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PROJECT FINAL REPORT

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Project acronym: DITSEF

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GLOSSARY

Term	Meaning
2D	Bi dimensional
3D	Tri dimensional
API	Application Programming Interface
CBRN	Chemical, biological, radiological, and nuclear
CC	Command Centre, where the operations are co-ordinated
CCC	Command Centre Computer; a computer placed in the Command Centre, where
CCTV	Closed-Circuit Television
DoW	Description of Work
EC	European Commission
EMI	Electro-Magnetic Interference
EPC	Embedded PC, a PC board worn by First Responders
FB	Fire Brigade
FC	Field Coordinator
FR	First Responder
GPS	Global Positioning System
HMD	Head Mounted Display
HMI	Human Machine Interface
HPTS	Hydroxypyrene - Trisulfonic Acid, Trisodium Salt
HQ	Headquarter
ICT	Information and Communication Technology
IDR	Independent Digital Repeater
PC	Personal Computer
PMR	Private Mobile Radio
RAW	Image Format

R&D	Research and Development
RIP	Recorder Data
SAW	Surface Acoustic Waves
SLAM	Simultaneous Localization And Monitoring
SP	Sub-Project
ToA	Time of Arrival
USB	Universal Serial Bus
UWB	Ultra Wide Band
WP	Work Package

4.1 Final publishable summary report

1 Executive summary

When a natural or man-made disaster strikes a particular area, very often emergency services and communications also get hit, hampering rescue and recovery efforts significantly. In cases where the infrastructure is damaged, first responders must have efficient and ongoing communications with control centres to ensure optimal response and to minimise trauma. This was the aim of the EU-funded project 'Digital and innovative technologies for security and efficiency of first responders operation' (Ditsef).

The project worked on supporting first responders through a network of sensors, localisation and communication systems, particularly in the event of large fires. Sensor technology can help warn against hazards such as gases and toxic chemicals, as well as assist in low-visibility scenarios. This can then be enhanced through indoor localisation network, improved radio data transmission and human-machine interface technology to improve efficiency and security of first responders.

After several workshops and laboratory experiments, the project team completed the proposed security solution and tested it in two different settings, namely a chemical plant and a large hotel area. The technology integrates the latest in indoor localisation, wireless communication, human interfaces, sensor equipment and radar technology, and other key innovations, appreciably facilitating data exchange with higher command levels.

All these technologies have been integrated into an easy-to-use wearable system for every first responder, offering a highly informative open channel to command and control centres. This security solution will be especially useful for European fire brigades and other emergency authorities, enabling quick response times in disaster situations. The project represents another success in boosting technology related to safety and security across the EU.

2 A summary description of project context and objectives

Context

One of the main problems of the First Responders (FR) (fire fighters, police, etc.) in case of crisis occurring at critical infrastructures is the availability of relevant information for the First Responder level and for the local manager. The loss of communications and location, the lack of information concerning the environment (temperature, hazardous gases, etc.) and the poor efficiency of the Human Machine Interface (HMI) on the first responder side are the main current drawbacks. Therefore, during the intervention there is a gap between the First Responders' situation (positioning, health, etc.) and the overall overview at their mobile headquarter.

This project is supported by the FP7 EU Security Research for an amount of 2.8 million Euros.
Key Dates: Starting at 1st of January, 2010. Duration : 39 months
Partners : Ten partners from Bulgaria, Czech Republic, France, Greece, Italy, & Netherlands
Coordinator : Sagem Defense Securité

Expected results

The DITSEF project focuses on the necessary technologies that will allow an enhanced intervention characterised by the terms faster, more efficient and safer. In that respect, the solutions foreseen by the DITSEF project are:

- **Communication**: DITSEF will enhance the communication between the First Responders on the field and between the units and their HQ by providing self-organising, robust ad-hoc communication where the existing infrastructure may be compromised;

- **Positioning**: The provision of accurate 3D positioning in indoor environments is exceptionally difficult for current techniques. Therefore, the DITSEF project will investigate and implement novel techniques, which will take into consideration the operational environment and the end-users' needs;

- **Sensors**: It is of vital importance that, for an operation, the First Responders be equipped with sensors that offer a reliable overview of the situation and of the potential threats (CBRN, fire, etc.), in order to provide more accurate situation awareness and enhanced decision making;

- **Human Machine Interface**: the HMI provided by DITSEF will play an important role in reading, sending and continuity of real-time information.

The aim of the project has been to propose to integrate these technologies in some integrated system through some scenarios validated by the end users.
These new technologies had to respond to the end users needs by bringing them some help in their work.

DITSEF has provided:

- Self-organising, robust ad-hoc communication where the existing infrastructure may be compromised, allowing communication between First Responders and between them and their command level;
- Accurate novel 3D positioning in indoor environments;
- Sensors that offer a reliable overview of the situation and of the potential threats (explosives, chemicals, fire, etc.);
- Enhanced vision for the First Responder in visually-impaired conditions, through ingenious and unprecedented HMIs consisting of sensor-based visual elements, showing spatial features and thermal imagery overlaid on the direct perception of the First Responder.

DITSEF has been implemented by a strong partnership of 10 partners including SMEs and large industries, research centres, technology providers, system integrators and end-users.

Project Objectives

DITSEF aims at increasing the effectiveness and safety of First Responders by optimal information gathering and sharing with their higher command levels.

Ditsef project is organised in 7 Sub Projects and 5 workshops.
Each subprojects is relative to the technical effort lines (Communications & localisation – WP400, Sensors – WP500, HMI – WP600), the project management – WP100, the management of the WS and the End-Users Involvement – WP200, the system definition – WP300, and the final demonstration through outdoor trials – WP700.

Contacts between DITSEF work team and End-Users are intended through five Workshops:

- **First Workshop**: The first workshop has been dedicated to the common and usual scenarios which drive for a FR interventions (analysis of potential threats, typical emergency operations with definition of role of FR according their defined missions).

  End-user inputs: Presentation of some typical infrastructures (arrangement of the buildings, legal constraints, emergency measures) and of typical intervention of FR

- **Second Workshop:** Discussion and analysis of the technical and functional requirement issues.

  End-user inputs: Classification of expected functional requirements in line with defined scenarios

- **Third Workshop:** Presentation by the consortium of the selected technologies (innovated and/or improved) and analysis by End-Users.

  End-user inputs: Analysis and Classification of the most valuable future technical solutions proposed by R&D

- **Fourth Workshop:** Presentation of innovative results proposed by R&D in line with the End-users support.

End-user inputs: analyse and comments with the R&D team of the proposed solutions and first view on the integration in a systemic approach.

- **Fifth Workshop:** Demonstration on site with concrete FR evolving in concrete site and scenario.

  End-users inputs: Discussion on future needs and research plan experimentation and demonstration program.

Results

The Ditsef solution has been defined by analysis of End-Users requirements and some functional system architecture studies. The system demonstrator has been tested in two different settings, namely a chemical plant and a large hotel area.

The following figures present the Ditsef system ; Figure 1 below here below shows a close-up of the mannequin head, with the infra-red camera (orange, on the left side of the head), the head-mount display (in front of the left eye), the head orientation sensor (orange, on top of the helmet), the push-to-talk button for voice communication (blue, in front of the left shoulder), and CEA's positioning tag (grey, behind the left shoulder, partially visible; only the long green antenna is totally visible).

Figure 2 below shows a close-up of the mannequin chest with the chest box and gives evidence of the breathing grid for the gas sensors (on the left of the "DITSEF" writing on the chest box), the command box of the head-mount display (above the oxygen pressure meter), the ergonomic switches (on the left arm, kept there by a rubber band) and the PMR (on the bottom).

Figure 1 - Close-up of the mannequin head

Figure 2 - Close-up of the mannequin chest

A rescue has been operated by 5 FRs in the chemical plant. Figure 3 and Figure 4 below show the Field Commander fully dressed, just before the rescue (front view and rear view).

	
Figure 3 - Field Commander (front view)	**Figure 4 - Field Commander (rear view)**

The execution of the demonstration was successful. The FR could move across the scenario and their positions were constantly tracked at the CC. The tabular presentation of data has allowed to detect the two hotspots of Carbon Monoxide. Thanks to the tracking of their positions from the CC, it was possible to spread the FRs efficiently across the scenario, so that the two victims have been found very soon. In addition, it has been possible to guide (using voice communication) more FRs to the place where a victim had been found, to help pull him out of there.

However, some technical issues remain to be completed or changed in subsequent work done by each partner.

These are mainly the following :

- Disturbance between communication & localisation equipments
- High flow of data between sensors and the embedded PC – Powerful embedded PC
- IR micro camera & SLAM radar achievement to be plug-and-play

3 Description of the main S&T results/foregrounds

Reminder of the context

The scope of DITSEF is to indirectly protect critical infrastructures by means of providing ICT support to First Responders dealing with any crisis situation that might arise in Critical Infrastructure, through effective and cost-efficient designed solutions taking into account the limited financial resources available to both public and private organizations.

DITSEF aims at reducing any delay in response, increasing the effectiveness and safety of First Responders by means of maximizing information gathering and communication with higher command levels, while simultaneously reducing risk and increasing chances of survival for both the rescued and the personnel involved.

The DITSEF project will focus on the needed technologies that will allow for enhanced intervention procedures to be faster, more efficient and safer. In that respect, the solutions foreseen by the DITSEF project are the following:

- **Communication**: DITSEF will enhance the communication among the First Responders on the field, the units and their HQ by providing self-organizing, robust ad-hoc communications in cases where the existing infrastructure may be compromised.
- **Personnel/Vehicle Positioning**: The extraction of accurate 3D positioning in indoor environments is exceptionally troublesome by current standards. Therefore, the DITSEF project will investigate and implement novel techniques, which will take into consideration the operational environment and the end-users' needs.
- **Area/Threat Identification Sensors:** It is of vital importance, in any operation, for the First Responders to be equipped with sensors that offer a reliable overview of the situation and of potential threats (CBRN, fire, etc.), in order to provide more accurate situation awareness and enhanced decision making.
- **Human Machine Interface**: When implementing the aforementioned solutions, First Responders' small time frame must not be ignored. For that reason the HMI provided by DITSEF will play an important role in the reading, sending and continuity of real-time information.

These technologies will be adapted following the requirements of the various end-users that are either partners, or members of the End-Users' Club, specifically paying attention to creating awareness and facilitating end-users' acceptance while being compatible and complementary to legacy.

Ditsef organisation of work

The sub projects (Work Package) have been organised upon the technologies lines on which the project was focused.
The WP100 & WP200 were dedicated to the management and the work shop organisation respectively.
The others WP have been achieved with the following edited reports:

- ❖ WP300 : System preliminary definition

Technical coherence report of subsystems with the system definition and operational end-user needs.
Evaluation of Performance and Roadmap for the system

❖ WP400 : communication & localisation

Definition of the Communication & localisation equipments

❖ WP500 : sensors of environment

Sensors system for quicker and safer operation
Sensors equipment for demonstration

❖ WP600 : HMI

Tactile belt description
Enhanced Vision HMI description

❖ WP700 : Demonstration Trial

Demonstration Plan
Architecture design and interfaces specifications
Demonstrator: validation plan & report
Demonstration report

The present description of the DITSEF project results is set up through the following chapters:

- The context
- The organization of WP
- DITSEF system architecture
- Choice of the components
- The system demonstrator
- The demonstration trial

DITSEF system architecture,

Overview of the system architecture

DITSEF system is set for some FR equipments linked to the Command Control (C2) Centre.
The following figures present the main FR architecture (Commander Version - Figure 6) and the C2 centre one (Figure 5). In the basic version, the FR architecture is mainly setting on communication and localisation equipments with some low data sensors.

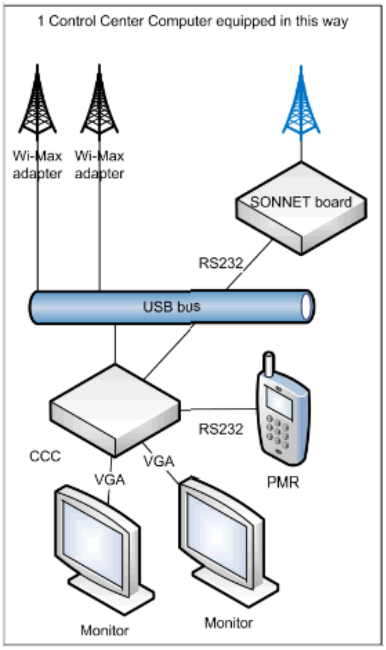


Figure 5 - DITSEF architecture of the C2 centre

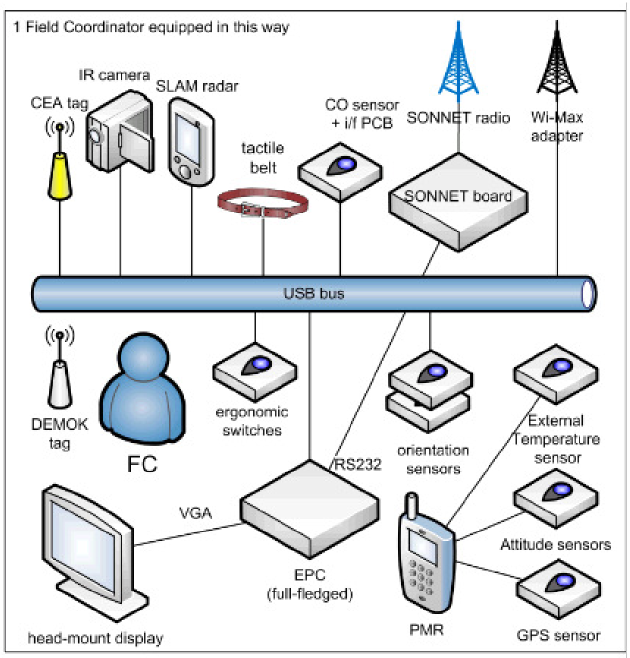


Figure 6 - DITSEF architecture of the FR – Commander version

Architecture elements

The system architecture is presented through the physical integration between the hardware components: each device is placed, how it is kept in a stable and fixed position, how the components are interconnected, i.e. what cables run where. This will include the batteries required to power up all the devices.

FR team members are basically suited with gas sensors, radio and localisation devices. They also get a body sensors and attitude sensors for their own security. In that configuration the FR is equipped with the security set, the radio and localisation devices, but will not get enhanced vision.

FC (or FR commander) wears the same suit as the FR team member but gets an enhanced vision with the SLAM radar, the IR thermal imager and the HMI devices.

The following Figure 7 reports the arrangement of devices. The box worn on the chest is open to air circulation, to allow the gas sensors to sense the gases. The configuration shown is full: for the demonstration, fewer sensors will be used (e.g. some gas sensors will be simulated).

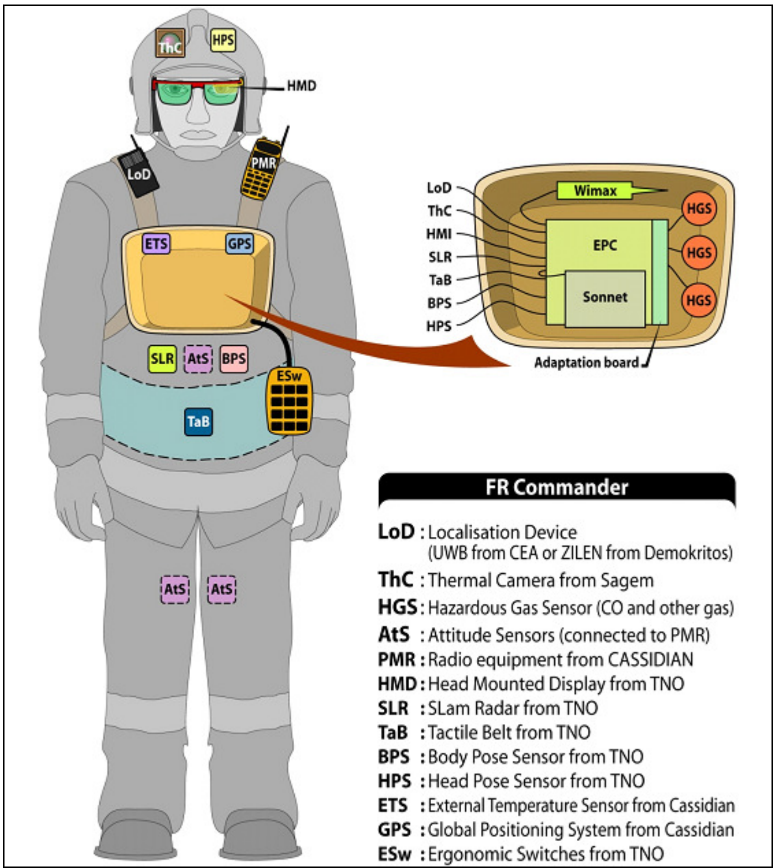


Figure 7 – FR commander suit

At the CC, a single desktop computer will be used. Its feature was following:

- 2 serial RS232 ports
- 4 USB ports
- 2 Wi-MAX adapters (possibly USB-to-WiMax)
- 1 SONNET board connected to an RS232 port
- 1 PMR device connected to an RS232 port
- 2 independent video output, one at 1280x1024 resolution, the other at 640x480
- 2 large monitors (20”), one at 1280x1024 resolution, the other at 640x480. The dimensions of the monitors depend from the number of spectators.
- Power supply

Choice of the components & equipment

DITSEF provides some innovative sensors for chemical (Carbon Monoxide, Oxygen) and physical (ambient temperature, attitude sensors), and for HMI also (head mounted display & tactical belt).

An Infrared camera and SLAM radar are provided by the project to allow infra-red vision in dense smoke and automatic estimation of the distance of objects.

The fusion of sensors, camera and radar data are fused to elaborate and optimise the presentation on the HMI device.

a) Sensor Components

Here below the components developed in the project or procured for the demonstration are listed. For each of them, it is specified which partner will make that resource available, and how many pieces will be provided for the demonstration.

Gas detectors

An innovative chemical substances sensor, using Surface Acoustic Waves (SAW), is being developed by CEA for DITSEF. However this sensor is a laboratory device and not adapted yet for test on the field.
The Ditsef demonstration was performed with commercial gas detectors (from Alpha sense).
One commercial sensor is dedicated to one gas; the PC board shown above (Figure 8), can house two gas sensors. Basically, each FR was wearing a CO gas detector (ref. CO-AX). One FR can be equipped also with an O_2 gas sensor more (ref. O2-A2).

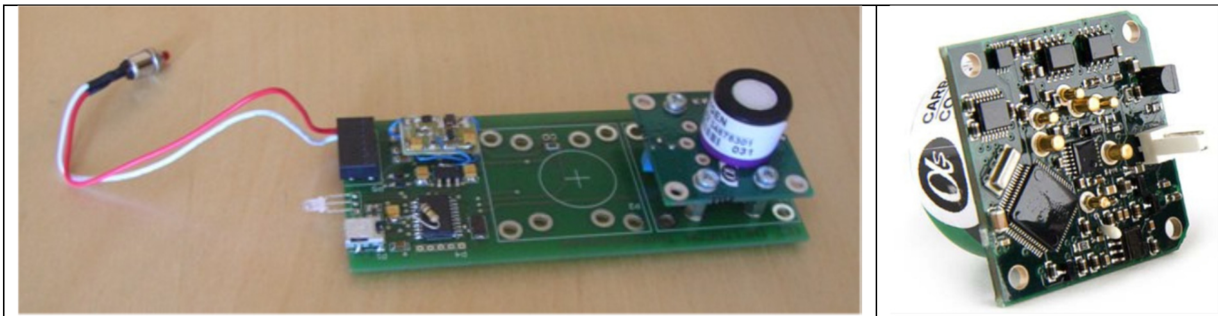


Figure 8 – Gas sensor mounted on a PC board developped by Infitheon.

That demo worked and the use of a report of the CO concentration to the Control Centre is useful. That can be adapted to some other gases if the gas sensor is wearable by the FR.

IR camera

SAGEM has provided an Infra-red camera (Figure 9) which can stand the high temperature of a fire scenario and can allow infra-red vision in that scenario. The data stream produced by this camera, besides being displayed on the in-mask visor of the FR that wears the camera, can be sent to other receivers only through the Wi-Max connection, unless suitable compression or rate reduction techniques are adopted.
Two such cameras have been provided for demonstration.

Figure 9 - IR camera prototype for handeld use.

The IR micro camera worked when plugged to a standard PC and has demonstrated, during the "international Hotel" trial, the capacity to see through smoke and dark environment for localisation of the victims and help the FR.
Unfortunately, the IR micro camera was not be able to link to the Embedded PC and then to be wore by the FR ; the following supposed items are to be examined :

- Default in the USB output board for delivering the high speed data,
- Bug in the API software
- Adaptation of the Embedded PC & Windows XP OS to the high flow of data (same problem for the SLAM radar device)

These items will be analysed by Sagem for the final IR micro camera product.

SLAM radar

TNO has provided a SLAM radar (Figure 10). This is a small device, equipped with electronically scanned antenna that may be worn by a FR, fixed on his/her chest. A 76 GHz wave allows detecting obstacles. The radar will be used to detect the distance of obstacles in the direction where the FR is heading; this information will be used to integrate the infra-red vision that is presented to the FR.
One such radar has been provided for demonstration, although the current radar operates on 10 GHz.

The radar provides a set of numbers representing measured distances for discrete angles. The radar system supports two modes. In the first mode the system calculates for each range/azimuth cell (25 cm range * 7° azimuth) the returned radar power (the raw radar data). In the second mode it provides for each angle a distance estimate to the first object in that direction.

- The distance measures provide much information (perhaps too much for the untrained eye). For that reason, a filter was implemented to detect large objects. The filtered data gives a cleaner look, although it may omit useful information.
- Interfacing characteristics:
  - Physical interface: USB/Ethernet connection.
  - Software interface:
    - This interface provides an array of distance measures in 52 directions (32-bit integers).

- o The array is updated 2 times per second.
  - o Provides access to the DITSEF Database, as defined in the DITSEF documentation.
- Software: A small driver was developed to collect and provide the information. The driver performs filtering to detect large objects.
  Programming Language: C++ combined with MATLAB®
- Power: Supplied by the USB interface, no need for additional power source.

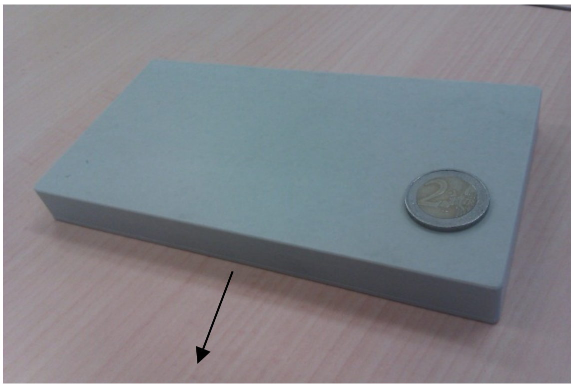


Figure 10 - TNO Radar provided for demonstration. The current radar operates on 10 GHz

The SLAM RADAR is combined with an orientation sensor which is borne by the FC. (cf after for description)

The SLAM radar has been connected to the FR Embedded PC early in the demo ; however, the delivered distance data was sometimes wrong, and it has been decided to presented the device connected to its own PC environment.

The following supposed items are to be examined:

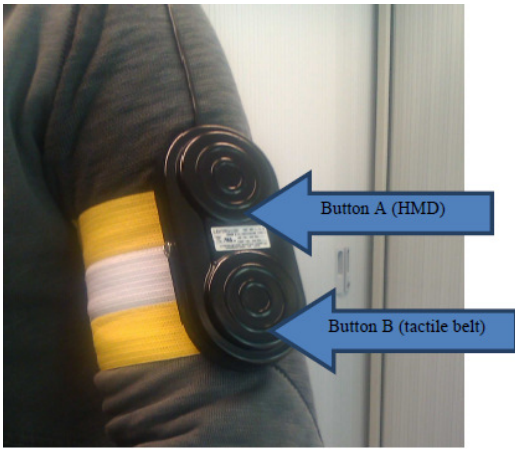
- Default in the USB output board for delivering the high speed data,
- Bug in the API software
- Adaptation of the Embedded PC & Windows XP OS to the high flow of data (same problem for the SLAM radar device)

These items will be analysed by TNO for the final product.

Tactical belt

Tactile displays are displays for the skin (Figure 11). They consist of one or more small vibration elements, called tactors, that are pressed close to the skin. The intensity, rhythm and position of the vibrations can be used to convey information. Now the technology starts to be sufficiently sophisticated to build comfortable, light weight, wearable and easily controllable tactile displays.

An interaction device (Figure 12) makes the FR able to switch the data display on the HMD or the tactical belt.

	
Figure 11 - Inside view of tactile belt	**Figure 12 - Interaction device with two separate buttons, to be worn on the upper arm.**

For the demo the tactical belt has shown the following options:

- Bump alert, i.e., indicate the orientation/direction of the nearest obstacle, wall, as is detected by the radar. Due to the radar problem this option was out of order;
- Warning alert, i.e., indicate that there is a warning/danger alert (also presented in the HMD);
- Exit indication, i.e., indicate the orientation/direction of the exit.

External temperature sensor

The external temperature is sensed with a CASSIDIAN device (Figure 13) fixed on FR suit. It's linked with the PMR equipment via RS232.
These sensors generate external temperature reading of which the FR may be not aware due to its garment. The IDR/PMR system will transport these readings, multiplex them and deliver them to the CCC, as has been described for the GPS-base positioning information in chapter GPS positioning

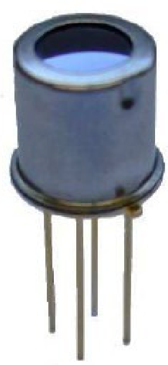


Figure 13 – External temperature sensor

For the demonstration one FR was equipped with one temperature sensor located on his trunk. The temperature value was displayed at the CCC.

Attitude sensors

The goal of such sensors is to detect whether a FR is still operational or needs help from colleagues to be removed from the site.

Attitude sensors (Figure 14) are be provided by CASSIDIAN and are attached via RS232 link to the PMR born by the FRs.
These sensors generate information about the position of the FRs that wear them, in particular whether the FR is standing still on, on knees, laying down, and so on. The IDR/PMR system will transport this information, multiplex it and deliver it to the CCC.

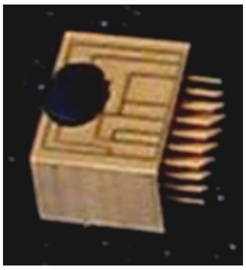


Figure 14 – Attitude sensor

Due to no compatibility between radio devices, the attitude sensors were demonstrated in Montana on a mannequin, equipped with 3 of them.

Orientation sensors

The system architecture accommodate two Orientation sensors (Figure 15), provided by TNO.
Both Orientation sensors are to be be borne by the FC. The stream of data that they produce should be delivered via USB to the embedded PC borne by the FC. On that PC, the data should be acquired and be made available to the graphical application (HMI) that is in charge to present the positioning data of the FRs.
Like for the Infra-red camera and the SLAM radar, the data stream produced by this sensor can be forwarded via Wi-MAX to the CCC, so that the same elaboration and presentation can be performed there, which are performed on the embedded PC of the FC. The orientation sensors are XSens MTi.

Figure 15 – Orientation sensor

The orientation sensors, which should allow to situate camera and radar images in an absolute space, were of poor contribution at the Montana demonstration since the radar was not operational. But the uses of the sensors were successfully demonstrated at a meeting in Athens.

b) Specifics equipments

Localisation

- ELECTRA System (Demokritos)

For the DITSEF project several options have been studied for the localisation function. At the end, we have chosen a Time of Arrival (ToA) localization system. This system utilizes Chirp Spread Spectrum modules in the 2.4 GHz ISM band for gathering ToA measurements, which can be used to estimate the position of a FR via up to 16 beacons and 16 tags.
The DITSEF Flyer, provided by NCSR Demokritos, focused to the ELECTRA system:

- CEA System

In the project we had also studied an another system developed by CEA (Figure 16)
For the Ditsef project, CEA has improved the performance of its localization system. The hardware has been completely reshaped and new electronics have been developed. Table below summarizes these improvements.

	Previous system	**DITSEF system**
Size	17.5 x 10.5 cm	8.5 x 5.5 cm
Autonomy	2h30	7h00
Range	80 m	800 m
Algorithm	PC	Embedded

We notice in particular the range of 800m which is probably the longest range achieved using the UWB technology for positioning.

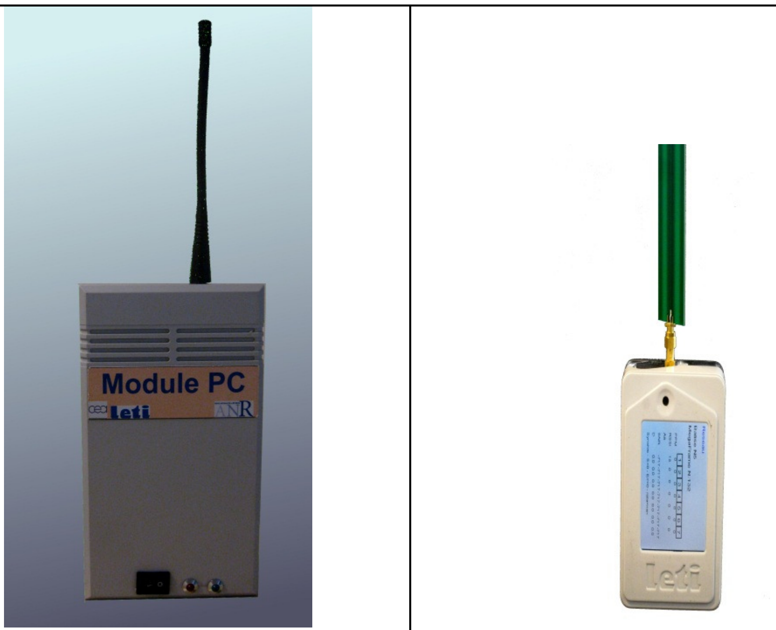


Figure 16 - Previous beacons (left) and new beacons (right) from CEA localisation device

New positioning algorithms have also been developed to enable embedded processing. In addition, these new algorithms have better immunity to outliers, making the system more robust in harsh environments like the chemical plant for instance.

The contribution of CEA to integration was two folds:

- Software specific design
- Tests and measurements

For the purpose of the CEA localisation presentation, CEA has designed a new software interface (Figure 17) to show positioning data.
This software features:

- 3D modelling of the chemical plant and the hotel
- Marking capability of specific points on the scene
- Alert messages support

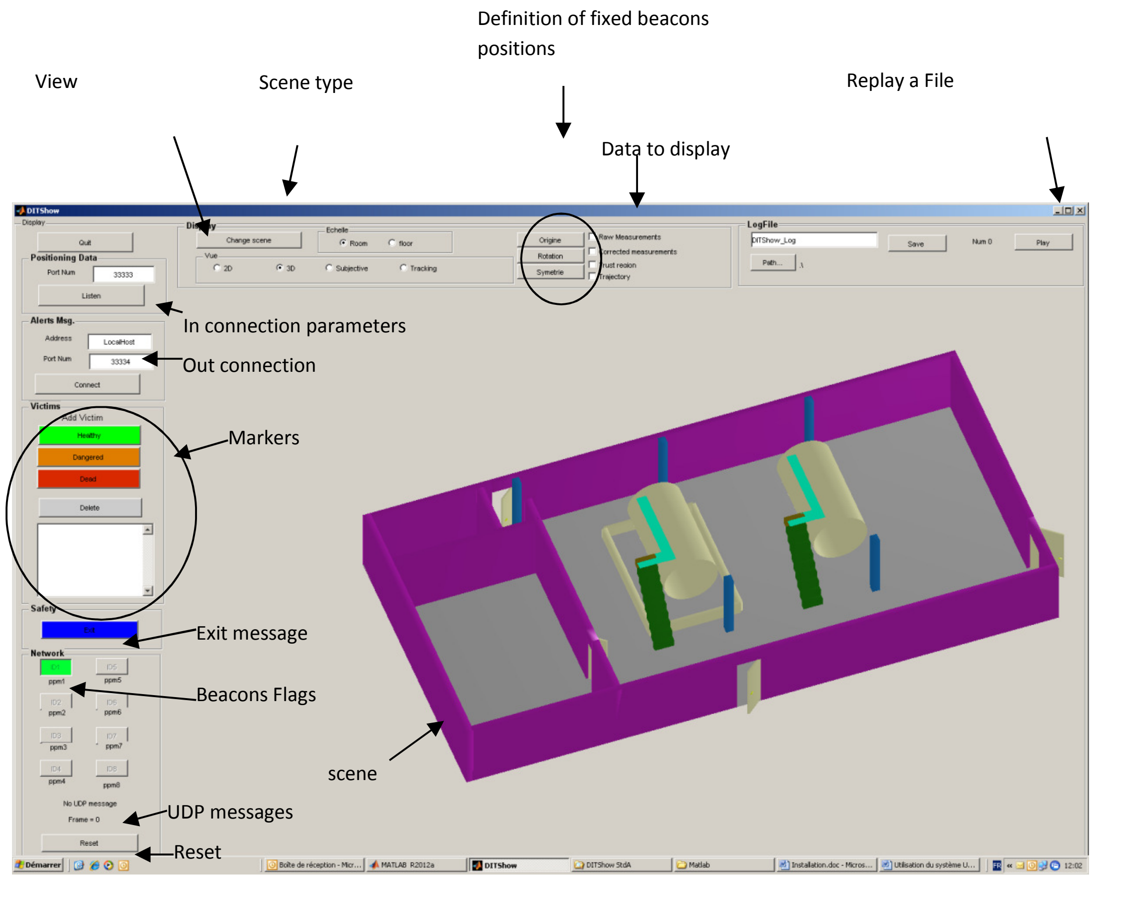


Figure 17 - presentation of CEA positioning interface

Measurements have been made on the chemical plant to test the proper functioning of the localization system (Figure 18).

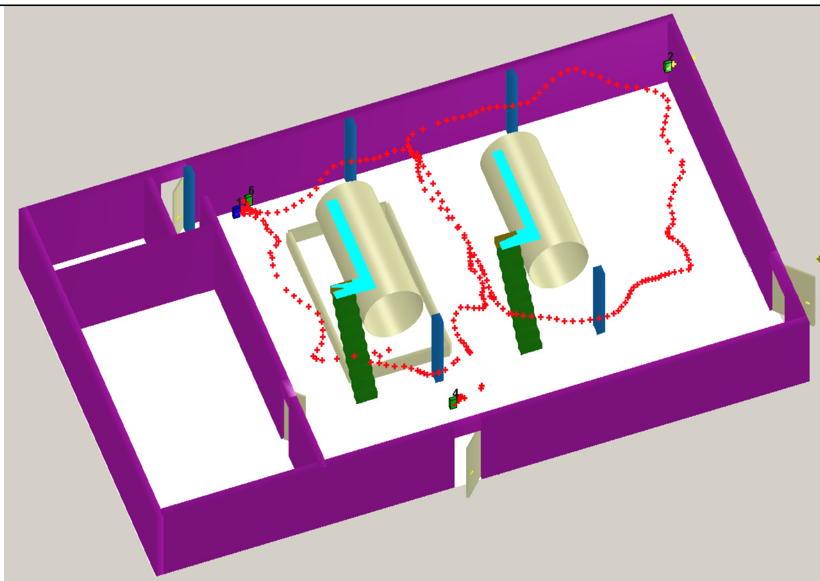


Figure 18 - results of localization tests in the chemical plant – moving trajectory

IHM from Demokritos

For the purposes of demonstration and for more efficient End-User Validation, partner DEM designed and implemented the ELECTRA graphical user interface and C3 application (Figure 19), which enabled display of sensor data in the form of easy-to-read gauges in order to facilitate the work of the C3 personnel. Screenshot follows:

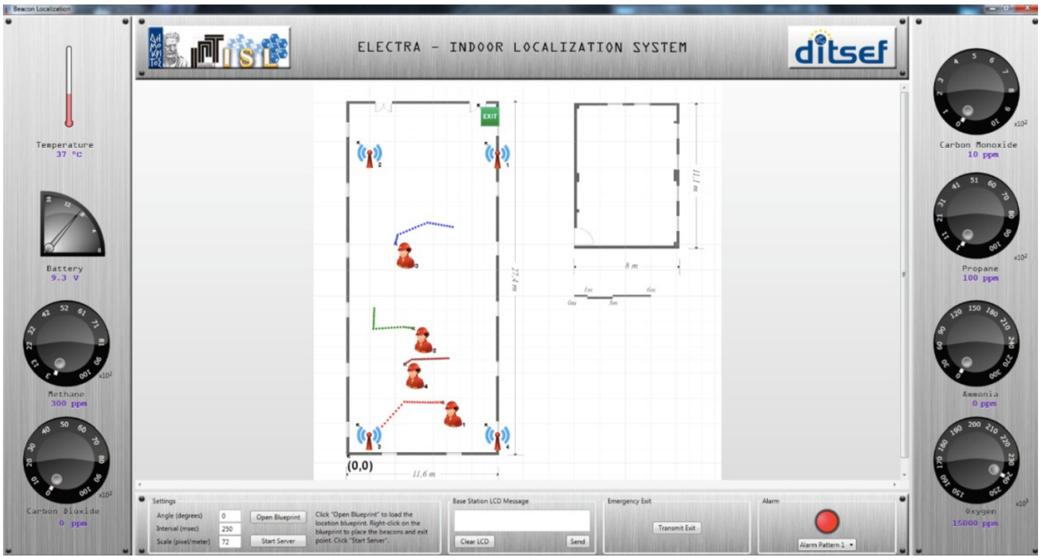


Figure 19 – ELECTRA user interface from Demokritos

The C3 application had the following features:

- Full screen support, with real-time visualization of First Responders position (through position data message decoding received through Base Station broadcasting).
- Availability of loading various blueprint images' format (BMP, JPG, GIF, PNG) as infrastructure UI map.
- Support up to 5 First Responder (Tag) concurrent visualization on the map.
- First responder and Beacon drag-able icons to ease initial ELECTRA system set-up.
- Sensor data (temperature, battery, methane, butane-propane) are presented on gauges to make UI more intuitive to the user/commander.

Partner DEM also conducted necessary integration work on the C3 Electra GUI for integrated visualisation of localization, sensor telemetry, Alarm patterns transmission, Text-Messaging and real time camera feed.

Head mounted display from TNO

HMDs are used for providing visual information to users who are not located at a fixed position at and therefore can't use a regular image display on a desk (Figure 20). A typical consumer application of this type of HMD is a traveller watching TV or surfing the internet while sitting in the train or waiting at the station.
HMDs are useful when the user has to move around and in the same time also wants to look up information that is connected with locations in the environment of the user. HMDs are especially

useful when the real world of the user can be enhanced with additional information that is not visible by direct vision, e.g. infrared and radar.
The challenge of a HMD design is to use robust technology to organize and present information in a way that meets the expectations and abilities of the user. A typical HMD has a small light weight display with additional optics to lead the visual information to the eyes of the user.
The goal of the application of HMDs in a working environment is to improve the performance of the user. The HMD should help the user to accomplish the task more quickly, accurately, safely and with less effort. In case of fire fighters: better navigation through a burning building and locate and find victims more quickly and avoiding dangerous spots (e.g., fire, gas).
The design and use of visualizations for HMDs requires a systematic approach, where user requirements should be established whose degree of fulfilment is measurable.
As stated in the introduction, their current challenges include limited communication means, limited information on the environment and other FR's and low usability of existing HMI's (if used at all).
The DITSEF HMI was aimed to address these challenges.

Figure 20 - Firefighter professionals participated in the end-user assessment at TNO

Communication

In DITSEF, the terminals and the IDR work in tactical mode, they are not connected to the TETRAPOL network infrastructure. The PMR network is in charge to ensure voice communication because of its main characteristics i.e. its extreme reliability and the possibility to carry data without hampering voice communication (voice is given priority). Although PMR can be interfaced to the rest of DITSEF, the PMR subsystem is autonomous, i.e. it does not need the rest of DITSEF to operate.

The PMR solution for tactical mode is based on the Independent digital repeater (IDR – see Figure 21) developed in WP400 ; the IDR features are the followings:

- Voice and data, with possibility of interconnecting to an operating room
- End-to-end encryption

- Installation in a building or in a vehicle (19' rack)
- Easy to deploy (operational in less than one minute)
- Compliant solution for public building infrastructure coverage requested by European authorities
- Operates with all types of TETRAPOL radio terminals
- IP interconnection between several IDR cells to create tactical macro cell
- Channel dedicated to IDR mode (voice communications independent from TETRAPOL network communications)
- Extension of network radio coverage through a gateway
- Ideal solution to back up network radio cell (connected with Radio Access Gate)
- Management and remote supervision by an Ethernet link with HTML pages embedded in the equipment.
- Monitoring of internal alarms (dry contact).

	
Figure 21 - Independent Digital Repeater (IDR) from Cassidian	**Figure 22 - Cassidian HMI on android tablet**

For the Ditsef project, Cassidian developed the data on the Independent Digital Repeater. This solution was fully tested and successfully working for the final demonstration.
The Independent Digital Repeater 3G Indoor (IDR 3G IDO) has been added to Cassidian portfolio.

IDR 3G IDO presentation: the CASSIDIAN® M9665 C 3G IDO is designed to provide secure group data and voice communication.
It is used to create RIP radio coverage independently of or as an extension to TETRAPOL network coverage (coupled with the radio AG) and is compatible with every type of TETRAPOL radio terminal. In addition it has the benefit of high quality radio coverage over a wide area, by interconnecting RIP cells over an IP link.
As it is easy to install and quick to use, the M9665 C 3G IDO is instantly operational. Compact (19'') and rackable, it can be installed in a building or in a vehicle.

New gas sensor

The CEA has developed a new SAW (Surface Acoustic Wave) device for the DITSEF project. Because this SAW is running with a filter, we have chosen, with the help of the end users, two gases for the demonstration trial: NH_3 and H_2S.

<u>Gas detector</u>

- Problematics of the SAW detector

It is reminded that, in the framework of DITSEF, the present research aims basically at adapting the SAW (surface acoustic wave) detector to the quantitative and selective detection of NH_3 and H_2S gases. Actually, there are no commercial detectors able to discriminate them. The SAW components are covered with a thin layer of DNP (diamond nano particles), which present the advantage of being very stable over time and an easy interface with specific chemical receptors. During the third period we worked on reliability demonstration of NH_3 detection and tuning of NH_3 and H_2S filters.

- Influence of flow rate and concentration of gas to be detected

The goal of this study is to assess sensitivity of the SAW device. Measurements demonstrated that the sensor response is proportional to the flow rate (until the saturation limit of flow rate). This result shows that it is possible to tune the sensitivity of the response by varying the flow. Reciprocally for a given flow rate the sensor response is proportional to the gas concentration (until the saturation limit).

- Study of reproducibility and stability of the sensors

Four SAW sensors with the same –OH coating were simultaneously exposed to NH_3. They showed very similar responses and this was demonstrated for various flow rates and various concentrations. In a second step, the sensors were only exposed to nitrogen and the all responses returned to the initial value. This means that the SAW surface is not modified by the exposure to NH_3.
The conclusion is that the four sensors have the same response and that the responses are reversible. We have a robust sensor.

- Tuning of sol-gel gas filters

For NH_3 filters:

In the first step, sol-gel monoliths doped with HPTS (probe molecule) were exposed to a flow of NH_3. Ammonium salt appeared; this prevented the reaction between HPTS and NH_3 then the normal functioning of the filter.
In the second step, another probe molecule (being patented) was tested for NH3 filtering. The filter was placed upstream the SAW device and their efficiency for NH_3 trapping was confirmed: the SAW response showed clearly the breakthrough curves, along with the colour change of the filter.

For H_2S filters:

The objective is to trap selectively H_2S without interfering with the gas to be detected, NH3. A probe molecule was chosen (being patented). The sol-gel monolith was exposed near an H2S source. The monolith, changed color (from yellow to dark green) when saturated, showing the efficiency of the chosen probe molecule.

The studies on the SAW detector were performed according to the initial programme. Nevertheless the present detector is a lab device for upstream/feasibility studies, not convenient to be worn by FR (weight, dimensions, necessary batteries...), and fragile (not adapted to transportation and not temperature/shock withstanding). These are the reasons why the SAW detector was replaced by much more operational commercial detectors (but not as precise and selective).

The system demonstrator

A Distef system demonstrator has been built up and was presented during an indoor presentation session.

A mannequin was demonstrated, fully dressed up with the complete DITSEF system (it is shown on the left in the next picture - Figure 23). In addition, the Control Centre was demonstrated as well which was made of a single mini-tower computer (on the ground close to the foot of the desk) and two monitors where the CCC applications were run.

Figure 23 - Indoor presentation/demonstration of DITSEF

Figure 25here below shows the FR commander with the infra-red camera (orange, on the left side of the head), the head-mount display, the head orientation sensor (orange, on top of the helmet), the push-to-talk button for voice communication (blue, in front of the left shoulder), and Ditsef satchel with PC, gas sensors and miscellaneous inside.

Figure 24 below shows a rear view of the FR commander with CEA localization infrastructure fixed on the top of air bottle.

Figure 24 - Field Commander (rear view)

Figure 25 - Field Commander (front view)

Figure 26 - Demokritos positioning system

Figure 26 shows Demokritos' localization infrastructure, made of the Base Station (the big device on a tripod), the beacon (the small device on a tripod) and the tag (the small device on the shelf).

Finally, Figure 27 shows some of the Control Centre applications, in particular the sTABC application (bottom left), with tabular presentation of low-rate data, and the HMI window (top left) with an image from the infra-red camera.

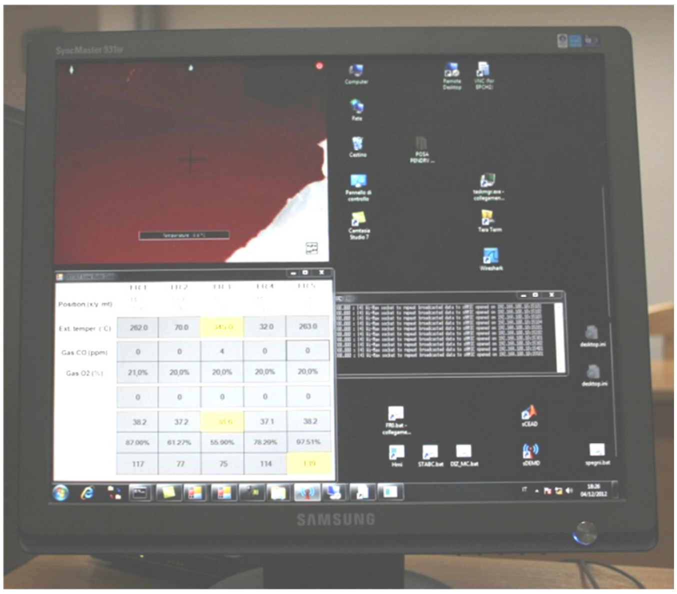


Figure 27 - sTABC and sHMIC

Figure 28 shows the sDEMD application from DEMOKRITOS at the Control Centre, displaying the positions of the First Responders.

Figure 28 - sDEMD displaying the positions of the FRs in the Chemical Plant

Gas detectors during the demonstration

During the final project demonstration done in Montana (Bulgaria) in December 2012, each of the four first responders was equipped with CO sensors. MES had prepared a CO source in the demonstration buildings (actually a transportable oil motor, located outside the buildings, delivering CO gas, at a safety level, through a pipe to the relevant buildings).

Selex had tailored screen displays in the command post to monitor the sensor responses. During the experimentation a table displayed on the PC screen showed permanently the CO gas rate measured by each FR's detector, with yellow and red flashing signals when 2 predetermined warning gas thresholds were reached.

The command post displays showed clearly that positive CO sensor measurements were appearing and increasing (with possibly warnings activated) when the first responders were approaching the CO source (the localisation of first responder was insured by the Demokritos localisation device). This clearly demonstrated the feasibility of the use and the integration of gas sensors in a complex management software / transmission system.

This demonstration was possible thanks to the successful work done by Selex and Demokritos.

Figure 29 - View of the global Command Control Center

Localisation and communication devices during the demonstration

When demonstration working and during the preparation tests also, some interferences appeared beetween both localisation & communication devices. Two main artefacts have been found :

- The CEA localisation system is a based on a wide band reception and once has been disturbed by the PMR emission. That unique case must be analyse by CEA for further application.

- The ELECTRA system has been disturbed once by the Cassidian IDR radio data system, during the “International Hotel” demonstration. It was supposed to be coming from the high level of output energy of the IDR, but that system has been developped to be used in firebrigade trucks and police cars, and is respecting the whole of public safety standards ; that point must be analysed by Demokritos and Cassidian.

A demonstration within two scenarios

a) Execution of rescue at the chemical plant

A rescue has been operated by 5 FRs in the chemical plant (Figure 30). Figure 31below show the Field Commander fully dressed, just before the rescue.

The **execution of the first realistic demonstrations** was successful. The FR could move across the scenario and their positions were constantly tracked at the CC. The tabular presentation of data has allowed to detect the two hotspots of Carbon Monoxide. Thanks to the tracking of their positions from the CC, it was possible to spread the FRs efficiently across the scenario, so that the two victims have been found very soon. In addition, it has been possible to guide (using voice communication) more FRs to the place where a victim had been found, to help pull him out of there.

The whole execution of the first realistic demonstration lasted 15 minutes.

In this scenario, the First Responders have been able to accomplish their mission, find and rescue 2 victims and find 2 hotspots of Carbon Monoxide.

Figure 30 – Chemical factory

Figure 31 – FR Commander entering into the Chemical factory

b) Execution of rescue at the hotel

A second realistic scenario had been prepared at the International Hotel, the unfinished building selected for that demonstration. Figure 32 shows the Hotel.

Figure 32 - International Hotel

Like for the Chemical Plant, the hotel had been darkened, obstacles and noise sources had been introduced and victims (simulated with mannequins) had been hidden in the hotel, as well as hotspots of heat and of Carbon Monoxide. Figure 33 below shows three heat generators and some obstacles, while Figure 34 shows a simulated victim, partially buried under debris.

Figure 33 - CO hotspot and obstacles

Figure 34 - A simulated victim under debris

Depending on the severity of injuries, the victims were marked either with a bracelet on the hand, or an embossed button on the clothing (see Figure 34). The FRs had been instructed to comply with these indications and extract the most severely injured victims first.

This scenario could not be completely executed because the positioning system did not work properly as mentionned in the § "Localisation and communication devices during the demonstration" - Page 30 . Figure 35 below displays the map of the hotel.

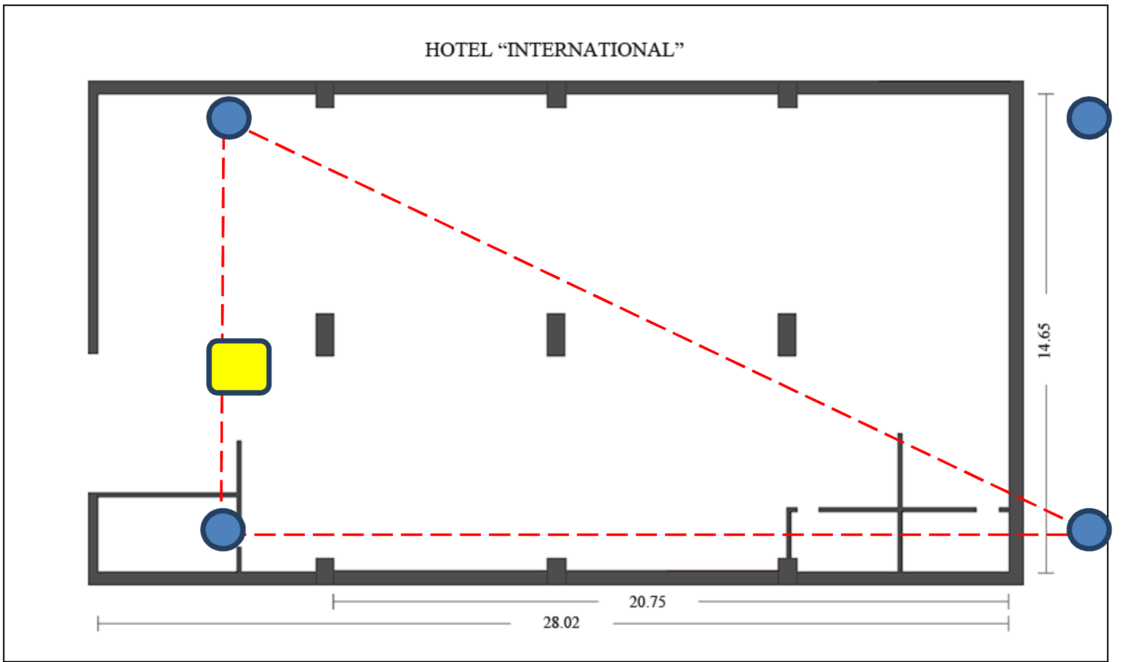


Figure 35 - Map of the International Hotel

The positions are marked of the Base Station (yellow box) and of the 4 beacons (blue circles).

The red dashed triangle shows the area in which the positions of the FRs were reported, however when the FRs exited from that triangle, their positions were reported still along the border of the triangle.

Three developers of the positioning system (Demokritos) were available on-site so the issue could be very quickly analysed but unfortunately no correction was possible. According to Demokritos, the issue was due to a very strong interference from Cassidian's IDR, which transmitted at a high power, thus saturating the input preamplifier of the radio circuit of the positioning devices.

According to Cassidian experts, the IDR was transmitting at the same power than the terminals used during the frequency interference tests, where no interference was detected between both systems. We could only observe that during the first trial, when the IDR had been placed by Cassidian inside the building, no localization at all was possible; then the IDR was moved out of the building, at about 40 m distance, and the localization became possible but only inside the triangle. No conclusion is possible at this step, and Demokritos & Cassidian must analyse that issue.

c) Main lessons and experiences from the Ditsef project

The plans that did not work

WiMax : It was initialy plan to use a WiMax antenna (5GHz) for the whole data transmission between FR and CCC. Because of the overcrowding on the FR it was decided to put a Wifi antenna with it small control box. However, the WiMax is needed.

Radio interferences : The Ditsef system is making with radio PMR, radio Sonnet, Localisation UWB (433MHz), Localisation on 2,4GHz, and Wifi (2,4Ghz). Due to Energy compatibility and Interferences, we have got one main disrupting point between Radio PMR and Localisation UWB.

Tactical belt : The tactile belt has been tested, demonstrated,and used in DITSEF experiments since 2011. For some reason the tactile belt did not work properly during the final demonstration. It could have been caused by mechanical interruption. This should be investigated.

Micro IR camera : The micro IR camera has been presented working on the demo but plugged in a standard PC only. It was no more time to make it compatible with an Embedded PC & Windows XP OS; it would be also useful to get a more powerful embedded PC in the future.

SLAM Radar : same point as Micro IR camera.

Gas sensors : As far as ergonomics is concerned, display of the numerical gas rates is interesting for the CCC, but do not look essential for the FR, and even may be impairing since the FR face a lot of information data. Just the alert signals should be displayed to the FR.

Temperature sensors : Same remark about ergonomics as the gas sensor.
Attitude sensors : Although working as expected, the algorithms of position inferred from the sensors data should be refined, since some particular positions were not clearly detected.

Obstacles encountered

Scenario 2 : The complete achievement of that scenario had not be possible due to a strong interference between two device, as mentionned before. Nevertheless, the demo has been done for its main objectives (discovering victims and rescuing in a hard environment) without a precise self localisation of each FR.

End-users feedback on ergonomic aspects

During the last WS5, the invited End-Users made some useful comments on the demo and the system.

- For the suit : Volume, size & weight have to be smaller for an operational system. A kind of life vest would be better with some pockets around for putting the devices inside.
- About the system itself : Strong interest of using the localisation device for FR (position report to the CCC) and for victims (Tag position when finding a victim). Another point is the great interest to get some communication between the FR.
- About the HMI : It's very useful to get voice orders and inlays in the picture during urgent situations.
- About the CCC : The CCC data are usefull but a little bit confusing ; End-users can help to the definition of the data presentation on the CCC.

Future work to be performed

The work to be done in the future for an operational DISTEF system is explained well in the “D110.7 - Exploitation plan”.

Mainly, both micro IR camera & SLAM radar devices have to be improved on about their USB link capabilities.

The Embedded PC must be more powerfull with high data flow capability.

Then, the localisation & communication devices have to be upgraded in terms of compatibilies and size.

4 The potential impact (including the socio-economic impact and the wider societal implications of the project so far) and the main dissemination activities and exploitation of results

Main dissemination activities

a) Scientific papers

During the DITSEF project duration, 10 scientific papers have been produced. All these papers involve a full reference and acknowledgement of the DITSEF project.

b) Participation to conferences

DITSEF has been represented during three mains conferences:

- European Research Conference, Belgium, September 2010.
- PSC Europe Forum Conference, Austria, June 2010.
- 56th Annual Meeting of the Human Factors and Ergonomics Society, Boston - Massachusetts, October 22-26, 2012

c) Participation to workshops, exhibitions and infodays

DITSEF has also participated to workshops, infodays and exhibitions as mentioned below:

- European Materials Research Society 2012.
- E-SPONDER Kick-Off Meeting, Greece, July 2010.
- Information Day in Interoperability, Italy, May 2011.
- EXPOSEC, Greece, March 2010.
- STRAW, Spain, March 2010.
- The 20th International Trade Fair for Security and Fire Protection
- E-SPONDER Workshop, France, April 2012.
- Essen Security Even , September 2012

d) References in Mass media

DITSEF has been mentioned in an interview and media presentation within the context of a Greek technology-oriented show. Dr. N. TSAMPIERIS, representing INFITHEON, promoted DITSEF and its objectives and goals, also pointing out the main website. The entire article (http://technologein.pathfinder.gr/infitheon-icerberus/) is available on the internet site http://technologein.pathfinder.gr which has an average number of 1.6 million visitors.

Furthermore, in the context of the Final Demonstration that took place in Montana, Bulgaria, the Bulgarian press made significant references to the DITSEF solution:

1. Radio Darik news
   http://dariknews.bg/view_article.php?article_id=1005670
2. National Newspaper 24 hours
   http://www.24chasa.bg/Article.asp?ArticleId=1662686

   http://montana-dnes.com/modules.php?name=News&op=SeeNews&id=5736
3. Regional newspaper Mont press
   http://www.mont-press.com/index.php?

Exploitation of results

Added value of DITSEF project

DITSEF demonstrated the possibility of improving FR's efficiency by reducing the time delay for information transmission, localising more easily the people involved knowing their behaviour, and improving perception of the environment.

For that purpose, some equipment have been developed or improved and dedicated software has been done.

Exploitable Knowledge and its use

The exploitation intentions of the consortium are seen in two parts:

- Results aiming at promoting new standards ; there will be a free dissemination of information,
- Results which are close to the pre-competitive level. Each partners intends to exploit these results and the market opportunities is further presented.

Some exploitation areas have been identified for these both kinds of results:

- Low cost IR Sensor, with specific adaptation to the FR environment in term of strength & heat resistance, and thermography image processing,
- Localization device and the deployment procedure
- Communication with the demanding high level of the data transmission rate
- HMI for the easiest exploitation

For the four technical parts (communication, localisation, sensors, HMI) of the project, we have identified the below exploitation results.

1. Communication

TETRAPOL communication

CASSIDIAN provided modifications on actual PMR repeater by adding DATA communication capability. This improvement is useful to add some new functionalities for the First Responder like:

- Transmission to the command centre of the First responder attitude,
- Transmission of the body temperature to the command centre.
- Transmission of the position of the first responder

SONNET communication

INFITHEON Technologies provided some new interfaces of its SONNET device linked with the embedded computer, and will enhance the integration.
SONNET provides communication for warnings and localisation data to the Command Center.
The SONNET communication frequency shifted from 902 MHz to 868 MHz to comply with the European Standards on radio frequencies.

Embedded computer

INFITHEON Technologies provided an embedded computer adapted for the first responder. This computer manages a high rate communication system, combined with low weight and small dimensions.
Due to the different mission of the FR Commander and the FR Team Member, it has been used two kinds of embedded computers. It will work on only one kind of computer in the future, due to the technical progress of miniaturisation devices.

2. Localisation

UWB Localization system

The CEA partner developed a new interface (interfacing with the embedded computer) which enhanced the performances of the equipment.
The new system is composed of two boards packed together in the same box.

- The "UWB board" performs all the radio-ranging tasks. It could be stand-alone.
- The "Processing Board" is stacked on the "UWB board" from which it retrieves the ranging data, and performs the computation of the positions. Results can be broadcasted through a USB connexion to the Embedded-PC or display them directly on a tactile LCD screen.

The Enhanced Location Estimation and Tracking System (ELECTRA)

In the context of DITSEF partner DEMOKRITOS designed and developed the tracking system ELECTRA (Enhanced Location Estimation and Centralized Tracking) along with a platform for supporting add-on components for First Responders. ELECTRA was based on the Chirp Spread Spectrum (CSS) technology at 2.4 GHz, and compared to similar systems offers enhanced performance accuracy as well as faster setup capabilities due to lack of need for offline calibration, making it suitable for fast deployment emergency scenarios and applications. The system primarily offers accurate location estimation both indoors and outdoors, and under extreme situations like e.g. the existence of thick smoke due to fire. ELECTRA's base infrastructure includes wireless devices called beacons and a base station, all devices being highly portable, lightweight and suitable to be carried around and easily deployed by First Responders. First Responders can then continue their search and rescue operations, while being tracked thanks to a matchbox-sized wearable mini device, the ELECTRA tag. The position of first responders is not only shared across first responders but also to the command and control centre of the operations, visualised effectively through a developed by DEMOKRTIOS monitoring application, presenting the location and movements of all first responders on the area map.

Moreover, the ELECTRA base station also offers a platform for adding supporting sensors, like e.g. dangerous gas and chemicals detection sensors, temperature sensors and other. The platform also supports an acoustic alert sub-system for announcing alerts in extreme emergency cases, like e.g. initiating an immediate evacuation of all first responders. Finally, another co-operating sub-system which was developed includes an infrared camera, allowing transmission of live video feed to the command and control centre.

ELECTRA is already demonstrated and disseminated in various occasions throughout the duration of DITSEF. It was successfully presented at the World Forum for Security and Fire Prevention, at Essen, Germany in September 2012. It was also successfully tested during two field trials in collaboration with the Fire Brigade of Bulgaria, at Montana test sites in December 2012. End users reported that the location and monitoring information provided by the ELECTRA system are very helpful for their operations.

3. Sensors

Infrared camera

For this project SAGEM has developed an infrared camera for the security market. The main advantages of this camera are:

- A highly integrated modular design
- A low consumption thanks to the use of portable equipment
- A complete software, image and thermograph processing integrated in the infrared camera
- Enhanced image processing (superior image quality):
- A competitive price for this market

The next step will be to industrialise this device for safety and security applications.

The image processing development, delivered for DITSEF project, has been oriented by the expression of functional needs of the end-users. It still will be improved, mainly through some end-users survey for testing the ergonomic of the image presentation.

SAW Gas sensor

In an industrialized version (which is not the stage at the end of the project), the SAW detector will be able to selectively detect several gases according to the choice of the first responder. Two versions could be contemplated according to the gas spectrum and concentration ranges proposed:

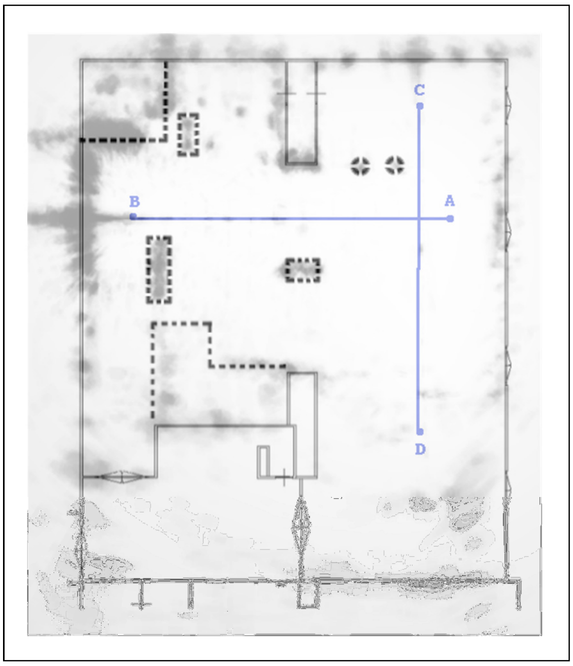
- A version equipped with upstream filters, dedicated to the very precise detection of a specific gas.

- A cheaper version without sol-gel filters, equipped with a series of elementary differentiated SAW sensors, devoted to the multi-detection of harmful gases (featuring different “SAW signatures”).

It should be noted that an industrialization phase is needed for the adaptation of devices to ground use as well as for extending the detection range of the SAW detector to other gases than NH3 or H2S.
In commercial version, the sol-gel gas detector can be used separately and have the form of a thin plastic case for example 8cm in length including colorimetric matrix. The colour of matrix changes after exposition to a certain quantity of the relevant gas.
For consumers, the detector can be used as such and is not expensive. For professional use the toxic gases can be analysed (daily for example) by using an instrumentation based on the principle of absorption measurements. This method is much more accurate.

SLAM radar

TNO partner developed a radar system that can be worn on the body and serves to observe objects through smoke and in darkness. In addition, this radar allows for Simultaneous Location And Mapping (SLAM). Thereby the system can “memorize” what it has seen before and thereby it builds a complete and actual map of the building. This feature is adding to the already available positioning information and offers the FR guidance on his or her way back..
Electronic antenna steering makes the radar highly robust and, in combination with modern semiconductor technology, extremely small and light-weight. Also power consumption is very low.
An example of a SLAM image is shown below (overlay of SLAM image and actual building map):



4. *Human machine interface*

End-users needs

The user needs for the DITSEF system were studied in workshops with end-users, which led to enhanced vision concepts for First Responders:

- "See through smoke"
- "See other people"
- Alerts restitution

These concepts are generic and reliable for a final and commercial system.

DITSEF HMI

An adaptable HMI is required to efficiently use systems by humans. In the DITSEF project, the user requirements were sometimes described at a too high level to be useful in the design. As a consequence, the DITSEF HMI only addressed "features to demonstrate" which were based on information provided by the available sensors..

The T-SOFT partner adapted the HMI software to the needs of DITSEF. TNO designed the HMI to improve First Responder's situation awareness through integrated

- Advanced augmented vision (integrated direct view, IR camera view, radar view)
- Tactile feedback.

The final demonstration was the occasion to get First Responders' opinion concerning the use of DITSEF HMI for an industrial product.

The next step will be to industrialise the obtained DITSEF HMI knowledge in safety and security applications, in cooperation with industry.

5 The address of the project public website, if applicable as well as relevant contact details.

Partner name	Country Name
Sagem Defense Securite (SDS)	France
Nederlandse Organisatie voor toegepast-natuurwetenschappelijk Onderzoek (TNO)	Netherland
EADS Defence and Security Systems (EADS)	France
Center for Security Studies (KEMEA)	Grece
Commissariat à l'Energie Atomique (CEA)	France
Selex System Integrati (SSI)	Italie
National Centre for Scientific Research “Demokritos”	Grece
INFITHEON Technologies Ltd (INFI)	Grece
T - SOFT spol. s r.o.	PrahaCzech Republic
Ministry of Emergency Situations Territory Depertment”Civil Protection”- Montana Region	Bulgaria

Attached documents :
Furthermore, project logo, diagrams or photographs illustrating and promoting the work of the project (including videos, etc…), as well as the list of all beneficiaries with the corresponding contact names can be submitted without any restriction.

4.2 Use and dissemination of foreground

A plan for use and dissemination of foreground (including socio-economic impact and target groups for the results of the research) shall be established at the end of the project. It should, where appropriate, be an update of the initial plan in Annex I for use and dissemination of foreground and be consistent with the report on societal implications on the use and dissemination of foreground (section 4.3 – H).

The plan should consist of:

- Section A

  This section should describe the dissemination measures, including any scientific publications relating to foreground. **Its content will be made available in the public domain** thus demonstrating the added-value and positive impact of the project on the European Union.

- Section B

  This section should specify the exploitable foreground and provide the plans for exploitation. All these data can be public or confidential; the report must clearly mark non-publishable (confidential) parts that will be treated as such by the Commission. Information under Section B that is not marked as confidential **will be made available in the public domain** thus demonstrating the added-value and positive impact of the project on the European Union.

Section A (public)

This section includes two templates

- Template A1: List of all scientific (peer reviewed) publications relating to the foreground of the project.
- Template A2: List of all dissemination activities (publications, conferences, workshops, web sites/applications, press releases, flyers, articles published in the popular press, videos, media briefings, presentations, exhibitions, thesis, interviews, films, TV clips, posters).

These tables are cumulative, which means that they should always show all publications and activities from the beginning until after the end of the project. Updates are possible at any time.

TEMPLATE A1: LIST OF SCIENTIFIC (PEER REVIEWED) PUBLICATIONS, STARTING WITH THE MOST IMPORTANT ONES

NO.	Title	Main author	Title of the periodical or the series	Number, date or frequency	Publisher	Place of publication	Year of publication	Relevant pages	Permanent identifiers[2] (if available)	Is/Will open access[3] provided to this publication?
1	Indoor localization with wireless sensor networks	Thomopoulos		*No 43, March 1990*	*Publications of the European Communities*		*2010*	*pp. 441 – 471 Vol 109*		yes/no
2	WAX-ROOM: an indoor WSN-based localization platform	Thomopoulos		April 5-9, 2010		Orlando FL, USA.	2010	pp. 1-5		

[2] A permanent identifier should be a persistent link to the published version full text if open access or abstract if article is pay per view) or to the final manuscript accepted for publication (link to article in repository).
[3] Open Access is defined as free of charge access for anyone via Internet. Please answer "yes" if the open access to the publication is already established and also if the embargo period for open access is not yet over but you intend to establish open access afterwards.

NO.	Title	Main author	Title of the periodical or the series	Number, date or frequency	Publisher	Place of publication	Year of publication	Relevant pages	Permanent identifiers[4] (if available)	Is/Will open access[5] provided to this publication?
3	An Indoor WSN-based Localization Platform Using XBee Radios	Thomopoulos		April 2010		SPIE International Defense and Security Symposium	2010			
4	DALE: A range-free, adaptive indoor localization method enhanced by limited fingerprinting	Thomopoulos		September 15-17		Zurich, Switzerland	2010	pp. 234-241		
5	Indoor Localization Using Passive RFID	Thomopoulos		April 25-27		Orlando FL, USA	2011			
6	Study of the Performance of Wireless Sensor Networks Operating with Smart Antennas	Thomopoulos	IEEE Antennas and Propagation Magazine	To be published						
7	A Sub-gigahertz UWB Positioning System with Automatic Network Configuration	Villien C	8th Workshop on Positioning, Navig. and Communication 2011	April 07-08		Dresden, Germany	2011			

[4] A permanent identifier should be a persistent link to the published version full text if open access or abstract if article is pay per view) or to the final manuscript accepted for publication (link to article in repository).
[5] Open Access is defined as free of charge access for anyone via Internet. Please answer "yes" if the open access to the publication is already established and also if the embargo period for open access is not yet over but you intend to establish open access afterwards.

NO.	Title	Main author	Title of the periodical or the series	Number, date or frequency	Publisher	Place of publication	Year of publication	Relevant pages	Permanent identifiers[6] (if available)	Is/Will open access[7] provided to this publication?
8	Evaluating a Multimodal Interface for Firefighting Rescue Tasks.”	Streefkerk J	Proceedings of the Human Factors and Ergonomics Society Annual Meeting				2012	pp 277-281		
9	Fast Simulation of Average Small-Scale Fading for Indoor Localization Applications		Personal Communications, DOI 10.1007/s11277-012-0842-9			Springer, US,	2012			
10	Indoor Radar SLAM, A radar application for Vision and GPS Denied Environments	Marck, J.W	European Radar Conference 2013				2013			

[6] A permanent identifier should be a persistent link to the published version full text if open access or abstract if article is pay per view) or to the final manuscript accepted for publication (link to article in repository).
[7] Open Access is defined as free of charge access for anyone via Internet. Please answer "yes" if the open access to the publication is already established and also if the embargo period for open access is not yet over but you intend to establish open access afterwards.

TEMPLATE A2: LIST OF DISSEMINATION ACTIVITIES								
NO.	Type of activities[8]	Main leader	Title	Date/Period	Place	Type of audience[9]	Size of audience	Countries addressed
1	*SEE BELOW THE LIST OF ACTIVITIES*							
2								
3								

European Research Conference, Belgium, September 2010.

The DITSEF Project was successfully presented by NCSR Demokritos during the European Security Research Conference[10], which took place at Ostend Belgium, 22-24 September 2010.

8 A drop down list allows choosing the dissemination activity: publications, conferences, workshops, web, press releases, flyers, articles published in the popular press, videos, media briefings, presentations, exhibitions, thesis, interviews, films, TV clips, posters, Other.

9 A drop down list allows choosing the type of public: Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias, Other ('multiple choices' is possible).

10 Event website: http://www.src10.be/

PSC Europe Forum Conference, Austria, June 2010.

DITSEF was successfully presented by CASSIDIAN (EADS) during the Public Safety Communication Europe (PSCE) Forum Conference[11] that took place at Vienna, Austria, 16-17 June 2010.

56th Annual Meeting of the Human Factors and Ergonomics Society, October 22-26, 2012.

DITSEF was successfully presented by TNO during the 56th Annual Meeting of the Human Factors and Ergonomics Society12, October 22-26, 2012, at Boston, Massachusetts.

European Materials Research Society 2012.

In the context of DITSEF Dissemination activities, CEA gave a presentation in the European Materials Research Society Exhibition (E-MRS 2012) that took place in Strasburg, France in May 14-18, 2012. The presentation was given by A. Trouvé (with co-authors: B. Tard, H. A. Girard, E. Scorsone, P. Bergonzo) and was titled "Functionalized diamond nanoparticles as sensitive layers for gas sensing and recognition in a multichannel SAW sensor system".

E-SPONDER Kick-Off Meeting, Greece, July 2010.

DITSEF project was invited in the context of E-SPONDER Kick-Off meeting . The E-SPONDER platform is a suite of real-time data-centric technologies and applications, which provides actionable information and communication support to first responders that act during abnormal events (crises) occurring in critical infrastructures. The workshop took place in Vravrona, Greece on July 5-7th, 2010. The DITSEF Consortium was represented by NCSR Demokritos and during the last day of E-SPONDER Kick-Off meeting, DITSEF Project was successfully presented by Dr. S. C. A. Thomopoulos launching a fruitful discussion among the participants.

[11] Event website: http://www.psc-europe.eu/index.php?id=320
[12] Event website: https://www.hfes.org//Web/Default.aspx

Information Day in Interoperability, Italy, May 2011.

DITSEF was successfully presented by Philippe Clément during the Information Day in Interoperability[13] that took place in Scuola Grande di San Rocco, Venezia, Italy, on May 19th, 2011. Policy makers, interoperability services representatives and European research projects relative to interoperability were among the audience, presenting the most recent trends and outcomes.

EXPOSEC, Greece, March 2010.

DITSEF was presented during the 9th EXPOSEC 2010 - Homeland & Corporate Security Conference & Exhibition[14], that took place at Zappeion Megaron, Athens 16-17 March 2010. EXPOSEC is an exhibition that is organased every year in Athens and the audience consists of security services from public and private sector, first responders, industry representatives, academic and research representatives and venture capital as well.

STRAW, Spain, March 2010.

The DITSEF Poster was presented during the 2nd STRAW Workshop "Strengthening the European Security Network" [15] that took place in Madrid, on 9 March 2010.

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[13] Event website: http://www.vigilfuoco.it/aspx/notizia.aspx?codnews=11787&grande=si
[14] Event website: http://www.tsomokos.gr/projects2.php
[15] Event website: http://www.straw-project.eu/

The 20th International Trade Fair for Security and Fire Protection

DITSEF project was demonstrated during the 20th International Trade Fair for Security and Fire Protection[16] that is organised in Essen, Germany, Sept 25-28, 2012. DITSEF was one of seven EU-funded projects in the area of security that have been selected as part of the exhibition, in a dedicated booth of 35 m^2. During the Trade Fair, the DITSEF Videos about the Localisation and IR Vision Systems,[17] and the Slam Radar System[18] where presented.

Video material of the DITSEF booth is also available in YouTube[19,20].

E-SPONDER Workshop, France, April 2012.

DITSEF was presented during the E-Sponder (A holistic approach towards the development of the first responder of the future) workshop 1 that took place at Valabre (France) on 18 April 2012.

DITSEF concept has been presented during this workshop.

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[16] Event website: http://www.security-messe.de/en/security/index.html

[17] DITSEF Video URL: http://www.youtube.com/watch?feature=player_embedded&v=xh0QTTfdZnE
[18] DITSEF Video URL: http://www.youtube.com/watch?feature=player_embedded&v=FfwBlolYyJU
[19] DITSEF Essen Booth Part 1: http://www.youtube.com/watch?&v=ceqpWpdNtng
[20] DITSEF Essen Booth Part 2: http://www.youtube.com/watch?&v=odOlcY3auF4

Section B (Confidential[21] or public: confidential information to be marked clearly)
Part B1

The applications for patents, trademarks, registered designs, etc. shall be listed according to the template B1 provided hereafter.

The list should, specify at least one unique identifier e.g. European Patent application reference. For patent applications, only if applicable, contributions to standards should be specified. This table is cumulative, which means that it should always show all applications from the beginning until after the end of the project.

TEMPLATE B1: LIST OF APPLICATIONS FOR PATENTS, TRADEMARKS, REGISTERED DESIGNS, ETC.					
Type of IP Rights[22]:	Confidential Click on YES/NO	Foreseen embargo date dd/mm/yyyy	Application reference(s) (e.g. EP123456)	Subject or title of application	Applicant (s) (as on the application)
					NO PATENTS REGISTED YET

[21] Note to be confused with the "EU CONFIDENTIAL" classification for some security research projects.

[22] A drop down list allows choosing the type of IP rights: Patents, Trademarks, Registered designs, Utility models, Others.

Part B2

Please complete the table hereafter:

Type of Exploitable Foreground[23]	Description of exploitable foreground	Confidential Click on YES/NO	Foreseen embargo date dd/mm/yyyy	Exploitable product(s) or measure(s)	Sector(s) of application[24]	Timetable, commercial or any other use	Patents or other IPR exploitation (licences)	Owner & Other Beneficiary(s) involved
NO PATENTS REGISTED YET								

In addition to the table, please provide a text to explain the exploitable foreground, in particular:

- Its purpose
- How the foreground might be exploited, when and by whom
- IPR exploitable measures taken or intended
- Further research necessary, if any
- Potential/expected impact (quantify where possible)

[19] A drop down list allows choosing the type of foreground: General advancement of knowledge, Commercial exploitation of R&D results, Exploitation of R&D results via standards, exploitation of results through EU policies, exploitation of results through (social) innovation.

[24] A drop down list allows choosing the type sector (NACE nomenclature) : http://ec.europa.eu/competition/mergers/cases/index/nace_all.html

4.3 Report on societal implications

See the report on the SESAM portal