# High level description of messages between centre and signs

## Glossary

|  |  |
| --- | --- |
| Item | Description |
| Centre | The central control system or instation. |
| Hash | In this document hash refers to a SHA-224 hash value. |
| PNG | Portable Network Graphics is a raster graphics file format. It is the most widely used lossless image compression format on the Internet. |
| SHA-224 | One of the set of SHA-2 cryptographic hash functions designed by the U.S. National Security Agency (NSA). |
| New line | A special character signifying the end of a line of text, represented by character 10 decimal in the ASCII character set. |
| URL | Uniform resource locator. A web address that constitutes a reference to a resource, such as a file or web page. |
| RGB | The **RGB** colour model is an additive colour model in which red, green, and blue light are added together in various ways to reproduce a broad array of colours. The name of the model comes from the initials of the three additive primary colours, red, green, and blue. |

## To display plain text

Signs implementing this protocol may support upper-case text only or mixed-case text. The centre never imposes any font data, the sign must therefore always decide what fonts to use. The VmsText message type is used to display text. More sophisticated text can be displayed as pictograms on signs that support them.

### VmsText

The centre sends the ID of a pre-defined legend or text. The sign replies with a hash of the actual text so that the centre can verify it is the same text that it was expecting. In case the sign does not have the predefined text stored the centre can set vmsStoretext to true, which tells the sign to store the text in vmsText. The sign replies with vmsStoretext true if it has stored the text or already has the correct text matching that ID.

## To display a pictogram

The centre sends the ID of a stored image. It may optionally send a URL where the sign can download the pictogram and a hash of the image. The sign downloads from the URL if this is an unknown ID or the hash is different to the copy in the sign.

If the sign has managed to display the pictogram it responds with the ID of the pictogram, otherwise it responds with pictogram ID zero and sets an appropriate fault. The sign may optionally provide, if requested, an image representing the current display.

## Prism signs

Prism signs are supported. The centre sends the ID of the face to be displayed in the range 1 to 4.

## Colours

Colours will be specified in RGB format.

In BS EN 12966:2014 there are 6 defined colours which are the legal, mandated colours. This specification adds Black for convenience.

|  |  |  |  |
| --- | --- | --- | --- |
| Colour Enumeration/RGB | Red | Green | Blue |
| Red | 255 | 0 | 0 |
| Yellow | 255 | 255 | 0 |
| Green | 0 | 255 | 0 |
| Blue | 0 | 0 | 255 |
| Orange | 255 | 128 | 0 |
| White | 255 | 255 | 255 |
| Black | 0 | 0 | 0 |

## Luminance

BS EN12966:2014 dimming is based on ambient light levels there are 6 light levels specified:

40,000 lux

10,000 lux

4,000 lux

400 lux

40 lux

4 lux

Because the sign output for 40,000 and 10,000 lux are identical the following enumerations are proposed

|  |  |
| --- | --- |
| Enumeration | Light level |
| Level 1 | 4 lux |
| Level 2 | 40 lux |
| Level 3 | 400 lux |
| Level 4 | 4,000 lux |
| Level 5 | 40,000 lux |

## Faults

Faults are sent from the sign to the centre asynchronously, rather than in direct response to a command. To determine programmatically whether the sign is displaying what it was commanded to the centre must use the information received in the corresponding reply message from the sign. Faults are classified as critical if the sign is not displaying what it should. This means that the centre does not have to attempt to interpret the impact of reported faults.

The most meaningful faults are enumerated (in VmsFaultEnum). If a sign manufacturer wishes to send other fault types then the fault type “Other”. Additional data may be conveyed in VmsFaultDescription and VmsFaultCode.

## Responses

Where a particular object is sent from the centre it must also be included in the reply from the sign. This allows the sign to confirm that it has actioned the request (if the value matches) or not (if the value is different).

## Time

The signs will obtain their time from an NTP time source. Without NTP the time drift shall be no more than 5 seconds in 24 hours

## Default Legend

The legend Id 0 will define the default legend to be displayed by the sign when ‘blank’

## To be discussed

Is it a good idea to mix operational commands with configuration, e.g. vmsStoretext? Should this protocol be used for any configuration of the sign at all?

Should flashing text or pictograms be supported? The UNECE Consolidated Resolution on Road Signs and Signals and the Mare Nostrum project both recommend avoiding alternating messages.

# Definitions

M – Mandatory, must always be present

O – Optional, must be present if facility in use. Must be used in any reply to its use by the central system.

No – data not expected, although will be parsed if provided. Where “No” is in both columns the final specification will not contain this property.

Items in green are proposed extensions to the DatexII protocol

# Setting and Status

## Vms

| **DatexII Name** | **DatexII Comment** | **C2F** | **F2C** |
| --- | --- | --- | --- |
| vmsMessageSequencingInterval | The time duration that each message is displayed for before the VMS displays the next message in the sequence. | O | O |
| vmsWorking | Indicates whether the VMS is usable. Note it may still be usable with minor faults. | No | M |
| vmsLanternFlashInterval | For a lantern flasher unit the time interval in mS for the on and off periods. This shall be divisible into 60,000 without remainder. A flash shall start at the minute boundary (xx:xx:00) | O | O |
| vmsLanternOn | For this message are the lanterns on | O | O |

When determining the time at which to display messages, then irrespective of the value of vmsMessageSequencingInterval the first page must start displaying at the minute boundary (xx:xx:00). This is achieved by inserting a blank message into the sequence. For example, if a sign has four messages and vmsMessageSequencingInterval is set to 25. Then the sequence will end after 100 seconds, for the next 20 seconds (up until 120 seconds after the start) a blank message will be displayed.

## VmsMessage

| **DatexII Name** | **DatexII Comment** | **C2F** | **F2C** |
| --- | --- | --- | --- |
| associatedManagementOrDiversionPlan | The identification of the traffic management plan or diversion plan with which the message is associated. | No | No |
| codedReasonForSetting | The reason, in terms of a high level coded classification, why the sign has been set. | No | No |
| distanceFromSituationRecord | Distance of the VMS from the location of the related situation record/element. If the VMS is located within the extent of the situation record/element this should be set to zero. | No | No |
| mareNostrumCompliant | Indication that the displayed message (text and pictogram) conforms with the formulation recommended by the Mare Nostrum project. | No | No |
| messageSetBy | The organisation or authority which set the message currently being displayed. | No | No |
| primarySetting | Identifies whether the message setting is primary (explicitly requested) or is secondary (derived according to an algorthm as the result of setting other signs). True = a primary setting. | No | No |
| reasonForSetting | The reason why the sign has been set. | No | No |
| requestedBy | The authority, organisation or system which requested the setting of the message. This may be different from the authority or system which actually set the message on behalf of the requestor. | No | No |
| setBySystem | Indicates whether the message has been set automatically by a system. True = automatically set. | No | No |
| situationRecordToWhichMessageIsRelated | A reference to the situation record/element within a managed situation to which the set message relates. | No | No |
| situationToWhichMessageIsRelated | A reference to the managed situation to which the set message relates. | No | No |
| textPictogramSequencingInterval | The time duration that each text page or pictogram within a message is displayed for before the VMS displays the next text page and/or pictogram in the message. | O | O |
| timeLastSet | The date/time at which the sign was last set. | No | No |
| vmsMessageInformationType | Type of information being displayed. | No | No |
| vmsDim | Set True to override VMS to dim state. | O | O |

## VmsText

| **DatexII Name** | **DatexII Comment** | **C2F** | **F2C** |
| --- | --- | --- | --- |
| vmsLegendCode | The code of the legend/text from the legend code list referenced in the VmsTextDisplayCharacteristics. | O | O |
| vmsTextImageUrl | Reference to a URL from where an image of the displayed legend text can be be obtained. | No | No |
| vmsText | The text to display. Lines are separated by the new line character. | O | No |
| vmsTextHash | Hash of all lines currently displayed, separated by newline character. | No | M |
| vmsStoreText | Set to TRUE to force the VMS to store this legend as vmsLegendCode (therefore vmsLegendCode and vmsText must always be sent from the centre when this is true). | O | O |

## VmsTextLine

| **DatexII Name** | **DatexII Comment** | **C2F** | **F2C** |
| --- | --- | --- | --- |
| vmsTextLine | A free-text string that is displayed on a single line on the text display area. | No | No |
| vmsTextLineColour | The colour of the displayed line of text. | No | No |
| vmsTextLineFlashing | Indication of whether the displayed line of text is flashing. | No | No |
| vmsTextLineHtml | The displayed line of text defined by an HTML string showing text formatting tags. | No | No |
| vmsTextLineLanguage | The language of the displayed line of text, specified by an ISO 639-2 3-alpha code. | No | No |

## VmsPictogramDisplayArea

| **DatexII Name** | **DatexII Comment** | **C2F** | **F2C** |
| --- | --- | --- | --- |
| synchronizedSequencingWithTextPages | Indicates whether the sequence of pictograms are sequenced synchronously with the text pages. If there is a mismatch in the number of sequenced text pages and sequenced pictograms, the sequences are assumed to resynchronize at the start of each sequence. | O | O |

## VmsPictogram

| **DatexII Name** | **DatexII Comment** | **C2F** | **F2C** |
| --- | --- | --- | --- |
| additionalPictogramDescription | Additional description of the pictogram. | No | No |
| distanceAttribute | Value of distance that is displayable as part of the pictogram (e.g. for keep minimum safe distance). | No | No |
| heightAttribute | Value of height that is displayable as part of the pictogram (e.g. for a vehicle height restriction). | No | No |
| lengthAttribute | Value of length that is displayable as part of the pictogram (e.g. for a vehicle length restriction). | No | No |
| pictogramCode | The code of the pictogram from the pictogram code list referenced in the VmsPictogramDisplayCharacteristics for the VMS that is identified in the relevant VMS Unit table. | O | O |
| pictogramDescription | Description of the (main) displayed pictogram. | No | No |
| pictogramFlashing | Indication of whether the pictogram is flashing. | No | No |
| pictogramInInverseColour | The pictogram is displayed in inverse colour (i.e. the colours are the inverse of normal). | No | No |
| pictogramUrl | Reference to a URL from where an image of the displayed pictogram can be be obtained. | O | O |
| presenceOfRedTriangle | Indication of the presence of a red triangle around the pictogram, often used to indicate imminence, typically within 2km, of signed danger. | No | No |
| speedAttribute | Value of speed that is displayable as part of the pictogram (e.g. for a maximum speed limit). | No | No |
| viennaConventionCompliant | Indicates that the displayed pictogram conforms with the Vienna Convention defined pictogram list as modified by "UNECE Consolidated Resolution on Road Signs and Signals". | No | No |
| weightAttribute | Value of weight that is displayable as part of the pictogram (e.g. for a maximum weight restriction). | No | No |
| weightPerAxleAttribute | Value of axle weight that is displayable as part of the pictogram (e.g. for a maximum axle weight restriction). Value of width that is displayable as part of the pictogram (e.g. for a vehicle width restriction). | No | No |
| pictogramHash | Hash of the pictogram either requested or displayed. | O | O |

## VmsSupplementaryPanel

| **DatexII Name** | **DatexII Comment** | **C2F** | **F2C** |
| --- | --- | --- | --- |
| supplementaryMessageDescription | Free text description of the message that is displayed in the panel which is supplemental to the main pictogram display. | No | No |

## VmsSupplementaryPictogram

| **DatexII Name** | **DatexII Comment** | **C2F** | **F2C** |
| --- | --- | --- | --- |
| additionalSupplementaryPictogramDescription | Additional free text description of the supplementary pictogram. | No | No |
| pictogramFlashing | Indication of whether the pictogram is flashing. | No | No |
| supplementaryPictogramCode | The code of the supplementary pictogram from the supplementary pictogram code list referenced in the VmsSupplementaryPanelCharacteristics for the VMS that is identified in the relevant VMS Unit table. | O | O |
| supplementaryPictogramDescription | Description of the supplementary displayed pictogram. | No | No |
| supplementaryPictogramUrl | Reference to a URL from where an image of the displayed supplementary pictogram can be obtained. | O | O |
| supplementaryPictogramHash | Hash of the pictogram either requested or displayed. | O | O |

# Configuration Data

## VmsUnitRecord

| **DatexII Name** | **DatexII Comment** | **C2F** | **F2C** | |
| --- | --- | --- | --- | --- |
| numberOfVms | Number of variable message signs controlled by the unit. | No | No |
| vmsUnitElectronicAddress | Electronic address of the VMS unit (if not IP addressable). | No | No |
| vmsUnitIdentifier | Identification of a VMS unit used by the supplier or consumer systems. | No | M |
| vmsUnitIPAddress | IP network address of the VMS unit. | O | O |

## VmsRecord

| **DatexII Name** | **DatexII Comment** | **C2F** | **F2C** |
| --- | --- | --- | --- |
| dynamicallyConfigurableDisplayAreas | Identifies (when True) that the VMS has a display area that may be dynamically configured to display different combinations of text and pictogram areas. The current configuration will normally be given with each published current VMS setting. | No | M |
| numberOfPictogramDisplayAreas | Number of pictogram display areas which the VMS contains. | No | M |
| vmsDescription | The description of the VMS (possibly giving a description of its location or its normal use). | No | O |
| vmsDisplayHeight | Height in metres of the sign's overall display area. | No | O |
| vmsDisplayWidth | Width in metres of the sign's overall display area. | No | O |
| vmsHeightAboveRoadway | Height in metres of the mounted sign above the roadway, measured to the bottom of the display area. | No | O |
| vmsOwner | Owner (authority or organisation) of the VMS. This may not necessarily be the same as the authority or organisation which is currently controlling the VMS. | No | O |
| vmsPhysicalMounting | Description of how the VMS is physically mounted or deployed on the road. | No | O |
| vmsType | Broad classification of the type of variable message sign. | No | O |
| vmsTypeCode | Specification of the type of VMS defined by a code, normally country or even manufacturer specific (e.g. MS4). | No | O |

## GroupOfLocations

### Point + PointByCoordinates

| **DatexII Name** | **DatexII Comment** | **C2F** | **F2C** |
| --- | --- | --- | --- |
| Bearing | A bearing at the point measured in degrees (0 - 359). Unless otherwise specified the reference direction corresponding to 0 degrees is North. | No | O |
| Latitude | Latitude in decimal degrees using the European Terrestrial Reference System 1989 (ETRS89). | O | O |
| Longitude | Longitude in decimal degrees using the European Terrestrial Reference System 1989 (ETRS89). | O | O |

## VmsTextDisplayCharacteristics

| **DatexII Name** | **DatexII Comment** | **C2F** | **F2C** |
| --- | --- | --- | --- |
| legendCodeListIdentifier | Indicates which legend/text code list is referenced. This may be specific to the VMS type defined by vmsTypeCode. | O | O |
| maxFontHeight | Maximum font height in pixels. | No | No |
| maxFontSpacing | Maximum font spacing in pixels. | No | No |
| maxFontWidth | Maximum font width in pixels. | No | No |
| maxNumberOfCharacters | Maximum number of displayable characters on a single line in the textual display area of the VMS. | No | M |
| maxNumberOfRows | Maximum number of rows of displayable characters in the textual display area of the VMS. | No | M |
| maxNumberOfSequentialPages | Maximum number of text pages which the VMS is capable of scrolling through sequentially, (2 to n). | No | No |
| maxTextLuminanceLevel | Maximum integer luminance level that is available on the textual display area of the VMS. | No | No |
| minFontHeight | Minimum font height in pixels. | No | No |
| minFontSpacing | Minimum font spacing in pixels. | No | No |
| minFontWidth | Minimum font width in pixels. | No | No |
| textDisplayHeight | The vertical height measured in metres of the specific text display area. | No | No |
| textDisplayWidth | The horizontal width measured in metres of the specific text display area. | No | No |
| textLanternsPresent | Indicates whether the VMS is equipped with flashing lanterns associated with the textual display area. | No | M |
| textPageSequencingCapable | Indicates whether the text display on the VMS is capable of sequencing through multiple pages of text. True = capable. | No | No |
| textPixelsAcross | Number of pixels horizontally across the textual display area of the VMS. | No | No |
| textPixelsDown | Number of pixels vertically down the textual display area of the VMS. | No | No |
| textPositionAbsolute | The position of the area in which the text is displayed, e.g. at the left, right, top or bottom of the VMS display. | No | No |
| textPositionX | The X-coordinate (horizontal) position of the area in which the text is displayed measured from the bottom left of the sign's overall display area to the bottom left of the specific text display area. | No | No |
| textPositionY | The Y-coordinate (vertical) position of the area in which the text is displayed measured from the bottom left of the sign's overall display area to the bottom left of the specific text display area. | No | No |

## VmsPictogramDisplayCharacteristics

| **DatexII Name** | **DatexII Comment** | **C2F** | **F2C** |
| --- | --- | --- | --- |
| maxNumberOfSequentialPictograms | The maximum number of pictograms that can be sequenced through on the pictogram display area. | No | O |
| maxPictogramLuminanceLevel | Maximum integer luminance level that is available on the pictogram display area of the VMS. | No | No |
| pictogramCodeListIdentifier | Indicates which pictogram code list is referenced. | No | O |
| pictogramDisplayHeight | The vertical height measured in metres of the specific pictogram display area. | No | O |
| pictogramDisplayWidth | The horizontal width measured in metres of the specific pictogram display area. | No | O |
| pictogramLanternsPresent | Indicates whether the VMS is equipped with flashing lanterns associated with the pictogram display area. | No | M |
| pictogramNumberOfColours | The number of colours the pictogram display area is capable of rendering. | No | M |
| pictogramPixelsAcross | Number of pixels horizontally across the pictogram display area of the VMS. | No | M |
| pictogramPixelsDown | Number of pixels vertically down the pictogram display area of the VMS. | No | M |
| pictogramPositionAbsolute | The position of the area in which the pictogram is displayed, i.e. at the left, right, top or bottom of the VMS display. | No | No |
| pictogramPositionRelativeToText | The position of the area in which the pictogram is displayed relative to the textual area of the VMS (e.g. to the left, to the right ....). | No | O |
| pictogramPositionX | The X-coordinate (horizontal) position of the area in which the pictogram is displayed measured from the bottom left of the sign's overall display area to the bottom left of the specific pictogram display area. | No | M |
| pictogramPositionY | The Y-coordinate (vertical) position of the area in which the pictogram is displayed measured from the bottom left of the sign's overall display area to the bottom left of the specific pictogram display area. | No | M |
| pictogramSequencingCapable | Indicates whether the pictogram display area on the VMS is capable of sequencing through multiple pictograms. True = capable. | No | M |

## VmsSupplementaryPanelCharacteristics

| **DatexII Name** | **DatexII Comment** | **C2F** | | **F2C** |
| --- | --- | --- | --- | --- |
| relativePositionToPictogramArea | The position of the panel in which the supplementary details are displayed relative to the position of the pictogram display area which it is used to qualify (e.g. below). | No | O | |
| supplementaryPanelDisplayHeight | The vertical height measured in metres of the supplementary panel display area. | No | O | |
| supplementaryPanelDisplayWidth | The horizontal width measured in metres of the supplementary panel display area. | No | O | |
| supplementaryPanelPixelsAcross | Number of pixels horizontally across the supplementary panel display area. | No | M | |
| supplementaryPanelPixelsDown | Number of pixels vertically down the supplementary panel display area. | No | M | |
| supplementaryPanelPositionX | The X-coordinate (horizontal) position of the supplementary panel measured from the bottom left of the sign's overall display area to the bottom left of the supplementary panel. | No | M | |
| supplementaryPanelPositionY | The Y-coordinate (vertical) position of the supplementary panel measured from the bottom left of the sign's overall display area to the bottom left of the supplementary panel. | No | M | |
| supplementaryPictogramCodeListIdentifier | Indicates which supplementary pictogram code list is referenced. | No | O | |

# Faults

| **DatexII Name** | **DatexII Comment** | **F2C** | |
| --- | --- | --- | --- |
| VmsFaultEnum | The type of fault which is being reported for the specified variable message sign panel. | | M |
| VmsCriticalFault | True if VMS is either not displaying anything or not displaying what is requested | | M |
| VmsFaultTimestamp | Time and date of occurrence (not time reported) | | M |
| VmsFaultDescription | Text describing the fault. | | O |
| VmsFaultCode | Allocated by the supplier/configuration manager for maintenance purposes if required. | | O |

## VmsFaultEnum

| DatexII Name | DatexII Comment | UTMC Usage | Critical Fault |
| --- | --- | --- | --- |
| communicationsFailure | Comunications failure affecting VMS. | Records that the VMS tried and failed to communicate with the centre. | No |
| incorrectMessageDisplayed | Incorrect message is being displayed. | VMS is unable to display the requested text | Yes |
| incorrectPictogramDisplayed | Incorrect pictogram is being displayed. | VMS is not displaying the requested pictogram | Yes/No |
| powerFailure | Power to VMS has failed. | Running under backup power (non-critical) | No |
| unableToClearDown | Unable to clear down information displayed on VMS. | Not used (covered in response) | No |
| Unknown | Unknown VMS fault. | Not used (this is applicable to centre to centre) | No |
| Other | Other than as defined in this enumeration. | Manufacturers faults | Yes if VMS unable to display requested message. |
| FailedToDownloadPictogram | VMS could not download pictogram image from supplied URL. | 1. Fault code should indicate web-server response code if received. 2. VMS should continue to display associated text even if pictogram not available | Yes |
| pixelFault |  | The VMS has detected one or more pixel faults | No |
| temperatureTooHigh |  | The sign is internally too hot | No |
| temperatureTooLow |  | The sign is internally too cold | No |
| auxEquipmentFault |  | There is a fault in an item of auxiliary equipment. E.g. fan, heater, ambient light sensor, UPS | No |
| timeFault |  | The sign failed to synchronise with the time source | No |
| unitReset |  | The sign has restarted. This fault is only reported once. | No |
|  |  |  |  |