Troubleshooting Problems Affecting Radio Frequency Communication

Document ID: 8630

Refer to the Cisco Wireless Downloads (registered customers only) page in order to get Cisco Aironet drivers, firmware and utility software.

Contents

Introduction

This document addresses some of the major issues you encounter when you try to establish a radio link between elements of a wireless LAN (WLAN). You can trace problems with the radio frequency (RF) communications between Cisco Aironet WLAN components to four root causes:

1. Firmware and driver problems
2. Software configuration problems
3. RF impairments that include antenna and cable problems
4. Client Issues

Prerequisites

Requirements

There are no specific requirements for this document.

Components Used

This document is not restricted to specific software and hardware versions.

Conventions

Refer to the Cisco Technical Tips Conventions for more information on document conventions.

Firmware and Driver Problems

Occasionally, you can trace a problem with the radio signal to a problem in the firmware on the communicating devices.

If you encounter a radio communication problem with your WLAN, ensure that each component runs the latest revision of its firmware or driver. Use the most recent version of the driver or firmware with your WLAN products. Use the Cisco Downloads (registered customers only) to obtain updated drivers and firmware.

You can find the directions to upgrade firmware at:

- Upgrading VxWorks Firmware from the Console
- Upgrade Cisco IOS on an Autonomous Access Point
- Upgrading IOS on the 1400 series Wireless Bridge
- Installing the Client Adapter Software
- Wireless LAN Controller (WLC) Software Upgrade

Software Configuration Problems

When you encounter radio communication problems, the configuration of the WLAN devices can be the cause of the radio failure. You must configure certain parameters properly for the devices to communicate successfully. If you configure the parameters incorrectly, the problem that results appears to be a problem with the radio. These parameters include the Service Set Identifier, frequency, data rate, and distance.

Service Set Identifier

Cisco Aironet WLAN devices must be set to the same Service Set Identifier (SSID) as all the other Cisco Aironet devices on the wireless infrastructure. Units with different SSIDs fail to communicate directly with each other.

Frequency

Radio devices are set to automatically find the correct frequency. The device scans the frequency spectrum, either to listen for an unused frequency or to listen for transmitted frames that have the same SSID as the device. If you have not configured the frequency as Automatic, ensure that all the devices in the WLAN infrastructure are configured with the same frequency.

Data Rate

Data rates affect AP coverage areas. Lower data rates (such as 1 Mbps) can extend the coverage area farther from the AP than higher data rates. If WLAN devices are configured for different data rates (expressed in megabits per second), the devices fail to communicate. Here are some common scenarios:

- Bridges are used to communicate between two buildings. If one bridge is set at a data rate of 11 Mbps and the other is set at a data rate of 1 Mbps, communications fail.
- If the pair of devices are configured to use the same data rate, other factors probably prevent them from reaching that rate. As a result, communications fail.
- If one of a pair of bridges has a data rate of 11 Mbps set, and the other is set to use any rate, then the units communicate at 11 Mbps. But, if there is some impairment in the communication that requires the units to fall back to a lower data rate, the unit set for 11 Mbps fails to fall back, and communications fail.

Cisco recommends that WLAN devices are set to communicate at more than one data rate.

Distance

The radio link between bridges are sometimes very long. Therefore, the time that the radio signal takes to travel between the radios can become significant. The Distance parameter adjusts the various timers used in radio protocol to account for the delay. Enter the parameter only on the root bridge, which tells the repeaters. The distance of the longest radio link in the set of bridges is entered in kilometers, *not* in miles.

RF Impairments

Many factors impair the successful transmission or reception of a radio signal. The most common issues are radio interference, electromagnetic interference, cable problems, and antenna problems.

Radio Interference

You do not require a license to operate radio equipment in the 2.4 GHz band where the Cisco Aironet WLAN equipment operates. As a result, other transmitters can broadcast on the same frequency that your WLAN uses.

A spectrum analyzer is the best tool to determine the presence of any activity on your frequency. The Carrier Busy test available in the Test menus of Cisco Aironet bridges functions as a substitute for this item. This test generates a rough display of activity on the different frequencies. If you suspect radio interference with transmission and reception on your WLAN, turn off the equipment that operates on the frequency in question and run the test. The test shows any activity on your frequency and the other frequencies on which the equipment can operate. You can thus determine if you want to change frequencies.

Note: High error counters on radio interfaces on the client, the access point or bridge indicate the effects of RF interference. You can also identify RF interference through system messages in the logs of the access point (AP) or bridge. The output looks like this:

```
May 13 18:57:38.208 Information Interface Dot11Radio0, Deauthenticating Station
000e.3550.fa78 Reason: Previous authentication no longer valid

May 13 18:57:38.208 Warning Packet to client 000e.3550.fa78 reached max retries,
removing the client
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CRC, PLCP errors

CRC errors and PLCP errors can occur due to RF interference. The higher the number of radios in a cell (APs, Bridges or Clients), higher are the chances for the occurrence of these errors. Refer to the CRC, PLCP errors section of Intermittent Connectivity Issues in Wireless Bridges for an explanation of how CRC and PLCP errors affect performance.

Electromagnetic Interference

Non−radio equipment that operates in close proximity to the Cisco Aironet WLAN equipment can sometimes generate electromagnetic interference (EMI). Theoretically, this interference can directly affect the reception and transmission of signals. However, EMI more likely affects the components of the transmitter rather than the transmission.

Isolate the radio equipment from potential sources of EMI in order to minimize the possible effects of EMI. Locate the equipment away from such sources if possible. Also, supply conditioned power to the WLAN equipment in order to lessen the effects of EMI generated on the power circuits.

Cable Problems

The cables that connect antennas to Cisco Aironet WLAN devices are a possible source of radio communication difficulties.

Cable Selection

If you set up bridges to communicate over a long distance, ensure that the antenna cables are not longer than is necessary. The longer a cable, the more is the signal attenuation, which results in lower signal strength and consequently, a lower range. A tool is available which you can use to calculate the maximum distance over which two bridges can communicate based on the antenna and cable combinations in use. Download this tool from the antennae calculation spreadsheet (Microsoft Excel format).

Installation

Like any other network cables, you must properly install the antenna cables to ensure that the signal carried is clean and free from interference. In order to ensure that the cables perform to their specifications, avoid these:

- *Loose connections* Loose connectors on either end of the cable result in poor electrical contact and degrade the signal quality.
- *Damaged cables* Antenna cables with obvious physical damage do not perform to specification. For instance, damage sometimes results in induced reflection of the signal within the cable.
- *Cable runs shared with power cables* The EMI that power cables produce can affect the signal on the antenna cable.

Antenna Problems

Communication Range

Use the antennae calculation spreadsheet (Microsoft Excel format) to calculate the maximum distance two bridges can communicate based on the antenna and cable combinations in use.

Line of Sight and Antenna Placement

In many instances Line of Sight (LOS) is not seen as a problem, particularly for WLAN devices that communicate over short distances. Due to the nature of radio wave propagation, devices with omni−directional antennae often communicate successfully from room to room. The density of the materials used in the construction of a building determine the number of walls the RF signal can pass through and still maintain adequate coverage. Here is a list of material impact on signal penetration:

- Paper and vinyl walls have little effect on signal penetration.
- Solid and pre−cast concrete walls limit signal penetration to one or two walls without degrading

coverage.
- Concrete and concrete block walls limit signal penetration to three or four walls.
- Wood or drywall allows for adequate signal penetration for five or six walls.
- A thick metal wall causes signals to reflect off. This results in poor signal penetration.
- Chain link fence, wire mesh with 1 − 1 1/2" spacing acts as a 1/2" wave that blocks a 2.4 GHz signal.

When you connect two points together (for example, an Ethernet bridge), you must consider the distance, obstructions, and antenna location. If you can mount the antennas indoors and the distance is short several hundred feet you can use the standard dipole or magnetic mount 5.2 dBi omni−directional or Yagi antenna.

For long distances of ½ mile or more, use directional high gain antennas. These antennas must be as high as possible, and above obstructions such as trees and buildings. If you use directional antennas, ensure that you align them such that you direct their main radiated power lobes at each other. With a line of sight configuration and the Yagi antennas, distances of up to 25 miles at 2.4 GHz are reachable with the help of Parabolic Dish Antennas, provided a clear line of site is maintained.

Note: The Federal Communications Commission (FCC) requires professional installation of high gain directional antennas for systems that must operate solely as point−to−point systems and have total power which exceeds the +36 dBm Effective Isotropic Radiated Power (EIRP). The EIRP is the apparent power transmitted towards the receiver. The installer and the end user must ensure that the high power systems are operated strictly as a point−to−point system.

Client Issues

The document Troubleshooting Client Issues in the Cisco Unified Wireless Network explains various issues that you can encounter when you connect a wireless client in a Cisco Unified Wireless environment, as well as the steps to be taken to troubleshoot and resolve these issues.

Other Reasons for Reduced Signal Strength

Even if there is a clear LOS or no fresnel blockage between wireless links, you might still receive a low signal strength. There can be several reasons for this problem.

- One possible reason might be the radiation pattern of the antennas used. In many cases, a higher gain omni has a pattern that resembles a champagne glass. Lower gain omni−directional antennas resemble a doughnut or a frisbee, centered around the long axis of the stick.

  The way to check this is to look at the radiation pattern diagrams that accompany most, if not all, antennas. There are usally two diagrams. One shows the pattern from the side (important for an omni), and the other shows the pattern from the top (important for directionals, Yagis, dishes, and panels). There is a good chance that the transmitted signal goes over the head of your receiving antenna.
- Check whether the devices are properly grounded. The grounding is very important, if only for the safety aspects. Lightning Arrestors do not stop lightning. These arrestors bleed off static electricity and (tend to) reduce the space charge that can accumulate on exposed elements.
- Also, it is always a good idea to put a segment of fiber between the APs and the wired network to prevent the zap from killing the rest of the network.
- Check the coax for kinks or places that were kinked, sharp bends, broken jacket, etc. At Gigaplus frequencies, any malformed section of cabling can have a significant impact on the propagation of the signal.

Related Information

- **Troubleshooting Connectivity in a Wireless LAN Network**
- **Cisco Aironet Antennas and Accessories Reference Guide**
- **Upgrading VxWorks Firmware from the Console**
- **Cisco Aironet Access Point Software Configuration Guide**
- **Wireless LAN Technology Support Page**
- **Cisco Software Center for Wireless Products**
- **Technical Support & Documentation − Cisco Systems**

Updated: Oct 19, 2009 Document ID: 8630