



Introduction:

360°RF was retained to perform an onsite RF survey of the operative network frequencies used by the store's pricing guns and related. Aided by precision equipment such as logging spectrum analyzers and other specialized test setups, the test administrator performed onsite precision measurements and related. The resultant data and how it was measured and analyzed with respect field strength, interference, and RF optimization follows.

Store

Location:

360°RF Site Visit: 20xx

Reported Condition: Poor 2.4 GHz ISM connectivity in store corner, etc. Store served by 5 dispersed Cisco APs.

Site Survey: Storewide WiFi RF Environment

Test | Measure | Analyze

- Active Frequencies and Field Strength
- Investigation of Discovered Interference
- Reporting Post Field Testing

Findings:

360°RF visited the ...store (#...) on ... 20xx. A detailed spectrum and wireless Local Area Network (LAN) survey was performed and **no significant interferers were found—including an instance during an analyzer scan when a reader disconnection event was reported.**

Frequency Planning to Avoid Neighbors

The nail shop "... Nails" shares a common wall with the store's warehouse. This shop operates a wireless LAN on channel 6. The warehouse was inaccessible during our visit as it was literally packed with merchandise with no path available to move through it. While 360°RF was unable to do a survey in the warehouse area, it is clear that the "...Nails" LAN will have a strong signal in the warehouse and therefore channel 6 should be avoided in the warehouse. A second LAN on channel six was identified as "... Dentistry" was only occasionally observed and was always weaker than "...Nails." A business with such a name is across ... Street from the store.

Another LAN that identified as 2wire558 on channel 8 (which overlaps channels 6 and 11) was observed from the office, but weak on the store floor. Informal investigation indicates that this LAN is in the "... Grill" on the other side of the nail shop from the store. This will probably not be a significant source of interference in the warehouse, but channel one is probably the best choice in the warehouse.

Transient Interferers

Several LANs appeared briefly as “FORDsyncxxxx” where xxxx was a number. These correlated to the appearance of new model Ford vehicles parked at the front of the store. The LANs appeared to shut down a few minutes after the vehicle was parked.

AirMagnet

In the process of initial survey of the store, an “AirMagnet” unit was discovered in the center of the store near AP1. This unit is intended to help identify and manage wireless LAN threats. In addition to monitoring for ‘rogue’ (unauthorized by user) access points, the manufacturer claims to support “true spectrum analysis.” If the manufacturer’s claims are accurate, most of the functions performed by 360°RF could be accomplished remotely. The one exception to this is the ability to move about the store.



Figure 1 AirMagnet 5020 Sensor

AP5 As Built

AP5 should have been located in the warehouse according to Figure 3 shown on page 4. The actual location of the AP is above the entry to the break room. See Figure 2, below. This may have been caused by the fact that the warehouse entry doors are not located as shown on the drawing in Figure 3, and instead are set back from the location shown in the drawing. Ideally this AP should be located in the center of the warehouse or slightly toward the front of the store.

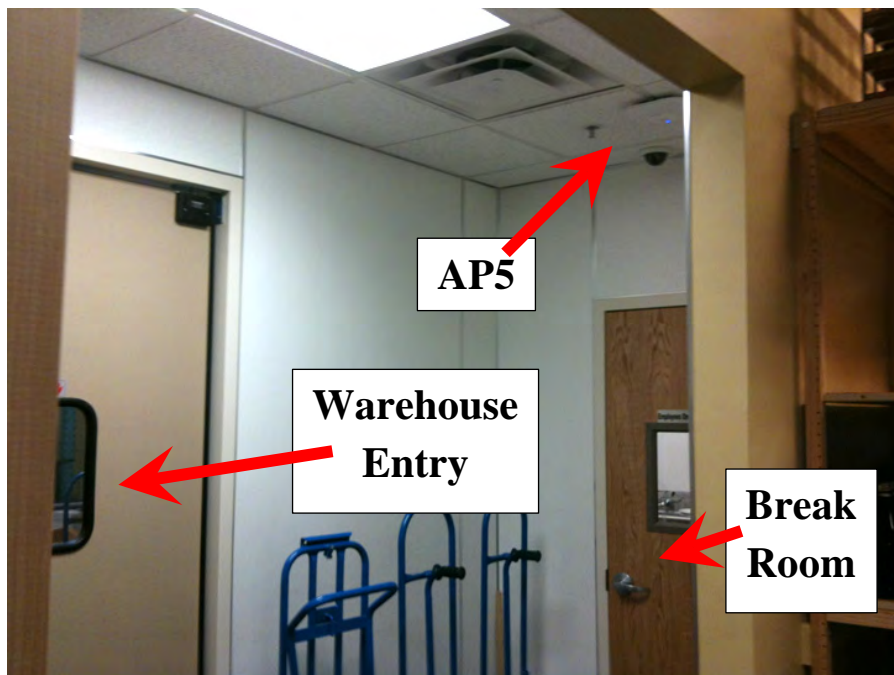


Figure 2 AP5 Location

External Survey

After completing the in store survey, 360°RF walked the entire exterior perimeter of the building looking for narrowband 2.4 GHz interference sources—none of any significance were identified.

Network Capacity

Store personnel indicated that network capacity is limited to 4 Motorola handheld readers and ... confirmed this understanding—such capacity seems very low. The handheld devices are not sending much data, and each access point can handle far more simultaneous users (several hundred.)

It is clear from on-air observations that each access point is providing four virtual radios/SSIDs per band. While the access points are entirely capable of doing this, they each seem to be configured for different 802.11 standards revisions. While all of this is possible, none of it should be required for an installation of this type. It hints at configuration challenges that can leave the network brittle and easily interrupted by interferers.

Table 1 Access Point Data			
AP Name	Channels	Base Radio MAC	AP MAC Address
364:AP1	11, 157	18:33:9d:f8:bd:80	a4:93:4c:c2:58:11
364:AP2	1, 149	58:97:1e:22:d3:40	e4:d3:f1:8f:d9:44
364:AP3	1, 149	34:bd:c8:da:a1:e0	30:f7:0d:92:5f:1b
364:AP4	6, 165	20:3a:07:0c:10:20	60:73:5c:2f:61:4c
364:AP5	11,36	20:3a:07:0d:34:c0	60:73:5c:2f:68:46
364:AP6	Disabled	Not observed, disabled	Not observed, disabled

Other Antennas

Two apparent antennas were located roughly midway between the location AP2 and AP6. 360 could detect no energy from these in the 2.4 or 5 GHz bands. Their purpose is unclear.



Figure 3 Unknown Antennas

Recommendations for Future Visits

It is most efficient to have store and AP layout, channel plan, and AP radio mac addresses in advance. 360°RF did find it necessary to spend quite a bit of time identifying and confirming friendly APs.

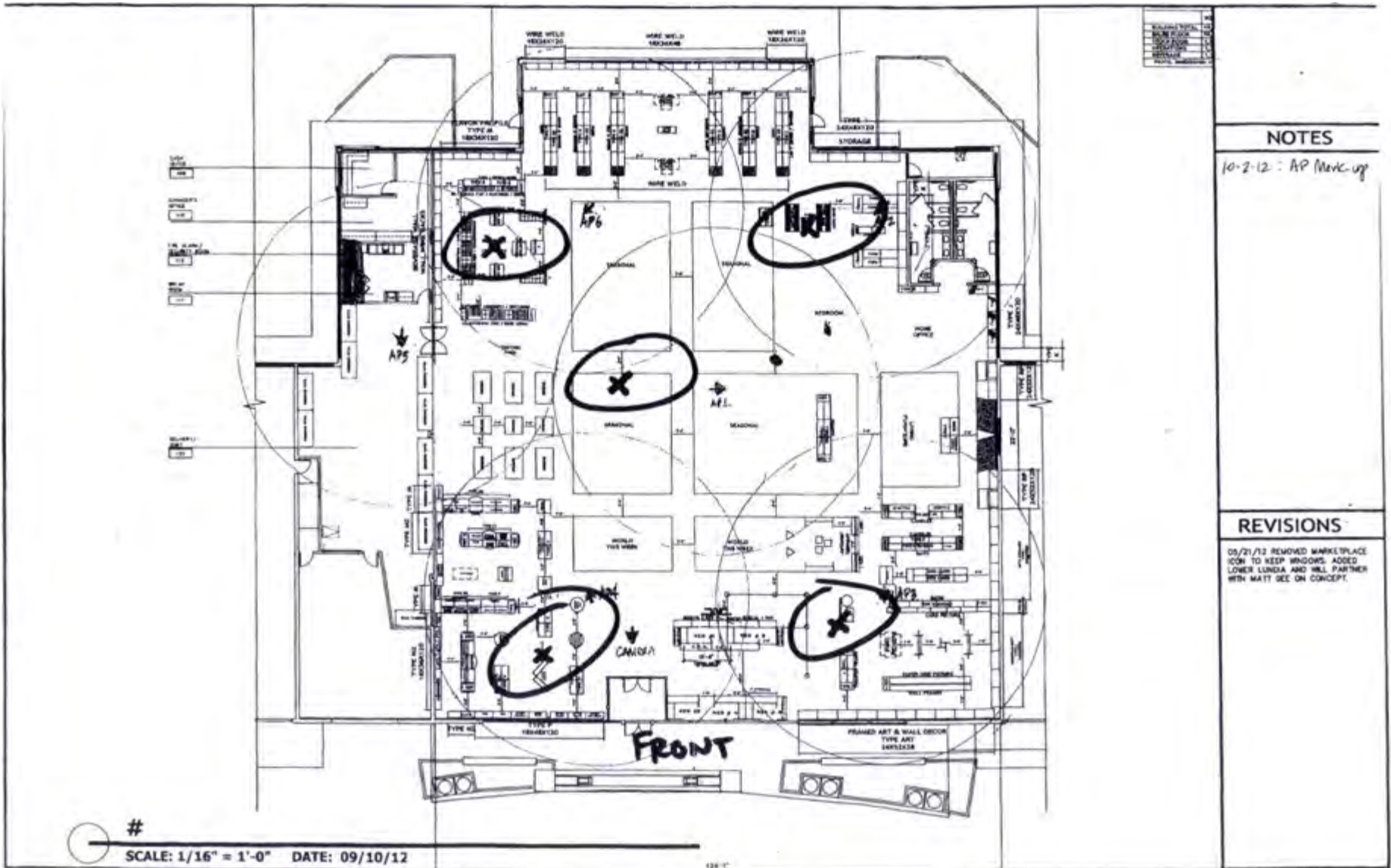


Figure 4 ... Store #555 Layout

Appendix 1: Scan Images and Tabular Data

Data was collected by two methods, scanning spectrum with a calibrated handheld spectrum analyzer for narrowband interference sources, and using the inSSIDer application on a laptop to scan for 802.11 wireless LANs.

Scans were performed from locations under access points and at the rearmost corners of the store. Scans were taken under access points to provide a readily identifiable location, look at the signal level of *other* access points, and signal levels of potential inference sources.

Peak signal measurements were made using the MAX HOLD (maximum hold function that stores the peak values received) in all directions for a location. The MAX HOLD values are the red traces. **No significant sources of interference were identified.**

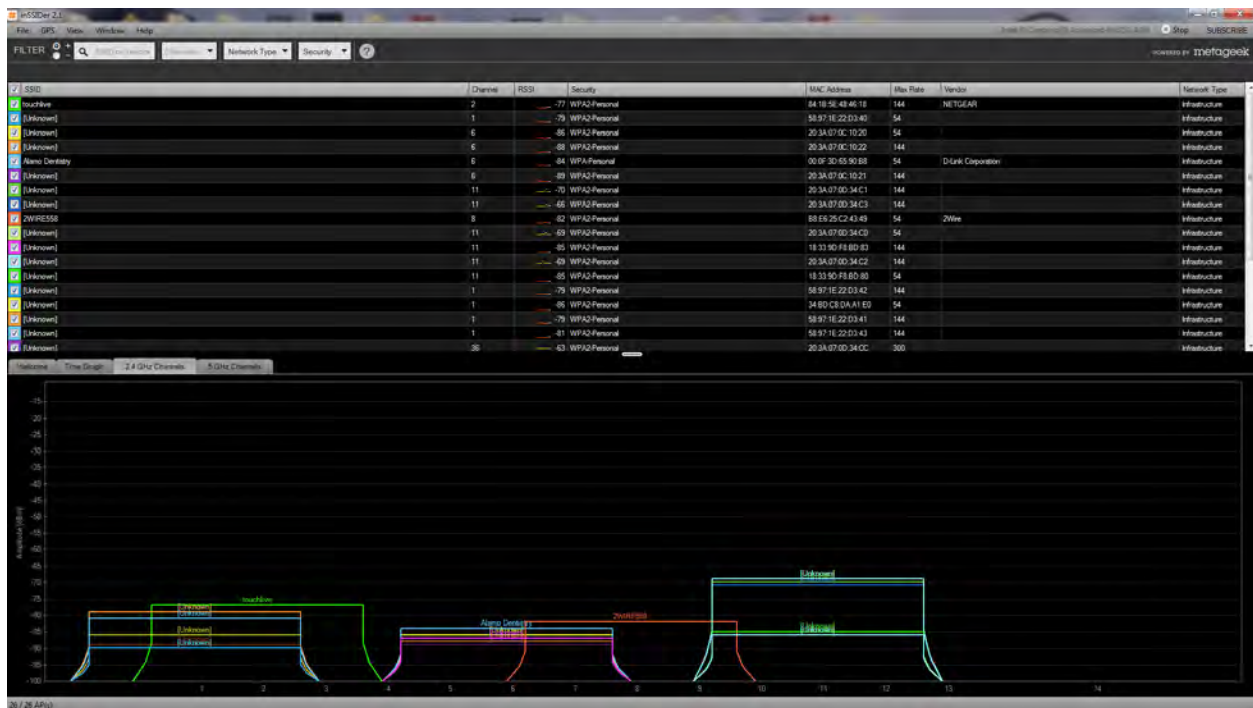


Figure 5 WLAN view at 0630 on 10 NOV 20xx from Office

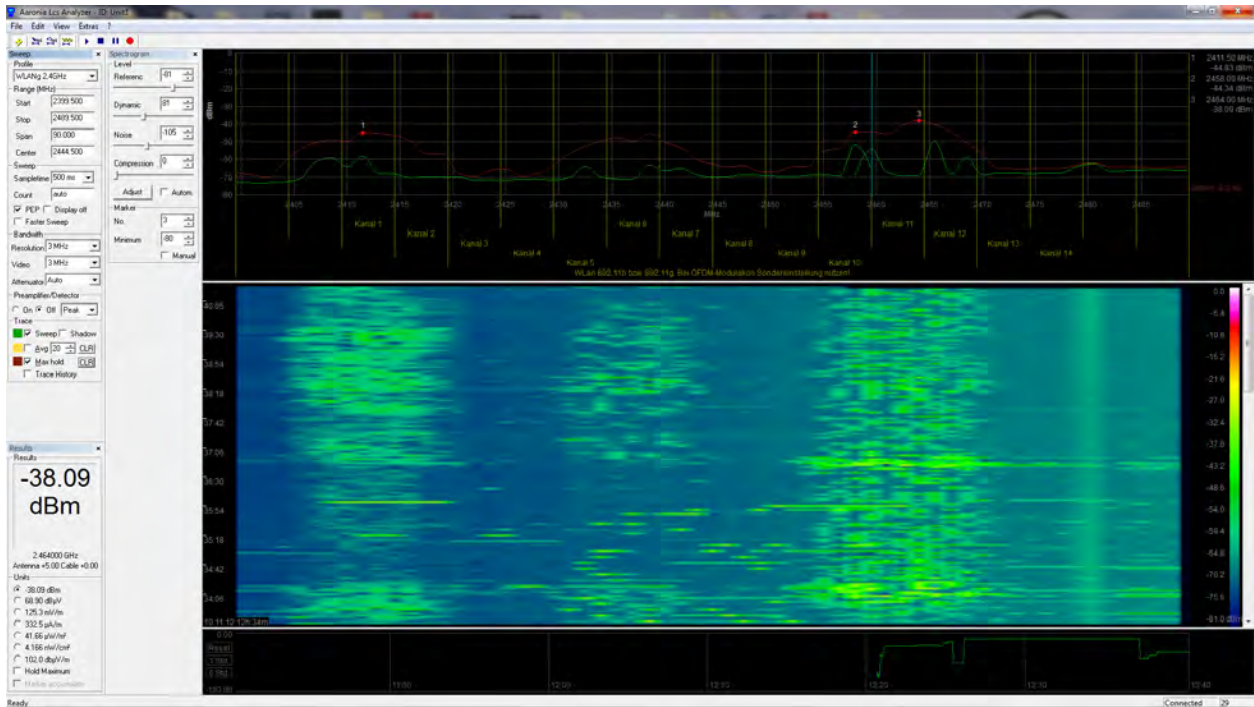


Figure 6 Peak signals under AP6 (disabled) 10:41 AM

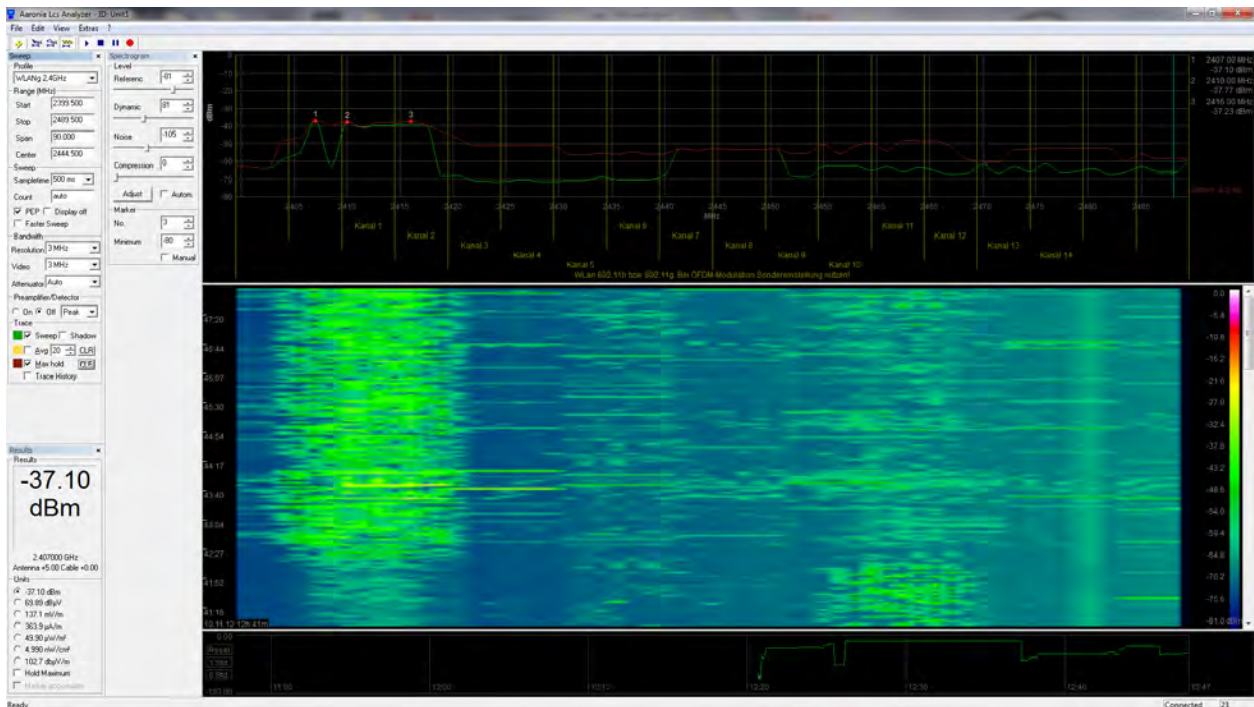


Figure 7 Peak Signals Near AP2 (not practical to block aisle beneath)

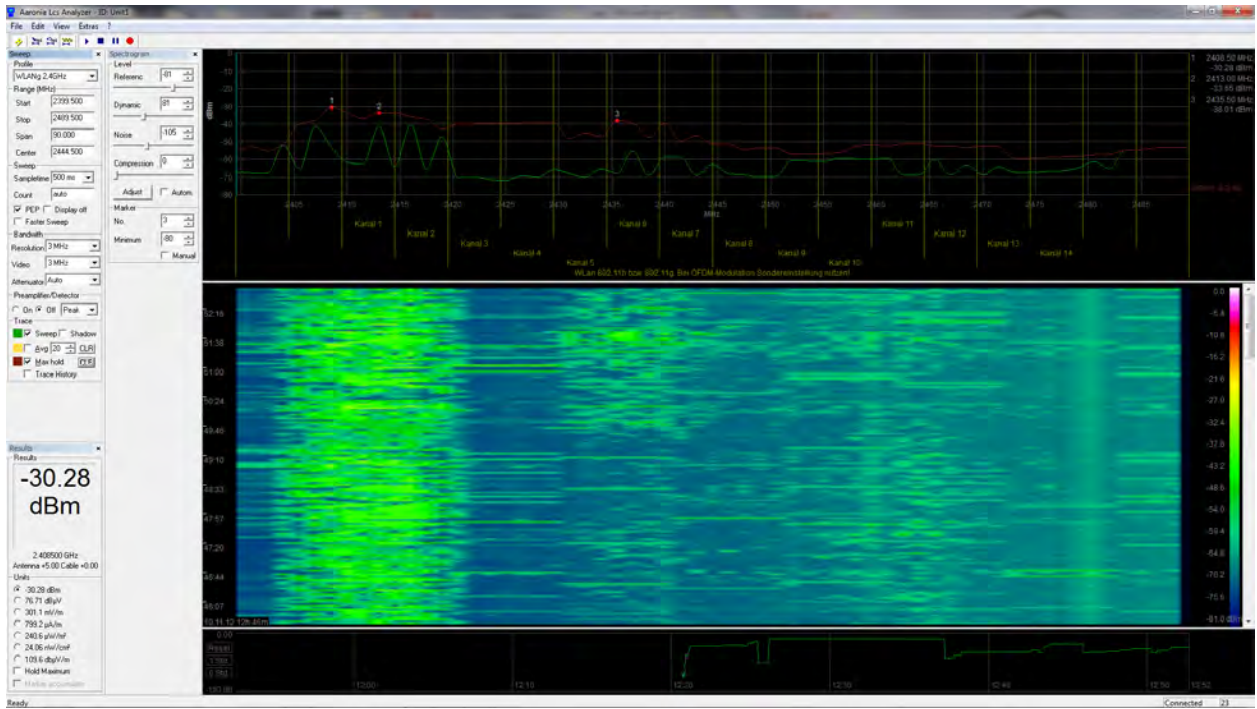


Figure 8 Peak Signals Beneath AP3

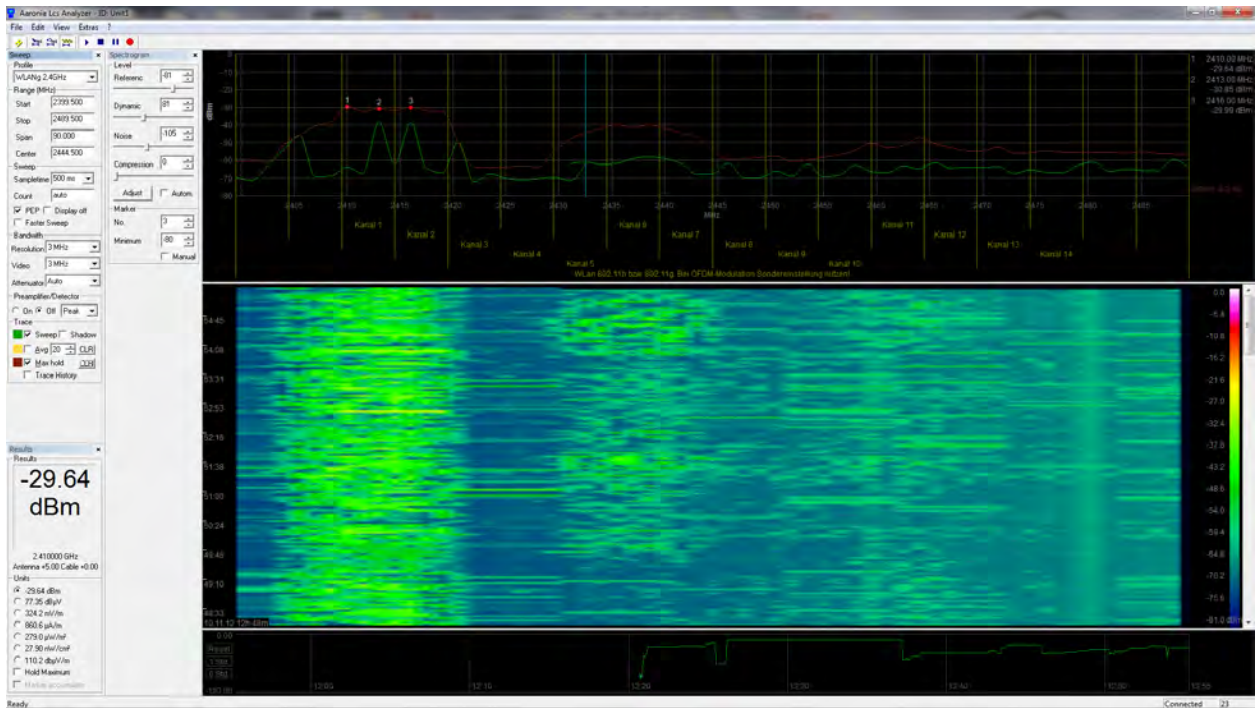


Figure 9 Peak energy Beneath AP3 facing AP4

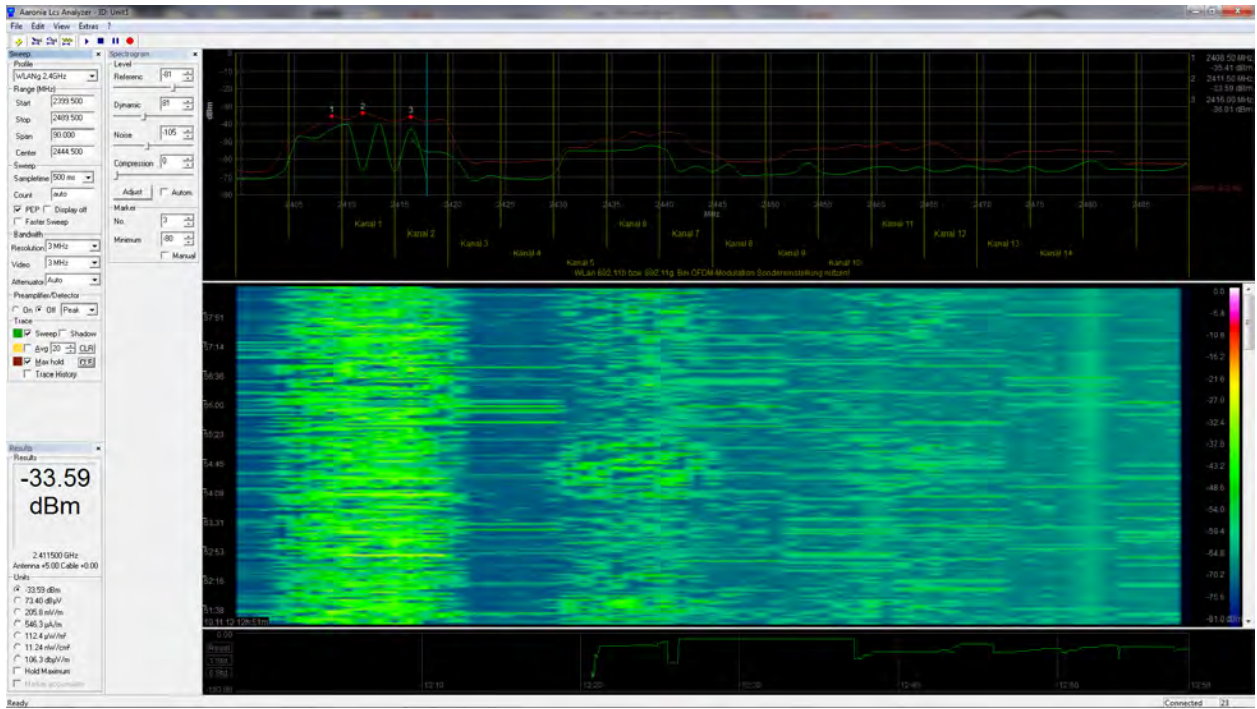


Figure 10 Peak signals Under AP3 facing AP1

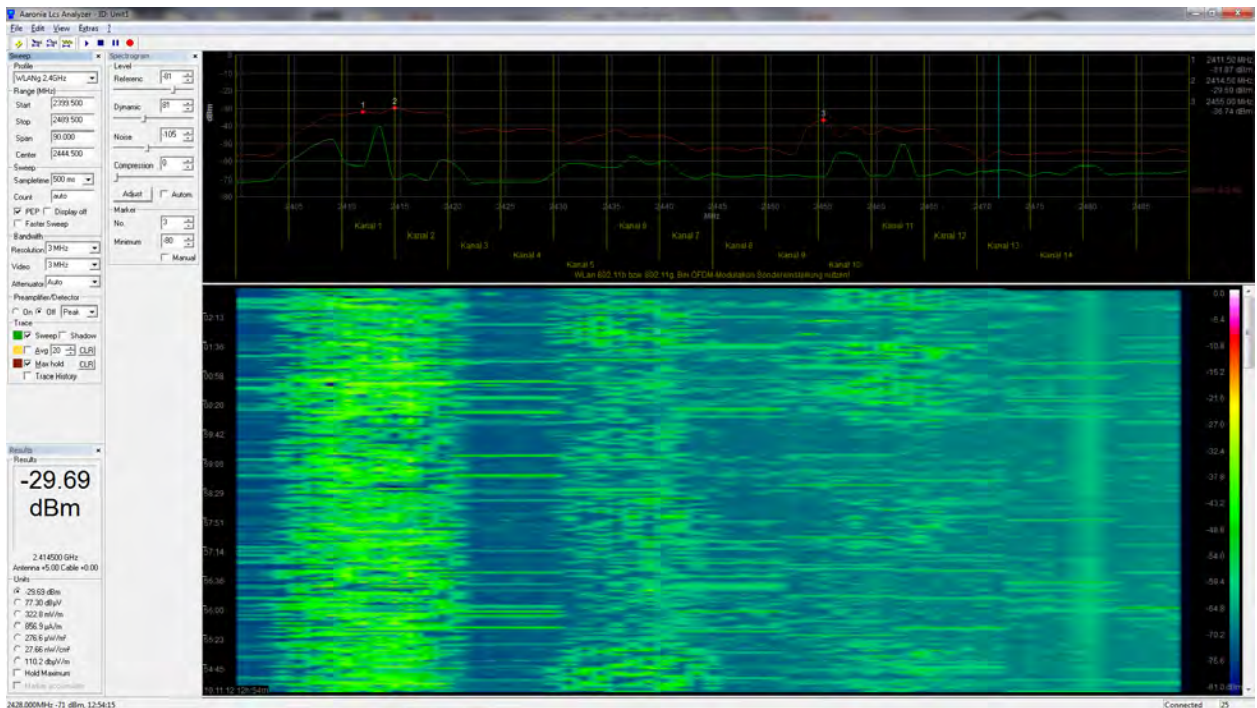


Figure 11 Peak Signals under AP1

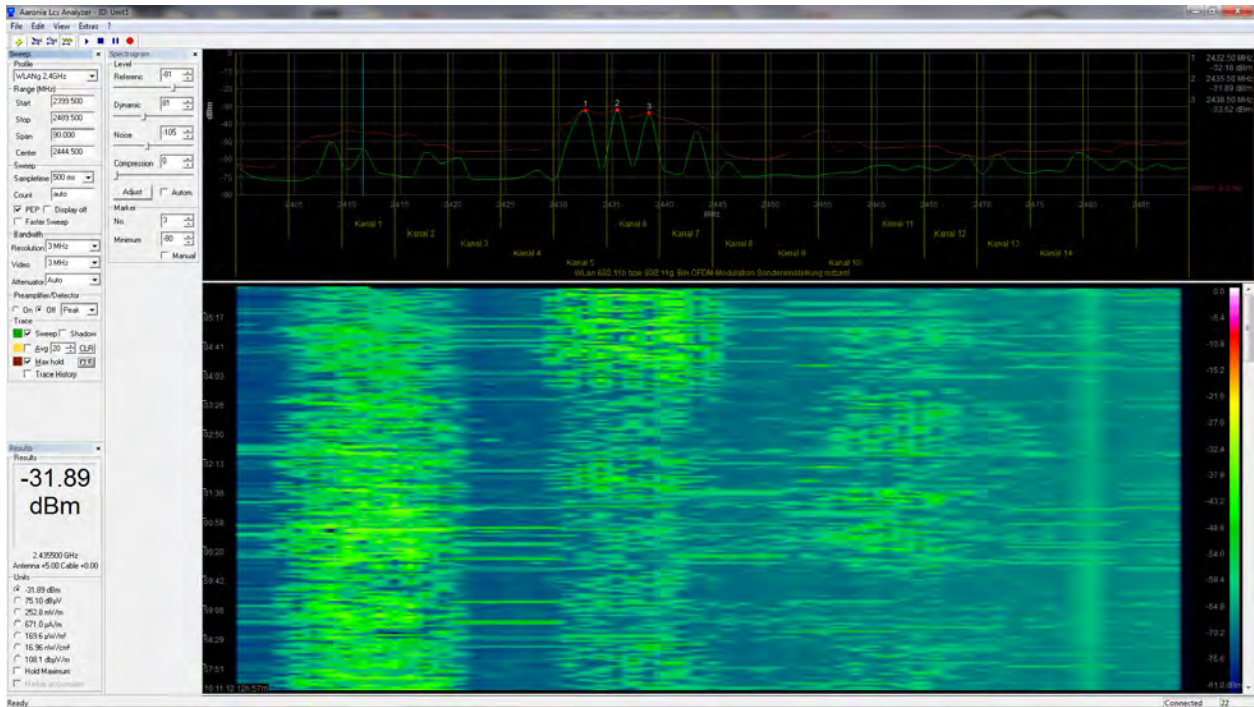


Figure 12 Peak signals under AP4



Figure 13 2.4 GHz nets from office

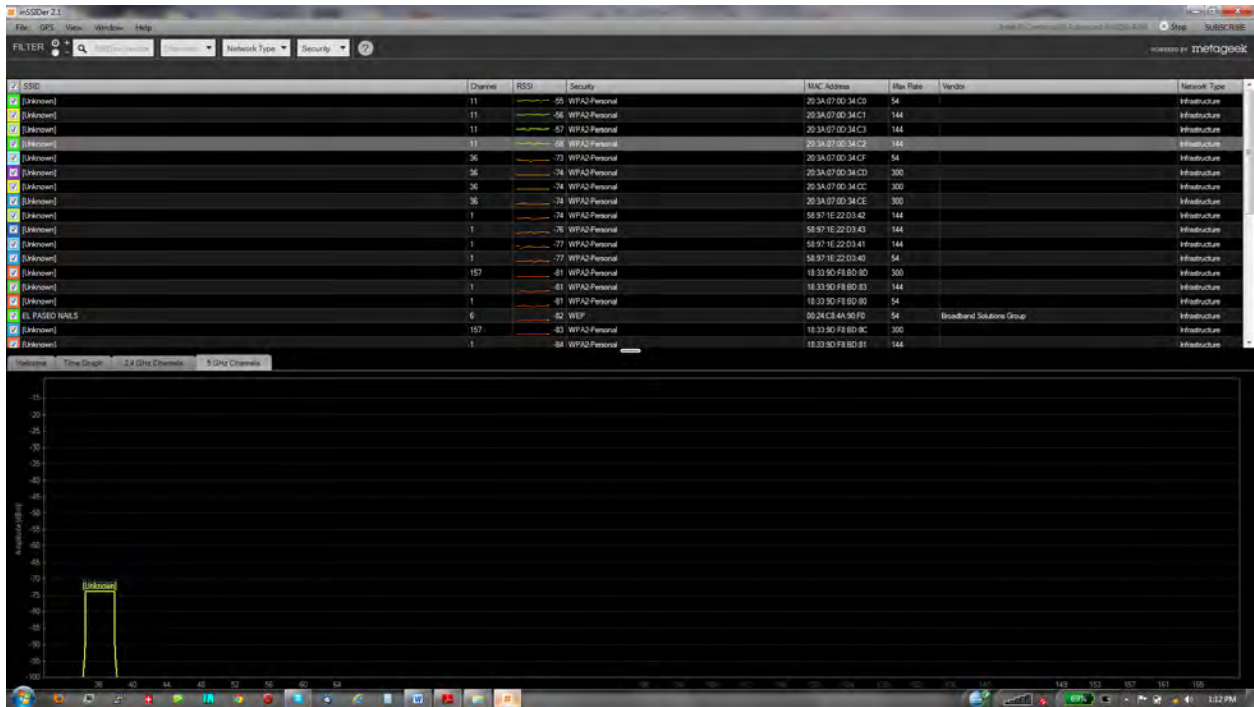


Figure 14 5 GHz LANs from Office



Figure 15 2.4 GHz LANs under AP6 (inactive)



Figure 16 5 GHz LANs under AP6 (inactive)

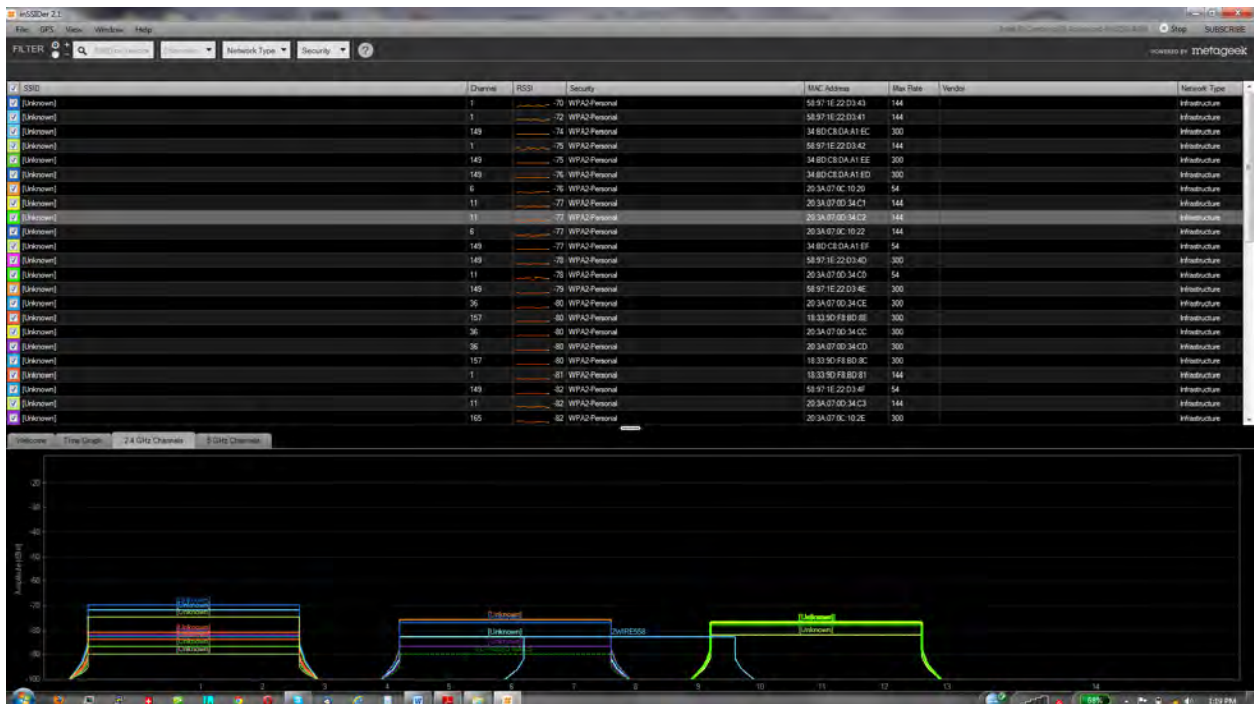


Figure 17 2.4 GHz LANs Far Rear Corner of store closest to AP6

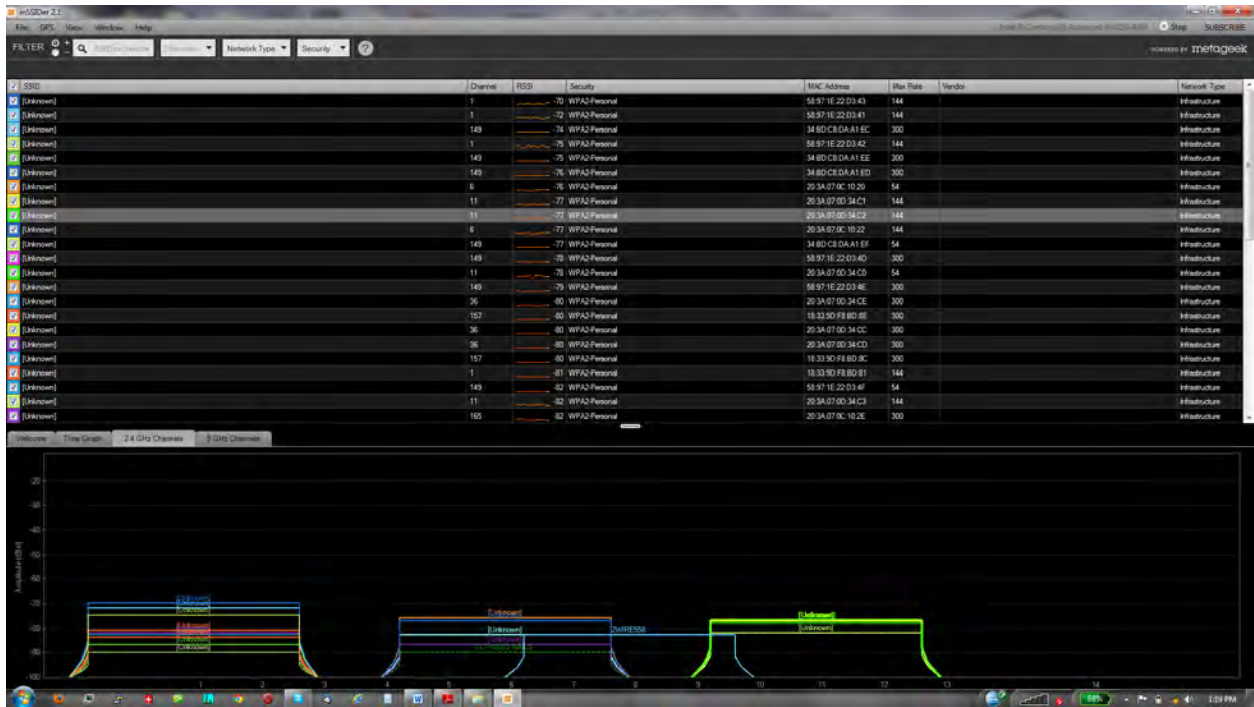


Figure 18 5 GHz LANs in Far Rear Corner of store closest to AP6

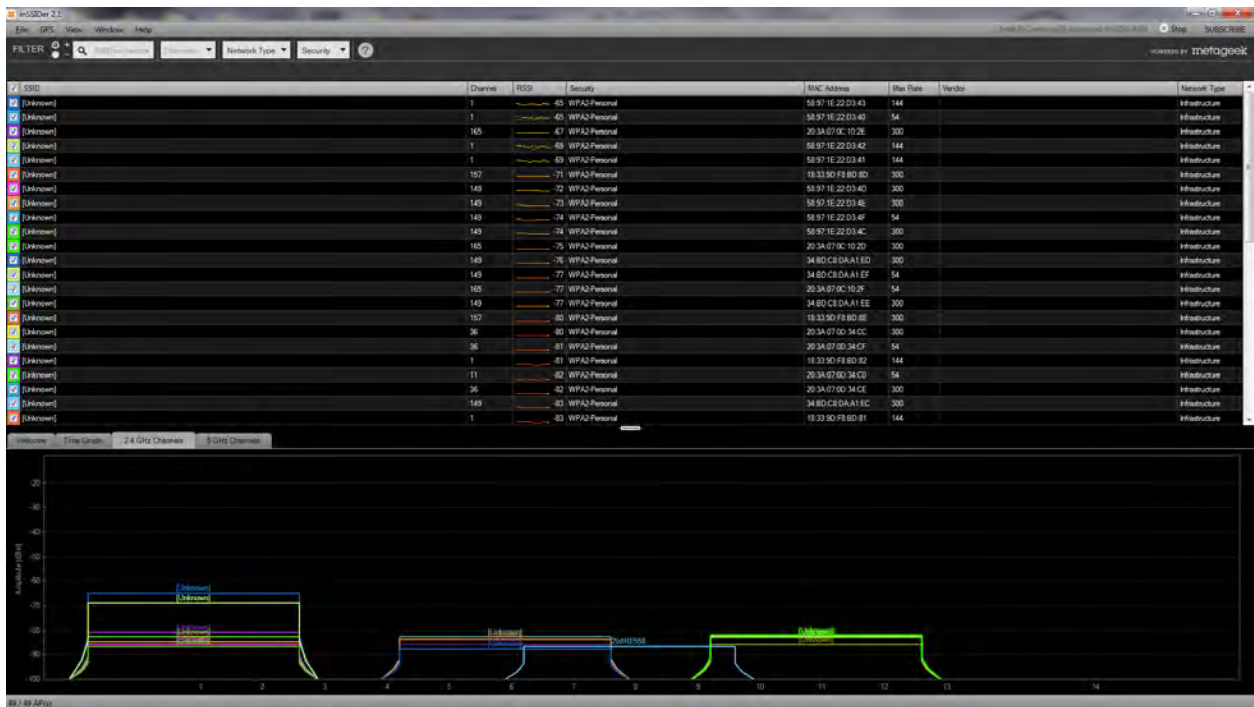


Figure 19 2.4 GHz LANs in Far Rear Corner of Store closest to AP2



Figure 20 5 GHz LANs in Far Rear Corner of store closest to AP2

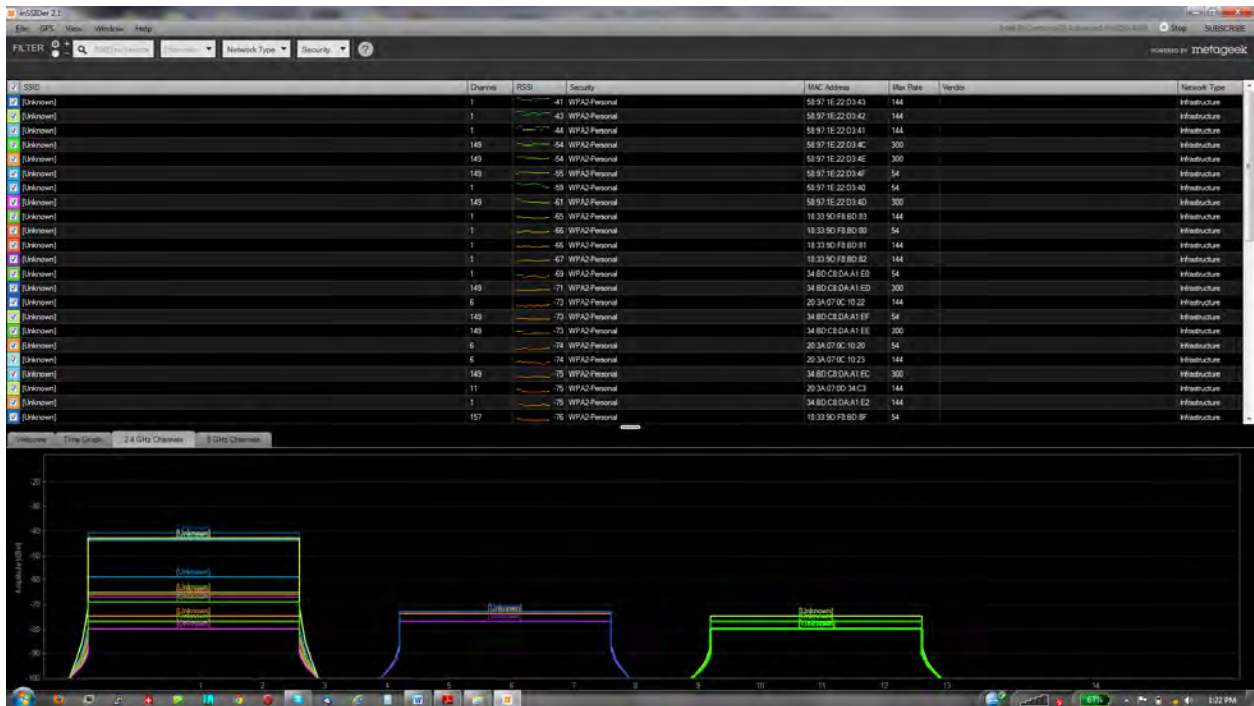


Figure 21 2.4 GHz LANs under AP2



Figure 22 5 GHz LANs under AP2

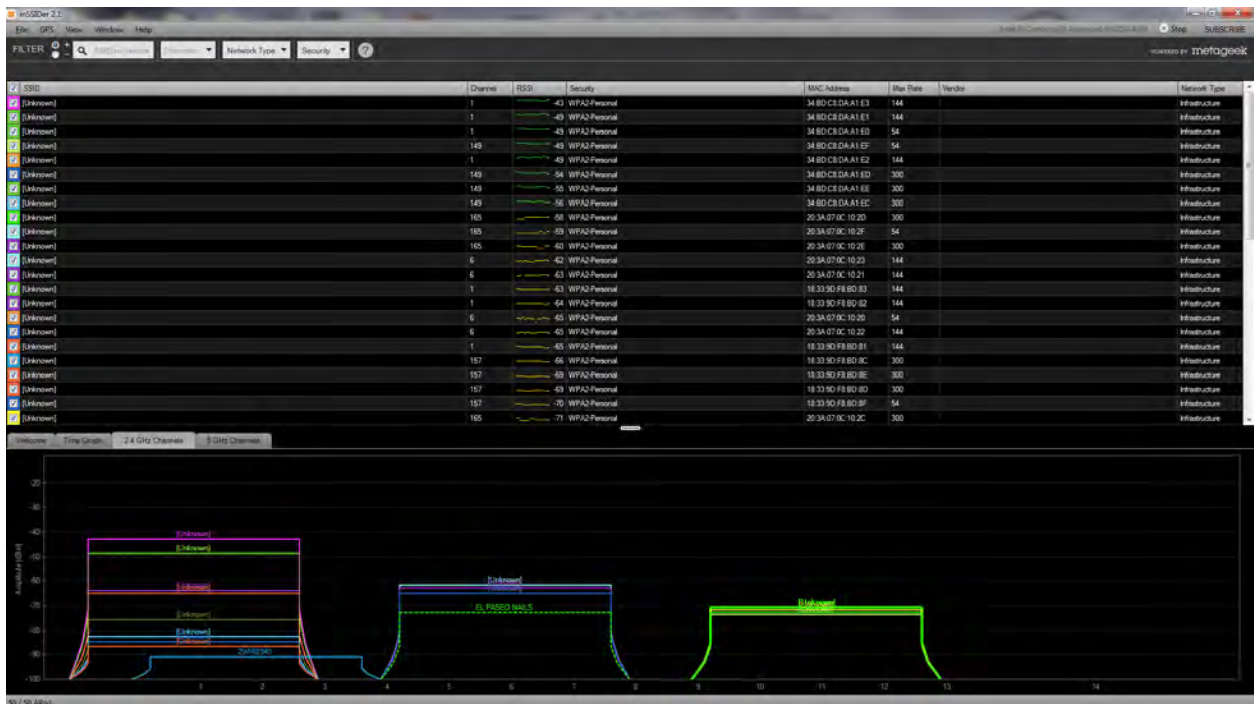


Figure 23 2.4 GHz LANs under AP3



Figure 24 5 GHz LANs under AP3



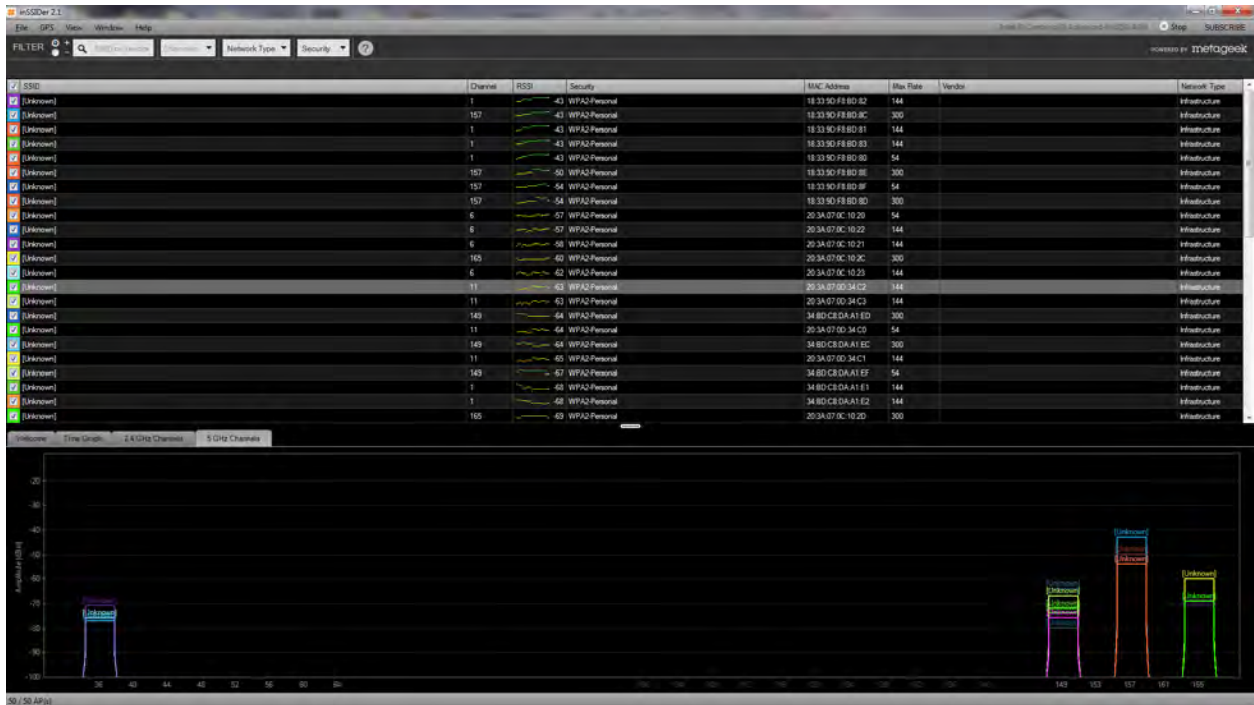


Figure 26 5 GHz LANs under AP1



Figure 27 2.4 GHz LANs under AP4

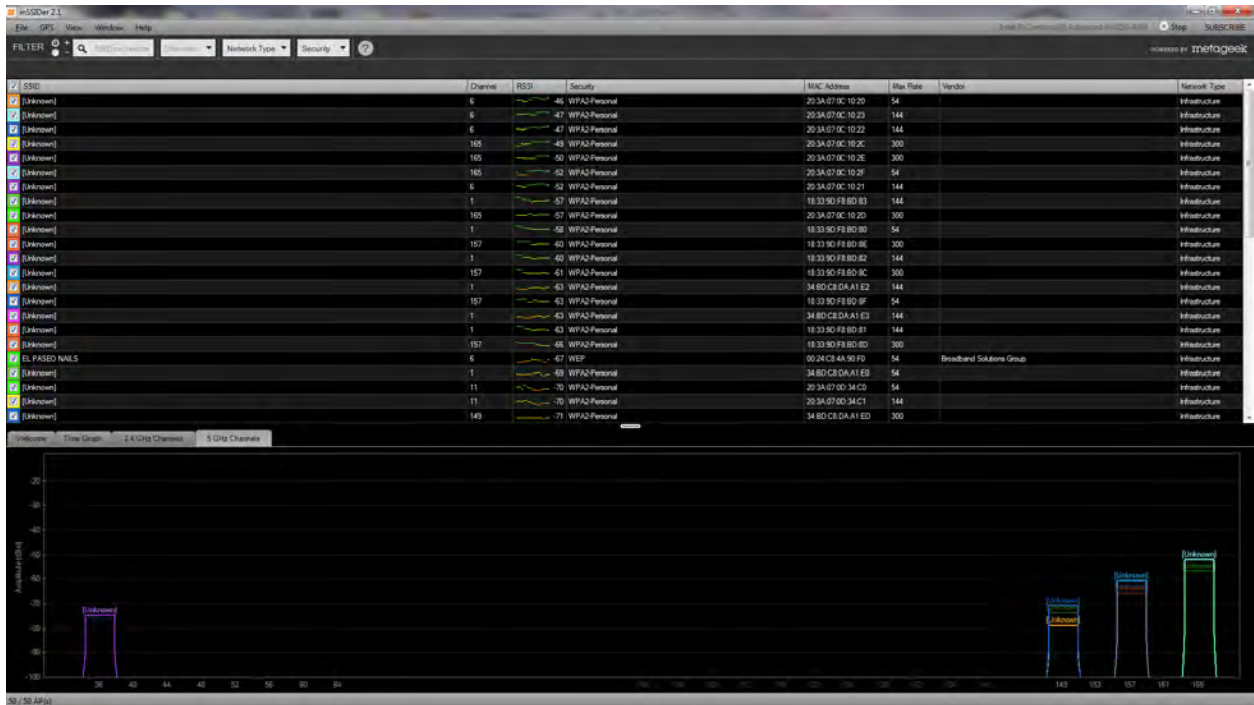


Figure 28 5 GHz LANs under AP4

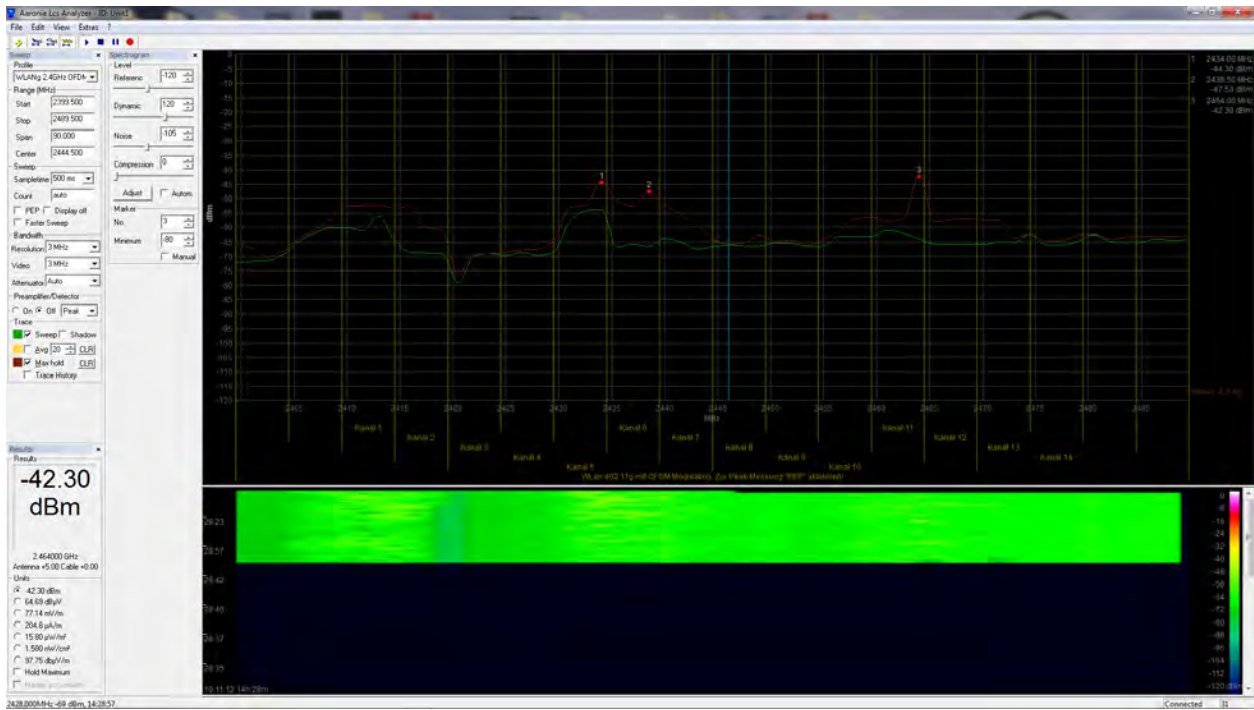


Figure 29 Peak Signals in 2.4 GHz Band at Far Rear Corner of store closest to AP6

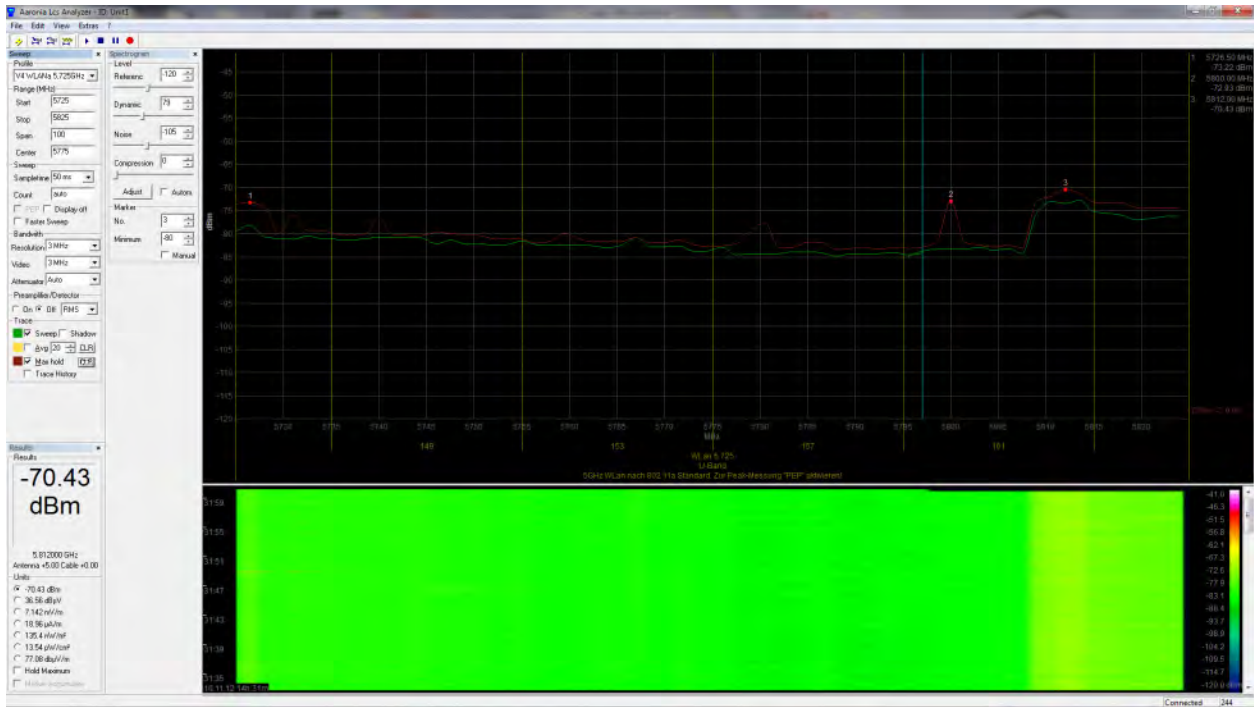


Figure 30 Peak Signals in 5 GHz band at Far Rear Corner of store closest to AP6