ASSISTANCE

Adapted situation awareneSS tools and tallored training curricula for increaSing capabiliTies and enhANcing the proteCtion of first respondErs

European Commission

Project co-funded by the European Union within the Horizon 2020 Programme

Project Ref. N°	ASSISTANCE H2020 - 832576
Start Date / Duration	May 1, 2019 (36 months)
Dissemination Level[1]	PU (Public)
Author / Organisation	UPV

Deliverable D5.4

Final SA Platform Integration

30/04/2021

[1] PU: Public; PP: Restricted to other programme participants (including the EC services); RE: Restricted to a group specified by the Consortium (including the EC services); CO: Confidential, only for members of the Consortium (including the EC services).

ASSISTANCE

Nowadays different first responder (FR) organizations cooperate together to face large and complex disasters that in some cases can be amplified due to new threats such as climate change in case of natural disasters (e.g. larger and more frequent floods and wild fires, etc) or the increase of radicalization in case of man-made disasters (e.g. arsonists that burn European forests, terrorist attacks coordinated across multiple European cities).

The impact of large disasters like these could have disastrous consequences for the European Member States and affect social well-being on a global level. Each type of FR organization (e.g. medical emergency services, fire and rescue services, law enforcement teams, civil protection professionals, etc.) that mitigate these kinds of events are exposed to unexpected dangers and new threats that can severely affect their personal safety.

ASSISTANCE proposes a holistic solution that will adapt a well-tested situation awareness (SA) application as the core of a wider SA platform. The new ASSISTANCE platform is capable of offering different configuration modes for providing the tailored information needed by each FR organization while they work together to mitigate the disaster (e.g. real time video and resources location for firefighters, evacuation route status for emergency health services and so on).

With this solution ASSISTANCE will enhance the SA of the responding organisations during their mitigation activities through the integration of new paradigms, tools and technologies (e.g. drones/robots equipped with a range of sensors, robust communications capabilities, etc.) with the main objective of increasing both their protection and their efficiency.

ASSISTANCE will also improve the skills and capabilities of the FRs through the establishment of a European advanced training network that will provide tailored training based on new learning approaches (e.g. virtual, mixed and/or augmented reality) adapted to each type of FR organizational need and the possibility of sharing virtual training environments, exchanging experiences and actuation procedures.

ASSISTANCE is funded by the Horizon 2020 Programme of the European Commission, in the topic of Critical Infrastructure Protection, grant agreement 832576.

Disclaimer

Executive Summary

This deliverable provides a comprehensive description of the integration process of the ASSISTANCE wearable sensors, mobile platforms and their mounted sensors and the advanced software modules developed during the project: Augmented Video Fusion Module, Chemical Hazard Module, Damaged Assets Location and Routing, and Mission Management Module. The integration of these modules in the ASSISTANCE SAP provides a set of innovative Situation Awareness capabilities to the FRs.

The internal and technical integration processes of each module are widely described in other documents like D3.2. In this document just, a practical description on how the integration process is reflected in the usage of all these modules capabilities and sensors through the SAP is stated. The document follows the structure below:

Section 2.1 provides the integration description of the mobile platforms used in ASSISTANCE: Drones, Robots and their mounted sensors and how all this information is visualized in the SAP main HMI.

Section 2.2 shows the integration process of the Mission Management Module and how the information is sent and visualized in the different interfaces (GCS and MMM main HMI).

Section 2.3 describes the integration of the Chemical Hazard module innovate features in the SAP, with an emphasis on the calculation and display of both toxic plumes and FRs alarms.

Section 2.4 explains the integration of the Damaged Assets Location and Routing module, showing how the secure evacuation routes calculated taking into account damaged assets and traffic information, are visualized in the SAP main HMI.

Section 2.5 describes the integration of the different wearable sensors used in ASSISTANCE: Vital signs' sensors, wearable cameras and GPS sensors. Also, this section provides a description of how the wearable sensors information is visualized in the SAP main HMI

Section 2.6 describes the integration of the advanced video fusion module with the SAP and also describe how the advanced video fusion capabilities are shown through the SAP main HMI.

Finally, section 3 closes the document with the main conclusions

List of Authors

Organisation	Authors
UPVLC	Federico Carvajal, Manuel Esteve, Israel Pérez, Débora Robles

Change control datasheet

Version	Changes	Chapters	Pages	Date
0.1	First draft (ToC)	All	14	22/02/21
0.2	Internal version updated	All	25	29/03/21
0.3	First consolidated version	All	29	02/04/21

Content

List of Figures

Acronyms

ASSISTANCE	Adapted situation awareneSS tools and taIlored training curricula for increaSing capabiliTie and enhANcing the proteCtion of first respondErs
PC	Project Coordinator
D#.#	Deliverable number #.# (D1.1 deliverable 1 of work package 1)
DoA	Description of Action of the project
EC	European Commission
EU	European Union
GA	Grant Agreement
H2020	Horizon 2020 Programme for Research and Innovation
IPR	Intellectual Property Rights
M#	#th month of the project (M1=May 2017)
WP	Work Package
IPR	Intellectual Property Rights
PSC	Project Steering Committee
PIC	Project Implementation Committee
PSB	Project Security Board
AB	Advisory Board
TL	Task Leader
WPL	Work Package Leader
SA	Situation Awareness
UAV	Unmanned Aerial Vehicle
HMI	Human Machine Interface
GCS	Ground Control Station
CHT	Chemical Hazard Tool
DAL&R	Damaged Assets Location & Routing Module

1. Introduction

This deliverable shows the results of T5.4 “Advanced Modules, SAS & Communications Infrastructure Integration in ASSISTANCE SA Platform”. In the different sections of the document is stated, in a descriptive manner, the overall integration process results of each ASSISTANCE module and the visualization of this information in the SAP. This integration is fully compliant with the system architecture designed in D2.4 and follows all logical interfaces developed in D3.2. In addition, the integrated data visualization is based on the D5.1 result.

For this reason, this document is not going to duplicate the logical interfaces description, since they have been already described in D3.2 and just is going to show the integrated information in the SAP.

1.1. Purpose

The purpose of this document is to provide a detailed description of the integration of all modules developed during the project in the SAP to form the whole ASSISTANCE system. Once the integration has been performed ASSISTANCE system will offer its new tools and capabilities to the First Responders (FRs) for being tested during the project pilots.

With all these new capabilities integrated into the Situation Awareness Platform (SAP) ASSISTANCE provides new tools and capabilities to the FRs for both increase their SA and also their own safety.

1.2. Relationship with other work packages

This deliverable has a strong link with different ASSISTANCE work-packages. With WP2, since this WP provided the end users requirements (D2.2) and the system architecture design (D2.4), which are the basis for the overall system integration.

With WP3, since in this WP the Sensors Abstraction Service (SAS) including the logical interfaces design (D3.1) and development (D3.2) were provided as the technical basis for the system integration described in this document.

With WP4, since the different sensors and mobile platforms were selected (D4.1) and adapted (D4.2 and D4.3) as one of the key elements to be integrated in the system.

With WP5, since all modules and tools integrated were developed and adapted in the first tasks of WP5.

Finally, this task is correlated with WP7 where the integrated ASSISTANCE system will be tested and evaluated in a controlled environment by the FRs of the consortium.

2. Advanced Modules Integration with the SAP

Figure 1 exhibits the ASSISTANCE system architecture provided by D2.4 showing the different tools and modules integrated which implement the comprehensive ASSISTANCE system.

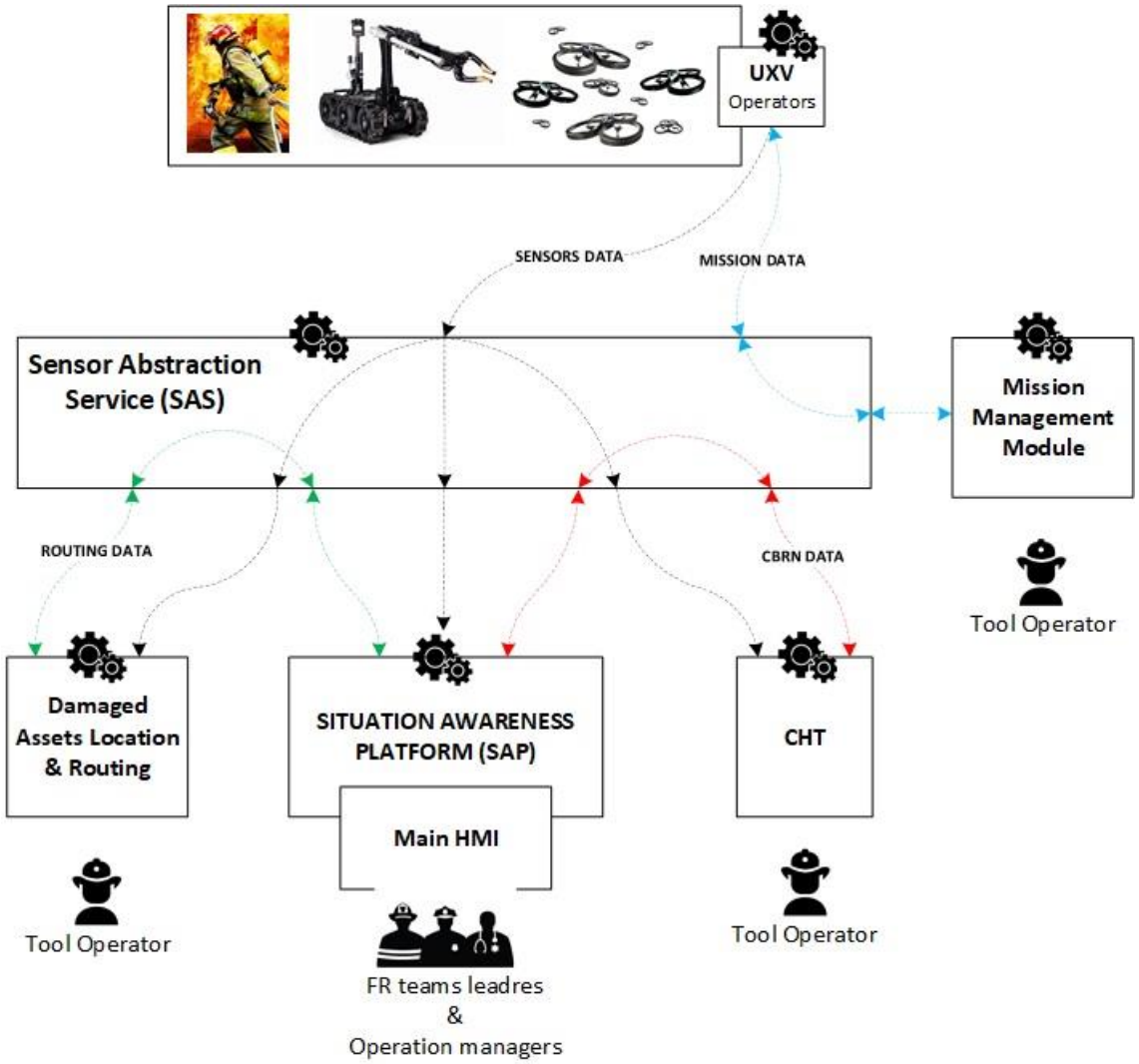

Figure 1 ASSISTANCE Architecture schema

According to the architecture schema during T5.4 the following integrations have been performed successfully through the SAS:

- Mobile platforms integration: UxV telemetry and sensors information with the SAP to provide the FRs real time information from the sensors mounted in these mobile platforms (chemical sensors, video cameras, thermal cameras, etc.) for increasing their SA and self-protection.
- Mission Management Module (MMM) with the UxV Ground Control Stations (GCS) to provide to the FRs the mechanism for creating missions to be executed by the unmanned platforms.

- Chemical Hazard Tool (CHT) with the SAP in order to provide the FRs real-time information on the potential toxic areas and plumes and individual alarms in case of danger.
- Advanced video fusion module with SAP in order to provide the real-time location of the UAVs videos on the map for increasing the FRs SA.
- Wearable sensors with the SAP in order to provide the commanders and also to other FRs, real-time information of FRs status, real time videos from wearable cameras and FRs location.
- Damaged Assets Location & Routing module with the SAP to provide to the FRs information concerning secure evacuation/intervention routes from a particular point or area to a safe location (Shelter) avoiding damaged assets or impassable areas.

In the following section of this document the above-mentioned individual integration will be described in detail.

2.1. Mobile Platforms integration

2.1.1. Drones sensors and telemetry integration

The drones' integration (mounted sensors measurements and telemetry) with the SAP has been performed through the SAS, which utilises logical interfaces designed and developed for exchanging data among the different ASSISTANCE SA components. The scope of this integration includes data exchanges from the sensors mounted in the drones' (e.g. gas measurements and video flows) and the drones' telemetry. See D3.1 and D3.2 for more details regarding the SAS definition and implementation.

The technical integration was performed successfully and all the information is visualized in the SAP HMI following the FRs recommendations stated in D5.1.

In the following screenshots the drones' integration with the SAP is shown.

In Figure 2 the drone's icon shows its location information received through the SAS. Once the FR clicks on the icon, the drone unit interface appears (See the red circle in figure 2). Then the FR clicks on the "Gas sensor" button and the last measurement appears according to the visualization agreed with the FRs (See the blue circle in figure 2).

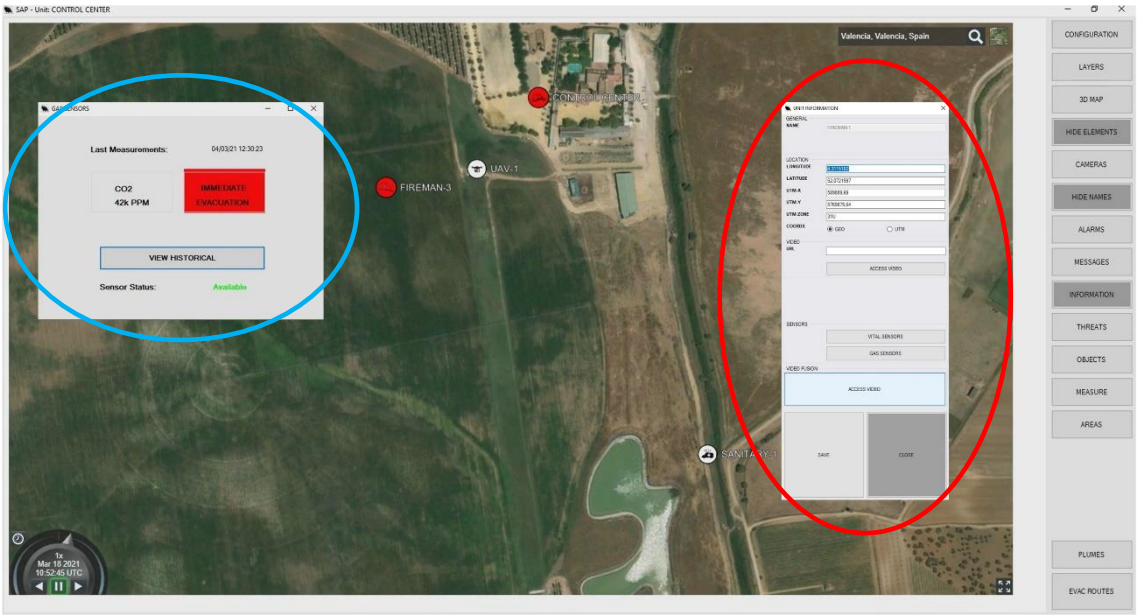

Figure 2 Drone location and gas measurements visualization

Finally, if the FRs want to see the last measurements taken by the gas sensor mounted in the drone they have to click on the "View Historical" button in the measurement visualization interface and all measures taken by the sensor will be shown on the map associated with the location of the drone in the moment of taking each measure.

The result of the visualization of all gas measurements taken during the real flight test, associated with the drone location in each moment, is shown in Figure 3.

Figure 3 Drone location and historical gas measurements visualization

For the real-time video integration and visualization, the process is shown in Figure 4.

After clicking on the drone icon, the drone unit interface appears. Then the FRs have to click on the “Access Video” button and the video window appear showing the real time-video flow from the drone camera. If the drone was equipped with a thermal camera the process for visualizing the thermal images would be the same.

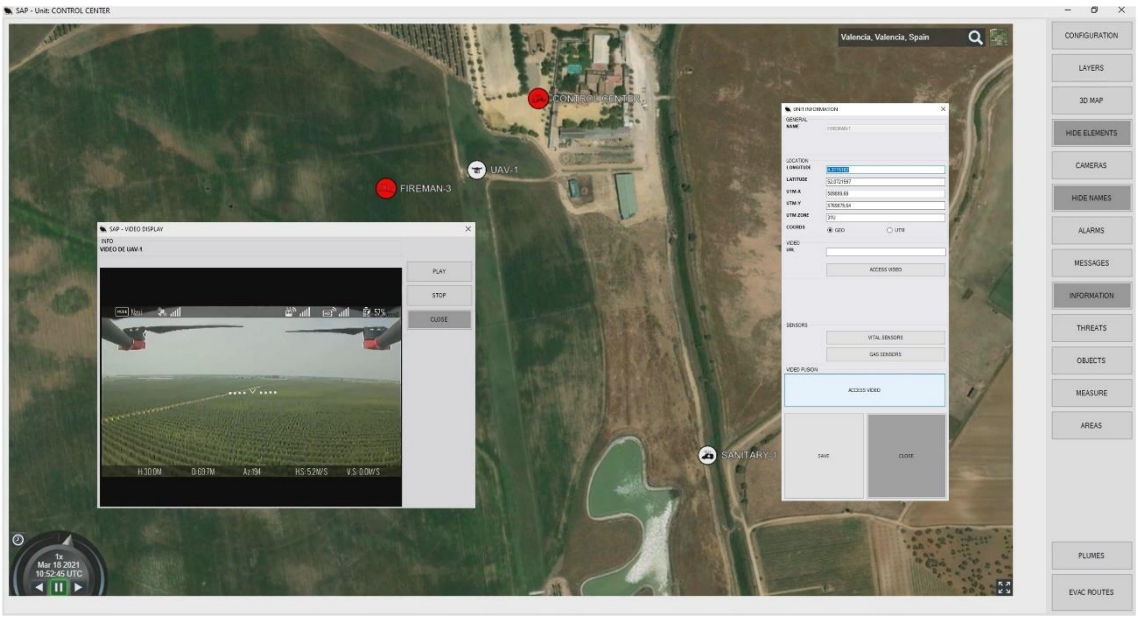

Figure 4 Real time video visualization from drone’s camera

2.1.2. Robots sensors and telemetry integration

The robots' integration (mounted sensors measurements and telemetry) with the SAP has been performed through the SAS, which utilises logical interfaces designed and developed for exchanging data among the different ASSISTANCE SA components. The scope of this integration includes data exchanges from the sensors mounted in the robots (e.g. gas measurements and video flows) and the robots' telemetry. See D3.1 and D3.2 for more details regarding the SAS definition and implementation.

The technical integration was delayed due to the COVID-19 pandemic and T4.3 was delayed for 6 months.

Therefore, on the date of writing this deliverable just robots' telemetry and video flows had been integrated successfully and this information is visualized in the SAP HMI following the FRs recommendations stated in D5.1.

In the following screenshots, the robots' current integration with the SAP is shown.

In Figure 5 the robot icon shows its location information received through the SAS. Once the FR clicks on the icon the robot unit interface appears in the SAP HMI as is also shown in Figure 5.

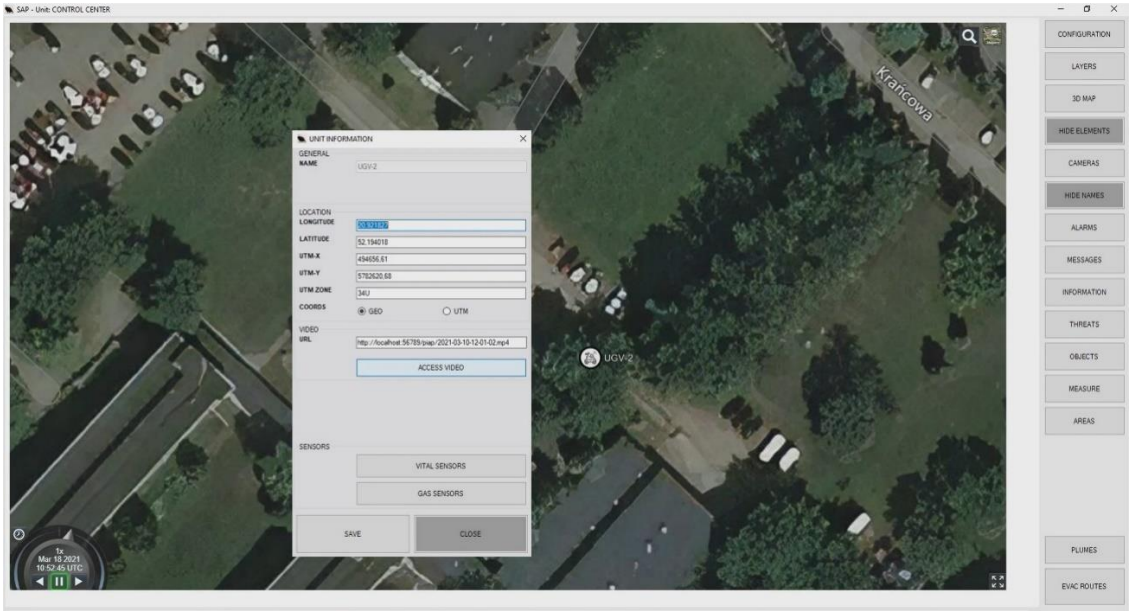

Figure 5 Robots' video access

Then the FR clicks on the "Access Video" button and the four video flows provided by the four cameras mounted on the robot appear according to the visualization agreed with the FRs.

The visualization of the robots' cameras video flows is shown in Figure 6.

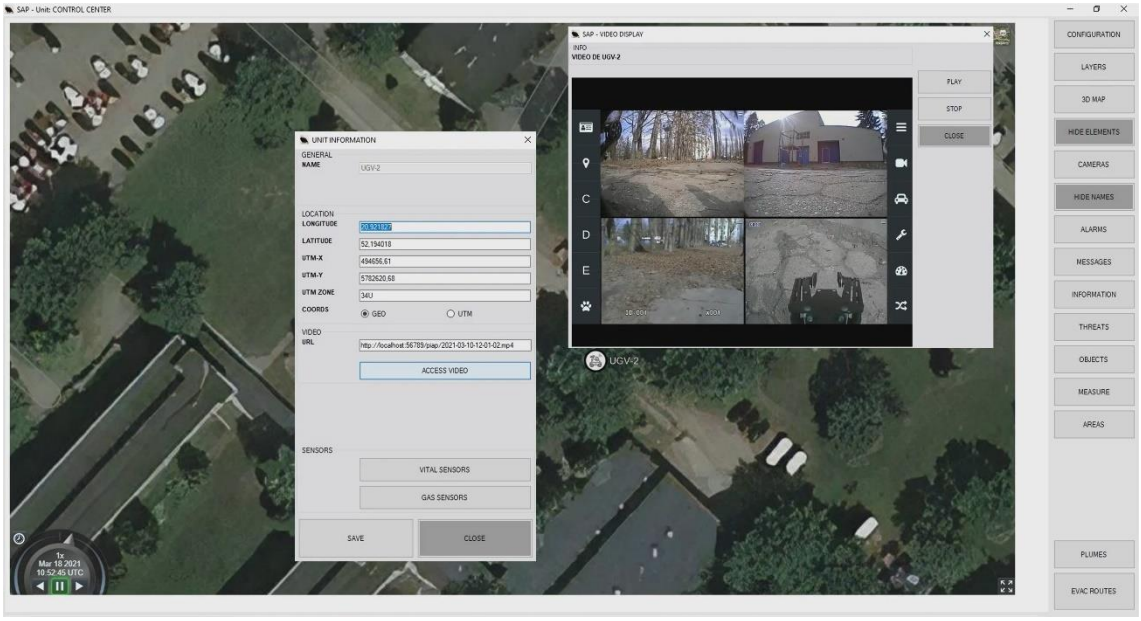

Figure 6 Robots' video visualization

2.2. Mission Management Module (MMM) integration

The MMM integration has been performed also through the SAS, like the rest of the modules and also using the logical interfaces developed in D2.3. For describing the MMM integration with the GCS of the UxV the mission information flow is shown in the following paragraphs and figures.

In Figure 7 the creation of a mission in the MMM HMI is shown. Once the mission information is introduced in the system, the computation workflow can be launched by using the button “Create Mission”. The result of the computation (i.e. the mission path and the payload actions) is submitted to the GCS involved in the mission. See red circle in Figure 7.

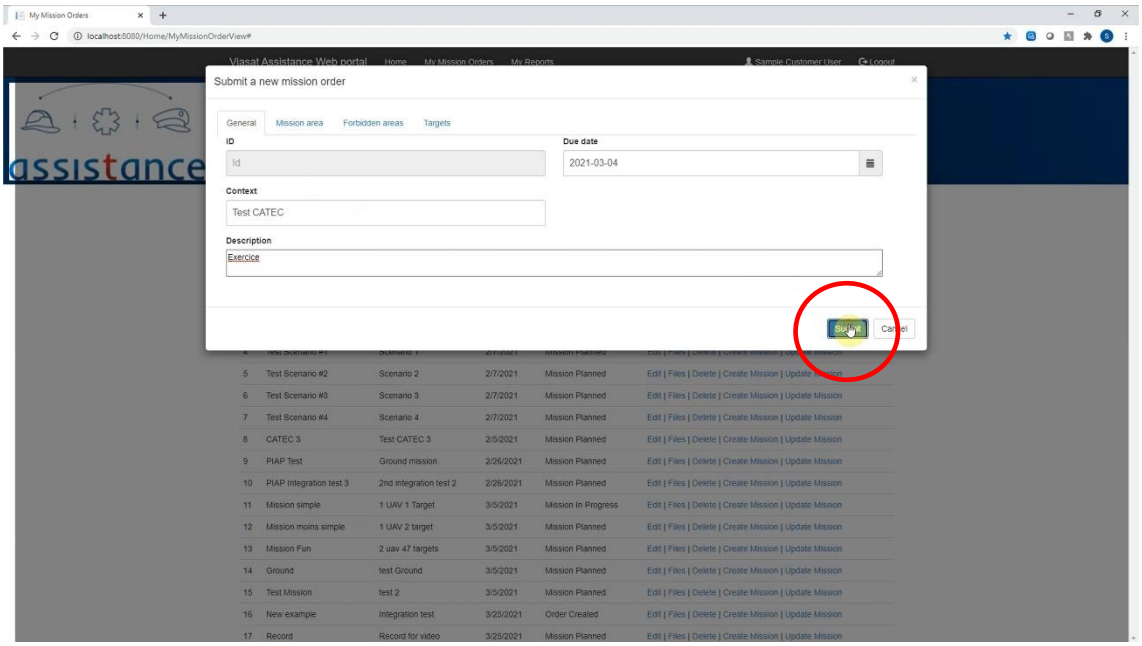

Figure 7 Mission Creation

The mission information arrives to the UxV GCS through the logical interfaces developed in the SAS. The correct reception of the mission data and its visualization in the UxV GCS is shown in Figure 8.

In this figure can be seen all information received through the SAS in the GCS: the way points received in term of geographical coordinates (See the red circle in Figure 8), the mission ID and the mission description (See the blue circle in Figure 8) and also the visualization of the way points received on the map in the central part of Figure 8.

The visualization of the waypoints on the map also shows the order of the way point in the mission that will be followed by the UxV for completing the mission.

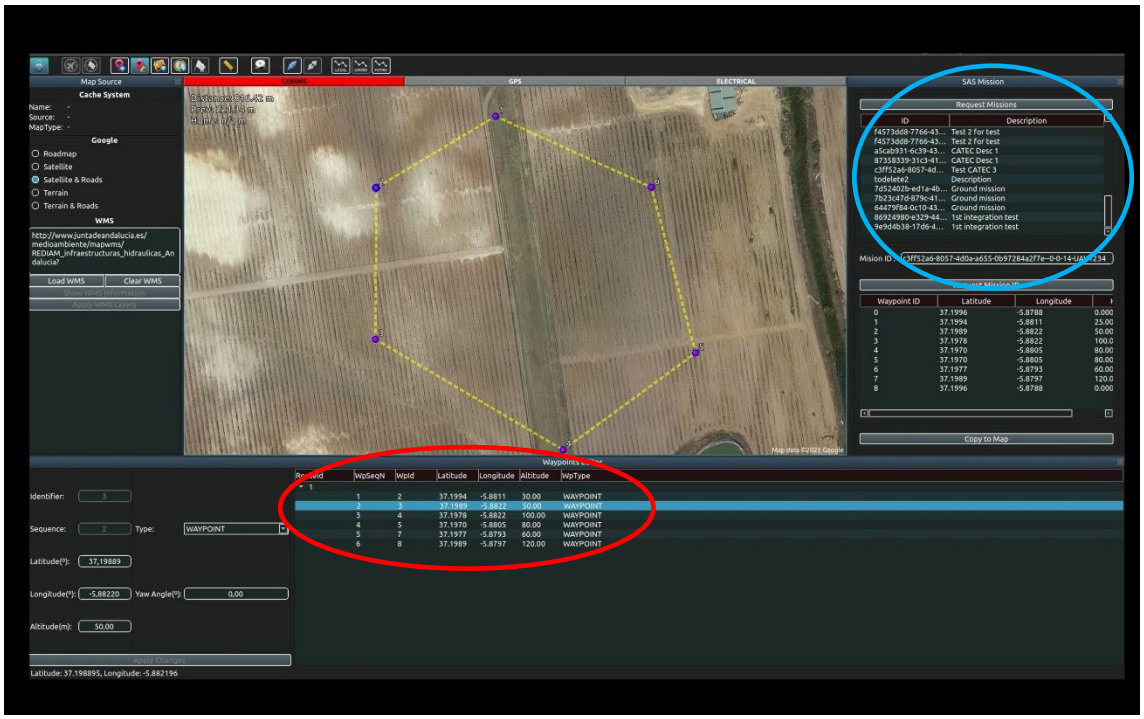

Figure 8 Mission Reception

Once the mission is received correctly in the UxV GCS it is executed by the mobile platform and the sensors send the information taken according to the mission parameters. The execution of the mission in the real GCS performed during the drones flight test is shown in Figure 9.

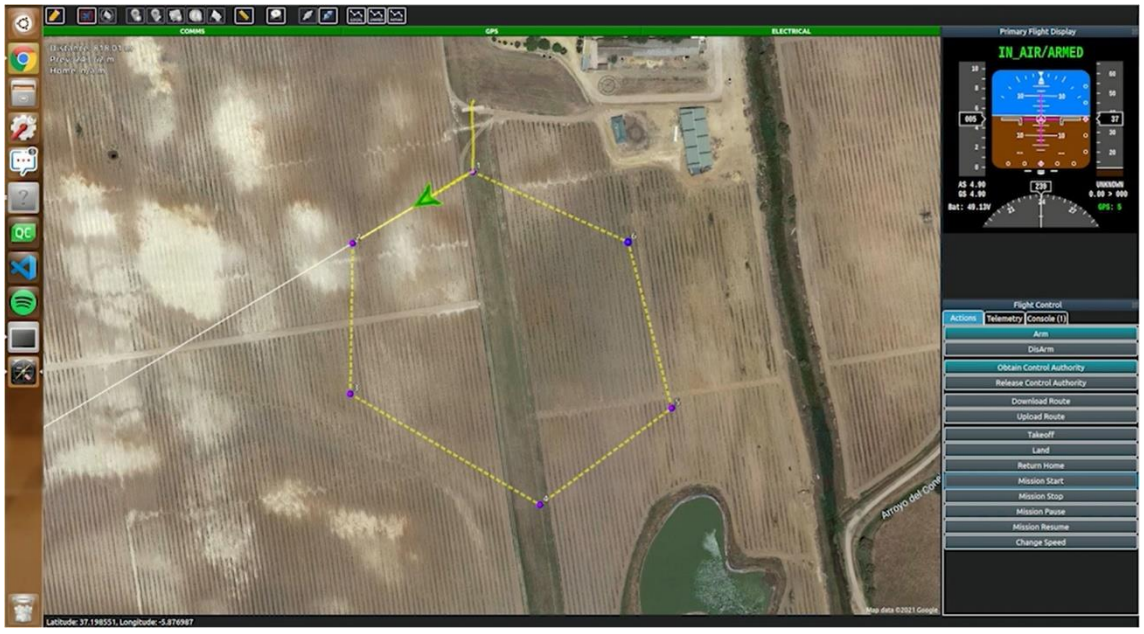

Figure 9 Mission Execution

The sensors information will be also sent through the SAS and visualized as stated in section 2.1.

Finally, when the mission has been computed it can be reviewed through the MMM main HMI to check if all mission objectives are covering correctly by the computation workflow.

For reviewing the mission, it is selected from the list of missions shown in the MMM HMI and displaying the resources involved in the mission as it is shown in Figure 10.

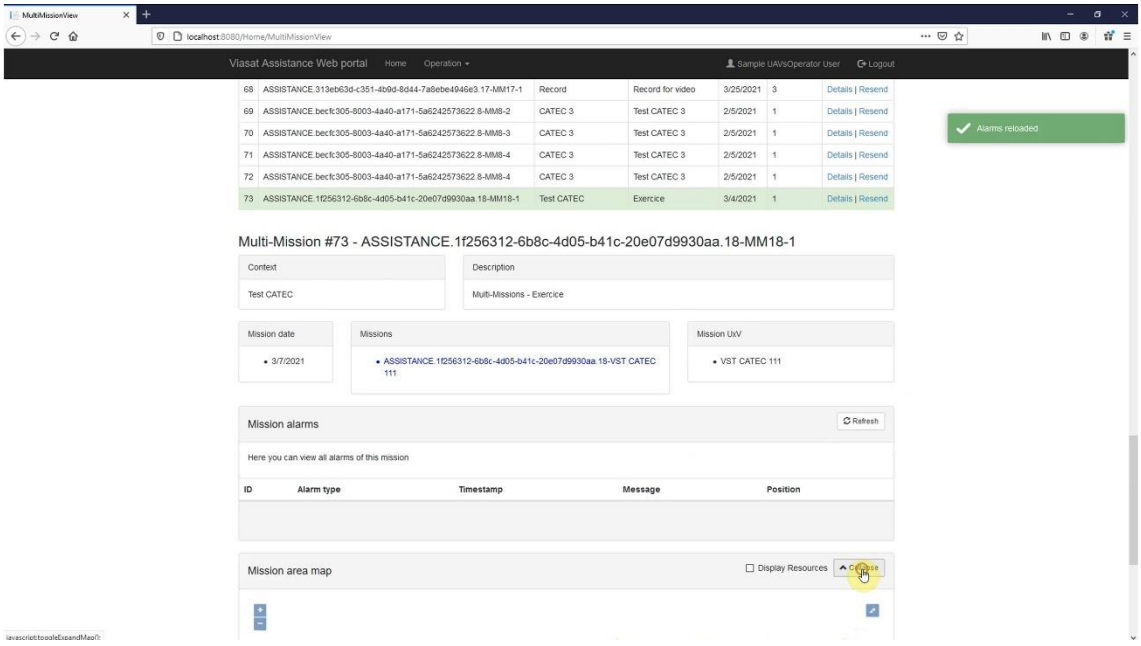

Figure 10 Mission Review

In Figure 11 the mission parameters are shown in the MMM HMI in order to review whether the mission has been computed correctly.

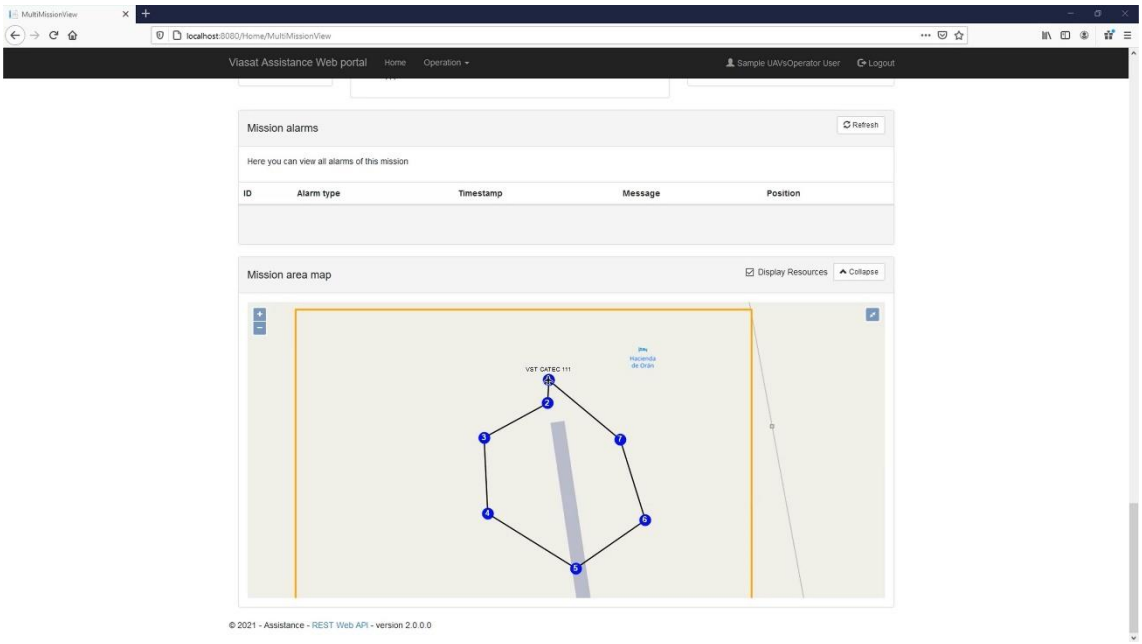

Figure 11 Mission Review

2.3. Chemical Hazard Tool (CHT) integration

The CHT works autonomously performing its calculations such as; toxic plumes calculation and forecast, send alarms to FRs in potential danger due to the toxic plumes' evolution calculation, etc.

For doing these calculations CHT receives information from sensors through the SAS and other external sources. Once these calculations are performed their results (toxic plumes perimeters and alarm objects) are shown in the CHT HMI and also sent automatically to the SAS using the corresponding interfaces developed in D3.2.

The integration with the SAP works as follows; when the FRs wants to know information regarding the potential evolution of the toxic plumes in a determinate area they perform a plume request to the SAS. Then the SAS send the available plumes perimeters for the selected area to the SAP. These plumes are shown in the interface for request and load plumes and the FRs select the more suitable plume and load the plume in the SAP HMI.

In Figure 12, the interface for request and load plumes is shown. In this interface can be seen the "Request Plumes" button for asking about available plumes to the SAS. The available plumes sent by SAS and stored in the SAP database are also shown in this interface.

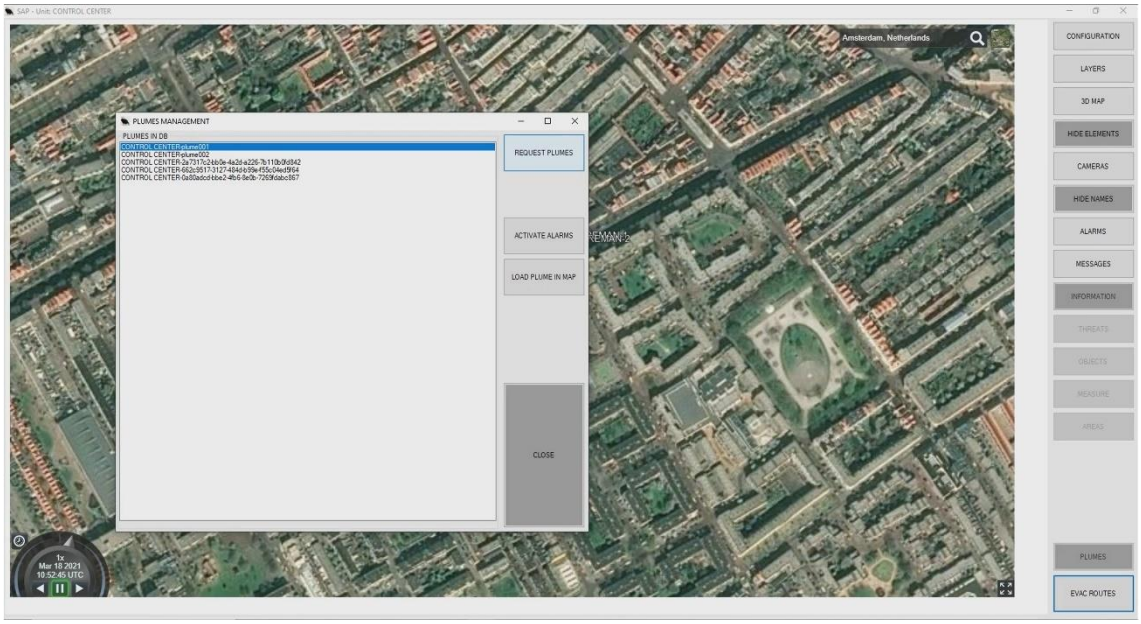

Figure 12 Plume Request and selection

Once the FRs have selected a plume, it is drawn in the SAP HMI by clicking on the "Load Plumes in Map" button and the plume selected is shown in the main SAP HMI as is described in Figure 13

Figure 13 Plume Visualization in the SAP HMI

If a FRs is in potential danger due to his/her location is close to the calculation of the evolution of a determinate toxic plume the CHT will send an alarm message to these FRs. This alarm mechanism is shown in Figure 14 CHT alarm sent to a FR in danger.

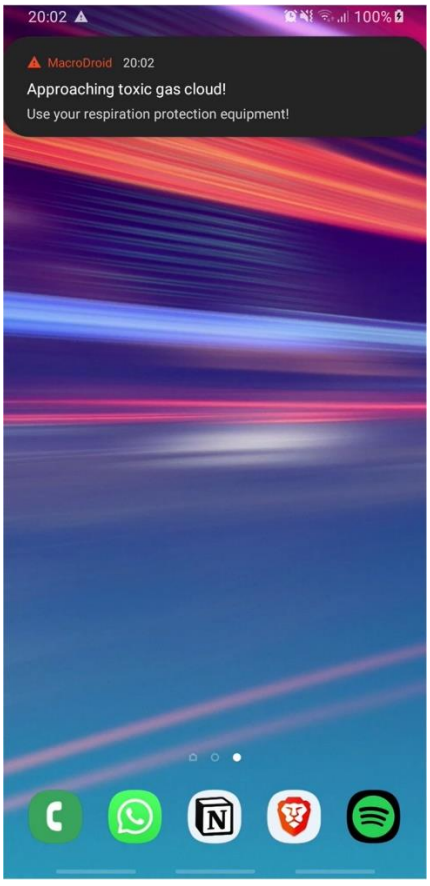

Figure 14 CHT alarm sent to a FR in danger

2.4. Damaged Assets Location & Routing Module integration

The DAL&R module works also autonomously performing its calculations such as; damaged assets location, traffic evolution, potential shelters/assembly points locations, evacuation/intervention routes and evacuation modelling.

For doing these calculation DAL&R receives information from sensors (e.g. video flows from mobile platforms) through the SAS and other external sources obtaining simulation parameters (e.g. population density, traffic information or geographic information). Figure 15 shows the main DAL&R HMI showing a damaged example area identified and located through the drone real-time video flows.

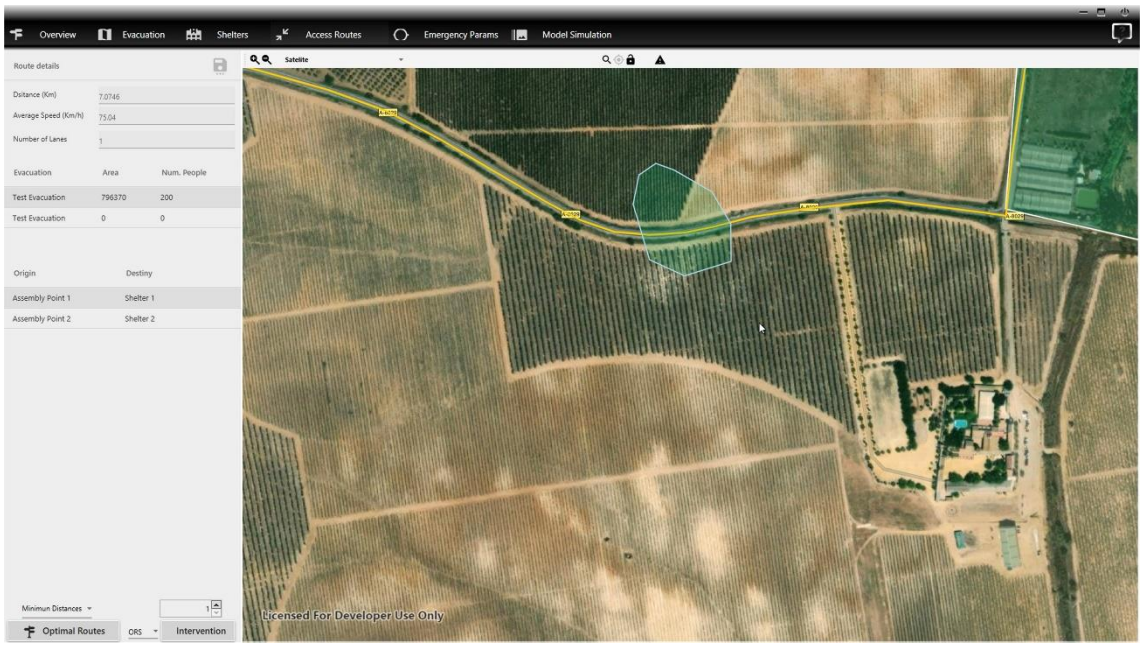

Figure 15 DAL&R main HMI showing a damaged road in the map

The integration with the SAP works as follows; The FRs wants to know the available evacuation routes from a particular location or area. Then they click on the evacuation route button in the SAP menu (See the red circle in Figure 16) and then define on the map a single point or a set of points determining an area boundary. This information is sent to the DAL&R automatically through the SAS using the corresponding interfaces developed in D3.2.

Once the DAL&R receives the route request message including the origin location of the route requested, it performs the necessary calculations obtaining damaged areas stored in the SAS and traffic information from external services to provide a set of optimal safe routes avoiding damaged assets or impassable areas. This information is sent to the SAP automatically through the SAS.

Finally, the SAP shows in its main HMI and the optimal shelter locations and the received routes for evacuating the selected area avoiding the damaged roads identified. The example received route is shown in Figure 16 in the SAP main HMI..

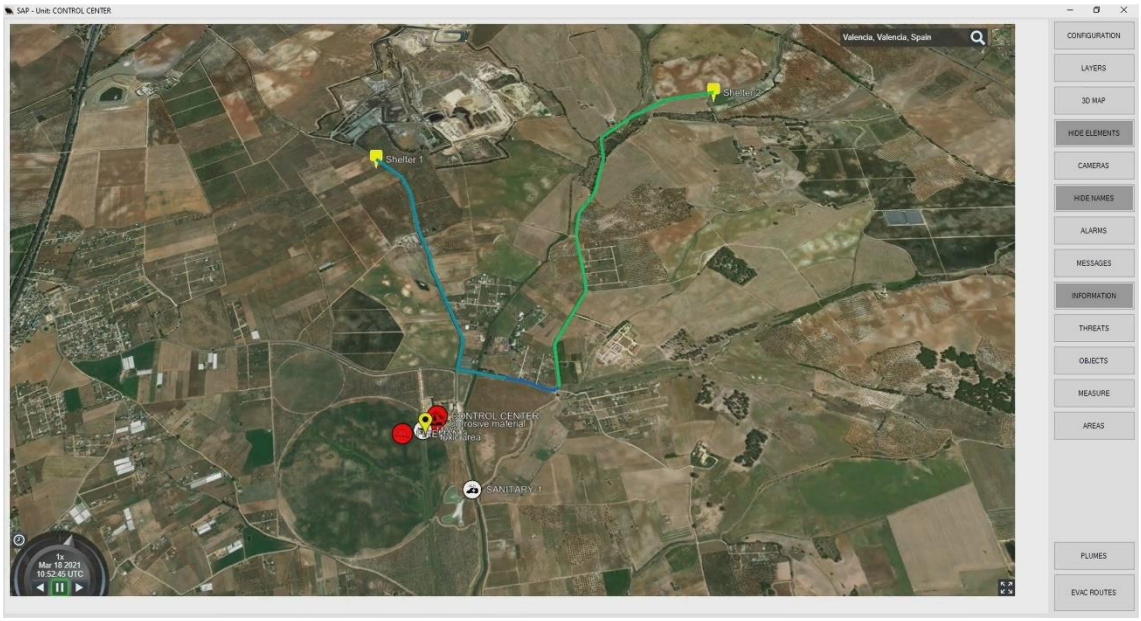

Figure 16 Secure Route Visualization

2.5. Wearable Sensors integration

ASSISTACE system includes three different kind of wearable sensors, which have been integrated with the SAP through the SAS and the corresponding logical interfaces developed in D3.2. The wearable sensors integrated are the following:

- Vital sign sensors: In-ear sensor Cosinuss 2
- Wearable cameras: AXIS M1045-LW
- GPS sensors: Traccar server application

All the details of these wearable sensors can be found in D4.4. In the following paragraphs the wearable sensors integration results are going to be shown.

In Figure 17 is described how the vital sign sensors are integrated into the SAP main HMI. The information on FRs heart rate and temperature is sent to the SAS through the Cosinuss 2 gateway mounted on the FR uniform. This data is then sent automatically to the SAP according to the interface developed in D3.2 and stored in the SAP data base.

For visualizing the vital sign information of a determinate unit, the FRs just have to click on the unit icon and then click on the “Vital sensors” button in the unit interface (See blue circle in Figure 17).

When the “Vital sensors” button is clicked the vital signs’ information of the selected unit appears in the manner agreed with the end-users, which is fully described in D5.1.

In this Vital signs’ interface the FR unit temperature and heart rate are shown in both numerical and graphical formats. In addition, when the heart rate or the temperature of a unit overcome some predefined thresholds a red circle appears rounding the unit and indicating to the commanders and other FRs that something is happening with this unit.

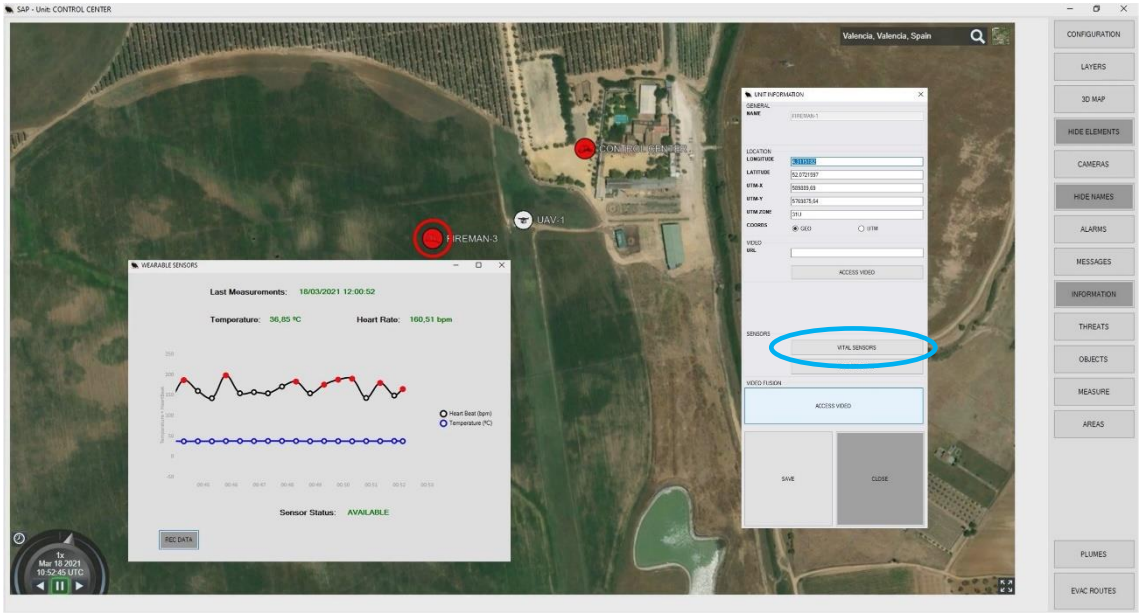

Figure 17 Vital Signs Sensors Integration

This additional safety mechanism implemented in the SAP was previously agreed with the end-users and it is also shown in Figure 17.

In Figure 18 the integration of the wearable cameras is described. At the UPV premises a simulated police unit is located. When the unit's icon is clicked the unit's interface appears showing the sensors available for this unit.

By clicking on the "Access Video" button (See blue circle in Figure 18), the real-time video flow sent to the SAS by the FR unit camera is displayed in the main SAP HMI as can be seen in Figure 18.

This way the real time video flows from any unit can be visualized in the control room or by other units on the field through the SAP mobile application.

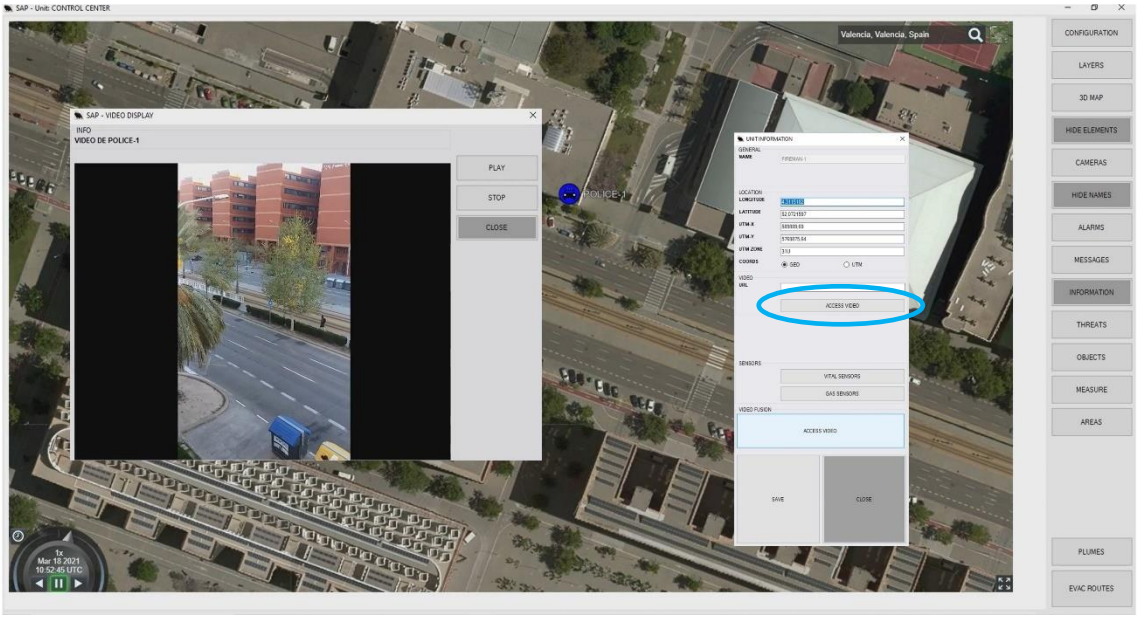

Figure 18 Wearable Cameras Integration

In Figure 19 the integration of the FRs GPS location information is described. For performing the integration of the GPS units' information, the consortium has selected a flexible solution based on the Traccar server instead of performing a solution based on a unique GPS sensor.

Traccar server is compatible with a large number of GPS devices and also can use the GPS information of the FRs smart phones or tablets. This last feature has been used by the consortium form integrating the FRs GPS location easily and reliably.

In the integration test performed Traccar server sent to the SAS GPS information from two smart phones, which had installed the client app. These smart phones were located in TNO premises in The Netherlands and their GPS information was sent automatically by the SAS to the SAP and visualized in its main HMI as described in Figure 19.

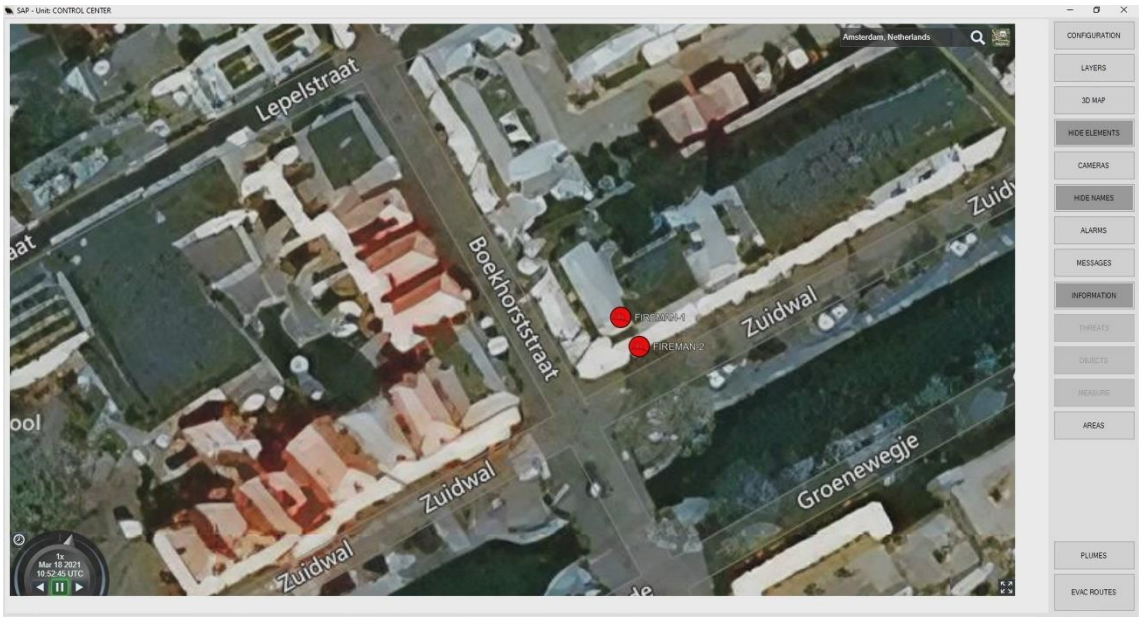

Figure 19 GPS Location Integration

2.6. Video Fusion Module integration

The video fusion module is one of the advanced ASSISTANCE modules developed during WP5. This innovative module allows projecting the drone camera video flow window on the map. This way the FRs can see easily in which exact geographical location is happening the action shown by the drone camera.

With this new capability the FRs' SA is increased, since they can locate on the map easily and quickly whatever event detected through the video such as; a fire, victims on the field, a potentially dangerous asset (e.g. a gas tank, a petrol station, a school, etc).

For performing the integration of this module with the SAP, the drones have to send to the SAS their exact telemetry associated with each photogram on the video flow. Once this information is received in the SAS it is sent to the SAP automatically for being used on demand.

In Figure 20 the integration of the video fusion module in the SAP is described. When the FRs need to see the video fusion information they have to click on the drone's icon and once the unit interface appears the FRs have to click on "Access Video" button in the video fusion section of the interface (See blue circle in Figure 20).

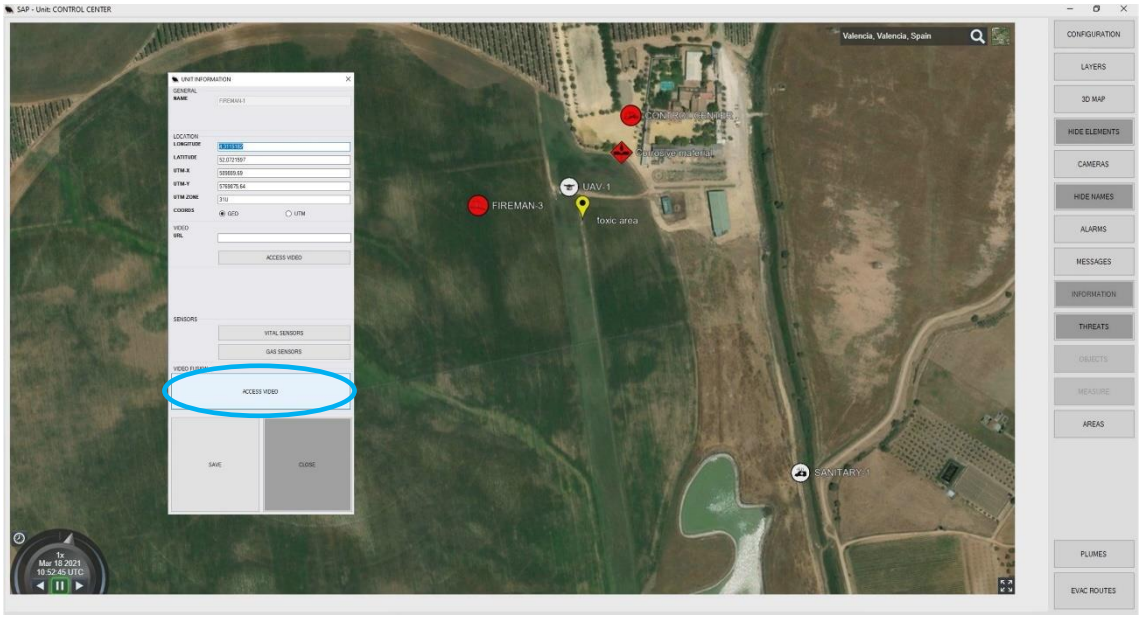

Figure 20 Video Fusion Request

After clicking this button, the main SAP interface was showing the drone video fusion, displaying the video window directly at its exact location on the map. In addition, the video window can be also be visualized in the main SAP HMI.

This process is fully described in Figure 21 where the real-time video is displayed in the normal video window and also projected on the map right in the point where the action is happening.

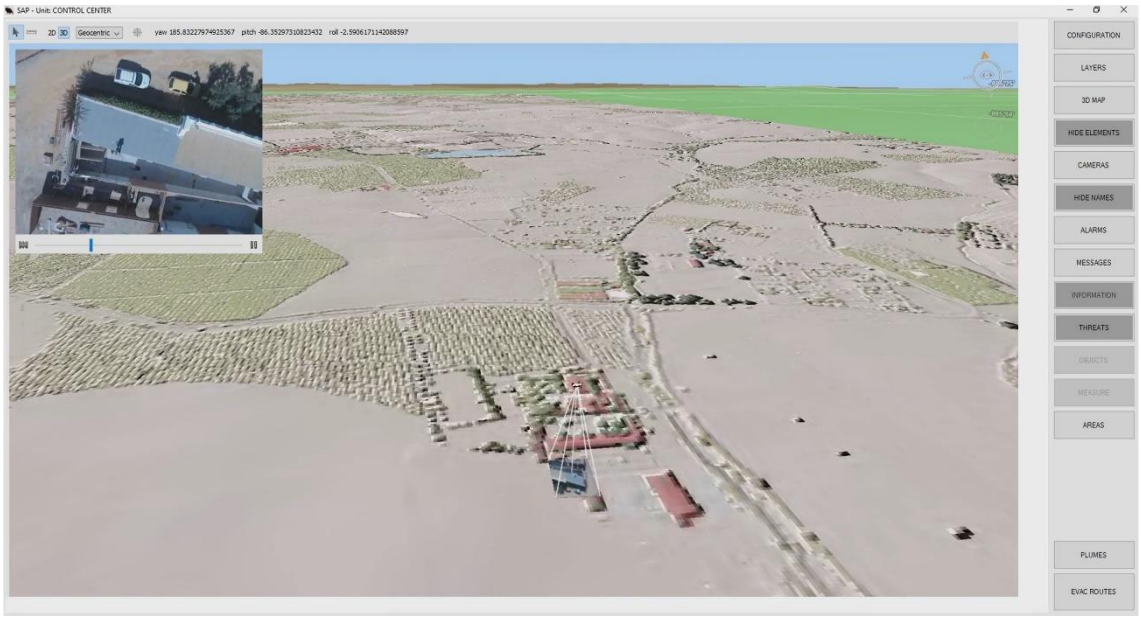

Figure 21 Video Fusion Integration

This way is some event (e.g. a fire, collapsed building, etc) or potentially dangerous asset (e.g. a gas truck, chemical tank, etc.) was detected through the real-time video flow it could be located quickly on its exact location through the SAP, for example inserting an alarm or an object in this location for informing all FRs on the event or the potentially dangerous asset detected.

3. Conclusions

This document describes the different individual integration processes of all modules platforms and sensors developed in ASSISTANCE project.

The successful integration of these modules and sensors and the visualization of their innovative capabilities and information through the SAP main HMI will provide new capabilities to the FRs, which increase their SA and their own safety.

Finally, as a result of T5.4, a fully operational prototype of ASSISTANCE system is ready for being assessed and tested during WP7 evaluation tests in lab and also tested under real conditions in controlled environments by the project end users during the three project demonstration pilots