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LANE AND CARRIAGEWAY SIGNS (LCS)

Intelligent Transport Systems (ITS) Delivery Specification

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More information
This delivery specification is to be read in conjunction with the Notes to LCS Delivery Specification.
If you have further queries, contact the Intelligent Transport Systems Standards and Specifications (ITS S&S) team via email: itsspec@nzta.govt.nz

More information about ITS is available on the NZTA website at https://www.nzta.govt.nz/its

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Contents

List of figures

List of tables

1 OVERVIEW AND OUTCOMES

This section defines the purpose of the equipment within the operational system.

1.1 Purpose

This document specifies the requirements for lane and carriageway signs, and details the system integration requirements (eg protocols, interfaces, data standards) to ensure compliance with Client systems and standards.

1.2 Scope

This delivery specification covers lane signs and carriageway signs. Both are regulatory speed-capable devices.

NZTA ITS class: 001 Signs. Equipment which provides visual messages or warnings to the users of the transport network. Class definitions

1.2.1 Carriageway signs

Carriageway signs are gated (or paired) at the same longitudinal position to the left of the emergency shoulder (or left-hand traffic lane if absent), on either side of a carriageway or on-ramp (Figure 1).

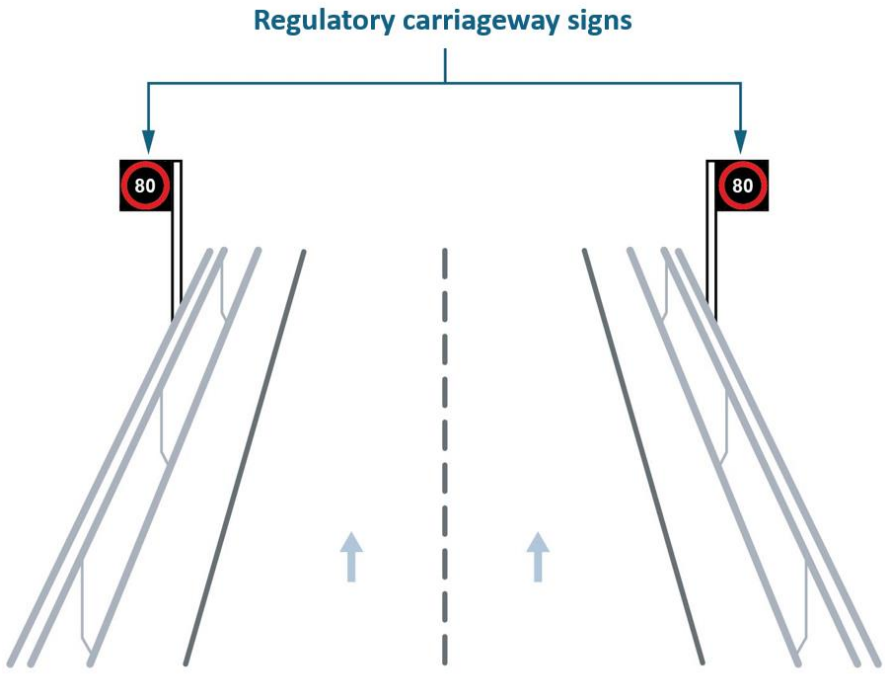

Figure 1. Carriageway signs (typical arrangement) – front view

Carriageway signs can only display speeds that are applicable to all traffic lanes heading in the same direction. Both signs must show the same speed (eg mandatory 80km/h in Figure 1 above).

1.2.2 Lane signs

Lane signs are positioned centrally above each lane to display a symbol or speed that applies specifically to the lane below (see Figure 2).

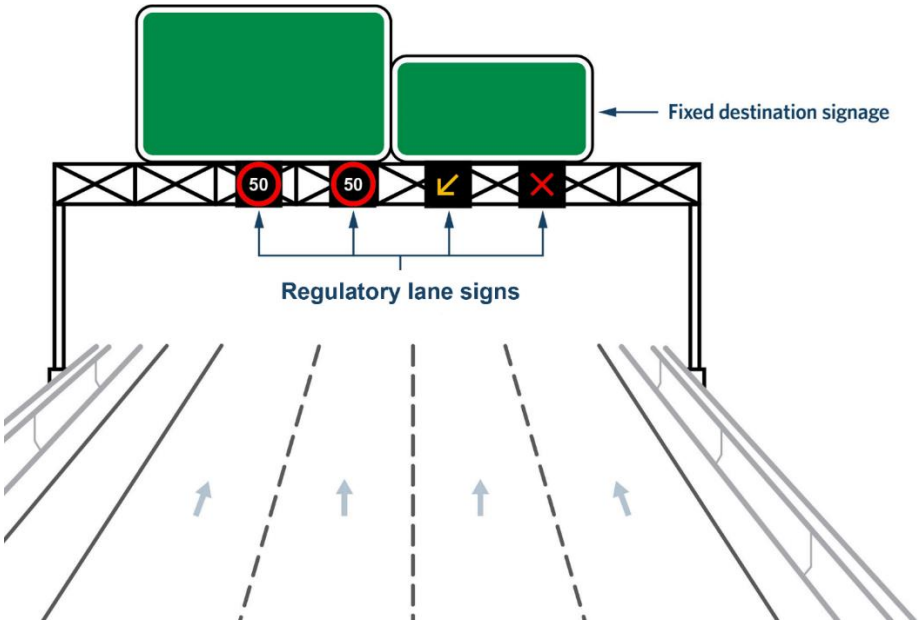

Figure 2. Lane signs (typical arrangement) – front view

1.3 Outcomes

The critical outcomes are the ability to manage traffic speed and/or manage lanes under degraded modes (eg for incidents, events and roadworks) and to deliver consistent and unambiguous instructions to road users across the strategic road network.

LCS must:

i. be used to control traffic flow more efficiently using dynamic speed limits
ii. manage lane availability by actively reconfiguring lanes
iii. execute traffic management plans in response to planned or unplanned events across coordinated groups of signs
iv. ensure the equipment is available for use and out of service for maintenance for very short periods.
v. enable users of the transport network to easily recognise and understand the instructions relating to lane management or speed control under all operating conditions
vi. cause no confusion or distraction to road users
vii. provide users of the transport network information about upcoming lane availability
viii. provide users of the transport network mandatory speed limit information.
ix. enable road controlling authorities (RCAs) and transport operations centres (TOCs) are to have the ability to obtain status and fault logging information in real time about the performance of LCS
x. enable road controlling authorities (RCAs) and transport operations centres (TOCs) are to have the ability to manage lane use and speed
xi. enable road controlling authorities (RCAs) and transport operations centres (TOCs) are to have the ability to support temporary traffic management functions.

2 FUNCTIONAL REQUIREMENTS

This section outlines what the equipment and systems need to do, and how they need to do it.

An LCS must be:

i. able to present and maintain a visible and legible symbol or speed to road users under all weather and lighting conditions and be clearly seen by road users from a significant distance (between approximately 75m and 300m)
ii. compliant with Client system interface design standards
iii. able to self-diagnose faults and send appropriate fault messages to the fault management system
iv. able to display the colour palette referred to in sections 3.4.1 ‘LED colour palette’ and 3.4.2 ‘Colour’.

2.1 LCS unit

An LCS must be able to control the display of the red (regulatory speed) roundel independently from the other features of a sign. The display priority is included in the message content, and LCS speeds and symbols are organised strictly hierarchically, where the lane closed symbol always takes priority over lane divert/merge symbols, which in turn always take priority over speed displayed. The issue of contention where messages with the same priority are competing for display is not possible as each LCS given has a unique priority.

2.1.1 Standard speeds and symbols

As a minimum, the speeds (from 10km/h to 110km/h in 10km/h increments) and symbols (shown in Figures 5 to 8) must be supported by the LCS.

Figure 3. Regulatory 80km/h speed limit

Figure 4. Regulatory 100km/h speed limit

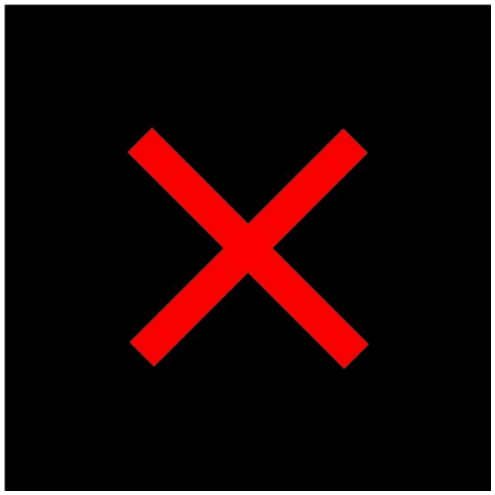

Figure 5. Lane or carriageway closed symbol

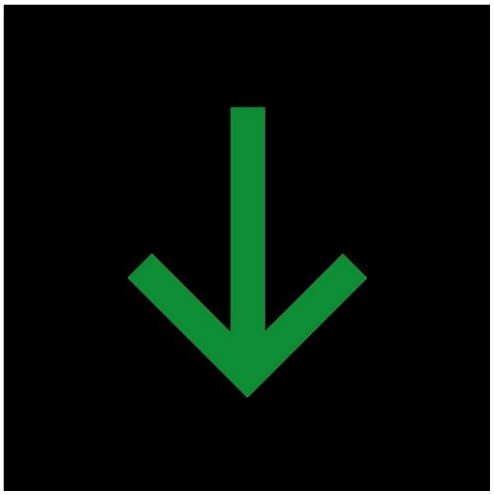

Figure 6. Lane open symbol

Figure 7. Divert/merge left symbol

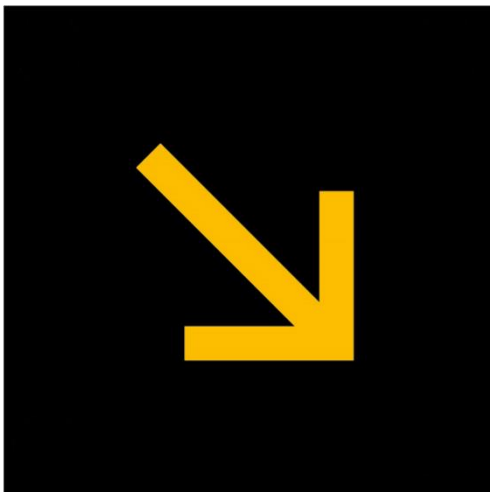

Figure 8. Divert/merge right symbol

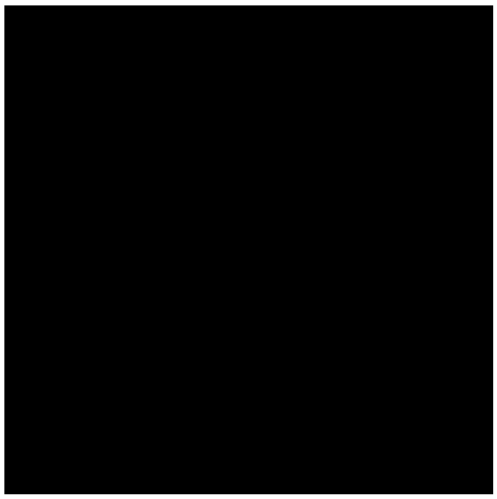

Figure 9. Blank display

For font requirements to support visibility for speeds and symbols displayed on LCS, refer to the latest version of ITS core requirements standard: Electronic message signage fonts.

2.1.2 Roundel internal and external diameters, thickness

LCS shall have roundels in which the difference between the external diameter and internal diameter (thickness) are larger than their fixed sign equivalents. For example, the roundels of static mandatory speed signs have an external diameter of 600mm and an internal diameter of 450mm (a thickness of 75mm). Dynamic signage with a 600mm external diameter has an internal diameter of 420mm (a thickness of 90mm).

2.1.3 Roundels formed from concentric rings

For dynamic signage, the roundel shall be composed of two or more concentric rings of LEDs. The outer ring must be continuously illuminated while the other rings may flash with a frequency of 1Hz in accordance with TCD Rule (Schedule 1 Signs, R1 Speed limit signs: R1-2 Variable speed)

For signs with an external diameter of 600mm, the total thickness of the roundel (all rings) must be 90mm.

Figure 10. The two states of an oscillating red roundel

2.1.4 LCS dimensions and application

LCS enclosure and display dimensions shall be consistent with **Error! Reference source not found.** and Table 1.

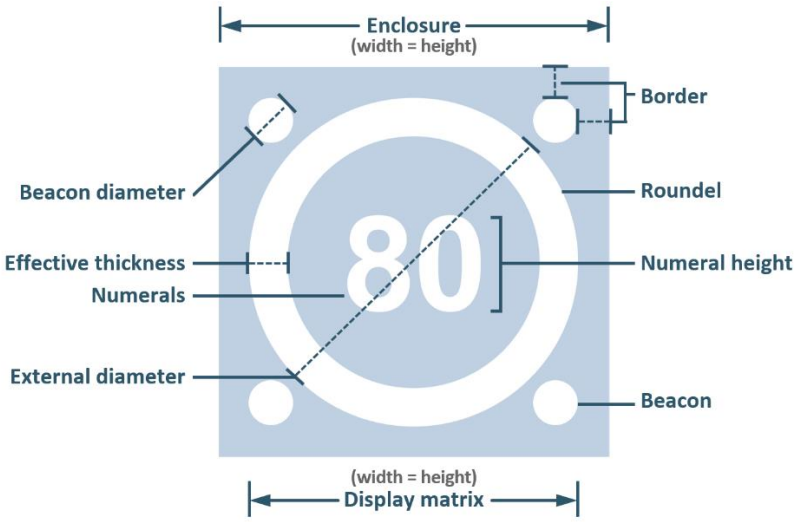

Figure 11. LCS display for variable regulatory speed limit dimensions

The display matrix area shall be fully populated with LEDs.

Speed limit numerals must use proportional character spacing.

The numeral height of LCS speed displays shall be consistent with Table 1.

LCS dimensions shall be consistent with those shown in Table 1**Error! Reference source not found.**.

All dimensions are in millimetres unless otherwise stated.				
				
Environment	Local urban roads	Rural roads	Tunnels and gated carriageways	Motorway and expressway overhead lane signs
Enclosure dimensions* (width x height)	800 x 800	1000 x 1000	1200 x 1200	1600 x 1600
Display matrix dimension* (width × height, minimum)	600 × 600	750 × 750	900 × 900	1200 × 1200
Border	The maximum border size is 15% of the display matrix height or width			
Roundel external diameter	600	750	900	1200
Roundel thickness	90	112	135	180
Numeral height	200	250	300	400
Beacon diameter	90	112	135	180
Pixel pitch (maximum)	16	16	20	20
Weight (kg, maximum)	35	60	80	100
Power consumption (W, maximum)	200	300	400	700

* Display matrix and enclosure face must be square.

Table 1. LCS standard sizes

2.1.5 Full-colour display matrix

The display must be composed of LEDs that are mounted in a full matrix arrangement (see section **Error! R eference source not found.** '**Error! Reference source not found.**' for pixel pitch requirements) and are each capable of displaying a full-colour palette (see sections 3.4.1 'LED colour palette' and 3.4.2 'Colour').

2.1.6 Display uniformity

The display of the LCS must appear to be uniform and consistent across the display matrix and in the following areas.

2.1.6.1 Luminous intensity (brightness)

There must be no visible variation in brightness across the display. The luminous intensity of the LCS must be capable of automatically adjusting to align with ambient lighting conditions.

2.1.6.2 Colour

Optically there must be no visible variation in the colour of the light produced across the display.

2.1.7 Contrast ratio

The contrast ratio must ensure that all images displayed on the LCS are clearly legible under all conditions (see also sections 3.4.3 ‘Luminance’ and 3.4.4 ‘Luminance ratio’).

2.1.8 Beacons and flashing roundels

The LCS must be able to display circular illuminated beacon representations in each corner of the display matrix (not using separate beacon units). Two pages – one with beacons and one without beacons – need to be shown for 0.5 seconds each (which is the equivalent of a beacon flashing at 1Hz) in any combination of patterns as defined in NTCIP 1203 v03 National Transportation Communications for ITS Protocol – Object Definitions for Dynamic Message Signs (DMS) (NTCIP 1203), section titled ‘Beacon Type Parameter’.

The LCS must be able to display illuminated circular red roundel representations. When the roundel comprises two or more concentric rings of illuminated elements, the outer ring must be continuously lit, but the inner rings must flash at approximately 1Hz when required operationally.

2.1.9 Display matrix pixel control

Each individual pixel must be able to be addressed and controlled separately. In effect, the LCS is full colour and graphics capable – it is not constrained to use alphanumeric characters or predefined symbols.

2.1.10 Display matrix parameters

The LCS display must consist of a full matrix.

2.1.11 Visible flicker – machine readability

During testing there shall be no visible light flicker, whether the LEDs of an LCS are operating at full intensity or are dimmed. LCS messages must be machine readable (eg by traffic sign recognition systems).

2.1.11.1 Frequency

The LCS must meet the frequency requirement of 100Hz or greater.

2.1.12 Storage of text and graphics

The LCS must be able to display alphanumeric characters and graphics from an onboard library that can be commanded by sending a reference to, rather than the full configuration of, the message (eg set message 1 could translate to display the red lane-closed symbol).

2.1.13 Message conflict

The LCS must be able to display speeds or symbols that resemble alphanumeric characters or pictograms, requested from approved external sources such as TOCs or as part of a local response such as from a remote tunnel supervisory control and data acquisition (SCADA) system. At least one input relay contact must be available.

2.1.14 Remote configuration

The LCS must support remote configuration by RCAs or their appointed agents such that text and graphics can be uploaded into the onboard library and modifications can be made to font files and other configurable objects.

2.1.15 Status information

The LCS must be able to communicate status information (including fault, confirm-receipt and read-back messages) and any required performance parameters to the external source(s).

2.1.15.1 Status update in real time

Status information must be updated in real time (in less than two seconds from the point when a message is received by the LCS network interface).

2.1.16 Internal logging requirement

The LCS must maintain logs and retain performance parameters, including fault conditions, until they are retrieved (and removed) during the prevailing periodic maintenance cycle for resolution. Logs must be able to be retrieved remotely. Log data shall be available for export analysis in a non-proprietary common format (eg CSV, XML, JSON files) and recorded with a time stamp.

2.1.16.1 Internal logging retention period

Logs, including errors and performance parameters captured by the LCS, must be retained for a minimum two-year period, or until they are retrieved.

2.1.17 Communication failure

After a communication failure the LCS must present a blank display matrix.

Note: A communication failure is deemed to have occurred when a defined period of time from the last received communication from the associated controlling entity (such as the back-office system or local controller) has been exceeded.

2.1.17.1 Communication timer

The communication failure timer must be configurable.

2.1.17.2 Communication timeout

The default setting for the communication failure timer is a period of two minutes from the last incoming communication.

2.1.17.3 Post-communication timeout state

The LCS must blank into the lowest priority state (idle) so that the asset is ready for service on recovery of communications.

2.1.18 Message queuing and prioritisation

The LCS must be able to prioritise incoming display requests from different external sources using NTCIP 1203 priorities (eg tunnel control system and advanced traffic management system (ATMS)) based on the message's hierarchy (lane closed, lane divert, lane exit left, mandatory speed limit). Only the highest priority messages will be displayed.

All speeds and symbols will be implemented through standard NTCIP 1203 commands. All graphic and text messages will be pre-installed in the LCS and must be loaded into the same library locations or slots.

Operational priority hierarchy for standard speeds and symbols		
Display	**Priority**	**Note**
Blank	0	Reserved for putting the LCS into a known state when the LCS goes into an unknown state, or when control of the LCS is lost.
SCADA (relay contact) mission critical applications (local control)	1	
Red X	2	
Arrow (left and right)	3	These have equal priority. The last requested setting at this priority takes precedence.
Lane exit left arrow	4	Note: This symbol is not allowed by the TCD Rule.
Straight-ahead arrow	5	
Regulatory speeds	6, 7…17	Lower speeds have a higher priority than higher speeds. Speeds range from 10km/h to 110km/h in 10km/h increments.

Table 2. Message queuing and prioritisation

2.1.19 Fault actions

The LCS must take appropriate action when it detects faults. Under no circumstances can the LCS display to road users:

i. brightness levels that are inconsistent with ambient lighting, not uniform across the LCS display, or not consistent with adjacent LCS
ii. partial, incomplete or otherwise potentially unintelligible messages.

When a fault occurs, the LCS shall be blank.

2.2 LCS group

Where multiple lane signs are installed at the same longitudinal location on a gantry, or carriageway signs installed in pairs at either side of the carriageway, functionality must be consistent across every device. The grouped or system functions are as follows.

2.2.1 Display uniformity

Optically there must be no visible variation in:

i. the colour of the light produced by adjacent or paired LCS
ii. the luminance (brightness) display by adjacent or paired LCS.

Individual unit luminance levels must be able to be calibrated to ensure consistent brightness across the group.

2.2.2 Prompt message display

The time difference between receipt and display of all messages must be such that there is no discernible lag between one device updating and updating of the adjacent LCS.

2.2.2.1 Display update time

For LCS in a group or pair, the maximum lag between sequential LCS updating is one second.

2.2.3 Handling of fault conditions

When a critical fault (see section 2.3.2 ‘Fault reporting’) occurs on any grouped or paired LCS, then the TOC operators will make the decision on what to display on the LCS.

2.2.4 Beacon synchronisation

Where LCS simulate flashing beacons to attract the attention of road users to specific messages, multi-page message transition must be synchronised across all LCS in a group or pair, that is they must appear to operate in unison.

2.2.5 Manage conflicting sign settings

Conflicting sign settings on sign groups are usually managed by the central control system (eg DYNAC). In some special cases a local controller may be required, such as where the direction of travel of specific lanes can be reversed.

In cases where a local controller is used to manage LCS, the local controller must be able to resolve conflicting sign settings.

2.2.6 Roundel synchronisation

When flashing roundels are used as a means to attract road users' attention (as an alternative to corner beacons) or to indicate a change of speed, it is essential that this action is synchronised across all LCS in a group or pair, that is they must appear to operate in unison.

2.2.7 Group management

Where a group sign controller is deployed to manage a group of LCS, it must be able to execute or manage the conflict rules and sign settings, and manage fault reporting of the group.

2.3 LCS controller

2.3.1 Status reporting

The LCS controller must:

i. retain fault logs locally until retrieved by the client or logging system
ii. report LCS fault conditions to the central control system as soon as the communication network is available.

2.3.1.1 Retention period

Minimum of 24 months.

2.3.2 Fault reporting

The LCS controller must monitor the operation and health of the LCS and communicate status with the control room. Alerts on the operators' workstations indicate whenever a problem occurs that will prevent the correct display of messages on the LCS.

Alerts must indicate the level of criticality. There are three levels:

i. Critical: detected fault results in unit outage or may have safety implications
ii. Urgent: detected fault prevents designed operation to support outcomes
iii. Routine: detected fault has no impact on operation to support outcomes.

2.3.2.1 Fault reporting error types

The minimum error types are shown in Table 3 below.

Error type	Definition
Pixel	A pixel error must be raised when pixels fail. Should multiple failures occur on any display matrix, this may affect message interpretation; however, as LCS fulfil a safety critical role they will continue to display a (potentially partial or incomplete) speed or symbol. The LCS will generate a pixel error. The threshold at which a critical pixel error is raised must be configurable and will occur on any display matrix when either: i. the number of pixels that have failed has exceeded a certain percentage (the default for this shall be set at 2%), or ii. the number of failed pixels in any 3 × 3 square matrix has exceeded a certain number (the default for this shall be set at 7). Note: Any LED pixel shall be deemed failed if it does not behave as expected. Such behaviour shall include pixels remaining in the wrong state (on or off), pixels that flicker, and pixels that exhibit reduced or increased brightness compared to properly functioning pixels. The display module(s) where faults have occurred must have a visible fault indicator to facilitate efficient maintenance, removal and replacement.
Message	This error is raised when the LCS is not able to display any message either because of internal device failure(s) or because the LCS is unable to resolve a message in the format in which it is presented.
Power	This error is raised when one or more power supplies becomes faulty or the mains power supply fails. The LCS must log the fault.
Temperature	If the temperature inside the enclosure exceeds a critical threshold level, the LCS must report the temperature and log it.
Photocell	This error is raised when one or more photocells becomes faulty. LCS must log this fault.
Internal communication	This error advises a communication failure within the LCS unit.
External communication	The LCS must log when external communication failure has occurred and must report this error as soon as external communication is restored.

Table 3. Fault reporting error types

2.3.3 Error handling

The controller must incorporate an error handler to detect out-of-program conditions and reset the controller.

The error handler must put the LCS into a known state (eg clear the message automatically and immediately) in the event of internal or external critical failures such as a communications failure.

All errors must be logged.

The controller must be able to deal with unexpected events (exceptions) and faults.

The error handler must place the equipment into a known state so that it transitions back to normal operation when the error condition has been resolved.

Error handling exceptions are shown in Table 4 below.

Error type	Speed or symbol displayed	Action
Partial, incomplete or otherwise potentially unintelligible messages	Speed	Blank sign
	Lane closed Divert left/right	Continue displaying symbol
Brightness levels that are inconsistent with ambient lighting, not uniform across the LCS display, or not consistent with adjacent LCS	All	Continue displaying speed or symbol
The temperature inside the enclosure exceeds a critical threshold level	N/A	The sign must be turned off to protect the sensitive electronic components from damage.

Table 4. Error handling exceptions

2.3.4 Configuration and administration

The LCS controller must:

i. provide an interface in the LCS for a device to be connected to upload and download graphics and facilitate diagnostic testing
   - The LCS must support both local and remote access for the Contractor's proprietary software.
   - Associated software must be provided by the Contractor for use by the Client or its agents.

ii. store, as a minimum, 500 options (speeds or symbols) for immediate display

iii. be able to upload and download the speed or symbol on demand.

2.3.5 Command and control

The LCS controller must:

i. be able to operate the LCS in both local-control mode (ie no external communications) and remote-control mode (ie communicating with an external central control system)

ii. in both local and remote modes, support technician/operator selection of all NTCIP 1203 functions (such as manually changing dimming level, commanding display of pre-stored messages, and running diagnostic routines capable of testing full LCS operation)

iii. display a message on the LCS within one second of receiving the message.

2.3.6 Remote management interface

The LCS must be able to have remote management and configuration functionality through a standard interface (eg a web browser). If propriety software is required to administer the LCS, then the Contractor must make this available to the Client at no additional cost.

2.3.7 Security and access

Access to all management reporting and command functions (as detailed in sections 2.3.4 ‘Configuration and administration’, 2.3.5 ‘Command and control’ and 2.3.6 ‘Remote management interface’) must be done through a single communications port.

The LCS shall:

i. support user authentication remotely and locally
ii. comply with Client) cyber security requirements.

3 PERFORMANCE REQUIREMENTS

This section outlines the reliability and availability requirements of equipment, which may require independent certification and/or declarations of conformity.

3.1 Resistance to the effects of external conditions

Equipment shall operate effectively while exposed to New Zealand climate conditions[1] for a minimum of 15 years.

LCS shall be capable of continuous, normal operation (24 hours a day, 7 days a week) and maintaining performance criteria in the conditions described below:

i. installed and operated in direct sunlight
ii. ambient temperature range between −25°C and +55°C (class T2 as per EN 12966:2014+A1:2018 Road vertical signs – Variable message traffic signs (EN 12966))
iii. enclosure air temperature between −10°C and +75°C
iv. maximum wind conditions likely to occur at the installation site as per AS/NZS 1170.2:2011 Structural design actions – Part 2: Wind actions
v. solar radiation with value of up to 2000W/m^2 at direct sunlight, incident at an angle of 30° from the vertical
vi. humidity between 10% and 95% non-condensing
vii. conditions, both permanent and temporary, that may be unique to the specified location (eg instances of thick smoke or electromagnetic interference)
viii. marine environment
ix. road surface reflection.

3.2 Display matrix finish

The finish of all LCS surfaces shall not result in specular (mirror) reflection that distracts road users.

3.2.1 Display matrix surfaces

The display matrix must:

i. not reflect light back to the user, in order to maintain contrast of the message being displayed
ii. be finished as per BS4800:2011 colour chart (matt black 00 E 53)
iii. be powder-coated
iv. not use smooth, monolithic front screens (such as polycarbonate panels).

3.2.2 Frame surfaces

Frame surfaces (internal and external) must be powder-coated as per AS 4506-2005 Metal finishing – Thermoset powder coatings. The colour of the frame case is to be light grey. The coating must facilitate the removal of graffiti.

[1] New Zealand climate data is available from the National Institute of Water and Atmospheric Research (NIWA) website: https://niwa.co.nz/education-and-training/schools/resources/climate.

3.3 Mechanical

The LCS shall be designed to ensure reliable transfer of all static and dynamic forces to the fixing and mounting structures.

The LCS must meet class TBD6 as per EN 12966 for temporary bending deflection. See EN 12966 section titled ‘Mechanical performance requirements’.

3.3.1 Resistance of electrical/electronic components to the effects of pollution

The Contractor shall declare the degree of resistance in accordance with EN 12966 section titled ‘Resistance of electrical/electronic components to the effects of pollution’.

3.3.2 Resistance to surface corrosion

The surface protection of LCS enclosures against corrosion shall meet the requirements of EN 12966 section titled ‘Resistance to corrosion of discontinuous VMS’.

3.3.3 Enclosure: ingress protection against water and dust

All LCS enclosures must meet a minimum IP rating of IP56 (P3 as per EN 12966).

3.3.4 Enclosure: protection against external mechanical impacts

The sensitive electrical equipment inside the LCS shall be given adequate protection against mechanical impacts such that the enclosure does not deform, delaminate, lose its structural integrity, or suffer a reduction in ingress protection if struck. The LCS must meet a rating of IK8 (as per EN 62262:2002+A1:2021 Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)).

3.3.5 Vibration resistance

The LCS shall be capable of withstanding vibration in accordance with table 19 of EN 12966 section titled ‘Environmental and mechanical tests’.

3.4 Visual performance

3.4.1 LED colour palette

When observing the whole LCS display matrix from all viewing angles within the specified beam width, colours shall not be discernible as individual red, green and blue light sources.

Each individual red, green and blue LED must be capable of displaying 256 shades of corresponding colours equating to 255 × 255 × 255 colour permutations (>16M colours).

3.4.2 Colour

All LCS must meet colour class C2 as per EN 12966. The chromaticity coordinates of the required colour parameters are defined in table 3 and figure 1 of EN 12966 section titled ‘Colour’.

3.4.3 Luminance

All LCS must meet luminance levels to class L3 as per tables 4 to 9 of EN 12966 section titled ‘Luminance’.

3.4.4 Luminance ratio

All LCS must meet luminance ratio (LR) class R3 as per table 10 of EN 12966 section titled ‘Luminance ratio’.

3.4.5 Uniformity of luminous intensity

Each colour (as specified in section 3.4.2 ‘Colour’) must meet the luminous intensity requirements listed below in Table 5.

Luminous intensity		Ratio of output
Highest 12%	Lowest 12%	3:1
Highest 4%	Lowest 4%	5:1

Table 5. Uniformity of luminous intensity

3.4.6 Design life

The specified design life (operational service life) of the LCS is 15 years.

3.4.7 Degradation of visual performance

The visual performance requirements must be achieved during the entire operational lifetime of the LCS (see section 4 ‘Technical requirements’).

3.5 Maintainability

LCS shall be designed:

i. so all the internal components can be easily and quickly replaced in the field (see mean time to repair (MTTR) in section 4.6 ‘General requirements’)
ii. to be installed and maintained by local technicians following the Contractor’s supplied documentation
iii. to have a standard access from the rear
iv. for easy cleaning
v. to minimise onsite cyclic maintenance
vi. so that no specialist tools are required.

4 TECHNICAL REQUIREMENTS

This section outlines specific technical and physical constraints for the equipment.

4.1 Electrical safety

All ITS equipment must comply with and be installed in accordance with Electricity (Safety) Regulations 2010 (SR 2010/36).

4.1.1 Equipment declaration of conformity

The Contractor shall supply a declaration of conformity for the LCS in accordance with SR 2010/36, sections 80(2) and 81.

4.1.2 Installation of electrical equipment

The installer is required to supply a certificate to confirm the equipment has been installed correctly and is compliant with AS/NZS 3000:2018 Electrical installations – Known as the Australian/New Zealand Wiring Rules. The electrician/electrical engineer who installs the equipment must provide the required certification. This includes acceptance of the declaration of conformity.

4.2 Electrical

4.2.1 Power supply

The LCS must be supplied with reticulated mains power 230V AC.

The LCS shall have the necessary termination equipment to cater for reticulated mains power supply or other type(s) (specified during the procurement). Earthing/equipotential bonding connection point must be provided within the LCS.

The LCS enclosure must not contain an uninterruptable power supply (UPS) or batteries. If required, an alternative power source shall be housed separately near to the enclosure.

4.2.2 Nominal voltages

The standard nominal voltage for connection to the public supply shall be taken to be 230V AC RMS single phase.

4.2.3 AC operating voltage range

Variations in the nominal supply voltage defined in EN 12966 section titled ‘Operating voltage range’ shall not affect the LCS functions. This shall be tested in accordance with tables 16 and 17 of EN 12966 section titled ‘Electrical tests’ and shall meet the requirements given therein.

4.2.4 Mains frequency

Variations within the frequency range of 50±1Hz shall not affect the LCS functions.

4.2.5 Power-up activation

The LCS shall be ready for activation when the supply voltage reaches a value within its operating voltage range. At no time during power-up activation shall partial, incomplete or false messages be displayed.

4.2.6 Low voltage – switch-off voltage response

A drop in the nominal voltage of more than 13% shall not cause:

i. partial, incomplete or false messages to be displayed
ii. damage to the LCS.

4.2.7 Low voltage – voltage interruption

The device always needs to be in a known state, and the default after a reboot must be blank.

The effect of voltage interruption shall be as per EN 12966 section titled ‘Voltage interruption’.

4.2.8 Low voltage – temporary over-voltage

When protection for temporary (not transient) over-voltage is incorporated, the operating voltage range of the protective device shall be stated and shall be tested in accordance with table 16 of EN 12966 section titled ‘Electrical tests’, and shall meet the requirements given therein.

4.2.9 Electromagnetic emission and immunity

For all types of environment, the LCS shall conform to EN 50293:2012 Road traffic signal systems – Electromagnetic compatibility.

The performance of any external equipment must not be interrupted by any radio frequency or electromagnetic interference generated by the LCS or vice versa.

4.2.10 Electrical surge protection

All equipment shall be internally protected against damage resulting from:

i. lightning strikes near the LCS or gantry
ii. electrical transients on power cabling
iii. electrical transients on internal and external sign wiring
iv. electromagnetic interference
v. static electrical discharge.

4.3 LCS controller

The embedded controller must:

i. support both local and remote access through the same RJ45 Ethernet port with 100Mbps and higher
ii. support a fully featured, industry standard, embedded operating system
iii. be able to support as a minimum the following communication interface standards:
   - Transmission Control Protocol (TCP) as per Request for Comment (RFC) 793
   - User Datagram Protocol (UDP) as per RFC 768
   - Internet Protocol (IP) as per RFC 791
   - Dynamic Host Configuration Protocol (DHCP) as per RFC 2131
iv. as a minimum provide two communication ports, one for a local connection and one to connect to the ATMS.

The controller must:

i. support NTCIP 1203 including mark-up language for transportation information (MULTI) and, as a minimum, support the LCS-applicable speeds or symbols defined in section 2.1.1 ‘Standard speeds and symbols’
ii. comply with theClient cyber security requirements
iii. support user authentication remotely and locally
iv. support time synchronisation from an external clock (eg Coordinated Universal Time (UTC), Network Time Protocol (NTP)).

4.4 Physical characteristics

4.4.1 Front panels

LCS front panels shall be designed in such a way that no part of the message displayed is obscured when observed from the required viewing positions. They shall be designed in such a way as to minimise the effects of ice and snow.

4.4.2 Front screens

Front screens adversely impact the intensity of light being transmitted from the LCS and can be prone to degradation caused by weathering and exposure to intense direct sunlight. Consequently, monolithic screens such as polycarbonate panels or louvres are not permitted.

LCS that allow portions of the front screen to be removed (modular) can risk weather tightness of the enclosure and are not permitted.

4.4.3 Display matrix

4.4.3.1 Physical layout

The display must be formed using a regular matrix, ie the spacing between individual light sources in both the *x* and *y* axes is uniform.

4.4.3.2 Display technology options

The displays for all LCS applications shall be LED technologies. The display shall have a good visibility under most viewing conditions, high reliability and low optical degradation, and has low maintenance requirements.

4.4.3.3 Pixel pitch

The pixel pitch of LCS shall facilitate the display of smooth graphics and numerals that closely resemble fixed speed limit signage. The LCS pixel pitch shall be as per **Error! Reference source not found.** in section REF _Ref57734979 \r \h * MERGEFORMAT **Error! Reference source not found.** '**Error! Reference source not found.**'.

4.4.3.4 Beam width

Depending on application, the beam width shall be in accordance with EN 12966 section titled 'Beam width'.

Beam width class	Beam angles			
	Horizontal			Vertical
B3	−10°	0°	+10°	0°
				0°
				−5°
B4	−10°	0°	+10°	0°
				0°
				−10°
B5	−15°	0°	+15°	0°
				0°
				−5°
B6	−15°	0°	+15°	0°
				0°
				−10°

Table 6. Beam width class

4.4.3.5 LEDs

The Contractor shall submit evidence that LEDs supplied as part of any LCS meet the quality requirements, luminous intensity ratings, batch requirements and life expectancy requirements defined in this section and in section 3.4.6 'Design life'.

The Contractor shall submit details of the current rating of the proposed LEDs to be used, and what actual current they will be driven at to meet the luminous intensity requirements.

LEDs must be sourced from the same batch/bin in order to mitigate the risk of minor variations in colour output.

The latest high-quality manufacturing techniques must be used to ensure that:

i. exposure of components to mechanical or thermal stress is minimised
ii. manual handling of sensitive componentry is minimised
iii. conformal coatings are consistently applied to circuit boards to minimise exposure to condensation.

Modules forming the display shall be of a size that is easy to replace with the LCS in situ in the field and without the need to dismantle any part of the LCS. No soldering or heat-based bonding is permitted to be undertaken as part of LCS maintenance.

4.4.4 Heating and forced ventilation

The provision of heaters and fans for supplementary environmental control within the enclosure is not generally permitted.

4.4.5 Doors and maintenance access

All covers, doors, protective screens, plates, glands, external connectors etc shall be provided with rubber seals or equivalent materials that are maintenance free and shall remain effective for the design life of the equipment.

Where access doors are provided, they shall all be fitted with a suitable retention stay to hold the door in the open position for the safety of maintenance personnel working inside the enclosure. The LCS shall have a mechanism to restrict the door opening from left to right and from right to left at a 90° or 120° angle. They must include physical security against unauthorised access and have a door-open alarm capability to remotely report that any of the doors were opened.

For security, access doors and panels shall be fitted with suitable locks (one lock per door/panel) designed for outside conditions. Unless specified otherwise, all access door locks shall have an identical key and the Contractor shall provide at least four copies of the key.

4.4.6 Cable entries

All power supply, control and communication cabling shall enter the LCS enclosure through appropriately constructed, sealed and glanded entry holes. All the cable entry points must be through the bottom of the LCS frame as standard.

4.4.7 Electrolytic compatibility

Components shall comprise materials that when assembled into the LCS are electrolytically compatible and environmentally stable.

4.4.8 Lifting eyes

The enclosure shall be provided with at least two lifting eyes that enable the LCS to remain vertical and upright when lifting the enclosure onto the support structure.

The lifting eyes shall be appropriately located ensuring sufficient structural strength to allow the LCS to be lifted or moved without causing any damage or deformation to any part of the LCS.

4.4.9 Mounting to support structure

The LCS must be designed to be mounted to the structure on which it will be supported. Modifications to the LCS enclosure are not permitted once it has left the place of manufacture.

The LCS enclosure mounting points must be agreed with the design engineer. The mounting points are specified in the site or gantry design.

Penetration through the enclosure for mounting is not permitted. Captive nuts in the LCS must be used to attach the structure to the LCS with appropriately sized fixings (bolts or screws).

4.4.10 Speed environment and character height

Guidance for LCS dimensions and application is available in Section 2.1.

4.4.11 Labelling

All LED modules, sign controller boards and other similar serviceable parts shall have unique serial numbers permanently marked, which cannot be removed and shall not ever be modified.

4.4.12 Transportation

LCS shall be shipped in containers that protect their contents from damage in transit, including damage from extreme temperature, humidity, impact/shock etc. The LCS shall be wrapped to prevent contamination, and the packaging shall be fitted with a device (shock indicator) to show whether the unit has been subjected to rough treatment during its journey. If the shock indicator has been triggered, then the Client may reject the LCS.

4.5 Documentation

4.5.1 Certification and declarations of conformity

The Contractor shall request LCS test certificates from the the Client list of accredited test houses.

All LCS supplied to Client must include:

i. certification from an accredited independent testing facility demonstrating compliance with EN 12966
ii. a declaration of conformity from the manufacturer.

The Contractor must provide supplementary report information from the testing facility stating all the tests performed, including, but not limited to, the LED colour(s), pixel pitch, beam width, luminance, LR and IP rating of the specific LCS type being supplied.

4.5.2 Documentation, software and licensing

4.5.2.1 Documentation

The Contractor must supply original equipment manufacturer (OEM) maintenance, service and operations guidelines and manuals, which will include maintenance schedules and procedures, handling and storage instructions, and a spares list.

4.5.2.2 Software and licensing

The Contractor must supply all software and licensing required to configure and manage the LCS to the Client or its agents.

4.6 General requirements

Item	Requirement
Reliability	99.99% excluding mains power or external communications failures.
Failure modes (power or communications failures)	i. Display or enter default mode. ii. Shutdown in safe manner where specified. iii. Automatic restart in safe manner upon restoration of power or communications.
Privacy/security of data	Comply with: i. ISO/IEC 27002:2013 Information technology – Security techniques – Code of practice for information security controls ii. ISO/IEC 27001:2013 Information technology – Security techniques – Information security management systems – Requirements. Note: Compliance from January 2024 will be enforced.
Functional safety	i. Comply with the IEC 61508 series. ii. Carry out functional safety study in conjunction with the Client to determine any safety integrity level requirements.
Alarms, events and status	Configurable and monitored from TOCs.
Communications	Interface to the Client communications network.
Mean time between failure (MTBF)	All LCS equipment shall have a specified MTBF of 55,000 hours or greater, unless otherwise approved in writing bythe Client.
Mean time to repair (MTTR)	Ability to readily replace modules or components from when the maintenance contractor turns off the power supply to the unit, until the unit is powered back on and working. The default MTTR is 10 minutes, which applies to LCS components for onsite repair only. Replacing the whole LCS is outside the scope of this delivery specification.
Disposal	LCS shall utilise materials where possible that are recyclable to minimise the adverse environmental effect of disposal.

Table 7. General requirements

5 REFERENCES

This section lists all references included in this document.

5.1 Industry standards

Standard number/name
AS 4506-2005 Metal finishing – Thermoset powder coatings
AS/NZS 1170.2:2011 Structural design actions – Part 2: Wind actions
AS/NZS 3000:2018 Electrical installations – Known as the Australian/New Zealand Wiring Rules
ISO/IEC 27001:2013 Information technology – Security techniques – Information security management systems – Requirements
ISO/IEC 27002:2013 Information technology – Security techniques – Code of practice for information security controls
BS4800:2011 colour chart (matt black 00 E 53)
EN 12966:2014+A1:2018 Road vertical signs – Variable message traffic signs
EN 50293:2012 Road traffic signal systems – Electromagnetic compatibility
EN 62262:2002+A1:2021 Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)
IEC 61508 series (for functional safety)
NTCIP 1203 v03 National Transportation Communications for ITS Protocol – Object Definitions for Dynamic Message Signs (DMS)
SR 2010/36 Electricity (Safety) Regulations 2010
RFC 793: Transmission Control Protocol
RFC 768: User Datagram Protocol
RFC 791: Internet Protocol
RFC 2131: Dynamic Host Configuration Protocol

5.2 NZTA standards, specifications and resources

5.2.1 Standards and specifications

See the NZTA website for the latest versions of the ITS design standards, delivery specifications and core requirements listed below.

Document name
ITS core requirements standard: Electronic message signage fonts

5.2.2 Resources

Document name/code	NZTA website link
Land Transport Rule: Traffic Control Devices 2004 Rule 54002/2004 Updated 19 May 2022 (TCD Rule)	https://www.nzta.govt.nz/assets/resources/rules/docs/traffic-control-devices-2004-as-at-19-may-2022.pdf
NIWA climate data and activities	https://niwa.co.nz/education-and-training/schools/resources/climate
Traffic control devices manual (TCD manual)	https://www.nzta.govt.nz/resources/traffic-control-devices-manual/

5.3 Other resources

Document name/code	NZTA website link
NIWA climate data and activities	https://niwa.co.nz/education-and-training/schools/resources/climate

5.4 ITS standard drawings

See the NZTA website for the latest versions of the ITS standard drawings.

6 TERMINOLOGY USED IN THIS DOCUMENT

Term	Definition
DRAFT	The document is being written and cannot be used outside of NZTA.
PENDING	The document has been finalised and is pending approval and ratification by NZTA. It can be used for procurement at this status.
RATIFIED	The document is an official NZTA document. NZTA projects and other road controlling authorities connected to NZTA back-end systems must include this document in the contracts. The obligation to follow the requirements in this document would come from the inclusion of the S&S document in the contract.
RETIRED	The document is obsolete, and/or superseded.
NZTA	This is noted as being equivalent to the New Zealand Transport.
AS	Australian standard
AS/NZS	Australian/New Zealand standard
ATMS	Advanced traffic management system
Beacon	An illuminated circle that flashes in order to draw a user's attention to a sign. Beacons are typically located and displayed in the corners or along the edges of a sign display matrix.
Border	Border surrounding an active display matrix on an electronic sign
BS	British standard
Character height	Height of an upper-case character expressed in millimetres
Character spacing	Horizontal spacing between individual characters on the same line of a message, expressed as a ratio of stroke width
CSV	Comma separated values
Display matrix	Visible part of an electronic sign which contains the pixels that can be activated to display the message
EN	Europäische Norm (European standard)
Enclosure	Housing for electronics systems to protect against environmental conditions
Exception	Any unexpected or undefined state for a controller in a device
FAT	Factory acceptance test
Frame surface	Internal and external surfaces of an electronic sign enclosure
Front screen	Screen protecting the display matrix or the parts of it against dust, water etc
Gantry	Support structure spanning a carriageway for the purpose of supporting electronic signs
IEC	International Electrotechnical Commission
IK code	International numeric classification for the degrees of protection provided by enclosures for electrical equipment against external mechanical impacts

Term	Definition
IP code	International Protection code (sometimes interpreted as Ingress Protection code) classifies the degree of protection provided by mechanical casings and electrical enclosures against intrusion, dust, accidental contact and water
ISO	International Organization for Standardization
ITS	Intelligent transport systems
JSON	JavaScript Markup Language
LCS	Lane and carriageway sign
LED	Light-emitting diode
LR	Luminance ratio
Message	Configuration consisting of symbols and/or text
MTBF	Mean time between failure
MTTR	Mean time to repair
MULTI	Mark-up language for transportation information
NTCIP	National Transportation Communications for Intelligent Transport Systems (ITS) Protocol
NTP	Network Time Protocol
OEM	Original equipment manufacturer
Pictogram	Pictorial symbol that conveys its meaning through resemblance to a physical object
Pixel	Smallest controllable element of a display matrix for an electronic sign
Pixel pitch	Distance between centres of adjacent pixels
RCA	Road controlling authority
RFC	Request for Comments
RGB256	Red, green and blue can each have values from 0 to 255 using 8 bits (binary digits). This equates to the ability to display 255 × 255 × 255 (>16.5M) colour permutations.
SAT	Site acceptance test
SCADA	Supervisory control and data acquisition (system)
Symbol	Covers individual LCS images (arrows and red cross) being displayed on LCS
TCD manual	Traffic control devices manual
TCD Rule	Land Transport Rule: Traffic Control Devices 2004
TCP	Transmission Control Protocol
TOC	Transport operations centre
UDP	User Datagram Protocol
UPS	Uninterruptable power supply
UTC	Coordinated Universal Time
XML	Extensible Markup Language

7 CONTENT TO BE REDIRECTED

This section records any circumstances where content from this document will be reclassified and moved into future documents. This table is then updated with a reference to the new location.

Section reference	Section name	Future document title	Class
2	Introduction, point i. Only: i. and be clearly seen by road users from a significant distance (between approximately 75m and 300m)	Lane and carriageway signs design standard	001 Signs
3.1	Resistance to the effects of external conditions	Environmental core requirements specification	000 Core requirements
3.3	Mechanical	Environmental core requirements standard	000 Core requirements
4.1.2	Installation of electrical equipment	Electrical core requirements standard	000 Core requirements
4.2	Electrical	Electrical core requirements specification	000 Core requirements
4.3	Signal controller, point iii. Only: The controller must: iii. support user authentication remotely and locally	Security core requirements standard	000 Core requirements
4.3	Signal controller, point iv. Only: The controller must: iv. support time synchronisation from an external clock, eg UTC, NTP.	Network time protocol design standard	012 System interfaces
4.4.6	Cable entries	Electrical core requirements specification	000 Core requirements
4.4.7	Electrolytic compatibility	Environmental core requirements specification	000 Core requirements

8 DOCUMENT CONTROL

8.1 Document information

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8.2 Document owner

Role Head of Technology Engineering

Organisation NZTA

8.3 Document approvers

This table shows a record of the approvers for this document.

Approval date	Approver	Role	Organisation
11/05/2023	Endorsed by Technical Standards Committee	Technical Standards Committee	NZTA
21/02/2024	Approved by Ratification Group chair and NMPAS	Delegated approver	NZTA

8.4 Full version history

This table shows the full history of changes made to this document, both minor and major, in chronological order, since the document was first authored.

Minor versions are numbered 0.1, 0.2 etc until such point as the document is approved and published, then it becomes 1.0 (major version). Subsequent edited versions become 1.1, 1.2 etc, or if it's a major update 2.0, and so on.

Version	Date	Author	Role and organisation	Reason
0.1	18/05/2021	ITS Working Group Kirill Yushenko Peter Bathgate Editorial services	NZTA Consultant, Resolve Group Consultant, Resolve Group Final Word	Document issued
0.2	05/07/2021	ITS Working Group	NZTA	Updated to align with VMS delivery specification
0.3	09/07/2021	ITS Working Group	NZTA	Reviewed internally and version 2.0 issued
0.4	04/10/2021	ITS Working Group	NZTA	Updated section 4.1.15 Message currency (and subsections) to Communication failure (and subsections) Updated to latest template version 1.19 Updated URL links for industry standards sources and ITS S&S new web pages Added interim watermark and file name extension
0.5	06/10/2021	ITS Working Group	NZTA	Reviewed internally and version 0.5 finalised
0.6	01/09/2022	Final Word	Editorial services	Updated to latest template version 1.22, updated file name, updated watermark from 'interim' to 'draft'
0.7	27/09/2022	Kirill Yushenko	Consultant, Resolve Group	Minor updates in sections 3.2.1 and 4.1.1
0.8	22/02/2023	Kirill Yushenko	Consultant, Resolve Group	Updates post TCD review
0.9	8/03/2023	Anandita Pujara	Document Manager, NZTA	Minor updates to include application of SM0 series and changed document name to

Version	Date	Author	Role and organisation	Reason
				Lane and Carriageway signs as per TCD consultation
0.10	13/03/2023	Kirill Yushenko	Consultant, Resolve Group	Updates post RCA and TSC reviews
0.11	17/03/2023	Matthew Bauer	Editor, Clear Edit NZ	Copyedit
0.12	20/03/2023	Kirill Yushenko	Consultant, Resolve Group	Updates post editor/proofer review
0.13	22/03/2023	Matthew Bauer	Editor, Clear Edit NZ	Proofread final draft
0.14	10/05/2023	Anandita Pujara	Document Manager, NZTA	Updates post Technical Standard Committee's feedback
0.15	6/07/2023	Anandita Pujara	Document Manager, NZTA	Updated to clarify the contractual roles as per ratification group's feedback
0.16	20/12/2023	Anandita Pujara	Document Manager, NZTA	Updated document after receiving further comments from Ratification group chair
0.17 0.18	15/01/2024 30/01/2024	Anandita Pujara John MacDonald	Document Manager, NZTA Lead Advisor, Asset Management, NZTA	Updated document to address further feedback received from the ratification group chair
1.0	20/02/2024	Anandita Pujara	Document Manager, NZTA	Approved version