ITS USE CASE

Use Case Title:	**ProbeData for the ITS-G5 context**
Project Name:	Standaardisatie Tafel (NL)
Source:	Amsterdam Group (AG)
Date:	2015-09-25
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Abstract:	Use-Cases and related functional as technical requirements dealing with recovering Road User (Vehicles and others) floating data send along urban road and highway by my means of ITS-G5.
Agenda Item:	None
Work item(s):	None
Document(s) Impacted	Dutch Profile
Intended purpose of document:	☐ Decision ☒ Discussion ☐ Information ☐ Other <specify>
Decision requested or recommendation:	None

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ProbeData for the ITS-G5 context

This ProbeData use-case focuses specifically on road user floating data recovery. It enables road operators to improve road safety and efficiency and limit CO_2 emission based on awareness and warning messages provided by C-ITS solution.

Road Users such as cars, trucks, motorcycles, mopeds, bicycles, impaired road users, pedestrians, prioritised traffic and others, send awareness and warning messages to each other and others. Road operators can collect the information via ITS-G5 equipped Road Side Unit (RSU) ITS Stations (ITS-S) along urban roads and highways.

From the implementation point of view there can be 2 sub-Use-Cases. Both result in collecting similar information types about traffic, but possibly differ slightly in coverage / the amount of data gathered.

1. The locations of RSU ITS-S's do not fully cover the road network. Standard messages from initiating ITS-S's are only received when in range of a RSU ITS-S.
2. The locations of RSU ITS-S's do not fully cover the road network, but in addition to option 1 above, the RSU can send requests to ITS-S's in the vicinity. Road User ITS-S's receiving this request need to have stored the requested information. When Road User ITS-S's are equipped with this function, they can send this requested information when requested. Via this mechanism the road infrastructure can receive information which was not possible to receive earlier by the/other RSU ITS-S's.

This use-case description only specifies the required functional requirements. It does not cover privacy and security related requirements although these are essential for the realisation of this use-case.

Beside data recovery being realized based on ITS-G5 awareness and warning services, data recovery can also be done through other communication techniques (e.g. 3G/4G). This use case description handles solely the ITS-G5 implementation and only indicates others when relevant.

1.0 Use Cases

At present time 2 sub Use-Cases can be identified. Sub Use-Case 1, based on information derived from the reception of CAM, DENM and event messages and Sub Use-Case 2, similar to Sub Use-Case 1, but with the possibility to request (buffered / collected) information from other stations. When implementing Sub Use-Case 2, a limited RSU coverage enables a much larger coverage for collecting awareness and warning messages.

1.1 Introduction Sub Use-Case 1, based on information derived from received CAM and DENM messages

1.1.1 Use case ID:

<Naming convention to be defined >

1.1.2 Objective:

To recover the relevant information from road users to support road operators in increasing road efficiency and safety, while taking into account privacy and security issues, by placing Infrastructural ITS-G5 stations such that relevant data can be received.

1.1.3 Source:

Amsterdam Group; Eco-AT; Dutch Corridor project; Scoop@F; C2C-CC Trigger conditions

ETSI EN 302 637-2/3, Cooperative Awareness Message (CAM) and Decentralized Environmental Notification Message (DENM) services

- Provide the normative and optional data elements to be provided at Day-1 deployment by the Car manufacturing community.

ETSI TS 102 894-2, Common Data Directory (CDD)

- Required describing the elements required for EN 302 637-2/3.

1.1.4 Description

The intention of this Use-Case is that all, for traffic controler relevant information, can be received form road users by road operators with the purpose to improve road efficiency, to improve road safety and lower CO_2 emissions.

In this Sub-Use-Case this is realized by placing RSU at critical locations in the road network, thereby ensuring that most relevant information can be captured by the road infrastructure system.

The only thing to agree on, is that road user ITS-S's provide the relevant information/parameters. Within the section requirements a description of the current known required parameters are included as well as expected message transmission behaviour.

This initial use-case description is followed by ECco-AT, Scoop@F and expected to be followed by the Dutch Corridor project and is supported by the Amsterdam Group. The related Infrastructural implementation may differ based on the existing infrastructure. The message exchange will be harmonized on a European level and specified at ETSI in cooperation with CEN/ISO.

1.1.5 Target System

The targeted system is composed of road user ITS's, RSU ITS's and road infrastructure data systems enabled to collect and combine information as received my more than 1 RSU.

Target system includes: any user ITS-S (such as V-ITS-S), R-ITS-S, C-ITS-S and traffic management system (TMC).

1.1.6 Implementation environment

None.

1.1.7 Actors

- Road user
- Road user ITS-S
    - Road user equipment provider
    - Road user service provider
- Road Infrastructure ITS-S
    - Road Infrastructure supplier
    - Road Infrastructure service provider (such as NDW)
- Road Operator (such as RWS)

1.1.8 Pre-conditions

- For this Use-Case it is required that RSU's are placed such that most relevant road user ITS-S's information can technically be received without any request from the RSU being sent to any user ITS-S.
- TMC is connected to the ITS-G5 equipped R-ITS-S's which can provide information on current (T=0) and the TMC can process the information within T=0+t, where t needs to be defined but is in line with maximum CAM rate.
- The R-ITS-S's can receive CAM and DEMN information from other ITS-S's.
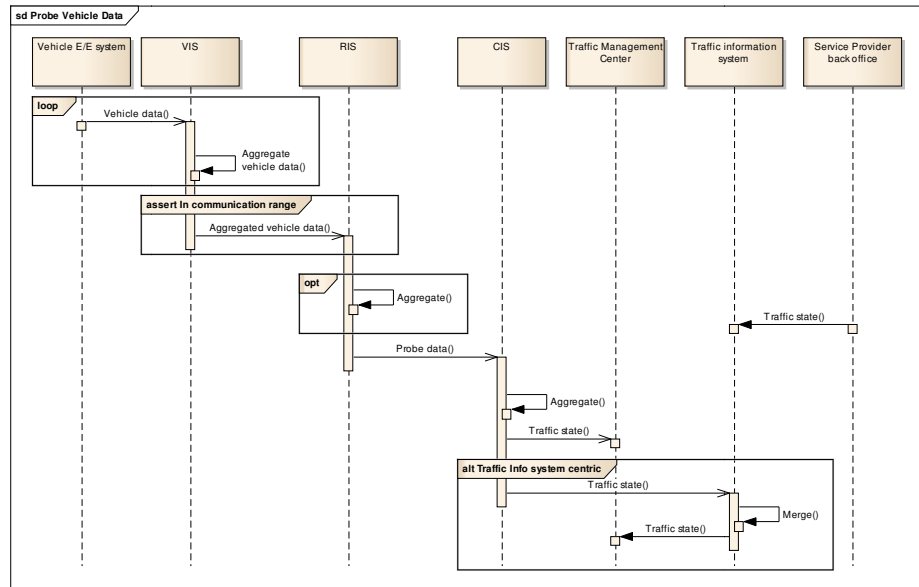- The V-ITS-S provides CAM and DEMN as standardized.
-

1.1.9 Triggers conditions

None

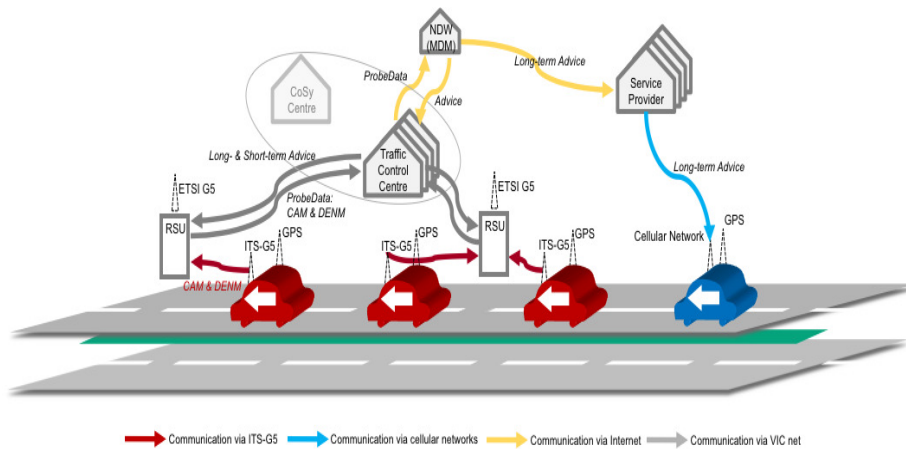### 1.1.10 Use -Case Diagram
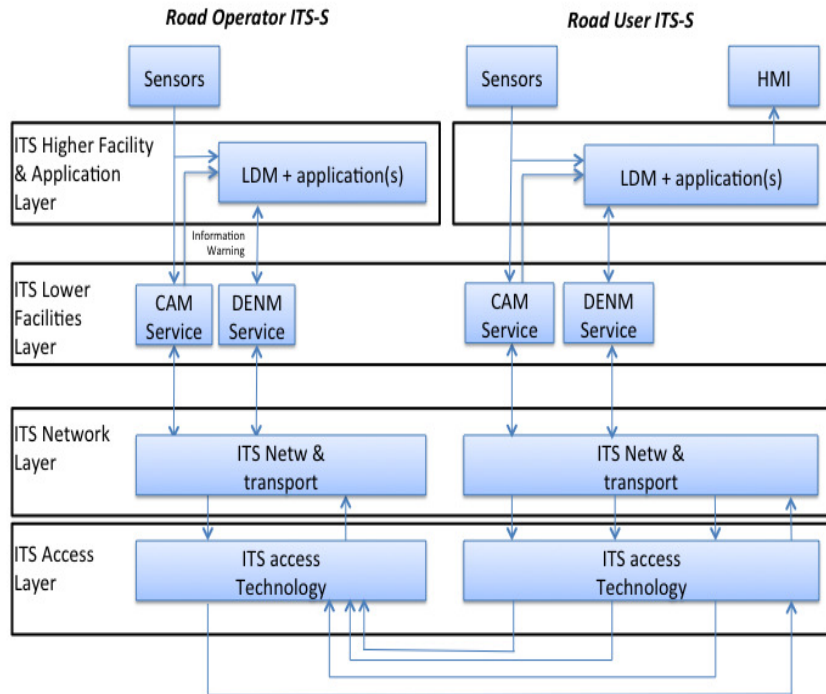
1.1.11 Normal Flow

1.1.12 Post-conditions

At this moment None.

1.1.13 Terminiation conditions

At this moment None.

1.1.14 Use-Case Illustration

1.1.15 Requirements

- Awareness Data parameters (CAM related)
  - Minimum required Parameters
    - Road User Type
    - Vehicle length (wish)/ width (optional)
    - Time/Position
      - Lane accuracy (not in CAM today)
    - Speed
    - Longitudinal Acceleration
    - Drive direction (forward / backward)
    - Heading
  - Optional Parameters
    - Wiper status (not in CAM today)
    - Headlight status
    - Road temperature (not in CAM today)
    - Road condition (slippery, bumps,....) (not in CAM today)
    - Warning light blinking (not in CAM today)

header	
protocolVersion	Version of the protocol. Current version is 1, thus field is set to 1.
messageID	Indicates the type of message. Examples are denm(1), cam(2), ivi(6), etc. Here 2 is used.
stationID	This is the ID of the station (vehicle) broadcasting the message.
cam	
generationDeltaTime	Timestamp belonging to the referencePosition.
basicContainer	
stationType	This DE can be 0 or 4 – 10. Other values indicate vehicles that are not allowed on the motorway.

referencePosition	This DF is of type ReferencePosition (DF A.124 from ETSI TS 102 894-2). It contains the coordinates (WGS 84) of the ITS station (vehicle).

highFrequencyContainer	
heading	The (compass) direction of the vehicle, in 1/10th of a degree.
speed	Speed of the vehicle in cm/s.
driveDirection	The direction the vehicle is travelling in: forward(0), backward(1) or unavailable(2).
vehicleLength	Length of the vehicle in steps of 10 cm. 1 == 10cm.
vehicleWidth	*The vehicle width in 10 cm steps. 1 == 10cm. Required by the standard but not part of the wish list.*
longitudinalAcceleration	The longitudinal (forward / backward) acceleration of the vehicle in steps of 0.1 m/s^2.
curvature	*The curvature of the vehicle trajectory. Required by the standard but not part of the wish list.*
curvatureCalculationMode	*The calculation mode for the curvature. Required by the standard but not part of the wish list.*
yawRate	*The rate the vehicle is spinning around its centre of mass. Required by the standard but not part of the wish list.*

lowFrequencyContainer	
vehicleRole	*The role of the vehicle (e.g. public transport). This is set in accordance with ETSI TS 102 894-2 (usually 0-default). Required because of the use of the lowFrequencyContainer but not part of the wish list.*
exteriorLights	This DE is a sequence of bits (BIT STRING) of size 8. Each bit holds the status of the exterior light switches of a vehicle (e.g. fogLightOn, leftTurnSignalOn, etc.).
pathHistory	*This DF can hold up to 40 points (PathPoint) of where the vehicle has been, optionally with an accompanying timestamp (pathDeltaTime). The timestamp would allow for speed calculation between the points. Required because of the use of the lowFrequencyContainer but not part of the wish list.*

Legend	
bold	required by standard
cursive	optional by standard
normal	required when parent container is used

- Detected Data parameters (DENM related)
  - Optional warning Messages
    - Slow vehicle warning
    - Wrong way driving warning
    - Road condition warnings
    - E-call warning
- Behavioral
  - No requirement other than specified in current CAM and DENM specifications.
- Security
  - No requirement other than specified in current CAM and DENM specifications.
- Privacy
  - No requirement other than specified in current CAM and DENM specifications.

1.1.16 Linked use cases

At this moment None.

1.2 Introduction Sub Use-Case 2, Extended Sub Use-Case 1 with requests (PDM) sent by RSU's and earlier transmitted data response (PVD) by Road User ITS-S's.

1.2.1 Use case ID:

<Naming convention to be defined >

1.2.2 Objective:

To recover the relevant information from road users to support road operators in increasing road efficiency and safety, while taking into account privacy and security issues, by placing Infrastructural ITS-G5 stations such that most relevant data can be received and no relevant information gets lost.

1.2.3 Source:

Amsterdam Group; Eco-AT; Dutch Corridor project; Scoop@F; C2C-CC Trigger conditions

ETSI EN 302 637-2/3, Cooperative Awareness Message (CAM) and Decentralized Environmental Notification Message (DENM) services

- Provide the normative and optional data elements to be provided at Day-1 deployment by the Car manufacturing community.

ETSI TS 102 894-2, Common Data Directory (CDD)

- Required describing the elements required for EN 302 637-2/3.

1.2.4 Description

The intention of this Use-Case is that all, for traffic controler relevant information, can be received form road users by road operators with the purpose to improve road efficiency and predictable travel time, to improve road safety and, lower CO_2 emissions and improve road safety.

In this Sub-Use-Case this is realized by a handshake between road infrastructure RSU's and Road User ITS stations such that RSU's can be intermittently placed along urban roads and highways but still get most relevant information while not being present at all locations to receive the data without a request.

This methode will allow the deployment with a much lower amount of RSU's especially in rural areas. The functionally as described in Sub-Use-Case 1 is also applicable here and for those aspects we refer to this Sub-Use-Case 1.

This initial use-case description is followed by ECo-AT, and expected to be followed by the Dutch Corridor project and is supported by the Amsterdam Group. The related Infrastructural implementation may differ based on the existing infrastructure. The message exchange will be European wide harmonized and specified at ETSI in cooperation with CEN/ISO.

1.2.5 Target System

The targeted system is composed of road user ITS's, RSU ITS's and road infrastructure data systems enabled to collect and combine information as received my more than 1 RSU.

Target system includes: any user ITS-S (such as V-ITS-S), R-ITS-S, C-ITS-S and traffic management system (TMC).

1.2.6 Implementation environment

None.

1.2.7 Actors

- Road user
- Road user ITS-S
  - o Road user equipment provider
  - o Road user service provider
- Road Infrastructure ITS-S
  - o Road Infrasturctture supplier
  - o Road Infrastructure service provider (such like NDW)
- Road Operator (such like NDW)

1.2.8 Pre-conditions

- For this Use-Case it is required that RSU's are placed such that most relevant road user ITS-S's information can technically be received without any request from the RSU being sent to any user ITS-S.

- TMC is connected to the ITS-G5 equipped R-ITS-S's which can provide information on current (T=0) and the TMC can process the information within T=0+t, where t needs to be defined but is in line with maximum CAM rate.
- The R-ITS-S's can receive CAM, DEMN and PVD information from other ITS-S's and provides PDM to those others.
- The V-ITS-S can receive CAM, DENM and PDM from other ITS-S's and provides CAM, DEMN and PVD.
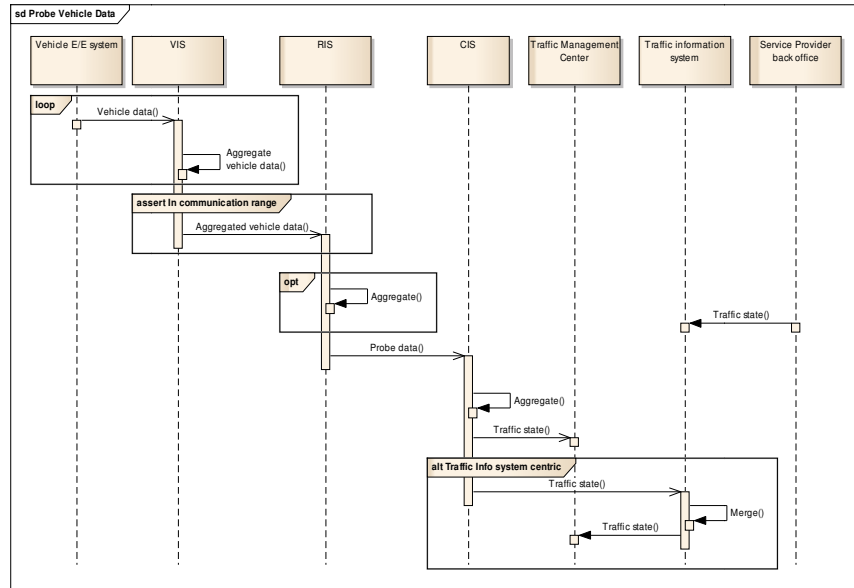- That PDM and PVD are standardized which they are not at the moment of release of this document.

1.2.9 Triggers conditions

None

1.2.10 Use -Case Diagram
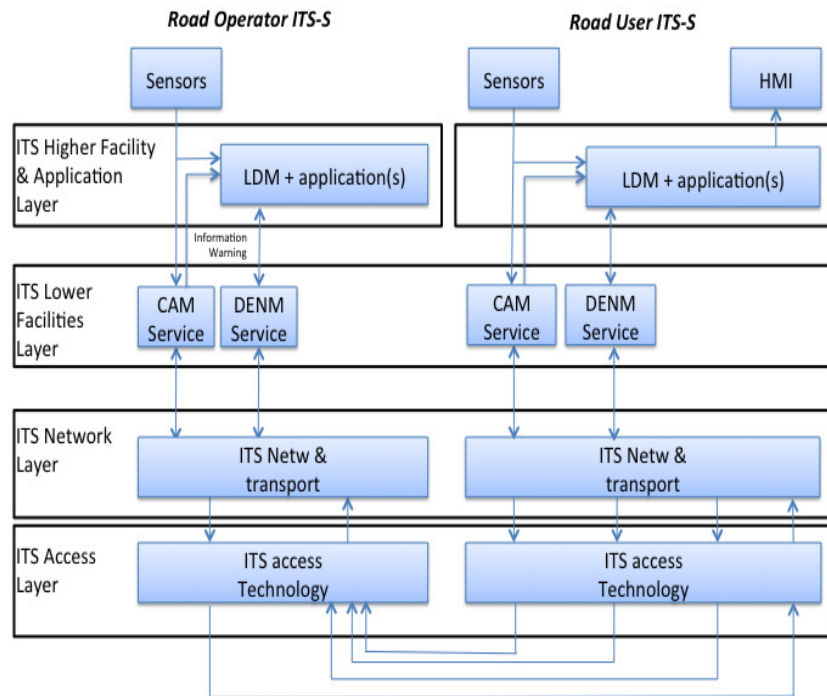
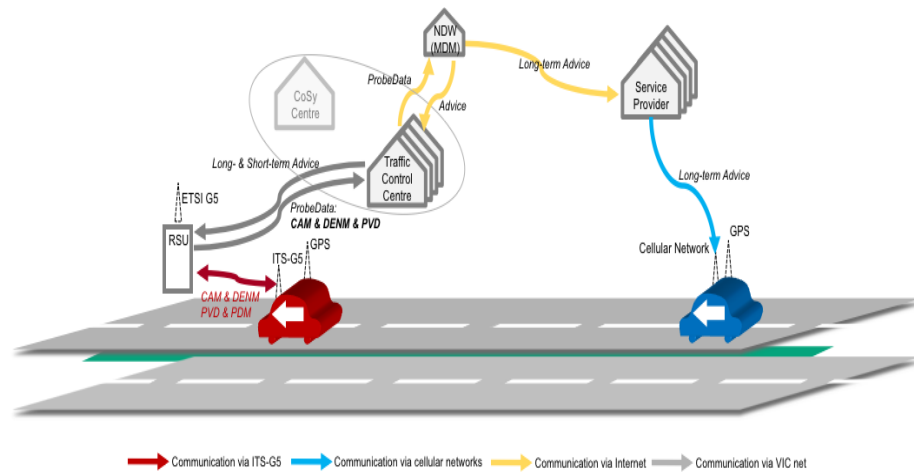### 1.2.11 Normal Flow ?? to be edit.

1.2.12 Post-conditions

At this moment None.

1.2.13 Terminiation conditions

At this moment None.

1.2.14 Use-Case Illustration

1.2.15 Requirements

- Awareness Data parameters (CAM related)
  - Minimum required Parameters
    - Road User Type
    - Vehicle length (wish)/ width (optional)
    - Time/Position

- Lane accuracy (not in CAM today)
  - Speed
  - Longitudinal Acceleration
  - Drive direction (forward / backward)
  - Heading
- o Optional Parameters
  - Wiper status (not in CAM today)
  - Headlight status
  - Road temperature (not in CAM today)
  - Road condition (slippery, bumps,….) (not in CAM today)
  - Warning light blinking (not in CAM today)

header	
protocolVersion	Version of the protocol. Current version is 1, thus field is set to 1.
messageID	Indicates the type of message. Examples are denm(1), cam(2), ivi(6), etc. Here 2 is used.
stationID	This is the ID of the station (vehicle) broadcasting the message.

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generationDeltaTime	Timestamp belonging to the referencePosition.

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referencePosition	This DF is of type ReferencePosition (DF A.124 from ETSI TS 102 894-2). It contains the coordinates (WGS 84) of the ITS station (vehicle).

highFrequencyContainer	
heading	The (compass) direction of the vehicle, in 1/10th of a degree.
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curvatureCalculationMode	*The calculation mode for the curvature. Required by the standard but not part of the wish list.*
yawRate	*The rate the vehicle is spinning around its centre of mass. Required by the standard but not part of the wish list.*

lowFrequencyContainer	
vehicleRole	*The role of the vehicle (e.g. public transport). This is set in accordance with ETSI TS 102 894-2 (usually 0-default). Required because of the use of the lowFrequencyContainer but not part of the wish list.*

exteriorLights	This DE is a sequence of bits (BIT STRING) of size 8. Each bit holds the status of the exterior light switches of a vehicle (e.g. fogLightOn, leftTurnSignalOn, etc.).
pathHistory	*This DF can hold up to 40 points (PathPoint) of where the vehicle has been, optionally with an accompanying timestamp (pathDeltaTime). The timestamp would allow for speed calculation between the points. Required because of the use of the lowFrequencyContainer but not part of the wish list.*

Legend	
bold	required by standard
cursive	optional by standard
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- Detected Data parameters (DENM related)
  - Optional warning Messages
    - Slow vehicle warning
    - Wrong way driving warning
    - Road condition warnings
    - E-call warning
- Behavioral
  - No requirement other than specified in current CAM and DENM specifications.
- Security
  - No requirement other than specified in current CAM and DENM specifications.
- Privacy
  - No requirement other than specified in current CAM and DENM specifications.

1.2.16 Linked use cases

Sub use-case 1.