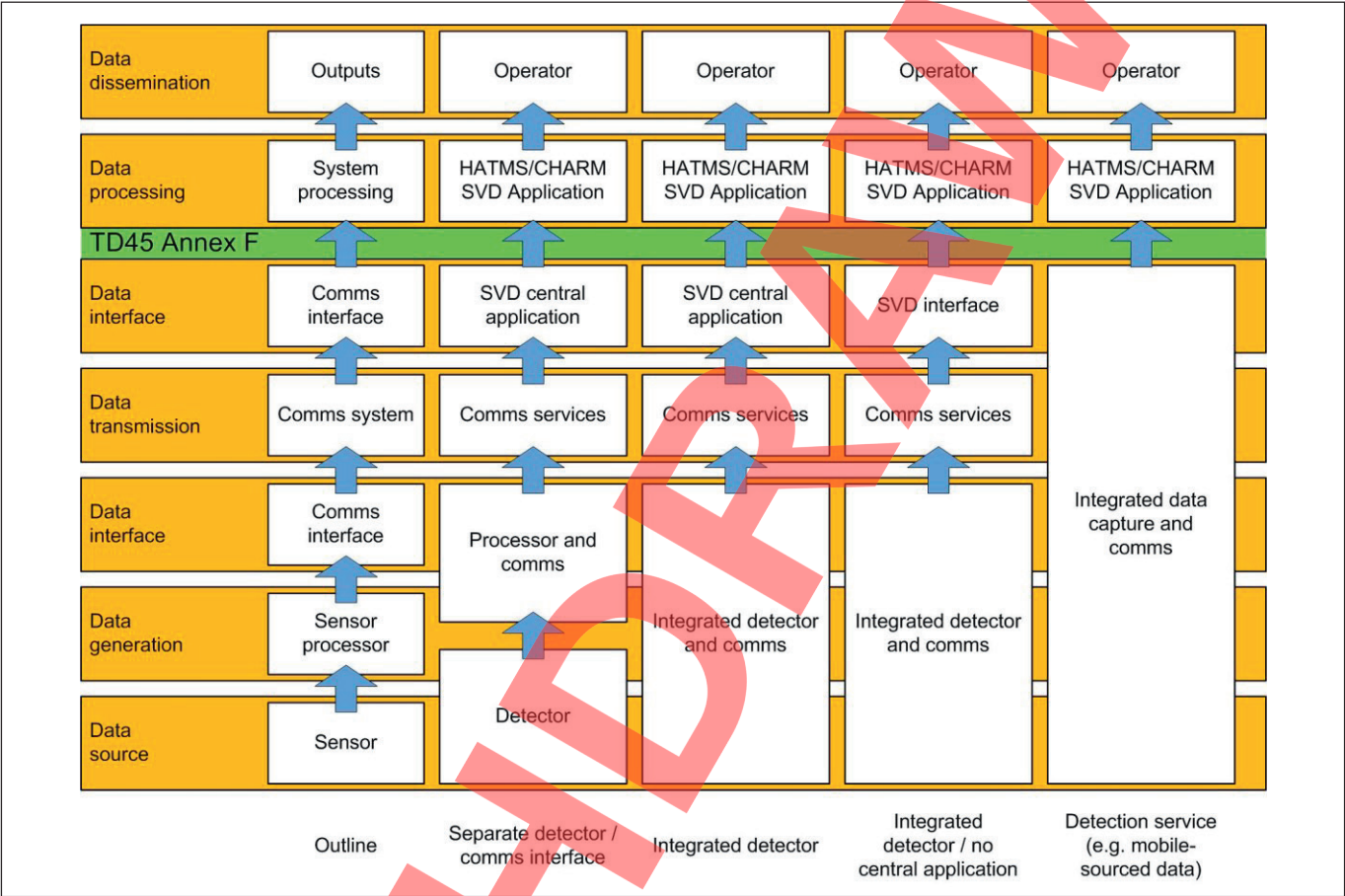


Figure 1 Outline of SVD data flows showing some examples of data capture, generation and transmission arrangements

1.1.2 Table 1 provides a summary of the detection requirements for an SVD service. This is described in section 3 and the clauses identified in the “Detailed requirement reference” column should be examined for further information.

Table 1 Summary of detection requirements

General requirement criteria	Criteria	Requirement	Detailed requirement reference
Measurement Source	Calculation/Estimation Method	No specific requirement	3.2.1.
	Collection Method	No specific requirement	3.2.2.
	Calculation Period	<20 seconds for “alert” status <60 seconds for “clear” status	3.2.3.
	Estimation/Simulation Model Identity	No specific requirement	3.2.4.
	Equipment Type	No restriction	3.2.5.
	Number of Data Points	No specific requirement	3.2.6.
Precision	Number of Decimal Places	No specific requirement	3.3.1.
	Number of Significant Figures	No specific requirement	3.3.2.
	Time Precision	Hours, minutes and seconds	3.3.3.
Service Availability	Availability Period	(24/7/365)	3.4.1.
	Mean Time Between Failures (MTBF)	>5 years (> 3 years to first failure)	3.4.2.
	Mean Time to Repair (MTTR)	<15 minutes after attendance	3.4.3.
Service Completeness	Business Rules Coverage	All motorway-legal vehicles, all weather and lighting conditions	3.5.1.
	Data Types Covered	SVD alerts	3.5.2.
	Percentage Occurrence Coverage	>80% detection rate >95% physical coverage	3.5.3.
	Physical Coverage	Mainline carriageway lanes and emergency areas	3.5.4.
Service Grade	Service Grade	None	3.6.1.
Timeliness	Data Validity Period	None	3.7.1.
	Data Time Stamping	Time when alert is first processed	3.7.2.
	Data Update Mode	“Occurrence”	3.7.3.
	Data Update Interval	Zero	3.7.4.
Veracity	Data Correctness	No specific requirement	3.8.4.
	Error probability	<15% false detection rate	3.8.5./3.8.6.
	Mean Absolute Error	No specific requirement	3.8.7.
	Error Standard Deviation	No specific requirement	3.8.8.
	Mean Error	No specific requirement	3.8.9.
	Reliability	No specific requirement	3.8.10.

2. INTRODUCTION

2.1 Background

- 2.1.1 This annex of TD 45 is supplementary to the main text and it should not be read in isolation. It provides the input detection requirements for an SVD service that is delivered using a HATMS/CHARM SVD application. Requirements in the main body of TD 45 shall be met unless superseded by this annex.
- 2.1.2 Successful stopped vehicle detection depends on receipt of data from the highway that indicates that a vehicle has stopped on the carriageway. The data consists of SVD alerts which operators can access, enabling them to verify the SVD alerts and take appropriate mitigating action.
- 2.1.3 SVD alert data can also be collected from other sources (including mobile data), which can be processed to identify the required traffic characteristics.

2.2 Scope and Purpose

- 2.2.1 SVD systems use the detection data gathered by detectors or detection services to create an output. The output might be in the form of an operator alert or a log record.
- 2.2.2 The aim of SVD is to identify vehicles that have stopped in live lanes during low flows as soon as possible and present an alert to operators, enabling them to take prompt, appropriate action. This is necessary to improve safety, customer experience and network performance.
- 2.2.3 This annex of TD 45 is intended for use in England only.

WITHDRAWN

3. FUNCTIONAL PERFORMANCE REQUIREMENTS

3.1 Stopped Vehicle Detection Performance Requirements

- 3.1.1 SVD alerts shall be generated in accordance with the performance requirements in this section. The performance requirements are described using detection quality object descriptions derived from PD ISO/TR 21707:2008 (Intelligent Transport Systems – Integrated transport information, management and control – Data quality in ITS systems).

Note that the performance requirements have been derived from initial trials of SVD.

3.2 Measurement Source

- 3.2.1 **Calculation/Estimation Method:** There is no specific requirement for the method of calculating alerts.
- 3.2.2 **Collection Method:** There is no specific requirement for the method of collecting data.
- 3.2.3 **Calculation Period:** An SVD alert message with status “alert” shall be generated within 20 seconds of the vehicle stopping. An SVD alert message with status “clear” shall be generated within 60 seconds of the vehicle moving off.
- 3.2.4 **Estimation/Simulation Model Identity:** There is no specific requirement for the estimation/simulation model identity.
- 3.2.5 **Equipment Type:** There is no restriction on the equipment type that can be used to deliver the SVD alert data performance requirements.
- 3.2.6 **Number of Data Points:** There is no specific requirement for the number of data points.

3.3 Precision

- 3.3.1 **Number of Decimal Places:** There is no specific requirement for the number of decimal places.
- 3.3.2 **Number of Significant Figures:** There is no specific requirement for the number of significant figures.
- 3.3.3 **Time Precision:** Time stamp information relating to SVD alerts shall be identified using hours, minutes and seconds.

3.4 Service Availability

- 3.4.1 **Availability Period:** SVD alerts shall be provided on a full-time basis (24/7/365).
- 3.4.2 **Mean Time Between Failures (MTBF):** The MTBF for SVD alert data equipment shall be at least 5 years. The minimum period before the first failure shall be 3 years.
- 3.4.3 **Mean Time to Repair (MTTR):** The MTTR for SVD alert data equipment technology shall be at most 15 minutes after attendance.

Note that the MTBF and MTTR figures identified above relate to detection technology only (i.e. they exclude communications and system failures).

3.5 Service Completeness

3.5.1 **Business Rules Coverage:** Detection shall be achieved according to the performance requirements identified in this annex, subject to the following conditions:

- Detection equipment shall be capable of detecting any vehicle permitted to use motorways.
- Detection performance requirements shall be delivered when carriageway traffic flows are below 1000 vehicles per hour per lane.
- Detection performance requirements shall be delivered under all weather and lighting conditions unless otherwise stated in the environmental performance requirements (for example, temperature).

3.5.2 **Data Types Covered:** The detection input data for SVD shall be provided in the form of SVD alerts.

3.5.3 **Percentage Occurrence Coverage:** The detection rate for stopped vehicle events that trigger an SVD alert shall be at least 80%. The defined coverage is the full physical coverage area as defined in paragraph 3.5.4. The service shall provide at least 95% coverage of the defined coverage area.

Note that blind spots should be avoided in high risk areas, such as accident or breakdown hotspots, steep inclines and areas away from safe havens.

3.5.4 **Physical Coverage:** The service shall provide coverage of the mainline carriageway running lanes and emergency areas (formerly known as emergency refuge areas). If any part of a vehicle lies within this area it shall be considered to be within the required area of coverage. The area of coverage shall be configurable to include additional areas of interest or exclude areas.

3.6 Service Grade

3.6.1 **Service Grade:** No service grade is identified for the SVD service.

3.7 Timeliness

3.7.1 **Data Validity Period:** There is no data validity period for detection data associated with SVD. The SVD status shall remain at “alert” until the alert condition no longer exists.

3.7.2 **Data Time Stamping Regime:** Time stamping of SVD alert data shall be based on the time that the alert is first processed and subject to the precision requirement identified in paragraph 3.3.3. and detection timestamp accuracy requirement in paragraph 3.8.3. Time stamping shall be in accordance with BS ISO 8601:2004 (data elements and interchange formats – information interchange – representation of dates and times).

3.7.3 **Data Update Mode:** Alerts associated with an SVD service shall be updated as an occurrence of a change in the alert condition.

3.7.4 **Data Update Interval:** The data update interval for SVD alert data is zero. This means that the alert status of the detection represents a snapshot “occurrence”.

3.8 Veracity

- 3.8.1 The longitudinal detection location accuracy for any individual stopped vehicle shall be ± 25 metres or better.
- 3.8.2 The detection location shall be attributed to the correct carriageway.
- 3.8.3 The detection timestamp accuracy shall be ± 100 milliseconds or better.
- 3.8.4 **Data Correctness:** There is no specific data correctness requirement associated with SVD alert data inputs.
- 3.8.5 **Error probability:** There is no specific overall error probability requirement associated with SVD alert data inputs. Refer to the false detection rate requirement in paragraph 3.8.6.
- 3.8.6 The false detection rate for the detection inputs for an SVD service shall be lower than 15% of all SVD alerts raised.

Note that the false detection rate is the proportion of all SVD alerts reported incorrectly, either because an SVD alert does not relate to a true stopped vehicle event, or because the SVD alert data is not within the performance limits specified in this section, e.g. the longitudinal location is greater than 25 metres from the true location or the wrong carriageway is reported.

- 3.8.7 **Mean Absolute Error:** There is no specific mean absolute error requirement associated with SVD alert data inputs.
- 3.8.8 **Error Standard Deviation:** There is no specific error standard deviation requirement associated with SVD alert data inputs.
- 3.8.9 **Mean Error:** There is no specific mean error requirement associated with SVD alert data inputs.
- 3.8.10 **Reliability (i.e. reliability of detection data):** There is no specific reliability requirement associated with SVD alert data inputs.

WITHDRAWN

4. INTERFACE REQUIREMENTS

4.1 System Interface

- 4.1.1 Data structures and standards for SVD shall be consistent with TR 2627 (Requirements Specification for Stopped Vehicle Detection Outstation).
- 4.1.2 SVD alert data facilities shall support the HATMS/CHARM SVD application in accordance with TR 2627 (Requirements Specification for Stopped Vehicle Detection Outstation).

WITHDRAWN

WITHDRAWN

5. APPROVAL

Approval of this document for publication is given by the undersigned.

Highways England
Temple Quay House
The Square
Temple Quay
Bristol
BS1 6HA

M WILSON
Chief Highway Engineer

Transport Scotland
8th Floor, Buchanan House
58 Port Dundas Road
Glasgow
G4 0HF

R BRANNEN
Chief Executive

Welsh Government
Transport
Cardiff
CF10 3NQ

S HAGUE
Deputy Director
Network Management Division

Department for Infrastructure
Clarence Court
10-18 Adelaide Street
Belfast
BT2 8GB

P B DOHERTY
Director of Engineering

All technical enquiries or comments on this Document should be sent to
DMRB_Enquiries@highwaysengland.co.uk

WITHDRAWN