Learning from BLE Advertisements

It’s not machine learning (yet), relax.

Yibo Wei

Background

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What does a BLE device advertise (usually)?

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- Manufacturer data (with a company ID)
- Service/Characteristic UUIDs
- Tx power level (for distance estimation)
- …
- Many other things that are defined but rarely used

When does a BLE device advertise?

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  - Wireless earbuds
  - Smartwatches

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  - Temperature sensors
  - Beacons
  - Apple’s FindMy network

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Reality:

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  - Temperature sensors
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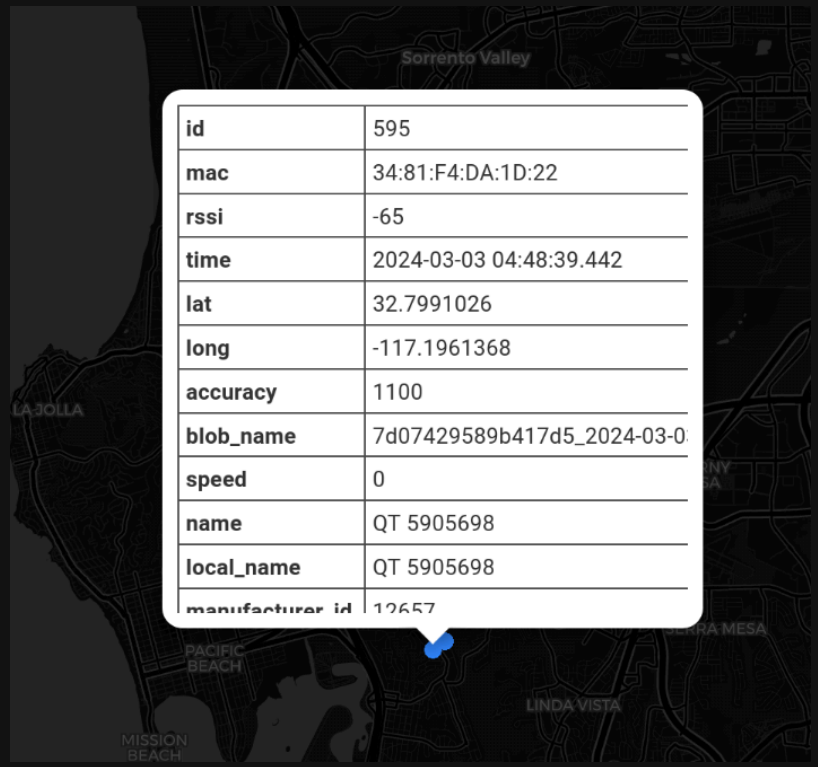
Reality:

When it shouldn’t

Example: CARR Alarm System

Don’t install this when your dealer tries to sell you one!



id	595
mac	34:81:F4:DA:1D:22
rssi	-65
time	2024-03-03 04:48:39.442
lat	32.7991026
long	-117.1961368
accuracy	1100
blob_name	7d07429589b417d5_2024-03-0
speed	0
name	QT 5905698
local_name	QT 5905698
manufacturer_id	12657

Example: MyQ Garage Door Opener

This device only needs to be paired once, but we found a lot of advertisements.

Example: Govee LED Strip

This is the worst one so far.

We want to find more bad devices like these.

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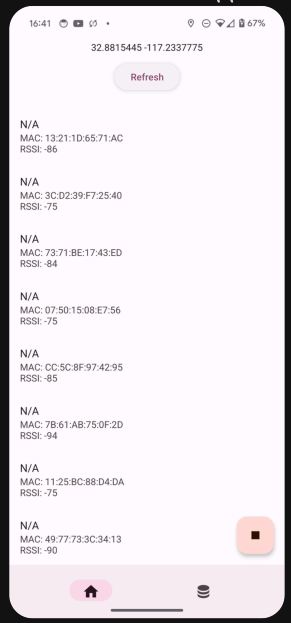
Our work

Data sources

Cluetooth App

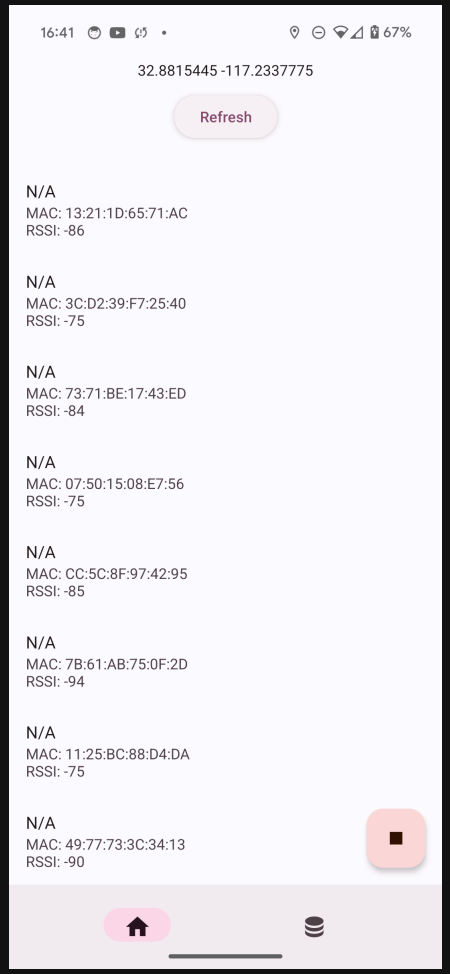


PostgreSQL

Apkpure

JADX

Bluetooth SIG Assigned Numbers



Cluetooth App

BLE scanner that uploads data to our server

Sample Data:

```
{
  "mac": "00:11:22:33:44:55",
  "rssi": -50,
  "time": "2024-03-03T12:34:56Z",
  "name": "My Device",
  "manufacturer_id": 12657,
  "lat": 37.7749,
  "lon": -122.4194,
  "accuracy": 10,
  "uuids": ["0000180D-0000-1000-8000-00805F9B34FB"],
  ...
}
```

Extracting UUIDs from APKs

Fully automated APK uuid extraction workflow:

Keyword based search


```
[
  {
    "name": "Govee Home"
    "app_id": "com.govee.home",
    "description": "Govee Home is an app to help you manage your smart devices."
  },
   ...
]
```



```
[
  {
    "uuid": "00010203-0405-0607-0809-0a0b0c0d2b11",
    "variable": "f22453y",
    "path": "com/govee/barelightv1/ble/BleComm.java"
  },
   ...
]
```

Assigned Numbers

16-bit UUIDs are assigned by the Bluetooth SIG

```yaml
- uuid: 0x1809
  name: Health Thermometer
  id: org.bluetooth.service.health_thermometer
- uuid: 0x180A
  name: Device Information
  id: org.bluetooth.service.device_information
- uuid: 0x180D
  name: Heart Rate
  id: org.bluetooth.service.heart_rate
- uuid: 0x180E
  name: Phone Alert Status
  id: org.bluetooth.service.phone_alert_status
- uuid: 0x180F
  name: Battery
  id: org.bluetooth.service.battery_service
```

More details:

https://bitbucket.org/bluetooth-SIG/public/src/main/assigned_numbers/uuids/

Assigned Numbers

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```yaml
- uuid: 0x1809
  name: Health Thermometer
  id: org.bluetooth.service.health_thermometer
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  name: Device Information
  id: org.bluetooth.service.device_information
- uuid: 0x180D
  name: Heart Rate
  id: org.bluetooth.service.heart_rate
- uuid: 0x180E
  name: Phone Alert Status
  id: org.bluetooth.service.phone_alert_status
- uuid: 0x180F
  name: Battery
  id: org.bluetooth.service.battery_service
```

More details:

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Assigned Numbers

16-bit UUIDs are assigned by the Bluetooth SIG

```yaml
# Assigned 16-bit UUIDs converted to 128-bit UUIDs
- uuid: 00001809-0000-1000-8000-00805F9B34FB
  name: Health Thermometer
  id: org.bluetooth.service.health_thermometer
- uuid: 0000180A-0000-1000-8000-00805F9B34FB
  name: Device Information
  id: org.bluetooth.service.device_information
- uuid: 0000180D-0000-1000-8000-00805F9B34FB
  name: Heart Rate
  id: org.bluetooth.service.heart_rate
- uuid: 0000180E-0000-1000-8000-00805F9B34FB
  name: Phone Alert Status
  id: org.bluetooth.service.phone_alert_status
- uuid: 0000180F-0000-1000-8000-00805F9B34FB
  name: Battery
  id: org.bluetooth.service.battery_service
```

More details:

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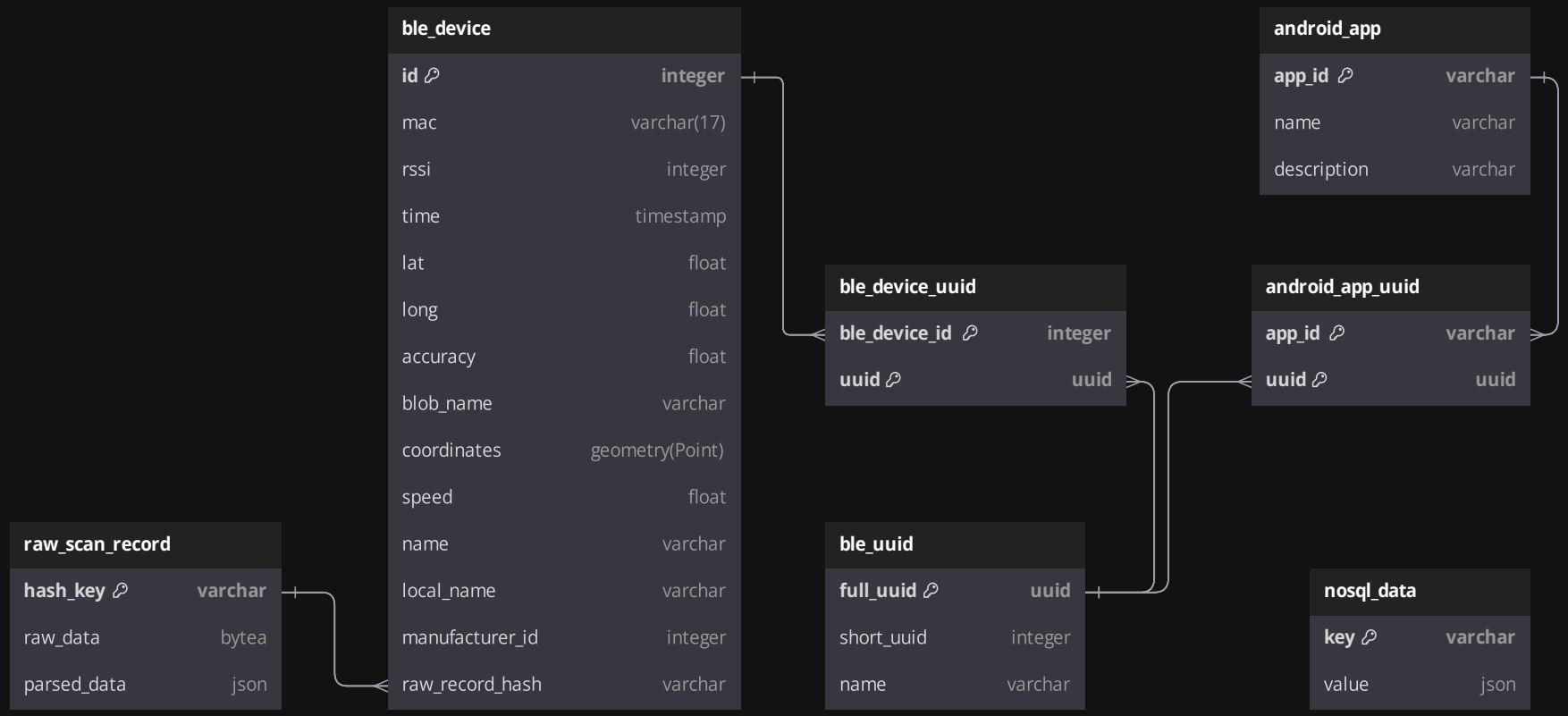
Database

We use UUIDs to associate scanned devices with Android apps.



Future work

Future work

- Scan a lot more

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- Scan a lot more
- Data analysis

Future work

- Scan a lot more
- Data analysis
- Machine learning?

Questions?

About this presentation

I hate PowerPoint and Google Slides.

- Slides are made with Slidev
- Diagrams are made with Excalidraw
- The database schema diagram is made with dbdiagram.io (Non-free)

Thank you!