Project Specific Technical Specification

Transport and Main Roads
PSTS004 STREAMS Connect and FP for C-ITS applications

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Queensland Government

Document control sheet

Contact for enquiries and proposed changes

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Version history

Version no.	Owner	Date	Nature of amendment
0.3	R. Elunai	04/06/18	Initial Draft
0.5	R. Elunai	25/06/18	included review comments
1.0	M. Blogg	29/06/20	Final
1.1	J. Qin	29/09/2021	Updated High-Level C-ITS Architecture figure 5.1 and associated text.

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Hold Point	Reviewer/s	Implemented by owner
30% Review	Igor Santic	RE
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Document sign off

The following officers have **approved** this document.

Customer

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Position _____

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Sponsor

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Position _____

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The following officer has **endorsed** this document.

Name _____

Position _____

Signature _____ Date _____

Contents

1 Introduction

1.1 Purpose

This specification defines the design, supply, installation, testing and commissioning, performance, documentation, training and maintenance requirements for the provision of a STREAMS compatible Field Processors (FP) for use in the Cooperative Intelligent Transport System (C-ITS) pilot for traffic intersection safety applications.

A Field Processor is an industrial, microprocessor-based computer suitable for use in traffic management applications hosted by the STREAMS System. They are used by the STREAMS system to provide a platform to host the distributed components of the STREAMS software that interface to the field equipment.

Field Processors used in traffic signal intersection applications are typically mounted within traffic signal controller cabinets. In some situations, they may be deployed within Traffic Management Centres to interface to ITS infrastructure and networks.

1.2 Scope

- Cabinets with an accessible field processor

1.3 Out of Scope

- Field processors connected to private wireless or fibre

2 Referenced documents

The requirements of the referenced documents listed in Table 3 of MRTS201 and Table 2 below apply to this specification. Where there are inconsistencies between this specification and referenced MRTS, the requirements specified in this specification shall take precedence.

Table 2 – Referenced documents

Document ID	Document Name / Description
AS 1768:2007	Lightning protection
AS/NZS 4251.1	Electromagnetic Compatibility (EMC) – generic Emission Standard
AS 60529	Degrees of protection provided by enclosures (IP Code)
ETSI TS 103 301 V1.1.1 (2016-11)	Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Facilities layer protocols and communication requirements for infrastructure services
ETSI EN 302 665 V1.1.1 (2010-09)	Intelligent Transport Systems (ITS); Communications Architecture
MRTS201	General Equipment Requirements
MRTS232	Provision of Field Processors
MRTS232.1	Annexure - Provision of Field Processors Specific Contract Requirement
MRTS245	ITS Telecommunications Network (ITS TN)
PSTS005	R-ITS-S Specification
PSTS006	Use Case Specification ANNEX – Message Data Entity Catalogue
PSTS007	C-ITS Station Protocol Specification

Document ID	Document Name / Description
AS 1768:2007	Lightning protection
PSTS013	ARLW Use Case Specification – Advanced Red Light Warning
PSTS014	TWVR Use Case Specification – Turning Warning Vulnerable Road user
SAE J2735	Dedicated Short Range Communications (DSRC) Message Set Dictionary

3 Definition of terms

The terms defined in MRTS201 apply to this specification. Additional terminology relevant under this specification are defined in Table 3 below.

Table 3 – Definitions

Term	Definition
ACMA	Australian Communications and Media Authority
ARLW	Advanced Red Light Warning
C-ITS	Cooperative ITS
CPU	Central Processing Unit
Field Processor	Ruggedized field computer used to connect field devices to the ITS Network
FP	Field Processor
HMI	Human Machine Interface
ITS	Intelligent Transport Systems
ITS Network	Principal's Telecommunications Network in accordance with MRTS245
MAPEM	MAP Extended Message
RAM	Random Access Memory
R-ITS-S	Roadside ITS station
SC	STREAMS Connect
Site Identifier	A non-volatile memory device that stores a site identification. It connects to a dedicated serial port on the field processor.
SPaT	Signal Phasing and Timing
SPATEM	Signal Phasing and Timing Extended Message
STREAMS	Main Roads ITS Platform and Transport Management System
TSC	Traffic Signal Controller
TWVR	Turning Warning Vulnerable Road User
UDP	User datagram protocol
UPER	Unaligned Packed Encoding Rule
V-ITS-S	Vehicle ITS station

4 Quality system requirements

The quality system requirements defined in MRTS201 apply under this specification. There are no additional quality system requirements for equipment provided under this specification.

5 System requirements

5.1 C-ITS Pilot Architecture

The FP is a component of the broader C-ITS system architecture as shown in Figure 5-1 (see dashed-line boxes). The existing system is also illustrated (see solid-line boxes)

The FP shall be an industrial PC and shall be located in the traffic signal controller (TSC) and collocated in the same intersection with the roadside ITS station (R-ITS-S). The FP also interfaces to STREAMS as part of the existing TMR IPRT ITS network. The schematic shown in Figure 5-2 is a typical connection.

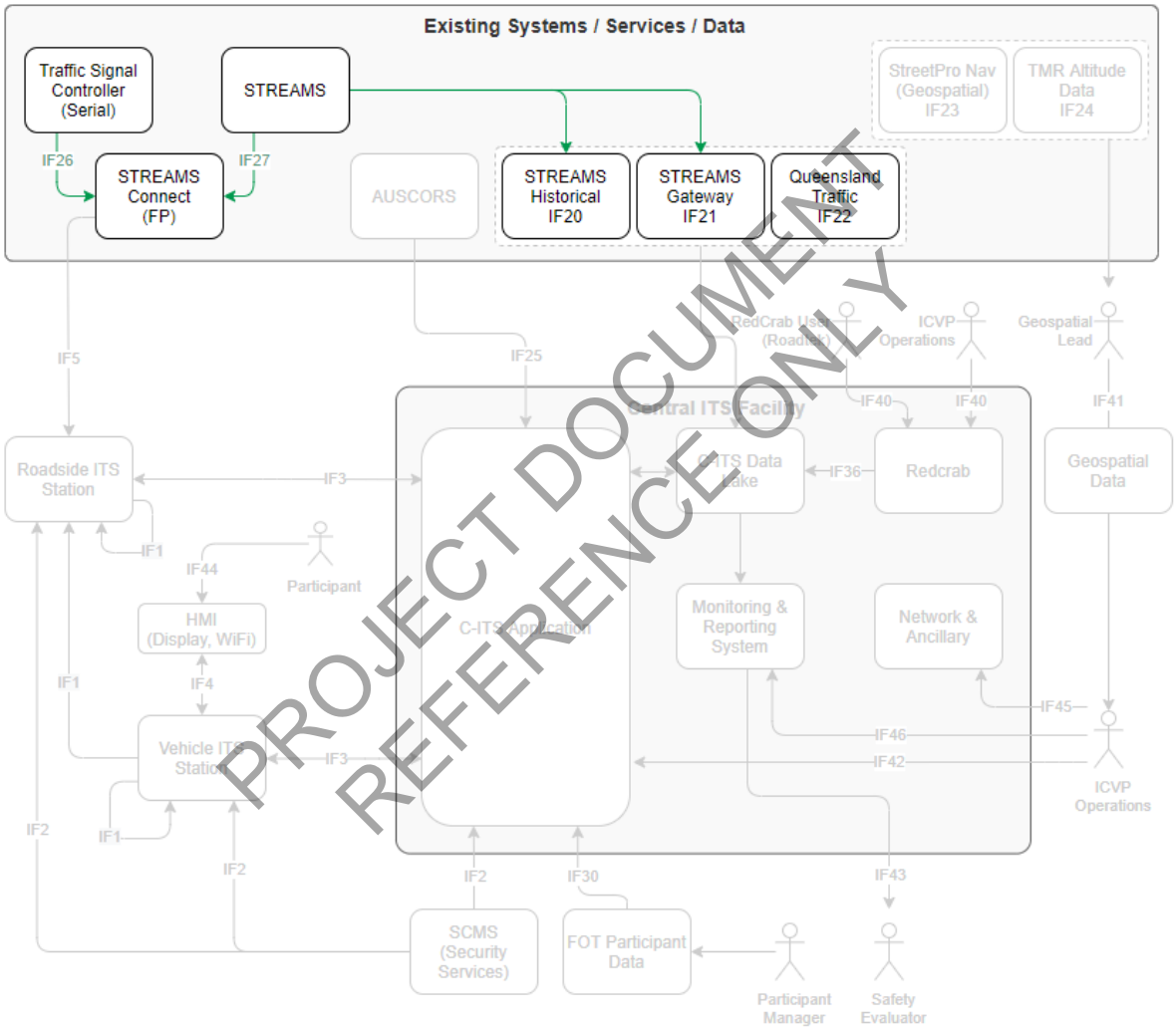

Figure 5-1: STREAMS and FP in C-ITS Pilot architecture

5.2 FP interfaces

Table 5-1presents the main interfaces of STREAMS and FP in the C-ITS Pilot.

Table 5-1 - C-ITS Pilot system STREAMS and FP interfaces

Interface	Description	Interface Type
IF26	TSC ↔ FP	Serial
IF27	STREAMS® → STREAMS® Connect	HTTPS (ITS network)

Table 5-2: Communication Methods

Interfaces	Access	Networking and Transport	Facilities Required
Field Processor to R-ITS-S (IF5)	Ethernet 802.3 (One-way)	UDP/IP	Data Handling (Refer to PSTS-005 and PSTS-007)
Field Processor to TSC (IF26)	RS-232 UART		Data Handling
Field Processor to STREAMS via TMR Network (IF27)	Ethernet 802.3	TCP/IP, IPv4	Data Handling, Configuration, Monitoring (Refer to MRTS232 and MRTS245)

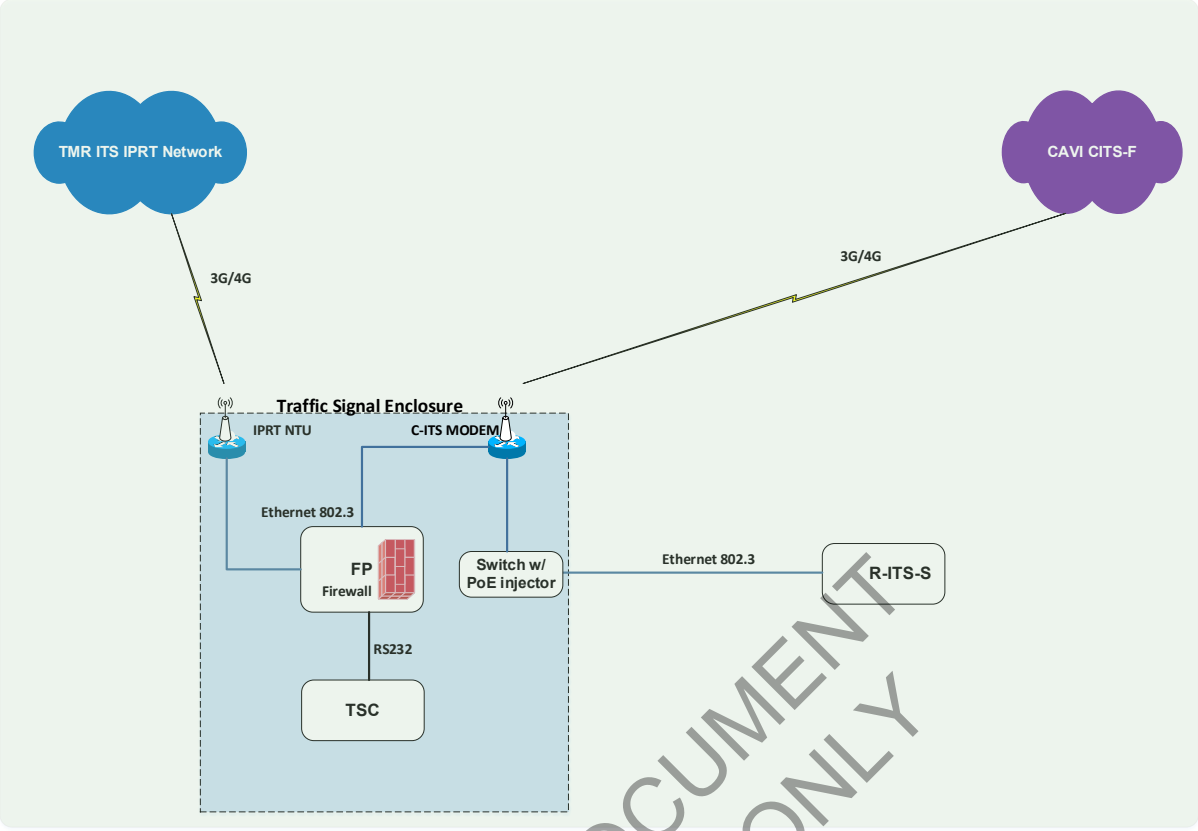

Figure 5-2: Physical connection of FP, R-ITS-S and TSC

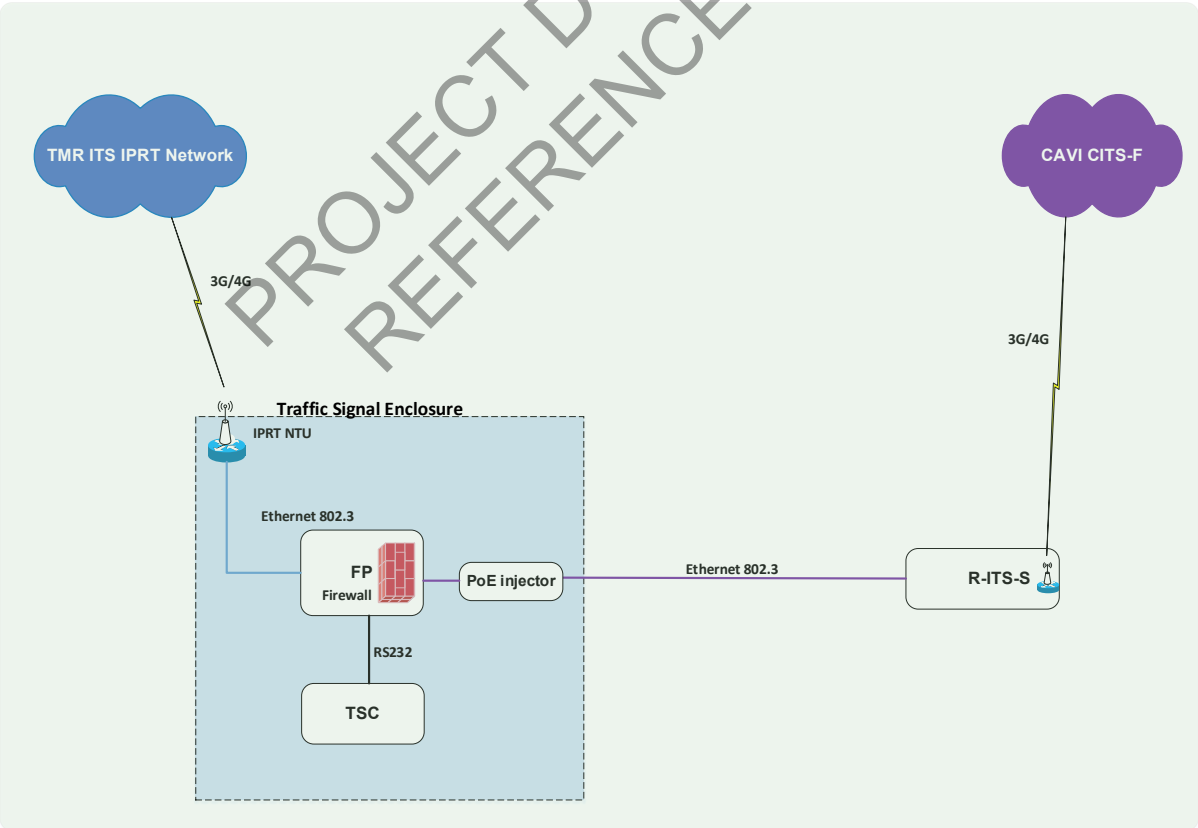

Figure 5-3: (Alternate) Physical connection of FP, R-ITS-S and TSC

6 Operational Requirements (Applications)

6.1 Use Case Applications

The FP shall support two (2) use cases. These use cases are:

- Advanced Red Light Warning (detailed in *PSTS013*)
- Turning Warning - Vulnerable Road user (detailed in *PSTS014*)

6.2 FP C-ITS data requirements

The FP shall

- Extract Signal phasing and timing data from the TSC
- Transform the data into a UPER encoded SPATEM to PSTS-006, ETSI TS 103 301 and SAE J2735
- Load (Transmit) the UPER encoded SPATEM into the R-ITS-S using UDP

The SPATEM data received by the R-ITS-S will be further sent to the V-ITS-S where it is utilised by the residing use case applications, namely, ARLW and TWVR. Therefore the SPATEM data elements generated by the FP shall conform to the format requirements in PSTS 013ARLW, PSTS 014TWVR and the SPATEM catalogue in PSTS-006 and PSTS007. Additional data requirements are listed in section 6.3

6.3 FP SPATEM data sources and formats

The FP shall extract information about the signal phases and their timings from TRAFF, by polling the TSC at a minimum rate of 2Hz.

In addition, The FP shall populate specific data elements in the SPATEM such that they match the corresponding data elements from the associated MAPEM of the intersection. These data elements include:

- *map.intersections.id.region*
- *map.intersections.id.id*
- *map.intersections.laneSet.connectsTo.connectionID*

Only a subset of the *connectionID* information, which is relevant to Pedestrian movements, shall be extracted from the MAPEM to be used in SPATEM. The extracted *connectionID* shall be used in both the following SPATEM locations:

- *spat.intersections.states.maneuverAssistList.connectionID* and
- *spat.intersections.maneuverAssistList.connectionID*

A detailed data structure for both MAPEM and SPATEM for the intended applications can be found in PSTS 006.

Figure 6-2 describes the intersection-level logic that will be used to provide SPaT to the V-ITS-S. The population of the *spat.intersections.states.status* element is shared between the STREAMS® Connect application and the R-ITS-S SPaT application.

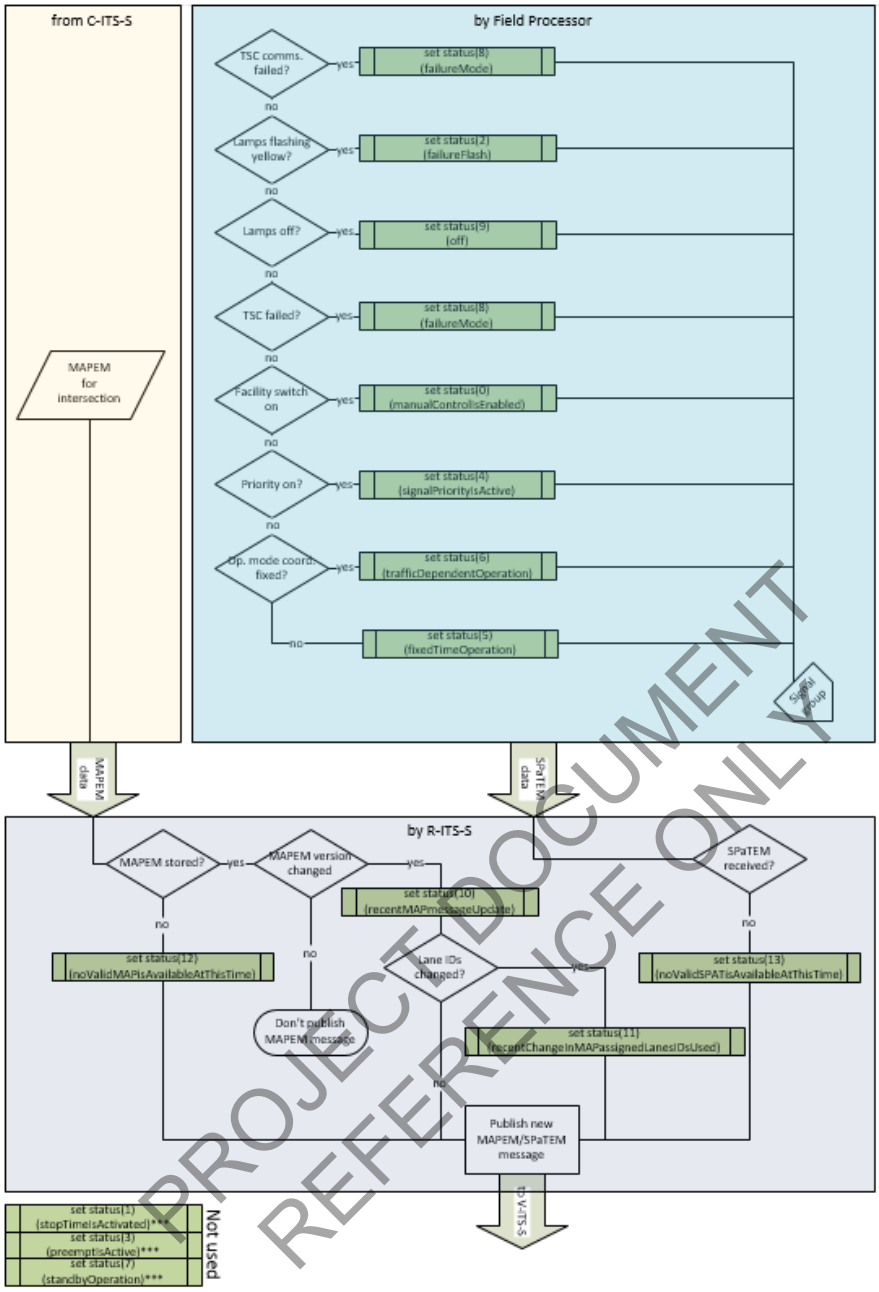

Figure 6-1 SPaT intersection logic overview

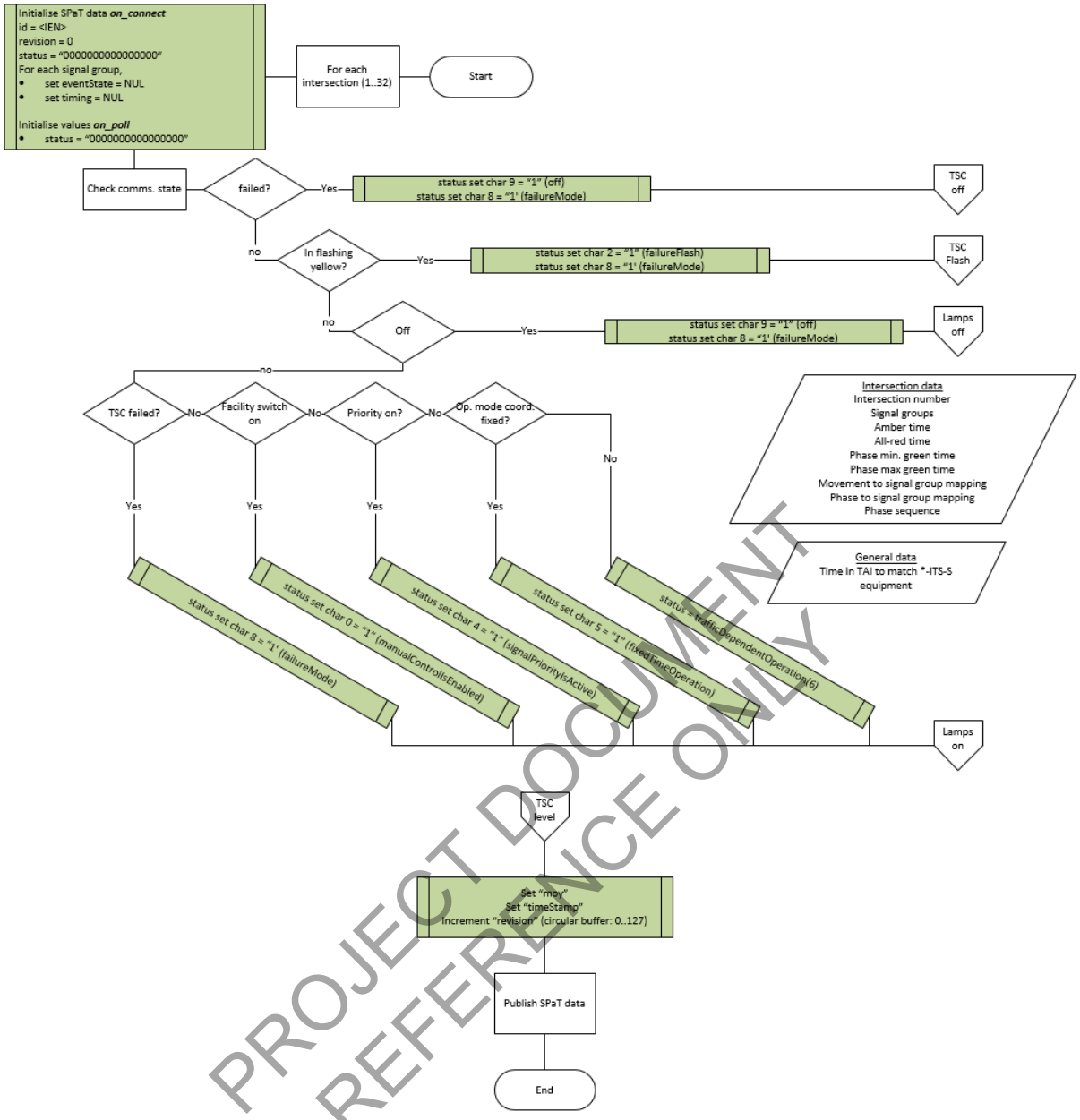

Figure 6-2: Intersection level SPaT logic

6.4 Intersection data latency

The FP shall communicate to the traffic signal controller at 1200 bps or 9600 bps and poll the TSC for signal information at a minimum rate of 2Hz. The maximum expected lamp-change latency (defined as the time taken from lantern change to message availability at the FP) shall be 700ms.

Figure 6-3 shows a typical data flow and latencies for SPaT based on the TRAFF system used in the TSC. Latency could be improved by increasing the poll rate (e.g. 200 milliseconds) when using the higher serial communications (9600 bps or better).

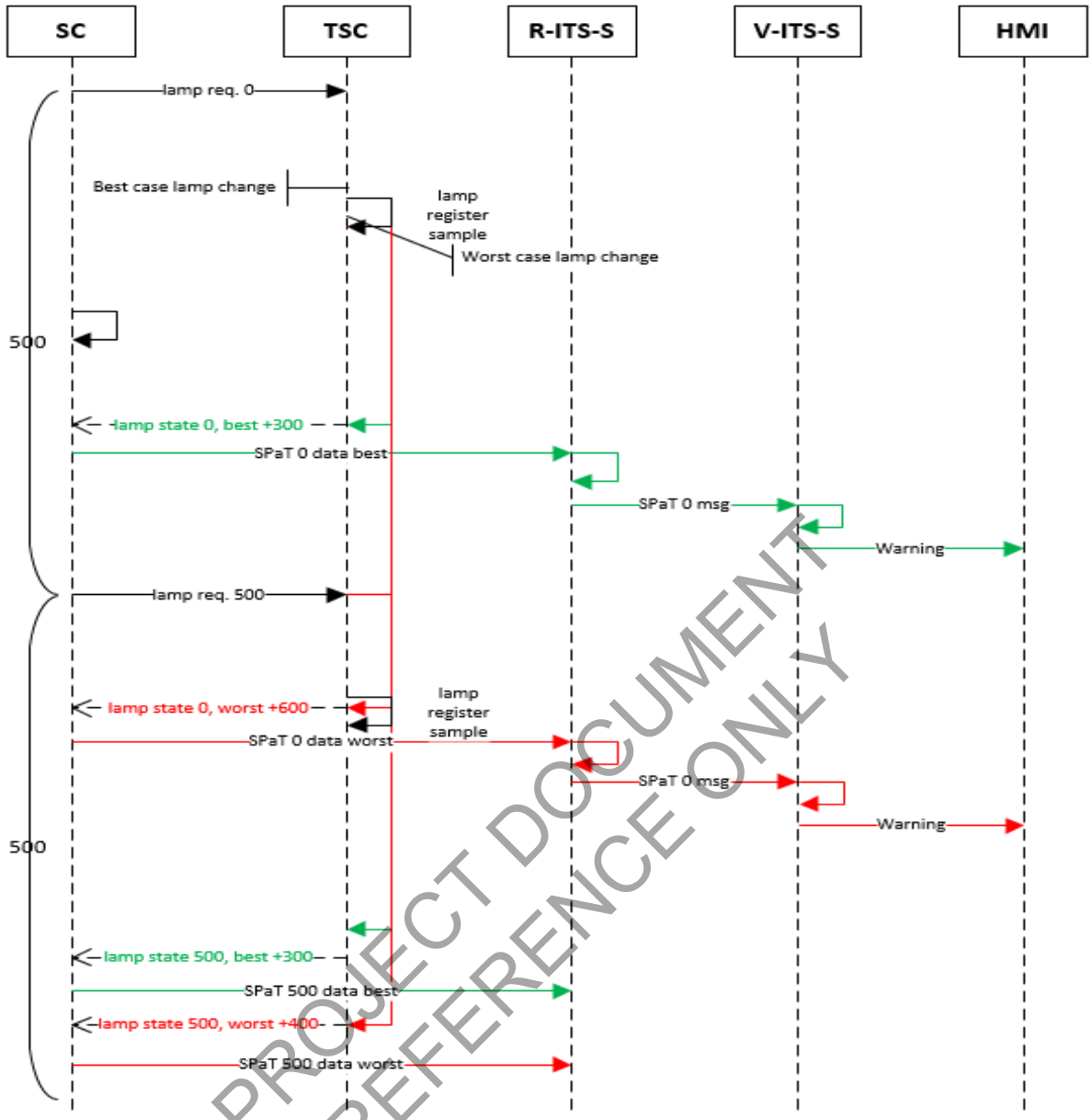

Figure 6-3: TRAFF data latency

6.5 FP – R-ITS-S data transmission frequency

The FP shall transmit UPER encoded SPATEM messages to the R-ITS-S every 100ms. This means that between the polling intervals of 500ms, 5 SPATEM messages will be sent to the R-ITS-S. The *spat.intersections timestamp* of each successive SPATEM message shall be incremented by 100ms.

6.6 FP –SPATEM message revision

The SPATEM message revision shall be updated whenever there is a change of state in any signal group. This is effected by incrementing the *spat.intersections.revision* data element.

6.7 FP monitoring

The FP monitoring data shall include:

- Session monitoring – used to identify a FP session (Uptime, Downtime) and to detect session exceptions
- Platform performance metrics (e.g. CPU, memory)
- Platform exception logs

6.8 FP security

The security requirements for the FP shall be in accordance with the security standards defined in MRTS 245.

The FP is not an entity defined in the C-ITS reference architecture described in ETSI EN 302 665. Thus, the security requirements applicable to C-ITS systems (C-ITS-S, V-ITS-S and R-ITS-S) do not apply to the FP.

7 Technical specifications

The FP equipment components, technical specifications, configuration and STREAMS compliance testing shall be in accordance with the requirements described in MRTS232.

In addition, the following requirements apply:

- The FP shall have sufficient resources to perform its functions both for the existing applications in the TMR ITS network and the newly designated C-ITS applications.
- The FP shall provide an extra 10/100 or 10/100/1000 megabit Ethernet adaptor with Linux driver, to enable connection to the C-ITS network.

8 Standards compliance

The requirements described in section 8 of MRTS232 apply to this section

9 Mechanical and physical requirements

The mechanical and physical requirements including requirements on environmental conditions shall be as defined in MRTS201 and section 11.1 of MRTS232.

10 Supply and Installation requirements

The service, warranty, guarantee and repair requirements shall be as described in section 9 of MRTS232.

Packaging and delivery shall be as described in section 10 of MRTS232 and the annexure thereof.

The installation requirements defined in MRTS201 and section 12 of MRTS232 apply to this section. In addition, any C-ITS specific settings shall be in accordance with the C-ITS installation plan. The C-ITS installation plan is designed to be in harmony with the existing installations.

11 Electrical requirements

The electrical requirements defined in MRTS201 and MRTS232 apply to equipment provided under this specification.

In addition, the contractor shall consult with the site owner (TMR-Metro) and the electricity supply authorities operating at the C-ITS pilot area, to determine whether additional Socket outlets will be required to be included in the Traffic signal enclosure to cater for the additional equipment required as part of the C-ITS pilot. The additional C-ITS equipment may include PoE injector (or switch), modems or other accessories which may require socket outlets.

For unmetered supplies, the power supply authorities may require load details of the new equipment including number of equipment, consumption requirements to determine the number of Socket Outlets required for each installation.

12 Networking Requirements

The telecommunication network requirements defined in MRTS245 shall apply to equipment provided in this standard.

In addition, the CAVI network and the TMR ITS IPRT network, at their point of termination at the FP, must be segregated via a firewall as shown in Figure 5-2.

The FP communicates SPATEM to the R-ITS-S using a unidirectional communication line. Any reverse communication from R-ITS-S to the FP shall not be permitted.

The FP shall be managed remotely using the STREAMS application accessible from the TMR ITS IPRT network.

13 Testing and commissioning

The testing and commissioning requirements defined in C-ITS Master test Plan apply to this specification.

14 Documentation

The documentation requirements defined in MRTS232 apply to equipment provided under this specification.

In addition, the following information shall be provided **Hold Point:**

- an electronic copy of engineering hardware documentation detailing the additional interfaces and software configurations required to enable the C-ITS applications
- an electronic copy of Technical and User Manuals showing how SPATEM data is generated in the FP, including how the SPATEM is matched to the associated MAPEM. The manual shall also describe the Firewall policy implemented in the FP to segregate the C-ITS network from the existing TMR-ITS network
- an electronic copy of all testing and certification documentation which demonstrate the requirements specified in this document.

15 Training

The training and handover requirements defined in MRTS201 and the Annexure MRTS232.1 apply to equipment provided under this specification. In addition, the contractor shall provide training on the maintenance and operation of the upgraded FP including:

- Configuration of the FP for C-ITS communications. This includes the configuration of communications between the FP and the TSC as well as FP and the R-ITS station
- Troubleshooting to isolate the source of communication fault in the event that SPATEM messages cease to be generated by the R-ITS-S. The source of the fault should be identified by running tests on all potential causes, including interfaces IF8 and IF9.

16 Maintenance

The maintenance requirements defined in MRTS201 and MRTS232 apply to equipment provided under this specification.