LYNCEUS
People localisation for safe ship evacuation during emergency

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Coordinator: RTD TALOS Ltd. (Cyprus)

Beneficiaries:

| Association of Information Technology Companies of Northern Greece | SEPVE | Greece |
| Safemarine S.rl | SFM | Italy |
| G.G. Dedalos Technology Services Ltd | GGD | Cyprus |
| I. Panaretou –Char. Kostopoulos OE - OPTIONSNET | OPTIONS | Greece |
| Canepa and Campi Srl | CAMPI | Italy |
| Epistimoniko Techniko Epimelitirio Kyprou (Technical Chamber of Cyprus) | ETEK | Cyprus |
| Asociación de Empresarios Textiles de la Comunidad Valenciana | ATEVAL | Spain |
| Foro Maritimo Vasco | FMV | Spain |
| SignalGeneriX Ltd | SG | Cyprus |
| Centre Suisse d'Electronique et Microtechnique SA | CSEM | Switzerland |
| Technical University of Dresden | TUD | Germany |
| Maritime Institute of Eastern Mediterranean | MARINEM | Cyprus |
| Louis Ship Management Ltd | LOUIS | Cyprus |
| Lloyds's Register EMEA | LLOYDS | UK |
PUBLISHABLE SUMMARY

Description of the project context and objectives

The maritime industry is currently facing critical problems associated with the evacuation of people from ships in an emergency situation. Difficult to predict factors such as ship motion, floating position, unexpected sudden changes of the environment (fire, flooding, explosion etc) affect passenger behaviour and increase the risk for casualties. Even though there are established evacuation procedures to be followed during maritime accidents, the industry still reports deaths as a result of people failing to follow evacuation procedures and inefficient safety and evacuation plans. This issue becomes even more crucial as the passenger ships keep getting bigger and bigger.

Therefore, the industry is in great need of a system which will allow the ship’s command to locate the passengers in real time and provide to centralized evacuation control system vital information about their position and their health status. The system should be able to gather a vast amount of information related to the emergency (water levels, temperature, smoke detection, inclination, moisture etc.) in real time so as to be able to perform continuous assessment of the status and the spread of the emergency and provide updated information to the passengers for safe evacuation. A wide network of sensors installed all over the ship is needed so as to assist the management of the emergency and also for localizing (tracking) the passengers. A distributed sensor network is needed for monitoring in real-time the spread of the disaster during emergency and also to provide vital information about the ship as a structure during normal operation.

The objective of the LYNCEUS project is to investigate and demonstrate ultra-low power wireless body-area-network technologies for enabling unobtrusive localisation and tracking of people for onboard and overboard search and rescue as well as for safe evacuation of ships during emergency. The LYNCEUS technology aims to revolutionise current emergency management and ship evacuation practice through the development of beyond the state-of-the-art real-time emergency management and safe evacuation systems which will significantly contribute towards early localisation and rescue of people in danger located onboard a ship or in the sea.

The LYNCEUS novel technology will be transferred into the SME-driven market segments of smoke alarm/fire detection systems, lifesaving equipment, emergency management decision support systems and assistive search and rescue equipment. The proposed research will generate high societal and market impact for the European SMEs, and will enable major technological breakthroughs in the areas of ultra-low power wireless systems, wearable antennas, wireless and sensor electronics, digital signal processing and decision support systems.
Work performed and main results

The technical work is decomposed into specific work packages (WP). The following work has been performed:

**WP1: Users Requirements and Specifications**
The SMEs and SME-AGs provided their expertise for defining the user requirements from their target user groups, and for organizing them according to the technology blocks of the onboard and overboard sub-systems. The four demonstrators described in the DoW were used to define three usage scenarios, which will be used to demonstrate the results of LYNCEUS to the SMEs and SME-AGs. RTD partners have analysed the collection of user requirements and scenarios, and designed a structured functional specification describing in detail each functional module to be implemented in the system, specifying its inputs, outputs and dependencies. A particular focus was put on the precise functional definition of the demonstration of use-case scenarios, taking into account the platforms and system components provided by the end-user SME-AGs and SMEs. Finally, RTD partners have translated functional specifications into technical specifications, choosing technical solutions for each functional module.

**WP2: Wireless Sensor Node Platform**
A modular architecture of the wireless sensor node platform was developed, allowing for hardware and software reuse in the wireless gateway, the life-jacket node, and the wireless bracelet. The basic node uses state-of-the-art ultra-low-power hardware and embedded software for localization, communication and sensing. It allows for the addition of complementary components that deal with backbone communication and processing. The software architecture, operational architecture and components have been defined, taking into account the potential large number of nodes present on a vessel. Drivers for node data acquisition and communication are under development, including communication drivers for an ad-hoc organization of the gateway nodes, in case of a backbone network failure.

**WP3: Active Reflector IC and Interrogator**
The basic system parameters of the overboard positioning system were derived, including the frequency band of operation, the required accuracy, supported resolution, the number of identifiable reflectors, and power consumption. The architecture of the FMCW radar base station (interrogator) has been defined, including the RF/IF and baseband modules, taking into account integration aspects with respect to UAV and scanner deployment, and communication with external agencies. Test signals are being developed for system simulation purposes. Two versions of the active reflector have been designed, manufactured and tested.

**WP4: Antenna and Propagation**
Channel analysis and modelling was performed in a number of relevant environments (including cases when the ship is docked and in-sea) as well as in maritime surface links. The Path Loss Exponent of these environments was estimated, allowing for the optimisation of the components used on the wireless communication chain, and for the estimation of distances or locations. Using the wireless communication link specifications from WP1, specifications of the indoor and outdoor antennas were defined, and a number of initial antenna designs were produced. These include the wireless sensor node life-jacket embedded antenna, the active reflector life jacket embedded antenna, and antennas for the UAV mounted interrogator.
WP5: Localisation and Decision Support algorithms
The definition and specifications of algorithms for on-board and overboard localization of multiple targets within a wireless sensor network, was performed. For the former, the method was chosen taking into account requirements, technological limitations, and usage scenarios. For the latter, the concept of the UAV-mounted ‘virtual’ basestation was defined together with and the architecture of the localization software. Finally, the architecture of the decision support system was specified, and the graphical representation of the system data was defined.

Expected final results and potential impact

The expected final results of the LYNCEUS project remain unchanged at the end of the first reporting period. LYNCEUS will therefore deliver the following:

LYNCEUS ultra low power wireless node module: The generic LYNCEUS ultra low power wireless module is the core element of the LYNCEUS in-ship passenger localisation and Emergency Management systems: It can be embedded with its associate antennas in the lifejackets as a separate module with or without the integration of sensors. The result is the wireless node component integrated in a lifejacket and as a standalone sensor node and its associated documentation.

LYNCEUS active reflector module: The LYNCEUS active reflector module is the core element of the LYNCEUS overboard people localisation system and the passenger counting and identification device. It embeds the pulsed active reflector designed in a silicon technology and the associated documentation. The result is the active reflector component with its associated antenna integrated in a lifejacket and its relevant documentation.

LYNCEUS wireless node gateway module: The LYNCEUS wireless gateway to the wireline fire detection system infrastructure is a main component of the onboard localisation system. The gateway is the main communication electronic component to be integrated in the smoke alarm sensors. Due to its modular design, the wireless gateway module can be used to produce a family of products, each having a different backbone interface for supporting different ship communication wireline infrastructures. The overall result is a gateway hardware board with its associated antenna integrated in a smoke detector with its associate wireline connection and relevant documentation.

LYNCEUS handheld reflector module: The handheld active reflector interrogator based on RFID technology. The overall result is a PDA with the corresponding mobile application and associated documentation.

LYNCEUS UAV active reflector interrogator radar: The UAV mounted interrogator based on a customised LYNCEUS hardware board for executing real time localisation. The overall result is the processing board, active reflector interrogator and antenna in the form of UAV radar and its associated documentation.

On board localisation software modules: The software components and associated localisation algorithms for real-time onboard people localisation and its associated documentation.
Overboard localisation software modules: The software components and associated localisation algorithms for real-time overboard people localisation and its associated documentation.

Emergency management decision support software modules: The software components and associated decision support algorithms for real-time information processing, decision support and visualisation of results.

The foreseen potential impact also remains unchanged at this stage. In the first reporting period the end-user SME-AGs and SMEs have been able to work out precise use-case scenarios, which is a clear indication on the potentials of the LYNCEUS technology.

The address of the project website is: http://www.lynceus-project.eu/