

Cassia Enhanced Locationing (Version 1.0) User Guide

Release date: June 27th, 2023

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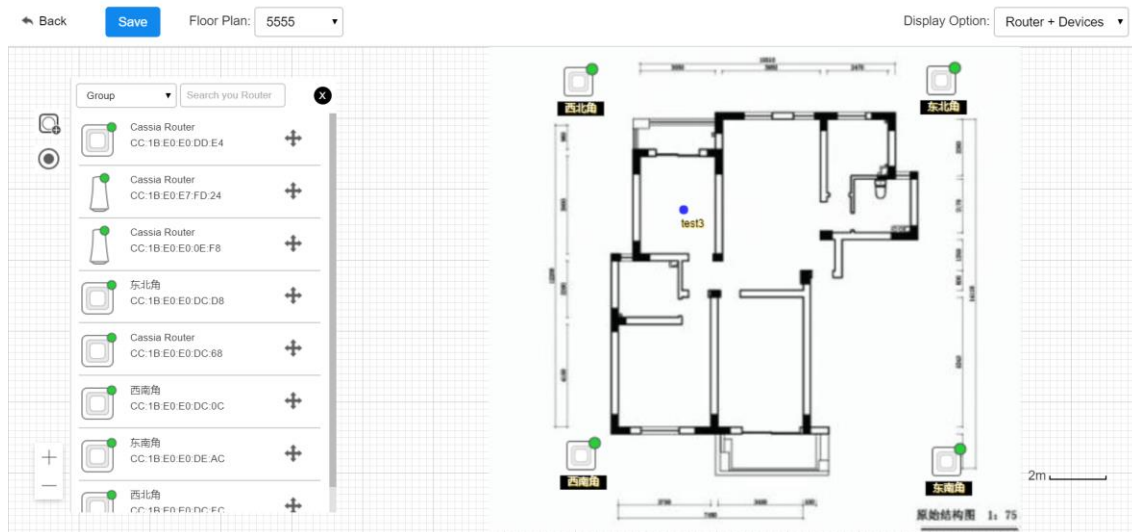
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1. Overview

From firmware 2.0, the Cassia IoT Access Controller (AC) provides Enhanced Locationing functionality (version 1.0) and the corresponding RESTful API. The Cassia IoT AC in conjunction with multiple Cassia Bluetooth gateways, can triangulate the position of the BLE devices within its coverage. The accuracy of the enhanced locationing function is about 5 meters.

Customer can use this RTLS (Real Time Location System) function in AC console directly. Customer can also integrate the RESTful API with customer's own people and assets tracking system.

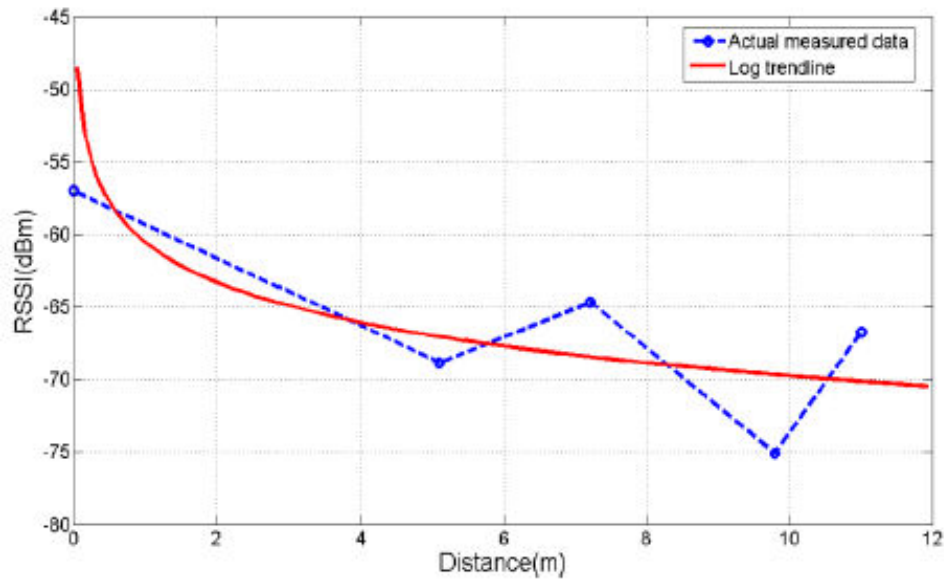
The current Cassia Enhanced Locationing service (version 1.0) provides real time locationing, but won't store the location data in AC, so it can't provide the historical tracking information. Customer can build their own location engine and location application by gathering the raw RSSI data from Cassia Bluetooth gateways directly.



2. Algorithm

Similar as Wi-Fi triangle location algorithm, the Enhanced Locationing function makes full use of the RSSI detected by three or more nearby gateways and calculate the location of Bluetooth devices.

First of call, there is a direct relationship between the received Bluetooth RSSI value and the distance between the Bluetooth gateway and the Bluetooth device. When the distance increases, the RSSI will decreases accordingly.



When the Enhanced Locating function is enabled, all the Bluetooth gateways controlled by the Cassia IoT AC will start to scan the Bluetooth devices and report the received RSSI value to AC. The AC will collect, filter and process the RSSI values.

If three or more Bluetooth gateways detected strong enough RSSI from one Bluetooth device, the AC can calculate the location of the Bluetooth device and show it on AC RTLS console or report it to customer's own people and assets tracking system by RESTful API.

In order to handle the Bluetooth devices with different output power and avoid the impact of too weak Bluetooth signals, we introduced two parameters in AC **Setting** page. They are "Base RSSI" and "RSSI Threshold".

Base RSSI is the RSSI value (check in gateway) when you put BLE device one meter away from the gateway. This parameter has big impact on accuracy. You can check the RSSI by using Bluetooth Debug Tool in AC (see Cassia User Manual).

RSSI Threshold is the RSSI that gateway uses to filter advertisement packets. Gateway will filter out the advertisement packets whose RSSI are lower than this value.

If two or more gateways receive Bluetooth advertisement packets with RSSI higher than "RSSI Threshold" and none of them is higher than "Base RSSI", the Bluetooth device will be displayed on the floor plan as a blue dot.

If one gateway receives RSSI higher than "Base RSSI", the Bluetooth device will be displayed as an orange dot near the gateway.

If less than two gateways receive RSSI higher than "RSSI Threshold", the Bluetooth device will not show on the floor plan.

3. Example

Below examples can give you a reference for what can be achieved by Enhanced Locationing function. The locationing accuracy in a specific RTLS project will be impacted by the radio environment, Bluetooth device, Bluetooth gateway deployment, and some other factors.

The Bluetooth devices we used in the examples are Cassia Personal Safety Sensors. The output power is +5dBm. The advertising interval is 1s.



3.1. In-door example

We tested Enhanced Locationing feature in a theater. There are four Cassia Bluetooth gateway E1000 (see the red arrows) installed in this theater. The size of the theater is 10 meters x 22 meters. Ten Cassia Personal Safety Sensors were used, and don't move.



When both of the four E1000 are used, the average accuracy (the distance between the calculated location and the real location of the Bluetooth device) is 3.5m. Most of the time,

the accuracy is less than 5m. Sometimes, the accuracy is between 0.6m to 9.3m.

If only three E1000 are used (one E1000 is shutdown), the average accuracy is 4.4m. Most of the time, the accuracy is less than 6m. Sometimes, the accuracy is between 1m to 9.2m.

3.2. Out-door example

We also tested Enhanced Locationing feature in the garden of a school. There are four Cassia Bluetooth gateway X1000 around the garden. The size of the garden is 65 meters x 70 meters. There are trees around the garden. One Cassia Personal Safety Sensor is used, and doesn't move.

The average accuracy (the distance between the calculated location and the real location of the Bluetooth device) is 5m to 10m.



4. RESTful API

First, please load floor plans manually and set scale in AC. After that, you can call below locationing RESTful APIs.

1) Get map information

GET /api/ac/map

Sample Result:

```
[{"name":"test",          // map (floor plan) name
"type":"","
"url":"/assets/uploads/maps/map_1576052977624.png",          // map picture
"zoomScale":"1.2194215216993847",    // every 100 pixels mapping to meter
"plottingScale":"","
"groupId":"0",
"scaleUnit":"m",    // can be "m" (meter) or "ft" (feet). If it is ft, will multiple 0.3048 to zoomScale
"id":"1576053001988"    // mapid
}]
```

2) Add Bluetooth device which needs to locate

```
POST /api/ac/device-policy
{"name":"<friendlyname>","id":"<deviceMAC>"}
```

3) Get device position

```
GET /api/ac/map/<mapid>/devices-position
```

Sample Result:

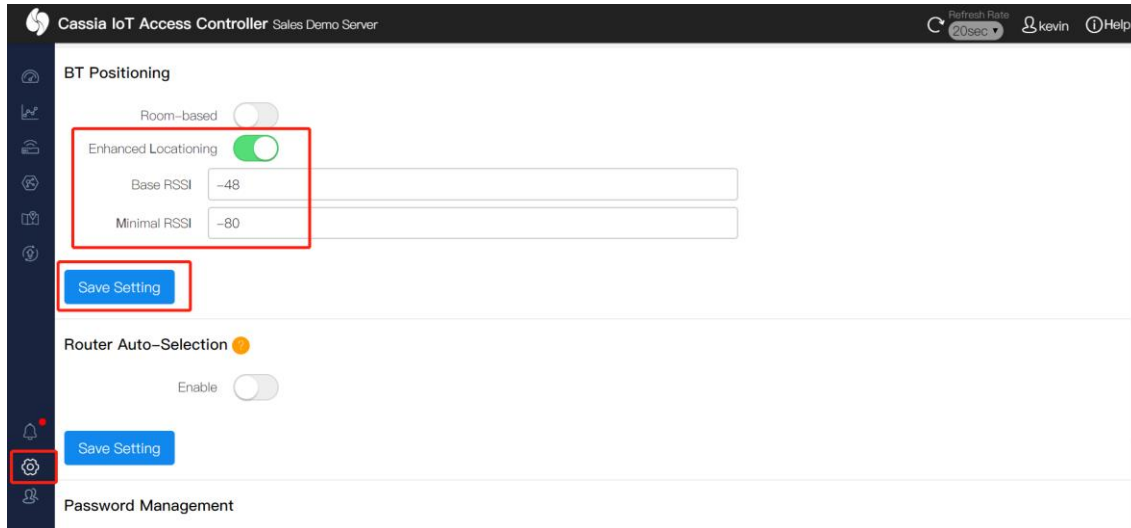
```
[{
"type":"point",          // can be "point" or "ap"
"x": 256.768,            // x coordinate (in pixels) from the topleft of the map
"y": 134.345,            // y coordinate (in pixels) from the topleft of the map
"map":"1576053001988" // mapid
},{
"type":"ap",              // if RSSI is higher than Base RSSI, will return the nearest gateway's MAC
"ap": <ap MAC>,
"map":"1576053001988"
}]
```

NOTE: x, y coordinate can convert to meters by $x * \text{zoomScale} / 100$

5. AC Configuration

5.1. Enable Enhanced Locationing

First, please enable Enhanced Locationing function in AC **Setting** page like below. Only one of **Enhanced Locationing** and **Room-based** option can be enabled.



5.2. Set Base RSSI and RSSI Threshold

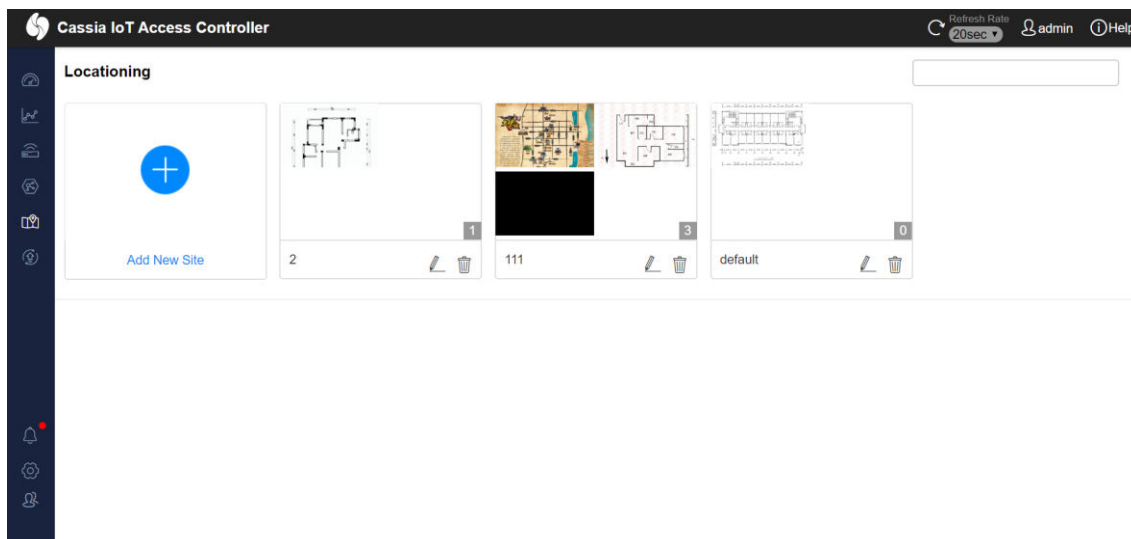
In AC **Setting** page (see above), please configure “Base RSSI” and “RSSI Threshold” to tune the Enhanced Locationing algorithm for your BLE device. Please check chapter 2 for more information.

Base RSSI is the RSSI value (check in gateway) when you put BLE device one meter away from the gateway. This parameter has big impact on accuracy. You can check the RSSI by using Bluetooth Debug Tool in AC (see Cassia User Manual).

RSSI Threshold is the RSSI that gateway uses to filter advertisement packets. Gateway will filter out the advertisement packets whose RSSI are lower than this value.

5.3. Create a New Site

Open **Locationing** page.



Click **Add New Site**, and add the name (up to 200 characters) for the new site.

Add New Site

Up to 200 characters

Cancel

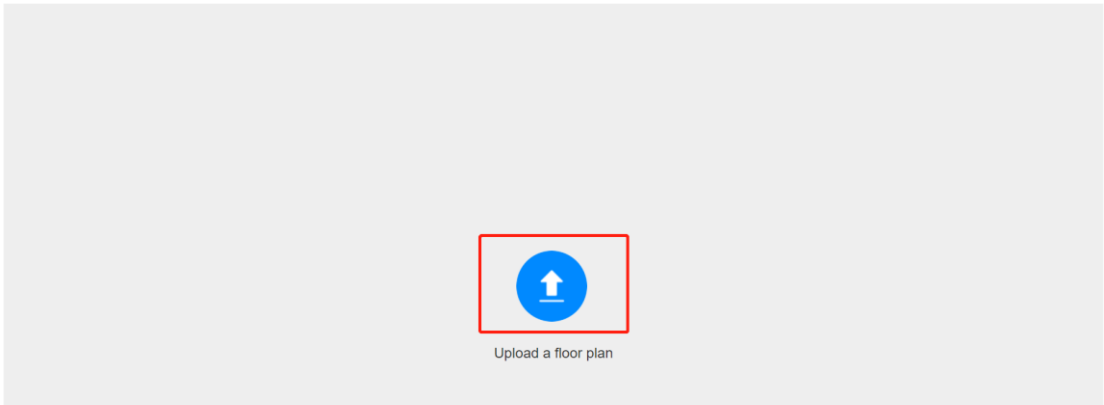
OK

5.4. Upload Floor Plan

Click **Add New Floor Plan** in the new site created in step 3 and upload the new floor plan. The format of floor plan should be jpg or png, and the size should be less than 2MB.

Add Floor Plan

Enter the floor plan



Upload a floor plan

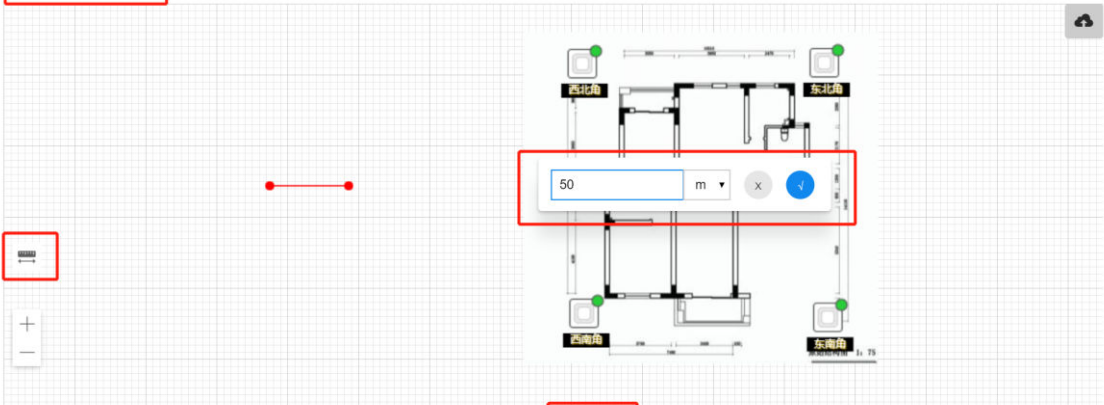
正在连接...

Cancel OK

Then, please set the name of the floor plan, set the floor scale, and then click **OK**.

Add Floor Plan

Enter the floor plan



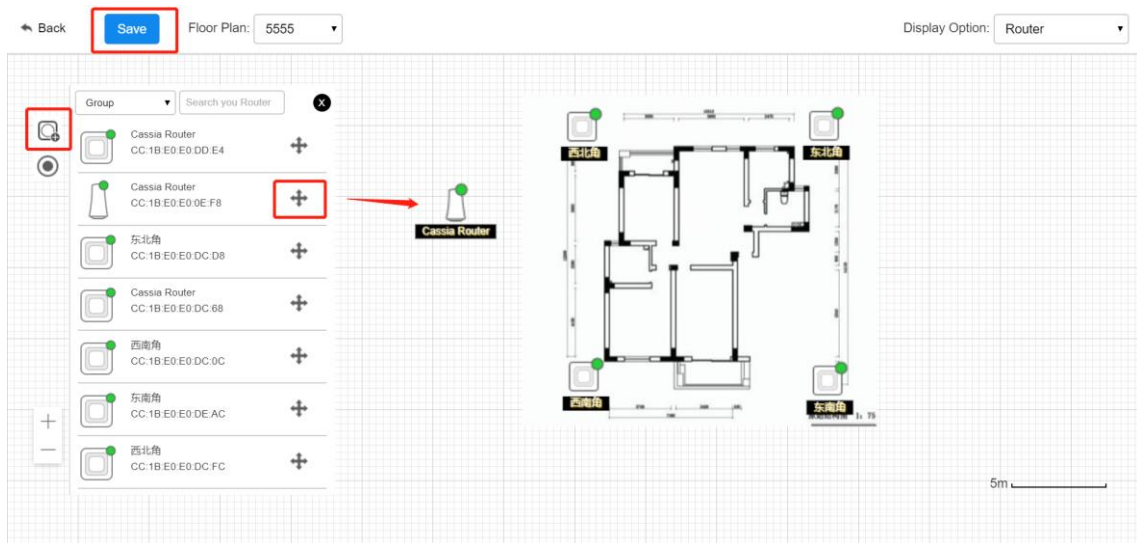
50 m x

Cancel OK

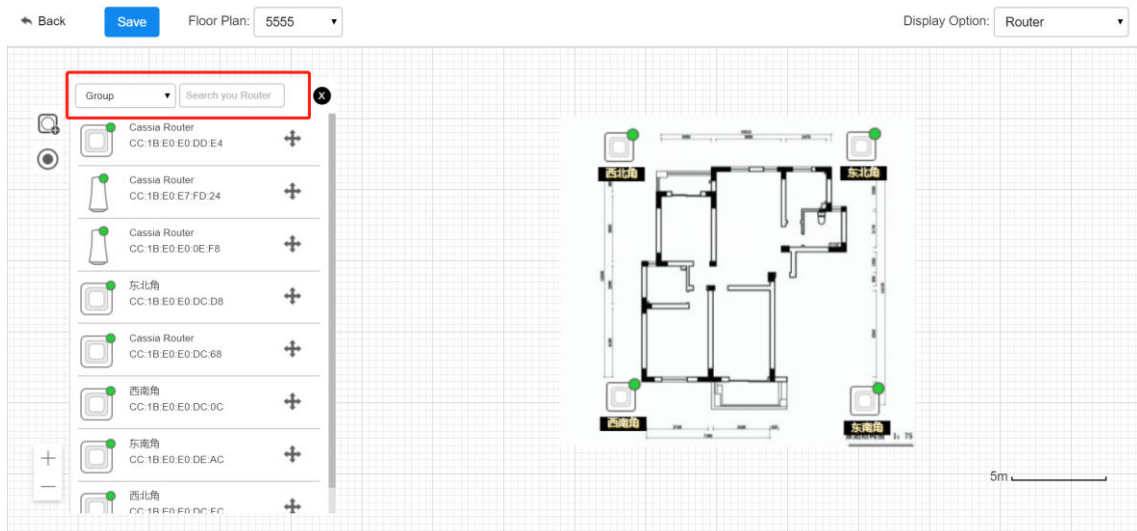
5.5. Add Gateways to Floor Plan

Open the floor plan uploaded in step 4, click  on the left, find the gateway and drag it to the floor plan.

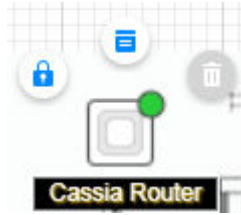
When all the gateways are added, please click **Save** on the top to save the setting. The gateway will start scan automatically after it is added to a floor plan.



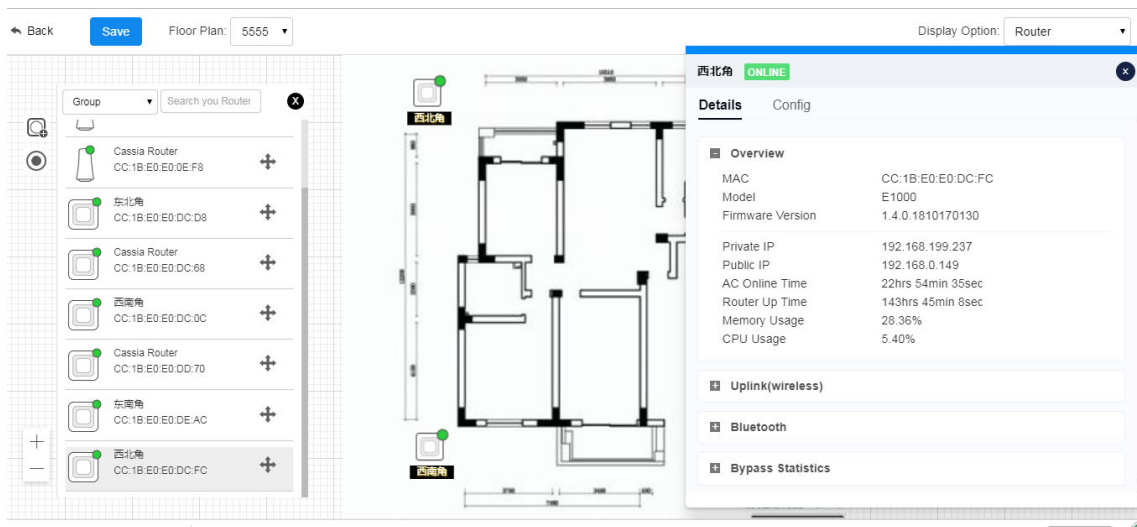
The customer can search the gateway or filter the gateways by the group.



The customer can edit or delete the gateway. Please click the gateway, then it will show three icons around the gateway.



The lock icon shows the gateway can be deleted or not. Clicking the lock icon will enable the delete icon. The customer can delete the gateway by clicking delete icon. When clicking edit icon, it can show the **Details** and **Config** tab of this gateway.



5.6. Add Devices for Locationing

NOTE: Please skip this step if you are using RESTful API in chapter 4.

Please open **Device** page, and click the **Detected** tab. You will find all the devices scanned by the gateways.



Click **Add to locationing** in column operation, and please add an Alias for this device.

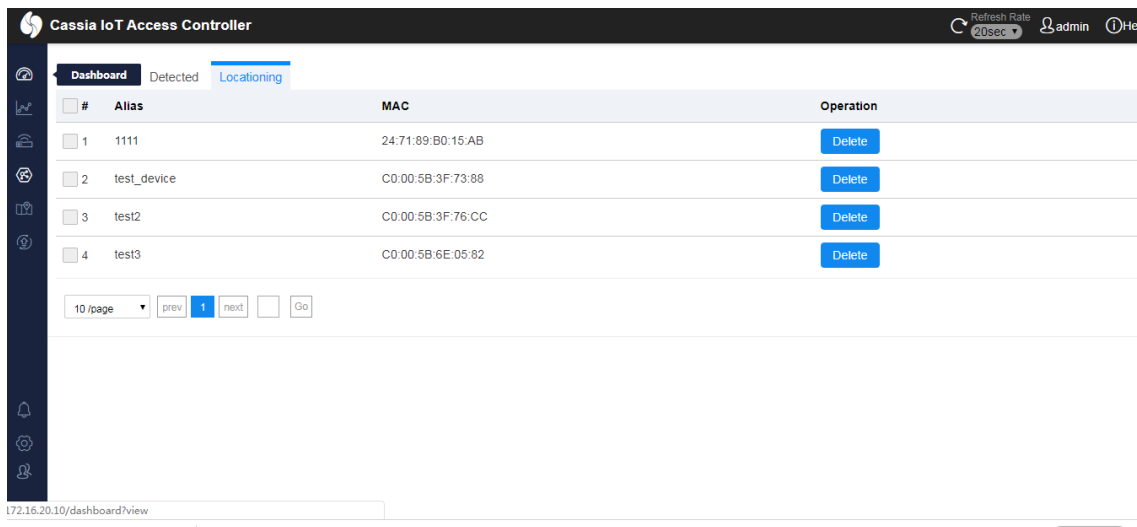
Add To Locationing

Alias

Cancel

OK

Now, you can find this device in **Locationing** tab.



The screenshot shows the Cassia IoT Access Controller web interface. The top navigation bar includes 'Dashboard', 'Detected', and 'Locationing' (which is active). The 'Locationing' tab displays a table with columns: #, Alias, MAC, and Operation. The table contains four rows of test devices. Below the table is a pagination control showing '10 /page' and buttons for 'prev', '1', 'next', and 'Go'. The browser address bar at the bottom shows '172.16.20.10/dashboard?view'.

#	Alias	MAC	Operation
1	1111	24:71:89:B0:15:AB	Delete
2	test_device	C0:00:5B:3F:73:88	Delete
3	test2	C0:00:5B:3F:76:CC	Delete
4	test3	C0:00:5B:6E:05:82	Delete

5.7. View the Locationing Result

NOTE: Please skip this step if you are using RESTful API in chapter 4.

Please open the floor plan and set the display option, e.g., Gateway + Devices. Then, the customer can see the devices with device alias. Customer can choose to show device alias, MAC, or none of them.

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If less than two gateways receive RSSI higher than “RSSI Threshold”, the Bluetooth device will not show on the floor plan.

