TeamAware

TEAM AWARENESS ENHANCED WITH ARTIFICIAL INTELLIGENCE AND AUGMENTED REALITY

Deliverable D14.5

Dissemination and Communiation Report – v 1

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Document Description

Document Revision History

Version	Date	Modifications Introduced	
		Modification Reason	**Modified by**
0.1	03/03/2022	Initial Version to All Partners	Yildiray Kabak
0.2	30/03/2022	Magazines, Papers, Blogs, Newsletters are inserted	Yildiray Kabak
1.0	28/04/2022	Comments by JOAFG and HAVELSAN integrated.	Yildiray Kabak

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Executive Summary

The main objective of TeamAware Project is to develop an integrated and cost-efficient situational awareness system for first responders from different sectors.

This is the Deliverable 14.5 Dissemination and Communication Report, developed within Work Package 14. This strategy aims to plan, organise, and evaluate key communication and dissemination activities undertaken by the Consortium for the promotion of TeamAware's results and findings, including the diffusion of innovations generated, to targeted audiences. The current document is a working document and will be updated throughout the project's duration. Communication and dissemination objectives are to:

- Raise awareness of the project objectives, results, and scheduled events to build reputation, create engagement/adherence and support/endorsement
- Widely disseminate the project’s concepts, findings, and results throughout the project's life, while constantly revising and evaluating effectiveness of selected mediums
- Ensure the long-term impact of the project by establishing appropriate lines of communication to maximize influence on policy and decision makers within targeted communities (first responders, research, and academia)
- Promote collaboration with similar EU and national level projects
- Inform stakeholders about the relevance of the project's outcomes
- Promote the findings and the results of the project to the targeted audiences in a regular and consistent manner

In the context of the TeamAware Project, this will be done through:

Target audiences - the stakeholders in emergency management including (1) End-user community that represent “potential customers” such as firefighters, first responder organisations, LEAs, MDs, practitioner organisations, and experts, (2) Policy and decision makers that represent “influencers, deciders and regulators” in the area of emergency operations and first responder, (3) Business community: technology developer industry organisations, SMEs, industrial associations, umbrella organisations, national/European level industry platforms, consultants, solution providers, system integrators, (4) Research community: universities, research centres/institutes, academicians, researchers and (5) General public: NGOs, civil society and citizens

Key messages - related to the project's innovative solutions in delivering situational awareness to first responders, its impact and contributions, as well as its collaborative approach.

Key tools - those mediums & channels, which will be utilised per audience in order to facilitate awareness, understanding and action, from the perspective of the different targeted audiences.

Evaluation and monitoring procedures - which will allow for the entire communication and dissemination plan and respective activities to be monitored and assessed on a regular basis during the project life. Minimum success thresholds will be used for each communication tool.

The overall communication and dissemination strategy has been divided into distinct phases, in accordance with the phases of the project, focusing on:

1. Awareness-raising - aiming to motivate targeted audiences to become interested in being informed about the progress of the findings and to actively engage in dialogue about the project goals.
2. Communicating with targeted-audiences on available project results, aiming to promote a deeper understanding as well as to further motivate their involvement.
3. Dissemination of results that will ensure long-term impact and utilization of the project results.

The aim of this deliverable is to present the current status and figures in terms of aimed KPIs described in D14.1 Dissemination and Communication Plan. The organization of the deliverable is as follows:

- Section 2 describes the status and figures of dissemination KPIs of our project.
- Section 3 presents the publications (Papers, Posters and Magazines) published by TeamAware partners.
- Section 4 reports on the conference participations by our partners.
- Section 5 presents our social media activities.
- Section 6 gives information about the online lectures developed in our project.
- Section 7 gives information about a new initiative called HorizonResultBooster.eu to support our dissemination activities.
- Section 8 reports about our web site activities (published Blogs and Newsletters)
- Section 9 concludes the deliverable.

1. Introduction

1.1. About This Deliverable

The Deliverable 14.1 and 14.4, entitled Dissemination and Communication Plan, aims to define the strategy to appropriately plan and organise all communication and dissemination activities undertaken by the Consortium for the promotion and diffusion of TeamAware's results and findings to target audiences (first responders, decision makers/funders/regulators/policy representatives, ICT developers of digital tools/developers of emergency management systems and academics in this field). The following EU H2020 definitions to inform communication and dissemination strategy have been used:

Communication: 'Strategic and targeted measures for promoting the action itself and its results to a multitude of audiences, including the media and the public' with the aim of promoting your project and its results beyond the projects own community, reach out to society.

Dissemination: 'The public disclosure of the results by any appropriate means, including by scientific publications in any medium. Transfer of knowledge and results to the ones that can best make use of it' which in turn 'maximizes the impact of research, enabling the value of results to be potentially wider than the 'original focus'. This includes open access to publications and data which are all considered to be an 'essential element of all good research practice' and 'prevents results becoming sticky and effectively' and 'strengthens and promotes the profile of the organisation'.

The present deliverable gives status update on the dissemination activities (planned in D14.1 and D14.4) in the first year of the project duration.

1.2. Document Structure

The organization of the deliverable is as follows:

- Section 2 describes the status and figures of dissemination KPIs of our project.
- Section 3 presents the publications (Papers, Posters and Magazines) published by TeamAware partners.
- Section 4 reports on the conference participations by our partners.
- Section 5 presents our social media activities.
- Section 6 gives information about the online lectures developed in our project.
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- Section 9 concludes the deliverable.

1.3. Relation with Other Tasks and Deliverables

This deliverable is related with all of the project work packages in that it presents the results of the achievements to the stakeholders.

2. KPI Status

Communication tools	Target group	Success measures / KPIs	Status
Peer-to-peer interaction	Consortium team	· 7 pre-defined consortium meetings	Not scheduled yet (due to COVID)
Internal meetings		· >36 regular online meetings/tele-conferences	Due to COVID all work is carried out through weekly/biweekly/monthly meetings. We already achieved the KPI target. For example, the number of meetings for some workpackages in the first year is as follows: WP5: 9 meetings, WP8: 7 meetings, WP9: 7 meetings, WP10: 10 meetings, WP11: 8 meetings
Internal reporting		· 6 semi-annual progress reports	For the period from M1-M6 (closed). We are working for the second progress report M6-M12 (April 2022).
		· A reserved area for internal document exchange (repository with versioning control)	Alfresco repository is installed.
TeamAware Website	All	· > 2 blog post per month	17 blog post published (~ 2 blog post per month from partners)
		· > 3 newsletters published on the website	3 newsletters published
		· > 250 members for the mailing list	In our mailing list we have currently 93 members.
Forum at TeamAware Website	All	· > 100 forum members	It is 26 as of writing this deliverable.

Promotional tools and materials	All	· > 1000 visits for the project video	According to Individual Dissemination Plan Sheet, the first video should be published in July 2022.
		· > 3 leaflets translated to partner languages	It is 2 now (They are in English for the time being)
		· 1 project roll-up for each partner	Not prepared yet.
Social media	All	· > 300 Twitter followers	It is 58 as of writing this report.
		· > 250 members in the LinkedIn page	It is 90 now as of writing this report.
		· > 3 posts released per month	It is 3 post per-month.
		· > 2 debates started per month	Not started yet.
Press and other media	All	· > 5 press releases or articles published	According to Individual Dissemination Plan Sheet, the first video should be published in Nov 2022. 3 Magazines published.
		· > 5 news on TV	1 news on YouTube Channel.
Scientific publications	Priority	· > 10 publications/papers released to journals/conferences	2 publications.
	4 & 3		
3rd party events	All	· > 10 international events (conferences, fairs etc.) participated for representing TeamAware	4 conference participation realized.
Face-to-face interaction: visits	Priority 1 & 2	· > 10 visits to end-users outside the consortium	Planned for the second year.
		· > 5 visits to policy/decision makers	Planned for the second year.

TeamAware events*	All	· 1 international workshop	Planned for the last year.
		· 3 networking events organised by TeamAware	Planned for the last year.
		· > 50 attendees for each event	Planned for the last year.
Advisory Board membership	Priority	· > 15 Advisory Board members	
	1, 2, 3 & 4	· 3 Advisory Board meeting organised	
Stakeholder's acceptance survey**	All	· > 10 filled survey per each group	Planned for the last year.
Online Lectures	Priority 3, 4 & 5	· one online lecture regarding the final expected outcome of TeamAware	Scheduled for the last year 1 Online Lecture realized.
		· one online lecture focusing on the general introduction of AR/VR	Scheduled for the last year
		· one online lecture focusing on the user experience of the final TeamAware output	Scheduled for the last year

3. Publications

3.1. Magazines

3.1.1. Editorial Published in the "Tecnologia ed Innovazione" Magazine (May 2021)

TeamAware system is presented in the "Tecnologia ed Innovazione" magazine.

Figure 1 Tecnologia ed Innovazione-1(May 2021)

ELETTRONICA

/ DUNE s.r.l. – Enrico de Marinis

MAPPATURA TRIDIMEN RAPIDA DI AMBIENTI IP

Un nuovo approccio per la **mappatura tridimensionale** e rapida di ambienti sotterranei, ignoti e rischiosi.

La presenza di cavità ipogee (grotte o gallerie), può compromettere la stabilità delle strutture sovrastanti (strade, case, ponti), con considerevoli rischi per beni e persone; la loro rapida mappatura riveste quindi un ruolo essenziale per garantire la sicurezza delle strutture sovrastanti. Ad oggi, i rilievi cartografici richiedono dei tempi o dei costi incompatibili con i requisiti di rapidità e di sostenibilità economica. Il sistema ARIANNA® della DUNE, basato su sensori inerziali, rappresenta una soluzione innovativa, rapida, economica e sicura per la mappatura tridimensionale di ambienti ignoti.

La ricostruzione delle planimetrie di grotte o gallerie (rilievo ipogeo), riveste un ruolo essenziale, non solo per il censimento di tali strutture, ma ancor di più per verificare la sicurezza di edifici o strutture superficiali (strade, case, ponti) al di sotto delle quali possano trovarsi parti di strutture ipogee (ignote al momento della costruzione o createsi in seguito) che potrebbero compromettere la stabilità delle strutture sovrastanti, con considerevoli rischi per beni e persone.

Tempi, costi e rischi

Da un lato, l'importanza della ricostruzione planimetrica di questi ambienti è evidente; dall'altro, le tempistiche ed/o i costi associati alla restituzione cartografica giocano un ruolo particolarmente rilevante. I tempi di realizzazione assumono una valenza critica quando si considerano ambienti che espongono gli addetti ai rilievi cartografici ad un rischio costante (crolli, cedimenti, respirazione, stress), senza contare che la consapevolezza del rischio per gli edifici sovrastanti può essere maturata solo a valle del completamento della cartografia. Anche il costo da sostenere assume un ruolo chiave; infatti, non è infrequente che gli enti preposti alla restituzione cartografica non abbiano sufficienti o immediate disponibilità di personale e finanziarie per realizzare le mappature di tutti gli ambienti ipogei d'interesse, dilatando ulteriormente le tempistiche.

Metodologie attuali

Da quanto detto, i requisiti di rapidità e sostenibilità economica emergono chiaramente, ma le attuali tecniche militano in verso opposto, perché richiedono: a) un accurato e lungo processo di acquisizione di dati (con inclinometri, distanziometri, bussole, etc.) con la presenza sul campo di operatori esperti per considerevoli lassi di tempo ed infine una laboriosa fase per la restituzione cartografica; b) in alternativa, laser scanner portatili (attualmente allo stadio di prototipi), che forniscono una restituzione cartografica in tempi brevi, ma con costi difficilmente affrontabili. Chiaramente non ci si può basare sul segnale di localizzazione GNSS, che è assente in ambienti ipogei.

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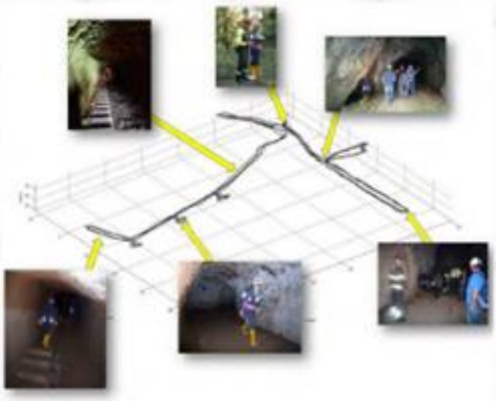
Figure 2 Tecnologia ed Innovazione-2(May 2021)

SIONALE
)GEI

Necessità di nuove tecnologie

Emerge quindi la necessità di un sistema che, utilizzando tecnologie radicalmente diverse da quelle attuali, consenta di ottenere delle planimetrie degli ambienti ipogei, sia pur meno accurate, ma che siano disponibili in tempi molto rapidi (e.g. decine di minuti) e con costi molto ridotti. Ciò aumenterebbe in modo decisivo la sicurezza degli operatori, fornirebbe un'immediata consapevolezza del rischio per le strutture sovrastanti e, grazie alla compressione dei costi, permetterebbe la mappatura di molti più ambienti ipogei di quanto non sia consentito oggi, a parità di budget disponibile.



Il sistema ARIANNA® di DUNE, vincitore di tre progetti della Commissione Europea, è ad oggi l'unica soluzione disponibile per eseguire mappature cartografiche preliminari e speditive di grotte e cavità sotterranee (o, più in generale, di qualsiasi ambiente), in assenza di segnale GPS, in tempi brevi e con costi molto competitivi.

Il sistema si basa sull'uso di una piattaforma inerziale indossabile da un operatore che deve semplicemente deambulare nell'ambiente; con il suo progredire, il corrispondente tracciato stimato da ARIANNA® si va via via formando e rappresenta, di fatto, una stima della planimetria dell'ambiente stesso. Ciò in un tempo di poche decine di minuti e con costi irrisori, se comparati con le tecniche attuali.

Grazie al sistema ARIANNA® è possibile:

- INDIVIDUARE in tempi brevi aree urbane e/o archeologiche ad alto rischio di crolli e voragini;
- ESPLORARE, METTERE IN SICUREZZA E RENDERE FRUIBILI nuove grotte e catacombe di interesse storico;
- LOCALIZZARE, TRACCIARE (ed eventualmente SOCCORRERE) speleologi o tecnici che operino in cavità o grotte;
- FORNIRE LA PLANIMETRIA DELL'AMBIENTE OPERATIVO, in scenari di emergenza (polizia, vigili del fuoco), quando questo sia indisponibile.

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Figure 3 Tecnologia ed Innovazione-3(May 2021)

3.1.2. AITEX Magazine (Feb 2022)

Publication is in private domain. It can be reached from https://t.co/tQ2HDRqlZb .

3.1.3. Editorial Published in the "Tecnologia ed Innovazione" Magazine(Mar 2022)

ARIANNA and TeamAware system is presented in the "Tecnologia ed Innovazione" magazine.

ELETTRONICA

/ Dune s.r.l. – Enrico de Marinis

PROGETTO TEAMAWARE:
I SOCCORRITORI DEL FUTURO

Un nuovo approccio integrato per l'efficienza e la sicurezza degli operatori di primo intervento

TeamAware

È un progetto totalmente finanziato della Commissione Europea (H2020, 7 M€, 24 partner) che mira alla realizzazione di una nuova struttura tecnica ed informativa per migliorare la gestione delle crisi, la flessibilità e le capacità di reazione degli operatori di primo intervento provenienti da diverse aree specialistiche (e.g., Vigili del Fuoco, forze dell'ordine).

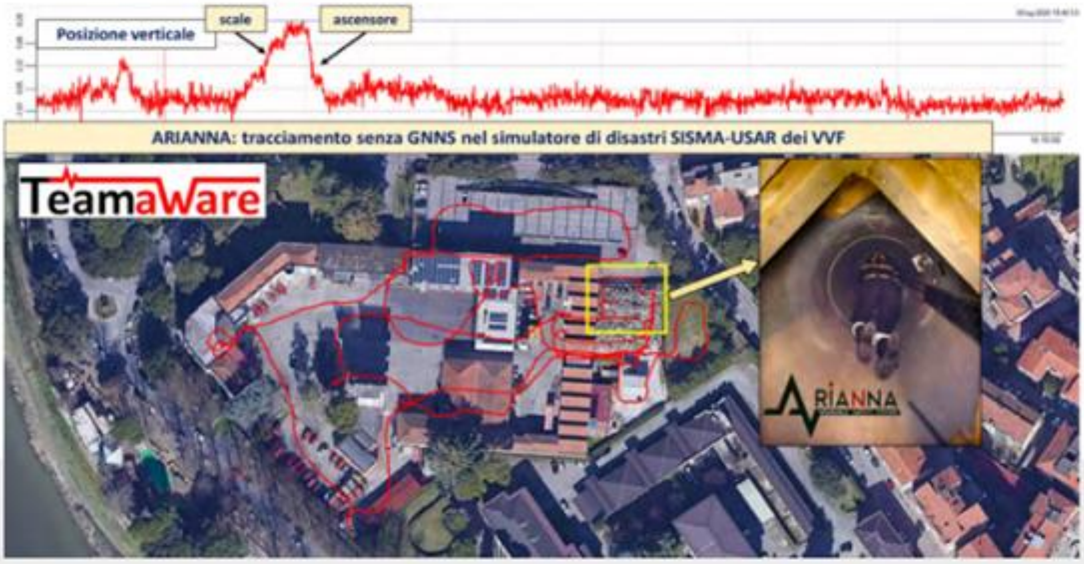
Lo scopo del progetto è di costruire un sistema "cost-effective" integrato per amplificare la consapevolezza della situazione per i soccorritori, mediante sistemi sensoriali eterogenei e non interoperabili, sia indossabili che esterni.

Le operazioni di primo intervento

I primi soccorritori sono un gruppo di persone, servizi ed organizzazioni con abilità specialistiche e qualifiche, il cui compito è di giungere per primi nella zona di emergenza, attuare operazioni di soccorso, gestire le crisi in disastri naturali o causati dall'uomo. Tipicamente ci si riferisce a Vigili del Fuoco, servizi medici di emergenza, forze dell'ordine e protezione civile.

In funzione dell'impatto e degli effetti del disastro, i diversi settori possono reagire all'emergenza sia individualmente che congiuntamente. I loro compiti sono difficili e critici, poiché il salvataggio di vite umane e di beni preziosi sono il fulcro delle loro operazioni, in condizioni di elevato stress ed incertezza. Ad esempio, i primi soccorritori medici furono le prime vittime infettate dal virus della SARS, quando si presero cura dei pazienti infetti.
Per questi motivi, gli operatori di primo soccorso devono essere protetti, connessi e pienamente consapevoli dei diversi aspetti dell'emergenza da fronteggiare, per poter salvare e soccorrere in modo efficiente ed efficace, senza esporsi ai rischi legati alle operazioni.

Figure 4 Tecnologia ed Innovazione-1(Mar 2022)



Le carenze attuali

Sebbene i primi soccorritori forniscano protezione e sicurezza sociale, proteggendo le comunità, rispondendo a disastri e soccorrendo vite, a tutt'oggi impiegano tecnologie spesso inefficienti ed obsolete. Rispetto alla situazione corrente, le capacità operative dei primi soccorritori potrebbero essere enormemente amplificate dai progressi tecnologici disponibili come, ad esempio: sistemi di sensori intelligenti, sensori indossabili, elaborazione e fusione di dati, infrastrutture avanzate di comunicazione e strumenti di intelligenza artificiale.

L'analisi delle attuali carenze effettuato dalla IFAFRI (The International Forum to Advance First Responder Innovation), ha evidenziato quattro aree di grande rilevanza per i primi soccorritori, ma non ancora soddisfatte:

- **carenza 1:** geo-localizzazione e monitoraggio in tempo reale dei membri del team di soccorritori;
- **carenza 2:** rilevamento delle minacce e dei rischi in prossimità degli operatori;
- **carenza 3:** fusione delle informazioni provenienti da diversi tipi di sorgenti eterogenee;
- **carenza 4:** presentazione delle informazioni fuse su display *"user-friendly"*.Progetto TeamAware

Progetto TeamAware

TeamAware (Team Awareness Enhanced with Artificial Intelligence and Augmented Reality") è un progetto totalmente finanziato con circa 7 M€ dalla Commissione Europea (Grant Agreement 101019808), che vede il coinvolgimento di 24 partner da 13 diverse nazioni (PMI, università, grandi industrie, utenti finali). Il coordinatore è la rumena SIMAVI ed il coordinatore scientifico è la turca Havelsan.

TeamAware, iniziato a Maggio 2021, finirà ad Aprile 2024 e mira alla realizzazione di un sistema integrato che risponda alle quattro carenze particolarmente penalizzanti individuate dalla IFAFRI. La riposta del progetto passa attraverso la costruzione di un sistema integrato multisensoriale, per tracciare gli operatori in ambienti indoor (GNSS indisponibile), monitorare il comportamento e lo stato di salute dei singoli, rilevare sostanze chimiche dannose ed esplosioni, assicurare connessioni sicure, usare strumenti di AI per ottenere dati fusi, raffinati e facilmente comprensibili attraverso interfacce uomo-macchina.

DUNE ed ARIANNA in TeamAware

L'Italia gioca un ruolo di rilievo nel progetto **TeamAware**, grazie alla presenza della società **DUNE s.r.l.** (Roma) che, oltre a fornire il suo sistema ARIANNA® per il tracciamento in assenza di GNSS (www.ariannasystem.com), ha la responsabilità di coordinare tutte le attività del progetto per il monitoraggio dei singoli operatori (salute, postura, comportamento, posizione).

ARIANNA®, vincitore di tre progetti della Commissione Europea, è stato modellato sulle specifiche esigenze operative delle squadre di pronto intervento (civile o militare); garantisce l'accuratezza necessaria per tutto l'orizzonte temporale di una missione e può rispondere a svariate esigenze operative, grazie alla sua architettura stratificata. È attualmente usato da diversi corpi dei Vigili del Fuoco in Asia ed Europa, oltre ad una importante Agenzia delle Nazioni Unite per l'ispezione di Infrastrutture Critiche.

Figure 5 Tecnologia ed Innovazione-2(Mar 2022)

3.2. Papers/Posters

3.2.1. Use of UAS for Damage Inspection and Assessment of Bridge Infrastructures

The paper is published by M.Mandirola, C.Casarotti, S.Peloso, I.Lanese, E.Brunesi, I.Senaldi for the International Journal of Disaster Risk Reduction.

https://doi.org/10.1016/j.ijdrr.2022.102824

3.2.2. Team Awareness Enhanced with Artificial Intelligence and Augmented Reality

The poster is published by Marietta Pateinioti, Stylianos Xeniadis in EUSEM 2021 conference, October 27-31, 2021, Lisbon, Portugal

Figure 6 EUSEM 2021 Poster

4. Conference Participations

4.1. 5th Symposium on New Generation Technologies in Emergency Technologies on 16-17 March 2022, Izmir, Turkey.

Partners AAHD and HAVELSAN presented our project 5th symposium on New Generation Technologies in Emergency Technologies on 16-17 March 2022, Izmir, Turkey.

Figure 7 5th symposium on New Generation Technologies in Emergency Technologies on 16-17 March 2022, Izmir, Turkey.

Figure 8 Havelsan Presentation

4.2. European Emergency Number Association 2021 Conference

Dr. Turhan Sofuoglu and Dr. Zeynep Sofuoglu from AAHD team participated to European Emergency Number Association 2021 Conference (EENA 2021, 6-8 October 2021, Riga, Latvia) and presented TeamAware project.

Figure 9 EENA Conference-1

Figure 10 EENA Conference-2

Figure 11 EENA Conference-3

4.3. RTD, Innovation, Industry and Technology Fair

Dr. Zeynep Sofuoglu participated to RTD, Innovation, Industry and Technology Fair on 13-14 October 2021 in Izmir, Turkey and presented TeamAware project.

Figure 12 RTD, Innovation, Industry and Technology Fair-1

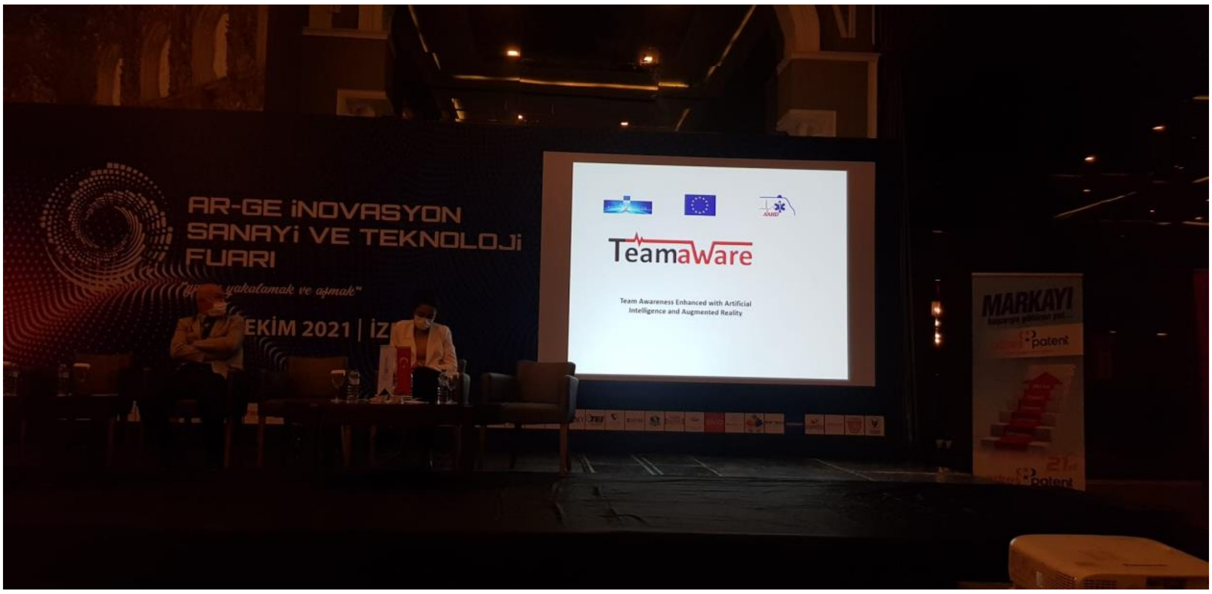


Figure 13 RTD, Innovation, Industry and Technology Fair-2

4.4. Milipol 2021

DUNE presented TeamAware project at Milipol 2021 event in Paris on 19-22 October 2021. DUNE used this event successfully for both dissemination and exploitation activities. They contacted around 20 executive-level-only contacts that showed a tangible interest toward TeamAware. It is believed that this will add great value to TeamAware commercialization opportunities.

Figure 14 Milipol-1

They also demonstrated the first (as known for now) tracking of a dog of a K9 unit, performed with the equipment that will be the basis of TeamAware WP7 indoor localization tasks.

Figure 15 Milipol-2

Figure 16 Milipol-3

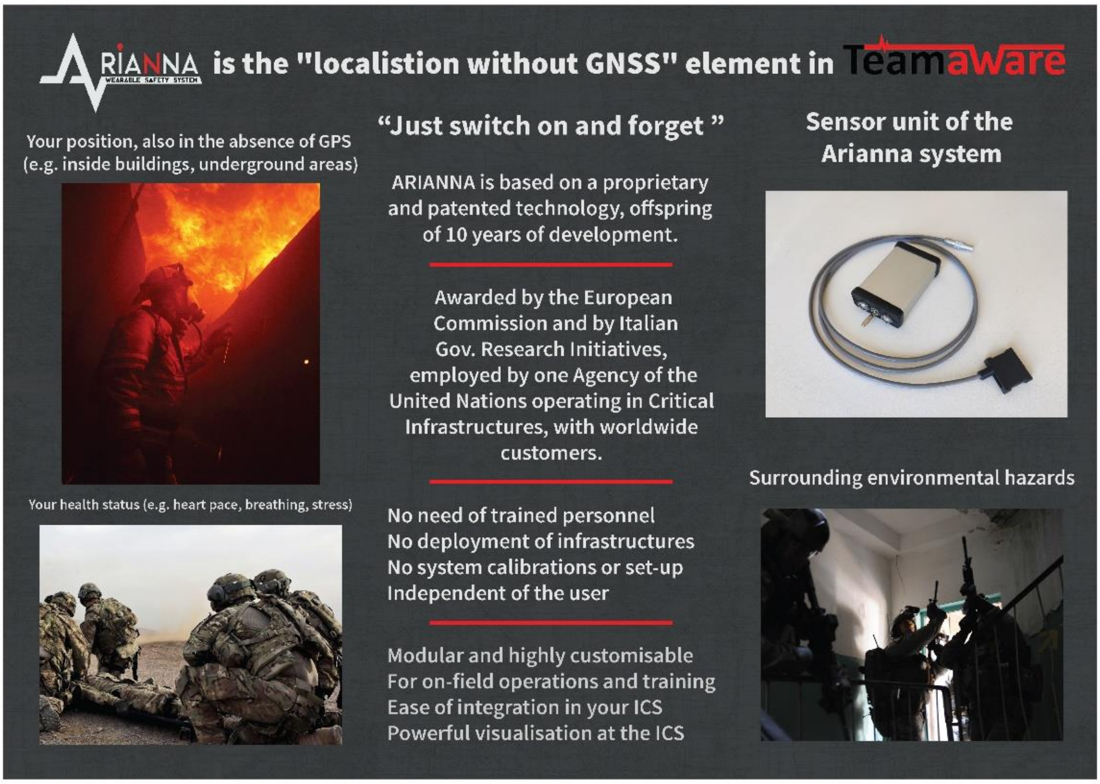


Figure 17 Milipol-4

4.5. CERIS - DISASTER RESILIENT SOCIETIES Cluster Conference

DUNE participated to the online conference held on March 23-25, 2022. TeamAware has been introduced and explained (component by component) by a representative of the DRS02 cluster (Based on the contribution DUNE sent on 14/03/2022). TeamAware project has been presented and highlighted to a high-level and qualified audience, made of practitioners, Academic/Research Institutions, SMEs, representatives of the European Commission. The video is available at https://www.youtube.com/watch?v=tHM0pUXhv9I.

TeamAware related screenshots are presented below.

Figure 18 TeamAware presented in CERIS

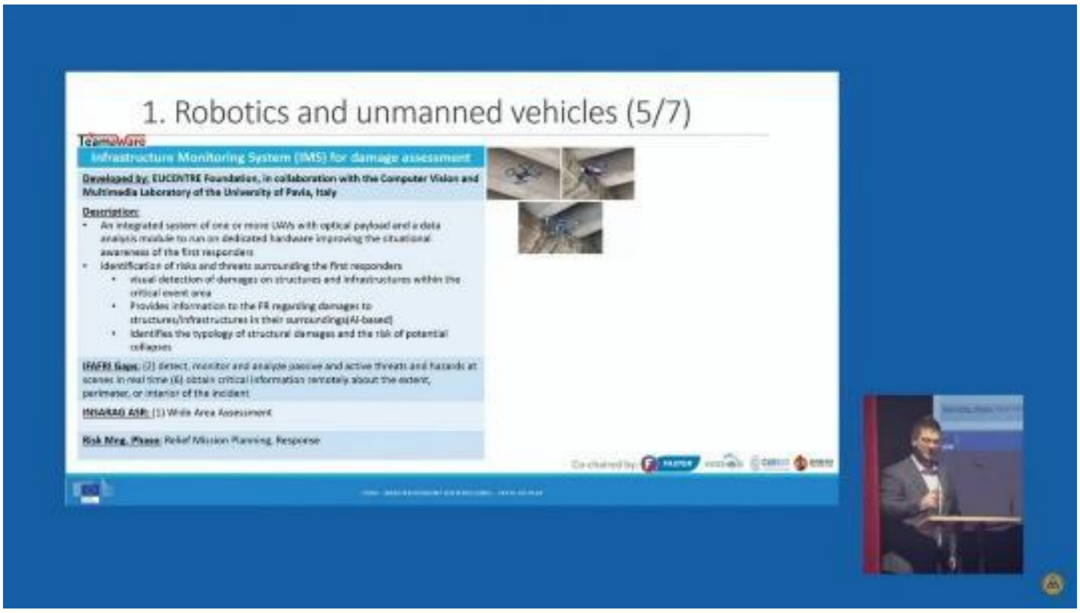


Figure 19 CERIS Screenshot 1

Figure 20 CERIS Screenshot 2

Figure 21CERIS Screenshot 3

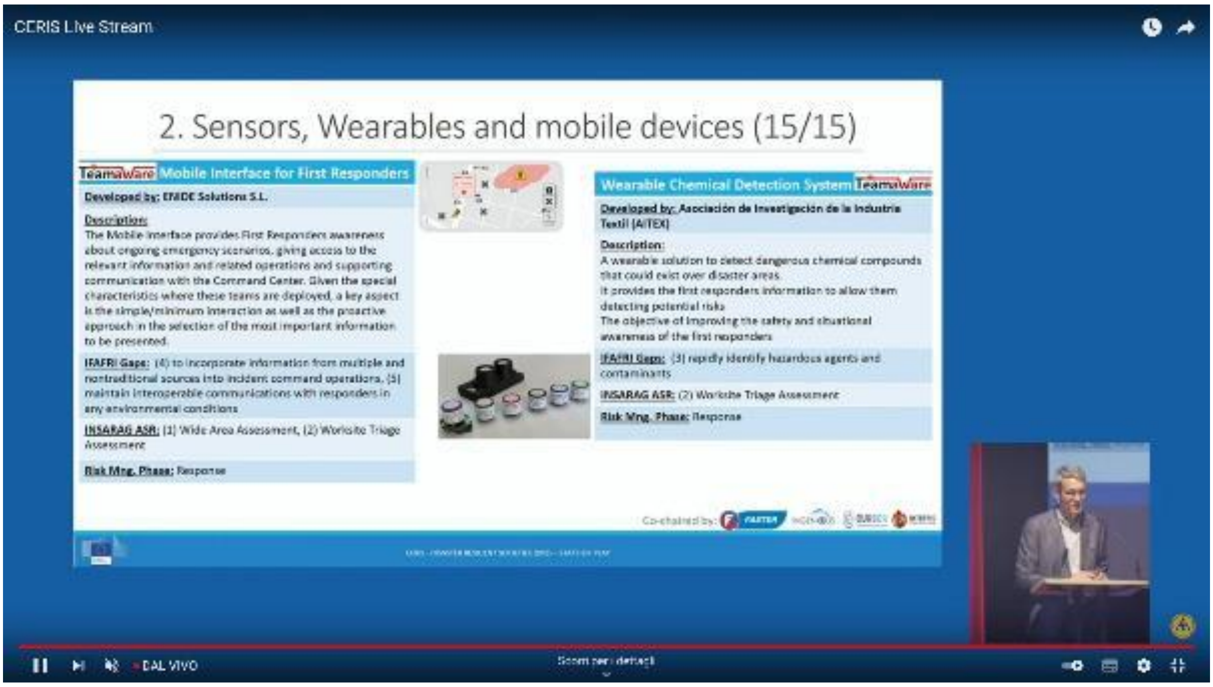


Figure 22 CERIS Screenshot 4

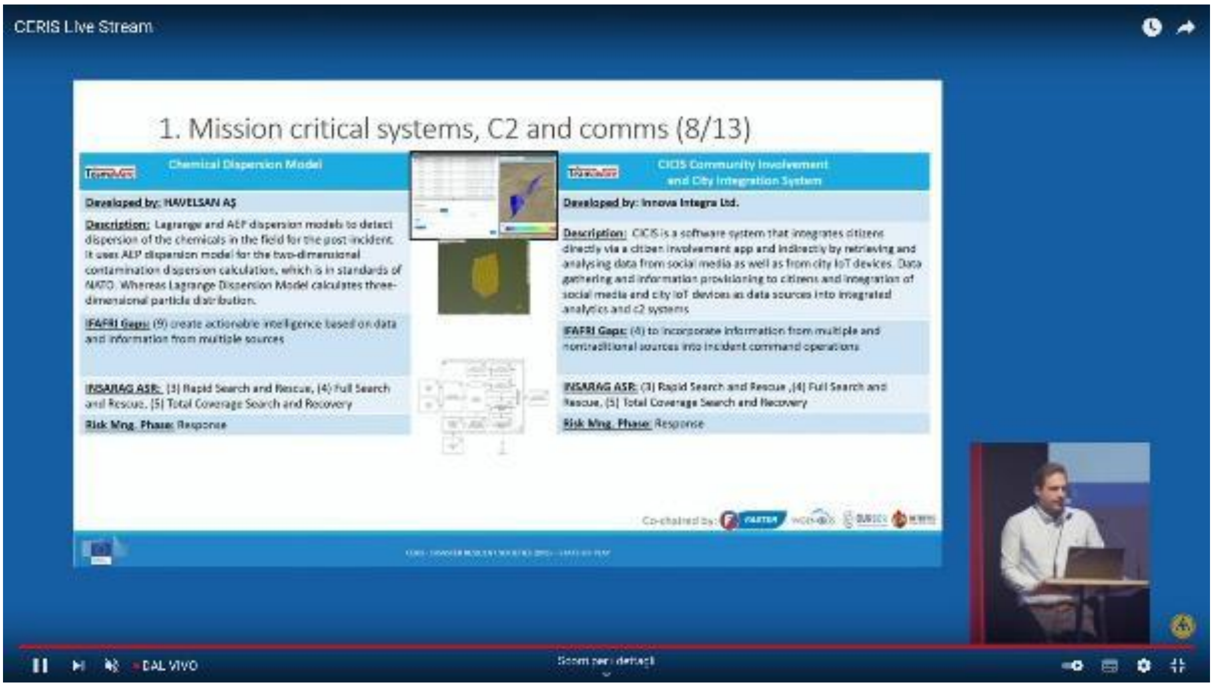


Figure 23 CERIS Screenshot 5

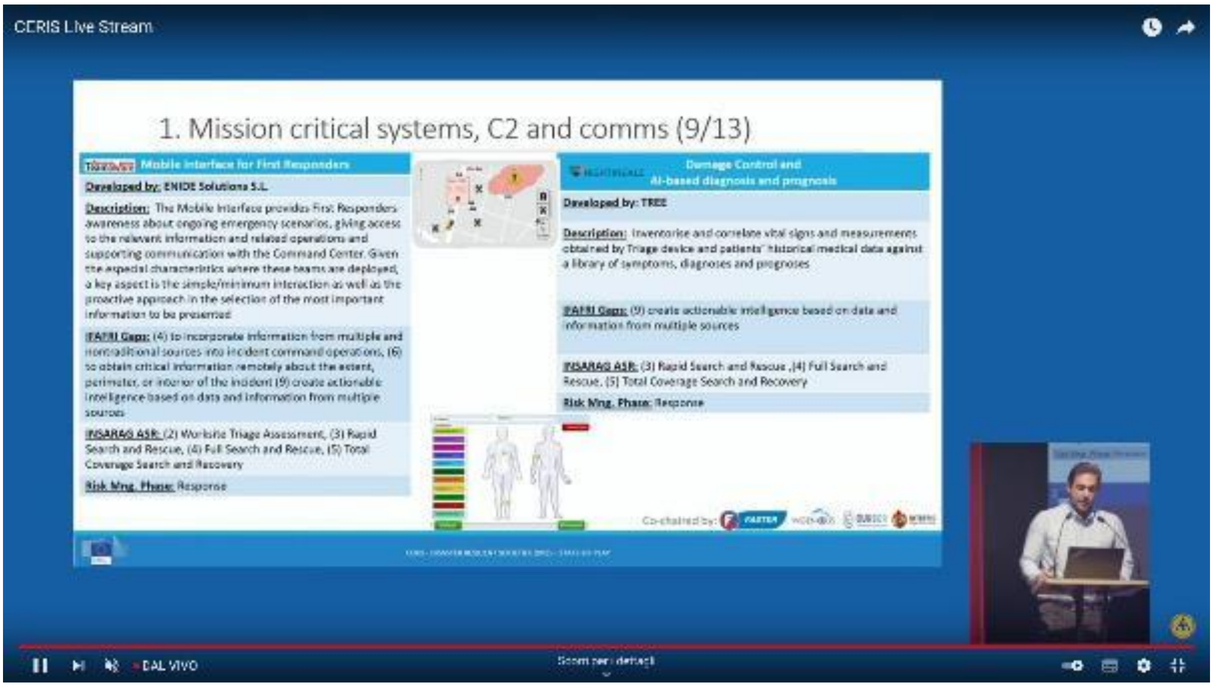


Figure 24 CERIS Screenshot 6

Figure 25 CERIS Screenshot 7

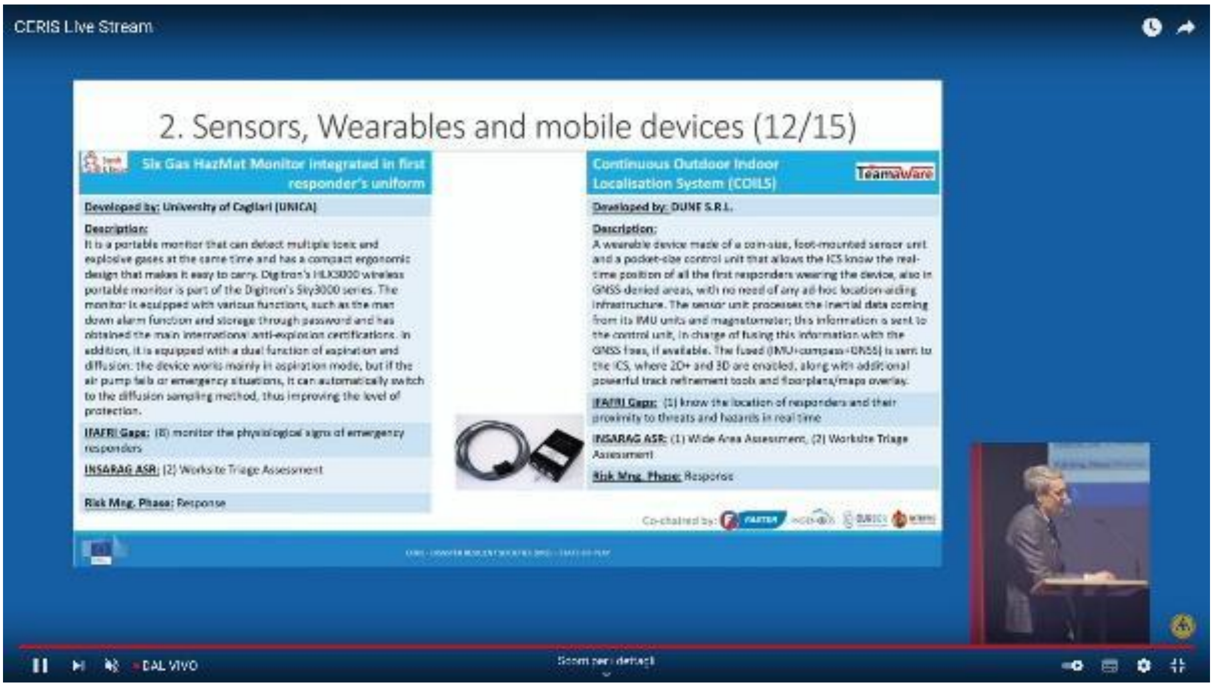


Figure 26 CERIS Screenshot 8

5. Social Media Activities

In TeamAware project, social media activities are currently run on two channels: Twitter and LinkedIn.

5.1. https://twitter.com/TeamAware_EU

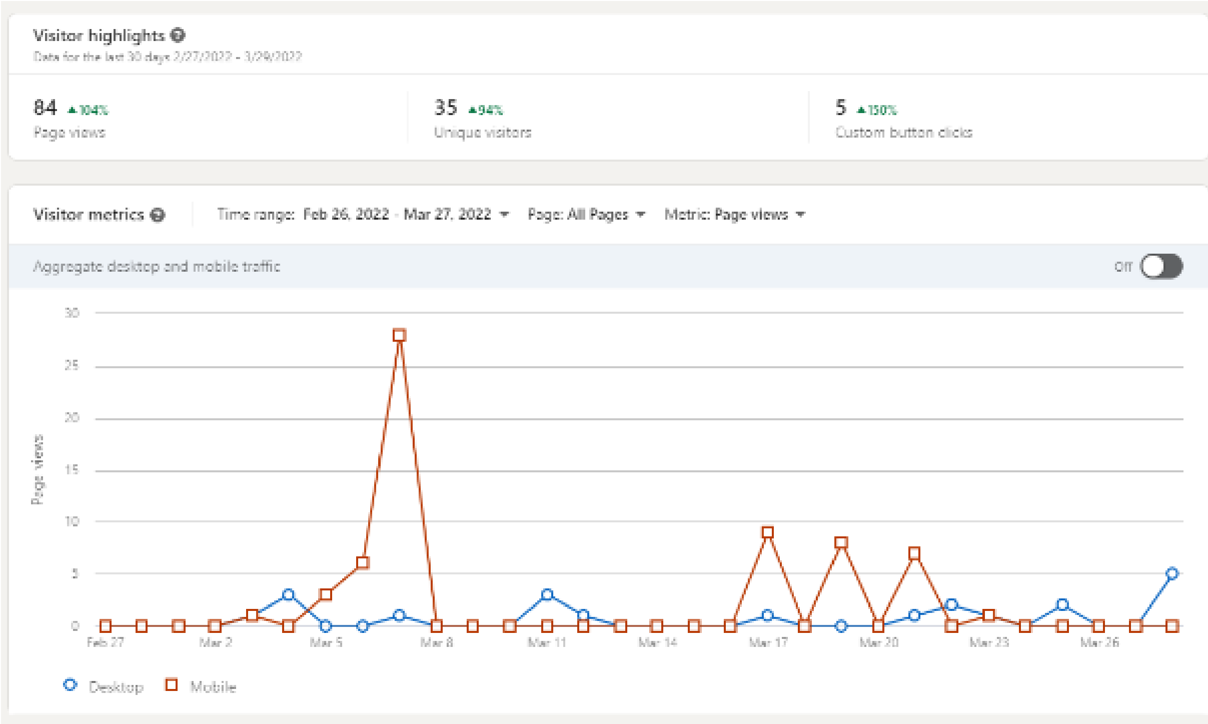
TeamAwareTwitter account is active nearly from the beginning of the project. The project is presented quite active in this platform and the followers are regularly updated about the project results. In this section the visitor statistics are presented for month March 2022.

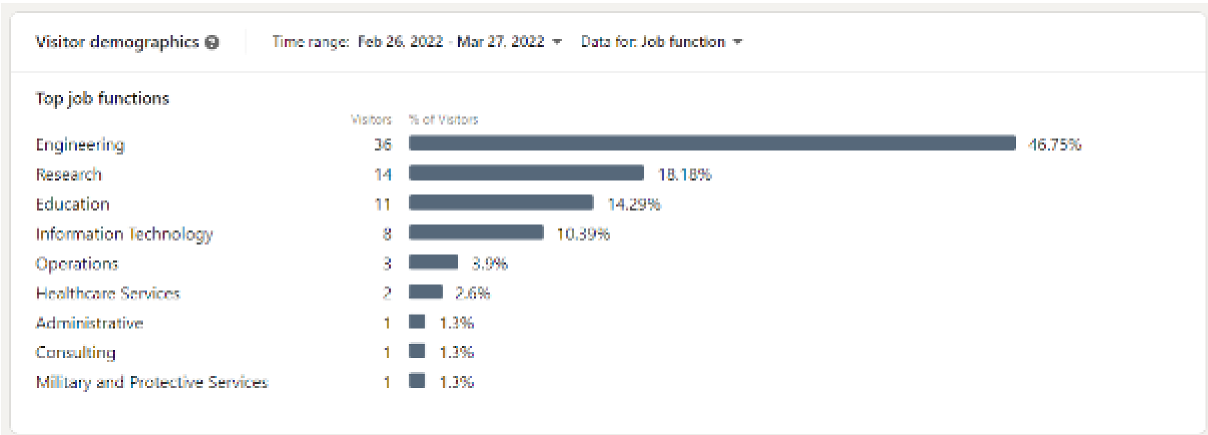
Figure 27 Number of impressions for March 2022

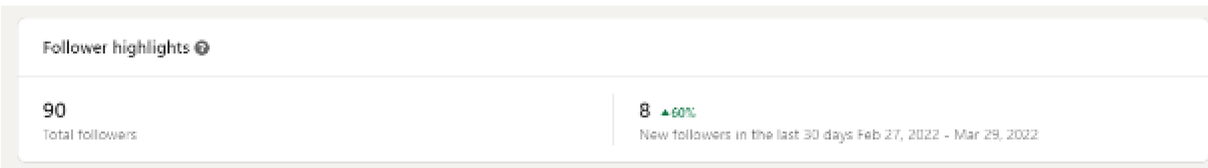
Figure 28 General statistics for our Twitter Platform

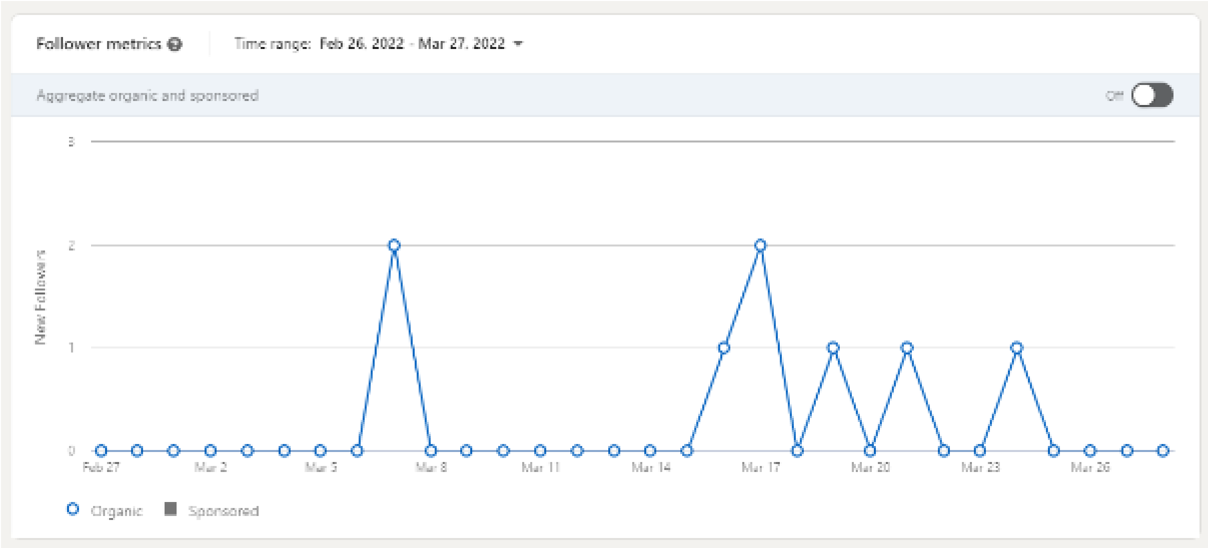
5.2. https://www.linkedin.com/company/teamaware-eu/

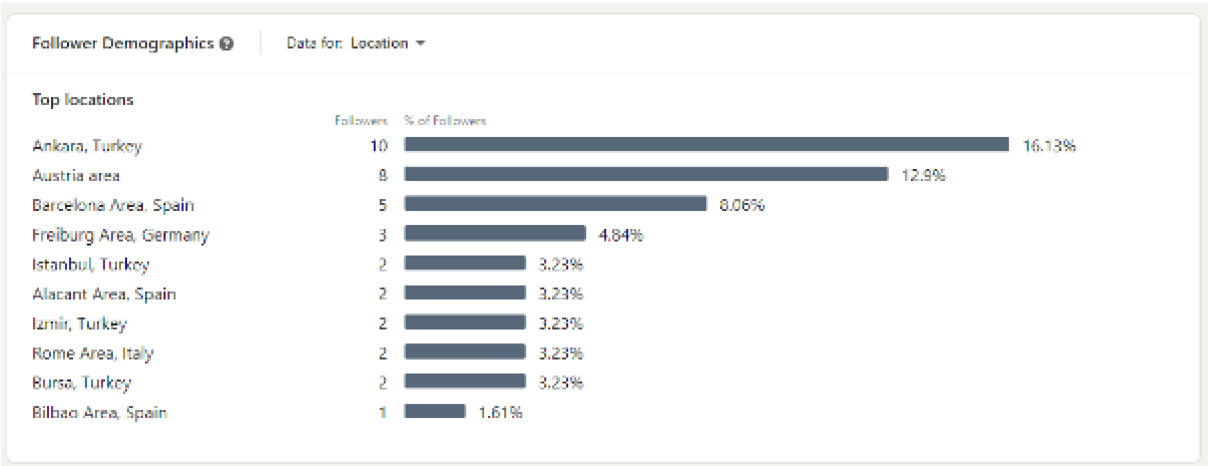
TeamAware LinkedIn page (https://www.linkedin.com/company/teamaware-eu/) is active nearly from the beginning of the project. Project is represented quite active in this platform. In this section the visitor statistics are presented for month March 2022.

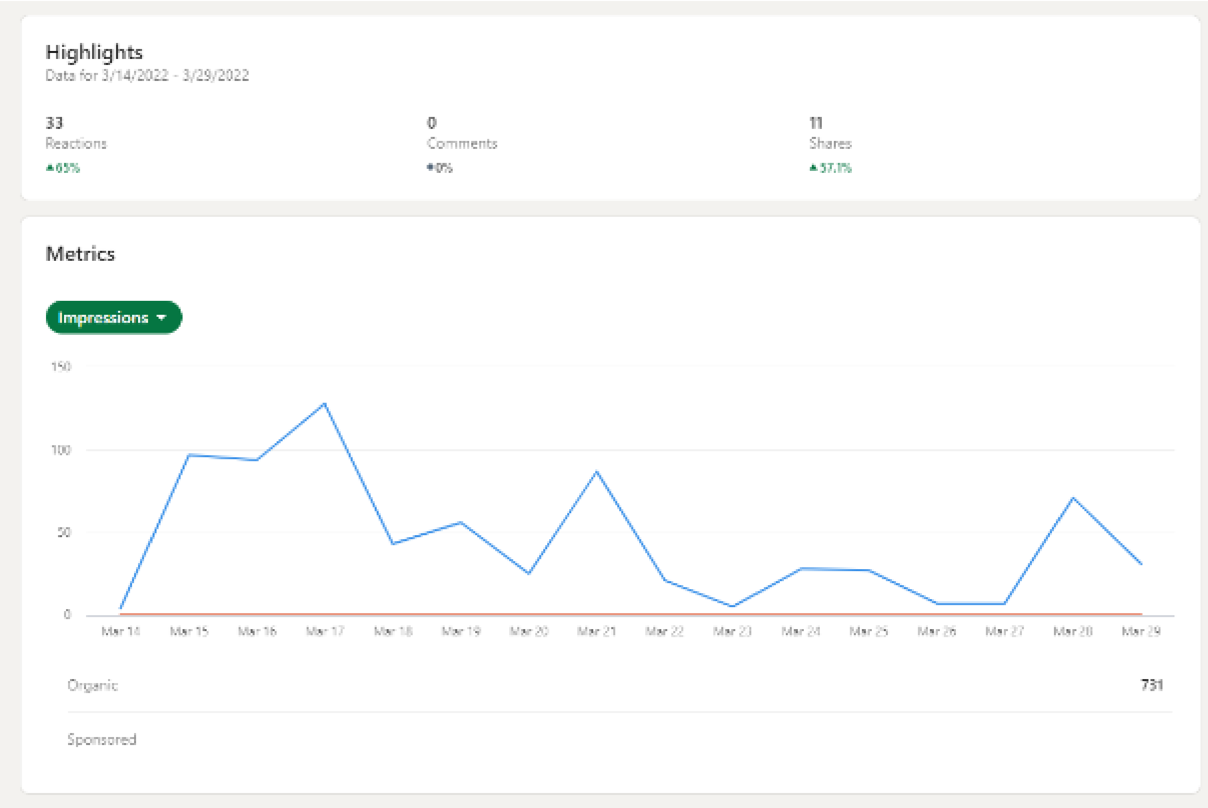

Visitor highlights
Data for the last 30 days 2/27/2022 - 3/29/2022
84 ▲104%
Page views
35 ▲94%
Unique visitors
5 ▲150%
Custom button clicks
Visitor metrics
Time range: Feb 26, 2022 - Mar 27, 2022
Page: All Pages
Metric: Page views
Aggregate desktop and mobile traffic
Off
Page views
30
25
20
15
10
5
0
Feb 27
Mar 2
Mar 5
Mar 8
Mar 11
Mar 14
Mar 17
Mar 20
Mar 23
Mar 26
Desktop
Mobile


Visitor demographics
Time range: Feb 26, 2022 - Mar 27, 2022
Data for: Job function
Top job functions
Visitors
% of Visitors
Engineering 36 46.75%
Research 14 18.18%
Education 11 14.29%
Information Technology 8 10.39%
Operations 3 3.9%
Healthcare Services 2 2.6%
Administrative 1 1.3%
Consulting 1 1.3%
Military and Protective Services 1 1.3%


Follower highlights
90
Total followers
8 ▲60%
New followers in the last 30 days Feb 27, 2022 - Mar 29, 2022


Follower metrics
Time range: Feb 26, 2022 - Mar 27, 2022
Aggregate organic and sponsored
Off
New Followers
3
2
1
0
Feb 27
Mar 2
Mar 5
Mar 8
Mar 11
Mar 14
Mar 17
Mar 20
Mar 23
Mar 26
Organic
Sponsored


Follower Demographics
Data for: Location
Top locations
Followers
% of Followers
Ankara, Turkey 10 16.13%
Austria area 8 12.9%
Barcelona Area, Spain 5 8.06%
Freiburg Area, Germany 3 4.84%
Istanbul, Turkey 2 3.23%
Alacant Area, Spain 2 3.23%
Izmir, Turkey 2 3.23%
Rome Area, Italy 2 3.23%
Bursa, Turkey 2 3.23%
Bilbao Area, Spain 1 1.61%


Highlights
Data for 3/14/2022 - 3/29/2022
33
Reactions
▲65%
0
Comments
0%
11
Shares
▲57.1%
Metrics
Impressions
Organic
731
Sponsored

6. Lectures

6.1. Introduction of TeamAware in the Invited lecture at the IFAFRI (International Forum to Advance First Responder Innovation) committee meeting

Online lecture has been given by DUNE at IFAFRI Meeting on May 12, 2021. In this lecture the integration of TeamAware and ARIANNA system has been introduced. An example screenshot is presented below.

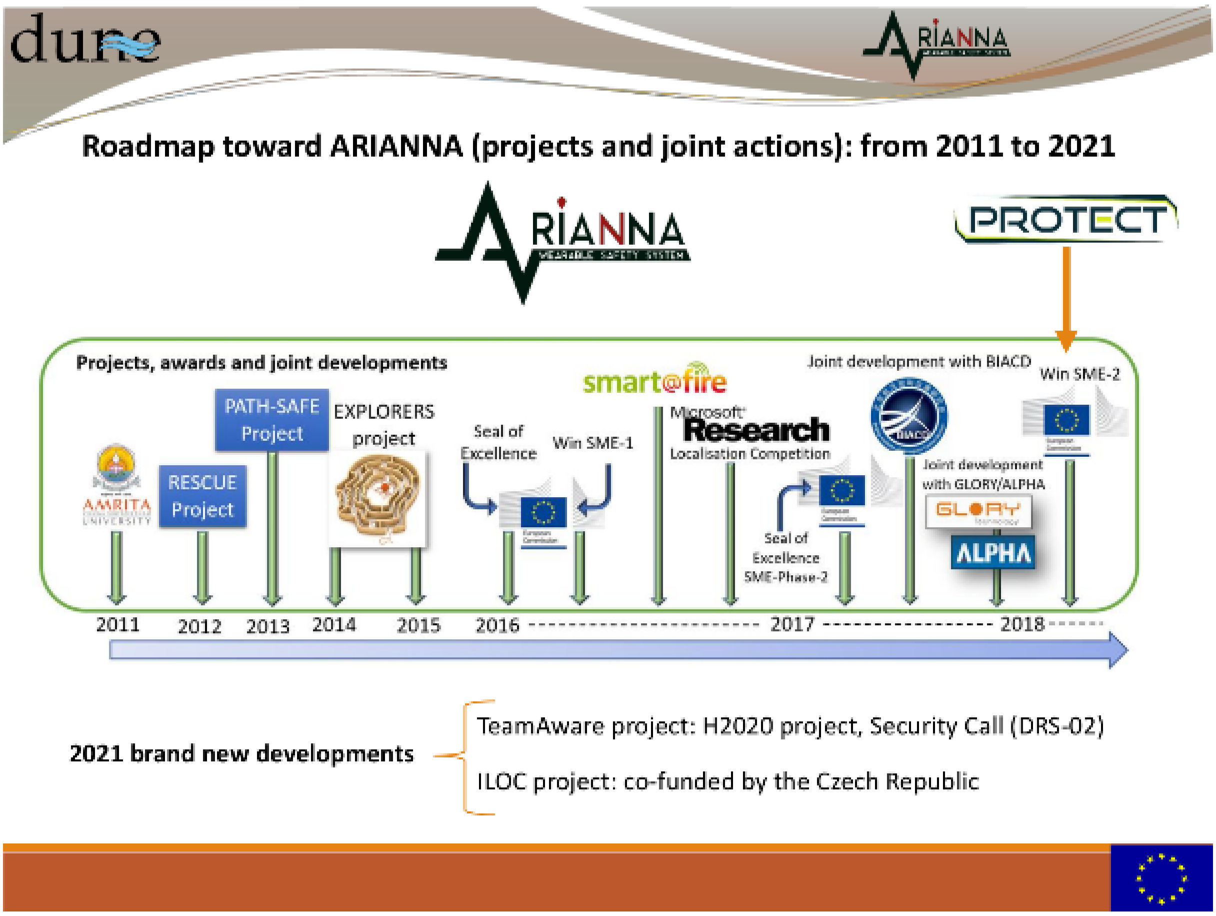


Figure 29 IFAFRI Meeting

7. Horizon Result Booster Initiative

In order to support the dissemination activities, it is decided to benefit from the free-of-charge services offered by HorizonResultBooster.eu[1] initiative. The Horizon Results Booster is a new initiative backed by the European Commission which aims to maximise the impact of research projects funded by FP7, Horizon 2020 and HE. It helps to bring a continual stream of innovation to the market and beyond. It will help to speed up the journey towards creating an impact, providing support to remove bottlenecks.

The "à la carte" tailor-made services designed to build your capacity for disseminating research results can be benefited. This project can also get support to increase the results' exploitation potential and improve the access to markets. The services are delivered to FP7, H2020, HE projects at no cost and fully supported by the European Commission.

Especially Portfolio Dissemination and Exploitation Strategy Service will be used. This service is divided in two main streams addressing Dissemination & Exploitation strategies, activities and goals. The aim of Dissemination services (Module A and B) is to strengthen the capacity of Project Groups (PGs) in disseminating, maximising the dissemination of a portfolio of results and offering a wider and more complete view to potential users. The aim of Exploitation service (Module C) is to support single projects in exploiting their research results and enhance beneficiaries' capacity to improve the exploitation strategy.

[1] https://www.horizonresultsbooster.eu/

8. Web Site Activities

8.1. Google Analytics

TeamAware web site is used quite effectively. Google Analytics system is installed to monitor the statistics. In this section, these statistics are presented. As of writing month (March 2022) of this deliverable, all the figures are for March 2022. (It should be noted that the numbers will increase as more project results will be obtained to promote the dissemination activities).

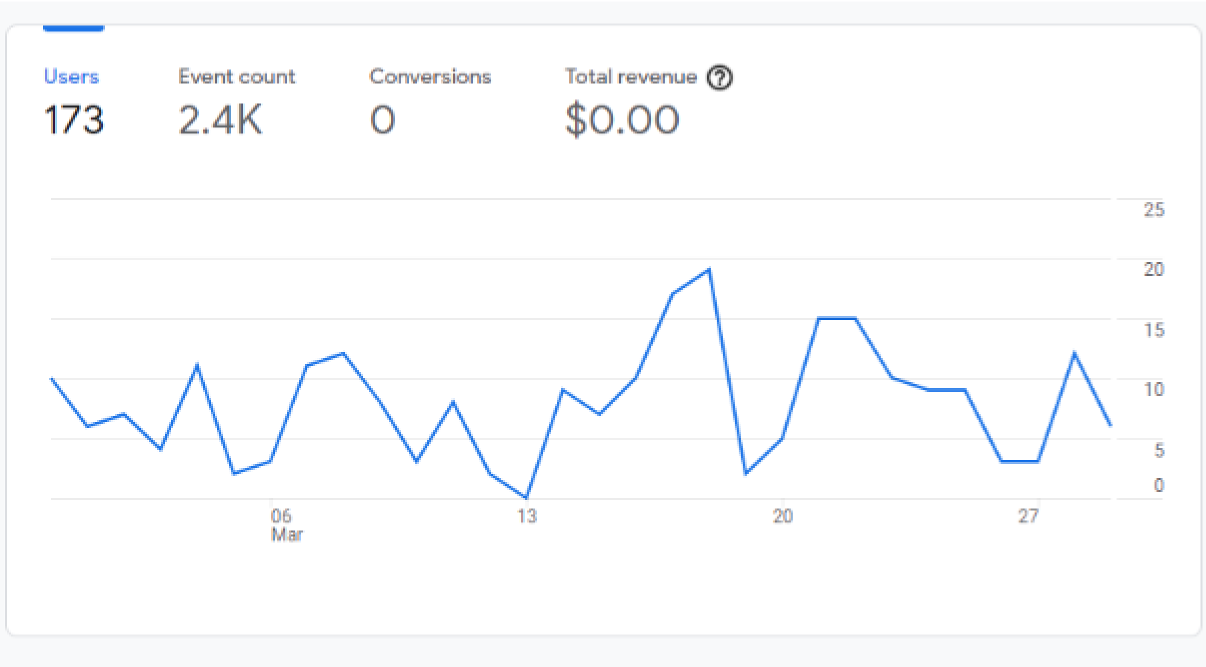


Figure 30 Number of users

As shown in the above figure, TeamAware web site has been visited by 173 users. In addition, users from all over the world is visiting the webpage as shown in the following figure.

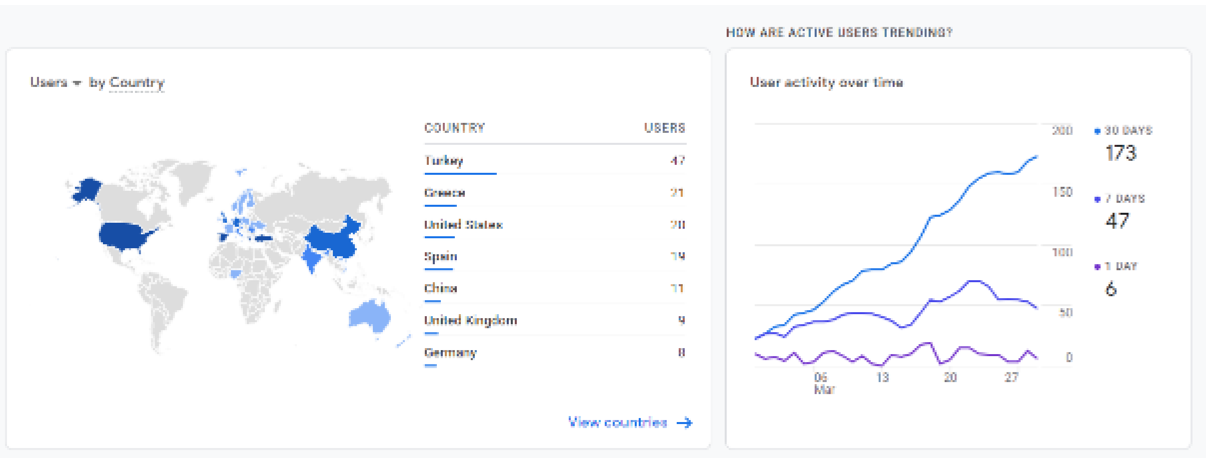


Figure 31 Users by Country and activity over time

The following figure presented which pages are visited most in our web site.

WHICH PAGES AND SCREENS GET THE MOST VIEWS?

Views by Page title and screen class

PAGE TITLE AND SCREEN…	VIEWS
TeamAware | Te...ented Reality	188
TeamAware | Blogs	130
TeamAware | Mobile Interface	44
TeamAware | N...ovember 2021	40
TeamAware | PSH	40
TeamAware | Si...latform Part 1	38
TeamAware | News	36

View pages and screens →

Figure 32 Which pages and screens get the most views

Users by
Platform / device category

PLATFORM / DEVI…	USERS
web / desktop	119
web / mobile	54

Figure 33 Users by platform

Users from both desktop and mobile platforms are visiting the website. Furthermore, the following figure shows how TeamAware web site is discovered on the web. It is very good that the project are discovered by native search results (Organic search Organic search refers to the search results of a search engine that cannot be influenced by paid advertising. Organic search results are ranked according to their relevance to the search term. Organic search results therefore do not include adverts, but can include search snippets such as maps, images, articles or the knowledge graph).

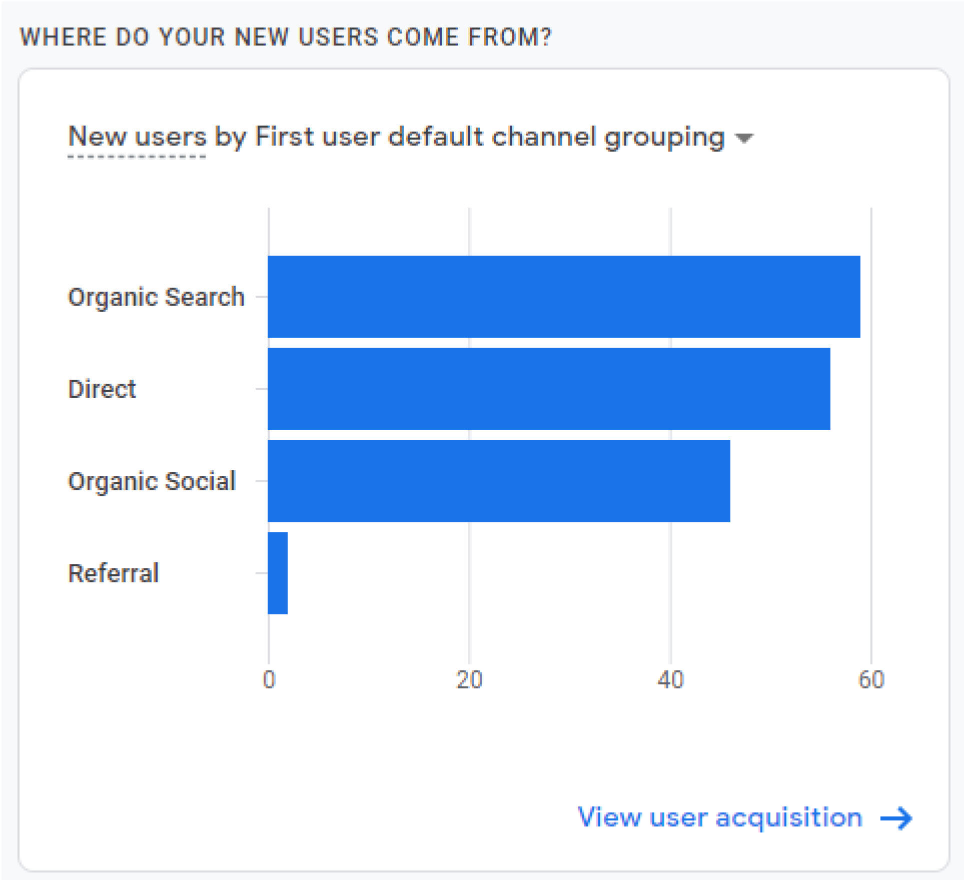
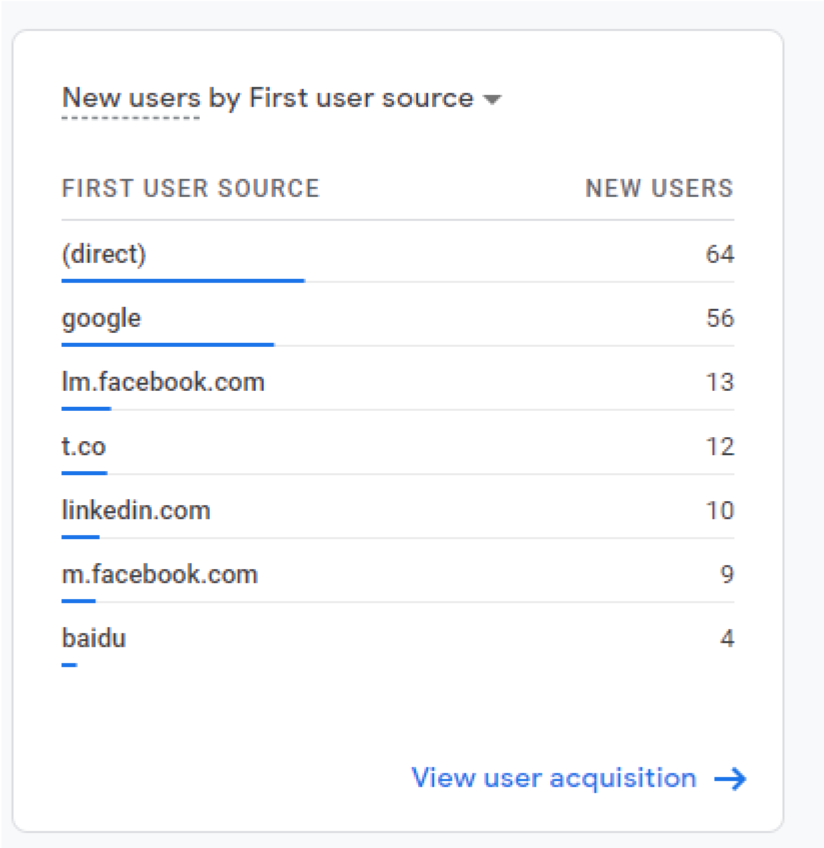


Figure 34 How is the TeamAware found on the web?



New users by First user source

FIRST USER SOURCE	NEW USERS
(direct)	64
google	56
lm.facebook.com	13
t.co	12
linkedin.com	10
m.facebook.com	9
baidu	4

View user acquisition →

Figure 35 From which platforms the users acceesed to the web site

8.2. Blogs

8.2.1. Secure and Standardized Communication Network

The aim of TeamAware Secure and Standardized is to establish a cloud-based secure network. All of the components of TeamAware will communicate over this network, which means it will be at the core of the architecture. The network will use standard based data models and APIs in order to enable wider adoption of our platform. We plan to integrate it to existing first responder Operation Centers.

During the implementation of the network, first a TeamAware Data Ontology will be defined based on data models of existing sensor types and operation centers used in first responder operations. For this purpose, first a survey will be carried out in the TeamAware Consortium (data models of Sensor Gateways in the TeamAware Architecture and interfaces of the Operation Centers of the end users).

After that the survey will be extended with the existing standardized data models (OGC SensorThings API for sensor communication and OASIS Emergency Data Exchange Language – EDXL). Based on the survey, the data models will be harmonized and formalized into TeamAware Data Ontology.

Based on the TeamAware Data Ontology, a set of Sensor and Operation Center Adapter interfaces will be defined to manage the integration of sensors as well as the integration of operation centers to the TeamAware Network. (These will be called as TeamAware Interoperability Service APIs.) The Interoperability Services will respect existing procedures of actors in the whole disaster management cycle like (prevention, preparedness, response, recovery) fire brigades or ambulance services and will be integrated seamlessly in the workflow of decision makers. The adapter interfaces will provide registration, removal and querying of sensors dynamically as well as creation of sensor networks for cases requiring utilisation of complementary sensor types.

After the definition of the interfaces (TeamAware Interoperability Service APIs), the envisaged cloud network architecture will be designed and implemented based on open-source tools. The main objective at this point is a network architecture design, which will be scalable and optimized to connect different types and numbers of wearable, portable, and drone-borne sensors. The TeamAware Secure Cloud Architecture will be composed of three main parts:

1. Data Ingestion Layer: The data in the TeamAware Platform comes from a variety of data sources including IoT Devices, Social Media, Camera and Operation Centers. Most of the data is streaming data. Furthermore, considering the database requirements of the above listed TeamAware components, both NoSQL and Relational databases are used. For example, social media data is required to be stored in NoSQL database. Before storage the data should also be transferred to TeamAware Data Ontology for data interoperability. This means data from a number of data source (with different data rates) should be stored to different data bases. In the literature it is called flow management. Considering these requirements, the data ingestion layer has different aspects.
    a) Flow Management: This part is responsible to retrieve (supporting any type of transport protocol) data from a data source, transform it to TeamAware Ontology and send it (or store it) to corresponding system. Currently, the Apache Nifi tool is one of the best open-source tools to realize flow management. Apache NiFi is an integrated data logistics platform for automating the movement of data between disparate systems. It provides real-time control that makes it easy to manage the movement of data between any source and any destination. It is data source agnostic, supporting disparate and distributed sources of differing formats, schemas, protocols, speeds and sizes such as machines, geo location devices, click streams, files, social feeds, log files and videos and more. It is configurable plumbing for moving data around through its Web based GUI, similar to how Fedex, UPS or other courier delivery services move parcels around. And just like those services, Apache NiFi allows you to trace your data in real time, just like you could trace a delivery. The data transformation will realize in Nifi through custom TeamAware processors. Based on the interoperability service definitions and ontology, the processors for each sensor (Sensor Gateway Adapter Processors) and operation center system (Operation Center Gateway Adapter Processors) will be developed.
    b) Robust (Fault-Tolerant) Fast Streaming Bus: Inline with this tool, a scalable, robust, fast and durable (fault-tolerant) message queue is required to accommodate streaming data in TeamAware. For this purpose, the widely used Apache Kafka (open-source tool from LinkedIn) distributed data store will be used.
    c) Database: Considering database as mentioned before there are many data requirements in the TeamAware platform. NoSQL, relational and streaming data is used in the system. For this purpose, the following open-source databases are considered to be used: MongoDB as NoSQL database, PostgreSQL as relational database and TimescaleDB as timeseries database.
2. Data Query/Retrieval Layer: After the data is stored to its proper location, interoperability services for query will be implemented to get required data (for presentation and/or analysis). The queries can be simple or complex, like requiring distributed querying. In those cases, Apache Spark will be used. Apache Spark is an open-source unified analytics engine for

large-scale data processing. Spark provides an interface for programming entire clusters with implicit data parallelism and fault tolerance. An alternative implementation can be Apache Flink.

The following figure shows the envisaged TeamAware architecture. The components shown in the figure will be deployed to a cloud architecture. All the components will be deployed through Dockerized images. At the cloud level, a Kubernetes environment for effective management of Dockerized images (containerized applications) will be used.

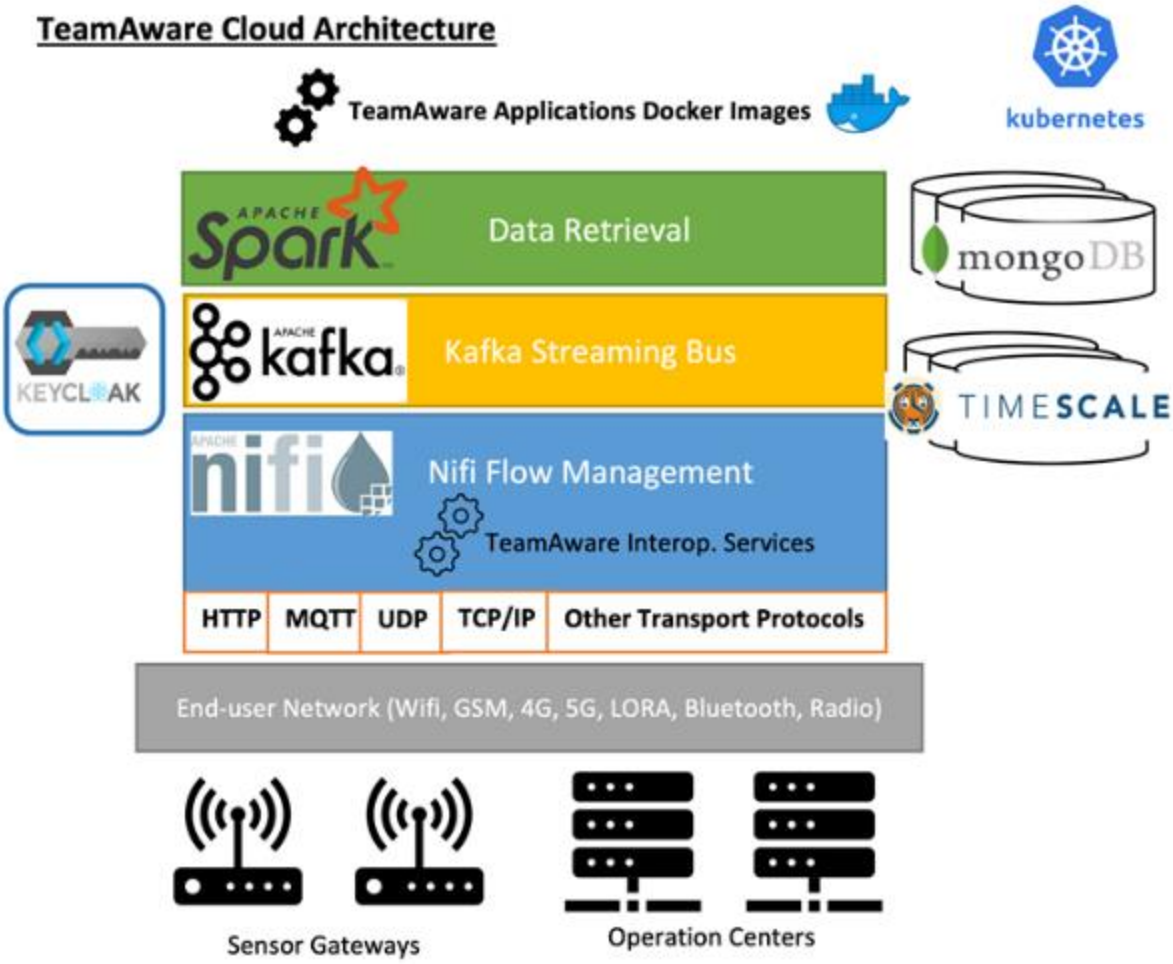


Figure 36 Secure and Standardized Communication Network-1

Yıldıray Kabak, PhD, SRDC

BSc (2001), MSc (2003), PhD (2009) from the Computer Engineering Department of the Middle East Technical University.

His research areas include emergency management, IoT Technologies, Big Data Technologies, Smart Cities, Cloud Architectures, maritime surveillance, eHealth, eBusiness, Interoperability Solutions, Semantic Web Technologies, Conformance and Interoperability Testing. He has participated in many EC supported projects including EFPF, NIMBLE, C2-SENSE and iSURF (in IoT, eFactory and emergency management domains). He also work as project manager in ITEA2 RECONSURVE, ITEA3 APPS and ITEA3 i2PANEMA projects, which are in maritime surveillance and port IoT domains.

He actively participates to CEN standardization activities. He is a technical expert in CEN/WS Business Interoperability Interfaces and CEN/WS Global Interoperability Test Bed. He is vice-chair of Turkish Standards Institute MTC 51 : Health Informatics (CEN/TC 251,ISO/TC 215)

He implemented the eInvoice Management Information System for the Ministry of Environment and Urbanisation, Turkey. He provided consultancy to Ministry of Finance of Turkey for "Enhancing Efficiency of Public Expenditures" and for the development of Electronic Public Procurement Architecture (EPPA) for Turkey. He provided consultancy to Revenue Administration of Turkey for the development of eInvoice architecture of Turkey. In this respect, he realized the customization of UBL 2.0 Invoice document and business processes to be used in the Turkish eInvoice System (www.efatura.gov.tr). He also implemented the customization of UBL 2.1 Despatch Advice and Receipt Advice documents and related business processes for the Revenue Administration of Turkey. He has provided consultancy services on the management of National Health Information System to the Ministry of Health, Turkey; as well as to Hospital Information System vendors for their standards-based implementation and testing activities.

He has many journal and conference papers in the above mentioned domains and they are available at:

- https://www.srdc.com.tr/publications-all/
- https://scholar.google.com/citations?user=sx_9jJIAAAAJ&hl=en

	All	Since 2016
Citations	1344	226
h-index	17	8
i10-index	29	6

In TeamAware Project, he is the Dissemination & Communication (D&C) Manager, Standardisation Task Leader and Workpackage 9 Secure and Standardized Communication Network.

8.2.2. Body Motion Analysis System

“The International Forum to Advance First Responder Innovation” (IFAFRI) 2018 Report came up with the following gaps as part of an analysis:

- Real-time remote monitoring of the state and activities of team members

- Real-time identification and monitoring of risks and perils
- Real-time locations of first responder teams (especially indoors)
- Monitoring the health status of first responder teams, and their state of emergency and anomalies

There are a variety of technologies and solutions to eliminate the aforementioned gaps. Equipping first responder teams with instantaneous situational awareness, augmented reality, sensor fusion and network (5G etc.) technologies has grown into a major capability all over the world. The integrated use of motion sensors and indoor positioning systems helps monitor the activities and location of first responders in real time. This raises the bar for the situational awareness of first responders.

8.2.2.1. Motion Sensors

Motion sensors enable to monitor all body motion of staff members in real time. Motion is classified by artificial intelligence algorithms and one's specific activity can be identified. In addition, anomalies such as exhaustion and blackout can be detected such that risks and perils can be seen through remote monitoring of team activities.

Inertial measurement systems are deployed for remote detection and monitoring of motions of soldiers on the ground. Inertial measurement sensors placed on 10 different spots of the body help detect the posture of one's body in real time and relay that information to an operation center. These sensors are wireless, operating on low energy. Figure 1 shows the main structure of the system.

Of wearable sensors, there are 3-axis accelerometers/tachometers/magnetometers. Collected via BLE, data is exported to a cloud system through a Wi-Fi gateway. Data can then be quickly sorted out by artificial intelligence algorithms operating on a cloud system. This makes it possible to detect a soldier's motions (such as running, walking, ascending stairs, pointing a gun) from afar. This can be monitored instantly through AR glasses and a VR interface in any operation center.

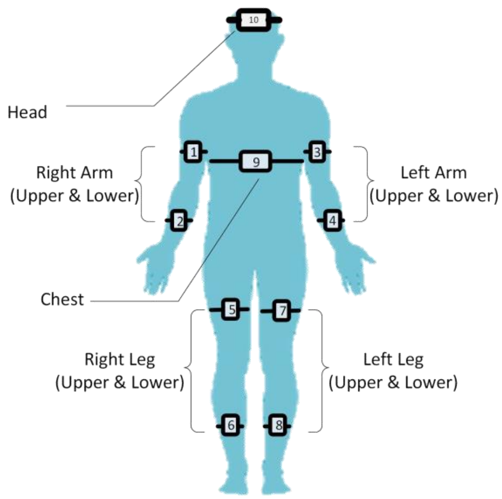


Figure 37 TeamAware Body Motion Analysis System-1

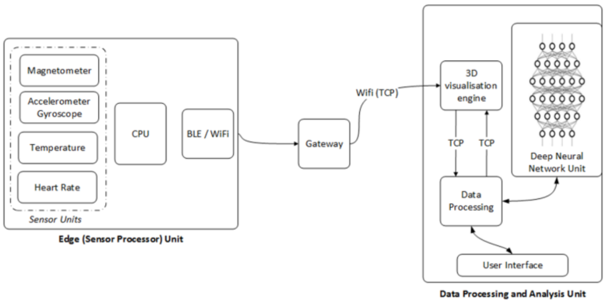


Figure 38 TeamAware Body Motion Analysis System-2

Figure 39 TeamAware Body Motion Analysis System-3

8.2.2.2. Situational Awareness Applications

BMAS can be used for situational awareness applications as it has the capability of full-body motion monitoring as well as activity detection. It can be used in first-responder operations to provide situational awareness to the members during the save and rescue. It is significantly important to monitor and know the status of the members in such circumstances. BMAS can provide fatigue analysis, postural information about the first responders lying, sitting, running, walking, holding a hose, abnormal body postures (alerts), etc.

In the scope of situational awareness, BMAS is integrated with indoor/outdoor localization systems and wearables such as smart health monitoring modules, cameras, augmented reality (AR) devices, and virtual reality (VR) devices as illustrated in Figure 31. This system provides continuous monitoring and tracking of the activity, health, and location of each team member. Wearable cameras are also used for scene sharing between team members.

Each member wears AR glasses so that they can see the status of the other members while they can see the operation scene at the same time. In other words, each team member will be aware of what the other members are doing so that they can plan the safe and rescue operation efficiently. Furthermore, they will be able to respond to urgent cases. For example, the team member will be able to see a member lying on the floor or a stuck member under a load with the locations via AR glasses. Hence, the team will be able to respond to this urgent case to rescue the team member. While the AR interfaces are used by the team members, the VR interface is used by the operation center to monitor the overall scene.

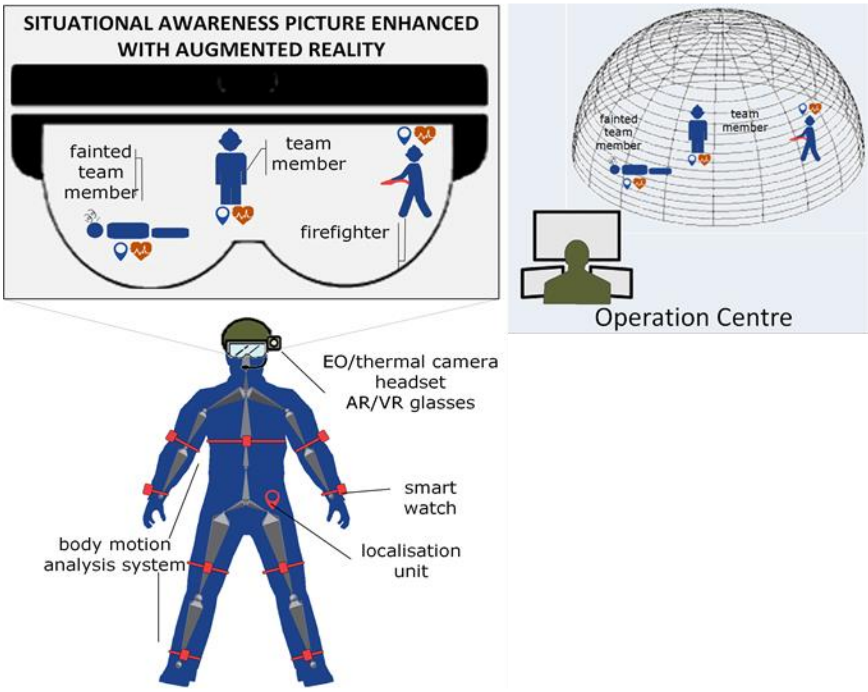


Figure 40 TeamAware Body Motion Analysis System-4

Dr.Tolga SÖNMEZ

Dr. Tolga SÖNMEZ has been graduated from BILKENT University electrical engineering department in 1995. He completed his M.S. and Ph. D. studies in University of Maryland College Park in electrical engineering. During his Ph.D. study he has worked on optimal sensor scheduling and tracking algorithms in sonar applications. After that, he worked in Advanced Acoustic concepts in USA then he continued to work in TÜBITAK Sage in Ankara to develop integrated navigation systems. He recently joined HAVELSAN Inc. as a signal processing and modelling manager to work on sensor fusion projects. His is interested in sensor fusion, sensor networks and integrated navigation systems. He has managed several research and development project in sensor fusion, navigation systems and acoustic signal processing. He also participated in several EU project applications and took part in EU project evaluations as an expert.

PhD candidate Çağlar AKMAN

PhD candidate Çağlar AKMAN has been graduated from Middle East Technical University Electrical and Electronics Engineering Department in 2008. He completed his M.S. degree in robotics area in electrical and electronic engineering at Middle East Technical University in 2017. During his MSc. he has worked on system modelling, sensor arrays, array signal processing, beamforming, multi-object detection and sensor fusion. He is a PhD candidate at Middle East Technical University in robotics field in Electrical and Electronics Engineering department. He joined HAVELSAN Inc. as a system engineer and he is the senior engineer in the modelling and sensor technologies. He has been working on system architecture design, algorithm development for control systems, sensor networks, and sensor fusion as well as embedded system design project. He has taken a role in several international R&D projects as a technical coordinator. He is going to work as the Technical Coordinator in the TeamAware project.

8.2.3. Visual Scene Analysis System

The main objective of Visual Scene Analysis System (VSAS) is to provide vision-based solutions that will help First Responders (FRs) before or during their interventions. Depending on targeted use cases, these vision-based solutions will be embedded within two different subsystems: the “head mounted camera” subsystem (called the “helmet” subsystem) and the “UAV mounted camera” subsystem (called the “UAV payload” subsystem). These subsystems will be linked through dedicated radios to a ground subsystem acting as a gateway.

8.2.3.1. Targeted Emergency Scenario

Typical emergency scenarios that vision-based subsystems are targeted for are the following ones:

1. Exploration of a building with a UAV before FRs intervention: Before operating in a potential hazardous building, FRs will use a dedicated small UAV to explore the building. FRs will use a dedicated Radio Command (RC) to pilot the UAV. The RC will have a video feedback. During such exploration, a piloting-aid system will help the non-expert pilot to control the UAV within potential complex indoor environment, thanks to a real-time on-board analysis that will prevent the UAV to collide with obstacles.
2. FRs or UAV localisation during their intervention: During FRs intervention or UAV exploration, the knowledge of their 3D position on a map is a key functionality for the person in charge of monitoring the evolution of the situation. This scenario intend to show the localisation of any FR or UAV equipped with the dedicated hardware based on GNSS-information when available and based on magneto-visuo-inertial fused data when the FRs or the UAV is for example inside a building (i.e. in a GNSS-denied environment).
3. Semantic Mapping: During UAV exploration, it is worth automatically collecting information that may help FRs to better understand the situation or to plan their future intervention. To this aim, semantic mapping may be a real benefit. This functionality may run on on-board or on-ground HW systems. 2D semantic mapping enables FRs to have a better situational awareness by analysing the map on which semantic information (e.g. presence of chemical products) are displayed. The semantic information to detect has to be defined.
4. Victim detection and localisation: During UAV exploration, a nice-to-have functionality is to automatically detect and localise victims within the built map of the building, so that FRs can recue them as fast as possible. This functionality may run on on-board or on-ground HW system.
5. Guide FRs to join other FRs already in the building / Guide FRs to come out from a building: First Responder localisation may be also used for other scenarios such as the following:
    1. Having an estimation of the First Responder’s trajectory, guide him/her to come out of the building when required;
    2. Guide a rescue team to join the First Responder that is already inside the building.

    To guide the FRs, visual indication may be displayed on dedicated AR glasses or a voice guiding system may also be used.

8.2.3.2. Basic Technical Functionalities

To address these scenarios, the following technical functionalities are required:

1. A localisation solution for GNSS-denied environment: The solution will be integrated on the dedicated helmet and UAV including an electro optical system with IR and/or stereo camera as well as AR glasses in order to:
    1. localise the First Responder, in particular in indoor environment
    2. to guide First Responder to come out from a building

    The localisation solution will be based on a magneto-visuo-inertial solution, combining magnetic data, inertial data and visual data, thanks to a well-suited fusion algorithm. The localisation solution is an odometry solution that estimate the movement, i.e. the pose (position and orientation) of the subsystem. This kind of solution remains subject to drift. To cancel this drift, it is required to get from time-to-time absolute positions provided by a GNSS sensor when available.

2. An UAV piloting assistance solution: In order to support a non-expert UAV pilot to navigate within unknown and complex indoor environments, the indoor UAV will be equipped with an electro optical system with a RGB or IR camera and Time-of-Flight ranging sensors (i.e. VCSEL: Vertical-Cavity Surface-Emitting Laser). Specific algorithms will process data coming from the sensors and will prevent the UAV from colliding with the obstacles.
3. A semantic mapping solution: This module intends to build a 2D map in which semantic information will be added in real-time or a posteriori thanks to the analysis of images collected by the FRs equipped with a camera on its helmet or in the UAV. Mapping will be based on SLAM (Simultaneous Localisation and Mapping) techniques exploiting VCSEL sensors data and semantic information will be extracted thanks to dedicated neural networks.
4. Victim detection and localisation: The used approach will be based on the OpenPose algorithm (or similar algorithm) that takes into account both the variability of the shapes observed (due to the fact that people are articulated elements) and the presence of partial occlusions. OpenPose is based on a CNN architecture and makes it possible to detect different characteristic points of the human body (joints, eyes, mouth, nose, ears, hands, feet) and, jointly, to group these points in a graph forming a skeleton representation.

These basic technical functionalities will be embedded on the helmet subsystem or on the UAV subsystem and will target several scenarios as synthetized in Table 1.

Table 1 Visual Scene Analysis System-1

Basic technical functionalities	Subsystem			Typical scenario(s)
	Helmet	UAV	On ground	
Localisation in GNSS-denied environments	X	X		FRs localisation to get a good situation awareness, FRs guidance
Piloting assistance		X		Building exploration to collect information, to detect victims…
Semantic mapping	(X)	(X)	X	Building exploration to collect information, to detect victims, to help for FRs deployment…
Victim detection and localisation	(X)	(X)	X	Indoor victims rescue

8.2.3.3. Subsystems Appearance

Figure 41 Visual Scene Analysis System-2

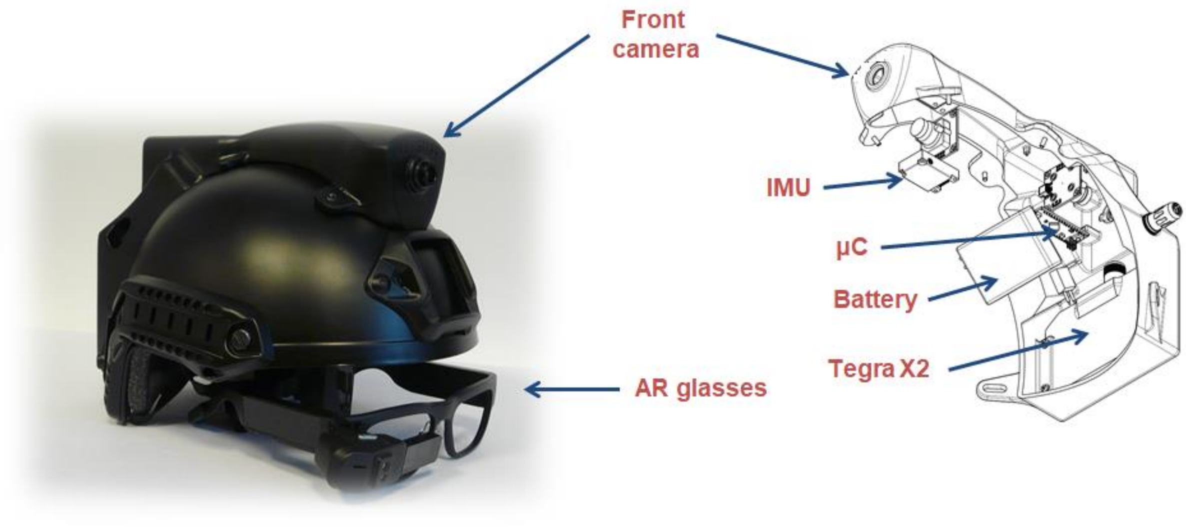


Figure 42 Visual Scene Analysis System-3

Helmet or UAV subsystems have their own power supply. Typical autonomy is 20 minutes for the UAV and 4 hours for the helmet. The helmet, as well as the UAV, is equipped with a 1500 mAh (3S) battery.

UAV subsystem can be use alone. Helmet subsystem can be used alone, except for guidance scenario where at least two helmets are required. It is possible to use several UAVS or helmet at the same time. The limitation comes from radio bandwidth, in particular for video transmission.

Within TeamAware project, we plan to use during demonstration one UAV and two helmets.

8.2.4. Tree Technology S.A

TREE Technology SA (TREE, www.treetk.com) is a Spanish R&D-performing SME providing information and communication technology solutions based on Big Data and Artificial Intelligence for different sectors and markets (including healthcare, safety and security, finance, public bodies, cultural heritage, energy, space, industry, and transport). TREE works within an open innovation model to provide their customers with advanced ICT solutions, helping them to optimise their processes and improve their business. R&D activities, in particular cooperative initiatives, are key to the company business model in assessing the maturity of emerging technologies, gathering new and differential knowledge, and identifying strategic partners to create new business opportunities.

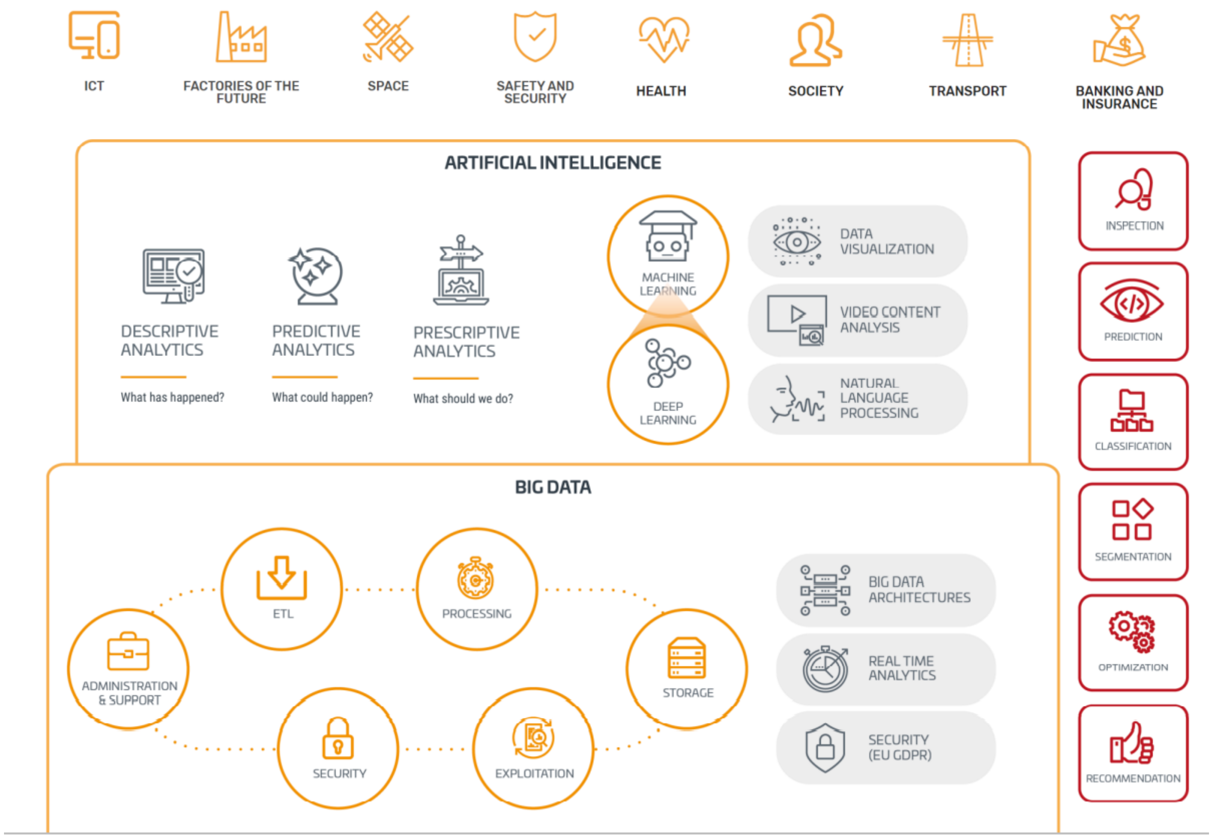


Figure 43 Tree Technology-1

Its R&D unit focuses on Artificial Intelligence and Big Data, integrating emerging technologies as part of the Smart Data ecosystem. In this context, Machine Learning and Analytics, Computer Vision, Cognitive Systems, Distributed and Scalable Computing, or Visual Analytics occupy a relevant position among the company's research lines.

This multi-faceted and cross-cutting expertise in data has motivated the assignment the leadership of WP2 to Tree Technology. Indeed, WP2 ("System Architecture Specifications and Design") deals with the definition of requirements for all the components of the TeamAware ecosystem including the different subsystems, the platform, and the secure and standardised network. The analysis is made across the

- organisational,
- technical, and
- legal

dimensions with the cooperation with the rest of partners involved in the work package. As part of the activities carried out in this work package, Tree Technology also leads tasks T2.2 ("End-users needs, requirements, constraints and scenarios") and T2.5 ("System architecture and communication network design") devoted to the definition of validation scenarios and the design of the TeamAware systems, respectively.

Tree Technology also has a pre-eminent role in WP3 and WP4. The goal of WP3 ("Visual Scene Analysis System") is to design and develop the TeamAware system devoted to the recognition of a disaster zone with a drone-mounted camera and the subsequent analysis of the video footage and images. Within this work package, Tree Technology leverages its Computer Vision expertise to lead T3.3 ("Semantic understanding of environmental features") related to the analysis of images and classification of the elements involved in the scene, as well as T3.5 ("System validation") involving the definition of unit tests as part of the global validation activities.

In turn, WP4 ("Infrastructure Monitoring System") deals with a system capable of identifying structural risks and threats surrounding the first responders based on the visual detection of damages on structures and infrastructures within the critical event area, using drone surveillance. Again, Tree Technology relies on its Computer Vision expertise to achieve a more effective collaboration towards the adaptations' design of the TeamAware system.

Other activities performed by Tree Technology also involve WP12 ("Integration and Test"), WP13 ("Demonstration and Validation"), aside from other cross-cutting dissemination and management activities.

Jorge Fontenla

Dr. Jorge Fontenla, R&D Project Manager in TREE, holds a degree in Telecommunication Engineering by the University of Vigo with the specialisations of Telematics (2006) and Radiocommunications (2010), a PhD in Telematics (2010), and an MsC in Signal Processing for communications (2014). He has a wide experience in a variety of fields of applications, although his main areas of expertise are E-Learning, Cloud Computing, Software-Defined Networks, Cybersecurity, and Connected and Autonomous Transportation. He has participated and coordinated some of the most relevant European projects in this regard, including SONATA (H2020 – 671517), C-ROADS Spain (CEF Transport 2016), CONCORDA (CEF Transport 2016), and CRUSOE (CEF Telecom 2016). He has authored more than 40 scientific publications and holds two US patents.

Serge Sushkov

MSc (1996), PhD (2003) from Physics Institute of Humboldt University of Berlin, Germany. His background comes from the High-Energy Physics science, where he worked between 1994 and 2009 mostly on the CERN-based (http://cern.ch) Experiments. His activities included statistical data analysis (data mining, pattern recognition, machine learning, Neural Networks), Monte-Carlo simulations, large-scale data processing with LCG-GRID software, including software & UNIX system administration. From the middle of 2004 till the end of 2009 he actively participated in SW design and SW development of Trigger and Data Acquisition (TriggerDAQ) for ATLAS experiment (http://Atlas.cern) at CERN, Geneva, Switzerland. There he obtained initial experiences in SW Development and Project Management methodologies.

Since 2010 and till now, Serge worked in various FinTech and IT companies in Barcelona area, Spain, taking roles of Senior Data Engineer, Data and SW Architect, including Team Management and Project Management / CEO. Over those years, he accumulated rich professional skills in the IT areas of data/DB/DWH architecture (SQL / NoSQL), data integration (ETL, pipelines), real-time / live stream data processing, data analysis with R, data monitoring /reporting and Business Intelligence, including web development, SW development methodologies (Agile, SCRUM) and Project Management. In terms of IT technology stacks, he worked with wide range of them: Microsoft SQL Server & Microsoft C# / .NET stacks, Oracle SQL Server, Informatica Cloud ETL, SalesForce CRM, open web stacks with LAMP (Linux, Apache HTTP Server, MySQL/MariaDB, PHP) and MEAN (MongoDB, Ember, Angular, Node.js), as well as Android mobile SW development and Big Data processing with Hadoop / Map-Reduce / Apache Spark & Scala. Among the projects were Serge served as a major contributor in SW architecture area were P2P Lending FinTech where he designed web-based P2P Lending platform from scratch, and his own CamerLender.net start-up projects where he designed and prototyped Mongo+Node.js backend server with Android client App implementing crowdsourcing approach for photo & video exchange social network.

Víctor Fernández-Carbajales

Dr. Víctor Fernández-Carbajales Cañete (M): Head of Computer Vision in TREE, holds a degree in Electronic Engineering from the Autonomic University of Madrid (2004) and Ph. D. in Computer and Telecommunication Engineering from the Autonomic University of Madrid (2018). He has a wide experience in R&D project related to a wide range of technologies, though he is specialized in video-surveillance systems, low-level video processing, semantics and personalization technologies and Internet of Things. As a researcher, he has been involved in several national and international projects, like: Cathedra UAM-Infoglobal (PROFIT FIT-360000-2006-89; image processing algorithms to integrate intelligent video surveillance system in indoor scenarios); SmartPrevent (FP7-606952; detection and prevention of frequent petty crimes with high impact to local communities and citizens in urban scenarios); SAFEROADS (E!-8217; tools for the automation of traffic management, based on the already existing camera infrastructure, with the purpose of improving the current capacities); APRIL (H2020-870142; Robots handling flexible materials in production line environments) and VOJEXT (H2020-952197; Value Of Joint EXperimentation in digital Technologies for manufacturing and construction). As a manager, he was the coordinator of the European projects CogLaboration (FP7-287888), SmartPrevent (FP7-287888) and SAFEROADS (E!-8217), among others. As Technical manager, he was coordinator of the European projects APRIL (H2020-870142) and VOJEXT (H2020-952197).

Aratz Setién

Aratz Setién is a telecommunications engineer specialised in computer vision, data analytics, and medical applications. With more than 13 years of experience in the ICT sector, he has been involved in diverse projects as R&D Engineer and Project Manager, including international (ICT FP7 - Collaborative Project: Embedded Computer Engineering Learning Platform E2LP, H2020 - Integrated personalized care for patients with Advanced Chronic Diseases to improve health and quality of life ADLIFE), regional (VIRUSES - Visually Immersive Researching Unit for Scientific and Educational Scenarios. Patent ES2649789A1) or private funded (eVida©Knee), with diverse publications on the work carried out. Focusing his activity on the research and health sector in the last years, he is specialised in Computer Vision, Medical Imaging, and Machine/Deep Learning technologies with strong knowledge of the ultimate trends and technologies in this area.

8.2.5. The Resilience Advisors Network

The Resilience Advisors Network (RAN) is a group of some 150 practitioners, all experienced emergency and/or crisis managers. The Network has offices worldwide but operates through companies (Ltd) in UK and Ireland.

Advisors work together to form expert teams to bring their practitioner knowledge to support projects and programs for governments, businesses and other international organizations.

Our Advisors come from a broad range of emergency service and disaster management-related backgrounds, most holding senior positions in Emergency Management, Rescue Service or Civil Protection authorities. They all have practical and real experience of 'doing the job'; preparing for, responding to and managing real-life emergencies and disasters.

RAN also manages CMINE, the Crisis Management Innovation Network Europe, providing a comprehensive engagement platform under an MoU with the European Research Executive Agency. This provides TeamAware with immediate access to over 1000 Crisis Managers. We also facilitate the Network of Centers of Expertise deploying the products of the FP7/H2020 project Driver+

Within horizon 2020 and horizon Europe programmes, RAN focusses on bringing-in it's knowledge of real-life experience from first responders and crisis management organisations. RAN delivers:

- Collecting user requirements
- Validating and testing of solutions
- Interaction with end users through the wide network of the experts

Within TeamAware, RAN activity includes:

- Work package 2 - an European overview on the scenarios, doctrines and protocols in which the first responders work in Europe. This overview is the basis for the scenario development for the validation tests in WP 13 and is a background document for the developers who work on the development of the technical tools.
- RAN leads in WP13, organising the demonstration and validations together with end users in the project. For this, we will be using the Driver+ trail guidance methodology as the basis for the work, developing and adjusting it to fit the requirements of TeamAware.
- CMINE is to be used in the dissemination (WP14).

Peter Glerum

European Director Resilience advisors

Peter's education in environmental planning and crisis management gives him an unrivalled knowledge of planning within governmental organisations on a strategic and an operational level. He is well educated in policy development and implementation on a strategic level and in bridging the often existing gap between first responders and policy makers.

Developing himself from operational fire officer within regional government to strategic policy advisor on a national level, he is highly experienced in all levels of government.

Peters more recent experiences include as head of advisors and project manager delivering results in a challenging surrounding, where several stakeholders are influencing the projects and their results.

As project manager of numerous EU funded projects. Peter has also represented the Netherlands on several EU expert groups and as the national training coordinator for EU civil protection training with responsibility for international deployment of experts in the EU civil protection mechanism. With this role, he is very familiar with the EU commission and its working methods and culture and can help you 'find your way around' in this extremely complex operating environment.

Peter is an experienced team leader within the European Union Civil Protection Mechanism with 8 deployments as Team leader in disaster response and needs assessment mission.

Peter is an experienced evaluator both in civil protection and in horizon 2020 projects and proposals.

With a high cultural experience and awareness, Peter is invaluable part of any team working in an international environment, meeting and working with people from different backgrounds and cultures - particularly preparing for and responding to disaster situations.

Jon Hall

Network Manager

Jon is the founder and Managing Director of the Resilience Advisors Network. He is a former Chief Fire Officer, head of UK fire & rescue resilience and government advisor.

More recently, Jon headed organisational development for a major UK training organisation following their purchase of the blue light training facility at Moreton-in-Marsh and was responsible for corporate training and creation of the 'School of Resilience'.

His early career saw early roles managing high-risk operations in the marine oil & gas industry which led to a long & successful career within the emergency services and as the UK government's first resilience adviser. Several years working with the training & business development teams of a professional services provider resulted in a growing portfolio of domestic and international commercial success.

In 2015, RAN was formed!

Ten years served as a Chief Fire Officer in the Midlands - Hereford & Worcester and Gloucestershire - of leading development of local & national policy and commanding a number of major incidents. Jon is a long-standing member\chairman of multi-agency Resilience Forums and regional coordinating groups overseeing planning, preparation, response and recovery phases of emergencies and infrastructure compromises including; civil unrest, major fires and repeated wide-area flooding.

Jon is currently involved with many Horizon 2020 projects, particularly with RESILOC concentrating on delivering improved resilience to local communities. On behalf of RAN, he also manages CMINE and delivery of the trial guidance methodology both of which are legacy products of the FP7 project Driver+ which ended in 2020.

A corporate member of the Institute of Fire Engineers (IFE), the Emergency Planning Society (EPS) and the Institute of Risk Management (IRM). Jon was proud to be awarded the Queens Fire Service Medal in 2014 and has, this year, been appointed a Fellow of the Institute of Strategic Risk Management.

8.2.6. System Architecture

Before the start of the project, TeamAware's subsystems represented separate and standalone entities, and their operation was not tailored for their use as a part of a broader platform to be used by first responders.

During the first months of the project, WP2 has worked on describing the different subsystems that will be integrated into the whole TeamAware ecosystem. These systems will be adapted later in the project in their respective work packages according to the needs from end users and technical specifications defined by the technical work packages. Indeed, WP2's descriptions have provided a common ground for the technical work packages that have officially kicked off in November 2021.

Nevertheless, these descriptions are just the first iteration, and they will be discussed and adapted within the technical work packages. This will result in a second iteration of the specifications which will be compiled and harmonised by WP2 to achieve interoperability with the TeamAware platform. As a result, a second version of the subsystems' specifications will be generated by April 2022.

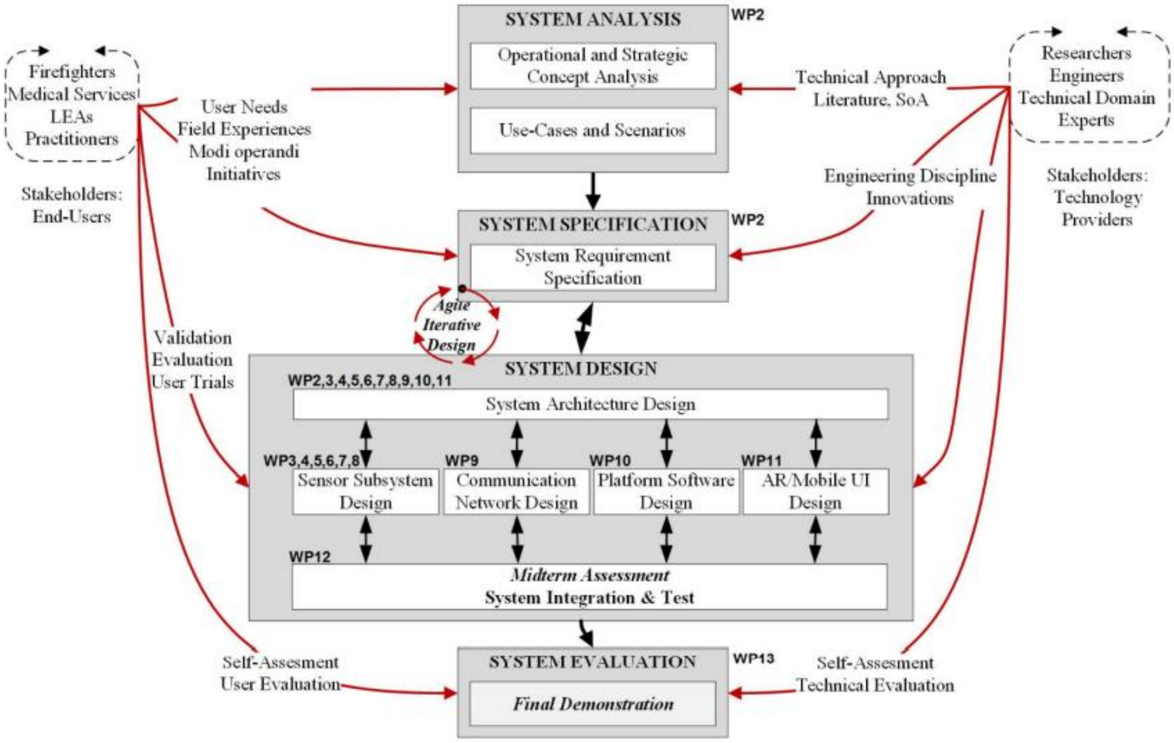


Figure 44 System Architecture-1

Except for the secure and standardised communication network, the description of all the subsystems has followed a systematic approach comprising a description of the following points:

- General information, including a description of the subsystem and its functionality principles.
- Team members who are supposed to use it.
- A brief description of the underlying technologies and sensors.
- A high-level architecture depiction.
- The power source and power consumption of the subsystem.
- The main data types it operates with.
- The software stack of the prototypes, if it operates in a master-slave structure, and if it complies with any standards and recommendations, among others.
- Information on the communications and integration, such as the data flows into and out of the subsystem as well as the formats and protocols used.
- The need for fail-proof data transmission.
- The existence of reference APIs.
- The scalability of the subsystem and potential bottlenecks.
- Typical data rates per unit.
- IT resources (e.g. hardware, software, bandwidth, storage) required for the subsystem to operate with the whole TeamAware system.
- Any other additional information that may be useful to achieve the integration with the platform.
- Information on the operation of the subsystem, such as its essential features and operational parameters.

- Whether they rely on other systems (such as a sensor depending on a drone).
- The monitoring of the subsystem's health.
- Whether the system can be moved into the scene by alternative means if the scenario was too risky for humans.
- Specific information which does not fall into any of the previous categories, because it is tied to the distinctive operation and characteristics of the subsystem. It has been structured as a set of specific questions for each individual subsystem.

Not only was this approach adopted in order to increase the readability and internal coherence of the specifications, but also to facilitate subsequent analysis and evolution of the specifications into their final version.

Additionally, it was possible to evaluate the targeted integration level of each subsystem into the overall TeamAware platform by the end of the project. The degree of integration has been divided into six incremental steps:

- Step 1: any integration of system-specific data visualisation and/or GUI components only (for those subsystems which have them). This is the very minimal requirement to ensure common and single data visualisation in the TeamAware platform.
- Step 2: "dockerising" system-specific data processing components, i.e. run system-specific components "as is" inside a Docker container in the TeamAware common cloud and deliver the system's processing results "as is" into the TeamAware platform.
- Step 3: common data storage under the TeamAware platform. Systems' server-side components will store data on the same technological stack as they do in a standalone operation but relying on a common data lake instead of a separate system own storage.
- Step 4: wrapping system-specific Docker containers together with I/O and flow control API. This would enable to control the system processes execution from the common TeamAware workflow, share common state control, or process logging.
- Step 5: integrating into the TeamAware workflow server-side components which were used by the system in standalone mode (e.g. Apache Airflow). Here, minimal refactoring may be needed, although the component in general should not be re-implemented.
- Step 6: fully integrating system server-side components into TeamAware as plugins, microservices or other kind of batch jobs according to the major TeamAware workflow framework.

For the purposes of this analysis all subsystems have been considered as black boxes, although for the second iteration of the specifications the analysis will zoom into the specific architecture elements of each subsystem and evaluate how that integration can be achieved.

Table 2 System Architecture-2

TeamAware system	Integration level up to step #	Comments
Visual Scene Analysis System	1-2	VSAS Machine Learning results are stored together with video, and there is no separate GUI for integration.

TeamAware system	Integration level up to step #	Comments
Infrastructure Monitoring System	1+	Further integration levels could be considered, although a robust laptop deployed on-site may suffice to perform infrastructures' analysis in a reasonable amount of time.
Chemical Detection System	3	Little or no complex CDS-specific data processing or GUI.
Acoustic Detection System	3	Step 1 (GUI) feasible. Subsequent integration steps may take place later in the project.
Team Monitoring Systems (Continuous Outdoor Indoor Localisation System)	1+	Step 1 (GUI) is agreed as a basic scenario with passive GUI. However, an "interactive" GUI (sending info to a mobile client) would need deeper levels of integrations.
Team Monitoring Systems (Activity Monitoring System)	3	Step 3 is the most feasible one since it provides both privacy and data fusion.
Citizen Involvement and City Integration System	3	The CICIS system operates as a two-way communications channel with citizens (i.e. collects messages from them and sends messages back to them). CICIS has its own GUI with a very specific data flow related to navigation logic. This GUI and workflow functionality are internal parts of CICIS, and do not need to integrate it into the TeamAware platform at any of the integration steps.

8.2.7. The EUCENTRE Foundation

Eucentre is a private non-profit foundation that pursues a mission of research, training and service provision in the field of earthquake engineering and, more generally, of risk engineering.
Active in Pavia since 2003, it was established by four Founders, the University of Pavia, the University School for Advanced Studies IUSS of Pavia, the Italian Department of Civil Protection, the National Institute of Geophysics and Volcanology, to further develop the scientific, research and training expertise in the sector present in Pavia.
Today Eucentre has an important asset of experimental labs consisting of shaking tables able to reproduce any seismic event for testing both structural and non-structural elements and for the qualification of anti-seismic devices.
Eucentre operates within an international network with other research centres, earthquake engineering laboratories, institutions and companies.
Eucentre is Centre of Competence of the Italian Department of Civil Protection, to which it provides emergency support, elaboration of risk scenarios and research activities for the improvement of Civil Protection activities.

Today Eucentre is an international reference centre for institutions, for which it operates in the definition of emergency plans, in the elaboration of risk scenarios, in the vulnerability assessment of buildings and infrastructures, and for companies, to which it offers experimental and supporting services for the seismic design in various sectors.

EUCENTRE is supported by the Computer Vision & Multimedia Lab of University of Pavia. The CVM Lab is part of the Department of Electrical, Computer and Biomedical Engineering (DIII). Since 1976, CVMLab has gained substantial experience in automated image analysis in several fields like robotic vision, security surveillance, structural assessment, face recognition, medical imaging, advanced human-machine interfaces and digital humanities. More recently, CVMLab has specialized and focused on AI methods for computer vision and deep learning.

8.2.7.1. The Infrastructure Monitoring System

Within Teamaware project, EUCENTRE is responsible for the implementation if the Infrastructure Monitoring System, which is intended for the identification of risks and threats surrounding the first responders based on the visual detection of damages on structures and infrastructures in the critical event area, using drone surveillance.

The system can be used in any situation in which the structural integrity may be jeopardized. This means as a first use after earthquake or explosion, but also in case of landslides hitting infrastructures or fires on structures.

Two basic assumptions have to be kept in mind:

- The system is intended to be used at minimum by a drone operator and a payload operator. Both are suggested to be structural engineers, but the latter has to be.
- Result output from the tool is intended to be used by structural engineers in order to evaluate structural danger situations
- Onsite independent performance of the system shall be guaranteed

Specific procedures will be designed for structural damage detection and identification: based on visual data caught by drones, mostly acquired with optical sensors and in daytime, post-flight external inspection will be carried out on damaged structure with post-flight automated screening techniques. In addition, images/video collected by other means can be as well analysed. The main purpose of the automated screening process will be reducing the amount of data by several orders of magnitude to a reduced set of data that might be worth inspecting by human experts, thus enhancing the capability to assess and detect structure-critical situations.

The automated screening algorithm for damage recognition will be based on Deep Convolutional Neural Networks (DCNN) trained for item detection and localization.

The system will be designed for running offline (i.e. on non-embarked computing devices) and will be able to run on high-end portable computers (laptop) equipped with a suitable GPU.

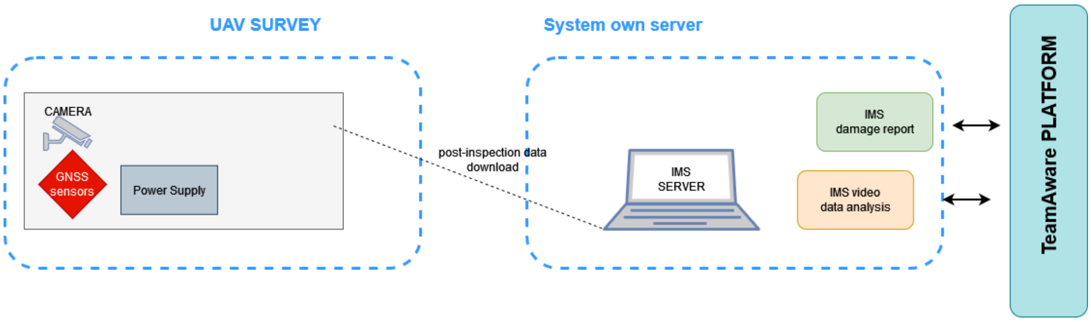


Figure 45 The EUCENTRE-1

Chiara Casarotti
EUCENTRE Emergency Support Department Head

Dr. Casarotti, senior researcher at the Eucentre Foundation since 2011. She received a Master of Science and a PhD in Earthquake Engineering jointly awarded by the Institute for Advanced Study of Pavia (IUSS) and the Università degli Studi di Pavia in 2004, after which spent about one year at the University of California San Diego as post-doctoral researcher.

Dr. Casarotti main scientific interests concern applied experimental research the field of earthquake engineering, dynamic response of RC structures, seismic isolation and dissipation devices and emergency technical response.

Particularly she dealt with linear and nonlinear static procedures for seismic design ad assessment of structures, static and dynamic analysis of RC structures, engineering seismology, experimental response and numerical modelling of isolation/dissipation devices, experimental data processing, inverse problems for structural characterization.

Since 2007 she is in charge of the scientific supervision of the tests carried out on the Bearing Tester System (BTS) lab facility of Eucentre.

Since 2009 she has been deeply involved in the emergency management and rapid response to earthquake disasters, both within the framework of pilot projects on the European Civil Protection Mechanism modules, national Civil Protection projects and in real disasters (Abruzzi-Aquila 2009, Emilia 2012 and Central Italy 2016), with technical coordination roles.

Marco Piastra
Professor of Artificial Intelligence

Marco Piastra is contract professor of Artificial Intelligence, with particular reference to machine learning, deep learning and deep reinforcement learning for wearable sensors and robotics.

He received the M.Sc. (Eng.) and the Ph.D. degree in Electronic and Computer Engineering from the University of Pavia. He has published several articles in international journals, books and conference proceedings. At present he is technical coordinator for the University of Pavia of the project Home of IoT (ID 139625).

As professional engineer, he has carried out several professional assignments in the banking, manfacturing, automotive and service sectors, in Italy, Germany, Switzerland and France. He has been CTO of Nexo France, where he realized the Cobra Connex automotive satellite anti-theft system and the technical coordinator of several projects for central and local public administrations in Italy.

8.2.8. The Fraunhofer-Gesellschaft

The Fraunhofer-Gesellschaft, headquartered in Germany, is the world’s leading applied research organization. With its focus on developing key technologies that are vital for the future and enabling the commercial exploitation of this work by business and industry, Fraunhofer plays a central role in the innovation process. As a pioneer and catalyst for groundbreaking developments and scientific excellence, Fraunhofer helps shape society now and in the future. Founded in 1949, the Fraunhofer-Gesellschaft currently operates 75 institutes and research institutions throughout Germany. The majority of the organization’s 29,000 employees are qualified scientists and engineers, who work with an annual research budget of 2.8 billion euros. Of this sum, 2.4 billion euros are generated through contract research. The Fraunhofer Institute for High-Speed Dynamics, Ernst-Mach-Institut, EMI for short, is one of those institutes.

8.2.8.1. Profile of Fraunhofer EMI

Fraunhofer EMI recognizes its task in understanding the physics of high-speed, transient processes in order to derive solutions for applications in the industry. EMI adopts interdisciplinary and comprehensive material strategies to investigate crash, impact, and shock-wave phenomena by experiment and simulation.

The solutions elaborated at EMI by experimental, computer-based and analytical methods aim at improving the security and reliability of components and structures under dynamic loads. With the utilization of the most recent research results for technical applications, their efficiency is increased – conserving resources at the same time. Thereby, society profits from optimized systems in the areas of defense, security and resilience, automotive, space, aviation and sustainability.

The security of living environments and working spaces as well as the protection of urban environments and critical infrastructure are central topics in the business unit Security and Resilience. Through targeted risk management, solutions against extreme conditions such as explosions, impacts, fire, strong wind events and earthquakes can be elaborated. We provide safety, efficiency and robustness analyses of technical systems and develop sensor systems and software for safety and security applications.

Integration into the academic research landscape, on the one hand, as well as cross-linking and competent presence in the development departments of the relevant industry, on the other hand, are prerequisites for pursuing applied research in such an economical way as is common standard for Fraunhofer Institutes.

Three different work groups of EMI participate in the work in TeamAware: “Reliability of Learning Systems”, “Intelligent Data and X-Ray Analysis” and “Agent-Based Modeling”. Within their research scope the application and reliability of AI methods in the context of security applications is a main focus.

8.2.8.2. Role within the project TeamAware

With this expertise, Fraunhofer EMI was assigned WP Lead in WP10 "TeamAware Software AI Platform". In preparation for WP10, EMI partakes in WP2 ("System Architecture Specifications and Design") as Task Lead for T2.4 ("TeamAware Software Platform Architecture and Design") to develop the first iteration for the platform software design documents in close relation to the other participating partners in TeamAware.

The work performed in T2.4 acts as a foundation for the AI software platform itself as well as it plays a major role in the later integration of the individual works from other WPs within TeamAware. Within the realization of this software platform during WP10, the main focus is on providing a reliable data source for the TeamAware ecosystem based on our database expertise. Also, the enhancement of individual sensor data by employing different methods of analytical and AI-based single and multi-sensor data fusion are also a major research topic in this. The final goal is the provision of the most relevant data to the operator at any given time while providing the operator with a powerful set of tools for decision support to plan and act on any emergency scenario. WP10 plays a major role in bringing the TeamAware data and benefits to the first responders.

To achieve the best possible integration of WP10 within the TeamAware ecosystem, Fraunhofer EMI also participates in WP2 for the system planning, WP9 ("Secure and Standardized Cloud network") for the network and cloud systems, WP12 ("Integration and Test") and WP13 ("Demonstration and Validation").

Dr.Katharina Ross

Dr. Katharina Ross received her PhD (Dr. rer. nat.) at Friedrich Schiller University Jena in 2013 for the thesis: "Multi-scale Model for Transport Coefficients in Heterogeneous Fractured Media" in the field of computational hydrosystems in a joint project together with the Global Research for Safety (GRS) in Braunschweig for modeling the groundwater transport of radionuclides. Since 2016, she has worked for Fraunhofer as research associate and responsible person for the project "EDEN" within the department "Safety Technologies and Protectives Structures" and has focussed on modeling and evaluation of the possible damage effects on infrastructure after natural and man-made hazards and an efficient resilience management. Since 2019, she has been the manager of the group "Reliability of Learning Systems", which focusses on AI-based systems and the reliability of its results to open the black box.

Jakob Stigler

Jakob Stigler has held a position as research associate at Fraunhofer EMI in the group "Intelligent Data and X-Ray Analysis" since 2020 and a MsC in Computer Science from the University of Freiburg with a specialization for neural-network-based AI. In 2013, he started at Fraunhofer EMI as student assistant and was involved in security projects like DURCHBLICK.

Dr. Corinna Köpke

Dr. Corinna Köpke studied geophysics and -informatics at the TU Bergakademie Freiberg, Germany, and received her master's degree in collaboration with the Max Planck Institute for Solar System Research in Göttingen, Germany. In 2018, she received a PhD in geophysics from the University of Lausanne, Switzerland. Her work was focussed on the influence of modeling errors in inverse theory and uncertainty quantification. Afterwards, she spent one year at the DLR Institute for the Protection of Maritime Infrastructures in Bremerhaven, Germany, and joined Fraunhofer EMI in 2019. She focusses her work on resilience quantification and agent-based modeling for critical infrastructure protection and was involved in the EU project SATIE. As of recently, she fills the position of deputy group manager for "Agent-Based Modeling".

Dr. Victoria Heusinger

Dr. Victoria Heusinger received her PhD (Dr. rer. nat.) at the University of Freiburg in 2019 for her work focussed on the optimization of computed tomography algorithms concerning the reduction of reconstruction artefacts, especially on undersampled data sets. The investigated iterative algebraic reconstruction method (ART) is very similar in its setup to the structure and learning process of neural networks, which is one of the reasons why, as of 2021, she manages the research group "Intelligent Data and X-Ray Analysis", which focusses on AI application in the field of measurement data analysis (X-ray, radar, optical, data fusion), and especially the reduction of training data needed and the topic of "frugal learning". Victoria has been at EMI since 2012 and participated in many projects in the area of security research, such as ECSIT, XP-Dite and DURCHBLICK.

Andreas Weber

Andreas Weber studied physics at Technical University Darmstadt where, during his master's thesis at the Institute of Nuclear Physics, he specialized in machine learning. He implemented and investigated neural networks and their ability to solve complex tasks with the goal to improve the position resolution of a photon detector. Since 2020, he has been a research associate at Fraunhofer EMI in the group "Reliability of Learning Systems", which focusses on AI-based systems and the reliability of their predictions.

8.2.9. The Dune

8.2.9.1. TeamAware Team Monitoring System (TMS)

The Team Monitoring System in TeamAware encompasses two major developments: the Continuous Indoor Outdoor Localisation System (COILS) and the Body Motion Analysis (BMS); the latter has been introduced in the here, therefore the COILS is the focus here.

8.2.9.2. Dune in TeamAware

DUNE is an Italian R&D SME operating since 1980 in aerospace, industrial control and telecommunications, with a major focus on sensor technologies, signal processing, localisation, and embedded solutions. Throughout its 41 years history, DUNE has collaborated with several leading Italian Companies, International Academic Partners and Research Agencies to carry out industrial and research Projects, also having 22 years of seamless involvement in European Projects, spanning from aerospace, industrial control, underwater applications, wireless communication, and indoor localisation.

Within TeamAware, DUNE will coordinate the partners' efforts in WP7 (Team Monitoring System), bringing into the project its 10 years of expertise on inertial localisation, condensed around its (registered) ARIANNA tracking and safety system system, 5 patents on inertial processing, and the DUNE expertise gained in the involvement into R&D on-topic projects, leading two European H2020 (PROTECT, PROTECT-2), leading three Italian projects (RESCUE, PATH-SAFE, EXPLORERS), and participating into one EU FP7 Pre-Commercial Procurement (Smart@Fire) and one Czech TREND initiative (ILOC).

8.2.9.3. Background of the Indoor Localisation

Despite the GNSS availability makes "tracking" a trivial task, almost all the safety/security interventions, the Critical Infrastructures (CIs) and urban soft targets are GNSS-denied environments (e.g., indoor and underground areas); therefore, safety/security operators are (almost) never traceable, jeopardising the Situational Awareness and the effectiveness of the operations, thus increasing the loss-probability of human lives and high-value assets. In addition, GNSS is also very easy to jam; a point to be considered when intentional hostile actions are accounted in the scenario.

The impossibility of locating the operators in scenarios where the GNSS signal is absent (e.g., hostile jamming, indoor environments) is still a major cause of severe decrease of the Situational Awareness, thus decreasing the prevention, preparedness, intervention, and post-crisis recovery capabilities.

Given the above, it is not surprising that the IFAFRI (International Forum to Advance First Responder Innovation) has identified 10 "common global capability gaps" (i.e., areas where new or improved technologies could greatly enhance the safety, effectiveness and efficiency of the world's first responders) and the Capability gap 1 is: "The ability to know the location of responders and their proximity to threats and hazards in real time".

8.2.9.4. The issues and the Challenge

Performance: tracking personnel in the absence of GPS is a very hard scientific and technological challenge, therefore most of the solutions offered in the recent past have been basically academic prototypes with little or no chance of commercial success. Only in the last 6 years in USA and Europe several Companies (e.g., Sony, Intel, Navigine, Indoors, Insoft, Qrok, Combain, RadiantRfid, all gathered in the powerful InLocation Alliance) have performed working deployments of **infrastructure-based** localisation systems (e.g. WiFi, RFID) in airports and malls, insuring accurate tracking over a virtually unlimited time span. These systems are precise, but they are effective only in specific conditions that are not met in CIs or security/emergency scenarios.

An alternative approach is based on **infrastructure-free** solutions, solely based on **wearable sensors:** mainly inertial sensors, possibly augmented by ancillary sensors (compass, altimeter, optic, UWB). Although their main advantage is to get rid of any location-aiding infrastructure (unsuited for safety/security applications), they suffer from a rapid growth of the position errors, making the estimated location useless just after few minutes.

Suitability: although the infrastructure-based solutions have demonstrated to be able to offer commercial and performing solutions, they are entirely based on the presence of elements that are almost never available in the realm of safety, security and in CIs protection: indeed, first responders face high-risk, time-critical missions and cannot deploy ad-hoc infrastructures during the interventions in unknown areas; many CIs (e.g. power plants) cannot provide the necessary clearance to allow the deployment of location-aiding infrastructures or disclose their floorplans. Also, the "fingerprinting" campaigns in CIs are subject to clearance restrictions and suffer from time obsolescence, thus must be refreshed on a regular (yearly) basis, severely impacting on the OPEX.

Affordability: disregarding the operational suitability issues above, both the deployment of dense localisation aiding infrastructure or the use of wearable strategic-grade IMUs have the potential to meet the desired performance level, but the resulting acquisition cost (CAPEX) and the necessary maintenance (OPEX) might need a budget largely exceeding the available budget of the potential customers. Any solution aiming at having a real impact on the operation must be financially affordable, both on the acquisition and on the maintenance side.

The challenge: on the one hand, the infrastructure-based solutions can provide good tracking performance, but have little or no room in the CIs protection and safety applications; on the other hand, the infrastructure-free solutions suffer from rapidly degrading performance, making them unsuitable for long term operations; therefore, the key problem is to find a reasonable tradeoff solution capable of insuring sufficient accuracy by solely relying on infrastructure-free solutions, implemented with an operationally suitable and commercially affordable/profitable system.

8.2.9.5. The TeamAware Approach

TeamAware employs a new approach for the seamless continuous outdoor/indoor localisation, based on innovative fusion paradigms (owned by the partner DUNE and widely on-field tested) based on the joint use of wearable IMUs for motion tracking purposes, Compass, Altimeter, GNSS and UWB. The localisation solution is designed to be infrastructure-free and wearable, being also specifically designed to be a "switch-on and forget" paradigm, coping with the operational needs of the responders (e.g., no need of complex calibrations, expert users, cumbersome setup).

In-team situational awareness system will consist of continuous outdoor/indoor localisation system (COILS), health and body posture monitoring subsystems (BMS: Body Motion Analysis). In-team situational awareness system will be a wearable system and will be connected to the cloud-based TeamAware platform via wearable gateways. Fully integrated real-time indoor/outdoor localisation system is required to localise responders in hazardous and risky situations during operations. More specifically, Inertial + GNSS fusion will be used for the outdoor localisation, whereas wireless beacons, RF transceivers and inertial measurement units (along with new multisensory fusion techniques) will be employed in indoor, underground and, in general, in all the environments where GNSS is unavailable, unreliable or intermittent. Furthermore, activity monitoring system (AMS) will consist of health monitoring and body motion capture systems. Health monitoring subsystem will monitor the vital signals of the first responders. Body motion capture will monitor position and orientation of a first responder to detect activity of the responder such as still, moving, holding a hose or lying on the ground. COILS and AMS will build up the Team Monitoring System (TMS).

8.2.9.6. Key Development Elements

To meet the best tradeoff between performance, usability, and marketing issues, the COILS system has been developed around the following key elements.

- *Infrastructure-free:* solely based on wearable sensors, with no need of setting up, deploying, calibrating any external or internal infrastructure (e.g., radio beacons, RFID tags, BT tags).
- *User-independent:* the system can be shared and switched among different users, with no decrease of performance.
- *Switch-on and forget:* the system doesn't need any intervention during the operations, performed by the user (they have their job to do).
- *Wearability:* the system is pocket-size, lightweight, easily wearable, and not annoying.
- *Open Communication:* COILS output needs a very low data rate link (e.g., < 1 kbps) and the output interface is rather universal and can accommodate a widespread ensemble of Communication standards (including most of the ones already owned by the users).
- *Affordability:* the acquisition and maintenance costs must not exceed the (reasonable) budget available on the end-users' side.
- *Hierarchical information management:* even in the lack of any information source (e.g., no GNSS, UWB out of range, unreliable altimeter, no floorplans available) the system will guarantee a minimum level of performance, solely based on the wearable IMU; however, as soon as any information source is available (and reliable), the system improves its

performance (e.g., when the magnetic information becomes reliable, the system can perform a position-drift compensation).

- *Processing topology and offloading:* the general "rule" is to process information where is generated; however, this is not straightforward when a location-refinement algorithm needs the information from multiple sources, generated or available in different places (e.g., the inertial information is generated in the foot-mounted sensor, but the digital floorplan is available at the remote ICS). Considering also that the information transfer impacts on the bandwidth requirements of the wireless links, the COILS distributes the processing elements as a reasonable tradeoff between the available computation power, battery consumption, and bandwidth requirements.

8.2.9.7. COILS Sensors and Processing

The following figure schematically illustrates the COILS sensors and processing elements: the leftmost orange box represents the wearable elements: IMU unit, altimeter, GNSS receiver, TAG reader (e.g., UWB), magnetometer. The rightmost box illustrates the processing elements (i.e., inertial localisation with compass-based drift compensation, fusion with altimeter data, fusion with the GNSS data, track refinement based on the TAG data, improvement based on the availability of the floorplans).

Albeit the figure illustrates the physical elements (left) and the processing tasks (right), specific choices affect the place where the processing elements are performed; for instance, the inertial localisation with compass-based drift compensation is presently performed inside the foot-mounted sensor unit; the fusion between the altimeter and the inertial vertical position is presently performed at the ICS side, as well as the map-matching track refinement, whereas the GNSS-inertial fusion is placed inside the wearable smartphone. Different choices about "where" a specific processing is located are possible, and no choice is a-priori "optimal", each entailing pro and cons on the battery consumption, processing power, bandwidth requirements and so on.

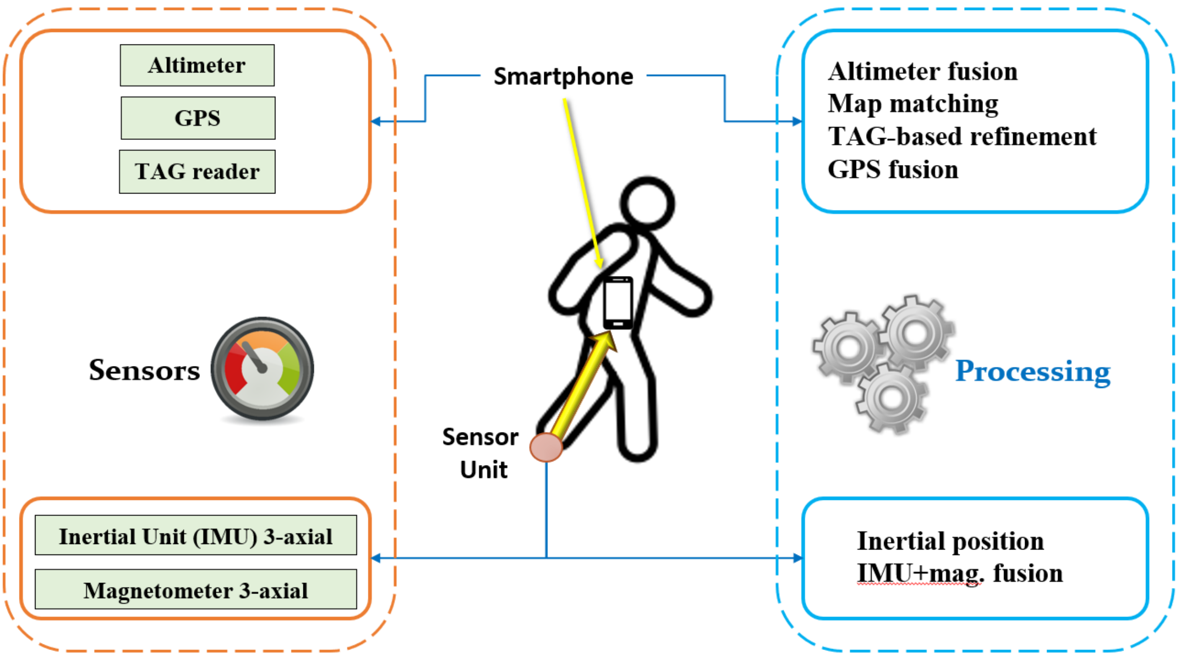


Figure 46 The Dune-1

Based on the fulfilment of the above elements, DUNE has developed the ARIANNA indoor localisation system (www.ariannasystem.com) that constitutes the backbone of the COILS to be developed in TeamAware. The ARIANNA elements are illustrated in the following figure.

Wearable segment: miniaturised foot-mounted sensor unit (9DOF MEMS IMU), a Control Unit with power supply and communication management, plus an optional smartphone; the drift-compensated inertial track is computed inside the sensor unit; the Control Unit oversees the collection of additional information coming from other (optional) sensors (e.g., GNSS fixes and NMEA data, altimeter, heart pace), format and deliver them to the communication system.

Remote segment: receives all the data from the wearable system, performs additional track-refinement operation, either automatic (e.g., inertial track fusion with the altimeter, fusion with the GNSS fixes) or operator-assisted (e.g., floorplan-assisted track refinement, track deskewing with landmarks); visualises in 2D, 2.5D and in 3D the track with the satellite maps (multiple servers); manages the contextual presence of additional visual information (e.g., photos, audio notes); generates automatic reports of the whole mission.

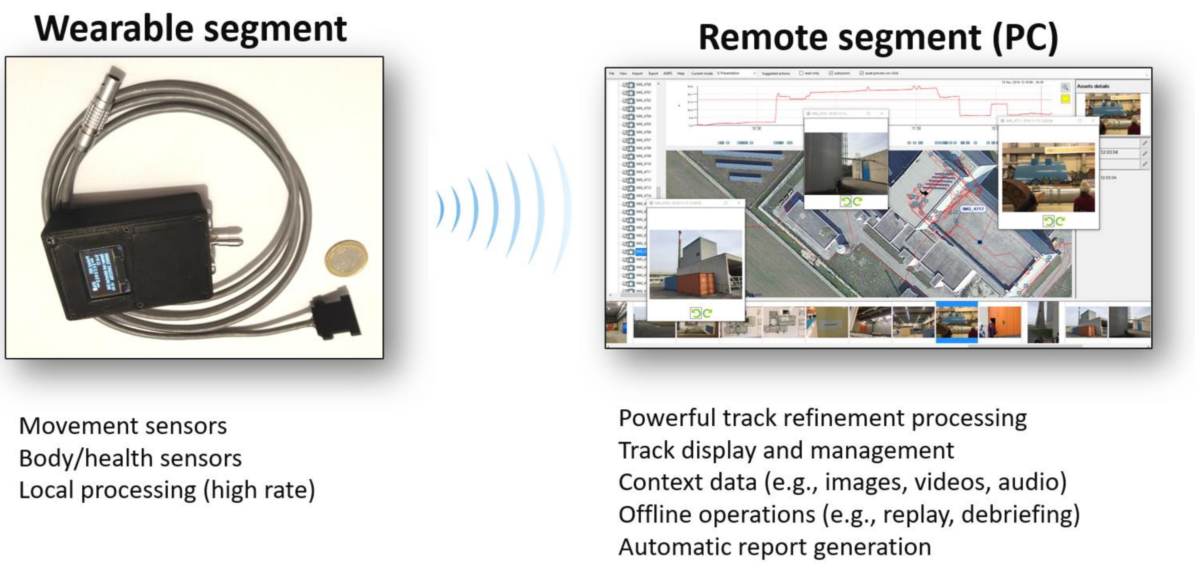


Figure 47 The Dune-2

8.2.9.8. Examples of On-Field Result

As a starting point, the development of the COILS system of TeamAware will leverage from the performance achieved by the DUNE's ARIANNA system, already assessed by countless experiments and trials performed in realistic operational conditions by the end-users (e.g., an Agency of the United Nations operating in Critical Infrastructures, Italian Firefighters, Chinese Firefighters, Taiwanese firefighters, and so on).

The first figure reports the result (in 3D) of a test performed in cooperation with the Italian Firefighters inside an underground cave (GNSS never available), exploiting the presence of four landmarks established during the operations (no deployment of location-aiding elements).

The second figure is relevant to a demonstration session performed in the disaster simulator SISMA-USAR (Urban Research and Rescue) facility of the Italian Firefighters (with real collapsed buildings, collapsed industrial shed and car parking, one large field of debris). In the figure, the yellow squares indicate the indoor areas (no GNSS) and the red path is the estimated track walked by the firefighter. The overlaid image is the firefighter crawling inside the tunnels located under the field of debris.

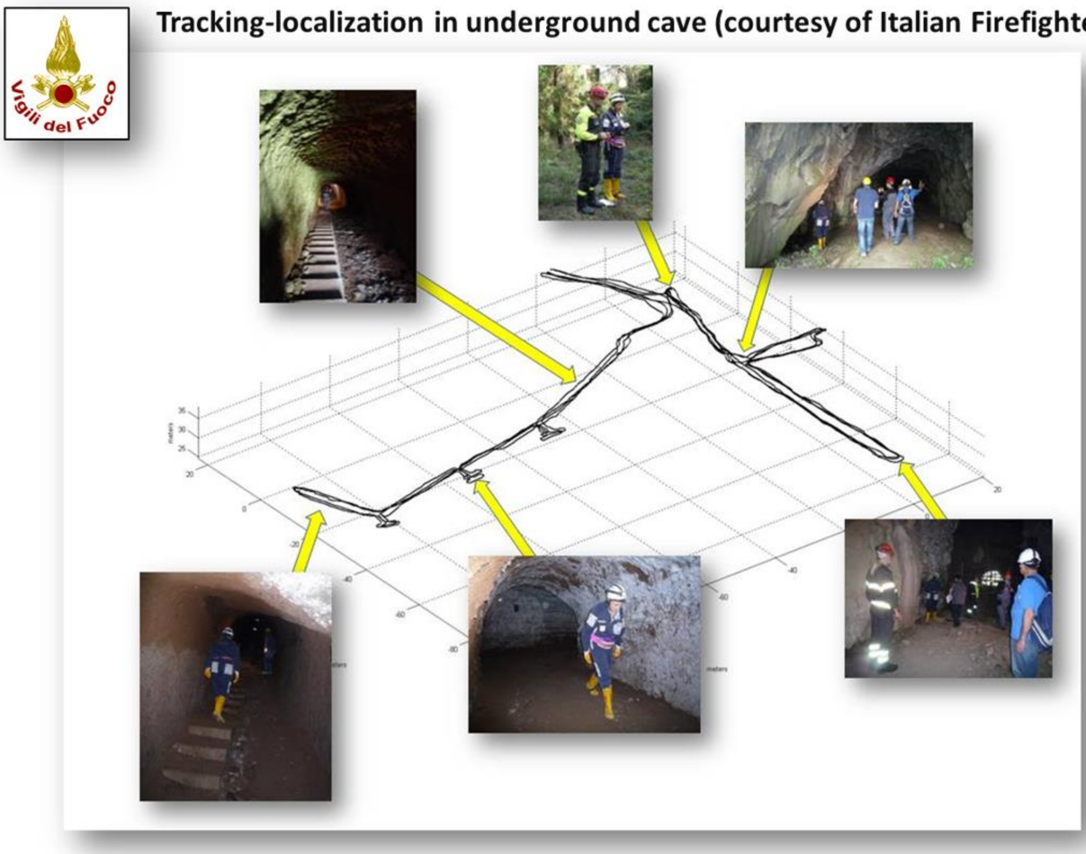


Figure 48 The Dune-3

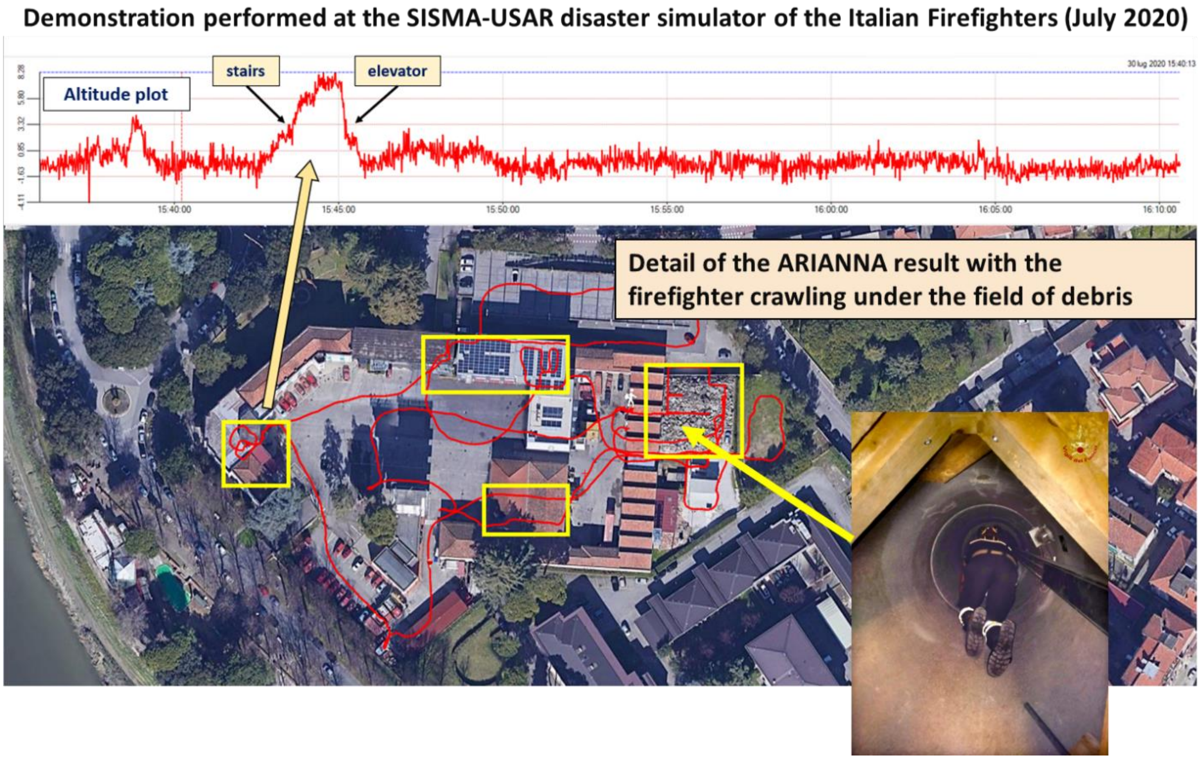


Figure 49 The Dune-4

Fabio ANDREUCCI (M)

Fabio ANDREUCCI (M) member of IEEE and AEI, is a founder partner and financial manager of DUNE Srl. Born in Siena (Italy) in 1950, he received in 1975 the Master's Degree in Electronic Engineering (magna cum laude) from the University of Pisa. From 1985 he manages and supervises the financial and market policy of DUNE S.r.l. During his 46 years of career, he carried out the DUNE financial management of a number of EC co-funded projects, among which: WAICS, VERIPARSE, SWAN, SATURN, STARMATE, TROPIC ROMANTIK, SURFACE, FREEDOM, PROTECT, and INSAT. From 2012 he developed an intense marketing cooperation with the countries of the Middle East and in particular Saudi Arabia. From 1975 to 1981: system engineer at SELEX ES (former Selenia), and Fondazione U. Bordoni, in Rome. Mr. Andreucci has acquired a broad set of skills; particularly in IR and image processing, robot vision, Doppler estimation and automatic noise canceller for underwater acoustic instruments. In the latest years his interests were steered toward multiprocessing with DSPs, FPGA and RISC processors. Author and co-author of several scientific papers on signal processing (communication, vision processing and underwater acoustic), Mr. Andreucci has been involved in several EU Projects with focus on algorithms development for signal detection and waveforms estimation.

Enrico de MARINIS (M)

Enrico de MARINIS (M) born in Naples (IT) in 1960. He received the Master's Degree in Physics (magna cum laude) at the University of Naples. 2018-2020 PROTECT project (H2020, SME-instrument ph.2) on the marketing plan and scale-up of the ARIANNA system for the localisation of first responders in GPS-denied environments. 2015-2016: management of the PROTECT project (H2020, SME-instrument ph.1) on the human tracking for the protection of critical infrastructures. 2011-2015: financial and market management of the projects RESCUE, PATH-SAFE and EXPLORERS projects (co-funded by Italian national R&D initiatives) on infrastructure-free inertial localisation and RAMPS (on inertial augmentation of GNSS, co-funded by the Italian Space Agency). Involved in the management of the ISTSATURN (FP5, telecommunication); TOMPACO (MURST, underwater acoustics).1999-2015: management and project co-responsible in DUNE (signal processing and inertial tracking). Until 1998: senior scientist and project responsible in Whitehead Alenia Sistemi Subacquei. Contract professor of Underwater Acoustics at the Istituto Universitario Navale in Naples. Author of several published works in the field of inertial tracking, geophysics, underwater acoustic and signal processing. Involved in the EC co-funded projects SATURN, ROMANTIK, WINSOC, SURFACE, ROCKET, FREEDOM, TROPIC, PROTECT-2, PROTECT, INSAT (from FP5 to FP7 and H2020).

Marco Valerio ARBOLINO (M)

Marco Valerio ARBOLINO (M) gained his Master's Degree in Physics (magna cum laude) at the University of Rome "La Sapienza" in 1985. Since 1988 he has been employed by Dune, as a system analyst first, and a senior system engineer. 1998/99: blind and supervised equalisation algorithms and processing for underwater acoustic communications networks, in MAST-3 SWAN project. 1998: Design and implementation of images processing algorithms for industrial welding machine control. 1997: Design and implementation of the control algorithms of a steel plate bending machine for ship building. 96: Feasibility analysis of an interferometric satellite-borne bi-static rain radar for the ESA. 1995/96: Algorithm review for a marine environment monitoring system, including radar and sonar sensors, for tracking and classification of vessel traffic. Participation to a project funded by the Italian Research Council, for the study of Vessel Traffic Service (VTS) systems.

Fabrizio Pucci

Master's Degree in Physics (110/110) at the University of Rome "La Sapienza" in 1993. Since 1993 he collaborated with DUNE S.r.l. His activity is mainly focused on the analyses, definition and optimization of SW computing architectures and real-time interface for telemetry and sonar systems, active and passive, with high volumes of data input and calculation. He has been involved in research and development projects dealing with: image processing (scientific, industrial and medical), signal processing, implementation of real-time algorithms, sonar and radar processing, wireless communication, integration of on-line services (e.g., Google maps) under Android OS. Computer skills: Operating Systems: Window; Linux/Unix/Android; LinxOs; VxWorks; Programming languages: Assembler (for TMS370, ADSP 21060, Hammerhead 21160, TigerShark ADSP TS101, uP196). C (standard, C#, Unix, VxWorks, Visual C++, Visual Studio, Visual DSP); Fortran; Java; Matlab; Matlink.

Michele ULIANA (M)

Michele ULIANA (M) born in Rome (IT) 1961. He received the Master's Degree in Electronic Engineering (magna cum laude) at the University of Rome "La Sapienza". Since 1990 he has been employed by Dune, as a system analyst first, and a senior system engineer. 2015-2020: PROTECT project (H2020, SME-instrument ph.1 and 2): analysis, design and development of the ARIANNA system for the localisation of first responders in GPS-denied environments. 2011-2015: RESCUE, PATH-SAFE and EXPLORERS projects (co-funded by Italian national R&D initiatives): design and implementation of signal processing algorithms for infrastructure-free inertial localisation. 2003-2011: RAN21S and KRONOS projects (ALENIA): design and implementation of radar signal processing algorithms on parallel DSP architecture. 1995-2003: SEA90 project (Whitehead Alenia Sistemi Subacquei): design and implementation of signal processing algorithms for a towed array sonar. 1990-1995: SARA project

(ENEA): design and implementation of the inertial navigation system of autonomous underwater vehicles.

Dr. Eng. Fabrizio Gambetti

Dr. Eng. Fabrizio Gambetti studied Electronic Engineering and received his master's degree from the University "La Sapienza" of Rome with a specialization in Radar and Environmental Remote Sensing. Since 2000, he has been working for Dune S.r.l. as embedded and real-time software developer within the System Integration Team and has been involved in many projects in the areas of radar processing, telecommunication and industrial automation.

8.2.10. The Microflown AVISA

Microflown AVISA develops acoustic intelligence, surveillance and reconnaissance (ISR) systems, based on its worldwide unique and patented in-house Acoustic Vector Sensor (AVS) technology.

Based in the Netherlands, Microflown AVISA is an internationally staffed SME spending 70% of efforts on R&D. Next to offering both commercial off the shelf products as well as customized solutions for a global range of customers in defense and security, Microflown AVISA also advises governmental agencies and NATO industry groups in the field of acoustic situational awareness.

Microflown AVISA develops and markets highly innovative and complete battlefield acoustic solutions, providing 3D situational awareness by detecting, localizing and classifying the full range of audible battlefield threats, such as small arms fires, rockets, artillery and mortars and engine driven platforms (heavy ground vehicles, helicopters and UAV's).

8.2.10.1. Key Benefits of AVS

The benefits to the user of the acoustic vector sensing technology are:

- Low power consumption: persistent operations
- Passive: undetectable, flown sensor cannot be jammed
- Acoustic; day & night operations, line-of-sight not required, all-weather (temperature, dust, fog, rain, smoke)
- Inherent directional: small form factor allows miniaturized sensor packaging
- Inherent broadband: simultaneously sensing various threat types having an acoustic signature in low and high frequencies

Microflown AVISA as the leader of the WP6 together with its Greek partner company, CERTH, provides Acoustic Detection System (ADS) for the TeamAware project in which the following objectives will be followed:

- Design of a compact and lightweight georeferenced array of acoustic vector sensor to be installed on a UAV
- Detection and localization of gunshots and explosions
- Detection and localization of people whistling or asking for help (human speech)

The main objective of the ADS of WP6 is to detect and determine the location of explosions or gunshots near first responders. ADS will detect and locate explosions, gunshots, and snipers as well as human voices (e.g., screams asking for help) and whistling in the operations. This is done through an array of acoustic vector sensor and required acoustic signal processing algorithms for rescue purposes. The ADS system can be drone mounted or portable depending on the situation and requirements of end users.

The ADS system will be able to detect and locate the above-mentioned acoustic sources in emergency events (i.e., terrorist attack, search and rescue, natural disasters). An initial implementation of the ADS system will be conducted using commercial equipment by CERTH to prepare and test the relevant algorithms. Then the developed algorithms will be evaluated and modified using a recorded data from an acoustic vector sensor array similar to what it is supposed to be designed and developed for the ADS system. While CERTH will be working on evaluating and developing the algorithms with the recorded data, a prototype of the acoustic vector sensor array with a recording capability will be developed by AVISA to be tested and used on a drone for the system's tests and demonstrations at the end of the project. Figure 1 illustrates a detailed view of the ADS architecture, regarding its software components.

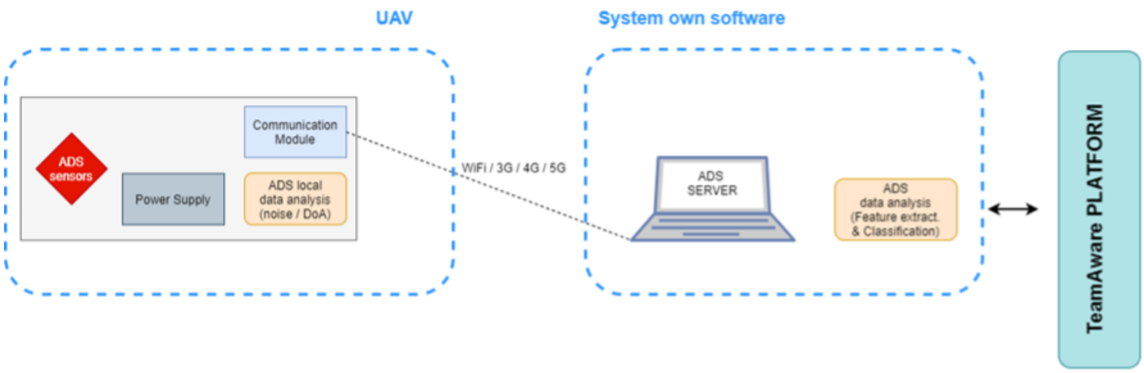


Figure 50 Avisa-1

8.2.10.2. Acoustic Vector Sensor

Acoustic vector sensor (AVS), also called particle velocity sensor is a MEMS based sensor enabling measurements of acoustic particle velocity. The very small sized elements are created on silicon wafers using clean room technology. The sensing element consists of two ultra-thin wires. These wires are platinum resistors that act as temperature sensors. They are powered by an electrical current which causes them to heat up. Local temperature variations cause changes in the wires' resistance. When the sound propagates across the wires, it asymmetrically alters the temperature distribution around the resistors (wires). The resulting resistance difference provides a broad band (20 Hz up to at least 10 kHz) signal with a figure of directivity that is proportional to the acoustic particle velocity. Directivity of a particle velocity sensor (produced by Microflown AVISA) versus a microphone is shown in Figure 2. The Microflown particle velocity sensor provides broad banded directionality, over the entire audio range in the human's hearing range.

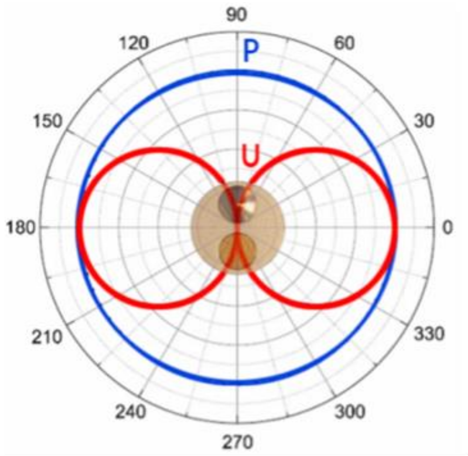


Figure 51 Avisa-**2**

Figure 52 Avisa-3

8.2.10.3. Acoustic Multi Mission Sensor

By combining two orthogonally placed Microflown transducers and a microphone into a single wind and weather proof unit, a so called Acoustic Multi Mission Sensor (AMMS) is created. There are two versions of AMMS, with a 30 cm and 23 cm outer diameters. Reducing the diameter implies an increase in the sensitivity to wind, which is important especially for moving platforms. Each AMMS provides directional information. A figure of an AMMS with wind-cap is demonstrated in Figure 4.

Figure 53 Avisa-4

Dr. Zahra Madadi

Dr. Zahra Madadi is a scientist and signal processing engineer at Microflown AVISA B.V. She joined

Microflown in May 2017 and since then, she is working on developing signal processing algorithms for different applications such as tracking and localization of multiple acoustic sources (UAVs, ground vehicles, gun shots, explosions) using distributed arrays of acoustic vector sensors, and machine learning algorithms for weather parameter estimation. Before joining Microflown, she has worked as a senior researcher at ElpaNav B.V. on developing algorithms for indoor localization using Bluetooth technology.

From Jan 2014 until Dec 2016, she was a post-doc research fellow at school of Electronic and Electrical Engineering of Nanyang Technological University (NTU) in Singapore, working in the field of statistical signal processing in two big projects: one for self-localization and tracking of a moving robot using signals of opportunities for DSTA of Singapore, and the other for autonomous vehicle localization using DSRC (802.11p) and its fusion with data from other sensors (GPS, IMU, Map,..) in collaboration with NXP from the Netherlands.

Zahra received her PhD from school of computer science and engineering in 2013 from NTU in Singapore, in the field of signal processing. During her PhD, she was working on developing nonlinear array signal processing algorithms for detection and localization of weak acoustic sources in shallow ocean in presence of non-Gaussian noise. She has received her BS (Bachelor of Science) and MS (Master of Science) degrees in electronics and telecommunication engineering, from Shahid Beheshti University and K.N.T. University of Technology in Tehran respectively.

Mr Michael Maassen

Mr Michael Maassen is working at Microflown AVISA since Feb 2015. He started as an electrical/test engineer and currently he is the lead of hardware development team. He spends part of his time in the field, being close to the actual shooters and loud explosives with the end-users for real-time feedback, doing field tests, integration projects, ... As a hardware lead team member, he tries to get the most out the hardware team, putting the best people on the right jobs and see them more as co-workers/friends to get the best out of them. He finds it always nice to learn new things and to apply new approaches to solve new problems. Michael received his Bachelor’s degree in electrical engineering from Saxion university of applied sciences in Enschede in 2015.

8.2.11. Citizen Involvement and City Integration System

In this blog post, we introduce the work contributed to the project by Innova Integra Limited. Innova Integra is a research and development-focused SME located on the campus of the University of Reading in the United Kingdom.

Innova Integra participates in TeamAware with the Citizen Involvement and City Integration System CICIS. The purpose of CICIS is to involve citizens during first responder activities and to enable first responders to access IoT devices and systems that are under the control of city or other relevant authorities.

The Citizen involvement component of CICIS is being developed based on the Innova Participation Platform developed by Innova Integra. For TeamAware, this platform will be customized and enhanced in order to provide citizens with the opportunity to provide useful information and reports to first responders in real-time and in order to implement efficient means to improve the safety of citizens by providing relevant information to them to keep citizens safe and outside of dangerous areas.

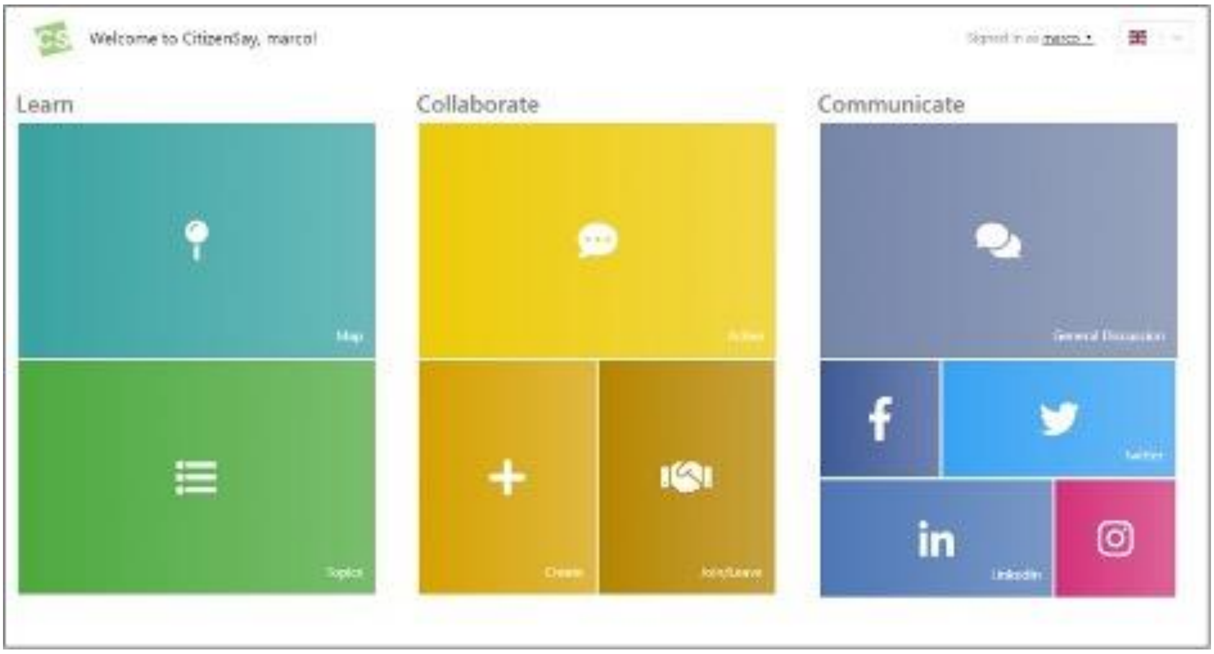


Figure 54 CICIS-1

The City Integration part of the system will integrate a standard IoT integration middleware into TeamAware, so that any device that can communicate via that standard IoT middleware can be accessed through TeamAware in emergency situations. This can for example include weather stations and air quality measurement systems deployed by municipalities or private citizens and building management systems with detailed information on fire alarms and fire countermeasure deployments.

Marco Tiemann

Marco Tiemann coordinates the activities of Innova Integra in the TeamAware project. Marco has extensive experience in both theoretical and applied computer science research and has previously worked at Philips Research Europe and at the University of Reading. Marco has participated in and coordinated activities in over a dozen EU-co-funded research projects to date.

8.2.12. The Luciad (part of Hexagon)

Hexagon is a global leader in digital reality solutions, combining sensor, software, and autonomous technologies. We are putting data to work to boost efficiency, productivity, quality, and safety across industrial, manufacturing, infrastructure, public sector, and mobility applications. Our technologies are shaping production and people-related ecosystems to become increasingly connected and autonomous – ensuring a scalable, sustainable future.

Hexagon’s Safety, Infrastructure & Geospatial division improves the resilience and sustainability of the world’s critical services and infrastructure. Our solutions, including Luciad, turn complex data about people, places and assets into meaningful information and capabilities for better, faster decision-making in public safety, utilities, defense, transportation, and government.

- **We are the global leader in public safety solutions, helping to protect 1 billion people.**

Building on our long-standing leadership in computer-aided dispatch, we provide a public safety platform for data collection, management, analysis, collaboration, and response.

- **We support more than two dozen departments and ministries of national defense.**

  We deliver mapping and imagery intelligence capabilities and enable high-performance, real-time applications for command and control, mission planning and more.

- **We aid government services in more than 100 countries**

  Our geospatial data collection, management and analysis capabilities support land and property administration, census taking, natural resources management, sustainability mobility and more.

- **We ensure safe and efficient transportation for millions of travellers.**

  We support aviation, maritime, rail and road planning, operations and safety, from mapping and maintaining infrastructure to monitoring traffic and services.

Hexagon (Nasdaq Stockholm: HEXA B) has approximately 21,000 employees in 50 countries and net sales of approximately 3.8bn EUR. Learn more at hexagon.com and follow us @HexagonAB.

8.2.12.1. Luciad

The Luciad portfolio is the SDK of choice for building high-performance mission-critical geospatial applications featuring static, dynamic and moving data in 2D and 3D. It is used extensively in defense, aviation, maritime and other sectors and powers solutions for NATO, EUROCONTROL, Lufthansa Systems, Airbus Defence and Space and many other leading organizations. The Luciad software is developed in Leuven (Belgium). Since 2017, Luciad is part of Hexagon, which gives us access to the rest of the resources and infrastructure of Hexagon.

8.2.12.2. Our Role in TeamAware

Hexagon’s contribution to the project focuses on bringing situational awareness to the first responders by visualizing geospatial data in augmented reality (AR) glasses and on mobile devices. Tracking information is combined with sensor data, alarms, and commands from the Command-and-Control Center to bring a common operational picture to the first responders in real time.

With it’s Luciad software, Hexagon has the leading role of Work Package 11 “TeamAware AR/Mobile Interfaces” and is responsible for coordinating the joint effort of the other members of the work package to ensure effective communication, productive collaboration, and a seamless integration of the different building blocks that integrate WP11. We expect to learn and benefit from the expertise of every team member while ensuring a successful completion of the project.

Situational Awareness has been the focus of Luciad since its creation, and for more than two decades we have been shaping this field. TeamAware’s goals are bringing situational awareness to a completely new level.

During the development of WP11, Luciad’s AR interface will bring critical data to the eyes of the first responders so that they are immersed in the mission, making them aware not only of potential threats, but also of helpful assets that can help them to complete their job successfully. The AR glasses will also work as a secondary communication system on top of the existing voice communications, as it will allow sending commands to the first responders to assign missions and tasks to specific members of the team.

Hexagon is also involved in the management of the project, more specifically on the “Innovation & Exploitation” activities. Our proven expertise is backed by more than 20 years of experience in creating successful commercial applications and contributing to multiple research projects including European Commission and OGC projects.

Frédéric Houbie

Frédéric Houbie, Program Director for Digital Reality in Hexagon’s Visual Computing Hub, has joined Luciad (now part of Hexagon) in 2015 after working more than 15 years in the GIS domain industry. Holding a degree in Computer Science from Helmo in Belgium, he has participated in several research projects in FP6, FP7 & H2020 programs. He is leading the Research Projects activity within Hexagon’s Visual Computing Hub. Involved in standardization for 15 years, Mr Houbie has contributed to Open Geospatial Consortium (OGC) with multiple standards defining Geospatial Web Services, Data and Metadata models. He has participated in ISO TC 211 normalization and has joined multiple working groups of experts for the INSPIRE regulation. Since 2010, he has a seat at the OGC Architecture Board. He also joined the DGIWG (Defence Geospatial Information Working Group) early 2018.

Mert Bıçakçı

After graduating from Bilkent University Computer Science department in Turkey, Mert Bıçakçı started working in the Telecoms industry with various GSM operators such as Turkcell and Orange, and with telecom software vendors such as Atos. After working for 6 years in the telecoms industry in different countries including Turkey, Greece, Germany and Israel, he reoriented towards the defence industry in 2004 and worked for several Turkish defence companies for 13 years. Since 201? he is working at Hexagon as a Project Manager for Luciad projects.

David de la Fuente Escobar

David de la Fuente Escobar graduated in Mathematics and Computer Science from the Rey Juan Carlos University in Spain. He has experience on several projects in the GIS domain, such as processing 3D objects to create OGC 3D tiles. He joined Hexagon in 2021 and is currently working as a Research Programmer on the R&D department in Hexagon’s Visual Computing Hub in Leuven (Belgium).

Felipe Carrillo Romero

Felipe Carrillo Romero has joined Luciad (now part of Hexagon) in 2014 after working for more than 10 years in the area of telecommunications. During this time, he worked with fixed and mobile technologies. For the past seven years he has been deeply immerged in the field of GIS while working on several situational awareness projects, serving in different roles including presales, marketing activities and product management. He has been involved in several aviation research projects within OGC. Mr. Carrillo graduated as an Electronic Engineer from UAM in Mexico City and has an MBA from the Vlerick Business School in Belgium. Since 2021 he is part of the R&D department in Hexagon's Visual Computing Hub in Leuven (Belgium).

8.2.13. Public Safety Hub by AIT

Public Safety Hub (PSH) has been developed by AIT Austrian Institute of Technology as a specialized interoperability hub for public safety services. The PSH enables the seamless, scalable, secure, and flexible exchange of information between federated systems of different organizations (both civil and defence IT systems). The PSH helps the stakeholders to improve the cooperation of organizations, and citizens by interlinking services and processes for an effective management of disasters and crisis. Within TeamAware, PSH will be brought to the edge to ensure a reliable and secure communication over instable network connections.

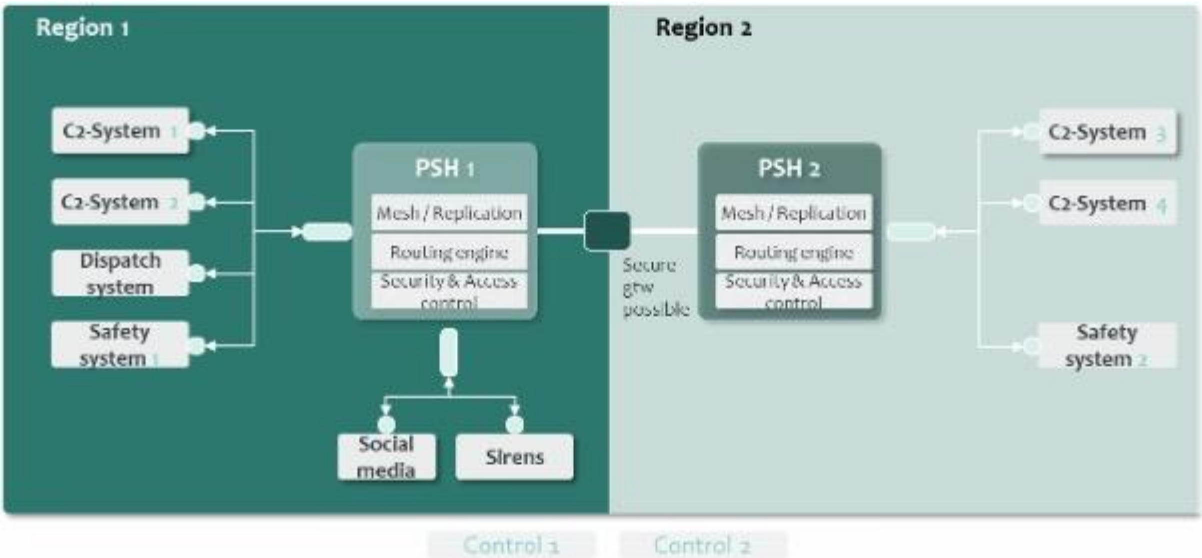


Figure 55 AIT-1

The PSH's federated design reflects the resilience and division of responsibilities needs of the CM and other public safety domains. This is especially reflected in the following design qualities:

Figure 56 AIT-2

8.2.13.1. Targeted Emergency Scenarios

Typical emergency scenarios that PSH targets are ones involving data exchange between multiple stakeholder organisations, such as in Public Warning and Alerting, Cross-Stakeholder Notifications, and assuring the seamless information exchange between command-and-control systems.

PSH is designed as a replacement for a generic Enterprise Service Bus (e.g. Apache Kafka) or custom made legacy information exchange solutions. It relates to Kafka in a similar way that a minibus relates to an ambulance. Both a minibus and an ambulance can transport goods and people, but a minibus is a generic solution that needs to be heavily customized for use as an ambulance, whereas an ambulance is specialised vehicle that provides exactly the features medical first responders need.

Similarly, both PSH and Kafka transport data, but Kafka is a fully generic solution that needs heavy customising, whereas PSH has been designed as a resilient data exchange solution for safety and security domain. Most notably, PSH aims to transport information reliably and securely between multiple organisations even in case of partial network outages, or temporary unavailability of some communication nodes.

8.2.13.2. Use Within TeamAware

In the TeamAware architecture, PSH is used as a secure gateway that ensures data exchange between systems and organisations, whereas Kafka will be used to exchange the data between applications running on the same system. PSH will therefore be extended and improved in the following ways:

1. PSH-edge (or "PSH light") version of the service will be developed to allow deploying of *PSH on devices with limited computational power*– most notably on sensor gateway devices.
2. Capability of PSH to gracefully handle network and system outages as well as data transport over unreliable channels will be extended to better support highly dynamic situations, e.g. data exchange over ad-hoc wireless networks where several networks with different capabilities and security levels may be available in parallel and some of them are likely to experience ruptures during emergency.
3. Further increase in security of data exchange, to meet the needs of network-centric safety and security applications using ad hoc and mashed wireless networks.

One of the key anticipated features to be implemented in TeamAware is a mechanism for handling the network degradation by prioritising the network traffic according to relative importance and urgency of the data packages.

Dr. Mag. Denis Havlik

Dr. Mag. Denis Havlik holds a PhD in natural sciences from University of Vienna, Austria. He joined the AIT Safety and Security department in 2005, and successfully participated in multiple European research projects related to environmental informatics, crisis management and Climate change – mostly as coordinator, technical/scientific lead, or part of the core project team. Denis acts as a primary point of contact for AIT in TeamAware.

Andrés Carrasco

Andrés Carrasco holds a Master of Computer Science degree from University of Antwerp, Belgium. Since 2020, he works as a lead engineer at the AIT Austrian Institute of Technology focusing on cooperative systems, such as interoperability solutions and distributed sensor networks. In TeamAware, Andrés acts as a main developer of Public Safety Hub.

8.2.14. AR/VR Techologies Adopted for First Responders and Emergency Cases

The increase in the amount and type of data related to emergency cases pose continuous challenges to first responders, who mainly consist of firefighters, emergency medical services, and law enforcement agencies. As equipped with specialized skills and qualifications, they are the groups of people, services and organizations whose duty is to arrive first to the emergency zone, carry out rescue operations, and perform crisis management in natural or human-made disasters. Usually, the characteristics and nature of such emergency cases are quite complicated. On the other hand, as the existing information communication technology suffers from fragility and unstable connectivity, the adaptation of advancement of latest computer technologies in the emergency-related scenarios are far from the satisfactory level.[2]

Recently, there emerged some recent achievements focusing on adopting the latest technologies of augmented reality (AR) and virtual reality (VR) to serve first responders. Wang et al. proposed an AR system designed to facilitate the control of rescue robot and explore unknown environments for urban search and save operations[1]. Based on simultaneous localization and mapping (SLAM) technology with RGB-D camera, their system first runs to get the position and posture of the rescue robot. Subsequently, they used a deep learning-based algorithm to obtain the target location, place an AR marker in the global coordinate and display it on operator screen to indicate the target even when it is out of camera view. Park et al. presented an AR-based emergency management system for fire safety route guidance[2]. Their system can acquire visibility and grasp occupants in case of fire disasters in buildings, and provide visualization information and optimal guide for quick initial response using smart element AR-based disaster management service through linkage of physical virtual domain in the building. Hu et al. developed a high scene-rendering frame rate to achieve better immersion and prevent users from feeling dizzy in disaster scene simulation[3]. In their study, they designed a plugin-free browser/sever (B/S) architecture for 3D disaster scene construction and visualization based in mobile VR, and focused on the construction and optimization of a 3D disaster scene to satisfy the high framerate requirements for the rendering of 3D disaster scenes in mobile VR.

[1]Runze Wang, Huimin Lu, Junhao Xiao, Yi Li, and Qihang Qiu, “The design of an augmented reality system for urban search and rescue”, IEEE International Conference on Intelligence and Safety for Robotics (ISR), 24-27 Aug. 2018. DOI: 10.1109/IISR.2018.8535823

[2]S. Park, S.H. Park, L.W. Park, S. Park, S. Lee, T. Lee, S.H. Lee, H. Jang, S.M. Kim, H. Chang, and S. Park, “Design and implementation of a smart IoT based building and town disaster management system in smart city infrastructure”, Applied Science 2018, 8(11). https://doi.org/10.3390/app8112239

[3]Y. Hu, J. Zhu, W. Li, Y. Zhang, Q. Zhu, H. Qi, H. Zhang, Z. Cao, W. Yang, and P. Zhang, “Construction and optimization of three-dimensional disaster scenes within mobile virtual reality”, ISPRS International Journal of Geo-Information, 7 (2018). https://doi.org/10.3390/ijgi7060215

Meanwhile, AR/VR serves as an effective approach to reproduce a disaster scene such that information can be extracted from the virtual environment for safety assessment. For this regard, safety training based on AR/VR is another significant application in this field. Virtual simulations of complex situations can enable trainees to grasp a comprehensive understanding of safety issues[4]. Gong et al. designed an earthquake evacuation education system and conducted a virtual dormitory earthquake[5]. Boulos et al. studied the possibility of applying a VR geographic information system (GIS) in emergency training[6]. Pham et al. used VR interactive safety education and building anatomy modeling to instruct students safety operatio[3]ns knowledge[7]. Lovreglio et at. presented a comparison of effectiveness of fire

[4]D. Lorenz, W. Armbruster, C. Vogelgesang, H. Hoffmann, A. Pattar, D. Schmidt, T. Volk, and D. Kubulus, "A new age of mass casualty education? The InSitu project: realistic training in virtual reality environments", Anaesthesist 65 (2016), pages 703-709. https://doi.org/10.1007/s00101-016-0196-x

[5]X. Gong, Y. Liu, Y. Jiao, B. Wang, J. Zhou, and H. Yu, "A novel earthquake education system based on virtual reality", IEICE Transactions on Information Systems, E98D (2015) 2242-2249.https://doi.org/10.1587/transinf.2015EDP7165

[6]M.N.K. Boulos, Z. Lu, P. Guerrero, C. Jennett, and A. Steed, "From urban planning and emergency training to Pokemon Go: applications of virtual reality GIS (VRGIS) and augmented reality GIS (ARGIS) in personal, public, and environmental health", International Journal of Health Geography. 16 (2017).https://doi.org/10.1186/s12942-017-0081-0

[7]H.C. Pham, A. Pedro, Q.T. Le, D.Y. Lee, and C.S. Park, "Interactive safety education using building anatomy modelling", Universal Access in the Information Society, 18, 269-285 (2019).https://doi.org/10.1007/s10209-017-0596-y

[8]R. Lovreglio, X. Duan, A. Rahouti, R. Phipps, and D. Nilsson, "Comparing the effectiveness of fire extinguisher virtual reality and video training", Virtual Reality (2020).https://doi.org/10.1007/s10055-020-00447-5

[9]F. Meng, and W. Zhang, "Way-finding during a fire emergency: an experimental study in a virtual environment", Ergonomics 57 (2014), 816-827. https://doi.org/10.1080/00140139.2014.904006

[10]E.M. Bourhim, and A. Chekaoui, "Efficacy of virtual reality for studying people's pre-evacuation behavior under fire", International Journal of Human-Computer Studies, vol: 142, (2020).https://doi.org/10.1016/j.ijhcs.2020.102484

[11]B.F. Goldiez, A.M. Ahmad, and P.A. Hancock, "Effects of augmented reality display settings on human wayfinding performance", IEEE Transactions on Systems, Man, and Cybernetics, Part C (Applications and Reviews), vol:37, issue: 5, September 2007.https://doi.org/10.1109/TSMCC.2007.900665

[12]Z. Xu, X.Z. Lu, H. Guan, C. Chen, and A.Z. Ren, "A virtual reality-based fire training simulator with smoke hazard assessment capacity", Advances in Engineering Software, vol: 68, pages: 1-8, February 2014. https://doi.org/10.1016/j.advengsoft.2013.10.004

[13]F. Dai, S. Dong, V.R. Kamat, and M. Lu, "Photogrammetry assisted measurement of inter-story drift for rapid post-disaster building damage reconnaissance", Journal of Nondestructive Evaluation, 30 (2011) 201-212. https://doi.org/10.1007/s10921-011-0108-6

[14]S. Dong, C. Feng, and V.R. Kamat, "Sensitivity analysis of augmented reality-assisted building damage reconnaissance using virtual prototyping", Automation in Construction, vol: 33, pages: 24-36, August 2013. https://doi.org/10.1016/j.autcon.2012.09.005

[15]W. Kim, N. Kerle, and M. Gerke, "Mobile augmented reality in supporting of building damage and safety assessment", Natural Hazards and Earth System Sciences, vol: 16, pages 287-298, February 2016.https://doi.org/10.5194/nhess-16-287-2016

[16]A.H. Behzadan, S. Dong, and V.R. Kamat, "Augmented reality visualization: a review of civil infrastructure system applications", Advanced Engineering Informatics, vol:29, issue:2, pages: 252-267, April 2015.https://doi.org/10.1016/j.aei.2015.03.005

extinguisher trained with VR and video, and concluded that people trained with VR obtained better score in knowledge acquisition and self-efficacy[8].

On the other hand, AR/VR-based applications gained tremendous attention in the emergency response research area during the last several years. Meng et al. discovered that a virtual environment with smoke and virtual fire can induce participants to experience higher physiological and psychological stress. Their study focused on how to improve the emergency simulation quality in a VR experiment, and better simulate a real fire situation[9]. Bourhim et al. proposed a holistic evaluation system to measure the efficacy of VR simulation of fire, and concluded that VR simulation could be both realistic and engaging[10]. Goldiez et al. evaluated rescue navigation training using an AR map. Their results indicated that compared with a traditional paper map or a compass, an AR map can promote wayfinding performance in search and rescue[11]. Xu et al. used a VR-based fire training simulator for smoke hazards in a fire[12]. One of their training scenarios was fire rescue in a primary school, and they utilized VR to train firefighters to choose a safer path to rescue a trapped pupil.

There are also some studies focusing on employing AR/VR technology for post-emergency recovery, which mainly includes damage detection and building reconstruction, to take measures to assess the disaster damage and rebuild the buildings in the affected areas. In such cases, AR/VR can help better understand the condition of a building and plan the way to rebuild it. Dai et al.[13] investigated the application of AR visualization to inter-story drift measurement through photogrammetry to extract the information from an image and measure the inter-story drift through the generated data. Dong et al.[14] carried out inter-story drift measurement based on AR technology. They used an AR algorithm to superimpose the baseline on a structure and detect building edges to avoid pre-installation of infrastructure. Authors in[15] employed mobile AR for rapid status assessment of a building after earthquakes due to its advantages when measuring structural integrity and specific damage status.

At the same time, some other studies focused on utilizing AR/VR technology in the emergency [4]management field. Visualization enhancement can improve the learning ability of users, transfer the complex knowledge conveniently, and demonstrate abstract concepts to them[16]. Such advantages are

[17]S. Arias, R. Fahy, E. Ronchi, D. Nilsson, H. Frantzich, and J. Wahlqvist, "Forensic virtual reality: investigating individual behavior in the MGM Grand fire", Fire Safety Journal, vol: 109, October 2019. https://doi.org/10.1016/j.firesaf.2019.102861

[18]H. Li, J. Zhang, L. Xia, W. Song, and N.W.F. Bode, "Comparing the route-choice behavior of pedestrians around obstacles in a virtual experiment and a field study", Transportation Research Part C: Emerging Technologies, vol:107, pages: 120-136, October 2019.https://doi.org/10.1016/j.trc.2019.08.012

[19]L. Chittaro and R. Sioni, "Serious games for emergency preparedness: evaluation of an interactive vs. a non-interactive simulation of a terror attack", Computers in Human Behavior, vol: 50, pages 508-519, September 2015. https://doi.org/10.1016/j.chb.2015.03.074

[20]First responder augmented reality test bed, project description available at: https://www.nist.gov/ctl/pscr/funding-opportunities/past-funding-opportunities/psiap-augmented-reality/first-responder

[21]Augmented Training Systemshttps://www.augmentedtrainingsystems.com

[22]Edgybeeshttps://www.edgybees.com

beneficial to applications in emergency management, such as safety training and hazard identification, because they help participants better understand what my happen and what should be done in emergencies. Together with visualization, AR/VR can also be used as bidirectional interactive tools between humans and computers. Arias et al.[17] used VR to simulate a fire scene in a hotel and provided several items that the participants could interact with, such as chairs that can be picked up and moved, pillows and towels that can be wetted and used to block smoke vents, telephones that produce dial tones, and windows that open and close. Li et al.[18] designed a virtual escape experiment involving people and obstacles when investigating escape route finding behavior. Another important aspect in AR/VR-based bidirectional interaction is observing how the virtual environment influences participant's behavioral modes and mental states in emergencies[19]. Emergencies simulated in a virtual environment is proven to influence participants' behavioral modes. The basic collection method for behavioral modes includes recording the time, distance, and route in the virtual environment. In addition, the mental state in a virtual emergency scene is also significant for researching the interaction effect.

Besides, there also exist some state-sponsored projects focusing on employing AR/VR technologies in emergency cases. In April 2021, the Research Triangle Institute (RTI) was awarded a $750K to develop a user-centered persistent first responder AR (FRAR) test bed[20]; they aim to create and support a market for public safety user interfaces (UIs) through improvements of existing AR technologies for firefighters, emergency medical services (EMS), and law enforcement operations and tasks. There are also some commercial-level companies that focus on using AR/VR for first responder training[21], or search and rescue operations[22].

8.2.14.1. About Sabancı University – BAVLAB

At the national level, SU has received the highest number of EU funded projects per faculty member, taking part in 20 FP6 projects, 53 FP7 projects including 37 Marie Curie Grants, Cooperation Projects and 4 Capacities Projects. In H2020, SU has been involved in 13 funded projects. SU also has a commendable performance in the EU funded education programs, with 5 Jean Monnet European Modules, 3 Jean Monnet Chairs Ad Personam and 1 Jean Monnet Centre of Excellence. These European grants constitute about 18% of the SU's total budget for research.

Sabanci University's Behavioral Analytics & Visualization Lab (BAVLAB) will be representing Sabanci University in this call. The main goal of BAVLAB is to conduct research on Big Data Analytics for understanding human behavior and data analytics as well as visualizing Big Data in many diverse settings. Since 2015 the lab has got funded by research grants, corporate funding and sponsorship. The researchers of the lab pursue collaborations or partnerships with companies in different sectors, such as Telecom, Finance, Retailing, Energy and Healthcare, where large datasets or Big Data are involved. The lab currently hosts 2 Faculty Members, 2 Visiting Researchers, 2 PhD students, 6 Master's students at Sabancı University. In 2020 BAVLAB presented research results at more than 15 international conferences and journals. In this project, BAVLAB with the lead of Prof. Balcisoy will contribute in designing and developing visual analytics systems for large spatio-temporal datasets and trajectories where Prof. Balcisoy and his team has an extensive track record of publications and enterprise level projects.

8.2.14.2. SU in TeamAware

Based on HMI displaying refined, filtered, and managebale common situational awareness picture, Sabancı University will take part in the development of AR-enhanced user interfaces (UI) to present redefined information to the first responders during the TeamAware project.

Besides, together with other partners, SU will also make contribution to the validation of TeamAware platform in terms of defined performance metrics (correct display of data received from sensors in the field, successful fusion of collected data, resultant Common Situational Awareness Picture approved by first responders) with respect to related requirements.

Prof. Selim Balcısoy

Prof. Dr. Selim Balcısoy graduated from ETH Zurich in Electronics Engineering in 1996. In 2001, he completed his PhD on "Analysis and Development of Interaction Techniques between Real and Virtual Worlds" in the field of Computer Science in EPFL Lausanne. He worked on mobile graphics as a senior research engineer at Nokia Research Center (USA) between 2001-2004. He has been working as a faculty member at Sabancı University since 2004. Dr. Balcısoy established the Behavioral Analytics and Visualization Laboratory (BAVLAB) jointly with MIT Media Lab in 2015. Two technopark companies were established within BAVLAB and more than ten industry supported research projects were successfully completed. Dr. Balcısoy's research areas are: Data Analytics, Visual Analytics, Machine Learning, Augmented Reality, Virtual Reality, Cultural Heritage and Mobile Graphics. He has publications in more than 80 international refereed journals and conferences, 2 IBM Research Awards, one TÜBİTAK Career Award and one US patent office patent.

Ekberjan Derman

Ekberjan is currently pursuing his PhD degree in computer science at Sabancı University. After obtaining his M.Sc degree in Electrical & Electronics engineering from Boğaziçi University, he gained more than seven years of industrial experience in AI & ML. Together with publications, he has participated in two EU projects, proposed & conducted two national projects, led & developed two commercial products. His current research interests include: machine learning, deep learning, data visualization, crowd capturing, behavioral analysis, computer vision, and data mining.

8.2.15. Validation Scenarios

As part of the overall roadmap of TeamAware, the whole set of solutions developed in the project will be tested and evaluated in dedicated demonstrations. There will be a mid-term demonstration at month 18, focused on validation of standalone systems and components, and a final demonstration and tests of version 2 TeamAware software at month 36, which will entail the global evaluation and validation of the project.

As a preliminary step for the final demonstration, one of the recent tasks performed by TeamAware's Work Package 2 has been the elaboration of detailed demonstration scenario scripts, per-system scenario requirements, and evaluation methodologies. Two demonstration scenarios have been considered, providing a good representation of the complexities found in real life, and covering the entire set of hardware and software systems of the project.

The first scenario features a natural disaster leading to a technological disaster. There will be multiple types of incidents such as fire and smoke in a subway, victims, human screams, etc. It will involve damaged buildings, human victims, gas leakage, and fire and smoke in an underground. The scenario is planned in the BursaRay metro line, which is an important means of transport in Bursa city. The 39-km-long line is used by 250.000 passengers on a daily basis. Overall, the tunnel is 900 meters long.

An explosion takes place at the 530th meter of the tunnel's entrance, and the emergency exits are located at the 450th meter of the tunnel. The main goal of the scenario is, therefore, to rescue the citizens trapped in the tunnel.

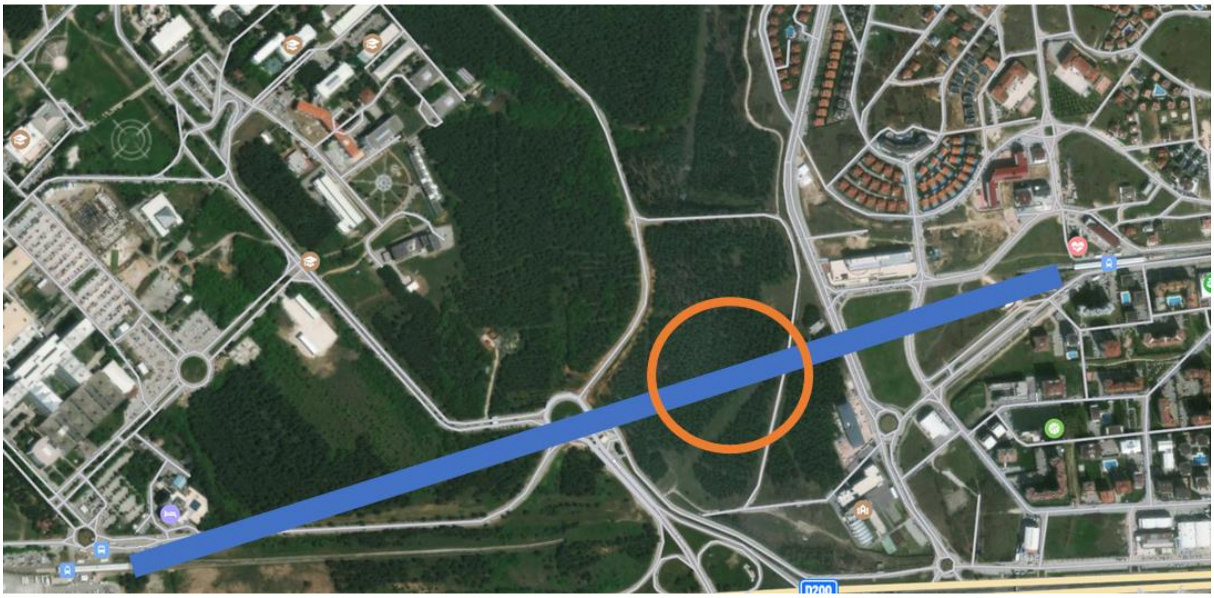


Figure 57 Validation Scenarios-1

The second scenario is planned at the city centre of Bucharest, in a crowded area with high volumes of traffic, near offices and residential areas. The great variety of buildings surrounding the venue (e.g. from older with a high degree of degradation to newer buildings, from one level houses to 20-storey apartment buildings, from local stores to factories, etc.) is also a factor to take into consideration. On the same day of an international summit, a terrorist attack with further incidents (e.g. explosions, toxic chemical attacks) will take place, some of which can only be detected once first responders have arrived at the scene.

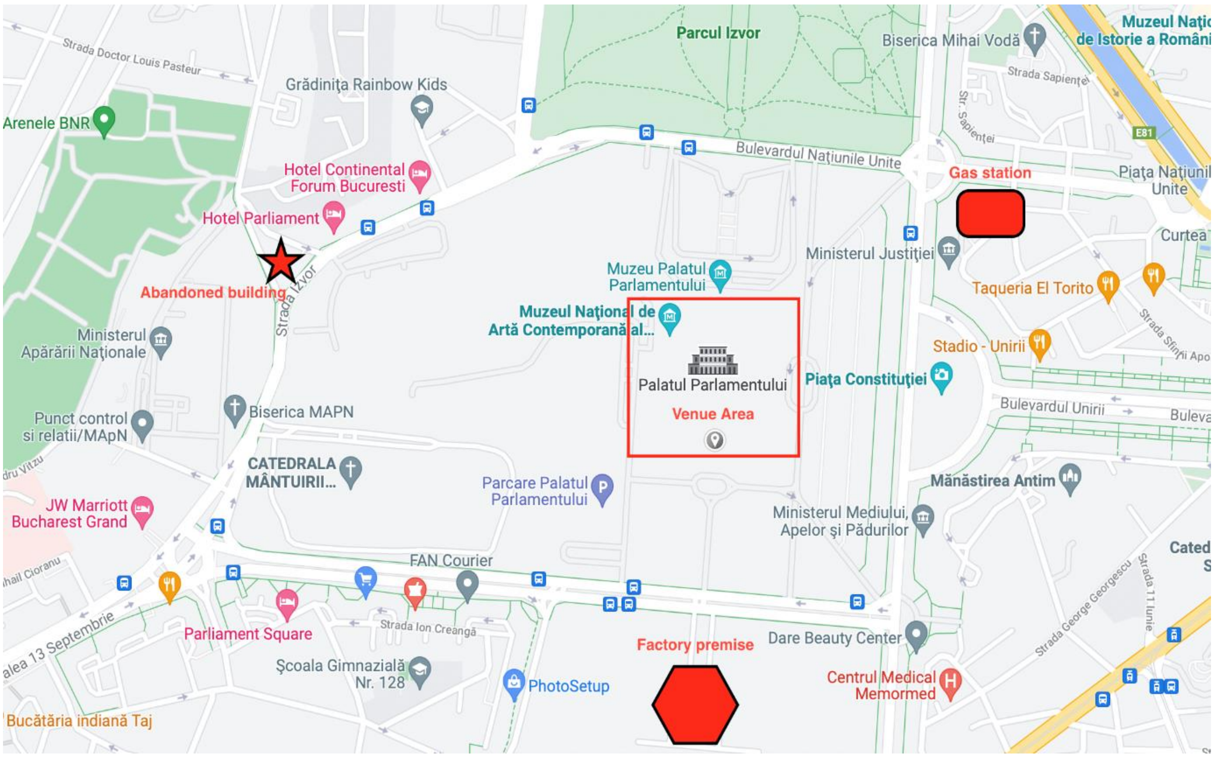


Figure 58 Validation Scenarios-2

The adopted methodology for demonstrations evaluation is based on the Trial Guidance Methodology (TGM), which has gained broad acceptance within the IT community, and which is at high scale composed by three consecutive phases: preparation, execution, and evaluation. Within the preparation phase, among others, the Gaps and Research Questions are identified with the help of the end users. Then scenarios are then formulated in detail for each TeamAware system. For the data collection phase, basic data sets per system are defined together with a set of project-wide KPIs which, in the Evaluation phase, will be calculated for each system to give an answer to the Research Questions. Finally, for each demonstration scenario, some requirements for the TeamAware systems are specified and mapped to the Gaps defined per scenario.

8.2.16. Mobile Interface by ENIDE

ENIDE is an SME specialised in business innovation and digital solutions. Through innovation based on deep customer insights, the company helps clients and partners to understand and implement the latest ICT solutions to meet the most pressing challenges in Mobility, Automotive and Logistics sectors. The highly skilled team has decades of collective experience creating solutions that help projects and companies to remain competitive by leveraging technology and adopting sustainable business models.

TeamAware project develops a system of global support for rapid intervention teams in different sectors, in an integrated and cost-effective manner; the project incorporates heterogeneous and interoperable sensors and reconnaissance technologies (sensory steps, wearables, external sensor systems, services of existing equipment and operating centres).

TeamAware focuses on three main challenges:

- Real-time localisation and real-time monitoring of first responder team members
- Detection of Surrounding Risks and Threats
- Information Fusion and Comprehensible User Interfaces:

Concerning the third challenge, Information fusion will be achieved by applying Artificial Intelligence (AI) to detect, identify and classify the information to generate detailed common situational awareness picture. As for the Comprehensible User Interfaces, Enide develops a **Mobile user Interface (MI)** that will provide to the First Responders teams additional relevant information about the operations related to emergency scenarios, facilitating the communication with the Command Center.

8.2.16.1. Mobile Interaction and HMI

The TeamAware ultimate purpose is to improve crisis management, flexibility and reaction capability of teams from different sectors through real-time, merged, refined, and filtered information management, using highly standardised person-machine interfaces, and augmented reality and pro-active support from technology.

The aim of the **Mobile Interface (MI)** is to support the team members deployed in the field of an incident scenario, complementing the Augmented Reality (AR) Interface, giving proactive access to the most relevant information to them. Users must be able to easily find information in real time to make decisions in different scenarios.

It is foreseen that facilitating human interaction with the Mobile Interface is a priority: therefore, Enide will build the TeamAware MI application following the UX Laws below.

- Hick’s Law: the time it takes to make a decision, increases with the number and complexity of choices.
- Aesthetic-Usability Effect Law: users often perceive aesthetically pleasing design as design that’s more usable.
- Fitts’s Law: the time to acquire a target is a function of the distance to and size of the target.

As responsible for the MI, Enide oversees developing a tool focused on the user experience (UX) to help first responders to access real-time information of the environment (from drone cameras, team members health status, position, and tracking, etc) and give them all the information needed to enhance their performance at an emergency.

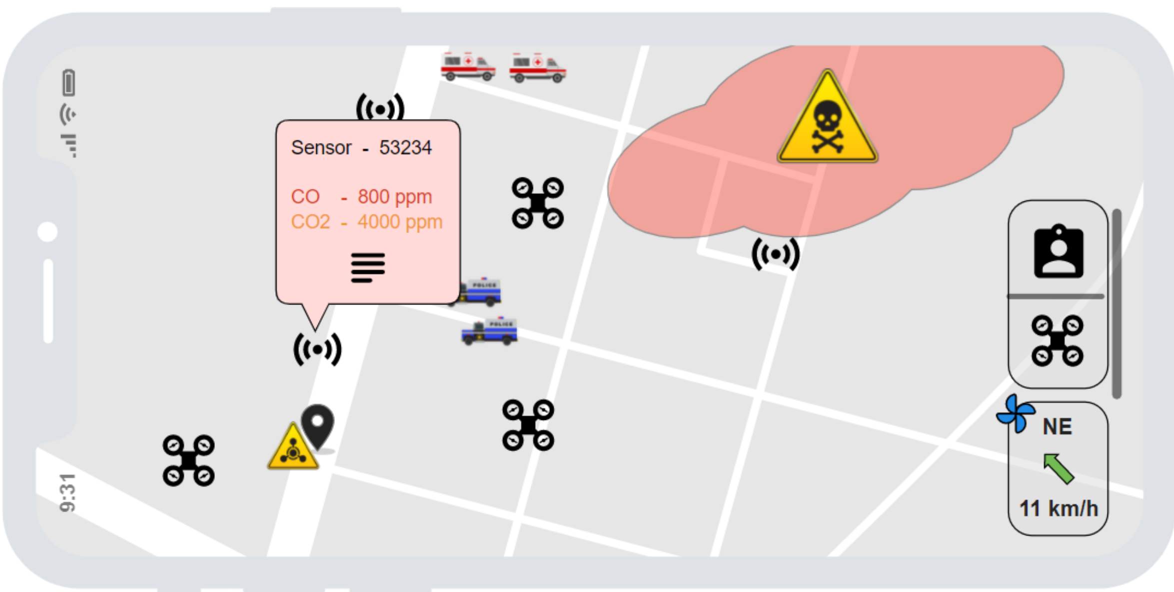


Figure 59 Mobile Interface by ENIDE-1

To facilitate the interaction with the team member, the device will be worn horizontally on the user's forearm so it can be operated efficiently and quickly to communicate with control centre.

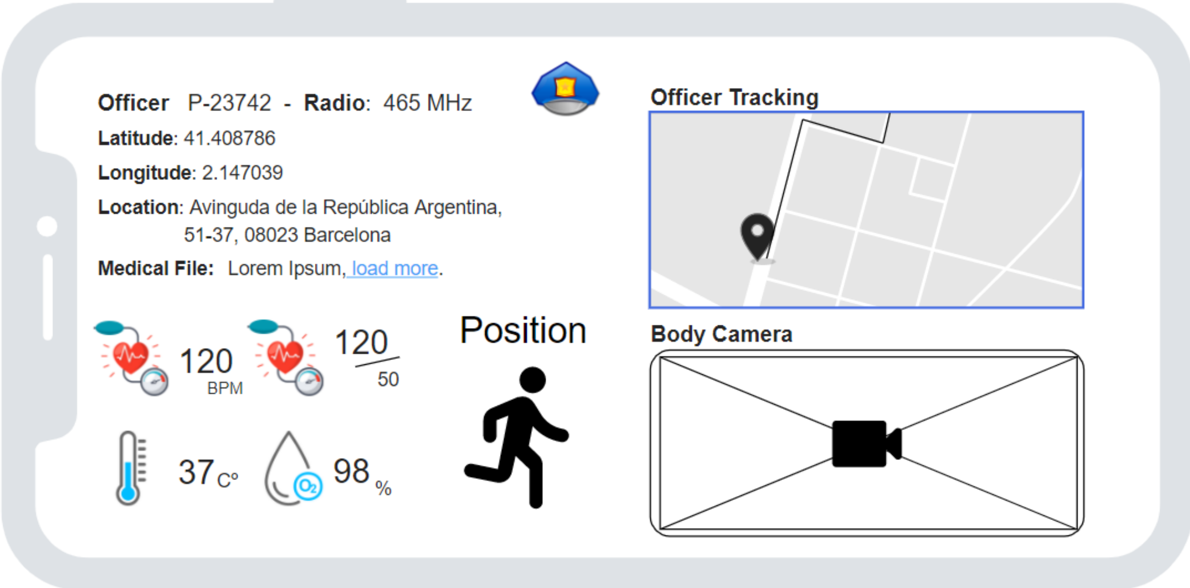


Figure 60 Mobile Interface by ENIDE-2

As part of the TeamAware global architecture design, the team of experts of ENIDE works on the one hand, to complement AR components to provide teams with additional event details with multi-purpose sets of information such as performance plans and material descriptions, among others.

On the other hand, with the TeamAware AI-boosted platform where multiple data sources converge (as sensors, cameras, etc). The MI must organize the information according to the type of situation that the user is attending, providing access to the required essential information for the teams under extreme conditions (stress, visibility, accessibility, speed, etc.).

David Quesada

Technical Director CTO & Co-Owner, Degree in Computer engineering

Focused on innovation for CCAM, mobility, logistics and agri-food sectors for the last 15 years, having a lead role in several R&D projects as H2020 TeamAware (Integrated and cost-efficient situational awareness system for first responders); H2020 DIGITBrain (Easy access to Digital Twins for SMEs); H2020 5G-Routes (5th Generation connected and automated mobility cross-border EU trials); H2020 INFRAMIX (Automated driving); H2020 Clusters 2.0 (Logistics); and others. Before founding ENIDE, he had lead roles in the building of complex IT systems for the Athens 2004, Torino 2006, and Beijing 2008 Olympic Games.

Ignacio López

Senior developer specialized in Python and C+

He currently works at Enide as a Software architect and Senior developer in the TeamAware, 5GRoutes and DIGITBrain projects. He began working in CTAG at 2013, developing different projects like, PSA Peugeot Citroën autonomous driving program (MobiLAB), and European smart roads/cities

(SISCOGA/Co2perautos2/Compass4D). He also was part of the modernization of systems and infrastructures in Barcelona transport (T-Mobilitat) team at INDRA. Other projects that he worked on include the development of an EV onboard charger at Ficosa for the Mercedes-Daimler group and a facial recognition application for UOC (Universidad Oberta de Barcelona)

Armand Carreras

Junior Full-Stack Developer

Credits in Computer engineering (UPC), Bootcamps in Front & BackEnd Development. Focused on HUM@N, Logicon and TeamAware Projects. Before working for ENIDE, he had worked for Linucleus as UI/UX designer.

8.2.17. Situational Awareness Platform – Part 1: Data Fusion

Within the TeamAware System, the Situational Awareness Platform acts as the central data aggregation system, where every data collected with all the TeamAware Sensor Systems are brought together to one situational awareness picture, which can be accessed by the mission operators directly and by the first responders on field.

Within the platform, all the data and information gained is organized in a common database that contains raw data but also processed data and knowledge gained by fusing some of the data incidents to get easy access to a very complex overall situational picture. Included in the platform is also an AI-based decision support system to help operators and first responders decide which could be the next logical steps to take in a very complex situation.

The first development step in that direction is the database itself (coming up in a later blog entry), but also the data fusion modules integrated into the platform system.

The different data fusion capabilities are set up as singular modules to make them interchangeable and to give the possibility to add further data fusion modules. As new sensor systems are added and make new data types available for the system and as research gets farther in that topic they can be easily added into the system. This structure also serves the purpose to make the information more easily accessible by any information point within the TeamAware system like the operation center or the wearable information systems like the AR glasses or the mobile devices of the first responders themselves.

There are single data type data fusion modules, which are mainly for correlating and synchronizing the same type of data coming in from different sensor systems, mostly geographical and time-related reference data. With this, a Personnel Localization Enhancement (PLE) will be set up to provide very accurate position data on every first responder on the field.

On the other hand, there will also be data fusion of multi-sensor data points with correlation in geographical and time reference stamps. For one this is the MuFASA System (Multimodal Fusion Architecture for Sensor Applications) wherein high-level data and identified events are put into correlation concerning their geographical and timely closeness to each other. It tracks important events via bringing different incidences and alarms together, shows codependences and weights confidences of the different data gained to give a more in-depth situational awareness. This helps to reduce false alarms and aims to vastly increase the confidence of high-level detection events by essentially confirming them through different sensor modalities.

Additionally, a Sensor Information Density System (SID) is set up to keep track of all the incidences and alarms raised and their time and spatial relation as well as their degradation over time or their repeated occurrence. Hereby, the main objective of SID is to work on data of any processing level to provide essential knowledge about sensor coverage and information reliability in an easy but comprehensive way.

Lastly, an Incident Based Path Proposal (IBPP) is calculated in case of a staggered deployment of first responders to give later coming teams or personnel an as-secure-as-possible way to the location they are needed at. This is based on the information gained within SID and MuFASA but also takes into account knowledge of paths taken of first responder groups that have reached the point of interest before.

Through the course of the project, as the system gets set up and further developed, additional ways of combining data to enhance the knowledge base for the operation can and will be implemented within the TeamAware Situational Awareness Platform.

Figure 61 Data Fusion-1

8.3. Newsletters

8.3.1. Welcome to TeamAware (Aug 2021)

We are thrilled to set ourselves on this Horizon 2020 Research and Innovation Action project, under the call H2020-SU-SEC-2019 (SU-DRS02-2018-2019-2020) – Technologies for first responders, (total budget of 6,964,702 EUR) for the next three years (May 2021 – Apr 2024).

The main objective of the TeamAware Project is to develop an integrated and cost-efficient situational awareness system for first responders from different sectors with heterogeneous and hardly interoperable sensor units including drone mounted, wearable, and external sensor systems.

First responders are the groups of people, services and organizations with specialized skills and qualifications whose duty it is to arrive to the emergency zone first, search, save and rescue operations, and perform crisis management in natural or human-made disasters. Although first responders provide secure and safe societies by protecting the communities, responding to the disasters, and rescuing lives, they often use inefficient, weak and obsolete technologies in the operations. With respect to the current situation, the operational capabilities of the first responders can be dramatically boosted by the advances in technology and engineering fields such as smart sensor systems, wearables, data processing, data fusion, data analytics, communication infrastructure, and artificial intelligence tools.

In this respect, TeamAware will enhance crisis management, flexibility and reaction capability of first responders from different sectors through real time, fused, refined, and manageable information by using highly standardized augmented reality and mobile human machine interfaces.

Our consortium is composed of 24 private and public organizations from 13 different countries, with HAVELSAN (Turkey) as the technical coordinator and SIMAVI (Romania) as the administrative coordinator. We count on first responder service providers and managers, experts in digital development of emergency management solutions and experts in IoT (Sensor) deployment and evaluation. The well-balanced TeamAware consortium is our strength to achieve the main goal of the project.

We invite you to get acquainted with the TeamAware project and get the latest updates on the project progress via our newsletter!

8.3.1.1. Events

The project's kick-off meeting was held online on 5-6 May 2021 with about 70 researchers from 13 difference countries.

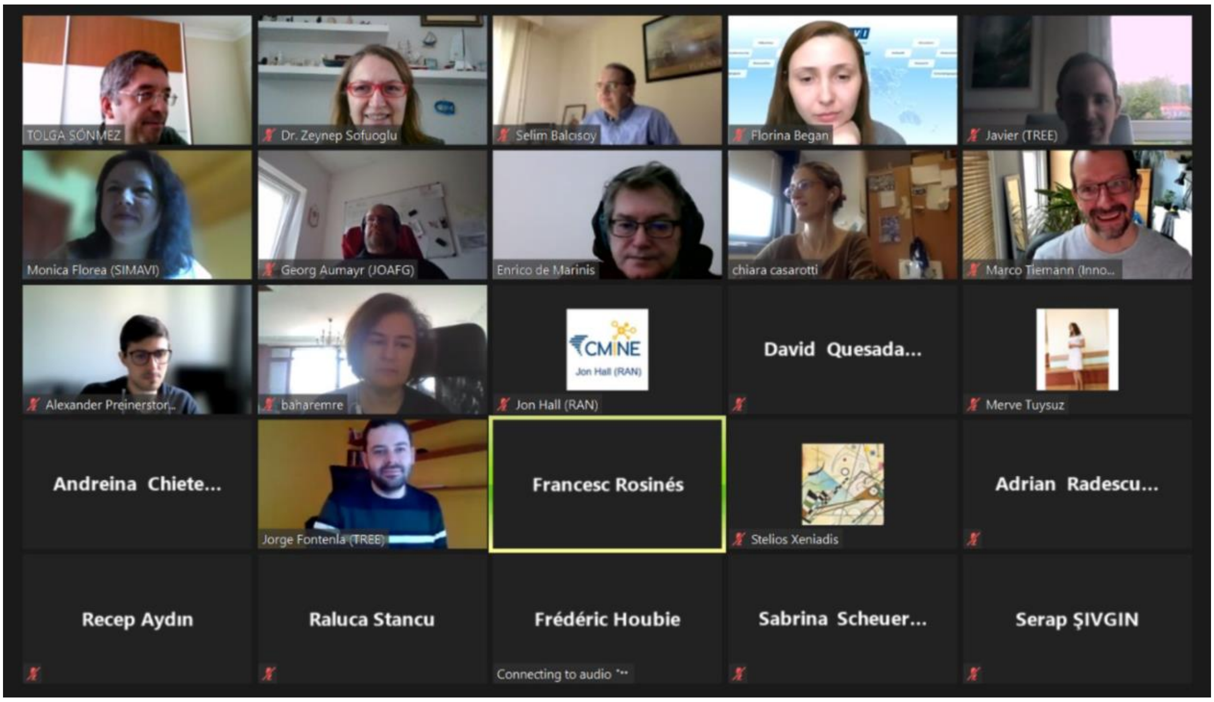


Figure 62 Newsletter Aug 2021-1

8.3.1.2. Who is Involved?

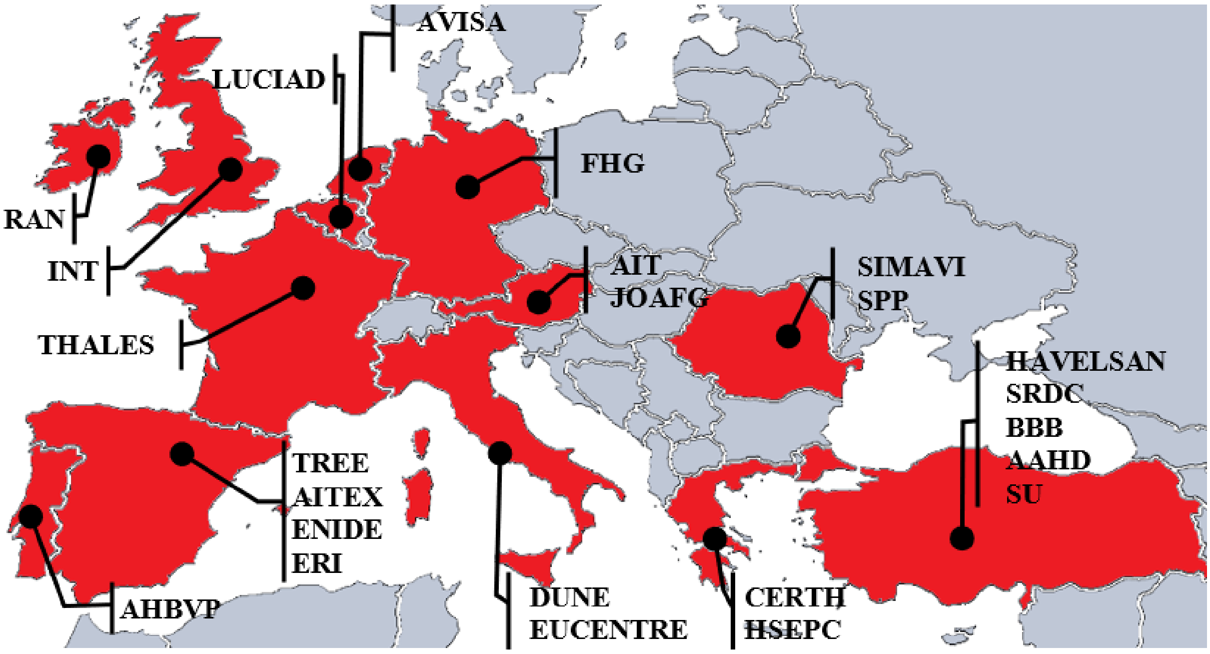


Figure 63 Newsletter Aug 2021-2

There will be two demonstrations, namely "natural disaster" and "human-made disaster" in real environment so that participating end users will deploy, test and measure the performance under real conditions with direct participation of the end users. The TeamAware consortium brings into play the expertise from different specializations under sensor network, fusion, data processing, AI, interoperability, AR etc. There are also 7 first responder organizations (2 fire fighters, 3 medical first responders, 1 LEA and 1 resilience advisor network) participating as full partners. The strong involvement of the end-users and organizations as full partners provides the project with coordination and expertise on the first responder operations. Main expertise areas of each partner and complementariness among them are summarized, below:

Participant		Type*	Main expertise areas and competences	Main contribution in the Project
1	HAVELSAN	IND.	High-tech sensor and modelling technologies	Technical Coord., chemical dispersion modelling and team activity monitoring systems
2	TREE	SME	Computer vision, machine learning	System architecture design and analysis
3	THALES	IND.	Computer vision, environmental modelling	Visual scene analysis system

Participant		Type*	Main expertise areas and competences	Main contribution in the Project
4	EUCENTRE	RI.	Computer vision, structure risk analysis	Infrastructure monitoring system
5	AITEX	RI.	Chemical agent detection systems, wearables	Wearable chemical detection system
6	AVISA	SME	Acoustic signal processing system	Acoustic event (gunshot) detection system
7	DUNE	SME	Indoor localization systems	Outdoor/indoor localization system
8	INT	SME	Computer science, artificial intelligence	Citizen and city integration system
9	SRDC	SME	Communication protocols and interfaces	Cloud based communication network
10	AIT	RI.	IoT and sensor applications	Interoperability and data collection
11	FHG	RI.	Sensor fusion, incident management	Sensor fusion, platform software
12	LUCIAD	IND.	Augmented reality	Augmented reality applications and HMI
13	ENIDE	SME	Mobile applications	Mobile applications and HMI
14	SU	UNIV	Augmented reality	Augmented reality applications and HMI
15	CERTH	NPO	Acoustic signal processing system	Acoustic event (speech) detection system
16	ERI	NPO	Ethical/legal/social implications of technology	Ethics, societal impacts, data protection
17	SIMAVI	IND.	Support for pilot implementations	Administrative Coord. TeamAware system integration and test
18	RAN	NW	First responders' network	TeamAware demonstration
19	BBB	FF	Demonstration zones (underground and buildings)	TeamAware demonstration support
20	AAHD	MD	Medical first responders in the operations	Definition of use cases and scenarios

Participant		Type*	Main expertise areas and competences	Main contribution in the Project
21	AHBVP	FF	Fire fighters in the operations	Definition of use cases and scenarios
22	JOAFG	MD	Medical first responders in the operations	Definition of use cases and scenarios
23	SPP	LEA	Security first responders in the operations	TeamAware demonstration support
24	HSEPC	MD	Medical first responders in the operations	Definition of use cases and scenarios
* **IND:** large industry, **RI**: research institute, **SME:** small and medium sized enterprise, **UNIV:** university, **FF:** Firefighter, **MD:** medical first responder, **LEA:**law enforcement agency, **NPO:** non-profit organisation, **NW:** first responder network				


HAVELSAN A.Ş. (Turkey)

Tree Technology SA (Spain)

Thales SIX GTS (France)

EUCENTRE Centro Europeo di Formazione e Ricerca in Ingegneria Sismica (Italy)

Asociación de Investigación de la Industria Textil (Spain)

Microflown AVISA (Netherlands)

DUNE SRL (Italy)

INNOVA INTEGRA (UK)

SRDC Software Research & Development and Consultancy Corp. (Turkey)

AIT AUSTRIAN INSTITUTE OF TECHNOLOGY GMBH (Austria)

Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V. (Germany)

HEXAGON / LUCIAD (Belgium)

ENIDE Solutions, S.L. (Spain)

Sabanci University (Turkey)

ETHNIKO KENTRO EREVNAS KAI TECHNOLOGIKIS ANAPTYXIS (Greece)

Eticas Research and Innovation (Eticas Foundation) (Spain)

Software Imagination & Vision S.R.L. (Romania)

Resilience Advisors Network (Ireland)

Bursa Büyükşehir Belediyesi (Turkey)

Ambulance and Emergency Physicians Association (Turkey)

Associação Humanitária Bombeiros Voluntários Peniche (Portugal)

Johanniter Österreich Ausbildung und Forschung gem. GmbH (Austria)

Protection and Guard Service (Romania)

HELLENIC SOCIETY OF EMERGENCY PREHOSPITAL CARE (Greece)

Figure 64 Newsletter Aug 2021-3

Horizon 2020
European Union Funding
for Research & Innovation

8.3.2. Newsletter November 2021

Welcome back to TeamAware's newsletter! Here's a summary of what we have achieved in the last three months.

We held our initial TeamAware consortium plenary meeting on September 10th, 2021 and WP2 Technical Co-creation workshop on September 8th, 2021. As you might guess the meetings took place virtually due to COVID. However, as we have all adapted this new working paradigm we had fruitful and interesting discussions.

From a technical perspective, inline with the timeplan, we mainly worked on WP2 System Architecture Specification and Design. The achievements are as follows:

- Task 2.1. Analysis of the strategic and operational context: This task gives an overview and analysis of the emergency management in Europe based on a detailed description of seven European countries (Turkey, Romania, Portugal, Ireland, Greece, Denmark and Austria) who represent together a picture of the emergency management in Europe as a whole. The deliverable is a comprehensive literature analysis conducted by RAN and supported by the end users in the consortium who were interviewed on the structure in their country, delivered relevant protocols, procedures and literature and reviewed their country profiles. This overview is the basis for the scenarios which will be developed and presented in Deliverable 2.5 for the demonstrations and validations in work package 13 and is a background document/knowledge base for the researchers in the tools development work packages 3-11.
- Task 2.4 TeamAware platform software architecture design: Conceptual platform architecture and software design represents the first conceptual iteration of the main integral software platform in the TeamAware ecosystem. Based on the technical data provided by the TeamAware project partners and careful consideration on the project parameters, the partners from Fraunhofer EMI developed iteratively an initial architecture and design document for the operator front-end, the data fusion module and the database within the software platform. In a close working relationship with Task 2.1 and Task 2.5, the results of those tasks have been considered during the development. This initial work has been documented in deliverable 2.2 to function as a foundation for the upcoming work packages and tasks which rely on these initial thoughts with further refinements planned throughout the project.
- Task 2.5 System architecture and communication network design: This task has collected the main functional and non-functional requirements about the different systems involved in the TeamAware ecosystem. After taking into account specific considerations in relation to the physical parameters of the devices, their technological stack, the size, format, limitations of

the data and their processing, and the way they communicate with external entities, it has been possible to shape with first responders the specific changes to the subsystems to better fit their needs and, in the long term, to achieve a tighter integration through the TeamAware platform. This work has been consolidated into deliverable D2.3, which also evaluates the targeted integration level of each subsystem into the overall TeamAware platform by the end of the project.

November 2021 is a very crucial month for our project. The vertical technical workpackages (WP3 to WP11) have started. All workpackage leaders organized their Kick-off meetings and monthly regular meetings. We will keep you posted about our progresses.

On the other hand, we were very active in out dissemination activities. We have participated to the following conferences and presented our TeamAware project.

8.3.2.1. European Emergency Number Association 2021 Conference

Dr. Turhan Sofuoglu and Dr. Zeynep Sofuoglu from AAHD team participated to European Emergency Number Association 2021 Conference (EENA 2021, 6-8 October 2021, Riga, Latvia) and presented TeamAware project.

Figure 65 Newsletter Nov 2021-1

Figure 66 Newsletter Nov 2021-2

Figure 67 Newsletter Nov 2021-3

8.3.2.2. RTD, Innovation, Industry and Technology Fair

Dr. Zeynep Sofuoglu participated to RTD, Innovation, Industry and Technology Fair on 13-14 October 2021 in Izmir, Turkey and presented TeamAware project.

Figure 68 Newsletter Nov 2021-4

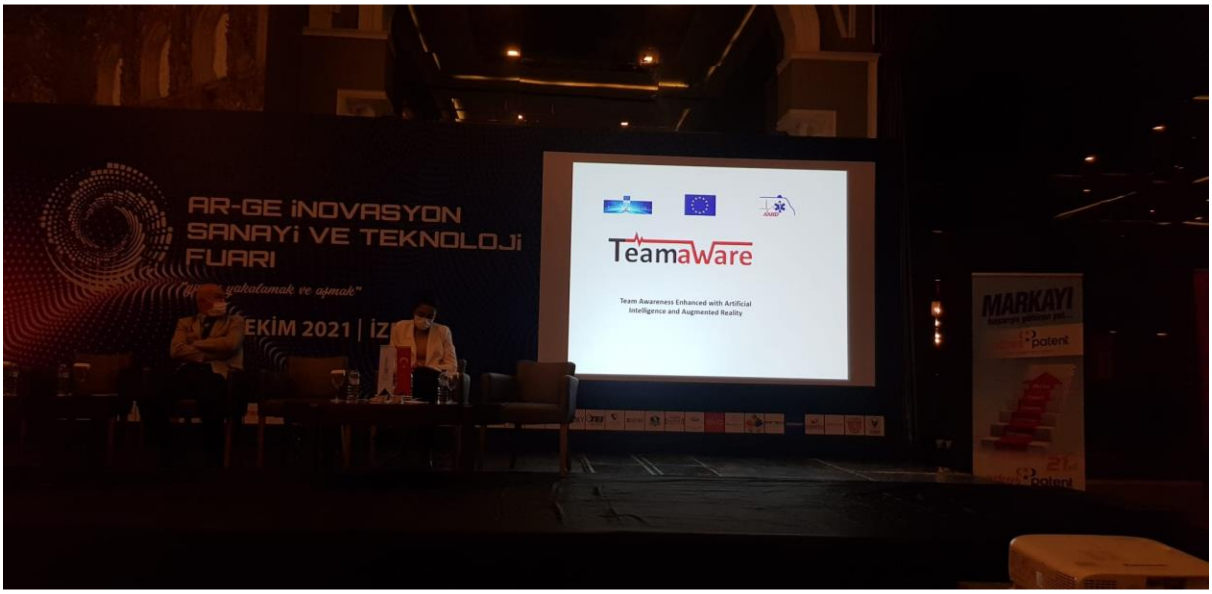


Figure 69 Newsletter Nov 2021-5

8.3.2.3. Milipol Paris 2021, 19-22 October 2021, France

Our partner DUNE presented TeamAware project at Milipol 2021 event in Paris on 19-22 October 2021. They used this event successfully for both dissemination and exploitation activities. They contacted around 20 executive-level-only contacts that showed a tangible interest toward TeamAware. We believe this will add great value to our commercialization opportunities.

Figure 70 Newsletter Nov 2021-6

They also demonstrated the first (to our best knowledge) tracking of a dog of a K9 unit, performed with the equipment that will be the basis of TeamAware WP7 indoor localization tasks.

Figure 71 Newsletter Nov 2021-7

Figure 72 Newsletter Nov 2021-8

Figure 73 Newsletter Nov 2021-9

8.3.2.4. European Emergency Medicine Congress 2021

On 27-31th October 2021, Marietta Pateinioti, Stylianos Xeniadis from Hellenic Society of Emergency Prehospital Care (HSEPC) presented our project at EUSEM 2021 congress in Lisbon Portugal.

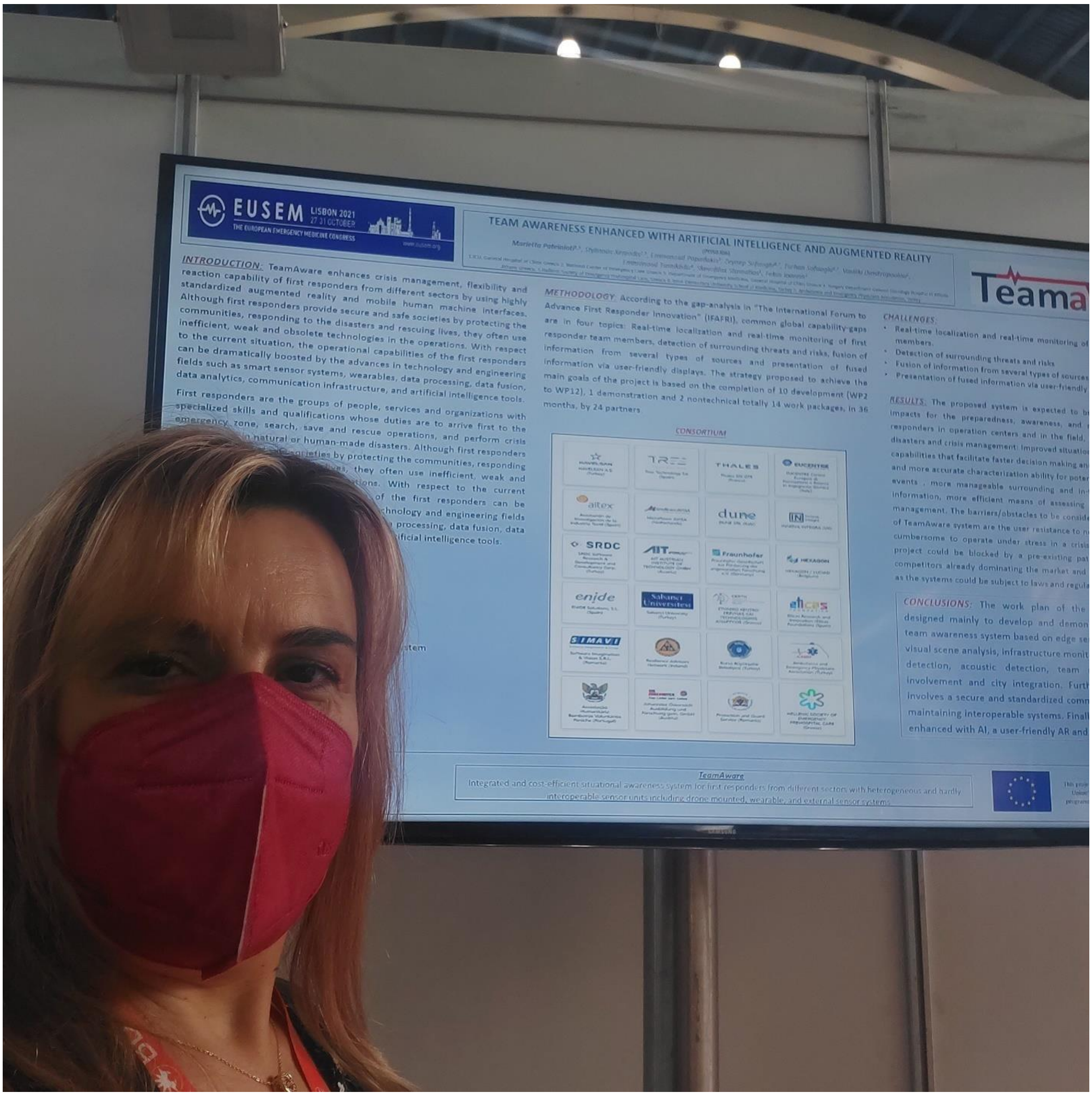


Figure 74 Newsletter Nov 2021-10

Figure 75 Newsletter Nov 2021-11

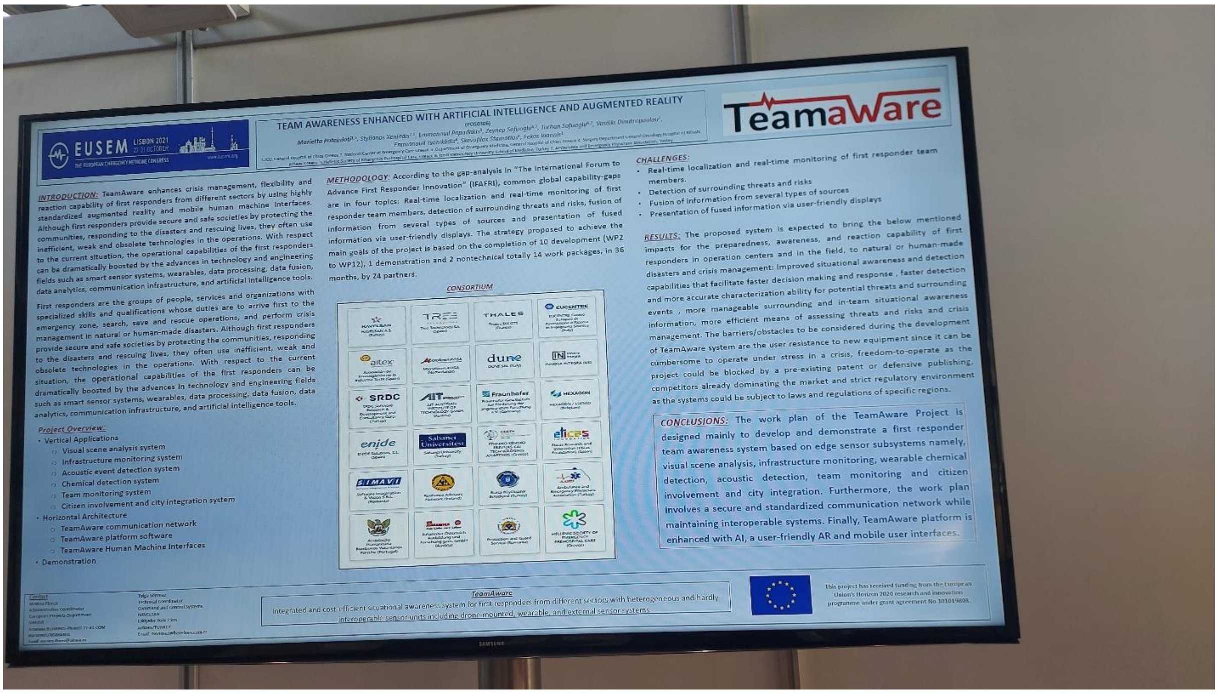


Figure 76 Newsletter Nov 2021-12

We will continue to update you on our exciting development activities, so look out for more information about how TeamAware is progressing in future issues of our Newsletter!

8.3.3. Newsletter February 2022

Welcome back to our newsletter with February issue! With this issue, we summarize what we achieved in the last three months.

As mentioned previously, November 2021 was a very crucial month. The vertical technical workpackages (WP3 to WP11) have started. All workpackage leaders organized their Kick-off meetings and monthly regular meetings.

Here is the summary of achievements in each workpackage:

- WP2 System Architecture Specification and Design: WP2 has continued its work as the main meeting point for technical discussions between end users and technology providers. On the one hand, it has served to define a baseline of the final demonstrations that will take place in year 3 of the project. This baseline lays the foundations for the work to be carried out in WP13 right after its kickoff. On the other hand it has allowed to outline the main functional and technical requirements of the main elements of the TeamAware ecosystem, concretising crucial aspects that will define their good operation in real-life situations represented by the final demonstration scenarios.

A crucial work has been to map the gaps that end users usually face in their everyday operations to the functional requirements of TeamAware's systems, platform, and cloud infrastructure, and their technical requirements. Also, a baseline procedure for evaluate the different components of the TeamAware ecosystem has been put in place. This has entailed the definition of research questions, evaluation KPIs, and links among them and with the user gaps.

Last, but not least, WP2 has set the legal and ethical principles that will be followed throughout the different stages of the TeamAware project. For this purpose, an analysis of the main legislation in relation to data rights and privacy and fundamental rights has been carried out.

All in all, WP2 has set the framework in which the rest of the project will operate. After its conclusion in M12 of the project (April), the rest of work packages will build onto the foundations and guidelines set in WP2.

- WP3 Visual Scene Analysis System: After technical meetings with the end users, suitable technologies have been identified. It includes an indoor drone platform and two types of sensors: mini-lidars for obstacle avoidance, and a RGB-D camera for mapping. Mini-lidars are now being studied in order to determine how many of those are needed and how to place them properly on the drone. A huge care is brought to the system's autonomy, as it is crucial for all the end users. Multiple algorithms are being developed, tested and improved too in order to maximize the system's resilience. State of the art algorithms are taken into account as well, as the final solution may integrate one of those. Besides that, other discussions are still on going on the segmentation tasks and the identification of the list of elements to detect with end-users. The results of all these elements will feed a dataset on the VSAS system.
- WP7 Team Monitoring System: In the scope of the AMS (Activity Monitoring System), the implementation of the calibration and neural network algorithms have started. Tests are being

conducted to obtain calibration parameters and to search for the ideal ways to include them within the measurements and fuse the sensor data coming from IMU. Both CNN (Convolutional Neural Network) and LSTM (Long Short-Term Memory) based neural network architectures are currently addressed in the activity. The WP7 activities about the COILS (Continuous Outdoor-Indoor Localisation System) has progressed in several ways. The GNSS (Global Navigation Satellite System) has been introduced to be fused with the Inertial and geomagnetic information coming from the foot-mounted IMU (Inertial measurement System). Both a first GNSS quality metric and a preliminary fusion strategy have been designed. Several experimental data (indoor, outdoor, and mixed) have been collected and both the quality metric and the fusion paradigm have been tested (see figure below). In addition, two different GNSS receivers have been employed: 1) the fix (latitude and longitude) coming from a commercial smartphone, with no RTK (Real Time Kinematics) augmentation; 2) the fix coming from a GNSS development kit (Simplertk2b v1 1, with ZED-F9P chip), with RTK augmentation.

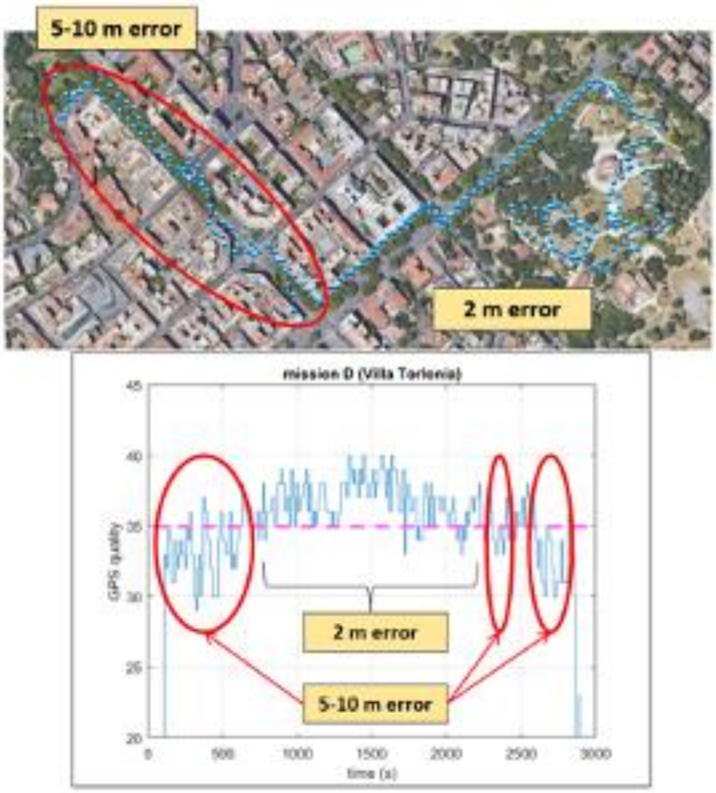
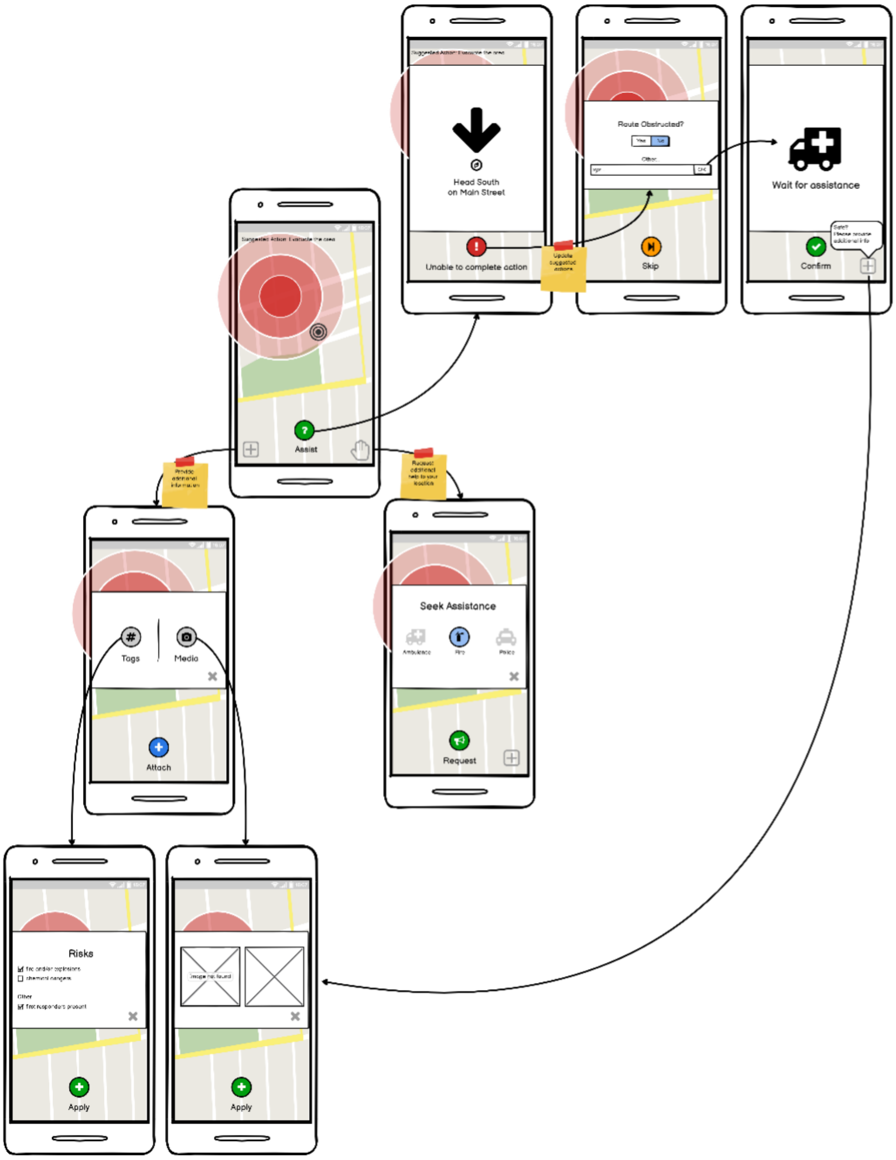


Figure 77 Newsletter Feb 2022-1

WP8 Citizen Involvement and City Integration System: Our work package aims to integrate and involve city Internet of Things devices and citizens that may be affected by emergency situations as part of the overall TeamAware solution. Our work package has now started and we are working on the initial steps in prototyping and design of the detailed solution for these purposes. This includes the integration of relevant publicly available social media messages shared by citizens, continuing work on a custom mobile phone app that we prototyped prior to the project as proof of concept and beginning work on an automatic framework to provide guidance to citizens caught up in emergency



situations.

Figure 78 Newsletter Feb 2022-2

WP9 Secure and Standardised Cloud Network: In this workpackage, we designed and installed initial version of the Secure Cloud Architecture in SRDC premises. The system is based on Kubernetes and we provide necessary installation guidelines; therefore, it can be installed to bare metal servers in any private network. In addition to the architecture, we currently work on security/privacy mechanism for TeamAware. The mechanism will be based RBAC (Role based access control) with the use of Open ID Connect (together with OAuth and User Managed Access specifications) and as the software, we will use open-source Keycloak tool. Furthermore, we are building the domain ontology through which all of the TeamAware components talk. The ontology will be standard-based and we will benefit from widely used emergency management and IoT standards like OASIS Emergency Data Exchange

Language (EDXL) and OGC SensorThings API.

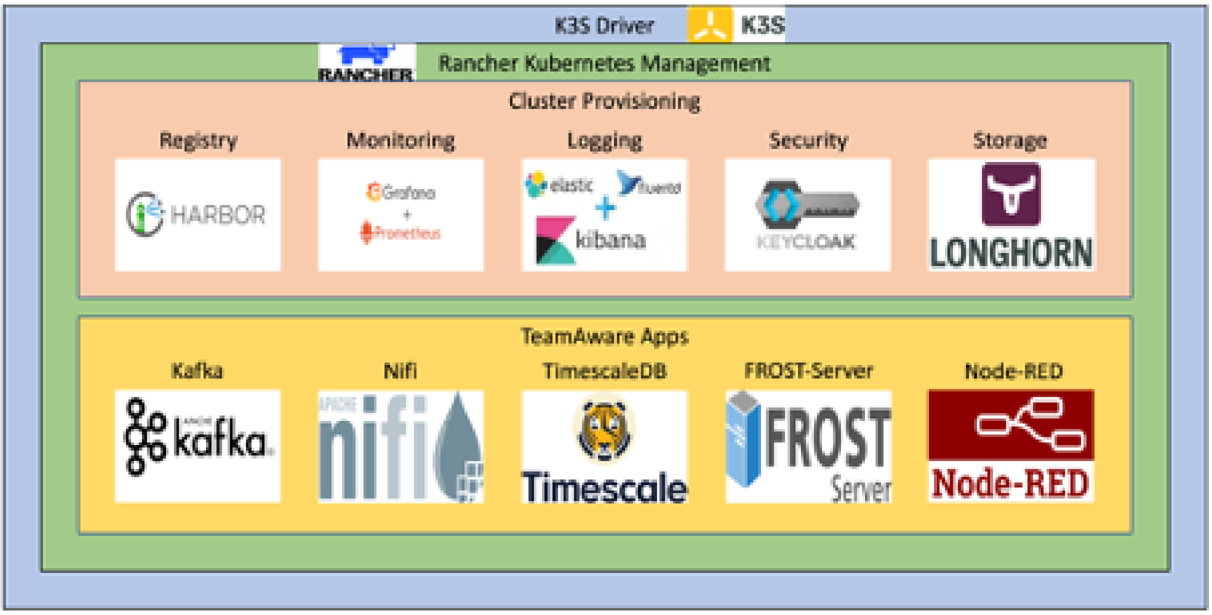


Figure 79 Newsletter Feb 2022-3

- WP10 TeamAware AI Platform Software: Within the WP10 work package of the TeamAware project, we worked hard on the further definition and detail planning of the TeamAware platform software design and architecture in conjunction with WP2 and WP9. Together with our partners from the project, we introduced and defined the structure of the relevant data flow and resulting parameters and the connection points to the different platform modules. In regard to the database, the architectural design started to integrate this information in its planning process. The same goes for the data fusion and front-end modules for the operator within the software platform of TeamAware. Within WP10 directly, the planning and design of the data fusion modules has started, which includes robust and detailed review of existing and new data fusion methods and their evaluation towards the integration within the TeamAware ecosystem. Singular modules are currently being evaluated towards their usability in respect to the specific sensors and data present in the project as well as the resulting technical prerequisites and needs. The operator front-end module from WP10 is in its design and planning phase also, which includes major incorporation of the outcome of WP11 to form a coherent access for the end-users to the system and definitions of interfaces for data exchange and communication with other modules within WP10 and the whole TeamAware ecosystem.
- WP11 TeamAware AR/Mobile Interfaces: After the kickoff, on work package 11 we have been focusing on 2 aspects:
    - First, we researched the best suitable technologies for the project and developed mockups for the AR and Mobile user interfaces. Then, we contacted the end users to get their input on this first design. We got valuable information from them that will help us design solutions better suited to their needs. A second iteration of the user interfaces reflecting the input we received is already under development.
    - The second focus of our work has been to start working together with WP9 and WP10 to make the integration with the platform as early as possible. This would provide us with more time to understand what data we have, how we should retrieve and lastly

find the best way to present it to the final users. We have already had some productive conversations and more meetings are already planned to continue cooperation between our work packages.

On the other hand we had promising achievements in our dissemination activities. Our partner EUCENTRE published the following journal publication.

Use of UAS for damage inspection and assessment of bridge infrastructures, M.Mandirola, C.Casarotti, S.Peloso, I.Lanese, E.Brunesi, I.Senaldi, **International Journal of Disaster Risk Reduction**, Volume 72, 1 April 2022, 102824

Our partner AITEX presented our project in their regular magazine.

AITEX Smart Textiles and Digitalisation Research Group

TeamaWare

AITEX is participating in the European TEAMAWARE project funded by the Horizon 2020 Programme. The main objective of the project is to develop an integrated and sustainable system that allows first responders and emergency teams from different sectors to be warned in different situations with heterogeneous sensors that are difficult to interoperate, such as integrated sensors, wearables and drone-mounted sensors. The overall goal is to improve crisis management and the flexibility and responsiveness of emergency teams and first responders in real time, merging and debugging information using highly standardised augmented reality and mobile human-machine interfaces.

The project involves 24 European partners including AITEX, FRAUNHOFER, THALES, UNIVERITY OF TWENTE, etc., and is led by the Turkish company HAVELSAN, leader in the software for the defence sector. AITEX is participating in the development of a system with different harmful gas sensors integrated into textile garments, which alerts first responders to the presence of dangerous airborne agents and pathogens near a disaster or accident.

First responders are specialized groups, services and organisations with specialised skills and qualifications whose duty it is to be first on the scene at an emergency or rescue opera-

Figure 80 Newsletter Feb 2022-4

Furthermore, DUNE prepared an editorial to be published in the "Tecnologia ed Innovazione" magazine (paper and online), Issue March 2022.

We will continue to update you on our exciting development activities, so look out for more information about how TeamAware is progressing in future issues of our Newsletter!

9. Conclusions

A concise strategy has been proposed targeting specific audiences and proposing tools, means and time plan per audience in D14.1 Dissemination and Communication Plan and its second version D14.4. Some tools have already been developed (e.g., social media strategy, newsletter) and communication and dissemination has already started. Importantly the plan includes metrics upon which aids the monitoring activity and progress and ensure that our intended outcomes are met.

Inline with the dissemination strategy/plan, the dissemination activities have been worked on a number of channels to promote our project results. This document is a working document and gives status update on the dissemination plan and achievements.