

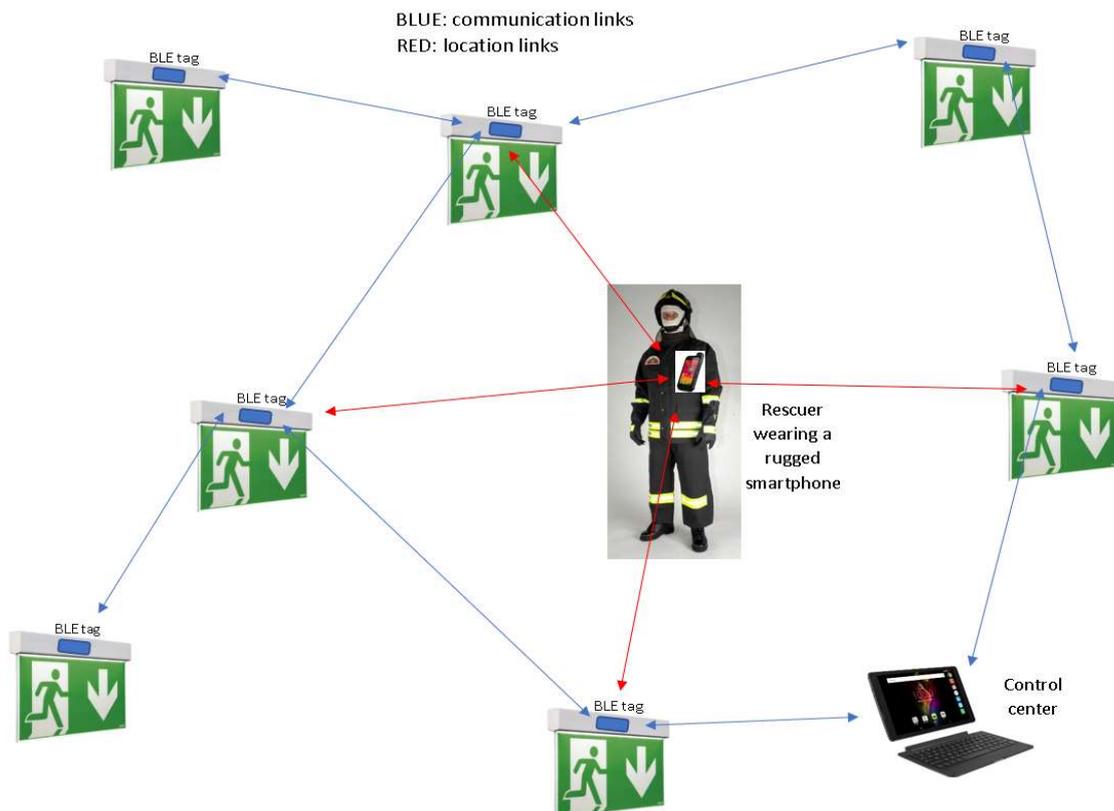
The REFIRE project

REFIRE (REference implementation of interoperable indoor location & communication systems for First Responders) started as a collaborative project promoted by Italian National Corps of Firemen, which included as partners the following Italian companies/institutions: IES Solutions, CAMPUS BIOMEDICO University, BECAR (Beghelli Group), INDICOD-ECR Servizi, RadioLabs.

The first stage of the collaborative project (2011-2013) has received financial support of the Prevention, Preparedness and Consequence Management of Terrorism and other Security related Risks Programme European Commission – Directorate General Home Affairs.

The project's objective is the definition of an open standard for the implementation of an indoor location and navigation system for rescuers involved in critical operations inside buildings, based on a network of RF tags preinstalled in buildings which wirelessly interact with RF mobile terminals worn by the rescuers. The standard defines not only the protocols but also the building related information that the tags can relay to the rescuers (e.g. information about presence of "dangers", chemicals, useful tools for emergency operations, ...).

The RF tags, called PLIDs (Pre-Installed Location Device) are preferably embedded into emergency luminaries (lamps) which are safety devices already installed in any public building by law prescriptions. Indeed emergency lamps are pervasively and homogeneously distributed inside buildings; emergency lighting function is active also in absence of energy in the building thanks to incorporated batteries and thus tags can work for long periods of time on the batteries in critical conditions, in absence of energy inside the building. Emergency lamps are installed at the top of rooms in optimal positions for Radio Frequency interaction with the mobile terminals worn by the firemen. The following figure shows the REFIRE system's architecture.



With reference to the figure, the proposed latest REFIRE project architecture is based on BLE tags, (Bluetooth Low Energy) active beacons embedded in the emergency luminaries, deployed all over the building. The beacons provide the IPS (Indoor Positioning System) infrastructure. All the beacons are wirelessly interconnected each other in a Bluetooth meshed network. Each Refire BLE beacon periodically emits a radio frequency signal broadcasting its Refire information according to the standard.

The rescuers are equipped with special mobile terminals based on rugged smartphones with custom Refire Software; the mobile terminals communicate with the BLE beacons exchanging radio packets that enable the indoor location of the mobile terminals.

The BLE tags are connected together in a meshed network that enable the transfer of information along the network for the purposes of:

- Updating the Refire information inside the tags
- Allowing the data communication of the mobile terminals with the other mobile terminals and with the control teams located in other parts of the building and/or outside the building (e.g. in the Control room)

The user memory of each BLE tag is configured with an information set concerning:

- Location data, Date of installation, Accuracy, Tag classification, and (optionally)
- Information about the area of installation
- Hazards and safety resources
- Free text

BLE tags are extremely low cost, use a standard protocol and rely on modern paradigms of indoor positioning systems. The BLE active tags use very low power and can run tens of hours on the emergency lamp's batteries, even after the lamps have exhausted their light, in blackout conditions. The active tags make it very reliable the communication with the mobile terminals.

The mobile terminal is a lightweight rugged smartphone, which uses low power (thanks to the active BLE tags) and its battery runs for long time (tens of hours); the wearing position is not so critical for the fireman.

The evolution of BLE standards is continuously improving; the 5.1 specifications already include the «angle of direction» detection which improves the accuracy of the traditional indoor location based on the analysis of RSSI (Received Signal Strength Indicator); using the Bluetooth standards for the implementation of the wireless location and communication services complies with the REFIRE aim of setting an open standard for rescuers operating inside buildings.