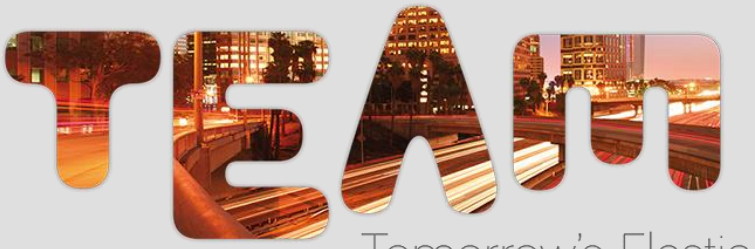

Tomorrow's Elastic Adaptive Mobility

D2.3.1

EMPOWER requirements and initial specifications.

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Summary

EMPOWER's role is to build the technological basis of the TEAM system and to specify the overall system and its architecture (functional blocks, data structures, interfaces). The overall objective of the EMPOWER SP is to deliver enabling communication technologies, cloud services (for LDM++), and cooperative positioning as required by FLEX and DIALOGUE, fulfilling at the same time any privacy and security related requirements.

EMPOWER verifies the technological components, assuring technical interoperability in all levels (vehicle, personal, central and roadside ITS subsystems). And its final goal is to provide the building blocks to FLEX and DIALOGUE. This deliverable is the main output of WP2.3 highlighting the requirements and initial specifications of EMPOWER. Its main objective is to group, organize and validate requirements both internal and SP specific (FLEX and DIALOGUE) as indicated by the individual use cases.

This document collects the requirements to EMPOWER system as extracted from the use cases of the four main technological categories of EMPOWER reported in D1.0 (TEAM users, stakeholders and uses cases), namely:

1. communication,
2. cooperative positioning,
3. automotive cloud and dynamic maps, and
4. security and privacy.

As it was mentioned in D1.0 for each of these technological category a dedicated technology group of TEAM partners was formed. These groups first analysed TEAM use cases (in D1.0) and then defined the relevant requirements reported in this deliverable. This four basic technologies support the applications and consist one of the cornerstones of TEAM. In the horizontal perspective TEAM is separated in the different ITS subsystems where these technologies will be integrated, which are the vehicle, roadside, central and personal subsystems. The vertical perspective comprises these different technologies. In EMPOWER several components will be developed such as communication convergence, positioning accuracy, mapping, privacy and security. In this phase the requirements that these components will fulfil are first developed in this work.

The contribution of TEAM in these four basic technologies is detailed in D1.0, here a brief description is also given for introducing the requirements tables that follow. Regarding

communication TEAM will employ, adapt, combine and advance some of the available technologies in novel ways in order to cope with challenges established by Intelligent Traffic Systems. The project concentrates basically on future-oriented technologies dealing with long-range (LTE) and short-range (IEEE 802.11p) communications, combined with standards and protocols like GeoNetworking, and others. For cooperative positioning TEAM will use the experience gained in previous projects, such as CoVeL and Ko-PER, and will base its development on GPS raw data exchange between vehicles and infrastructure. Main goal of cooperative positioning is to use low-cost GPS hardware and improve the positioning precision with the information that is available via car-to-car communication. The LDM concept developed in previous projects (SAFESPOT and CVIS) originally addressed cooperative systems for safety and traffic efficiency applications, serving time critical highly dynamic data needs (e.g. position of surrounding vehicles). In TEAM this approaches will be exploited together with cloud services to provide a basis for a new solution to enable open and ubiquitous access to traffic and mobility information. In the field of security TEAM will provide a multimodal security solution for ITS, based on recent findings for singular communication technology modes.

The technology oriented TEAM requirements are also accompanied with the requirements implied from the functionalities that the personal, vehicle and roadside FLEX and DIALOGUE applications do have. The total of EMPOWER requirements is organised into the four main technological categories and the rest not belonging into one of these categories. The production of requirements was made using a uniform template including multiple information. It contains the source of the requirement that could be a TEAM application or enabler or a generic technology requirement, the relevance to a specific EMPOWER subsystem or component, the requirement's category as functional or non functional, the criticality level, risk analysis, validation method, acceptance criteria, relationship with other requirements and potential technologies involved. All this collected information offers the opportunity to TEAM system analysers to perform a sufficient requirement organisation leading to the definition of the system specifications.

First step to this direction is the mapping of these requirements to the four EMPOWER ITS subsystems: Central, Roadside, Vehicle and Personal. The relevant aspects of the overall EMPOWER requirements are mapped to one or more of these subsystems, corresponding to specific functionalities that it should fulfil. In this manner the initial step for the EMPOWER system specification takes place. This concludes the current document D2.3.1. The final EMPOWER system specification will be reported in a dedicated internal report describing the final outcome of the work performed within WP2.3 for EMPOWER requirements and specifications.

1 Introduction

The EMPOWER sub-project specifies the overall system and its architecture (functional blocks, data structures, interfaces). It also builds the technological basis of the TEAM project. The overall objective of the EMPOWER SP is to deliver enabling communication technologies and cloud services (for LDM++) as required by FLEX and DIALOGUE.

Deliverable 2.3.1 EMPOWER requirements and initial specifications is the main output of the work conducted in WP2.3 that is the collection of the meaningful EMPOWER requirements, both internal and related to FLEX and DIALOGUE applications, and their sorting according to the individual subsystem they belong to. Internal EMPOWER requirements concern the four basic technologies to support the applications that were defined in D1.0 (TEAM users, stakeholders and uses cases). These technologies are communication convergence, positioning accuracy, mapping, privacy and security. Additionally FLEX and DIALOGUE applications supported by EMPOWER building blocks, have their own requirements towards EMPOWER platform. The defined in D1.0 matrix organisation of EMPOWER system also comprises the subsystems where these technologies will be integrated, which are the vehicle, roadside, central and personal subsystems. Then these requirements will be input to the system specification activities. We state, that the final specification of the TEAM system do not necessarily meet all of the requirements listed in this document. These requirements will be tracked during the continuation of the project so as to ensure that (a) the final specifications and (b) the EMPOWER implementation will meet as many requirements as possible.

First task was the definition of the data requirements towards the EMPOWER platform. For this purpose the requirements originating from FLEX and DIALOGUE were considered, together with the EMPOWER specific requirements that come from the EMPOWER use cases defined in task WP2.2. Except for the above, additional internal requirements (i.e. input, output, communication, aggregation/fusion etc.) which will be addressed for the development of the platform and the respective enabling technological components were posed also inside the framework of this task. These were basically outcome of the FLEX and DIALOGUE use cases and requirements analysis.

The security, privacy and reliability requirements of the technological framework were also analysed. Requirements for encryption, credentials, data integrity, privacy and security in general were collected. Three primary services are essential for security as well as privacy and were examined here: authentication, integrity and confidentiality. Furthermore, reliability requirements from the sensors perspective but also from an organizational and certification point of view were taken into consideration.

After the collection of requirements their taxonomy according to the individual EMPOWER subsystems, namely vehicle, personal, central and roadside, followed. These subsystems division is

originating from the harmonised European Communications Architecture (ETSI EN 302 665 V1.1.1). The requirements of these ITS subsystems, which are independent of each other and interact via communication, were analysed further on. The specific characteristics for each of these subsystems were highlighted to facilitate the specifications and the architecture design in the following tasks of this sub-project.

Requirements collection and taxonomy for such an extended and complicated project was a demanding task. EMPOWER serves a big number of applications that cover multiple technological areas with tens of use cases in total. In sequence the requirements to achieve these use cases were many and difficult to completely achieve. In this deliverable every application and technological use case reported in D1.0 was analysed and the subsequent requirements were described in detail. The fact that different working groups in three subprojects worked in requirements for the EMPOWER system, generated in some occasions conflicting requests. Thanks to common templates and targeted table fields the conflicts have been eliminated and additionally requirements have been filtered to the absolutely necessary ones. Important step to link requirements and specifications of the systems was that of the taxonomy of requirements according to ITS subsystem. This significantly clarified the unclear and questionable aspects of the systems at the beginning and assisted the specification team. However, evaluation of feasibility of initial requirements will take place throughout the project, including the architectural, design and implementation phases when a more solid system view will be constantly known.

The structure of this deliverable is described in the next. After the introductory Section 1, Section 2 describes the methodology to conduct this work. This includes the procedure for requirements engineering, the definition of a suitable template to define the requirements, the list of sources of information for the relevant tasks, and finally the methods for the taxonomy of the selected requirements. Section 3 presents the collection of all the requirements that the EMPOWER platform should meet. These requirements are separated and were identified according to their fitting in the following technology related areas: communication, automotive cloud and LDM++, cooperative positioning and security, privacy and reliability requirements. Requirements not belonging to any one of the above written technological categories, are reported as well. Section 4 concerns the mapping of all the requirements accumulated in the previous sections according to the specific ITS subsystem they belong. Thus, requirements of the EMPOWER Central, Roadside, Vehicle and Personal subsystem were defined. Finally, Section 5 closes the deliverable with the conclusions sum up.

2 Methodology

In this Section, the methodology followed to collect and define the EMPOWER requirements and initial specifications is described. Firstly the overall procedure is outlined, and more specifically the input sources for the task of requirements collection are presented. Then, the taxonomy process for the requirements sorting according to their relevance to each subsystem is given. Finally, the definition of the requirement collection template is illustrated and the procedure towards the definition of the EMPOWER specifications is explained.

2.1 Procedure for requirements engineering

In order to proceed with the EMPOWER requirements collection, the common project format and processes defined in IR4.3.2 were considered. It was stressed that , before a system is designed and developed, it is important to identify the requirements that the system must satisfy in order to meet the expectations of the users and stakeholders. This step is the first and one of the most important in any development process. Requirements engineering is the process of collecting and analyzing requirements.

Collection of information by the users and extraction of use cases, actors, flow of actions and interactions have already been done in WP2.2, WP3.2, and WP4.2. Additionally the consequent application-related have been received requirements from FLEX and DIALOGUE WP3.3 and WP2.4 respectively. Thus, the main focus of this WP has been the review of this input and the extraction of the EMPOWER requirements that fulfil the applications' needs as they emerged from the users' needs analysis. This requirements collection phase is the fundamental step in order to enable and efficient EMPOWER subsystem specifications phase.

2.2 Sources of information

Apart from the already cited IR4.3.2, which was used as the reference for the requirements' common format and for the overall requirements engineering process, WP2.3 used three main sources of information: (a) D1.0 "TEAM users, stakeholders and use cases", (b) IR3.3.1 "Requirements to EMPOWER and to DIALOGUE" and (c) IR4.3.1 "DIALOGUE requirements to EMPOWER and to FLEX". The internal reports are not public documents are used for internal reference only. The core of their work is reported in this deliverable.

2.3 Requirements taxonomy

There are two main steps of work followed during the technical and functional EMPOWER requirements collection. First, four technology-relevant working groups were defined according to the members' interest and expertise. These groups worked in WP2.2 and WP2.3, gathering the

relevant use cases and requirements. The four technology areas are: (a) Communication: ITS, V2X and LTE technologies, (b)Automotive Cloud and LDM++, (c) Cooperative Positioning and (d) Security, Privacy and Reliability. Any other requirement that is necessary to accomplish application needs by the EMPOWER platform and is not covered in these four main categories has been grouped in an additional fifth group of requirements (Figure 2-1).

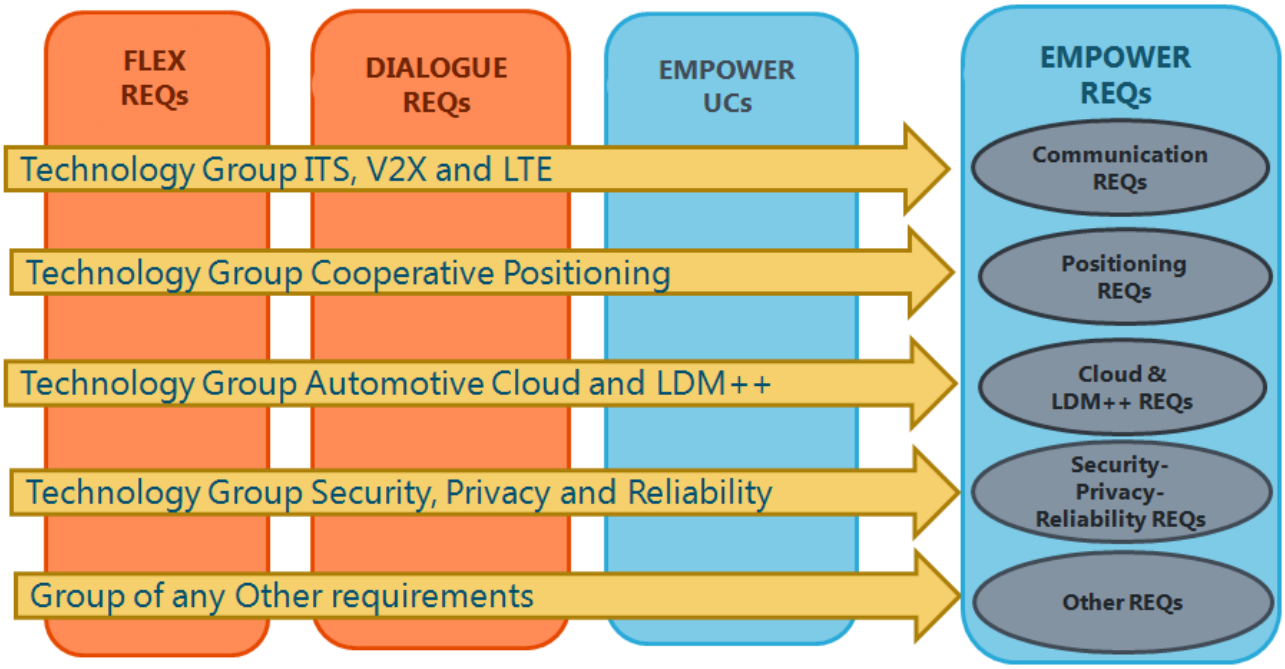

Figure 2-1: Extraction of EMPOWER requirements based on technology categories

After assembling all EMPOWER requirements, a new step of taxonomy follows. According to the harmonised European Communications Architecture, (Intelligent Transport Systems (ITS): Communications Architecture standard ETSI EN 302 665 V1.1.1 (2010-09)) the EMPOWER system is further divided into four standard subsystems, namely: Central, Roadside, Vehicle and Personal. Thus, all requirements were mapped to each one of the four subsystem (Figure 2-2). This requirement mapping forms an initial specification of each one of the relevant EMPOWER subsystems from a functional point of view, which forms a basis for the final EMPOWER specifications that will follow within WP2.3.

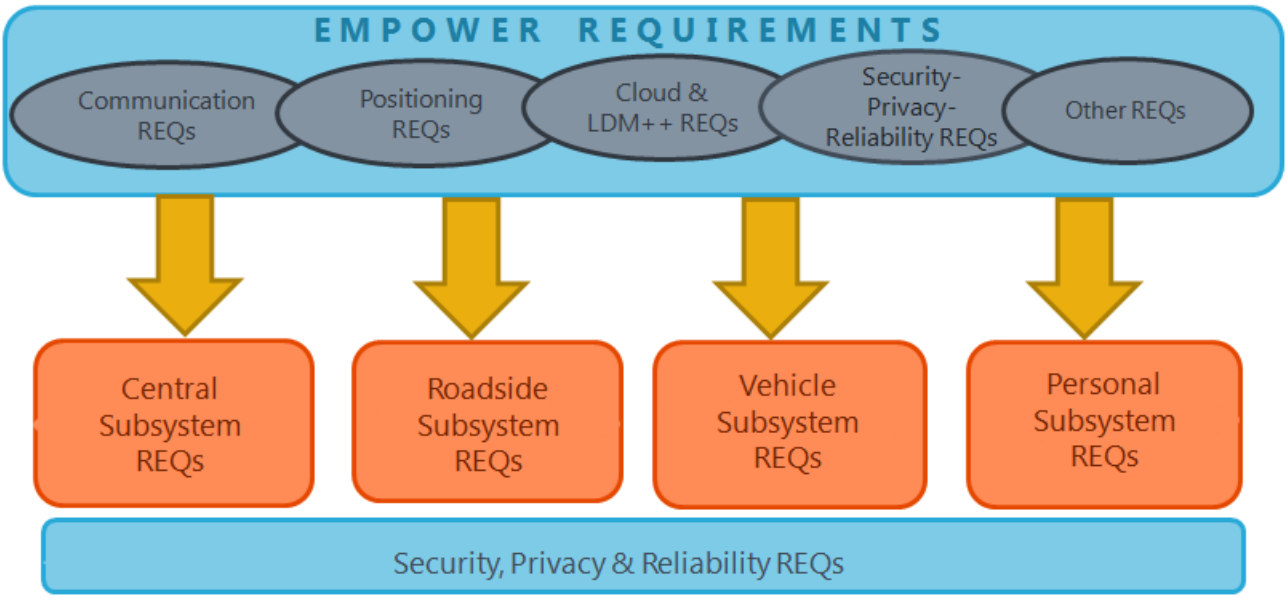

Figure 2-2: Mapping procedure for the EMPOWER subsystems initial specification

2.4 Template for requirements collection

In order to produce the EMPOWER system requirements the common proposed template was used as a starting point. Afterwards the modifications made to meet the EMPOWER specific needs were integrated. The needs of EMPOWER system are reflected form the use cases analysis for the four main technology groups defined in D1.0. The template table used to collect the requirements is the following:

Table 2-1: Requirements collection table.

Requirement ID:	<SPx_REQ_XXX_yy_vZ.z (x is the SP name, XXX initial for taxonomy purposes*, yy is the serial number of the requirement, and Z.z is the version number) *according to relevance: POS: positioning, SEC: security, LDM: LDM++, COM: communication, DAT: data, APP: application, ALG: algorithm, TOO: tool, OTH: other.>
Name of requirement:	<A brief title assigned by the author>
Created by	<(List of) person making changes to this requirement with initials and contact email, e.g. John Smith (JS) – john.smith@company.com, for easily identification and

	questions that might arise>
Assigned partner	<Partners to which the requirement has been assigned>
History	<Date – Initials of person making the change – brief description of change>
Goal	<Short description for why this requirement is specified>
Related EMPOWER Use Case	<The related EMPOWER Use Case name(s) or ID(s)>
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- DIALOGUE Applications:** ☐ Collaborative ACC ☐ Collaborative parking ☐ Collaborative driving and merging ☐ Collaborative eco-friendly navigation ☐ Serious game and community building **- FLEX Applications:** ☐ Collaborative pro-active urban/inter-urban monitoring and ad-hoc control ☐ Collaborative co-modal route planning ☐ Co-modal coaching with support from virtual/avatar users ☐ Collaborative smart intersection for bus priority (intelligent priorities) ☐ Collaborative public transport optimization ☐ Community gaming (cities, infrastructure) ☐ Dynamic collaborative corridors **- Enabler:** ☐ Data or Aggregated data: "_____" ☐ Algorithm: "_____" ☐ Tool: "_____"

	☐ Other: "_____" **- Application independent:** ☐ "_____"
Relevance to EMPOWER subsystem and component	**- Vehicle** ☐ HMI ☐ Application ☐ Security & Privacy ☐ Other "_____" **- Personal** ☐ HMI ☐ Application ☐ Security & Privacy ☐ Other "_____" **- Central** ☐ Positioning unit ☐ Communication unit ☐ LDM++ ☐ Security & Privacy ☐ Data management unit ☐ Other "_____" **- Roadside** ☐ Application ☐ Security & Privacy ☐ Other "_____"
Requirement category	☐ Functional - Non-functional

	☐ General architectural and equipment requirements ☐ Connectivity and communication requirements ☐ Application requirements ☐ Security requirements ☐ User acceptance ☐ Technological and development requirements ☐ Other:" _____"
Critical level (priority)	Define the importance of the requirement: ☐ Mandatory ☐ Recommended ☐ Optional
Risk analysis	<Identify the risks if this requirement is not met. Also identify the risks for meeting this requirement>
Validation method (tests, indicators, performance bounds)	<e.g. function availability, proposed testing/validation method if known>
Acceptance criteria	<The acceptance criteria identified at this stage are from the users'/stakeholders' perspective; what will make them to say that the related use case will be accepted. Can be either functional (what the module/application/systems should provide) or non-functional (properties of a module/application/systems), and their role is to complement a high-level system requirement in a way that will promote user acceptance>
Relationship with other requirements	- No ☐ - Same level with: - Hierarchical - Parent req. of: - Child req. of:
Potential conflicts	<Conflicts with other requirements>
Potential technologies	<Should include some of the technologies that in view of

involved / affected	the use-case authors the proposed requirement may cause an impact to. That should ease mapping requirements to SP2 technologies>
Status of requirement description	☐ Draft ☐ Final ☐ Rejected
Other	

This analytic template for requirements is reported in the Annexes, while in the main body of the deliverable a short synthesized table is only presented. This is done for the sake of drawing the reader's attention to the most significant aspects, while details may be retrieved in the Annexes.

2.5 Towards final specifications

After collecting the EMPOWER requirements the formulation of the subsystems initial specifications follows. It is achieved by sorting the requirements according to the subsystem they belong to, sketching in this manner the first outline of EMPOWER subsystem specifications. These include the subsystems' high level objectives and functionalities from the user perspective. In a next step, functions belonging to the same category will be grouped together, to form one common functional block. The result of this task is the smooth transition from the initial to the final EMPOWER specifications. The latter are not part of D2.3.1 and will be reported in D2.0.

3 EMPOWER requirements

This Section contains the list of EMPOWER requirements that were selected for implementation. These requirements are grouped according to their technological category, that is communication, cooperative positioning, automotive cloud and LDM++ and security and privacy.

3.1 Communication related requirements

The following tables describe the communication-related requirements on EMPOWER (physical infrastructure). These were extracted from the SP3 and SP4 application requirements. The hierarchy of communication requirements is depicted in Figure 3-1. Requirements numbers were added to diagram blocks to facilitate traceability. All current requirements are described at a very high level and need to be further refined in order to come up with real specifications.

A high level description of the requirements related to Communication is provided in the remainder of this sub-section. The complete tables are provided in the Annexes. A hyper-link can be followed from the "reference" entry of each requirement description, leading to the relevant full requirement table in the Annexes.

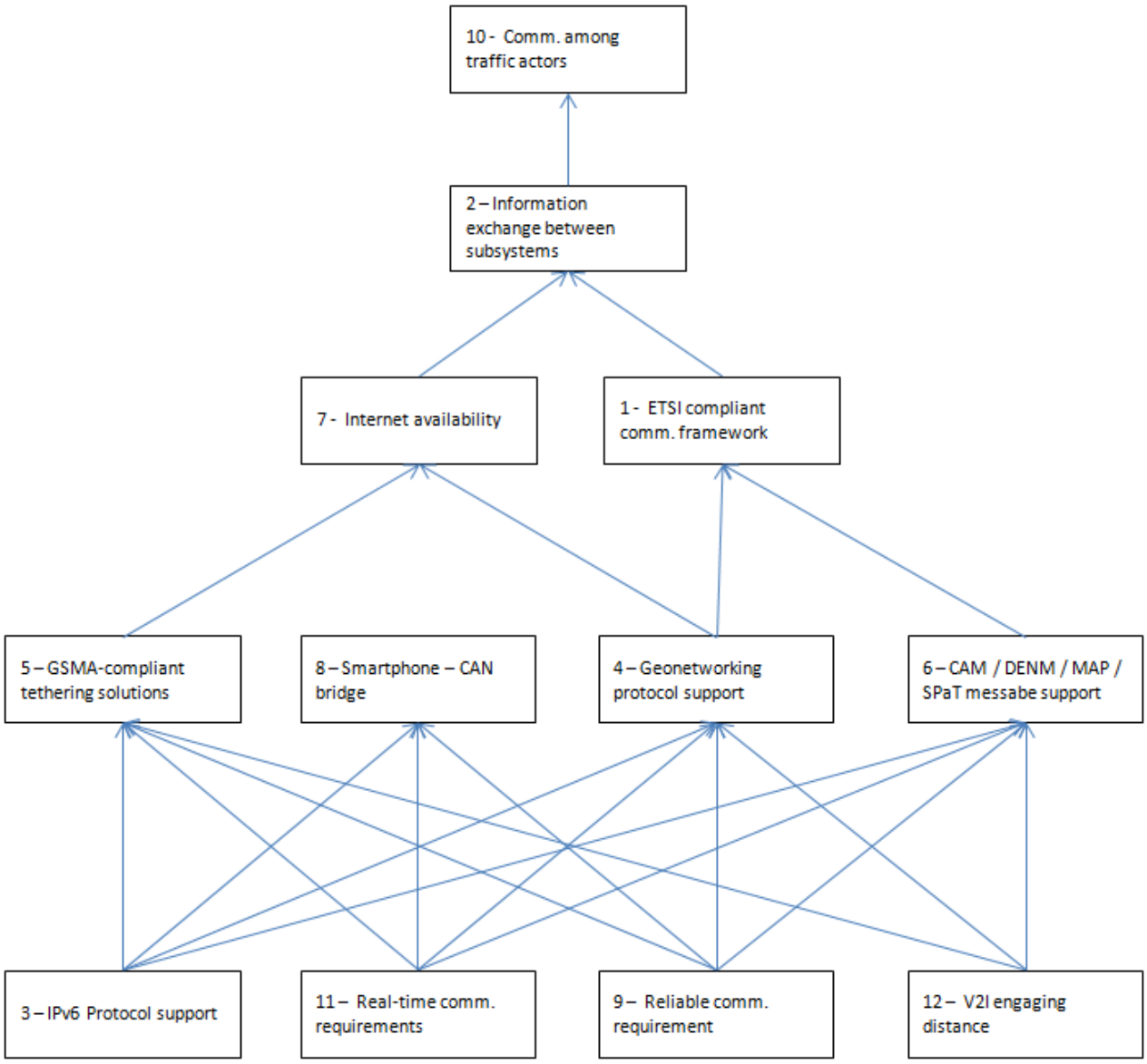

Figure 3-1: Hierarchy of EMPOWER Communication requirements.

Requirement ID	SP2_REQ_COM_1
Name	Communication Framework

Description	The EMPOWER communication framework shall be compliant with ETSI TC ITS Reference Architecture (ETSI EN 302 665: "Intelligent Transport Systems (ITS); Communication Architecture").
Reference	SP2_REQ_COM 1, SP2_REQ_IVL_1_v1.0

Requirement ID	SP2_REQ_COM_2
Name	Information exchange
Description	The EMPOWER communication framework shall support information exchange between central ITS stations and: vehicle / roadside ITS stations / personal stations using: 802.11 p, LTE, 3G and all the available legacy 3GPP communication systems (long range wireless communication).
Reference	SP2_REQ_COM 2, SP2_REQ_IVL_2_v1.0

Requirement ID	SP2_REQ_COM_3
Name	IPv6 protocol support
Description	The EMPOWER communication framework shall support the use of IPv6 protocol.
Reference	SP2_REQ_COM 3, SP2_REQ_IVL_3_v1.0

Requirement ID	SP2_REQ_COM_4
Name	Geo-Networking protocol support
Description	The EMPOWER communication framework shall support Geo-Networking protocols compliant with ETSI TC ITS reference documents.
Reference	SP2_REQ_COM 4, SP2_REQ_IVL_4_v1.0

Requirement ID	SP2_REQ_COM_5
Name	GSMA-compliant tethering solutions
Description	For the communication between a vehicle station and a personal station, the EMPOWER communication framework shall support tethering solutions complying with GSMA guidelines (GSMA White Paper "Connecting Cars: Bring your Own Device - Tethering Challenges", Feb. 2013 available on: http://www.gsma.com/connectedliving/wp-content/uploads/2013/02/cl_ma_tethering_02_13.pdf)
Reference	SP2_REQ_COM 5, SP2_REQ_IVL_5_v1.0

Requirement ID	SP2_REQ_COM_6
Name	CAM / DENM / MAP / SPaT message support
Description	Whenever possible, TEAM applications should use ETSI CAM (TS 102 868-x) and ETSI DENM (TS 102 869-x) protocols to communicate applicative information. MAP and SPaT protocols should be also considered.
Reference	SP2_REQ_COM 6, SP2_REQ_IVL_6_v1.0

Requirement ID	SP2_REQ_COM_7
Name	Internet availability
Description	Applications will be available to the user through the Internet on Smartphones (also on PCs, where available). (source: use cases SP4 SG).
Reference	SP2_REQ_COM 7

Requirement ID	SP2_REQ_COM_8
Name	Smartphone-CAN bridge

Description	The software infrastructure / framework will provide a Smartphone-CAN communication bridge for gathering vehicle related data. (source: use cases SP4 SG).
Reference	SP2_REQ_COM 8

Requirement ID	SP2_REQ_COM_9
Name	Reliable comm. bandwidth
Description	The communication facility will reliably provide enough communication bandwidth. Estimated required throughput 1Kb/s for Serious Gaming applications.
Reference	SP2_REQ_COM 9, SP4_REQ_SG_LDMRBW_v0.1

Requirement ID	SP2_REQ_COM_10
Name	Comm. among traffic actors
Description	The EMPOWER communication framework will provide reliable, robust and real-time communications among traffic actors (travellers, vehicles, infrastructure), through long-range (3G/4G) and, where available, short-range (e.g. IEEE 802.11p) communication links. The latter should be particularly useful for traffic infrastructure elements like e.g., traffic-lights.
Reference	SP2_REQ_COM 10, SP4_REQ_SG_COMMSYS_v0.1

Requirement ID	SP2_REQ_COM_11
Name	Real-time communication requirements

Description	The EMPOWER communication framework will allow the local tactical control devices to operate in real time. The communication requirements of the selected tactical control devices in terms of latency and bandwidth should be met. Bi-directional communication specific requirements should be defined (e.g. in order to enable feedback loop control with the TMC).
Reference	SP2_REQ_COM 11, SP3_REQ_CMC_03_v0.1

Requirement ID	SP2_REQ_COM_12
Name	V2I engaging distance
Description	Vehicles shall receive information from intersection infrastructure when they are in range (at least 600m). The vehicles shall send information to the intersection as early as possible to give the intersection enough time to prioritize.
Reference	SP2_REQ_COM 12, SP3_REQ_CSI_3_v0.1

3.2 Automotive Cloud and LDM++ related requirements

This section contains the list of EMPOWER requirements that are related to automotive cloud and LDM++. These requirements were defined from the use cases of the LDM++ and automotive cloud generic requirements provided in D1.0 (TEAM users, stakeholders and uses cases) and after the review of the related SP3 and SP4 application use cases and requirements to the EMPOWER system. The requirements have been grouped according to different aspects of the architecture of the LDM++: the location based content (static and dynamic), the overall structure, the data input and output and the associated services. The hierarchy of these requirements is illustrated in Figure 3-2. The requirements are categorised into three separate levels. The first one includes the LDM++ basic functionalities, then the application and infrastructure input and output related requirements and finally a higher level with advanced services for the applications.

A high level description of the requirements related to Cloud and LDM++ is provided in the remainder of this sub-section. The complete tables are provided in the Annexes. A hyper-link can be followed from the "reference" entry of each requirement description, leading to the relevant full requirement table in the Annexes.

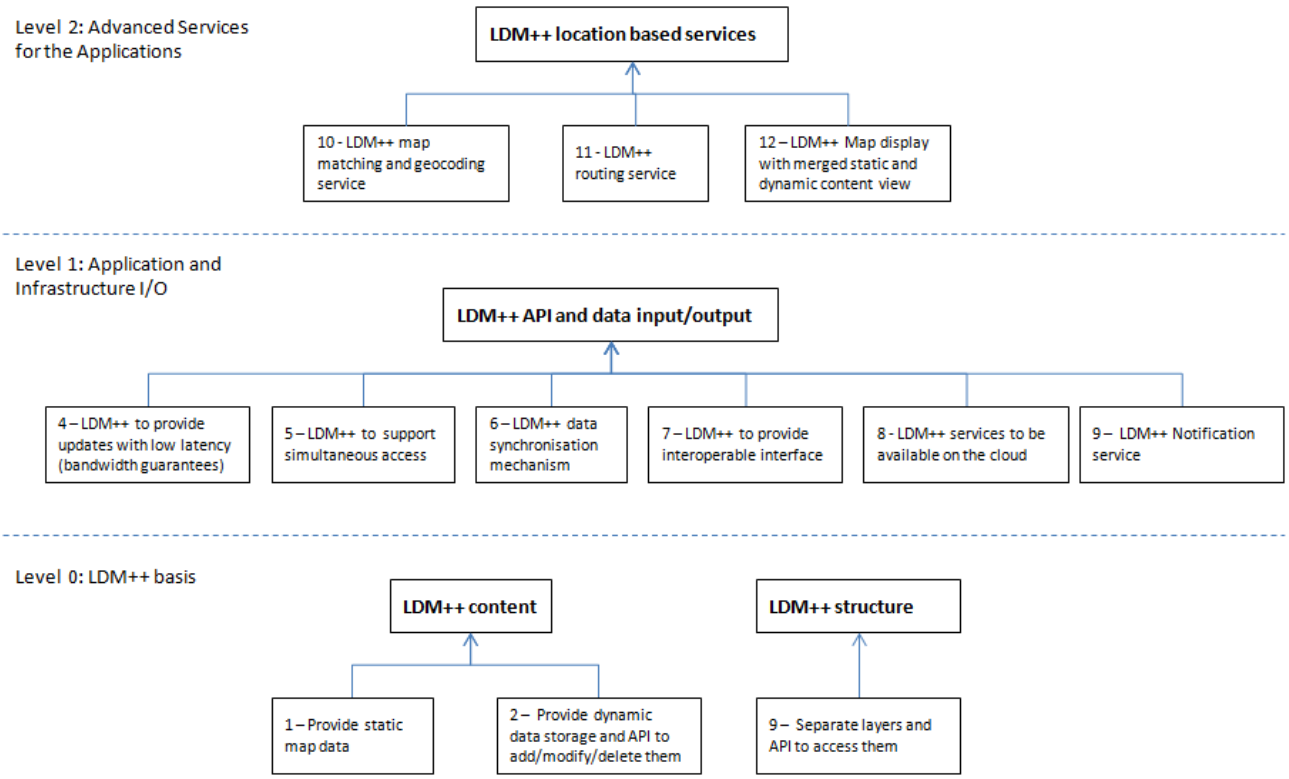

Figure 3-2: Hierarchy of EMPOWER LDM++ requirements.

3.2.1 LDM++ content and structure

In order to limit the number of requirements for an efficient subsequent validation, requirements about the map data in the LDM++ have been grouped based on whether they concern static or dynamic content. The lists of static and dynamic content have been created based on use cases and requirements stemming from the SP3 and SP4 Sub-Projects. The list is not exhaustive and will be possibly enhanced during the architecture and development phases. The amount of data to be stored in the LDM++ should however be limited in order to avoid performance issues during the data access process.

For each type of data, it should be evaluated if it needs to be stored directly in the database within the LDM++ or be retrieved from the cloud via an API. The place of actual storage of the data can be decided at implementation time. However, it is necessary to be ensured that all exported data, whether local or in the cloud, can be accessed transparently via the unified LDM++interface.

Requirement ID	SP2_REQ_LDM_1
Name	Provide static map data
Description	The LDM++ is the component that stores all relevant static map data and provides them to other components. Static data include the following clusters: 1. Road topology and attributes associated to road links: a. Road type b. Urban area c. Lanes (number of lanes and geometry) d. directions of travel e. access and exit junctions f. Intersections (locations and reference tracks). g. traffic lights (locations) h. roundabouts i. Slope and curvature 2. Regulations a. speed limits (including time and weather dependant) b. noise c. emission (low emission zones) 3. Public transport: a. Bus routes and stops b. Static time tables/frequency information 4. Parking slots locations (Parking POIs) Data structures should follow existing standards as far as possible and if available, like the one defined by ISO TC 204 WG18 and ETSI or GDF.
Reference	SP2_REQ_LDM 1

Requirement ID	SP2_REQ_LDM_2
Name	Provide dynamic data storage and API to add/modify/delete them

Description	Dynamic map related data needs to be stored and changed. These will include the following clusters: 1. Traffic information: a. Traffic flow: i. average speed data from Real-Time Traffic information source ii. data sent by the TEAM equipped vehicles like type of vehicle present in a traffic queue b. Traffic incidents/events: road works and incidents received from infrastructure and TEAM equipped vehicles. For accidents, it shall be possible to add data such as number of involved vehicles, injured people, presence or time of arrival of emergency vehicles. 2. Dynamic data associated to POIs: a. Variable speed limits (e.g. for VMS) b. State of traffic lights c. Parking availability 3. Emissions & noise a. Pollution levels like CO2, CO, HC, NOx and PMx. b. Control parameters: desired pollution level, desired number of vehicles. 4. Safety: live and historic data on hazardous road locations and safe routes, such as roads that few accidents happen, etc. Related with point 1.b). 5. Public transport: a. Bus routes, bus stops, timetables dynamically updated (after the performance of the TEAM routing optimization algorithms) b. Buses positions/availability/load etc. updated in real-time 6. Other vehicles' locations and itineraries. Data structures should follow existing standards as far as possible and if available, like the one defined by ISO TC 204 WG18 and

Reference	SP2_REQ_LDM 2

Requirement ID	SP2_REQ_LDM_3
Name	Separate layers and API to access them
Description	Data stored within the LDM++ shall be separated for different types of data and different applications. The LDM++ should also provide a number of private layers maintained by applications (historical data, statistical data, dynamic event data including several snapshots at periodic/event-triggered intervals for historical/statistical/analytical purposes, etc.). Custom layers should be updatable with real time data (e.g., vehicular information). The term layer is used here to illustrate that the data types need to be differentiated inside the LDM and be accessible via dedicated portions of the API. The layers can however be actually virtual as only one storage structure (e.g. RDMS) should be used.
Reference	SP2_REQ_LDM 3

3.2.2 LDM++ Data Input/Output

Requirement ID	SP2_REQ_LDM_4
Name	LDM++ to provide updates with low latency (bandwidth guarantees)
Description	The LDM++ should have the ability to provide low-latency database updates, whereby low-latency should be considered in the context of the specific service request and the type of data. The LDM++ should provide a latency time limit according to communication requirements.

Reference	SP2_REQ_LDM 4

Requirement ID	SP2_REQ_LDM_5
Name	LDM++ to support simultaneous access
Description	The LDM++ shall be able to provide simultaneous access (read and write operations) from a number of TEAM application instances (including distributed applications), but also simultaneous access from other potential client applications.
Reference	SP2_REQ_LDM 5

Requirement ID	SP2_REQ_LDM_6
Name	LDM++ data synchronisation mechanism
Description	LDM++ shall provide a synchronisation mechanism within and with the cloud.
Reference	SP2_REQ_LDM 6

Requirement ID	SP2_REQ_LDM_7
Name	LDM++ to provide interoperable interface
Description	Access to the LDM++ shall be defined through standard interfaces in order to allow independence and interoperability with different map providers.
Reference	SP2_REQ_LDM 7

Requirement ID	SP2_REQ_LDM_8
Name	LDM++ services to be available on the cloud
Description	The LDM++ should include a service seamlessly available on the cloud, not residing on the vehicle. This is necessary for sustainability of the development effort.

Reference	SP2_REQ_LDM 8

Requirement ID	SP2_REQ_LDM_9
Name	LDM++ Notification service
Description	LDM++ to have a dedicated component/service that will check the position of a vehicle and propagate a message to the subscribed applications when the vehicle enters or exits: 1. A predefined location of interest, such as a parking slot, an intersection and highway entrance/exit. 2. A virtual area based on speed, fuel consumption (low priority requirement). This event can serve as a trigger to download relevant data for that area from the cloud. Rules for triggering and types of actions must be defined.
Reference	SP2_REQ_LDM 9

3.2.3 LDM++ Location based services

Requirement ID	SP2_REQ_LDM_10
Name	LDM++ map matching and geocoding service
Description	LDM++ to provide a service to applications for converting a geographical position into a location on the road network or into a geo-referenced position.
Reference	SP2_REQ_LDM 10

Requirement ID	SP2_REQ_LDM_11
Name	LDM++ routing service

Description	LDM++ to provide a simple routing service. The service must include origin/destination selection and shortest and fastest route option. The development of more advanced routing functionalities will be possible accessing both static and dynamic data at the level of road links via the dedicated APIs.
Reference	SP2_REQ_LDM 11

Requirement ID	SP2_REQ_LDM_12
Name	LDM++ Map display with merged static and dynamic content view
Description	LDM++ to provide an API to provide a merged view on static and dynamic content and a visual rendering component
Reference	SP2_REQ_LDM 12

3.3 Cooperative Positioning related requirements

This section contains the list of EMPOWER requirements that are related to the technology of cooperative positioning and to the related SP3 and SP4 application use cases and requirements. The goals of Cooperative Positioning is to improve the localisation of nodes. Firstly, an absolute geo-position shall be calculated that exceeds the precision of standard GPS receivers and secondly a high-accuracy relative position between nodes shall be calculated, i.e. distance and orientation between nodes. Cooperative Positioning focuses on gaining high precision positioning by exchange of GNSS data. However when the GNSS signal reception is poor other sources, such as cellular information, can be used. The hierarchy is illustrated in the following Figure 3-3. The list is not exhaustive and might be completed or adapted during the architecture and development phases.

A high level description of the requirements related to Cooperative positioning is provided in the remainder of this sub-section. The complete tables are provided in the Annexes. A hyper-link can be followed from the "reference" entry of each requirement description, leading to the relevant full requirement table in the Annexes.

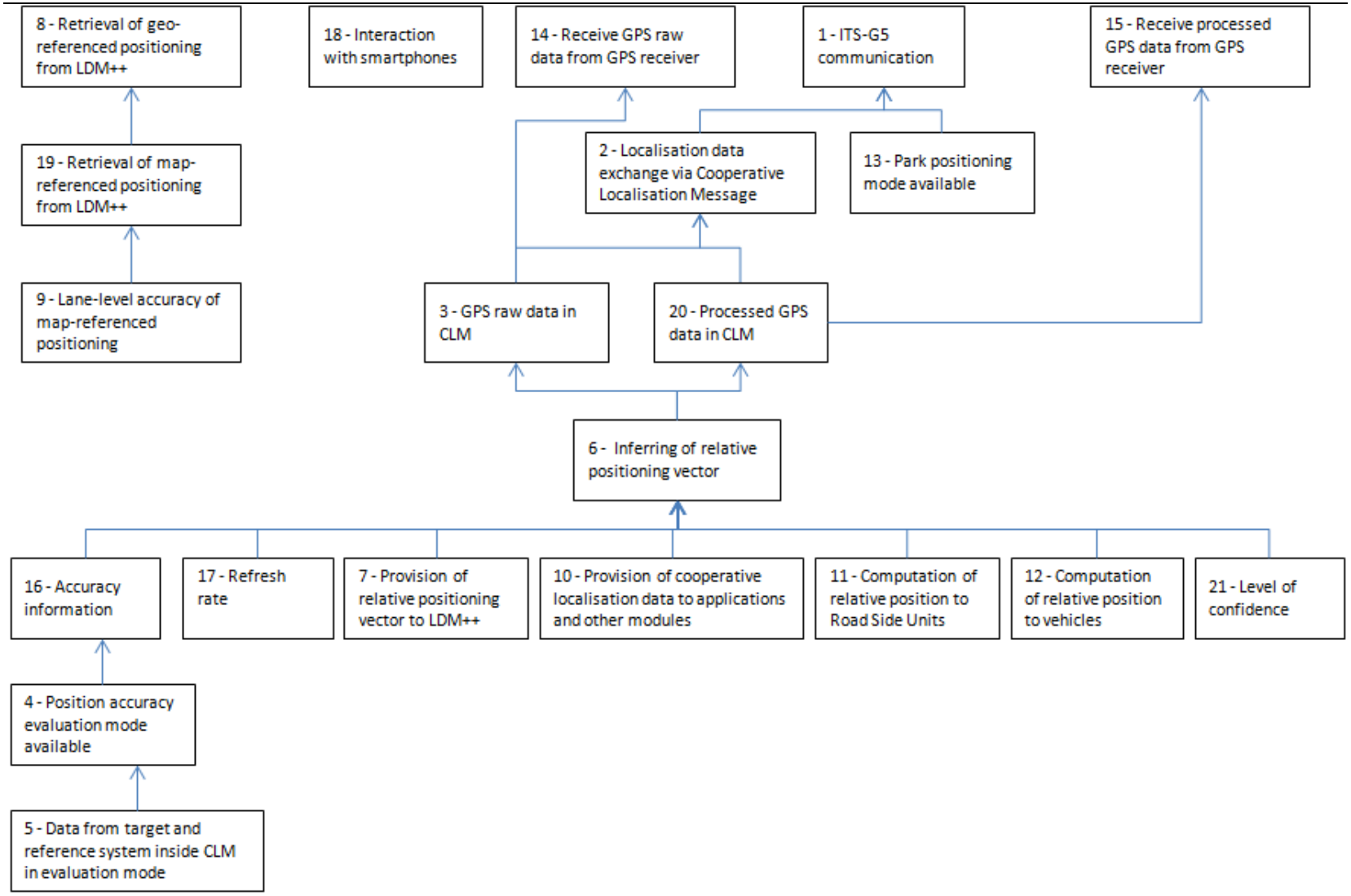

Figure 3-3: Hierarchy of EMPOWER Cooperative Positioning requirements.

Requirement ID	SP2_REQ_POS_01
Name	ITS-G5 communication
Description	Localisation data among nodes shall be exchanged via ITS-G5 communication. This is necessary to improve the localization of the nodes.
Reference	SP2_REC_POS 1

Requirement ID	SP2_REQ_POS_02
Name	Localisation data exchange via Cooperative Localisation Message
Description	The localisation data of nodes shall be exchanged via Cooperative Localisation Message. This is necessary to process the localization data of surrounding nodes. Localisation data comprises raw GNSS data
Reference	SP2_REC_POS 2

Requirement ID	SP2_REQ_POS_03
Name	GPS raw data in CLM
Description	The node localisation data in CLM shall include GPS raw data. This data is necessary to compute the relative vector between the cooperating vehicles.
Reference	SP2_REC_POS 3

Requirement ID	SP2_REQ_POS_04
Name	Position accuracy evaluation mode available
Description	Positioning system shall be able to work in "position accuracy evaluation mode", using both the target GPS modules and a reference system in parallel (e.g. DGPS/RTK).

Reference	SP2_REC_POS 4

Requirement ID	SP2_REQ_POS_05
Name	Data from target and reference system inside CLM in evaluation mode
Description	When in "evaluation mode", localisation data shall include data of both target GPS and of reference system (e.g. DGPS).
Reference	SP2_REC_POS 5

Requirement ID	SP2_REQ_POS_06
Name	Inferring of relative positioning vector
Description	Within positioning system, the cooperative position module shall be able to infer relative positioning vector.
Reference	SP2_REC_POS 6

Requirement ID	SP2_REQ_POS_07
Name	Provision of relative positioning vector to LDM++
Description	Cooperative position module shall provide relative positioning vector to the LDM++.
Reference	SP2_REC_POS 7

Requirement ID	SP2_REQ_POS_08
Name	Retrieval of geo-referenced positioning from LDM++
Description	Positioning system shall retrieve geo-referenced positioning from the LDM++.
Reference	SP2_REC_POS 8

Requirement ID	SP2_REQ_POS_09
Name	Lane-level accuracy of map-referenced positioning
Description	The geo-referenced and map-referenced position with lane- level accuracy of LDM++ shall be used.
Reference	SP2_REC_POS 9

Requirement ID	SP2_REQ_POS_10
Name	Provision of cooperative localisation data to applications and other modules
Description	Positioning system shall provide both geo-referenced and relative positioning data, speed and heading to SP3 and SP4 applications as well as to other SP2 modules (e.g. ITS-G5 Geo-casting communication support, if available).
Reference	SP2_REC_POS 10

Requirement ID	SP2_REQ_POS_11
Name	Computation of relative position to Road Side Units
Description	Positioning system shall be able to compute relative position from ego-position and raw GPS position data of nearby roadside units (see SP2 Use case C-GPS – 1).
Reference	SP2_REC_POS 11

Requirement ID	SP2_REQ_POS_12
Name	Computation of relative position to vehicles
Description	Positioning system shall be able to compute relative position from GPS raw data sent by nearby vehicles (see SP2 Use case C-GPS – 2).
Reference	SP2_REC_POS 12

Requirement ID	SP2_REQ_POS_13
Name	Park positioning mode available
Description	When "parking positioning mode" is active positioning system shall be able to work even after key off, as beacon for the positioning of other vehicles (see SP2 Use case C-GPS – 3).
Reference	SP2_REC_POS 13

Requirement ID	SP2_REQ_POS_14
Name	Receive GPS raw data from GPS receiver
Description	Cooperative position module shall receive unprocessed GPS data (e.g. measurement data, ephemeris data, ionospheric parameters) from the raw data GPS receiver. This data is needed for cooperative positioning algorithm calculations.
Reference	SP2_REC_POS 14

Requirement ID	SP2_REQ_POS_15
Name	Receive processed GPS data from GPS receiver
Description	Cooperative position module shall receive processed GPS data (e.g. absolute GPS position) from the raw data GPS receiver. Together with calculated position data of GPS raw data an accuracy evaluation can be performed.
Reference	SP2_REC_POS 15

Requirement ID	SP2_REQ_POS_16
Name	Accuracy information

Description	Cooperative position module should be able to indicate the accuracy of the current position, both relative and absolute positions. This is necessary to perform graceful degradation of application functionality in case the necessary accuracy is not possible to be achieved. It is a reliability related requirement.
Reference	SP2_REC_POS 16

Requirement ID	SP2_REQ_POS_17
Name	Refresh rate
Description	The time necessary to perform the necessary calculations should be minimized and the refresh rate should be real-time. The update rate should be kept at most 1Hz as regular GPS receivers. The ideal is to have higher update rates (such as 10Hz) available for safety applications that need higher resolution.
Reference	SP2_REC_POS 17

Requirement ID	SP2_REQ_POS_18
Name	Interaction with smartphones
Description	The cooperative positioning module shall be able to interact with smartphones. The GPS sensor and the cellular network interface of smartphones should be used.
Reference	SP2_REC_POS 18

Requirement ID	SP2_REQ_POS_19
Name	Retrieval of map-referenced positioning from LDM++
Description	Positioning system shall retrieve map-referenced positioning from the LDM++.
Reference	SP2_REC_POS 19

Requirement ID	SP2_REQ_POS_20
Name	Processed GPS data in CLM
Description	The node localisation data in CLM shall include processed GPS data. This is necessary to calculate the relative positioning vector.
Reference	SP2_REC_POS 20

Requirement ID	SP2_REQ_POS_21
Name	Level of confidence
Description	Applications and other components must know how reliable the position is. Therefore, a level of confidence must be given. The confidence level can be based on the number and quality of input sources.
Reference	SP2_REC_POS 21

3.4 Security, Privacy and Reliability requirements

This section contains the list of EMPOWER requirements that are related to security, privacy, and reliability. The requirements are derived from the security related EMPOWER use cases. Nevertheless, all requirements may be derived from SP3 and SP4, if the main security requirement SP2_REQ_SEC_1 is taken into account. A high level description of the requirements related to security, privacy, and reliability is provided in the remainder of this sub-section. The complete tables are provided in the Annexes. A hyper-link can be followed from the "reference" entry of each requirement description, leading to the relevant full requirement table in the Annexes.

The hierarchy (levels) of security, privacy and reliability requirements depicted in Figure 3-4 is derived from description of their relationships provided in detailed description to each requirement.

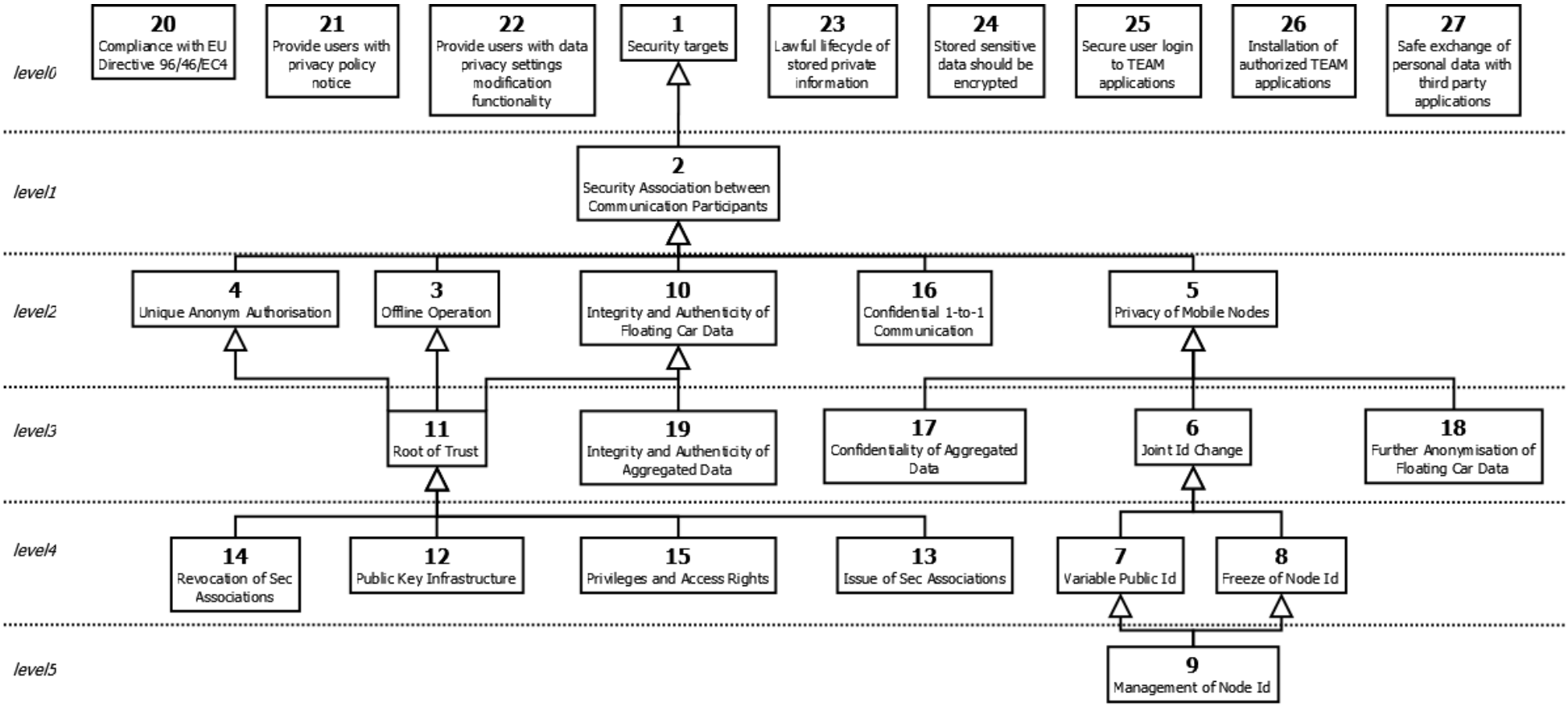

Figure 3-4: Hierarchy of EMPOWER security, privacy and reliability requirements.

Requirement ID	SP2_REQ_SEC_1
Name	Security Targets
Description	The TEAM platform shall respect the common security targets of privacy, confidentiality, integrity, authenticity, accountability, and non-repudiation.
Reference	SP2_REQ_SEC 1

Requirement ID	SP2_REQ_SEC_2
Name	Security Association between Communication Participants
Description	For all kinds of communications, there must be a security association between the communication participants, i.e. the sender and the receiver(s). The security association must work independently of the communication mode (connectionless or connection-oriented) and the number of participants (one-to-one or one-to-many).
Reference	SP2_REQ_SEC 2

Requirement ID	SP2_REQ_SEC_3
Name	Offline Operation
Description	The security association and related security operations must not require permanent online access to any backend systems.
Reference	SP2_REQ_SEC 3

Requirement ID	SP2_REQ_SEC_4
Name	Unique and Anonymous Authorisation

Description	There shall be different types of security associations that a node may choose. Unique authorization legitimates and identifies an individual node. Anonymous authorisation legitimates a node without revealing its identity.
Reference	SP2_REQ_SEC 4

Requirement ID	SP2_REQ_SEC_5
Name	Privacy of Mobile Nodes
Description	In order to preserve their privacy, mobile nodes shall be able to communicate in an anonymous or pseudonymous way. This may concern one-to-many (e.g. beaconing) as well as one-to-one communications (e.g. backend data aggregation).
Reference	SP2_REQ_SEC 5

Requirement ID	SP2_REQ_SEC_6
Name	Joint Identifier Change
Description	All public identifiers of a mobile node shall be changed in regular intervals. The change must be atomic, so that every two messages following each other to contain either only the new or the old identifiers. Old and new identifiers shall not be linkable.
Reference	SP2_REQ_SEC 6

Requirement ID	SP2_REQ_SEC_7
Name	Variable Public Identifiers

Description	All components and applications relying on public identifiers (i.e. identifiers used in non-confidential communications) are required to subscribe for node id changes and immediately change all their public identifiers on such events. Since old and new identifiers shall not be linkable, it is recommended to derive public identifiers from the globally unique node id.
Reference	SP2_REQ_SEC 7

Requirement ID	SP2_REQ_SEC_8
Name	Freeze of Node Identifier
Description	Applications and components shall be able to freeze the node id under special circumstances, e.g. during safety critical situations or cooperative driving manoeuvres. The duration of a freeze shall not exceed the required period.
Reference	SP2_REQ_SEC 8

Requirement ID	SP2_REQ_SEC_9
Name	Management of Node Identifiers
Description	There must be a "Node ID Manager" component that triggers regular identifier changes, provides globally unique node ID's, communicates to authority services to obtain node ID's, and provides an interface to node components and applications that allows subscription for id change events.
Reference	SP2_REQ_SEC 9

Requirement ID	SP2_REQ_SEC_10
Name	Integrity and Authenticity of Transmitted Data

Description	Integrity and authenticity of communications (one-to-one as well as one-to-many) shall be ensured. Recipients of transmitted data shall be able to verify the integrity and authenticity of the data and its originator.
Reference	SP2_REQ_SEC 10

Requirement ID	SP2_REQ_SEC_11
Name	Root of Trust
Description	There shall be a central ITS authority, which impersonates the root of trust.
Reference	SP2_REQ_SEC 11

Requirement ID	SP2_REQ_SEC_12
Name	Public Key Infrastructure
Description	There shall be a public key infrastructure, which establishes security associations between all potential communication participants and provides mechanisms to deploy and manage security credentials.
Reference	SP2_REQ_SEC 12

Requirement ID	SP2_REQ_SEC_13
Name	Issue of Security Associations
Description	The ITS authority shall issue enrolment and authorisation credentials. Enrolment credentials have a long-term validity and allow unique authorisation. Authorisation credentials expire after short periods of time and must be changed and renewed frequently; they are used for anonymous authorisation.

Reference	SP2_REQ_SEC 13

Requirement ID	SP2_REQ_SEC_14
Name	Revocation of Security Associations
Description	The ITS authority shall provide mechanisms to revoke security associations. Revocation may be implicit, e.g. by not further issuing authorisation credentials to a specific node.
Reference	SP2_REQ_SEC 14

Requirement ID	SP2_REQ_SEC_15
Name	Privileges and Access Rights
Description	Security credentials shall contain immutable attributes reflecting access rights or specific privileges, e.g. for public service vehicles.
Reference	SP2_REQ_SEC 15

Requirement ID	SP2_REQ_SEC_16
Name	Confidential One-to-one Communications
Description	One-to-one communication channels should not be interceptable by third parties, so that exchanged data stays confidential between the two communication participants.
Reference	SP2_REQ_SEC 16

Requirement ID	SP2_REQ_SEC_17
Name	Confidentiality of Aggregated Data

Description	Huge sets of aggregated data on backend services might allow to link floating car data with different public identifiers to the same mobile node. Aggregating services must not try to deanonymise any data. Generally, gathered data sets are considered to be confidential and must be protected from unauthorized access. Redistribution is not permitted unless further anonymisation procedures are applied that eliminate the risk of linking data to individuals.
Reference	SP2_REQ_SEC 17

Requirement ID	SP2_REQ_SEC_18
Name	Further Anonymisation of Floating Car Data
Description	Mobile nodes should apply further anonymisation procedures before sharing data with aggregating backend services. These procedures may include cooperative id changes or silent gaps and are subject to further research.
Reference	SP2_REQ_SEC 18

Requirement ID	SP2_REQ_SEC_19
Name	Integrity and Authenticity of Aggregated Data
Description	Before processing incoming or stored floating car data, aggregating backend services shall validate its integrity and authenticity. On the other hand, recipients of aggregated data (or information derived from that data) shall be able to verify the integrity and authenticity of the data and the originating backend service.
Reference	SP2_REQ_SEC 19

Requirement ID	SP2_REQ_SEC_20

Name	Compliance with EU Directive 96/46/EC4
Description	TEAM platform must comply with applicable laws governing the processing of personal data and specifically with EU Directive 96/46/EC4.
Reference	SP2_REQ_SEC 20

Requirement ID	SP2_REQ_SEC_21
Name	Provide users with a clear and understandable privacy policy notice.
Description	TEAM system must provide users with a clear and understandable privacy notice, prior to any data collection that the applications may perform. The requested data should be mentioned, so that users are aware and decide whether to use or not an application or certain of its features.
Reference	SP2_REQ_SEC 21

Requirement ID	SP2_REQ_SEC_22
Name	Provide users with data privacy settings modification functionality
Description	Users must have the option to determine how their personal data or location is processed. Modifiable users' privacy settings option shall exist in the users' interface.
Reference	SP2_REQ_SEC 22

Requirement ID	SP2_REQ_SEC_23
Name	Lawful lifecycle of stored private information

Description	Information stored by the TEAM data storage devices should be deleted or anonymized when this data is no longer necessary for the purposes it was originally collected for. Moreover, private data should be deleted only if it is allowed by the law. Users must be able to delete private information stored by TEAM, as well.
Reference	SP2_REQ_SEC 23

Requirement ID	SP2_REQ_SEC_24
Name	Stored sensitive data should be encrypted
Description	TEAM has to adopt appropriate information security measures to protect Personal Data against unauthorized access, use, modification or loss when stored on the device or other repositories. Sensitive data encryption should be considered.
Reference	SP2_REQ_SEC 24

Requirement ID	SP2_REQ_SEC_25
Name	Secure user login to TEAM applications
Description	Login will be required to access the TEAM applications. Option to remember the login details shall be available.
Reference	SP2_REQ_SEC 25

Requirement ID	SP2_REQ_SEC_26
Name	Installation of authorized TEAM applications
Description	TEAM has to authorize applications before allowing their installation.
Reference	SP2_REQ_SEC 26

Requirement ID	SP2_REQ_SEC_27
Name	Safe exchange of personal data with third party applications
Description	If a TEAM application requires it, TEAM shall send and receive securely transmitted data when a connection with third party applications exists.
Reference	SP2_REQ_SEC 27

3.5 Other requirements

This section contains the list of EMPOWER requirements that are not related to one of the four basic technology categories that are investigated within SP2. These technology categories are communications, dynamic map data management and automotive cloud, collaborative positioning, and security, privacy and reliability. Any requirement that cannot be assigned to any of these technology categories is listed in this section. These include requirements related to data types, protocols, interfaces, external data sources, equipment characteristics, applications and components interaction, web and mobile technologies etc. This requirement category concerns the overall EMPOWER system but does not fits to one of its main technologies, other requirements are also technology, infrastructure and data related requirements that the system shall implement but form smaller categories.

The list of high level description of the identified requirements after reviewing the TEAM applications use cases is given here. The complete tables are provided in the Annexes. A hyper-link can be followed from the "reference" entry of each requirement description, leading to the relevant full requirement table in the Annexes. Other requirements do not build any hierarchy, but can be grouped into several groups (as derived from their description). Classification of other requirements is presented in Figure 3-5.

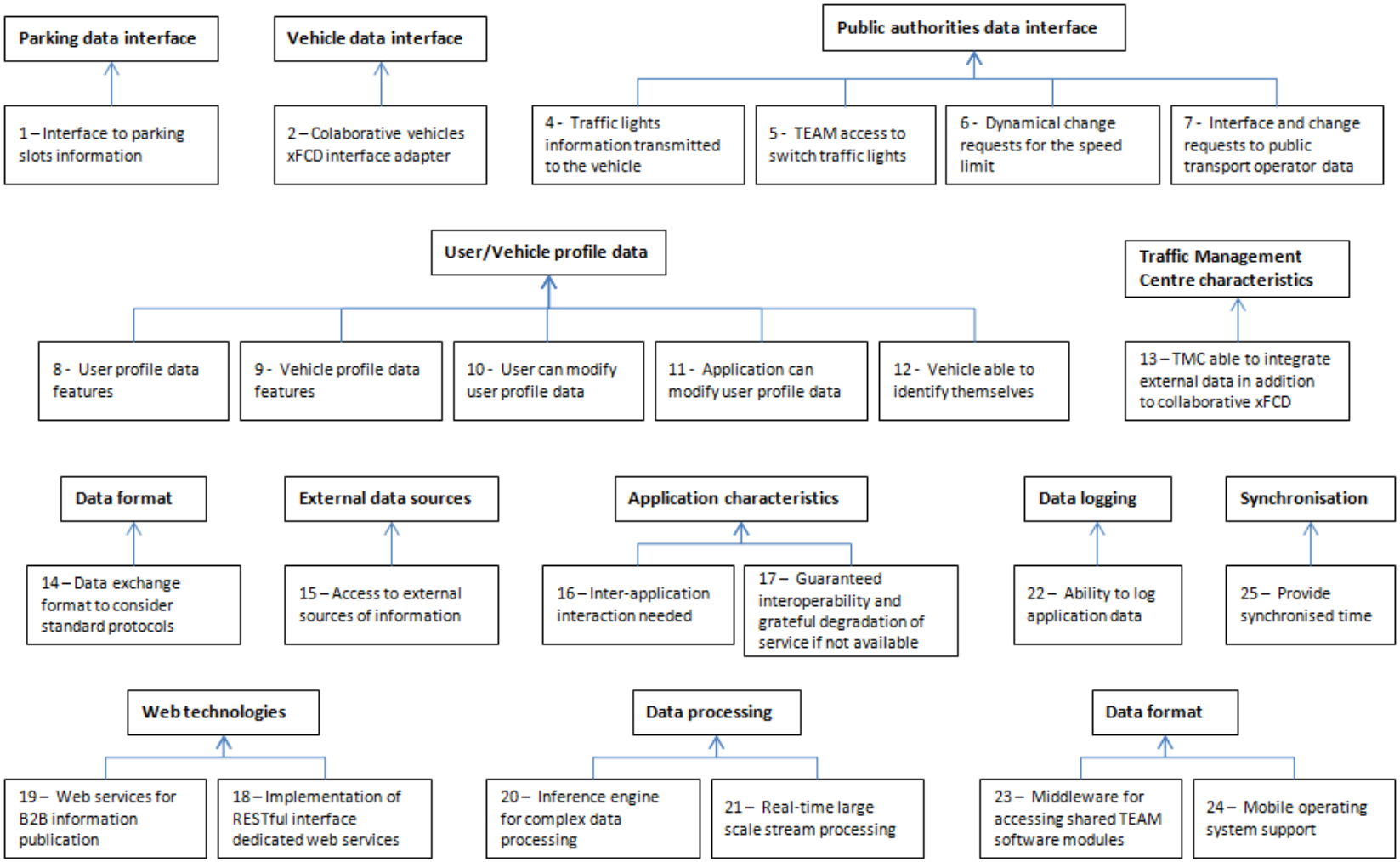

Figure 3-5: Taxonomy of EMPOWER other requirements.

Parking data Interface

Requirement ID	SP2_REQ_OTH_1
Name	Interface to parking slots information
Description	An interface is needed to provide instantaneous information on free parking slots within an area. Information needed includes: free slots, parking events, pending parking requests and parking forecasts.
Reference	SP2_REQ_OTH 1

Vehicle data Interface

Requirement ID	SP2_REQ_OTH_2
Name	Collaborative vehicles xFCD interface adapter
Description	Need for collaborative vehicles xFCD interface adapter. Project standardisation activities should be taken into account. Proper algorithms and protocols (e.g. based on the well known SIMONE protocol for CFD) for XFCD processing will be defined and developed. A specialised (or a number of) web service(s) should be developed to allow vehicles to connect. The REST architecture should be evaluated.
Reference	SP2_REQ_OTH 2

Equipment characteristics

Requirement ID	SP2_REQ_OTH_3
Name	Travellers mobile devices should allow MAC address based tracking

Description	Need for travellers to allow their mobile devices to be tracked using their MAC addresses.
Reference	SP2_REQ_OTH 3

Public authorities data interface

Requirement ID	SP2_REQ_OTH_4
Name	Traffic lights information should be transmitted to the vehicle
Description	Traffic lights information (SPaT – Signal Phases and Timing) should be transmitted to the vehicle. The outcomes of use case SP3_CMC_MLP (application of multi-layered control policies according to operator settings, networks performance criteria and spot needs) should be translated into a set of actions/information applied by means of different devices systems for collaborative traffic control, continuously validated by double loop control, and sent to the vehicle.
Reference	SP2_REQ_OTH 4

Requirement ID	SP2_REQ_OTH_5
Name	TEAM should have access to switch traffic lights
Description	TEAM should have access to switch traffic lights. The TMC of local pilots should be able to do that in restricted areas. The system should be able to quickly react to traffic forecasts done by the SP3_CMC_NOS use case (Network observation to obtain reliable traffic forecasts), taking into account the policies defined in the SP3_CMC_MLP use case. Access should guarantee the capability to collaborate with vehicles and collecting feedbacks about relevant tactical control actions (e.g. forecasted vs. actual time to green).
Reference	SP2_REQ_OTH 5

Requirement ID	SP2_REQ_OTH_6
Name	Dynamical change requests for the speed limit
Description	The authorities shall allow and enable TEAM applications to change the speed limit dynamically.
Reference	SP2_REQ_OTH 6

Requirement ID	SP2_REQ_OTH_7
Name	Interface and change requests to public transport operator data
Description	Public transport operator should be flexible to accept schedule or route change requests and coordination among buses to dynamically adapt their distance. Route changes concern mainly event driven changes; normal scheduling is required in cases of traffic flow problems and traveller request. The latter is understood that is problematic and its implementation could be limited. The application should also have access to the public transport operator data.
Reference	SP2_REQ_OTH 7

User/Vehicle profile data

Requirement ID	SP2_REQ_OTH_8
Name	User profile data features

Description	User profile shall include: • locations like "home", "work" etc, • user preference criteria regarding: travel time, cost, environmental criteria, number of changes, desired traffic modes, • Record of badges rewarding good performance: connected with access to pool lanes, discounts for parking costs, free bus tickets, etc. information such as: friends, type of car, interests, geographical area, time periods, etc., disabled person wanting to cross the street.
Reference	SP2_REQ_OTH 8

Requirement ID	SP2_REQ_OTH_9
Name	Vehicle profile data features
Description	Vehicle profile to include: fuel level, engine type {electric, hybrid, IEC}, emission factors, max speed, type, truck, bus, tram, car, motorcycle, pedestrians, cyclists, truck with dangerous goods, ambulance, cabriolet etc. Additional data for buses include: type, weight, number of passengers, schedule, route etc.
Reference	SP2_REQ_OTH 9

Requirement ID	SP2_REQ_OTH_10
Name	User can modify user profile data
Description	An application user should be able and allowed to modify their user profile data (including their vehicle data).

Reference	SP2_REQ_OTH 10

Requirement ID	SP2_REQ_OTH_11
Name	Application can modify user profile data
Description	User profile should allow for updates by applications, (e.g. based on user driving and mobility behaviour etc).
Reference	SP2_REQ_OTH 11

Requirement ID	SP2_REQ_OTH_12
Name	Vehicle should be able to identify themselves
Description	Vehicles should be able to identify themselves. This will be required for those application scenarios where vehicle/user specific services will be delivered.
Reference	SP2_REQ_OTH 12

Traffic Management Centre characteristics

Requirement ID	SP2_REQ_OTH_13
Name	TMC able to integrate external data in addition to collaborative xFCD
Description	A Traffic Management Centre should be able to integrate external data in addition to collaborative xFCD. Need for floating traveller & external data aggregated and stored to TMC database. TMC able to aggregate and store floating traveller and external data such as transport infrastructure data: Raw data (coming from legacy road sensors and specific systems) and processed information about the current and forecasted status of the network (accidents, expected congestion, …), traffic control parameters (e.g. SPaT) and demand driving multi-layered policies.

Reference	SP2_REQ_OTH 13

Data format

Requirement ID	SP2_REQ_OTH_14
Name	Data exchange format should take into consideration standard protocols
Description	Data exchange format should take into consideration standard protocols and formats such as, e.g. DATEX II, TPEG, SIRI.
Reference	SP2_REQ_OTH 14

External data sources

Requirement ID	SP2_REQ_OTH_15
Name	Access to external sources of information
Description	External sources of information data needed: Public Safety Answering Points (PSAP), police, fire brigade, municipality services, road operator, historical traffic related data, weather forecast information, road constructions, event timetables (such as stadiums, museums programs or conferences, concerts programs or relevant information such as number of attendees).
Reference	SP2_REQ_OTH 15

Application characteristics

Requirement ID	SP2_REQ_OTH_16
Name	Inter-application interaction needed
Description	Inter-application interaction is needed in terms of data exchange and functionalities integration (overlapping should be minimised and functionalities should be complementary each other).

Reference	SP2_REQ_OTH 16

Requirement ID	SP2_REQ_OTH_17
Name	Guaranteed interoperability and graceful degradation of service if not available
Description	The interoperability should be guaranteed from the basic components, such as communication, positioning and LDM++. In case some required information is not available, the application should be able to perform graceful degradation of service. LDM++ should be integrated with the standard protocols.
Reference	SP2_REQ_OTH 17

Web technologies

Requirement ID	SP2_REQ_OTH_18
Name	Implementation of RESTful interface dedicated web services
Description	RESTful interfaces should be provided in order to facilitate the access to data and services.
Reference	SP2_REQ_OTH 18

Requirement ID	SP2_REQ_OTH_19
Name	Web services for B2B information publication
Description	TEAM should expose dedicated Web services for accessing B2B information.
Reference	SP2_REQ_OTH 19

Data processing

Requirement ID	SP2_REQ_OTH_20
Name	Inference engine for complex data processing
Description	Need for an inference engine / module to perform complex queries, eventually supporting data pre-processing, filtering, aggregation, sensor data fusion.
Reference	SP2_REQ_OTH 20

Requirement ID	SP2_REQ_OTH_21
Name	Real-time large-scale stream processing
Description	TEAM should develop a real-time large-scale stream processing in order to deal with those use cases, where large amounts of data originating from moving vehicles or mobile users should be processed in real-time.
Reference	SP2_REQ_OTH 21

Data Logging

Requirement ID	SP2_REQ_OTH_22
Name	Ability to log application data
Description	Ability to log data (e.g. for the authorities or gaming purposes).
Reference	SP2_REQ_OTH 22

Mobile technologies

Requirement ID	SP2_REQ_OTH_23
Name	Middleware for accessing shared TEAM software modules

Description	EMPOWER core services should be accessed from mobile phones through a middleware platform. This will facilitate the re-use of TEAM software modules (e.g., networking, security and privacy, V2X) and therefore accelerate the software development time.
Reference	SP2_REQ_OTH 23

Requirement ID	SP2_REQ_OTH_24
Name	Mobile operating system support
Description	TEAM mobile applications shall support both iPhone and Android operating systems. This means there shall be 2 versions of each mobile application: one downloadable form the Google Play targeting android-based devices, and one from the Appstore and targeting iOS smartphones.
Reference	SP2_REQ_OTH 24

Synchronisation

Requirement ID	SP2_REQ_OTH_25
Name	Provide synchronised time
Description	A synchronized time is required. This time has to be the same for all used components across the TEAM system and needs to be synchronized on regular intervals. It is recommended that this time is also synchronized with a public time source like NTP servers.
Reference	SP2_REQ_OTH 25

4 Mapping of Requirements to ITS Subsystems

In this Section, the mapping of each EMPOWER requirement to its relevant ITS subsystem(s) is reported. One requirement could be associated to one or more of these subsystems. This Section first summarises the EMPOWER subsystems and their internal components and then lists the requirements per subsystem.

4.1 EMPOWER subsystems description

According to ITS: Communications Architecture standard ETSI EN 302 665 V1.1.1 (2010-09), the following ITS subsystems are identified:

- personal ITS subsystem; in hand-held devices,
- central ITS subsystem; part of an ITS central system,
- vehicle ITS subsystem; in cars, trucks, etc., in motion or parked,
- roadside ITS subsystem; on gantries, poles, etc.,

These subsystems are illustrated in the following picture.

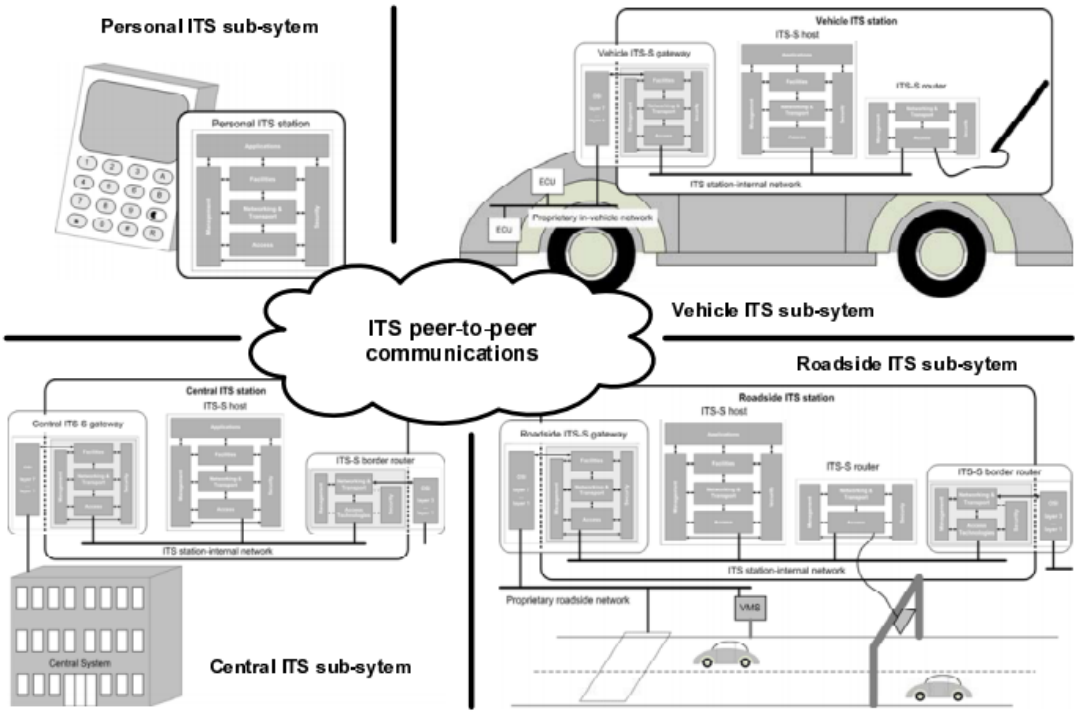

Figure 4-1: Illustration of ITS subsystems (source: ETSI EN 302 665 V1.1.1)

The selection of ETSI ITS Communications Architecture standard was a decision made in an early phase of the project and was already followed in D1.0 (TEAM users, stakeholders and uses cases). TEAM is a large ITS project that shall follow standardisation guidelines and the global communication architecture of this standard covers all the basic aspects of TEAM operation. Moreover, ETSI is recognized by the European Union as a European Standards Organization.

Each of these four ITS subsystems contains an ITS station, dependent on the context, an ITS station typically will contain other functional components presented. The functionality of an ITS station may be implemented in a single physical unit or in several physical units. Furthermore it is possible to structure the functionality, such that it is divided into individually addressable entities within the same physical unit. In both cases the ITS station-internal network is used to interconnect these units/entities, which may be reduced to a node in a single unit.

The requirements defined in Chapter 3 are mapped to the relevant ITS subsystem that their functionalities are reflected to. The collective tables of the mappings per requirement category are given in the following tables. In the next sections the requirement functionalities that should be followed by each ITS subsystem will be described in more detail.

Table 4-1: Mapping of communications requirements to the different subsystems

Requirement ID	Central subsystem	Roadside subsystem	Vehicle subsystem	Personal subsystem	Comment
SP2_REQ_COM_1	✔	✔	✔	✔	General recommendation
SP2_REQ_COM_2	✔	✔	✔	✔	Mandatory
SP2_REQ_COM_3	✔	✔	✔	✔	Mandatory
SP2_REQ_COM_4	✔	✔	✔		Mandatory
SP2_REQ_COM_5			✔	✔	Vehicle and Personal related
SP2_REQ_COM_6	✔	✔	✔	✔	Mandatory
SP2_REQ_COM_7		✔	✔	✔	General recommendation
SP2_REQ_COM_8			✔		Vehicle related
SP2_REQ_COM_9			✔		Mandatory
SP2_REQ_COM_10	✔	✔	✔	✔	General recommendation
SP2_REQ_COM_11		✔	✔	✔	General recommendation

Requirement ID	Central subsystem	Roadside subsystem	Vehicle subsystem	Personal subsystem	Comment
SP2_REQ_COM_12		✔	✔		Vehicle and Roadside related

Table 4-2: Mapping of cloud and LDM++ requirements to the different subsystems

Requirement ID	Central subsystem	Roadside subsystem	Vehicle subsystem	Personal subsystem	Comment
SP2_REQ_LDM_1	✔	✔	✔		Functionality mandatory but content may vary depending on the subsystem
SP2_REQ_LDM_2	✔	✔			Functionality mandatory but content may vary depending on the subsystem
SP2_REQ_LDM_3	✔		✔		Mandatory
SP2_REQ_LDM_4	✔				General recommendation
SP2_REQ_LDM_5	✔				Mandatory
SP2_REQ_LDM_6	✔		✔		Mandatory
SP2_REQ_LDM_7	✔				Mandatory
SP2_REQ_LDM_8	✔				Mandatory
SP2_REQ_LDM_9	✔		✔		Mandatory
SP2_REQ_LDM_10	✔		✔		General recommendation
SP2_REQ_LDM_11	✔		✔		General recommendation
SP2_REQ_LDM_12	✔		✔		General recommendation

Table 4-3: Mapping of cooperative positioning requirements to the different subsystems

Requirement ID	Central subsystem	Roadside subsystem	Vehicle subsystem	Personal subsystem	Comment

Requirement ID	Central subsystem	Roadside subsystem	Vehicle subsystem	Personal subsystem	Comment
SP2_REQ_POS_1	✔	✔	✔		Mandatory
SP2_REQ_POS_2	✔	✔	✔		Mandatory
SP2_REQ_POS_3	✔		✔		Mandatory
SP2_REQ_POS_4			✔		Internal requirement
SP2_REQ_POS_5			✔		Internal requirement
SP2_REQ_POS_6			✔		Internal requirement
SP2_REQ_POS_7	✔		✔		Requirement with LDM++
SP2_REQ_POS_8	✔		✔		Requirement with LDM++
SP2_REQ_POS_9			✔		Requirement with LDM++
SP2_REQ_POS_10	✔		✔		General recommendation
SP2_REQ_POS_11		✔	✔		Roadside related
SP2_REQ_POS_12			✔		Vehicle related
SP2_REQ_POS_13			✔		Vehicle related
SP2_REQ_POS_14		✔	✔		Internal requirement
SP2_REQ_POS_15		✔	✔		Internal requirement
SP2_REQ_POS_16			✔		Internal requirement
SP2_REQ_POS_17		✔	✔		General recommendation
SP2_REQ_POS_18				✔	Personal related
SP2_REQ_POS_19	✔		✔	✔	Requirement with LDM++
SP2_REQ_POS_20			✔		Internal requirement
SP2_REQ_POS_21			✔	✔	Internal requirement

Table 4-4: Mapping of security requirements to the different subsystems

Requirement ID	Central subsystem	Roadside subsystem	Vehicle subsystem	Personal subsystem	Comment[1]
SP2_REQ_SEC_1	✔	✔	✔	✔	General recommendation
SP2_REQ_SEC_2	✔	✔	✔	✔	High-level internal requirements regarding security and privacy of communications
SP2_REQ_SEC_3	✔	✔	✔	✔	
SP2_REQ_SEC_4	✔	✔	✔	✔	
SP2_REQ_SEC_5			✔	✔	
SP2_REQ_SEC_6			✔	✔	
SP2_REQ_SEC_7			✔	✔	Requirement to non-security components
SP2_REQ_SEC_8			✔	✔	Security-internal components/interfaces
SP2_REQ_SEC_9		✔	✔	✔	
SP2_REQ_SEC_10	✔	✔	✔	✔	General recommendation
SP2_REQ_SEC_11	✔				Internal requirements regarding public key infrastructures, a central ITS authority, and security associations
SP2_REQ_SEC_12	✔		✔		
SP2_REQ_SEC_13	✔				
SP2_REQ_SEC_14	✔				
SP2_REQ_SEC_15	✔		✔		
SP2_REQ_SEC_16	✔	✔	✔	✔	General recommendation
SP2_REQ_SEC_17	✔				Requirement to non-security cloud services
SP2_REQ_SEC_18			✔	✔	Internal recommendation
SP2_REQ_SEC_19	✔	✔	✔	✔	Requirements to cloud services and LDM++
SP2_REQ_SEC_20			✔	✔	Mandatory

[1] Recommendations/requirements addressing non-security components are highlighted

Requirement ID	Central subsystem	Roadside subsystem	Vehicle subsystem	Personal subsystem	Comment[1]
SP2_REQ_SEC_21			✔	✔	Mandatory
SP2_REQ_SEC_22	✔		✔	✔	General recommendation
SP2_REQ_SEC_23	✔	✔	✔	✔	Mandatory
SP2_REQ_SEC_24	✔	✔	✔	✔	High-level internal requirements regarding security and privacy of users' personal data
SP2_REQ_SEC_25	✔		✔	✔	Mandatory
SP2_REQ_SEC_26			✔	✔	General recommendation
SP2_REQ_SEC_27	✔	✔	✔	✔	High-level internal requirements regarding security and privacy of users' personal data

Table 4-5: Mapping of other requirements to the different subsystems

Requirement ID	Central subsystem	Roadside subsystem	Vehicle subsystem	Personal subsystem	Comment
SP2_REQ_OTH_1		✔	✔		External data
SP2_REQ_OTH_2		✔	✔	✔	Vehicle related
SP2_REQ_OTH_3		✔		✔	Personal related
SP2_REQ_OTH_4		✔	✔	✔	External data
SP2_REQ_OTH_5	✔	✔			External data
SP2_REQ_OTH_6	✔		✔	✔	External data
SP2_REQ_OTH_7	✔	✔		✔	External data
SP2_REQ_OTH_8	✔		✔	✔	Mandatory

Requirement ID	Central subsystem	Roadside subsystem	Vehicle subsystem	Personal subsystem	Comment
SP2_REQ_OTH_9	✔		✔		Mandatory
SP2_REQ_OTH_10	✔		✔	✔	Mandatory
SP2_REQ_OTH_11	✔				Mandatory
SP2_REQ_OTH_12			✔		Mandatory
SP2_REQ_OTH_13	✔	✔			Roadside related
SP2_REQ_OTH_14	✔	✔	✔	✔	General recommendation
SP2_REQ_OTH_15	✔	✔	✔	✔	External data
SP2_REQ_OTH_16	✔	✔	✔		Application hosting related
SP2_REQ_OTH_17	✔	✔	✔		Application hosting related
SP2_REQ_OTH_18		✔	✔	✔	Application hosting related
SP2_REQ_OTH_19	✔	✔	✔		Application hosting related
SP2_REQ_OTH_20	✔	✔			Data processing
SP2_REQ_OTH_21	✔	✔			Data processing
SP2_REQ_OTH_22	✔	✔	✔	✔	General recommendation
SP2_REQ_OTH_23	✔	✔			Application hosting related
SP2_REQ_OTH_24				✔	Personal related
SP2_REQ_OTH_25	✔	✔	✔		General recommendation

4.2 Central ITS subsystem requirements

In this paragraph the requirements related to the CENTRAL subsystem are listed. The requirements are separated according to their relevance to the four basic technological categories.

Table 4-6: Requirements mapping to CENTRAL ITS subsystem

Requirement category	Requirement(s) ID's relevant to CENTRAL ITS Subsystem
Communication	SP2_REQ_COM_1, SP2_REQ_COM_2, SP2_REQ_COM_3, SP2_REQ_COM_4, SP2_REQ_COM_6, SP2_REQ_COM_10
Automotive Cloud and LDM++	SP2_REQ_LDM_1, SP2_REQ_LDM_2, SP2_REQ_LDM_3, SP2_REQ_LDM_4, SP2_REQ_LDM_5, SP2_REQ_LDM_6, SP2_REQ_LDM_7, SP2_REQ_LDM_8, SP2_REQ_LDM_9, SP2_REQ_LDM_10, SP2_REQ_LDM_11, SP2_REQ_LDM_12
Positioning	SP2_REQ_POS_01, SP2_REQ_POS_02, SP2_REQ_POS_03, SP2_REQ_POS_07, SP2_REQ_POS_08, SP2_REQ_POS_10, SP2_REQ_POS_19
Security, Privacy and Reliability	SP2_REQ_SEC_1, SP2_REQ_SEC_2, SP2_REQ_SEC_3, SP2_REQ_SEC_4, SP2_REQ_SEC_10, SP2_REQ_SEC_11, SP2_REQ_SEC_12, SP2_REQ_SEC_13, SP2_REQ_SEC_14, SP2_REQ_SEC_15, SP2_REQ_SEC_16, SP2_REQ_SEC_17, SP2_REQ_SEC_19, SP2_REQ_SEC_22, SP2_REQ_SEC_23, SP2_REQ_SEC_24, SP2_REQ_SEC_25, SP2_REQ_SEC_27
Other	SP2_REQ_OTH_5, SP2_REQ_OTH_6, SP2_REQ_OTH_7, SP2_REQ_OTH_8, SP2_REQ_OTH_9, SP2_REQ_OTH_10, SP2_REQ_OTH_11, SP2_REQ_OTH_13, SP2_REQ_OTH_14, SP2_REQ_OTH_15, SP2_REQ_OTH_16, SP2_REQ_OTH_17, SP2_REQ_OTH_19, SP2_REQ_OTH_20, SP2_REQ_OTH_21, SP2_REQ_OTH_22, SP2_REQ_OTH_23, SP2_REQ_OTH_25

In the following table, a report (requirement name and short analysis) of the relationship of each assigned requirement with respect to the functionalities of the CENTRAL subsystem is provided.

Table 4-7: Requirements aspects associated to the CENTRAL ITS subsystem

Mapped requirement ID	Requirement aspects affecting CENTRAL ITS Subsystem
SP2_REQ_COM_1	Communication Framework The Central ITS subsystem communication unit shall be compliant with ETSI TC ITS Reference Architecture (ETSI EN 302 665: "Intelligent Transport Systems (ITS); Communication Architecture").
SP2_REQ_COM_2	Information exchange The Central ITS station should support information exchange communicating with vehicle / roadside ITS stations / personal stations using: 802.11 p, LTE, 3G and all the available legacy 3GPP communication systems (long range wireless communication).
SP2_REQ_COM_3	IPv6 protocol support The Central ITS station communication framework shall support the use of IPv6 protocol.
SP2_REQ_COM_4	Geo-Networking protocol support The Central ITS station communication framework shall support Geo-Networking protocols compliant with ETSI TC ITS reference documents.
SP2_REQ_COM_6	CAM / DENM message support. The Central ITS station communication component should be able to communicate with all TEAM applications with ETSI CAM and DENM protocols.

Mapped requirement ID	Requirement aspects affecting CENTRAL ITS Subsystem
SP2_REQ_COM_10	Communication among traffic actors The Central ITS communication subsystem should support reliable, robust and real-time communications among traffic actors (travellers, vehicles, infrastructure), through long-range (3G/4G).
SP2_REQ_LDM_1	Provide static map data Central ITS subsystem servers as part of the TEAM automotive cloud will take over the storage of part of LDM++ data.
SP2_REQ_LDM_2	Provide dynamic data storage and API to add/modify/delete them Central ITS subsystem servers as part of the TEAM automotive cloud will take over the storage of part of LDM++ dynamic data and host software API to provide modification options.
SP2_REQ_LDM_3	Separate layers and API to access them Central ITS subsystem servers should host part of the separate LDM++ layers and data maintenance operations.
SP2_REQ_LDM_4	LDM++ to provide updates with low latency (bandwidth guarantees) Central ITS subsystem communication facilities should support low latency requirements for LDM++ database updates.

Mapped requirement ID	Requirement aspects affecting CENTRAL ITS Subsystem
SP2_REQ_LDM_5	LDM++ to support simultaneous access Central ITS subsystem part of LDM++ database and program should allow for simultaneous access from multiple LDM++ users.
SP2_REQ_LDM_6	LDM++ data synchronisation mechanism Central ITS subsystem should provide and/or respect LDM++ synchronisation mechanism with clients.
SP2_REQ_LDM_7	LDM++ to provide interoperable interface LDM++ interface option should be part of Central ITS subsystem.
SP2_REQ_LDM_8	LDM++ services to be available on the cloud As part of the TEAM automotive cloud, Central subsystem has to host LDM++ functionalities.
SP2_REQ_LDM_9	LDM++ Notification service LDM++ notification component/service or part of it will be hosted in the Central ITS subsystem.
SP2_REQ_LDM_10	LDM++ map matching and geocoding service Central ITS subsystem will host part of LDM++ map matching and geocoding operations.
SP2_REQ_LDM_11	LDM++ routing service Operations or complete hosting of LDM++ routing service will take place in the Central ITS subsystem.

Mapped requirement ID	Requirement aspects affecting CENTRAL ITS Subsystem
SP2_REQ_LDM_12	LDM++ Map display with merged static and dynamic content view LDM++ API should be part of Central ITS subsystem functionalities.
SP2_REQ_POS_01	ITS-G5 communication The Central ITS station shall be able to receive ITS-G5 messages with localisation data sent from communication nodes.
SP2_REQ_POS_02	Localisation data exchange via Cooperative Localisation Message The Central ITS station shall be able to exchange Cooperative Localisation Messages.
SP2_REQ_POS_03	Central ITS station components shall be able to receive and process GPS raw data, included in Cooperative Localisation Messages. This may refer to a dedicated positioning unit of Central subsystem that makes computations for cooperative vehicles locations.
SP2_REQ_POS_07	Provision of relative positioning vector to LDM++ Cooperative position module shall provide relative positioning vector to the LDM++, that is an internal component of the Central ITS station.
SP2_REQ_POS_08	Retrieval of geo-referenced positioning from LDM++ Geo-referenced position is retrieved from LDM++ via Central Subsystem.

Mapped requirement ID	Requirement aspects affecting CENTRAL ITS Subsystem
SP2_REQ_POS_10	Provision of cooperative localisation data to applications and other modules Central subsystem should be able to transfer both geo-referenced and relative positioning data, speed and heading to applications and other modules.
SP2_REQ_POS_19	Retrieval of map-referenced positioning from LDM++ The Central subsystem should allow the Positioning module to retrieve map-referenced positioning from the LDM++.
SP2_REQ_SEC_1	Security Targets This is a root parent requirement that should be followed by the Central ITS subsystem. It should ensure that security, privacy, confidentiality, integrity, authenticity and non-repudiation of incoming and outcoming messages will be maintained. A possible separate security layer or component should be present in the Central subsystem.
SP2_REQ_SEC_2	Security Association between Communication Participants Central ITS subsystem should ensure that for all kinds of communications a security association between all the participants should exist. A component for secure communications should be present in the Central subsystem.

Mapped requirement ID	Requirement aspects affecting CENTRAL ITS Subsystem
SP2_REQ_SEC_3	Offline Operation Security associations and operations should be independent of online access to any other system. This is a requirement that should be met by the security component of Central subsystem, as well.
SP2_REQ_SEC_4	Unique and Anonymous Authorisation Central subsystem as a communication node of TEAM should support unique and anonymous authorisation. This could be a functionality of its security component.
SP2_REQ_SEC_10	Integrity and Authenticity of Floating Car Data Central ITS subsystem should support Integrity and Authenticity of Floating Car Data. Recipients of floating car data shall be able to verify the incoming data. This could be a functionality of its security component.
SP2_REQ_SEC_11	Root of Trust In Central subsystem there shall be a central ITS authority, which impersonates the root of trust. A component for central ITS authority should be present in the Central subsystem.
SP2_REQ_SEC_12	Public Key Infrastructure Central subsystem as a communication node of TEAM should support a public key infrastructure, which establishes security associations between all potential communication participants. This could be a functionality of its security component.

Mapped requirement ID	Requirement aspects affecting CENTRAL ITS Subsystem
SP2_REQ_SEC_13	Issue of Security Associations The ITS authority in Central subsystem issues enrolment and authorisation credentials. This could be a functionality of its security component.
SP2_REQ_SEC_14	Revocation of Security Associations The ITS authority in Central subsystem shall provide mechanisms to revoke security associations. This could be a functionality of its security component.
SP2_REQ_SEC_15	Privileges and Access Rights Security credentials shall contain immutable attributes reflecting access rights or specific privileges, e.g. for public service vehicles. Relevant to mange identities of operators working in the TMC
SP2_REQ_SEC_16	Confidential One-to-one Communications Confidentiality of one-to-one communications is a general requirement, which is applicable to all subsystems. It is in particular relevant to the central subsystem, since there reside backend services that communicate usually through one-to-one channels.
SP2_REQ_SEC_17	Confidentiality of Aggregated Data Huge sets of aggregated data on backend services might allow to link floating car data with different public identifiers to the same mobile node. Aggregating services must not try to deanonymise any data. Generally, gathered data sets are considered to be confidential and must be protected from unauthorized access.

Mapped requirement ID	Requirement aspects affecting CENTRAL ITS Subsystem
SP2_REQ_SEC_19	Integrity and Authenticity of Aggregated Data Before processing incoming or stored floating car data, aggregating backend services shall validate its integrity and authenticity. On the other hand, recipients of aggregated data (or information derived from that data) shall be able to verify the integrity and authenticity of the data and the originating backend service. Relevant to ensure reliability to TEAM collaborative applications.
SP2_REQ_SEC_22	Provide users with data privacy settings modification functionality The central subsystem shall allow users to have the option to determine how their personal data or location is processed. Modifiable users' privacy settings option should be supported.
SP2_REQ_SEC_23	Lawful lifecycle of stored private information Information stored by the TEAM data storage devices should be deleted or anonymized when this data is no longer necessary for the purposes it was originally collected. Moreover, private data should be deleted only if it is allowed by the law. Users must be able to delete private information stored by TEAM, as well.
SP2_REQ_SEC_24	Stored sensitive data should be encrypted The central subsystem should adopt appropriate information security measures to protect Personal Data against unauthorized access, use, modification or loss when stored on the device or other repositories. Sensitive data encryption should be considered.

Mapped requirement ID	Requirement aspects affecting CENTRAL ITS Subsystem
SP2_REQ_SEC_25	Secure user login to TEAM applications The central subsystem should provide the Login facility that will be required to access the TEAM applications. Option to remember the login details shall be available.
SP2_REQ_SEC_27	Safe exchange of personal data with third party applications If it is required, the central subsystem should allow TEAM to send and receive securely transmitted data when a connection with third party applications exists.
SP2_REQ_OTH_5	TEAM should have access to switch traffic lights Central subsystem should have communication to TMC and traffic lights control centre. According to the output of applications certain signals enforcing traffic lights status to a local pilot area should be transmitted from the Central subsystem.
SP2_REQ_OTH_6	Dynamical change requests for the speed limit Central subsystem should have communication to TMC with messages sending the application based calculation of an adaptive speed limit to a certain road. A functionality and interface to TMC should be specified.

Mapped requirement ID	Requirement aspects affecting CENTRAL ITS Subsystem
SP2_REQ_OTH_7	Interface and change requests to public transport operator data Central subsystem should have communication interface to public transport operator. Schedule or route change requests and coordination among buses are transmitted from (or via?) the Central subsystem to the Public transport operator. A functionality and interface to the Public transport operator should be specified.
SP2_REQ_OTH_8	User profile data features Central subsystem should provide a database for user profile data, which is utilised by TEAM applications and other subsystems.
SP2_REQ_OTH_9	Vehicle profile data features Central subsystem should provide a database for vehicle profile data, which is utilised by TEAM applications and other subsystems.
SP2_REQ_OTH_10	User can modify user profile data Central subsystem should provide an interface to the user (and vehicle) profile database so that user can modify their own data.
SP2_REQ_OTH_11	Application can modify user profile data Central subsystem should provide an interface to the user (and vehicle?) profile database so that TEAM applications can modify the data.

Mapped requirement ID	Requirement aspects affecting CENTRAL ITS Subsystem
SP2_REQ_OTH_13	TMC able to integrate external data in addition to collaborative xFCD Traffic Management Centre should be able to integrate external data in addition to collaborative xFCD. Need for floating traveller & external data aggregated and stored to TMC database.
SP2_REQ_OTH_14	Data exchange format should take into consideration standard protocols Data exchange format should take into consideration standard protocols such as DATEX II, TPEG, SIRI.
SP2_REQ_OTH_15	Access to external sources of information External sources of information data needed: Public Safety Answering Points (PSAP), police, fire brigade, municipality services, road operator, historical traffic related data, weather forecast information, road constructions.
SP2_REQ_OTH_16	Inter-application interaction needed Inter-application interaction needed in terms of data exchange and functionalities integration (overlapping should be minimised and functionalities should be complementary each other). This requirements should be mapped to ALL subsystems.
SP2_REQ_OTH_17	Guaranteed interoperability and graceful degradation of service if not available The interoperability should be guaranteed from the basic components, such as communication, positioning and LDM++. Relevant in case of critical issues in the centre.

Mapped requirement ID	Requirement aspects affecting CENTRAL ITS Subsystem
SP2_REQ_OTH_19	Web services for B2B information publication The central subsystem should expose its services/applications for B2B information through a Web service interface
SP2_REQ_OTH_20	Inference engine for complex data processing The central subsystem should include an inference engine / module to perform complex queries, eventually supporting data pre-processing, filtering, aggregation, sensor data fusion.
SP2_REQ_OTH_21	Real-time large-scale stream processing The central subsystem should include a real-time large-scale stream processing in order to deal with those use cases, where large amounts of data originating from moving vehicles or mobile users should be processed in real-time.
SP2_REQ_OTH_22	Ability to log application data The central subsystem should allow the various applications to log data (e.g. for the authorities or gaming purposes).
SP2_REQ_OTH_23	Middleware for accessing shared TEAM software modules EMPOWER core services should be accessed through a middleware platform, to be hosted in the central subsystem. This will facilitate the re-use of TEAM software modules (e.g., networking, security and privacy, V2X) and therefore accelerate the software development time.

Mapped requirement ID	Requirement aspects affecting CENTRAL ITS Subsystem
SP2_REQ_OTH_25	Provide synchronised time All the TEAM system components shall be synchronised with a common time, possibly with a public time source like NTP servers. This synchronisation functionality should be taken over by the Central subsystem.

4.3 Roadside ITS subsystem requirements

In this paragraph the requirements related to the Roadside (ROA) subsystem are listed. The requirements are separated according to their relevance to the four basic technological categories.

Table 4-8: Requirements mapping to ROADSIDE ITS subsystem

Requirement category	Requirement(s) ID's relevant to ROA ITS Subsystem
Communication	SP2_REQ_COM_1, SP2_REQ_COM_2, SP2_REQ_COM_3, SP2_REQ_COM_4, SP2_REQ_COM_6, SP2_REQ_COM_7, SP2_REQ_COM_10, SP2_REQ_COM_11, SP2_REQ_COM_12
Automotive Cloud and LDM++	SP2_REQ_LDM_1, SP2_REQ_LDM_2
Positioning	SP2_REQ_POS_1, SP2_REQ_POS_2, SP2_REQ_POS_11, SP2_REQ_POS_14, SP2_REQ_POS_15, SP2_REQ_POS_17
Security, Privacy and Reliability	SP2_REQ_SEC_1, SP2_REQ_SEC_2, SP2_REQ_SEC_3, SP2_REQ_SEC_4, SP2_REQ_SEC_9, SP2_REQ_SEC_10, SP2_REQ_SEC_16, SP2_REQ_SEC_19, SP2_REQ_SEC_23, SP2_REQ_SEC_24, SP2_REQ_SEC_27

Requirement category	Requirement(s) ID's relevant to ROA ITS Subsystem
Other	SP2_REQ_OTH_1, SP2_REQ_OTH_2, SP2_REQ_OTH_3, SP2_REQ_OTH_4, SP2_REQ_OTH_5, SP2_REQ_OTH_7, SP2_REQ_OTH_13, SP2_REQ_OTH_14, SP2_REQ_OTH_15, SP2_REQ_OTH_16, SP2_REQ_OTH_17, SP2_REQ_OTH_18, SP2_REQ_OTH_19, SP2_REQ_OTH_20, SP2_REQ_OTH_21, SP2_REQ_OTH_22, SP2_REQ_OTH_23, SP2_REQ_OTH_25

In the following table, a report (requirement name and short analysis) of the relationship of each assigned requirement with respect to the functionalities of the ROADSIDE (ROA) subsystem is provided.

Table 4-9: Requirements aspects associated to the ROADSIDE ITS subsystem

Mapped requirement ID	Requirement aspects affecting ITS Subsystem ROA
SP2_REQ_COM_1	Communication Framework ROA will fully support TEAM communication framework and its associated ITS and communication standards since it behaves as general-purpose access point to the TEAM infrastructure
SP2_REQ_COM_2	Information exchange ROA will provide information exchange between all traffic participants and the cloud infrastructure and it will therefore support short and long-range communications.
SP2_REQ_COM_3	IPv6 protocol support ROA will support future-oriented protocols and technologies employing IPv6

Mapped requirement ID	Requirement aspects affecting ITS Subsystem ROA
SP2_REQ_COM_4	Geo-Networking protocol support ROA will provide Geo-Networking-based V2V short-range communications.
SP2_REQ_COM_6	CAM / DENM message support ROA will support standard messaging protocols like e.g. CAM and DENM. Extensions to these protocols to cover further TEAM functionality are foreseen.
SP2_REQ_COM_7	Internet availability ROA will need access to the Internet to provide on-demand services, to route data over WANs (e.g. emails, alerts, traffic updates to other services, c etc.) and to grant access for remote maintenance.
SP2_REQ_COM_10	Comm. among traffic actors ROA will provide the physical infrastructure to guarantee bandwidth and reliability requirements to the applications.
SP2_REQ_COM_11	Real-time communication requirements ROA hardware architecture will comply with real-time requirements as demanded by TMCs and all traffic actors depending on it.
SP2_REQ_COM_12	V2I engaging distance ROA will have enough resources to provide the minimum necessary engaging distance to different traffic actors that comply with safety regulations.

Mapped requirement ID	Requirement aspects affecting ITS Subsystem ROA
SP2_REQ_LDM_1	LDM++ to provide static map data ROA needs access to LDM++ road map data for delivery to clients
SP2_REQ_LDM_2	LDM++ to provide dynamic data storage and API to add/modify/delete them ROA will need to modify LDM++ layer content upon information from end-user and client applications
SP2_REQ_POS_1	ITS-G5 communication ROA will support the exchange of localization information among vehicles
SP2_REQ_POS_2	Localisation data exchange via Cooperative Localisation Message ROA will support localization information exchange via CAM facility
SP2_REQ_POS_11	Computation of relative position to Road Side Units ROA will support the computation of relative positioning by providing raw GPS positioning data to vehicles and other TEAM traffic actors
SP2_REQ_POS_14	Receive GPS raw data from GPS receiver ROA will support relative positioning by retrieving raw GPS positioning data from its GPS receiver
SP2_REQ_POS_15	Receive processed GPS data from GPS receiver ROA will support the evaluation of relative positioning by receiving processed GPS positioning data from its GPS receiver

Mapped requirement ID	Requirement aspects affecting ITS Subsystem ROA
SP2_REQ_POS_17	Refresh rate ROA will support high refresh rates by the computation of geo-positions (1 Hz) → requirement on data exchange density and data throughput
SP2_REQ_SEC_1	Security Targets. Peer-to-peer communication occurs between all subsystems, thus each subsystem including ROA must take into account secure targets. Implementation: application, user, service, interface
SP2_REQ_SEC_2	Security Association between Communication Participants. Peer-to-peer communication occurs between all subsystems, thus each subsystem including ROA must take into account secure targets. Implementation: application, user, service, interface
SP2_REQ_SEC_3	Offline Operation This high-level requirement to communication security demands security mechanism not to rely on permanent online access to backend services. It is relevant to all subsystems.
SP2_REQ_SEC_4	Unique and Anonymous Authorisation This high-level requirement to communication security is relevant to all subsystems. It allows nodes and their components to authorize themselves either by unique identification or anonymously without revealing their identity

Mapped requirement ID	Requirement aspects affecting ITS Subsystem ROA
SP2_REQ_SEC_9	Management of Node Identifiers. Management is performed in CENTRAL subsystem. ROA subsystem uses the manager to get an id and to provide the id by managers request. Implementation: interfaces, usage
SP2_REQ_SEC_10	Integrity and Authenticity of Floating Car Data. All subsystems can receive the floating car data. Thus all must verify its integrity and authenticity. ROA subsystem must take care in proving the integrity and authenticity of floating car data before it is output.
SP2_REQ_SEC_16	Confidential One-to-one Communications. Confidentiality in 1 to 1 communication must be provided in all subsystems, including the ROA subsystem.
SP2_REQ_SEC_19	Integrity and Authenticity of Aggregated Data. According to requirements definition the backend services must take care about integrity and authenticity of aggregated data. The recipients of this data must also be able to check these issues. Thus this task must be implemented by all subsystems, taking into account their specifics
SP2_REQ_SEC_23	Lawful lifecycle of stored private information. Since the ROA might manage personal data, it must be able to delete data as dictated by the lawful lifecycle.

Mapped requirement ID	Requirement aspects affecting ITS Subsystem ROA
SP2_REQ_SEC_24	Stored sensitive data should be encrypted. According to definition personal data stored on devices or other repositories (ROA, CENTRAL subsystems) must be encrypted and protected.
SP2_REQ_SEC_27	Safe exchange of personal data with third party applications ROA must provide the necessary facilities to guarantee the safety exchange of its clients with the CENTRAL subsystem and other applications employing the TEAM infrastructure.
SP2_REQ_OTH_1	Interface to parking slots information ROA will support an interface for current information on parking slots availability
SP2_REQ_OTH_3	Travellers mobile devices should allow MAC address based tracking ROA will support user's MAC address tracking
SP2_REQ_OTH_4	Traffic lights information should be transmitted to the vehicle ROA will transmit traffic light info to vehicles (SPaT)
SP2_REQ_OTH_5	TEAM should have access to switch traffic lights ROA will provide access point to traffic light switching mechanisms (fulfilling all safety and security regulations as imposed by regulatory entities)

Mapped requirement ID	Requirement aspects affecting ITS Subsystem ROA
SP2_REQ_OTH_7	Interface and change requests to public transport operator data ROA will support access to public transport operator data
SP2_REQ_OTH_13	TMC able to integrate external data in addition to collaborative xFCD ROA will support integration of external data by TMC
SP2_REQ_OTH_14	Data exchange format should take into consideration standard protocols ROA to support standard data exchange formats (DATEX II, TPEG, SIRI, etc.)
SP2_REQ_OTH_15	Access to external sources of information ROA to support access to external sources of information
SP2_REQ_OTH_16	Inter-application interaction needed ROA will make use of TEAM inter-application interaction mechanisms (e.g. TEAM Messaging Protocol)
SP2_REQ_OTH_17	Guaranteed interoperability and graceful degradation of service if not available ROA to provide all services with graceful degradation characteristic or mechanisms to provide similar functionality by an alternative service
SP2_REQ_OTH_18	Implementation of RESTful interface dedicated web services ROA to support RESTful interface

Mapped requirement ID	Requirement aspects affecting ITS Subsystem ROA
SP2_REQ_OTH_19	Web services for B2B information publication ROA to support web services for B2B information publication
SP2_REQ_OTH_20	Inference engine for complex data processing ROA to provide additional inference engine and computation capabilities for data processing and analytics
SP2_REQ_OTH_21	Real-time large-scale stream processing ROA to support real-time large-scale stream processing, maybe as a first pre-processing / filtering stage
SP2_REQ_OTH_22	Ability to log application data ROA to support data logging after proper standards in order to have legal relevance
SP2_REQ_OTH_23	Middleware for accessing shared TEAM software modules ROA to support middleware for TEAM infrastructure re-usability
SP2_REQ_OTH_25	Provide synchronised time ROA to deliver synchronized time to end-user devices (distribution point)

In the next ROADSIDE ITS subsystem requirements are analysed in order to extract whether certain equipments essentials are needed for them to achieve. This kind of analysis is valid for ROA and VEHICLE only, as these two stations could include particular equipments such as sensors or other components.

ROA Equipment-related essentials

- ROA to support connection to variety of physical sensors (ITS, environmental, etc.) through a number of standard interfaces (CAN, I2C, RS232, etc.)
- ROA to support alternative energy power supplies, e.g. regenerative energies in the form of solar panels, etc. To this end adequate electronic should be included in the unit.
- ROA to support future hardware through a flexible system architecture.
- ROA to support secure and robust remote access and maintainability.
- ROA to impose minimal adaptation requirements on existing hardware, i.e. installed basis.
- ROA to support flexible connection of antennas and external devices, like sensors, through standard connectors and interfaces.
- ROA to support wire-line (e.g. Ethernet) and wire-less connections to the cloud.

4.4 Vehicle ITS subsystem requirements

In this paragraph the requirements related to the VEHICLE subsystem are reported. The requirements are separated according to their relevance to the four basic technological categories.

Table 4-10: Requirements mapping to VEHICLE ITS subsystem

Requirement category	Requirement(s) ID's relevant to VEHICLE ITS Subsystem
Communication	SP2_REQ_COM_1, SP2_REQ_COM_2, SP2_REQ_COM_3, SP2_REQ_COM_4, SP2_REQ_COM_5, SP2_REQ_COM_6, SP2_REQ_COM_7, SP2_REQ_COM_8, SP2_REQ_COM_9, SP2_REQ_COM_10, SP2_REQ_COM_11, SP2_REQ_COM_12

Requirement category	Requirement(s) ID's relevant to VEHICLE ITS Subsystem
Automotive Cloud and LDM++	**LDM++ content and structure** SP2_REQ_LDM_1, SP2_REQ_LDM_3 **LDM++ Data Input/Output** SP2_REQ_LDM_6, SP2_REQ_LDM_9 **LDM++ Location based services** SP2_REQ_LDM_10, SP2_REQ_LDM_11, SP2_REQ_LDM_12
Positioning	SP2_REQ_POS_01, SP2_REQ_POS_02, SP2_REQ_POS_03, SP2_REQ_POS_04, SP2_REQ_POS_05, SP2_REQ_POS_06, SP2_REQ_POS_07, SP2_REQ_POS_08, SP2_REQ_POS_09, SP2_REQ_POS_10, SP2_REQ_POS_11, SP2_REQ_POS_12, SP2_REQ_POS_13, SP2_REQ_POS_14, SP2_REQ_POS_15, SP2_REQ_POS_16, SP2_REQ_POS_17, SP2_REQ_POS_19, SP2_REQ_POS_20, SP2_REQ_POS_21

Requirement category	Requirement(s) ID's relevant to VEHICLE ITS Subsystem
Security, Privacy and Reliability	Level0: SP2_REQ_SEC_1, SP2_REQ_SEC_20, SP2_REQ_SEC_21, SP2_REQ_SEC_22, SP2_REQ_SEC_23, SP2_REQ_SEC_24, SP2_REQ_SEC_26, SP2_REQ_SEC_25, SP2_REQ_SEC_27 Level1: SP2_REQ_SEC_2 Level2: SP2_REQ_SEC_3, SP2_REQ_SEC_4, SP2_REQ_SEC_5, SP2_REQ_SEC_10, SP2_REQ_SEC_16 Level3: SP2_REQ_SEC_6, SP2_REQ_SEC_18, SP2_REQ_SEC_19 Level4: SP2_REQ_SEC_7, SP2_REQ_SEC_8, SP2_REQ_SEC_12, SP2_REQ_SEC_15 Level5: SP2_REQ_SEC_9
Other	SP2_REQ_OTH_1, SP2_REQ_OTH_2, SP2_REQ_OTH_4, SP2_REQ_OTH_6, SP2_REQ_OTH_8, SP2_REQ_OTH_9, SP2_REQ_OTH_10, SP2_REQ_OTH_12, SP2_REQ_OTH_14, SP2_REQ_OTH_15, SP2_REQ_OTH_16, SP2_REQ_OTH_17, SP2_REQ_OTH_18, SP2_REQ_OTH_19, SP2_REQ_OTH_22, SP2_REQ_OTH_25

In the following table, a report (requirement name and short analysis) of the relationship of each assigned requirement with respect to the functionalities of the VEHICLE subsystem is provided.

Table 4-11: Requirements aspects associated to the VEHICLE ITS subsystem

Mapped requirement ID	Requirement aspects affecting ITS Subsystem VEHICLE
SP2_REQ_COM_1	Communication Framework. Communication framework affects all subsystems, inclusive vehicle
SP2_REQ_COM_2	Information exchange. According to definition, information exchange between different ITS stations including those in vehicles must be implemented
SP2_REQ_COM_3	IPv6 protocol support. EMPOWER framework should support IPv6 protocol, thus all its subsystems (vehicles too) should also support this protocol.
SP2_REQ_COM_4	Geo-Networking protocol support. According to definition each subsystem of EMPOWER framework should support geo-networking compliant with ETSI TC ITS reference documents
SP2_REQ_COM_5	GSMA-compliant tethering solutions. According to definition – tethering should take place only between two subsystems: personal and vehicle, thus both subsystems must implement tethering solutions.
SP2_REQ_COM_6	CAM / DENM message support. All TEAM application on different subsystems should use ETSI CAM and DENM protocols. Vehicle subsystem is not an exception.
SP2_REQ_COM_7	Internet availability. Applications are used by vehicle, personal and roadside subsystems.

Mapped requirement ID	Requirement aspects affecting ITS Subsystem VEHICLE
SP2_REQ_COM_8	Smartphone-CAN bridge. Vehicles provide access to its data to central subsystem.
SP2_REQ_COM_9	Reliable comm. bandwidth. Vehicles use communication bandwidth for SG apps
SP2_REQ_COM_10	Comm. among traffic actors. All traffic actors are participating in real-time communications, thus use EMPOWER comm. framework
SP2_REQ_COM_11	Real-time communication requirements. Vehicles participate in communication, which takes place in real-time. Thus vehicle subsystem should take care about communication in real time (hardware, software)
SP2_REQ_COM_12	V2I engaging distance. According to the definition communication takes place between vehicles and road infrastructure. Thus vehicle and roadside subsystem should implement this task
SP2_REQ_LDM_1	Provide static map data Vehicles should be able to use this static map data (application)
SP2_REQ_LDM_3	Separate layers and API to access them Vehicles should be able to use this separate layers. There should be hardware and software possibilities implemented in vehicles to present this information.
SP2_REQ_LDM_6	LDM++ synchronisation mechanism Vehicle should be able to synchronize with LDM++

Mapped requirement ID	Requirement aspects affecting ITS Subsystem VEHICLE
SP2_REQ_LDM_9	LDM++ Notification service Vehicles should be able to listen for notifications and react to them
SP2_REQ_LDM_10	LDM++ map matching and geocoding service Vehicles should use this services and accept information according to geocoding service
SP2_REQ_LDM_11	LDM++ routing service Vehicle should be able to use the routing service for autonomous driving
SP2_REQ_LDM_12	LDM++ Map display with merged static and dynamic content view Hardware and software facilities to visualize maps and content view
SP2_REQ_POS_1	ITS-G5 communication Vehicles are the entities to be localized. Thus they are the nodes, which should support ITS-G5 protocol
SP2_REQ_POS_2	Localization data exchange via Cooperative Localization Message Vehicles are the entities to be localized. Thus they are the nodes, which should support cooperative localization message
SP2_REQ_POS_3	GPS raw data in CLM Vehicles are the entities to be localized. Thus they should support GPS raw data in CLM
SP2_REQ_POS_4	Position accuracy evaluation mode available Vehicles should be able to provide data at different level of accuracy

Mapped requirement ID	Requirement aspects affecting ITS Subsystem VEHICLE
SP2_REQ_POS_5	Data from target and reference system inside CLM in evaluation mode Vehicles should include these data in evaluation node
SP2_REQ_POS_6	Infering of relative positioning vector Vehicles should be able to infer relative positioning vector
SP2_REQ_POS_7	Provision of relative positioning vector to LDM++ Vehicles should be able to understand relative positioning vector to LDM++
SP2_REQ_POS_8	Retrieval of geo-referenced positioning from LDM++ Vehicles should understand geo-referenced data
SP2_REQ_POS_9	Lane-level accuracy of map-referenced positioning Vehicles should use this accurate information
SP2_REQ_POS_10	Provision of cooperative localisation data to applications and other modules Vehicles should be able to provide geo-referenced data and understand relative pos data, speed
SP2_REQ_POS_11	Computation of relative position to Road Side Unit Vehicles should be able to use information about relative position to themselves and gps pos data
SP2_REQ_POS_12	Computation of relative position to vehicles Vehicles should be able to compute this relative position from nearby vehicles

Mapped requirement ID	Requirement aspects affecting ITS Subsystem VEHICLE
SP2_REQ_POS_13	Park positioning mode available Vehicles are using this feature – they should be able to run pos system after the key is off
SP2_REQ_POS_14	Receive GPS raw data from GPS receiver Vehicles must be able to receive raw data
SP2_REQ_POS_15	Receive processed GPS data from GPS receiver Vehicles must be able to receive processed data
SP2_REQ_POS_16	Accuracy information Vehicles should be able to provide information about position accuracy
SP2_REQ_POS_17	Refresh rate Vehicle positioning system should be able to refresh the data at real-time.
SP2_REQ_POS_19	Retrieval of map-referenced positioning from LDM++ Vehicles positioning system should be able to retrieve map-ref position from the LDM++
SP2_REQ_POS_20	Processed GPS data in CLM Vehicles positioning system should be able to calculate relative pos vector using processed gps data.
SP2_REQ_POS_21	Level of confidence Vehicle should provide the information about the level of confidence of pos data retrieval.

Mapped requirement ID	Requirement aspects affecting ITS Subsystem VEHICLE
SP2_REQ_SEC_1	Security Targets. Peer-to-peer communication occurs between all subsystems, thus each subsystem including VEHICLE must take into account secure targets. Implementation: application, user, service, interface
SP2_REQ_SEC_2	Security Association between Communication Participants. Peer-to-peer communication occurs between all subsystems, thus each subsystem including VEHICLE must take into account secure targets. Implementation: application, user, service, interface
SP2_REQ_SEC_3	Offline Operation. All ITS-subsystems could perform offline security association and related security operations (specific for this subsystem). Implementation: application (local host)
SP2_REQ_SEC_4	Unique and Anonymous Authorisation. Single vehicles need to receive unique and anonymous access (user). Implementation: application
SP2_REQ_SEC_5	Privacy of Mobile Nodes. As the name of requirement states, it must be provided for mobile nodes. Thus members of VEHICLE subsystem must be able to publish floating car data in an anonymous or pseudonymous way.
SP2_REQ_SEC_6	Joint Identifier Change. This requirement is a child of 5, which is to be fulfilled by mobile nodes. Thus as it follows also from the description of this requirement it must be implemented in VEHICLE subsystem.

Mapped requirement ID	Requirement aspects affecting ITS Subsystem VEHICLE
SP2_REQ_SEC_7	Variable Public Identifiers. Further refinement of requirement 5 and now 6. Variable public identifier can be used for mobile nodes, thus is to be implemented in VEHICLE subsystem.
SP2_REQ_SEC_8	Freeze of Node Identifier. A sibling of requirement 7 (child of 6 and grandchild of 5). If VEHICLE subsystem can change the id (req6), it must be also able to freeze it.
SP2_REQ_SEC_9	Management of Node Identifiers. Management is performed in CENTRAL subsystem. VEHICLE subsystem uses the manager to get an id and to provide the id by managers request. Implementation: interfaces, usage
SP2_REQ_SEC_10	Integrity and Authenticity of Floating Car Data. All subsystems can receive the floating car data. Thus all must verify its integrity and authenticity. VEHICLE subsystem must take care in proving the integrity and authenticity of floating car data before it is output.
SP2_REQ_SEC_12	Public Key Infrastructure. Each subsystem must be able to participate in public key infrastructure to provide security association for communication partners. VEHICLE subsystem is no exception.
SP2_REQ_SEC_15	Privileges and Access Rights. All ITS-subsystems including VEHICLE subsystem must be able to function according their privileges and access rights.

Mapped requirement ID	Requirement aspects affecting ITS Subsystem VEHICLE
SP2_REQ_SEC_16	Confidential One-to-one Communications. Confidentiality in 1 to 1 communication must be provided in all subsystems, in VEHICLE subsystem too.
SP2_REQ_SEC_18	Further Anonymisation of Floating Car Data. By definition floating car data is produced by mobile nodes: vehicles and persons, thus they should implement further anonymisation of this data. VEHICLE subsystem must take care about its part.
SP2_REQ_SEC_19	Integrity and Authenticity of Aggregated Data. According to requirements definition the backend services must take care about integrity and authenticity of aggregated data. The recipients of this data must also be able to check these issues. Thus this task must be implemented by all subsystems, taking into account their specifics
SP2_REQ_SEC_20	Compliance with EU Directive 96/46/EC4. All subsystems must comply with applicable laws governing the processing of personal data. VEHICLE data is not an exclusion
SP2_REQ_SEC_21	Provide users with a clear and understandable privacy policy notice. As the user must be able to read the policy note and take a decision to use the application or not, VEHICLE subsystem must implement necessary application side.
SP2_REQ_SEC_22	Provide users with data privacy settings modification functionality. According to definitions the users (mobile nodes: personal and vehicle subsystem) must be able to select the privacy settings. VEHICLE subsystem must be capable of performing this modification (application).

Mapped requirement ID	Requirement aspects affecting ITS Subsystem VEHICLE
SP2_REQ_SEC_23	Lawful lifecycle of stored private information. According to definition the users (VEHICLE and personal subsystem) must be able to delete their data.
SP2_REQ_SEC_24	Stored sensitive data should be encrypted. According to definition personal data stored on device (vehicle, personal subsystems) or other repository (roadside, central subsystems) must be encrypted and protected. VEHICLE subsystem must take care about the sensitive data stored on its devices.
SP2_REQ_SEC_25	Secure user login to TEAM applications TEAM platform with this requirement ensures that only registered users have access to its services.
SP2_REQ_SEC_26	Installation of authorized TEAM applications. Wherever the application on VEHICLE subsystem device should be installed, its installation must be authorized.
SP2_REQ_SEC_27	Safe exchange of personal data with third party applications This requirement is responsible for the secure transmission of users' personal data between TEAM and third party applications.
SP2_REQ_OTH_1	Interface to parking slots information This requirement is about communication between smartphones and vehicles. VEHICLE subsystem must provide interfaces to smartphone to access vehicles data.
SP2_REQ_OTH_2	Collaborative vehicles xFCD interface adapter According to the definition of this requirement – this is a vehicle-specific adapter, thus must be implemented in VEHICLE subsystem

Mapped requirement ID	Requirement aspects affecting ITS Subsystem VEHICLE
SP2_REQ_OTH_4	Traffic lights information should be transmitted to the vehicle. VEHICLE subsystem should enable the vehicles to receive and use the traffic lights data
SP2_REQ_OTH_6	Dynamical change requests for the speed limit. Vehicles must immediately get an update about the actual speed limit
SP2_REQ_OTH_8	User profile data features. VEHICLE subsystem must be able to read and interpret related user data information: home, work (as address), adapt to environmental criteria, etc.
SP2_REQ_OTH_9	Vehicle profile data features. Profile information about the vehicle must be accumulated by VEHICLE subsystem. An idea for cars, buses, trucks, motorcycles: include some kind of constant memory card, where this information is stored and can be easily accessed by request.
SP2_REQ_OTH_10	User can modify user profile data. VEHICLES must be able to read and interpret changes in related user data.
SP2_REQ_OTH_12	Vehicle should be able to identify themselves. VEHICLE subsystem should provide the mechanism for vehicles to identify themselves.

Mapped requirement ID	Requirement aspects affecting ITS Subsystem VEHICLE
SP2_REQ_OTH_14	Data exchange format should take into consideration standard protocols All subsystems use this data exchange format, thus it must be implemented in all of them, also in VEHICLE subsystem
SP2_REQ_OTH_15	Access to external sources of information. This access could be useful if the drivers would also get this info – e.g. that the road is closed because of ice (weather forecast), or that emergency car needs a place between the lanes. Thus VEHICLE subsystem could also implement this access
SP2_REQ_OTH_16	Inter-application interaction needed. Each subsystem deals with applications. Thus inter-application interaction is necessary for all subsystems, also for VEHICLE
SP2_REQ_OTH_17	Guaranteed interoperability and graceful degradation of service if not available. VEHICLE subsystem could also request a service from CENTRAL subsystem. Thus mechanisms to request the service and to deal with the result must be implemented.
SP2_REQ_OTH_18	Implementation of RESTful interface dedicated web services. Users (vehicles and persons) must understand RESTful interfaces and be able to access the data through it. VEHICLE subsystem must implement these interfaces for vehicles.
SP2_REQ_OTH_19	Web services for B2B information publication. Users and thus VEHICLE subsystem should be able to use Web services to access B2B information

Mapped requirement ID	Requirement aspects affecting ITS Subsystem VEHICLE
SP2_REQ_OTH_22	Ability to log application data. Each subsystem must be able to log its own data, VEHICLE subsystem too.
SP2_REQ_OTH_25	Provide synchronised time. According to description this task is to be implemented for all components and thus subsystems across TEAM.

In the next VEHICLE ITS subsystem requirements are analysed in order to extract whether certain equipments essentials are needed for them to achieve. This kind of analysis is valid for ROA and VEHICLE only, as these two station could include particular equipments such as sensors or other components.

Equipment essentials for VEHICLE ITS subsystem coming from FLEX

From Section 3.1 Collaborative pro-active urban/inter-urban monitoring and ad-hoc control

Communication component

SP3_REQ_CMC_02_v0.1 Communication

To ensure that the vehicles and infrastructure can communicate with each other effectively

SP3_REQ_CMC_05_v0.1 Interoperability and reliability

To guarantee that the application can work reliably in different locations.

Privacy component

SP3_REQ_CMC_04_v0.1 Privacy

To ensure that exchanged data cannot be linked to any individual.

From Section 3.2 Collaborative co-modal route planning

Communication component

SP3_REQ_COPLAN_04_v0.1 Communication Facility at Lower Layers

To ensure that the end users (user terminals, vehicles, sensors/machines etc) can communicate with each other and with the infrastructure effectively

From Section 3.3 Co-modal coaching with support from virtual/avatar users

Positioning component

SP3_REQ_CCA_1_v0.1 Position accuracy

To ensure that accurate positioning info is available in real time for the coached users

From Section 3.4 Collaborative smart intersection for intelligent priorities

Communication component

SP3_REQ_CSI_03_v0.1 Communication

To ensure that the vehicles and intersections can communicate with each other effectively

SP3_REQ_CSI_05_v0.1 Interoperability and reliability

To guarantee that the application can work reliably in different locations.

SP3_REQ_CSI_07_v0.1 Vehicle data provider

An interface providing access to vehicle sensor data for in-vehicle applications

SP3_REQ_CSI_11_v0.1 Support for ITS-G5

To provide support for ITS-G5. The OBU must be able to support ITS-G5

SP3_REQ_CSI_12_v0.1 Functionality for CAM broadcast

To provide functionality to the OBU for broadcasting CAM messages.

SP3_REQ_CSI_13_v0.1 Positioning with lane level accuracy

To be able to determine the current position with lane level accuracy

The OBU must be able to determine its position with accuracy at lane level.

Application component

SP3_REQ_CSI_14_v0.1 Time reference

All parts of the system bases on the same time.

SP3_REQ_CSI_16_v0.1 CAM protocol

The request information is available from the information received from the vehicles.

SP3_REQ_CSI_18_v0.1 Central side protocol

communication with central side management system is possible

Security component

SP3_REQ_CSI_19_v0.1 Handle fall back

To provide a mechanism to handle fall back on error conditions.

The vehicle must be able to temporarily fall back to a manual non-TEAM mode

From Section 3.5 Collaborative public transport optimization

Positioning component

SP3_REQ_CPTO_03_v0.1 Positioning accuracy

To ensure that the position of the buses and the travelers will be available in the required accuracy

Communication component

SP3_REQ_CPTO_05_v0.1 Communication system

To ensure that all the actors are communicating in a seamless and reliable way

From Section 3.6 Community building

Positioning component

SP3_REQ_CB_04_v0.1 Positioning accuracy

To ensure that the position of the vehicles and of other transportation means (e.g., buses and trains) will be available in the required accuracy

Communication component

SP3_REQ_CB_06_v0.1 Communication system

To ensure that all the actors are communicating in a reliable way

From Section 3.7 Dynamic collaborative corridors

Comm. component

SP3_REQ_DC_03_v0.1 Communication

To ensure that the vehicles and infrastructure can communicate with each other effectively

SP3_REQ_DC_05_v0.1 Interoperability and reliability

To guarantee that the application can work reliably in different locations.

SP3_REQ_DC_07_v0.1 Vehicle data provider

To have all vehicle information needed for the application

SP3_REQ_DC_11_v0.1 Time-stamped vehicle data

To ensure that the all the vehicle/infrastructure signals can be evaluated in a time perspective

Equipment essentials for VEHICLE ITS subsystem coming from DIALOGUE

From Section 3.1 Collaborative ACC (DCAITI)

Communication component

SP4_REQ_CACC_V2XBRIDGEACC_v0.1 V2X – In Vehicle Network Bridge - ACC

Communication with the Vehicle - Adapt the ACC speed of the vehicle according to the relevant goals of the CACC application.

SP4_REQ_CACC_V2XBRIDGEACCDEC_v0.1 V2X – In Vehicle Network Bridge – Speed, braking, emergency braking

Communication with the Vehicle - Adapt the speed and braking value and activate emergency braking.

SP4_REQ_CACC_COMMSYSV2X_v0.1 V2X Communication system

To ensure that all the vehicles are communicating in a reliable way

From Section 3.2 Collaborative Parking (CRF)

Communication component

SP4_REQ_EFP_VEHPOSAV_v0.1 Vehicle position availability

To ensure that vehicle position is known to EFP whenever required

SP4_REQ_EFP_COMMUNICATION_v0.1 Communication for EFP

To ensure that the communication system enables EFP

Application component

SP4_REQ_EFP_LOCACCURACY_v0.1 Localization accuracy

To enable parking indications with different level of accuracy

SP4_REQ_EFP_ GRAPHIND_v0.1 Parking indication type 3: graphic indication

To obtain indications on a graphic user interface, e.g. a map picture and a set of indications (e.g. like browsing on google map)

SP4_REQ_EFP_COLLABPARK_v0.1 Collaborative parking state notification by user

To know and inform that a vehicle is parking/leaving at given moment in a given area, from the reception of an user notification.

SP4_REQ_EFP_VEHUSERDATA_v0.1 Vehicle and user data

To provide EFP with useful data to optimize and tailor service provision

From Section 3.3 Collaborative Driving and Merging (Volvo)

Communication component

SP4_CDM_R_00003 Geo-broadcast a message in a region

Communicate message to nearby vehicle in a geographical area => vehicles should be able to receive it

SP4_CDM_R_00010 Broadcast current status and speed (between the vehicles)

SP4_CDM_R_00025 Accurate Position, speed, direction and breaking situation of the vehicle

provide accurate position, speed, direction of the vehicle

Application components

SP4_CDM_R_00005 Distance to roundabouts, highway entrance/exit

Distance to approaching roundabouts, highway entrance/exit for supporting the computation of maneuvers

From Section 3.4 Collaborative eco-friendly navigation (Fokus)

Application component

SP4_REQ_CONAV_SP2_01 Provide (synchronized) time

Receive a system wide synchronized time

Comm. component

SP4_REQ_CONAV_SP2_03 Provide vehicle information (motor, emission class)

Receive input data about vehicle characteristics automatically

From Section 3.5 Green, safe and collaborative driving serious game and community building (UniGe)

Application component

SP4_REQ_SGCB_LDMUI_v0.1 Map's graphic user interface

The Nokia map should provide the basis for the interface of the collaborative map

Communication component

SP4_REQ_SGCB_POSACC_v0.1 Positioning accuracy

To ensure that the position of the vehicles and of other transportation means (e.g., buses and trains) will be available in the required accuracy

SP4_REQ_SGCB_COMMSYS_v0.1

Communication system

To ensure that all the actors are communicating in a reliable way

4.5 Personal ITS subsystem requirements

In this paragraph the requirements related to the Personal ITS subsystem are reported. The requirements are separated according to their relevance to the four basic technological categories.

Table 4-12: Requirements mapping to PERSONAL ITS subsystem

Requirement category	Requirement(s) ID's relevant to Personal ITS Subsystem
Communication	SP2_REQ_COM_1, SP2_REQ_COM_2, SP2_REQ_COM_3, SP2_REQ_COM_5, SP2_REQ_COM_6, SP2_REQ_COM_7, SP2_REQ_COM_8, SP2_REQ_COM_9, SP2_REQ_COM_10, SP2_REQ_COM_11
Automotive Cloud and LDM++	SP2_REQ_LDM_1, SP2_REQ_LDM_2, SP2_REQ_LDM_3, SP2_REQ_LDM_6, SP2_REQ_LDM_8, SP2_REQ_LDM_9, SP2_REQ_LDM_10, SP2_REQ_LDM_11, SP2_REQ_LDM_12
Positioning	SP2_REQ_POS_18, SP2_REQ_POS_19, SP2_REQ_POS_21
Security, Privacy and Reliability	SP2_REQ_SEC_1, SP2_REQ_SEC_2, SP2_REQ_SEC_3, SP2_REQ_SEC_4, SP2_REQ_SEC_5, SP2_REQ_SEC_6, SP2_REQ_SEC_7, SP2_REQ_SEC_8, SP2_REQ_SEC_9, SP2_REQ_SEC_10, SP2_REQ_SEC_16, SP2_REQ_SEC_18, SP2_REQ_SEC_19, SP2_REQ_SEC_20, SP2_REQ_SEC_21, SP2_REQ_SEC_22, SP2_REQ_SEC_23, SP2_REQ_SEC_24, SP2_REQ_SEC_25, SP2_REQ_SEC_26, SP2_REQ_SEC_27
Other	SP2_REQ_OTH_2, SP2_REQ_OTH_3, SP2_REQ_OTH_4, SP2_REQ_OTH_6, SP2_REQ_OTH_7, SP2_REQ_OTH_8, SP2_REQ_OTH_10, SP2_REQ_OTH_14, SP2_REQ_OTH_15, SP2_REQ_OTH_18, SP2_REQ_OTH_22, SP2_REQ_OTH_24

In the following table, a report (requirement name and short analysis) of the relationship of each assigned requirement with respect to the functionalities of the PERSONAL subsystem is provided.

Table 4-13: Requirements aspects associated to the PERSONAL ITS subsystem

Mapped requirement ID	Requirement aspects affecting Personal ITS Subsystem
SP2_REQ_COM_1	Communication Framework It will fully support TEAM communication framework and its associated ITS and communication standards since it behaves as general-purpose access point to the TEAM infrastructure.
SP2_REQ_COM_2	Information exchange It will provide information exchange between all traffic participants and the cloud infrastructure and it will therefore support short and long-range communications.
SP2_REQ_COM_3	IPv6 protocol support Most smartphones already support IPv6
SP2_REQ_COM_5	GSMA-compliant tethering solutions All new smartphones models allows tethering using Wi-Fi and/or USB and/or Bluetooth
SP2_REQ_COM_6	CAM / DENM message support. Whenever possible, TEAM applications should use ETSI CAM (TS 102 868-x) and ETSI DENM (TS 102 869-x) protocols to communicate applicative information. Also apps on Personal ITS should support it.
SP2_REQ_COM_7	Internet availability Personal ITS will need access to the Internet to provide on-demand services, to route data over WANs (e.g. emails, alerts, traffic updates to other services, c etc.) and to grant access for remote maintenance.

Mapped requirement ID	Requirement aspects affecting Personal ITS Subsystem
SP2_REQ_COM_8	Smartphone-CAN bridge The software infrastructure / framework will provide a Smartphone-CAN communication bridge for gathering vehicle related data. (source: use cases SP4 SG)
SP2_REQ_COM_9	Comm. bandwidth for SG app For Serious Gaming applications, the communication facility will reliably provide enough communication bandwidth. Estimated required data rate 1Kb/s The Internet communication bandwidth is directly associated to the cell available radio resources and it is not possible to guarantee in any situation a minimal bandwidth (see 3GPP standard).
SP2_REQ_COM_10	Comm. among traffic actors Personal ITS applications will provide the reliability requirements.
SP2_REQ_COM_11	Real-time communication requirements Personal IT provide real-time communications among traffic actors (travelers, vehicles, infrastructure), through long-range (3G/4G) and, where available, short-range (e.g. IEEE 802.11p) communication links. For the time been, smartphones implement only IEEE 802.11 protocol.
SP2_REQ_LDM_1	Provide static map data Personal ITS subsystem will be able to access and show a small excerpt of the stored static map data around its current position.

Mapped requirement ID	Requirement aspects affecting Personal ITS Subsystem
SP2_REQ_LDM_2	Provide dynamic data storage and API to add/modify/delete them Personal ITS subsystem will be able to access and show a small excerpt of dynamic traffic data. Personal ITS subsystem will also be able to act as a data source for dynamic data.
SP2_REQ_LDM_3	Separate layers and API to access them Personal ITS subsystem will be able to make use of separate layers to reduce amount of traffic for communication.
SP2_REQ_LDM_6	LDM++ data synchronisation mechanism Personal ITS subsystem should use a data synchronisation mechanism to update its own and remote stored data.
SP2_REQ_LDM_8	LDM++ services to be available on the cloud As subsystem with limited capacities, the Personal ITS subsystem will rely on LDM++ services in the cloud.
SP2_REQ_LDM_9	LDM++ Notification service Personal ITS subsystem will use notification service to provide updated information to a traveller.
SP2_REQ_LDM_10	LDM++ map matching and geocoding service Personal ITS subsystem will use the map matching ang geocoding service to determine its current position.
SP2_REQ_LDM_11	LDM++ routing service Personal ITS subsystem will guide non-vehicle travellers by providing access to a LDM++ routing service.

Mapped requirement ID	Requirement aspects affecting Personal ITS Subsystem
SP2_REQ_LDM_12	LDM++ Map display with merged static and dynamic content view Personal ITS subsystem will need a merged view on content to reduce calculation and communication requirements for aggregating the cloud-stored data
SP2_REQ_POS_18	The cooperative positioning module should be able to interact with smartphones. The personal ITS subsystem should use its GPS sensor, and/or the cell power information from the cellular network and the WiFi to provide its positioning data with the desired accuracy.
SP2_REQ_POS_19	The Personal ITS subsystem can retrieve map-referenced positioning from the LDM++.
SP2_REQ_POS_21	Applications and other components must know how reliable the position is. Therefore, a level of confidence must be given. The confidence level can be based on the number and quality of input sources.
SP2_REQ_SEC_1	Security Targets. Peer-to-peer communication occurs between all subsystems, thus each subsystem including Personal IT must take into account secure targets. Implementation: application, user, service, interface
SP2_REQ_SEC_2	Security Association between Communication Participants. Peer-to-peer communication occurs between all subsystems, thus each subsystem including Personal IT must take into account secure targets. Implementation: application, user, service, interface

Mapped requirement ID	Requirement aspects affecting Personal ITS Subsystem
SP2_REQ_SEC_3	Offline Operation Personal IT can provide, if the case, security association and related security operations without requiring permanent online access to any backend systems.
SP2_REQ_SEC_4	Unique and Anonymous Authorisation There shall be different types of security associations that a node may choose. Unique authorization legitimates and identifies an individual node. Anonymous authorisation legitimates a node without revealing its identity.
SP2_REQ_SEC_5	Privacy of Mobile Nodes In order to preserve their privacy, mobile nodes shall be able to publish floating car data in an anonymous or pseudonymous way. This may concern one-to-many (e.g. beaconing) as well as one-to-one communications (e.g. backend data aggregation).
SP2_REQ_SEC_6	Joint Identifier Change All public identifiers of a mobile node shall be changed in regular intervals. The change must be atomic, so that every two messages following each other to contain either only the new or the old identifiers. Old and new identifiers shall not be linkable.

Mapped requirement ID	Requirement aspects affecting Personal ITS Subsystem
SP2_REQ_SEC_7	Variable Public Identifiers All components and applications relying on public identifiers (i.e. identifiers used in non-confidential communications) are required to subscribe for node id changes and change all their public identifiers immediately on such events. Since old and new identifiers shall not be linkable, it is recommended to derive public identifiers from the globally unique node id.
SP2_REQ_SEC_8	Freeze of Node Identifier Applications and components shall be able to freeze the node ID under special circumstances, e.g. during safety critical situations or cooperative driving manoeuvres. The duration of a freeze shall not exceed the required period.
SP2_REQ_SEC_9	Management of Node Identifiers The node-id management component is in charge to store and regularly renew authorisation and enrolment credentials, manage the joint identifier change, and communicate with the central authority. Roadside units do usually not have any privacy restrictions that would require regular changes of their node identifiers. However, it is required for roadside units to be equipped with valid enrolment and authorisation credentials in order to secure their communication channels. Hence, a management component for node identifiers (in this case especially credentials) is also required on the roadside subsystem.

Mapped requirement ID	Requirement aspects affecting Personal ITS Subsystem
SP2_REQ_SEC_10	Integrity and Authenticity of Floating Car Data. All subsystems can receive the floating car data. Thus all must verify its integrity and authenticity. Personal ITS subsystem should take care of proving the integrity and authenticity of floating car data before it is output.
SP2_REQ_SEC_16	Confidential One-to-one Communications. Confidentiality in 1 to 1 communication must be provided in all subsystems, including the Personal ITS subsystem.
SP2_REQ_SEC_18	Further Anonymisation of Floating Car Data Mobile nodes should apply further anonymisation procedures before sharing data with aggregating backend services. These procedures may include cooperative id changes or silent gaps and are subject to further research. This requirement is at application level.
SP2_REQ_SEC_19	Integrity and Authenticity of Aggregated Data. According to requirements definition the backend services must take care about integrity and authenticity of aggregated data. The recipients of this data must also be able to check these issues. Thus this task must be implemented by all subsystems, taking into account their specifics. This requirement is at application level.
SP2_REQ_SEC_20	Compliance with EU Directive 96/46/EC4. All subsystems must comply with applicable laws governing the processing of personal data, including Personal ITS

Mapped requirement ID	Requirement aspects affecting Personal ITS Subsystem
SP2_REQ_SEC_21	Provide users with a clear and understandable privacy policy notice. TEAM system must provide users with a clear and understandable privacy notice, prior to any data collection that the applications may perform. The requested data should be mentioned, so that users are aware and decide whether to use or not an application or certain of its features. This requirement is at application level.
SP2_REQ_SEC_22	Provide users with data privacy settings modification functionality Users must have the option to determine how their personal data or location is processed. Modifiable users' privacy settings option should exist in the users' interface. This requirement is at application level.
SP2_REQ_SEC_23	Lawful lifecycle of stored private information. Since the Personal ITS might manage personal data, it must be able to delete data as dictated by the lawful lifecycle. This requirement is at application level.
SP2_REQ_SEC_24	Stored sensitive data should be encrypted. According to definition personal data stored on devices must be encrypted and protected. This requirement is at application level.

Mapped requirement ID	Requirement aspects affecting Personal ITS Subsystem
SP2_REQ_SEC_25	Secure user login to TEAM applications Login will be required to access the TEAM applications. Option to remember the login details shall be available. This requirement is at application level.
SP2_REQ_SEC_26	Installation of authorized TEAM applications. Wherever a new application on the Personal ITS subsystem should be installed, its installation must be authorized.
SP2_REQ_SEC_27	Safe exchange of personal data with third party applications If it is required, Personal ITS should send and receive securely transmitted data when a connection with third party applications exists. This requirement is at application level.
SP2_REQ_OTH_2	Collaborative vehicles xFCD interface adapter Need for collaborative vehicles xFCD interface adapter. Project standardisation activities should be taken into account. Proper algorithms and protocols (e.g. based on the SIMONE protocol for CFD) for XFCD processing will be defined and developed. A specialised (or a number of) web service should be developed to allow vehicles to connect, REST architecture should be evaluated. This requirement is at application level.

Mapped requirement ID	Requirement aspects affecting Personal ITS Subsystem
SP2_REQ_OTH_3	Travellers mobile devices should allow MAC address based tracking Need for travellers to allow their mobile devices to be tracked using their MAC addresses. All Personal ITS have an assigned MAC address.
SP2_REQ_OTH_4	Traffic lights information should be transmitted to the vehicle Traffic lights information (SPaT – Signal Phases and Timing) should be transmitted to the vehicle. The outcomes of use case SP3_CMC_MLP (application of multi-layered control policies) should be translated into a set of actions/information applied by means of different devices systems for collaborative traffic control, continuously validated by double loop control, and sent to the vehicle. This requirement is at application level.
SP2_REQ_OTH_6	Dynamical change requests for the speed limit The speed limit should be dynamically changeable. This requirement is at application level.
SP2_REQ_OTH_7	Interface and change requests to public transport operator data This requirement is at application level.
SP2_REQ_OTH_8	User profile data features This requirement is at application level.
SP2_REQ_OTH_10	User can modify user profile data

Mapped requirement ID	Requirement aspects affecting Personal ITS Subsystem
SP2_REQ_OTH_14	Data exchange format should take into consideration standard protocols
SP2_REQ_OTH_15	Access to external sources of information This requirement is at application level.
SP2_REQ_OTH_18	Implementation of RESTful interface dedicated web services This requirement is at application level.
SP2_REQ_OTH_22	Ability to log application data
SP2_REQ_OTH_24	Mobile operating system support TEAM mobile applications should support several operating systems (i.e. iPhone, Android, Windows Phone 8). This means there should be more versions of each mobile application downloadable from the respective stores.

5 Conclusion

The requirements of the EMPOWER system were presented and analysed in this document. These requirements were a result of the analysis of the D1.0 use cases, related to EMPOWER system and to FLEX and DIALOGUE applications. The FLEX and DIALOGUE requirements to EMPOWER platform were collected and reviewed to form the EMPOWER system requirements. EMPOWER requirements were structured based on four basic technologic categories and working groups: communication, local dynamic maps, cooperative positioning, security and the rest. Summarising the collected requirements, 12 communication related requirements were defined, 13 LDM++ requirements, 21 positioning related requirements, 27 security related requirements and 25 requirements not belonging to one of the basic technology categories.

Then these requirements were further analysed and grouped into the ITS station they belong to, Central, Roadside, Vehicle and Personal. One requirement could be associated to one or more of these subsystems. Equipment essentials steming from these requirements were also defined where applicable. This work was the initial step of the EMPOWER specification as the operation and functionalities of each subsystem could be defined using this mapping of requirements. The results of this procedure are illustrated in the following Figures 5-1 to 5-4.

The main challenge of this work is that it covered a significant number of demanding ITS applications that produce an equivalent great number of different and generic requirements, making it hard to handle such an amount of information. The horizontal separation of tasks between the four main technology categories lead to the reduction of this workload and to the excellent exploitation of the expertise within the consortium. Then the vertical sorting of the collected requirements to the four ITS communication architecture subsystems made it easier to start with the initial definition of the actual functional components that the system will have. The targeted selecton of the requirements template offered the oportunity for a straightforward organisation of the requirements and their details in an early phase. This in turn, together with the proper ID selection and the early phase sorting of these requirments, could potentially assist to a smoother transition to the definition of the final system specification and architecture. This also allows for a requirement tracking in the next phases of the project.

Next step of the WP2.3 work that continues beyond D2.3.1 is the further elaboration of the subsystem requirements in order to extract their final specifications. This work will be reported internally and will serve to the completion of EMPOWER system and component design being partly integrated in D2.0.

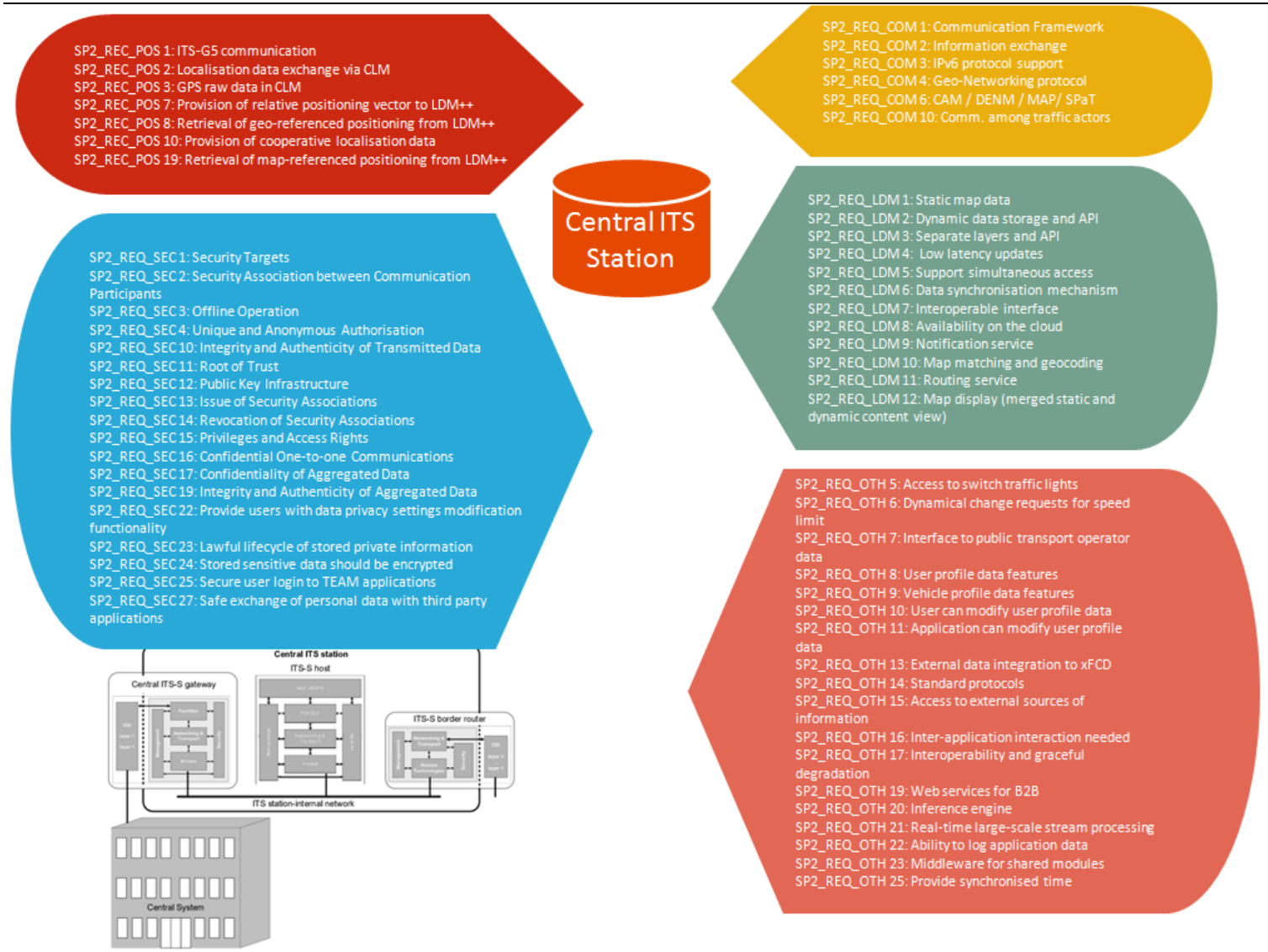

Figure 5-1: Requirements for the Central ITS Station

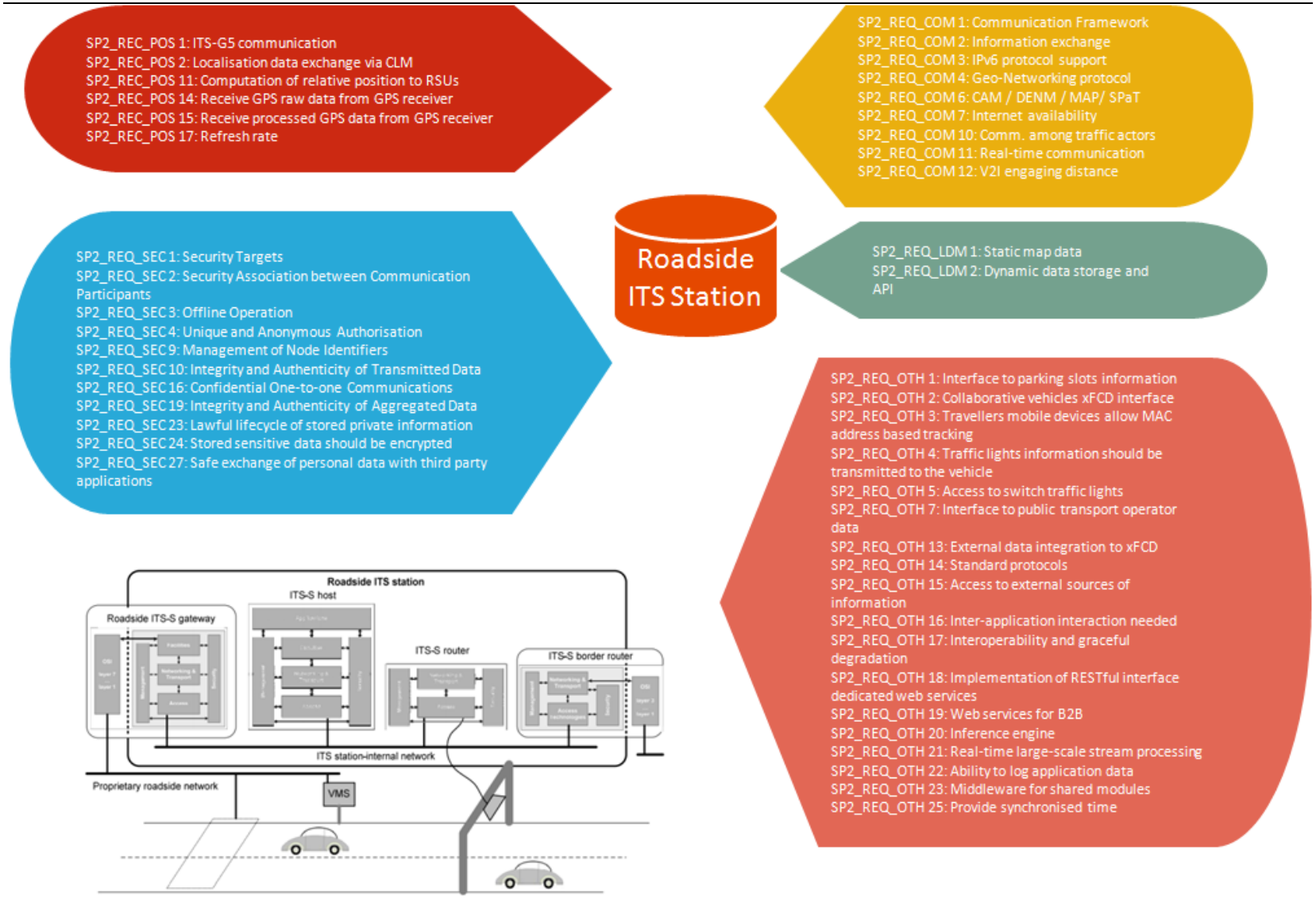

Figure 5-2: Requirements for the Roadside ITS Station

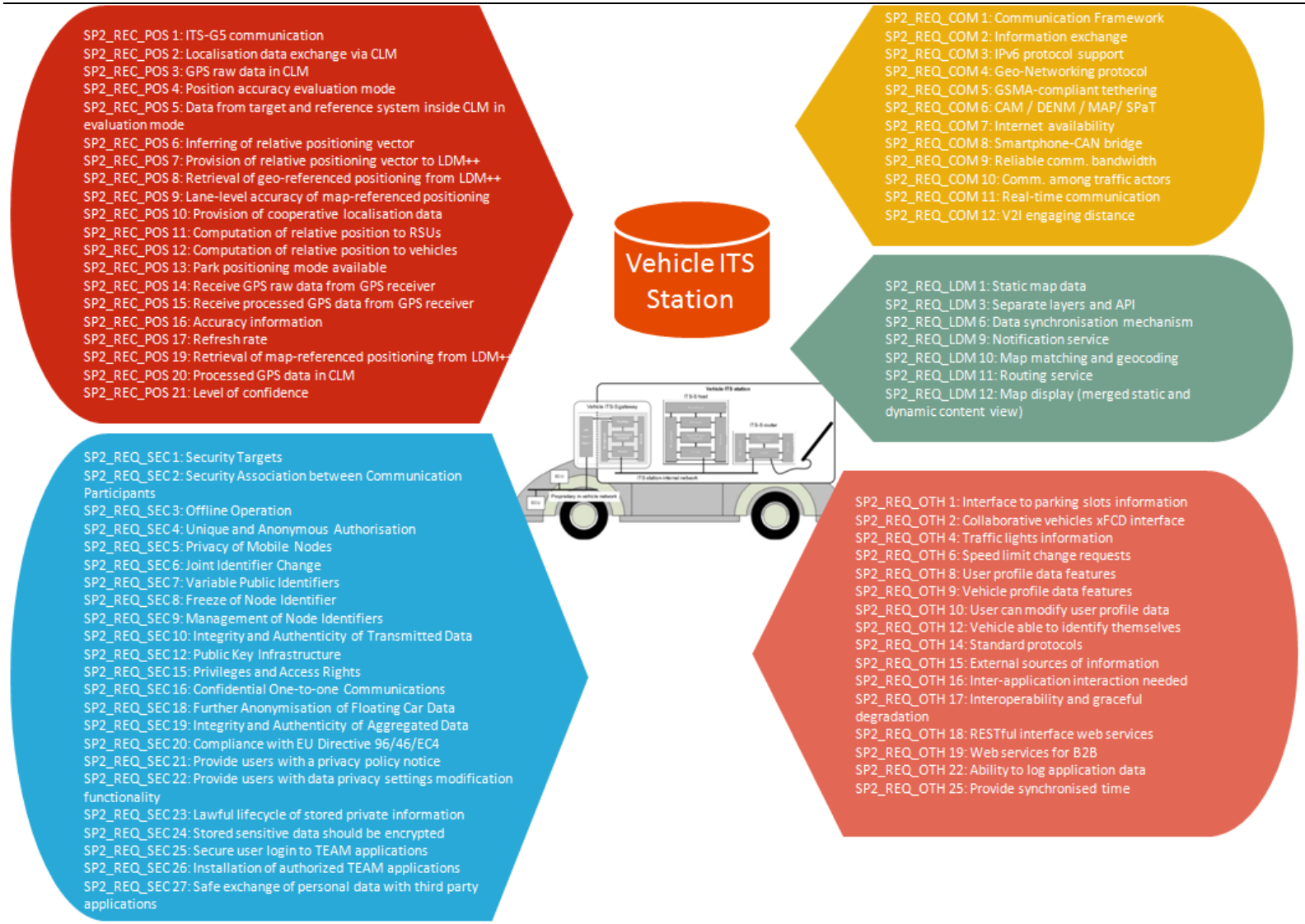

Figure 5-3: Requirements for the Vehicle ITS Station

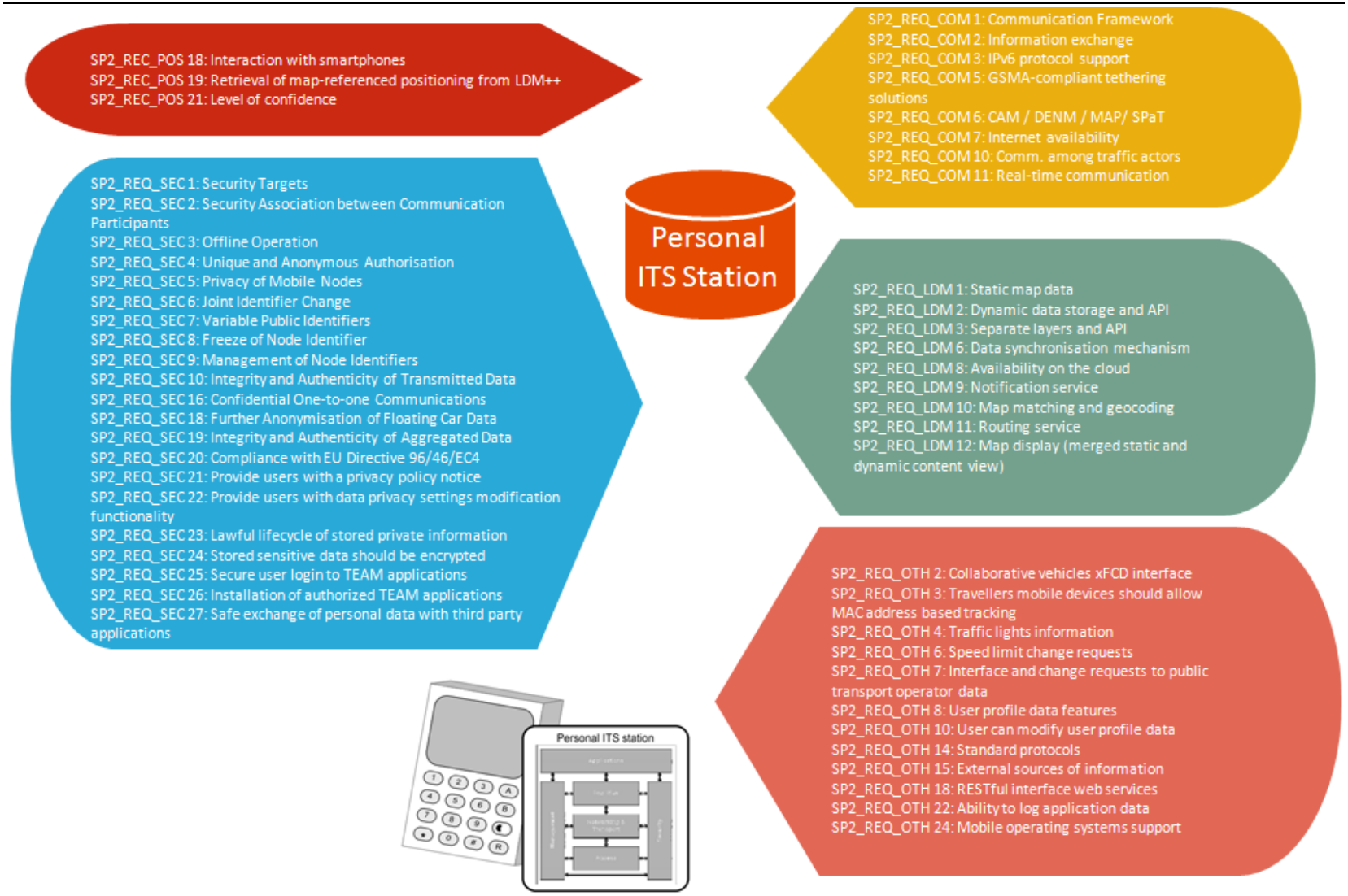

Figure 5-4: Requirements for the Personal ITS Station

List of abbreviations and acronyms

Abbreviation	Meaning
ACC	Autonomous Cruise Control
CAM	Co-operative Awareness Message
CAN	Controller Area Network (http://encyclopedia2.thefreedictionary.com/Controller+Area+Network)
CLM	Cooperative Localisation Message
DATEX II	(version 2 of European standard for traffic and travel) data exchange (between traffic control and information centres as well as other actors of the traffic and travel information sector)
DE	Data Element
DEN	Decentralized Environmental Notification
DENM	DEN Message
DGPS	Differential Global Positioning System
ETSI	European Telecommunications Standards Institute
FCD	Floating Car Data
GSM	Global System for Mobile Communications, originally *Groupe Spécial Mobile*
HMI	Human-Machine Interface
ITS	Intelligent Transportation System
ITS-G5	Work on IEEE standard 802.11 for ITS in the 5GHz band
ICS	Implementation Conformance Statement
IR	Internal Report
IUT	Implementation Under Test
LDM++	Local Dynamic Map, enhanced
LTE	Long Term Evolution

Abbreviation	Meaning
LTZ	Limited Traffic Zone
MAC	Media Access Control
NTP	Network Time Protocol
OBU	On Board Unit
PICS	Protocol Implementation Conformance Statement
POI	Point of Interest
PT	Public Transport
PVT	Position, velocity, time
OoS	Quality of Service
RDMS	Relational Database Management System
REST	Representational State Transfer
ROA	ROAD Side Subsystem (see RSU)
RSU	Road Side Unit
RTK	Real Time Kinematic
SIRI	Service Interface for Real Time Information
SIMONE	http://simone.5t.torino.it/
SP	Sub-project
SUT	System Under Test
TMC	Traffic Message Channel
TPEG	Transport Protocol Experts Group
UML	Unified Modelling Language
UTMC	Urban Traffic Management and Control
V2X	Vehicle-to-X (Vehicle or Infrastructure)

Abbreviation	Meaning
WP	Work Package
XFCD	Extended FCD

References

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[8] SAE J 2735-2009, Dedicated Short Range Communications (DSRC) Message Set Dictionary (for SPaT and MAP messages).

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Annex 1 EMPOWER requirements detailed tables

The complete list of the collected EMPOWER requirements can be found in this Annex. Their detailed tables follow.

SP2_REQ_COM 1: Communication Framework

SP2_REQ_COM 2: Information exchange

SP2_REQ_COM 3: IPv6 protocol support

SP2_REQ_COM 4: Geo-Networking protocol support

SP2_REQ_COM 5: GSMA-compliant tethering solutions

SP2_REQ_COM 6: CAM / DENM / MAP/ SPaT message support

SP2_REQ_COM 7: Internet availability

SP2_REQ_COM 8: Smartphone-CAN bridge

SP2_REQ_COM 9: Reliable comm. bandwidth

SP2_REQ_COM 10: Comm. among traffic actors

SP2_REQ_COM 11: Real-time communication requirements

SP2_REQ_COM 12: V2I engaging distance

SP2_REQ_LDM 1: Provide static map data

SP2_REQ_LDM 2: Provide dynamic data storage and API to add/modify/delete them

SP2_REQ_LDM 3: Separate layers and API to access them

SP2_REQ_LDM 4: LDM++ to provide updates with low latency (bandwidth guarantees)

SP2_REQ_LDM 5: LDM++ to support simultaneous access

SP2_REQ_LDM 6: LDM++ data synchronisation mechanism

SP2_REQ_LDM 7: LDM++ to provide interoperable interface

SP2_REQ_LDM 8: LDM++ services to be available on the cloud

SP2_REQ_LDM 9: LDM++ Notification service

SP2_REQ_LDM 10: LDM++ map matching and geocoding service

SP2_REQ_LDM 11: LDM++ routing service

SP2_REQ_LDM 12: LDM++ Map display with merged static and dynamic content view

SP2_REQ_LDM 13: LDM++ visual (GUI) component

SP2_REC_POS 1: ITS-G5 communication

SP2_REC_POS 2: Localisation data exchange via Cooperative Localisation Message

SP2_REC_POS 3: GPS raw data in CLM

SP2_REC_POS 4: Position accuracy evaluation mode available

SP2_REC_POS 5: Data from target and reference system inside CLM in evaluation mode

SP2_REC_POS 6: Infering of relative positioning vector

SP2_REC_POS 7: Provision of relative positioning vector to LDM++

SP2_REC_POS 8: Retrieval of geo-referenced positioning from LDM++

SP2_REC_POS 9: Lane-level accuracy of map-referenced positioning

SP2_REC_POS 10: Provision of cooperative localisation data to applications and other modules

SP2_REC_POS 11: Computation of relative position to Road Side Units

SP2_REC_POS 12: Computation of relative position to vehicles

SP2_REC_POS 13: Park positioning mode available

SP2_REC_POS 14: Receive GPS raw data from GPS receiver

SP2_REC_POS 15: Receive processed GPS data from GPS receiver

SP2_REC_POS 16: Accuracy information

SP2_REC_POS 17: Refresh rate

SP2_REC_POS 18: Interaction with smartphones

SP2_REC_POS 19: Retrieval of map-referenced positioning from LDM++

SP2_REC_POS 20: Processed GPS data in CLM

SP2_REC_POS 21: Level of confidence

SP2_REQ_SEC 1: Security Targets

SP2_REQ_SEC 2: Security Association between Communication Participants

SP2_REQ_SEC 3: Offline Operation

SP2_REQ_SEC 4: Unique and Anonymous Authorisation

SP2_REQ_SEC 5: Privacy of Mobile Nodes

SP2_REQ_SEC 6: Joint Identifier Change

SP2_REQ_SEC 7: Variable Public Identifiers

SP2_REQ_SEC 8: Freeze of Node Identifier

SP2_REQ_SEC 9: Management of Node Identifiers

SP2_REQ_SEC 10: Integrity and Authenticity of Transmitted Data

SP2_REQ_SEC 11: Root of Trust

SP2_REQ_SEC 12: Public Key Infrastructure

SP2_REQ_SEC 13: Issue of Security Associations

SP2_REQ_SEC 14: Revocation of Security Associations

SP2_REQ_SEC 15: Privileges and Access Rights

SP2_REQ_SEC 16: Confidential One-to-one Communications

SP2_REQ_SEC 17: Confidentiality of Aggregated Data

SP2_REQ_SEC 18: Further Anonymisation of Floating Car Data

SP2_REQ_SEC 19: Integrity and Authenticity of Aggregated Data

SP2_REQ_SEC 20: Compliance with EU Directive 96/46/EC4

SP2_REQ_SEC 21: Provide users with a privacy policy notice

SP2_REQ_SEC 22: Provide users with data privacy settings modification functionality

SP2_REQ_SEC 23: Lawful lifecycle of stored private information

SP2_REQ_SEC 24: Stored sensitive data should be encrypted

SP2_REQ_SEC 25: Secure user login to TEAM applications

SP2_REQ_SEC 26: Installation of authorized TEAM applications

SP2_REQ_SEC 27: Safe exchange of personal data with third party applications

SP2_REQ_OTH 1: Interface to parking slots information

SP2_REQ_OTH 2: Collaborative vehicles xFCD interface adapter

SP2_REQ_OTH 3: Travellers mobile devices should allow MAC address based tracking

SP2_REQ_OTH 4: Traffic lights information should be transmitted to the vehicle

SP2_REQ_OTH 5: TEAM should have access to switch traffic lights

SP2_REQ_OTH 6: Dynamical change requests for the speed limit

SP2_REQ_OTH 7: Interface and change requests to public transport operator data

SP2_REQ_OTH 8: User profile data features

SP2_REQ_OTH 9: Vehicle profile data features

SP2_REQ_OTH 10: User can modify user profile data

SP2_REQ_OTH 11: Application can modify user profile data

SP2_REQ_OTH 12: Vehicle should be able to identify themselves

SP2_REQ_OTH 13: TMC able to integrate external data in addition to collaborative xFCD

SP2_REQ_OTH 14: Data exchange format should take into consideration standard protocols

SP2_REQ_OTH 15: Access to external sources of information

SP2_REQ_OTH 16: Inter-application interaction needed

SP2_REQ_OTH 17: Guaranteed interoperability and graceful degradation of service if not available

SP2_REQ_OTH 18: Implementation of RESTful interface dedicated web services

SP2_REQ_OTH 19: Web services for B2B information publication

SP2_REQ_OTH 20: Inference engine for complex data processing

SP2_REQ_OTH 21: Real-time large-scale stream processing

SP2_REQ_OTH 22: Ability to log application data

SP2_REQ_OTH 23: Middleware for accessing shared TEAM software modules

SP2_REQ_OTH 24: Mobile operating systems support

SP2_REQ_OTH 25: Provide synchronised time

Communication related requirements

SP2_REQ_COM 1: Communication Framework

Requirement ID:	SP2_REQ_IVL_1_v1.0
Name of requirement:	Communication Framework
Created by	Fabrizio Gatti (FG) – fabrizio1.gatti@telecomitalia.it
Assigned partner	TG Tech Group "ITS V2X LTE"
History	2013.04.29 – FG – initial version
Goal	EMPOWER communication framework shall be compliant with ETSI TC ITS Reference Architecture (ETSI EN 302 665: "Intelligent Transport Systems (ITS); Communication Architecture").
Related EMPOWER Use Case	"V2X wireless communication support", SP2_CSSR
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- Application independent:** ☑ "Communication "
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ Other "Communication" **- Personal** ☑ Other "Communication" **- Central** ☑ Communication unit **- Roadside** ☑ Other "Communication"
Requirement category	- Non-functional

	☑ General architectural and equipment requirements
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	A non-standard solution will have less opportunities on the market.
Validation method (tests, indicators, performance bounds)	Design analysis
Acceptance criteria	Not available yet.
Relationship with other requirements	- Same level with: SP2_REQ_COM_7
Potential conflicts	None.
Potential technologies involved / affected	Not applicable.
Status of requirement description	☑ Final
Other	None.

SP2_REQ_COM 2: Information exchange

Requirement ID:	SP2_REQ_IVL_2_v1.0
Name of requirement:	Information exchange
Created by	Fabrizio Gatti (FG) – fabrizio1.gatti@telecomitalia.it
Assigned partner	TG Tech Group "ITS V2X LTE"
History	2013.04.29 – FG – initial version
Goal	EMPOWER framework shall support information exchange between central ITS stations and: vehicle / roadside ITS stations / personal stations using: 802.11 p, LTE, 3G and all the available legacy 3GPP communication systems (long range wireless communication)

Related EMPOWER Use Case	"V2X wireless communication support", SP2_CSSR
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- Application independent:** ☑ "Communication "
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ Other "Communication" **- Personal** ☑ Other "Communication" **- Central** ☑ Communication unit **- Roadside** ☑ Other "Communication"
Requirement category	- Non-functional ☑ General architectural and equipment requirements
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	A non-standard solution will have less opportunities on the market .
Validation method (tests, indicators, performance bounds)	Communication function analysis
Acceptance criteria	The ITS subsystem communication functionality is able to use the communication technologies stated by this requirement.
Relationship with other requirements	- No ☑
Potential conflicts	None.

Potential technologies involved / affected	Not applicable.
Status of requirement description	☑ Final
Other	None.

SP2_REQ_COM 3: IPv6 protocol support

Requirement ID:	SP2_REQ_IVL_3_v1.0
Name of requirement:	IPv6 protocol support
Created by	Fabrizio Gatti (FG) – fabrizio1.gatti@telecomitalia.it
Assigned partner	TG Tech Group "ITS V2X LTE"
History	2013.04.29 – FG – initial version
Goal	EMPOWER framework shall support the use of IPv6 protocol
Related EMPOWER Use Case	"V2X wireless communication support", SP2_CSSR
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- Application independent:** ☑ "Communication "
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ Other "Communication" **- Personal** ☑ Other "Communication" **- Central** ☑ Communication unit **- Roadside** ☑ Other "Communication"

Requirement category	- Non-functional ☑ General architectural and equipment requirements
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	A non-standard solution will have less opportunities on the market .
Validation method (tests, indicators, performance bounds)	Communication function analysis
Acceptance criteria	The ITS subsystem is able to manage an IPv6 connection.
Relationship with other requirements	- Same level with: SP2_REQ_COM_11, SP2_REQ_COM_9, SP2_REQ_COM_12
Potential conflicts	None.
Potential technologies involved / affected	Not applicable.
Status of requirement description	☑ Final
Other	None.

SP2_REQ_COM 4: Geo-Networking protocol support

Requirement ID:	SP2_REQ_IVL_4_v1.0
Name of requirement:	Geo-Networking protocol support
Created by	Fabrizio Gatti (FG) – fabrizio1.gatti@telecomitalia.it
Assigned partner	TG Tech Group "ITS V2X LTE"
History	2013.04.29 – FG – initial version
Goal	EMPOWER framework shall support Geo-Networking protocols compliant with ETSI TC ITS reference documents
Related EMPOWER Use Case	"V2X wireless communication support", SP2_CSSR
Source (TEAM application or	From which application/enabler the requirement has been

enabler)	created: **- Application independent:** ☑ "Communication "
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ Other "Communication" **- Personal** ☑ Other "Communication" **- Central** ☑ Communication unit **- Roadside** ☑ Other "Communication"
Requirement category	- Non-functional ☑ General architectural and equipment requirements
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	A non-standard solution will have less opportunities on the market .
Validation method (tests, indicators, performance bounds)	Communication function analysis
Acceptance criteria	The ITS subsystem is able to manage GeoNetworking as networking procedure.
Relationship with other requirements	- Same level with: SP2_REQ_COM_5, SP2_REQ_COM_8, SP2_REQ_COM_6
Potential conflicts	None.
Potential technologies involved / affected	Not applicable.

Status of requirement description	☑ Final
Other	None.

SP2_REQ_COM 5: GSMA-compliant tethering solutions

Requirement ID:	SP2_REQ_IVL_5_v1.0
Name of requirement:	GSMA-compliant tethering solutions
Created by	Fabrizio Gatti (FG) – fabrizio1.gatti@telecomitalia.it
Assigned partner	TG Tech Group "ITS V2X LTE"
History	2013.04.29 – FG – initial version
Goal	For the communication between Vehicle station and Personal station, EMPOWER framework shall support tethering solutions complying with GSMA guidelines (GSMA White Paper "Connecting Cars: Bring your Own Device - Tethering Challenges", feb. 2013 available on: http://www.gsma.com/connectedliving/wp-content/uploads/2013/02/cl_ma_tethering_02_13.pdf)
Related EMPOWER Use Case	"V2X wireless communication support", SP2_CSSR
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- Application independent:** ☑ "Communication "
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ Other "Communication" **- Personal** ☑ Other "Communication"

Requirement category	- Non-functional ☑ General architectural and equipment requirements
Critical level (priority)	Define the importance of the requirement: ☑ Recommended
Risk analysis	A non-standard solution will have less opportunities on the market .
Validation method (tests, indicators, performance bounds)	Communication function analysis
Acceptance criteria	The personal station and the vehicle station are able to connect themselves using the procedure stated by the reference document.
Relationship with other requirements	- Same level with: SP2_REQ_COM_8, SP2_REQ_COM_4, SP2_REQ_COM_6
Potential conflicts	None.
Potential technologies involved / affected	Not applicable.
Status of requirement description	☑ Final
Other	None.

SP2_REQ_COM 6: CAM / DENM / MAP/ SPaT message support

Requirement ID:	SP2_REQ_IVL_6_v1.1
Name of requirement:	CAM / DENM / MAP / SPaT message support
Created by	Fabrizio Gatti (FG) – fabrizio1.gatti@telecomitalia.it
Assigned partner	TG Tech Group "ITS V2X LTE"
History	2013.04.29 – FG – initial version

	2013.06.21 – NF – updates for MAP, SPaT
Goal	Whenever possible, TEAM applications should use ETSI CAM (TS 102 868-x) and ETSI DENM (TS 102 869-x) protocols to communicate applicative information. MAP and SPaT protocols should be also considered.
Related EMPOWER Use Case	"V2X wireless communication support", SP2_CSSR
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- Application independent:** ☑ "Communication "
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ Other "Communication" **- Personal** ☑ Other "Communication" **- Central** ☑ Communication unit **- Roadside** ☑ Other "Communication"
Requirement category	- Non-functional ☑ General architectural and equipment requirements
Critical level (priority)	Define the importance of the requirement: ☑ Recommended
Risk analysis	A non-standard solution will have less opportunities on the market .
Validation method (tests, indicators, performance bounds)	Communication function analysis
Acceptance criteria	The ITS subsystem's communication functionality is able to use

	the CAM and DENM protocols; tests are described in ETSI standards.
Relationship with other requirements	- Same level with: SP2_REQ_COM_5, SP2_REQ_COM_8, SP2_REQ_COM_4
Potential conflicts	None.
Potential technologies involved / affected	Not applicable.
Status of requirement description	☑ Final
Other	None.

SP2_REQ_COM 7: Internet availability

Requirement ID:	SP2_REQ_COM 7
Name of requirement:	Internet availability
Created by	Nikola Zahariev (NEC) - Nikola.Zahariev@neclab.eu
Assigned partner	TG Tech Group "ITS V2X LTE"
History	IR4.3.1 – initial version
Goal	To offer internet connectivity on the sub-system
Related EMPOWER Use Case	Most application Use Cases.
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- DIALOGUE Applications:** ☑ Collaborative parking ☑ Serious game and community building **- FLEX Applications:** ☑ Community gaming (cities, infrastructure)

	- Application independent: ☑ "Communication "
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ Other "Communication" **- Personal** ☑ Other "Communication" **- Central** ☑ Communication unit **- Roadside** ☑ Other "Communication"
Requirement category	- Non-functional ☑ Connectivity and communication requirements
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	Lack of reliable and real-time communication will stop the operation of the applications
Validation method (tests, indicators, performance bounds)	Ping an internet site
Acceptance criteria	Real-time communication
Relationship with other requirements	- Same level with: SP2_REQ_COM_1
Potential conflicts	None.
Potential technologies involved / affected	Not applicable.
Status of requirement description	☑ Final
Other	None.

SP2_REQ_COM 8: Smartphone-CAN bridge

Requirement ID:	SP2_REQ_COM 8
Name of requirement:	Smartphone-CAN bridge
Created by	Nikola Zahariev (NEC) - Nikola.Zahariev@neclab.eu
Assigned partner	TG Tech Group "ITS V2X LTE"
History	Initial version
Goal	To allow a direct connection to car sensors and internal subsystems, e.g. car ACC.
Related EMPOWER Use Case	Use cases of Application SG-CB.
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- DIALOGUE Applications:** ☑ Serious game and community building **- FLEX Applications:** ☑ Community gaming (cities, infrastructure) **- Application independent:** ☑ "Communication "
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ Other "Communication" **- Personal** ☑ Other "Communication"
Requirement category	- Non-functional ☑ Connectivity and communication requirements
Critical level (priority)	Define the importance of the requirement:

	☑ Mandatory
Risk analysis	Lack of the database would force applications to access vehicle data directly from the CAN bus, which would be problematic both for the technical implementation and from the point of view of Intellectual Property Rights.
Validation method (tests, indicators, performance bounds)	Availability of the real-time database
Acceptance criteria	Availability of the database with a real-time behavior
Relationship with other requirements	- Same level with: SP2_REQ_COM_4, SP2_REQ_COM_5, SP2_REQ_COM_6.
Potential conflicts	None.
Potential technologies involved / affected	Not applicable.
Status of requirement description	☑ Final
Other	None.

SP2_REQ_COM 9: Reliable comm. bandwidth

Requirement ID:	SP2_REQ_COM_9, SP4_REQ_EFP_LDMRBW_v0.1
Name of requirement:	Reliable bandwidth, in particular for the LDM++
Created by	CRF - filippo.visintainer@crf.it
Assigned partner	SP2/LDM++ and Communications groups
Source (TEAM application or enabler)	Collaborative Parking (EFP) Serious Gaming (SG)
Requirement category	Technological and development requirements
Goal	To ensure that the EFP can send and receive all the data to or from the cloud storage
Definition:	The cloud should be able to continuously (rate, about 1Hz)

	receive and host the data during a collaborative parking session. Data include vehicle speed, position, vehicle type, vehicle dimension, etc. and driver performance assessment. Estimated required throughput 1Kb/s (for SG application).
Critical level (priority)	High
Validation Method (tests, indicators, performance bounds)	It must be possible to continuously transmit and receive the EFP application data to the cloud
Acceptance criteria	Data available on the cloud
Relationship with other requirements	- Same level with: SP2_REQ_COM_2, SP2_REQ_COM_11, SP2_REQ_COM_12.
Potential conflicts	None.
Risk analysis	Correctly received data are needed for a proper functioning of the application
Status	☑ Final
Other	None.

SP2_REQ_COM 10: Comm. among traffic actors

Requirement ID:	SP2_REQ_COM 10
Name of requirement:	Communication among traffic actors
Created by	UniGe - franz@elios.unige.it
Assigned partner	TG Tech Group "ITS V2X LTE"
History	IR4.3.1 – initial version
Goal	To ensure that all the actors are communicating in a reliable way
Related EMPOWER Use Case	"V2X wireless communication support", SP2_CSSR
Source (TEAM application or	From which application/enabler the requirement has been

enabler)	created: **- Application independent:** ☑ "Communication "
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ Other "Communication" **- Personal** ☑ Other "Communication" **- Central** ☑ Communication unit **- Roadside** ☑ Other "Communication"
Requirement category	- Non-functional ☑ Connectivity and communication requirements
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	Lack of reliable and real-time communication will stop the operation of the SG application
Validation method (tests, indicators, performance bounds)	Test the connection among the different actors
Acceptance criteria	Real-time communication
Relationship with other requirements	- No ☑
Potential conflicts	None.
Potential technologies involved / affected	Not applicable.
Status of requirement description	☑ Final
Other	None.

SP2_REQ_COM 11: Real-time communication requirements

Requirement ID:	SP2_REQ_COM 11
Name of requirement:	Real-time communication requirements
Created by	Marco Bottero (SWARCO) - marco.bottero@swarco.com
Assigned partner	TG Tech Group "ITS V2X LTE"
History	IR3.3.1 – initial version
Goal	To ensure that the control can be properly operated
Related EMPOWER Use Case	"V2X wireless communication support", SP2_CSSR
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- FLEX Applications:** ☑ Collaborative pro-active urban/inter-urban monitoring and ad-hoc control **- Application independent:** ☑ "Communication "
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ Other "Communication" **- Personal** ☑ Other "Communication" **- Central** ☑ Communication unit **- Roadside** ☑ Other "Communication"

Requirement category	- Non-functional ☑ Connectivity and communication requirements
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	This requirement is compulsory for the application. Some kind of degraded mode could be defined in case of poor QoS
Validation method (tests, indicators, performance bounds)	Test the connection among the different actors
Acceptance criteria	Real-time communication
Relationship with other requirements	- Same level with: SP2_REQ_COM_3, SP2, SP2_REQ_COM_9, SP2_REQ_COM_12._
Potential conflicts	None.
Potential technologies involved / affected	Not applicable.
Status of requirement description	☑ Final
Other	None.

SP2_REQ_COM 12: V2I engaging distance

Requirement ID:	SP2_REQ_COM_12
Name of requirement:	V2I engaging distance
Created by	Rafael Basso (VTEC) - rafael.basso@volvo.com
Assigned partner	TG Tech Group "ITS V2X LTE"
History	IR3.3.1 – initial version
Goal	To ensure that the vehicles and intersections can communicate with each other effectively
Related EMPOWER Use Case	"V2X wireless communication support", SP2_CSSR
Source (TEAM application or	From which application/enabler the requirement has been

enabler)	created: **- FLEX Applications:** ☑ Collaborative smart intersection for bus priority (intelligent priorities) **- Application independent:** ☑ "Communication "
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ Other "Communication" **- Central** ☑ Communication unit **- Roadside** ☑ Other "Communication"
Requirement category	- Non-functional ☑ Connectivity and communication requirements
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	This requirement is compulsory for the application.
Validation method (tests, indicators, performance bounds)	Test the connection among the different actors
Acceptance criteria	Real-time communication
Relationship with other requirements	- Same level with: SP2_REQ_COM_3, SP2_REQ_COM_11, SP2_REQ_COM_9.
Potential conflicts	None
Potential technologies involved / affected	Not applicable.
Status of requirement description	☑ Final

Other	None.

Automotive Cloud and LDM++ related requirements

SP2_REQ_LDM 1: Provide static map data

Requirement ID:	SP2_REQ_LDM_1
Name of requirement:	Provide static map data
Created by	ICCS, HERE - stephane.dreher@here.com
Assigned partner	FOKUS, ICCS, SWARCO, UNIGE, VTT
History	2013-01-25 - NF - first draft release
Goal	The LDM++ should represent the surroundings of a vehicle, infrastructure element or person populated with static road network topology and attributes as well as other objects and information which are relevant for cooperative applications and services. The road network description should be of automotive quality grade and fully routable. Attributes should be referenced to road network links or segments. Static content identified by applications includes: 1. Road topology and attributes associated to road links: a. Road type b. Urban area c. Lanes (number of lanes and geometry) d. directions of travel e. access and exit junctions f. Intersections (locations and reference tracks). g. traffic lights (locations) h. roundabouts i. Slope and curvature 2. Regulations a. speed limits (including time and weather dependant) b. noise c. emission (low emission zones)

	3. Public transport: a. Bus routes and stops b. Static time tables/frequency information 4. Parking slots locations (Parking POIs)
Related EMPOWER Use Case	N/A
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- DIALOGUE Applications:** ☑ Collaborative ACC ☑ Collaborative parking ☑ Collaborative driving and merging ☑ Collaborative eco-friendly navigation ☑ Serious game and community building **- FLEX Applications:** ☑ Collaborative pro-active urban/inter-urban monitoring and ad-hoc control ☑ Collaborative co-modal route planning ☑ Co-modal coaching with support from virtual/avatar users ☑ Collaborative smart intersection for bus priority (intelligent priorities) ☑ Collaborative public transport optimization ☑ Community gaming (cities, infrastructure) ☑ Dynamic collaborative corridors - Enabler: ☑ Data or Aggregated data: "_____"
Relevance to EMPOWER subsystem and component	- Vehicle

	☑ HMI ☑ Application - Personal ☑ HMI ☑ Application - Central ☑ HMI ☑ Synchronisation module
Requirement category	☑ Functional - Non-functional
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	Absence of static road network data as listed will prevent applications from working or limit their scope and the quality of their service. Public transport operator commitment to receive information might be necessary.
Validation method (tests, indicators, performance bounds)	Tests on availability of required static content in the demonstration areas and on the possibility to access this data via the APIs.
Acceptance criteria	Availability of the map data affects functionality of several applications which affects their user acceptance.
Relationship with other requirements	- Yes ☑ - SP2_REQ_LDM_2 and SP2_REQ_POS_9
Potential conflicts	N/A
Potential technologies involved / affected	LDM++ and automotive cloud

Status of requirement description	☑ Final
Other	None.

SP2_REQ_LDM 2: Provide dynamic data storage and API to add/modify/delete them

Requirement ID:	SP2_REQ_LDM_2
Name of requirement:	Provide dynamic data storage and API to add/modify/delete them
Created by	ICCS, HERE - stephane.dreher@here.com
Assigned partner	FOKUS, ICCS, SWARCO, UNIGE, VTT
History	2013-01-25 - NF - first draft release
Goal	The LDM++ should represent the surroundings of a vehicle, infrastructure element or person populated with dynamic attributes related to static features or dynamic data and objects which are relevant for cooperative applications and services. The LDM++ should allow to add/delete and modify the dynamic data via APIs. Dynamic data should be referenced to road network links/segments. Dynamic data as identified by applications includes: 1. Traffic information: a. Traffic flow: i. average speed data from Real-Time Traffic information source ii. data sent by the TEAM equipped vehicles like type of vehicle present in a traffic queue b. Traffic incidents/events: road works and incidents received from infrastructure and TEAM equipped vehicles. For accidents, it should be possible to add data such as

	number of involved vehicles, injured people, presence or time of arrival of emergency vehicles. 2. Dynamic data associated to POIs: a. Variable speed limits (e.g. for VMS) b. State of traffic lights c. Parking availability 3. Emissions & noise a. Pollution levels like CO2, CO, HC, NOx and PMx. b. Control parameters: desired pollution level, desired number of vehicles. 4. Safety: live and historic data on hazardous road locations and safe routes, such as roads that few accidents happen, etc… 5. Public transport: a. Bus routes, bus stops, timetables dynamically updated (after the performance of the TEAM routing optimization algorithms) b. Buses positions/availability/load etc. updated in real-time 6. Other vehicles' locations and itineraries. Data structures should follow existing standards as far as possible and if available, like the one defined by ISO TC 204 WG18 and ETSI.
Related EMPOWER Use Case	N/A
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- DIALOGUE Applications:** ☑ Collaborative ACC ☑ Collaborative parking

	☑ Collaborative driving and merging ☑ Collaborative eco-friendly navigation ☑ Serious game and community building**- FLEX Applications:** ☑ Collaborative pro-active urban/inter-urban monitoring and ad-hoc control ☑ Collaborative co-modal route planning ☑ Co-modal coaching with support from virtual/avatar users ☑ Collaborative smart intersection for bus priority (intelligent priorities) ☑ Collaborative public transport optimization ☑ Community gaming (cities, infrastructure) ☑ Dynamic collaborative corridors - Enabler: ☑ Data or Aggregated data: "_____"
Relevance to EMPOWER subsystem and component	- Vehicle ☑ HMI ☑ Application - Personal ☑ HMI ☑ Application - Central ☑ HMI ☑ Synchronisation module
Requirement category	☑ Functional - Non-functional

Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	Absence of dynamic road network data as listed will prevent applications from working or limit their scope and the quality of the service. Public transport operator commitment is necessary to receive updated information about current public transport positions.
Validation method (tests, indicators, performance bounds)	Tests on availability of required dynamic content in the demonstration areas and on the possibility to access this data via the APIs.
Acceptance criteria	Availability of the map data affects functionality of several applications which affects their user acceptance.
Relationship with other requirements	- Yes ☑ - SP2_REQ_LDM_1 and SP2_REQ_POS_9
Potential conflicts	N/A
Potential technologies involved / affected	LDM++ and automotive cloud, Communication technologies for updates.
Status of requirement description	☑ Final
Other	None.

SP2_REQ_LDM 3: Separate layers and API to access them

Requirement ID:	SP2_REQ_LDM_3
Name of requirement:	Separate layers and API to access them
Created by	HERE - stephane.dreher@here.com
Assigned partner	FOKUS, ICCS, SWARCO, UNIGE, VTT
History	2013-06-10 - SD - first draft release

Goal	Data stored within the LDM++ needs to be separated for different types of data and different applications. The LDM++ should also provide a number of private layers maintained by applications (historical data, statistical data, dynamic event data including several snapshots at periodic/event-triggered intervals for historical/statistical/analytical purposes, etc.). Custom layers should be updatable with real time data (e.g., vehicular information). It should also be possible to subscribe as an application to a specific layer.
Related EMPOWER Use Case	N/A
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- DIALOGUE Applications:** ☑ Collaborative ACC ☑ Collaborative parking ☑ Collaborative driving and merging ☑ Collaborative eco-friendly navigation ☑ Serious game and community building **- FLEX Applications:** ☑ Collaborative pro-active urban/inter-urban monitoring and ad-hoc control ☑ Collaborative co-modal route planning ☑ Co-modal coaching with support from virtual/avatar users ☑ Collaborative smart intersection for bus priority (intelligent priorities)

	☑ Collaborative public transport optimization ☑ Community gaming (cities, infrastructure) ☑ Dynamic collaborative corridors - Enabler: ☑ Data or Aggregated data: "_____"
Relevance to EMPOWER subsystem and component	**- Vehicle** ☑ HMI ☑ Application **- Personal** ☑ HMI ☑ Application **- Central** ☑ HMI ☑ Synchronisation module
Requirement category	☑ Functional - Non-functional
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	- To ensure that additional application layers will not deteriorate standalone LDM++ performance - Ensure that access to read/ write on an application layer is allowed for authorized users/ applications only.
Validation method (tests, indicators, performance bounds)	Tests on availability of independent layers.
Acceptance criteria	Possibility for an application to access and modify data of a specific layer based on a position within a road link/segment.

Relationship with other requirements	- No ☑
Potential conflicts	N/A
Potential technologies involved / affected	LDM++ and automotive cloud
Status of requirement description	☑ Final
Other	None.

SP2_REQ_LDM 4: LDM++ to provide updates with low latency (bandwidth guarantees)

Requirement ID:	SP2_REQ_LDM_4
Name of requirement:	Updates with low latency (bandwidth guarantees)
Created by	HERE - stephane.dreher@here.com
Assigned partner	FOKUS, ICCS, SWARCO, UNIGE, VTT
History	2013-06-10 - SD - first draft release
Goal	The LDM++ should have the ability to provide low-latency database update, whereby low-latency should be considered in the context of the specific service request and the type of data. The LDM++ should provide a latency time limit according to communication requirements.
Related EMPOWER Use Case	N/A
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- DIALOGUE Applications:** ☑ Collaborative ACC ☑ Collaborative parking ☑ Collaborative driving and merging ☑ Collaborative eco-friendly navigation

	☑ Serious game and community building **- FLEX Applications:** ☑ Collaborative pro-active urban/inter-urban monitoring and ad-hoc control ☑ Collaborative co-modal route planning ☑ Co-modal coaching with support from virtual/avatar users ☑ Collaborative smart intersection for bus priority (intelligent priorities) ☑ Collaborative public transport optimization ☑Community gaming (cities, infrastructure) ☑ Dynamic collaborative corridors - Enabler: ☑ Data or Aggregated data: "_____"
Relevance to EMPOWER subsystem and component	**- Vehicle** ☑ HMI ☑ Application **- Personal** ☑ HMI ☑ Application **- Central** ☑ HMI ☑ Synchronisation module
Requirement category	☑ Functional - Non-functional
Critical level (priority)	Define the importance of the requirement:

	☑ Mandatory
Risk analysis	- The required latency is dependent on the platform the application is running on, the necessity and amount of data to exchange with other vehicles or systems and the size of the area around the ego-position the application targets. A failure for the LDM++ to allow update frequency with sufficiently low latency will prevent the most performance demanding applications to work. - Overall performance might be low if latency is too high in case multiple applications access the LDM++
Validation method (tests, indicators, performance bounds)	Tests of latency to receive dynamic data updates from the LDM++ for all applications in different sub-systems (vehicle, Central, Personal).
Acceptance criteria	All applications requiring dynamic data should be able to receive updates with a latency ensuring proper functionality.
Relationship with other requirements	- No ☑
Potential conflicts	N/A
Potential technologies involved / affected	LDM++ and automotive cloud
Status of requirement description	☑ Final
Other	None.

SP2_REQ_LDM 5: LDM++ to support simultaneous access

Requirement ID:	SP2_REQ_LDM_5
Name of requirement:	LDM++ to support simultaneous access
Created by	HERE - stephane.dreher@here.com
Assigned partner	FOKUS, ICCS, SWARCO, UNIGE, VTT

History	2013-06-10 - SD - first draft release
Goal	The LDM++ should be able to provide simultaneous access (read and write operations) from a number of applications (including distributed applications), but also simultaneous access from other potential client applications.
Related EMPOWER Use Case	N/A
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- DIALOGUE Applications:** ☑ Collaborative ACC ☑Collaborative parking ☑ Collaborative driving and merging ☑ Collaborative eco-friendly navigation ☑ Serious game and community building **- FLEX Applications:** ☑ Collaborative pro-active urban/inter-urban monitoring and ad-hoc control ☑ Collaborative co-modal route planning ☑ Co-modal coaching with support from virtual/avatar users ☑ Collaborative smart intersection for bus priority (intelligent priorities) ☑ Collaborative public transport optimization ☑Community gaming (cities, infrastructure) ☑ Dynamic collaborative corridors - Enabler: ☑ Data or Aggregated data: "_____"

Relevance to EMPOWER subsystem and component	**- Vehicle** ☑ Application **- Personal** ☑ Application **- Central** ☑ Synchronisation module
Requirement category	☑ Functional - Non-functional
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	Overall performance might be reduced and access to some services or applications impossible if simultaneous access to the LDM++ by a sufficient number of applications cannot be guaranteed.
Validation method (tests, indicators, performance bounds)	Tests of simultaneous read/write access by an increasing number of applications within the different sub-systems (vehicle, personal, central)
Acceptance criteria	All applications can perform their necessary read/write access to the LDM++ to deliver services and functionalities according to their performance criteria.
Relationship with other requirements	- No ☑
Potential conflicts	N/A
Potential technologies involved / affected	LDM++ and automotive cloud
Status of requirement description	☑ Final
Other	None.

SP2_REQ_LDM 6: LDM++ data synchronisation mechanism

Requirement ID:	SP2_REQ_LDM_6
Name of requirement:	LDM++ data synchronisation mechanism
Created by	HERE - stephane.dreher@here.com
Assigned partner	FOKUS, ICCS, SWARCO, UNIGE, VTT
History	2013-06-10 - SD - first draft release
Goal	LDM++ to provide a synchronisation mechanism within and with the cloud.
Related EMPOWER Use Case	N/A
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- DIALOGUE Applications:** ☑ Collaborative ACC ☑ Collaborative parking ☑ Collaborative driving and merging ☑ Collaborative eco-friendly navigation ☑ Serious game and community building **- FLEX Applications:** ☑ Collaborative pro-active urban/inter-urban monitoring and ad-hoc control ☑ Collaborative co-modal route planning ☑ Co-modal coaching with support from virtual/avatar users ☑ Collaborative smart intersection for bus priority (intelligent priorities) ☑ Collaborative public transport optimization

	☑Community gaming (cities, infrastructure) ☑ Dynamic collaborative corridors - Enabler: ☑ Data or Aggregated data: "_____"
Relevance to EMPOWER subsystem and component	- Vehicle ☑ Application - Personal ☑ Application - Central ☑ Synchronisation module
Requirement category	☑ Functional - Non-functional
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	- The absence of a proper synchronization mechanism with the cloud will limit up-to-dateness of local LDM++ content and thus lead to applications using expired or false data.
Validation method (tests, indicators, performance bounds)	Tests of synchronization of dynamic content of the different sub-systems (vehicle, personal, central) with the cloud with visible impact on application via e.g. HMI.
Acceptance criteria	Real time update (within a few seconds) of the user interface with dynamic content automatically or after request
Relationship with other requirements	- No ☑
Potential conflicts	N/A
Potential technologies involved / affected	LDM++ and automotive cloud

Status of requirement description	☑ Final
Other	None.

SP2_REQ_LDM 7: LDM++ to provide interoperable interface

Requirement ID:	SP2_REQ_LDM_7
Name of requirement:	LDM++ to provide interoperable interface
Created by	HERE - stephane.dreher@here.com
Assigned partner	FOKUS, ICCS, SWARCO, UNIGE, VTT
History	2013-06-10 - SD - first draft release
Goal	Access to the LDM++ should be defined through standard interfaces in order to allow independence and interoperability with different map providers.
Related EMPOWER Use Case	N/A
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- DIALOGUE Applications:** ☑ Collaborative ACC ☑ Collaborative parking ☑ Collaborative driving and merging ☑ Collaborative eco-friendly navigation ☑ Serious game and community building **- FLEX Applications:** ☑ Collaborative pro-active urban/inter-urban monitoring and ad-hoc control ☑ Collaborative co-modal route planning

	☑ Co-modal coaching with support from virtual/avatar users ☑ Collaborative smart intersection for bus priority (intelligent priorities) ☑ Collaborative public transport optimization ☑ Community gaming (cities, infrastructure) ☑ Dynamic collaborative corridors - Enabler: ☑ Data or Aggregated data: "_____"
Relevance to EMPOWER subsystem and component	- Vehicle ☑ Application - Personal ☑ Application - Central ☑ Synchronisation module
Requirement category	☑ Functional - Non-functional
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	- The absence of interoperable interfaces will prevent the use of different map data sources and dynamic data providers. - Use of interoperable and standardized interfaces will ensure the viability of the developed TEAM system and applications.
Validation method (tests, indicators, performance bounds)	Tests with various data sources for the same type of data in a demonstration area.

Acceptance criteria	The access to the data should be transparent for the application independently from the underlying data provider source.
Relationship with other requirements	- No ☑
Potential conflicts	N/A
Potential technologies involved / affected	LDM++ and automotive cloud
Status of requirement description	☑ Final
Other	None.

SP2_REQ_LDM 8: LDM++ services to be available on the cloud

Requirement ID:	SP2_REQ_LDM_8
Name of requirement:	LDM++ services to be available on the cloud
Created by	HERE - stephane.dreher@here.com
Assigned partner	FOKUS, ICCS, SWARCO, UNIGE, VTT
History	2013-06-10 - SD - first draft release
Goal	The LDM++ should include a service seamlessly available on the cloud, not residing on the vehicle.
Related EMPOWER Use Case	N/A
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- DIALOGUE Applications:** ☑ Collaborative ACC ☑Collaborative parking ☑ Collaborative driving and merging ☑ Collaborative eco-friendly navigation

	☑ Serious game and community building **- FLEX Applications:** ☑ Collaborative pro-active urban/inter-urban monitoring and ad-hoc control ☑ Collaborative co-modal route planning ☑ Co-modal coaching with support from virtual/avatar users ☑ Collaborative smart intersection for bus priority (intelligent priorities) ☑ Collaborative public transport optimization ☑Community gaming (cities, infrastructure) ☑ Dynamic collaborative corridors - Enabler: ☑ Data or Aggregated data: "_____"
Relevance to EMPOWER subsystem and component	- Vehicle ☑ Application - Personal ☑ Application - Central ☑ Synchronisation module
Requirement category	☑ Functional - Non-functional
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	- This is necessary for sustainability of the development effort.

Validation method (tests, indicators, performance bounds)	Tests during development phase on a larger scale.
Acceptance criteria	N/A
Relationship with other requirements	- No ☑
Potential conflicts	N/A
Potential technologies involved / affected	LDM++ and automotive cloud
Status of requirement description	☑ Final
Other	None.

SP2_REQ_LDM 9: LDM++ Notification service

Requirement ID:	SP2_REQ_LDM_9
Name of requirement:	LDM++ Notification service
Created by	HERE - stephane.dreher@here.com
Assigned partner	FOKUS, ICCS, SWARCO, UNIGE, VTT
History	2013-06-10 - SD - first draft release
Goal	LDM++ to have a dedicated component/service that will check the position of a vehicle and propagate a message to the applications when the vehicle enters or exits: 1. A predefined location of interest, such as a parking slot, an intersection and highway entrance/exit. 2. A virtual area based on speed, fuel consumption (low priority requirement). This event can serve as a trigger to download relevant data for that area from the cloud. Rules for triggering and types of actions
Related EMPOWER Use Case	N/A
Source (TEAM application or	From which application/enabler the requirement has been

enabler)	created: **- DIALOGUE Applications:** ☑ Collaborative ACC ☑Collaborative parking ☑ Collaborative driving and merging ☑ Collaborative eco-friendly navigation ☑ Serious game and community building **- FLEX Applications:** ☑ Collaborative pro-active urban/inter-urban monitoring and ad-hoc control ☑ Collaborative co-modal route planning ☑ Co-modal coaching with support from virtual/avatar users ☑ Collaborative smart intersection for bus priority (intelligent priorities) ☑ Collaborative public transport optimization ☑Community gaming (cities, infrastructure) ☑ Dynamic collaborative corridors - Enabler: ☑ Data or Aggregated data: "_____"
Relevance to EMPOWER subsystem and component	**- Vehicle** ☑ Application **- Personal** ☑ Application **- Central** ☑ Synchronisation module

Requirement category	☑ Functional - Non-functional
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	- This is necessary for sustainability of the development effort.
Validation method (tests, indicators, performance bounds)	Tests to ensure that notification service is rightly triggered
Acceptance criteria	Applications are notified in time for entrance/exit to predefined locations.
Relationship with other requirements	- No ☑
Potential conflicts	N/A
Potential technologies involved / affected	LDM++ and automotive cloud
Status of requirement description	☑ Final
Other	None.

SP2_REQ_LDM 10: LDM++ map matching and geocoding service

Requirement ID:	SP2_REQ_LDM_10
Name of requirement:	LDM++ map matching and geocoding service
Created by	HERE - stephane.dreher@here.com
Assigned partner	FOKUS, ICCS, SWARCO, UNIGE, VTT
History	2013-06-10 - SD - first draft release
Goal	LDM++ to provide a service to applications for converting a geographical position into a location on the road network or into a geo-referenced position.

Related EMPOWER Use Case	N/A
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- DIALOGUE Applications:** ☑ Collaborative ACC ☑Collaborative parking ☑ Collaborative driving and merging ☑ Collaborative eco-friendly navigation ☑ Serious game and community building **- FLEX Applications:** ☑ Collaborative pro-active urban/inter-urban monitoring and ad-hoc control ☑ Collaborative co-modal route planning ☑ Co-modal coaching with support from virtual/avatar users ☑ Collaborative smart intersection for bus priority (intelligent priorities) ☑ Collaborative public transport optimization ☑Community gaming (cities, infrastructure) ☑ Dynamic collaborative corridors - Enabler: ☑ Data or Aggregated data: "_____"
Relevance to EMPOWER subsystem and component	**- Vehicle** ☑ Application **- Personal** ☑ Application

	- Central ☑ Synchronisation module
Requirement category	☑ Functional - Non-functional
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	- The geocoding and map-matching services are necessary to enable an application to reference an event and data on the static map inside the LDM++. Without such a mechanisms inherent to the LDM++, writing to the LDM++ will not be possible.
Validation method (tests, indicators, performance bounds)	Testing of the geocoding and map matching functionalities for a few events in different road environments based on geographical positions.
Acceptance criteria	Events properly referenced on the static map of the LDM++ and proper position verified on the HMI.
Relationship with other requirements	- No ☑
Potential conflicts	N/A
Potential technologies involved / affected	LDM++ and automotive cloud
Status of requirement description	☑ Final
Other	None.

SP2_REQ_LDM 11: LDM++ routing service

Requirement ID:	SP2_REQ_LDM_11
Name of requirement:	LDM++ routing service
Created by	HERE - stephane.dreher@here.com

Assigned partner	FOKUS, ICCS, SWARCO, UNIGE, VTT
History	2013-06-10 - SD - first draft release
Goal	LDM++ to provide a simple routing service. The service must include origin/destination selection and shortest and fastest route option. The development of more advanced routing functionalities will be possible for external applications (e.g. CONAV) accessing both static and dynamic data at the level of road links via the dedicated APIs.
Related EMPOWER Use Case	N/A
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- DIALOGUE Applications:** ☑ Collaborative ACC ☑Collaborative parking ☑ Collaborative driving and merging ☑ Collaborative eco-friendly navigation ☑ Serious game and community building **- FLEX Applications:** ☑ Collaborative pro-active urban/inter-urban monitoring and ad-hoc control ☑ Collaborative co-modal route planning ☑ Co-modal coaching with support from virtual/avatar users ☑ Collaborative smart intersection for bus priority (intelligent priorities) ☑ Collaborative public transport optimization ☑Community gaming (cities, infrastructure)

	☑ Dynamic collaborative corridors - Enabler: ☑ Data or Aggregated data: "_____"
Relevance to EMPOWER subsystem and component	**- Vehicle** ☑ Application **- Personal** ☑ Application **- Central** ☑ Synchronisation module
Requirement category	☑ Functional - Non-functional
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	N/A
Validation method (tests, indicators, performance bounds)	Testing of the routing functionality for a few start (including ego-position) and destination locations and driving environments with different routing criteria
Acceptance criteria	Route calculation triggered by an application or user from the routing service and accessible by the applications.
Relationship with other requirements	- No ☑
Potential conflicts	N/A
Potential technologies involved / affected	LDM++ and automotive cloud
Status of requirement description	☑ Final
Other	None.

SP2_REQ_LDM 12: LDM++ Map display with merged static and dynamic content view

Requirement ID:	SP2_REQ_LDM_12
Name of requirement:	LDM++ Map display with merged static and dynamic content view
Created by	HERE - stephane.dreher@here.com
Assigned partner	FOKUS, ICCS, SWARCO, UNIGE, VTT
History	2013-06-10 - SD - first draft release
Goal	LDM++ to provide an API to provide a merged view on static and dynamic content and a visual rendering component (from SG application?)
Related EMPOWER Use Case	N/A
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- DIALOGUE Applications:** ☑ Collaborative ACC ☑Collaborative parking ☑ Collaborative driving and merging ☑ Collaborative eco-friendly navigation ☑ Serious game and community building **- FLEX Applications:** ☑ Collaborative pro-active urban/inter-urban monitoring and ad-hoc control ☑ Collaborative co-modal route planning ☑ Co-modal coaching with support from virtual/avatar users ☑ Collaborative smart intersection for bus priority (intelligent priorities)

	☑ Collaborative public transport optimization ☑Community gaming (cities, infrastructure) ☑ Dynamic collaborative corridors - Enabler: ☑ Data or Aggregated data: "_____"
Relevance to EMPOWER subsystem and component	**- Vehicle** ☑ Application **- Personal** ☑ Application **- Central** ☑ Synchronisation module
Requirement category	☑ Functional - Non-functional
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	N/A
Validation method (tests, indicators, performance bounds)	Tests for API and display to ensure it contains static and dynamic content.
Acceptance criteria	N/A
Relationship with other requirements	- No ☑
Potential conflicts	N/A
Potential technologies involved / affected	LDM++ and automotive cloud
Status of requirement description	☑ Final
Other	None.

Cooperative Positioning related requirements

SP2_REC_POS 1: ITS-G5 communication

Requirement ID:	SP2_REQ_POS_01_v1.0
Name of requirement:	ITS-G5 communication
Created by	Filippo Visintainer – filippo.visintainer@crf.it Bernd Schäufele - bernd.schaeufele@dcaiti.com
Assigned partner	TG Positioning
History	2013-05-13 – BS – first draft of description
Goal	Localisation data among nodes shall be exchanged via ITS-G5 communication. This is necessary to improve the localization of the nodes.
Related EMPOWER Use Case	Affects almost every TEAM application.
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- Application independent:** ☑ "_____"
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ HMI ☑ Application **- Central** ☑ Positioning unit ☑ Communication unit ☑ LDM++ - **Roadside** ☑ HMI

	☑ Application
Requirement category	☑Functional
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	If this requirement is not met, the localisation cannot be improved with position information of other nodes.
Validation method (tests, indicators, performance bounds)	Test ITS-G5 communication for all technology use cases in different situations.
Acceptance criteria	Localisation information is exchanged between nodes via ITS-G5, when another node is within range.
Relationship with other requirements	- Same level with: Req. 14, 15 - Hierarchical Parent req. of: Req. 2, 13
Potential conflicts	None identified
Potential technologies involved / affected	This requirement is related to ITS-G5 communication
Status of requirement description	☑ Final
Other	None.

SP2_REC_POS 2: Localisation data exchange via Cooperative Localisation Message

Requirement ID:	SP2_REQ_POS_02_v1.0
Name of requirement:	Localisation data exchange via Cooperative Localisation Message
Created by	Filippo Visintainer – filippo.visintainer@crf.it Bernd Schäufele – bernd.schaeufele@dcaiti.com
Assigned partner	TG Positioning

History	2013-05-13 – BS – first draft of description
Goal	The localisation data of nodes shall be exchanged via Cooperative Localisation Message. This is necessary to process the localization data of surrounding nodes.
Related EMPOWER Use Case	Affects almost every TEAM application.
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- Application independent:** ☑ "_____"
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ HMI ☑ Application **- Central** ☑ Positioning unit ☑ Communication unit ☑ LDM++ **- Roadside** ☑ Application
Requirement category	☑Functional
Critical level (priority)	Define the importance of the requirement: ☑ Recommended
Risk analysis	If this requirement is not met, the localisation cannot be improved with position information of other nodes.
Validation method (tests, indicators, performance bounds)	Test localization exchange via CLM for all technology use cases in different situations. The data must be encoded on one station and decoded on different stations. The tests must be

	performed with all computer architectures that are relevant in the project.
Acceptance criteria	CLM can be encoded on one node and decoded on another node after having received its.
Relationship with other requirements	- Same level with: Req. 13 - Hierarchical Parent req. of: Req. 3, 20 Child req. of: Req. 2
Potential conflicts	None identified
Potential technologies involved / affected	This requirement is related to ITS-G5 communication and LDM++.
Status of requirement description	☑ Final
Other	None.

SP2_REC_POS 3: GPS raw data in CLM

Requirement ID:	SP2_REQ_POS_03_v1.0
Name of requirement:	GPS raw data in CLM
Created by	Filippo Visintainer – filippo.visintainer@crf.it Bernd Schäufele – bernd.schaeufele@dcaiti.com
Assigned partner	TG Positioning
History	2013-05-13 – BS – first draft of description
Goal	The node localisation data in CLM shall include GPS raw data. This data is necessary to compute the relative vector between the cooperating vehicles.

Related EMPOWER Use Case	Affects almost every TEAM application.
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- Application independent:** ☑ "_____"
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ HMI ☑ Application **- Central** ☑ Positioning unit ☑ LDM++
Requirement category	☑Functional
Critical level (priority)	Define the importance of the requirement: ☑ Recommended
Risk analysis	If this requirement is not met, the relative vector between the cooperating vehicles cannot be estimated. Applications rely on high accuracy position might fail with unpredictable results, including safety issues.
Validation method (tests, indicators, performance bounds)	Test the exchange of GPS raw data for all technology use cases in different situations.
Acceptance criteria	GPS raw data is included in CLM by one node and is read by another node.
Relationship with other requirements	- Hierarchical Parent req. of: Req. 6 Child req. of: Req. 2, 14
Potential conflicts	None identified

Potential technologies involved / affected	This requirement is related to ITS-G5 communication and LDM++.
Status of requirement description	☑ Final
Other	None.

SP2_REC_POS 4: Position accuracy evaluation mode available

Requirement ID:	SP2_REQ_POS_04_v1.0
Name of requirement:	Position accuracy evaluation mode available
Created by	Filippo Visintainer – filippo.visintainer@crf.it Bernd Schäufele – bernd.schaeufele@dcaiti.com
Assigned partner	TG Positioning
History	2013-05-13 – BS – first draft of description
Goal	Positioning system shall be able to work in "position accuracy evaluation mode", using both the target GPS modules and a reference system in parallel, e.g. Differential GPS (DGPS) / Real Time Kinematics (RTK).
Related EMPOWER Use Case	Affects almost every TEAM application.
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- Application independent:** ☑ "_____"
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ Other "Positioning component"
Requirement category	- Non-functional

	☑ Technological and development requirements
Critical level (priority)	Define the importance of the requirement: ☑ Recommended
Risk analysis	If the requirement is not met, the cooperative positioning system cannot be evaluated.
Validation method (tests, indicators, performance bounds)	Test, if the reference system is available
Acceptance criteria	The criteria is met when there is a reference system available, that generally provides better accuracy than GPS.
Relationship with other requirements	- Hierarchical Parent req. of: Req. 5 Child req. of: Req. 16
Potential conflicts	None identified
Potential technologies involved / affected	This requirement is related to CLM, Differential GPS and RTK
Status of requirement description	☑ Final
Other	None.

SP2_REC_POS 5: Data from target and reference system inside CLM in evaluation mode

Requirement ID:	SP2_REQ_POS_05_v1.0
Name of requirement:	Data from target and reference system inside CLM in evaluation mode
Created by	Filippo Visintainer – filippo.visintainer@crf.it Bernd Schäufele – bernd.schaeufele@dcaiti.com
Assigned partner	TG Positioning
History	2013-05-13 – BS – first draft of description
Goal	When in "evaluation mode", localisation data shall include data

	of both target GPS and of reference system (e.g. DGPS)
Related EMPOWER Use Case	Affects almost every TEAM application.
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- Application independent:** ☑ "_____"
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ Other "Positioning component"
Requirement category	- Non-functional ☑ Technological and development requirements
Critical level (priority)	Define the importance of the requirement: ☑ Optional
Risk analysis	N/A
Validation method (tests, indicators, performance bounds)	Test that CLM includes data from target and reference system
Acceptance criteria	The data from target and reference system can be included in CLM.
Relationship with other requirements	- Hierarchical Child req. of: Req. 4
Potential conflicts	None identified
Potential technologies involved / affected	This requirement is related to CLM, Differential GPS and RTK
Status of requirement description	☑ Final
Other	None.

SP2_REC_POS 6: Infering of relative positioning vector

Requirement ID:	SP2_REQ_POS_06_v1.0
Name of requirement:	Inferring of relative positioning vector
Created by	Filippo Visintainer – filippo.visintainer@crf.it Bernd Schäufele – bernd.schaeufele@dcaiti.com
Assigned partner	TG Positioning
History	2013-05-13 – BS – first draft of description
Goal	Within positioning system, the cooperative position module shall be able to infer relative positioning vector
Related EMPOWER Use Case	Affects almost every TEAM application.
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- Application independent:** ☑ "_____"
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ HMI ☑ Application
Requirement category	☑ Functional - Non-functional ☑ Technological and development requirements
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	If the relative position cannot be calculated, the localisation cannot be improved by the system.
Validation method (tests,	The relative positioning vector is calculated in different

indicators, performance bounds)	situations for all technology use cases listed, when position data of another node is available.
Acceptance criteria	The calculation of the relative positioning vector is correct in all tested situations.
Relationship with other requirements	- Hierarchical Parent req. of: Req. 7, 10, 11, 12, 16, 17, 21 Child req. of: Req. 3, 20
Potential conflicts	None identified
Potential technologies involved / affected	This requirement is related to CLM and localisation
Status of requirement description	☑ Final
Other	None.

SP2_REC_POS 7: Provision of relative positioning vector to LDM++

Requirement ID:	SP2_REQ_POS_07_v1.0
Name of requirement:	Provision of relative positioning vector to LDM++
Created by	Filippo Visintainer – filippo.visintainer@crf.it Bernd Schäufele – bernd.schaeufele@dcaiti.com
Assigned partner	TG Positioning
History	2013-05-13 – first draft of description
Goal	Cooperative position module shall provide relative positioning vector to the LDM++
Related EMPOWER Use Case	Affects almost every TEAM application.
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- Application independent:**

	☑ "_____"
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ Application **- Central** ☑ LDM++
Requirement category	- Non-functional ☑ General architectural and equipment requirements
Critical level (priority)	Define the importance of the requirement: ☑ Recommended
Risk analysis	If this requirement is not met, there is a risk if applications rely on relative positioning data from the LDM++. These applications will not be able to work.
Validation method (tests, indicators, performance bounds)	Relative positioning vectors are transferred to LDM++ on all available communication ways.
Acceptance criteria	The relative positioning vector is transferred to LDM++ in all tests.
Relationship with other requirements	- Same level with: Req. 10, 11, 12, 16, 17, 21 - Hierarchical Child req. of: Req. 6
Potential conflicts	None identified
Potential technologies involved / affected	This requirement is related to CLM, localisation and the LDM++.
Status of requirement description	☑ Final
Other	None.

SP2_REC_POS 8: Retrieval of geo-referenced positioning from LDM++

Requirement ID:	SP2_REQ_POS_08_v1.0
Name of requirement:	Retrieval of geo-referenced positioning from LDM++
Created by	Filippo Visintainer – filippo.visintainer@crf.it Bernd Schäufele – bernd.schaeufele@dcaiti.com
Assigned partner	TG Positioning
History	2013-05-13 – BS – first draft of description
Goal	Positioning system shall retrieve geo-referenced positioning from the LDM++
Related EMPOWER Use Case	Affects almost every TEAM application.
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- Application independent:** ☑ "_____"
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ HMI ☑ Application **- Central** ☑ LDM++
Requirement category	- Non-functional ☑ General architectural and equipment requirements
Critical level (priority)	Define the importance of the requirement: ☑ Recommended
Risk analysis	If this requirement is not met, there is a risk if applications use geo-referencing information. These applications will not work

	properly.
Validation method (tests, indicators, performance bounds)	Geo-referenced position is retrieved from LDM++ in different situations for all technology use cases listed.
Acceptance criteria	LDM++ provides geo-referencing and cooperative positioning uses it when available.
Relationship with other requirements	- Hierarchical Parent req. of: Req. 19
Potential conflicts	None identified
Potential technologies involved / affected	This requirement is related to the LDM++ and geo-referencing
Status of requirement description	☑ Final
Other	None.

SP2_REC_POS 9: Lane-level accuracy of map-referenced positioning

Requirement ID:	SP2_REQ_POS_09_v1.0
Name of requirement:	Lane-level accuracy of map-referenced positioning
Created by	Filippo Visintainer – filippo.visintainer@crf.it Bernd Schäufele – bernd.schaeufele@dcaiti.com
Assigned partner	TG Positioning
History	2013-05-13 – BS – first draft of description
Goal	The geo-referenced and map-referenced position with lane-level accuracy of LDM++ shall be used.
Related EMPOWER Use Case	Affects almost every TEAM application.
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- Application independent:**

	☑ "_____"
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ HMI ☑ Application
Requirement category	- Non-functional ☑ Other: Quality
Critical level (priority)	Define the importance of the requirement: ☑ Recommended
Risk analysis	If this requirement is not met, there is a risk if applications use lane-accurate map-referenced position. These applications will not work properly.
Validation method (tests, indicators, performance bounds)	Lane-level accuracy position is retrieved from LDM++ in different situations for all technology use cases listed.
Acceptance criteria	LDM++ provides lane-level accuracy for multi-lane roads and cooperative positioning uses it when available.
Relationship with other requirements	- Hierarchical Child req. of: 19
Potential conflicts	None identified
Potential technologies involved / affected	This requirement is related to the LDM++, geo-referencing and map matching.
Status of requirement description	☑ Final
Other	None.

SP2_REC_POS 10: Provision of cooperative localisation data to applications and other modules

Requirement ID:	SP2_REQ_POS_10_v1.0

Name of requirement:	Provision of cooperative localisation data to applications and other modules
Created by	Filippo Visintainer – filippo.visintainer@crf.it Bernd Schäufele – bernd.schaeufele@dcaiti.com
Assigned partner	TG Positioning
History	2013-05-13 – BS – first draft of description
Goal	Positioning system shall provide both geo-referenced and relative positioning data, speed and heading to SP3 and SP4 applications as well as to other SP2 modules (e.g. ITS-G5 Geo-casting communication support, if available)
Related EMPOWER Use Case	Affects almost every TEAM application.
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- Application independent:** ☑ "_____"
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ HMI ☑ Application **- Central** ☑ Communication unit ☑ LDM++
Requirement category	- Non-functional ☑ General architectural and equipment requirements
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	If this requirement is not met, there is a risk for applications

	that rely on positioning. They can only use the standard positioning and might fail with unpredictable results, including safety issues, when cooperative positioning is not available.
Validation method (tests, indicators, performance bounds)	The interface for other modules is tested in different situations for all technology use cases listed.
Acceptance criteria	Cooperative positioning offers and interface for other applications and provides the position in all test cases via this interface, whenever the position is available.
Relationship with other requirements	- Same level with: Req. 7, 11, 12, 16, 17, 21 - Hierarchical Child req. of: Req. 6
Potential conflicts	None identified
Potential technologies involved / affected	This requirement is related to ITS-G5.
Status of requirement description	☑ Final
Other	None.

SP2_REC_POS 11: Computation of relative position to Road Side Units

Requirement ID:	SP2_REQ_POS_11_v1.0
Name of requirement:	Computation of relative position to Road Side Units
Created by	Filippo Visintainer – filippo.visintainer@crf.it Bernd Schäufele – bernd.schaeufele@dcaiti.com
Assigned partner	TG Positioning
History	2013-05-13 – BS – first draft of description
Goal	Positioning system shall be able to compute relative position from ego-position and raw GPS position data of nearby roadside units (see SP2 Use case C-GPS – 1)

Related EMPOWER Use Case	Affects almost every TEAM application.
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- Application independent:** ☑ "_____"
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ HMI ☑ Application **- Roadside** ☑ Positioning unit ☑ Communication unit ☑ LDM++
Requirement category	☑ Functional
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	If this requirement is not met, there is a risk for applications that rely on relative positioning. They might fail when relative positioning does not include Road Side Units, with unpredictable results, including safety issues.
Validation method (tests, indicators, performance bounds)	The computation of the relative position to Road Side Units is tested in different situations for all technology use cases listed.
Acceptance criteria	The relative position to Road Side Units is computed and sufficiently accurate.
Relationship with other requirements	- Same level with: Req. 7, 10, 12, 16, 17 - Hierarchical Child req. of: Req. 6

Potential conflicts	None identified
Potential technologies involved / affected	N/A
Status of requirement description	☑ Final
Other	None.

SP2_REC_POS 12: Computation of relative position to vehicles

Requirement ID:	SP2_REQ_POS_12_v1.0
Name of requirement:	Computation of relative position to vehicles
Created by	Filippo Visintainer – filippo.visintainer@crf.it Bernd Schäufele – bernd.schaeufele@dcaiti.com
Assigned partner	TG Positioning
History	2013-05-13 – BS – first draft of description
Goal	Positioning system shall be able to compute relative position from GPS raw data sent by nearby vehicles (see SP2 Use case C-GPS – 2)
Related EMPOWER Use Case	Affects almost every TEAM application.
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- Application independent:** ☑ "_____"
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ HMI ☑ Application
Requirement category	☑ Functional

Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	If this requirement is not met, there is a risk for applications that rely on relative positioning. They might fail when relative positioning does not include vehicles, with unpredictable results, including safety issues.
Validation method (tests, indicators, performance bounds)	The computation of the relative position to vehicles is tested in different situations for all technology use cases listed.
Acceptance criteria	The relative position to vehicles is computed and sufficiently accurate.
Relationship with other requirements	- Same level with: Req. 7, 10, 11, 16, 17, 21 - Hierarchical Child req. of: Req. 6
Potential conflicts	None identified
Potential technologies involved / affected	N/A
Status of requirement description	☑ Final
Other	None

SP2_REC_POS 13: Park positioning mode available

Requirement ID:	SP2_REQ_POS_13_v1.0
Name of requirement:	Park positioning mode available
Created by	Filippo Visintainer – filippo.visintainer@crf.it Bernd Schäufele – bernd.schaeufele@dcaiti.com
Assigned partner	TG Positioning
History	2013-05-13 – first draft of description

Goal	When "parking positioning mode" is active positioning system shall be able to work even after key off, as beacon for the positioning of other vehicles (see SP2 Use case C-GPS – 3)
Related EMPOWER Use Case	Affects almost every TEAM application.
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- Application independent:** ☑ "_____"
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ HMI ☑ Application
Requirement category	☑ Functional
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	If this requirement is not met, there is a risk for applications that rely on relative positioning. They might fail when relative positioning does not include parking vehicles, with unpredictable results, including safety issues.
Validation method (tests, indicators, performance bounds)	The positioning system is active, even after key-off and computation of the relative position to parking vehicles is tested in different situations for all technology use cases listed.
Acceptance criteria	Parked vehicles can send their position. On receiving nodes, the relative position to parking vehicles is computed and sufficiently accurate.
Relationship with other requirements	- Same level with: Req. 3 - Hierarchical Child req. of: Req. 1

Potential conflicts	None identified
Potential technologies involved / affected	N/A
Status of requirement description	☑ Final
Other	None.

SP2_REC_POS 14: Receive GPS raw data from GPS receiver

Requirement ID:	SP2_REQ_POS_14_v1.0
Name of requirement:	Receive GPS raw data from GPS receiver
Created by	Sebastian Papierok – sebastian.papierok@delphi.com Arnd Romfeld – arnd.romfeld@delphi.com Bernd Schäufele – bernd.schaeufele@dcaiti.com
Assigned partner	TG Positioning
History	2013-05-13 – BS – first draft of description
Goal	Cooperative position module shall receive unprocessed GPS data (e.g. measurement data, ephemeris data, ionospheric parameters) from the raw data GPS receiver. This data is needed for cooperative positioning algorithm calculations
Related EMPOWER Use Case	Affects almost every TEAM application.
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- FLEX Applications:** ☑ Co-modal coaching with support from virtual/avatar users ☑ Collaborative smart intersection for bus priority (intelligent priorities) ☑ Collaborative public transport optimization

	☑ Community gaming (cities, infrastructure) ☑ Dynamic collaborative corridors **- Enabler:** ☑ Algorithm: "Cooperative Positioning Algorithm"
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ Application ☑ Security & Privacy - **Roadside** ☑ Application ☑ Security & Privacy
Requirement category	☑ Functional
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	If this requirement is not met, there is a risk if the applications rely on high position accuracy and the module in some situations cannot provide that. In this case the application might fail with unpredictable results, including safety issues.
Validation method (tests, indicators, performance bounds)	The reception of GPS raw data is tested in different situations.
Acceptance criteria	GPS raw data can be retrieved by the positioning module.
Relationship with other requirements	- Same level with: Req. 1, 15 - Hierarchical Parent req. of: Req. 3
Potential conflicts	None identified
Potential technologies involved / affected	This requirement is related to GPS.
Status of requirement description	☑ Final

Other	None.

SP2_REC_POS 15: Receive processed GPS data from GPS receiver

Requirement ID:	SP2_REQ_POS_15_v1.0
Name of requirement:	Receive processed GPS data from GPS receiver
Created by	Sebastian Papierok – sebastian.papierok@delphi.com Arnd Romfeld – arnd.romfeld@delphi.com Bernd Schäufele – bernd.schaeufele@dcaiti.com
Assigned partner	TG Positioning
History	2013-05-13 – BS – first draft of description
Goal	Cooperative position module shall receive processed GPS data (e.g. absolute GPS position) from the raw data GPS receiver. Together with calculated position data of GPS raw data an accuracy evaluation can be performed.
Related EMPOWER Use Case	Affects almost every TEAM application.
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- FLEX Applications:** ☑ Co-modal coaching with support from virtual/avatar users ☑ Collaborative smart intersection for bus priority (intelligent priorities) ☑ Collaborative public transport optimization ☑ Community gaming (cities, infrastructure) ☑ Dynamic collaborative corridors **- Enabler:**

	☑ Algorithm: "Cooperative Positioning Algorithm"
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ Application ☑ Security & Privacy - **Roadside** ☑ Application ☑ Security & Privacy
Requirement category	- Non-functional ☑ Connectivity and communication requirements
Critical level (priority)	Define the importance of the requirement: ☑ Recommended
Risk analysis	If this requirement is not met, the ITS station is not functional. Proper positioning is a key enabler for various functions. In the context of cooperative positioning, absolute positions are used for referencing purposes during testing and validation. Testing functionalities would be limited if the requirements is not met.
Validation method (tests, indicators, performance bounds)	The reception of processed GPS data is tested in different situations.
Acceptance criteria	Test correct reception of processed GPS data and compare position with position data of fully functional test GPS receiver
Relationship with other requirements	- Same level with: Req. 1, 14 - Hierarchical Parent req. of: Req. 20
Potential conflicts	None identified
Potential technologies involved / affected	This requirement is related to GPS.
Status of requirement description	☑ Final

Other	None.

SP2_REC_POS 16: Accuracy information

Requirement ID:	SP2_REQ_POS_16_v1.0
Name of requirement:	Accuracy information
Created by	Rafael Basso – rafael.basso@volvo.com
Assigned partner	TG Positioning
History	2013.04.25 - RB - first draft description
Goal	Cooperative position module should be able to indicate the accuracy of the current position, both relative and absolute positions. This is necessary to perform graceful degradation of application functionality in case the necessary accuracy is not possible to be achieved. It is a reliability related requirement.
Related EMPOWER Use Case	Affects almost every TEAM application.
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- FLEX Applications:** ☑ Collaborative pro-active urban/inter-urban monitoring and ad-hoc control ☑ Co-modal coaching with support from virtual/avatar users ☑ Collaborative smart intersection for bus priority (intelligent priorities) ☑ Collaborative public transport optimization ☑ Community gaming (cities, infrastructure) ☑ Dynamic collaborative corridors
Relevance to EMPOWER subsystem and component	**- Vehicle**

	☑ Application **- Roadside** ☑ Application
Requirement category	☑ Functional
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	If this requirement is not met, there is a risk if the applications rely on high position accuracy and the module in some situations cannot provide that. In this case the application might fail with unpredictable results, including safety issues.
Validation method (tests, indicators, performance bounds)	Test accuracy information in different situations for all technology use cases listed.
Acceptance criteria	Accuracy information matches the actual position accuracy provided by the cooperative position module
Relationship with other requirements	- No ☑ - Same level with: Req. 7, 10, 11, 12, 17, 21 - Hierarchical - Parent req. of: Req. 4 - Child req. of: Req. 6
Potential conflicts	None identified
Potential technologies involved / affected	This requirement is related to the LDM++ and map matching.
Status of requirement description	☑ Final
Other	None.

SP2_REC_POS 17: Refresh rate

Requirement ID:	SP2_REQ_POS_17_v1.0
Name of requirement:	Refresh rate
Created by	Rafael Basso – rafael.basso@volvo.com
Assigned partner	TG Positioning
History	2013.04.25 - RB - first draft description
Goal	The time necessary to perform the necessary calculations should be minimized and the refreshing rate should be real-time. The update rate should be kept at most 1Hz as regular GPS receivers. The ideal is to have higher update rates (such as 10Hz) available for safety applications that need higher resolution.
Related EMPOWER Use Case	Affects almost every TEAM application.
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- FLEX Applications:** ☑ Co-modal coaching with support from virtual/avatar users ☑ Collaborative smart intersection for bus priority (intelligent priorities) ☑ Collaborative public transport optimization ☑ Community gaming (cities, infrastructure) ☑ Dynamic collaborative corridors
Relevance to EMPOWER subsystem and component	**- Vehicle** ☑ HMI ☑ Application **- Roadside**

	☑ Application
Requirement category	☑ Functional
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	If this requirement is not met, there is a risk that some applications will not work properly.
Validation method (tests, indicators, performance bounds)	Test refresh rate in different situations for all technology use cases listed.
Acceptance criteria	Refresh rate is at least 1Hz.
Relationship with other requirements	- No ☑ - Same level with: Req. 7, 10, 11, 16, 17, 21 - Hierarchical - Child req. of: Req. 6
Potential conflicts	None identified
Potential technologies involved / affected	This requirement is related to the LDM++ and map matching.
Status of requirement description	☑ Final
Other	None.

SP2_REC_POS 18: Interaction with smartphones

Requirement ID:	SP2_REQ_POS_18_v1.0
Name of requirement:	Interaction with smartphones
Created by	Rafael Basso – rafael.basso@volvo.com Bernd Schäufele – bernd.schaeufele@dcaiti.com
Assigned partner	TG Positioning

History	2013.04.25 - BS - first draft description
Goal	The cooperative positioning module should be able to interact with smartphones. The GPS sensor and the cellular network interface of smartphones should be used.
Related EMPOWER Use Case	Affects almost every TEAM application.
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- FLEX Applications:** ☑ Dynamic collaborative corridors
Relevance to EMPOWER subsystem and component	**- Personal** ☑ HMI ☑ Application ☑ Security & Privacy
Requirement category	- Non-functional ☑ General architectural and equipment requirements ☑ Connectivity and communication requirements
Critical level (priority)	Define the importance of the requirement: ☑ Optional
Risk analysis	If this requirement is not met, there is a risk that applications will not work correctly when there is no other node in range of ITS-G5 or when the GPS receiver of the node has no reception.
Validation method (tests, indicators, performance bounds)	Test cellular connection and phone GPS sensor in different situations for all technology use cases listed.
Acceptance criteria	The cellular connection of the phone and the GPS sensor can be used.
Relationship with other requirements	- No ☑

Potential conflicts	None identified
Potential technologies involved / affected	This requirement is related to the GPS and cellular networks.
Status of requirement description	☑ Final
Other	None.

SP2_REC_POS 19: Retrieval of map-referenced positioning from LDM++

Requirement ID:	SP2_REQ_POS_19_v1.0
Name of requirement:	Retrieval of map-referenced positioning from LDM++
Created by	Bernd Schäufele – bernd.schaeufele@dcaiti.com
Assigned partner	TG Positioning
History	2013-05-13 – BS – first draft of description
Goal	Positioning system shall retrieve map-referenced positioning from the LDM++
Related EMPOWER Use Case	Affects almost every TEAM application.
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- Application independent:** ☑ "_____"
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ HMI ☑ Application **- Personal** ☑ HMI ☑ Application

	- Central ☑ LDM++
Requirement category	- Non-functional ☑ General architectural and equipment requirements
Critical level (priority)	Define the importance of the requirement: ☑ Recommended
Risk analysis	If this requirement is not met, there is a risk if applications use map-referencing information. These applications will not work properly
Validation method (tests, indicators, performance bounds)	Map-referenced position is retrieved from LDM++ in different situations for all technology use cases listed.
Acceptance criteria	LDM++ provides map-referencing and cooperative positioning uses it when available.
Relationship with other requirements	- Hierarchical Parent req. of: Req. 9 Child req. of: Req. 8
Potential conflicts	None identified
Potential technologies involved / affected	This requirement is related to the LDM++ and geo-referencing.
Status of requirement description	☑ Final
Other	None.

SP2_REC_POS 20: Processed GPS data in CLM

Requirement ID:	SP2_REQ_POS_20_v1.0
Name of requirement:	Processed GPS data in CLM
Created by	Bernd Schäufele – bernd.schaeufele@dcaiti.com

Assigned partner	TG Positioning
History	2013-05-13 – BS – first draft of description
Goal	The node localisation data in CLM shall include processed GPS data. This is necessary to calculate the relative positioning vector.
Related EMPOWER Use Case	Affects almost every TEAM application.
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- Application independent:** ☑ "_____"
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ HMI ☑ Application
Requirement category	☑Functional
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	If this requirement is not met, applications that rely on cooperative positioning will not work properly.
Validation method (tests, indicators, performance bounds)	Test the exchange of processed GPS data for all technology use cases in different situations.
Acceptance criteria	Processed GPS data is included in CLM by one node and is read by another node.
Relationship with other requirements	- Hierarchical Parent req. of: Req. 6 Child req. of: Req. 2, 15
Potential conflicts	None identified

Potential technologies involved / affected	This requirement is related to ITS-G5 communication and LDM++.
Status of requirement description	☑ Final
Other	None.

SP2_REC_POS 21: Level of confidence

Requirement ID:	SP2_REQ_POS_21_v1.0
Name of requirement:	Level of confidence
Created by	Bernd Schäufele – bernd.schaeufele@dcaiti.com
Assigned partner	TG Positioning
History	2013-05-31 – BS – first draft of description
Goal	Applications and other components must know how reliable the position is. Therefore, a level of confidence must be given. The confidence level can be based on the number and quality of input sources.
Related EMPOWER Use Case	Affects almost every TEAM application.
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- Application independent:** ☑ "_____"
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ HMI ☑ Application **- Central** ☑ Positioning unit

	☑ LDM++
Requirement category	☑Functional
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	If this requirement is not met, there is a risk that applications that rely on cooperative positioning will not work properly.
Validation method (tests, indicators, performance bounds)	Test the exchange of processed GPS data for all technology use cases in different situations. Validate that the confidence level is in line with the quality of the actually calculated position in all situations.
Acceptance criteria	Confidence level represents the quality of the actually calculated position.
Relationship with other requirements	- Same level with: Req. 7, 10, 11, 12, 16, 17 - Hierarchical Child req. of: Req. 6
Potential conflicts	None identified
Potential technologies involved / affected	This requirement is related to GNSS.
Status of requirement description	☑ Final
Other	None.

Security, Privacy and Reliability requirements

SP2_REQ_SEC 1: Security Targets

Requirement ID:	SP2_REQ_SEC_1_v1.0
Name of requirement:	Security Targets
Created by	Rafael Grote (RG) – rafael.grote@fokus.fraunhofer.de
Assigned partner	All
History	2013.04.23 – RG – initial version
Goal	The TEAM platform shall respect the common security targets of privacy, confidentiality, integrity, authenticity, accountability, and non-repudiation.
Related EMPOWER Use Case	SP2_SEC_PBVC, SP2_SEC_PUVC, SP2_SEC_PLP, SP2_SEC_PPL, SP2_SEC_PAVD, SP2_SEC_DSC, SP2_SEC_UPDP, SP2_SEC_SSLD, SP2_SEC_SITA, SP2_SEC_SIEA
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- DIALOGUE Applications:** ☑ Collaborative ACC ☑ Collaborative parking ☑ Collaborative driving and merging ☑ Collaborative eco-friendly navigation ☑ Serious game and community building **- FLEX Applications:** ☑ Collaborative pro-active urban/inter-urban monitoring and ad-hoc control ☑ Collaborative co-modal route planning ☑ Co-modal coaching with support from virtual/avatar users

	☑ Collaborative smart intersection for bus priority (intelligent priorities) ☑ Collaborative public transport optimization ☑ Community gaming (cities, infrastructure) ☑ Dynamic collaborative corridors **- Enabler:** ☑ Data or Aggregated data: "_____" ☑ Algorithm: "_____" ☑ Tool: "_____" ☑ Other: "_____" **- Application independent:** ☑ "Security & privacy "
Relevance to EMPOWER subsystem and component	- Vehicle ☑ HMI ☑ Application ☑ Security & Privacy ☑ Other "_____" - Personal ☑ HMI ☑ Application ☑ Security & Privacy ☑ Other "_____" - Central ☑ Positioning unit

	☑ Communication unit ☑ LDM++ ☑ Security & Privacy ☑ Data management unit ☑ Other "_____" - Roadside ☑ Application ☑ Security & Privacy ☑ Other "_____"
Requirement category	- Non-functional ☑ Security requirements
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	The TEAM platform might be vulnerable to attacks, if this requirement is not met.
Validation method (tests, indicators, performance bounds)	Security analysis.
Acceptance criteria	A secure, reliable, and privacy respecting system is crucial for user acceptance.
Relationship with other requirements	- Hierarchical Parent req. of: SP2_REQ_SEC_2
Potential conflicts	None.
Potential technologies involved / affected	All technologies are affected.
Status of requirement description	☑ Final
Other	This is the root security requirement from which all other security requirements are derived.

SP2_REQ_SEC 2: Security Association between Communication Participants

Requirement ID:	SP2_REQ_SEC_2_v1.0
Name of requirement:	Security Association between Communication Participants
Created by	Rafael Grote (RG) – rafael.grote@fokus.fraunhofer.de
Assigned partner	TG Security
History	2013.04.23 – RG – initial version
Goal	For all kinds of communications, there must be a security association between the communication participants, i.e. the sender and the receiver(s). The security association must work independently of the communication mode (connectionless or connection-oriented) and the number of participants (one-to-one or one-to-many).
Related EMPOWER Use Case	SP2_SEC_PBVC, SP2_SEC_PUVC, SP2_SEC_PLP, SP2_SEC_PPL, SP2_SEC_PAVD, SP2_SEC_DSC
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- DIALOGUE Applications:** ☑ Collaborative ACC ☑ Serious game and community building **- FLEX Applications:** ☑ Collaborative smart intersection for bus priority (intelligent priorities) ☑ Dynamic collaborative corridors **- Application independent:** ☑ "Security & privacy "

Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ Security & Privacy **- Personal** ☑ Security & Privacy **- Central** ☑ Security & Privacy **- Roadside** ☑ Security & Privacy
Requirement category	- Non-functional ☑ Security requirements
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	Communications might be vulnerable to attacks, if this requirement is not met.
Validation method (tests, indicators, performance bounds)	Security analysis
Acceptance criteria	A secure, reliable, and privacy respecting system is crucial for user acceptance.
Relationship with other requirements	- Hierarchical Child req. of: SP2_REQ_SEC_2
Potential conflicts	None.
Potential technologies involved / affected	Communication
Status of requirement description	☑ Final
Other	This is the main security requirement to protect all kinds of communication. Many further requirements are derived from it.

SP2_REQ_SEC 3: Offline Operation

Requirement ID:	SP2_REQ_SEC_3_v1.0
Name of requirement:	Offline Operation
Created by	Rafael Grote (RG) – rafael.grote@fokus.fraunhofer.de
Assigned partner	TG Security
History	2013.04.23 – RG – initial version
Goal	The security association and related security operations must not require permanent online access to any backend systems.
Related EMPOWER Use Case	"V2X wireless communication support", SP2_CSSR
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- DIALOGUE Applications:** ☑ Collaborative ACC **- FLEX Applications:** ☑ Collaborative smart intersection for bus priority (intelligent priorities) **- Application independent:** ☑ "Security & privacy "
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ Security & Privacy **- Personal** ☑ Security & Privacy **- Central** ☑ Security & Privacy **- Roadside**

	☑ Security & Privacy
Requirement category	- Non-functional ☑ Security requirements
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	Ad-hoc communications would no longer be possible (or not be secure) without online access.
Validation method (tests, indicators, performance bounds)	Security analysis
Acceptance criteria	A mobile system relying on online access (and thus being not reliable) would significantly decrease the acceptance.
Relationship with other requirements	- Hierarchical Child req. of: SP2_REQ_SEC_2
Potential conflicts	None.
Potential technologies involved / affected	N/A
Status of requirement description	☑ Final
Other	None.

SP2_REQ_SEC 4: Unique and Anonymous Authorisation

Requirement ID:	SP2_REQ_SEC_4_v1.0
Name of requirement:	Unique and Anonymous Authorisation
Created by	Rafael Grote (RG) – rafael.grote@fokus.fraunhofer.de
Assigned partner	TG Security
History	2013.04.23 – RG – initial version
Goal	There shall be different types of security associations that a

	node may choose. Unique authorization legitimates and identifies an individual node. Anonymous authorisation legitimates a node without revealing its identity.
Related EMPOWER Use Case	SP2_SEC_PBVC, SP2_SEC_DSC, SP2_SEC_PLP
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- DIALOGUE Applications:** ☑ Collaborative parking ☑ Serious game and community building **- FLEX Applications:** ☑ Collaborative public transport optimization ☑ Community gaming (cities, infrastructure) **- Application independent:** ☑ "Security & privacy "
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ Security & Privacy **- Personal** ☑ Security & Privacy **- Central** ☑ Security & Privacy **- Roadside** ☑ Security & Privacy
Requirement category	- Non-functional ☑ Security requirements
Critical level (priority)	Define the importance of the requirement:

	☑ Mandatory
Risk analysis	The system might be vulnerable, if this requirement is not met.
Validation method (tests, indicators, performance bounds)	Security analysis
Acceptance criteria	A secure, reliable, and privacy respecting system is crucial for user acceptance.
Relationship with other requirements	- Hierarchical Child req. of: SP2_REQ_SEC_2
Potential conflicts	None.
Potential technologies involved / affected	N/A
Status of requirement description	☑ Final
Other	None.

SP2_REQ_SEC 5: Privacy of Mobile Nodes

Requirement ID:	SP2_REQ_SEC_5_v1.1
Name of requirement:	Privacy of Mobile Nodes
Created by	Rafael Grote (RG) – rafael.grote@fokus.fraunhofer.de
Assigned partner	TG Security
History	2013.04.23 – RG – initial version 2013.06.05 – RG – removed restriction to floating car data
Goal	In order to preserve their privacy, mobile nodes shall be able to communicate in an anonymous or pseudonymous way. This may concern one-to-many (e.g. beaconing) as well as one-to-one communications (e.g. backend data aggregation).
Related EMPOWER Use Case	SP2_SEC_PLP, "floating car data beaconing"
Source (TEAM application or	From which application/enabler the requirement has been

enabler)	created: **- DIALOGUE Applications:** ☑ Collaborative parking ☑ Collaborative driving and merging ☑ Collaborative eco-friendly navigation ☑ Serious game and community building **- FLEX Applications:** ☑ Collaborative pro-active urban/inter-urban monitoring and ad-hoc control ☑ Collaborative co-modal route planning ☑ Co-modal coaching with support from virtual/avatar users ☑ Collaborative public transport optimization ☑ Community gaming (cities, infrastructure) **- Application independent:** ☑ "Security & privacy "
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ Security & Privacy **- Personal** ☑ Security & Privacy
Requirement category	- Non-functional ☑ Security requirements
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	Mobile nodes would be easily traceable for everybody. Consequently, privacy of users would be seriously violated, if

	this requirement is not met.
Validation method (tests, indicators, performance bounds)	Try to track individual vehicles over a longer period (i.e. several hours or days) without following them.
Acceptance criteria	Traceability of mobile nodes would decrease user acceptance seriously.
Relationship with other requirements	- Hierarchical Child req. of: SP2_REQ_SEC_2
Potential conflicts	Some applications/use cases might rely on tracking.
Potential technologies involved / affected	N/A
Status of requirement description	☑ Final
Other	None.

SP2_REQ_SEC 6: Joint Identifier Change

Requirement ID:	SP2_REQ_SEC_6_v1.0
Name of requirement:	Joint Identifier Change
Created by	Rafael Grote (RG) – rafael.grote@fokus.fraunhofer.de
Assigned partner	TG Security
History	2013.04.23 – RG – initial version
Goal	All public identifiers of a mobile node shall be changed in regular intervals. The change must be atomic, so that every two messages following each other do contain either only the new or the old identifiers. Old and new identifiers shall not be linkable.
Related EMPOWER Use Case	SP2_SEC_PLP
Source (TEAM application or enabler)	From which application/enabler the requirement has been created:

	- Application independent: ☑ "Security & privacy "
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ Security & Privacy **- Personal** ☑ Security & Privacy
Requirement category	- Non-functional ☑ Security requirements
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	An id change is only effective if all identifiers are changed simultaneously. A single identifier that stays static or changes only one second to late makes the whole concept useless.
Validation method (tests, indicators, performance bounds)	Compare the outgoing messages directly before with those directly after the joint id change. There should be no common identifier.
Acceptance criteria	Privacy/non-tracebility is crucial for user acceptance.
Relationship with other requirements	- Hierarchical Child req. of: SP2_REQ_SEC_5
Potential conflicts	None.
Potential technologies involved / affected	N/A
Status of requirement description	☑ Final
Other	None.

SP2_REQ_SEC 7: Variable Public Identifiers

Requirement ID:	SP2_REQ_SEC_7_v1.0
Name of requirement:	Variable Public Identifiers
Created by	Rafael Grote (RG) – rafael.grote@fokus.fraunhofer.de
Assigned partner	SP2/3/4: all components/applications on mobile nodes
History	2013.04.23 – RG – initial version
Goal	All components and applications relying on public identifiers (i.e. identifiers used in non-confidential communications) are required to subscribe for node id changes and change all their public identifiers immediately on such events. Since old and new identifiers shall not be linkable, it is recommended to derive public identifiers from the globally unique node id.
Related EMPOWER Use Case	SP2_SEC_PLP
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- Application independent:** ☑ "Security & privacy "
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ Application ☑ Security & Privacy ☑ Other "Components with public identifiers" **- Personal** ☑ Application ☑ Security & Privacy ☑ Other "Components with public identifiers"
Requirement category	- Non-functional

	☑ Security requirements
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	See SP2_REQ_SEC_6
Validation method (tests, indicators, performance bounds)	See SP2_REQ_SEC_6
Acceptance criteria	See SP2_REQ_SEC_6
Relationship with other requirements	- Hierarchical Child req. of: SP2_REQ_SEC_6
Potential conflicts	Applications and components might rely on static identifiers.
Potential technologies involved / affected	Communication
Status of requirement description	☑ Final
Other	None.

SP2_REQ_SEC 8: Freeze of Node Identifier

Requirement ID:	SP2_REQ_SEC_8_v1.0
Name of requirement:	Freeze of Node Identifier
Created by	Rafael Grote (RG) – rafael.grote@fokus.fraunhofer.de
Assigned partner	TG Security
History	2013.04.23 – RG – initial version
Goal	Applications and components shall be able to freeze the node id under special circumstances, e.g. during safety critical situations or cooperative driving manoeuvres. The duration of a freeze shall not exceed the required period.
Related EMPOWER Use Case	SP2_SEC_PLP

Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- DIALOGUE Applications:** ☑ Collaborative ACC **- Application independent:** ☑ "Security & privacy "
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ Security & Privacy **- Personal** ☑ Security & Privacy
Requirement category	- Non-functional ☑ Security requirements
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	Safety critical components and applications might require static identifiers in specific situations
Validation method (tests, indicators, performance bounds)	See SP2_REQ_SEC_6. After freeze the node id, identifiers should remain static.
Acceptance criteria	A secure, reliable, and privacy respecting system is crucial for user acceptance.
Relationship with other requirements	- Hierarchical Child req. of: SP2_REQ_SEC_6
Potential conflicts	SP2_REQ_SEC_5
Potential technologies involved / affected	N/A
Status of requirement description	☑ Final

Other	None.

SP2_REQ_SEC 9: Management of Node Identifiers

Requirement ID:	SP2_REQ_SEC_9_v1.0
Name of requirement:	Management of Node Identifiers
Created by	Rafael Grote (RG) – rafael.grote@fokus.fraunhofer.de
Assigned partner	TG Security
History	2013.04.23 – RG – initial version
Goal	There must be a "Node ID Manager" component that triggers regular identifier changes, provides globally unique node id's, communicates to authority services to obtain node id's, and provides an interface to node components and applications that allows subscription for id change events.
Related EMPOWER Use Case	SP2_SEC_
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- Application independent:** ☑ "Security & privacy "
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ Security & Privacy **- Personal** ☑ Security & Privacy **- Central** ☑ Security & Privacy **- Roadside**

	☑ Security & Privacy
Requirement category	- Non-functional ☑ Security requirements
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	The system might be vulnerable, if this requirement is not met.
Validation method (tests, indicators, performance bounds)	Test interface to applications. (Id change notification and freeze) Equip with expired security credentials and check if they were replaced with valid new ones after some time. Check regular id change (see SP2_REQ_SEC_6)
Acceptance criteria	A secure, reliable, and privacy respecting system is crucial for user acceptance.
Relationship with other requirements	- Hierarchical Child req. of: SP2_REQ_SEC_6, SP2_REQ_SEC_7, SP2_REQ_SEC_8
Potential conflicts	None.
Potential technologies involved / affected	N/A
Status of requirement description	☑ Final
Other	None.

SP2_REQ_SEC 10: Integrity and Authenticity of Transmitted Data

Requirement ID:	SP2_REQ_SEC_10_v1.1
Name of requirement:	Integrity and Authenticity of Transmitted Data
Created by	Rafael Grote (RG) – rafael.grote@fokus.fraunhofer.de

Assigned partner	TG Security
History	2013.04.23 – RG – initial version 2013.06.05 – RG – addressing 1-to-1 communications.
Goal	Integrity and authenticity of communications (one-to-one as well as one-to-many) shall be ensured. Recipients of transmitted data shall be able to verify the integrity and authenticity of the data and its originator.
Related EMPOWER Use Case	SP2_SEC_PBVC
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- DIALOGUE Applications:** ☑ Collaborative parking ☑ Serious game and community building **- FLEX Applications:** ☑ Collaborative co-modal route planning ☑ Collaborative public transport optimization **- Application independent:** ☑ "Security & privacy "
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ Security & Privacy **- Personal** ☑ Security & Privacy **- Central** ☑ Security & Privacy **- Roadside** ☑ Security & Privacy

Requirement category	- Non-functional ☑ Security requirements
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	The system might be vulnerable, if this requirement is not met.
Validation method (tests, indicators, performance bounds)	Analyse incoming data and try to verify its integrity and authenticity.
Acceptance criteria	A secure, reliable, and privacy respecting system is crucial for user acceptance.
Relationship with other requirements	- Hierarchical Child req. of: SP2_REQ_SEC_2
Potential conflicts	This requirement might potentially increase system load, network traffic, and network latency.
Potential technologies involved / affected	Communication
Status of requirement description	☑ Final
Other	None.

SP2_REQ_SEC 11: Root of Trust

Requirement ID:	SP2_REQ_SEC_11_v1.0
Name of requirement:	Root of Trust
Created by	Rafael Grote (RG) – rafael.grote@fokus.fraunhofer.de
Assigned partner	TG Security
History	2013.04.23 – RG – initial version
Goal	There shall be a central ITS authority, which impersonates the root of trust.

Related EMPOWER Use Case	SP2_SEC_DSC
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- Application independent:** ☑ "Security & privacy "
Relevance to EMPOWER subsystem and component	**- Central** ☑ Security & Privacy
Requirement category	- Non-functional ☑ Security requirements
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	The system might be vulnerable, if this requirement is not met.
Validation method (tests, indicators, performance bounds)	Presence of a central ITS authority, which impersonates the root of trust.
Acceptance criteria	A secure, reliable, and privacy respecting system is crucial for user acceptance.
Relationship with other requirements	- Hierarchical Child req. of: SP2_REQ_SEC_2, SP2_REQ_SEC_3, SP2_REQ_SEC_4, SP2_REQ_SEC_10
Potential conflicts	None.
Potential technologies involved / affected	N/A
Status of requirement description	☑ Final
Other	None.

SP2_REQ_SEC 12: Public Key Infrastructure

Requirement ID:	SP2_REQ_SEC_12_v1.0
Name of requirement:	Public Key Infrastructure
Created by	Rafael Grote (RG) – rafael.grote@fokus.fraunhofer.de
Assigned partner	TG Security
History	2013.04.23 – RG – initial version
Goal	There shall be a public key infrastructure, which establishes security associations between all potential communication participants and provides mechanisms to deploy and manage security credentials.
Related EMPOWER Use Case	SP2_SEC_DSC
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- Application independent:** ☑ "Security & privacy "
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ Security & Privacy **- Personal** ☑ Security & Privacy **- Central** ☑ Security & Privacy **- Roadside** ☑ Security & Privacy
Requirement category	- Non-functional ☑ Security requirements

Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	The system might be vulnerable, if this requirement is not met.
Validation method (tests, indicators, performance bounds)	Presence of a public key infrastructure mechanism.
Acceptance criteria	A secure, reliable, and privacy respecting system is crucial for user acceptance.
Relationship with other requirements	- Hierarchical Child req. of: SP2_REQ_SEC_2, SP2_REQ_SEC_3, SP2_REQ_SEC_4, SP2_REQ_SEC_10, SP2_REQ_SEC_11
Potential conflicts	None.
Potential technologies involved / affected	N/A
Status of requirement description	☑ Final
Other	None.

SP2_REQ_SEC 13: Issue of Security Associations

Requirement ID:	SP2_REQ_SEC_13_v1.0
Name of requirement:	Issue of Security Associations
Created by	Rafael Grote (RG) – rafael.grote@fokus.fraunhofer.de
Assigned partner	TG Security
History	2013.04.23 – RG – initial version
Goal	The ITS authority issues enrolment and authorisation credentials. Enrolment credentials have a long-term validity and allow unique authorisation. Authorisation credentials expire after short periods of time and must be changed and renewed frequently; they are used for anonymous authorisation.

Related EMPOWER Use Case	SP2_SEC_DSC
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- Application independent:** ☑ "Security & privacy "
Relevance to EMPOWER subsystem and component	**- Central** ☑ Security & Privacy
Requirement category	- Non-functional ☑ Security requirements
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	This requirement is enforced by other security requirements, which rely on it. Consequently, security of the TEAM platform might be prone, if this requirement is not met.
Validation method (tests, indicators, performance bounds)	A test application (or a regular mobile node) requests the different available types of security credentials from the ITS authority.
Acceptance criteria	A secure, reliable, and privacy respecting system is crucial for user acceptance.
Relationship with other requirements	- Hierarchical Child req. of: SP2_REQ_SEC_10, SP2_REQ_SEC_11
Potential conflicts	None.
Potential technologies involved / affected	N/A
Status of requirement description	☑ Final
Other	None.

SP2_REQ_SEC 14: Revocation of Security Associations

Requirement ID:	SP2_REQ_SEC_14_v1.0
Name of requirement:	Revocation of Security Associations
Created by	Rafael Grote (RG) – rafael.grote@fokus.fraunhofer.de
Assigned partner	TG Security
History	2013.04.23 – RG – initial version
Goal	The ITS authority shall provide mechanisms to revoke security associations. Revocation may be implicit, e.g. by not further issuing authorisation credentials to a specific node.
Related EMPOWER Use Case	SP2_SEC_DSC
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- Application independent:** ☑ "Security & privacy "
Relevance to EMPOWER subsystem and component	**- Central** ☑ Security & Privacy
Requirement category	- Non-functional ☑ Security requirements
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	Security credentials or whole mobile nodes might be abused or stolen. Revocation mechanisms are required to suspend those abused nodes from the system. If the requirement is not met, it would not be possible to handle these attacks.
Validation method (tests, indicators, performance bounds)	Request authorisation credentials, after revocation. The ITS authority should reject the request.

Acceptance criteria	A secure, reliable, and privacy respecting system is crucial for user acceptance.
Relationship with other requirements	- Hierarchical Child req. of: SP2_REQ_SEC_4, SP2_REQ_SEC_10, SP2_REQ_SEC_11
Potential conflicts	None.
Potential technologies involved / affected	N/A
Status of requirement description	☑ Final
Other	None.

SP2_REQ_SEC 15: Privileges and Access Rights

Requirement ID:	SP2_REQ_SEC_15_v1.0
Name of requirement:	Privileges and Access Rights
Created by	Rafael Grote (RG) – rafael.grote@fokus.fraunhofer.de
Assigned partner	TG Security
History	2013.04.23 – RG – initial version
Goal	Security credentials shall contain immutable attributes reflecting access rights or specific privileges, e.g. for public service vehicles.
Related EMPOWER Use Case	SP2_SEC_PBVC
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- FLEX Applications:** ☑ Collaborative smart intersection for bus priority (intelligent priorities)

	☑ Dynamic collaborative corridors **- Application independent:** ☑ "Security & privacy "
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ Security & Privacy **- Personal** ☑ Security & Privacy **- Central** ☑ Security & Privacy **- Roadside** ☑ Security & Privacy
Requirement category	- Non-functional ☑ Security requirements
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	If this requirement is not met, access rights of communication participants could not be differentiated. It would not be possible to distinguish between ordinary vehicles and privileged ones (e.g. emergency vehicles). Several use cases would not work (securely) any longer.
Validation method (tests, indicators, performance bounds)	Analyse outgoing messages of mobile nodes with different privileges.
Acceptance criteria	A secure, reliable, and privacy respecting system is crucial for user acceptance.
Relationship with other requirements	- Hierarchical Child req. of: SP2_REQ_SEC_11

Potential conflicts	None
Potential technologies involved / affected	N/A
Status of requirement description	☑ Final
Other	None

SP2_REQ_SEC 16: Confidential One-to-one Communications

Requirement ID:	SP2_REQ_SEC_16_v1.0
Name of requirement:	Confidential One-to-one Communications
Created by	Rafael Grote (RG) – rafael.grote@fokus.fraunhofer.de
Assigned partner	TG Security
History	2013.04.23 – RG – initial version
Goal	One-to-one communication channels should not be interceptable by third parties, so that exchanged data stays confidential between the two communication participants.
Related EMPOWER Use Case	SP2_SEC_PUVC
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- DIALOGUE Applications:** ☑ Collaborative parking ☑ Serious game and community building **- FLEX Applications:** ☑ Collaborative co-modal route planning ☑ Collaborative public transport optimization ☑ Community gaming (cities, infrastructure) **- Application independent:**

	☑ "Security & privacy "
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ Security & Privacy **- Personal** ☑ Security & Privacy **- Central** ☑ Security & Privacy **- Roadside** ☑ Security & Privacy
Requirement category	- Non-functional ☑ Security requirements
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	The system might be vulnerable, if this requirement is not met.
Validation method (tests, indicators, performance bounds)	Eavesdrop and analyse one-to-one communications. The communication channel should be encrypted or protected in a similar way.
Acceptance criteria	A secure, reliable, and privacy respecting system is crucial for user acceptance.
Relationship with other requirements	- Hierarchical Child req. of: SP2_REQ_SEC_2
Potential conflicts	None.
Potential technologies involved / affected	N/A
Status of requirement description	☑ Final
Other	None.

SP2_REQ_SEC 17: Confidentiality of Aggregated Data

Requirement ID:	SP2_REQ_SEC_17_v1.0
Name of requirement:	Confidentiality of Aggregated Data
Created by	Rafael Grote (RG) – rafael.grote@fokus.fraunhofer.de
Assigned partner	SP2/LDM++
History	2013.04.23 – RG – initial version
Goal	Huge sets of aggregated data on backend services might allow to link floating car data with different public identifiers to the same mobile node. Aggregating services must not try to deanonymise any data. Generally, gathered data sets are considered to be confidential and must be protected from unauthorized access. Redistribution is not permitted unless further anonymisation procedures are applied that eliminate the risk of linking data to individuals.
Related EMPOWER Use Case	SP2_SEC_PPL
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- Application independent:** ☑ "Security & privacy "
Relevance to EMPOWER subsystem and component	**- Central** ☑ Security & Privacy
Requirement category	- Non-functional ☑ Security requirements
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory

Risk analysis	If this requirement is not met, privacy of mobile nodes would be seriously endangered. Also SP2_REQ_SEC_6 may become useless.
Validation method (tests, indicators, performance bounds)	Analyse aggregating backend systems. Check redistributed data for anonymity.
Acceptance criteria	A secure, reliable, and privacy respecting system is crucial for user acceptance.
Relationship with other requirements	- Same level with: SP2_REQ_SEC_6, SP2_REQ_SEC_18 - Hierarchical Child req. of: SP2_REQ_SEC_5
Potential conflicts	None.
Potential technologies involved / affected	LDM++
Status of requirement description	☑ Final
Other	This requirement extends SP2_REQ_SEC_6 in order to address the additional threats of aggregating data in backend systems.

SP2_REQ_SEC 18: Further Anonymisation of Floating Car Data

Requirement ID:	SP2_REQ_SEC_18_v1.0
Name of requirement:	Further Anonymisation of Floating Car Data
Created by	Rafael Grote (RG) – rafael.grote@fokus.fraunhofer.de
Assigned partner	TG Security
History	2013.04.23 – RG – initial version
Goal	Mobile nodes should apply further anonymisation procedures before sharing data with aggregating backend services. These procedures may include cooperative id changes or silent gaps and are subject to further research.

Related EMPOWER Use Case	SP2_SEC_PPL
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- DIALOGUE Applications:** ☑ Collaborative eco-friendly navigation **- Application independent:** ☑ "Security & privacy "
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ Security & Privacy **- Personal** ☑ Security & Privacy
Requirement category	- Non-functional ☑ Security requirements
Critical level (priority)	Define the importance of the requirement: ☑ Recommended
Risk analysis	If this requirement is not met, the privacy of mobile nodes is still ensured by SP2_REQ_SEC_17. But it relies on the behaviour the backend service. It is recommended to take further anonymisation measures directly on the mobile node.
Validation method (tests, indicators, performance bounds)	Analyse outgoing floating car data of mobile nodes.
Acceptance criteria	Privacy is a key factor to user acceptance. Privacy measures on the local system lead to far higher acceptance than privacy measures on a backend system.
Relationship with other requirements	- Same level with: SP2_REQ_SEC_6, SP2_REQ_SEC_17 - Hierarchical Child req. of: SP2_REQ_SEC_5

Potential conflicts	The quality of aggregating backend service may be decreased through the additional privacy measures.
Potential technologies involved / affected	LDM++
Status of requirement description	☑ Final
Other	None.

SP2_REQ_SEC 19: Integrity and Authenticity of Aggregated Data

Requirement ID:	SP2_REQ_SEC_19_v1.0
Name of requirement:	Integrity and Authenticity of Aggregated Data
Created by	Rafael Grote (RG) – rafael.grote@fokus.fraunhofer.de
Assigned partner	SP2/LDM++, TG Security
History	2013.04.23 – RG – initial version
Goal	Before processing incoming or stored floating car data, aggregating backend services shall validate its integrity and authenticity. On the other hand, recipients of aggregated data (or information derived from that data) shall be able to verify the integrity and authenticity of the data and the originating backend service.
Related EMPOWER Use Case	SP2_SEC_PAVD
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- Application independent:** ☑ "Security & privacy "
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ Security & Privacy **- Personal**

	☑ Security & Privacy **- Central** ☑ Security & Privacy **- Roadside** ☑ Security & Privacy
Requirement category	- Non-functional ☑ Security requirements
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	The system might be vulnerable, if this requirement is not met.
Validation method (tests, indicators, performance bounds)	Analyse traffic between aggregating services and mobile nodes (in all directions). Check if integrity and authenticity can be verified.
Acceptance criteria	A secure, reliable, and privacy respecting system is crucial for user acceptance.
Relationship with other requirements	- Hierarchical Child req. of: SP2_REQ_SEC_10
Potential conflicts	None.
Potential technologies involved / affected	LDM++
Status of requirement description	☑ Final
Other	This requirement extends SP2_REQ_SEC_10 in order to address the additional threats of aggregating data in backend systems.

SP2_REQ_SEC 20: Compliance with EU Directive 96/46/EC4

Requirement ID:	SP2_REQ_SEC_20_v1.0

Name of requirement:	Compliance with EU Directive 96/46/EC4
Created by	ICCS - nikos.floudas@iccs.gr
Assigned partner	TG Security
History	2013.04.18 - first draft description 2013.04.23 - completed
Goal	TEAM platform must comply with applicable laws governing the processing of personal data and specifically with EU Directive 96/46/EC4. Reference: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:1995:281:0031:0050:EN:PDF
Related EMPOWER Use Case	User profile data privacy (SP2_SEC_UPDP)
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- Application independent:** ☑ "_____"
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ Application ☑ Security & Privacy **- Personal** ☑ Application ☑ Security & Privacy **- Central** ☑ Security & Privacy ☑ Data management unit

Requirement category	- Non-functional ☑ Application requirements ☑ Security requirements ☑ User acceptance
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	Insure that the users are informed about their data usage and that the accepting agreement complies with EU criteria.
Validation method (tests, indicators, performance bounds)	No particular validation methods are needed for this requirement. The TEAM has to comply with EU Data Protection Directive (96/46/EC4).
Acceptance criteria	TEAM users should be sure that their personal and sensitive data are processed according to both country-specific regulation and EU Directives (Directive 96/46/EC4).
Relationship with other requirements	- Same level with: SP2_REQ_SEC_21
Potential conflicts	N/A
Potential technologies involved / affected	Technologies regarding data security and data privacy. These technologies have to be consistent with Directive 96/46/EC4 instructions.
Status of requirement description	☑ Final
Other	None.

SP2_REQ_SEC 21: Provide users with a privacy policy notice

Requirement ID:	SP2_REQ_SEC_21_v1.0
Name of requirement:	Provide users with a clear and understandable privacy policy notice.

Created by	ICCS - nikos.floudas@iccs.gr
Assigned partner	TG Security
History	2013.04.18 - first draft description 2013.04.23 - completed
Goal	TEAM system must provide users with a clear and understandable privacy notice, prior to any data collection that the applications may perform. The requested data should be mentioned, so that users are aware and decide whether to use or not an application or certain features of this.
Related EMPOWER Use Case	User profile data privacy (SP2_SEC_UPDP)
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- Application independent:** ☑ "_____"
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ Application ☑ Security & Privacy **- Personal** ☑ Application ☑ Security & Privacy
Requirement category	- Non-functional ☑ Security requirements ☑ User acceptance
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	Absence of data privacy notice might prevent the application

	installation. Absence of data privacy notice might prevent authorities to give market license. Unintentional disclosure of personal or private information and illegal data processing are prohibited in the EU. It is mandatory to obtain user consent for the collection of information identified as personal.
Validation method (tests, indicators, performance bounds)	A TEAM tester has to check: what Personal Data is collected and how it is used and shared and for how long it is retained. when Personal Data is shared with third parties. when tracking technologies are used and the information type of this data (co-ordinates, speed, route, etc) what means the user has to manage his/her privacy preferences and if there are clear instructions on how to use these means. If the user could find what Personal Data TEAM has about him/her. If the user could request deletion or modification of unnecessary or out-dated Personal Data. The security measures that TEAM applies to protect his/her Personal Data against unauthorized access, use, modification or loss; If the user has convenient contact methods with TEAM owners and help desk.
Acceptance criteria	TEAM has to provide a readable, understandable and easily accessible privacy policy, which at a minimum informs users about: who they are (identity and contact details),

	what precise categories of personal data the application needs to collect and process, why the data processing is necessary (for what precise purposes), whether data will be disclosed to third parties (not just a generic but a specific description to whom the data will be disclosed), what rights users have, in terms of withdrawal of consent and deletion of data
Relationship with other requirements	- Same level with: SP2_REQ_SEC_20, SP2_REQ_SEC_22
Potential conflicts	N/A
Potential technologies involved / affected	No special technologies are required for a privacy policy message to be displayed to users.
Status of requirement description	☑ Final
Other	The user should not be confronted with a screen containing a single 'Yes I accept' option in order to finish the installation. An option to 'Cancel' or otherwise halt the installation must be available.

SP2_REQ_SEC 22: Provide users with data privacy settings modification functionality

Requirement ID:	SP2_REQ_SEC_22_v1.0
Name of requirement:	Provide users with data privacy settings modification functionality
Created by	ICCS - nikos.floudas@iccs.gr
Assigned partner	TG Security
History	2013.04.18 - first draft description 2013.04.23 - completed

Goal	Users must have the option to determine how their personal data or location is processed. Modifiable users' privacy settings option should exist in the users' interface.
Related EMPOWER Use Case	User profile data privacy (SP2_SEC_UPDP)
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- DIALOGUE Applications:** ☑ Serious game and community building **- FLEX Applications:** ☑ Community gaming (cities, infrastructure) **- Application independent:** ☑ "_____"
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ Security & Privacy **- Personal** ☑ Security & Privacy
Requirement category	- Non-functional ☑ Security requirements
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	Failure for a user to be able to modify the amount of its private data used by the application may lead to complete application rejection.
Validation method (tests, indicators, performance bounds)	TEAM tester has to assess that the users will be able to: Insert personal data.

	Find easily their personal data on TEAM application. Modify their personal data successfully.
Acceptance criteria	A user that feels exercising complete control over their private data will acquire increased trust and acceptance to the application.
Relationship with other requirements	- Same level with: SP2_REQ_SEC_21
Potential conflicts	N/A
Potential technologies involved / affected	Application should be immediately updated according to privacy settings modifications by the users.
Status of requirement description	☑ Final
Other	-

SP2_REQ_SEC 23: Lawful lifecycle of stored private information

Requirement ID:	SP2_REQ_SEC_23_v1.0
Name of requirement:	Lawful lifecycle of stored private information.
Created by	ICCS - nikos.floudas@iccs.gr
Assigned partner	TG Security
History	2013.04.18 - first draft description 2013.04.23 - completed
Goal	Information stored by the TEAM data storage devices should be deleted or anonymized when this data is no longer necessary for the purposes it was originally collected. Moreover, private data should be deleted only if it is allowed by the law. Users must be able to delete private information stored by TEAM, as well.
Related EMPOWER Use Case	User profile data privacy (SP2_SEC_UPDP)

Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- Application independent:** ☑ "_____"
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ Application ☑ Security & Privacy **- Personal** ☑ Application ☑ Security & Privacy **- Central** ☑ Security & Privacy ☑ Data management unit
Requirement category	- Non-functional ☑ Security requirements
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	The risks of a not having a data lifecycle policy are related to: Loss of customers Loss of market share Fines and civil penalties Significant cost and effort to notify affected parties and recover from the breach
Validation method (tests, indicators, performance bounds)	TEAM has to validate how users' data are manipulated regarding its stored data lifecycle policy. (Different scenarios

	e.g. if a user has not used TEAM over a year what happens with his/her data, etc.)
Acceptance criteria	TEAM must define deletion schedules for server logs, cache, user profiles and account information, including deactivation or termination of inactive user accounts. TEAM users have to know the deletion schedules of their personal data. e.g. for how long a user can be inactive until the user's data are deleted. Users must be able to delete information stored by the Application in the in-device storage(s) (for example, caches, search histories, keyboard logs and other such storages) and to prevent distribution, display or other publishing of their user generated content on your servers.
Relationship with other requirements	- No ☑
Potential conflicts	N/A
Potential technologies involved / affected	Technologies regarding the procedures of lifecycle data manipulation. (Automated warning emails to users regarding the deletion schedules, etc.)
Status of requirement description	☑ Final
Other	None.

SP2_REQ_SEC 24: Stored sensitive data should be encrypted

Requirement ID:	SP2_REQ_SEC_24_v1.0
Name of requirement:	Stored sensitive data should be encrypted.
Created by	ICCS - nikos.floudas@iccs.gr
Assigned partner	TG Security
History	2013.04.18 - first draft description

	2013.04.23 - completed
Goal	TEAM has to adopt appropriate information security measures to protect Personal Data against unauthorized access, use, modification or loss when stored on the device or other repositories. Sensitive data encryption should be considered.
Related EMPOWER Use Case	User profile data privacy (SP2_SEC_UPDP), Secure storage of local data (SP2_SEC_SSLD)
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- Application independent:** ☑ "_____"
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ Security & Privacy **- Personal** ☑ Security & Privacy **- Central** ☑ Security & Privacy ☑ Data management unit
Requirement category	- Non-functional ☑ Security requirements ☑ Technological and development requirements
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	Failure to provide a strong encryption technique for sensitive data could allow for intruders to violate this data. At the same time authorized users and application should have quick access to this data even in the cases that credentials or privacy

	method change.
Validation method (tests, indicators, performance bounds)	Testing techniques to violate data encryption and intercept stored data can be implemented, to locate possible system weaknesses.
Acceptance criteria	Secure storage of data is not constantly visible to users, yet a serious data security problem can deteriorate application reputation. TEAM has to implement security mechanisms to prevent the loss of sensitive data if the device is lost or stolen. TEAM must store sensitive data on memory media that are not easy for someone to reach (internal memory is better than a memory card). TEAM has to implement security mechanisms again side channel attacks. These attacks try to have access to data that is usually retained indefinitely on temporary directories. TEAM has to implement security mechanisms when shares data with external sites or other installed applications. TEAM has to take possibly operating systems vulnerabilities into consideration (Android, iOS vulnerabilities, etc). Available public TEAM source code must not contain sensitive data.
Relationship with other requirements	- No ☑
Potential conflicts	N/A
Potential technologies involved / affected	Data encryption techniques are required.
Status of requirement description	☑ Final
Other	TEAM has to create a "security plan" covering the security issues regarding the manipulation of personal data. Also, TEAM has to be updated when "bugs" or new vulnerabilities are

	discovered.

SP2_REQ_SEC 25: Secure user login to TEAM applications

Requirement ID:	SP2_REQ_SEC_25_v1.0
Name of requirement:	Secure user login to TEAM applications
Created by	ICCS - nikos.floudas@iccs.gr
Assigned partner	TG Security
History	2013.04.18 - first draft description 2013.04.23 – completed
Goal	Login will be required to access the TEAM applications. Option to remember the login details shall be available.
Related EMPOWER Use Case	User profile data privacy (SP2_SEC_UPDP), Secure storage of local data (SP2_SEC_SSLD)
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- Application independent:** ☑ "_____"
Relevance to EMPOWER subsystem and component	**- Personal** ☑ Security & Privacy
Requirement category	- Non-functional ☑ Application requirements ☑ Security requirements
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	If the login procedure on TEAM applications is not secure then

	it will be easy for someone to gain access to a user's account and user's personal information.
Validation method (tests, indicators, performance bounds)	Testing if TEAM system gives the option to the user to try repeatedly login attempts. (Brute forcing methods)
Acceptance criteria	N/A
Relationship with other requirements	- No ☑
Potential conflicts	N/A
Potential technologies involved / affected	Functions regarding user login, such as: forgotten passwords changing passwords remembering passwords logout techniques multiple logins
Status of requirement description	☑ Final
Other	TEAM has to foresee passwords that are alphanumeric, include special characters and a minimum length of six characters, to limit the attack surface. TEAM has to allow for password change functionality only to authenticated users by validating the old password, the new password and the user answer to the challenge question, to prevent brute forcing of a password via password change.

SP2_REQ_SEC 26: Installation of authorized TEAM applications

Requirement ID:	SP2_REQ_SEC_26_v1.0
Name of requirement:	Installation of authorized TEAM applications
Created by	ICCS - nikos.floudas@iccs.gr

Assigned partner	TG Security
History	2013.04.18 - first draft description 2013.04.23 - completed
Goal	TEAM has to authorize applications before allow their installation.
Related EMPOWER Use Case	Secure installation of TEAM applications (SSP2_SEC_SITA)
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- Application independent:** ☑ "_____"
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ Security & Privacy **- Personal** ☑ Security & Privacy **- Central** ☑ Security & Privacy ☑ Data management unit
Requirement category	- Non-functional ☑ Security requirements
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	A not strong enough authorization procedure for TEAM application installations and updates can allow malicious software to exploit security vulnerabilities.
Validation method (tests, indicators, performance bounds)	No particular validation method is forecasted for this

	requirement.
Acceptance criteria	Installation of authorized application can improve user acceptance.
Relationship with other requirements	- No ☑
Potential conflicts	N/A
Potential technologies involved / affected	Functionalities related to digital signatures and application authorization.
Status of requirement description	☑ Final
Other	None.

SP2_REQ_SEC 27: Safe exchange of personal data with third party applications

Requirement ID:	SP2_REQ_SEC_27_v1.0
Name of requirement:	Safe exchange of personal data with third party applications
Created by	ICCS - nikos.floudas@iccs.gr
Assigned partner	ICCS
History	2013.04.18 - first draft description 2013.04.23 - completed
Goal	If it is required, TEAM should send and receive securely transmitted data when a connection with third party applications exists.
Related EMPOWER Use Case	Safe interconnection with external applications (SSP2_SEC_SIEA)
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- DIALOGUE Applications:**

	☑ Serious game and community building **- FLEX Applications:** ☑ Community gaming (cities, infrastructure)
Relevance to EMPOWER subsystem and component	**- Personal** ☑ Application ☑ Security & Privacy **- Central** ☑ Security & Privacy ☑ Data management unit
Requirement category	- Non-functional ☑ Application requirements ☑ Security requirements
Critical level (priority)	Define the importance of the requirement: ☑ Recommended
Risk analysis	Connections with external application can lead to private data leakage and should be treated with increased attention on privacy requirements.
Validation method (tests, indicators, performance bounds)	Tests regarding the data exchange between TEAM and third party applications are needed. Tests could use eavesdropping techniques regarding HTTP, RMI protocol, SQL statements, etc
Acceptance criteria	Interconnection with popular external applications such as social networks, can improve the user acceptance for the TEAM applications, e.g. that of serious game and community building. However, the following issues should be taken into account: Continuously control regarding the security of transmitting channel between TEAM and other applications.

	TEAM has to check the integrity of exchanged data. TEAM has to check that the transmitted data are encrypted.
Relationship with other requirements	- No ☑
Potential conflicts	N/A
Potential technologies involved / affected	Knowledge on the technologies used for the interconnection to the external application is needed.
Status of requirement description	☑ Final
Other	None.

Other requirements

SP2_REQ_OTH 1: Interface to parking slots information.

Requirement ID:	SP2_REQ_OTH_01_v1.0
Name of requirement:	Interface to parking slots information.
Created by	Nikos Floudas (NF) - nikos.floudas@iccs.gr
Assigned partner	Collaborative parking development group.
History	2013.06.05 - NF - completed description
Goal	An interface is needed to provide instantaneous information on free parking slots within an area. Information needed includes: free slots, parking events, pending parking requests and parking forecasts.
Related EMPOWER Use Case	N/A
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- DIALOGUE Applications:** ☑ Collaborative parking **- Enabler:** ☑ Data or Aggregated data: from parking operators.
Relevance to EMPOWER subsystem and component	**- Vehicle** ☑ Application ☑ Other "Communication unit" **- Personal** ☑ Application ☑ Other "Communication unit" **- Central**

	☑ Communication unit
Requirement category	- Non-functional ☑ Connectivity and communication requirements ☑ Application requirements
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	- Absence of this external interface for parking data acquisition will obstruct the proper operation of collaborative parking operation.
Validation method (tests, indicators, performance bounds)	Testing of application functionality in cases of no data or low update rate should be taken into account.
Acceptance criteria	Real time update (within a few seconds) of the application with required data automatically or after request will promote user acceptance.
Relationship with other requirements	- No ☑
Potential conflicts	N/A
Potential technologies involved / affected	Communication data interface needs to be defined for this kind of external data (if available).
Status of requirement description	☑ Final
Other	None.

SP2_REQ_OTH 2: Collaborative vehicles xFCD interface adapter.

Requirement ID:	SP2_REQ_OTH_02_v1.0
Name of requirement:	Collaborative vehicles xFCD interface adapter.
Created by	Marco Bottero - marco.bottero@swarco.com

Assigned partner	Vehicle development groups
History	2013.04.16 - NF - first draft description 2013.04.23 – MB – improved description
Goal	Need for collaborative vehicles xFCD interface adapter. Project standardisation activities should be taken into account. Proper algorithms and protocols (e.g. based on the well known SIMONE protocol for CFD) for XFCD processing will be defined and developed. A specialised (or a number of) web service should be developed to allow vehicles to connect, REST architecture should be evaluated.
Related EMPOWER Use Case	N/A
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- FLEX Applications:** ☑ Collaborative pro-active urban/inter-urban monitoring and ad-hoc control **- Enabler:** ☑ Data or Aggregated data: "Vehicle data"
Relevance to EMPOWER subsystem and component	**- Vehicle** ☑ Application ☑ Security & Privacy ☑ Other "Vehicle status information module" **- Central** ☑ Positioning unit ☑ Communication unit ☑ Security & Privacy

	☑ Data management unit
Requirement category	- Non-functional ☑ Connectivity and communication requirements
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	No integration of xFCD info if the interface will not be defined.
Validation method (tests, indicators, performance bounds)	Vehicle2TMC data exchange tests. Performance to be evaluated in terms of latency, network load, scalability potentiality, time-based availability.
Acceptance criteria	The protocol can guarantee transmission of needed collaborative xFCD information (to be defined later in the project).
Relationship with other requirements	- No ☑
Potential conflicts	Not at this level of definition
Potential technologies involved / affected	SIMONE FCD protocol, LTE communication
Status of requirement description	☑ Final
Other	Not at this level of definition

SP2_REQ_OTH 3: Travellers mobile devices should allow MAC address based tracking.

Requirement ID:	SP2_REQ_OTH_03_v1.1
Name of requirement:	Travellers mobile devices should allow MAC address based tracking.
Created by	Nikos Floudas (NF) - nikos.floudas@iccs.gr
Assigned partner	Smartphone development group.
History	2013.04.16 - NF - first draft description

	2013.04.18 - NF - completed description 2013.04.26 - NF - addition of source of driving style monitoring enabler
Goal	Need for travellers to allow their mobile devices to be tracked using their MAC addresses.
Related EMPOWER Use Case	N/A
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- DIALOGUE Applications:** ☑ Collaborative driving and merging **- Enabler:** ☑ Algorithm: for traveller tracking base on MAC address. ☑ Algorithm: "Driving style monitoring" ☑ Other: Equipment characteristic that requires user consent.
Relevance to EMPOWER subsystem and component	**- Personal** ☑ Application ☑ Security & Privacy ☑ Other "Smartphone settings"
Requirement category	- Non-functional ☑ Application requirements ☑ Security requirements ☑ User acceptance
Critical level (priority)	Define the importance of the requirement: ☑ Recommended
Risk analysis	- Maybe another innovative crowd-sourcing data that allows

	traveller tracking should be defined. - Security and privacy issues might be raised by this.
Validation method (tests, indicators, performance bounds)	An reliable and respecting user's privacy traveller tracking method should be defined. Application functionality in cases of failures to locate accurately a traveller's identity should be tested.
Acceptance criteria	Real time update (within a few seconds) of the user interface with application content taking into account correct user preferences will promote user acceptance. At the same time user should feel comfortable and feel that their privacy is violated.
Relationship with other requirements	- No ☑
Potential conflicts	None
Potential technologies involved / affected	A more generic algorithm for smartphone tracking that combines technologies might be necessary: GPS, Wi-Fi positioning, possibly cell tower triangulation.
Status of requirement description	☑ Final
Other	Maybe a different project wide technique for traveller equipment to identify themselves should be defined.

SP2_REQ_OTH 4: Traffic lights information should be transmitted to the vehicle.

Requirement ID:	SP2_REQ_OTH_04_v1.1
Name of requirement:	Traffic lights information should be transmitted to the vehicle.
Created by	Marco Bottero - marco.bottero@swarco.com
Assigned partner	Pilot site leaders and infrastructure development groups
History	2013.04.16 - NF - first draft description 2013.04.23 – MB – improved description

	2013.04.26 - NF - addition of source of driving style monitoring enabler
Goal	Traffic lights information (SPaT – Signal Phases and Timing) should be transmitted to the vehicle. The outcomes of use case SP3_CMC_MLP (application of multi-layered control policies) should be translated into a set of actions/information applied by means of different devices systems for collaborative traffic control, continuously validated by double loop control, and sent to the vehicle.
Related EMPOWER Use Case	N/A
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- DIALOGUE Applications:** ☑ Collaborative ACC **- FLEX Applications:** ☑ Collaborative smart intersection for bus priority (intelligent priorities) **- Enabler:** ☑ Algorithm: "Driving style monitoring"
Relevance to EMPOWER subsystem and component	**- Vehicle** ☑ Application **- Central** ☑ Communication unit ☑ LDM++ ☑ Data management unit **- Roadside** ☑ Application

Requirement category	☑ Functional
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	If traffic light information will not be available at the vehicle side, most of the collaborative functionalities of traffic control will not be available to be demonstrated. Local public administrations should agree to make local traffic control data available. Probably existing legacy systems should be adapted to meet this next requirement.
Validation method (tests, indicators, performance bounds)	Tests - vehicles can receive information about SPaT through the TMC and/or the RSU ITS station (this choice depends on the communications architecture that will be defined in the next stages of the project).
Acceptance criteria	SPaT is available at the vehicle side.
Relationship with other requirements	- No ☑ (at this level)
Potential conflicts	Not at this level of definition
Potential technologies involved / affected	LTE
Status of requirement description	☑ Final
Other	SPaT provisioning is in charge of the central/road-side subsystem. GLOSA (Green Light Optimised Speed Advice) and/or waiting time provisioning is in charge of the vehicle subsystem.

SP2_REQ_OTH 5: TEAM should have access to switch traffic lights.

Requirement ID:	SP2_REQ_OTH_05_v1.0
Name of requirement:	TEAM should have access to switch traffic lights.

Created by	Marco Bottero - marco.bottero@swarco.com
Assigned partner	Pilot site leaders and infrastructure development groups
History	2013.04.16 - NF - first draft description 2013.04.23 – MB – improved description
Goal	TEAM should have access to switch traffic lights. The TMC of local pilots should be able to do it in restricted areas. The system should be able to quickly react on traffic forecasts done by the SP3_CMC_NOS use case, taking into account to the policies defined in the SP3_CMC_MLP use case. Access should guarantee the capability to collaborate with vehicles and collecting feedbacks about relevant tactical control actions (e.g. forecasted vs. actual time to green).
Related EMPOWER Use Case	N/A
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- DIALOGUE Applications:** ☑ Collaborative ACC **- FLEX Applications:** ☑ Collaborative pro-active urban/inter-urban monitoring and ad-hoc control ☑ Collaborative smart intersection for bus priority (intelligent priorities) **- Enabler:** ☑ Data or Aggregated data: "Transport infrastructure data "
Relevance to EMPOWER subsystem and component	**- Central** ☑ Communication unit ☑ Data management unit

	- Roadside ☑ Application
Requirement category	☑ Functional
Critical level (priority)	Define the importance of the requirement: ☑ Recommended
Risk analysis	If TEAM will not have access to traffic lights, some collaborative functionalities will not be available for demonstration.
Validation method (tests, indicators, performance bounds)	TMC/traffic light communication tests.
Acceptance criteria	The TEAM TMC is able to have access to local traffic light control systems.
Relationship with other requirements	- No ☑
Potential conflicts	Not at this level of definition.
Potential technologies involved / affected	LTE (for intersections not yet centralised).
Status of requirement description	☑ Final
Other	Not at this level of definition.

SP2_REQ_OTH 6: Dynamical change requests for the speed limit.

Requirement ID:	SP2_REQ_OTH_06_v1.0
Name of requirement:	Dynamical change requests for the speed limit.
Created by	Nikos Floudas (NF) - nikos.floudas@iccs.gr
Assigned partner	Pilot site leaders.
History	2013.04.16 - NF - first draft description 2013.04.18 - NF - completed description
Goal	Need for the speed limit to be able to change dynamically.

Related EMPOWER Use Case	N/A
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- FLEX Applications:** ☑ Collaborative smart intersection for bus priority (intelligent priorities) **- Enabler:** ☑ Data or Aggregated data: Speed limit information.
Relevance to EMPOWER subsystem and component	**- Vehicle** ☑ Application **- Personal** ☑ Application **- Central** ☑ Communication unit **- Roadside** ☑ Application
Requirement category	- Non-functional ☑ Application requirements
Critical level (priority)	Define the importance of the requirement: ☑ Recommended
Risk analysis	- Acceptance to dynamically change speed limit might be not accepted by public authorities. - Such request for speed limit adaptation needs exhaustive testing to ensure safe application operation with increased reliability.
Validation method (tests, indicators, performance bounds)	Problems that might arise from incorrect speed limit adaptation should be tested.
Acceptance criteria	Correct speed limit adaptation can improve traffic flow and in sequence user acceptance.
Relationship with other requirements	- No ☑
Potential conflicts	N/A
Potential technologies involved / affected	Interface to Public Authorities needed to enforce and transmit a new speed limit.
Status of requirement description	☑ Final

Other	None.

SP2_REQ_OTH 7: Interface and change requests to public transport operator data.

Requirement ID:	SP2_REQ_OTH_07_v1.0
Name of requirement:	Interface and change requests to public transport operator data.
Created by	Nikos Floudas (NF) - nikos.floudas@iccs.gr
Assigned partner	Collaborative public transport optimization development group.
History	2013.04.16 - NF - description 2013.04.18 - NF - completed description
Goal	Public transport operator should be flexible to accept schedule or route change requests and coordination among buses to dynamically adapt their distance. Route changes concern mainly event driven changes; normal scheduling is required in cases of traffic flow problems and traveller request. The latter is understood that is problematic and its implementation could be limited. Application should also have access to public transport operator data.
Related EMPOWER Use Case	N/A
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- FLEX Applications:** ☑ Collaborative public transport optimization **- Enabler:** ☑ Data or Aggregated data: Public transport operator data.
Relevance to EMPOWER subsystem and component	**- Central** ☑ LDM++

	- Roadside ☑ Application
Requirement category	- Non-functional ☑ Application requirements
Critical level (priority)	Define the importance of the requirement: ☑ Recommended
Risk analysis	- Access to static and dynamic public transport data is prerequisite for this application to work. - Public transport operator centre and employees should be obliged to accept the modifications to schedule or routes calculated by the application, which is not an easy agreement to achieve.
Validation method (tests, indicators, performance bounds)	Traffic flow metrics, public transport operator calculated times to follow routes and accordance with the schedules, public transport commuters time to reach their destinations are indicators for the well performance of this application.
Acceptance criteria	Public transport operator and users will be satisfied with this application. If users arrive in time to their destination, their acceptance to the operator will raise. At the same time PT Operator will see their customers number to increase because of the improvement of their services and at the same time their fleet management exploitation will be more profitable and efficient.
Relationship with other requirements	- No ☑
Potential conflicts	N/A
Potential technologies involved / affected	Interface to Public Transport Operator Centre through Roadside or Central Subsystem is required.
Status of requirement description	☑ Final
Other	None

SP2_REQ_OTH 8: User profile data features.

Requirement ID:	SP2_REQ_OTH_08_v1.1
Name of requirement:	User profile data features.
Created by	Nikos Floudas (NF) - nikos.floudas@iccs.gr
Assigned partner	User profile enablers development group.

History	2013.04.16 - NF - first draft description 2013.04.18 - NF - completed description 2013.04.26 - NF - addition of source of driving style monitoring enabler
Goal	User profile to include: locations like "home", "work" etc, user preference criteria regarding: travel time, cost, environmental criteria, number of changes, desired traffic modes, badges to good performers: connected with access to pool lanes, discounts for parking costs, free bus tickets, etc. include information such as: friends, type of car, interests, geographical area, time periods, etc., disabled person wanting to cross the street.
Related EMPOWER Use Case	N/A
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- DIALOGUE Applications:** ☑ Collaborative ACC ☑ Collaborative eco-friendly navigation ☑ Serious game and community building **- FLEX Applications:** ☑ Collaborative co-modal route planning ☑ Co-modal coaching with support from virtual/avatar users ☑ Collaborative smart intersection for bus priority (intelligent priorities) **- Enabler:** ☑ Data or Aggregated data: User profile data ☑ Algorithm: "Driving style monitoring" **- Application independent:** ☑ This operation can be application independent.

Relevance to EMPOWER subsystem and component	**- Vehicle** ☑ Application ☑ Security & Privacy **- Personal** ☑ Application ☑ Security & Privacy **- Central** ☑ Security & Privacy ☑ Data management unit
Requirement category	- Non-functional ☑ Application requirements ☑ User acceptance
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	To ensure user data security and privacy.
Validation method (tests, indicators, performance bounds)	No significant validation indicators needed for this RQ. All necessary user related data should be available and safely stored for the application and the users to utilise.
Acceptance criteria	- Users should feel that their personal data are secure and their privacy is respected by the application or external sources.
Relationship with other requirements	- No ☑
Potential conflicts	Related with vehicle profile data.
Potential technologies involved / affected	Security related issues should be taken into account when sending/receiving privacy vulnerable user data. User data should be stored in the Central data management system.
Status of requirement description	☑ Final
Other	None.

SP2_REQ_OTH 9: Vehicle profile data features.

Requirement ID:	SP2_REQ_OTH_09_v1.1
Name of requirement:	Vehicle profile data features.

Created by	Nikos Floudas (NF) - nikos.floudas@iccs.gr
Assigned partner	Vehicle profile enablers development group.
History	2013.04.16 - NF - first draft description 2013.04.18 - NF - completed description 2013.04.26 - NF - addition of source of driving style monitoring enabler
Goal	Vehicle profile to include: fuel level, engine type {electric, hybrid, IEC}, emission factors, max speed, type, truck, bus, tram, car, motorcycle, pedestrians, cyclists, truck with dangerous goods, ambulance, cabriolet etc. For buses: type, weight, number of passengers, schedule, route etc.
Related EMPOWER Use Case	N/A
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- DIALOGUE Applications:** ☑ Collaborative eco-friendly navigation **- FLEX Applications:** ☑ Co-modal coaching with support from virtual/avatar users ☑ Collaborative smart intersection for bus priority (intelligent priorities) **- Enabler:** ☑ Data or Aggregated data: Vehicle data. ☑ Algorithm: "Driving style monitoring" **- Application independent:** ☑ This operation can be application independent.
Relevance to EMPOWER subsystem and component	**- Vehicle** ☑ Application

	☑ Security & Privacy **- Personal** ☑Application ☑ Security & Privacy **- Central** ☑ Security & Privacy ☑ Data management unit
Requirement category	- Non-functional ☑ Application requirements ☑ User acceptance
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	To ensure vehicle data security and privacy.
Validation method (tests, indicators, performance bounds)	No significant validation indicators needed for this RQ. All necessary vehicle related data should be available and safely stored for the application and the users to utilise.
Acceptance criteria	Users should feel that their personal data are secure and their privacy is respected by the application or external sources.
Relationship with other requirements	- No ☑
Potential conflicts	Relate with user profile data .
Potential technologies involved / affected	Security related issues should be taken into account when sending/receiving privacy vulnerable vehicle data. Vehicle data should be stored in the Central data management system.
Status of requirement description	☑ Final
Other	None.

SP2_REQ_OTH 10: User can modify user profile data.

Requirement ID:	SP2_REQ_OTH_10_v1.0
Name of requirement:	User can modify user profile data.
Created by	Nikos Floudas (NF) - nikos.floudas@iccs.gr
Assigned partner	User profile enablers development group.

History	2013.04.16 - NF - first draft description 2013.04.18 - NF - completed description
Goal	An application user should be able and allowed to modify their user profile data (including their vehicle data).
Related EMPOWER Use Case	N/A
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- DIALOGUE Applications:** ☑ Serious game and community building **- Enabler:** ☑ Data or Aggregated data: User profile data. **- Application independent:** ☑ This operation can be application independent.
Relevance to EMPOWER subsystem and component	**- Vehicle** ☑ Application ☑ Security & Privacy **- Personal** ☑ Application ☑ Security & Privacy **- Central** ☑ Security & Privacy ☑ Data management unit
Requirement category	- Non-functional ☑ Application requirements ☑ User acceptance
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	- User should securely send and receive information from their user profile. - User should not be able to insert false or erroneous data, or

	modify sensitive data, such as badges of good performance.
Validation method (tests, indicators, performance bounds)	No particular validation indicators are required, users should be able to modify safely some part of their profile data.
Acceptance criteria	User should easily and safely command their profile, modify their allowed data, delete their profile if their wish and in general feel comfortable with the applications and their privacy.
Relationship with other requirements	- No ☑
Potential conflicts	Similarities with applications being able to modify user profile data.
Potential technologies involved / affected	Secure communication of data and data base technologies.
Status of requirement description	☑ Final
Other	None

SP2_REQ_OTH 11: Application can modify user profile data.

Requirement ID:	SP2_REQ_OTH_11_v1.1
Name of requirement:	Application can modify user profile data.
Created by	Iacopo Carreras (IC) - iacopo.carreras@create-net.org
Assigned partner	Application and user profile enablers development groups
History	2013.04.16 - NF - first draft description 2013.04.18 - IC – revised version 2013.04.26 - NF - addition of source of driving style monitoring enabler
Goal	User profile should allow for updates by applications, (e.g. based on user driving and mobility behavior etc).
Related EMPOWER Use Case	N/A
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- DIALOGUE Applications:**

	☑ Collaborative parking ☑ Collaborative eco-friendly navigation ☑ Serious game and community building **- Enabler:** ☑ Algorithm: "Driving style monitoring"
Relevance to EMPOWER subsystem and component	**- Personal** ☑ Application ☑ Security & Privacy **- Central** ☑ Security & Privacy
Requirement category	- Non-functional ☑ General architectural and equipment requirements ☑ Application requirements
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	If this requirement is not met, user profile cannot be dynamically updated. Any use case based on this, will not be supported. As an example, gamification approaches to eco-friendly mobility cannot be realized (e.g., EFP-UC2).
Validation method (tests, indicators, performance bounds)	Verify that the data of the user profile are updated throughout the execution of a use case. As an example, when a driver does not behave properly, e.g. when it drives not following a eco-sustainable behavior.
Acceptance criteria	Users' profile will reflect users' mobility behavior, as measured by the TEAM system and supported applications.
Relationship with other requirements	- No ☑

Potential conflicts	N/A
Potential technologies involved / affected	N/A
Status of requirement description	☑ Final
Other	None.

SP2_REQ_OTH 12: Vehicle should be able to identify themselves.

Requirement ID:	SP2_REQ_OTH_12_v1.0
Name of requirement:	Vehicle should be able to identify themselves
Created by	Iacopo Carreras (IC)- iacopo.carreras@create-net.org
Assigned partner	Vehicle development groups
History	2013.04.16 - NF - first draft description 2013.04.18 – IC – revised version
Goal	Vehicles should be able to identify themselves. This will be required for those application scenarios where vehicle/user specific services will be delivered.
Related EMPOWER Use Case	N/A
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- DIALOGUE Applications:** ☑ Collaborative ACC
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ Application ☑ Security & Privacy **- Roadside**

	☑ Application ☑ Security & Privacy
Requirement category	- Non-functional ☑ General architectural and equipment requirements ☑ Application requirements ☑ Security requirements
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	- it will not be possible to support and deliver vehicle specific interactions
Validation method (tests, indicators, performance bounds)	- availability of vehicle unique identifier - inclusion of vehicle unique identifier as part of V2X communications
Acceptance criteria	The vehicle is able to identify itself through a unambiguous code.
Relationship with other requirements	- No ☑
Potential conflicts	N/A
Potential technologies involved / affected	N/A
Status of requirement description	☑ Final
Other	None.

SP2_REQ_OTH 13: TMC able to integrate external data in addition to collaborative xFCD.

Requirement ID:	SP2_REQ_OTH_13_v1.0
Name of requirement:	TMC able to integrate external data in addition to collaborative xFCD.

Created by	Marco Bottero (MB) - marco.bottero@swarco.com
Assigned partner	Pilot site leaders, Infrastructure development group
History	2013.04.16 - NF - first draft description 2013.04.23 – MB – improved description
Goal	Traffic Management Centre should be able to integrate external data in addition to collaborative xFCD. Need for floating traveller & external data aggregated and stored to TMC database. TMC able to aggregate and store floating traveller and external data such as transport infrastructure data: Raw data (coming from legacy road sensors and specific systems) and processed information about the current and forecasted status of the network (accidents, expected congestion, …), traffic control parameters (e.g. SPaT) and demand driving multi-layered policies.
Related EMPOWER Use Case	N/A
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- FLEX Applications:** ☑ Collaborative pro-active urban/inter-urban monitoring and ad-hoc control **- Enabler:** ☑ Data or Aggregated data: "_____"
Relevance to EMPOWER subsystem and component	**- Central** ☑ LDM++ ☑ Data management unit
Requirement category	☑ Functional
Critical level (priority)	Define the importance of the requirement:

	☑ Optional
Risk analysis	Potentially the integration of external data will increase the impact of collaborative technologies and integration with existing systems.
Validation method (tests, indicators, performance bounds)	Performance indicators (TBD) to assess the impact of the additional information.
Acceptance criteria	Accuracy and reliability of information extracted only from collaborative data is significantly increased, when such data are integrated with data coming from external providers (e.g. legacy traffic monitoring systems, other providers, …).
Relationship with other requirements	- No ☑
Potential conflicts	No
Potential technologies involved / affected	Cloud
Status of requirement description	☑ Final
Other	Stop-line sensors integration is the most interesting one.

SP2_REQ_OTH 14: Data exchange format should take into consideration standard protocols.

Requirement ID:	SP2_REQ_OTH_14_v1.0
Name of requirement:	Data exchange format should take into consideration standard protocols such as DATEX II, TPEG, SIRI.
Created by	Iacopo Carreras (IC)- iacopo.carreras@create-net.org
Assigned partner	TG Communication
History	2013.04.16 - NF - first draft description 2013.04.18 – IC – revised version
Goal	Data exchange format should take into consideration standard protocols and formats such as, e.g, DATEX II, TPEG, SIRI.

Related EMPOWER Use Case	N/A
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- FLEX Applications:** ☑ Collaborative pro-active urban/inter-urban monitoring and ad-hoc control
Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ Application **- Central** ☑ Data management unit **- Roadside** ☑ Application
Requirement category	☑ Functional - Non-functional ☑ General architectural and equipment requirements
Critical level (priority)	Define the importance of the requirement: ☑ Recommended
Risk analysis	- Integration across different application domains - interoperability
Validation method (tests, indicators, performance bounds)	- data on traffic situation should be based on DATEXII - data on real time traffic should be based on SIRI - data on traffic stops should be based on IFOPT
Acceptance criteria	Data on traffic situation, timetables should be exposed and managed according to standards.
Relationship with other requirements	- No ☑

Potential conflicts	N/A
Potential technologies involved / affected	N/A
Status of requirement description	☑ Final
Other	None.

SP2_REQ_OTH 15: Access to external sources of information.

Requirement ID:	SP2_REQ_OTH_15_v1.0
Name of requirement:	Access to external sources of information.
Created by	Marco Bottero - marco.bottero@swarco.com
Assigned partner	Pilot site leaders and application development groups
History	2013.04.16 - NF - first draft description 2013.04.23 – MB – improved description
Goal	External sources of information data needed: Public Safety Answering Points (PSAP), police, fire brigade, municipality services, road operator, historical traffic related data, weather forecast information, road constructions, event timetables (such as stadiums, museums programs or conferences, concerts programs or relevant information such as number of attendees).
Related EMPOWER Use Case	N/A
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- DIALOGUE Applications:** ☑ Collaborative driving and merging **- FLEX Applications:** ☑ Collaborative co-modal route planning

	- Enabler: ☑ Data or Aggregated data: "external data"
Relevance to EMPOWER subsystem and component	**- Central** ☑ Communication unit ☑ LDM++ ☑ Security & Privacy ☑ Data management unit
Requirement category	☑ Functional
Critical level (priority)	Define the importance of the requirement: ☑ Optional
Risk analysis	If this requirement will not be met, the integration of TEAM applications with external data sources will be poor. Integration with open data sources will improve the collaborative side of TEAM.
Validation method (tests, indicators, performance bounds)	Testing about availability and reliability of connected external data sources.
Acceptance criteria	Data coming from external systems are available at the TEAM TMC and for vertical applications.
Relationship with other requirements	- Same level with: SP2_REQ_OTH_13
Potential conflicts	Not at this level of detail
Potential technologies involved / affected	Cloud, LTE
Status of requirement description	☑ Final
Other	None.

SP2_REQ_OTH 16: Inter-application interaction needed.

Requirement ID:	SP2_REQ_OTH_16_v1.0
Name of requirement:	Inter-application interaction needed.
Created by	Marco Bottero - marco.bottero@swarco.com
Assigned partner	Application development groups, TG IVL
History	2013.04.16 - NF - first draft description 2013.04.23 – MB – improved description
Goal	Inter-application interaction needed in terms of data exchange and functionalities integration (overlapping should be minimised and functionalities should be complementary each other).
Related EMPOWER Use Case	N/A
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- DIALOGUE Applications:** ☑ Collaborative driving and merging ☑ Serious game and community building **- FLEX Applications:** ☑ Collaborative pro-active urban/inter-urban monitoring and ad-hoc control ☑ Collaborative smart intersection for bus priority (intelligent priorities) ☑ Collaborative public transport optimization ☑ Community gaming (cities, infrastructure)
Relevance to EMPOWER subsystem and component	**- Vehicle** ☑ Application **- Personal**

	☑ Application **- Central** ☑ Communication unit ☑ LDM++ ☑ Data management unit **- Roadside** ☑ Application
Requirement category	- Non-functional ☑ General architectural and equipment requirements
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	If this requirement will not be met, the whole project will have a lower impact on pilots. The effort needed to develop functionalities will be higher.
Validation method (tests, indicators, performance bounds)	Architecture analysis.
Acceptance criteria	Overlapping and missing functionalities are reduced to the minimum in architecture definition and development phase.
Relationship with other requirements	- Hierarchical - Parent req. of: ALL
Potential conflicts	No
Potential technologies involved / affected	N/A
Status of requirement description	☐ Draft ☑ Final ☐ Rejected
Other	Complementary to other requirements.

SP2_REQ_OTH 17: Guaranteed interoperability and graceful degradation of service if not available.

Requirement ID:	SP2_REQ_OTH_17_v1.1
Name of requirement:	Guaranteed interoperability and graceful degradation of service if not available.
Created by	Marco Bottero - marco.bottero@swarco.com
Assigned partner	Application development groups
History	2013.04.16 - NF - first draft description 2013.04.23 – MB – improved description 2013.04.26 - NF - addition of source of driving style monitoring enabler
Goal	The interoperability should be guaranteed from the basic components, such as communication, positioning and LDM++. In case some required information is not available, the application should be able to perform graceful degradation of service. LDM++ should be integrated with the standard protocols.
Related EMPOWER Use Case	N/A
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- FLEX Applications:** ☑ Collaborative pro-active urban/inter-urban monitoring and ad-hoc control ☑ Collaborative smart intersection for bus priority (intelligent priorities) ☑ Dynamic collaborative corridors **- Enabler:**

	☑ Algorithm: "Driving style monitoring"
Relevance to EMPOWER subsystem and component	**- Central** ☑ Communication unit ☑ LDM++ ☑ Data management unit **- Roadside** ☑ Application
Requirement category	- Non-functional ☑ General architectural and equipment requirements
Critical level (priority)	Define the importance of the requirement: ☑ Optional
Risk analysis	In case of no information/service availability, TEAM applications will not work, instead of having a degraded mode.
Validation method (tests, indicators, performance bounds)	Stress tests.
Acceptance criteria	Availability of a degraded mode for services.
Relationship with other requirements	- No ☑
Potential conflicts	No
Potential technologies involved / affected	N/A
Status of requirement description	☑ Final
Other	No

SP2_REQ_OTH 18: Implementation of RESTful interface dedicated web services.

Requirement ID:	SP2_REQ_OTH_18_v1.1

Name of requirement:	Implementation of RESTful interface dedicated web services
Created by	Iacopo Carreras (IC)- iacopo.carreras@create-net.org
Assigned partner	Application development groups
History	2013.04.16 - NF - first draft description 2013.04.18 – IC – updated version 2013.04.26 - NF - addition of source of driving style monitoring enabler
Goal	RESTful interfaces should be provided in order to facilitate the access to data and services.
Related EMPOWER Use Case	N/A
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- DIALOGUE Applications:** ☑ Collaborative ACC **- Enabler:** ☑ Algorithm: "Driving style monitoring"
Relevance to EMPOWER subsystem and component	**- Central** ☑ Other "Application TEAM EMPOWER services" **- Roadside** ☑ Application
Requirement category	- Non-functional ☑ General architectural and equipment requirements ☑ Application requirements
Critical level (priority)	Define the importance of the requirement: ☑ Recommended

Risk analysis	- easiness of development of applications - easiness of integration
Validation method (tests, indicators, performance bounds)	- tests over the exposed RESTful interfaces
Acceptance criteria	The RESTful interface is implemented and passes the tests defined in the validation methods
Relationship with other requirements	- No ☑
Potential conflicts	N/A
Potential technologies involved / affected	N/A
Status of requirement description	☑ Final
Other	None.

SP2_REQ_OTH 19: Web services for B2B information publication.

Requirement ID:	SP2_REQ_OTH_19_v1.0
Name of requirement:	Web services for B2B information publication.
Created by	Iacopo Carreras (IC) - iacopo.carreras@create-net.org
Assigned partner	Application development groups.
History	2013.04.16 - NF - first draft description 2013.04.18 – IC – revised version
Goal	TEAM should expose dedicated Web services for accessing B2B information.
Related EMPOWER Use Case	N/A
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- FLEX Applications:**

	☑ Collaborative pro-active urban/inter-urban monitoring and ad-hoc control
Relevance to EMPOWER subsystem and component	**- Central** ☑ Other "Web services for TEAM applications"
Requirement category	- Non-functional ☑ Application requirements
Critical level (priority)	Define the importance of the requirement: ☑ Recommended
Risk analysis	- limited integration with external services - software development overhead
Validation method (tests, indicators, performance bounds)	- availability of web services for B2B information access
Acceptance criteria	B2B information services should be exposed as web services.
Relationship with other requirements	- No ☑
Potential conflicts	N/A
Potential technologies involved / affected	N/A
Status of requirement description	☑ Final
Other	None.

SP2_REQ_OTH 20: Inference engine for complex data processing.

Requirement ID:	SP2_REQ_OTH_20_v1.0
Name of requirement:	Inference engine for complex data processing.
Created by	Nikos Floudas (NF) - nikos.floudas@iccs.gr
Assigned partner	Application development groups

History	2013.04.16 - NF - first draft description 2013.04.18 - NF - completed description
Goal	Need for an inference engine / module to perform complex queries, eventually supporting data pre-processing, filtering, aggregation, sensor data fusion.
Related EMPOWER Use Case	N/A
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- FLEX Applications:** ☑ Collaborative co-modal route planning **- Enabler:** ☑ Algorithm: Inference engine for data queries ☑ Tool: Inference engine can be tool or algorithm **- Application independent:** ☑ This operation can be application independent.
Relevance to EMPOWER subsystem and component	**- Central** ☑ Data management unit
Requirement category	- Non-functional ☑ Technological and development requirements ☑ Other: A smart and fast inference engine for data aggregation.
Critical level (priority)	Define the importance of the requirement: ☑ Recommended
Risk analysis	- This recommended inference engine might have to handle a huge number of requests and can end up to delay procedures, possibly application should handle their queries on their own.

	- The intermediate inference engine could limit the performance of applications, especially if application developers have more innovative and specific queries to perform.
Validation method (tests, indicators, performance bounds)	Response time to queries can be an evaluation tool to assess this requirement.
Acceptance criteria	Fast response time of applications is a reliable index for user acceptance, when investigating this requirement.
Relationship with other requirements	- No ☑
Potential conflicts	N/A
Potential technologies involved / affected	Data base queries and other operations is the main technology involved in this requirement.
Status of requirement description	☑ Final
Other	None.

SP2_REQ_OTH 21: Real-time large-scale stream processing.

Requirement ID:	SP2_REQ_OTH_21_v1.0
Name of requirement:	Real-time large-scale stream processing.
Created by	Iacopo Carreras (IC)- iacopo.carreras@create-net.org
Assigned partner	Application development groups
History	2013.04.16 – NC – first daft description 2013.04.18 – IC – filled requirement form
Goal	TEAM should develop a real-time large-scale stream processing in order to deal with those use cases, where large amounts of data originating from moving vehicles or mobile users should be processed in real-time.

Related EMPOWER Use Case	N/A
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- DIALOGUE Applications:** ☑ Collaborative parking ☑ Collaborative eco-friendly navigation
Relevance to EMPOWER subsystem and component	**- Central** ☑ Data management unit
Requirement category	☑ Functional - Non-functional ☑ General architectural and equipment requirements ☑ Technological and development requirements
Critical level (priority)	Define the importance of the requirement: ☑ Recommended
Risk analysis	- impossibility to react in the TEAM time constraints
Validation method (tests, indicators, performance bounds)	- response time of the real-time use cases - # of events processed in real-time
Acceptance criteria	The use cases should respond in real-time.
Relationship with other requirements	- No ☑
Potential conflicts	N/A
Potential technologies involved / affected	N/A
Status of requirement description	☑ Final
Other	None.

SP2_REQ_OTH 22: Ability to log application data.

Requirement ID:	SP2_REQ_OTH_22_v1.0
Name of requirement:	Ability to log application data.
Created by	Nikos Floudas (NF) - nikos.floudas@iccs.gr
Assigned partner	Application development groups.
History	2013.04.16 - NF - first draft description 2013.04.18 - NF - completed description
Goal	Ability to log data (e.g. for the authorities or gaming purposes).
Related EMPOWER Use Case	N/A
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- FLEX Applications:** ☑ Dynamic collaborative corridors **- Application independent:** ☑ It main concern all applications.
Relevance to EMPOWER subsystem and component	**- Vehicle** ☑ Other: Vehicle data storage component **- Personal** ☑ Other: User data storage component **- Central** ☑ Other: Central data storage component **- Roadside** ☑ Other: Roadside data storage component
Requirement category	- Non-functional

	☑ Application requirements
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	- Ensure that not excessive and not useful amount of data is logged. Especially in devices where data storage capacity is limited.
Validation method (tests, indicators, performance bounds)	No particular validation method is needed for this requirement.
Acceptance criteria	Data logging application property is not related to user acceptance.
Relationship with other requirements	- No ☑
Potential conflicts	N/A
Potential technologies involved / affected	No specific technology is needed to achieve data logging.
Status of requirement description	☑ Final
Other	Specific data logging should be allowed after request and on special occasions. Data format should be clarified in advance. It should take place in Central or Roadside Subsystems where a system administrator can handle the log files and the data storage capacity is adequate.

SP2_REQ_OTH 23: Middleware for accessing shared TEAM software modules.

Requirement ID:	SP2_REQ_OTH_23_v1.1
Name of requirement:	Middleware for accessing shared TEAM software modules
Created by	Iacopo Carreras (IC)- iacopo.carreras@create-net.org
Assigned partner	WP2.5 team, Development groups
History	2013.04.16 - NF - first draft description

	2013.04.18 – IC – filled requirement form 2013.04.26 - NF - addition of source of driving style monitoring enabler
Goal	EMPOWER core services should be accessed from mobile phones through a middleware platform. This will facilitate the re-use of TEAM software modules (e.g., networking, security and privacy, V2X) and therefore accelerate the software development time.
Related EMPOWER Use Case	N/A
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- DIALOGUE Applications:** ☑ Collaborative parking ☑ Collaborative eco-friendly navigation ☑ Serious game and community building **- Enabler:** ☑ Algorithm: "Driving style monitoring"
Relevance to EMPOWER subsystem and component	**- Personal** ☑ Other " middleware for the mobile"
Requirement category	☑ Functional - Non-functional ☑ General architectural and equipment requirements
Critical level (priority)	Define the importance of the requirement: ☑ Recommended
Risk analysis	- limited reuse of TEAM software modules - High maintenance costs of TEAM platform

	- Difficult to extend the TEAM platform and to integrate different domains
Validation method (tests, indicators, performance bounds)	- availability of a TEAM mobile middleware platform - # of TEAM modules available as a middleware platform
Acceptance criteria	The use- cases relying on a TEAM mobile application for interacting with the users, should be based on the developer middleware platform.
Relationship with other requirements	- No ☑
Potential conflicts	N/A
Potential technologies involved / affected	All technologies available/accessible from smartphones should verify whether they could be integrated in the middleware platform.
Status of requirement description	☑ Final
Other	None

SP2_REQ_OTH 24: Mobile operating systems support.

Requirement ID:	SP2_REQ_OTH_24_v1.0
Name of requirement:	Mobile operating system support
Created by	Iacopo Carreras (IC)- iacopo.carreras@create-net.org
Assigned partner	Smartphone development groups
History	2013.04.16 - NF - first draft description 2013.04.18 – IC – filled requirement form
Goal	TEAM mobile applications should support both iPhone and Android operating systems. This means there should be 2 versions of each mobile application: one downloadable form

	the Google Play targeting android-based devices, and one from the Appstore and targeting iOS smartphones.
Related EMPOWER Use Case	N/A
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- DIALOGUE Applications:** ☑ Collaborative parking ☑ Collaborative eco-friendly navigation ☑ Serious game and community building
Relevance to EMPOWER subsystem and component	**- Personal** ☑ HMI ☑ Application
Requirement category	☑ Functional - Non-functional ☑ Application requirements
Critical level (priority)	Define the importance of the requirement: ☑ Recommended
Risk analysis	- limited reach of TEAM mobile applications - limited involvement of mobile users, especially in gaming scenarios
Validation method (tests, indicators, performance bounds)	- Availability of TEAM mobile applications on both Google Play and the Appstore stores.
Acceptance criteria	- Availability of TEAM mobile applications on both Google Play and the Appstore stores.
Relationship with other requirements	- No ☑

Potential conflicts	N/A
Potential technologies involved / affected	N/A
Status of requirement description	☑ Final
Other	None.

SP2_REQ_OTH 25: Provide synchronised time.

Requirement ID:	SP2_REQ_OTH_25_v1.0
Name of requirement:	Provide synchronised time
Created by	FOKUS (SP4_REQ_CONAV_SP2_01) - sebastian.schwardt@fokus.fraunhofer.de
Assigned partner	WP2.5 team, Development groups
History	2013.06.10 - NF - filled requirement form
Goal	A synchronized time is required. This time has to be the same for all used components across the TEAM system and needs to be synchronized on regular intervals. It is recommended that this time also is synchronized with a public time source like NTP servers.
Related EMPOWER Use Case	N/A
Source (TEAM application or enabler)	From which application/enabler the requirement has been created: **- DIALOGUE Applications:** ☑ Collaborative eco-friendly navigation **- Application independent:** ☑ Common time synchronisation needed for all the applications and functionalities of TEAM system.

Relevance to EMPOWER subsystem and component	- **Vehicle** ☑ Application **- Personal** ☑ Application **- Central** ☑ Synchronisation module
Requirement category	☑ Functional - Non-functional ☑ Application requirements
Critical level (priority)	Define the importance of the requirement: ☑ Mandatory
Risk analysis	All data related to traffic is only valid for a specific time; Application with not be useable if there is no reliable time source.
Validation method (tests, indicators, performance bounds)	Compare local time with time of remote systems inside TEAM system and outside TEAM system.
Acceptance criteria	Deviation of local time to remote and internet time.
Relationship with other requirements	- No ☑
Potential conflicts	N/A
Potential technologies involved / affected	N/A
Status of requirement description	☑ Final
Other	None.