
TII492 Intelligent Transport Systems (ITS) - Equipment Supply and Installation Framework - Generation 2 - Lot 2

Volume A: Works Requirements

**Part 3: Technical Specification
Section 5: Cycle Monitoring Units**

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1. CYCLE MONITORING UNIT (CMU) EQUIPMENT

1.1 Introduction and Scope

CMUs are a range of equipment used for detecting the presence of bicycles on the road network and measuring various parameters related to those bicycles and their passage. Data from the CMUs include, but not limited to, collection of cycle traffic volume.

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

CMUs utilise different technologies to detect and measure, including;

- Imbedded Inductive Loop Detectors;
- Piezo Sensors;
- Radar and Microwave;
- Optical Detection;
- Wi-Fi and Bluetooth Detection; and
- Magnetometers.

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

The relevant TII standards shall be met, which include but are not limited to:

- DN-ITS-03029 Traffic Control and Communications Infrastructure Design;
- DN-ITS-03037 The Use of Variable Message Signs on All-Purpose and Motorway Roads;
- DN-ITS-03021 - VMS Standard;
- DN-TSM-03083 - VMS Policy; and
- DN-TSM-03084 - VMS Messaging Guidelines.

Traffic data is required for in-depth data analysis of traffic patterns.

The supplier shall provide warranties ensuring that spares will be available for a period of 10 years from the date of purchase.

The Contractor shall provide a warranty of 1 year following substantial completion of the works. As part of this warranty, the Contractor shall agree to repair or replace all equipment that are found to be faulting in the warranty period. The Contractor shall provide technical support to the ITS Maintenance Contractor during the warranty period.

2. GENERAL REQUIREMENTS

2.1 Date and Time

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

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

2.2 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 CMU.

The CMU 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.

CMU shall be configurable to either push / pull data on a configurable time period.

Data to be returned may include Cycle By Cycle (CBC) and / or aggregated data as specified by the Employer.

Internal data storage shall be appropriately sized to allow for storage of Per Cycle Record (PCR) for a period of at least 180 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 CMU shall support the separation of different configurable time bins and different configurable classification bins. These bins shall be definable by the Employer as required.

2.3 Site Setup

Each CMU shall be equipped with a local interface to facilitate the Employer or the Contractor to test the correct operation of the CMU. The interface can be either wired or wireless. The Employer or the 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;
- Reconfigure device parameters;
- Re-set any equipment faults including self-resetting of the CMU itself; and
- Set the state of detector outputs for test purposes.

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

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

2.4 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, or uses of non-volatile memory to retain data in case of power supply loss.

2.5 Processing

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

2.6 CE Marking

The Contractor shall ensure all CMU equipment has appropriate CE marking (Conformité Européene, or European Conformity marking). The support documents, when upon requested, shall be provided. Contractors should note The National Standards Authority of Ireland (NSAI) are the national certification authority for CE Marking in Ireland.

2.7 Detector Loops and Feeder Cables

Where loops are used, 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 the drawings. For the purposes of this contract each CMU 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.

2.7.1 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 CMU as a ‘valid vehicle’ it shall be assigned a vehicle number.

2.7.2 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. CYCLE RECORDS

3.1 Classification

The Cycle Classification System shall determine the following 2 types (or other classifications agreed with the Employer):

- Pedestrian;
- Pedal cycle;

3.2 Cycle Detection and Associated Data Records

The CMU shall be capable of providing time stamped, CBC or PCR information to C2 Cloud.

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

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

The CMU shall be capable of storing data at the roadside for a minimum of 180 days.

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

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

The PCR shall include;

- Site reference;
- Date;
- Time;
- Count of Cycle;
- Cycle Lane Number/Name;
- Direction of Travel;
- Speed in kilometres per hour (configurable);
- Vehicle Length in metres (configurable);
- Classification in accordance with classification;
- Headway (in seconds);
- Gap (in seconds).

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

- Suspect flag;
- Fault information; and
- All incoming data from sensor sites.

3.2.1 Cycle by cycle Data

Cycle by cycle data is required for in-depth data analysis of traffic patterns. In addition, the CMU is required to aggregate and store the cycle-by-cycle information as detailed previously on a cycle lane by cycle 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 CMU shall have the capacity to store the following:

- capacity for 200,000 CBC records per day;
- capacity for 180 days storage (minimum) for both CBC 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 CMU allocates memory on a day-by-day basis, then the user shall be able to configure / define the storage per day.

4. CMU EQUIPMENT REQUIREMENTS

4.1 Core Performance Requirements

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

The CMU 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 Tracking System to record the time the fault was repaired.

4.2 Inputs

Where loops are used, inputs in relation to inductive loops are as follows:

- One Lane of two loops per lane;
- Two lanes of one loop per lane;
- Two 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:

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

The CMU shall provide data continuously or as directed by C2 Cloud.

The Contractor shall provide appropriate software to facilitate data upload from the CMU to C2 Cloud including CBC data and traffic statistics. This software shall enable remote on-line configuration and set up of the CMU 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

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

CMU equipment shall be easily removable by maintenance personnel, i.e. the mass and dimensions of each CMU 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 CMU 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 a CMU that meets the performance criteria defined during the agreement in terms of classification.
- The Contractor shall provide statistics (percentage) on the accuracy of readings for volume indicating that the above minimum requirements can be met.

4.7 Hardware Equipment

CMU 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 Traffic Monitoring System.

CMU 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 CMU 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 CMUs 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 CMU shall be IP compatible and capable of transmitting data via the following communication mediums:

- 4/5G (via IP address);
- GPRS (via IP address);
- GSM;
- PSTN 'landline';
- Fixed fibre (via IP address); and
- Copper.

Fibre communications shall be the primary choice for communications at all CMU 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 a CMU 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 CMU hardware (other than replacement of SIM card); or
- The reconfiguration of any onboard firmware.

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

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

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

6. POWER

All proposed CMU 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 CMU sites. The battery system shall be recharged by either the renewable power source or the mains power supply.

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

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

Where renewable power is the primary power source, the CMU 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 CMUs shall be capable of polling data every minute for a two-hour period each day. Over and above this basic requirement each CMU 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 CMU 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 CMU shall automatically restart itself without manual intervention within 6 minutes after mains power is restored.

Following power failure, the CMU shall automatically switch to alternative backup power sources capable of powering the CMU 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 CMU shall be able to detect and report to C2 Cloud and/or the Employers AFMS (as and when detected) the following fault and alert conditions. This shall relate to both CBC and traffic statistics data. Each fault/alert report is configurable and can be switched on/off by the Employer.

The CMU 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; and

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.

7.1 Faults

The CMU 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.