Dataset Collection of Multi-Communication Technologies Monitored in Different Mobility Contexts

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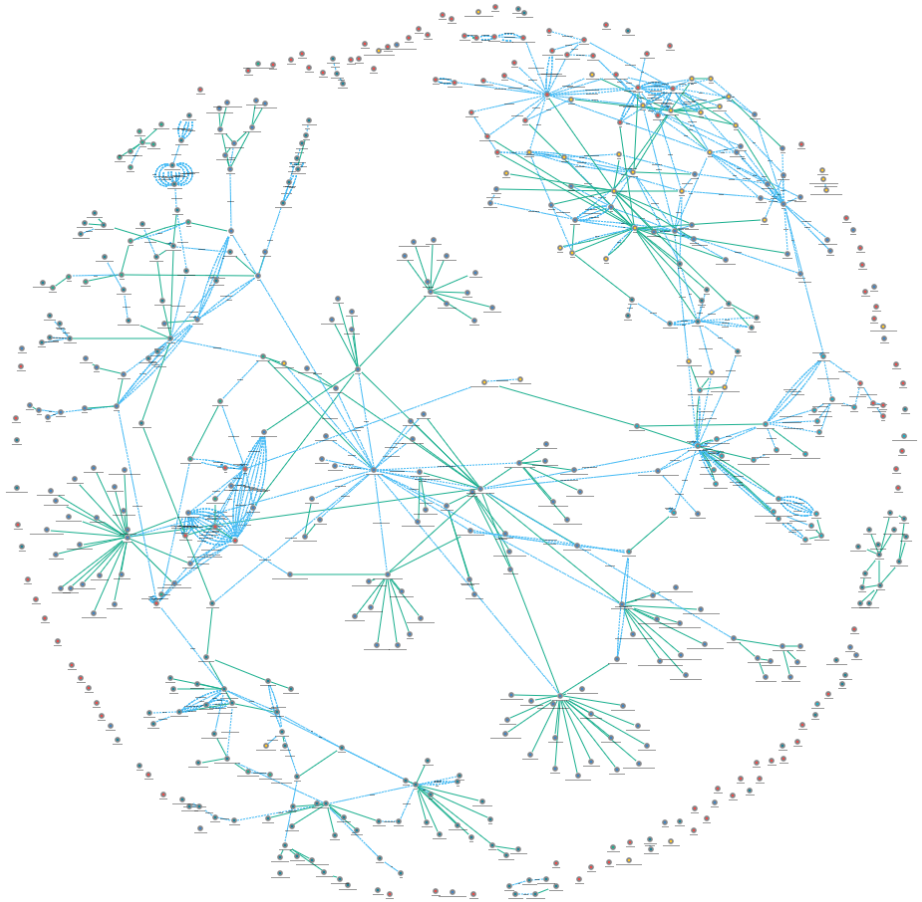
Why Collecting Data?

Context aware forwarding protocols in wireless ad hoc networks

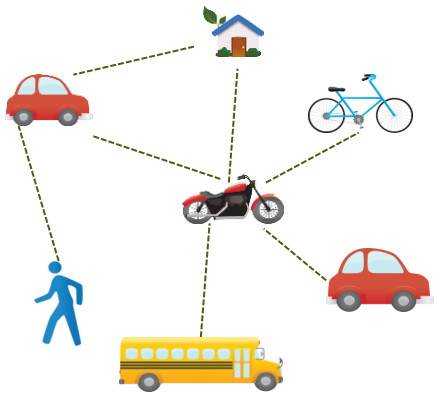
Find an alternative for information flow in the absence of infrastructure.

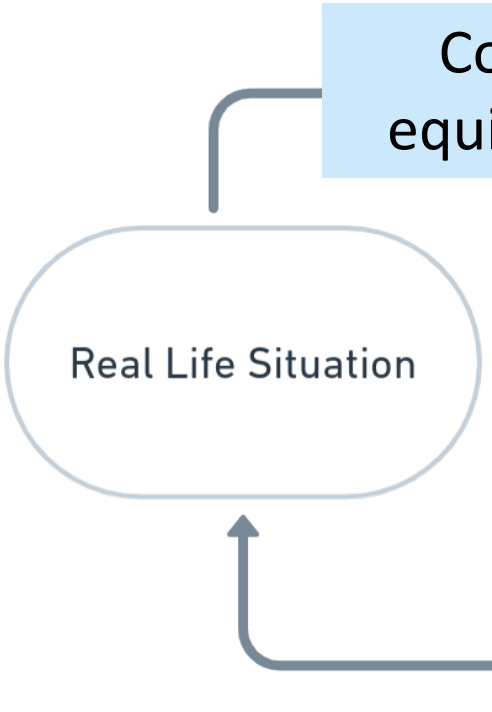
Human Mobility

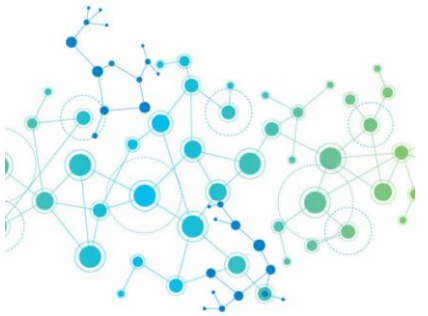


Human Mobility

To improve the flow of information and make communication more adaptive:







Goal

Wireless technologies used to study human mobility:

- WiFi probles
- BLE beacons
- Cellular network data, etc.

Combination

Short Range

Long Range

New insights

The aim is to collect wireless data as much as possible at the same time.

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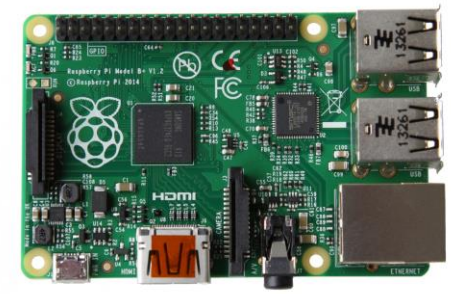
Hardware

Get wireless data → Limited by hardware capabilities/services



Raspberry pi

Arduino

ESP32

FiPy - Pycom

WiFi

Bluetooth

SigFox

LTE

LoRa

Implementation

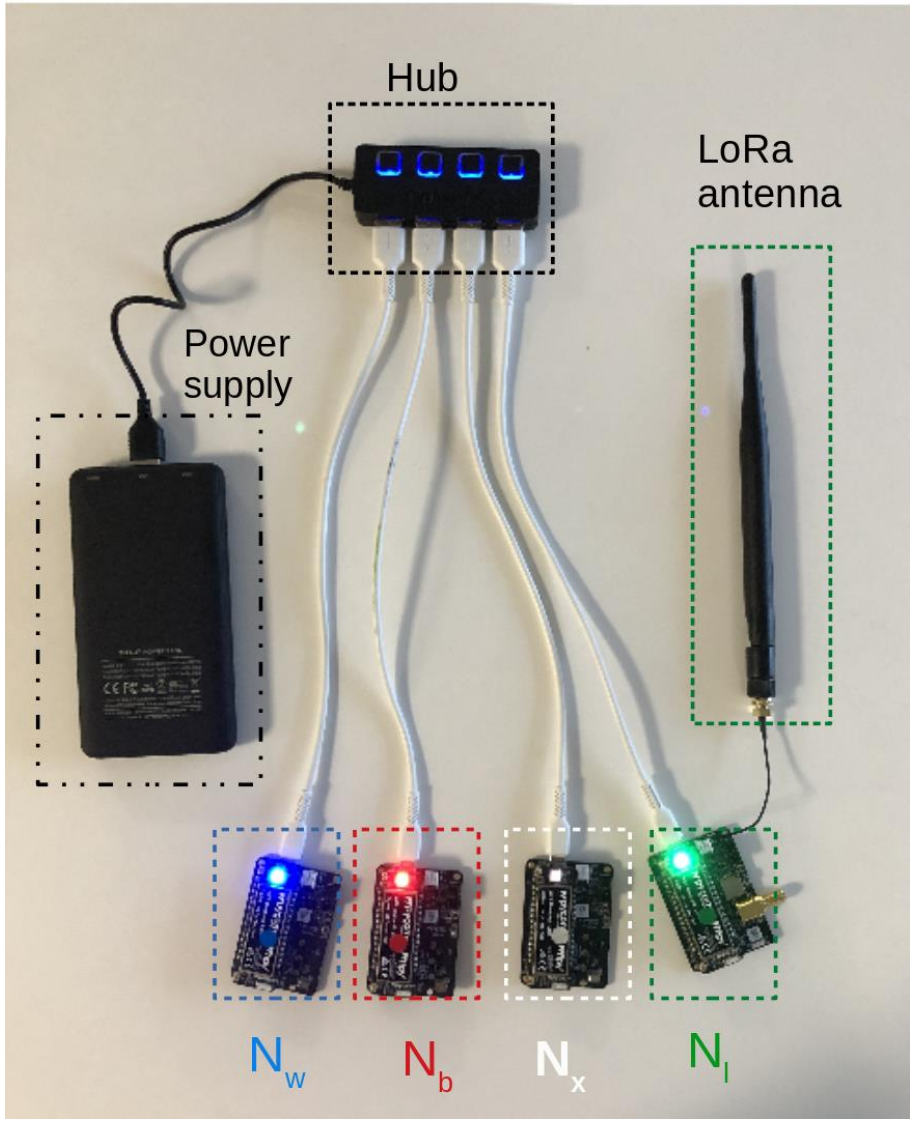
WiFi

BLE

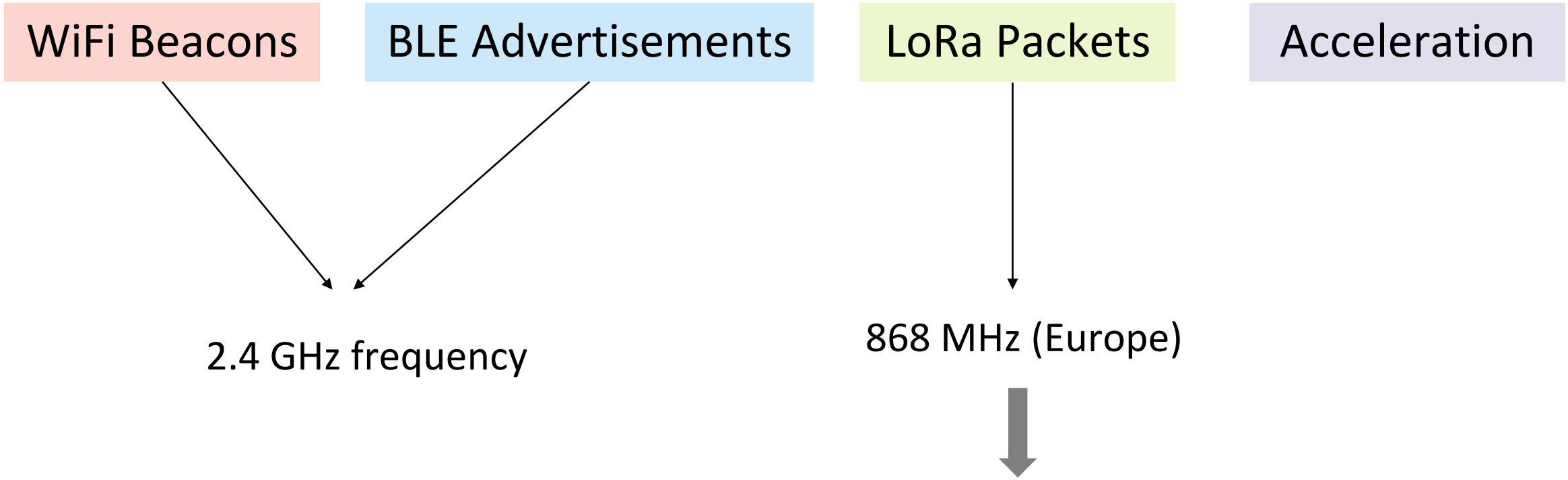
LoRa

Acc

Final set-up

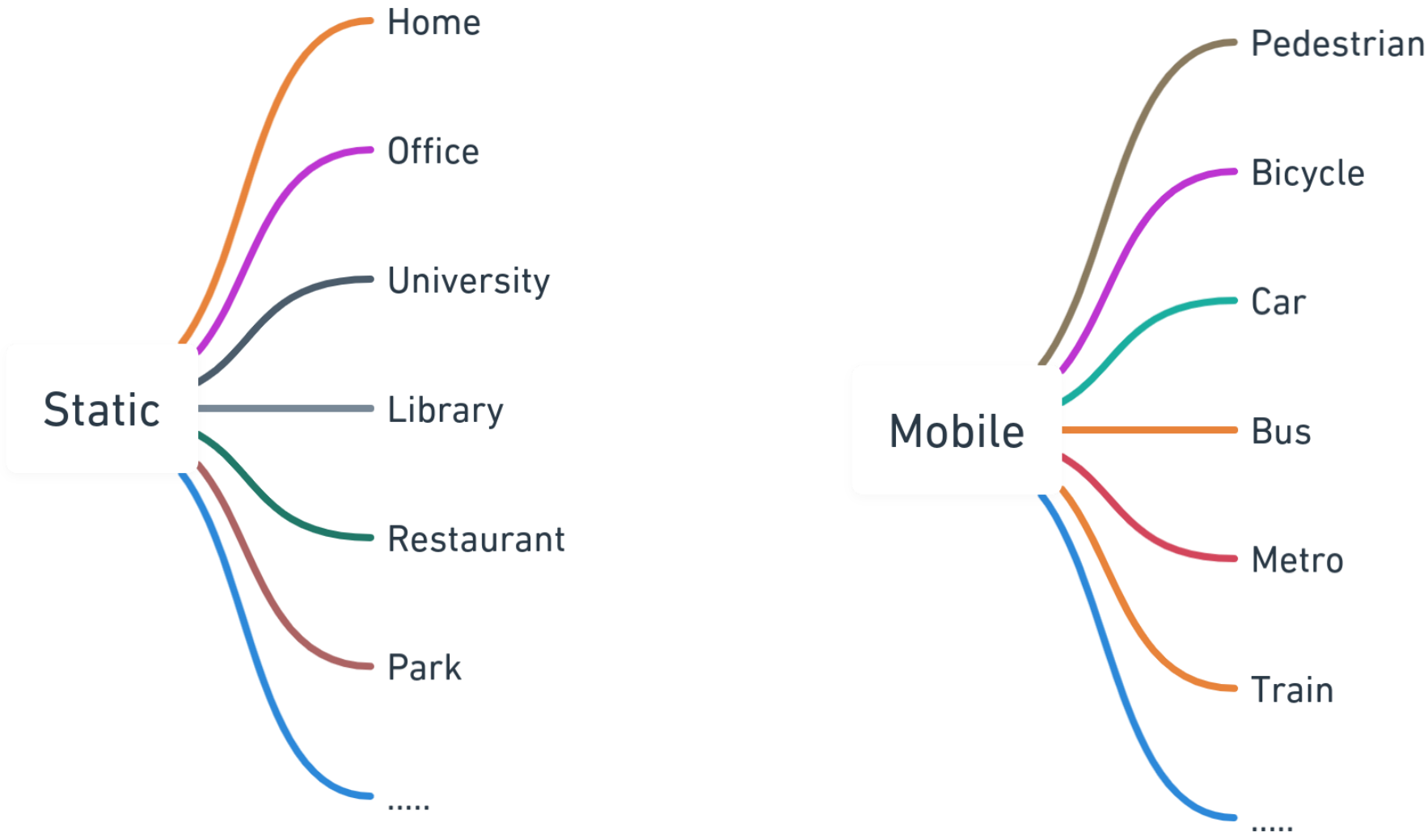


Scanning Configuration

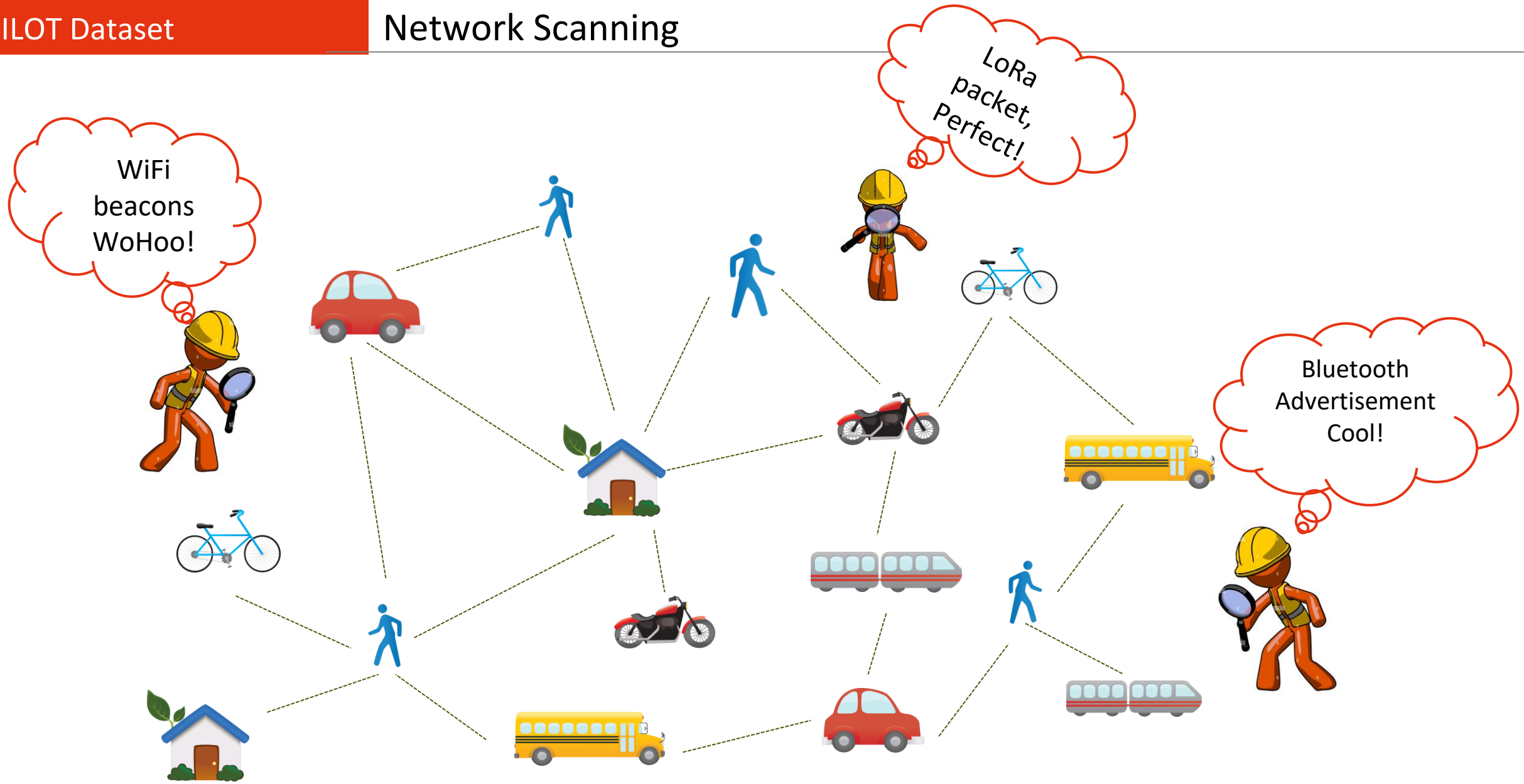


The LoRa device listens to different frequencies and switch between them every second. [**863000000, 864000000, 865000000, 866000000, 867000000, 868000000, 869000000, 864862500, 865062500, 865402500, 865602500, 865985000, 866200000, 866400000, 866600000**].

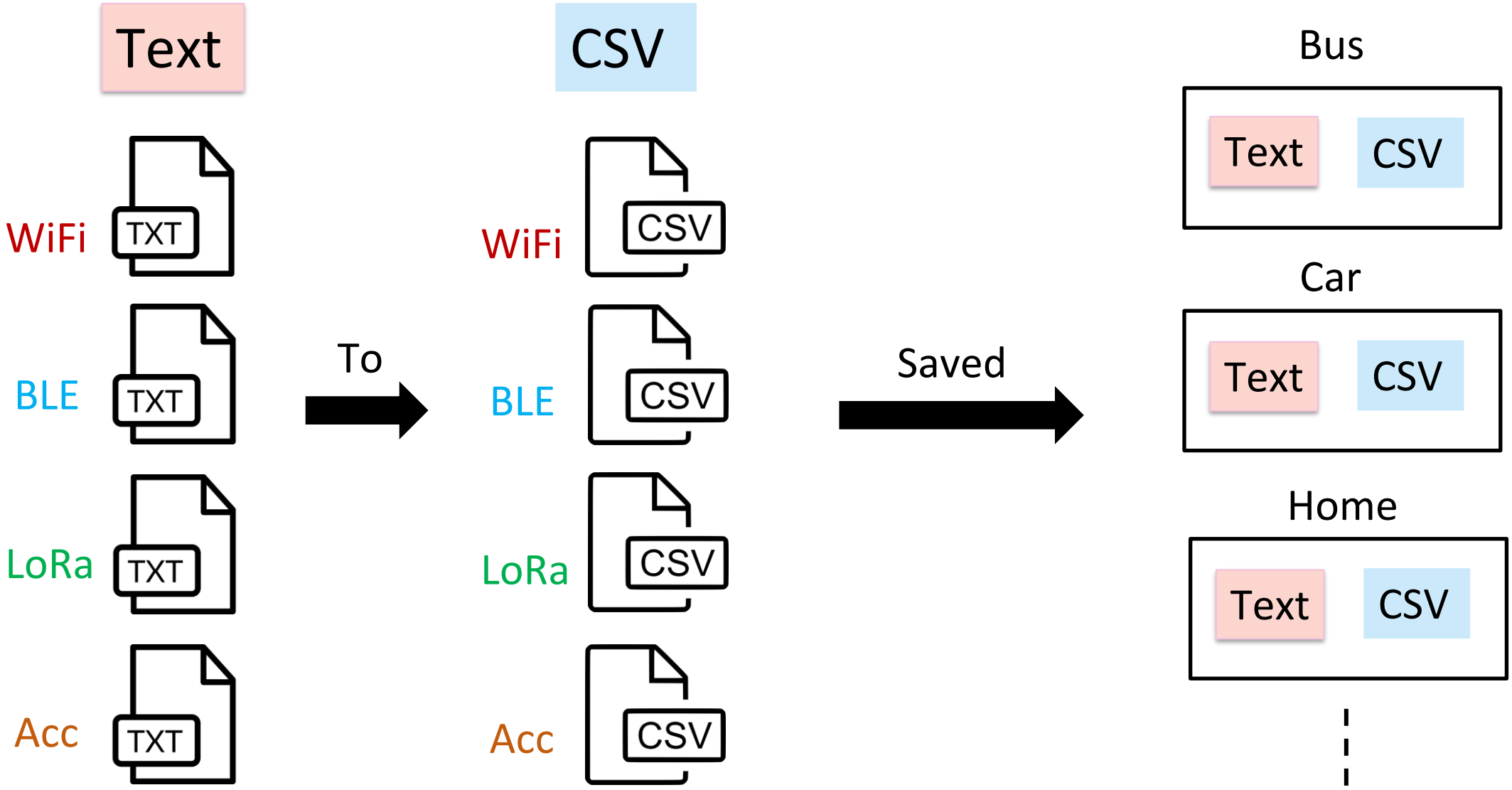
Scenarios


Static
Home
Office
University
Library
Restaurant
Park
.....
Mobile
Pedestrian
Bicycle
Car
Bus
Metro
Train
.....

Network Scanning



Retrieved Data from SD cards



WiFi

```
2022-06-09 17:43:02: {'ssid':'edm', 'bssid':b'<Q\...\xa0', 'sec':5, 'channel':1, 'rssi':-66}
2022-06-09 17:43:02: {'ssid':'guest', 'bssid':b'<Q\...\xa2', 'sec':0, 'channel':1, 'rssi':-66}
2022-06-09 17:43:04: {'ssid':'IA', 'bssid':b'<Q\...\x84#', 'sec':0, 'channel':6, 'rssi':-83}
2022-06-09 17:43:04: {'ssid':'IA-intr', 'bssid':b'<Q\...\x84$', 'sec':5, 'channel':6, 'rssi':-83}
2022-06-09 17:43:06: {'ssid':'IA-guest', 'bssid':b'<Q\...\xa2', 'sec':0, 'channel':1, 'rssi':-64}
2022-06-09 17:43:06: {'ssid':'edm', 'bssid':b'<Q\...\xa0', 'sec':5, 'channel':1, 'rssi':-65}
```

LoRa Log

LoRa

```
2022-07-06 12:16:06:
        {'spreading_factor': 7, 'data': b'V\xcd\xc4&{\xd3\x9a\x14', 'frequency': 869000000, 'bandwidth': 0}
        {'rx_timestamp':1735434803, 'rssi':-124, 'snr':-12.0, 'sfrx':7, 'sftx':0, 'tx_trials':0, 'tx_power':14,
        'tx_time_on_air':0, 'tx_counter':0, 'tx_frequency':0}
2022-07-06 12:16:08:
        {'spreading_factor': 7, 'data': b'', 'frequency': 864862500, 'bandwidth': 0}
        {'rx_timestamp':1735434803, 'rssi':-124, 'snr':-12.0, 'sfrx':7, 'sftx':0, 'tx_trials':0, 'tx_power':14,
        'tx_time_on_air':0, 'tx_counter':0, 'tx_frequency':0}
2022-07-06 12:16:10:
        {'spreading_factor': 7, 'data': b'', 'frequency': 865062500, 'bandwidth': 0}
        {'rx_timestamp':1735434803, 'rssi':-124, 'snr':-12.0, 'sfrx':7, 'sftx':0, 'tx_trials':0, 'tx_power':14,
        'tx_time_on_air':0, 'tx_counter':0, 'tx_frequency':0}
2022-07-06 12:16:12:
        {'spreading_factor': 7, 'data': b'', 'frequency': 865402500, 'bandwidth': 0}
        {'rx_timestamp':1735434803, 'rssi':-124, 'snr':-12.0, 'sfrx':7, 'sftx':0, 'tx_trials':0, 'tx_power':14,
        'tx_time_on_air':0, 'tx_counter':0, 'tx_frequency':0}
```

BLE and Acceleration Logs

BLE

2022-06-09 17:43:02: {'adv_flag': None, 'def_tx_pwr': 3, 'mac': b'26...8d', 'rssi': -75, 'name': None, 'scan_tx_pwr': 3, 'conn_tx_pwr': 64, 'tx_range': None, 'adv_tx_pwr': 3}
2022-06-09 17:43:03: {'adv_flag': None, 'def_tx_pwr': 3, 'mac': b'26...8d', 'rssi': -81, 'name': None, 'scan_tx_pwr': 3, 'conn_tx_pwr': 64, 'tx_range': None, 'adv_tx_pwr': 3}
2022-06-09 17:43:04: {'adv_flag': None, 'def_tx_pwr': 3, 'mac': b'26....8d', 'rssi': -85, 'name': None, 'scan_tx_pwr': 3, 'conn_tx_pwr': 64, 'tx_range': None, 'adv_tx_pwr': 3}
2022-06-09 17:43:05: {'adv_flag': None, 'def_tx_pwr': 3, 'mac': b'26...8d', 'rssi': -84, 'name': None, 'scan_tx_pwr': 3, 'conn_tx_pwr': 64, 'tx_range': None, 'adv_tx_pwr': 3}
2022-06-09 17:43:05: {'adv_flag': None, 'def_tx_pwr': 3, 'mac': b'267...8d', 'rssi': -72, 'name': None, 'scan_tx_pwr': 3, 'conn_tx_pwr': 64, 'tx_range': None, 'adv_tx_pwr': 3}
2022-06-09 17:43:06: {'adv_flag': None, 'def_tx_pwr': 3, 'mac': b'267...8d', 'rssi': -69, 'name': None, 'scan_tx_pwr': 3, 'conn_tx_pwr': 64, 'tx_range': None, 'adv_tx_pwr': 3}

Acceleration

2022-06-09 17:43:02: {'Acceleration': '(0.2675781, -0.1103516, 0.9726563)', 'Roll': '-15.3816', 'battery_voltage': 4.556237, 'battery_percentage': 88.95696, 'Pitch': '6.242762'}
2022-06-09 17:43:03: {'Acceleration': '(0.2646484, -0.1101074, 0.9729004)', 'Roll': '-15.2174', 'battery_voltage': 4.556237, 'battery_percentage': 88.95696, 'Pitch': '6.232354'}
2022-06-09 17:43:03: {'Acceleration': '(0.2667236, -0.1104736, 0.9689941)', 'Roll': '-15.39001', 'battery_voltage': 4.561255, 'battery_percentage': 89.45872, 'Pitch': '6.23429'}
2022-06-09 17:43:04: {'Acceleration': '(0.2658691, -0.1096191, 0.9736328)', 'Roll': '-15.44312', 'battery_voltage': 4.566273, 'battery_percentage': 89.96055, 'Pitch': '6.285924'}
2022-06-09 17:43:05: {'Acceleration': '(0.2670898, -0.1098633, 0.9730225)', 'Roll': '-15.44367', 'battery_voltage': 4.556237, 'battery_percentage': 88.95696, 'Pitch': '6.236812'}
2022-06-09 17:43:06: {'Acceleration': '(0.2672119, -0.1097412, 0.9681396)', 'Roll': '-15.4298', 'battery_voltage': 4.556237, 'battery_percentage': 88.95696, 'Pitch': '6.260544'}

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WiFi - Office

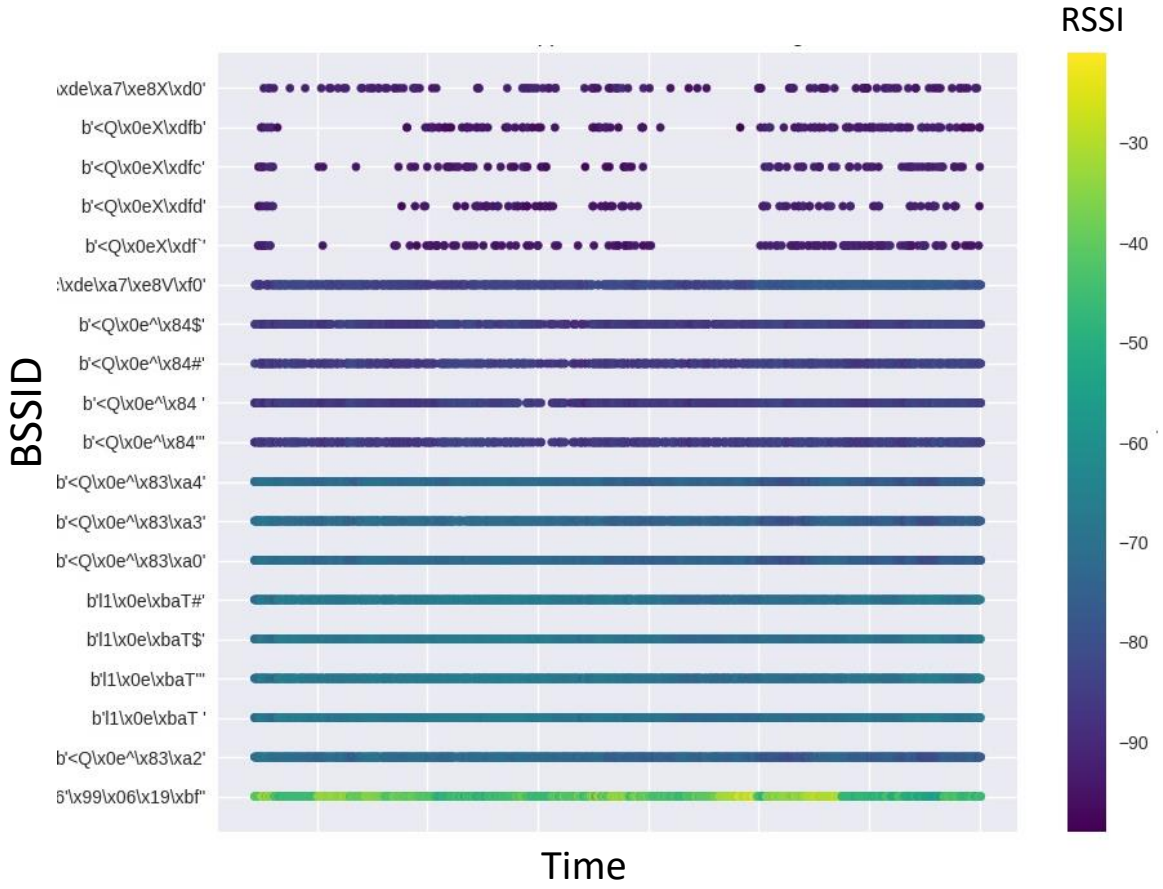


Fig 1: WiFi AP appeared in office monitoring

WiFi - Bus

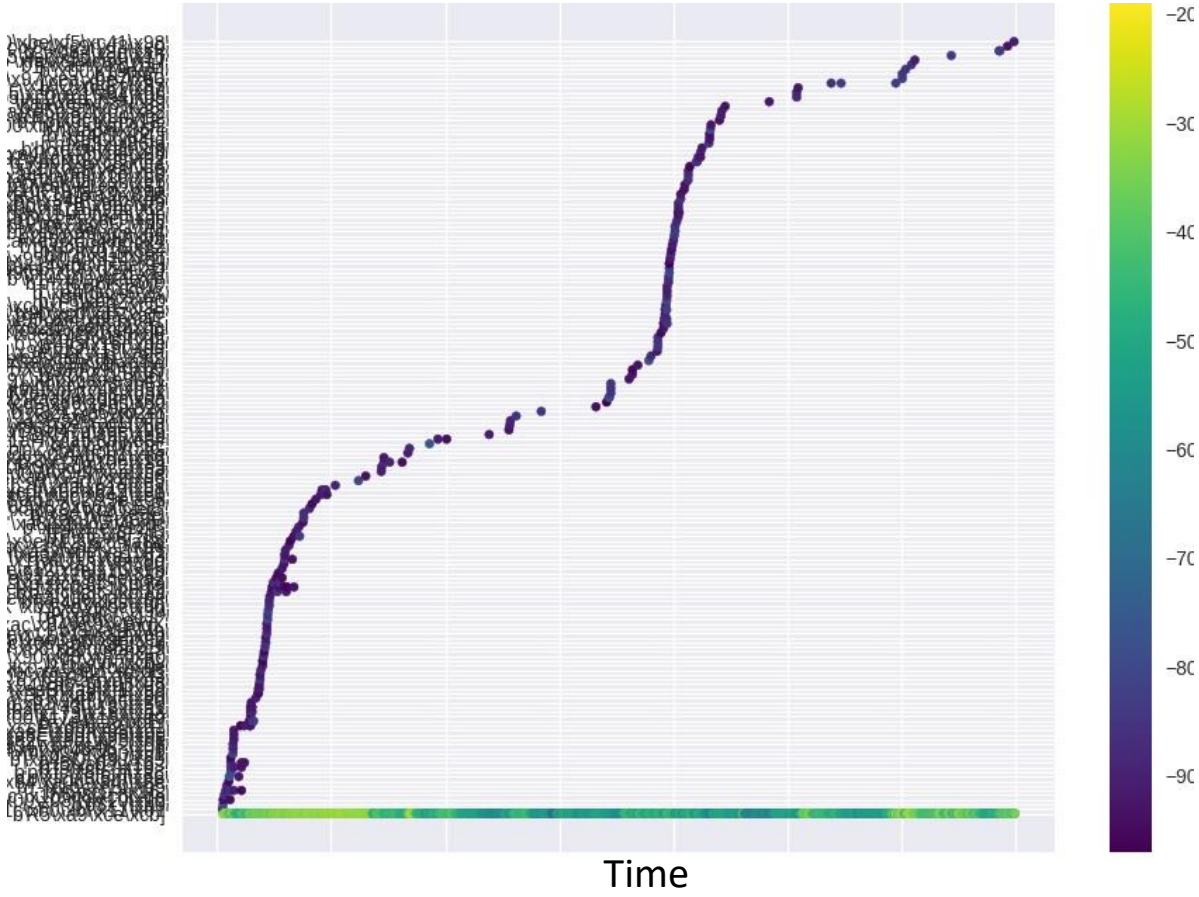


Fig 2: WiFi AP appeared in Bus monitoring

WiFi Observation

WiFi - Car

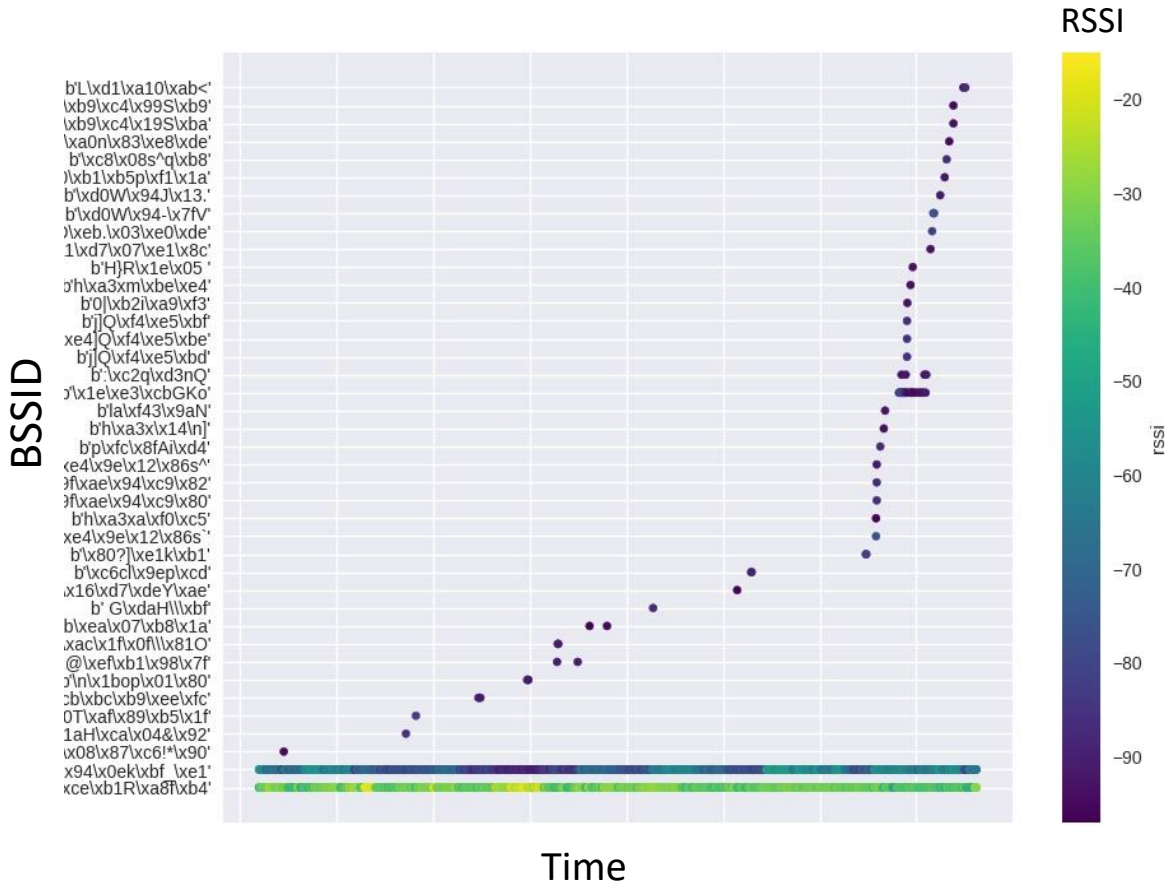


Fig 3: WiFi AP appeared in Car monitoring

WiFi - Train

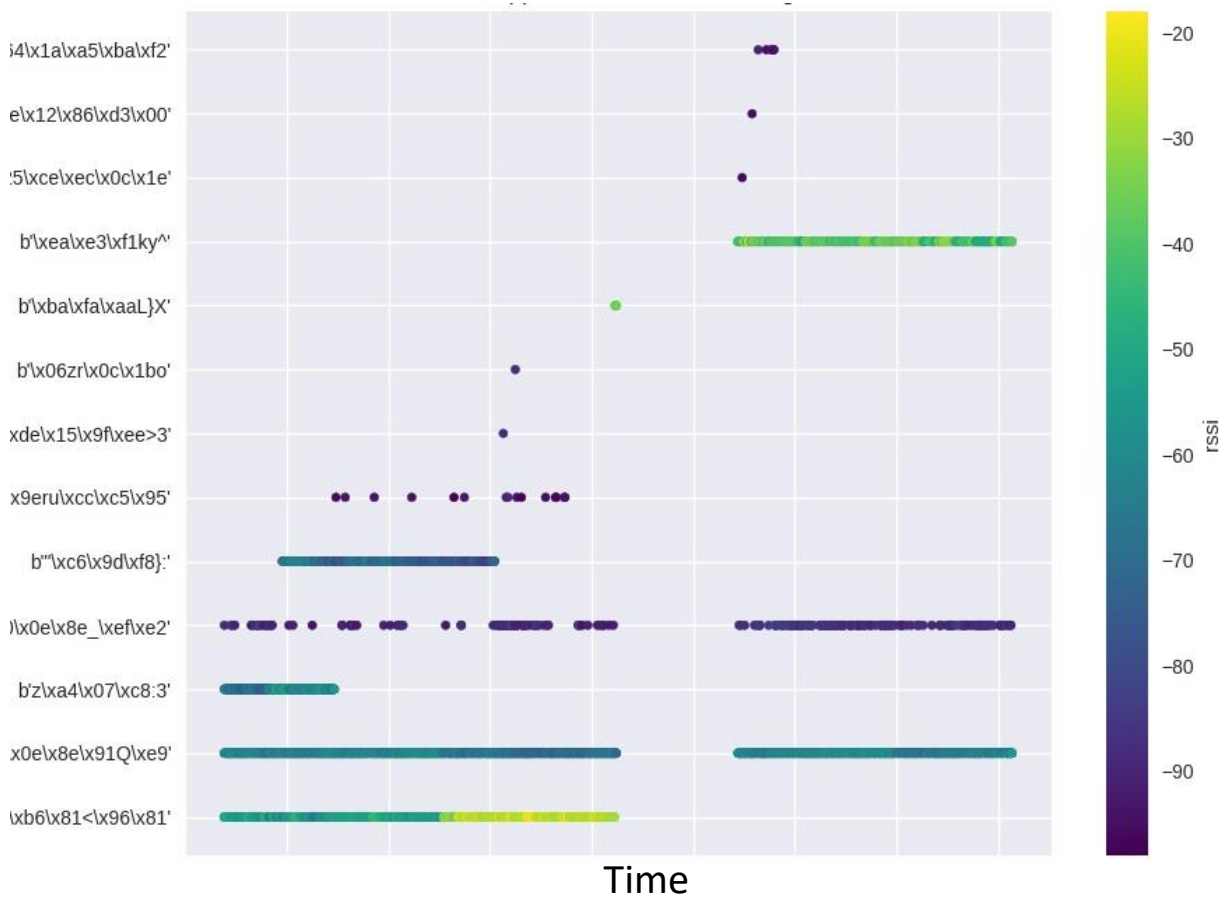


Fig 4: WiFi AP appeared in Train monitoring

Packet Loss!

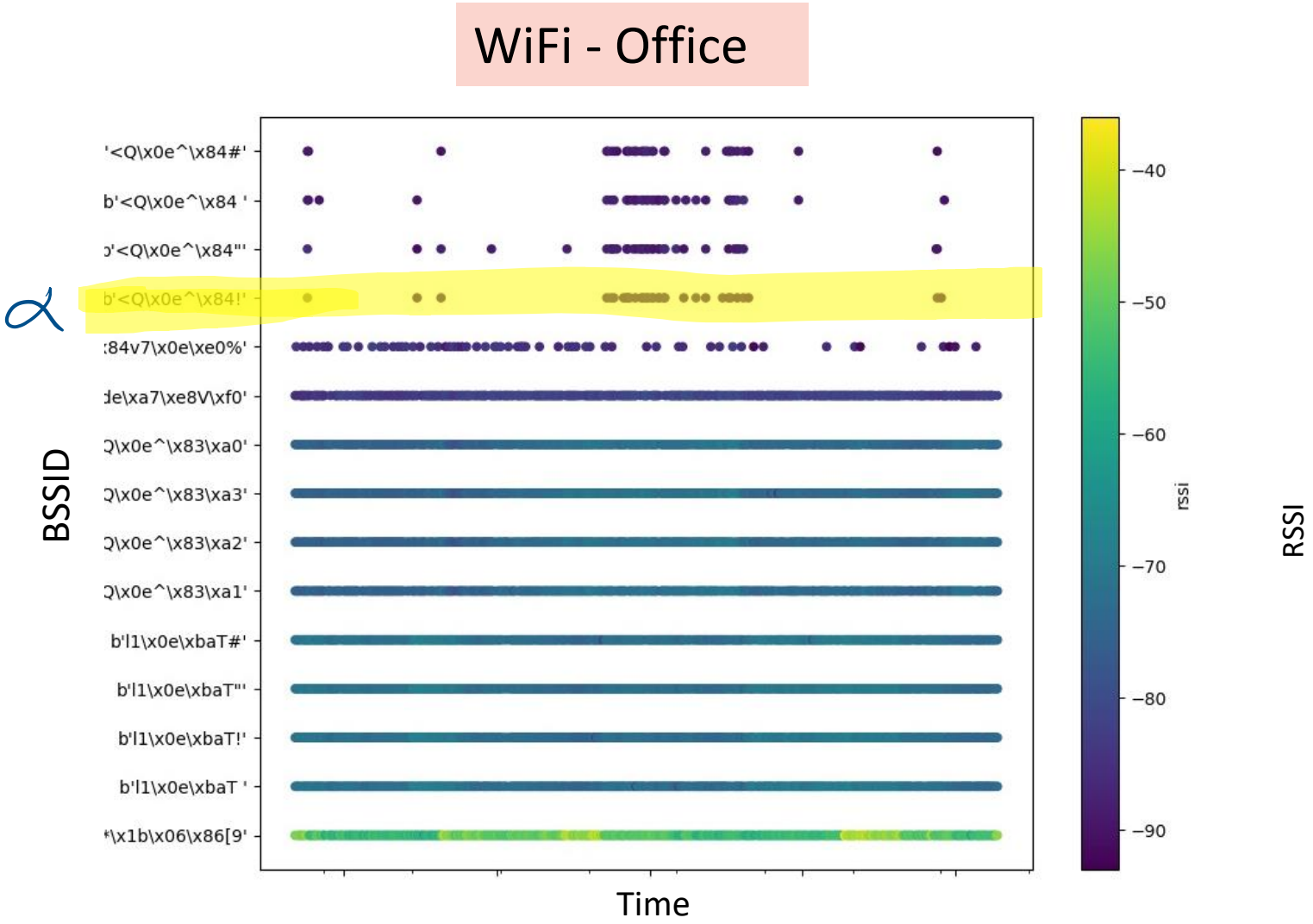


Fig 1: WiFi AP appeared in office monitoring

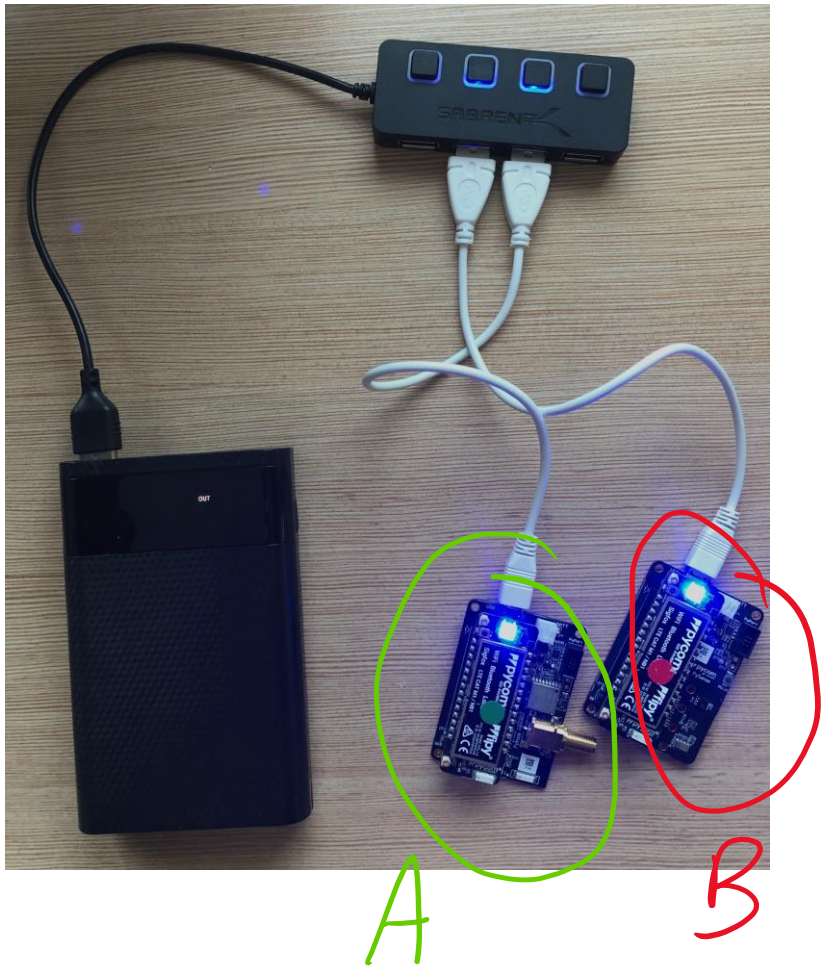
Effect of Dwell Time

Check the configuration → Dwell Time = 20 ms

Represents the scanning time on each channel to listen for packets.

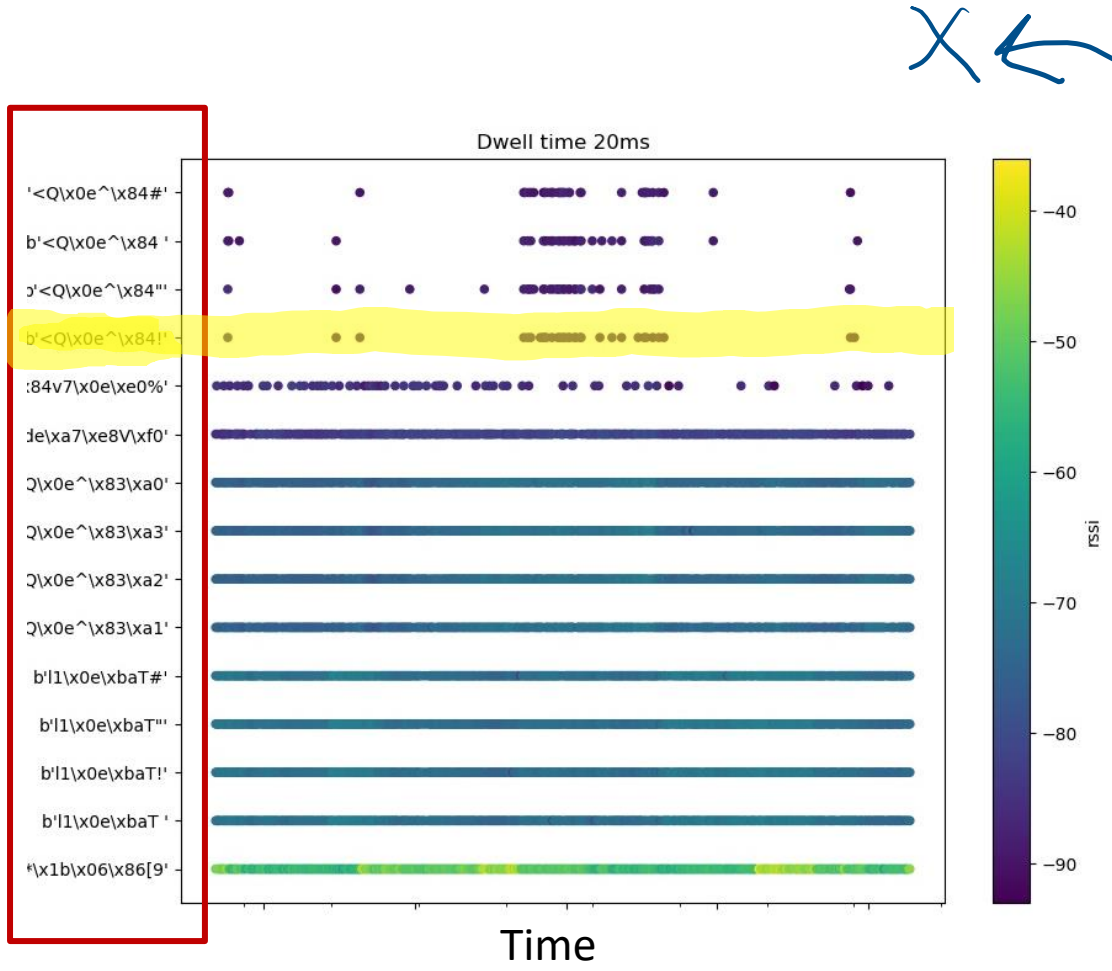
Node A: Scanning on 2.4GHz frequency with **20 ms** dwell time on each channel

Node B: Scanning on 2.4GHz frequency with **120 ms** dwell time on each channel



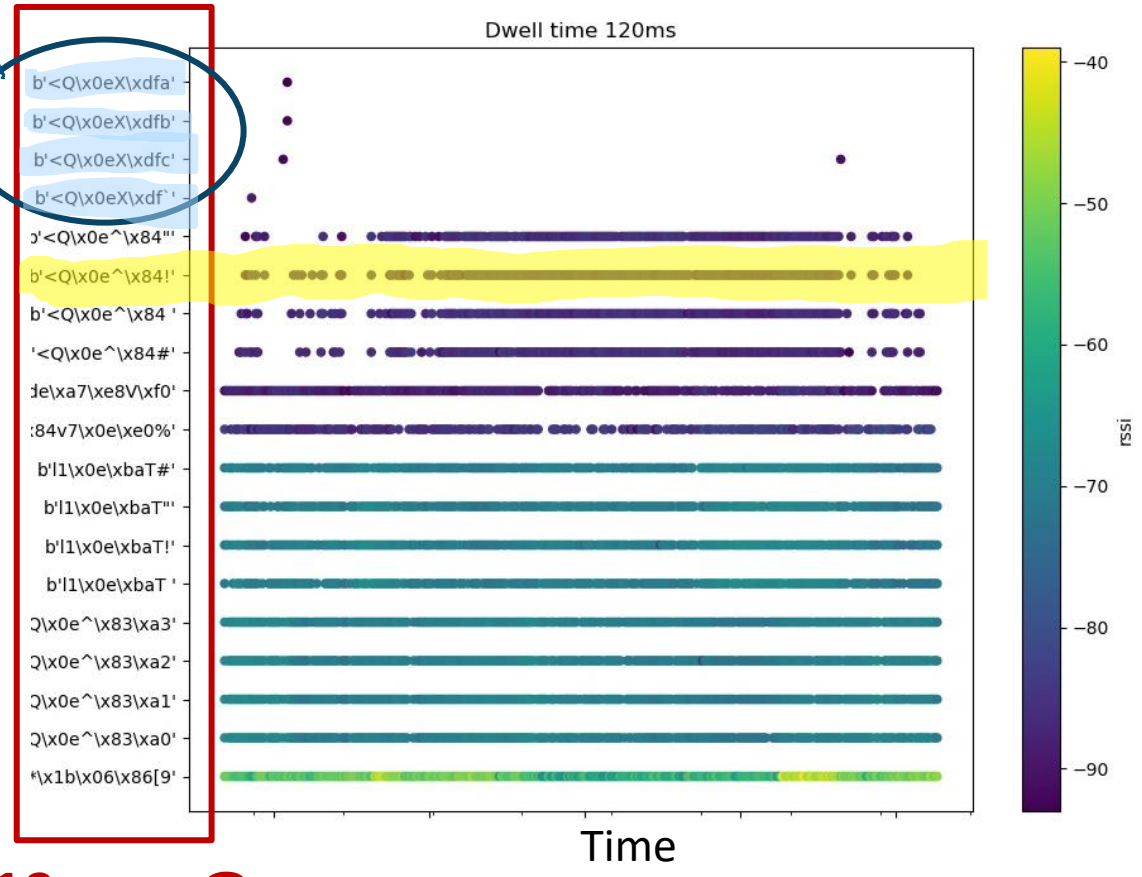
Both nodes are scanning at the same time for 23 minutes

Effect of Dwell Time



15 mac @

Fig 1: Node A - 20 ms



19 mac @

Fig 2: Node B - 120 ms

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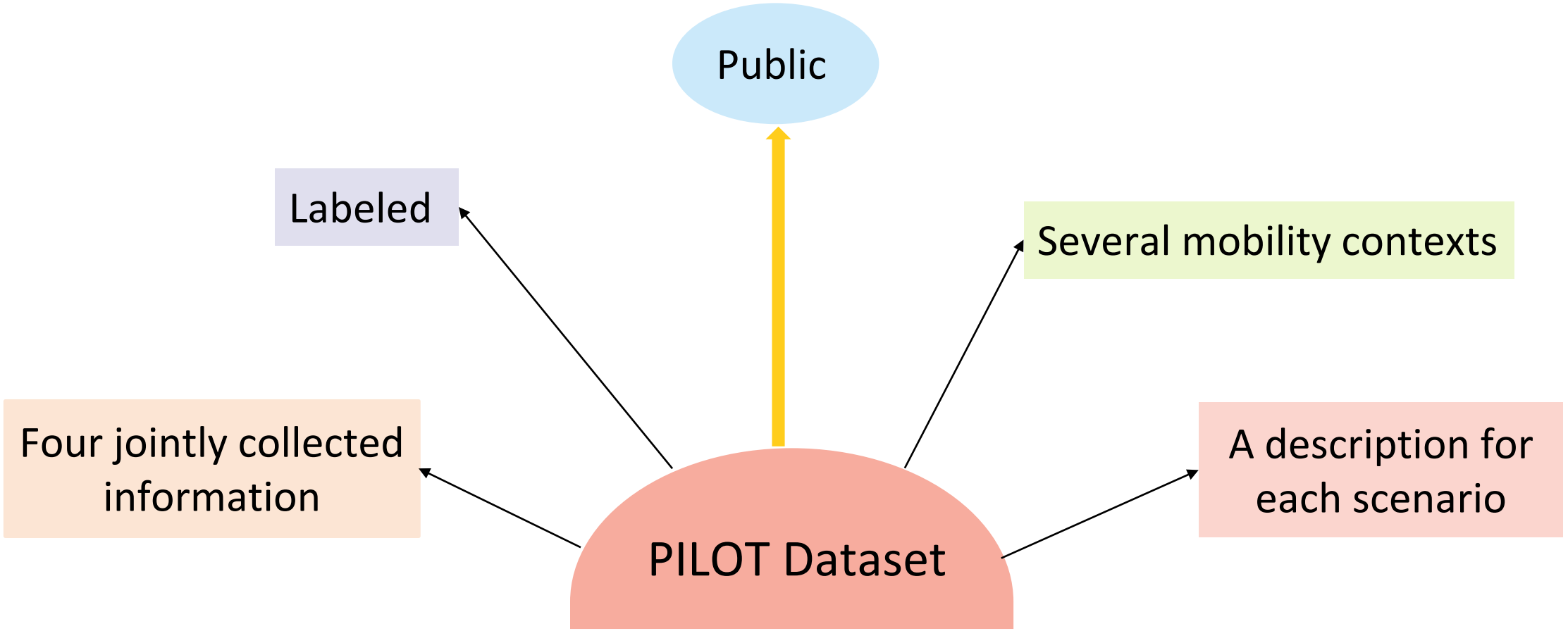
Summary

The dataset collected for approximately 70 hours, with a size around 170 MB



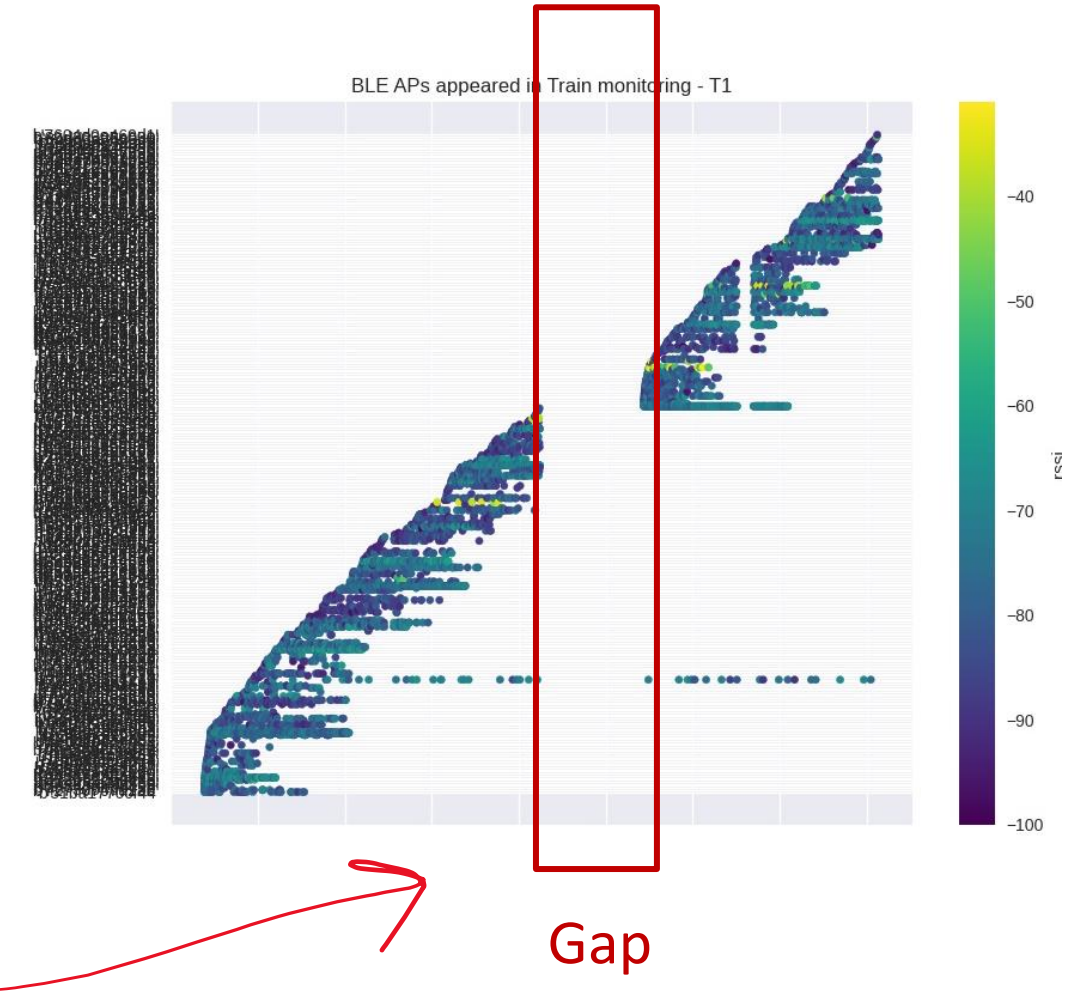
Challenges

Hardware challenges

RTC syncronization

Corrupted SD card

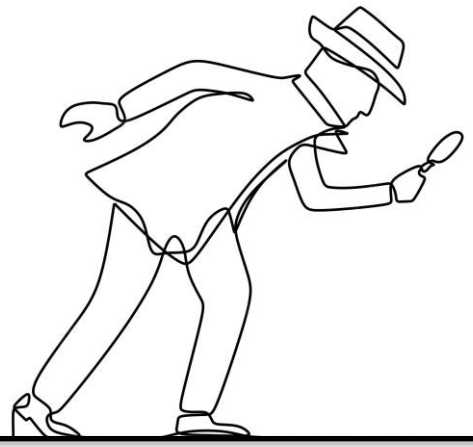
Device disconnected/ Reboots



Future Work

Work in progress and future plan:

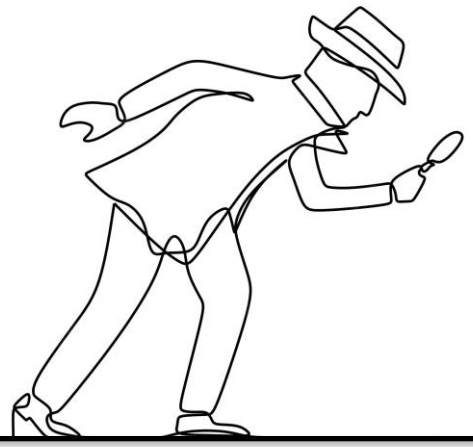
- Enrich the dataset
- Scan for more scenarios
- Select a specific mobility model to collect real data
- Investigate in the open issues (LoRa, Packet loss)
- Create a machine learning model to guess the flow of network or the mobility context of devices.



Data, Data, Data!

I cannot make bricks without clay.

- Sherlock Holmes



Data, Data, Data!

I cannot make bricks without clay.

- Sherlock Holmes

Thanks for Listening!

Email: jana.koteich@inria.fr

GitHub: https://github.com/Janakoteich/PILOT-Dataset-Collection-of-Multi-communication-Technologies

Inria