

CONVERGE

Communication Network VEHICLE Road Global Extension

Proposal for a Car2X Systems Network

Deliverable D1.1

Operational Requirements and Role Models

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Executive Summary

Pioneering approaches to traffic management and vehicle safety issues are increasingly growing together. Still a holistic system architecture for flexible interaction between different service providers and communications network operators is missing in a decentralized, scalable structure. The aim of the project CONVERGE is to close this gap.

The CONVERGE partners prepare regulations for the Car2X systems network, how different traffic institutions should work together in the future according to their responsibilities and roles. Therefore the Car2X Systems Network establishes a completely new open communication-, services-, and organization architecture that reflects communication technologies and technologies of IT security at state of the art. Not only the technology-overarching connecting of communication of vehicles with relevant information sources is taken into account, but also information providers will be included, which are responsible organizationally for the operation of cooperative systems. These include the operators of traffic infrastructures, cellular networks, and networks of traffic infrastructure - the so-called IRS networks - as well as vehicle manufacturers and IVS service providers. Through defined access points, they can be integrated into the open and secure system architecture. The ultimate goal is the decentralized and dynamic coupling of all systems and actors across national borders.

Deliverable D1.1 “Operational Requirements and Role Models” describes user stories and use cases for the CONVERGE system and derives resulting requirements. This document communicates

- (a) the use cases and system requirements to the system architects and developers who will be designing and developing the Car2X Systems Network,
- (b) basic information on the role model approach,
- (c) some user stories as starting point for the definition of one or more CONVERGE demonstrators and finally
- (d) first thoughts on the final assessment of the Car2X Systems Network.

The D1.1 Operational Requirements and Role Models deliverable is the first CONVERGE deliverable prepared by the work package “WP1 Requirements and Role Models”. It will be followed up by a D1.2 Final Operational Requirements and Role Models documentation, at the end of the project (Month 36). While D1.1 put the focus on use cases and requirements and only gives a short introduction to Role Models, D1.2 focus on and elaborate Role Models based on the CONVERGE system architecture.

1 INTRODUCTION

1.1 System Overview

The CONVERGE projects aims to design a system architecture for flexible interaction between different service providers and communications network operators in a decentralized, scalable structure.

The Car2X Systems Network will establish a completely new open communication-, services-, and organization architecture that reflects communication technologies and technologies of IT security at state of the art. Through well-defined access points, service providers as traffic control centres or vehicles manufacturers can be integrated into the open and secure system architecture. The ultimate goal is the decentralized and dynamic coupling of all systems and actors across national borders in an open, but secure, distributed, transregional/international connecting, provider-independent, scalable, flexible and hybrid communicating Car2X the system network.

1.2 Document Overview

The reasons and motivation for this deliverable are to achieve the following:

- to describe the vision of the CONVERGE project,
- to present the major high level objectives,
- to provide an overview on the basic use cases and requirements,
- to introduce the role model approach,
- to describe the major user stories and
- to make the link to the assessment of the Car2X Systems Network.

The figure below shows the process for WP1 and the interaction with other WPs according to the description of work. As can be seen the output of WP1 are goals, use cases, and requirements, which will be used as input for further activities in WP2 to WP8. This output is provided by WP1 and documented in Deliverable D1.1. The delivery of D1.1 is part of the first milestone in the CONVERGE project.

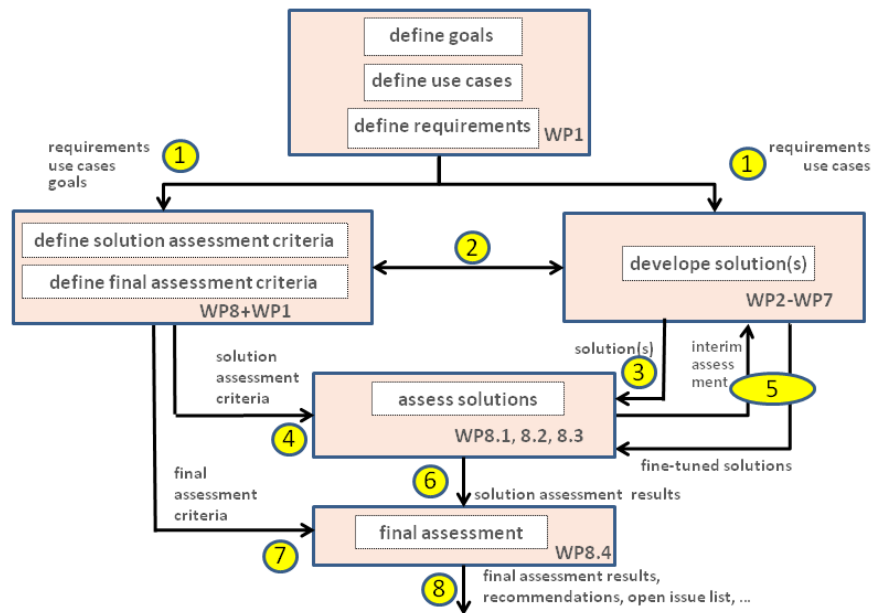


Figure 1: Process overview

1.2.1 Document Structure

This document is arranged as follows:

- **Chapter 2** - provides a vision of how the future Car2X Systems Network might look like, respectively will be used by public and private service providers to offer intelligent mobility services using different means of communication media.
- **Chapter 3** - lists the goals which the CONVERGE project aims to achieve.
- **Chapter 4** - presents the use cases and requirements identified as basic information for the design of the system architecture for the CAR2X Systems Network.
- **Chapter 5** - introduces to the role model driven approach for operating a system like the Car2X Systems Network chosen by the project.
- **Chapter 6** - describes user stories which will be used for the definition of the concrete CONVERGE demonstrators showing the development results of the project.
- **Chapter 7** - is the last chapter of Deliverable D1.1 and contains a reference to WP8 which is responsible for the final assessment of the CONVERGE project and shortly describes the relation between WP1 and WP2.

2 CONVERGE – A FUTURE SCENARIO

The aim of the **Car2X Systems Network** is to develop a decentralised platform that networks the public and private organizations involved in operating the cooperative systems with each other, so that applications and data services for supporting efficient, safe, and environmentally friendly mobility can be implemented in an innovative manner. The focus is in particular linking these organisations to communication networks for the optimized exchange of information between ITS service providers and the **mobile ITS nodes (IVS)** using complementary communication technologies, while considering security and privacy and using standard interfaces. In addition, we also focus in particular on open system access so that new, economically interesting cooperation models can be created between the participating organisations.

In the following five sections, different scenarios of how the Car2X Systems Network could look like and operate in the future are presented. These scenarios do not intend to provide the basic requirements for the work in CONVERGE, but intend to give an idea about the vision how future cooperative ITS systems might look like.

2.1 Scenario – Information services for end users

2.1.1 The Private Service provider view

The company CN-A wants to offer a local information service for end customers in the Frankfurt metropolitan area, which supports the IVSs in their daily mobility as well as scheduling by fleet operators using data services. Part of the business model for the IVS is a reduced cost rate for providing data ("FCD" option). The "FCD" issue, in particular the aspect of customer data protection, is particularly important for CN-A. After a thorough analysis of the options (transparent communication with customers/IVS, hybrid network access, flexible cost models, data protection and IT security) offered by the Car2X Systems Network, they decide to offer the service via the Car2X Systems Network. The company takes all necessary steps to be able to participate in the Car2X Systems Network as a service provider. At the same time, it acquires access to use the IRS and mobile phone networks. Finally, CN-A registers its service with the Car2X Systems Network. The service can now be offered passively via the 'notice board' and actively via a Car2X Systems Network service announcement.

The necessary steps to participate in the Car2X Systems Network as a service provider include among others the setup of all security relevant functionality and data and a process, which assures that the privacy of CN-A's customers, will be protected.

CN-A also registers on the Car2X Systems Network for safety-related information in the Frankfurt metropolitan area, which is provided without charge by other registered users in the Car2X Systems Network.

2.1.2 The Private Service users view

Erika M. wants to make her mobility more efficient and safe and is therefore looking for an appropriate service that supports her on her daily trips from A to B. Searching for an appropriate service provider online, she finds the services offered by the Car2X Systems Network. She is persuaded by the transparent depiction of the services on offer, the hybrid communication approach, and the security concept. In the information on the Car2X Systems Network, she finds the offer from CN-A, in addition to information on other safety-related Car2X applications and the efficiency-increasing car-2-infrastructure applications. She decides to conclude a temporary contract with CN-A for the 'FCD' option first. She also orders an ETSI G5 compliant communication module to benefit from car2car and car2x applications. A few days later, she receives the communication module sent by post and Erika M. installs the hardware and software at her vehicle / portable device. Erika M.'s on-board unit connects without problems, the additional aerial is installed quickly, the necessary software is downloaded via her mobile network and installed, and the necessary secure identities are configured and negotiated with the C2X Systems Network. Erika M. is now able to participate as a user on the Car2X Systems Network. Finally, she registers with CN-A.

Max B. already has a Car2X-enabled device. When travelling through Frankfurt he receives information about the new information service by CN-A via the Car2X integrated system. In particular, the distinctive local character with many specific regional data offers persuades him to try out the information service. Max B. also chooses the 'FCD' option because as a commuter he wants to contribute to improving the amount and quality of the information. Even while on the move he registers for the information service, accepts the terms and conditions and installs the necessary software modules to authenticate, receive, and prepare the information received.

2.1.3 A typical day in the life of users of the Car2X Systems Network

Erika M. has a business meeting and will drive to her contact. Her vehicle is equipped with ACC with eco-mode for predictive driving, the traffic forecast, and traffic light assistant functions, and she has subscribed to the CN-A data service.

Immediately after Erika M. starts her car, it connects via the mobile network to the information service and requests the current information for the ACC and traffic forecast functions. Her device receives the data, the integrated security module checks that the sender and the message are trustworthy and releases the information to other applications for further processing. Her navigation system uses the information to determine the best route. Her route takes her along an artery to the motorway that has a 'green wave' system for traffic lights. Via the communication module, she receives information on the 'green wave' and the ACC in her vehicle helps her ride the 'green wave'. The installed service from CN-A sends FCD information over a secure connection

to the head office from the 'green wave' area. Just before joining the motorway, she receives new information about the current traffic situation on her route and her navigation system then sends her on an alternative route. On the route, using the minor road network, she receives traffic light phase information for equipped intersections. After a previous check by the security module, this information is used by her ACC to optimise the approach and passage through a junction or to optimise stopping and moving off. In the reception area of equipped junctions, her vehicle provides CAM information to the ITS roadside stations.

On the motorway, Erika M.'s vehicle receives CAM messages from adjacent vehicles. Her ACC uses this information for optimised control. Warnings that are generated suddenly by emergency braking ahead mean that her ACC reduces the speed and transfers appropriate and anonymised information to her service providers. At the same time, her vehicle sends CAM messages to adjacent vehicles.

The rest of the trip is event-free and Erika M. arrives at her meeting safely, in good time and comfortably.

2.2 Scenario – Business cooperation

Company CN-B has developed a product that allows freight hauliers and truck drivers to pre-book parking lots with appropriate characteristics along their routes. Thus, they can comply with their prescribed rest periods without having the problem to find alternatives in case of overcrowded or inappropriate rest areas. To achieve this, CN-B has developed an Internet-based booking system and concluded contracts with various operators of service stations along heavily used routes in order to record their parking lots and facilitate appropriate bookings. Via an Internet portal, a client of the service can book parking lots along his planned route in advance. There are special software components for on-board units in the truck or smartphones that enable monitoring of the driven route, so that changes can be made to the reservations, in case of delays due to unforeseen events like congestions, accidents, or breakdowns.

CN-B has heard about the existence of the Car2X Systems Network and wants to use this to offer its parking aide service. Furthermore, CN-B plans to improve the functionality of the service by exploiting additional up to date traffic information. So CN-B registers as a new service provider on the Car2X Systems Network and after the offered service has been checked, it is accredited by the Car2X accreditation authority. CN-B also registers to the virtual mobility data marketplace service MDM for obtaining available information on parking space occupancy at motorway service stations. It also subscribes to a new payable service offered on the Car2X Systems Network that provides predictions on traffic jams from existing traffic flow information on motorways and major roads at a particular point in time. So the parking aide service can be complemented such that in the case of necessary rearrangements at the connected

service stations, it is possible to find alternatives at other locations. In addition, the prediction of traffic jam situations allows a more efficient and precise planning for the service.

2.2.1 The Private Service provider view

Freight haulier CN-C has been working for some time with CN-B and uses the parking aide service. This service has significantly reduced the cases of delayed transportation due to parking lot problems. This enables haulier CN-C to calculate its trips more precisely and offer them to the market at a lower price. In case of very high traffic, it can occur repeatedly that a booking is not possible due to overloads at the connected service stations. However, CN-B has announced another improvement because of the recent connection to the Car2X integrated system.

The scheduler at haulier CN-C plans to transport expensive medicines from Cologne to Frankfurt/Oder. The trip normally takes around 11 hours. After informing the driver Mr Müller accordingly, he uses the CN-B booking system to book spaces for the driver's compulsory rest breaks and also chooses the new option 'secure parking lot', which uses camera-based security monitoring of the valuable freight in order to provide protection against the risk of freight thefts from car parks. As the trip is planned at the beginning of the school holidays in North Rhine-Westphalia, the booking system proposes the reservation of 3 parking lots as the predicted duration is around 13 hours and because of the prescribed rest periods every 4 hours, the usually planned 2 stops will probably not be enough this time.

2.2.2 The Private Service user view

On his departure, the driver Mr Müller receives both the transport documents and the information about the planned stops via the app installed on his Smartphone. After around 2 hours ride, he discovers that the tires are losing pressure and have to be replaced. This delays the trip by around 1 hour. As the app has a secure mobile phone connection, it can provide information on the actual distance travelled at regular intervals to the CN-B booking system. This delay can be taken into account, so that the pre-booked spaces can be changed to an earlier service station. After the repair is complete, the driver can continue his journey and arrives at the first service station at the planned time. After the rest break, Mr Müller continues the trip without additional incidents but because of heavy traffic, he arrives somewhat late at the second service station where he will spend the prescribed 8-hour long break. The pre-booked secure space is available as the system was able to divert two other vehicles to alternative spaces at another service station even though all were highly frequented. On arrival at the service station, he receives information about the additional services offered here, e.g. a special fitness and relax program of the day, via the recently installed Car2X module and the IRS information stored on this service station. The trip continues as

planned, and after the third stop as planned at the booked service station, he arrives at the customer's location and delivers the goods.

2.3 Scenario – Road operator

2.3.1 The Public Service provider view

The road operator has the task of ensuring the best possible traffic management. For this reason, road operators want the existing traffic control infrastructure to be used in the best possible way. This covers such matters as influencing the route and traffic on the route, so that it is more secure and efficient depending on the current traffic situation. Another point is influencing the road network so that route selection is affected depending on the current traffic situation. These functions can fundamentally be covered by the existing available road infrastructure (route guidance systems, variable message signs, dWiStA etc.). Cooperative systems can make an important contribution to disseminating information and warnings. The basis for efficient control measures is the precise awareness of the traffic situation in the network. This is determined by stationary detectors in the road network.

The traffic centre (TC) wants to make regional/local traffic information on the current traffic situation/traffic forecast available to all road users in order to enable an optimised flow of traffic in the area it covers.

To achieve this, the TC offers local/regional information services with quality-checked similar and additional data/information content in parallel to the private service provider CN-A. It obtains FCD data or traffic information services (from aggregated IVS data) from the IVSs via an IRS networks and/or directly using mobile communication. The TC first checks the trustworthiness of the received data and subsequently merges this data with its own traffic data collected by stationary loop detectors and possibly other traffic information obtained via the MDM. The TC interprets the information received by different data sources and provides fused and aggregated traffic information as well as information about traffic events or weather, including local and regional traffic forecasts using different distribution channels as

- (a) via IRS networks directly to IVS,
- (b) own dWista,
- (c) radio stations,
- (d) own internet portal and
- (e) via MDM to other service users.

The IVS receives the traffic information via its communication module. The IVS checks the trustworthiness of the sender (TC) and the traffic information prior to using the traffic information.

2.3.2 The Private Service user view

Erika M. is on her way to a business meeting and is approaching temporary road works. The TC offers local/regional road works information with two main functions: warning about sites and the situation around the site. Both functions are used to improve traffic safety (for vehicles and site personnel) and to improve the database at the TC for derived services such as strategic traffic management functions.

With the road works warning, a warning is displayed in Erika M.'s vehicle when she approaches the temporary road works. The necessary information is sent to IVS, which shows the current distance to the road works, their scope, and important information such as speed restrictions in the vehicle. The information can be transferred to the vehicle via a service provider back-end and mobile communication or directly via ETSI G5.

For the road works traffic situation, the IVS sends its own traffic data as e.g. position, and speed either via an IRS network or via mobile communication to the traffic control centre. In either case, the privacy of the IVS is preserved.

In addition, the TCC can also send local hazard warnings (e.g. hindrances, end of traffic jam, road weather, accident, emergency vehicles) to Erika M. via various communication channels.

During the continued drive, Erika's car detects that it requires new pseudonymous authentication data to maintain its privacy in future communication. Therefore, it requests those from a service being in charge for Erika's security.

A group of vehicles, of which Erika M.'s is one, is moving from Bavaria via Munich towards Cologne, Rhineland. The preferred route is via the A9 and A3. However, due to an unforeseen event, a long traffic jam has formed around Würzburg. There is a local diversion in the Würzburg region. A wider diversion is possible via the A8, A5, and A3. Traffic volume information indicates low capacity reserves on the local diversion and larger reserves on the wider alternative route.

Model calculations executed by the traffic control centre show that distributing 10% of vehicles on the original route, 20% on the local alternative and 70% on the wider alternative would minimise total travel times for all travellers in the network.

The intersectional and cross-responsibility traffic management of the Road Operators offers a large-scale, strategic diversion recommendation for alternative routes. These are initiated by congestions on the strategic network. The suggestion of rerouting is based on the traffic information provided by IVS via the IRS network, the road operator's own traffic measurements collected by loop detectors, historical route lines, model calculations etc. Activation criteria and diversion strategies are matched in the strategic layer between the Road Operators and private navigation operators. The information is

sent to Erika M. and other vehicles on the route using the above mentioned distribution channels (a) to (e) as well as to other TCs. All those receivers first check the trustworthiness of the received message and second take appropriate decisions.

2.4 Scenario – Vehicle Manufacturer

2.4.1 The Vehicle Manufacturer view

The vehicle manufacturer or a supplier develops communication modules, which provide the communication with the Car2X Systems Network. For that purpose, these modules have the necessary communication protocols available. During the manufacturing or initialization process, a set of secure identities is generated and stored to enable connections with the Car2X access network. The modules are incorporated in series or delivered separately at ordering customers.

2.4.2 The Private Customer view

Ms M. utilizes services of the Car2X Systems Network with her vehicle. These are of various kinds, including charged services that are registered to her personally respectively her Car2X identity, which can be accessed by the Car2X Systems Network via the communication module.

Due to the age of her vehicle, she wants to sell it. Mr K. is found as purchaser. She wants to ensure that Mr K. can access none of her personal data via her former car with the objective to protect her privacy and to prevent misuse of her service access data. For that reasons, all her personal and service access data are removed from her vehicle when selling it. Besides, Mr K. wants to continue using his own services with the newly bought car. With the purchase, his personal and service data are transferred to his new vehicle. Hence, he can continue to utilize the services as before

2.5 Scenario – IRS Communication Network Provider

2.5.1 The IRS Communication Network Provider View

An IRS-communication network provider wants to extend its network to cover specific blind spots in the G5-coverage. Therefore, it obtains a new IRS-unit from its supplier. It plans a wired connection of the new unit to its network. The ideal position is determined to achieve a minimal overlap with other IRS-units, a maximum of area coverage and a guaranteed coverage of the problematic blind spots.

After delivery, the new unit is initialized with a set of credentials in order to authenticate and connect the unit to the secured IRS-network.

A technician deploys the new unit at the selected location and establishes the physical connection to the IRS-network. After activation, the unit connects and is registered by the network. The system provides further credentials in order to enable the unit to

authenticate to the system and participate in Car2X communication. It is also configured to perform the necessary operations such as data forwarding from and to the Car2X Systems Network and service-endpoint-functionalities.

Finally, a number of tests are performed locally by the technician to ensure backend connection, a sufficient area coverage, and basic service functionality.

After passing these tests, the IRS is considered fully functional and treated as integrated part of the IRS-network.

3 GOALS ADDRESSED BY CONVERGE

The stated goal of the CONVERGE project is the definition of an architecture and interface for an open, distributed, transregional as well as international connecting, provider-independent, scalable, flexible, secure and hybrid communicating Car2X system network. The aim of the Car2X Systems Network is to create a dynamical extendable association for cooperative systems in ITS, comparable with the internet with open standards and interoperability, which picks up current innovations in the field of ICT and thus provides novel approaches for system- and software-design.

Based on the above-mentioned stated goal of the CONVERGE project the following high level objectives of the *Car2X Systems Network* were identified.

Table 1: High-level objectives of the Car2X Systems Network

Nr	ID	Goal
1	G_C2X_001	The Car2X Systems Network supports communication between service providers and mobile nodes that is transparent for the application and uses hybrid communication technologies.
2	G_C2X_002	The Car2X Systems Network is open <ul style="list-style-type: none"> • That is, not exclusive to manufacturers (e.g. car manufacturers, service provider) • to various (access) technologies (e.g. UMTS, LTE, ETSI G5)
3	G_C2X_003	The Car2X Systems Network provides options for restricting access, use, and provision of services.
4	G_C2X_004	The Car2X Systems Network supports flexible billing models.
5	G_SP_001	A service provider can send data to and receive data from an IVS according to given requirements as <ul style="list-style-type: none"> • Blanket coverage • Cross-border (e.g. country, county) • Communication costs • Sub-quantities (geographical, time, type-specific)
6	G_SP_002	Quality measures are an integrated part of exchanged information, e.g. <ul style="list-style-type: none"> • Age • (Location) precision • Type (e.g. raw data, aggregated data)
7	G_SP_003	The Car2X Systems Network provides information on to determine the current Quality of Service.
8	G_COM_001	A common interface between IRS-Network and cellular network enables interoperability between ETSI G5 and mobile communication ETSI IMT Public.
9	G_COM_002	The Car2X Systems Network implements technology- and provider spanning geocasts.
10	G_COM_003	The Car2X Systems Network communicates with an IRS communication network carrier and needs no knowledge about single IRS.

Nr	ID	Goal
11	G_IVS_001	Safety relevant messages are provided in a timely manner regardless of the communication technology lying behind.
12	G_IVS_002	For each safety relevant application, either sufficient data quality is guaranteed or a confidence interval for the data (e.g. including data acquisition time) is provided.
13	G_SEC-001	The Car2X Systems Network implements a security architecture to ensure authenticity, integrity and trustworthiness of messages and entities where needed
15	G_SEC-002	Security ensures that the privacy of the IVS is retained. <ul style="list-style-type: none"> 1. Both ETSI G5 and mobile communication have to be considered. 2. Legal and regulatory requirements must be fulfilled. 3. Privacy-affected objects and data including their respective level of privacy have to be defined.

4 REQUIREMENTS AND USE CASES

4.1 Use Cases

In this paragraph the CONVERGE use cases are described. Based on the visionary scenarios presented in chapter 2 the following groups of CONVERGE use cases were identified

- Car2X Systems Network - Basic functions offered by the Car2X Systems Network
- Service Provider to Other Interaction - A service provider communicating with other registered users of the Car2X Systems Network
- IVS to Other Interaction - An IVS or IRS communication with other registered users of the Car2X Systems Network
- Service Provider - Basic functions required at the Service Providers
- IVS or IRS - Basic functions required on an IVS or IRS
- ComNet - Basic functions provided by the Communication Network Providers
- Security - Basic security functions

The use case description is provided using the following table structure:

Table 2: Template for use case description

UC Code	Sub-Group	Priority	Ref Req
Use case code; UC_GROUPID_NUMBER	Groups affected	Implementation priority, either Mandatory or Optional	Reference to requirement
Author			
Company, Author			
Description			
Short description including information on involved groups and result			
Pre-Conditions			
List of any activities that must take place, or any conditions that must be true, before the use case can be started			
Post-Conditions			
Describe the state of the system at the conclusion of the use case execution. Should include both minimal guarantees (what must happen even if the actor's goal is not achieved) and the success guarantees (what happens when the actor's goal is achieved)			
Notes			
List any additional comments about this use case or any remaining open issues			

4.1.1 Car2X Systems Network

This paragraph presents use cases describing relevant aspects of the Car2X Systems Network.

The following figure shows relevant management aspects within the Car2X Systems Network using the Archimate® Business Layer notation. Please note, this figure does not describe the sequence of actions that needs to be performed in order to get access to the Car2X Integrated System. The order is described in the Use Cases:

1. UC-C2X-101_01 Registration
2. UC-C2X-101_02 Accreditation
3. UC-C2X-101_03 Authentication

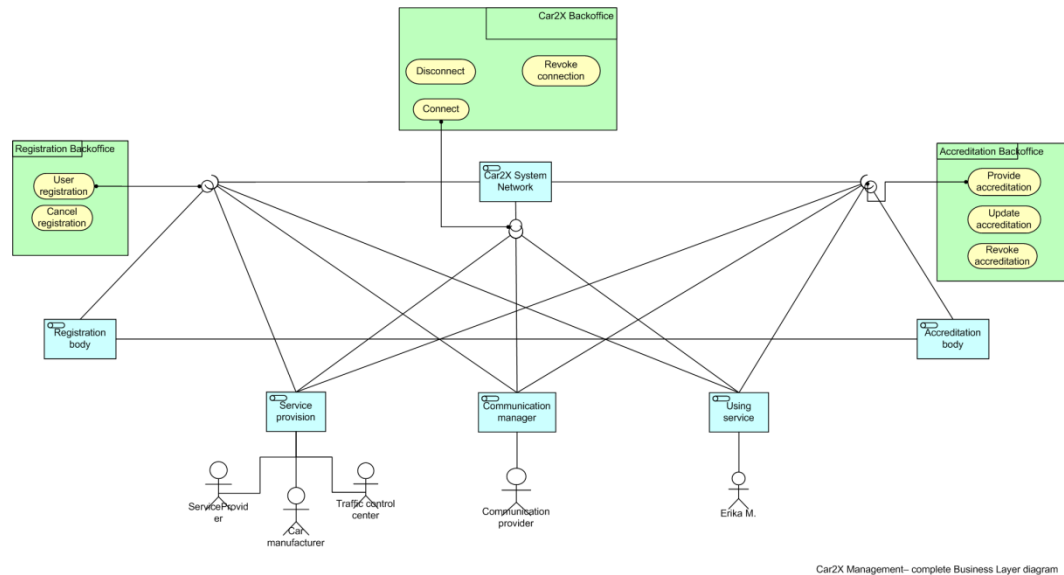


Figure 2: Business Layer – Car2X

The identified building blocks of this Business Layer are listed in the following tables.

Table 3: Actors identified in Car2X

Value	Description
Service provider	e.g. a fleet operator
Car manufacturer	A car manufacturer
Traffic control centre	A traffic control centre
Communication provider	A communication network provider
Erika M.	Example user

Table 4: Roles identified in Car2X

Value	Description
Service provision	The service provider, represented by e.g. car manufacturer, traffic control centre

Value	Description
Car2X Systems Network	The Car2X Systems Network
Communication manager	A communication facility
Using service	The user of a service, e.g. represented by Erika M.
Registration body	Responsible for the registration process
Accreditation body	Organizations that issue credentials or certify third parties

Table 5: Services identified in Car2X

Value	Description
User registration	Registration service for users (e.g. service provider, Erika M.)
Cancel registration	Deregistration service for users (e.g. service provider, Erika M.)
Provide accreditation	Credential service for users (e.g. service provider, Erika M.)
Update accreditation	Update credential(s) service
Revoke accreditation	Revoke credential (s) service
Connect	Car2X Systems Network Connect service
Disconnect	Car2X Systems Network Disconnect service
Revoke connection	Car2X Systems Network revoke connection service

Table 6: Interfaces identified in Car2X

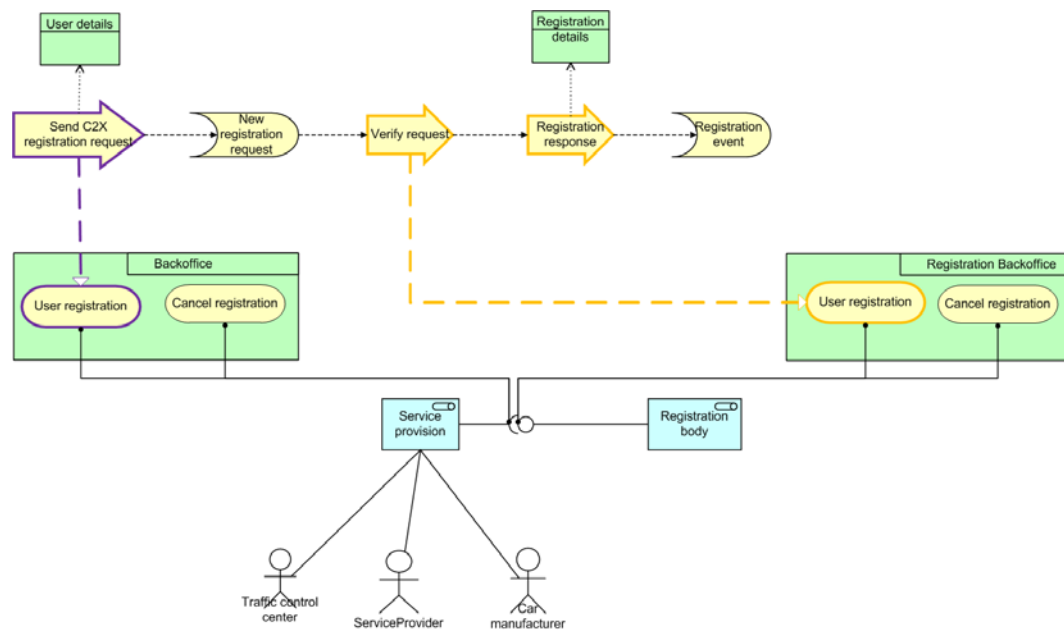
Value	Description
Registration Interface	Interface offered by the [Registration body] to [Car2X Systems Network], [Service Provision], [Communication Manager] and [Using Service] for registration
Accreditation Interface	Interface offered by the [Accreditation body] to [Car2X Systems Network], [Service Provision], [Communication Manager] and [Using Service] for handling credentials
Car2X Access Interface	Interface offered by the [Car2X Systems Network] to [Service Provision], [Communication Manager] and [Using Service] for access

UC-C2X Entering the Car2X Systems Network

All Service Providers, including the communication network provider or Service User have to register / enter the Car2X Systems Network before they can use the functionality provided by the system and participate in the system. The following use cases describe the steps to be taken in order to enter the Car2X Systems Network.

UC-C2X-101_01 Registration

The following figure shows relevant registration aspects within the Car2X Systems Network using the Archimate® Business Layer notation.



Car2X registration – complete Business Layer diagram

Figure 3: Business Layer – UC-C2X-101_01 Registration

The identified building blocks of the Business Layer for UC-C2X-101 Registration are listed in the following tables.

Table 7: Processes identified UC-C2X-101_01 Registration

Value	Description
Send C2X registration process	[Service provision] sends registration request to [Registration body]
Verify request	[Registration body] verifies request
Registration response	[Registration body] provides response

Table 8: Events identified in UC-C2X-101_01 Registration

Value	Description
New registration request	New registration request
Registration event	New registration response

Table 9: Actors identified in UC-C2X-101_01 Registration

Value	Description
Service provider	A fleet operator
Car manufacturer	A car manufacturer
Traffic control centre	A traffic control centre

Table 10: Roles identified in UC-C2X-101_01 Registration

Value	Description
Service provision	The service provider, represented by e.g. car manufacturer, traffic control centre
Registration body	The responsible for providing the certificates

Table 11: Services identified in UC-C2X-101_01 Registration

Value	Description
User registration	Registration offered by [Registration body]
Cancel registration	Deregistration offered by [Registration body]

Table 12: Interfaces identified in UC-C2X-101_01 Registration

Value	Description
Registration Interface	Interface offered by the [Registration body] to [Service Provision] for registration

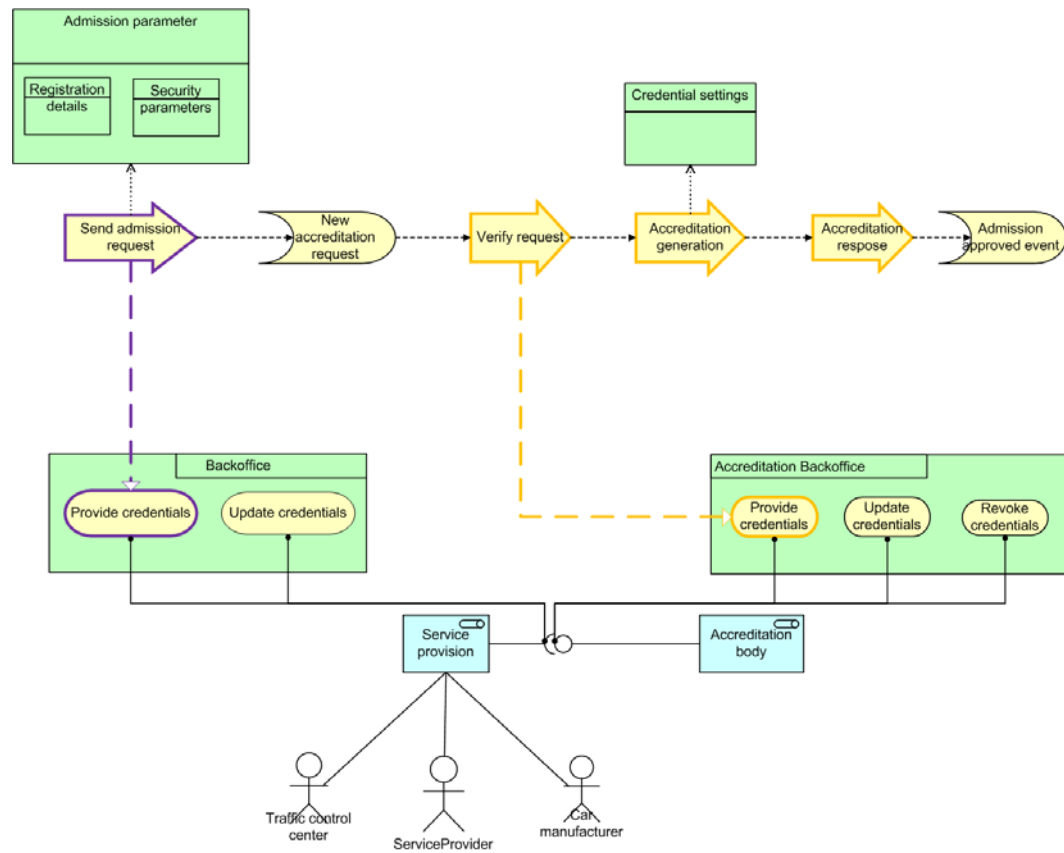
Table 13: Objects identified in UC-C2X-101_01 Registration

Value	Description
User details	Data object holding information about the new user
Registration details	Data object holding registration details

UC Code	Sub-Group	Priority	Ref Req
UC-C2X-101_01	Car2X Systems Network, Service Provider, IVS, Communication Network Provider	Mandatory	REQ-C2X-007 REQ-SEC-PP-006, REQ-SEC-PS-002, REQ-SEC-PA-001
Author			
PTV, Matthias Mann			
Description			
Car2X Systems Network offers a registration for Service Providers, IVSs and Communication Network Providers.			
Pre-Conditions			
Rules and regulations are available for SPs.			
Post-Conditions			
Registration details are available for further use. Details about a new user are used as input for accreditation to the Car2X Systems Network.			
Notes			
The new user, either service provider or individual, provides information about himself Confidentiality is required, because registration might include information that should not be disclosed to third parties.			

UC-C2X-101_02 Accreditation

The following figure shows relevant certification aspects within the Car2X Systems Network using the Archimate© Business Layer notation.



Car2X certification – complete Business Layer diagram

Figure 4: Business Layer – UC-C2X-101_02 Accreditation

The identified building blocks of the Business Layer for UC-C2X-102 Certification are listed in the following tables.

Table 14: Processes identified UC-C2X-101_02 Accreditation

Value	Description
Send admission request	[Service provision] sends grant admission request to [Accreditation body]
Verify request	[Accreditation body] verifies request
Accreditation generation	[Accreditation body] generates credentials
Accreditation response	[Accreditation body] provides credentials

Table 15: Events identified in UC-C2X-101_02 Accreditation

Value	Description
New accreditation request	New accreditation request
Admission approved event	New accreditation response

Table 16: Actors identified in UC-C2X-101_02 Accreditation

Value	Description
Service provider	e.g. a fleet operator
Car manufacturer	A car manufacturer
Traffic control centre	A traffic control centre

Table 17: Roles identified in UC-C2X-101_02 Accreditation

Value	Description
Service provision	The service provider, represented by e.g. car manufacturer, traffic control centre
Accreditation body	The responsible providing credentials to the Car2X Systems Network

Table 18: Services identified in UC-C2X-101_02 Accreditation

Value	Description
Provide credentials	Provide credentials offered by [Accreditation body]
Update credentials	Update credentials offered by [Accreditation body]
Revoke credentials	Revoke credentials offered by [Accreditation body]

Table 19: Interfaces identified in UC-C2X-101_02 Accreditation

Value	Description
Accreditation Interface	Interface offered by the [Accreditation body] to [Service Provision] for accreditation

Table 20: Objects identified in UC-C2X-101_02 Accreditation

Value	Description
Admission parameter	Data object holding information about the admission parameters
Registration details	Data object holding registration details
Security parameters	Data object holding the security parameters
Credential settings	Data object holding the credential parameters

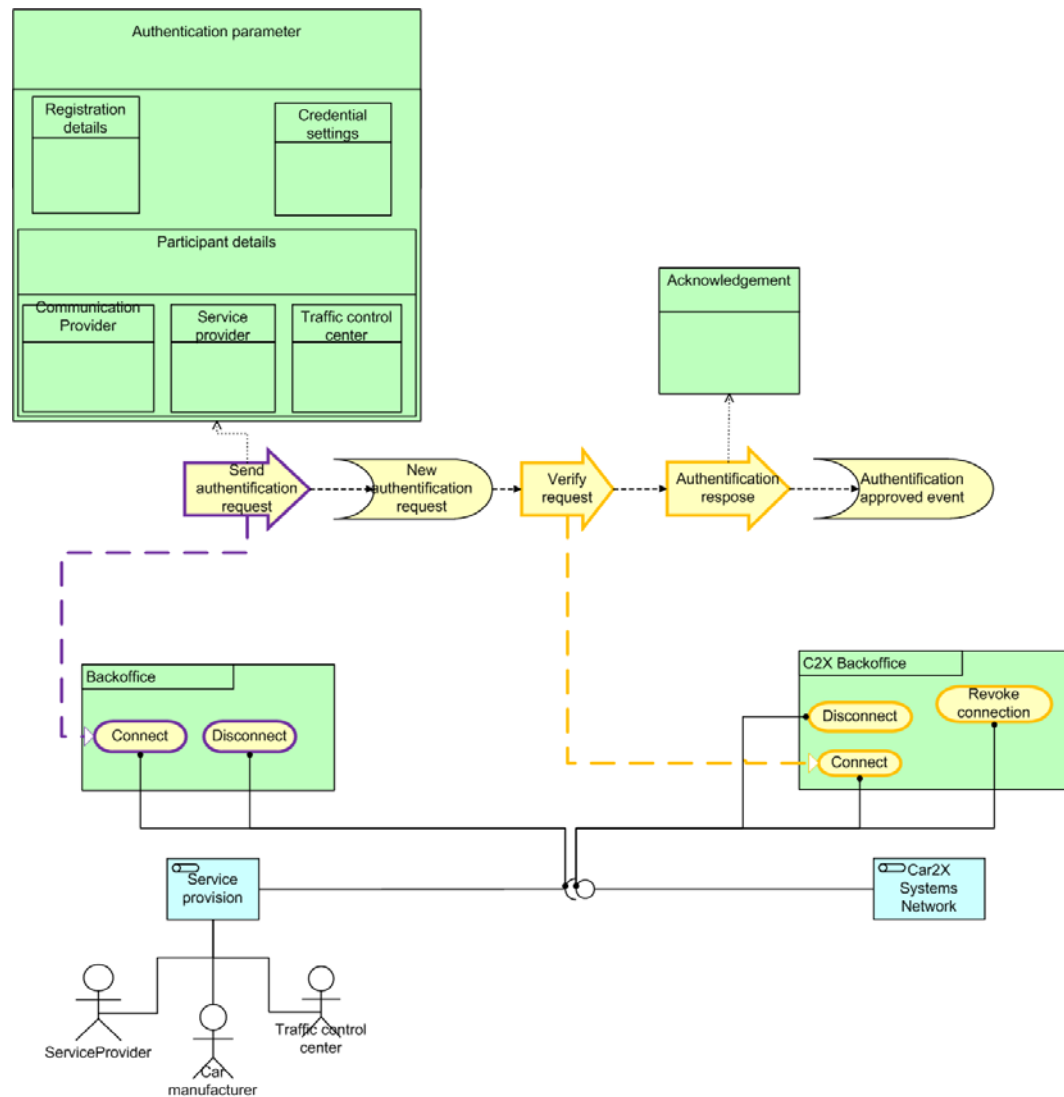
UC Code	Sub-Group	Priority	Ref Req
UC-C2X-101_02	Car2X Systems Network Service Provider IVS Communication Network Provider	Mandatory	REQ-SEC-PP-006, REQ-SEC-PS-002, REQ-SEC-PA-001 REQ-SEC-Trust_SP
Author			
PTV, Matthias Mann			
Description			
Car2X Systems Network offers an accreditation for Service Providers, IVSs and Communication Network Providers.			
Pre-Conditions			
<ul style="list-style-type: none"> • UC-C2X-101_01: Registration details are available • Security parameters are described 			
Post-Conditions			
Credential settings are available for further use for authentication of a new service offered within the Car2X Systems Network or a participant to use the Car2X Systems Network.			
Notes			
<p>Confidentiality is required, because data relevant for accreditation might include information that should not be disclosed to third parties.</p> <p>During the accreditation process, the trustworthiness of the SP is to be assessed.</p>			

UC-C2X-101_03 Authentication

Authentication comprises the act of confirming, that

- (a) a new person or company is now participating in the Car2X Systems Network (see UC-C2X-101_03_01) or that
- (b) a new service is now part of the Car2X Systems Network (see UC-C2X-101_03_01).

The following figure shows relevant authentication aspects within the Car2X Systems Network using the Archimate® Business Layer notation.



Car2X authentication – complete Business Layer diagram

Figure 5: Business Layer – UC-C2X-101_03 Authentication

The identified building blocks of the Business Layer for UC-C2X Authentication are listed in the following tables.

Table 21: Processes identified UC-C2X-101_03 Authentication

Value	Description
Send authentication request	[Service provision] sends authentication request to [C2X Systems Network]
Verify request	[C2X Systems Network] verifies request
Authentication response	[C2X Systems Network] provides authentication response

Table 22: Events identified in UC-C2X-101_03 Authentication

Value	Description
New authentication request	New authentication request
Authentication approved event	Authentication response

Table 23: Actors identified in UC-C2X-101_03 Authentication

Value	Description
Service provider	A fleet operator
Car manufacturer	A car manufacturer
Traffic control centre	A traffic control centre

Table 24: Roles identified in UC-C2X-101_03 Authentication

Value	Description
Service provision	The service provider, represented by e.g. car manufacturer, traffic control centre
Car2X Systems Network	The Car2X Systems Network

Table 25: Services identified in UC-C2X-101_03 Authentication

Value	Description
Connect	Authentication service offered by [C2X Systems Network]
Disconnect	Disconnect service offered by [C2X Systems Network]
Revoke connection	Revoke connection realized by [C2X Systems Network]

Table 26: Interfaces identified in UC-C2X-101_03 Authentication

Value	Description
Authentication Interface	Interface offered by the [C2X Systems Network] to [Service Provision] for accreditation

Table 27: Objects identified in UC-C2X-101_03 Authentication

Value	Description
Authentication parameter	Data object holding information about the authentication parameters
Credential settings	Data object holding information about the credential parameters
Participant details	Data object holding information about the participant
Communication provider	Data object holding specific information about the participant [Communication provider]
Traffic control centre	Data object holding specific information about the

Value	Description
	participant [Traffic control centre]
Service provider	Data object holding specific information about the participant [Service provider]

UC-C2X-101_03_01 Authentication of a new participant

UC Code	Sub-Group	Priority	Ref Req
UC-C2X-101_03_01	Car2X Systems Network, Service Provider, IVS, Communication Network Provider	Mandatory	REQ-SEC-PP-006, REQ-SEC-PS-002, REQ-SEC-PA-001
Author			
PTV, Matthias Mann			
Description			
Car2X Systems Network offers an authentication for Service Providers, IVSs and Communication Network Providers.			
Pre-Conditions			
<ul style="list-style-type: none"> UC-C2X-101_02: Credential details (including security settings) are available Participant details are described Roles und rules describing the requirements of the Car2X Systems Network are documented and available 			
Post-Conditions			
The participation of the new participant in the Car2X Systems Network is acknowledged. He can now use the functionality offered by and is accessible within the Car2X Systems Network.			
Notes			

UC-C2X-101_03_02 Authentication of a new service

UC Code	Sub-Group	Priority	Ref Req
UC-C2X-101_03_02	Car2X Systems Network, Service Provider, Communication Network Provider	Mandatory	REQ-SEC-PP-006, REQ-SEC-PS-002, REQ-SEC-PA-001
Author			
PTV, Matthias Mann			
Description			
Car2X Systems Network offers an authentication for new services.			
Pre-Conditions			
<ul style="list-style-type: none"> UC-C2X-101_02: Credential details (including security settings) are available 			

<ul style="list-style-type: none"> Service details are described Roles und rules describing the requirements of the Car2X Systems Network are documented and available
Post-Conditions
The participation of the new service in the Car2X Systems Network is acknowledged. The service offered is now accessible within the Car2X Systems Network.
Notes

UC-C2X-101_04 Advertisement

UC Code	Sub-Group	Priority	Ref Req
UC-C2X-101_04	Car2X Systems Network Service Provider IVS	Mandatory	REQ-SEC-PP-004, REQ-SEC-PA-001
Author			
PTV, Matthias Mann			
Description			
Car2X Systems Network offers an advertisement service that enables (a) Service Provider and Communication Network Provider to advertise the services they offer (b) Service Provider and Mobile Nodes to lookup services offered within the C2X integrated system.			
Pre-Conditions			
<ul style="list-style-type: none"> UC-C2X-101_03: Services offered are acknowledged by Car2X Systems Network Details about service and service provider are described 			
Post-Conditions			
Details about service and service provider are provided			
Notes			
Service should probably be identified; if pseudonymous advertisements are required, privacy profile REQ-SEC-PP-001 could be used instead.			

UC-C2X-102 Life cycle management

Life cycle management comprises the process of initialization, maintenance, and termination of a service. The initialization process consists of the following steps:

1. subscribing to a service,
2. downloading required software or data for using a service,
3. installation of software and
4. activation of a service for usage.

The maintenance process allows for

5. updates and

the termination process consists of the inverse steps of the initialization process:

6. deactivation of a service,
7. de-installation of the software and
8. de-subscription of the service.

UC-C2X-102_01 Subscribe service

UC Code	Sub-Group	Priority	Ref Req
UC-C2X-102-01	Car2X Systems Network Service Provider IVS	Mandatory	REQ-SEC-PP-006, REQ-SEC-PS-002, REQ-SEC-PA-001
Author			
PTV, Matthias Mann; Bosch, Hendrik Fuchs			
Description			
A data sink (SP, IVS, IRS) subscribes for a service offered by a service provider			
Pre-Conditions			
UC-C2X-101_03: Services offered are acknowledged by Car2X Systems Network			
Post-Conditions			
<ul style="list-style-type: none"> Contract is completed Required software and/or access details are available for the client Service can be used 			
Notes			
<p>Depending on the service, privacy profile REQ-SEC-PP-006 is appropriate if the service needs to identify the subscriber (REQ-SEC-PP-003 would be required for services that are available to authorized pseudonymous participants).</p> <p>If availability of the service subscription is not required, security profile REQ-SEC-PS-006 would be appropriate instead of REQ-SEC-PS-002.</p> <p>Confidentiality is required, because service subscription could include information that should not be disclosed to third parties.</p>			

UC-C2X-102_02 Download software

UC Code	Sub-Group	Priority	Ref Req
UC-C2X-102_02	Service Provider, IVS	Mandatory	REQ-SEC-PP-003, REQ-SEC-PS-007, REQ-SEC-PA-001
Author			
PTV, Matthias Mann; Bosch, Hendrik Fuchs			
Description			
An IVS respectively IRS downloads the software for a (new) application.			
Pre-Conditions			
Post-Conditions			
The software is available at the IVS and ready for installation.			
Notes			
<p>A download is a simple file transfer that loads the program and installation files onto your computer so that the program runs correctly.</p> <p>At least an interface is available which supports, if required, the download of application software by the (new) user of a service. If pseudonymous download is not allowed, privacy profile REQ-SEC-PP-006 would be required (might depend on the actual software).</p> <p>Only participants in a role with an appropriate authorization should be able to download the software.</p>			

UC-C2X-102_03 Install software

UC Code	Sub-Group	Priority	Ref Req
UC-C2X-102_03	Service Provider IVS	Mandatory	REQ-SEC-PP-003, REQ-SEC-PS-007
Author			
PTV, Matthias Mann; Bosch, Hendrik Fuchs			
Description			
<p>Authorised entities can install new software running on an IVS or IRS. This includes software belonging to applications or services. The installation is done remotely over the air without user interaction or acknowledgement.</p> <p>The Installation is including the unpacking and loading of software.</p>			
Pre-Conditions			
UC-C2X-102_02			
Post-Conditions			
Software is installed.			
Notes			
<p>A Setup Assistant will walk the user through this process once the software was successfully downloaded.</p> <p>No communication, hence only generic security requirements apply.</p>			

UC-C2X-102_04 Activate service

UC Code	Sub-Group	Priority	Ref Req
UC-C2X-102_04	Service Provider IVS	Mandatory	REQ-SEC-PP-003, REQ-SEC-PS-007
Author			
PTV, Matthias Mann; Bosch, Hendrik Fuchs			
Description			
After the successful installation of an application, the installed application is activated. Activation is the process of verifying that a computer is running software in compliance with the software license associated with it. Activation takes place after a successful installation.			
Pre-Conditions			
UC-C2X-102_03			
Post-Conditions			
Service or application is ready for use.			
Notes			
No communication, hence only generic security requirements apply.			

UC-C2X-102_05 Update software

UC Code	Sub-Group	Priority	Ref Req
UC-C2X-102_05	Service Provider, IVS	Mandatory	REQ-SEC-PP-003, REQ-SEC-PS-007, REQ-SEC-PA-001
Author			
PTV, Matthias Mann; Bosch, Hendrik Fuchs			
Description			
A new version (software update) of an installed service or application is provided to the IVS respectively IRS.			
Pre-Conditions			
A new version is available. The software update is done application or service specific (e.g. silent update, active user request).			
Post-Conditions			
Software is updated.			
Notes			
The same security requirements and remarks as in UC-C2X-102_02 (Download Software) and in UC-C2X-102_03 (Install software) are applicable.			

UC-C2X-102_06 Discontinue service

UC Code	Sub-Group	Priority	Ref Req
UC-C2X-102_06	Service Provider IVS	Mandatory	REQ-SEC-PP-003, REQ-SEC-PS-007, REQ-SEC-PA-001
Author			
PTV, Matthias Mann; Bosch, Hendrik Fuchs			
Description			
The service or application provider stops offering the service or supporting the application.			
Pre-Conditions			
Post-Conditions			
The service or application user is informed.			
Notes			
The same security requirements and remarks as in UC-C2X-102_02 (Download Software) is applicable.			

UC-C2X-102_07 Uninstall software

UC Code	Sub-Group	Priority	Ref Req
UC-C2X-102_07	Service Provider IVS	Mandatory	
Author			
PTV, Matthias Mann; Bosch, Hendrik Fuchs			
Description			
Authorised entities can uninstall software running on an IVS or IRS. This includes software belonging to applications or services. The uninstallation is done remotely over the air without user interaction or acknowledgement			
Pre-Conditions			
UC-C2X-102_03			
Post-Conditions			
Software is uninstalled.			
Notes			

UC-C2X-102_08 Unsubscribe service

UC Code	Sub-Group	Priority	Ref Req
UC-C2X-102_08	Service Provider IVS	Mandatory	REQ-SEC-PP-006, REQ-SEC-PS-006, REQ-SEC-PA-001
Author			
PTV, Matthias Mann; Bosch, Hendrik Fuchs			
Description			
A data sink (SP, IVS, IRS) unsubscribes a service offered by a service provider			
Pre-Conditions			
UC-C2X-102-01			
Post-Conditions			
The contract between data sink and service provider is cancelled. The service provider knows that the data sink is no longer using its service.			
Notes			
If availability of unsubscribing the service would be required, security profile REQ-SEC-PS-002 would be appropriate instead of REQ-SEC-PS-006. Confidentiality is probably required, because the unsubscribe process could require information that should not be disclosed to third parties.			

UC-C2X-103 Provide information on communication networks

The following use cases describe functionalities offered by the Car2X Systems Network related to communication aspects.

UC-C2X-103_01 Determine transmitting networks

UC Code	Sub-Group	Priority	Ref Req
UC-C2X-103_01	Car2X Systems Network, Communication Network Provider	Mandatory	
Author			
PTV, Matthias Mann			
Description			
On request the Car2X Systems Network determines all available communication networks.			
Pre-Conditions			
Post-Conditions			
The party interested in knowing the available communication networks has all relevant information for further processing.			
Notes			
The Car2X Systems Network provides information on all available communication networks, which can be used by the applications.			

UC-C2X-103_02 Determine communication status

UC Code	Sub-Group	Priority	Ref Req
UC-C2X-103_02	Car2X Systems Network Communication Network Provider	Mandatory	
Author			
PTV, Matthias Mann			
Description			
On request the Car2X Systems Network determines the status (e.g. availability, supported bandwidth, communication costs) of a selected communication network.			
Pre-Conditions			
An application requests the status of the available communication networks.			
Post-Conditions			
Status information is available to requesting services or applications for further use.			
Notes			

UC-C2X-103_03 Select suitable communication networks

UC Code	Sub-Group	Priority	Ref Req
UC-C2X-103_03	Car2X Systems Network, Communication Network Provider	Mandatory	REQ-C2X-001 REQ-C2X-002 REQ-C2X-003 REQ-C2X-004_02
Author			
HTW, M. Fünfroeken			
Description			
On request the Car2X Systems Network determines which communication network is best suited to provide the requested quality.			
Pre-Conditions			
<ul style="list-style-type: none"> QoS parameters are known UC-C2X-103_01 and UC-C2X-103_02 			
Post-Conditions			
Notes			
Based on the evaluation of connection properties like QoS, cost, etc. and given communication requirements from SP or application, the best suitable communication network is chosen.			

UC-C2X-104 Leaving Car2X Systems Network

The following use cases describe different ways of leaving the Car2X Systems Network.

UC-C2X-104_01 Leaving Car2X Systems Network – Stop Service

UC Code	Sub-Group	Priority	Ref Req
UC-C2X-104_01	Car2X Systems Network Service Provider IVS Communication Network Provider	Mandatory	
Author			
PTV, Matthias Mann			
Description			
A Service Provider discontinue a service			
Pre-Conditions			
<ul style="list-style-type: none"> UC-C2X-101_03: Participant and Services offered are acknowledged by Car2X Systems Network UC-C2X-102_01: Subscribers are known to service provider 			
Post-Conditions			
The service is not offered or can be used via the Car2X Systems Network anymore.			
Notes			

UC-C2X-104_02 Leaving Car2X Systems Network – Resign contract

UC Code	Sub-Group	Priority	Ref Req
UC-C2X-104_02	Car2X Systems Network Service Provider IVS Communication Network Provider	Mandatory	REQ-SEC-PS-009
Author			
PTV, Matthias Mann			
Description			
A service user decides to resign its contract for a service.			
Pre-Conditions			
UC-C2X-102-01			
Post-Conditions			
The service subscription is invalid.			
Notes			
The resignation must be authenticated and guarantee non-repudiation.			

UC-C2X-104_03 Leaving Car2X Systems Network – Invalidate Service

UC Code	Sub-Group	Priority	Ref Req
UC-C2X-104_03	Car2X Systems Network, Service Provider, IVS, Communication Network Provider	Mandatory	
Author			
PTV, Matthias Mann			
Description			
An actor is leaving the service chain and the service becomes invalid (until a new actor takes over the missing role)			
Pre-Conditions			
The service is realised having several providers along the service value chain.			
Post-Conditions			
The service becomes invalid and generates an appropriate information to registered users.			
Notes			

UC-C2X-104_04 Leaving Car2X Systems Network – Leave Car2X Systems Network

UC Code	Sub-Group	Priority	Ref Req
UC-C2X-104_04	Car2X Systems Network, Service Provider, IVS, Communication Network Provider	Mandatory	REQ-SEC-PS-009 REQ-SEC-Purge
Author			
PTV, Matthias Mann			
Description			
A service provider or service user is leaving the Car2X Systems Network.			
Pre-Conditions			
A service provider or service user is registered to the Car2X Systems Network.			
Post-Conditions			
All services offered by the service provider are stopped and are no longer accessible via the Car2X Systems Network. The service user is no longer actively participating in the Car2X Systems Network, but still has a valid contract.			
Notes			
This use cases addresses not topics as described in UC-C2X-102_06 and UC-C2X-102_08. Here the service provider or service user is only leaving (active logout) the Car2X Systems Network but not cancelling the contract. This process must be authenticated and and guarantee non-repudiation .			

UC-C2X-104_05 Leaving Car2X Systems Network – Revoke authentication

UC Code	Sub-Group	Priority	Ref Req
UC-C2X-104_05	Car2X Systems Network, Service Provider, IVS, Communication Network Provider	Mandatory	REQ-SEC-PS-009 REQ-SEC-Exclude
Author			
PTV, Matthias Mann			
Description			
The Car2X Systems Network revokes the credential of a participant due to misuse or misbehavior.			
Pre-Conditions			
A service provider (including communication network provider) or service user is participating in the Car2X Systems Network.			
Post-Conditions			
The participant is no longer part of the Car2X Systems Network and can thus no longer act as data source, data sink or communication network provider within the Car2X Systems Network. All services offered by a service provider are stopped and become invalid.			
Notes			
This process must be authenticated and and guarantee non-repudiation.			

UC-C2X-105 Data quality assessment

UC Code	Sub-Group	Priority	Ref Req
UC-C2X-105	IVS, Service Provider	Mandatory	
Author			
BMW, Oliver Klemp			
Description			
Data sinks assess the quality of perceived data based on a predefined set of quality metrics.			
Pre-Conditions			
<ul style="list-style-type: none"> Predefined set of data quality metrics including relevant information from originating sensor such as data granularity, timestamp, geographical reference, applied geo-referencing techniques. The sensor class itself also needs to be categorized. Sensor classes like on-board vehicle sensors or e. g. consumer electronics-located inertial sensors need to be differentiated. It needs to be furthermore differentiated whether the level of data truly means the raw information that can be obtained from the originating sensor or whether the information represents already post-processed and aggregated information by using different individual sensor data. For some use cases, a standardized interpretation of data quality is required (e. g. in case of safety-relevant information). 			
Post-Conditions			

Notes
In case of post-processed and therefore filtered and aggregated raw data, the filtering steps might need to be exchanged with the filtered information especially in case of safety-relevant information (such as local hazard warnings, etc.): Besides the result of the interpretation of a certain data set that was executed in an on-board- or off-board context, also the raw data (or the filtering algorithms) needs to be known at the recipient such that the interpretation result can be checked with the receivers (e.g. OEM #2, TCC or 3 rd party ITS SP) filtering techniques: Standardized information retrieval for safety-relevant functions vs. receiver-centric information retrieval.

UC-C2X-106 Communication Channel Selection

UC Code	Sub-Group	Priority	Ref Req
UC-C2X-106	IVS, IRS, Service Provider	Mandatory	REQ-C2X-001 REQ-C2X-002 REQ-C2X-003 REQ-IVS-012 REQ-IVS-013 REQ-IVS-014 REQ-IVS-016 REQ-IVS-017 REQ-IVS-018
Author			
Adam Opel AG, Carsten Büttner, Harald Berninger			
Description			
<p>The IVS respectively IRS observes the communication environment, identifies available access points / networks selects the appropriate according to a predefined set of criteria (e.g. application, costs, contract, bandwidth, QoS, ...).</p> <p>The SP selects the appropriate communication access point / network according to a predefined set of criteria (e.g. application, costs, contract, bandwidth, QoS, IVS access availability, ...).</p>			
Pre-Conditions			
<ul style="list-style-type: none"> UC-C2X-103_01 and UC-C2X-103_02 IVS needs different communication units (G5A/B, MNO 1/2/3) including authentication IVS needs to be in communication range (stationary or moving) SP needs access to C2X communication networks to IVS The IVS has a "decision maker" to select a communication link and protocol type 			
Post-Conditions			
The IVS has selected the proper communication link			
Notes			
In this use case the communication link to be used is actively selected by an application whereas in UC-C2X-103_03 the communication link is selected by the Car2X Systems Network.			

4.1.2 Service Provider to Other Interaction

In this paragraph, functionalities, which are needed to realize an information exchange between a Service Provide and another communication partner (e.g. IVS) are described using use cases.

It is required for all use cases that the involved parties are authenticated participants in the Car2X Systems Network (see UC-C2X-101_03).

The following figure shows relevant aspects for Service Provider to Other interaction within the Car2X Systems Network using the Archimate® Business Layer notation.

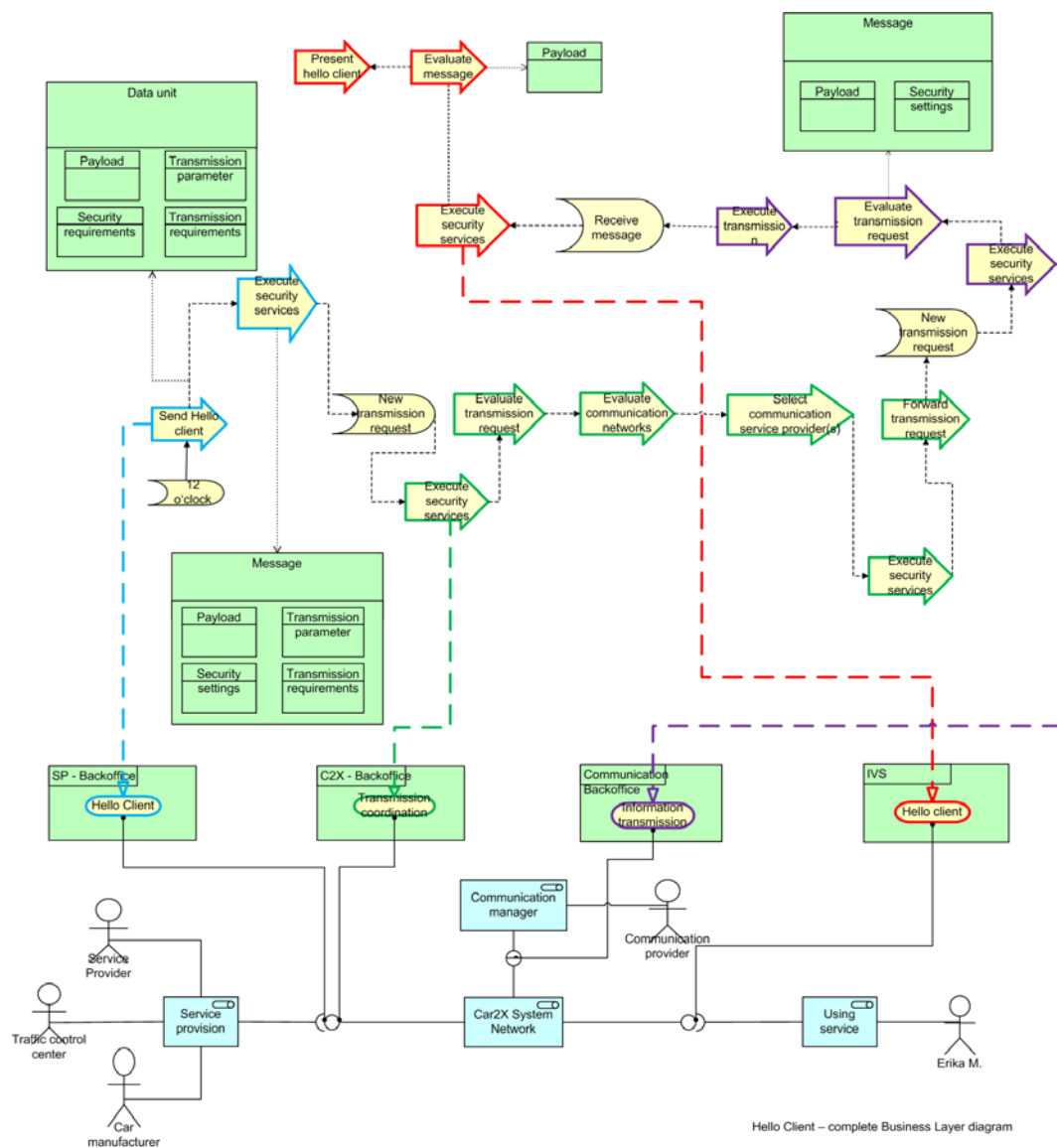


Figure 6: Business Layer – Service Provider to Other Interaction

The identified building blocks of the Business Layer for UC Car2X Systems Network are listed in the following tables.

Table 28: Processes identified in Service Provider to Other Interaction

Value	Description
Send Hello client	[Service provision] sends "Hello client" to [service user]
Execute security service	[C2X Systems Network] executes the security process. This is an integrated part of all products.
Evaluate transmission request	[C2X Systems Network] evaluates the transmission parameters and requirements
Evaluate communication networks	[C2X Systems Network] evaluates the [communication manager] with respect to the transmission parameters and requirements
Select communication network provider	[C2X Systems Network] selects [communication manager]
Forward transmission request	[C2X Systems Network] forwards the message to (the selected) [communication manager] for transmission
Execute transmission	[Communication manager] transmits the message to the [mobile node]
Evaluate message	The [mobile node / C2X Systems Network] evaluates the message. The actual payload is interpreted and, if required, decoded for the further use within "Present hello client"
Present hello client	"Hello client" is presented to [service user]

Table 29: Events identified in Service Provider to Other Interaction

Value	Description
12 o'clock	Triggering event; [service provision] sends "Hello client" always at 12 o'clock
New transmission request	[Service provision / C2X Systems Network] initiates message transmission
Receive message	[service user] receives new message

Table 30: Actors identified in Service Provider to Other Interaction

Value	Description
Service provider	A fleet operator
Car manufacturer	A car manufacturer
Traffic control centre	A traffic control centre
Communication provider	A communication network provider
Erika M.	Erika

Table 31: Roles identified in Service Provider to Other Interaction

Value	Description
Service provision	The service provider, represented by e.g. car manufacturer, traffic control centre
Car2X Systems Network	The Car2X Systems Network
Communication manager	A communication facility
Using service	The user of a service, e.g. represented by Erika M.

Table 32: Services identified in Service Provider to Other Interaction

Value	Description
Hello Client - Server	Welcome service (provider)
Transmission coordination	Coordination of transmission requests
Information transmission	Realization of message transmission
Hello Client - Client	Welcome service (receiver)

Table 33: Interfaces identified in Service Provider to Other Interaction

Value	Description
Information Transmission	Interface offered by the [C2X Systems Network] to [Service Provision], [Using service] and [Communication manager] for transmission of information

Table 34: Objects identified in Service Provider to Other Interaction

Value	Description
Data unit	Data object holding information about [Payload], [Security requirements], [Transmission parameters] and [Transmission requirements]
Payload	Data object holding information about the payload to be transmitted, e.g. "Hello client"
Security requirements	Security parameter, e.g. certificate
Transmission parameters	Transmission parameter, e.g. identifier of receiver
Transmission requirements	Transmission requirements, e.g. communication type, costs, bandwidth
Message	Data object holding information about [Payload] and [Security settings]
Security settings	Data object holding information about security settings, e.g. certificate

The processes identified in Table 28: Processes identified in Service Provider to Other Interaction as

- Evaluate transmission request,
- Evaluate communication networks

- Select communication network provider

describe the need for this kind of functionality. The decision which communication media should be used can be made in different ways. On one hand the Car2X Systems Network can decide which communication means should be used based on given transmission requirements. On the other hand the Car2X Systems Network can provide methods, measurements and indicators that in turn allow the communication participants or other system elements to choose the medium. The details of this have to be worked out in AP2.

The requirements

- REQ-C2X-004_01 Determine transmitting networks
- REQ-C2X-004_02 Determine communication status
- REQ-C2X-005_01 Reuse existing connections
- REQ-C2X-005_02 Determine accessibility of IVS
- REQ-ComNet-004 Geographical area information

are to be seen in the same way. They shall not determine a solution but describe the need for appropriate functionality.

UC-ComNet2IVS-01 Receiving message via backbone communication infrastructure

UC Code	Sub-Group	Priority	Ref Req
UC-ComNet2IVS-01	IVS, Communication Network Provider	Mandatory	REQ-IVS-001 REQ-IVS-018 REQ-ComNet-007
Author			
BMW, Oliver Klemp			
Description			
Receiving message via backbone communication infrastructure			
Pre-Conditions			
<ul style="list-style-type: none"> • The IVS supports infrastructure-based transmission mode • The IVS is registered to and certified for the Car2X Systems Network 			
Post-Conditions			
IVS has received the message			
Notes			

UC-ComNet2SP-01 Message reception at SP

UC Code	Sub-Group	Priority	Ref Req
UC-ComNet2SP-01	Service Provider, Communication Network Provider	Mandatory	REQ-ComNet-001 REQ-IVS-018 REQ-ComNet-007
Author			
BMW, Oliver Klempe			
Description			
The use case describes message forwarding at the interface between the communication network and the attached SP. The provider of the communication network (e. g. MNO, IRS-operator or IVS) distributes e. g. sensor information to the SP.			
Pre-Conditions			
<ul style="list-style-type: none"> The message to be distributed includes a georeferenced relevance (relevance area), such as e. g. aLHW warning. The communication network knows the location of the communication partner (geoserver, etc.). This information needs to be forwarded to the SP as well such that a geographical reference of the sensor information can be determined. The SP knows (will determine) the destination area of the message to be distributed later on in the direction of the return link. The SP has registered to deliver the messages (e. g. filtering for LHW messages at the level of the Car2X System Network) 			
Post-Conditions			
<ul style="list-style-type: none"> Established routing of a e.g. road hazard warning message through the core network to the back end of an SP. All recipients within the given destination area have been identified 			
Notes			

UC-SP2ComNet-01 Sending message to the communication partner in the destination area by the SP

UC Code	Sub-Group	Priority	Ref Req
UC-SP2ComNet-01	Service Provider, IVS, Communication Network Provider	Mandatory	REQ-ComNet-001 REQ-IVS-002 REQ-IVS-003 REQ-ComNet-003
Author			
BMW, Oliver Klempe			
Description			
Transmission of message between SP to the communication partner in the destination area as defined by the SP.			

Pre-Conditions
<ul style="list-style-type: none"> The message to be distributed includes a georeferenced relevance, such as a LHW warning. The SP provides the capabilities to identify the relevant communication partners (destination area, node ID) in the relevance area. As such the SP is able to distribute the georeferenced message in the relevance area. The communication partner can be reached via the communication network and has also registered to the provider of the communication network.
Post-Conditions
<ul style="list-style-type: none"> Routing of a local hazard warning and the destination information through the cellular core network to the cellular radio access network. Message has been delivered to all clients in the destination area
Notes

UC-SP2IRS-01 Sending message to IRS

UC Code	Sub-Group	Priority	Ref Req
UC-SP2IRS-01	Service Provider, IRS, Communication Network Provider	Mandatory	REQ-SEC-PS-013
Author			
VW, Simsek Burak			
Description			
Service provider provides additional information to IRS (e.g. at a blocking trailer), which was not available before (e.g. blocked lanes, duration of the Road Works, speed limits and topology)			
Pre-Conditions			
<ul style="list-style-type: none"> UC-IRS2SP-01 The service provider (most probably a federal TCC) has information about the Road Works 			
Post-Conditions			
IRS sends updated information as in UC-IRS2IVS-01			
Notes			

UC-SP2IVS-01 Inform selected vehicles about roadworks

UC Code	Sub-Group	Priority	Ref Req
UC-SP2IVS-01	Service Provider, IVS, Communication Network Provider	Mandatory	REQ-SEC-PS-005
Author			
VW, Simsek Burak			
Description			
SP informs selected vehicles about roadworks			
Pre-Conditions			
<ul style="list-style-type: none"> UC-SP2SP-01_01 Some vehicles are registered at SP for respective services The SP is able to select vehicles that might be interested in the information The selected vehicles can be reached using a wireless technology (ETSI G5 (in case of a private network provider), 3G, 4G, DAB) and SP knows the best way to reach them 			
Post-Conditions			
Vehicles receive up-to-date information from their service providers			
Notes			

UC-SP2IVS-02 Inform selected vehicles about traffic signs

UC Code	Sub-Group	Priority	Ref Req
UC-SP2IVS-02	Service Provider, IVS, Communication Network Provider	Mandatory	REQ-C2X-008 REQ-SEC-PS-001
Author			
VW, Simsek Burak			
Description			
SP informs selected vehicles about the change in traffic sign (see UC-SP2IVS-01)			
Pre-Conditions			
<ul style="list-style-type: none"> UC-SP-03 Vehicles are able to receive information Vehicle has a connection to SP 			
Post-Conditions			
Vehicles can use these information for driver assistance systems			
Notes			

UC-SP2IVS-03 Inform selected vehicles about traffic conditions

UC Code	Sub-Group	Priority	Ref Req
UC-SP2IVS-03	Service Provider, IVS, Communication Network Provider	Mandatory	REQ-C2X-008 REQ-SEC-PS-001
Author			
VW, Simsek Burak			
Description			
SP informs selected vehicles about roadworks and traffic conditions nearby			
Pre-Conditions			
Some vehicles are registered at the SP for respective services The SP is able to select vehicles that might be interested in the information The selected vehicles can be reached using a wireless technology (ETSI G5 (in case of a private network provider), 3G, 4G, DAB) and SP knows the best way to reach them			
Post-Conditions			
Vehicles receive up-to-date information from their service providers			
Notes			

UC-SP2IVS-04 Sending of Hello Opel/Volkswagen/BMW/Bosch

UC Code	Sub-Group	Priority	Ref Req
UC-SP2IVS-04	Service Provider, IVS, Communication Network Provider	Mandatory	REQ-SP-005_01 REQ-SEC-PP-004 REQ-SEC-PS-001
Author			
Adam Opel AG, Carsten Büttner, Harald Berninger			
Description			
A service provider (OEM Backend) sends a greeting message via CONVERGE platform to a set of IVS (e.g. all IVS or a specific subset i.e. Opel) in a specific area.			
Pre-Conditions			
Post-Conditions			
Initiate next actions: UC-C2X-106, UC-ComNet-02, display to driver			
Notes			

UC-SP2SP-01 Exchange of data between service providers

The following Use Cases describe the exchange of data between different service providers, one acting as data source and the other acting as data sink.

UC-SP2SP-01_01 Provide RWW information to SP

UC Code	Sub-Group	Priority	Ref Req
UC-SP2SP-01_01	Service Provider	Mandatory	REQ-C2X-008 REQ-SEC-PS-005 REQ-SEC-PP-006
Author			
VW, Simsek Burak			
Description			
SP provides information about Road Works to other SPs			
Pre-Conditions			
<ul style="list-style-type: none"> UC-IRS2SP-01 The service of SP is known to other SPs There is a contract between two SPs, which enables the exchange of such information Through pull or push services other SPs are able to receive this new information and each update 			
Post-Conditions			
All interested and authorized SPs receive the information for further processing			
Notes			

UC-SP2SP-01_02 Provide traffic state information to SP

UC Code	Sub-Group	Priority	Ref Req
UC-SP2SP-01_02	Service Provider	Mandatory	REQ-C2X-008 REQ-SEC-PS-005 REQ-SEC-PP-006
Author			
VW, Simsek Burak			
Description			
SP informs all interested and authorized SPs about the traffic condition			
Pre-Conditions			
UC-IRS2SP-02			
Post-Conditions			
<ul style="list-style-type: none"> All interested and authorized SPs receive the information and can process it further Use Case UC-SP2IVS-03 is initiated if the result of the traffic flow analysis is that there is a traffic jam or (exclusive) UC-SP2SP-01_04 is initiated 			
Notes			

UC-SP2SP-01_03 Provide traffic sign information to SP

UC Code	Sub-Group	Priority	Ref Req
UC-SP2SP-01_03	Service Provider	Mandatory	REQ-C2X-008 REQ-SEC-PS-005 REQ-SEC-PP-006
Author			
VW, Simsek Burak			
Description			
SP informs other service providers about change in traffic sign (see UC-SP2SP-01_01)			
Pre-Conditions			
<ul style="list-style-type: none"> All prior conditions of UC-SP2SP-01_02 are satisfied UC-SP-01 SP has received an update on a traffic sign Other service providers are aware of the service and can use this service as a pull or a push service SP validates the information before sharing it 			
Post-Conditions			
All service providers that receive the information processes it and can forward to relevant vehicles based on UC-SP2IVS-02			
Notes			

UC-SP2SP-01_04 Request traffic state information from SP

UC Code	Sub-Group	Priority	Ref Req
UC-SP2SP-01_04	Service Provider	Mandatory	REQ-SEC-PS-005 REQ-SEC-PA-002 REQ-SEC-PP-006
Author			
VW, Simsek Burak			
Description			
SP request more information about traffic condition in a specific area from another SP (See UC-SP2SP-01_01)			
Pre-Conditions			
<ul style="list-style-type: none"> SP has got a message about traffic conditions from SP (UC-SP2SP-01_02) SP does not know enough vehicles in the relevance area to validate the information of the traffic condition 			
Post-Conditions			
Use Case UC-SP2SP-06 is initiated			
Notes			

UC-SP2SP-01_05 Provide response for traffic state information from SP

UC Code	Sub-Group	Priority	Ref Req
UC-SP2SP-01_05	Service Provider	Mandatory	REQ-C2X-008 REQ-SEC-PS-005 REQ-SEC-PA-002 REQ-SEC-PP-006
Author			
VW, Simsek Burak			
Description			
SP response to requesting SP with more information about traffic condition in a specific area			
Pre-Conditions			
SP has requested this information from other SP (UC-SP2SP-01_04)			
Post-Conditions			
<ul style="list-style-type: none"> SP is able to validate information about traffic condition Use Case UC-SP2IVS-03 is initiated if the result of the traffic flow analysis is that there is a traffic jam 			
Notes			

4.1.3 IVS to Other interactions

In this paragraph functionalities which are needed to realize an information exchange between an IVS or an IRS and another communication partner (e.g. SP) are described using use cases.

It is required for all use cases that the involved parties are authenticated participants in the Car2X Systems Network (see UC-C2X-101_03).

The following figure shows relevant aspects for IVS to Other interaction within the Car2X Systems Network using the Archimate© Business Layer notation.

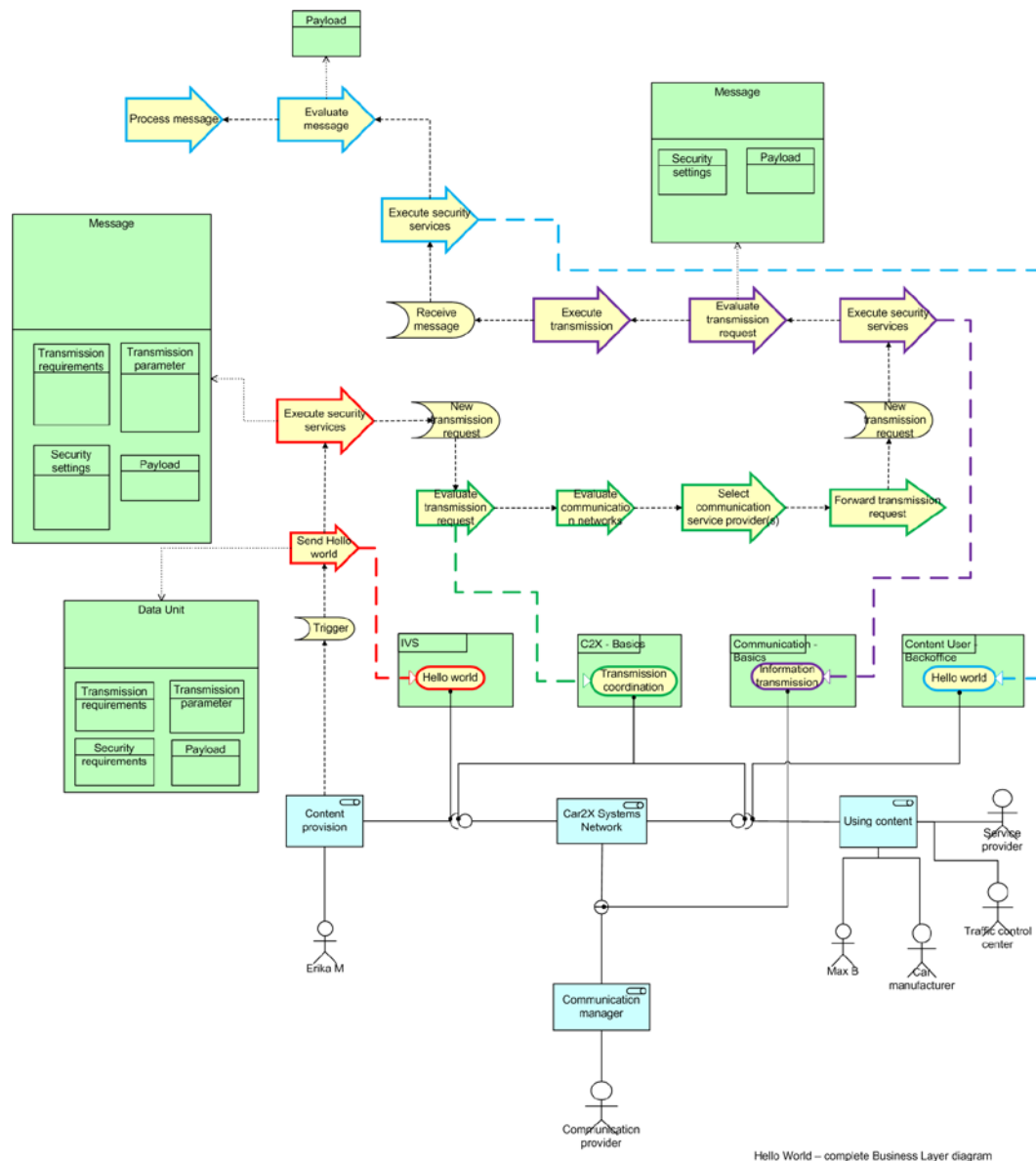


Figure 7: Business Layer – IVS to Other Interaction

The identified building blocks of the Business Layer for UC Car2X Systems Network are listed in the following tables.

Table 35: Processes identified in Service Provider to Other Interaction

Value	Description
Send Hello world	[Content provision] sends "Hello world" to [service user]
Execute security services	[Car2X Systems Network] executes the security process. This is an integrated part of all products.
Evaluate transmission request	[Car2X Systems Network] evaluates the transmission parameters and requirements

Value	Description
Evaluate communication networks	[Car2X Systems Network] evaluates the [communication manager] with respect to the transmission parameters and requirements
Select communication network provider	[Car2X Systems Network] selects [communication manager]
Forward transmission request	[Car2X Systems Network] forwards the message to (the selected) [communication manager] for transmission
Execute transmission	[Communication manager] transmits the message to the [IVS]
Evaluate message	The [IVS / Car2X Systems Network] evaluates the message
Process message	The message is further processed (e.g. is presented to [Using content])

Table 36: Events identified in IVS to Other Interaction

Value	Description
Trigger	Triggering event; [Content provision] sends “Hello world” always at 12 o’clock
New transmission request	[Content provision / Car2X Systems Network] initiates message transmission
Receive message	[Using content] receives new message

Table 37: Actors identified in IVS to Other Interaction

Value	Description
Service provider	A fleet operator
Car manufacturer	A car manufacturer
Traffic control centre	A traffic control centre
Communication provider	A communication network provider
Erika M.	Erika
Max B	Max

Table 38: Roles identified in IVS to Other Interaction

Value	Description
Content provision	The content provider, represented by e.g. car manufacturer, traffic control centre
Car2X Systems Network	The Car2X Systems Network
Communication manager	A communication facility
Using content	The user of a content provided by Erika M.

Table 39: Services identified in IVS to Other Interaction

Value	Description
Hello World – Content Provider	Welcome service (provider)
Transmission coordination	Coordination of transmission requests
Information transmission	Realization of message transmission
Hello World – Content Receiver	Welcome service (receiver)

Table 40: Interfaces identified in IVS to Other Interaction

Value	Description
Information Transmission	Interface offered by the [Car2X Systems Network] to [Content Provision], [Using content] and [Communication manager] for transmission of information

Table 41: Objects identified in IVS to Other Interaction

Value	Description
Data unit	Data object holding information about [Payload], [Security requirements], [Transmission parameters] and [Transmission requirements]
Payload	Data object holding information about the payload to be transmitted, e.g. "Hello world"
Security requirements	Security parameter, e.g. certificate
Transmission parameters	Transmission parameter, e.g. identifier of receiver
Transmission requirements	Transmission requirements, e.g. communication type, costs, bandwidth
Message	Data object holding information about [Payload] and [Security settings]
Security settings	Data object holding information about security settings, e.g. certificate

The processes identified in Table 35: Processes identified in Service Provider to Other Interaction as

- Evaluate transmission request,
- Evaluate communication networks
- Select communication network provider

describe the need for this kind of functionality. The decision which communication media should be used can be made in different ways. On one hand the Car2X Systems Network can decide which communication means should be used based on given transmission requirements. On the other hand the Car2X Systems Network can provide methods, measurements and indicators that in turn allow the communication participants or other system elements to choose the medium. The details of this have to be worked out in AP2.

The requirements

- REQ-C2X-004_01 Determine transmitting networks
- REQ-C2X-004_02 Determine communication status
- REQ-C2X-005_01 Reuse existing connections
- REQ-C2X-005_02 Determine accessibility of IVS
- REQ-ComNet-004 Geographical area information

are to be seen in the same way. They shall not determine a solution but describe the need for appropriate functionality.

UC-IVS2ComNet-01 Sending message via backbone network infrastructure

UC Code	Sub-Group	Priority	Ref Req
UC-IVS2ComNet-01	IVS, Communication Network Provider	Mandatory	REQ-ComNet-002 REQ-IVS-002 REQ-IVS-004 REQ-IVS-018 REQ-SEC-PS-001 REQ-SEC-PP-003
Author			
BMW, Oliver Klemp			
Description			
The message is exchanged between an IVS and an infrastructure based termination point of the network. The source destination is being operated by an infrastructure provider (e. g. an MNO or an IRS infrastructure provider)			
Pre-Conditions			
<ul style="list-style-type: none"> • The IVS supports infrastructure-based transmission mode. • The IVS is registered to and certified for the Car2X Systems Network • The communication system is able to deliver messages to the desired recipients 			
Post-Conditions			
IVS has sent the message			
Notes			
This use case is a specialisation of UC-ComNet-02 Transmission of messages by a communication system.			

UC-IVS2IVS-01 Sending message via direct communication to IVS (C2C)

UC Code	Sub-Group	Priority	Ref Req
UC-IVS2IVS-01	IVS, Communication Network Provider	Mandatory	REQ-IVS-003 REQ-IVS-002 REQ-IVS-004 REQ-IVS-018 REQ-SEC-PS-001
Author			
BMW, Oliver Klemp			
Description			
This use-case describes direct message forwarding between two network termination points (IVS). The communication is not established via a fixed infrastructure but directly between the two communicating nodes via device-2-device communication.			
Pre-Conditions			
Both IVS supports direct transmission mode and are able to properly code or decode the message.			
Post-Conditions			
IVS#1 has sent the message			
Notes			
This use case is a specialisation of UC-ComNet-02 Transmission of messages by a communication system.			

UC-IVS2IVS-02 Receiving message via another IVS

UC Code	Sub-Group	Priority	Ref Req
UC-IVS2IVS-02	IVS, Communication Network Provider	Mandatory	REQ-IVS-001 REQ-IVS-018 REQ-ComNet-007 REQ-SEC-PS-001
Author			
BMW, Oliver Klemp			
Description			
The use case describes message reception at the IVS level when the message was sent from another IVS. No additional fixed infrastructure is required to establish the exchange of messages.			
Pre-Conditions			
Both IVS supports direct transmission mode.			
Post-Conditions			
IVS has received the message			
Notes			

UC-IVS2IRS-01 Broadcast CAM information

UC Code	Sub-Group	Priority	Ref Req
UC-IVS2IRS-01	IVS, Communication Network Provider	Mandatory	REQ-ComNet-005 REQ-SEC-PP-001 REQ-SEC-PS-009
Author			
VW, Simsek Burak			
Description			
IVS respectively IRS sends CAMs to adjacent ITS-Stations.			
Pre-Conditions			
Both IVS and IRS supports direct transmission mode.			
Post-Conditions			
CAM is available at data sink.			
Notes			

UC-IVS2SP-01 Renew Certificates

The following use cases describe functionalities, which are necessary to update security credentials.

UC-IVS2SP-01_01 Renew Authorized Pseudonyms – Request

UC Code	Sub-Group	Priority	Ref Req
UC-IVS2SP-01_01	IVS	Mandatory	REQ-C2X-009 REQ-IVS-008 REQ-SEC-PP-003 REQ-SEC-PS-001
Author			
Adam Opel AG, Carsten Büttner, Harald Berninger			
Description			
An IVS observes that its authorized pseudonyms are exhausted in X time units (e.g. 1 Week). Then the IVS sends a request for new authorized pseudonyms when it has a connection via one of the communication channels to its service provider. The IVS then requests new authorized pseudonyms according to ETSI TS 102 941. Next action: UC-C2X-106 > UC-ComNet-02 > UC-SP-05			
Pre-Conditions			
<ul style="list-style-type: none"> IVS must know the address and how to access the service provider. IVS is known to the service provider and needs access rights. IVS needs his authentication information. 			
Post-Conditions			
Notes			
The above described use cases holds for IRS as well.			

UC-IVS2SP-01_02 Renew Authorized Pseudonyms - Reception

UC Code	Sub-Group	Priority	Ref Req
UC-IVS2SP-01_02	IVS	Mandatory	REQ-SEC-PP-005 REQ-SEC-PS-001
Author			
Adam Opel AG, Carsten Büttner, Harald Berninger			
Description			
The IVS receives, checks, and stores the authorized pseudonyms on board.			
Pre-Conditions			
Completion of UC-IVS2SP-02_01			
Post-Conditions			
Notes			

UC-IVS2SP-02 Vehicle Environment Sensing – Receiving and distributing of Content

UC Code	Sub-Group	Priority	Ref Req
UC-IVS2SP-02	Service Provider, IVS, Communication Network Provider	Mandatory	REQ-SP-001 REQ-SP-002 REQ-SEC-PP-006 REQ-SEC-PA-002 REQ-SEC-PS-001
Author			
Adam Opel AG, Carsten Büttner, Harald Berninger			
Description			
<p>The service provider receives sensor readings of IVSs, which are registered at this service provider, checks the access rights of the IVS and validates the data. The service provider aggregates, advertises, and provides the data to other service providers and/or the MDM. In addition the service provider presents the results via remote-GUI to web-clients for project evaluation.</p> <p>If necessary, the service provider can request sensor data from IVSs in a specific area of interest.</p> <p>Reception of vehicle detected data will be acknowledged to the IVS</p>			
Pre-Conditions			
Successful execution of UC-IVS-03 and UC-SP-03N, UC-SP-03			
Post-Conditions			
Notes			

UC-IVS2SP-03 Parking Direction Pointer – Process Request

UC Code	Sub-Group	Priority	Ref Req
UC-IVS2SP-03	Service Provider, IVS, Communication Network Provider	Mandatory	REQ-SP-005_01 REQ-ComNet-001 REQ-SEC-PP-005 REQ-SEC-PS-001
Author			
Adam Opel AG, Carsten Büttner, Harald Berninger			
Description			
The service provider receives a service request and checks the access rights of requesting IVS. The service provider selects the data corresponding to the request, calculates waypoints (with descriptions) guiding to the free parking and finally sends it to the IVS.			
Pre-Conditions			
Post-Conditions			
Execution of UC-C2X-106 and UC-ComNet-02, display of message (see UC-IVS2SP-03)			
Notes			

UC-IVS2SP-04 Send traffic sign information to SP

UC Code	Sub-Group	Priority	Ref Req
UC-IVS2SP-04	Service Provider, IVS, Communication Network Provider	Mandatory	REQ-C2X-008 REQ-SEC-PS-005 REQ-SEC-PP-003 REQ-SEC-PA-002
Author			
VW, Simsek Burak			
Description			
A vehicle detects a change in one of the traffic signs that it has in its own map and informs SP about this change			
Pre-Conditions			
<ul style="list-style-type: none"> Vehicle possesses required sensors and functionalities Vehicles are registered at their own SP Vehicle has a connection to SP 			
Post-Conditions			
SP is informed about the change			
Notes			

UC-IRS2IVS-01 Broadcast RWW information

UC Code	Sub-Group	Priority	Ref Req
UC-IRS2IVS-01	Service Provider, IRS, Communication Network Provider	Mandatory	REQ-C2X-008 REQ-ComNet-005 REQ-SEC-PS-013
Author			
VW, Simsek Burak			
Description			
An ITS-equipped blocking trailer is broadcasting RWW information using ETSI G5			
Pre-Conditions			
Trailer is able to fill in DENMs with sufficient data including reliable positioning, and speed.			
Post-Conditions			
Notes			

UC-IRS2SP-01 Send RWW information to SP

UC Code	Sub-Group	Priority	Ref Req
UC-IRS2SP-01	Service Provider, IRS, Communication Network Provider	Mandatory	REQ-C2X-008 REQ-SEC-PP-006 REQ-SEC-PS-008 REQ-SEC-PA-002
Author			
VW, Simsek Burak			
Description			
An ITS-equipped blocking trailer informs the service provider about the start of RWW with all the information that is required by the SP in order to identify the roadworks			
Pre-Conditions			
Trailer has connection to the SP (Wi-Fi, 2G, 3G, 4G...) and is able to select the best connection type			
Post-Conditions			
The service provider is informed about the running RWW at a previously known IRS			
Notes			

UC-IRS2SP-02 Send traffic state information to SP

UC Code	Sub-Group	Priority	Ref Req
UC-IRS2SP-02	Service Provider, IRS, Communication Network Provider	Mandatory	REQ-C2X-008 REQ-SEC-PP-006 REQ-SEC-PS-008 REQ-SEC-PA-002
Author			
VW, Simsek Burak			
Description			
Blocking trailer informs SP about the actual traffic condition using the best available network technology (see UC-IRS2SP-01)			
Pre-Conditions			
<ul style="list-style-type: none"> Trailer has connection to the SP (Wi-Fi, 2G, 3G, 4G...) and is able to select the best connection type All prior conditions of UC-IRS2SP-01 are satisfied Blocking trailer is able to detect traffic conditions using CAMs and DENMs 			
Post-Conditions			
Use Case US-SP2SP-01_02 is initiated			
Notes			

4.1.4 Service Provider

In this paragraph, use-cases describe basic functionality provided by Service Providers.

UC-SP-01 Message aggregation

UC Code	Sub-Group	Priority	Ref Req
UC-SP-01	Service Provider	Mandatory	REQ-IVS-010 REQ-IVS-011 REQ-SEC-PA-002
Author			
BMW, Oliver Klemp			
Description			
Message aggregation at the SP			
Pre-Conditions			
<ul style="list-style-type: none"> The SP has a means to identify those messages describing the same single event and can group the messages accordingly. The SP knows methods and algorithms for the aggregation The data of the aggregated messages are anonymized. 			
Post-Conditions			
There are no more single messages but aggregated event descriptions			
Notes			
This can be useful either at a Communication Network Provider to reduce the amount of messages transmitted or it is related to data aggregation at a service provider to achieve added value.			

UC-SP-02 New message generation

UC Code	Sub-Group	Priority	Ref Req
UC-SP-02	Service Provider	Mandatory	REQ-IVS-010 REQ-IVS-011 REQ-SEC-PP-005 REQ-SEC-PS-001 REQ-SEC-GEN-006
Author			
BMW, Oliver Klemp			
Description			
Based on a modified level of data being aggregated at the SP level, a new message (e. g. a warning message with a geographical context) was generated at SP level.			
Pre-Conditions			
<ul style="list-style-type: none"> The SP has additional information relevant for received events; e. g. temperature data to (de-)plausibilize black ice detection. The SP has a means to identify those aggregated event descriptions that are related to the above-mentioned additional information. There is a method how that data can be added to them. Authentication of the SP, data integrity, confidentiality, non reputation, and pseudonymity of the addressed vehicle are satisfied. 			
Post-Conditions			
The aggregated event descriptions from UC-SP-01 have been enriched by additional information. The level of enrichment is defined by the recently retrieved level of data at SP level.			
Notes			

UC-SP-03 Information evaluation

UC Code	Sub-Group	Priority	Ref Req
UC-SP-03	Service Provider	Mandatory	REQ-IVS-010 REQ-IVS-011 REQ-SEC-PP-005 REQ-SEC-PS-001 REQ-SEC-GEN-006
Author			
VW, Simsek Burak			
Description			
Service Provider evaluates and validates the information coming from vehicles (Plausibility check; Detection of abuse) This also includes that the authenticity of the message sender, the integrity and confidentiality of the data, non repudiation of the message, and pseudonymity of the vehicle are satisfied.			
Pre-Conditions			
Post-Conditions			
Notes			

UC-SP-04 Parking Direction Pointer – Update data

UC Code	Sub-Group	Priority	Ref Req
UC-SP-04	Service Provider	Mandatory	REQ-SEC-PP-006 REQ-SEC-PS-001
Author			
Adam Opel AG, Carsten Büttner, Harald Berninger			
Description			
<p>The service provider collects periodically up to date parking space availability (parking information system) and traffic data (IGLZ) via the MDM or directly.</p> <p>The service provider calculates possible zone approach routes for a requesting IVS and creates a parking space prediction based on the obtained data. The service provider assigns the obtained parking space data to predefined destination categories.</p>			
Pre-Conditions			
<ul style="list-style-type: none"> collect up to date parking space- and traffic data via MDM calculate the zone approaching route using the above mentioned data parking space prediction based on above mentioned data assign parking space data to predefined destination categories 			
Post-Conditions			
Notes			

UC-SP-05 Renew Authorized Pseudonyms - Processing

UC Code	Sub-Group	Priority	Ref Req
UC-SP-05	Service Provider, IVS, Communication Network Provider	Mandatory	REQ-ComNet-001 REQ-SEC-PP-006 REQ-SEC-PS-001
Author			
Adam Opel AG, Carsten Büttner, Harald Berninger			
Description			
<ul style="list-style-type: none"> The service provider receives the request (UC-IVS2SP-02_01) and checks the access rights of the requesting IVS. The service provider forwards the request to the corresponding provider for authorized pseudonyms. The provider for authorized pseudonyms validates the request and creates the authorized pseudonyms for the IVS and sends them according to ETSI TS 102 941 back to the service provider. Having received, the service provider sends the authorized pseudonyms to the IVS. 			
Pre-Conditions			
<ul style="list-style-type: none"> UC-IVS2SP-02_01 executed successfully confidential authorized pseudonyms provision by provider for authorized pseudonyms 			
Post-Conditions			
Execution of UC-C2X-106 and UC-ComNet-02 and finally UC-IVS2SP-02_02			
Notes			

4.1.5 IVS

In this paragraph, use-cases describe basic functionality provided by IVS.

UC-IVS-01 Detection of local hazard

UC Code	Sub-Group	Priority	Ref Req
UC-IVS-01	IVS	Mandatory	REQ-IVS-003
Author			
BMW, Oliver Klemp			
Description			
A dangerous situation is detected by the on-board sensor equipment of the mobile node (e. g. video- or gear rate sensors of a vehicle). The information of a dangerous situation can also be determined from the aggregation of multiple on-board sensor information.			
Pre-Conditions			
UC-IVS-03			
IVS has access to needed data for the service (latitude, longitude, heading, speed, time, etc.)			
Post-Conditions			
IVS has detected the hazard situation			
Notes			
If the hazardous information was derived from the aggregation of multiple raw data values at the level of the IVS on-board unit, also the filtering-/ processing chain needs might need to be exchanged between vehicle and SP. This needs to be discussed within the project. The interpretation of a hazardous situation may depend on the specific implementation of the mobile node.			

UC-IVS-02 Generation of DENM message

UC Code	Sub-Group	Priority	Ref Req
UC-IVS-02	IVS	Mandatory	REQ-IVS-003 REQ-IVS-010 REQ-IVS-011 REQ-IVS-012 REQ-IVS-013 REQ-IVS-014 REQ-SEC-PP-001 REQ-SEC-PA-001 REQ-SEC-PS-013
Author			
BMW, Oliver Klemp			
Description			
Generation of message (DENM)			
Pre-Conditions			
<ul style="list-style-type: none"> IVS is able to construct and encode messages describing the situation Provision of destination area to ensure an optimal distribution of the messages Provision of approach/egress data 			
Post-Conditions			
IVS has prepared (constructed and encoded) the message for sending			
Notes			

UC-IVS-03 Vehicle Environment Sensing - Collecting of Data

UC Code	Sub-Group	Priority	Ref Req
UC-IVS-03	IVS	Mandatory	REQ-SP-001 REQ-SP-004 REQ-IVS-003 REQ-SEC-PP-003 REQ-SEC-PA-002 REQ-SEC-PS-005
Author			
Adam Opel AG, Carsten Büttner, Harald Berninger			
Description			
A vehicle collects sensor readings of the vehicle road environment via its integrated sensors. The data will be aggregated and anonymized.			
Pre-Conditions			
The vehicle is equipped with the environment and localization sensors with data connection to IVS.			
Post-Conditions			
Execution of UC-C2X-106 > UC-ComNet-02, further processing at SP (see UC-IVS2SP-03)			
Notes			
This data aggregation will be sent confidential (content service) to the OEM Backend in predefined time intervals or upon request.			

UC-IVS-04 Decode received message

UC Code	Sub-Group	Priority	Ref Req
UC-IVS-04	IVS	Mandatory	
Author			
BMW, Oliver Klemp			
Description			
A message has been received by the IVS and is being decoded and interpreted properly by the IVS.			
Pre-Conditions			
The IVS has necessary information to decode the message and has been updated with proper certificates to properly decode the information.			
Post-Conditions			
IVS has decoded the message			
Notes			

UC-IVS-05 Check message relevance

The following use cases describe activities, which are needed in order to check the relevance of a message for further processing.

UC-IVS-05_01 Check message relevance – motion state

UC Code	Sub-Group	Priority	Ref Req
UC-IVS-05_01	IVS	Mandatory	REQ-IVS-006 REQ-IVS-007 REQ-IVS-010 REQ-IVS-011
Author			
BMW, Oliver Klempe			
Description			
IVS checks the relevance of the message with respect to its motion state (message is valid for "me") considering <ul style="list-style-type: none"> vehicle course (message is currently valid for IVS due to course) distance from vehicle to event location (urgency of the message) 			
Pre-Conditions			
<ul style="list-style-type: none"> The data needed to check the relevance (latitude, longitude, heading, speed, time, etc.) is available on the IVS. The message contains approach/egress data The current distance to the event location is known The current kinematical data (especially velocity and acceleration) is known 			
Post-Conditions			
The received message is relevant for the IVS and can be processed further <ul style="list-style-type: none"> The message is classified according to its current spatial relevance. The distance has been calculated An urgency has been calculated			
Notes			

UC-IVS-05_02 Check message relevance – vehicle course

UC Code	Sub-Group	Priority	Ref Req
UC-IVS-05_02	IVS	Mandatory	REQ-IVS-006 REQ-IVS-007
Author			
BMW, Oliver Klempe			
Description			
IVS checks the relevance of the message with respect to vehicle course (message is currently valid for IVS due to course)			
Pre-Conditions			
<ul style="list-style-type: none"> The data needed to check the relevance (latitude, longitude, heading, speed, time, etc.) is available on the IVS. The message contains approach/egress data 			
Post-Conditions			

<ul style="list-style-type: none"> The message is classified according to its current spatial relevance. The distance has been calculated
Notes

UC-IVS-05_03 Check message relevance – event distance

UC Code	Sub-Group	Priority	Ref Req
UC-IVS-05_03	IVS	Mandatory	REQ-IVS-006 REQ-IVS-007
Author			
BMW, Oliver Klemp			
Description			
IVS checks the urgency of the message with respect to distance from vehicle to event location			
Pre-Conditions			
<ul style="list-style-type: none"> The current distance to the event location is known The current kinematical data (especially velocity and acceleration) is known 			
Post-Conditions			
An urgency has been calculated			
Notes			

UC-IVS-05_04 Check message relevance – event type

UC Code	Sub-Group	Priority	Ref Req
UC-IVS-05_04	IVS	Mandatory	REQ-IVS-006 REQ-IVS-008 REQ-IVS-010 REQ-IVS-011 REQ-IVS-012
Author			
BMW, Oliver Klemp			
Description			
Further processing of the message according to the type of the hazard			
Pre-Conditions			
For each hazard type there is an "application" to handle it (e. g. for type=31 there is an "obstacle warning")			
Post-Conditions			
The received messages are distributed to the "right" applications			
Notes			

UC-IVS-06 Display warnings

UC Code	Sub-Group	Priority	Ref Req
UC-IVS-06	IVS	Mandatory	REQ-IVS-008 REQ-IVS-009
Author			
BMW, Oliver Klemp			
Description			
A warning message is being announced to the user. This could be done via e. g. an optical feed-back, a haptic feed-back or an audible feed-back. The feed-back to the driver (HMI concept of the IVS) is implementation-specific and always defined by the vendor of the mobile equipment (e. g. vehicle, CE device).			
Pre-Conditions			
<ul style="list-style-type: none"> The IVS has a suitable device (e. g. a display) capable of giving information and warnings to the driver The current urgency is known IVS is able to interpret the warning message 			
Post-Conditions			
The info/warning has been displayed			
Notes			

4.1.6 IRS

In this paragraph, use-cases describe basic functionality provided by IRS.

UC-IRS-01 Collecting and processing of CAMs

UC Code	Sub-Group	Priority	Ref Req
UC-IRS-01	IRS	Mandatory	REQ-SEC-PA-002
Author			
VW, Simsek Burak			
Description			
IRS collects information about the actual traffic condition and processes it.			
Pre-Conditions			
<ul style="list-style-type: none"> UC-IVS2IRS-01 A subset of vehicles in the vicinity of the blocking trailer send ETSI G5 messages Privacy of the drivers is secured Blocking trailer is able to pre-process traffic information using ETSI G5 messages from the other vehicles 			
Post-Conditions			
Blocking Trailer is aware of the traffic in its environment depending on the wireless coverage and UC-IRS2SP-02 is enabled			
Notes			
Security: The blocking trailer is not the initiating element of the collection/reception of information but the sending traffic component. That means no security-requirement are raised towards the trailer according to message-reception. It is however the initiating element according to further processing so the security-requirements reference to that aspect of the use-case. Sending or forwarding of information is not included. While processing the privacy of the CAM-sending entities has to be protected (aggregation).			

UC-IRS-02 IRS as application host

UC Code	Sub-Group	Priority	Ref Req
UC-IRS-02	IRS	Mandatory	REQ-SEC-PP-005 REQ-SEC-PA-001 REQ-SEC-PS-001
Author			
HTW, M. Fünfroeken			
Description			
The IRS may serve as a host for applications. Those applications may be part of a service provider or provide services themselves.			
Pre-Conditions			
<ul style="list-style-type: none"> The IRS provider has a business relation to the owner of the application. The application fulfils the requirements the IRS provider has set. (QoS, reliability, security) The application has been certified for the C2X systems network. 			
Post-Conditions			
The application extends the possibilities of the IRS and may use its resources to provide a service.			
Notes			
The detailed mechanisms of the hosting are left to the network provider and its customers. Especially provisioning and communication paths of an IRS application to a service provider are not in the scope of CONVERGE.			

UC-IRS-03 IRS provides service announcements

UC Code	Sub-Group	Priority	Ref Req
UC-IRS-03	IRS	Mandatory	REQ-SEC-PP-004 REQ-SEC-PA-001 REQ-SEC-PS-009
Author			
HTW, M. Fünfroeken			
Description			
The IRS will announce the services that it provides via ITS G5.			
Pre-Conditions			
On the IRS are one or more running services.			
Post-Conditions			
Passing IVS are informed about services on the IRS.			
Notes			

4.1.7 ComNet

In this paragraph, use-cases describe basic functionality provided by the communication network providers.

UC-ComNet-01 Message reception and processing by the communication network

UC Code	Sub-Group	Priority	Ref Req
UC-ComNet-01	Communication Network Provider	Mandatory	REQ-ComNet-003 REQ-IVS-018 REQ-ComNet-007 REQ-SEC-PA-002
Author			
BMW, Oliver Klemp			
Description			
A message has been received by a termination point of the infrastructure-based communication network that is assigned to the source-region of the message. The message is being forwarded through the backbone network to a termination point of the infrastructure-based communication network that is assigned to the sink-region of the message. Since the mobile network operators of source- and sink region do not necessarily need to be the same, specific service level agreements (e. g. QoS control, payment charges) need to be in place.			
Pre-Conditions			
A message is available			
Post-Conditions			
A message has been processed in the communication network and can be forwarded			
Notes			
Security: While for the sending of messages requirements can be defined, at the reception spot there is only a verification of security. Due to that the reception-aspect is omitted. While processing the privacy of the sending entities has to be protected (aggregation).			

UC-ComNet-02 Transmission of messages by a communication system

UC Code	Sub-Group	Priority	Ref Req
UC-ComNet-02	Communication Network Provider	Mandatory	REQ-ComNet-001 REQ-ComNet-002 REQ-ComNet-005 REQ-ComNet-006 REQ-SEC-PP-002 REQ-SEC-PS-005
Author			
Bosch, G. Schaaf, F. Wildschütte, H. Fuchs, K. Eckert, F. Hofmann			
Description			
Messages from one IVS to another are to be transmitted by a communication system, either directly between them (ETSI G5) or via cellular radio. The messages must be transmitted correct and in a timely manner.			
Pre-Conditions			
UC-C2X-103_03 respectively UC-C2X-106			
Post-Conditions			
Notes			
This use case is a general description of the use cases UC-IVS2ComNet-01 Sending message via backbone network infrastructure and UC-IVS2IVS-01 Sending message via direct communication to IVS (C2C).			

4.1.8 Security

UC-SEC-001 Misbehaviour detection

UC Code	Sub-Group	Priority	Ref Req
UC-SEC-001	Car2X Systems Network, Service Provider, IVS, Communication Network Provider	Optional	REQ-SEC-Privacy_Misbehavior_Detection
Author			
VW, Timo Winkelvoss			
Description			
Misbehavior detection is the precondition for revocation of credentials of a Car2X Systems Network participant.			
Pre-Conditions			
The detection framework has to be supplied with relevant information; this depends on the mechanism			
Post-Conditions			
<ul style="list-style-type: none"> Certificates of misbehaving nodes can be passed on to others Revocation is initiated 			
Notes			
The types of misbehavior that can and will be detected are yet to be defined. Whether the detection is a backend or a mobile-node-application depends on the mechanism to be used.			

4.2 Requirements

In this paragraph the CONVERGE requirements are described. Based on the visionary scenarios presented in chapter 2 and the use cases in chapter 3 the following groups of CONVERGE requirements were identified

- Car2X Systems Network - Basic requirements on the Car2X Systems Network
- Service Provider - Basic requirements on Service Provider
- IVS or IRS - Basic requirements on IVS or IRS
- Communication Network Provider - Basic requirements on Network Communication Network Providers
- Security – Basic security requirements

The requirement description is provided using the following table structure:

Table 42: Template for requirement description

Code	Sub-Group	Priority	Ref Use Case
Requirements code; REC-GROUPID-NUMBER	<i>Groups affected</i>	<i>Implementation priority, either Mandatory or Optional</i>	<i>Reference to Use Case</i>
Responsible			
<i>Company, Author</i>			
Description			
<i>Short description of the requirement including information on involved groups</i>			

4.2.1 Car2X Systems Network

REQ-C2X-001 Observe communication environment

Code	Sub-Group	Priority	Ref Use Case
REQ-C2X-001	Car2X Systems Network, IVS	Mandatory	UC-C2X-106
Responsible			
Adam Opel AG, Carsten Büttner, Harald Berninger			
Description			
The IVS shall observe the communication environment to identify the available access points and networks.			

REQ-C2X-002 IVS - Select appropriate network access point

Code	Sub-Group	Priority	Ref Use Case
REQ-C2X-002	Car2X Systems Network, IVS	Mandatory	UC-C2X-106
Responsible			
Adam Opel AG, Carsten Büttner, Harald Berninger			
Description			
The IVS shall select the appropriate access point / network according to a predefined set of criteria (e.g. application, costs, contract, bandwidth, QoS, ...).			

REQ-C2X-003 SP - Select appropriate network access point

Code	Sub-Group	Priority	Ref Use Case
REQ-C2X-003	Car2X Systems Network, Service Provider	Mandatory	UC-C2X-106
Responsible			
Adam Opel AG, Carsten Büttner, Harald Berninger			
Description			
The SP shall select the appropriate communication access point / network according to a predefined set of criteria (e.g. application, costs, contract, bandwidth, QoS, IVS access availability, ...).			

REQ-C2X-004_01 Determine transmitting networks

Code	Sub-Group	Priority	Ref Use Case
REQ-C2X-004_01	Car2X Systems Network, Communication Network Provider	Mandatory	UC-SP2IVS-01 UC-SP2IVS-04
Responsible			
HTW, M. Fünfrohen			
Description			
The Car2X Systems Network determines all networks, which may be able to populate the given message in its target area.			

REQ-C2X-004_02 Determine communication status

Code	Sub-Group	Priority	Ref Use Case
REQ-C2X-004_02	Car2X Systems Network, Communication Network Provider	Mandatory	UC-SP2IVS-01 UC-SP2IVS-04
Responsible			
HTW, M. Fünfroeken			
Description			
The Car2X Systems Network aggregates the communication results and passes a response of available and used communication networks.			

REQ-C2X-005_01 Reuse existing connections

Code	Sub-Group	Priority	Ref Use Case
REQ-C2X-005_01	Car2X Systems Network, Communication Network Provider	Mandatory	UC-SP2IVS-01
Responsible			
HTW, M. Fünfroeken			
Description			
Once a connection between an ITS-service and an IVS is established, the Car2X Systems Network will use this connection until the communication is closed or the connection fails.			

REQ-C2X-005_02 Determine accessibility of IVS

Code	Sub-Group	Priority	Ref Use Case
REQ-C2X-005_02	Car2X Systems Network, Communication Network Provider	Mandatory	UC-SP2IVS-01
Responsible			
HTW, M. Fünfroeken			
Description			
The Car2X Systems Network has the possibility to determine over which communication network a specific IVS is currently reachable for use with value added services.			

REQ-C2X-006_01 Category of mobility data

Code	Sub-Group	Priority	Ref Use Case
REQ-C2X-006_01	Car2X Systems Network, IVS	Mandatory	UC-IVS2SP-04
Responsible			
BMW, Oliver Klemp			
Description			
The origin and nature of received mobility data can be resolved at the receiver. This provides the receiver with an assessment of data quality and relevant information from the originating sensor that derived the mobility information. Data quality assessment is based on a predefined set of quality metrics.			

REQ-C2X-006_02 Category of Sensor Device

Code	Sub-Group	Priority	Ref Use Case
REQ-C2X-006_02	Car2X Systems Network, IVS, IRS	Optional	UC-IVS2SP-04
Responsible			
BMW, Oliver Klemp			
Description			
Knowledge about the device category can be relevant for the interpretation of crowd sourced data with data from individual sensor equipment (e. g. IVS different sensor, vendor, etc.).			

REQ-C2X-006_03 Priority of data based on pre-defined data quality scheme

Code	Sub-Group	Priority	Ref Use Case
REQ-C2X-006_03	Car2X Systems Network, IVS	Mandatory	UC-IVS2SP-04
Responsible			
BMW, Oliver Klemp			
Description			
Mobility information can be categorized through individual data quality metrics (accuracy, timeliness, confirmation status) and is subject to a predefined data quality scheme. Based on this scheme, data prioritization can be retrieved at IVS stage.			

REQ-C2X-006_04 Bandwidth requirement

Code	Sub-Group	Priority	Ref Use Case
REQ-C2X-006_04	Car2X Systems Network, IVS	Optional	UC-IVS2SP-04
Responsible			
BMW, Oliver Klemp			
Description			
The IVS is able to retrieve information for maximum bandwidth allocation from the available wireless networks for service provisioning in the vehicle.			

REQ-C2X-006_05 Latency requirement

Code	Sub-Group	Priority	Ref Use Case
REQ-C2X-006_05	Car2X Systems Network, IVS	Mandatory	UC-IVS2SP-04
Responsible			
BMW, Oliver Klemp			
Description			
The IVS requests minimum latency requirements from the available communication networks such that it is able to transmit safety relevant information between transmitting and receiving nodes in time.			

REQ-C2X-007 Rules and Regulations

Code	Sub-Group	Priority	Ref Use Case
REQ-C2X-007	Car2X Systems Network	Mandatory	UC-C2X-101_01
Responsible			
PTV AG, Matthias Mann			
Description			
All rules and regulations required for participating in the Car2X Systems Network are defined, documented and available to all interested actors (companies, institutions, authorities, ...).			

REQ-C2X-008 Geo-Information is map independent

Code	Sub-Group	Priority	Ref Use Case
REQ-C2X-008	Car2X Systems Network	Mandatory	UC-SP2IVS-02 UC-SP2IVS-03 UC-SP2SP-01_01 UC-SP2SP-01_02 UC-SP2SP-01_03 UC-SP2SP-01_05 UC-IVS2SP-04 UC-IRS2IVS-01 UC-IRS2SP-01 UC-IRS2SP-02
Responsible			
PTV AG, Matthias Mann			
Description			
All geo referenced information is described in a map independent way, in other words neither map vendor nor map version specific attributes (e.g. node ids or road element ids) are used to describe location references.			

REQ-C2X-009 Observe security credential stack

Code	Sub-Group	Priority	Ref Use Case
REQ-C2X-009	Car2X Systems Network	Mandatory	UC-IVS2SP-01_01 UC-IVS2SP-02
Responsible			
Opel, Berninger, Büttner			
Description			
The IVS shall recognise when its security credentials are used up in TBD time units (e.g. 1 week).			

4.2.2 Service provider

REQ-SP-001 SP - service / data advertisement

Code	Sub-Group	Priority	Ref Use Case
REQ-SP-001	Service Provider	Mandatory	UC-IVS2SP-02 UC-IVS2SP-03 UC-IVS-03
Responsible			
Opel, Berninger, Büttner			
Description			
The service provider shall advertise and provide the data to other service providers.			

REQ-SP-002 SP - data request from IVS according to spatial condition

Code	Sub-Group	Priority	Ref Use Case
REQ-SP-002	Service Provider	Manadatory	UC-IVS-003
Responsible			
Opel, Berninger, Büttner			
Description			
The service provider shall request sensor data from IVSs registered at this service provider in a specific area of interest if required.			

REQ-SP-003 SP - select data sinks (IVS)

Code	Sub-Group	Priority	Ref Use Case
REQ-SP-003	Service Provider	Mandatory	UC-IVS-003
Responsible			
Opel, Berninger, Büttner			
Description			
The service provider shall select the IVS, for which a message should be send to.			

REQ-SP-004 Service providers support connection oriented communication.

Code	Sub-Group	Priority	Ref Use Case
REQ-SP-004	Service Provider	Mandatory	UC-SP2IVS-01 UC-IVS-03
Responsible			
HTW, M. Fünfroeken			
Description			
To enable connection-oriented communication between SP and IVS as specified in the use case, the service provider needs to be able to provide such a communication.			

REQ-SP-005_01 SP - push message to IVS

Code	Sub-Group	Priority	Ref Use Case
REQ-SP-005_01	Service Provider	Mandatory	UC-IVS2SP-03 UC-SP2IVS-01 UC-SP2IVS-04
Responsible			
Bosch, G. Schaaf, F. Wildschütte, H. Fuchs, K. Eckert, F. Hofmann			
Description			
Service Provider: In case of any change in the planned parking lot bookings for a certain trip, the Service Provider shall send a push message about the changes to the respective IVS.			

REQ-SP-005_02 SP - registration for traffic data (via C2X)

Code	Sub-Group	Priority	Ref Use Case
REQ-SP-005_02	Service Provider	Mandatory	UC-SP2SP-01_02
Responsible			
Bosch, G. Schaaf, F. Wildschütte, H. Fuchs, K. Eckert, F. Hofmann			
Description			
Service Provider: The service provider shall register itself for traffic information from a traffic-data service provider.			

REQ-SP-005_03 SP – data provision to registered IVS

Code	Sub-Group	Priority	Ref Use Case
REQ-SP-005_03	Service Provider	Mandatory	UC-SP2IVS-01
Responsible			
Bosch, G. Schaaf, F. Wildschütte, H. Fuchs, K. Eckert, F. Hofmann			
Description			
Service Provider: registered customers receive an update of requested data on a regularly or event driven basis; e.g. travel times on street segments.			

4.2.3 Communication network provider

REQ-ComNet-001 Deliver messages to the desired recipients

Code	Sub-Group	Priority	Ref Use Case
REQ-ComNet-001	Communication Network Provider	Mandatory	UC-IVS2SP-03 UC-SP-05 UC-ComNet2SP-01 UC-SP2ComNet-01
Responsible			
BMW, Oliver Klemp			
Description			
The communication system is able to deliver messages to the desired recipients			

REQ-ComNet-002 Deliver messages in time

Code	Sub-Group	Priority	Ref Use Case
REQ-ComNet-002	Communication Network Provider	Mandatory	UC-IVS-02 UC-IVS2ComNet-01 UC-IVS2IVS-01 UC-SP2IVS-04 UC-SP2ComNet-01
Responsible			
BMW, Oliver Klemp			
Description			
The communication system is able to deliver messages in a timely manner such that a deadline limit for the transmission of a safety-relevant message can be met. The communication participants retrieve information from the communication networks regarding transmission latency and transmission status (e. g. acknowledgement).			

REQ-ComNet-003 Congestion handling

Code	Sub-Group	Priority	Ref Use Case
REQ-ComNet-003	Communication Network Provider	Mandatory	UC-ComNet2SP-01 UC-ComNet-01 UC-SP2ComNet-01
Responsible			
BMW, Oliver Klemp			
Description			
The communication system is able to handle situations where a very large number of IVSs is present within a limited geographical area (e. g. TPC or TRC in ETSI TC ITS).			

REQ-ComNet-004 Geographical area information

Code	Sub-Group	Priority	Ref Use Case
REQ-ComNet-004	Communication Network Provider	Mandatory	UC-C2X-103_01
Responsible			
HTW, M. Fünfroeken			
Description			
The communication network tells the Car2X Systems Network which geographical areas it can send messages to.			

REQ-ComNet-005 A broadcast mechanism is available

Code	Sub-Group	Priority	Ref Use Case
REQ-ComNet-005	Communication Network Provider	Mandatory	
Responsible			
PTV AG, Matthias Mann			
Description			
The communication network provider offers a mechanism to broadcast information.			

REQ-ComNet-006 Correct message delivery

Code	Sub-Group	Priority	Ref Use Case
REQ-ComNet-006	Communication Network Provider	Mandatory	UC-ComNet-02
Responsible			
Bosch, G. Schaaf, F. Wildschütte, H. Fuchs, K. Eckert, F. Hofmann			
Description			
The communication system is able to deliver messages correctly in terms message is not corrupted.			

REQ-ComNet-007 Acknowledge QoS

Code	Sub-Group	Priority	Ref Use Case
REQ-ComNet-007	Communication Network Provider	Mandatory	UC-ComNet-01 UC-ComNet2SP-01 UC-SP2SP-01_01 UC-SP2ComNet-01 UC-IVS2IVS-02 UC-ComNet2IVS-01
Responsible			
BMW, Oliver Klemp			
Description			
The communication system is able to acknowledge-back the supported QoS of the transmission			

4.2.4 IRS

REQ-IRS-001 IRS is able to aggregate information.

Code	Sub-Group	Priority	Ref Use Case
REQ-IRS-001	IRS	Mandatory	
Responsible			
HTW, M. Fünfroeken			
Description			
An IRS is able to aggregate information, which has been received over one of its interfaces, to save bandwidth and generally reduce the amount of data, which needs to be processed by service providers or other IRS network instances.			

4.2.5 IVS

REQ-IVS-001 Radio interface available

Code	Sub-Group	Priority	Ref Use Case
REQ-IVS-001	IVS	Mandatory	UC-IVS2IVS-02 UC-ComNet2IVS-01
Responsible			
BMW, Oliver Klemp			
Description			
The IVS is able to receive messages via its on-board radio interface.			

REQ-IVS-002 Send motion data (CAM)

Code	Sub-Group	Priority	Ref Use Case
REQ-IVS-002	IVS	Mandatory	UC-IVS2IVS-01 UC-IVS2ComNet-01
Responsible			
BMW, Oliver Klemp			
Description			
The IVS shall send its motion data (latitude, longitude, heading, speed, etc.) and time stamp as a message on a regular basis			

REQ-IVS-003 Detect incidents

Code	Sub-Group	Priority	Ref Use Case
REQ-IVS-003	IVS	Mandatory	UC-IVS-01 UC-IVS-02 UC-IVS-03
Responsible			
BMW, Oliver Klemp			
Description			
In case of a hazard situation the incident shall be detected, the corresponding messages shall be constructed			

REQ-IVS-004 Send event message (DENM)

Code	Sub-Group	Priority	Ref Use Case
REQ-IVS-004	IVS	Mandatory	UC-IVS2IVS-01 UC-IVS2ComNet-01
Responsible			
BMW, Oliver Klemp			
Description			
In case of a hazard situation a specific (standard compliant) message containing relevant data shall be sent.			

REQ-IVS-005 (DENM) message includes destination area information

Code	Sub-Group	Priority	Ref Use Case
REQ-IVS-005	IVS	Mandatory	UC-IVS-02
Responsible			
BMW, Oliver Klemp			
Description			
The message shall comprise a destination area to ensure an efficient distribution of the specific messages			

REQ-IVS-006 Check relevance (space)

Code	Sub-Group	Priority	Ref Use Case
REQ-IVS-006	IVS	Mandatory	UC-IVS-05_01 UC-IVS-05_02 UC-IVS-05_03 UC-IVS-05_04
Responsible			
BMW, Oliver Klemp			
Description			
The IVS shall use its position and approach information of the received hazard to determine if it is approaching the location of the event.			

REQ-IVS-007 Predict trajectory

Code	Sub-Group	Priority	Ref Use Case
REQ-IVS-007	IVS	Mandatory	UC-IVS-05_01 UC-IVS-05_02 UC-IVS-05_03
Responsible			
BMW, Oliver Klemp			
Description			
The IVS shall use its position and motion data to predict its trajectory to decide if it is approaching the location of the event			

REQ-IVS-008 Check relevance (type)

Code	Sub-Group	Priority	Ref Use Case
REQ-IVS-008	IVS	Optional	UC-IVS-05_04 UC-IVS-06 UC-IVS2SP-01_01
Responsible			
BMW, Oliver Klemp			
Description			
Depending on the hazard information the IVS shall display an information or a warning. The HMI implementation is subject to the automotive OEM.			

REQ-IVS-009 Check relevance (space and time)

Code	Sub-Group	Priority	Ref Use Case
REQ-IVS-009	IVS	Mandatory	UC-IVS-06
Responsible			
BMW, Oliver Klemp			
Description			
The IVS shall display an information or a warning if both spatial relevance as well as mandatory criticality in time are given. The HMI implementation is subject to the automotive OEM.			

REQ-IVS-010 Categorize mobility data

Code	Sub-Group	Priority	Ref Use Case
REQ-IVS-010	IVS	Mandatory	UC-IVS-02 UC-SP-01 UC-SP-02 UC-IVS-05_*
Responsible			
BMW, Oliver Klemp			
Description			
The category of mobility data (e. g. type of LHW) is known. Based on the category of information, different functional requirements (e. g. latency- and bandwidth requirements) need to be met.			

REQ-IVS-011 Categorize of IVS

Code	Sub-Group	Priority	Ref Use Case
REQ-IVS-011	IVS	Mandatory	UC-IVS-02 UC-SP-01 UC-SP-02 UC-IVS-05_*
Responsible			
BMW, Oliver Klemp			
Description			
The category of IVS (sensor source or device category) is known. The information is relevant for the interpretation of mobility data from different sources and enable to prioritize or weight information from independent sources individually.			

REQ-IVS-012 Classify data (LHW)

Code	Sub-Group	Priority	Ref Use Case
REQ-IVS-012	IVS	Mandatory	UC-IVS-02 UC-C2X-106
Responsible			
BMW, Oliver Klemp			
Description			
The priority classification of detected data (e.g. LHW) is known			

REQ-IVS-013 Application-/ Message bandwidth requirement

Code	Sub-Group	Priority	Ref Use Case
REQ-IVS-013	IVS	Mandatory	UC-IVS-02 UC-C2X-106
Responsible			
BMW, Oliver Klemp			
Description			
The bandwidth requirement of the application or message that is to be transmitted is known.			

REQ-IVS-014 Message delay requirement

Code	Sub-Group	Priority	Ref Use Case
REQ-IVS-014	IVS	Mandatory	UC-IVS-02 UC-C2X-106
Responsible			
BMW, Oliver Klemp			
Description			
The delay requirement of the message is known.			

REQ-IVS-015 Specify message life time

Code	Sub-Group	Priority	Ref Use Case
REQ-IVS-015	IVS	Mandatory	
Responsible			
BMW, Oliver Klemp			
Description			
The message lifetime is specified.			

REQ-IVS-016 Identify number of message recipients

Code	Sub-Group	Priority	Ref Use Case
REQ-IVS-016	IVS SP	Optional	UC-C2X-106
Responsible			
BMW, Oliver Klemp			
Description			
The number of recipients for the message type is known. This includes a specification of the message type (unicast with one recipient or broadcast with multiple recipients for the same message).			

REQ-IVS-017 (C2X) provide network quality indicators

Code	Sub-Group	Priority	Ref Use Case
REQ-IVS-017	IVS	Optional	UC-C2X-106
Responsible			
BMW, Oliver Klemp			
Description			
Network quality indicators are available and measurable.			

REQ-IVS-018 (ComNet) determine message receiver

Code	Sub-Group	Priority	Ref Use Case
REQ-IVS-018	IVS	Mandatory	UC-C2X-106 UC-IVS2IVS-01

			UC-IVS2ComNet-01 UC-ComNet-01 UC-ComNet2SP-01 UC-SP2SP-01_01 UC-SP2ComNet-01 UC-IVS2IVS-02 UC-ComNet2IVS-01
Responsible			
BMW, Oliver Klemp			
Description			
The communication system is able to determine the recipient of the message			

4.2.6 Security Requirements

In this context, "authorized pseudonym" denotes a pseudonymous authentication ticket that is authorized to participate in the "Car2X Systems Network". In the following, there are two categories of security requirements:

- Use case specific: these requirements are only applied in the respectively mentioned use cases:
- REQ-SEC-PP-*: profiles covering privacy protection of directly communicating parties
- REQ-SEC-PA-*: profiles to regulate data aggregation
- REQ-SEC-PS-*: profiles to specify the traditional security properties between directly communicating parties.
- General: these requirements are globally relevant, that means they are applied everywhere, including all use cases:
- REQ-SEC-GEN-*

REQ-SEC-PP-001 Authorized pseudonymous to anonymous

Code	Sub-Group	Priority	Ref Use Case
REQ-SEC-PP-001	ALL	Mandatory	
Responsible			
AISEC, D. Angermeier, A. Kiening			
Description			
The initiating actor shall use an authorized pseudonym. All other participating entities shall remain anonymous.			

REQ-SEC-PP-002 Authorized pseudonymous to authorized pseudonymous

Code	Sub-Group	Priority	Ref Use Case
REQ-SEC-PP-002	ALL	Mandatory	
Responsible			
AISEC, D. Angermeier, A. Kiening			
Description			
The initiating actor and all other participating entities shall use an authorized pseudonym.			

REQ-SEC-PP-003 Authorized pseudonymous to identifiable

Code	Sub-Group	Priority	Ref Use Case
REQ-SEC-PP-003	ALL	Mandatory	UC-IVS-03
Responsible			
AISEC, D. Angermeier, A. Kiening			
Description			
The initiating actor shall use an authorized pseudonym. All other participating entities shall be identifiable using their real identity.			

REQ-SEC-PP-004 Identifiable to anonymous

Code	Sub-Group	Priority	Ref Use Case
REQ-SEC-PP-004	ALL	Mandatory	
Responsible			
AISEC, D. Angermeier, A. Kiening			
Description			
The initiating actor shall be identifiable using its real identity. All other participating entities shall remain anonymous.			

REQ-SEC-PP-005 Identifiable to authorized pseudonymous

Code	Sub-Group	Priority	Ref Use Case
REQ-SEC-PP-005	ALL	Mandatory	UC-IVS2SP-01_02 UC-IVS2SP-03 UC-SP-02 UC-SP-03
Responsible			
AISEC, D. Angermeier, A. Kiening			
Description			
The initiating actor shall be identifiable using its real identity. All other participating entities shall use authorized pseudonyms.			

REQ-SEC-PP-006 Identifiable to identifiable

Code	Sub-Group	Priority	Ref Use Case
REQ-SEC-PP-006	ALL	Mandatory	
Responsible			
AISEC, D. Angermeier, A. Kiening			
Description			
The initiating actor and all other participating entities shall be identifiable using their real identities.			

REQ-SEC-PA-001 No aggregation

Code	Sub-Group	Priority	Ref Use Case
REQ-SEC-PA-001	ALL	Mandatory	
Responsible			
AISEC, D. Angermeier, A. Kiening			
Description			
If applied in a use case, aggregation of data shall not be allowed to take place in the involved communication.			

REQ-SEC-PA-002 Anonymous aggregation

Code	Sub-Group	Priority	Ref Use Case
REQ-SEC-PA-002	ALL	Mandatory	UC-SP-01
Responsible			
AISEC, D. Angermeier, A. Kiening			
Description			
If data is aggregated, it shall be anonymized.			

REQ-SEC-PS-001 Confidentiality, availability, non-repudiation, authorization

Code	Sub-Group	Priority	Ref Use Case
REQ-SEC-PS-001	ALL	Mandatory	UC-IVS2SP-01_01 UC-IVS2SP-02 UC-IVS2SP-03 UC-SP-02 UC-SP-03
Responsible			
AISEC, D. Angermeier, A. Kiening			
Description			
The confidentiality of all exchanged messages shall be protected. Mechanisms to ensure the availability of the service(s) shall be in place. Senders of messages shall be accountable for sending these messages (non-repudiation). Senders of messages shall be authorized to send these messages for this use case.			

REQ-SEC-PS-002 Confidentiality, availability, non-repudiation

Code	Sub-Group	Priority	Ref Use Case
REQ-SEC-PS-002	ALL	Mandatory	
Responsible			
AISEC, D. Angermeier, A. Kiening			
Description			
The confidentiality of all exchanged messages shall be protected. Mechanisms to ensure the availability of the service(s) shall be in place. Senders of messages shall be accountable for sending these messages (non-repudiation).			

REQ-SEC-PS-003 Confidentiality, availability, authorization

Code	Sub-Group	Priority	Ref Use Case
REQ-SEC-PS-003	ALL	Mandatory	UC-IVS-03
Responsible			
AISEC, D. Angermeier, A. Kiening			
Description			
The confidentiality of all exchanged messages shall be protected. Mechanisms to ensure the availability of the service(s) shall be in place. Senders of messages shall be authorized to send these messages for this use case.			

REQ-SEC-PS-004 Confidentiality, availability

Code	Sub-Group	Priority	Ref Use Case
REQ-SEC-PS-004	ALL	Mandatory	
Responsible			
AISEC, D. Angermeier, A. Kiening			
Description			
The confidentiality of all exchanged messages shall be protected. Mechanisms to ensure the availability of the service(s) shall be in place.			

REQ-SEC-PS-005 Confidentiality, non-repudiation, authorization

Code	Sub-Group	Priority	Ref Use Case
REQ-SEC-PS-005	ALL	Mandatory	
Responsible			
AISEC, D. Angermeier, A. Kiening			
Description			
The confidentiality of all exchanged messages shall be protected. Senders of messages shall be accountable for sending these messages (non-repudiation). Senders of messages shall be authorized to send these messages for this use case.			

REQ-SEC-PS-006 Confidentiality, non-repudiation

Code	Sub-Group	Priority	Ref Use Case
REQ-SEC-PS-006	ALL	Mandatory	
Responsible			
AISEC, D. Angermeier, A. Kiening			
Description			
The confidentiality of all exchanged messages shall be protected. Senders of messages shall be accountable for sending these messages (non-repudiation).			

REQ-SEC-PS-007 Confidentiality, authorization

Code	Sub-Group	Priority	Ref Use Case
REQ-SEC-PS-007	ALL	Mandatory	
Responsible			
AISEC, D. Angermeier, A. Kiening			
Description			
The confidentiality of all exchanged messages shall be protected. Senders of messages shall be authorized to send these messages for this use case.			

REQ-SEC-PS-008 Confidentiality

Code	Sub-Group	Priority	Ref Use Case
REQ-SEC-PS-008	ALL	Mandatory	
Responsible			
AISEC, D. Angermeier, A. Kiening			
Description			
The confidentiality of all exchanged messages shall be protected.			

REQ-SEC-PS-009 Availability, non-repudiation, authorization

Code	Sub-Group	Priority	Ref Use Case
REQ-SEC-PS-009	ALL	Mandatory	
Responsible			
AISEC, D. Angermeier, A. Kiening			
Description			
Mechanisms to ensure the availability of the service(s) shall be in place. Senders of messages shall be accountable for sending these messages (non-repudiation). Senders of messages shall be authorized to send these messages for this use case.			

REQ-SEC-PS-010 Availability, non-repudiation

Code	Sub-Group	Priority	Ref Use Case
REQ-SEC-PS-010	ALL	Mandatory	
Responsible			
AISEC, D. Angermeier, A. Kiening			
Description			
Mechanisms to ensure the availability of the service(s) shall be in place. Senders of messages shall be accountable for sending these messages (non-repudiation).			

REQ-SEC-PS-011 Availability, authorization

Code	Sub-Group	Priority	Ref Use Case
REQ-SEC-PS-011	ALL	Mandatory	
Responsible			
AISEC, D. Angermeier, A. Kiening			
Description			
Mechanisms to ensure the availability of the service(s) shall be in place. Senders of messages shall be authorized to send these messages for this use case.			

REQ-SEC-PS-012 Availability

Code	Sub-Group	Priority	Ref Use Case
REQ-SEC-PS-012	ALL	Mandatory	
Responsible			
AISEC, D. Angermeier, A. Kiening			
Description			
Mechanisms to ensure the availability of the service(s) shall be in place.			

REQ-SEC-PS-013 Non-repudiation, authorization

Code	Sub-Group	Priority	Ref Use Case
REQ-SEC-PS-013	ALL	Mandatory	
Responsible			
AISEC, D. Angermeier, A. Kiening			
Description			
Senders of messages shall be accountable for sending these messages (non-repudiation). Senders of messages shall be authorized to send these messages for this use case.			

REQ-SEC-PS-014 Non-repudiation

Code	Sub-Group	Priority	Ref Use Case
REQ-SEC-PS-014	ALL	Mandatory	
Responsible			
AISEC, D. Angermeier, A. Kiening			
Description			
Senders of messages shall be accountable for sending these messages (non-repudiation).			

REQ-SEC-PS-015 Authorization

Code	Sub-Group	Priority	Ref Use Case
REQ-SEC-PS-015	ALL	Mandatory	
Responsible			
AISEC, D. Angermeier, A. Kiening			
Description			
Senders of messages shall be authorized to send these messages for this use case.			

REQ-SEC-Trust_SP Trustworthiness of SP

Code	Sub-Group	Priority	Ref Use Case
REQ-SEC-Trust_SP	Service Provider	Mandatory	UC-C2X-101_02
Responsible			
AISEC, D. Angermeier, A. Kiening			
Description			
The trustworthiness of a service provider shall be categorizable.			

REQ-SEC-Purge Purging personal data

Code	Sub-Group	Priority	Ref Use Case
REQ-SEC-Purge	IVS	Mandatory	UC-C2X-104_04
Responsible			
AISEC, D. Angermeier, A. Kiening			
Description			
No Car2X Systems Network related personal data of the previous owner shall remain on the vehicle.			

REQ-SEC-Exclude Exclude participants

Code	Sub-Group	Priority	Ref Use Case
REQ-SEC-Exclude	Car2X Systems Network	Mandatory	UC-C2X-104_05
Responsible			
AISEC, D. Angermeier, A. Kiening			
Description			
<p>The Car2X Systems Network shall be able to exclude participants as fast as technically possible.</p> <p>ITS-S may be removed from the system because they are:</p> <ul style="list-style-type: none"> • demolished, and therefore scrapped • disassembled, for scrapping • misbehaving 			

REQ-SEC-Exchange Secure hw and sw exchange

Code	Sub-Group	Priority	Ref Use Case
REQ-SEC-Exchange	IVS, Service Provider, Communication network operator, Car2X Systems Network	Mandatory	UC-C2X-102_03 UC-C2X-102_05 UC-C2X-102_07
Responsible			
AISEC, D. Angermeier, A. Kiening			
Description			
Security-relevant soft- or hardware components as well as protocols at the Car2X Systems Network level shall be exchangeable in a secure manner.			

REQ-SEC-Privacy_Misbehavior_Detection Handling of misbehavior detection

Code	Sub-Group	Priority	Ref Use Case
REQ-SEC-Privacy_Misbehavior_Detection	IVS, Service Provider, Communication network operator, Car2X Systems Network	Mandatory	UC-SEC-001
Responsible			
AISEC, D. Angermeier, A. Kiening			
Description			
Misbehaviour detection shall not violate the privacy-related requirements of the Car2X Systems Network.			

The following requirements are not specific to any use case but relevant for all use cases.

REQ-SEC-GEN-001 Consideration of complexity and resources

Code	Sub-Group	Priority	Ref Use Case / Ref Goal
REQ-SEC-GEN-001		Mandatory	G_IVS_001
Responsible			
AISEC, D. Angermeier, A. Kiening			
Description			
The security architecture / mechanisms shall consider complexity and resource constraints.			

REQ-SEC-GEN-002 Performant message processing

Code	Sub-Group	Priority	Ref Use Case / Ref Goal
REQ-SEC-GEN-002		Mandatory	G_IVS_001 G_SEC-001
Responsible			
AISEC, D. Angermeier, A. Kiening			
Description			
The message transmission and processing must be fast enough to take advantage of the content of the message, i.e. the message must still be up-to-date for processing and reaction purposes.			

REQ-SEC-GEN-003 Safe message handling

Code	Sub-Group	Priority	Ref Use Case / Ref Goal
REQ-SEC-GEN-003			G_SEC-001
Responsible			
AISEC, D. Angermeier, A. Kiening			
Description			
Received messages shall not result in an unauthorized change to the recipient of the message, e.g., firmware manipulation via buffer overflows.			

REQ-SEC-GEN-004 Legislation compliance

Code	Sub-Group	Priority	Ref Use Case / Ref Goal
REQ-SEC-GEN-004			
Responsible			
AISEC, D. Angermeier, A. Kiening			
Description			
The data protection laws and regulations must be followed.			

REQ-SEC-GEN-005 Compliance to ETSI

Code	Sub-Group	Priority	Ref Use Case / Ref Goal
REQ-SEC-GEN-005			G_SEC-001
Responsible			
AISEC, D. Angermeier, A. Kiening			
Description			
For the G5 communication, the C2C CC or ETSI agreed security standards have to be met.			

REQ-SEC-GEN-006 Secure authenticity and integrity

Code	Sub-Group	Priority	Ref Use Case / Ref Goal
REQ-SEC-GEN-006			UC-SP-02 UC-SP-03 G_SEC-001
Responsible			
AISEC, D. Angermeier, A. Kiening			
Description			
The authenticity and integrity of each message in the communication must be secured according to the requirements of the service.			

REQ-SEC-GEN-007 Verify messages

Code	Sub-Group	Priority	Ref Use Case / Ref Goal
REQ-SEC-GEN-007			G_SEC-001
Responsible			
AISEC, D. Angermeier, A. Kiening			
Description			
Each message of relevance to the receiving entity shall be verified. The receiving entity shall decide on the message's relevance and trigger a verification process (Verify on Demand).			

REQ-SEC-GEN-008 Ensure platform (IVS/IRS) integrity

Code	Sub-Group	Priority	Ref Use Case / Ref Goal
REQ-SEC-GEN-008			G_SEC-001
Responsible			
AISEC, D. Angermeier, A. Kiening			
Description			
Platform integrity of the IVS and IRSs must be ensured.			

REQ-SEC-GEN-009 Verify data trustworthiness

Code	Sub-Group	Priority	Ref Use Case / Ref Goal
REQ-SEC-GEN-009			G_SEC-001
Responsible			
AISEC, D. Angermeier, A. Kiening			
Description			
The trustworthiness of the data must be verifiable.			

REQ-SEC-GEN-010 Privacy protection

Code	Sub-Group	Priority	Ref Use Case / Ref Goal
REQ-SEC-GEN-010			G_SEC-002
Responsible			
AISEC, D. Angermeier, A. Kiening			
Description			
The Privacy systems have to be consistent. (Full privacy protection)			

REQ-SEC-GEN-011 Defined interfaces for anonymisation

Code	Sub-Group	Priority	Ref Use Case / Ref Goal
REQ-SEC-GEN-011			G_SEC-002
Responsible			
AISEC, D. Angermeier, A. Kiening			
Description			
Anonymisation must take place at defined interfaces.			

REQ-SEC-GEN-012 Robustness of security

Code	Sub-Group	Priority	Ref Use Case / Ref Goal
REQ-SEC-GEN-012	ALL	Mandatory	G_SEC-001
Responsible			
AISEC, D. Angermeier, A. Kiening			
Description			
Application-specific emergency scenarios (e.g. due to a component failure) shall not jeopardize the security of the complete system.			

REQ-SEC-GEN-013 Initiation of ITS-S security modules

Code	Sub-Group	Priority	Ref Use Case / Ref Goal
REQ-SEC-GEN-013	ALL	Mandatory	G_C2X_003
Responsible			
Fraunhofer FOKUS, Florian Friederici			
Description			
ITS-S integrated security modules must be initialized with security credentials. <ul style="list-style-type: none"> For a new car IVS, the security module is initiated, during the car manufacturing process. If an IVS changes its owner, the security module is to be reinitiated with different credentials. IRS will be initialized by the roadside operator. 			

5 ROLE MODEL

This chapter gives an introduction into the institutional role model approach. Therefore, it is necessary to identify institutions and actors, which will later operate or use C2X services. In a first step, it is evident to compare the previous used business approach of operator models with the obviously relatively new theoretical approach of economic institutional role models. In a second step, the clear advantages of the institutional role model approach for the implementation of C2X-services are pinpointed. At last the designing steps and relevant elements of the institutional role model of CONVERGE are explained and illustrated.

5.1 Institutional role models versus traditional operator models

Purely private and publicly private operator companies within the range of cooperative vehicle systems particularly suffer in relation to purely public operator companies from the following systems-inherent weaknesses, which mainly result from the operational-organizational partner structure:

- Tendency to instability due cost reductions by profit pressure,
- and lack of adaptability to changes of market parameters and lack of innovation readiness.

The main tendency for the instability of the traditional operator model results from the fact that the partners are usually profit-oriented. Due to information asymmetries of C2X-services and their technological complexity, the customer is not able to get a full picture of the possible benefits by using the provided services. Therefore, the market implementation and the market growth of C2X-services are more difficult than for normal goods and services, which are more or less self-explaining. C2X-systems can be usually characterized as experience goods. That means that the customer before the purchase of a passenger car with a C2X-system cannot measure, which benefit he will get. The C2X-system has thereby so-called "hidden characteristics", which can lead to the situation, that systems with high road safety effects are displaced by systems with low road safety effects. With hidden characteristics in context with C2X-systems features of the systems or the services are meant, which are unknown to a private car driver before the purchase. The manufacturer even hides these characteristics from the private car driver and/or the manufacturer has no influence on the consulting quality of his salesperson. For example, the current sales conversation for automatic headway control gives no information to the consumer that this system is not working under bad weather conditions. Whether the present sales practice of the car dealers is intended by the automotive industry cannot be verified. The hidden characteristic is in this case "the system switches itself off at bad weather conditions and it gives then no safety gain." Experiencing this hidden characteristic in a driving situation will lead to a future sceptic

of car drivers to buy safety systems. Both consumer acceptance and the willingness to pay of the private car driver are reduced. This information asymmetry can have negative consequences for the market demand altogether, because the hidden characteristics can be revealed by empiric reports, customer reviews and word-of-mouth processes¹ [Grewall, Cline, Davies (2003)] and thus the decrease in demand is introduced, which can lead to the following process cycle:

1. These market growth difficulties due to the hidden characteristics mean that the minimum of the total average costs cannot be reached.
2. The expected profit, therefore, is not realized. In the worst case, the hidden characteristics lead to a situation of losses because the sold quantity is too low to reach neither the minimum of total variable average costs nor the minimum of total marginal costs. In this case, an additional financing is required. The readiness of the partners for such an "external financial input" can be estimated as marginal because the slowness of demand was not expected.
3. Missing the expected profits by market growth in connection with the strong profit expectations of the principals unquestionably forces the decisions of the management board of the operator company to reduce significantly their internal costs. This kind of cost pressures possibly enables a small profit for the moment, which can be distributed to the principals to satisfy their profit requirements.
4. The internal cost reduction process, however, reduces the possibilities of accomplishing business actions for the initiation of market growth and to overcome the unexpected demand-reduction by hidden characteristics.
5. The financial reductions hinder further activities as instruction courses for the salespersons of the car dealer to explain in a correct way and manner the functionality of C2X-systems. The operator company has no effective possibilities to overcome the hidden characteristics because of the financial bottleneck. Positive demand effects like the bandwagon effect will not be possible. In the opposite, even the demand can dramatically decrease.
6. Due to the shrinking market-demand, the cost pressure increases. The downwards borderline is reached at the time when the cost reduction is only possibly by reducing labour costs.
7. The downward process accelerates itself, so that the operator company withdraws from the market.

¹ Regarding the negative effect on the effective demand word-of-mouth processes may not be underestimated. In contrast, this contains new independent theory beginning in marketing also rudiments such as viral marketing, social media marketing, Ambassador marketing and Buzz-Marketing, those for C2X-systems can be quite used.

In operator companies with public participation this downward spiral can be stopped, if the public body (e.g. federal states, transport minister) is ready to make the necessary monetary funding. The problem, however, will be that with the readiness of the government to finance gaps a false signal is given to the private firms. An increasing readiness of the public to overcome financial shortfalls lowers the willingness of private firms to spend additional money for the common public/private operator company. To that extent, the question arises for the government whether a purely public operator association is more efficient in relation to a private/public mixed operator association.

The downward spiral clarifies that the substantial problem is the strategically behavior of the partners. The partners are merged into own business objectives (e.g. concentration strategy, market growth strategy, revenue maximizing strategy, rationalization strategy) which can be easily changed, especially in stock companies with their flexible shareholder structure. That means, even a harmonized goal-achievement agreement between the members of an operator company at the start-up can be changed easily to disagreements between the members for operational, tactical, and strategic management decisions. Permanently, the danger of moral hazard threatens the operator company. That means for example that the management of the operating company would like to introduce a new service. Unfortunately, one of the member firms wants to introduce this service by their own. For this reason this member of the operating company starts an undermining strategy to hinder the market introduction of the new service by the operating company. Finally, the operating company is in a rationality trap: the interests of the operating company diverge to the interests of individual partners of the operating company.

Therefore, moral hazard and rationality trap of the operating company are also the reasons for the lacking adaptability to changed market conditions and for the small innovation readiness for new products or services.

The general objective of the institutional role models is it to overcome the weaknesses of the operator model. Therefore, as a first step, the structure of an operating company as a legal entity in terms of the company law is replaced by an open institutional structure, which is indeed also a legal entity, but with a more cooperative structure regarding the limits by competition law. In place of the legal hierarchical well-defined structure of the operating model with a strong profit maximization objective the institutional role model establishes a monitoring system with the objective to reduce the income uncertainties overall members [Schneider (1997)]. Substantial basis is that the defined roles can be overtaken by different actors. Therefore, the perception of the roles and not the self-interest of the actors is the leading principle for the conceptual framework of an institutional role model. Altogether, a higher flexibility is reached in relation to the operator models what further increases the adaptability to changing market conditions.

5.2 Institutional role models

5.2.1 Definitions

Firms, public authorities, federations, courts, fixed institutions are designated in generally linguistic usage as institutions. Economically, an institution is equipped with full-action rights, property rights, and obligations to act as a social subsystem, which regulates behaviour, communication and acting of individuals in a certain way.

Institutions come into existence, in order to reduce income uncertainties by an improved planning and predictability because of unequally distributed incomplete knowledge. In addition, an institution creates rules, according to which the individuals align or coordinate their acting among themselves. The whole of the rules of an institution forms off in the organizational structure [**Schneider (1997)**]:

- Instances (committees, jobs, working groups, projects, etc.)
- Linkage of the instances with co-ordination rules

Co-ordination rules are for example:

- Rules for communication (among others instruction, hearing, control)
- Rules for decision making (among other company meeting, hierarchy, team rules)
- Rules for control (e.g. if A occurs, then B)

Institutions can be autonomous or partly autonomous. Thus, operating companies are also institutions. To that extent, the term institution is to be understood comprehensive and as generic term. A semantic level under the institutional role model are the operator model as well as a multiplicity of further institutional solutions (e.g. state, enterprise, market), which are also social subsystems. Consequently, the scientifically correct denomination would be institutional operator models, institutional state models and so on. However, the general linguistic usage became certainly accepted and it dispensed on the adjective institutional for these kind of institutional solutions.

In order to avoid ambiguities and wordplays like the firm is an institution with an organization, the definition by [**Schneider (1995)**] is used: Institution is the generic term for regulating systems (orders) and acting systems (organizations).

Unfortunately, the term role model is also used in psychological sciences. Therefore, to avoid confusion the full denomination “institutional role models” is used.

Definition characteristics of roles are actions. The allocation of the actions to a role takes place structured under the aspect of the compatibility. Structure characteristics from actions are:

- Actions are among themselves complementary and/or neutral. If an action is assigned to a role, the further assigned actions may not contradict the first action.

Conflicting actions are not a component of a role, but must be combined into their own role.

- The contribution of the actions for goal fulfilment can be measured.
- The summarized actions can be implemented by an actor.

A role can therefore be oversized, so that an actor is not able to implement the actions. Then the role must be again defined and further roles have to be introduced.

If institutions take up market activities, the following roles can be identified [**Schneider (1995)**]:

- Business management
 - Co-ordination
 - Arrangement
 - Control
- Sales / Service offer
 - Knowledge collection
 - Knowledge spreading
 - Sales negotiations
 - Conclusion of a contract by exchange of disposal rights
 - Selling activities (packing, dispatching, insurance etc.)
- Procurement/data acquisition
- Human resource management
- Financing
- Investment
- Production/data preparation
 - Research and development
 - Manufacturing
 - Storekeeping of the production factors
 - Administration
- Controlling

5.3 Proceeding for the development of a role model

Figure 8 illustrates the structure and the process for the development of a role model.

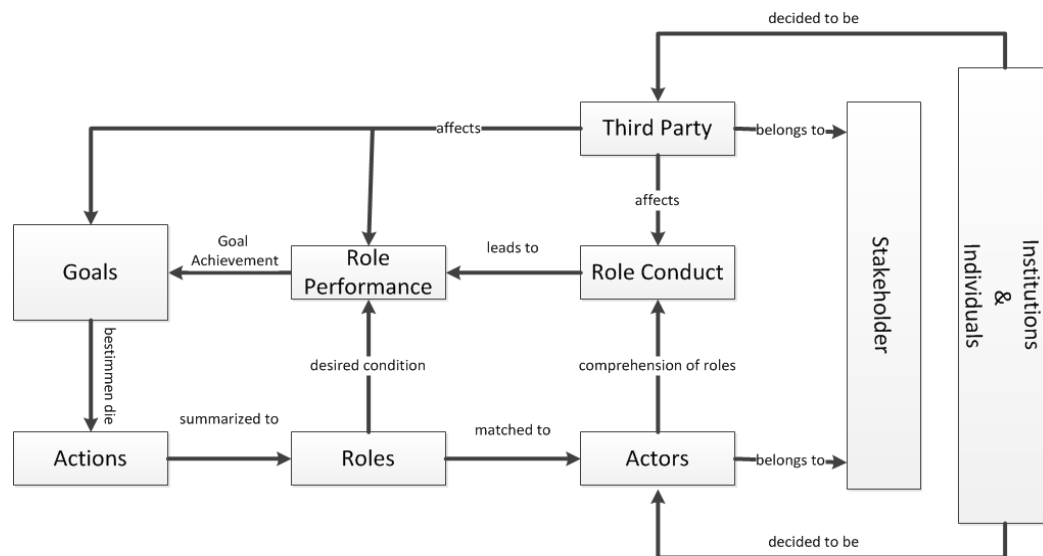


Figure 8: Structure and process for the development of a role model (source: own representation.)

From the overall group of institutions and individuals, two groups split themselves off:

- Institution/individuals, who become a third party,
- Institution/individuals, who become an actor.

The difference between third parties and actors is that between both groups no market relations exist. Because of the absence of market relations, there is no negotiation possibility, usufruct or excluding from the consumption of a property and/or applications of a service between participants and third parties. The third parties are positively and/or negatively affected by the institutional role model. For this reason, they try to promote or to prevent role conduct, role performance and the goal achievement. This group of third parties is not generally determined, but for each kind of institutional role model, it is possible to identify the specific third parties. The group of thirds can be naturally zero, which is good for the actors, but not embodies the best case. The best case is that the group of the thirds is not zero, but all thirds support the institutional role model. The worst case is that the group of the thirds is not zero and all thirds act against the role model.

The pattern for the development of a role model shows Figure 9.

		Market Phase																													
		Development						Growth						Maturity						Decline/Stagnation/ Reactivation											
M e t a - r o l e s	Business Management																												high	A c t i n g I n t e n s i t y	
	Sales																														medium
	Procurement																														low
	Production																														high
	Human resources																														medium
	Financial Management																														low
	Controlling																														high
																															medium
		S	M	T	P	R	D	G	F	U	S	M	T	P	R	D	G	F	U	S	M	T	P	R	D	G	F	U			
		Institutions																													

Figure 9: Matrix for assigning institutions and roles (source: own representation.)

with:

- S: Science
M: Marketing
T: General Technological development
P: Production
RD: Research and Development (Research and development)
G: State / Government
F: Enterprise / Firm
U: University/ies of

With this matrix, an operational dimensioning of typical characteristics can be reached. It is possible to consider the relevant action intensity (high, middle, zero) and the market phases (development, growth, matures, decrease –stagnation – revival). However, a flexible usage of the matrix allows increasing the details. So for example, the developing phase could be specified still more exactly into the phase's research & development, introduction and enterprise.

The so-called meta-roles altogether sieved superordinate necessary roles for a lasting market success were defined [**Schneider (1997)**]:

- Business management takes place via a corporate management, which identifies and then exercises the relevant entrepreneur functions,
- the sales, which is to be equated within the range of the cooperative driving assistance system and the service offer,
- the procurement is identically with the data acquisition,

- production as material execution of the activities between procurement and sales markets corresponds to systems of data preparation within the range of C2X,
- the financial system covers the external financing, the internal financing, the interior investment,
- the account system is not the monitoring system, but the activity in order to make an accounting control process possible.

Crucial always is that with the implementation of an institutional role model, the relevant roles can be identified more specifically. Therefore, it can be appropriate that the meta-roles financing is split up into three roles:

- External financing (e.g. borrowing, liquidity procurement with investors)
- Internal financing (e.g. optimization of the monetary rivers by improved collection)
- Financing of investments

The list of the institutions can be likewise narrowed or extended. These processes for the production of the relevant institutions, roles, and market phases must be led collaborative between the actors, who fit into the institutional role model.

6 USER STORIES

Within the next four paragraphs, the user stories which will be used for the definition of the concrete CONVERGE demonstrators are presented.

6.1 User Story - Mobile Road Works

In the following, the User Story for a Mobile Road Works Service in the context of the Car2X Systems Network is presented. The following figure shows in form of a sequence diagram how relevant processes operate with one another and in what order which are necessary to realize the service using the Use Cases and Requirements provided in chapter 4.

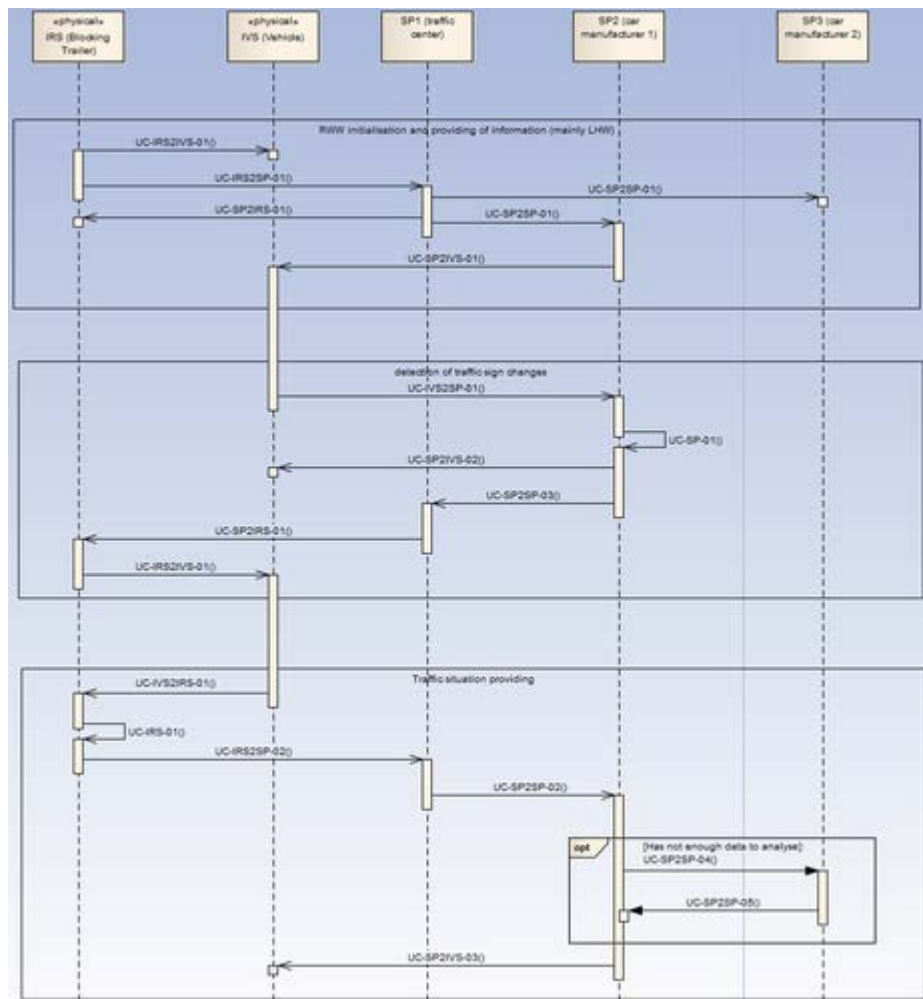


Figure 10: Sequence diagram describing the Roadworks Warning Service using the Use Cases and Requirements from chapter 4.

6.1.1 Motivation

Road works are one of the key factors decreasing road safety not only for the workers at the construction area but also for all the traffic participants. In addition, traffic efficiency is seriously suffering from road works, which result up to tens of kilometres of traffic jams. Considering the ever-increasing trend in manufacturing and the resulting growth in logistics related transportation it becomes clear that the number of road works as well as their negative consequences on the safety and the efficiency of the roads will be even more severe.

Therefore, the introduction of Road Works Warning can increase the safety of both, the construction workers and the drivers. The idea is to equip the vehicles used for road works with an IRS, which periodically sends a warning message from the roadwork to the vehicles, so that the vehicles can adjust their behaviour to the conditions of the road works.

6.1.2 Construction worker view

Bob works for a company, which offers services for road maintenance. They use blocking trailers for temporary road works. Recently, the company receives only contracts, which dictate them to install small boxes on the blocking trailers. These boxes do not influence the way in which work should be accomplished. These boxes send messages using Car-2-Car communication technology informing approaching vehicles about the road works in front of them. This information and the awareness of the driver about the upcoming situation increase the safety for Bob and his colleagues.

6.1.3 Vehicle view

Mr Smith is a businessman who leads his own company. He has to visit his costumers often and therefore has to spend a lot of time with his car on highways. Therefore, he bought a car with modern driver assistance systems including ACC, Vehicle2Vehicle communication and a mobile communication for a connection to the backend of the car manufacturer.

On the way to one of his customers, he calls a colleague and has an intensive discussion with him. Mr Smith activates his ACC sensor and sets the vehicle speed to 160 km/h. On the highway, there are only a few vehicles. The car suddenly cuts of the engine such that the car starts rolling out and the speed decreases slowly. His car informs him that in a few hundred meters there is a roadwork with a speed limit of 120 km/h. After a short while, he can see the sign with the speed limit. Following this, the speed limit is decreased to 100 km/h and finally to 80 km/h. Each time the car reacts to the speed limit by decreasing its speed. The car also informs Mr Smith that the lane that he is using is blocked and that he has to change the lane to the right. After he changes the lane and leaves the roadwork behind him, he drives during the rest of his journey as usual.

6.1.4 System View: What happens in Mr Smith's car?

Bob receives an order to patch a small hole on a highway. In order to safeguard the roadwork he picks up a full charged blocking trailer randomly and some speed limit signs. First, he has to setup the speed limit signs. Therefore, he uses the blocking trailer to block the hard shoulder so that the worker who installs the speed limit signs is secured. After the signs are installed, he changes the configuration of the blocking trailer to block the right lane. Afterwards, Bob makes sure whether he was able to correctly safeguard the hole on the highway or not. Finally, he and his colleagues start patching the hole.

The IRS on the blocking trailer starts to send a warning message via ITS G5 to the vehicles at the moment when Bob starts blocking the hard shoulder. The content of the message is the position from where the hard shoulder is blocked. The IRS also sends this information to the backend of the traffic centre. In this way the operator at the traffic centre knows exactly where the blocking trailer is and what the trailer displays. The traffic centre also provides this information to others who are interested (i.e. the car manufactures). As soon as Bob changes the configuration of the trailer, the IRS informs the traffic centre about this change and the traffic centre informs all interested parties about this.

The information from the blocking trailer is provided to the backend of the car manufacturer of Mr Smith's car and the backend informs all vehicles in the vicinity of the blocking trailer. Vehicles using their traffic sign recognition systems in order to determine the position of all traffic signs send information about the traffic signs near to the blocking trailer to the backend. The backend compares this information with its own. In case there is a change in signs, the backend adds them to its map and marks them as temporary. Such new signs are provided to each vehicle of the manufacturer approaching to these new signs.

As soon as the backend is informed about a configuration change at the trailer, the backend updates the information that is provided to the vehicles. All vehicles approaching the road works receive information about the road works. This information contains of the position of the road works, the speed limits before the roadwork and which lane is blocked by the trailer.

Mr Smith car also gets this information few kilometres before he reaches the roadwork. The car determines the optimal strategy in terms of speed and decides that an engine cut off is the most efficient method to reduce the speed. Therefore, the car is able to react to the roadwork much before than Mr Smith is even able to recognize the roadwork.

Mr Smith passes by another roadwork half an hour later. The IRS on the blocking trailer detects that the traffic density is increasing and that the average speed before the trailer

is falling under 60 km/h. Therefore, the trailer informs the traffic centre about this situation. The traffic centre informs the backend of the car manufacturers.

One of the car manufacturers classifies this situation as critical, because there could be a traffic jam. The backend decides to try detecting the end of a traffic jam. However, there are not enough vehicles of the manufacturer to detect the end of the traffic jam reliably and promptly. Therefore, the backend asks backend of another market player for support in order to detect the traffic jam. Together, they are able to detect the traffic jam reliably and they inform the vehicles approaching the traffic jam, so that those vehicles are able to adapt her behaviours correspondingly. The backends of the manufacturers also inform the traffic centre about the end of the traffic jam. In this way, the traffic centre is able to develop a strategy to mitigate the situation.

After Bob patches the hole on the highway, he removes the signs and the blocking trailer. The blocking trailer is aware about this action and sends this information to the traffic centre, which again informs the backends of the manufacturers. The backend checks whether the traffic signs were removed or not by using the traffic sign detection systems of the cars. If the signs are all removed, the backend also removes the signs.

6.2 User Story – Local Hazard Warning

In the following, the User Story for a Local Hazard Warning Service in the context of the Car2X Systems Network is presented. The following figure shows in form of a sequence diagram how relevant processes operate with one another and in what order which are necessary to realize the service using the Use Cases and Requirements provided in chapter 4.

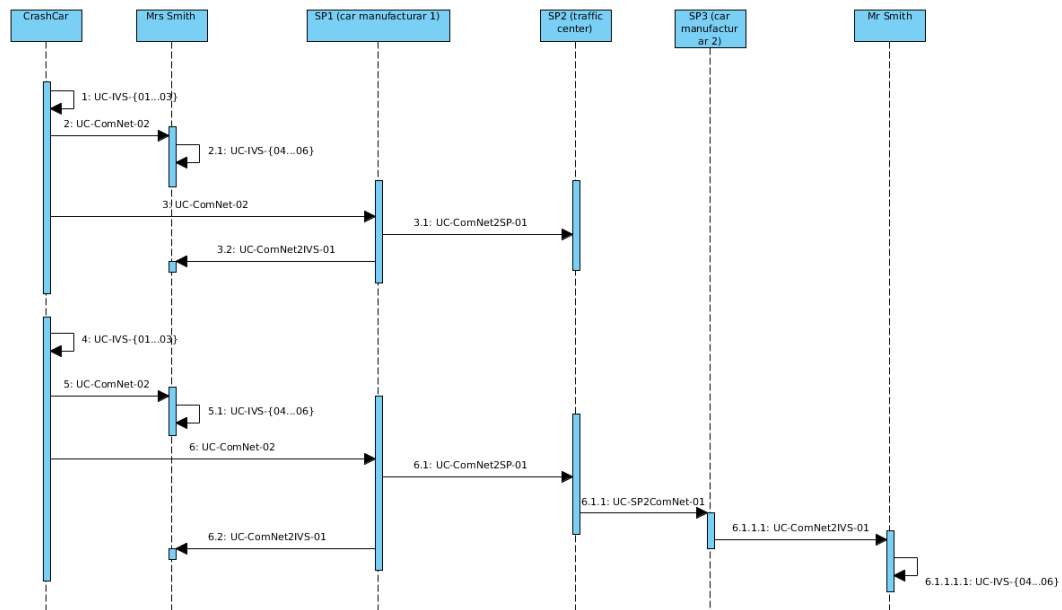


Figure 11: Sequence diagram describing the Local Hazard Warning (LHW) using the Use Cases and Requirements from chapter 4.

6.2.1 Motivation

Local hazard situations such as unexpectedly occurring traffic jams, slippery road conditions, and damaged- or non-operational vehicles severely affect the safety and sustainability of vehicular road traffic. Especially in case of suddenly occurring hazard situations with a short pre-warning time for reaction for the upcoming traffic, advanced driver assistance systems may significantly reduce the number and severity of road fatalities caused by local hazard situations.

Therefore, cooperative wireless communications between vehicles as well as vehicles and infrastructure-based system components can be used to efficiently distribute Local Hazard Warnings (LHW) in order to meet the performance requirements such as latency and related pre-warning times.

6.2.2 Vehicle View

Mr and Mrs Smith recently became grandparents. Their kids live separated at a different place some 50 km away. Mr and Mrs Smith usually take their car to visit their children and grandchildren because it is the most convenient mode of mobility for them. They have to use the highway as well as the country road for their journey since they would like to reach their destination in a short time. They would like to travel frequently to periodically visit their grandchildren to have an overview about their progress of development. Since their travel is scheduled across the whole year, they exhibit all different kinds of traffic and road situations: Heavy rain falls in spring, plenty of sunshine in summer, falling leaves, and again lots of rain in the autumn as well as snow and ice in winter. Besides those temporal and regularly occurring weather conditions, additional,

mostly event-driven situations may occur that Mr and Mrs Smith would like to be aware of in order to mitigate or even re-solve safety-critical situations on their journey. Recently, a traffic jam suddenly started right behind an unobservable curve of the country road when Mr and Mrs Smith wanted to visit their children. Mrs Smith who was driving the car had to break very hard in order to decelerate the vehicle in time. In order to prevent from such situations in the future, Mr and Mrs Smith car was equipped with an adaptive driver assistance system that can be used for cooperative wireless communications. Since their vehicle update, they may even use an adaptive navigation system that can directly react on LHWs if they were distributed in a timely manner and made available to Mr and Mrs Smith car. For the distribution of the messages, any kind of communication protocol and communication infrastructure might be used – direct vehicle-to-vehicle communications or infrastructure-based distribution of LHWs: But honestly, Mr and Mrs Smith do not want to care about these technical issues. The only parameter that draws their attention is defined by the timely reception of relevant messages that affect their journey.

They need to arrive in a relaxed mood at the living place of their children and grandchildren since their visit usually requires lots of attention and devotion from their side. Therefore, they would like to receive relevant LHWs well in advance

6.2.3 System View

The other day, right after Mr and Mrs Smith vehicle was equipped with the cooperative communications device to detect and react upon LHW messages, a vehicle suddenly was damaged and stopped on the country road at an unobservable position for the upcoming traffic. Even though the vehicle got damaged and blocked the road for the upcoming traffic from that time, the vehicle automatically transmitted a LHW message via all available modes of communication: direct vehicle-to-vehicle communications as well as infrastructure-based communications. That day, Mr and Mrs Smith were driving with separate cars to their children since they needed to deliver many items for the upcoming Christmas Eve.

Mrs Smith was driving ahead – as usually – and was just a few hundred meters driving behind the vehicle that got damaged. Mr Smith who followed his wife in his car was travelling slowly and was a few kilometres away from the hazardous situation when the LHW message was send out. Mrs Smith received the relevant message just in time via direct vehicle-to-vehicle communications. She was informed about the damaged vehicle's position and was able to steer her vehicle accordingly, preventing from a crash. Mr Smith's on-board communication device was attached to a cellular network. He received the same LHW message with a completely different distribution mode: vehicle-to-infrastructure communications using the available cellular bearer. The LHW message was received by the core network of the mobile network operator (MNO) of the owner of the damaged vehicle and processed to a traffic control centre. The traffic control

centre provides interfaces to all other core networks of alternative mobile network operators. Also to the provider core of Mr Smith's, network operator.

Service level agreements between all available MNOs guarantee the processing of messages, e.g. distributing them in a destination area, within a confined delay bound. In this case Mr Smith will receive the LHW message including information on the position of the LHW situation that much in advance that his adaptive navigation device is able to compute an alternative route in order to reduce fuel consumption through the upcoming traffic jam that just started to grow due to the damaged vehicle that blocked the only available lane of the country road.

6.3 User Story – Mr Adam

6.3.1 Motivation

Hybrid communication between an IVS and all sorts of service providers using IRS G5 A, G5B and different Mobile Networks enables seamless, efficient and high quality communication.

However, communication does not end in itself - it is the carrier of data for user services. Therefore, Mr Adam's trip includes some variety of services to challenge hybrid communication operation.

The following figure shows in form of a sequence diagram how relevant processes operate with one another and in what order which are necessary to realize the service using the Use Cases and Requirements provided in chapter 4.

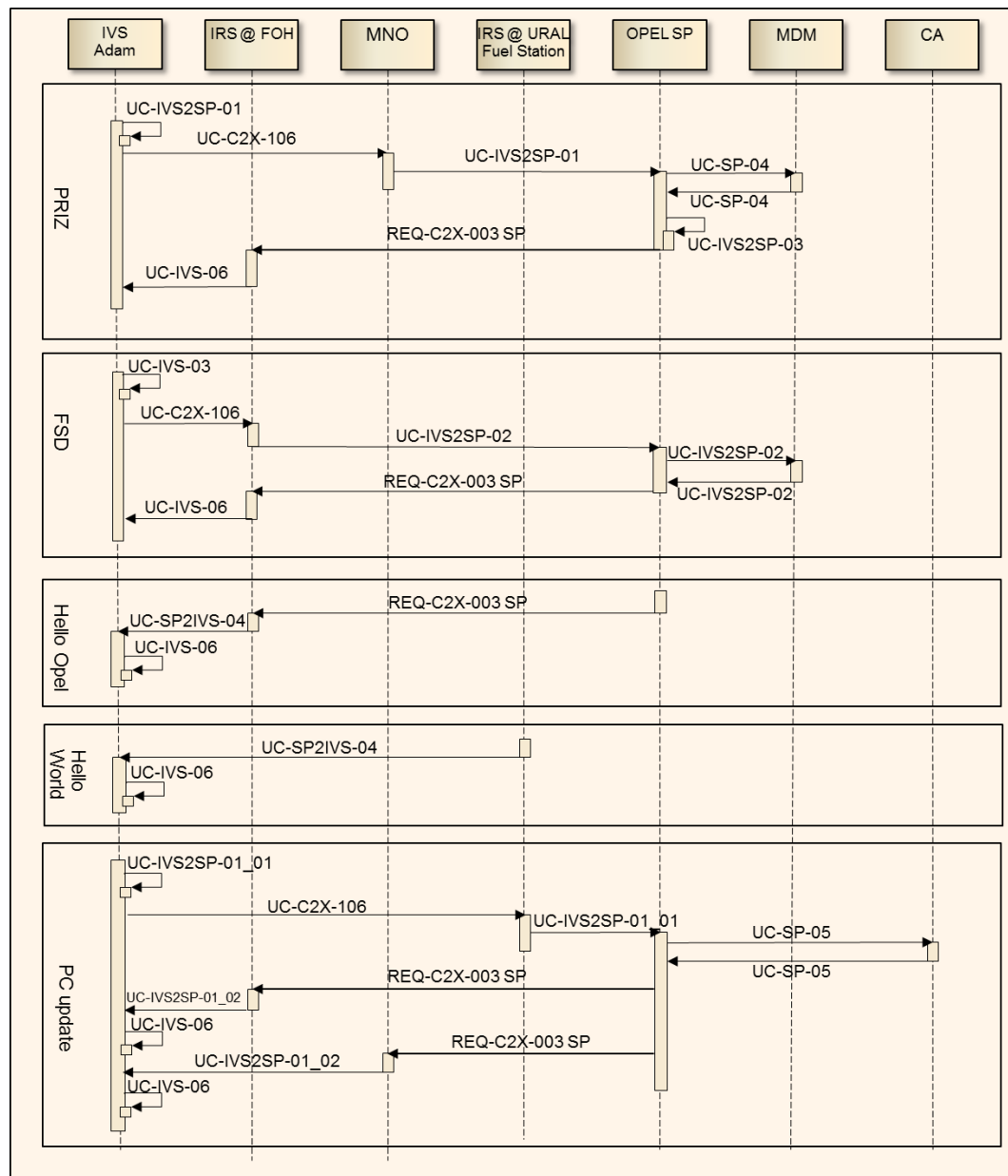


Figure 12: Sequence diagram describing the OpelStar Service using the Use Cases and Requirements from chapter 4

6.3.2 Mr Adam's view

Mr Adam lives in Hometown, drives a fully equipped Opel car. Today he is traveling to Frankfurt town hall to pay his amusement tax. When having left the motorway driving to the city centre, he enters his request to park “near town hall”. Continuing his ride, he drives past a friendly Opel dealer. He is welcomed “hello Opel driver” and “thank you for your contribution to OpelStar traffic sign detection”. At the same time, parking direction menu screen pops up “Free parking lot in Römer Garage”. He confirms with the GoTo screen button and is guided to this free parking space.

Having paid his duty Mr Adam drives back home. Approaching an URAL gas station, he receives an announcement “Dear Motorist –URAL 95 fuel is 1.499 € today” and as this seems a good price to him and his tank is half-empty, he decides to enter the fuel station. When stopped at the fuel pump, OpelStar package manager appears on the screen with the question: “Your car has Privacy Certificates for a month – do you like to fill up your certificate stock?” His answer is “yes” and he selects “for 6 Months” and leaves the car to fuel it up. During that the certification service starts, the display starts counting up “1, 2, 3, .. months”. Coming back from payment, he enters the car and departs.

Certificate transmission is not finished, the display remains at “4 month”. Continuing the ride the counter proceeds and finally it displays “Certificates delivered successfully – Yours OpelStar”

Driving on the Motorway back to Hometown suddenly an “Emergency Brake Light” warning appears. Followed by increasing traffic density he is entering a temporary roadwork zone (see Mobile Road Works story)

6.3.3 Vehicle view

Mr Adams vehicle is equipped with a CONVERGE IVS unit. This unit comprises a vehicle interface, a hybrid communication module and an applications processing unit. The application unit operates the OpelStar Service Package including services like Parking Direction Pointer, Vehicle Environment Sensing and package management. A hybrid communication module always checks and selects optimal communication link.

6.3.4 Service provider view

The OEM backend service provider operates vehicle-oriented services, like Parking Direction Pointer, Vehicle Environment Sensing and customer vehicle maintenance (including certificate update). For this operation, it has access to communication networks or single units. A hybrid communication management always checks and selects optimal communication link. On the operation side, it collects and sells data and services from and to vehicles, other service providers and ITS centres.

6.3.5 System View: What happens in Mr Adam’s car?

The on-board IVS permanently operates activated service routines, communication manager, vehicle maintenance, and GUI.

The communication manager permanently checks the available communication links and connects if service is activated. If communication fails (quality below threshold), it re-connects to an appropriate alternative.

When the driver interacts with his IVS unit, the vehicle communicates with the related ITS Service centre. Service performance continues in the car.

6.4 User Story – Short distance public transport

6.4.1 Motivation

The short distance public transport forms a group of traffic participants, which possesses unique opportunities as well as specific problems for themselves. Busses for example are obviously influenced by heavy road traffic but have only very limited possibilities to react to traffic conditions, as they are bound to their routes. If one extends the focus of ITS communication from vehicles to other traffic participants, as it is the goal of CONVERGE, like pedestrians, there exists a couple of use cases for ITS and short distance public transport.

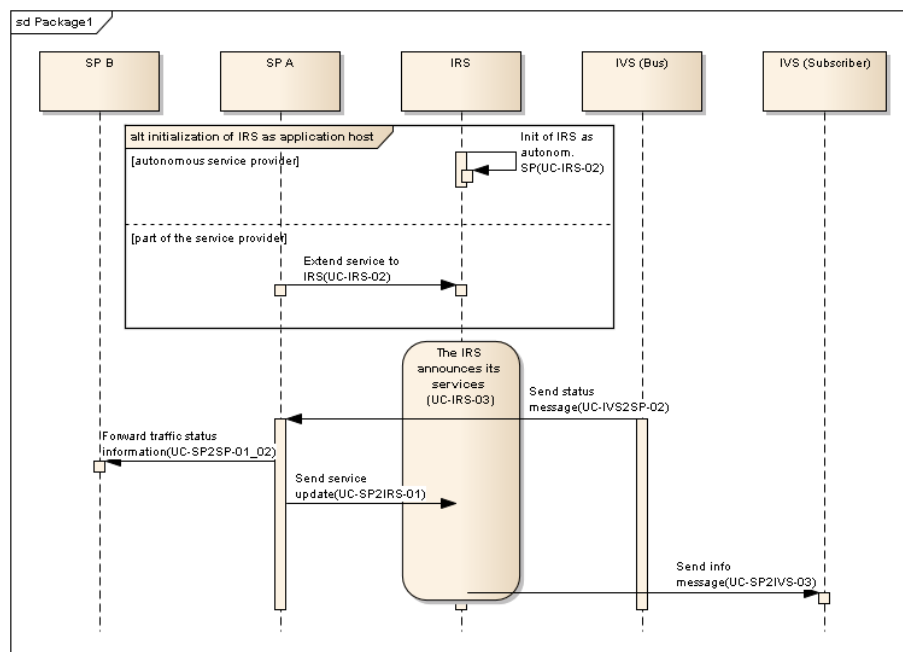


Figure 13: Sequence diagram describing the Short distance public transport user story using the Use Cases and Requirements from chapter 4

This is also true for short distance public transport in smaller cities where only a limited amount of transport possibilities is available to the customer. Also such cities often do not have the capacities to easily handle rare but huge events like fairs, concerts or other public events. Those cities may profit of an optimization of the information flow regarding short distance public transport.

6.4.2 Pedestrian view

Lisa usually takes the bus to work. While she is waiting at the bus stop near her apartment, she uses her new Smartphone to check her mail. As she is reading a message from one of her co-workers, a popup window informs her about a 10-minute delay of the bus she is usually taking. It is the free schedule app provided by the bus operator, which she installed lately. After installation, she has registered herself for notifications

for the buses she usually takes. Her smartphone gets the information about the current delay statistics from the bus service provider over ITS-G5. If there were not a public IRS near the bus stop by coincidence, she would get the requested data over UMTS. With this helpful information, Lisa can decide whether to wait or to take another bus to get to work on time.

6.4.3 Vehicle view

Mr and Mrs Smith visit a concert of their favourite singer in a small city an hour drive away from their hometown. Mr Smith's new car is equipped with modern driver assistance systems and a navigation system, which shows him the best route to the concert hall. When programming the navigation system, Mr Smith also configured the system to check notifications for the event if possible.

As they approach the city by car and he passes a motorway IRS, he gets informed about the current parking situation and the presence of a shuttle bus. On top of this information, Mr Smith's car also receives the current schedule of the shuttle bus, so his navigation system can decide if using the shuttle will be a faster option as driving into the city and looking for a parking spot himself. The navigation system then prompts a message to Mr Smith informing him that he may take the public transport from a parking lot if he takes the next exit and will therefore be approximately 10 minutes early at the concert hall.

6.4.4 Bus driver view

James works for a bus operator in a small city as a bus driver. In the morning, he takes his assigned bus, which is equipped with an ITS OBU, from the depot and starts driving.

James reaches a reduced-traffic area whereas only busses are permitted to drive through. To enforce this, the street is blocked by a submersible bollard. The bollard is attached to an ITS roadside station. This IRS detects the bus and submerges the bollard after the bus has been authenticated and authorized. (Either through his CAM alone or by exchanging a security message after the bus itself has detected the admission control IRS.)

6.4.5 Bus operator view

A bus of the bus operator, which is equipped with an ITS OBU left its depot.

While driving, the bus periodically sends its position to its SP (Bus operator service), which may use this data to detect delays and update the bus schedule. The communication path is chosen by the IVS according to pre-set rules.

The bus operator service also passes this data to an IRS on the motorway near the city, where an application of the city management is installed. The bus operator participates in a program of the city's traffic management which collects traffic information from

busses, taxis and other 'public-vehicles' which are equipped with an ITS G5 system. Those vehicles examine CAM data of surrounding non-public vehicles. Furthermore, they log their own paths as well as relevant telematics data from their sensors, e.g. vehicle speed. Additionally, the bus collects traffic information received through other messages, as road works information for short term road works received via DENM. That information is passed to a corresponding SP of the traffic management, which uses this information to determine the current traffic situation. This data is also sold to other SPs that are interested in this data. Therefore, as the bus passes an ITS-equipped traffic light, it receives a service announcement from the traffic lights IRS in which the IRS informs passing vehicles, that it collects those traffic situation data. The bus then passes its aggregated data to the IRS.

As the bus returns to the depot and approaches the entrance, the admission control IRS of the bus operator detects it and opens the barrier after the bus has been authenticated and authorized. (Either through his CAM alone or by exchanging a security message after the bus itself has detected the admission control IRS.)

7 VERIFICATION AND VALIDATION

The task of WP8 Final Assessment is to finally assess the results of the CONVERGE project. The assessment will be done from three different points of view: technology, security, and economy. The identification of the assessment criteria together with the description of the assessment methodology will be presented in *D6.1 Final Assessment Part1: Initial set of Assessment Criteria*.

Input for WP8 is project goals, use cases, and requirements. This input is provided by WP1 and documented in Deliverable D1.1.

8 LITERATURE

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9 TERMS AND ABBREVIATIONS

Term	Definition
3G	3rd generation of mobile telecommunications technology
4G	4th generation of mobile telecommunications technology
ACC	Adaptive Cruise Control
Accreditation	Process to certify competency, authority, or credibility
Accreditation Authority	An organizational or technical body to perform an entity's accreditation
Archimate®	An open and independent modelling language for enterprise architecture
Actor	Companies/institution/... , that fulfils one or multiple roles. Multiple actors (companies/institutions/...) can fulfil a role.
Authorized Pseudonym	Denotes a pseudonym which is authorized to participate in the Car2X Systems Network
CA	Certification Authority
CAM	Co-operative Awareness Message
CE device	Consumer Electronics device
CN-[A .. Z]	Company Name – [A .. Z] (Example names used in CONVERGE scenarios)
CONVERGE	COmmunication Network Vehicle Road Global Extension
C2C / Car2Car	Car-to-Car respectively vehicle-to-vehicle Communication; information exchange between vehicles using ETSI G5
C2I / Car2Infrastructure	Car-to-Infrastructure respectively vehicle-to-infrastructure Communication; information exchange between vehicles and infrastructure using ETSI G5
C2X / Car2X	Car-2-X Communication; including communication between vehicles as well as between vehicles and infrastructure
DAB	Digital Audio Broadcasting
DENM	Decentralized Environmental Notification Message
dWiStA	Dynamischer Wegweiser mit integrierten Stauinformationen – variable message sign for providing route recommendation and traffic jam information
CONVERGE Demonstrator	A demonstrator will exist to prove the concept of the Car2X Systems Network
ETSI	European Telecommunications Standards Institute
ETSI G5	IEEE 802.11 based communication standard for vehicular communication, standardized by ETSI in standard ETSI ES 202 663
ETSI TC ITS	ETSI Technical Committee for Intelligent Transport Systems
FCD	Floating Car Data
Goal	A statement that describes what the project will accomplish, or the business value the project will achieve
ICS	ITS Central Station
ICT	Information and Communication Technology
IGLZ	“Integrierte Gesamtverkehrs-Leitzentrale” – Traffic Control Center of Frankfurt
IRS	ITS Roadside Station
ITS	Intelligent Transport System
ITS-S	Intelligent Transport System Station
IVS	ITS Vehicle Station respectively any Mobile ITS Node (e.g. smartphone)
LHW	Local Hazard Warning
LOS	Level of Service
LTE	Long Term Evolution (4G)
MDM	“Mobilitätsdatenmarktplatz”, German Mobility Data Marketplace
MIMO	Multiple-Input and Multiple-Output, is the use of multiple antennas as both the transmitter and receiver to improve communication performance
MNO	Mobile Network Operator
Non-repudiation	The non-repudiation of a message refers to a procedure that ensures that messages which lead to certain actions can be traceable without any doubt. Such a procedure includes the authenticity and integrity of a message as well

Term	Definition
	as comprehensive and tamper-proof logging mechanisms.
OBUE	On-board Unit
OEM	Original Equipment Manufacturer
QoS	Quality of Service
RDS-TMC	Radio Data System - Traffic Message Channel
Requirement (REQ)	A requirement describes a condition or capability to which a system must conform; either derived directly from user needs, or stated in a contract, standard, specification, or other formally imposed document.
Role	<p>Roles are considered as a set of actions. Whereby a role is strong for action bundles, which are full complementary. A role can be characterized as weak if the relation between some actions is neutral. The bundling of actions to a role is determined by a given objective. Conflicting actions are not in a set of actions for a role. The set of actions for a role is limited to the capabilities of the actor.</p> <ul style="list-style-type: none"> • Institutional roles are the expression to clarify that the actor of the role is an institution. • Individual roles are the expression to clarify that the actor of the role is an individual.
RWW	Roadworks Warning
SEC	Security
Service	Intangible equivalent of economic goods, e.g. a communication service offered by a communication network provider or a traffic information service offered by a traffic control centre.
Service chain	Several actors having different roles in the value creation chain of a service
SP	Service Provider
TC / TCC	Traffic (Control) Centre
TPC	Transmit power control
TRC	Transmit rate control
UML	Unified Modelling Language
UMTS	Universal Mobile Telecommunications System (3G)
Use Case – UC	A use case is used to describe the system behaviour on a high level. It typically defines external system behaviour from a user perspective respectively it declares interactions between a role (known in UML as an "actor") and a system, to achieve a measurable goal. The actor can be a human or an external system.
User Story	<p>Descriptive way of formulating software requirements. The aim is to describe the system from the user perspective. A User Story can be seen as a script for a demonstrator to be developed.</p> <p>Based on the identified Use Cases and Requirements it should be possible to realize a User Story.</p>
Verification and Validation	Process of checking that the system meets its specifications and that it fulfils its intended purpose. With verification, giving answers to "Am I building the product right?" and validation giving answers to "Am I building the right product?"
Visionary Scenario	Description of how the Car2X Systems Network might influence ITS in the future in terms of co-operation between service provider, communication network provider, traffic infrastructure and the end user respectively the vehicles.
Wi-Fi	Standards that allows an electronic device to exchange data wirelessly (using radio waves) over a computer network, including high-speed Internet connections