TECHNICAL SPECIFICATION

ISO/TS 14822-1

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Traffic and Travel Information — General specifications for medium-range pre-information via dedicated short-range communication —

Part 1: **Downlink**

Information sur le trafic et le transport — Spécifications générales pour la préinformation de gamme moyenne via la communication de gamme courte dédiée —

Partie 1: «Downlink»

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

In other circumstances, particularly when there is an urgent market requirement for such documents, a technical committee may decide to publish other types of normative document:

— an ISO Publicly Available Specification (ISO/PAS) represents an agreement between technical experts in an ISO working group and is accepted for publication if it is approved by more than 50 % of the members of the parent committee casting a vote;

— an ISO Technical Specification (ISO/TS) represents an agreement between the members of a technical committee and is accepted for publication if it is approved by 2/3 of the members of the committee casting a vote.

An ISO/PAS or ISO/TS is reviewed after three years in order to decide whether it will be confirmed for a further three years, revised to become an International Standard, or withdrawn. If the ISO/PAS or ISO/TS is confirmed, it is reviewed again after a further three years, at which time it must either be transformed into an International Standard or be withdrawn.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO/TS 14822-1 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 278, *Road transport and traffic telematics*, in collaboration with Technical Committee ISO/TC 204, *Intelligent transport systems*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

ISO/TS 14822 consists of the following parts, under the general title *Traffic and Travel Information — General specifications for medium-range pre-information via dedicated short-range communication*:

— *Part 1: Downlink*

Introduction

Traffic and Travel Information may be disseminated through a number of services or means of communication, covering static displays, portable terminals and in-vehicle equipment.

For all such services the data to be disseminated, and message structure involved in the various interfaces, require clear definition and standard formats in order to allow competitive products to operate with any received data. This Technical Specification focuses on the application data specification whereby data are produced at a central location and disseminated via a network of Dedicated Short-Range Communication (DSRC) beacons. This part of ISO 14822 addresses the data specifications for the downlink data flows between a central location and moving vehicles passing a predetermined location. ISO 14822-2 addresses the data specification for the uplink data flows that emanate from a moving vehicle, passing a predetermined location, to a central location. In order to facilitate all the demands of ISO 14822-2, four bytes in the downlink message are reserved for the beacon to insert the date/time stamp of the download. Due to the need for the in-station to generate message CRCs, these bytes are not included in the header CRC.

Other documents are being produced by the CEN/TC 278 Working Group 4 and ISO/TC 204 Working Group 10 to cover TTI dissemination via other communication means and services.

This Technical Specification specifies the application protocols and message structures for delivering Medium Range Pre Information (MRPI) as accepted within CEN TC 278 for Traffic and Travel Information (TTI) via Dedicated Short Range Communication (DSRC) devices.

DSRC has specific characteristics that differentiate this communication medium from other communication media envisaged for traffic and traveller information, i.e. RDS-TMC (and later DAB) and GSM.

These characteristics are:

— bi-directional communication, which is useful for collecting information/data from the vehicle or perhaps selecting vehicles for a particular dialogue; and

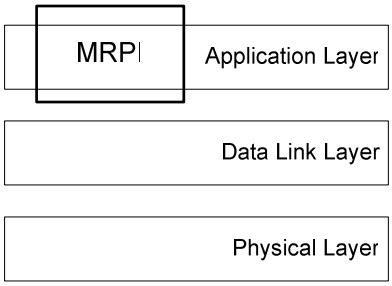
— spot communication, i.e. communications that can only take place at a precise point. This is a particularly important characteristic. The communication zone does not exceed some 10 m or 20 m in front of the beacon. At the time of communication, the position of the vehicle is accurately known, not only in terms of geographical localization (i.e. comparable to what can be obtained with a GPS receiver) but in terms of road and travel direction on this road. This localization feature is used beyond the communication zone. By combining initial location information with information from the vehicle's speed sensor or odometer, the position of the vehicle is known with great accuracy for several kilometres and reasonable accuracy for tens of kilometres. Location information is updated when the vehicle passes the next beacon, probably at the next junction. This may be a small distance in urban areas or a large distance on motorway or expressway networks.

This part of ISO 14822 describes the application protocol, data definitions and message structures for each MRPI service defined.

It forms part of a series of Technical Specifications defining the framework of a DSRC link in the Road Transport Traffic Telematics (RTTT) environment.

The communication requirements of many RTTT applications can be fulfilled by DSRC. The DSRC International Standards enable compliant communication systems to serve multiple RTTT application in parallel.

This Technical Specification deals with the Application layer only.



CEN has issued the following set of European Standards for the DSRC link:

— EN 12253 *Road transport and traffic telematics — Dedicated short-range communication — Physical layer using microwave at 5,8 GHz*;

— EN 12795 *Road transport and traffic telematics — Dedicated Short Range communication (DSRC) — DSRC data link layer: medium access and logical link control*;

— EN 12834 *Road transport and traffic telematics — Dedicated short range communication — Application layer*;

— EN 13372 *Road transport and traffic telematics — Dedicated short range communication — Profiles for RTTT applications*.

ISO has issued the following International Standard for the DSRC link:

— ISO 15628 *Transport information and control systems (TICS) — Dedicated Short-Range Communication (DSRC) — DSRC application layer*.

General architecture of MRPI application

For simple applications, the information transmitted defines an event or a characteristic and the distance from the point of delivery to this event or characteristic. Information from the vehicle odometer is used to measure the distance driven by the vehicle and modify the distance shown on the driver's display or operate alert messages as the event is approached. The vehicle equipment need not possess geographic localization knowledge as the information is presented relative to the position of the last beacon passed. Whilst information will often be related to the road conditions immediately following a beacon, the architecture will allow the transmission of data covering much larger distances (up to two hours travelling time may be appropriate on Trans European network roads). Such information will be updated by subsequent beacons.

The bi-directional communication facility can be used to retrieve information from vehicles such as average speed data, location of fog, heavy rain, slippery roads, etc. This information can provide valuable floating car data for Road Network Managers and subsequently as a warning to the following traffic.

Application architecture description

From analysis carried out within the MARTA project WP2, a typical architecture is based on:

— a central control system which configures information broadcast by each beacon, based on the various sources of information available. It also retrieves information collected from vehicles at the different beacon sites;

— beacons located along the road network. Each beacon consists of a beacon controller with one or more heads as required to provide full coverage over multi-lane roads. The controller interfaces to the communication network;

— on-board terminals located in vehicles. Equipment is composed of a tag for communication which may be linked to a terminal supporting the application. The complexity and cost of this equipment will vary according to the applications supported.

Beacon equipment may take different forms. Complicated beacons handling dynamic information and two-way communications with vehicles will be connected to a high-speed communications network. Less complicated beacons handling static information (which may be changed) will be connected to low-speed networks and at the other extreme the simplest beacons, warning perhaps of black spots or advertising some infrastructure detail, could be stand-alone.

Information flow

This Technical Specification assumes that the DSRC supporting architecture will be as follows:

— a central system configures beacons with appropriate information to be transmitted to vehicles, and regularly polls beacons to retrieve information collected from vehicles;

— each beacon broadcasts a signal to indicate its presence; when a tag is present in the communication zone of the beacon, it indicates its presence and receives information from the beacon; in parallel, it transmits to the beacon information stored and configured by the on-board application;

— when receiving data collected from vehicles, a beacon can, where the network allows, send information directly to the control centre, without waiting for the poll, especially if the information is related to safety;

— the application running on the on-board terminal may regularly poll the tag (communication controller) to detect new data, and to update vehicle-based information stored in the tag, ready for transmission to the next beacon.

It is important to note that these information flows can run in parallel, i.e. for MRPI applications no real dialogue is expected between the on-board equipment, beacons and central system; information processing is detached from the transmission process.

On-board terminals

One key aspect of the transmission of traffic and travel information on DSRC is that different types of on-board terminals can be envisaged, covering a wide range of end-users' prices.

The simpler terminal envisaged for MRPI is a tag developed for electronic fee collection, with limited possibilities to warn the driver of equipped vehicles in case of incidents on the next 4 km or 5 km (i.e. with a LED or a buzzer); the terminal could indicate two or three levels of seriousness (from incident to major accident, for example).

A second level of terminal could consist of an after-sale terminal with simple graphic display and limited interface with the vehicle (power, possibly speed sensor).

The third level of terminal consists of a fully integrated terminal, available as an option on the vehicle, and possibly having connection with other communication media (GSM or RDS-TMC). In this case, more information can be retrieved from the vehicle (activation of fog lamp, high-speed wipers, etc.).

Characteristics of applications from an HMI point of view

The information transmitted to a beacon will generally consist of an event and a relative distance from the beacon. The information does not need to be immediately presented to the driver of equipped vehicles. The time of presentation is related to the nature of the information as well as the location.

This feature is important, as it means that the place where the transmission takes place (i.e. the position of the beacon) does not need to be correlated with the nature of the information transmitted (nature and location). This means that the driving factor for the installation of the beacons is mainly the refreshment rate of the information on board the vehicle, rather than the exact position of the beacon.

Therefore, for the driver of equipped vehicles the transmission of information can be completely transparent. For example, information about road works can be transmitted at a beacon, with an indication of, for example, 5 km. For the benefit of the driver, there is no need to announce the information immediately, as in this case

the information will not modify the route (which is not the case for a big accident) and an early warning will have no impact on the driving attitude. On the contrary, information can be announced 1 km before the roadwork, which in this case will have an impact on the driver of equipped vehicles (he/she should be more alert during the following minutes and could even start to reduce his/her speed).

One characteristic of the announcements, from an HMI point of view, is that information about an event is presented to the driver of equipped vehicles depending on the relative distance between the vehicle and the event, which brings advantages, as compared to information which can be given through channels such as FM radio (where the “absolute” location of the problem is given, for example “Roadwork after ROISSY toward LILLE”).

Information is correctly filtered (information displayed is pertinent for the driver) and there is no ambiguity on the location, especially for drivers who are not familiar with the environment and who do not know place names.

An advantage of such a way to present the information to the driver of equipped vehicles is that the information transmitted is self-sufficient, i.e. there is no need to have an on-board database to decode geographic names. Geographic names can still be used for some MRPI applications (to indicate distances or journey times to given places, for example), but due to the high data rate of the DSRC, it seems possible to achieve such an application without on-board decoding database.

Of course, information transmitted can be language-independent, following for example the coding of events proposed by RDS-TMC.

Traffic and Travel Information — General specifications for medium-range pre-information via dedicated short-range communication —

Part 1: Downlink

1 Scope

This part of ISO 14822 addresses the passive DSRC issues associated with Medium Range Pre-Information (MRPI) as applied to Traffic and Travel Information (TTI) issued from an information service provider to a suitably equipped moving vehicle.

The AID (Application identification) No. for all MRPI Application entities is defined as No. 8 in accordance with ISO 15628.

2 Normative references

The following referenced documents are indispensable for the application 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 4217, *Codes for the representation of currencies and funds*

ISO 3166-1, *Codes for the representation of names of countries and their subdivisions — Part 1: Country codes*

ISO 14819-2, *Traffic and Traveller Information (TTI) — TTI messages via traffic message coding — Part 2: Event and information codes for Radio Data System — Traffic Message Channel (RDS-TMC)*

ISO/TS 14823[1], *Traffic and Travel Information — Messages via media-independent stationary dissemination systems — Graphic data dictionary for pre-trip and in-trip information dissemination system*

ISO 15628, *Transport information and control systems (TICS) — Dedicated Short-Range Communication (DSRC) — DSRC application layer*

1) To be published.

3 Terms, definitions and abbreviated terms

3.1 General

For the purposes of this document, the following terms and definitions apply.

3.1.1
beacon
roadside DSRC device

3.1.2
dam
message variable addressed in tens of metres

NOTE dam = deca [da] × metre [m].

3.1.3
hm
message variable addressed in hundreds of meters

NOTE hm = sector [h] × metre [m].

3.1.4
journey time
travel time plus delay

3.1.5
link (road)
length of motorway between two locations

3.1.6
link (telecom)
electronic or wireless interface between two matching devices

3.1.7
Motorway Applications for Road Traffic Advisor
MARTA
European-funded project to review similar existing projects throughout Europe with the aim to establish the foundation of this Technical Specification

3.1.8
on-board unit
OBU
electronic equipment closely coupled with the tag that interprets the messages and presents the embodied information to the Driver

3.1.9
pkmp
motorway network physical address in kilometres, represented in the number of kilometres at the referenced location from the start of the designated motorway

3.1.10
road network manager
authority responsible for the smooth operation and maintenance of the motorway or trunk roads on which the DSRC device is installed

3.1.11
route
series of links

3.1.12
tag
in-vehicle passive DSRC device to provide by-directional communication between the vehicle and a roadside beacon

3.1.13
Transport Protocol Experts Group
TPEG
protocol commissioned by the EBU's Broadcast Management Committee for the multimedia broadcast of TTI

3.1.14
trans-European transport network roads
roads comprising the network that handles almost half of all goods and passenger traffic and is therefore the veritable lifeblood of the EU

NOTE In recent years, the excessive use made of roads for the transport of goods, the tremendous expansion in travel by air and the shortcomings in the rail system have seen a sharp increase in congestion on the main European arteries.

3.1.15
travel time
unimpeded time to transverse a link in free flow

3.2 Data dictionary

3.2.1
application-crc
cyclic redundancy characters that are used to validate the integrity of the concatenated DSRC message, based on the ITU polynomial $x^{16} + x^{12} + x^5 + 1$

3.2.2
application-data
concatenated MRPI messages intended for delivery to and from a single DSRC outstation

3.2.3
average-speed
single byte field containing the average speed in kilometres per hour (km/h) of a slow-moving vehicle

3.2.4
callbox-offset-in-dam
two-byte field defining the distance offset in tens of metres between the DSRC and the first device or the distance offset in tens of metres between subsequent devices

3.2.5
country-code
two-byte numeric field defining the country code in accordance with the three-digit code taken from ISO 3166-1 that signifies the dictionary's country of origin

3.2.6
currency
three-byte field defining the currency of the monitory fields in the message in a form that corresponds to ISO 4217

3.2.7
date/time-of-information-generation
four-byte field containing the number of seconds since 1970

3.2.8
date/time-of information-transfer
four-byte field containing the number of seconds since 1970

3.2.9
dictionary-code
single-byte numeric field defining the pictogram dictionary from which the pictogram codes have been taken

3.2.10
displayextent-in-dam
distance offset in tens of metres in advance of the roadside indicator or device that the message is deemed as valid

3.2.11
distance2next-dsrc
distance in tens of metres form the DSRC dispatching the message to the next DSRC on the designated highway

3.2.12
dsrc-application-id
DSRC application identifier

NOTE For MRPI messages this will always be set to eight.

3.2.13
dsrc-network-id
unique network address of the DSRC used also as the electronic address

3.2.14
forward-link-id
variable containing the link identity of the downstream message block where the DSRC dispatches information for a different link in advance of the next DSRC

3.2.15
information-type
single-byte encoded value defining the structure of the message

3.2.16
journey-time
two-byte field containing the journey time in minutes to the associated exit or destination

3.2.17
junction-id
20-byte character string containing the exit description or destination

3.2.18
length-of-route-affected-in-hm
distance offset in hundreds of metres between the incident and the location in advance of the incident at which message becomes valid

3.2.19
length-of-the-frame
two-byte field that defines the number of bytes in the complete message including this header

3.2.20
link-block length
two-byte field containing the number of bytes in the concatenated message block including this header

3.2.21
mandatory-speed
mandatory speed in kilometres per hour (km/h)

3.2.22
message-duration
duration in minutes from the date/time stamp of information generation that the message is deemed to be valid

3.2.23
mrpi-application-entity-id
MRPI message identifier that defines the structure and format of the message block

3.2.24
name-of-the-road
seven-byte ASCII field containing the name of the designated road network on which the link resides

3.2.25
name-of-exit
ASCII string defining the name of the exit associated with the service station or rest area terminated by an ASCII carriage return

3.2.26
name-of-facility
ASCII string defining the name of the service station or rest area terminated by an ASCII carriage return

3.2.27
no-instruments
single-byte field containing the number of emergency telephone instruments that are recorded in the information message

3.2.28
no-of-jt-elements
single-byte binary field defining the number of exists or destinations for which journey times have been incorporated into the information message

3.2.29
offset2device-in-dam
distance offset in tens of metres, from the DSRC to the roadside indicator or device

3.2.30
offset2event-in-dam
distance from the DSRC to the TMC event in tens of metres

3.2.31
offset2vadid
distance offset in tens of metres, from the DSRC to the location where the message becomes valid

3.2.32
pkmp-reference
kilometre point or marker post reference indicating a road network location address

3.2.33
recommended-speed
recommended speed in kilometres per hour (km/h)

3.2.34
referenced-distance-in-hm
distance referenced in the message in hundreds of metres

3.2.35
rest-area-facilitates
two-byte bit map defining the facilities available at the rest area

3.2.36
road-length
two-byte field containing the distance from the DSRC to the next road network divergence or termination in kilometres

3.2.37
road-network-link-id
block identity relating to concatenated messages for a designated section of road network link

3.2.38
road-type
one-byte field defining the characteristics of the designated road network link

3.2.39
road-works-no
single byte containing the number of roadwork entities included in this information message

3.2.40
rw-configuration
single-byte binary field defining the configuration of the roadwork in accordance with Table 1 below

NOTE The encoding defines a lane closed when the bit is set.

Table 1 — rw-configuration

rw-configuration	Bit number
exit slip hard shoulder	0
exit slip inside lane	1
exit slip outside lane	2
hard shoulder	3
lane 1	4
lane 2	5
lane 3	6
lane 4	7

3.2.41
site-identifier
DSRC site address that is unique within a designated region of the road network

3.2.42
speed-events
variable defining the number of speed events contained in the one information message

3.2.43
tcc-telephone-no
character string containing the telephone number of the TCC or PCO that is responsible for the current section of road network

3.2.44
tmc-evt
two-byte field containing the Alert-C RDS-TMC event code that can be translated into any descriptive language as defined in ISO 14819-2

3.2.45
tmc-oq
one-byte field containing the optional quantifier associated with the incident

3.2.46
tmc-sl
one-byte field containing the speed limit in kilometres (km) associated with the incident

3.2.47
type-of-vehicle
single-byte binary field depicting the special vehicle type

3.2.48
validity-extent-in-dam
distance offset in tens of metres after the roadside indicator or device that the condition applies

3.3 Abbreviated terms

AID	Application identification
ASCII	American Standard Code for Information Interchange
DSRC	Dedicated Short-Range Communication
HMI	Human Machine Interface
ITU	International Telecommunication Union
MARTA	Motorway Applications for Road Traffic Advisor
MRPI	Medium-Range Pre-Information
OBU	On-board unit
PCO	Police Control Office
RDS	Radio Data System
TCC	Traffic Control Centre
TMC	Traffic Message Channel
TPEG	Transport Protocol Experts Group
TTI	Traffic and Travel Information
VMS	Variable Message Sign

4 Application protocol (similar to TPEG)

Following the emerging TPEG model, the DSRC application protocol can be described as follows; however, it must be assumed that the service provider generating the DSRC data stream has constructed the application level frames that have been targeted at a specific roadside DSRC device:

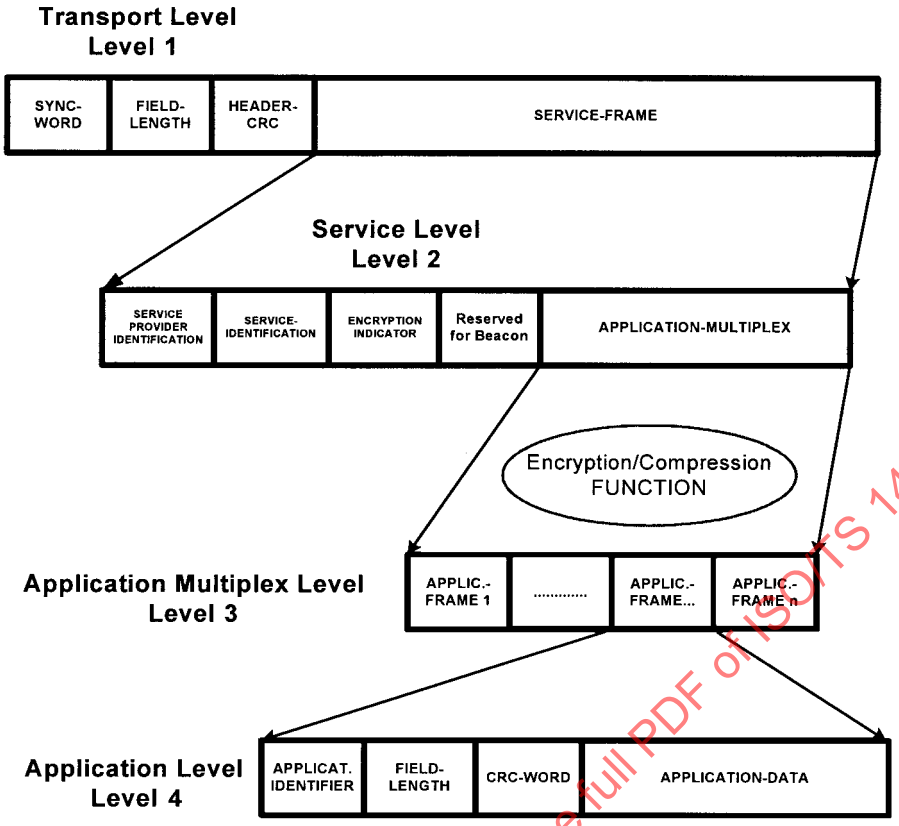


Figure 1 — DSRC description hierarchy

4.1 Transport level

Overall frame structure level 1

The byte stream contains consecutive transport frames.
Each frame includes:

The Synchronization Word (syncword)	2 bytes: FF0FH
The length of the frame (field length)	2 bytes
The Header CRC	2 bytes
The service Frame	n bytes (n = length of frame)

ASN.1 format

```
TransportHeader ::= SEQUENCE {
        sync-word ::= INTEGER (65295),
        field-length ::= INTEGER (0 .. 65536),
        header-crc ::= INTEGER (0 .. 65536)
        }
```

The byte stream is built according to the above-mentioned repetitive structure of transport frames.

Syncword

The syncword is two bytes long and has a value of FF0F hex.

Field length

The field length consists of two bytes and represents the number of bytes from the start of the header CRC up to and including the end of the service frame.

Header CRC

The header CRC is two bytes long, and is based on the ITU polynomial $x^{16} + x^{12} + x^5 + 1$.

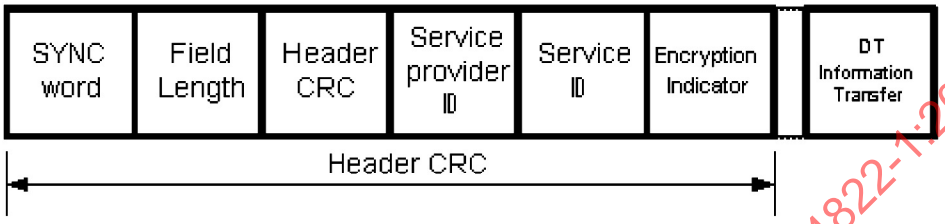


Figure 2 — Header CRC

The header CRC is calculated on the first eleven bytes and includes the sync word through to the encryption indicator.

4.2 Service level

Overall frame structure level 2

Each service frame comprises:	
The service provider ID	2 bytes
The service ID	2 bytes
The encryption indicator	1 byte
Date/Time stamp of information transfer	4 bytes
The Application Data	n bytes

ASN.1 format

```
serviceHeader ::= SEQUENCE {
        service-provider-id ::= INTEGER (0 .. 65295),
        service-id ::= INTEGER (0 .. 255)
        encryption-indicator ::= INTEGER (0 .. 255)
        date-time-of-information-transfer ::= INTEGER (0 .. 4294967295)
        }
```

The service level is defined by the service frame. Each transport frame carries one and only one service frame.

The service frame includes an application multiplex comprising one or more application frames. Each service frame may contain a different range and number of application frames as required by the service provider.

4.2.1 Service information

Each transport frame may be used by only one service provider and one dedicated service which can comprise a mixture of applications.

A multiplex of service providers or services is realized by concatenation of multiple transport frames. Each service frame includes service information, which comprises the service provider identification, the service identification and the encryption indicator.

The service provider ID is unique worldwide, and the service IDs are unique to each service provider.

4.2.2 Service provider identification

Length: 2 bytes

This is assigned worldwide. Each service provider has a unique number.

The use of a country code is not regarded as being appropriate, since applications and services will be assigned on a worldwide basis.

However, this implies that the numbers need to be assigned on a worldwide basis.

4.2.3 Encryption indicator

Length: 1 byte

The service provider may freely choose the encryption technique and compression algorithms.

0	no encryption/compression.
1 to 127	reserved for standardized methods.
128 to 255	may be freely used by each service provider, may indicate the use of proprietary methods.

4.2.4 Date/time stamp of information transfer

Length: 4 bytes

In accordance with the CEN/TC 287 time format, this field defines the timestamp at which the information was compiled at the in-station. This field is not included in any of the CRC calculations performed by the in-station and is inserted into the byte stream by the beacon.

4.3 Application multiplex level

The application multiplex is a collection of one or more application frames, the type and order of which are freely determined by the service provider.

Overall frame structure level 3

Each application frame comprises:

DSRC Application ID	2 bytes
Date/Time stamp of information generation	4 bytes
The length of the frame (field length)	2 bytes
The Application CRC	2 bytes
The Application Data	*n* bytes

ASN.1 format

```
dsrc-id DsrcApplicationEntityId ::= medium-range-pre-information

ApplicationHeader ::= SEQUENCE {
        application-id ::= DsrcApplicationEntityId,
        date-time-of-information-generation ::= INTEGER (0 .. 4294967295),
        application-length ::= INTEGER (0 .. 65536),
        application-crc ::= INTEGER (0 .. 65536)
        }
```

4.3.1 Application identity

Length: 2 bytes

In accordance with ISO/TC204 WG15 this field is the first two bytes of the application frame being made up as follows:

```
DSRCApplicationID ::= INTEGER{
    system                              (0),
    automatic-fee-collection            (1),
    freight-fleet-collection            (2),
    public-Transport                    (3),
    traffic-traveller-information       (4),
    traffic-control                     (5),
    parking-management                  (6),
    geographic-road-database            (7),
    medium-range-pre-information        (8),
    man-machine-interface               (9),
    intersystem-interface               (10),
    automatic-vehicle-identification    (11),
    emergency-warning                   (12),
    private                             (13),
    multi-purpose-payment               (14),
    dsrc-resource-manager               (15),
    after-theft-system                  (16),
    cruise-assist-highway-system        (17),
    multi-purpose-information-system    (18),
    multi-mobile-information-system     (19),
    reserved-for-ISO-DSRC-application0  (20),
    reserved-for-ISO-DSRC-application1  (21),
    reserved-for-ISO-DSRC-application2  (22),
    reserved-for-ISO-DSRC-application3  (23),
    reserved-for-ISO-DSRC-application4  (24),
    reserved-for-ISO-DSRC-application5  (25),
```

reserved-for-ISO-DSRC-application6 (26),
reserved-for-ISO-DSRC-application7 (27),
reserved-for-ISO-DSRC-application8 (28),
private1 (29),
private2 (30),
reserved-for-ISO-DSRC-application9 (31),
} (0..31)

4.3.2 Date/time stamp of information generation

Length: 4 bytes

In accordance with the TC 287 time format this field defines the timestamp at which the information message was generated at the *i*n-station and is the reference time against which all the individual message durations are compiled.

4.3.3 Length of frame

Length: 2 bytes

The inclusion of this field enables the decoder to skip an unknown application. The length includes the six bytes of the header plus the application data.

4.3.4 Application Header CRC

Length: 2 bytes

The application CRC is two bytes long, and based on the ITU polynomial $x^{16} + x^{12} + x^5 + 1$.

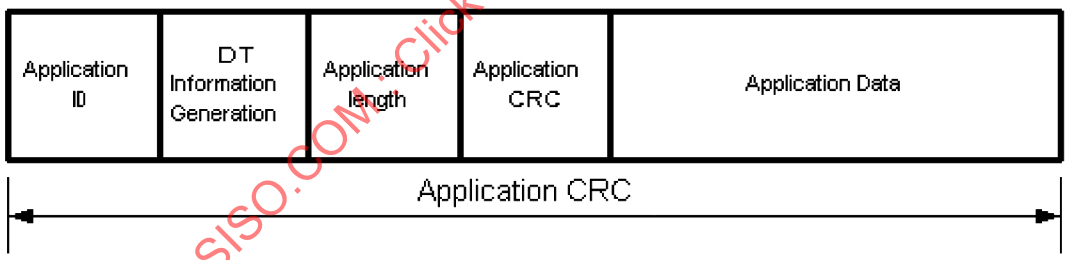


Figure 3 — Application CRC

The application CRC is calculated on all the bytes from the application ID to the end of the application data.

4.4 Conventions and symbols

4.4.1 Conventions

Naming conventions

Names shall start with a capital letter and contain no word separation characters. Variable names shall be in lower case with the words separated by a hyphen.

Byte ordering

All numeric values using more than one byte shall be coded in “big endian” format (most significant byte first). Where a byte is subdivided into bits, the most significant bit (“b7”) shall be at the left-hand end and the least significant bit (“b0”) shall be at the right-hand end of the structure.

Method of describing the byte-oriented protocol

This textual representation is designed to be unambiguous, easy to understand and to modify, and does not require a detailed knowledge of programming languages.

Data types are built up progressively. Primitive elements that may be expressed as a series of bytes are built into compound elements.

More and more complex structures are built up with compound elements and primitives.

Reserved data fields

If any part of a DSRC data structure is not completely defined, then it shall be assumed to be available for future use. No particular value is assigned to it.

The notation is UAV (unassigned value). A decoder that is not aware of the use of any former UAVs can still make use of the remaining data fields of the corresponding information entity.

However, the decoder shall not be able to process the newly defined additional information.

4.4.2 Symbols

Variable numbers

Symbols shall used to represent numbers whose values are not predefined within the TPEG specifications. In these cases, the symbol used shall always be local to the data type definition.

For example, within the definition of a data type, symbols such as n or m are often used to represent the number of bytes of data within the structure, and the symbol id is used to designate the occurrence of the identifier of the data type.

Implicit numbers

Within the definition of a data structure it is frequently necessary to describe the inclusion of a component that is repeated any number of times, zero or more.

In many of these cases it is convenient to use a numerical symbol to show the component structure being repeated a number of times, but it is not necessary to include the number itself within the definition of the data structure.

Often, the symbol m is used for this purpose.

Printable stings

Within the message structure, where variable length text is to be transmitted at the end of a message then the message length shall determine the length of the field. Where the variable length text is imbedded within the message the last character shall be an ASCII carriage return character (CR). When the text is deemed to be in multiple rows then the row separator shall be an ASCII line feed character (LF).

5 Application data

The following DSRC MRPI application entities are defined in this Technical Specification:

```
MRPIApplicationEntityID ::= INTEGER{
    dsrc-message header                    (0),    -- Downlink defined in part 1
    highway-link-header                    (1),    -- Downlink defined in part 1
    incident-information                   (2),    -- Downlink defined in part 1
    incident-indication                    (3),    -- Uplink: defined in part 2
    journey-time-data                      (4),    -- Uplink: defined in part 2
    static-road-signs-mandatory            (5),    -- Downlink defined in part 1
    static-road-signs-information          (6),    -- Downlink defined in part 1
    Vms                                    (5),    -- Downlink defined in part 1
    pictograms                             (8),    -- Downlink defined in part 1
    speed-recommendation                   (9),    -- Downlink defined in part 1
    variable-mandatory-signs               (10),   -- Downlink defined in part 1
    weather-information                    (11),   -- Downlink defined in part 1
    road-condition                         (12),   -- Downlink defined in part 1
    rest-area-information                  (13),   -- Downlink defined in part 1
    fuel-station-information               (14),   -- Downlink defined in part 1
    parking-information                    (15),   -- Downlink defined in part 1
    not-allocated                          (16),   -- Downlink defined in part 1
    request-for-emergency-call-information (17),   -- Downlink defined in part 1
    origin-destination                     (18),   -- Uplink: defined in part 2
    extended-floating-vehicle-data         (19),   -- Uplink: defined in part 2
    traffic-conditions                     (20),   -- Downlink defined in part 1
    diversion-path                         (21),   -- Downlink defined in part 1
    special-vehicles                       (22),   -- Downlink defined in part 1
    journey-time                           (23),   -- Downlink defined in part 1
    roadwork                               (24),   -- Downlink defined in part 1
    private0                               (25),
    private1                               (26),
    private2                               (27),
    private3                               (28),
    reserved-for-cen-mrpi-applications     (29),
    reserved-for-cen-mrpi-applications     (30),
    reserved-for-cen-mrpi-applications     (31),
    reserved-for-cen-mrpi-applications     (32),
} (0..32)
```

The MRPIApplicationEntityID shall always be the first element of the level 4 application data.

The structure of the level 3 component has been defined to enable messages targeted at different highways to be accommodated in such a way that the highway architecture can be described. The level 4 component with an MRPIApplicationEntityID of zero is always the first element of a road block.

5.1 DSRC headers

5.1.1 Objective

The DSRC header provides the reference information that enables the in-vehicle equipment to set the reference location and time stamp for all subsequent message offsets and expiry times.

5.1.2 Structure

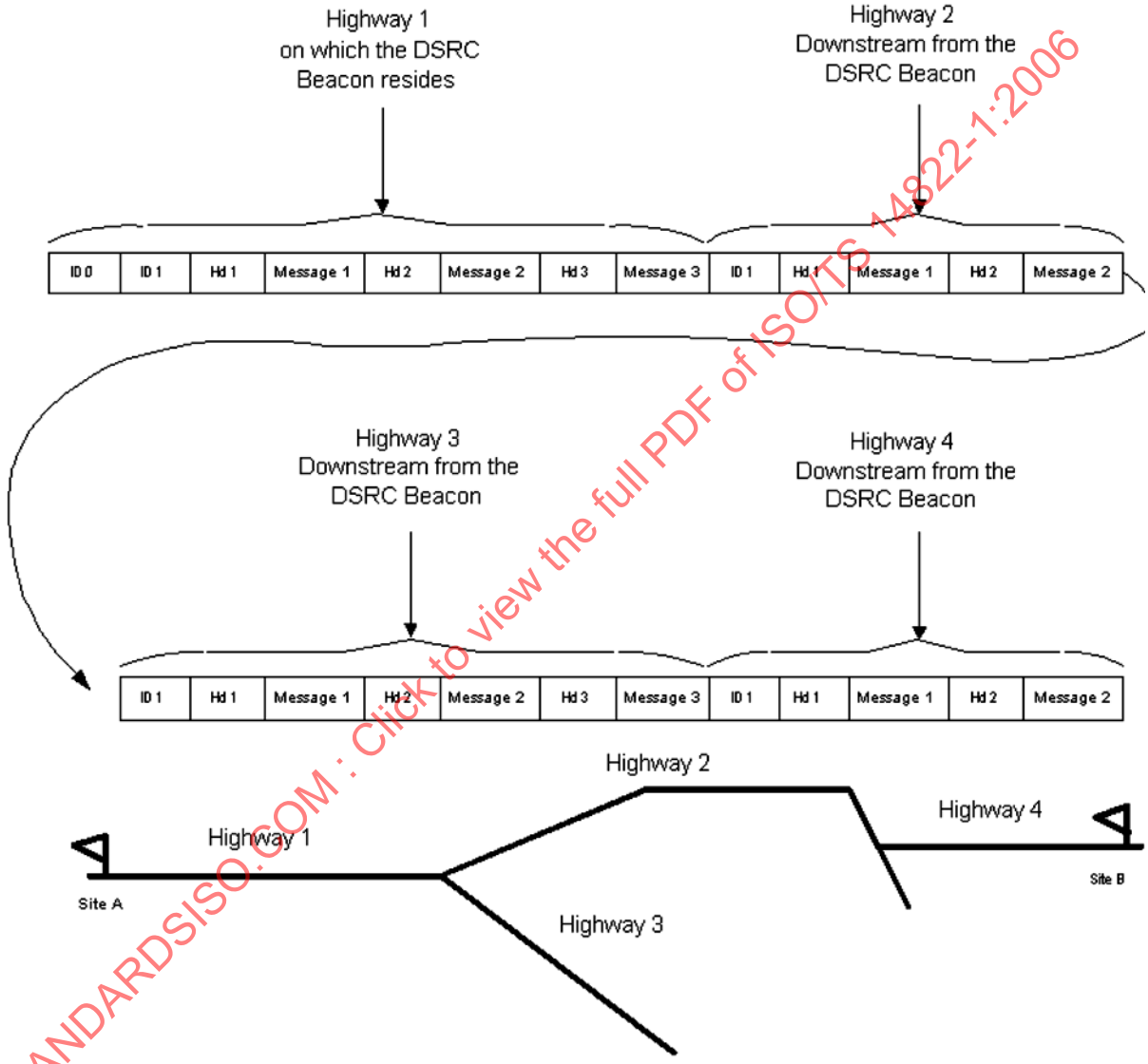


Figure 4 — DSRC message structure

The above message structure can accommodate multiple highway links between two DSRC beacons. The DSRC header provides the beacon details and the link header provides all the metadata pertaining to a particular section of highway. Within the level 3 structure there is one DSRC header and one or more link headers. The link headers are used to separate different sections of the road network. When the in-car equipment is used in conjunction with a satellite navigation system, the appropriate link should be automatically enabled. Where no navigation system exists, the forward link ID element will enable the correct chain of links to be maintained between DSRC sites.

5.1.3 DSRC downlink message header (Entity 0)

The DSRC downlink message header shall be used so that the in-car equipment can determine the identity and location of the beacon and the distance to the next beacon.

Overall frame structure level 4.0

The MRPI Header frame comprises:

MRPI Application Entity Identifier	1 byte
Site identifier	1 byte
DSRC Network ID	3 bytes
PKMP reference	4 bytes
No. of highway links	1 byte
Distance to next DSRC in dam	2 bytes

ASN.1 format

```
mrpi-id MRPIApplicationEntityID ::= dsrc-header

DsrcIdentifier ::= SEQUENCE {
        site-identifier ::= INTEGER (0 .. 255),
dsrc-network-id ::= INTEGER (0 .. 16777215),
        pkmp-reference ::= REAL (0 .. 99999),
        no-of-highway-links ::= INTEGER (1 .. 5),
        distance2next-dsrc-in-dam =:: INTEGER (0 .. 9999)
        }
```

5.1.4 Highway link header (Entity 1)

Overall frame structure level 4.1

Road Network link ID	1 byte
Link block length	2 bytes
Name of the road	7 bytes
Road type	1 byte
Road length	2 bytes
Forward link ID	1 byte

ASN.1 format

```
mrpi-id MRPIApplicationEntityID ::= highway-link-header

CurrentRoad ::= SEQUENCE {
        road-network-link-id ::= INTEGER (1 .. 255),
        link-block-length ::= INTEGER (1 .. 9999),
        name-of-the-road ::= PrintableString (SIZE(7)),
        road-type ::= RoadType,
        total-length-in-km ::= INTEGER (0 .. 999),
        forward-link-id ::= INTEGER (0 .. 255)
        }

RoadType ::= ENUMERATED {
        motorway (0),
        highway (1),
        freeway (2),
        national-secondary-road (3),
        regional-secondary-road (4)
        }
```

5.2 Incident information (Entity 2)

5.2.1 Objective

Provide the driver of equipped vehicles with information related to traffic oriented incidents before they meet them.

5.2.2 Short description

Warnings on whatever traffic incident happening several kilometres ahead of the vehicle are displayed during the journey. Thus the drivers of equipped vehicles could decide to slow down at the right time and place, which will increase their safety.

5.2.3 Data flow

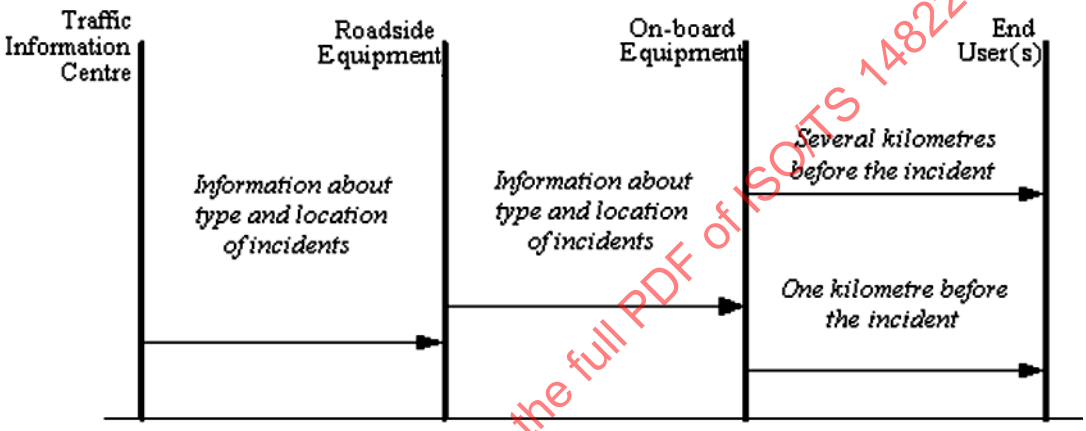


Figure 5 — Incident information: data flow

Information shall be collected from numerous inputs, processed by the control centre operators and finally transmitted to equipped vehicles.

5.2.4 Constraints

Like any MRPI compliant service, the information shall be given to the driver of equipped vehicles in close proximity to the incident location: it could be done twice if necessary. However the on-board unit shall not warn the driver of equipped vehicles for an event happening too far away from the vehicle (e.g. 100 km). Furthermore, the warning should be cancelled shortly after the vehicle has passed the location of the event.

To get an efficient service, a significant number of beacons shall be installed (typically every 5 km).

5.2.5 Structure

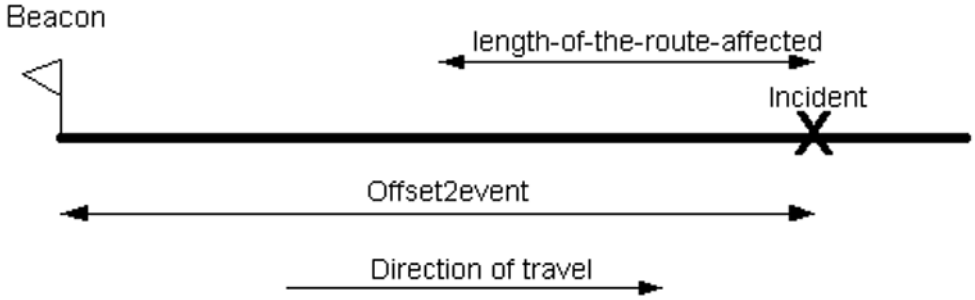


Figure 6 — Incident information: structure

Overall frame structure level 4.2

The MRPI Incident Info frame comprises:

MRPI Application Entity Identifier	1 byte
The length of the frame (field length)	1 byte
The Application CRC	2 bytes
Message duration in minutes	2 bytes
Incident location in dam	2 bytes
TMC event	2 bytes
TMC speed limit	1 byte
TMC optional qualifier	1 byte
Length of route affected in hm	1 byte

ASN.1 format

```
mrpi-id MrpiApplicationEntityId ::= incident-information

ApplicationLength ::= INTEGER (5 .. 14)
ApplicationCrc ::= INTEGER (0 .. 65535)

TrafficIncidentAndInformation ::= SEQUENCE {
        Message-duration-in-60s                 INTEGER (0 .. 44000),
        offset2event-in-dam                     INTEGER (0 .. 9999),
        tmc_evt                                 INTEGER (0 .. 9999),
        tmc_sl                                  INTEGER (0 .. 254),
        tmc_oq                                  INTEGER (0 .. 99),
        length-of-the-route-affected-in-hm      INTEGER (0 .. 255)
        }
```

5.3 Static road signs mandatory (Entity 5)

5.3.1 Objective

Advise the driver of equipped vehicles of a mandatory condition.

5.3.2 Short description

The road signs are displayed by the OBU at appropriate time and place.

5.3.3 Data flow

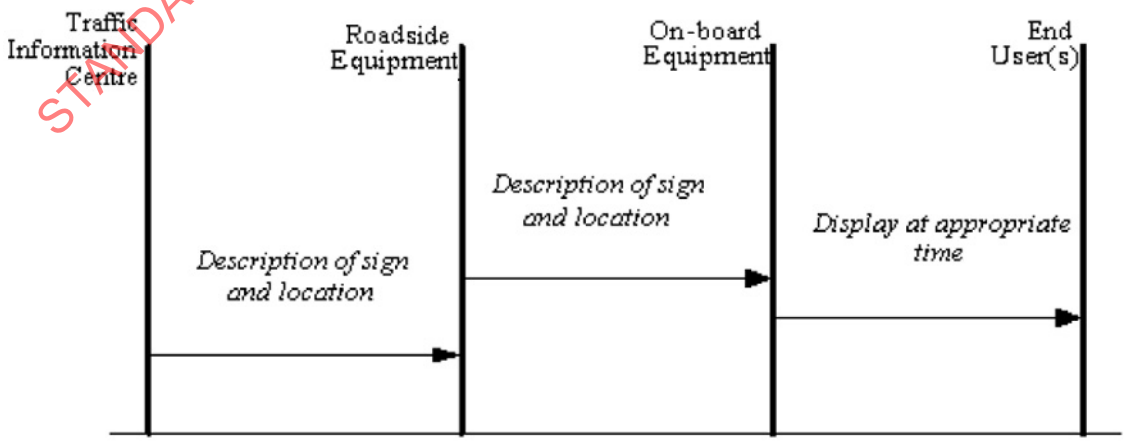


Figure 7 — Static road signs mandatory: data flow

5.3.4 Constraints

The on-board unit shall be able to display a pictogram, which advises drivers of a mandatory condition. It may also be used as an input stimulus to a haptic throttle control system.

5.3.5 Structure

A list of mandatory conditions covered by this service could be: speed limits, environmental, height or weight restrictions.

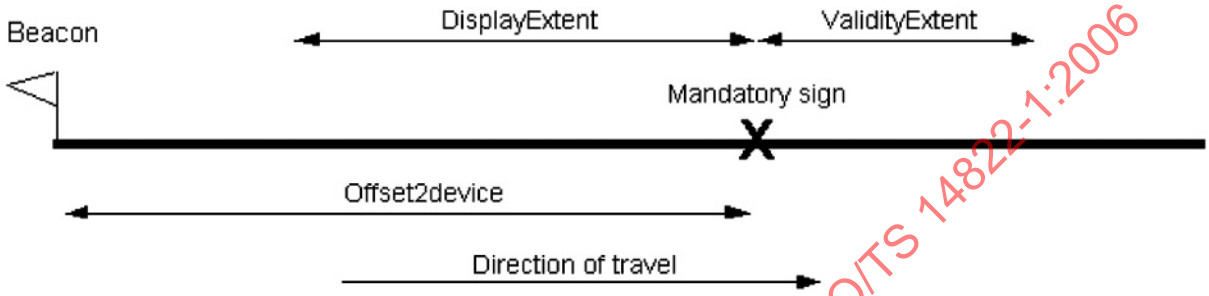


Figure 8 — Static road signs mandatory: structure

Overall frame structure level 4.5

The MRPI mandatory static signs frame comprises:

MRPI Application Entity Identifier	1 byte
The length of the frame (field length)	2 bytes
The Application CRC	2 bytes
Distance from DSRC to Mandatory Static Sign	2 bytes
Area over which the sign details are to be displayed in advance of the sign in dam	1 byte
Extent after the sign for which the mandatory condition applies in dam	1 byte
Message duration in minutes	2 bytes
Information type	1 byte
Sign details text	*n* bytes (Max 64)

ASN.1 format

```
mrpi-id MrpiApplicationEntityId ::= static-road-signs-mandatory

ApplicationLength ::= INTEGER (8 .. 76)
ApplicationCrc ::= INTEGER (0 .. 65535)

RoadSignsMandatory ::= SEQUENCE {
        offset2device ::= INTEGER (0 .. 9999),
        display-extent-in-dam ::= INTEGER (0 .. 255),
        validity-extent-in-dam ::= INTEGER (0 .. 255),
        message-duration-in-60s ::= INTEGER (0 .. 44000),
        information-type ::= InformationType,
        mandatory-text ::= PrintableString
        }
```

```
InformationType ::= ENUMERATED {
        ascii (0),
        unicode (1),
        html (2),
        xml (3),
        traffic-signs-code (4)
        }
```

If the sign detail has been encoded in another CEN/ISO traffic signs standard, such as ISO/TS 14823, then the appropriate code shall be encoded in the following way.

information-type ::INTEGER(4)
mandatory-text ::= PrintableString (“%specification%code%”)

EXAMPLE For a mandatory static sign advising that overtaking is prohibited, the mandatory-text should read: %14823%542%.

5.4 Static road signs information (Entity 6)

5.4.1 Objective

Warn the driver of equipped vehicles of an advisory condition.

A list of conditions covered by this service could be: road direction signs, advisory speed limits, warning signs in general (slippery road or low bridge for example).

5.4.2 Short description

The road signs are displayed by the OBU at appropriate time and place.

5.4.3 Data flow

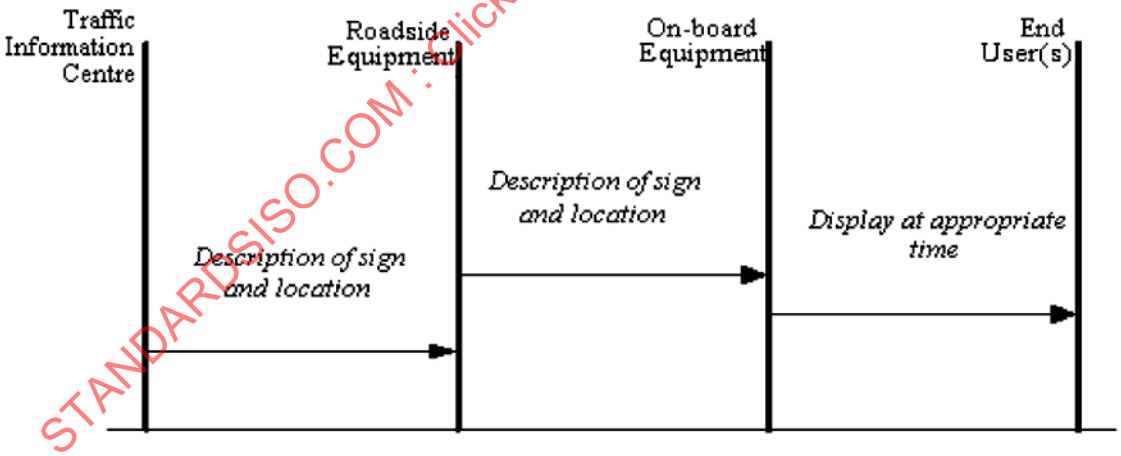


Figure 9 — Static road signs information: data flow

5.4.4 Constraints

The on-board unit shall be able to display text or a pictogram, which advises drivers of a non-mandatory condition. It shall not be used as an input stimulus to a haptic throttle control system.

5.4.5 Structure

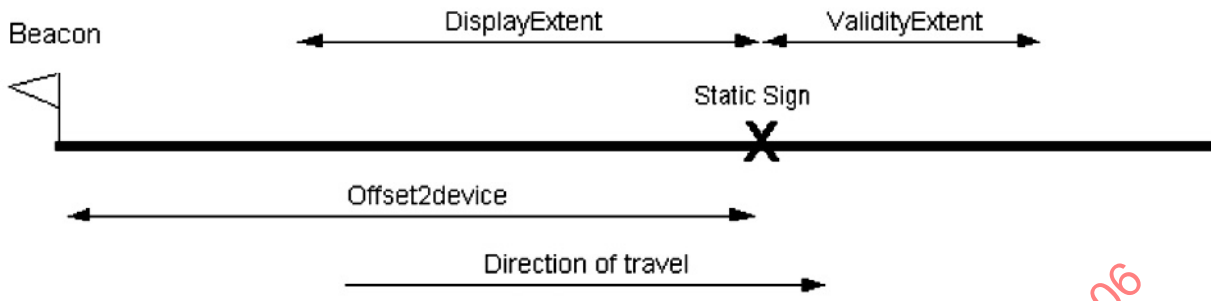


Figure 10 — Static road signs information: structure

Overall frame structure level 4.6

The MRPI Advisory Static signs frame comprises:

MRPI Application Entity Identifier	1 byte
The length of the frame (field length)	1 byte
The Application CRC	2 bytes
Distance from DSRC to Advisory Static Sign	2 bytes
Area over which the sign details are to be displayed in advance of the sign in dam	1 byte
Extent after the sign for which the advisory condition applies in dam	1 byte
Message duration in minutes	2 bytes
Information type	1 byte
Sign details text	*n* bytes (Max 64)

ASN.1 format

```
mrpi-id MrpiApplicationEntityId ::= static-road-signs-information

ApplicationLength ::= INTEGER                    (5 .. 76)
ApplicationCrc ::= INTEGER                       (0 .. 65535)

RoadSignsInformation ::= SEQUENCE {
        offset2device-in dam ::= INTEGER (0 .. 9999),
        display-extent-in-dam ::= INTEGER (0 .. 255),
        validity-extent-in-dam ::= INTEGER (0 .. 255),
        message-duration-in-60s ::= INTEGER (0 .. 44000),
        information-type ::= InformationType,
        information-text ::= PrintableString (SIZE(64))
        }

Where

InformationType ::= ENUMERATED {
        ASCII (0),
        UNICODE(1),
        HTML (2),
        XML (3),
        Traffic signs code (4)
        }
```

If the sign detail has been encoded in another CEN/ISO traffic signs standard, then the appropriate code can be encoded in the following way.

iInformation-type ::= INTEGER (4)
information-text ::= PrintableString (%specification%code%)

EXAMPLE For a static sign warning of low flying aircraft, the information-text should read %14823%362%.

5.5 Variable message signs (text messages) (Entity 7)

5.5.1 Objective

Advise drivers of a traffic condition or information massage that is also delivered using strategic and local Variable Message Signs (VMS).

5.5.2 Short description

Free texts are displayed by the OBU at the appropriate time and place. It is normal to see variable message signs on the roadside with different line lengths and number of lines. To accommodate this, the message text should separate each line with an LF character.

5.5.3 Data flow

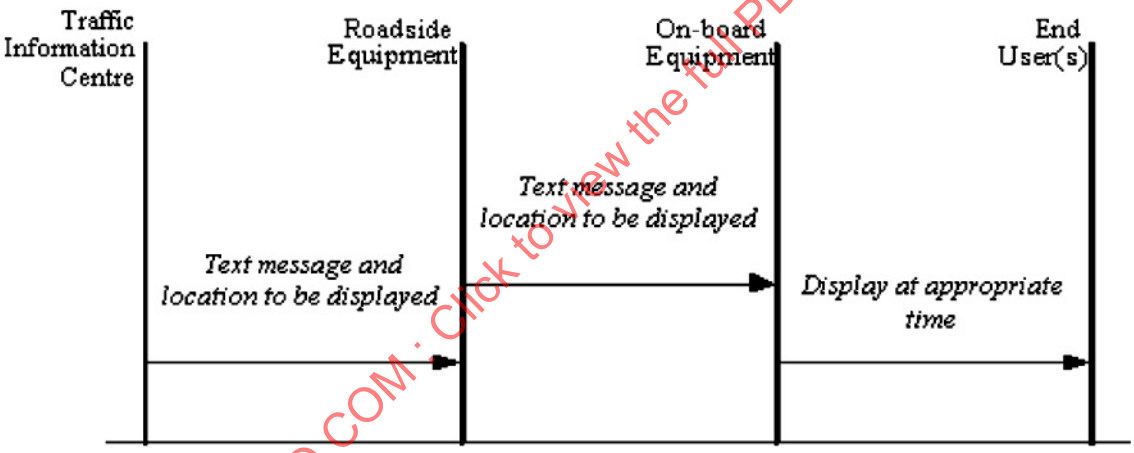


Figure 11 — Variable message signs: data flow

5.5.4 Constraints

The local language shall be used. The message length is limited by the display size.

5.5.5 Structure

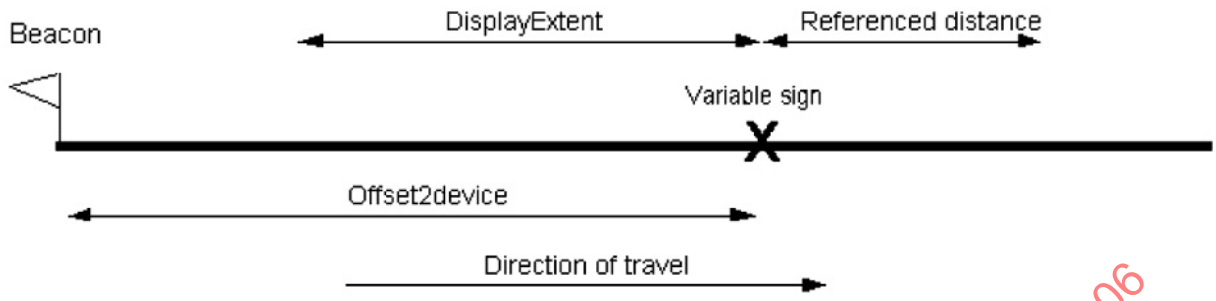


Figure 12 — Variable message signs: structure

Overall frame structure level 4.7

The MRPI VMS frame comprises:

MRPI Application Entity Identifier	1 byte
The length of the frame (field length)	1 byte
The Application CRC	2 bytes
Distance from DSRC to Variable Message Sign	2 bytes
Area over which the VMS details are to be displayed in advance of the sign in dam	1 byte
Distance referenced in message in hm	1 byte
Message duration in minutes	2 bytes
Information Type	1 byte
Message text	64 bytes

ASN.1 format

```
mrpi-id MrpiApplicationEntityId ::= vms

ApplicationLength ::= INTEGER (5 .. 76)
ApplicationCrc ::= INTEGER (0 .. 65535)

        VariableMessageSigns ::= SEQUENCE {
        offset2device-in-dam ::= INTEGER (0 .. 9999),
        display-extent-in-dam ::= INTEGER (0 .. 255),
        referenced-distance-in-hm ::= INTEGER (0 .. 255),
        message-duration-in-60s ::= INTEGER (0 .. 44000),
        information-type ::= InformationType,
        message-text ::= PrintableString (SIZE(64))
        }

Where

InformationType ::= ENUMERATED {
        ASCII (0),
        UNICODE(1),
        HTML (2),
        XML (3)
        }
```

5.6 Pictograms (Entity 8)

5.6.1 Objective

Provide the driver of equipped vehicles with a pictorial representation of a downstream event or incident.

5.6.2 Short description

Display of pictogram either using monochrome or colour to provide language independent incident or event information and the distance to the event

5.6.3 Data flow

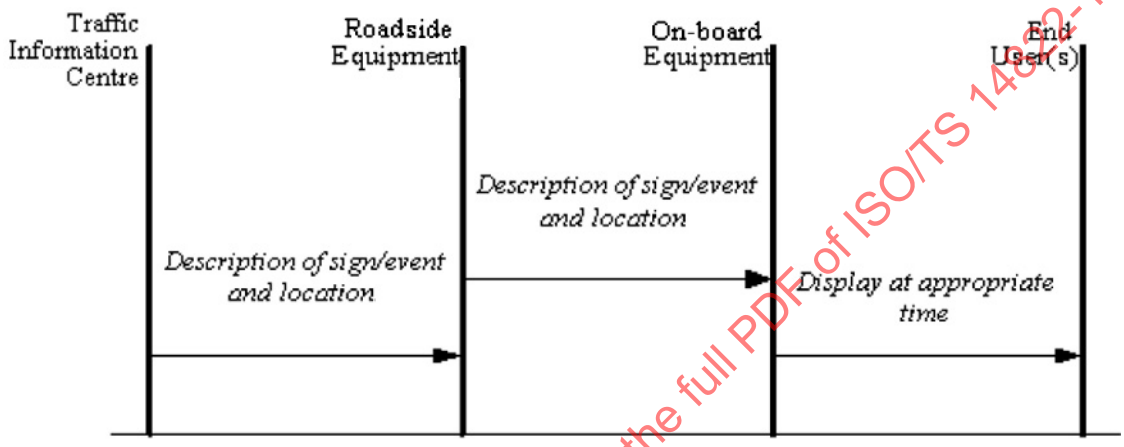


Figure 13 — Pictograms: data flow

5.6.4 Constraints

Some drivers may require training to understand pictograms. Moreover the range of standard pictograms is limited.

5.6.5 Structure

Warning and mandatory signs could be covered by this service. At the time of generation of this technical specification it is assumed that an International Standard will be produced to define a coded repository of pictograms.

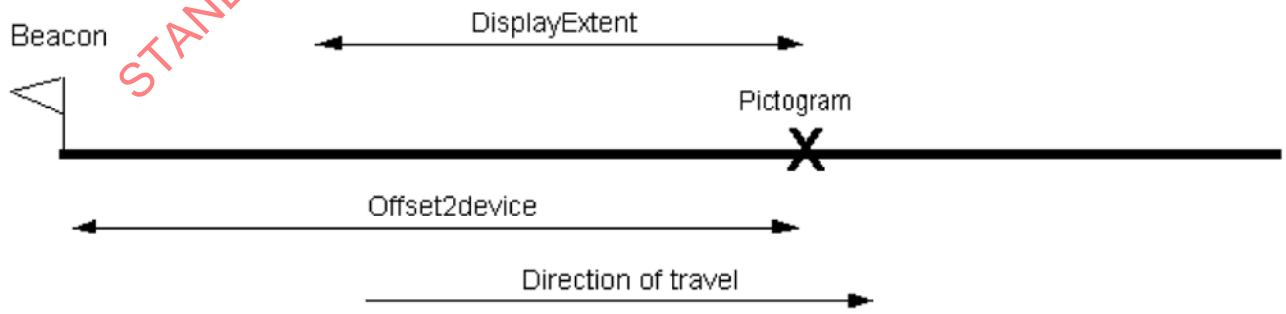


Figure 14 — Pictograms: structure

Overall frame structure level 4.8

The MRPI pictogram frame comprises:

MRPI Application Entity Identifier	1 byte
The length of the frame (field length)	1 byte
The Application CRC	2 bytes
Distance from DSRC to pictogram message Sign	2 bytes
Area over which the sign details are to be displayed in advance of the sign in hm	1 byte
Message duration in minutes	2 bytes
Country code	2 bytes
Dictionary code	1 byte
Information type	1 byte
Text pictogram recommendation	*n* bytes (Max 32)
Pictogram	*n* bytes (Max 4)

ASN.1 format

```
mrpi-id MrpiApplicationEntityId ::= pictograms

ApplicationLength ::= INTEGER (5 .. 51)
ApplicationCrc ::= INTEGER (0 .. 65535)

PictogramSigns ::= SEQUENCE {
        offset2device-in-dam ::= INTEGER (0 .. 9999),
        display-extent-in-hm ::= INTEGER ((0 .. 255),
        message-duration-in-60s ::= INTEGER (0 .. 44000),
        country-code ::= INTEGER (0 .. 999),
        dictionary-code ::= INTRGER (0 .. 255),
        information-type ::= InformationType,
        InformationType ::= ENUMERATED{
                text-only (0),
                text-with-two-pictograms (1),
                one-pictogram-only (2),
                two-pictograms-only (3)
                },
        Text-pictogram-recommendation ::= PrintableString (SIZE(32)),
        Pictogram ::= SEQUENCE {
                pictogram0 (0) ::= INTEGER (0 .. 65535),
                ...
                pictogramn (n) ::= INTEGER (0 .. 65535)
                m
                } (0 2)
        }
```

5.7 Speed recommendation (Entity 9)

5.7.1 Objective

Limit or smooth the traffic speed by informing the driver of equipped vehicles about the recommended speed limit.

5.7.2 Short description

The speed information is an advice given to the driver of equipped vehicles to adapt his/her speed to the current traffic, road and/or weather conditions. This advice should not be given in normal (free) flow of traffic with good weather conditions.

5.7.3 Data flow

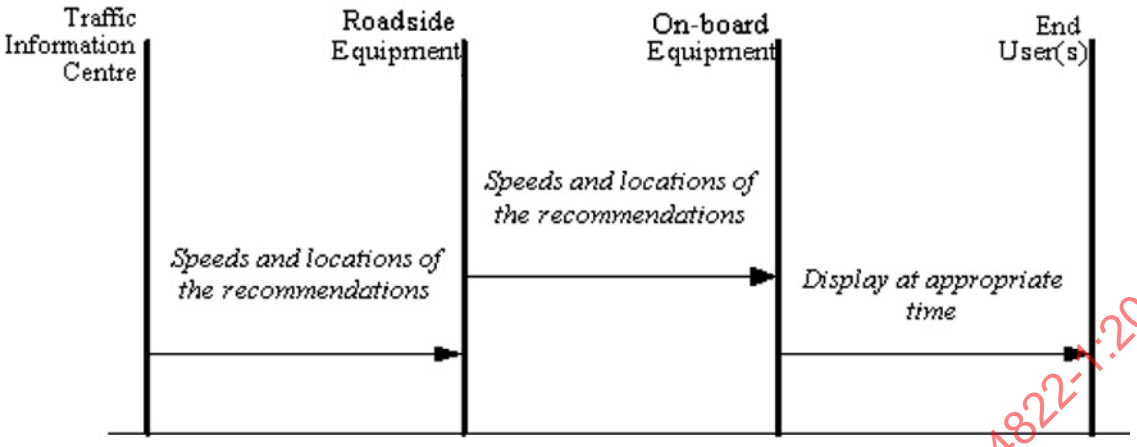


Figure 15 — Speed recommendation: data flow

5.7.4 Constraints

Consistency of speed recommendations along the route shall be guaranteed at the level of the traffic centre. It must be clear to the user of the OBU that displayed speed limits are recommended. The system should anticipate future usage by countries that decide to distinguish between mandatory and recommended speed limits.

5.7.5 Structure

The purpose of this message is to promulgate to the car information associated with a change to the recommended maximum speed that applied to the road ahead.

The message display offset is the distance between the DSRC device and the location at which the message becomes valid.

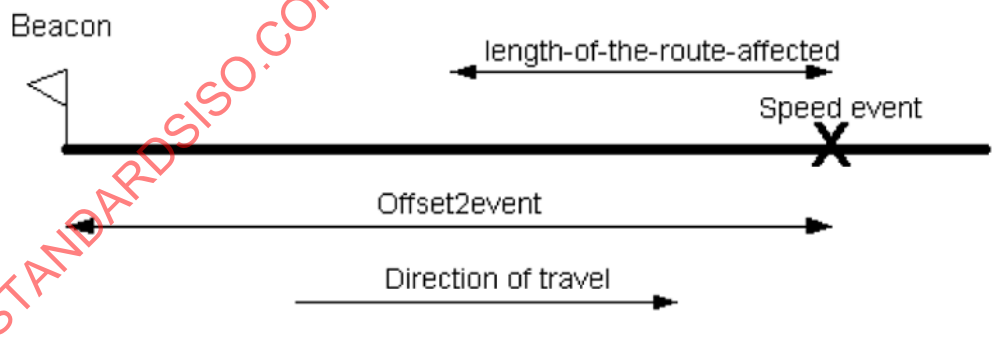


Figure 16 — Speed recommendation: structure

Overall frame structure level 4.9

The MRPI Recommended Speed frame comprises:

MRPI Application Entity Identifier	1 byte
The length of the frame (field length)	1 byte
The Application CRC	2 bytes
Number of recommended speed events	1 byte
Message duration in minutes	2 bytes
Message display offset in dam	2 bytes
LRA distance in hm	1 byte
Recommended speed (km/h)	1 byte

ASN.1 format

```
mrpi-id MrpiApplicationEntityId ::= speed-recommendation

ApplicationLength ::= INTEGER (5 .. 77)
ApplicationCrc ::= INTEGER (0 .. 65535)

RecommendedSpeed ::= SEQUENCE {
        no-of speed-events ::= INTEGER (1 .. 12),
        SpeedEvents ::= SEQUENCE {
                message-duration-in-60s ::= INTEGER (0 .. 44000),
                offset2event-in-dam ::= INTEGER (0 .. 9999),
                length-of-the-route-affected-in-hm ::= INTEGER (0 .. 255),
                recommended-speed-in-km/h ::= INTEGER (0 .. 254),
                } m (1 .. 12)
        }
```

5.8 Variable mandatory signs (Entity 10)

5.8.1 Objective

Advise the driver of equipped vehicles of mandatory condition that is remotely controlled.

5.8.2 Short description

Applied on roads where conditions demand different speed limits under different conditions. If the speed limit is enforceable, it is essential that there is no possibility that the in-vehicle message differs from that shown on road signs.

5.8.3 Data flow

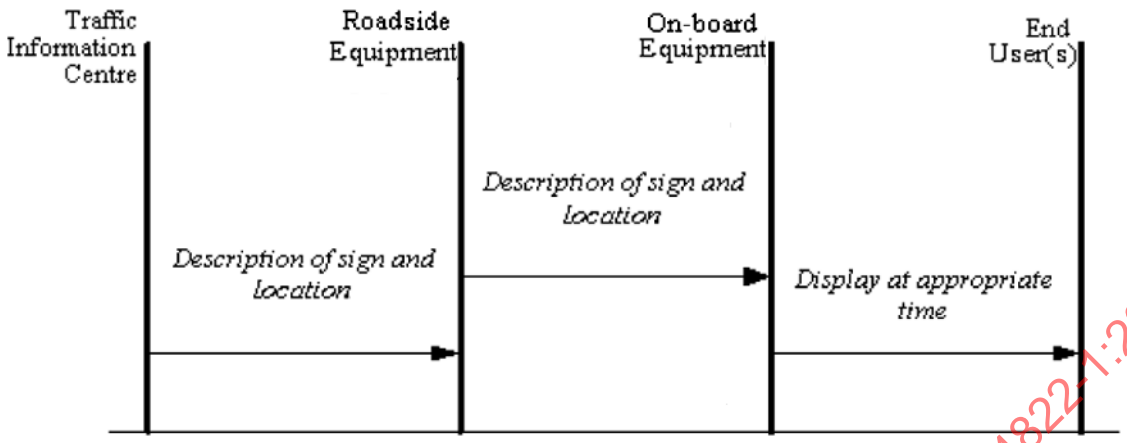


Figure 17 — Variable mandatory signs: data flow

5.8.4 Constraints

Timing constraints mean that beacons shall be controlled from the local sign setting system, not the traffic control centre. Speed control beacons shall be dedicated to that task. Vehicle systems may have driver-controlled linkage to a haptic throttle. The subject of message security will need to be further analysed to determine the most appropriate method. Some kind of secure link protocol will be necessary to enable the on-board equipment to validate the message before proceeding with any kind of automated command actions.

5.8.5 Structure

To enable an equipped vehicle to respond in safety to a reduction in speed, the DSRC device shall be located with sufficient distance upstream of the start of an enforced restriction.

The restriction start offset is the distance between the DSRC device and the location at which the restriction is applied.

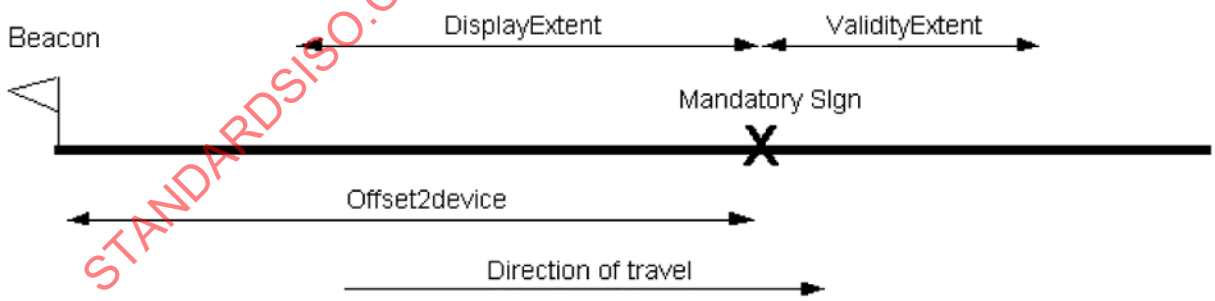


Figure 18 — Variable mandatory signs: structure

Overall frame structure level 4.10

The MRPI Mandatory Signs frame comprises:

MRPI Application Entity Identifier	1 byte
The length of the frame (field length)	1 byte
The Application CRC	2 bytes
Number of Mandatory events	1 byte
Message duration in minutes	2 bytes
Offset to device in dam	2 bytes
Area over which the sign details are to be displayed in advance of the sign in dam	1 byte
Extent after the sign for which the mandatory condition applies in hm	1 byte
Mandatory speed	1 byte

ASN.1 format

```
mrpi-id MrpiApplicationEntityId ::= variable-mandatory-speed

ApplicationLength ::= INTEGER (8 .. 51)
ApplicationCrc ::= INTEGER (0 .. 65535)

VariableMandatorySpeeds ::= SEQUENCE {
        speed-events ::= INTEGER (1 .. 12),
        mandatory-speeds ::= SEQUENCE {
                message-duration-in-60s0 (0) ::= INTEGER(0 .. 44000),
                offset2device-in-dam0 (0) ::= INTEGER (0 .. 9999),
                display-extent-in-dam0 (0) ::= INTEGER (0 .. 9999),
                validity-extent-in-hm0 (0) ::= INTEGER (0 .. 255),
                mandatory-speed0 (0) ::= INTEGER (0 .. 254),
                …..
                message-duration-in-60sn (n) ::= INTEGER(0 .. 44000),
                offset2device-in-damn (n) ::= INTEGER (0 .. 9999),
                display-extent-in-damn (n) ::= INTEGER (0 .. 9999),
                validity-extent-in-hmn (n) ::= INTEGER (0 .. 255),
                mandatory-speedn (n) ::= INTEGER (0 .. 254),
                m } (1..12)
        }
```

5.9 Weather information (Entity 11)

5.9.1 Objective

Warn the driver of equipped vehicles about local, up-stream, weather situations that could affect traffic safety.

5.9.2 Short description

In particular, this service will cover special weather situations such as fog, snow, rain, hail and (side) wind.

5.9.3 Data flow

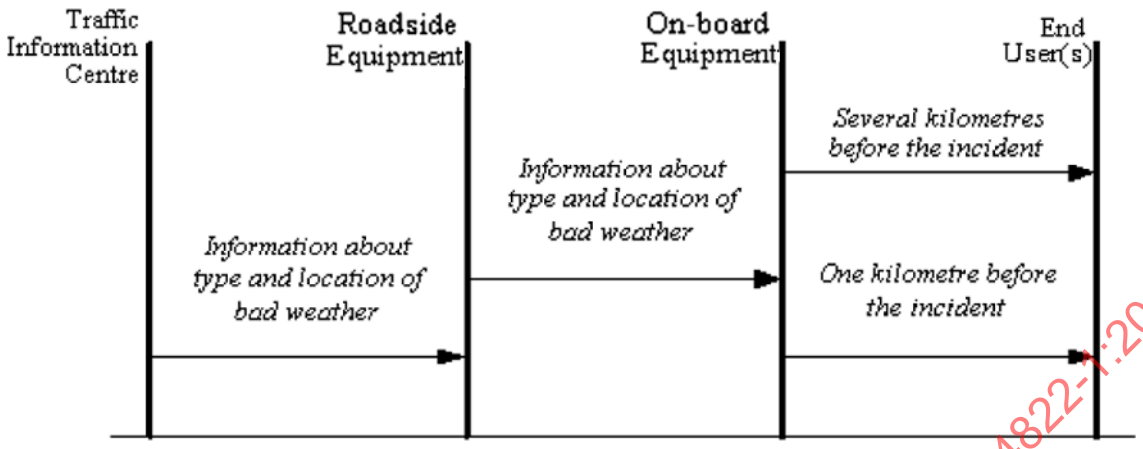


Figure 19 — Weather information: data flow

5.9.4 Constraints

Like any MRPI compliant service, the information shall be given to the driver of equipped vehicles in close proximity to the location of weather conditions: it could be done twice if necessary. However, the on-board unit shall not warn the driver of equipped vehicles for an event happening too far away from the vehicle (e.g. 100 km). Furthermore, the warning should be cancelled shortly after the vehicle has passed the location of the event.

5.9.5 Structure

A list of events covered by this service could be: heavy rain, bridge closed for heavy trucks and caravans due to gusty or heavy side wind.

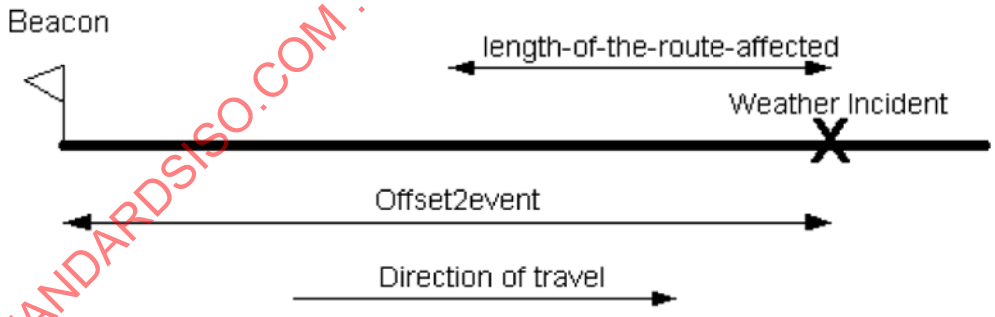


Figure 20 — Weather information: structure

Overall frame structure level 4.11

The MRPI Weather Info frame comprises:

MRPI Application Entity Identifier	1 byte
The length of the frame (field length)	1 byte
The Application CRC	2 bytes

Message duration in minutes	2 bytes
Incident location in dam	2 bytes
TMC event	2 bytes
TMC speed limit	1 byte
TMC optional qualifier	1 byte
Length of route affected in hm	1 byte

ASN.1 format

```
mrpi-id MrpiApplicationEntityId ::= weather-information

ApplicationLength ::= INTEGER (5 .. 14)
ApplicationCrc ::= INTEGER (0 .. 65535)

WeatherInformation ::= SEQUENCE {
        message-duration-in-60s ::= INTEGER (0 .. 44000),
        offset2event-in-dam ::= INTEGER (0 .. 9999),
        tmc-evt ::= INTEGER (0 .. 9999),
        tmc-sl ::= INTEGER (0 .. 254),
        tmc-oq ::= INTEGER (0 .. 99),
        length-of-the-route-affected-in-hm ::= INTEGER (0 .. 255)
        }
```

5.10 Road condition (Entity 12)

5.10.1 Objective

Warn the driver of equipped vehicles about special road conditions that affect traffic safety and/or comfort.

5.10.2 Short description

In general this service can be decomposed into:

— skid-risk warnings due to ice-forming, water, oil or other substances on the road surface;

— warnings due to defects of the road-surface itself, caused by roadworks, wear or other causes.

5.10.3 Data flow

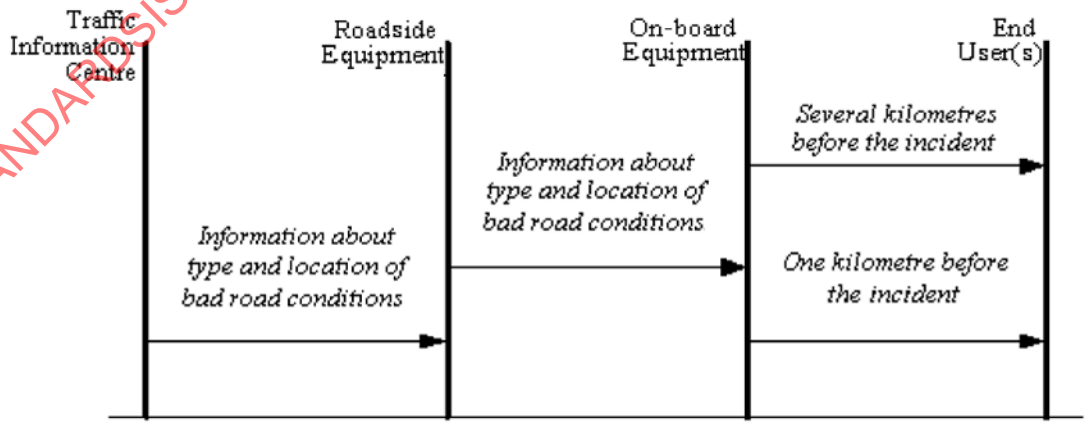


Figure 21 — Road condition: data flow

5.10.4 Constraints

Like all MRPI compliant services, the information shall be given to the driver of equipped vehicles in close proximity to the location of road condition; it could be done twice if necessary. However, the on-board unit shall not warn the driver of equipped vehicles for an event happening too far away from the vehicle (e.g. 100 km). Furthermore, the warning should be cancelled shortly after the vehicle has passed the location of the event.

5.10.5 Structure

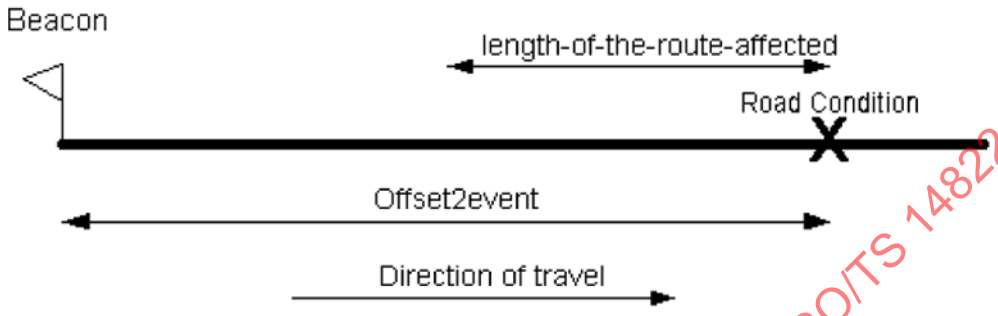


Figure 22 — Road condition: structure

Overall frame structure level 4.12

The MRPI Road Condition frame comprises:

MRPI Application Entity Identifier	1 byte
The length of the frame (field length)	1 byte
The Application CRC	2 bytes
Message duration in minutes	2 bytes
Incident location in dam	2 bytes
TMC event	2 bytes
TMC speed limit	1 byte
TMC optional qualifier	1 byte
Length of route affected in hm	1 byte

ASN.1 format

```
mrpi-id MrpiApplicationEntityId ::= road-condition

ApplicationLength ::= INTEGER (5 ..14)
ApplicationCrc ::= INTEGER (0 .. 65535)

RoadCondition ::= SEQUENCE {
        message-duration-in-60s ::= INTEGER (0 .. 44000),
        offset2event-in-dam ::= INTEGER (0 .. 9999),
        tmc-evt ::= INTEGER (0 .. 9999),
        tmc-sl ::= INTEGER (0 .. 254),
        tmc-oq ::= INTEGER (0 .. 99),
        length-of-the-route-affected-in-hm ::= INTEGER (0 .. 255)
        }
```

5.11 Rest area information (Entity 13)

5.11.1 Objective

Provide the driver of equipped vehicles with information about names, distances to and services at rest areas in real time.

5.11.2 Short description

From a functional point of view, this service will enhance driver comfort by giving information about the remaining distance to, for instance, the next rest areas with their included services. The rest area indications are displayed after a request from the driver.

5.11.3 Data flow

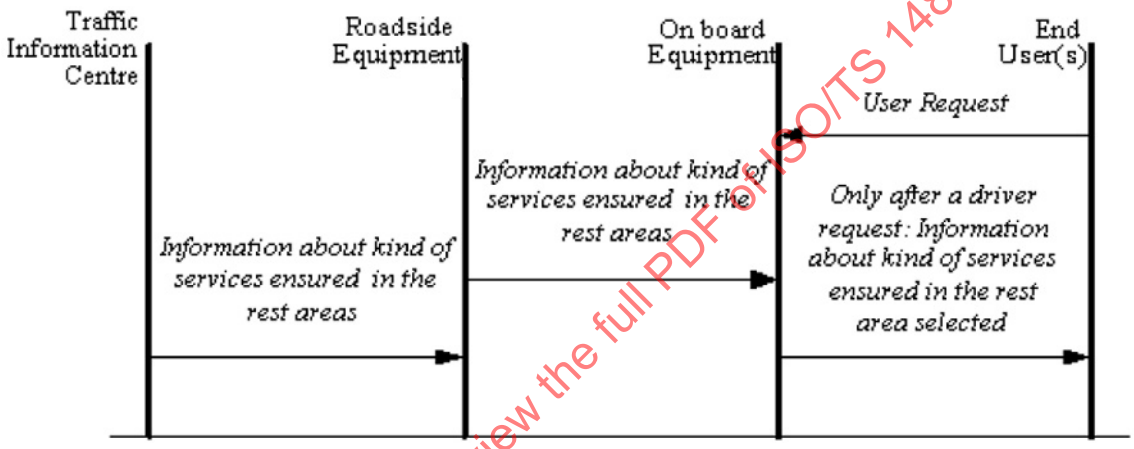


Figure 23 — Rest area information: data flow

5.11.4 Constraints

Database shall be periodically updated: temporary equipment or exhibition, new services in the rest area.

5.11.5 Structure

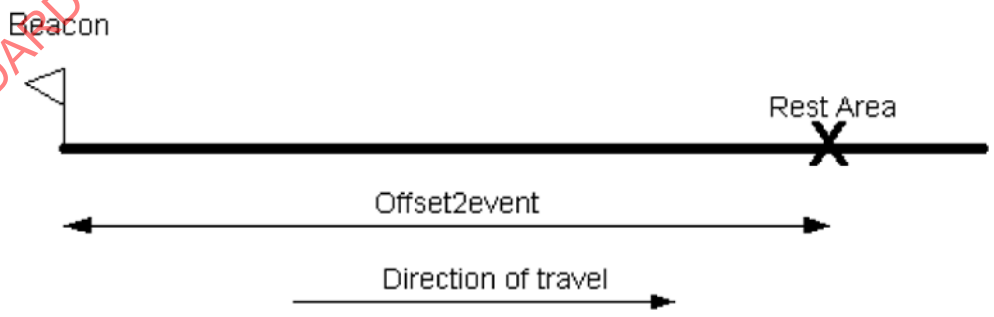


Figure 24 — Rest area information: structure

Overall frame structure level 4.13

MRPI Application Entity Identifier	1 byte
The length of the frame (field length)	1 byte
The Application CRC	2 bytes
Rest area facilities	3 bytes
Distance to facility from DSRC in dam	2 bytes
Name of facility	n bytes (Max 20)
Name of exit	n bytes (Max 20)

ASN.1 format

```
mrpi-id MrpiApplicationEntityId ::= rest-area-information

ApplicationLength ::= INTEGER (8 .. 52)
ApplicationCrc ::= INTEGER (0 .. 65535)

RestAreaInformation ::= SEQUENCE {
        rest-area-facilities ::= BITMAP {
                fuel-services (0),
                police (1),
                restaurant (2),
                cafeteria (3),
                equipment-for-disabled-persons (4),
                picnic-area (5),
                rest-area (6),
                children-play-area (7),
                information (8),
                cash-point (9),
                hotel-motel (10),
                toilet (11),
                shop (12),
                equipment-4-babies (13),
                phone (14),
                first aid (15),
                camping-caravan-facilities (16),
                not-allocated1 (17)
                not-allocated2 (18)
                not-allocated3 (19)
                not-allocated4 (20)
                not-allocated5 (21)
                not-allocated6 (22)
                not-allocated7 (23)
                },
        offset2event-in-dam ::= INTEGER (0 .. 9999),
        name-of-facility ::= PrintableString (SIZE(20)),
        name-of-exit ::= PrintableString (SIZE(20))
        }
```


5.12 Fuel station information (Entity 14)

5.12.1 Objective

Provide the driver of equipped vehicles with information about locations, distances to fuel station areas.

5.12.2 Short description

Drivers of equipped vehicles can request to be informed about the remaining distance to, for instance, the three next fuel station areas.

5.12.3 Data flow

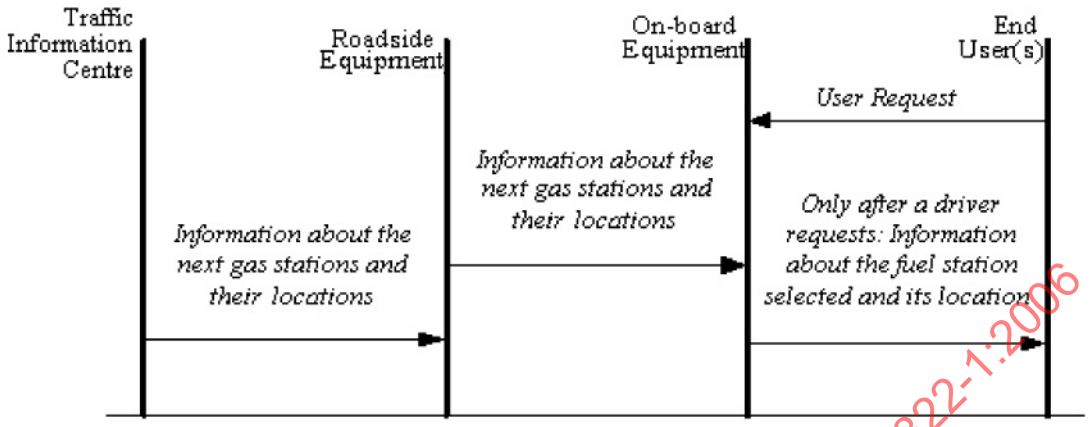


Figure 25 — Fuel station information: data flow

5.12.4 Constraints

Database might be updated daily (minor).

5.12.5 Structure

The message could have the following structure: “X km for the next fuel station”.

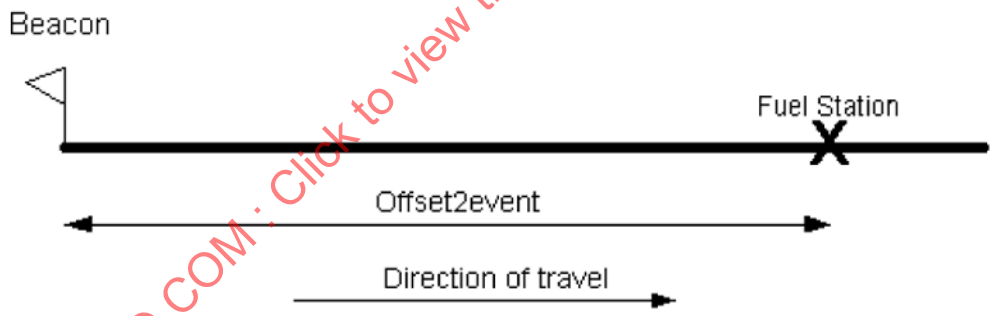


Figure 26 — Fuel station information: structure

Overall frame structure level 4.14

The MRPI Fuel Station frame comprises:

MRPI Application Entity Identifier	1 byte
The length of the frame (field length)	1 byte
The Application CRC	2 bytes
Name-of-facility	20 bytes
Brand name	10 bytes
Exit name	20 bytes
Distance from DSRC in dam	2 bytes
Currency	3 bytes
services	1 byte,
Fuel type	1 byte
Fuel price in litres*100	2 bytes

ASN.1 format

```
mrpi-id MrpiApplicationEntityId ::= fuel-station-information

ApplicationLength ::= INTEGER (5 .. 84)
ApplicationCrc ::= INTEGER (0 .. 65535)

FuelStationIformation ::= SEQUENCE {
        name-of-facility ::= PrintableString (SIZE(20)),
        name-of-brand ::= PrintableString (SIZE(10)),
        name-of-exit ::= PrintableString (SIZE(20)),
        offset2event-in-dam ::= INTEGER (0 .. 9999),
        fuel-station-services ::= BITMAP {
                breakdown-repairs-cars (0),
                breakdown-repairs-hgv (1),
                tyre-services (2),
                tyre-pressure-control(3),
                car-wash (4),
                not-allocated0 (5),
                not-allocated1 (6),
                not-allocated2 (7) },
        currency ::= PrintablrString (SIZE(3)), -- 3 characters as defined in ISO 4217
        no-of-fuel-types ::= INTEGER (0 .. 8),
        Fuel ::= SEQUENCE {
                fuel-type-0 (0) ::= FuelType,
                fuel-price in litres*100-0 (0) ::= INTEGER (0 .. 65535),
                …..
                fuel-type-n (n) ::= FuelType,
                fuel-price in litres*100-n (n) ::= INTEGER (0 .. 65535),
                m } (1 .. 8)
        }

FuelType ::= ENUMERATED {
        Super-lpr (0),
        unleaded (1),
        super-unleaded (2),
        diesel (3),
        eco-Diesel (4),
        electric-terminal (5),
        lpg (6),
        hydrogen (7)
        },
```

5.13 Parking information (Entity 15)

5.13.1 Objective

Inform the driver of equipped vehicles about the location of car parks and related data such as parking tariffs and transfer to other transport modes (modal split).

5.13.2 Short description

In inter-urban environments, car parks will often be associated with roadside service areas such as fuel stations, rest areas, restaurants and hotels. Transfer to other transport modes will be more applicable in conurbation areas. This information can be requested by the driver if available.

5.13.3 Data flow

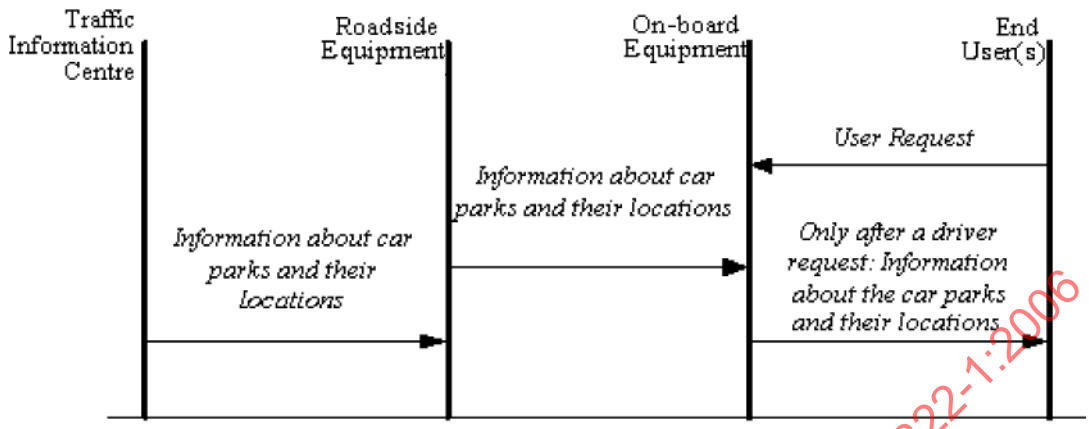


Figure 27 — Parking information: data flow

5.13.4 Constraints

None.

5.13.5 Structure

A list of information covered by this service could be: type of car park (Park & Ride in case of modal split), parking tariffs, availability info (car park full or empty).

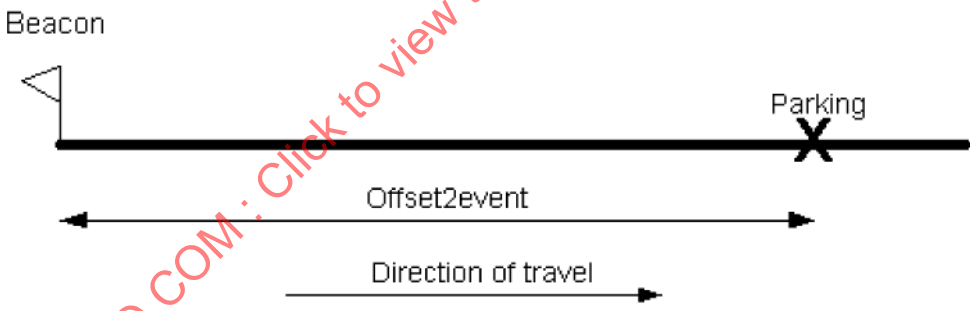


Figure 28 — Parking information: structure

Overall frame structure level 4.15

The MRPI Parking Info frame comprises:

MRPI Application Entity Identifier	1 byte
The length of the frame (field length)	1 byte
The Application CRC	2 bytes
Offset from DSRC in dam	2 bytes
Parking name	20 bytes
Exit name	20 bytes
Phone number	15 bytes
Facilities	2 bytes
Currency	3 bytes
Car park fee Car *100	2 bytes
Car park fee HGV *100	2 bytes
Car park fee Coach *100	2 bytes

ASN.1 format

```
mrpi-id MrpiApplicationEntityId ::= parking-information

ApplicationLength ::= INTEGER (5 .. 74)
ApplicationCrc ::= INTEGER (0 .. 65535)

ParkingInformation ::= SEQUENCE {
        offset2event-in-dam ::= INTEGER (0 .. 9999),
        name-of-facility ::= PrintableString SIZE(20)),
        name-of-exit ::= PrintableString SIZE(20)),
        phone-no ::= PrintableString (SIZE(15)),
        facilities ::= BITMAP {
                full (0),
                park&ride (1),
                coaches (2),
                hgv (3),

                caravans(4),
                overnight-parking (5),
                manned (6),
                cctv-monitored(7),
                indoor(8),
                multistorey(9),
                marshal-direction(10),
                handicap-facilities-access-ramps(11),
                handicap-facilities-toilets (12),
                shuttle(13)
                },
        currency ::= PrintableString SIZE(3)), -- 3 Characters as defined in ISO 4217
        fee-car ::= INTEGER (0 .. 65535),
        fee-hgv := INTEGER (0 .. 65535),
        fee-coach ::= INTEGER (0 .. 65535)
        }
```

5.14 Request for emergency call information (Entity 17)

5.14.1 Objective

Help the driver of equipped vehicles in case of an emergency.

5.14.2 Short description

In case of an emergency (breakdown or accident) on the motorway, the driver of an equipped vehicle has to call for help. To facilitate this task a DSRC system can provide some information about:

— walking distance to the nearest motorway call stations;

— accurate vehicle location on the motorway, and current telephone number of the emergency service in charge of this section of the road (in case the driver of equipped vehicles owns a mobile phone);

— guidance to drivers to move to a safe location behind the vehicle restraint barriers.