C-MOBILE

Accelerating C-ITS Mobility Innovation and deployment in Europe

D6.2: Technical validation report

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Abbreviations

Abbreviation	Definition
3G	3rd generation of mobile telecommunications technology
AVG	Algemene Verordening Gegevensbescherming (Holland GDPR)
BSD	Blind Spot Detection
CACC	Cooperative (Adaptive) Cruise Control
CAM	Cooperative Awareness Message
CPBO	Communication Provider Back Office
DENM	Decentralised Notification Message
DPBO	Data Provider Back Office
EBL	Emergency Brake Light
ETSI	European Telecommunications Standards Institute
EVW	Emergency Vehicle Warning
GLOSA	Green Light Optimal Speed Advisory
GP	Green Priority
HMI	Human Machine Interface
ITS	Intelligent Transport System
ITS-5G	ITS at 5 GHz frequency band
ITS-S	ITS Station
IVS	In-Vehicle Signage
MAPEM	Map Extended Message
MoV	Mean of Validation
MTTA	Mode and Trip Time Advice
OBU	On Board Unit
PID	Personal Information Device
PVD	Probe Vehicle Data
RHW	Road Hazard Warning
R-ITS-S	Roadside ITS Station
RS	Roadside System
RSU	Road Side Unit
RWW	Roadworks Warning
SPATEM	Signal Phase and Time Extended Message
SPBO	Service Provider Back Office
SVW	Signal Violation Warning
TLC	Traffic Light Controller
TMC	Traffic Management Centre
TMS	Traffic Management System
UPA	Urban Parking Availability
Vehicle ITS-S	Vehicle ITS Station
WSP	Warning System For Pedestrian

Executive Summary

C-MobILE aims to stimulate / push existing and new pilot sites towards large-scale, real-life C-ITS deployments interoperable across Europe. Well-defined operational procedures will lead to decentralized and dynamic coupling of systems, services and stakeholders across national and organizational borders in an open, but secure C-ITS ecosystem, based on different access technologies, the usage of which is transparent for service providers and seamless and continuous for the end-users across different transport modes, environments and countries.

The objective of Task 6.2 is to homogeneously validate the implementation of the system architecture, to validate the services and to assert the interoperability across all Deployment Sites (DS).

The inputs of Task 6.2 are the following:

- D2.2 Analysis and Determination of use cases [1]
- D2.3 Requirements for C-ITS implementation [2]
- D3.3 Low-level implementation ready architecture and service definition [3]
- D6.1 Validation and impact assessment methodology [4]

Task 6.2 "Technical Validation" comprises the following subtasks:

- Technical validation of C-ITS services with a common validation methodology. This involves:
  - Definition of testing scenarios covering all considered use cases of the services.
  - Execution of the tests that apply to the use cases that will be deployed in a DS.
- Technical validation of the implemented architecture resulting from Task 3.4.
- Technical validation of cross-modal and seamless (cross-border) service operation.

Part of the results in this document are not final. Several constraints prevent D6.2 to gather all the test results by October 2019:

- The requirements have an update planned by the end of 2019. Requirement validation might render obsolete because of this.
- Some services have not been deployed yet due to different reasons, depending on each case. These services are then not validated.

With these reasons T6.2 decided to deliver current results, provinding status updates for those pending services and mitigation plans to ensure a validation by the end of 2019.

Assumptions taken in the writing of this deliverable:

- Development of system components and interfaces is functional and well tested. This involves work of Tasks 5.1 and 5.2.
- Verification of shared interfaces for cross-modal service operation is functional and tested, done in Task 5.3.

Finally, this document can be followed as a reference in future sites willing to implement C-MobILE services.

1. Introduction

1.1. C-MobILE at a glance

The C-MobILE (Accelerating C-ITS Mobility Innovation and depLoyment in Europe) vision is a fully safe & efficient road transport without casualties and serious injuries on European roads, in particular in complex urban areas and for Vulnerable Road Users. We envision a congestion-free, sustainable and economically viable mobility, minimizing the environmental impact of road transport. C-MobILE will set the basis for large scale deployment in Europe, elevating research pilot sites to deployment locations of sustainable services that are supported by local authorities, using a common approach that ensures interoperability and seamless availability of services towards acceptable end user cost and positive business case for parties in the supply chain.

1.2. Objective

Task 6.2 is required to directly validate the architecture and the implementation of services. This document covers the whole process from identification of the validation methodology to the results on all Deployment Sites,

The main milestones are:

- Identification and definition of test scenarios for use cases described in D2.2 [1]
- Validation of Architecture: Fulfilment assertion of general requirements as described in D2.3 [2]
- Validation of Services: Execution of tests related to present use cases in each DS.
- Validation of interoperability: Execution of tests in cross-modal operation, with components of different DS involved (e.g. PID of a user from a DS using services on another DS).

1.3. Intended audience

This document is targeted to developers of C-MobILE services, to guide them to validate their implementation homogeneously with other deployment sites across Europe, easing the work for interoperability and assuring it.

1.4. Approach

Each milestone of the Task has been approached individually.

- The identification and definition of test scenarios started when D2.2 [1] and D2.3 [2] were available, test definition was done by a DS where the service would be relevant. Tests were defined for use cases, taking into account service requirements as defined in D2.3 [2].
- The validation of architecture comprised two steps:
  - The requirements are classified by level and mean of validation.
  - The validation for each requirement is approached at the identified level (global, Deployment Site or service) with the identified mean of validation.
- The validation of the services is performed by each DS, following a common methodology.
- The validation of the services in cross-modal operation follows the same methodology as the validation in local operation, but involving two coordinated DS.

1.5. Document structure

This document has 3 main chapters:

- Architecture validation

  This chapter focuses on the general requirements that are not involved to specific services. The subchapters are:

  1. Methodology: In this subchapter the methodology to validate the requirements is described.
  2. Identification of validation method: In this subchapter the requirements are classified regarding the approach to validate them.Service specific requirements

- The service requirements relevant in validation will be addressed in the next section, Technical validation of services.

- Since the service validation test the fulfilment of a use case, some requirements will be unable to be checked. It is assumed that these requirements have been tested in lower level tests.

You can find the list of checked requirements in the traceability matrix subsections after the test definitions.

- Technical validation of services
  1. Methodology: In this subchapter the methodology to validate the services is described.
  2. Test description: In this subchapter the tests are defined.
- Technical validation of services in cross-modal operation

Two cross-test events were executed in Bordeaux and Thessaloniki DS.

Participating DS did test their service implementations against the host DS Communication Provider Back Office (CPBO).

The same tests defined in Section 3.2 were executed.

Due to time constraints a selection of services was tested, to cover the variety of C-MobILE messages:

- RWW and RHW, which use DENM.
- GLOSA which use MAPEM and SPATEM.
- IVS, which use IVIM.

Interoperability of other services will be tested in further events, both project-wide and through small agreements between DS.

The next event will be the C-MobILE testfest, planned for 2-4 of December 2019.

- Results
  1. Architecture validation results: In this subchapter the results on architecture validation are listed.

1.5.1. Further work

Detected issues have been analysed and addressed individually.

For requirements that do not apply or require further details, feedback has been provided to WP2 to help with the update of requirements expected in the next months.

Development issues are being addressed and will be fixed as part of the upcoming Task 5.4.

2. Service validation results: In this subchapter the results on service validation are listed. Mitigation plans are provided for those services which have not been validated yet.

2. Architecture validation

2.1. Methodology

To validate the architecture, we assess the general requirements defined in D2.3 [2].

The general requirements have been categorized regarding the Mean of Validation (MoV).

MoV	Definition
Examination	For most requirements, this means assessment of experts/developers involved. For some technical requirements, this may involve validation through testing.
Expert Rating	Educated opinion of one or more experts, based on the available documentation.
N/A	Validation as part of WP6 not applicable for this requirement.

Also, requirements can be classified by the architecture level:

Architecture level	Definition
Global Architecture	Can be verified by looking at the global architecture documentation.
Deployment Site	Can be verified by looking at the implementation/architecture of each DS.
Service	Needs to be verified for each service (implementation specific).

Requirements specific for each service will be validated in section 3 Technical validation of services. Service specific requirements

2.2. Identification of validation method

2.2.1. Global architecture requirements

2.2.1.1. Validatable by examination

Requirement ID	Requirement
R/G05-SE-03	The authentication service shall be able to provide at least 100 pseudonyms at once to any authenticated user with an authorized real identity.
R/G05-SE-11	A Certificate Authority (CA) shall be present.
R/G09-LE-17	Payment method should be privacy friendly.
R/G09-LE-19	The pseudonymization can be lifted for special cases.
R/G09-LE-20	International transfer of personal data shall be protected.

2.2.1.2. Validatable by expert rating

Requirement ID	Requirement
R/G01-AR-02	The architecture shall be flexible to allow extensions for new messages and protocol elements.
R/G01-AR-03	The architecture shall allow "hybrid" communication i.e. same content being delivered through multiple channels simultaneously
R/G01-AR-04	Same information through different channels can be identified to be the same by a receiver
R/G01-AR-05	Bi-directional communication shall be supported

R/G01-AR-06	C-MobILE systems shall be able to store, communicate and process UTF-8 encoded text.
R/G01-AR-08	A map tiling/geofencing system should be implemented for saving data and resources.
R/G01-AR-11	C-MobILE systems shall comply with the latest ITS communication standards.
R/G01-AR-13	Standardized interfaces shall be defined and used.
R/G03-OP-06	WGS84 reference system shall be used for GNSS coordinates
R/G03-OP-12	A priority system for the alerts and warnings based on the critical level of the services should be implemented.
R/G03-OP-14	Each Vehicle ITS-Ss shall be identified. The ID may change over space and/or time due to privacy concerns.
R/G05-SE-01	The authentication service shall ensure a new user can register and obtain a so called “real identity” for the system.
R/G05-SE-02	The authentication service shall ensure that all possible actors are unable to determine the real user name (or personal data) bound to a pseudonym.
R/G05-SE-04	The authentication service shall be able to validate a pseudonym upon request.
R/G05-SE-09	V2X PKI as defined for Europe should be supported by the architecture.
R/G05-SE-10	Communication with different security properties shall be possible.
R/G05-SE-18	ETSI standards for ITS security compliance shall be followed.
R/G05-SE-23	The project shall be able to exclude participants as fast as technically possible.
R/G05-SE-24	Misbehaviour detection shall be handled.
R/G10-EC-02	Systems shall be designed to be future proof.
R/G10-EC-05	Clear B2B business models.

2.2.2. Deployment site specific requirements

2.2.2.1. Validatable by examination

Requirement ID	Requirement
R/G01-AR-01	All clocks shall be synchronized to TAI (International Atomic Time).
R/G01-AR-09	Services should be integrated with existing on-board systems
R/G01-AR-10	Services should be integrated with existing road systems
R/G01-AR-14	Use English for Documentation and system messages.
R/G02-DE-05	The resilience of each service shall be evaluated.
R/G03-OP-01	Vehicle ITS-Ss and Roadside ITS-S shall be able to encode, send, receive and decode CAM messages.
R/G03-OP-02	Vehicle ITS-Ss and Roadside ITS-S shall be able to encode, send, receive and decode DENM messages.
R/G03-OP-03	Vehicle ITS-Ss and Roadside ITS-S shall be able to encode, send, receive and decode SPATEM messages.
R/G03-OP-04	Vehicle ITS-Ss and Roadside ITS-S shall be able to encode, send, receive and decode MAPEM messages.
R/G03-OP-05	Vehicle ITS-Ss shall have access to GNSS data.

R/G03-OP-07	Service warnings and notifications should be disabled when the accuracy/quality of the location system (GNSS) is below a certain threshold.
R/G03-OP-08	The Roadside ITS-S should retransmit the received DENMs.
R/G03-OP-09	Unique sequence number shall be used for each new event detected. A Roadside ITS-S receiving a DENM from a Vehicle ITS-S should retransmit this using the same ActionID.
R/G03-OP-11	Roadside ITS-Ss should be remotely accessible by authorized personnel.
R/G03-OP-13	Infrastructure components should have a monitoring system to detect if the device has operating problems (broken, connection issues, etc.).
R/G05-SE-12	Only secured connections shall be used.
R/G05-SE-13	Stored personal data shall be encrypted.
R/G05-SE-14	Personal data shall be encrypted during transfer.
R/G05-SE-15	Unintended or unauthorized data modifications shall be prevented.
R/G05-SE-16	The message transmission and processing shall be fast enough to take advantage of the content of the message
R/G05-SE-17	Safe message handling.
R/G05-SE-19	The messages shall be verified on reception.
R/G05-SE-20	Data trustworthiness shall be verified.
R/G05-SE-21	Robustness of security shall be ensured.
R/G05-SE-22	Purging personal data from vehicles.
R/G05-SE-25	All data relevant for billing shall be digitally signed
R/G05-SE-26	All data transmissions to billing services shall be encrypted and authenticated
R/G07-HU-01	Users should be supported to sustain or develop situation awareness according to a driving scenario
R/G07-HU-02	Usage should not interfere with driving tasks
R/G07-HU-03	Additional/altered/enhanced tasks during driving should be defined and documented
R/G07-HU-04	For necessary “perceived” parallel information and according actions, information flow and action demands should be prioritized.
R/G07-HU-05	Services shall not enforce drivers to only rely on the service information.
R/G06-AP-01	Connectivity information should be displayed
R/G06-AP-02	The interaction with the service shall be efficient. Physical, mental, or material effort should not escalate (Efficiency)
R/G06-AP-03	Precise goal achieving shall be realized (Effectivity)
R/G06-AP-04	Using the service shall not result in impairments (Impairment-free)
R/G06-AP-05	Sound notifications’ intensity and quantity shall be evaluated for each service.
R/G06-AP-06	Users should be able to configure the notifications they receive.
R/G06-AP-07	A “Help” section should be provided in the applications.
R/G06-AP-08	Values to put in or values shown should fit context (Input/Output Suitability).
R/G06-AP-09	Service should address the suitable perception channel (visual, auditory) or input channel, and the channel should be adaptable (Channel Suitability)
R/G06-AP-10	Common or similar feel and touch among applications should be followed.
R/G06-AP-11	Interaction should be able to be started by the user and input pace/direction should be able to be determined (Controllability)
R/G06-AP-12	Input should lead to perceivable changes on the point of interaction or display and the points of interaction should be well defined to enable a precise interaction (Evaluability/ Executability).
R/G06-AP-13	Service should provide information in case of service availability and interruption.

R/G06-AP-14	User should be supported and guided in learning about the service (Learnability).
R/G06-AP-15	Information should be clear, distinct, consistent, perceivable, accessible, readable, comprehensible (Perceptivity).
R/G06-AP-16	Services' HMI should provide language selection between local language and English.
R/G06-AP-17	The user should be able to select which C-MobILE services to use.
R/G06-AP-18	A day/night mode to provide the right illumination for displaying information should be available.
R/G08-SO-05	Age related specificities should be taken into account in order to guarantee accessibility and age specific analyses/ forecasts
R/G09-LE-03	Stored personal data (if any) shall be deleted after purpose the data was collected for has been reached.
R/G09-LE-04	The user shall be able to configure which personal data is processed.
R/G09-LE-05	Systems shall be able to block personal data from further processing.
R/G09-LE-06	Consent revocation and processing after consent revocation shall be available.
R/G09-LE-07	Documentation and information about the data flow should be available.
R/G09-LE-09	The system shall be able to inform the data subject about the processing and purpose of the data.
R/G09-LE-14	The default settings of the system shall be preconfigured in the most privacy-friendly way.
R/G09-LE-15	The vehicle has one and only one unique ID per service.
R/G09-LE-16	Access to personal data shall be restricted.
R/G09-LE-18	Read and write permissions shall be limited.
R/G09-LE-21	No self-incriminating messages shall be sent by ITS stations.
R/G09-LE-22	Regulation and policy fulfilment.
R/G09-LE-23	Drivers shall be made aware that the warnings, advices and recommendations (and especially the lack of thereof) are not legally binding.
R/G09-LE-24	The services shall not tempt the driver to disobey the regulations (e.g. by speeding).
R/G10-EC-03	HMI should show C-MobILE logo at start-up
R/G10-EC-04	The bundling of services should be easily grasped by the users
R/G10-EC-06	Easy to understand terms of use and terms of payment
R/G10-EC-08	The users shall de informed about the indirect costs the use of the services may have in the cellular case.
R/G11-EN-05	Battery/Electricity consumption due to system usage should optimized.

2.2.2.2. Validatable by expert rating

Requirement ID	Requirement
R/G01-AR-07	All required services have to be designed to fit the available city architecture
R/G01-AR-12	Services should be integrated with each other (to provide economy of scale).
R/G02-DE-03	The business case for each service shall be detailed.
R/G02-DE-04	The maturity level of each service shall be defined
R/G02-DE-06	The readiness for scaling for each service shall be defined
R/G02-DE-12	The services' compliance to ethical guidelines (GDPR regulation 2016/679 [4]) shall be ensured.

R/G03-OP-10	Communication between POMS and TMC (and/or other management servers) should use DATEX II.
R/G09-LE-01	The C-MobILE services shall comply entirely with the General Data Protection Regulation (GDPR) 2016/679 regarding privacy protection.
R/G10-EC-01	Systems shall be designed such that they can continue operation after the project.
R/G11-EN-01	The usage of C-MobILE services (and bundles) shall not cause environmental damage or lead to less environmental sustainability.
R/G11-EN-02	Potential and evident environmental benefits due to the use of C-MobILE services may be highlighted.
R/G11-EN-06	The services should be able to be integrated into existing infrastructure and should focus upon long-term use.
R/G11-EN-07	Server architecture should be as efficient as possible.

2.2.3. Service specific requirements

The service requirements relevant in validation will be addressed in the next section, Technical validation of services.

Since the service validation test the fulfilment of a use case, some requirements will be unable to be checked. It is assumed that these requirements have been tested in lower level tests.

You can find the list of checked requirements in the traceability matrix subsections after the test definitions.

3. Technical validation of services

3.1. Methodology

In this section the methodology to test the services is described. Tests are defined following a template. And the pre-established execution methodology is described.

3.1.1. Test description template

The following is the template used in the test definition.

Test Case ID	Identifier of test.
Test Case Objective	Brief description of the use case under test.
Applicability	Architectural requirements of the use case under test. Namely ETSI-G5 or cellular components. With possible additional components.
C-MobILE Requirements	Service specific requirements involved in the use case under test.
Pre-test conditions	Description of the setup of the scenario prior to the use case event. This should describe a common or stand-by status of the service.

Step	Description	Logging component	Logged data
1	Test execution steps are described.	Component where data shall be generated.	Description of data required for the test validation
2	Step 2		
n	Step n		

Figure showing the components relevant to the use case under test.

Acceptance criteria
List of criteria required for the test to be considered passed. If any criteria are not met, the test cannot be considered completely passed.

3.1.2. Test execution methodology

- Setting up of the scenario as stated in "Pre-test conditions"
- Execution of the steps defined in the test description.
- Gathering of the logs indicated on the logged data column.
- Validation of the results against the acceptance criteria provided.
  - An educated guess will be provided in case a requirement is not well defined (i.e. D2.3 [2] update pending).

3.1.3. Identified extra requirements

The following requirements not defined in D2.3 [2] were identified

- Acceptable delay for critical service over cellular connection.
- Acceptable delay for no-critical service over cellular connection.

These requirements will be indicated as “Latency is lower than X ms” where X is yet to be defined.

3.2. Test description

An update of requirements is expected by the end of the year 2019. Tests are susceptible to modifications. The final version of the tests will be provided when the requirements are available.

3.2.1. General, error recovery scenarios

These scenarios are meant for alternative execution flows, to be shared with most of the services.

Test Case ID	G-01
Test Case Objective	To test automatic recovery from the Services when an internal error happens.
Applicability	OBU or Smartphone running the service
C-MobILE Requirements	R/G06-AP-13, R/S10-GLOSA-14, pending requirement update
Pre-test conditions	OBU with HMI or Smartphone, with the application installed.

Step	Description	Logging component	Logged data
1	A critical error happens that impedes the Application from providing the service.	PID	Error log from App
2	The application shows a message warning the user.	PID	HMI log
3	The application restarts itself.	PID	Start-up log from APP

Acceptance criteria
Test scenario G-01 is considered as passed if: / The application restarts itself.

Test Case ID	G-02
Test Case Objective	To test automatic recovery from the Services when a communication error happens.
Applicability	OBU or Smartphone running the service
C-MobILE Requirements	R/G06-AP-13, R/S10-GLOSA-15, pending requirement update
Pre-test conditions	OBU with HMI or Smartphone, with the application installed.

Step	Description	Logging component	Logged data
1	A communication error happens that impedes the Application from providing correctly the service.	PID	Error log from App
2	The application shows a message warning the user.	PID	HMI log
3	The application tries to re-establish communication.	PID	Startup log from APP

Acceptance criteria
Test scenario G-01 is considered as passed if: / The application tries to re-establish the communication.

3.2.2. Blind Spot Detection

3.2.2.1. Test Scenarios

3.2.2.1.1. Test scenario Blind Spot Detection over ITS-G5

Test Case ID	BSD-01
Test Case Objective	To test BSD functionality: The RS sees a VRU arriving in the blind spot of a vehicle. With a DENM message it alerts the vehicle.
Applicability	Vehicle equipped with OBU capable of ETSI-G5 communication modem Roadside system with blind spot detection sensor connected to a RSU with ETSI-G5 communication modem
C-MobILE Requirements	R/S20-BSD-02, R/S20-BSD-05, R/S20-BSD-06, R/S20-BSD-07, R/S20-BSD-08, R/S20-BSD-09, R/S20- R/S20-BSD-10
Pre-test conditions	Vehicle is equipped with an OBU capable of ETSI ITS-G5 communication and a HMI The road side equipment has a Roadside System with a detector for VRU and/or vehicles in the designated blind spot

Step	Description	Logging component	Logged data
1	The Blind spot detector sensor in the Roadside System detects a Vehicle or VRU in the blind spot of a Vehicle	Roadside System	Detection with timestamp
2	The Roadside Systems sends a DENM to the Road Side Unit	Roadside System	Generated DENM with timestamp
3	The RSU receives the DENM message.	Road Side Unit	Received DENM with timestamp
4	The RSU broadcasts the DENM message	Road Side Unit	Send DENM with timestamp
5	The vehicle OBU receives the DENM message	OBU	Received DENM with timestamp
6	Vehicle shows warning in HMI since his position and direction matches the DENM information.	OBU	HMI log file (DENM, trajectory of the VRU and timestamp when warning is given)
7	The Roadside system sends the event to the Traffic Management Center (Optionally)	Roadside System	Pending update of requirements
8	The TMC receives the event	TMC	Pending update of requirements

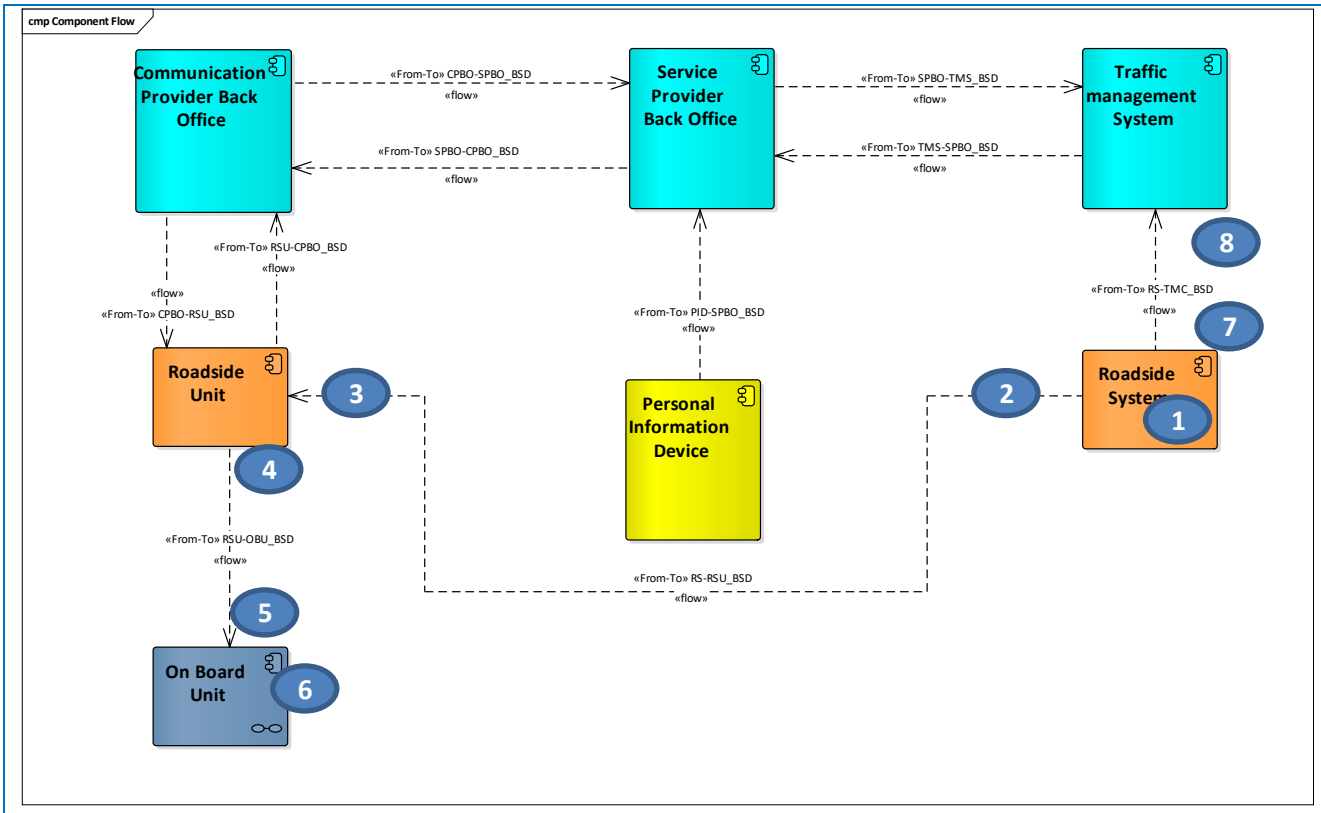


Figure 1. Logging steps in BSD-01 test scenario

Acceptance criteria
Test scenario BSD-01 is considered as passed if: / Latency (time elapsed between the VRU detection and the message on the HMI) is lower than 200 ms. / A warning is displayed to the user indicating the presence of a VRU or vehicle in the blind spot. / When the warning is given to the user, the user is within the relevance area of the DENM message. / There is only a warning when there is a VRU or other vehicle in the blind spot

3.2.2.1.2. Test scenario Blind Spot Detection over cellular

Test Case ID	BSD-02
Test Case Objective	To test BSD functionality: The RS sees a VRU arriving in the blind spot of a vehicle. With a DENM message it alerts the vehicle.
Applicability	Vehicle equipped with OBU with cellular communication
C-MobILE Requirements	R/S20-BSD-02, R/S20-BSD-05, R/S20-BSD-06, R/S20-BSD-07, R/S20-BSD-08, R/S20-BSD-09, R/S20- R/S20-BSD-10, R/S20-BSD-11
Pre-test conditions	Both vehicles are equipped with an OBU. One of the vehicles has a sensor that can detect the VRU. The second vehicle has an information system to inform the driver.

Step	Description	Logging component	Logged data
1	The Blind spot detector sensor in the RS detects a Vehicle or VRU in the blind spot of a Vehicle	Roadside System	Detection with timestamp

2	The Roadside Systems sends a DENM to the TMC	Roadside System	Generated DENM with timestamp
3	The TMC receives the DENM message	TMC	Received DENM with timestamp
4	The TMC sends the DENM message to the Service Provider Back Office	TMC	Send DENM with timestamp
5	The Service Provider Back Office receives the DENM message	SPBO	Received DENM with timestamp
6	The Personal Information Device sends a CAM message with its position and trajectory	PID	Send CAM with timestamp
7	The Service Provider Back Office receives the CAM message	SPBO	Received CAM with timestamp
8	The SPBO calculates the risk	SPBO	Risk calculation result
9	The SPBO sends a DENM message to the Communication Provider Back Office	SPBO	Send DENM with timestamp
10	The CPBO receives the DENM message	CPBO	Received DENM with timestamp
11	The CPBO sends the DENM message to the Personal Information Device	CPBO	Send DENM with timestamp
12	The Personal Information Device receives the DENM message	PID	Received DENM with timestamp
13	The Personal Information Device displays a warning to the driver.	PID	HMI log with timestamp

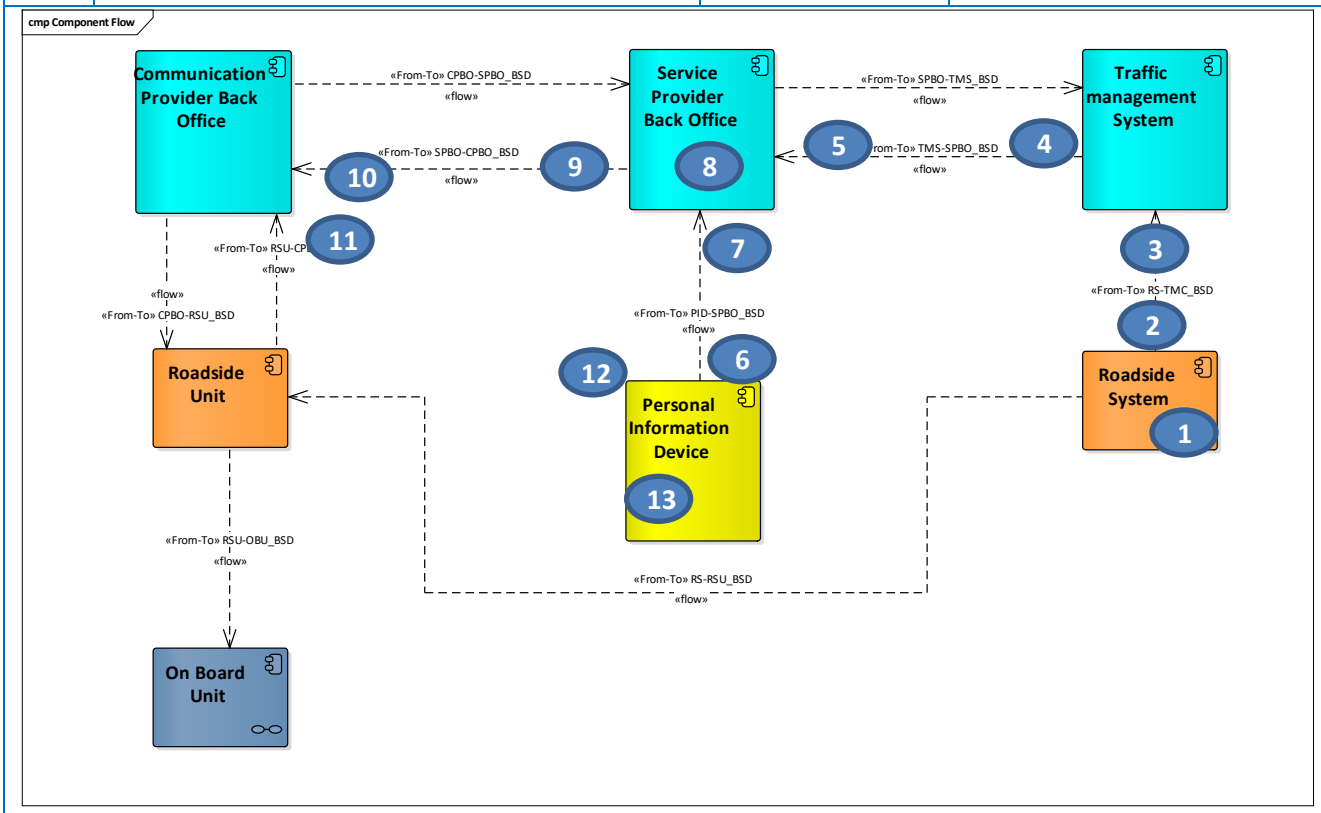
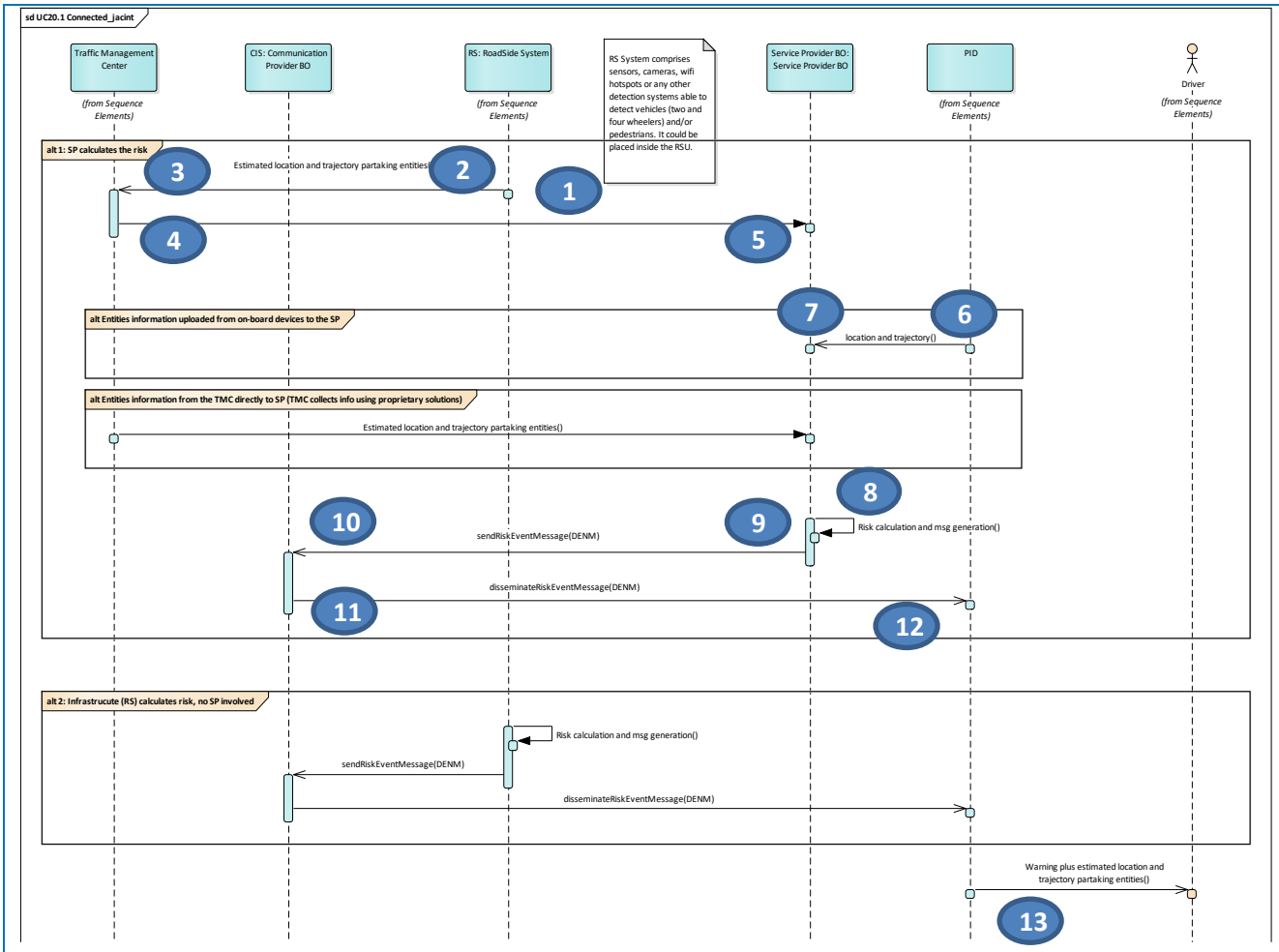


Figure 2. Logging steps in BSD-02 test scenario



Acceptance criteria

Test scenario BSD-02 is considered as passed if:

- Latency (time elapsed between the VRU detection and the message on the HMI) is lower than 200 ms.
- A warning is displayed to the user indicating the presence of a VRU or vehicle in the blind spot.
- When the warning is given to the user, the user is within the relevance area of the DENM message.
- There is only a warning when there is a VRU or other vehicle in the blind spot

3.2.2.2. Traceability Matrix

The traceability matrix is used to assist in determining the completeness of the requirements being met against the test scenarios.

The identifier for each of the requirements is placed in the first column while the identifiers for test scenarios are placed across the top row. When an item in the left column is related to an item across the top, a mark is placed in the intersecting cell. The number of relationships is added up for each row and each column. This value indicates the mapping of the two items. An empty value indicates that no relationship exists.

	Test scenarios	BSD-01	BSD-02
Requirements Tested		7	8
R/S20-BSD-01	0		
R/S20-BSD-02	2	X	X
R/S20-BSD-03	0		
R/S20-BSD-04	2	X	X
R/S20-BSD-05	2	X	X
R/S20-BSD-06	2	X	X
R/S20-BSD-07	2	X	X
R/S20-BSD-08	2	X	X
R/S20-BSD-09	2	X	X
R/S20-BSD-10	2	X	X
R/S20-BSD-11	1		X
R/S20-BSD-12	0		
R/S20-BSD-13	0		

3.2.2.3. Communication performance – Latency

Total latency can be calculated from the moment that the service provider generates a DENM message and the moment the DENM message is received by the vehicle or personal information device.

In the case of ETSI G5, latency between RSUs and OBUs should be measured as well.

3.2.3. Cooperative Adaptive Cruise Control

3.2.3.1. Test Scenarios

3.2.3.1.1. V2V Cooperative Adaptive Cruise Control

Test Case ID	CACC-01
Test Case Objective	To test CACC functionality: Vehicle enters the relevance area of the sending vehicle.
Applicability	Using ETS ITS-G5 and/or Cellular connection
C-MobILE Requirements	R/S17-CACC-11, R/S17-CACC-14, R/S17-CACC-15, R/S17-CACC-16, R/S17-CACC-17, R/S17-CACC-18, R/S17-CACC-19, R/S17-CACC-20, R/S17-CACC-21, R/S17-CACC-22, R/S17-CACC-23
Pre-test conditions	The in-vehicle application is installed and activated on the driver's vehicle or smart phone and running in the background.

Step	Description	Logging component	Logged data
1	The Vehicle Electrical & Electronic System (VEES) of the transferring vehicle generates a CAN message and sends it to the On Board Unit (OBU)	OBU	VEES info received by the OBU with timestamp
2	The OBU generates a CAM message and forwards it to the OBU of the receiving vehicle.	OBU	Generated CAM message together with the timestamp

3	The receiving OBU generates the CAN message from the receiving CAM message and forwards it to the VEES of the receiving vehicle	OBU	Received CAN with timestamp
4	The VEES acts on the CAN message and sets speed set-point.	OBU	VEES log file.
5	The VEES generates and sends the status as a CAN message to the OBU.	OBU	Received CAN with timestamp.
6a	The OBU displays the status on the HMI.	OBU	HMI log file
6b	The OBU generates a JSON (encoded with ASN.1) message and forwards it to the OBU of the receiving vehicle.	PID/OBU	Received JSON message together with the timestamp
7	The receiving PID constructs the message and display on the PID Display	PID/OBU	HMI log file

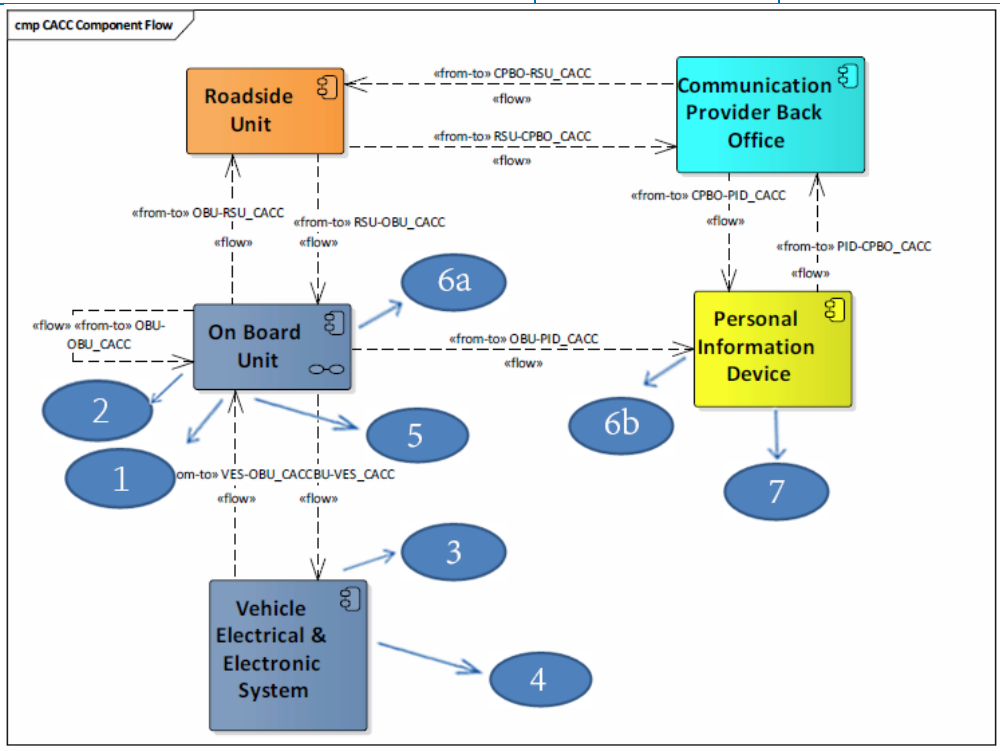


Figure 3. Logging steps in CACC-01 test scenario

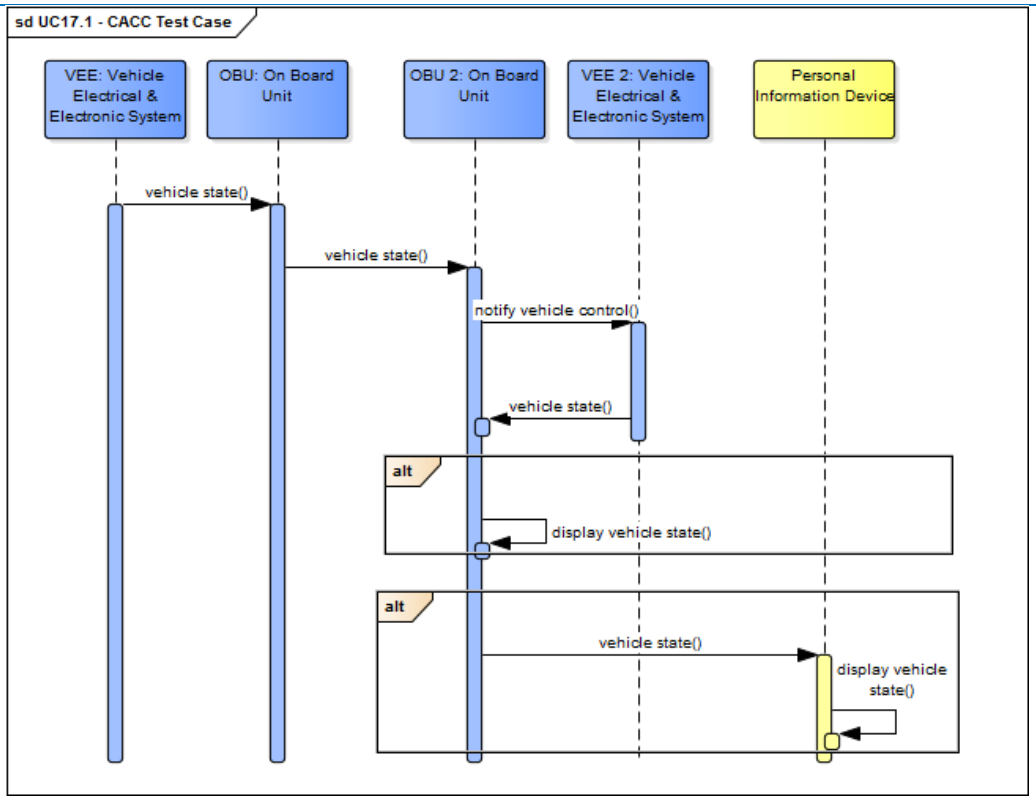


Figure 9: CACC-01

Acceptance criteria
Test scenario CACC-01 is considered as passed if: / When the message is received by the user, the user is within the relevance area of the sending vehicle.

3.2.3.1.2. I2V for Cooperative Adaptive Cruise Control.

Test Case ID	CACC-02
Test Case Objective	To test CACC functionality: The vehicle approaches and enters an urban or semi-urban environment and has an On-Board Unit.
Applicability	Using ETS ITS-G5
C-MobILE Requirements	R/S17-CACC-01, R/S17-CACC-02, R/S17-CACC-03, R/S17-CACC-05, R/S17-CACC-06, R/S17-CACC-07, R/S17-CACC-08, R/S17-CACC-09, R/S17-CACC-10, R/S17-CACC-11, R/S17-CACC-12, R/S17-CACC-13, R/S17-CACC-14, R/S17-CACC-17, R/S17-CACC-18, R/S17-CACC-19
Pre-test conditions	The application is installed and activated on the driver's vehicle or smartphone able to communicate with the OBU.

Step	Description	Logging component	Logged data
1	The Roadside Unit (RSU) generates a SPAT/MAP message with data from the Traffic Light Controller (TLC) and sends it to the On Board Unit (OBU) of the receiving vehicle.	Vehicle	Received SPAT/MAP message together with the timestamp
2	The receiving OBU generates the CAN message from the received message and forwards it to the VEES of the receiving vehicle.	Vehicle	Received CAN message together with the timestamp

3	The VEES acts on the CAN message and sets speed set-point.	Vehicle	VEES log file
4	The VEES generates and sends the status as a CAN message to the OBU.	Vehicle	Received CAN with timestamp
5	The OBU constructs the message and displays on the vehicle HMI	Vehicle	HMI log file

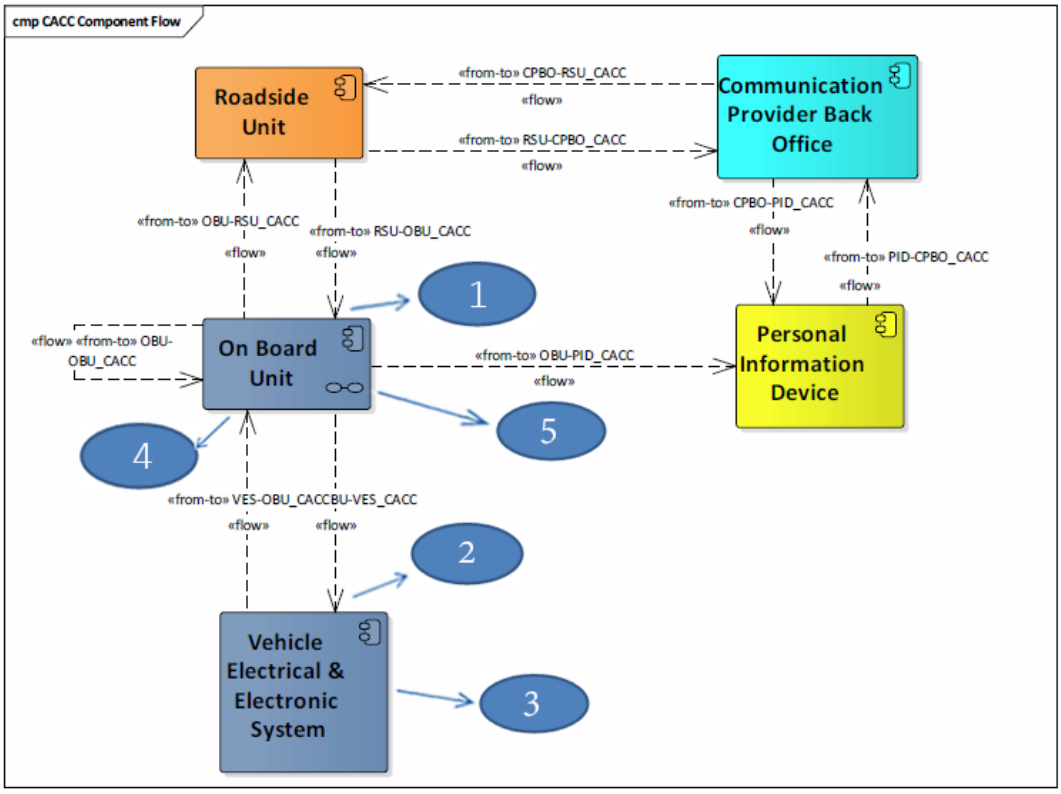
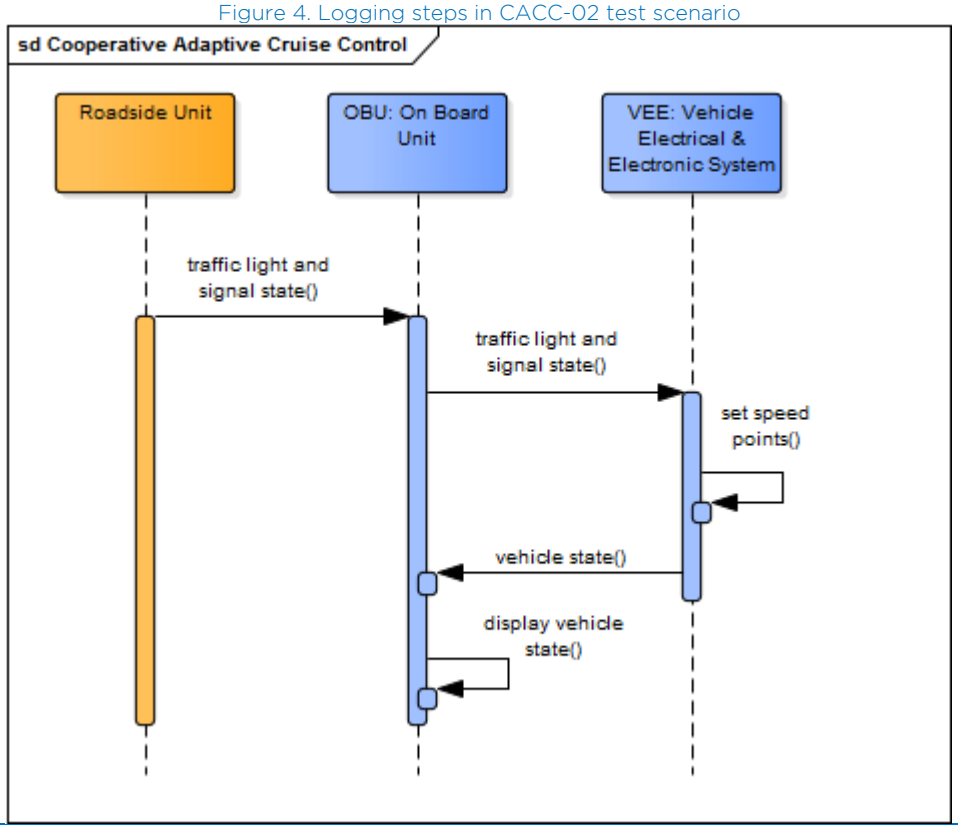


Figure 4. Logging steps in CACC-02 test scenario



Acceptance criteria
Test scenario CACC-02 is considered as passed if: / When the message is received by the user, the user is within the relevance area of the sending RSU and is in an urban or semi-urban environment.

Test Case ID	CACC-03
Test Case Objective	To test CACC functionality: The recieving vehicle approaches and enters an urban or semi-urban environment and has a Personal Information Device (PID) as the HMI that is registered to and connects to the VEES of the Vehicle.
Applicability	Using Cellular
C-MobILE Requirements	R/S17-CACC-01, R/S17-CACC-02, R/S17-CACC-04, R/S17-CACC-05, R/S17-CACC-06, R/S17-CACC-07, R/S17-CACC-08, R/S17-CACC-17, R/S17-CACC-18, R/S17-CACC-19
Pre-test conditions	The application is installed and activated on the driver's vehicle or smartphone able to communicate with the OBU.

Step	Description	Logging component	Logged data
1	The Roadside Unit (RSU) generates a JSON message with data from the Traffic Light Controller (TLC) (traffic light status and timing information) and sends it to the Communication Provider Back Office (CPBO)	CPBO	Generated and received JSON message with timestamp
2	The CPBO forwards the JSON to the Personal Information Device (PID) of the receiving vehicle.	PID	Received JSON message together with the timestamp
3	The receiving PID constructs the message and display on the PID Display	PID	PID/HMI log file.

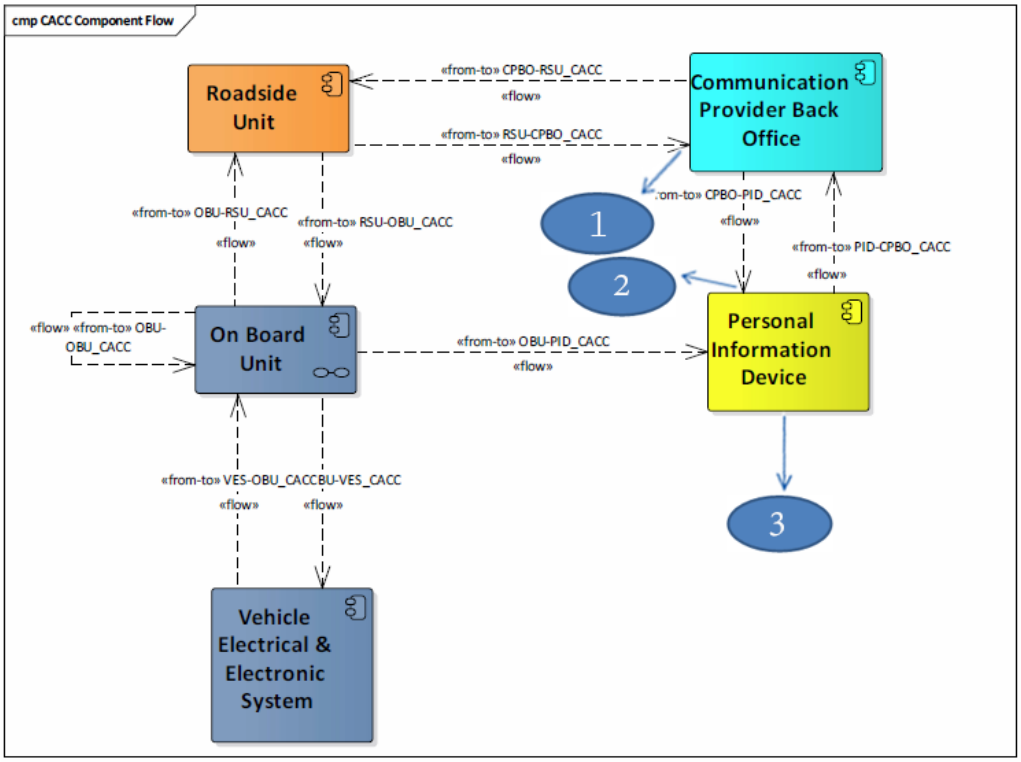
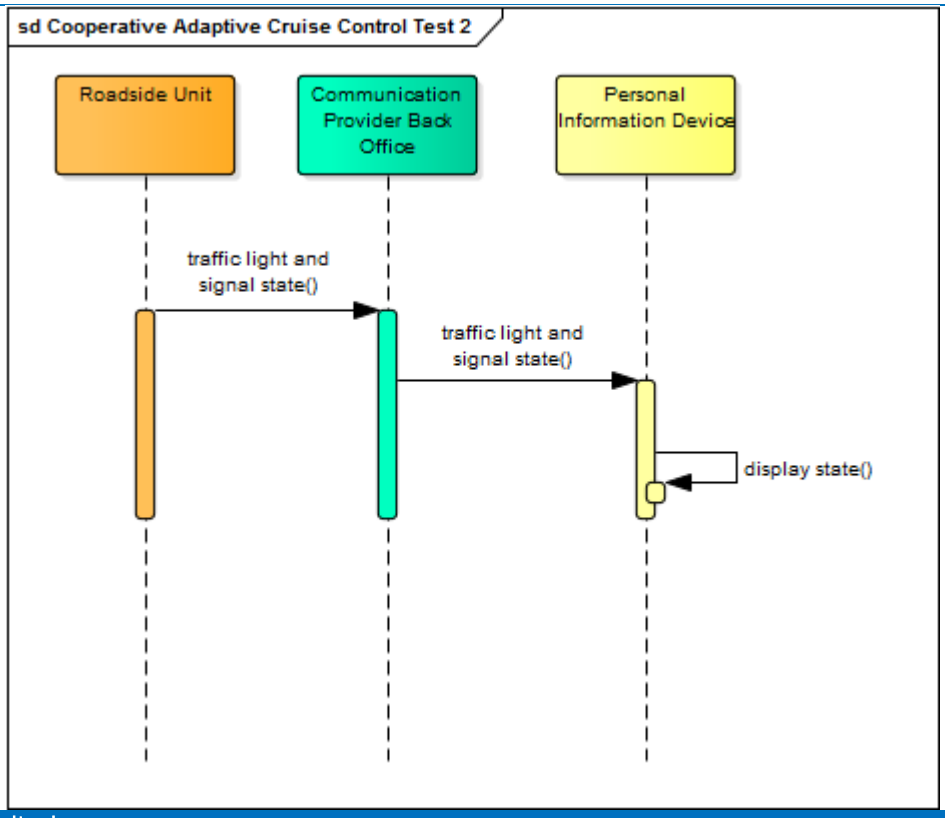


Figure 5. Logging steps in CACC-03 test scenario



Acceptance criteria
Test scenario CACC-03 is considered as passed if: / When the message is received by the user, the user is within the relevance area defined in the CPBO and is in an urban or semi-urban environment.

3.2.3.1.3. Cooperative Adaptive Cruise Control for Truck Platooning

Test Case ID	CACC-04
Test Case Objective	To test CACC functionality: Truck platoon approaches and enters an urban or sem-urban environment and have active OBUs.
Applicability	Using ETS ITS-G5
C-MobILE Requirements	R/S17-CACC-04, R/S17-CACC-05, R/S17-CACC-06, R/S17-CACC-07, R/S17-CACC-08, R/S17-CACC-09, R/S17-CACC-10, R/S17-CACC-11, R/S17-CACC-12, R/S17-CACC-13, R/S17-CACC-14, R/S17-CACC-15, R/S17-CACC-16, R/S17-CACC-17, R/S17-CACC-18, R/S17-CACC-19
Pre-test conditions	The application is installed and activated on the driver's vehicle or smartphone able to communicate with the OBU.

Step	Description	Logging component	Logged data
1	The On-Board Unit (OBU) generates a CAM message with priority request and sends it to the Roadside Unit (RSU).	RSU	The CAM message together with the timestamp.
2	The RSU generates a message with priority status, traffic light status and timing information and sends it to the OBU.	OBU	Received message together with the timestamp
3	The OBU constructs the message and displays it on the HMI	OBU	HMI log file.

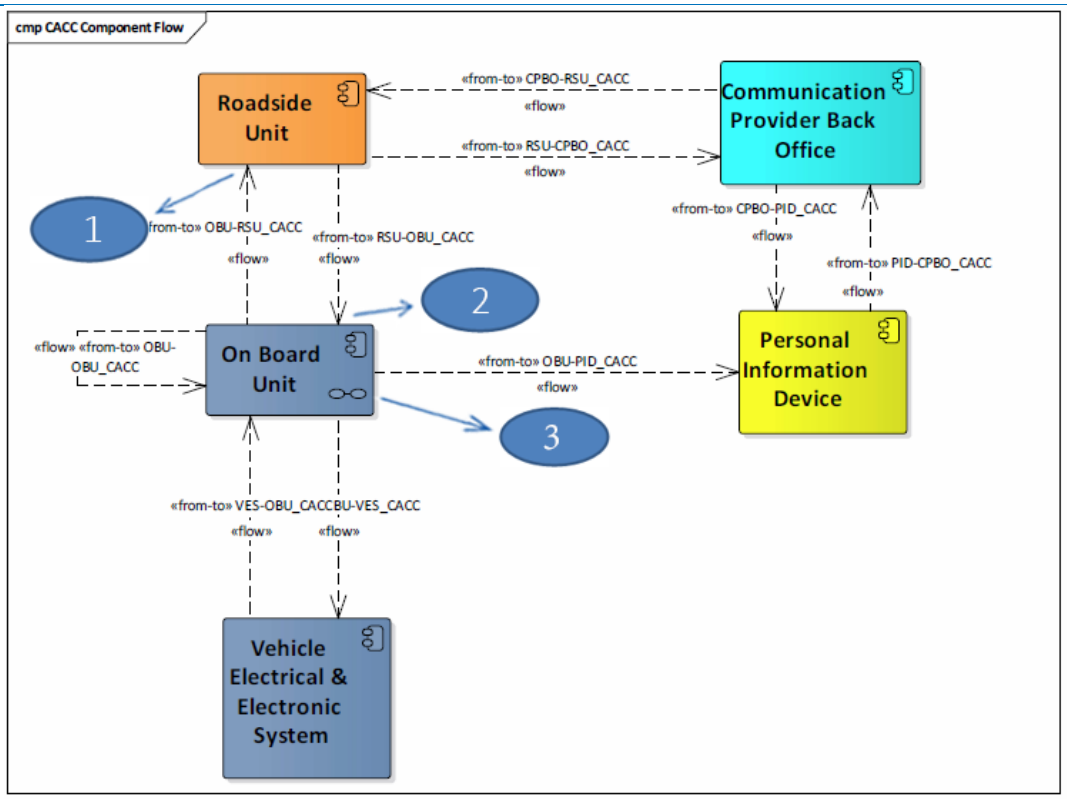
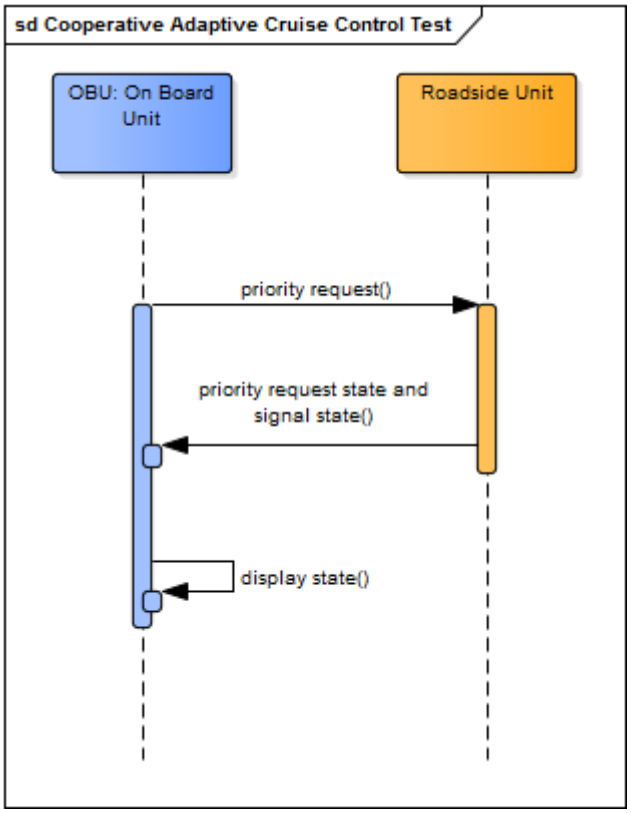


Figure 6. Logging steps in CACC-04 test scenario



Acceptance criteria

Test scenario CACC-04 is considered as passed if:

- When the message is received by the user, the user is within the relevance area of the RSU and is in an urban or semi-urban environment.

Test Case ID	CACC-05
Test Case Objective	To test CACC functionality: Truck platoon approaches and enters an urban or semi-urban environment and have Personal Information Device (PID) as the HMI.
Applicability	Using ETS ITS-G5 or Cellular Communication
C-MobILE Requirements	R/S17-CACC-04, R/S17-CACC-05, R/S17-CACC-06, R/S17-CACC-07, R/S17-CACC-08, R/S17-CACC-15, R/S17-CACC-16, R/S17-CACC-18, R/S17-CACC-19
Pre-test conditions	The application is installed and activated on the driver's vehicle or smartphone able to communicate with the OBU.

Step	Description	Logging component	Logged data
1	The On-Board Unit generates a JSON (with ASN.1 encoding) message with priority request and sends it to the Personal Information Device (PID) connected or registered with the vehicle.	PID	Received JSON message together with the timestamp.
1	The PID forwards the JSON message and sends it to the Communication Provider Back Office (CPBO).	CPBO	Received JSON message together with the timestamp.
2	The CPBO forwards the JSON message to the Roadside Unit (RSU).	RSU	JSON message together with the timestamp.
3	The RSU generates a JSON message with status for the priority request, traffic light status and timing information and sends it to the CPBO.	CPBO	Generated JSON message received by the CPBO with timestamp
4	The CPBO forwards the JSON message to the PID.	PID	JSON message together with the timestamp.
5	The PID constructs the message and displays it on the HMI	PID	PID/HMI log file.

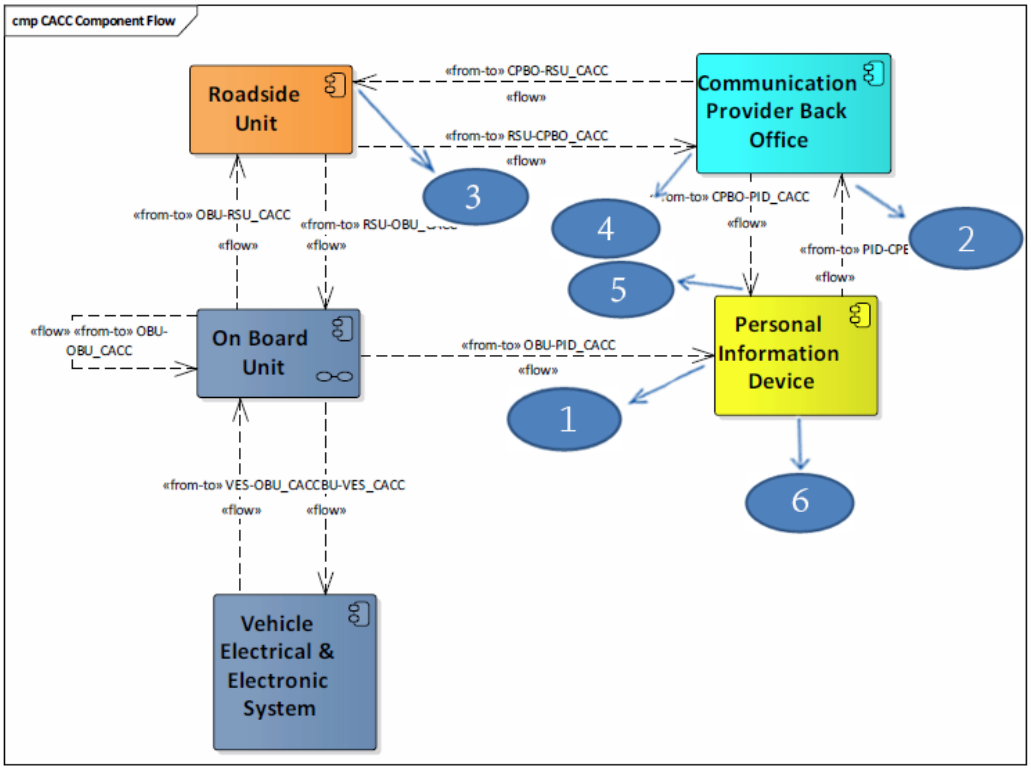
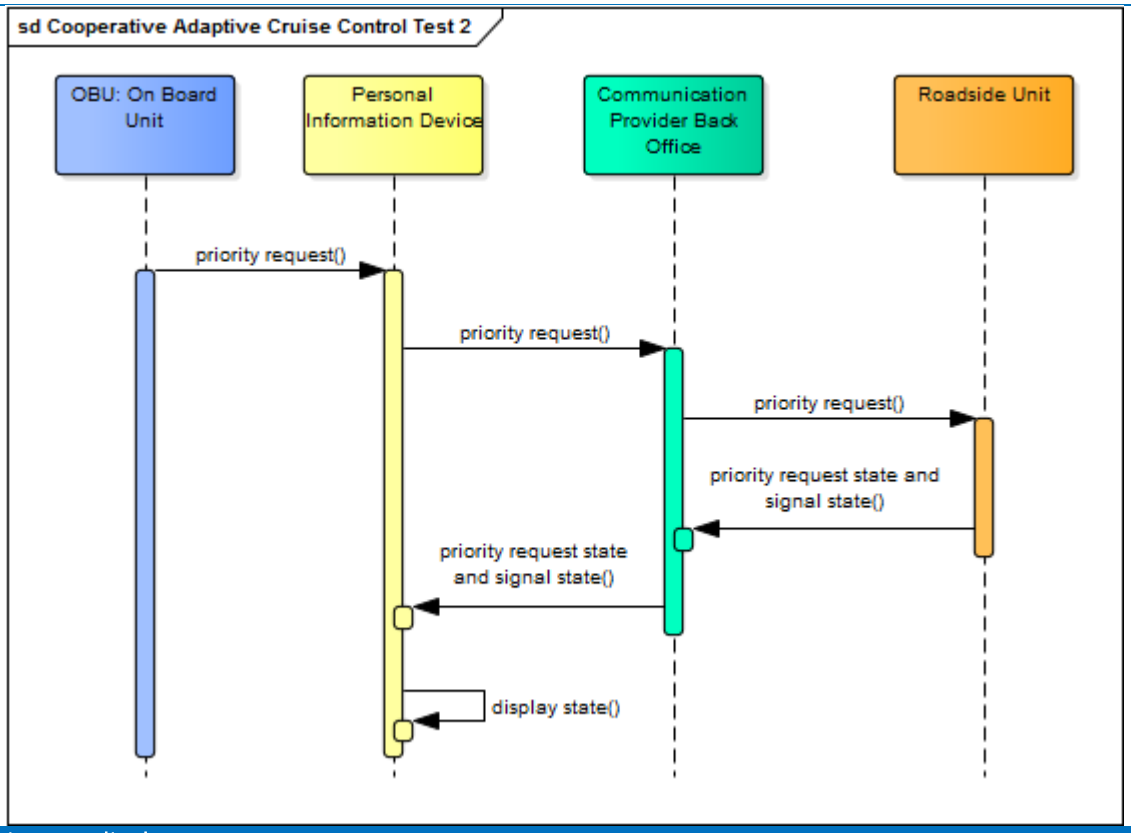


Figure 7. Logging steps in CACC-05 test scenario



Acceptance criteria

Test scenario CACC-05 is considered as passed if:

- When the message is received by the user, the user is within the relevance area of the sending RSU and is in an urban or semi-urban environment.

3.2.3.2. Traceability Matrix

The traceability matrix is used to assist in determining the completeness of the requirements being met against the test scenarios.

The identifier for each of the requirements is placed in the first column while the identifiers for test scenarios are placed across the top row. When an item in the left column is related to an item across the top, a mark is placed in the intersecting cell. The number of relationships is added up for each row and each column. This value indicates the mapping of the two items. An empty value indicates that no relationship exists.

	Test scenarios	CACC-01	CACC-02	CACC-03	CACC-04	CACC-05
Requirements Tested		7	16	10	16	9
R/S17-CACC-01	2		X	X		
R/S17-CACC-02	2		X	X		
R/S17-CACC-03	1		X			
R/S17-CACC-04	3			X	X	X
R/S17-CACC-05	4		X	X	X	X
R/S17-CACC-06	4		X	X	X	X
R/S17-CACC-07	4		X	X	X	X
R/S17-CACC-08	4		X	X	X	X
R/S17-CACC-09	2		X		X	

R/S17-CACC-10	2		X		X	
R/S17-CACC-11	3	X	X		X	
R/S17-CACC-12	2		X		X	
R/S17-CACC-13	2		X		X	
R/S17-CACC-14	3	X	X		X	
R/S17-CACC-15	3	X			X	X
R/S17-CACC-16	3	X			X	X
R/S17-CACC-17	4	X	X	X	X	
R/S17-CACC-18	5	X	X	X	X	X
R/S17-CACC-19	5	X	X	X	X	X

3.2.3.3. Communication performance – Latency

Total latency can be calculated from the moment that the service provider generates a DENM message and the moment the DENM message is received by the vehicle or personal information device.

In the case of ETSI G5, latency between RSUs and OBUs should be measured as well.

3.2.4. Cooperative Traffic Lights for VRUs

3.2.4.1. Test Scenarios

3.2.4.1.1. Test scenario over cellular

Test Case ID	CTLV-01
Test Case Objective	To test CTLV functionality: VRUs with PIDs approach an area with traffic lights. VRUs send the priority request/notify their location to the TLC. VRUs receive extended green time.
Applicability	Using cellular networks.
C-MobILE Requirements	R/S11-CTLV-01, R/S11-CTLV-02, R/S11-CTLV-03, R/S11-CTLV-04, R/S11-CTLV-06, R/S11-CTLV-07, R/S11-CTLV-08, R/S11-CTLV-12, R/S11-CTLV-13, R/S11-CTLV-14
Pre-test conditions	The in-vehicle or mobile application is installed and activated on the smart phone and running in the background.

Step	Description	Logging component	Logged data
1	VRUs sends the priority request, using CAM messages, to the CPBO.	PID	Generated CAM with timestamp
2	CPBO transfers the priority request to SPBO.	SPBO	Received MAPEM/SPATEM/CAM and Generated MAPEM/SPATEM with timestamp
3	SPBO transfers the priority request to the Traffic Management System (TMS).	SPBO	Timestamps of when messages are received and sent.
4	TMS authenticates and authorises the request, processes the priority request and transfers the information to TLC.	TLC	Internal logging about priority handling (granted, rejected, etc.)
3/4	Some DS will have the application running locally with CAM subscriptions to the CPBO	RSU	Communication timestamp logging and priority handling logging (granted, rejected, etc.)

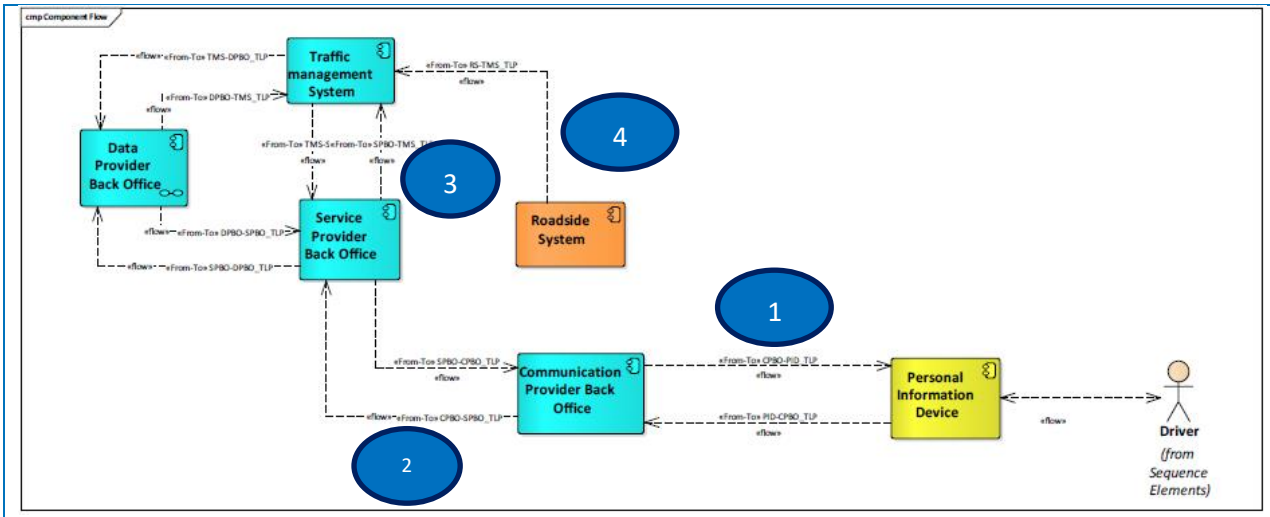


Figure 7. Logging steps in CTLV-01 test scenario

Acceptance criteria
Test scenario CTLV-01 is considered as passed if: / Latency (time elapsed between the message transmission by the service provider and the message reception by the CPBO is lower than X ms. / TLC extends green light.

Note that MAP/SPAT are not officially required for CTLV, but are very convenient for logging signal changes. A contingency plan is required if the intersection doesn't have GLOSA deployed as well and therefore access to those messages.

3.2.4.1.2. Test scenario over ITS-G5

Test Case ID	CTLV-02
Test Case Objective	To test CTLV functionality: VRUs approach the TLC. TLC detects and counts the number of VRUs. TLC access the situation and extends green light for VRUs
Applicability	Using ETSI ITS-G5
C-MobILE Requirements	R/S11-CTLV-02, R/S11-CTLV-03, R/S11-CTLV-06, R/S11-CTLV-07, R/S11-CTLV-08, R/S11-CTLV-10, R/S11-CTLV-11, R/S11-CTLV-12, R/S11-CTLV-13
Pre-test conditions	Sensors are installed for VRUs detection.

Step	Description	Logging component	Logged data
1	TLC detects and counts, or receives the number of VRUs entering in the target detection zone of an intersection on regular intervals and registers a priority request	TLC	Roadside log file
2	TMC transfers the priority information to SPBO	SPBO	Received MAPEM/SPATEM with timestamp
3	SPBO notifies the CPBO	CPBO	Received MAPEM/SPATEM with timestamp
4	TLC extends green light	TLC	Roadside log file

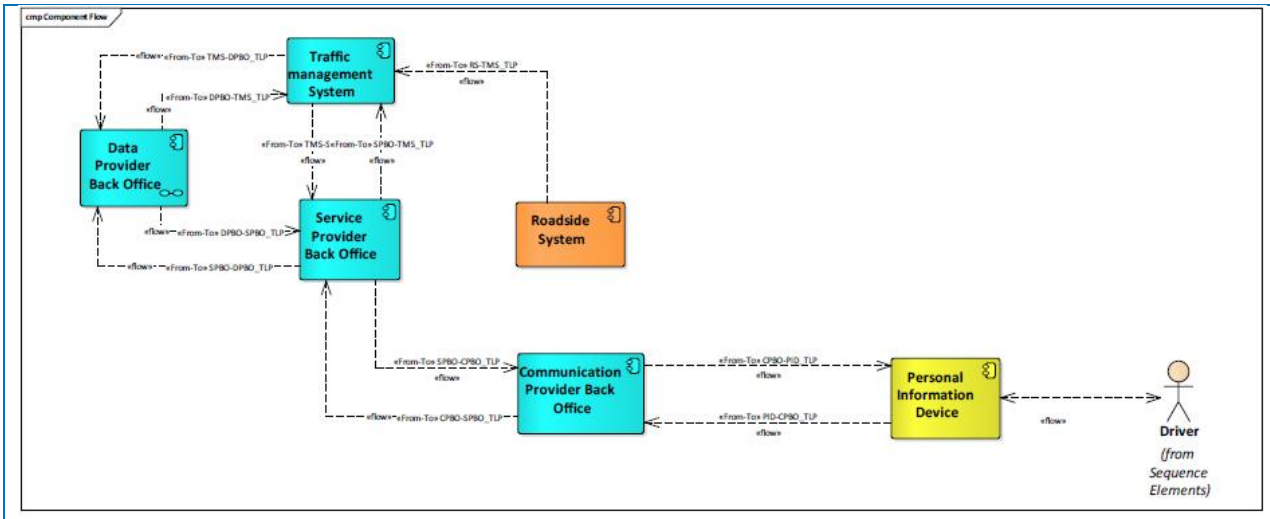


Figure 8. Logging steps in CTLV-02 test scenario

Acceptance criteria

Test scenario CTLV-02 is considered as passed if:

- Total latency between priority request and SPBO is lower than X ms.
- TLC extends green light.

3.2.4.2. Traceability Matrix

The traceability matrix is used to assist in determining the completeness of the requirements being met against the test scenarios.

The identifier for each of the requirements is placed in the first column while the identifiers for test scenarios are placed across the top row. When an item in the left column is related to an item across the top, a mark is placed in the intersecting cell. The number of relationships is added up for each row and each column. This value indicates the mapping of the two items. An empty value indicates that no relationship exists.

	Test scenarios	CTLV-01	CTLV-02
Requirements Tested		13	10
R/S11-CTLV-01	1	X	
R/S11-CTLV-02	2	X	X
R/S11-CTLV-03	2	X	X
R/S11-CTLV-04	1	X	
R/S11-CTLV-05			
R/S11-CTLV-06	2	X	X
R/S11-CTLV-07	2	X	X
R/S11-CTLV-08	2	X	X
R/S11-CTLV-09			
R/S11-CTLV-10	2	X	X
R/S11-CTLV-11	2	X	X
R/S11-CTLV-12	2	X	X
R/S11-CTLV-13	2	X	X
R/S11-CTLV-14	2	X	X
R/S11-CTLV-15	1	X	

3.2.4.3. Communication performance – Latency

Total latency can be calculated from the moment that the Traffic Light Controller (TLC) generates a MAPEM/SPATEM message and the moment the MAPEM/SPATEM message is received by the CPBO.

In the case of ETSI G5, latency between RSUs and OBUs should be measured as well.

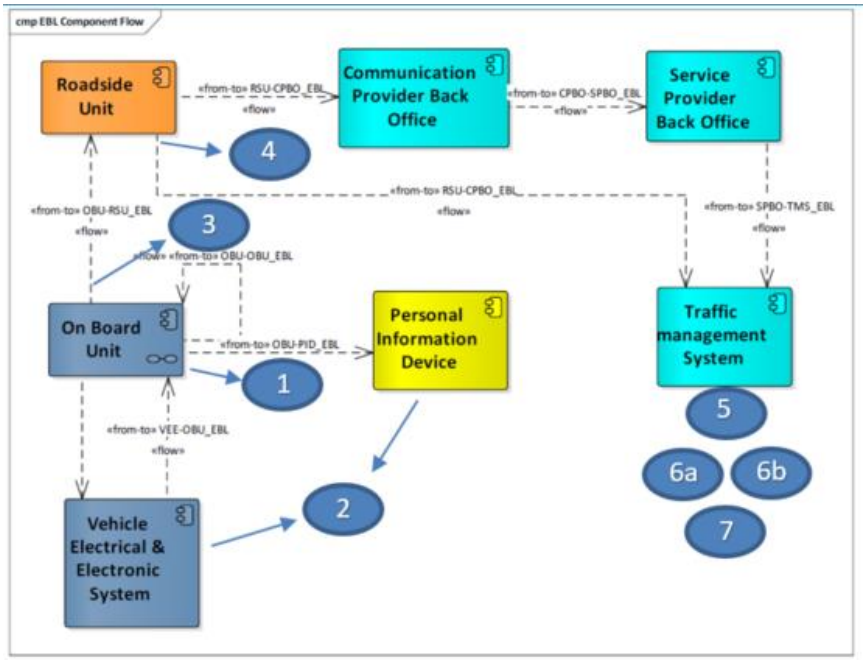
3.2.5. Emergency Brake Light

3.2.5.1. Test Scenarios

3.2.5.1.1. Test scenario about Emergency Brake Light

Test Case ID	EBL-01
Test Case Objective	To avoid rear end collisions, when any vehicle abruptly slows down, it switches on emergency electronic brake lights. The service warns the local followers, in due time, so they can adopt their speed to avoid collision with the vehicle.
Applicability	Using ETSI ITS-G5 DENM messages.
C-MobILE Requirements	R/S16-EBL-01, R/S16-EBL-02, R/S16-EBL-03, R/S16-EBL-04, R/S16-EBL-05, R/S16-EBL-06, R/S16-EBL-07, R/S16-EBL-08, R/S16-EBL-09, R/S16-EBL-10, R/S16-EBL-11, R/S16-EBL-12, R/S16-EBL-13, R/S16-EBL-14 R/S16-EBL-15, R/S16-EBL-16, R/S16-EBL-17, R/S16-EBL-18, R/S16-EBL-19, R/S16-EBL-20, R/S16-EBL-21, R/S16-EBL-22
Pre-test conditions	The first vehicle abruptly slows down and sends out its vehicle state to the OBU. The OBU processes and transmits an EBL message with relevant vehicle state information. The Vehicle ITS-S is installed and activated on the Vehicle Driver's smart phone or on-board unit and running in the background

Step	Description	Logging component	Logged data
1	The following vehicle assesses the information about EBL message in smart phone or on-board unit.	OBU	Vehicle log file with timestamp
2	Vehicle ITS-S displays the emergency braking warning and activates emergency brake lights.	OBU	HMI log file (DENM, remaining distance to roadworks location and timestamp when warning is given)
3	Vehicle ITS-S disseminates the detected emergency braking information to R-ITS-S and other vehicles within the range.	RSU / OBU	Roadside log file or Vehicle log file with timestamp
4	R-ITS-S that received the emergency braking information, sends it to the Road Operator/Traffic Manager	RSU	Roadside log file with timestamp
5	Road operator (TMS) signals the existence of a road hazard and creates a DENM message (causeCode is 98 and subCauseCode is 1). Repeat EBL DENM while the event is active.	SPBO	Generated DENM with timestamp
6a	A vehicle is approaching the area of braked vehicle from the front, the vehicle ITS-S has no reaction to EBL event or DENM message and nothing will be displayed in the Vehicle ITS-S.	OBU	Vehicle log file with timestamp
6b	A vehicle is approaching the area of braked vehicle in another lane and a collision risk doesn't exist. The vehicle ITS-S has no reaction to EBL event or DENM message and nothing will be displayed in the Vehicle ITS-S.	OBU	Vehicle log file with timestamp
7	When the originating ITS station detects the event has finished, shall send out a cancellation DENM	SPBO	DENM with timestamp



Acceptance criteria

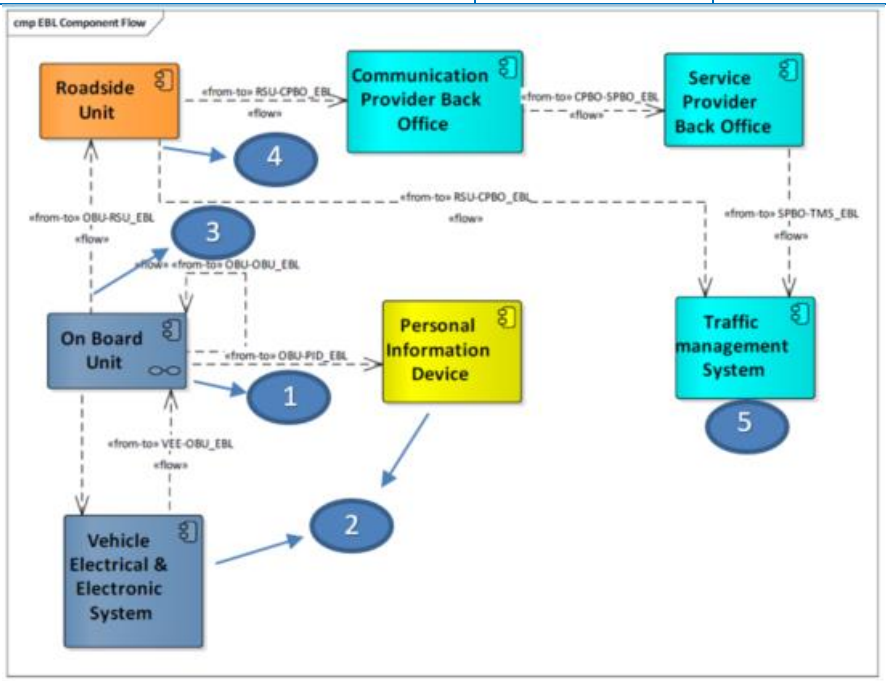
Test scenario EBL-01 is considered as passed if:

- All following vehicles in a local area and in the same direction are warned about emergency braking from preceding vehicle/s and it is displayed on the Vehicle ITS-S. If a vehicle that is approaching from the front nothing will be displayed in the Vehicle ITS-S (R/S16-EBL-03)
- The delay between detection of an emergency brake in the braking vehicle until reception of the message in surrounding vehicles in communication range should be less than 50 ms. (R/S16-EBL-01)
- DENM message shall contain information about the EBL event: Valid time, current position of detecting vehicle and risk assessment valid time. ((R/S16-EBL-08, R/S16-EBL-11, R/S16-EBL-12)
- DENM message shall be send with a determinate transmission latency and within a transmission area. (R/S16-EBL-09, R/S16-EBL-10)

Test Case ID	EBL-02
Test Case Objective	To avoid rear end collisions, when any vehicle abruptly slows down, it switches on emergency electronic brake lights. The service warns the local followers, in due time, so they can adopt their speed to avoid collision with the vehicle.
Applicability	Using ETSI ITS-G5
C-MobILE Requirements	R/S16-EBL-01, R/S16-EBL-02, R/S16-EBL-03, R/S16-EBL-04 R/S16-EBL-10, R/S16-EBL-13, R/S16-EBL-14, R/S16-EBL-20, R/S16-EBL-21, R/S16-EBL-22
Pre-test conditions	The first vehicle abruptly slows down and sends out its vehicle state to the OBU. The OBU processes and transmits and EBL message with relevant vehicle state information. The Vehicle ITS-S is installed and activated on the Vehicle Driver's smart phone or on-board unit and running in the background.

Step	Description	Logging component	Logged data
1	The following vehicle assesses the information about EBL message in smart phone or on-board unit. It also assesses CAM information about vehicle state information	OBU	Vehicle log file with timestamp

2	Vehicle ITS-S displays the emergency braking warning and activates emergency brake lights.	OBU	HMI log file (DENM, remaining distance to roadworks location and timestamp when warning is given)
3	Vehicle ITS-S disseminates the detected emergency braking information to R-ITS-S and other vehicles within the range.	RSU / OBU	Roadside log file or Vehicle log file with timestamp
4	R-ITS-S that received the emergency braking information, sends it to the Road Operator/Traffic Manager	RSU	Roadside log file with timestamp



Acceptance criteria

Test scenario EBL-02 is considered as passed if:

- The vehicle/s that are approaching from the front, they are not warned about emergency braking and nothing will be displayed in the Vehicle ITS-S (R/S16-EBL-03)
- DENM message shall contain information about the EBL event: Valid time, current position of detecting vehicle and risk assessment valid time. ((R/S16-EBL-08, R/S16-EBL-11, R/S16-EBL-12)
- DENM message shall be send with a determinate transmission latency and within a transmission area. (R/S16-EBL-09, R/S16-EBL-10)

3.2.5.2. Traceability Matrix

The traceability matrix is used to assist in determining the completeness of the requirements being met against the test scenarios.

The identifier for each of the requirements is placed in the first column while the identifiers for test scenarios are placed across the top row. When an item in the left column is related to an item across the top, a mark is placed in the intersecting cell. The number of relationships is added up for each row and each column. This value indicates the mapping of the two items. An empty value indicates that no relationship exists.

	Test scenarios	EBL-01	EBL-02
Requirements Tested		21	10
R/S16-EBL-01	2	X	X
R/S16-EBL-02	2	X	X
R/S16-EBL-03	2	X	X
R/S16-EBL-04	2	X	X
R/S16-EBL-05	1	X	
R/S16-EBL-06	1	X	
R/S16-EBL-07	1	X	
R/S16-EBL-08	1	X	
R/S16-EBL-09	1	X	
R/S16-EBL-10	2	X	X
R/S16-EBL-11	1	X	
R/S16-EBL-12	1	X	
R/S16-EBL-13	2	X	X
R/S16-EBL-14	1		X
R/S16-EBL-15	1	X	
R/S16-EBL-16	1	X	
R/S16-EBL-17	1	X	
R/S16-EBL-18	1	X	
R/S16-EBL-19	1	X	
R/S16-EBL-20	2	X	X
R/S16-EBL-21	2	X	X
R/S16-EBL-22	2	X	X

3.2.5.3. Communication performance – Latency

Total latency can be calculated from the moment a request is sent to the moment the reply is received.

In the case of cellular communication, latency is highly dependent on the network, which is out of scope of C-MobILE. Nevertheless the time the Open Data server needs for processing the request (from the moment it is received to when the reply is sent) will be measured.

3.2.6. Emergency Vehicle Warning

3.2.6.1. Test Scenarios

3.2.6.1.1. Test scenarios over cellular

Test Case ID	EVW-01
Test Case Objective	To test EVW Situation 1 for the connected case: The emergency vehicle is approaching the equipped vehicle from behind and will overtake it soon. The equipped vehicle has to give way or speed up in order to not block the emergency vehicle.
Applicability	Using cellular networks.

C-MobILE Requirements	R/S06-EVW-01, R/S06-EVW-02, R/S06-EVW-03, R/S06-EVW-04, R/S06-EVW-05, R/S06-EVW-07, R/S06-EVW-08, R/S06-EVW-09, R/S06-EVW-10, R/S06-EVW-11, R/S06-EVW-12, R/S06-EVW-13, R/S06-EVW-14
Pre-test conditions	The in-vehicle or mobile application is installed and activated on the driver's vehicle or smart phone and running in the background. The emergency vehicle is registered in the Service Provider Exchange System and is able to send CAM messages to the Service Provider Back Office.

Step	Description	Logging component	Logged data
1	The Personal Information Device (PID) of the emergency vehicle sends a CAM message to the Service Provider Back Office (SPBO)	PID	CAM with timestamp is sent to the SPBO
2	Service Provider Back Office (SPBO) receives CAM message from Personal Information device (PID)	SPBO	CAM with timestamp is received by the SPBO
3	Service Provider Back Office (SPBO) forwards the message to the Communication Provider Back Office (CPBO)	SPBO	CAM with timestamp
4	The Communication Provider Back Office (CPBO) uses the GeoMessaging and "broadcasts" the original CAM message or a CAM-based DENM message to the relevant vehicles.	PID	Received CAM/DENM message with reception timestamp
5	Vehicle shows warning in HMI. The vehicle driver receives timely an awareness message on the in-vehicle display. This message includes the remaining distance (or time) for emergency vehicle to reach the vehicle's location. It can also provide driving recommendation (e.g. lane or speed change).	PID	HMI log file (timestamp when warning is given, remaining distance for emergency vehicle to reach the vehicle's location)

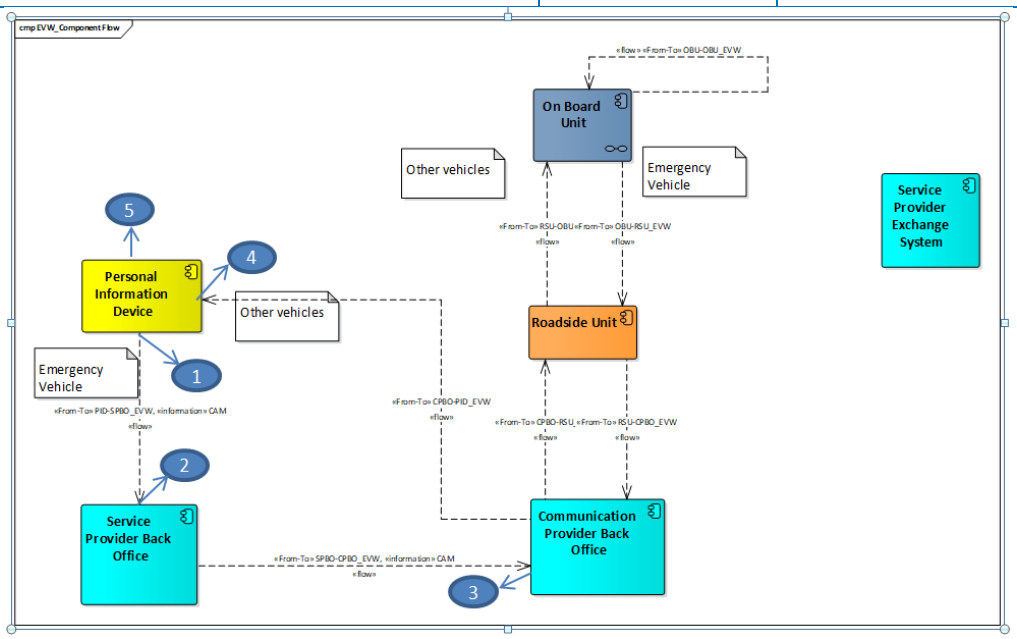


Figure 9. Logging steps in EVW-01 test scenario

Acceptance criteria

Test scenario EVW-01 is considered as passed if:

- Latency (time elapsed between the message transmission by the service provider and the message reception by the vehicle or personal information device) is lower than X ms.
- The private vehicle driver receives an awareness message on the in-vehicle display. This message should include the remaining distance (or time) for emergency vehicle to reach the vehicle's location.
- When the warning is given to the user, the user is within the relevance area of the DENM message.

Test Case ID	EVW-02
Test Case Objective	To test EVW Situation 2 for the connected case: The emergency vehicle is approaching the equipped vehicle slanted from the front. The equipped vehicle has to expect the emergency vehicle passing a nearby intersection from the left or from the right. Priority has to be given.
Applicability	Using cellular networks.
C-MobILE Requirements	R/S06-EVW-01, R/S06-EVW-02, R/S06-EVW-03, R/S06-EVW-04, R/S06-EVW-05, R/S06-EVW-07, R/S06-EVW-08, R/S06-EVW-09, R/S06-EVW-10, R/S06-EVW-11, R/S06-EVW-12, R/S06-EVW-13, R/S06-EVW-14
Pre-test conditions	The in-vehicle or mobile application is installed and activated on the driver's vehicle or smart phone and running in the background. The emergency vehicle is registered in the Service Provider Exchange System and is able to send CAM messages to the Service Provider Back Office.

Step	Description	Logging component	Logged data
1	The Personal Information Device (PID) of the emergency vehicle sends a CAM message to the Service Provider Back Office (SPBO)	PID	CAM with timestamp is sent to the SPBO
2	Service Provider Back Office (SPBO) receives CAM message from Personal Information device (PID)	SPBO	CAM with timestamp is received by the SPBO
3	Service Provider Back Office (SPBO) forwards the message to the Communication Provider Back Office (CPBO)	SPBO	CAM with timestamp
4	The Communication Provider Back Office (CPBO) uses the GeoMessaging and "broadcasts" the original CAM message or a CAM-based DENM message to the relevant vehicles.	PID	Received CAM/DENM message with reception timestamp
5	Vehicle shows warning in HMI. The vehicle driver receives timely an awareness message on the in-vehicle display. This message includes the remaining distance (or time) for emergency vehicle to reach the vehicle's location. It can also provide driving recommendation (e.g. lane or speed change).	PID	HMI log file (timestamp when warning is given, remaining distance for emergency vehicle to reach the vehicle's location)

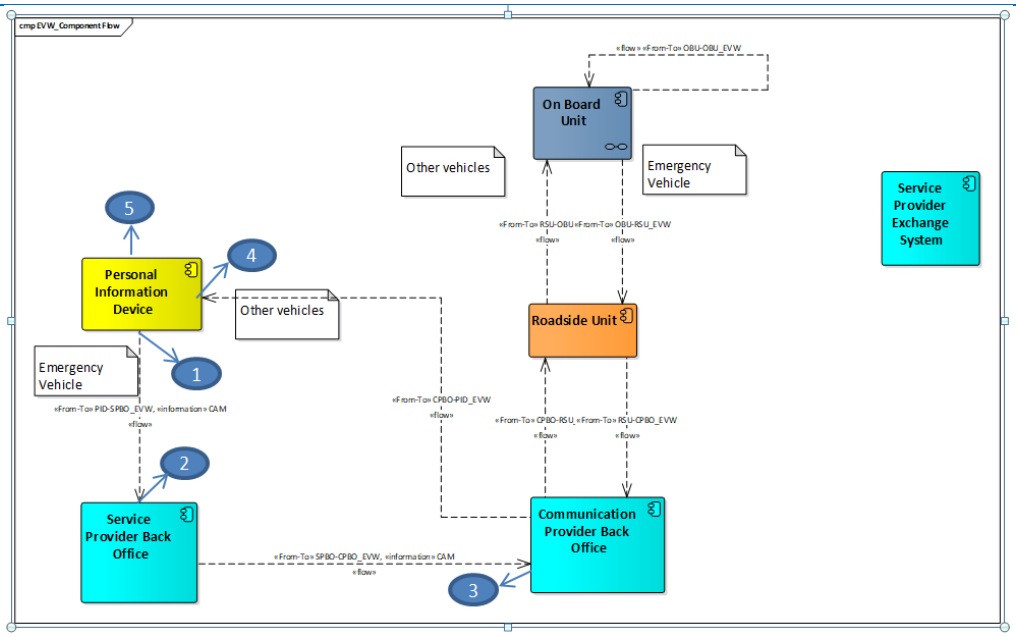


Figure 10. Logging steps in EVW-02 test scenario

Acceptance criteria

Test scenario EVW-02 is considered as passed if:

- Latency (time elapsed between the message transmission by the service provider and the message reception by the vehicle or personal information device) is lower than X ms.
- The private vehicle driver receives an awareness message on the in-vehicle display. This message should include the remaining distance (or time) for emergency vehicle to reach the vehicle's location.
- When the warning is given to the user, the user is within the relevance area of the DENM message.

Test Case ID	EVW-03
Test Case Objective	To test EVW Situation 3 for the connected case: The emergency vehicle is approaching from the front and will pass by soon. The equipped vehicle must be aware of an overtaking emergency vehicle and give way to it or to other vehicles trying not to block the emergency vehicle.
Applicability	Using cellular networks.
C-MobILE Requirements	R/S06-EVW-01, R/S06-EVW-02, R/S06-EVW-03, R/S06-EVW-04, R/S06-EVW-05, R/S06-EVW-07, R/S06-EVW-08, R/S06-EVW-09, R/S06-EVW-10, R/S06-EVW-11, R/S06-EVW-12, R/S06-EVW-13, R/S06-EVW-14
Pre-test conditions	The in-vehicle or mobile application is installed and activated on the driver's vehicle or smart phone and running in the background. The emergency vehicle is registered in the Service Provider Exchange System and is able to send CAM messages to the Service Provider Back Office.

Step	Description	Logging component	Logged data
1	The Personal Information Device (PID) of the emergency vehicle sends a CAM message to the Service Provider Back Office (SPBO)	PID	CAM with timestamp is sent to the SPBO
2	Service Provider Back Office (SPBO) receives CAM message from Personal Information device (PID)	SPBO	CAM with timestamp is received by the SPBO
3	SPBO forwards the message to the Communication Provider Back Office (CPBO)	SPBO	CAM with timestamp

4	The Communication Provider Back Office (CPBO) uses the GeoMessaging and "broadcasts" the original CAM message or a CAM-based DENM message to the relevant vehicles.	PID	Received CAM/DENM message with reception timestamp
5	Vehicle shows warning in HMI. The vehicle driver receives timely an awareness message on the in-vehicle display. This message includes the remaining distance (or time) for emergency vehicle to reach the vehicle's location. It can also provide driving recommendation (e.g. lane or speed change).	PID	HMI log file (timestamp when warning is given, remaining distance for emergency vehicle to reach the vehicle's location)

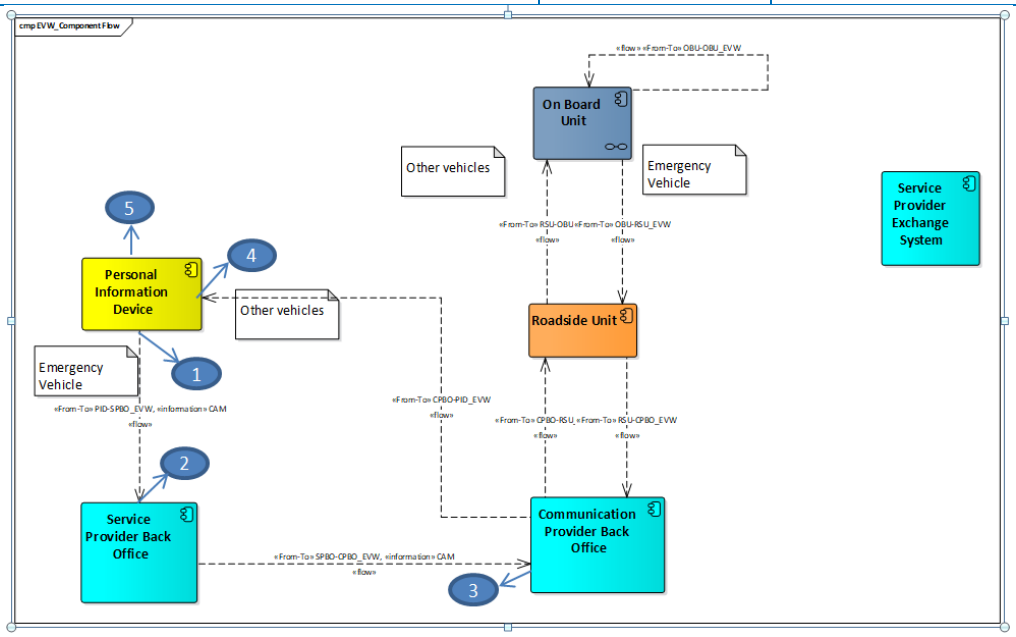


Figure 11. Logging steps in EVW-02 test scenario

Acceptance criteria

Test scenario EVW-03 is considered as passed if:

- Latency (time elapsed between the message transmission by the service provider and the message reception by the vehicle or personal information device) is lower than X ms.
- The private vehicle driver receives an awareness message on the in-vehicle display. This message should include the remaining distance (or time) for emergency vehicle to reach the vehicle's location.
- When the warning is given to the user, the user is within the relevance area of the DENM message.

3.2.6.1.2. Test scenario over ITS-G5

Test Case ID	EVW-04
Test Case Objective	To test EVW Situation 1 for the cooperative case: The emergency vehicle approaching the equipped vehicle from behind and will overtake the vehicle soon. The equipped vehicle has to give way or speed up in order to not block the emergency vehicle.
Applicability	Using ETSI ITS-G5 DENM messages
C-MobILE Requirements	R/S06-EVW-01, R/S06-EVW-02, R/S06-EVW-03, R/S06-EVW-04, R/S06-EVW-06, R/S06-EVW-07, R/S06-EVW-08, R/S06-EVW-09, R/S06-EVW-10, R/S06-EVW-11, R/S06-EVW-12, R/S06-EVW-13, R/S06-EVW-14
Pre-test conditions	The in-vehicle or mobile application is installed and activated on the driver's vehicle or smart phone and running in the background.

	The emergency vehicle is registered in the Service Provider Exchange System and is able to send CAM messages to the RSU. A RSU is installed in the range of the emergency vehicle.

Step	Description	Logging component	Logged data
1	The On Board Unit (OBU) of the emergency vehicle disseminates a CAM message, via the interface OBU-OBU_EVW	OBU	CAM with timestamp is sent by the OBU of the emergency vehicle.
2a	Roadside Unit receives CAM message and converts it into a DENM message. RSU disseminates the DENM message down to the vehicles in the relevance zone.	RSU	CAM with timestamp is received by the RSU
2b	CAM/DENM message is received by nearby equipped stations (vehicles and Roadside Units) in the communication range of the sending emergency vehicle.	OBU	CAM/DENM with received timestamp
3	Vehicle shows warning in HMI. The vehicle driver receives timely an awareness message on the in-vehicle display. This message includes the remaining distance (or time) for emergency vehicle to reach the vehicle's location. It can also provide driving recommendation (e.g. lane or speed change).	OBU	HMI log file (timestamp when warning is given, remaining distance for emergency vehicle to reach the vehicle's location)

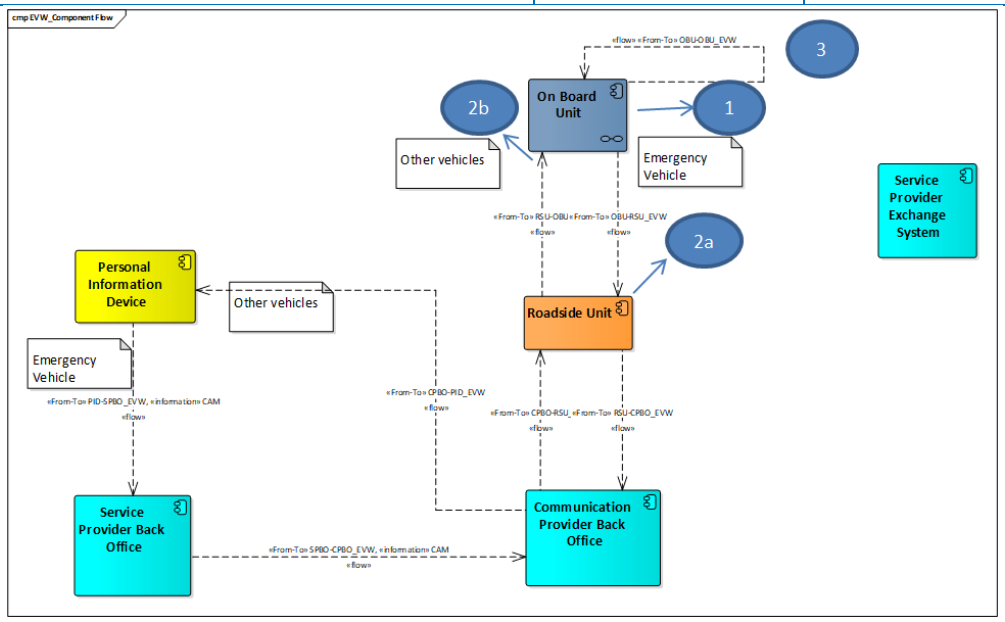


Figure 12. Logging steps in EVW-04 test scenario

Acceptance criteria

Test scenario EVW-04 is considered as passed if:

- Latency between RSU and vehicle is lower than 100 ms (R/S06-EVW-06).
- The private vehicle driver receives an awareness message on the in-vehicle display. This message should include the remaining distance (or time) for emergency vehicle to reach the vehicle's location.
- When the warning is given to the user, the user is within the relevance area of the DENM message.

Test Case ID	EVW-05
Test Case Objective	To test EVW Situation 2 for the cooperative case: The emergency vehicle is approaching the equipped vehicle slanted from the front. The equipped vehicle has to

	expect the emergency vehicle passing a nearby intersection from the left or from the right. Priority has to be given.
Applicability	Using ETSI ITS-G5 DENM messages
C-MobILE Requirements	R/S06-EVW-01, R/S06-EVW-02, R/S06-EVW-03, R/S06-EVW-04, R/S06-EVW-06, R/S06-EVW-07, R/S06-EVW-08, R/S06-EVW-09, R/S06-EVW-10, R/S06-EVW-11, R/S06-EVW-12, R/S06-EVW-13, R/S06-EVW-14
Pre-test conditions	The in-vehicle or mobile application is installed and activated on the driver's vehicle or smart phone and running in the background. The emergency vehicle is registered in the Service Provider Exchange System and is able to send CAM messages to the RSU. A RSU is installed in the range of the emergency vehicle.

Step	Description	Logging component	Logged data
1	The On Board Unit (OBU) of the emergency vehicle disseminates a CAM message, via the interface OBU-OBU_EVW	OBU	CAM with timestamp is sent by the OBU of the emergency vehicle.
2a	Roadside Unit receives CAM message and converts it into a DENM message. RSU disseminates the DENM message down to the vehicles in the relevance zone.	RSU	CAM with timestamp is received by the RSU
2b	CAM/DENM message is received by nearby equipped stations (vehicles and Roadside Units) in the communication range of the sending emergency vehicle.	OBU	CAM/DENM with received timestamp
3	Vehicle shows warning in HMI. The vehicle driver receives timely an awareness message on the in-vehicle display. This message includes the remaining distance (or time) for emergency vehicle to reach the vehicle's location. It can also provide driving recommendation (e.g. lane or speed change).	OBU	HMI log file (timestamp when warning is given, remaining distance for emergency vehicle to reach the vehicle's location)

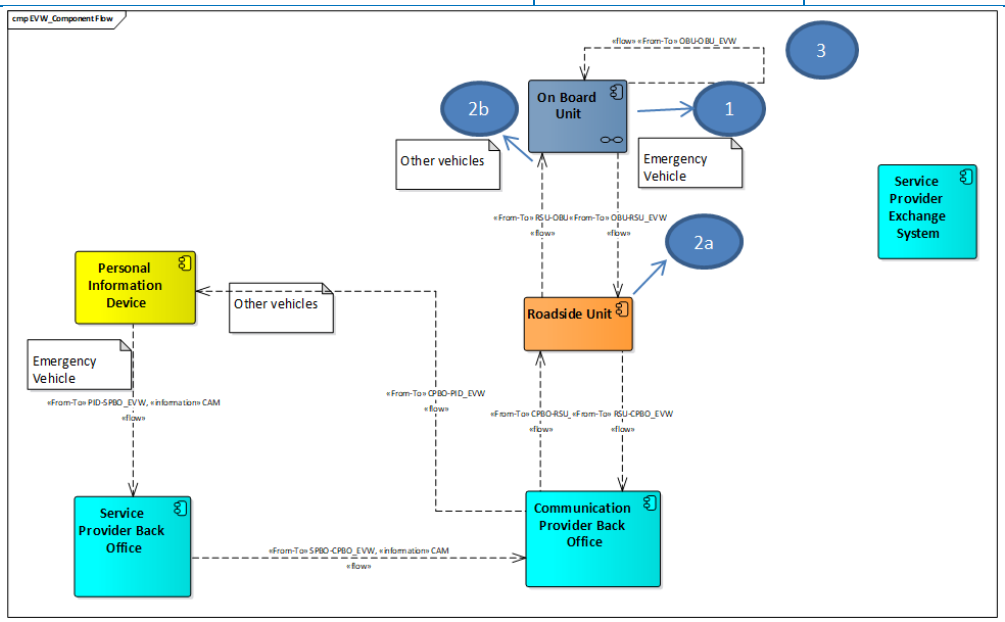


Figure 13. Logging steps in EVW-05 test scenario

Acceptance criteria
Test scenario EVW-05 is considered as passed if: / Latency between RSU and vehicle is lower than 100 ms (R/S06-EVW-06).

- The private vehicle driver receives an awareness message on the in-vehicle display. This message should include the remaining distance (or time) for emergency vehicle to reach the vehicle's location.
- When the warning is given to the user, the user is within the relevance area of the DENM message.

Test Case ID	EVW-06
Test Case Objective	To test EVW Situation 3 for the cooperative case: The emergency vehicle is approaching from the front and will pass by soon. The equipped vehicle must be aware of an overtaking emergency vehicle and give way to it or to other vehicles trying not to block the emergency vehicle.
Applicability	Using ETSI ITS-G5 DENM messages
C-MobILE Requirements	R/S06-EVW-01, R/S06-EVW-02, R/S06-EVW-03, R/S06-EVW-04, R/S06-EVW-06, R/S06-EVW-07, R/S06-EVW-08, R/S06-EVW-09, R/S06-EVW-10, R/S06-EVW-11, R/S06-EVW-12, R/S06-EVW-13, R/S06-EVW-14
Pre-test conditions	The in-vehicle or mobile application is installed and activated on the driver's vehicle or smart phone and running in the background. The emergency vehicle is registered in the Service Provider Exchange System and is able to send CAM messages to the RSU. A RSU is installed in the range of the emergency vehicle.

Step	Description	Logging component	Logged data
1	The On Board Unit (OBU) of the emergency vehicle disseminates a CAM message, via the interface OBU-OBU_EVW	OBU	CAM with timestamp is sent by the OBU of the emergency vehicle.
2a	Roadside Unit receives CAM message and converts it into a DENM message. RSU disseminates the DENM message down to the vehicles in the relevance zone.	RSU	CAM with timestamp is received by the RSU
2b	CAM/DENM message is received by nearby equipped stations (vehicles and Roadside Units) in the communication range of the sending emergency vehicle.	OBU	CAM/DENM with received timestamp
3	Vehicle shows warning in HMI. The vehicle driver receives timely an awareness message on the in-vehicle display. This message includes the remaining distance (or time) for emergency vehicle to reach the vehicle's location. It can also provide driving recommendation (e.g. lane or speed change).	OBU	HMI log file (timestamp when warning is given, remaining distance for emergency vehicle to reach the vehicle's location)

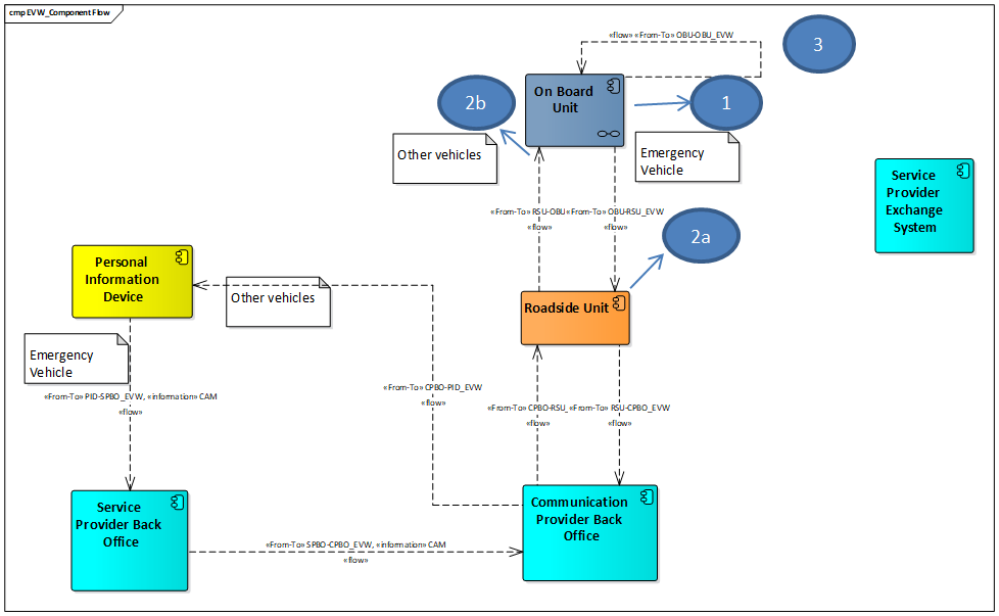


Figure 14. Logging steps in EVW-05 test scenario

Acceptance criteria

Test scenario EVW-06 is considered as passed if:

- Latency between RSU and vehicle is lower than 100 ms (R/S06-EVW-06).
- The private vehicle driver receives an awareness message on the in-vehicle display. This message should include the remaining distance (or time) for emergency vehicle to reach the vehicle's location.
- When the warning is given to the user, the user is within the relevance area of the DENM message.

3.2.6.2. Traceability Matrix

The traceability matrix is used to assist in determining the completeness of the requirements being met against the test scenarios.

The identifier for each of the requirements is placed in the first column while the identifiers for test scenarios are placed across the top row. When an item in the left column is related to an item across the top, a mark is placed in the intersecting cell. The number of relationships is added up for each row and each column. This value indicates the mapping of the two items. An empty value indicates that no relationship exists.

	Test scenarios	EVW-01	EVW-02	EVW-03	EVW-04	EVW-05	EVW-06
Requirements Tested		13	13	13	13	13	13
R/S06-EVW-01	6	X	X	X	X	X	X
R/S06-EVW-02	6	X	X	X	X	X	X
R/S06-EVW-03	6	X	X	X	X	X	X
R/S06-EVW-04	6	X	X	X	X	X	X
R/S06-EVW-05	3	X	X	X			
R/S06-EVW-06	3				X	X	X
R/S06-EVW-07	6	X	X	X	X	X	X
R/S06-EVW-08	6	X	X	X	X	X	X
R/S06-EVW-09	6	X	X	X	X	X	X
R/S06-EVW-10	6	X	X	X	X	X	X
R/S06-EVW-11	6	X	X	X	X	X	X

R/S06-EVW-12	6	X	X	X	X	X	X
R/S06-EVW-13	6	X	X	X	X	X	X
R/S06-EVW-14	6	X	X	X	X	X	X

3.2.6.3. Communication performance – Latency

Total latency can be calculated from the moment that the service provider generates a DENM message and the moment the DENM message is received by the vehicle or personal information device.

In the case of ETSI G5, latency between RSUs and OBUs should be measured as well.

3.2.7. Flexible Infrastructure

3.2.7.1. Test Scenarios

3.2.7.1.1. Test scenario: Dynamic Lane Management over cellular

Test Case ID	FI-01
Test Case Objective	To test Flexible Infrastructure functionality: Vehicle enters and passes area where there are dynamic lanes within the driving direction. While approaching the dynamic lanes, vehicle drivers receive related lane information, warnings and/or guidance on the in-vehicle display or smartphone indicating if they are allowed to use it.
Applicability	Using cellular networks.
C-MobILE Requirements	R/S12-FI-02, R/S12-FI-03, R/S12-FI-04, R/S12-FI-06, R/S12-FI-07, R/S12-FI-08, R/S12-FI-10, R/S12-FI-11, R/S12-FI-12
Pre-test conditions	The in-vehicle or mobile application is installed and activated on the driver's vehicle or smart phone and running in the background. The roadworks are informed by the corresponding Road Operator.

Step	Description	Logging component	Logged data
1	Dynamic lanes info is disseminated by the Data Provider Back Office to the SPBO	SPBO	Dynamic lanes info is received by the SPBO with timestamp
2	SPBO signals the existence of a location with dynamic lanes information to the CPBO	SPBO	Generated MAPEM with timestamp
3	Vehicle enters the range area defined by the Flexible Infrastructure service and receives MAPEM messages.	PID	Received MAPEM with reception timestamp
4	Vehicle shows warning in HMI since his position and direction matches the MAPEM information. This message includes: the remaining distance (or time) to reach the dynamic lanes location and which lanes are allowed for the vehicle.	PID	HMI log file (MAPEM, remaining distance to dynamic lanes location and timestamp when warning is given)

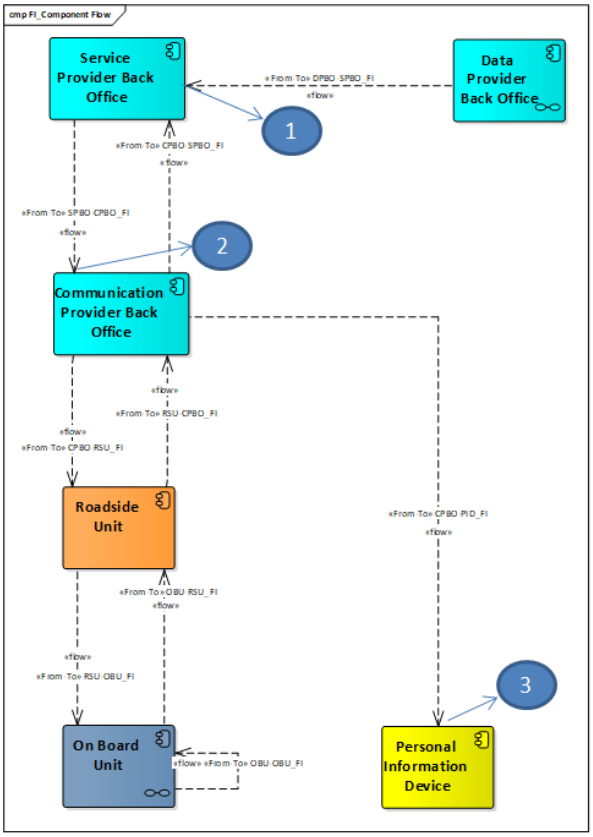


Figure 15. Logging steps in FI-01 test scenario

Acceptance criteria
Test scenario FI-01 is considered as passed if: / Latency (time elapsed between the message transmission by the service provider and the message reception by the vehicle or personal information device) is lower than X ms. / A warning is displayed to the user with the distance to the location of the dynamic lanes. / A warning is displayed to the user indicating which lanes the vehicle is allowed to use. / When the warning is given to the user, the user is within the relevance area of the MAPEM message.

Test Case ID	FI-02
Test Case Objective	To test Flexible Infrastructure functionality: Vehicle enters and passes area where there are dynamic lanes not relevant since they are located in the opposite driving direction. Verify that vehicle drivers do not receive dynamic lanes information on the in-vehicle display or smartphone since they are not affected.
Applicability	Using cellular networks.
C-MobILE Requirements	R/S12-FI-02, R/S12-FI-03, R/S12-FI-04, R/S12-FI-06, R/S12-FI-07, R/S12-FI-08, R/S12-FI-10, R/S12-FI-11, R/S12-FI-12
Pre-test conditions	The in-vehicle or mobile application is installed and activated on the driver's vehicle or smart phone and running in the background. The roadworks are informed by the corresponding Road Operator.

Step	Description	Logging component	Logged data
1	Dynamic lanes info is disseminated by the Data Provider Back Office to the SPBO	SPBO	Dynamic lanes info is received by the SPBO with timestamp

2	SPBO signals the existence of a location with dynamic lanes information to the CPBO	SPBO	Generated MAPEM with timestamp
3	Vehicle enters the range area defined by the Flexible Infrastructure service and receives MAPEM messages.	PID	Received MAPEM with reception timestamp
4	Vehicle does not show warning in HMI since his position and direction does not match the MAPEM information.	PID	HMI log file

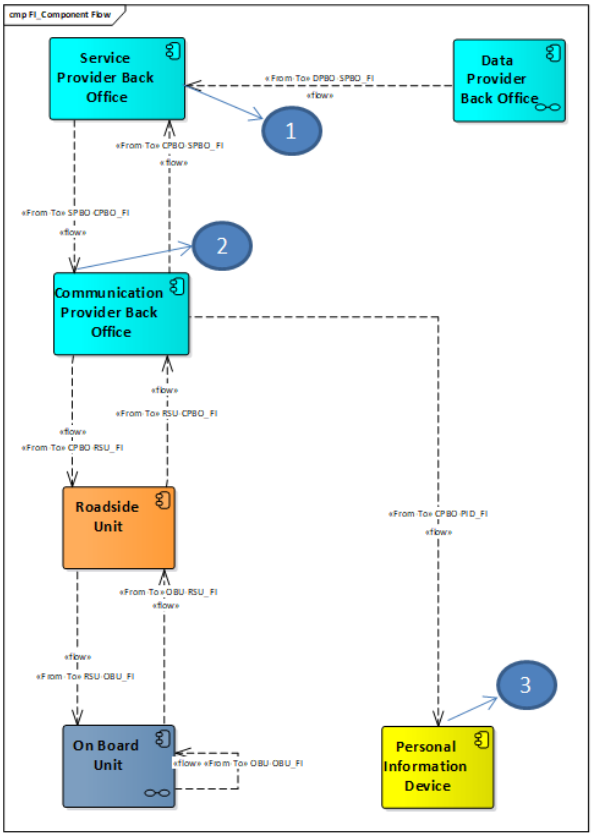


Figure 16. Logging steps in FI-02 test scenario

Acceptance criteria
Test scenario FI-02 is considered as passed if: / Latency (time elapsed between the message transmission by the service provider and the message reception by the vehicle or personal information device) is lower than X ms. / A warning is not displayed to the user.

3.2.7.1.2. Test scenario: Dynamic Lane Management over ITS-G5

Test Case ID	FI-03
Test Case Objective	To test Flexible Infrastructure functionality: Vehicle enters and passes area where there are dynamic lanes within the driving direction. While approaching the dynamic lanes, vehicle drivers receive related lane information, warnings and/or guidance on the in-vehicle display or smartphone indicating if they are allowed to use it.
Applicability	Using ETSI ITS-G5 DENM messages
C-MobILE Requirements	R/S12-FI-01, R/S12-FI-03, R/S12-FI-04, R/S12-FI-05, R/S12-FI-06, R/S12-FI-07, R/S12-FI-08, R/S12-FI-09, R/S12-FI-10, R/S12-FI-11, R/S12-FI-12
Pre-test conditions	The in-vehicle or mobile application is installed and activated on the driver's vehicle or smart phone and running in the background.

	The roadworks are informed by the corresponding Road Operator A RSU is installed in the dynamic lanes location.

Step	Description	Logging component	Logged data
1	Dynamic lanes info is disseminated by the Data Provider Back Office to the SPBO	SPBO	Dynamic lane info is received by the SPBO with timestamp
2	SPBO signals the existence of a location with dynamic lanes information to the CPBO	SPBO	Dynamic lanes info is received by the CPBO with timestamp
3	RSU receives MAPEM data and generates MAPEM messages.	RSU	Roadside log file(MAPEM with reception timestamp)
4	Vehicle enters the range area defined by the Flexible Infrastructure service and receives MAPEM messages.	OBU	Vehicle log file (MAPEM with reception timestamp)
5	Vehicle shows warning in HMI since his position and direction matches the MAPEM information. This message includes: the remaining distance (or time) to reach the dynamic lanes and which lanes are allowed for the vehicle.	OBU	HMI log file (MAPEM and remaining distance to dynamic lanes location)

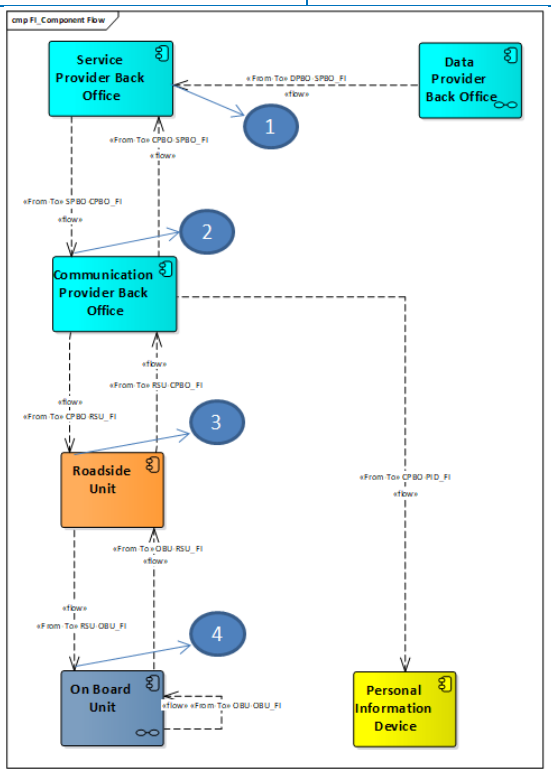


Figure 17. Logging steps in FI-03 test scenario

Acceptance criteria

Test scenario FI-03 is considered as passed if:

- Total latency between SPBO and vehicle is lower than X ms.
- Latency between RSU and vehicle is lower than X ms.
- A warning is displayed to the user with the distance to the location of the dynamic lanes.
- When the warning is given to the user, the user is within the relevance area of the MAPEM message.

Test Case ID	FI-04
Test Case Objective	To test Flexible Infrastructure functionality: Vehicle enters and passes area where there are dynamic lanes not relevant since they are located in the opposite driving direction. Verify that vehicle drivers do not receive dynamic lanes information on the in-vehicle display or smartphone since they are not affected.
Applicability	Using ETSI ITS-G5 DENM messages
C-MobILE Requirements	R/S12-FI-01, R/S12-FI-03, R/S12-FI-04, R/S12-FI-05, R/S12-FI-06, R/S12-FI-07, R/S12-FI-08, R/S12-FI-09, R/S12-FI-10, R/S12-FI-11, R/S12-FI-12
Pre-test conditions	The in-vehicle or mobile application is installed and activated on the driver's vehicle or smart phone and running in the background. The roadworks are informed by the corresponding Road Operator. A RSU is installed in the dynamic lanes location.

Step	Description	Logging component	Logged data
1	Dynamic lanes info is disseminated by the Data Provider Back Office to the SPBO	SPBO	Dynamic lane info is received by the SPBO with timestamp
2	SPBO signals the existence of a location with dynamic lanes information to the CPBO	SPBO	Dynamic lanes info is received by the CPBO with timestamp
3	RSU receives MAPEM data and generates MAPEM messages.	RSU	Roadside log file(MAPEM with reception timestamp)
4	Vehicle enters the range area defined by the Flexible Infrastructure service and receives MAPEM messages.	OBU	Vehicle log file (MAPEM with reception timestamp)
5	Vehicle does not show a warning in HMI since his position and direction does not match the MAPEM information.	OBU	HMI log file (MAPEM and remaining distance to dynamic lanes location)

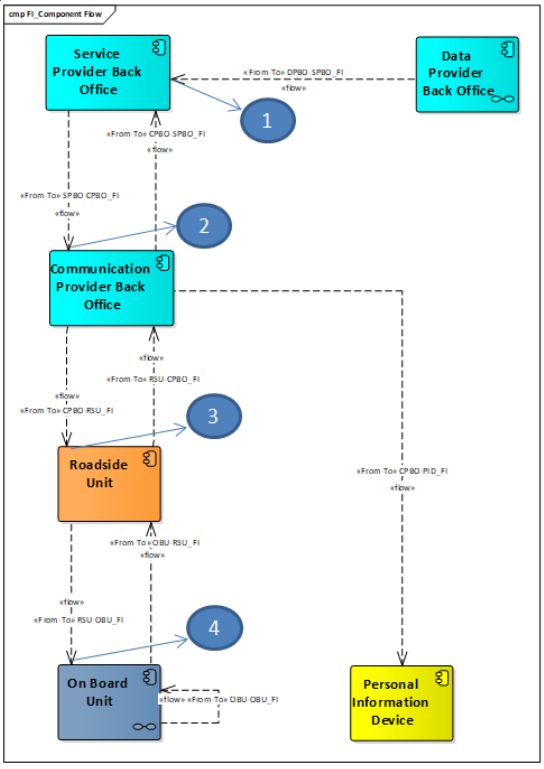


Figure 18. Logging steps in FI-04 test scenario

Acceptance criteria
Test scenario FI-04 is considered as passed if: / Total latency between SPBO and vehicle is lower than X ms. / Latency between RSU and vehicle is lower than X ms / A warning is not displayed to the user.

3.2.7.2. Traceability Matrix

The traceability matrix is used to assist in determining the completeness of the requirements being met against the test scenarios.

The identifier for each of the requirements is placed in the first column while the identifiers for test scenarios are placed across the top row. When an item in the left column is related to an item across the top, a mark is placed in the intersecting cell. The number of relationships is added up for each row and each column. This value indicates the mapping of the two items. An empty value indicates that no relationship exists.

	Test scenarios	FI-01	FI-02	FI-03	FI-04
Requirements Tested		8	8	11	11
R/S12-FI-01	2			X	X
R/S12-FI-02	2	X	X		
R/S12-FI-03	4	X	X	X	X
R/S12-FI-04	4	X	X	X	X
R/S12-FI-05	2			X	X
R/S12-FI-06	4	X	X	X	X
R/S12-FI-07	4	X	X	X	X
R/S12-FI-08	4	X	X	X	X
R/S12-FI-09	2			X	X
R/S12-FI-10	4	X	X	X	X
R/S12-FI-11	2			X	X
R/S12-FI-12	4	X	X	X	X

3.2.7.3. Communication performance – Latency

Total latency can be calculated from the moment that the service provider generates a MAPEM message and the moment the MAPEM message is received by the vehicle or personal information device.

In the case of ETSI G5, latency between RSUs and OBUs should be measured as well.

3.2.8. Green Light Optimal Speed Advisory

3.2.8.1. Test Scenarios

3.2.8.1.1. Optimized Driving Experience with GLOSA Cellular

Test Case ID	GLOSA-01
Test Case Objective	To test GLOSA functionality: Vehicle enters area with traffic lights in the driving direction. Vehicle approaches a traffic light at the moment that a speed advice would allow to pass without a stop. Vehicle drivers receive speed advice on the in-vehicle display or smartphone, in order to not stop at the next traffic light.

Applicability	Using cellular networks
C-MobILE Requirements	R/S10-GLOSA-01, R/S10-GLOSA-04, R/S10-GLOSA-05, R/S10-GLOSA-06, R/S10-GLOSA-07, R/S10-GLOSA-08, R/S10-GLOSA-09, R/S10-GLOSA-10, R/S10-GLOSA-11, R/S10-GLOSA-12, R/S10-GLOSA-13, R/S10-GLOSA-14, R/S10-GLOSA-15, R/S10-GLOSA-16, R/S10-GLOSA-17, R/S10-GLOSA-18
Pre-test conditions	The in-vehicle or mobile application is installed and activated on the driver's vehicle or smart phone and running in the background. The advice is provided by the SPBO via the CPBO.

Step	Description	Logging component	Logged data
1	Traffic Light Controller (TLC) sends the signal state of the traffic light and the time required for the next signal to the Traffic Management System (TMS).	TLC	Generic Message containing the signal phase and the time to next signal (Message depends on the technology selected by the site)
2	Traffic Management System (TMS) sends the signal state of the traffic light and the time required for the next signal to the SPBO. This step is optional, some deployment sites have a direct link between RSU and SPBO.	SPBO	Received generic message with timestamp. Generated MAPEM/SPATEM with timestamp.
3	SPBO sends the calculated optimal speed profiles together with the signal state of the traffic light and the time required for the next signal to the CPBO.	CPBO	Received MAPEM/SPATEM and Generated MAPEM/SPATEM with timestamp
4	Personal Information Device enters the range area and the road lane defined by the SP BO and receives the MAPEM/SPATEM/MQTT message from the CPBO via GeoMessaging.	PID	Received MAPEM/SPATEM together with MQTT message/topics with timestamp
5	Personal Information Device displays the advice since his position, lane and direction matches the MAPEM/SPATEM information. This message includes: the speed to take so as not to get a red at the traffic signal.	PID	HMI log file (MAPEM/SPATEM, speed advice and timestamp when warning is given)

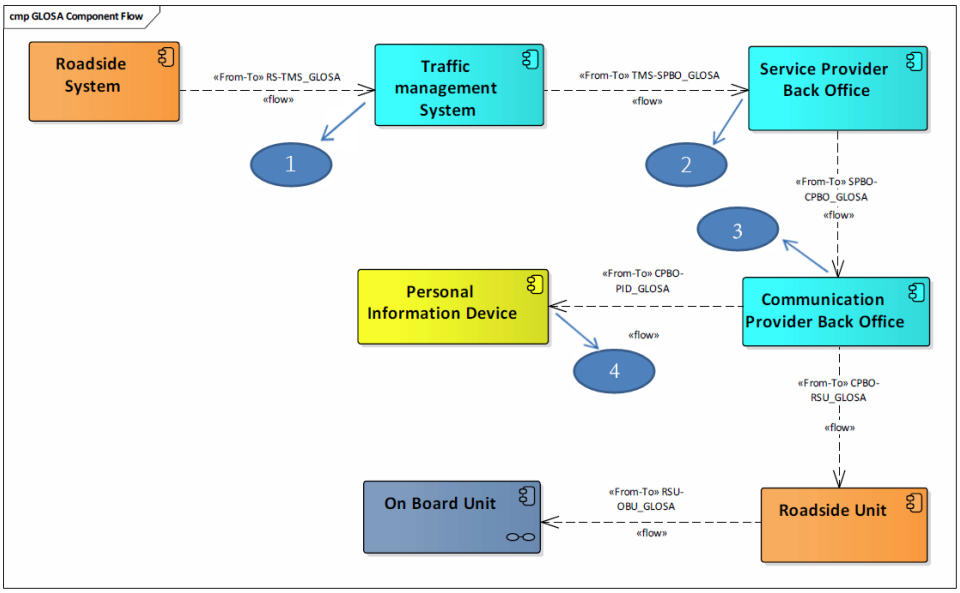


Figure 19. Logging steps in GLOSA-01 test scenario

Acceptance criteria

Test scenario GLOSA-01 is considered as passed if:

- Latency (time elapsed between the message transmission by the service provider and the message reception by the vehicle or personal information device) is lower than X ms.

/ Speed advice to get a green light signal is displayed to the user.

/ When the advice is given to the user, the user is within the relevant area.

Test Case ID	GLOSA-02
Test Case Objective	To test GLOSA functionality: Vehicle enters area with traffic lights in the driving direction. Vehicle approaches a traffic light at the moment that a speed advice would not allow to pass without a stop. Vehicle drivers shall not receive speed advice on the in-vehicle display or smartphone since they cannot get green light at any legal speed.
Applicability	Using cellular networks
C-MobILE Requirements	R/S10-GLOSA-01, R/S10-GLOSA-04, R/S10-GLOSA-05, R/S10-GLOSA-06, R/S10-GLOSA-07, R/S10-GLOSA-08, R/S10-GLOSA-09, R/S10-GLOSA-10, R/S10-GLOSA-11, R/S10-GLOSA-12, R/S10-GLOSA-13, R/S10-GLOSA-14, R/S10-GLOSA-15, R/S10-GLOSA-16, R/S10-GLOSA-17, R/S10-GLOSA-18
Pre-test conditions	The in-vehicle or mobile application is installed and activated on the driver's vehicle or smart phone and running in the background. The advice is provided by the SPBO via the CPBO.

Step	Description	Logging component	Logged data
1	Traffic Light Controller (TLC) sends the signal state of the traffic light and the time required for the next signal to the Traffic Management System (TMS).	TLC	Generic Message containing the signal phase and the time to next signal (Message depends on the technology selected by the site)
2	Traffic Management System (TMS) sends the signal state of the traffic light and the time required for the next signal to the SPBO. This step is optional, some deployment sites have a direct link between RSU and SPBO.	SPBO	Received generic message with timestamp. Generated MAPEM/SPATEM with timestamp.
3	SPBO sends the calculated optimal speed profiles together with the signal state of the traffic light and the time required for the next signal to the CPBO.	CPBO	Received MAPEM/SPATEM and Generated MAPEM/SPATEM with timestamp
4	Personal Information Device enters the range area and the road lane defined by the SP BO and receives the MAPEM/SPATEM/MQTT message from the CPBO via GeoMessaging.	PID	Received MAPEM/SPATEM together with MQTT message/topics with timestamp
5	Personal Information Device calculates the speed advice but does not show an advice in the HMI since he cannot get green light at any speed.	PID	HMI log file (No advice is given)

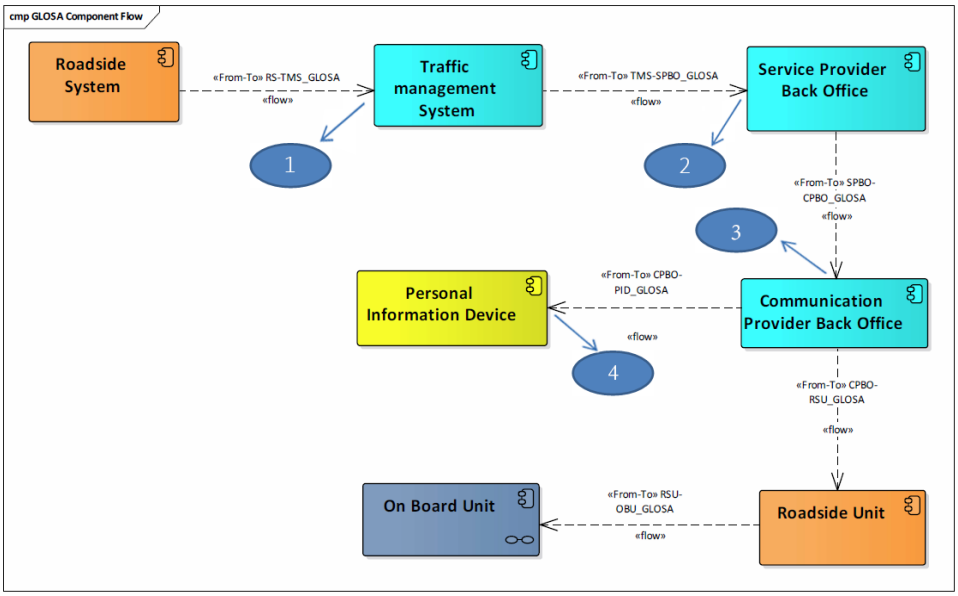


Figure 20. Logging steps in GLOSA-02 test scenario

Acceptance criteria

Test scenario GLOSA-02 is considered as passed if:

- The advice is not displayed to the user.

Test Case ID	GLOSA-03
Test Case Objective	To test GLOSA functionality: Vehicle enters area with traffic lights in the driving direction, however, the vehicle is going the opposite direction. Verify that the vehicle drivers do not receive GLOSA advice on the in-vehicle display or smartphone since the vehicle is going in the opposite direction.
Applicability	Using cellular networks
C-MobILE Requirements	R/S10-GLOSA-01, R/S10-GLOSA-04, R/S10-GLOSA-05, R/S10-GLOSA-06, R/S10-GLOSA-07, R/S10-GLOSA-08, R/S10-GLOSA-09, R/S10-GLOSA-10, R/S10-GLOSA-11, R/S10-GLOSA-12, R/S10-GLOSA-13, R/S10-GLOSA-14, R/S10-GLOSA-15, R/S10-GLOSA-16, R/S10-GLOSA-17, R/S10-GLOSA-18
Pre-test conditions	The in-vehicle or mobile application is installed and activated on the driver's vehicle or smart phone and running in the background. The advice is provided by the SPBO via the CPBO.

Step	Description	Logging component	Logged data
1	Traffic Light Controller (TLC) sends the signal state of the traffic light and the time required for the next signal to the Traffic Management System (TMS).	TLC	Generic Message containing the signal phase and the time to next signal (Message depends on the technology selected by the site)
2	Traffic Management System (TMS) sends the signal state of the traffic light and the time required for the next signal to the SPBO.	SPBO	Received generic message with timestamp. Generated MAPEM/SPATEM with timestamp.
3	SPBO sends the calculated optimal speed profiles together with the signal state of the traffic light and the time required for the next signal to the CPBO.	CPBO	Received MAPEM/SPATEM and Generated MAPEM/SPATEM with timestamp
4	Personal Information Device enters the range area and the road lane defined by the SP BO	PID	Received MAPEM/SPATEM together with MQTT

	and receives the MAPEM/SPATEM/MQTT message from the CPBO via GeoMessaging.		message/topics with timestamp
5	Personal Information Device calculates the speed advice but does not show an advice in the HMI since he is going in the opposite direction.	PID	HMI log file (No advice is given)

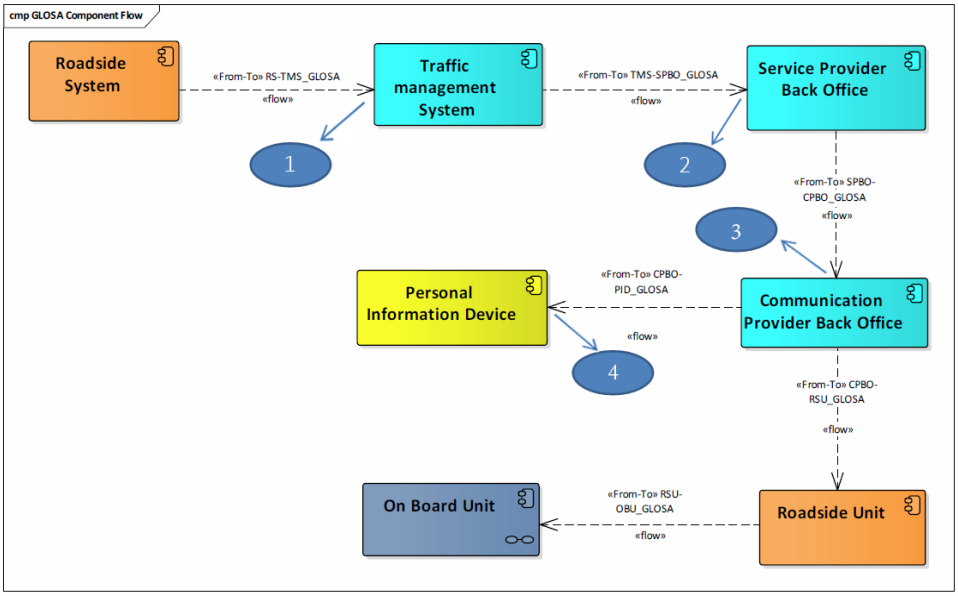


Figure 21. Logging steps in GLOSA-02 test scenario

Acceptance criteria

Test scenario GLOSA-03 is considered as passed if:

/ The advice is not displayed to the user.

3.2.8.1.2. Optimized Driving Experience with GLOSA over ITS-G5

Test Case ID	GLOSA-04
Test Case Objective	To test GLOSA functionality: Vehicle enters area with traffic lights in the driving direction. Vehicle approaches a traffic light at the moment that a speed advice would allow to pass without a stop. Vehicle drivers receive speed advice on the in-vehicle display in order to not stop at the next traffic light.
Applicability	Using ETSI ITS-G5
C-MobILE Requirements	R/S10-GLOSA-01, R/S10-GLOSA-02, R/S10-GLOSA-03, R/S10-GLOSA-04, R/S10-GLOSA-05, R/S10-GLOSA-06, R/S10-GLOSA-07, R/S10-GLOSA-08, R/S10-GLOSA-09, R/S10-GLOSA-10, R/S10-GLOSA-11, R/S10-GLOSA-12, R/S10-GLOSA-13, R/S10-GLOSA-14, R/S10-GLOSA-15, R/S10-GLOSA-16, R/S10-GLOSA-17, R/S10-GLOSA-18
Pre-test conditions	The in-vehicle or mobile application is installed and activated on the driver's vehicle or smart phone and running in the background. The advice is provided by the SPBO via the CPBO. A RSU is installed in the area of the traffic light location.

Step	Description	Logging component	Logged data
1a	Traffic Light Controller (TLC) sends the signal state of the traffic light and the time required for the next signal to the Road Side Unit (RSU) near the TLC.	RSU	Generic Message containing the signal phase and the time to next signal (Message depends on the technology selected by the site)

1b	Traffic Light Controller (TLC) sends the signal state of the traffic light and the time required for the next signal to the Traffic Management System (TMS).	TLC	Generic Message containing the signal phase and the time to next signal (Message depends on the technology selected on the site)
2a	The RSU generates MAPEM/SPATEM messages and sends it to the vehicle that entered the communication range.	PID	Generated MAPEM/SPATEM with timestamp
2b	The TMS sends the signal state of the traffic light and the time required for the next signal to the SPBO.	SPBO	Received MAPEM/SPATEM with timestamp and reception timestamp
3b	SPBO sends the calculated optimal speed profiles together with the signal state of the traffic light and the time required for the next signal to the CPBO.	CPBO	Received MAPEM/SPATEM and Generated MAPEM/SPATEM with timestamp
4b	RSU near the traffic lights receives MAPEM/SPATEM message from the CPBO (CPBO).	RSU	Received MAPEM/SPATEM with timestamp.
5	Vehicle enters the communication range and receives the MAPEM/SPATEM.	PID	Received MAPEM/SPATEM messages with timestamp
6/3a	Vehicle calculates the speed advice and displays the advice since his position, lane and direction matches the MAPEM/SPATEM information. This message includes: the speed to take so as not to get a red at the traffic signal.	PID	HMI log file (MAPEM/SPATEM, speed advice and timestamp when warning is given)
7/4a	Verify that the GLOSA advice was provided in sufficient time in advance to allow the driver to react (R/S10-GLOSA-11)	PID	MAPEM/SPATEM with received timestamp and vehicle log file.

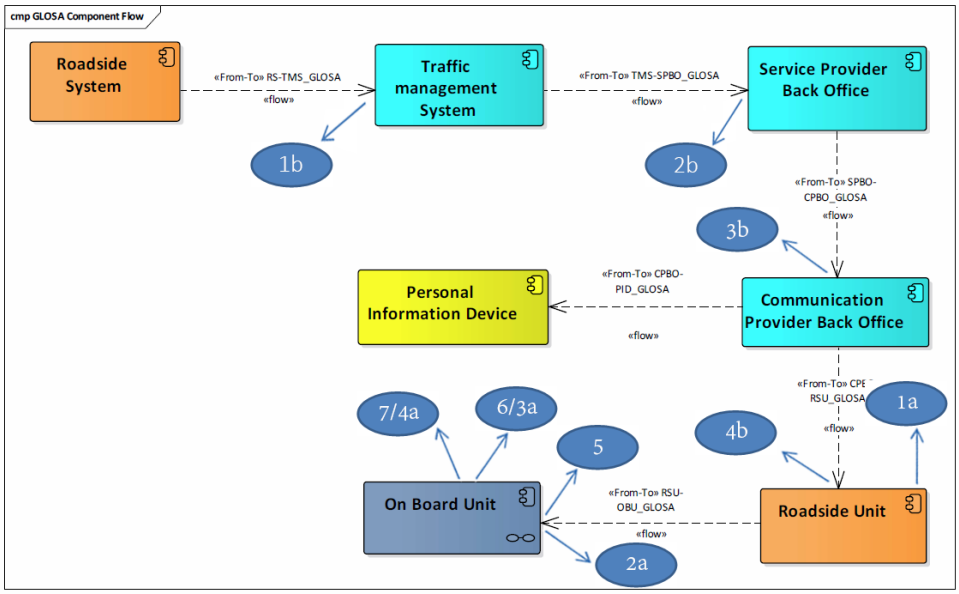


Figure 22. Logging steps in GLOSA-04 test scenario

Acceptance criteria

Test scenario GLOSA -04 is considered as passed if:

- Latency between RSU and vehicle is lower than 100 ms. (Similar from (R/S04-RWW-06)).
- An advice is displayed to the user with speed to take to get a green light signal.
- When the advice is given to the user, the user is within the relevant area and lane of the MAPEM/SPATEM message.

Test Case ID	GLOSA-05
Test Case Objective	To test GLOSA functionality: Vehicle enters area with traffic lights in the driving direction. Vehicle approaches a traffic light at the moment that a speed advice would not allow to pass without a stop. Vehicle drivers shall not receive speed advice on the in-vehicle display since they cannot get green light at any legal speed.
Applicability	Using ETSI ITS-G5
C-MobILE Requirements	R/S10-GLOSA-01, R/S10-GLOSA-02, R/S10-GLOSA-03, R/S10-GLOSA-04, R/S10-GLOSA-05, R/S10-GLOSA-06, R/S10-GLOSA-07, R/S10-GLOSA-08, R/S10-GLOSA-09, R/S10-GLOSA-10, R/S10-GLOSA-11, R/S10-GLOSA-12, R/S10-GLOSA-13, R/S10-GLOSA-14, R/S10-GLOSA-15, R/S10-GLOSA-16, R/S10-GLOSA-17, R/S10-GLOSA-18
Pre-test conditions	The in-vehicle or mobile application is installed and activated on the driver's vehicle or smart phone and running in the background. The advice is provided by the SPBO via the CPBO. A RSU is installed in the area of the traffic light location.

Step	Description	Logging component	Logged data
1a	Traffic Light Controller (TLC) sends the signal state of the traffic light and the time required for the next signal to the Road Side Unit (RSU) near the TLC.	RSU	Generic Message containing the signal phase and the time to next signal (Message depends on the technology selected by the site)
1b	Traffic Light Controller (TLC) sends the signal state of the traffic light and the time required for the next signal to the Traffic Management System (TMS).	TLC	Generic Message containing the signal phase and the time to next signal (Message depends on the technology selected on the site)
2a	The RSU generates MAPEM/SPATEM messages and sends it to the vehicle that entered the communication range.	PID	Generated MAPEM/SPATEM with timestamp
2b	Traffic Management System (TMS) sends the signal state of the traffic light and the time required for the next signal to the SPBO.	SPBO	Received MAPEM/SPATEM with timestamp and reception timestamp
3b	SPBO sends the calculated optimal speed profiles together with the signal state of the traffic light and the time required for the next signal to the CPBO.	CPBO	Received MAPEM/SPATEM and Generated MAPEM/SPATEM with timestamp
4b	RSU near the traffic lights receives MAPEM/SPATEM message from the CPBO (CPBO).	RSU	Received MAPEM/SPATEM with timestamp.
5	Vehicle enters the communication range and receives the MAPEM/SPATEM.	PID	Received MAPEM/SPATEM messages with timestamp
6/3a	Vehicle calculates the speed advice but does not show an advice in the HMI since he cannot get green light at any speed.	PID	HMI log file.

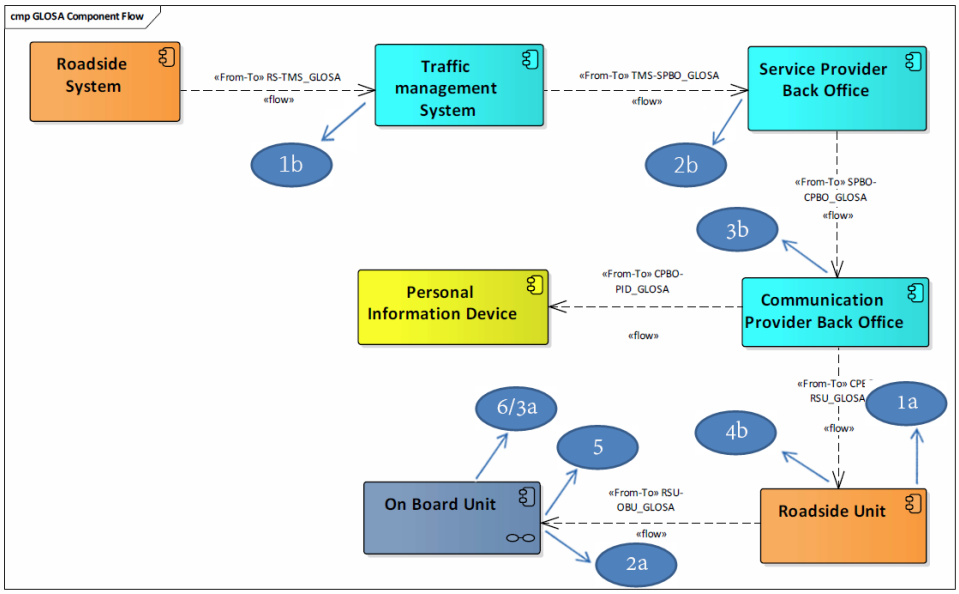


Figure 23. Logging steps in GLOSA-05 test scenario

Acceptance criteria

Test scenario GLOSA -05 is considered as passed if:

- Latency between RSU and vehicle is lower than 100 ms. (Similar from (R/S04-RWW-06)).
- An advice is not displayed to the user.

Test Case ID	GLOSA-06
Test Case Objective	To test GLOSA functionality: Vehicle enters area with traffic lights in the driving direction, however, the vehicle is going the opposite direction. Verify that the vehicle drivers do not receive GLOSA advice on the in-vehicle display since the vehicle is going in the opposite direction.
Applicability	Using ETSI ITS-G5
C-MobILE Requirements	R/S10-GLOSA-01, R/S10-GLOSA-02, R/S10-GLOSA-03, R/S10-GLOSA-04, R/S10-GLOSA-05, R/S10-GLOSA-06, R/S10-GLOSA-07, R/S10-GLOSA-08, R/S10-GLOSA-09, R/S10-GLOSA-10, R/S10-GLOSA-11, R/S10-GLOSA-12, R/S10-GLOSA-13, R/S10-GLOSA-14, R/S10-GLOSA-15, R/S10-GLOSA-16, R/S10-GLOSA-17, R/S10-GLOSA-18
Pre-test conditions	The in-vehicle or mobile application is installed and activated on the driver's vehicle or smart phone and running in the background. The advice is provided by the SPBO via the CPBO. A RSU is installed in the area of the traffic light location.

Step	Description	Logging component	Logged data
1a	Traffic Light Controller (TLC) sends the signal state of the traffic light and the time required for the next signal to the Road Side Unit (RSU) near the TLC.	RSU	Generic Message containing the signal phase and the time to next signal (Message depends on the technology selected by the site)
1b	Traffic Light Controller (TLC) sends the signal state of the traffic light and the time required for the next signal to the Traffic Management System (TMS).	TLC	Generic Message containing the signal phase and the time to next signal (Message depends on the technology selected on the site)

2a	The RSU generates MAPEM/SPATEM messages and sends it to the vehicle that entered the communication range.	PID	Generated MAPEM/SPATEM with timestamp
2b	Traffic Management System (TMS) sends the signal state of the traffic light and the time required for the next signal to the SPBO.	SPBO	Received MAPEM/SPATEM with timestamp and reception timestamp
3b	SPBO sends the calculated optimal speed profiles together with the signal state of the traffic light and the time required for the next signal to the CPBO.	CPBO	Received MAPEM/SPATEM and Generated MAPEM/SPATEM with timestamp
4b	RSU near the traffic lights receives MAPEM/SPATEM message from the CPBO (CPBO).	RSU	Received MAPEM/SPATEM with timestamp.
5	Vehicle enters the communication range and receives the MAPEM/SPATEM.	PID	Received MAPEM/SPATEM messages with timestamp
6/3a	Vehicle calculates the speed advice but does not show an advice in the HMI since the vehicle is going in the opposite direction.	PID	HMI log file.

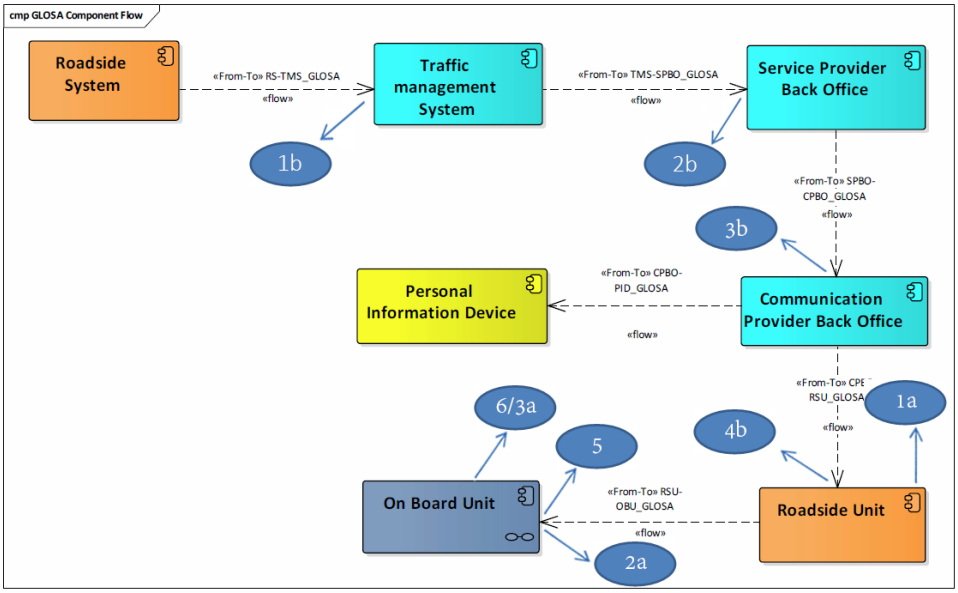


Figure 24. Logging steps in GLOSA-06 test scenario

Acceptance criteria

Test scenario GLOSA -06 is considered as passed if:

- Latency between RSU and vehicle is lower than 100 ms. (Similar from (R/S04-RWW-06)).
- An advice is not displayed to the user.

3.2.8.2. Traceability Matrix

The traceability matrix is used to assist in determining the completeness of the requirements being met against the test scenarios.

The identifier for each of the requirements is placed in the first column while the identifiers for test scenarios are placed across the top row. When an item in the left column is related to an item across the top, a mark is placed in the intersecting cell. The number of relationships is added up for each row and each column. This value indicates the mapping of the two items. An empty value indicates that no relationship exists.

	Test scenarios	GLOSA-01	GLOSA-02	GLOSA-03	GLOSA-04	GLOSA-05	GLOSA-05
Requirements Tested		16	16	16	18	18	18
R/S10-GLOSA-01	6	X	X	X	X	X	X
R/S10-GLOSA-02	3				X	X	X
R/S10-GLOSA-03	3				X	X	X
R/S10-GLOSA-04	6	X	X	X	X	X	X
R/S10-GLOSA-05	6	X	X	X	X	X	X
R/S10-GLOSA-06	6	X	X	X	X	X	X
R/S10-GLOSA-07	6	X	X	X	X	X	X
R/S10-GLOSA-08	6	X	X	X	X	X	X
R/S10-GLOSA-09	6	X	X	X	X	X	X
R/S10-GLOSA-10	6	X	X	X	X	X	X
R/S10-GLOSA-11	6	X	X	X	X	X	X
R/S10-GLOSA-12	6	X	X	X	X	X	X
R/S10-GLOSA-13	6	X	X	X	X	X	X
R/S10-GLOSA-14	6	X	X	X	X	X	X
R/S10-GLOSA-15	6	X	X	X	X	X	X
R/S10-GLOSA-16	6	X	X	X	X	X	X
R/S10-GLOSA-17	6	X	X	X	X	X	X
R/S10-GLOSA-18	6	X	X	X	X	X	X

3.2.8.3. Communication performance – Latency

Total latency can be calculated from the moment that the Traffic Light Controller (TLC) generates a MAPEM/SPATEM message and the moment the MAPEM/SPATEM message is received by the vehicle or personal information device.

In the case of ETSI G5, latency between RSUs and OBUs should be measured as well.

3.2.9. Green Priority

3.2.9.1. Test Scenarios

3.2.9.1.1. Change of the traffic signal status in the path of a Designated Vehicle

Test Case ID	GP-01
Test Case Objective	To test GP functionality: Emergency vehicle enters area with traffic lights in the driving direction. Emergency vehicle driver sends the priority request to the TLC or turn-on the siren and waits for the priority response status before passing the intersection. Emergency vehicles have the priority over the rest.
Applicability	Using cellular networks
C-MobILE Requirements	R/S09-GP-01, R/S09-GP-02, R/S09-GP-03, R/S09-GP-04, R/S09-GP-05, R/S09-GP-07, R/S09-GP-08, R/S09-GP-09, R/S09-GP-11, R/S09-GP-12, R/S09-GP-14, R/S09-GP-15, R/S09-GP-16
Pre-test conditions	The Vehicle ITS-S is installed and activated on the designated driver´s smart phone or on-board unit and running in the background. For emergency vehicles: the siren of the emergency vehicles is turned on.

Step	Description	Logging component	Logged data
1a	Emergency vehicle ITS-S sends the priority request, using CAM messages, to the SPBO.	PID	Generated CAM with timestamp
1b	RSU transfers the current state information (e.g. state: green, time-to-change: 9s) to the SPBO.	SPBO	Received MAPEM/SPATEM/CAM and Generated MAPEM/SPATEM with timestamp
2	SPBO transfers the priority request and the current state information to the Traffic Management System (TMS).	SPBO	Received MAPEM/SPATEM and Generated MAPEM/SPATEM with timestamp
3	TMS authenticates and authorises the Vehicle ITS, processes the priority request and transfers the information to the Roadside System (RS).	RSU	Received MAPEM/SPATEM with timestamp
4	RS decides on designated emergency vehicle data and conditions set by de TMS if GP is granted or not and transfer the information to the RSU.	RSU	Received MAPEM/SPATEM with timestamp
5	RSU sends the signal phase and timing to the CPBO.	CPBO	Received MAPEM/SPATEM with timestamp
6	CPBO receives SPAT message, checks for active prioritizations and informs the designated vehicle PID	PID	Received MAPEM/SPATEM together with MQTT message/topics with timestamp
7	CPBO realizes green priority and extension in the direction the designated emergency vehicle is driving.	CPBO	MAPEM/SPATEM, speed advice and timestamp when warning is given)
8	After passing intersection, Vehicle ITS-S stops the priority request and RS stops the green priority.	RSU	Received MAPEM/SPATEM and Generated MAPEM/SPATEM with timestamp

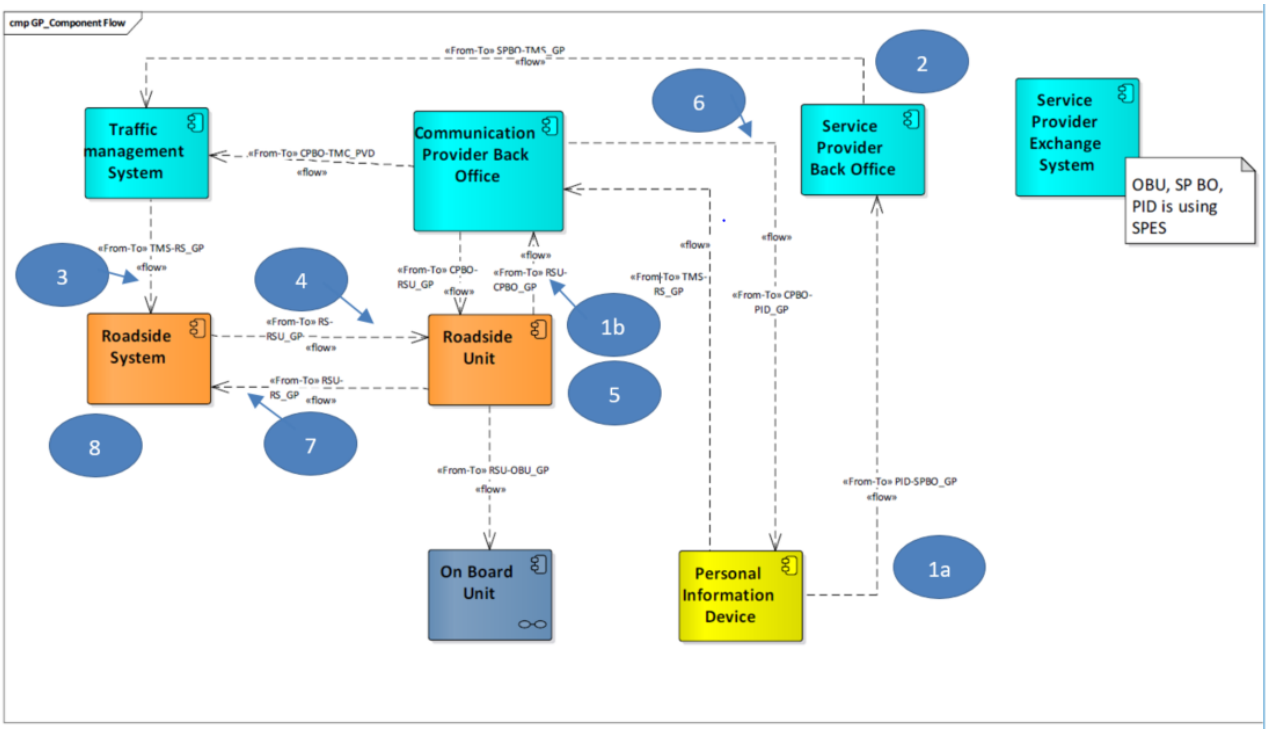


Figure 4. Logging steps in GP-01 test scenario

Acceptance criteria
Test scenario GP-01 is considered as passed if: / Latency (time elapsed between the message transmission by the service provider and the message reception by the vehicle or personal information device) is lower than X ms. / An advice is displayed to the user with the distance to the traffic light location.

Test Case ID	GP-02
Test Case Objective	To test GP functionality: Non-Emergency vehicle enters area with traffic lights in the driving direction. Emergency vehicle driver sends the priority request to the TLC or turn-on the siren and waits for the displaying priority responde status before passing the intersection. Non-Emergency vehicles have a lower priority level than emergency vehicles.
Applicability	Using cellular networks
C-MobILE Requirements	R/S09-GP-01, R/S09-GP-02, R/S09-GP-03, R/S09-GP-04, R/S09-GP-05, R/S09-GP-06, R/S09-GP-07, R/S09-GP-08, R/S09-GP-10, R/S09-GP-11, R/S09-GP-12, R/S09-GP-13, R/S09-GP-14, R/S09-GP-15, R/S09-GP-16, R/S09-GP-17
Pre-test conditions	The Vehicle ITS-S is installed and activated on the designated driver´s smart phone or on-board unit and running in the background. For emergency vehicles: the siren of the emergency vehicles is turned on.

Step	Description	Logging component	Logged data
1a	Non-Emergency vehicle ITS-S sends the priority request, using SREM messages, to the SPBO.	PID	Generated MAPEM/SPATEM/SREM with timestamp
1b	RSU transfers the current state information (e.g state: green, time-to-change: 9s) to the SPBO.	SPBO	Received MAPEM/SPATEM/SREM and Generated MAPEM/SPATEM with timestamp
2	SPBO transfers the priority request and the current state information to the Traffic Management System (TMS).	SPBO	Received MAPEM/SPATEM and Generated MAPEM/SPATEM with timestamp
3	TMS authenticates and authorises the Vehicle ITS, processes the priority request and transfers the information to the Roadside System (RS).	RSU	Received MAPEM/SPATEM with timestamp
4	RS decides on designated non-emergency vehicle data and conditions set by de TMS if GP is not granted and transfer the information to the RSU.	RSU	Received MAPEM/SPATEM with timestamp
5	RSU sends the signal phase and timing to the CPBO, which receives SPAT message and checks for active prioritizations.	CPBO	Received MAPEM/SPATEM with timestamp
6	CPBO informs the designated vehicle driver by displaying priority response status in the PID.	PID	Received MAPEM/SPATEM together with MQTT message/topics with timestamp
7	CPBO realizes green priority and extension on the direction the prioritized designates non-emergency vehicle is approaching.	CPBO	HMI log file (MAPEM/SPATEM, speed advice and timestamp when warning is given)
8	After passing intersection, Vehicle ITS-S stops the priority request and RS stops the green priority.	RSU	Received MAPEM/SPATEM and Generated MAPEM/SPATEM with timestamp

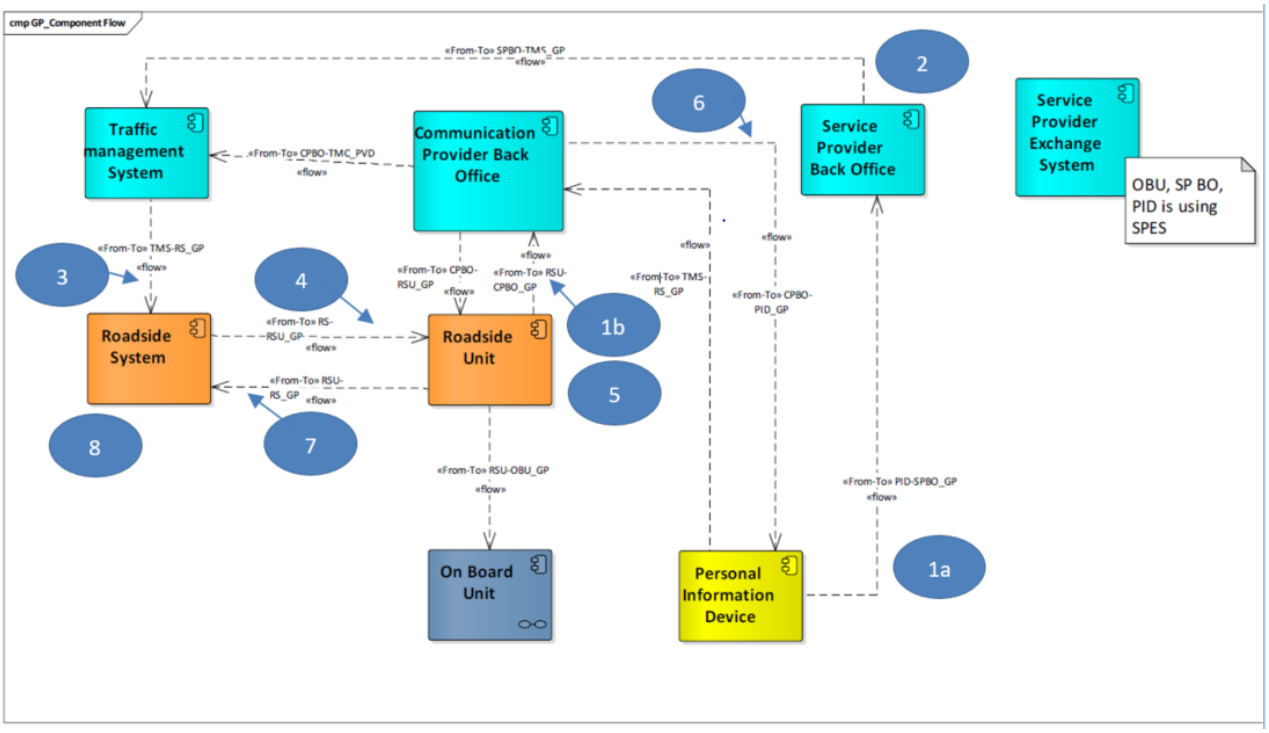


Figure 5. Logging steps in GP-02 test scenario

Acceptance criteria

Test scenario GP-02 is considered as passed if:

- Latency (time elapsed between the message transmission by the service provider and the message reception by the vehicle or personal information device) is lower than X ms.
- Latency between RSU and vehicle is lower than 100 ms. (Similar from (R/S04-RWW-06)).
- An advice is displayed to the user with the distance to the traffic light location and the result to the request priority,
- When the advice is given to the user, the user is within the relevant area.

3.2.9.2. Traceability Matrix

The traceability matrix is used to assist in determining the completeness of the requirements being met against the test scenarios.

The identifier for each of the requirements is placed in the first column while the identifiers for test scenarios are placed across the top row. When an item in the left column is related to an item across the top, a mark is placed in the intersecting cell. The number of relationships is added up for each row and each column. This value indicates the mapping of the two items. An empty value indicates that no relationship exists.

	Test scenarios	GP-01	GP-02
Requirements Tested		13	16
R/S09-GP-01	2	X	X
R/S09-GP-02	2	X	X
R/S09-GP-03	2	X	X
R/S09-GP-04	2	X	X
R/S09-GP-05	2	X	X
R/S09-GP-06	1		X
R/S09-GP-07	2	X	X

R/S09-GP-08	2	X	X
R/S09-GP-09	1	X	
R/S09-GP-10	1		X
R/S09-GP-11	2	X	X
R/S09-GP-12	2	X	X
R/S09-GP-13	1		X
R/S09-GP-14	2	X	X
R/S09-GP-15	2	X	X
R/S09-GP-16	2	X	X
R/S09-GP-17	1		X

3.2.9.3. Communication performance – Latency

Total latency can be calculated from the moment that the Traffic Light Controller (TLC) generates a MAPEM/SPATEM message and the moment the MAPEM/SPATEM message is received by the vehicle or personal information device.

In the case of ETSI G5, latency between RSUs and OBUs should be measured as well.

3.2.10. In-Vehicle Signage

3.2.10.1. Test Scenarios

3.2.10.1.1. Test scenarios over cellular

Test Case ID	IVS-01
Test Case Objective	To test IVS functionality: Vehicle enters and passes area with static or dynamic traffic signs within the driving direction. While approaching a traffic sign, vehicle drivers receive advisory or mantatory signs related with speed limits, overtaking prohibition, actual travel times and other traffic information.
Applicability	Using cellular networks.
C-MobILE Requirements	R/S04-IVS-01, R/S04-IVS-02, R/S04-IVS-03, R/S04-IVS-06, R/S04-IVS-07, R/S04-IVS-08, R/S04-IVS-9, R/S04-IVS-10, R/S04-IVS-11, R/S04-IVS-13, R/S04-IVS-14, R/S04-IVS-16, R/S04-IVS-17, R/S04-IVS-18
Pre-test conditions	The mobile application is installed and activated on the driver's smart phone and running in the background. The road signs are informed by the corresponding Road Operator.

Step	Description	Logging component	Logged data
1	Road operator (TMS) signals the existence of a traffic sign location and the information is disseminated by the Data Provider Back Office to the SPBO.	SPBO	IVS information is received by the SPBO with timestamp.
2	SPBO signals the existence of a traffic sign location to the CPBO.	SPBO	Generated IVIM with timestamp, using GeoMessaging.
3	Driver enters the range area defined by the IVS and receives IVIM messages.	PID	Received IVIM with timestamp.
4	Mobile application shows warnings in HMI since driver's position and direction matches the IVIM information. This message includes: the speed limit, overtaking prohibition (if existing) (R/S04-RWW-07).	PID	HMI log file (IVIM, speed limit, overtaking prohibition and timestamp when warning is given).

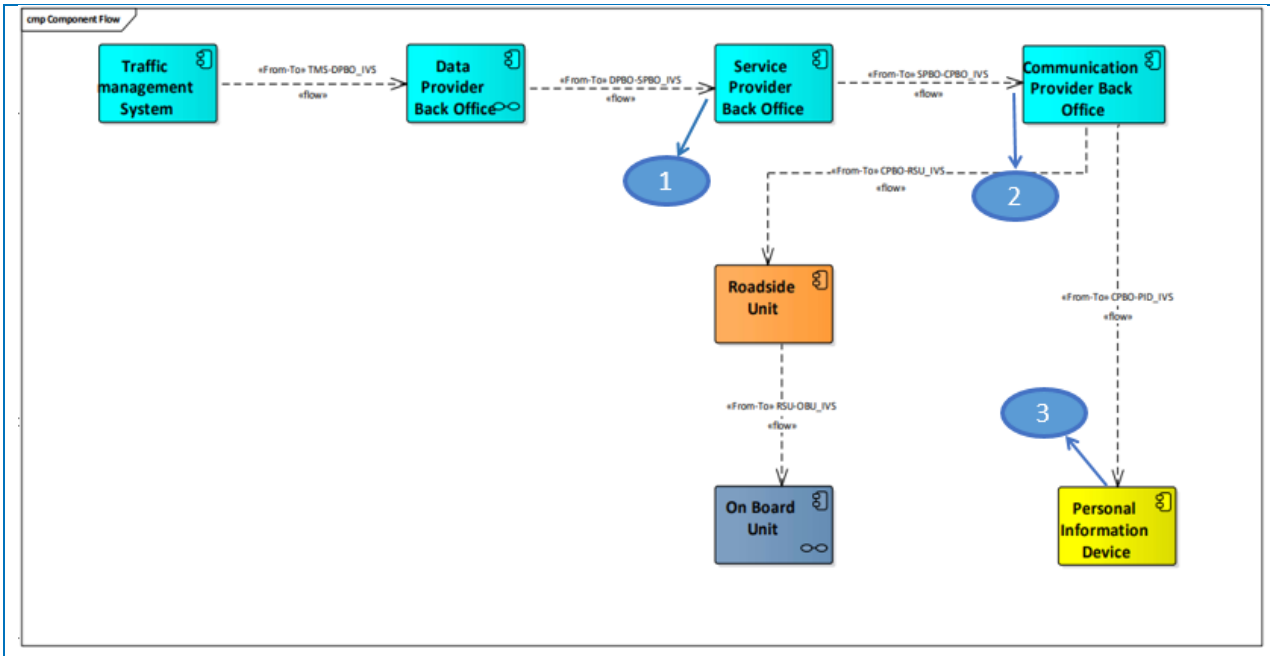


Figure 25: Logging steps in IVS-01 test scenario

Acceptance criteria

Test scenario IVS-01 is considered as passed if:

- Latency (time elapsed between the message transmission by the service provider and the message reception by the vehicle or personal information device) is lower than X ms.
- A warning is displayed to the user with the distance to the traffic sign location.
- A warning is displayed to the user with the advice or the mandate of the sign.
- When the warning is given to the user, the user is within the relevance area of the IVIM message.

Test Case ID	IVS-02
Test Case Objective	To test IVS functionality: Vehicle enters and passes area with a traffic sign that is not relevant, since it is located in the opposite driving direction. Verify that vehicle drivers do not receive road sign information on the in-vehicle display or smartphone since they are not affected.
Applicability	Using cellular networks.
C-MobILE Requirements	R/S04-IVS-01, R/S04-IVS-02, R/S04-IVS-03, R/S04-IVS-06, R/S04-IVS-07, R/S04-IVS-08, R/S04-IVS-9, R/S04-IVS-10, R/S04-IVS-11, R/S04-IVS-13, R/S04-IVS-14, R/S04-IVS-16, R/S04-IVS-17, R/S04-IVS-18
Pre-test conditions	The mobile application is installed and activated on the driver's vehicle or smart phone and running in the background. The road signs are informed by the corresponding Road Operator.

Step	Description	Logging component	Logged data
1	Road operator (TMS) signals the existence of a traffic sign and the information is disseminated by the Data Provider Back Office to the SPBO.	SPBO	IVS information is received by the SPBO with timestamp.
2	SPBO signals the existence of a traffic sign to the CPBO.	SPBO	Generated IVIM with timestamp, using GeoMessaging.
3	Driver enters the range area defined by the IVS and receives IVIM messages.	PID	Received IVIM with reception timestamp.

4	Mobile application does not show warnings in HMI since driver's position and direction do not match the IVIM information.	PID	HMI log file (no warning is given).

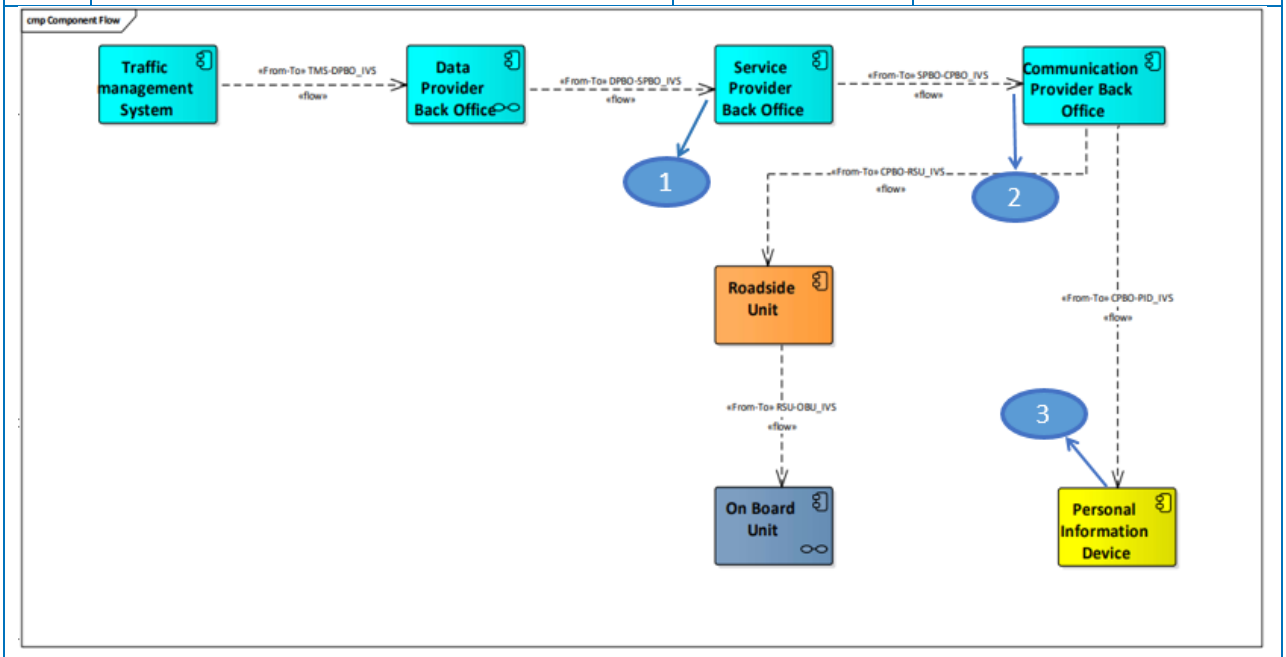


Figure 26: Logging steps in IVS-02 test scenario

Acceptance criteria
Test scenario IVS-02 is considered as passed if: / Latency (time elapsed between the message transmission by the service provider and the message reception by the vehicle or personal information device) is lower than X ms. / A warning is not displayed to the user.

3.2.10.1.2. Test scenario over ITS-G5

Test Case ID	IVS-03
Test Case Objective	To test IVS functionality: Vehicle enters and passes area with static or dynamic traffic signs within the driving direction. While approaching a road sign, vehicle drivers receive advisory or mantatory signs related with speed limits, overtaking prohibition, actual travel times and other traffic information.
Applicability	Using ETSI ITS-G5 IVIM messages.
C-MobILE Requirements	R/S04-IVS-01, R/S04-IVS-02, R/S04-IVS-03, R/S04-IVS-04, R/S04-IVS-05, R/S04-IVS-06, R/S04-IVS-07, R/S04-IVS-08, R/S04-IVS-09, R/S04-IVS-10, R/S04-IVS-11, R/S04-IVS-12, R/S04-IVS-13, R/S04-IVS-15, R/S04-IVS-16, R/S04-IVS-17, R/S04-IVS-18, R/S04-IVS-19
Pre-test conditions	The in-vehicle application is installed and activated on the driver's vehicle and running in the background. The road signs are informed by the corresponding Road Operator. A RSU is installed at the road signs location.

Step	Description	Logging component	Logged data
1	Road operator (TMS) signals the existence of a traffic sign and the information is disseminated by the Data Provider Back Office to the SPBO.	SPBO	IVS information is received by the SPBO with timestamp.
2	SPBO signals the existence of a traffic sign to the CPBO.	SPBO	Generated IVIM with timestamp, using GeoMessaging.

3	RSU receives IVS data and generates IVIM messages.	RSU	Roadside log file (IVIM with reception timestamp).
4	Vehicle enters the range area defined by the IVS and receives IVIM messages.	OBU	Vehicle log file (IVIM with reception timestamp).
5	Vehicle shows warning in HMI since his position and direction matches the IVIM information. This message includes: the speed limit, overtaking prohibition (if existing) (R/S04-RWW-07).	OBU	HMI log file (IVIM and remaining distance to road sign location).

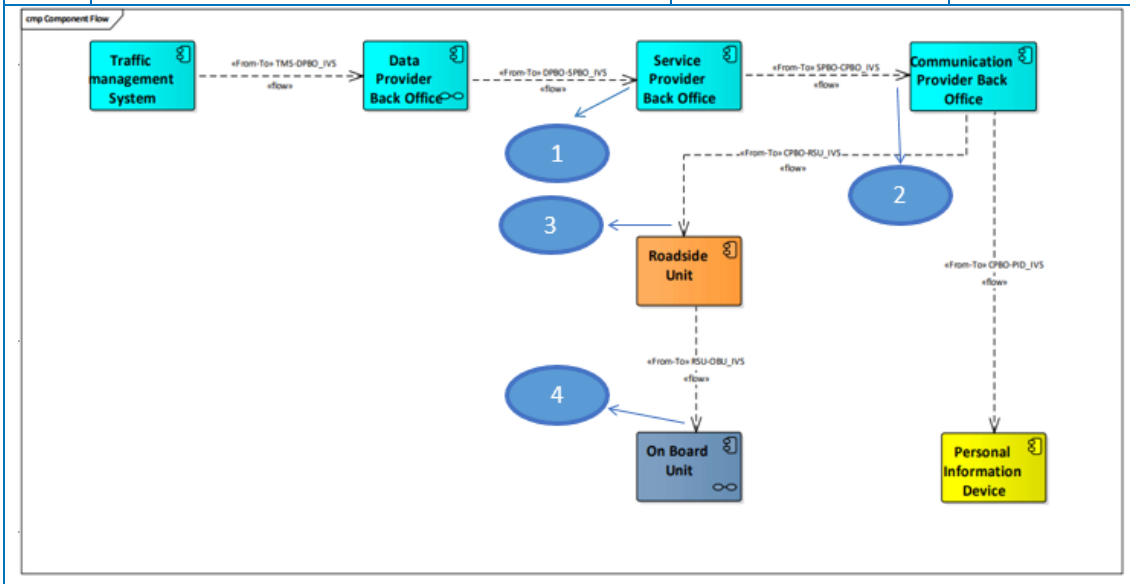


Figure 27: Logging steps in IVS-03 test scenario

Acceptance criteria
Test scenario IVS-03 is considered as passed if: / Total latency between SPBO and vehicle is lower than X ms. / Latency between RSU and vehicle is lower than 100 ms (R/S04-RWW-06). / A warning is displayed to the user with the distance to the road sign location. / A warning is displayed to the user with the advice or mandate of the sign. / When the warning is given to the user, the user is within the relevance area of the IVIM message.

Test Case ID	IVS-04
Test Case Objective	To test IVS functionality: Vehicle enters and passes area with a traffic sign that is not relevant since it is located in the opposite driving direction. Verify that the user is not notified on his/ her HMI.
Applicability	Using ETSI ITS-G5 IVIM messages.
C-MobILE Requirements	R/S04-IVS-01, R/S04-IVS-02, R/S04-IVS-03, R/S04-IVS-04, R/S04-IVS-05, R/S04-IVS-06, R/S04-IVS-07, R/S04-IVS-08, R/S04-IVS-09, R/S04-IVS-10, R/S04-IVS-11, R/S04-IVS-12, R/S04-IVS-13, R/S04-IVS-15, R/S04-IVS-16, R/S04-IVS-17, R/S04-IVS-18, R/S04-IVS-19.
Pre-test conditions	The in-vehicle application is installed and activated on the driver's vehicle and running in the background. The road signs are informed by the corresponding Road Operator. A RSU is installed at the road signs location.

Step	Description	Logging component	Logged data

1	Road operator (TMS) signals the existence of a traffic sign and the information is disseminated by the Data Provider Back Office to the SPBO.	SPBO	IVS information is received by the SPBO with timestamp.
2	SPBO signals the existence of a traffic sign to the CPBO.	SPBO	Generated IVIM with timestamp, using GeoMessaging.
3	RSU receives IVS data and generates IVIM messages.	RSU	Roadside log file (IVIM with reception timestamp).
4	Vehicle enters the range area defined by the IVS and receives IVIM messages.	OBU	Vehicle log file (IVIM with reception timestamp).
5	Vehicle does not show a warning in HMI since its position and direction do not match the IVIM information.	OBU	HMI log file (IVIM, speed limit, overtaking prohibition and timestamp when warning is given).

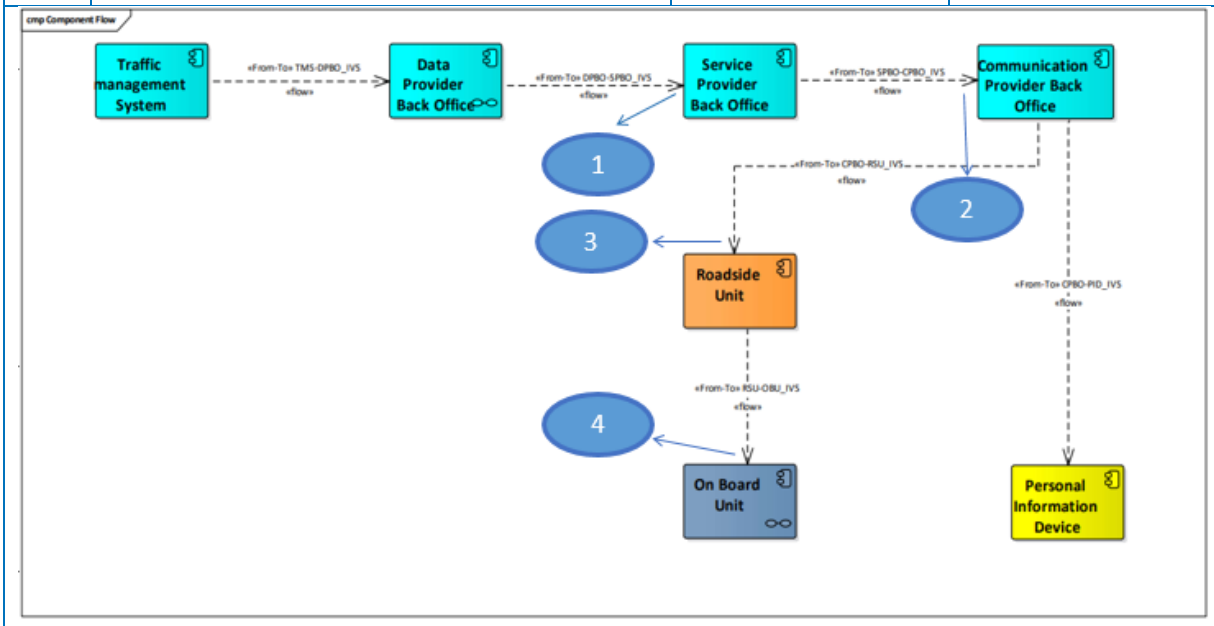


Figure 28: Logging steps in IVS-04 test scenario

Acceptance criteria

Test scenario IVS-04 is considered as passed if:

- Total latency between SPBO and vehicle is lower than X ms.
- Latency between RSU and vehicle is lower than 100 ms (R/S04-RWW-06).
- A warning is not displayed to the user.

3.2.10.2. Traceability Matrix

The traceability matrix is used to assist in determining the completeness of the requirements being met against the test scenarios.

The identifier for each of the requirements is placed in the first column while the identifiers for test scenarios are placed across the top row. When an item in the left column is related to an item across the top, a mark is placed in the intersecting cell. The number of relationships is added up for each row and each column. This value indicates the mapping of the two items. An empty value indicates that no relationship exists.

	Test scenarios	IVS-01	IVS-02	IVS-03	IVS-04
Requirements Tested		14	14	18	18
R/S13-IVS-01	4	X	X	X	X
R/S13-IVS-02	4	X	X	X	X
R/S13-IVS-03	4	X	X	X	X
R/S13-IVS-04	2			X	X
R/S13-IVS-05	2			X	X
R/S13-IVS-06	4	X	X	X	X
R/S13-IVS-07	4	X	X	X	X
R/S13-IVS-08	4	X	X	X	X
R/S13-IVS-09	4	X	X	X	X
R/S13-IVS-10	4	X	X	X	X
R/S13-IVS-11	4	X	X	X	X
R/S13-IVS-12	2			X	X
R/S13-IVS-13	4	X	X	X	X
R/S13-IVS-14	2	X	X		
R/S13-IVS-15	2			X	X
R/S13-IVS-16	4	X	X	X	X
R/S13-IVS-17	4	X	X	X	X
R/S13-IVS-18	4	X	X	X	X
R/S13-IVS-19	2			X	X

3.2.10.3. Communication performance – Latency

Total latency can be calculated from the moment that the service provider generates a DENM message and the moment the DENM message is received by the vehicle or personal information device.

In the case of ETSI G5, latency between RSUs and OBUs should be measured as well.

3.2.11. Motorcycle Approaching Indication (MAI)

3.2.11.1. Test Scenarios

3.2.11.1.1. V2V two-wheeler warning approaching

Test Case ID	MAI-01
Test Case Objective	To test MAI functionality: Two-wheeler motorcycle is approaching another vehicle with a high relative speed. A crossing with the two-wheeler is detected or the relative distance between the two vehicles decreases below a given safety margin. Therefore, a warning is issued.
Applicability	Using ETSI ITS-G5
C-MobILE Requirements	R/S19-MAI-02, R/S19-MAI-03, R/S19-MAI-04, R/S19-MAI-05, R/S19-MAI-06, R/S19-MAI-07, R/S19-MAI-08, R/S19-MAI-09, R/S19-MAI-10, R/S19-MAI-11, R/S19-MAI-12, R/S19-MAI-13, R/S19-MAI-14, R/S19-MAI-15, R/S19-MAI-16.
Pre-test conditions	The Vehicle ITS-S is installed and activated on the designated vehicle driver´s smart phone/helmet or on-board unit and running in the background.

	The two-wheeler vehicle is registered in the Service Provider Exchange System and is able to send CAM messages to the Service Provider Back Office.

Step	Description	Logging component	Logged data
1	OBU is periodically sending CAMs to near vehicles in case of approaching.	OBU	CAM message together with the timestamp
2	PID sends periodically CAMs to the SPBO once two-wheeler enters a specific area and produces approaching among vehicles.	SPBO	CAM message together with the timestamp
3	In case that SPBO detects colliding trajectories, it generates a DENM and sends it to the CPBO.	CPBO	Received CAM and generated DENM
4	CPBO sends the DENM previously generated to the related PIDs through the GeoMessaging.	OBU	Received DENM
5	The PID displays a warning.	PID	Generated HMI log file.

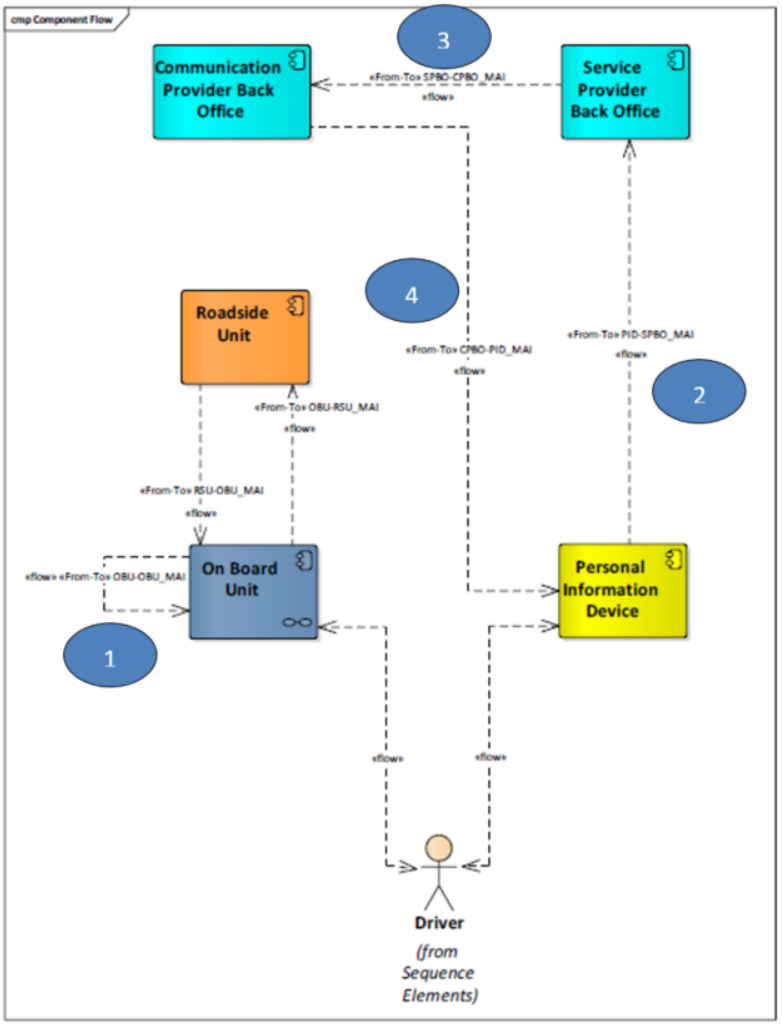


Figure 6. Logging steps in MAI-01 test scenario

Acceptance criteria

Test scenario MAI-01 is considered as passed if:

- Latency (time elapsed between the message transmission by the service provider and the message reception by the vehicle or personal information device) is lower than 100 ms.
- A warning is indicated to the user(s) in scope of Motorcycle approaching.

Test Case ID	MAI-02
Test Case Objective	To test MAI functionality: Two-wheeler motorcycle is approaching another vehicle with a non-high relative speed. The relative distance between the two vehicles does not decrease below a given safety margin. Therefore, the service provides only visual and non-acoustic notification in the case of presence but not danger.
Applicability	Using ETSI ITS-G5
C-MobILE Requirements	R/S19-MAI-02, R/S19-MAI-03, R/S19-MAI-04, R/S19-MAI-05, R/S19-MAI-06, R/S19-MAI-07, R/S19-MAI-08, R/S19-MAI-09, R/S19-MAI-10, R/S19-MAI-11, R/S19-MAI-12, R/S19-MAI-13, R/S19-MAI-14, R/S19-MAI-17.
Pre-test conditions	The Vehicle ITS-S is installed and activated on the designated vehicle driver´s smart phone/helmet or on-board unit and running in the background. The two-wheeler vehicle is registered in the Service Provider Exchange System and is able to send CAM messages to the Service Provider Back Office.

Step	Description	Logging component	Logged data
1	OBU is periodically sending CAMs to near vehicles in case of approaching.	OBU	CAM message together with the timestamp
2	PID sends periodically CAMs to the SPBO once two-wheeler enters a specific area and produces approaching among vehicles.	SPBO	CAM message together with the timestamp
3	In case that SPBO detects approaching but not dangerous situation, it also sends information to CPBO and generates a DENM.	CPBO	Received CAM and generates DENM
4	CPBO sends the DENM generated before as Geo Message to the related PIDs	OBU	Received DENM.
5	The PID shows a warning with a visual and non-acoustic notification.	PID	Generated HMI log file

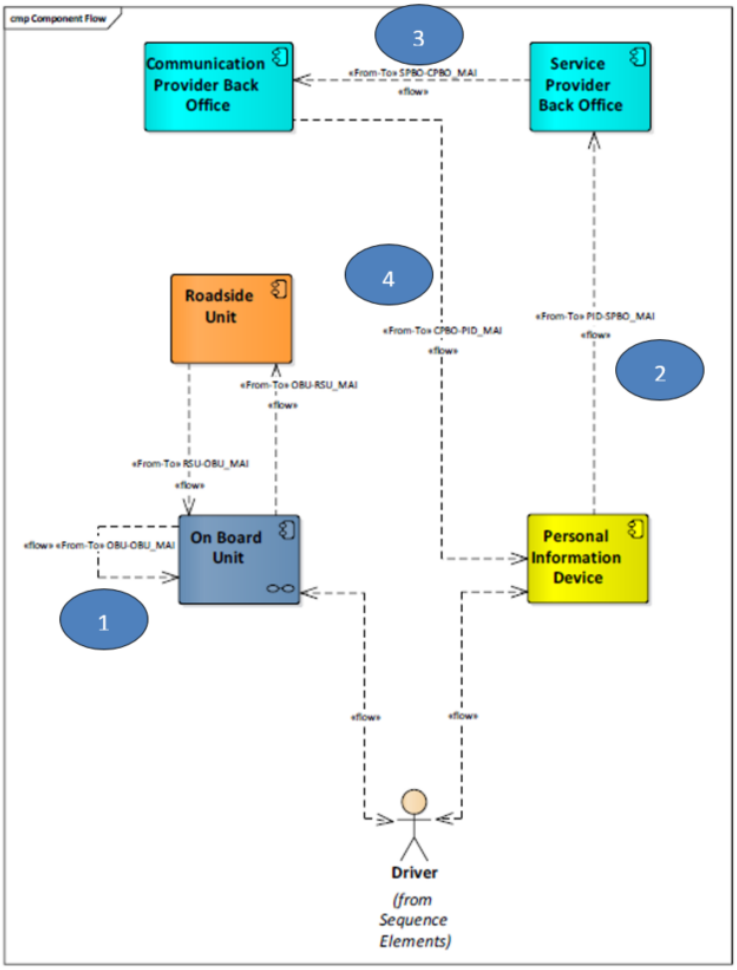


Figure 7. Logging steps in MAI-02 test scenario

Acceptance criteria
Test scenario MAI-02 is considered as passed if: / Latency (time elapsed between the message transmission by the service provider and the message reception by the vehicle or personal information device) is lower than 100 ms. / A warning visual and non-acoustic is indicated to the user in scope of Motorcycle approaching.

3.2.11.1.2. V2I two-wheeler warning approaching

Test Case ID	MAI-03
Test Case Objective	To test MAI functionality: Two-wheeler cyclist defined as VRU is approaching another vehicle and the relative distance between both decreases below a given safety margin sending its personal location to the RSU nearby. If another vehicle is detected by the RSU, a warning is issued and both drivers adapt their driving behaviour.
Applicability	Using ETSI ITS-G5/and Cellular connection
C-MobILE Requirements	R/S19-MAI-01, R/S19-MAI-02, R/S19-MAI-03, R/S19-MAI-04, R/S19-MAI-05, R/S19-MAI-06, R/S19-MAI-07, R/S19-MAI-08, R/S19-MAI-09, R/S19-MAI-10, R/S19-MAI-11, R/S19-MAI-13, R/S19-MAI-14, R/S19-MAI-15, R/S19-MAI-16
Pre-test conditions	The Vehicle ITS-S is installed and activated on the designated vehicle driver´s smart phone/helmet or on-board unit and running in the background.

	The two-wheeler vehicle is registered in the Service Provider Exchange System and is able to send CAM messages to the Service Provider Back Office.

Step	Description	Logging component	Logged data
1a	OBU (Smartphone form a cyclist) is periodically sending CAMs to near vehicles in case of approaching. Also, OBU is sending its location to the RSU.	OBU	CAM message together with the timestamp
1b	PID sends periodically CAMs to the SPBO once two-wheeler enters a specific area and produces approaching among vehicles.	SPBO	CAM message together with the timestamp
2	If a potential collision is detected, the RSU sends DENMs to the OBU for warning near vehicles.	RSU	Received CAM and generates DENM
3	In case that SPBO detects colliding trajectories, it sends information to CPBO and generates a DENM.	CPBO	Received CAM and generates DENM
4	CPBO sends the DENM generated before to the related PIDs for warning the drivers.	OBU	Received DENM and generates HMI log file

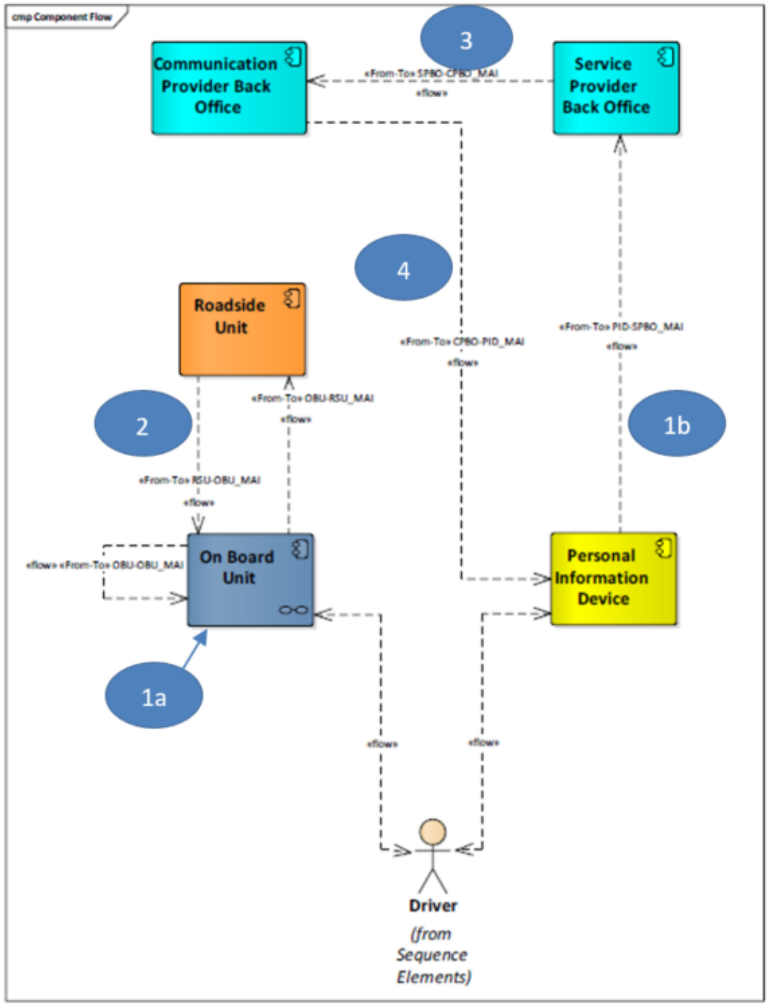


Figure 8. Logging steps in MAI-03 test scenario

Acceptance criteria

Test scenario MAI-03 is considered as passed if:

- Latency (time elapsed between the message transmission by the service provider and the message reception by the vehicle or personal information device) is lower than 100 ms.
- A warning is indicated to the user in scope of Motorcycle approaching.

3.2.11.2. Traceability Matrix

The traceability matrix is used to assist in determining the completeness of the requirements being met against the test scenarios.

The identifier for each of the requirements is placed in the first column while the identifiers for test scenarios are placed across the top row. When an item in the left column is related to an item across the top, a mark is placed in the intersecting cell. The number of relationships is added up for each row and each column. This value indicates the mapping of the two items. An empty value indicates that no relationship exists.

	Test scenarios	MAI-01	MAI-02	MAI-03
Requirements Tested		15	15	15
R/S19-MAI-01	1			X
R/S19-MAI-02	3	X	X	X
R/S19-MAI-03	3	X	X	X
R/S19-MAI-04	3	X	X	X
R/S19-MAI-05	3	X	X	X
R/S19-MAI-06	3	X	X	X
R/S19-MAI-07	3	X	X	X
R/S19-MAI-08	3	X	X	X
R/S19-MAI-09	3	X	X	X
R/S19-MAI-10	3	X	X	X
R/S19-MAI-11	3	X	X	X
R/S19-MAI-12	2	X	X	
R/S19-MAI-13	3	X	X	X
R/S19-MAI-14	3	X	X	X
R/S19-MAI-15	3	X	X	X
R/S19-MAI-16	2	X		X
R/S19-MAI-17	1		X	

3.2.11.3. Communication performance – Latency

Total latency can be calculated from the moment that the service provider generates a CAM and DENM message and the moment the CAM/DENM message is received by the vehicle or personal information device.

In the case of ETSI G5, latency between RSUs and OBUs should be measured as well.

3.2.12. Motorway Parking Availability

3.2.12.1. Test Scenarios

3.2.12.1.1. Information on parking lots location, availability and services via internet

Test Case ID	MPA-01
Test Case Objective	To test motorway parking availability functionality. A truck driver/a dispatcher/a planner is looking for an available truck parking place on its route.
Applicability	Using cellular networks / another internet connection

C-MobILE Requirements	R/S02-MPA-01, R/S02-MPA-02, R/S02-MPA-03, R/S02-MPA-04, R/S02-MPA-05, R/S02-MPA-07, R/S02-MPA-09, R/S02-MPA-13
Pre-test conditions	The in-vehicle or mobile application is installed and activated on the driver's vehicle or smartphone / access to internet website via a browser.

Step	Description	Logging component	Logged data
1	Driver/dispatcher/planner requests a parking place information near the planned route to the service provider back office. Alternatively, in case the request is made via app, the application localises the vehicle	PID	MPA request by user
2	The service provider requests information about parking places availabilities from the traffic management system (who has an overview on the roadside unit/system)	SPBO	MPA message with reception timestamp
3	The traffic management system sends the requested information to the service provider back office	SPBO	MPA message with reception timestamp
4	The service provider calculates and provides information on parking places referenced in the vicinity Information include: location, driving time, availability (free/full + optionally the number of available places), booking possibility, vehicle type permitted, services provided.	SPBO	MPA info for the user

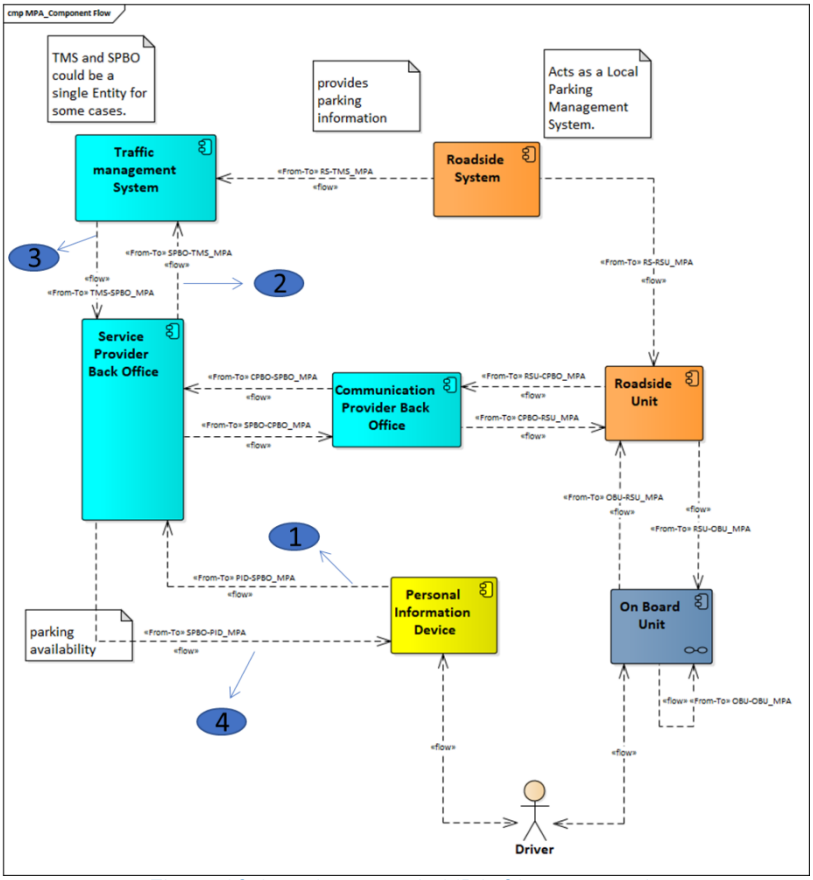


Figure 29. Logging steps in MPA-01 test scenario

Acceptance criteria
The scenario MPA-01 is considered passed if:

/ The user receives the requested information

3.2.12.1.2. Information on parking lots location, availability and services via V2I

Test Case ID	MPA-02
Test Case Objective	To test motorway parking availability functionality. A truck driver/a dispatcher/a planner is looking for an available truck parking place on its route.
Applicability	Using cellular Wi-Fi networks.
C-MobILE Requirements	R/S02-MPA-01, R/S02-MPA-02, R/S02-MPA-03, R/S02-MPA-04, R/S02-MPA-05, R/S02-MPA-07, R/S02-MPA-09, R/S02-MPA-13
Pre-test conditions	The in-vehicle or mobile application is installed and activated on the driver's vehicle OBU. The OBU has cellular/Wi-Fi connection capabilities.

Step	Description	Logging component	Logged data
1	Driver/dispatcher/planner/vehicle requests a parking place information near the planned route to the service provider back office. Optionally, in case the request is made via app, the application localises the vehicle	OBU	MPA request by user
2	The service provider requests information about parking places availabilities from the traffic management system (who has an overview on the roadside unit/system)	SPBO	MPA message with reception timestamp
3	The traffic management system sends the requested information to the service provider back office	SPBO	MPA message with reception timestamp
4	The service provider calculates and provides information on parking places referenced in the vicinity Information include: location, driving time, availability (free/full + optionally the number of available places), booking possibility, vehicle type permitted, services provided.	SPBO	MPA info for the user

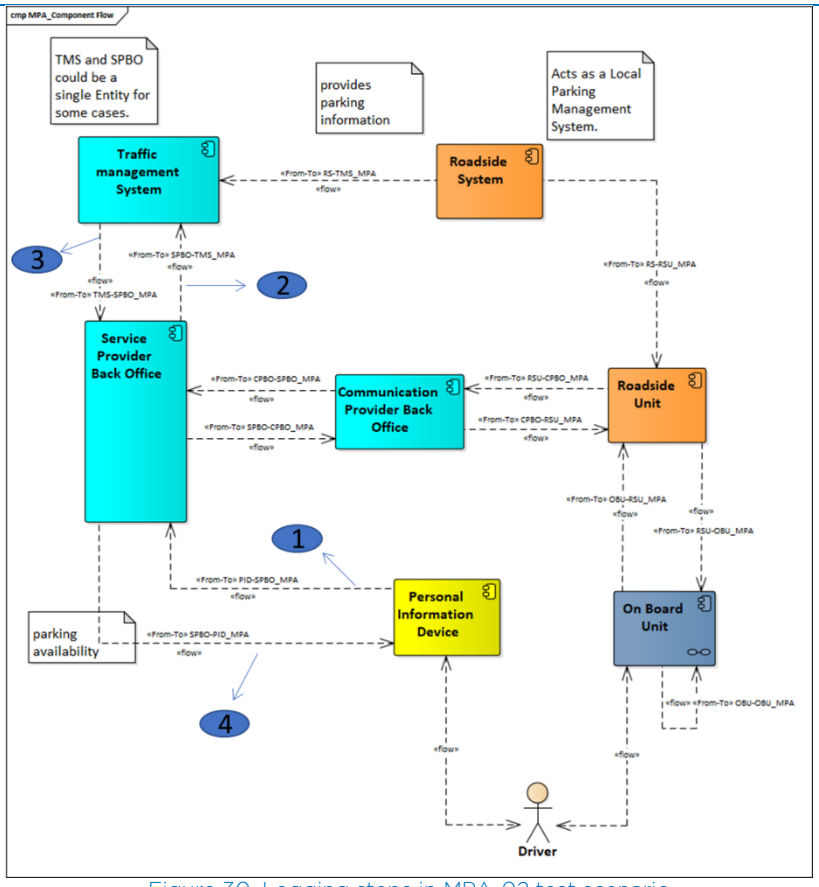


Figure 30. Logging steps in MPA-02 test scenario

Acceptance criteria
The scenario MPA-02 is considered passed if: / The user receives the requested information

3.2.12.1.3. Information about a truck parking space released by a user

Test Case ID	MPA-03
Test Case Objective	To test the functionality of motorway parking availability: A truck parking place is released to truck drivers looking for a space in a given area
Applicability	Using cellular networks
C-MobILE Requirements	R/S02-MPA-01; R/S02-MPA-03; R/S02-MPA-04; R/S02-MPA-05; R/S02-MPA-06 ; R/S02-MPA-13
Pre-test conditions	The in-vehicle or mobile application is installed and activated on the driver's OBU or smartphone or internet portal.

Step	Description	Logging component	Logged data
1	Truck 1 sends a message to the service provider back office: it leaves its parking place Alternative A road side unit (sensor) detects that the parking place is free and send a message to the traffic management system which in turn informs the service provider back office that a parking place has been released	PID RSU SPBO	Vehicle log file (DENM with reception timestamp) Vehicle log file MPA info with timestamp

2	Service provider back office releases the information: the parking place is free, its location, driving time and available services and type of vehicle permitted.	SPBO	MPA info with timestamp

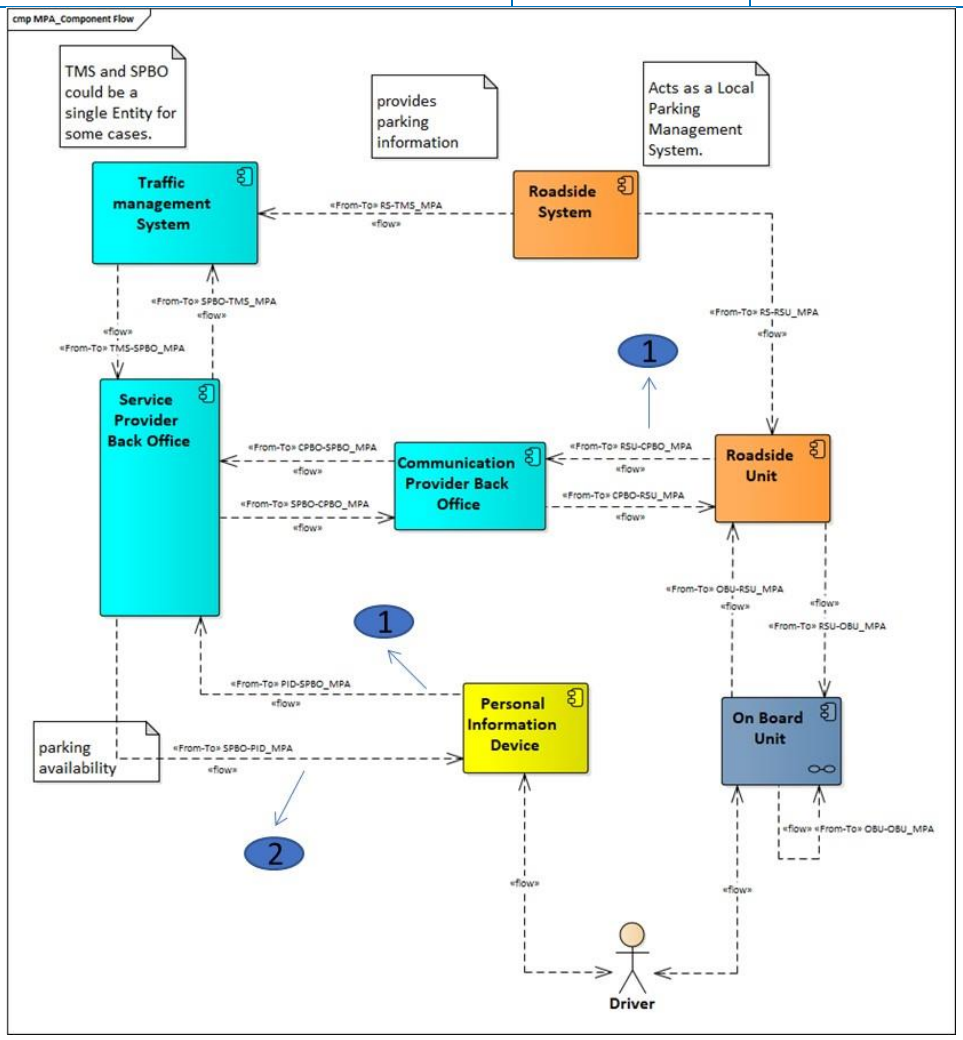


Figure 31. Logging steps in MPA-03 test scenario

Acceptance criteria

The scenario MPA-03 is considered passed if:

- The user can see that the parking place released is available
- The user can see all available information correctly

3.2.12.1.4. Reservation of a truck parking space released by a user

Test Case ID	MPA-04
Test Case Objective	To test motorway parking availability. A truck parking place is booked by a user
Applicability	cellular networks
C-MobILE Requirements	R/S02-MPA-01; R/S02-MPA-02; R/S02-MPA-03; R/S02-MPA-04; R/S02-MPA-05; R/S02-MPA-06, R/S02-MPA-07; R/S02-MPA-08; R/S02-MPA-09; R/S02-MPA-13

Pre-test conditions	The in-vehicle or mobile application is installed and activated on the driver's OBU or smartphone.		
Step	**Description**	**Logging component**	**Logged data**
1	Truck 1 sends a message to the service provider back office: it leaves its parking place (V2I or internet) Alternative A road side unit (sensor) detects that the parking place is free and send a message to the traffic management system which in turn informs the service provider back office that a parking place has been released	PID RSU SPBO	Vehicle log file (DENM with reception timestamp) Vehicle log file MPA info with timestamp
2	Truck 2 sends a message to the service provider back office: looking for a parking place in the vicinity	PID	Vehicle log file (?) (with geolocalisation?) with timestamp
3	Service provider back office releases the information: the parking place is free and can be booked, its location, driving time and available services and type of vehicle permitted.	SPBO	MPA info with timestamp
4	Truck 2 books the parking place by generating a message to the service provider back office.	PID	MPA booking file with timestamp
5	The provider back office informs the traffic management system that the place is booked (with booking information)	SPBO	MPA booking file with timestamp
6	The traffic management system confirms the booking to the service provider back office	SPBO	MPA booking confirmation file with timestamp
7	Truck 2 drives to the parking place according to the routing indicated by the app	PID	
8	Truck 2 parks and indicates that he is on the parking place (internet or V2I) Alternative A roadside unit (sensor) detects that a truck is parked and send a message to the traffic management system which in turn informs the service provider back office that a parking place has been released	Personal PID RSU SPBO	Vehicle log file (DENM with reception timestamp) Vehicle log file MPA info with timestamp

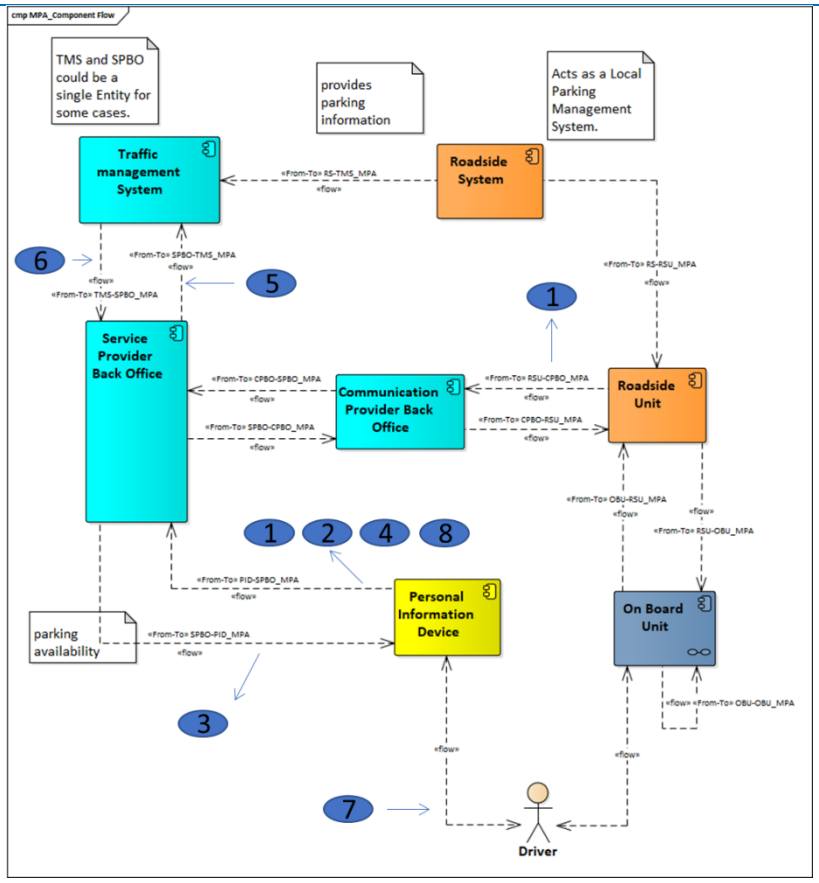


Figure 32. Logging steps in MPA-04 test scenario

Acceptance criteria
The scenario MPA-04 is considered passed if: / Truck 2 can book the parking place / Truck 2 can see all available information correctly

Test Case ID	MPA-05
Test Case Objective	To test motorway parking availability. A truck parking place is booked by a user and, in the meantime, another truck arrives at the parking place and tries to park on the already booked parking place.
Applicability	Using cellular networks
C-MobILE Requirements	R/S02-MPA-01; R/S02-MPA-02; R/S02-MPA-03; R/S02-MPA-04; R/S02-MPA-05; R/S02-MPA-06, R/S02-MPA-07; R/S02-MPA-08; R/S02-MPA-09; R/S02-MPA-13
Pre-test conditions	The in-vehicle or mobile application is installed and activated on the driver's OBU or smartphone.

Step	Description	Logging component	Logged data
1	Truck 1 send a message to the service provider back office: it leaves its parking place Alternative A road side unit detects that the parking place is free and send a message to the traffic management system which in turn informs the service provider back office that a parking place has been released	PID RSU SPBO	Vehicle log file (DENM with reception timestamp) Vehicle log file MPA info with timestamp

2	Truck 2 sends a message to the service provider back office: looking for a parking place in the vicinity		Vehicle log file (?) (with geolocalisation?) with timestamp
3	Service provider back office releases the information: the parking place is free and can be booked, its location, driving time and available services and type of vehicle permitted.	SPBO	MPA info with timestamp
4	Truck 2 books the parking place by generating a message to the service provider back office.	PID	MPA booking file with timestamp
5	The service provider back office informs the traffic management system that the place is booked (with booking information)	SPBO	MPA booking file with timestamp
6	The traffic management system confirms the booking to the provider back office	SPBO	MPA booking confirmation file with timestamp
7	Truck 3 arrives at the parking place. Parking is refused by the traffic management system.	SPBO	

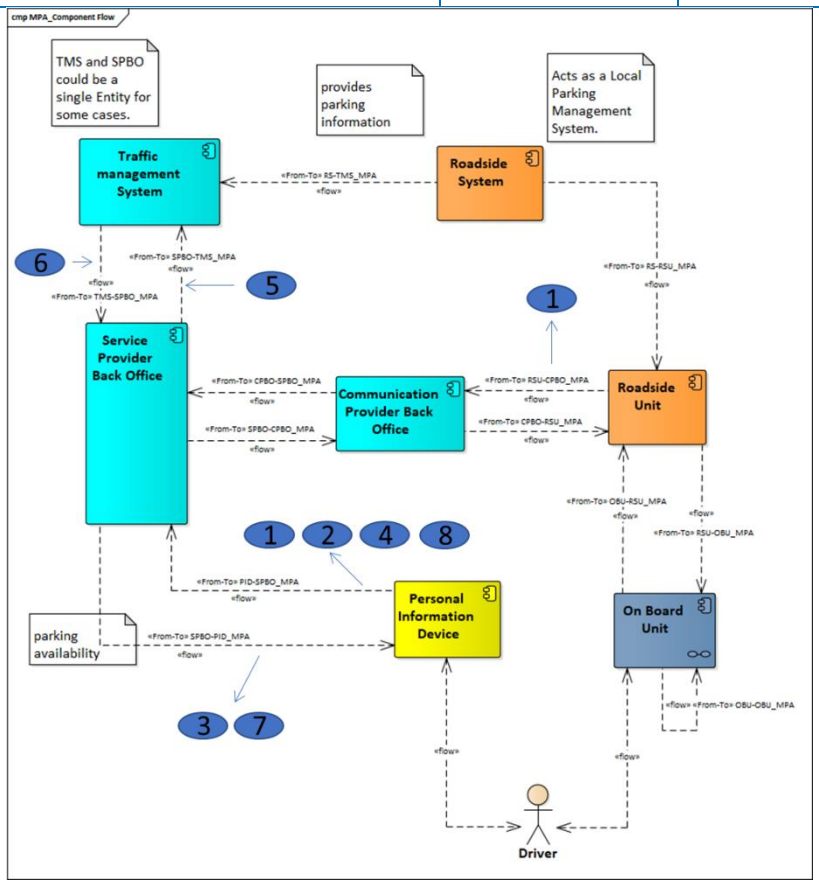


Figure 33. Logging steps in MPA-05 test scenario

Acceptance criteria

The scenario MPA-05 is considered passed if:

- Truck 2 can book the parking place
- Truck 2 can see all available information correctly
- Truck 3 booking request is refused

3.2.12.1.5. Guide the truck in the port (terminal or truck parking)

Test Case ID	MPA-06
Test Case Objective	To test motorway parking availability. The service is guiding the truck in the port
Applicability	Using cellular networks
C-MobILE Requirements	R/S02-MPA-08; R/S02-MPA-09
Pre-test conditions	The in-vehicle or mobile application is installed and activated on the driver's vehicle or smartphone.

Step	Description	Logging component	Logged data
1	Truck enters the port; a message is sent to the service provider back office (Either the driver indicates it manually via app, or via V2I with a roadside unit).	PID	Vehicle log file (with geolocalisation?) with timestamp
2	The service provider back office sends the information to the traffic management system and requests information on where the truck should park	SPBO	MPA info file with timestamp
3	The traffic management system receives the message and indicates the service provider back office where the truck must go	SPBO	MPA info file with timestamp
4	The service provider back office calculates the itinerary and sends a message to the personal information device of the truck driver	SPBO	MPA info file
5	The truck driver drives as indicated on its device to its parking place	PID	
6	The truck driver indicates that he arrives at his parking place (internet or V2I), or the truck is detected by a roadside unit. A message is sent to the service provider back office.	PID	Vehicle log file with timestamp
7	The service provider back office informs the traffic management system that the truck is on its parking place	SPBO	MPA info file

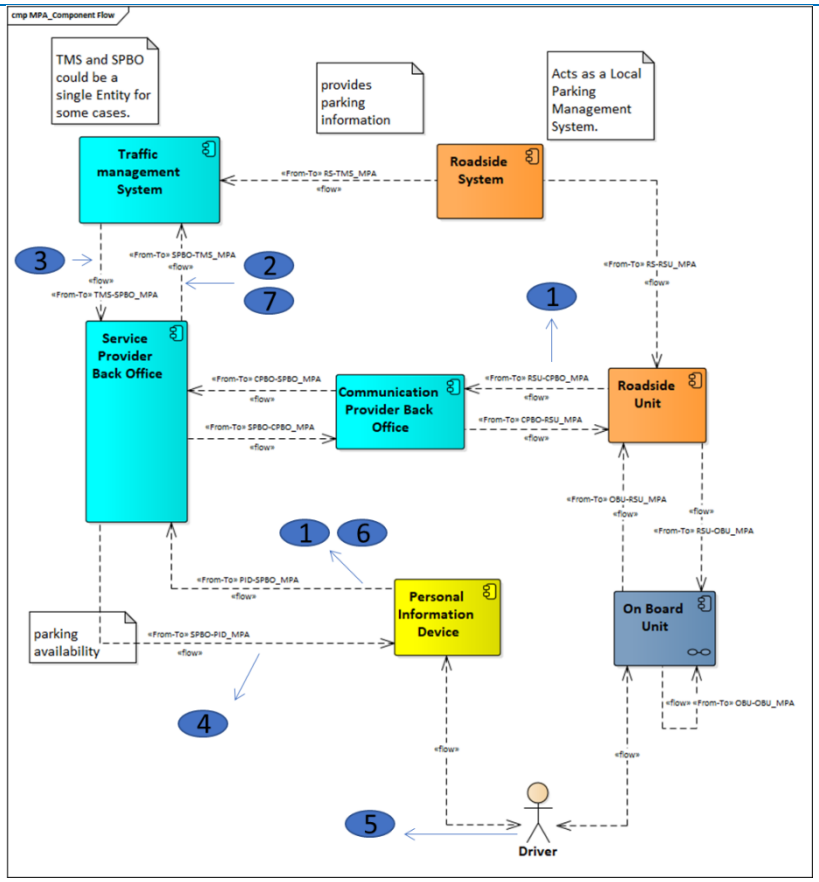


Figure 34. Logging steps in MPA-06 test scenario

Acceptance criteria

The scenario MPA-06 is considered passed if:

- The truck received the information where it should park
- The truck is guided to the right parking place
- The information that the truck is parked is available

3.2.12.2. Traceability Matrix

The traceability matrix is used to assist in determining the completeness of the requirements being met against the test scenarios.

The identifier for each of the requirements is placed in the first column while the identifiers for test scenarios are placed across the top row. When an item in the left column is related to an item across the top, a mark is placed in the intersecting cell. The number of relationships is added up for each row and each column. This value indicates the mapping of the two items. An empty value indicates that no relationship exists.

	Test scenarios	MPA-01	MPA-02	MPA-03	MPA-04	MPA-05	MPA-06
Requirements Tested		8	8	9	10	10	2
R/S02-MPA-01	5	X	X	X	X	X	
R/S02-MPA-02	4	X	X		X	X	
R/S02-MPA-03	5	X	X	X	X	X	
R/S02-MPA-04	5	X	X	X	X	X	
R/S02-MPA-05	5	X	X	X	X	X	

R/S02-MPA-06	3			X	X	X	
R/S02-MPA-07	5	X	X		X	X	
R/S02-MPA-08	4				X	X	X
R/S02-MPA-09	6	X	X		X	X	X
R/S02-MPA-10							
R/S02-MPA-11							
R/S02-MPA-12							
R/S02-MPA-13	5	X	X	X	X	X	

3.2.12.3. Communication performance – Latency

No requirements apply.

3.2.13. Mode & Trip Time Advice (MTTA)

3.2.13.1. Test Scenarios

3.2.13.1.1. Test scenarios over cellular

Test Case ID	MTTA-01
Test Case Objective	To test MTTA functionality: An event visitor, a driver or a cyclist ask informations about the trip's mode and time and receives the suitable and correct information.
Applicability	Using cellular networks
C-MobILE Requirements	R/S14-MTTA-01, R/S14-MTTA-02, R/S14-MTTA-03, R/S14-MTTA-04, R/S14-MTTA-05, R/S14-MTTA-06, R/S14-MTTA-07, R/S14-MTTA-08, R/S14-MTTA-09, R/S14-MTTA-10, R/S14-MTTA-11, R/S14-MTTA-12, R/S14-MTTA-13, R/S14-MTTA-14, R/S14-MTTA-15, R/S14-MTTA-16, R/S14-MTTA-17, R/S14-MTTA-18, R/S14-MTTA-19, R/S14-MTTA-20, R/S14-MTTA-21, R/S14-MTTA-22, R/S14-MTTA-23, R/S14-MTTA-24
Pre-test conditions	The in-vehicle or mobile application is installed and activated on the driver's vehicle or smartphone and running in the background.

Step	Description	Logging component	Logged data
1a	Service Provider collects traffic information from the road operator (TMS).	SBPO	MTTA information is received by the SPBO.
1b	Service Provider collects traffic information from the Data Provider Back Office.	SBPO	MTTA information is received by the SPBO.
2	Service Provider Back Office sends the traffic information to Personal Information Device.	SBPO	Received information.

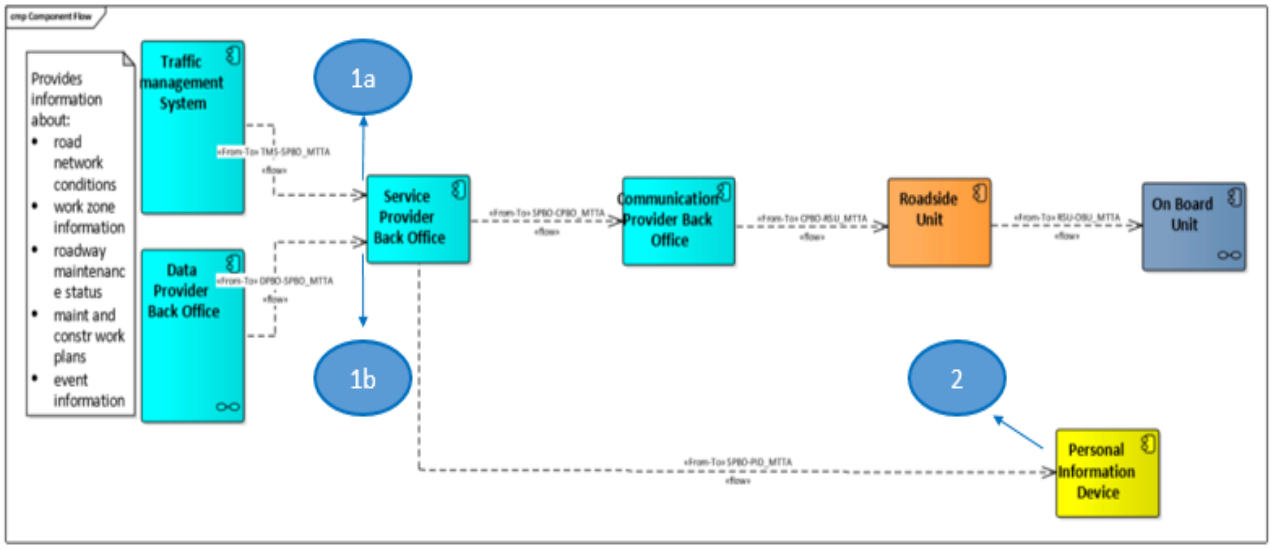


Figure 35: Logging steps in MTTA-01 test scenario

Acceptance criteria

Test scenario MTTA-01 is considered as passed if:

- Vehicle ITS-S generates the correct and suitable mode & trip time advice based on the traffic information and displays the advice to the Driver.

3.2.13.1.2. Test scenario over ITS-G5

Test Case ID	MTTA-02
Test Case Objective	To test MTTA functionality: An event visitor, a driver or a cyclist ask informations about the trip's mode and time and receives the suitable and correct information.
Applicability	Using ETSI ITS-G5 DENM messages
C-MobILE Requirements	R/S14-MTTA-01, R/S14-MTTA-02, R/S14-MTTA-03, R/S14-MTTA-04, R/S14-MTTA-05, R/S14-MTTA-06, R/S14-MTTA-07, R/S14-MTTA-08, R/S14-MTTA-09, R/S14-MTTA-10, R/S14-MTTA-11, R/S14-MTTA-12, R/S14-MTTA-13, R/S14-MTTA-14, R/S14-MTTA-15, R/S14-MTTA-16, R/S14-MTTA-17, R/S14-MTTA-18, R/S14-MTTA-19, R/S14-MTTA-20, R/S14-MTTA-21, R/S14-MTTA-22, R/S14-MTTA-23, R/S14-MTTA-24
Pre-test conditions	The in-vehicle or mobile application is installed and activated on the driver's vehicle or smart phone and running in the background.

Step	Description	Logging component	Logged data
1a	Service Provider collects traffic information from the road operator (TMS).	SBPO	MTTA information is received by the SPBO.
1b	Service Provider collects traffic information from the Data Provider Back Office.	SBPO	MTTA information is received by the SPBO.
2	Service Provider Back Office sends the traffic information to Communication Provider Back Office.	CBPO	Received information.
3	Communication Provider Back Office signals the traffic data to RSU.	RSU	Roadside log file.
4	RSU receives MTTA data and generates DENM messages for the On Board Unit	OBU	OBU log file.

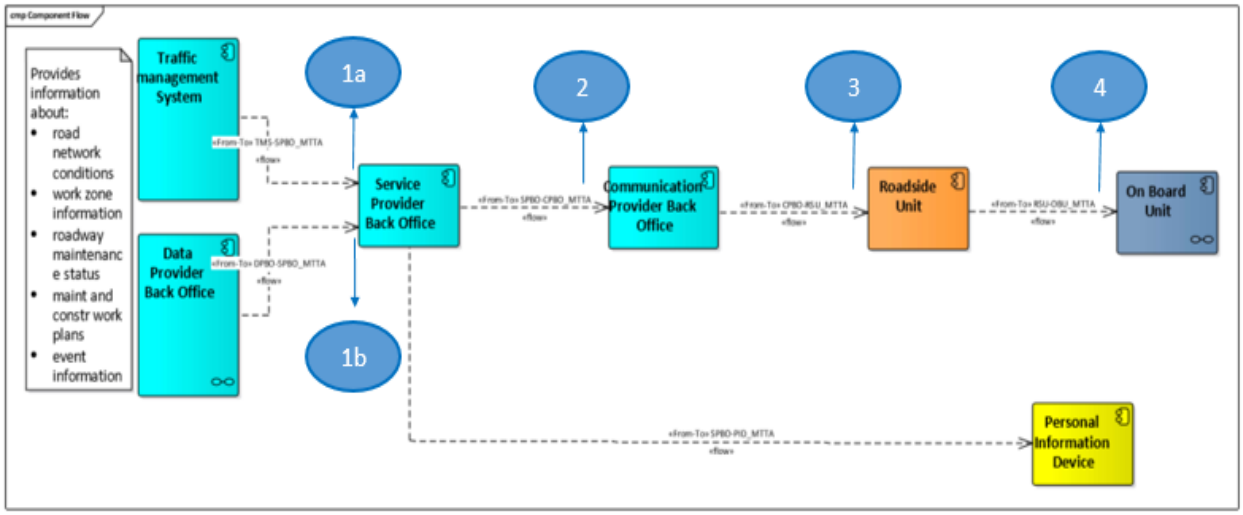


Figure 36: Logging steps in MTTA-02 test scenario

Acceptance criteria

Test scenario MTTA-02 is considered as passed if:

- Vehicle ITS-S generates the correct and suitable mode & trip time advice based on the traffic information and displays the advice to the Driver.

3.2.13.2. Traceability Matrix

The traceability matrix is used to assist in determining the completeness of the requirements being met against the test scenarios.

The identifier for each of the requirements is placed in the first column while the identifiers for test scenarios are placed across the top row. When an item in the left column is related to an item across the top, a mark is placed in the intersecting cell. The number of relationships is added up for each row and each column. This value indicates the mapping of the two items. An empty value indicates that no relationship exists.

	Test scenarios	MTTA-01	MTTA-02
Requirements Tested		9	9
R/S14-MTTA-01	2	X	X
R/S14-MTTA-02	2	X	X
R/S14-MTTA-03	2	X	X
R/S14-MTTA-04	2	X	X
R/S14-MTTA-05	2	X	X
R/S14-MTTA-06	2	X	X
R/S14-MTTA-07	2	X	X
R/S14-MTTA-08	2	X	X
R/S14-MTTA-09	2	X	X
R/S14-MTTA-10	2	X	X
R/S14-MTTA-11	2	X	X
R/S14-MTTA-12	2	X	X
R/S14-MTTA-13	2	X	X
R/S14-MTTA-14	2	X	X

R/S14-MTTA-15	2	X	X
R/S14-MTTA-16	2	X	X
R/S14-MTTA-17	2	X	X
R/S14-MTTA-18	2	X	X
R/S14-MTTA-19	2	X	X
R/S14-MTTA-20	2	X	X
R/S14-MTTA-21	2	X	X
R/S14-MTTA-22	2	X	X
R/S14-MTTA-23	2	X	X
R/S14-MTTA-24	2	X	X

3.2.13.3. Communication performance – Latency

Total latency can be calculated from the moment that the service provider distributes messages/ information and the moment the messages/ information are received by the vehicle or personal information device.

In the case of ETSI ITS-G5, latency between RSUs and OBUs should be measured as well.

3.2.14. Probe Vehicle Data

3.2.14.1. Test Scenarios

3.2.14.1.1. Test scenario over cellular

Test Case ID	PVD-01
Test Case Objective	To test PVD functionality: Vehicle enters and passes area with a slippery (oil) spot. While approaching the slippery (oil) spot a driver receives a warning about a slippery road surface which was determined and broadcasted by a previously passing vehicle.
Applicability	Using cellular networks.
C-MobILE Requirements	R/S15-PVD-01, R/S15-PVD-02, R/S15-PVD-05, R/S15-PVD-06, R/S15-PVD-07
Pre-test conditions	The in-vehicle or mobile application is installed and activated on the driver's vehicle or smart phone and running in the background. The driver accepts to share the data generated by the vehicle.

Step	Description	Logging component	Logged data
1	PID collects the probe data and the information related with the slippery surface is disseminated to the SPBO.	PID	Generated ProbeVehicleData_Msg or ETSI ITS CAM with timestamp.
2	SPBO signals the info to the Traffic management System.	SPBO	Received ProbeVehicleData_Msg or ETSI ITS CAM with reception timestamp.

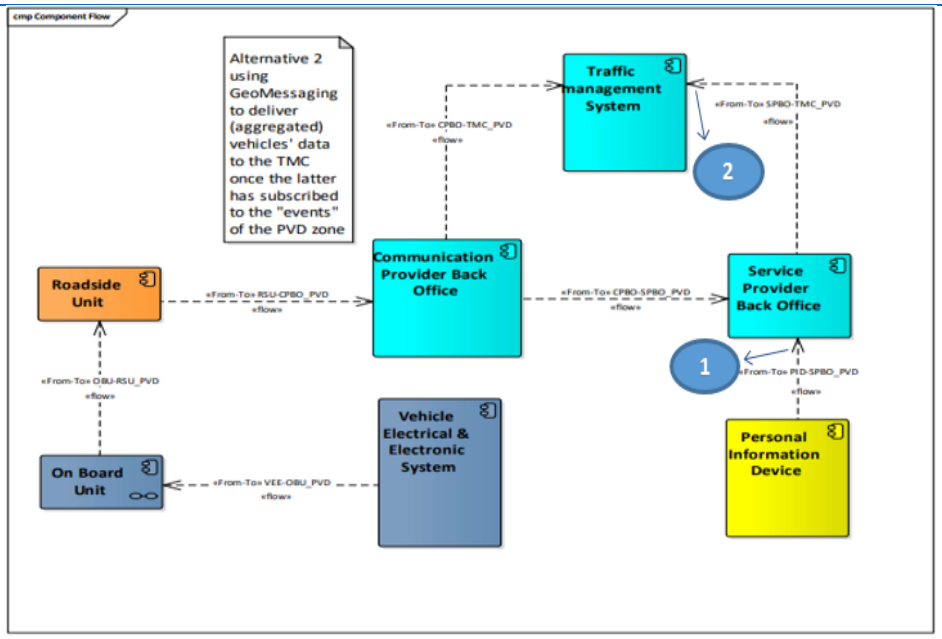


Figure 37: Logging steps in PVD-01 test scenario

Acceptance criteria
Test scenario PVD-01 is considered as passed if: / Latency (time elapsed between the information transmission by the personal information device and the information reception by the traffic management system) is lower than X ms.

3.2.14.1.2. Test scenario over ITS-G5

Test Case ID	PVD-02
Test Case Objective	To test PVD functionality: Vehicle enters and passes area with a slippery (oil) spot within the driving direction. Driver receives a warning about a slippery road surface.
Applicability	Using ProbeVehicleData_Msg or ETSI ITS-G5
C-MobILE Requirements	R/S15-PVD-01, R/S15-PVD-02, R/S15-PVD-03, R/S15-PVD-04, R/S15-PVD-05, R/S15-PVD-06, R/S15-PVD-07
Pre-test conditions	The in-vehicle or mobile application is installed and activated on the driver's vehicle or smart phone and running in the background. The driver accepts to share the data generated by the vehicle.

Step	Description	Logging component	Logged data
1	VEE system collects and shares the information with On Board Unit.	OBU	Generated ProbeVehicleData_Msg or ETSI ITS CAM with timestamp.
2	On Board Unit disseminate the existence of a slippery spot to Roadside Unit via ITSG5.	RSU	Received ProbeVehicleData_Msg or ETSI ITS CAM with reception timestamp.
3	RSU receives PVD data and provides it to the CPBO.	RSU	Received ProbeVehicleData_Msg or ETSI ITS CAM with reception timestamp.
4a	TMS receives probe data directly from CPBO.	CPBO	Received ProbeVehicleData_Msg or ETSI ITS CAM with reception timestamp.

4b	TMS receives probe data indirectly from CPBO through SPBO.	CPBO	Received ProbeVehicleData_Msg or ETSI ITS CAM with reception timestamp.

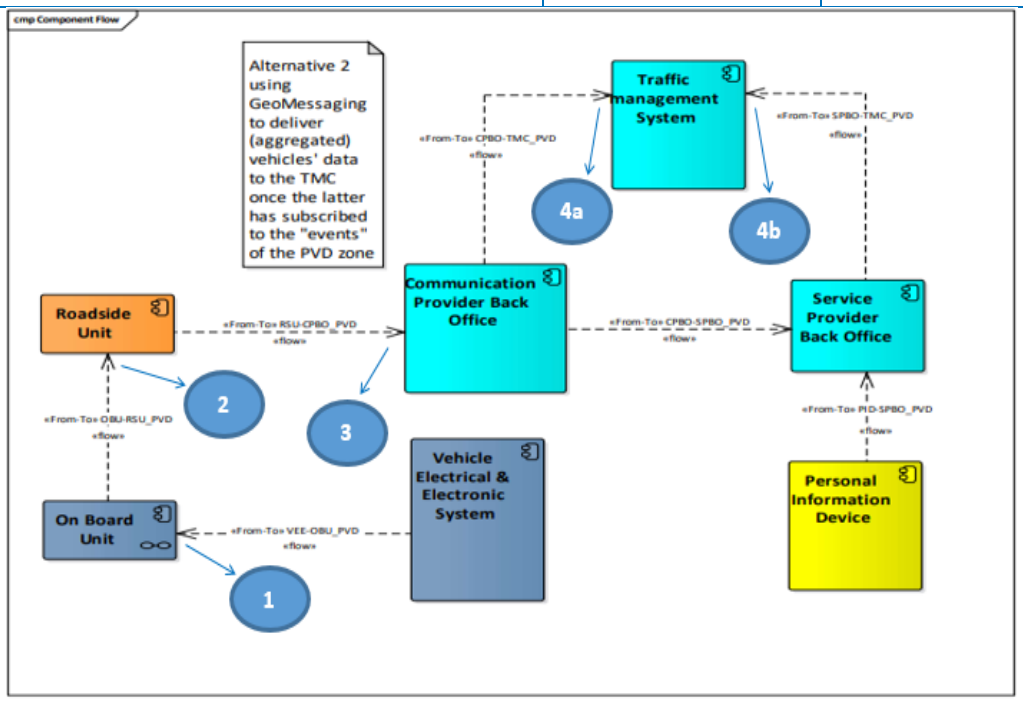


Figure 38: Logging steps in PVD-02 test scenario

Acceptance criteria

Test scenario PVD-02 is considered as passed if:

- Latency (time elapsed between the information transmission by the personal information device and the information reception by the traffic management system) is lower than X ms.
- A warning is displayed to the user with the distance to the slippery spot location.

3.2.14.2. Traceability Matrix

The traceability matrix is used to assist in determining the completeness of the requirements being met against the test scenarios.

The identifier for each of the requirements is placed in the first column while the identifiers for test scenarios are placed across the top row. When an item in the left column is related to an item across the top, a mark is placed in the intersecting cell. The number of relationships is added up for each row and each column. This value indicates the mapping of the two items. An empty value indicates that no relationship exists.

	Test scenarios	PVD-01	PVD-02
Requirements Tested		5	7
R/S15-PVD-01	5	X	X
R/S15-PVD-02	5	X	X
R/S15-PVD-03	5		X
R/S15-PVD-04	4		X
R/S15-PVD-05	4	X	X
R/S15-PVD-06	3	X	X
R/S15-PVD-07	5	X	X

3.2.14.3. Communication performance – Latency

Total latency can be calculated from the moment that the service provider generates a DENM message and the moment the DENM message is received by the vehicle or personal information device.

In the case of ETSI G5, latency between RSUs and OBUs should be measured as well.

3.2.15. Road Hazard Warning

3.2.15.1. Test Scenarios

3.2.15.1.1. Test scenarios over cellular

Test Case ID	RHW-01
Test Case Objective	To test RHW functionality: Vehicle enters and passes area with a road hazard (i.e. accident, traffic jam, weather conditions) within the driving direction. While approaching a road hazard, vehicle drivers receive road hazard related information, warnings and/or guidance on the in-vehicle display or smartphone.
Applicability	Using cellular networks.
C-MobILE Requirements	R/S05-RHW-01,R/S05-RHW-02,R/S05-RHW-03,R/S05-RHW-04,R/S05-RHW-05,R/S05-RHW-06,R/S05-RHW-07,R/S05-RHW-08,R/S05-RHW-09,R/S05-RHW-10,R/S05-RHW-11
Pre-test conditions	The in-vehicle or mobile application is installed and activated on the driver's vehicle or smart phone and running in the background.

Step	Description	Logging component	Logged data
1a	Road operator (TMS) signals the existence of a road hazard location and the info is disseminated to the SPBO.	SPBO	RHW info received by the SPBO with timestamp
1b	Road operator (TMS) signals the existence of a road hazard location and the info is disseminated by the Data Provider Back Office to the SPBO.	SPBO	RHW info received by the SPBO with timestamp
2	SPBO signals the existence of a road hazard location to the CPBO.	CPBO	Generated DENM with timestamp
3	Vehicle enters the range area defined by the RHW and receives DENM messages.	OBU/PID	Received DENM with reception timestamp
4	Vehicle shows warning in HMI since his position and direction matches the DENM information.	OBU/PID	HMI log file (DENM, remaining distance to roadworks location and timestamp when warning is given)

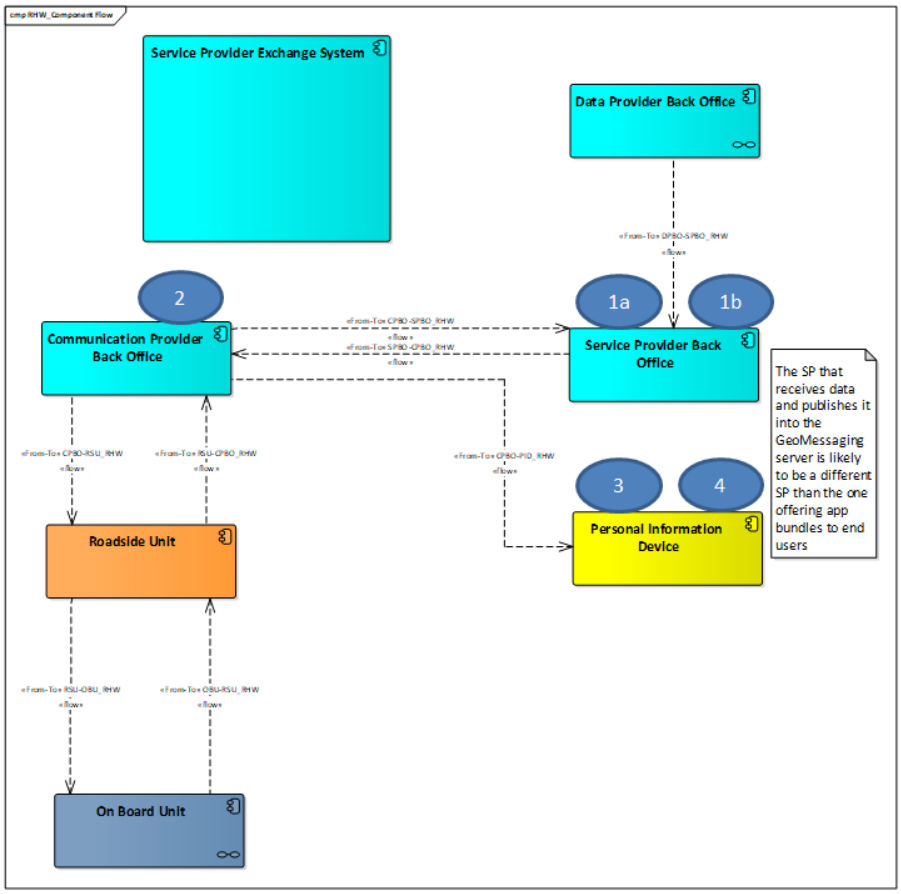


Figure 39. Logging steps in RHW-01 test scenario

Acceptance criteria
Test scenario RHW-01 is considered as passed if: / Road hazard warnings should be displayed to the driver from 5 to 20 seconds before reaching the hazard relevance area. (R/S05-RHW-08) / Road Hazard Warning should show the types of hazard ahead (i.e. Wrong Way Driving, Adverse Weather Condition, Hazardous location and Traffic Condition.) (R/S05-RHW-10) / When the warning is given to the user, the user is within the relevance area of the DENM message.

Test Case ID	RHW-02
Test Case Objective	To test RHW functionality: Vehicle is present in an area when a road hazard is detected within the driving direction. Vehicle drivers receive road hazard related information, warnings and/or guidance on the in-vehicle display or smartphone.
Applicability	Using cellular networks.
C-MobILE Requirements	R/S05-RHW-01,R/S05-RHW-02,R/S05-RHW-03,R/S05-RHW-04,R/S05-RHW-05,R/S05-RHW-06,R/S05-RHW-07,R/S05-RHW-08,R/S05-RHW-09,R/S05-RHW-10,R/S05-RHW-11
Pre-test conditions	The in-vehicle or mobile application is installed and activated on the driver's vehicle or smart phone and running in the background. The vehicle is in the relevant area of the upcoming road hazard.

Step	Description	Logging component	Logged data
1a	Road operator (TMS) signals the existence of a road hazard location and the info is disseminated to the SPBO.	SPBO	RHW info received by the SPBO with timestamp

1b	Road operator (TMS) signals the existence of a road hazard location and the info is disseminated by the Data Provider Back Office to the SPBO.	SPBO	RHW info received by the SPBO with timestamp
2	SPBO signals the existence of a road hazard location to the CPBO.	CPBO	Generated DENM with timestamp
3	CPBO sends DENM to vehicles in the relevance area.	CPBO	Sent DENM with timestamp
4	Vehicle shows warning in HMI since his position and direction matches the DENM information.	OBU/PID	HMI log file (DENM, remaining distance to roadworks location and timestamp when warning is given)

Acceptance criteria

Test scenario RHW-02 is considered as passed if:

- Latency (time elapsed between the message transmission by the service provider and the message reception by the vehicle or personal information device) is lower than X ms.
- Road Hazard Warning shows the types of hazard ahead (i.e. Wrong Way Driving, Adverse Weather Condition, Hazardous location and Traffic Condition.) (R/S05-RHW-10)

Test Case ID	RHW-03
Test Case Objective	To test RHW functionality: Vehicle enters and passes area with a road hazard that is not relevant since it is located in the opposite driving direction. Verify that vehicle drivers do not receive road hazard related information on the in-vehicle display or smartphone since they are not affected.
Applicability	Using cellular networks.
C-MobILE Requirements	R/S05-RHW-01,R/S05-RHW-02,R/S05-RHW-03,R/S05-RHW-04,R/S05-RHW-05,R/S05-RHW-06,R/S05-RHW-07,R/S05-RHW-08,R/S05-RHW-09,R/S05-RHW-10,R/S05-RHW-11
Pre-test conditions	The in-vehicle or mobile application is installed and activated on the driver's vehicle or smart phone and running in the background. The road hazards are informed by the corresponding Road Operator.

Step	Description	Logging component	Logged data
1a	Road operator (TMS) signals the existence of a road hazard location and the info is disseminated to the SPBO.	SPBO	RHW info received by the SPBO with timestamp
1b	Road operator (TMS) signals the existence of a road hazard location and the info is disseminated by the Data Provider Back Office to the SPBO.	SPBO	RHW info received by the SPBO with timestamp
2	SPBO signals the existence of a road hazard location to the CPBO.	CPBO	Generated DENM with timestamp
3	Vehicle enters the range area defined by the RHW and receives DENM messages.	OBU/PID	Received DENM with reception timestamp
4	Vehicle does not show a warning in HMI since his position and direction do not match the DENM information.	OBU/PID	HMI log file (no warning is given)

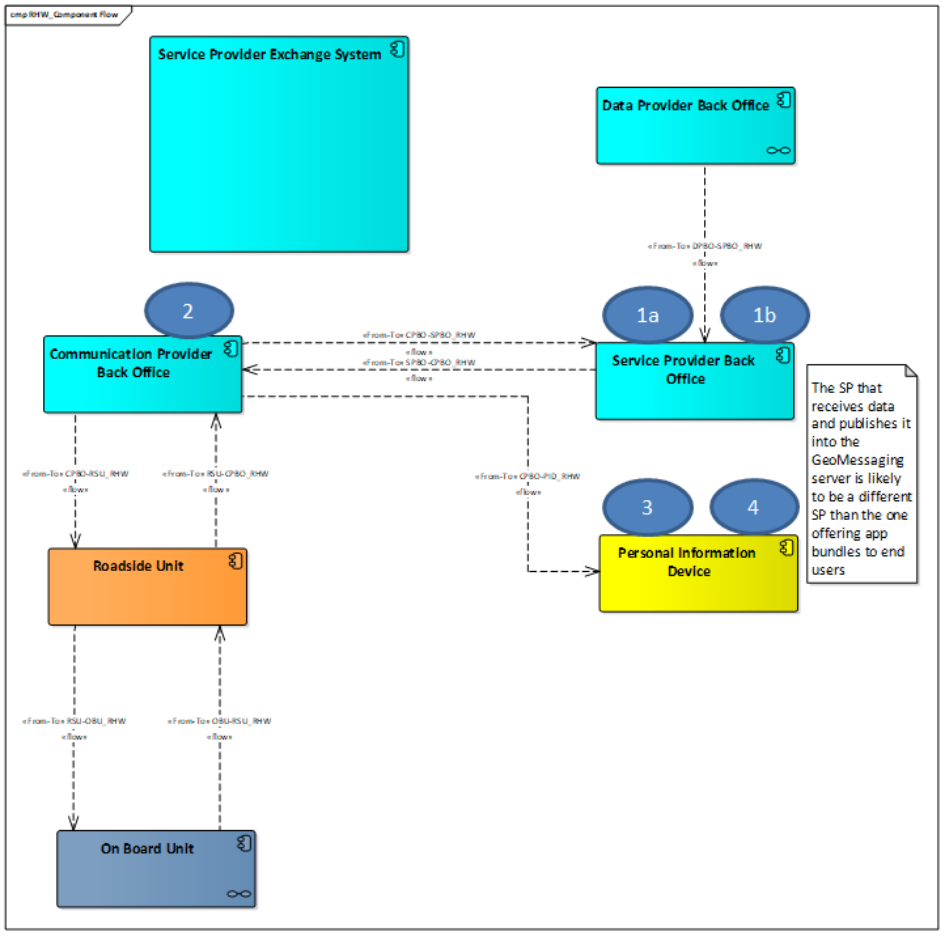


Figure 40. Logging steps in RHW-03 test scenario

Acceptance criteria
Test scenario RHW-03 is considered as passed if: / Total latency between SPBO and vehicle is lower than X ms. / A warning is not displayed to the user.

3.2.15.1.2. Test scenario over ITS-G5

Test Case ID	RHW-04		
Test Case Objective	To test RHW functionality: Vehicle enters and passes area with a road hazard location within the driving direction. While approaching a road hazard location, vehicle drivers receive related information, warnings and/or guidance on the in-vehicle display.		
Applicability	Using ETSI ITS-G5 DENM messages		
C-MobILE Requirements	R/S05-RHW-01,R/S05-RHW-02,R/S05-RHW-03,R/S05-RHW-04,R/S05-RHW-05,R/S05-RHW-06,R/S05-RHW-07,R/S05-RHW-08,R/S05-RHW-09,R/S05-RHW-10,R/S05-RHW-11		
Pre-test conditions	The in-vehicle or mobile application is installed and activated on the driver's vehicle or smart phone and running in the background. The road hazard locations are informed by the corresponding Road Operator A RSU is installed at the road hazard location.		
Step	Description	Logging component	Logged data

1a	Road operator (TMS) signals the existence of a road hazard location and the info is disseminated to the SPBO	SPBO	RHW info received by the SPBO with timestamp
1b	Road operator (TMS) signals the existence of a road hazard location and the info is disseminated by the Data Provider Back Office to the SPBO	SPBO	RHW info received by the SPBO with timestamp
2	SPBO signals the existence of a road hazard location to the CPBO	CPBO	RHW info received by the CPBO with timestamp
3	CPBO forwards road hazard info to RSU in the relevant area.	CPBO	RHW info sent by the CPBO with timestamp
4	RSU receives RHW data and generates DENM messages.	RSU	Roadside log file (DENM with reception timestamp)
5	Vehicle enters the range area defined by the RHW and receives DENM messages.	OBU	Vehicle log file (DENM with reception timestamp)
6	Vehicle shows warning in HMI since his position and direction matches the DENM information. This message includes: the remaining distance (or time) to reach the hazardous location and current speed and road type.	OBU	HMI log file (DENM and remaining distance to roadworks location)

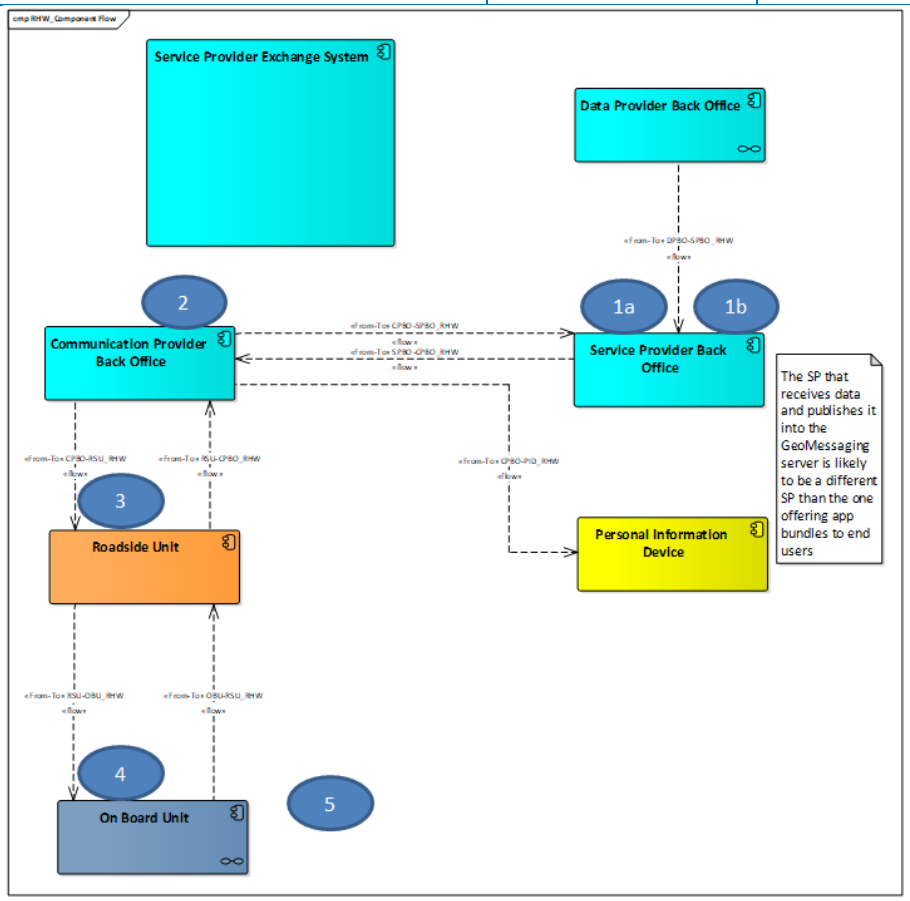


Figure 41. Logging steps in RHW-04 test scenario

Acceptance criteria

Test scenario RHW-04 is considered as passed if:

- Latency between RSU receiving the DENM and vehicle is lower than 100 ms.

- Road hazard warnings should be displayed to the driver from 5 to 20 seconds before reaching the hazard relevance area. (R/S05-RHW-08)
- Road Hazard Warning should show the types of hazard ahead (i.e. Wrong Way Driving, Adverse Weather Condition, Hazardous location and Traffic Condition.) (R/S05-RHW-10)
- When the warning is given to the user, the user is within the relevance area of the DENM message.

Test Case ID	RHW-05
Test Case Objective	To test RHW functionality: Vehicle is present in an area when a road hazard is detected within the driving direction. Vehicle drivers receive road hazard related information, warnings and/or guidance on the in-vehicle display.
Applicability	Using ETSI ITS-G5 DENM messages
C-MobILE Requirements	R/S05-RHW-01,R/S05-RHW-02,R/S05-RHW-03,R/S05-RHW-04,R/S05-RHW-05,R/S05-RHW-06,R/S05-RHW-07,R/S05-RHW-08,R/S05-RHW-09,R/S05-RHW-10,R/S05-RHW-11
Pre-test conditions	The in-vehicle or mobile application is installed and activated on the driver's vehicle or smart phone and running in the background. The vehicle is in the relevant area of the upcoming road hazard. A RSU is installed at the road hazard location.

Step	Description	Logging component	Logged data
1a	Road operator (TMS) signals the existence of a road hazard location and the info is disseminated to the SPBO.	SPBO	RHW info received by the SPBO with timestamp
1b	Road operator (TMS) signals the existence of a road hazard location and the info is disseminated by the Data Provider Back Office to the SPBO.	SPBO	RHW info received by the SPBO with timestamp
2	SPBO signals the existence of a road hazard location to the CPBO.	CPBO	Generated DENM with timestamp
3	CPBO forwards road hazard info to RSU in the relevant area.	CPBO	Sent DENM with timestamp
4	RSU receives RHW data and generates DENM messages.	RSU	Roadside log file (DENM with reception timestamp)
5	Vehicle shows warning in HMI since his position and direction matches the DENM information.	OBU/PID	HMI log file (DENM, remaining distance to roadworks location and timestamp when warning is given)

Acceptance criteria

Test scenario RHW-05 is considered as passed if:

- Latency (time elapsed between the message transmission by the service provider and the message reception by the vehicle or personal information device) is lower than X ms.
- Latency between RSU receiving the DENM and vehicle is lower than 100 ms.
- Road Hazard Warning shows the types of hazard ahead (i.e. Wrong Way Driving, Adverse Weather Condition, Hazardous location and Traffic Condition.) (R/S05-RHW-10)

Test Case ID	RHW-06
Test Case Objective	To test RHW functionality: Vehicle enters and passes area with a road hazard location that is not relevant since it is located in the opposite driving direction. Verify that the user is not notified in his/her HMI.

Applicability	Using ETSI ITS-G5 DENM messages
C-MobILE Requirements	R/S05-RHW-01,R/S05-RHW-02,R/S05-RHW-03,R/S05-RHW-04,R/S05-RHW-05,R/S05-RHW-06,R/S05-RHW-07,R/S05-RHW-08,R/S05-RHW-09,R/S05-RHW-10,R/S05-RHW-11
Pre-test conditions	The in-vehicle or mobile application is installed and activated on the driver's vehicle or smart phone and running in the background. The road hazard locations are informed by the corresponding Road Operator. A RSU is installed at the road hazard location.

Step	Description	Logging component	Logged data
1a	Road operator (TMS) signals the existence of a road hazard location and the info is disseminated to the SPBO.	SPBO	RHW info is received by the SPBO with timestamp
1b	Road operator (TMS) signals the existence of a road hazard location and the info is disseminated by the Data Provider Back Office to the SPBO.	SPBO	RHW info received by the SPBO with timestamp
2	SPBO signals the existence of a road hazard location to the CPBO.	CPBO	RHW info received by the CPBO with timestamp
3	CPBO forwards road hazard info to RSU in the relevant area.	CPBO	RHW info sent by the CPBO with timestamp
4	RSU generates periodic DENM messages.	RSU	Roadside log file (DENM with emission timestamp)
5	Vehicle enters the range area defined by the RHW and receives DENM messages.	OBU	Vehicle log file (DENM with reception timestamp)
6	Vehicle does not show a warning in HMI since his position and direction does not match the DENM information.	OBU	HMI log file (DENM received with timestamp and remaining distance to hazardous location)

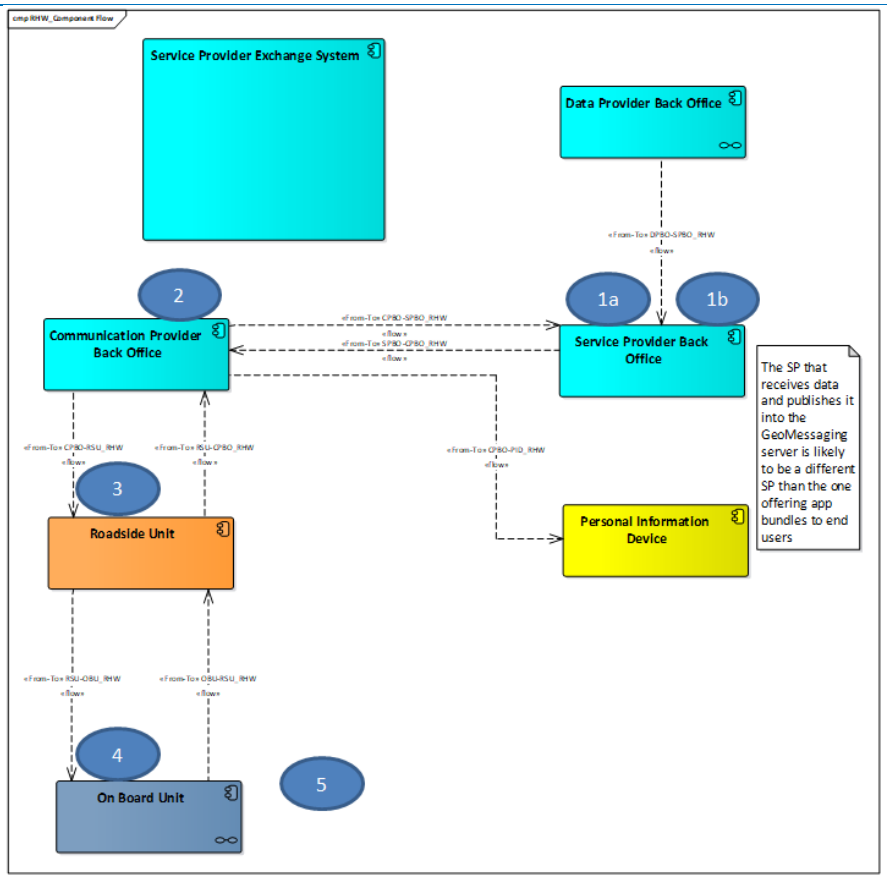


Figure 42. Logging steps in RHW-06 test scenario

Acceptance criteria

Test scenario RHW-06 is considered as passed if:

- Total latency between SPBO and vehicle is lower than X ms.
- Latency between RSU receiving the DENM and vehicle warning the driver is lower than 100 ms.
- A warning is not displayed to the user.

3.2.15.2. Traceability Matrix

The traceability matrix is used to assist in determining the completeness of the requirements being met against the test scenarios.

The identifier for each of the requirements is placed in the first column while the identifiers for test scenarios are placed across the top row. When an item in the left column is related to an item across the top, a mark is placed in the intersecting cell. The number of relationships is added up for each row and each column. This value indicates the mapping of the two items. An empty value indicates that no relationship exists.

	Test scenarios	RHW-01	RHW-02	RHW-03	RHW-04	RHW-05	RHW-06
Requirements Tested		11	11	11	11	11	11
R/S05-RHW-01	6	x	x	x	x	x	x
R/S05-RHW-02	6	x	x	x	x	x	x
R/S05-RHW-03	6	x	x	x	x	x	x
R/S05-RHW-04	6	x	x	x	x	x	x
R/S05-RHW-05	6	x	x	x	x	x	x
R/S05-RHW-06	6	x	x	x	x	x	x

R/S05-RHW-07	6	x	x	x	x	x	x
R/S05-RHW-08	6	x	x	x	x	x	x
R/S05-RHW-09	6	x	x	x	x	x	x
R/S05-RHW-10	6	x	x	x	x	x	x
R/S05-RHW-11	6	x	x	x	x	x	x

3.2.15.3. Communication performance – Latency

Total latency can be calculated from the moment that the service provider generates a DENM message and the moment the DENM message is received by the vehicle or personal information device.

In the case of ETSI G5, latency between RSUs and OBUs should be measured as well.

3.2.16. Roadworks Warning

3.2.16.1. Test Scenarios

3.2.16.1.1. Test scenarios over cellular

Test Case ID	RWW-01
Test Case Objective	To test RWW functionality: Vehicle enters and passes area with a roadwork zone within the driving direction. While approaching a roadwork zone, vehicle drivers receive roadwork related information, warnings and/or guidance on the in-vehicle display or smartphone.
Applicability	Using cellular networks.
C-MobILE Requirements	R/S04-RWW-01, R/S04-RWW-02, R/S04-RWW-03, R/S04-RWW-04, R/S04-RWW-05, R/S04-RWW-07, R/S04-RWW-10, R/S04-RWW-11, R/S04-RWW-13
Pre-test conditions	The in-vehicle or mobile application is installed and activated on the driver's vehicle or smart phone and running in the background. The roadworks are informed by the corresponding Road Operator.

Step	Description	Logging component	Logged data
1a	Road operator (TMS) signals the existence of a roadworks location and the info is disseminated to the SPBO	SPBO	RWW info is received by the SPBO with timestamp
1b	Road operator (TMS) signals the existence of a roadworks location and the info is disseminated by the Data Provider Back Office to the SPBO	SPBO	RWW info is received by the SPBO with timestamp
2	SPBO signals the existence of a roadworks location to the CPBO	CPBO	Generated DENM with timestamp
3	Vehicle enters the range area defined by the RWW and receives DENM messages.	PID	Received DENM with reception timestamp
4	Vehicle shows warning in HMI since his position and direction matches the DENM information.	PID	HMI log file (DENM, remaining distance to roadworks location and timestamp when warning is given)

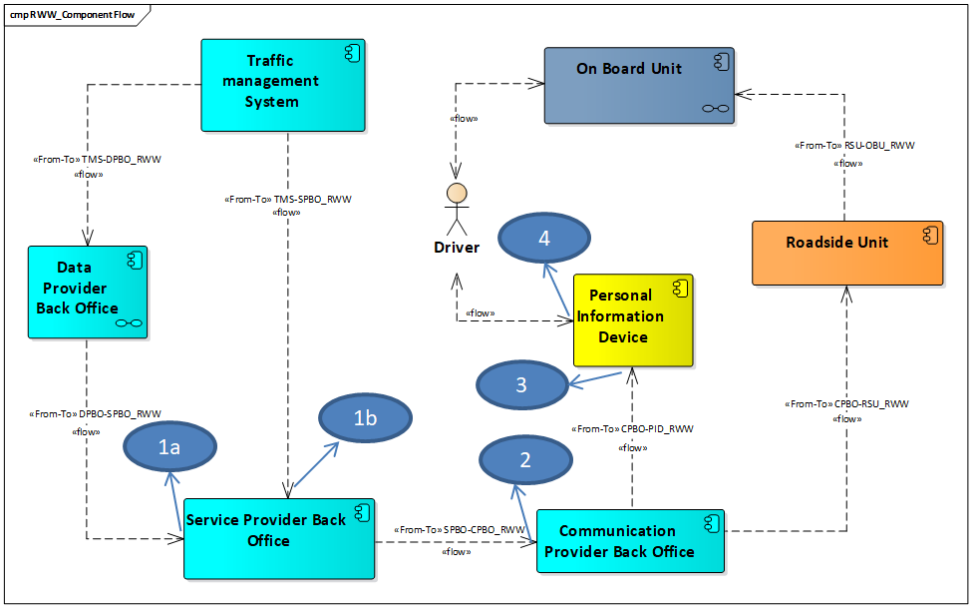


Figure 43. Logging steps in RWW-01 test scenario

Acceptance criteria

Test scenario RWW-01 is considered as passed if:

- Latency (time elapsed between the message transmission by the service provider and the message reception by the vehicle or personal information device) is lower than X ms.
- A warning is displayed to the user with the distance to the roadworks location.
- When the warning is given to the user, the user is within the relevance area of the DENM message.

Test Case ID	RWW-02
Test Case Objective	To test RWW functionality: Vehicle enters and passes area with a roadwork zone that is not relevant since it is located in the opposite driving direction. Verify that vehicle drivers do not receive roadwork related information on the in-vehicle display or smartphone since they are not affected.
Applicability	Using cellular networks.
C-MobILE Requirements	R/S04-RWW-01, R/S04-RWW-02, R/S04-RWW-03, R/S04-RWW-04, R/S04-RWW-05, R/S04-RWW-07, R/S04-RWW-10, R/S04-RWW-11, R/S04-RWW-13
Pre-test conditions	The in-vehicle or mobile application is installed and activated on the driver's vehicle or smart phone and running in the background. The roadworks are informed by the corresponding Road Operator.

Step	Description	Logging component	Logged data
1a	Road operator (TMS) signals the existence of a roadworks location and the info is disseminated to the SPBO	SPBO	RWW info is received by the SPBO with timestamp
1b	Road operator (TMS) signals the existence of a roadworks location and the info is disseminated by the Data Provider Back Office to the SPBO	SPBO	RWW info is received by the SPBO with timestamp
2	SPBO signals the existence of a roadworks location to the CPBO	CPBO	Generated DENM with timestamp
3	Vehicle enters the range area defined by the RWW and receives DENM messages.	PID	Received DENM with reception timestamp

4	Vehicle does not show a warning in HMI since his position and direction does not match the DENM information.	PID	HMI log file (no warning is given)

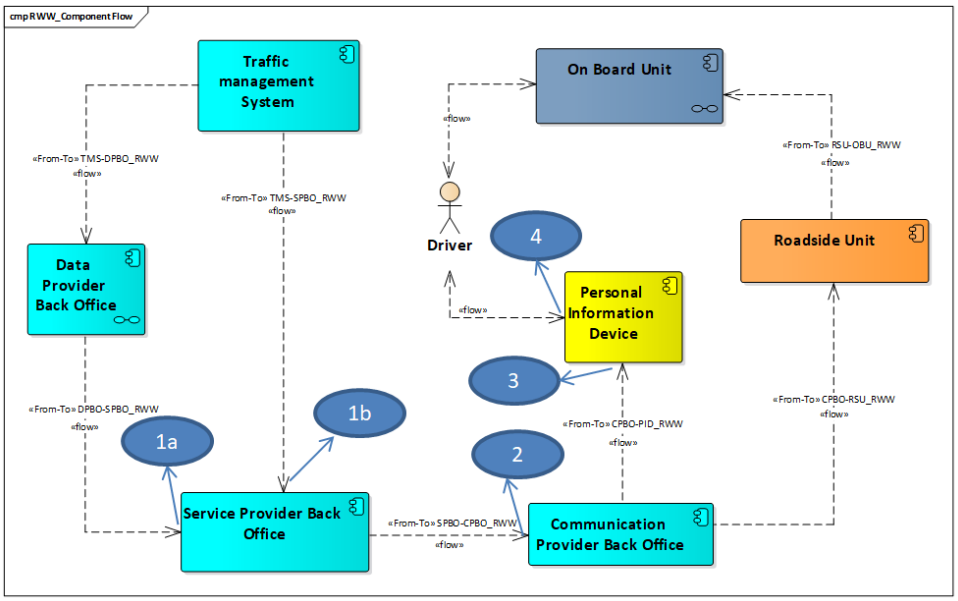


Figure 44. Logging steps in RWW-02 test scenario

Acceptance criteria

Test scenario RWW-02 is considered as passed if:

- Latency (time elapsed between the message transmission by the service provider and the message reception by the vehicle or personal information device) is lower than X ms.
- A warning is not displayed to the user.

3.2.16.1.2. Test scenario over ITS-G5

Test Case ID	RWW-03
Test Case Objective	To test RWW functionality: Vehicle enters and passes area with a roadwork zone within the driving direction. While approaching a roadwork zone, vehicle drivers receive roadwork related information, warnings and/or guidance on the in-vehicle display or smartphone.
Applicability	Using ETSI ITS-G5 DENM messages
C-MobILE Requirements	R/S04-RWW-01, R/S04-RWW-02, R/S04-RWW-03, R/S04-RWW-04, R/S04-RWW-05, R/S04-RWW-06, R/S04-RWW-07, R/S04-RWW-10, R/S04-RWW-11, R/S04-RWW-13
Pre-test conditions	The in-vehicle or mobile application is installed and activated on the driver's vehicle or smart phone and running in the background. The roadworks are informed by the corresponding Road Operator A RSU is installed at the roadworks location.

Step	Description	Logging component	Logged data
1a	Road operator (TMS) signals the existence of a roadworks location and the info is disseminated to the SPBO	SPBO	RWW info is received by the SPBO with timestamp
1b	Road operator (TMS) signals the existence of a roadworks location and the info is	SPBO	RWW info is received by the SPBO with timestamp

	disseminated by the Data Provider Back Office to the SPBO		
2	SPBO signals the existence of a roadworks location to the CPBO	CPBO	RWW info is received by the CPBO with timestamp
3	RSU receives RWW data and generates DENM messages.	RSU	Roadside log file(DENM with reception timestamp)
4	Vehicle enters the range area defined by the RWW and receives DENM messages.	OBU	Vehicle log file (DENM with reception timestamp)
5	Vehicle shows warning in HMI since his position and direction matches the DENM information.	OBU	HMI log file (DENM and remaining distance to roadworks location)

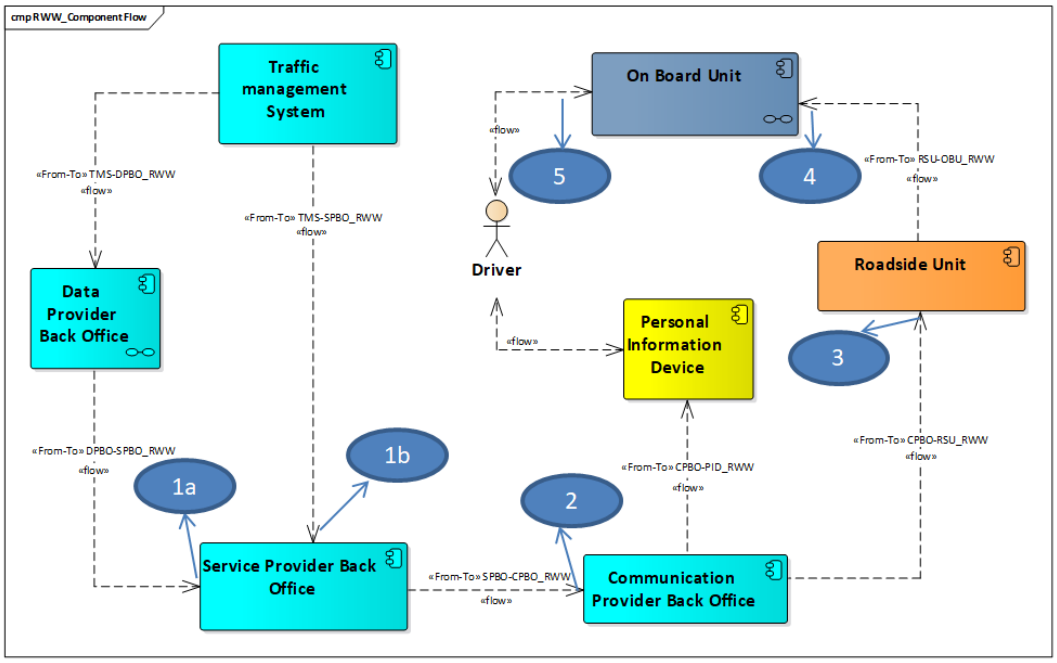


Figure 45. Logging steps in RWW-03 test scenario

Acceptance criteria

Test scenario RWW-03 is considered as passed if:

- Total latency between SPBO and vehicle is lower than X ms.
- Latency between RSU and vehicle is lower than 100 ms (R/S04-RWW-06).
- A warning is displayed to the user with the distance to the roadworks location.
- When the warning is given to the user, the user is within the relevance area of the DENM message.

Test Case ID	RWW-04
Test Case Objective	To test RWW functionality: Vehicle enters and passes area with a roadworks that is not relevant since it is located in the opposite driving direction. Verify that the user is not notified in his/her HMI.
Applicability	Using ETSI ITS-G5 DENM messages
C-MobILE Requirements	R/S04-RWW-01, R/S04-RWW-02, R/S04-RWW-03, R/S04-RWW-04, R/S04-RWW-05, R/S04-RWW-06, R/S04-RWW-07, R/S04-RWW-10, R/S04-RWW-11, R/S04-RWW-13
Pre-test conditions	The in-vehicle or mobile application is installed and activated on the driver's vehicle or smart phone and running in the background.

	The roadworks are informed by the corresponding Road Operator. A RSU is installed in the roadworks location.

Step	Description	Logging component	Logged data
1a	Road operator (TMS) signals the existence of a roadworks location and the info is disseminated to the SPBO	SPBO	RWW info is received by the SPBO with timestamp
1b	Road operator (TMS) signals the existence of a roadworks location and the info is disseminated by the Data Provider Back Office to the SPBO	SPBO	RWW info is received by the SPBO with timestamp
2	SPBO signals the existence of a roadworks location to the CPBO	CPBO	RWW info is received by the CPBO with timestamp
3	RSU receives RWW data and generates DENM messages.	RSU	Roadside log file(DENM with reception timestamp)
4	Vehicle enters the range area defined by the RWW and receives DENM messages.	OBU	Vehicle log file (DENM with reception timestamp)
5	Vehicle does not show a warning in HMI since his position and direction does not match the DENM information.	OBU	HMI log file (DENM received with timestamp and remaining distance to hazardous location)

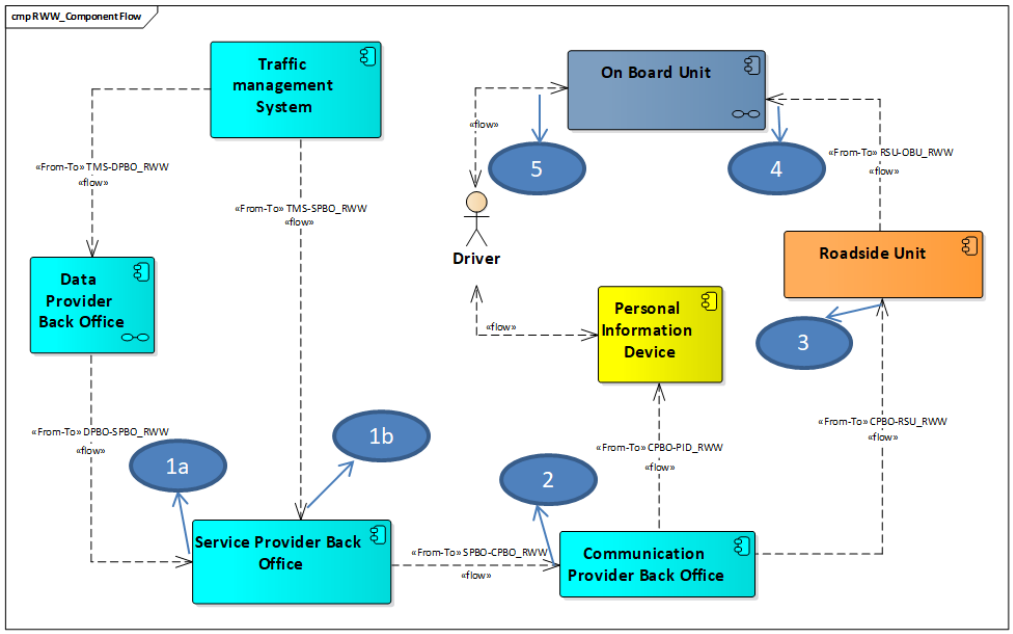


Figure 46. Logging steps in RWW-04 test scenario

Acceptance criteria

Test scenario RWW-04 is considered as passed if:

- Total latency between SPBO and vehicle is lower than X ms.
- Latency between RSU and vehicle is lower than 100 ms (R/S04-RWW-06).
- A warning is not displayed to the user.

3.2.16.1.3. Test scenario with mobile RSU

Test Case ID	RWW-05
Test Case Objective	To test RWW functionality: Vehicle enters and passes area with a mobile roadworks equiped with a RSU within the driving direction. While approaching the mobile roadwork , vehicle drivers receive roadwork related information, warnings and/or guidance on the in-vehicle display or smartphone.
Applicability	Using ETSI ITS-G5 DENM messages
C-MobILE Requirements	R/S04-RWW-01, R/S04-RWW-02, R/S04-RWW-03, R/S04-RWW-06, R/S04-RWW-07, R/S04-RWW-08, R/S04-RWW-09, R/S04-RWW-10, R/S04-RWW-11, R/S04-RWW-12, R/S04-RWW-13, R/S04-RWW-14
Pre-test conditions	The in-vehicle or mobile application is installed and activated on the driver's vehicle or smart phone and running in the background. The roadworks are informed by the corresponding Road Operator. A mobile roadworks equiped with a RSU is installed in the roadworks location.

Step	Description	Logging component	Logged data
1	RSU at the mobile roadworks generates and disseminates DENM message.	RSU	Generated DENM at the RSU with timestamp
2	Vehicle enters the range area and receives DENM messages.	OBU	DENM received with timestamp
3	Vehicle shows warning in HMI since his position and direction matches the DENM information. This message includes: the remaining distance (or time) to reach the hazardous location and current speed and road type. (R/S04-RWW-07)	OBU	HMI log file (DENM and remaining distance to roadworks location)
4	Verify that latency time is not higher than 100 ms between RSU and vehicle (R/S04-RWW-06)	RSU and OBU	DENM with received timestamp and Vehicle log file (DENM with timestamp)

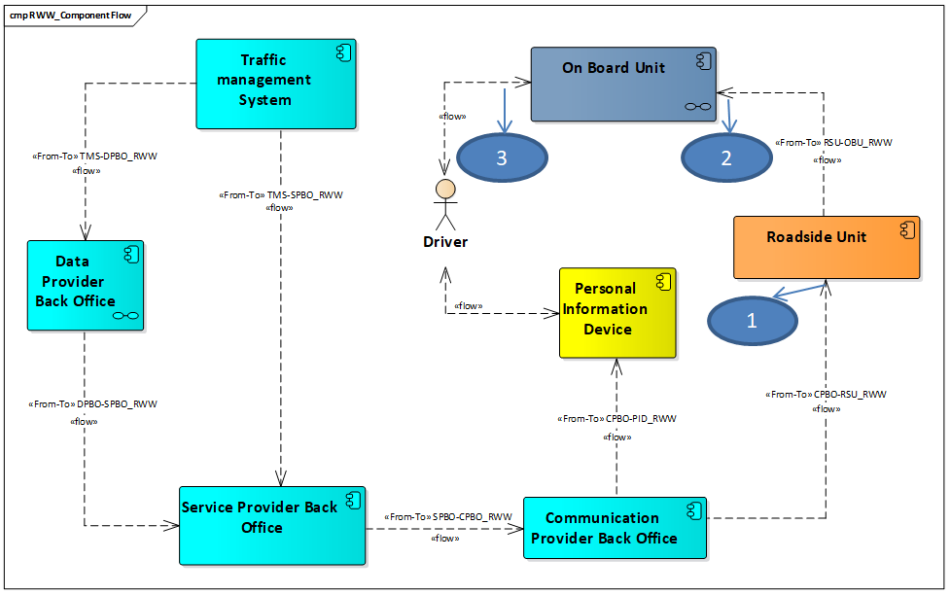


Figure 47. Logging steps in RWW-05 test scenario

Acceptance criteria

Test scenario RWW-05 is considered as passed if:

- Latency between RSU and vehicle is lower than 100 ms (R/S04-RWW-06).
- A warning is displayed to the user with the distance to the roadworks location.

/ When the warning is given to the user, the user is within the relevance area of the DENM message.

3.2.16.2. Traceability Matrix

The traceability matrix is used to assist in determining the completeness of the requirements being met against the test scenarios.

The identifier for each of the requirements is placed in the first column while the identifiers for test scenarios are placed across the top row. When an item in the left column is related to an item across the top, a mark is placed in the intersecting cell. The number of relationships is added up for each row and each column. This value indicates the mapping of the two items. An empty value indicates that no relationship exists.

	Test scenarios	RWW-01	RWW-02	RWW-03	RWW-04	RWW-05
Requirements Tested		9	9	10	10	12
R/S04-RWW-01	5	X	X	X	X	X
R/S04-RWW-02	5	X	X	X	X	X
R/S04-RWW-03	5	X	X	X	X	X
R/S04-RWW-04	4	X	X	X	X	
R/S04-RWW-05	4	X	X	X	X	
R/S04-RWW-06	3			X	X	X
R/S04-RWW-07	5	X	X	X	X	X
R/S04-RWW-08	1					X
R/S04-RWW-09	1					X
R/S04-RWW-10	5	X	X	X	X	X
R/S04-RWW-11	5	X	X	X	X	X
R/S04-RWW-12	1					X
R/S04-RWW-13	5	X	X	X	X	X
R/S04-RWW-14	1					X

3.2.16.3. Communication performance – Latency

Total latency can be calculated from the moment that the service provider generates a DENM message and the moment the DENM message is received by the vehicle or personal information device.

In the case of ETSI G5, latency between RSUs and OBUs should be measured as well.

3.2.17. Slow or stationary vehicle warning

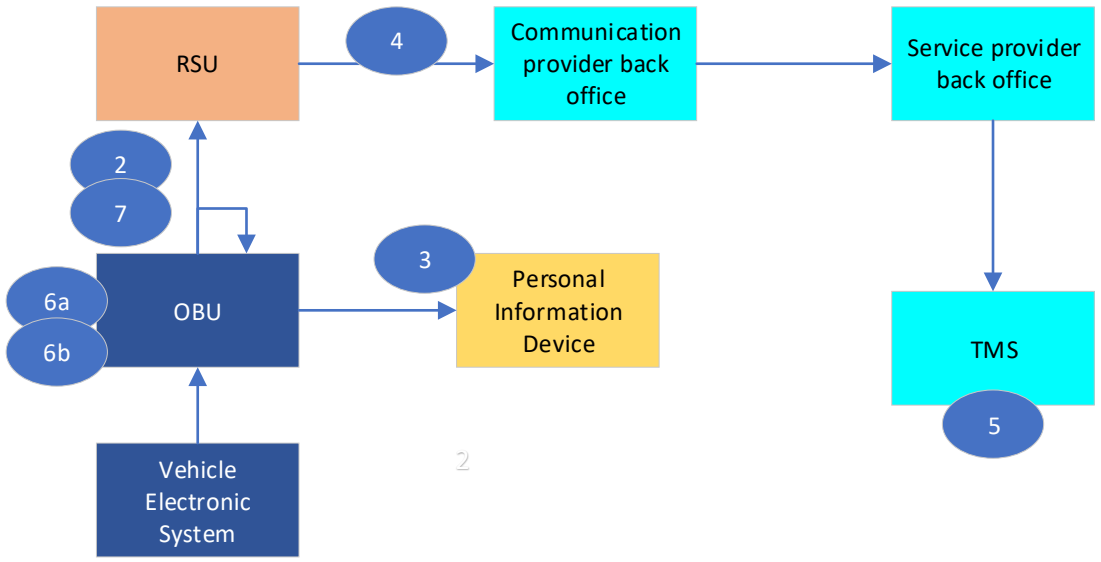
3.2.17.1. Test Scenarios

3.2.17.1.1. Test scenario about Slow or Stationary Vehicle Warning

Test Case ID	SSVW-01
Test Case Objective	To avoid rear end collisions, when any vehicle is driving slowly or is stationary on the road, it sends the DENM message to all others OBU. The service warns the local followers, in due time, so they can adopt their speed to avoid collision with the vehicle.
Applicability	Using ETSI ITS-G5 DENM messages
C-MobILE Requirements	R/S18-SSVW-02,R/S18-SSVW-03,R/S18-SSVW-05,R/S18-SSVW-06,R/S18-SSVW-07,R/S18-SSVW-08,R/S18-SSVW-09,R/S18-SSVW-10,R/S18-SSVW-11

Pre-test conditions	The first vehicle slows down to a very low speed and sends out its vehicle state to the OBU. The OBU processes and transmits and SSVW message with relevant vehicle state information. The Vehicle ITS-S is installed and activated on the Vehicle Driver's smart phone or on-board unit and running in the background

Step	Description	Logging component	Logged data
1	The following vehicle assesses the information about SSVW message in smart phone or on-board unit.	OBU	Vehicle log file with timestamp
2	Vehicle ITS-S disseminates the detected slow vehicle warning to R-ITS-S and other vehicles within the range.	RSU/ OBU	Roadside log file or Vehicle log file with timestamp
3	Following vehicle ITS-S displays the slow vehicle warning.	OBU	HMI log file (DENM, remaining distance to slow vehicle location and timestamp when warning is given)
4	R-ITS-S that received the slow vehicle warning, sends it to the CPBO	RSU	Roadside log file with timestamp
5	The CPBO signals the existence of a road hazard and repeat SSVW DENM while the event is active.	CPBO	Generated DENM with timestamp
6a	A vehicle is approaching the area of braked vehicle from the front, the vehicle ITS-S has no reaction to SSVW event or DENM message and nothing will be displayed in the Vehicle ITS-S.	OBU	Vehicle log file with timestamp
6b	A vehicle is approaching the area of slow vehicle in another lane and a collision risk doesn't exist. The vehicle ITS-S has no reaction to SSVW event or DENM message and nothing will be displayed in the Vehicle ITS-S.	OBU	Vehicle log file with timestamp
7	When the originating ITS station detects the event has finished (accelerate or exit from the road), it shall send out a cancellation DENM	SPBO	DENM with timestamp



Test scenario SSVW-01 is considered as passed if:

- All following vehicles in a local area and in the same direction are warned about slow vehicle from preceding vehicle/s and it is displayed on the Vehicle ITS-S.

- The delay between detection of the use case in the slow vehicle until reception of the message in surrounding vehicles in communication range should be less than 50 ms.
- DENM message shall contain information about the SSVW event: Valid time, current position of detecting vehicle, lane position and risk assessment valid time.
- DENM message shall be send with a determinate transmission latency and within a transmission area.

3.2.17.2. Traceability Matrix

The traceability matrix is used to assist in determining the completeness of the requirements being met against the test scenarios.

The identifier for each of the requirements is placed in the first column while the identifiers for test scenarios are placed across the top row. When an item in the left column is related to an item across the top, a mark is placed in the intersecting cell. The number of relationships is added up for each row and each column. This value indicates the mapping of the two items. An empty value indicates that no relationship exists.

	Test scenarios	SSVW-01
Requirements Tested		9
R/S18-SSVW-2	1	1
R/S18-SSVW-3	1	1
R/S18-SSVW-5	1	1
R/S18-SSVW-6	1	1
R/S18-SSVW-7	1	1
R/S18-SSVW-8	1	1
R/S18-SSVW-9	1	1
R/S18-SSVW-10	1	1
R/S18-SSVW-11	1	1

3.2.17.3. Communication performance – Latency

Total latency can be calculated from the moment a request is sent to the moment the reply is received.

In the case of cellular communication, latency is highly dependent on the network, which is out of scope of C-MobILE. Nevertheless the time the Open Data server needs for processing the request (from the moment it is received to when the reply is sent) will be measured.

3.2.18. Signal Violation Warning

3.2.18.1. Test Scenarios

3.2.18.1.1. Test scenarios over cellular

Test Case ID	SVW-01
Test Case Objective	To test SVW, we verify that the infrastructure messages (SPaTM, MAPM) have been received and evaluated by the vehicle. Furthermore, we verify if the vehicle has detected the warning threshold correctly and shown a warning where appropriate.
Applicability	Using ETSI ITS-G5, cellular
C-MobILE Requirements	R/S07-SVW-01, R/S07-SVW-02, R/S07-SVW-03, R/S07-SVW-04, R/S07-SVW-06

Pre-test conditions	The in-vehicle or mobile application is installed and activated on the driver's vehicle or smart phone and running in the background. SPaTM/MAPM for the traffic lights in the test area are transmitted over the communication channel for this test case.

Step	Description	Logging component	Logged data
1	The RSU sends MAPM/SPaTM periodically.	RSU, CPBO	SPaTEM, MAPEM
2	The vehicle receives a MAPM indicating the presence of a signalled intersection.	Vehicle, PID	MAPEM
3	The vehicle receives SPaTM, giving indication of the signalling of an intersection it is approaching.	Vehicle, PID	SPaTEM
4	The vehicle verifies, if it is approaching the intersection described by SPaTM/MAPM. It does this by examining the MAPM lane data and his own data, e.g. position, trace point chain and current driving direction.	Vehicle, PID	Timestamp, SPaTEM/MAPEM reference (id or hash), verification result ("approaching", "not approaching").
5	The vehicle evaluates if a red light violation is imminent and logs that information.	Vehicle, PID	Timestamp, Algorithm parameters and result of the evaluation ("Warn", "Do not warn")
6	If the vehicle evaluated that a warning is necessary ("Warn"), it triggers a warning message on the HMI.	Vehicle, PID	Timestamp, indication that the warning has been shown on HMI.
7	The vehicle logs, if it was able to prevent a red light. A logging entry is created, when the vehicle crosses the stop bar.	Vehicle, PID	Timestamp, vehicle position, stop bar position, current signal phase.

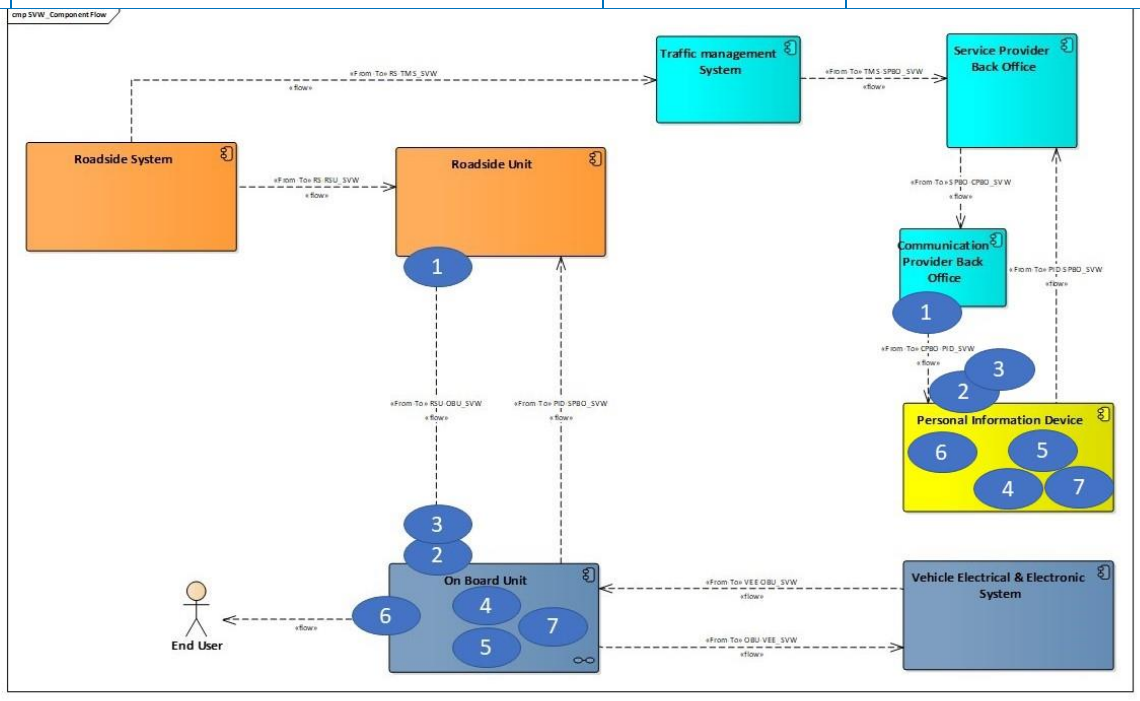


Figure 48. Logging steps in SVW-01 test scenario

Acceptance criteria

- The test is successful, if the driver gets a warning every time an inminent red line crossing is detected.
- The test is also successful, if the vehicle correctly identifies warn/no-warn situation based on SPATEM data, which is checked based on the logged parameters and inputs for the decision algorithm.

3.2.18.2. Traceability Matrix

The traceability matrix is used to assist in determining the completeness of the requirements being met against the test scenarios.

The identifier for each of the requirements is placed in the first column while the identifiers for test scenarios are placed across the top row. When an item in the left column is related to an item across the top, a mark is placed in the intersecting cell. The number of relationships is added up for each row and each column. This value indicates the mapping of the two items. An empty value indicates that no relationship exists.

	Test scenarios	SVW-01
Requirements Tested		5
R/S07-SVW-01	1	X
R/S07-SVW-02	1	X
R/S07-SVW-03	1	X
R/S07-SVW-04	1	X
R/S07-SVW-05	0	
R/S07-SVW-06	1	X

3.2.19. Urban Parking Availability

3.2.19.1. Test Scenarios

3.2.19.1.1. Information about a vehicle parking space released by a user, and reserved for another vehicle

Test Case ID	UPA-01
Test Case Objective	To test UPA functionality: The Vehicle driver who is searching for a parking space sends a broadcast message through the ITS-S, stating that he/she is looking for a parking space. Another vehicle driver who is preparing to leave with her/his truck, sends a message (V2V Unicast*) stating that he/she is releasing its parking space. The searching vehicle's ITS-S sends to the leaving vehicle's ITS-S its position and confirms that it is approaching. If the searching vehicle's ITS-S has several parking options, it informs only to the chosen one. When the searching vehicle arrives at the destination, the leaving vehicle leaves its space
Applicability	Using ETSI ITS-G5
C-MobILE Requirements	R/S03-UPA-01, R/S03-UPA-02, R/S03-UPA-03, R/S03-UPA-05, R/S03-UPA-06, R/S03-UPA-07, R/S03-UPA-08, R/S03-UPA-09, R/S03-UPA-10, R/S03-UPA-11, R/S03-UPA-12
Pre-test conditions	The Vehicle ITS-S is installed and activated on the Vehicle drivers' smart phone or on-board units and running in the background.

Step	Description	Logging component	Logged data
1	The Vehicle driver who's searching for a parking space sends a broadcast message through the ITS-S, stating that he/she is looking for a parking space.	OBU / PID	UPA request is sent by a driver.
2	The Vehicle driver of the parked vehicle who is preparing to leave, sends a message (V2V Unicast*) stating that he/she is releasing the parking space.	OBU / PID	UPA notification is sent by a driver

3	The searching vehicle's ITS-S sends to the leaving vehicle's ITS-S its position and confirms that it is approaching. If the searching vehicle's ITS-S has several proposals, it informs only the one chosen.	OBU / PID	UPA notification is sent by a driver, to another specific recipient
4	When the searching vehicle arrives at the destination, the leaving vehicle leaves its space.	OBU / PID	Parking occupation.

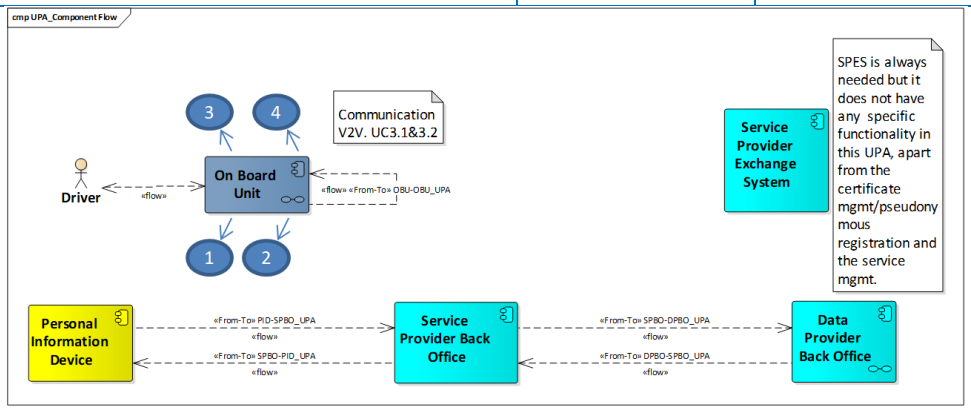


Figure 49. Logging steps in UPA-01 test scenario

Acceptance criteria

Test scenario UPA-01 is considered as passed if:

- The searching vehicle receives a message on the Vehicle ITS-S containing information on the location of the vehicle parking space sent by the leaving vehicle.
- Accurate information on availability of vehicle parking spaces and services at parking lots are displayed on the Vehicle ITS-S.

3.2.19.1.2. Information about on-street parking availability for urban freight (loading zones)

Test Case ID	UPA-02
Test Case Objective	To provide professional last-mile delivery drivers with near real-time information about the occupancy of loading zones. It also enables the optimization of the on-street loading zones, by providing insights about the use of these spaces to the administrators
Applicability	Using cellular networks.
C-MobILE Requirements	R/S03-UPA-01, R/S03-UPA-03, R/S03-UPA-04, R/S03-UPA-06, R/S03-UPA-07, R/S03-UPA-13.
Pre-test conditions	The loading zones in the city must be monitored, and the occupancy data transmitted to the traffic management centre. Sensing might come from fixed sensors, and/or from the fleet of cars equipped with ALPR cameras deployed by the metered parking, that will report occupancy data refreshed at least every 15 minutes. There is an app available to show the Open-Data information about parking availability.

Step	Description	Logging component	Logged data
1	The deliverer makes a request to the Open Data portal in order to know about the loading zones close to his delivery address, and checking their occupancy.	PID	Information request to the municipality Open Data Portal
2	The Service Provider Back Office/Data Provider Back Office receives the vehicle request	SPBO	Request received by Service Provider Back Office/ Data Provider Back Office

3	The deliverer receives information about occupancy in the loading zones close to his delivery address	PID	Information received about occupancy
4	When the vehicle parks, its presence is detected within the next 15 minutes (maximum).	SPBO	Municipality's central system.
5	When the vehicle leaves, the free spot in the loading zone is detected within 15 minutes at the most	SPBO	Municipality's central system.

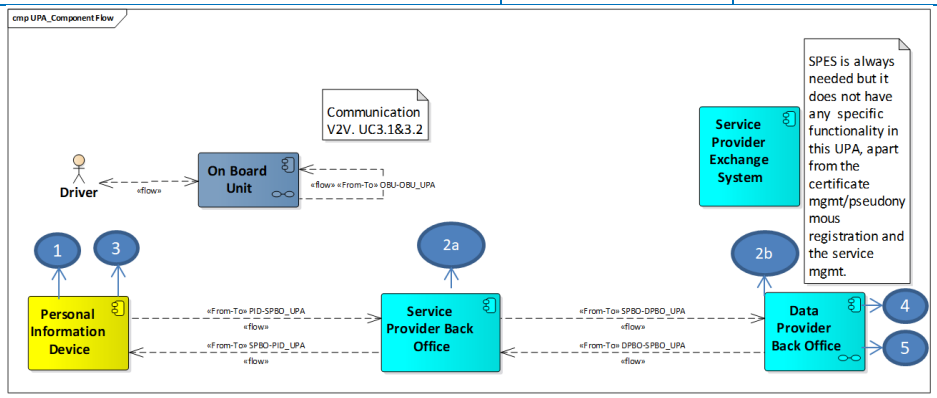


Figure 50. Logging steps in UPA-02 test scenario

Acceptance criteria

Test scenario UPA-02 is considered as passed if:

/ The free spot is detected within 15 minutes.

3.2.19.1.3. Information about on-street parking for private car drivers

Test Case ID	UPA-03
Test Case Objective	To help drivers for finding on-street parking, by informing them about the occupancy level for each street stretch. The service also includes specific information for disabled private drivers that can use the parking spots exclusively dedicated to them.
Applicability	Using cellular networks.
C-MobILE Requirements	R/S03-UPA-01, R/S03-UPA-03, R/S03-UPA-04, R/S03-UPA-06, R/S03-UPA-07, R/S03-UPA-13.
Pre-test conditions	The on-street metered parking operator has deployed a patrolling fleet of cars equipped with ALPR cameras that will detect cars parked on-street, and thus also parking space availability per block. Information will be refreshed every 15 minutes. There is an app available to show the Open-Data information about parking availability in Bilbao. Parking spaces reserved for the disabled might additionally be equipped with sensors to provide real-time information.

Step	Description	Logging component	Logged data
1a	The (disabled) driver who's searching for a parking space makes a request to the Open Data portal, stating that he/she is looking for a (reserved) parking space in a certain city street/area.	PID	Data request
2	The Service Provider/Data Provider Back Office receives the request	SPBO	Data request received

3	The car Driver receives information from the Open Data portal about occupancy of parking spaces	PID	Data received
4	When the car parks, a patrolling ALPR car detects the new parking within the next 15 minutes. Alternatively, a sensor might detect occupancy with shorter latency.	SPBO	Field data
5	When a car leaves, the free parking spot is detected within 15 minutes by a patrolling ALPR car (if no other car occupies the spot). Alternatively, a sensor might detect occupancy with shorter latency.	SPBO	Field data

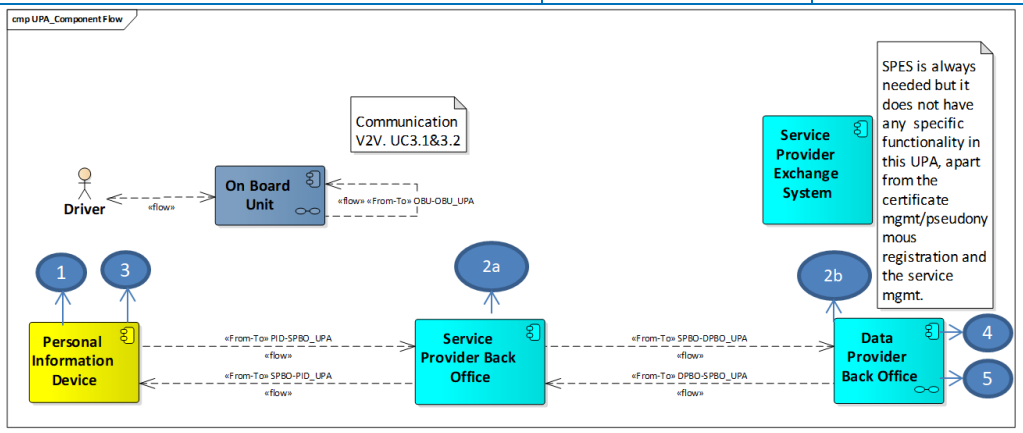


Figure 51. Logging steps in UPA-03 test scenario

Acceptance criteria

Test scenario UPA-03 is considered as passed if:

- Near-real time about parking availability (for private drivers and spaces reserved for people with disabilities) is available in the data provider portal.
- An app can correctly send requests and show the relevant information about parking availability to the driver.

3.2.19.2. Traceability Matrix

The traceability matrix is used to assist in determining the completeness of the requirements being met against the test scenarios.

The identifier for each of the requirements is placed in the first column while the identifiers for test scenarios are placed across the top row. When an item in the left column is related to an item across the top, a mark is placed in the intersecting cell. The number of relationships is added up for each row and each column. This value indicates the mapping of the two items. An empty value indicates that no relationship exists.

	Test scenarios	UPA-01	UPA-02	UPA-03
Requirements Tested		11	6	6
R/S03-UPA-01	3	X	X	X
R/S03-UPA-02	1	X		
R/S03-UPA-03	3	X	X	X
R/S03-UPA-04	2		X	X
R/S03-UPA-05	1	X		
R/S03-UPA-06	3	X	X	X
R/S03-UPA-07	3	X	X	X
R/S03-UPA-08	1	X		

R/S03-UPA-09	1	X		
R/S03-UPA-10	1	X		
R/S03-UPA-11	1	X		
R/S03-UPA-12	1	X		
R/S03-UPA-13	2		X	X

3.2.19.3. Communication performance – Latency

Total latency can be calculated from the moment a request is sent to the moment the reply is received.

In the case of cellular communication, latency is highly dependent on the network, which is out of scope of C-MobILE. Nevertheless the time the Open Data server needs for processing the request (from the moment it is received to when the reply is sent) will be measured.

3.2.20. Warning System for Pedestrians

3.2.20.1. Test Scenarios

3.2.20.1.1. Test scenario with 2 vehicles, no Road Side Units

Test Case ID	WSP-01
Test Case Objective	To test WSP functionality: A first vehicle sees a VRU. With a DENM message it averts a second vehicle..
Applicability	Two vehicles equipped with OBUs and sensors to detect VRUs with ETSI-G5 communication.
C-MobILE Requirements	R/S08-WSP-01, R/S08-WSP-02, R/S08-WSP-03, R/S08-WSP-06, R/S08-WSP-07, R/S08-WSP-09, R/S08-WSP-10, R/S08-WSP-11, R/S08-WSP-12
Pre-test conditions	Both vehicles are equipped with an OBU. One of the vehicles has a sensor that can detect the VRU. The second vehicle has an information system to inform the driver.

Step	Description	Logging component	Logged data
1	Vehicle 1 detects a VRU and sends a DENM message	OBU	Generated DENM with timestamp
2	Vehicle 2 receives a DENM message	OBU	Received DENM with reception timestamp
3	Vehicle shows warning in HMI since his position and direction matches the DENM information.	OBU	HMI log file (DENM, trajectory of the VRU and timestamp when warning is given)

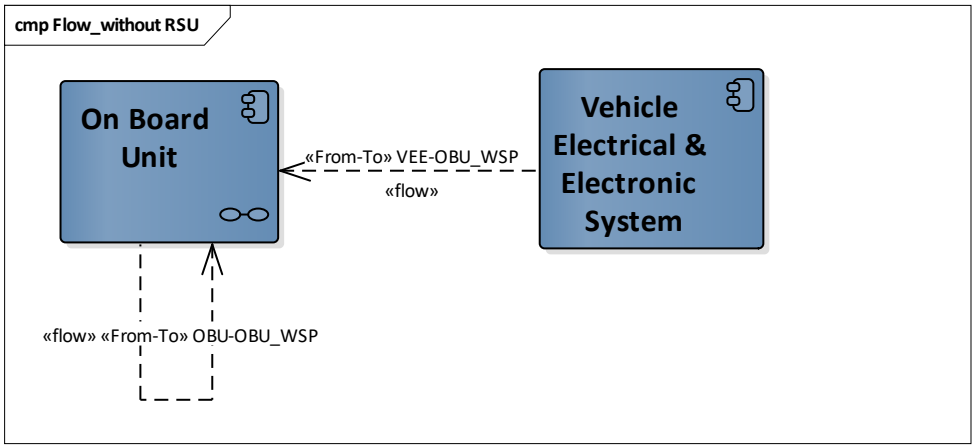
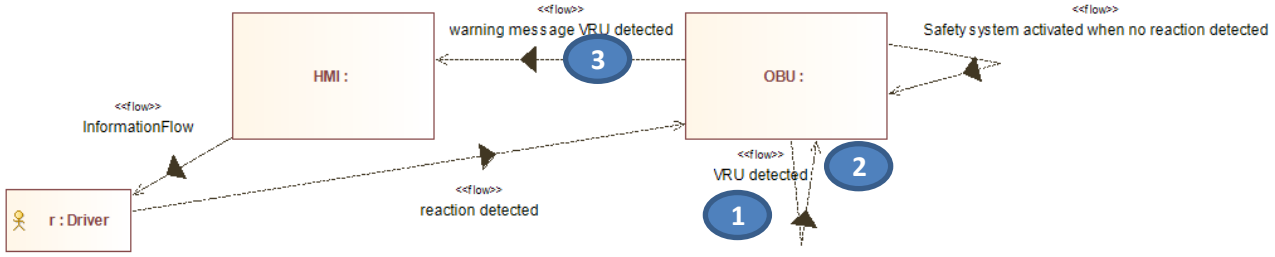


Figure 52. Logging steps in WSP-01 test scenario



Acceptance criteria
Test scenario WSP-01 is considered as passed if: / Latency (time elapsed between the VRU detection and the message on the HMI) is lower than 200 ms. / A warning is displayed to the user indication the presence of a VRU on the road. / When the warning is given to the user, the user is within the relevance area of the DENM message.

3.2.20.1.2. Test scenario Unsignalled crossing with RSU for VRU detection

Test Case ID	WSP-02
Test Case Objective	To test WSP functionality: A RSU sees a VRU. With a DENM message it averts a vehicle.
Applicability	Vehicle equipped with OBUs and RSU with sensors to detect VRUs and ETSI ITS-G5 communication.
C-MobILE Requirements	R/S08-WSP-01, R/S08-WSP-02, R/S08-WSP-03, R/S08-WSP-04, R/S08-WSP-06, R/S08-WSP-07, R/S08-WSP-09, R/S08-WSP-10, R/S08-WSP-11, R/S08-WSP-12
Pre-test conditions	Both vehicles are equipped with an OBU. One of the vehicles has a sensor that can detect the VRU. The second vehicle has an information system to inform the driver.

Step	Description	Logging component	Logged data
1	Vehicle sends a CAM message	OBU	Generated CAM with timestamp
2	RSU receives the CAM message	RSU	Received CAM with reception timestamp

3	RSU detects a VRU	RSU	RSU logfile (trajectory of the VRU)
4	RSU sends a DENM message	RSU	Generated DENM with timestamp
5	Vehicle receives the DENM message	OBU	Received DENM with reception timestamp
6	Vehicle shows warning in HMI since his position and direction matches the DENM information.	OBU	HMI log file (DENM, trajectory of the VRU and timestamp when warning is given)

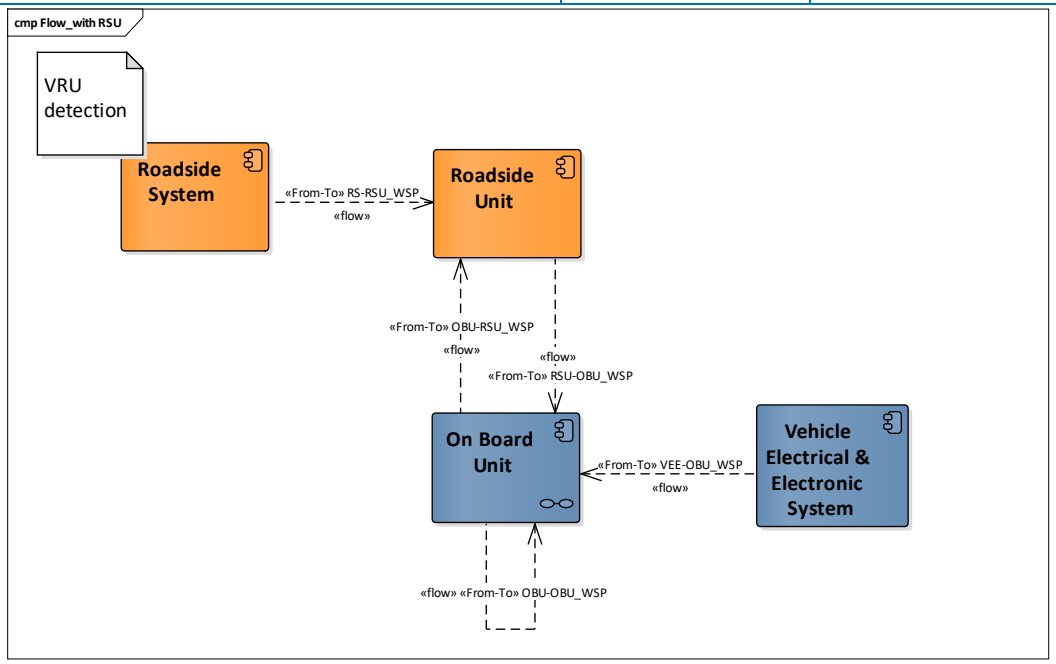
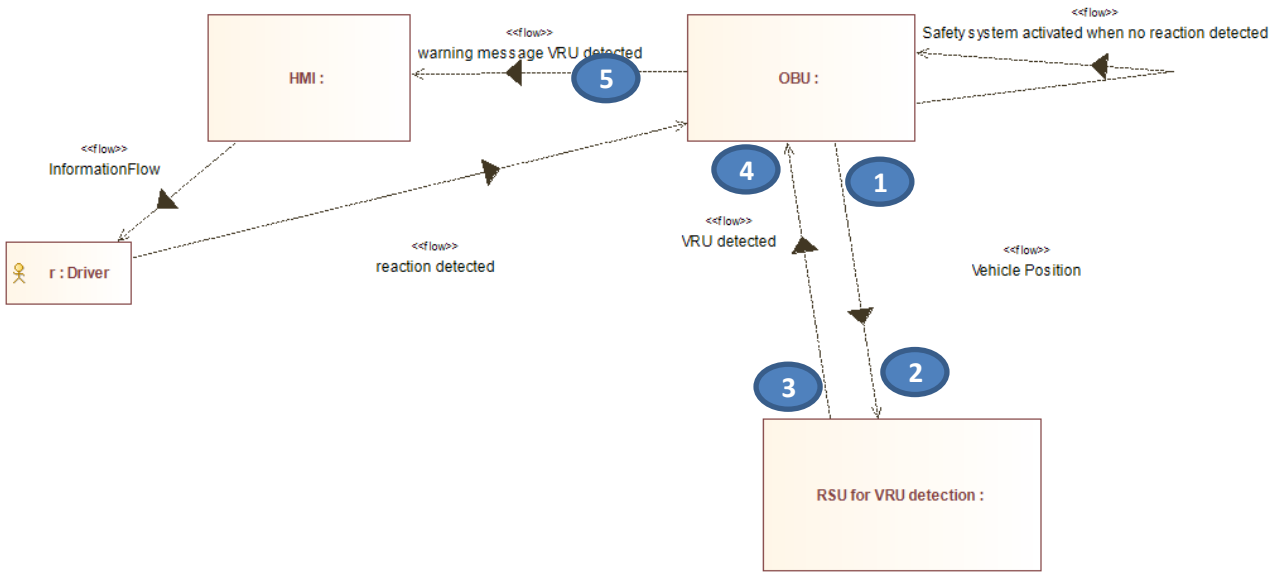


Figure 53. Logging steps in WSP-02 test scenario



Acceptance criteria

Test scenario WSP-02 is considered as passed if:

- Latency (time elapsed between the VRU detection and the message on the HMI) is lower than 200 ms.
- A warning is displayed to the user indication the presence of a VRU on the road.

/ When the warning is given to the user, the user is within the relevance area of the DENM message.

3.2.20.1.3. Test scenario Signaled crossing without RSU for VRU detection

Test Case ID	WSP-03
Test Case Objective	To test WSP functionality: Vehicle is informed about traffic light status. Only warns when VRU violates red light.
Applicability	Vehicle equipped with OBUs and Traffic light controller with ETSI ITS-G5 communication.
C-MobILE Requirements	R/S08-WSP-01, R/S08-WSP-02, R/S08-WSP-03, R/S08-WSP-04, R/S08-WSP-06, R/S08-WSP-07, R/S08-WSP-09, R/S08-WSP-10, R/S08-WSP-11, R/S08-WSP-12
Pre-test conditions	Two vehicles are equipped with an OBU a One of the vehicles has a sensor that can detect the VRU. The second vehicle has an information system to inform the driver. Traffic Light Controller that can send SPAT messages

Step	Description	Logging component	Logged data
1	Vehicle 1 sends a DENM message	OBU	Generated DENM with timestamp
2	Vehicle 2 receives a DENM message	OBU	Received DENM with reception timestamp
3	Traffic light controller sends a SPAT message	RSU	Generated SPAT with timestamp
4	Vehicle 2 received the SPAT message	RSU	Send SPAT with timestamp
5	Vehicle shows warning in HMI since his position and direction matches the DENM information.	OBU	HMI log file (DENM, trajectory of the VRU and timestamp when warning is given)

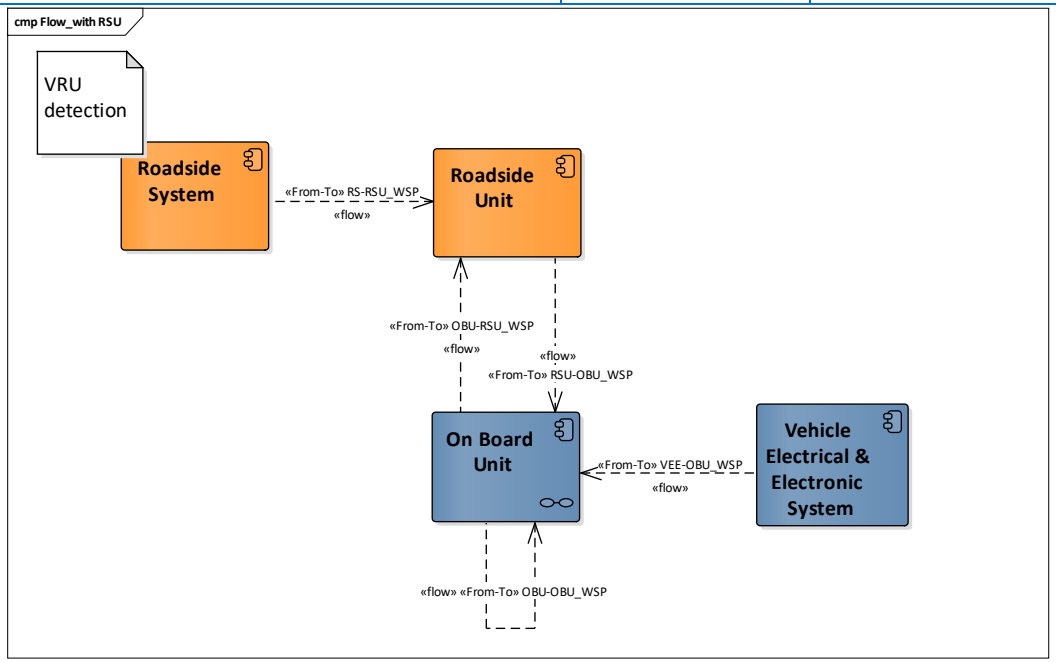
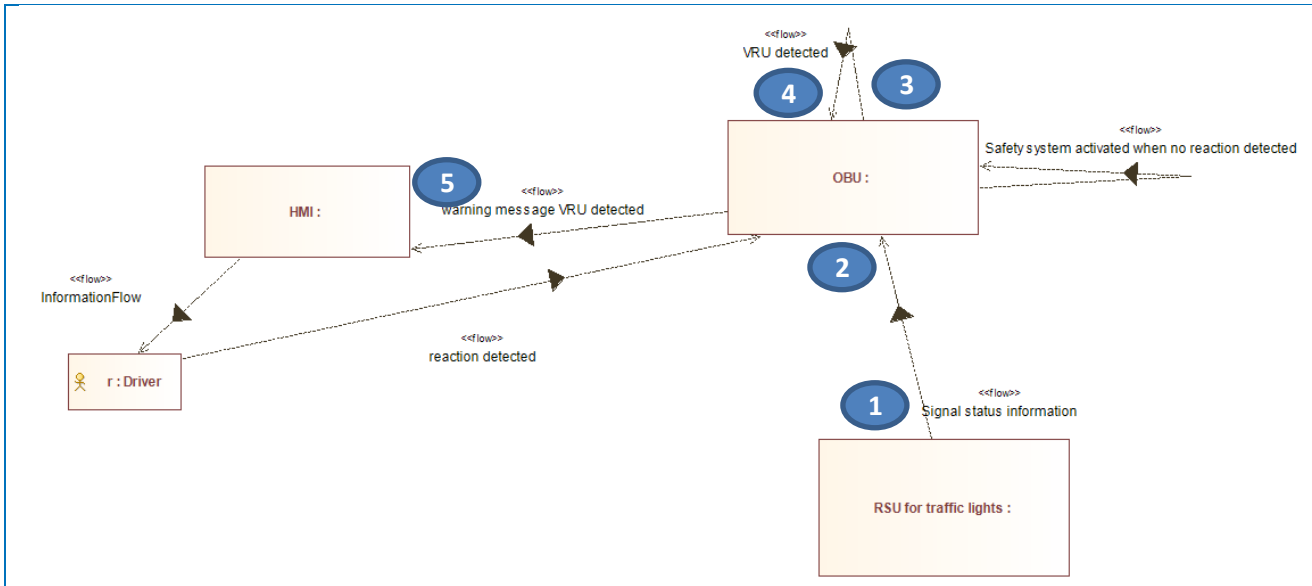


Figure 54. Logging steps in WSP-03 test scenario



Acceptance criteria

Test scenario WSP-03 is considered as passed if:

- Latency (time elapsed between the VRU detection and the message on the HMI) is lower than 200 ms.
- A warning is displayed to the user indication the presence of a VRU on the road.
- When the warning is given to the user, the user is within the relevance area of the DENM message.

3.2.20.1.4. Test scenario Signaled crossing with RSU for VRU detection

Test Case ID	WSP-04
Test Case Objective	To test WSP functionality: Roadside system is informed about traffic light status, can detect VRUs and is informed about the vehicle position. Only warns when VRU violates red light.
Applicability	Vehicle equipped with OBUs and Roadside system with ETSI ITS-G5 communication.
C-MobILE Requirements	R/S08-WSP-01, R/S08-WSP-02, R/S08-WSP-03, R/S08-WSP-04, R/S08-WSP-06, R/S08-WSP-07, R/S08-WSP-09, R/S08-WSP-10, R/S08-WSP-11, R/S08-WSP-12
Pre-test conditions	Vehicles is equipped with an OBU capable of ETSI ITS-G5 communication and an HMI The Roadside system has a sensor that can detect the VRU and a RSU. Traffic Light Controller that can send SPAT messages

Step	Description	Logging component	Logged data
1	Vehicle 1 sends a CAM	OBU	Generated CAM with timestamp
2a	The RSU receives the CAM message	RSU	Received CAM with reception timestamp
2b	The RSU sends the CAM message to the Roadside system	RSU	Generated CAM with timestamp
2c	The Roadside system receives the CAM message	RSU	Received CAM with reception timestamp
3	Traffic light controller sends a SPAT message	RSU	Generated SPAT with timestamp
4	Roadside system receives the SPAT message	RSU	Send SPAT with timestamp
5	The Roadside system detects a VRU	RSU	Detection with timestamp

6	The Roadside system does a risk calculation taking into account the trajectories of the Vehicle, the VRU and the status of the traffic light	RSU	Risk calculation result
7a	The Roadside system sends a DENM message to the RSU	RSU	Generated DENM with timestamp
7b	The RSU receives the DENM message	RSU	Received DENM with reception timestamp
7c	The RSU broadcasts the DENM message	RSU	Send DENM with timestamp
8	The vehicle OBU receives the DENM message	OBU	Received DENM with timestamp
9	Vehicle shows warning in HMI since his position and direction matches the DENM information.	OBU	HMI log file (DENM, trajectory of the VRU and timestamp when warning is given)

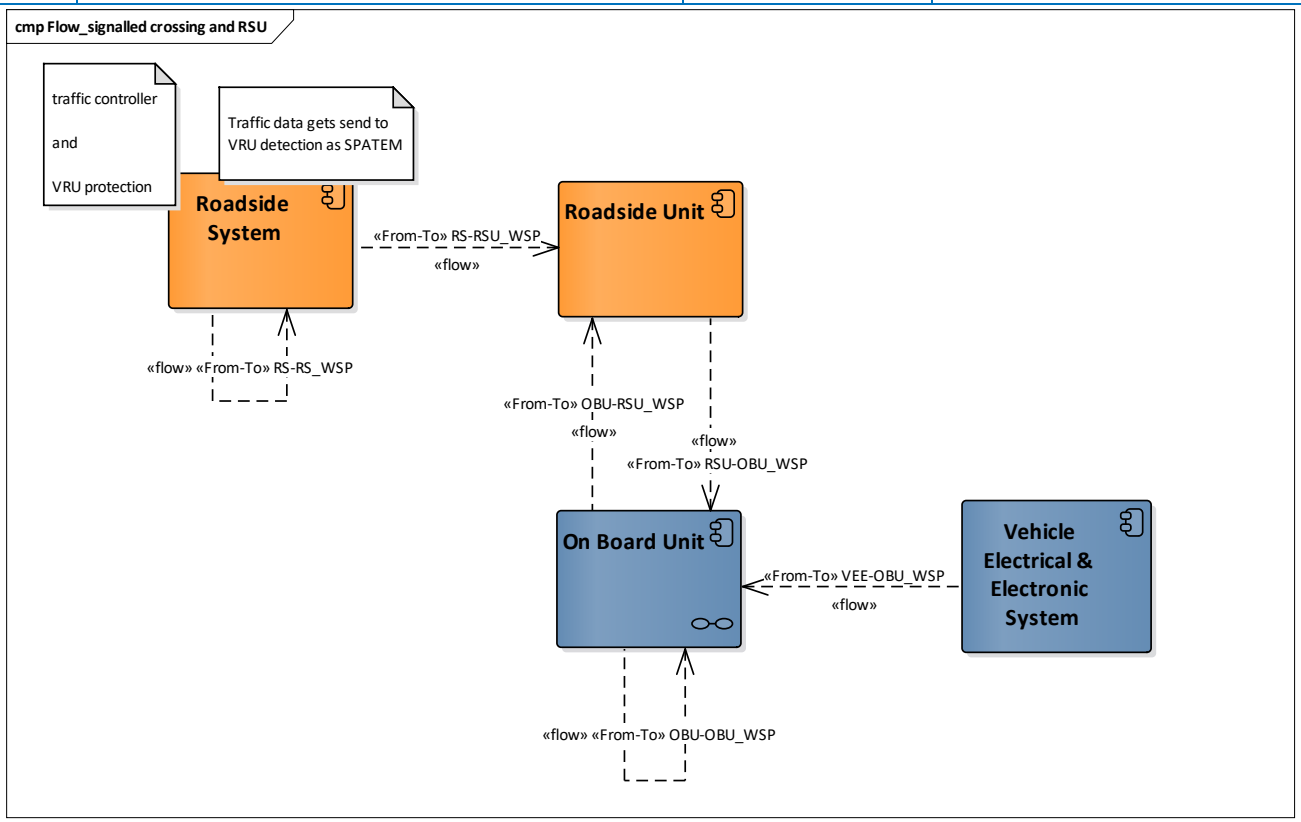
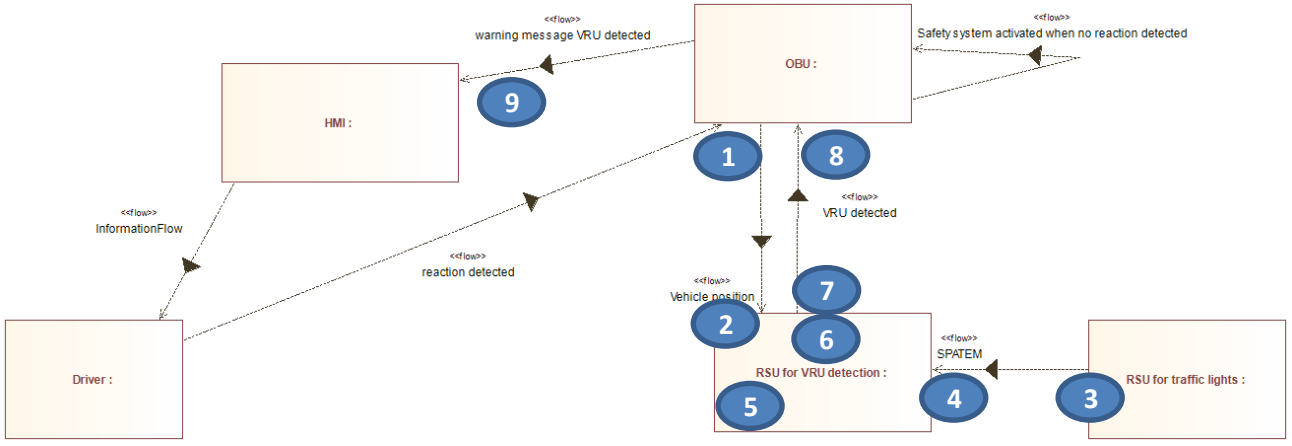


Figure 55. Logging steps in WSP-04 test scenario



Acceptance criteria
Test scenario WSP-04 is considered as passed if: / Latency (time elapsed between the VRU detection and the message on the HMI) is lower than 200 ms. / A warning is displayed to the user indication the presence of a VRU on the road. / When the warning is given to the user, the user is within the relevance area of the DENM message.

3.2.20.1.5. Test scenario VRU with cellular PID crossing an intersection crosswalk

Test Case ID	WSP-05
Test Case Objective	To test WSP functionality: a VRU with PID is at an intersection crosswalk. A vehicle turns in this intersection towards the VRU. The Vehicle receives a presence warning of VRUs.
Applicability	Cellular
C-MobILE Requirements	R/S08-WSP-01, R/S08-WSP-02, R/S08-WSP-03, R/S08-WSP-04, R/S08-WSP-06, R/S08-WSP-07, R/S08-WSP-09, R/S08-WSP-10, R/S08-WSP-11, R/S08-WSP-12
Pre-test conditions	A VRU with a PID approaches a crosswalk at an intersection. A vehicle approaches the intersection from a perpendicular road.

Step	Description	Logging component	Logged data
1	The VRU steps into the crosswalk. The PID sends a CAM to SPBO	SPBO	Received CAM
2	The SPBO generates a DENM and sends it to the CPBO	SPBO	Generated DENM
3	The vehicle approaches the intersection and turns towards road where the VRU is crossing.	PID	CAM/Vehicle data
4	The CPBO sends the DENM to the vehicle	PID	Received DENM
5	The PID displays a warning to the driver	PID	HMI log

Acceptance criteria
Test scenario WSP-05 is considered as passed if: / Latency (time elapsed between the VRU detection and the message on the HMI) is lower than 200 ms. / A warning is displayed to the user indication the presence of a VRU on the road. / When the warning is given to the user, the user is within the relevance area of the DENM message.

3.2.20.2. Traceability Matrix

The traceability matrix is used to assist in determining the completeness of the requirements being met against the test scenarios.

The identifier for each of the requirements is placed in the first column while the identifiers for test scenarios are placed across the top row. When an item in the left column is related to an item across the top, a mark is placed in the intersecting cell. The number of relationships is added up for each row and each column. This value indicates the mapping of the two items. An empty value indicates that no relationship exists.

	Test scenarios	WSP-01	WSP-02	WSP-03	WSP-04	WSP-05
Requirements Tested		9	10	11	11	11
R/S08-WSP-01	5	X	X	X	X	X
R/S08-WSP-02	5	X	X	X	X	X
R/S08-WSP-03	5	X	X	X	X	X
R/S08-WSP-04	4		X	X	X	X
R/S08-WSP-05	3			X	X	X
R/S08-WSP-06	5	X	X	X	X	X
R/S08-WSP-07	5	X	X	X	X	X
R/S08-WSP-08	0					
R/S08-WSP-09	5	X	X	X	X	X
R/S08-WSP-10	5	X	X	X	X	X
R/S08-WSP-11	5	X	X	X	X	X
R/S08-WSP-12	5	X	X	X	X	X

3.2.20.3. Communication performance – Latency

Total latency can be calculated from the moment that the service provider generates a DENM message and the moment the DENM message is received by the vehicle or personal information device.

In the case of ETSI G5, latency between RSUs and OBUs should be measured as well.

3.3. Technical validation of services in cross-modal operation

Two cross-test events were executed in Bordeaux and Thessaloniki DS.

Participating DS did test their service implementations against the host DS Communication Provider Back Office (CPBO).

The same tests defined in Section 3.2 were executed.

Due to time constraints a selection of services was tested, to cover the variety of C-MobILE messages:

- RWW and RHW, which use DENM.
- GLOSA which use MAPEM and SPATEM.
- IVS, which use IVIM.

Interoperability of other services will be tested in further events, both project-wide and through small agreements between DS.

The next event will be the C-MobILE testfest, planned for 2-4 of December 2019.

4. Results

An update of D2.3 [2] is expected by the end of the year 2019.

4.1. Architecture validation results

4.1.1. Global architecture requirements

Requirement	Result	Comments
R/G01-AR-02	Fulfilled	
R/G01-AR-03	Fulfilled	
R/G01-AR-04	Fulfilled	
R/G01-AR-05	Fulfilled	
R/G01-AR-06	Fulfilled	
R/G01-AR-08	Fulfilled	
R/G01-AR-11	Fulfilled	Ongoing
R/G01-AR-13	Fulfilled	
R/G03-OP-06	Fulfilled	
R/G03-OP-12	Fulfilled	Proposal turned into de facto standard
R/G03-OP-14	Fulfilled	
R/G05-SE-01	Unable to assess	At global level, there are registration server disagreements across DS.
R/G05-SE-02	Conditionally fulfilled	Some Pseudonyms implementations may be broken if the user is physically under vigilance.
R/G05-SE-03	Unable to assess	The authentication service is in development.
R/G05-SE-04	Fulfilled	
R/G05-SE-09	Conditionally fulfilled	EU Certificate Authority is not ready. C-MobILE architecture is prepared.
R/G05-SE-10	Fulfilled	
R/G05-SE-11	Unable to assess	The CA is not yet implemented,
R/G05-SE-18	Fulfilled	
R/G05-SE-23	Fulfilled	
R/G05-SE-24	Fulfilled	
R/G09-LE-17	Unable to assess	The payment methods are still not identified. This will be further developed in Tasks 4.5 and 6.4
R/G09-LE-19	Fulfilled	
R/G09-LE-20	Fulfilled	
R/G10-EC-02	Fulfilled	
R/G10-EC-05	Unable to assess	Output of Tasks 4.5 and 6.4

4.1.2. Deployment site requirements

There are requirements that do not apply to the implemented architecture of a DS (e.g. related to a communication protocol – ETSI ITS-G5 or cellular – which is not implemented in the DS). These are marked as N/A.

4.1.2.1. Barcelona

Requirement	Result	Comments
R/G01-AR-01	Not Fulfilled	Clocks are synchronized to EPOCH
R/G01-AR-07	Fulfilled	
R/G01-AR-09	Fulfilled	Services are implemented in Smartphones, not related to other vehicle systems
R/G01-AR-10	Fulfilled	Services are implemented through cellular communication, not involving any road system
R/G01-AR-12	Fulfilled	
R/G01-AR-14	Fulfilled	
R/G02-DE-03	Unable to assess	This will be the output of Tasks 4.3 and 6.5, which work is still ongoing.
R/G02-DE-04	Fulfilled	
R/G02-DE-05	Fulfilled	
R/G02-DE-06	Fulfilled	
R/G02-DE-12	Unable to assess	The DPO will be available on 2020. The services are implemented according to GDPR guidance, but the expert opinion of the DPO is not yet available.
R/G03-OP-01	Conditionally Fulfilled	Some fields are still not available on the Service provider
R/G03-OP-02	Fulfilled	
R/G03-OP-03	Not Fulfilled	Implementation still under development
R/G03-OP-04	Fulfilled	
R/G03-OP-05	Fulfilled	
R/G03-OP-07	Fulfilled	
R/G03-OP-08	N/A	Only cellular interfaces, there are no RSUs in Barcelona
R/G03-OP-09	N/A	Only cellular interfaces, there are no RSUs in Barcelona
R/G03-OP-10	Fulfilled	DATEX II implemented in data providers without previous interfaces.
R/G03-OP-11	N/A	Only cellular interfaces, there are no RSUs in Barcelona
R/G03-OP-13	N/A	Only cellular interfaces, there are no infrastructure components in Barcelona
R/G05-SE-12	Fulfilled	
R/G05-SE-13	Fulfilled	
R/G05-SE-14	Fulfilled	
R/G05-SE-15	Fulfilled	
R/G05-SE-16	Fulfilled	
R/G05-SE-17	Fulfilled	
R/G05-SE-19	Fulfilled	
R/G05-SE-20	Fulfilled	
R/G05-SE-21	Fulfilled	
R/G05-SE-22	N/A	Services are provided through personal smartphones
R/G05-SE-25	N/A	Services are free to use.

R/G05-SE-26	N/A	Services are free to use.
R/G06-AP-01	Fulfilled	
R/G06-AP-02	Fulfilled	
R/G06-AP-03	Fulfilled	
R/G06-AP-04	Fulfilled	
R/G06-AP-05	Fulfilled	
R/G06-AP-06	Fulfilled	
R/G06-AP-07	Fulfilled	
R/G06-AP-08	Fulfilled	
R/G06-AP-09	Fulfilled	
R/G06-AP-10	Fulfilled	
R/G06-AP-11	Fulfilled	
R/G06-AP-12	Fulfilled	
R/G06-AP-13	Fulfilled	
R/G06-AP-14	Fulfilled	
R/G06-AP-15	Fulfilled	
R/G06-AP-16	Fulfilled	
R/G06-AP-17	Fulfilled	
R/G06-AP-18	Not Fulfilled	Services implemented through Android "toasts" which have no day/night mode.
R/G07-HU-01	Fulfilled	
R/G07-HU-02	Fulfilled	
R/G07-HU-03	Fulfilled	
R/G07-HU-04	Fulfilled	
R/G07-HU-05	Fulfilled	
R/G08-SO-05	Fulfilled	
R/G09-LE-01	Unable to assess	The DPO will be available on 2020. The services are implemented according to GDPR guidance, but the expert opinion of the DPO is not yet available.
R/G09-LE-03	Fulfilled	
R/G09-LE-04	Conditionally fulfilled	The only processed information is the bare required for the services to work properly. There is no option to disable them other than stopping the services.
R/G09-LE-05	Conditionally fulfilled	The only processed information is the bare minimum required for the services to work properly. There is no option to disable them other than stopping the services.
R/G09-LE-06	Fulfilled	
R/G09-LE-07	Unable to assess	Information about the data flow is available in the ToS.
R/G09-LE-09	Fulfilled	
R/G09-LE-14	Fulfilled	
R/G09-LE-15	Not Fulfilled	The device does not distinguish between services. The device ID is shared between services.
R/G09-LE-16	Fulfilled	

R/G09-LE-18	Fulfilled	
R/G09-LE-21	Fulfilled	
R/G09-LE-22	Fulfilled	
R/G09-LE-23	Unable to assess	Application under development
R/G09-LE-24	Fulfilled	
R/G10-EC-01	Fulfilled	
R/G10-EC-03	Fulfilled	
R/G10-EC-04	Fulfilled	
R/G10-EC-06	N/A	Services are free to use.
R/G10-EC-08	Unable to assess	Services still under development
R/G11-EN-01	Fulfilled	
R/G11-EN-02	Fulfilled	
R/G11-EN-05	Fulfilled	
R/G11-EN-06	Fulfilled	
R/G11-EN-07	Fulfilled	

4.1.2.2. Bilbao

Test	Result	Comments
R/G01-AR-01	Not Fulfilled	The servers with open data information are not in TAI time
R/G01-AR-07	Fulfilled	
R/G01-AR-09	Fulfilled	Services are implemented in Smartphones, not related to other vehicle systems
R/G01-AR-10	Fulfilled	Services are implemented through cellular communication, not involving any road system
R/G01-AR-12	Not Fulfilled	Each service is implemented in a different app due to: -Some services (MPA) are implemented in a city that is not Bilbao (Vitoria-Gasteiz) -Some services are implemented with Bordeaux PID (RWW, RHW) -Strategy from Bilbao's municipality does not allow to merge a PoC service (BSD) with other services (UPA) at the official app
R/G01-AR-14	Fulfilled	Apps available in English and Spanish
R/G02-DE-03	Unable to assess	This will be the output of Tasks 4.3 and 6.5, which work is still ongoing.
R/G02-DE-04	Fulfilled	Maturity level is reflected at the deliverables
R/G02-DE-05	Conditionally Fulfilled	Services have been tested but probably the large scale deployment would be the best stress-test
R/G02-DE-06	Fulfilled	Bilbao city council currently has 2 official apps related with the services under deployment in C-MobILE. They attempt to integrate all the deployed services in the corresponding application by the end of the project. With more than 70,000 users between both applications.
R/G02-DE-12	Unable to assess	Implementation followed GDPR guidelines. Validation to be done by the DPO (available 2020)

R/G03-OP-01	Fulfilled	CAM messages are logged at 1Hz in app logging
R/G03-OP-02	Fulfilled	DENM messages implemented for BSD
R/G03-OP-03	N/A	Bilbao DS does not implement SPATEM messages
R/G03-OP-04	N/A	Bilbao DS does not implement SPATEM messages
R/G03-OP-05	Fulfilled	
R/G03-OP-07	Fulfilled	
R/G03-OP-08	N/A	Only cellular interfaces, there are no RSUs in Bilbao
R/G03-OP-09	N/A	Only cellular interfaces, there are no RSUs in Bilbao
R/G03-OP-10	Conditionally Fulfilled	UPA, RWW and RHW back-end uses DATEX II format. MPA and BSD no.
R/G03-OP-11	N/A	Only cellular interfaces, there are no RSUs in Bilbao
R/G03-OP-13	N/A	Only cellular interfaces, there are no infrastructure components in Bilbao
R/G05-SE-12	Not Fulfilled	PKI is not used. C-MobILE decision.
R/G05-SE-13	Fulfilled	
R/G05-SE-14	Fulfilled	
R/G05-SE-15	Fulfilled	
R/G05-SE-16	Fulfilled	
R/G05-SE-17	Fulfilled	
R/G05-SE-19	Fulfilled	
R/G05-SE-20	Fulfilled	
R/G05-SE-21	Fulfilled	
R/G05-SE-22	N/A	Services are provided through personal smartphones
R/G05-SE-25	N/A	There is no billing in Bilbao's services
R/G05-SE-26	N/A	There is no billing in Bilbao's services
R/G06-AP-01	Fulfilled	
R/G06-AP-02	Fulfilled	
R/G06-AP-03	Fulfilled	
R/G06-AP-04	Fulfilled	
R/G06-AP-05	Fulfilled	Apps like UPA and MPA do not use audible warning, it is not considered necessary. Just BSD app uses SOUND and VIBRATION since it is safety-critical.
R/G06-AP-06	Fulfilled	
R/G06-AP-07	Fulfilled	This function provides specific information about the service, data privacy and use of 3G/4G network
R/G06-AP-08	Fulfilled	
R/G06-AP-09	Fulfilled	
R/G06-AP-10	Fulfilled	
R/G06-AP-11	Fulfilled	

R/G06-AP-12	Fulfilled	
R/G06-AP-13	Fulfilled	
R/G06-AP-14	Fulfilled	
R/G06-AP-15	Fulfilled	
R/G06-AP-16	Fulfilled	
R/G06-AP-17	Conditionally Fulfilled	Each service works on a different app.
R/G06-AP-18	Fulfilled	
R/G07-HU-01	Fulfilled	
R/G07-HU-02	Fulfilled	
R/G07-HU-03	N/A	Implemented services do not interfere in the driving tasks
R/G07-HU-04	Conditionally Fulfilled	Each service works on a different app. However, if more than one app would be running at the same time, just the safety-critical services show a notification and sound + vibration if activated.
R/G07-HU-05	Fulfilled	
R/G08-SO-05	Fulfilled	
R/G09-LE-01	Unable to assess	Implementation followed GDPR guidelines. Validation to be done by the DPO (available 2020)
R/G09-LE-03	Fulfilled	
R/G09-LE-04	Fulfilled	There is a message warning about the record of GPS data
R/G09-LE-05	N/A	No personal data are recorded
R/G09-LE-06	Fulfilled	The user could deactivate de GPS of his/her smartphone
R/G09-LE-07	Fulfilled	Help function provides specific information about the service, data privacy and use of 3G/4G network
R/G09-LE-09	Fulfilled	Help function provides specific information about the service, data privacy and use of 3G/4G network
R/G09-LE-14	Fulfilled	
R/G09-LE-15	Fulfilled	
R/G09-LE-16	Fulfilled	
R/G09-LE-18	Fulfilled	
R/G09-LE-21	Fulfilled	
R/G09-LE-22	Fulfilled	
R/G09-LE-23	Fulfilled	
R/G09-LE-24	Fulfilled	
R/G10-EC-01	Fulfilled	
R/G10-EC-03	Fulfilled	
R/G10-EC-04	Not Fulfilled	Each service has a separate app associated
R/G10-EC-06	N/A	There is no billing in Bilbao's services
R/G10-EC-08	Fulfilled	
R/G11-EN-01	Fulfilled	

R/G11-EN-02	Fulfilled	
R/G11-EN-05	Fulfilled	
R/G11-EN-06	Fulfilled	
R/G11-EN-07	Fulfilled	

4.1.2.3. Bordeaux

Requirement	Result	Comments
R/G01-AR-01	Fulfilled	
R/G01-AR-07	Fulfilled	
R/G01-AR-09	Fulfilled	
R/G01-AR-10	Fulfilled	
R/G01-AR-12	Fulfilled	
R/G01-AR-14	Fulfilled	
R/G02-DE-03	Fulfilled	
R/G02-DE-04	Fulfilled	
R/G02-DE-05	Fulfilled	
R/G02-DE-06	Fulfilled	
R/G02-DE-12	Fulfilled	
R/G03-OP-01	Fulfilled	
R/G03-OP-02	Fulfilled	
R/G03-OP-03	Fulfilled	
R/G03-OP-04	Fulfilled	
R/G03-OP-05	Fulfilled	
R/G03-OP-07	Fulfilled	
R/G03-OP-08	Fulfilled	
R/G03-OP-09	Fulfilled	
R/G03-OP-10	Conditionally Fulfilled	There are several sources for messages, including opendata which don't use DATEX2. These sources cannot be changed.
R/G03-OP-11	Fulfilled	
R/G03-OP-13	Fulfilled	
R/G05-SE-12	Fulfilled	
R/G05-SE-13	Fulfilled	
R/G05-SE-14	Fulfilled	
R/G05-SE-15	Fulfilled	
R/G05-SE-16	Fulfilled	
R/G05-SE-17	Fulfilled	
R/G05-SE-19	Fulfilled	
R/G05-SE-20	Fulfilled	
R/G05-SE-21	Fulfilled	
R/G05-SE-22	Fulfilled	
R/G05-SE-25	N/A	No billing

R/G05-SE-26	N/A	No billing
R/G06-AP-01	Fulfilled	
R/G06-AP-02	Fulfilled	
R/G06-AP-03	Fulfilled	
R/G06-AP-04	Fulfilled	
R/G06-AP-05	Fulfilled	
R/G06-AP-06	Fulfilled	
R/G06-AP-07	Fulfilled	
R/G06-AP-08	Conditionally Fulfilled	GLOSA is shown in km/h as our C-MobILE application is relevant only in countries that use this unit. An option for displaying in miles will be added when it will be necessary.
R/G06-AP-09	Fulfilled	
R/G06-AP-10	Fulfilled	
R/G06-AP-11	Fulfilled	
R/G06-AP-12	Fulfilled	
R/G06-AP-13	Fulfilled	
R/G06-AP-14	Fulfilled	
R/G06-AP-15	Fulfilled	
R/G06-AP-16	Fulfilled	
R/G06-AP-17	Fulfilled	
R/G06-AP-18	Fulfilled	
R/G07-HU-01	Fulfilled	
R/G07-HU-02	Fulfilled	
R/G07-HU-03	Fulfilled	
R/G07-HU-04	Fulfilled	
R/G07-HU-05	Fulfilled	
R/G08-SO-05	N/A	Age of the driver is unknown since the android app is available anonymously on Google Play.
R/G09-LE-01	Fulfilled	
R/G09-LE-03	N/A	No data stored since it is not compliant with GDPR rules. All the data is sent in real time to the evaluation database.
R/G09-LE-04	N/A	No data stored since it is not compliant with GDPR rules. All the data is sent in real time to the evaluation database.
R/G09-LE-05	N/A	No data stored since it is not compliant with GDPR rules. All the data is sent in real time to the evaluation database.
R/G09-LE-06	N/A	No data stored since it is not compliant with GDPR rules. All the data is sent in real time to the evaluation database.
R/G09-LE-07	Fulfilled	
R/G09-LE-09	Fulfilled	
R/G09-LE-14	Fulfilled	
R/G09-LE-15	Fulfilled	
R/G09-LE-16	Fulfilled	

R/G09-LE-18	Fulfilled	
R/G09-LE-21	Not Fulfilled	The speed limits are not known to the application, and the speed of the driver is sent in the CAM. So, the app can't stop to emit CAM when the driver is over the speed limit
R/G09-LE-22	Fulfilled	
R/G09-LE-23	Fulfilled	
R/G09-LE-24	Fulfilled	
R/G10-EC-01	Fulfilled	
R/G10-EC-03	Fulfilled	
R/G10-EC-04	Fulfilled	
R/G10-EC-06	Fulfilled	
R/G10-EC-08	Fulfilled	
R/G11-EN-01	Fulfilled	
R/G11-EN-02	Fulfilled	
R/G11-EN-05	Fulfilled	
R/G11-EN-06	Fulfilled	
R/G11-EN-07	Fulfilled	

4.1.2.4. Copenhagen

Requirement	Result	Comments
R/G01-AR-01	Fulfilled	
R/G01-AR-07	Unable to assess	We are in the process of upgrading all the RSU's in Copenhagen to 2016. First 6 to be done before the end of the year. It is therefore too early to assess this.
R/G01-AR-09	Unable to assess	We are in the process of upgrading all the RSU's in Copenhagen to 2016. First 6 to be done before the end of the year.
R/G01-AR-10	Unable to assess	We are in the process of upgrading all the RSU's in Copenhagen to 2016. First 6 to be done before the end of the year.
R/G01-AR-12	Fulfilled	Bundling is followed in the same way as other DS
R/G01-AR-14	Conditionally Fulfilled	Most of the documents will be in English
R/G02-DE-03	Fulfilled	
R/G02-DE-04	Fulfilled	Dynniq OBU was present at the Bordeaux interoperability test.
R/G02-DE-05	Conditionally Fulfilled	HMI is still under development stage and we are in the process of upgrading RSU to 2016 standards. Service performance could be tested before the end of the year.
R/G02-DE-06	Unable to assess	Most systems are still under development, it's too early to evaluate this.
R/G02-DE-12	Fulfilled	No data is stored in the CPH DS. Central logging of C-MobILE should be assessed separately.
R/G03-OP-01	Fulfilled	
R/G03-OP-02	N/A	

R/G03-OP-03	Fulfilled	
R/G03-OP-04	Fulfilled	
R/G03-OP-05	Fulfilled	
R/G03-OP-07	Fulfilled	For OBU
R/G03-OP-08	N/A	
R/G03-OP-09	N/A	
R/G03-OP-10	Not Fulfilled	DATEX II is not used in the Copenhagen DS. This is due to dependence on already existing external systems
R/G03-OP-11	Fulfilled	
R/G03-OP-13	Fulfilled	
R/G05-SE-12	Conditionally Fulfilled	RWW data is pulled from a public database. This is due to dependence on already existing external systems
R/G05-SE-13	Fulfilled	
R/G05-SE-14	Fulfilled	
R/G05-SE-15	Fulfilled	
R/G05-SE-16	Unable to assess	We are in the process of upgrading all the RSU's in Copenhagen to 2016. First 6 to be done before the end of the year.
R/G05-SE-17	Fulfilled	
R/G05-SE-19	Unable to assess	We are in the process of upgrading all the RSU's in Copenhagen to 2016. First 6 to be done before the end of the year.
R/G05-SE-20	Unable to assess	We are in the process of upgrading all the RSU's in Copenhagen to 2016. First 6 to be done before the end of the year.
R/G05-SE-21	Fulfilled	
R/G05-SE-22	Fulfilled	
R/G05-SE-25	N/A	
R/G05-SE-26	N/A	
R/G06-AP-01	Fulfilled	The HMI shows connectivity to the OBU and the phone itself shows connectivity to the internet.
R/G06-AP-02	N/A	
R/G06-AP-03	Fulfilled	
R/G06-AP-04	Fulfilled	
R/G06-AP-05	Fulfilled	the sound is subtle and should not interfere with other services such as music streaming either.
R/G06-AP-06	N/A	
R/G06-AP-07	Not Fulfilled	The HMI is designed to be self-explanatory in its functions
R/G06-AP-08	Fulfilled	km used
R/G06-AP-09	Fulfilled	Audio enabled
R/G06-AP-10	Not Fulfilled	Much difference among sites because of different user preferences
R/G06-AP-11	Conditionally Fulfilled	The app is simply designed and only has two windows. Switch is easy between the two.

R/G06-AP-12	Fulfilled	
R/G06-AP-13	Fulfilled	
R/G06-AP-14	Fulfilled	
R/G06-AP-15	Fulfilled	
R/G06-AP-16	Not Fulfilled	Language is barely used in the app, mostly icons
R/G06-AP-17	Not Fulfilled	All C-MobILE services in one
R/G06-AP-18	Not Fulfilled	
R/G07-HU-01	Fulfilled	The HMI has a minimal interface showing GLOSA on most of the screen, with the other services as smaller icons.
R/G07-HU-02	Fulfilled	The information shown is does not contain unnecessary graphical elements. Sound option is provided for the Bicycle mode for the cyclists to be fully aware of their surroundings. Audio is non-verbal and minimal.
R/G07-HU-03	Conditionally Fulfilled	If speed limit is exceeded information is turned off and warning is shown. If GLOSA advice exceeds speed limit (or for cyclists possible cycling speeds) time to green/time to red is shown instead. NASA-TLX has not been applied.
R/G07-HU-04	Fulfilled	GLOSA is prioritized as a "behavioral change" service and is therefore shown continuously and larger than the other services. The other services act as information for the driver, where actual traffic and physical signage must be referred to for detailed warnings and advice.
R/G07-HU-05	Fulfilled	Information such as GLOSA shuts down +/- 10 meter prior to an intersection and a warning to watch traffic is shown. Furthermore, the terms and conditions state that the information is meant as guidance and the real traffic situation is more important.
R/G08-SO-05	Not Fulfilled	Users such as cyclists and trucks etc. are targeted, not based on age
R/G09-LE-01	Fulfilled	No data is stored in the CPH DS. Central logging of C-MobILE should be assessed separately.
R/G09-LE-03	Fulfilled	No personal data collected
R/G09-LE-04	Fulfilled	No personal data collected
R/G09-LE-05	Fulfilled	No personal data collected
R/G09-LE-06	Fulfilled	We cannot identify the person who has given consent as no personal data is collected
R/G09-LE-07	Fulfilled	No personal data collected
R/G09-LE-09	Fulfilled	No personal data collected
R/G09-LE-14	Fulfilled	
R/G09-LE-15	N/A	
R/G09-LE-16	Fulfilled	No personal data collected
R/G09-LE-18	Fulfilled	No personal data collected

R/G09-LE-21	Conditionally Fulfilled	We do get the GPS point and from there one could calculate the driving speed. But this speed and the GPS points on which it is based cannot be referred to a driver.
R/G09-LE-22	Fulfilled	
R/G09-LE-23	Fulfilled	
R/G09-LE-24	Fulfilled	Information shuts off automatically if speed limit is exceeded
R/G10-EC-01	Fulfilled	
R/G10-EC-03	Not Fulfilled	At odds with the simple design requirement
R/G10-EC-04	Not Fulfilled	The user does not choose bundles, all information is given on the same app and window.
R/G10-EC-06	N/A	No payment required
R/G10-EC-08	Not Fulfilled	
R/G11-EN-01	Fulfilled	
R/G11-EN-02	Fulfilled	
R/G11-EN-05	Fulfilled	
R/G11-EN-06	Fulfilled	
R/G11-EN-07	Fulfilled	Several papers presented at ITS World/Europe congresses demonstrate the efficiency of the C-MobILE architecture compared to its predecessors

4.1.2.5. Newcastle

Requirement	Result	Comments
R/G01-AR-01	Unable to assess	SPAT uses UTC. DENM available Nov 2019
R/G01-AR-07	Fulfilled	Government RWW, RHW source, City TLCs and UTC
R/G01-AR-09	Fulfilled	PID is independent
R/G01-AR-10	Fulfilled	GLOSA, priority implemented with TLC
R/G01-AR-12	Unable to assess	4G RWW/RHW available Nov 2019. To be verified Nov 2019
R/G01-AR-14	Fulfilled	All documentation is in English
R/G02-DE-03	Conditionally Fulfilled	Modifications to BC expected through operational phase/ evaluation process
R/G02-DE-04	Fulfilled	
R/G02-DE-05	Conditionally Fulfilled	Existing services on ETSI 2015 are undergoing SAT and are functional and robust.
R/G02-DE-06	Conditionally Fulfilled	Logging, event aggregation will be in cloud so ready for scaling
R/G02-DE-12	Conditionally Fulfilled	Data logging yet to commence but GDPR is under compliance. Testing Dec 2019.
R/G03-OP-01	Fulfilled	
R/G03-OP-02	Conditionally Fulfilled	We are about to use DENMs to distribute Road hazard warning and roadworks messages into the GeoMessaging platform. Testing Dec 2019.
R/G03-OP-03	Fulfilled	

R/G03-OP-04	Fulfilled	
R/G03-OP-05	Fulfilled	
R/G03-OP-07	Not Fulfilled	Not currently provided, but will be added by HMI developer. Testing Dec 2019.
R/G03-OP-08	N/A	No VRU DENM use case
R/G03-OP-09	Not Fulfilled	Siemens not able to provide this at the current time
R/G03-OP-10	Not Fulfilled	Using AMQP as per InterCor
R/G03-OP-11	Fulfilled	
R/G03-OP-13	Fulfilled	
R/G05-SE-12	Fulfilled	
R/G05-SE-13	Fulfilled	Personal data will include location data, which has been collected in tests.
R/G05-SE-14	Fulfilled	Personal data will include location data, which has been collected in tests.
R/G05-SE-15	Fulfilled	Personal data will include location data, which has been collected in tests.
R/G05-SE-16	Not Fulfilled	A Mean of Validation is under development. This is context specific and will be difficult to demonstrate (especially anything over the mobile network, GeoMessaging, as latency is not guaranteed)
R/G05-SE-17	Not Fulfilled	A Mean of Validation is under development
R/G05-SE-19	Not Fulfilled	A Mean of Validation is under development
R/G05-SE-20	Not Fulfilled	A Mean of Validation is under development
R/G05-SE-21	Not Fulfilled	A Mean of Validation is under development
R/G05-SE-22	Fulfilled	
R/G05-SE-25	Conditionally Fulfilled	Using NeoGLS GeoMessaging server – Planned by Dec 2019
R/G05-SE-26	Conditionally Fulfilled	Using NeoGLS GeoMessaging server – Planned by Dec 2019
R/G06-AP-01	Not Fulfilled	Not currently provided but will be added by HMI developer. Testing in Dec 2019
R/G06-AP-02	Unable to assess	This will be performed through driver testing. To be verified Nov-Dec 2019
R/G06-AP-03	Unable to assess	This will be performed through driver testing. To be verified Nov-Dec 2019
R/G06-AP-04	Fulfilled	Test runs have revealed no negative impacts
R/G06-AP-05	Fulfilled	The interface is primarily visual. There are audio options but these can be disabled
R/G06-AP-06	Fulfilled	The driver can disable or configure the on-board device
R/G06-AP-07	Not Fulfilled	
R/G06-AP-08	Fulfilled	The app shows appropriate speed measurements
R/G06-AP-09	Fulfilled	The interface is primarily visual. There are audio options but these can be disabled
R/G06-AP-10	Fulfilled	C-MobILE branding is included
R/G06-AP-11	Conditionally Fulfilled	
R/G06-AP-12	Unable to assess	

R/G06-AP-13	Fulfilled	
R/G06-AP-14	Fulfilled	The HMI is intuitive and easy to navigate. Use is supplemented by dedicated driver training sessions
R/G06-AP-15	Fulfilled	Information is clear, concise and consistent throughout the app
R/G06-AP-16	Fulfilled	All services provided in English
R/G06-AP-17	Conditionally Fulfilled	Conditionally fulfilled in test runs - This will be fulfilled through driver testing. To be fulfilled Nov 2019
R/G06-AP-18	Fulfilled	Supported by the phones OS
R/G07-HU-01	Unable to assess	This will be fulfilled through driver testing. To be fulfilled Nov 2019
R/G07-HU-02	Conditionally Fulfilled	This will be fulfilled through driver testing. Conditionally fulfilled through design involving drivers, management and trade unions, to avoid cognitive overload. In line with UK regulations on information displayed in cab (V5 compliance). Not demonstrated in roll out as yet though. To be fulfilled Nov-Dec 2019
R/G07-HU-03	Not Fulfilled	Zircon is developing method to demonstrate/test that the limits around driver behaviour (as implemented) work as expected. Mean of Validation under development
R/G07-HU-04	Unable to assess	This will be fulfilled through driver testing. Prioritization of services exists but needs to be tested in operational setting. To be verified Nov-Dec 2019
R/G07-HU-05	Fulfilled	Fleet drivers are aware that the systems augment but do not replace existing training and driving practices
R/G08-SO-05	N/A	
R/G09-LE-01	Fulfilled	Through data management activities of the project
R/G09-LE-03	Unable to assess	Personal data is not required for the DS services but may be collected as part of the subjective evaluation (e.g. through questionnaires). Timeline: end of subjective evaluation phase and in collaboration with WP6
R/G09-LE-04	Unable to assess	Personal data is not required for the DS services but may be collected as part of the subjective evaluation (e.g. through questionnaires). Anonymity will be respected and personal data will be optional. Timeline: subjective evaluation phase (from Oct 2019)
R/G09-LE-05	Unable to assess	Personal data is not required for the DS services. Subjective data will only be processed for subjective evaluation then deleted. Timeline: End of subjective evaluation phase and in collaboration with WP6
R/G09-LE-06	Unable to assess	Full ethical good practice, including participant consent, will be observed. Anonymity will be respected and personal data will be optional. Timeline-subjective evaluation phase (from Oct 2019)

R/G09-LE-07	Unable to assess	Full ethical good practice, including participant consent, will be observed. Anonymity will be respected and personal data will be optional. Timeline-subjective evaluation phase (from Oct 2019)
R/G09-LE-09	Unable to assess	This is part of the consent process. Anonymity will be respected and personal data will be optional. Timeline: subjective evaluation phase (from Oct 2019)
R/G09-LE-14	Fulfilled	No personal data is collected by the system. Users have to activate the system
R/G09-LE-15	Unable to assess	This will be performed through driver testing and data transfer to local server. To be verified Nov 2019
R/G09-LE-16	Unable to assess	Access to personal data will be for subjective evaluation only. Anonymity will be respected and personal data will be optional. Timeline: subjective evaluation phase (from Oct 2019)
R/G09-LE-18	Unable to assess	Access to personal data will be for subjective evaluation only and will be analysed by the assessor only. Anonymity will be respected and personal data will be optional. Timeline: subjective evaluation phase (from Oct 2019)
R/G09-LE-21	Fulfilled	Not built into app functionality.
R/G09-LE-22	Fulfilled	All service deployment is done in line within local and national regulatory framework
R/G09-LE-23	Unable to assess	To be implemented with individual driver training. To be verified Nov-Dec 2019
R/G09-LE-24	Fulfilled	A prerequisite of the implementation of CITS services
R/G10-EC-01	Conditionally Fulfilled	Evaluation and development of future business plan/ funding model will determine this. To be fulfilled from 2020. Mean of Validation - business plan
R/G10-EC-03	Unable to assess	Not currently provided, but will be added by HMI developer. To be verified Dec 2019
R/G10-EC-04	Unable to assess	To be performed with individual driver training. To be verified Nov-Dec 2019
R/G10-EC-06	N/A	There are no terms of payment
R/G10-EC-08	Unable to assess	Relates to cellular services (RHW/RWW). Drivers to be informed at individual training sessions. To be verified during training of drivers for cellular services Nov-Dec 2019
R/G11-EN-01	Conditionally Fulfilled	A pre-condition of the NCL DS deployment is to improve environmental sustainability of transport services. Impact evaluation will determine this (2020)
R/G11-EN-02	Conditionally Fulfilled	A pre-condition of the deployment is to improve environmental sustainability of transport services. Evaluation will determine this (2020)
R/G11-EN-05	Fulfilled	
R/G11-EN-06	Conditionally Fulfilled	Will be fulfilled when project finishes and services continue. Mean of Validation - continued operation after Nov 2020
R/G11-EN-07	Conditionally Fulfilled	The operational phase may reveal further improvements that can be made

4.1.2.6. North Brabant

Requirement	Result	Comments
R/G01-AR-01	Fulfilled	
R/G01-AR-07	Fulfilled	Road side systems are deployed and integrated with the existing infrastructure of the city. The roadside equipment is integrated and connected to the local Talking traffic project and information of both projects are cooperating with both services of 4G and G5.
R/G01-AR-09	Fulfilled	
R/G01-AR-10	Fulfilled	
R/G01-AR-12	Fulfilled	The roadside equipment installed in Helmond is integrating and supporting all use cases for both 4G and G5 according to the local iVRI specification. The combination of the OBU and GreenFlow app is bundling various use cases like GLOSA, RWW, RHW and EVW. The GreenFlow app is supporting both G5 connection as 4G connection for all mentioned use cases.
R/G01-AR-14	Conditionally Fulfilled	Most of documentation will be in English
R/G02-DE-03	Unable to assess	This is the output of T4.3 and T6.4
R/G02-DE-04	Fulfilled	Planned to roll out 104 OBU's in trucks (roll out has not taken place yet). Installed 45 Roadside unit's in Helmond. 40% currently active, the rest will be commissioned in November. All road side units support both 4G and G5.
R/G02-DE-05	Fulfilled	Already done for Talking Traffic
R/G02-DE-06	Fulfilled	1.) Roadside units installed in the field and communicating with traffic lights (see also comments on R/G02 -DE-04) 2.) OBU's in final test stage and field trials, almost ready for roll out on 104 trucks. P211DS 3.) 4G needs to be ready for large scale deployment.
R/G02-DE-12	Unable to assess	DPO still not available for C-MobILE. Developers i.e. Dynniq, MACQ (and IDIADA for cellular app). Made efforts to ensure GDPR compliance in the implementation.
R/G03-OP-01	Fulfilled	
R/G03-OP-02	Fulfilled	
R/G03-OP-03	Fulfilled	
R/G03-OP-04	Fulfilled	
R/G03-OP-05	Fulfilled	Information has to be saved in the CAM message
R/G03-OP-07	Fulfilled	For OBU
R/G03-OP-08	Fulfilled	
R/G03-OP-09	Fulfilled	
R/G03-OP-10	Unable to assess	DATEX II is not used in the North Brabant DS, they are working with the standardized Talking Traffic architecture.
R/G03-OP-11	Fulfilled	

R/G03-OP-13	Fulfilled	
R/G05-SE-12	Conditionally Fulfilled	The system is prepared for the PKI security standard. In North Brabant there is chosen to roll out without PKI security. This due to the fact that Talking Traffic does not yet use the PKI standard.
R/G05-SE-13	Fulfilled	In North Brabant all the AVG rules are applied
R/G05-SE-14	Conditionally Fulfilled	The data is not encrypted during transfer, although the AVG rules are applied
R/G05-SE-15	Fulfilled	In North Brabant all the AVG rules are applied
R/G05-SE-16	Fulfilled	
R/G05-SE-17	Fulfilled	
R/G05-SE-19	Fulfilled	
R/G05-SE-20	Fulfilled	The system is prepared for the PKI security standard. In North Brabant there is chosen to roll out without PKI security. This due to the fact that Talking Traffic does not yet use the PKI standard.
R/G05-SE-21	Fulfilled	
R/G05-SE-22	Fulfilled	
R/G05-SE-25	Not Fulfilled	This component is not yet available, because there is no partner yet.
R/G05-SE-26	Not Fulfilled	This component is not yet available, because there is no partner yet.
R/G06-AP-01	Fulfilled	Basic connection indicator is available
R/G06-AP-02	Fulfilled	For OBU
R/G06-AP-03	Fulfilled	For OBU
R/G06-AP-04	Fulfilled	For OBU
R/G06-AP-05	Fulfilled	For OBU
R/G06-AP-06	Not Fulfilled	HMI for OBU is fixed., It can be turned off and notifications are not sent.
R/G06-AP-07	Not Fulfilled	OBU is simple and does not need help
R/G06-AP-08	Fulfilled	For OBU
R/G06-AP-09	Fulfilled	In the OBU it is only visible
R/G06-AP-10	Conditionally Fulfilled	For OBU
R/G06-AP-11	Not Fulfilled	For OBU
R/G06-AP-12	Fulfilled	For OBU
R/G06-AP-13	Fulfilled	For OBU
R/G06-AP-14	Conditionally Fulfilled	For OBU
R/G06-AP-15	Fulfilled	For OBU
R/G06-AP-16	Fulfilled	For OBU; all information is Graphical and numerical
R/G06-AP-17	Fulfilled	OBU has only one purpose.
R/G06-AP-18	Fulfilled	
R/G07-HU-01	Fulfilled	For OBU
R/G07-HU-02	Fulfilled	For OBU
R/G07-HU-03	Fulfilled	For OBU
R/G07-HU-04	Fulfilled	For OBU

R/G07-HU-05	Fulfilled	For HMI, info is suppressed by 5 sec before reaching the stop line
R/G08-SO-05	N/A	For OBU
R/G09-LE-01	Unable to assess	DPO still not available for C-MobILE. Developers i.e. Dynniq, MACQ (and IDIADA for cellular app). Made efforts to ensure GDPR compliance in the implementation.
R/G09-LE-03	Conditionally Fulfilled	The data is not encrypted during transfer, although the AVG rules are applied
R/G09-LE-04	Fulfilled	This data is not handled
R/G09-LE-05	Fulfilled	NA
R/G09-LE-06	Fulfilled	The data is automatically cleared after 10 seconds
R/G09-LE-07	Fulfilled	In North Brabant all the AVG rules are applied
R/G09-LE-09	N/A	The OBU is a professional system, which will be delivered with a contract to fulfil this goal.
R/G09-LE-14	Fulfilled	
R/G09-LE-15	Fulfilled	
R/G09-LE-16	Fulfilled	
R/G09-LE-18	Fulfilled	
R/G09-LE-21	Fulfilled	
R/G09-LE-22	Fulfilled	
R/G09-LE-23	Fulfilled	
R/G09-LE-24	Fulfilled	
R/G10-EC-01	Fulfilled	All individual products are embedded in the daily process within the Company.
R/G10-EC-03	Not Fulfilled	At odds with the simple design requirement.
R/G10-EC-04	Fulfilled	
R/G10-EC-06	N/A	
R/G10-EC-08	Fulfilled	
R/G11-EN-01	Fulfilled	All use cases supported by the services created and installed in the field, contribute to less environment damage.
R/G11-EN-02	Fulfilled	Flyers and brochures of the Dynniq products refers to the Environmental benefits.
R/G11-EN-05	N/A	The OBU can't be in sleep mode, because it has to send every second a CAM message.
R/G11-EN-06	Fulfilled	Both roadside units and on-board units are integrated into the existing infrastructure and comply to the standards as are defined in the Talking Traffic program.
R/G11-EN-07	Fulfilled	The cloud platform that is used for C-MobILE is using the same environments as is defined by the Talking Traffic program.

4.1.2.7. Thessaloniki

Requirement	Result	Comments
R/G01-AR-01	Not Fulfilled	We use Unix time (EPOCH)
R/G01-AR-09	Fulfilled	
R/G01-AR-10	Fulfilled	
R/G01-AR-14	Fulfilled	
R/G02-DE-05	Unable to assess	Our app is still in the late stage development
R/G03-OP-01	Unable to assess	We're finalizing ASN.1 support for our PID. All messages are broadcasted according to ETSI standards
R/G01-AR-07	Fulfilled	
R/G03-OP-02	Unable to assess	We're finalizing ASN1 support for our PID. All messages are broadcasted according to ETSI standards
R/G03-OP-03	Conditionally Fulfilled	We're finalizing ASN.1 support for our PID. All messages are broadcasted according to ETSI standards
R/G01-AR-12	Fulfilled	RWW, RHW, FI, IVS, GLOSA, MTTA and PVD are integrated in the app.
R/G03-OP-04	Conditionally Fulfilled	We're finalizing ASN.1 support for our PID. All messages are broadcasted according to ETSI standards
R/G02-DE-03	Fulfilled	
R/G02-DE-04	Fulfilled	
R/G03-OP-05	Fulfilled	
R/G02-DE-06	Fulfilled	
R/G02-DE-12	Fulfilled	
R/G03-OP-07	Fulfilled	
R/G03-OP-08	N/A	We don't have roadside units in THES
R/G03-OP-09	N/A	
R/G03-OP-11	N/A	We don't have roadside units in THES
R/G03-OP-13	N/A	We don't have roadside units in THES
R/G05-SE-12	Fulfilled	TLS encryption
R/G03-OP-10	Fulfilled	For the time being there is no offer of data in DATEX II format.
R/G05-SE-13	N/A	
R/G05-SE-14	Fulfilled	
R/G05-SE-15	Not Fulfilled	We do not have a mechanism to ensure this
R/G05-SE-16	Fulfilled	
R/G05-SE-17	Not Fulfilled	We do not have a mechanism to ensure this
R/G05-SE-19	Fulfilled	The PID is connected to our GEOM server using a secure ssl connection
R/G05-SE-20	Fulfilled	
R/G05-SE-21	N/A	Our GeoM /app will be free, no billing is necessary
R/G05-SE-22	N/A	Our GeoM /app will be free, no billing is necessary
R/G05-SE-25	N/A	

R/G05-SE-26	N/A	
R/G06-AP-01	Fulfilled	
R/G06-AP-02	Fulfilled	
R/G06-AP-03	Fulfilled	
R/G06-AP-04	Fulfilled	
R/G06-AP-05	Fulfilled	
R/G06-AP-06	Not Fulfilled	PID/HMI has fixed notifications.
R/G06-AP-07	Fulfilled	
R/G06-AP-08	Fulfilled	
R/G06-AP-09	Fulfilled	
R/G06-AP-10	Fulfilled	
R/G06-AP-11	Fulfilled	
R/G06-AP-12	Fulfilled	
R/G06-AP-13	Fulfilled	
R/G06-AP-14	Not Fulfilled	English only
R/G06-AP-15	Fulfilled	
R/G06-AP-16	Fulfilled	
R/G06-AP-17	Not Fulfilled	All services are on by default
R/G06-AP-18	Unable to assess	This feature is under development
R/G07-HU-01	Fulfilled	
R/G07-HU-02	Fulfilled	
R/G07-HU-03	Not Fulfilled	We currently do not have the mechanism to assess the workload
R/G07-HU-04	Unable to assess	Services prioritization is under development.
R/G07-HU-05	Fulfilled	We don't store any personal data
R/G08-SO-05	Fulfilled	We don't store any personal data
R/G09-LE-03	Fulfilled	We don't store any personal data
R/G09-LE-04	Fulfilled	We don't store any personal data
R/G09-LE-05	Fulfilled	We don't store any personal data
R/G09-LE-01	Unable to assess	
R/G09-LE-06	Fulfilled	We don't store any personal data
R/G09-LE-07	Fulfilled	We don't store any personal data
R/G09-LE-09	Fulfilled	We use the client-id generated in the device
R/G09-LE-14	Fulfilled	We don't store any personal data
R/G09-LE-15	Fulfilled	We don't store any personal data
R/G09-LE-16	Fulfilled	
R/G09-LE-18	Fulfilled	
R/G09-LE-21	Not Fulfilled	We do not have a mechanism to ensure this
R/G09-LE-22	Fulfilled	
R/G09-LE-23	Fulfilled	
R/G09-LE-24	Fulfilled	
R/G10-EC-01	Conditionally fulfilled	Evaluation and development of future business plans will determine this. Services

		iterations and implementation of business plans will be developed in 2020.
R/G10-EC-03	Fulfilled	
R/G10-EC-04	Fulfilled	
R/G10-EC-06	Not Fulfilled	Our GeoM /app will be free, no billing is necessary
R/G10-EC-08	Fulfilled	
R/G11-EN-01	Not Fulfilled	We do not have a mechanism to ensure this
R/G11-EN-02	Not Fulfilled	We do not have a mechanism to ensure this
R/G11-EN-05	Fulfilled	
R/G11-EN-06	Fulfilled	
R/G11-EN-07	Fulfilled	

4.1.2.8. Vigo

Requirement	Result	Comments
R/G01-AR-01	Fulfilled	
R/G01-AR-07	Fulfilled	
R/G01-AR-09	Fulfilled	
R/G01-AR-10	Fulfilled	
R/G01-AR-12	Fulfilled	
R/G01-AR-14	Fulfilled	
R/G02-DE-03	Unable to assess	
R/G02-DE-04	Fulfilled	
R/G02-DE-05	Unable to assess	
R/G02-DE-06	Fulfilled	
R/G02-DE-12	Unable to assess	
R/G03-OP-01	Fulfilled	
R/G03-OP-02	Fulfilled	
R/G03-OP-03	Fulfilled	
R/G03-OP-04	Fulfilled	
R/G03-OP-05	Fulfilled	
R/G03-OP-07	Fulfilled	
R/G03-OP-08	N/A	Not applicable as VIGO DS uses cellular communication instead ITS G5
R/G03-OP-09	N/A	No OBU and/or RSU are directly used in Vigo as only cellular-based services are implemented
R/G03-OP-10	Fulfilled	
R/G03-OP-11	N/A	Not applicable as VIGO DS implements over cellular communication instead of ITS G5
R/G03-OP-13	N/A	Not applicable as VIGO DS implements over cellular communication instead ITS G5
R/G05-SE-12	Fulfilled	Cellular JWT, no PKI
R/G05-SE-13	Fulfilled	No personal data

R/G05-SE-14	N/A	No personal data is transmitted in the communications
R/G05-SE-15		No personal data is transmitted in the communications
R/G05-SE-16	Fulfilled	
R/G05-SE-17	Fulfilled	
R/G05-SE-19	Fulfilled	
R/G05-SE-20	Fulfilled	TLS Certificates in the broker
R/G05-SE-21	Fulfilled	
R/G05-SE-22	Fulfilled	
R/G05-SE-25	N/A	NA
R/G05-SE-26	N/A	NA
R/G06-AP-01	Fulfilled	
R/G06-AP-02	Fulfilled	
R/G06-AP-03	Fulfilled	
R/G06-AP-04	Fulfilled	
R/G06-AP-05	Fulfilled	
R/G06-AP-06	Conditionally Fulfilled	Different versions of the application will be releases depending on bundles and group of users. Each group of users will have a set of notification but not all the existing ones in the Deployment Site
R/G06-AP-07	Conditionally Fulfilled	A tutorial session will be organized before the experiment. A user manual will be given to the users
R/G06-AP-08	Fulfilled	
R/G06-AP-09	Unable to assess	Acoustic and visual advices will be given
R/G06-AP-10	Fulfilled	
R/G06-AP-11	N/A	NA
R/G06-AP-12	Fulfilled	Minimum interaction is required. For the interactions required in the app, new screens or messages are displayed
R/G06-AP-13	Fulfilled	Messages on error will be displayed
R/G06-AP-14	Fulfilled	A tutorial session will be organized before the experiment. A user manual will be given to the users
R/G06-AP-15	Fulfilled	
R/G06-AP-16	Fulfilled	
R/G06-AP-17	Conditionally Fulfilled	Different versions of the application will be releases depending on bundles and group of users. Each group of users will have a set of notification but not all the existing ones in the Deployment Site
R/G06-AP-18	Unable to assess	Features under development
R/G07-HU-01	Fulfilled	
R/G07-HU-02	Fulfilled	
R/G07-HU-03	N/A	NA
R/G07-HU-04	Fulfilled	
R/G07-HU-05	Fulfilled	

R/G08-SO-05	N/A	NA
R/G09-LE-01	Unable to assess	
R/G09-LE-03	N/A	No personal data will be stored
R/G09-LE-04	N/A	No personal data will be stored
R/G09-LE-05	N/A	No personal data will be stored
R/G09-LE-06	N/A	No personal data will be stored
R/G09-LE-07	N/A	No personal data will be stored
R/G09-LE-09	N/A	No personal data will be stored
R/G09-LE-14	Fulfilled	
R/G09-LE-15	Fulfilled	
R/G09-LE-16	N/A	No personal data will be stored
R/G09-LE-18	N/A	No personal data will be stored
R/G09-LE-21	Fulfilled	
R/G09-LE-22	Fulfilled	
R/G09-LE-23	Unable to assess	Under development
R/G09-LE-24	Fulfilled	
R/G10-EC-01	Unable to assess	
R/G10-EC-03	Fulfilled	
R/G10-EC-04	N/A	Service selection not available. Different versions of the application will be releases depending on bundles and group of users. Each group of users will have a set of notification but not all the existing ones in the Deployment Site. A tutorial session will be organized before the experiment. A user manual will be given to the users
R/G10-EC-06	Fulfilled	
R/G10-EC-08	Fulfilled	
R/G11-EN-01	Unable to assess	
R/G11-EN-02	Unable to assess	
R/G11-EN-05	N/A	NA
R/G11-EN-06	Unable to assess	
R/G11-EN-07	Unable to assess	

4.1.3. Further work

Detected issues have been analysed and addressed individually.

For requirements that do not apply or require further details, feedback has been provided to WP2 to help with the update of requirements expected in the next months.

Development issues are being addressed and will be fixed as part of the upcoming Task 5.4.

4.2. Service validation results

At this point use case RWW-05 is not implemented in any DS. It will be tested in case it is finally available in any site. Hence, it is maintained in the deliverable for future reference.

4.2.1. Test results in local operation

4.2.1.1. Barcelona

Test Id	Test Result	Comments
G-01	Passed	
G-02	Passed	
EVW-01	Unable to assess	Data provider not ready
EVW-02	Unable to assess	Data provider not ready
EVW-03	Unable to assess	Data provider not ready
FI-01	Passed	
FI-02	Passed	
GLOSA-01	Unable to assess	Data provider not ready
GLOSA-02	Unable to assess	Data provider not ready
GLOSA-03	Unable to assess	Data provider not ready
IVS-01	Passed	
IVS-02	Passed	
MAI-03	Unable to assess	Issues detected during validation.
MTTA-01	Failed	Service potentially to be discarded due to negative user feedback
PVD-01	Passed	
RHW-01	Passed	
RHW-02	Passed	
RHW-03	Passed	
RWW-01	Passed	
RWW-02	Passed	
SVW-01	Unable to assess	Data provider not ready
WSP-05	Unable to assess	Issues detected during validation.

4.2.1.1.1. Deployment plan for services not ready

4.2.1.1.1.1. EVW

Barcelona has several data providers for the EVW service, two of them are actively working on development of their data interface.

All C-MobILE-owned components required to provide the service are ready.

The service is expected to be ready before the end of 2019.

4.2.1.1.1.2. GLOSA

Conversations with Barcelona TLC data provider are ongoing, but the process is stuck by technical difficulties on their side.

As mitigation plan, IDIADA is setting up a new test track with a traffic light. Proof of concept tests are being prepared to be done ASAP. The track is expected to be ready by January of 2020.

4.2.1.1.1.3. SVW

Since the service is implemented with the same communication that GLOSA, the previous reasoning applies.

4.2.1.1.1.4. MAI

Issues in the implementation have been detected during the testing.

Development to fix those issues is ongoing, expected to last the next few weeks.

The service is expected to be validated by end of November 2019.

4.2.1.1.1.5. WSP

Issues in the implementation have been detected during the testing.

Development to fix those issues is ongoing, expected to last the next few weeks.

The service is expected to be validated by end of November 2019.

4.2.1.2. Bilbao

Test Id	Test Result	Comments
G-01	Passed	MPA, UPA and BSD apps PASSED.
G-02	Passed	MPA, UPA and BSD apps PASSED.
BSD-02	Passed	Service does not fit exactly the scenario. None of the vehicles is provided with a Blind Spot detector sensor. The collision risk is calculated from the geolocalization of the bike and the time arrival estimation of the bus by the SPBO. When the collision risk is high the SPBO sends a DENM message to the CPBO and the CPBO sends the DENM message to the PID. Finally, the PID displays a warning to the biker.
MPA-01	Passed	Request is made via app
MPA-02	Passed	Request is made via app
MPA-03	Passed	The parking is provided with plate readers to monitor exits and entries. There is no possibility to know the exact location of the released parking slot. But, the information of the number of available parking slots is updated in real-time in the app.
RHW-01	Partially passed	Pending to confirm data availability in DATEX II. Data Provider details are needed for further improvements. This service is integrated into the Bordeaux GeoMessaging. Validation results would be the same.
RHW-02	Partially passed	
RHW-03	Partially passed	
RWW-01	Partially passed	Data Provider details are needed for further improvements. This service is integrated in the Bordeaux GeoMessaging. Validation Results would be the same.
RWW-02	Partially passed	
UPA-02	Passed	Currently working with fake dynamic data.
UPA-03	Passed	Currently working with fake dynamic data.

4.2.1.2.1. Deployment plan for services not ready

4.2.1.2.1.1. RHW

Data source was not available until October 2019. The municipality will provide the information of traffic status and accidents that is available automatically while other hazards will be introduced manually, as agreed in an internal meeting held on October 25th. This information will be packed in DATEX II and Open Data Bilbao platform. This is planned for November 30th, 2019. Then the integration with the Bordeaux GeoMessaging is straightforward.

4.2.1.2.1.2. RWW

The data available at Open Data Bilbao does not include information of relevance area. This has been requested to the municipality and is planned to be included by November 30th, 2019. Then, the integration with the Bordeaux GeoMessaging will be straightforward.

4.2.1.3. Bordeaux

Test Id	Test Result	Comments
G-01	Passed	
G-02	Passed	
BSD-01	Unable to assess	PoC to be validated at project approved time by the end of the year.
BSD-02	Unable to assess	
CACC-01	Unable to assess	PoC to be validated at project approved time by the end of the year.
CACC-02	Unable to assess	
CACC-03	Unable to assess	
CACC-04	Unable to assess	
CACC-05	Unable to assess	
CTLV-01	Unable to assess	PoC to be validated at project approved time by the end of the year.
CTLV-02	Unable to assess	
EBL-01	Unable to assess	PoC to be validated at project approved time by the end of the year.
EBL-02	Unable to assess	
EVW-01	Passed	
EVW-02	Passed	
EVW-03	Passed	
EVW-04	Passed	
EVW-05	Passed	
EVW-06	Passed	
FI-01	Passed	
FI-02	Passed	
FI-03	Passed	
FI-04	Passed	
GLOSA-01	Passed	
GLOSA-02	Passed	
GLOSA-03	Passed	
GLOSA-04	Passed	
GLOSA-05	Passed	
GLOSA-06	Passed	
GP-01	Partially passed	ITS-G5 only (GP is only given to emergency vehicles, not to everyone downloading the public application). The emergency vehicles are only equipped with G5 so cellular is not possible.
GP-02	Partially passed	
IVS-01	Passed	
IVS-02	Passed	
IVS-03	Passed	
IVS-04	Passed	
MAI-01	Unable to assess	Unable to validate PoC. Expected results by end of the year.
MAI-02	Unable to assess	
MAI-03	Unable to assess	
MPA-01	Passed	

MPA-02	Passed	
MPA-03	Passed	
MPA-04	Passed	
MPA-05	Passed	
MPA-06	Passed	
MTTA-01	Passed	
MTTA-02	Passed	
PVD-01	Passed	
PVD-02	Passed	
RHW-01	Passed	
RHW-02	Passed	
RHW-03	Passed	
RHW-04	Passed	
RHW-05	Passed	
RHW-06	Passed	
RWW-01	Passed	
RWW-02	Passed	
RWW-03	Passed	
RWW-04	Passed	
RWW-05	Passed	
SSVW-01	Passed	
SVW-01	Passed	
UPA-01	Passed	
UPA-02	Passed	
UPA-03	Passed	
WSP-01	Passed	
WSP-02	Passed	
WSP-03	Passed	
WSP-04	Passed	
WSP-05	Passed	

4.2.1.3.1. Deployment plan for services not ready

4.2.1.3.1.1. CACC

This use case will be provided as a proof of concept with announced delivery time since the beginning of the project in December. We are able to detect the first vehicle and calculate the distance. We still need to develop the HMI receiving and managing this information in the second vehicle.

4.2.1.3.1.2. CTLV

This use case will be provided as a proof of concept with announced delivery time since the beginning of the project in December. We wanted to use a Macq camera, but none seem available. We will buy one from a local partner. The test ground for the PoC has been chosen and deployment is feasible in December.

4.2.1.3.1.3. EBL

Our Renault Mégane Scoop equipped vehicle sends out an automatic message when an emergency brake is operated. We are able to receive this message, but we still need to manage it in our HMI in order to finalize the PoC. Should be finalized in December.

4.2.1.3.1.4. MAI

This use case will be provided as a proof of concept with announced delivery time since the beginning of the project in December. It will be provided on a bicycle. The material has been bought and we need to finalize the android app. This should be finalized in December.

4.2.1.4. Copenhagen

Test Id	Test Result	Comments
G-01	Passed	
G-02	Passed	
CTLV-01	Unable to assess	Blocking issues in HMI development
CTLV-02	Unable to assess	
GLOSA-01	Passed	
GLOSA-02	Unable to assess	Blocking issues in HMI development
GLOSA-03	Unable to assess	
GLOSA-04	Unable to assess	
GLOSA-05	Unable to assess	
GLOSA-06	Unable to assess	
GP-01	Unable to assess	Blocking issues in RSU.
GP-02	Unable to assess	
RHW-01	Unable to assess	Data provider not ready.
RHW-02	Unable to assess	
RHW-03	Unable to assess	
RWW-01	Unable to assess	Blocking issues in HMI development
RWW-02	Unable to assess	
RWW-03	Unable to assess	
WSP-01	Unable to assess	Blocking issues in HMI development
WSP-02	Unable to assess	
WSP-03	Unable to assess	
WSP-04	Unable to assess	
WSP-05	Unable to assess	

4.2.1.4.1. Deployment plan for services not ready

4.2.1.4.1.1. HMI issues, relates to CTLV, GLOSA, RWW and WSP

The HMI is delayed due to some details lacking in the specifications, especially surrounding the Registration Server. This issue has been compounded by the fact that Technolution, the developer of the HMI/PID, did not originally budgeted the number of meetings necessary for the conference calls etc. in which they could have resolved some of the outstanding issues not covered by the specifications. The implementation is planned to be finalized by December 2019.

4.2.1.4.1.2. GP

Dynniq DK and Copenhagen became aware very late that the update to ETSI2016 would impact the MK1 RSUs already installed in the city in such a way, that priority would not be possible.

Corrective actions were taken and are ongoing. The implementation is planned to be finalized by December 2019.

4.2.1.4.1.3. RHW

Public database is not ready, the road surface temperature data, which the RHW service in CPH is based on, is being transferred to a new national access point for Denmark in accordance with EU legislation. This has disrupted the source and flow of data to the GeoMessaging server.

The data source is expected to be available by end of October.

4.2.1.5. Newcastle

Test Id	Test Result	Comments
G-01	Passed	
G-02	Passed	
BSD-02	Failed	This service is no longer being implemented due to negative end-user feedback
FI-01	Unable to assess	PoC under development.
FI-02	Unable to assess	
GLOSA-01	Unable to assess	Use case under development.
GLOSA-02	Unable to assess	
GLOSA-03	Unable to assess	
GLOSA-04	Partially passed	Hardware and development issues.
GLOSA-05	Partially passed	
GLOSA-06	Partially passed	
GP-01	Partially passed	Hardware and development issues.
GP-02	Partially passed	
IVS-01	Unable to assess	Static UC only. Under development
IVS-02	Unable to assess	
PVD-02	Unable to assess	Hardware issues.
RHW-01	Partially passed	Currently available but not with C-MobILE compatible GeoMessaging format. Hardware and development issues.
RHW-02	Partially passed	
RHW-03	Partially passed	
RWW-01	Unable to assess	Currently available but not with C-MobILE compatible GeoMessaging format. Hardware and development issues.
RWW-02	Unable to assess	
WSP-03	Unable to assess	PoC under development.
WSP-04	Unable to assess	

4.2.1.5.1. Deployment plan for services not ready

4.2.1.5.1.1. FI

Proof of concept only. Development not started yet.

4.2.1.5.1.2. GLOSA

The 4G use cases will be implemented on the NeoGLS GeoMessaging server and will be demonstrated at the December testfest.

RSU sites and Dynniq OBUs being upgraded to ETSI 2016.

Operational from November and demonstrated at December testfest.

4.2.1.5.1.3. GP

Currently available at ETSI 2015.

RSU sites and Dynniq OBUs being upgraded to ETSI 2016.

Operational from November and demonstrated at December testfest.

4.2.1.5.1.4. IVS

Static UC only.

Speed signs to be issued from GeoMessaging server and received by NeoGLS app.

Operational from December.

4.2.1.5.1.5. PVD

RSU sites and Dynniq OBUs being upgraded to ETSI 2016.

Operational from December.

4.2.1.5.1.6. RHW/RWW

Being converted to DENM format to be forwarded to GM server and presented via NeoGLS app,

Currently available but not with C-MobILE compatible GM format.

To be demonstrated at December testfest.

4.2.1.5.1.7. WSP

Proof of concept only. Development not started yet.

4.2.1.6. North Brabant

Test Id	Test Result	Comments
G-01	Passed	
G-02	Passed	
BSD-01	Partially passed	Single PoC case executed. New PoC under planning.
CACC-01	Unable to assess	Not large-scale demonstration.
CACC-02	Unable to assess	
CACC-03	Unable to assess	
CACC-04	Unable to assess	
CACC-05	Unable to assess	
CTLV-01	Unable to assess	Validation blocked by issues in component integration.
CTLV-02	Unable to assess	
EVW-01	Unable to assess	Blocking issues caused by third parties.
EVW-02	Unable to assess	
EVW-03	Unable to assess	
EVW-04	Unable to assess	Validation blocked by infrastructure issues.
EVW-05	Unable to assess	

EVW-06	Unable to assess	
GLOSA-01	Partially passed	Service works according to Test ID description, but unable to locate GLOSA data and HMI log file
GLOSA-02	Partially passed	Service works according to Test ID description, but unable to locate GLOSA data and HMI log file
GLOSA-03	Partially passed	Tested remotely by IDIADA with the support of Dynniq.
GLOSA-04	Passed	
GLOSA-05	Passed	
GLOSA-06	Passed	
GP-01	Passed	
GP-02	Passed	
MPA-01	Unable to assess	Blocking issues caused by third parties.
MPA-02	Unable to assess	
MPA-03	Unable to assess	
MPA-04	Unable to assess	
MPA-05	Unable to assess	
MPA-06	Unable to assess	
RHW-01	Passed	
RHW-02	Partially passed	Tested remotely by IDIADA with the support of Dynniq.
RHW-03	Passed	
RHW-04	Passed	
RHW-05	Partially passed	Tested remotely by IDIADA with the support of Dynniq.
RHW-06	Passed	
RWW-01	Passed	
RWW-02	Partially passed	Tested remotely by IDIADA with the support of Dynniq.
RWW-03	Passed	
RWW-04	Passed	
RWW-05	Passed	
SVW-01	Unable to assess	
WSP-01	N/A	Test scenario N/A for North Brabant
WSP-02	Passed	Non repeatable PoC.
WSP-03	N/A	Test scenario N/A for North Brabant
WSP-04	N/A	Test scenario N/A for North Brabant
WSP-05	N/A	Test scenario N/A for North Brabant

4.2.1.6.1. Deployment plan for services not ready

4.2.1.6.1.1. BSD

Test scenario Cooperative Blind Spot Detection. PoC was shown at the C-ITS congress in Helmond.

Test will be executed again (automotive campus) in week 46 to have logging information. A study has been made for the crossing at the Neckerspoel bus station in Eindhoven. The result of the study was that the crossing is so dangerous, that the crossing itself will be rearranged.

The city of Eindhoven is looking for an alternative location because of this. Decision for new location is expected end of week 45. Technically this service scenario is the same as WSP-02, only the position of the traffic participants is different.

4.2.1.6.1.2. CACC

C-ACC is a proof of concept and will be evaluated in Task 5.5.

That task will not start before M34 (March 2020).

4.2.1.6.1.3. CTLV

In the Eindhoven CTLV implementation the VRUs are detected by four cameras. The detections are centralized by one camera and sent to the TLC by means of CAM messages. The cameras are installed and the protocol with the TLC has been tested. We need to verify that the WGS84 positions of the VRUs that the camera calculates (from the pixel positions) correspond to the ITF description of the TLC. The logging must be converted to the C-MobILE format and uploaded in the CTAG server. Validation expected to be carried out mid-November.

4.2.1.6.1.4. EVW

EVW is planned to be provided by associate partners. The agreements with these partners have not been formalized, neither it is guaranteed that the data provision from these services can meet the requirements for evaluation. For North Brabant therefore, these services will not be evaluated as part of the common evaluation of large-scale demonstration. EVW via ITS G5 will be evaluated.

Validation test was planned by 25-10-2019 but could not be executed because 1 of the 2 OBUs needed for the test was defective. The plan is to:

- Repair or replace the defective OBU (latest wk48)
- Redo test at Helmond location (latest wk. 49)

4.2.1.6.1.5. MPA

MPA is planned to be provided by associate partners. The agreements with these partners have not been formalized, neither it is guaranteed that the data provision from these services can meet the requirements for evaluation. For North Brabant therefore, these services will not be evaluated as part of the common evaluation of large-scale demonstration.

4.2.1.6.1.6. WSP

Test scenario: unsignalled crossing with RSU for VRU detection. PoC was shown at the C-ITS congress in Helmond. Test will be executed again (automotive campus) in week 46 to have logging information. A study has been made for the crossing at the Neckerspoel bus station in Eindhoven. The result of the study was that the crossing is so dangerous, that the crossing itself will be rearranged. The city of Eindhoven is looking for an alternative location because of this. Decision for new location is expected end of week 45.

4.2.1.7. Thessaloniki

Test Id	Test Result	Comments
G-01	Failed	Mobile app crashes and a standard Android system error message appears prompting the user to restart or close the application manually.
G-02	Passed	Mobile app tries to re-connect, sends log to server.
CTLV-01	Unable to assess	Development ongoing.
CTLV-02	Unable to assess	
EVW-01	Unable to assess	Development ongoing.
EVW-02	Unable to assess	
EVW-03	Unable to assess	
FI-01	Passed	MAPEM message is not used. Dynamic Lanes are taken from DENM message (Traces equivalent)

FI-02	Passed	MAPEM message is not used. Dynamic Lanes are taken from DENM message (Traces equivalent)
GLOSA-01	Passed	
GLOSA-02	Passed	
GLOSA-03	Passed	
GP-01	Unable to assess	Development ongoing.
GP-02	Unable to assess	
IVS-01	Passed	
IVS-02	Passed	
MTTA-01	Passed	
PVD-01	Passed	
RHW-01	Passed	
RHW-02	Passed	
RHW-03	Passed	
RWW-01	Passed	
RWW-02	Passed	
SVW-01	Unable to assess	Development ongoing.
MPA-05	Unable to assess	Development ongoing.

4.2.1.8. Vigo

Test Id	Test Result	Comments
G-01	Failed	Application cannot restart itself after a critical error
G-02	Passed	
EBL-02	Passed	Pending logging at server level.
EVW-01	Passed	
EVW-02	Passed	
EVW-03	Passed	
GLOSA-01	Passed	Not GLOSA, but TTR/TTG
GLOSA-02	Passed	Not GLOSA, but TTR/TTG
GLOSA-03	Passed	Not GLOSA, but TTR/TTG
IVS-01	Passed	
IVS-02	Passed	
MAI-03	Passed	
PVD-01	Unable to assess	Service under development
RHW-01	Passed	
RHW-02	Passed	
RHW-03	Passed	
RWW-01	Passed	
RWW-02	Passed	
SSVW-01	Unable to assess	Development ongoing.
SVW-01	Passed	
WSP-0X	Unable to assess	Vigo use case details are work in progress.

4.2.1.8.1. Deployment plan for services not ready

4.2.1.8.1.1. PVD

Service working but the assessment is pending as development to generate information derived from the data uploaded from vehicles is ongoing.

Development will be ready before the end of 2019.

4.2.1.8.1.2. WSP

The service is working but the assessment is pending as the installation of the RSU was delayed as the equipment was unavailable due to other tests and maintenance.

The installation will be ready before the end of 2019.

4.2.2. Test results in cross-modal operation

4.2.2.1. Cross-modal operation in Bordeaux

Test Id	Barcelona	North Brabant (OBU)	Vigo
GLOSA-01	Unavailable	Passed	Passed
GLOSA-02	Unavailable	Passed	Passed
GLOSA-03	Unavailable	Passed	Passed
IVS-01	Passed	N/A	Passed
IVS-02	Passed	N/A	Passed
RHW-01	Passed	Passed	Passed
RHW-02	Passed	Passed	Passed
RHW-03	Passed	Passed	Passed
RWW-01	Passed	Passed	Passed
RWW-02	Passed	Passed	Passed

All detected issues were fixed before the end of the event.

GLOSA was not ready with Barcelona App by the time of the event.

North Brabant brought an OBU to test ITS G5 implementations. North Brabant will use Barcelona App for cellular cases.

4.2.2.2. Cross-modal operation in Thessaloniki

Test Id	Barcelona	Bordeaux	Vigo
GLOSA-01	Unavailable	Passed	Passed
GLOSA-02	Unavailable	Passed	Passed
GLOSA-03	Unavailable	Passed	Passed
IVS-01	Passed	Passed	Passed
IVS-02	Failed	Failed	Failed
RHW-01	Failed	Failed	Passed
RHW-02	-	-	-
RHW-03	N/A	N/A	Passed

There was not enough time to fix detected issues. They have been addressed after the event.

GLOSA was not ready with Barcelona App by the time of the event.

IVS-02 event tested was shown for all applications in the opposite direction. We detected several possible causes, but we were not able to fix them during the event.

Due to technical difficulties and time constraints, tests of RHW-02 were discarded. RWW events were not available. During this event, it was identified that the requirements constraints of C-MobILE for the IVIM are not enough to guarantee interoperability. This issue was identified and raised so profiles may be accorded and defined in C-MobILE to ensure interoperability.

4.2.2.3. Interoperability validation plan for absent DS in previous events

4.2.2.3.1. Bilbao

4.2.2.3.1.1. Current status

- Currently, Bilbao DS has MPA and BSD (PoC) services in operation, the first version of the apps is finished. The baseline period is planned to start in November. UPA service was delayed due a public tender, previously explained in the project. Nevertheless, the deployment of the service is planned to be finished by the end of October using fake dynamic data (excluding app logging).
- The services that where tested at X-DS Tests events both in Bordeaux and Thessaloniki did not fit the deployed services of Bilbao DS. BSD, UPA and MPA services were not available to be tested neither in Bordeaux nor Thessaloniki. RWW and RHW were the only services Bilbao DS could try, and, those work with Bordeaux PID so the results are identical as Bordeaux DS.
- Nevertheless, it should be noted that two partners from CEIT attended two days to the Bordeaux event to physically check Bordeaux app for RWW and RHW. In addition, they also tried the connection to the NeoGLS GeoMessaging server with Bilbao PID. It was not prepared to show events at HMI since the app was designed to cover other service (i.e. BSD) but it was sufficient to test the reception of the different messages that were active at the test track.

4.2.2.3.1.2. Interoperability Plan

- CPBO and HMI interoperability tests were done at T5.3 simulating location at the different countries. Since the implementation of UPA and BSD was not finished in the rest of the deployment sites (Bordeaux, North Brabant and Newcastle). The interoperability plan is to wait until some test examples are available. These test examples will allow testing the message reception and HMI visualization working with a virtual location in each DS (this was already done for MPA with Bordeaux data and uploaded at D5.4 Annex 3 Bordeaux CPBO – Bilbao PID)
- After validating these test examples, and for a more rigorous verification, the apps will be sent to each DS partner so that they can test them on site.

1. Finish deployment of the apps (BSD & MPA are finished, pending UPA app 1st version release)
2. Test interoperability (comm. + HMI visualization) by HMI. IO test examples when available using a virtual location (MPA is already tested).
3. Send 1st version app release to Bordeaux (MPA+UPA+BSD), North Brabant (MPA+BSD) and Newcastle (BSD) Deployment sites to test interoperability on site.

4.2.2.3.1.3. Expected date to validate results

- MPA to be sent by 8.11.2019
- BSD pending test examples
- UPA pending first version app release, pending test examples

4.2.2.3.2. Copenhagen

4.2.2.3.2.1. Current status

- Other deployment sites and service providers have been able to develop PIDs without the use of the Dynniq SDK, but this was again done via coordination in conference calls and correspondences within the project. As they were relying on simply following the specifications, Technolution did not originally plan budget to participate in the amount of conference calls that the C-MobILE project consists of.
- An attempt to follow the specifications and creating a PID - without the use of the Dynniq SDK - has shown that the specifications written in earlier WPs and tasks were not detailed and encompassing enough. This has caused severe delays in the development of the PID, which had to be done – not based on the specifications – but rather in dialog with Dynniq personnel, which was more cumbersome.

- Lastly, sourcing the data for the services – especially GLOSA – was more complicated than originally anticipated, which would have caused delays, if the above issues had not already done so.
- As the CPH PID was not ready for the cross-test, CPH did not participate in this.

4.2.2.3.2.2. Interoperability Plan

- The questions of detailed specifications and the compliance to them are being handled in the Interoperability Task Force, where agreements about the development not covered in the specifications are made and partners made to comply fully.
- Technolution is participating in the Interoperability Task Force conference calls, as well as other relevant conference calls.
- Technolution is working closely together with Dynniq to finalize the PID development, interface testing and verification of interoperability will be done towards Dynniq server in different locations, first Copenhagen and Helmond and later other sites.
- The main plan is to participate in the test fest at Vigo in December to test interoperability.
- There are plans for doing remote testing of the PID interfaces towards the Helmond site. Other sites can be included.
- Once the PID is ready in December, the application can and will be shared with other deployment sites, which can do real interoperability tests towards their local GeoMessaging servers.
- The CPH uses the same OBUs and RSUs as Helmond and other sites, in an independent test of these might therefore be unnecessary.
- As soon as either the Barcelona, Thessaloniki or Bordeaux PIDs are fully available, real test runs will be done in Copenhagen with one or more of them.

4.2.2.3.2.3. Expected date to validate results

- PID interfaces will be tested remotely throughout November.
- GLOSA will be tested in Vigo (Dec2-Dec4).
- OBUs will be tested in Vigo.

4.2.2.3.3. Newcastle

4.2.2.3.3.1. Current status

- Newcastle offers ITS-G5 services: GLOSA, Green Priority (GP) and Probe Vehicle Data (PVD).
- Newcastle already offers RWW and RHW (hazardous location notification and traffic condition warning) but not in compliant format with C-MobILE.
- The G5 services are undergoing upgrading of RSUs and OBUs to 2016 ETSI standard in the coming weeks. This is essential to enable compatibility between the existing equipped zone and C-MobILE.
- In Vehicle Signage (IVS) will also be offered as a cellular service. Warning System for Pedestrians (WSP) is a proof of concept.
- Newcastle participated in the Bordeaux tests in September 2019, represented by Siemens UK. The work done in Bordeaux reveals the necessary implementations for full interoperability at the DS and involves use of the NeoGLS GeoMessaging server.

4.2.2.3.3.2. Interoperability Plan

- The tests in Bordeaux have shown interoperability of message formats between the Newcastle system and other C-MobILE partners. For G5, the Siemens RSU was used to capture the SPaT, MAP, CAM, DENM and IVI messages being broadcast from a NeoGLS RSU.
- Newcastle technical partners, Siemens and Zircon, are continuing to work with NeoGLS and Bordeaux to demonstrate interoperability of cellular services.
- For 4G RWW/RHW, the current implementation is to be changed to be compatible with the DENM message format. Currently the App takes a feed direct from the internet, this needs to be translated into a number of DENM messages. These will be forwarded to NeoGLS GeoMessaging server and routed to Newcastle to be displayed on NeoGLS App.
- For 4G GLOSA, the use case can be implemented as a demonstrator on the NeoGLS GeoMessaging server. The service will be demonstrated on the NeoGLS 2016 OBU.

- For 4G IVS, speed sign messages will be issued from the NeoGLS GeoMessaging server and received by the NeoGLS App.
- Siemens will participate in the test fest at Vigo in December to test interoperability of 4G services RWW, RHW, and GLOSA.
- Newcastle will continue to work with NeoGLS GeoMessaging server towards the test fest and full deployment in December (16th).
- For the G5 services, Siemens Mobility to upgrade RSUs sites to ETSI 2016. The service will be demonstrated with an ETSI 2016 OBU from Dynniq when available.

4.2.2.3.3.3. Expected date to validate results

- Work with NeoGLS through November, prioritising 4G RWW/RHW/GLOSA.
- Upgrade of Dynniq OBU during November to ETSI 2016 to enable C-MobILE G5 launch.
- Cellular services – GLOSA, RHW, RWW on NeoGLS App – will be tested in Vigo (Dec 2-4).

4.2.2.3.4. Thessaloniki

4.2.2.3.4.1. Current status

- Currently Thessaloniki DS has the following functional services: RWW, RHW, FI, GLOSA, IVS, MTTA, PVD. The first version of the app is ready and has been tested at local level. An update, in order to have the final version of the app with the integration of ASN.1 encoding/ decoding will be performed in November. By the end of November, we plan to have checked that version and it will be ready for public download on December 16th. Application logging is planned to be finalized also in November, when logs will be uploaded to CTAG and checked in parallel, in order to ensure that logging is complete by the end of that month.
- The reason for not being able to participate in the interoperability verification test in Bordeaux was that the ASN.1. encoding/ decoding was missing from the app. Nevertheless, it should be mentioned that Thessaloniki hosted the other interoperability verification test as all the back-end systems of the deployment site are ready and could support services. During this test Thessaloniki participated in the test runs with a temporary version of the app which was able to parse proprietary JSON format messages. This was done so that other participants were able to test their HMI against the one of the Thessaloniki app.

4.2.2.3.4.2. Interoperability Plan

- All pending tests, mainly the ones concerning the PID, are planned to be complete by the end of November. This will be done with the final version of the app, including ASN.1 decoding/ encoding, and by simulating the locations of the other deployment sites. This will be accompanied by app test logs upload and CTAG checking.
- After validating the final version of the app this way and since all debugging has been performed, the app will be provided to each deployment site, in order to make sure that there are no issues in real-life function and interoperability concerns are addressed.

4.2.2.3.4.3. Expected date to validate results

- Tests with simulated locations for the services RWW, RHW, FI, IVS, MTTA, GLOSA, PVD to be complete by November 20th.
- Final version of the app to be send to the other deployment sites after November 25th. Deployment sites will have a few days to try the app and spot any problems.
- Until December 13th all issues to be solved, in order to upload the app and be available for public download by December 16th.

5. Conclusions

After carrying out all the validation activities, we could briefly conclude giving four main points, which will guide the future actions:

- Among the validators of the Deployment Sites, the general opinion is that the results are satisfactory even if not complete. Most services have been successfully tested even if the result could not be mark as "Passed" due to a variety of issues.
- Regarding the results of the interoperability test events. A lot of issues have been identified and are being addressed, with tight work with Task 5.3, Data Management Task Force and Interoperability Task Force.
- The interoperability will be further validated in future events, the next one being the C-MobILE Testfest n December 2-4. Several small events are already being coordinated by the DS in the scope of such developments.
- Work of validation of pending services, and applicable corrective measures will be continued as part of task 5.4 to ensure large-scale deployment.

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