



CHAPTER 14

Cisco Spectrum Expert and Network Operations

Cisco Spectrum Expert and Real World Applications

The preceding sections of this guide have been devoted to an overview of Cisco Spectrum Expert, and then a detailed discussion of how to use specific features and operational modes. This section explains how to put Cisco Spectrum Expert Software to work in the real world of network planning, maintenance, and troubleshooting.

A key, general principle to keep in mind is that the RF environment, by its very nature, is highly dynamic and unpredictable. The environment varies over time as both RF sources and RF reflectors move about or change in their activity and keep in mind that an “RF reflector” can be virtually anything at all, obviously including metallic objects, but also other types of objects, and even people. Further, some RF sources, such as directional antennas, have a strong RF impact in limited spaces or directions. This chapter describes how the variability of the RF environment must be taken into account when putting Cisco Spectrum Expert Software to work.

Site Survey

A site survey is a series of RF measurements conducted not only prior to network deployment, but possibly even prior to deciding what type of network equipment to purchase. The site survey is intended to provide a general picture of the RF environment, and particularly those aspects of the RF environment which may influence purchase decisions. The information gained in a site survey will also contribute to network planning (covered in the next section).

The primary goal of the site survey is to determine which channels/bands are acceptable for network deployment. The survey can also suggest the number of network devices that may need to be purchased and deployed. This is particularly crucial for those networks, such as Wi-Fi networks, where you have a choice of the type of network equipment to purchase (802.11a, b, or g).

Physical Movement of the Laptop

The site survey entails physically moving your Cisco Spectrum Expert Software laptop throughout the network space, monitoring changes in the readings as you go. You can carry the laptop, but typically you place the laptop computer on a cart and wheel the cart about. In offices you will want to at least walk around the perimeter of each office, and perhaps up and down and side-to-side through the center of each office. In a hallway or corridor, it may be sufficient to roll the laptop down the center of the hallway. In a large, open space you may want to walk up and down in lanes, much as if you were “mowing” the carpeting or floor tiles with the laptop.

We can't tell you the exact physical "granularity" of the survey – that is, we can't say if you should walk up and down your office in lanes spaced five feet apart or fifteen feet apart. Partly it depends on the size of the site you are covering – you are likely to have the time to follow a finer, more closely spaced path in a 5,000 square foot office than in a 100,000 square foot warehouse. We can say that the more fine-grained your site survey, the more accurate the information you will obtain. Certainly, just taking measurements in four corners of a large space, and at the center of that same space, is generally *not* sufficient.

**Note**

Site surveys can be done not only for indoor areas, but also for outdoor deployments of network equipment. For example, it is now common to set up network backhaul links on the rooftops of buildings. A site survey done on the rooftop can detect all kinds of interference activity from neighboring transmitters. Again, the more rooftop space that is covered in the survey, the clearer and more accurate will be the picture of RF activity.

Cisco Spectrum Expert Software Survey Data

Typically, during the survey you will want to look at the Cisco Spectrum Expert Software **Channel Summary**, the **Devices View**, and two or three of the spectrum plots: the **Real Time FFT** plot, the **FFT Duty Cycle** plot, and very likely the **Swept Spectrogram** plot.

- The **Channel Summary** tells you which channels are showing the most RF activity, and gives a rough indication of how much of that activity is due to interferers, and how much is due to other network devices.
 - If the activity is due to interferers—and if those devices are in your space and under your control—you may be able to either remove or shield some of the interfering devices.
 - We are assuming that you have not deployed your own network yet. So, if you are picking up activity from other network devices, these are likely to be devices in neighboring networks. If you do not own these networks (for example, they belong to a company in an adjoining office), you may not be able to do anything to prevent this interference. In this case, you may need to plan your own network to use other channels or bands which are not in use by that network.
- The **Devices View** shows you specifically which devices are causing RF activity. The information includes the channels on which these devices are operating. Based on this specific information, you can start to determine whether you can mitigate or remove these devices; or whether, instead, you'll need to plan your network operations to work around this device activity. (For example, if the devices cannot be removed or shielded—or just plain turned off—you may need to operate your network on channels not affected by those devices.)
- The plots—**Real Time FFT**, **FFT Duty Cycle**, and **Swept Spectrogram**—can be used to obtain a more fine-grained view of spectrum activity. Note that the **Swept Spectrogram** can be used to view either the RF power or RF duty cycle. The combined time and frequency view offered by the **Swept Spectrogram** is also especially useful for viewing a variation or stability in spectrum activity over the time interval of a few minutes.
 - These plots can be particularly useful for evaluating channels that are borderline in the **Channel Summary**, or in terms of the number of devices seen on a channel in the **Devices View**.

Both the **Channel Summary** and **Devices View** present a summary of RF activity seen over some extended period of time. It may be, however, that on some particular channel(s), the RF activity is in fact bursty in nature, i.e., it is characterized by sporadic pulses of RF activity. Because network activity itself is also bursty, such a channel may in fact be acceptable for network purposes – RF activity from non-network devices will only occasionally occur at the same time as network RF activity.

In other words, looking at the spectrum plots can help you determine if the interference is constant or intermittent; and if the interference on a give channel is, in fact, tolerable from a network standpoint.

The spectrum plots are also useful for detecting interference which is created by devices that are completely unclassified by Cisco Spectrum Expert Software. While these devices will not show up in the **Devices View**, and will not impact the measurements in the **Channel Summary**, you will see their RF activity on the spectrum plots.

There are at least two conclusions you can generally draw from the data obtained in the above manner:

- You can determine which are your cleanest RF channels. This may determine which types of network equipment you buy, or at least which bands or channels you set your network equipment to use. For example, for Wi-Fi, if you find that the entire 5 GHz band is being swamped by nearby RF activity, you can plan your network purchases and configuration to operate in the 2.4 GHz band.
- You may find that even your best channels or bands are only relatively clean; there may still be substantial, unpreventable RF activity. This will generally indicate that you will need to purchase more network devices to obtain adequate network performance and coverage.

Of course, “more network devices” is a relative term. More than what? You would need to make some kind of baseline decision for your particular network technology—for example, how many access points would it take to provide adequate coverage for your Wi-Fi network, in a clean RF environment?—based on the particular specifications of the network equipment. Then, if the available channels are fairly congested with RF activity, you may need to scale that number by, say, 50% or 100%, to ensure reliable and speedy network performance.

Rather than purchasing more network devices, another option—if significant RF interference will be an ongoing issue—is to instead purchase more powerful network backbone devices, which can overcome the local interference with a stronger signal.

Note, however, that boosting, say, the power of your Wi-Fi access points, does not boost the power of the Wi-Fi stations which may be in use. (Your network environment may be a public one, where you do not control the design or broadcast power of all the stations that may be in use.) In this case, a higher density of backbone devices (For example, access points for Wi-Fi) may be the only effective solution.

Additional Notes on the Site Survey and the Spectrum Plots

Monitoring Multiple Bands on Spectrum Plots

A spectrum plot can only monitor one band at a time (such as 2.4 GHz or 5.15 to 5.35 GHz for Wi-Fi). However, on a single spectrum tab, you can open more than one instance of the same type of plot (such as the **Real Time FFT**). By setting each instance to monitor a different band, you can monitor at the same time all, or almost all, of the bands of interest.

Real Time Plots Versus Software-Based Plots

We do not recommend the **Power vs. Frequency** or **Power vs. Time** plots for site survey purposes. These two plots require extensive software analysis on your Cisco Spectrum Expert Software laptop, and are intended mainly for analyzing specific RF issues (typically, RF problems related to some unknown device).

The plots indicated above—**Real Time FFT**, **FFT Duty Cycle**, and **Swept Spectrogram**—offer data directly from the Sensor card, and are designed to give a better, more accurate picture of overall RF activity in a particular band. It's that band-inclusive view which is most applicable for site survey purposes.

Conducting the Site Survey

Cisco Spectrum Expert needs to be wheeled about the anticipated network environment, and you will benefit from using multiple Cisco Spectrum Expert modes—**Devices View**, **Channel Summary**, and several spectrum plots—to conduct an effective site survey. So you need to wheel the laptop about, while switching between viewing modes, in order to get the job done.

A physical map of your site, where you can record notes of key readings, may prove helpful as well. There is no one mandatory method of doing the site survey, but what follows is one possible approach.

-
- Step 1** Pick a location, typically one corner of the anticipated network space, in which to start the survey. Look at both the **Devices View** and the **Channel Summary**, to see which channels are causing the most activity, and what devices are responsible for that activity. Make note of this information on your map of the network space.
 - Step 2** Switch to the spectrum view mode, and set up the plots you wish to view. Since there are two spectrum tabs, you may want to use each tab for a different kind of plot. For example, on one tab you may set up multiple instances of the **Real Time FFT**, with each instance set for a different band. On the other tab, you might establish multiple instances of the **Swept Spectrogram** (again, picking a different band for each instance), with the **Trace Type** set to **Duty Cycle**.
 - Step 3** Wheel the Cisco Spectrum Expert laptop through the anticipated network environment. As you move, keep your eye on the spectrum plots—**Real Time FFT** or **Duty Cycle**, as you prefer—perhaps pausing occasionally to switch from one spectrum tab to the other.
 - Step 4** View all the bands you've set to display on the plots. However, you probably want to keep an eye on those bands which encompassed both the most active and least active channels seen on the **Devices View** and the **Channel Summary**. The goal is to see if this activity remains fairly consistent throughout the network space, or varies significantly.
 - Step 5** Any time you see a significant change in the spectrum plots—either a spike in RF activity at some frequency, or a notable drop-off—you can switch back to **Channel Summary** or **Devices View**. The **Channel Summary** will likely confirm what you've seen on the plots, namely, that there is a notable increase or decrease in RF activity on particular channels. The **Devices View**, of course, will help you identify the particular cause(s) of that activity.
 - Step 6** Next, switch back to the spectrum plots, and continue your walk through the network space.
 - Step 7** Again, at appropriate points, you will want to stop and make notes on your map of the network space.

There are several possible variations on this procedure.

- In terms of how you set up your display during the survey, another option is to put two **Real Time FFT** plots and two **Duty Cycle** plots on the same tab, covering two bands. Put two more **Real Time FFT** plots, and two more **Duty Cycle** plots, on the other tab, measuring two other bands. (You always have the option of using the **Swept Spectrogram**, and setting it to display either duty cycle or RF power.)

- You could make an entire sweep through the network environment looking only at the **Channel Summary**; then another sweep, along the same path, with the spectrum plots on display. After determining those locations with the most RF activity, you may return to those specific locations and use the **Devices View** to ascertain the particular RF sources involved.
 - If you note a particularly high level of RF activity at some point, but the source is not obvious, the **Device Finder** may help you track down the source. See [Device Finder Mode](#) for more information.
-

Save the RF Map

We recommend that you save the RF map you create in the course of the site survey. It will come in handy later, both for initial network device deployment, and for charting any changes in your RF environment over time.

Drawing Conclusions

At the conclusion of this process—and with your marked up network map in hand—you should have a very clear picture of which frequencies are relatively clear, and which frequencies are relatively crowded with RF activity, throughout your network space. Ideally, it will be immediately clear which channels or bands you wish to use for your network deployment.

You may find that certain bands would be best to use at some locations in your network environment, while other bands would be better to use elsewhere. In the worst case, these bands may be hardware incompatible (For example, you'd want to use 802.11b/g in part of your network, and 802.11a in another part). In this case, part of your network planning may entail removing or shielding some current sources of RF activity, to free up a particular band in a particular location.

As indicated above, the general level of network activity will also help you determine the number of network backbone devices that you need.

Antenna Options

The Wi-Fi version of Cisco Spectrum Expert has an optional directional antenna. Normally though, during the initial phase of a site survey, you will want to use the standard omni antenna, so that at each location you can pick up RF activity from all possible sources in the vicinity.

In some cases, you may find RF activity that is highly localized, without the source being apparent. (This can happen, for example, if there is a directional broadcast antenna at some distance. You will only pick up a signal when you happen to cross the path of the antenna beam.) At these locations, the directional antenna can be used to help determine the exact direction of the source of RF activity. See [“Using the Directional Antenna”](#) for more information.

Network Layout

Once you have purchased your network backbone equipment—such as access points for Wi-Fi—Cisco Spectrum Expert can support a dynamic, real-time network layout process that results in near-optimum placement of access points, and so on. Here again you will rely upon the **Devices View**, the **Channel Summary**, and the spectrum plots (**Real Time FFT**, **Duty Cycle**, and/or **Swept Spectrogram**).

Placing the First Access Point

To start the process of deploying devices, follow these steps:

-
- Step 1** Select a location for placement of your initial access point. Select a location that is sufficiently close to an Ethernet connection for your wired LAN.
- In addition, you'll want to select a location which you had determined, in the course of your site survey, to have low RF interference. (We recommend that you save the RF map that you created during your RF site survey.)
- Step 2** At the selected location, you'll use Cisco Spectrum Expert to double check that RF activity remains at acceptably low levels in the channel you intend to use. (Depending on your overall environment, the RF activity may or may not vary substantially over a relatively short time frame. For example, a neighboring office may have rearranged or reconfigured their WLAN in ways that will affect your network deployment.)
- As with the site survey, you can use the **Channel Summary** and spectrum plots to check the overall level of RF activity at the selected location. The **Devices View** can tell you about any specific devices that are now causing interference, and which can possibly be removed or shielded. If there is new, and uncontrollable, RF interference which had not been detected during the site survey, you may need to select another location for initial access point deployment.
- Step 3** You have selected a location for the initial access point, set it in place, and probably wired it into the WLAN. Before powering up the access point, you should set one of the **Real Time FFT** plots to monitor the channel which will be used by the access point. When you turn on the access point, you should see an immediate and dramatic gain in RF power in that channel. This tells you that the access point is broadcasting RF on the appropriate channel.
- Step 4** You will now turn to the **Devices View**. Cisco Spectrum Expert should quickly detect and classify the access point, so that it is shown in **Devices View**. Of the most interest is the **Signal Strength** field. Normally, the signal strength near to the access point should be well above -70 dBm.



Note The expected, near-to-the-device signal strength will vary depending on the type of network you are deploying. Similarly, the too-low-for-reliable-operations power level (discussed below) will also vary depending on the network technology you are implementing. The values described here, in the range of -70 to -80 dBm, are appropriate for Wi-Fi network access points.

Placing the Second Access Point

To place the second access point, follow these steps:

-
- Step 1** With Cisco Spectrum Expert once again in hand or on a rolling cart, you now want to move in some direction away from the access point you have just placed. The direction you choose will depend on your general plan of network deployment, as well as on the RF map created during the site survey.
- For simplicity of description here, we'll assume you are laying out your network in some relatively, wide open space, such as a warehouse or airport terminal. Naturally, if you are in a more constrained space, such as an office, your movements will probably entail leaving one room and entering the adjacent room, or possibly walking down a hallway outside the room.

- Step 2** In general, your goal for placing the next access point is find a location which is again structurally convenient—for example, you may want to remain close to a wall, so the access point is relatively out of the way of other activity and movement—and close to another Ethernet connection.
- Step 3** As you move Cisco Spectrum Expert in the general desired direction, check the device **Signal Strength** on the **Devices View**. When the **Signal Strength** falls to around -70 to -80 dBm, it is an indication that the first access point can no longer reliably communicate with network devices at your current location. Choosing the higher threshold value, -70 dBm, will provide greater network reliability, at the price of placing access points closer together. That will mean purchasing more access points. The lower threshold, -80 dBm, may result in somewhat less network reliability and/or data rates, but also involves deploying fewer access points.
- Step 4** At this point, where the access point signal strength has dropped to -70 dBm or -80 dBm, you will probably want to deploy the next access point. You should set the new access point to a channel substantially apart from the channel used for the first access point. (For example, you might vary your access points between channels 2, 5, and 8, or 1, 6, and 11.). However, before “committing” your access point to this new location, you should use Cisco Spectrum Expert to double-check a few things:
- Using the **Channel Summary**, make sure that the channel you have in mind is reasonably free of local interference.
 - Check the spectrum plots to ensure that the location is fairly free from excessive RF activity of all kinds.
 - If you encounter undesirable RF activity at the location of interest, take steps to mitigate the interference, deploy a more powerful access point, or choose another location.
- Step 5** Set the second access point in place at the new location, and wire it into the WLAN. Set one of the **Real Time FFT** plots to monitor the channel which will be used by the access point. When you turn on the access point, you should see an immediate and dramatic gain in RF power in that channel. This tells you that the access point is broadcasting RF on the appropriate channel.
- Step 6** Check the **Devices View**. Cisco Spectrum Expert should quickly detect and classify the access point, so that it is shown in **Devices View**.
-

Placing Successive Access Points

With Cisco Spectrum Expert once again in hand or on a rolling cart, you now want to move in some direction away from the access point you have just placed. The direction you choose will depend on your general plan of network deployment, as well as on the RF map created during the site survey. Check the **Devices View**. Cisco Spectrum Expert should quickly detect and classify the access point, so that it is shown in **Devices View**. You may need to go back to the first access point, and find a new direction—at right angles to your first path, or directly opposite—to place the third access point. Depending where each access point is placed in your overall network environment, you may need to place anywhere from one to four access points that are adjacent at some distance.

In each case, however, as you travel away from an access point, an indication that the access point no longer provides adequate signal coverage is when the access point’s signal falls to around -70 to -80 dBm.

Also, be sure that adjacent access points are not broadcasting on the same channel.

After-Deployment Site Survey

After deploying all your access points, you will want to conduct another site survey. This time, you do not need to cover all the ground, as with the initial survey. However, you want to focus on areas which, just by looking at your access point layout, you can see are relatively far from any one access point.

In those areas, you will want to move Cisco Spectrum Expert around a bit, and use Cisco Spectrum Expert's **Devices View** to ensure that at least one access point is clearly detectable, preferably, giving a **Signal Strength** greater than -70 dBm. This ensures that any device in the area will be able to communicate with at least one access point.

In addition, you may want to activate some of the known interferer devices that operate within or near the perimeter of your network—cordless phones, microwave ovens, and so on. You can use both the spectrum plots and the **Channel Summary** to see if any of these devices are swamping the RF environment with so much energy that they are likely to impede RF communications. If that is the case, you can deploy additional access points, or more powerful access points, to compensate for the interference.

Long-Term Trend Analysis

Your network's RF environment can change over time, requiring adaptive changes in your network deployment. Quite typically, these changes will be for the worse—more RF activity, and more interference—as your organization grows, and the number of wireless devices (both network related, and interferers), increases as well. You may need to deploy more network backbone devices (access points, Wi-Fi Readers, and so on.), or more powerful devices, to compensate for the change.

Ideally, you would like to know about emerging RF trends before they impact your network. Cisco Spectrum Expert can be used for systematic monitoring and recording of the RF environment, enabling you to observe emerging trends. The key tools here are the **Devices View**, the **Channel Summary**, the spectrum charts, the screen capture feature, and the record/playback feature.

Trend Analysis Procedure

The general strategy is to pick a number of key locations in your network environment, and record spectrum data at those locations at regular intervals. How frequent those intervals should be depends on your own assessment of the pace of change in your network environment. At a small but rapidly growing startup company, you may want to make measurements as often as every two weeks. At a much larger, established organization, with a more gradual growth curve in staff and activity, once every two months might be sufficient.

You can record data both in the form of CSC files, which capture real-time data for later playback (see [“Spectrum Recording and Playback”](#) for more information). For screen shots, you can maintain a notebook where you store printouts of the capture screen shots. The screen images should be annotated by both the date and location. Flipping through the pages in the date order (or laying them out on a table for side-by-side comparison) will make it easy to see significant trends in network and RF activity. Similarly, you can view successive CSC files, one after another; to discern any important increases in RF activity.

Type of Data to Record

We recommend the following types of data as being most useful for long-term trend analysis.

- **Devices View**—The particular RF devices in use at any given moment can vary widely during the course of a day. However, you can set the **Devices View** to display all devices that have been used during an extended period of time during the day, such as the last four hours or the last twelve hours. This will create a broad picture of all the RF devices in use during a typical day, or large part of a day. If you capture this data at regular intervals (every few weeks or every few months), you can see if there is substantial growth in device usage.

You can also see if a particular type of device is being used more and more, and can make a decision as to whether the type of device in question is likely to impact network operations.

- **Channel Summary**—This view of the RF spectrum indicates the amount of activity on each channel. Taking “snapshots” of this information at regular intervals will help you determine if any particular channels are become crowded with excess activity. This may result in you choosing to change the channel assignments for your network backbone devices.



Note The **Channel Summary** is a snapshot view of “right now.” Like the use of devices, channel usage can vary significantly over the course of a day. Therefore, on the days when you elect to record data for long-term trend analysis, you may want to capture channel usage at several times during the day. This will make it easier to determine which channels have consistently high activity or low activity.

- **Time-Oriented Charts**—The time-oriented spectrum charts—**Devices vs. Time** and **Channel Utilization vs. Time**—are the ideal tool to ascertain overall RF activity over the course of a single day. By setting the time interval to 8 hours or 24 hours, you can obtain a global view of RF activity over the course of a day (8 hours, of course, is appropriate for most office environments; while the 24 hour view is appropriate for environments—some factories and warehouses, airports, and so on.—which are the hub of day and night activity).

Since a single **Devices vs. Time** chart can display, at most, four different types of devices, you may want to put two charts on display at the same time, to capture up to eight different device types. Similarly, the **Channel Utilization vs. Time** chart can only display data for one band; putting multiple instances of the chart on display enables you to record data for multiple bands.

As discussed above, the goal is to take screen captures of these charts at regular intervals in time (for example, every two weeks), noting both the location and date. After some extended time has passed (typically several months), placing the charts from different dates side-by-side, in ascending date order, will clearly indicate significant increases in the number of devices in use, or the RF duty cycle, or both.

- **Channel-Oriented Charts**—The **Devices vs. Channel** and **Channel Utilization** charts provide more specific information about RF usage. While they only cover a fixed, short interval of time—they update approximately every twenty seconds—they provide a clearer indication of specifically which channels are being impacted by RF activity. As with the **Channel Summary** display, discussed above, we recommend that on your “trend analysis days”, you take snapshots of the channel-oriented charts at several times over the course of the day. This will help provide a combined time and channel-oriented view of RF activity.

Routine Network Monitoring and Troubleshooting

Once your network is up and running, Cisco Spectrum Expert enables you to monitor the RF environment on a daily basis, often detecting potential problems before they become apparent to users. In addition, when users flag problems, such as network slowdowns or lost connectivity, Cisco Spectrum Expert enables you to quickly pinpoint the source of the problem.

Routine Monitoring

For routine monitoring, we suggest that you set one of the two spectrum tabs to display the following plots and charts: **Real Time FFT**, **FFT Duty Cycle**, **Swept Spectrogram**, and all of the spectrum charts (**Active Devices**, **Channel Utilization**, **Channel Utilization vs. Time**, **Devices vs. Channel/Time**).

Notice that more than one **Devices vs. Time** plot is in use (lower right of the picture). This is because each such plot can track a maximum of four device types. To track more than four devices, you need to put at least two such plots into use. Similarly, you have the option of using more than one **Real Time FFT** plot, or **FFT Duty Cycle** plot, in order to monitor additional bands.

Monitoring Points and Monitoring Rotation

The general procedure for routine monitoring is to pick selected monitoring points throughout your network environment.

- Throughout the day, you move Cisco Spectrum Expert from one monitoring location to another, holding your position at each location for some extended length of time (say, one hour, or two hours).
- In a large network environment—and depending on how many Cisco Spectrum Expert computers you have, and the size of your network support staff—you may not be able to cover all of your monitoring points in a single day. Instead, you may have a rotation among monitoring points that takes, say, a full week to complete, and then starts again, covering the same points, the following week.
- **Vary The Sampling Times** – If possible, each set monitoring point on your route should NOT be always sampled at the same time of day. As a very simple example, and supposing you had just five designated monitoring points (call them A, B, C, D, and E), and exactly one Cisco Spectrum Expert computer, you might employ a rotation similar to the following:

.Time Slot	.Monday	.Tuesday	.Wednesday	.Thursday	.Friday
.8 a.m. to 10 a.m.	.A	.B	.C	.D	.E
.10 a.m. to Noon	.B	.C	.D	.E	.A
.Noon to 2 p.m.	.C	.D	.E	.A	.B
.2 p.m. to 4 p.m.	.D	.E	.A	.B	.C
.4 p.m. to 6 p.m.	.E	.A	.B	.C	.D

The point is to make sure that each location is monitored at different times of day, because it is possible that certain locations have low network utilization at one time of day, and higher utilization at another time of day.

- **Selection of Monitoring Points** – As for the selection of monitoring points, you will typically seek a mix of locations, some of which are relatively near to your network backbone devices (such as access points); while others are relatively from the network backbone devices.

The goal is both to make sure that monitoring points far removed from the network backbone have a healthy RF environment, so they can pick up signals from the backbone; and also to ensure that the backbone devices themselves will be able to clearly receive signals from network members.

- **Variation Analysis** – In the *Section Long-Term Trend Analysis, Long-Term Trend Analysis* Long-Term Trend Analysis, we discussed capturing screen shots, or recording spectrum activity, as a tool for long-term trend analysis. You could use this daily monitoring as the core of that long-term

trend analysis. However, recording and storing data from multiple locations every single day is likely to result in an overwhelming amount of data. We recommend measurements intended for long-term trend analysis be taken at longer intervals.

However, what you can do is make spectrum recordings or spectrum screen shots on a daily basis during the week, and then compare the recordings/screen taken at the same location, but on different days of the week, and at different times. This comparison will quickly reveal any unexpected, dramatic changes in the RF and network environment.

You can quickly determine if a particular location has dramatically increased activity at different times of day.

If you measure the same location, at the same time, at the beginning of a week, and again at the end of the week, you can immediately detect any abrupt change in RF activity. This can occur, for example, if a new RF device (say, a new microwave oven) was installed during the course of the week, and is now introducing unacceptable levels of RF.

RF and Device Monitoring

Using the spectrum view configuration described above:

- **Spectrum Charts**—The spectrum charts will show you if there is an excess of RF activity on a given channel, or an excess of devices on a given channel. You can also see how RF activity and device activity vary over time.
- **Spectrum Plots**—The **Real Time FFT**, **FFT Duty Cycle**, and the **Swept Spectrogram** all help you detect “bursty” RF activity, which may or may not register strongly on the spectrum charts (the charts generally reflect more sustained trends in RF activity). Bursty RF activity can cause network transmission and reception problems, even if the spectrum charts seem to show a relatively clear environment.
- **Active Devices Chart** and **Active Devices Tree**—Together, these two display elements provide a clear picture of which types of devices—network or interferer—are active in the network environment. The **Active Devices Tree** will also show you if there are network devices impacting your network, but which are not actually part of your network (For example, access points from neighboring Wi-Fi networks).

Troubleshooting

In addition to routine monitoring, there will be times when a network user (or, on a bad day, users), notify you about problems with network performance or connectivity. In these cases, you will want to take Cisco Spectrum Expert to the location(s) where the problems are being reported, and scan the same plots, charts, and the **Active Devices List**, as described above.

It is possible that the flawed network activity will be intermittent. You can set Cisco Spectrum Expert in place at the location where the problems are reported, and set it to record spectrum data over the course of a day for later review. At the conclusion of monitoring, you can also look at the **Devices View**, which presents an historical view of devices that were seen over a period of up to 24 hours.

Problem Resolution

Once a problem has been detected, and the general cause has been ascertained—such as too many devices in use, or excessive interference on a particular channel—the exact nature of the solution will vary depending on the problem at hand.

In some cases, the cause of the problem is immediately evident—for example, a new microwave oven has been put into use, and the RF leaking from the microwave can be clearly seen as increasing the duty cycle every time the microwave is turned on. You could move the microwave, shield the microwave (or, possibly, try eating cold food). Similarly, the office may just have gone from standard wired-phones to cordless phones, and the new phones are causing the interference. The solution here may be to change the channel used by the network backbone devices.

In still other cases, it may be that more and more network devices are being put into use—for example, as more staff is hired, more wireless computers are used—and a threshold has finally been reached where the existing network backbone (access points) can no longer handle the traffic. The solution here is to purchase additional access points, or reallocate some access points from locations where network demand is not as strong.

Device Finder

In other cases, the general nature of the problem may be apparent, but the particular cause is not. For example, the plots and charts may clearly show increased RF activity when some device is coming into use—but the device itself is not known. (For example, it may be a generic device, and the network administrator does not recognize what device is actually implicated, based solely on the generic parameters.)

In this case, Cisco Spectrum Expert's **Device Finder** feature becomes an essential tool for tracking down the ill-behaving RF device. See "[Device Finder Mode](#)" for more information.