



Bonneagar Iompair Éireann
Transport Infrastructure Ireland

TII492 Intelligent Transport Systems (ITS) Equipment Supply and Installation Framework

Volume A: Works Requirements

Part 3: Technical Specification Section 6: Automatic Incident Detector

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1. Automatic Incident Detector (AID)

1.1 Introduction

The purpose of this document is to specify the requirements for the detailed works that shall be undertaken under the Contract. Under this Contract, the Contractor shall be responsible for the supply, installation, testing and commissioning of AIDs on the motorway network.

The Contractor shall design, supply and install AIDs and ancillary equipment in accordance with this specification.

The Contractor shall test and commission AIDs in accordance with this specification and Volume A - Part 4: Testing and Commissioning Specification.

The Contractor shall refer to the following documents which are referred in this document.

- Volume A – Part 2: Works Specification
- Volume A – Part 3: Technical Specifications Section 13 Power Supplies
- Volume A – Part 3: Technical Specifications Section 14 Telecoms
- Volume A – Part 4: Testing, Commissioning, Documentation and Training.

AID equipment shall be capable of monitoring, storing, processing and communicating traffic data collected from the equipment located across the road network. AID equipment shall be located in roadside cabinets or other housings at locations across the road network. The AIDs shall communicate with and transmit data to TII's C2 Cloud data hosting service, Asset and Fault Management System (AFMS), Network Intelligence and Management System (NIMS) and Associated Services.

1.2 Scope of Works

The scope of works includes but is not limited to the following:

- The Contractor shall design all AID equipment in accordance with the requirements of this specification.
- The Contractor shall supply and install AID systems, including all necessary mounting bracketry, power connections and communications interfaces in accordance with the requirements of this specification.
- The Contractor shall support the integration of the AID systems with the AFMS, NIMS and Associated Services, in accordance with the requirements of this specification.
- In all cases, the AID shall connect the AID unit to TII's data communications infrastructure and configure it to relay data to the AID instation located at TII's MOCC at Dublin Port Tunnel.
- All testing and commissioning of all AID systems in accordance with the requirements of this specification as well as TII492 Volume A Part 3 - Technical Specification - Section 6 – AID and Volume A - Part 4: Testing, Commissioning, Documentation and Training.

2. GENERAL REQUIREMENTS

2.1 General

The primary function of the AID loop detector is to detect the presence of vehicles by embedding inductive loops into the road surface. The change of inductance signal shall be processed and transmitted to the controller in the roadside cabinet and the AID controller shall interpret the electrical pulse into the following traffic information per vehicle;

- Presence of Vehicle
- Speed of Vehicle
- Classification of Vehicle
- Incident Detection

The Contractor shall ensure AIDs comply with TII standards. Where upon request, the evidence of compliance to the TII standards shall be provided:

- CC-SCD-01530 - Installation Drawing TCC - Inductive Loop Test Certificate;
- CC-SCD-01530 - Installation Drawing TCC - Inductive Loop Test Certificate;
- CC-SCD-01538 - Installation Drawing TCC - Loop (Inductive) - All Purpose Roads Details of Feeder Cable Slots;
- CC-SCD-01540 - Installation Drawing TCC - Loop (Inductive) - All Purpose Roads Details of Carriageway Chamber;
- CC-SCD-01539 - Installation Drawing TCC - Loop (Inductive) - All Purpose Roads Details of Entry to the Footway;
- CC-SCD-01541 - Installation Drawing TCC - Loop (Inductive) - All Purpose Roads Detail of Signal Duct Chamber;
- CC-SCD-01543 - Installation Drawing TCC - Loop (Inductive) All - Purpose Road Turning, Queue and Speed Measuring Loops -Sheet 1;
- CC-SCD-01544 - Installation Drawing TCC - Loop (Inductive) All - Purpose Road Speed Measuring Loops -Sheet 2;
- CC-SCD-01545 - Installation Drawing TCC - Loop (Inductive) All - Purpose Road Speed Measuring Loops -Sheet 3;
- CC-SCD-01542 - Installation Drawing TCC - Loop (Inductive) - All Purpose Roads Chevron Loops;
- CC-SCD-01547 - Installation Drawing TCC - Loop (Inductive) All - Purpose Road Mova Loops;
- CC-SCD-01546 - Installation Drawing TCC - Loop (Inductive) All - Purpose Road Typical Loop Configuration;
- CC-SCD-01538 - Installation Drawing TCC - Loop (Inductive) - All Purpose Roads Details of Feeder Cable Slots;
- CC-SCD-01540 - Installation Drawing TCC - Loop (Inductive) - All Purpose Roads Details of Carriageway Chamber;
- CC-SCD-01539 - Installation Drawing TCC - Loop (Inductive) - All Purpose Roads Details of Entry to the Footway;

- CC-SCD-01541 - Installation Drawing TCC - Loop (Inductive) - All Purpose Roads Detail of Signal Duct Chamber;
- CC-SCD-01543 - Installation Drawing TCC - Loop (Inductive) All - Purpose Road Turning, Queue and Speed Measuring Loops -Sheet 1;
- CC-SCD-01544 - Installation Drawing TCC - Loop (Inductive) All - Purpose Road Speed Measuring Loops -Sheet 2;
- CC-SCD-01545 - Installation Drawing TCC - Loop (Inductive) All - Purpose Road Speed Measuring Loops -Sheet 3;
- CC-SCD-01542 - Installation Drawing TCC - Loop (Inductive) - All Purpose Roads Chevron Loops;
- CC-SCD-01547 - Installation Drawing TCC - Loop (Inductive) All - Purpose Road Mova Loops; and
- CC-SCD-01546 - Installation Drawing TCC - Loop (Inductive) All - Purpose Road Typical Loop Configuration.

All AIDs shall be configured to Greenwich Mean Time (GMT) or as specified by the Employer.

All AIDs shall be capable of automatic Daylight savings clock changes.

2.2 Date and Time

All AID equipment shall be configured to GMT or as specified by the Employer.

All AIDs shall be capable of automatic Daylight savings clock changes.

2.3 Data Format and Data Return

The data format shall be agreed with the Employer.

The date and time of the data shall be clearly indicated by a timestamp, which shall be at the start or end of the time period, depending on the user configuration of the AID.

The AID shall upload all required data to TII's data hosting service and / or other designated systems to fulfil the requirements set out in this Section.

AID shall be configurable to push data on a configurable time interval.

Data to be returned may include Per Vehicle Records (PVR) and / or aggregated data as specified by the Employer.

Internal data storage shall be appropriately sized to allow for storage of PVR for a period of at least 90 days. Data from the internal storage shall be automatically retrievable for a period of 90 days.

Overwritten data shall be on the basis of first in first out i.e. most recent 180 days shall remain intact.

The AID shall support the separation of different configurable time bins and different configurable classification bins. These bins shall be definable by the Employer as required.

2.4 Site Setup

Each AID shall be equipped with a local interface to facilitate the Employer or the Contractor to test the correct operation of the AID. The interface can be either wired or wireless. The Employer or Contractor via the interface using a portable PC or similar shall be able to undertake the following tasks:

- Observe the operation of the detector in real time;
- Monitor the current flows;
- Monitor the current occupancy level;
- Access all stored flow levels;
- Monitor the speed of vehicles;
- Observe vehicle classification;
- Reconfigure device parameters;
- Re-set any equipment faults including self-resetting of the AID itself; and
- Set the state of detector outputs for test purposes.

Each AID shall be equipped with an interface to facilitate the Employer or the Contractor establishing remote communications with the AID to;

- Monitor correct operation of the AID;
- Data upload or download;
- Reconfigure device parameters;
- Observe the operation of the detector in real time; and
- Software / Firmware updates.

2.5 Power

Internal setup parameters, including site specific details, date and time and other programmable data shall be maintained through a memory backup battery in the event of a power failure.

AID unit shall be equipped with a standby power source. In the event of power failure, or disconnection, the standby power source shall take over maintaining the full functionality of the unit under normal operating conditions for 120 hours.

2.6 Processing

The AID shall be required to process and present data for transmission to the Employer.

2.7 CE Marking

The Contractor shall ensure all AID equipment has appropriate CE marking. Contractors should note The National Standards Authority of Ireland (NSAI) are the national certification authority for CE Marking in Ireland.

2.8 Detector Loops and Feeder Cables

All loops shall be installed in accordance with, Series 1500 “Motorway Communications” of the Specification for Roadworks Volume 1 and specifically clause 1523 Detector Loops. Loops shall be installed at equipment locations identified in call off documents. For the purposes of this contract each AID location shall operate using two loops per lane.

The change of inductance caused by a metal vehicle passing over the loops shall be monitored and a presence indicated when the change of inductance exceeds a sensitivity threshold.

2.8.1 Presence Events

Presence events derived from the loops in each lane shall be monitored. Where there are two loops in a lane the passage of a vehicle shall only be registered if the events overlap (i.e. there is a period of concurrent presence). As each vehicle traverses the loop array and is computed by the AID as a ‘valid vehicle’ it shall be assigned a vehicle number.

2.8.2 Vehicle Speed

Where a valid vehicle is registered, the speed of a vehicle shall be determined from the arrival event at each loop and the distance between the leading edge of the upstream loop and the leading edge of the downstream loop.

The distance (i.e. the loop separation) shall be a configurable parameter which can be changed remotely or at the AID interface at each specific site.

2.8.3 Headway

The headway is defined as the time difference between the leading edge of the currently processed vehicle record and the leading edge of the previous vehicle. The measurement shall have a resolution of 100ms and shall have a maximum value of 3600 seconds. If the value exceeds 3600 seconds, then 3600 seconds shall be registered.

3. VEHICLE RECORDS

3.1 Classification

The vehicle classification shall be determined by the loop signature profile generated by a vehicle passing over the detector loops.

The vehicle classification system shall be capable of determining a minimum of 7 different vehicle classes.

The vehicle classification system shall determine the following 7 vehicle types (or other vehicle classifications agreed with the Employer):

- a) Motorbike;
- b) Car;
- c) Light Goods Vehicle (LGV);
- d) Bus;
- e) Heavy Goods Vehicle (HGV) Rigid;
- f) HGV articulated; and
- g) Caravan – vehicle pulling a trailer or LGV pulling a trailer.

3.2 Vehicle Detection and Associated Data Records

The AID shall be capable of providing time stamped, PVR information to C2 Cloud.

The AID shall be capable of providing real time PVR locally at the roadside for SAT and Verification purposes.

The AID shall be capable, upon instruction from C2 Cloud, of collecting other periods defined by the user, to a minimum of 5-minute periods.

The AID shall be capable of storing data at the roadside for a minimum of 90 days.

The AID shall communicate with the C2 Cloud at predetermined time intervals and “push” the information to C2 Cloud.

The AID shall be capable of being interrogated remotely by C2 Cloud to re-retrieve any stored data and change configurable settings/parameters.

The PVR record shall include;

- Site reference;
- Date;
- Time;
- Vehicle Speed in kilometres per hour (configurable);
- Vehicle Length in metres (configurable);
- Vehicle Classification in accordance with classification;
- Lane Number/Name;

- Direction of Travel (including 'reverse notification' for wrong direction vehicles);
- Headway (in seconds);
- Gap (in seconds);

The AID shall have the capability to identify 'straddling' vehicles which are changing lanes and thus shall include these vehicles in the correct traffic / lane count as required.

The AID shall be capable of providing real time data records, both locally and returned to the Associated Services, regarding:

- Suspect flag (such as Stationary Vehicle, Slow Vehicle / Abnormally Low Speed, Sudden Speed Drop, Congestion / High Traffic Density);
- Fault information; and
- All incoming data from WIM Sites.

3.2.1 Per Vehicle Record Data

PVR data is required for in-depth data analysis of traffic patterns. In addition, the AID is required to aggregate and store the PVR information as detailed previously on a lane-by-lane basis in time 'bins' blocks/intervals.

These time intervals shall be configurable by the Employer as required.

3.2.2 Storage Capacity

In relation to storage of records, the AID shall have the capacity to store the following:

- capacity for 200,000 PVR records per day;
- capacity for 180 days storage (minimum) for both PVR and aggregated traffic statistics; and
- ability to expand storage capacity via upgrades of 50%, 100% or 200% memory.

It shall also be noted that if the AID allocates memory on a day-by-day basis, then the user shall be able to configure / define the storage per day.

4. AID EQUIPMENT REQUIREMENTS

4.1 Core Performance Requirements

The Contractor shall demonstrate that the AID equipment supplied under the Contract has a mean time between failures of at least 50,000 hours.

The AID shall be configured to:

- Provide fault reporting;
- Log all faults and keep a record of the history of all faults;
- Produce a monthly report on all faults; and
- Allow the Contractor's Personnel to clear faults following repair and update the fault monitoring systems to record the time the fault was repaired.

4.2 Inputs

Inputs in relation to inductive loops are as follows:

- Two lanes of two loops per lane (minimum requirement);
- Four lanes of two loops per lane;
- Six lanes of two loops per lane;
- Eight lanes of two loops per lane; and
- Ten lanes of two loops per lane.

4.3 Telemetry

Telemetry options are to include an automated periodic data upload and data provision in response to a request from C2 Cloud, configurable by the user, dependent on location, number of daily records etc.

The telemetry shall include the following data:

- PVR data;
- Traffic statistics;
- Power at acceptable level;
- Battery (batteries) voltage;
- Current AID date and time (with the option in software for correction if different by user-defined number of minutes);
- Storage used as percentage of capacity;
- AID configuration; and
- Date and time of previous successful communications transmission.

The AID shall provide data continuously or at intervals as directed by the Employer and shall be capable of both.

The Contractor shall provide appropriate firmware to facilitate data upload from the AID to C2 Cloud including PVR data and traffic statistics. This firmware shall enable remote on-line configuration and set up of the AID as well as the ability to alter the clock timings and reset the device if so required.

4.4 Loop sensitivity

All loop boards shall allow the user to adjust the gain/sensitivity to suit local site conditions.

4.5 Enclosure Construction and Operation

AID equipment shall be supplied in self-contained modular units.

AID equipment shall be easily removable by maintenance personnel, i.e. the mass and dimensions of each AID shall not make it difficult to move/replace.

The enclosure shall be passive in design to minimise impact in the case of collision.

The enclosure shall be sufficiently insulated to remove the possibility of cold weather having an adverse impact on the performance of the equipment.

4.6 Performance Criteria

The following information relating to AID performance criteria shall be provided by the Contractor;

- Battery life (by type/capacity of battery) both with communications in use 100% of each day polling once a minute and 100% of each day with the minimum polling period;
- Accuracy of readings - The Contractor shall provide an AID that meets the following performance criteria in terms of classification;
 - Classify 99% of Cars (+/- 1%) at a 95% confidence level;
 - Classify 90% of LGVs (+/- 1%) at a 95% confidence level;
 - Classify 85% of HGVs (+/- 1%) at a 95% confidence level; and
 - Counts 96% of all Vehicles in a 12-hour period (+/1%) at a 95% confidence level.
- The Contractor shall provide statistics (percentage) on the accuracy of readings for classification/volume indicating that the above minimum requirements can be met.

4.7 Hardware Equipment

AID equipment shall be supplied in both self-contained units and/or 3U 19" rack models.

Enclosure shall comply with the requirements of EN 60529 (Degrees of Protection Provided by Enclosures).

Modularity in Hardware and Software is required in view of the operation and maintenance requirements and future growth and enhancement of the AID System.

AID equipment elements supplied shall meet the following requirements:

- Industry Standard Interfaces and fixings shall be used throughout;
- Readily available from multiple manufacturers;

- Modular in design (as far as is reasonably practical);
- Flexible (allowing for enhancement of hardware / functional capabilities);
- Subject to low maintenance requirements;
- Easily serviceable;
- Not be restricted to one service provider in the case of Communications Equipment (Modem/Router); and
- Self-diagnostic to the greatest extent.

Electrical/electronic components supplied shall be provided by multiple suppliers and shall not be restricted to long lead times, but instead be readily available;

In their Works Proposals, the Contractor shall provide details of any AID components which have long lead times (greater than 7 days) and specify the lead in times for these components.

All equipment and its component parts shall be supplied new and manufactured from new apparatus.

5. COMMUNICATIONS

The AIDs shall communicate with local devices, instation systems and data hosting services via one or more of the following: (to accommodate both local and remote communications)

- RS232 serial or parallel communications
- 10/100mbps network interface via RJ45 Ethernet connector;
- USB and Bluetooth;
- Fibre Optic Cable; or
- In-built integrated cellular communications.

The AID shall be IP compatible and capable of transmitting data via the following communication mediums:

- 4/5G cellular (via TCP/IP);
- GPRS (via TCP/IP);
- GSM;
- Fixed fibre (via IP address); and
- Copper.

Fibre communications shall be the primary choice for communications at all AID sites. Where Fibre is not possible at any site, wireless communications shall be provided. The Contractor following liaison with the Employer shall engage the network service provider.

Where an AID has a SIM card installed it shall be the data only type (no voice). The Employer shall be able to switch network provider by replacement of the SIM card only. A change of network provider shall not require;

- The upgrade or reconfiguration of AID hardware (other than replacement of SIM card); or
- The reconfiguration of any onboard firmware.

The AIDs shall be configurable to supply data to more than one destination if required.

Where an IP based system is used, IP addresses and network details will be provided by the Employer.

The AID shall be fitted with a suitable interface to allow remote / local control of the AID by means of a laptop PC.

The AID shall be capable of being switched between remote and local / manual control.

The AID shall be equipped with an interface for use by the Employer or maintenance personnel to check the correct operation of the AID. The Contractor shall provide modems or other suitable connections and associated ancillaries to provide connectivity to C2 Cloud.

6. POWER

All proposed AID sites shall be powered via one or a combination of the following sources:

- Renewable Power Source
- Mains Power

The Contractor shall install a backup battery system at all proposed AID sites. The battery system shall be recharged by either the renewable power source or the mains power supply.

The AID shall be designed to automatically switch between power sources without loss of data or performance.

The status of all power sources used within AID equipment shall be relayed to C2 Cloud.

Where renewable power is the primary power source, the AID shall remain fully operational all-year round using the solar and/or wind generators, with the battery providing the appropriate level of backup for winter months when day light is limited. The Contractor shall submit to the Employer details of the minimum battery life (by type/capacity of battery) with equipment in use 100% of each day and with the varying minimum levels of polling set out for Priority 1, Priority 2 and Priority 3 sites.

All AIDs shall be capable of polling data every minute for a two-hour period each day. Over and above this basic requirement each AID shall be supplied with enough power to fulfil the additional minimum polling levels as set out below, based on the priority levels;

- Priority 1 (Polling every 5 minutes 24 hours per day every day)
- Priority 2 (Polling every hour 24 hours per day every day)
- Priority 3 (Polling every 4-6 Hours 24 hours per day every day)

Where directly connected to mains power, the equipment supplied shall have capability to operate from a single phase mains supply and operate correctly within a voltage of 230V over a frequency tolerance range of +10% to -10%.

The AID shall be fitted with a means of isolation from all electrical supplies, to include for connections to alternative sources of power connections such as battery / solar power. Electrical supplies shall automatically be isolated in the event of a vehicle colliding with the cabinet.

Following a removal of the supply or a power failure, the AID shall automatically restart itself without manual intervention within 6 minutes after mains power is restored.

Following power failure, the AID shall automatically switch to alternative backup power sources capable of powering the AID for a period in excess of 120 hours under normal operating conditions.

A minimum of three ducting elbows shall be provided linking cabinets to external environment via foundations. These shall be sealed with a cap to allow future expansion at each site.

Power supply components shall be modular in nature to facilitate efficient upgrade or replacement in the case of component failure. Replacement or upgrade shall not be restricted by a system which necessitates components unique to one manufacturer.

Power supplies shall be designed to maximise efficiency whilst minimising ongoing maintenance requirements and both risk of and resistance to vandalism.

7. FAULT MONITORING AND ALERTS

The AID shall be able to detect and report to C2 Cloud and/or the Employer's AFMS (as and when detected) the following fault and alert conditions. This shall relate to both PVR and traffic statistics data. Each fault/alert report shall be configurable and can be switched on/off by the Employer.

The AID shall have the following fault identification and reporting functionality:

- Fault alert on detection of faulty loop (shorted or open circuit)
- Fault alert on detection of faulty electronics
- Fault Alert on low battery (see power alert requirement below)

Detector fault information shall identify the detector and, if appropriate, channel(s). A 'suspect flag' shall be assigned to the traffic data for a lane or site if there is a loop fault on the associated lane or site (open circuit or short circuit).

In the event of a power related fault, information regarding this fault shall be communicated instantly to C2 Cloud and AFMS / NIMS.

7.1 Faults

The AID shall detect and communicate the following fault types:

- Power source has been 'lost' or restricted;
- Battery Low Voltage (below Employer configurable specified level);
- Loop / sensor fault per lane;
- Electronic Component Failure;
- Cabinet Door Open;
- Real-Time Clock Fault and
- Communication Error.