Road-, Air- and Water-based Future Internet Experimentation

Project Acronym:	RAWFIE		
Contract Number:	645220		
Starting date:	Jan 1st 2015	**Ending date:**	Dec 31st, 2018

Deliverable Number and Title	D3.3 - Specification & Analysis of RAWFIE Components Requirements (c)		
Confidentiality	PU	**Deliverable type[1]**	R
Deliverable File	RAWFIE_D_3_3	**Date**	2017-03-10
Approval Status[2]	WP leader	**Version**	1.000
Contact Person	Nikolaos Pringouris	**Organization**	HAI
Phone	+30 22620 46572	**E-Mail**	PRIGGOURIS.Nikolaos@haicorp.com

---

[1] Deliverable type: P(Prototype), R (Report), O (Other)
[2] Approval Status: WP leader, 1st Reviewer, 2nd Reviewer, Advisory Board

AUTHORS TABLE

Name	Company	E-Mail
Nikolaos Pringouris	HAI	PRIGGOURIS.Nikolaos@haicorp.com
Vasil Kumanov	Epsilon Bulgaria	Vasil.kumanov@epsilon-bulgaria.com
Kostas Kolomvatsos	UOA	kostasks@di.uoa.gr
Marcel Heckel	FRAUNHOFER	marcel.heckel@ivi.fraunhofer.de
Jason Ramapuram	HESSO	jason-emmanuel.ramapuram@hesge.ch
Lionel Blonde	HESSO	lionel.blonde@hesge.ch
Miltiadis Kyriakakos	UOA	miltos@di.uoa.gr
Phillippe Dallemagne	CSEM	pda@csem.ch
Giovanni Tusa	IES	g.tusa@iessolutions.eu
Kiriakos Georgouleas	HAI	GEORGOULEAS.Kiriakos@haicorp.com
Marc Bonazountas	AVIONTEK	marc.bonazountas@aviontek.com
Joerg Schaller	AVIONTEK	joerg.schaller@aviontek.com

REVIEWERS TABLE

Name	Company	E-Mail
Sotirios Glykofrydis	HMOD	sglikofridis@dideap.mil.gr
Amandine Vole	SAFE CLUSTER	amandine.vole@safecluster.com
Elena Krikigianni	AVIONTEK	Krikigia@hotmail.com

DISTRIBUTION

Name / Role	Company	Level of confidentiality[3]	Type of deliverable
All		PU	R

CHANGE HISTORY

---

[3] Deliverable Distribution: PU (Public, can be distributed to everyone), CO (Confidential, for use by consortium members only), RE (Restricted, available to a group specified by the Project Advisory Board).

Version	Date	Reason for Change	Pages/Sections Affected
0.001	2017-01-20	First Document Issue with Introduction & ToC.	All
0.002	2017-02-09	Integrated contribution/updates in chapter 5	Section 5
0.003	2017-02-15	Integrated additional contribution/updates in chapter 5	Section 5
0.004	2017-02-20	Added UxV interface category subsection. UxV generic and node requirements updated	Section 5
0.005	2017-02-21	Updated section 4.1 related to "man in the loop". Updated requirements and text in section 5.3	Section 4, Section 5.3
0.006	2017-02-22	Updated/added requirements related to Aggregate Manager	Section 5.2
0.007	2017-02-24	Updates requirements of certain modules	Sections 5.1.12, 5.2.3, 5.3.3
0.008	2017-02-26	Added mapping between risks and SW requirements	Section 6
0.009	2017-03-06	1st version issued for internal review	Sections 3.1, 5.2, 5.4, 6
1.000	2017-03-09	Final version incorporating internal review comments	All

Abstract:
This deliverable comprises the 3nd version of the RAWFIE Components requirements. Based on the grounds of the 2nd version and by utilizing information regarding the architecture and detailed design elaborated during the 2nd iteration of the project it attempts to refine the list of requirements defined in the previous version of the Requirements document and identify any missing ones.

Version 2 of the Requirements Analysis elaborated and classified requirements following the RAWFIE component breakdown structure prescribed by the RAWFIE Architecture. Therefore, requirements were defined on a more detailed level (system & detailed level) compared to version 1. The methodology used was based on the VOLERE like card template agreed in the 1st version. A similar approach is used and in the present document starting from the point that D3.2 concluded.

In keeping with the overall project workflow, the requirements captured and synthesized here will be provided as input to WP4 – Platform Design for the 3nd development cycle.

While the use cases/scenarios defined in the previous versions of the Requirements document remain valid the present version attempts to go one step further and identify a list of features that could be available to platform oncoming experimenters.

A traceability matrix is also provided allowing the user to track and navigate between the requirements defined in each iteration.

Keywords: requirements, scenario, experiment, constraints standards & regulations, functional & non-functional

Part II: Table of Contents

List of Figures

List of Tables

Part III: Executive Summary

The deliverable provides a deep look at the requirements and needs of the RAWFIE system. It attempts a more elaborated analysis and allocation of requirements to certain components based on experience gained and feedback provided during the 2nd iteration cycle. RAWFIE deliverables D4.4 (High Level Design and Specification of RAWFIE Architecture [4]) and D4.5 (Design & Specification of RAWFIE Components [5]) were used as input as well as the experience obtained during the implementation and validation activities in the 2nd year of the project.

The results of the work on the Risks Analysis and Prevention Plan from D1.1(b), are also taken into account for this new iteration of the platform requirements. To this end, mitigation strategies corresponding to technical / technological risks have been translated in the corresponding software requirements, where needed.

Finally, the use of the Slice Federated Architecture (**SFA**), considered mandatory for FIRE related projects was also taken into account during the requirement analysis.

The present document is the third in a series of three requirements analysis documents each one to be delivered in the beginning of each RAWFIE iteration cycle (see [1] 1.3.2. WT2 list of deliverables, page 93) . In order to avoid replication of information, detailed information about requirements that are still valid from deliverable D3.2 ([3]) was not included in chapter 5. However, the reader could refer to Table 5 which provides traceability with the requirements of the previous iteration(s).

Part IV: Main Section

1   Introduction

1.1   Scope of Deliverable

The purpose of this document, "D3.3 **Specification & Analysis of RAWFIE Components Requirements**", is to review/recheck requirements, possibly identifying missing ones, that were assigned to the various components of the RAWFIE architecture. The present document is the last deliverable in a series of three that will all focus on incrementally identifying requirements for the various RAWFIE components. All version 2 requirements (component and system level) will be reviewed based on the feedback provided mainly by WP4, WP5.

This document structure has as follows:

- Chapter 2 briefly restates the methodology adopted, the general formalizations followed and the changes (if any) to the templates used.
- Chapter 3 presents any updates, additions to the list of use/cases defined in the previous iterations. A chapter's subsection attempts to compile a list of features that could be available for future experimenters when the RAWFIE platform goes live.
- Chapter 4 addresses issues that should be considered during the operation of certain testbeds with special emphasis on UAV testbeds and the "pilot in the loop" concept imposed by applicable regulations.
- Chapter 5 presents the result of requirement analysis performed in the third iteration. It records down the RAWFIE detail level requirements both functional and non-functional, following an appropriate categorization based on the defined components. In order to avoid replication of information from previous deliverables only newly defined requirements are listed as well as requirements that have changed or augmented.
- Chapter 6 presents a traceability table highlighting the links between the risks identified in D1.1(b) (and related attachments), the corresponding mitigation strategies, and the derived (or anyway related) software requirements
- Chapter 7 provides a traceability matrix between the requirements defined in the various requirements deliverables (1st, 2nd, 3rd iteration)
- Chapter 8 provides a summary of the work performed in the present deliverable and a conclusion/assessment of the requirement analysis process performed in the RAWFIE project

1.2   Abbreviations

Please also refer to online list of abbreviations located in [36]. For the terminology used within this document and throughout RAWFIE in general see [35]

Abbreviation	Meaning
AAI	Authentication and Authorization Infrastructure
AHRS	Attitude and Heading Reference System

AGL	Above Ground Level
AP	Access Point
AT	Aerial Testbed
AUV	Autonomous Underwater Vehicle
B-VLOS	Beyond Visual Line Of Sight
CAA	Civil Aviation Authority
CAO	Cognitive-based Adaptive Optimization
CBNR	Chemical Biological Nuclear Radiological
CEP	Circular Error Probability
CPU	Central Processing Unit
CRS	Coordinate Reference System
CRUD	CREATE, READ, UPDATE, DELETE
DETEC	Department of the Environment, Transport, Energy and Communication
DGCA	Directorate General of Civil Aviation
DoA	Description of Activities
DoW	Description of Work (synonym to DoA)
EASA	European Aviation Safety Agency
ECC	Error Correction Code
EDL	Experiment Description Language
EU	European Union
E-VLOS	Extended Visual Line Of Sight
FIRE	Future Internet Research & Experimentation
FOCA	Federal Office of Civil Aviation
FPS	Frames Per Second
FPV	First Person View
GAA	German Aviation Act
GIS	Geographical Information System
GNSS	Global Navigation Satellite System
GPIO	General Purpose Input/Output
GPS	Global Positioning System
HD	High Definition
HW	Hardware
IAA	Irish Aviation Authority
IaaS	Infrastructure as a Service
IFR	Instrument Flight Rules
IDE	Integrated Development Environment
IP	Internet Protocol
ISO	International Standards Organization
JSON	JavaScript Object Notation
KPI	Key Performance Indicators
LBL	Long Baseline
MEMS	MicroElectroMechanical System
MM	Monitoring Manager
MSO	Multi Swarm Optimization
MT	Maritime Testbed
MTOM	Maximum Take-Off Mass
NF	Non Functional
OEDL	OMF EDL
OMF	Control and Management Framework

OS	Operating System
OTA	Over The Air
P2P	Point to Point
PSO	Particle Swarm Optimization
PTZ	Pan Tilt Zoom
QoS	Quality of Service
RC	Radio Controller
RE	Requirement Engineering
RIA	Research and Innovation Action
ROS	Robot Operating System
ROV	Remotely Operated Vehicle
RPA	Remotely Piloted Aircraft
RPAS	Remotely Piloted Aircraft System
RPS	Remotely Piloted Station
SaaS	Software as a Service
SFA	Slice Federated Architecture
SQL	Simple Query Language
SRID	Spatial Reference System Identifier
SVM	Support Vector Machine
TM	Testbed Manager
TMS	Testbed Manager Suite
TP	Testbed Proxy
UAS	Unmanned Aerial System
UAV	Unmanned Aerial Vehicle
UGV	Unmanned Ground Vehicle
UI	User Interface
USB	Universal Serial Bus
USV	Unmanned Surface Vehicle
UxV	Unmanned System (of any type)
VFR	Visual Flight Rules
VLL	Very Low Level flight, below 150m above ground level
VLOS	Visual Line of Sight
VT	Vehicular Testbed
XML	Extensible Markup Language
WYSIWYG	What You See Is What You Get

Table 1: Abbreviations

2 Methodology

2.1 General

The methodology adopted has been described in the first version of the deliverable, thus it will not be analysed in details again. The approach is incremental in nature and iterative utilizing feedback from subsequent phases of the system design lifecycle (see Figure 1). VOLERE template cards (similar to the ones used in iteration 2) are used for presenting detailed information for each requirement.
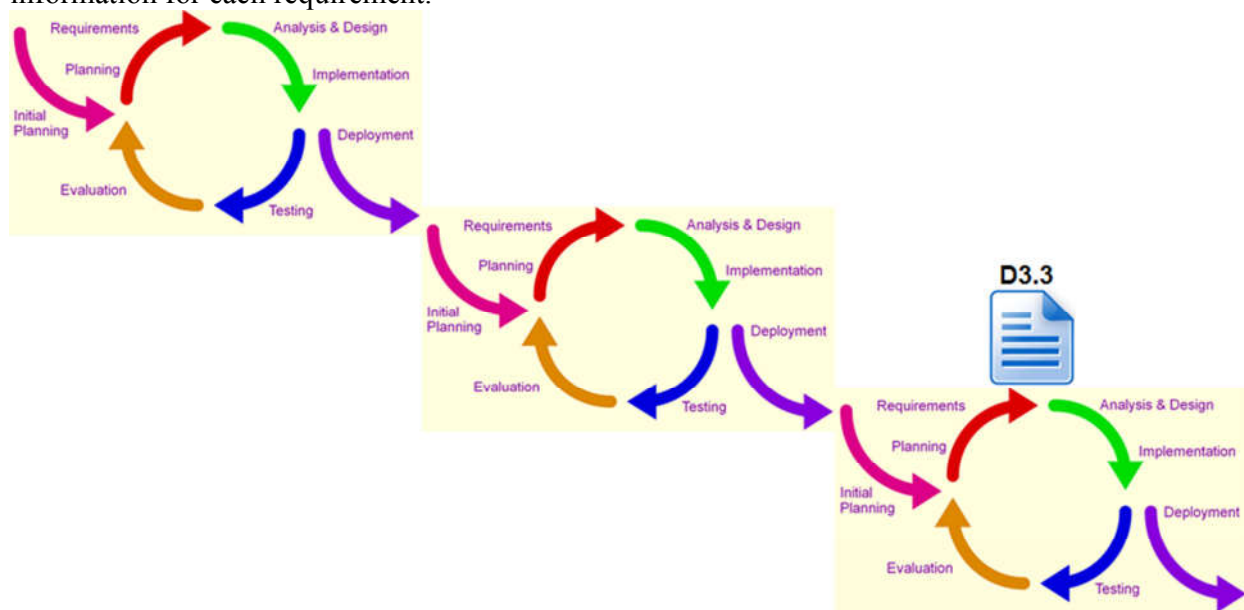
Figure 1: RAWFIE iterative development process (3rd cycle)

The requirements process is comprised of four (4) main activities: requirements discovery, classification, prioritization and negotiation. During classification of requirements, coherency among requirements is achieved by organizing them according to the identified classification categories. Subsequently, prioritization and negotiation of requirements assists in identifying and resolving requirements conflicts.

The list of requirements types remain intact as defined in previous versions of the deliverable while the list of components and subsystems has some modifications (see Table 2 below and corresponding footnotes).

Subsystem	ClassId	Component	Component ClassId
General	**GEN**		
Platform	**PT**	General	**PT-GEN-R**
		Web Portal	**PT-WEB-P**
		Wiki Tool[4]	**PT-WIK-P**

---

[4] Wiki Tool separated from Web Portal

		Booking Tool	**PT-BOK-T**
		System Monitoring Tool	**PT-SYM-T**
		Resource Explorer Tool	**PT-REE-T**
		Experiment Authoring Tool	**PT-EXA-T**
		Experiment Monitoring Tool	**PT-EXM-T**
		UxV Navigation Tool	**PT-NAV-T**
		Visualisation Tool	**PT-VIS-T**
		Data Analysis Tool	**PT-DAA-T**
		Testbeds Directory Service	**PT-DIR-S**
		EDL Compiler and Validator	**PT-CPV-S**
		Experiment Validation Service	**PT-EXV-S**
		Users & Rights Service	**PT-USR-S**
		Booking Service	**PT-BOK-S**
		Launching Service	**PT-LAU-S**
		Visualisation Engine	**PT-VIS-S**
		Experiment Controller	**PT-EXP-C**
		Data Analysis Engine	**PT-DAA-S**
		System Monitoring Service	**PT-SYM-S**
		Accounting Service	**PT-ACC-S**
Testbed	**TB**	General	**TB-GEN-R**
		Monitoring Manager	**TB-MOM**
		Network Controller	**TB-NEC**
		Resource Controller	**TB-REC**
		~~Testbed Proxy~~[5]	~~**TB-PRX**~~
		Aggregate Manager[6]	**TB-AGG**
		Testbed Manager	**TB-MAN**

---

[5] Component removed as obsolete since its pursued functionality is already "in place" due to the use of appropriate Message Bus technology
[6] New component defined to comply with SFA standard

		General	**UXV-GEN**
UxV	**UXV**	UxV Node	**UXV-NOD**
		UxV Proximity[7]	**UXV PRX**
		UxV Network and Communication	**UXV-NET**
		UxV Sensor and Localisation	**UXV-SEN**
		UxV On-board storage	**UXV-STO**
		UxV On-board processing	**UXV-PRC**
		UxV Management	**UXV-MGT**

Table 2 List of subsystems and components

2.2 Definitions

To enable better formalization of requirements throughout this document, the following wording is encouraged to be used during definition of requirements:

"Shall" statements are binding requirements. They describe something that is mandatory. If a requirement uses "shall", then that requirement must be satisfied without fail. Non-compliance is not allowed. Failure to comply with one single 'shall' is sufficient reason to reject the entire product

"Should" is weaker. It can be regarded as a non-mandatory provision. It describes something that might not be satisfied in the final product, but that is desirable enough that any non-compliance shall be *explicitly* justified. Any use of "should" has be examined carefully, as it probably means that something is not stated clearly. If a "should" can be replaced by a "shall" or can be discarded entirely, so much the better.

 "May" statements are also non-mandatory provisions. It grants permission to do something, and makes only a weak statement. It does not mean that it is possible to do it, only that you have permission to do it. In a user requirements document it shall only appear rarely, if ever. It is more appropriate to the detailed design where it could be used to define the behaviour of the product.

"Will" statements are non-mandatory, either they imply intent on design constraints or future tense.

---

[7] New component defined to enhance safety in scenarios involving multi UxVs (mainly UAVs)

3 User Scenarios

In the previous version of the deliverable six main scenarios were defined and used as a starting point to identify the user level and overall system level requirements. These scenarios included:

- Scenario 1 – Environmental Monitoring of Water Canal
- Scenario 2 – Border Surveillance or Perimeter protection of large area
- Scenario 3 – On demand deployable Internet facilities
- Scenario 4 – Exploration & Assessment of Network Technologies Robustness
- Scenario 5 – Efficient Coordination for phenomena or mission coverage
- Scenario 6 – Over the Air (OTA) UxV Re-programming
- Scenario 7 – Gathering Information for Naval Search and Rescue (SAR) Operations
- Scenario 8 – Mobilize resources and gather sensor data (1st year review scenario)

The list of scenarios remains unchanged based on what was defined in the previous iterations. However in the present deliverable, in order to make more evident the testing capabilities that RAWFIE FIRE platform could offer, a list of test features that RAWFIE platform may offer to potential experimenters was compiled. This list – that is also based on feedback from the open calls – is presented in the section that follows.

3.1 List of experimenter features offered by RAWFIE Platform

The section briefly presents an unnumbered list of possible capabilities that can be available to a RAWFIE platform experimenter. In order to facilitate reading, the capabilities were classified in certain categories. This list of features should be considered as a wish to support list. The suggested features may not be available in their entirety in the initial version of the platform but the majority of them should be supported by the end of the project.

Navigation related
- Test execution of goto commands and monitor corresponding adherence or deviations to the expected route.
- Test movement based on predefined patterns
- Test movement based on predefined loaded algorithms (motion planning, mapping coverage)
- Test movement and behavior triggered by events (sensor related etc.)
- Recording of route for offline data analysis
- Test overall UxV kinematic (motion) behavior (i.e,. flight dynamics)
- Test distant remote navigation and responsiveness of a UxV device

Platform is expected to offer near-real time visualization of the UxVs movements to an experimenter

Sensor related features

- Test Remote Activation/de-activation of sensors (manually, based on predefined mission plan or triggered by certain event)
- Test various characteristics related to video monitoring (live streaming)
- Test various characteristics related image capture
- Allow environmental data acquisition, depending on onboard installed sensors (humidity, temperature etc.)
- Time-stamping of sensor measurements (for subsequent correlation or comparison)

Mission related
- Test scheduling algorithms (single or multiple devices)
- Test (re)programming of devices during mission (i.e. task planning)
- Movement outlier detection (see also Data Analysis related features)
- Test resource usage (i.e. battery consumption) and the behavior of optimization algorithms
- Test localization algorithms
- Test spatial coverage algorithms
- Test and analyze collaboration/swarm algorithms (involving the same or different types of UxVs)
- Test search pattern optimization algorithms
- Test obstacle detection and avoidance algorithms
- Test geo-fencing behavior
- Test group control & decision support algorithms

Network/Communication related
Depending on available on board network interfaces the following may be supported:
- network robustness related experiments
- network coverage related experiments
- network latency related experiments
- network throughput related experiments
- testing (benchmarking) of routing algorithms and/or communication protocols
- dynamic creation and testing of various mobile/wireless network topologies (ad hoc, mesh)
- Testing of (network) security solutions
- testing of switching between network technologies/interfaces
- channel QoS parameters monitoring

Data and statistics collected from these types of experiments (SNR, throughput, disconnections etc.) could be available for further offline analysis

Data Analysis related

Data analytics algorithms can apply to all data that have an associated schema tied to message bus (i.e. sensor recordings from UxVs, position, attitude data, or metrics coming from any entity on the platform). Such analytics can be performed either online or offline since certain algorithms have both an online and offline variant. The algorithms available through the helper classes provided in the Data Analysis Tool include:

- Outlier detection (online and offline)
- Clustering: streaming K-means[8] (online) and regular K-means (offline)
- Classification: linear Support Vector Machines (SVMs) and logistic regression[9]. Linear SVMs supports only binary classification, while logistic regression supports both binary and multi-class classification problems (offline).
- Dimensionality reduction[10] (offline)

---

[8] a classical unsupervised clustering algorithm that associates points to a cluster (out of K total clusters). It does this by modeling the cluster centroids and updating them as the system receives new data. Each new data point is associated with a centroid. . More info about online K-means can be found in [33] . Basic information on standard K-means can be obtained from [34]

[9] Logistic regression is a supervised learning algorithm that is utilized to do classification. SVM's are a slightly more advanced method (and when combined with kernels to make them non-linear) and are powerful methods that are useful in order to do binary (1/0) or multiclass (1 of K) classification

[10] Dimensionality reduction is an overarching field that involves reducing the dimensionality of some seen data. An example of this is PCA (principal component analysis) which does SVD on the covariance matrix. This can be utilized to downsample some data from say 100 dimensions to say 2 or 3 in order to visualize the dataset. It is also useful as a unsupervised method to reduce the size of the features to work with in other models that are computationally intensive

4 Testbed Operation issues

In general certain testbed operation issues apply. All testbeds sites may have special restrictions related to:

- Operational hours
- Security – Safety (i.e. monitoring, maintenance, remote pilot constrain for UAVs which is further elaborated in section 4.1, etc.)
- Number of supported devices
- A priori notification and approval of UxV usage
- Approval/Acceptance of certain UxV sensors usage (also related to security issues)

All the above may vary based on the testbed regional characteristics, the type of supported devices involved in an experiment but also depending on internal procedures that govern their operation. We have initially tackle this subject in the first issue of the requirements analysis document. Moreover, many of the testbed general requirements (TB-GEN-XXX) in section 5.2 have been defined bearing in mind that such restrictions may need to be considered for each testbed of the RAWFIE federation.

It must be noted that operational framework is even more restrictive for testbeds hosting UAV devices due to existing legal framework at national or European level imposed by the extra safety precautions and certification activities that autonomous aerial devices should adhere to. TB-GEN-R-011 requirement has been defined to draw attention to this and make evident that it is the responsibility of each testbed site to accurately inform RAWFIE platform about such restrictions that are in place.

4.1 "Human in the loop" concept

RAWFIE is considered an experimental platform for unmanned system. The initial concept of RAWFIE is to have experimental facilities hosting a large number of UxV devices and capable of running experiments that utilize these devices in a fully autonomous way. However for certain types of devices fully autonomous operation combined with concurrent usage of them may be not possible or subject to certain limitations including a "human in the loop" factor. In the present section we try to look more thoroughly to this issue, analyse its implications and compatibility with the RAWFIE concept and present the existing situation and where it applies. This section attempts to address a major comment of the 1st year review report stating:

"*The description of regulations applicable to UAVs does not mention the role of the pilot, which is highly constrained and may not be compatible with the RAWFIE concept. The next iteration of this deliverable must address "human in the loop" issues for all UxVs and explain how the RAWFIE concept provides a solution. The role of the pilot must be clarified*"

In the case of UAVs, the presence of a properly trained personnel acting as "remote pilot" generally is always required by national or international legislation and therefore RAWFIE can do nothing but comply with this constrain. In the previous version of the deliverable requirement TB-GEN-R-010 was defined stating that "Testbeds should be supported by on-site personnel". In

the present version the description of the requirement was augmented to explicitly state the need for trained remote pilot to support each experiment/UxV.

The "man in the loop" concept, especially if we consider the strict case requiring one person per UxV device, may "narrow" the initial vision of RAWFIE of having testbeds of different types of devices performing concurrently a large number of experiments or even few experiments with a large number of devices. However this limitation is applicable only for UAVs and is acceptable since it is largely related to safety issues. An additional important remark that must be made here is that since UxVs devices are expected to operate in fully autonomous mode during the majority of RAWFIE experiments, the trained personnel mentioned above should be considered more as a "safety/security supervisor", capable to timely intervene and take control of the devices(s) under certain circumstances, and less as a "remote pilot" steering the UxV device. It must also be noted that EU and national regulations regarding the use of UAVs for commercial and/or research activities is still an evolving and largely debated area that may considerable change in the near future. Finally it must be stated that usage of multiple UAV devices during RAWFIE experiments is not fully prohibited since each testbed (based on area/country of operation and providing that certain preconditions are met) may allow relaxing of the general rule 1 remote pilot per UAV device.

Below the rules that apply in France, Spain & Greece (the 3 countries that at present deploy or intent to deploy UAV testbed facilities) are summarized:

France

French regulation contains a set of default rules. These default rules specify that a pilot can only control one UAV at once and the pilot is not allowed to move during the flight excepting when the UAV is piloted from a boat and if the surrounding area is clear. These restrictions only concern Unnamed Aerial Vehicle and not UxV in general which are operated outside.

However, even if a specific use case (specific mission) is not directly allowed by the French regulation, there is a solution to execute it: to ask to the national regulator a specific authorization for a mission or a set of missions. This authorisation, called "Laissez-passer", is delivered in France by the Directorate General for Civil Aviation (DGAC) and is valid for one or several UAVs, on a specific location during a set of time.

Concerning the RAWFIE concept to have multiple experiments involving 2 or 3 UAVs, national regulator generally impose the following safety conditions related to the mission:

- airspaces must be segregated.
- the pilot must have the possibility to know the exact position of each UAV in real time and be able to keep them in line of sight as much as possible;
- UAVs must include failsafe which will be automatically activated if an UAV goes out the flight area;
- Pilot must be able to abort the mission or to activate an emergency landing for all the UAV's simultaneously if the mission integrity can't be guaranteed. The emergency command must be easily accessible from a remote command;
- Number of UAVs will be limited to 3 or 4 UAVs per pilot.

To conclude, at least one pilot is required per mission. The number of pilots will depend on the number of UAVs simultaneous in flight. Autonomous flights (not under the responsibility of a pilot) are not allowed, while automatic flights are permitted[11].

Even if the pilot does not interfere with UAVs during the mission, he must be present during all mission long and be able to abort the flight if one safety condition is not respected.

Spain

Generally 1 remote pilot per UAV is required. However, it may be possible to have only one UAV qualified pilot monitoring a squad of UAVs (3/4 maximum) – this is applicable only to research projects that are covered by a special treatment – but some special approvals before initiation of the UAV flight operations are required:

- The flights must be done in a special segregated airspace but additionally the Spanish Aviation Safety & Security Authority (Agencia Estatal de Seguridad Aérea – AESA) must be notified of this kind of special flight configuration prior the start.

- It is mandatory to file a complete report about technical characteristics of the UAVs

- It is mandatory to perform and submit to AESA a specific risk mitigation report, analyzing and evaluating the flight plan, tasks to be performed for the squad, operation range, altitude, etc.

- The owner of the UAVs must have a 3rd parties liability insurance

- Officially, the pilot in command must be qualified personnel of the testbed,. The experimenter is only a supervisor of the flight and the tasks to be performed by the UAV or UAVs squad.

- Due to the exceptional considerations required, the time to obtain the needed approvals is around 60 days, unlike the standard normal operation for one pilot monitoring one UAV, that can be resolved in our 5-10 days (1-2 weeks).

Greece

In Greece the legislation and context that governs the operation of UAVs was very recently defined (see [32]). Based on it a remote pilot is always needed during a UAV flight belonging to the UAS Open Category (systems with MTOM < 25 kg) while the flight should be VLOS within a maximum distance of 500m and a height less than 400 ft. In general, the pilot shall have obtained a UAV pilot certificate, after attending the appropriate course and training.

The owner of the UAVs must have a 3rd parties liability insurance and be registered in a special register of the Greek Civil Aviation Authority.

The legislation does not clearly prescribe whether a single remote pilot is allowed to control more than one UAV at the same time.

---

[11] The term automatic flight refers to the fact that some tasks are automated and can be performed without human intervention. However the presence of a remote pilot/supervisor is always required. Autonomous goes one step further suggesting that the device has intelligence, the power of self-governance and the ability to compensate for system failures without external intervention.

5 System & Component Requirements

The classification of requirements is based on information regarding the subsystems and components defined during the second iteration of architecture design. This information is presented in Table 2 and is also used within this section to provide appropriate sub-sectioning. Figure 2 provides an overview of the envisaged architecture components as defined in D4.4.
Compared to the previous version of the architecture that was used as reference in D3.2 the following major changes were introduced that affect the requirement analysis that will follow:

- Addition of Wiki Tool
- Discarding of Testbed Proxy component
- Explicit addition of SFA Aggregation Manager at the Testbed level
- Addition of a Local Database at the testbed level
- Addition of Proximity Component at testbed/UxV level

Only requirements that are new or modified ones are presented in the sections that follow. Requirements are defined based on the component they belong to. Requirements considered for implementation by multiple components are defined just once in a subsection and the involved components or subsystems are listed in the corresponding field of the requirement card. New requirements are defined with a version number 3 while modified ones retain a version number 2. Obsolete or discarded requirements are mentioned in the beginning of each section.
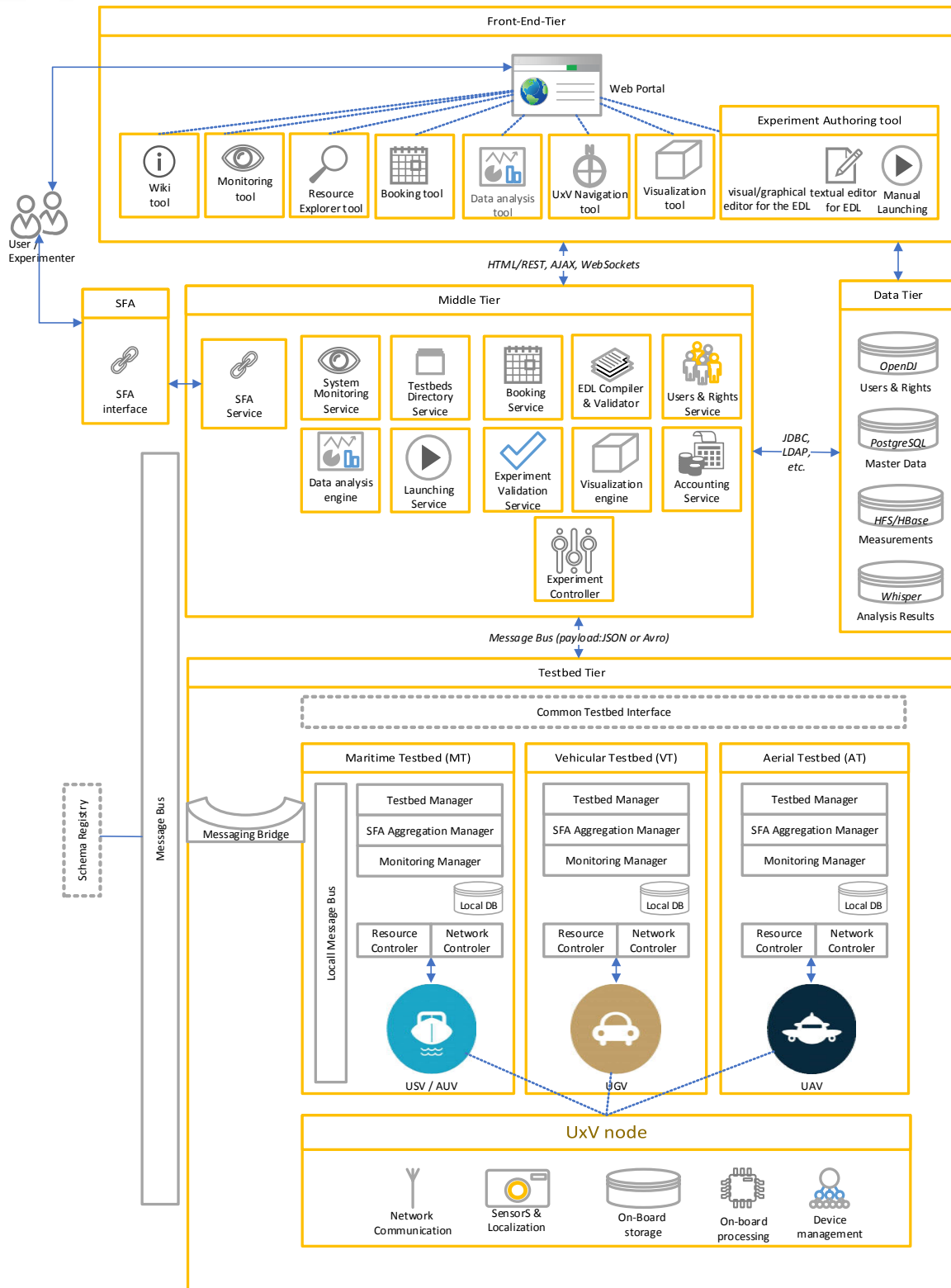
Figure 2: RAWFIE Overall Component Architecture (see also Error! Reference source not found.**,[1])**

5.1 Platform Requirements

The term Platform refers to the middleware solution responsible for managing and monitoring the lifecycle of an experiment in the context of the RAWFIE system.

5.1.1 General

- 1 requirement updated (PT-GEN-R-001) by adding reference to specific components
- 1 requirement is added (PT-GEN-R-005)
- All other version 2 requirements remain valid and intact.

Id:	PT-GEN-R-001	Type:	FUNC	Importance (priority):	HIGH	Source:	Iteration1 Exp	Ver:	2
Title:		RAWFIE Platform should adopt Sliced Federated Architecture (SFA)							
Description:		The RAWFIE Platform should be compatible with the overall SFA concept adopted in other FIRE projects. SFA prescribes a minimal interface to enable federation of testbeds with different technologies and belonging to different administrators.							
Additional Info (comments):		See also section 5.2.6 (SFA Aggregate Manager)							
Component or Subsystem		SFA Aggregate Manager							
Refines/Replaces		PT-P-001, PT-NF-008							

Id:	PT-GEN-R-005	Type:	SEC	Importance (priority):	HIGH	Source:	Consortium	Ver:	3
Title:		RAWFIE platform shall support secure data exchange based on certificates							
Description:		All communications and accesses to the system shall be secured through certificate (X.509) based encryption (e.g. TSL, HTTPS) Authentication and authorisation mechanisms should also be certificate based where possible.							
Additional Info (comments):		Concretises based on Risk number 32							
Component or Subsystem		All							
Refines/Replaces		PT-NF-001							

5.1.2 Web Portal

- 1 requirement discarded (PT-WEB-P-003) since it was moved to the Wiki Tool section and changed Id to PT-WIK-001
- All other version 2 requirements remain valid and intact.

5.1.3 Wiki Tool

Wiki Tool is a new component.
- 4 new requirements were added

Id:	PT-WIK-001	**Type:**	DATA	**Importance (priority):**	LOW	**Source:**	DoW	**Ver:**	3
Title:	A tutorial or similar type of documentation shall be provided to the users of the platform								
Description:	A self-contained didactic material shall be provided to the experimenters about the experiment design, the use and the variety of resources, the testbed facilities, etc. This can be in the form of a wiki. These functionalities shall be available to all possible future experimenters that may be interested in RAWFIE federation and want to explore its capabilities								
Additional Info (comments):	Wiki should contain: - Manuals - Tutorials - Testbed information - UxVs information								
Component or Subsystem	Wiki Tool								
Refines/Replaces	PT-P-002 PT-WEB-P-003								

Id:	PT-WIK-002	**Type:**	DATA	**Importance (priority):**	HIGH	**Source:**	Consortium	**Ver:**	3
Title:	The Wiki shall use the user credentials from the User & Rights repository								
Description:	To avoid mutable different accounts, the used wiki software shall load user credentials from the User & Rights repository A single sign on may also be implemented.								
Additional Info (comments):									

Component or Subsystem	Wiki Tool
Refines/Replaces	

Id:	PT-WIK-003	**Type:**	DATA	**Importance (priority):**	MEDIUM	**Source:**	Consortium	**Ver:**	3
Title:		The Wiki should support internationalization and localization							
Description:		The wiki should support different languages to provided manuals to customers from different regions.							
Additional Info (comments):									
Component or Subsystem		Wiki Tool							
Refines/Replaces									

Id:	PT-WIK-004	**Type:**	DATA	**Importance (priority):**	MEDIUM	**Source:**	Consortium	**Ver:**	3
Title:		The Wiki should be easy to use and edit							
Description:		The ease of use and edit it important to manage and maintain a large wiki. The wiki should provide a WYSIWYG editor and full text search.							
Additional Info (comments):									
Component or Subsystem		Wiki Tool							
Refines/Replaces									

5.1.4 Booking Tool

- 4 requirements updated (PT-BOO-T-002, PT-BOO-T-007, PT-BOO-T-008, PT-BOOK-T-010)
- 1 requirement discarded as obsolete (PT-BOO-T-013) since it is not compatible with the RAWFIE federation concept
- 1 requirement moved to another component (Booking Service) with changed Id (PT-BOO-T-012)
- 4 requirement added (PT-BOO-T-014, PT-BOO-T-0015, PT-BOO-T-0016, PT-BOO-T-0017)
- All other version 2 requirements remain valid and intact.

Id:	PT-BOO-T-002	Type:	FUNC	Importance (priority):	HIGH	Source:	Iteration1 Exp	Ver:	2
Title:		Booking Tool functionality shall be compatible with the SFA architecture and the notion of slices reservations							
Description:		SFA specification, provides mechanisms for reserving underline resources for an experimenter. RAWFIE booking functionality shall try to reuse whatever functionality from there can fit its business model.							
Additional Info (comments):									
Component or Subsystem		Booking Tool, SFA Aggregate Manager							
Refines/Replaces		PT-B-001							

Id:	PT-BOO-T-007	Type:	FUNC	Importance (priority):	HIGH	Source:	Arcitecture Deliverables	Ver:	2
Title:		Booking Tool should allow editing of Reservations defined in a future time							
Description:		A user should be able to edit/modify existing reservations this may include: • Modification of time reservation period (adding or removing timeslots) • Adding and deletion of resources associated with existing reservation (only for resources not involved in running experiments)							
Additional Info (comments):		• Modifications after approval of a reservation may be subject to constraints • Modifications should be allowed only by the creator of the initial reservation							
Component or Subsystem		Booking Tool							
Refines/Replaces		PT-B-002							

Id:	PT-BOO-T-008	Type:	FUNC	Importance (priority):	HIGH	Source:	Arcitecture Deliverables	Ver:	2
Title:		Booking Tool should allow cancellation of present and future defined Reservations							

Description:	Existing Reservations may be cancelled based on user request. • If no experiments are running or are associated with the reservation, a direct cancellation is possible. • If running or scheduled experiments are found for a given reservation then the running experiments should allow to complete but the reservation should be marked cancelled and future scheduled experiments should be deleted (or not allowed to be launched).
Additional Info (comments):	• A user should be able to cancel reservations created by him • An administrator/testbed operator should be able to cancel any reservation. Experimenter should be informed by a proper notification
Component or Subsystem	Booking Tool. Booking Service
Refines/Replaces	PT-B-002

Id:	PT-BOO-T-010	Type:	FUNC	Importance (priority):	HIGH	Source:	Arcitecture Deliverables	Ver:	3
Title:		Appropriate notification mechanism should be provided to the user in case status of reservation request is not directly available.							
Description:		Since resources are whole UxV systems there is a possibility that the actual reservation response is not directly available. In such a case the experimenter should be informed via a proper notification mechanism							
Additional Info (comments):		This may include situations where a reservation is impossible to be satisfied in the future or situations where a confirmation of the booking may require manual inspection at the testbed level by an operator or administration authority.							
Component or Subsystem		Booking Tool, Booking Service							
Refines/Replaces		PT-B-002, PT-B-008							

Id:	PT-BOO-T-014	Type:	FUNC	Importance (priority):	HIGH	Source:	Iteration 2 Exp	Ver:	3
Title:		Booking Tool UI interface should be protected with appropriate authorization and differentiate available actions and view based on user and its assigned role							
Description:		The actions provided to a logged user should differentiate based on the user role. I.e. not allowing a simple experimenter to initiate reservations approvals or/and view reservations of other users (the latter one may be configurable)							
Additional Info (comments):									

Component or Subsystem	Booking Tool
Refines/Replaces	

Id:	PT-BOO-T-015	**Type:**	FUNC	**Importance (priority):**	HIGH	**Source:**	Iteration1 Exp	**Ver:**	3

Title:	Booking Tool should be integrated in the RAWFIE web portal.
Description:	Booking Tool should be accessible from within RAWFIE web portal and reuse the authentication/authorization information provided during initial user login
Additional Info (comments):	
Component or Subsystem	Booking Tool
Refines/Replaces	

Id:	PT-BOO-T-016	**Type:**	FUNC	**Importance (priority):**	HIGH	**Source:**	Iteration 2 Exp	**Ver:**	3

Title:	Booking Tool should limit reservation of resources during testbeds operational hours.
Description:	Testbeds may have constraints regarding the time they are operable which should be indicated/provided during their initial registration. Booking functionality should consider this and disallow reservations outside the allowed periods of operations
Additional Info (comments):	
Component or Subsystem	Booking Tool, Booking Service
Refines/Replaces	

Id:	PT-BOO-T-017	**Type:**	FUNC	**Importance (priority):**	HIGH	**Source:**	Iteration 2 Exp	**Ver:**	3

Title:	Booking Tool should prohibit reservation of the same resource by different users at overlapping time periods.
Description:	Booking Tool and corresponding service should ensure that a UxV resource is reserved by a single user/experimenter at a given timeslot.

Additional Info (comments):	
Component or Subsystem	Booking Tool, Booking Service
Refines/Replaces	

5.1.5 System Monitoring Tool

- All version 2 requirements remain valid and intact.

5.1.6 Resource Explorer Tool

- All version 2 requirements remain valid and intact.

5.1.7 Experiment Authoring Tool

- 1 requirement updated (PT-EXA-T-013)
- 1 requirement added (PT-EXA-T017)
- The remaining version 2 requirements remain valid and intact.

Id:	PT-EXA-T-013	Type:	FUNC	Importance (priority):	HIGH	Source:	Other	Ver:	2
Title:		The visual editor should allow the definition of movement and location waypoints from a map.							
Description:		The Visual editor will provide a graphical interface where users will define the routes for each node as well as other information related to the execution of the experiment.							
Additional Info (comments):									
Component or Subsystem		Experiment Authoring Tool							
Refines/Replaces		PT-A-012, PT-A-013							

Id:	PT-EXA-T-017	Type:	FUNC	Importance (priority):	HIGH	Source:	Iteration2 Exp	Ver:	3

Title:	The Visual editor should be synchronized with the Textual Editor.
Description:	Editing in the EDL visual editor should be reflected to the EDL textual editor and vice versa.
Additional Info (comments):	
Component or Subsystem	Experiment Authoring Tool
Refines/Replaces	

5.1.8   Experiment Monitoring Tool

- All version 2 requirements remain valid and intact.

5.1.9   UxV Navigation Tool

- All version 2 requirements remain valid and intact.

5.1.10   Visualisation Tool

- 1 new requirement (PT-VIS-T-008)
- 2 modified requirements (PT-VIS-T-004, PT-VIS-T-006), modified description/additional info
- All other version 2 requirements remain valid and intact.

Id:	PT-VIS-T-004	Type:	FUNC	Importance (priority):	HIGH	Source:	Architecture Deliverables	Ver:	2
Title:		The Visualisation Tool shall provide access to information / features associated to each UxV device on the geographic map.							
Description:		From the Visualisation Tool GUI, it shall be possible to access to the features associated to each UxVs, after e.g. clicking on the specific UxV icon on the map. Available information may include: - current location (e.g. lat and lon values) - list of on-board sensors - current values of all measurements coming from the different sensors - basic information about the status of the device - option to turn ON/OFF different sensors (if available at UxVs)							

Additional Info (comments):	
Component or Subsystem	Visualisation Tool
Refines/Replaces	

Id:	PT-VIS-T-006	**Type:**	FUNC	**Importance (priority):**	MEDIUM	**Source:**	Architecture Deliverables	**Ver:**	2
Title:		Possibility of Adding/Removing/Updating graphical widgets should be provided.							
Description:		The experimenter can directly edits the widgets in the browser window. The new widgets are plotted on the screen. The user can adjust the information on the screen based, on the requirements and the current scenario.							
Additional Info (comments):		All sensor information is presented in widgets. If there are many UxVs with a couple of sensors, then the user cannot see all of them in widgets on the screen at the same time, because there is no space for that. So the user can choose which sensors from which UxVs to be presented on the screen.							
Component or Subsystem		Visualisation Tool							
Refines/Replaces									

Id:	PT-VIS-T-008	**Type:**	FUNC	**Importance (priority):**	HIGH	**Source:**	Architecture Deliverables	**Ver:**	3
Title:		Provide information for experiments and allow only experiments to be visualized that are assigned to logged in user.							
Description:		Dependent on the user's role and project assignment, the VT would show only the experiments that are available for that user and will prohibit access to experiments that are not assigned to that user.							
Additional Info (comments):									
Component or Subsystem		Visualisation Tool							
Refines/Replaces									

5.1.11 Data Analysis Tool

The Data Analysis Tool is the main UI interface that relays information to the Data Analysis Engine. It implements the standard UI decoupling interface. The Analysis Tool has five components: the main UI for writing jobs (Apache Zeppelin), the data selection section (Landoop Schema Registry UI), the result database(whisper), result visualization (Grafana) and the job manager which is provided via the Spark jobserver. Utilizing the UI provided by Zeppelin users will be able to write and deploy their own jobs via their own code or via the helper API's described in PT-DAA-T-006.

This revision contains the following changes:

- Slight change in PT-DAA-T-001 in order to be consistent with Zeppelin
- Addition of PT-DAA-T-006 & PT-DAA-T-007
- All other version 2 requirements remain valid and intact.

Id:	PT-DAA-T-001	Type:	FUNC	Importance (priority):	MEDIUM	Source:	Iteration1 Exp	Ver:	2
Title:		Analysis tool will provide interface to data engine.							
Description:		The Data Analysis Tool provides a user interface with which the consumer can select data metric(s) and a data analytics procedure, coupled with source and destination points. This information is relayed to the analytics engine which builds the required spark job.							
Additional Info (comments):		- The metrics that will be support are currently restricted to integer/floating point values, however a user may decide to write a custom job that utilizes character values for say NLP. - A spark job is basically a model coupled with the parameters for it.Based on how the user implements the job (i.e. UI interface or DAE CLI tool) the model will be deployed as a class collection or a spark JAR.							
Component or Subsystem		Data Analysis							
Refines/Replaces		PT-E-003, PT-E-002							

Id:	PT-DAA-T-006	Type:	FUNC	Importance (priority):	MEDIUM	Source:	Iteration2 Exp	Ver:	3
Title:		The Analysis Tool will provide an interface for the end-user to write their own code.							
Description:		The Data Analysis Tool will provide an interface whereby the user will be able to write their own code.							
Additional Info (comments):		Helper classes will be provided in order to be able to easily use algorithms such as PCA & Anomaly Detection.							

• Helpers will also be provided to write data to graphite (time series database) and to kafka.						

Component or Subsystem	Data Analysis
Refines/Replaces	PT-DAA-T-001

Id:	PT-DAA-T-007	**Type:**	FUNC	**Importance (priority):**	MEDIUM	**Source:**	Iteration2 Exp	**Ver:**	3
Title:	The Analysis Tool will provide authenticated login.								
Description:	The Data Analysis Tool will provide a mechanism such as LDAP or other such authentication mechanism to allow for logins of different users. The Data Analysis Tool should have access to the DAE after a login has been made								
Additional Info (comments):									
Component or Subsystem	Data Analysis								
Refines/Replaces									

5.1.12 Testbeds Directory Service

This version of the Testbed Directory Service requirements contains:
- slight updates to requirements PT-DIR-S-001, PT-DIR-S-002, PT-DIR-S-003, PT-DIR-S-004, PT-DIR-S-006
- All other version 2 requirements remain valid and intact.

Id:	PT-DIR-S-001	**Type:**	FUNC	**Importance (priority):**	HIGH	**Source:**	Architecture Deliverables	**Ver:**	2
Title:	The Testbed Directory Service shall provide REST / Web Service API to access to information on all Testbeds registered in RAWFIE								
Description:	The Testbed Directory Service shall provide the REST / Web Service interface for other RAWFIE components to be able to access information on the testbeds' registered in the RAWFIE database.								
Additional Info (comments):	All information about a specific testbed, as available in the database and therefore according to the corresponding data model, will be available. This may include: • name • geographic location								

- short description (possibly mentioning guidelines applying to the testbed usage)
- type of resources supported/available
- total number of resources available / in use
- list of resources with an indication as "free","booked","in use"
- connectivity / health status

Component or Subsystem	Testbeds Directory Service
Refines/Replaces	PT-P-003

Id:	PT-DIR-S-002	**Type:**	FUNC	**Importance (priority):**	MEDIUM	**Source:**	Architecture Deliverables	**Ver:**	2

Title:	The Testbed Directory Service should provide REST / Web Service API to access to information on all Testbeds registered in RAWFIE according to predefined filters
Description:	The Testbed Directory Service should provide the REST / Web Service interface for other RAWFIE components to be able to filter and access information of the testbeds' registered in the RAWFIE database, according to pre-defined filtering parameters (e.g. available UxV types)
Additional Info (comments):	
Component or Subsystem	Testbeds Directory Service
Refines/Replaces	

Id:	PT-DIR-S-003	**Type:**	FUNC	**Importance (priority):**	HIGH	**Source:**	Architecture Deliverables	**Ver:**	2

Title:	The Testbed Directory Service shall provide REST / Web Service API to access to information about available resources (UxVs) belonging to the testbeds registered in RAWFIE
Description:	The Testbed Directory Service shall provide the REST / Web Service interface for other RAWFIE components to be able to access information on the resources belonging to the different testbeds registered in RAWFIE.
Additional Info (comments):	All information about registered resources (UxVs), as available in the database and therefore according to the corresponding data model, will be available. This may include: • name • geographic location • short description (may include UxV characteristics) • testbed to which the resource is associated

	• type of resource (e.g. USV, UAV, etc) • status (e.g. "free","booked","in use", "non operational") • health status
Component or Subsystem	Testbeds Directory Service
Refines/Replaces	

Id:	PT-DIR-S-004	Type:	FUNC	Importance (priority):	MEDIUM	Source:	Architecture Deliverables	Ver:	2
Title:		The Testbed Directory Service should provide REST / Web Service API to access to information on available resources (UxVs) belonging to the testbeds registered in RAWFIE, and according to predefined filters							
Description:		The Testbed Directory Service should provide the REST / Web Service interface for other RAWFIE components to be able to filter and access information of the resources, according to pre-defined filtering parameters (e.g. name, type, testbed, status, available sensors measurements)							
Additional Info (comments):									
Component or Subsystem		Testbeds Directory Service							
Refines/Replaces									

Id:	PT-DIR-S-005	Type:	FUNC	Importance (priority):	HIGH	Source:	Architecture Deliverables	Ver:	2
Title:		The Testbed Directory Service should provide the possibility to register new testbeds in the RAWFIE platform, as well as to unregister (delete) testbeds from the platform							
Description:		Each participating testbed shall be registered in order to participate in RAWFIE Platform. During initial registration important details needed to access the testbed shall be provided and stored in an appropriate testbed directory service. The registration service should allow for periodic or testbed initiated updates of the registered data. Basically, the Testbed Directory Service should provide basic CRUD operations (CREATE, READ, UPDATE, DELETE) for testbeds and resources							
Additional Info (comments):									
Component or Subsystem		Testbeds Directory Service							
Refines/Replaces		PT-P-004							

Id:	PT-DIR-S-006	Type:	FUNC	Importance (priority):	MEDIUM	Source:	Architecture Deliverables	Ver:	2
Title:		Some basic query capabilities should be provided.							
Description:		Some basic query capabilities should be provided to find resources that provide certain capabilities (testbed or/and UxV resource specific) that may need for an experiment.							
Additional Info (comments):		Need to define what exactly these capabilities could be for the testbed node and its various resources (i.e. CPU, RAM, Op. system, battery state, communication interfaces, sensor types, capabilities regarding resource controller, etc.)							
Component or Subsystem		Testbeds Directory Service							
Refines/Replaces		PT-A-016							

5.1.13 EDL Compiler and Validator

- All version 2 requirements remain valid and intact.

5.1.14 Experiment Validation Service

- All version 2 requirements remain valid and intact.

5.1.15 Users & Rights Service

- All version 2 requirements remain valid and intact.

5.1.16 Booking Service

- 1 requirement discarded as obsolete (PT-BOO-S-009) since it is not compatible with the RAWFIE federation concept
- 1 new requirement added (PT-BOO-S-013).
- 1 requirement moved from Booking Tool section with adapted Id (PT-BOO-S-012)
- 1 requirement moved to another component (Launching Service) with changed Id (PT-BOO-S-011)
- All other version 2 requirements remain valid and intact.

Id:	PT-BOO-S-012	Type:	FUNC	Importance (priority):	HIGH	Source:	Iteration2 Exp	Ver:	3
Title:		Booking functionality should provide means to ensure fairness in resource booking as well as protect for malevolent actions that a user may perform.							

Description:	The booking process should ensure that some checks/validations apply to ensure resource reservation fairness and avoid spurious actions that may lock out other users like: • Reservation of enormous size of resources by a single user • Reservation of resources for very long lasting periods
Additional Info (comments):	The process may use some configurable max limits for number of resource, number of consecutive timeslots, total number of reservations that should be validated upon issuing a Booking request. Note: Requirement should be addressed mainly by the Booking Service.
Component or Subsystem	Booking Service, Booking Tool
Refines/Replaces	Replaces PT-BOO-T-012

Id:	PT-BOO-S-013	Type:	FUNC	Importance (priority):	HIGH	Source:	Iteration 2 Exp	Ver:	3
Title:		All Booking Service incoming requests should contain user initiating information and delegate/contact the User & Rights service in order to perform validation\authorization							
Description:		In every Booking Service incoming requests information about the initiating user should be provided (together with proper authorization or any additional required info) that should be used for checking credibility of the initiator to perform the provided action.							
Additional Info (comments):		User credibility should be checked against the User & Rights service. In case of failure appropriate feedback should be returned as feedback							
Component or Subsystem		Booking Tool							
Refines/Replaces		PT-NF-002							

5.1.17 Launching Service

- 1 requirement discarded as obsolete (PT-LAU-S-011) since it is not applicable to the Launching Service actual role
- 1 requirement added (PT-LAU-S-014)[12]
- All other version 2 requirements remain valid and intact.

---

[12]. The requirement actually existed in iteration 2 but defined wrongly within the Booking Service. Moved and change of its Id occurred

Id:	PT-LAU-S-014	Type:	FUNC	Importance (priority):	MEDIUM	Source:	Consortium	Ver:	3
Title:		Notification mechanisms may be provided for experiments scheduled for execution in the future.							
Description:		A notification mechanism to remind an experimenter the date and the timeslot allocated for running his/her experiment on the RAWFIE infrastructure may also be envisaged to improve the user experience. The time of notification prior to the experiment launch should be configurable.							
Additional Info (comments):									
Component or Subsystem		Launching Service							
Refines/Replaces		Replaces PT-BOO-S-011							

5.1.18 Visualisation Engine

- 1 new requirement (PT-VIS-E-005)
- All other version 2 requirements remain valid and intact.

Id:	PT-VIS-E-005	Type:	FUNC	Importance (priority):	HIGH	Source:	Architecture Deliverables	Ver:	3
Title:		The Visualization Engine shall provide the possibility to visualize experiments for different users at the same time							
Description:		For each user there could be only one experiment that (s)he can visualize at the same time. But if there are concurrently more than one users, that are connected to the platform, the VE will make it possible that each user, that is logged into the platform, can visualize one experiment without interrupting the work of the other users that are online.							
Additional Info (comments):									
Component or Subsystem		Visualisation Engine							
Refines/Replaces									

5.1.19 Experiment Controller

- 1 requirement discarded as incompatible with the RAWFIE architecture (PT-EXP-C-005) since each experiment is supposed to span only one testbed.
- All other version 2 requirements remain valid and intact.

5.1.20 Data Analysis Engine

The Data Analysis Engine is the unit from the Data Analytics component that is responsible for the execution of data analysis task. Those tasks can be provided in two different ways, either seamlessly via the Data Analysis Tool through which the user designed tasks to be run, or directly via interaction with the Jobserver API providing the user commands enabling him to upload and launch experiments independently designed. The execution is performed by Spark, a distribution computation framework. When they are given to the Data Analysis Engine, tasks have to be bundled in jars that Spark will interpret as jobs. The Data Analysis Tool transparently performs the packaging of the jobs into jars. However, when interacting through the Jobserver API, the user have to package the tasks before uploading and ordering their execution.

The revision contains the following changes:

- Slight changes in the wording of the requirements PT-DAA-S-001 and PT-DAA-S-002 to keep the requirements aligned with the changes made in both Data Analysis components.
- Addition of PT-DAA-S-003, PT-DAA-S-004 and PT-DAA-S-005
- All other version 2 requirements remain valid and intact

Id:	PT-DAA-S-001	**Type:**	FUNC	**Importance (priority):**	MEDIUM	**Source:**	Iteration1 Exp	**Ver:**	2
Title:		The Data Analysis Engine will support accepting analysis jobs							
Description:		The Data Analysis Engine will provide a schema based approach where it will accept analytics jobs, providing access to Spark transparently.							
Additional Info (comments):		A range of data analytical algorithms will be available through the use of the Data Analysis Tool (unit providing the interface of the Data Analysis component), providing functionalities such as the following via helper classes available to the user: - Outlier detection, - Distribution shift detection, - Classification/clustering, - Dimensionality reduction. The end user will also be able to deploy custom jobs by posting a model ['jar'] to the jobserver, via the Jobserver API.							
Component or Subsystem		Data Analysis							

Refines/Replaces	PT-E-004, PT-E-005

Id:	PT-DAA-S-002	**Type:**	FUNC	**Importance (priority):**	MEDIUM	**Source:**	Iteration1 Exp	**Ver:**	2

Title:	The Data Analysis Engine will support executing analysis jobs
Description:	• The Analysis Engine supports posting models ['jar'] and parameters ['job']. A given model has to be preliminary posted before an execution with provided parameters can be performed. • For obvious reasons a model should be decoupled from its parameters because we might want to post models of the same type with different parameters and/or working on different metrics, hence the separation in jars and jobs. • A job is either a streaming job or a batch job. A streaming job has no end of life, while a batch job does.
Additional Info (comments):	
Component or Subsystem	Data Analysis
Refines/Replaces	PT-E-005

Id:	PT-DAA-S-003	**Type:**	FUNC	**Importance (priority):**	MEDIUM	**Source:**	Iteration2 Exp	**Ver:**	3

Title:	The Data Analysis Engine will provide the ability to end running jobs.
Description:	The Data Analysis Engine will provide the user with the ability to kill running jobs, a functionality available via the Data Analysis Engine command line interface.
Additional Info (comments):	The primitive enabling the user to kill a running job is the one that the jobserver UI provided in the Data Analysis Tool transparently use when the user orders, via the DAT graphical interface, to kill a running job. In order to kill a given job, the user will have to use the associated primitive with the exact ID of the job, that has been communicated to the user when requesting the execution of the given job (provided in the acknowledgement message). The fact that only the user who launched the job possesses the job ID ensures that no one else will be able (apart from admins) to end the execution.
Component or Subsystem	Data Analysis
Refines/Replaces	

Id:	PT-DAA-S-004	Type:	FUNC	Importance (priority):	MEDIUM	Source:	Iteration2 Exp	Ver:	3
Title:		The Data Analysis Engine should be scalable.							
Description:		The Data Analysis Engine should be resilient with respect to the addition of workers, coordinated by the master, in the Spark cluster. Those processing units can be of various specifications in terms of hardware, as long as they fit the requirements imposed by the Spark cluster ruleset (e.g. memory per added node).							
Additional Info (comments):									
Component or Subsystem		Data Analysis							
Refines/Replaces									

Id:	PT-DAA-S-005	Type:	FUNC	Importance (priority):	MEDIUM	Source:	Iteration2 Exp	Ver:	3
Title:		The Data Analysis Engine will provide authenticated login							
Description:		In order to be granted access to the Data Analysis Engine, the user will need to credentials corresponding to the ones stored on the LDAP server, similarly to how a user authenticate on the Data Analysis Tool, since they both built on the same instance where Spark is running. Once the login has been made, the user should be able to use the commands the Data Analysis Engine offers via its CLI, e.g. in proceeding with the upload of a jar or the initiation of a job based on a preliminarily posted jar.							
Additional Info (comments):									
Component or Subsystem		Data Analysis							
Refines/Replaces									

5.1.21 System Monitoring Service

- All version 2 requirements remain valid and intact.

5.1.22 Accounting Service

- All version 2 requirements remain valid and intact.

5.2 Testbed Requirements

Testbed requirements include all the requirements pertaining the testbed facility components. The testbed components are mainly used for interconnecting with the RAWFIE server platform and for managing the UxV resources.

5.2.1 General

- Additional info and description fields updated in 5 requirements (TB-GEN-R-002, TB-GEN-R-004, TB-GEN-R-009, TB-GEN-R-010, TB-GEN-R-011)
- Priority modified (lowered) in 1 requirement (TB-GEN-R-008)
- 1 requirement (TB-GEN-R-001) discarded as obsolete since it is addressed by the definition of SFA Aggregate manager and its associated requirements
- 3 new requirements added (TB-GEN-R-012, TB-GEN-R-013, TB-GEN-R-014)
- All other version 2 requirements remain valid and intact

Id:	TB-GEN-R-002	Type:	ENV	Importance (priority):	HIGH	Source:	Other	Ver:	1
Title:		Each Testbed should provide the exact boundaries within which its UxVs can operate							
Description:		The spatial boundary where UxVs can operate within a testbed should be predefined a priori. Any attempt of a UxV to move outside this boundary should be prohibited. Also requests by ground components attempting to breach the operating boundary should be rejected.							
Additional Info (comments):		In case of swarm flight or special mission, flight boundary could be reduced to be compliant with national regulation.							
Component or Subsystem									
Refines/Replaces									

Id:	TB-GEN-R-004	Type:	ENV	Importance (priority):	HIGH	Source:	Other	Ver:	2
Title:		Testbed areas environment should be closely monitored							
Description:		Testbed areas should provide a controlled environment depending on the extend of the outdoor and indoor space.							
Additional Info (comments):		Monitoring should be based usually on external tools that each testbed operator may offer but a possibility to integrate/access them via the RAWFIE interface							

should be provided if considered feasible				
Consider also TB-GEN-R-008 in relation to this one				
Component or Subsystem	N/A			
Refines/Replaces	TB-G-002			

Id:	TB-GEN-R-008	Type:	ENV	Importance (priority):	MEDIUM	Source:	Other	Ver:	2
Title:	Testbed areas should provide proper facilities and equipment								
Description:	Facility area should have appropriate ground – based and mobile equipment that may include (depending on the case): • radar, • cameras, • antennas, • receivers, • optical tracking, • video services.								
Additional Info (comments):									
Component or Subsystem	N/A								
Refines/Replaces	TB-G-002								

Id:	TB-GEN-R-009	Type:	ENV	Importance (priority):	HIGH	Source:	Other	Ver:	1
Title:	Testbed must provide dedicated computational resources								
Description:	Testbed must provide either a committed PCs and/or Virtual Machines, with very-high-bit-rate digital subscriber line, able to host and support RAWFIE system.								
Additional Info (comments):	This computational resources could not be available on outside flight zone but will be at least present on the office of the testbed.								
Component or Subsystem	N/A								
Refines/Replaces									

Id:	TB-GEN-R-010	Type:	OTH	Importance (priority):	HIGH	Source:	Other	Ver:	1

Title:	Testbeds should be supported by on-site personnel
Description:	During testbed demonstrations the physical presents of personnel must be provided. Assigned personnel is important for security issues, technical support, UxV battery charging, maintenance and upgrades
Additional Info (comments):	For certain types of UxV devices (UAVs) the need of a properly trained on-site personnel acting as remote pilot/supervisor of one or more autonomous devices is mandatory and imposed by existing legislation.
Component or Subsystem	N/A
Refines/Replaces	

Id:	TB-GEN-R-011	Type:	SEC	Importance (priority):	HIGH	Source:	Other	Ver:	1

Title:	Testbeds should conform to all legal regulations and restrictions and advertise them to the RAWFIE platform
Description:	Testbeds areas should adhere and follow all legal restrictions that are applicable, according to specific laws and regulations, at local national and EU level that can be applied.This information should be available and viewable by the experimenters
Additional Info (comments):	Testbeds are in charge of getting all the required authorizations according to the experimentations to legally perform them and timely inform RAWFIE federation on the actions needed to make certain UxVs operable in their facilities. I.e. • in certain cases they may be a need to submit technical data from UAVs manufacturer in order to get UAVs Certification of Type or any other administrative document • special authorization may be needed if multiple devices are involved in a single experiment • etc.
Component or Subsystem	N/A
Refines/Replaces	TB-NF-G-005

Id:	TB-GEN-R-012	Type:	FUNC	Importance (priority):	HIGH	Source:	Iteration2 Exp	Ver:	3

Title:	Testbeds should provide information regarding the expected Coordination Reference System (CRS) their resources are expected to operate
Description:	Testbeds should keep information regarding the CRS of operation for the UxVs. The SRID can be used for that purpose. This mainly applies to outdoor testbeds while for indoor a default internal SRID for Cartesian 3D can be used . Certain platform and testbed components should consider this during coordination manipulation
Additional Info (comments):	Normally SRID 4326 (WGS-84) or 4979 (WGS-84 3D) should always be supported
Component or Subsystem	Resource Controller, Experiment Controller, Experiment Authoring Tool
Refines/Replaces	

Id:	TB-GEN-R-013	Type:	OTH	Importance (priority):	HIGH	Source:	Iteration2 Exp	Ver:	3
Title:		Testbeds should provide information about their hours of operation							
Description:		Each testbed depending on, personnel, country, regional or UxV types may have constraints concerning their expected time of operation, It is important that this information is provided to RAWFIE and regularly updated in case of change since the functionality of certain components may need to consider this							
Additional Info (comments):									
Component or Subsystem		Booking Tool, Launching Service, Experiment Validation Service, Testbed Manager, Aggregate Manager							
Refines/Replaces									

Id:	TB-GEN-R-014	Type:	SEC	Importance (priority):	HIGH	Source:	Iteration2 Exp	Ver:	3
Title:		Testbed messaging solution configuration should ensure local and isolated flow of control commands and navigation sensors feedback							
Description:		Each testbed and the overall communication setup should be configured in way to ensure that control & navigation messages are not accessible or available by other testbeds for security and latency purposes							
Additional Info (comments):									
Component or Subsystem		Resource Controller, Network Controller							

Refines/Replaces	

5.2.2 Monitoring Manager

- 2 requirements have been updated (TB-MOM-002, TB-MOM-003)
- 1 requirement added (TB-MOM-005)
- All other version 2 requirements remain valid and intact.

Id:	TB-MOM-002	Type:	DATA	Importance (priority):	HIGH	Source:	Iteration1 Exp	Ver:	2
Title:		The Monitoring Manager component should collect and report current status of computing resources of the testbed facilities							
Description:		Testbed's monitoring component should check periodically the status of computing resources of the testbed facilities like CPU load, free RAM and disk space							
Additional Info (comments):									
Component or Subsystem		Monitoring Manager							
Refines/Replaces		TB-G-001							

Id:	TB-MOM-003	Type:	DATA	Importance (priority):	HIGH	Source:	Iteration1 Exp	Ver:	2
Title:		The Monitoring Manager component should store periodically all testbed information							
Description:		Testbed monitoring manager should collect and store the status of the testbed characteristics and the devices in a data log file or testbed's local database, with a specific timestamp.							
Additional Info (comments):		This has to be feasible as in some specific cases communication with other tiers, i.e. System Monitoring Service, may not exist.							
Component or Subsystem		Monitoring Manager							
Refines/Replaces		TB-G-003							

Id:	TB-MOM-005	Type:	FUNC	Importance (priority):	MEDIUM	Source:	Iteration2 Exp	Ver:	3

Title:	Monitoring Manager should be able to communicate and collect information from other services that provide important information related to the operation of testbed facility
Description:	Monitoring Manager should be able to utilize information coming from other services like network connections available from Network Controller and weather conditions from testbed's weather station
Additional Info (comments):	
Component or Subsystem	Monitoring Manager
Refines/Replaces	

5.2.3 Network Controller

- All requirements (5) were updated (TB-NEC-001, TB-NEC-002, TB-NEC-003, TB-NEC-004, TB-NEC-005)

Id:	TB-NEC-001	Type:	FUNC	Importance (priority):	MEDIUM	Source:	Consortium	Ver:	2
Title:		Network Controller shall offer appropriate connectivity management							
Description:		The RAWFIE communication resources shall be managed in order to offer seamless connectivity in the normal operations of the system, between the testbed and its resources (typically UxV).							
Additional Info (comments):		The Network Controller will manage and optimize the use and allocation of the communication resources in collaboration with the Resource controller. This is the case in particular with respect to the communication link and its associated quality of service as well as the possible switching between the main and available alternate communication links. This process is done in real-time on the basis of the monitoring of the communication metrics. It is done in conjunction with the Resource Controller.							
Component or Subsystem		Network Controller, Resource Controller, UxV Network & Communication							
Refines/Replaces		PT-L-009, TB-G-008							

Id:	TB-NEC-002	Type:	FUNC	Importance (priority):	MEDIUM	Source:	Consortium	Ver:	2
Title:		Network Controller shall offer provision of all network communication resources							
Description:		The Network controller shall identify and characterize the connection resources available in a testbed for connecting it to resources such as UxVs. The							

	connection shall subsequently be made available to the Resource controller so that they can be used for communicating between resources.
Additional Info (comments):	The Network controller shall provide the connection information to the resources to be connected so that they can establish the communication, in collaboration with the Resource Controller. The main properties of the connection (e.g. standard, throughput, timeliness, range, etc.) shall be known from the Network controller so that it can establish the equivalence between connections.
Component or Subsystem	Network Controller, Resource Controller
Refines/Replaces	

Id:	TB-NEC-003	Type:	FUNC	Importance (priority):	MEDIUM	Source:	Consortium	Ver:	2
Title:		Alternative connection interfaces should be supported							
Description:		Enables switching between the connections available between RAWFIE resources.							
Additional Info (comments):		Based on the quality of the current connection between a resource and the testbed, and the list of available connections in a testbed maintained by the Network controller, the Resource controller or the UxV can decide to switch from one connection to the other. The impact on the experiment should be minimal. This feature should be offered on a per connected resource basis (e.g. a UxV), depending on the required communication quality between this entity and the Testbed.							
Component or Subsystem		Network Controller, Resource Controller, UxV Network & Communication							
Refines/Replaces		TB-R-013							

Id:	TB-NEC-004	Type:	FUNC	Importance (priority):	MEDIUM	Source:	Consortium	Ver:	2
Title:		The communication status shall be checked							
Description:		The testbed and the connected resources (e.g. UxVs) shall regularly check the communication status to detect any disconnection, defective link or degradation of the quality of service							
Additional Info (comments):		This feature is bilateral and it shall be present on both sides of the communication: the communicating entity (e.g. a UxV) and the Testbed. This is particularly useful when the UxVs are moving in an environment with obstacles between them and the other components.							

Component or Subsystem	Network Controller, Resource Controller, UxV Network & Communication
Refines/Replaces	TB-NF-G-006

Id:	TB-NEC-005	Type:	FUNC	Importance (priority):	MEDIUM	Source:	Consortium	Ver:	2 1
Title:		Connection Timeliness verification and notification							
Description:		The Network controller shall verify during the execution of the experiment that the time constraints specified on the exchanged data for the different types of UxVs are met. Whenever such time constraint is not met, this event shall be notified to the Experiment Controller and the resource controller, so that they can take the appropriate measures							
Additional Info (comments):		Measures include relaxing the constraint, switching to other resources (e.g. alternative communication system), re-balancing the existing resources, stopping the experiment, etc.							
Component or Subsystem		Network Controller, Experiment controller, Resource Controller, UxV Network & Communication							
Refines/Replaces									

5.2.4 Resource Controller

- Requirement TB-REC-002 priority changed to HIGH
- All remaining version 2 requirements remain valid and intact.

Id:	TB-REC-002	Type:	FUNC	Importance (priority):	HIGH	Source:	Iteration1 Exp	Ver:	2
Title:		RAWFIE platform should be able to activate the "Emergency Scenario"							
Description:		The "Remote Control" component ensures that the system is performing as intended and additionally, guarantees the safety of the equipment. If one of the following conditions occurs, automatically, the component activates an emergency scenario. • The component does not receive any feedback from the units for several time steps • The component receives feedback from the units which report severe localization issues							
Additional Info (comments):									
Component or Subsystem		Resource Controller							

Refines/Replaces	PT-L-009, TB-G-008

5.2.5 Testbed Manager

- 2 requirements have been updated (TB-MAN-002, TB-MAN-009)
- 1 requirement added (TB-MAN-010)
- All other version 2 requirements remain valid and intact.

Id:	TB-MAN-002	**Type:**	FUNC	**Importance (priority):**	HIGH	**Source:**	Consortium	**Ver:**	2
Title:		Testbed Manager shall provide information about the capabilities of each resource node							
Description:		Testbed Manager shall provide a complete set of each resource node capabilities. Such information for UxV nodes may include: • Identity and resource type (UAV, UGV, USV, AUV) • HW characteristics (CPU architecture and speed, RAM). • Communication capabilities (i.e. supported network standards, networking interfaces, software defined radio) • Sensing capabilities, sensor types and measurement units							
Additional Info (comments):									
Component or Subsystem		Testbed Manager							
Refines/Replaces		TB-G-004							

Id:	TB-MAN-009	**Type:**	DATA	**Importance (priority):**	LOW	**Source:**	Consortium	**Ver:**	2
Title:		Testbed Manager may provide statistical data/information about testbed operation							
Description:		Statistical datashall include: • number of experiments • Testbed time alive • Completed/Failed/Canceled experiments • experiments duration • Statistical information about time utilization and number of experiments per resource							

Additional Info (comments):	
Component or Subsystem	Testbed Manager
Refines/Replaces	TB-D-002

Id:	TB-MAN-010	Type:	FUNC	Importance (priority):	HIGH	Source:	Consortium	Ver:	3
Title:		Testbed Manager shall provide the ability to cancel an ongoing experiment in case of communication failure with the RAWFIE platform							
Description:		Testbed Manager shall be equipped with the capability of taking control of testbed resources with the help of Resource Controller in cases where control through Web Portal fails. This shall mainly operate as a safety backup mechanism enabling testbed users with appropriate access to cancel an ongoing experiment and safely stop utilized resources of the testbed participating in the experiment.							
Additional Info (comments):		(see also TB-REC-002)							
Component or Subsystem		Testbed Manager, Resource Controller							
Refines/Replaces									

5.2.6 SFA Aggregate Manager

Aggregate Manager is a new component that was considered in order to enable RAWFIE testbeds to be interoperable/compatible with the SFA standard. Aggregate Manager will be based on an existing implementation of the SFA Aggregate Manager – defined in other FIRE projects – including however the necessary adaptations prescribed by the special needs of the RAWFIE asynchronous resource reservation process.

- 5 new requirements were added

Id:	TB-AGG-001	Type:	FUNC	Importance (priority):	HIGH	Source:	Other	Ver:	3
Title:		SFA Aggregate Manager (SAM) should provide an SFA Interface to comply with SFA based testbeds or testbed federations							
Description:		To respect to the RAWFIE platform architecture SAM should provide an XML-RPC API that enables the interoperability with existing tools for experimenters (e.g., omni [29], jFed [30], etc) and allows federation with testbeds or testbed federations that confront to the SFA GENI API v3 specification [31]							

Additional Info (comments):	
Component or Subsystem	SFA Aggregate Manager
Refines/Replaces	PT-GEN-R-001, TB-GEN-R-001

Id:	TB-AGG-002	Type:	FUNC	Importance (priority):	HIGH	Source:	Other	Ver:	3
Title:		SFA Aggregate Manager (SAM) should provide a REST API to comply with RAWFIE testbeds.							
Description:		The SAM should support a REST-API which can be used from any front-end tools of the RAWFIE platform for the support of the experiment life-cycle management.							
Additional Info (comments):									
Component or Subsystem		SFA Aggregate Manager							
Refines/Replaces		PT-GEN-R-001, TB-GEN-R-001							

Id:	TB-AGG-003	Type:	FUNC	Importance (priority):	HIGH	Source:	Other	Ver:	3
Title:		SFA Aggregate Manager (SAM) should advertise the resources of a testbed							
Description:		The provided SAM interface for each testbed should enable the extraction of information relevant to the testbed and its resources: - Attributes for the testbed - Attributes for the testbed resources - Attributes for the reservation life cycle of testbed resources - Attributes of the users (experimenters) of the testbed.							
Additional Info (comments):									
Component or Subsystem		SFA Aggregate Manager							
Refines/Replaces		PT-GEN-R-001, TB-GEN-R-001							

Id:	TB-AGG-004	Type:	FUNC	Importance (priority):	HIGH	Source:	Other	Ver:	3

Title:	SFA Aggregate Manager (SAM) reservation process should comply with the resource reservation process of RAWFIE testbeds
Description:	The current SAM model which is based on the (SFA) Nitos Aggregate Manager [1] design principles is deployed to support an SFA model of resources reservation in an automatic process (automatic approval). This design should be extended to support the RAWFIE reservations of UxVs which requires manual approval from a testbed administrator/operator.
Additional Info (comments):	See also requirement PT-B-001, PT-BOO-T-010
Component or Subsystem	SFA Aggregate Manager
Refines/Replaces	PT-GEN-R-001, TB-GEN-R-001

Id:	TB-AGG-005	Type:	FUNC	Importance (priority):	HIGH	Source:	Other	Ver:	3

Title:	SFA Aggregate Manager (SAM) should provide an interface to testbed administrators for managing RAWFIE testbeds
Description:	The SAM REST API should expose essential administrative management methods for testbed administrators to perform administrative procedures in order to keep up to date the RAWFIE testbed information. Such procedures include the resource description creation, update and deletion.
Additional Info (comments):	
Component or Subsystem	SFA Aggregate Manager
Refines/Replaces	PT-GEN-R-001, TB-GEN-R-001

5.3 UxV Requirements

This subsection includes requirements related to UxVs and the expected functionality. UxV are provided by different vendors, they are of different types and are generally customized in house by each vendor. Clearly identifying components for them is not easy. However, in order to participate in RAWFIE experiments the UxVs should satisfy the needs of experimenters and meet environmental and regulatory constraints. In addition, a UxV must implement a minimum level of common functionality irrespective of their type (UGV, UAV, USV, AUV) in terms of interfaces, communication capabilities, on-board processing capabilities and localization. Keeping this in mind, in the present chapter we have defined the UxV node subsections that refers to the UxV in general. The other subsections should not be considered to address specific SW or HW components in the strict sense but as general categories/classes where UxV requirements were divided in order to facilitate their listing. Exception to this rule is the UxV

Proximity which is defined and implemented within the consortium as a distinct software module.

5.3.1 General

- 1 requirement updated and its id was corrected (TB-UGV-001 renamed to UXV-GEN-001
- 1 new requirement added (UXV-GEN-002)

Id:	UXV-GEN-001	Type:	FUNC	Importance (priority):	HIGH	Source:	Iteration1 Exp	Ver:	1
Title:		Compliance of UxV to RAWFIE specification and interfaces							
Description:		To be able to operate in a RAWFIE Tesbed, a RAWFIE UxV interacts with the other Testbed entities (controllers, other UxV's). As such the UxV shall conform to the RAWFIE global architecture and conceptual components defined in D4.5.							
Additional Info (comments):		The UxV Node component provides an abstraction layer to the unmanned vehicle systems (such as ROS and other proprietary operating systems) to make it appearing as a RAWFIE compliant component. It provides interfaces to the robot operation resources such as setting the robot waypoints and speed or real-time remote control. The UxV shall for example provide a minimum set of capabilities to the RAWFIE system. The minimum set of features is a subset of the following items: Processing capabilities (type of processors, number of cores, speed); Size and dimensions; Weight; Payload; Battery; Number and type or sensors; Number and type of integrated network components and supported communication interfaces; Minimum and maximum autonomy of the device; Auto-return capability (return to the base station automatically); Ability of the vehicle to operate as an access point; (Remote) Control interface; Over-the-air programming capabilities; Provision of collision avoidance mechanism; Compatibility with Apache Kafka architecture; Data storage of the vehicle; Support of "safe mode" operation; Localization capabilities (e.g., GNSS); Ability to operate in indoor/outdoor/mixed environments; Compliance with standards, Operational conditions (e.g., day/night) and temperature limitations.							
Component or Subsystem									
Refines/Replaces									

Id:	UXV-GEN-002	Type:	FUNC	Importance (priority):	LOW	Source:	Consortium	Ver:	3
Title:		UxV providers may provide for their supplied devices a simulator/emulator mimicking its real-world behavior and kinematics							

Description:	A UxV simulator/emulator should be able to interact with the messages received from the RAWFIE infrastructure and support the defined interfaces. This should include navigation and guidance instructions and should be based on proper motion models of the UxVs providing realistic kinematics behaviour.
Additional Info (comments):	The simulator/emulator can be used: • in RAWFIE experiments for early validation/testing of normal execution flow before the actual deployment of a device in a testbed. • To enable definition of experiments involving multiple "virtual" devices which will not be possible with real devices due to regulation constraints or limitations regarding the number of available devices
Component or Subsystem	
Refines/Replaces	

5.3.2 UxV Node

• 3 new requirements added (UXV-NOD-004, UXV-NOD-005, UXV-NOD-006)
• All other version 2 requirements remain valid and intact

Id:	UXV-NOD-004	Type:	FUNC	Importance (priority):	MEDIUM	Source:	Iteration2 Exp	Ver:	3
Title:		Each UxV node may register the Coordination Reference System CRS it is expected to operate.							
Description:									
Additional Info (comments):		Information can be provided in the form of SRID code. If not provided the SRID defined at testbed level will apply							
Component or Subsystem		UxV Node, Resource Controller							
Refines/Replaces									

Id:	UXV-NOD-005	Type:	FUNC	Importance (priority):	HIGH	Source:	Architecture Deliverables	Ver:	3
Title:		A proper message communication protocol should be defined for the communication between a UxV node and the tesbed ground components							

Description:	In order to abstract the differences between UxVs and expose a simple, compact, extensible, and expressive interface to monitor and control UxVs in a platform-agnostic way. New UxVs can therefore be added to the RAWFIE infrastructure by creating adapters or translators to convert UxV specific information to the RAWFIE UxV Protocol.
Additional Info (comments):	For more details on supported messages see section 0 (interface category requirements)
Component or Subsystem	UxV node, Resource Controller, Network Controller, Testbed Manager
Refines/Replaces	

Id:	UXV-NOD-006	**Type:**	SEC	**Importance (priority):**	HIGH	**Source:**	Other	**Ver:**	3
Title:		All command messages received by the UxVs should be ensured that they originate from an authorized testbed component or other UxV involved in an experiment before being processed							
Description:									
Additional Info (comments):									
Component or Subsystem		UxV node, Resource Controller, Network Controller							
Refines/Replaces		TB-NF-G-004 (partially)							

5.3.3 UxV Proximity

UxV proximity is a new component.
- 6 new requirements were added

Id:	UXV-PRX-001	**Type:**	FUNC	**Importance (priority):**	HIGH	**Source:**	Other	**Ver:**	3
Title:		Embedded UxV proximity component shall be into the UxV							
Description:		The UxV shall embed an additional short range, low-power RF interface that offers an alternative communication channel. The main objective of the proximity component is to allow members of a swarm of autonomous vehicles to discover the presence and possibly interact with each other with very low latency							

	without depending on the Rawfie middleware or any other ground equipment.
Additional Info (comments):	The proximity component provides an alternative publish-subscribe communication system to UxVs that are sharing the same common RF domain. detection of the presence and identification of neighbouring UxV, distance estimation between a UxV and its neighbours, exchange of status data, etc. This is particularly useful to share information across swarms of UxVs, e.g. speed, location, etc. for formation flying, or read external sensors that complies to the same wireless networking technology, or to help for search & rescue operation by providing an extended lifetime to the UxV communication capabilities. This local "message bus" can be used for many other uses, such as alternative communication means in case of the primary communication system fails.
Component or Subsystem	UxV proximity
Refines/Replaces	

Id:	UXV-PRX-002	Type:	FUNC	Importance (priority):	HIGH	Source:	Other	Ver:	3
Title:		UxV proximity component shall provide information sharing							
Description:		The UxV proximity component shall provide a flexible information sharing mechanism across UxVs pertaining to a group. The shared information is of two types: general (default, always on) and custom (topics are defined by the application).							
Additional Info (comments):		The proximity component provides an alternative publish-subscribe communication system to UxVs that are sharing the same common RF domain. This is particularly useful to share basic information across swarms of UxVs, e.g. speed, location, etc. for presence detection, formation flying, etc. This can be used by the local UxV controller to perform collision avoidance, to a certain degree.							
Component or Subsystem		UxV proximity							
Refines/Replaces									

Id:	UXV-PRX-003	Type:	FUNC	Importance (priority):	HIGH	Source:	Other	Ver:	3
Title:		UxV proximity component shall provide presence detection of other compliant UxVs							
Description:		The UxV proximity component shall provide a service allowing for the automatic detection of a RAWFIE compliant UxV in the vicinity.							
Additional Info (comments):		The proximity component provides an alternative publish-subscribe communication system to UxVs that are sharing the same common RF domain.It							

	includes the detection of the surrounding RAWFIE compliant UxVs. Based on this capability, the proximity component can be used for searching lost or failed UxVs, or resuming operation after the main communication infrastructure has failed.									
Component or Subsystem	UxV proximity									
Refines/Replaces										

Id:	UXV-PRX-004	**Type:**	FUNC	**Importance (priority):**	MEDIUM	**Source:**	Other	**Ver:**	3
Title:	UxV proximity shall offer data relay capabilities								
Description:	The UxV proximity component shall allow for relaying (or store-and-forward) the data gathered from other neighbouring Proximity-component enabled devices (including UxV or ground sensors, for example).								
Additional Info (comments):	The proximity component provides an alternative publish-subscribe communication system to UxVs that are sharing the same common RF domain. Information that is received by a Proximity component can be received and later forwarded to other Proximity components.								
Component or Subsystem	UxV proximity								
Refines/Replaces									

Id:	UXV-PRX-005	**Type:**	FUNC	**Importance (priority):**	HIGH	**Source:**	Other	**Ver:**	3
Title:	UxV proximity component shall provide information helping in collision avoidance								
Description:	The UxV shall use the information provided by the Proximity component to implement some collision avoidance mechanisms.								
Additional Info (comments):	The proximity component provides an alternative publish-subscribe communication system to UxVs that are sharing the same common RF domain. Information that is received can be used for collision avoidance (to a certain degree).								
Component or Subsystem	UxV proximity								
Refines/Replaces									

Id:	UXV-PRX-006	**Type:**	FUNC	**Importance (priority):**	MEDIUM	**Source:**	Other	**Ver:**	3

Title:	UxV proximity component shall offer temporary storage
Description:	The UxV proximity component shall allow for storing the data obtained from other neighbouring Proximity-component enabled devices (including UxV or ground sensors, for example).
Additional Info (comments):	The proximity component provides an alternative publish-subscribe communication system to UxVs that are sharing the same common RF domain. Information that is received by a Proximity component can be stored for a variable amount of time and then forwarded to other Proximity components.
Component or Subsystem	UxV proximity
Refines/Replaces	

5.3.4 UxV Interface category

The interface category was introduced in this final version of requirements deliverable. The intention of this category is to provide a list of requirements clearly defining the available messages that UxV devices should be able to send or receive during RAWFIE experiments. The requirements were identified based on work performed during the first two iterations of design and development and therefore their largely refer to the corresponding architecture and implementation documents. The messages defined below adhere to 3 main categories:

- Command related messages
- Sensor related messages
- Resource & System info related messages

Most of the requirements in this section should be considered as an elaboration of requirement UXV-NOD-005. All requirements of this section affect the UxV node in general as well as testbed components interacting with it (Resource Controller, Network Controller). Each UxV that wants to participate in RAWFIE experiments should comply with the interface requirements listed below.

Id:	UXV-INT-001	Type:	FUNC	Importance (priority):	HIGH	Source:	Architecture Deliverables	Ver:	3
Title:		All messages of the UxV Message API should contain in their header basic information about the dispatching entity.							
Description:		Messages that flow between UxV and ground components should contain certain information in a header field that will facilitate identification of the originator and ordering							
Additional Info (comments):		Header Information should include at a minimum: • Source system • Source module • time							

	See architecture deliverable D4.5
Component or Subsystem	UxV Node
Refines/Replaces	

Id:	UXV-INT-002	**Type:**	FUNC	**Importance (priority):**	HIGH	**Source:**	Architecture Deliverables	**Ver:**	3
Title:		UxV should support the Goto command							
Description:		UxVs shall receive and act upon messages of type eu.rawfie.uxv.commands.Goto. Which will command the UxV to move to a given location							
Additional Info (comments):		See architecture deliverable D4.5							
Component or Subsystem									
Refines/Replaces		Refines UXV-NOD-005							

Id:	UXV-INT-003	**Type:**	FUNC	**Importance (priority):**	MEDIUM	**Source:**	Architecture Deliverables	**Ver:**	3
Title:		UxV should support the KeepStation command							
Description:		UxVs shall receive and act upon messages of type eu.rawfie.uxv.commands.KeepStation. Which will command the UxV to stay at a given location							
Additional Info (comments):		See architecture deliverable D4.5							
Component or Subsystem									
Refines/Replaces		Refines UXV-NOD-005							

Id:	UXV-INT-004	**Type:**	FUNC	**Importance (priority):**	HIGH	**Source:**	Architecture Deliverables	**Ver:**	3
Title:		UxV should support the Abort command							

Description:	UxVs shall receive and act upon messages of type eu.rawfie.uxv.commands.Abort and stop the execution of any previously sent command/ UxV entering standby mode
Additional Info (comments):	See architecture deliverable D4.5
Component or Subsystem	
Refines/Replaces	Refines UXV-NOD-005

Id:	UXV-INT-005	Type:	FUNC	Importance (priority):	HIGH	Source:	Architecture Deliverables	Ver:	3
Title:		UxVs should be able to advertise themselves to the RAWFIE infrastructure							
Description:		UxVs shall advertise themselves to the RAWFIE infrastructure using the eu.rawfie.uxv.SystemInfo message							
Additional Info (comments):		See architecture deliverable D4.5							
Component or Subsystem									
Refines/Replaces		Refines UXV-NOD-005							

Id:	UXV-INT-006	Type:	FUNC	Importance (priority):	HIGH	Source:	Architecture Deliverables	Ver:	3
Title:		UxVs should be able to advertise information about their sensors to the RAWFIE infrastructure							
Description:		UxVs shall advertise their set of sensors to the RAWFIE infrastructure using the eu.rawfie.uxv.SensorInfo message							
Additional Info (comments):		See architecture deliverable D4.5							
Component or Subsystem									
Refines/Replaces		Refines UXV-NOD-005							

Id:	UXV-INT-007	Type:	FUNC	Importance (priority):	MEDIUM	Source:	Architecture Deliverables	Ver:	3
Title:		UxVs should be able to inform testbed about their CPU usage							
Description:		UxVs should periodically publish their CPU usage using the eu.rawfie.uxv.CpuUsage message							
Additional Info (comments):		See architecture deliverable D4.5							
Component or Subsystem									
Refines/Replaces		Refines UXV-NOD-005							

Id:	UXV-INT-008	Type:	FUNC	Importance (priority):	HIGH	Source:	Architecture Deliverables	Ver:	3
Title:		UxVs should be able to inform testbed about their on-board storage							
Description:		UxVs shall periodically publish their on-board storage usage using the eu.rawfie.uxv.Storage message							
Additional Info (comments):		See architecture deliverable D4.5							
Component or Subsystem									
Refines/Replaces		Refines UXV-NOD-005							

Id:	UXV-INT-009	Type:	FUNC	Importance (priority):	HIGH	Source:	Architecture Deliverables	Ver:	3
Title:		UxVs should be able to inform testbed about their fuel storage							
Description:		UxVs shall periodically publish their fuel usage using the eu.rawfie.uxv.FuelUsage message							
Additional Info (comments):		See architecture deliverable D4.5							
Component or Subsystem									

Refines/Replaces	Refines UXV-NOD-005

Id:	UXV-INT-010	**Type:**	FUNC	**Importance (priority):**	HIGH	**Source:**	Architecture Deliverables	**Ver:**	3
Title:		UxVs should be able to inform testbed about their orientation (attitude)							
Description:		UxVs shall periodically publish their orientation using the eu.rawfie.uxv.Attitude message							
Additional Info (comments):		See architecture deliverable D4.5							
Component or Subsystem									
Refines/Replaces		Refines UXV-NOD-005							

Id:	UXV-INT-011	**Type:**	FUNC	**Importance (priority):**	MEDIUM	**Source:**	Architecture Deliverables	**Ver:**	3
Title:		UxVs should be able to inform testbed about their velocity and acceleration							
Description:		UxVs shall periodically publish velocity and acceleration information. The expected information depends on the type of device and may include one or more of the following: • eu.rawfie.uxv.LinearVelocity message (mandatory) • eu.rawfie.uxv.LinearAcceleration • eu.rawfie.uxv.AngularVelocity message							
Additional Info (comments):		See architecture deliverable D4.5 for more details on each message format							
Component or Subsystem									
Refines/Replaces		Refines UXV-NOD-005							

Id:	UXV-INT-012	**Type:**	FUNC	**Importance (priority):**	HIGH	**Source:**	Architecture Deliverables	**Ver:**	3
Title:		UxVs shall periodically publish a digest of their scalar sensor readings							

Description:	UxVs shall periodically publish a digest of their scalar sensor readings using the eu.rawfie.uxv.SensorReadingScalar message. The supplied information should contain at least: • measured value • unit value
Additional Info (comments):	See architecture deliverable D4.5
Component or Subsystem	Refines UXV-NOD-005
Refines/Replaces	

5.3.5 UxV Network and Communication category

- Updated additional info in 3 requirements (UXV-NET-005, UXV-NET-006, UXV-NET-007)
- 1 new requirement added (UXV-NET-010)
- All remaining version 2 requirements remain valid and intact.

Id:	UXV-NET-005	Type:	FUNC	Importance (priority):	MEDIUM	Source:	Consortium	Ver:	1
Title:		UxV network interface management							
Description:		The UxV shall be able to detect, configure, control and use the network interfaces installed on the UxV specifically for communicate with the RAWFIE components.							
Additional Info (comments):		A UxV interacts with the RAWFIE Network Controller through the network interface management. This allows for the coordination of the communication among the UxVs and the testbed.							
Component or Subsystem		UxV node							
Refines/Replaces									

Id:	UXV-NET-006	Type:	FUNC	Importance (priority):	MEDIUM	Source:	Consortium	Ver:	1
Title:		UxV communication interoperability with RAWFIE (incoming)							

Description:	The UxV shall be able to receive and de-capsulate incoming messages from the Testbed, and to deliver them to the relevant on-board component.
Additional Info (comments):	The UxV will be accessed as a resource through the same means using the available communication channels and the RAWFIE data bus.
Component or Subsystem	UxV node
Refines/Replaces	

Id:	UXV-NET-007	Type:	FUNC	Importance (priority):	MEDIUM	Source:	Consortium	Ver:	1
Title:		UxV communication interoperability with RAWFIE (outgoing)							
Description:		The UXV shall be able to encapsulate and send messages originating from on-board components to the RAWFIE platform via the Testbed.							
Additional Info (comments):		The UxV will access the testbed resources using the available communication channels and the RAWFIE data bus.							
Component or Subsystem		UxV node							
Refines/Replaces									

Id:	UXV-NET-010	Type:	FUNC	Importance (priority):	HIGH	Source:	Consortium	Ver:	3
Title:		The primary communication channel of the node should support IPv4/IPv6 protocol stack.							
Description:		Communication between UxV and RAWFIE platform should support message exchanges through a message bus over an IP network. If the network interfaces used by UxV manufacturer does not support the above protocol, a bridge must be deployed in testbed site translating messages to/from UxV from proprietary format to IP network compliant.							
Additional Info (comments):									
Component or Subsystem		UxV node							
Refines/Replaces									

5.3.6 UxV Sensor and Localisation category

- 1 requirement updated (UXV-SEN-001)
- All other version 2 requirements remain valid and intact

Id:	UXV-SEN-001	Type:	FUNC	Importance (priority):	HIGH	Source:	Iteration1 Exp	Ver:	2
Title:		Each UxV node should tag timing capability to each sensor readings							
Description:		Sensors should provide to RAWFIE system measurement points, namely sensor information together with an associated timestamp.							
Additional Info (comments):									
Component or Subsystem		UxV node							
Refines/Replaces		TB-G-005, TB-R-009							

5.3.7 UxV On-board storage category

- All version 2 requirements remain valid and intact.

5.3.8 UxV On-board processing category

The on-board processing aims at connecting data streams to on-board processing algorithms and publish the resulting output after checking for sufficient computing and energy resources. Allow the installation of new data processing algorithm and keep a registry.

- 1 requirement updated (UXV-PRC-005)
- All other version 2 requirements remain valid and intact

Id:	UXV-PRC-005	Type:	FUNC	Importance (priority):	HIGH	Source:	Iteration1 Exp	Ver:	2
Title:		Each UxV node shall be able to keep position while waiting for new instructions.							
Description:		Each UxV node shall provide the possibility to keep its position (either stopped in a location, or moving within a contained radius) as default option while waiting for new instructions from the RAWFIE software toolchain.							

Additional Info (comments):	While system like UGVs usually stay at a fixed position when not actuated, other systems like USVs or UAVs are unable to keep position (not the case for rotary wing UAVs). This happens for UxV nodes that are underactuated. To ensure safety and guarantee nodes are kept within network reach, each UxV shall have a built-in software routine that prevents drifting from a defined region.
Component or Subsystem	UxV node
Refines/Replaces	

Id:	UXV-PRC-006	Type:	FUNC	Importance (priority):	MEDIUM	Source:	Consortium	Ver:	3
Title:		UxVs shall be capable of processing sensor data in order to summarize large sensor data-sets.							
Description:		UxVs shall be able to process sensor data and perform functions such as adding to a set, comparing with the average value, comparing value within limits, extracting mean value. This shall enable UxVs to send sensors data when needed in accordance with a predefined schedule and limit network traffic.							
Additional Info (comments):									
Component or Subsystem		UxV node							
Refines/Replaces									

5.3.9   UxV Management category

- All version 2 requirements remain valid and intact.

5.4   Ethics and Security Requirements

In the table below we present requirements that directly or indirectly relate to ethics or security/safety issues. The reader is prompted to refer also to the corresponding section in D3.2 ([3]). Traceability between versions is also provided

Iteration 3	Iteration 2	Iteration 1
	PT-GEN-R-002	
PT-GEN-R-005		PT-NF-001
PT-BOO-T-014		PT-NF-002
	PT-SYM-T-001	PT-NF-007
	PT-EXV-S-001	PT-L-001
PT-BOO-S-012	PT-BOO-T-012	PT-B-005
PT-BOO-S-013		PT-NF-002

	PT-LAU-S-004	PT-L-002
	PT-LAU-S-005	PT-L-002
	PT-SYM-S-003	PT-NF-007
	PT-SYM-S-004	PT-NF-007
TB-GEN-R-004		TB-G-002
	TB-GEN-R-007	TB-G-002
TB-NEC-004		TB-NF-G-006
TB-REC-002		TB-G-008 , PT-B-005
TB-MAN-010		
UXV-NOD-006		TB-NF-G-004
	UXV-STO-003	
	UXV-PRC-002	TB-R-002
UXV-MGT-002		TB-NF-R-003
		TB-NF-G-002

Table 3: Requirements that relate to security/safety/ethics (including traceability between iterations)

6 Mapping between risks, mitigation strategies and software requirements

The following table represents the traceability mapping between risks, corresponding mitigation strategies and derived / related software requirements in this deliverable. Risks were defined during WP1 risk analysis activities. Some risks are not presented here since they are irrelevant to the software development activities and platform operation..

Risk ID	Risk description	Severity	Mitigation strategies	Related requirement(s) in D3.3
1	EDL limitations prohibit the execution of feasible experiments or permit the execution of infeasible experiments	4 - Slight	1. Software: give the experimenters the opportunity to define experiment commands in more details, and remove commands that probably allow confusion or lead to infeasible scenarios to experimenters during the experiments definition; 2. Software: definition of more "strict" validation rules and use of efficient notifications (warnings and error messages) that will inform experimenters for infeasible scenarios.	PT-EXA-T-003 PT-EXA-T-004 PT-EXA-T-005 PT-EXA-T-009 PT-EXA-T-0014 PT-EXA-T-0015 PT-EXA-T-0018
2	Poor documentation could lead to a low RAWFIE utilisation rate	4 - Slight	1. The consortium will pay particular attention to the documentation preparation, also through the realisation of a dedicated wiki;	Existence of Wiki Tool and corresponding reqs PT-WIK-T-001 PT-WIK-T-002 PT-WIK-T-003 PT-WIK-T-004
3	The synchronisation between the EDL textual and visual could not be performed	4 - Slight	Software: The consortium will implement custom code and extend the existing to secure the synchronization between the editors.	PT-EXA-T-017
5	Improper failure in the validation of EDL scripts	4 - Slight	1. Software: Careful selection of the validation rules and use of additional rules to cover any possible flaw in the definition of the experiments. Also careful design of the possible experimenters scripts that can be generated	PT-EXV-S-001 PT-EXV-S-002 PT-EXV-S-003
6	The EDL compiler could not generate the appropriate format for the UxVs nodes	4 - Slight	1. Solved at architectural and software level by a) providing requirements and specifications for the integration of UxVs in RAWFIe and b) proper RAWFIE services implementation	UXV-GEN-001 (also all interface category requirements)
7	Extra unforeseen costs for UxVs that need to be insured for third party damage that may be caused (Organisational)	4 - Slight	This is especially true for UAVs that is obligatory to be insured against damage that may cause during a fall. Depending on the case this may imply an additional cost that was not initially considered. The mitigation strategy is that this potential implications are clearly exposed in the contracts with 3rd parties joining the RAWFIE federation and during Open Calls recruitment	TB-GEN-R-011
8	Malevolent experimenter attempts spurious booking (almost all resources of a testbed and/or for a very large timeframe)	4 - Slight	1. The implemented platform services will ensure that such kind of reservations are prohibited (limits may occur on both time and number of devices allowed for single user booking) 2. Reservation process for an experimenter should be reviewed by an appropriate testbed operator before being approved; 3. The initial Experimenter X509 certificate approval (signing) involves human intervention that guarantees that only legitimate experimenters are granted access to booking mechanisms. This will allow the traceability of any malicious behaviour of the experimenters. The rest reservation process is automated and human intervention is not necessary	PT-BOO-S-012 PT-BOO-S-013 PT-LAU-S-0005
10	RAWFIE cloud infrastructure collapse	3 - Moderate	1. Cloud environment realised with specific load balancing and failover strategies, so that system failures can be recovered in short time; 2. For collapses that may be due to performance reasons, the architecture was designed having scalability in mind, so that the platform can handle increasing loads	PT-NF-010 (still valid from iteration 1) UXV-PRX-002 (addresses the need to have collective emergency strategies for autonomous "return-to-safe-

				home")
11	Risks of UxVs damages during an experiment	3 - Moderate	1. UxVs own control / collision avoidance strategies; 2. Use of the proposed RAWFIE UxVs control solution and algorithms (Resource Controller - RC); 3. Ensure that specific "Emergency procedures", automatic or involving humans, are in place on each Testbed	UXV-PRC-002 UXV-MGT-002 TB-GEN-R-010 (updated to mention remote pilot) TB-REC-001 TB-REC-002 TB-REC-003 TB-REC-004 TB-REC-005 TB-REC-006
12	Imposed delay on experiment execution due to technical and technological issues	4 - Slight	1. Suitable technological and architectural choices related to platform deployment, e.g. suitable communication technologies and envisioning of local message broker (message bus) nodes in each testbed site, so that control commands are intercepted and addressed locally	UXV-NET-009 TB-GEN-R-014
13	Collisions between UxVs occurred (Technical)	3 - Moderate	1. Own UxVs controlling mechanisms i.e. usage of UxV proximity sensors and user input (for detecting crossing planned routes by UxVs) during experiment execution; 2. UxVs controlled using the RAWFIE Resource Controller	UXV-PRC-002 (for collision avoidance) Definition of Proximity component in general And particularly UXV-PRX-005 Resource Controller requirements (TB-REC-001 TB-REC-002 TB-REC-003 TB-REC-004 TB-REC-005 TB-REC-006)
14	Two or more experiments interfere with each other and do not allow one or more experiments to continue	4 - Slight	1. Before starting an experiment or applying a user action, it should be verified by other running experiments. 2. RAWFIE will provide mechanisms to ensure the exclusive use of resources during an experiment	T-BOO-017 Generally implied by Booking Tool/Service & Launching service design
16	Missing data or failure in correct timing of data from UxVs (due to communication link loss, hardware failure)	3 - Moderate	The risk can be mitigated at the system level using the following strategies: 1. Graceful transition into a more robust behaviour, albeit degraded; 2. With respect to data exchange, the UxV can alternatively use a less performing, alternative communication interface (provided by the Proximity component) for exchanging critical data. Required: notification of the fault to the involved component and specification of the alternative behaviour of the components. Associated action: corrective action, diagnostic and selection of the fallback scenario. This mechanisms must be implemented for any scenario, into every component that is considered as critical.	UXV-NET-002 (for time synchronization) TB-NEC-005 Proximity component offers a back-up solution for isolated UxV (UXV-PRX-004) or for temporary storage (UXV-PRX-006)

17	Not detailed specification of requirements during the Open Calls, leading to a) newcomers not being able to connect their UxVs / Platform to the platform in the proper way b) Higher costs in terms of resources (for consortium partners and newcomers) for solving the derived issues	3 - Moderate	1. Detailed requirements for connecting testbeds and UxVs to the RAWFIE platform have been prepared and provided in the second iteration deliverables D4.4 (Common Testbed Interface Requirements) and D4.5 (UxV Node (Adaptor) specifications). These have been provided to newcomers, and then discussed together with them to be sure no particular issues will arise. These specifications will also be improved in the 2nd Open Call	UXV-GEN-001 UXV-NOD-005 UXV-INT-001 to UXV-INT-012
18	Inoperable RAWFIE vehicles due to lack of maintenance	3 - Moderate	Testbed operators responsibility. This is covered as part of the agreement signed with the external partners, ensuring that the testbeds / UxVs will be available for a certain number of days, and that prompt notifications will be made available in case of problems	UXV-MGT-006 TB-GEN-R-006
19	Failure in the integration of new UxV models and testbed facilities with the existing infrastructure (Organisational)	3 - Moderate	1. Modification on existing infrastructure and model requirements, based on the integration requirements and guidelines provided by the consortium	UXV-GEN-001, UXV-NOD-005 (at UxV level) TB-GEN-R-001, TB-GEN-R-008 , TB-GEN-R-009 (at Testbed level)
21	The UxVs cannot perform the experiments due to bad weather conditions	3 - Moderate	In principle, weather forecasts must be always available on each testbed site and should be taken into consideration during the booking process; In case the booking is performed quite in advance and forecasts are not reliable, other solutions are: a) The Experimenter is notified and asked if he/she wants to postponed the experiment, or b) The Experiment will be performed through simulated data	TB-MOM-005
22	Wireless interference and congestion (in free band spectrum) could make the UAV to not operate properly	3 - Moderate	Two cases: the fault occurs but the UAV continues to operate properly, possibly by switching to a degraded mode; the fault happens in one of the UxVs (that means that failure occurred at the level of the UxV, but the RAWFIE system and experiment can still continue the mission). Other UxVs must be notified of the fault and switch to a pre-defined mode (e.g. reduced quality of service). In the worst case, the system must reach a safe mode (e.g. the UxV return safely to base). 1. Possible mitigations of the cause of the fault include the use of robust protocols, CRC checks, acknowledgement and retransmission strategies. 2. Fallback can be: graceful transition into a more robust, albeit degraded mode; parallel operation of a robust, maybe less performing, interface for safety related data (Proximity component); allow multi-hop operation so that the communication link can be totally or partially (degraded mode) recovered using another UxV as a relay.	UXV-NOD-006 (replacing TB-NF-G-004) UXV-PRX-002 Network Controller requirements (TB-NEC-002, TB-NEC-004)
23	Failure in the integration of new UxV models and testbed facilities with the existing infrastructure (Technical)	3 - Moderate	1. Specification of requirements and guidelines for the integration of new Testbeds and UxVs (see D4.4 and D4.5), including the specification of the interfaces and data formats for information exchange	UXV-GEN-001, UXV-NOD-005 (at UxV level) TB-GEN-R-001, TB-GEN-R-008 , TB-GEN-R-009 (at Testbed level)
24	Malfunctioning of a sensor causes the user to receive wrong data about the execution of the experiment	3 - Moderate	1. Usage of UxV sensor feedback to detect sensor failures; 2. Impose periodic calibration of UxVs sensors & test of sensors prior to experiment. It can be even part of the prior-to-experiment standard operating procedure	UXV-MGT-004
25	Sporadic errors occur on the wireless link for short periods	3 - Moderate	See the case 1 of #13. The communication link quality may degrade abruptly or smoothly. 1. The UxV must adapt its behaviour consequently and eventually use the secondary wireless communication system offered by the proximity component. Detection of the fault can be provided by missing acknowledgements or nacks, or by "livelist"mechanisms. Retransmission is typical approach to recover from failure, but it introduces more latency in the communication. 2. Fallback can be: Graceful transition into a more robust, albeit degraded mode; Parallel operation of a robust, less performing interface for safety related data (e.g. 3G in addition to Wifi); Multi-hop operation so that the communication link can be totally or partially recovered using another UxV as a relay.	UXV-NET-004 TB-NF-G-003 UXV-PRX-002
26	A UxV resource booked during experiment authoring isn't available at experiment launching due to malfunction	3 - Moderate	Notifications / warnings to the users, asking to rearrange the experiment script; 2. Specific mechanisms to adapt the experiment automatically	PT-LAU-S-014

27	The (wireless) communication between the UxV and the Resource Controller and the Network Controller is broken	3 - Moderate	See #13, in which this corresponds to the second case of #13; 2. Another option is to use the secondary wireless interface (i.e. the low-power short range wireless connectivity offered by the Proximity component); 3. From UxV side there is always dilemma, should UxV stop/abort mission/go home or should UxV continue in case of lack of remote supervision. Common mitigation strategy is to implement no-comms. function into the UxV control system	UXV-NOD-006 (replacing TB-NF-G-004) UXV-PRX-002 Network Controller requirements (TB-NEC-002, TB-NEC-004)
30	Bugs in the navigation software lead to collisions between UxVs	3 - Moderate	1. Own UxVs controlling mechanisms i.e. usage of UxV proximity sensors and user input (for detecting crossing planned routes by UxVs) during experiment execution; 2. UxVs controlled using the RAWFIE Resource Controller; 3. Ensuring that each Testbed has a planned Emergency procedure	UXV-PRX-003 and UXV-PRX-005 TB-REC-001, TB-REC-002, TB-REC-003, TB-REC-004, TB-REC-005, TB-REC-006 However generally it can be addressed only by testing and SW verification process.
31	UxVs constraints: Lack of controlling capabilities, related to technical issues (e.g. high latency, low quality communication), may affect the correct execution of experiments and/or the operational safety of the UxVs	3 - Moderate	The consortium is taking seriously the potential related issues. Mitigation strategies are: 1. Investigation of any particular constraints that have not been highlighted yet with the newcomers, and converting them to specific rules that will be added to the experiments' validation process, to be cross-checked with the requested experiment's script at booking time, before the execution itself; 2. Performances measurements, and identification of possible performance issues (throughput, latency) affecting the experiment and the safety of the UxVs and the environment ; 3. Especially for experiments involving UAVs a "man in the loop" may be required, i.e. the presence of humans which supervise the experiments and act in case of problems	For man in the loop involvement, see also risk #45 Generally it can be addressed only be performance testing and proper selection of implementation choices
32	Risks related to system hacking / Gain unauthorised access to remote UxVs piloting / Cryptography mechanisms failure, and specifically to Confidentiality, and Data Integrity	3 - Moderate	1. Use of robust authentication & authorisation mechanisms (AAI for resource booking lifecycle based on X.509 certificates mechanisms); 2. Intrusion detection and controlling through the System Monitoring tool, ensuring data integrity i.e. that data is not modified in an unauthorised manner during processing, storage, and transmission	PT-GEN-R-005 UXV-NOD-006 (replacing TB-NF-G-004) UXV-MGT-002
33	It is impossible to operate UxV remotely	3 - Moderate	1. Own UxVs controlling mechanisms i.e. usage of UxV proximity sensors and user input (for detecting crossing planned routes by UxVs) during experiment execution; 2. UxVs controlled using the RAWFIE Resource Controller; 3. Ensuring that each Testbed has a planned Emergency procedure and e.g.a backup communication link exists with e.g. home function	TB-GEN-R-007 (at testbed level) UXV-MGT-002 UXV-NET-001 UXV-PRX-002
34	UxV private area (intimacy) not respected	3 - Moderate	1. Software level: legal and other rules related to the specific testbed conditions, as part of the experiments' validation rules and, therefore, avoid such risks to happen; 2. Conversely, similar critical situations shall be managed in a systematic way or through specific instructions specified in the mission; 3. Emergency procedures must be imposed to be present on each testbed site, either automatic or involving "man in the loop" actions	Testbed Emergency procedures TB-GEN-R-007, TB-GEN-R-004 UXV-PRX-003 and UXV-PRX-005 TB-GEN-R-010 TB-GEN-R-011 See also section 4.1 related to "human in the loop"

35	Errors occur on the wireless link for long periods	3 - Moderate	See the case 1 of #13. In the considered case, the communication link quality degrades abruptly for long periods. The UxV must adapt its behaviour consequently during the communication is re-established. During this period, it can rely on its own or use the secondary wireless communication system offered by the proximity component.	UXV-NET-004 TB-NF-G-003 UXV-PRX-002
37	Collisions between UxVs occurred (Behavioural)	4 - Slight	1. Own UxVs controlling mechanisms i.e. usage of UxV proximity sensors and user input (for detecting crossing planned routes by UxVs) during experiment execution; 2. UxVs controlled using the RAWFIE Resource Controller	See #13
40.1	In experiments where multiple different UxVs are used within the same Testbed (e.g a Swarm of UxVs by different manufacturers) the risk may arise, that the different UxVs will not be able to coordinate each other for the proper execution of a specific mission, including the proper addressing of collision avoidance issues (safety)	4 - Slight	1. Harmonisation in the design phase, with the provision of the "UxV Node" concept, i.e. the software Adaptor with all the needed functionalities and interfaces to communicate with the rest of the RAWFIE platform. This Adaptor must be implemented by each UxV manufacturer for connection to RAWFIE, regardless of the testbed where the UxV will run. 2. Relying on the control capabilities provided by the Resource Controller implemented in the project, therefore imposing to the UxVs manufactures, the ability to communicate with the RAWFIE RC, to understand and follow ALL the control commands provided	UXV-PRC-004 TB-REC-001 TB-REC-002 TB-REC-003 TB-REC-004 TB-REC-005 TB-REC-006
40.2	In experiments where multiple different UxVs are used within the same Testbed (e.g a Swarm of UxVs by different manufacturers) the risk may arise, that the different UxVs will not be able to coordinate each other for the proper execution of a specific mission, including the proper addressing of collision avoidance issues (safety)	4 - Slight	1. Harmonisation in the design phase, with the provision of the "UxV Node" concept, i.e. the software Adaptor with all the needed functionalities and interfaces to communicate with the rest of the RAWFIE platform. This Adaptor must be implemented by each UxV manufacturer for connection to RAWFIE, regardless of the testbed where the UxV will run; 2. Relying on UxVs own control capabilities	UXV-PRC-004 UXV-PRC-003 (regarding task planning in real time)
41	Unattended operation of UxVs within a testbed may not be allowed due to security constraints or limitations imposed by legislation.	3 - Moderate	Testbed sites will require additional personnel with special skills to be available during experiments' execution	TB-GEN-R-010 TB-GEN-R-011 See also section 4.1 related to "human in the loop"
42.2	Upcoming and existing regulatory frames preventing some or all of the planned experiments. Full compliance with any applicable regulatory requirements is essential, particularly for UAVs. Legal issues in UAV flights reduces experimentation impact of the RAWFIE platform	4 - Slight	Testbed owners have to provide specific constraints for each country; These should be inserted in the RAWFIE platform and experimenters may check testbed constraints for particular testbeds prior to experiment booking / execution	TB-GEN-R-010 TB-GEN-R-011 (advertise restrictions) TB-GEN-R-012 TB-GEN-R-013, PT-BOO-T-016 (time of operation) PT-BOO-S-012 (limits max number of reserved resources)
43	Testbed Constraints do not allow the execution of a particular experiment leading to late experiment issues discovery and users dissatisfaction	4 - Slight	Testbed owners have to provide specific constraints for each country; These should be inserted in the RAWFIE platform and experimenters may check testbed constraints for particular testbeds prior to experiment booking / execution	See #42.2
45	Failure and safety risks due to the lack of fail-safe operations / emergency procedures of the used UxVs	3 - Moderate	Impose the verification of the fail-safe operations, including but not limited to man in the loop approaches (e.g. the use of specialized personnel able to apply a predefined "emergency procedure"). Testbed sites will require additional personnel with special skills to be available during experiments' execution	TB-GEN-R-007 TB-GEN-R-010 (see also section 4.1 related to

				"human in the loop")
	-010			TB-MAN-010
				UXV-MGT-002
47	UxVs constraints: the size of UxV resources (too small for covering one area) prohibits the execution of large scale experiments	3 - Moderate	In cases when the capabilities of the available resources are not enough to execute particular large scale experiments, the use of swarms of cooperating drones is envisaged	Experimenter should be able to view device characteristics before issuing an experimenter. PT-DIR-S-001, PT-DIR-S-002, PT-DIR-S-003, PT-DIR-S-004

Table 4: Risks, mitigation strategies and software requirements addressing them

7 Overview requirement table and traceability mapping

In this section we provide a traceability matrix which can be used to track requirements defined in the 3 iterations of the requirements process. Summarizing, there are:

- 54 new requirements defined in this version of the deliverable indicated by a version number 3 and a bold ID field.
- 10 requirements discarded (as obsolete, already addressed or because they were moved to another module with changed ID). These requirements are strikethrough in the table and do not have an incremental number in the first column.
- In 41 requirements there were updates in their title or/and their fields. These requirements retain a version number of 2 and their IDs are present in the "*ID*" column.
- 152 requirements remain valid and unchanged as defined during the previous version of the deliverable. The ID column of this requirement is empty (their initial ID can however be seen in the "*iteration 2 Reqs*" column)

No	ID	Component	Category	Title	Type	Priority	Source	Version	iteration 2 Reqs	Iteration 1 Reqs	Iteration 1 Reqs (2)
1	PT-GEN-R-001	General	PLATFORM	RAWFIE Platform should adopt Sliced Federated Architecture (SFA)	FUNC	HIGH	Iteration1 Exp	2	PT-GEN-R-001	PT-P-001	PT-NF-008
2		General	PLATFORM	RAWFIE platform shall support various roles with different privileges at every level of access.	FUNC	HIGH	DoW	2	PT-GEN-R-002	PT-GEN-002	
3		General	PLATFORM	The RAWFIE Data model should include all basic entities that are used or/and exchanged by the various components of the RAWFIE Platform	DATA	HIGH	Architecture Deliverables	2	PT-GEN-R-003	PT-P-005	
4		General	PLATFORM	RAWFIE platform shall provide appropriate data storage for information that needs to be persisted, or used after an experiment completion (e.g. analysed by the various tools and services).	DATA	HIGH	Iteration1 Exp	2	PT-GEN-R-004	PT-P-005	
5	**PT-GEN-R-005**	General	PLATFORM	RAWFIE platform shall support secure data exchange based on certificates	SEC	HIGH	Consortium	**3**	PT-NF-001		
6		Web Portal Tool	PLATFORM	A web portal interface shall be provided to the users of the platform to access almost all main functionalities.	FUNC	HIGH	DoW	2	PT-WEB-P-001	PT-GEN-001	
7		Web Portal Tool	PLATFORM	Web portal usage shall be allowed only to authenticated users	FUNC	HIGH	DoW	2	PT-WEB-P-002	PT-GEN-003	
		~~Web Portal Tool~~	~~PLATFORM~~	~~A tutorial or similar type of documentation shall be provided to the users of the platform~~	~~FUNC~~	~~HIGH~~	~~DoW~~	~~2~~	~~PT-WEB-P-003~~	~~PT-P-002~~	-
8	**PT-WIK-T-001**	Wiki Tool	PLATFORM	A tutorial or similar type of documentation shall be provided to the users of the platform	DATA	LOW	DoW	**3**	PT-WEB-P-003	PT-P-002	
9	**PT-WIK-T-002**	Wiki Tool	PLATFORM	The Wiki shall use the user credentials from the User & Rights repository	DATA	HIGH	Consortium	**3**	NEW		
10	**PT-WIK-T-003**	Wiki Tool	PLATFORM	The wiki should support different languages to provided manuals to customers from different regions.	DATA	MEDIUM	Consortium	**3**	NEW		
11	**PT-WIK-T-004**	Wiki Tool	PLATFORM	The Wiki should be easy to use and edit	DATA	MEDIUM	Consortium	**3**	NEW		
12		Booking Tool	PLATFORM	Booking Tool should allow booking of resources at the experimenter level for a specified period and for selected resources	FUNC	HIGH	Iteration1 Exp	2	PT-BOO-T-001	PT-B-001	
13	PT-BOO-T-002	Booking Tool	PLATFORM	Booking Tool functionality shall be compatible with the SFA architecture and the notion of slices reservations	FUNC	HIGH	Iteration1 Exp	2	PT-BOO-T-002	PT-B-001	
14		Booking Tool	PLATFORM	Booking Tool should delegate all its actions related to Booking of a resource to the Booking Service	FUNC	HIGH	Architecture Deliverables	2	PT-BOO-T-003	PT-B-001	
15		Booking Tool	PLATFORM	Booking Tool shall also interact with the Testbeds Directory Service in order to retrieve information on unallocated testbed resources	FUNC	HIGH	Iteration1 Exp	2	PT-BOO-T-004	PT-B-001	
16		Booking Tool	PLATFORM	Booking Tool should communicate with the underline services using JSON formatted messages (through an RPC or REST API)	FUNC	HIGH	Iteration1 Exp	2	PT-BOO-T-005	PT-B-001	
17		Booking Tool	PLATFORM	Booking Tool should provide appropriate functionality for viewing the reservations of a user/experimenter	FUNC	HIGH	Architecture Deliverables	2	PT-BOO-T-006	PT-B-002	
18	PT-BOO-T-007	Booking Tool	PLATFORM	Booking Tool should allow editing of Reservations defined in a future time	FUNC	HIGH	Architecture Deliverables	2	PT-BOO-T-007	PT-B-002	

#	ID	Component	Type	Description	Cat	Priority	Source	It	Code	Ref1	Ref2
19	PT-BOO-T-008	Booking Tool	PLATFORM	Booking Tool should allow cancellation of present and future defined Reservations	FUNC	HIGH	Architecture Deliverables	2	PT-BOO-T-008	PT-B-002	
20		Booking Tool	PLATFORM	Booking Tool should allow creation of bookings through an intuitive UI interface	FUNC	HIGH	Architecture Deliverables	2	PT-BOO-T-009	PT-B-002	
21	PT-BOO-T-010	Booking Tool	PLATFORM	Appropriate notification mechanism should be provided to the user in case status of reservation request is not directly available.	FUNC	HIGH	Architecture Deliverables	2	PT-BOO-T-010	PT-B-002	PT-B-008
22		Booking Tool	PLATFORM	Booking Tool may provide assistance of feedback to the potential experimenter during the booking process	FUNC	MEDIUM	Other	2	PT-BOO-T-011	PT-B-005	
		~~Booking Tool~~	~~PLATFORM~~	~~Booking functionality should provide means to ensure fairness in resource booking as well as protect for malevolent actions that a user may perform.~~	~~FUNC~~	~~HIGH~~	~~Iteration1 Exp~~	~~2~~	~~PT-BOO-T-012~~	~~PT-B-005~~	
		~~Booking Tool~~	~~PLATFORM~~	~~RAWFIE platform should allow virtualization of available UxVs resources during reservation process~~	~~FUNC~~	~~LOW~~	~~Consortium~~	~~2~~	~~PT-BOO-T-013~~	~~PT-B-006~~	~~-~~
23	PT-BOO-T-014	Booking Tool	PLATFORM	Booking Tool UI interface should be protected with appropriate authorization and differentiate available actions and view based on user and its assigned role	FUNC	HIGH	Iteration2 Exp	3	NEW	PT-NF-002	
24	PT-BOO-T-015	Booking Tool	PLATFORM	Booking Tool should be integrated in the RAWFIE web portal.	FUNC	HIGH	Iteration2 Exp	3	NEW		
25	PT-BOO-T-016	Booking Tool	PLATFORM	Booking Tool should limit reservation of resources during testbeds operational hours	FUNC	HIGH	Iteration 2 Exp	3	NEW		
26	PT-BOO-T-017	Booking Tool	PLATFORM	Booking Tool should prohibit reservation of the same resource by different users at overlapping time periods	FUNC	HIGH	Iteration 2 Exp	3	NEW		
27		System Monitoring Tool	PLATFORM	Listing and/or visualisation of current system health status shall be available	FUNC	HIGH	Iteration1 Exp	2	PT-SYM-T-001	PT-NF-007	
28		System Monitoring Tool	PLATFORM	The current system health status should be grouped thematically.	FUNC	MEDIUM	Iteration1 Exp	2	PT-SYM-T-002	NEW	
29		System Monitoring Tool	PLATFORM	Filtering of the accessible component health statuses by user roles/rights should be possible.	FUNC	MEDIUM	Iteration1 Exp	2	PT-SYM-T-003	NEW	
30		System Monitoring Tool	PLATFORM	The health statuses webpage should be updated automatically.	DATA	MEDIUM	Iteration1 Exp	2	PT-SYM-T-004	NEW	
31		System Monitoring Tool	PLATFORM	The health status information should include a severity indication and possibly textual information with additional details.	FUNC	HIGH	Iteration1 Exp	2	PT-SYM-T-005	NEW	
32		Resource Explorer Tool	PLATFORM	The UI interface shall illustrate testbed and UxV information of the RAWFIE federation that the experimenters should take advantage of	FUNC	HIGH	DoW	2	PT-REE-T-001	PT-P-001	PT-P-003
33		Resource Explorer Tool	PLATFORM	Registration of testbeds and UxVs may be possible via the Web Portal	FUNC	LOW	Iteration1 Exp	2	PT-REE-T-002	PT-P-004	
34		Resource Explorer Tool	PLATFORM	Resource Explorer tool shall allow for fine-grained resources' searches	FUNC	MEDIUM	Consortium	2	PT-REE-T-003	PT-A-016	
35		Resource Explorer Tool	PLATFORM	Link to the Booking Tool should be provided	FUNC	MEDIUM	Consortium	2	PT-REE-T-004	PT-P-001	PT-P-003
36	PT-EXA-T-001	Experiment Authoring Tool	PLATFORM	Experiment Description Language (EDL) shall be used as a language for the definition of experiment scenarios	FUNC	HIGH	Iteration1 Exp	2	PT-EXA-T-001	PT-A-001	
37		Experiment Authoring Tool	PLATFORM	The EDL shall allow the definition of all necessary requirements for an experiment	FUNC	HIGH	Iteration1 Exp	2	PT-EXA-T-002	PT-A-002	
38		Experiment Authoring Tool	PLATFORM	For each defined experiment specific metadata, i.e. name, version, date and description shall be defined.	FUNC	MEDIUM	Consortium	2	PT-EXA-T-003	PT-A-002	
39		Experiment Authoring Tool	PLATFORM	An experimenter shall be able to provide initial conditions and/or configuration parameters for an experiment		MEDIUM	Consortium	2	PT-EXA-T-004	PT-A-009	
40		Experiment Authoring Tool	PLATFORM	An experimenter shall be able to manage/guide the available booked resources during experiment authoring	FUNC	HIGH	Scenario	2	PT-EXA-T-005	PT-A-004	PT-A-005
41		Experiment Authoring Tool	PLATFORM	An experimenter shall be able to define the type of information to be gathered and/or stored by UxV resource(s)	FUNC	HIGH	Iteration1 Exp	2	PT-EXA-T-006	PT-A-006	
42		Experiment Authoring Tool	PLATFORM	An experimenter shall be able to define the type of metrics to be gathered and/or stored during an experiment and/or per UxV resource	FUNC	HIGH	Scenario	2	PT-EXA-T-007	PT-A-007	

#	ID	Component	Category	Description	Type	Priority	Source	It	ID	Ref	Ref2
43		Experiment Authoring Tool	PLATFORM	An experimenter shall be able to provide navigation or movement directives during experiment authoring	FUNC	HIGH	Scenario	2	PT-EXA-T-008	PT-A-008	
44		Experiment Authoring Tool	PLATFORM	An experimenter should be able to create groups of UxVs resources, for which specific directives will apply.	FUNC	MEDIUM	Scenario	2	PT-EXA-T-009	PT-A-010	
45		Experiment Authoring Tool	PLATFORM	A textual editor shall be provided for the authoring of RAWFIE experiments	FUNC	HIGH	DoW	2	PT-EXA-T-010	PT-A-011	
46		Experiment Authoring Tool	PLATFORM	A visual/graphical editor shall be provided for the authoring of RAWFIE experiments	FUNC	HIGH	DoW	2	PT-EXA-T-011	PT-A-012	
47		Experiment Authoring Tool	PLATFORM	Platform shall allow saving, editing and/or deletion of an experiment defined via EDL	FUNC	HIGH	Other	2	PT-EXA-T-012	PT-A-015	
48	PT-EXA-T-013	Experiment Authoring Tool	PLATFORM	The visual editor should allow the definition of movement and location waypoints from a map	FUNC	HIGH	Other	2	PT-EXA-T-013	PT-A-012	PT-A-013
49		Experiment Authoring Tool	PLATFORM	During authoring of an experiment selection of resources should be limited only to the ones previously reserved from the user at the foreseen time of experiment	FUNC	HIGH	Iteration1 Exp	2	PT-EXA-T-014	NEW	
50		Experiment Authoring Tool	PLATFORM	Validation of EDL script should be possible prior to or during saving	FUNC	HIGH	Iteration1 Exp	2	PT-EXA-T-015	PT-L-002	
51		Experiment Authoring Tool	PLATFORM	An experimenter shall have the means to define actions or tasks that should run on a periodic or ad hoc basis during execution of an experiment	FUNC	MEDIUM	Scenario	2	PT-EXA-T-016	PT-L-010	
52	PT-EXA-T-017	Experiment Authoring Tool	PLATFORM	The Visual editor should be synchronized with the Textual Editor	FUNC	HIGH	Iteration 2 Exp	3	NEW		
53		Experiment Monitoring Tool	PLATFORM	Experiment Monitoring Tool shall provide overview of experiments of a user	FUNC	HIGH	DoW	2	PT-EXM-T-001	PT-L-004	
54		Experiment Monitoring Tool	PLATFORM	Experiment Monitoring and Visualisation should be integrated	FUNC	MEDIUM	Iteration1 Exp	2	PT-EXM-T-002	NEW	
55		Experiment Monitoring Tool	PLATFORM	Cancellation of running experiments should be possible via Web Portal	FUNC	MEDIUM	Iteration1 Exp	2	PT-EXM-T-003	NEW	
56		UxV Navigation Tool	PLATFORM	This component will provide to the user the ability to remotely navigate a squad of UxVs through a user friendly interface.	FUNC	HIGH	DoW	2	PT-NAV-T-001	PT-L-008	
57		UxV Navigation Tool	PLATFORM	The tool should provided some validation of user's instructions	FUNC	HIGH	Iteration1 Exp	2	PT-NAV-T-002	NEW	
58		UxV Navigation Tool	PLATFORM	UxV Navigation Tool should be available for the navigation of all moving resources	FUNC	HIGH	DoW	2	PT-NAV-T-003	PT-L-008	
59		UxV Navigation Tool	PLATFORM	UxV Navigation Tool should be available to read from the database a detailed version of the map of the available areas	FUNC	HIGH	Iteration1 Exp	2	PT-NAV-T-004	NEW	
60		Visualisation Tool	PLATFORM	The Visualisation Tool shall allow the visualisation of information about the running experiments, in tabular/graphical form	FUNC	HIGH	Architecture Deliverables	2	PT-VIS-T-001	NEW	
61		Visualisation Tool	PLATFORM	A 3D visualization should be available for the tracking of all moving resources	FUNC	MEDIUM	DoW	2	PT-VIS-T-002	PT-L-006	
62		Visualisation Tool	PLATFORM	The Visualisation Tool may allow visualisation of video streams coming from the experiment, and experiment's camera control	FUNC	LOW	Architecture Deliverables	2	PT-VIS-T-003	NEW	
63	PT-VIS-T-004	Visualisation Tool	PLATFORM	The Visualisation Tool shall provide access to information / features associated to each UxV device on the geographic map	FUNC	HIGH	Architecture Deliverables	2	PT-VIS-T-004	NEW	
64		Visualisation Tool	PLATFORM	The Visualisation Tool shall allow organization and manipulation of multiple geographic layers	FUNC	HIGH	Architecture Deliverables	2	PT-VIS-T-005	NEW	
65	PT-VIS-T-006	Visualisation Tool	PLATFORM	Possibility of Adding/Removing/Updating graphical widgets should be provided	FUNC	MEDIUM	Architecture Deliverables	2	PT-VIS-T-006	NEW	
66	PT-VIS-T-007	Visualisation Tool	PLATFORM	Possibility to display both actual and expected UxVs' route and position should be provided	FUNC	HIGH	Architecture Deliverables	2	PT-VIS-T-007	NEW	
67	PT-VIS-T-008	Visualisation Tool	PLATFORM	Provide information for experiments and allow only experiments to be visualized that are assigned to logged in user	FUNC	HIGH	Architecture Deliverables	3	NEW		

68	PT-DAA-T-001	Data Analysis Tool	PLATFORM	Analysis tool will provide interface to data engine.	FUNC	MEDIUM	Iteration1 Exp	2	PT-DAA-T-001	PT-E-003	PT-E-002
69		Data Analysis Tool	PLATFORM	Analysis tool will provide access to past experiments	FUNC	LOW	Iteration1 Exp	2	PT-DAA-T-002	PT-E-003	PT-E-001
70		Data Analysis Tool	PLATFORM	Analysis tool will provide ability to query message bus streams	FUNC	MEDIUM	Iteration1 Exp	2	PT-DAA-T-003	PT-E-004	
71		Data Analysis Tool	PLATFORM	Analysis tool will provide interface to end running jobs	FUNC	MEDIUM	Iteration1 Exp	2	PT-DAA-T-004	PT-E-003	PT-E-004
72		Data Analysis Tool	PLATFORM	Analysis tool will provide a simple metric selection interface, a view of the result stream & the job status tab	FUNC	MEDIUM	Iteration1 Exp	2	PT-DAA-T-005	PT-E-003	PT-E-002
73	**PT-DAA-T-006**	Data Analysis Tool	PLATFORM	The Analysis Tool will provide an interface for the end-user to write their own code.	FUNC	MEDIUM	Iteration2 Exp	3	PT-DAA-T-001		
74	**PT-DAA-T-007**	Data Analysis Tool	PLATFORM	The Analysis Tool will provide authenticated login	FUNC	MEDIUM	Iteration2 Exp	3	**NEW**		
75	PT-DIR-S-001	Testbeds Directory Service	PLATFORM	The Testbed Directory Service shall provide REST / Web Service API to access to information on all Testbeds registered in RAWFIE	FUNC	HIGH	Architecture Deliverables	2	PT-DIR-S-001	PT-P-003	
76	PT-DIR-S-002	Testbeds Directory Service	PLATFORM	The Testbed Directory Service should provide REST / Web Service API to access to information on all Testbeds registered in RAWFIE according to predefined filters	FUNC	MEDIUM	Architecture Deliverables	2	PT-DIR-S-002	NEW	
77	PT-DIR-S-003	Testbeds Directory Service	PLATFORM	The Testbed Directory Service shall provide REST / Web Service API to access to information about available resources (UxVs) belonging to the testbeds registered in RAWFIE	FUNC	HIGH	Architecture Deliverables	2	PT-DIR-S-003	NEW	
78	PT-DIR-S-004	Testbeds Directory Service	PLATFORM	The Testbed Directory Service should provide REST / Web Service API to access to information on available resources (UxVs) belonging to the testbeds registered in RAWFIE, and according to predefined filters	FUNC	MEDIUM	Architecture Deliverables	2	PT-DIR-S-004	NEW	
79		Testbeds Directory Service	PLATFORM	The Testbed Directory Service shoud provide the possibility to register new testbeds in the RAWFIE platform,as well as to unregister (delete) testbeds from the platform	FUNC	HIGH	Architecture Deliverables	2	PT-DIR-S-005	NEW	
80	PT-DIR-S-006	Testbeds Directory Service	PLATFORM	Some basic query capabilities should be provided	FUNC	MEDIUM	Architecture Deliverables	2	PT-DIR-S-006	PT-A-016	
81		Testbeds Directory Service	PLATFORM	The Testbed Directory Service shall provide the possibility to register new resources belonging to a specific testbed in the RAWFIE platform, as well as to unregister (delete) resources	FUNC	HIGH	Architecture Deliverables	2	PT-DIR-S-007	NEW	
82		EDL Compiler and Validator	PLATFORM	A tool for translating EDL into user directives shall be provided	FUNC	HIGH	DoW	2	PT-CPV-001	PT-A-003	
83		EDL Compiler and Validator	PLATFORM	An experimenter should have the opportunity to use a code generation engine	FUNC	HIGH	DoW	2	PT-CPV-002	PT-A-003	
84		EDL Compiler and Validator	PLATFORM	Experiments defined via EDL shall be validated after their authoring	FUNC	HIGH	DoW	2	PT-CPV-003	PT-A-014	
85		EDL Compiler and Validator	PLATFORM	The compiler and validator should communicate with the authoring tool in order to transfer error indications and hints for solving them	FUNC	HIGH	DoW	2	PT-CPV-004	NEW	
86		Experiment Validation Service	PLATFORM	RAWFIE shall provide a validator to constantly check experiment scenarios during runtime	FUNC	HIGH	DoW	2	PT-EXV-S-001	PT-L-001	
87		Experiment Validation Service	PLATFORM	The validation service should perform syntactic checking	FUNC	HIGH	DoW	2	PT-EXV-S-002	PT-L-001	
88		Experiment Validation Service	PLATFORM	The validation service should perform semantic checking	FUNC	HIGH	DoW	2	PT-EXV-S-003	PT-L-001	
89		Users & Rights Service	PLATFORM	User login credentials checking shall be provided	FUNC	HIGH	DoW	2	PT-USR-S-001	PT-GEN-002	
90		Users & Rights Service	PLATFORM	RAWFIE platform shall support various roles with different privileges at every level of access.	FUNC	HIGH	DoW	2	PT-USR-S-002	PT-GEN-002	
91		Users & Rights Service	PLATFORM	The Users & Rights Service may provide a proxy service for web application that do not check access rights.	FUNC	HIGH	Iteration1 Exp	2	PT-USR-S-003	NEW	
92		Booking Service	PLATFORM	Booking Service shall support reservations of resources at both user level and experiment level	FUNC	HIGH	Iteration1 Exp	2	PT-BOO-S-001	PT-B-001	

#	ID	Component	Type	Description		Priority	Source		Code	Ref	
93		Booking Service	PLATFORM	User level booking shall be triggered by the Booking Tool via a REST API.	FUNC	HIGH	Iteration1 Exp	2	PT-BOO-S-002	PT-B-001	
94		Booking Service	PLATFORM	Experiment level booking shall be triggered by the experimenter before issuing a manual or schedule launching of a validated experiment	FUNC	HIGH	Iteration1 Exp	2	PT-BOO-S-003	PT-B-001	PT-L-002
95		Booking Service	PLATFORM	Experiment level booking shall support both immediate booking as well as booking at a future time	FUNC	HIGH	Iteration1 Exp	2	PT-BOO-S-004	PT-B-001	
96		Booking Service	PLATFORM	Booking Service shall provide all the necessary methods to manage the bookings including addition, modification and cancellation/deletion operations	FUNC	HIGH	Architecture Deliverables	2	PT-BOO-S-005	NEW	
97		Booking Service	PLATFORM	Booking Service shall be able to compute and return feedback on conflicting bookings for a provided booking request	FUNC	HIGH	Architecture Deliverables	2	PT-BOO-S-006	NEW	
98		Booking Service	PLATFORM	Reservation Data should be persistent in order to survive service failures and be available by other services	FUNC	HIGH	Iteration1 Exp	2	PT-BOO-S-007	NEW	
99		Booking Service	PLATFORM	Historical data retrieval for Bookings/Reservations should be available on demand	FUNC	MEDIUM	Iteration1 Exp	2	PT-BOO-S-008		
		~~Booking Service~~	~~PLATFORM~~	~~Booking functionality shall support reservation of resources involving multiple testbeds~~	~~FUNC~~	~~HIGH~~	~~Architecture Deliverables~~	~~2~~	~~PT-BOO-S-009~~	~~PT-B-003~~	-
100		Booking Service	PLATFORM	Booking functionality shall be able to correctly handle simultaneous Reservations requests by end users	FUNC	HIGH	Iteration1 Exp	2	PT-BOO-S-010	PT-B-003	
		~~Booking Service~~	~~PLATFORM~~	~~Notification mechanisms may be provided for experiments scheduled for execution in the future.~~	~~FUNC~~	~~MEDIUM~~	~~Consortium~~	~~2~~	~~PT-BOO-S-011~~	~~PT-B-004~~	
101	**PT-BOO-S-012**	Booking Tool	PLATFORM	Booking functionality should provide means to ensure fairness in resource booking as well as protect for malevolent actions that a user may perform.	FUNC	HIGH	Iteration2 Exp	3	PT-BOO-T-012	PT-B-005	
102	**PT-BOO-S-013**	Booking Tool	PLATFORM	All Booking Service incoming requests should contain user initiating information and delegate/contact the User & Rights service in order to perform validation\authorization	FUNC	HIGH	Iteration2 Exp	3	NEW	PT-NF-002	
103		Launching Service	PLATFORM	Launching Service shall support short-term or manual launching of an experiment initiated directly by an experimenter	FUNC	HIGH	Architecture Deliverables	2	PT-LAU-S-001	NEW	
104		Launching Service	PLATFORM	Launching Service shall support long-term or scheduled launching of an experiment initiated directly by an experimenter	FUNC	HIGH	Architecture Deliverables	2	PT-LAU-S-002	NEW	
105		Launching Service	PLATFORM	Each executing experiment shall be uniquely identified within RAWFIE ecosystem	FUNC	HIGH	Architecture Deliverables	2	PT-LAU-S-003	PT-E-001	
106		Launching Service	PLATFORM	During launching it must be ensured that the experiment to be started has been validated based on spatio-temporal constraints	FUNC	HIGH	Architecture Deliverables	2	PT-LAU-S-004	PT-L-002	
107		Launching Service	PLATFORM	During launching it must be ensured that the experiment to be started belongs to an authorized user of the RAWFIE platform	FUNC	HIGH	Architecture Deliverables	2	PT-LAU-S-005	PT-L-002	
108		Launching Service	PLATFORM	The Launching Service shall be able to address simultaneous requests for starting an experiment	FUNC	HIGH	Architecture Deliverables	2	PT-LAU-S-006	NEW	
109		Launching Service	PLATFORM	The Launching Service shall send an appropriate message upon successful starting of an experiment	FUNC	HIGH	Architecture Deliverables	2	PT-LAU-S-007	PT-E-001	
110		Launching Service	PLATFORM	The Launching Service shall interact with other components or database services in order to retrieve information needed for deciding on launching an experiment	FUNC	HIGH	Architecture Deliverables	2	PT-LAU-S-008	NEW	
111		Launching Service	PLATFORM	Interactions of the launching service with database services and/or other components should respect the RAWFIE platform boundary	FUNC	HIGH	Iteration1 Exp	2	PT-LAU-S-009	NEW	
112		Launching Service	PLATFORM	Launching service shall support requests for experiment cancellation	FUNC	HIGH	Iteration1 Exp	2	PT-LAU-S-010	NEW	
		~~Launching Service~~	~~PLATFORM~~	~~RAWFIE platform shall provide means to ensure fairness in experiments execution~~	~~FUNC~~	~~MEDIUM~~	~~Consortium~~	~~2~~	~~PT-LAU-S-011~~	~~PT-L-007~~	-

113		Launching Service	PLATFORM	Launching service shall provide appropriate feedback to the requested entity regarding failures on fulfilling a request	FUNC	HIGH	Iteration1 Exp	2	PT-LAU-S-012	NEW
114		Launching Service	PLATFORM	Launching service shall not alter or modify any information related to the actual execution of an experiment	FUNC	HIGH	Iteration1 Exp	2	PT-LAU-S-013	NEW
115	PT-LAU-S-014	Launching Service	PLATFORM	Notification mechanisms may be provided for experiments scheduled for execution in the future.	FUNC	HIGH	Iteration1 Exp	3	PT-BOO-S-012	
116		Visualisation Engine	PLATFORM	The Visualization Engine shall retrieve from the message bus all runtime experiment information needed for visualizing the UxVs and/or any sensor measurments	FUNC	HIGH	Architecture Deliverables	2	PT-VIS-E-001	PT-L-005
117		Visualisation Engine	PLATFORM	The Visualization Engine shall provide a GIS server capable of handling geographical layers (overlays)	FUNC	HIGH	Architecture Deliverables	2	PT-VIS-E-002	NEW
118		Visualisation Engine	PLATFORM	The Visualization Engine may allow cache of data for faster access to the available geographic layers	FUNC	MEDIUM	Architecture Deliverables	2	PT-VIS-E-003	NEW
119		Visualisation Engine	PLATFORM	The Visualization Engine shall provide the possibility to reply experiments using historical data	FUNC	HIGH	Architecture Deliverables	2	PT-VIS-E-004	NEW
120	PT-VIS-E-005	Visualisation Engine	PLATFORM	The Visualization Engine shall provide the possibility to visualize experiments for different users at the same time	FUNC	HIGH		3		
121		Experiment Controller	PLATFORM	Cancellation of running experiments should be possible	FUNC	HIGH	Iteration1 Exp	2	PT-EXP-C-001	NEW
122		Experiment Controller	PLATFORM	RAWFIE platform shall allow experimenters to remotely navigate UxVs.	FUNC	MEDIUM	Consortium	2	PT-EXP-C-002	PT-L-008
123		Experiment Controller	PLATFORM	The Experiment Controller shall support the execution of experiments that involve multiple testbeds	FUNC	HIGH	Iteration1 Exp	2	PT-EXP-C-003	NEW
124		Experiment Controller	PLATFORM	The Experiment Controller shall be able to support multiple experiments running the same time in parallel	FUNC	HIGH	Iteration1 Exp	2	PT-EXP-C-004	NEW
		~~Experiment Controller~~	~~PLATFORM~~	~~The Experiment Controller shall be able to analyse the whole experiment script and dispatch the appropriate parts to each responsible testbed facility~~	~~FUNC~~	~~HIGH~~	~~Iteration1 Exp~~	~~2~~	~~PT-EXP-C-005~~	~~NEW~~	-
125		Experiment Controller	PLATFORM	The Experiment Controller shall support receiving feedback at regular intervals from all testbed facilities about the progress of the experiment in this time interval	FUNC	HIGH	Iteration1 Exp	2	PT-EXP-C-006	NEW
126		Experiment Controller	PLATFORM	The Experiment Controller may be able to override the order of instructions described in the input script while the experiment is running	FUNC	HIGH	Iteration1 Exp	2	PT-EXP-C-007	NEW
127		Experiment Controller	PLATFORM	The Experiment Controller shall be able to continuously feed the front-end tier (Experiment Monitoring Tool) giving the experimenter a clear view of the experiment workflow as a whole	FUNC	HIGH	Iteration1 Exp	2	PT-EXP-C-008	PT-L-004
128		Experiment Controller	PLATFORM	The Experiment Controller shall send distinct error and warning messages in every case the experiment's state diverges from the aimed target	FUNC	HIGH	Iteration1 Exp	2	PT-EXP-C-009	NEW
129	PT-DAA-S-001	Data Analysis Engine	PLATFORM	The Data Analysis eEngine will support accepting of analysis jobs	FUNC	MEDIUM	Iteration1 Exp	2	PT-DAA-S -001	PT-E-004	PT-E-005
130	PT-DAA-S-002	Data Analysis Engine	PLATFORM	The Data Analysis Eengine will support executingcompiling analysis jobs	FUNC	MEDIUM	Iteration1 Exp	2	PT-DAA-S -002	PT-E-005
131	PT-DAA-S-003	Data Analysis Engine	PLATFORM	The Data Analysis Engine will provide the ability to end running jobs	FUNC	MEDIUM	Iteration2 Exp	3	NEW	
132	PT-DAA-S-004	Data Analysis Engine	PLATFORM	The Data Analysis Engine should be scalable.	FUNC	MEDIUM	Iteration2 Exp	3	NEW	
133	PT-DAA-S-005	Data Analysis Engine	PLATFORM	The Data Analysis Engine will provide authenticated login	FUNC	MEDIUM	Iteration2 Exp	3	NEW	
134		System Monitoring Service	PLATFORM	RAWFIE middle tier shall include a module to monitor the performance of the middle tier components.	FUNC	HIGH	Consortium	2	PT-SYM-S-001	PT-GEN-004
135		System Monitoring Service	PLATFORM	RAWFIE Testbeds and UxVs statuses should be monitored	FUNC	HIGH	Iteration1 Exp	2	PT-SYM-S-002	NEW
136		System Monitoring Service	PLATFORM	RAWFIE system administrators should be informed if critical, for the RAWFIE platfrom operation, services are down	FUNC	HIGH	Iteration1 Exp	2	PT-SYM-S-003	PT-NF-007

137		System Monitoring Service	PLATFORM	User may register for notifications if certain components are down	FUNC	**LOW**	Iteration1 Exp	2	PT-SYM-S-004	PT-NF-007	
138		System Monitoring Service	PLATFORM	Notifications about planned downtimes	FUNC	**MEDIUM**	Iteration1 Exp	2	PT-SYM-S-005	PT-NF-007	
139		Accounting Service	PLATFORM	The accounting service should be capable to accept different cost models regarding RAWFIE usage on a per service basis	FUNC	**MEDIUM**	DoW	2	PT-ACC-S-001	PT-B-007	
140		Accounting Service	PLATFORM	The accounting service should be capable to gather statistics regarding usage of the platform by experimenters.	FUNC	**MEDIUM**	DoW	2	PT-ACC-S-002	PT-B-007	
141		Accounting Service	PLATFORM	The RAWFIE platform should record information related to time and type of access for a service by a user.	FUNC	**MEDIUM**	DoW	2	PT-ACC-S-003	PT-B-007	
142		Accounting Service	PLATFORM	The cost model used may take into consideration the overall time of experiments executed by a user of the platform.	FUNC	**MEDIUM**	Iteration1 Exp	2	PT-ACC-S-004	PT-B-007	
143		Accounting Service	PLATFORM	The accounting service may support different types of charging based on the type of the experimenter (industrial, research, university etc.)	FUNC	**MEDIUM**	Iteration1 Exp	2	PT-ACC-S-005	PT-B-007	
144		Accounting Service	PLATFORM	The accounting service may support predefined types of memberships regarding usage of the platform that may depend on various types of parameters	FUNC	**MEDIUM**	Iteration1 Exp	2	PT-ACC-S-006	PT-B-007	
145		Accounting Service	PLATFORM	The accounting service should be able to handle the addition of new services that may be incorporated in the RAWFIE platform during time.	FUNC	**MEDIUM**	Iteration1 Exp	2	PT-ACC-S-007	PT-B-007	
	-	~~General~~	~~TESTBED~~	~~Each UxV Testbed should provide a Slice Interface for federating their capabilities/resources to the experimenter.~~	~~FUNC~~	~~**HIGH**~~	~~Iteration1 Exp~~	~~2~~	~~TB-GEN-R-001~~	~~NEW~~	-
146	TB-GEN-R-002	General	TESTBED	Each Testbed should provide the exact boundaries within which its UxVs can operate	ENV	**HIGH**	Other	2	TB-GEN-R-002	NEW	
147		General	TESTBED	Testbed areas should at least be able to host/operate multiple UxVs of one or more types	FUNC	**HIGH**	Other	2	TB-GEN-R-003	NEW	
148	TB-GEN-R-004	General	TESTBED	Testbed areas environment should be closely monitored	ENV	**HIGH**	Other	2	TB-GEN-R-004	TB-G-002	
149		General	TESTBED	Indoor spaces of a testbed should provide a controlled indoor environment	ENV	**HIGH**	Other	2	TB-GEN-R-005	TB-G-002	
150		General	TESTBED	Testebed facility areas should comprise storing spaces and be able to receive inspect and assemble and/or fix UxVs	SUPP	**HIGH**	Other	2	TB-GEN-R-006	TB-G-002	
151		General	TESTBED	Testbed facilities should provide emergency services in an extraordinary event	SEC	**HIGH**	Other	2	TB-GEN-R-007	TB-G-002	
152	TB-GEN-R-008	General	TESTBED	Testbed areas should provide proper facilities and equipment	ENV	**MEDIUM**	Other	2	TB-GEN-R-008	TB-G-002	
153	TB-GEN-R-009	General	TESTBED	Testbed must provide dedicated computational resources	ENV	**HIGH**	Other	2	TB-GEN-R-009	NEW	
154	TB-GEN-R-010	General	TESTBED	Testbeds should be supported by on-site personnel	OTH	**HIGH**	Other	2	TB-GEN-R-010	NEW	
155	TB-GEN-R-011	General	TESTBED	Testbeds should conform to all legal regulations and restrictions and advertise them to the RAWFIE platform	SEC	**HIGH**	Other	2	TB-GEN-R-011	TB-NF-G-005	
156	**TB-GEN-R-012**	General	TESTBED	Testbeds should provide information regarding the expected Coordination Reference System (CRS) their resources are expected to operate	FUNC	**HIGH**	Iteration2 Exp	**3**	**NEW**		
157	**TB-GEN-R-013**	General	TESTBED	Testbeds should provide information about their hours of operation	OTH	**HIGH**	Iteration 2 Exp	**3**	**NEW**		
158	**TB-GEN-R-014**	General	TESTBED	Testbed messaging solution configuration should ensure local and isolated flow of control commands and navigation sensors feedback	SEC	**HIGH**	Iteration 2 Exp	**3**	**NEW**		
159		Monitoring Manager	TESTBED	The Monitoring Manager component should be able to provide information about the capabilities of each resource node.	DATA	**HIGH**	Iteration1 Exp	2	TB-MOM-001	TB-G-004	TB-G-006
160	TB-MOM-002	Monitoring Manager	TESTBED	The Monitoring Manager component should collect and report current status of computing resources of the testbed facilities	DATA	**HIGH**	Iteration1 Exp	2	TB-MOM-002	TB-G-001	
161	TB-MOM-003	Monitoring Manager	TESTBED	The Monitoring Manager component should store periodically all testbed information	DATA	**HIGH**	Iteration1 Exp	2	TB-MOM-003	TB-G-003	

#	ID	Component		Description	Type	Priority	Source	Iter	Code	Ref1	Ref2
162		Monitoring Manager	TESTBED	Testbed monitoring manager should be able to transmit the current status to the System Monitoring Service.	FUNC	HIGH	Iteration1 Exp	2	TB-MOM-004	TB-G-003	
163	**TB-MOM-005**	Monitoring Manager	TESTBED	Monitoring Manager should be able to communicate and collect information from other services that provide important information related to the operation of testbed facility	FUNC	MEDIUM	Iteration1 Exp	3	NEW		
164	TB-NEC-001	Network Controller	TESTBED	Network Controller shall offer appropriate connectivity management	FUNC	MEDIUM	Consortium	2	TB-NEC-001	TB-G-008	PT-L-009
165	TB-NEC-002	Network Controller	TESTBED	Network Controller shall offer provision of all network communication resources	FUNC	MEDIUM	Consortium	2	TB-NEC-002		
166	TB-NEC-003	Network Controller	TESTBED	Alternative connection interfaces should be supported	FUNC	MEDIUM	Consortium	2	TB-NEC-003	TB-R-013	
167	TB-NEC-004	Network Controller	TESTBED	The communication status shall be checked	FUNC	MEDIUM	Consortium	2	TB-NEC-004	TB-NF-G-006	
168	TB-NEC-005	Network Controller	TESTBED	Connection Timeliness verification and notification	FUNC	MEDIUM	Consortium	2	TB-NEC-005	NEW	
169		Resource Controller	TESTBED	RAWFIE platform shall support a semi-autonomously way of navigation of the UxVs	FUNC	HIGH	Consortium	2	TB-REC-001	PT-L-008	TB-G-007
170	TB-REC-002	Resource Controller	TESTBED	RAWFIE platform should be able to activate the "Emergency Scenario"	FUNC	HIGH	Iteration1 Exp	2	TB-REC-002	PT-L-009	TB-G-008
171		Resource Controller	TESTBED	The Resource Controller shall receive location messages from the vehicles at regular intervals	FUNC	HIGH	Iteration1 Exp	2	TB-REC-003	TB-G-005	TB-G-003
172		Resource Controller	TESTBED	The Resource Controller shall transmit the next location for the current experiment to the vehicles	FUNC	HIGH	Iteration1 Exp	2	TB-REC-004	TB-G-008	
173		Resource Controller	TESTBED	The Resource Controller shall be able to plan the next location that will be transmitted in the vehicle taking into account the locations of all UxVs that are active in that testbed	FUNC	HIGH	Iteration1 Exp	2	TB-REC-005	NEW	
174		Resource Controller	TESTBED	For the experiment accomplishment the Resource Controller shall operate in close coordination with the Experiment Controller	FUNC	HIGH	Iteration1 Exp	2	TB-REC-006	TB-I-001	TB-G-005
		~~Testbed Proxy~~	~~TESTBED~~	~~Testbed proxy should act as a reverse proxy~~	~~FUNC~~	~~MEDIUM~~	~~Consortium~~	~~2~~	~~TB-PRO-001~~	~~NEW~~	~~-~~
		~~Testbed Proxy~~	~~TESTBED~~	~~Testbed proxy contains Inner and Outer Firewall~~	~~FUNC~~	~~MEDIUM~~	~~Iteration1 Exp~~	~~2~~	~~TB-PRO-002~~	~~NEW~~	~~-~~
175	TB-MAN-001	Testbed Manager	TESTBED	Testbed Manager shall support permanent storage of all testbed attributes and resources attributes that belong to testbed	FUNC	HIGH	Consortium	2	TB-MAN-001	TB-D-001	
176	TB-MAN-002	Testbed Manager	TESTBED	Testbed Manager shall provide information about the capabilities of each resource node	FUNC	HIGH	Consortium	2	TB-MAN-002	TB-G-004	
177		Testbed Manager	TESTBED	Testbed Manager shall check periodically the status of all other services running at testbed level	FUNC	HIGH	Iteration1 Exp	2	TB-MAN-003	NEW	
178		Testbed Manager	TESTBED	Testbed Manager shall contain a registration log for all the experiments executed in the testbed	FUNC	HIGH	Iteration1 Exp	2	TB-MAN-004	TB-D-002	
179		Testbed Manager	TESTBED	Testbed Manager shall be periodically informed about the status of all running experiments in the testbed	FUNC	HIGH	Iteration1 Exp	2	TB-MAN-005	NEW	
180		Testbed Manager	TESTBED	Testbed Manager shall store configuration parameters for the UxVs in the relevant testbed	FUNC	MEDIUM	Iteration1 Exp	2	TB-MAN-006	TB-G-004	
181		Testbed Manager	TESTBED	Testbed Manager shall implement a user interface to support the interactions between testbed operators and machines	FUNC	HIGH	Iteration1 Exp	2	TB-MAN-007	NEW	
182		Testbed Manager	TESTBED	Testbed Manager shall be capable to handle temporary interruption of communication and store data locally in case of transmission failure	FUNC	HIGH		2	TB-MAN-008	TB-D-001	
183	TB-MAN-009	Testbed Manager	TESTBED	Testbed Manager may provide statistical data/information about testbed operation	DATA	LOW	Consortium	2	TB-MAN-009	TB-D-002	
184	**TB-MAN-010**	Testbed Manager	TESTBED	Testbed Manager shall provide the ability to cancel an ongoing experiment in case of communication failure with the RAWFIE platform	FUNC	HIGH	Consortium	3	NEW		
185	**TB-AGG-001**	SFA Aggregate Manager	TESTBED	SFA Aggregate Manager (SAM) should provide an SFA Interface to comply with SFA based testbeds or testbed federations	FUNC	HIGH	Consortium	3	TB-GEN-R-001		

186	TB-AGG-002	SFA Aggregate Manager	TESTBED	SFA Aggregate Manager (SAM) should provide a REST API to comply with RAWFIE testbeds.	FUNC	HIGH	Consortium	3	TB-GEN-R-001		
187	TB-AGG-003	SFA Aggregate Manager	TESTBED	SFA Aggregate Manager (SAM) should advertise the resources of a testbed	FUNC	HIGH	Consortium	3	TB-GEN-R-001		
188	TB-AGG-004	SFA Aggregate Manager	TESTBED	SFA Aggregate Manager (SAM) reservation process should comply with the resource reservation process of RAWFIE testbeds	FUNC	HIGH	Consortium	3	TB-GEN-R-001		
189	TB-AGG-005	SFA Aggregate Manager	TESTBED	SFA Aggregate Manager (SAM) should provide an interface to testbed administrators for managing RAWFIE testbeds	FUNC	HIGH	Consortium	3	TB-GEN-R-001		
190	UXV-GEN-001	General	UxV	Complianceof UxV to RAWFIE specification and interfaces	FUNC	HIGH	Iteration1 Exp	2	TB-UVG-001	NEW	
191	UXV-GEN-002	General	UxV	UxV providers may provide for their supplied devices a simulator/emulator mimicking its real-world behavior and kinematics	FUNC	LOW	Consortium	3	NEW	TB-G-009	
192		UxV Node	UxV	Each UxV shall have a unique Identification code.	FUNC	HIGH	Consortium	2	UXV-NOD-001	TB-R-003	
193		UxV Node	UxV	Each UxV node should ensure a minimum autonomy of 15-30 minutes.	FUNC	HIGH	DoW	2	UXV-NOD-002	TB-R-007	
194		UxV Node	UxV	Each UxV node should ensure payload.	FUNC	HIGH	DoW	2	UXV-NOD-003	TB-R-008	
195	UXV-NOD-004	UxV Node	UxV	Each UxV node may register the Coordination Reference System CRS it is expected to operate.	FUNC	MEDIUM	Iteration 2 Exp	3	NEW		
196	UXV-NOD-005	UxV Node	UxV	A proper message communication protocol should be defined for the communication between a UxV node and the tesbed ground components	FUNC	HIGH	Architecture Deliverables	3	NEW		
197	UXV-NOD-006	UxV Node	UxV	All command messages received by the UxVs should be ensured that they originate from an authorized testbed component or other UxV involved in an experiment before being processed	SEC	HIGH	Other	3	NEW	TB-NF-G-004	
198	UXV-INT-001	UxV Node	UxV	All messages of the UxV Message API should contain in their header basic information about the dispatching entity.	FUNC	HIGH	Architecture Deliverables	3	NEW		
199	UXV-INT-002	UxV Node	UxV	UxV should support the Goto command	FUNC	HIGH	Architecture Deliverables	3	NEW		
200	UXV-INT-003	UxV Node	UxV	UxV should support the KeepStation command	FUNC	MEDIUM	Architecture Deliverables	3	NEW		
201	UXV-INT-004	UxV Node	UxV	UxV should support the Abort command	FUNC	HIGH	Architecture Deliverables	3	NEW		
202	UXV-INT-005	UxV Node	UxV	UxVs should be able to advertise themselves to the RAWFIE infrastructure	FUNC	HIGH	Architecture Deliverables	3	NEW		
203	UXV-INT-006	UxV Node	UxV	UxVs should be able to advertise information about their sensors to the RAWFIE infrastructure	FUNC	HIGH	Architecture Deliverables	3	NEW		
204	UXV-INT-007	UxV Node	UxV	UxVs should be able to inform testbed about their CPU usage	FUNC	MEDIUM	Architecture Deliverables	3	NEW		
205	UXV-INT-008	UxV Node	UxV	UxVs should be able to inform testbed about their on-board storage	FUNC	HIGH	Architecture Deliverables	3	NEW		
206	UXV-INT-009	UxV Node	UxV	UxVs should be able to inform testbed about their fuel storage	FUNC	HIGH	Architecture Deliverables	3	NEW		
207	UXV-INT-010	UxV Node	UxV	UxVs should be able to inform testbed about their orientation (attitude)	FUNC	HIGH	Architecture Deliverables	3	NEW		
208	UXV-INT-011	UxV Node	UxV	UxVs should be able to inform testbed about their velocity and acceleration	FUNC	MEDIUM	Architecture Deliverables	3	NEW		
209	UXV-INT-012	UxV Node	UxV	UxVs shall periodically publish a digest of their scalar sensor readings	FUNC	HIGH	Architecture Deliverables	3	NEW		
210	UXV-PRX-001	UxV proximity	UxV	Embedded UxV proximity component shall be into the UxV	FUNC	HIGH	Other	3	NEW		
211	UXV-PRX-002	UxV proximity	UxV	UxV proximity component shall provide information sharing	FUNC	HIGH	Other	3	NEW		
212	UXV-PRX-003	UxV proximity	UxV	UxV proximity component shall provide presence detection of other compliant UxVs	FUNC	HIGH	Other	3	NEW		
213	UXV-PRX-004	UxV proximity	UxV	UxV proximity shall offer data relay capabilities	FUNC	MEDIUM	Other	3	NEW		
214	UXV-PRX-005	UxV proximity	UxV	UxV proximity component shall provide information helping in collision	FUNC	HIGH	Other	3	NEW		

				avoidance						
215	**UXV-PRX-006**	UxV proximity	UxV	UxV proximity component shall offer temporary storage	FUNC	MEDIUM	Other	3	NEW	
216		UxV Network and Communication	UxV	Capability of taking the control of the UxVs from distance.	FUNC	MEDIUM	Consortium	2	UXV-NET-001	TB-R-006
217		UxV Network and Communication	UxV	UxVs should be able to Synchronize their Time-References between them.	FUNC	MEDIUM	Consortium	2	UXV-NET-002	TB-R-011
218		UxV Network and Communication	UxV	The UxV should provide Access Point functionality.	FUNC	MEDIUM	Consortium	2	UXV-NET-003	TB-R-012
219		UxV Network and Communication	UxV	Each UxV node shall be equipped with primary and secondary communication means.	FUNC	HIGH	Consortium	2	UXV-NET-004	TB-R-013
220	UXV-NET-005	UxV Network and Communication	UxV	UxV network interface management	FUNC	MEDIUM	Consortium	2	UXV-NET-005	NEW
221	UXV-NET-006	UxV Network and Communication	UxV	UxV communication interoperability with RAWFIE (incoming)	FUNC	MEDIUM	Consortium	2	UXV-NET-006	NEW
222	UXV-NET-007	UxV Network and Communication	UxV	UxV communication interoperability with RAWFIE (outgoing)	FUNC	MEDIUM	Consortium	2	UXV-NET-007	NEW
223		UxV Network and Communication	UxV	Neighbouring UxV monitoring	FUNC	MEDIUM	Consortium	2	UXV-NET-008	NEW
224		UxV Network and Communication	UxV	Each UxV node should be able to send navigation state feedback with at least 2 Hz frequency and maximum 1 sec latency when within radio communication reach.	FUNC	HIGH	Consortium	2	UXV-NET-009	NEW
225	**UXV-NET-010**	UxV Network and Communication	UxV	The primary communication channel of the node should support IPv4/IPv6 protocol stack.	FUNC	HIGH	Consortium	3	NEW	
226	UXV-SEN-001	UxV Sensor and Localisation	UxV	Each UxV node should tag timing capability to each sensor readings	FUNC	HIGH	Iteration1 Exp	2	UXV-SEN-001	NEW
227		UxV Sensor and Localisation	UxV	Each UxV node shall be able to list the available sensors	FUNC	HIGH	Iteration1 Exp	2	UXV-SEN-002	NEW
228		UxV Sensor and Localisation	UxV	UxV location and sensor data should be made available to the experimenter	FUNC	HIGH	Iteration1 Exp	2	UXV-SEN-003	NEW
229		UxV Sensor and Localisation	UxV	Location sensors should be supported in each UxV unit and can be used remotely during testbed demonstrations.	FUNC	HIGH	Iteration1 Exp	2	UXV-SEN-004	NEW
230		UxV Sensor and Localisation	UxV	UxVs should sent a notification to the Resource Controller when they reach the desired location	FUNC	HIGH	Iteration1 Exp	2	UXV-SEN-005	NEW
231		UxV On-board storage	UxV	UxVs shall be able to store data on board.	DATA	HIGH	Consortium	2	UXV-STO-001	TB-R-004
232		UxV On-board storage	UxV	UxV's shall provide a management tool of the available storage.	FUNC	HIGH	Consortium	2	UXV-STO-002	TB-R-004
233		UxV On-board storage	UxV	UxV's shall provide an authorized access to the data management tool.	SEC	HIGH	Consortium	2	UXV-STO-003	NEW
234		UxV On-board storage	UxV	UxV's shall provide a data log.	FUNC	HIGH	Consortium	2	UXV-STO-004	NEW
235		UxV On-board storage	UxV	UxV's may provide an automated syncing of servers.	FUNC	MEDIUM	Consortium	2	UXV-STO-005	NEW
236		UxV On-board processing	UxV	Each UxV shall be able to operate autonomously.	FUNC	HIGH	Consortium	2	UXV-PRC-001	TB-R-001
237		UxV On-board processing	UxV	The UxV should provide collision avoidance mechanism.	FUNC	MEDIUM	Consortium	2	UXV-PRC-002	TB-R-002
238		UxV On-board processing	UxV	Capability of task planning of the UxVs nodes during run-time.	FUNC	MEDIUM	Consortium	2	UXV-PRC-003	TB-R-005
239		UxV On-board processing	UxV	UxVs should be able to cooperate during the execution of an experiment.	FUNC	MEDIUM	Consortium	2	UXV-PRC-004	TB-R-010
240	UXV-PRC-005	UxV On-board processing	UxV	Each UxV node shall be able to keep position while waiting for new instructions	FUNC	HIGH	Iteration1 Exp	2	UXV-PRC-005	NEW
241	**UXV-PRC-006**	UxV On-board processing	UxV	UxVs shall be capable of processing sensor data in order to summarize large sensor data-sets.	FUNC	MEDIUM	Consortium	3	NEW	

242		UxV Management	UxV	UxVs shall offer on demand resources (Network, Sensor, Processing, and Controller).	OTH	**HIGH**	Consortium	2	UXV-MGT-001	TB-NF-R-001	
243		UxV Management	UxV	UxV shall be capable to revert to a safe mode	SEC	**HIGH**	Consortium	2	UXV-MGT-002	TB-NF-R-003	
244		UxV Management	UxV	UxV shall be capable to restart its internal components independently	FUNC	**HIGH**	Consortium	2	UXV-MGT-003	NEW	
245		UxV Management	UxV	UxV shall be capable to monitor the health of its components and provide appropriate health status messages to the testbed	FUNC	**HIGH**	Iteration1 Exp	2	UXV-MGT-004	NEW	
246		UxV Management	UxV	UxV shall be capable to enable/disable certain internal components	FUNC	**HIGH**	Iteration1 Exp	2	UXV-MGT-005	NEW	
247		UxV Management	UxV	UxV shall be capable to offer safe maintenance access for manufacturers	OTH	**HIGH**	Consortium	2	UXV-MGT-006	NEW	

Table 5: Overview of Iteration 3 defined requirements including traceability to D3.2, D3.1 Requirements

Based on the above traceability matrix the following table was created which includes requirements of D3.1 & D3.2 that do not have links to requirements defined in the present document. Two extra columns are provided for each such requirement specifying whether it is now OBSOLETE, already CONSIDERED or still VALID.

#	Iteration 1 Reqs	Iteration 1 Category	Iteration 1 Description	NOT MAPPED	VALID	COMMENT
1	PT-E-002	Evaluation Phase	RAWFIE platform shall include a service enabling the data collection, analysis and processing.	#N/A	CONSIDERED	BY definition of Data Analysis Tool & Engine
2	PT-L-003	Launching Phase	Launching tool shall be kept informed upon an experiment's state	#N/A	CONSIDERED	Experiment State is updates handled by Experiment Controller and written to DB
3	PT-NF-003		RAWFIE platform should be able to support backups of all critical data	#N/A	YES	
4	PT-NF-004		RAWFIE platform shall exhibit high degree of network availability	#N/A	YES	
5	PT-NF-005		RAWFIE platform shall be able to support (near) real-time information gathering from the UxV sensors	#N/A	YES	
6	PT-NF-006		RAWFIE platform shall exhibit high degree of scalability	#N/A	YES	
7	PT-NF-009		RAWFIE architecture should adopt a modular design approach.	#N/A	CONSIDERED	By architecture design
8	PT-NF-010		RAWFIE platform shall be deployed as a cloud based service (or list of services).	#N/A	YES	
9	PT-NF-011		RAWFIE software modules should be implemented as Web Service or as REST	#N/A	CONSIDERED	design choice
10	PT-NF-012		RAWFIE modules should use Open Standards and Open Software as far as possible	#N/A	CONSIDERED	design choice
11	TB-I-002	Interconnectivity	The communication system shall be able to use UxVs to relay information to and from other UxVs	#N/A	CONSIDERED	By Proximity Component and UxV Network related requirements
12	TB-I-003	Interconnectivity	A Testbed's communication system may provide at least 3 levels of Service and the communication means will adapt to these Levels of Service	#N/A	OBSOLETE	
13	TB-I-004	Interconnectivity	The Testbed shall be able to dispatch UxV information on demand	#N/A	OBSOLETE	
14	TB-NF-G-001	General	The Testbed shall provide concurrent requests capacity	#N/A	CONSIDERED	certain testbed components are by design multithreaded
15	TB-NF-G-002	General	The Testbed infrastructure should provide reliability and robustness of all components/modules.	#N/A	YES	
16	TB-NF-G-003	General	The communication system shall offer a high availability	#N/A	YES	
17	TB-NF-R-001	Resource	UxVs shall offer on demand resources (Network, Sensor, Processing, and Controller).	#N/A	YES	
18	TB-NF-R-002	Resource	UxVs sensor system shall be compliant to connection standards and communication interfaces.	#N/A	CONSIDERED	design choice
19	TB-R-009	Resource	Each UxV node should be equipped with a location identification system.	#N/A	YES	

Table 6: Not mapped Requirements of iteration 1 and their status regarding RAWFIE system

8 Conclusion

The present deliverable concludes the requirements elicitation activities in the context of RAWFIE project. Based on the grounds of D3.2 it integrates the feedback from the 2nd iteration cycle of design and development activities as well as information obtained from newcomers from the first open call. It must also be noted that a number of new requirements were defined based on the risk matrix defined in WP1. All in all, this document seeks to present a complete list of requirements focusing in each distinct component defined in D4.5 deliverable. The overall methodology and templates used were similar to the previous iteration and an attempt was made to maintain traceability between the requirements defined in previous revisions of the deliverable (see chapter 7).

Another goal of this deliverable was the identification of the list of features that the platform offers to potential experimenters. This list should be seen as an initial attempt, that should be revised and elaborated in the coming months, based on the results of the second open call but also on feedback obtained from the actual RAWFIE platform usage.

9 References

[1] RAWFIE DoA AMENDMENT Reference No AMD-645220-14, Amendment AMD-645220-14.pdf, 7/12/2015

[2] RAWFIE_D_3_1_final.pdf – RAWFIE Deliverable March 2015

[3] RAWFIE_D_3_2_final.pdf – RAWFIE Deliverable March 2016

[4] D4.4 - High Level Design and Specification of RAWFIE Architecture.pdf – RAWFIE Deliverable June 2016

[5] RAWFIE - D4.5 - 645220_Design and Specification of RAWFIE Components (b).pdf – RAWFIE Deliverable July 2016

[6] International Organization for Standardization; ISO/IEC WD 29148.3; Software and Systems Engineering – Life Cycle Processes – Requirements Engineering, 2010.

[7] Volere Template Edition 13, 2007, http://www.volere.co.uk/template.htm

[8] Patibandla, S.T.; Bakker, T.; Klenke, R.H. "Initial evaluation of an IEEE 802.11s

[9] S. Morgenthaler, T. Braun, Zhongliang Zhao, T. Staub and M. Anwander, "'UAV Net: A mobile wireless mesh network using Unmanned Aerial Vehicles," Globecom Workshops (GC Wkshps), 2012 IEEE, pp. 1603

[10] Thierry Rakotoarivelo, Max Ott, Guillaume Jourjon, Ivan Seskar, "OMF: a control and management framework for networking testbeds", in ACM SIGOPS Operating Systems Review 43 (4), 54-59, Jan. 2010.

[11] http://www.ruby-lang.org

[12] http://omf.mytestbed.net

[13] Mathieu Lacage, Martin Ferrari, Mads Hansen, Thierry Turletti. NEPI: Using Independent Simulators, Emulators, and Testbeds for Easy Experimentation, ROADS 2009

[14] Alina Quereilhac, Mathieu Lacage, Claudio Freire, Thierry Turletti and Walid Dabbous. NEPI: An integration framework for Network Experimentation, in proceedings of *19th International Conference on Software, Telecommunications and Computer Networks (SoftCOM), 2011*

[15] http://nepi.inria.fr

[16] http://www.des-testbed.net/node/231

[17] European Remotely-Piloted Aircraft Systems (RPAS) Steering Group (ERSG) Roadmap for the integration of civil Remotely-Piloted Aircraft Systems into the European Aviation System, Final report from the European RPAS Steering Group (June 2013) http://ec.europa.eu/enterprise/sectors/aerospace/files/rpas-roadmap_en.pdf

[18] European Commission, "A new era for aviation: Opening the aviation market to the civil use of remotely piloted aircraft systems in a safe and sustainable manner", Communication from the

Commission to the European Parliament and the Council, http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014DC0207&from=EN, COM(2014) 207 final

[19] ParStream – https://www.parstream.com/

[20] RapidMiner – https://rapidminer.com/

[21] Apache Samoa – http://samoa.incubator.apache.org/

[22] Apache Storm – https://storm.apache.org/

[23] Apache Samza – http://samza.apache.org/

[24] Apache S4 – http://incubator.apache.org/s4/

[25] http://www.riot.ch/legal-information-about-flying-multicopter-drones-commercial/

[26] http://www.developpement-durable.gouv.fr/Quelle-place-pour-les-drones-dans.html (in French)

[27] https://okeanos.grnet.gr/home/

[28] http://nitlab.inf.uth.gr/NITlab/papers/Broker.pdf

[29] http://trac.gpolab.bbn.com/gcf/wiki/Omni

[30] http://jfed.iminds.be/

[31] http://groups.geni.net/geni/wiki/GAPI_AM_API_V3_DETAILS

[32] Greek legislation for UAS operation http://www.ypa.gr/userfiles/fa3cb89c-ac1a-4d4b-99ab-a34f011804e1/document%20%282%29%20%CE%A6%CE%95%CE%9A-30-9-2016.pdf (in Greek), September 2016

[33] http://www.cs.yale.edu/homes/el327/papers/OnlineKMeansAlenexEdoLiberty.pdf - Online K-Means

[34] https://en.wikipedia.org/wiki/K-means_clustering - Standard K-Means

[35] rawfie-redmine.di.uoa.gr/redmine/projects/rawfie/wiki/Online_RAWFIE_Glossary –RAWFIE Glossary

[36] https://rawfie-redmine.di.uoa.gr/redmine/projects/rawfie/wiki/Online_List_of_abbreviations - RAWFIE List of Abbreviations