N-TRON Corp.
820 S. University Blvd. Suite 4E
Mobile, Al. 36609
phone: 251-342-2164 **fax:** 251-342-6353 or 251-342-6436

Wireless Frequency Site Surveys

Wireless LANs operate using radio frequencies in the unlicensed 2.4 GHz Industrial Scientific Medical (ISM) band between 2.4000 GHz and 2.4835 GHz. They also operate in the Unified National Information Infrastructure (UNII) band between 5.150 GHz and 5.825 GHz. These are in turn broken into the Lower, Middle and Upper UNII ranges. These frequencies are usually referred to by channel which include a range of individual frequencies.

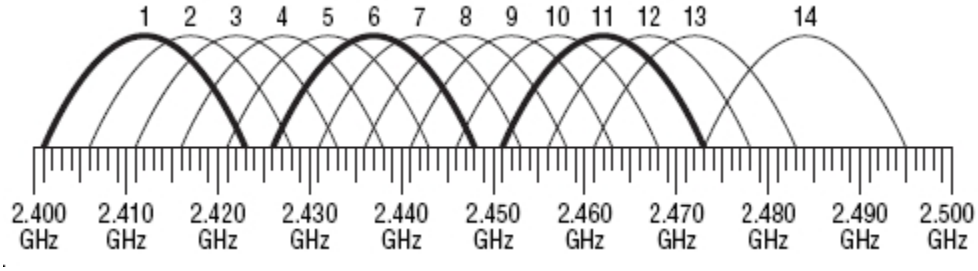

Figure 1. 2.4 GHz channels

In the 2.4 GHz range, the channels are 22 MHz wide. In order for channels not to overlap leading to co-channel interference the channels have to be separated by 5 or 25 MHz. Therefore only channels 1, 6, and 11 are non-overlapping.

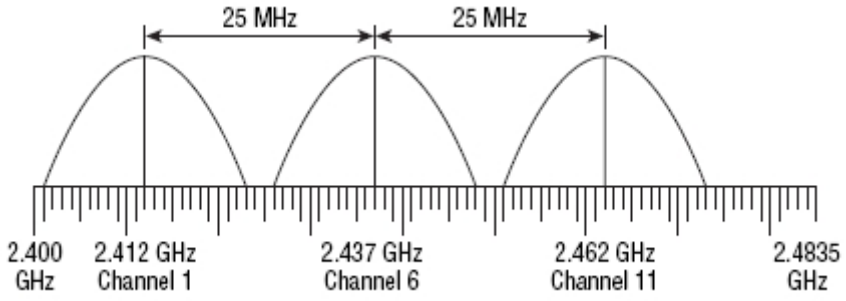

Figure 2. 2.4 GHz non-overlapping channels

In the UNII band, there are 4 non-overlapping channels with 20 MHz separation between center frequencies.

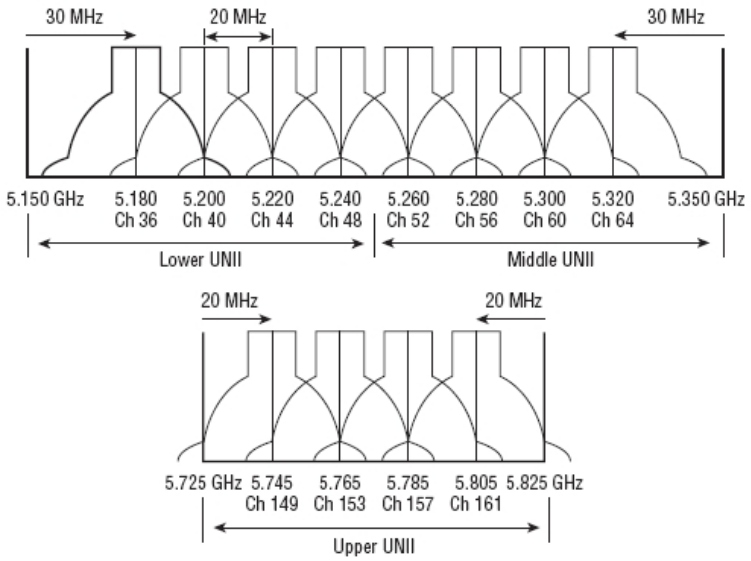

Figure 3. UNII band channel spacing

However, Wireless LAN devices are not the only devices which utilize the radio frequencies in these bands. Bluetooth, baby monitors, cordless phones, Zigbee devices, even microwave ovens radiate in the same range as 802.11 equipment. Simply deploying wireless devices, even with proper channel separation can lead to disaster if an accurate picture of the frequencies present is not obtained. This is accomplished through spectral analysis.

Using a spectrum analyzer, the 2.4 GHz and 5 GHz frequency ranges can be swept to identify what may be operating. Spectrum analyzer can range from laptop based USB devices to standalone units which cost thousands of dollars.

The following graphs were captured using the Metageeks Wi-Spy DBx. It is a USB device that can be used with a laptop or desktop running the Metageeks Chanalyzer software. Other hardware may have similar capabilities.

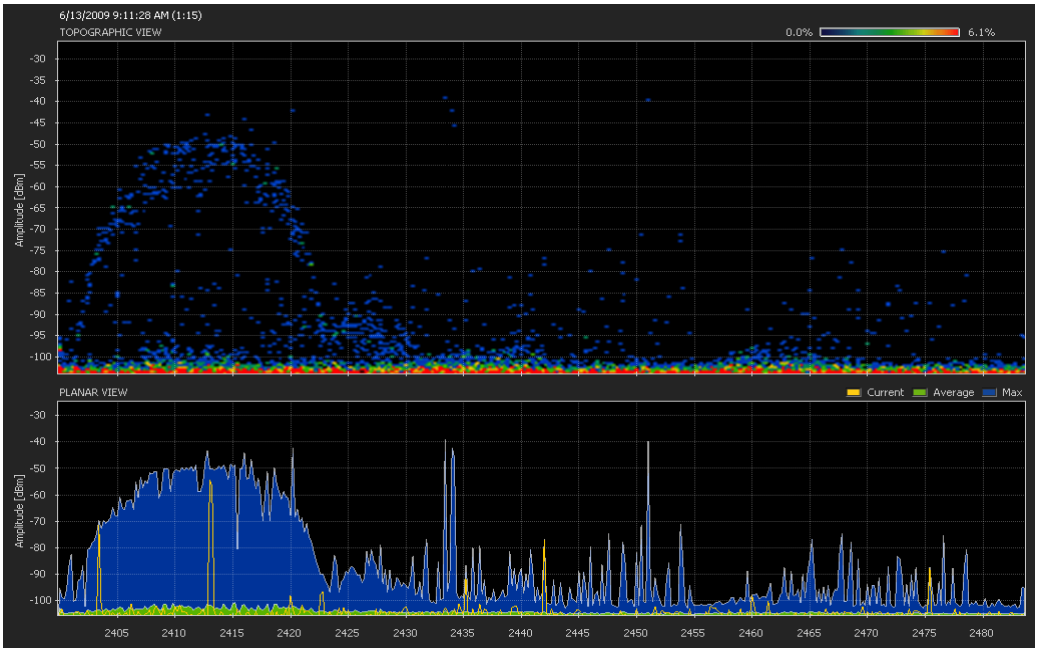

Figure 4. 2.4 GHz range with frequency on x-axis

Figure 4 is a scan of the 2.4 GHz range in a typical residential neighborhood. The top graph shows the frequency range on the x-axis and the signal strength on the y-axis. The bottom shows the current, maximum, and average.

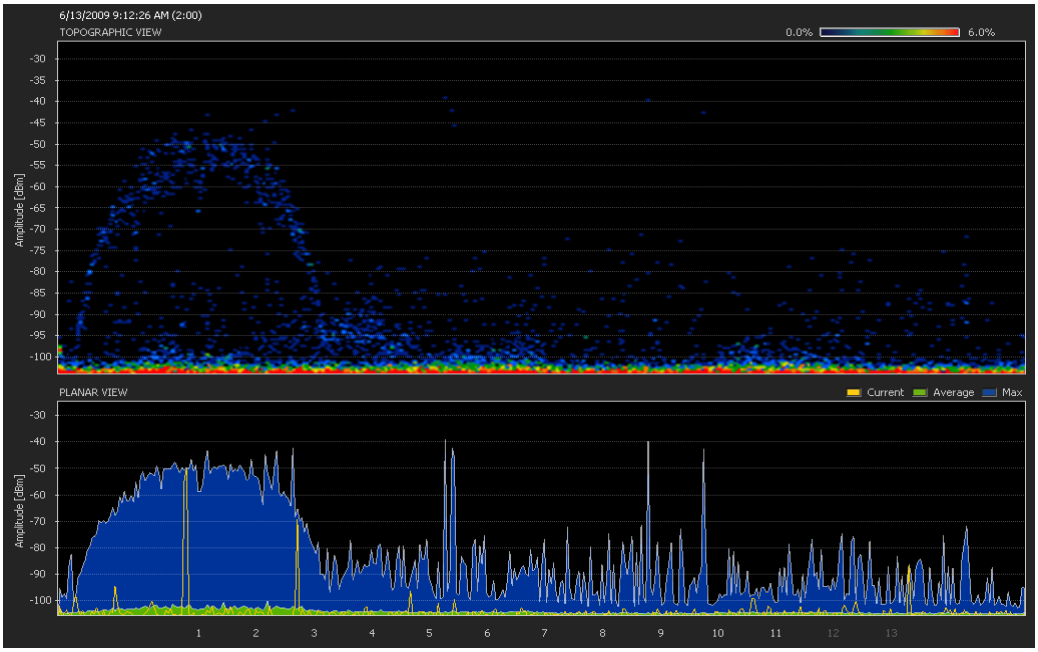

Figure 5. 2.4 GHz range with channels on the x-axis

In Figure 5, the channel numbers replace frequencies on the x-axis. Devices are usually configured by channel not by frequency so changing this makes the information more meaningful. It is readily apparent that there is activity in the 2.4 GHz range.

Incorporating SSID information from the wireless card onto the graph shows which wireless LAN (if any) corresponds to which channel.

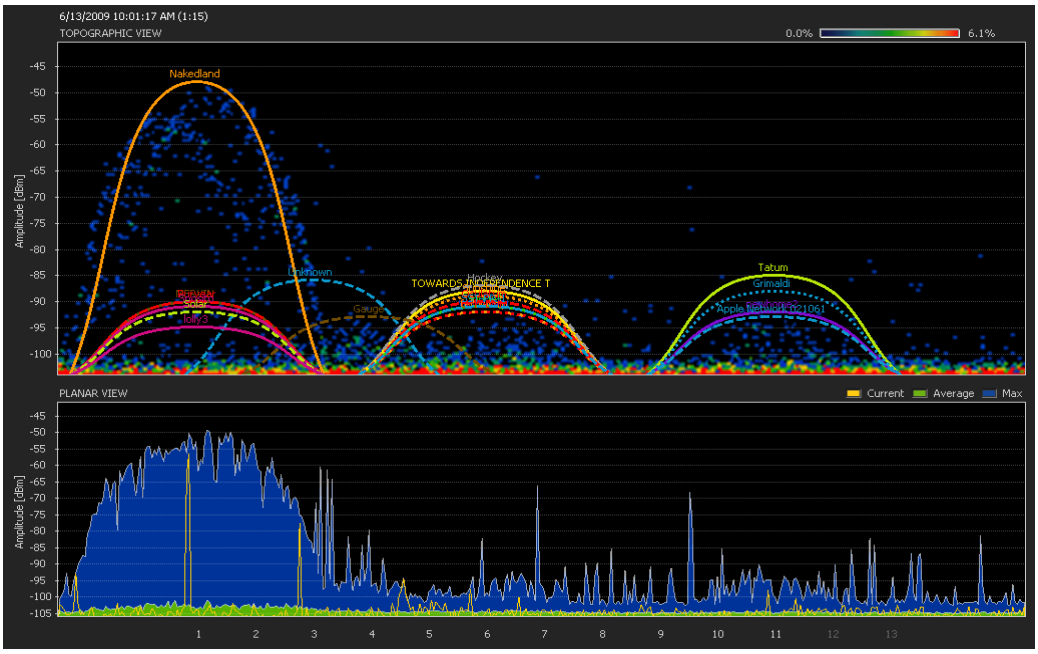

Figure 6. SSID information from nearby wireless LANs overlaid

There are 20 wireless LANs visible at this location in the 2.4 GHz range. The solid orange line with the highest amplitude is either the closest or transmitting with the most power with -54 dBm being reported as the signal strength. It can be seen that there are 4 others using the same and also 2 using channels that overlap. One is using channel 3 and the other channel 4. Based on the signal strength of nearby access points, deploying in 2.4 GHz is possible as the signal strength of all but one is not overly high. In a single access point or bridging scenario, it may be more advisable to use channel 11.

While useful, frequency analysis is not needed to obtain this sort of information. Client software for many wireless adapters will report signal strength as well as signal to noise ratio. However they will not identify sources of interference that are not due to wireless LANs.

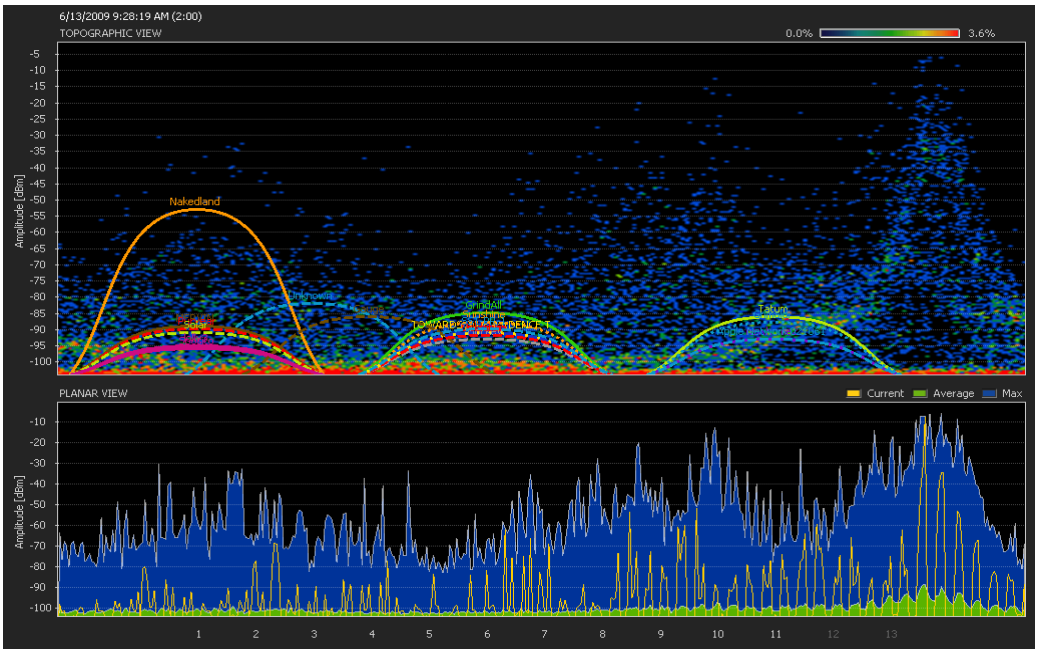

Figure 7. 2.4 GHz range with interference from a microwave

Figure 7 shows what the frequency spectrum looks like with a microwave oven operating nearby. Older “leaky” microwave ovens that are not properly shielded will interfere with 802.11 equipment. From this graph it can be see that channels 6 and 11 would become virtually unusable while the microwave oven was in operation and channel 1 would experience substantial interference. This is not information what could be found without frequency analysis.

A microwave is just one example of possible sources of interference and is one that can be eliminated. If it were something that were not able to be eliminated this can be determined before anything is installed. The other option in that scenario is to move into the 5 GHz range which is significantly less crowded.

Fewer devices use the 5 GHz band. Generally the interference from 5 GHz devices will be by other 802.11 devices operating in 5 GHz, 5 GHz cordless phones, and possible radar. For the latter, in order to operate in the UNII band that encompasses radar, the device must support 802.11h Spectrum and Transmit Power Management Extensions. These include Transmit Power Control and Dynamic Frequency Selection. TPC will reduce the transmit power to reduce interference. Dynamic Frequency Selection will shift frequency to do the same.

Figure 8 shows a scan of the 5 GHz spectrum used by 802.11 in the same physical location.

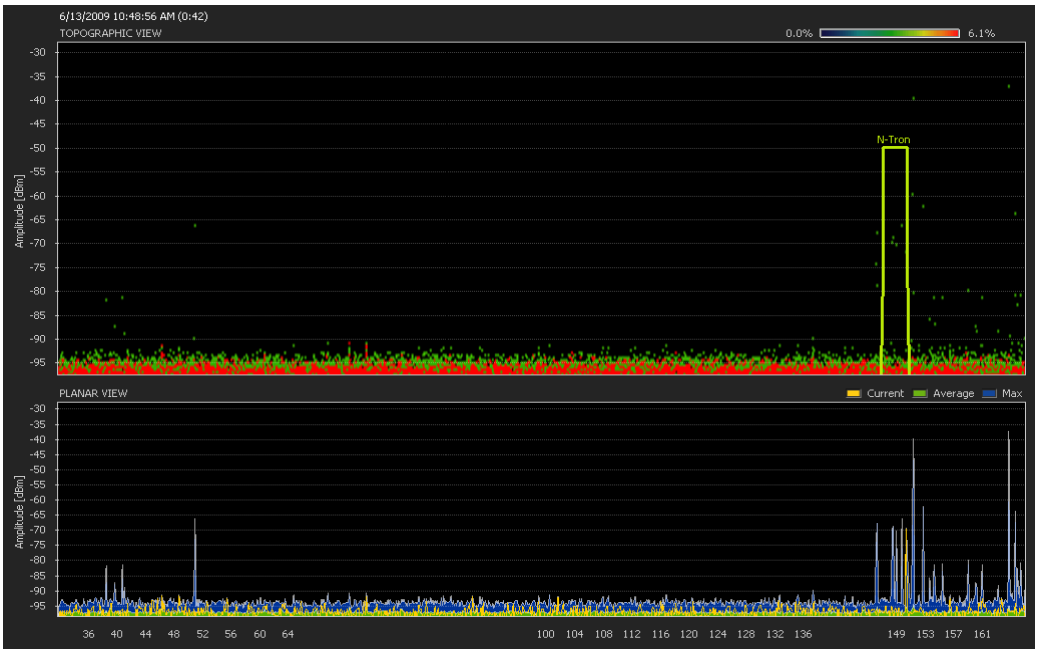

Figure 8. 5 GHz frequency spectrum at same physical location

There is only 1 wireless LAN in operation with a 5.8 GHz cordless phone intentionally operated to add to the 5 GHz spectrum. It is apparent that at this location 5 GHz virtually unused. 5 GHz does have the drawback of attenuating faster than 2.4 GHz. If range or equipment compatibility is not a factor, using 5 GHz would be a better option. The N-Tron 702-W support 802.11b/g/n in 2.4 GHz and 802.11a/n in 5 Ghz.

Frequency analysis is a part of a site survey. Site surveys not only determine where access points should be placed but whether or not it is even feasible from a frequency standpoint to implement a wireless LAN. The spectrum analyzer should be run for at least 24 hours. This will capture any intermittent frequency usage. For example, running the spectrum analyzer for a shorter period may not catch the use of a leaky microwave which may only be in use enough to cause problems around lunch hours.