

WHITE PAPER

3Com[®]
Solutions:
MITIGATING
THE “BIG THREE”
RISK FACTORS
IN WIRELESS
DEPLOYMENT

3Com Solutions: MITIGATING THE "BIG THREE" RISK FACTORS IN WIRELESS DEPLOYMENT

CONTENTS

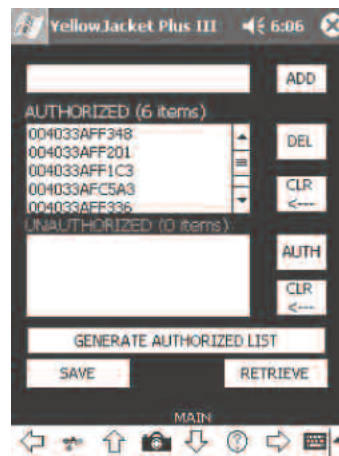
Rogue Devices2
 Security3
 Real World Examples6
 Return on Investment.....7
 About the Author8

Deploying a wireless network can be risky business without attention to three major risk factors: rogue devices, security, and return on investment. For many IT managers, unless they can be assured that they have the same level of control and security as their wired LANs, deploying wireless technology can feel like they are literally tossing their tightly managed network into the air. This paper explores the expertise and tests that can be applied to identify and resolve potential problems before the system is installed.

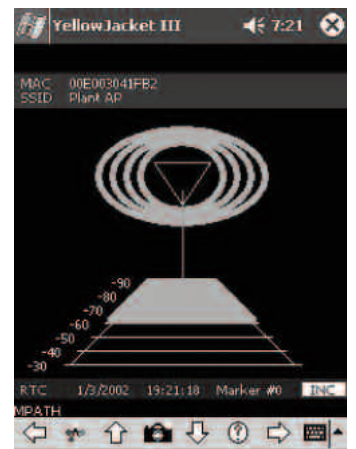
ROGUE DEVICES

Wireless is hot technology, readily available and often brought into the workplace by employees before it is officially sanctioned by the company they work for. From PDAs and hand held devices to wireless phones and computers, wireless devices are sprouting like weeds at the edge of countless small business and corporate networks. A Wireless Site Survey is a good way to uncover and document rogue devices by monitoring the signals on all the available channels and creating a list of authorized users. Once rogue devices are identified, companies have the option to shut them down or ensure that they are registered and adhere to company security and radio frequency (RF) guidelines.

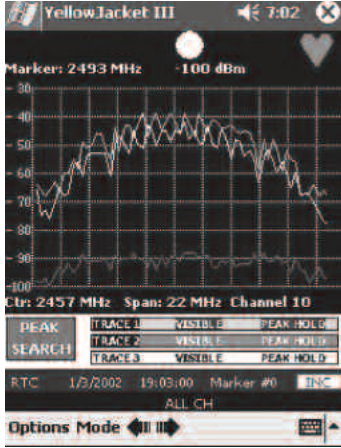
Sometimes a rogue access point belongs to another company's adjacent network in a nearby office within the same building or general location. Because wireless client devices automatically select the strongest RF signal, they may connect to a nearby company's network or vice versa. While this type of rogue activity is generally unintentional, it is problematic as it puts confidential company information at risk. Documenting the situation is the first step toward taking the appropriate security precautions.



During a Wireless Site Survey the engineer generates an authorized list and documents unauthorized users.



Tests enable the engineer to determine the location of unauthorized access points.



In addition to the frequency selected for the transmission from each AP, the throughput, power level and choice of channel are very important. Greater throughput is required for higher bandwidths but the power levels must adhere to government regulations.

SECURITY

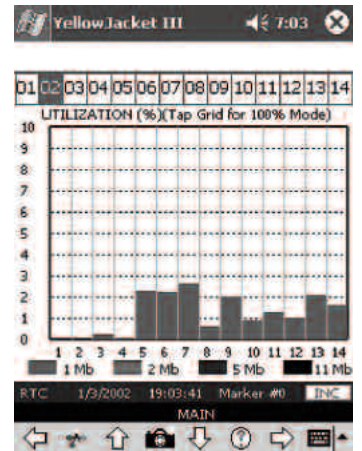
Wireless security takes many forms including company practices, encryption methods, RF coverage and system architecture. Skillful network design and implementation is an important starting point for creating and maintaining a secure wireless network. Wireless RF broadcast coverage must be managed in order to stay within defined physical boundaries of a building or campus location and at the same time meet standards and government requirements.

There are currently three primary standards for Wireless LAN implementations, 802.11a, b, and g. These standards specify radio frequency ranges that have been designated by the European Community and US Federal Communications Commission for unlicensed devices. Although standard, regulations for usage vary from country to country.

Each standard and its associated radio frequency have a limited number of channels that can be used for broadcast. When channels are set on a wireless device by an inexperienced person, it can cause performance degradation of the network due to signal interference as well as security issues.

In a traditional client-AP wireless network the access point (AP) sends a signal through its antenna. The signal is received by the wireless client located inside or attached to the personal computer or PDA. Ideally that signal is broadcast at a specific frequency that differs from other AP signals in its immediate vicinity in order to avoid overlap, leakage into unauthorized areas, and to insure good reception. An expert site survey insures that APs are tuned to the right channel, provide maximum RF coverage for the desired building or location and have optimal placement to assure the proper coverage. This is especially important in a large installation where hundreds of APs must be tuned to maximize coverage but still remain secure.

#	CH#	MAC	SSID	RSSI
1	6	00E003041FB2	Plant AP	-63
2	10	004033AFF348	Wireless	-48
3	10	004033AFF1C3	Wireless	-58
4	10	004033AFF5D1	Wireless	-51
5	10	004033AFF201	Wireless	-51



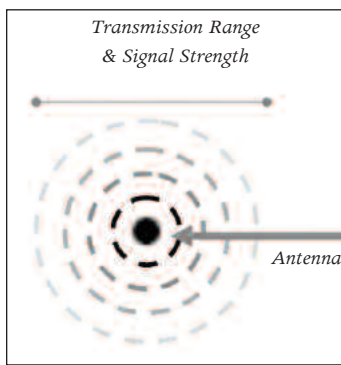
The type of antenna determines the radiation pattern of the signal. Selecting the appropriate antenna significantly improves signal strength and quality. It also controls the broadcast pattern, keeping it within defined authorized areas.

Performance characteristics of each antenna vary and are based upon radio frequency transmitted, size, gain, radiation patterns, and other factors beyond the scope of this document.

OMNIDIRECTIONAL ANTENNAS

Omnidirectional antennas do just what their name implies, they receive signals from all directions, which means they cover a 360-degree pattern around the antenna. Omnidirectional antennas are great for hotspots in meeting rooms or public facilities or in office spaces where teams of employees need to work together effectively and efficiently. Figure 1 shows a top view of an omnidirectional antenna radio transmission pattern.

FIGURE 1. Omnidirectional Antenna

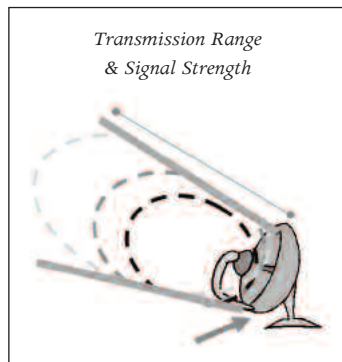
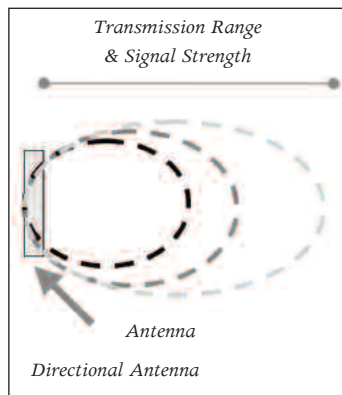


DIRECTIONAL ANTENNAS

Directional antennas—also known as sector panel, bidirectional, parabolic, patch, or Yagi antennas—come in a variety of designs. These antennas operate by focusing and re-directing the radio waves from the transmitting unit to the receiver in the antenna.

The advantage of directional antennas is that they can be used to pick up weak signals at greater distances than other designs. They also optimize the signal because they can partly reject interference when the interferer is located in the path of the antenna. There is a trade-off, however. As shown in Figure 2, the more gain, or power the antenna has (measured in dBi) the smaller the receiving angle of the signal it can pick up. As an example, an 8 dBi antenna might be able to support a vertical beam width of 60 degrees, but an identical antenna with an 18 dBi gain might only be able to receive the signal in a 19-degree arc.

FIGURE 2. Directional Antennas

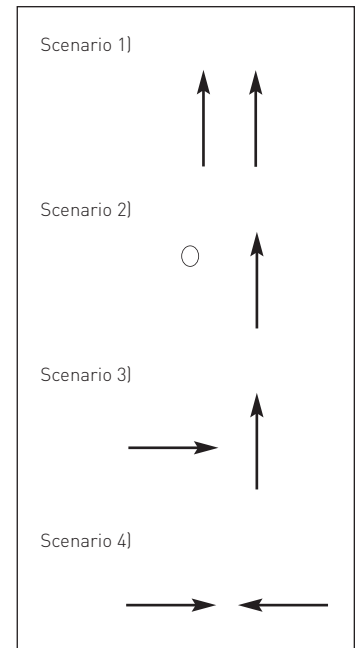


Antenna radiation patterns are often used to display the characteristics and capabilities of a particular antenna. Antenna radiation patterns indicate how the electromagnetic wave propagates away from the antenna. A radiation pattern is dependent on something called polarization between the transmit antenna and receive antenna. Antenna polarization can be horizontal, vertical or circular; knowing which one is correct and how to apply it to your environment is essential for optimal antenna system performance.

Vertically-polarized antennas have their electric field perpendicular to the earth's surface, while horizontally-polarized antennas have their electric field parallel to the earth's surface. An antenna that is circularly polarized radiates the signal in both the vertical and horizontal planes and everywhere in between.

As shown in Figure 3, there are four possible configurations for transmit and receive antennas, known as cross-couplings. For most applications, an antenna system should use Scenario #1. Note that when two antennas are 90 degrees offset an effect called polarization loss occurs. The best signal strength occurs when two devices use the same polarization method.

FIGURE 3. Antenna Polarization Scenarios



A typical, desired antenna pattern for an omnidirectional antenna looks like the one in Figure 4. This flat diagram shows the vertical intersection (elevation plane) of a radiation diagram. The line circulating around the inside of the graph shows the strength of the signal relative to the radial location in a 360-degree arc.

FIGURE 4. Two-Dimensional Radiation Pattern

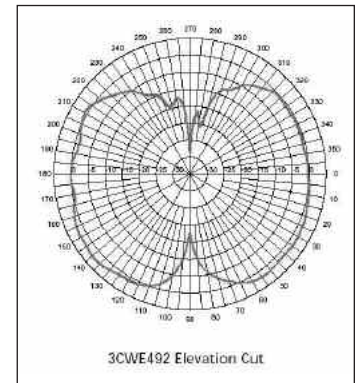


FIGURE 5. Three-Dimensional Side View of an Omnidirectional Antenna Radiation Pattern

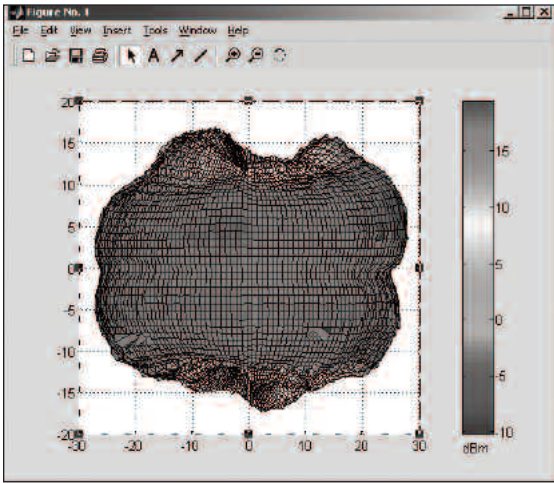
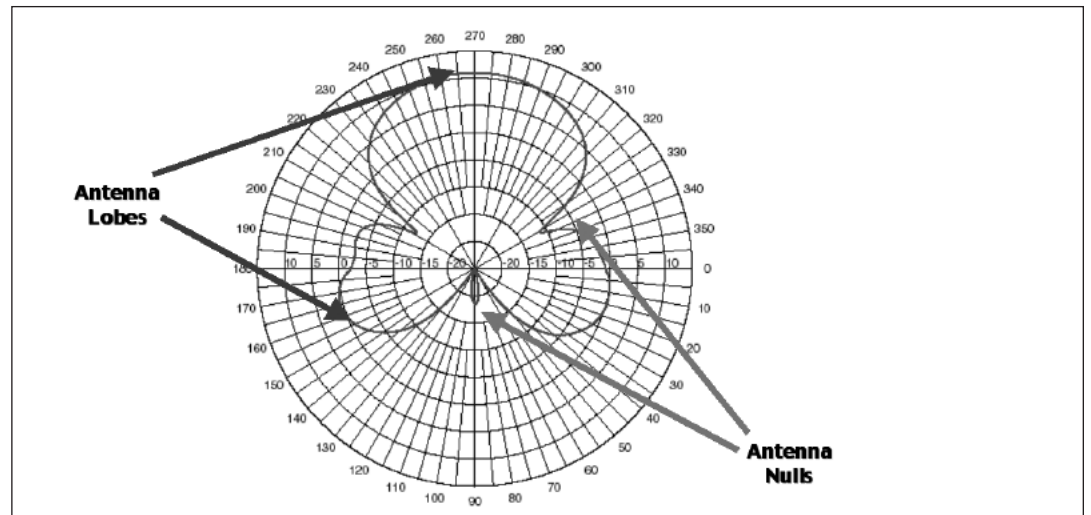
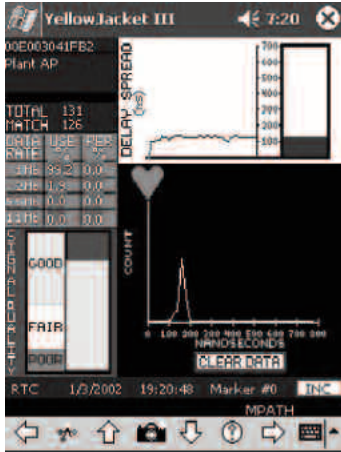


Figure 5 shows a detailed three-dimensional side view of an omnidirectional antenna with relative signal strength in relation to the antenna in the middle. As you can see, the shape is like a doughnut or apple.

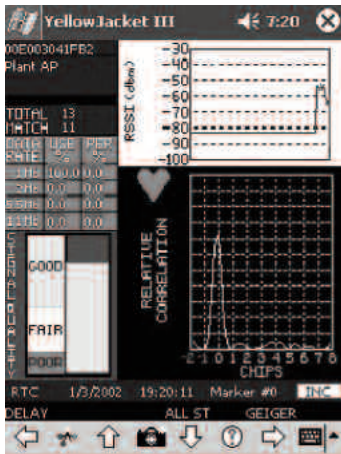
To select the proper antenna for your wireless networking application, you need to understand antenna performance patterns. On many patterns you will see bulges called lobes and indentations known as nulls. Lobes identify where the stronger area of the signal is relative to the antenna. Nulls identify where the signal is weaker—you don't want the nulls of an antenna to be in your most populated locations. Figure 6 shows a sample radiation pattern indicating some of the lobes and nulls.

FIGURE 6. Radiation Pattern Showing Lobes and Nulls





Sophisticated tests map multipath distortion so that adjustments can be made.



Utilizing a sophisticated RF Spectrum analysis tool, an exact Received Signal Strength Indication (RSSI) was derived to determine signal quality.

REAL WORLD EXAMPLES

The primary difference between a wired and a wireless network is that a wired signal is contained within the cable whereas radio waves, like pebbles in a pond, ripple out in all directions from a central transmitter. As each ripple encounters obstacles it is reflected in opposite and proportional directions creating a bounce affect that causes the same signal to be received at different times from different reflections. Known as multipath distortion, this occurrence can confuse the receiver causing bit errors and ultimately slower throughput.

A good example of multipath distortion was found when conducting 3Com's Wireless LAN Site Survey on the fourth floor of a high rise building. The conference rooms were located in the corners, next to emergency exits, with the cubicles clustered in the center of the floor. The task was to insure coverage for the conference rooms as well as the cubicles. It sounds simple until you consider the "hidden" obstacles in the environment. Each of the exit stairwells and the support structure that housed the elevator were made of steel. The floors were constructed of six inch concrete slabs supported by steel I-beams and the walls contained metal studs. Collectively the obstacles prevented a strong and usable RF signal.

A massive filing system consisting of ten floor-to-ceiling cabinets, with shelving on both sides, was mounted on wheels and rolled back and forth across the room during the day. Each time one of the cabinets moved, so would the RF reflections, which in turn impacted the quality of the signal strength.

The engineers who administered 3Com's Wireless LAN Site Survey understood the implications of the moving filing system, the distortion patterns created by the various obstacles, as well as the security issues. They took signal strength measurements that pro-

vided quantitative data for careful analysis. Based on the data, 3Com recommended the optimum placement of access points with clear channel select that is designed to virtually eliminate distortion issues. The exact specifications, including antenna type and mounting locations, were detailed on a floor plan to facilitate installation. The final report included recommendations for the utilization of security settings embedded in 3Com's wireless products to ensure that only employees of this company could access the wireless network.

Each business has a unique set of variables that need to be addressed. It takes the right combination of equipment, placement, and tuning to obtain the best results. Experienced engineers know the pros and cons of the various options and can make recommendations that insure optimum performance and security.

Another example of a challenging environment was found when conducting 3Com's Wireless LAN Site Survey in a private single story building. A close look at the structure disclosed that it had several rooms with lead lined walls as the previous tenant had been a doctor. The current occupants were eager to increase their productivity and almost everyone in the office was already using wireless devices including cordless phones and PDAs. It was a situation that required extreme care in order to insure that the new wireless LAN avoided interference, met expectations, and protected the company's intellectual property.

Based on the collected data and a detailed map of the building, the 3Com engineer was able to determine the number of APs, the optimum placement, and the best channels for this "noisy" wireless environment. The engineer's report included additional security recommendations using the robust set of authentication and encryption features that are imbedded in 3Com wireless products.

3Com Global Services puts an emphasis on pragmatic, business-oriented results. 3Com offers a portfolio of wireless LAN, IP telephony, and data network assessment services to help you achieve your objectives and maximize the value of your network. 3Com wireless solutions offer scalability, manageability, and security equal to wired LANs. Visit www.3com.com/wireless_mobility for more information.

RETURN ON INVESTMENT

A professional wireless site survey begins with a discussion of the company’s business needs and performance objectives. One important consideration is bandwidth requirements. Companies that expect to send large files over the wireless LAN, or use voice over WiFi (VoWiFi) needs different equipment and access point placement than companies that are looking for a less demanding and lower cost scenario.

Understanding these preferences, the engineer designs the network accordingly. Another consideration is work patterns. Parts of the building with heavy user traffic or portable equipment may require specialized configurations that the site survey engineer can test for to insure adequate coverage.

Analysis of the test results and documentation of the findings is crucial. A professional wireless LAN site survey includes a written report with floor plans of the site surveyed, a detailed location of the AP placement locations, recommended channel selections, wireless switching requirements if needed, as well as a detailed list of materials required to install the wireless network.

There is significant value in having an experienced engineer on-site to answer important questions like these: What do I need to do to prepare for a wireless LAN implementation? What are the things that make my site different? How will the building materials used in my facility impact my installation? I have neighbors; will they be able to illegally use my equipment? What causes signal interference? What can I expect as my business grows? Is a FAT AP or Wireless Switched deployment the correct architecture for me? Should I be concerned about other technologies currently under development?

No environment is static. A periodic network review and documentation of changes will help you adjust to new variables. Whatever aspect of your network needs attention, look to experienced professionals to provide valuable assistance—including help with crucial transitions and upgrades that might otherwise overload in-house staff.

ABOUT THE AUTHOR

Ed Sturm, a product developer for 3Com Global Services, brings extensive experience to his discussion of wireless site surveys. During more than a dozen years in the telecommunications and networking industries, he has focused on professional services offerings. Ed began his 3Com career as an engineer tasked with enhancing support process for 3Com's products. He earned a Bachelors Degree in Business with a minor in Electronic Engineering following ten years as an electronics technician with the U.S. Navy.

ACKNOWLEDGEMENTS

Test screen shots are from Yellowjacket Plus analyzer software and were provided courtesy of the manufacturer, Berkeley Varitronics Systems of Metuchen, New Jersey.

The antenna illustrations are taken from 3Com's Wireless Dual-Band Antenna Guide, literature # 101900-003. Learn more about 3Com wireless products at www.3Com.com/wireless.

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