



French C-ITS Deployment Coordination committee

Master technical specifications for V2X use cases

2.4.1.1_M_Master_V2X

Activity 2: Studies

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			Retroaction n°1169 : Specification of use case B2d (Scoop) Retroaction n°1610 : No modification on D11 use case. Same validity duration indicated for B2d use case.	
15/06/2023	4.50	A.LE CALVEZ	Remarks of May 2023 COCSIC Studies taken into account. Retroaction n°1610 rejected. Deletion of B2d in the Vro-ITS-S triggering conditions table.	COCSIC
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24/06/2024	4.70	Younes BOUCHAALA AMO DMR	Diffusion COCSIC Studies.	COCSIC Studies.

Black highlighted text are problem with standards.

The following legend is used on master document tables (next sub-chapters) and on profiles in each UC documents:

Standard / Field: if status is mandatory in standard: **bold**, If optional: *italic*.

Profile / Status:

- If mandatory: **v**
- If optional in standard:
 - Used (**U**) when always used
 - Not used (**x**) when never used. However, at reception, ITS-S receiving a message with not used **x** DE shall not discard the message.
 - Sometimes (**S**) when it depends.

Profile / Content: important settings or information are in ***bold italic pink underline***.

Quality rules

Reference to the version administration

Version number to be composed of 3 digits > vR.XY

- **R** corresponds to the release number: it is upgraded each time SC Studies validates the diffusion of a new release,
- **X** is the major version number: it is upgraded each time SC Studies validates the deliverable,
- **Y** is the minor version number: it is upgraded each time a contributor changes anything.

Once the deliverable is approved, its version number is upgraded from vR.XY to vR.(X+1)0

Once the deliverable is release, its version number is upgraded from vR.XY to v(R+1).00

As illustration:

- 0.03 > Work in progress version
- 0.10 > Del. Approved by SC Studies but not released
- 2.00 > Del. approved & released (in release 2)
- 2.05 > Del. Updated - in progress version

Requirements identification & traceability

In this document, the following verbal forms are used to indicate requirements: **Shall / Shall not**

Recommendations shall be indicated by the verbal forms: **Should / Should not**

Permissions shall be indicated by the verbal forms: **May / May not**

Possibility and capability shall be indicated by the verbal forms: **Can / Cannot**

Inevitability used to describe behaviour of systems beyond of the scope of this del. shall be indicated by: **Will / Will not**

Facts shall be indicated by the verbal forms: **Is / Is not**

In the table here below:

2.4.X.XX > is the number given to the deliverable (e.g. 2.4.4.8)

YYYY > for digit are given to identifying which component/entity the requirement is addressing (e.g. LTCA for long term certificate authority)

ZZZ > is the numeration of the requirement

ID	2.4.X.XX-YYYY-ZZZ
Component(s)	(e.g.) Vru-ITS-S, Vrq-ITS-S, R-ITS-S, PKI
Requirement	(e.g.) An ITS station SHALL be able to request and get a Long term Certificate (LTC) from the SCOOP Public Key Infrastructure (PKI).
Acceptance	(e.g.) CA1: Vru-ITS-S sends a LTC request to the LTCA CA2: R-ITS-S relays the LTC request CA3: The LTCA verifies the request and sends a response CA4: The R-ITS-S relays the response CA5: The response is received by the Vru-ITS-S and is valid
Additional information	

Acronyms & abbreviations

API	Application Programming Interface
CAM	Cooperative Awareness Message
CAN_bus	Controller Area Network BUS: Cabling inside a vehicle transmitting electronic data.
CC/SCC	causeCode/subCauseCode
C-ITS	Cooperative Intelligent Transport Systems
C-ITS-S	Cooperative ITS Station
DATEX	Data Exchange : A data exchange protocol, structured in a set of technical annexes, containing also a database of road traffic related events, standardized by the CEN under the number 16157.
DE	Data Element
DENM	Decentralized Environmental Notification Message
DF	Data Frame
DSL	Dynamic Speed Limit
ETA	Estimated Time of Arrival
eVMS	embedded VMS
GLOSA	Green Light Optimal Speed Advisory
GNSS	Global navigation satellite system, system used for positioning and road segment identification
GPS	Global Positioning System : American GNSS
HMI	Human-Machine Interface
I2V	Infrastructure To Vehicle
ICPU	Name for the basic part of a Vro-ITS-S
ITS	Intelligent Transport Systems
ITS AID	ITS-Application Identifier
IVI	Infrastructure to Vehicle Information
MAP	Map data
MCTO	Multimodal Cargo Transport Optimization
Nfr-ITS-S	French National ITS Station
PF	Platform
R-ITS-S	Roadside ITS Station (RSU in the French Terminology)
RLT	Road and Lane Topology
RR-ITS	Regulatory Region ITS
RWW+	RoadWorks Warning enhanced
SPAT	Signal Phase and Timing
SSP	Service Specific Permissions
TCC	Traffic Control Centre
TLM	Traffic Light Maneuver
TLOGS	Records related to Technical data
TMS	Traffic Management System
UC	Use Case
ULOGS	Records related to User data
VDS	Vehicle Descriptor Section
V-ITS-S	Vehicular ITS Station
VMS	Variable Message Sign
Vro-ITS-S	Road operator V-ITS-S
Vru-ITS-S	Road user V-ITS-S
WMI	World Manufacturer Identifier
WWD	Wrong-Way Driving

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1. Introduction

1.1. Purpose of the document

This Master_V2X document contains the common technical specifications for V2X C-ITS use cases in France. They are valid for each use case of the 2.4.1.1_M activity.

Note that 2.4.1.1_M activity does not explain architecture concerns which are described in 2.4.1_M deliverable, nor functional descriptions that are detailed in 2.2_H / catalogue deliverable. However, this document contains a chapter on the first level of C-ITS architecture in France.

Indeed, the present specification is a legacy of the SCOP₁ project.

The general objective of the SCOP₁ project was to test the implementation conditions for the cooperative systems. The stakes of the project were as follows:

- Improve road safety
- Optimise the management and impact of traffic and road information
- Help reduce environmental pressures, especially greenhouse gas emissions
- Optimise the costs of managing the infrastructure and develop new services, including intermodal
- Help prepare the vehicles of tomorrow

This deliverable now presents the specifications of C-ITS use-cases in V2X context. Those specification are in a migrated version.

- The first objective (chapter 2) of this document is to define the “Master” technical specifications for V2X use-cases (SCOP₁ or not), especially by defining CAM (Cooperative Awareness Message) and DENM (Decentralized Environmental Notification Message) specifications. It addresses the nomenclature based on the transmitters (V-ITS-S) and use cases, and explains the mandatory fields that have to be filled in and the optional ones.
- The second objective (chapter 3) is to recall /define the SCOP₁ use-cases and associated parameters, compliant with the Master technical choices (chapter 2). The list of SCOP₁ use-cases is given at the beginning of the chapter 3.
- The third objective (chapter 4) of the document is to recall the architecture of the SCOP₁ project specifications, 100% G5. However, the reader must be aware that the dedicated chapter defines the first SCOP₁ architecture 100% G5 and that the global architecture with hybrid communication and smartphone application is presented in the 2.4.1_M document, which is an upper rank reference than the present document.

1.2. Set of 2.4.1.1_M documents

The set of 2.4.1.1_M document is composed of :

- **Master_V2X document (this document)**
- **A4 - Detection of a vehicle in a critical area (V2I)**
- **A5 – Wrong way users detection (V2I)**
- **B7 - In-vehicle signage embedded mobile VMS) (i.e eVMS from Vro itself) (Vro2V)**
- **D12 - Emergency Vehicle Approaching (V2V)**
- **G2 - Traffic signal priority request by designated vehicles (V2I)**
- **I5 - Vulnerable user at a public transport stop (Vpt2V)**
- **K4 – Detection of a vehicle in distress in a level crossing critical area (V2I)**
- **L2 - Stationary law enforcement vehicle (Vlev2V)**

Exception : this document contains the details on SCOOP₁ I2V use-cases (A1-2-3, B2, B3, D1-2-3-4-5-6-8-10-11 and E6) in a dedicated chapter “SCOOP₁ V2X use cases). They are not in separated documents.

2. Master technical choices in V2X context

2.1. General concept of CAM and DENM

Two main types of cooperative messages are used to realize SCOP₁ use cases: the CAM (Cooperative Awareness Message) and DENM (Decentralized Environmental Notification Message). They are explained by standards and all use cases of C-ITS projects are specified based on the body of standards presented in the 2.4.1bis_M document.

CAM are intended to activate the cooperative awareness (i.e. locate in real time the vehicles or cooperative infrastructure and signal the position and state of the vehicles). CAM are transmitted regularly by the V-ITS-S and all of the C-ITS-S within range can receive and process them.

DENM are warning messages intended to be broadcast in a geographic zone. They are only transmitted during an unexpected event. They are triggered automatically (involving different sensors on the vehicle) or can result from a (driver's or operator's) manual action via an HMI embedded in the vehicle.

These messages can also be transmitted by the R-ITS-Ss to broadcast information from the operator, generally coming from a TMS (see 2.4.1.2_M documents).

CAM architecture is described in following figure. It is composed by mandatory data (ITS PDU header, Basic container containing in particular the ID and the last geographic positions of the ITS station as well as the High Frequency (HF) container containing the vehicle's fast-changing data) and conditional data, which should be specified based on the message's sender.

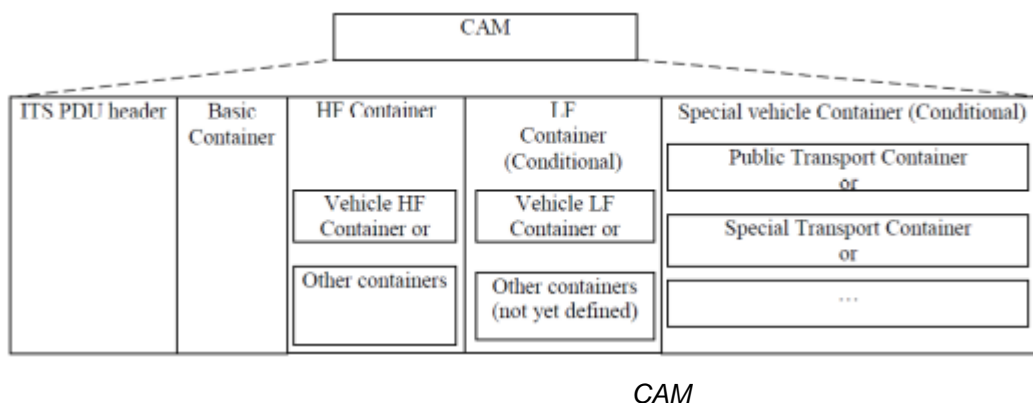


Figure 1: Structure of a

DENM architecture is described in following figure. A header followed by a set of containers including different sets of unitary fields to be filled defines DENM.

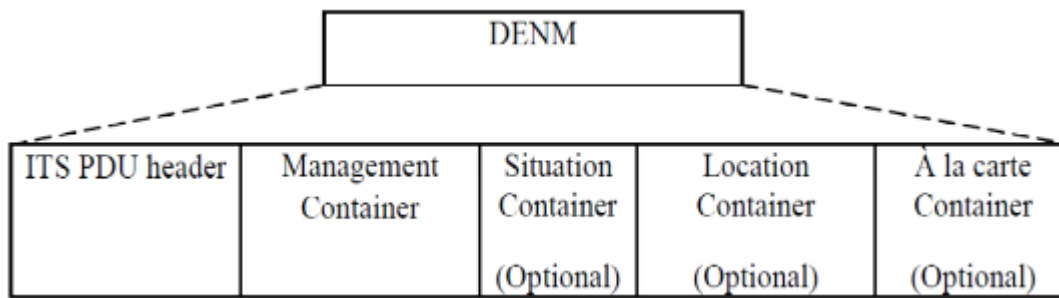


Figure 2: Structure of a

DENM

The structure of secure messages (CAM or DENM) is presented in the 2.4.4.X documents.

2.2. Choice of fields to fill in and how to fill them in

- All of the mandatory fields in CAM and DENM standards are considered as mandatory for this deliverable, which may specify how to fill them in.
- For all optional fields in the CAM and DENM standards, this document states (status) if they are needed or not for the C-ITS projects.

If the information is not available for the C-ITS station and the element is mandatory in the standard, the data element **should** be filled in with “unavailable”, if the value “unavailable” exist in the standard. If the data element is optional, the field **can** be absent of the encoded message in ASN.

For example: The elements of the CAM or DENM standards, which specifically concern the information presented on the CAN_bus of vehicles cannot be supplied by the ITS stations not connected to the vehicle's CAN_bus. If the element is mandatory in the standard and a value “unavailable” exists, it is used.

2.3. CAM




This chapter describes the CAM profile from standard and the choices made for the projects concerned by this document.

ID	2.4.1.1_M_Master_CAMessageProfile
Component(s)	Broadcast: V-ITS-S Reception: R-ITS-S, Nfr
Requirement	The CAM transmitted by the V-ITS-S shall respect what is expected in the following table.
Acceptance	Referring to the “Status for the UC” column in the table: CA1: All mandatory v DE and used U DE shall be present in the message emitted, with the defined values. CA2: All optional S DE can be present in the message emitted. See expected values in the table when defined. CA3: Not used DE: x . Message shall not be discarded at reception if the DE is present.
Additional information	

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CAM ETSI Standard status		CAM Master choices V2X		
Field	Type of data	Status	Comments	Value set
Header				
protocolVersion	INTEGER (0..255)	✓	Version for is ETSI EN 302 637-2 1.3.1 (2019-04), referenced in the DA, is 2.	(is 2)
messageID	denm(1), cam(2), poi(3), spatem(4), mapem(5), ivim(6), ev-rsr(7), tistpgtransaction(8), srem(9), ssem(10), evcsn(11), saem(12), rtcmem(13)	✓	cam (2)	(is 2)
stationID	INTEGER(0..4294967295)	✓	INTEGER (0.4294967295) StationID is computed from the pseudonym certificate, see deliverable 2.4.4.8_M	
CoopAwareness				
generationDeltaTime	INTEGER { oneMilliSec(1) } (0..65535)	✓	Generation time of the CAM « The value of the DE shall be wrapped to 65 536. This value shall be set as the remainder of the corresponding value of Timestamppls divided by 65 536 as below: generationDeltaTime = Timestamppls mod 65 536 »	
>BasicContainer				
StationType	(0), pedestrian (1), cyclist (2), moped (3), motorcycle (4), passengerCar (5), bus (6), lightTruck (7), heavyTruck (8), trailer (9), specialVehicles (10), tram (11), roadSideUnit (15)	✓	The Vru-ITS-S should use the code (5). The Vro-ITS-S should use : <ul style="list-style-type: none"> In user mode : (5), (7) or (8), depending on the vehicle type, in user mode In operator mode : (9) if FLR and (10) for all other operator vehicles 	
ReferencePosition >	SEQUENCE (see four next lines)	✓	Vehicle's position and related precision. This measurement is made on the temporal basis of B.3 GenerationDeltaTime	
>latitude	INTEGER {oneMicrodegreeNorth (10), oneMicrodegreeSouth (-10), unavailable(900000001) } (-900000000..900000001)	✓	latitude of the front central point of the bumper	
>longitude	INTEGER {oneMicrodegreeEast (10), oneMicrodegreeWest (-10), unavailable(1800000001) } (-1800000000..1800000001)	✓	longitude of the front central point of the bumper	
>confidencePositionEllipse	SEQUENCE { semiMajorConfidence SemiAxisLength, semiMinorConfidence SemiAxisLength, semiMajorOrientation HeadingValue}	✓	The precision, obtained based on a PositionEllipse Confidence, should be 95% Failing this, it is declared unavailable.	
>altitude	SEQUENCE { altitudeValue AltitudeValue, altitudeConfidence AltitudeConfidence}	✓	If known. If not, set to unavailable value.	
>HighFrequencyContainer > CHOICE -> basicVehicleContainerHighFrequency				

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CAM ETSI Standard status		CAM Master choices V2X		
Field	Type of data	Status	Comments	Value set
heading	<p>Heading ::= SEQUENCE {headingValue HeadingValue, headingConfidence HeadingConfidence}</p> <p>HeadingValue ::= INTEGER {wgs84North(0), wgs84East(900), wgs84South(1800), wgs84West(2700), unavailable(3601)} (0..3601)</p> <p>HeadingConfidence ::= INTEGER {equalOrWithinZeroPointOneDegree (1), equalOrWithinOneDegree (10), outOfRange(126), unavailable(127)} (1..127)</p>		Vehicle's orientation toward North.. This precision should be reliable at 95%. Failing this, the precision is declared unavailable.	
speed	<p>Speed ::= SEQUENCE {speedValue SpeedValue, speedConfidence SpeedConfidence}</p> <p>SpeedValue ::= INTEGER {standstill(0), oneCentimeterPerSec(1), unavailable(16383)} (0..16383)</p> <p>SpeedConfidence ::= INTEGER {equalOrWithinOneCentimeterPerSec(1), equalOrWithinOneMeterPerSec (100), outOfRange(126), unavailable(127)} (1..127)</p>		<p>Vehicle's speed. This precision should be reliable at 95%. Failing this, the precision is declared unavailable.</p> <p>This information is important for A1 use-case</p>	
driveDirection	<p>DriveDirection ::= ENUMERATED {forward (0), backward (1), unavailable (2)}</p>		Vehicle's direction of motion: frontwards or backwards	

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CAM ETSI Standard status		CAM Master choices V2X		
Field	Type of data	Status	Comments	Value set
vehicleLength	<p>VehicleLength ::= SEQUENCE { vehicleLengthValue VehicleLengthValue, vehicleLengthConfidenceIndica tion VehicleLengthConfidenceIndica tion } VehicleLengthValue ::= INTEGER {tenCentimeters(1), outOfRange(1022), unavailable(1023)} (1..1023)</p> <p>VehicleLengthConfidenceIndica tion ::= ENUMERATED {noTrailerPresent(0), trailerPresentWithKnownLength (1), trailerPresentWithUnknownLen gth(2), trailerPresencelsUnknown(3), unavailable(4)}</p>	✓	<p>Length of the vehicle and related precision: * the length of the vehicle includes the accessories like a trailer * the precision covers the detection of an accessory like a trailer and the knowledge of its length</p> <p>The Vro-ITS-S will indicate the maximum possible for length. This information can be tuned if it's possible to detect accessories like trailer.</p> <p>This information is important for A1 use-case</p>	
VehicleWidth	<p>VehicleWidth ::= INTEGER {tenCentimeters(1), outOfRange(61), unavailable(62)} (1..62)</p>	✓	<p>Vehicle's overall width (including the side view mirrors)</p> <p>The Vro-ITS-S will indicate the maximum possible for width.</p> <p>This information is useful for road operator (A1 use-case).</p>	
longitudinalAcceleration	<p>LongitudinalAcceleration ::= SEQUENCE { longitudinalAccelerationValue LongitudinalAccelerationValue, longitudinalAccelerationConfide nce AccelerationConfidence } LongitudinalAccelerationValue ::= INTEGER {pointOneMeterPerSecSquared Forward(1), pointOneMeterPerSecSquared Backward(-1), unavailable(161)} (-160 .. 161)</p> <p>AccelerationConfidence ::= INTEGER {pointOneMeterPerSecSquared (1), outOfRange(101), unavailable(102)} (0 .. 102)</p>	✓	<p>This information is not necessarily available for all Vro-ITS-S (without connection to the CAN_bus)</p>	

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CAM ETSI Standard status		CAM Master choices V2X		
Field	Type of data	Status	Comments	Value set
curvature	Curvature ::= SEQUENCE { curvatureValue CurvatureValue, curvatureConfidence CurvatureConfidence } CurvatureValue ::= INTEGER {straight(0), unavailable(1023)} (-1023..1023) CurvatureConfidence ::= ENUMERATED { onePerMeter-0-00002 (0), onePerMeter-0-0001 (1), onePerMeter-0-0005 (2), onePerMeter-0-002 (3), onePerMeter-0-01 (4), onePerMeter-0-1 (5), outOfRange (6), unavailable (7)}	✓	This information is not necessarily available for all Vro-ITS-S (without connection to the CAN_bus)	
curvatureCalculationMode	CurvatureCalculationMode ::= ENUMERATED {yawRateUsed(0), yawRateNotUsed(1), unavailable(2), ...}	✓	This information is not necessarily available for all Vro-ITS-S (without connection to the CAN_bus)	
yawRate	YawRate ::= SEQUENCE { yawRateValue YawRateValue, yawRateConfidence YawRateConfidence } YawRateValue ::= INTEGER {straight(0), degSec-000- 01ToRight(-1), degSec-000- 01ToLeft(1), unavailable(32767)} (- 32766..32767) YawRateConfidence ::= ENUMERATED { degSec-000-01 (0), degSec-000-05 (1), degSec-000-10 (2), degSec-001-00 (3), degSec-005-00 (4), degSec-010-00 (5), degSec-100-00 (6), outOfRange (7), unavailable (8)}	✓	Yawrate: characterises the vehicle's speed of rotation around its centre of gravity when empty: <ul style="list-style-type: none"> • negative value if rotation is clockwise (as seen from above) • positive value if rotation is counter clockwise (as seen from above) This information is not necessarily available for all Vro-ITS-S (without connection to the CAN_bus)	

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CAM ETSI Standard status		CAM Master choices V2X		
Field	Type of data	Status	Comments	Value set
<i>accelerationControl</i>	AccelerationControl ::= BIT STRING { brakePedalEngaged (0), gasPedalEngaged (1), emergencyBrakeEngaged (2), collisionWarningEngaged (3), accEngaged (4), cruiseControlEngaged (5), speedLimiterEngaged (6) } (SIZE(7))	S	Not required, filled in if available	
<i>lanePosition</i>	INTEGER {offTheRoad(-1), hardShoulder(0), outermostDrivingLane(1), secondLaneFromOutside(2)} (-1..14) LanePosition ::= INTEGER {offTheRoad(-1), innerHardShoulder(0), innermostDrivingLane(1), secondLaneFromInside(2), outerHardShoulder(14)} (-1..14) in text part (of CDD) LanePosition ::= INTEGER {offTheRoad(-1), hardShoulder(0), outermostDrivingLane(1), secondLaneFromOutside(2)} (-1..14) in asn part (end of CDD)	S	Not required, filled in if available with a confidence of 95% minimum.	
<i>steeringWheelAngle</i>	SteeringWheelAngle ::= SEQUENCE { steeringWheelAngleValue SteeringWheelAngleValue, steeringWheelAngleConfidence SteeringWheelAngleConfidence}	S	Not required, filled in if available	

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CAM ETSI Standard status		CAM Master choices V2X		
Field	Type of data	Status	Comments	Value set
<i>lateralAcceleration</i>	<p>LateralAcceleration ::= SEQUENCE { lateralAccelerationValue LateralAccelerationValue , lateralAccelerationConfidence AccelerationConfidence}</p> <p>LateralAccelerationValue ::= INTEGER {pointOneMeterPerSecSquaredToRight(-1), pointOneMeterPerSecSquaredToLeft(1), unavailable(161)} (-160 .. 161)</p> <p>AccelerationConfidence ::= INTEGER {pointOneMeterPerSecSquared(1), outOfRange(101), unavailable(102)} (0 .. 102)</p>	S	Not required, filled in if available	
<i>verticalAcceleration</i>	<p>VerticalAcceleration ::= SEQUENCE { verticalAccelerationValue VerticalAccelerationValue, verticalAccelerationConfidence AccelerationConfidence}</p> <p>VerticalAccelerationValue ::= INTEGER {pointOneMeterPerSecSquaredUp(1), pointOneMeterPerSecSquaredDown(-1), unavailable(161)} (-160 .. 161)</p> <p>AccelerationConfidence ::= INTEGER {pointOneMeterPerSecSquared(1), outOfRange(101), unavailable(102)} (0 .. 102)</p>	S	Not required, filled in if available	

2.4.1.1_M_Master technical specifications for V2X use cases

CAM ETSI Standard status		CAM Master choices V2X		
Field	Type of data	Status	Comments	Value set
<i>performanceClass</i>	PerformanceClass ::= INTEGER {unavailable(0), performanceClassA(1), performanceClassB(2)} (0..7)	S	Not required, filled in if available	
<i>cenDsrcTollingZone</i>	CenDsrcTollingZone ::= SEQUENCE { protectedZoneLatitude Latitude, protectedZoneLongitude Longitude, cenDsrcTollingZoneID CenDsrcTollingZoneID OPTIONAL, ... }	S	Not required, filled in if available	
<i>>LowFrequencyContainer> basicVehicleContainerLowFrequency</i>		S	All CAM does not contain this data field. Following DE are mandatory when the container is present in the message.	
<i>vehicleRole</i>	default(0), publicTransport(1), specialTransport(2), dangerousGoods(3), roadWork(4), rescue(5), emergency(6), safetyCar(7), agriculture(8), commercial(9), military(10), roadOperator(11), taxi(12), reserved for future usage (13,14,15)	v	The Vru-ITS-S should use by default the value (0). The Vro-ITS-S should use the values (0) in user mode and (11) in operator mode. All following vehicleRole are associated with a specialVehicleContainer: A vehicle transporting dangerous goods should result in the usage of dangerousGoods(3) together with the dangerousGoodsContainer. A vehicle being part of a roadworks area should result in the usage of roadWork(4) together with the roadWorksContainerBasic. Other special roles indicated by warning lights should result in the usage of rescue(5) together with the rescueContainer or safetyCar(7) together with the safetyCarContainer. An emergency vehicle in operation having right of way should result in the vehicle role set to emergency(6) and the usage of the EmergencyContainer. For other codes, refer to standard ETSI TS 102 894-2 V1.3.1 (requirement A.94 DE_VehicleRole)	
<i>exteriorLights</i>		v	This information is not necessarily available for all Vro-ITS-S (without connection to the CAN_bus)	
<i>pathHistory</i>		v	Path History implementation is based on the Design Method One specified in CAMP 811492B - Vehicle Safety Communications – Applications (VSC-A), Final Report: annex Volume 1 - System Design and Objective Test, September 2011, annex B-2. Default setting: a maximum of 23 tracking points with a distance of 22.5 m between the points. The operators can use different variables After a pseudonym change, path history shall be deleted.	

2.4.1.1_M_Master technical specifications for V2X use cases

CAM ETSI Standard status		CAM Master choices V2X		
Field	Type of data	Status	Comments	Value set
>SpecialVehicleContainer	SpecialVehicleContainer ::= CHOICE { publicTransportContainer PublicTransportContainer, specialTransportContainer SpecialTransportContainer, dangerousGoodsContainer DangerousGoodsContainer, roadWorksContainerBasic RoadWorksContainerBasic, rescueContainer RescueContainer, emergencyContainer EmergencyContainer, safetyCarContainer SafetyCarContainer, ... }	S	It is a choice between the following containers, depending on the type of vehicle and the vehicleRole (between 0 and 7).	
>>publicTransportContainer	PublicTransportContainer ::= SEQUENCE { embarkationStatus EmbarkationStatus, ptActivation PtActivation OPTIONAL }	X	Currently not used regarding use cases of the projects considered.	
>>specialTransportContainer	SpecialTransportContainer ::= SEQUENCE { specialTransportType SpecialTransportType, lightBarSirenInUse LightBarSirenInUse }	X	Currently not used regarding use cases of the projects considered.	
>>dangerousGoodsContainer	DangerousGoodsContainer ::= SEQUENCE { dangerousGoodsBasic DangerousGoodsBasic }	S	To be used when vehicleRole is dangerousGoods(3).	
dangerousGoodsBasic		V	When received, this information could be useful for the road operator (A use-cases).	

2.4.1.1_M_Master technical specifications for V2X use cases

CAM ETSI Standard status		CAM Master choices V2X		
Field	Type of data	Status	Comments	Value set
>>roadWorksContainerBasic	RoadWorksContainerBasic ::= SEQUENCE { roadworksSubCauseCode RoadworksSubCauseCode OPTIONAL, lightBarSirenInUse LightBarSirenInUse, closedLanes ClosedLanes OPTIONAL }	S	To be used when vehicleRole is roadWork(4).	
roadworksSubCauseCode		U	Depending on the use case, the subCauseCode associated to the event and described in the DENM profile shall be provided.	
lightBarSirenInUse		v	Indicates whether light bar (value set as 0) or siren (value set as 1) is in use.	
closedLanes		x	Not used.	
>>rescueContainer		S	To be used when vehicleRole is rescue(5).	
lightBarSirenInUse		v	Indicates whether light bar (value set as 0) or siren (value set as 1) is in use.	
>>emergencyContainer		S	To be used when vehicleRole is emergency(6).	
lightBarSirenInUse		v	Indicates whether light bar (value set as 0) or siren (value set as 1) is in use.	
incidentIndication		U	Depending on the use case, the causeCode and subCauseCode associated to the event and described in the DENM profile shall be provided (e.g. 15/1 or 95/1).	
emergencyPriority		S	Indicates the vehicle's necessity for priority. 0 for requestForRightOfWay and 1 for requestForFreeCrossingAtATrafficLight.	
>>safetyCarContainer		S		
lightBarSirenInUse		v	Indicates whether light bar (value set as 0) or siren (value set as 1) is in use.	
incidentIndication		U	Depending on the use case, the causeCode and subCauseCode associated to the event and described in the DENM profile shall be provided (e.g. 15/0 or 95/2).	
trafficRule		S	It indicates traffic rules that apply to vehicles at the position of the vehicle. It includes the following information: • If overtaking is prohibited for all vehicles, the DE shall be set to 0. • If overtaking is prohibited for trucks, the DE shall be set to 1. • If vehicles should pass to the right lane, the DE shall be set to 2. • If vehicles should pass to the left lane, the DE shall be set to 3.	
speedLimit		S	The speed limit at the position of the vehicle is set between 1 and 255, with the unit being kilometers per hour.	

Other data elements (which are mandatory in the interface Geonetworking/BTP stack) :

CAM ETSI Standard status		CAM Master choices V2X		
Field	Type of data	Status	Comments	Value set
Traffic class	itsGnTrafficClass Integer32 (0..255)	V	<p>"As defined in ETSI EN 302 636-4-1."</p> <p>Channel offload bit is 0 (see RS_RSP_042 (C-Roads PF Roadside profile) based on RS_BSP_262)</p> <p>Traffic class values is "2" according to RS_BSP_235 and RS_RSP_063.</p>	is 2
Maximum packet lifetime	Shall not exceed 1 000 ms	V	Set to 1s	is 1s

2.4. DENM

This chapter describes the DENM profile from standard and the choices made for the projects concerned by this document.

ID	2.4.1.1_M_Master_DENMessageProfile
Component(s)	Broadcast: V-ITS-S Reception: R-ITS-S, Nfr
Requirement	The DENM transmitted by the V-ITS-S shall respect what is expected in the following table.
Acceptance	<p>Referring to the "Status for the UC" column in the table:</p> <p>CA1: All mandatory V DE and used U DE shall be present in the message emitted, with the defined values.</p> <p>CA2: All optional S DE can be present in the message emitted. See expected values in the table when defined.</p> <p>CA3: Not used DE: X. Message shall not be discarded at reception if the DE is present.</p>
Additional information	

DENM standard (ETSI EN 302 637-3)			DENM Master choices V2X		
Field	Definition / Meaning	Type of data	Status	Content	Value set
Header					
protocol Version	"Version of the C-ITS message and/or communication protocol."	INTEGER (0..255)	V	Version for is ETSI EN 302 637-2 1.3.1 (2019-04), referenced in the DA, is 2.	is 2
messageID	"Type of the C-ITS message."	INTEGER{ denm(1), cam(2), poi(3), spatem(4), mapem(5), ivim(6), ev-rsr(7), tistpgtransaction(8), srem(9), ssem(10), evcsn(11), saem(12), rtcmem(13) } (0..255),	V	denm(1)	is 1
stationID	"The identifier of the C-ITS-S that generates the C-ITS message in question." This is the ID of the station broadcasting the message.	INTEGER(0..4294967295)	V	ID of the V-ITS-S for V2X (see 2.4.4.8 documents)	by V-ITS-S
Management container					

2.4.1.1_M_Master technical specifications for V2X use cases

DENM standard (ETSI EN 302 637-3)			DENM Master choices V2X		
Field	Definition / Meaning	Type of data	Status	Content	Value set
actionID	SEQUENCE : StationID + SequenceNumber "It is used by a receiving C-ITS-S to process information for DENMs that are multiply received."	SEQUENCE {originatingStationID StationID, sequenceNumber SequenceNumber} StationID ::= INTEGER(0..4294967295) SequenceNumber ::= INTEGER(0..65535)	V	The actionID has to be same for DENMs relating to the same event, even for updates and cancel. Each terminal V-ITS increments each new event it detects. Once the maximum number of events is reached (65535) or at a new start-up of the station, the event numbering starts over at a random value different from 0. The actionID is unique ID of the event.	by V-ITS-S
detection Time	"Time at which the event is detected by the originating ITS-S. For the DENM repetition, this DE shall remain unchanged. For the DENM update, this DE shall be the time at which the event update is detected. For the DENM termination, this DE shall be the time at which the termination of the event is detected."	Timestamps ::= INTEGER {utcStartOf2004(0), oneMillisecAfterUTCStartOf2004(1)} (0..4398046511103)	V	The detectionTime corresponds to: • when the triggering conditions are fulfilled for automatic or automated triggering, • when the user activates a manually triggered report via the embedded HMI, (if the device includes manual declaration of events e.g Vro-ITS-S) • the beginning of the event estimated by the TMS when the V-ITS-S acts just as a relay of I2V information. This DE is used as versioning of the event (identified by its actionID).	from V-ITS-S except when acting as a relay of I2V information
reference Time	"This DE refers to the time at which a new DENM, an update DENM or a cancellation DENM is generated."	Timestamps ::= INTEGER {utcStartOf2004(0), oneMillisecAfterUTCStartOf2004(1)} (0..4398046511103)	V	Time of encoding of the message by V-ITS-S.	by V-ITS-S
termination	This DF is used to cancel the DENM from the originating C-ITS-S (cancellation) or another C-ITS-S (negation).	ENUMERATED {isCancellation(0), isNegation(1)}	S	Only present when cancel or termination is done. isNegation not used in FR (unwanted), because the right to negate the DENMs issued from another station is not allowed. So if this DE is present in DENM, it shall be an isCancellation (0) The termination message is sent with the same Repetition Interval than the message it terminates. Its validityDuration (and Repetition Duration) corresponds to the time to the max endtime of all previous versions of the event it terminates.	by V-ITS-S
event Position	"Geographical position of the detected event." "When the event position corresponds to the position of a vehicle C-ITS-S, the eventPosition shall be set to the position of the vehicle C-ITS-S at detectionTime. This DF shall be presented as specified in ETSI TS 102 894-2 ReferencePosition" (Réf. DF A.124)	SEQUENCE See next 4 DE (latitude, longitude, confidencePositionEllipse and altitude)	V	See four next lines	▼▼▼

2.4.1.1_M_Master technical specifications for V2X use cases

DENM standard (ETSI EN 302 637-3)			DENM Master choices V2X		
Field	Definition / Meaning	Type of data	Status	Content	Value set
>latitude	"latitude of the geographical point; it shall be presented as specified in clause A.41 Latitude," "Absolute geographical latitude in a WGS84 coordinate system, providing a range of 90 degrees in north or in south hemisphere."	INTEGER {oneMicrodegreeNorth (10), oneMicrodegreeSouth (-10), unavailable(900000001) } (-900000000..900000001)	v	Latitude of eventPosition <i>It corresponds by default to the vehicle's position (front central point of the bumper) when the user activates the function via the HMI (manual) or when the triggering conditions are fulfilled (automatic).</i>	by V-ITS-S
>longitude	"longitude of the geographical point; it shall be presented as specified in clause A.44 Longitude," "Absolute geographical longitude in a WGS84 coordinate system, providing a range of 180 degrees to the east or to the west of the prime meridian."	INTEGER {oneMicrodegreeEast (10), oneMicrodegreeWest (-10), unavailable(1800000001) } (-1800000000..1800000001)	v	Longitude of eventPosition <i>It corresponds by default to the vehicle's position (front central point of the bumper) when the user activates the function via the HMI (manual) or when the triggering conditions are fulfilled (automatic).</i>	by V-ITS-S
>confidence Position Ellipse	"positionConfidenceEllipse: accuracy of the geographical position; it shall be presented as specified in clause A.119 PosConfidenceEllipse,"	SEQUENCE { semiMajorConfidence SemiAxisLength, semiMinorConfidence SemiAxisLength, semiMajorOrientation HeadingValue}	v	The confidence position of the GPS shall be used.	By V-ITS-S
>altitude	"altitude and altitude accuracy of the geographical point; it shall be presented as specified in clause A.103 Altitude."	SEQUENCE { altitudeValue AltitudeValue, altitudeConfidence AltitudeConfidence}	v	Always given because mandatory in standard. Can be set to the values corresponding to 'unavailable' e.g. {800001, unavailable (15)} when no possibility to provide it. This is acceptable for Golf 8 vehicles.	is {800001, unavailable (15)} or current altitude
relevance Distance	DE describing a distance of relevance for information indicated in a message, for example, it may be used to describe the distance of relevance of an event indicated in a DENM as defined in ETSI EN 302 637-3." "The distance in which event information is relevant for the receiving ITS-S, starting from the event position as defined in clause 6.1.3.1."	ENUMERATED {lessThan50m(0), lessThan100m(1), lessThan200m(2), lessThan500m(3), lessThan1000m(4), lessThan5km(5), lessThan10km(6), over10km(7)}	x	The usefulness of these DEs is unclear, so not used. => Appropriate displaying on on-board HMI is automotive constructors domain. It could be used in the future for manual declaration use cases from Vro.	




2.4.1.1_M_Master technical specifications for V2X use cases

DENM standard (ETSI EN 302 637-3)			DENM Master choices V2X		
Field	Definition / Meaning	Type of data	Status	Content	Value set
<i>relevanceTrafficDirection</i>	<p>“DE describing a traffic direction that is relevant to information indicated in a message. For example, it may be used to describe traffic direction which is relevant to an event indicated by a DENM as defined in ETSI EN 302 637-3 [i.3], The terms "upstream", "downstream" and "oppositeTraffic" are relative to the event position.” “The traffic direction along which the event information is relevant for the receiving ITS-S, as defined in clause 6.1.3.1.” This DF indicates for which traffic direction the message is relevant (from the perspective of the sender).</p>	ENUMERATED {allTrafficDirections(0), upstreamTraffic(1), downstreamTraffic(2), oppositeTraffic(3)}	V	<p>If a vehicle receives an upstreamTraffic or an allTrafficDirections event and is on one traces of the event, it is concerned by event.</p> <p>To clarify the process that could be done by a vehicle-receiver of a DENM and determine if the event is relevant or not for the vehicle-receiver due to the relevanceTrafficDirection, the following logic may be followed :</p> <ul style="list-style-type: none"> - upstream : receiver checks if on (one) trace of the event. If yes, concerned. - downstream : receiver checks if event is on its pathHistory AND if the heading of the event is quite the same compares to its own. If yes, concerned. - allTrafficDirection : receiver is concerned if approaching the event point (or eventHistory). - oppositeTraffic : receiver is concerned if approaching the event (or eventHistory), and if its pathHistory is going to complete as a line (one) traces of the event, without superposition (as soon as superposed, the reveiver is downstream of the event and thus no more concerned). (see also 2.4.1.2_M-Master_I2V) <p>See each UC for details.</p>	by V-ITS-S

2.4.1.1_M_Master technical specifications for V2X use cases

DENM standard (ETSI EN 302 637-3)			DENM Master choices V2X		
Field	Definition / Meaning	Type of data	Status	Content	Value set
validityDuration	<p>"Validity duration of a DENM. The validityDuration is set by the originating ITS-S. Therefore, it represents an estimation of how long the event may persist. It implies the duration over which the DENM should be kept at the DEN basic service of the receiving ITS-S and the DENM dissemination be maintained in the relevance area or destination area, until the expiration of validityDuration. In case the expiry time of the event cannot be estimated at the originating ITS-S, a default value is used for the DENM protocol operation. This DE may be renewed by the originating ITS-S, if the pre-set expiry time has reached to its limit and the originating ITS-S detects that the event persists." "The DE is represented as a time offset in the unit of second since detectionTime. This DE is optional. It shall be present if the information is required by the ITS application. If the DE is not present in DENM, a default value defaultValidity is assumed."</p>	<p>INTEGER {timeOfDetection(0), oneSecondAfterDetection(1)} (0..86400)" e.g. time in seconds. And if unknown, not present, a defaultValidity is assumed (is 600s e.g. 10mn)</p>	v	<p>ValidityDuration is an estimated duration of event since detectionTime (cf. standard)</p> <p>See each use cases for details.</p> <p>The policies on duration may change during experiment to find the best compromise between uses of short, medium or long time.</p>	by V-ITS-S
transmissionInterval	<p>"Time interval between two consecutive message transmissions." "Time interval for DENM transmission as defined by the originating ITS-S. This DE informs the receiving ITS-Ss about the intended transmission interval of two consecutive DENM transmissions. It is used for the forwarding ITS-S operation."</p>	<p>INTEGER {oneMilliSecond(1), tenSeconds(10000)} (1..10000)</p>	x	Not used.	
stationType	<p>"This DE provides the station type information of the originating ITS-S." This defines the type of the station broadcasting the DENM.</p>	<p>INTEGER {unknown(0), pedestrian(1), cyclist(2), moped(3), motorcycle(4), passengerCar(5), bus(6), lightTruck(7), heavyTruck(8), trailer(9), specialVehicles(10), tram(11), roadSideUnit(15)} (0..255)</p>	v	<p>The Vru-ITS-S should use the code (5).</p> <p>The Vro-ITS-S should use: :</p> <ul style="list-style-type: none"> In user mode : (5), (7) or (8), depending on the vehicle type, in user mode In operator mode : (9) if FLR and (10) for all other operator vehicles 	



2.4.1.1_M_Master technical specifications for V2X use cases

DENM standard (ETSI EN 302 637-3)			DENM Master choices V2X		
Field	Definition / Meaning	Type of data	Status	Content	Value set
Situation container					
information Quality	"Quality level of the information provided by the ITS-S application of the originating ITS-S. It indicates the probability of the detected event being truly existent at the event position."	INTEGER {unavailable(0), lowest(1), highest(7)} (0..7)		<p>This can be set to one of eight different values (0..7). ETSI does not specify what the different values mean, but 0 when quality is unknown.</p> <p>As a conclusion of C-Roads PF discussion, vehicles shall use the following values in V2X :</p> <ul style="list-style-type: none"> - 6 (which correspond to certain in I2V context) when the vehicle is a Vro in operator mode - Car2Car informationQuality grid when the vehicle is a Vru or a Vro in user mode. Value "1" is used when the event is manually declared in these context (because Car2Car grid doesn't use this value) - informationQuality issued from I2V grid when the V-ITS-S acts just as a relay of I2V information. <p>See each UC for more details</p>	by V-ITS-S
eventType	"Description for the event type, including direct cause and sub cause." See table 10 ETSI EN 302 637-3 for further details	CauseCodeType and SubCauseCodeType are INTEGER (0..255)		See each UC for details	by V-ITS-S
linkedCause	"Description for a linked event of the provided eventType, including direct cause and sub cause of the linked event."	CauseCodeType and SubCauseCodeType are INTEGER (0..255)		Not used in V2X	

2.4.1.1_M_Master technical specifications for V2X use cases

DENM standard (ETSI EN 302 637-3)			DENM Master choices V2X		
Field	Definition / Meaning	Type of data	Status	Content	Value set
<i>eventHistory</i>	<p>"This DF indicates the list of positions that a plain event has been detected prior to the eventPosition"</p> <p>"The DF consists of a list of event points which represents the dimension of a plain event in a predefined order. In case that the plain event is detected by a vehicle ITS-S, the DF consists of a list of event detection points along the path that the detecting ITS-S has travelled over some past time and/or distance. Each event point corresponds to a point at which the same event was detected along the path. In the present document up to 40 EventPoint may be added in this DF. The generation of each EventPoint is specified in the related ITS application requirements". (Note that 40 points is written on DENM standard but max 23 points for eventHistory is written in common data dictionary)</p>	<p>SEQUENCE (SIZE(1..23)) OF EventPoint</p> <p>EventPoint ::= SEQUENCE { eventPosition DeltaReferencePosition, eventDeltaTime PathDeltaTime OPTIONAL, informationQuality InformationQuality }</p> <p>DeltaReferencePosition ::= SEQUENCE { deltaLatitude DeltaLatitude, deltaLongitude DeltaLongitude, deltaAltitude DeltaAltitude }</p> <p>DeltaLatitude ::= INTEGER {oneMicrodegreeNorth (10), oneMicrodegreeSouth (-10), unavailable(131072)} (-131071..131072)</p> <p>...</p>	S	<p>This field is used to signal an event spread over a linear zone.</p> <p>Event linked to the road operator work (sent by Vro-ITS-S) is a punctual event (no event history).</p> <p>V-ITS-S can emit a DENM with an eventHistory for some cases (e.g D1 slippery, D6 visibility or E6 precipitation).</p> <p>Both following solutions are admitted even if the first one is preferred (correspond to the I2V way to do and avoid overlapping of trace and eventHistory) :</p> <ul style="list-style-type: none"> – The event position remains identical at each update and new event history points are added along with each update. – The event position changes at each update and the previous event position become point of the eventhistory. Trace and eventhistory overlap. <p>C-Roads PF and Car2Car has harmonized the max number of points to 23 values.</p> <p>The way to encode it is as follows : EP = CP + delta with EP = EventPoint (new eventhistory point) and CP = CurrentPoint (or eventposition for the first one)</p> <p><i>informationQuality</i> in the DF of EventPoint is set to the same value than the informationQuality of the event.</p>	by V-ITS-S
Location container					
<i>eventSpeed</i>	<p>"Moving speed of a detected event and the confidence of the moving speed information."</p> <p>"When the eventPosition corresponds to the position of a vehicle ITS-S, the eventSpeed shall be set to the vehicle speed at detectionTime."</p>	<p>Speed ::= SEQUENCE {speedValue SpeedValue, speedConfidence SpeedConfidence}</p> <p>SpeedValue ::= INTEGER {standstill(0), oneCentimeterPerSec(1), unavailable(16383)} (0..16383)</p> <p>SpeedConfidence ::= INTEGER {equalOrWithinOneCentimeterPerSec(1), equalOrWithinOneMeterPerSec(100), outOfRange(126), unavailable(127)} (1..127)</p>	S	<p>In practice, this field will be filled in by the V-ITS-S:</p> <ul style="list-style-type: none"> • for the B1c (mobile roadwork), B2a (approaching vehicle) and B3a/b/c (winter road maintenance vehicle) cases for the Vro-ITS-S; • by the transmitting vehicles for the relevant use cases for the Vru-ITS-S, when it is an ego use-cases. 	

2.4.1.1_M_Master technical specifications for V2X use cases

DENM standard (ETSI EN 302 637-3)			DENM Master choices V2X		
Field	Definition / Meaning	Type of data	Status	Content	Value set
<i>event Position Heading</i>	“The heading direction of the event and the confidence of the heading information, if applicable.”	<p>Heading ::= SEQUENCE {headingValue HeadingValue, headingConfidence HeadingConfidence}</p> <p>HeadingValue ::= INTEGER {wgs84North(0), wgs84East(900), wgs84South(1800), wgs84West(2700), unavailable(3601)} (0..3601)</p> <p>HeadingConfidence ::= INTEGER {equalOrWithinZeroPointOneDegree (1), equalOrWithinOneDegree (10), outOfRange(126), unavailable(127)} (1..127)</p>		<p>For moving event, direction of the movement.</p> <p>For static event, set as the direction of the carriageway concerned by the event, at the eventPosition, possibly thanks to the vehicle's pathHistory.</p> <p>This information is built with information from GNSS or CAN_bus.</p>	by V-ITS-S
traces	<p>“This DF is the location referencing information of eventPosition. It includes a group of traces as defined in clause 6.1.3.2.</p> <p>Each trace describes a set of consecutive PathPoint positions leading to the event position. ITS-S located near to or inside this trace path may be concerned by the event.</p> <p>Multiple traces may be defined in case multiple road sections or traffic flows are leading to the event position. In the present standards, up to seven traces may be added in a DENM.</p> <p>For each trace, multiple PathPoint positions are provided to describe the trace path.”</p> <p>“Within one trace, the PathPoint closest to the event position shall be put as the first waypoint, it presents an offset delta position with regards to the eventPosition. Other PathPoints shall be structured in ascending order according to the distance to the eventPosition along the trace path. Each PathPoint presents an offset delta position and optionally an offset travel time with regards to the previous PathPoint.”</p> <p>“When the event position corresponds to the position of a vehicle ITS-S, the first trace in the DF shall be the PathHistory of the vehicle as defined in the CA basic service ETSI EN 302 637 – 2 7.”</p>	<p>SEQUENCE SIZE(1..7) OF PathHistory</p> <p>PathHistory ::= SEQUENCE (SIZE(0..40)) OF PathPoint</p> <p>PathPoint ::= SEQUENCE { pathPosition DeltaReferencePosition, pathDeltaTime PathDeltaTime OPTIONAL}</p>		<p>This DF consists of minimum 1, maximum 7 traces of type PathHistory. These traces consist of points describing the path towards the eventLocation. These are used by approaching vehicles to determine whether the DENM is relevant or not.</p> <p>The maximum number of points a trace can hold is assumed to be 40, the minimum number of points is 2 (start and end). This is a sequence of delta positions from point-to-point.</p> <p>Sequence of delta positions from event position to the beginning of the way leading to the eventPosition.</p> <p>The way to encode it is as follows: PP = CP + delta with PP = PathPoint (new pathpoint of the trace) and CP = CurrentPoint (or eventposition for the first one)</p> <p>Depending of the emitter the traces could have been generated differently. For the Vro-ITS-S, the algorithm for generate the traces is described in the 2.4.2.2 documents.</p> <p><u>In addition, Car2Car has defined a 1km max length of each trace in V2X context (and a moderate length of each trace seems needed to avoid too heavy messages). Traces of 40 points distant of 22,5 m or so is an acceptable default way-to-do, assumed by the projects.</u></p>	by V-ITS-S

2.4.1.1_M_Master technical specifications for V2X use cases

DENM standard (ETSI EN 302 637-3)			DENM Master choices V2X		
Field	Definition / Meaning	Type of data	Status	Content	Value set
<i>roadType</i>	"The road type information at the event position."	ENUMERATED {urban-NoStructuralSeparationToOppositeLanes(0), urban-WithStructuralSeparationToOppositeLanes(1), nonUrban-NoStructuralSeparationToOppositeLanes(2), nonUrban-WithStructuralSeparationToOppositeLanes(3)}	S	Provided if the station can do it.	by V-ITS-S
<i>À la carte container</i>					
<i>lanePosition</i>	"The lane position of the event position in the road counted from the outside boarder of the road. This DE is included in the alacarte container. If this data is provided, the originating ITS-S is required to determine the lane position with a predefined confidence level as defined by the ITS applications (e.g. 95 %)."	<p>INTEGER {offTheRoad(-1), hardShoulder(0), outermostDrivingLane(1), secondLaneFromOutside(2)} (-1..14)</p> <p>LanePosition ::= INTEGER {offTheRoad(-1), innerHardShoulder(0), innermostDrivingLane(1), secondLaneFromInside(2), outerHardShoulder(14)} (-1..14)</p> <p>in text part (of CDD)</p> <p>LanePosition ::= INTEGER {offTheRoad(-1), hardShoulder(0), outermostDrivingLane(1), secondLaneFromOutside(2)} (-1..14)</p> <p>in asn part (end of CDD)</p>	N	Not provided in V2X (except if the V-ITS-S can really do so)	
<i>impactReduction</i>	"It contains the vehicle detailed information required for mitigating the consequences of a collision."	SEQUENCE See next DE from heightLonCarLeft to requestResponseIndication	S	Not provided except in collision cases involving the ego vehicle. and information (following DE) are available. This may involve a connection to the CAN bus.	
>heightLonCarrLeft >heightLonCarrRight	"Height of [left/right] longitudinal carrier of the vehicle from base to top. The [left/right] carrier refers to the [left/right] side seen from vehicle rear to vehicle front."	HeightLonCarr ::= INTEGER {oneCentimeter(1), unavailable(100)} (1..100)	▲		
>posLonCarrLeft >posLonCarrRight	"Distance from the centre of vehicle front bumper to the front of the [left/right] longitudinal carrier of vehicle. The [left/right] carrier refers to the [left/right] side seen from vehicle rear to vehicle front."	PosLonCarr ::= INTEGER {oneCentimeter(1), unavailable(127)} (1..127)	▲		
>positionOfPillars	"The positionOfPillars contains a list of distance, which refers to the perpendicular distance between centre of vehicle front bumper to vehicle A pillar, between neighbour vehicle pillars until the last pillar of the vehicle."	PosPillar ::= INTEGER {tenCentimeters(1), unavailable(30)} (1..30)	▲		




2.4.1.1_M_Master technical specifications for V2X use cases

DENM standard (ETSI EN 302 637-3)			DENM Master choices V2X		
Field	Definition / Meaning	Type of data	Status	Content	Value set
>posCentMass	"Perpendicular distance from centre of mass of an empty charged vehicle to vehicle front bumper."	INTEGER {tenCentimeters(1), unavailable(63)} (1..63)	▲		
>wheelBaseVehicle	Perpendicular distance between front and rear axle of the wheel base of a passenger vehicle.	INTEGER {tenCentimeters(1), unavailable(127)} (1..127)	▲		
>turningRadius	"The turning radius of a vehicle is the size of the smallest circular turn (i.e. U-turn) that the vehicle is capable of making."	INTEGER {point4Meters(1), unavailable(255)} (1..255)	▲		
>posFrontAx	"Perpendicular distance between the front wheel axle and front bumper."	INTEGER {tenCentimeters(1), unavailable(20)} (1..20)	▲		
>positionOfOccupants	"This DF indicates whether a in vehicle seat is occupied at the moment when the impactReduction is generated. The in vehicle seats layout is defined in rows from the front to the rear of the vehicle. The left seat of a row refers to the left side with regards to the vehicle heading direction."	BIT STRING { row1LeftOccupied (0), row1RightOccupied (1), row1MidOccupied (2), row1NotDetectable (3), row1NotPresent (4), row2LeftOccupied (5), row2RightOccupied (6), row2MidOccupied (7), row2NotDetectable (8), row2NotPresent (9), row3LeftOccupied (10), row3RightOccupied (11), row3MidOccupied (12), row3NotDetectable (13), row3NotPresent (14), row4LeftOccupied (15), row4RightOccupied (16), row4MidOccupied (17), row4NotDetectable (18), row4NotPresent (19) } (SIZE(20))	▲		
>vehicleMass	"This DE indicates the mass of an empty load vehicle."	INTEGER {hundredKg(1), unavailable(1024)} (1..1024)	▲		
>requestResponseIndication	"This DE is included in impactReduction DF in the alacarte container. It indicates whether the originating ITS-S transmitting the impactReduction DF is requesting the receiving ITS-S to provide also its impactReduction DF. On reception of a DENM with this DE set to 0, the receiving ITS-S may in turn transmit a DENM with its impactReduction DF as response to the request."	ENUMERATED {request(0), response(1)}	▲		
externalTemperature	"Information included in the alacarte container for the adverse weather condition use case as specified in ETSI TS 101 539-1 [i.4]."	Temperature ::= INTEGER {equalOrSmallerThanMinus60Deg (-60), oneDegreeCelsius(1), equalOrGreaterThan67Deg(67)} (-60..67)	S	In practice, this information is easy for the Vru-ITS-S to report. This data is interesting for road operator.	

2.4.1.1_M_Master technical specifications for V2X use cases

DENM standard (ETSI EN 302 637-3)			DENM Master choices V2X		
Field	Definition / Meaning	Type of data	Status	Content	Value set
roadWorks	"It includes information of the road work zone and specific access conditions."	SEQUENCE See next DE from lightBarSirenInUse referenceDenms to	S	See next lines for details. (when this DF is used by the UC). This container shall only be used by Vro (no Vru)	▼▼▼
>lightBarSirenInUse	"This DE indicates whether a roadwork vehicle has switched on the light bar or siren."	BIT STRING {lightBarActivated (0), sirenActivated (1) } (SIZE(2))	N	Not used.	
>closedLanes	This DF indicates the opening/closure status of a lane or a set of lanes. HardShoulderStatus: "indicates the current status of a hard shoulder lane whether it is available for special usage (e.g. for stopping or for driving) or closed for all vehicles." DrivingLaneStatus: "indicates whether a driving lane is open to traffic. A lane is counted from outside boarder of the road. The numbering is matched to LanePosition DE as defined in clause A.40. If a lane is closed to traffic, the corresponding bit shall be set to 1. Otherwise, it shall be set to 0."	SEQUENCE { innerhardShoulderStatus HardShoulderStatus OPTIONAL, outerhardShoulderStatus HardShoulderStatus OPTIONAL, drivingLaneStatus DrivingLaneStatus OPTIONAL, ... } HardShoulderStatus ::= ENUMERATED {availableForStopping(0), closed(1), availableForDriving(2)} DrivingLaneStatus ::= BIT STRING { outermostLaneClosed(1), secondLaneFromOutsideClosed(2) } (SIZE (1..14)) BIT STRING (SIZE (1..13))	N	Not used in V2X.	
>restriction	"This DF indicates the types of vehicles that are restricted to access the road work zone. More than one vehicle types may be provided by this DF if the restriction apply to multiple vehicle types."	RestrictedTypes ::= SEQUENCE (SIZE(1..3, ...)) OF StationType StationType ::= INTEGER {unknown(0), pedestrian(1), cyclist(2), moped(3), motorcycle(4), passengerCar(5), bus(6), lightTruck(7), heavyTruck(8), trailer(9), specialVehicles(10), tram(11), roadSideUnit(15)} (0..255)	N	Not needed as: - restricted lane should be described via IVI format (not DENM) - give restriction of the access of a road work zone. Kind of things not done in FR.	
>speedLimit	"This DE indicates the speed limitation applied to the roadwork zone."	INTEGER {oneKmPerHour(1)} (1..255)	S	If applicable and information is available (e.g static RO trailer with a speedLimit on it).	by V-ITS-S
>incidentIndication	"This DF indicates the incident related to the roadworks to provide additional information of the roadworks zone."	CauseCode ::= SEQUENCE {causeCode CauseCodeType, subCauseCode SubCauseCodeType}	N	If needed to link road work to a cause, linkedCause will be used (and not incidentIndication). This DF is a redundancy in standard from the point of view of FR.	

2.4.1.1_M_Master technical specifications for V2X use cases

DENM standard (ETSI EN 302 637-3)			DENM Master choices V2X		
Field	Definition / Meaning	Type of data	Status	Content	Value set
>recommendedPath	<p>This DF indicates the recommended itinerary in order to contour the roadworks zone. A recommended path is presented with a list of path points in the order from the starting point closest to the roadworks zone to the end point of the recommended path.</p> <p>This DF shall be presented as specified in ETSI TS 102 894-2 [5] ItineraryPath.</p>	<p>ItineraryPath ::= SEQUENCE SIZE(1..40) OF ReferencePosition</p> <p>ReferencePosition ::= SEQUENCE {latitude Latitude, longitude Longitude, positionConfidenceEllipse PosConfidenceEllipse, altitude Altitude}</p>		Not used in V2X.	
>startingPointSpeedLimit	<p>The DF indicates the effective starting position of a speed limit being applied to the roadwork zone. Generally speaking, the speed limit applies a certain distance prior to the roadwork zone starting position. It is described as a delta position with regards to the eventPosition for a DENM.</p> <p>This DF shall be presented as specified in ETSI TS 102 894-2 [5] DeltaReferencePosition.</p>	<p>DeltaReferencePosition ::= SEQUENCE {deltaLatitude DeltaLatitude, deltaLongitude DeltaLongitude, deltaAltitude DeltaAltitude}</p>		Not used in V2X.	
>trafficFlowRule	<p>The DE indicates the side of the road to which the traffic should flow around a roadwork. The traffic could flow to the left or to the right of the roadwork.</p> <p>This DE shall be presented as specified in ETSI TS 102 894-2 [5] TrafficRule.</p>	<p>TrafficRule ::= ENUMERATED {noPassing(0), noPassingForTrucks(1), passToRight(2), passToLeft(3), ... }</p>	S	<p>If applicable and information is available (e.g static RO trailer with a flow rule on it).</p> <p>Sadly, for the moment, an ENUMERATED for passToLeftOrRight is missing (and may be needed)</p>	by V-ITS-S
>referenceDenms	<p>The DF indicates is a sequence of actionIDs for different DENMs that describe the same event. If it is available it is part of all DENMs describing this event.</p> <p>This DF consists of list of other DENMs describing the same road work event. Each DENM shall be presented as specified in ETSI TS 102 894-2 [5] ActionID.</p>	<p>SEQUENCE (SIZE(1..8, ...)) OF ActionID</p>		Not used in V2X.	
positioningSolution	<p>This DE indicates technical solution being used by the originating ITS-S to estimate the event position. Typically, this DE may be included for events that are caused by vehicle ITS-S.</p>	<p>PositioningSolutionType ::= ENUMERATED {noPositioningSolution(0), sGNSS(1), dGNSS(2), sGNSSplusDR(3), dGNSSplusDR(4), dR(5), ...}</p>	S	Should be emitted in V2X.	
stationaryVehicle	<p>DF included in the alacarte container for the stationary vehicle use case as specified in ETSI TS 101 539-1 [i.4]. It provides information of the stationary vehicle.</p>	<p>SEQUENCE</p> <p>See next DE from stationarySince energyStorageType to</p>	S	<p>It shall be present when the information is required by the ITS application and when the information is available.</p> <p>Should be filled in for all use cases D when a vehicle is stationary.</p>	

2.4.1.1_M_Master technical specifications for V2X use cases

DENM standard (ETSI EN 302 637-3)			DENM Master choices V2X		
Field	Definition / Meaning	Type of data	Status	Content	Value set
>stationary Since	"This DE provides the time duration of the stationary vehicle being stationary."	StationarySince ::= ENUMERATED {lessThan1Minute(0), lessThan2Minutes(1), lessThan15Minutes(2), equalOrGreater15Minutes(3)}	▲		
>stationary Cause	"This DE provides additional information to describe causes of the stationary vehicle event such as human problem as defined in ETSI TS 101 539-1 [i.4]." "This DE shall be presented as specified in ETSI TS 102 894-2 [5] CauseCode."	CauseCode ::= SEQUENCE {causeCode CauseCodeType, subCauseCode SubCauseCodeType}	▲		
>carryingD angerousG oods	"DF included in the stationaryVehicle DF in the alacarte container if a vehicle carrying dangerous goods is involved in a stationary vehicle event. It provides information on the type of dangerous goods, the required emergency action and other information." "This DF shall be presented as specified in ETSI TS 102 894-2 [5] DangerousGoodsExtended."	DangerousGoodsExtended ::= SEQUENCE {dangerousGoodsType DangerousGoodsBasic, unNumber INTEGER (0..9999), elevatedTemperature BOOLEAN, tunnelsRestricted BOOLEAN, limitedQuantity BOOLEAN, emergencyActionCode IA5String (SIZE(1..24)) OPTIONAL, phoneNumber IA5String (SIZE(1..24)) OPTIONAL, companyName UTF8String (SIZE(1..24)) OPTIONAL}	▲		
>numberOf Occupants	"This DE provides the estimated number of occupants involved in the stationary vehicle event as specified in ETSI TS 101 539-1 [i.4]." "Number of occupants in a vehicle. For values equal to or higher than 126, the value shall be set to 126. If the information is not available, the value shall be set to 127."	INTEGER {oneOccupant (1), unavailable (127)} (0 .. 127)	▲		
>vehicleId entification	"This DF provides the vehicle identification of the stationary vehicle as specified in ETSI TS 101 539-1 [i.4], including the World Manufacturer Identifier (WMI) code and the Vehicle Descriptor Section (VDS) as defined in ISO 3779 [i.15]." WMI number: "World Manufacturer Identifier (WMI). The values are assigned according to ISO 3779 [i.7]." VDS: "Vehicle Descriptor Section (VDS). The values are assigned according to ISO 3779 [i.7]."	SEQUENCE {wMI number WMI number OPTIONAL, vDS VDS OPTIONAL, ...} WMI number ::= IA5String (SIZE(1..3)) VDS ::= IA5String (SIZE(6))	▲	Not provided according to C2C specification on stationary vehicles.	

2.4.1.1_M_Master technical specifications for V2X use cases

DENM standard (ETSI EN 302 637-3)			DENM Master choices V2X		
Field	Definition / Meaning	Type of data	Status	Content	Value set
>energyStorageType	<p>"This DE provides the vehicle energy storage type information of the stationary vehicle as specified in ETSI TS 101 539-1 [i.4], such as electric, diesel, etc."</p> <p>"Type of energy being used and stored in vehicle. If a storage type is used by the vehicle, the corresponding bit shall be set to 1. Otherwise, the corresponding bit shall be set to 0."</p>	BIT STRING {hydrogenStorage(0), electricEnergyStorage(1), liquidPropaneGas(2), compressedNaturalGas(3), diesel(4), gasoline(5), ammonia(6)} (SIZE(7))	▲		

Other elements from IF.DEN.1 (transmission) :

DENM standard (ETSI EN 302 637-3)			DENM Master choices I2V		
Field	Definition / Meaning	Type of data	Status	Content	Value set
repetitionDuration	"Duration of the DENM repetition in units of milliseconds."	ms	v	Until the end of the validityDuration	
repetitionInterval	"Interval of DENM repetition in units of milliseconds."	ms	v	500ms except for : - emergency brake (D10) : 100ms - reduced visibility (D6) and extreme weather (E6) : 4s	is 500ms or 100ms or 4s
Destination area	<p>"Destination area for DENM dissemination as specified in ETSI EN 302 931."</p> <p>"itsGnMaxGeoAreaSize ; 10 ; Maximum size of the geographical area for a GBC and GAC packet [km2]. If the geographical area size exceeds the maximum value, the GeoNetworking packet shall not be sent (source) and not be forwarded (forwarder)"</p>	GeoAreaPosLatitude [1/10 microdegree] GeoAreaPosLongitude [1/10 microdegree] Distance a [m] Distance b [m] Angle [°]	v	Generally defined as a circle of distance a and b equal to 5000m, centred on the eventPosition. By consequence, less than or equal to 80km² as defined through C-Roads PF (see also annex II table 1 of the draft of DA)	(area of max 80km²)
Maximum Hop Limit	<p>"The Maximum Hop Limit specifies the number of hops a packet is allowed to have in the network, i.e. how often the packet is allowed to be forwarded."</p> <p>"itsGnDefaultHopLimit : 10 : Default hop limit indicating the maximum number of hops a packet travels"</p>	itsGnDefaultHopLimit Integer32 (0..255)	v	For the moment, no complication seems linked to the choice of a high value. So that 10 hop is chosen.	is 10
Traffic class	"GN traffic class of the DENM as defined in ETSI EN 302 636-4-1 if GeoNetworking/BTP is used."	itsGnTrafficClass Integer32 (0..255)	v	Channel offload bit is 0 (see RS_RSP_042 (C-Roads PF Roadside profile) based on RS_BSP_262) Traffic class values is "1" except for emergency brake (D10) for which a TC "0" is required.	is 1 (or 0 for emergency brake)

2.5. Note on Timestamps

As a reminder, here how the timestampITS **should** be computed within the ITS stations:

TimestampITS = UTC_Time_system – UTC_Time_startof2004 + leap_seconds_since2004

The UTC_Time_system and the way to update the leap seconds (GNSS update, manual configuration, etc.) are under the provider responsibility.

However, since some systems cannot update the leap seconds during the project, if a control is implemented on the timestamps for the received messages, **it is required to have a 3 seconds tolerance for CAM messages and a 10 minutes tolerance for DENM messages.**

2.6. IVIM

Part to be added when B7 will be specified. (TBC), including the “other element” table (destination area, frequencies, ...).

2.7. SREM

This chapter describes the SREM profile from standard and the choices made for the projects concerned by this document.

ID	2.4.1.1_M_Master_SREMessageProfile
Component(s)	Broadcast: Vpt-ITS-S, Vru-ITS-S, Vro-ITS-S Reception: R-ITS-S
Requirement	The SREM transmitted by the V-ITS-S shall respect what is expected in the following table.
Acceptance	Referring to the “Status for the UC” column in the table: CA1: All mandatory V DE and used U DE shall be present in the message emitted, with the defined values. CA2: All optional S DE can be present in the message emitted. See expected values in the table when defined. CA3: Not used DE: X . Message shall not be discarded at reception if the DE is present.
Additional information	

SREM standard (ISO TS 19091)			SREM Master choices V2X		
Field	Description / Meaning	Type of data	Status	Content	Value set
Header	ItsPduHeader				
protocol Version	“Version of the ITS message and/or communication protocol.”	INTEGER (0..255)	V	Current version is 2.	is 2

2.4.1.1_M_Master technical specifications for V2X use cases

SREM standard (ISO TS 19091)			SREM Master choices V2X		
Field	Description / Meaning	Type of data	Status	Content	Value set
messageID	"Type of the ITS message."	INTEGER{ denm(1), cam(2), poi(3), spatem(4), mapem(5), ivim(6), ev-rsr(7), tistpgtransaction(8), srem(9), ssem(10), evcsn(11), saem(12), rtcmem(13)	v	srem(9)	is 9
stationID	"The identifier of the ITS-S that generates the ITS message in question." This is the ID of the station broadcasting the message.	INTEGER(0..4294967295)	v	ID of the V _{PT} -ITSS This stationID SHALL not change during pending SREM. (see "requestor / id below") Unique identifier of the message is stationID together with srm/timestamp and srm/second	by V _{PT} -ITSS
srm	SignalRequestMessage				
timestamp	The MinuteOfTheYear data element expresses the number of elapsed minutes of the current year in the time system being used (typically UTC time).	MinuteOfTheYear ::= INTEGER (0..527040)	u		
second		DSecond ::= INTEGER (0..65535)	v	(in milliseconds)	
sequenceNumber	Message identifier Request identifier: This identifier is used by the RSE to distinguish between requests from different connected devices and to distinguish different requests from the same connected vehicle. The message identifier increments by one whenever the contents of the message has changed	MsgCount ::= INTEGER (0..127)	u	Not really useful as long as the unicity of message is made of the stationID + timestamp + second	
requests		SignalRequestList ::= SEQUENCE (SIZE(1..32)) OF SignalRequestPackage	u	See the dedicated next table.	
requestor		RequestorDescription	v		
id	Vehicle identity : A connected PTV or commercial vehicle shall include its vehicle identifier as part of the signal request message transmitted to an RSE. The vehicle identifier may be a permanent identifier assigned by the owning public transport agency	VehicleID ::= CHOICE { entityID TemporaryID, stationID StationID} TemporaryID ::= OCTET STRING (SIZE(4)) StationID imported from CDD (ETSI)	v	Choice of stationID. Identical to the stationID of the CAM message broadcast by the V _{PT} and the SREM message. This stationID SHALL not change during pending SREM.	

2.4.1.1_M_Master technical specifications for V2X use cases

SREM standard (ISO TS 19091)			SREM Master choices V2X		
Field	Description / Meaning	Type of data	Status	Content	Value set
L type	<p>► role</p> <p>► <i>subrole</i></p> <p>► <i>request</i></p> <p>► <i>iso3883</i></p> <p>► <i>hpmsType</i></p> <p>► <i>regional</i></p> <p>Vehicle class</p> <p>A connected PTV or commercial vehicle shall include its vehicle class type and level to determine which vehicle receives priority in the event multiple requests are received by the same signalized intersection.</p> <p>Priority request level</p> <p>A connected PTV or commercial vehicle shall include a priority request level as part of the signal request message transmitted to an RSE</p> <p>The priority request level shall be configurable with 1 being lowest and 10 being highest. The default request shall be set to 5</p>	<p>RequestorType ::= SEQUENCE {</p> <p>role BasicVehicleRole,</p> <p>subrole RequestSubRole OPTIONAL,</p> <p>request RequestImportanceLevel OPTIONAL,</p> <p>iso3883 Iso3883VehicleType OPTIONAL,</p> <p>hpmsType VehicleType OPTIONAL,</p> <p>regional RegionalExtension {{Reg-RequestorType}} OPTIONAL,</p> <p>...}</p> <p>BasicVehicleRole ::= ENUMERATED {</p> <p>basicVehicle (0), publicTransport (1), specialTransport (2), dangerousGoods (3), roadWork (4), roadRescue (5), emergency (6), safetyCar (7), none-unknown (8), truck (9), motorcycle (10), roadSideSource (11), police (12), fire (13), ambulance (14), dot (15), transit (16), slowMoving (17), stopNgo (18), cyclist (19), pedestrian (20), nonMotorized (21), military (22), ...}</p>	<p>U</p>	<p>- role is provided (publicTransport (1))</p> <p>- subrole and request are optional (if useful for the signal priority system manager)</p> <p>- iso3883, hpmsType and regional are not used</p>	<p>role is publicTransport (1)</p>

2.4.1.1_M_Master technical specifications for V2X use cases

SREM standard (ISO TS 19091)			SREM Master choices V2X		
Field	Description / Meaning	Type of data	Status	Content	Value set
L <i>position</i>	<p>► position</p> <p>► <i>heading</i></p> <p>► <i>speed</i></p> <p>Vehicle location and speed : A connected PTV or commercial vehicle shall include its current location, speed and heading as part of the signal request message transmitted to an RSE. This information may be used by the traffic signal controller to determine what operational strategy it will perform (service) in the event there are more than one request for preferential treatment from different connected vehicles. It may also be used to optimize the signal timing to accommodate the vehicle for an ad hoc request.</p>	<p>RequestorPositionVector ::= SEQUENCE {</p> <p>position Position3D,</p> <p>heading Angle OPTIONAL,</p> <p>speed</p> <p>TransmissionAndSpeed OPTIONAL,</p> <p>...}</p> <p>Position3D ::= SEQUENCE {</p> <p>lat Latitude,</p> <p>long Longitude,</p> <p>elevation Elevation OPTIONAL,</p> <p>regional SEQUENCE (SIZE(1..4)) OF RegionalExtension {{Reg-Position3D}} OPTIONAL,</p> <p>...}</p> <p>Angle ::= INTEGER (0..28800)</p> <p>TransmissionAndSpeed ::= SEQUENCE {</p> <p>transmission TransmissionState,</p> <p>speed Velocity}</p> <p>TransmissionState ::= ENUMERATED {</p> <p>neutral (0), park (1), forwardGears (2), reverseGears (3), reserved1 (4), reserved2 (5), reserved3 (6), unavailable (7)}</p> <p>Velocity ::= INTEGER (0..8191)</p>	X	Not used	
L <i>name</i>		DescriptiveName ::= IA5String (SIZE(1..63))	S	Can be filled if useful for the signal priority system manager.	
L <i>routeName</i>		DescriptiveName ::= IA5String (SIZE(1..63))	S	Can be filled if useful for the signal priority system manager.	

2.4.1.1_M_Master technical specifications for V2X use cases

SREM standard (ISO TS 19091)			SREM Master choices V2X		
Field	Description / Meaning	Type of data	Status	Content	Value set
^L <i>transitStatus</i>	<p>Service information :</p> <p>A connected PTV shall include its public transport service status as part of the signal request message transmitted to an RSE</p> <p>The passenger load information may be used by the traffic signal controller to determine what operational strategy to service in the event there are more than one conflicting request for preferential treatment from different connected vehicles</p> <p>status information may include the passenger load of the PTV, if the PTV is stopped, if the PTV vehicle door is open, and if the PTV is in the process of loading a mobility device (e.g., wheelchair) or bicycle (device that needs to be racked)</p>	<p>TransitVehicleStatus ::= BIT STRING {</p> <p>loading (0),</p> <p>anADAuse (1),</p> <p>aBikeLoad (2),</p> <p>doorOpen (3),</p> <p>charging (4),</p> <p>atStopLine (5)</p> <p>} (SIZE(8))</p>	S	Optional	
^L <i>transitOccupancy</i>		<p>TransitVehicleOccupancy ::= ENUMERATED {</p> <p>occupancyUnknown (0),</p> <p>occupancyEmpty (1),</p> <p>occupancyVeryLow (2),</p> <p>occupancyLow (3),</p> <p>occupancyMed (4),</p> <p>occupancyHigh (5),</p> <p>occupancyNearlyFull (6),</p> <p>occupancyFull (7)}</p>	S	Optional	
^L <i>transitSchedule</i>	<p>Transit schedule</p> <p>When PTV transmit a signal priority request, the signal request message shall include the time difference between the PTV's current location and its scheduled location with a positive value indicating that the PTV is in advance of its schedule and a negative value indicating that the PTV is behind its schedule with the value in minutes.</p>	<p>DeltaTime ::= INTEGER (-122 .. 121)</p>	S	Optional	

2.4.1.1_M_Master technical specifications for V2X use cases

SREM standard (ISO TS 19091)			SREM Master choices V2X		
Field	Description / Meaning	Type of data	Status	Content	Value set
regional		SEQUENCE (SIZE(1..4)) OF RegionalExtension {{Reg-RequestorDescription}} OPTIONAL	x		
regional		SEQUENCE (SIZE(1..4)) OF RegionalExtension {{Reg-SignalRequestMessage}} OPTIONAL	x		

Requests **SignalRequestList ::= SEQUENCE (SIZE(1..32)) OF SignalRequestPackage**

SREM standard (ISO TS 19091)			SREM Master choices V2X		
Field	Description / Meaning	Type of data	Status	Content	Value set
request		SignalRequest	v		
id	Intersection identifier A connected PTV shall include the unique identifier of the intersection that is the target of the signal request message transmitted to an RSE. The intersection identifier is assigned as part of a roadway geometric message broadcasted by an RSE	IntersectionReferenceID ::= SEQUENCE { region RoadRegulatorID OPTIONAL, id IntersectionID}	v		
requestID	Transaction identifier Each signal request message shall also include a unique identifier for the specific request and use that same identifier for all subsequent changes related to that same request. For example, if the expected arrival time were to change, then the vehicle could transmit a new arrival time [in the SRM] using that same request identifier	RequestID ::= INTEGER (0..255)	v		

2.4.1.1_M_Master technical specifications for V2X use cases

SREM standard (ISO TS 19091)			SREM Master choices V2X		
Field	Description / Meaning	Type of data	Status	Content	Value set
LrequestType	Request signal priority cancellation A connected PTV shall transmit to an RSE a message to cancel a previously transmitted signal request message The priority request ID combined with the vehicle ID shall be sufficient to cancel the request	PriorityRequestType ::= ENUMERATED { priorityRequestTypeReserved (0), priorityRequest (1), priorityRequestUpdate (2), priorityCancellation (3), ...}	v		
LinBoundLane	Approach lane A connected PTV or commercial vehicle shall include the lane, approach, or connection number to be used to approach the intersection on as part of the signal request message transmitted to an RSE. The lane numbers and lane information are assigned by the RSE at the signalized intersection as part of the roadway geometrics information broadcasted by the RSE	IntersectionAccessPoint ::= CHOICE { lane LaneID, approach ApproachID, connection LaneConnectionID, ...}	v	Lane of the intersection to which the request applies to.	
LoutBoundLane	Egress lane A connected PTV or commercial vehicle shall include the lane number to be used to exit the intersection as part of the signal request message transmitted to an RSE The lane numbers and lane information are assigned by the RSE at the signalized intersection as part of the roadway geometrics information broadcasted by the RSE	IntersectionAccessPoint ::= CHOICE { lane LaneID, approach ApproachID, connection LaneConnectionID, ...}	s	Lane number to exit the intersection. SHOULD be provided to precise the movement of the requestor at the intersection.	
Lregional		SEQUENCE (SIZE(1..4)) OF RegionalExtension {{Reg-SignalRequest}} OPTIONAL	u	SHALL contain the countryCode to complete the RoadRegulatorID of the requestor (which are managed and assigns nationally).	

2.4.1.1_M_Master technical specifications for V2X use cases

SREM standard (ISO TS 19091)			SREM Master choices V2X		
Field	Description / Meaning	Type of data	Status	Content	Value set
<i>minute</i>	Time of service A connected PTV or commercial vehicle shall include the time when the signal service is requested to start as part of the signal request message transmitted to an RSE This is the estimated time point representing minutes, and seconds that the connected vehicle arrives at the intersection's stopping point. The time is assumed to be a future time and is based on the current local time.	MinuteOfTheYear ::= INTEGER (0..527040)	S	Present for request and not for cancellation. It is the time in minute of the year that the PT is expected at the intersection. The following "second DSecond" completes the information.	
<i>second</i>		DSecond ::= INTEGER (0..65535)	S	See the case above. (in milliseconds)	
<i>duration</i>	Duration Each signal request message shall include a "duration" value as calculated by the requesting vehicle. The duration value shall be the time as seconds that the request may remain active after the time of service occurs.	DSecond ::= INTEGER (0..65535)	X	(in milliseconds)	
<i>regional</i>		SEQUENCE (SIZE(1..4)) OF RegionalExtension {{Reg-SignalRequestPackage}} OPTIONAL	S	Not used in FR (but optional for C-Roads PF)	

Other elements for transmission purpose:

ETSI TS 103 301			Master choices		
Field	Description / Meaning	Type of data	Status	Content	Value set
repetitionDuration		ms	V	During 5s seconds to ensure the reception by the RSU.	is 5 000ms
repetitionInterval		ms	V	500ms	is 500ms

2.4.1.1_M_Master technical specifications for V2X use cases

ETSI TS 103 301			Master choices		
Field	Description / Meaning	Type of data	Status	Content	Value set
Destination area	<p>"As specified in ETSI EN 302 931."</p> <p>"itsGnMaxGeoAreaSize ; 10 ; Maximum size of the geographical area for a GBC and GAC packet [km2]. If the geographical area size exceeds the maximum value, the GeoNetworking packet shall not be sent (source) and not be forwarded (forwarder)"</p>	<p>GeoAreaPosLatitude [1/10 microdegree]</p> <p>GeoAreaPosLongitude [1/10 microdegree]</p> <p>Distance a [m]</p> <p>Distance b [m]</p> <p>Angle [°]</p>	V	Defined as a circle of 1km radius around the public transport.	(area of 3,14km²)
Maximum Hop Limit	<p>"The Maximum Hop Limit specifies the number of hops a packet is allowed to have in the network, i.e. how often the packet is allowed to be forwarded."</p> <p>"itsGnDefaultHopLimit : 10 : Default hop limit indicating the maximum number of hops a packet travels"</p>	itsGnDefaultHopLimit Integer32 (0..255)	V	Direct communication between the public transport and the RSU. Transmission is done in SHB (single hop broadcast).	is 1
Traffic class	"GN traffic class of the DENM as defined in ETSI EN 302 636-4-1 if GeoNetworking/BTP is used."	itsGnTrafficClass Integer32 (0..255)	V	<p>Channel offload bit is 0 (see RS_RSP_042 based on RS_BSP_262 (C-Roads PF Roadside profile))</p> <p>Traffic class values is "4"</p>	is 4

For SSEM, see description and message profile in 2.4.1.2_M_Master I2V.

2.8. CPM

This chapter describes the CPM profile from standard ETSI TR 103 562 v2.1.1 and the choices made for the projects concerned by this document.

ID	2.4.1.1_M_Master_CPMMessageProfile
Component(s)	Broadcast: Vpt-ITS-S Reception: V-ITS-S
Requirement	The CPM transmitted by the Vpt-ITS-S shall respect what is expected in the following table.
Acceptance	<p>Referring to the "Status for the UC" column in the table:</p> <p>CA1: All mandatory V DE and used U DE shall be present in the message emitted, with the defined values.</p> <p>CA2: All optional S DE can be present in the message emitted. See expected values in the table when defined.</p> <p>CA3: Not used DE: X. Message shall not be discarded at reception if the DE is present.</p>
Additional information	

CPM standard (ETSI TR 103 562)			CPM Master choices V2X		
Field	Description/Meaning	Type of data	Status	Content	Value
Header	ItsPduHeader				

2.4.1.1_M_Master technical specifications for V2X use cases

CPM standard (ETSI TR 103 562)			CPM Master choices V2X		
Field	Description/Meaning	Type of data	Status	Content	Value
protocolVersion	"Version of the ITS message and/or communication protocol."	INTEGER (0..255)	v		
messageID	"Type of the ITS message."	INTEGER{ denm(1), cam(2), poi(3), spatem(4), mapem(5), ivim(6), evrsr(7), tistpgtransaction(8), srem(9), ssem(10), evcsn(11), saem(12), rtcmem(13)	v	CPM Message ID is 8 (TR 103 562)	(is 8)
stationID	"The identifier of the ITS-S that generates the ITS message in question." This is the ID of the station broadcasting the message.	INTEGER(0..4294967295)	v		
cpm		CollectivePerceptionMessage ::= SEQUENCE { generationDeltaTime GenerationDeltaTime, cpmParameters CpmParameters}			
generationDeltaTime			v		
>cpmParameters	The sequence of CPM mandatory and optional containers. Other containers may be added in the future.	CpmParameters ::= SEQUENCE { managementContainer CpmManagementContainer, stationDataContainer StationDataContainer OPTIONAL, sensorInformationContainer SensorInformationContainer OPTIONAL, perceivedObjectContainer PerceivedObjectContainer OPTIONAL, freeSpaceAddendumContainer FreeSpaceAddendumContainer OPTIONAL, numberOfPerceivedObjects NumberOfPerceivedObjects,			
Management container					
stationType	Station type of the originating ITS-S. For vehicle ITS-Ss the value of this DE should be set to one out of the values 3 to 10.		v	Public transport vehicle station type, e.g. vehicle tramway...	
perceivedObjectContainerSegmentInfo	The perceived object container segment info describes the segmentation information in case the data for CPM transmission needs to be split up into multiple messages due to message size constraints.	PerceivedObjectContainerSegmentInfo ::= SEQUENCE { totalMsgSegments SegmentCount, thisSegmentNum SegmentCount} SegmentCount ::= INTEGER(1..127)	S		
referencePosition	The reference position indicates the location of the originating ITS station or an arbitrary position which should be used for referencing received objects.		v		
>latitude	Latitude of public transport vehicle	INTEGER {oneMicrodegreeNorth (10), oneMicrodegreeSouth (-10), unavailable(900000001) } (-900000000..900000001)	v		
>longitude	Longitude of public transport vehicle	INTEGER {oneMicrodegreeEast (10), oneMicrodegreeWest (-10), unavailable(1800000001) } (-1800000000..1800000001)	v		
>confidencePositionEllipse		SEQUENCE { semiMajorConfidence SemiAxisLength, semiMinorConfidence SemiAxisLength, semiMajorOrientation HeadingValue}	v		
>altitude		SEQUENCE { altitudeValue AltitudeValue, altitudeConfidence AltitudeConfidence}	v		

2.4.1.1_M_Master technical specifications for V2X use cases

CPM standard (ETSI TR 103 562)			CPM Master choices V2X		
Field	Description/Meaning	Type of data	Status	Content	Value
stationdataContainer			S		
originatingVehicleContainer			S		
		OriginatingVehicleContainer ::= SEQUENCE { heading, speed, vehicleOrientationAngle, driveDirection, longitudinalAcceleration, lateralAcceleration, verticalAcceleration, yawRate, pitchAngle, rollAngle, vehicleLength, vehicleWidth, vehicleHeight, trailerDataContainer }			
>heading	Heading and heading accuracy of the vehicle movement of the originating ITS-S with regards to the true north. The heading accuracy provided in the DE headingConfidence value should provide the accuracy of the measured vehicle heading with a confidence level of 95 %.		V	Vehicle heading towards North in degree	
>speed	Driving speed and speed accuracy of the originating ITS-S. The speed accuracy provided in the DE speedConfidence should provide the accuracy of the speed value with a confidence level of 95 %.		v	Vehicle speed value SHOULD be 0 when vehicle is stopped	0
>vehicleOrientationAngle	Angle and angle accuracy of the absolute orientation of the disseminating vehicle in the WGS84 coordinate system with respect to true North. This is opposed to the vehicle heading which is calculated taking into account the speed vector. The confidence denotes the accuracy of the measured angle value for a confidence level of 95 %.	WGS84Angle	S		
>driveDirection	Denotes whether a vehicle is driving forward or backward. When the information is unavailable, the value should be set to 2.		S		
>longitudinalAcceleration	Vehicle longitudinal acceleration of the originating ITS-S at the reference point of the vehicle. It should include the measured vehicle longitudinal acceleration and its accuracy value with the confidence level of 95 %. Otherwise, the longitudinalAccelerationConfidence should be set to unavailable.		S		
>lateralAcceleration	Vehicle lateral acceleration of the originating ITS-S at the reference point of the vehicle. It should include the measured vehicle lateral acceleration and its accuracy value with the confidence level of 95 %. This DE should be present if the data is available at the originating ITS-S.		S		

2.4.1.1_M_Master technical specifications for V2X use cases

CPM standard (ETSI TR 103 562)			CPM Master choices V2X		
Field	Description/Meaning	Type of data	Status	Content	Value
>verticalAcceleration	Vehicle vertical acceleration of the originating ITS-S at the reference point of the vehicle. It should include the measured vehicle vertical acceleration and its accuracy value with the confidence level of 95 %. This DE should be present if the data is available at the originating ITS-S.		S		
>yawRate	The yawRate denotes the vehicle rotation around the centre of mass of the empty vehicle together with its confidence level.		S		
>pitchAngle		CartesianAngle	S		
>rollAngle		CartesianAngle	S		
>vehicleLength			S		
>vehicleWidth			S		
>vehicleHeight			S		
>trailerDataContainer		TrailerDataContainer ::= SEQUENCE SIZE(1..2) OF TrailerData	S		
sensorInformationContainer		SensorInformationContainer ::= SEQUENCE SIZE(1..128, ...) OF SensorInformation	S		
sensorID			V		
sensorType			V		
detectionArea		DetectionArea ::= CHOICE { vehicleSensor VehicleSensor, stationarySensorRadial AreaRadial, stationarySensorPolygon AreaPolygon, stationarySensorCircular AreaCircular, stationarySensorEllipse AreaEllipse, stationarySensorRectangle AreaRectangle, ...} VehicleSensor ::= SEQUENCE { refPointId RefPointId DEFAULT 0, xSensorOffset XSensorOffset, ySensorOffset YSensorOffset, zSensorOffset ZSensorOffset OPTIONAL, vehicleSensorPropertyList VehicleSensorPropertyList, ...}	V		
freeSpaceConfidence			S		
perceivedObjectContainer		PerceivedObjectContainer ::= SEQUENCE SIZE(1..128, ...) OF PerceivedObject	U		
PerceivedObject		PerceivedObject SEQUENCE of following DE			
>objectID		Identifier ::= INTEGER (0..255)	V	Unique identifier of the detected object	
>sensorIDList			S		
>timeOfMeasurement		TimeOfMeasurement ::= INTEGER {oneMilliSecond(1)} (-1500..1500)	V		
>objectAge	Time difference with respect to the generationDeltaTime for the provided measurement. Negative values indicate that the provided object state refers to a point in time after the generationDeltaTime has been computed, i.e. after the latest disseminating ITS-S position update which is used to calculate the generationDeltaTime	ObjectAge ::= INTEGER {oneMilliSecond(1)} (0..1500)	S		

2.4.1.1_M_Master technical specifications for V2X use cases

CPM standard (ETSI TR 103 562)			CPM Master choices V2X		
Field	Description/Meaning	Type of data	Status	Content	Value
>objectConfidence	The confidence in the existence of the object and its characteristics as indicated by the perceivedObject container. The value should be set to: • Unknown (0): if the object confidence is unknown • A value between 1 and 100 to express the confidence • Unavailable (101): if the confidence could not be computed and does not apply	ObjectConfidence ::= INTEGER {unknown(0), onePercent(1), oneHundredPercent(100), unavailable(101)} (0..101)	S		
>xDistance		ObjectDistanceWithConfidence ::= SEQUENCE { value DistanceValue, confidence DistanceConfidence} DistanceValue ::= INTEGER {zeroPointZeroOneMeter(1), oneMeter(100)} (-132768..132767) DistanceConfidence ::= INTEGER {zeroPointZeroOneMeter(1), oneMeter(100), outOfRange(101), unavailable(102)} (0..102)	V	Position of the object along x axis of the sensor	
>yDistance			V	Position of the object along y axis of the sensor	
>zDistance			S		
>xSpeed	Relative speed of detected object from the ITS-S's reference point in x-direction at the time of measurement.	SpeedExtended ::= SEQUENCE { value SpeedValueExtended, confidence SpeedConfidence} SpeedValueExtended ::= INTEGER {standstill(0), oneCentimeterPerSec(1), unavailable(16383)} (-16383..16383)	V		
>ySpeed	Relative speed of detected object from the ITS-S's reference point in y-direction at the time of measurement.	SpeedExtended (see xSpeed)	V		
>zSpeed	Relative speed of detected object from the ITS-S's reference point in z-direction at the time of measurement.	SpeedExtended (see xSpeed)	S		
>xAcceleration	Relative acceleration of detected object from the ITS-S's reference point in x-direction at the time of measurement.		S		
>yAcceleration	Relative acceleration of detected object from the ITS-S's reference point in y-direction at the time of measurement.		S		
>zAcceleration	Relative acceleration of detected object from the ITS-S's reference point in z-direction at the time of measurement.		S		
>yawAngle			S		
>planarObjectDimension1	First dimension of object as provided by the sensor or environment model. This dimension is always contained in the plane which is perpendicular to the direction of the angle indicated by the yawAngle and which contains the object reference point.	ObjectDimension ::= SEQUENCE { value ObjectDimensionValue, confidence ObjectDimensionConfidence }	S		

2.4.1.1_M_Master technical specifications for V2X use cases

CPM standard (ETSI TR 103 562)			CPM Master choices V2X		
Field	Description/Meaning	Type of data	Status	Content	Value
>planarObjectDimension2	Second dimension of the object as provided by the sensor environment model. This dimension is contained in the plane which contains the direction of the angle indicated by the yawAngle and the object reference point.	ObjectDimension ::= SEQUENCE { value ObjectDimensionValue, confidence ObjectDimensionConfidence }	S		
>verticalObjectDimension	Vertical dimension of object as provided by the sensor or object model.	ObjectDimension ::= SEQUENCE { value ObjectDimensionValue, confidence ObjectDimensionConfidence }	S		
>objectRefPoint		INTEGER {mid (0), bottomLeft(1), midLeft(2), topLeft(3), bottomMid(4), topMid(5), bottomRight(6), midRight(7), topRight(8)} (0..8)	S		
>dynamicStatus		INTEGER {dynamic(0), hasBeenDynamic(1), static(2)} (0..2)	S		
>classification		ObjectClassDescription ::= SEQUENCE (SIZE(1..8)) OF ObjectClass ObjectClass ::= SEQUENCE { confidence ClassConfidence, class CHOICE { vehicle VehicleSubclass, person PersonSubclass, animal AnimalSubclass, other OtherSubclass}}}	U		
>matchedPosition			S		
freeSpaceAddendumContainer		FreeSpaceAddendumContainer ::= SEQUENCE SIZE(1..128, ...) OF FreeSpaceAddendum			
freeSpaceConfidence	Confidence indicating that an indicated area is not occupied by a traffic participant or obstacle.	FreeSpaceConfidence ::= INTEGER {unknown(0), onePercent(1), oneHundredPercent(100), unavailable(101)} (0..101)	V		
freeSpaceArea	Describes the free space area for which the free space confidence of this addendum container is valid.	FreeSpaceArea ::= CHOICE { freeSpacePolygon AreaPolygon, freeSpaceCircular AreaCircular, freeSpaceEllipse AreaEllipse, freeSpaceRectangle AreaRectangle }	V		
sensorIDList	Provides a list of pseudonym sensor IDs which performed the measurement to indicate the free space.	SensorIDList ::= SEQUENCE SIZE(1..128, ...) OF Identifier	S		
shadowingApplies	Indicates if the shadowing applies also within the described area.	ShadowingApplies ::= BOOLEAN	V		
>>numberOfPerceivedObjects	A number representing the total number of detected and shared objects of an ITS-S transmitting a CPM.	NumberOfPerceivedObjects ::= INTEGER (0..255)	V		

Other elements for transmission purpose:

ETSI TR 103 562			Master choices		
Field	Description / Meaning	Type of data	Status	Content	Value set
repetitionDuration		ms	X	None : live information produced each 0,5 second and sent 1 time.	N/A
repetitionInterval		ms	X	None : live information produced each 0,5 second and sent 1 time.	N/A

2.4.1.1_M_Master technical specifications for V2X use cases

ETSI TR 103 562			Master choices		
Field	Description / Meaning	Type of data	Status	Content	Value set
Destination area	<p>"As specified in ETSI EN 302 931."</p> <p>"itsGnMaxGeoAreaSize ; 10 ; Maximum size of the geographical area for a GBC and GAC packet [km2]. If the geographical area size exceeds the maximum value, the GeoNetworking packet shall not be sent (source) and not be forwarded (forwarder)"</p>	<p>GeoAreaPosLatitude [1/10 microdegree]</p> <p>GeoAreaPosLongitude [1/10 microdegree]</p> <p>Distance a [m]</p> <p>Distance b [m]</p> <p>Angle [°]</p>	V	Defined as a circle of 500m radius around the public transport	(area of 0,785km ²)
Maximum Hop Limit	<p>"The Maximum Hop Limit specifies the number of hops a packet is allowed to have in the network, i.e. how often the packet is allowed to be forwarded."</p> <p>"itsGnDefaultHopLimit : 10 : Default hop limit indicating the maximum number of hops a packet travels"</p>	itsGnDefaultHopLimit Integer32 (0..255)	V	Direct communication between the bus and the vehicles in the vicinity. No hop.	is 0
Traffic class	"GN traffic class of the DENM as defined in ETSI EN 302 636-4-1 if GeoNetworking/BTP is used."	itsGnTrafficClass Integer32 (0..255)	V	<p>Channel offload bit is 0 (see RS_RSP_042 based on RS_BSP_262 (C-Roads PF Roadside profile))</p> <p>Traffic class values is "2"</p>	is 2

2.9. SSP (service specific permission)

See 2.4.1.2_M_Master_I2V for the SSP related to each kind of stations and messages.

3. SCOOP₁ use-cases : technical specifications

At first, all the following use-cases have to be compliant with the Master choices in V2X context (previous chapter). Only then, specific details related to each use-case are given in this part.

3.1. List of SCOOP₁ use cases

Functional descriptions and definitions of the following use-cases are given in the document : catalog of the use-cases (2.2 document).

Table 3.1-1 : Use Cases on vehicle data (managed by Road Operators)

A1	Traffic data (position, speed, direction)	
A2	Collected Data from Automatic Road Hazard Signaling (crashes, etc.)	All following D or E uses-cases, except D10 (emergency brake which is a V2V emergency use-cases)
A3	Collected Data from Manual Road Hazard Signaling	All following use-cases when declared manually (it can especially be D2a (animal), D2b (pedestrian), D3 (obstacle), D5 (accident), D8 (blockage))

The A use-cases almost concerns the R-ITS-S and not directly the V-ITS-S (which is here just the source of information used by the use-cases)

Table 3.1-2 : Use Cases on roadworks (managed by Road Operators)

B1	Roadwork Warning - planned roadwork (stationary and mobile plus salting zone)	B1a - Alert closure of part of a lane, whole lane or several lanes B1b - Alert closure of a road or a carriageway B1c - Alert planned roadworks - mobile
B2	Roadwork Warning – road operator intervention	B2a - Alert road operator vehicle approaching B2b - Alert road operator vehicle in intervention B2c - Alert road operator vehicle in patrol B2d – Alert end of queue by a road operator vehicle
B3	Roadwork Warning - winter maintenance	B3a - Winter maintenance - salting in process B3b - Winter maintenance - snow removal in process B3c - Winter maintenance - alert vehicle moving

B1a and B1b are I2V use-cases, and not V2X. That's why they are written in grey. However, they can be broadcast by Vro-ITS-S which can act as a R-ITS-S (as a relay) for I2V use-cases.

Table 3.1-3 : Use Cases on road hazard and weather conditions

D1	Road hazard Signalling - temporary slippery road	
D2	Road hazard Signalling - animal, people on the road	D2a: animal on the road D2b: pedestrian on the road
D3	Road hazard Signalling - obstacle on the road	
D4	Road hazard Signalling - stationary vehicles, breakdown	D4a: stationary vehicle D4b: vehicle breakdown
D5	Road hazard Signalling - unprotected accident area	
D6	Road hazard Signalling - reduced visibility	
D8	Road hazard Signalling - unsecured blockage of a road	

D10	Road hazard Signalling - emergency brake	
D11	Road hazard Signalling - end of queue	
E6	Road hazard Signalling - exceptional weather conditions	

3.2. eventType - relevanceTrafficDirection (V2X)

In the following tables:

- causeCode, subCauseCode and relevanceTrafficDirection refers to the values that **shall** be set in the DENM message for the use-case

Following table is applicable to all V-ITS-S (Vru or Vro) :

Table 3.2-1 : DENM management container elements for SCOOP V-ITS-S (per use case)

Use-case	causeCode	subCauseCode	relevanceTrafficDirection	Declaration type*	Comments
D1 - Temporary slippery road	6: adverse weather condition - adhesion	0: unavailable	allTrafficDirection	Automatic	
D2a - Animal on the road	11: hazardous animal – animal on the road	0: unavailable	allTrafficDirection	Manual*	To the question of distinguishing between a small and big animal, it was decided to stay with a unique "Animal on the road" triggered report.
D2b - Person on the road	12: human presence on the road	0: unavailable	allTrafficDirection	Automatic Manual*	Automatic triggering can be by the V-ITS-S detecting that one of its occupants is leaving the vehicle.
D3 - Obstacle on the road	10: hazardous – obstacle on the road	0: unavailable	allTrafficDirection	Manual*	To the question of distinguishing between a small and big obstacle, it was deemed difficult to implement and would require an additional choice in the HMI. Therefore it was decided to stay with a unique "Obstacle on the road" report.
D4a - Warning stationary vehicle	94: stationary vehicle	0: unavailable	allTrafficDirection	Automatic	
D4b - Warning (EGO) vehicle breakdown	94: stationary vehicle	2: vehicle breakdown	allTrafficDirection	Automatic	
D5 - Warning accident zone	94: stationary vehicle	3: post crash	allTrafficDirection	Automatic	Always concern the EGO vehicle (the one which emit the message)
	2: accident	0: unavailable	allTrafficDirection	Manual*	Declaration of a user about an other vehicle
D6 - Warning reduced visibility	18: Adverse weather condition - visibility	1: fog	allTrafficDirection	Automatic	
D8 - Unsecured blockage of a road (road with blocked traffic)	5: impassibility	0: unavailable	allTrafficDirection	Manual*	

Use-case	causeCode	subCauseCode	relevanceTrafficDirection	Declaration type*	Comments
D10 - Warning emergency brake	99: Dangerous situation	1: Emergency electronic Brake lights	allTrafficDirection	Automatic	
D11 - Warning end of queue	27: Dangerous end of queue	0: unavailable	upstreamTraffic	Automatic	
			allTrafficDirection	Manual*	
E6 - Warning exceptional weather conditions	19: Adverse weather condition - precipitation	0: unavailable	allTrafficDirection	Automatic	

* : all declaration type should be automatic mid-term or long-term. In a proof-of-concept approach, manual declaration is tolerated (but is not an optimum). If automatic can replace the manual solution, there is no interdiction to do so.

Following table is only applicable to Vro-ITS-S in operator mode (**Shall not** be available in Vru) :

Table 3.2-2 : DENM management container elements for SCOOP Vro-ITS-S in operator mode (per use case)

Use-case	causeCode	subCauseCode	relevanceTrafficDirection	Declaration type*	Comments
B1c - Alert planned roadworks - mobile	3: Roadwork	3: Slow moving Road Maintenance	upstreamTraffic	Vro - Manual* Vro - Automatic	(Ego UC)
B2a - Alert road operator vehicle approaching	95: Emergency vehicle approaching	2: prioritised	<u>downstreamTraffic</u>	Vro - Manual* Vro - Automatic	(Ego UC)
B2b - Alert road operator vehicle in intervention	15: Rescue and recovery work in progress	0: unavailable	upstreamTraffic	Vro - Manual* Vro - Automatic	(Ego UC)
B2c - Alert road operator vehicle in patrol	26: Slow Vehicle	1: maintenance Vehicle	upstreamTraffic	Vro - Manual* Vro - Automatic	(Ego UC)
B2d - Alert end of queue by a road operator vehicle	27: Dangerous end of queue	0: unavailable	upstreamTraffic	Vro - Manual*	(Ego UC)
B3a - Winter maintenance - salting in process	26: slow vehicle	8: salting vehicle	allTrafficDirection	Vro - Manual* Vro - Automatic	(Ego UC)
B3b - Winter maintenance - snow removal in process	26: slow vehicle	6: snow plough	allTrafficDirection	Vro - Manual* Vro - Automatic	(Ego UC)
B3c - Winter maintenance - alert vehicle moving	3: Roadwork	6: winter Service	allTrafficDirection	Vro - Manual* Vro - Automatic	(Ego UC)

3.3. informationQuality - triggering condition - validityDuration - Update - Termination (V2X)

informationQuality - Emission by a V-ITS-S :

- Vru-ITS-S **should** emit informationQuality according the requirements of the Car2Car consortium. Except when the event is manually declared. In that case, the informationQuality **shall** be set to "1".
- Vro-ITS-S in user mode :
 - should** emit informationQuality according the requirements of the Car2Car consortium when the event is triggered automatically (it involves that the V-ITS-S is connected to the CAN_bus of the car in which the device is mounted). For information, the following tables gives an overview on triggering condition and the informationQuality level used by the Car2Car Consortium.
 - shall** emit an informationQuality set to "0" when the event is manually declared.
- Vro-ITS-S in operator mode **should** emit an informationQuality set to "6".

informationQuality - Reception by a R-ITS-S :

- When the informationQuality of an incoming event is “0” or “1”, the event **shall** be reported to the PF with a CITS-DATEX quality of “riskof”.
- When the informationQuality of an incoming event is “6” and the stationType is 9 or 10 (Vro-ITS-S in operator mode), the event **shall** be reported to the PF with a CITS-DATEX quality of “certain”.
- In other cases, the event **should** be reported to the PF with the following CITS-DATEX quality : “probable”.

In the following tables :

- Triggering condition and scale iQ (informationQuality) C2C : given for information. The triggering condition in automatic mode involves the connection to the CAN_bus for Vru use-cases and to equipments for Vro use-cases. informationQuality for Vro use-cases are already defined at the beginning of this chapter (so there are not given in the dedicated table to Vro).
- validityDuration refers to the values that **should** be set in the DENM message for the use-case.
- Update gives the rhythm of update cycle when the UC is automatic : if after the interval given the trigger conditions are still fulfilled, the message is updated. The update cycle is not applicable for manual.
- Termination explain the condition in which a cancel is emitted in automatic mode. In manual, only the author can cancel, if the device permits it.

Table 3.3-1 : DENM conditions and life cycle for SCOOP V-ITS-S (per use case)

Use-case	Triggering condition (Auto) + scale iQ C2C	validityDuration	Update cycle (Auto)	Termination (Auto)
D1 - Temporary slippery road	ASR Request + accelerator pressure or ABS action + brake pressure, acceleration / deceleration, friction iQ : 1->7	600(s)	each 20s (add point*)	Shall not be used
D2a - Animal on the road		600(s)		
D2b - Person on the road		1 200(s)		
D3 - Obstacle on the road		1 200(s)		
D4a - Warning stationary vehicle	Warning, duration of null-speed, neutral, parking brake, seat belt, door open iQ : 1->3	30(s)	each 15s	If at least one of the following conditions is satisfied : (a) the vehicle is no longer stationary for a duration of 5 s; (b) the hazard lights are disabled; (c) the position of the vehicle has changed more than 500 m (e.g. because the vehicle has been towed away).
D4b - Warning (EGO) vehicle breakdown	Warning, breakdown detection, duration of null-speed, neutral, parking brake, seat belt, door open iQ : 1->3	900(s)	each 15s	
D5 - Warning accident zone	Null-speed, e-call, crash detection, airbag iQ : 1->3	Auto : 1 800(s)	each 60s	If at least one of the following conditions is satisfied : (a) the vehicle is no longer stationary for a duration of 15 s; (b) the position of the vehicle has changed more than 500 m (e.g. because the vehicle has been towed away).
		Manual : 1 200(s)		
D6 - Warning reduced visibility	Low-speed (7 to 80kmph), fog lights, dipped headlights, visibility range detector iQ : 1->4	300(s)	each 20s (add point*)	Shall not be used

2.4.1.1_M_Master technical specifications for V2X use cases

Use-case	Triggering condition (Auto) + scale iQ C2C	validityDuration	Update cycle (Auto)	Termination (Auto)
D8 - Unsecured blockage of a road (road with blocked traffic)		3 600(s)		
D10 - Warning emergency brake	Electronic emergency brake light, deceleration, duration of deceleration iQ : 1->3	2(s)	each 100ms	Shall not be used
D11 - Warning end of queue	Speed, deceleration, duration of deceleration, hazard lights, surrounding CAMs and/or DENMs iQ : 1->3	Auto : 20(s)	Shall not be used	Shall not be used
		Manual : 1 800(s)		
E6 - Warning exceptional weather conditions	Low-speed (7 to 80kmph), windscreen wipers at max, duration, dipped headlights, rain sensor iQ : 1->4	300(s)	each 20s (add point*)	Shall not be used

* : for linear event, when the triggering condition are still fulfilled, the update consist on adding points in the eventHistory (instead of just changing the location of referencePosition for a punctual event). Note that if there is no point to add at the first update cycle, the event is punctual (no eventHistory) instead of linear (with eventHistory). In that case, the punctual event is located where the triggering condition were fulfilled.

Following table is only applicable to Vro-ITS-S in operator mode (**Shall not** be available in Vru) :

Table 3.3-2 : DENM conditions and life cycle for SCOOP Vro-ITS-S in operator mode (per use case)

Use-case	Triggering condition (Auto)	validityDuration	Update cycle (Auto)	Termination (Auto)
B1c - Alert planned roadworks - mobile	Activity is « chantier mobile » (mobile roadworks) AND ((manual activation) XOR (automatic : light arrow OR an other equipment is activated))	600s	each 1s	Conditions are no longer satisfied
B2a - Alert road operator vehicle approaching	Activity is « intervention » AND ((manual activation) XOR (automatic : beacon OR an other equipment is activated))	2s	each 1s	Conditions are no longer satisfied
B2b - Alert road operator vehicle in intervention	(Activity is « patrouillage » OR « intervention ») AND ((manual activation) XOR (automatic : speed ≤ Vstop* AND (beacon OR an other equipment is activated)))	600s	each 1s	Conditions are no longer satisfied

Use-case	Triggering condition (Auto)	validityDuration	Update cycle (Auto)	Termination (Auto)
B2c - Alert road operator vehicle in patrol	Activity is « patrouillage » AND ((manual activation) XOR (automatic : Vstop* < speed ≤ Vslow* OR (beacon OR an other equipment is activated)))	2s	each 1s	Conditions are no longer satisfied
B3a - Winter maintenance - salting in process	Activity is « VH » AND (triggering conditions for B3b are not reached) AND ((manual activation) XOR (automatic : salting is on))	2s	each 1s	Conditions are no longer satisfied
B3b - Winter maintenance - snow removal in process	Activity is « VH » AND ((manual activation) XOR (automatic : snow blade is down))	2s	each 1s	Conditions are no longer satisfied
B3c - Winter maintenance - alert vehicle moving	Activity is « VH » AND (triggering conditions for B3a OR B3b are not reached)	2s	each 1s	Conditions are no longer satisfied

3.4. relevanceDistance - destination area - notion of zones

The notion of zone is covered by several definitions within the C-ITS projects :

- the advance notice distance, marked D, is the distance between the eventPosition and the place where we want the user to be informed, which can be configured by the automobile manufacturers
- the destinationArea, marked D', is the area where the information is broadcast in.

The applications provide this information to the DENM service, which then transmits it to the networking & transport layer.

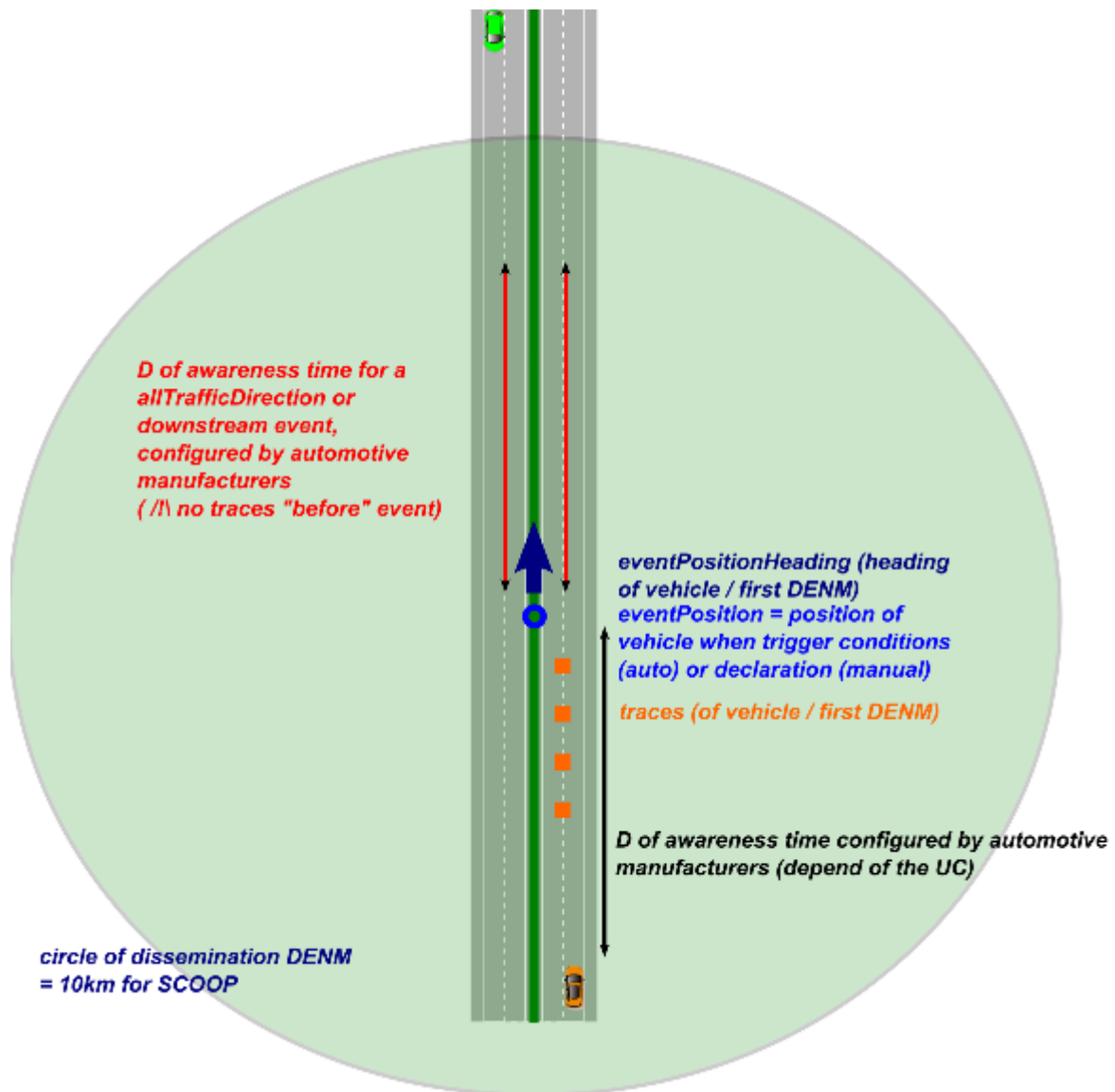


Figure 3: Illustration of a use case – Punctual event

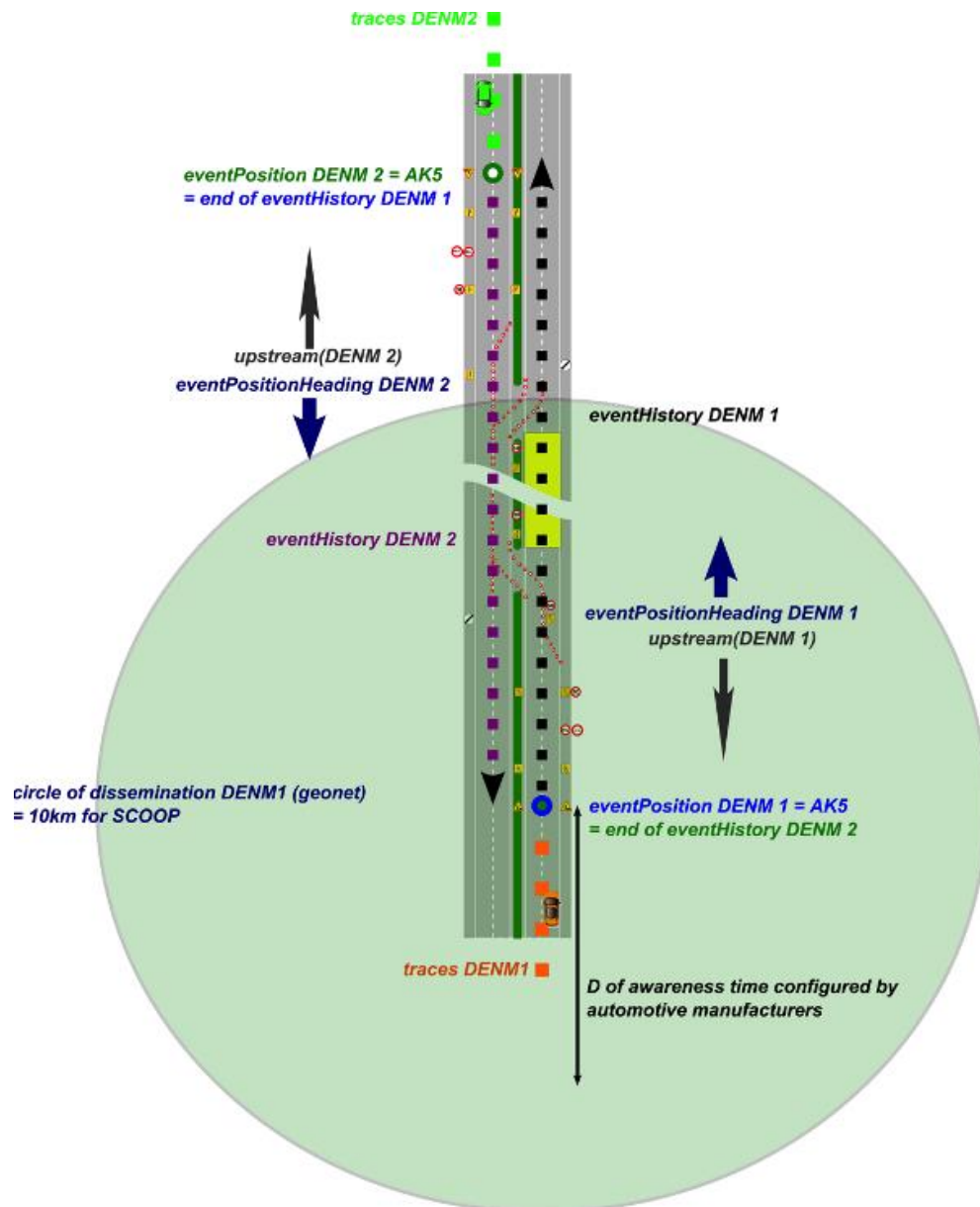


Figure 4: Illustration of a use case – Basic B1a&b on warning stationary roadwork (linear event I2V)

3.5. Major display prioritisation principles

The message display principles for the HMI are more detailed in the deliverables 2.4.2.2_M and 2.4.2.3.

The parameters taken into account for the display are all of the information in the DENM fields.

The main parameters taken into account to determine the type of display on the screen are:

- the location of the event (eventPosition and eventHistory)
- the type of event (eventType)
- the event's validity duration (validityDuration)
- the quality level (informationQuality)
- the way-to-event (traces) especially when relevanceTrafficDirection is upstreamTraffic

4. Architecture G5

Warning : this chapter of the document defines the first SCOOP₁ architecture 100% G5. For any following content which presents a discrepancy with the 2.4.1_M document (which presents not only G5 architecture, but also hybrid communication), the 2.4.1_M positions prevail over what is defined in this chapter.

4.1. List of system components

SCOOP₁ system components shall designate all physical components that enable users to produce or exchange the messages necessary to produce the SCOOP₁ use cases.

The components underpinning the cooperative systems are the ITS stations as defined in the ETSI standard (see 2.4.1bis_M) and 2.4.2 documents.

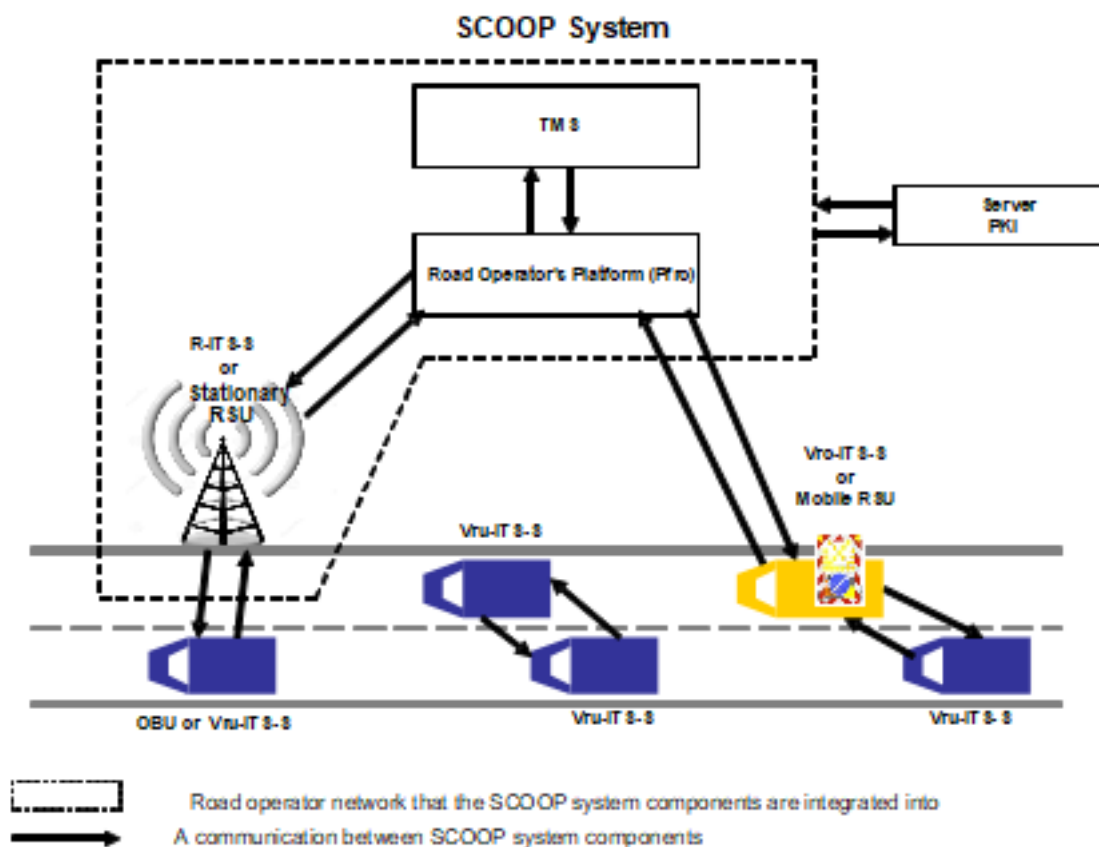


Diagram of the SCOOP₁ system

Figure 5:

Roles of system components (excluding PKI)

The Road Operator's Platform, or PFro receives and processes information received from the management terminal or the road operator's traffic management system. It sends information to the operator's cooperative equipment (roadside stations or stations in the operators' vehicles), but does not communicate directly with the users' vehicles. It processes information received from the roadside stations and makes it available to the operator.

- The functional specifications for the PFro, are set out in the specification 2.4.3.2 (detailed specifications) deliverables.

The roadside stations, **R-ITS-S**, receive the information from the PFro, and broadcast them locally to user vehicles. They receive information and queries transmitted by vehicles, which are then processed (for storage, routing or sending). They send the event-based messages to the PFro. They send the traffic information (A1 cases) to the platform after consolidating the data (aggregation). They **can** broadcast service announcement messages through CAM-I (Cooperative Awareness Message -Infrastructure) message specified in 2.4.1.2_M.

- The R-ITS-Ss' technical specifications are described in the deliverable 2.4.2.1.

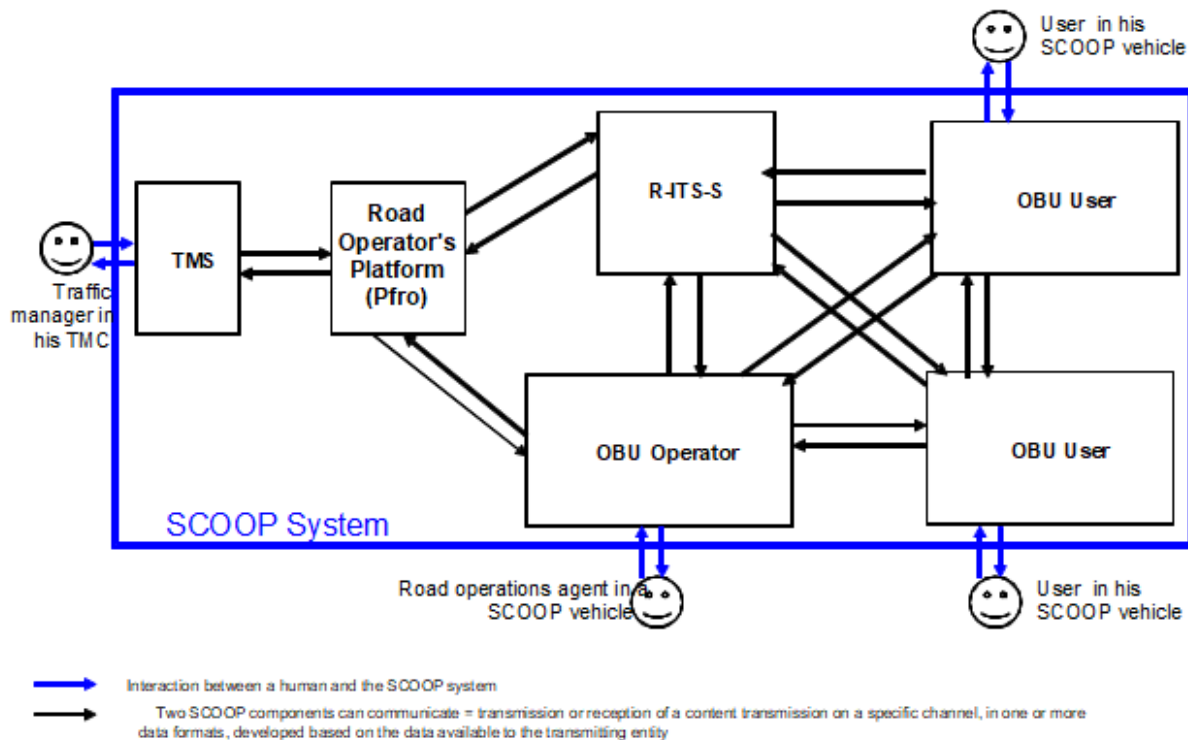
The vehicle embedded units, **V-ITS-S** are the ITS stations installed in users' vehicles (**Vru-ITS-S** or user V-ITS-S) or operators' vehicles (**Vro-ITS-S** or operator V-ITS-S), which are equipped with a human-machine interface (HMI). They are able to broadcast automatically and sometimes manually (if enabled), via HMI, messages to other ITS stations. They receive information sent by other vehicles or roadside stations, process information for potential display to the driver via his HMI.

Vru-ITS-S cannot communicate (send and receive messages) directly with the PFro whereas the Vro-ITS-S **can**. The Vro-ITS-S include all the functionalities of the Vru-ITS-S plus the functionalities specific to the road operator ("operator mode").

"**mobile R-ITS-S**" function designates a Vro-ITS-S function that sends to the user the TMS based messages (i.e all I2V use cases) and collect messages of the users' vehicles, like the R-ITS-S. On the other hand, the mobile R-ITS-S function does not collect traffic information (A1 use-cases)

- The technical specifications concerning the Vro-ITS-S are described in the deliverable 2.4.2.2.
- **Human-machine interfaces (HMI)** connected to the V-ITS-S are used to display warning messages or to inform drivers. The Vru-ITS-S HMI are specific to each automobile manufacturer. They are described in two deliverables (2.4.2.3 Renault and 2.4.2.3 PSA) on HMI components developed by each manufacturer but they won't be considered as specification, and may not be public. HMI of road operator is partially described in 2.4.2.2Ter.

View of the possible functional communication paths in the SCOOP system (without representing the PKI)



6: View of the functional communication for the SCOOP1 system (excluding PKI)

Figure

4.2. General architecture of an ITS station and list of related standards

The ITS stations are based on an architecture defined by the European standardisation organisation, ETSI (European Telecommunications Standards Institute) in the standard EN 302 665.

The standards list is given in 2.4.1bis_M document.

4.3. Types of messages exchanged in SCOOP₁

4.3.1. CAM (Cooperative awareness message) and DENM (decentralized environmental notification message)

The messages sent from V-ITS-S to the R-ITS-S or V-ITS-S are CAM and DENM. The messages sent from the R-ITS-S to V-ITS-S are CAM-I and DENM.

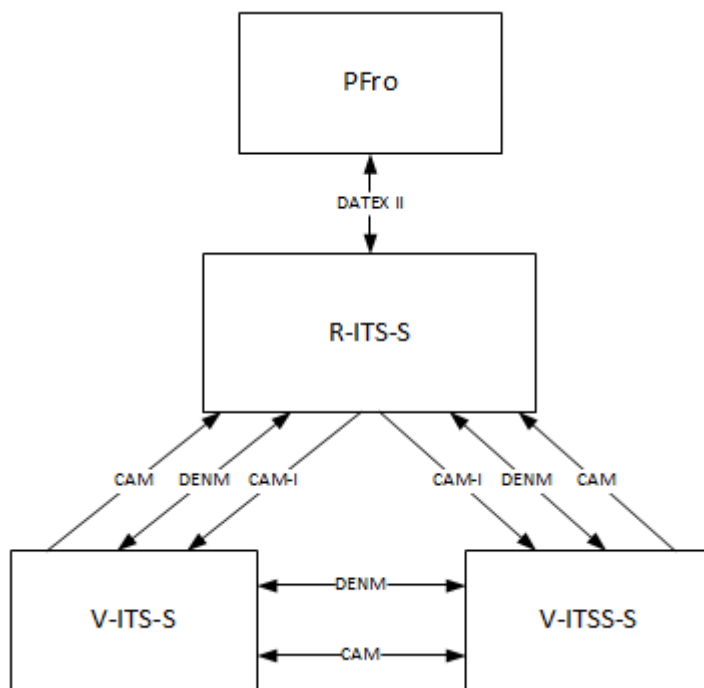


Figure 7: View of the types of messages exchanged in SCOOP₁

- The CAM messages sent by the R-ITSSs are called CAM-I messages and are detailed in the deliverable 2.4.1.2_M_Master_I2V.

4.3.2. Processing of CAM and DENM for data collection

The V-ITSS regularly transmit CAM data. The R-ITS-S consolidate CAM messages to construct the traffic data (e.g. average speed), which are then sent in DATEX II V2.3 to the PFr.

The R-ITS-S do not consolidate (no aggregation) the DENM. There is no prioritisation between the DENMs to be processed by an R-ITS-S:

- All new DENM are translated individually in DATEX II V2.3 and **should** be sent to the PFro, which consolidates them and makes the information available to the TMS;
- Updated DENM are translated only after a temporization parameter, the default value being 2 seconds.

NB: Unlike updates, repetitions of the same DENM are not translated into DATEX II.

4.3.3. Messages related to SCOOP₁ experimentation

Other **messages related to SCOOP₁ experimentation** for assessment, supervision and validation needs are sent by the V-ITS-S and R-ITS-S: these are the U-logs and T-logs (data for users' evaluation and data for technical evaluation).

The specifications of U-Logs and T-Logs are defined in deliverable 2.4.1.3. They result from studies related to their different uses :

- The use of the **U-logs and T-logs for evaluation needs**
- The use of **system component supervision needs**
- The use of the **U-logs and T-logs for validation needs**

4.3.4. DATEX II V2.3 messages

The messages transmitted by the Road Operator's Platform (PFro) to the R-ITS-S are sent thanks to DATEX II V2.3. The R-ITS-S translate the DATEX II V2.3 messages into DENM to broadcast them to the V-ITS-S.

The PFro receive the DATEX II message from the TMS, the PFro have to adapt it for them to be translated then by R-ITS-S.

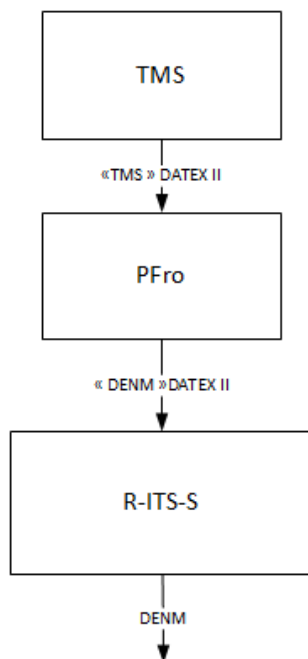


Figure 8: Format of messages transmitted

- A DATEX II V2.3 <--> ETSI Message dictionary is specified in the deliverable 2.4.1.4.

4.4. Principles for the system architecture

4.4.1. Definition principles for SCOOP₁

The architecture principles for SCOOP₁ can be stated as follows:

- Transmitters are responsible for qualifying the information upon transmission.
- Transmitter qualifies the information independently of the processes that will then be performed by the receiving entities.
- Rules for qualifying the information are shared between all SCOOP₁ partners at a level that enables the same level of understanding.
- Major principles regarding the prioritisation between displayed uses cases have been established between the partners.
- Each receiving entity is responsible for processing and displaying the information.

4.4.2. Flow of ETSI messages

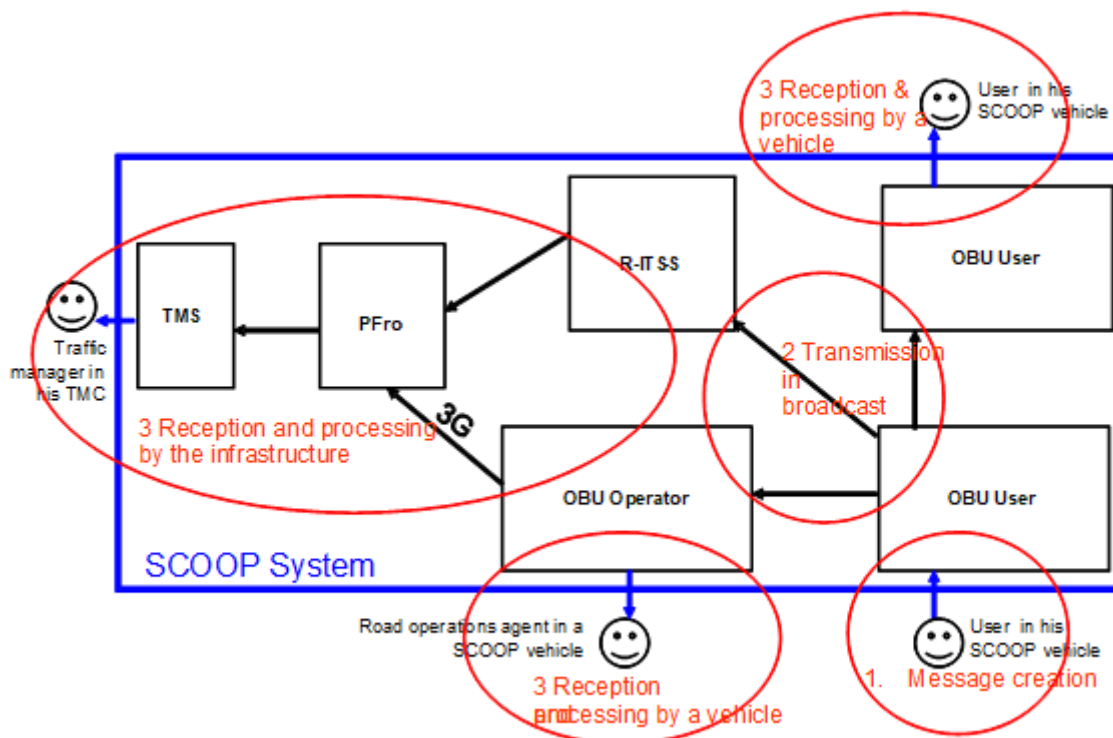
The cooperative message broadcast logic distinguishes 3 steps:

- Transmission of a message;
- Reception of a message;
- How to process a message received.

Once received, cooperative messages can be forwarded.

There are 3 message creation logics :

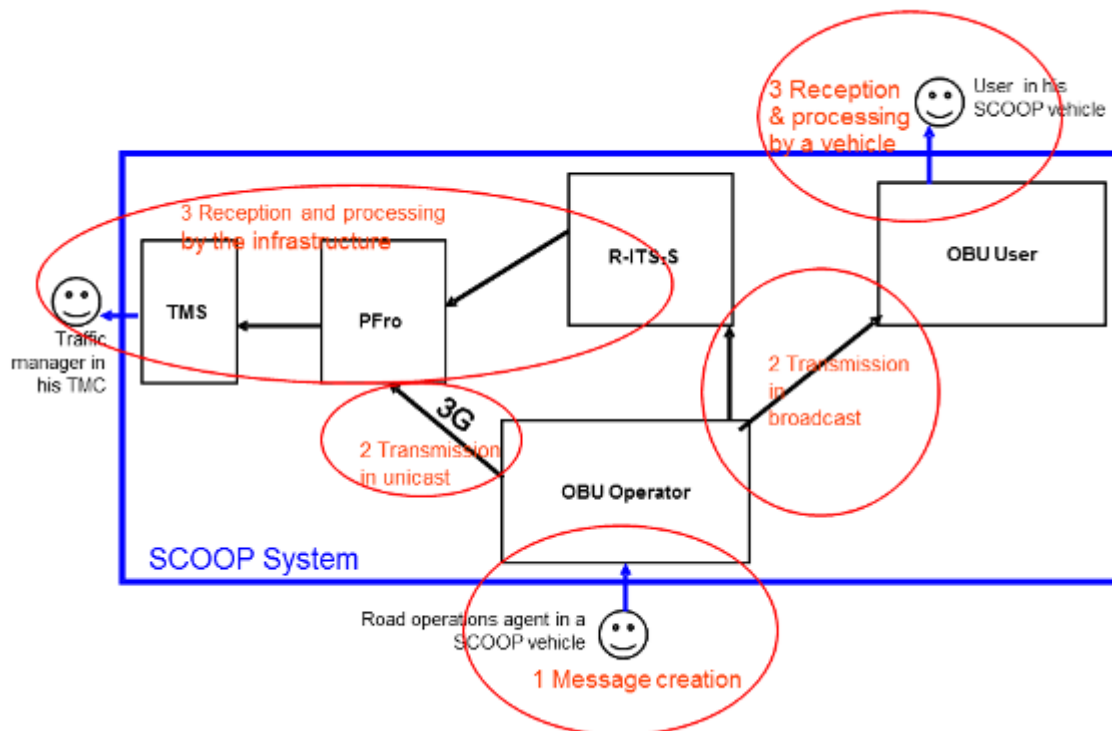
- **1. Creation of message by a Vru-ITS-S** (automatically or manually) **or a Vro-ITS-S in “user mode”** : message broadcast ; message received by a V-ITS-S or an R-ITS-S; and message processed by the V-ITS-S or R-ITS-S



of message by a Vru-ITS-S

Figure 9: Creation

• **2. Creation of message by a Vro-ITS-S in “operator mode”** : broadcast and reception by V-ITS-S or R-ITS-S. Messages are processed by the V-ITS-S or R-ITS-S.



Creation of message by a Vro-ITS-S

Figure 10:

• **3. Creation of message by the operator via its TMS:** the TMS transmits the message to the PFro ; the platform identifies the relevant R-ITS-Ss and transmits the message for broadcasting ; the R-ITS-S broadcast the message; message received by a V-ITS-S ; message processed by the V-ITS-S (broadcast logic for a DENM from theTMS).

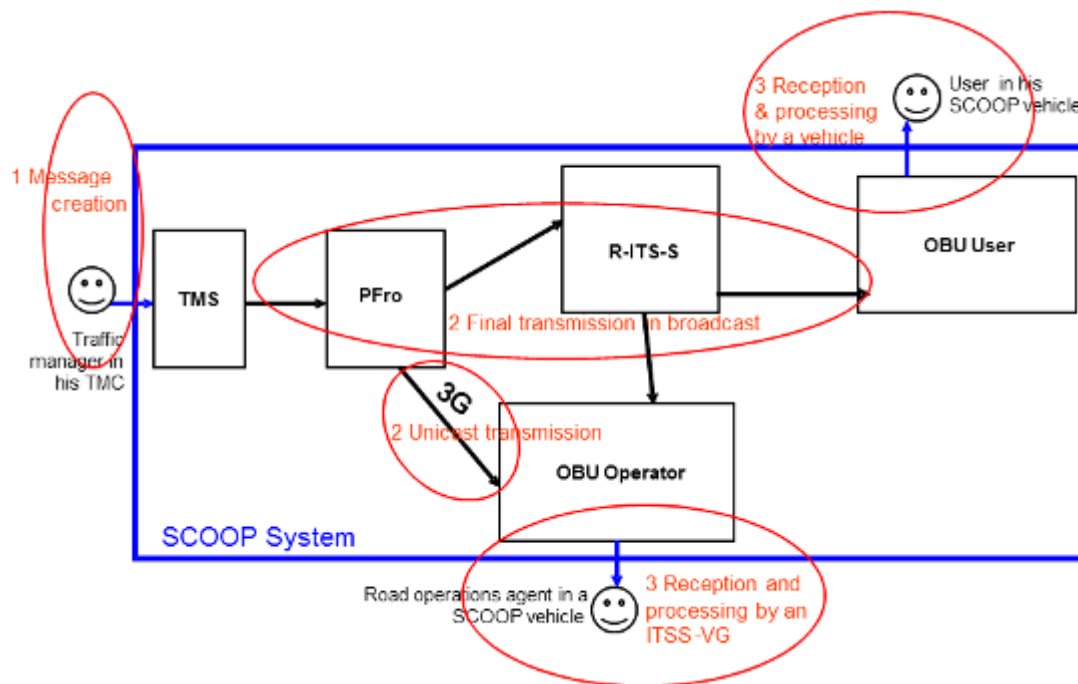


Figure 11: Creation of

message by the operator via its TMS

4.4.3. Communication principles between system components

Two types of transmitted messages will be differentiated:

- Transmitted messages are intended to be broadcast in a relevant geographic zone and do not identify the receiver in advance (every ITS station travelling in the geographic zone is likely to be a receiver of the message). This is the broadcast mode that can be assigned to a precise or undefined geographic zone.
- Transmitted messages are addressed to a pre-identified recipient. This is the "unicast" mode (point-to-point).
- The table specifies the message transmission modes by transmitter-receiver pair.

Table 4.4-1 : Communication between components

RECEIVER > SENDER ▼	R-ITS-S	Vro-ITS-S	Vru-ITS-S	PFro	TMS	PKI Server
R-ITS-S	(ETSI)	ETSI	ETSI	CITS-DATEX		PKI
Vro-ITS-S	ETSI	(ETSI)	ETSI	CITS-DATEX		PKI
Vru-ITS-S	ETSI	ETSI	(ETSI)			PKI
PFro	CITS-DATEX				DATEX	PKI
TMS				DATEX		
PKI Server	PKI	PKI	PKI	PKI		

Type of communications :

- **CITS-DATEX** or **DATEX** => Addressing: transmitted messages that are addressed to one or more pre-identified receiver
- **ETSI** :
 - **DENM** => Geographic broadcasting: transmitted messages are broadcast in a relevant geographic zone and do not identify the receiver in advance (DENM logic)

- CAM => General broadcasting: transmitted message is intended to be received by every ITS station in the ad-hoc network (CAM logic)
- PKI => Addressing of requests and answers.

4.5. Communication Profiles

4.5.1. Definitions of the communication profiles

A communication profile describes a set of communication protocol. Each communication profile has different characteristics in terms of performance, bandwidth and reliability. A use case may use one or more profiles for exchanging messages between the systems to meet the communications requirements. A C-ITS-S should be able to select an optimal communication profile for each message transmission. This feature is specified as the management entity component.

Table 4.5-1 : Communication profiles

Communication Profile	Transport	Network	Access
CP1	BTP (Basic transport Protocol)	Geonetworking	ITS G5 CCH
CP2	BTP (Basic transport Protocol)	Geonetworking	ITS G5 SCH1
CP3	BTP (Basic transport Protocol)	Geonetworking	ITS G5 SCH2
CP4	BTP (Basic transport Protocol)	Geonetworking	ITS G5 SCH3
CP5	TCP	IPV4	ITS G5 SCH1
CP6	UDP	IPV4	ITS G5 SCH1
CP7	TCP	IPV6	ITS G5 SCH1
CP8	UDP	IPV6	ITS G5 SCH1
CP9	TCP	IPV4	3G/4G
CP10	UDP	IPV4	3G/4G
CP11	TCP	IPV6	3G/4G
CP12	UDP	IPV6	3G/4G
CP13			Ethernet
CP14			Ethernet
CP15			Ethernet
CP16			Ethernet

4.5.2. Communication profile for CAMs, DENMS and CITS-DATEX

For SCOOP₁, it has been decided :

- for the exchange of CAM/DENM messages, CP1 will be the used.
- for the PKI requests and logs, CP8 will be the used.

Table 4.5-2 : Communication profile for CAMs and DENMs

Application protocol	CAM	DENM	CITS-DATEX
SENDER	V-ITS-S	V-ITS-S	Vro-ITS-S in operator mode
RECEIVER	Any ITS station in the ad-hoc local network	Any ITS station in the defined geographic zone	PF

Addressing mode	General broadcast	Geographic broadcast	Addressing through cellular network (without routing by an R-ITS-S)
Content of com.	CAM messages created	DENM messages created or relayed	Position of the road operator vehicle and DENM messages created
Access layer	G5= 802.11p	G5= 802.11p	cellular 3G/4G
Channel	CCH	CCH	3G/4G
N° of related port	Port 2001	Port 2002	CITS-Datex in HTTP
Network transport	BTP Geonet	BTP Geonet	TCP/IPv4

IPv6 is considered, this implies that the SCOOP₁ components must be able to support IPv6, potentially encapsulated in IPv4.

- The communication profiles between the R-ITS-S and the PFro, which doesn't require a consensus of different stakeholders, is not covered in this document.

4.6. Network and Transport Layer

Regarding geonetworking forwarding algorithms, the Non-area contention-based forwarding algorithm and the Area contention-based forwarding algorithm (Annex E3 and F3 of ETSI EN 302 636-4-1) are required, based on the selection principles outlined in Annex D.

According to GeoNet specifications, the conservation period of the CAM certificate is set to 1s before erasing the CAM certificate.

The HopLimit is set as indicated previously in this document (see profile of the ETSI messages). After each hop, the count is decreased by the value -1.

4.7. Security

Security aspects are part of deliverables 2.4.4.X

But regarding the pseudonym changes, none of them can occur during PKI request, transmission of logs, or sending a DENM message.