BL(u)E CRAB:

RSSI Detection Pattern Analysis for Flagging System Development

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Bluetooth Low Energy (BLE)

- Smaller devices that use battery and are often portable
- Virtually all laptops, tablet computers, computer printers and cellphones now have 802.11 wireless modems using the 2.4 and 5.7 GHz ISM bands.
- Transfers small pieces of information to connect as a part of the Internet of things
- Not compatible with Bluetooth classic rather they connect with a device with both types to relay information. Cellphones have both and can act as the connection
- Smart home, Fitness device, **GPS replacement**
- Line of sight 50 m
- New feature of Bluetooth 5 now the range is up to 800 m

What is the Threat?

Stalking

- Making unwanted and persistent phone calls
- Approaching or showing up in places uninvited
- Following and watching the person
- Sending unwanted texts, emails, and social media messages
- Delivering unwanted gifts
- Utilizing technology for monitoring and tracking

What is the Threat?

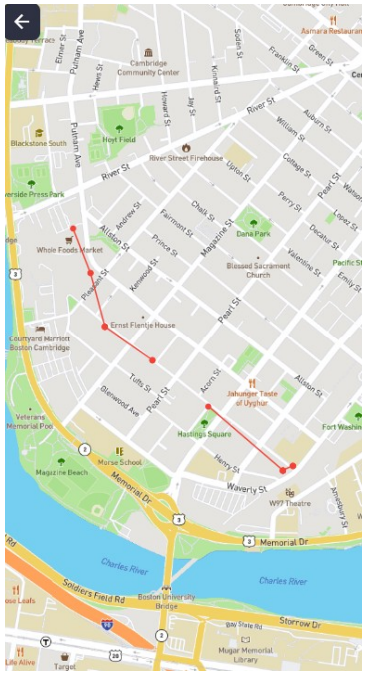
- Utilizing technology for monitoring and tracking
- Technology improvements has transformed the landscape of stalking, with more than twice as many victims being stalked through digital means compared to traditional methods.

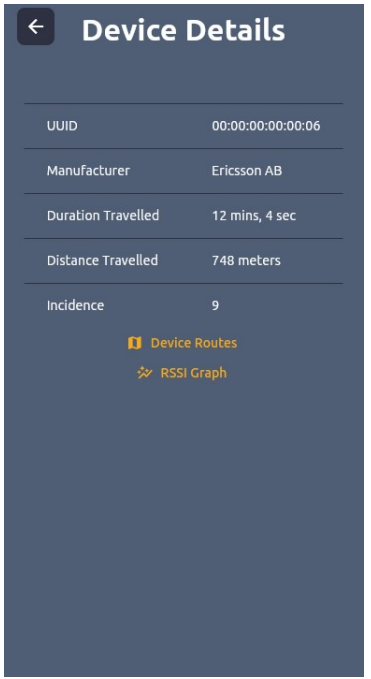
BL(u)E CRAB

- It can be used across many platforms
- Scans for BLE nearby
- Assesses device risk by z-score to grade each
- And displays information like device mac address
- Logs device info

Information log

- location
- time
- RSSI





What is this?

Received Signal Strength Indicator

As the name suggests, it is an indication of the strength level received in radio signals. the greater the RSSI value, the stronger the signal. In this case the focus is on BLE device transmissions

Question

How does the RSSI values differ for suspicious and non-suspicious devices?

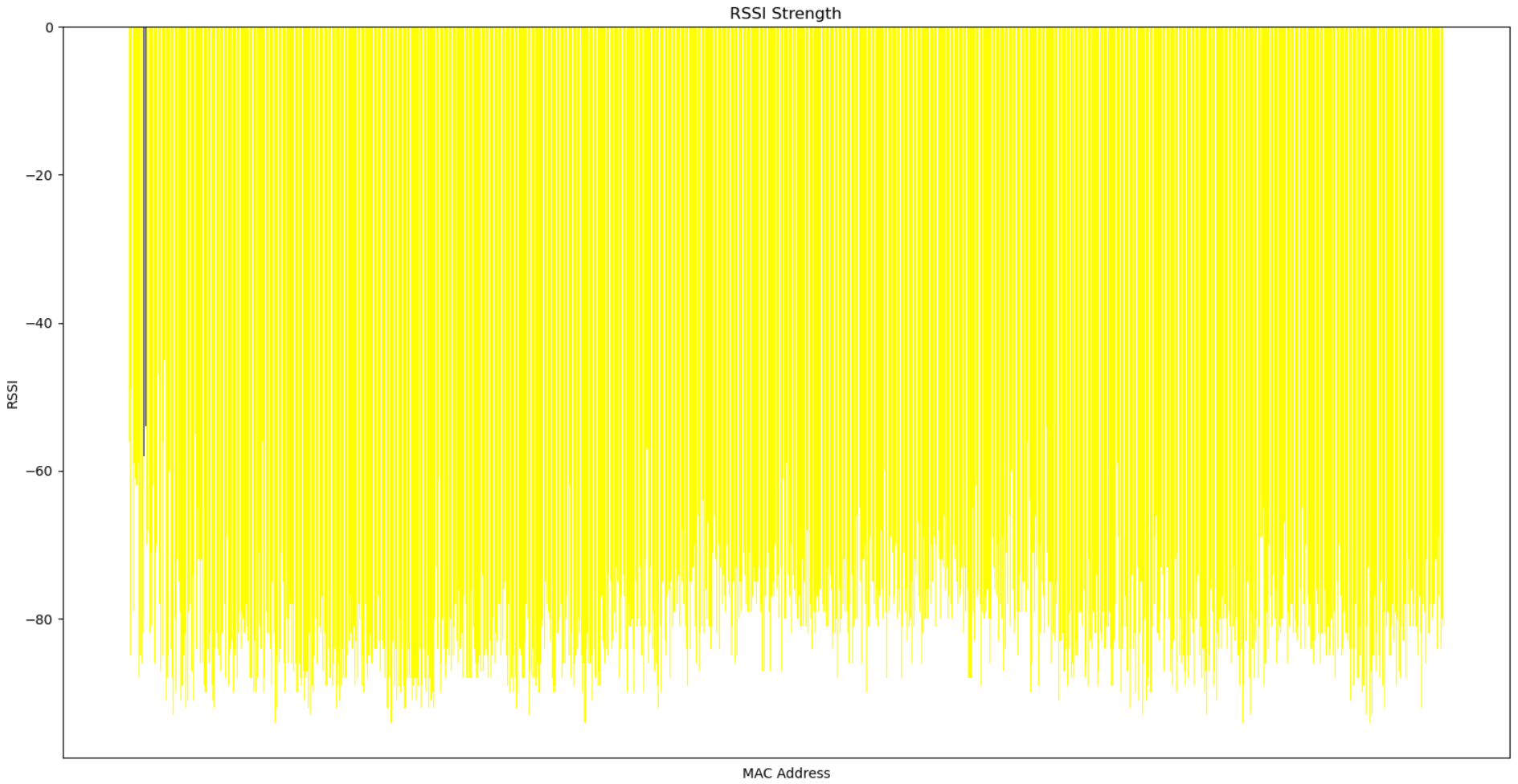
- Are they correlated?
- Is there a pattern throughout?

Reading the data

- The data analyzed is from BLE-Doubt a open-source Android
- application
- json
-

	Movement	Location
A	Walking	Backpack
B	Walking	Backpack
C	Walking	Pockets
D	Walking	Pockets
E	Car	Car
F	Jogging	Backpack
G	Walking	Backpack
H	Walking	Backpack
I	Train	Backpack
J	Train	Backpack
K	Walking	Pockets
L	Walking	Pockets
M	Train	
N	Car	Car

Graph



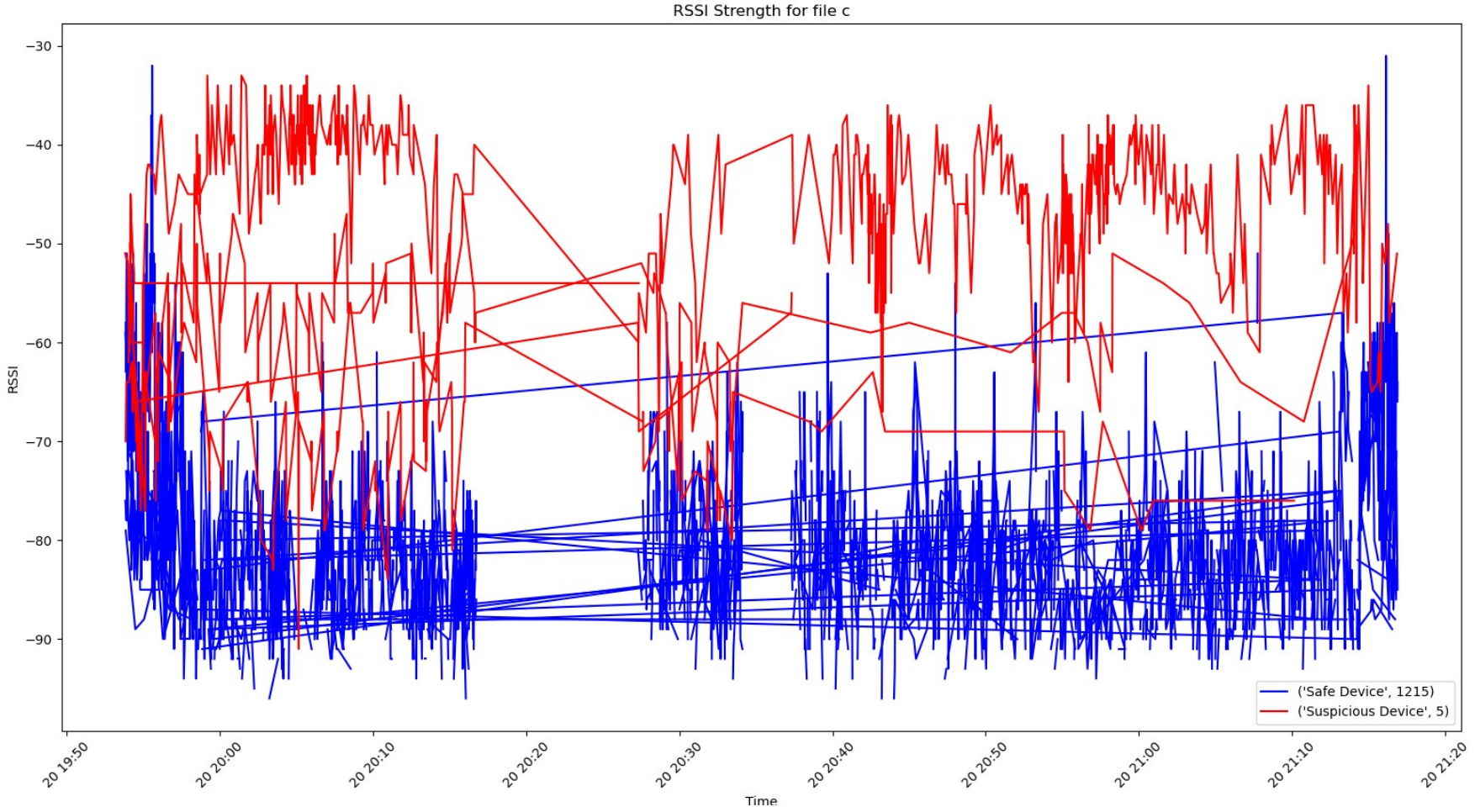
Graph

Wait. What is this?

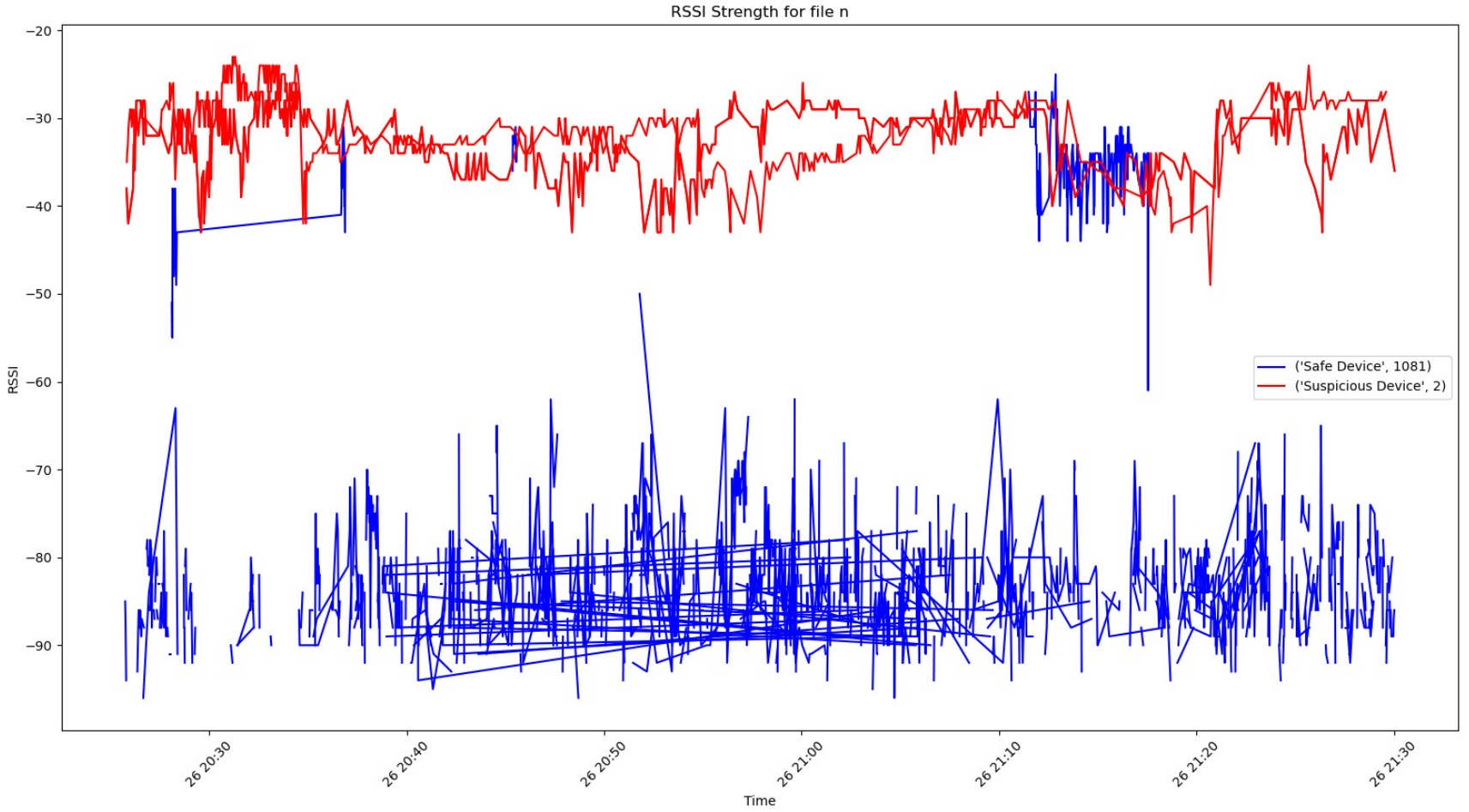
Identifying each mac id

```
36  def sort():
37      mac, rssi, time = make_rssi()
38      fmac = list(set(mac))
39      arssi = []
40      atime = []
41      for i in fmac:
42          r = []
43          t = []
44          for idx, e in enumerate(mac):
45              if i == e:
46                  r.append(rssi[idx])
47                  t.append(time[idx])
48          arssi.append(r)
49          atime.append(t)
```

Data file c


RSSI Strength for file c
RSSI
−30
−40
−50
−60
−70
−80
−90
20 19:50
20 20:00
20 20:10
20 20:20
20 20:30
20 20:40
20 20:50
20 21:00
20 21:10
20 21:20
Time
('Safe Device', 1215)
('Suspicious Device', 5)

Data file n


RSSI Strength for file n
RSSI
−20
−30
−40
−50
−60
−70
−80
−90
('Safe Device', 1081)
('Suspicious Device', 2)
26 20:30
26 20:40
26 20:50
26 21:00
26 21:10
26 21:20
26 21:30
Time

Significant time Detected

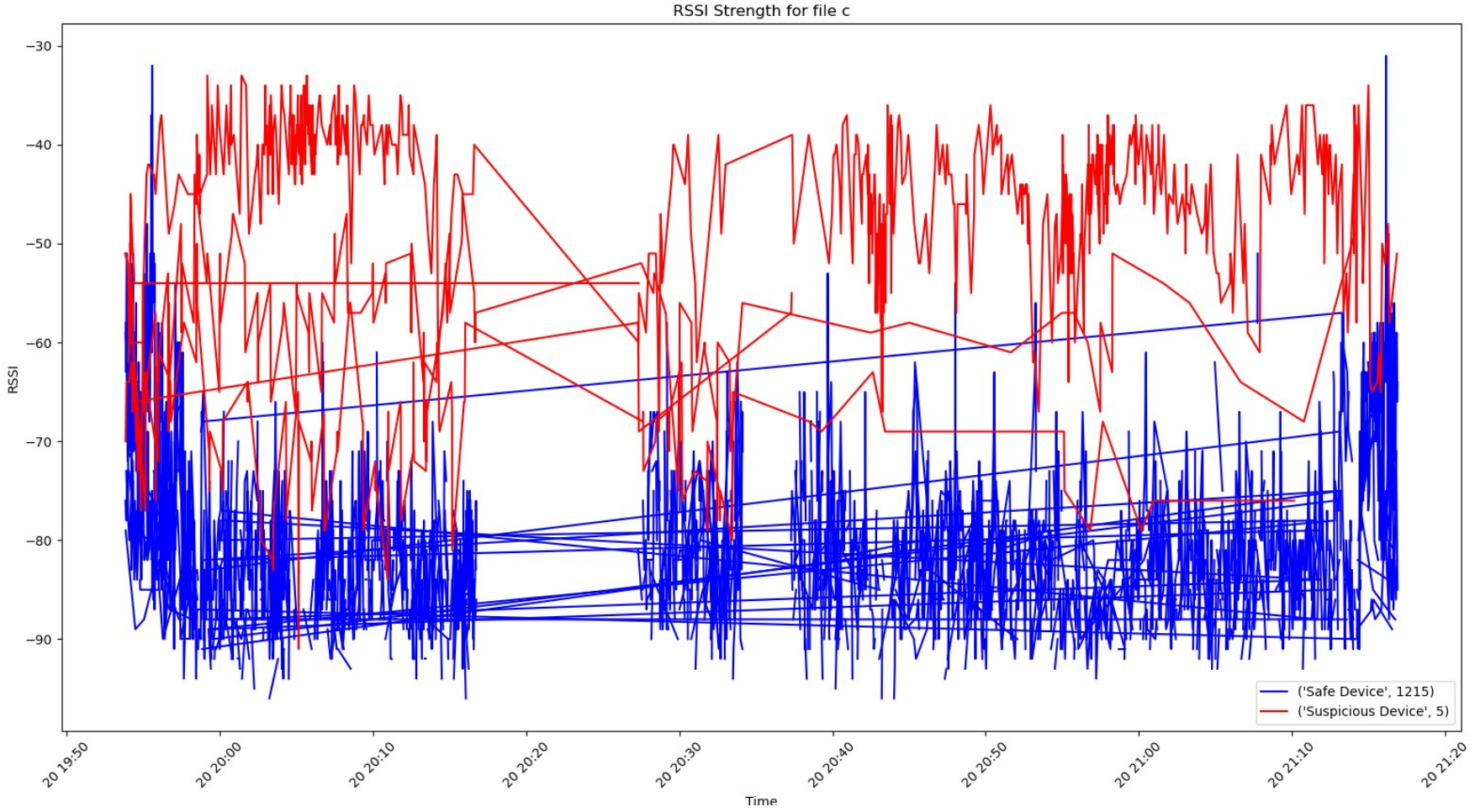
```
86      for a in macsafe:
87          idx = macsafe.index(a)
88          if len(timesafe[idx]) > 60:
89              labelsafe.append(a)
90              labelsafe_r.append(rssisafe[idx])
91              labelsafe_t.append(timesafe[idx])
92          else:
93              next
94      for a in macsus:
95          idx = macsus.index(a)
96          if len(timesus[idx]) > 60:
97              labelsus.append(a)
98              labelsus_r.append(rssisus[idx])
99              labelsus_t.append(timesus[idx])
100         else:
101             next
```

Setting threshold to 60 seconds

Plotting with different colors

```
130 #the colors were changed to be a lighter verson of the original colors
131     for i in range(len(macsafe)):
132         sorted_pairs = sorted(zip(timesafe[i], rssisafe[i]), key=lambda x: x[0])
133         timesafe_paired, rssisafe_paired = zip(*sorted_pairs)
134         plt.plot(timesafe_paired, rssisafe_paired, color="lightskyblue")
135
136 # specially plot significant devices with bold color
137     for i in range(len(labelsafe)):
138         sorted_pairs = sorted(zip(labelsafe_t[i], labelsafe_r[i]), key=lambda x: x[0])
139         timesafe_paired, rssisafe_paired = zip(*sorted_pairs)
140         plt.plot(timesafe_paired, rssisafe_paired, color = "blue")
141         plt.text(labelsafe_t[i][-1], labelsafe_r[i][-1], labelsafe[i], color="navy")
142
```

Data file c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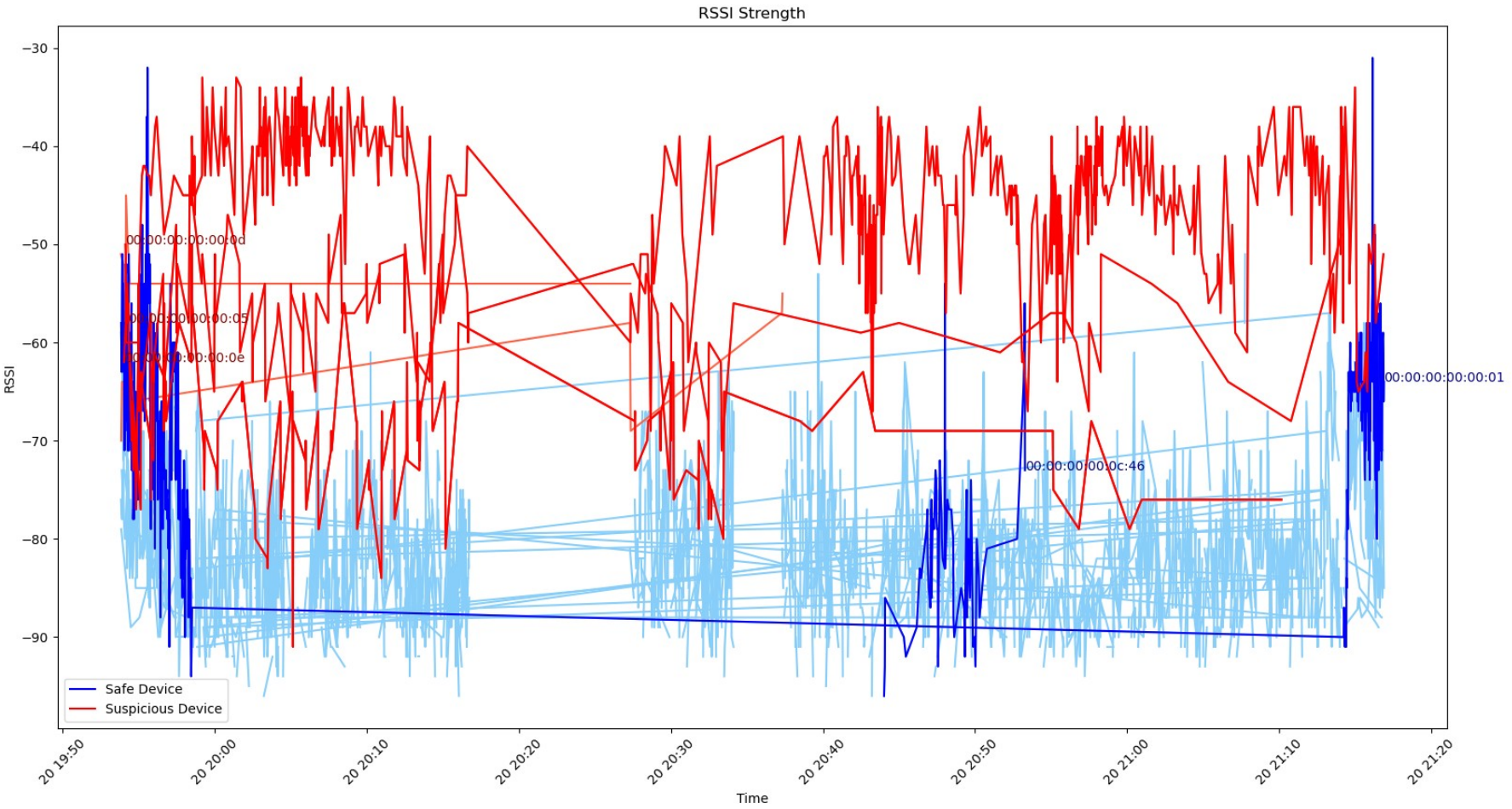
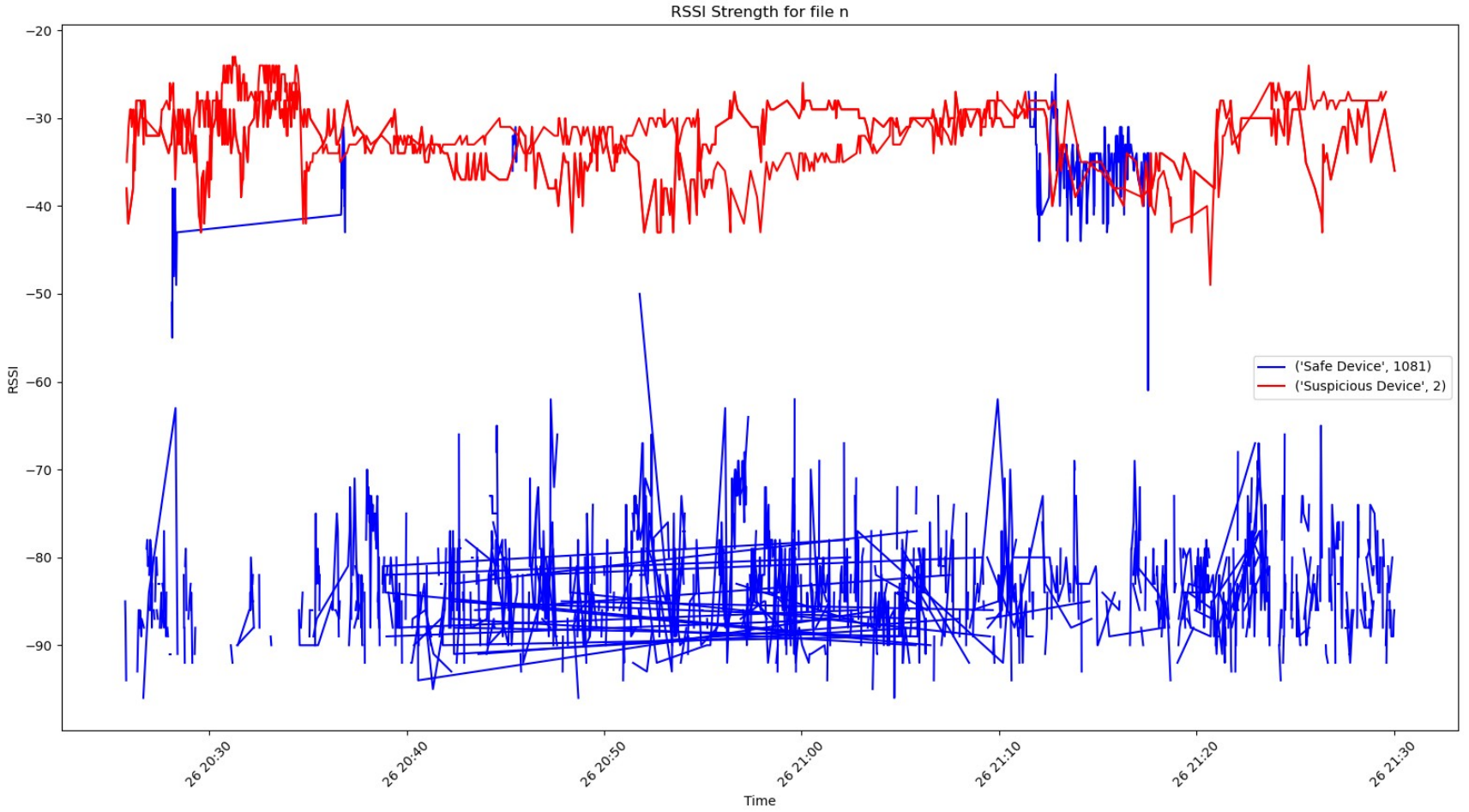
20 20:10
20 20:20
20 20:30
20 20:40
20 20:50
20 21:00
20 21:10
20 21:20
Time
('Safe Device', 1215)
('Suspicious Device', 5)

Data file c – long detection



Data file n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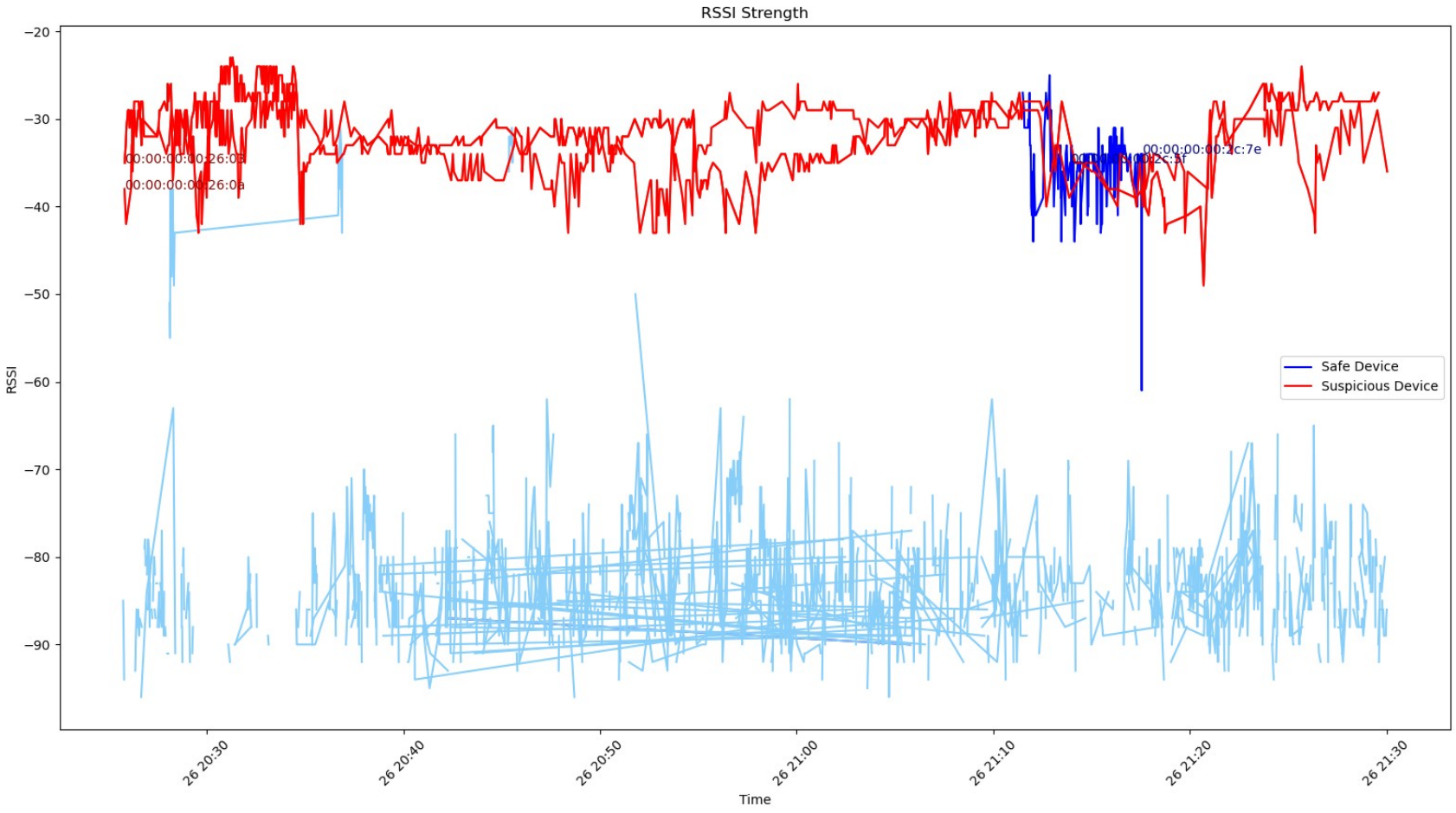
('Suspicious Device', 2)
26 20:30
26 20:40
26 20:50
26 21:00
26 21:10
26 21:20
26 21:30
Time

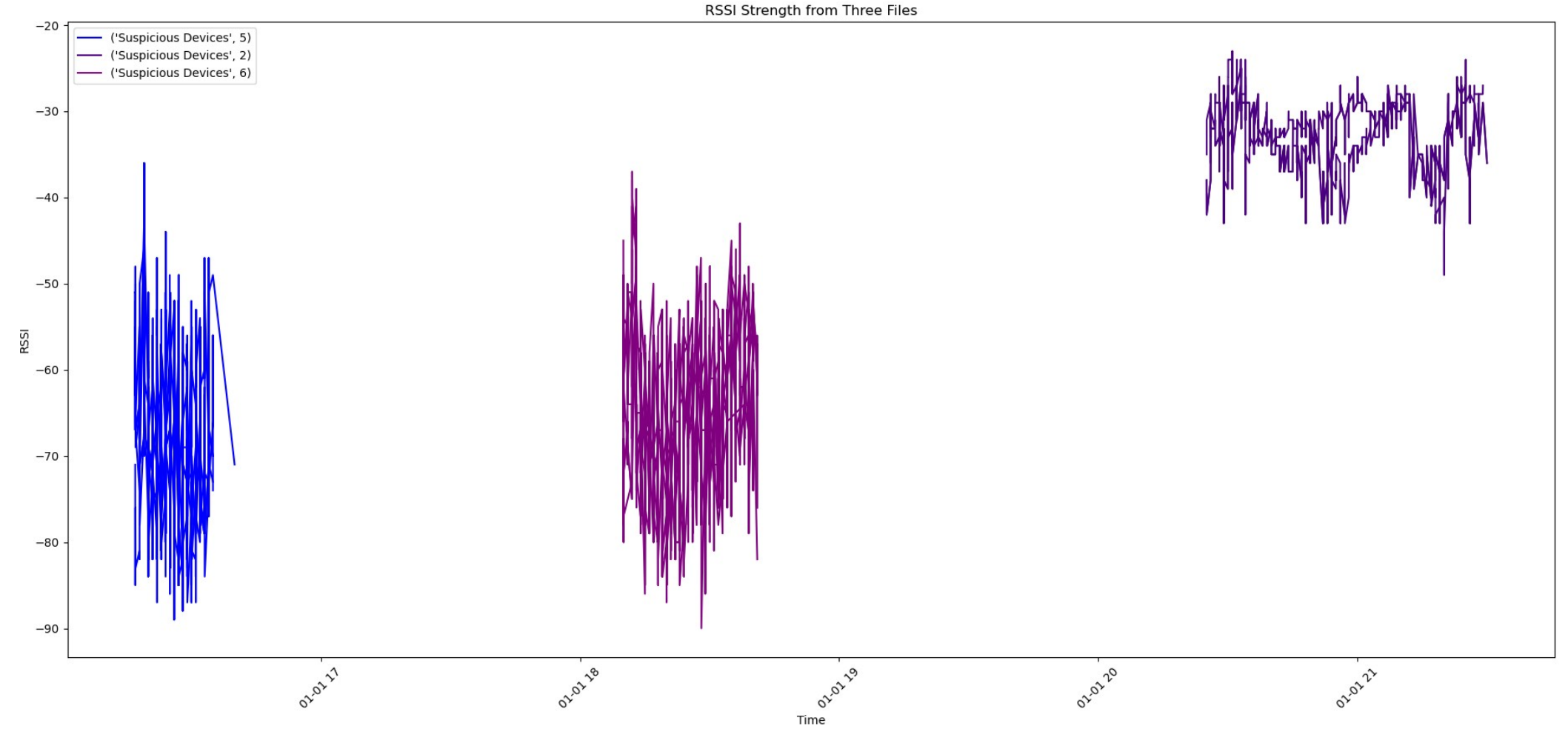
Data file n - long detection



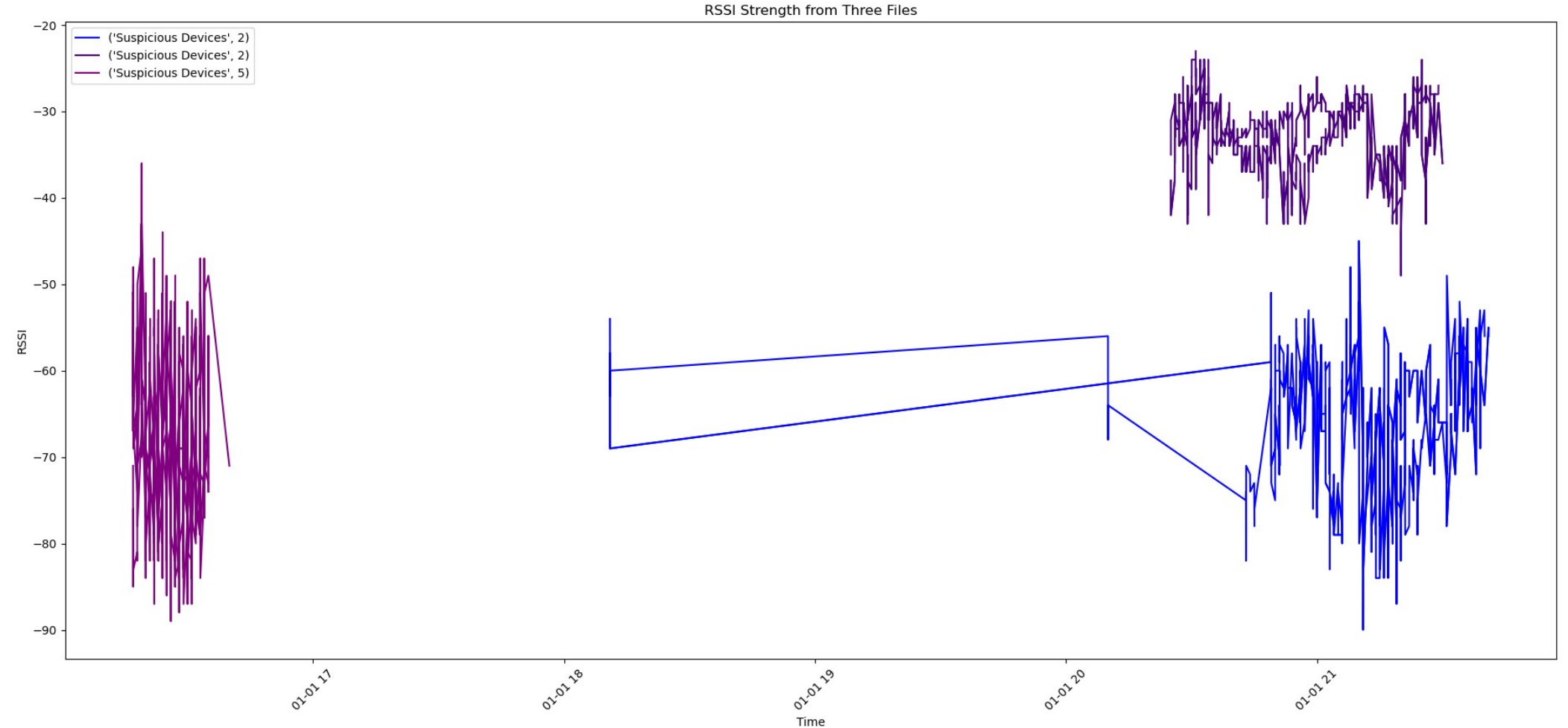
Time of Day

```
88  #note: change function to takes in variable
89  # new plot function to simplify main()
90  def plot(data, setsus, color1):
91      mac, rssi, time = make_rssi(data)
92      fmac, arssi, atime = sort(mac, rssi, time)
93      macsus, rssisus, timesus, = findsus(setsus, fmac, arssi, atime)
94
95      plt.plot(timesus[0], rssisus[0], color=color1, label=("Suspicious Devices", len(macsus)))
96
97      for i in range(len(macsus)):
98          sorted_pairs = sorted(zip(timesus[i], rssisus[i]), key=lambda x: x[0])
99          timesus_paired, rssisus_paired = zip(*sorted_pairs)
100         plt.plot(timesus_paired, rssisus_paired, color=color1)
```

Time of day – G,N,J



Time of day – G,N,A



Conclusion

Discussion

- As a user travels they will encounter many safe devices that are belong to normal crowds meaning they usually won’t get very close as a reflection of human behavior but Suspicious devices are placed on the user’s clothing possessions, or vehicle thus is closer and has stronger signals
- Suspicious devices have long detection time: may be by design of the testing
- The difference of RSSI values seen on time of day graphs is more likely to be related to the planted location of the suspicious trackers