Installation Guideline

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Introduction

First, thank you for choosing Pozyx for your indoor positioning solution. This guideline has the objective to assist you in the installation process of the Pozyx hardware and software.

Positioning basics

Reference frame

A position is always relative of where you are. So in order to position a certain object, a reference frame is necessary. This reference frame provides **the origin, scale and direction** of the object that you are willing to track. A reference frame can be the entire space of the warehouse.

Reference points

To have an accurate position it is necessary that within this reference frame some reference points with known positions are given. These reference points are **the anchors**. Due to these reference points we can measure the relative position of the object to be tracked. This relative position renders the position of the object within the chosen reference frame.

Techniques on defining the position

Within Pozyx we use Ultra Wide Band (UWB) positioning where this relative positioning can be done in 2 ways, Two Way Ranging (TWR) and Time Difference On Arrival (TDOA).

Two Way Ranging system: In a TWR system, a message is sent back and forth between all the different anchors and the tags. From the Time of Flight and the speed of light, the distance to each anchor can be determined.

TDOA system: In this system a tag broadcasts a message to all the anchors in its range, but the anchors don't send a message back. This system will be mainly implemented.

	TWR	TDOA
Messages	Anchors and tags will transmit multiple messages	Only the tags broadcast a signal
Position estimation	The tag is located at the intersection of the spheres.	The tag is located at the intersection of the hyperbolas.
Calculation	Calculated based on the Time of flight	Calculated on the Time Difference
Implication	• Positioning can be known on the tag, the positioning server, or both.	• The position is only known on the server. • Very long battery life. • Can support very large number of tags. • Requires that the anchors are sufficiently within line-of-sight of each other for wireless synchronization • Reduces positioning performance outside the anchor area.

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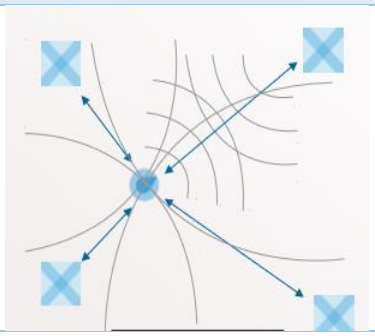
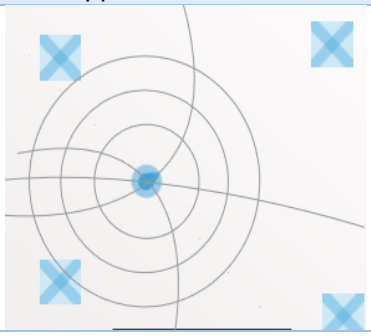
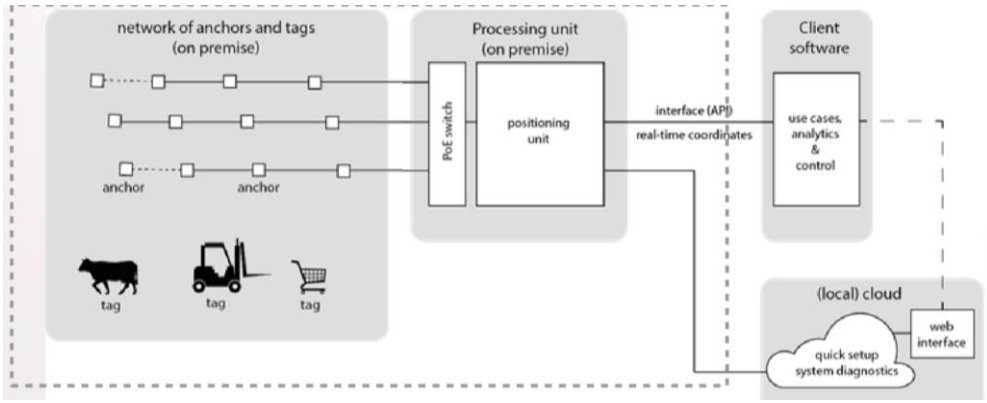
		• Only 2D positioning is supported.
Visualisation = anchor = tag		

Hardware

Overview

In the below overview you can see high-level how the set-up is designed.



Anchors with antenna

Each anchor needs to be powered by an Ethernet cable, through a RJ45 port. The anchor receives power and can send data to the central gateway. The anchor has an IN and OUT port, so all the anchors can be daisy chained from the gateway with up to 8 hops and a maximum amount of cable (see below). A general rule is that there should be 1 anchor each 10m (1 anchor/100m2). This, however, depends on the environment.

On the anchor an external antenna is placed. It is connected through an SMA connector. The antenna is omni-directional except for the top and bottom direction. The antenna should always be placed vertical, so the antenna should be on top or at the bottom of the anchor. As UWB is just like any other radio signal, conductive materials like metal, water and wires should stay away from the antenna.

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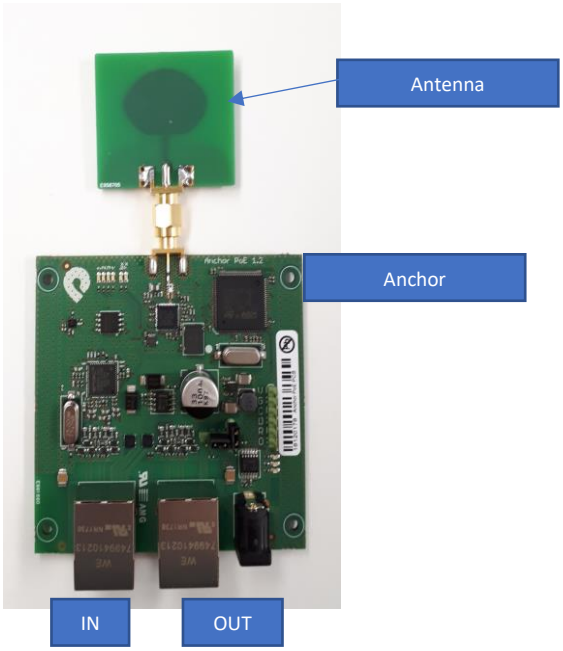

Tag

The tag uses a battery for its power. Depending on the update rate of positioning, the battery life is higher or lower. It is also omni-directional with exception of the top and bottom direction. The tag should be able to see at least 4 anchors for reliable positioning, so no big blocking conductive objects should be in the line of sight of the anchor.

Gateway or processing unit

All anchors are connected to the gateway through 8 PoE+ ports (big gateway). Per port we can install 8 daisy chained connected anchors with a maximum (see below) amount of meters PoE cable (64 anchors in total). The gateway processes the time differences into robust positions and sends this data to the cloud or to a local client app.

When using a small gateway, you only have 2 ports. 1 for the internet and one for the anchor daisy chains or for the switches.

You can also use switches to increase the number of anchors for the installation. In that installation the anchors are connected through 7 PoE+ ports with the switch and the switches are connected to the gateway.

Here are shown the front side of the gateway for the connection of the anchors (8 ports) and the back side of the gateway for the connection of the internet.

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Switch

If the installation requires more than 64 anchors, it is needed to install switches. Switches will be then connected to the gateway. A switch also contains 8 PoE+ ports of which one needs to be connected to the gateway.

Cable and connectors

The cable should be delivered by the client and should be AWG 26 or better. An example of the cable specifications could be **CAT5E 24AWG/4PAIR CMP 350MHz F/UTP SHIELDED** (solid) and for the connectors **RJ45 Cat5e Shielded Connector** (with Cap Sleeves Protector).

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Installation on site

Installation Requirements

To guarantee an optimal performance of the positioning software, we need to take into consideration some rules of thumb:

- Preferably, you should place an anchor every 10m to achieve an optimal range
- Maximum use of cable per port and a max of 8 anchors

hops	AWG26	AWG25	AWG24
1	165	215	285
2	150	200	260
3	135	180	235
4	120	160	210
5	100	140	185
6	85	120	165
7	70	100	140
8	55	85	115

- Make sure anchors aren't blocked by big conducting objects (ventilators, TV's, Cables, metal structures,…)
- If possible, it is recommended to not place anchors on **single straight lines** in order to reduce possible symmetry issues in positioning. If there are anchors across, this is not a problem.
- A tag should be able to be seen by 4 anchors at every relevant location (perfect Line Of Sight)
- The gateway and the switches are the power suppliers to the anchors, so at these locations there should be access to power.
- Do not place a switch and gateway on top of each other as this may result in overheating, maintain a small distance.
- The anchors should not be placed directly to metal. For the antenna it is better that there is a space around so that the signal will be optimal received. This can be ordered with Pozyx if needed.

- Internet should be available on site to connect the gateway. Please bare in mind these firewall ports
  80 TCP/UDP OUT
  443 TCP/UDP OUT
  123 UDP IN/OUT

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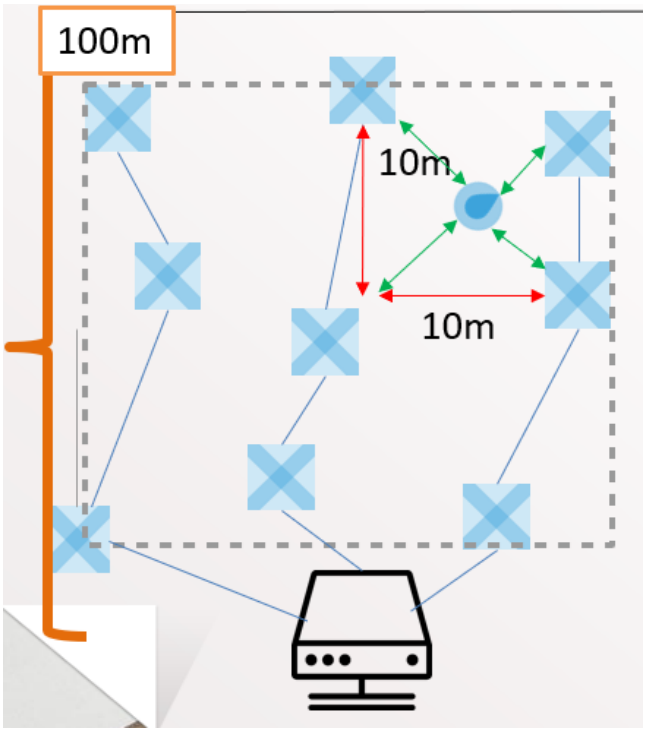
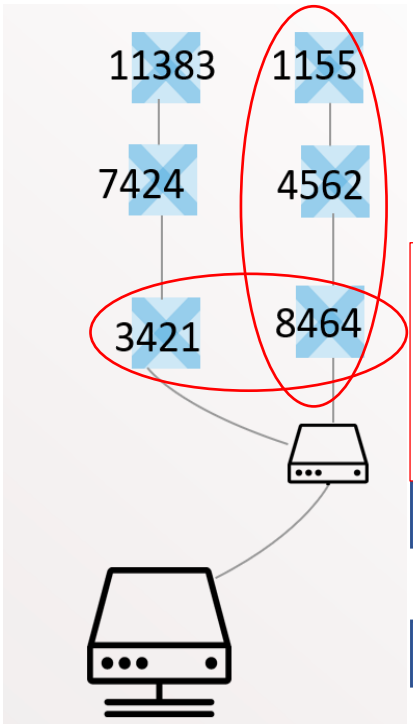
22 TCP/UDP IN
1194 TCP/UDP IN/OUT
4000 TCP/UDP IN
1883 TCP/UDP IN

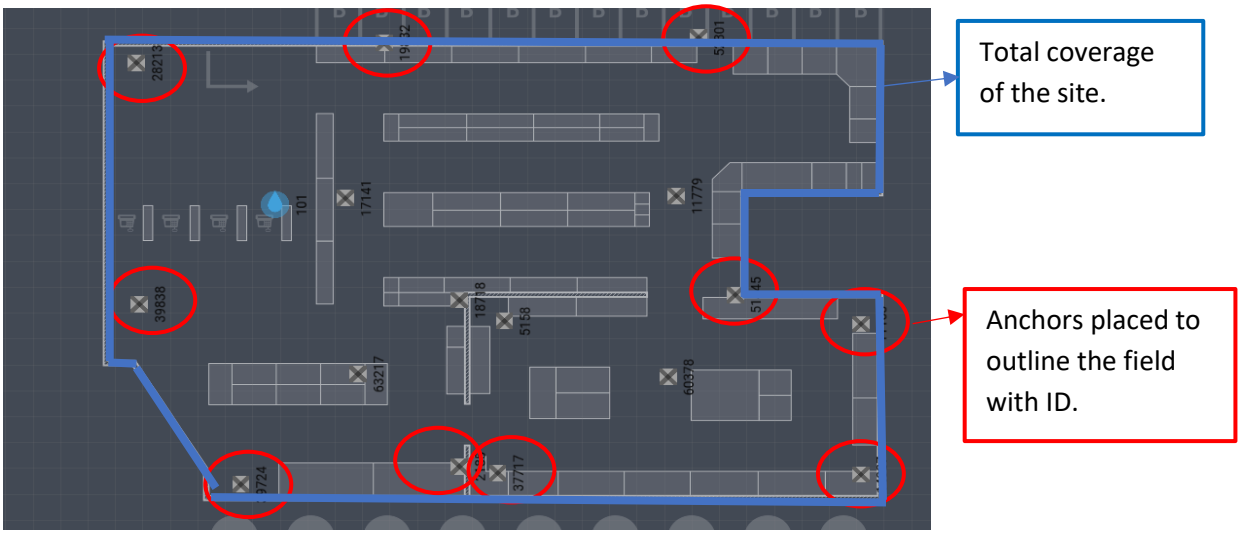




Anchor placement plan

Keeping in mind the installation requirements, an anchor placement plan should be made up. This is a plan that illustrates the positions of the anchors on the site that needs to be covered.

Best to place anchors on the outline of the field you want to cover. It is also easier that you give every anchor an ID with the accurate positions so that you can retrace the anchor locations more rapidly once you have to do the setup.



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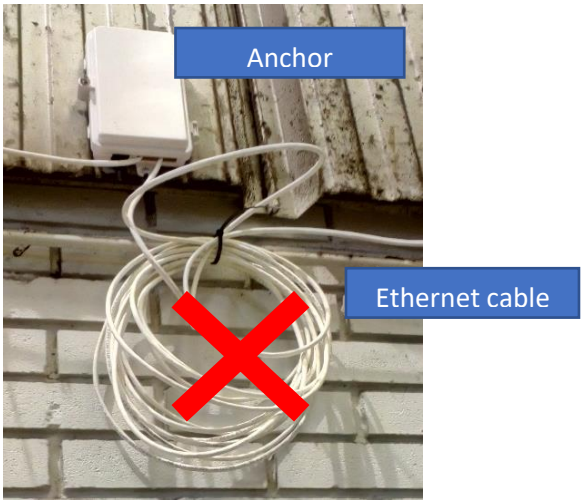
Tag placement plan

There should be a tag on the product that one needs to position. The position of the tag will be given in the gateway. If the tag will be fixed to the host, the antenna needs to be placed vertically pointing to the ceiling and should be at least 20 cm away from metal.

Instructions for installation of the hardware

1. Start from the anchor placement plan (see above)
2. Cut the cables in the correct length and install the ethernet port at the end.
    a. Make sure there are no loops in the ethernet cables, this will lead to a performance loss to the system.



3. To avoid tearing off the previous anchor, first put up the cables with the correct lengths.
4. Do another round to hang up the correct anchors.
    a. The correct anchor ID should be on the indicated position of the Anchor placement plan (exp anchor 1 on position 1)
    b. Make sure the anchor **ID is always in sight** when hanging the anchors up.
5. The anchors should be oriented vertically with the antenna pointing to the ceiling or to the ground (not tiled)
6. The Ethernet cable should be plugged in the right port (IN vs OUT) of the anchors
    a. The gateway or the switch is the power supplier to the anchors
    The first anchor should contain a cable from the IN port of the anchor to a port of either a switch or either a gateway.

    b. The last anchor in the daisy chain should only have an IN cable
7. To be sure, take again the exact measurements of the anchor position by laser.
    a. Distance to the wall in 2 directions

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b. Height of the anchor position

8. Connect the gateway and switch both at the Pozyx system side and to the internet
   a. Lan 1 of the gateway needs to be connected to the internet

   b. When using a small gateway: Lan 2 needs to be connected to the switch at the port to the far right and the anchors can be connected to the switch or you can use this port to connect the minimal amount of anchors.

9. Connect the respective power adapters to the switches, gateways and power.

Configuring the system for TDOA

Configuration in the Pozyx web application

You can use the Pozyx webapp for the configuration of the hardware installation. After connecting the pre-configured gateway and verifying the site setup, the following steps need to be taken:

1. Connect to the Pozyx web app at **bapp.cloud.pozyxlabs.com**

2. Log in with your personal mail and password. If you don't already have a login you can create an account

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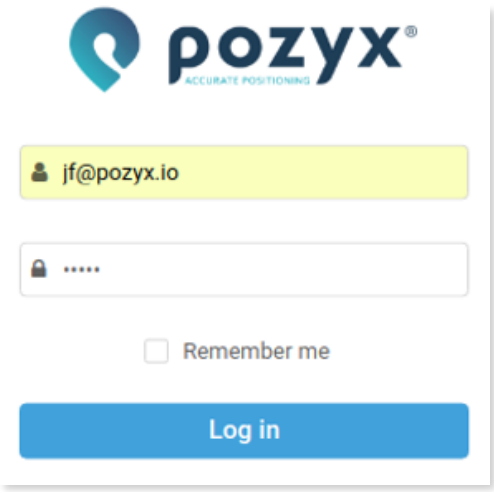
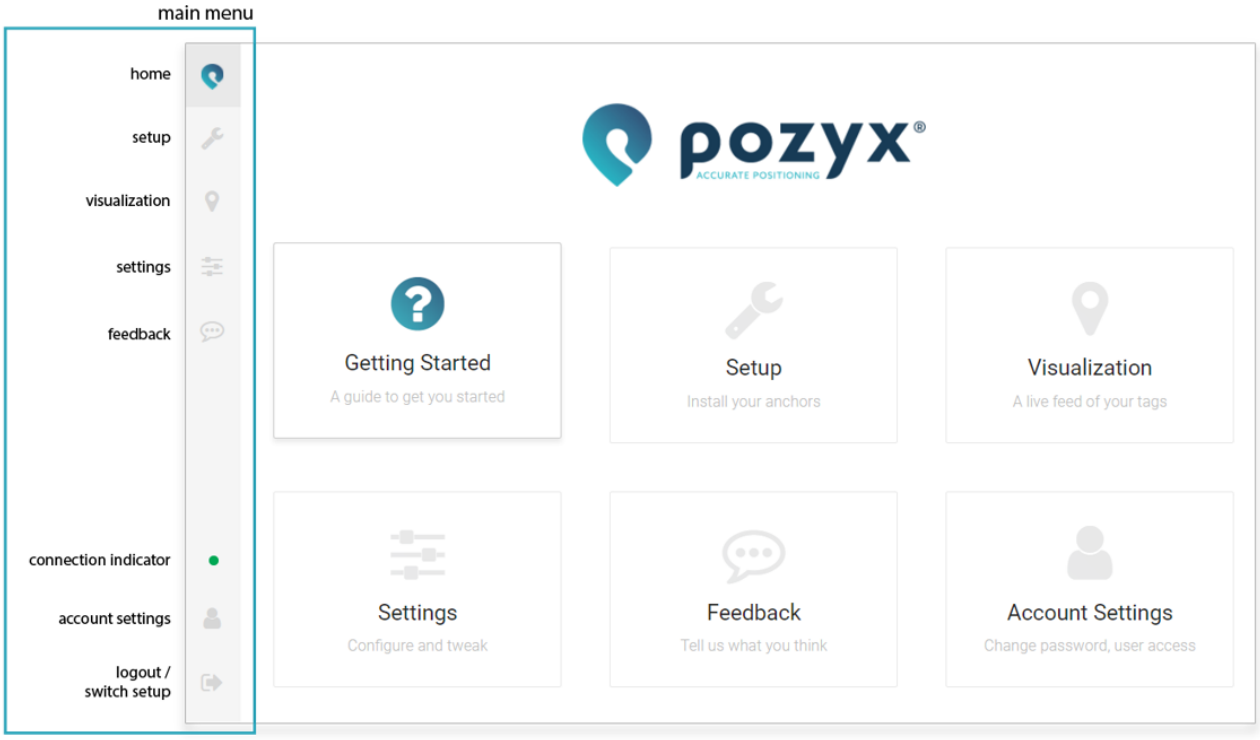


3. When logging in, you are redirected to the homepage where you can see on the left side the instructions bar.



The connection indicator will indicate if the system is correctly working. The color of the connection indicator shows what is going on:

- Green: the system is correctly connected to the cloud. It may still be that no Pozyx is connected.
- Orange: the system is not connected to the cloud. (check the internet connection, or if the Pozyx tray application is running)

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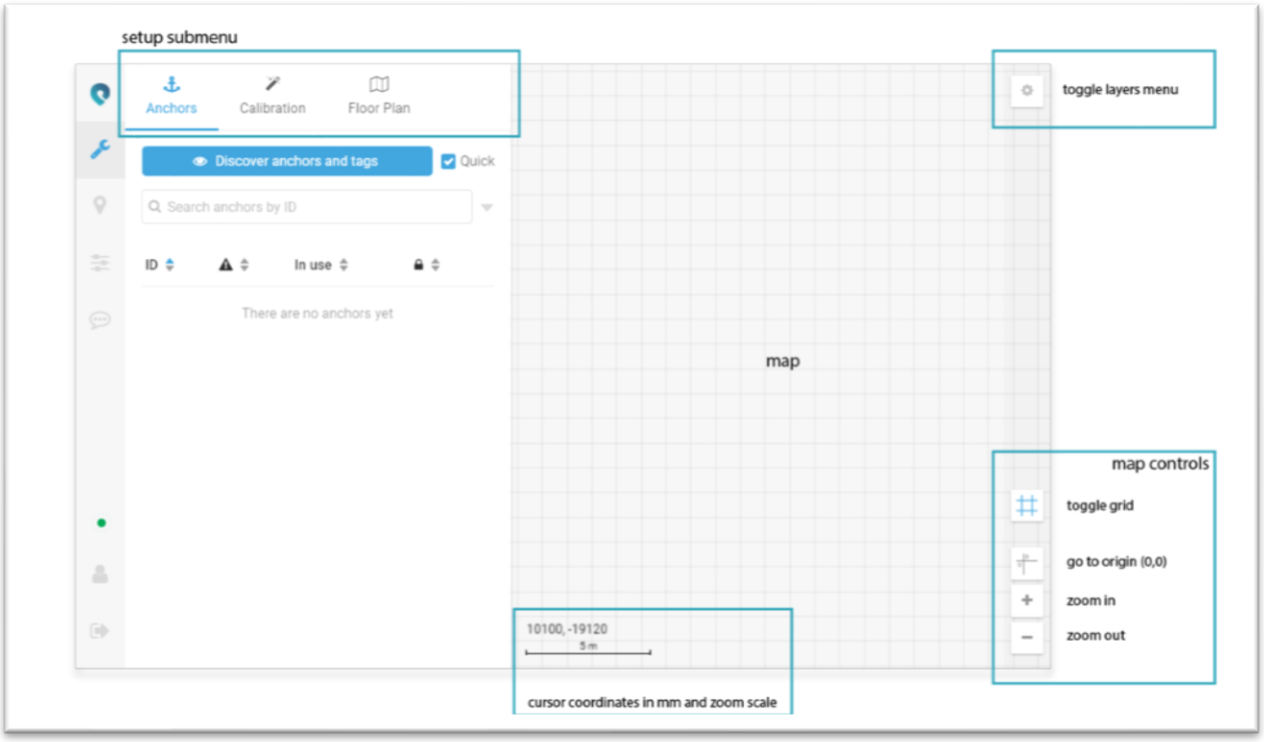
- Red: the system is connected to the cloud, but there is an error. (restart the Pozyx tray application)

If the connection indicator is green, you are all set up and you can start working with the system.

Anchor Configuration

1. If the gateway is connected you can go to the setup page where you can do the configuration of the anchors. Once the anchors are connected, the anchors will be visible in the application.

2. Press 'Discover anchors and tags'. Anchors that have been discovered this way are not immediately shown on the map because they do not have any coordinates yet.
   Setting the coordinates either manually or automatically.
   a. Manually setting the anchors can be done in two ways:
      i. either clicking on an anchor and inputting its coordinates
      ii. uploading all coordinates for all anchors in bulk. Importing the anchor coordinates can be done by hovering the arrow next to the search field and pressing "Upload coordinates" via a csv file (first is the anchor ID, x-axe, y-axe and z-axe)



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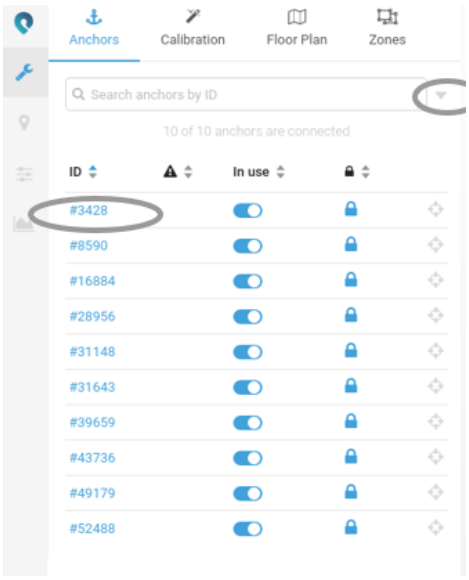
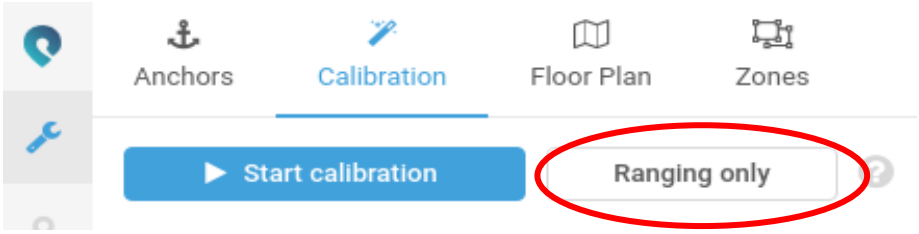



```
23602;9770;9730;0
26476;0;9730;0
52659;9770;0;0
12123;0;18690;0
35448;0;0;0
43083;9770;18270;0
```

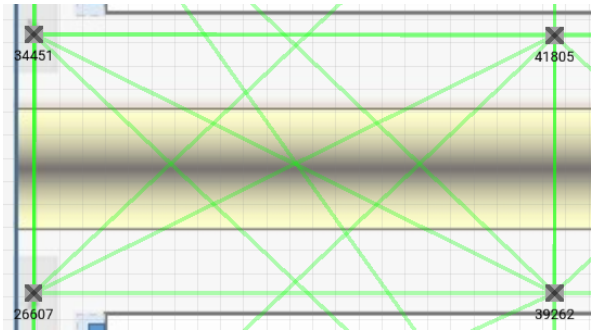
3. After filling in the coordinates of each anchor, click the 'All anchors' link, lock the anchor and proceed to the next one. You should see the anchor with positions on the floorplan on the right.

4. When all the anchors are done (and locked) go on to the 'Calibration tab'

5. Once in the calibration tab **don't click 'Start calibration'**, but click on the tab 'Ranging only'. *The calibration button can be used if you want that the anchors define their position themselves relatively against each other. It is not advisable to do this when the setup exceeds more than 8 anchors (due to length of the computation).*



6. When using the 'Ranging only' button, the system can determine which anchors can reach each other in order to synchronize. This should always be done once the anchors will be moved or when new anchors will be added.



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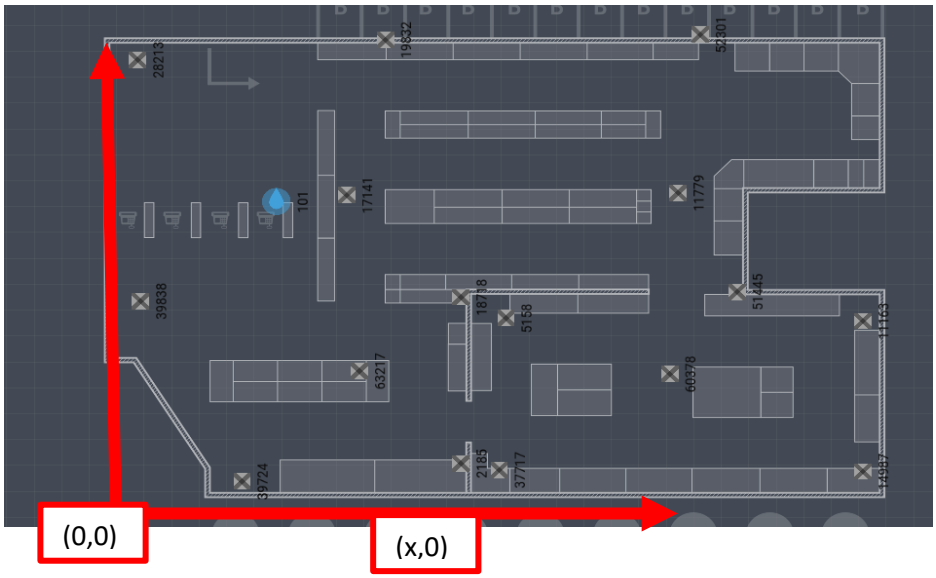
7. As a last step go to the ‘Floor plan’ tab. Here you can select and upload a file that is a representative image for your floorplan. It is only possible to upload image files (JPEG, PNG or GIF). The image floorplan does not have a sense of scale. Because of this, we must fit it to our reference frame.

8. As a fitting method, we suggest to choose ‘Two points’. This method allows you to fix the coordinates of two points on the map. The points are again created by double clicking on the map in the desired location. Once the two points are positioned correctly, you can enter the coordinates in mm and press the "Fit points" button to scale and rotate the floorplan in order to fit the coordinates.

9. Lastly you can add the origin and the scale along the x-axis so you can now easily enter 2 known points (I.e (0,0) and (x,0))



10. Before going to visualization there is one setting you should change. Because the TDOA system only offers 2D positioning, it is required to fix the height of the tag to achieve the best positioning accuracy. This can be done in the settings page under raw settings in the positioning master tab.

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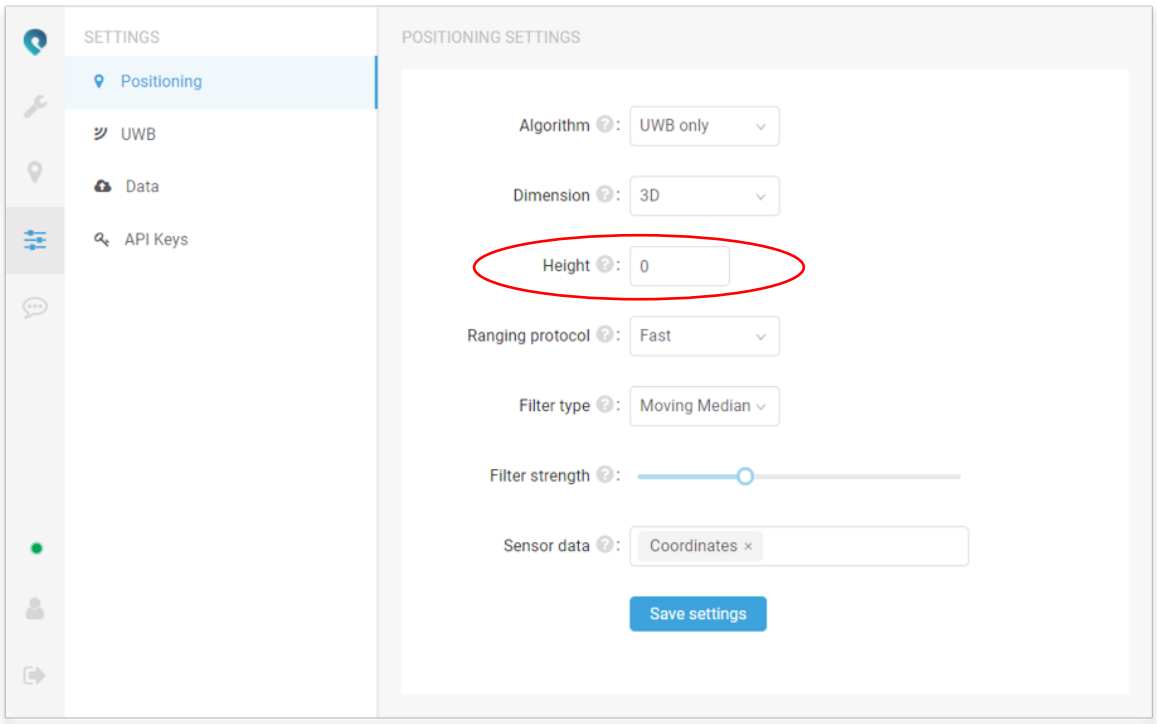

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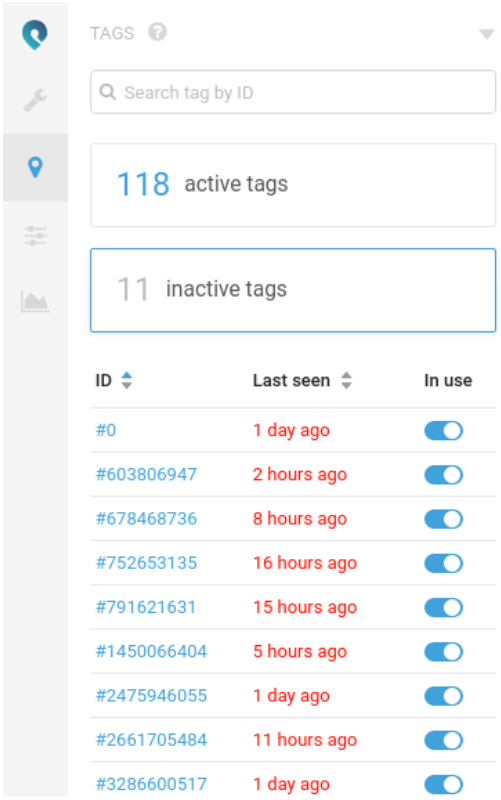
Tag configuration

1. Go to the 'Visualization page'
2. If you click on the tag ID's of the 'Active tags' you can view the tag information (position, update rate,…)
3. If you click one of the tag IDs of the 'Inactive tags' you can view when the tag was last seen.



Contact

If you need any help or have any further questions about this manual, please contact your account manager of mail to sales@pozyx.io

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