H2020 – Secure societies - Protecting freedom and security of Europe and its citizens

SU-DRS02-2018-2019-2020– Technologies for first responders – Research and Innovation Action (RIA)

# Emerging technologies for the Early location of Entrapped victims under Collapsed Structures & Advanced Wearables for risk assessment and First Responders Safety in SAR operations

## D7.9 S&R platform Test Cases and overall system evaluation results 1st version

| | |
|---|---|
| **Workpackage:** | WP7- SnR Platform Design, Development and Service Integration |
| **Authors:** | THALIT |
| **Status:** | Final |
| **Due Date:** | 31/12/2021 |
| **Version:** | 1.00 |
| **Submission Date:** | 31/12/2021 |
| **Dissemination Level:** | PU |

# Search and Rescue Project Profile

**Grant Agreement No.:** 882897

| | |
|---|---|
| **Acronym:** | Search and Rescue |
| **Title:** | Emerging technologies for the Early location of Entrapped victims under Collapsed Structures & Advanced Wearables for risk assessment and First Responders Safety in SAR operations |
| **URL:** | www.search-and-rescue.eu |
| **Start Date:** | 01/07/2020 |
| **Duration:** | 36 months |

## Partners

| | | |
|---|---|---|
| | NATIONAL TECHNICAL UNIVERSITY OF ATHENS (NTUA) Co-ordinator | Greece |
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| SIMAVI Software Imagination & Vision | SOFTWARE IMAGINATION & VISION S.R.L (SIMAVI) | Romania |
| GRUPPO Maggioli | MAGGIOLI SPA (MAG) | Italy |
| Konnekt-able | KONNEKT-ABLE TECHNOLOGIES LIMITED (KT) | Ireland |
| THALES | THALES ITAIA Italia SPA (THALIT) | Italy |
| Atos | ATOS IT SOLUTIONS AND SERVICES IBERIA SL (ATOS) | Spain |
| HELLENIC INSTITUTE OF TRANSPORT CERTH / HIT | ETHNIKO KENTRO EREVNAS KAI TECHNOLOGIKIS ANAPTYXIS (CERTH) | Greece |

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|  | SPOLECZNA AKADEMIA NAUK (SAN) | Poland |
|  | GIOUMPITEK MELETI SCHEDIASMOS YLOPOIISI KAI POLISI ERGON PLIROFORIKIS ETAIREIA PERIORISMENIS EFTHYNIS (UBITECH) | Greece |

| Search and Rescue End-Users | | |
|---|---|---|
| | ELLINIKI OMADA DIASOSIS SOMATEIO (HRT) | Greece |
| | ENOSI PTYCHIOYCHON AXIOMATIKON YPAXIOOMATIKON PYROSVESTIR OY SOMATEIO (EPAYPS) | Greece |
| | JOHANNITER-UNFALL-HILFE EV (JOHAN) | Germany |
| | JOHANNITER OSTERREICH AUSBLIDUNG UND FORSCHUNG GEMEINNUTZIGE GMBH (JOAFG) | Austria |
| | CONSIGLIO NAZIONALE DELLE RICERCHE | Italy |
| | POMPIERS DE L'URGENCE INTERNATIONALE (PUI) | France |
| | ASOCIATA CLUSTERUL ROAMN RENTRU PROTECTIE SI ECOLOGIE IN DOMENIUL MATERIALELOR CHIMICE, BIOLOGICE, RADIOLOGICE/NUCLEARE SI EXPLOZIVE (PROECO) | Romania |
| | SERVICIO MADRILEÑO DE SALUD (SERMAS)<br>SERVICIO DE URGENCIAS MEDICAS DE MADRID<br>SUMMA112 | Spain |
| | FUNDACIÓN PARA LA INVESTIGACIÓN E INNOVACIÓN BIOSANITARIA DE ATENCIÓN PRIMARIA (FIIBAP) | Spain |
| | ESCUELA ESPANOLA DE SALVAMENTO Y DETECCION CON PERROS (ESDP) | Spain |

# Document History

| Version | Date | Author (Partner) | Remarks/Changes |
|---|---|---|---|
| 0.10 | 01/12/2021 | Marco Guerri (THALIT) | ToC and first draft |
| 0.20 | 05/12/2021 | Marta Burgos González (ESDP) | Comments sent to THALIT |
| 0.30 | 09/12/2021 | Adela Frentescu (SIVECO) | Comments sent to THALIT |
| 0.40 | 10/12/2021 | Iosif Sklavidis (KONNEKTABLE) | Comments sent to THALIT |
| 0.50 | 10/12/2021 | Gomez Usabiaga.Cristina (SERMAS) | Comments sent to THALIT |
| 0.60 | 20/12/2021 | Lorenzo Nerantzis (HRT) | Comments sent to THALIT |
| 0.70 | 21/12/2021 | Marco Guerri (THALIT) | Merged contributions and reviewed overall text |
| 0.71 | 24/12/2021 | Marco Guerri (THALIT) | Executive summary added |
| 0.80 | 28/12/2021 | Michail Chalaris (EPAYPS)<br>Themis Karafasoulis (EPAYPS) | Deliverable Review 1 |
| 0.90 | 29/12/2021 | Chara Kapsala, Zenia Koti (UGL) | Deliverable Review 2 |
| 0.91 | 30/12/2021 | Marco Guerri (THALIT) | UGL's and EPAYPS's comments implemented |
| 0.92 | 30/12/2021 | Iliana Malliou (NTUA) | Quality Control |
| 1.00 | 31/12/2021 | Christos Ntanos (NTUA) | FINAL VERSION TO BE SUMBITTED |

## Table 1 1: Task 5.4 Contributors

| # | Name | Organisation | e-mail |
|---|---|---|---|
| 1 | Marco Guerri | THALIT | marco.guerri@thalesgroup.com |
| | Gianluca Mando | | gianluca.mando@thalesgroup.com |
| | Marco Merlini | | marco.merlini@thalesgroup.com |
| 2 | Iosif Sklavidis | KONNEKTABLE | isklavidis@konnektable.com |
| 3 | Marta Burgos González | ESDP | esdp.eu@escuelasalvamento.org |
| 4 | Adela Frentescu | Simavi | Adela.Frentescu@siveco.ro |
| 5 | Gomez Usabiaga.Cristina | SUMMA112 | cgomezu@salud.madrid.org |
| 6 | Lorenzo Nerantzis | HRT | l.nerantzis@hrt.org.gr |
| 7 | Chalaris Michail | EPAYPS | chalarismichail@gmail.com |
| 8 | Themis Karafasoulis | | tkarafas@gmail.com |
| 9 | Takis Kotis | UGL | takiskotis@gmail.com |
| 10 | Chara Kapsala | | chara.kapsala@ukemedglobal.com |

# Executive Summary

The Deliverable D7.9, titled "SnR platform Test Cases and overall system evaluation results 1st version", introduces the topic of the testing for the Platform and each equipment developed within the WP7 in Search & Rescue Project.

In particular, after a smart introduction the Integration and Verification, methodology is described. This is to be considered a guide for a testing procedure following a V-Cycle Scheme.

The main chapters of this Deliverable are the third and the fourth with the correspondents Overviews of the Platform Integration and the related Components.

The D7.9 is also used as draft for the Deliverable 7.10 titled "SnR platform Test Cases and overall system evaluation results Final version" and consequently, the chapters fifth and sixth will describe the test cases that will be developed in the next months as well as the related Test results that will be gathered during the testing activities.

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# List of Abbreviations

| | |
|---|---|
| AC or ac | Alternating Current |
| Cat-6 | Category 6 |
| CCTV | Closed Circuit Television |
| FAT | Factory Acceptance Test |
| FOC | Fibre Optic Cable |
| FOV | Field of View |
| GPS | Global Positioning System |
| GLONASS | Global Navigation Satellite System |
| HMI | Human Machine Interface |
| IEEE | Institute of Electrical & Electronic Engineers |
| IP | Internet Protocol |
| IVVQ | Integration, Verification, Validation and Qualification |
| IT | Information Technology |
| ITU | International Telecommunication Union |
| LAN | Local Area Network |
| LCD | Liquid Crystal Display |
| LED | Light Emitting Diode |
| Lipo | Lithium Polymer |
| Mb/s | Megabits per second |
| MIMS | Membrane Inlet Mass Spectrometer |
| ODS | Obstacle Detection System |
| PoE | Power over Ethernet |
| RTMP | Real-Time Messaging Protocol |
| SnR | Search and Rescue |
| SAT | Site Acceptance Test |
| SDK | Software Development Kit |
| SW | Software |
| TCP/IP | Transmission Control Protocol/Internet Protocol |
| UC | Use case |

# 1 Introduction

## 1.1 SnR D7.9 introduction and T7.7 Work Plan

The main aim of D7.9 "SnR platform Test Cases and overall system evaluation results 1st version" is to introduce the structure of the test procedure for the tests on SnR platform regarding each individual component and also with regard to their integration Platform.

The D7.9 can be considered a draft of the D7.10 "*SnR platform Test Cases and overall system evaluation results Final version*" that will be submitted at the end of the SnR Project, at month 30, as per Deliverables Schedule. Therefore, a subset of SW tests will be collected to validate that the prototype will be stable enough for future implementations. Finally, the test results will provide feedback for the necessary modifications on the prototype. Testing will be performed to verify the proper functioning and performance of the integrated SnR platform and its components.

# 2 IVVQ Methodology introduction

The following sections describe the considered IVVQ (Integration, Verification, Validation and Qualification) methodology including the introduction of the theoretical approach with V-Cycle Scheme and the management of the interfaces on the platform.

## 2.1 The V-Cycle Scheme

The V-Cycle scheme is a model usually considered in the IVVQ strategy that represents the theory of the systems development lifecycle within the System Engineering and Project Management disciplines. In particular it is applied for complex Integration System in an industrial context [1].

The Figure 1 shows all the steps and the dependences foreseen on the V-Cycle scheme:

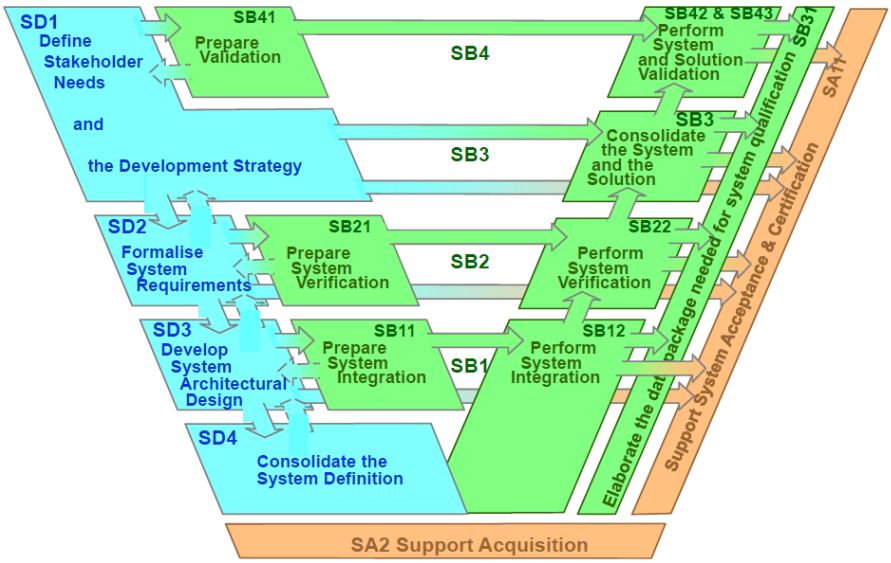


**Figure 1: V Cycle Scheme**

The SD1 is the step at the beginning of the Design, and it is fundamental to well define the Stakeholder Needs and the consequent development strategy; in particular, the needs can come from customer "nice to have", formal specifications and/or from experience of who is in charge of the providing of the System that will suggest the right need.

The SD2 is the second step which is very useful to formalise the System requirements; these are not to be confused with the Stakeholder Needs, in fact this is the list of the technical issues to achieve the Stakeholder Needs. Often only the system engineer knows the constrains, the performances and the activities to reach a Stakeholder Need.

After the formalisation of the System requirements, the related System Architecture can be designed and developed with a block diagram (SD3) and the System definition (SD4) can be consolidated for example with the submission of a Functional Design Specification.

It is important to perform a review at the end of each step, an internal review and/or with customer in order to search eventual issues and to consider a new revision of the previous step.

At the bottom of the V-Cycle, the activity SA2 Support Acquisition is often considered the "point of no return" of the design and development. In fact, this will produce the Contracts with outside companies (vendors) and the eventual manufacturing will start.

As shown in Figure 1, the parallel activities to the left side of the "V" can proceed. For instance, by following the architecture, the preparation of System integration (SB11) can be prepared with related document and consequently, the System integration can be implemented (SB12).

"Prepare System Verification" (SB21) and "Prepare System Validation" (SB41) mean to write the documentation that will describe the related phase of testing, usually procedures are submitted. An important note is the difference between Verification, which is the test statement by statement of all requirements, and Validation, which is the test statement by statement of all Stakeholder needs.

Having passed all the steps also on the right side of the "V", the activity for System Qualification (SB31) can be performed. This could push the related manufacturing. Finally, the Acceptances and/or Certifications (SA11) can also be performed. In particular, the steps of the Acceptances are usually two: the first is the FAT (Factory Acceptance Test) and the second is the SAT (Site Acceptance Test), which follows the Verification and the Validation with the Customer presence.

The arrows that go from the left side to the right side of the "V" define Requirements Traceability, in fact that from requirements to preparation, are called the "Link to Design", that from requirements to verification/validation are called the "Link to Test". The Test Procedure will be derived directly from the Requirements Traceability and developed in the final revision "D7.10 "SnR platform Test Cases and overall system evaluation results Final version".

## 2.2 SnR T7.7 - Integration and Verification Plan

The Integration and Verification strategy takes into consideration the V-Cycle scheme with the adaptation on the context of the SnR Project. In particular, the project is characterised by several partners who have the responsibility of a single component.

Following a lean approach, the strategy is to anticipate as much as possible all feasible test in house and to consider the integration test as the key point of verification of the integrated design to de-risk the validation phase at the end of the Project.

Refer to the following example of flowchart integration and testing plan, where the FAT is a preliminary preparation test for each component, the i-FAT is the/an integration test in the platform while the SAT is the final test during the Use Cases:

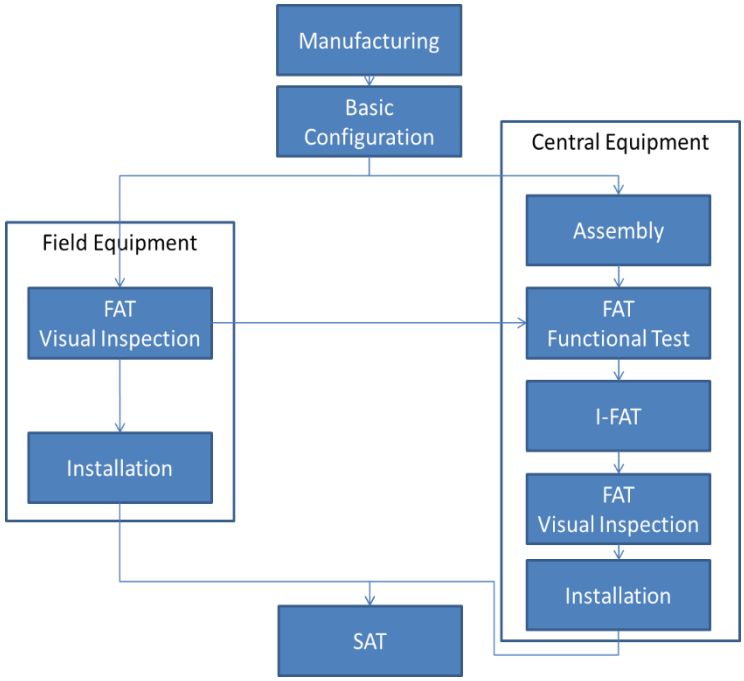


**Figure 2: Example of Integration and Testing Flowchart**

Moreover, to anticipate any integration SW issues, an additional remote test could be foreseen between each component.

# 3 Integration Platform Overview

In this paragraph the Integration Platform is introduced like a summary of what is already described in other Deliverables. As anticipated in the paragraphs above the statements of this description will be translated in the D7.10 "SnR platform Test Cases and overall system evaluation results Final version" in test procedures to be considered during the real tests on the SW.

The Search & Rescue project aims to create an integration platform which will help in the optimisation of the intervention operations. The platform will bring together all the functionalities needed in order to achieve this goal. With the help and implication of all partners involved in the project. Several pilot scenarios will take to help us have a better understanding of the outcome as well as the resources needed, depending on the type of the incident.

## 3.1 Platform Integration Introduction

The integration platform aims at helping the intervention processes. Because of that, it will be created based on the outputs from various pilot scenarios and data gathered from a diversity of sensors and data sources. Its main purpose is to help the First Responders and rescuers to optimise the entire process.

Taking that into consideration, based on the data which will come from various sources, like the historical, the ConcORDE project and the outputs of the pilots, the interoperability framework will be developed.

## 3.2 Software Architecture

The integration platform will be created based on a microservices architecture. The main purpose of this approach is to improve scalability and bring together components which solve a particular problem. Beside of that, the architecture will be based on two main platforms, the data bus and the ESB for service integration. The below diagram (Fig. 3) displays the connection between all components which will be part of the framework, and how the data will flow through.

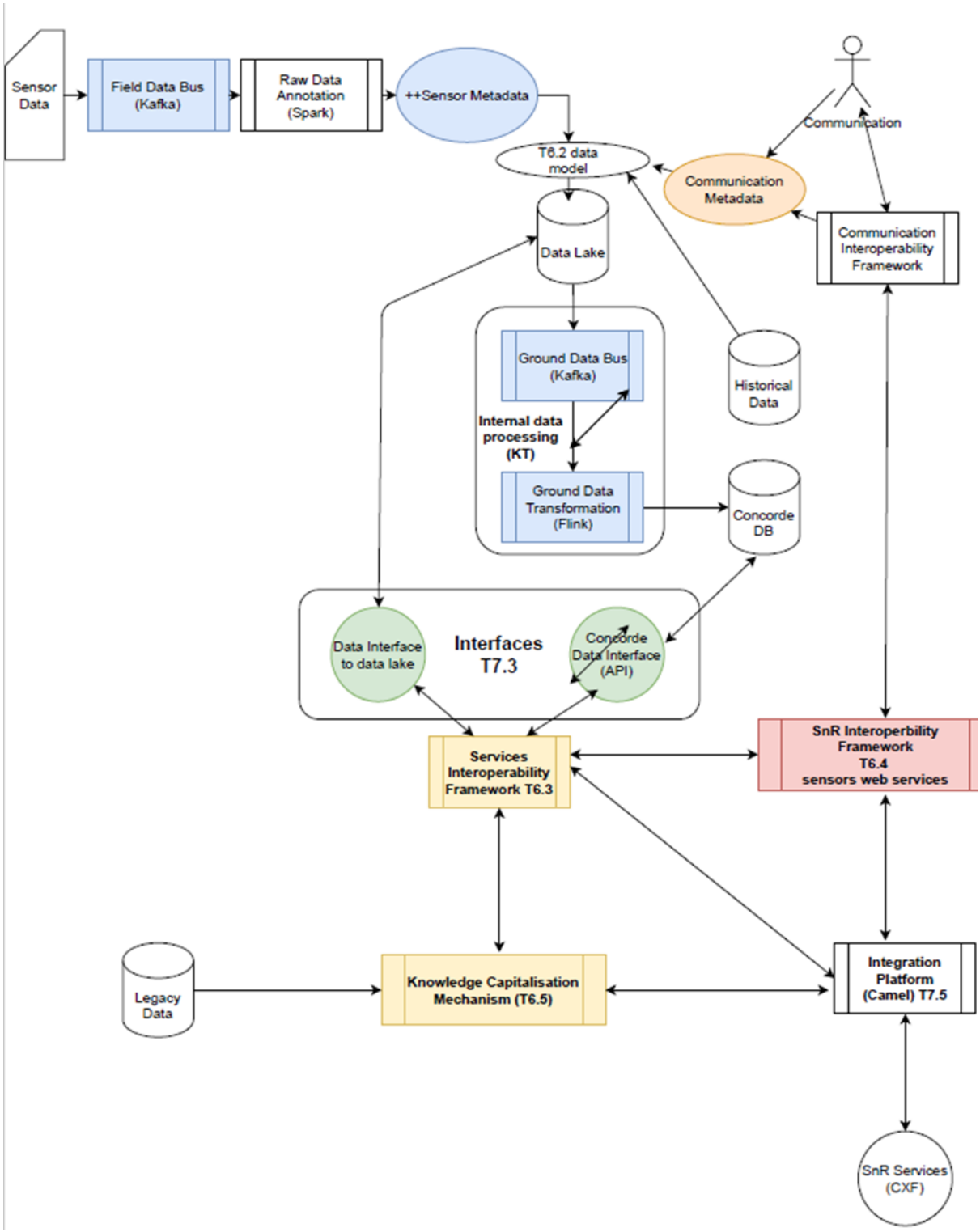


**Figure 3 Integration plan**

## 3.3 Interfaces Description

As it was mentioned before, the application will be built based on different microservices. In order to have access to such an architecture, all the services involved will have to be exposed to the end users.

The transformation of a SOAP web service to an exposable REST API will be an entire process. Once a service is located, it will be processed through the Service Interoperability Framework, which has the following components: Service handler, Service Control, Routing Engine and Access Control. Then the service is sent to the Protocol Bridge where the handler executed the request for a specific service and is preparing it for the instantiation, based on the protocol.

As a final step, the service gets to the routing engine which will handle the transformation process. In the end it will be exposed as a different endpoint, so it can be used by other applications or by the final users (Figure 4).

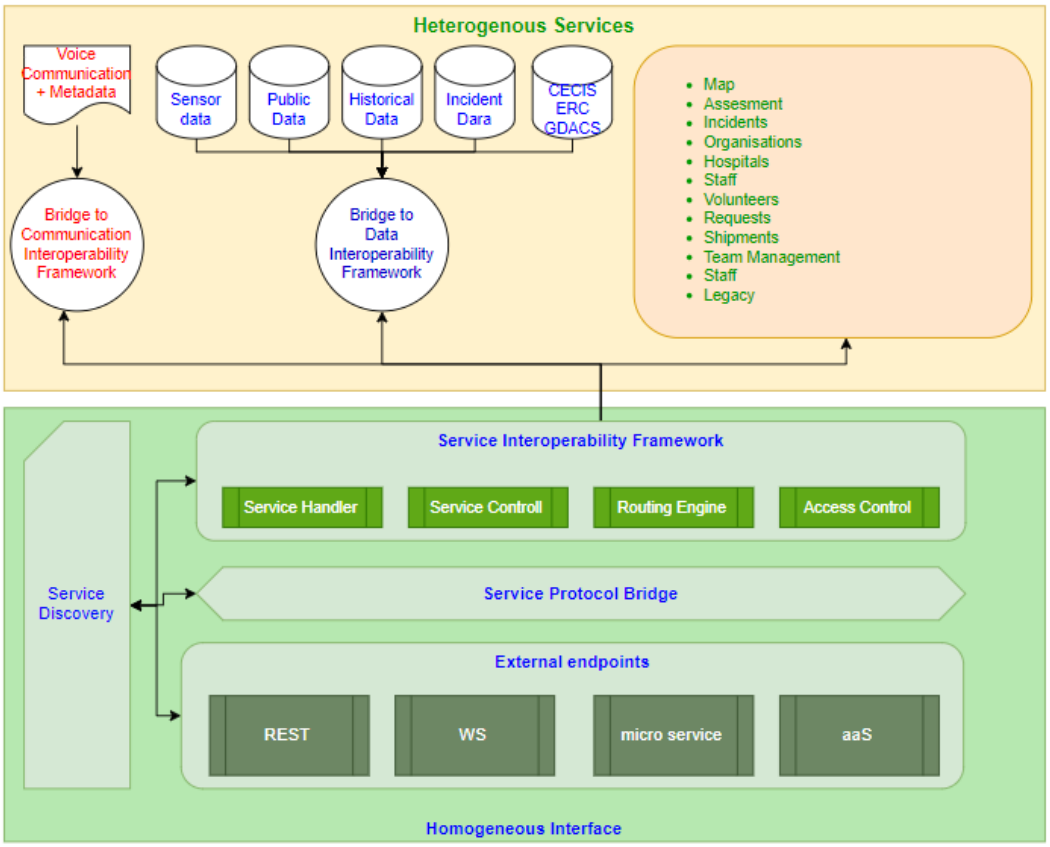


**Figure 4 Service Framework**

# 4 Components Overview

In this section each component is introduced as a summary of what is already described in other Deliverables. As anticipated in the paragraphs above the statements of each description will be translated in the D7.10 "SnR platform Test Cases and overall system evaluation results Final version" in test procedures to be considered during the real tests on the SW.

## 4.1 Component interface specifications for interoperability Description

Component Interface specifications for interoperability were presented in the homonym deliverable D7.3 by KT. An attempt was made with the aim of collecting of the available interfaces from each component getting involved in the SnR platform. For the sake of simplicity, a division of the components was made into:

- Hardware Components
- Software Components
- Integration Components
- Databases

More specifically, each technology provider was asked to fill provide:

- The role of their technology in the Project
- The API specifications
- The Services
- The data format

As an outcome of D7.3, the Project's members are more aware of the adaptation capabilities to the SnR Platform. A combination of D7.3 and the dedicated documents of the developed technologies in SnR will lead to a better and faster adaptation to the overall system.

The following table demonstrates what components were presented in D7.3, as long as if there is an extra deliverable analysing the technology.

**Table 1: Components presented in D7.3**

| | **Component** | **Provider** | **Other SnR Deliverable(s)** |
|---|---|---|---|
| 1 | Smartwatch | KT | - |
| 2 | Rescue MIMS | NTUA | D5.1, D5.3, D5.4 |
| 3 | Wearable GPS Tracker | UNICA | D5.2 |

| | | | |
|---|---|---|---|
| 4 | Wearable Strain Sensors | UNICA | D5.2 |
| 5 | Wearable ECG, EMG | UNICA | D5.2 |
| 6 | Six Gas Monitor | UNICA | https://alfresco.epu.ntua.gr/share/page/site/search-rescue/document-details?nodeRef=workspace://SpacesStore/086a9b3b-c81c-4d07-b7ea-47404d9d37df & https://alfresco.epu.ntua.gr/share/page/site/search-rescue/document-details?nodeRef=workspace://SpacesStore/e9ab4909-a13c-47f8-80d4-ef27938645c9 |
| 7 | Radiation sensors | UNICA | D5.2 |
| 8 | Emergency Response Health Condition Monitoring Device | CERTH | D5.2- |
| 9 | Drones & Collaborative drone platform | UHASSELT | D5.1, D5.4 |
| 10 | 3D Mixed Reality CC | CERTH | D4.2 |
| 11 | Smart Glasses | SIMAVI | D6.7 |
| 12 | Rescue Robots & autonomous vehicles | DFKI | D5.4 |
| 13 | COncORDE | KT | D6.7 |
| 14 | Situation awareness modules | UBITECH | D3.2, D3.8 |
| 15 | BIM based services & apps | UBITECH | D3.3, D3.4 |
| 16 | Sensor Web Services | MAG | D6.4 |

| | | | |
|---|---|---|---|
| 17 | SOT DSS | KT | D4.3, D4.5, D4.7, D4.9, D4.11 |
| 18 | PHYSIO DSS | CNR | D4.4, D4.6, D4.7, D4.10, D4.11 |
| 19 | Volunteer app | CERTH & KT | D2.5 |
| 20 | e-learning based platform | CERTH | D2.4 |
| 21 | Object detection algorithms on Autonomous Vehicles | THALIT | D3.6, D5.4 |
| 22 | Object detection on UAV imagery | AIDEAS | D3.5 |
| 23 | Integration Platform | SIMAVI | D7.5, D7.6 |
| 24 | SnR Data model | THALIT | D6.2 |
| 25 | Data Lake Ecosystem | KT | D4.1, D4.8 |

## 4.2 Adaptation of systems and services Description

All the aforementioned components will be bridged, to constitute the overall SnR interoperability platform. This process combines all the components with the integration platform, the Data Lake Ecosystem and the provided services.

D7.4 is a technical deliverable, that will depict the work done from:

- The technology providers themselves (see the table above),
- The responsible for integration SIMAVI
- The responsible for adaptation KT

under a common work plan.

This work plan was divided into Technical Use Cases for:

- Integration of hardware technologies to SnR Platform
- Integration of services to SnR Platform

In the current time of the project, an implementation has been done in:

- **TUC1**: Integration of Smartwatch data into the COncORDE platform

  This technical use case has fulfilled developing the following steps:

  - Smartwatch data generation [KT]
  - Smartwatch synchronisation to smartphone via Bluetooth [KT]
  - VeryFitPro synchronisation to Strava app [KT]
  - Smartwatch data retrieval via Strava API [KT]
  - Creation of Apache Kafka Topic [SIMAVI]
  - Smartwatch data published to Apache Kafka Topic [KT]
  - Data retrieval to the Data Lake Ecosystem via Apache Spark Streaming [KT]
  - Data filtering [THALIT]
  - Data retrieval from the HDFS to COncORDE platform (event log service) via WebHDFS [KT]
- **TUC2**: Integration of UNICA's technologies into the COncORDE platform:

  This technical use case is under development in the current time, following the steps bellow:

- Creation of a custom Android app [UNICA]
- Build the REST API [KT]
- Creation of Apache Kafka Topic [SIMAVI]
- Post data to Rest API [UNICA]
- UNICA's technologies data published to Apache Kafka Topic via the Rest API [KT]
- Data retrieval to the Data Lake Ecosystem via Apache Spark Streaming [KT]

- Data filtering [THALIT]
- Data retrieval from the HDFS to COncORDE platform (event log service) via WebHDFS [KT]

By completing TUC2, UC1 field technologies will be ready to interoperable with the rest of the SnR Platform components, meaning the COncORDE platform and the SOT DSS. CNR's PHYSIO DSS and UBITECH's SA model will supplement the rest of the platform.

Following the above philosophy, the rest Technical Use Cases will be addressed depending on the needs of every Use Case, as long as the capabilities of every technology provided.

# 5 Test Cases Descriptions

As described in the above paragraphs the tests will be described following the finalisation of SW design and Development. Together to the test procedure the Prerequisite conditions, the Test inputs and the Main expected test results will be listed.

## 5.1 Prerequisite conditions

To be included in D7.10 "SnR platform Test Cases and overall system evaluation results Final version".

## 5.2 Test inputs

To be included in D7.10 "SnR platform Test Cases and overall system evaluation results Final version".

## 5.3 Test procedure

To be included in D7.10 "SnR platform Test Cases and overall system evaluation results Final version".

## 5.4 Main expected test results

To be included in D7.10 "SnR platform Test Cases and overall system evaluation results Final version".

# 6 Test results

The following sub-sections will describe the Test results that will be collected on all foreseen tests in the paragraphs above. In particular, the possible problems encountered will be highlighted and a specific reasoning will be conducted to learn on them. Moreover the "Impact on test environment" and "Recommended improvements" will be well described.

## 6.1 Summary of test results

To be included in D7.10 "SnR platform Test Cases and overall system evaluation results Final version".

## 6.2 Problems encountered

To be included in D7.10 "SnR platform Test Cases and overall system evaluation results Final version".

## 6.3 Impact on test environment

To be included in D7.10 "SnR platform Test Cases and overall system evaluation results Final version".

## 6.4 Recommended improvements

To be included in D7.10 "SnR platform Test Cases and overall system evaluation results Final version".

# References

[1] Bröhl, A.-P. (1995), Das V-Modell: Der Standard für die Softwareentwicklung mit Praxisleitfaden, Software - Anwendungsentwicklung - Informationssysteme, 2nd ed., Oldenbourg, München.