

SAFESPOT INTEGRATED PROJECT - IST-4-026963-IP

DELIVERABLE



SP2 – INFRASENSE

D2.2.2 Part C List of INFRASENS System Requirements



Revision Log

Version	Date	Action	Company
V0.1	20-09-06	Template agreement and Draft List of SP2 System requirements	CRF
V0.2	28.09.06	Integration of the input provided by each partner	All SP2 partners
V0.3	13.10.06	Update on the infrastructure components definition	CRF, Mizar, CSST
V1.0	19.10.06	Final version	CRF

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1. INTRODUCTION

This Annex contains the List of System Requirements defined within SP2 referred to system components and matched with the use cases and previously defined user needs.

The list of requirements is part of the deliverable D2.2.2, but have been proposed as Annex to the main document just to simplify the consultation and revision of this output.

1.1. System Requirements structure

System requirements are presented in a table format and associated to each architecture components.

The table reporting the requirements is organized in two dimension.

Vertically, there are the main system components:

- Data acquisition (detection systems)
- Roadside Unit (MFO)
- Alert System
- Centre
- Communications (which have been identified as a key point for the SAFESPOT applications as they 'link' all the other components).

In the analysis of each system components some horizontal criteria have been taken into account, so to be as much exhaustive as possible:

- General Features,
- Installation, Repair, Maintenance
- Quality of Service
- Robustness
- Safety
- Security
- User Friendliness
- Cooperation
- Communication

Looking to the table from horizontal point of view, each requirements is characterized by the following features.

Table 1 – Requirements explanation fields

Title	Explanation
System requirement ID (Mandatory)	Each requirement has a unique ID number traceability purposes. The format used is as follows: SPX_REQ#ID_themeID#_partnerID#_v1.#> Where X is the Sub-Project Number The theme is related to the req classification (example_GEN related to a general requirement)
Name (Mandatory)	Denotes a unique name that complements the ID, but is easier to memorize.
System requirement Definition (Mandatory)	Each requirement supporting the implementation of a use case must be written in a precise and concise manner using the "shall" language ("The system shall" ...). The use of formal methods in the form of modeling languages like UML 2.0 will facilitate the formulation of requirements.
System requirement Relevance (Mandatory)	This priority will help WP3 to prioritize the items to be developed during the system specifications. The value must either be: C – Critical, must be incorporated S – Significant, should be incorporated I – of Interest, may be incorporated.
Responsibility (Mandatory)	Specifies the organization and if possible the person responsible for implementing and maintaining a requirement.
Type of System requirement (Mandatory)	It can be Functional requirement, Non-functional requirement, or Context requirement.
Link to global architecture system requirement (Mandatory)	ID of the global architecture system requirement identified.
Acceptance (condition)	Is mandatory if the word "should" is used in the description attribute. It specifies when the decision will be made and the criteria the decision will be based upon.
Rationale (Optional)	Is an explanation why this requirement is necessary.
Originator (Optional)	When particular system requirements are included, the link with a given Sub-Project should be established. It should work as the <i>Client</i> to a particular requirement.
Assumption (Optional)	Represents the facts we already know about the requirement or design decisions we already made

2. LIST OF SYSTEM REQUIREMENTS

REQ ID # NAME	REQUIREMENTS DEFINITION	RELEVANCE	RESPONSABILITY	TYPE OF REQUIREMENT	ACCEPTANCE	RATIONALE	ORIGINATOR	ASSUMPTIONS	USE CASES	USER NEEDS
1	DATA ACQUISITION									
1.01	GENERAL FEATURES									
1.01.01 Road Conditions	The system shall determine road status: ice, road works, oil, objects on the road	C	System integrator / System Developer	F	-	Based on the application, system integrator must select fundamental parameters affecting safety.	CID			2.04.02
1.01.02 Traffic Conditions	The system shall determine traffic status which can compromise road safety: traffic jam, stopped vehicles, incident.	C	System integrator / System Developer	F	-	Based on the application, system integrator must select fundamental parameters affecting safety	CID			2.01.01
1.01.03 Environment Conditions	The system shall determine environment conditions: rain, fog, low visibility	C	System integrator / System Developer	F	-	Based on the application, system integrator must select fundamental parameters affecting safety.	CID			1.01.03; 2.04.01; 4.01.04;
1.01.04 Scalability	The system shall be configured to work in different road scenario (intersection, motorway, etc)	C	System integrator / System Developer	NF	-	Accordingly to application requirements the system shall be easily adapted to context application	CRF		ALL	1.01.04
1.01.05 Pre-processing	The detection system shall pre-process all data received from the sensing system (e.g. plausibility and quality check, data aggregation).	C	System developer	F	-	Preliminary information processing is needed to make more effective the role of MFO and to check the data quality.	PTV/TUM		SP5_UC4114 12, 42, 43, 44, 22, 31, 33, 52, 55 SP4_UC6B,6 C,8A,9A,1A,1 B,1C,1F,1D	1.03

REQ ID # NAME	REQUIREMENTS DEFINITION	RELEVANCE	RESPONSABILITY	TYPE OF REQUIREMENT	ACCEPTANCE	RATIONALE	ORIGINATOR	ASSUMPTIONS	USE CASES	USER NEEDS
1.01.06 Road anomalies	The system shall be able to detect presence on the road of a vehicle (user, emergency or maintenance vehicle) which can be a possible dangerous obstacle.	C	System integrator/ System Developer	F	-	User needs	CRF		SP5_UC11	3.01.05; 3.01.06; 4.03.06;
1.01.07 Vehicle behaviour	The system shall detect strange vehicle behaviour which can be cause of accident (driver inattention)	S	System integrator/ System Developer	F	Specification phase	User needs	CRF		SP5_UC 21, 34	4.01.06
1.01.08 Road scenario	The system shall notice all the vehicle present in the area, position and speed and identify dangerous overtaking	S	System integrator/ System Developer	F	Specification phase	This represent a main input to create Local Dynamic Map	CRF		SP5_UC22; 23	1.01.02
1.01.09 Visibility system	The system shall detect visibility ranges below 400m.	C	System producer	F	-	Scope of project	LCPC	French Norm NF P 99-320		2.01.05_ SP2
1.01.10 Visibility system	The system shall classify low visibility ranges in 4 classes (200 to 400 m, 100 to 200m, 50 to 100m, below 50m)	C	System producer	F	-	Scope of project	LCPC	French Norm NF P 99-320		2.04.01_ SP2
1.01.11 Visibility system	The system shall detect the origin of a visibility reduction (fog, precipitation, projections, pollutions, darkness).	S	System producer	F	Specification phase	Scope of project	LCPC	French Norm NF P 99-320		2.04.01_ SP2
1.01.12 Laser scanner interface	The system shall provide an interface to connect a Laser scanner and process its raw data. The processing includes object detection, tracking and classification.	C	IBEO	NF	-	This requirement is a precondition for the requirement "Co-operative Laser scanner , V2I pre-data fusion"	IBEO	-		SP2_2.0 1.02 SP2_2.0 1.03

REQ ID # NAME	REQUIREMENTS DEFINITION	RELEVANCE	RESPONSABILITY	TYPE OF REQUIREMENT	ACCEPTANCE	RATIONALE	ORIGINATOR	ASSUMPTIONS	USE CASES	USER NEEDS
1.01.13 Lack of grip	The system shall identify weather conditions which can be cause of lack of grip	C	System developer	F	-	-	CRF		SP5_UC411	2.04.02
1.01.14 Co-operative Laser scanner, V2I pre-data fusion	The system shall be able to perform pre-data fusion of vehicle data transferred to node and laser scanner data in cooperation with static map information. The fusion shall yield improved object tracking and classification capabilities in terms of robustness and reliability.	C	IBEO	F	At least one Laser scanner and one V2I communication system has to be connected to the node.	Map and vehicle data can be used to improve detection, tracking and classification based on Laser scanner data. It realizes a medium level fusion technique and therefore represents a cooperative approach to improve road safety.	IBEO			SP2_1.0 1.09 SP2_1.0 3.01 SP2_1.0 3.03 SP2_2.0 1.02 SP2_2.0 1.03 SP2_3.0 1.01
1.01.15 Link to Info Centre	The detection system shall directly pass-through all data received from the Information Centre to the MFO (no-pre-processing necessary).	C	System developer	F	-	Data/information from external sources is pre-processed in Information Centre. So no further pre-processing within detection system is necessary.	PTV/TUM		SP5_UC411 412, 42, 43, 44, 22, 31, 33, 52, 55 SP4_UC6B,6 C,8A,9A,1A,1 B,1C,1F,1D	
1.01.16 Detailed static map	The system shall hold a static map of the surrounding area covering approximately a diameter of 500m. It shall contain the road geometry and landmarks. The data has to be accessible by the pre-data fusion system and shall deliver the data in real-time.	C	TA, Navteq	F	-	This requirement is a precondition for the requirement "Co-operative Laser scanner , V2I pre-data fusion"	IBEO			SP2_1.0 1.05

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1.01.17 Accuracy	The systems shall check data values by comparing different sources, when available, so to ensure high-accuracy and completeness.	C	System developer	F	-	It can be necessary to have more than one source providing the same information. It is important to check the congruence of the received data to understand if one of the components is faulty	Mizar			1.03.03
1.01.18 Measurement Acquisition	The system shall acquire the following measurements: -traffic measures: vehicle passage, presence class, length position, instantaneous speed, -non-traffic measures: noise, vibrations, collision, rollover, grip, temperature, wet pavement, fire, etc.	C	CSST	F	-	For events generation	CSST	-	SP5_UC131 SP5_UC132_V.0.1 SP5_UC14	2.01.04 3.01.01
1.01.19 Traffic Measurement Files Building	The system shall build files containing traffic data aggregated over a certain time step (parametric - defined by the Centre): -flow -average speed (arithmetic/harmonic, etc.) -occupancy per vehicle class and lane	C	CSST	F	-	First aggregation of data over a time interval	CSST	-	SP5_UC131 SP5_UC132_V.0.1 SP5_UC14	2.01.01

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1.01.20 Non-Traffic Measurement Files Building	The system shall build files containing non-traffic data aggregated over certain time step (parametric - defined by Centre) per vehicle-class and lane	C	CSST	F	-	First aggregation of data over a time interval	CSST	-	SP5_UC131 SP5_UC132_ V.0.1 SP5_UC14	2.02.01 2.04.01
1.01.21 Information update	The detection system shall carry out data pre-processing and forward acquired data only if a quantified difference from previous data is present	C	System developer	F	-	Data detected at roadside belongs to different classes: real time, environmental, static. Detection refresh time is constant, but data change is variable.	CRF			
1.01.22 Class of information	The detection system shall measure data characterized by different timing restriction (some information are static and related to the road geometry)	C	System developer	F	-	-	CRF			
1.01.23 Reactivity	The system shall react to events with appropriate timing, depending on type of detected events. SF application time around 10 seconds.	C	System developer /techn. owner	F	-	Efficiency of detection system	ISMB/ CRF			
1.01.24 Energy	The system shall include energy scavenging techniques to make nodes self-sustained in term of energy	S	System developer	F	-	Self-sustained energy source	ISMB			
1.01.25 Power subsystem	The system shall have different type of power module depending the road scenario, power consumption and energy source	S	System developer		-	Variety of power subsystem with scenario	ISMB			

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1.01.26 Power consumption	The system shall be developed taking into account power consumption in each part	S	System developer	F	-	Energy budget to guarantee the physical reliability	ISMB			
1.01.28 Moving RFID reader	The system should be able to read the installed long-range RFID tags	S	BME/LCPC	F		Onboard RFID reader detects tags and collects all coupled information (e.g. road temperature) Independent positioning is possible	BME	Installed and operating RFID tags		1.01.04; 1.01.05; 4.02.03
1.01.27 Visibility analysis data	The system should be able to collect spatial data produced by terrestrial laser scanner for junction visibility analysis	S	BME	F		By performing junction survey by terrestrial laser scanner, accurate visibility analysis of a junction can be executed for the drivers' viewpoints. It could result actions on reducing speed.	BME			1.01.08; 2.03.01;
1.02	Installation, Repair, Maintenance									
1.02. 01 Modularity	The detection system should be modular and scalable from hardware and software point of view. The components can be different accordingly to application and infrastructure area (motorway, intersection, etc).	I	System developer/ road operator	NF	-	-	CRF	SF architecture		

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1.02.02 Laser scanner installation (intersection)	The Laser scanners shall be mounted on opposite corners or traffic islands (depending on the intersection shape) of the intersection and shall have an unblocked view over the whole intersection.	S	IBEO	NF	Specification phase	To ensure that the full intersection and also its vicinity lies in the visible range of the Laser scanners, even if one Laser scanner is partially blocked (e.g. by a road user) they need to be installed as described.	IBEO	SF architect ure		
1.02.03 Maintenance	The detection system nodes shall be easily maintainable (with minimum disturbance)	I	System developer/ road operator	NF	-	To minimize respectively avoid down times of the overall system.	PTV/TUM	-	SP5_UC411, 412, 42, 43, 44, 22,31,33, 52, 55 SP4_UC6B,6 C,8A,9A,1A,1 B,1C,1F,1D	1.02.02
1.02.04 Repair	The detection system nodes shall be easily repairable (with minimum disturbance)	I	System developer/ road operator	NF	-	To minimize respectively avoid down times of the overall system.	PTV/TUM	-	SP5_UC411, 412, 42, 43, 44, 22, 31,33, 52, 55 SP4_UC6B,6 C,8A,9A,1A,1 B,1C,1F,1D	1.02.01
1.02.05 Installation	The system shall be easily installed on the road without impacting on the functionalities of the current equipment	I	System developer/ road operator	NF	-	-	CRF	-		1.02.04; 1.02.05;
1.02.06 Remote control	The system shall be remote controlled for maintenance and software update	S	System developer	F	Specification phase	-	CRF	-		

REQ ID # NAME	REQUIREMENTS DEFINITION	RELEVANCE	RESPONSABILITY	TYPE OF REQUIREMENT	ACCEPTANCE	RATIONALE	ORIGINATOR	ASSUMPTIONS	USE CASES	USER NEEDS
1.02.07 Compliance	The system shall be compliance with electrical requirement to work in critical environment (protection to voltage spike, water, etc)	C	System developer/ road operator	NF	-	Road environment present strong constraints	CRF	-		
1.02.08 Junction survey	High accuracy intersection survey (done only once in an intersection) should be executed for visibility analysis	S	BME	F		The collected point cloud enables the visibility mapping	BME			1.02.03
1.02.09 RFID tag maintenance	Power supply of active RFID tags should be checked periodically	S	Road operator	F		Active RFID tags must have adequate power supply, e.g. batteries	BME			
1.03	Quality of Service & Security									
1.03.01 Integrity	The system shall check and ensure the integrity of sensor data/information. (e.g. allocation of an all level penetrating quality index for the input data)	C	System developer	F	-	The integrity and correctness of sensor data/information is the basic requirement to provide a reliable and safety enhancing SAFESPOT Service.	PTV/TUM		SP5_UC411, 412, 42, 43, 44, 22,31,33, 52, 55 SP4_UC6B,6 C,8A,9A,1A,1 B,1C,1F,1D	1.03.02
1.03.02 Sensor data	The system shall transmit reliable sensor data to the MFO for further processing.	C	System developer	F	-	The data quality on sensor level is important for the overall quality	PTV/TUM		SP5_UC411, 412, 42, 43, 44, 22, 31,33, 52, 55 SP4_UC6B,6 C,8A,9A,1A,1 B,1C,1F,1D	

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1.03.03 Reliability	The detection system shall enable error checking in the communication with nodes	C	System developer	F	The communication should enable error checking	The communication protocol includes extra information to enable error checking	CID			1.03.02
1.03.04 Traffic Conditions	The system shall determine the validity (in terms of safety) of data from detection systems regarding traffic and environmental conditions	C	System integrator / System Developer	F	-	Based on the application, system integrator/developer must define the algorithms to validate the accuracy and reliability of data	CID			1.03.02
1.03.05 Road Conditions	The system shall determine the validity (in terms of safety) of data from detection systems regarding road conditions.	C	System integrator / System Developer	F	-	Based on the application, system integrator/developer must define the algorithms to validate the accuracy and reliability of data	CID			1.03.02
1.03.06 QoS	All types of delivered data from the detection system to the MFO shall fulfil a minimum of quality (to be defined) even in case of fault.	C	System developer	NF	-	To ensure a reliable SAFESPOT Service a minimum quality of data is needed to guarantee only relevant data is transferred between detection system and MFO.	PTV/ TUM		SP5_UC411, 412, 42, 43, 44, 22, 31,33, 52, 55 SP4_UC6B,6 C,8A,9A,1A,1 B,1C,1F,1D	1.03.01
1.03.07 Timing	The processing time at the detection system should be kept as low as possible (low than 2 sec)	C	System developer	NF	-	For efficient accident prevention all safety relevant information has to be transmitted as fast as possible. This is basic requirement for an safety enhancing service.	PTV/ CRF		SP5_UC411, 412, 42, 43, 44, 22, 31, 33, 52, 55 SP4_UC6B,6 C,8A,9A,1A,1 B,1C,1F,1D	4.05.04

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1.03.08 Fault tolerance	The system shall be fault tolerant and even in case of failure shall not affected any other function	C	System developer	F	-		CRF			1.05.01; 1.05.04;
1.03.09 Peripherals Firewall	The detection system shall be protected or shall be able to protect the peripheral device against forbidden actions	C	CSST	NF	-	The devices/junction box/node may be affected by intrusions from outside since it communicates with the external through the wireless sensors network	CSST	-	SP5_UC131 SP5_UC132_ V.0.1 SP5_UC14	1.06.01 1.06.02
1.04	Robustness & safety									
1.04.01 Environment	The system shall be compliant with the road environment (temperature range, voltage spike, dust, wind, etc)	C	System designer	NF	-	-	CRF			
1.04.02 Diagnosis	Each system components shall make self diagnosis	C	System producer	F	-	-	CRF			3.02.01
1.04.03 Regulation	The system shall be compliant with sector specific regulations	C	System producer	NF	-	-	ISMB			
1.04.04 Installation robustness	Each system components shall be installed and uninstalled more than once and cables and connectors shall not be broken	C	System producer / system integrator	NF	-	-	CRF			1,02
1.05	Cooperation									
1.05.01 Data fusion	Detection system can be composed by more than one components. Data provided are fused and considered as a whole	S	System producer	NF	Specification phase	System scalability	CRF			

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1.05.02 I2V	The system shall not perform I2V communication	C	System producer	F	-	-	CRF	Architecture definition		
1.05.03 SF area components	The detection system shall cooperate with the other SAFESPOT components belonging to the same area	I	System producer / system integrator	F	-	-	CRF	Architecture definition		3.01.02
1.06	Communication									
1.06.01 Connection	The system shall be able to receive (safety-relevant) data/information from the sensing system (roadside and in-vehicle sensors) as well as from the Information Centre.	C	System developer	F	-	User Need	PTV/TUM		SP5_UC411, 412, 42,43,44, 22,31,33, 52, 55 SP4_UC6B,6 C,8A,9A,1A,1 B,1C,1F,1D	3.01.02
1.06.02 Bi-directional info exchange	The detection system can be composed by more than one node. The nodes shall exchange information: bidirectional or one way link, point 2 point or broadcast	I	System developer	F	Communication with detection systems from nodes can enable change in operation mode	To expand possibilities of detection systems	CID			

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1.06.03 Range	The detection system shall have a communication range that enables the reception of the information from the components so to make possible all INFRASENS functionalities	C	System developer	F	-	The range of the communication is limited by the distance to the nodes	CID			
1.06.04 Communication Bandwidth and Baud rate	The detection system shall have a communication bandwidth and baud rate that enables components functionalities	C	System designer / System developer	NF	Bandwidth and baud rate of the communication is settled by the application running into nodes or MFO	To exchange just relevant information	CID			
1.06.05 Consumption	The detection system shall reduce consumption by reducing transmissions when not needed.	S	System designer / developer	F	Consumption is reduced if there's no need to exchange information	To exchange just relevant information, when it is needed	CID			
1.06.06 Number of data sources	The connection time shall enable data transmission from multiple simple data source in real time (> 1 Mbit/s)	C	Service provider	NF	The data can pass the link in real time	User needs	VTT			4.05.01 AND 4.05.04
1.06.07 Bi-directional info exchange	The system shall exchange information with MFO	C	System developer	F	-	Bidirectional exchange of information is required to run the applications	CID			3.01.02
1.06.08 Mutual	Communication range between Nodes of the detection system is	S	System Producer	NF	-	Scope of project	VTT			

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communication of Nodes	at least 100 m									
1.06.09 Network	System components can form ad hoc network and have multi-hop capability	S	System Producer	NF	Nodes can change data mutually	Architecture	VTT			
1.06.10 Multipoint	Nodes of the detection system shall have multipoint capability (at least to eight vehicles)	C	Service provider	NF	-	User needs, Looking at an intersection there are in the urban area usually more then 8 vehicles.	VTT			4.05.01 AND 4.05.04
1.06.11 Data Messages Sending	To send the messages with the traffic, non-traffic and diagnostics information to the MFO level	C	CSST	F	-	To allow MFO be updated each time step	CSST	-	SP5_UC131 SP5_UC132_ V.0.1 SP5_UC14	2.01.01

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1.06.12 V2I interface	The node shall provide interface to attach a V2I communication system. It should be able to transfer the following host-vehicle data to infrastructure node: - vehicle position (map matched or at least GPS) - heading - velocity - acceleration - steering angle - status of direction indicator (turn signal) - yaw rate - position of pedals - current timestamp (GPS) - intended route (based on onboard navigation system) - vehicle type - vehicle length, width and mass	C	System developer	F	-	This requirement is a precondition for the requirement "Co-operative Laser scanner, V2I pre-data fusion"	IBEO			SP2_3.0 1.04
1.06.13 Redundancy communication	The system shall provide different type of communication depending on the criticality of the data	S	System developer	F	Specification phase	-	ISMB			
1.06.14 Reliable communication	The system shall provide multi-channel and/or multi-path communication to ensure reliability of the data transfer	C	System developer	F	-	-	ISMB			
2	ROADSIDE UNIT (MFO)									

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2.01	General Features									
2.01.01 Data processing	The MFO shall be able to receive and integrate all data coming from the detection system for further processing.	C	System developer	F	-	User Need	PTV/TUM		SP5_UC	3.01.02
2.01.02 Algorithm	The MFO shall process all received data/information according to the defined algorithms (e.g. data fusion, risk assessment, data prioritisation).	C	System developer	F	-	Basic Requirement for the SAFESPOT System due to the fact that the MFO contains the fundamental logic for data processing.	PTV/TUM		SP5_UC	
2.01.03 Data quality	The MFO shall estimate/evaluate data quality.	C	System developer	F	-	User Need	PTV/TUM		SP5_UC	1.04.04
2.01.04 Traffic regulation	The MFO shall identify how to regulate traffic among the road lines when the system receives from the detection system that there is an accident, with the support of the local dynamic map	C	System developer	F	-		CRF	SF specification	SP5_UC	4.03.03
2.01.05 Traffic flow	The MFO shall understand if due to traffic flow condition the vehicle shall be deviated	C	System developer	F	-	SP5 Application	CRF	SF specification	SP5_UC 14	4.03.03
2.01.06 Vehicle behaviour	The MFO shall identify if the incoming vehicle behaviour is coherent with the road signal	C	System developer	F	-	SP5 Application	CRF	SF specification	SP5_UC33	4.01.06
2.01.07 Alert selection	The MFO shall select the appropriate alert strategy and activate the procedure	C	System developer	F	-	SP5 Application	CRF			4.05.02

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2.01.08 Alert system	The MFO shall be able to pilot all the alert system available	C	System developer	F	-	SP5 Application	CRF			4.05.06
2.01.09 Storage	The system shall be able to store dynamic data (e.g. speed limits, safety margin) in a own database	C	System developer	F	-		Mizar			1.01.07
2.01.10 Info centre storage	The system shall enable the data stored to the CENTRE	S					Mizar			1.01.06; 1.02.03
2.01.11 Retrieve	The system shall be able to retrieve, analyse, and process data from different type of sources	C		F			Mizar			3.01.01
2.01.12 Configuration	The system shall include applications for different types of roads (motorways, urban roads, etc.)	C/S		F/NF			Mizar			1.01.04
2.01.13 I2V	The system shall be able to send warnings and collision avoidance data (intersection congestion, approaching vehicles, potential collision hazards, etc) to the on board unit-OBU - I2V communication	C		F			Mizar			3.01.03; 4.01.01; 4.01.02;
2.01.14 Peripherals Data Processing	To process the data coming from the peripherals level: -data cleaning -data validation -data reconstruction	C	CSST	Functional	-	To get the data ready to be used by the detection modules (e.g. AID) and other modules	CSST	-	SP5_UC131 SP5_UC132_V.0.1 SP5_UC14	2.01.01

REQ ID # NAME	REQUIREMENTS DEFINITION	RELEVANCE	RESPONSABILITY	TYPE OF REQUIREMENT	ACCEPTANCE	RATIONALE	ORIGINATOR	ASSUMPTIONS	USE CASES	USER NEEDS
2.01.15 Traffic Data on Required Interval	To calculate the traffic data values (flow, speed, density, congestion, occupancy), distinguishing by vehicle class (e.g. light, heavy vehicles) and by lane, <u>with the required time interval for the various applications</u>	C	CSST	F	-	As an input for the Centre level functions (e.g. AID algorithms module)	CSST	-	SP5_UC131 SP5_UC132_ V.0.1 SP5_UC14	2.01.01
2.01.16 Events Data on Required Interval	To build events files (collision, ice, wet-pavement, etc.) starting from the non-traffic data, <u>with the required time interval for the various applications</u>	C	CSST	F	-	As an input for the Centre level functions (e.g. AID algorithms module)	CSST	-	SP5_UC131 SP5_UC132_ V.0.1 SP5_UC14	2.02.02
2.01.17 Intersection	The system shall be able to retrieve information about traffic lights characteristic in order to support the drivers at the intersections	C		F			Mizar			3.01.07
2.01.18 Coordination	The MFO shall be considered as a centralized unit for each area. Detection system and alert system are considered as peripheral components of the MFO. MFO is expected to be a central processing unit	S	System designer / system developer	NF	Specification phase	-	CRF	SF specification		
2.02	Installation, Repair, Maintenance									

REQ ID # NAME	REQUIREMENTS DEFINITION	RELEVANCE	RESPONSABILITY	TYPE OF REQUIREMENT	ACCEPTANCE	RATIONALE	ORIGINATOR	ASSUMPTIONS	USE CASES	USER NEEDS
2.02.01 Sensors Interrogation	MFO shall receive from sensing system information in push and pull mode; it can interrogate single sensors (included those on vehicles) for diagnostics on device, interface, communications	C	CSST	F	-	The MFO level needs to know which sensors are sending relevant data	CSST	-	SP5_UC131 SP5_UC132_ V.0.1 SP5_UC14	1.03.02 1.04.02
2.02.02 Sensors Diagnostics Aggregation	The MFO shall understand if data received from detection system are meaningful or not and consequently identify possible detection system fault	C	CSST	F	-	For maintenance of the detection SW and HW	CSST	-	SP5_UC131 SP5_UC132_ V.0.1 SP5_UC14	1.04.02 1.03.02
2.02.03 MFO Diagnostics	The MFO shall produce a diagnostics file concerning its status and send to the centre for maintenance and statistics	C	CSST				CSST			
2.02.04 Maintenance	The MFO shall be easily maintainable (with minimum disturbance)	I		NF		To minimize respectively avoid down times of the SAFESPOT System.	PTV/TU M		SP5_UC411, 412, 42, 43, 44, 22, 31,33, 52, 55 SP4_UC6B,6 C,8A,9A,1A,1 B,1C,1F,1D	1.02.02
2.02.05 Reparability	The MFO shall be easily repairable (with minimum disturbance)	I		NF		To minimize respectively avoid down times of the SAFESPOT System.	PTV/TU M		SP5_UC411, 412, 42, 43,44, 22, 31,33, 52, 55 SP4_UC6B,6 C,8A,9A,1A,1 B,1C,1F,1D	1.02.01
2.02.06	The MFO shall be managed and	I	System	F	-	-	CRF			

REQ ID # NAME	REQUIREMENTS DEFINITION	RELEVANCE	RESPONSABILITY	TYPE OF REQUIREMENT	ACCEPTANCE	RATIONALE	ORIGINATOR	ASSUMPTIONS	USE CASES	USER NEEDS
Link to Centre	maintained from the info centre		integrator							
2.03	Quality of Service & Security									
2.03.01 MFO Firewall	The MFO shall be protected against forbidden actions	C	CSST	NF		The MFO may be affected by intrusions since it communicates with the external through the backbone network	CSST	-	SP5_UC131 SP5_UC132_V.0.1 SP5_UC14	1.06.01 1.06.02
2.03.02 Data Validation	The MFO shall be able to validate the data coming from the peripherals according to their accuracy	C	CSST	NF	-	To improve the detection reliability	CSST	-	SP5_UC131 SP5_UC132_V.0.1 SP5_UC14	1.03.01 4.05.01
2.03.03 Data Production for Performance Statistics	The MFO shall be able to produce and send to the Info Centre the needed data for the performance statistics calculation of the detection modules (e.g. AID)	C	CSST	NF	-	For maintenance and enhancement of the detection SW modules (e.g. AID module)	CSST	-	SP5_UC131 SP5_UC132_V.0.1 SP5_UC14	1.01.06 2.02.06
2.03.04 Accuracy	The systems shall check data values by comparing different sources, when available, so to ensure high-accuracy and completeness	C		F			Mizar			1.03.03
2.03.05 Diagnosis	The systems shall detect if it is not working properly (correctly) and shall notify that to the info centre, switching to failure mode and warning the road user	C					Mizar			1.04.01; 1.05.04;

REQ ID # NAME	REQUIREMENTS DEFINITION	RELEVANCE	RESPONSABILITY	TYPE OF REQUIREMENT	ACCEPTANCE	RATIONALE	ORIGINATOR	ASSUMPTIONS	USE CASES	USER NEEDS
2.03.06 Timing	The processing time at the MFO should be kept as low as possible (maximum processing time must be defined).	C	System developer	NF		To keep to overall processing time as low as possible.	PTV/ TUM		SP5_UC411, 412, 42, 43, 44, 22, 31,33, 52, 55 SP4_UC6B,6 C,8A,9A,1A,1 B,1C,1F,1D	4.05.04
2.03.07 Data quality	The MFO shall provide accurate, reliable, timely data/information.	C	System developer	NF		The MFO data output shall fulfil several quality parameters like accuracy, correctness, up-to-dateness, completeness (to be defined).	PTV/ TUM		SP5_UC411, 412, 42, 43,44, 22, 31,33, 52, 55 SP4_UC6B,6 C,8A,9A,1A,1 B,1C,1F,1D	4.05.01
2.04	Robustness & safety									
2.04.01 Data Cleaning	To remove low-reliable data	C	CSST	NF	-	To improve the detection reliability	CSST	-	SP5_UC131 SP5_UC132_V.0.1 SP5_UC14	1.03.01 1.03.02
2.04.02 Data Reconstruction	To rebuild, where possible, measurements for step codes with missing data	C	CSST	NF	-	To improve the detection reliability	CSST	-	SP5_UC131 SP5_UC132_V.0.1 SP5_UC14	1.04.03

REQ ID # NAME	REQUIREMENTS DEFINITION	RELEVANCE	RESPONSABILITY	TYPE OF REQUIREMENT	ACCEPTANCE	RATIONALE	ORIGINATOR	ASSUMPTIONS	USE CASES	USER NEEDS
2.04.03 Road Incident assessment	MFO's shall merge data from different sensors and shall determine the existence of an incident due to bad road conditions.	C	System integrator / System Developer	F	Based on the application, system integrator/developer must define incident detection algorithms		CID			1.03.03
2.04.04 Road Risk Assessment	MFO's shall merge data from different sensors and shall determine the level of risk for an incident due to bad road conditions.	S	System integrator / System Developer	F	Based on the application, system integrator/developer must define incident detection algorithms		CID			1.03.03
2.04.05 Traffic Incident assessment	MFO's shall merge data from different sensors and shall determine the existence of an incident due to bad traffic conditions.	C	System integrator / System Developer	F	Based on the application, system integrator/developer must define incident detection algorithms		CID			1.03.03

REQ ID # NAME	REQUIREMENTS DEFINITION	RELEVANCE	RESPONSABILITY	TYPE OF REQUIREMENT	ACCEPTANCE	RATIONALE	ORIGINATOR	ASSUMPTIONS	USE CASES	USER NEEDS
2.04.06 Traffic Risk assessment	MFO's shall merge data from different sensors and shall determine the level of risk for an incident due to bad traffic conditions	S	System integrator / System Developer	F	Based on the application, system integrator/developer must define incident detection algorithms		CID			1.03.03
2.04.07 Environment incident assessment	MFO's shall merge data from different sensors and shall determine the existence of an incident due to bad environmental conditions.	C	System integrator / System Developer	F	Based on application, system integrator/developer must define incident detection algorithms		CID			1.03.03
2.04.08 Diagnosis	The MFO shall be able to detect errors in operation and to report them to the Information Centre for immediate repairing.	S	System developer	NF		User Need	PTV/ TUM		SP5_UC411, 412, 42, 43, 44, 22,31,33, 52, 55 SP4_UC6B,6 C,8A,9A,1A,1 B,1C,1F,1D	1.04.01 1.04.02
2.05	Cooperation									

REQ ID # NAME	REQUIREMENTS DEFINITION	RELEVANCE	RESPONSABILITY	TYPE OF REQUIREMENT	ACCEPTANCE	RATIONALE	ORIGINATOR	ASSUMPTIONS	USE CASES	USER NEEDS
2.05.01	The system shall support two-way roadside-to-vehicle communication (V2R, point-to-point; R2V, point-to-multipoint by broadcasting to a specific area -- geo-broadcast --)	C					Mizar			
2.05.02	The system shall support use of CVIS communications network where available	S					Mizar			
2.06	Communication									
2.06.01 Communication MFO - Centre	To communicate with the Information Centre in order to: -send data for diagnostics and statistics -receive data for updating and maintenance	C	CSST	F	-	-	CSST	-	SP5_UC131 SP5_UC132_ V.0.1 SP5_UC14	3.01.01 3.01.02
2.06.02 Bi-directional info exchange	The MFO shall exchange information with (1) infrastructure: Alert systems (2) Nodes (3) and Control Centre	C		F	Bidirectional communication is required	Necessary to supervise and to configure the applications	CID, VTT			3.01.02
2.06.03 Range	The MFO shall have a communication range that enables SAFESPOT applications	C		F	Range of communication limited by application.		CID			
2.06.04 Communication Bandwidth and Baud rate	The MFO shall have a communication bandwidth and baud rate that enables the applications running on it	C		F	The baud rate and the bandwidth is settled by the application.	To exchange just relevant information, when it is needed	CID			

REQ ID # NAME	REQUIREMENTS DEFINITION	RELEVANCE	RESPONSABILITY	TYPE OF REQUIREMENT	ACCEPTANCE	RATIONALE	ORIGINATOR	ASSUMPTIONS	USE CASES	USER NEEDS
2.06.05 Consumption	The MFO's shall reduce consumption by reducing transmissions when not needed.	S		F	Consumption is reduced if no need to exchange data	To exchange just relevant information, when it is needed	CID			
2.06.06 Reliability	The MFO's shall check any possible error in communication. It will enable error checking in communication with nodes.	C		F	Communication should enable error checking	Communication protocol includes extra information to enable error checking	CID			1.04.01
2.06.07 Broadcast	The MFO's shall broadcast the warning and alert messages to all users, equipped or not.	S		NF	Communication of warning messages extended to all road users.	User Needs	CID, VTT			4.05.06
2.06.08 Point2Point	The MFO shall communicate with single points to exchange all necessary information (not only warning-alerts) by means of communication point to point.	S		NF	Extended communication with equipped users.		CID			3.01.02
2.06.09 Amount of nodes	Multiple Nodes of detection system can communicate with one MFO	C	System Producer	NF		Architecture	VTT			3.01.02
2.06.10 Info exchange between MFOs	The system is capable of changing information between MFOs mutually	C	System Producer	NF		Architecture	VTT			
2.06.11 Bi-directional info exchange	The MFO shall exchange information with: detection system, alert systems, Info centre	C		F	Bidirectional communication is required	Necessary to supervise and to configure the applications	CID			3.01.02

REQ ID # NAME	REQUIREMENTS DEFINITION	RELEVANCE	RESPONSABILITY	TYPE OF REQUIREMENT	ACCEPTANCE	RATIONALE	ORIGINATOR	ASSUMPTIONS	USE CASES	USER NEEDS
3	ALERT SYSTEM									
3.01	General Features									
3.01.01 Interaction	The system shall be able to provide non equipped users-vehicles with SAFESPOT elaborated information	S	System designer	F	Better defined in agreement with SF overall architecture	-	Mizar	SF architect ure		4.01.09;
3.01.02 Input	The alert system shall receive input and instruction from MFO	C	System designer and developer	F	-	System architecture	CRF	SF architect ure		3.01.02
3.01.03 Feedback	The alert system shall provide feedback to the MFO about its status	C	System designer and developer	F	--	Important for the system diagnosis and maintenance	CRF			3.01.02
3.01.04 Warning	The alert system shall provide driver warning concerning road anomalies and suggest right behaviour to increase safety	S	System developer	F	The strategy will be defined within SF framework	To give the drive information about system reliability	CRF	SF architect ure		4.01.02
3.01.05 Modularity	The alert system shall be composed by different modules each one characterized by a specific alert strategy (VMS, Lights, I2V communication.)	C	System developer	NF	-	The alert strategy depends on the application	CRF	SP5		4.05.08
3.01.06 Timing	The alert system shall execute instruction from MFO with the requested timing	C	System developer	F	-	Timing depends on the application	CRF	SF and SP5		

REQ ID # NAME	REQUIREMENTS DEFINITION	RELEVANCE	RESPONSABILITY	TYPE OF REQUIREMENT	ACCEPTANCE	RATIONALE	ORIGINATOR	ASSUMPTIONS	USE CASES	USER NEEDS
3.01.07 Human interaction	The alert system shall be visible in case of low visibility and not be source of distraction for the driver	C	System developer/ implementer	NF	-	-	CRF			1.05.03
3.01.08 Usability	The alert system shall provide to the driver clear information avoiding misunderstanding	S	System developer	NF	Clarification will come with the specification	-	CRF			1.05
3.01.09 Compliance	The alert system shall be compliant with European standard symbol and indication (standard symbol for manoeuvre indication, road operator messages, etc)	S	System developer	NF	Clarification will come with the specification	SAFESPOT is willing to be scalable and compliant with European standard	CRF			
3.01.10 Coherence	The alert system can be composed by different parts. The MFO is responsible to provide a coherent indication (light, VMS)	C	System developer	F, CR	-	System design	CRF			4.05.06
3.02	Installation, Repair, Maintenance									
3.02.01 Malfunctioning	The alert system shall clearly inform about malfunctioning so not to create false alarm to driver	S	System developer	F	Clarification will come with the specification	To manage repair operation	CRF			1.05.04
3.02.02 Remote control	The alert system shall be able to be remotely controlled and maintained	C	System developer/ Road operator	F	-	-	CRF			1.02.02
3.03	Quality of Service & security									

REQ ID # NAME	REQUIREMENTS DEFINITION	RELEVANCE	RESPONSABILITY	TYPE OF REQUIREMENT	ACCEPTANCE	RATIONALE	ORIGINATOR	ASSUMPTIONS	USE CASES	USER NEEDS
3.04	Robustness & safety									
3.04.01 Diagnosis	The alert system shall be able to perform self diagnosis and to communicate its status to MFO	C	System developer/ Road operator	F	-	-	CRF			
3.04.02 Time	Time of system to produce alert / warning shall be compatible with user reaction time.	C	system designer	F	-	Application defines response time	CID			
3.04.03 Appropriate	The alert / warning message will be appropriate for the application	C	System designer	F	-	Different levels of hazardous situations will be communicated with different levels of warning / alert messages	CID			
3.04.04 Redundant	Alert / warning message shall be communicated to user in many formats as convenient to give support to different road users.	C	System designer	NF	-	Driver behaviour assessment	CID			
3.04.05 General	The critical alert / warning messages will be broadcasted to all users, equipped or not	C	System designer	F	-	Communication of warning or alerts should be extended to all road users.	CID			
3.04.06 Point2Point	Full alert / warning messages shall be communicated to equipped vehicles.	S	System designer	NF	Communication of extended information to equipped vehicles.	-	CID			

REQ ID # NAME	REQUIREMENTS DEFINITION	RELEVANCE	RESPONSABILITY	TYPE OF REQUIREMENT	ACCEPTANCE	RATIONALE	ORIGINATOR	ASSUMPTIONS	USE CASES	USER NEEDS
3.05	Cooperation									
3.06	Communication									
3.06.01 One way info exchange	Actuators (alert/warning system) shall receive data from MFO's.	C		F	-	Flow of information is from MFO to warning system, and from it to road user	CID			
3.06.02 Range	The actuators shall extend their range of warning / alert within the range of the application.	C		F	-	The range of the communication is defined by the application	CID			
3.06.03 Communication Bandwidth and Baud rate	The alert/warning system shall have a communication bandwidth and baud rate that enables the applications running on MFO's	C		F	-	The baud rate and the bandwidth is settled by the application.	CID			
3.06.04 Consumption	The alert/warning system shall reduce consumption by avoiding messages when they aren't needed.	S	System designer	F	Consumption is reduced if no need to exchange data	To exchange just relevant information, when it is needed	CID			
3.06.05 Reliability	The alert/warning system shall be reliable	C	System designer	F	Communication should enable error checking	Communication protocol includes extra information to enable error checking	CID			
3.06.06 Broadcast	Alert system for emergency shall be able to send broadcast information to the vehicles or to the system components	I	System designer	F	-	To make the system cooperative	CRF			

REQ ID # NAME	REQUIREMENTS DEFINITION	RELEVANCE	RESPONSABILITY	TYPE OF REQUIREMENT	ACCEPTANCE	RATIONALE	ORIGINATOR	ASSUMPTIONS	USE CASES	USER NEEDS
3.06.07 Point2Point	Alert system can be connected in a P2P mode with MFO	I	System producer	F	-	-	CRF			
3.06.08 Speed of alerts	The communication channel to actuators shall work fast enough (< 100 ms)	C	Service provider	NF	-	User needs	VTT			4.05.01 AND 4.05.04
3.06.09 One way info exchange	The actuators (alert/warning system) shall receive data from MFO's.	C	System developer	F	Flow of data is from MFO to alert system, and from it to road user	-	CID			
4	CENTRE									
4.01	General Features									
4.01.01 Day Types Profiles	To build and update the historical profiles for the different day types	C	CSST	F	-	As an input for the detection modules running at MFO or Centre level	CSST	-	SP5_UC131 SP5_UC132_ V.0.1 SP5_UC14	2.02.02
4.01.02	The system shall be able to store static and quasi-static data in an own database	S					Mizar			
4.01.03	The system shall know where every components is located within the road network	C					Mizar			
4.01.04	The system shall be able to support a database of the infrastructure SPOT	C					Mizar			

REQ ID # NAME	REQUIREMENTS DEFINITION	RELEVANCE	RESPONSABILITY	TYPE OF REQUIREMENT	ACCEPTANCE	RATIONALE	ORIGINATOR	ASSUMPTIONS	USE CASES	USER NEEDS
4.01.05	The system shall be able to support a database of the road-side equipment	C					Mizar			
4.01.06	The system shall enable the data stored to the MFO	C					Mizar			
4.01.07	The system shall be able to exchange (receive and transmit) information related to safety critical situation	C					Mizar			
4.01.08 Data exchange	The Information Centre shall be able to receive all kinds of safety relevant data/information (static and dynamic) coming from different external sources (e.g. police, infrastructure operator, traffic lights controller).	C	System developer	F		Data deriving from the sensing system shall be amended by information provided from different external sources.	PTV/TUM		SP5_UC411, 412, 42, ,44, 22,31,33, 52, 55 SP4_UC6B,6 C,8A,9A,1A,1 B,1C,1F,1D	2.03.02 3.01.03 3.01.08
4.01.09 Data exchange	The Information Centre shall be able to process, analyse and evaluate data/information coming from external sources.	C	System developer	F		A first pre-processing within the Information Centre is mandatory to provide data/information which could be easily accepted by the MFO.	PTV/TUM		SP5_UC411, 412, 42, 43, 44, 22,31,33, 52, 55 SP4_UC6B,6 C,8A,9A,1A,1 B,1C,1F,1D	
4.01.10 Priority message	The Information Centre shall be able to handle priority messages.	C	System developer	F		If there is more than one message to be transmitted at the same time but the capacity of the transmitting system is too low the most important message shall be transmitted at first.	PTV/TUM		SP5_UC411, 412, 42, 43, 44, 22,31,33, 52, 55 SP4_UC6B,6 C,8A,9A,1A,1 B,1C,1F,1D	

REQ ID # NAME	REQUIREMENTS DEFINITION	RELEVANCE	RESPONSABILITY	TYPE OF REQUIREMENT	ACCEPTANCE	RATIONALE	ORIGINATOR	ASSUMPTIONS	USE CASES	USER NEEDS
4.01.11 Database	The Information Centre shall be able to store all received data and it should support a database containing all safety-relevant information about the road network and its singular segments.	C	System developer	F		User Need	PTV/TUM		SP5_UC411, 412, 42, 43, 44, 22,31,33, 52, 55 SP4_UC6B,6 C,8A,9A,1A,1 B,1C,1F,1D	2.03.01
4.01.12 Link to MFO	The Information Centre shall be able to provide and transmit data/information to the MFO.	C	System developer	F		Required connection of the Information Centre to the MFO for data transmission.	PTV/TUM		SP5_UC411, 412, 42, 43, 44, 22,31,33, 52, 55 SP4_UC6B,6 C,8A,9A,1A,1 B,1C,1F,1D	03.01.03 03.01.05 03.01.08
4.01.13 Management	The Information Centre shall control, manage and maintain the SAFESPOT System. This includes for instance the update of SAFESPOT components (in case of reconfiguration and establishing new functions).	C	System developer	F		There is a necessity for a higher-level instance responsible for system controlling, maintaining and managing.	PTV/TUM		SP5_UC411, 412, 42,43,44, 22,31,33, 52, 55 SP4_UC6B,6 C,8A,9A,1A,1 B,1C,1F,1D	
4.02	Installation, Maintenance Repair,									

REQ ID # NAME	REQUIREMENTS DEFINITION	RELEVANCE	RESPONSABILITY	TYPE OF REQUIREMENT	ACCEPTANCE	RATIONALE	ORIGINATOR	ASSUMPTIONS	USE CASES	USER NEEDS
4.02.01 storage management	All stored external data/information shall be easily maintainable and updatable.	S	System developer	NF		User Needs	PTV/ TUM		SP5_UC411, 412, 42, 43, 44, 22,31,33, 52, 55 SP4_UC6B,6 C,8A,9A,1A,1 B,1C,1F,1D	1.02.03 1.02.02
4.02.02 Operation cost	The costs for operating the Information Centre shall be as low as possible.	S	System developer	C		The costs of the SAFESPOT Service will influence the usage of the service.	TUM/ PTV		SP5_UC411, 412, 42, 43, 44, 22,31,33, 52, 55 SP4_UC6B,6 C,8A,9A,1A,1 B,1C,1F,1D	
4.02.03 Technology evolution	The Information Centre shall react flexibly to possible technology evolution.	S	System developer	C		To guarantee usage of the Service in long-term. Flexibility necessary to keep SAFESPOT System at state-of-the-art level. Not only important to react on new technologies but also on user's acceptance.	TUM /PTV		SP5_UC411, 412, 42,43,44, 22,31,33, 52, 55 SP4_UC6B,6 C,8A,9A,1A,1 B,1C,1F,1D	
4.03	Quality of Service									
4.03.01 Calculation of Performance Statistics	To process and store the performance statistics of the detection modules (e.g. AID)	C	CSST	Non Functi onal	-	For maintenance and enhancement of the detection SW modules (e.g. AID module)	CSST	-	SP5_UC131 SP5_UC132_ V.0.1 SP5_UC14	1.01.06 2.02.06

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4.03.02 External data	External data/information should be easily integrated into the Information Centre.	S	System developer	NF		To minimize amount of work and to keep processing time as low as possible.	PTV/TUM		SP5_UC411, 412, 42, 43,44, 22, 31,33, 52, 55 SP4_UC6B,6 C,8A,9A,1A,1 B,1C,1F,1D	4.05.04
4.03.03 Latency time	Latency time within the Information Centre should be as low as possible.	C	System developer	NF		For efficient accident prevention all safety relevant information has to be transmitted as fast as possible.	PTV/TUM		SP5_UC411, 412, 42, 43, 44, 22,31,33, 52, 55 SP4_UC6B,6 C,8A,9A,1A,1 B,1C,1F,1D	4.05.04
4.03.04 External data	The Information Centre shall be able to cope with a high number of external data/information, therefore it should be easily scalable.	S	System developer	NF		The amount of incoming and processed data could be very high.	PTV/TUM		SP5_UC411, 412, 42, 43, 44, 22,31,33, 52, 55 SP4_UC6B,6 C,8A,9A,1A,1 B,1C,1F,1D	
4.03.05 Redundancies	The Information Centre shall avoid data redundancies.	S	System developer	NF		To keep data amount as low as possible.	PTV/TUM		SP5_UC411, 412, 42, 43, 44, 22,31,33, 52, 55 SP4_UC6B,6 C,8A,9A,1A,1 B,1C,1F,1D	

REQ ID # NAME	REQUIREMENTS DEFINITION	RELEVANCE	RESPONSABILITY	TYPE OF REQUIREMENT	ACCEPTANCE	RATIONALE	ORIGINATOR	ASSUMPTIONS	USE CASES	USER NEEDS
4.03.06 Integrity	The Information Centre shall support the integrity of safety related data/information.	C	System developer	NF		No false or incomplete data transmission	PTV/ TUM		SP5_UC411, 412, 42,43,44, 22,31,33, 52, 55 SP4_UC6B,6 C,8A,9A,1A,1 B,1C,1F,1D	
4.04	Safety									
4.04.01 Supervision	Information Centre shall monitor safety conditions within the SAFESPOT area	S	System integrator / System Developer	NF	The centre receives data from different applications and can define general safety state of a road		CID			
4.04.02 Modification	Information Centre shall configure safety parameters of the applications running on the MFO's	C	System integrator / System Developer	F	The centre can modify several parameters of application (modes) according to safety criteria		CID			

REQ ID # NAME	REQUIREMENTS DEFINITION	RELEVANCE	RESPONSABILITY	TYPE OF REQUIREMENT	ACCEPTANCE	RATIONALE	ORIGINATOR	ASSUMPTIONS	USE CASES	USER NEEDS
4.04.03 Road data	The system shall be able to receive information on the structural integrity of roads, bridges, tunnels, gantries, etc., in order to check that there is no safety critical damage.	S					Mizar			2.03.02
4.05	Security									
4.05.01 Centre Firewall	To protect the devices against forbidden actions	C	CSST	NF	-	The Centre may be affected by intrusions since it communicates with the external through the WAN	CSST	-	SP5_UC131 SP5_UC132_V.0.1 SP5_UC14	1.06.01 1.06.02
4.05.02 Data confidentiality	All data exchanges between the Information Centre and the SAFESPOT System shall be confidential.	S	System developer	NF		Ensure that data transmission is protected against the denunciation of a third party. Spoofing and snooping should be prevented to guarantee the acceptance and reliability of the Sefaspot Service.	PTV/TUM		SP5_UC411, 412, 42, 43,44, 22, 31,33, 52, 55 SP4_UC6B,6 C,8A,9A,1A,1 B,1C,1F,1D	1.06.02
4.06	User Friendliness									

REQ ID # NAME	REQUIREMENTS DEFINITION	RELEVANCE	RESPONSABILITY	TYPE OF REQUIREMENT	ACCEPTANCE	RATIONALE	ORIGINATOR	ASSUMPTIONS	USE CASES	USER NEEDS
4.06.01 System acceptance	The concept of the Information Centre shall be easily manageable/understandable in order to ensure the acceptance of the system.	I	System developer	NF		User Need	PTV/TUM		SP5_UC411, 412, 42, 43, 44, 22,31,33, 52, 55 SP4_UC6B,6C,8A,9A,1A,1B,1C,1F,1D	1.07.01
4.07	Robustness									
4.07.01 General functions	Systems shall be able to monitor each safety-related component (including software), warn the user (Infrastructure Manager) in case of problems, and disable it, or reduce it to a safe state.	C					Mizar			1.04.02
4.08	Cooperation									
4.08.01 Automatic Incident Detection	To generate the "high-level" events (e.g. AID event) on the basis of the traffic and non-traffic data (sent by the vehicle and from the infrastructure via the MFO) and of the lower level events generated by the MFO	C	CSST	Functional	-	Queues and congestions are very common on highways; they often result into pile-ups that may involve a large number of vehicles and therefore cause serious injuries and damage.	CSST	SP1	SP5_UC131 SP5_UC132_V.0.1 SP5_UC14	1.01.01 2.01.01 2.01.04 2.02.01 2.02.02 2.02.04 4.01.03 4.03.02 4.05.04
4.09	Communication									
4.09.01 Bi-directional	The Information centre will exchange information with MFO's	C		NF	Monitor the application		CID			

REQ ID # NAME	REQUIREMENTS DEFINITION	RELEVANCE	RESPONSABILITY	TYPE OF REQUIREMENT	ACCEPTANCE	RATIONALE	ORIGINATOR	ASSUMPTIONS	USE CASES	USER NEEDS
info exchange	/ NODES to define application specifications or special environment conditions				running on MFO's - NODES, settle working conditions, update with information from environment					
4.09.02 Range	The range of the communication must fulfil SAFESPOT applications	C		F	Range of communication is limited by the application.	If communication range is well designed, costs and power consumption are reduced	CID			
4.09.03 Communication Bandwidth and Baud rate	The communication between NODES/MFO's and Information Centre shall have a communication baud rate that enables SAFESPOT applications	C		F	Baud rate of communication is settled by the application.	To exchange just relevant information, when it is needed	CID			3.01.02
4.09.04 Consumption	Communication between Information Centre and Infrasense systems shall exist only when relevant data had to be updated	S		F	Consumption is reduced no need to exchange information	To exchange just relevant information, when it is needed	CID			
4.09.05 Reliability	Information Centre will enable error checking in communication with system	C		F	Communication should enable error checking	Communication protocol includes extra information to enable error checking	CID			1.04.04
4.09.06 Wireless	The communication shall be wireless	I		NF	When possible, any kind of wiring		CID			

REQ ID # NAME	REQUIREMENTS DEFINITION	RELEVANCE	RESPONSABILITY	TYPE OF REQUIREMENT	ACCEPTANCE	RATIONALE	ORIGINATOR	ASSUMPTIONS	USE CASES	USER NEEDS
					should be removed					
4.09.07 Point2Point	The system shall communicate with single MFO's - NODES point to point	S		NF	Full information shall be available to equipped road users.		CID			
4.09.08 Communication interface	The Information Centre shall be able to communicate bi-directional with the peripheral components.	C	System developer	F			PTV/ TUM		SP5_UC411, 412, 42, 43,44, 22, 31,33, 52, 55 SP4_UC6B,6 C,8A,9A,1A,1 B,1C,1F,1D	3.01.03
4.10	COMMUNICATIONS									
4.10.01 Protocol	The communication protocol between components shall follow "open" standard protocol	I	System Producer	NF		User Needs	VTT			3.01.05
4.10.02 Network addressing	The communication channels are IPV4 or IPV6 compatible	I	System Producer	NF			VTT			
4.10.03 Type of communication	The communication link between detection system and MFO shall be wireless or wired when possible									
4.10.04 Wireless	Vehicles shall communicate with infrastructure wirelessly	C	System Producer	NF			VTT			

REQ ID # NAME	REQUIREMENTS DEFINITION	RELEVANCE	RESPONSABILITY	TYPE OF REQUIREMENT	ACCEPTANCE	RATIONALE	ORIGINATOR	ASSUMPTIONS	USE CASES	USER NEEDS
4.10.05 Diagnostics	The system shall report communication errors	S	System Producer	F		Architecture	VTT			1.03.02
4.10.06 Maintenance	The communication equipment is commercially available	I	System Producer	NF			VTT			
4.10.07 Quality of Service	System shall check interruptions in the communication channel	C	System Producer	F		User needs	VTT			4.05.01
4.10.08 Bandwidth	The bandwidth shall enable image transmission between components (> 10 Mbit/s)	I	Service provider	NF			VTT			4.05.01 AND 4.05.04
4.10.09 Range	Node shall establish a connection to a vehicle in less than a 200 ms	S	Service provider	NF		User needs	VTT			4.05.01 AND 4.05.04
4.10.10 Robustness	The bandwidth is sufficient in varying traffic densities	S	Service provider	NF		User needs	VTT			4.05.01
4.10.11 Temperature	The communication devices shall work in temperature range -40, + 80 °C	C	System Producer	NF		User needs	VTT			1.03.1
4.10.12 Weather conditions	The communication devices shall work properly in wet or snowy climate conditions	C	System Producer	NF		User needs	VTT			1.03.1
4.10.13 Safety	The communication devices shall not cause electrical disturbances for the passing vehicles	C	System Producer	NF			VTT			1.01.01
4.10.14 Encryption	Communication channels are encrypted	I	System Producer	F		User needs	VTT			1.06
4.10.15 Security	The communication gateways are protected against unauthorised access	C	System Producer	NF		User needs	VTT			1.06

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4.10.16 Co-operation with vehicles	The system shall have a bi-directional communication channel with vehicles	C	Service Provider	NF		Architecture	VTT			3.01.03
4.10.17 Timing	The communication of the data from sensor the MFO shall be done in less than 0.1sec.	C	System Producer	NF		For efficient accident prevention all safety relevant information must be transmitted as fast as possible. This is a basic requirement for a safety enhancing service	TUM/PT V		SP5_UC	4.05.01
4.10.18 Wireless	The communication shall be wireless and wired accordingly to the infrastructure layout	I		NF	When possible, any kind of wiring should be removed		CID			