E-SPONDER addresses the operational challenges that involve better understanding of the complexity of large-scale disasters by identifying, prioritizing and connecting the various heterogeneous domains involved. The project tackles a wide series of practical operational challenges in order to reduce operating costs, increase effectiveness in resource allocation, enhance situational awareness for crisis personnel, enable application of effective and safe tactics and strategies during operations, but also facilitate uninterrupted flow of information and decision making through different levels of command and logistics organization.

Context and Objectives
This research effort will help save lives. These being the lives of victims through more efficient operations, but also the lives of First Responders (FR) that are called upon to operate in the hardest of conditions. Statistics show that efficient emergency system can reduce accident losses to 6%, compared with situations without them.

E-SPONDER presents a testing ground for new emergency response-tailored software and hardware. Emergency response is a time- and safety-critical work practice, where periods of relative low-intensity work are rapidly shifted into high-intensity work associated with a high degree of ambiguity. Emergency response is therefore a valuable setting for investigating new design of information technology for time-critical work practices, providing an area where ICT can demonstrate more value and help reduce uncertainty and/or lack of exact information by improving quality of available data and information to FRs.

The main objective of E-SPONDER is to ensure that no illnesses or injury occurs to any first responder, first receiver, medical facility staff member, or other skilled support personnel as a result of preventable exposure to secondary trauma, chemical/radiological release, infectious disease, or physical and emotional stress after the initial incident or during decontamination and incident follow-up.

E-SPONDER’s overall objectives are:

- To research, develop and demonstrate the capabilities of a framework and congruent prototype that will enhance the effectiveness of operations of FRs operating in an emergency situation. This goal will be achieved subject to constraints, such as environmental conditions in the operating theatres of FRs, autonomous operation with extended duration, reliability of system and effectiveness of system to support crisis operations, interoperability with crisis management systems, open information exchange capability and collaboration among FR groups and involved players across Europe.

- To setup visible demonstrations of innovative First Responder Support Systems in realistic situations. The methodology employed in the E-SPONDER project lifecycle, will bring the FRs in the spotlight of all envisaged systems’ development and evolution. From the collection of user requirements, to the iterative development and validation of the system’s technical specifications and the performance of pilot demonstrations, the user groups affected by the developments of E-SPONDER – first responders, crisis managers, resource/infrastructure managers, and public agencies.

Concluded and on-going project activities
E-SPONDER has currently completed the third year of activity, already exhibiting significant results.
Work started in the first year with a thorough State-of-the-Art (SOTA) analysis in relevant scientific and technical domains, executed in parallel with a user requirements analysis covering operational/mission aspects. The SOTA report provides insights on decision support systems, information management systems and crisis communication systems and ends with 14 specific recommendations for the E-SPONDER system (already taken into account in the design activity; see below). User Requirements collection has been performed through real users interviews; Interviewed users came from various disciplines and operate in multiple levels of the crisis management hierarchy (First Responders, Incident Commanders and top level Crisis Managers). A questionnaire has been developed for this purpose. All results have been documented in the public project deliverable D2.1.

Moreover, the UR analysis activity resulted in the detailed description of three system usage scenarios exhibiting realistic cases that users confront in their daily work. The purpose of this activity was to directly link the envisioned usage of the system with realistic cases and directly extract requirements corresponding to its actual usage. Three scenarios were developed; a base scenario of an aircraft crash to exhibit core features of the platform, a building collapse scenario to cover advanced features (such as 3D and LPS), and a large scale scenario covering a forest fire to investigate scale and complexity increase implications. All these scenarios correspond one-by-one to the pilots foreseen to be demonstrated at the end of the project. An additional part of the work performed dealt with the development of the operational concept of E-SPONDER, namely the definition of the different emergency phases that will allow deriving the role and functions of E-SPONDER in each of the crisis response phases, the definition of the actors and layers in place, their role and responsibilities and the definition of the flows of information and the level of interaction between the actors and the layers in place.

Following the requirements analysis phase, the work continued with the definition of architecture and the design of the system. This activity commenced with the high level description of the envisioned system (see Figure 1) and the definition of Use Cases for the system. The compilation of the above resulted in the high level description and evaluation (through simulation) of the envisioned architecture and logical and functional design of platform internal components, covering FR hardware and software features, the communication infrastructure, the information flows and data processing (fusion), the various applications and services and the user interface (in both 2D and 3D displays).

During the second year the definition of the Integrated System Architecture and Interfaces Definition, and Communication Security and Interoperability aspects of the platform have also been finalized resulting in the in depth design and specification of the platform components.

Development of various FR-equipment has also started since first year and two prototypes have been developed. Prototype development is executed in validation cycles during which various integration steps are performed. During the second project year, validation procedure has been executed by collecting feedback during a specifically organized by the project Workshop during which available prototypes were demonstrated to real FRs. First prototyping experiments have been conducted, especially for the breath-rate extraction from body impedance signals, the potential outer garments of the First Responder uniform. Additionally a prototype board enabling (indoor) positioning has been produced and first evaluation has taken place. This work is again in progress and is to be continued almost until the end of the integration phase of the project in equivalent development and validation cycles.

During the second year of the project’s lifetime the project focused mainly in the implementation of the functional components of the platform, namely a web portal through which users will be enabled to manage all monitored resources and thus obtain all available from the crisis field information (including graphical presentation of the crisis situation overlaid to digital maps in 2D and 3D versions), the OPTIMIZER tool that is a tool used for managing available resources and logistics and the core components responsible for the fusion of data and information flows coming or being directed to the crisis field.
During the third year of the project’s lifetime the project focused mainly in finalising the implementation of the functional components of the platform. The E-SPONDER EOC and MEOC software components have been finalised as well as the web portal, the logistic support (OPTIMIZER tool), VOIP communication using push-to-talk and the core components responsible for the data fusion and information flow. Through these components the crisis management personnel is able to manage all monitored resources and thus obtain all available information from the crisis field. This information includes the 2D and 3D Common Operational Picture. In addition the development of the sensors for the First Responder Unit (FRU) has progressed as planned regarding the garment design, the local positioning sensor and the software component for the mobile devices which the sensors interact with. In parallel the training activities for the developed system have commenced. Regarding the standardisation activities, the project achieved a clear identification of the context where standardization activities of E-SPONDER should be concentrated. A structured way of collecting the input for partners has put in place, so that the project fully considers and understands all applicable aspects, laws, regulatory legislation at national and European levels. Contact has been made between E-SPONDER and EMTEL (Emergency Telecommunications) ETSI WG but also CEN/CENELEC in view of the project contributing in the development and publication of a CEN standard in the form of a CEN-Workshop Agreement. This activity is on-going and its results are expected towards the end of the project. Future steps include the finalisation of the validation of the FRU components as well as the integration of all components in view of creating a homogenized platform for First Response. The fourth year is focused in the test and validation of the E-SPONDER solution though three realistic field tests with the active involvement of end-users and first responders.

![E-SPONDER High level architecture](image)

Figure 1: E-SPONDER High level architecture

Expected final results and potential impact
The project has a three-fold focus linked to fully quantifiable results from a coherent set of properly scheduled research and innovation related activities. E-SPONDER is set to:

1. **Provide a new generation First Responder Support Platform, comprising of a full-set of systems and services, built in accordance to innovative, integrated standards and peer-to-peer architecture, supporting a vast variety of FR operations.** This will be achieved by:
   a. Developing a complete First Responder Unit (FRU) which aims at the total support and increased effectiveness of the FRs’ critical work, comprising of:
      a1. Interoperable wireless communication system; enabling the provision of continuous communication services to the first responders in the field of operations. The communication systems encompass: a) Standard of-the-shelf wireless communication interfaces and capabilities (e.g. GSM, 3G, WiFi, Mobile-WiMax, TETRA) to communicate through commercial networks to the headquarter-based Emergency Operations Centre (EOC) and a Mobile Emergency Operations Centres (MEOC) located close to the field of operations; b) ad-hoc and mesh networking capabilities to enable communication where there is no infrastructure or the infrastructure is severely damaged; c) communication management agent to manage interfaces and configure the communication system.
      a2. Ubiquitous and seamless localization and navigation based on GPS receivers for long range outdoor applications, and LPS (Local Positioning System) with high 3D accuracy and real-time ability for short range indoor scenarios.
      a3. Protective garment specially engineered to seamlessly accommodate:
         ▪ Wearable chemical sensors for the continuous scanning of the environment;
         ▪ Wearable physiological sensors that will continuously monitor the FR’s health status;
         ▪ Wearable motion detection and activity classification.
      a4. A mobile computing element in the form of a covert ruggedized smartphone interfacing between:
         ▪ the above described subsystems and the FR in order to support local data fusion and user interaction, enhance the evaluation of the situation by a multi-parametric approach and record the actual signals for later off-line analysis of the intervention outcome;
         ▪ the FRU and the MEOC supporting coordination and decision support.
   b. A Mobile Emergency Operations Centre (MEOC), which will act as an ad-hoc replica of the headquarter-based Emergency Operations Centre (EOC). This will have all the necessary Information and Communication Technology equipment (computer workstations, communication platforms and necessary software), in order to provide the bridge between the operating FRs and the main headquarters (e.g. main building of Civil Protection Agency), thus increasing situational awareness at the back-office.
   c. A centrally-located Emergency Operation Centre (EOC) that will attain control over remote operations and provide the necessary executive support during crisis situations and will facilitate collection, monitoring and planning in periods of low-intensity work. Main features of the EOC comprise:
      c.1 Communications infrastructure that allows the communication with the MEOC and other civil and military response units.
      c.2 Communication management agent capable to remotely configure communications devices in the FRU and the MEOC taken into account global situation awareness information and implement an Emergency Plan context communication.
      c.3 Logistics Management System that allows the establishment of scientific and reasonable reservation and distribution network of urgency rescue materials to help shorten emergency
A holistic approach towards the development of the first responder of the future

1. Define a holistic approach towards the development of a rescue radius, shaping an emergency logistics network with high timeliness and reducing losses caused by sudden disasters and public health events to minimum.

   d. Defining a full architecture and develop underlying necessary technological backbone, designed to provide improved data fusion, interconnection and interoperability between the different system elements and layers reducing data ambiguity to a minimum.

   e. Integration of different innovative and existing devices (sensors, positioning, communications, mobile devices and garment textiles) and perform the necessary hardware and software enhancements to the aforementioned architecture so that all involved system elements can be seamlessly integrated to the main platform.

2. Study and develop the underlying socio-economic environment where the above technology may operate by addressing:

   a. The emerging training needs for increased operational efficiency of FR Operations of involved players (operating crews and supporting personnel). E-SPONDER will develop a computer-supported simulation environment with an optimization module, to facilitate emergency response planning and training of first responders.

   b. The logistics by designing, developing and running simulation data on an optimization module to precisely identify size, parameters and risk of the disaster area, as well as to assist with the decisions for the location, allocation and management of resources such as personnel, medical supplies, facilities and humanitarian aid to be used in emergencies minimizing risks of casualties.

   c. The regulation framework, legal aspects, and the standardization issues relevant to the project’s objectives and research, as well as the societal implications so as to generate an initial framework for the design and development of suitable First Responder approach in Europe.

3. Demonstrate the developed system and validation of its operational characteristics in full-scale field trials that will simulate realistic emergencies and crises.

The whole system will be tested against a variety of events in 2 countries. A specific testing users group has been setup, covering the diverse nature of different FR disciplines. Different scenarios simulating real life will be considered in order to highlight the added value the E-SPONDER system brings for European or International cooperation.

**Consortium and contact point**

The E-SPONDER consortium consists of the following industrial, academic and research partners:

1. EXODUS S.A. (Greece) - Coordinator
2. University of Modena and Reggio Emilia Italy (Italy)
3. CrisisPlan BV (The Netherlands)
4. PROSYST Software GmbH (Germany)
5. Immersion S.A. (France)
6. Rose Vision (Spain)
7. Telcordia Poland Sp. z o.o. (Poland)
8. Centre Suisse d'Electronique et de Microtechnique SA (Switzerland)
9. SMARTEX (Italy)
10. Technische Universität Dresden (Germany)
11. YellowMap (Germany)
12. PANOU S.A. (Greece)
13. Telcordia Taiwan (Taiwan)
14. Institute for Information Industry (Taiwan)
15. Entente pour la forêt Méditerranéenne (France)

For more information on the project, please contact Dr. Alex Bartzas (abar@exus.co.uk), or visit the project’s web site:

www.e-sponder.eu