Indoor Position with IVY5661 96Boards

Bo Dong
bdong@ucrobotics.com
96boards@ucrobotics.com

Linaro connect
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Agenda

1. Brief introductions
2. About IVY5661
3. IVY5661 Indoor Position Solution
4. Use cases
5. Demo

1. Brief Introduction

What is uCRobotics?

uCRobotics is a Hi-tech company which focuses on Intelligent Platform, System Integration, and the development of Embedded System, etc.

Intelligent Platform	uCRobotics is the manufacturer of Bubblegum-96 which is the 4th intelligence development platform based on the Linaro Standard.
Solution	3D cloud printing solution, Robotics solution, big data solution
Open Source	Contribution in open source projects

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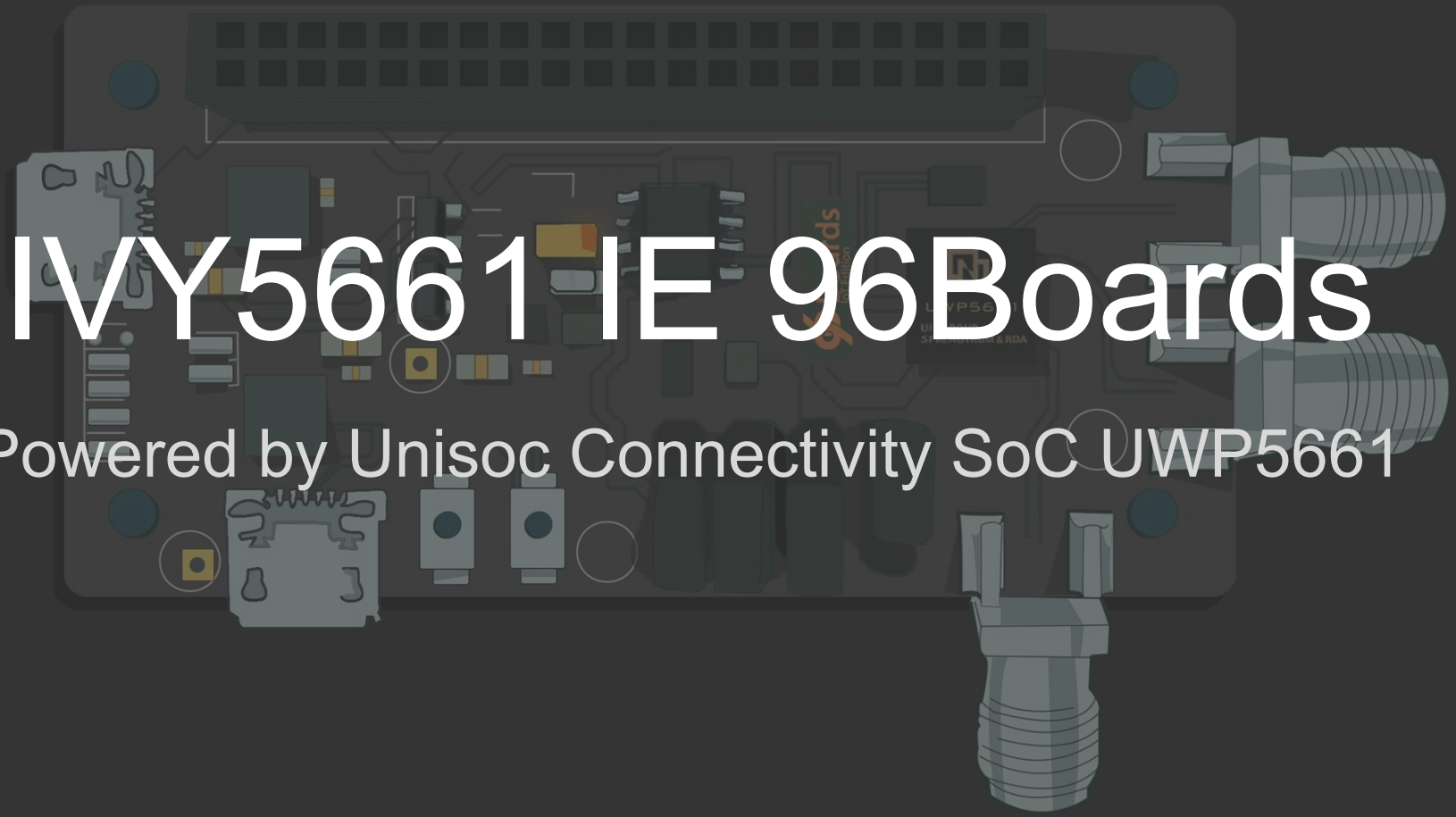
uCRobotics

IVY5661 IE 96Boards

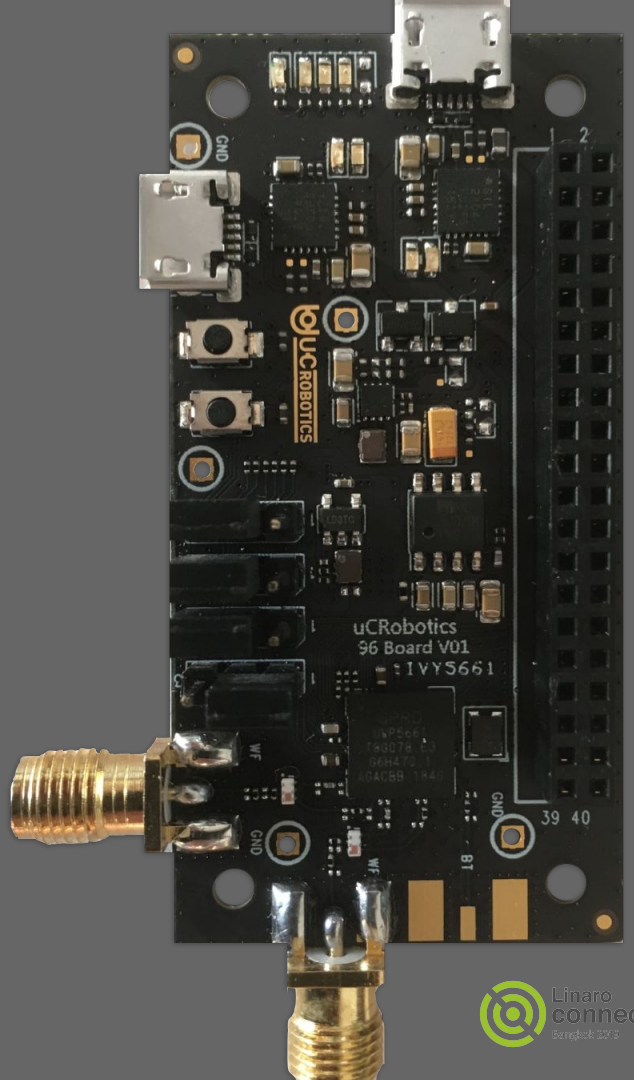
Powered by Unisoc Connectivity SoC UWP5661



2. About IVY5661

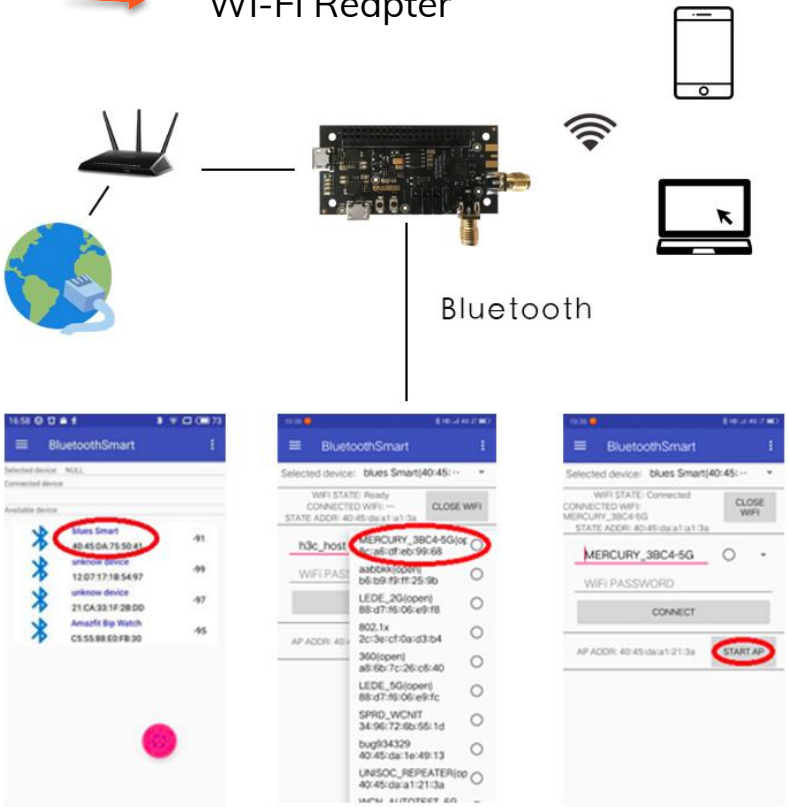
Specification

SoC	UWP5661@28nm
CPU	ARM Cortex-M4 Dual Core
Clock freq	416MHz
Storage	32Mbit
Wi-Fi	IEEE802.11ac 2x2
Bluetooth	Bluetooth 5
USB	2 x Micro USB
Expansion Interface	UART/I2C/SPI/I2S/GPIO
LED	4 user LED
Button	2 reset and user button
Power Source	Micro USB
OS Support	Zephyr
Size	60 x 30mm



2. About IVY5661

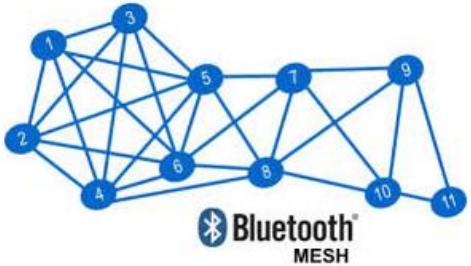
Wi-Fi Reapter



Connect smart phone and IVY5661 through Bluetooth. Configure IVY5661 to link it with known Wi-Fi router and set the password and ssid for the Wi-Fi channel which is broadcasted by IVY5661.

2. About IVY5661

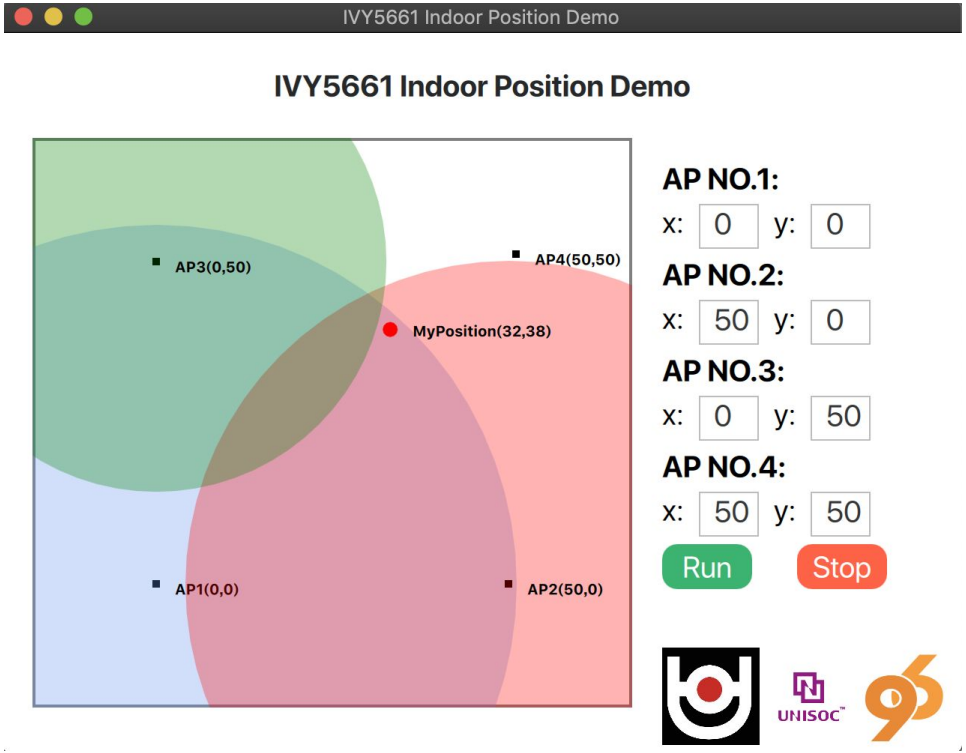
Bluetooth Mesh



Bluetooth mesh networking enables many-to-many (m:m) device communications and is optimized for creating large-scale device networks. It is ideally suited for building automation, sensor network, asset tracking, and other IoT solutions that require tens, hundreds or thousands of devices to communicate with one another.

2. About IVY5661

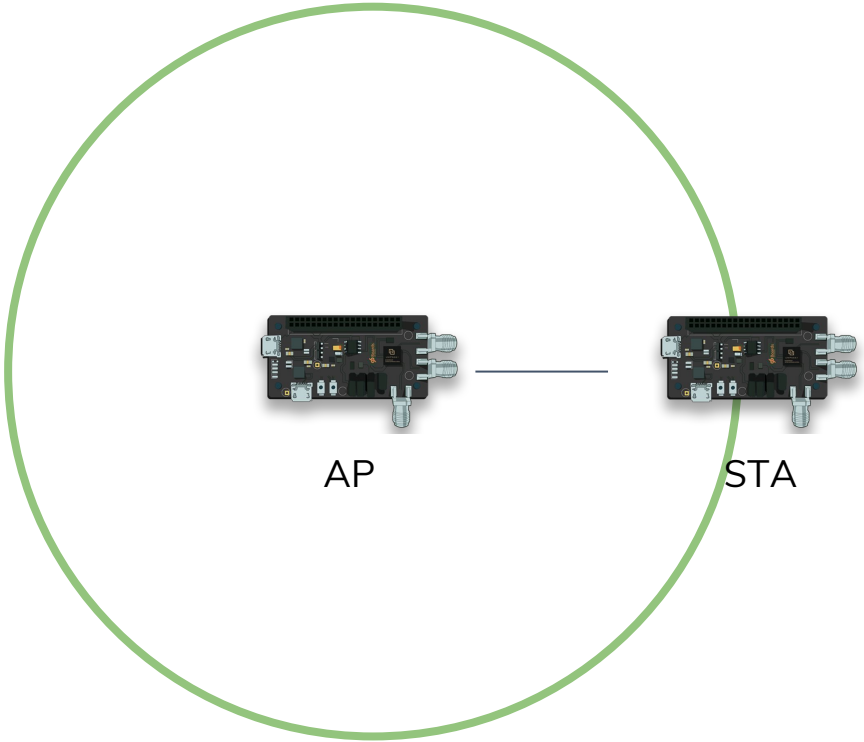
Indoor Position



With UniSoC UWP5661 inside and Zephyr deployed, IVY5661 can be used in intelligent household, IP camera, repeater Wi-Fi amplifier. We used Wi-Fi on IVY5661 to make indoor position happened.

3. IVY5661 Indoor Position Solution

Theory



- How to get the distance between STA and AP?
  - Through RTT(Run-Trip Time) protocol.

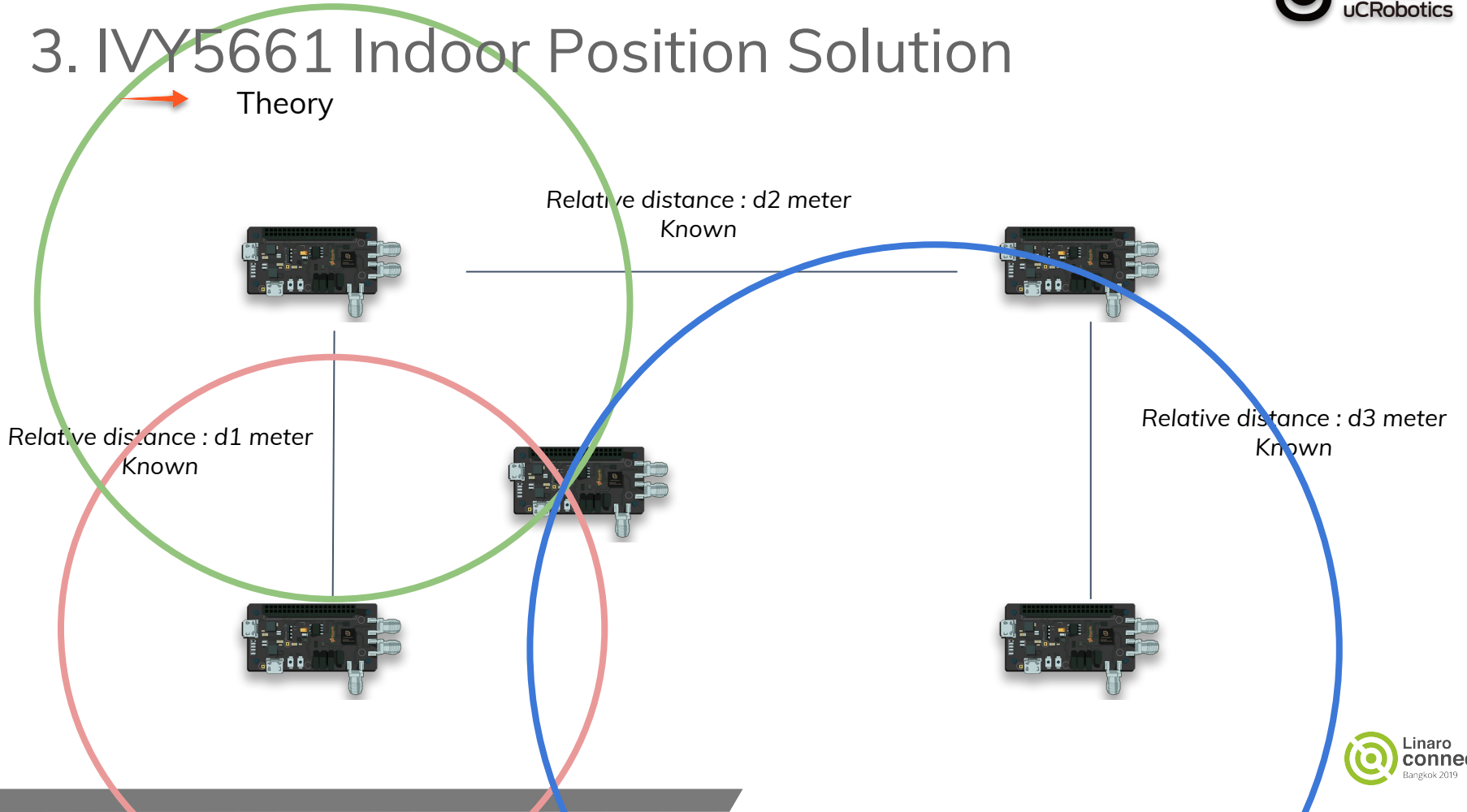
3. IVY5661 Indoor Position Solution

Theory

- You can use the Wi-Fi location functionality provided by the Wi-Fi RTT (Round-Trip-Time) API to measure the distance to nearby RTT-capable Wi-Fi access points and peer Wi-Fi Aware devices.
- If you measure the distance to three or more access points, you can use a multilateration algorithm to estimate the device position that best fits those measurements. The result is typically accurate within 1-2 meters.

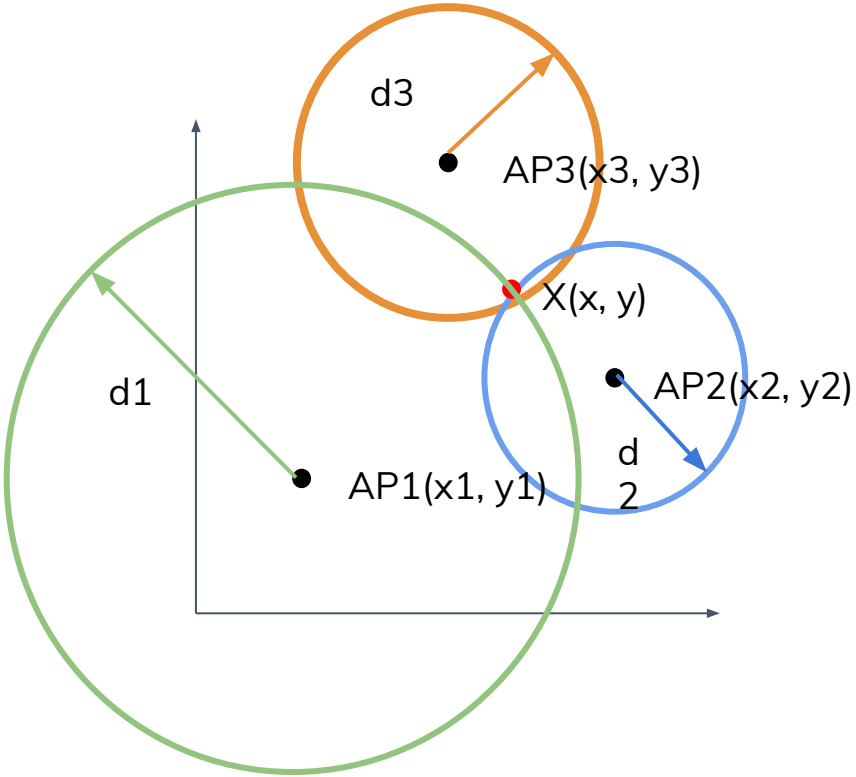
3. IVY5661 Indoor Position Solution

Theory



3. IVY5661 Indoor Position Solution

Theory



AP1(x1, y1)
AP2(x2, y2)
AP3(x3, y3)
X(x, y)

(x1-x)^2+(y1-y)^2=d1^2
(x2-x)^2+(y2-y)^2=d2^2
(x3-x)^2+(y3-y)^2=d3^2

3. IVY5661 Indoor Position Solution

Implement

```
aberr =0;
        do
        {
                for(i = 0;i <= 2*la;i++)
                {
                        for(j = 0;j <= 2*lb;j++)
                        {
                                if(cax_abeyance1[i] == cbx_abeyance1[j])
                                {

                                        if((cay_abeyance1[i]  >  (cby_abeyance1[j]  -  aberr  - abcerr))&&(cay_abeyance1[i] <
(cby_abeyance1[j] + aberr + abcerr)))
                                        {
                                                cabx_abeyance1[abrequery] = cax_abeyance1[i];
                                                caby_abeyance1[abrequery] = cay_abeyance1[i];
                                                abrequery++;
                                        }
                                }
                        }
                }
                if(abrequery < loopnum)aberr++;
        }
```

3. IVY5661 Indoor Position Solution

Implement

```
do
    {
        for(i = 0;i <= 2*la;i++)
        {
            for(j = 0;j <= 2*lc;j++)
            {
                if(cax_abeyance1[i] == ccx_abeyance1[j])
                {
                    if((cay_abeyance1[i]  >  (ccy_abeyance1[j]  -  acerr  - abcerr))&&(cay_abeyance1[i] <
(ccy_abeyance1[j] + acerr + abcerr)))
                    {
                        cacx_abeyance1[acrequery] = cax_abeyance1[i];
                        cacy_abeyance1[acrequery] = cay_abeyance1[i];
                        acrequery++;
                    }
                }
            }
        }
```

3. IVY5661 Indoor Position Solution

Implement

```
for(i = 0;i < abrequery;i++)
        {
                for(j = 0;j < acrequery;j++)
                {
                        if(cabx_abeyance1[i] == cacx_abeyance1[j])
                        {
                                requery1 = 1;
                                printf("final result is (%f,%f)\n",cabx_abeyance1[i],caby_abeyance1[i]);
                put_coordinate(cabx_abeyance1[i],caby_abeyance1[i]);
                        }
                }
        }
        if(requery1 == 0)
        {
                loopnum++;
                abcerr++;
        }
        if(loopnum == 10)
        {
                printf("check input figure is right\n");
        }
  }while(requery1 ==0);
  printf("finish!\n");
```

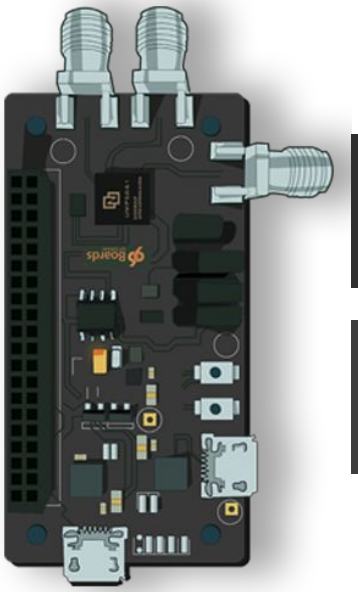
3. IVY5661 Indoor Position Solution

To be continued

- Support three dimension position.
  - Provide space position to implement positioning with different floor.
- Deploy with access points swarm.
  - Redundant ranging data processing
- Improve ranging data accuracy.
  - Bluetooth RSS position as reference
  - Location data smoothing

3. IVY5661 Indoor Position Solution

Implement



Easy to deploy

Low Cost

4. Indoor Position Solution Use Cases

Shopping Mall & Airport

Shopping Mall

Airport & Train station

4. Indoor Position Solution Use Cases

Industrial Scene

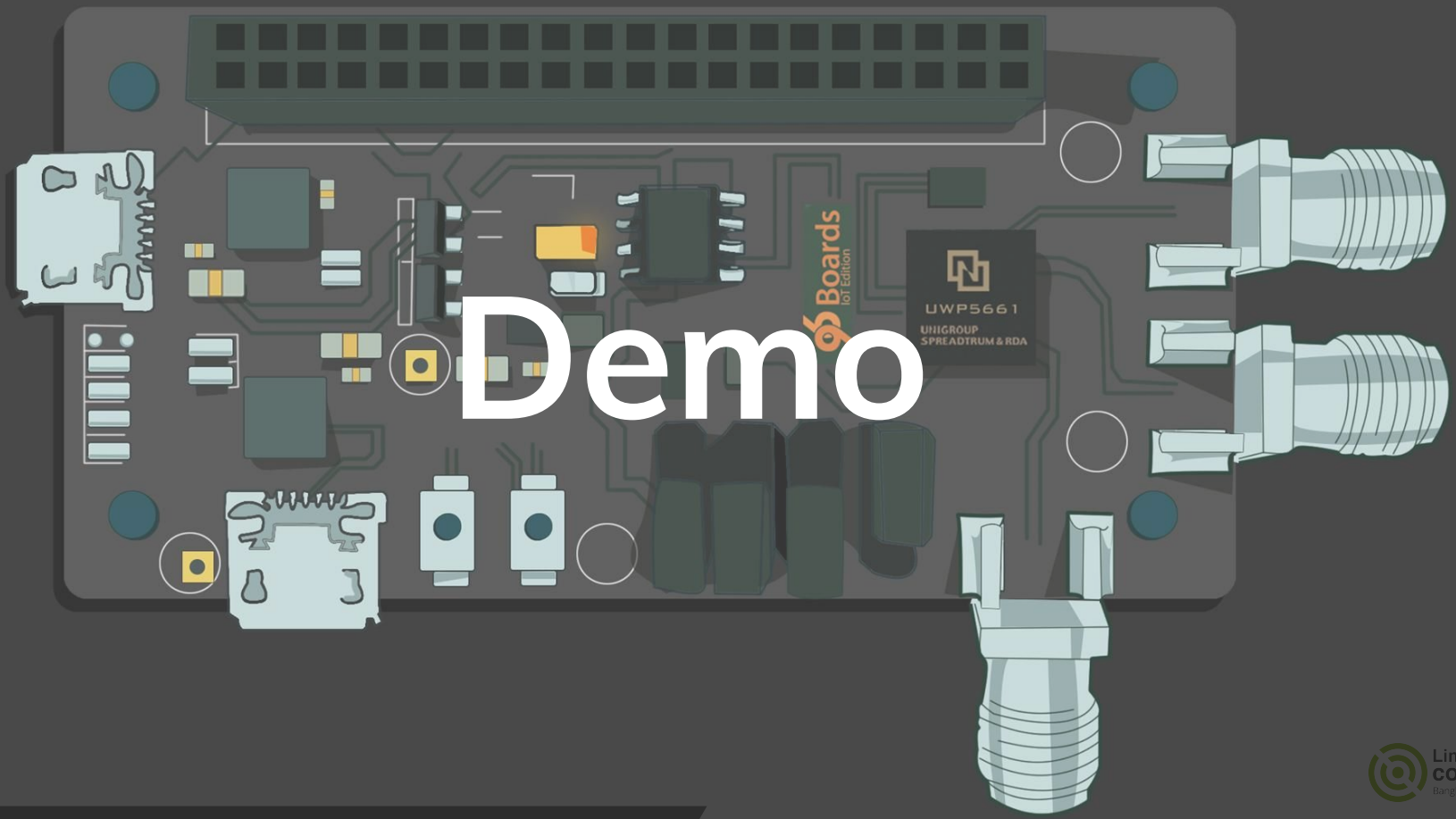
4. Indoor Position Solution Use Cases

Robotics

- Original: Use depth image based VSLAM to position..
  - Works well in small area.
  - Failed to localization in large area, for example, airport.

- Improved: Use IVY5661 indoor position system to navigate between big scenes. Then use VSLAM to navigate accurately in a specificate area.

Demo



Thank you

Bo Dong
bdong@ucrobotics.com
96boards@ucrobotics.com
https://github.com/uCRDev

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