2. Basics of the System

Here are examples of the Starter Sets:

2.1. What's in the Box

2.1.1. Starter Set Super-MP-3D:

- 4 x Stationary Super-Beacons with different frequences (19kHz, 22kHz, 25kHz, 28kHz, 31kHz, 34kHz, 37kHz, 45kHz). It can be used as IA, NIA, and MF NIA. See more in the architecture comparison.
- 1 x Mobile Super-Beacon
- 1 x Modem HW v5.1 supporting up to 250 beacons

2.1.2. Starter Set IA-04-2D-Badge:

- 2 x Super-Beacons – 915/868 MHz with different ultrasonic frequencies (f1 and f2 – usually 25kHz and 31kHz).
- 1 x Marvelmind Badge – 915/868 MHz as mobile beacon
- 1 x Modem HW v5.1 – 915/868 MHz as the central controller of the system

*This is just an example of two starter sets.
You can see more options on our website: Products.

2.2. Indoor Navigation System Architectures

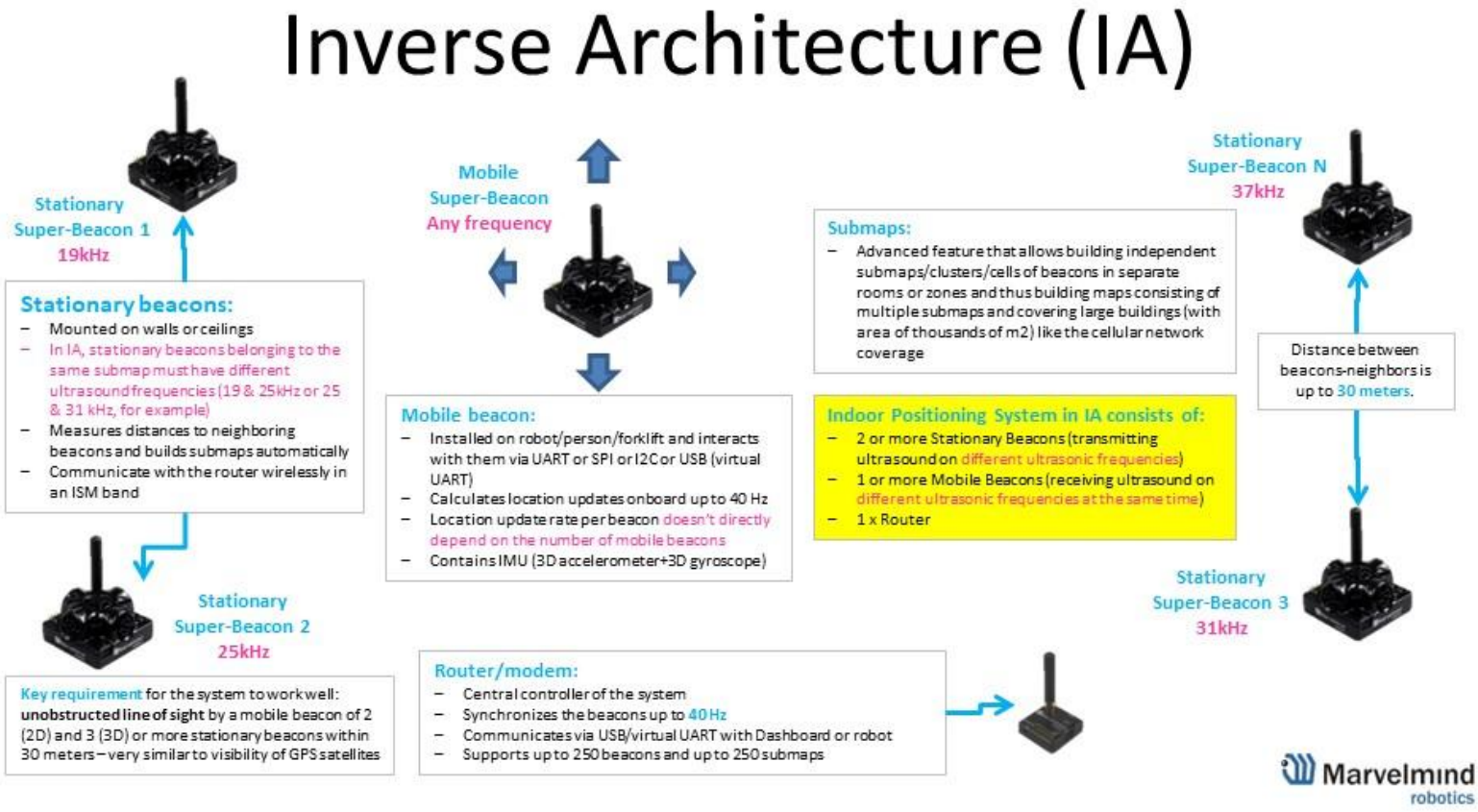
Marvelmind Indoor Navigation System provides high-precision (±2cm) indoor coordinates for autonomous robots and systems ("indoor GPS"). The scheme below briefly describes the system's key elements.

IA and NIA SW differ.
For IA, you should use stationary beacons with different frequencies.

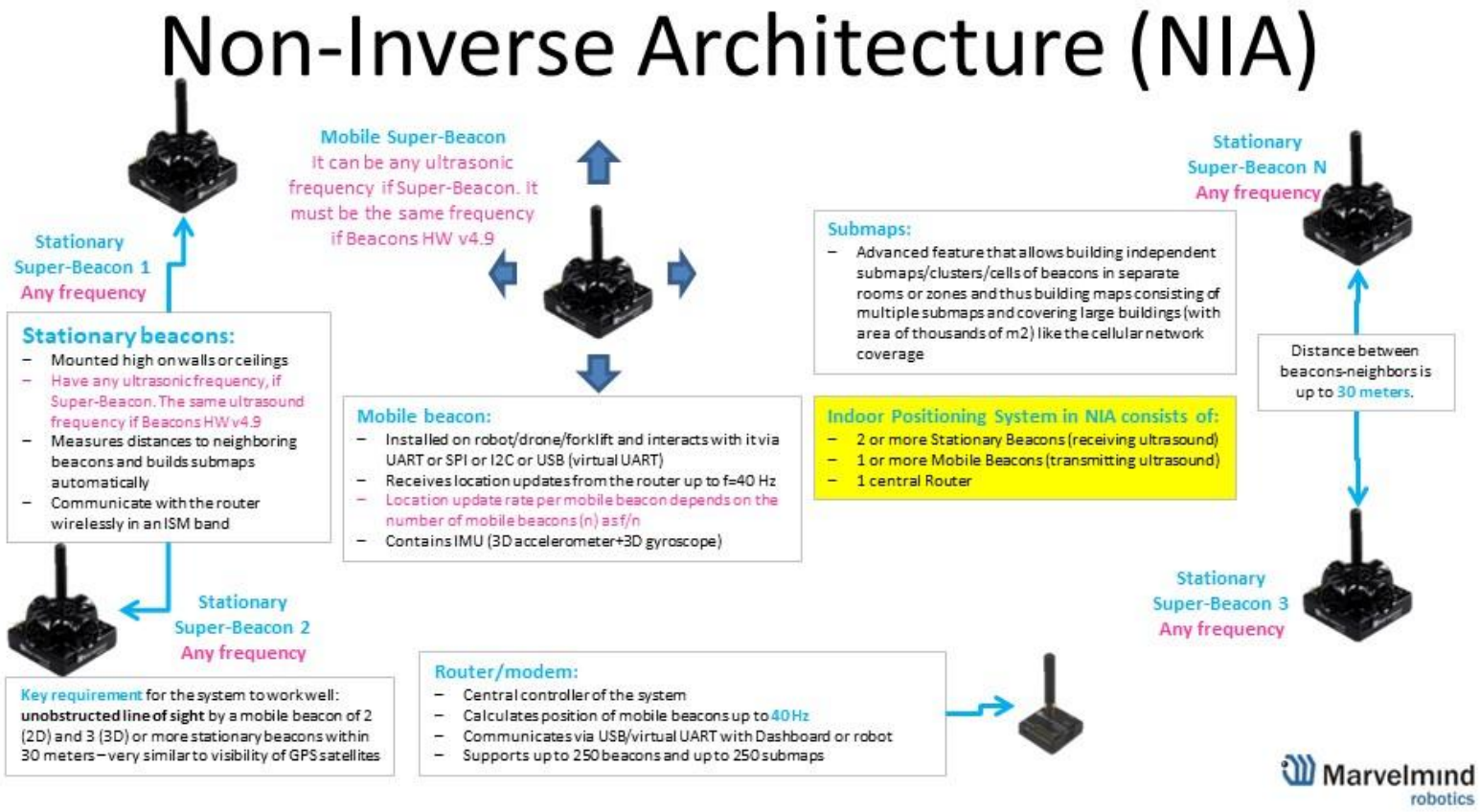
Below, you can see 3 types of architectures: Non-Inverse (NIA), Inverse (IA), and Multi-frequency NIA (MF NIA):

2.2.1. Inverse Architecture (IA)

For IA, you should use stationary beacons with different frequencies.

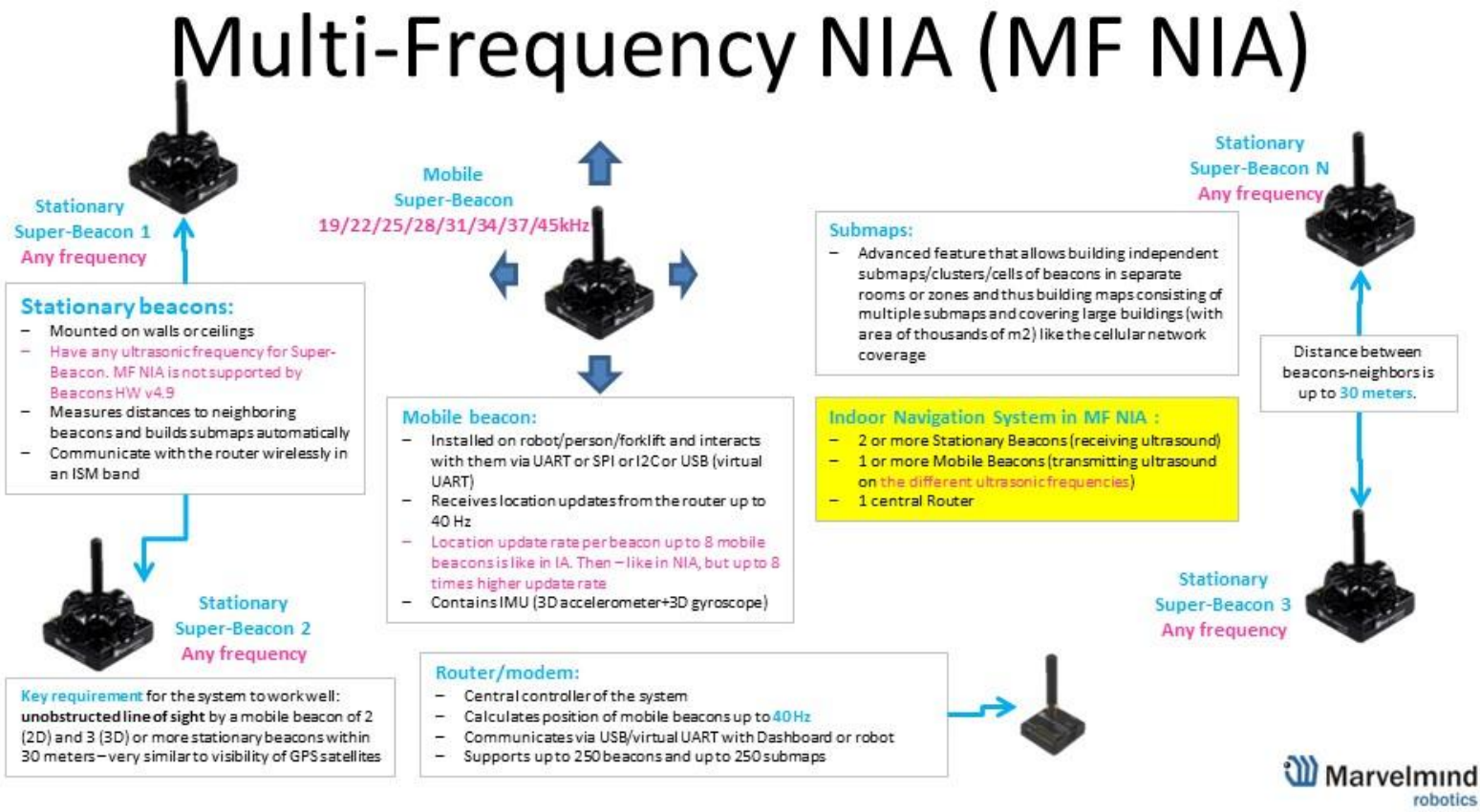


2.2.2. Non-Inverse Architecture (NIA)

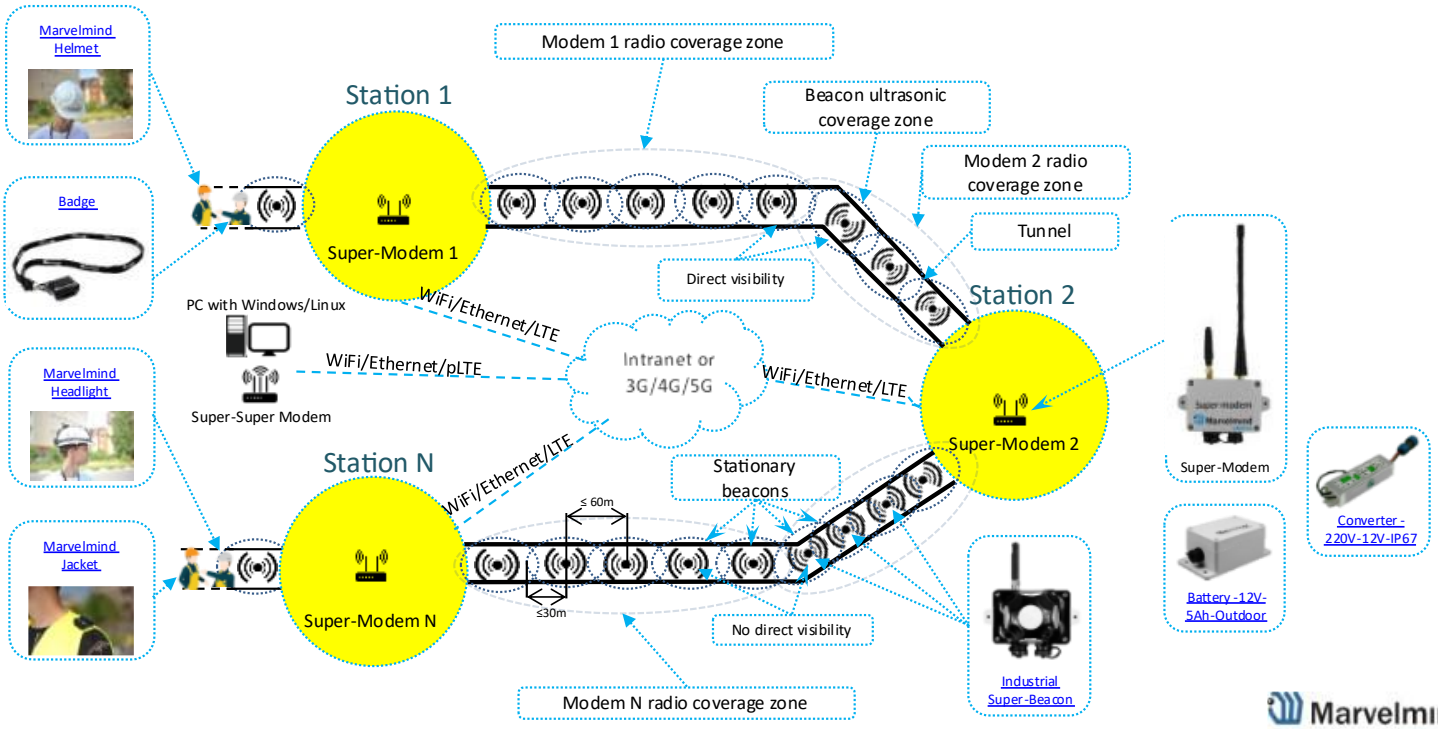


2.2.3. Multi-Frequency NIA (MF NIA)

License • MMSW0004: MF NIA support is needed to use MF NIA



2.2.4. Multi-modem Architecture for Very Large Networks



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2.2.5. Architectures Comparison Table

Architectures comparison

	Non-Inverse (NIA)	Inverse (IA)	Multi-Frequency NIA (MF NIA)	Multi-modem architecture
Typical usage	- 1-4 autonomous robots/drones - supports up to 250 beacons (stationary+mobile) - When mobile beacon shall be installed on a noisy drone/vehicle, but stationary beacons are in relatively quieter places	- Many mobile users (people, robots, VR) and when update rate per mobile is important - supports up to 250 beacons (stationary+mobile combined) - When mobile beacons are in quieter places	- 5-16 autonomous robots/drones - supports up to 250 beacons (stationary+mobile combined) - Effectively, MF NIA combines the best from both IA and NIA. But it is still "more NIA than IA", because the mobile beacons are emitting the ultrasound	- All three previous architectures are supported - When distance from some of the beacons to the modem is too big
Not recommended	- In applications, where emitting ultrasound of mobile beacon is undesirable	- For drones – because mobile beacons are receiving ultrasound. The range may be limited to just 2-5m. May be improved with future SW releases	- In applications, where emitting ultrasound of mobile beacon is undesirable	-
Accuracy	- ±2cm or better with more averaging	- ±2cm or better with more averaging	- ±2cm or better with more averaging	- ±2cm or better with more averaging
Update rate	- Depends on the number of mobile beacons (n) as f/n –TDMA is used - Slightly depends on the radio profile - Depends on the sizes of submaps - IMU fusion is HW and SW supported	- Does not depend on the number of mobile beacons, because they are receiving ultrasound at the same time - Slightly depends on the radio profile - (the same as NIA) - Depends on the sizes of submaps (the same as NIA) - IMU fusion is HW supported. SW support is coming	- Depends on the number of mobile beacons (n) for n>8 –TDMA is used, i.e. can provide up to 8 times higher update rate than NIA with the same number of mobiles. Up to 8 mobiles the update rate per mobile is equal to IA - The rest – like NIA	- Depends on the description for other architectures
Range	- Can cover as large territory as you wish using submaps - Up to 30m in real life and up to 50m in lab conditions within a single submap, i.e. stationary beacons shall be placed every 30m or closer (in 1D with horns – up to 120m)			
Map building	- Can build submaps automatically and manually	- Can build submaps automatically and manually	- Can build submaps automatically and manually	- Can build submaps automatically and manually

Version 2023_06_26

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Here are the tutorial videos about architectures:

[Help: Inverse Architectures (IA) vs. Non-Inverse Architectures (NIA)]

[NIA vs. IA vs. MF NIA - how to choose?]

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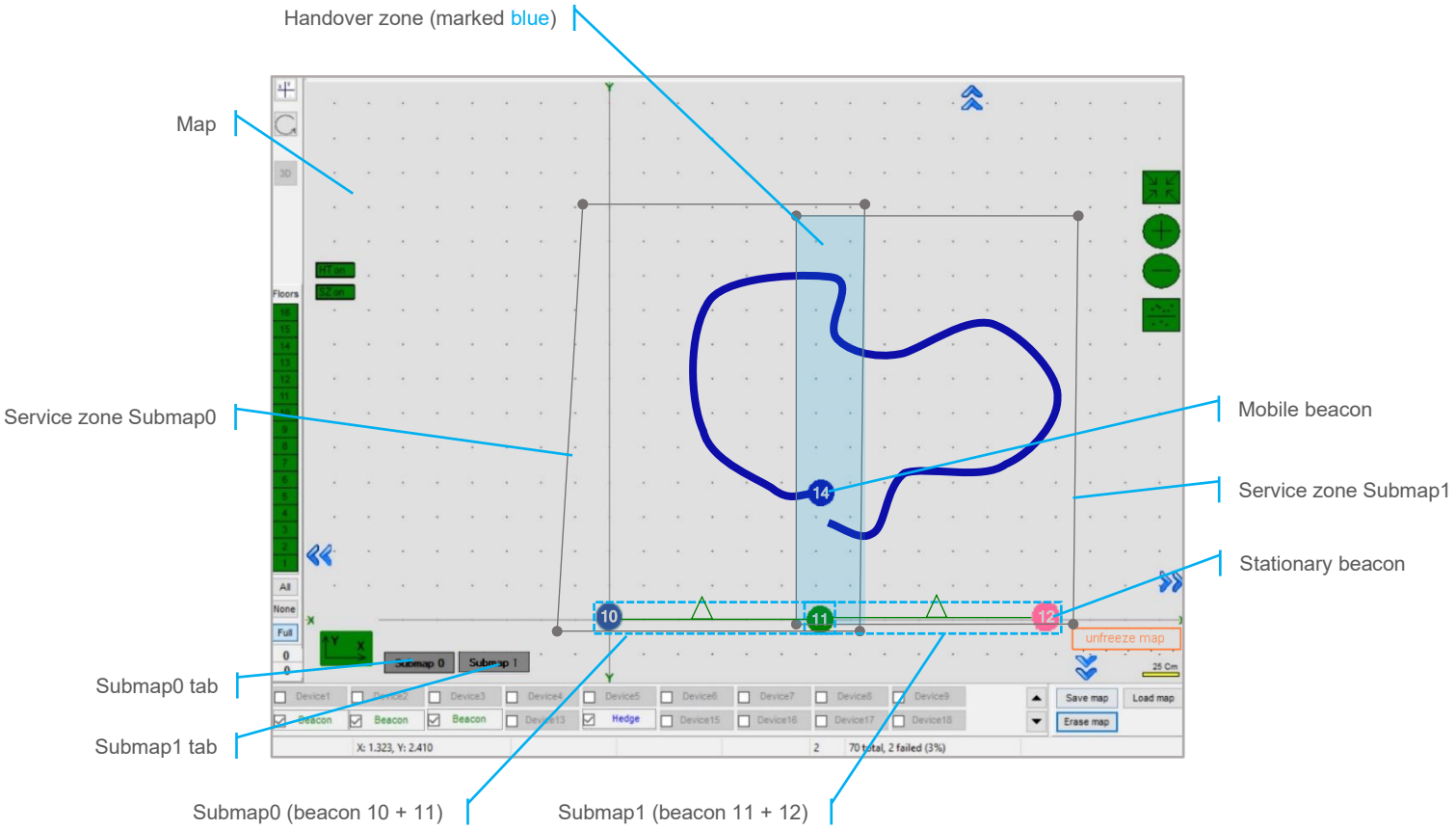
2.3. Architectures' Elements

A **map** is a system unit that includes **submaps, stationary beacons**, and **service zones**. Ultrasonic signals from the stationary beacons of this submap ensure the positioning of mobile beacons.



The main parameters of a submap are its **size, frequencies, and TDMA (Time Division Multiple Access) positions of stationary beacons, by which mobile beacons can not only be positioned** but also determine in which submap the mobile beacon is located.

Here is the main tutorial video about maps:

- Help: submaps, service zones, handover zones

Detailed explanation of complex map building:

- Building submaps: Part 1
- Building submaps: Part 2

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2.4. Indoor “GPS” System Close-up and Internal View

Here, you can see what system elements look like.

- Super-Beacon:

- Modem HW v5.1:

- Super-Modem:

- Beacon Mini-RX:

- Beacon Mini-TX:

- Beacon Industrial-RX:

- Industrial Super-Beacon Metal-25kHz:

- Industrial Super-Beacon-Plastic: