Technical Specification

ISO/TS 22741-10

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Intelligent transport systems — Roadside modules AP-DATEX data interface —

Part 10: Variable message signs

Systèmes de transport intelligents — Interface de données AP-DATEX pour les modules en bord de route —

Partie 10: Panneaux à messages variables

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Contents

Page

Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 204, *Intelligent transport systems*.

A list of all parts in the ISO 22741 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

0.1 Background

A variable message sign (VMS) is an electronic traffic sign installed on the roadside to provide real-time traffic information to travellers, thereby improving their efficiency in using road traffic. A VMS is a major physical component of the intelligent transportation system (ITS), to which it supplies information for improvement of the safety on the road.

More VMSs are expected to be installed and operated due to increasing demand for the establishment of ITS and the replacement of existing VMSs which have exceeded their durability terms.

Operators of traffic management centres need real-time data exchange between a VMS and the centre in order to supply information to the VMS in real time and to control and manage the VMS.

However, no standards for the information transmitted and received between the traffic management centre and the VMS have been established, leading to the development of various protocols and their application to each VMS construction project. As a result, a variety of problems have arisen, including redundant investment in development costs and forced dependence on the protocol of the previous operator when replacing the existing VMSs with new ones.

This document therefore defines the data items (messages), formats and communication protocols (application, presentation, session and transport layers) required to ensure the interoperability of the information transmitted and received between the VMS and the traffic management centre, thereby ensuring interoperability between the VMS and the centre.

0.2 Overview

This document defines the message, the data elements making up the message, and the application layer profile for message transmission in order to ensure the interoperability between the VMS and the traffic management centre.

In particular, in order to ensure the interoperability between the VMS and the traffic management centre, the interoperability is developed based on OSI (open system interconnection) 7 layers. A collection of standard protocols for each layer is referred to as a "profile".

ISO/IEC TR 10000-2 defines the basic classification and object presentation of OSI profiles as follows.

a) Interchange format and representation profiles define the information on and message structure of the data exchanged by applications.

b) Application profiles define the transmission mechanism for data exchange (concerning OSI layers 5 to 7 – session, presentation and application layers).

c) Transport profiles define the procedures and methods to exchange data packets between systems (concerning ;OSI layers 1 to 4 – transport, network, data link and physical layers).

d) Relay profiles define the relaying function which enables the interconnection between systems while using different transmission profiles.

This document specifies "interchange format and representation" as defined in ISO/IEC TR 10000-2, covering the following points:

1) components and data elements of basic messages define the messages and detailed data elements which the operator of the traffic information system needs for operation of the VMS;

2) the data exchange communication profile defines the procedures and encoding methods for information exchange between the traffic management centre and the VMS.

0.3 Document approach and layout

This document specifies the following:

a) physical architecture for varible message signs (Clause 6);

b) user needs that are deemed to be common to many types of field devices (Clause 7);

c) requirements for implementing the identified user needs, organized by major feature (Clause 8);

d) dialogues for exchange data between varible message signs and the central/local computer (Clause 9);

e) the data packet structures for the features defined by this document (Annex A);

f) a requirements traceability table that traces requirements to the design elements (Annex B).

In addition, a simplified version of the conformance table and the data packet structures are available electronically at https://standards.iso.org/iso/ts/22741/-10/ed-1/en/.

ISO 22741-1 provides additional details about how the ISO 22741 series relates to the overall ITS architecture.

Intelligent transport systems — Roadside modules AP-DATEX data interface —

Part 10: Variable message signs

1 Scope

Variable message signs (VMSs) are installed in areas where traffic managers identify a frequent need to convey information to the travelling public, such as upstream from interchanges to alert the public to downstream congestion in time for them to alter their routes. This allows traffic managers to improve the efficiency, safety and quality of traveller journeys.

In order to manage the operation of a VMS and the messages displayed, information exchange between the management systems and the VMS is needed.

This document identifies basic user needs for the management of light-emitting diode (LED) matrix VMSs and traces these needs to interoperable designs. This includes the ability to identify the device, its capabilities, and its status.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 22741-1, *Intelligent transport systems — Roadside modules AP-DATEX data interface — Part 1: Overview*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 22741-1 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
architecture
fundamental concepts or properties of a system in its environment embodied in its elements, relationships, and in the principles of its design and evolution

3.2
centre system
intelligent transport systems (ITS) component that provides application, management and/or administrative functions from a centralized location (i.e. not at the roadside)

3.3
message
data concept consisting of a grouping of data elements, data frames, or data elements and data frames, that is used to convey a complete set of information

3.4
traffic management system
centre system that monitors and controls traffic and the road network

3.5
variable message sign
VMS
field device that can display real-time traveller information to the public

Note 1 to entry: A VMS can display the message predefined in a stored library by the operator. A VMS can also immediately display the message desired by the operator.

Note 2 to entry: A VMS typically consists of one sign display, one sign controller, a cabinet that houses the sign controller, and potentially other components.

4 Symbols and abbreviated terms

ASCII	american standard code for information interchange
AP-DATEX	application profile-data exchange
CRC	cyclical redundancy check
I/O	input and output
ITS	intelligent transportation systems
MULTI	markup language for transportation information
NTCIP	national transportation communications for its protocol
RTM	requirements traceability matrix
UTF-8	universal coded character set transformation format – 8-bit
VMS	variable message signs

5 Conformance

This clause follows the rules defined in ISO 22741-1. Table 1 traces each user need to a set of software features. Table 2 traces each feature to a set of requirements. For a full understanding of these tables and codes, see ISO 22741-1.

NOTE 1 The development of the content of this document followed a formal systems engineering process, which entails:

a) defining needs;

b) developing a set of interface requirements;

c) developing features as a part of a high-level design to meet the requirements;

d) refining the interface requirements from Step 2 to reflect the high-level design; and

e) developing a low-level design defining the dialogues and data elements necessary to implement the requirements.

The documentation omits the original requirements as they are refined in Step 4 and listing the original requirements would make the document highly redundant.

Table 1 — User need to feature conformance

User Need	Feature	Conformance
Inherited user needs		
ISO/TS 22741-2:2024, 7.1: Monitor the field device		M
ISO/TS 22741-2:2024, 7.3.1: Monitor cabinet doors		O
ISO/TS 22741-2:2024, 7.3.2: Monitor and control cabinet fans		O
ISO/TS 22741-2:2024, 7.3.3: Monitor and control cabinet heaters		O
ISO/TS 22741-2:2024, 7.3.4: Monitor cabinet humidity		O
ISO/TS 22741-2:2024, 7.3.5: Monitor cabinet temperature		O
ISO/TS 22741-2:2024, 7.3.6: Monitor cabinet AC power		O
ISO/TS 22741-2:2024, 7.3.7: Monitor cabinet battery power		O
ISO/TS 22741-2:2024, 7.3.8: Monitor cabinet generator power		O
ISO/TS 22741-2:2024, 7.3.9: Monitor cabinet solar power		O
ISO/TS 22741-2:2024, 7.3.10: Monitor cabinet wind power		O
User needs defined in this document		
7.1: Manage the control mode of the VMS		**M**
	8.1: Message sign control mode	M
7.2: Manage the sign display		**M**
	8.2: Message library	M
	8.3: Sign display	M
	8.7: Sign display light sensors	O
	8.8: Sign display pixels	O
7.3: Monitor the sign display doors		**O**
	8.4: Sign display doors	M
	ISO/TS 22741-2:2024, 8.2: General-purpose I/O	M
7.4: Monitor the sign display mains power		**O**
	8.5: Sign display mains power	M
	ISO/TS 22741-2:2024, 8.2: General-purpose I/O	M
7.5: Monitor the sign display power supplies		**O**
	8.6: Sign display power supplies	M
	ISO/TS 22741-2:2024, 8.2: General-purpose I/O	M

Table 2 — Feature to requirement conformance

Feature	Requirement	Conformance[a]
8.1: Message sign control mode		
	8.1.2.1: Configure control mode	8.1.3.2:M
	8.1.2.2: Verify control mode	M
	8.1.3.1: Support central control mode	M
	8.1.3.2: Support local control mode	O
	8.1.3.3: Support central override control mode	8.1.3.2:M
8.2: Message library		
	8.2.2.1: Discover capabilities of the message library	M
	8.2.2.2: Configure default flash times	O
	8.2.2.3: Verify default flash times	8.2.2.2:M
	8.2.2.4: Configure default page times	O

a. Conformance column follows the rules defined in ISO 22741-1:2022, Clause 5

Table 2 *(continued)*

Feature	Requirement	Conformance[a]
	8.2.2.5: Verify default page times	8.2.2.4:M
	8.2.2.6: Configure default line justification	O
	8.2.2.7: Verify default line justification	8.2.2.6:M
	8.2.2.8: Configure default page justification	O
	8.2.2.9: Verify default page justification	8.2.2.8:M
	8.2.2.10: Configure default colours	M
	8.2.2.11: Verify default colours	M
	8.2.2.12: Configure message encoding	M
	8.2.2.13: Verify message encoding	M
	8.2.2.14: Configure a message	M
	8.2.2.15: Verify message configuration	M
	8.2.2.16: Verify message code	M
	8.2.2.17: Retrieve message enabled status	M
	8.2.2.18: Toggle message enabled status	M
	8.2.2.19: Delete message	M
	8.2.2.20: Delete all messages	M
	8.2.3.1.1: Supported minimum flash time	8.2.2.2:M
	8.2.3.1.2: Supported maximum flash time	8.2.2.2:M
	8.2.3.1.3: Supported flash time step size	8.2.2.2:M
	8.2.3.2.1: Supported minimum page time	8.2.2.4:M
	8.2.3.2.2: Supported maximum page time	8.2.2.4:M
	8.2.3.2.3: Supported page time step size	8.2.2.4:M
	8.2.3.3.1: Line justification – Left	8.2.2.6:M
	8.2.3.3.2: Line justification – Centre	8.2.2.6:M
	8.2.3.3.3: Line justification – Right	8.2.2.6:M
	8.2.3.3.4: Line justification – Full	8.2.2.6:M
	8.2.3.4.1: Page justification – Top	8.2.2.8:M
	8.2.3.4.2: Page justification – Middle	8.2.2.8:M
	8.2.3.4.3: Page justification – Bottom	8.2.2.8:M
	8.2.3.5.1: Message encoding – ASCII	0.1 (1..*)
	8.2.3.5.2: Message encoding – UTF-8	0.1 (1..*)
	8.2.3.6.1: Circular moving text	O
	8.2.3.6.2: Linear moving text	O
8.3: Sign display		
	8.3.2.1: Discover characteristics of the sign display	M
	8.3.2.2: Configure location of sign display	M
	8.3.2.3: Verify location of sign display	M
	8.3.2.4: Configure end duration message	M
	8.3.2.5: Verify end duration message	M
	8.3.2.6: Display a message on the sign display	M
	8.3.2.7: Monitor current message	M
	8.3.2.8: Monitor dynamic fields of current message	O
8.4: Sign display doors		

a. Conformance column follows the rules defined in ISO 22741-1:2022, Clause 5

Table 2 *(continued)*

Feature	Requirement	Conformance[a]
	8.4.3.1: Sign display doors monitored	M
	8.4.4.1: Sign display doors monitored through general-purpose I/O	M
8.5: Sign display mains power		
	8.5.3.1: Sign display mains power voltage	M
	8.5.3.2: Sign display mains power current	M
	8.5.4.1: Sign display mains power voltage monitored through general-purpose I/O	M
	8.5.4.2: Sign display mains power current monitored through general-purpose I/O	M
8.6: Sign display power supplies		
	8.6.3.1: Sign display power supplies voltage	M
	8.6.3.2: Sign display power supplies current	M
	8.6.4.1: Sign display power supplies voltage monitored through general-purpose I/O	M
	8.6.4.2: Sign display power supplies current monitored through general-purpose I/O	M
8.7: Sign display light sensors		
	8.7.3.1: Sign display light sensors monitored	M
	8.7.4.1: Sign display light sensors monitored through general-purpose I/O	M
8.8: Sign display pixels		
	8.8.2.1: Discover characteristics of sign display pixels	M
	8.8.2.2: Perform pixel test	M
	8.8.3.1: Sign display pixels monitored	M
	8.8.3.2: Colourful pixel	O

a. Conformance column follows the rules defined in ISO 22741-1:2022, Clause 5

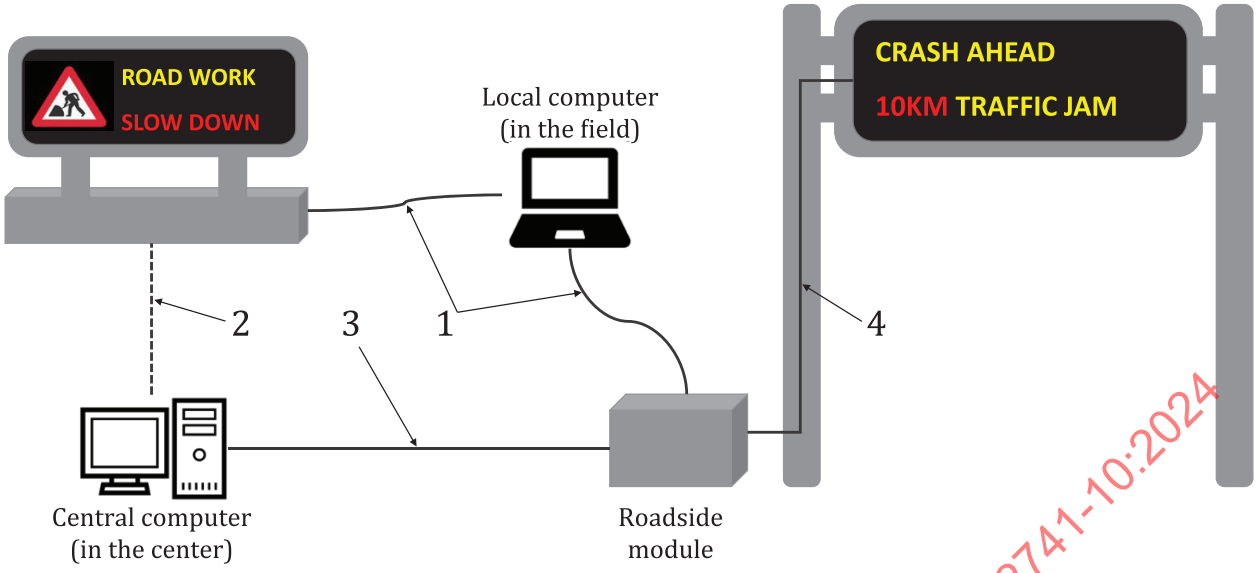
Each requirement specifying a need for a data exchange traces to one dialogue and one or more data element(s) that an implementation claiming conformance to the requirement shall support.

Data packet structure and dialogue for data exchange based on ISO 22741-1 shall conform to Annex A and Annex B.

NOTE 2 The dialogues defined in this document are specified to promote a common interface for testing purposes and are not intended to restrict otherwise allowable requests or notifications. The file for the maintenance portal is attached

6 Physical architecture

The physical architecture of the key components for a VMS system is depicted in Figure 1. A VMS, which may be portable or permanent, can be controlled from either a centre system (such as a traffic management system) or field support equipment (such as a laptop computer). The telecommunications network between these units can be wired or wireless. The local VMS typically includes a roadside module containing a processor and a sign display that displays the actual message, typically through a matrix of pixels.



Key

1 wire/wireless direct communication between a local computer and fixed/portable VMS [covered by ISO/TS 22741-10 (this document)]

2 wireless communication between central computer and portable VMS [covered by ISO/TS 22741-10 (this document)]

3 wire/wireless communication between central computer and fixed VMS [covered by ISO/TS 22741-10 (this document)]

4 communication between roadside module and the sign display is out of scope

Figure 1 — View of a physical architecture

This document is only concerned with the interface between an external computer (e.g. at the centre or the field support equipment) and the VMS. The interface between the roadside module and the sign display is out of scope in this document.

NOTE This document is designed with the expectation that all communications conform with ISO 15784-3, but the design is not necessarily restricted to that environment.

7 User needs

7.1 Manage the control mode of the VMS

After a VMS is installed in the field, a manager needs to be able to control and manage the VMS through any of the following modes:

a) central mode: the VMS is controlled and managed from a computer located in a (typically remote) centre, such as a traffic management centre;

b) local mode: the VMS is controlled and managed from field support equipment, such as a technician's laptop computer by activating a switch at the device;

c) central override mode: the VMS is controlled and managed from a computer located in a (typically remote) centre, such as a traffic management centre, even though the local control switch has been activated. This mode is primarily intended to overcome the problem of a technician failing to reset the switch before leaving the VMS. As the VMS can be in a remote location, forcing central control remotely can save time and expenses in placing the VMS back into the desired state.

7.2 Manage the sign display

A manager needs to be able to control the message on the sign display and monitor its overall operation and status.

7.3 Monitor the sign display doors

A manager needs to be able to monitor the open/closed status of doors associated with the sign display cabinet.

NOTE The doors on the controller cabinet are monitored through a separate user need defined in ISO/TS 22741-2.

7.4 Monitor the sign display mains power

A manager needs to be able to monitor the mains power associated with the sign display cabinet.

NOTE The power for the controller cabinet is monitored through a separate user need defined in ISO/TS 22741-2.

7.5 Monitor the sign display power supplies

A manager needs to be able to monitor the power supplies within the sign display.

8 Requirements

8.1 Message sign control mode

8.1.1 Message sign control mode definition

The term “variable message sign” (VMS) comprises the sign display, sign controller, the cabinet that houses the sign controller, and potentially other components. The VMS can potentially be controlled remotely (i.e. from a centre) or locally (i.e. from a local laptop interface or directly through the sign controller’s interface).

The control mode allows a manager to configure and determine which input has control over a sign to prevent conflicts from different sources. For example, the control mode allows a manager to ensure a message is not inadvertently overwritten by the other (i.e. local/remote) source. Both connections always have access to retrieve (i.e. subscription) any information, but only the selected source is able to control (i.e. publication) most information in the sign. The control mode feature defines the rules for configuring and monitoring the control mode.

The control mode is ideally controlled via a switch provided by the controller to select either local or remote control. However, an override mode is also provided.

8.1.2 Message sign control mode data exchange requirements

8.1.2.1 Configure control mode

The field device shall allow a manager to force the controller into a central override mode, which will override the local control switch on the controller.

8.1.2.2 Verify control mode

The field device shall allow a manager to verify the current control mode.

8.1.3 Message sign control mode capabilities

8.1.3.1 Support central control mode

The field device shall support the central control mode.

8.1.3.2 Support local control mode

The field device shall support a local control mode that allows a user at the sign to take control of the sign display.

8.1.3.3 Support central override control mode

The field device shall support the central override control mode.

8.2 Message library

8.2.1 Message library definition

The message library is a table that stores messages that can be displayed on the sign.

Each message consists of numbers, letters, images, symbols, etc. along with formatting information (e.g. flash codes and colour codes) to provide various information to the travelling public. The information to be conveyed by the message is defined by the manager.

Each message is stored in the message library and referenced or deleted as needed.

8.2.2 Message library data exchange requirements

8.2.2.1 Discover capabilities of the message library

The field device shall allow a manager to determine the capabilities of the message library, including:

a) maximum number of pages supported within a message;

b) maximum number of bytes in a message MULTI string;

c) support for message MULTI tags.

NOTE MULTI is defined in NTCIP 1203.[14]

8.2.2.2 Configure default flash times

The field device shall allow a manager to configure default flash times.

8.2.2.3 Verify default flash times

The field device shall allow a manager to verify default flash time configuration.

8.2.2.4 Configure default page times

The field device shall allow a manager to configure default page times.

8.2.2.5 Verify default page times

The field device shall allow a manager to verify default page time configuration.

8.2.2.6 Configure default line justification

The field device shall allow a manager to configure default line justification.

8.2.2.7 Verify default line justification

The field device shall allow a manager to verify default line justification configuration.

8.2.2.8 Configure default page justification

The field device shall allow a manager to configure default page justification.

8.2.2.9 Verify default page justification

The field device shall allow a manager to verify default page justification configuration.

8.2.2.10 Configure default colours

The field device shall allow a manager to configure default background and default foreground colours.

8.2.2.11 Verify default colours

The field device shall allow a manager to verify default background and default foreground colours configuration.

8.2.2.12 Configure message encoding

The field device shall allow a manager to configure the message encoding format (i.e. ASCII or UTF-8).

8.2.2.13 Verify message encoding

The field device shall allow a manager to verify the message encoding.

8.2.2.14 Configure a message

The field device shall allow a manager to configure a message for display.

NOTE The format of the message string conforms to the MarkUp Language for Transportation Information (MULTI) format defined in NTCIP 1203:2011, Section 6.[14]

8.2.2.15 Verify message configuration

The field device shall allow a manager to verify the configuration settings of a message.

8.2.2.16 Verify message code

The field device shall allow a manager to quickly verify message contents by retrieving an abbreviated reference code.

NOTE In practice, this is a CRC code of the message contents.

8.2.2.17 Retrieve message enabled status

The field device shall allow a manager to retrieve the enabled status of the message.

NOTE Enabled messages are available for immediate display.

8.2.2.18 Toggle message enabled status

The field device shall allow a manager to toggle the enabled status of a message.

8.2.2.19 Delete message

The field device shall allow a manager to delete a message.

8.2.2.20 Delete all messages

The field device shall allow a manager to delete all non-permanent messages.

8.2.3 Message library capabilities

8.2.3.1 Supported flash times

8.2.3.1.1 Supported minimum flash time

The field device shall support minimum flash on and off times as defined in the specification. If the specification does not define these values, the minimum flash on time shall be 0,5 s and the minimum flash off time shall be 0,5 s.

NOTE The flash on time indicates the duration that the text remains visible during one flash; the flash off time indicates the duration between flashes, when the text is not visible.

8.2.3.1.2 Supported maximum flash time

The field device shall support maximum flash on and off times as defined in the specification. If the specification does not define these values, the maximum flash on time shall be 10,0 s and the maximum flash off time shall be 10,0 s.

8.2.3.1.3 Supported flash time step size

The field device shall support flash time on and off step sizes as defined in the specification. If the specification does not define these values, the flash on time step size shall be 0,5 s and the flash off time step size shall be 0,5 s.

NOTE The step size indicates the valid values when configuring the flash on and flash off values. For example, the minimum allowed value is defined by the minimum flash time, the next valid value is the minimum flash time plus one step size.

8.2.3.2 Supported page times

8.2.3.2.1 Supported minimum page time

The field device shall support minimum page on and off times as defined in the specification. If the specification does not define these values, the minimum page on time shall be 0,5 s and the minimum page off time shall be 0,5 s.

NOTE 1 The page on time indicates the duration for which each page of the message is displayed prior to going to the page off time and then the next page display. The page off time indicates the duration between pages, when the sign display is blank.

NOTE 2 The page timer operates independently of any flashing text timers. For example, if a page with an on time of 5,0 s contains flashing text that flashes on for 1,0 s followed by flashing off for 1,0 s, the flashing text will appear 3 times, but the final flash off will be superseded by the page off time.

8.2.3.2.2 Supported maximum page time

The field device shall support maximum page on and off times as defined in the specification. If the specification does not define these values, the maximum page on time shall be 10,0 s and the page flash off time shall be 10,0 s.

8.2.3.2.3 Supported page time step size

The field device shall support page time on and off step sizes as defined in the specification. If the specification does not define these values, the page on time step size shall be 0,5 s and the page off time step size shall be 0,5 s.

8.2.3.3 Supported line justification

8.2.3.3.1 Line justification — Left

The field device shall support left line justification by supporting the [jl2] MULTI tag as defined in NTCIP 1203:2011, Section 6.

8.2.3.3.2 Line justification — Centre

The field device shall support centre line justification by supporting the [jl3] MULTI tag as defined in NTCIP 1203:2011, Section 6.

8.2.3.3.3 Line justification — Right

The field device shall support right line justification by supporting the [jl4] MULTI tag as defined in NTCIP 1203:2011, Section 6.

8.2.3.3.4 Line justification — Full

The field device shall support full line justification by supporting the [jl5] MULTI tag as defined in NTCIP 1203:2011, Section 6.

8.2.3.4 Supported page justification

8.2.3.4.1 Page justification — Top

The field device shall support top page justification by supporting the [jp2] MULTI tag as defined in NTCIP 1203:2011, Section 6.

8.2.3.4.2 Page justification — Middle

The field device shall support middle page justification by supporting the [jp3] MULTI tag as defined in NTCIP 1203:2011, Section 6.

8.2.3.4.3 Page justification — Bottom

The field device shall support bottom page justification by supporting the [jp4] MULTI tag as defined in NTCIP 1203:2011, Section 6.

8.2.3.5 Supported message encodings

8.2.3.5.1 Message encoding — ASCII

The field device shall support defining messages using ASCII encoded character strings.

8.2.3.5.2 Message encoding – UTF-8

The field device shall support defining messages using UTF-8 encoded character strings.

8.2.3.6 Supported moving text

8.2.3.6.1 Circular moving text

The field device shall support circular moving text by supporting the [mvc...] MULTI tag as defined in NTCIP 1203:2011, Section 6.

NOTE Circular moving text displays text in a defined region of the display and moves it across this region at a defined rate. If the text is shorter than the defined region, multiple copies of the text are shown appended to one another.

8.2.3.6.2 Linear moving text

The field device shall support linear moving text by supporting the [mvl...] MULTI tag as defined in NTCIP 1203:2011, Section 6.

NOTE Linear moving text displays text in a defined region of the display and moves it across this region at a defined rate. The region is initialized with the text string and it is moved across the defined region. Once the entire text string has been displayed, the region is cleared and reset to the original display.

8.3 Sign display

8.3.1 Sign display definition

The sign display includes the sign housing, associated doors, power supplies and the display that is visible to the public. The message sign housing is the enclosure that environmentally protects all of the other components of the sign display.

8.3.2 Sign display data exchange requirements

8.3.2.1 Discover characteristics of the sign display

The field device shall allow a manager to discover characteristics of the sign display, including:

a) sign type (e.g. portable or permanent and matrix arrangement);

b) sign access (e.g. walk-in versus rear access);

c) sign dimensions;

d) sign border dimensions;

e) legend;

f) beacon type.

8.3.2.2 Configure location of sign display

The field device shall allow a manager to configure the detailed location of the sign display in textual format.

NOTE 1 The location of the sign display can be different from the location of the controller (as defined in ISO/TS 22741-2).

NOTE 2 The latitude and longitude information is intended to be established by other means, e.g. through the use of a global navigation satellite system receiver, manually through the front panel of the controller, or through other non-NTCIP means.

8.3.2.3 Verify location of sign display

The field device shall allow a manager to verify the location of the sign display, including:

a) latitude;

b) longitude;

c) travel direction for which the sign display is intended;

d) accuracy of location information;

e) detail location information text.

8.3.2.4 Configure end duration message

The field device shall allow a manager to configure the message to be displayed on the sign when a previously requested message expires.

8.3.2.5 Verify end duration message

The field device shall allow a manager to verify the end duration message configuration.

8.3.2.6 Display a message on the sign display

The field device shall allow a manager to activate a message on the sign display with a defined priority and duration. The field device shall check for errors in the process of displaying a message and provide the information about errors to a manager.

8.3.2.7 Monitor current message

The field device shall allow a manager to monitor:

a) the contents of the current message;

b) the runtime priority of the current message;

c) the time remaining for the current message;

d) information about the source of message activation.

8.3.2.8 Monitor dynamic fields of current message

The field device shall allow a manager to monitor the value(s) currently being displayed within the dynamic fields.

8.4 Sign display doors

8.4.1 Sign display doors definition

The sign display door feature indicates the open/close status of each sign display door monitored by a sensor.

8.4.2 Sign display doors data exchange requirements

There are no sign display door data exchange requirements beyond those defined for the general-purpose I/O feature.

8.4.3 Sign display door capability requirements

8.4.3.1 Sign display doors monitored

The field device shall monitor each sign display cabinet door.

8.4.4 Sign display door design constraints

8.4.4.1 Sign display doors monitored through general-purpose I/O

For each cabinet door monitored, the field device shall provide an entry in the general-purpose I/O table where fdGPIOType equals “VDS".

8.5 Sign display mains power

8.5.1 Sign display mains power definition

The sign display mains power feature indicates the status of the main power line into the sign display housing, which is generally provided from the power grid.

8.5.2 Sign display mains power data exchange requirements

There are no sign display mains power data exchange requirements beyond those defined for the general-purpose I/O feature.

8.5.3 Sign display mains power capability requirements

8.5.3.1 Sign display mains power voltage

The field device shall support at least one voltage sensor for the sign display mains power. The project specification may specify support for additional voltage sensors for the sign display mains power.

8.5.3.2 Sign display mains power current

The field device shall support at least one electrical current sensor for the sign display mains power. The project specification may specify support for additional electrical current sensors for the sign display mains power.

8.5.4 Sign display mains power design constraints

8.5.4.1 Sign display mains power voltage monitored through general-purpose I/O

For each sign display mains power voltage sensor, the field device shall provide an entry in the general-purpose I/O table where fdGPIOType equals "VLV".

8.5.4.2 Sign display mains power current monitored through general-purpose I/O

For each sign display mains power electrical current sensor, the field device shall provide an entry in the general-purpose I/O table where fdGPIOType equals "VLA".

8.6 Sign display power supplies

8.6.1 Sign display power supplies definition

The sign display power supplies feature indicates the operational status of each sign display power supply.

8.6.2 Sign display power supplies exchange requirements

There are no sign display power display exchange requirements beyond those defined for the general-purpose I/O feature.

8.6.3 Sign display power supplies capability requirements

8.6.3.1 Sign display power supplies voltage

The field device shall monitor the voltage of each sign display power supply.

8.6.3.2 Sign display power supplies current

The field device shall monitor the current of each sign display power supply.

8.6.4 Sign display power supplies design constraints

8.6.4.1 Sign display power supplies voltage monitored through general-purpose I/O

For each sign display power supply, the field device shall provide an entry in the general-purpose I/O table where fdGPIOType equals “VPV" to report its voltage.

8.6.4.2 Sign display power supplies current monitored through general-purpose I/O

For each sign display power supplies current monitored, the field device shall provide an entry in the general-purpose I/O table where fdGPIOType equals “VPA" to report its current.

8.7 Sign display light sensors

8.7.1 Sign display light sensors definition

The sign display light sensors feature indicates the amount of light being detected by each sign display light sensor.

8.7.2 Sign display light sensors exchange requirements

There are no sign display light sensors exchange requirements beyond those defined for the general-purpose I/O feature.

8.7.3 Sign display light sensors capability requirements

8.7.3.1 Sign display light sensors monitored

The field device shall monitor the value reported by each sign display light sensor.

8.7.4 Sign display light sensors design constraints

8.7.4.1 Sign display light sensors monitored through general-purpose I/O

For each sign display light sensor monitored, the field device shall provide an entry in the general-purpose I/O table where fdGPIOType equals “VLS".

8.8 Sign display pixels

8.8.1 Sign display pixels definition

The sign display pixels feature indicates the operational status of each pixel in the sign.

8.8.2 Sign display pixels data exchange requirements

8.8.2.1 Discover characteristics of sign display pixels

The field device shall allow a manager to discover the capabilities of the pixels within the sign display, including:

a) sign dimensions in pixels;

b) character dimensions in pixels;

c) pixel spacing.

8.8.2.2 Perform pixel test

The field device shall allow a manager to perform a pixel test to identify any pixels reporting anomalous conditions.

8.8.3 Sign display pixels capability

8.8.3.1 Sign display pixels monitored

The field device shall monitor each sign display pixel.

8.8.3.2 Colourful pixel

Each sign display pixel shall support 16 777 216 colours using RGB colour controls.

9 Dialogues

The procedure for exchanging data between the central/local computer and the VMS follows ISO 22741-1:2022, Clause 10. Data exchanges between central/local computer and the VMS is divided into get elemental data from VMS and set elemental data in VMS. In this case, the central/local computer is to be the client and the VMS is to be the server.

9.1 Get elemental data

This dialogue shall be applied when the central/local computer requests data to VMS and VMS responds with requested data to the central/local computer. Figure 2 depicts the dialogue for get elemental data:

a) the central/local computer shall send a subscription-PDU for the data elements;

b) after receiving a subscription-PDU from the central/local computer, VMS shall send a publication-PDU providing the data elements to the central/local computer.

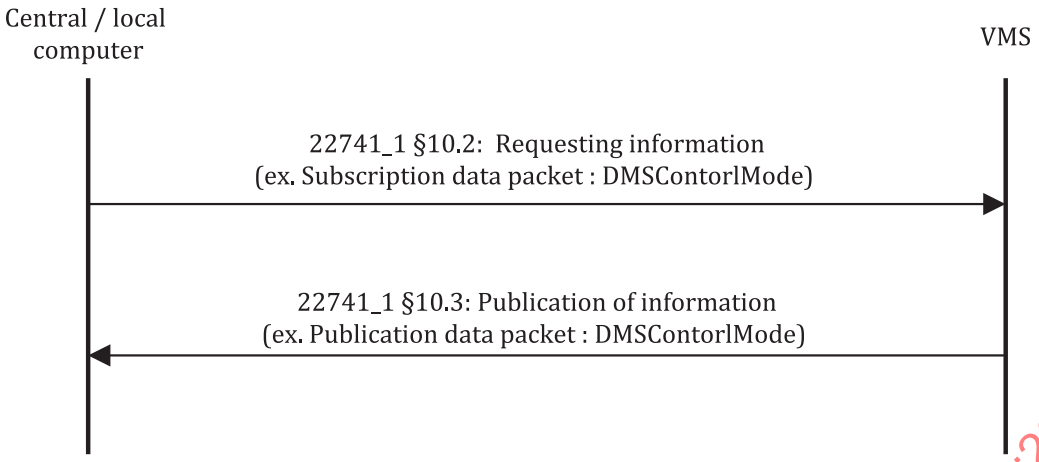


Figure 2 — Procedure to get elemental data

9.2 Set elemental data

This dialogue shall be applied when the central/local computer requests setting the data in VMS and then VMS responds with the result of set data to the central/local computer. Figure 3 depicts the dialogue for set elemental data:

a) the central/local computer shall send a subscription-PDU for the data elements for using values determined by the manager;

b) after receiving a subscription-PDU from the central/local computer, VMS shall respond the result of set data to the central/local computer.

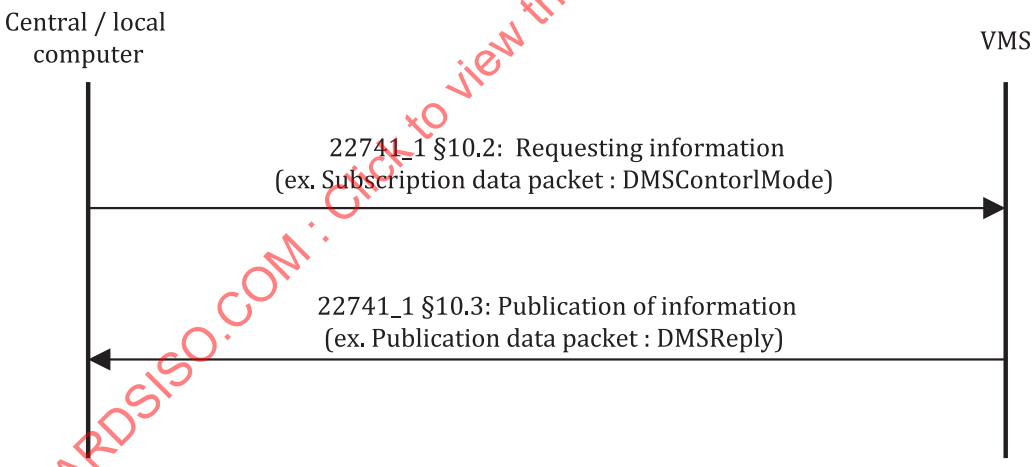


Figure 3 — Procedure to set elemental data

Annex A
(normative)

Data packet structures

This annex provides the formal definition for data exchange between a management centre and a field device or two field devices based on ISO 15784-3. Data packet structures for exchanging data have been defined based on ISO 15784-3 and refer to NTCIP 1203, with the exception of some data elements. Minimum data packet structures and data elements have been defined and can be further defined and used if necessary.

```
DatexDataPacket ::= SEQUENCE {
    datex-Version-nember              ENUMERATED {
    experimental (0),
    version1 (1),
    ...},
        datex-Release-number          INTEGER (0..255),
        datex-Data                    OCTET STRING,
        datex-CrC-nbr                 OCTET STRING (SIZE (2))
    }

ISO22741-MESSAGE ::= CLASS {
    &id                                   OBJECT IDENTIFIER,
    &MessageBody
}

Message ISO22741-MESSAGE ::= {
    {&id {1 0 22741 10 0 1}, &MessageBody SEQUENCE OF FdVmsConfigureGroup} |
    {&id {1 0 22741 10 0 2}, &MessageBody SEQUENCE OF DMSContorlMode} |
    {&id {1 0 22741 10 0 3}, &MessageBody SEQUENCE OF Capabilitiesofthemessagelibrary
} |
    {&id {1 0 22741 10 0 4}, &MessageBody SEQUENCE OF DefaultFlashTimes} |
    {&id {1 0 22741 10 0 5}, &MessageBody SEQUENCE OF DefaultPageTimes} |
    {&id {1 0 22741 10 0 6}, &MessageBody SEQUENCE OF DefaultLineJustification} |
    {&id {1 0 22741 10 0 7}, &MessageBody SEQUENCE OF DefaultPageJustification} |
    {&id {1 0 22741 10 0 8}, &MessageBody SEQUENCE OF DefaultBackgroundRGB} |
    {&id {1 0 22741 10 0 9}, &MessageBody SEQUENCE OF DMSMessage} |
    {&id {1 0 22741 10 1 0}, &MessageBody SEQUENCE OF DmsMessageCode} |
    {&id {1 0 22741 10 1 1}, &MessageBody SEQUENCE OF DmsMessageStatus} |
    {&id {1 0 22741 10 1 2}, &MessageBody SEQUENCE OF DeleteMessage} |
    {&id {1 0 22741 10 1 3}, &MessageBody SEQUENCE OF DeleteAllMessages} |
    {&id {1 0 22741 10 1 4}, &MessageBody SEQUENCE OF CharacteristicsOfTheSignDisplay
} |
    {&id {1 0 22741 10 1 5}, &MessageBody SEQUENCE OF DmsEndDuratrionMessage} |
    {&id {1 0 22741 10 1 6}, &MessageBody SEQUENCE OF DmsActivateMessage} |
    {&id {1 0 22741 10 1 7}, &MessageBody SEQUENCE OF MonitorCurrentMessage} |
    {&id {1 0 22741 10 1 8}, &MessageBody SEQUENCE OF MonitorDynamicFieldsOfCurentMes
sage} |
    {&id {1 0 22741 10 1 9}, &MessageBody SEQUENCE OF CharacteristicsOfSignDisplayPix
els} |
    {&id {1 0 22741 10 2 0}, &MessageBody SEQUENCE OF PerformPixelTest} |
    {&id {1 0 22741 10 2 1}, &MessageBody SEQUENCE OF SignDisplayPixelsMonitored} |
    {&id {1 0 22741 10 2 2}, &MessageBody SEQUENCE OF VMSReply}
}
    FdVmsConfigureGroup ::= SEQUENCE {
   fdVmsMessageEncoding    INTEGER {
                            other (0),
                            ascii (1),
                            utf-8 (2)
                            },
    ...
}--  DESCRIPTION
--  "An indication of how characters are encoded within dmsMessageMultiString.
--     The character code 0x00 shall never appear in a dmsMultiString.
--  other - an encoding not defined by the other values of this object; the
--     encoding is defined by an implementation-specific object. An attempt to
```

```
--     set this object to 'other' shall result in an error; but the value may
--     transfer 'other' due to setting the associated implementation-specific
--     object.
--  ascii - every character of the message shall be encoded in a single octet
--      nominally according to the the extended ASCII table. In other words, the
--      square open and close brackets for MULTI tags shall be encoded as decimal
--      91 (0x5B) and 93 (0x5D) and all characters within the tag shall be
--     encoded per their ASCII codes. The appearance of any character for
--     display is based on the font (e.g., which might be normal ASCII text or
--     might be more of a 'wingdings' style font.)
--  utf-8 - every character of the message shall be encoded per UTF-8 encoding
--     rules. UTF-8 is identicial to ASCII for character codes 1-127; thus, all
--     of the MULTI tags shall be encoded in the same way. However, UTF-8 uses
--     extensible encoding logic such that character codes above 127 require
--     more than one octet. This extensible encoding supports all characters
--     from all known languages, thereby facilitating the display of messages in
--     any language desired by a manager. As with 'ascii', the bitmap actually
--     displayed is based on the font definition. If the field device supports
--     both this object and the NTCIP1203 defaultCharacterSet object, the
--     following rules shall apply:
--      - setting this object to 'ascii' shall automatically transitioned
--             faultCharacterSet to 'eightBit'
--     - setting this object to 'utf-8' shall automatically transition
--             defaultCharacterSet to 'other', and
--     - setting defaultCharacterSet to 'eightBit' shall automatically
--             transition this object to 'ascii'"
--    REFERENCE  "NTCIP 1203 v03 Clause 5.5.21"

DMSContorlMode  ::= SEQUENCE
{
    dmsControlMode INTEGER {
                        --other (1), -retired
                        local (2),
                        --external (3), -retired
                        central (4),
                        centralOverride (5)
                        --simulation (6) -retired
                    },
    ...
}

Capabilitiesofthemessagelibrary     ::= SEQUENCE
{
    dmsMaxNumberPages           INTEGER (1..255),
    dmsMaxMultiStringLength     INTEGER (0..65535),
    dmsSupportedMultiTags       OCTET STRING (SIZE (4)),
    ...
}

DefaultFlashTimes   ::= SEQUENCE
{
    defaultFlashOn              INTEGER (0..255),
    defaultFlashOff             INTEGER (0..255),
    ...
}

DefaultPageTimes    ::= SEQUENCE
{
    defaultPageOnTime           INTEGER (1..255),
    defaultPageOffTime          INTEGER (0..255),
    ...
}

DefaultLineJustification    ::= SEQUENCE
{
    defaultJustificationLine    INTEGER {
                               --other(1), -retired
                               left(2),
                               center(3),
                               right(4),
                               full(5)
                               },
```

```
    ...
}

DefaultPageJustification    ::= SEQUENCE
{
    defaultJustificationPage   INTEGER {
                               --other(1), -retired
                               top(2),
                               middle(3),
                               bottom(4)
                               },
    ...
}

DefaultBackgroundRGB    ::= SEQUENCE
{
    defaultBackgroundRGB OCTET STRING (SIZE (1 | 3)),
    defaultForegroundRGB OCTET STRING (SIZE (1 | 3)),
    ...
}

DMSMessage   ::= SEQUENCE
{
    dmsValidateMessageError INTEGER {
                    other (1),
                    none (2),
                    beacons (3),
                    pixelService (4),
                    syntaxMULTI (5)
                    },
    dmsMessageMemoryType INTEGER {
                                    --other (1), -retired
                                    permanent (2),
                                    changeable (3),
                                    volatile (4),
                                    currentBuffer (5),
                                    schedule (6),
                                    blank (7)
                                    },
    dmsMessageNumber            INTEGER (1..65535),
    dmsMessageMultiString       OCTET STRING,
    dmsMessageOwner             OwnerString,
    dmsMessageRunTimePriority   INTEGER (1..255),
    dmsMessageBeacon            INTEGER (0..1),
    dmsMessagePixelService      INTEGER (0..1),
    dmsMessageStatus            INTEGER {
                    notUsed (1),
                    modifying (2),
                    validating (3),
                    valid (4),
                    error (5),
                    modifyReq (6),
                    validateReq (7),
                    notUsedReq (8)
                    },
    dmsMultiSyntaxError         INTEGER {
                    other (1),
                    none (2),
                    unsupportedTag (3),
                    unsupportedTagValue (4),
                    textTooBig (5),
                    fontNotDefined (6),
                    characterNotDefined (7),
                    fieldDeviceNotExist (8),
                    fieldDeviceError (9),
                    flashRegionError (10),
                    tagConflict (11),
                    tooManyPages (12),
                    fontVersionID (13),
                    graphicID (14),
                    graphicNotDefined (15)
                    },
```

```
    dmsMultiSyntaxErrorPosition     INTEGER (0..65535),
    dmsMultiOtherErrorDescription   DisplayString (SIZE (0..50)),
    ...
}

DmsMessageCode  ::= SEQUENCE
{
    dmsMessageCRC       INTEGER(0..65535),
    ...
}

DmsMessageStatus   ::= SEQUENCE
{
    dmsMessageStatus    INTEGER {
                    notUsed (1),
                    modifying (2),
                    validating (3),
                    valid (4),
                    error (5),
                    modifyReq (6),
                    validateReq (7),
                    notUsedReq (8)
                    },
    ...
}

DeleteMessage  ::= SEQUENCE
{
    dmsMessageStatus    INTEGER {
                    notUsed (1),
                    modifying (2),
                    validating (3),
                    valid (4),
                    error (5),
                    modifyReq (6),
                    validateReq (7),
                    notUsedReq (8)
                    },
    ...
}

DeleteAllMessages ::= SEQUENCE
{
    dmsMemoryMgmt       INTEGER {
                    --other (1), -retired
                    normal (2),
                    clearChangeableMessages (3),
                    clearVolatileMessages (4)
                    },
    ...
}

CharacteristicsOfTheSignDisplay ::= SEQUENCE
{
      dmsSignType       INTEGER{
                    other (1),
                    bos (2),
                    cms (3),
                    vmsChar (4),
                    vmsLine (5),
                    vmsFull (6),
                    portableOther (129),
                    portableBOS (130),
                    portableCMS (131),
                    portableVMSChar (132),
                    portableVMSLine (133),
                    portableVMSFull (134)
                    },
    dmsSignAccess       INTEGER (0..255),
    dmsSignHeight       INTEGER (0..65535),
    dmsSignWidth        INTEGER (0..65535),
    dmsHorizontalBorder INTEGER (0..65535),
```

```
    dmsVerticalBorder   INTEGER (0..65535),
    dmsLegend           INTEGER {
                    --other (1), -retired
                    noLegend (2),
                    legendExists (3)
                    },
    dmsBeaconType       INTEGER {
                    other (1),
                    none (2),
                    oneBeacon (3),
                    twoBeaconSyncFlash (4),
                    twoBeaconsOppFlash (5),
                    fourBeaconSyncFlash (6),
                    fourBeaconAltRowFlash (7),
                    fourBeaconAltColumnFlash (8),
                    fourBeaconAltDiagonalFlash (9),
                    fourBeaconNoSyncFlash (10),
                    oneBeaconStrobe (11),
                    twoBeaconStrobe (12),
                    fourBeaconStrobe (13)
                    },
    ...
}

FdVmsLocationGroup ::= SEQUENCE {
    fdVmsDisplayLatitude            Integer32 (-900000000..900000001),
                -- DESCRIPTION  "The latitude of the center of the sign display,
                --                          per WGS-84 datum."
                -- UNITS        "tenths of microdegrees"
                -- REFERENCE    "NTCIP 1204 v03 Clause 5.4.1" fdVMSDisplayLongitude
Integer32 (-1800000000..1800000001),
                -- DESCRIPTION  "The longitude of the center of the sign display,
                --          per WGS-84 datum."
                -- UNITS        "tenths of microdegrees"
                -- REFERENCE    "NTCIP 1204 v03 Clause 5.4.2" fdVMSDisplayHeadingDirection
INTEGER (0..360),
                -- DESCRIPTION "Compass direction of the sign display as measured
                -- from the front of the sign to the back of the sign (i.e.,
                -- representing the direction of travel for which the message is
                -- visible). The value zero means the sign display faces south
                -- and is visible to travelers currently headed north. The value
                -- 90 means the sign display faces west and is visible to
                -- travelers currently headed east. The value 360 indicates an
                -- error or unknown condition." fdVMSDisplayLocationAccuracy        INTEGER
(-3..8),
                -- DESCRIPTION "Estimate of the accuracy related to the location
                -- information provided for the center of the sign display
                -- indicated as a order of magnitude in metres. For  example, a
                -- value of -3 indicates the accuracy is within one millimetre; a
                -- value of 0 indicates the accuracy is within one metre; and a
                -- value of 3 indicates the accuracy is within one kilometer. The
                -- value of 8 can be used to mean unknown (i.e., 100,000
                -- kilometres is beyond the circumference of the earth). The
                -- accuracy reported should reflect inaccuracies related to
                -- obtaining a value (e.g., a GNSS receiver versus locating using
                -- a web-based map system) as well as any inaccuracies in the
                -- process used (e.g., using a GNSS receiver at the side of the
                -- road while the display is centered over the roadway)."
fdVMSDisplayLocationDescription OCTET STRING (SIZE (0..255)),
                -- DESCRIPTION "A textual description of the location of the sign
                -- display. The text should provide an indication as to the
                -- direction of travel to which the sign is visible."
    ...
 }

DmsEndDuratrionMessage  ::= SEQUENCE
{
    dmsEndDurationMessage   MessageIDCode,
    ...
}
MessageIDCode ::= OCTET STRING (SIZE(5))
```

```
DmsActivateMessage      ::= SEQUENCE
{
    dmsActivateMessage      MessageActivationCode,
    ...
}
MessageActivationCode   ::= OCTET STRING (SIZE(12))
MonitorCurrentMessage   ::= SEQUENCE
{
    dmsMessageMultiString       OCTET STRING,
    dmsMessageOwner             OwnerString,
    dmsMessageBeacon            INTEGER (0..1),
    dmsMessageRunTimePriority   INTEGER (1..255),
    dmsMessageTimeRemaining     INTEGER (0..65535),
    dmsMsgRequesterID           IpAddress,
    dmsMsgSourceMode            INTEGER {
                    other (1),
                    local (2),
                    external (3),
                    --otherCom1( 4), -retired
                    --otherCom2 (5), -retired
                    --otherCom3 (6), -retired
                    --otherCom4 (7), -retired
                    central (8),
                    timebasedScheduler (9),
                    powerRecovery (10),
                    reset (11),
                    commLoss (12),
                    powerLoss (13),
                    endDuration (14)
                    },
    ...
}

MonitorDynamicFieldsOfCurentMessage ::= SEQUENCE
{
    statMultiFieldRows          INTEGER (0..255),
    statMultiFieldCode          INTEGER (1..255),
    statMultiCurrentFieldValue  OCTET STRING (SIZE (0..50)),
    ...
}

CharacteristicsOfSignDisplayPixels  ::= SEQUENCE
{
    vmsSignHeightPixels         INTEGER (0..65535),
    vmsSignWidthPixels          INTEGER (0..65535),
    vmsCharacterHeightPixels    INTEGER (0..255),
    vmsCharacterWidthPixels     INTEGER (0..255),
    vmsHorizontalPitch          INTEGER (0..255),
    vmsVerticalPitch            INTEGER (0..255),
    dmsColorScheme              INTEGER {
                    monochrome1bit (1),
                    monochrome8bit (2),
                    colorClassic (3),
                    color24bit(4)
                    },
    ...
}

PerformPixelTest ::= SEQUENCE
{
    pixelTestActivation         INTEGER {
                    --other (1), -retired
                    noTest (2),
                    test (3),
                    clearTable (4)
                    },
    ...
}

SignDisplayPixelsMonitored  ::= SEQUENCE
{
    pixelFailureIndex           INTEGER (1..65535),
```

```
    pixelFailureXLocation       INTEGER (1..65535),
    pixelFailureYLocation       INTEGER (1..65535),
    pixelFailureStatus          INTEGER (0..255),
    ...
}

VMSReply    ::= SEQUENCE
{
    dmsReplyOfSetResult ENUMERATED { success(1), ... },
        ...
}

EndApplicationMessage ::= SEQUENCE
{
    endApplication-Message-id         ISO14827-MESSAGE.&id,
    endApplication-Message-msg        ISO14827-MESSAGE.&MessageBody
}
```