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BluEye Solution

Bluetooth Low Energy for social distancing

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Technology & Concept Bluetooth LE for social distancing

Under the term social distancing there are different ways to contain the spread of the virus, which are matched by different responses from technology, with the common goal of preventing infection or limiting its impact.

Highlight

- Why adopt Bluetooth LE technology?
- How does the BluEye system work?
- Social Distancing > Proximity alarm, Indoor crowding, Contact tracing.
- What's the answer of BluEye? Beyond technology, the concept.

Why adopt Bluetooth LE technology?

In order to understand how Bluetooth Low Energy (BLE) contributes to the containment of the COVID-19 outbreak, it is necessary to clarify some terms: under the word social-distancing there are different methods to contain the virus spreading, to which correspond different solutions from different technologies, having the common objective of **preventing the contagion or limiting its impact**.

The needs for safety are therefore divided into 3 levels:

- **Proximity alarm**: the BLE system signals when two people do not respect the safety distance of at least 1 meter; in this case, the BLE operates as an **electronic PPE**, indicating the dangerous proximity of the two people - **data flow is one-to-one**.
- **Indoor assemblies**: The BLE system monitors the concentration of people in a defined area (e.g. office rooms, factories, transportation, etc.).
  In this case the BLE operates as a **group PPE**, able to prevent, through an alarm, the dangerous **aggregation of people** in a specific area and time span, by taking action before the contagion risk occurs - **data flow is many-to-many.**
- **Contact tracing**: the BLE system allows **data collection for the traceability** of only those people with whom a virus positive subject has come into contact, isolating them due to the risk of contamination - **data flow is one-to-many**

Combining these **3 needs** with **BluEpyc**'s consolidated know-how on BLE, we developed **BluEye**, the organic system that meets the different needs of social distancing.

At each requirement corresponds a different type of Bluetooth LE structure that contributes to the **control and management of the epidemiological trend in the company**, also laying the foundations for greater operational efficiency once the actual emergency is over.

How does the BluEye system work?

BluEye is the modular solution that, through different BLE architectures, covers the 3 levels of safety at work, by configuring the following components:

- **Beacon** worn by the person,
- **EchoBeacon**, Bluetooth signal repeaters that collect data from the Beacon and broadcast it to the Gateway, monitoring a defined area,
- **Gateway** receives data from EchoBeacons and transmits it to the host or cloud server
- **BITS – BLE Item Tracking System**, the web-based middleware that manages the data collected, also providing location information of the Beacon's current location and history, allowing to track its movement in the past and its contacts with other people.

Proximity alarm

The BLE configurations that meet the requirements of the scenario are:

- Configuration **Beacon – smart phone**:

  person A, wearing a Beacon, approaches person B equipped with a smartphone (and vice versa); the App estimates the distance between the two persons and alerts them of any excessive proximity.

  The limits of this configuration are the variables related to the smartphone that influence its calculation (different models, detection sensitivity, orientation, etc.); to this is added the use of the personal device by the employee (privacy, App always active, distractions...).

- Configuration **Beacon – Beacon**:

  the data exchange takes place between 2 Beacons, equipped with special and advanced firmware: Beacon A transmits **watch-dog advertising** (presence), received by Beacon B that is **listening in precise timeframes**, set to limit battery consumption. If the **RSSI** (Receive Signal Strenght Indicator) thresholds are exceeded, it transmits a proximity advertising alert to the employee's smart phone and/or to the department manager.
  Beacon *advanced edition* with feedback (vibration/sound) and long battery life (1000 mA/h) are also available.
  The data source is the same for all subjects, the Beacons mount the same chip, are worn in the same manner and are set with the same parameters: this uniformity translates into consistency and reliability of the data.

Indoor assemblies

BluEpyc has always developed its **Real Time Locating System** solutions based on the Zones concept by using the **EchoBeacon** device: in particular, the architecture is composed by Beacons associated with people and/or objects, by EchoBeacons, each one assigned to monitor a defined area, forwarding the Beacon data to the **BLE Gateways** which collect all this data, and send it to the server (in Lan or Cloud) and optionally to **BITS, Data Base Engine Software** (the Middleware described below).

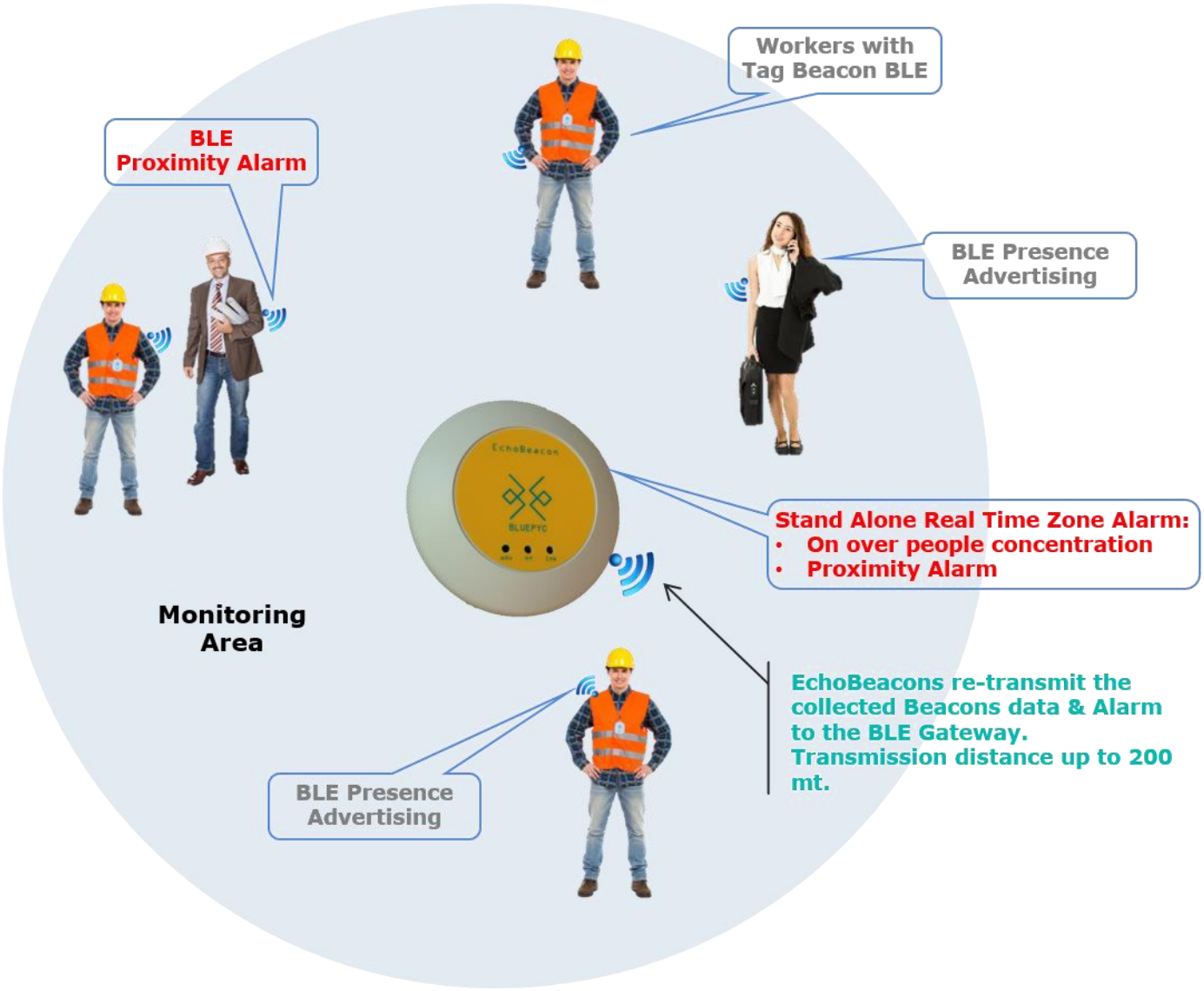
In order to respond to the current needs of COVID-19 containment and to act locally at the source of the contagion, avoiding aggregations, we have further enhanced the capabilities of the EchoBeacon, now able to operate in **stand-alone mode**, ideal to prevent indoor concentrations in small companies: offices, shops, transportation, etc.

> *In this case it is not necessary to install software and/or Host Server.*

In each EchoBeacon are set, through the provided App, several parameters, including: the size of the area (**RSSI filter & Kalman filter**), the timeframe and the number of Persons/Beacons that are allowed to be in the area in the same time; otherwise, the relay connected to an optical/acoustic alarm is activated in real-time.

In addition, the EchoBeacon can signal, through a differentiated warning, the proximity between two special Beacons, described previously: the result is a **consistent and interchangeable ecosystem**, with the **plug&play EchoBeacon as a fulcrum.**

Of course, the EchoBeacon can also monitor standard beacons and/or smart phones in beacon emulation mode.



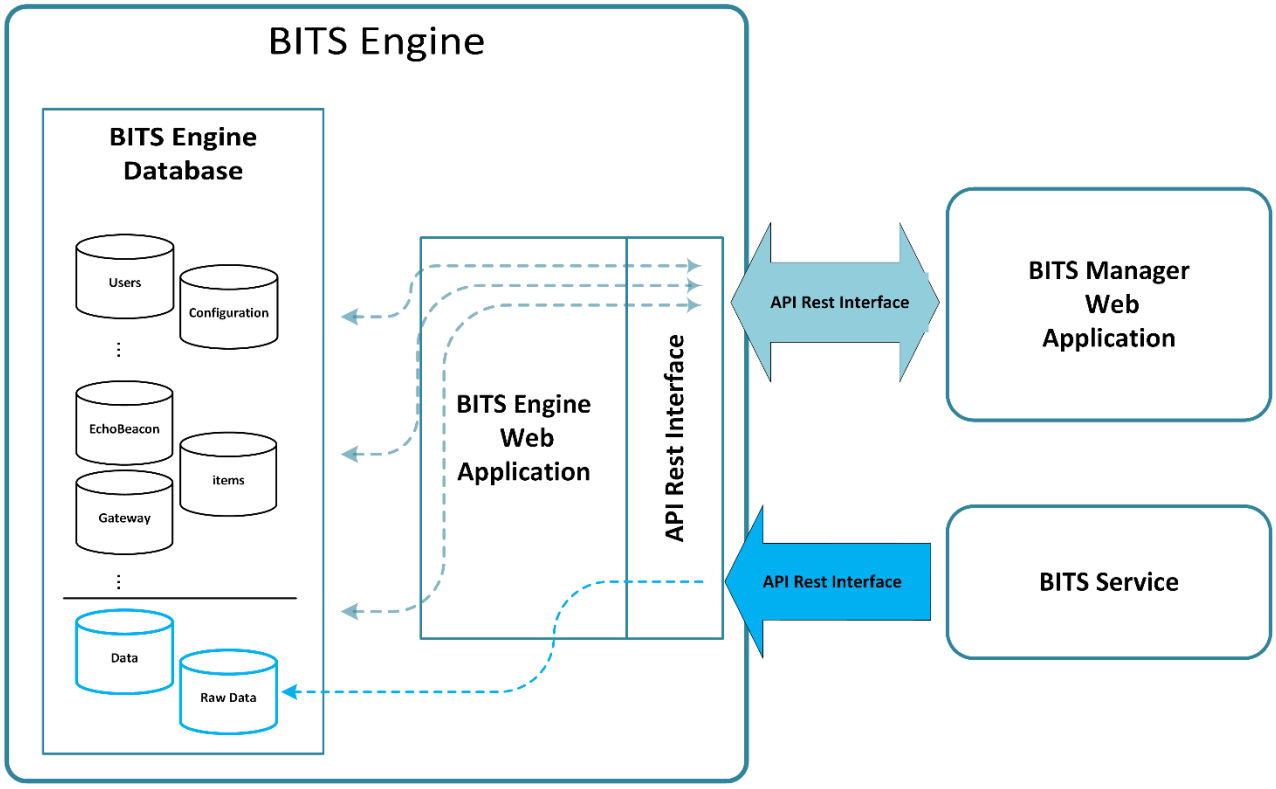
The role of the EchoBeacon in the more complete ecosystem described above remains unchanged, when the data chain continues towards the Gateway, the server and/or BITS, also data collection for **contact tracing**.

Contact tracing

The **BluEye** platform, which is both scalable and consistent, also meets the **need for contact tracing**, going back retroactively on the people who have come in contact with a positive subject in the past, thanks to specific queries on the historic data stored in the BITS databases.

In addition, it is possible to obtain centralized alerts which, in case of a concentration in a certain area, transmits a warning message on mobile devices.

The Zone **RTLS** data acquisition process is able to locate people (Beacons) and locate them in a specific indoor area (EchoBeacon), and through the Gateways transmit them to the **BITS - BLE Item Tracking System.**

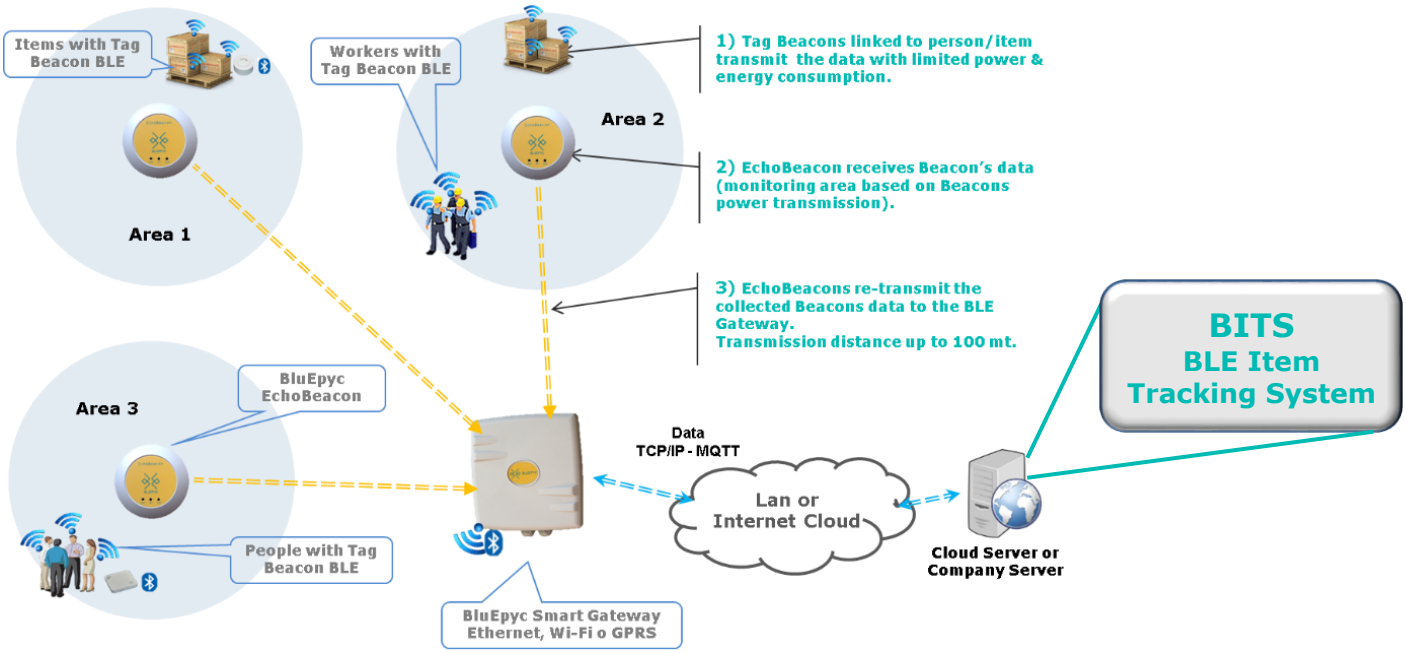


BITS is the Web Based Middleware composed by the data management engine that allows to know the last detected position of the Beacons and their historical position (**Data Base Engine**) and by GUI (**Graphic User Interface**), the application interface that gives a graphical meaning to the data and allows its analysis (query); the two parts can be implemented also separately.

BluEye's **Edge Computing** architecture (Beacon, EchoBeacon and Gateway) selects the useful data, discarding the superfluous ones and lightening the data flow.

Specifically, BITS:

- **differentiates between static data** (e.g. charts, Beacon association to the item or person, EchoBeacon assignation to a certain area, etc.) and **dynamic data** (e.g. location, i.e. when the person/object moves from one area to another and historical data),
- **applies data filters** that clean and store them in the Data Base through **Web Services** (Microsoft IIS Platform), allowing the traceability of past events;
- the data are displayed via the user interface and from now it can be managed according to the project requirements.



The value of BITS is therefore to improve the quality of the data collected by the Bluetooth LE, filtering them on several levels, to return only the useful data for the item's localization, then creating, according to the project, the expected event (**location-based service**: e.g. alarm, action, door closure/opening...).

What's BluEye's result? Technology & Concept

The distinctive feature of BluEye is its ability not only to respond to different forms of social distancing (3 levels), but above all to take action before the contagion occurs: all this with a **single platform, consistent and scalable, branched in different configurations**.

The hardware/firmware and middleware platform is in fact characterized by its **plasticity**, since its components **Beacon, EchoBeacon and Gateway are interchangeable**: just as Lego® bricks are combined in various ways to create different constructions, so the BluEye components connect to each other in **different configurations, which correspond to different degrees of social distancing of the Bluetooth LE, as well as different installation methods, times and costs**.

BluEye platform uses different types of Beacon, according to the project needs; among the advanced ones, the **Beacon Wake-Up** based on the Bluetooth release 5.1; thanks to the setting flexibility, it can transmit several information, including Watch Dog (to report its presence in the area), Key Button (to voluntarily report an event), Accelerometer Sensor (motion detection and/or operator fall).

> *In other words, BluEye is a consistent system because its hardware/firmware can be broken down into different functions and reassembled in different ways, laying the foundations for operational efficiency and localization in IoT.*

BluEye Solution - Products Overview

Product	Standard Highlight	Special Feature
	**Standard Beacon** Disk Beacon Bluetooth Low Energy R.2 Accelerometer sensor, waterproof, push button, blue/red Led. Battery CR(LRI)2032 replaceable	New firmware functions for Proximity Alarm (from 1 to 2 mtr.) & Contact Tracing (store contact in memory). Special "Proximity" advertising packet
	**Special Beacon** Disk Beacon Bluetooth Low Energy. Accelerometer sensor, waterproof, push button, Led. Battery CR(LRI)2477 replaceable	New firmware functions for Proximity Alarm (from 1 to 2 mtr.) & Contact Tracing (store contact in memory). Special "Proximity" advertising packet Vibration and Buzzer Proximity Alarm
	**BluEpyc BLE Sensor Beacon Wake-Up on trigger** Precision Wake-Up on LF trigger (accurate position detection), ultra low power, accelerometer sensors, push button & LEDs. ADV: Presence, Area Code, Action/Alarm (push button), accelerometer (transmission on movement or free fall). And more…	New firmware functions for Proximity Alarm (from 1 to 2 mtr.) & Contact Tracing (store contact in memory). Special "Proximity" advertising packet
	**BluEpyc BLE EchoBeacon Repeater Plus R5 Wall Mount with I/O** Industrial BLE repeater to implement zone localization & change of position of people & objects. Multitasking mode. Bluetooth 5.1, up to 2 Mbit/s. 3 x digital Input, 2 x output relè, 3 x Leds. Filtering (beacon mask, RSSI Level, Kalman). On-board beacon white list. And more…	Stand Alone New Add-on functions with parameter setting (App): Zone Alarm on over-concentration of people (number of people in the area). Zone Alarm on distance between two people (ADV from Beacon - see above)
	**BluEpyc BLE EchoBeacon Repeater Plus R5 Industrial IP 66 with I/O** Industrial BLE repeater to implement zone localization & change of position of people & objects. Multitasking mode. Bluetooth 5.1, up to 2 Mbit/s. 3 x digital Input, 2 x output relè, 3 x Leds. Filtering (beacon mask, RSSI Level, Kalman). On-board beacon white list. And more…	Stand Alone New Add-on functions with parameter setting (App): Zone Alarm on over-concentration of people (number of people in the area). Zone Alarm on distance between two people (ADV from Beacon - see above)
	**BluEpyc BLE Gateway Industrial Wall Mount Ethernet with I/O** Beacon observer for RTLS zones method. Receives data from EchoBeacon & transmits it to the server (TCP/IP or HTML). Host Interface: 10/100 Base-T Ethernet. Web Server on board, read BLE Advertising & RSSI, filtering beacons mask. And more…	

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