ZONITH Indoor Positioning Module
Bluetooth positioning and Lone-Worker protection

White Paper
Version 2.1a
Document History

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<th>Version</th>
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1. Introduction

ZONITH Indoor Positioning Module is a Bluetooth based localisation system. Any Bluetooth device such as Mobile Phones, Bluetooth Body-tags, TETRA, P25 or MOTOTRBO radios enabled by Bluetooth can be registered on the system. Each Bluetooth device has a unique identity and can be located and tracked by the system. The device positioning is achieved by using a network of strategically mounted ZONITH Bluetooth Positioning Beacons, which can monitor any Bluetooth device within its coverage area. If a Bluetooth device is registered in the ZONITH Indoor Positioning software its location is continuously monitored in real time. The positioning is based on Zonith’s enhanced cell-ID positioning technology. Each ZONITH Bluetooth Positioning Beacon is individually tuned to cover a specific room or geographical area thereby creating a precise cell structure.

The ZONITH Indoor Positioning Module is tightly integrated with our automatic alarm dispatch solution, the ZONITH Alarm Control System. While the ZONITH Indoor Positioning Module continuously monitors the position of Bluetooth device the ZONITH Alarm Control System ensures appropriate actions in case a problem arises. The tight integration ensures fast reaction to alerts in case the indoor positioning is used for lone worker protection. For more information about Zonith’s lone worker protection system we refer to documents available at www.zonith.com.
2. Monitoring, Localization and Notification Examples

There are numerous occasions where ZONITH Indoor Positioning Module helps locating employees:

When a lone worker lose consciousness or mobility, and do not respond inside a pre-set time interval, the ZONITH Indoor Positioning Module can automatically notify colleagues or an outside rescue team of the exact position of the employee in danger.

Security personnel can be located quickly if attacked or calling for back-up. Instead of having to convey the position by voice over the radio, security personnel can simply press the panic button on his radio. A few seconds later all his colleagues will know that he is in trouble and where he is in trouble.

Personnel with jobs, where there is a high risk of being attacked by clients (i.e. job centres or public institutions), can press their panic button if they are in a dangerous situation. Text messages with the exact location of the attack will then be sent directly to security personnel radios.

In all situations above and in many other - a quick and precise localisation of an employee is crucial for his safety. An automatic notification with position information from ZONITH Indoor Positioning Module is the most efficient way to protect employees. With the Zonith solution lone workers can feel more secure and protected at work.

The combination of the ZONITH Alarm Control System and the ZONITH Indoor Positioning System does not only make a safer working environment, but also a more efficient one with the automatic alarm dispatch.
3. **Using Indoor Positioning**

Indoor positioning is established through a number of ZONITH Bluetooth Position Beacons connected through a standard Ethernet LAN. The Bluetooth Position Beacons can be powered in two ways:

- With power over ethernet (PoE), these beacons require only an ethernet connection and a PoE switch to function and to establish Bluetooth coverage.
- With external 5VDC power supply

The indoor positioning system serves different purposes as described in the following sections.

3.1. **Lone Worker Protection**

If a user enables the Lone-Worker\(^1\) functionality on his digital radio terminal, lone worker supervision raises an alarm, the indoor location of the lone worker’s Bluetooth device can be detected (or the latest known position) and sent as text message to the on-call staff via the ZONITH Alarm Control System.

3.2. **Alarm Enable/Disable Based on Position**

The ZONITH Indoor Positioning Module is also able to establish automatic on-call alarm enable/disable functionality. If a ZONITH Bluetooth Position Beacon is located in a control room the monitored devices do not necessarily need all alarms dispatched, because some alarms will be superfluous and some will come directly to the control room as well. However, when they leave the control room and are on-duty again - the dispatch functionality can automatically be switched on. When they come back to the control room the dispatching can again automatically be disabled.

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\(^1\) The Lone-Worker functionality is not supported on all Digital Radio devices.
3.3. Critical Area Protection

Closely related to the situation described in the previous scenario. With ZONITH Indoor Positioning System it is possible to define critical areas in your building. These areas will require additional actions to be taken from your personnel. When a Bluetooth-device enters a critical area the ZONITH Alarm Control System automatically turns on the Dead Man’s Button-functionality, where personnel have to activate their radio at a pre-set time interval (every five minutes for example). If personnel fail to do so, an alarm will be raised and colleagues can hurry directly to the location. This is relevant in cold storage rooms and other hazardous isolated areas.
Figure 3 – Protection enabled when entering a critical area like a cold storage room
4. Setting up the Indoor Positioning Network

The three steps for setting up the indoor positioning system using Bluetooth are:

- A plan for where to best place the ZONITH Bluetooth Position Beacons
- Selection of the right number of positioning beacons depending on the size of the installation.
- Installation of the ZONITH Alarm Control System with a valid license for the Indoor Positioning Module software.

4.1. Bluetooth Network Beacon

The ZONITH Bluetooth Position Beacon can be mounted on a wall or on the ceiling. The Beacon has an RJ45 Ethernet connection and a power supply connector. You can use Power-Over-Ethernet (PoE) to power the beacon saving the external power supply. The beacons are 100% PoE compliant meaning they support both mid-span and end-span PoE.

The rating for the power supply is:

- Input: 100-240 VAC
- Output: 5VDC 450mA

The Beacon has build-in Bluetooth antennae. A version for external 2.4 GHz antennae is available too.

4.1.1. Installation of ZONITH Bluetooth Positioning Beacon

Mount the ZONITH Bluetooth Position Beacon on the wall or ceiling and connect the Beacon to the Ethernet using a standard straight CAT5 or CAT6 network cable. (Connect the power supply to the Beacon and turn on the power if PoE has not been chosen). You can validate that the Beacon is turned on if the network LED is blinking. If the yellow LED starts blinking fast, the Beacon has also registered on the network successfully. Repeat this procedure for all your Beacons.
4.1.2. The Tracking of Bluetooth-Devices

Each beacon will constantly be requesting all nearby Bluetooth-devices to send their Bluetooth identification address. Each time a Bluetooth-device is registered, its location is updated in the ZONITH Indoor Positioning System.

4.1.3. The Right Placement of the ZONITH Bluetooth Positioning Beacons

An important step for a successful deployment of the ZONITH Indoor Positioning System is the correct placement of the positioning beacons.

When planning the placement of your beacons, consider the following:

- Decide your required level of granularity in the positioning system: How accurate you need the positioning system to be.
- The front of the beacon is where the signal is slightly best, but otherwise the beacon emits a spherical signal.
- Thick concrete walls and floors weaken the signal strength.
- You can adjust the signal emitting power of each beacon, but do not turn it down too low as some overlap between signals from beacons is necessary to ensure coverage everywhere.
- There should be no “holes” in your coverage area.
- For greater granularity in your location information, you need to install a higher quantity of beacons, and decrease signal strength on each of these.
- When installing on different floors of a building, try to place the Beacons on the same location on each floor.
- Always use a floor plan of the location, so you can design beforehand how many beacons to install, and where to place them.
4.1.4. Example of Placement of 2 Beacons, Low Granularity

In this example only two beacons have been used to cover the entire building. The two beacons are placed on the walls where they are indicated by the red rectangles. The two beacons are covering the entire building, but the positioning detail level is restricted to two different positions; west- or east wing. This is a low cost system (less hardware and lower cost on software), and is ideal for situations where the detail level of positioning is of lesser importance.

It is possible in the indoor positioning software to enable the Intersection functionality. When enabled the intersection area between signals from each beacon are considered as an "in between" position. This means that when a monitored device is located in the intersection between signals, its position will be reported as “between west wing and east wing". This way you get an extra level of granularity, although it is not quite as reliable as placing more beacons in the building.

![Diagram of building with two beacons](image)

*Figure 6 - Two beacons divides the building in two, possibly 3, sections*
4.1.5. Example of Placement of 4 Beacons, Medium Granularity

In this example four Beacons have been installed. The Beacons are placed on the walls where they are indicated by the red rectangles. This setup gives the possibility to locate monitored devices with greater detail than in the previous example. Here you have the location information divided into four areas: North wing, east wing, south wing and west wing.

You can enable the “in between” feature of the positioning system to increase the granularity to 11 possible positions, although it should only be used as an indication of the location.

*Figure 7 - Four Beacons divides the building in four, possibly 11, sections.*
4.1.6. Example of Placement of 10 Beacons, High Granularity

In the third example the system has a very high and accurate granularity provided by the installation of 10 Beacons. The Beacons have in this example all been placed in the ceiling of the rooms. With granularity as high as this you set the beacons at a low signal power, and place them in the centre of each room – giving each room an identity. The configuration of this example is very accurate and has a high reliability on the position readings.

In a scenario like this, we recommend not to use the “in between” feature of the positioning system, because we have a very reliable setup using the 10 Beacons: Each section of the building is covered and you would get very accurate readings.

*Figure 8 - 10 Beacons divides the building into 10, possibly 23, sections.*
4.2. Ethernet

The ZONITH Bluetooth Positioning Beacons in the solution should all be connected to a TCP/IP / LAN network.

4.2.1. Connecting the Beacons to Existing Network

Connecting the ZONITH Bluetooth Positioning Beacons to the existing network is as simple as connecting an ordinary computer. When installing the beacons to the network you have to follow the same rules as setting up a normal Ethernet computer network.

When connecting a beacon to the network and powering it up, it will be given an IP-address by the DHCP server. After installing the software you should be ready to use the beacon for positioning.

There is no upper limit on how many Beacons you can connect to the Positioning System.

4.3. Setting the Correct Beacon Signal Strength

Each ZONITH Bluetooth Positioning Beacon can be configured to use only a certain percentage of its full signal potential. This is necessary to create a highly granulated coverage area as shown in example 4.1.6. Choosing the correct power setting for a beacon requires testing on the physical location. A number of issues should be taken into account when choosing the correct setting:

- Obstacles weaken the signal.
- The degree of granularity you need.
- The Bluetooth signal strength of your monitored devices.
- The size of the area to be covered by the beacon.
- The materials surrounding the beacon.

**NOTE:** A thorough test must always be completed to secure that there are no blind spots in the configuration of Beacons. The floor plan used in planning the correct placement of Beacons should be used to complete the test of coverage. Also use multiple Bluetooth devices of the kind that are to be used in the system when performing the coverage test.
5. Using the ZONITH Indoor Positioning Module in the ZONITH Alarm Control System

After successfully installing the ZONITH Bluetooth Position Beacons and the ZONITH Indoor Positioning software, you will get access to the position data in the ZONITH Alarm Control System. The following section will describe how to setup and use the positioning module in the ZONITH Alarm Control System.

5.1. Creating Your Positioning Beacons

For all of your installed Bluetooth Position Beacons, you have to create a Position Beacon in the ZONITH Alarm Control System. This is done using the menu on the left side of the user interface when logged in as an administrator.

Choose “Add Positioning Beacon” and enter the required information. This includes the logical name of the positioning beacon and the Bluetooth address of the beacon.

The “List Positioning Beacons” will show you all current beacons in the system.

When you are done creating your positioning beacons in the ZONITH Alarm Control System, you need to assign them to the various locations in your system. The procedure for doing this is described in the next paragraph.
5.2. Assigning Positioning Beacons to Locations

On your location you need to choose which positioning beacons to be assigned to this location. You simply select the positioning beacon in the dropdown list and choose “Add”.

![Positioning Beacons](image)

*Figure 11 - Three positioning beacons added to the Location.*

In this screenshot all 3 beacons have been added to this location. This means that whenever a monitored device is registered by any of the three beacons, the location of the device will be registered to this location.

5.3. Assigning a Bluetooth Device to a User

You also need to assign a monitored device to each of the users you need to monitor.

This assignment is done on the “Edit User” page, where you can either enter the Bluetooth address of the monitored device manually, or you can use the “Auto Detect” feature by placing the device next to the “Master Beacon” (defined in preferences) and pressing the “Auto Detect” button. The positioning module will then fill in the value of the detected device, and you can just press save.

5.4. Assigning a Bluetooth Device to a Contact Person

Assigning a Bluetooth device to a Contact Person is done in the exact same way as with a User. Adding a Contact Person and monitoring his location is very easy, and can be used to track temporary persons, such as external workmen ( plumbers, electricians), in a building.
5.5. See the Position of Monitored Users

After completing the steps described in the previous sections, the system will continuously monitor the locations of all Users and Contact Persons. In the “List Users” and “List Contact Person” screen you will be able to see the current location of your users.

![Figure 12 - List of Users and their current position.](image-url)
6. **F.A.Q**

6.1. **What is the accuracy and range of the ZONITH Bluetooth Positioning Beacons?**

Accuracy can be adjusted in each beacon to match the given situation, but you can easily define specific rooms and sections with ZONITH Indoor Positioning Module. Tracking range is a radius around the Bluetooth Position Beacon from 0 – 25 meters. The range will be interrupted by walls or other obstacles as with any other wireless radio technology.

Zonith will launch a new Bluetooth Position Beacon for external Bluetooth 2.4 GHz antennas. Depending on the antennas the range can be extended up to several hundred meters.

6.2. **How many positioning beacons can I connect to the system?**

There is no upper limit, but you need an ethernet infrastructure to support the system.

6.3. **Which Bluetooth Devices can I use for tracking purposes?**

You can use all Bluetooth enabled devices for tracking purposes (e.g. Bluetooth-enabled TETRA radio, MOTOTRBO Bluetooth adapter, P25 Bluetooth enabled radio, mobile phones, Bluetooth tags, PDA’s and even headsets).

6.4. **How many Bluetooth devices can I track?**

Again, there is not upper limit, but when many devices are in the vicinity of a single Bluetooth Position Beacon, the update frequency of positions may be reduced.