EMMON - EMbedded MOnitoring
ARTEMIS JU – FP7

D7.1 SOFTWARE REQUIREMENTS SPECIFICATION DOCUMENT

EMMON

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D7.1 SOFTWARE REQUIREMENTS SPECIFICATION DOCUMENT

EMMON

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TABLE OF CONTENTS

1. INTRODUCTION 7

1.1 OBJECTIVE 7
1.2 SCOPE 7
1.3 AUDIENCE 7
1.4 DEFINITIONS AND ACRONYMS 7
1.5 DOCUMENT STRUCTURE 8

2. DOCUMENTS 9

2.1 APPLICABLE DOCUMENTS 9
2.2 REFERENCE DOCUMENTS 9

3. EMMON PROJECT OVERVIEW 10

3.1 WORK-PACKAGE 7 OVERVIEW 11

4. SYSTEM OVERVIEW 12

5. TECHNICAL REQUIREMENTS 13

5.1 REQUIREMENTS TYPES 13
5.1.1 Functional Requirements 13
5.1.2 Non-Functional Requirements 13
5.1.2.1 Performance Requirements 13
5.1.2.2 Interface Requirements 13
5.1.2.3 Operational Requirements 13
5.1.2.4 Resource Requirements 13
5.1.2.5 Verification Requirements 13
5.1.2.6 Documentation Requirements 14
5.1.2.7 Security Requirements 14
5.1.2.8 Portability Requirements 14
5.1.2.9 Quality Requirements 14
5.2 REQUIREMENTS DEFINITION STANDARD 14
5.3 REQUIREMENTS CATALOGUE 16
5.3.1 C&C 16
5.3.1.1 Functional Requirements 16
5.3.1.2 Performance Requirements 28
5.3.1.3 Interface Requirements 29
5.3.1.4 Operational Requirements 29
5.3.1.5 Resource Requirements 29
5.3.1.6 Verification Requirements 30
5.3.1.7 Documentation Requirements 30
5.3.1.8 Security Requirements 30
5.3.1.9 Portability Requirements 32
5.3.1.10 Quality Requirements 32
5.3.1.11 Reliability Requirements 33
5.3.1.12 Maintainability Requirements 33
5.3.1.13 Safety Requirements 33
5.3.2 PDA 34
5.3.2.1 Functional Requirements 34
5.3.2.2 Performance Requirements 36
5.3.2.3 Interface Requirements 36
5.3.2.4 Operational Requirements 36
5.3.2.5 Resource Requirements 36
5.3.2.6 Verification Requirements 36
5.3.2.7 Documentation Requirements 37
5.3.2.8 Security Requirements 37
5.3.2.9 Portability Requirements 38
5.3.2.10 Quality Requirements 38
5.3.2.11 Reliability Requirements 38
5.3.2.12 Maintainability Requirements 38
5.3.2.13 Safety Requirements 38

6. PENDING ISSUES 39

ANNEX A. TRACEABILITY MATRIX END-USER REQUIREMENTS VS C&C AND PDA SOFTWARE REQUIREMENTS 40

ANNEX B. TRACEABILITY MATRIX C&C AND PDA SOFTWARE REQUIREMENTS VS END-USER REQUIREMENTS 43

TABLE OF FIGURES

FIGURE 1 - EMMON SYSTEM OVERVIEW AND WORK PACKAGE DECOMPOSITION 11
FIGURE 2 - EMMON MODULES 12

TABLE OF TABLES

TABLE 1 - TABLE OF ACRONYMS 8
TABLE 2 - TABLE OF DEFINITIONS 8
TABLE 3 - REQUIREMENTS PRESENTATION TABLE 14
TABLE 4 – TRACEABILITY MATRIX 42
TABLE 5 – TRACEABILITY MATRIX 45

1. Introduction

1.1 Objective

The main objective of this document is to present the software requirements for the C&C and PDA modules of the EMMON system.

1.2 Scope

The EMMON project is composed of eight (8) Work-Packages:

- WP1 – Project Management, Procedures and Communication;
- WP2 – Exploitation, Dissemination and standardization;
- WP3 – Study of user environment and definition of requirements and needs;
- WP4 – Research activities on Protocols & Communication Systems;
- WP5 – Definition of HW platforms and sensors;
- WP6 – Research on Embedded Middleware;
- WP7 – Implementation and System Integration;
- WP8 – Operational Testing & Validations.

This document is produced under the scope of Work-package 7 (WP7), Task 7.1 "C&C requirements and interfaces design" and is identified as D7.1.

According to Technical Annex I [AD-1], this document has one (1) release or issue planned, at instant T0+14 months during project execution (being T0 the project start date as per the contract).

1.3 Audience

The target audiences of this document are:

- ARTEMIS JU and the Commission Services;
- WSN research groups;
- Consortium participants;
- EMMON WP4, WP5, WP6, WP7 and WP8 participants.

1.4 Definitions and Acronyms

Table 1 presents the list of acronyms used throughout the present document.

Acronyms	Description
AD	Applicable Document
GUI	Graphical User Interface
HTTP	Hypertext Transfer Protocol
RD	Reference Document

Acronyms	Description
SMTP	Simple Mail Transfer Protocol
TBC	To Be Confirmed
TBD	To Be Defined

Table 1 - Table of acronyms

Definitions	Description
Real-time	This term is used in a broad sense in this document. It refers to when entities respond to events as they occur, having no significant delay in its timeliness.

Table 2 - Table of definitions

1.5 Document Structure

Section 1, Introduction, presents a general description of the contents, pointing its goals, intended audience and document structure.

Section 2, Documents, presents the documents applicable to this document and referenced by this document.

Section 3, EMMON Project Overview, presents an overview of the EMMON project.

Section 4, System Overview, presents an overview of the EMMON system.

Section 5, Technical Requirements, presents the technical requirements catalogue, derived from end-user requirements.

Section 6, Pending Issues, presents the pending issues related to this specification of software requirements for the C&C module of the EMMON system, if any.

Annex A, Traceability Matrix End-User Requirements Vs C&C and PDA Software Requirements, presents the matrix that contains information regarding the traceability between the end-user requirements and the software requirements for the C&C and PDA modules of the EMMON system.

Annex B, Traceability Matrix C&C and PDA Software Requirements Vs End-User Requirements, presents the matrix that contains information regarding the traceability between the software requirements for the C&C and PDA modules of the EMMON system and the end-user requirements.

2. Documents

This section presents the list of applicable and reference documents as well as the documentation hierarchy this document is part of.

2.1 Applicable Documents

This section presents the list of the documents that are applicable to the present document. A document is considered applicable if it contains provisions that through reference in this document incorporate additional provisions to this document.

[AD-1] "Technical Annex", EMMON Project, ARTEMIS Joint Undertaking Call for proposals ARTEMIS-2008-1, Grant agreement no. 100036, 2010-01-31.

[AD-2] “D3.1 Operational requirements consolidated from end-users input and opinions”, EMMON Project, Rui Mónica and Pedro Braga, FP7-JU-EMMON-2009-DL-WP3-020, Version 2, 2010-02-26.

2.2 Reference Documents

[RD-1] “ESA PSS-05-03 Guide to the software requirements definition phase”, ESA, ISSN 0379-4059, Issue 1, May 1995.

3. EMMON Project Overview

The EMMON project is an European Research and Development (R&D) project, sponsored by the 7th Framework Programme (7FP), ARTEMIS Joint Undertaking (JU) initiative and integrated in the Industrial Priority “Seamless connectivity and middleware”.

EMMON motivation is originated from the increasing societal interest and vision for smart locations and ambient intelligent environments (smart cities, smart homes, smart public spaces, smart forests, etc). The development of embedded technology allowing for smart environments creation and scalable digital services that increase human quality of life.

The project goal is to perform advanced technological research on large scale distributed Wireless Sensor Networks, including research and technology development activities in order to achieve the following specific objectives:

- Research, development and testing of a functional prototype for large scale WSN deployments;
- Advance the number of devices by one order of magnitude, by real world validation (10 thousand to 100 thousand nodes);
- Advance the number of devices by two orders of magnitude, by simulation (100 thousand to 1 million nodes);
- Improve reliability, security and fault tolerance mechanisms in WSN;
- Identify and capture end-user needs and requirements, as well as operational constraints;
- Determine a path for exploitation of project results;

EMMON’s main objective is the development of a functional prototype for the real-time monitoring of specific natural scenarios (related to urban quality of life, forest environment, civil protection, etc) using Wireless Sensor Network (WSN) devices. The goal of the project is to develop the technology to effectively monitor and control an area of 50 square km.

Areas of application for the project include a multitude of physical environments where continuous, large scale monitoring and situation analysis are of great interest, such as hydrographical systems (rivers and dam's), urban areas quality of life monitoring (pollution and noise), regional climate/marine monitoring, civil protection (forest fires, pollution propagation, etc), natural resources monitoring, energy production prediction, industrial plant monitoring, personal health monitoring and precision agriculture, just to name a few.

The increased environment awareness and detection of abnormal variations, allied with the possibility to rapidly broadcasting alarms and alerts, improves human quality of life and sustainability.

Project main results include:

- Large scale deployment of a fully-functional system prototype in a real world scenario (composed by thousands of nodes);
- New WSN embedded middleware with better overall energy efficiency, security and fault-tolerance;
- New efficient and low power consumption WSN multilevel communication protocols and reliable middleware for large scale monitoring;
- Simulation models for WSN behaviour analysis;

- Centralized C&C Centre for easy and centralized monitoring;
- Mobile C&C station or device for local access, diagnosing, viewing and troubleshooting of the network;

EMMON is structured on eight (8) work-packages (WP1 to WP8):

- WP1 and WP2 include management, dissemination, exploitation and standardization activities;
- WP3, WP4 and WP6 include the main RTD activities;
- WP5, WP7 and WP8 aggregate all integration, implementation and testing activities.

Figure 1, illustrates the work-packages distribution within project areas and how they are related.

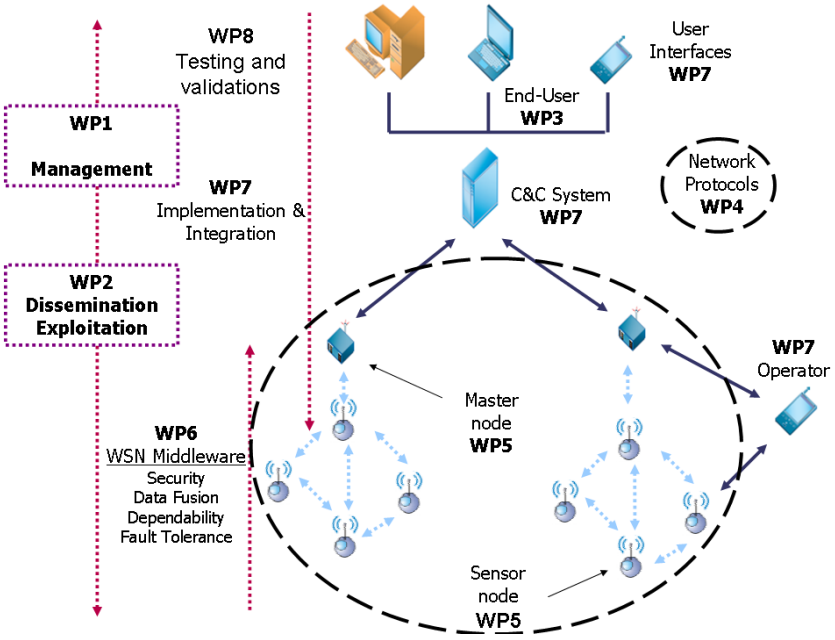

Figure 1 - EMMON system overview and work package decomposition

3.1 Work-Package 7 Overview

"WP7 - Implementation, System Integration" objective is to merge the end-users' requirements and implement all system, middleware and device interfaces required for the C&C module, converging all research and implementations into a common system prototype that can be used for system and module testing. The WP is split into six (6) Tasks:

- "T7.1 - C&C requirements and interfaces design";
- "T7.2 - C&C system and device Architecture Design";
- "T7.3 - New interaction Methods";
- "T7.4 - Implementation & Integration";
- "T7.5 - WSN Networking systems implementation";
- "T7.6 - Complexity Engine to interpret and forecast network signal propagation".

4. System Overview

The EMMON system can be divided into two main components. One is the sensor network, composed by nodes that sense some natural parameters and communicate the results amongst them to collaborate in providing the overall results to some entity. The other component gets the information from the sensor network and produces services to end users. This entity can be further divided into a Command and Control (C&C) module and a PDA module.

The C&C module encompasses everything that is presented to the end user which is monitoring and controlling the measurement of physical parameters covered by the sensor network. This includes the Graphical User Interfaces (GUI) where the user can monitor the values in real-time and navigate through the historical data. The intrinsic characteristic of this module is that it allows monitoring the entire sensor network, from a high level perspective, using every sensing value, to produce a complete picture of the status of the parameters being read, to a single sensor perspective.

The PDA module represents the mobile device used by the operational user that will go into the field and that needs to connect to the sensor network to monitor local values or to perform diagnostic or maintenance activities. This mobile device presents a helpful tool in searching for specific geographical areas associated to some values read on the top-level C&C monitoring that triggered alarms, for example. It will also be helpful for detecting malfunctioning sensor nodes. The main distinction between PDA and C&C modules, and that makes the PDA not being considered also as a Command & Control system by itself, is that it is not a mandatory part of the overall system – and not feasible – that the user be able to monitor the whole sensor network just by accessing the nearest sub-network of sensors.

Figure 2 illustrates the relation between these three modules. This structure and modules are considered throughout this document, including in the requirements.

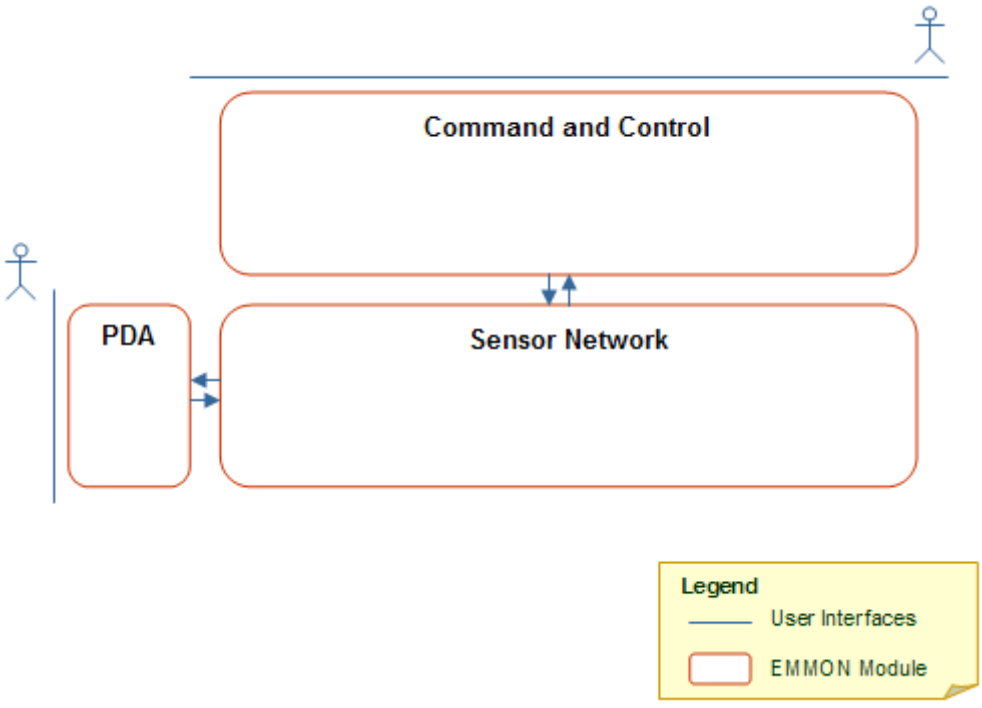

Figure 2 - EMMON modules

5. Technical Requirements

Requirements will be organised based on their type. The requirements types are presented in sub-section 5.1; sub-section 5.2 explains the requirements attributes and conventions; and finally on sub-section 5.3 the requirements catalogue presents all the requirements.

5.1 Requirements Types

The following requirements types were identified according to European Space Agency (ESA) "Guide to the software requirements definition phase" [RD-1].

5.1.1 Functional Requirements

A function is a "defined objective or characteristic action of a system or component" and a functional requirement "specifies a function that a system or system component must be able to perform".

5.1.2 Non-Functional Requirements

5.1.2.1 Performance Requirements

Performance Requirements specify numerical values for measurable variables used to define a function (e.g. rate, frequency, capacity, speed and accuracy). Performance requirements may be included in the quantitative statement of each function, or included as separate requirements.

5.1.2.2 Interface Requirements

Interface Requirements specify hardware, software or database elements that the system, or system component, must interact or communicate with. Interface requirements should also be classified into "internal" and "external" interface requirements, depending upon whether or not the interface coincides with the system boundary.

5.1.2.3 Operational Requirements

Operational Requirements specify how the system will run (i.e. when it is to be operated) and how it will communicate with human operators (e.g. screen and keyboards etc.). Operational requirements may describe physical aspects of the user interface. Descriptions of the dialogue, screen layouts, command language styles are all types of operational requirements.

5.1.2.4 Resource Requirements

Resource Requirements specify the upper limits on physical resources such as processing power, main memory, disk space, etc. They may describe any requirements that the development or operational environment place upon the software. A resource requirement should state the facts about the resources, and not constrain how they are deployed.

5.1.2.5 Verification Requirements

Verification Requirements constrain the design of the product. They may do this by requiring features that facilitate verification of system functions or by saying how the product is to be verified.

5.1.2.6 Documentation Requirements

Documentation Requirements state project-specific requirements for documentation. The format and style of the Interface Control Documents may be described in the documentation requirements, for example. Documentation should be designed for the target readers (i.e. users and maintenance personnel).

5.1.2.7 Security Requirements

Security Requirements specify the requirements for securing the system against threats to confidentiality, integrity and availability. They should describe the level and frequency of access allowed to authorised users of the software. If prevention against unauthorised use is required, the type of unauthorised user should be described. The level of physical protection of the computer facilities may be stated (e.g. backups are to be kept in a fire-proof safe off-site).

5.1.2.8 Portability Requirements

Portability Requirements specify how easy it should be to move the software from one environment to another. Possible computer and operating systems, other than those of the target system, should be stated.

5.1.2.9 Quality Requirements

Quality Requirements specify the attributes of the software that make it fit for its purpose. The major quality attributes of reliability, maintainability and safety should always be stated separately. Where appropriate, software quality attributes should be specified in measurable terms (i.e. with the use of metrics).

Software **reliability** is “the ability of a system or component to perform its required functions under stated conditions for a specified period of time”. The reliability metric, “Mean Time Between Failure” (MTBF), measures reliability according to this definition.

Maintainability is ‘the ease with which a software system or component can be modified to correct faults, improve performance or other attributes, or adapt to a changed environment'. All aspects of maintainability should be covered in the specification of the maintainability requirements, and should be specified, where appropriate, in quantitative terms.

5.2 Requirements Definition Standard

All requirements are presented in tabular format using Table 3:

<ID> - <Title>					
Type:	<Type>	**Priority:**	<Priority>	**Verification Method:**	<Verify-method>
Status:	<Status>	**Stability:**	<Stability>	**Version:**	<Version>
<Detail>					
Notes:	<Notes>				
Traceability:	<List of high-level user requirements, e.g. REQ1 ; REQ2; etc>				

Table 3 - Requirements presentation table

All the words enclosed by "<>" on Table 3 are keywords to be replaced by the real requirement information. Except for the <Notes>, every attribute is mandatory. These requirement attributes are explained next:

<**ID**>: This is the unique identifier of the requirement. This identifier will be used to reference the requirement (ex.: in traceability). The requirement follows the convention: "REQ-EMMON-<Module>-<Number>", where:

REQ-EMMON: A prefix that indicates the item describes a requirement;

<**Module**>: Name of the module (CC or PDA) to which the requirement refers.

<**Number**>: A 4 digit number that starts with 0000 and is incremented by steps of 10. Example: 0000, 0010, 0020, 0030 (allowing insertions of new requirements without changing order).

<**Title**>: A concise description of the requirement

<**Type**>: This is the type of the requirement as defined on sub-section 5.1.

<**Priority**>: The priority of the requirement:

"**High**": Hard requirement

"**Low**": Nice to have

<**Verify-method**>: The method(s) that will be used to verify if the requirement was fulfilled

"**Analysis**": The processing of accumulated data obtained from other qualification methods. Examples are reduction, interpretation or extrapolation of test results. Analysis also includes any analogy claims by the production of evidence of previously accepted testing. In the case of compliance by existing evidence as defined by a Test Plan, the acceptability of the evidence will be established by review, prior to the next level of test.

"**Demonstration**": The operation of a system (hardware of software), or part of a system, that relies on observable functional operation not requiring the use of instrumentation, special test equipment, or subsequent analysis.

"**Inspection**": The visual examination of an item of hardware, software code, documentation, etc., without the need for any manipulation or operation.

"**Test**": The operation of a system (hardware or software), or part of a system, using instrumentation or other special test equipment to collect data for later analysis.

"**Simulation**": The proving of an aspect of a system by theoretical modelling or calculation.

<**Status**>: This is the status of the requirement. It defines the workflow of the requirement.

"**Proposed**": Requirement has been proposed.

"**Approved**": Requirement is approved after formal internal review.

"**Deleted**": Requirement was deleted (even when deleted the requirement identifier shall be maintained and not reused for other requirements).

"**N/A**": This means "Not Applicable". The requirement is not applicable to the final solution, consequently it won't be fulfilled.

<**Stability**>: This is the stability. It defines the likelihood of changes on the requirement definition.

"**High**": The requirement is stable, understood by the project team, no open issues are associated to it, and is unlikely to be changed.

"**Medium**": The requirement could change but it's not expected.

"**Low**": The requirement most likely will change or there is high uncertainty associated to the realisation of specification of this requirement.

<**Version**>: This is the version of the requirement. It identifies the requirements document version where the requirement was created or last updated. In a new version of the requirements document, the requirements unchanged will keep the version number. New or updated requirements will have the new document's version as the requirement version. It will thus allow for traceability of changed requirements over different document versions. Versions are numbers starting with 1 and sequentially incremented by 1 unit. Example: 1, 2, 3, etc.

<**Detail**>: This is a multi-line text field that accepts carriage returns and presents detailed information about the requirement. This is where the requirement text is stated. This field is also known as the requirement body.

<**Notes**>: This is the only optional attribute and brings additional information about the requirement as for example: problems, issues, changes needed or traceability information from where the requirement was derived/originated.

<**Traceability**>: This field consists of one or more high-level user requirements from which each particular consolidated software requirement was derived.

5.3 Requirements Catalogue

This section presents the software requirements for the C&C and PDA modules of the EMMON system.

5.3.1 C&C

This section presents the software requirements for the C&C module of the EMMON project.

5.3.1.1 Functional Requirements

This section presents the functional requirements applicable to the Command & Control subsystem. The assigned numbering range for the Functional requirements is 0010 to 0990.

Monitoring

The requirements presented below specify the monitoring functions of the system.

REQ-EMMON-CC-0010 – Real-Time Data					
Type:	Functional	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall provide the users with real-time data regarding the measured values, as collected from the various sensors part of the network.					
Notes:	In this context, "real-time" means that the data is provided immediately after collection or with no significant delay in its timeliness (30 seconds maximum – see "REQ-EMMON-CC-1010 – Maximum Sensor Reading Delay").				

Traceability:	REQ-EMMON-0010

REQ-EMMON-CC-0020 – Validation of Sensor Readings					
Type:	Functional	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall classify each sensor reading as “Good”, “Suspicious” and “Invalid”, according to the following rules: - if the sensor reading is outside the configured range, the reading shall be classified as “Invalid”; - if the first derivative between the current reading and the previous reading is higher than a configurable threshold, the sensor reading shall be classified as “Invalid”; - if the first derivative over a configurable period of time is below a configurable threshold, the sensor reading shall be classified as “Suspicious”; - if none of the previous rules applies, the sensor reading shall be classified as “Good”.					
Notes:					
Traceability:	REQ-EMMON-0020				

REQ-EMMON-CC-0025 – Configurable Sensor Readings’ Ranges					
Type:	Functional	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall support the configuration of ranges for sensor readings (maximum and minimum allowed values).					
Notes:	Note that this requirement is not related to the definition of alert thresholds but rather with the validation of sensor readings. This requirement is related to requirement “REQ-EMMON-CC-0020 – Validation of Sensor Readings”.				
Traceability:	REQ-EMMON-0020				

REQ-EMMON-CC-0030 – Report Potential Malfunctions					
Type:	Functional	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall report potential sensor malfunctions to the users, when the reading is "Suspicious" or "Invalid".					
Notes:	The potential malfunctions might be reported to the users by displaying alerts or highlighting symbols in the map, for example. This requirement is related to requirement “REQ-EMMON-CC-0020 – Validation of Sensor Readings”.				
Traceability:	REQ-EMMON-0030				

REQ-EMMON-CC-0040 – Validation of Reported Potentially Invalid Readings					
Type:	Functional	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall allow users to validate readings that were qualified as “Suspicious” or “Invalid”. This means that users shall be allowed to qualify as “Good”, sensor readings that were classified as “Suspicious” or “Invalid” automatically.					
Notes:	This requirement is related to requirement “REQ-EMMON-CC-0020 – Validation of Sensor Readings”.				
Traceability:	REQ-EMMON-0040				

REQ-EMMON-CC-0050 - Manual Data Correction					
Type:	Functional	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1

The C&C shall allow users to manually correct values originated from sensor readings. The manual modifications shall be saved with the following information: - original value; - new value; - date of change; - operator identification.
Notes:
Traceability: REQ-EMMON-0050

REQ-EMMON-CC-0060 – Notification of Manually Corrected Data					
Type:	Functional	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall notify users if there are manually modified values, whenever it presents sensor data to them.					
Notes:	The notification can consist of displaying modified data with a different colour, for example. This requirement is related to requirement "REQ-EMMON-CC-0050 - Manual Data Correction". This requirement means that, when accessing information regarding the values measured by the sensors, a user has to have visibility over whether those values were manually altered or not.				
Traceability:	REQ-EMMON-0050				

REQ-EMMON-CC-0070 – Sensor Data Set					
Type:	Functional	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall support a data set received from sensors and composed of the following fields: - node identifier; - node location; - measurement parameter; - measurement type; - measurement value; - node operating condition; - node power status.					
Notes:	Node identifier: unique identifier associated with the sensor. Node location: information about the position (latitude, longitude and elevation) will be stored in a database in the C&C. Measurement parameter: defines what will be measured (temperature, wind speed, humidity, etc.) Measurement type: single measurement, RMS value, average, etc. Node operating condition: normal operation, critical operation, manual operation, etc. Information such as signal strength and sink location can be included in this field. Node power status: level of the battery.				
Traceability:	REQ-EMMON-0110				

REQ-EMMON-CC-0080 – Sensor Data Set Aggregation					
Type:	Functional	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall support a data set received from sensors and consisting of the following fields: - cluster location; - activated nodes; - estimated situation; - nodes' operating condition;					

- nodes' power status. The parameter "estimated situation" shall be calculated as defined in requirement "REQ-EMMON-CC-0085 – Calculation of Estimated Situation".	
Notes:	Estimated situation: information regarding the situation (normal situation, emergency, etc.) Node operating condition: normal operation, critical operation, manual operation, etc. Information such as signal strength and sink location can be included in this field. Node power status: level of the battery.
Traceability:	REQ-EMMON-0110

REQ-EMMON-CC-0085 – Calculation of Estimated Situation					
Type:	Functional	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall support the parameter "estimated situation", for the data set defined in requirement "REQ-EMMON-CC-0080 – Sensor Data Set Aggregation", defined as follows: - if 80% of the readings are above or below the thresholds (as defined in requirement "REQ-EMMON-CC-0400 – Thresholds Properties"), the parameter shall be classified as "emergency"; - otherwise, the parameter shall be classified as "normal".					
Notes:					
Traceability:	REQ-EMMON-0110				

REQ-EMMON-CC-0090 – GIS Environment					
Type:	Functional	**Priority:**	High	**Verification Method:**	Demonstration
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall have the sensor readings displayed in a GIS environment.					
Notes:					
Traceability:	REQ-EMMON-0120				

REQ-EMMON-CC-0100 – Operational Condition					
Type:	Functional	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall provide information in the GIS regarding the operational condition of the individual nodes, namely: - node power status; - node status (as defined in requirement "REQ-EMMON-CC-0350 - Node Enabling and Disabling").					
Notes:					
Traceability:	REQ-EMMON-0120				

REQ-EMMON-CC-0110 – Temporal Search For Data And Events					
Type:	Functional	**Priority:**	High	**Verification Method:**	Demonstration
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall allow users to perform temporal search for recorded data and events. This means that users shall be allowed to specify a date or timeframe for which the C&C will provide information regarding: - sensor values; - alert situations.					
Notes:					
Traceability:	REQ-EMMON-0120				

REQ-EMMON-CC-0115 – Spatial Search For Data And Events					
Type:	Functional	**Priority:**	High	**Verification Method:**	Demonstration
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall allow users to perform spatial search for recorded data and events. This means that users shall be allowed to navigate through the maps and find information regarding the sensor readings or alerts for specific locations.					
Notes:					
Traceability:	REQ-EMMON-0120				

REQ-EMMON-CC-0120 – Search, Selection And Geographical Visualization					
Type:	Functional	**Priority:**	High	**Verification Method:**	Demonstration
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall provide – through a Graphical User Interface (GUI) – the following operations for all areas being monitored by the system, using a Geographical Information System (GIS): - search (as defined in requirement "REQ-EMMON-CC-0115 – Spatial Search For Data And Events"); - selection of nodes; - geographical visualization of the location of the elements defined in requirement "REQ-EMMON-CC-0160 – Identification of Elements of Interest"; - zoom capabilities.					
Notes:					
Traceability:	REQ-EMMON-1510				

REQ-EMMON-CC-0130 – Node Graphical Representation					
Type:	Functional	**Priority:**	High	**Verification Method:**	Demonstration
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall represent the sensor nodes in the system as two-dimensional sets of dots (or symbols) in a rectangular panel.					
Notes:					
Traceability:	REQ-EMMON-1510				

REQ-EMMON-CC-0140 – Interactive Display of Sensor Readings					
Type:	Functional	**Priority:**	High	**Verification Method:**	Demonstration
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall provide a visual display of sensor readings to the users, by clicking on each sensor node's representation (as defined in requirement "REQ-EMMON-CC-0130 – Node Graphical Representation").					
Notes:					
Traceability:	REQ-EMMON-1520				

REQ-EMMON-CC-0160 – Identification of Elements of Interest					
Type:	Operational	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall identify each of the following elements of interest by a unique code or name: - sensors; - sensor nodes; - routers; - gateways.					

Notes:	
Traceability:	REQ-EMMON-2020

REQ-EMMON-CC-0170 – Selection of Elements of Interest Using Layers					
Type:	Operational	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall allow for the visual selection of elements of interest by using layers of information. Each layer shall be associated with a particular type of element of interest.					
Notes:					
Traceability:	REQ-EMMON-2030				

REQ-EMMON-CC-0180 – Set Endangerment Level					
Type:	Operational	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall set the appropriate endangerment level, according to the sensor readings.					
Notes:	The endangerment levels are defined in requirement “REQ-EMMON-CC-0410 – Definition of Endangerment Levels”.				
Traceability:	REQ-EMMON-2040				

REQ-EMMON-CC-0190 – Automatic Evaluation Of Sensor Readings					
Type:	Operational	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall compare the current sensor readings with historical data to make a primary automatic evaluation, classifying them as: - "normal", - "warning" or - "critical". If a warning or critical reading is identified, the C&C shall execute the following actions: - provide additional data from nearby regions to the user. - request an increase of the frequency of sensor readings to the Sensor Network; - increase the information update frequency, regarding the sensor readings presented to the users;					
Notes:	This classification is related to the endangerment levels defined in requirement “REQ-EMMON-CC-0410 – Definition of Endangerment Levels”.				
Traceability:	REQ-EMMON-2050				

REQ-EMMON-CC-0195 – Configurable Frequency of Sensor Readings					
Type:	Operational	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall define a parameter to specify the variation of the frequency of sensor readings, when a reading is classified as “warning” or “critical”, as defined in requirement “REQ-EMMON-CC-0190 – Automatic Evaluation Of Sensor Readings”. This parameter shall also be used to request an increase of the frequency of sensor readings to the Sensor Network.					
Notes:					
Traceability:	REQ-EMMON-2050				

History

The requirements presented below specify the data history management functions implemented by the system.

REQ-EMMON-CC-0200 – Historical Data					
Type:	Functional	**Priority:**	High	**Verification Method:**	Demonstration
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall provide the users with historical data regarding the measured values. The data to be provided to the user is defined in requirement "REQ-EMMON-CC-0210 – Stored Data".					
Notes:					
Traceability:	REQ-EMMON-0010				

REQ-EMMON-CC-0205 – Historical Data Log Length					
Type:	Functional	**Priority:**	High	**Verification Method:**	Demonstration
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall keep a history of collected sensor readings of up to 1 year.					
Notes:	This requirement is related with requirement "REQ-EMMON-CC-0200 – Historical Data".				
Traceability:	REQ-EMMON-0010				

REQ-EMMON-CC-0210 – Stored Data					
Type:	Functional	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall store the sensor readings that are read from the sensors and validated by system. The validation process is defined in requirement "REQ-EMMON-CC-0020 – Validation of Sensor Readings". The extent of sensor readings to store is defined in requirement "REQ-EMMON-CC-0205 – Historical Data Log Length".					
Notes:	This requirement is related with requirement "REQ-EMMON-CC-0200 – Historical Data".				
Traceability:	REQ-EMMON-0010				

REQ-EMMON-CC-0220 – Historical, Present and Future Comparative Diagrams					
Type:	Functional	**Priority:**	High	**Verification Method:**	Demonstration
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall provide comparative diagrams (i.e. charts) regarding historical, present and future measured values. The future values shall be provided by the event propagation simulation.					
Notes:					
Traceability:	REQ-EMMON-1540				

Forecasting

The requirements presented below specify the forecasting functions implemented by the system.

REQ-EMMON-CC-0230 – Event Propagation Model					
Type:	Functional	**Priority:**	High	**Verification Method:**	Demonstration
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall provide an event propagation model. This propagation model shall use past and present sensor data to predict future events.					
Notes:					
Traceability:	REQ-EMMON-0160				

REQ-EMMON-CC-0240 – Visual Sensor Readings Evolution					
Type:	Functional	**Priority:**	High	**Verification Method:**	Demonstration
Status:	Proposed	**Stability:**	Low	**Version:**	1
The C&C shall provide visual animations showing the evolution of sensor readings in a specific area, within a specific period, providing a fast forwarding capability. The event propagation simulation shall be used to achieve this.					
Notes:					
Traceability:	REQ-EMMON-1540				

Users Management

The requirements presented below specify the user management functions implemented by the system.

REQ-EMMON-CC-0250 – User Accounts Management					
Type:	Functional	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall allow the management (create, update, delete) of user accounts. The properties of each user account are defined in requirement "REQ-EMMON-CC-0260 – User Account Properties".					
Notes:					
Traceability:	REQ-EMMON-0090				

REQ-EMMON-CC-0260 – User Account Properties					
Type:	Functional	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall define user accounts by the following properties: - First name; - Last name; - Username; - Password; - E-mail.					
Notes:					
Traceability:	REQ-EMMON-0090				

REQ-EMMON-CC-0270 – User Accounts					
Type:	Functional	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall allow the association of user accounts into groups, as defined in requirement "REQ-EMMON-CC-0300 – Group Accounts".					
Notes:					
Traceability:	REQ-EMMON-0090				

REQ-EMMON-CC-0280 – Group Accounts Management					
Type:	Functional	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall allow the management (create, update, delete) of group accounts. The properties of each group					

account are defined in requirement "REQ-EMMON-CC-0290 – Group Account Properties".	
Notes:	
Traceability:	REQ-EMMON-0100

REQ-EMMON-CC-0290 – Group Account Properties					
Type:	Functional	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall define group accounts by the following properties: - Name; - Description.					
Notes:					
Traceability:	REQ-EMMON-0100				

REQ-EMMON-CC-0300 – Group Accounts					
Type:	Functional	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall allow the following operations over different group accounts types: - view; - configuring (view and edit); - manage (view, edit, create and delete). Each account type shall have its own access privileges.					
Notes:					
Traceability:	REQ-EMMON-0100				

REQ-EMMON-CC-0305 – Group Access Control					
Type:	Functional	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall allow the definition of different access privileges for each account type. The different access privileges are defined in requirement "REQ-EMMON-CC-0310 - Group Access Permissions".					
Notes:	This requirement is related to requirement "REQ-EMMON-CC-0300 – Group Accounts".				
Traceability:	REQ-EMMON-0100				

REQ-EMMON-CC-0310 - Group Access Permissions					
Type:	Functional	**Priority:**	High	**Verification Method:**	Demonstration
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall define the following access permission levels for each group account: - strategic; - management; - modelling; - training; - operational. According to the access permission level, each group account shall have access to specific information.					
Notes:	This means that, according to the level chosen by the user, the C&C will present different information.				
Traceability:	REQ-EMMON-0140				

Nodes Management

The requirements presented below specify the node management functions implemented by the system.

REQ-EMMON-CC-0320 – Nodes Management					
Type:	Functional	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall allow the nodes management (create, update and delete).					
Notes:					
Traceability:	REQ-EMMON-0120				

REQ-EMMON-CC-0330 – Nodes Creation					
Type:	Functional	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall allow the creation of new nodes using the following methods: - Manual insertion of the latitude and longitude; - Pick a point in the map.					
Notes:					
Traceability:	REQ-EMMON-0120				

REQ-EMMON-CC-0340 – Nodes Loading					
Type:	Functional	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall allow loading a file with spatial data (shapefile) containing nodes.					
Notes:					
Traceability:	REQ-EMMON-0120				

REQ-EMMON-CC-0350 - Node Enabling and Disabling					
Type:	Functional	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall allow users to configure individual nodes as “enabled” or “disabled”. A node with a “disabled” status shall be regarded by the system as not being part of it and as such, its readings shall be disregarded.					
Notes:					
Traceability:	REQ-EMMON-0080				

REQ-EMMON-CC-0360 – Setup Sensors’ Operating Parameters					
Type:	Functional	**Priority:**	High	**Verification Method:**	Demonstration
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall allow users to setup the sensors’ operating parameters.					
Notes:	This is related to configuring hardware parameters, and will depend on the hardware used.				
Traceability:	REQ-EMMON-0120				

REQ-EMMON-CC-0370 – Schedule Maintenance Activities					
Type:	Functional	**Priority:**	High	**Verification Method:**	Demonstration
Status:	Proposed	**Stability:**	Medium	**Version:**	1

The C&C shall allow for scheduling of node maintenance procedures.	
Notes:	The maintenance procedures might involve changing a node's battery, fixing a hardware problem, or replacing a node, for example.
Traceability:	REQ-EMMON-0120

REQ-EMMON-CC-0380 – Nodes Grouping					
Type:	Functional	**Priority:**	High	**Verification Method:**	Demonstration
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall allow the grouping of nodes, selecting them in the GIS.					
Notes:					
Traceability:	REQ-EMMON-3020				

Alarms Management

The requirements presented below specify alarm management functions implemented by the system.

REQ-EMMON-CC-0390 – Configurable Alarm Thresholds					
Type:	Functional	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall allow users to perform the following operations regarding alarm thresholds for the monitored physical variables: - create; - edit; - delete; - view.					
Notes:					
Traceability:	REQ-EMMON-0060				

REQ-EMMON-CC-0400 – Thresholds Properties					
Type:	Functional	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall have the thresholds defined by the following properties: - Value; - Type (lower or upper) - Action to be executed.					
Notes:					
Traceability:	REQ-EMMON-0060				

REQ-EMMON-CC-0410 – Definition of Endangerment Levels					
Type:	Functional	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall define the following endangerment levels: - normal; - warning; - critical.					
Notes:	This requirement is related to requirement "REQ-EMMON-CC-0180 – Set Endangerment Level".				
Traceability:	REQ-EMMON-0070				

REQ-EMMON-CC-0420 – Configuration of Endangerment Levels					
Type:	Functional	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall allow users to define sets of actions for the system to execute, for each of the endangerment levels specified by requirement "REQ-EMMON-CC-0410 – Definition of Endangerment Levels". The available actions shall be: - change of the frequency of readings (frequency at which the Sensor Network performs readings); - change of information update frequency (frequency at which the information is updated in the C&C); - sending SMS to specific authorities; - sending emails to specific authorities.					
Notes:					
Traceability:	REQ-EMMON-0070				

REQ-EMMON-CC-0430 – Inform Authorities					
Type:	Functional	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall allow distribution of data to the relevant authorities, through SMS and email.					
Notes:					
Traceability:	REQ-EMMON-0130				

REQ-EMMON-CC-0440 – Email Properties					
Type:	Functional	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall have the emails composed by the following properties: - Node; - Value; - Threshold; - Actions; - Image that contains the affected area.					
Notes:	This requirement is related to requirement "REQ-EMMON-CC-0430 – Inform Authorities".				
Traceability:	REQ-EMMON-0130				

REQ-EMMON-CC-0450 – SMS Properties					
Type:	Functional	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall have the SMS composed by the following properties: - Node; - Value; - Actions.					
Notes:	This requirement is related to requirement "REQ-EMMON-CC-0430 – Inform Authorities".				
Traceability:	REQ-EMMON-0130				

REQ-EMMON-CC-0460 – Alert Conditions					
Type:	Functional	**Priority:**	High	**Verification Method:**	Test

Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall alert users if the monitored parameters are outside of the thresholds specified in requirement "REQ-EMMON-CC-0390 – Configurable Alarm Thresholds".					
Notes:					
Traceability:	REQ-EMMON-0150				

REQ-EMMON-CC-0470 – Visual Alarm Notification					
Type:	Functional	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall visually notify users of any alarm or alert situation that might occur, independently of the display available to the user at the time. This information shall be visible at least until the user acknowledges the alarm/alert.					
Notes:					
Traceability:	REQ-EMMON-1530				

REQ-EMMON-CC-0480 – Geographical Visualization of Alert Areas					
Type:	Functional	**Priority:**	High	**Verification Method:**	Demonstration
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall provide a geographical visualization of all areas in alarm/alert status.					
Notes:	The nodes corresponding to that area might have, for example, their graphical representations blinking, with a specific alert colour, or the area might be highlighted with a specific colour.				
Traceability:	REQ-EMMON-1530				

REQ-EMMON-CC-0490 – Disable Alarm Notification					
Type:	Functional	**Priority:**	High	**Verification Method:**	Demonstration
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall allow users to disable an alarm for a set of sensors, for a set of parameters and for a time interval. The interval shall be limited to a system-wide configurable duration.					
Notes:					
Traceability:	REQ-EMMON-1535				

5.3.1.2 Performance Requirements

This section presents the performance requirements applicable to the Command & Control subsystem. The assigned numbering range for the Performance requirements is 1010 to 1490.

REQ-EMMON-CC-1010 – Maximum Sensor Reading Delay					
Type:	Performance	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall provide the values of parameters at most 30 seconds after the reading was ordered by the user and the data has been received from the Sensor Network, after it has been request by the C&C,.					
Notes:	This requirement reflects the fact the C&C has no control over the time from requesting a read to the Sensor Network and having receiving the corresponding data. Nevertheless, after the data is received from the Sensor Network, the C&C has to be able to process it and present it to the users within 30 seconds.				
Traceability:	REQ-EMMON-1010				

REQ-EMMON-CC-1020 – Information Update Frequency					
Type:	Performance	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall update the information available to the users every minute.					
Notes:	This means that the information presented to the user through the C&C is updated every minute. It does not imply that sensors take readings every minute too.				
Traceability:	REQ-EMMON-1020				

5.3.1.3 Interface Requirements

This section presents the interface requirements applicable to the Command & Control subsystem. The assigned numbering range for the Interface requirements is 1510 to 1990.

REQ-EMMON-CC-1510 – Middleware Interface					
Type:	Functional	**Priority:**	High	**Verification Method:**	Demonstration
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall access the interface provided by the EMMON middleware for retrieving sensor data.					
Notes:					
Traceability:	REQ-EMMON-0110				

REQ-EMMON-CC-1520 – Event Propagation Interface					
Type:	Functional	**Priority:**	High	**Verification Method:**	Demonstration
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall access the interface provided by the event propagation module.					
Notes:					
Traceability:	REQ-EMMON-0160				

5.3.1.4 Operational Requirements

This section presents the operational requirements applicable to the Command & Control subsystem. The assigned numbering range for the Operational requirements is 2010 to 2490.

REQ-EMMON-CC-2010 – Multi-language					
Type:	Operational	**Priority:**	High	**Verification Method:**	Demonstration
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall support multi-language. The default language shall be English.					
Notes:					
Traceability:	REQ-EMMON-1510				

5.3.1.5 Resource Requirements

This section presents the resource requirements applicable to the Command & Control subsystem. The assigned numbering range for the Resource requirements is 2510 to 2990.

Not applicable.

5.3.1.6 Verification Requirements

This section presents the verification requirements applicable to the Command & Control subsystem. The assigned numbering range for the Verification requirements is 3010 to 3490.

Not applicable.

5.3.1.7 Documentation Requirements

This section presents the documentation requirements applicable to the Command & Control subsystem. The assigned numbering range for the Documentation requirements is 3510 to 3990.

REQ-EMMON-CC-3510 – Event Propagation Model Technical Manual					
Type:	Documentation	**Priority:**	High	**Verification Method:**	Inspection
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall provide a technical manual for the event propagation model.					
Notes:					
Traceability:	REQ-EMMON-3510				

REQ-EMMON-CC-3520 – Event Propagation Model User Manual					
Type:	Documentation	**Priority:**	High	**Verification Method:**	Inspection
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall provide a user manual for the event propagation model.					
Notes:					
Traceability:	REQ-EMMON-3520				

5.3.1.8 Security Requirements

This section presents the security requirements applicable to the Command & Control subsystem. The assigned numbering range for the Security requirements is 4010 to 4490.

REQ-EMMON-CC-4010 – Access Restrictions to the Graphical User Interface					
Type:	Security	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall restrict access to the GUI to certified users with the proper credentials.					
Notes:					
Traceability:	REQ-EMMON-4010				

REQ-EMMON-CC-4020 – Access System for the Graphical User Interface					
Type:	Security	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall use an encrypted authentication and authorization system to access the GUI.					
Notes:					
Traceability:	REQ-EMMON-4010				

REQ-EMMON-CC-4030 – Access Restrictions to the Historical and Real-Time Data

Type:	Security	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall restrict access to historical and real-time data to certified users with the proper credentials, by using an encrypted authentication and authorization system.					
Notes:					
Traceability:	REQ-EMMON-4020				

REQ-EMMON-CC-4040 – Secure Data Transmission					
Type:	Security	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall be designed to work with secure, generic and well known communication protocols and encryption, to communicate with the Sensor Network					
Notes:	The Hypertext Transfer Protocol Secure (HTTPS) is a possibility for a secure communication protocol. TLS encryption might be used, as it is currently one of the most secure encryption methods known.				
Traceability:	REQ-EMMON-4030				

REQ-EMMON-CC-4050 – Access to Validation of Reported Potentially Invalid Readings					
Type:	Security	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall restrict access to the validation of reported potentially invalid readings, as defined in requirement "REQ-EMMON-CC-0060 - Validation of Reported Potentially Invalid Readings", to certified users with the proper credentials.					
Notes:					
Traceability:	REQ-EMMON-4040				

REQ-EMMON-CC-4060 – Access to Manual Data Correction					
Type:	Security	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall restrict access to the manual correction of data, as defined in requirement "REQ-EMMON-CC-0070 - Manual Data Correction", to certified users with the proper credentials.					
Notes:					
Traceability:	REQ-EMMON-4040				

REQ-EMMON-CC-4070 – Access to Sensors' Operating Parameters Setup					
Type:	Security	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall restrict access to the sensors' operating parameters' setup, as defined in requirement "REQ-EMMON-CC-0190 – Setup Sensors' Operating Parameters", to certified users with the proper credentials.					
Notes:					
Traceability:	REQ-EMMON-4040				

REQ-EMMON-CC-4080 – Access to Disablement of Alarm Notifications					
Type:	Security	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall restrict access to the disablement of alarm notifications, as defined in requirement "REQ-EMMON-CC-0310 – Disable Alarm Notification", to certified users with the proper credentials.					

Notes:	
Traceability:	REQ-EMMON-4040

REQ-EMMON-CC-4090 – Access to Remote Maintenance					
Type:	Security	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall restrict access to remote maintenance activities, as defined in requirement "REQ-EMMON-CC-6020 – Remote Maintenance", to certified users. These users shall be allowed to change system parameters and configuration options.					
Notes:					
Traceability:	REQ-EMMON-6020				

5.3.1.9 Portability Requirements

This section presents the portability requirements applicable to the Command & Control subsystem. The assigned numbering range for the Portability requirements is 4510 to 4990.

REQ-EMMON-CC-4510 – Event Propagation Model Portability					
Type:	Portability	**Priority:**	High	**Verification Method:**	Analysis
Status:	Proposed	**Stability:**	Low	**Version:**	1
The C&C shall guarantee that the event propagation model is portable between different event domains in the EMMON project, so that it can also model all the other scenarios identified for this project, in addition to fire and pollution for which it was initially considered.					
Notes:					
Traceability:	REQ-EMMON-4510				

REQ-EMMON-CC-4520 – Operating System Support					
Type:	Portability	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall be designed to work with the Microsoft Windows XP operating system.					
Notes:					
Traceability:	New requirement				

5.3.1.10 Quality Requirements

This section presents the quality requirements applicable to the Command & Control subsystem. The assigned numbering range for the Quality requirements is 5010 to 5490.

REQ-EMMON-CC-5010 – Event Propagation Model Integrity					
Type:	Quality	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall have its event propagation model maintain its integrity and functionality in the event of failure of up to 5% of the sensors.					
Notes:					
Traceability:	REQ-EMMON-5010				

REQ-EMMON-CC-5020 – Event Propagation Model Availability

Type:	Quality	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall have its event propagation model available continuously, in the event of failure of up to 5% of the sensors.					
Notes:					
Traceability:	REQ-EMMON-5020				

5.3.1.11 Reliability Requirements

This section presents the reliability requirements applicable to the Command & Control subsystem. The assigned numbering range for the Reliability requirements is 5510 to 5990.

REQ-EMMON-CC-5510 – C&C Reliability					
Type:	Reliability	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall remain operational in the event of temporary unavailability of the sub-trees of the Sensor Network or the unavailability of the complete Sensor Network.					
Notes:					
Traceability:	New requirement				

5.3.1.12 Maintainability Requirements

This section presents the maintainability requirements applicable to the Command & Control subsystem. The assigned numbering range for the Maintainability requirements is 6010 to 6490.

REQ-EMMON-CC-6010 – Over the Air Programming/Configuring					
Type:	Maintainability	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall provide a means to perform over the air programming of any node connected to the Sensor Network, including the ability to: - Upgrade the node's firmware. - Updating the node's configuration parameters.					
Notes:					
Traceability:	REQ-EMMON-6010				

REQ-EMMON-CC-6020 – Remote Maintenance					
Type:	Maintainability	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The C&C shall provide remote maintenance through the graphical user interface (GUI).					
Notes:					
Traceability:	REQ-EMMON-6020				

5.3.1.13 Safety Requirements

This section presents the safety requirements applicable to the Command & Control subsystem. The assigned numbering range for the Safety requirements is 6510 to 6990.

Not applicable.

5.3.2 PDA

This section presents the software requirements for the PDA module of the EMMON project.

5.3.2.1 Functional Requirements

This section presents the functional requirements applicable to the PDA module. The assigned numbering range for the Functional requirements is 0010 to 0990.

REQ-EMMON-PDA-0010 – Map Sensors' Positions on the PDA					
Type:	Functional	**Priority:**	High	**Verification Method:**	Demonstration
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The PDA shall map its area of coverage indicating the sensors' positions, by providing a visual two-dimensional map showing this information.					
Notes:	The area of coverage is, in this context, represented by the nodes within the sub-tree of the node to which the PDA is connected,				
Traceability:	REQ-EMMON-0210				

REQ-EMMON-PDA-0020 – Supervision of Operating Conditions Through the PDA					
Type:	Functional	**Priority:**	High	**Verification Method:**	Demonstration
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The PDA shall allow the supervision of the operating conditions of the sensor nodes in its area of coverage, namely: - operation status; - data availability.					
Notes:	The area of coverage is, in this context, represented by the nodes within the sub-tree of the node to which the PDA is connected, "Operation status" – signifies the node's power status. "Data availability" – indicates whether the sensor node is enabled or disabled (node status), as it should always have data available, unless it is disabled.				
Traceability:	REQ-EMMON-0210				

REQ-EMMON-PDA-0030 – Installation and Maintenance Instructions on the PDA					
Type:	Functional	**Priority:**	High	**Verification Method:**	Demonstration
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The PDA shall provide instructions for the installation and maintenance of the sensors.					
Notes:	These instructions can be textual instructions or graphic instructions.				
Traceability:	REQ-EMMON-0210				

REQ-EMMON-PDA-0040 – Field Sensor Configuring Through the PDA					
Type:	Functional	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The PDA shall allow for field sensor node configuring. The configuration parameters are TBD.					
Notes:	Field sensor node configuring can be with regards to position, thresholds, sampling frequency or communication requirements.				
Traceability:	REQ-EMMON-0210				

REQ-EMMON-PDA-0050 – Firmware Upgrade Through the PDA					
Type:	Functional	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1

The PDA shall provide a means to upgrade the firmware of any node connected to it.	
Notes:	
Traceability:	REQ-EMMON-0220

REQ-EMMON-PDA-0060 – Local Monitoring Through the PDA					
Type:	Functional	**Priority:**	High	**Verification Method:**	Demonstration
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The PDA shall provide up-to-date information regarding the values measured by sensor nodes to which it is locally connected.					
Notes:					
Traceability:	REQ-EMMON-0230				

REQ-EMMON-PDA-0070 – Alert Regional PDA					
Type:	Functional	**Priority:**	High	**Verification Method:**	Demonstration
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The PDA shall receive alerts when an emergency situation occurs in its area of coverage.					
Notes:	The area of coverage is, in this context, represented by the nodes within the sub-tree of the node to which the PDA is connected,				
Traceability:	REQ-EMMON-0240				

REQ-EMMON-PDA-0080 – Visualization of Nodes Status in the PDA					
Type:	Functional	**Priority:**	High	**Verification Method:**	Demonstration
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The PDA shall provide a visualization of the sensor nodes' operating conditions referred in requirement "REQ-EMMON-PDA-0370 – Supervision of Operating Conditions Through the PDA", using a colour code to identify and differentiate those operating conditions.					
Notes:					
Traceability:	REQ-EMMON-1590				

REQ-EMMON-PDA-0090 – Local Search, Selection and Geographical Visualization in the PDA					
Type:	Functional	**Priority:**	High	**Verification Method:**	Demonstration
Status:	Proposed	**Stability:**	Low	**Version:**	1
The PDA shall provide search by name or ID of all the nodes in the area of coverage, providing its corresponding sensor data.					
Notes:	The area of coverage is, in this context, represented by the nodes within the sub-tree of the node to which the PDA is connected,				
Traceability:	REQ-EMMON-1600				

REQ-EMMON-PDA-0100 – Sensor Connectivity Verification on the PDA					
Type:	Verification	**Priority:**	High	**Verification Method:**	Demonstration
Status:	Proposed	**Stability:**	Low	**Version:**	1
The PDA shall provide means of verification if the sensors are connected and reachable.					
Notes:					
Traceability:	REQ-EMMON-3030				

5.3.2.2 Performance Requirements

This section presents the performance requirements applicable to the PDA module. The assigned numbering range for the Performance requirements is 1010 to 1490.

Not applicable.

5.3.2.3 Interface Requirements

This section presents the interface requirements applicable to the PDA module. The assigned numbering range for the Interface requirements is 1510 to 1990.

REQ-EMMON-PDA-1510 – Middleware Interface					
Type:	Interface	**Priority:**	High	**Verification Method:**	Demonstration
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The PDA shall access the interface provided by the EMMON middleware for sending and receiving data.					
Notes:					
Traceability:	New requirement.				

5.3.2.4 Operational Requirements

This section presents the operational requirements applicable to the PDA module. The assigned numbering range for the Operational requirements is 2010 to 2490.

REQ-EMMON-PDA-2010 – Identification of Elements of Interest on the PDA					
Type:	Operational	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The PDA shall identify each of the following elements of interest by a unique code or name: - sensors; - sensor nodes; - routers; - gateways.					
Notes:					
Traceability:	REQ-EMMON-2130				

5.3.2.5 Resource Requirements

This section presents the resource requirements applicable to the PDA module. The assigned numbering range for the Resource requirements is 2510 to 2990.

Not applicable.

5.3.2.6 Verification Requirements

This section presents the verification requirements applicable to the PDA module. The assigned numbering range for the Verification requirements is 3010 to 3490.

Not applicable.

5.3.2.7 Documentation Requirements

This section presents the documentation requirements applicable to the PDA module. The assigned numbering range for the Documentation requirements is 3510 to 3990.

REQ-EMMON-PDA-3510 – PDA User Manual					
Type:	Documentation	**Priority:**	High	**Verification Method:**	Inspection
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The PDA shall provide a user manual with instructions on how to operate the PDA device.					
Notes:					
Traceability:	New requirement.				

5.3.2.8 Security Requirements

This section presents the security requirements applicable to the PDA module. The assigned numbering range for the Security requirements is 4010 to 4490.

REQ-EMMON-PDA-4110 – PDA Access Restrictions					
Type:	Security	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The PDA shall restrict access to the GUI to certified users, with the proper credentials.					
Notes:					
Traceability:	REQ-EMMON-4080				

REQ-EMMON-PDA-4120 – System Configuration Through the PDA					
Type:	Security	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The PDA shall allow certified users with the proper credentials to change system parameters and configuration options.					
Notes:					
Traceability:	REQ-EMMON-4080				

REQ-EMMON-PDA-4130 – Access System for the PDA's Graphical User Interface					
Type:	Security	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The PDA shall use an encrypted authentication and authorization system to access the GUI.					
Notes:					
Traceability:	REQ-EMMON-4080				

REQ-EMMON-PDA-4140 – Access to Field Sensor Node Configuring Through the PDA					
Type:	Security	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The PDA shall restrict access to the field sensor node configuring functionalities, as defined in requirement "REQ-EMMON-PDA-0390 – Field Sensor Configuring Through the PDA", to certified users with the proper credentials.					
Notes:					
Traceability:	REQ-EMMON-0210				

5.3.2.9 Portability Requirements

This section presents the portability requirements applicable to the PDA module. The assigned numbering range for the Portability requirements is 4510 to 4990.

REQ-EMMON-PDA-4510 – PDA Operating System Support					
Type:	Portability	**Priority:**	High	**Verification Method:**	Test
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The PDA shall support the Microsoft Windows Mobile operating system.					
Notes:					
Traceability:	New requirement.				

5.3.2.10 Quality Requirements

This section presents the quality requirements applicable to the PDA module. The assigned numbering range for the Quality requirements is 5010 to 5490.

Not applicable.

5.3.2.11 Reliability Requirements

This section presents the reliability requirements applicable to the PDA module. The assigned numbering range for the Reliability requirements is 5510 to 5990.

Not applicable.

5.3.2.12 Maintainability Requirements

This section presents the maintainability requirements applicable to the PDA module. The assigned numbering range for the Maintainability requirements is 6010 to 6490.

REQ-EMMON-PDA-6030 – PDA Remote Maintenance					
Type:	Maintainability	**Priority:**	High	**Verification Method:**	Demonstration
Status:	Proposed	**Stability:**	Medium	**Version:**	1
The PDA shall provide remote maintenance through a Graphical User Interface (GUI).					
Notes:					
Traceability:	REQ-EMMON-6040				

5.3.2.13 Safety Requirements

This section presents the safety requirements applicable to the PDA module. The assigned numbering range for the Safety requirements is 6510 to 6990.

Not applicable.

6. Pending Issues

This section states all pending issues that impact the requirements and that require clarification.

Regarding the specification of software requirements for the C&C and PDA modules of the EMMON project, we have the following pending issues at this point:

- Some clarification is still needed regarding what are the functionalities to implement in the PDA devices. This will be largely affected by the hardware used for the PDA devices.
- The middleware interfaces for accessing the network as well as the data aggregation functions provided by the middleware itself are still TBD.
- The configurable parameters of each node on the network are still TBD.

Annex A

Annex A. Traceability Matrix End-User Requirements Vs C&C and PDA Software Requirements

Table 4 presents the traceability matrix between the end-user requirements and the C&C and PDA software requirements.

End-User Requirements	C&C/PDA Software Requirements
REQ-EMMON-0010 - Historical and Real-time Data	REQ-EMMON-CC-0010 – Real-Time Data
	REQ-EMMON-CC-0200 – Historical Data
	REQ-EMMON-CC-0205 – Historical Data Log Length
	REQ-EMMON-CC-0210 – Stored Data
REQ-EMMON-0020 - Validation of Sensor Readings	REQ-EMMON-CC-0020 – Validation of Sensor Readings
	REQ-EMMON-CC-0025 – Configurable Sensor Readings' Ranges
REQ-EMMON-0030 - Report Potential Malfunctions	REQ-EMMON-CC-0030 - Report Potential Malfunctions
REQ-EMMON-0040 - Validation of Reported Potentially Invalid Readings	REQ-EMMON-CC-0040 - Validation of Reported Potentially Invalid Readings
REQ-EMMON-0050 – Manual Data Correction	REQ-EMMON-CC-0050 - Manual Data Correction
	REQ-EMMON-CC-0060 – Notification of Manually Corrected Data
REQ-EMMON-0060 - Configurable Alarm Thresholds	REQ-EMMON-CC-0390 – Configurable Alarm Thresholds
	REQ-EMMON-CC-0400 – Thresholds Properties
REQ-EMMON-0070 - Endangerment Levels	REQ-EMMON-CC-0410 – Definition of Endangerment Levels
	REQ-EMMON-CC-0420 – Configuration of Endangerment Levels
REQ-EMMON-0080 – Node Enabling and Disabling	REQ-EMMON-CC-0350 - Node Enabling and Disabling
REQ-EMMON-0090 – User Accounts	REQ-EMMON-CC-0250 – User Accounts Management
	REQ-EMMON-CC-0260 – User Accounts Properties
	REQ-EMMON-CC-0270 – User Accounts
REQ-EMMON-0100 – Group Accounts	REQ-EMMON-CC-0300 – Group Account Management
	REQ-EMMON-CC-0300 – Group Account Properties
	REQ-EMMON-CC-0300 – Group Account
	REQ-EMMON-CC-0305 – Group Access Control
REQ-EMMON-0110 – Sensor Data Sets	REQ-EMMON-CC-0070 – Sensor Data Set For Raw Data
	REQ-EMMON-CC-0080 – Sensor Data Set For Data Aggregation
	REQ-EMMON-CC-0085 – Calculation of Estimated Situation
	REQ-EMMON-CC-0310 - Group Access Permissions
	REQ-EMMON-CC-1510 – Middleware Interface
REQ-EMMON-0120 – C&C Services	REQ-EMMON-CC-0090 – GIS Environment
	REQ-EMMON-CC-0100 – Operational Condition
	REQ-EMMON-CC-0360 – Setup Sensors' Operating Parameters

End-User Requirements	C&C/PDA Software Requirements
	REQ-EMMON-CC-0110 – Temporal Search For Data And Events
	REQ-EMMON-CC-0370 – Schedule Maintenance Activities
	REQ-EMMON-CC-0320 – Nodes Management
	REQ-EMMON-CC-0330 – Nodes Creation
	REQ-EMMON-CC-0340 – Nodes Loading
REQ-EMMON-0130 – Inform Authorities	REQ-EMMON-CC-0430 – Inform Authorities
	REQ-EMMON-CC-0440 – Email Properties
	REQ-EMMON-CC-0450 – SMS Properties
REQ-EMMON-0140 – Customizable Information On Demand	REQ-EMMON-CC-0310 - Customizable Information On Demand
REQ-EMMON-0150 – Alert Conditions	REQ-EMMON-CC-0460 – Alert Conditions
REQ-EMMON-0160 – Event Propagation Model	REQ-EMMON-CC-0230 – Event Propagation Model
	REQ-EMMON-CC-1520 – Sensor interface
REQ-EMMON-1010 – Maximum Sensor Reading Delay	REQ-EMMON-CC-1010 – Maximum Sensor Reading Delay
REQ-EMMON-1020 – Information Update Frequency	REQ-EMMON-CC-1020 – Information Update Frequency
REQ-EMMON-1510 – Graphical User Interface	REQ-EMMON-CC-0120 – Search, Selection And Geographical Visualization
	REQ-EMMON-CC-0130 – Node Graphical Representation
	REQ-EMMON-CC-2010 – Multi-language
REQ-EMMON-1520 – Interactive Display of Sensor Readings	REQ-EMMON-CC-0140 – Interactive Display of Sensor Readings
REQ-EMMON-1530 – Alarm User Interface	REQ-EMMON-CC-0470 – Visual Alarm Notification
	REQ-EMMON-CC-0480 – Geographical Visualization of Alert Areas
REQ-EMMON-1535 - Disable Alarm Notification	REQ-EMMON-CC-0490 – Disable Alarm Notification
REQ-EMMON-1540 – Historical, Present and Future Comparative Diagrams	REQ-EMMON-CC-0220 – Historical, Present and Future Comparative Diagrams
	REQ-EMMON-CC-0240 – Visual Sensor Readings Evolution
REQ-EMMON-1550 – Propagation Model Interface	REQ-EMMON-CC-0130 – Node Graphical Representation
REQ-EMMON-1560 – Generic Alarm Interface	REQ-EMMON-CC-1510 – Generic Alarm Interface
REQ-EMMON-2010 – Data Correctness	-
REQ-EMMON-2020 – Identification of Elements of Interest on the C&C	REQ-EMMON-CC-0160 – Identification of Elements of Interest
REQ-EMMON-2030 – Selection of Elements of Interest Using Layers on the C&C	REQ-EMMON-CC-0170 – Selection of Elements of Interest Using Layers
REQ-EMMON-2040 – Set Endangerment Level	REQ-EMMON-CC-0180 – Set Endangerment Level
REQ-EMMON-2050 – Automatic Evaluation Of Sensor Readings	REQ-EMMON-CC-0190 – Automatic Evaluation Of Sensor Readings
	REQ-EMMON-CC-0195 – Configurable Frequency of Sensor Readings
REQ-EMMON-3020 – Sensor Connectivity Verification	REQ-EMMON-CC-0380 – Nodes Grouping
REQ-EMMON-3510 – Event Propagation Model Technical Manual	REQ-EMMON-CC-3510 – Event Propagation Model Technical Manual
REQ-EMMON-3520 – Event Propagation Model User Manual	REQ-EMMON-CC-3520 – Event Propagation Model User Manual
REQ-EMMON-4010 – Access to the Graphical User Interface	REQ-EMMON-CC-4010 – Access Restrictions to the Graphical User Interface
	REQ-EMMON-CC-4020 – Access System for the Graphical User Interface
REQ-EMMON-4020 – Access to Historical and Real-Time Data	REQ-EMMON-CC-4030 – Access Restrictions to the Historical and Real-Time Data
REQ-EMMON-4030 – C&C Secure Data Transmission	REQ-EMMON-CC-4040 – Secure Data Transmission
REQ-EMMON-4040 – C&C Access Restrictions	REQ-EMMON-CC-4050 – Access to Validation of Reported Potentially Invalid Readings

End-User Requirements	C&C/PDA Software Requirements
	REQ-EMMON-CC-4060 – Access to Manual Data Correction
	REQ-EMMON-CC-4070 – Access to Sensors' Operating Parameters Setup
	REQ-EMMON-CC-4080 – Access to Disablement of Alarm Notifications
REQ-EMMON-4510 – Event Propagation Model Portability	REQ-EMMON-CC-4510 – Event Propagation Model Portability
REQ-EMMON-5010 – Event Propagation Model Integrity	REQ-EMMON-CC-5010 – Event Propagation Model Integrity
REQ-EMMON-5020 – Event Propagation Model Availability	REQ-EMMON-CC-5020 – Event Propagation Model Availability
REQ-EMMON-6010 – Over the Air Programming/Configuring Through the C&C module	REQ-EMMON-CC-6010 – Over the Air Programming/Configuring
	REQ-EMMON-CC-6020 – Remote Maintenance
REQ-EMMON-6020 – Remote Maintenance	REQ-EMMON-CC-4090 – Access to Remote Maintenance
-	REQ-EMMON-CC-4520 – Operating System Support
-	REQ-EMMON-CC-5510 – C&C Reliability
REQ-EMMON-0210 – PDA Services	REQ-EMMON-PDA-0010 – Map Sensors' Positions on the PDA
	REQ-EMMON-PDA-0020 – Supervision of Operating Conditions Through the PDA
	REQ-EMMON-PDA-0030 – Installation and Maintenance Instructions on the PDA
	REQ-EMMON-PDA-0040 – Field Sensor Configuring Through the PDA
REQ-EMMON-0220 – Firmware Upgrade through the PDA module	REQ-EMMON-PDA-0050 – Firmware Upgrade Through the PDA
REQ-EMMON-0230 – Local Monitoring	REQ-EMMON-PDA-0060 – Local Monitoring Through the PDA
REQ-EMMON-0240 – Alert Regional PDA	REQ-EMMON-PDA-0070 – Alert Regional PDA
REQ-EMMON-1590 – Visualization of Node Status	REQ-EMMON-PDA-0080 – Visualization of Nodes Status in the PDA
REQ-EMMON-1600 – Local Search, Selection and Geographical Visualization	REQ-EMMON-PDA-0090 – Local Search, Selection and Geographical Visualization in the PDA
REQ-EMMON-2130 – Identification of Elements of Interest on the PDA	REQ-EMMON-PDA-2010 – Identification of Elements of Interest on the PDA
REQ-EMMON-2140 – Selection of Elements of Interest Using Layers on the PDA	-
REQ-EMMON-3030 – Sensor Connectivity Verification	REQ-EMMON-PDA-0100 – Sensor Connectivity Verification on the PDA
REQ-EMMON-4080 – PDA Access Restriction	REQ-EMMON-PDA-4110 – PDA Access Restrictions
	REQ-EMMON-PDA-4120 – System Configuration Through the PDA
	REQ-EMMON-PDA-4130 – Access System for the PDA's Graphical User Interface
	REQ-EMMON-PDA-4140 – Access to Field Sensor Node Configuring Through the PDA
REQ-EMMON-6040 – Remote Maintenance	REQ-EMMON-PDA-6030 – PDA Remote Maintenance
-	REQ-EMMON-PDA-1510 – Middleware Interface
-	REQ-EMMON-PDA-3510 – PDA User Manual
-	REQ-EMMON-PDA-4510 – PDA Operating System Support

Table 4 – Traceability matrix

Annex
B

Annex B. Traceability Matrix C&C and PDA Software Requirements Vs End-User Requirements

Table 4 presents the traceability matrix between the C&C and PDA software requirements and the end-user requirements.

C&C/PDA Software Requirements	End-User Requirements
REQ-EMMON-CC-0010 – Real-Time Data	REQ-EMMON-0010 - Historical and Real-time Data
REQ-EMMON-CC-0020 – Validation of Sensor Readings	REQ-EMMON-0020 - Validation of Sensor Readings
REQ-EMMON-CC-0025 – Configurable Sensor Readings' Ranges	REQ-EMMON-0020 - Validation of Sensor Readings
REQ-EMMON-CC-0030 - Report Potential Malfunctions	REQ-EMMON-0030 - Report Potential Malfunctions
REQ-EMMON-CC-0040 - Validation of Reported Potentially Invalid Readings	REQ-EMMON-0040 - Validation of Reported Potentially Invalid Readings
REQ-EMMON-CC-0050 - Manual Data Correction	REQ-EMMON-0050 – Manual Data Correction
REQ-EMMON-CC-0060 – Notification of Manually Corrected Data	REQ-EMMON-0050 – Manual Data Correction
REQ-EMMON-CC-0070 – Sensor Data Set For Raw Data	REQ-EMMON-0110 – Sensor Data Sets
REQ-EMMON-CC-0080 – Sensor Data Set For Data Aggregation	REQ-EMMON-0110 – Sensor Data Sets
REQ-EMMON-CC-0085 – Calculation of Estimated Situation	REQ-EMMON-0110 – Sensor Data Sets
REQ-EMMON-CC-0090 – GIS Environment	REQ-EMMON-0120 – C&C Services
REQ-EMMON-CC-0100 – Operational Condition	REQ-EMMON-0120 – C&C Services
REQ-EMMON-CC-0110 – Temporal Search For Data And Events	REQ-EMMON-0120 – C&C Services
REQ-EMMON-CC-0120 – Search, Selection And Geographical Visualization	REQ-EMMON-1510 – Graphical User Interface
REQ-EMMON-CC-0130 – Node Graphical Representation	REQ-EMMON-1510 – Graphical User Interface
REQ-EMMON-CC-0130 – Node Graphical Representation	REQ-EMMON-1550 – Propagation Model Interface
REQ-EMMON-CC-0140 – Interactive Display of Sensor Readings	REQ-EMMON-1520 – Interactive Display of Sensor Readings
- c	REQ-EMMON-2010 – Data Correctness
REQ-EMMON-CC-0160 – Identification of Elements of Interest	REQ-EMMON-2020 – Identification of Elements of Interest on the C&C
REQ-EMMON-CC-0170 – Selection of Elements of Interest Using Layers	REQ-EMMON-2030 – Selection of Elements of Interest Using Layers on the C&C
REQ-EMMON-CC-0180 – Set Endangerment Level	REQ-EMMON-2040 – Set Endangerment Level
REQ-EMMON-CC-0190 – Automatic Evaluation Of Sensor Readings	REQ-EMMON-2050 – Automatic Evaluation Of Sensor Readings
REQ-EMMON-CC-0195 – Configurable Frequency of Sensor Readings	REQ-EMMON-2050 – Automatic Evaluation Of Sensor Readings
REQ-EMMON-CC-0200 – Historical Data	REQ-EMMON-0010 - Historical and Real-time Data
REQ-EMMON-CC-0205 – Historical Data Log Length	REQ-EMMON-0010 - Historical and Real-time Data
REQ-EMMON-CC-0210 – Stored Data	REQ-EMMON-0010 - Historical and Real-time Data

C&C/PDA Software Requirements	End-User Requirements
REQ-EMMON-CC-0220 – Historical, Present and Future Comparative Diagrams	REQ-EMMON-1540 – Historical, Present and Future Comparative Diagrams
REQ-EMMON-CC-0230 – Event Propagation Model	REQ-EMMON-0160 – Event Propagation Model
REQ-EMMON-CC-0240 – Visual Sensor Readings Evolution	REQ-EMMON-1540 – Historical, Present and Future Comparative Diagrams
REQ-EMMON-CC-0250 – User Accounts Management	REQ-EMMON-0090 – User Accounts
REQ-EMMON-CC-0260 – User Accounts Properties	REQ-EMMON-0090 – User Accounts
REQ-EMMON-CC-0270 – User Accounts	REQ-EMMON-0090 – User Accounts
REQ-EMMON-CC-0300 – Group Account	REQ-EMMON-0100 – Group Accounts
REQ-EMMON-CC-0300 – Group Account Management	REQ-EMMON-0100 – Group Accounts
REQ-EMMON-CC-0300 – Group Account Properties	REQ-EMMON-0100 – Group Accounts
REQ-EMMON-CC-0305 – Group Access Control	REQ-EMMON-0100 – Group Accounts
REQ-EMMON-CC-0310 - Customizable Information On Demand	REQ-EMMON-0140 – Customizable Information On Demand
REQ-EMMON-CC-0310 - Group Access Permissions	REQ-EMMON-0110 – Sensor Data Sets
REQ-EMMON-CC-0320 – Nodes Management	REQ-EMMON-0120 – C&C Services
REQ-EMMON-CC-0330 – Nodes Creation	REQ-EMMON-0120 – C&C Services
REQ-EMMON-CC-0340 – Nodes Loading	REQ-EMMON-0120 – C&C Services
REQ-EMMON-CC-0350 - Node Enabling and Disabling	REQ-EMMON-0080 – Node Enabling and Disabling
REQ-EMMON-CC-0360 – Setup Sensors' Operating Parameters	REQ-EMMON-0120 – C&C Services
REQ-EMMON-CC-0370 – Schedule Maintenance Activities	REQ-EMMON-0120 – C&C Services
REQ-EMMON-CC-0380 – Nodes Grouping	REQ-EMMON-3020 – Sensor Connectivity Verification
REQ-EMMON-CC-0390 – Configurable Alarm Thresholds	REQ-EMMON-0060 - Configurable Alarm Thresholds
REQ-EMMON-CC-0400 – Thresholds Properties	REQ-EMMON-0060 - Configurable Alarm Thresholds
REQ-EMMON-CC-0410 – Definition of Endangerment Levels	REQ-EMMON-0070 - Endangerment Levels
REQ-EMMON-CC-0420 – Configuration of Endangerment Levels	REQ-EMMON-0070 - Endangerment Levels
REQ-EMMON-CC-0430 – Inform Authorities	REQ-EMMON-0130 – Inform Authorities
REQ-EMMON-CC-0440 – Email Properties	REQ-EMMON-0130 – Inform Authorities
REQ-EMMON-CC-0450 – SMS Properties	REQ-EMMON-0130 – Inform Authorities
REQ-EMMON-CC-0460 – Alert Conditions	REQ-EMMON-0150 – Alert Conditions
REQ-EMMON-CC-0470 – Visual Alarm Notification	REQ-EMMON-1530 – Alarm User Interface
REQ-EMMON-CC-0480 – Geographical Visualization of Alert Areas	REQ-EMMON-1530 – Alarm User Interface
REQ-EMMON-CC-0490 – Disable Alarm Notification	REQ-EMMON-1535 - Disable Alarm Notification
REQ-EMMON-CC-1010 – Maximum Sensor Reading Delay	REQ-EMMON-1010 – Maximum Sensor Reading Delay
REQ-EMMON-CC-1020 – Information Update Frequency	REQ-EMMON-1020 – Information Update Frequency
REQ-EMMON-CC-1510 – Generic Alarm Interface	REQ-EMMON-1560 – Generic Alarm Interface
REQ-EMMON-CC-1510 – Middleware Interface	REQ-EMMON-0110 – Sensor Data Sets
REQ-EMMON-CC-1520 – Sensor interface	REQ-EMMON-0160 – Event Propagation Model
REQ-EMMON-CC-2010 – Multi-language	REQ-EMMON-1510 – Graphical User Interface
REQ-EMMON-CC-3510 – Event Propagation Model Technical Manual	REQ-EMMON-3510 – Event Propagation Model Technical Manual

C&C/PDA Software Requirements	End-User Requirements
REQ-EMMON-CC-3520 – Event Propagation Model User Manual	REQ-EMMON-3520 – Event Propagation Model User Manual
REQ-EMMON-CC-4010 – Access Restrictions to the Graphical User Interface	REQ-EMMON-4010 – Access to the Graphical User Interface
REQ-EMMON-CC-4020 – Access System for the Graphical User Interface	REQ-EMMON-4010 – Access to the Graphical User Interface
REQ-EMMON-CC-4030 – Access Restrictions to the Historical and Real-Time Data	REQ-EMMON-4020 – Access to Historical and Real-Time Data
REQ-EMMON-CC-4040 – Secure Data Transmission	REQ-EMMON-4030 – C&C Secure Data Transmission
REQ-EMMON-CC-4050 – Access to Validation of Reported Potentially Invalid Readings	REQ-EMMON-4040 – C&C Access Restrictions
REQ-EMMON-CC-4060 – Access to Manual Data Correction	REQ-EMMON-4040 – C&C Access Restrictions
REQ-EMMON-CC-4070 – Access to Sensors' Operating Parameters Setup	REQ-EMMON-4040 – C&C Access Restrictions
REQ-EMMON-CC-4080 – Access to Disablement of Alarm Notifications	REQ-EMMON-4040 – C&C Access Restrictions
REQ-EMMON-CC-4090 – Access to Remote Maintenance	REQ-EMMON-6020 – Remote Maintenance
REQ-EMMON-CC-4510 – Event Propagation Model Portability	REQ-EMMON-4510 – Event Propagation Model Portability
REQ-EMMON-CC-4520 – Operating System Support	-
REQ-EMMON-CC-5010 – Event Propagation Model Integrity	REQ-EMMON-5010 – Event Propagation Model Integrity
REQ-EMMON-CC-5020 – Event Propagation Model Availability	REQ-EMMON-5020 – Event Propagation Model Availability
REQ-EMMON-CC-5510 – C&C Reliability	-
REQ-EMMON-CC-6010 – Over the Air Programming/Configuring	REQ-EMMON-6010 – Over the Air Programming/Configuring Through the C&C module
REQ-EMMON-CC-6020 – Remote Maintenance	REQ-EMMON-6010 – Over the Air Programming/Configuring Through the C&C module
REQ-EMMON-PDA-0010 – Map Sensors' Positions on the PDA	REQ-EMMON-0210 – PDA Services
REQ-EMMON-PDA-0020 – Supervision of Operating Conditions Through the PDA	REQ-EMMON-0210 – PDA Services
REQ-EMMON-PDA-0030 – Installation and Maintenance Instructions on the PDA	REQ-EMMON-0210 – PDA Services
REQ-EMMON-PDA-0040 – Field Sensor Configuring Through the PDA	REQ-EMMON-0210 – PDA Services
REQ-EMMON-PDA-0050 – Firmware Upgrade Through the PDA	REQ-EMMON-0220 – Firmware Upgrade through the PDA module
REQ-EMMON-PDA-0060 – Local Monitoring Through the PDA	REQ-EMMON-0230 – Local Monitoring
REQ-EMMON-PDA-0070 – Alert Regional PDA	REQ-EMMON-0240 – Alert Regional PDA
REQ-EMMON-PDA-0080 – Visualization of Nodes Status in the PDA	REQ-EMMON-1590 – Visualization of Node Status
REQ-EMMON-PDA-0090 – Local Search, Selection and Geographical Visualization in the PDA	REQ-EMMON-1600 – Local Search, Selection and Geographical Visualization
REQ-EMMON-PDA-0100 – Sensor Connectivity Verification on the PDA	REQ-EMMON-3030 – Sensor Connectivity Verification
-	REQ-EMMON-2140 – Selection of Elements of Interest Using Layers on the PDA

Table 5 – Traceability matrix