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# WiFi Testing – In the real world

September, 2016

CWNP WIFITREK

# Today’s agenda

- Understanding the environment
  - Pillars of Carrier Grade WiFi
  - Deployment types
- Test requirements
  - What to test
- Tools selection
  - Characterize the network performance
  - Baseline the environment
  - Logs & Analysis
- Test kit
- Samples of output & results



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## Understanding the environment

## Testing of Comcast Carrier Network

# Pillars of Carrier Grade WiFi

## Large Coverage Footprint

- Outdoor
- SMB (cafes, shops, restaurants, etc.)
- Venues

## Good Bandwidth / Speeds

- Home internet speeds on the go

## Security

- 802.1X support
- Federated Access
- Seamless network selection

## Reliable

- Ability to connect
- Good RF coverage
- Supporting fast handoffs (mobility)

## Easy to Use

- Rule of 6s

# Pillars of Carrier Grade WiFi

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# WiFi deployment approach

**Build WiFi coverage in locations where users most likely want to connect**

## Outdoor

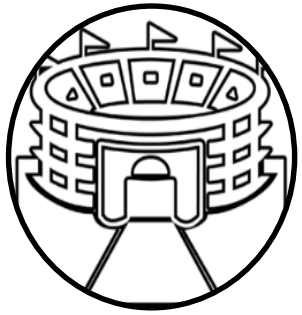
- Aerial strand
- Main streets
- Shop, dine, relax, wait, commute

## SMB

- Small business
- Seating areas
- Waiting areas

## Residential

- WG CPE
- Home network
- XFINITY WiFi



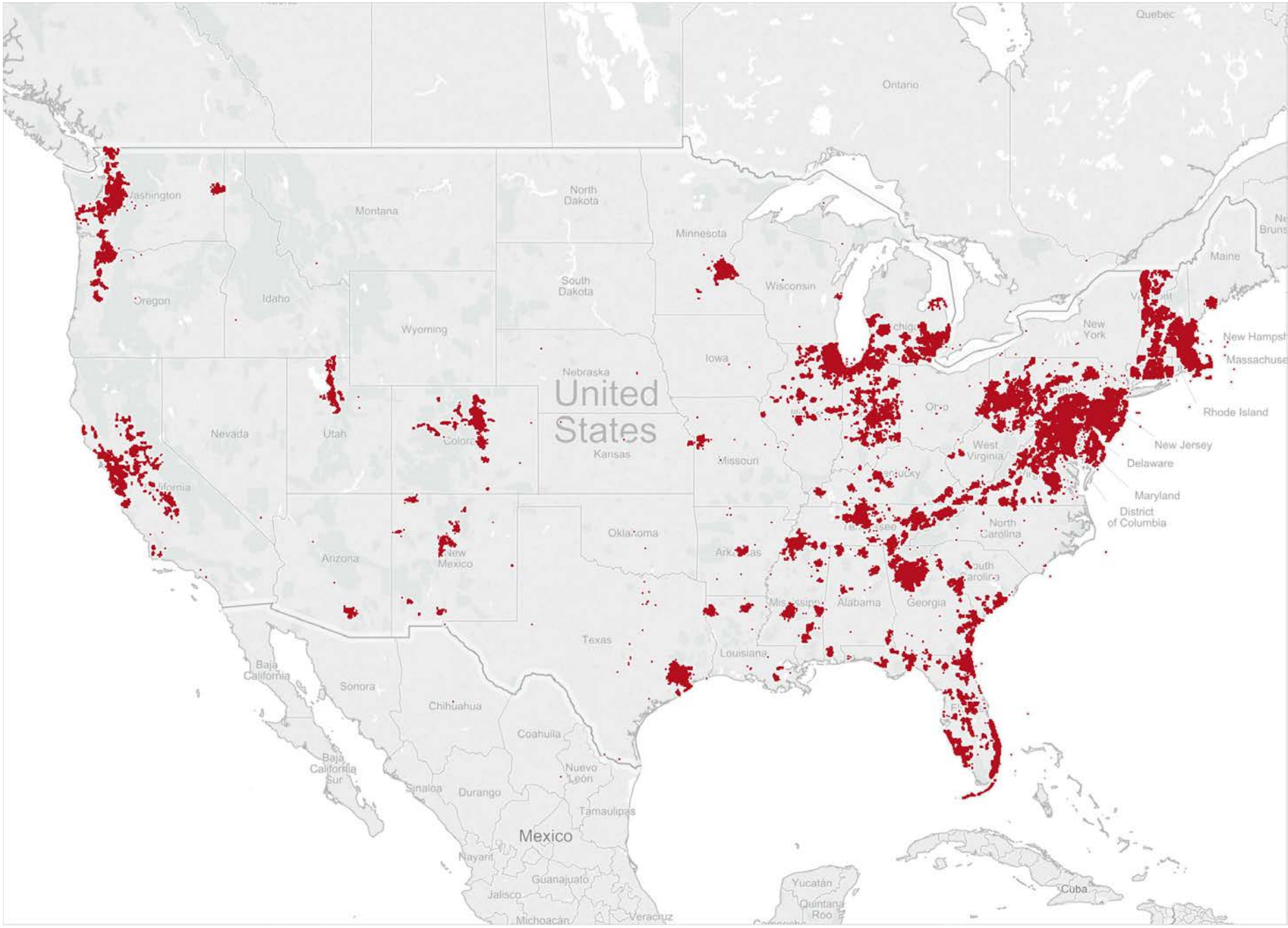
## Venues

- High traffic
- Strategic venue
- ROI targets

## CableWiFi

- 5 largest MSOs
- Partner sites
- Federations

**Each vertical has unique use cases and user base**


Quebec
Ontario
Washington
Montana
North Dakota
Minnesota
Maine
Oregon
Idaho
South Dakota
Wisconsin
Wyoming
New York
Iowa
Nebraska
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Nevada
Utah
Kansas
Missouri
West Virginia
Rhode Island
New Jersey
Delaware
Maryland
District of Columbia
Oklahoma
Arizona
New Mexico
North Carolina
Alabama
Georgia
Texas
Louisiana
Baja California
Sonora
Chihuahua
Coahuila
Baja California Sur
Nuevo León
Sinaloa
Durango
Tamaulipas
Mexico
Nayarit
Guanajuato
Jalisco
Michoacán
Veracruz
Yucatán
Quintana Roo
Cuba

# Dynamic Environment

- No control over buildings, people, materials, …
- I can “see” 30 networks and can’t connect

# Test Requirements

## Test Requirements

- All testing must be done from as a client would use the network
  - Real client handsets
  - Real client applications
  - Captures must be able to support client information
  - Tests must be repeatable
  - Tests must be measurable

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# Device Support

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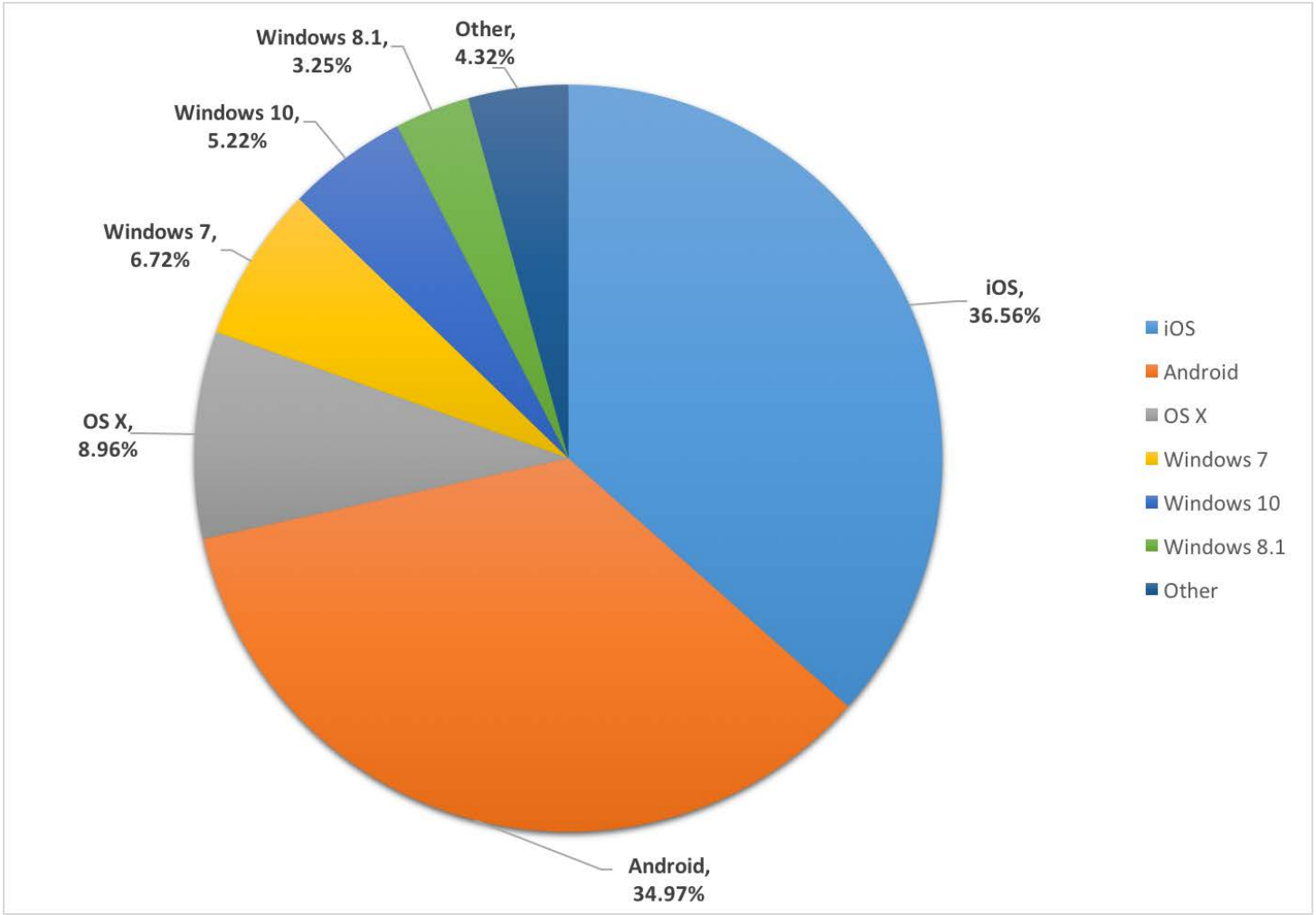
# Authenticated Device type distribution



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# Tools selection

# Tool Selection – Characterize the network performance

The first objective when characterizing any network is to have tools that provide empirical data. We needed something that would operate on the mobile platforms our customers are using and provide details into more than just upstream & download speeds.

Ideally we wanted the following:

- Timing associations (start of association -> DHCP address)
- Upload / Download Speed
- Measure video performance
- Measure browsing performance
- Measure VoIP performance
- Roaming Performance

After researching numerous tools, timing for associations and roaming performance are not exposed or available on mobile platforms. nPerf was able to achieve 3 of the remaining 4 items and was selected as a result.



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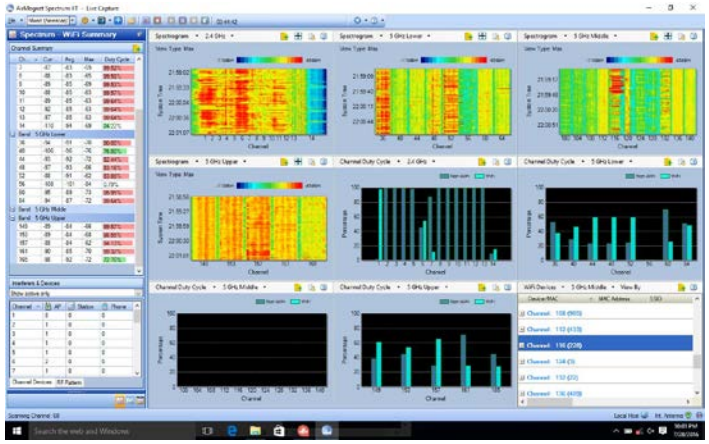
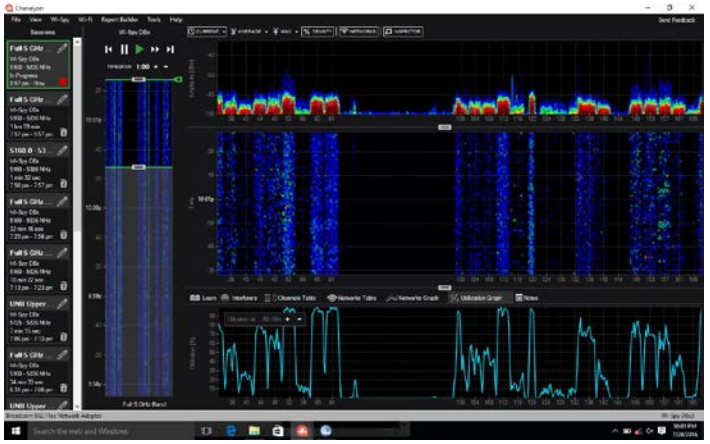
# Tool Selection – Baseline the environment

Our next object was to baseline the environments we are in. We wanted to baseline the RF environment from a spectrum usage, number of AP's, and AP capability standpoint. We needed a solution that was mobile and could capture enough data that we could replicate environments in the lab. For AP information, the Fluke AirCheck seemed like a no brainer.

Many tools were looked reviewed; however, AirMagnet Spectrum XT was locked in for the spectrum captures. Ekahau's rebranded version of MetaGeek's Wi-Spy DBx was also purchased for collecting data over the map. Spectrum XT is easier to read, in my opinion. Samples below:







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# Tool Selection – Logs and Analysis

The last thing we needed were logs and packets to round out our ability to see the big picture. Many different packet capture capabilities are out there, OmniPeek and WireShark most frequenty used. We selected OmniPeek due to the packet aggregation function being easy to use and the Netgear A6120 being a very inexpensive adapter. When one breaks replacing it is pretty easy and they will break in the field.

We also look at what hooks iOS and Android had available in the OS. Android has the debug shell and Apple has special access for developer accounts. For more information check this out:

https://developer.apple.com/bug-reporting/profiles-and-logs/

Find the Wi-Fi for iOS, read the instructions and install the profile. You will be glad you did

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# Test Kit

# Full Kit - Testing Devices & Tools

- Test devices will be the most popular mobile hand held devices used on the network.
  - iPhone 6(s)
  - Galaxy S6(edge)
  - iPad Air
- Applications used during testing
  - nPerf, SpeedTest.Net, WiFiPerf (Venues only)
  - xfinity TV (TV GO), You Tube
  - Network & Ping utilities
  - Network diagnostics & debug logs where available
- Capture tools
  - Fluke Aircheck
  - Fluke Spectrum XT & Ekahau Spectrum Analyzer
  - OmniPeak for packet captures

Test equipment, apps, and tools will be updated annually. Client devices constant change drives this requirement. Initial testing will create roadmap requirements for future testing tools

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# Kit Prep

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# Testing in Action

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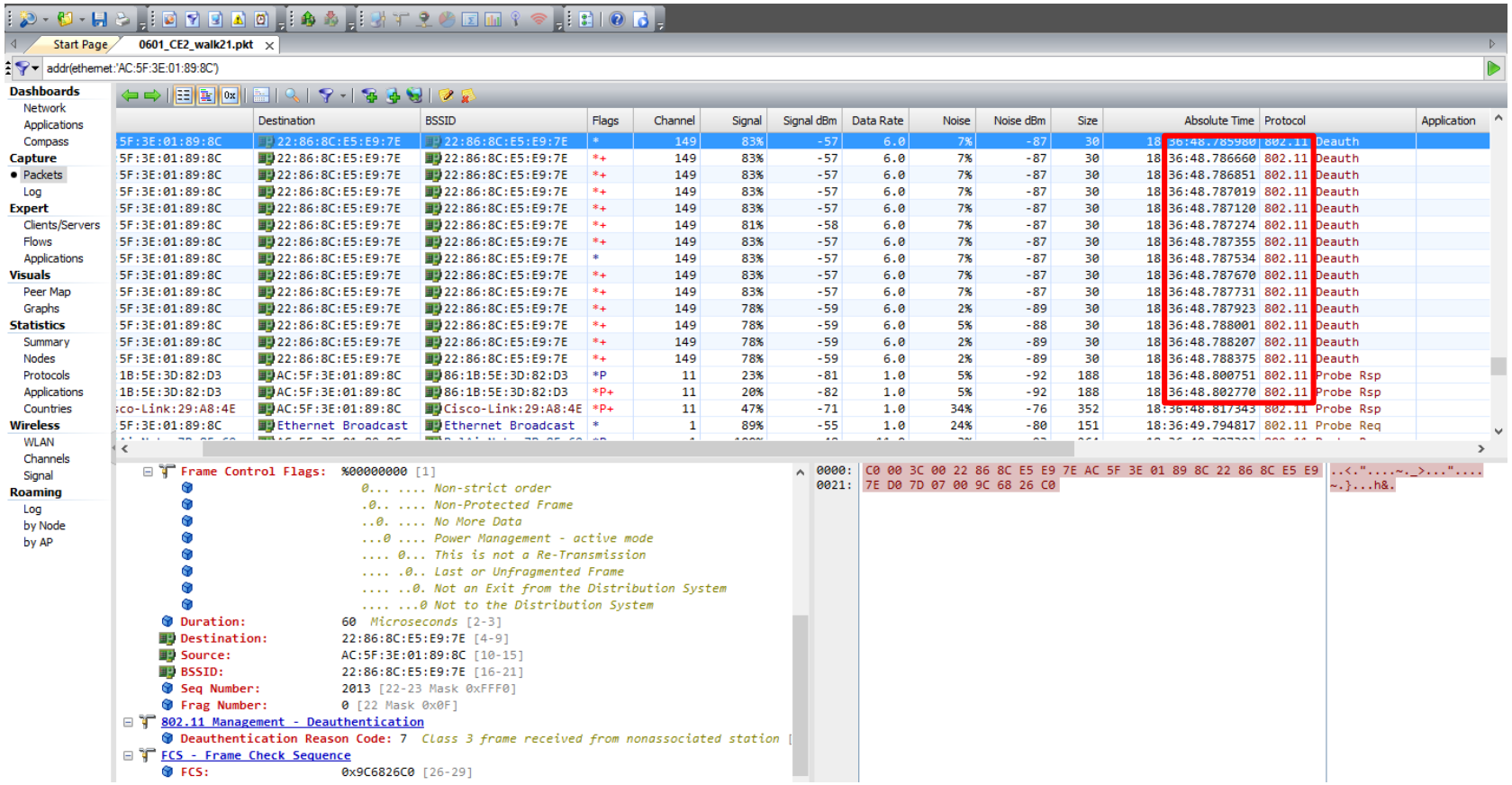
# Sample Outputs

# Mobility 2_1 – Edge




It seems as if the AP is allowing your client to Authenticate and Associate, and then a moment later, when the client starts sending real data traffic ("Class 3 frames"), the AP acts as if the client wasn't associated, and kicks it off the network (deauthenticates it).

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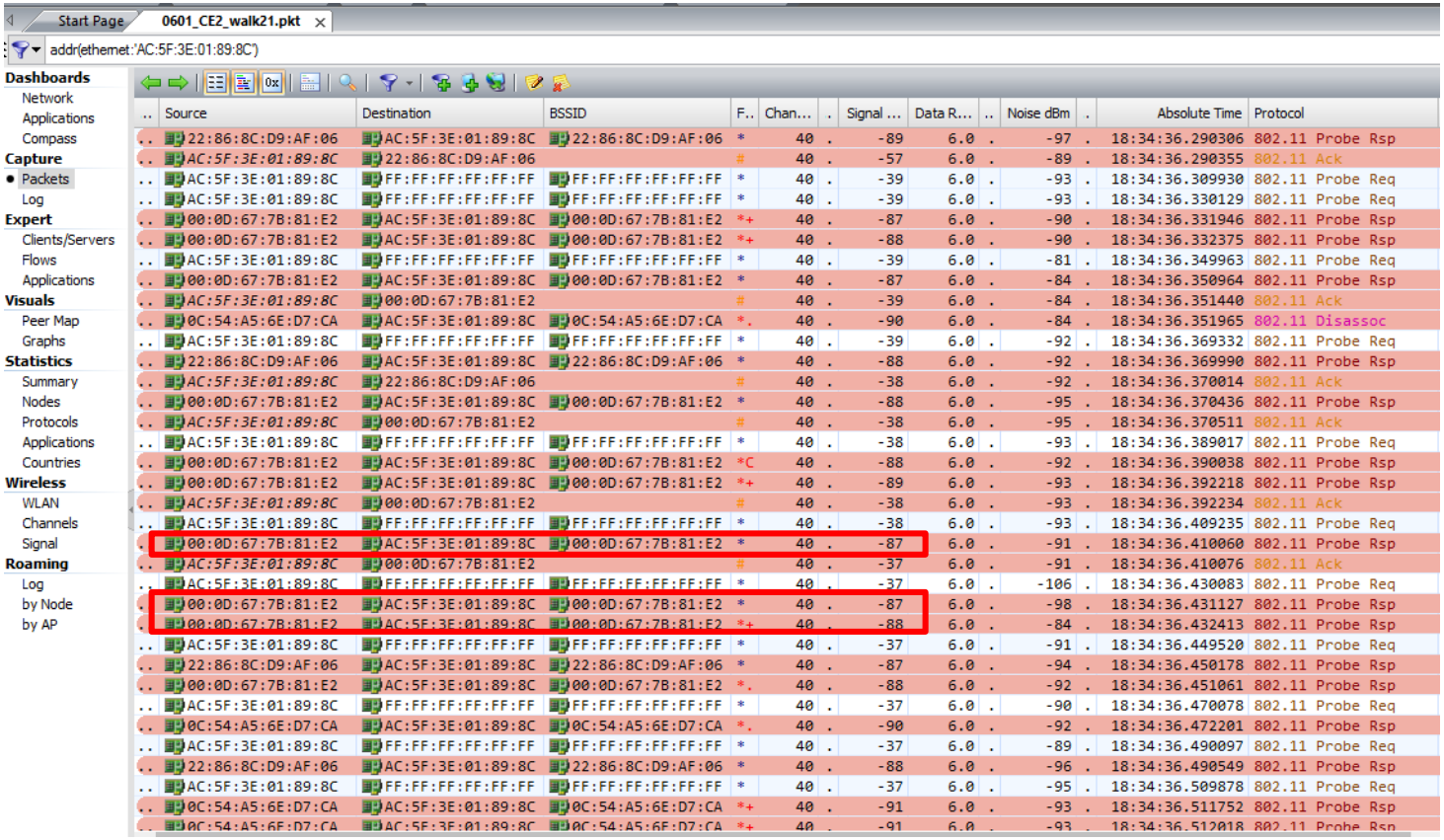
# Mobility 2_1 – Edge continued




Also before the Authentication took place, UE was not able to associate on the network. It send multiple Probe requests, but didn't receive any response. Also as seen from the screenshot the RSSI in downlink is very low. Indicating that the UE was in poor coverage area.

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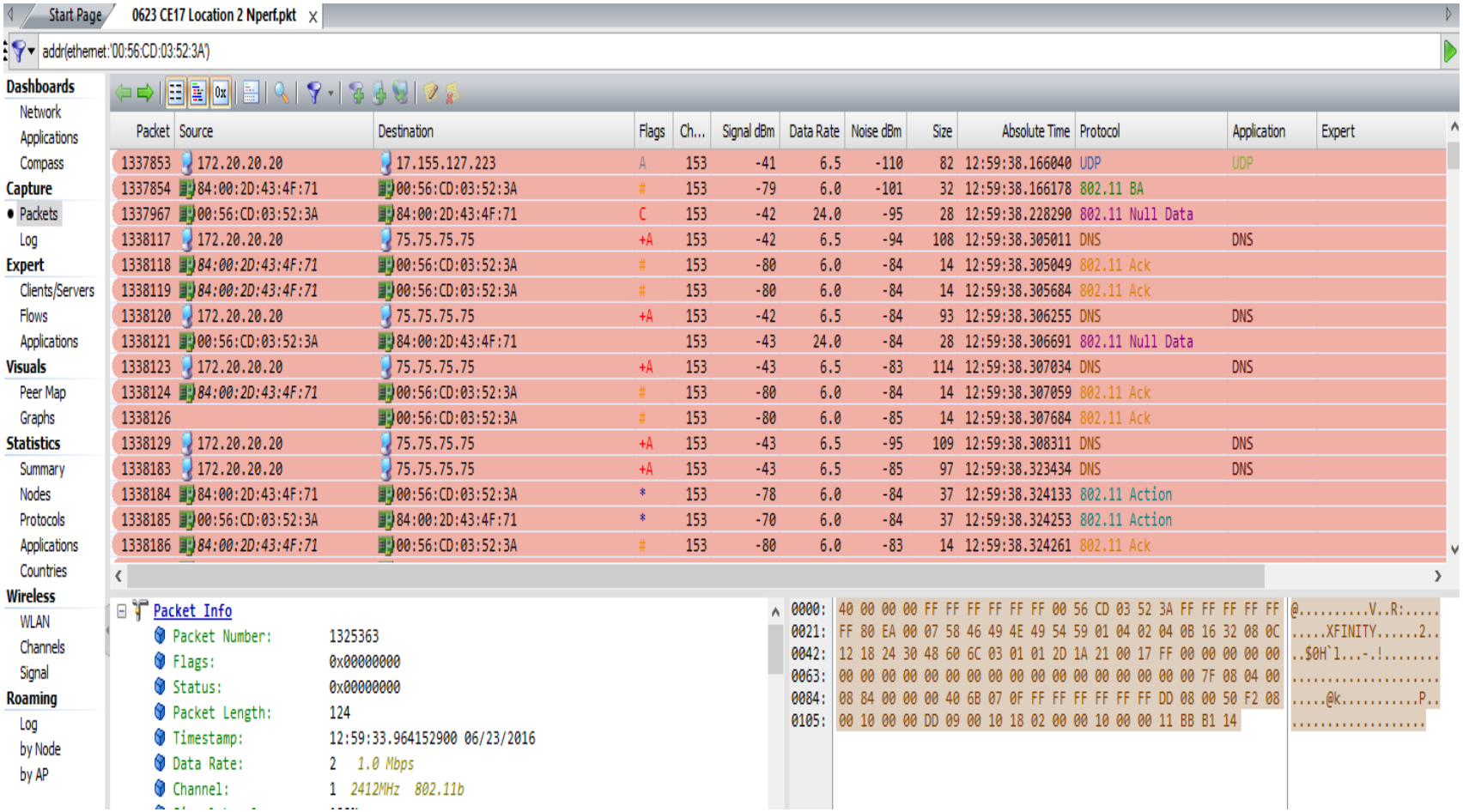
# CE17 Loc 2 - Nperf – iPhone6s – Weak Indoor Signal




**All devices worked fine, however performance could have been better, as this area had coverage from indoor routers, which were bleeding out on the street, outdoor AP signal was relatively weaker (below -80dBm). Slow performance is due to indoor signal weak coverage on the street.**

**Here we can see iphone6 (52:3A) and indoor router (4f:71) are communicating on channel 153, which has poor singal strength around (-80dBm) from router. Packets communication is happening well, however throughput is suffering due to low signal strength. This is the common reason seen across some devices which camped on ch. 153 from this indoor router. Root cause for poor Wifi performance at this location is weak indoor signal.**

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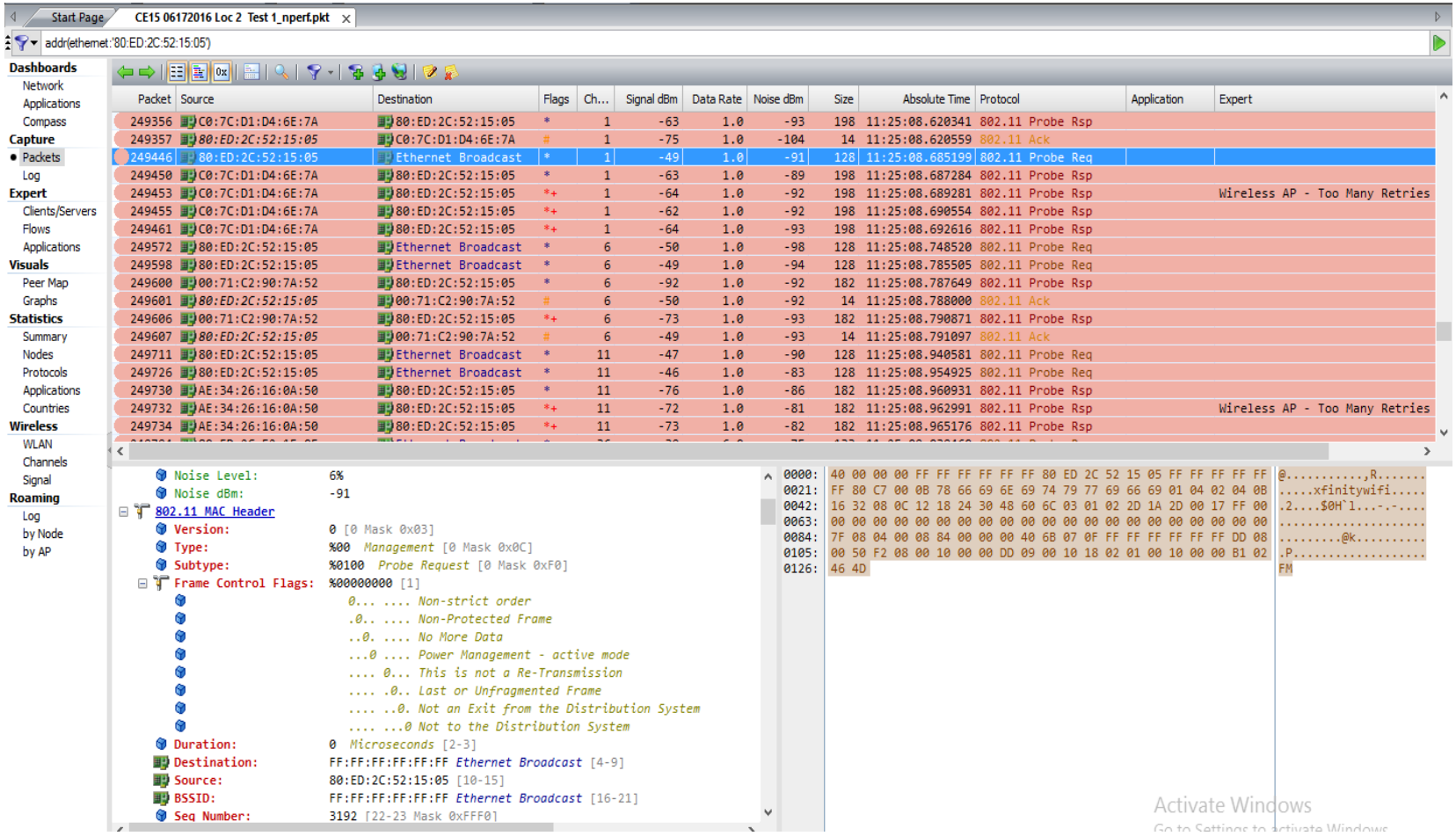
# CE15 Loc 2 - Nperf – iPhone6s+ – Poor Channel Selection




At this location, channel 11 and 157 are dominant channels as best server. However, device tried to connect to channel 1 which seems to be some indoor router coverage from above residential floors reaching inside shop, and it is not able to get the IP due to multiple probe requests on this channel. It is able to get probe response, but not able to get IP assigned. It will try to connect to other similar poor channel/AP (e.g. 6) as seen in attached screenshot in PPT. But it fails to connect to dominant channels ch. 11 and 157.

**Here we can see iphone6s+ (15:05) device was not able to get any authentication messages after getting probe response on channel 1 and then it tries to connect to channel 6 and other multiple channels, it was only this device which is trying to connect to channel 1 and it is not able to get the IP. So Poor channel selection is the reason.**

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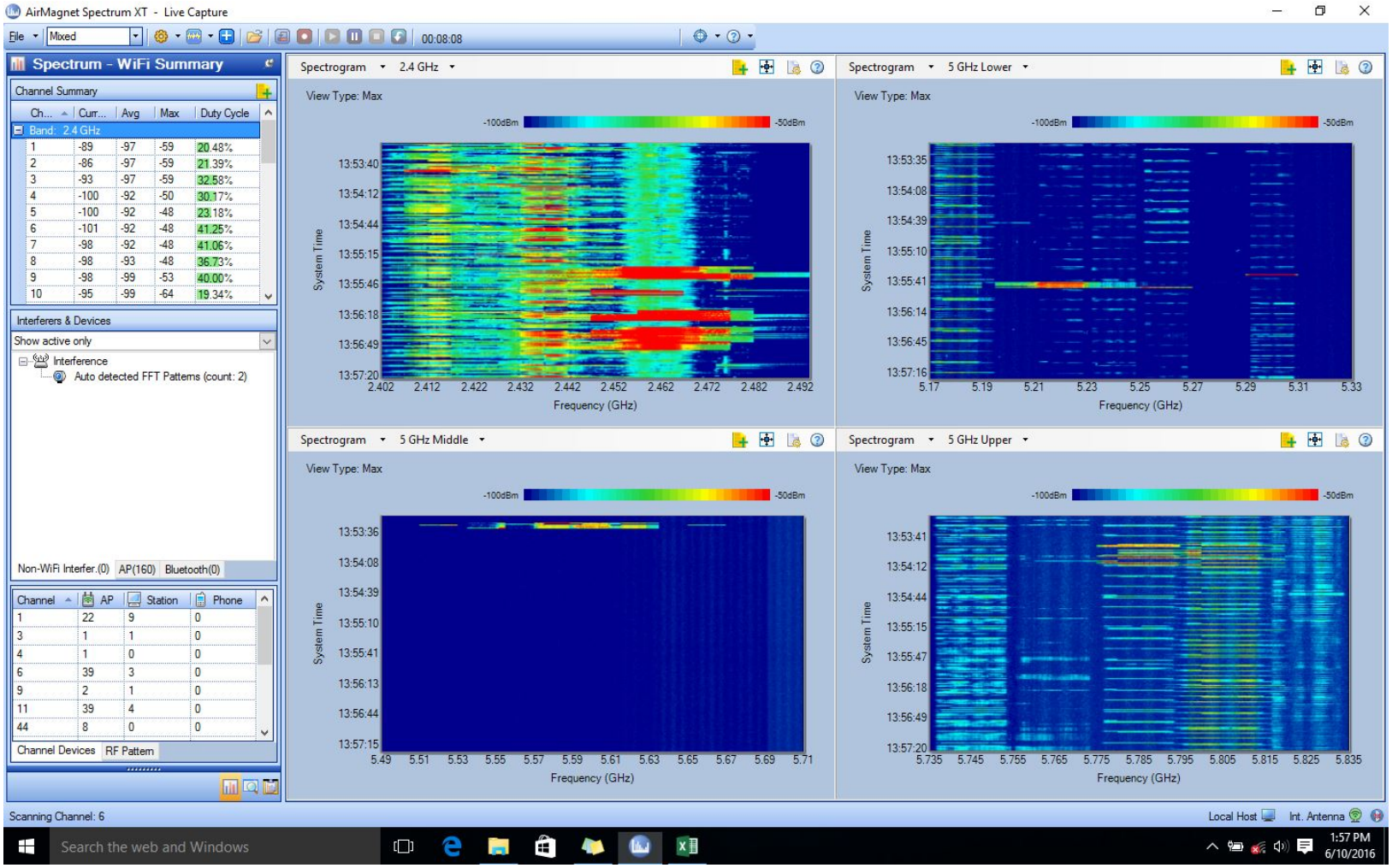
# Spectrum Sample – non-busy 5 GHz



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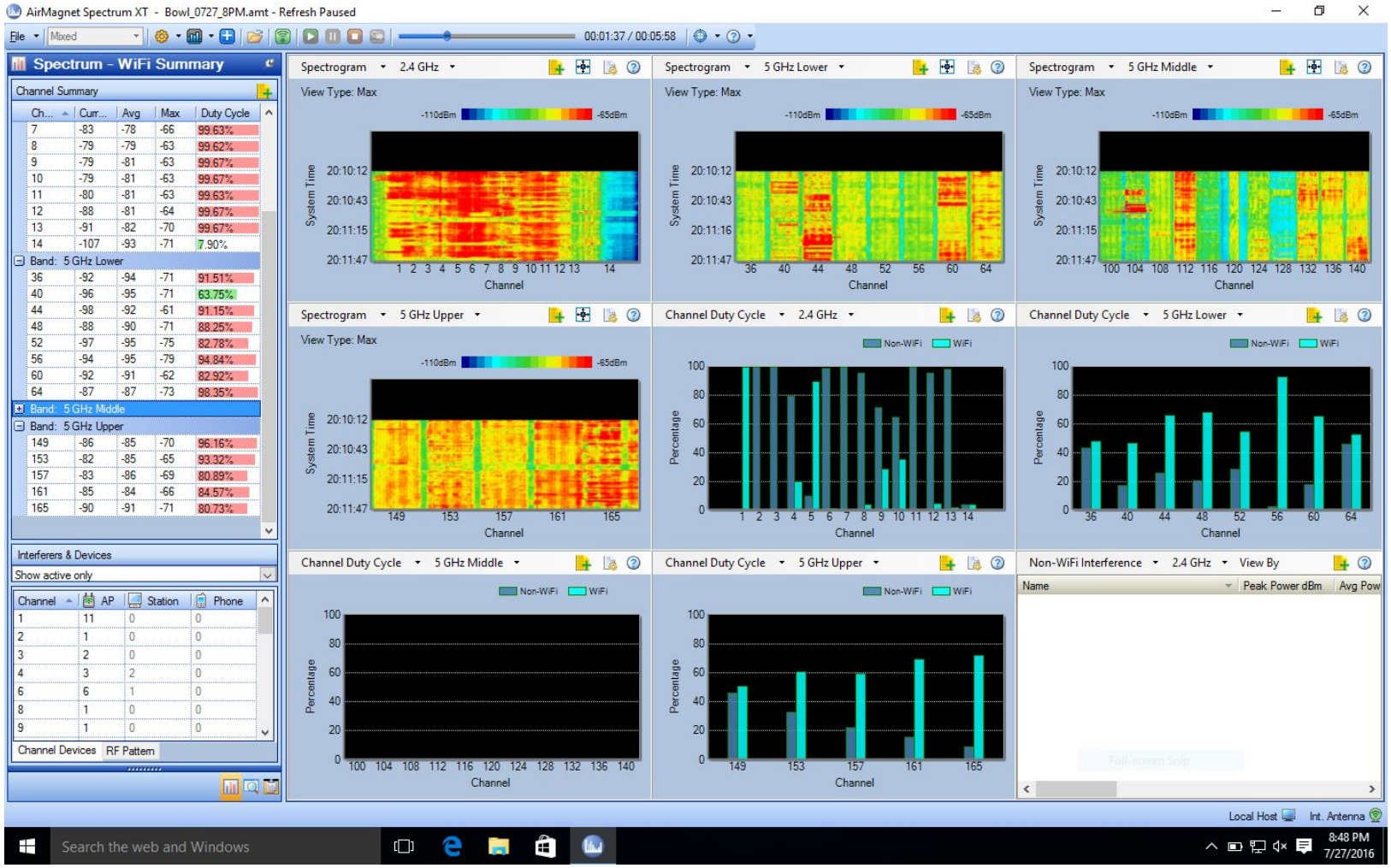
# Spectrum Sample – All channels full



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# Apple Logs Sample – Developer Account required

```
06/23/16 13:25:26.934 <NOTICE>: Attempting Apple80211ScanAsync on en0
06/23/16 13:25:27.203 <NOTICE>: __WiFiLQAMgrLogStats: Rssi: -86 Cca: 56 TxPer: 100.0% (3) BcnPer: 58.6% (29) RxFrms 0 TxRate: 13000 RxRate: 4294967295
06/23/16 13:25:27.203 <DEBUG>: Boolean __WiFiLQAMgrCheckTriggerDisconnect(WiFiLQAMgrRef, CFIndex, CFIndex):__WiFiLQAMgrCheckTriggerDisconnect: Better inf not available
06/23/16 13:25:29.604 <DEBUG>: Boolean __WiFiLQAMgrCheckTriggerDisconnect(WiFiLQAMgrRef, CFIndex, CFIndex):__WiFiLQAMgrCheckTriggerDisconnect: Better inf not available
06/23/16 13:25:30.557 <NOTICE>: Completed Apple80211ScanAsync on en0 (0x0)
06/23/16 13:25:30.576 <NOTICE>: Async scan request completed for "AirPort" (0)
06/23/16 13:25:31.810 <NOTICE>: Async scan requested by "AirPort" for 0 iterations with maxage=0 priority normal on en0
06/23/16 13:25:31.811 <NOTICE>: Enqueuing command type: "Scan" pending commands: 0
06/23/16 13:25:31.811 <NOTICE>: Dequeuing command type: "Scan" pending commands: 0
06/23/16 13:25:31.811 <NOTICE>: Attempting Apple80211ScanAsync on en0
06/23/16 13:25:32.204 <DEBUG>: Boolean __WiFiLQAMgrCheckTriggerDisconnect(WiFiLQAMgrRef, CFIndex, CFIndex):__WiFiLQAMgrCheckTriggerDisconnect: Better inf not available
06/23/16 13:25:35.427 <NOTICE>: Completed Apple80211ScanAsync on en0 (0x0)
06/23/16 13:25:35.448 <NOTICE>: Async scan request completed for "AirPort" (0)
06/23/16 13:25:36.841 <NOTICE>: Async scan requested by "AirPort" for 0 iterations with maxage=0 priority normal on en0
06/23/16 13:25:36.842 <NOTICE>: Enqueuing command type: "Scan" pending commands: 0
06/23/16 13:25:36.842 <NOTICE>: Dequeuing command type: "Scan" pending commands: 0
06/23/16 13:25:36.842 <NOTICE>: Attempting Apple80211ScanAsync on en0
06/23/16 13:25:37.210 <NOTICE>: __WiFiLQAMgrLogStats: Rssi: -80 Cca: 59 TxPer: 100.0% (3) BcnPer: 41.2% (34) RxFrms 0 TxRate: 13000 RxRate: 4294967295
06/23/16 13:25:37.210 <DEBUG>: Boolean __WiFiLQAMgrCheckTriggerDisconnect(WiFiLQAMgrRef, CFIndex, CFIndex):__WiFiLQAMgrCheckTriggerDisconnect: Better inf not available
06/23/16 13:25:40.469 <NOTICE>: Completed Apple80211ScanAsync on en0 (0x0)
06/23/16 13:25:40.486 <NOTICE>: Async scan request completed for "AirPort" (0)
06/23/16 13:25:41.386 <NOTICE>: Async scan requested by "AirPort" for 0 iterations with maxage=0 priority normal on en0
06/23/16 13:25:41.386 <NOTICE>: Enqueuing command type: "Scan" pending commands: 0
06/23/16 13:25:41.387 <NOTICE>: Dequeuing command type: "Scan" pending commands: 0
06/23/16 13:25:41.387 <NOTICE>: Attempting Apple80211ScanAsync on en0
06/23/16 13:25:42.215 <NOTICE>: __WiFiLQAMgrLogStats: Rssi: -80 Cca: 61 TxPer: 100.0% (3) BcnPer: 52.9% (17) RxFrms 0 TxRate: 6500 RxRate: 4294967295
06/23/16 13:25:42.216 <DEBUG>: Boolean __WiFiLQAMgrCheckTriggerDisconnect(WiFiLQAMgrRef, CFIndex, CFIndex):__WiFiLQAMgrCheckTriggerDisconnect: Better inf not available
06/23/16 13:25:45.007 <NOTICE>: Completed Apple80211ScanAsync on en0 (0x0)
06/23/16 13:25:45.035 <NOTICE>: Async scan request completed for "AirPort" (0)
06/23/16 13:25:46.235 <NOTICE>: Async scan requested by "AirPort" for 0 iterations with maxage=0 priority normal on en0
06/23/16 13:25:46.235 <NOTICE>: Enqueuing command type: "Scan" pending commands: 0
06/23/16 13:25:46.236 <NOTICE>: Dequeuing command type: "Scan" pending commands: 0
06/23/16 13:25:46.236 <NOTICE>: Attempting Apple80211ScanAsync on en0
06/23/16 13:25:47.217 <NOTICE>: __WiFiLQAMgrLogStats: Rssi: -80 Cca: 60 TxPer: 0.0% (0) BcnPer: 0.0% (0) RxFrms 0 TxRate: 0 RxRate: 0
06/23/16 13:25:47.217 <DEBUG>: Boolean __WiFiLQAMgrCheckTriggerDisconnect(WiFiLQAMgrRef, CFIndex, CFIndex):__WiFiLQAMgrCheckTriggerDisconnect: Better inf not available
06/23/16 13:25:49.845 <NOTICE>: Completed Apple80211ScanAsync on en0 (0x0)
06/23/16 13:25:49.864 <NOTICE>: Async scan request completed for "AirPort" (0)
```

Read more here by Ryan Adzima:
https://community.arubanetworks.com/t5/Technology-Blog/Tools-for-Troubleshooting-from-the-Client-Revisited/bc-p/275482#M1183



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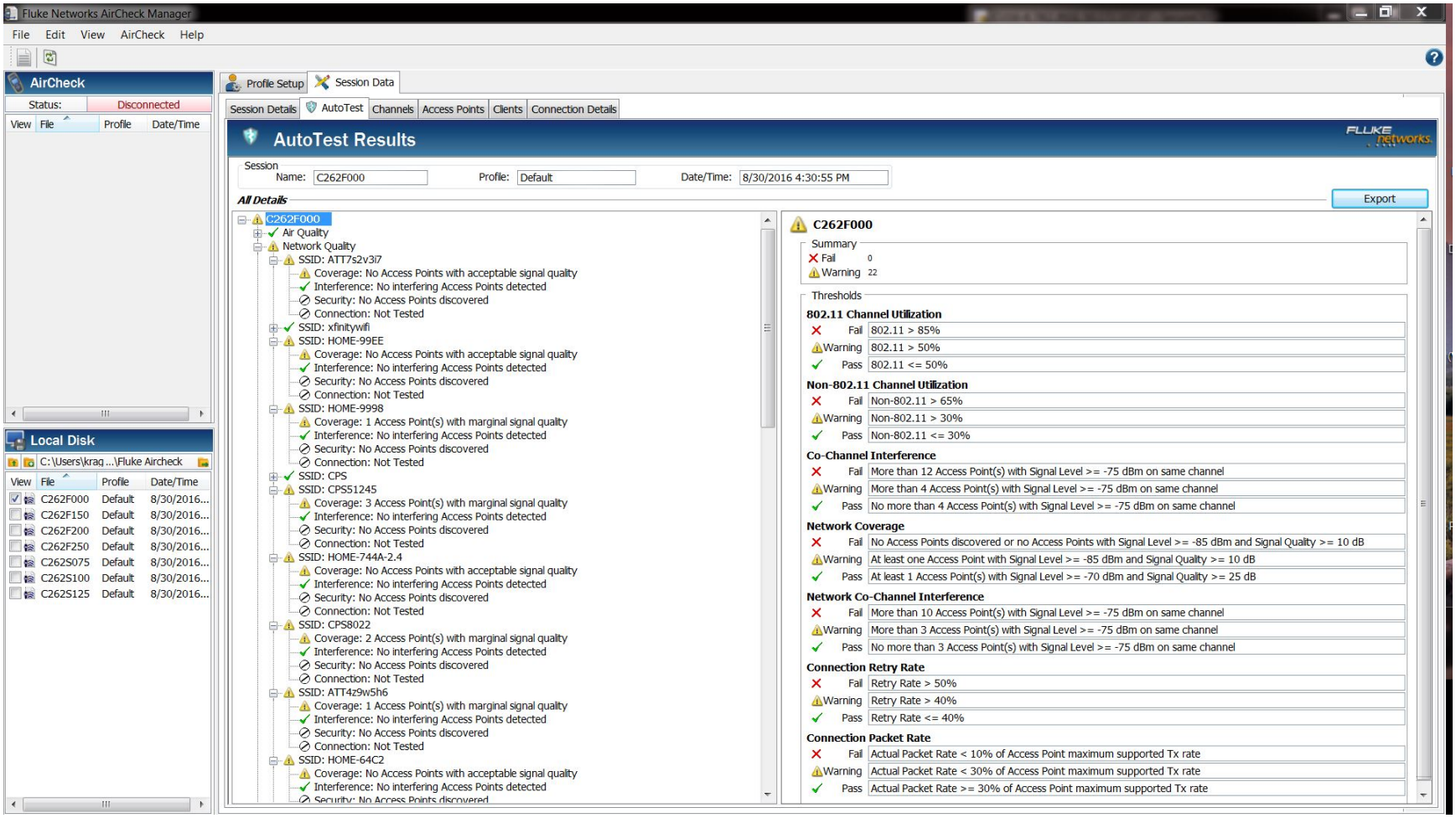
# AirCheck Data



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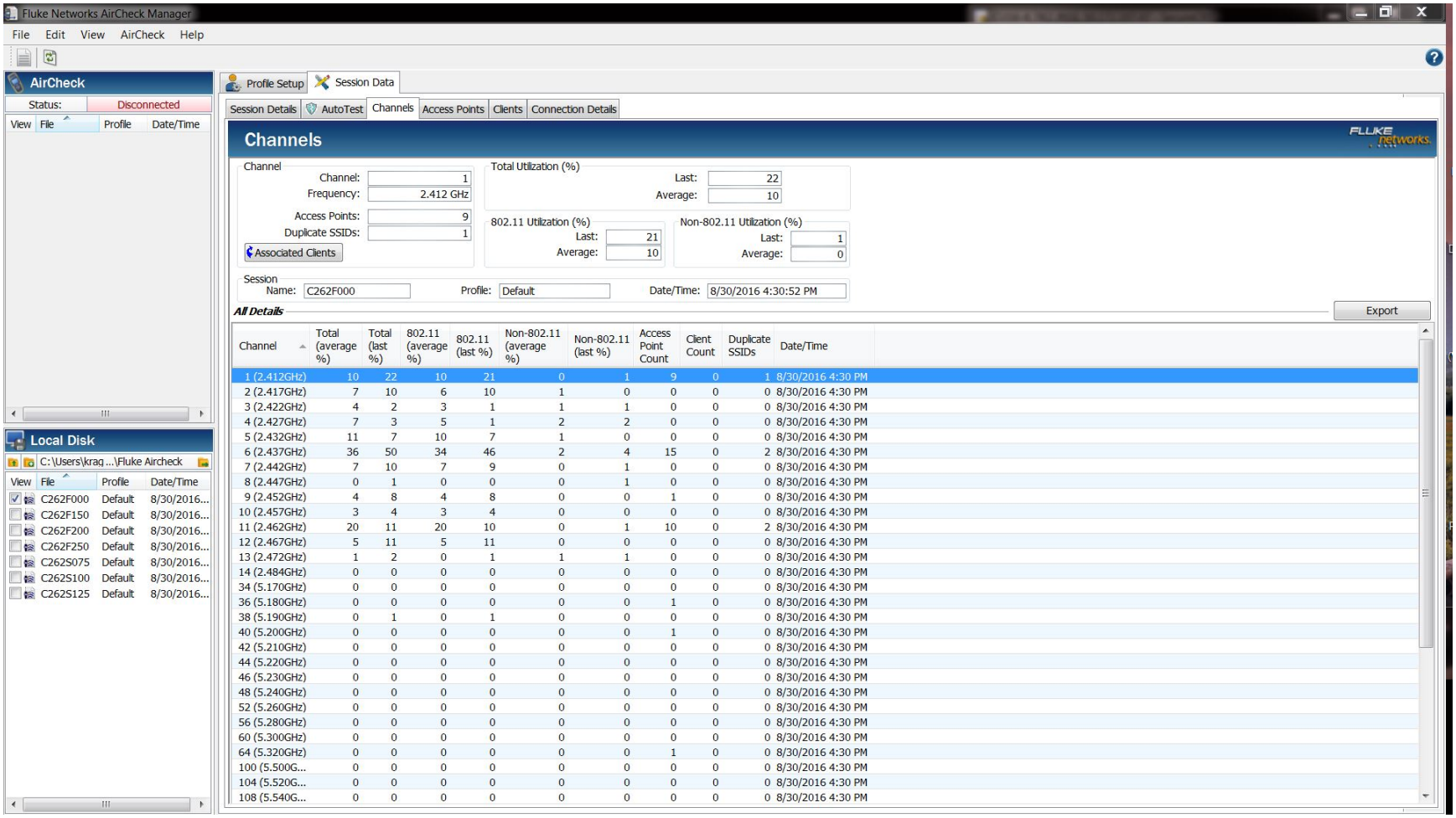
# AirCheck Data



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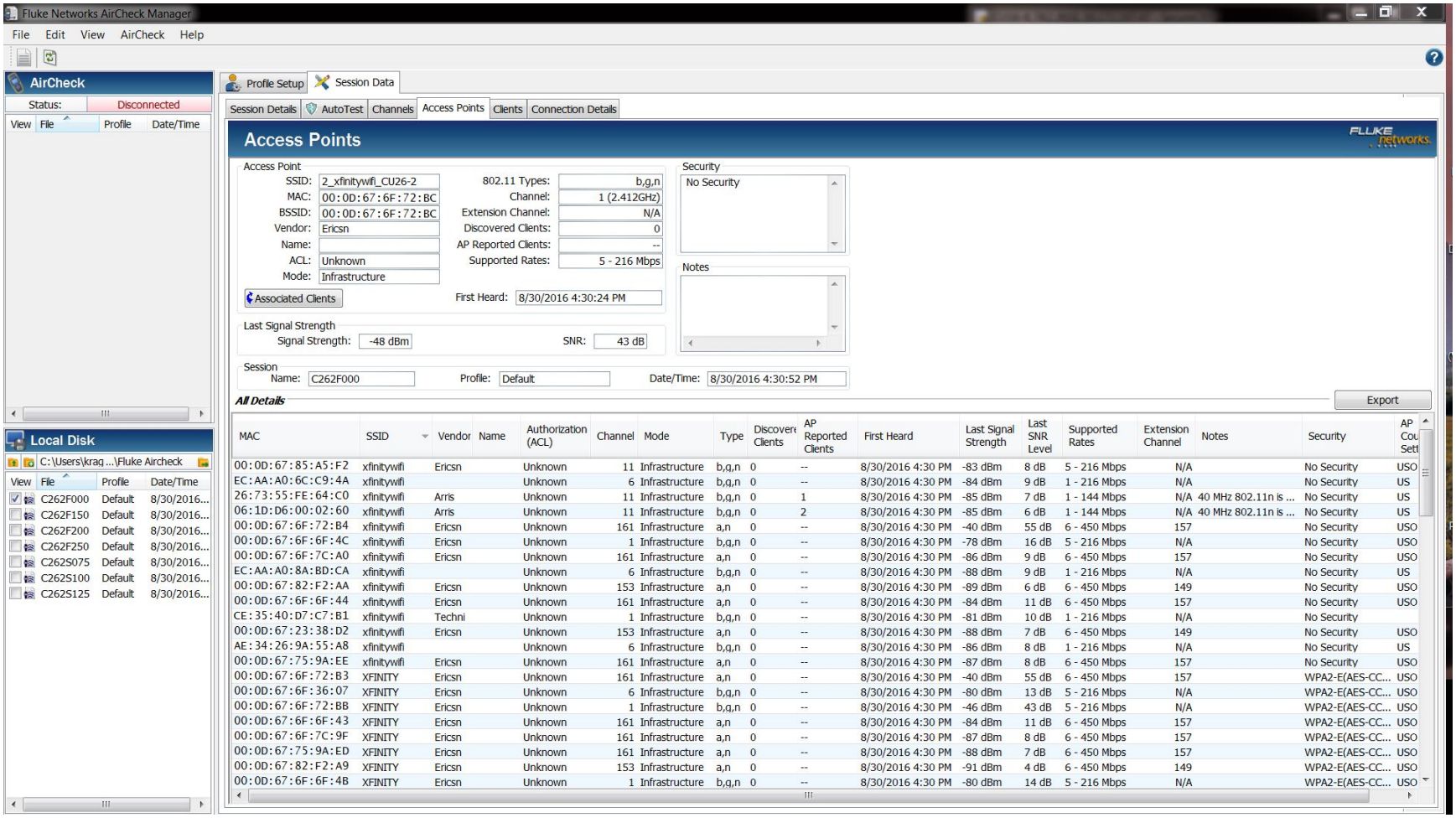




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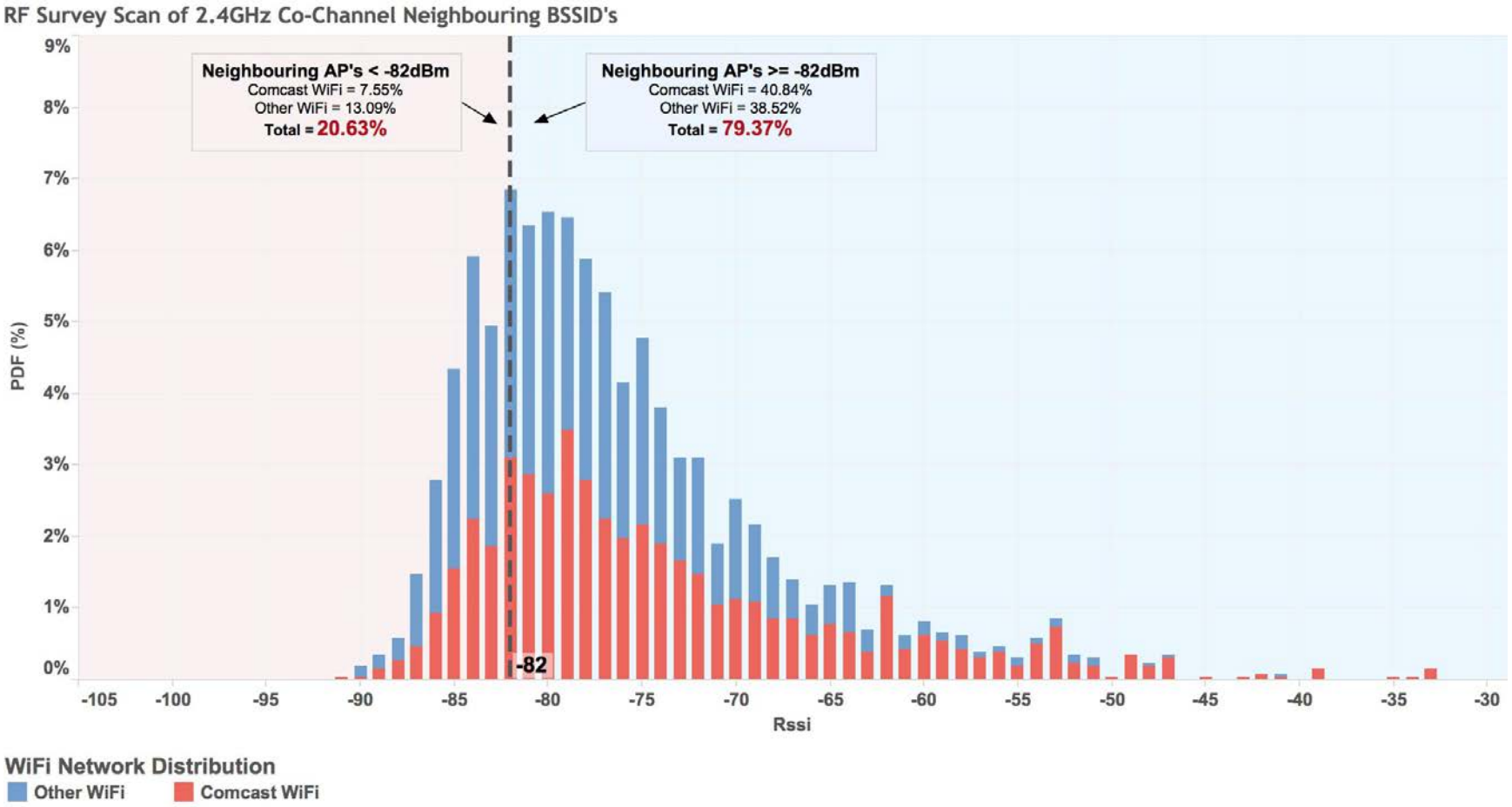
# Focus of control



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