

Interference Identification Guide

This document is a guide to help IT professionals optimize the performance of wireless networks by using spectrum analysis tools to identify sources of wireless interference. For packet analysis solutions, please see <http://www.metageek.net/products/airpcap/>

Although wireless networking allows users to transmit data without the use of cords, wireless devices must communicate on specific frequencies, or channels. With microwaves, cordless phones, security cameras, competing access points, and an increasing number of other devices operating on the same frequency range or spectrum as Wi-Fi interference or spectrum congestion is causing a growing number of performance problems in wireless networks.

Only by gaining visibility into the wireless spectrum can IT professionals quickly examine a situation, understand the issue, efficiently diagnose the situation, and prescribe a solution.

Enter portable spectrum analyzers. Please review this guide and join our community for even more information. MetaGeek forums are packed with dedicated users and users just getting started, as well as the MetaGeek support team. Join at <http://www.metageek.net/forums/>

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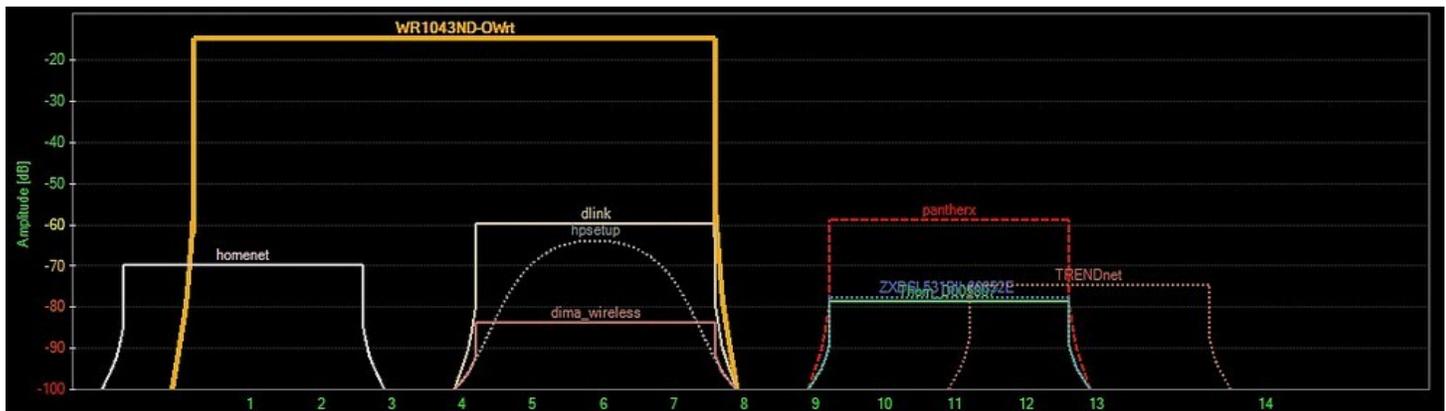
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Troubleshooting Interference with inSSIDer

Did you know the choice of a Wi-Fi channel can affect its throughput? As of 2011, most access points are deployed in the 2.4 GHz wireless spectrum. In the 2.4 GHz band all available channels overlap onto their neighboring channels. As a result there are only 3 non-overlapping Wi-Fi channels: 1, 6 and 11. inSSIDer shows you the potential overlapping of competing access points:



Key Wi-Fi features of inSSIDer.

- inSSIDer draws the Wi-Fi overlaps as they occur in the actual 2.4 GHz spectrum.
- The boxes are centered on the 20 MHz-wide Wi-Fi channels and represent APs capable of 802.11g (speeds greater than 11mpbs).
- Curves represent legacy 802.11b Wi-Fi.
- Dotted lines represent APs using no encryption.
- Dashed lines represent WEP encryption.
- Solid lines represent WPA encryption.
- WLANs that appear faded are likely not within usable range of your computer.

Without a Wi-Fi tool like inSSIDer, you'll know if there are neighboring wireless networks, but you won't know if they're causing interference because you won't know what channel they're on or how consistently they're broadcasting. inSSIDer's graphs provide this information, but your wireless card is blind to interference from non-Wi-Fi transmitters. Here are a few of the devices that your wireless card *won't* detect but can broadcast in the 2.4 GHz band and interfere with your wireless network's performance:

- Neighboring Wi-Fi
- Microwave Ovens
- Motion Sensors
- Security Badge Scanners

- Audio Video Transmitter
- Cordless Phones
- Bluetooth
- Wireless Mice

Since a Wi-Fi card is incapable of showing RF activity from these wireless transmitters, you'll need a spectrum analyzer to help you identify them and know if they're interfering with your WLAN.

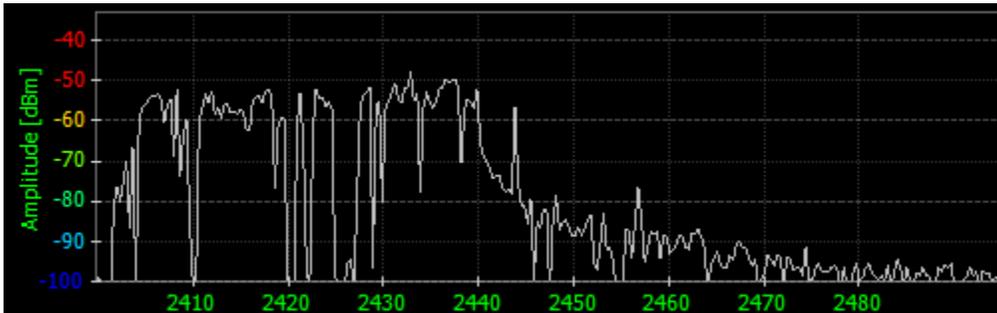
Spectrum Analysis

Spectrum Analyzers will show all RF activity within a given frequency range, Wi-Fi or non-Wi-Fi. This allows you to see if there are competing transmitters affecting the channel your WLAN is located on.

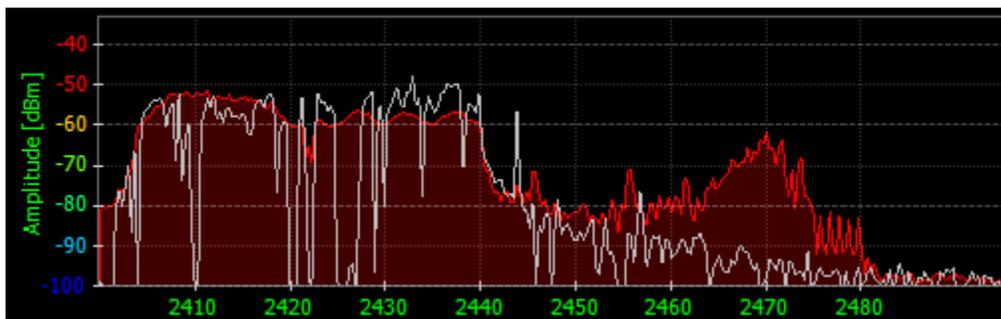
Each of these devices transmits using a specific modulation pattern. There are a few views spectrum analyzers offer to track the patterns these devices make in the RF spectrum, but each is a different method of visualizing the same data. Chanalyzer gives the user further control over the time span and frequency range included in the views.

Visual Displays in Spectrum Analysis

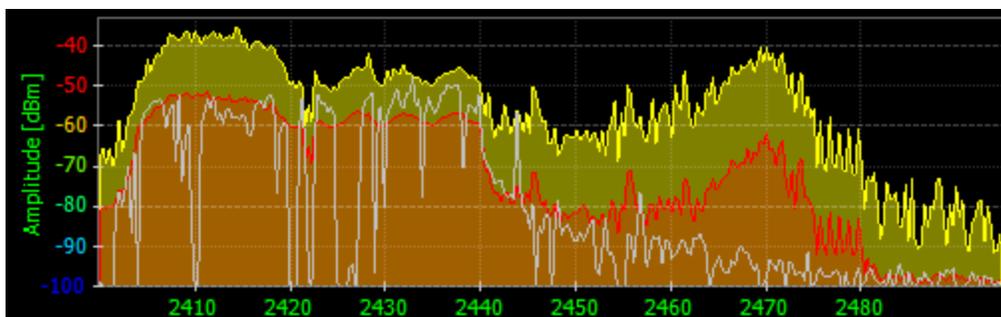
Current, known as the FFT graph in some spectrum analyzers, shows the most current RF activity by graphing amplitude levels over a given frequency range. Changes in the environment will be visible here first. If a cordless phone is turned on, look for a narrow spike drawn by the current line.



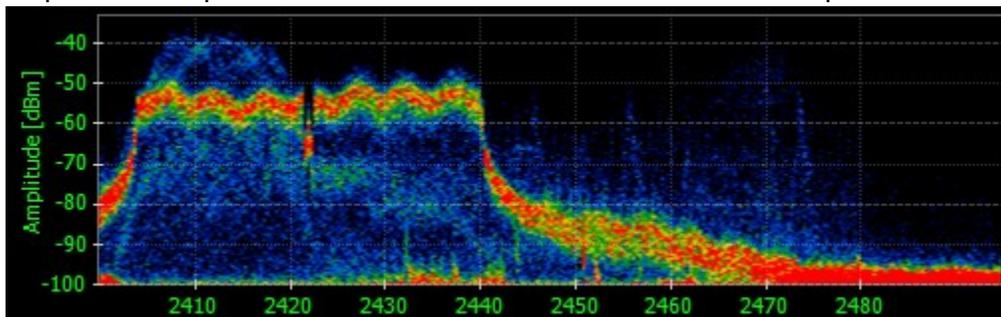
Average is the average power on a frequency over a segment of time. The average calculation is a good resource in determining how constant the interference may be.



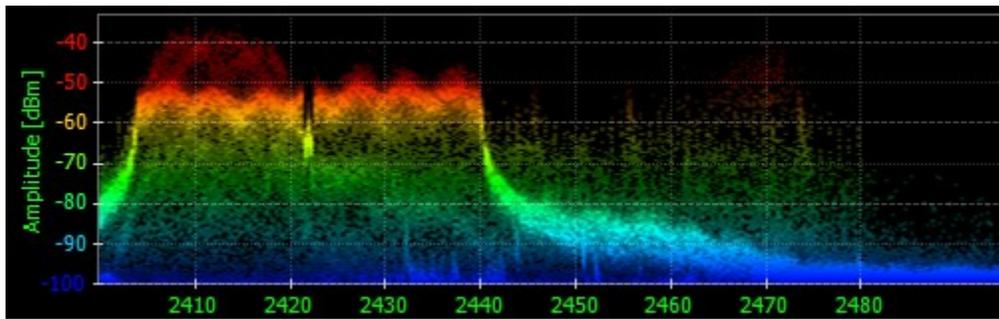
Max or Peak Hold - Represents the highest amplitude values recorded by the spectrum analyzer in a specified range of time. Often, the peak hold or max can indicate intermittent interference.



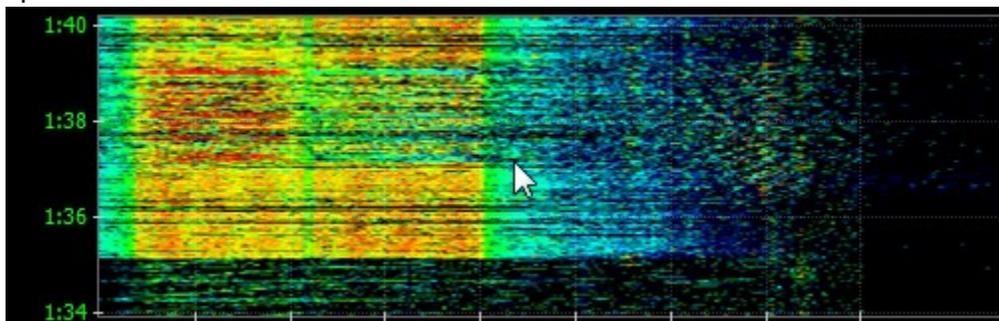
Density View shows how often each frequency/amplitude point is measured within a specified time range. Devices that transmit more frequently will appear progressively warmer, from blue to red. The density view helps track the patterns different wireless devices make in the spectrum.



Alternately, Chanalyzer can display the density view with amplitude coloration. This coloration of the density view is ideal for correlating the density activity to the waterfall view



Waterfall View graphs amplitude over time for each frequency in the band. The waterfall view colors represent changes in amplitude with dark blue as low and bright red as a higher amplitude level. This view will best indicate the instances where wireless devices like cordless phones or microwaves may have changed the spectrum.



Networks Graphs Tab uses the computer's internal Wi-Fi card to scan for SSID beacon broadcasts and graph the amplitude levels of WLANs, similar to inSSIDer.



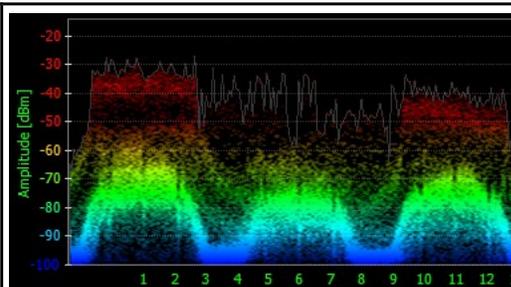
Interference Identification by Signature

Most modern spectrum analyzer solutions offer some form of automatic device classification, though many are rudimentary and can produce false positives. You can train yourself to more accurately identify interfering devices than any automatic tool, simply by familiarizing yourself with transmitter modulation patterns. Here are a few items to test with a spectrum analyzer:

- Neighboring APs occupying an overlapping channel.
- Cordless Phones
- Microwave Ovens
- Wireless Audio transmitters
- Video Transmitters (Security Cameras, IP cameras)
- PIR motion detectors.
- WLAN download
- WLAN upload

802.11b PSK

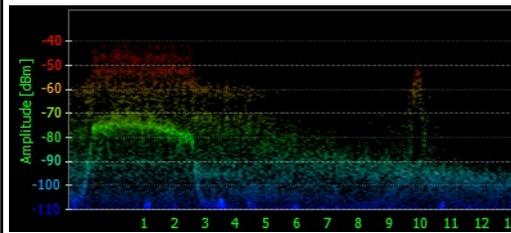
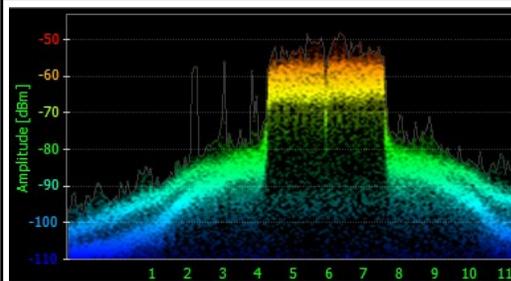
This is the most common shape you are likely to see when troubleshooting Wi-Fi in the 2.4 GHz band. APs tend to transmit beacons at the lowest common denominator of all Wi-Fi devices, or the most basic modulation, BPSK. This image shows APs on channels 1, 6, and 11.



802.11g ERP-OFDM

Identify 802.11g ERP-OFDM by looking for a flat top. The flat top of OFDM signatures are under 20 MHz wide. This is the same signature for 802.11a OFDM.

The second image is a more typical representation of what ERP-OFDM looks like in the 2.4 GHz band.



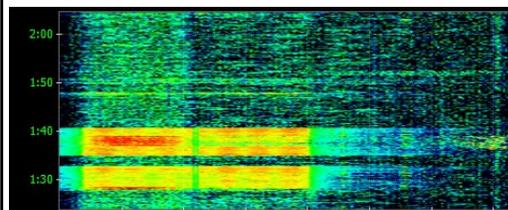
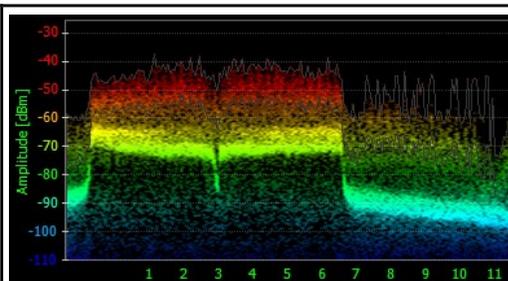
802.11n 2.4 GHz 40-MHz ERP-OFDM

802.11n OFDM APs with data rates of 300mbps use channel bonding, which appears as two 802.11g ERP-OFDM signatures bonded together.

Notice how the 40 MHz wide 802.11n access point goes beyond Wi-Fi Channel 6? There is not enough room in the 2.4 GHz public ISM band for two co-located 802.11n access points using channel bonding.

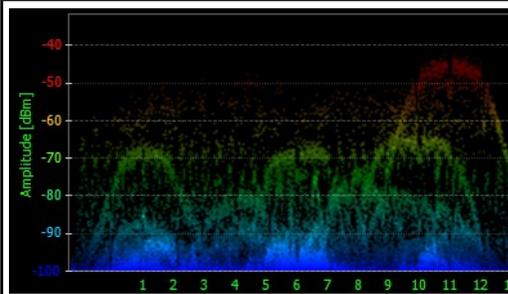
The width of an 802.11n AP transmitter will not always be 40 MHz. In most cases, 40 MHz transmissions appear in bursts when an AP's throughput exceeds the capabilities of 802.11g ERP-OFDM.

You can see the bursts in the waterfall view very easily. 802.11a/g/n typically shows abrupt edges, due to the dBm drop on each side of the signatures.



Adjacent Channel Interference

Your Wi-Fi may be on the same channel as other wireless APs. There are 11 channels in 2.4 GHz, but only three that don't overlap (1, 6 and 11 in the U.S.).

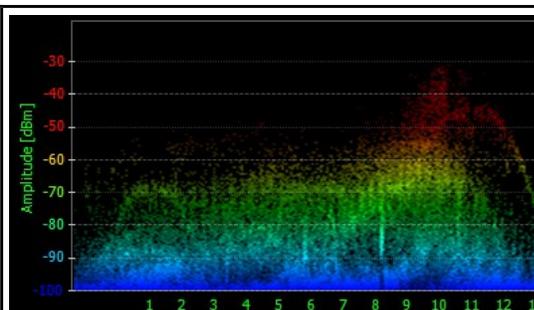


Non-Wi-Fi Patterns

Microwave Ovens

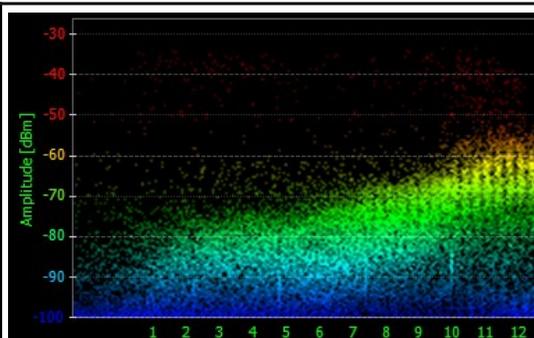
Microwave Ovens operate in the 2.4 GHz range, typically creating a shape similar to a mountain slope in the Density View. Since microwaves are usually used from 1-5 minutes, it helps to adjust the timespan to about two minutes.

Interference occurs when the microwave oven transmits on the same frequencies as the Wi-Fi channel. In this image, you can see how the mountain-shaped microwave oven covers the curvature of the Wi-Fi on channel 11.



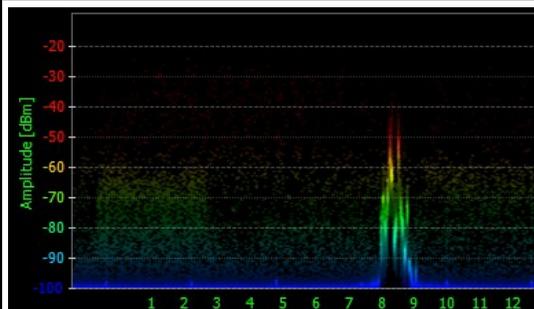
Microwave amplitude levels vary depending on their distance from the spectrum analyzer. Experiment with a microwave oven and varying locations.

You can also use the Waterfall View to help you identify microwave interference, because it shows how long a device is active, and will often show a distinctive “comma” shape when a microwave is used.



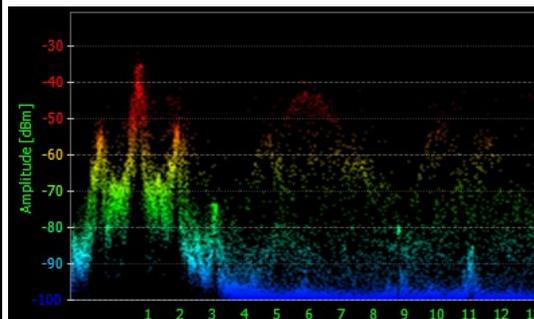
Motion Sensors

Motion sensors tend to transmit within very narrow frequency ranges. Sometimes a building will have motion sensors in each room. If this is the case, verify that they are not in the 2.4 GHz range by walking close to each sensor and watching the corresponding amplitude levels in the Waterfall View.



Audio Video Transmitter

Wireless security cameras generally create three spikes. They constantly transmit and rarely change channels. Look for three adjacent vertical lines in the Waterfall View.

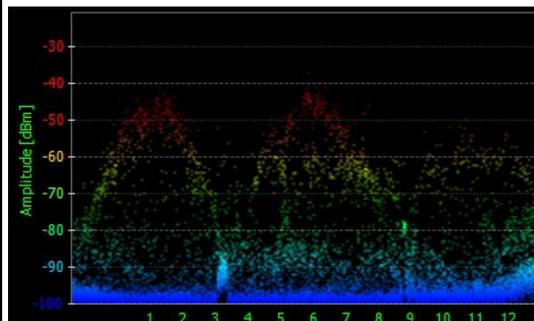


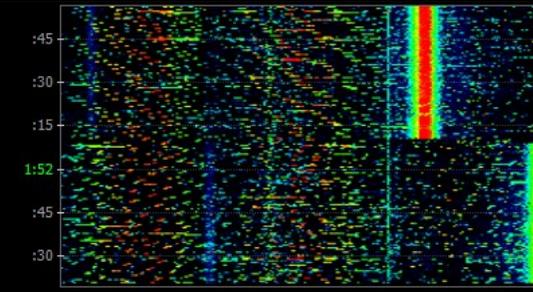
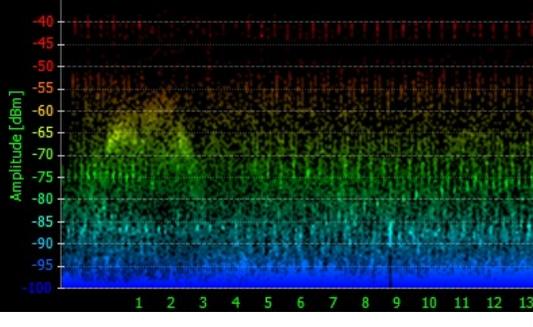
Cordless Phones

Not all cordless phones create the same pattern; some are very narrow and use the 2.4 GHz frequency band, while others scan for the clearest channel and vary in the frequencies used.

One of the easiest ways to identify cordless phone interference is by using the Waterfall View to search for a unique series of vertical lines. When a cordless phone changes channels, it will appear as a break in the waterfall.

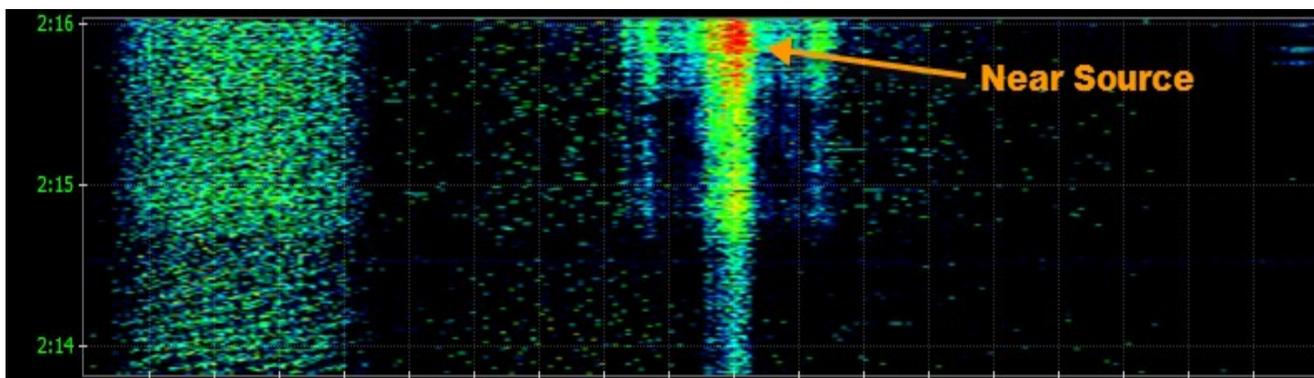
Some cordless phones may hop across the entire spectrum similar to Bluetooth..



	
<p>Bluetooth Bluetooth hops across the 2.4 GHz 1,600 times a second, which is a form of frequency-hopping spread spectrum (FHSS) modulation.</p> <p>Because frequency-hopping transmitters broadcast across large frequency ranges, they may cause WLAN degradation, though it is unlikely that Bluetooth will cause severe interference.</p>	

Tracking Amplitude Levels Over Time

Many spectrum analysis solutions offer a waterfall view for tracking amplitude levels. This emphasizes instances where wireless devices like cordless phones or microwaves may have changed the spectrum. For example, when a microwave is started or a cordless phone changes channels, it is very noticeable in the Waterfall View. When the spectrum analyzer is near a transmitter, the levels will appear more red. Finding a source of interference can be like playing a game of hot and cold.



Educate Yourself

As the 2.4 and 5 GHz public ISM bands are more heavily used by consumer electronics, accurate spectrum analysis becomes increasingly important. You can learn more about wireless interference identification and troubleshooting by joining the MetaGeek community at: <http://www.metageek.net/forums> Use the forums to share your questions, recordings and technical expertise with your fellow MetaGeeks!

Further Reading:

- [MetaGeek Videos](#)
- [MetaGeek Blog](#)
- [Chanalyzer Pro Evaluation Guide](#)