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« IIDRE: geolocation solution by UWB »

*Quick start guide*

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# I. Basics

## 1. Vocabulary

For those who are not familiar with real-time location systems, commonly shortened RTLS, the following lines give a short description of some specific terms used in this *quick start guide*.

- **UWB:** stands for ultra wideband. UWB is the radio technology used in the kit provided by IIDRE. The intrinsic qualities of UWB allow to achieve ranging schemes (based on time of flight measurement) between two transceivers with an accuracy of 10-30 cm, thus leading to precise positioning.
- **Tag:** mobile device placed on the element to be localized (vehicles, robots, assets, persons).
- **Anchors:** georeferenced devices placed around the tag progression area. The tag position is computed from the known coordinates of these elements (at least three) and the distances measured.
- **Gateway:** device acting as a listener for data centralization.
- **Node:** generic term for a device which can be a tag, an anchor or a gateway.
- **LOS/NLOS:** respectively stand for Line-Of-Sight and Non-Line-Of-Sight. A LOS measurement means that electromagnetic waves travel in a direct-path between two transceivers, while a NLOS measurement means that there is at least one obstacle between two transceivers.

## 2. Kit contents



The standard evaluation kit provided by IIDRE includes:

- 1 tag,
- 4 anchors/gateways,
- 4 cables (microUSB-USB) to connect the external batteries (powerbanks DC-5V not included),
- 4 mini tripods,
- 1 companion software *RTLS by IIDRE*,
- 1 complete documentation (*user guide*, *quick start guide* and *RTLS by IIDRE instruction manual*).

## 3. Typical applications

This evaluation kit could be used in many different ways since each device could be used as a desired node. The most common case involves one tag and four anchors. In this instance, the positions computed by the tag are available either on the tag or on one of the fixed anchors. A second common case uses one tag, three anchors and one gateway. Here, the positions computed by the tag are also available from every where thanks to the gateway.

This document describes the installation and configuration steps of the first case described above. The user is invited to refer to the *user guide* for other applications.

## II. Kit installation

1. The first step consists in identifying the type of each device in the kit (tag or anchor). Please refer to the delivery note to establish the correspondence between the ID (hexadecimal number) labelled on the rear of the housing of each device and its associated type.
2. It is recommended to write down the IDs of the anchors and to sort them in ascending order as shown on the Figure 1 below. This is in order to identify each anchor easily in the following steps.



Figure 1: Identification of the anchors

3. Place the anchors in your area. Take care of the visibility of each anchor from the point of view of the tag, this is in order to enhance LOS communications; thus allowing a better accuracy of the system. Note also that it is highly preferable to avoid metallic elements in the devices surrounding area.

Concerning the anchors installation height, the user is free to operate regarding the previous points. However, it is advisable to be close to the tag horizontal plane for a better accuracy. Note that anchors do not necessarily have the same height.

Consider the smallest ID as the X/Y-axis origin, then place the other anchors clockwise, as shown below on the Figure 2.

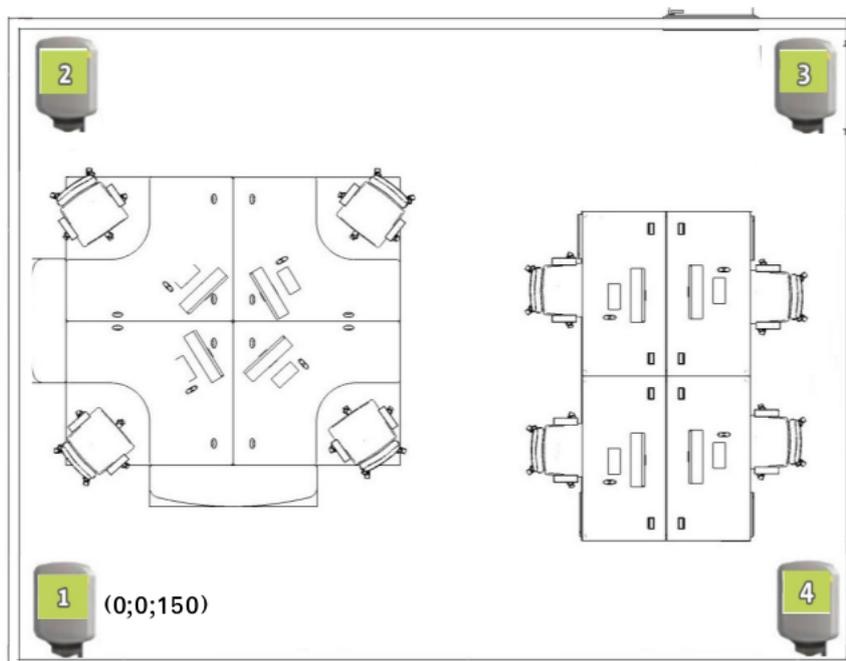


Figure 2: Installation of the anchors

4. To ensure the geolocation of the tag, the positions of each anchor of the infrastructure must be known. From the X/Y-axis origin, measure the coordinates (in centimetres) with the best possible accuracy using your own tools (total station, rangefinder, tape measure, steps, etc.).
5. Supply the anchors with the external batteries and USB cables.
6. The infrastructure is ready for use. The following part details the simplest way to configure the system.

### III. Kit configuration

#### 1. Basic configuration

In order to be able to compute its position, the tag must be configured with the current infrastructure. The following steps describe the basic guidelines using the *RTLS by IIDRE* companion software. Please refer to the *instruction manual* for installation and further details.

1. Launch the *RTLS by IIDRE* software and deploy the drop-down menus available on the welcome page as shown on the Figure 3 below.

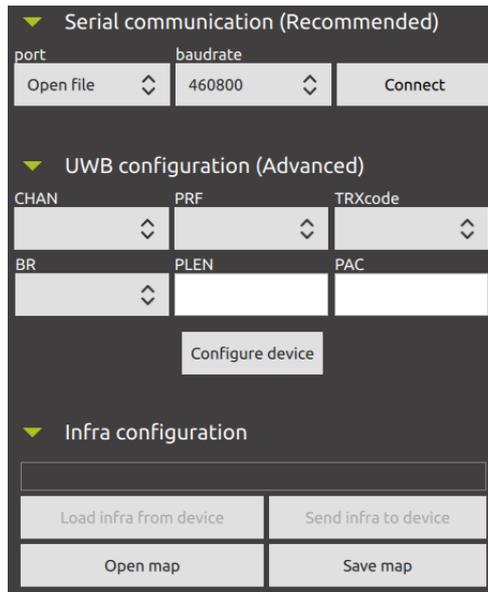


Figure 3: *RTLS by IIDRE* - welcome page menu

2. Connect the tag to the computer using the USB cable. When plugged, the device is automatically detected by the computer and the application.
3. In the **Serial communication** menu, click on **Connect**.
4. When connected, the current UWB parameters appear in the **UWB configuration** menu.
5. In the **Infra configuration** menu, click on the **Load infra from device** button; it will generate a default file (\*.json) for the configuration of the infrastructure.
6. A dialog box will open, choose the folder and the file name keeping a \*.json extension.
7. Open the created file with a simple text editor. The list of the anchors is displayed, as shown on the Figure 4.
8. Fill in the fields corresponding to the X and Y coordinates with the values measured preliminarily during the step 4 of the previous section *kit installation*.
9. Save the current file keeping its \*.json extension.
10. Go back to the Supervisor. In the **Infra configuration** menu, click on the **Send infra to device** button. A dialog box will open, select the file just filled; the coordinates of the anchors will be transferred into the flash memory of the tag.
11. **Disconnect/Connect** to update the infrastructure. The configuration is over, the tag evolves in its progression area.

```

{
  "ANCHORS": [
    {
      "DESCRIPTION": "",
      "ID": "1000000A",
      "X": 0,
      "Y": 0,
      "Z": 0
    },
    {
      "DESCRIPTION": "",
      "ID": "1000000B",
      "X": 0,
      "Y": 0,
      "Z": 0
    },
    {
      "DESCRIPTION": "",
      "ID": "1000000C",
      "X": 0,
      "Y": 0,
      "Z": 0
    },
    {
      "DESCRIPTION": "",
      "ID": "1000000D",
      "X": 0,
      "Y": 0,
      "Z": 0
    }
  ]
}

```

Figure 4: *RTLS by IIDRE* - default \*.json file

## 2. Advanced configuration

The *RTLS by IIDRE* software also makes possible to change the UWB parameters of a device (CHAN, PRF, BR and TRXcode). Note that for proper functioning the UWB parameters must be the same for each node in the infrastructure. Note also that both parameters PLEN and PAC are automatically set taking into account the current configuration.

1. Select the required value thanks to the drop-down corresponding menu.
2. When the chosen parameter implies a change for another one, the default corresponding value is automatically set.
3. Click on the **Configure device** button.

UWB configuration (Advanced)		
CHAN	PRF	TRXcode
2	64	9
BR	PLEN	PAC
850	512	16
Configure device		

Figure 5: *RTLS by IIDRE* - UWB configuration

4. **Disconnect/Connect** to update the configuration.
5. For the other nodes, when plugged and connected it is possible to directly click on the **Configure device** highlighted button and then **Disconnect/Connect** to update the configuration.

UWB configuration (Advanced)		
CHAN	PRF	TRXcode
2	64	9
BR	PLEN	PAC
850	512	16
Configure device		

Figure 6: *RTLS by IIDRE* - UWB configuration with highlighted button

For further details concerning the UWB configuration, see our *User guide*.

### 3. Configuration by AT commands

A set of commands based on AT commands principle allows for control and configuration of the devices using a *terminal* instead of the companion software. This section gives the basic and advanced configurations described above in a situation involving one tag (10000001) and four anchors (anchor1=1000000A, anchor2=1000000B, anchor3=1000000C and anchor4=1000000D). Note that on delivery, the nodes are already configured, the user is free to ignore this part.

1. In order to identify the tag from the anchors, for each device plug the serial line and check the ID. The command returns the node ID (hexadecimal number) and then its type where 1 and 2 respectively stand for ANCHOR and MOBILE. For example, if the tag is plugged on the serial line, the command returns:

```
AT+ID?  
+ID:10000001,2  
OK
```

while if the first anchor is plugged, the command returns:

```
AT+ID?  
+ID:1000000A,1  
OK
```

2. When the tag is identified among the other nodes, the user can check the infrastructure. Using our current example, the command returns:

```
AT+NODE?  
+NODE:10000001,2  
+NODE:1000000A,1  
+NODE:1000000B,1  
+NODE:1000000C,1  
+NODE:1000000D,1  
OK
```

3. Check the coordinates of the anchors in the infrastructure. Default coordinates of the anchors are (0;0;0).

```
AT+POS?  
+POS:1000000A,0,0,0  
+POS:1000000B,0,0,0  
+POS:1000000C,0,0,0  
+POS:1000000D,0,0,0  
OK
```

4. Enter the coordinates (in centimetres) of each anchor following the given format ( $AT+POS=ANCHOR\_ID, X\_coord, Y\_coord, Z\_coord$ ). When finished, check the validity of the coordinates using the previous command.
5. Changes are took into account only after a reset applied on the tag.

```
AT+RESET  
OK
```

6. From this point, the infrastructure is ready for use. However, the user is free to modify the UWB parameters following the given format ( $AT+PARAMETER=PARAMETER\_VALUE$ ), for example the communication channel could be set to 7 as shown below.

```
AT+CHAN=7  
OK
```

For further details concerning the configuration by AT commands, see our *User guide*.

The kit is now ready for you to start experimenting with RTLs. If you have any question, please contact **[supportkit@iidre.com](mailto:supportkit@iidre.com)**.

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