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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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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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Contents

Page

Foreword ... iv
Introduction ... v
1 Scope ... 1
2 Normative references ... 1
3 Terms, definitions and abbreviated terms ... 2
3.1 General ... 2
3.2 Data dictionary ... 3
3.3 Abbreviated terms ... 7
4 Application protocol (similar to TPEG) ... 7
4.1 Transport level ... 8
4.2 service level ... 9
4.3 Application multiplex level ... 10
4.4 Conventions and symbols ... 12
5 Application data ... 14
5.1 DSRC headers ... 15
5.2 Incident information (Entity 2) ... 17
5.3 Static road signs mandatory (Entity 5) ... 18
5.4 Static road signs information (Entity 6) ... 20
5.5 Variable message signs (text messages) (Entity 7) ... 22
5.6 Pictograms (Entity 8) ... 24
5.7 Speed recommendation (Entity 9) ... 25
5.8 Variable mandatory signs (Entity 10) ... 27
5.9 Weather information (Entity 11) ... 29
5.10 Road condition (Entity 12) ... 31
5.11 Rest area information (Entity 13) ... 33
5.12 Fuel station information (Entity 14) ... 34
5.13 Parking information (Entity 15) ... 36
5.14 Request for emergency call information (Entity 17) ... 38
5.15 Traffic conditions (Entity 20) ... 40
5.16 Diversion path (Entity 21) ... 41
5.17 Special vehicles (special transport) (Entity 22) ... 43
5.18 Journey time (Entity 23) ... 44
5.19 Roadwork (Entity 24) ... 46
Bibliography ... 49

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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

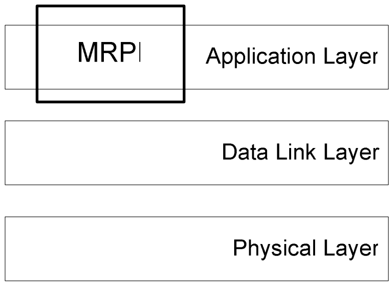
— spot communication, i.e. communications that can only take place at a precise point. This is a particularly important characteristic. The communication zone does not exceed some 10 m or 20 m in front of the beacon. At the time of communication, the position of the vehicle is accurately known, not only 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: