Indoor-Outdoor Positioning for Emergency Staff

Grant Agreement No. 874391

D5.3: Field test report 1

Lead contractor: SAReye

Date: 06/10/2021

Document status

Call (part) identifier	UCPM-2019-PP-AG
Topic	UCPM-2019-PP-PREP-AG Preparedness in civil protection and marine pollution
Grant Agreement Number	874391
Project Acronym	IOPES
Project Title	Indoor-Outdoor Positioning for Emergency Staff
Deliverable Number	D5.3
Title of the Deliverable	Field test report 1
Work Package	WP5
Type	Report
Due date	06/10/2021
Issue date	06/10/2021
Version	1.0
Lead beneficiary	SAReye
Contributors	Guðbrandur Örn Arnarson, M. Eulàlia Parés
Reviewers	Eduard Angelats, Pedro Espín
Dissemination level	Confidential

This project has received funding from the European Commission, Directorate-General Humanitarian Aid and Civil Protection (ECHO), under the call UCPM-2019-PP-AG.

Revision history

Version	Date	Description
0.9	*15/06/2021*	First draft
1.0	*06/10/2021*	First version

Disclaimer

The content of this report represents the views of the author only and is his/her sole responsibility. The European Commission does not accept any responsibility for use that may be made of the information it contains.

Table of Contents

List of figures

List of acronyms

CPET	Civil Protection Emergency Teams
EMS	Emergency Management System
GIS	Geographic Information Systems
LTE	Long Term Evolution
RPAS	Remotely Piloted Aircraft System
UAV	Unnamed Aerial Vehicles
Project partners	
ATH	ATHONET SRL
CATUAV	CATUAV SL
CTTC	Catalan Tecnological Telecommunications Centre
FBBR	Frederiskborg Fire and Rescue Service
PCF	Pau Costa Foundation
SAReye	SAReye EHF
SCARABOT	Scarabot Technologies GmbH

1. Executive summary

The functional exercise 1 aims to test and to validate the whole IOPES prototype A in a simulated, not hazardous scenario. The exercise took place in Catalonia (Spain), more precisely in CATUAV's premises (Barcelona Drone Centre, Collsuspina). In this report we present the performance of the IOPES prototype A and we assess the degree of compliance provided by the IOPES system with the CPE needs in an emergency scenario; identify IOPES prototype A limitations and features to be improved in the IOPES prototype B.

2. IOPES concept in brief

The IOPES project aims to increase the safety and efficiency of the CPETs (Civil Protection Emergency Teams) in the course of emergency operations resulting from human-made and natural disasters. To achieve that, the project develops and enhances operationally oriented technologies that are targeted to provide precise and detailed information about a hazardous environment that can drastically change where it becomes paramount to safeguard the lives and the physical integrity of the operatives in the field.

The IOPES technology relies on four pillars:

- RPAS-based fast mapping tool.
- Wearable positioning device.
- LTE/ 5G deployable communications.
- Mature EMS (Emergency Management System).

The combined use of these technologies will assist in better tracking the positions of the members of emergency teams, both in indoor and outdoor environments, which could help improve the CPETs situational awareness and facilitate their decision making during disaster-related operations.

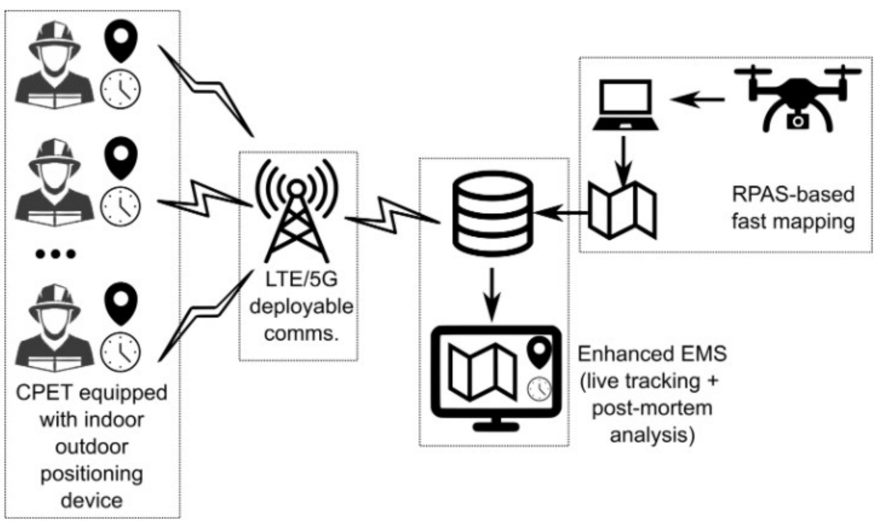

Figure 2-1. IOPES concept.

3. Objectives

The aim of the IOPES functional exercises is to test and validate the innovative technologies developed in the project in a simulated environment under controlled (not hazardous) conditions. Specific objectives are:

- Design realistic and dynamic emergency scenarios consisting of compromised situations where Search and Rescue operation are required.
- Deploy these scenarios in a small-scale field test involving the participation of end-user organisations.
- Showcase how the IOPES technology can be used in real emergency situations and the value it can provide to the end-users.
- Gather feedback (i.e., opinion and evaluation) from end-user organisations invited in order to identify current strengths and limitations leading to further refinement of the technology.

4. Exercise 1

Due to the corona situation, the consortium decided to record the exercise and to upload it on the web, allowing to maximize the number of potential actors aware of it.

Instead of describing the exercise, we believe the record (very exhaustive) is a more detailed and realistic way to show how the exercise was carried out.

The exercise was done in presence of staff of the following emergency services teams:

- Ilunion
- Bombers de la Generalitat de Catalunya.
- Mossos d'esquadra.
- Agents Forestals de Catalunya.
- Agents Rurals de Catalunya.
- Centre de Telecomunicacions i Tecnologies de la Informació (entity in charge of providing all Catalan emergency teams with the needed technology and services)

The record can be found at:

https://www.youtube.com/watch?v=0JYG5hj9wwk

5. Exercise evaluation

5.1. System performance

In the following table, the summary of the IOPES version A system performance, according to the indicators presented in the IOPES proposal, is showed.

Outcome	Output	Indicator	Baseline value	Target value	Actual value	Monitoring strategy
an IT-based solution to facilitate response	Wearable positioning device & data exchange protocol	Outdoor/Indoor Positioning performance	0.5 – 2 m outdoors 10 m indoors	0.5 – 2 m outdoors 5 m indoors	1 m outdoors 3 m indoors	Field testing
		Temporal resolution	1 position every 20s	1 position every 5s	1 position every 15 s	Field testing
		Operational time	4 hours	8 hours	4 hours	Field testing
		Cost	600€	300€	400€	Architecture document
	LTE/ 5G deployable communications	Number of communicated users (voice+data)	20	200	Tested with 6. Potential 200.	Unit testing
		Coverage	< 1km	several km	Tested with 300m	Field testing
		Network latency	100 millisecond	50 millisecond	50 ms	Field testing
	Enhanced EMS	Visualisation and management of simultaneously tracked users	50	100	Tested with 2 in the exercise, With 50 of of exercise	Unit testing
		Historical of team members positions (minutes)	10 minutes	30 minutes	days	Unit testing
	Mapping	Spatial resolution	10 cm	5 cm	2.5 cm	Field testing
		Required time to generate the cartography	Time per hectare	Time per hectare	15 minutes low resolution	Field testing
a system to collect /analyse	Enhanced EMS + LTE/ 5G deployable	Number of stored conversations and positions for post			>10	

response data for developing evidence-based response strategies	communications	mortem analysis	5	10		Field testing

5.2. Degree of compliance with CPE needs

Emergency services attending the functional exercises, both as participants and observers, has been asked to provide their feedback to evaluate the usefulness of the IOPES technology and propose improvements [3].

The advantage of having emergency services attending the functional exercise lies in the fact that they are potential end-users of the IOPES technology.

5.2.1. Evaluation objectives

The main points of the evaluation are:

- *Validation of the IOPES technological components based on their use in emergency management scenarios. I.e., What went well and what went wrong in using these technologies in a small-scale field exercise?*
- Regarding the Helmet subcomponent. It proves to be useful and to provide location with <5m precision. In the three scenarios it provides continuous and reliable solution. However, at some points there are problems with the communication component of the helmet. If the signal is lost, then the system is not able to do the re-call. The location is still depending on the magnetometer system and it can fail in future trials.

  Regarding the UAVs component. The fast-mapping system works perfectly and proves to be a useful tool for emergency analysis scenario. Regarding the UAV as RT system for emergency tracking, some faults occur with the drone radio system, and we were not able to see all the potential of the system.

  Regarding deployable LTE system, is proves to be very useful I urban and rural scenarios, and to have some minor problems in mountain and very difficult access areas. We believe that with a more powerful system, the problem would be solved.

  Regarding the EMS, it proves to be useful and to have all the needed information for tracking staff in real time and in post-processing. The system performance is quite dependent on internet connection quality. This can be improved by installing the system on a computer ad-hoc
- *Evaluation of the adaptability of the technology/implementation to any type of emergency situations. I.e., Can these technologies be used in any kind of emergency situations resulting from human-made and natural hazards? If not, please name which ones.*

  We tested the system in:

- Fire emergency. Here it is useful for rescue services that are not affected by smoke.
- Flooding. Here it is useful in any environment but underwater.
- Chemical incident. No limitations unless smoke or fog.

We do not foreseen limitations beyond this items.

- *Evaluation of the technology transfer to emergency services. I.e., Can these technologies be easily employed by your organisation to improve situational awareness and support decision making processes?*

  According to the conversations with the end user's that came to the exercise. It would be quite easy and direct to transfer each tested technology by their own. As a hole, it could be more complicated because some of those technologies, mainly EMS are already implemented in the emergency services. Regarding the rest of technologies, since their interact though very easy interfaces, can be transferred quite easily.

- *Advantages and limitations in the functionalities. What are the advantages and limitations of the functionalities of these technologies?*

  Knowing the situation of the staff seamless if it is indoor or outdoor is the main advantage of the solution. The main problem with the technology used is that do not work in foggy or smoky environment.

  The main problem with UAVs is that they have some limitations also in foggy, dark or smoky environment. Otherwise they provide almost real time (15 minutes from launching) perfect image of the situation.

  The main advantage of deployable communications is that the team do not depend on external communication providers. No cons were detected.

  EMS systems are widely used in the context of emergency and our test field do not add nothing new to the previous knowledge.

- *Compatibility with existing tools. Are these technologies compatible in use with other exiting tools currently available and well-established at your organisation?*

  The helmet transmits the position through classical LTE/5G system and with a pre-defined API. It is very easy to integrate in any visualization or database system.

  Regarding the drones, the images can be generated in any image format, also allowing to be easily uploaded to any emergency system.

  The communications system, is fully autonomous and is complementary to TETRA thanks to it improved bandwidth system.

5.2.2. End-Users’ feedback

The evaluation of end-users has been compiled by means of a dedicated questionnaire. One questionnaire will be designed for both functional exercises, however the questionnaire for the second exercise might be refined based on the results obtained from the first one.

The end-user’s evaluation form addressed each of the IOPES technologies:

- RPAS-based fast mapping tool

  The hole of the participants found it very useful, but in case of flying over smoky areas. They believe it can help a lot in emergency management and planning.

- Wearable positioning device

  Most of the attendants declared themselves impressed. They asked for improvements on ergonomy, since every emergency scenario and every emergency team has different limitation. The stated that if the system arrives to the market, it could be very valuable.

- LTE/ 5G deployable communications

  They all declared interest on the system. Since this is already a commercial system, they asked for ore information because it provides autonomy and enhanced bandwidth.

- Mature EMS (Emergency Management System)

  They all like the system but declared that they are using their own system and they are not going to change. Improving the own systems with a tracking module seema a very realistic and interesting solution.

6. Reference documents

[1] IOPES (2021). *D5.2 Scrip for field tests in ES, DE*.

[2] IOPES (2021). *D3.1 User requirements report*.

[3] IOPES (2021). *D5.1 CPE exercises operations plan_V2.*

IOPES

Indoor-Outdoor Positioning
for Emergency Staff