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**Intelligent Transport Systems (ITS);
Vehicular Communications;
Basic Set of Applications;
Part 2: Specification of Cooperative
Awareness Basic Service**

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Contents

Intellectual Property Rights	6
Foreword.....	6
Modal verbs terminology.....	6
Introduction	7
1 Scope	8
2 References	8
2.1 Normative references	8
2.2 Informative references.....	8
3 Definitions, symbols and abbreviations	9
3.1 Definitions	9
3.2 Symbols.....	10
3.3 Abbreviations	10
4 CA basic service introduction	11
4.1 Background	11
4.2 Services provided by CA basic service	11
4.3 Sending CAMs	11
4.4 Receiving CAMs	11
5 CA basic service functional description	12
5.1 CA basic service in the ITS architecture	12
5.2 CA basic service functional architecture	12
5.3 Interfaces of the CA basic service	13
5.3.1 Interface to ITS applications	13
5.3.2 Interface to data provisioning facilities.....	14
5.3.3 Interface to the Networking & Transport Layer	14
5.3.4 Interfaces protocol stacks of the Networking & Transport Layer.....	14
5.3.4.1 Interface to the GeoNetworking/BTP stack	14
5.3.4.2 Interface to the IPv6 stack and the combined IPv6/GeoNetworking stack	16
5.3.5 Interface to the Management entity.....	16
5.3.6 Interface to the Security entity.....	16
6 CAM dissemination.....	16
6.1 CAM dissemination concept	16
6.1.1 CAM dissemination requirements	16
6.1.2 CA basic service activation and termination.....	16
6.1.3 CAM generation frequency management for vehicle ITS-Ss	17
6.1.4 CAM generation frequency management for RSU ITS-Ss	18
6.1.5 CAM time requirement	18
6.1.5.1 CAM generation time.....	18
6.1.5.2 CAM Time stamp.....	18
6.2 CAM dissemination constraints	18
6.2.1 General Confidence Constraints	18
6.2.2 Security constraints.....	19
6.2.2.1 Introduction.....	19
6.2.2.2 Service Specific Permissions (SSP)	19
6.2.3 General priority constraints.....	20
7 CAM Format Specification	20
7.1 General Structure of a CAM PDU.....	20
7.2 ITS PDU header	21
7.3 Basic container	21
7.4 Vehicle ITS-S containers.....	21
7.5 RSU ITS-S containers	22
7.6 CAM format and coding rules.....	22

7.6.1	Common data dictionary	22
7.6.2	CAM data presentation	22
Annex A (normative):	ASN.1 specification of CAM	23
Annex B (normative):	Description for data elements and data frames.....	25
B.0	General requirements	25
B.1	header	25
B.2	cam	25
B.3	generationDeltaTime	25
B.4	camParameters	26
B.5	basicContainer	26
B.6	highFrequencyContainer	26
B.7	lowFrequencyContainer	26
B.8	specialVehicleContainer.....	26
B.9	basicVehicleContainerHighFrequency.....	26
B.10	basicVehicleContainerLowFrequency	27
B.11	publicTransportContainer.....	27
B.12	specialTransportContainer.....	27
B.13	dangerousGoodsContainer	27
B.14	roadWorksContainerBasic.....	27
B.15	rescueContainer.....	27
B.16	emergencyContainer.....	28
B.17	safetyCarContainer	28
B.18	stationType	28
B.19	referencePosition	28
B.20	performanceClass	28
B.21	heading	29
B.22	speed.....	29
B.23	vehicleRole.....	29
B.24	lanePosition	29
B.25	driveDirection.....	29
B.26	longitudinalAcceleration	30
B.27	accelerationControl	30
B.28	lateralAcceleration.....	30
B.29	verticalAcceleration.....	30
B.30	embarkationStatus	30
B.31	curvature.....	31
B.32	curvatureCalculationMode	31
B.33	yawRate.....	31

B.34	steeringWheelAngle	31
B.35	vehicleLength	32
B.36	vehicleWidth	32
B.37	exteriorLights	32
B.38	pathHistory	32
B.39	ptActivation	32
B.40	specialTransportType	33
B.41	dangerousGoodsBasic	33
B.42	roadworksSubCauseCode	33
B.43	closedLanes	33
B.44	trafficRule	33
B.45	speedLimit	34
B.46	lightBarSirenInUse	34
B.47	incidentIndication	34
B.48	emergencyPriority	34
B.49	rsuContainerHighFrequency	34
B.50	protectedCommunicationZoneRSU	35
B.51	cenDsrcTollingZone	35
B.52	protectedZoneLatitude	35
B.53	protectedZoneLongitude	35
Annex C (informative): Protocol operation of the CA basic service.....		36
C.1	Introduction	36
C.2	Originating ITS-S operation	36
C.2.1	Protocol data setting rules	36
C.2.2	T_CheckCamGen	36
C.2.3	Originating ITS-S message table	36
C.2.4	General protocol operation	37
C.2.5	CAM construction exception	37
C.3	Receiving ITS-S operation	37
C.3.1	Protocol data setting rules	37
C.3.2	General protocol operation	37
C.3.3	Exception handling	38
C.3.3.1	CAM decoding exception	38
Annex D (informative): Flow chart for CAM generation frequency management		39
Annex E (informative): Extended CAM generation		43
History		44

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Foreword

This European Standard (EN) has been produced by ETSI Technical Committee Intelligent Transport Systems (ITS).

The present document is part 2 of a multi-part deliverable covering Vehicular Communications; Basic Set of Applications, as identified below:

TS 102 637-1: "Functional Requirements";

EN 302 637-2: "Specification of Cooperative Awareness Basic Service";

EN 302 637-3: "Specifications of Decentralized Environmental Notification Basic Service".

The specification of the CA basic service was initially developed by the European Car-to-Car Communication Consortium, see Car2Car Communication Consortium Manifesto [i.2]. The service was evaluated by several initiatives such as the C2C-CC demonstration in 2008, ETSI Plugtests events and European projects including PRE-DRIVE C2X, DRIVE C2X, SafeSpot, CVIS, CoVeL, eCoMove SCOR@F and simTD. These evaluation efforts have provided feedback to ETSI TC ITS.

The present document replaces ETSI TS 102 637-2 in whole. It includes improvements and enhancements of the CA basic service specifications in ETSI TS 102 637-2 according to the feedback provided by the various initiatives.

National transposition dates

Date of adoption of this EN:	18 November 2014
Date of latest announcement of this EN (doa):	28 February 2015
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	31 August 2015
Date of withdrawal of any conflicting National Standard (dow):	31 August 2016

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**may not**", "**need**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the [ETSI Drafting Rules](#) (Verbal forms for the expression of provisions).

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Introduction

Cooperative awareness within road traffic means that road users and roadside infrastructure are informed about each other's position, dynamics and attributes. Road users are all kind of road vehicles like cars, trucks, motorcycles, bicycles or even pedestrians and roadside infrastructure equipment including road signs, traffic lights or barriers and gates. The awareness of each other is the basis for several road safety and traffic efficiency applications with many use cases as described in ETSI TR 102 638 [i.1]. It is achieved by regular exchange of information among vehicles (V2V, in general all kind of road users) and between vehicles and road side infrastructure (V2I and I2V) based on wireless networks, called V2X network and as such is part of Intelligent Transport Systems (ITS).

The information to be exchanged for cooperative awareness is packed up in the periodically transmitted Cooperative Awareness Message (CAM). The construction, management and processing of CAMs is done by the Cooperative Awareness basic service (CA basic service), which is part of the facilities layer within the ITS communication architecture ETSI EN 302 665 [1] supporting several ITS applications.

The CA basic service is a mandatory facility for all kind of ITS-Stations (ITS-S), which take part in the road traffic (vehicle ITS-S, personal ITS-S, etc.). The present document focuses on the specifications for CAMs transmitted by all vehicle ITS-Ss participating in the V2X network. Nevertheless, the present document defines the CAM format with flexibility in order to be easily extendable for the support of other types of ITS-Ss or future ITS applications.

The requirements on the performance of the CA basic service, the content of the CAM and the quality of its data elements are derived from the Basic Set of Applications (BSA) as defined in ETSI TR 102 638 [i.1] and in particular from the road safety applications as defined in ETSI TS 101 539-1 [i.8], ETSI TS 101 539-2 [i.9], and ETSI TS 101 539-3 [i.10].

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1 Scope

The present document provides the specifications of the Cooperative Awareness basic service (CA basic service), which is in support of the BSA road safety application.

This includes definition of the syntax and semantics of the Cooperative Awareness Message (CAM) and detailed specifications on the message handling.

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at <http://docbox.etsi.org/Reference>.

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2.1 Normative references

The following referenced documents are necessary for the application of the present document.

- [1] ETSI EN 302 665 (V1.1.1): "Intelligent Transport Systems (ITS); Communications Architecture".
- [2] ETSI TS 102 894-2 (V1.2.1): "Intelligent Transport Systems (ITS); Users and applications requirements; Part 2: Applications and facilities layer common data dictionary".
- [3] SAE J2735 (2009-11-19): "Dedicated Short Range Communications (DSRC) Message Set Dictionary".

NOTE: Available at http://standards.sae.org/j2735_200911/.

- [4] Recommendation ITU-T X.691/ISO/IEC 8825-2 (1997-12): "Information technology - ASN.1 encoding rules: Specification of Packed Encoding Rules (PER)".
- [5] ETSI EN 302 663 (V1.2.1): "Intelligent Transport Systems (ITS); Access layer specification for Intelligent Transport Systems operating in the 5 GHz frequency band".

2.2 Informative references

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

- [i.1] ETSI TR 102 638 (V1.1.1) (2009-06): "Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Definitions".
- [i.2] Car2Car Communication Consortium (2007-08): "Car2Car Communication Consortium Manifesto", Version 1.1.

NOTE: Available at <http://www.car-to-car.org/>.

- [i.3] ETSI TR 102 863 (V1.1.1) (2011-06): "Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Local Dynamic Map (LDM); Rationale for and guidance on standardization".
- [i.4] ETSI TS 102 636-3 (V1.1.1): "Intelligent Transport Systems (ITS); Vehicular Communications; GeoNetworking; Part 3: Network architecture".

- [i.5] ETSI EN 302 636-4-1 (V1.2.1): "Intelligent Transport Systems (ITS); Vehicular Communications; GeoNetworking; Part 4: Geographical addressing and forwarding for point-to-point and point-to-multipoint communications; Sub-part 1: Media-Independent Functionality".
- [i.6] ETSI TS 102 894-1 (V1.1.1): "Intelligent Transport System (ITS); Users & Applications requirements; "Intelligent Transport Systems (ITS); Users and applications requirements; Part 1: Facility layer structure, functional requirements and specifications".
- [i.7] ETSI EN 302 636-5-1 (V1.2.1): "Intelligent Transport Systems (ITS); Vehicular Communications; GeoNetworking; Part 5: Transport Protocols; Sub-part 1: Basic Transport Protocol".
- [i.8] ETSI TS 101 539-1 (V1.1.1): "Intelligent Transport Systems (ITS); V2X Applications; Part 1: Road Hazard Signalling (RHS) application requirements specification".
- [i.9] ETSI TS 101 539-2: "Intelligent Transport System (ITS); V2X Applications; Part 2: Intersection Collision Risk Warning (ICRW) application requirements specification".
- [i.10] ETSI TS 101 539-3 (V1.1.1): "Intelligent Transport Systems (ITS); V2X Applications; Part 3: Longitudinal Collision Risk Warning (LCRW) application requirements specification".
- [i.11] ETSI TS 102 723-5: "Intelligent Transport Systems (ITS); OSI cross-layer topics; Part 5: Interface between management entity and facilities layer".
- [i.12] ETSI TS 102 723-9: "Intelligent Transport Systems; OSI cross-layer topics; Part 9: Interface between security entity and facilities layer".
- [i.13] ETSI TS 102 723-11: "Intelligent Transport Systems (ITS); OSI cross-layer topics; Part 11: Interface between networking and transport layer and facilities layer".
- [i.14] ETSI TS 102 890-3: "Intelligent Transport System (ITS); Facilities layer function; Part 3: Position and time facility specification".
- [i.15] ISO EN 17419: "Intelligent Transport Systems -- Cooperative Systems -- Classification and management of ITS applications in a global context".
- [i.16] ETSI TS 102 724 (V1.1.1): "Intelligent Transport Systems (ITS); Harmonized Channel Specifications for Intelligent Transport Systems operating in the 5 GHz frequency band".
- [i.17] ETSI TS 103 097 (V1.1.1): "Intelligent Transport Systems (ITS); Security; Security header and certificate formats".
- [i.18] ETSI TR 102 965 (V1.1.1): "Intelligent Transport Systems (ITS); Application Object Identifier (ITS-AID); Registration list".
- [i.19] ISO 1176: "Road vehicles - Masses - Vocabulary and codes".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in ETSI EN 302 665 [1], ETSI EN 302 663 [5], LDM given in ETSI TR 102 863 [i.3] and DE and DF given in SAE J2735 [3] and the following apply:

basic set of applications: group of applications, supported by vehicular communication system

NOTE: The basic set of applications are defined in ETSI TR 102 638 [i.1].

Cooperative Awareness (CA) basic service: facility at the ITS-S facilities layer to generate, receive and process the CAM

Cooperative Awareness Message (CAM): CA basic service PDU

Cooperative Awareness Message (CAM) data: partial or complete CAM payload

Cooperative Awareness Message (CAM) protocol: ITS facilities layer protocol that operates the CAM transmission and reception

empty vehicle: complete vehicle kerb mass as defined in ISO 1176, clause 4.6 [i.19]

V2X: either vehicle to vehicle (V2V), or vehicle to infrastructure (V2I) and/or infrastructure to vehicle (I2V)

3.2 Symbols

For the purposes of the present document, the following symbols apply:

IF.CAM	Interface between CAM basic service and LDM or ITS application
IF.FAC	Interface between CAM basic service and other facilities layer entities
IF.N&T	Interface between CAM basic service and ITS networking & transport layer
IF.SEC	Interface between CAM basic service and ITS security entity

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

API	Application Programming Interface
ASN.1	Abstract Syntax Notation 1
BSA	Basic Set of Applications
BTP	Basic Transport Protocol
CA	Cooperative Awareness
CAM	Cooperative Awareness Message
CCH	Control CHannel
DCC	Decentralized Congestion Control
DE	Data Element
DENM	Decentralized Environmental Notification Message
DF	Data Frame
FA-SAP	Facilities/Applications Service Access Point
GN	GeoNetworking
HF	High Frequency
HMI	Human Machine Interface
I2V	Infrastructure-to-Vehicle
ID	Identifier
ISO	International Standards Organisation
ITS	Intelligent Transport Systems
ITS-G5A	ITS Frequency band 5,875 GHz to 5,905 GHz dedicated for safety related applications
ITS-S	ITS station
ITS-ST	ITS Station Time
LDM	Local Dynamic Map
LF	Low Frequency
MF-SAP	Management/Facilities Service Access Point
MIB	Management Information Base
MSB	Most Significant Bit
N&T	Networking & Transport Layer
NF-SAP	Networking & Transport/Facilities Service Access Point
OSI	Open System Interconnection
PCI	Protocol Control Information
PDU	Packet Data Unit
PER	Packed Encoding Rules
POTI	Position and Time management
RSU	Road Side Unit
SAE	Society of Automotive Engineers
SAP	Service Access Point
SF-SAP	Security Facilities - Service Access Point
SHB	Single-Hop Broadcasting
SSP	Service Specific Permissions
TC	Technical Committee

TR	Technical Report
V2I	Vehicle-to-Infrastructure
V2V	Vehicle-to-Vehicle
VDP	Vehicle Data Provider

4 CA basic service introduction

4.1 Background

Cooperative Awareness Messages (CAMs) are messages exchanged in the ITS network between ITS-Ss to create and maintain awareness of each other and to support cooperative performance of vehicles using the road network. A CAM contains status and attribute information of the originating ITS-S. The content varies depending on the type of the ITS-S. For vehicle ITS-Ss the status information includes time, position, motion state, activated systems, etc. and the attribute information includes data about the dimensions, vehicle type and role in the road traffic, etc. On reception of a CAM the receiving ITS-S becomes aware of the presence, type, and status of the originating ITS-S. The received information can be used by the receiving ITS-S to support several ITS applications. For example, by comparing the status of the originating ITS-S with its own status, a receiving ITS-S is able to estimate the collision risk with the originating ITS-S and if necessary may inform the driver of the vehicle via the HMI. Multiple ITS applications may rely on the CA basic service. It is assigned to domain application support facilities in ETSI TS 102 894-1 [i.6].

Besides the support of applications the awareness of other ITS-S gained by the CA basic service may be used in the networking & transport layer for the position dependent dissemination of messages, e.g. DENM by GeoBroadcasting as specified in ETSI EN 302 636-4-1 [i.5]. The generation and transmission of CAM is managed by the CA basic service by implementing the CAM protocol.

4.2 Services provided by CA basic service

The CA basic service is a facilities layer entity that operates the CAM protocol. It provides two services: sending and receiving of CAMs. The CA basic service uses the services provided by the protocol entities of the ITS networking & transport layer to disseminate the CAM.

4.3 Sending CAMs

The sending of CAMs comprises the generation and transmission of CAMs. In the course of CAM generation the originating ITS-S composes the CAM, which is then delivered to the ITS networking & transport layer for dissemination. The dissemination of CAMs may vary depending on the applied communication system. In the ITS-G5A network, defined in ETSI EN 302 663 [5], CAMs are sent by the originating ITS-S to all ITS-Ss within the direct communication range. This communication range may, inter alia, be influenced in the originating ITS-S by changing the transmit power.

CAMs are generated periodically with a frequency controlled by the CA basic service in the originating ITS-S. The generation frequency is determined taking into account the change of own ITS-Ss status, e.g. change of position or speed as well as the radio channel load as determined by DCC.

4.4 Receiving CAMs

Upon receiving a CAM, the CA basic service makes the content of the CAM available to the ITS applications and/or to other facilities within the receiving ITS-S, such as a Local Dynamic Map (LDM).

5 CA basic service functional description

5.1 CA basic service in the ITS architecture

Sending CAMs as part of the CA basic service shall be present in all ITS-S, which take part in the road traffic (vehicle ITS-S, personal ITS-S, etc.).

The CA basic service is a facilities layer entity of the ITS-S architecture as defined in ETSI EN 302 665 [1]. It may interface with other entities of the facilities layer and with the ITS application layer in order to collect relevant information for CAM generation and to forward the received CAM content for further processing. The CA basic service within the ITS-S architecture and the logical interfaces to other layers and potentially to entities within the facility layer are presented in Figure 1.

In a vehicle ITS-S entities for the collection of data may be the Vehicle Data Provider (VDP) and the Position and Time management (POTI) and for received data the Local Dynamic Map (LDM) as receiving terminal. The VDP is connected with the vehicle network and provides the vehicle status information. The POTI, as specified in ETSI TS 102 890-3 [i.14], provides the position of the ITS-S and time information. The LDM as outlined in ETSI TR 102 863 [i.3] is a database in the ITS-S, which may be updated with received CAM data. ITS applications may retrieve information from the LDM for further processing.

The CA basic service interfaces through the NF-SAP with the networking & transport layer (N&T) for exchanging of CAM messages with other ITS-Ss, the SF-SAP with the Security entity to access security services for CAM transmission and CAM reception, the MF-SAP with the Management entity and the FA-SAP with the application layer if received CAM data are provided directly to the applications.

The functionalities of the CA basic service are defined in clause 5.2, the interfaces in Figure 2 are defined in clause 5.3.

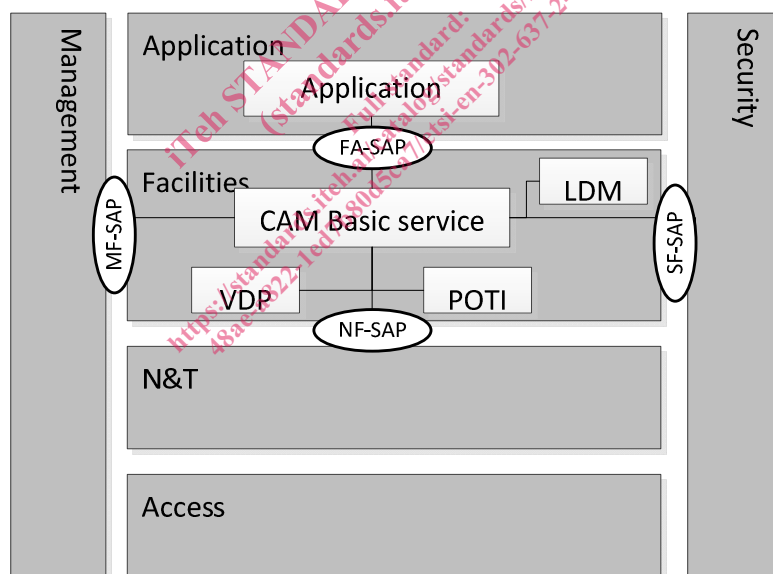


Figure 1: CA basic service within the ITS-S architecture

5.2 CA basic service functional architecture

The CA basic service is part of the Application Support domain of the Facilities Layer according to ETSI TS 102 894-1 [i.6]. Figure 2 shows the functional block diagram with the functional blocks of the CA basic service and interfaces to other facilities and layers, which are detailed in the following. The interfaces to other entities and layers are defined in clause 5.3.