UWB Q&A

Q: *pinout for the tags?*

W: pin1 ground
        pin2 rx
        pin3 tx
        pin4 +5 volt

Q: *What communication protocol are the tags using?*

W: TTL or cp210x with 5v

There are two types of **update rate**:
        fast mode - 10 times per second
        slow mode - 5 times per second
A tag discovers nearby anchors, then start ranging in fast update mode by default. If it fails 3 times to do ranging update , it will go for discovery again.

ranging quality monitoring
Every 5 seconds, the tag checks the number of successful ranging update. If the success rate is lower than 85%, it will decrease the ranging rate to 5 times per second (going to slow mode). In slow mode, it continues checking the ranging update quality and if it is more than 85% for 60 seconds, it will switch back to the fast mode.

ranging data
A Tag prints ranging data over serial interface. The following table exemplifies the format of data for a tag with serial number 00000001 and three anchors with serial numbers 0000001a, 0000001b and 0000001c.

anchor1_id	distance(m)	anchor2_id	distance(m)	anchor3_id	distance(m)	tag_id	tag's timestamps
0000001a	1.53	0000001b	4.96	0000001c	6.12	00000001	ad12(hex)

Q: *The anchors serial numbers are organized in sets of three (e.g., 1A, 1B, 1C). Is there any issue if we mix them with other serial numbers?*

W: Serial numbers can be mixed, but anchors should always be a set of A,B,C.

Anchors' placement
While network installation, setup the anchors in zigzag manner (good for trilateration) starting from A,B,C..A,B,C..A,B,C (the last digit in serial number) as depicted in the following image.
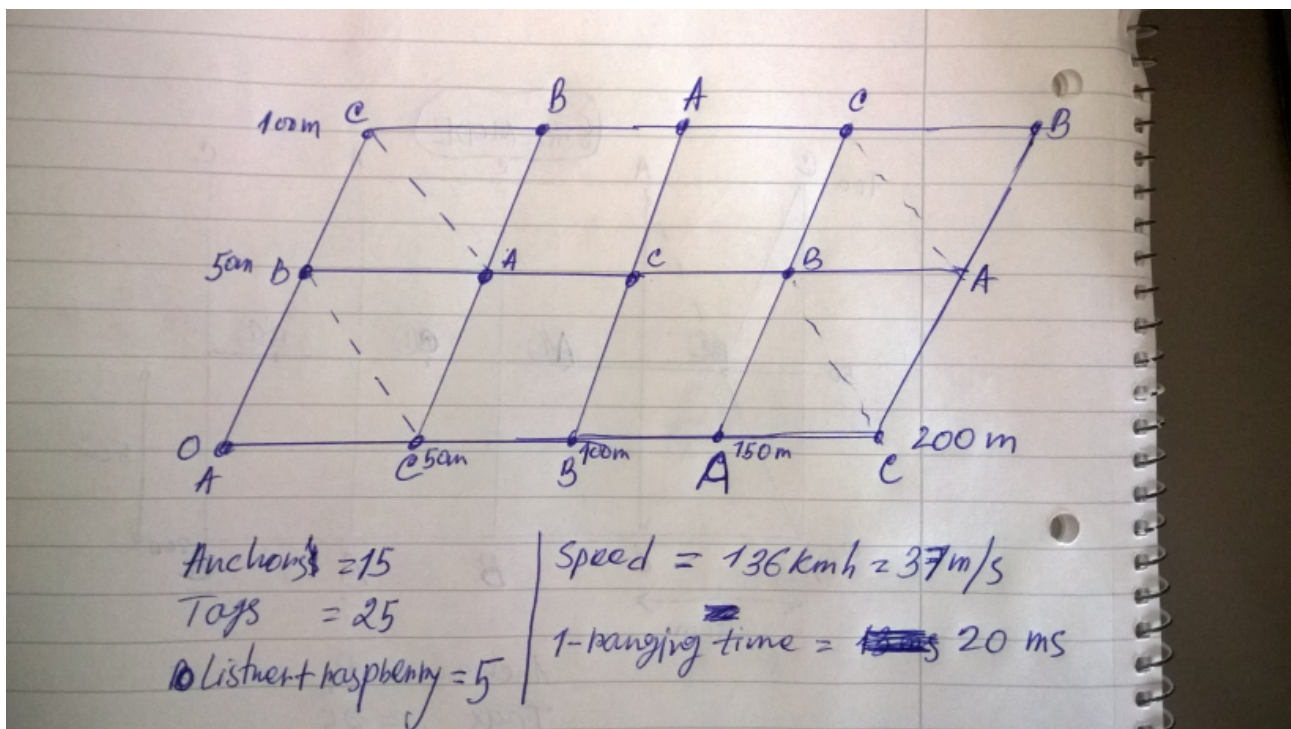
Q: *When the tag is receiving measures from three anchors, even if there is a fourth it does not measures the distance from it. Only if it loses the signal from one of the three. Is that right?*

W: Yes, you are right. If a tag fails 3 times to get ranging data, it goes to discovery mode to find nearby anchors: the tag sends discovery request; anchor A answers between 0 to 2 ms; anchor B answers between 3 to 5 ms; anchor C answers between 6 to 8ms; if the tag receives answers from any 3 anchors, it will start ranging.

Q: *But is it possible to ping more than 3 anchors? This could help in reducing the localization error. Does the firmware allow this?*

W: Basically all anchors within radio range receive discovery request and send back discovery reply based on anchor number (A, B, C) within their reply window time. First three anchors will be chosen for ranging. No ranging will be performed if 3 anchors are not discovered.

Current software supports 3 anchors. Pinging more anchors: this is tradeoff of time. Each anchor pinging should take ca 4-5ms.

Q: *The tag pings A, then B and then C. But imagine that we have 4 anchors: A1, B1, C1, B2. And imagine that the first three tags answering are B1, C1 and B2. What will happen? Will it compute the ranging based on these three tags? Most probably this will only happen if A1 is out of range?*

W: Tag will do broadcast and select strongest A, B, C tags (either B1 or B2). It will not select two Bs. There are two reasons for this: selecting 2 Bs may result in not optimal trilateration - 2 tags in one line will result in bigger trilateration error; negotiating with tags "you are the first, another one will wait" will consume time. Tag starts trilateration always with a A tag, then comes a B and then a C to save time.

Using the provided java application

Plotting data
For plotting a tag's position in a map/grid, you need to know three things

1. ranging data
2. anchors coordinates
3. trilateration algorithm

In the provided java software, write x,y coordinates in anchors coordinates panel and press draw. Find your serial COM port, and press start. You will see data coming in log window and tag's current position in the graph.

You can also use teraterm or putty to see the raw data.The baud rate is 230400.

Provided Code

The source codes are attached. The developer made use of netbeans IDE for software development. dependencies - jfreechart & RXTX java library

serial.rar - complete java code
trilateration.rar - trilateration C library

MonarCH UWB boards have firmware version rev0001(both anchor & tag).
next version is rev0002 (tag & anchor).
rev0002 will not work with rev0001. Both tags and anchors firmware need to be changed, in case you go for software upgrade.

key features rev0002:
1. capability to send ranging data to anchor-B. If anchor-B is connected with a raspberry-pi it can forwards the data to any remote server.
2. less floating point calculation.
3. code footprint < 40KB
4. supports ranging with 2 anchors also.