VALKYRIES

PARTICLE

# AN INTEROPERABLE FRAMEWORK FOR NETWORK-ENABLED CROSS-BORDER MULTI-AGENCY FIRST-AID VEHICLES IN MULTIPLE CASUALTY INCIDENTS

M. MANSO, P. PETIZ, B. GUERRA (PARTICLE)
A. MONTARELO (TASSICA), N. KOOCHANI (SUMMA)
J. VIDAL, M. TAYEDA (INDRA)
I. CHATZICHRISTOS (ARATOS), S. BERNAL (UMU)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101020676

VALKYRIES

# OUTLINE

I. Introduction

II. OPERATING IN A MULTIPLE CASUALTY INCIDENT SCENARIO

III. VALKYRIES ARCHITECTURE AND APPROACH

Overarching Architecture; Standards and Technologies; VIF Services

IV. VALKYRIES DATA MODEL AND METADATA

Minimum Data Set; Metadata;

V. Conclusion

VI. References

# INTRODUCTION

**MCI – Mass Casualty Incident**

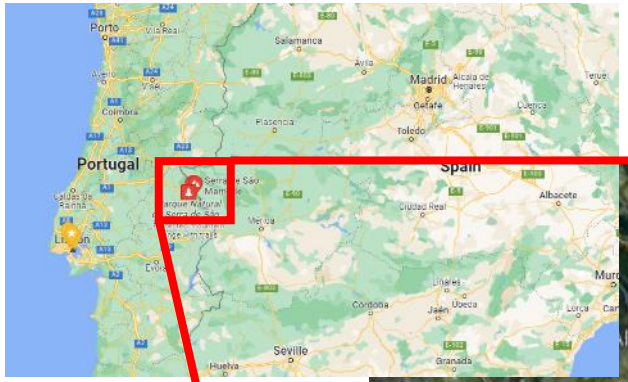
**High demand:**

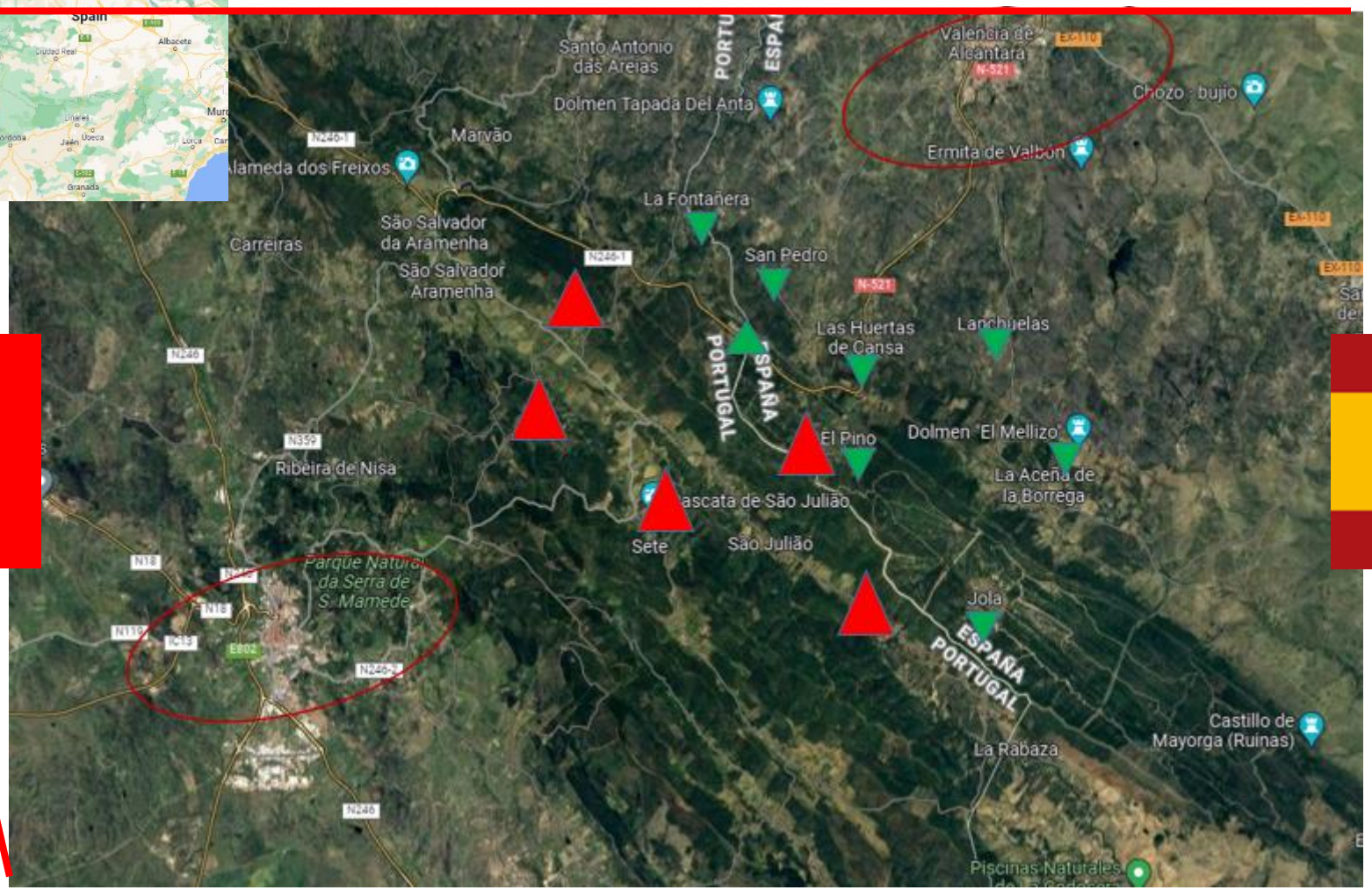
- **Large number of victims**
- **Limited resources**
- **Limited time**

**In a cross-border scenario, the situation is even more challenging as it requires international collaboration (agreements, processes, technologies).**

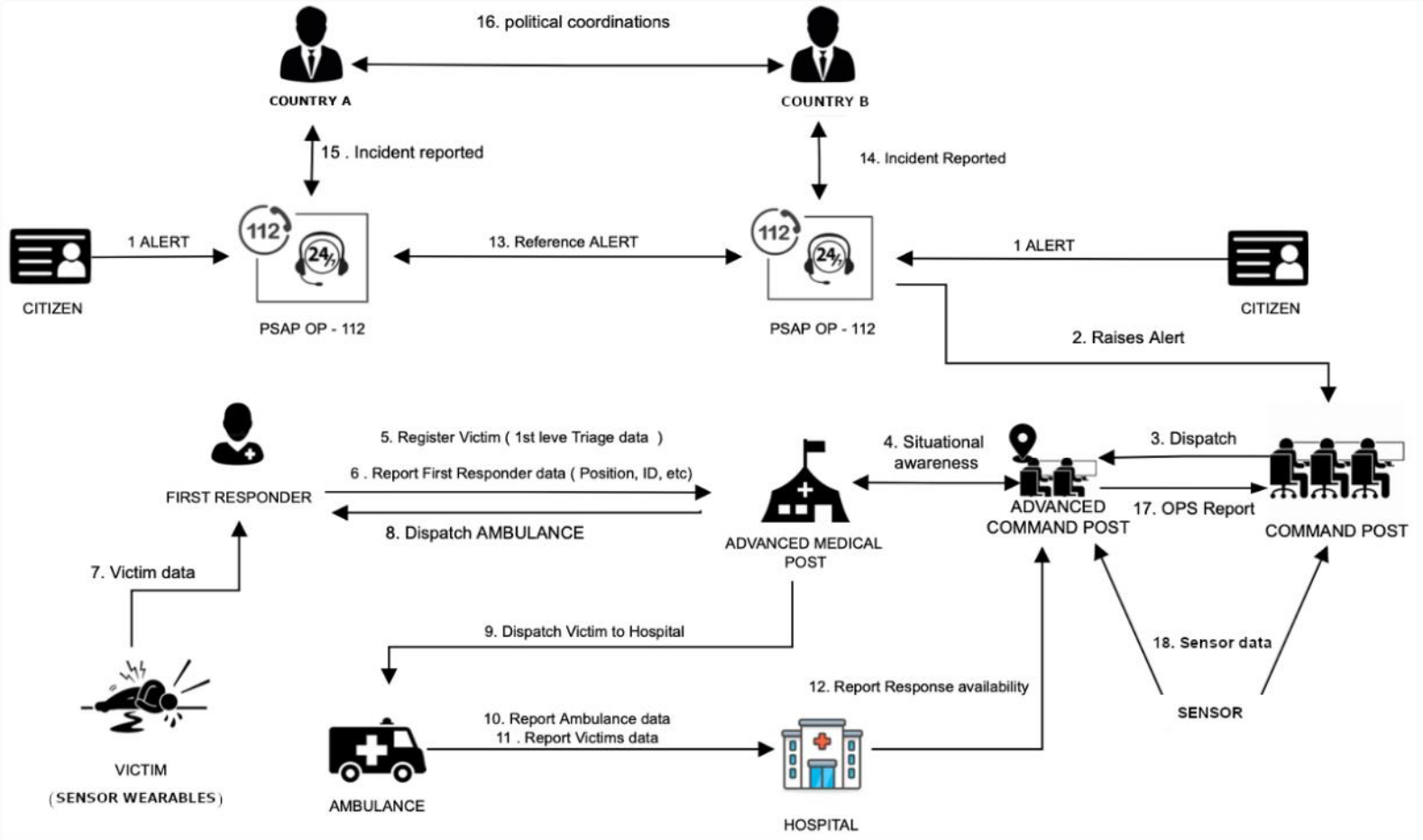
# OPERATING IN A MCI SCENARIO

## Forest Fire in the border



# OPERATING IN A MCI SCENARIO




| Actors | Technological Artifact |
|---|---|
| Citizens | User Terminal (e.g., Mobile phone and App), Web-client |
| Firefighters<br>FR (*)<br>Advanced Medical Post | Wearables (e.g., activity tracker with satellite positioning)<br>User Terminal (e.g., Professional Mobile Phone with App)<br>TETRA Terminal |
| PSAP (*) Operator<br>112 Coordination Centre | 112 Terminal<br>Emergency Management System |
| Coordination Centre<br>Command Post | Emergency Management System<br>Command and Control System |
| Political Liaison | User Terminal (e.g., Phone / E-mail) |
| First Aid Vehicles & Ambulances | Vehicle Terminal (with network connection and satellite positioning)<br>Medical devices and wearables |
| Hospital | Hospital Information System |
| Victims | Medical devices and wearables |

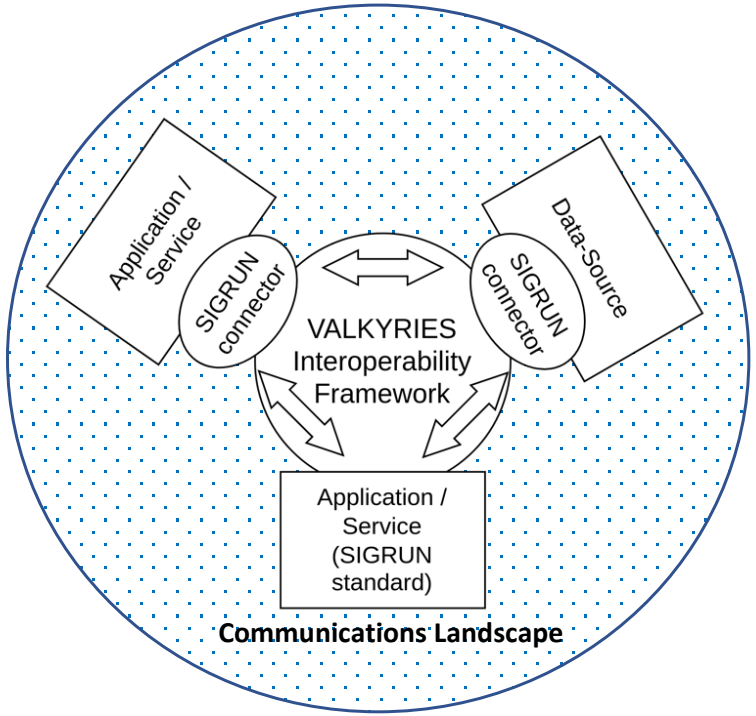
(*) PSAP: Public Safety Answering Point. FR: First Responder

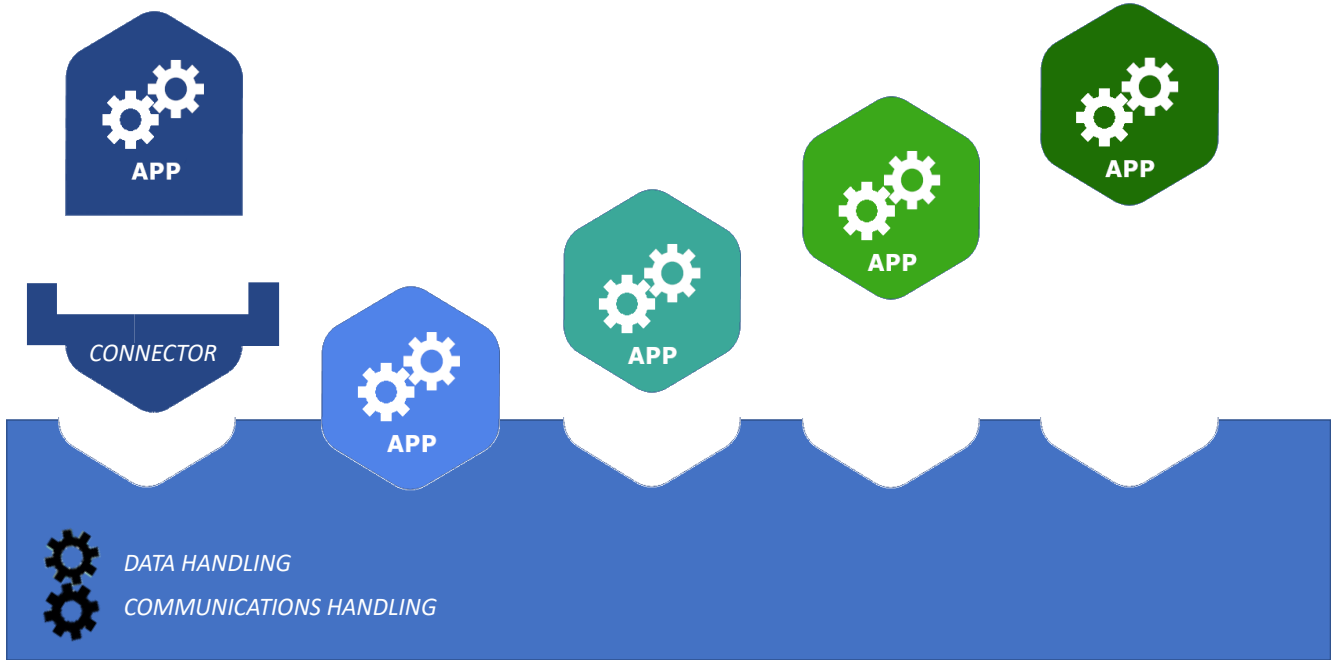
# ARCHITECTURE

A federated approach to connect different systems together

Distributed operational response, coordination capability and supporting services.

Modular plug'n'play services and applications, running on top of SIGRUN (the VALKYRIES interoperable framework), benefitting from available standards and protocols

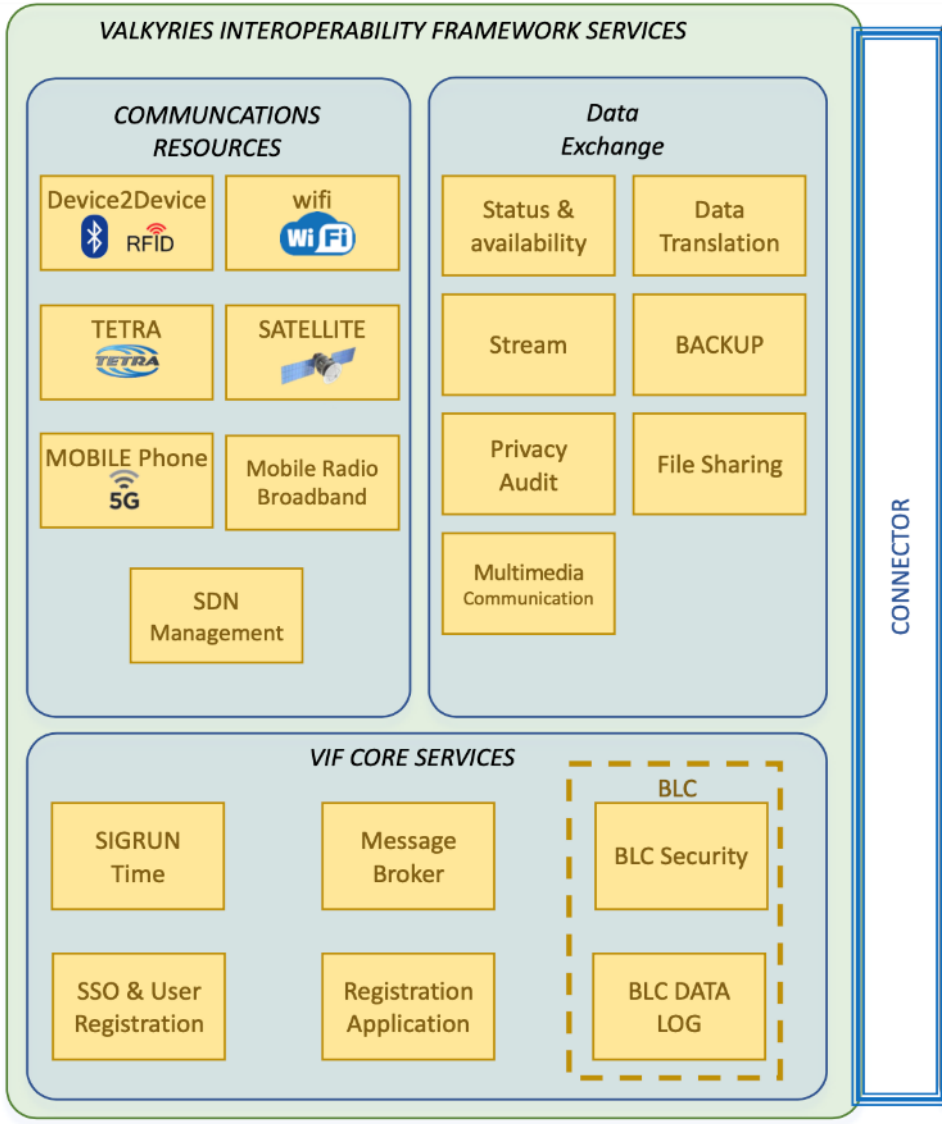


# ARCHITECTURE – STANDARDS AND PROTOCOLS

- All-over-IP
- OASIS Emergency Data Exchange Language (EDXL)
- EDXL Hospital Availability Exchange (EDXL-HAVE)
- NENA Emergency Incident Data Object (EIDO)
- FHIR for medical data
- Smart Applications REFerence ontology (SAREF) for IoT
- VALKYRIES web-based requests: REST, JSON, HTTP(S)
- MQTT
- WebRTC
- XMPP
- Security: TLS

# ARCHITECTURE – VIF SERVICES




- **Communication Resources**: These services are responsible for delivering communication capabilities to federated entities; management and coordination of different networks.
- **Data Exchange**: protocols for enabling operational services to exchange data within SIGRUN (e.g., subscribe messages to the message broker).
- **VIF Core Services**: necessary functions to set-up, deploy and orchestrate the VALKYRIES federation:
  - The Single Sign-On service & User registration (SSO).
  - The Registration service.
  - The SIGRUN time service.
  - The Message broker service.
  - Blockchain (BLC) based services, functioning as a secure trace and auditing mechanism in VALKYRIES.

# DATA MODEL AND METADATA

## Minimum dataset

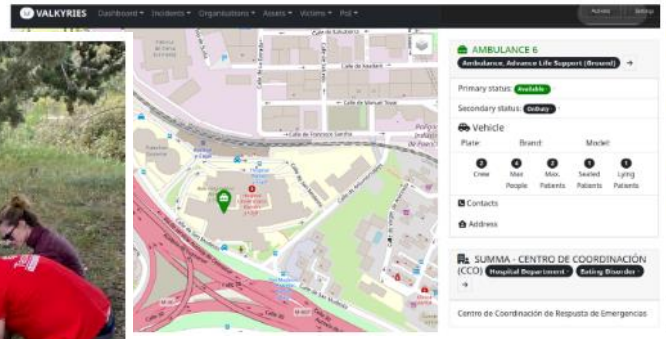
| Category | Description |
|---|---|
| Incident Data | Data related with an MCI. It observes EDXL and EIDO specifications. |
| Vehicle Data | Data concerning vehicles used in an MCI, like ambulances. It observes FHIR and EIDO specifications. |
| Smart Devices and IoT Data | Data related with connected devices and IoT, such as victims' vitals, fire detection and air quality. It observes FHIR and SAREF specifications. |
| First Responders Data | Data related to first responders. It observes EIDO and FHIR specifications. |
| Victim Data | Information collected about a victim during an MCI. This includes triage information, location and injuries. It observes FHIR standards. |
| Hospital Incident Data | Information about a hospital capabilities and capacity in receiving and treating victims. It observes EDXL, EDXL-HAVE and FHIR standards. |

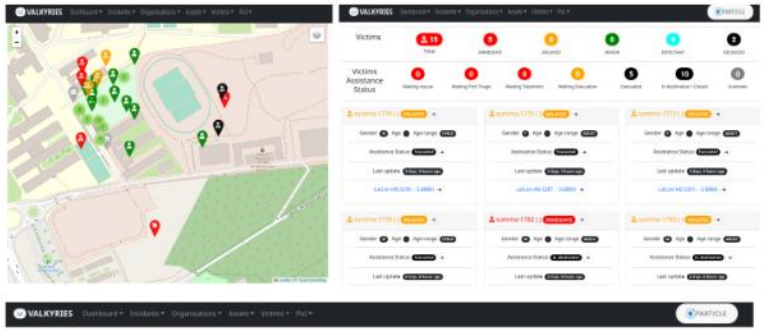
## Metadata

- Timestamp
- ProducerID
- DataTimeValidity
- OwnerID
- PriorityLevel
- UserID
- Shared

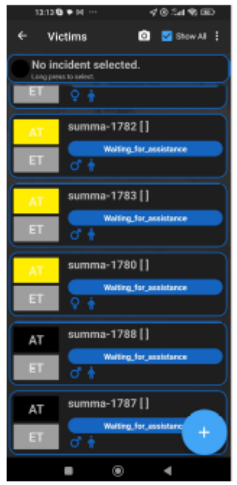
# CONCLUSION

- Two small-scale simulations performed:
  - https://particle-summary.pt/wp/2023/03/30/valkyries-demonstration-at-ifise/
  - https://particle-summary.pt/wp/2023/04/15/second-integration-test-of-the-valkyries-system/









# CONCLUSION

- This paper presents the work performed in the VALKYRIES project towards defining a technical architecture capable of enabling collaboration among multiple agencies operating in a cross-border MCI.
- An interoperability framework, named VIF, was defined. Organisations complying with VIF can participate in a federated collaborative environment, exchange MCI-related information and achieve high-levels of shared situational awareness, thus contributing towards a better employment of resources and improving the mission's effectiveness and efficiency.
- Next steps of VALKYRIES will be validated in demonstration scenarios planned for 2023 in Portugal, Spain, Bulgaria, Slovakia, Italy, Greece and Norway.
- A key objective will be to develop technical specifications serving as the basis for a standard, thus benefitting all organisations involved in MCI and cross-border emergency situations.

# REFERENCES


1. VALKYRIES website. https://www.valkyries-h2020.eu. [Retrieved: February, 2023].
2. OASIS. 2013. *Emergency Data Exchange Language (EDXL)* Distribution Element Version 2.0. Available at: https://docs.oasis-open.org/emergency/edxl-de/v2.0/cs02/edxl-de-v2.0-cs02.html. Dated: September, 2013. [Retrieved: February, 2023].
3. NENA. 2022. *NENA Standard for Emergency Incident Data Object (EIDO)*. NENA-STA-021.1-2021. Dated: October 19, 2021. Approved: April 4, 2022. [Retrieved: February, 2023].
4. FHIR Website. https://www.hl7.org/fhir/. Accessed version 4.3.0 generated at 2022-May-28. [Retrieved: February, 2023].
5. ETSI. 2020. *SmartM2M; Smart Applications; Reference Ontology and oneM2M Mapping*. ETSI TS 103 264 V3.1.1 (2020-02). [Retrieved: February, 2023].
6. Fielding, R., *Architectural Styles and the Design of Network-based Software Architectures*". Doctoral Dissertation, University of California, Irvine, Sep-tember 2000. Available at: http://roy.gbiv.com/pubs/dissertation/top.htm. [Retrieved: February, 2023].
7. OASIS. 2019. *MQTT Version 5.0. OASIS Standard*. Available at: https://docs.oasis-open.org/mqtt/mqtt/v5.0/mqtt-v5.0.html. [Retrieved: February, 2023].
8. W3C. 2021. *WebRTC 1.0: Real-Time Communication Between Browsers*. W3C Recommendation. Dated: 26 January 2021. Available at: https://www.w3.org/TR/webrtc/. [Retrieved: February, 2023].
9. Priyadarsini, M., and Bera, P., *Software defined networking architecture, traffic management, security, and placement: A survey*. Computer Networks, 192, 2021.
10. Regulation (EU) 2016/679 of The European Parliament and of The Council. Of 27 April 2016. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02016R0679-20160504


CONTACT POINT: M. MANSO | PARTICLE | MARCO@PARTICLE-SUMMARY.PT

Marco Manso
PARTICLE Summary
Lisbon, Portugal
e-mail: marco@particle-summary.pt

Alberto Montarelo
TASSICA
Madrid, Spain
e-mail: alberto.montarelo@tassica.com

Jorge Maestre Vidal
INDRA
Madrid, Spain
e-mail: jmaestre@indra.es

Pedro Petiz
PARTICLE Summary
Lisbon, Portugal
e-mail: pedro@particle-summary.pt

Navid Behzadi Koochani
Servicio de Urgencias Medicas de Madrid, Madrid, Spain
e-mail: navid.behzadi@salud.madrid.org

Meritxell Bassols Tayeda
INDRA
Madrid, Spain
e-mail: mbassols@indra.es

Bárbara Guerra
PARTICLE Summary
Lisbon, Portugal
e-mail: barbara@particle-summary.pt

Ioannis Chatzichristos
ARATOS
Athens, Greece
e-mail: ichatzichristos@aratos.gr

Sergio López Bernal
Universidad de Murcia
Murcia, Spain
e-mail: slopez@um.es

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101020676