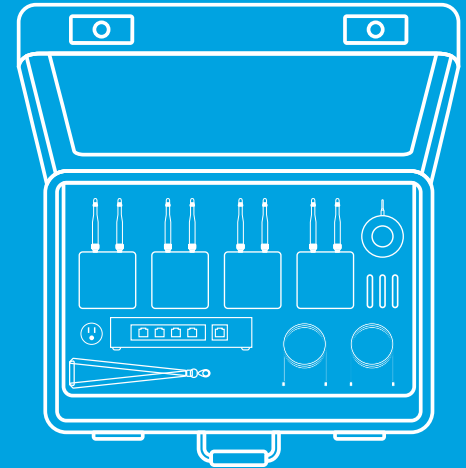




# UWB RTLS Evaluation Kit

Reference Guide





# UWB RTLS Evaluation Kit

## Introduction

With this UWB RTLS Evaluation Kit you will be enabled to create a simple single room 2D setup.

- You will get a “blue dot” on a map and can start testing with up to three tags (included)
- You will get a first impression of how Inpixon UWB RTLS works with sub-meter accuracy for personnel tracking using the Inpixon nanoLES location engine.

**Expectations:** sub-meter accuracy

# Prerequisites

## Hardware and materials required

- PC/Laptop with Windows 10 with Intel and AMD (not tested) processor supporting Advanced Vector Extensions (AVX). PCs manufactured after 2011 support AVX.
  - For details please check: [https://en.wikipedia.org/wiki/Advanced\\_Vector\\_Extensions](https://en.wikipedia.org/wiki/Advanced_Vector_Extensions)
- DHCP Server\* running on existing network router or on the PC/ Laptop
- Anchor mounting material if wall mounting is not an option: duct tape, wire strap or tripods
- Laser distance meter, measuring tape

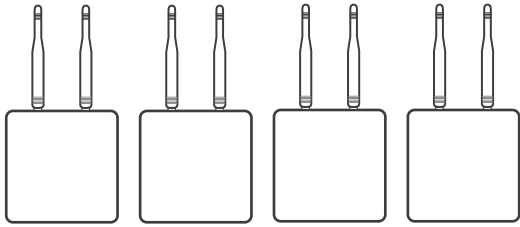
\* (please contact your server administrator for suggestions on DHCP servers)

# Unboxing

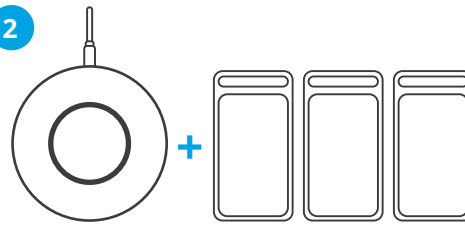
## Included in the kit

- 1 4x UWB Anchors**  
Inpixon nanoANQ UWB + wall mounting kit
- 2 3x Personnel Tags**  
Includes Qi Charger and table stand
- 3 1x Safety Vest**  
Includes Tag-holding loop
- 4 3x Lanyards**
- 5 1x PoE Managed Ethernet Switch**  
Includes U.S./U.K plug adapter
- 6 4x 15m Ethernet Cables**  
(anchors to PoE switch)
- 7 1x 2m Ethernet Cable**  
(PoE switch to PC/Laptop/Server)
- 8 1x Printed Guide**
- 9 3x Tag Stands + Velcro Tape**  
For vertical display of tags
- 10 1x Suitcase**  
For protection and storage of the RTLS kit

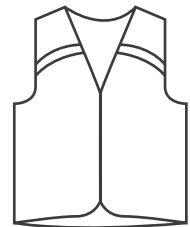
1



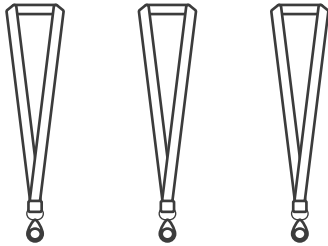
2



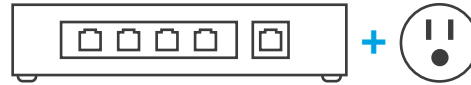
3



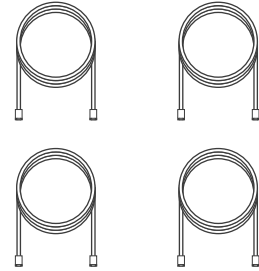
4



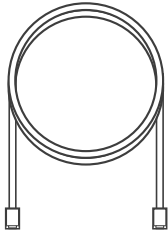
5



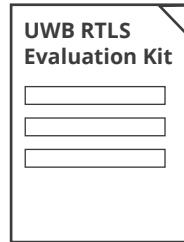
6



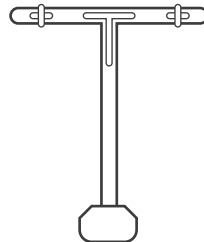
7



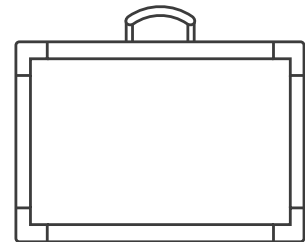
8



9



10



# Tag Activation

Activation, charging, behavior

## Tag Activation

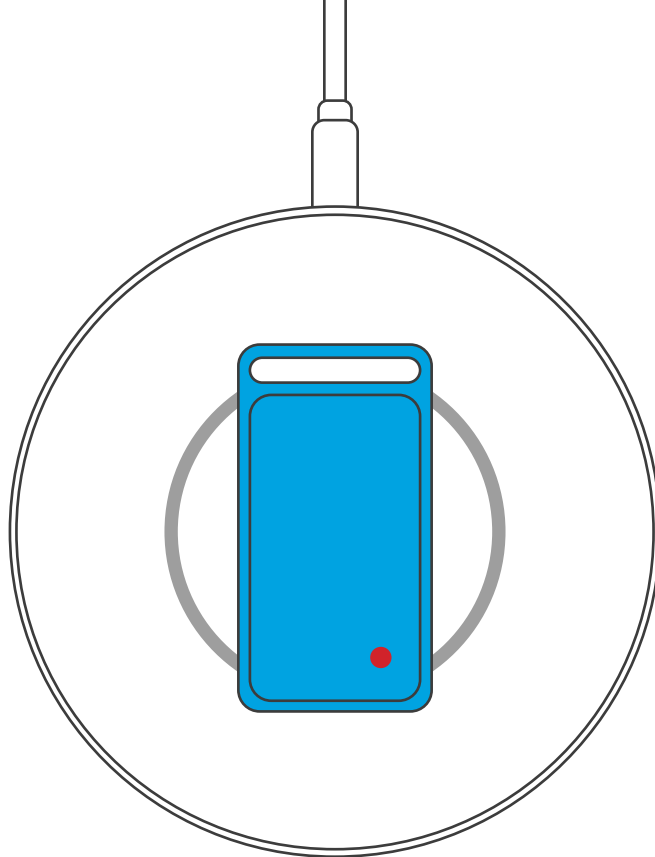
- **Activation:** The tag is activated for the first time by placing it on the Qi charger
  - It will not be flight safe after activation

## Tag Charging

- **Delivery Status:** The tag is delivered with an ~80% charged battery
- **How To Charge:** Place the tag in the middle of the Qi charger (label side down)
  - **Charging:** A red LED switches on
  - **Fully charged:** The red LED switches off

## Tag Behavior

- **Activate the Tag:** Remove the tag from the Qi charger (to activate sending packets to the anchors)
- **Orientation:** Ideally orient the tag vertically as depicted for best RF performance
- **Blink on Motion**
  - Blinks every 5 minutes *when stationary*
  - Blink every 0.5 seconds *when moving*
  - The transition from stationary to moving is immediate
  - The transition from moving to stationary takes at least 10 seconds after the stationary state has been detected



Inpixon Personnel Tag charging

# Downloads

## Download Inpixon software

### Get credentials for the eLibrary

- Please contact Inpixon Berlin Sales Operations to get an eLibrary account via:
  - **Phone:** +40 30 3999 54-0
  - **Mail:** nanotroninfo@inpixon.com

### Download Inpixon software from the eLibrary

- **Section [30] nanoLES 3.3.0 RTLS Location Engine** installation file:  
<https://nanotron.com/elibrary/index.php?act=~30>
- **Section [32] RTLS Tools** installer:  
<https://nanotron.com/elibrary/index.php?act=~32>



# Install Software

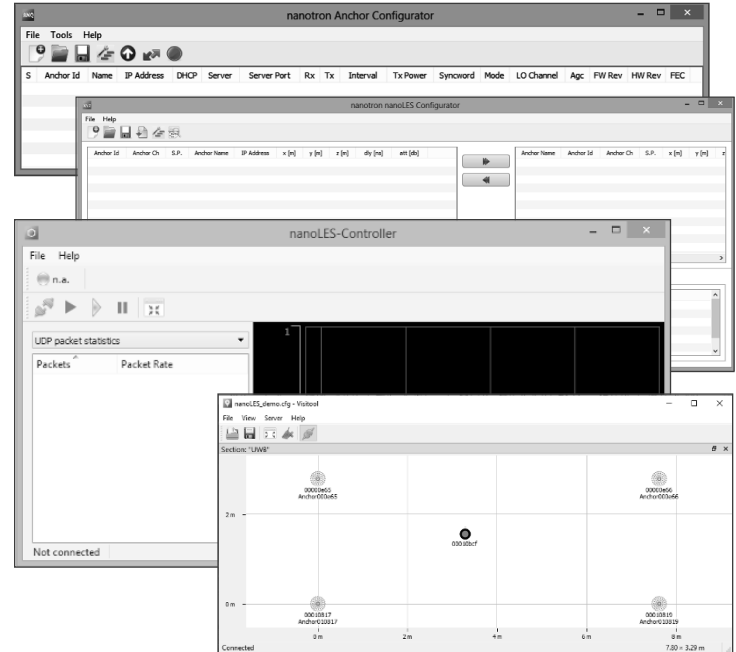
## RTL S Tools and third-party tools for Inpixon nanoLES Location Engine

### Install Inpixon software on Laptop (Server)

- Inpixon nanoLES 3
- RTL S Tools
  - Inpixon nanoANQ Configurator
  - Inpixon nanoLES Configurator
  - Inpixon nanoLES Controller
  - Visitoal (GUI)

### Third party tools (if required)

- DHCP server



# Anchor Placement

## Setup the hardware

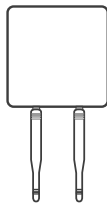
- **Assemble** two antennas and the mounting kit to each Inpixon nanoANQ\*
- **Place** anchors in the corners of a square of approximately 5m x 5m at 2m height for optimal performance. (e.g. mount anchors at walls or on tripods)
- **Hint:** Mark the position with tape if you do not fix the anchor's position. The fundament of a reliable RTLS is the correct anchor position known to the location engine

## Warning

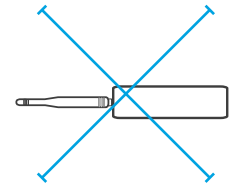
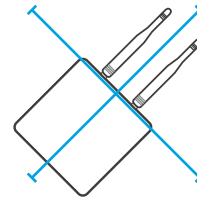
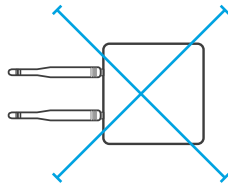
- Antennas need to be **vertically orientated**
- Anchors shall have direct line of sight (LOS) to each other and to the inner area, respectively to the tag. Metal objects, concrete walls, doors, boxes, water (humans) can attenuate the UWB signal
- Anchors should not lie flat on the floor or on a shelf
- The tag shall have a good view to at least 3-4 anchors for 2D locations



IDEAL



ACCEPTABLE

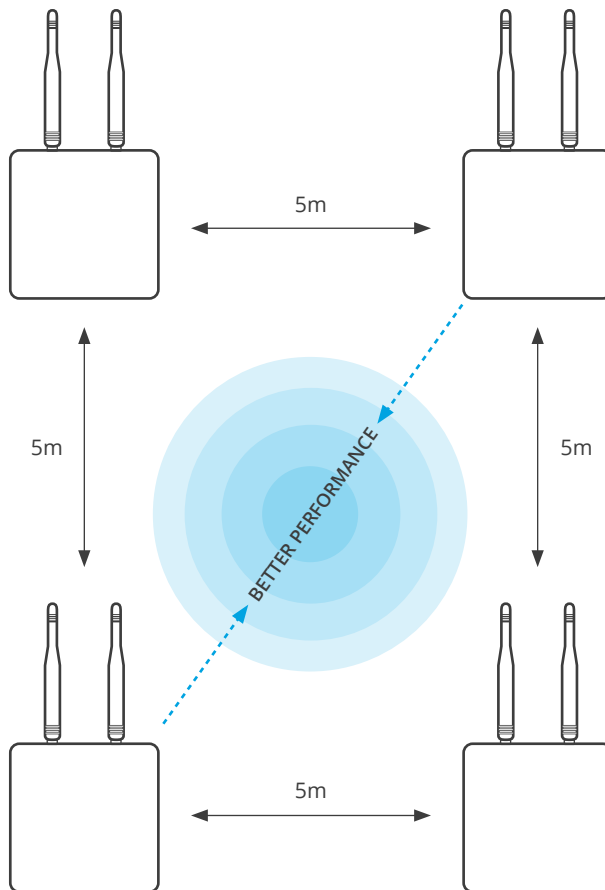


WRONG

\*Unless the Anchor is installed in accordance with the installation guide (Page 27) the IP Rating cannot be guaranteed – for testing and indoor solution not required

**Anchor 2**  
(0m, 5m)

**Anchor 3**  
(5m, 5m)



**Anchor 1**  
(0m, 0m)

**Anchor 4**  
(5m, 0m)

# Anchor Setup

## Setup and preparation

Create an Anchor list with Anchors #, MAC (ID), Position (x,y,z), IP address, e.g.:

- Anchor #: Give every anchor a number in clockwise or counterclockwise order
- MAC: To be found on the back of the anchor
- Position: Measure precisely with ruler or laser measure. Ideally place at 5m distance
- Optional: Define IP address as needed for your DHCP Server, see IP address example below

### EXAMPLE:

NAME	MAC	X	Y	Z	ADDRESS
A1	0x010819	0m	0m	2m	192.168.1.203
A2	0x010817	0m	5m	2m	192.168.1.201
A3	0X000E66	5m	5m	2m	192.168.1.204
A4	0X000E65	5m	0m	2m	192.168.1.202

### YOUR LIST

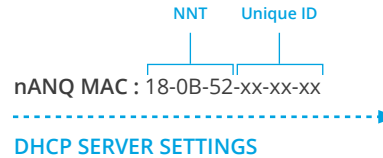
#	MAC	X	Y	Z	ADDRESS

# DHCP

## Setup example for DHCP settings

### EXAMPLE:

NAME	MAC	X	Y	Z	ADDRESS
A1	0x010819	0m	0m	2m	192.168.1.203
A2	0x010817	0m	5m	2m	192.168.1.201
A3	0X000E66	5m	5m	2m	192.168.1.204
A4	0X000E65	5m	0m	2m	192.168.1.202



```
#YourPC  
[Your PC-MAC ADDRESS]  
IPADDR=192.168.1.43  
ROUTER_1=192.168.1.43
```

```
##### UWB ANCHORS #####
```

```
#anchor1  
[18-0b-52-01-08-19]  
IPADDR=192.168.1.203
```

```
#anchor2  
[18-0b-52-01-08-17]  
IPADDR=192.168.1.201
```

```
#anchor3  
[18-0b-52-00-0e-66]  
IPADDR=192.168.1.204
```

```
#anchor4  
[18-0b-52-00-0e-65]  
IPADDR=192.168.1.202
```

# Connect Switch

## Setup the hardware

- Start the DHCP server on laptop or use existing DHCP server on your network
- Connect switch to laptop or network router
  - Connect switch using short ethernet cable
- Check the pop-up window >> PC IP e.g. 192.168.205.2

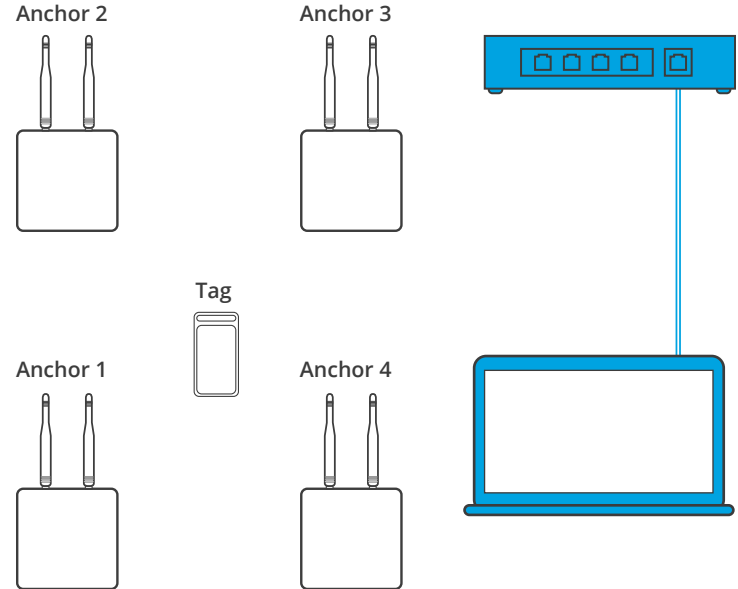


### DHCP Server V1.8.1

Assigning IP address 192.168.205.2 to client  
"your PC-MAC address"

OR,





- Check network router to ensure switch was discovered by the router



# Connect Anchors

## Setup the hardware

- **Connect Anchors**
  - Connect ethernet cables between each anchor and the POE switch using long cables
- **Check Connectivity (i or ii)**
  - i. Router: Check for anchor IP addresses

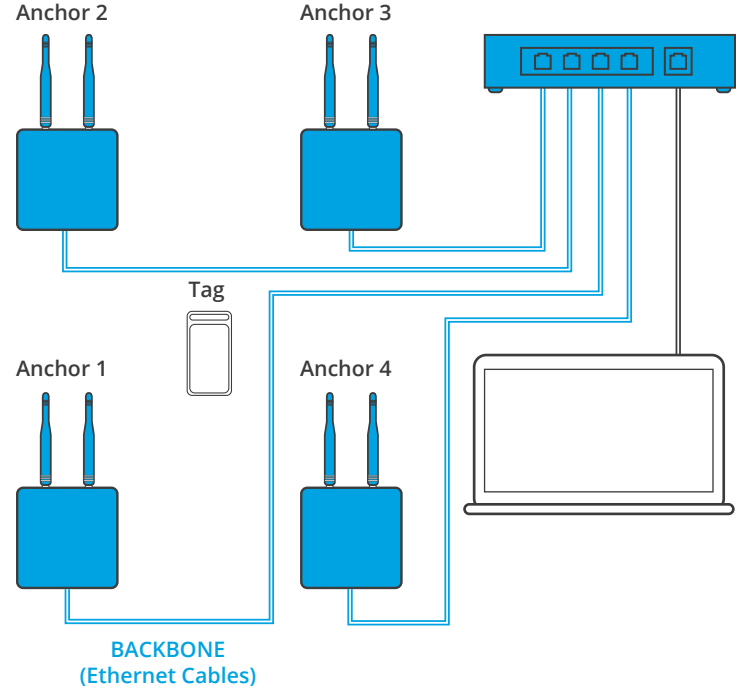
	nanotron Technologies gmbH ANQ ER X.0 192.168.1.203	192.158.1.203	18:0B:52:01:08:19	Wired
	nanotron Technologies gmbH ANQ ER 0.0 192.168.1.201	192.158.1.201	18:0B:52:01:08:17	Wired
	nanotron Technologies gmbH ANQ ER X.Y 192.168.1.204	192.158.1.204	18:0B:52:00:0E:66	Wired
	nanotron Technologies gmbH ANQ ER 0.Y 192.168.1.202	192.158.1.202	18:0B:52:00:0E:65	Wired

- ii. DHCP Server: Check the 4x pop-up windows on PC > each IP address e.g. 192.168.205.10... 13 assigned



### DHCP Server V1.8.1

Assigning IP address 192.168.205.2 to client  
"18:0B:52:01:08:19"

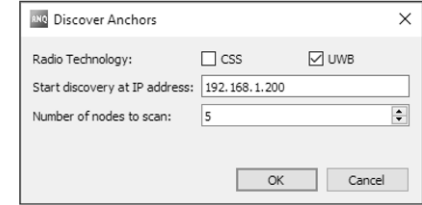


# Anchor Configuration

## 2D setup with four anchors

### Open Inpixon nanoANQ Configurator

- Discover the anchors (Tools->Discover Anchors)
  - Check UWB, select start IP address and number of nodes (IP address) to scan
  - Tool scans IP Addresses from Start to Start+N, in this case from 192.168.1.200 to 192.168.1.209
- Check the anchor settings (SDMD 15, PAN ID 6E6E)



S	Anchor Id	Radio Tech.	Name	IP Address	Server	Server Port	Rx	Tx	Interval	FW Rev.	HW Rev.	SDMD	PAN	STPD Ch. 0	STPD Ch. 1
✓	010819	UWB	Anchor010819	192.168.1.203	192.168.1.43	5555	3	3	250	1.2.1	7.000	15	6E6E	<input type="checkbox"/> Smart Power: 0	<input type="checkbox"/> Smart Power: 0
✓	010817	UWB	Anchor010817	192.168.1.201	192.168.1.43	5555	3	3	250	1.2.1	7.000	15	6E6E	<input type="checkbox"/> Smart Power: 0	<input type="checkbox"/> Smart Power: 0
✓	000e66	UWB	Anchor000e66	192.168.1.204	192.168.1.43	5555	3	3	250	1.2.1	7.000	15	6E6E	<input type="checkbox"/> Smart Power: 0	<input type="checkbox"/> Smart Power: 0
✓	000e65	UWB	Anchor000e65	192.168.1.202	192.168.1.43	5555	3	3	250	1.2.1	7.000	15	6E6E	<input type="checkbox"/> Smart Power: 0	<input type="checkbox"/> Smart Power: 0

- Configure your radio server address (server = PC running nanoLES software)
  - Edit "server"-parameter with your PC IPv4 IP-address
- Send anchor configuration to the anchors
- Save the anchor configuration file, e.g. "anchorconfig.anq" (File->Save as")

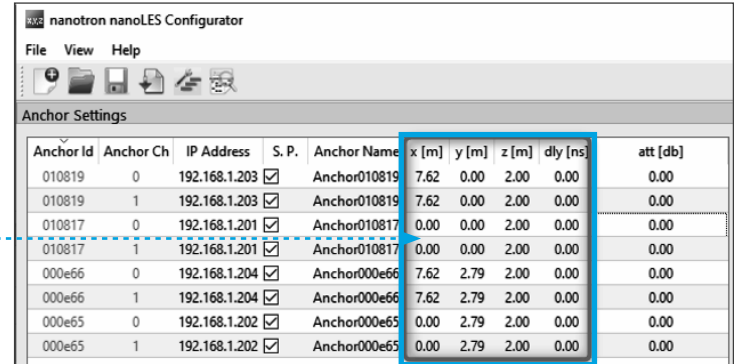


# Inpixon nanoLES Location Engine Configuration (Part 1)

Import anchor configuration and set position/coordinates

Open the Inpixon nanoLES configurator

- Read the anchor configuration file
  - File->Import->Anchors-> "\\directory\anchorconfig.ang
- Enter X, Y, Z coordinates for each anchor



The screenshot shows the 'nanotron nanoLES Configurator' application window. The title bar reads 'nanotron nanoLES Configurator'. Below the title bar is a menu bar with 'File', 'View', and 'Help'. Underneath the menu bar is a toolbar with several icons. The main area of the window is titled 'Anchor Settings' and contains a table with the following columns: 'Anchor Id', 'Anchor Ch', 'IP Address', 'S. P.', 'Anchor Name', 'x [m]', 'y [m]', 'z [m]', 'dly [ns]', and 'att [db]'. The table contains eight rows of data. A blue dashed line from the text 'Enter X, Y, Z coordinates for each anchor' points to the 'x [m]', 'y [m]', and 'z [m]' columns of the table. A blue box highlights the 'x [m]', 'y [m]', and 'z [m]' columns for the three rows where the 'Anchor Ch' is 1 (rows 3, 4, and 8).

Anchor Id	Anchor Ch	IP Address	S. P.	Anchor Name	x [m]	y [m]	z [m]	dly [ns]	att [db]
010819	0	192.168.1.203	<input checked="" type="checkbox"/>	Anchor010819	7.62	0.00	2.00	0.00	0.00
010817	0	192.168.1.201	<input checked="" type="checkbox"/>	Anchor010817	0.00	0.00	2.00	0.00	0.00
010817	1	192.168.1.201	<input checked="" type="checkbox"/>	Anchor010817	0.00	0.00	2.00	0.00	0.00
000e66	0	192.168.1.204	<input checked="" type="checkbox"/>	Anchor000e66	7.62	2.79	2.00	0.00	0.00
000e66	1	192.168.1.204	<input checked="" type="checkbox"/>	Anchor000e66	7.62	2.79	2.00	0.00	0.00
000e65	0	192.168.1.202	<input checked="" type="checkbox"/>	Anchor000e65	0.00	2.79	2.00	0.00	0.00
000e65	1	192.168.1.202	<input checked="" type="checkbox"/>	Anchor000e65	0.00	2.79	2.00	0.00	0.00

Each anchor has two Anchor Channels (0 and 1) with same coordinates

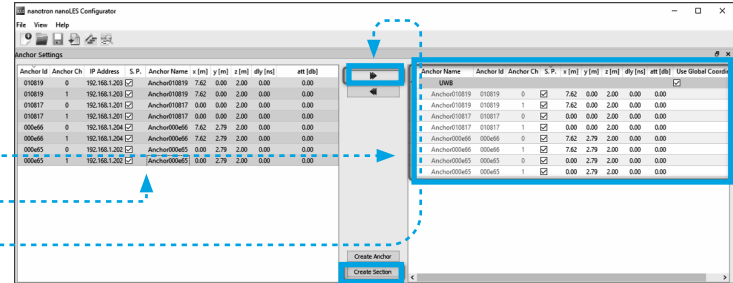
*\*Please note that the example uses a setup of 7.62 m x 2.79 m instead of the recommended 5m x 5m.*

# Inpixon nanoLES Location Engine Configuration (Part 2)

Create a 2D section and add anchors

In the Inpixon nanoLES configurator

1. Use Create Section button to create and name section e.g "UWB"
2. Select section name on the right
3. Select anchors on the left (CTRL + mouse click)
4. Click on green arrow button to add anchors to the section

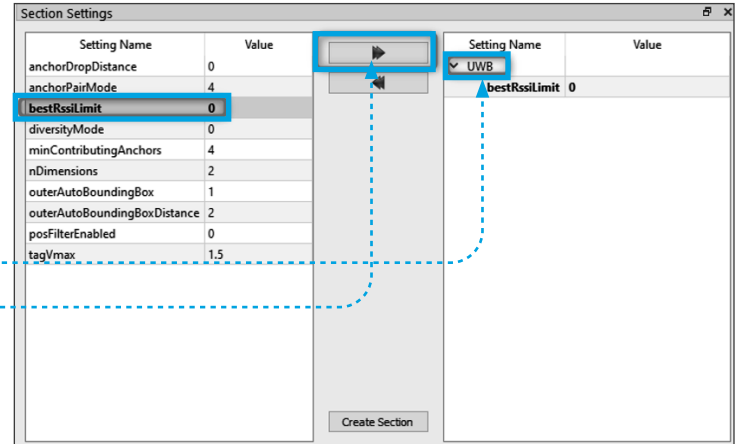


# Inpixon nanoLES Location Engine Configuration (Part 3)

## Section configuration

In the Inpixon nanoLES configurator

1. Set bestRssiLimit to 0
2. Select setting name on the right
3. Click green arrow to send configuration to the section

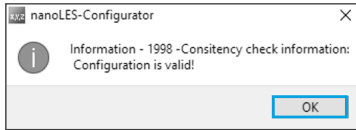


# Inpixon nanoLES Location Engine Configuration (Part 4)

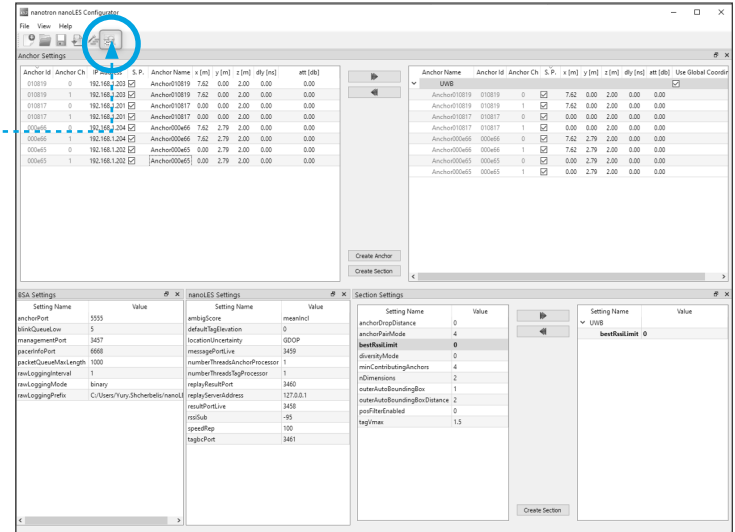
## Verify settings

### In the Inpixon nanoLES configurator

- Click on “Sanity Check” button
- Consistency check should come back as valid



- Save the configuration file
  - File -> Save As (e.g. “nanoLES\_demo.cfg”)



# Inpixon nanoLES Location Engine Configuration (Part 5)

## Activate monitoring

Open nanoLES\_demo.cfg file with text editor (e.g. notepad)

- Under [sections] add a line “UWB\technology=UWB”

```
[sections]
UWB\technology=UWB
UWB\bestRssiLimit=0
UWB\anchors=0x365, 0x366, 0x10817, 0x10819
```

- Under [anchor-conf] add a line for each anchor <anchorID>\technology=UWB

```
[anchor-conf]
0x10817\technology=UWB
0x10819\technology=UWB
0xe65\technology=UWB
0xe65\technology=UWB
```

- *Optional (only for use with Inpixon nanoLES controller)*
  - Under [nanoLES] change tagMonitorEnabled and anchorMonitorEnabled values from 0 to 1

```
tagMonitorEnabled=1
anchorMonitorEnabled=1
```

- Save file

*Note: some editors change the file name to \*.txt. Ensure not to change the name: nanoLES\_demo.cfg*

# Start Inpixon nanoLES Location Engine

Start and connect the Inpixon nanoLES location engine

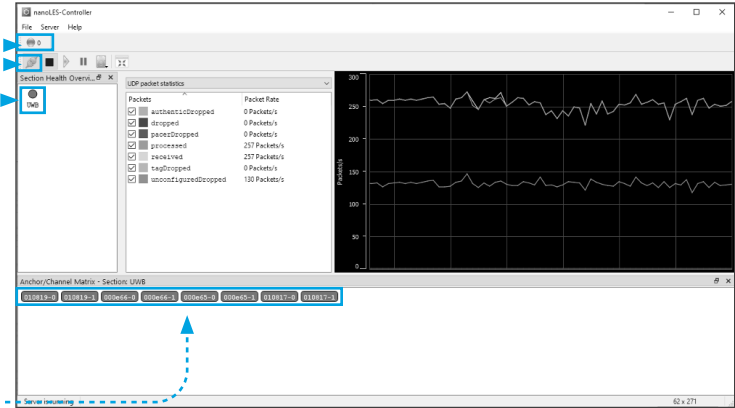
- Open Inpixon nanoLES using command line:  
"nanoLES-live.exe -e nanoLES\_demo.cfg"

```
nanotron Technologies - nanoLES3.3.0
"INFO 1002: start components of nanoLES...\n"
"INFO 1008: section UWB outerAutoBoundingBox (xmin/xmax;ymn/ymax) -2/9.628000000000001;-2/4.79"
"INFO 1023: section UWB anchorPairMode: 4"
"INFO 1005: starting pacer Info server..."
"INFO 1038: starting the UDP server"
"INFO 1018: management connection from: ::1"
```

- Check the Inpixon nanoLES console window >> no errors, configuration correct

- (Optional) Start Inpixon nanoLES controller

- Connect to Inpixon nanoLES
- Click on Connectivity Status button
- Click on Section button
- Verify that all anchors are shown green
  - Each anchor is shown as two channels
  - Only works when anchorMonitorEnabled=1 in nanoLES\_demo.cfg file
  - It may take a few minutes to turn green



# Blue Dot

## Finalize the deployment

### Open Visutool

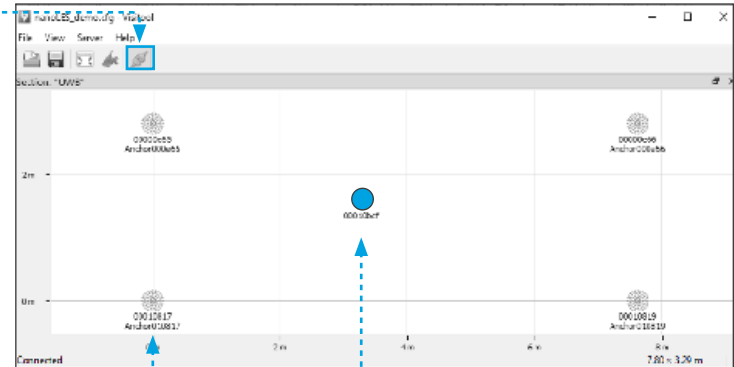
- Open Inpixon nanoLES configuration file
  - File -> Open and select nanoLES\_demo.cfg
- Connect to Inpixon nanoLES
- Check the anchor ID, name, position

### Power on a tag

- Remove one tag from charger to start position generation
- Observe blue dot for each tag in the Visutool

### Congratulations!

- you have successfully deployed your UWB RTLS!
- Now, you can start experimenting with various scenarios.

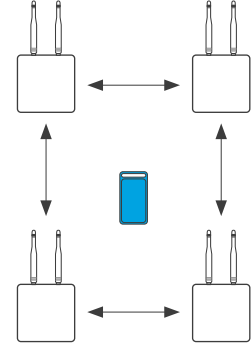
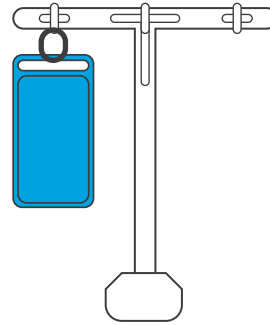


# Tag Placement

## Finalize the deployment

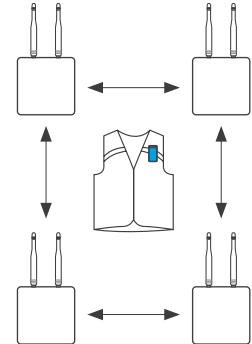
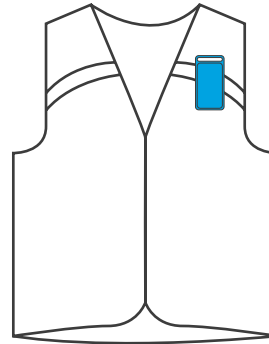
### Best Case Scenario

- Place the tag in the middle of the area spanned by your anchors on a table with direct line of sight to the anchors
- Use the stand to keep the tag upright with the eyelet on top
- Do not place the tag on the floor
- Remember, the tag starts blinking every 0.5 seconds when in motion. It takes 5 minutes to get positions if stationary



### Real World Scenario

- Hang the tag on your vest as high as possible
- Walk around within the anchor area
- The closer to the middle of the spanned area you are, the better the expected performance





# Summary

## Achievements

### Setup

- Inpixon nanoANQ UWB assembled and placed
- DHCP server running on PC or network
- Back bone (ethernet cables + switch) connected
- Inpixon nanoANQ UWB configured
- Inpixon nanoLES location engine setup and running
- Inpixon Personnel Tags running

### What happens in the background?:

- Tag blinks (broadcasts its node ID)
- Broadcasted node ID received by anchors
- Anchors send timestamped tag node IDs to Inpixon nanoLES 3 RTLS server
- Positions calculated on Inpixon nanoLES 3 Location Engine
  - Collects ToA, for TDoA calculation
- Derivation of tag 2D position

# Supporting Documentation

## For further reading

- **One stop shop for related documentation:**  
<https://support.inpixon.com/hc/en-us/articles/4403962808333-UWB-RTLS-Evaluation-Kit>

# Inpixon nanoANQ UWB RTLS Anchor

## Installation instructions

Unless the anchor is installed in accordance with this installation guide the IP Rating cannot be guaranteed.

Hint: For tests under IP65 conditions the thickness of the ethernet cable should be adjusted accordingly, the ones provided are for indoor use only.

Installation steps:

1. Install bracket at desired location using appropriate screws for point of attachment.
2. Connect each antenna to the two SMA connectors
3. Connect required cables into the anchor. The cable shall have a diameter of 6 mm ( $\pm 10\%$ )
4. Ensure cables are in cable slots and close rear cover.
5. Secure cover using screws supplied. Tighten screws to a torque of 0.65 Nm
6. Connect anchor to the bracket installed in 1 above

The IP rating of this anchor will be invalid if the cable access cover is removed and reinstalled. As with any IP rating, the seal should only be compressed once. Otherwise, there is no guarantee of maintaining the IP status.”

# Inpixon nanoLES 3 Location Engine

## RTLS block diagram

1. **Anchor Management Interface**  
(UDP, Binary, Port 4646)
2. **Anchor Blink Interface**  
(UDP, Binary, Port 5555)
3. **Application Result Interface**  
(TCP, Google Protocol Buffer, Port 3458)
4. **REST Management Interface**  
(HTTP, REST, Port 8080)
5. **Application Messaging Interface**  
(TCP, Text, Port 3459)
6. **Inpixon nanoLES Management Interface**  
(deprecated TCP, Text, Port 3457)
7. **Tag Backchannel Interface**  
(TCP, Text, Port 3461)
8. **Tag Backchannel Interface Anchor**  
(UDP, Binary, Port 4646)

