TRBONET
Dispatch Systems

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AUTHORIZED APPLICATION PROVIDER DIMETRA™ MOTOROLA SOLUTIONS

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TRBOnet Enterprise | PLUS

Bluetooth-based Indoor Positioning

User Guide

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USA Office
Neocom Software
150 South Pine Island Rd., Suite 300
Plantation, FL 33324, USA

Sales
EMEA: +44 203 608 0598
Americas: +1 872 222 8726
APAC: +61 28 607 8325

www.trbonet.com
info@trbonet.com

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1 Introduction

1.1 About This Guide

This document is intended for administrators setting up evaluation and proof-of-concept deployments of MOTOTRBO Dispatch over IP solutions. The document describes the minimum steps to configure the Bluetooth-based Indoor Positioning functionality of TRBOnet.

1.2 About TRBOnet

TRBOnet is a suite of professional applications for MOTOTRBO digital two-way radio networks. TRBOnet manages voice and data communication paths across network endpoints. It provides a unified graphical dispatcher workbench interface for the entire range of workforce fleet management tasks.

For more information about TRBOnet products, refer to our website.

1.3 Contacts

Region	Phone	Email & Support
EMEA	+44 203 608 0598	info@trbonet.com — general and commercial inquiries support@trbonet.com — technical support https://trbonet.com/kb/ — online knowledge base
Americas	+1 872 222 8726	
APAC	+61 28 607 8325	

2 Overview

2.1 TRBOnet Indoor Positioning

Indoor Positioning is a TRBOnet functionality that allows a TRBOnet Dispatch Console operator to trace indoor location of a MOTOTRBO two-way radio in real time. TRBOnet identifies the location of a radio by constantly receiving information about the radio's proximity to the closest hardware transmitter (beacon) installed in the monitored area.

2.2 Supported Transmitters

TRBOnet Indoor Positioning works with new-generation Bluetooth LE (Low Energy) transmitters based on Apple's iBeacon technology.

> Note: Though K-term beacon transmitters by Kilchherr Electronik are not in the scope of this document, they are supported. Documents discussing TRBOnet Indoor Positioning with K-term beacon transmitters can be provided by request.

2.3 Functional Architecture

The key components of a TRBOnet Bluetooth-based Indoor Positioning solution are iBeacon transmitters, preconfigured MOTOTRBO two-way radios, and TRBOnet software.

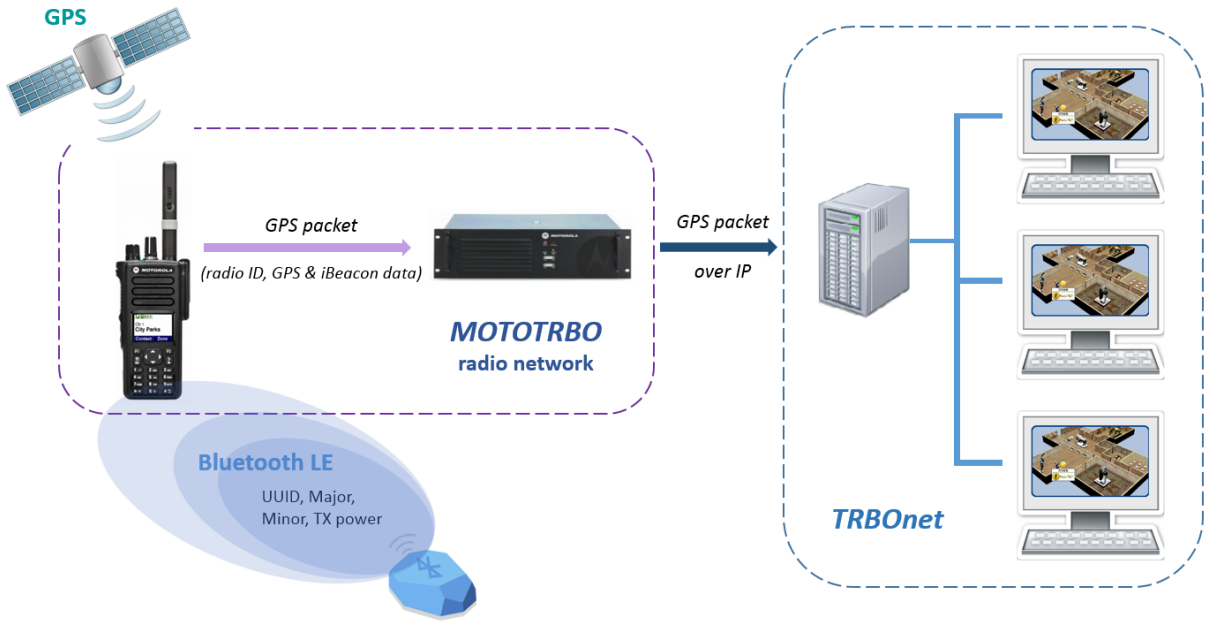


Figure 1: A Bluetooth-based Indoor Positioning solution

Beacons are installed in particular zones of the monitored area. Each beacon is assigned a set of identifiers and configured to broadcast this information to the range of up to 100 meters with regular time interval.

A broadcasted package consists of the following pieces of information:

- UUID: A 16-byte identifier used to differentiate a large group of related beacons.
- Major: A 2-byte identifier used to distinguish a smaller subset of beacons within a larger group.
- Minor: A 2-byte identifier used to identify individual beacons.
- TX Power: A hardcoded signal strength that is measured at one meter from a device. Devices use this value to determine their proximity to the beacon.

A MOTOTRBO two-way radio can be set up to hear beacons whose UUID are registered in the radio's configuration. At any moment, a radio can detect several beacons in close proximity. Information about the closest beacon is transmitted to TRBOnet on the radio channel.

The frequency of sending location data to the server and the package contents are configured on a per-radio basis. According to this configuration, a radio creates a package to transmit GPS data only, iBeacon data only, or both. Packages can be transmitted at regular time intervals and/or every time a radio enters an emergency mode of operation.

A Dispatch Console operator can see the real-time location of a radio on the floor map. TRBOnet can store location information, include it in predefined reports and provide them for retrospective analysis.

2.4 Features

With TRBOnet Indoor Positioning, a MOTOTRBO network system gains a new instrument to reduce industrial risks, make indoor activities safer, and make activities of Dispatch Console operators and emergency services more efficient and more productive. The new network system capabilities include:

- Indoor positioning on emergency

  When a radio feeds location data on entering the emergency mode, a Dispatch Console operator immediately sees the radio with alarm indication on the screen and reacts accordingly. Indoor positioning on emergency can be a recommended strategy where capacity of the radio channel is limited, there is a large number of radios in the network, and continuous location tracking is not a crucial requirement.

- Combined indoor and outdoor positioning

  Outdoor (GPS) and indoor positioning can be both activated on a radio to supplement each other, particularly, in GPS-only and beacon-only coverage zones. Combined positioning can be extremely useful when ongoing location tracking is required for activities running both indoors and outdoors.

- Real-time indoor positioning

When a radio feeds location data at a regular time interval, a Dispatch Console operator tracks the radio's location on the floor map in real time. This strategy is efficient when the channel capacity is sufficient for frequent transmissions, and when continuous location tracking of a radio is vitally important. For best results, real-time indoor location can be combined with indoor location on emergency.

- 2D and 3D visualization of subscribers' locations

  TRBOnet supports 2D and 3D floor maps on which physical beacons can be placed. When a radio feeds location data, a Dispatch Console operator can immediately see the closest beacon highlighted on the map and the radio and beacon names.

- Guard Tour

  Guard Tour (a TRBOnet feature) can employ indoor positioning as an underlying service. In this configuration, indoor beacons serve as checkpoints on the patrolled area, and indoor positioning settings on a guard's radio define the list of beacons to be heard and conditions for location data to be transmitted. During a guard tour, a Dispatch Console operator monitors the progress on the floor map and in the **Active Routes** pane in real time.

- Reporting

  TRBOnet supplies predefined reports **Visited Beacons** and **Beacon History** with advanced filtering capabilities to facilitate creation of well-structured location tracking documents with no effort.

- Show Route

  A radio's location history can be presented on the floor map as a route where location points (beacons) are connected with a line. Alternatively, TRBOnet can show a history of location events (beacon detected, beacon lost) and visualization of each step on the floor map.

2.5 Hardware and Software Requirements

Table 1: TRBOnet Bluetooth-based Indoor Positioning - hardware and software requirements

Hardware/software	Requirements
TRBOnet software	Version 5.0 and higher A license with the Indoor Positioning option
Two-way radio	MOTOTRBO Enhanced Portfolio (production: April 2016 and later) Bluetooth 4.x (Low Energy) supported Indoor Location Tracking license (MOTOROLA)
Hardware transmitter	iBeacon technology Vendor: any. Find more information in Recommendations on iBeacon Transmitters.

2.6 Recommendations on iBeacon Transmitters

The Bluetooth LE infrastructure can be built on iBeacon transmitters of any preferred vendor. Estimote beacons (estimote.com) can be a recommended choice.

The typical characteristics of iBeacon transmitters are:

- Battery life: 2 years and more. Use the fleet management system provided by the iBeacon manufacturer for monitoring the remaining battery life.
- Signal range: up to 70 meters (230 feet)

2.7 Abbreviations

This section lists all abbreviations used in this document.

Table 2: Abbreviations

Term	Description
2D	Two-dimensional
3D	Three-dimensional
BMAP	Block Map (file format)
BMP	Bitmap Picture (file format)
CPS	Customer Programming Software
CSBK	Control Signaling Block
EID	Entitlement ID
GPS	Global Positioning System
ID	Identifier
JPEG	Joint Photographic Experts Group (file format)
LRRP	Location Request and Response Protocol
PNG	Portable Network Graphics (file format)
RSSI	Received Signal Strength Indicator
TIF	Tagged Image File (file format)
TX	Transmission
UDP	User Datagram Protocol
UUID	Universally Unique Identifier

3 Configuration

This section describes how to configure TRBOnet software and MOTOTRBO radios for using TRBOnet Indoor Positioning.

3.1 Radio Configuration

To prepare a MOTOTRBO two-way radio for Bluetooth-based Indoor Positioning, activate the Indoor Location Tracking license and modify the radio's configuration as described below. You can do it in MOTOTRBO CPS or in the Radio Management software.

To configure a MOTOTRBO radio for Bluetooth-based Indoor Positioning:

1. Power off the radio and connect it to the computer. Power the connected radio.
2. Launch the MOTOTRBO CPS application on the computer.
3. Open the configuration of your radio in MOTOTRBO CPS by clicking the **Read** toolbar button, or by selecting **Device** and then **Read** in the application menu.

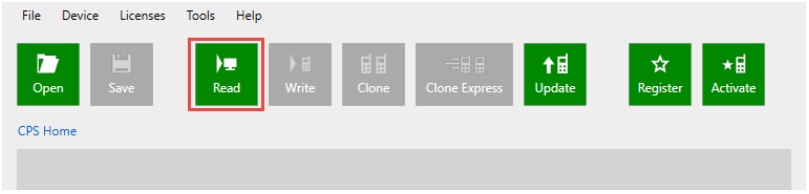


Figure 2: Opening the configuration of the connected radio in MOTOTRBO CPS

4. Register and activate the Indoor Location Tracking feature on your radio.
   a) To register the purchased feature, select **Licenses > Register Device Licenses** in the menu.

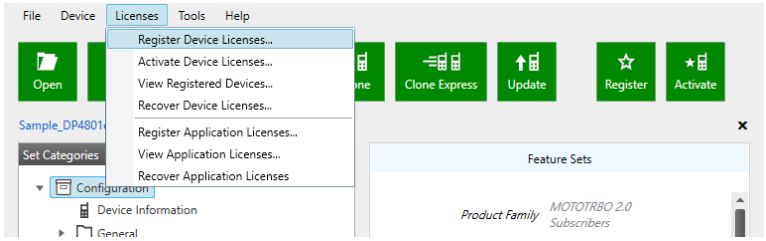


Figure 3: Registering the purchased feature on the radio

In the wizard, enter the EID and click **Next**. Select the Indoor Location Tracking feature from the list and click **Next**. Enter the serial number of your radio and click **Register**.

Note: To obtain the EID, contact your dealer or a MOTOROLA sales representative.

b) To activate the registered feature on your radio, select **Licenses > Activate Device Features** in the menu. In the wizard, click **Next** and again **Next**. Select the Indoor Location Tracking feature for the registered radio and click **Activate**.

5. In the **Set Categories** pane, select **General > Network**.
   In the right panel, navigate to the **Bluetooth** section and select the **Enable** check box to enable the Bluetooth feature on the radio.

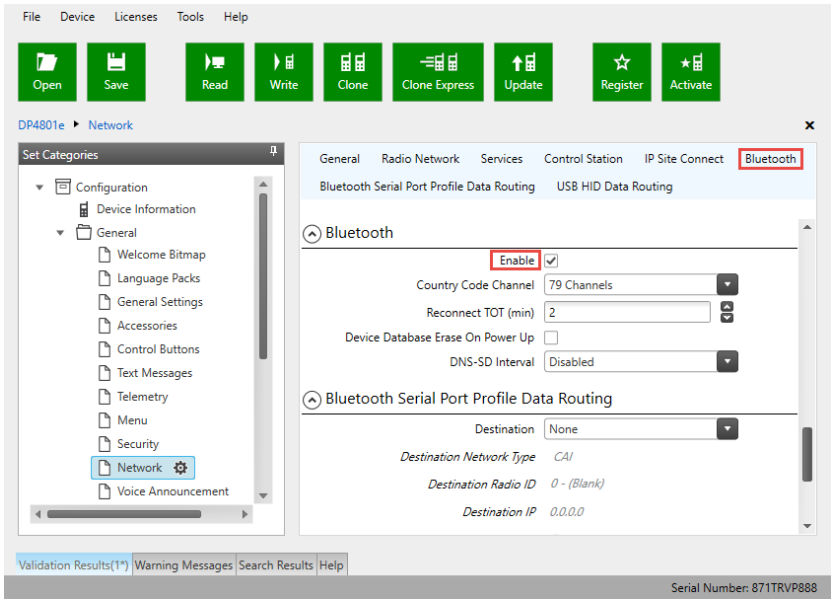


Figure 4: Enabling the Bluetooth feature on the radio

6. In the **Set Categories** pane, select **General > Indoor Location**.
   In the right panel, select the **Indoor Location** check box to enable the respective feature on the radio.

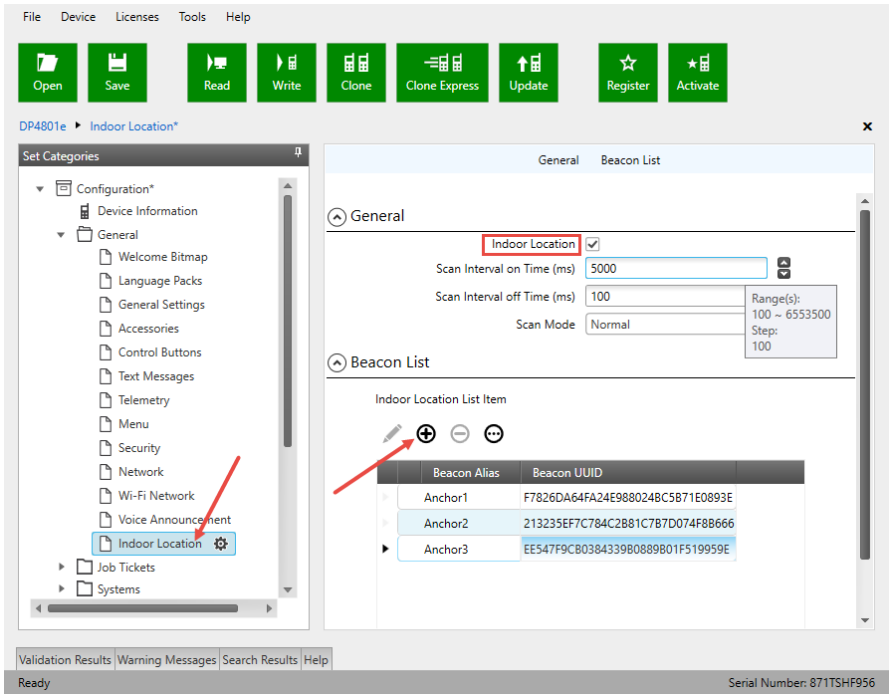


Figure 5: Enabling the Indoor Location feature and adding beacons

The **Beacon List** section shows all beacons registered on the radio.

7. To add a new iBeacon, click the plus sign button. In the line added at the bottom of the table, double-click the default text and type the preferred beacon alias and the UUID value.
8. In the **Set Categories** pane, select **General > Menu**.
   In the right pane, navigate to the **Utilities** section and select the **Indoor Location** check box to activate the Indoor Location menu on the radio.

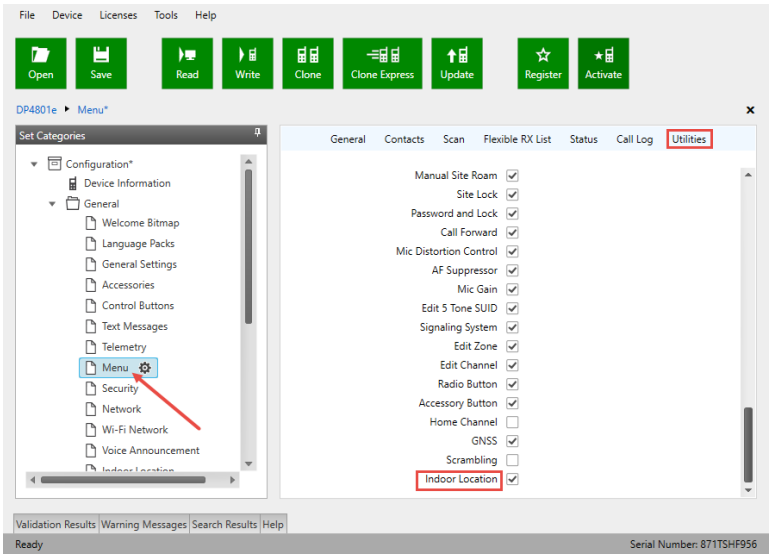


Figure 6: Activating the Indoor Location menu item on the radio

9. Click the **Write** toolbar button or select **Device** and **Write** in the application menu to load the updated configuration to the radio.
10. Power off the radio and disconnect it from the computer.

Radio Configuration Test



Figure 7: Detected beacons

To ensure that the updated configuration works properly:

1. Power the radio and bring it close to any physical beacon registered on the radio.
2. In the **Main Menu** of the radio, select **Bluetooth**. In this menu section:
   a) Go to **My Status** and select **On** to activate Bluetooth on the radio.
   b) Go to **Indoor Location** and select **Enabled**. Then select **Beacons**.

All detected beacons appear on the display, each with the UUID and Major and Minor identifiers.

3.1.1 Non-Display Radios

For radios that do not have a display, you have to manually switch on the Indoor Location feature every time you restart the radio. For this purpose, assign a dedicated button on the radio (*MOTOTRBO CPS* > *Buttons* > *Short/Long Press* > *Indoor Location On/Off*). In addition, you can add an appropriate voice announcement to be sure the Indoor Location feature is on.

3.2 Server Configuration

This section describes how to configure Indoor Positioning in TRBOnet Server.

Table 3: High-level steps for configuring Indoor Positioning on TRBOnet Server

#	High-level steps	Refer to
1	Launch TRBOnet Server by clicking the shortcut on the Windows desktop.	
2	Apply a license with Indoor Positioning support.	Applying a License with Indoor Positioning Support
3	Verify the status of the GPS Location service.	Verifying the Location Service

After the server-side configuration is finished, you need to specify several settings in the Dispatch Console as described in section Dispatch Console Configuration of this guide.

3.2.1 Applying a License with Indoor Positioning Support

TRBOnet Indoor Positioning requires a TRBOnet license with the Indoor Positioning option.

To check if your license supports Indoor Positioning:

1. In Dispatch Console, click the **Administration** tab in the left pane.
2. In the **Administration** pane, select **License** from the tree.
3. In the right pane, find **Indoor Positioning** under the **List of available features**.

If this option is not included, contact your sales representative to obtain a license with Indoor Positioning support.

To apply a new license:

1. Copy the new license file to a local folder. If this folder contains other license files, delete them.
2. Launch TRBOnet Server. In the configuration window, select **License** in the left pane.
3. Click the **License Manager** link in the right pane.
4. In the **License Manager** window, follow the instructions and select the new license file from the local folder.
5. Click **Finish** to close the wizard.
6. Click **Apply** and confirm to restart TRBOnet Server.

3.2.2 Verifying the Location Service

TRBOnet Indoor Positioning requires the Location service to be enabled.

To verify the status of the Location service:

1. Launch TRBOnet Server.
2. In the **Configuration** pane, select **Radio Systems**. The **Enable Radio Systems** option must be selected in the right pane.

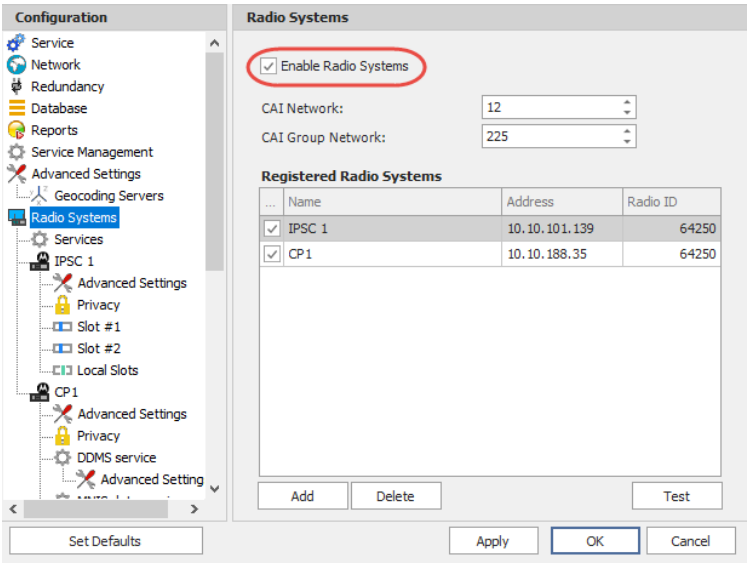


Figure 8: The Radio Networks are enabled

3. In the **Configuration** pane, select **Services** under **Radio Systems**. In the right pane, the **Location service (LRRP / Indoor)** option and/or **Location service (LIP / Indoor)** must be selected depending on the GPS data protocols in use.

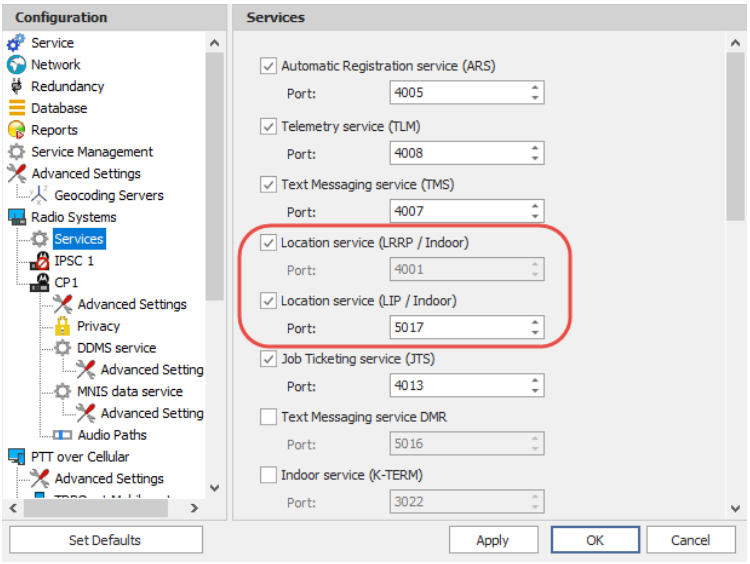


Figure 9: The GPS Location service is enabled

4. If you have made any changes, click **Apply** and confirm to restart TRBOnet Server.

3.3 Dispatch Console Configuration

This section describes how to configure Bluetooth-based Indoor Positioning in TRBOnet Dispatch Console.

Table 4: High-level steps for enabling iBeacon-based indoor positioning in TRBOnet Dispatch Console

#	High-level steps	Refer to:
1	Launch Dispatch Console by clicking the shortcut on the Windows desktop.	
2	Create location profile.	Creating a Location Profile
3	Assign a location profile to each radio.	Assigning a Location Profile to Radios
4	Prepare a floor map.	Preparing a Floor Map
5	Place beacons on the floor map.	Placing Beacons on a Map

3.3.1 Creating a Location Profile

A location profile defines the rules for sending GPS and/or iBeacon information from a radio to TRBOnet Server. You need at least one location profile with iBeacon support.

To create a location profile:

1. In Dispatch Console, click the **Administration** tab in the left pane.
2. In the **Administration** pane, select **Location Profile** in the tree.
3. To add a profile, click **Add** in the right pane. In the **Location Profile** dialog box, select **MOTOTRBO** from the **Profile type** list. Specify the **Profile name** and click **OK**.

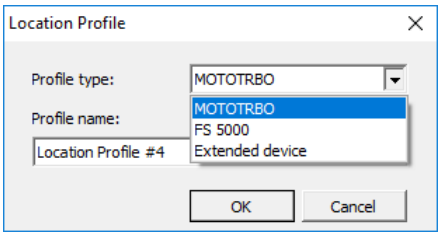


Figure 10: Creating a location profile

4. In the **Location Profile** dialog box, modify the default location profile settings where needed.
   - Click the **General** tab.

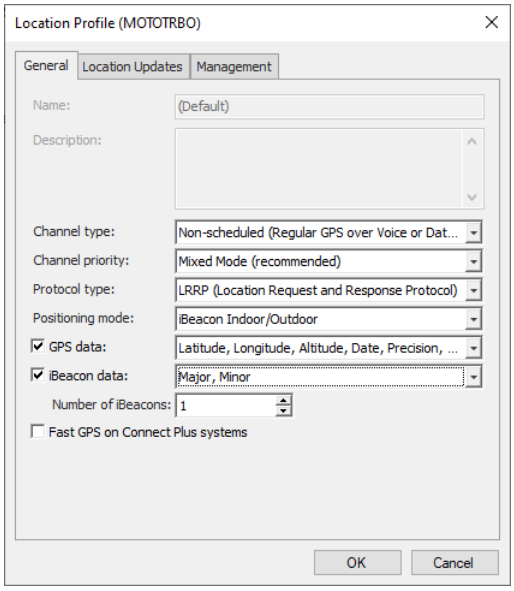


Figure 11: Location Profile – General settings

The following settings are important for sending iBeacon data:

- **Channel type**:
  From the drop-down list, select a radio channel for sending location data to TRBOnet Server:
  - **Non-scheduled**
    This is a channel with regular GPS (Enhanced GPS not supported).
  - **Scheduled**
    This channel is available when the Enhanced GPS feature is configured in the radio system.
  - **Non-scheduled with CSBK data**
    This channel allows using CSBK (Control Signaling Block) while decoding.
  - **Scheduled with CSBK data**
    This is a channel with Enhanced GPS, which allows using CSBK (Control Signaling Block) while decoding.

  WARNING: Because of the LRRP protocol limitations, CSBK options should not be selected for iBeacon data transfer. The **Fast GPS on Connect Plus systems** option should not be selected for the same reason.

- **Channel priority**
  From the drop-down list, select the channel that will be used by location triggers when both LMR and broadband channels are available.
  - **Mixed Mode (Recommended)**
    Location triggers are used for broadband and LMR channel simultaneously.

- **Broadband Channel**
  Location triggers are used for the broadband channel if available, and for the LMR channel if the broadband channel is not available.
- **LMR Channel**
  Location triggers are used for the LMR channel if available, and for the broadband if the LMR channel is not available.

Note: If you have entered the polling interval (**Location Updates** tab, **Periodic updates** > **Interval**) that is not supported for the selected channel, the closest larger value will be used.

- **Protocol type**
  From the drop-down list, select the protocol with which to send GPS data.
  - **LRRP** (Location Request and Response Protocol)
  - **LIP** (Location Information Protocol)

Note: The LIP protocol is supported on IPSC systems only.

- **Positioning mode**
  This option determines which GPS coordinates to show on the map and display in the radio's movement history when TRBOnet Server receives a data packet containing both iBeacon and GPS data.
  - **iBeacon Indoor/Outdoor**
    The coordinates of the iBeacons will be positioned on the indoor and outdoor maps.

Use case: When a person enters a building, the accuracy of the GPS location reported by their radio is likely to deteriorate. This may cause TRBOnet to show the radio's location outside the building. Using coordinates of iBeacons positioned on the floor plan will prevent this from happening, and the route travelled by the person will also be correct. This is especially useful for reinforced concrete or high-rise buildings.

  - **iBeacon Indoor/GPS Outdoor**
    The coordinates of the iBeacons will be positioned on the indoor map while the coordinates of the radio will be positioned on the outdoor map.

Use case: This option is used to show the route travelled by the person based on the GPS coordinates received from their radio rather than from a detected beacon, or when the speed and/or altitude of the device are used for some purpose. The user's icon will appear on the map twice, one icon will show their actual GPS location, whereas the other icon will appear over a detected beacon. Only iBeacon-based location will be displayed on the floor plan. When the radio's GPS coordinates become unavailable, the user's icon will be displayed over the detected beacon on both the map and the floor plan.

- **iBeacon Indoor/No Outdoor**
  Only the coordinates of the iBeacons will be positioned on the map, while the GPS coordinates of the radio will be ignored.

- **GPS data**
  Select this option to enable the user to select what GPS readings to send to TRBOnet Server. In the drop-down list, select which GPS data to include in a packet.
- **iBeacon data**: Select this check box to enable sending iBeacon data to TRBOnet Server. In the menu, select iBeacon data to be included in a packet:
  - **Major, Minor** (always included)
  - **UUID**
  - **TX Power, RSSI**
- **Number of iBeacons**
  Specify the number of the most recently detected iBeacons whose data will be included in the data packet sent to TRBOnet.

Location Updates tab

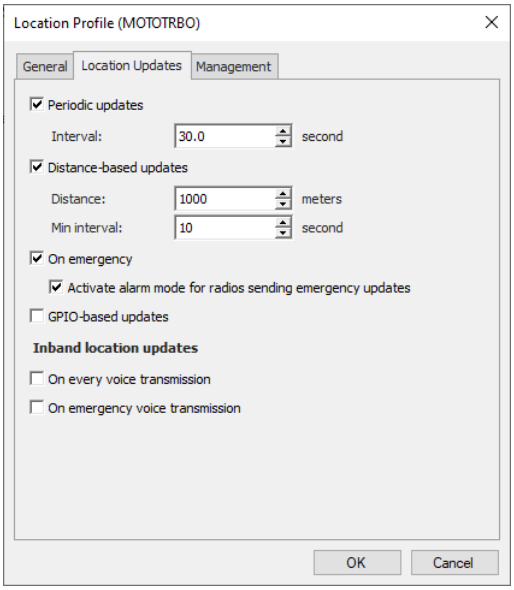


Figure 12: Location Profile – Location Updates settings

- **Periodic updates**
  Select this option to set a periodic location trigger on a radio. The trigger is a request to the radio to send its GPS and/or iBeacon data at the specified time interval.
  - **Interval**
    Specify the location update interval, in seconds.
- **Distance-based updates**
  Select this option to allow receiving location updates by a distance:
  - **Distance**
    A radio will send location updates if the travelled distance exceeds a specified distance from the last GPS point, in meters.
  - **Min. interval**
    A radio will send location updates no more than once within this time interval, in seconds.
- **On emergency**
  Select this option so that a radio will send GPS and/or iBeacon data upon entering the emergency mode.
  - **Activate alarm mode for radios sending emergency updates**
    Select this option if you want a Dispatch Console operator to see the emergency status of a radio that transmitted location data.
- **GPIO-based updates**
  Select this option so that a radio will send GPS and/or iBeacon data upon sending a Telemetry command.

Inband location updates

- **On every voice transmission**
  Select this option so that a radio will send GPS and/or iBeacon data every time the PTT is pressed and held more than 5 seconds.
- **On emergency voice transmission**
  Select this option so that a radio will send GPS and/or iBeacon data every time the PTT is pressed in the emergency mode.

5. If you have selected the **Scheduled** option for **Channel type**, click the "calculator" icon next to the **GPS data** field or **iBeacon data** field.

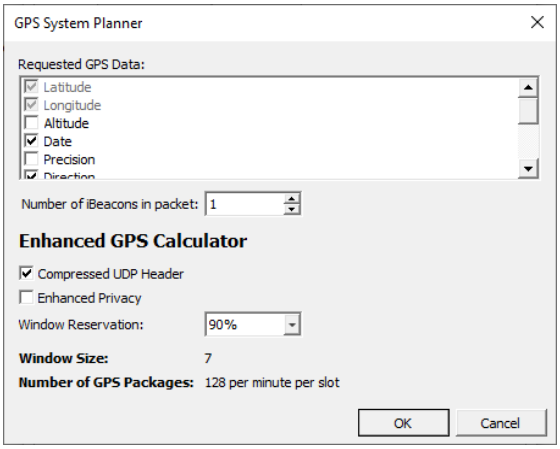


Figure 13: Calculating the window size for GPS data transfer

In the **GPS System Planner** dialog box, specify GPS and iBeacon data to be included in a package. The actual window size and the capacity of the Enhanced GPS Revert channel are recalculated as you change the package attributes.

WARNING: To prevent unexpected results of sending location data, make sure that all repeaters and subscribers in the system with Enhanced GPS feature are configured to use the same window size. To learn more about configuring Enhanced GPS in different system topologies, refer to MOTOTRBO System Planner.

6. Click **OK**. The newly created location profile appears under the **Location Profile** section in the left pane.

3.3.2 Assigning a Location Profile to Radios

Assign a location profile with iBeacon support to each radio that should send iBeacon information to TRBOnet Server.

To assign a location profile to a radio:

1. In Dispatch Console, click the **Administration** tab in the left pane.
2. In the **Administration** pane, select **Radios** from the tree.
3. Select a desired radio in the list and click **Edit** in the right pane.

4. In the dialog box, select the **General** tab. If advanced settings are collapsed, click **Show Advanced Settings**.
5. In the **Location Service** section, expand the **Location Profile** drop-down list and select the preferred profile with iBeacon support.

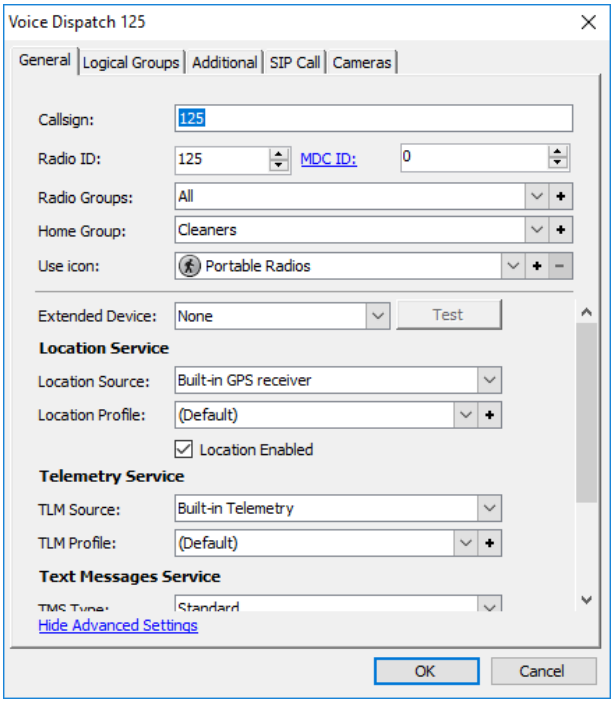


Figure 14: Updating a radio profile

Note: Alternatively, click the “plus” button next to the **Location Profile** box and create a new location profile as described in Creating a Location Profile. When you click OK, the created location profile is assigned to the radio and appears in the **Location Profile** box.

6. Select the **Location Enabled** option. This option enables TRBOnet Server to send location triggers to a radio.
7. Click **OK**.

3.3.3 Preparing a Floor Map

TRBOnet Dispatch Console supports 2D and 3D floor maps to let you visualize the location of each beacon on the monitored territory.

- A 2D map is a BMAP file that you can generate from an image file in TRBOnet Dispatch Console.
- A 3D map is an X (DirectX) file that you can create using third-party software.

To create a 2D map:

1. Place an image file with a floor map in a local folder. Dispatch Console can work with many image formats, including JPEG, PNG, TIF, and BMP.
2. In Dispatch Console, click the **Administration** tab in the left pane.
3. In the **Administration** pane, expand **Tools** and select **Indoor 2D Map Converter** in the tree.
4. In the right pane, specify the following parameters:
   - **Name**: The preferred name of the map.
   - **Image**: The full path of the source image file.
   - **Directory**: The full path of the folder where the generated map is located.
5. Click **Start**.

3.3.4 Placing Beacons on a Map

Open a floor map in TRBOnet Dispatch Console and indicate the location of each beacon on the map.

To open a floor map:

1. In TRBOnet Dispatch Console, click the **Location Tracking** tab in the left pane.
2. In the application menu, select **Map** and **Open New Map in Tab** to open a floor map in the right pane. Or, select **Open New Map in Window** to open a floor map in a separate window.
3. In the **Select Map** dialog box, specify the following parameters:
   - **Map Type**: Select **Beacon 2D** or **Beacon 3D**, depending on the type of your floor map.
   - **Caption**: Specify the name of your floor map to be displayed in the tab header.
   - **Available Maps**: Select the preferred map to activate the **OK** button. Click **OK**.

   Note: If you cannot find your map in the list, click **Add** and select the image file of the preferred map in the system dialog box. The selected map appears in the list.

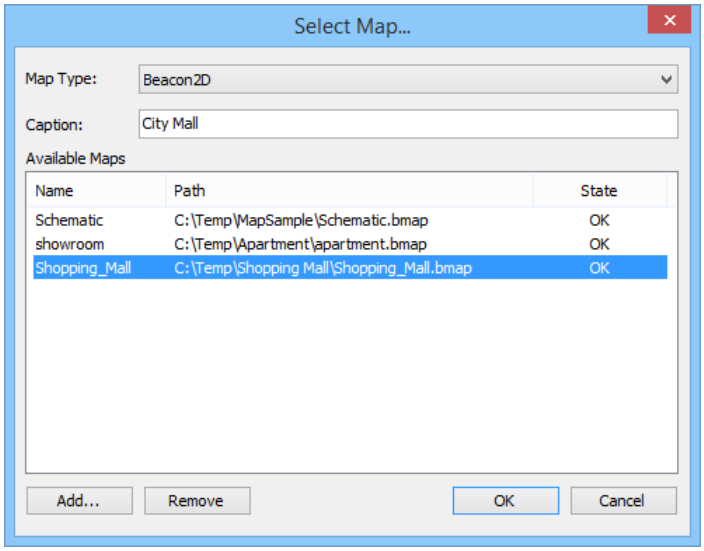


Figure 15: Selecting a floor map

4. Click **OK**. A new tab with the selected floor map appears in the right pane.

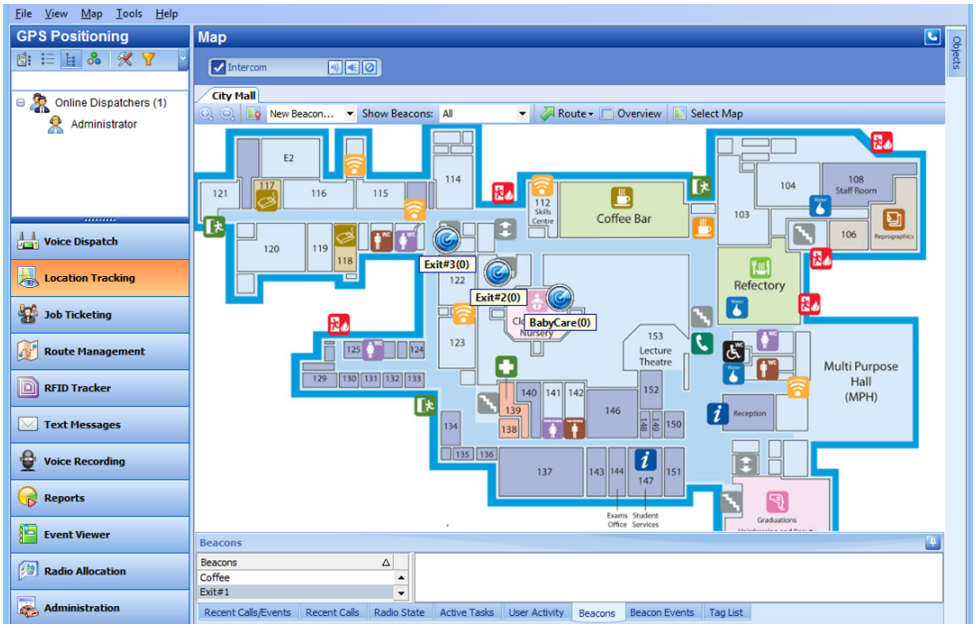


Figure 16: 2D floor map

You can adjust the view of your map as follows:

- To zoom in/out your map, scroll the mouse wheel.
- To pan a 2D map, click the map area and move the mouse cursor, keeping the primary mouse button pressed.
- To pan a 3D map, click the map area and move the mouse cursor, keeping the secondary mouse button pressed.
- To rotate a 3D map, click the map area and move the mouse cursor, keeping the primary mouse button pressed.
- To display the map with its original size and position, click the **Overview** button in the control bar.

To place beacons on a map:

1. In the right pane, select the tab with the preferred floor map.
2. To add a new beacon to the map, expand the list of beacons on the toolbar and select **New Beacon...**. To place an existing beacon, click it in the list.
3. Click the  (**Set Location**) button. The shape of the mouse cursor changes.
4. Click on the map to point the location of a physical beacon on the floor.
5. (Optional) If you add a new beacon, the **Beacon properties** window appears.

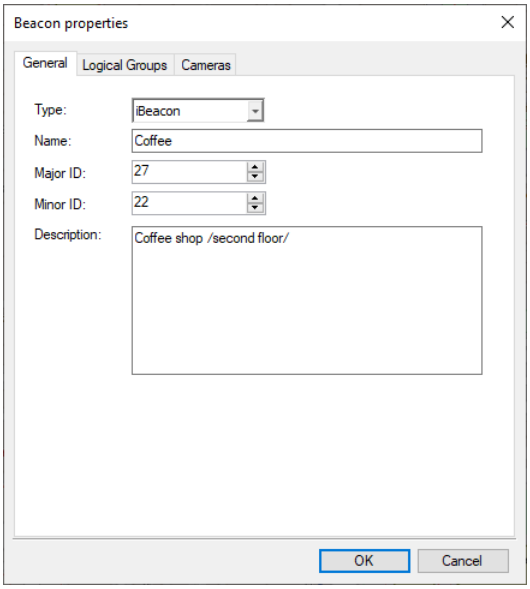


Figure 17: Specifying beacon properties

a) Select **iBeacon** in the **Type** menu.
b) Specify any descriptive name to identify the beacon.
c) Enter the beacon's major and minor ID exactly as specified on the iBeacon device.
d) Click **OK**. A new beacon with the specified name appears on the map.

You can edit beacons on the map as follows:

- To relocate a beacon on the map, right-click it and select **Set Location** in the context menu. Then point the desired location on the map.
- To edit properties of a beacon, double-click that beacon on the map or in the **Beacons** pane. Modify the properties in the **Beacon properties** window and click **OK**.
- To delete a beacon from the map, right-click it and select **Delete from the Map** in the context menu.

Note: The deleted beacon is not linked to a map but is still displayed in the **Beacons** pane.

- To completely remove a beacon, right-click it in the **Objects** pane and select **Remove Object** in the context menu.

3.4 Test

- Power on your radio configured for Bluetooth-based Indoor Positioning.
- Launch TRBOnet Dispatch Console and select **Location Tracking** in the navigation pane.

If all configuration settings are correct, the following happens:

1. In a few minutes, TRBOnet identifies the radio in the network and displays its status as Radio Online. This happens automatically, no action on the radio is required.

   Note: The identification time is three times the periodic trigger interval specified in the location profile assigned to the radio.

2. TRBOnet sends the GPS Start request to the radio.
3. The radio starts to report its own location - GPS data, or iBeacon data, or both - as specified in the associated location profile.
4. On the floor map, the closest beacon detected by the radio is displayed in the yellow color, indicating the radio's location. The value in brackets indicates the number of radios currently located by the yellow beacon. Beacons displayed in the blue color do not locate any radios.

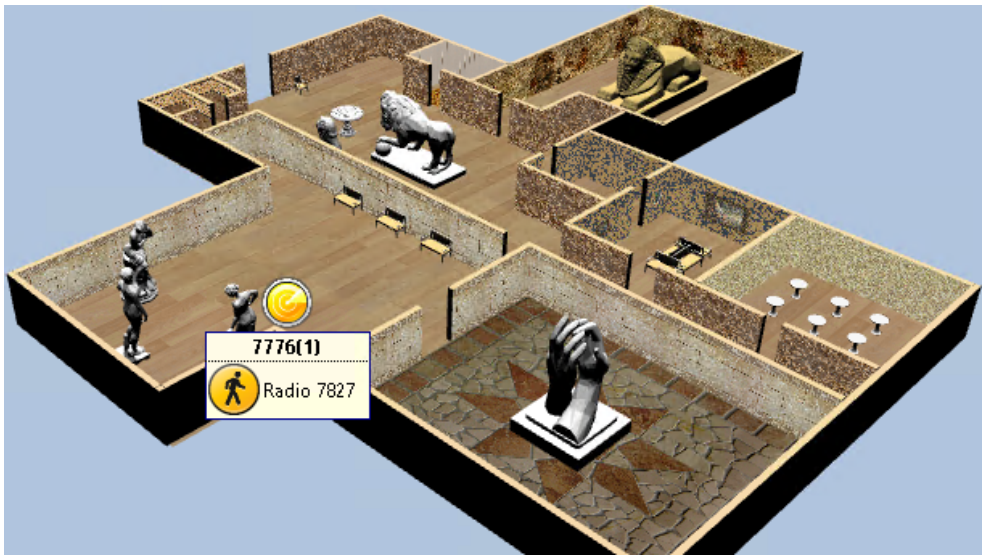


Figure 18: A radio detects the closest beacon on a 3D map