

Visualize Wireless Landscapes - quickly and easily.

New Wi-Fi products are only as good as the wireless network they operate on. Users can quickly become frustrated when they run into wireless issues - and often times the answer isn't completely apparent. If you're WLAN is unreliable and flaky, guess what, you're Wi-Fi access points, connected clients, sophisticated audio, control or automation systems will have flaky and unreliable performance, too.

Wi-Spy is a tool that helps you plan, deploy, manage and troubleshoot Wi-Fi and other RF systems. It detects the frequency and strength of RF signals in the air and passes that information to Chanalyzer software for recording and visual analysis of your wireless environment. There are three Wi-Spy devices that cover different frequency bands used by Wi-Fi and many other Wi-Fi devices (2.4 GHz, 5 GHz, and 900 MHz ISM bands).

Wi-Spy is the tool you need when trying to resolve intermittent Wi-Fi issues, figure out why Wi-Fi is great in certain areas and poor in others, or if you are tasked with making sure Wi-Fi networks stay up.

This document is designed to help you understand how to use a Wi-Spy with Chanalyzer Pro. While the Chanalyzer software that is included with each Wi-Spy does not have all the capabilities found in Chanalyzer Pro, an understanding of how to use the Pro version will give you all the knowledge you need to use the standard Chanalyzer software.

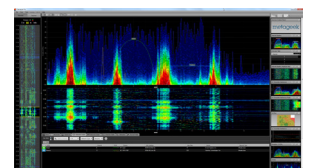
Inside You'll Learn About:

- [How To Get Started / First Time Use](#)
- [Building A Report](#)
- [Navigating The Waterfall View](#)
- [Customizing the Utilization Threshold](#)
- [Wi-Fi and Non-Wi-Fi Signature Patterns](#)
- [Building Your Own Signature](#)
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MetaGeek Tools

MetaGeek's Wi-Spy might fit in your pocket, but this portable USB spectrum analyzer is loaded with big-time performance. Its high-resolution and enhanced amplitude range make the Wi-Spy easy for you to identify interference in the 900 MHz, 2.4 GHz, or 5 GHz spectrum. With MetaGeek's compact spectrum analyzer, you can save time and money while installing, troubleshooting, and managing your wireless networks.

Our basic Chanalyzer visualization software, included with any purchase of a Wi-Spy, allows you to see what's happening in the wireless spectrum. Upgrade to Chanalyzer Pro to track down devices, use our beautiful and efficient Waterfall recording playback navigation, or create customized reports to explain to clients or co-workers where and why the interference is occurring.



Our Story

MetaGeek began with a need for accessibility. Founder and Chief Geek, Ryan Woodings, came up with the idea of an easy-to-use, affordable USB-based spectrum analyzer after having to share a single benchtop spectrum analyzer with fellow engineers. The spectrum analyzer cost a lot, was big and bulky, and had to be wheeled around on a cart.

In 2005, he began work in his free time on a simple USB-based spectrum analyzer and Wi-Spy was born. The Wi-Spy gave him enough information to do the analysis that he needed, and he knew that the smaller portable device would be a breakthrough for other wireless network troubleshooters as well. Today, there is a Basic and Professional version of our visualization software, and three spectrum options to choose from.

Getting Started

MetaGeek spectrum analysis works with a USB Wi-Spy and Chanalyzer visualization software. You can preview Chanalyzer Pro software using our [Recording Library](#), but to detect actual results in your environment, you must have a Wi-Spy connected to the computer.

- 1) [Download Chanalyzer Pro Software](#)
- 2) Go to the downloaded file and double-click the Installer
- 3) Follow the prompts to install the application
- 4) Connect a Wi-Spy to your computer's USB port
- 5) Run Chanalyzer

But - what does it mean? The following pages will walk you through first time use and several "How-To" scenarios using MetaGeek's spectrum analysis tools.

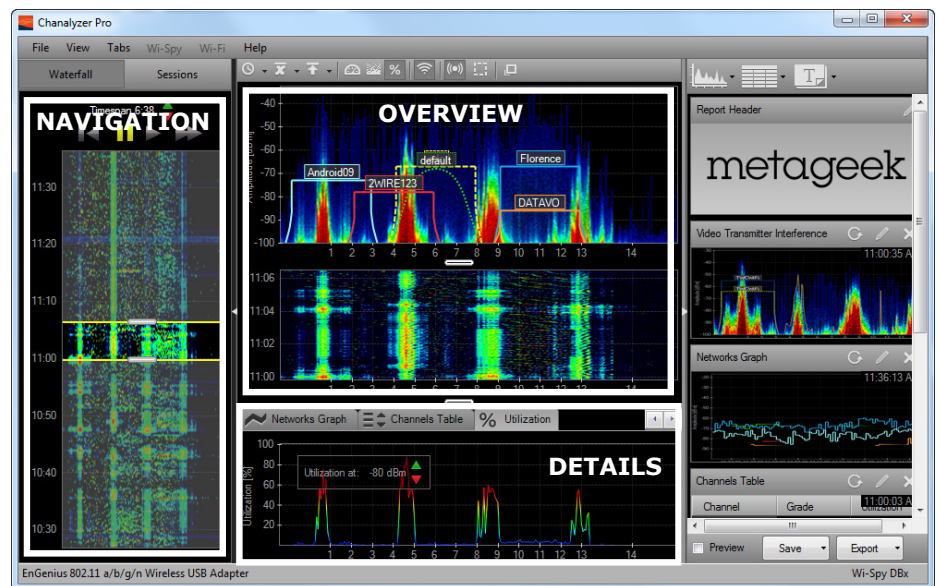
Learning Chanalyzer

Chanalyzer Pro is divided into three main viewing panes.

The **NAVIGATION** pane represents the entire Wi-Spy data capture. When you adjust the timespan, the Overview and Detail panes are automatically updated to match.

The **OVERVIEW** pane contains the Density and time-selected Waterfall data views.

The **DETAILS** pane provides additional graphs and views of the timespan, like the Networks Graph and Utilization.



Chanalyzer Pro Screenshot

Step-by-Step: First Time Use

To follow along, you will need a Wi-Spy 2.4x or a Wi-Spy DBx.

- 1) **Plug in a Wi-Spy to a USB port on your computer**
- 2) **Launch Chanalyzer Pro software**
- 3) **Select a Wireless Card**
Select your computers wireless card to access additional WLAN information about SSIDs, RSSI, MAC address and data rate. Click "Wi-Fi" in the menu bar, and select the wireless card you'd like to use. *NOTE: Wi-Spy is a spectrum analyzer. It is not capable of reading at the Wi-Fi packet layer. Therefore, Wi-Spy will not appear in the Wi-Fi card drop-down list.*
- 4) **Use the Wi-Fi Channels label on the Density View**
In the menu bar, select "View / Wi-Fi Channels". This will change the x-axis to display the Wi-Fi channels instead of the specific frequency range.
- 5) **Sort the Data by RSSI**
In the Details Pane, select Networks Table and sort by RSSI by clicking "RSSI" table header. Add a check mark to networks with an RSSI value above -85dBm.
- 6) **Select Current, Utilization and Networks**
In the Density View, click Current, Utilization and Network buttons. User selections are indicated by a darker shade of gray.
- 7) **Create a Two Minute Time Segment**
For this exercise, we will be using a Timespan of two minutes. Adjust the Timespan in the Navigation pane by clicking the green or red arrows until it displays two minutes.

The Overview and Details panes will update to display data from the indicated timespan. MetaGeek calls this Unified Time Segment. All graphs and tables display information for the exact same time segment.

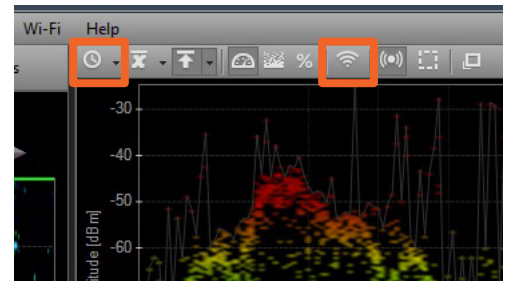
Chanalyzer uses a rolling Timespan, which displays all of the data in the selected time segment. It drops older data to keep information displayed in the main panels relevant to the user's location. This functionality improves the user's ability to track interfering device patterns.

- 8) **Establish a Baseline**
Now that Chanalyzer has been running for a bit, we will assume the displayed activity is representative of your normal wireless spectrum.

An important part of spectrum analysis is establishing a baseline to compare new RF activity against a history. This helps us understand RF activity that can negatively impact wireless communications.

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- 9) **Examine Patterns in the Density View**
Toggle off the Current and Networks icons to only see the Density View with the utilization coloration.



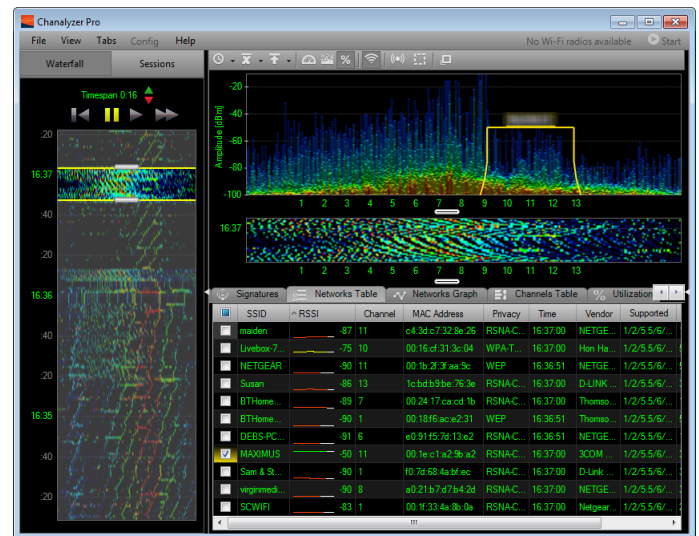
- 10) **Turn on a Microwave Oven**
Fill a cup with water and microwave it on high for two minutes with Chanalyzer running.

When the microwave oven is about to stop, press the yellow pause button in the Timespan controls.

In step 7, we set the Timespan to two minutes, and we ran the microwave for two minutes - so the time segment selected in the Waterfall View will show the microwave oven RF activity.

Pausing Chanalyzer captures function much the same way a DVR is paused. Chanalyzer continues to collect data from the Wi-Spy even while recording is paused.

Observe the changing data in the waterfall navigation pane.

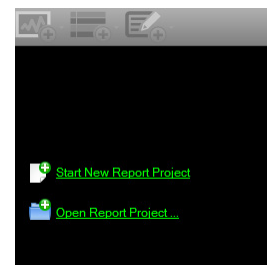


Microwave ovens tend to create a mountain-like shape in the Density View. It is never the same pattern, and can often change depending on the contents.

Step-by-Step: Building a Report

A powerful feature of Chanalyzer Pro is its report builder. This feature lets users highlight and visually explain how bad interference was when it occurred. The current selection should match the period of time the microwave was on. This will help generate a clearer snapshot of what the microwave RF interference looks like.

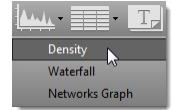
- 1) **Open Report Builder**
Click View from the top menu and select Report Builder (or Ctrl+R).
- 2) **Start New Report Project**
Chanalyzer can start with a previously built report project (.wsrx file) or build a new one. Select "Start New Report Project."



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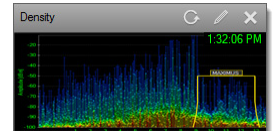
3) Add a Density View Block to the Report

At the top of the Report Builder interface, select add graph (the first button) and choose Density. Each of these menu items will add a graph block from Chanalyzer to your report.



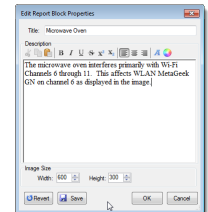
4) Update the Density Block

If you are not satisfied with the captured image, you can easily refresh it. Move the Timespan and turn off the network overlay at the top. Then click the refresh button at the top of the block.



5) Edit the Density Block details

Change the title and description of the report block by clicking the Pencil Icon. Describe the type of interference and which WLANs and channels are affected by the interference.

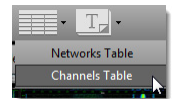


6) Add a Channels Table

Chanalyzer Pro generates a table with quantifiable results for Wi-Fi channels. Add the Channels table to your report by clicking the tables button at the top of the Report Builder interface.

7) Change the Title of the Channels Table Block

Edit the report block details to change the title. Give the block a title to relate it to the microwave oven, like "Microwave Oven Interference." The Channels Table is used to compare a Timespan when the microwave oven was not running. Point out the channels with an increased Utilization or lower grade.



Step-by-Step: Navigating the Waterfall View

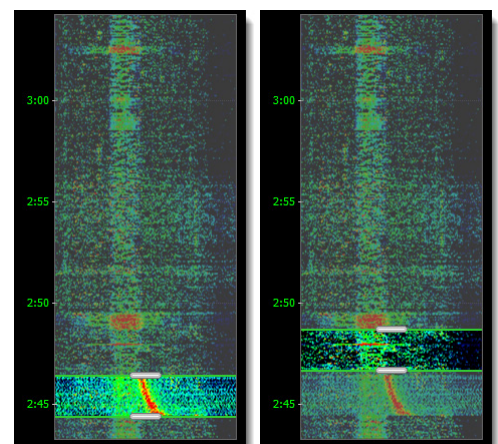
Like a seismometer measures vibrations of the earth, the Waterfall View in Chanalyzer Pro does the same thing for your RF environment. It uses colors to show when the RF environment changed, to what scale, and for how long.

1) Compare the Microwave Activity

Be sure the Waterfall navigation pane is visible by toggling it on (Ctrl + P). Click-and-drag our previously highlighted timespan up the waterfall by two minutes.

When you do this, be sure there is no microwave activity in the new Timespan (we want to compare non-microwave activity to when the microwave was running).

Notice as you drag to a new timespan that all views in other panels are updated too. This is MetaGeek's Unified Time Segment in action.



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2) Review the Density View Data

The mountain in the Density View created by the microwave oven should fade to possibly reveal a curve or two created by neighboring 802.11 wireless networks.

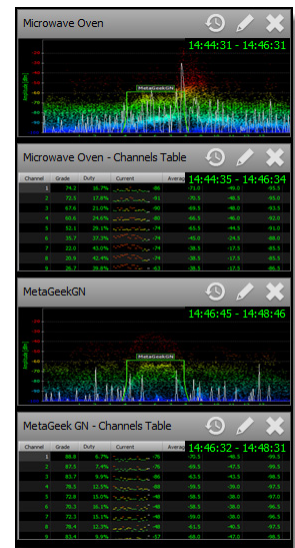
Selecting a Timespan where the WLAN worked well is important to determine the impacts of interference. We will compare this new timespan to the Density View and Channels Tables of our microwave interference.

3) Add another Density View block and Channels Table

By adding blocks from two different spans of time, Chanalyzer Pro can help users explain to customers and management the negative impacts of interference.

During site surveys, a wireless professional may decide to add several blocks per location. They will often turn on all wireless devices in the area to create a worst-case scenario, which allows them to choose the most interference-free channel for their WLAN.

To add our new data block, go to the top of Report Builder and add another Density View block, as well as another Channels Table block. Your report builder should now have 4 blocks as shown on the right.



4) Rearrange Report Builder Blocks

Click and drag a Density View block and place it below another Density View for easy contrast.

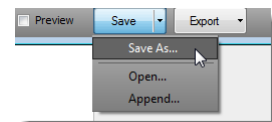
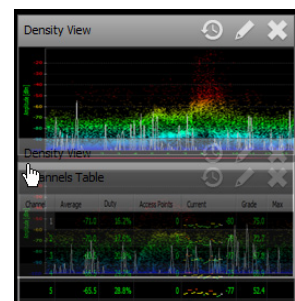
Report Builder lets users customize the layout of reports for simple comparisons.

5) Save the Report for Future Edits

Chanalyzer Pro lets users save a set of blocks for future editing. Reports are saved in .wsxr files.

You can also add new block sets by opening another .wsxr file. To do so, click "Append."

You might add a pre-built, vendor-specific block set discussing the latest features available and how they relate to the current spectrum data. You can also include product images or digital photos.



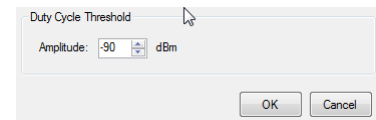
Step-by-Step: Customize the Utilization Threshold

Wireless engineers need to know how often noise levels cross a threshold. The Utilization or frequency utilization is a calculation that determines how much activity on a certain frequency occurs above the threshold. Utilization answers the question, "In the past five minutes, what percentage of time was noise above -90dBm?"

When planning, engineers must set a threshold that matches the SNR (Signal to Noise Ratio) requirements of their WLAN.

1) Adjust the Utilization Threshold to -90dBm

In the Chanalyzer File menu, click File > Preferences. The bottom of the preferences window contains an adjustable Utilization threshold. Set this value to -90dBm.

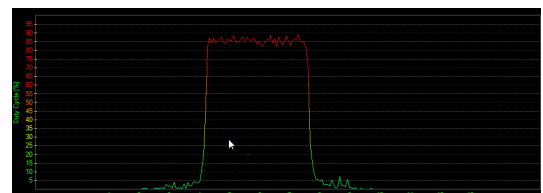


2) Open 2.4 GHz 802.11g on Channel 6.

Select the Showcase Tab in the Details pane. Click the right arrow until the "2.4 GHz 802.11g on Channel 6" recording appears. Press the Play button. Click on the Utilization tab in the bottom pane.



3) Change the Utilization Threshold to -80dBm



4) Press Pause

The Utilization graph shows a wide curved shape due to a lower Utilization threshold of -90dBm.



Get To Know: Wi-Fi Signature Patterns

Most modern spectrum analyzer solutions offer some form of device classification. Chanalyzer Pro's device classification attempts to match RF signatures based on its pre-built library of known transmitters. Wi-Fi transmission patterns, or modulation type, change with different types of usage.

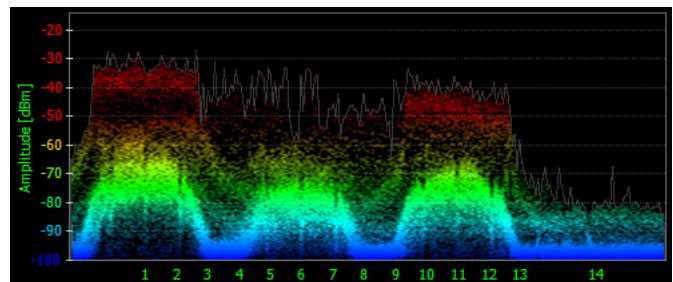
Chanalyzer Pro provides some quick reference recordings in its Showcase tab. Click the Play button to open the recording in Chanalyzer Pro. Toggle the transmitter option above the density view to experiment with device classification.



1) 802.11b Transmitter Pattern

To the right you'll see the most common shape when troubleshooting Wi-Fi in the 2.4 GHz band.

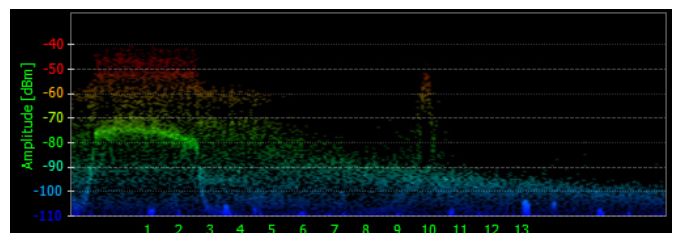
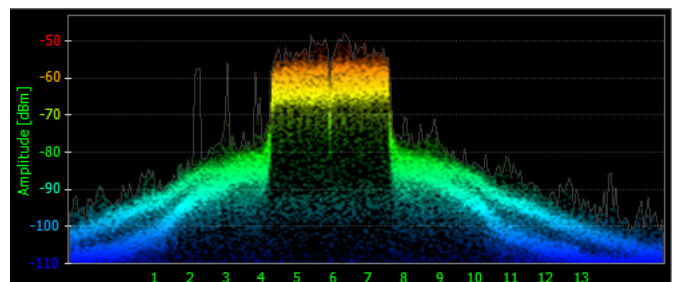
802.11b PSK APs tend to transmit beacons at the lowest common denominator of all Wi-Fi devices, or the most basic modulation, BPSK, causing the curved signature shape.



2) 802.11g Transmitter Pattern

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.



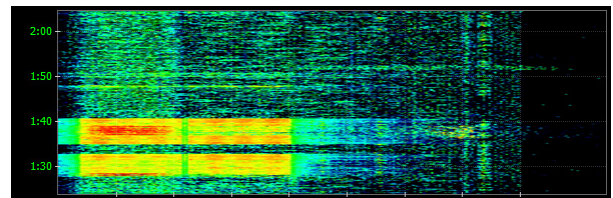
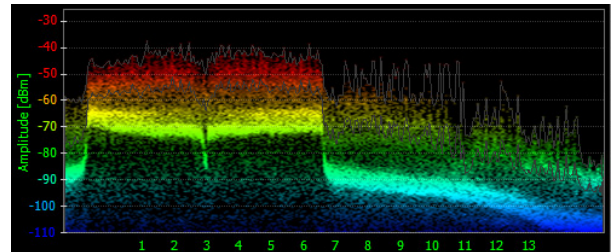
3) **802.11n Transmitter Pattern**

802.11n OFDM 802.11n APs with data rates of 300Mbps use channel bonding, which appear 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.

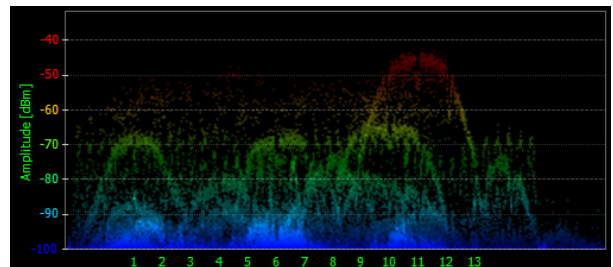
802.11n does not imply that the width of the AP transmitter will always be 40 MHz. In most cases, 40 MHz transmissions appear in bursts when an AP's throughput exceeds the capabilities of 802.11g ERP-OFDM.

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.



4) **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.).



Get To Know: Non-Wi-Fi Signature Patterns

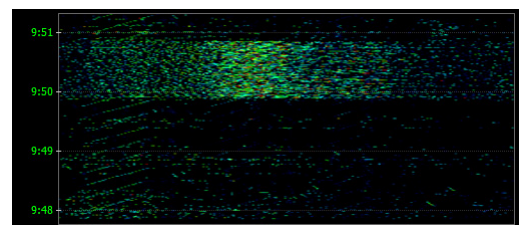
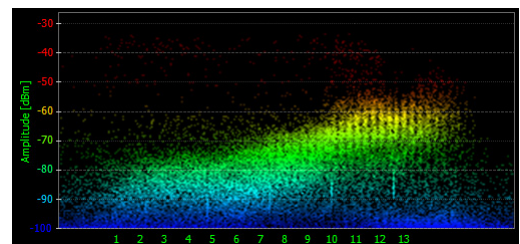
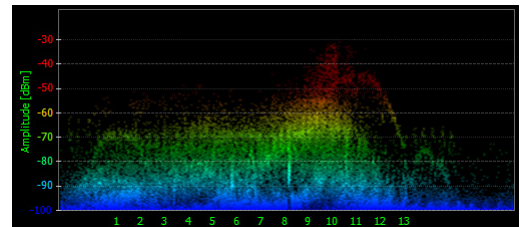
1) Microwave Ovens

Microwave Ovens operate in the 2.4 GHz range. Use the Density View of Chanalyzer to identify microwave oven leakage. Typically they create a sloping mountain shape 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.

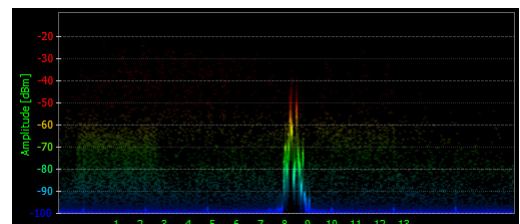
The amplitude levels of the microwave vary depending on the distance it is from the spectrum analyzer. Experiment with a microwave oven and varying locations.

Another great way to identify microwave oven interference is using the Waterfall View. The waterfall view shows how long something caused RF activity.



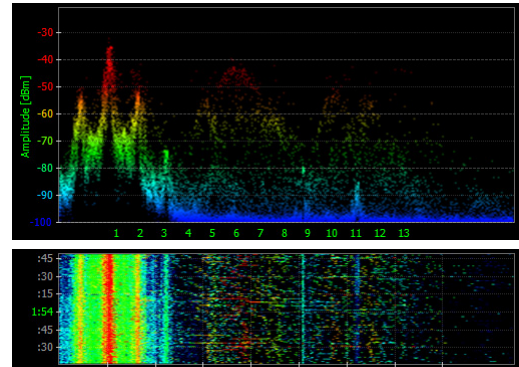
2) Motion Sensors

Motion sensors tend to transmit in 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.



3) **Audio Video Transmitter**

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

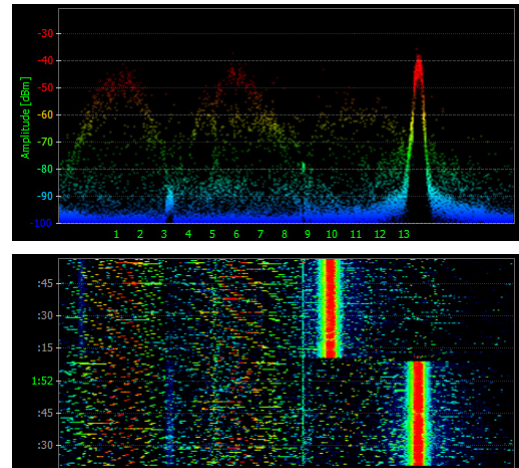


4) **Cordless Phones**

Not all cordless phones create the same pattern. Some are very narrow and use the lower 2.4 GHz band (2400-2420 MHz). Other cordless phones attempt to scan for the clearest channel, and vary the frequencies used.

One of the easiest way to identify cordless phone interference is by examining patterns in the Waterfall View, where they appear as vertical lines. When a cordless phone changes channels, it will appear as a break in the waterfall.

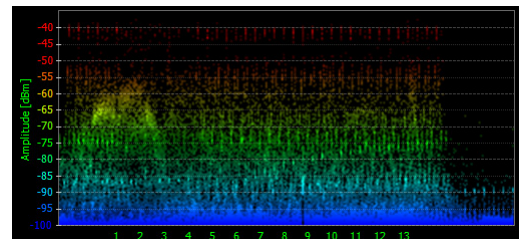
Some cordless phones may hop across the entire spectrum similar to bluetooth.



5) **Bluetooth**

Bluetooth hops across the 2.4 GHz 1,600 times a second, which is a form of frequency-hopping spread spectrum (FHSS) modulation.

Due to the nature of frequency-hopping transmitters, they may cause WLAN degradation, though it is unlikely that Bluetooth will cause severe Wi-Fi issues.

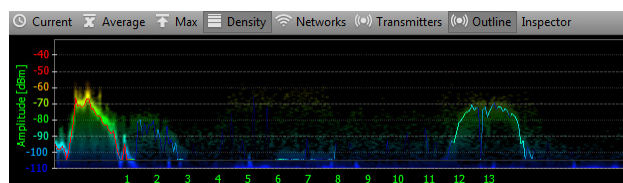


Step-by-Step: Build Your Own Signature

Users can create as many Custom Classifier signatures in Chanalyzer Pro as needed. To follow this example, please download the 16MB recording of a wireless audio projector made by Yamaha. <http://files.metageek.net/recordings/yamaha.wsx>

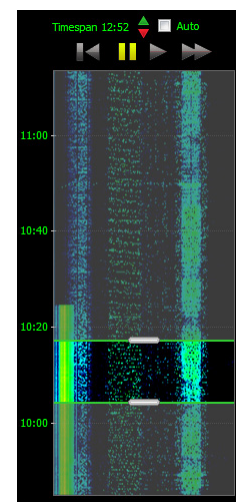
1) Open the Recording

Select a five minute Timespan in the Navigation pane. Turn off the current, average and max – we will only be using the Density and Outline views to create a signature.



2) Inspect the Outline

If the outline matches the shape in the density view, the pattern is good for a classifier. Move the timespan to narrow in on the time the transmitter was the strongest.

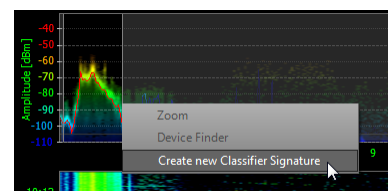


3) Use Playback Controls for Better Signature Results.

Press Pause when the shape appears to match the Density View modulation pattern. You may also want to shorten or lengthen the Timespan to get data to better fit the shape. Narrowing-in on instances in the waterfall view offers the best results for pattern matching. Press Pause when you have found a good fit.

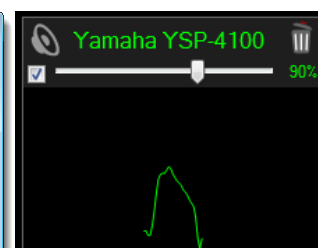
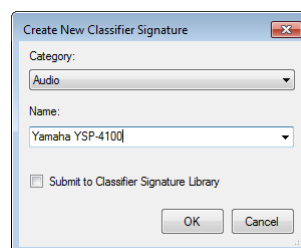
4) Highlight the Shape to Create a new Classifier Signature

Click-and-drag the mouse cursor across the shape of the transmitting device. After doing so, a contextual menu appears. Select "Create New Classifier Signature."



5) Assign the Audio Category

Add a title "Yamaha YSP-4100." After you click OK, a new signature box appears in the Signatures Tab of Chanalyzer. In this new box, you can set the threshold by dragging the slider left or right to avoid false positives.



NOTE: If a signature pops up for a few seconds then disappears and never comes on again, it's likely a false positive.

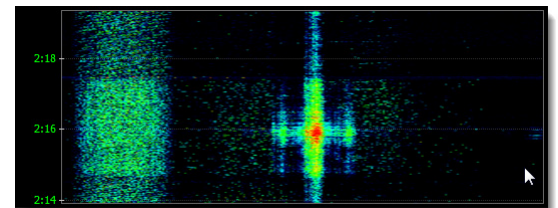
Step-by-Step: Tracking Down Transmitters

Chanalyzer Pro's waterfall view uses colors to map high amplitude points over time. This allows anyone with a spectrum analyzer to track down devices by watching amplitude changes over time. While walking around, the colors change to yellows and reds when a user is approaching the transmitting device.

To follow this exercise, please download the demo recording at <http://files.metageek.net/recordings/waterfall.wsx>

1) Review the Recording

In the image to the right we can see that the person performing this site survey walked right by a transmitting device. The amplitude levels of a transmitter increase and decrease. In the waterfall view, it looks like a bluish vertical line turning red.

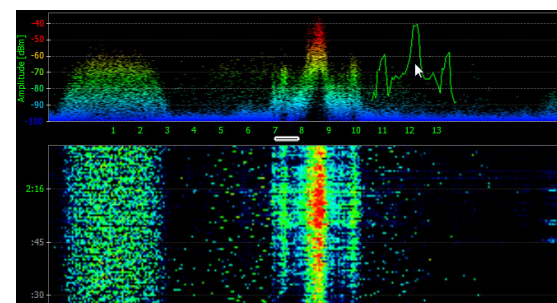
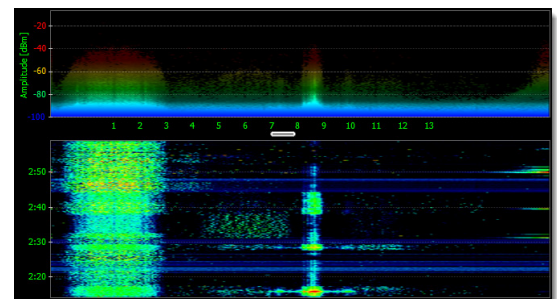


2) Adjust the Timespan

Select the range of time in which the amplitude was the highest (most red). Since the software continuously logs data from the Wi-Spy, we can zoom-in to view just the minute when the transmitter was within close range.

A shorter timespan helps users identify what type of a device was transmitting. Once the Timespan is shortened, we see three spikes of activity above Wi-Fi Channels 8 and 9.

Using the signatures tool, we can match the recorded pattern to an AV transmitter. Click on the signatures box and then hover the mouse over the pattern in the Density View. Click the box again to turn off the silhouette.



Step-by-Step: Using the Device Finder

The standard antenna in most spectrum analyzers and Wi-Fi receivers is omnidirectional. Omnidirectional antennas receive signals widely across on a horizontal donut-shaped plane, whereas a directional antenna is used in a similar manner to a flashlight – point it to gain visibility in that specific direction.

When performing site surveys, directional antennas minimize the guesswork associated when determining where interferers are transmitting from. Instead of blindly going into each room and testing to see if amplitude increases or decreases, Wi-Spy users armed with a Device Finder directional antenna can walk around and rotate the connected devices to find higher amplitude levels, moving toward the direction of the transmitter based on software feedback.

1) **Connect the Device Finder**

Highlight a transmitter by clicking and dragging across the Density View. Select Device Finder. Users can highlight frequency ranges of a transmitter's peak signal and track them using our directional antenna. It is very useful because it gives exact amplitude levels over time – freeing the user from interpreting color ranges. Note: This feature only works during live capture.

2) **Hot / Cold Real Time Tracking Results**

In the Details Device Finder tab, users can track down any device, no matter if the software identifies the interfering device or not. This method is perfect for transmitters that emit a constant signal, like cordless phones or AV transmitters. While using the Device Finder graph, continually monitor the Density View to identify the pattern of the device.

Learn More

As the 2.4 and 5 GHz public frequency bands are more and 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 user community. Use the forums to share your questions, recordings and technical expertise with your fellow MetaGeeks! <http://www.metageek.net/forums>

Also, review the Chanalyzer Pro User Guide for more detailed information about software functionality: <http://www.metageek.net/ChanalyzerProUserGuide>