



**TS 06268:1.0**

TSI-SP-084

**Specification**

# **Communications Protocol for School Zone Alert System**

Issue date: 30 January 2024

Effective date: 30 January 2024

**Intelligent Transport Systems – Traffic Systems**

## Disclaimer

This document has been prepared by Transport for NSW (TfNSW) specifically for its own use and is also available for use by NSW public transport agencies for transport assets.

Any third parties considering use of this document should obtain their own independent professional advice about the appropriateness of using this document and the accuracy of its contents. TfNSW disclaims all responsibility and liability arising whether directly or indirectly out of or in connection with the contents or use of this document.

TfNSW makes no warranty or representation in relation to the accuracy, currency or adequacy of this document or that the document is fit for purpose.

The inclusion of any third party material in this document, does not represent an endorsement by TfNSW of any third party product or service.

For queries regarding this document, please email Transport for NSW Asset Management Branch at [standards@transport.nsw.gov.au](mailto:standards@transport.nsw.gov.au) or visit [www.transport.nsw.gov.au](http://www.transport.nsw.gov.au)

## Document information

**Owner:** Director Telecom Engineering

**Mode:** Road

**Discipline:** Technology

## Document history

Revision	Effective date	Summary of changes
1.0	08/06/2021	First issue as TSI-SP-084. Original, derived from content of ITS-SZAS-SD-022 and ITS-SZAS-SD-023. Approved by Director ITS Engineering.
1.0	30/01/2024	First issue as TS 06268, superseding TSI-SP-084, <i>Communications Protocol for School Zone Alert System</i> , version 1.0. Version numbering recommenced in line with new designation. Changes from the previous version include fixing problems identified during integration testing, with most changes in Appendix A.

## Preface

This specification is the first issue as TS 06268 and supersedes TSI-SP-084 *Communications Protocol for School Zone Alert System, Version 1.0*.

This document describes the communications protocol to be used by TfNSW for control and monitoring of School Zone Alert Signs.

The changes from the previous issue include fixing problems identified during integration testing.

## CONTENTS

<b>1</b>	<b>SCOPE .....</b>	<b>7</b>
	1.1 Purpose .....	7
	1.2 Scope .....	7
<b>2</b>	<b>DEFINITIONS AND GLOSSARY OF TERMS .....</b>	<b>7</b>
<b>3</b>	<b>TFNSW SPECIFICATIONS AND DOCUMENTS .....</b>	<b>7</b>
<b>4</b>	<b>GENERAL .....</b>	<b>8</b>
	4.1 Network .....	8
	4.2 Data Link Layer .....	8
	4.3 Network Layer .....	8
	4.4 Transport Layer .....	8
	4.5 Operation .....	8
	4.6 Client and Server .....	8
	4.7 System Addressing .....	8
	4.8 CMC Address .....	9
	4.9 Sign Controller Address .....	9
<b>5</b>	<b>APPLICATION LAYER .....</b>	<b>9</b>
	5.1 Data .....	9
	5.2 Transparency .....	9
	5.3 Error Free Communications .....	9
	5.4 General Message Exchange .....	9
	5.5 Message Format .....	11
	5.6 Time Format .....	11
<b>6</b>	<b>SZAS MESSAGE FORMATS .....</b>	<b>11</b>
	6.1 Request Message .....	11
	6.2 Response Message .....	12
<b>7</b>	<b>SIGN CONTROLLER INFORMATION VALUES .....</b>	<b>12</b>
	7.1 Status Flags .....	12
	7.2 Display Error byte .....	12
	7.3 RTC Synchronisation .....	12
	7.4 Sign Logs and Alarm Reporting .....	13
<b>APPENDIX A MESSAGES .....</b>		<b>14</b>
	A.1 Configuration Messages .....	14
	A.2 Telemetry Messages .....	18
	A.3 CMC command messages .....	20
	A.4 Other messages .....	21
<b>APPENDIX B STATUS AND DISPLAY ELEMENT .....</b>		<b>22</b>
	B.1 Status Word .....	22
	B.2 Display Error Byte .....	22
<b>APPENDIX C TIMETABLE .....</b>		<b>23</b>
	C.1 Timetable structure .....	23
	C.2 Operation period enablement bits .....	23
	C.3 Timetable Example .....	24
<b>APPENDIX D LOG FILE MESSAGE .....</b>		<b>25</b>
	D.1 Composition of message .....	25
	D.2 Event codes .....	25
	D.3 Example Log File Entries .....	26

## Tables

Table 1 – Definitions and Glossary of Terms .....	7
Table 2 – Configuration messages.....	17
Table 3 – Telemetry messages .....	19
Table 4 – CMC command messages .....	20
Table 5 – Other messages .....	21
Table 6 – Status Word.....	22
Table 7 – Display Error Byte .....	22
Table 8 – Timetable structure.....	23
Table 9 – Operation period enablement bits .....	23
Table 10 – Timetable example detail .....	24
Table 11 – Calendar entries .....	24
Table 12 – Event codes.....	25
Table 13 – Example log file entries .....	26

## Figures

Figure 1 – CMC initiated communications sequence.....	10
Figure 2 – Sign controller-initiated communications sequence.....	10
Figure 3 – RTC synchronisation process sequence example.....	13

# 1 SCOPE

## 1.1 Purpose

This document describes the communications protocol to be used by TfNSW for control and monitoring of School Zone Alert Signs.

This protocol is a text-based protocol that is designed to operate over an IP network using both TCP and UDP.

## 1.2 Scope

This document defines the physical means and protocol messages to be used for communication between the School Zone Alert System (SZAS) Central Management Computer (CMC) and the signs.

Where necessary, the functionality required to implement the protocol is described.

# 2 DEFINITIONS AND GLOSSARY OF TERMS

The following definitions and abbreviations shall apply:

Term	Definition
4G	4 <sup>th</sup> generation public mobile communication system
Alert Display	Flashing display elements of an SZAS sign; lanterns and annulus.
CMC	Central Management Computer
CRC	Cyclic Redundancy Check
DNS	Domain Name System
ID	Identification or identification code
IP	Internet Protocol
ITS	Intelligent Transportation Systems
LSB	Least Significant Bit
MSB	Most Significant Bit
RTC	Real-time counter
SZAS	School Zone Alert System
TCP	Transmission Control Protocol
TfNSW	Transport for NSW, a New South Wales government agency
UDP	User Datagram Protocol
VPN	Virtual Private Network

**Table 1 – Definitions and Glossary of Terms**

# 3 TFNSW SPECIFICATIONS AND DOCUMENTS

[1] TS 06267 (TSI-SP-083) – School Zone Alert Signs

## **4 GENERAL**

### **4.1 Network**

A private IP-VPN wide area network is used.

### **4.2 Data Link Layer**

A wireless 4G communications data link layer shall be used.

### **4.3 Network Layer**

The Sign Controller shall use IP (Internet Protocol) as its network layer.

### **4.4 Transport Layer**

4.4.1 The TCP shall have a configurable port.

4.4.2 The TCP shall have a default port of 8007.

4.4.3 The TCP shall be used to transfer the management protocol messages and download firmware.

4.4.4 The UDP shall have a configurable port.

4.4.5 The UDP shall have a default port of 10080.

4.4.6 The UDP shall be used to send the trigger message from the CMC to the Sign Controller.

### **4.5 Operation**

The communications link between the CMC and the Sign Controller shall be used to download new configuration data (such as timetable) and device firmware, and to receive notifications of failures, and logs, for auditing purposes.

### **4.6 Client and Server**

4.6.1 In the SZAS architecture, the Sign Controller shall have the role of Client and the CMC that of Server.

4.6.2 The CMC initiates communications, and defined communication sequences, except as noted below.

(a) When the sign first starts up – sign initiates.

(b) In the case of an alarm – sign initiates.

### **4.7 System Addressing**

4.7.1 Each Sign Controller shall be addressed using an IP address.

4.7.2 The CMC shall be given a hostname and DNS used to resolve this to an IP Address.

4.7.3 IP addresses shall be allocated within the reserved private network ranges of the same class.

Note: All Signs and the CMC will be within a single subnet. The addresses might be 10.0.0.0/255.255.0.0. For the sake of illustration, the CMC address 10.50.108.101 is used in this document.

## **4.8 CMC Address**

- 4.8.1 The CMC shall be allocated a static IP address.
- 4.8.2 The CMC shall be addressed by the Sign Controller using DNS hostname or an IP address.

## **4.9 Sign Controller Address**

- 4.9.1 Each sign is manually allocated a SIM card (the SIM card has a pre-assigned static IP address).
- 4.9.2 UDP trigger packets shall be addressed to the IP address allocated to the sign.
- 4.9.3 The IP address identifies a sign and hence its sign ID. Each time the sign connects with an IP address, based on that IP Address a Sign ID is associated by the CMC.

# **5 APPLICATION LAYER**

## **5.1 Data**

- 5.1.1 The Sign Controller shall use as its application layer a message interpreter listening on each TCP connection.
- 5.1.2 The Sign Controller request and response messages shall be structured using three (3) character long descriptors.
- 5.1.3 The messages shall be transferred between nodes using a TCP/IP connection.

## **5.2 Transparency**

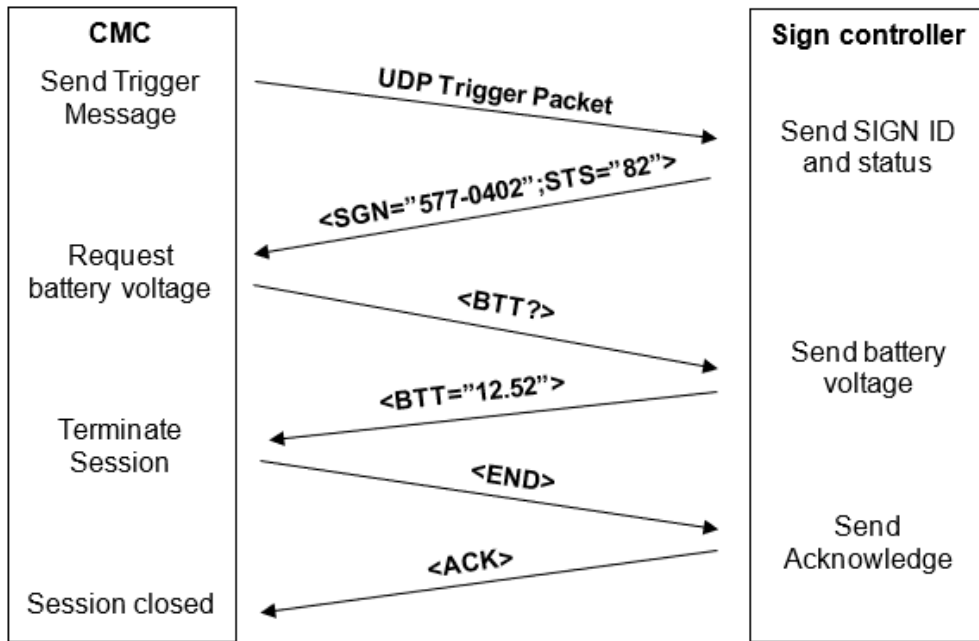
The protocol shall be implemented to be independent of the communications media.

## **5.3 Error Free Communications**

The Sign Controller shall rely on the underlying TCP protocol to ensure error free delivery of data.

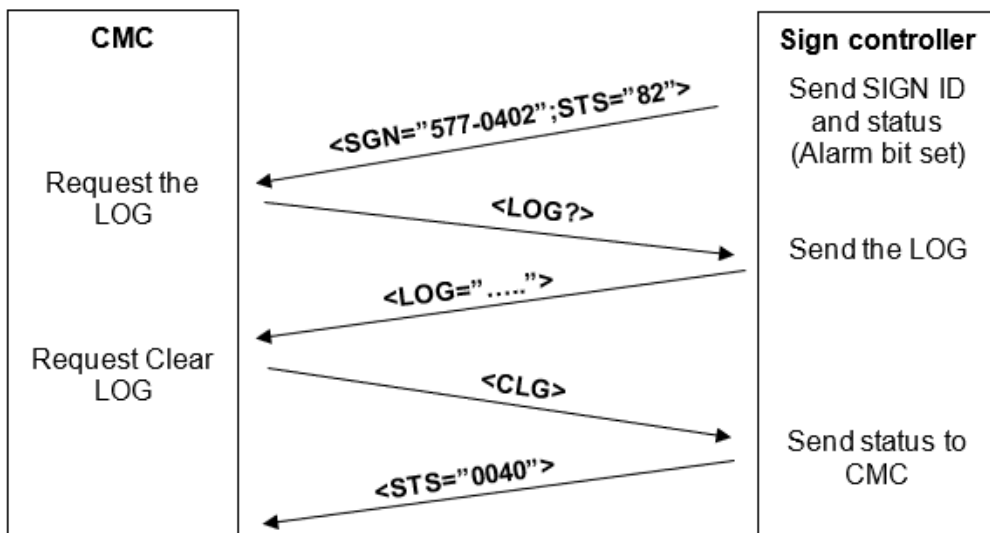
## **5.4 General Message Exchange**

- 5.4.1 The CMC shall initiate communications with the Sign Controller via the UDP trigger message.
- 5.4.2 Upon reception of the UDP trigger message, the Sign Controller shall establish a TCP connection with the CMC.
- 5.4.3 Upon a successful establishment of the TCP connection, the Sign Controller shall respond with a message containing its sign ID and status word.
- 5.4.4 The CMC shall then control all further exchanges. Refer to the Sequence diagram below for more details.
- 5.4.5 All message exchanges between the Sign Controller and the CMC shall be enclosed within a '<' start of message and '>' end of message characters as shown in the sequence diagrams below.



**Figure 1 – CMC initiated communications sequence**

- 5.4.6 The Sign Controller shall only initiate communications with the CMC, when it has an alarm or event to report.
- 5.4.7 The Sign Controller shall send its sign ID and the status word when it has an alarm or event to report.



**Figure 2 – Sign controller-initiated communications sequence**

- 5.4.8 A response message shall only be sent once all requests within a message have been processed.

## 5.5 Message Format

- 5.5.1 The messages shall exchange the defined CMC requests and Sign controller responses, as defined in Appendix A.
- 5.5.2 Multiple requests and responses shall either be:
  - a) included in a message separated by a semicolon character “;” or
  - b) sent individually.
- 5.5.3 Multiple responses shall be returned in the same order as the requests within a message.
- 5.5.4 The Sign Controller shall respond with a “REJ” response if it contains white spaces, including TAB, carriage returns and line feeds.
- 5.5.5 The Sign Controller shall respond with a “REJ” response when any character is received that is not part of the defined message.

## 5.6 Time Format

- 5.6.1 SZAS message timing operates in “ticks”.
- 5.6.2 Each tick is one second in duration.
- 5.6.3 The SZAS CMC clock operates in Epoch time (seconds since midnight 1/1/1970).

# 6 SZAS MESSAGE FORMATS

The various types of messages and their format are described below.

## 6.1 Request Message

- 6.1.1 Each request message shall conform to one of the defined entries in the tables given in Appendix A.
- 6.1.2 If a message contains several requests, (by using the semicolon separator described in 5.5.2 a), then all the requests therein shall be in the same message class. The message classes are as follows:
  - a) Configuration messages (refer Appendix A.1);
  - b) Telemetry messages (refer Appendix A.2);
  - c) Commands (refer Appendix A.3).
- 6.1.3 The request message shall either consist of the descriptor tag by itself or followed by an argument.
- 6.1.4 The argument shall either be a question mark character ‘?’ which implies that the value of that variable is requested, or an equals character ‘=’ which is used to set a variable’s value to the data after the equals character.

For example:

CLG	Clear log entries that have been confirmed sent
DTE?	Request current ticks
DTE=”SSSSSSSS”	Set current ticks

## 6.2 Response Message

- 6.2.1 The Response Message shall be determined according to the request message, as given in Appendix A.
- 6.2.2 If multiple requests were sent then the response shall be placed in the same order as the requests, except for correctly executed requests that do not require a response.
- 6.2.3 The response message shall be one of the following:
- (a) The tag of the message followed by an equals sign, followed by the requested response parameter/data, for messages with a defined reply.
  - (b) A single <ACK> response message if the overall response contains no other reply for all requests. See Appendix A.4.
  - (c) The tag of the message followed by a hash character (#), if the request fails such that the sign cannot execute the request.
  - (d) A reject <REJ> message if the sign received a corrupted or invalid request. In this event, the sign shall not enact any requests with that message.

## 7 SIGN CONTROLLER INFORMATION VALUES

The following sections identify and describe the status and alarm variables to be provided by the Sign Controller.

### 7.1 Status Flags

- 7.1.1 The 16-bit status word shall provide the status and state of alarms and events of the Sign Controller.
- 7.1.2 The status word shall be sent to the CMC when requested by the status request command (STS) as a zero padded 4-digit hexadecimal number.
- 7.1.3 The description of the status word is provided in Appendix B.1.

### 7.2 Display Error byte

- 7.2.1 The DISPERR bit in the status flags shall indicate whether a fault has occurred in one of the displays.
- 7.2.2 The specific sign element that is faulty shall be provided in the Display Error byte of the DER tag as a zero padded 2-digit decimal number (see Appendix A.2).
- 7.2.3 When one of the bits is set (1), it indicates a fault has occurred in the corresponding display element, as defined in Appendix B.2.

### 7.3 RTC Synchronisation

- 7.3.1 When the Sign Controller receives a RTC synchronisation request (SYN) from the CMC, the Sign Controller shall request the value of RTC (in ticks) from the CMC by sending a <DTE?> message.
- 7.3.2 The Sign Controller shall measure the total round trip time (in RTC ticks) ( $RTT_M$ ) taken from issuing its RTC value request <DTE?> to receiving the RTC value ( $T_{CMC}$ ) from the CMC. ( $RTT_M = T_{CMC} - RTC_{Sign}$ ).

7.3.3 The Sign Controller shall adjust its RTC only if:

The  $RTT_M$  is less than or equal to acceptable round trip time  $RTT_A$  that was specified in the RTC synchronisation request; or

The current Sign Controller's RTC is greater than  $(T_{CMC} + 3/2 \times RTT_M)$ ; or

The current Sign Controller's RTC is less than  $(T_{CMC} - 1/2 \times RTT_M)$ .

7.3.4 If the Sign Controller is required to adjust its RTC then the Sign Controller shall set its RTC to:  $T_{CMC} + (1/2 \times RTT_M)$ .

7.3.5 The Sign Controller shall complete the RTC synchronisation process by responding with the measured round trip time ( $RTT_M$ ) and the difference between the new Sign Controller RTC and the previous Sign Controller RTC. If the RTC is not adjusted then the difference value is 0.

7.3.6 If the magnitude of the adjustment is greater than 999 ticks, then it shall be reported as 999 or -999 ticks, depending upon the sign of the adjustment.

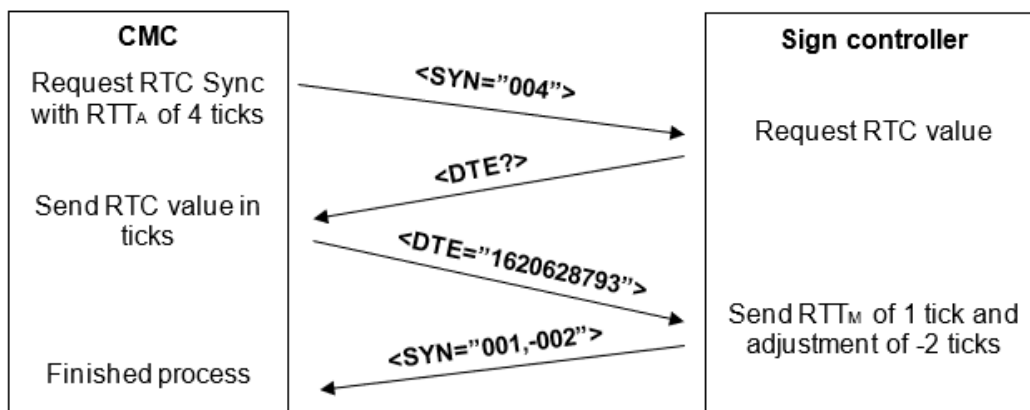


Figure 3 – RTC synchronisation process sequence example

## 7.4 Sign Logs and Alarm Reporting

7.4.1 Events (see TS 06267 (TSI-SP-083) [1]) shall be reported to the CMC in the format given in Appendix D.

7.4.2 If an alarm occurs, the following process shall be carried out (see Figure 2):-

- a) The Sign Controller shall send its Sign ID and the status to CMC;
- b) If the ALARM bit is set in the Status word, CMC asks for the sign log file.
- c) The Sign Controller responds, sending its current log;
- d) CMC issues the Clear log request (CLG)
- e) The Sign Controller clears all its log entries.
- f) If no other alarms have occurred during the above process, the Sign Controller shall clear the ALARM bit in the Status word, and respond with the current status of the Sign Controller.

## APPENDIX A MESSAGES

The lists in this appendix cover all messages in the SZAS protocol. However, some messages are aimed at the mode of operation of older signs. The applicability of individual messages to the current sign design is given in the current sign specification, TS 06267 (TSI-SP-083) [1].

### A.1 Configuration Messages

Tag	Description	Use	Requires ACK or REJ after command
ADN	Get Sign Controller number. Up to 32 characters 0-9, a-z, A-Z, ',', '-', '_', '/', '\'. This is a fixed number coded into the controller.	Get sign controller number: CMC request: ADN? Sign response: ADN="80000136"  Existing practice uses 8 digits. The first 4 digits are static for a manufacturer/protocol combination, and assigned by TfNSW (e.g. 8000). The next 4 digits are assigned by the manufacturer, in sequence of manufacture release. (e.g. 0136)	No
BVL	Get/Set battery voltage threshold. Battery voltage threshold is provided in volts and in DD.DD format.	<u>Set battery voltage threshold in sign:</u> CMC request: BVL="10.21"  <u>Get battery voltage threshold from sign:</u> CMC request: BVL? Sign response: BVL="10.21"	No
CMC	Get/Set the CMC IP address or hostname remotely	<u>Set CMC IP in sign</u> CMC request: CMC="010.109.010.001"  <u>Get CMC IP from sign:</u> CMC request: CMC? Sign response: CMC="010.109.010.001"	Yes
CTD	Get/Set the wait period (in RTC ticks) before attempting a reconnection. Up to a 4-digit number (not zero padded).	<u>Set reconnect wait period in sign:</u> CMC request: CTD="6000"  <u>Get reconnect wait period from sign:</u> CMC request: CTD? Sign response: CTD="6000"	No

Tag	Description	Use	Requires ACK or REJ after command
DRT	Get/Set Alert Display electrical current hysteresis for display alarm trigger. (Shall be 3 zero-padded digits)	<u>Set DRT in the sign:</u> CMC request: DRT="XXX"  <u>Get DRT from the sign:</u> CMC request: DRT? Sign response: DRT ="XXX"	Yes
ECT	Get/Set Alert Displays electrical current alarm threshold. Provided in mA in zero-padded DDDD format, separated with commas. The order of the thresholds is Left Lantern, Right Lantern and Annulus.	<u>Set electrical current threshold in sign</u> CMC request: ECT="0435,0435,1237"  <u>Get electrical current threshold from sign:</u> CMC request: ECT? Sign response: ECT="0435,0435,1237"	No
FPN	Get/Set Sign Controller flash pattern. Flash pattern is up to 32 bytes long. Each byte is structured as follows: Bit 0 – Left lantern, Bit 1 – Right lantern, Bit 2 – Annulus. The sequence of the pattern is from LSB to MSB. This is decimal encoded. If a bit is set in a byte it indicates that Alert Display is activated for that flash pattern stage.	<u>Set flash pattern in sign</u> CMC request: FPN ="555551100000226666"  <u>Get flash pattern from Sign:</u> CMC request: FPN? Sign response: FPN="555551100000226666"	No
FWV	Get the firmware version in operation. Firmware versions are sent as 32 characters in 0-9, a-z, A-Z, ',', '-', '_', '/', '\.	CMC request: FWV? Sign response: FWV="1.00"	No
ITT	Set sign call-home daily schedule times This is aimed at a sign connected to the CMC by satellite. The format is ITT="ENA,T1,T2,T3,T4,T5,T6" ENA = number of times per day the sign shall call home. Tn = UTC time as 4 digits from 0000 to 2359. (HHMM format). To align times, the sign shall assume CMC timestamp equals epoch time. Sign reject <REJ> to occur if ENA is not 4, 5 or 6, or if used times are not in ascending sequence, or if less than 5 minutes apart.	<u>Set call schedule:</u> CMC request: ITT="ENA,T1,T2,T3,T4,T5,T6"  <u>Get call schedule:</u> CMC request: ITT? Sign response: ITT="ENA,T1,T2,T3,T4,T5,T6" T1 applies first, unused time slots shall have an entry Example: ITT="4,0600,0800,1400,1600,0000,0000"	No
MID	Get parameters of the sign's modem: Response format: MID="modem chipset manufacturer', 'factory serial number', 'hardware version', 'software version', 'IMEI', 'IMSI'". Should return at least manufacturer name and serial number. If any parameters cannot be obtained then 'N/A' shall be returned	CMC request: MID? Sign response: MID="Mfr', 'Ser', 'hw', 'sw', 'imei', 'imsi'" .	No



Tag	Description	Use	Requires ACK or REJ after command
TTC	Initiate sign to calculate the timetable checksum and return with the encoded checksum value. Checksum is calculated using the CRC-CCITT (XModem) method.	<u>Get timetable checksum from sign:</u> CMC request: TTC? Sign response: TTC="797D"	No
TTO	Get/Set operating durations. There will be three operating durations (in ticks) specified which are: S1=Duration of the 1 <sup>st</sup> timetabled operation S2=Duration between 1 <sup>st</sup> and 2 <sup>nd</sup> timetabled operation S3=Duration of the 2 <sup>nd</sup> timetabled operation Numbers are unsigned non-zero padded integers.	<u>Set operating durations in sign:</u> CMC request: TTO="S1, S2, S3" Example: TTO="5400,18000,5400"  <u>Get operating durations from sign:</u> CMC request: TTO? Sign response: TTO="S1, S2, S3"	No
TTV	Set/Get timetable version. Timetable version is up to 32 characters 0-9, a-z, A-Z, ',', '-', '_', '/', '\'.	<u>Set timetable version in sign</u> CMC request: TTV="XXXXXX"  <u>Get timetable version from sign</u> CMC request: TTV? Sign response: TTV="XXXXXX"	Yes

**Table 2 – Configuration messages**

## A.2 Telemetry Messages

Tag	Description	Use
BTT	Get battery voltage from sign. Battery voltage is provided in DD.DD format. Not zero padded.	CMC request: BTT? Sign response: BTT="12.36"
CEL	Retrieve Serving Cell Information from the mobile network Shall be in csv format and include serving cell and frequency band.	CMC request: CEL? Sign response: CEL=" 4G,4436,22.....,0E8259F,29,38,NOCONN"
DER	Get display error byte. Display error byte is a decimal representation of the byte. See Appendix B.2 Zero padded in DD format.	CMC request: DER? Sign response: DER="1"
DMP	Initiate sign to dump trace data as string in intel hex format.	CMC request: DMP? Sign response: DMP="<intelhex_format>"
DTE	Get/Set the RTC on the Sign Controller. RTC is up to 10 digits long and less than 2 <sup>32</sup> -1.	<u>Set RTC in sign:</u> CMC request: DTE="1394078114" <u>Get RTC value from sign:</u> CMC request: DTE? Sign response: DTE="1394078114" <u>Get RTC from CMC</u> (part of time synchronisation sequence): Sign request: DTE? CMC response: DTE="1394078114" Sign request: SYN="27.999"
ESC	Get display element electrical current in mA. Electrical current is to be provided in zero padded DDDD,DDDD,DDDD format. The order of sampled current is 'Left Lantern, Right Lantern, Annulus' If no data is available, blank values are returned. For example: ESC=".,,"	CMC request: ESC? Sign response: ESC="0435,0429,1327"
GPS	Retrieve GPS location, in NMEA format	CMC request: GPS? Sign response: GPS = "LAT, LONG, HDOP"
LOG	Get sign log. The format of log be sent is detailed in Appendix D.	CMC request: LOG? Sign response: LOG="....."
TMP	Get sign temperature. To be provided in °Centigrade in signed DDD.D format. Not zero padded. Only negative sign allowed. No positive sign permitted.	CMC request: TMP? Sign response: TMP="-3.1"
RSS	Get the sign Received Signal Strength. Provided as a signed value in dBm up to three digits, whole numbers only. Not zero padded. Only negative sign allowed. No positive sign permitted.	CMC request: RSS? Sign response: RSS="-65"

Tag	Description	Use	
STS	Get sign status. Status is the hex representation of the status word in DDDD format. Zero padded hexadecimal value. See Appendix B.1.	CMC request: Sign response:	STS? STS="0080"
SVN	Retrieve more detailed firmware version info	CMC request: Sign response:	SVN? SVN="SVN1244".

**Table 3 – Telemetry messages**

### A.3 CMC command messages

Tag	Description	Use
CLG	Clear Sign log in sign.	CMC request: CLG Sign response: STS="0025"
END	Terminate and acknowledge end of session.	CMC request: END
RBT	Initiate sign to reboot with the current firmware.	CMC request: RBT Sign response: <ACK> , then reboot
SCK	Initiate sign self-check. After self-check the sign returns 1 for passed or 0 for failed.	CMC request: SCK Sign response: SCK="0"
SOP	Get/Set the state of operation of the Alert Displays. Either off (0) or on (1).	<u>Set state of display operation in sign</u> CMC request: SOP="0"; STS? <u>Get state of display operation from sign:</u> CMC request: SOP? Sign response: SOP="0"
SYN	Request Sign controller to initiate time synchronisation. Provide round-trip time (RTT) in DDD ticks and the adjustment in DDD or -DDD ticks.	<u>Time Synchronize the sign with the CMC</u> CMC request: SYN="45" Sign request DTE? CMC response: DTE="58752257" Sign response: SYN="27.999"
TFL	Initiate sign test flash cycle for the specified number of ticks, using the specified test pattern. The test flash cycle is two digits long (ranging from 01 to 99).	CMC request: TFL="30,Test_Flash_Pattern" Sign response: ACK or TFL# if test flash cycle not performed
UFW	Update firmware of sign. Sign to download, update, and resume operation. Detail message content and process is expected to vary to suit the sign model. The process used shall include a checksum. URL field is mandatory.	CMC request: UFW="XYZ" Sign response: ACK XYZ is the URL A URL may be sent for the site to use to source its new firmware, or the firmware may be encoded in the message itself.

**Table 4 – CMC command messages**

#### A.4 Other messages

Tag	Description	Use	
ACK	Acknowledgement from sign to CMC when no other response is defined.	Sign response:	ACK
REJ	Reject message from sign to CMC.	Sign response:	REJ
;	Used as a tag separator. Not to be used anywhere else in a message	Example:	BTT?;TMP?

**Table 5 – Other messages**

## APPENDIX B STATUS AND DISPLAY ELEMENT

### B.1 Status Word

Bit	Name	Description	Status Indication
0	ALARM	Alarm state	0 No alarms 1 Alarm occurred
1	DISPERR	Display error state	0 Normal 1 A fault has occurred in the displays
2	CFGERR	Configuration error state	0 Normal 1 Configuration is corrupt (reset when rebooted)
3	FWDL	Firmware download	0 Normal 1 Firmware downloading
4	FWDLER	Firmware download error	0 Normal 1 Error occurred during firmware download
5	BTTLW	Battery low voltage	0 Normal 1 Battery voltage is below threshold
6	FLH	Flashing state	0 No alert displays are flashing 1 One or more alert displays are flashing
7	SOP	State of operation (for alert displays)	0 State of Operation "off" 1 State of Operation "on"
8	DOORSTS	Door open state	0 Door is closed 1 Door is open
9-15	-	-	<i>undefined, for future use</i>

**Table 6 – Status Word**

### B.2 Display Error Byte

Bit	Display Element
0	Left Lantern
1	Right Lantern
2	Annulus

**Table 7 – Display Error Byte**

## APPENDIX C TIMETABLE

### C.1 Timetable structure

The timetable is sent in ASCII Hex, structured in the following manner:

Description	Length	Comment
Number of timetable segments	1-byte	Segments such as a school term
Absolute start time for the first timetabled operation (in ticks)	4-bytes	The time of day of this absolute time is to be used as the daily start time for the whole of the segment by repeatedly adding 24 hours.
Number of calendar entries in first timetable segment	1-byte	Number of days in this timetable segment
Calendar for the first timetable segment	Variable	Each day's timetabled operation is represented by 2-bits which are packed into a byte from LSB to MSB. See Table 9 below.
Absolute start time for the second timetabled operation (in ticks)	4-bytes	32-bit RTC value (CMC epoch time)
Number of calendar entries in second timetable segment	1-byte	Number of days in this timetable segment
Calendar for the second timetable segment	Variable	2-bits for each day's calendar operation. See Table 9 below.

**Table 8 – Timetable structure**

### C.2 Operation period enablement bits

Each day's worth of calendar entry comprises two bits that indicate which timetabled operations are required.

Bits	Description
00	Both timetabled operations are off
01	1st timetabled operation is ON and 2nd timetabled operation OFF
10	1st timetabled operation is OFF and 2nd timetabled operation is ON
11	Both timetabled operations are on

**Table 9 – Operation period enablement bits**



## APPENDIX D LOG FILE MESSAGE

### D.1 Composition of message

Each log file entry of the message shall comprise a cyclic sequence number (000 to 999), timestamp (RTC value in ticks), and a 2 digit event code field. A colon “:” shall separate each of the fields:

- Sequence Number: Timestamp: Event Code: Event Data

Event data shall be appended if the event code requires event data fields. Multiple log entries shall be separated by a comma character, “,”.

Note: White spaces including TAB, carriage return and line feeds are ignored by the CMC system in the log file.

### D.2 Event codes

The log entry event codes and associated event data required is tabled below.

Event code	Logged Event Description	Event data Required
01	Unexpected initialisation of the sign	None
02	Sign housing door opened	None
03	Closure of sign housing door (recovery from open)	None
04	Configuration error	None
05	Firmware download error	None
06	Battery voltage below minimum threshold	Battery voltage in DD.DD format.
07	Recovered from battery below minimum voltage (Battery voltage above minimum threshold)	None
08	Failure of any of the Alert Displays	Display error byte in DD format, then electrical current for that display in DDDD format.
09	Recovered from Alert Display failure	None
10	CMC communications timeout	None
11	Commencement of timetabled operation	None
12	Cessation of timetabled operation	None
13	Locally triggered test flash request	None
14	Trace data available	None
15	Controller initialised due unresponsive modem	None
16	Test Mode (Switch activated)	None
17	Test Mode (Switch deactivate)	None
18	Mains power failure	None
19	Recovery from mains power failure	None
20	Battery needs replacement	None
99	Debugging Aid	Customised

**Table 12 – Event codes**

### D.3 Example Log File Entries

Example log Entry	Explanation
001:1394078114:01,	Sign Controller initialised
002:1394078114:02,	Housing door opened
003:1394078114:03,	Closure of housing door (recovered from door open)
004:1394078114:04,	Configuration error
005:1394078114:05,	Firmware download error
009:1394078114:06:10.92,	Battery voltage below threshold at 10.92 V
010:1394078114:07,	Battery voltage above threshold (recovered from below threshold)
014:1394078114:08:02:0200,	Alert Display fault in right conspicuity device with the measured current of 200 mA
015:1394078114:09	Recovered from Alert Display fault
016:1394078114:10,	CMC communications timeout
017:1394078114:11,	Commencement of timetabled operation
018:1394078114:12,	Cessation of timetabled operation
019:1394078114:13,	Test Flash triggered locally by opening door (some signs)
020:1394078114:14,	Trace data available (some signs). Segger SystemView Trace data available for retrieval with <DMP?> command. Tracing is paused until existing data is retrieved.
021:1394078114:15,	Controller initialised due unresponsive modem (some signs) Reset done if internal communication not established in 10 attempts, and time is at least 10 minutes outside flashing cycle times.
022:1394078114:99: 0000:5aea5173,	Used for sending debug data (some signs) Recently used for sending the controller current timestamp during the time synchronisation issue troubleshooting.

**Table 13 – Example log file entries**