

Network  
Testing &  
Emulation  
Solutions



# WiFi Access Point Roaming Test

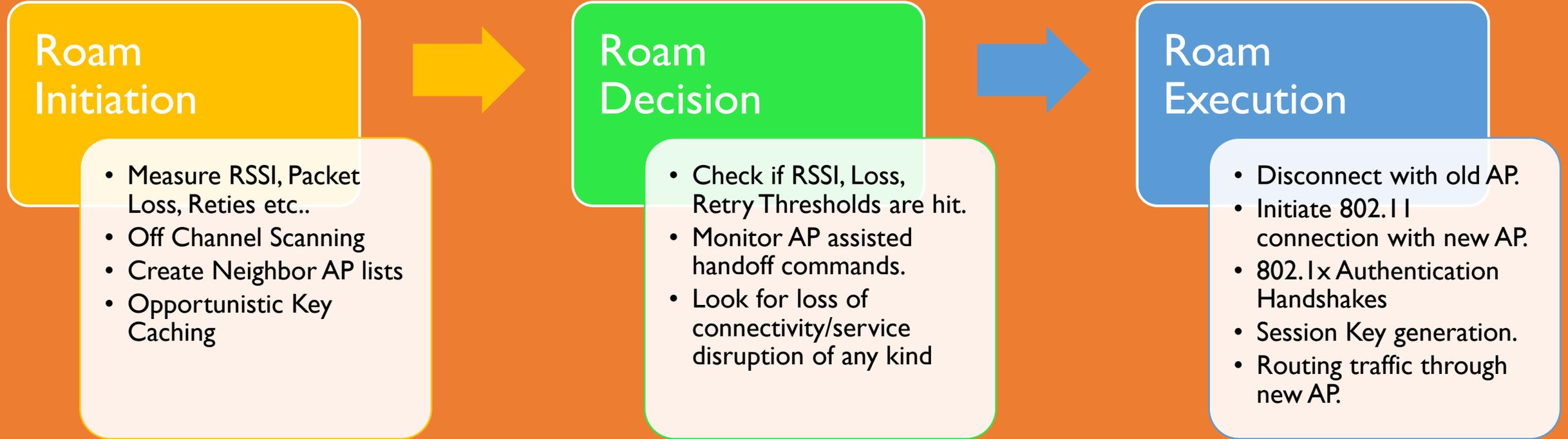


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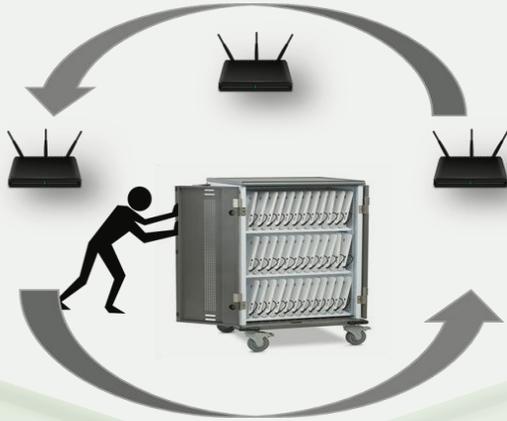
1-360-380-1618

# ROAMING PROCESS



# ROAMING TEST METHODS

## Walk Tests



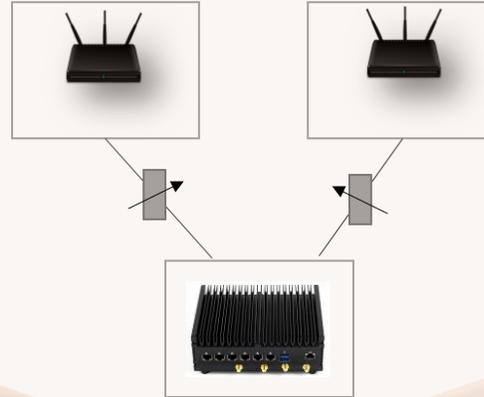
### Pros

- ✓ Highly realistic.
- ✓ Can test Interoperability with most popular stations.
- ✓ Can test all three steps of roaming (initiation, decision and execution)

### Cons

- ✓ Not Scalable
- ✓ Not Repeatable
- ✓ Not Automatable
- ✓ Extremely time consuming
- ✓ Extremely hard to debug issues

## Using Attenuators



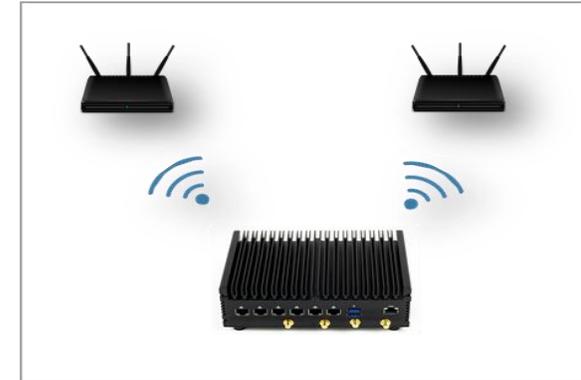
### Pros

- ✓ Repeatable
- ✓ Automatable.
- ✓ Can test all three steps of roaming (initiation, decision and execution)

### Cons

- ✓ Not Scalable
- ✓ Expensive setup
- ✓ Not easy to measure roaming delays and debug issues.
- ✓ Not easy to isolate AP issues from station issues.

## Forced Roaming



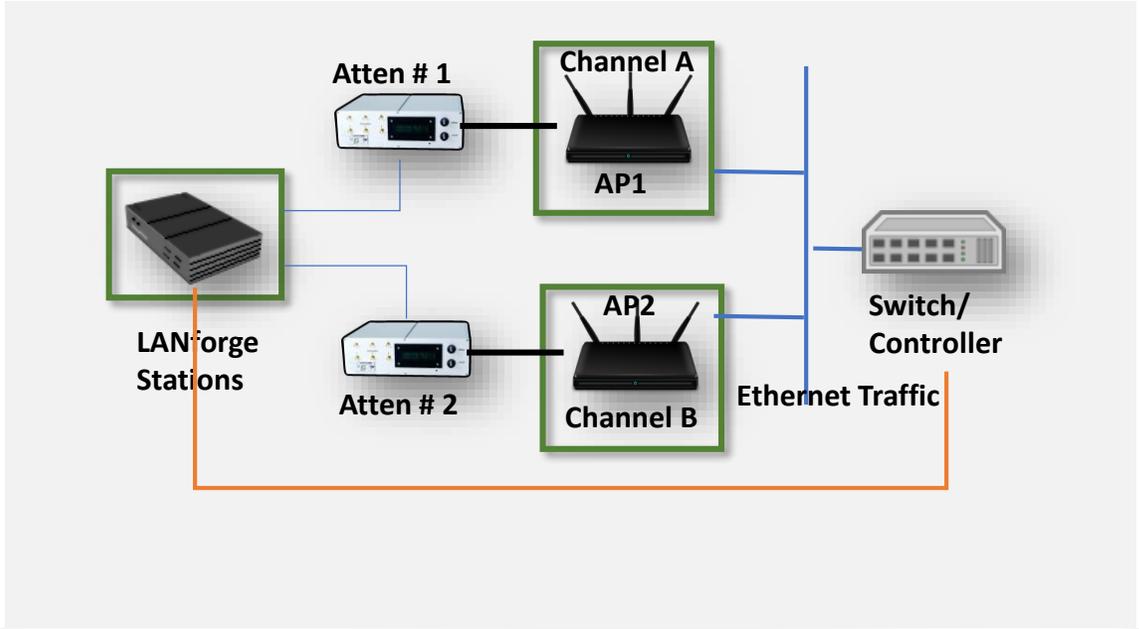
### Pros

- ✓ Can scale to 1000s of roams for many hours and the only way to find issues related to scale.
- ✓ Can run tests very fast.
- ✓ Fully Automatable, Controllable and Repeatable
- ✓ Cost per roam the lowest

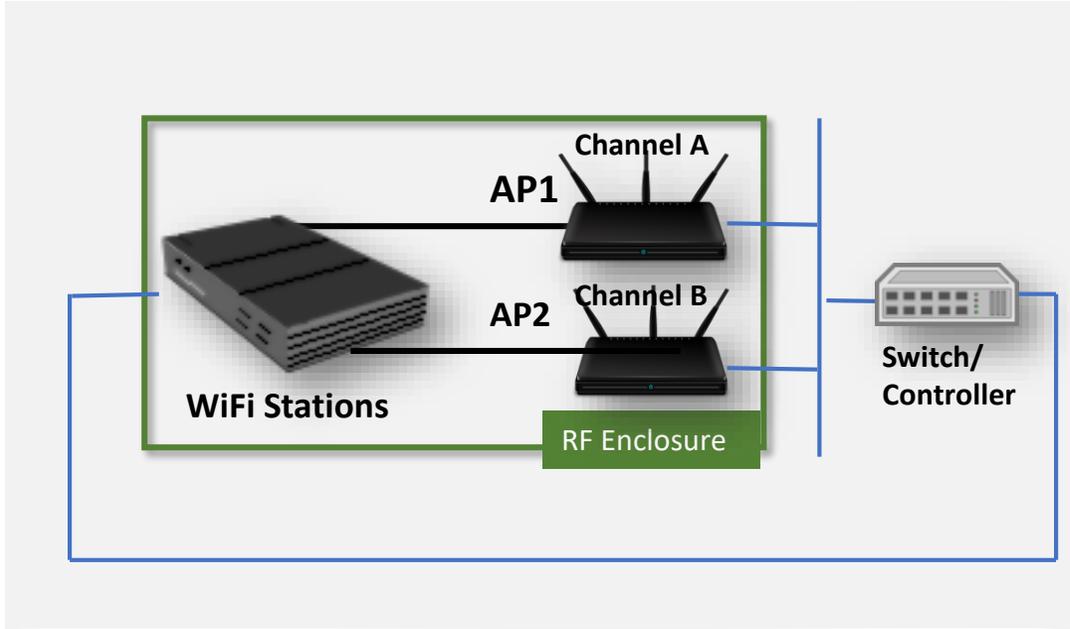
### Cons

- ✓ Can only test Roam execution.
- ✓ Cannot test improvements in execution because of steps taking during roam initiation.
- ✓ Not very real-world

# TEST SETUP

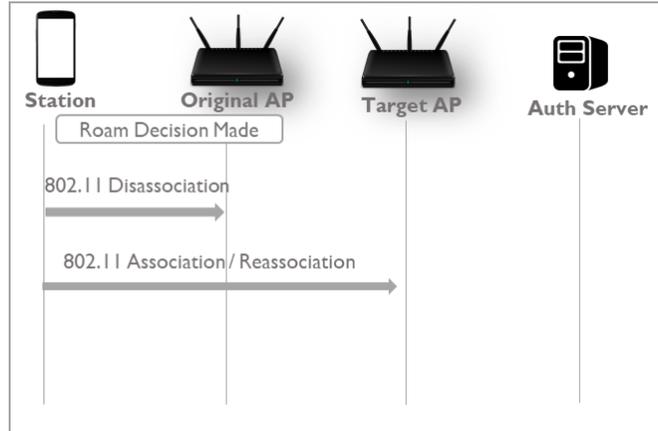


## ROAM USING ATTENUATION

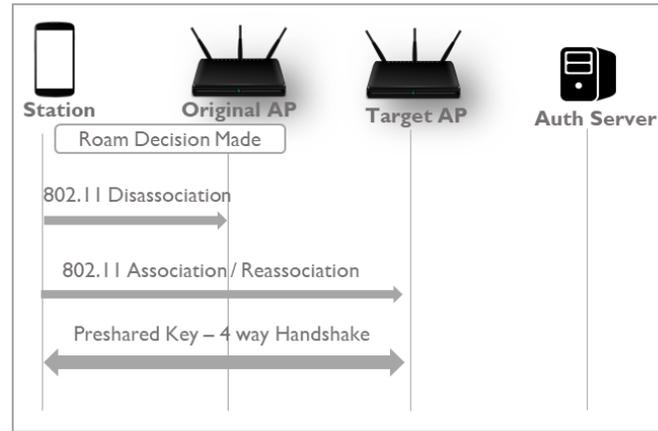


## FORCED ROAM METHOD

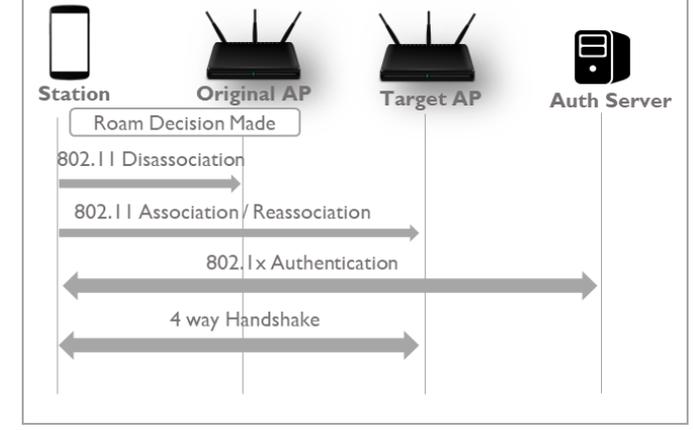
# ROAM EXECUTION METHODS



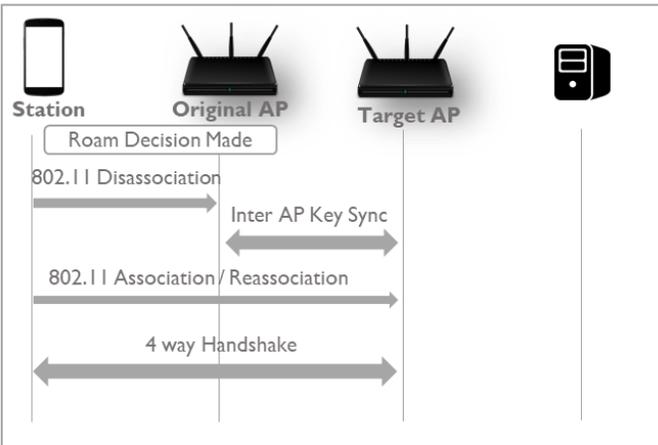
**Open Authentication**



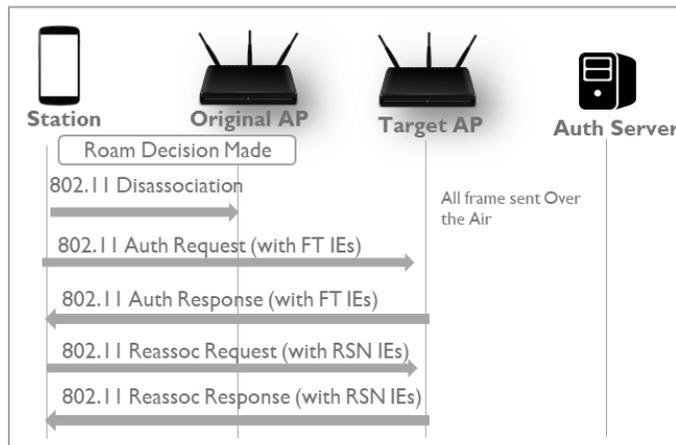
**WPA-PSK**



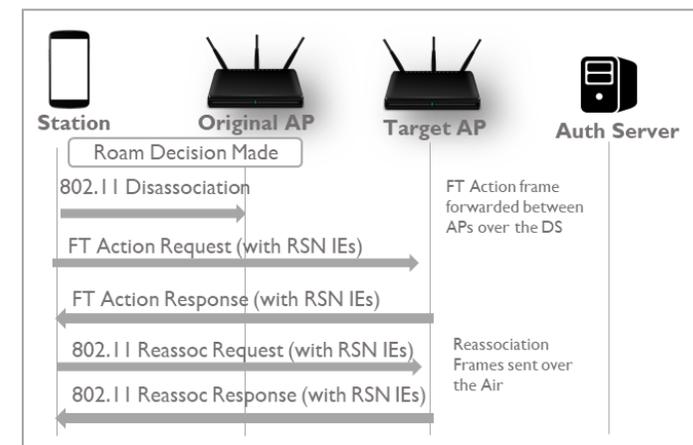
**WPA-Enterprise (no Key Caching)**



**WPA-Ent (with Key Caching)**

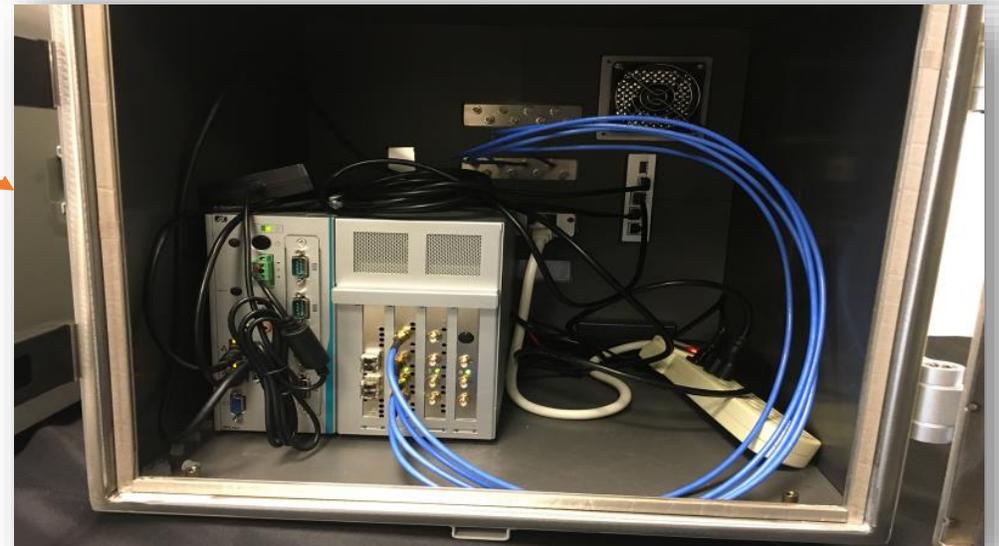
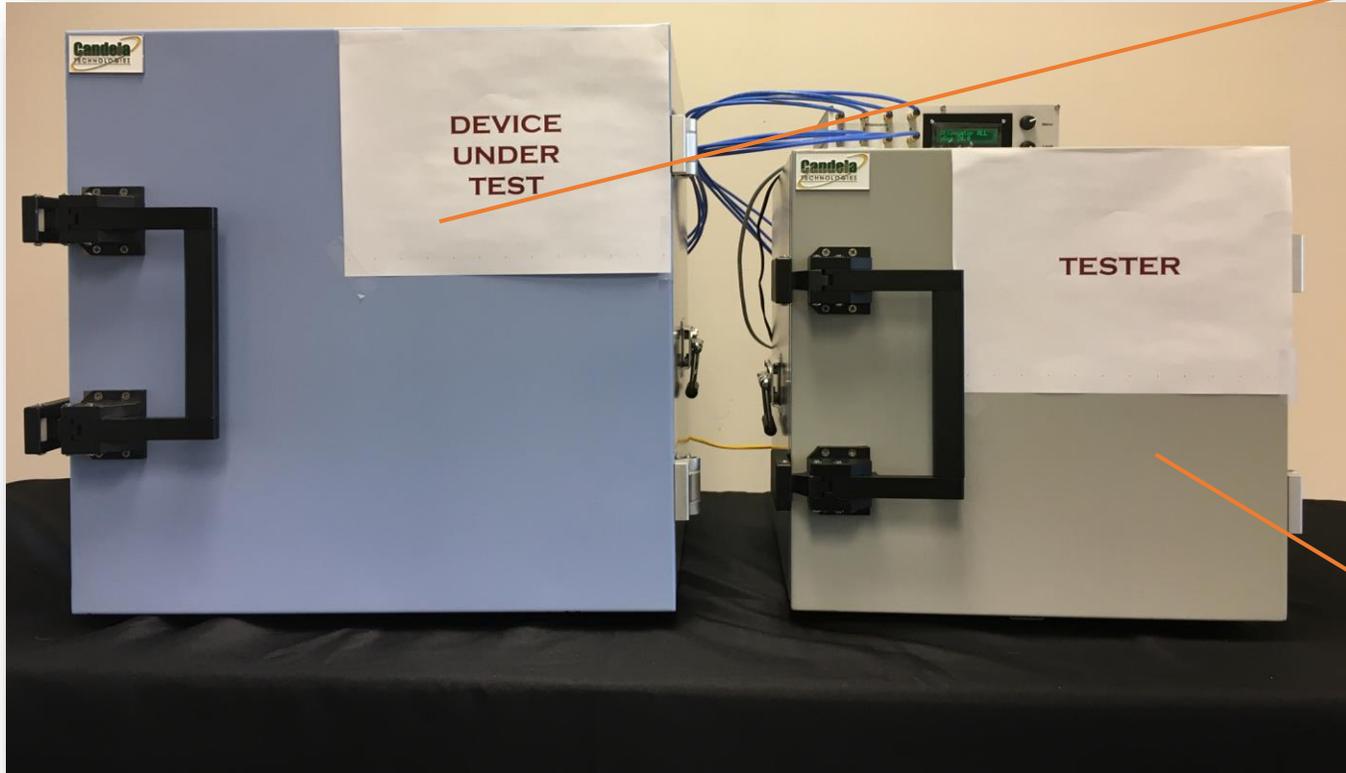


**Fast Roaming (over-the-Air)**

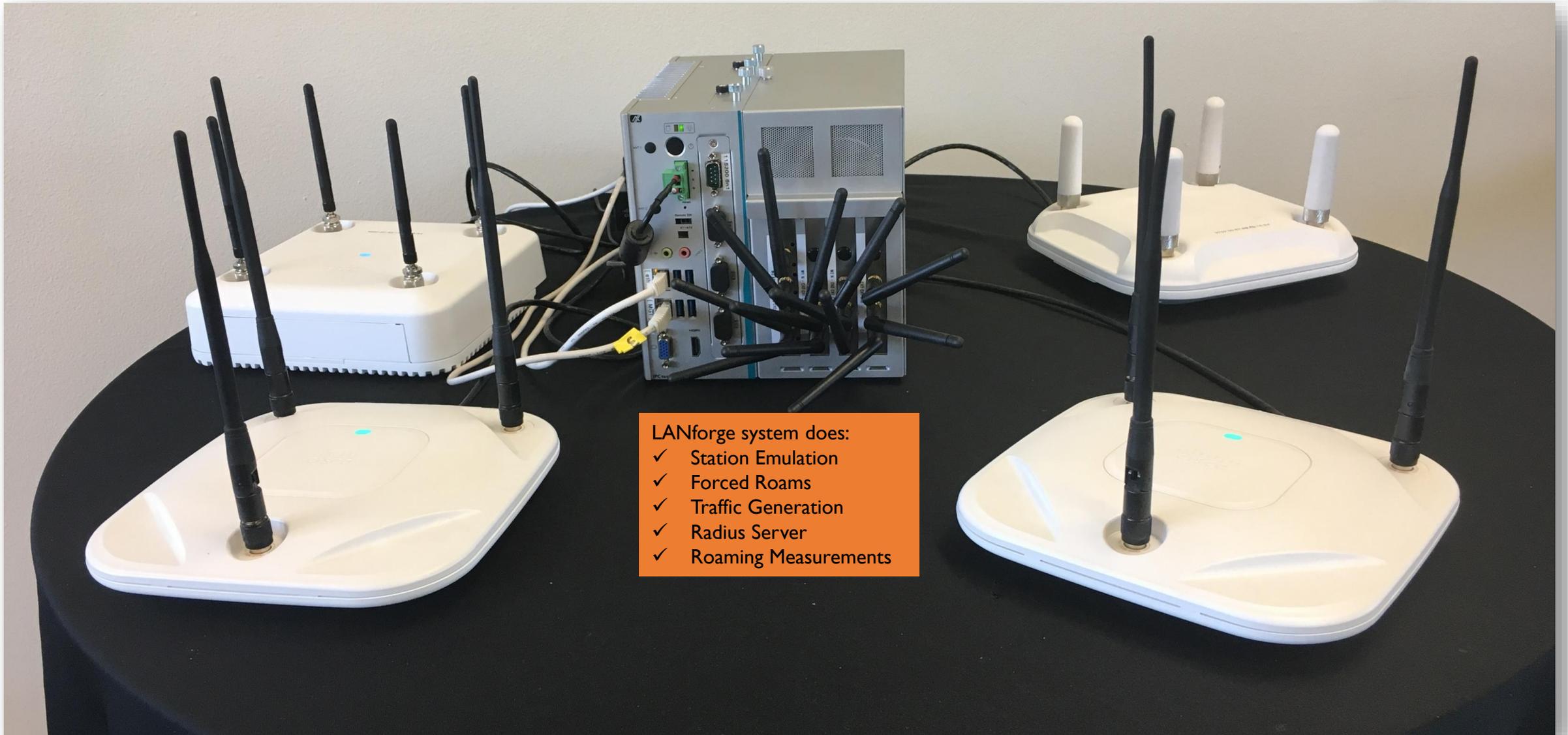


**Fast Roaming (over-the-DS)**

# Testbed Setup

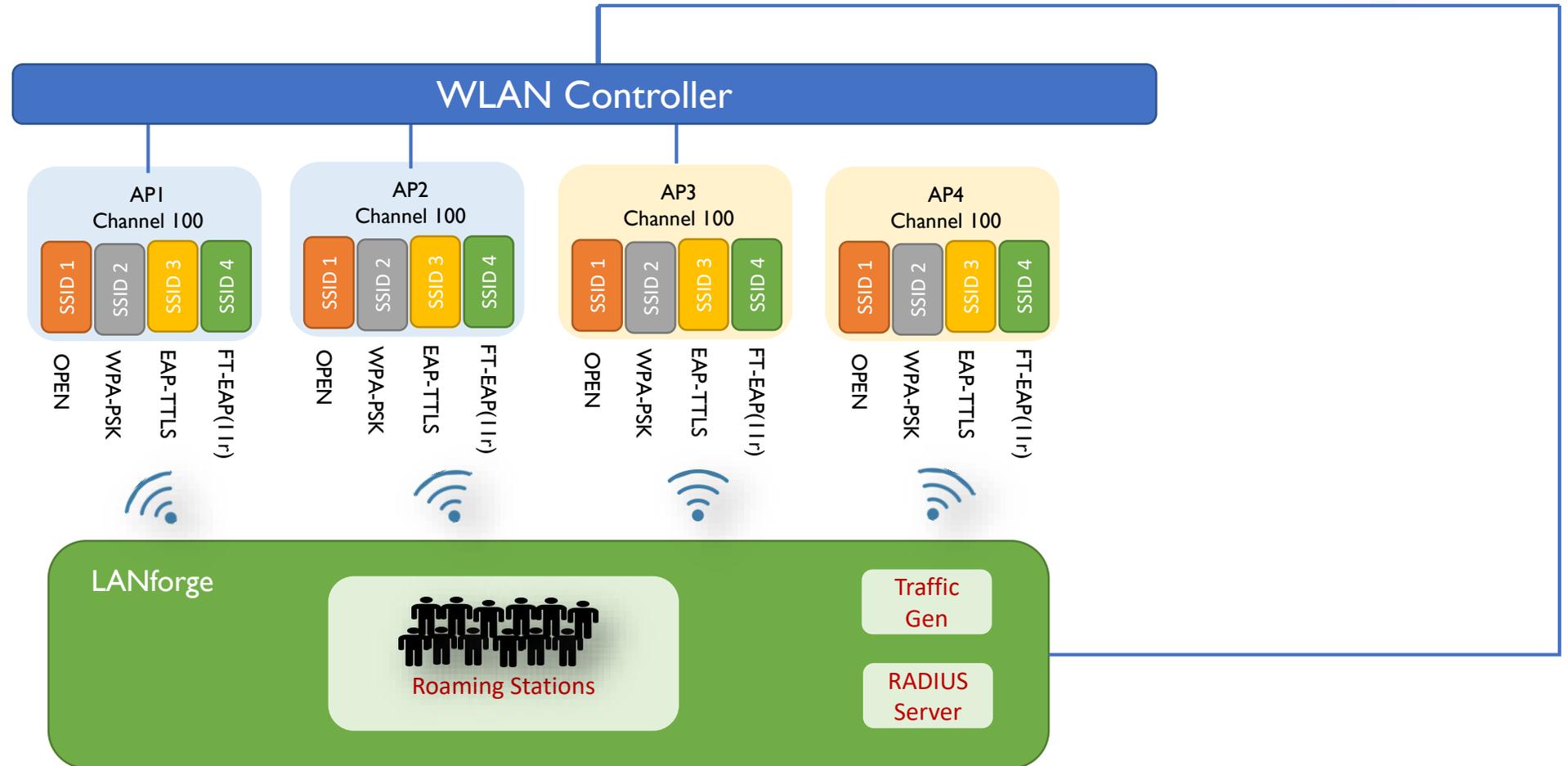


# FORCED ROAM TEST SETUP PICTURE

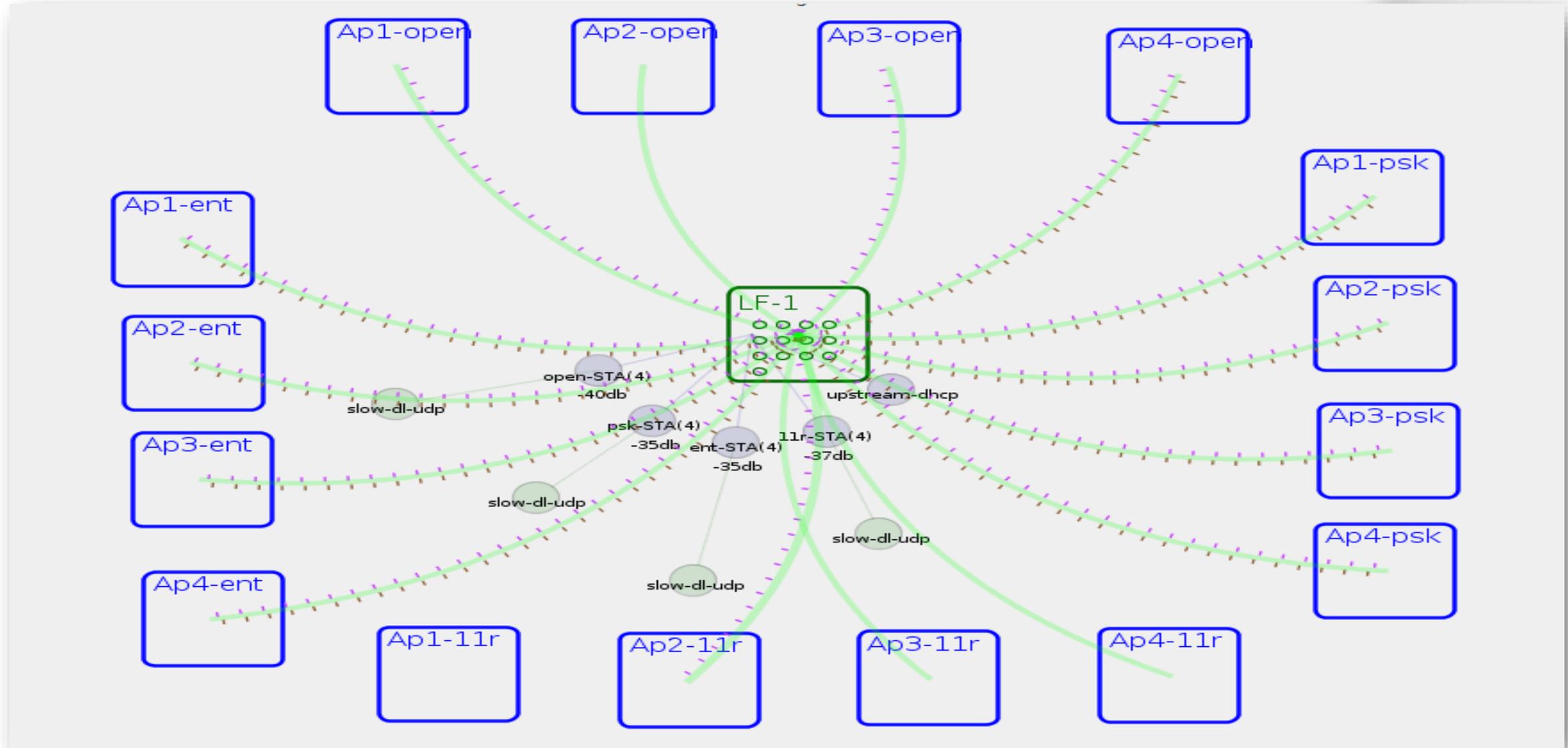


- LANforge system does:
- ✓ Station Emulation
  - ✓ Forced Roams
  - ✓ Traffic Generation
  - ✓ Radius Server
  - ✓ Roaming Measurements

# FORCED ROAM TEST SETUP



# LANforge GUI View

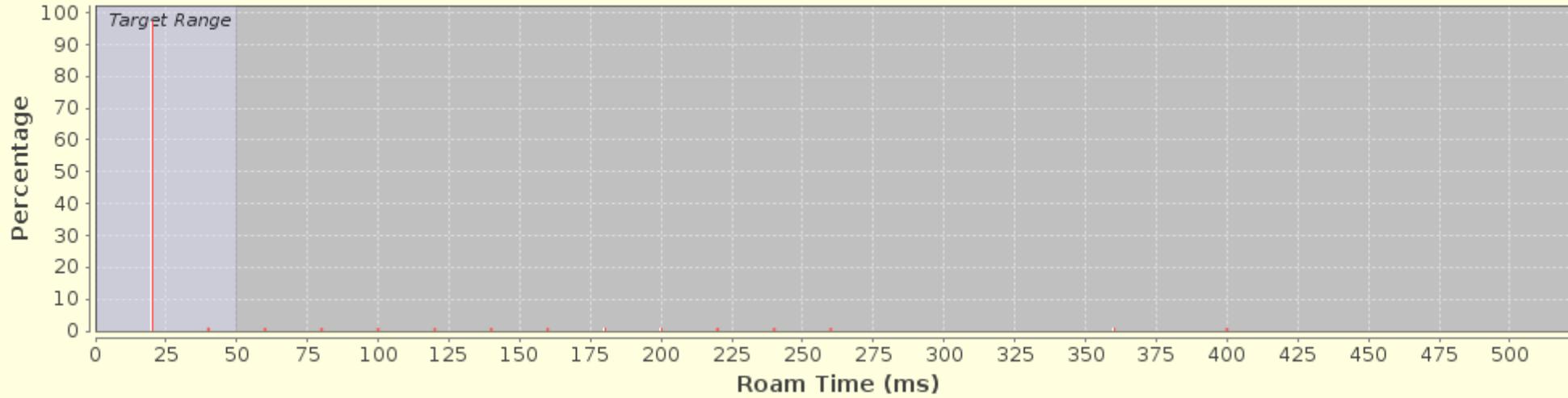


20,000 Roams

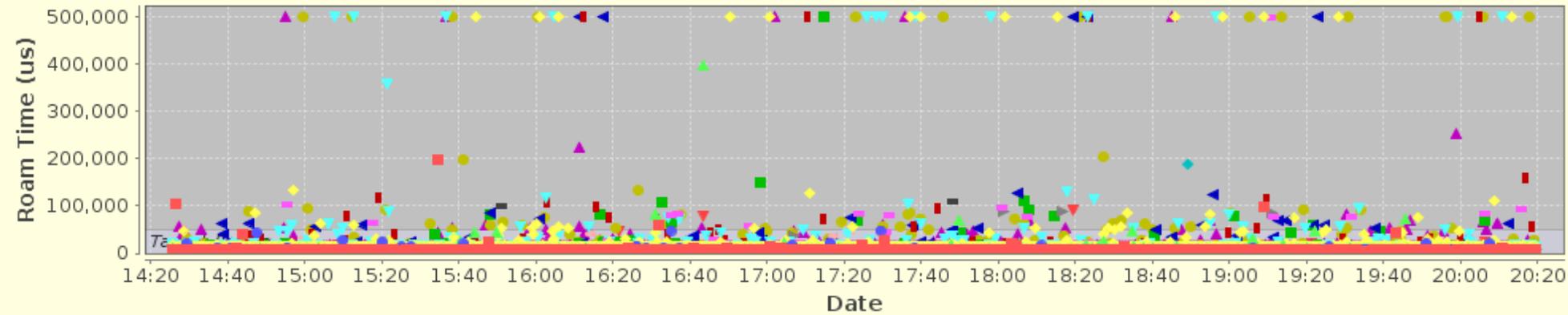
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**GOOD** Performance

### Roam Percentage per Duration

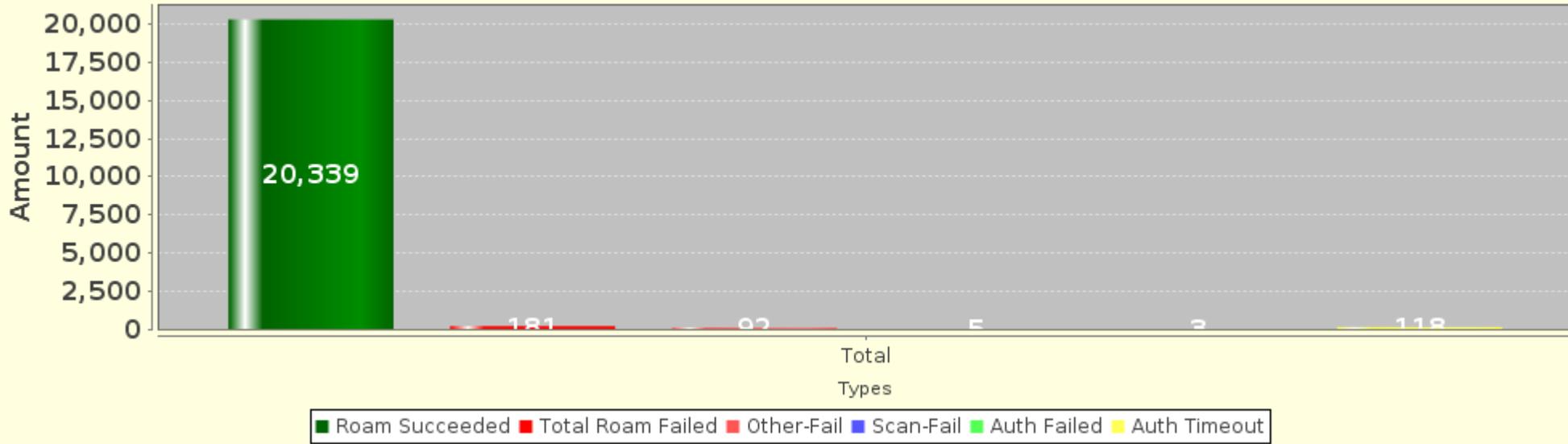


### Roam to AP Times

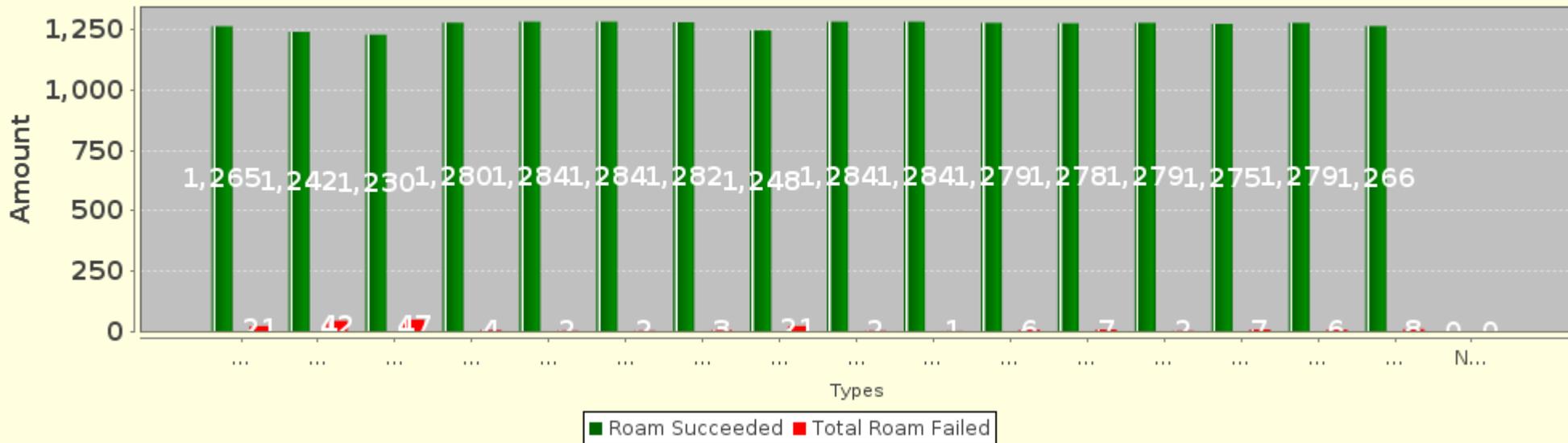


- 50:87:89:A9:1E:6E    ● DC:A5:F4:FF:4F:AE    ▲ DC:A5:F4:F3:CE:9E    ◆ DC:A5:F4:F3:CE:9D    ◆ 2C:33:11:D8:1B:AD    ▼ DC:A5:F4:FF:4F:AD    ● DC:A5:F4:FF:4F:AB
- ▶ 2C:33:11:D8:1B:AE    ■ 50:87:89:A9:1E:6D    ◀ 50:87:89:A9:1E:6C    ■ 2C:33:11:D8:1B:AC    ● DC:A5:F4:FF:4F:AC    ▲ DC:A5:F4:F3:CE:9C    ◆ 50:87:89:A9:1E:6B
- 2C:33:11:D8:1B:AB    ▼ DC:A5:F4:F3:CE:9B    ● Not-Associated

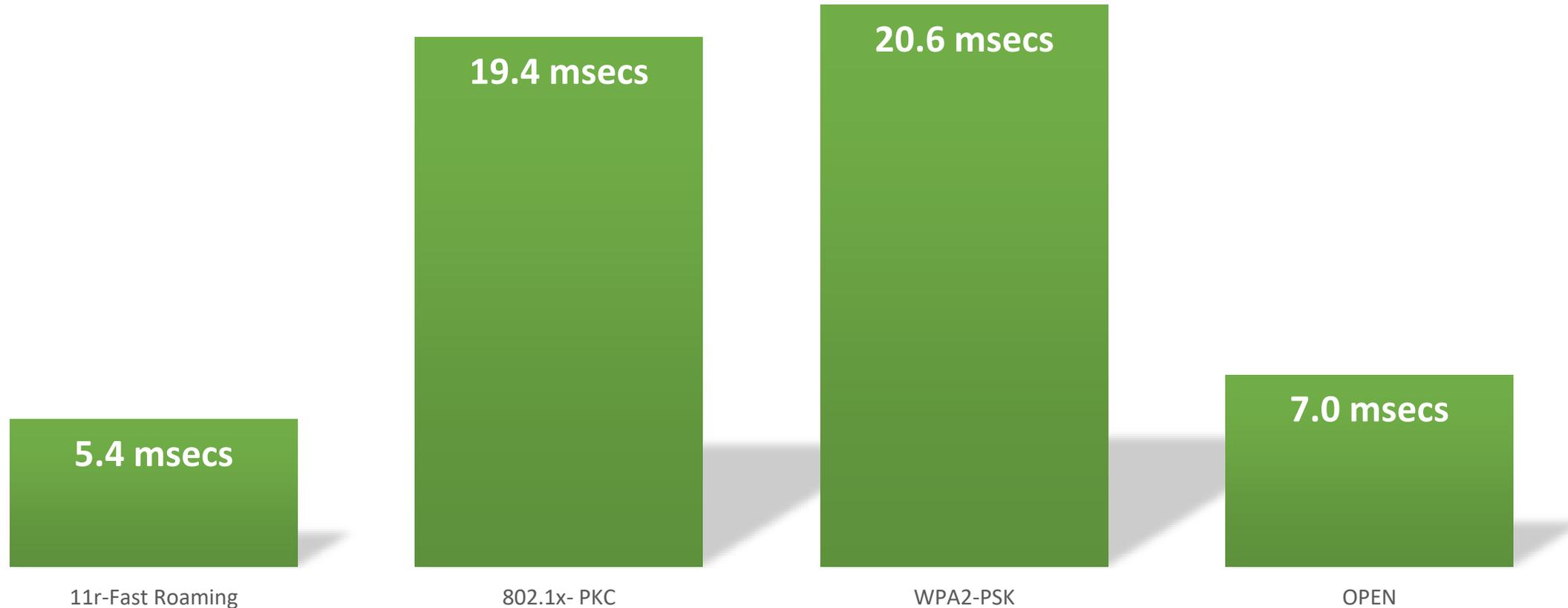
### Total Roams



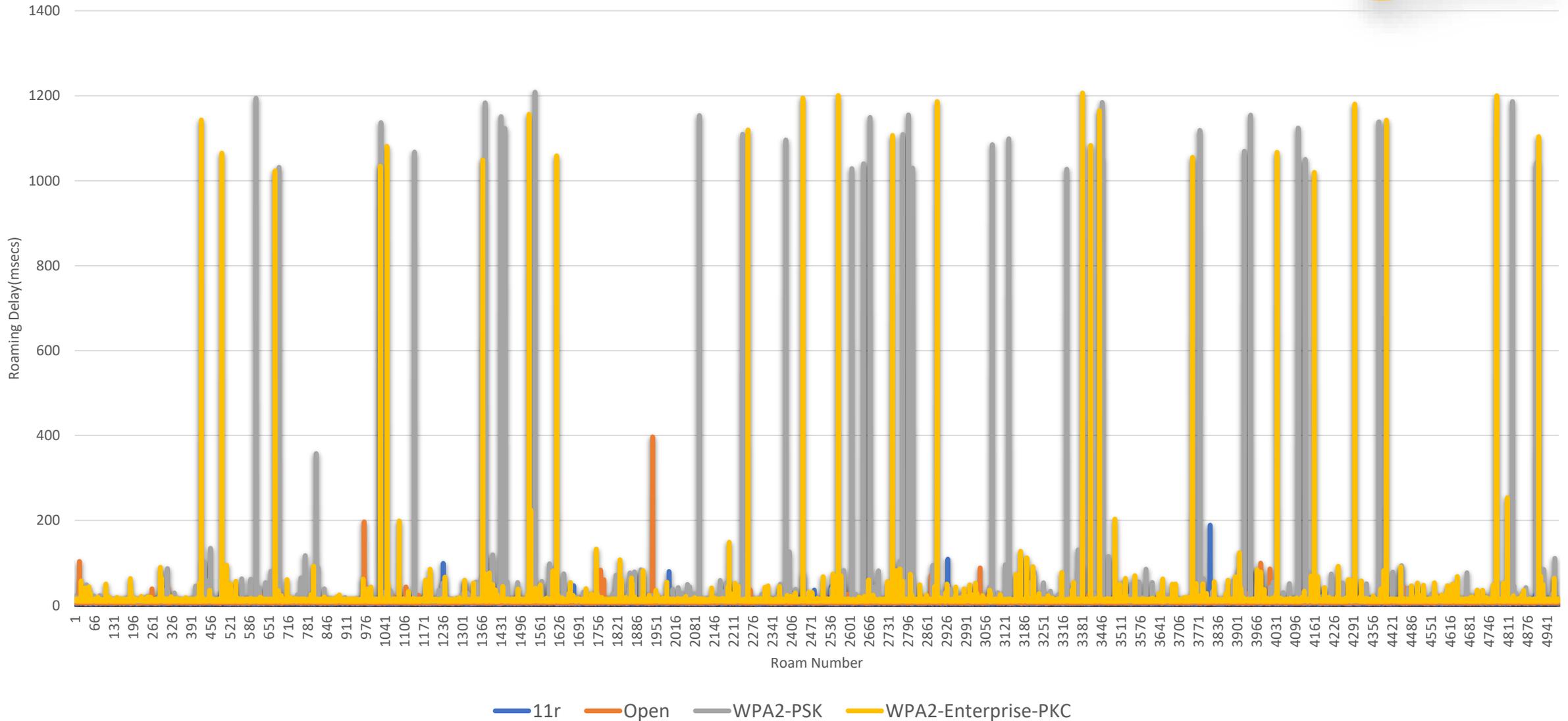
### Total Roams per AP



# Average Roaming Delay (msecs) – 20,000 Roams



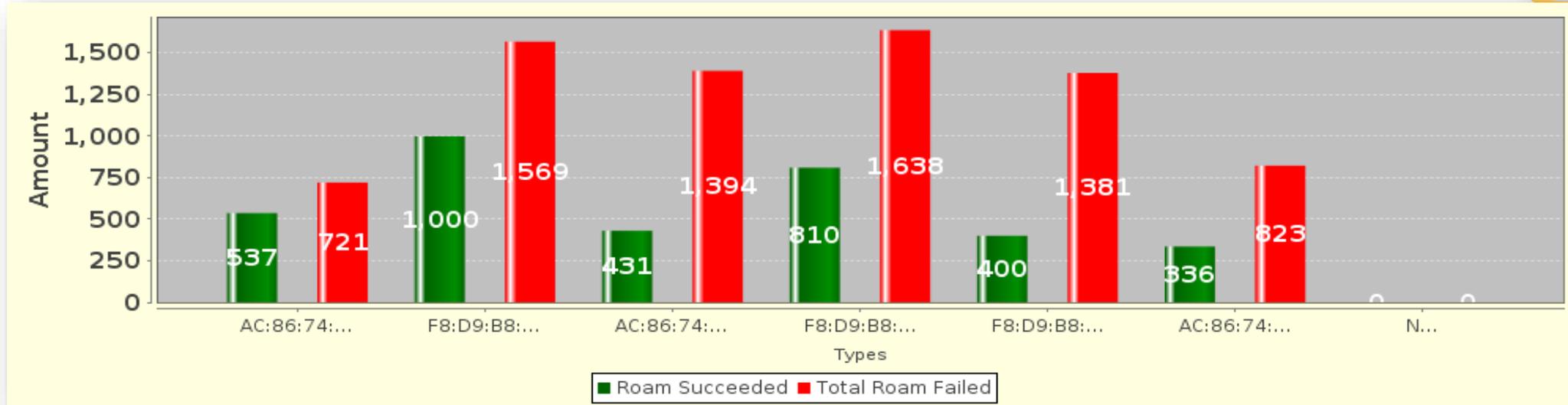
# Roaming Delay (msecs) for 20,000 roams



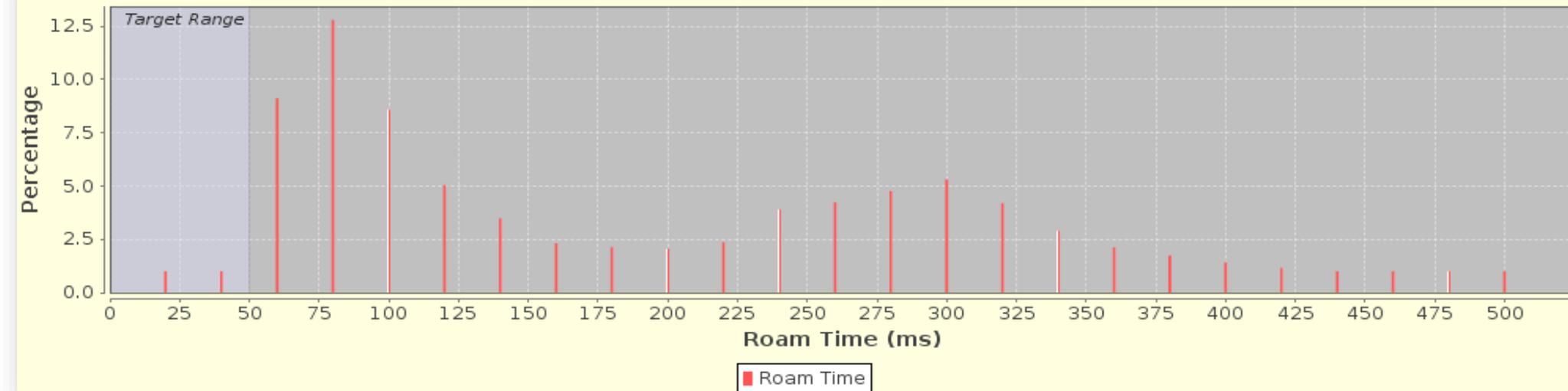
10,000 Roams

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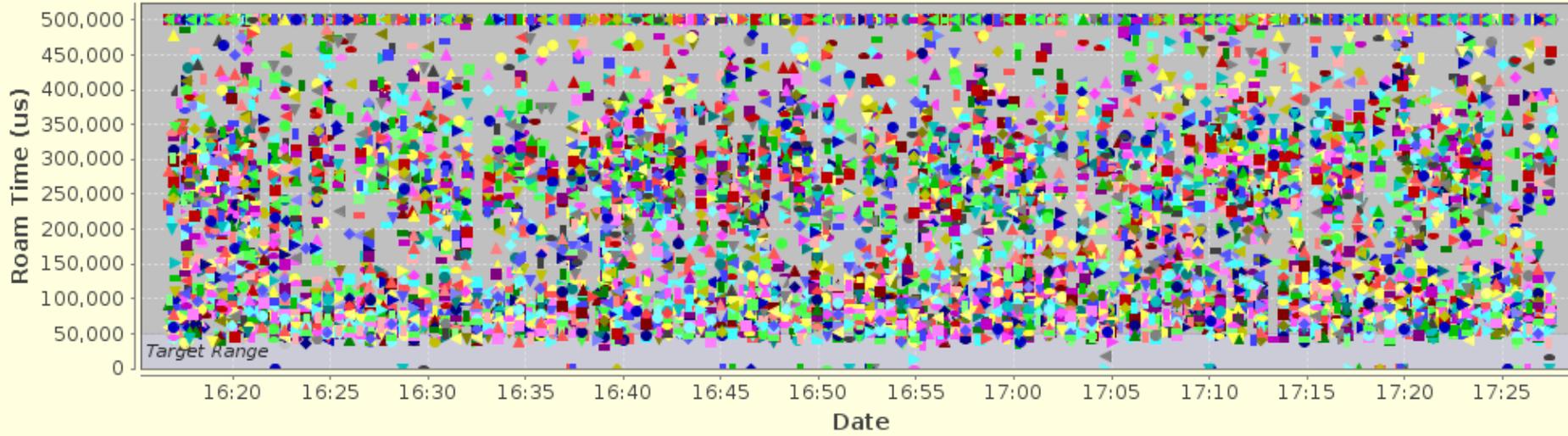
**BAD** Performance



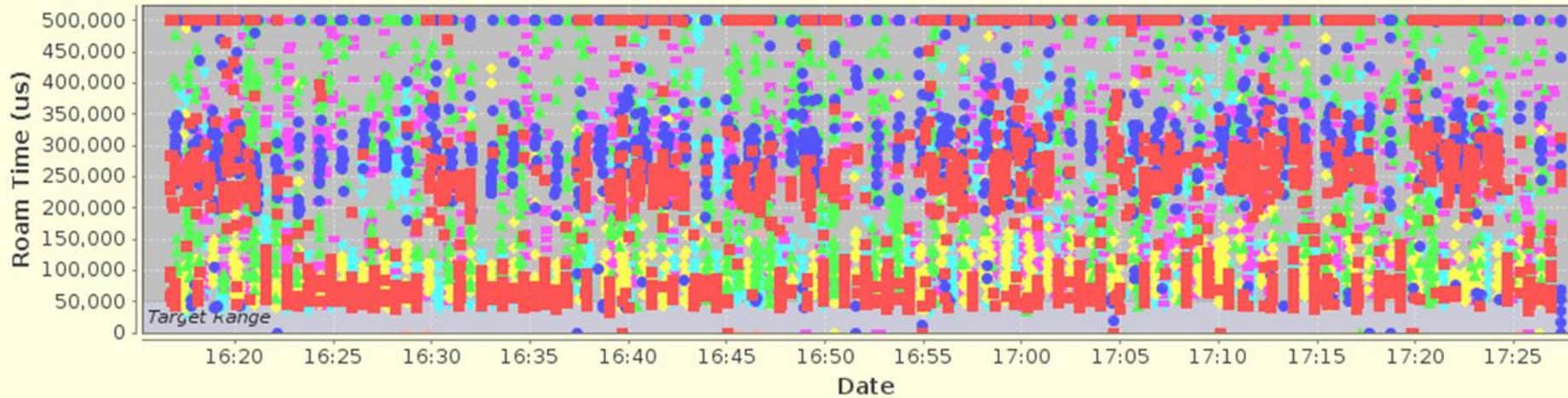
### Roam Percentage per Duration



### Station Roam Times

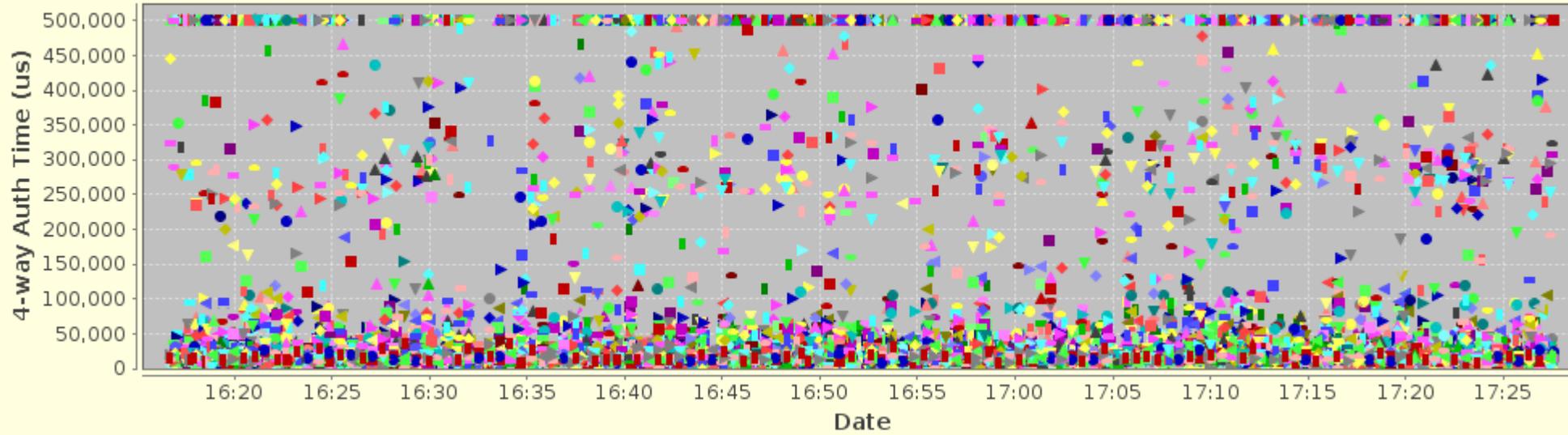


### Roam to AP Times

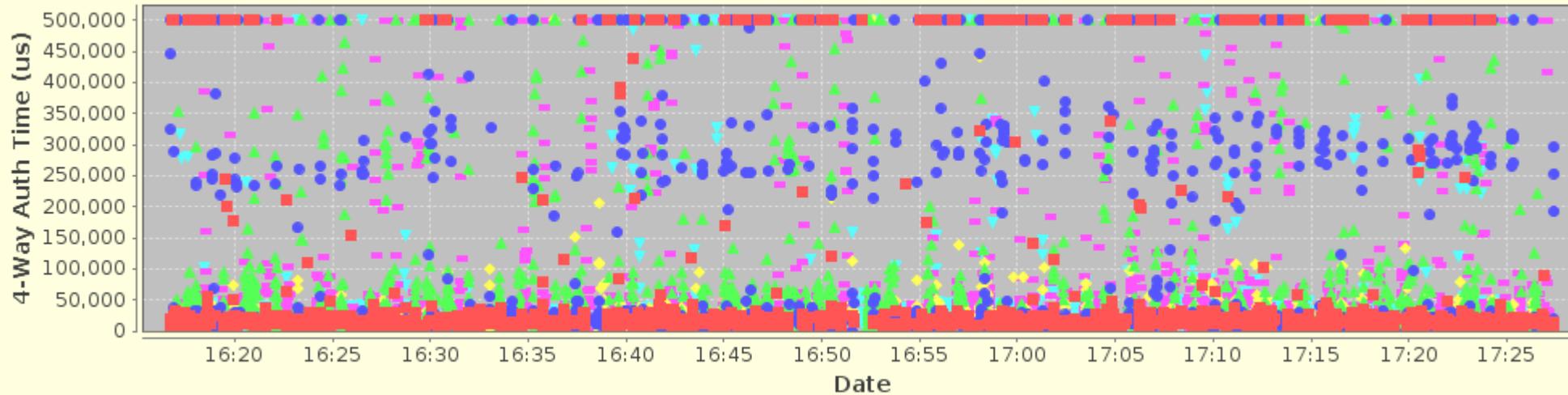


■ :69:A4 
 ● :3D:44 
 ▲ :EA:44 
 ◆ :41:44 
 ■ :42:64 
 ▼ :61:84 
 ■ Not-Associated

### Station 4-Way Auth Times

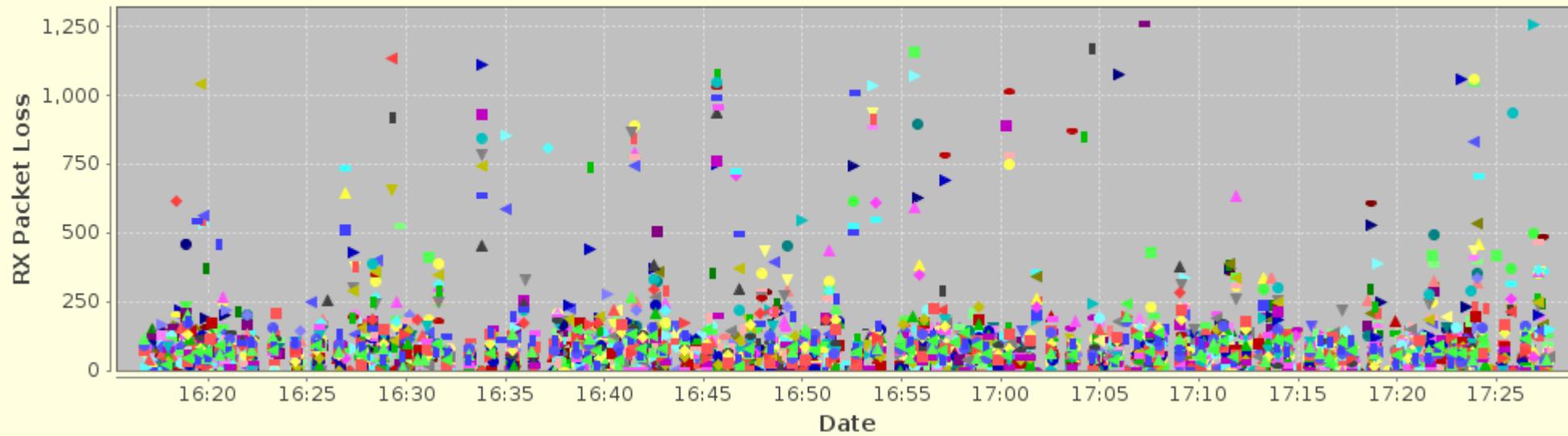


### 4-Way Auth per AP Times

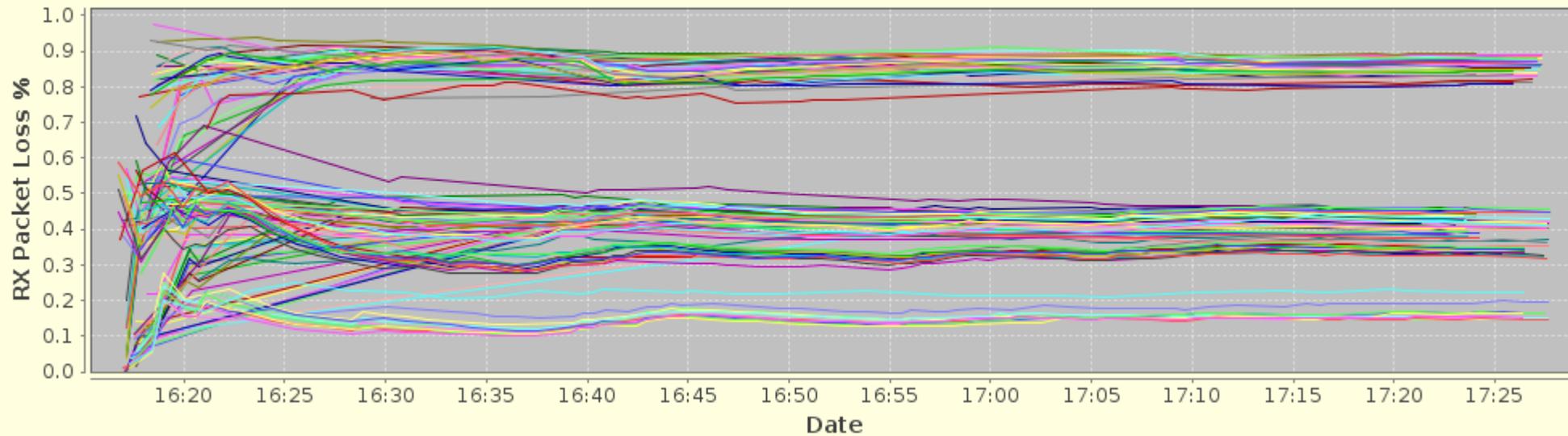


■ AC:86:74:8B:69:A4 
 ● F8:D9:B8:07:3D:44 
 ▲ AC:86:74:8C:EA:44 
 ◆ F8:D9:B8:AB:41:44 
 ■ F8:D9:B8:07:42:64 
 ▼ AC:86:74:A4:61:84 
 ■ Not-Associated

### RX Packet Loss Per Room



### Total RX Packet Loss Percentage





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