3Com®

AirConnect®
Site Survey
Administrator Guide

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A AIRCONNECT OVERVIEW

1

PREPARATION

Introduction

Installing an AirConnect wireless network begins with conducting a site survey. A site survey involves the use of the AirConnect Site Survey utility to determine the physical requirements for a site-specific AirConnect wireless network. A site survey analyzes the installation environment and provides users with recommendations for equipment and placement. The site may be a warehouse, manufacturing plant, office building, or retail space.

The AirConnect Site Survey utility determines the location of APs, as well as the number necessary to provide optimal coverage. Only qualified site survey technicians should use the AirConnect Site Survey utility to conduct site surveys.

When installing an AirConnect network, complete coverage may require multiple antennas. If the facility is small, or the coverage area is free from physical obstructions, one AP and antenna might be sufficient.

If you are unfamiliar with the AirConnect wireless infrastructure and the components that compose it, refer to Appendix A "AirConnect Overview" for an overview of AirConnect technology.

Inspecting the Survey Area

During the planning stages of the site survey, a representative from the site survey team will visit the proposed AirConnect radio coverage site. As a standard practice in the site survey consultation, the representative gathers facility drawings and completes a Site Survey Requirements document and a site survey questionnaire. The representative documents the wiring used within the facility (10BaseT, 10Base2, fiber optic) and assesses its applicability to AirConnect components.

Several trial installation areas should be selected. The site survey team analyzes each proposed installation area to document radio transmission constraints and to develop preliminary AP placement alternatives to be tested during the actual site survey. The findings from the initial site inspection should be documented in a Site Survey Request Form and serve as the outline of the site survey.

The following variables should also be considered in the site survey requirements definition:

- RF systems already in use
- Location of host system(s)
- Available AC power
- Interfering metal fire breaks and wall structures
- Doorways and passages causing RF propagation

The completion of the RF Site Survey Requirements document is a coordinated effort between the site survey team and the customer management team.

The RF Site Survey Requirements document does not identify potential installation constraints within the customer site, nor does it recommend AP and antenna placement location. The RF Site Survey Requirements document represents a preliminary overview of the customer site, and is used as a baseline for refining site survey requirements.

Environmental Considerations

The site survey team selects trial AirConnect component installation areas away from transformers, heavy-duty motors, fluorescent lights, microwave ovens, refrigerators, and other industrial equipment. Areas with excessive moisture, heat, and dust are inappropriate for installing an AirConnect wireless network.

Signal loss can occur when metal, concrete, walls, or floors block AP transmission areas. AirConnect AP antennas are trial-mounted in open areas or added to an existing AP to boost the AirConnect coverage area.

The positioning of an AP depends on the floor plan of the site. The site survey team makes AP placement recommendations based on the following installation site variables:

■ Indoor installation site

■ Large or small proposed radio coverage area

■ Wide or narrow proposed coverage area

■ Open coverage area or area with documented obstructions

Direct-Sequence Considerations

In a direct-sequence radio coverage cell, APs with identical direct-sequence channels cannot share the same cell. Direct-sequence access points operating on different channels require careful survey area testing to ensure that radio transmissions do not interface.

Antenna Placement Considerations

Radio coverage requirements relate directly to installation site constraints. With an omnidirectional antenna, the radio range of the AP (transmitting at 1Mbps) could have a radius up to 1000 feet (303 meters) in open areas. However, in office or retail environments, obstructions can reduce the coverage to a radius of 180 to 250 feet (54 to 76 meters). The coverage area is also referred to as a cell.

The final location of AP antennas is critical to the successful operation of the system. When conducting the survey, consider the exact conditions in the installation area. These conditions include all losses due to cabling and connectors.

Site Electrical Considerations	AirConnect APs draw power from wall outlets or over CAT 5 cabling using the AirConnect PowerBASE-T adapter. AP performance is subject to degradation due to inherent or random electrical problems or site-specific disturbances.

The following AirConnect AP electrical installation alternatives are listed from optimal to preferred for a particular installation area:

1 Isolated ground circuit with online, uninterruptable power supply (UPS) that also acts as filter and surge suppressor

2 Isolated ground circuit with surge suppressor

3 Dedicated circuit with UPS

4 Dedicated circuit with surge suppressor

3Com recommends using one of the preceding installation alternatives when using a Network Controller Unit. Deviation from theses options can cause data loss and serious transmissions problems.

NOTE: *The AP must be provided with power 24 hours a day. 3Com recommends that AP power never be provided from an Energy Management System.*

If a nondedicated circuit is necessary, 3Com recommends that the circuit does not support the following:

■ Hard wired devices

■ Devices with components intended or known to produce heat (space heaters, laser printers, heat guns, soldering irons, etc.)

■ Single devices drawing more than 20% of the rated value of the circuit

■ Multiple devices drawing a total of more than 60% of the rated circuit value

Requesting a Site Survey

The Site Survey Request Form contains detailed information about a customer, the 3Com Sales Associate representing that customer, an updated floor plan of the customer facility, host operating system considerations, and the quantity and type of AirConnect components being installed.

2 CONDUCTING A SITE SURVEY

Introduction

The AirConnect Site Survey utility is used to establish a two-way data network using both stationary and mobile devices at various points within the proposed radio coverage area. Assess AP signal strength using various AP configurations.

The AirConnect Site Survey utility runs under Windows 95/98, and NT.

Site Survey Installation

A site survey requires the AirConnect Site Survey utility be loaded on the wireless clients and the desktop computer used in the survey.

CD-ROM Installation

To install the AirConnect Site Survey utility from CD-ROM:

1 Insert the Administrator CD-ROM in the CD-ROM drive.

2 Click Start and select Run.

3 Enter `x:\Admin\SSurvey\Disk1\Setup.exe`

where "x" represents the letter assigned to the CD-ROM drive.

4 Click *OK*.

5 Complete the installation following the instructions provided with the AirConnect Site Survey utility.

6 Select *Yes* when asked if backup copies of replaced files are required.

Selecting Yes invokes the site survey utility uninstall feature for possible use.

The AirConnect Site Survey utility installation is completed. Launch the site survey utility by clicking on the program icon appearing on the Windows desktop.

AirConnect Wireless Network Trial

Before using the AirConnect Site Survey utility, an AirConnect wireless LAN infrastructure is created to test AirConnect component radio signal strength.

In addition to the AirConnect Site Survey utility, the following equipment is required to create an AirConnect wireless network:

- AirConnect Access Points
- Laptop computer
- PowerBASE-T and AC power supply
- CAT 5 cable
- Access Point mounting bracket
- AirConnect wireless clients with extra batteries

To install a trial AirConnect wireless network, use the following procedure.

1 Mount the APs.

Mount APs at the locations recommended on the floor plan drawing. Start with the most difficult coverage area first. Position the APs so that their antennas are not obstructed.

2 Power on the APs.

Use the PowerBASE-T and interconnecting 8-wire CAT 5 cable if an AC wall socket is not conveniently located.

3 Observe AP LED behavior.

Check the LEDs to verify normal boot operation. After the boot cycle is complete, the STATUS LED flashes approximately once every second to indicate that the AP is operating properly.

4 Power on the AirConnect wireless clients to be used for the site survey.

NOTE: *The AirConnect Site Survey utility should already be loaded on the AirConnect mobile devices used to perform the survey.*

When the device is powered on, a message indicating the AP is not connected to a boot server will be displayed. This is normal, since the AP is not yet connected to an Ethernet network.

5 Set the AirConnect AP and wireless client Network IDs.

Set the wireless client(s) and AP to the same Net ID.

An AirConnect wireless network now exists and can be tested for radio transmission effectiveness with the AirConnect Site Survey utility.

Starting the Site Survey Utility

Click the AirConnect Site Survey utility icon from the Windows desktop to launch the utility. The Site Survey utility Welcome dialog box appears.

You can use the Site Survey utility Welcome dialog box to open an existing site survey area workspace, create a new workspace, create a new workspace from an existing site survey area workspace, or open a recently used workspace.

If an existing site survey workspace is opened containing one or more survey areas, the Site Survey Test dialog box displays. Use the Site Survey Test dialog box to specify the ICMP and WNMP test parameters for the survey area. If an existing survey workspace does not have a survey area defined, the Site Survey dialog box displays. Use the Site Survey dialog box for entering the site survey area name, surveyor, and description. The Site Survey Test and Site Survey dialog boxes are described in greater detail in the sections that follow.

Closing the Welcome dialog box enables the File, Edit, View, Area, and Help pull-down menus. Use these menus to create a new site survey, view radio coverage areas within an existing site survey template, run a ping test for a survey area, display and configure the Edit menu property pages, and display help information for the usage of the utility.

Site Survey File Menu   Use the File menu to create a new survey area workspace, open an existing survey workspace, define a new survey area, save the survey workspace, upload/ download existing survey workspace data, import survey workspace data, and display recent survey information.

Creating a New Site Survey   Select *New Site Survey* in the File menu to open a Site Survey dialog box. Use the Site Survey dialog box to enter the site name, surveyor, and description. If a workspace is open, the user is prompted to save the existing workspace first. Click *OK* to display the new workspace name in the status bar at the bottom of the screen

Selecting an Existing Site Survey   Select *Open Site Survey* in the *File* menu to open a dialog box displaying files with the extension ".ssw." If an invalid file is read, an error message displays; otherwise, a progress dialog box is shown and the workspace is loaded. The Site Survey Test dialog box generates if the workspace has at least one defined area. The Site Survey Area dialog box displays if the existing workspace does not have a defined area. The status bar displays the workspace and area name.

Defining a New Site Survey Area   Select *New Area* in the File menu to display a *Site Survey Area* dialog box. Use the Site Survey Area dialog box to enter the area name and description. The Delete button is grayed when defining a survey area. The Test Name field lists the tests defined for that area. Add a new test by clicking the ellipsis (…) button. An error message displays if the Area Name field is left blank or the name of an existing area is entered. The area name displays at the bottom of the screen.

Save/Save As   Select *Save* in the File menu to save the open survey using the existing survey name. Select *Save As* in the File menu to save the survey using a different name.

Upload/Download   Select *Upload* in the File menu to display a *File Save As* dialog box. Use the Save As dialog box to indicate the target destination for the site survey workspace files. A pop-up dialog box indicates the results of the file upload.

Select *Download* in the File menu to display a *File* dialog box. Use the dialog box to navigate to the location of the site survey workspace on the desktop computer. A pop-up dialog box indicate the results of the file download.

Importing a Site Survey   Select *Import* in the File menu to display an *Import Areas and Tests* dialog box. Use the Import Areas and Tests dialog box to import survey areas and/or tests from another survey workspace. Select *Import Areas* and/or *Import Tests* to replace older survey workspace files with updated ones. Click the *Import* button to display a dialog box displaying files with the extension ".ssw."

Displaying Recent Site Surveys   Select *Recent Site Surveys* in the File menu to display the last four site survey workspace files created or accessed. Selecting any workspace in the list loads that workspace. If there is at least one area defined for the workspace, the Site Survey Test dialog box displays it. The status bar at the bottom of the dialog box displays the status, filename, area name, and workspace name. If a workspace is already open, the user is prompted to save the existing workspace first.

Site Survey Edit Menu   The Site Survey utility Edit menu contains Site Survey, Area, and Settings pull-down menus.

Use these menus to edit an open AirConnect site survey, display a list of coverage areas within the survey, and use the Setup, Meter Settings, Sounds and Logging property pages to configure surveyor, system sounds, and test data logging information.

Editing Site Survey Information   Select *Site Survey* in the Edit menu to display the Site Survey dialog box. Use the Site Survey dialog box to enter the site name, surveyor, and description. If a workspace is already open, the user is prompted to save the existing workspace. Click *OK* to display the new workspace name.

Surveyor.   Enter the surveyor name in the *Surveyor* field to automatically update the New Site Survey dialog box. Click *OK* to save the updated surveyor name in the registry for subsequent surveys.

ICMP Host Addr.   Enter an ICMP Host Address in the field provided (not needed for WNMP ping tests). The default address is the default address of the AP.

Ping Count.   Enter the number of pings to be transmitted during the ping test in the Ping Count field. The default Ping Count is 100, with a maximum of 2000.

Rerun Count.   Enter the number of times the ping test is transmitted in the Rerun Count field. The default Rerun Count is 100. The rerun can be continuous

Packet Size.   Enter the packet size transmitted during the ping test in the Packet Size field. The default Packet Size is 128 bytes, with a maximum of 1472 bytes.

Threshold Time.   Enter the maximum acceptable time to send out and receive the total number of pings for each test in the Threshold field. Choose a Threshold Time from1 second to 3600 seconds. The default Threshold Time for 100 pings is 13 seconds.

Auto Rerun.   If *Auto Rerun* is activated, the Site Survey utility test suite (in either Automatic or Manual mode) runs continually until the surveyor stops the tests.

Editing Site Survey Area Properties   Select *Area* in the Edit menu to display the Site Survey Area List dialog box. Use the Site Survey Area List dialog box to display a list and description of survey areas. Select an area and click *Edit Area* to display the Site Survey Area dialog box. Add new tests and survey area descriptions as needed. Click *OK* to save the changes to the site survey workspace. Click *Delete* to remove the area from the current site survey workspace.

Editing Setup Properties   Select *Settings* in the Edit menu to access the Setup, Meter Settings, Sounds, and Logging tabs. Use these dialog boxes to change default settings for the current site survey workspace.

Setup Property Page

Select the Setup tab to change the following default site survey workspace information:

Edit Note on Error.   Activate *Edit Note on Error* to display a pop-up dialog box for entering notes when an error condition is detected during the site survey ping test. Undocumented physical barriers (metal or block walls) could exist that the surveyor can describe as a possible reason for signal deflection and test failure. The reason for the error is automatically created as part of the note.

Override All Test ICMP Host Addresses.   Check this box to use the ICMP host address entered on this page for all tests. Checking this box does not replace the host address saved for each test

Meter Settings Property Page

Select the *Meter Settings* property page to set bounds (thresholds) for the signal quality gradient bars in the Round Trip, Missed Beacon, and Transmit Retry fields. The circular RTT Avg, Missed %, and Retry % indicators on the Site Survey Test dialog box show green if the average of the previous tests (20 tests for RTT Avg, 40 tests for Retry %, and 20 tests for Missed %) is below the lower threshold.

The circular indicators on the Site Survey Test dialog box show red if the average of the previous 30 tests is above the upper threshold. Test results between the bounds set on the Meter Settings property page result in Yellow displays on the circular indictors on the Site Survey Test dialog box.

Sounds Property Page

Select the *Sounds* property page to change the following default site survey workspace information:

Play on Timeout.   Select *Play on Timeout* to emit an audible timeout tone every time a ping test timeout is reached.

Play on Roam.   Select *Play on Roam* to emit an audible roaming tone every time an wireless client roams between APs.

Play on Threshold.   Select *Play on Threshold* to emit an audible threshold tone every time the threshold time is met or exceeded.

Play on Test Complete.   Select *Play on Test Complete* to emit an audible test complete tone every time a suite of ping tests has been transmitted.

The default for the Sounds property page is all sounds enabled. Set the volume level and/or sound by using the Windows Control Panel Volume and Sounds applet or the Sounds task tray applet.

Logging Property Page

Select the *Logging* property page to change the following default site survey workspace logging information.

Enable Logging. Select *Enable Logging* to enable Short Logging Format or Detailed Logging Format. If unchecked, no logging takes place during the ping tests. The default is Short Logging Format. Short logging provides an overview of ping transmission test activity. Detailed logging provides a comprehensive review of ping test activity.

Short Logging Format. Select *Short Logging Format* to generate a text file consisting of the site survey workspace and area name, the surveyor name, date, test start and end time, AP BSSID, packet size, ping count, and test totals. The test totals section indicates elapsed test time, the number of retries, roundtrip ping transmission time, and the number of timeouts. If an out-of-range condition exists, it is also logged.

Detailed Logging Format. Select *Detailed Logging* to generate a text file added to the Short Log content. Device roaming information, survey and site area descriptions, and error log notes are included in the Detailed Log.

Clear Log contents before each test. Select *Clear Log* contents before each test to automatically clear the content of the log before a test suite is run.

Confirm before log contents are cleared. If activated, the surveyor is prompted to decided whether the log file should be cleared before the test suite is run.

Navigating the View Menu

The Site Survey utility View menu contains Adapter Info, Areas, Known APs, Noise Meter, and Signal Quality pull-down menus.

Use the pull-down menus to view AirConnect WLAN adapter driver and firmware data, site survey areas, APs within range of a target AirConnect mobile device, or a graph depicting wireless client signal quality. You can also create a text file of the log file.

Viewing Adapter Info

Select *Adapter Info* in the View menu to display an Adapter Information dialog box. Use the Adapter Information dialog box to display AirConnect WLAN adapter driver and firmware version, adapter type and firmware type. The information is view only and cannot be modified.

Viewing Site Survey Area Info

Select *Areas* in the View menu to display the Site Survey Area List dialog box. Use the Site Survey Area List dialog box to display a list and description of survey areas. Select an area and click Edit Area to display the Site Survey Area dialog box. Add new tests and survey area descriptions as needed. Click *OK* to save the changes to the site survey workspace. Click *Delete* to remove the area from the current site survey workspace.

Viewing Access Point Info

Select *Known APs* in the View menu to display APs in range of the target wireless client. Use the Known APs dialog box to view the AP BSSID, number of associated wireless clients, wireless client type, and status and data rate. An icon next to each AP indicates whether the AP is mandatory or preferred and if the AP is associated. A list of APs within range of the wireless client is also shown. Select an AP and right click to change the AP type to Mandatory or Roaming. Click the *Rates* button to display the Transmission Rates dialog box. Use the Transmission Rates dialog box to set the transmission rate to 1Mb, 2Mb, 5.5Mb or 11Mb. Checking multiple rates defaults the wireless client to a lower rate if the higher rate AP association cannot be established. At least one rate is required.

Viewing Mobile Unit Noise Info

Select *Noise Meter* in the View menu to display a graph of *relative signal strength indicator* (RSSI) values and channel numbers. Use the Noise Meter dialog box to view the wireless client BSSID and the RSSI minimum, maximum, and average values. The RSSI values displayed in the graph are continuously updated with the last 6 received values displayed in blue. Click *Reset* to reset the graph to zero and begin a new display as RSSI values are received.

Viewing Mobile Unit Signal Quality Info

Select *Signal Quality* in the View menu to display the percentage of missed beacons, the percentage of transmission retries and the percentage of CRC errors logged during the ping test. Use the Signal Quality dialog box to display the strength of the radio signal transmitted by an AP. This information is useful in determining if the trial site survey AP placement locations are effective for providing radio coverage to the proposed radio coverage area.

Navigating the Area Menu

The Site Survey utility Area menu contains New, Select, Clear Log Contents, Edit Notes, Run ICMP Test, and Run WNMP Test menu items.

Use the menu items to create and edit a site survey area, view the settings of a survey area, clear a site survey log, edit or delete notes in a survey log, and start and stop ICMP and WNMP tests.

Creating a New Survey Area

Select *New* in the Area menu to display a Site Survey Area dialog box. Use the Site Survey dialog box for entering a survey area name and description. If a workspace is already open, you are prompted to save the existing workspace. Click *OK* to display the new workspace name.

Selecting and Editing an Existing Survey Area

Click *Select* in the Area menu to display the Site Survey Area List dialog box. Use the Site Survey Area List dialog box to display a list and description of survey areas. Select an area and click Edit Area to display the Site Survey Area dialog box. Add new tests and survey area descriptions as needed. Click *OK* to save the changes to the site survey workspace. Click *Delete* to remove the area from the current site survey workspace.

Clearing the Text File Log for an Open Survey Area

Use the *Clear Log Contents* option to delete the log contents for the active survey workspace.

Editing the Note File for an Open Survey Area

Select *Edit Note* in the Area menu to display the notes file for the active survey area. Use the Edit Note option to edit or delete the survey test notes entered for the active survey workspace.

Running ICMP or WNMP Tests

Select *Run ICMP Test* or *Run WNMP Test* in the Area menu to display the Site Survey Test dialog box.

Use the Site Survey Test dialog box to specify ICMP or WNMP test parameters. ICMP and WNMP tests are ping tests assessing radio transmission roundtrip, delay time and transmission signal strength.

Setting ICMP or WNMP Test Parameters

Use the Site Survey Test dialog box to set the following ICMP or WNMP test parameters:

Access Point. the Access Point field of the Site Survey Test dialog box lists the associated AP. Choose a different access point from the list of available APs by clicking the ellipsis (…) button.

Area. Define a new survey area by clicking the ellipsis button next to the Area pull-down menu.

Test. Use the Test pull-down menu to list the tests defined for the active survey area. Use the ellipsis button to open a dialog box or entering new test settings.

Test Statistics Use the Test Statistics field of the Site Survey Test dialog box to view the total ping roundtrip time, the number of tests remaining in the run, the number of test runs remaining, and the ping test transmit data rate.

Four graphs on the bottom of the Site Survey Test dialog box display an average roundtrip time, missed beacon percentage, retry percentage, and threshold percentage. Bounds (thresholds) set in the Meter Settings property page establish the limits for the variables in the graphs.

Results List Box Use the Results List Box to view ping count, errors, retry percentage, roundtrip time, and missed beacons values. Scroll backward or forward in the list. The list displays the last test suite run.

Start. Click *Start* to begin the ICMP or WNMP test. Once started, the Start button changes to a Stop button.

Edit Note. Click *Edit Note* to display a dialog box for entering notes for the test. Each note is added to the log file.

Clear List. Use the *Clear List* button in Site Survey Test dialog box the clear the results list box.

Test Totals. Click the *Test Totals* button within the Site Survey Test dialog box to display the Site Survey Totals dialog box.

Use the Site Survey Totals dialog box to display survey area final test results, including test start time, total number of tests, total number of runs, total test roundtrip time, average test roundtrip time, and total number of timeouts. The two checkboxes indicate if the user cancelled the test run and whether the test was run to completion.

Setting New Test Parameters

Open the New Test Settings dialog box by clicking the ellipsis button next to the Test pull-down menu in the Site Survey Test dialog box.

Use the New Test Settings dialog box to enter a test name, define test packet sizes, select a test ping count, enable the test Auto Rerun, Sounds and Logging features, change host address information and display the Settings property pages.

Test Name. Use the Test Name field in the New Test Settings dialog box to enter the test for the active survey workspace.

Packet Size. Use the Packet Size field in the New Test Settings dialog box to enter a packet size for the ICMP or WNMP test.

Ping Count. Use the Ping Count field in the New Test Settings dialog box to type in a ping count value for the ICMP or WNMP test.

Threshold. Use the Threshold field in the New Test Settings dialog box to type in threshold value for the ICMP or WNMP test.

Host Address The host address entered in the Settings Setup property page displays in the Host Address field. Change the host address value by typing it in.

Auto Rerun. Select the *Auto Rerun* option in the New Test Settings dialog box to enable the Auto Rerun test feature.

Enable Sounds. Select the *Enable Sounds* option in the New Test Settings dialog box to enable the Sounds feature.

Logging. Select the *Logging* option in the New Test Settings dialog box to enable the Logging feature.

Advanced. Click the *Advanced* button in the New Test Settings dialog box to access the Settings property pages for the active survey area workspace.
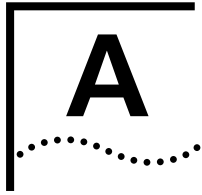
A AirConnect Overview

Introduction

AirConnect from 3Com is made up of a series of products that work together to deliver high-speed digital wireless networking. This technology provides connectivity between wireless clients and network nodes in a variety of indoor environments, and also provides bridging architecture between wired and wireless network segments. AirConnect is based on the IEEE 802.11HR standard, and delivers 11 Mbps data transfer rates.

The core hardware products that make up an AirConnect network include the following:

- PC card, installed in a wireless client (laptop or desktop computer)
- Access point, or AP, which serves as a wireless network node
- PowerBASE-T (optional), which provides bus power to the access point when connected to an Ethernet network

Also included in your AirConnect kit are an AP mounting bracket and hardware, a serial cable, a power adapter and associated power cables, and two CDs: the AirConnect Administrator CD, and the AirConnect User CD.

AirConnect Network Topologies

To better understand how the various AirConnect products work together to create a wireless network, it might be helpful to depict a few of the possible AirConnect network topologies. The topology used in a particular environment depends on many factors, such as the functionality of the AP in the network, or desired data transfer rates. Your AirConnect network topology will probably resemble one of the following scenarios, or perhaps a combination of two or more.

Peer-To-Peer Network   The simplest AirConnect topology consists of one AP providing a single-cell network for wireless clients. In this scenario, as shown in the following figure, the wireless clients (laptop and desktop computers with the AirConnect NIC installed) communicate through the AP on a peer-to-peer network. The clients can be moved anywhere within the coverage area of the AP, and still communicate with each other. The AP in this instance serves the same purpose as a stand-alone network hub, and is not connected to any other network segments.
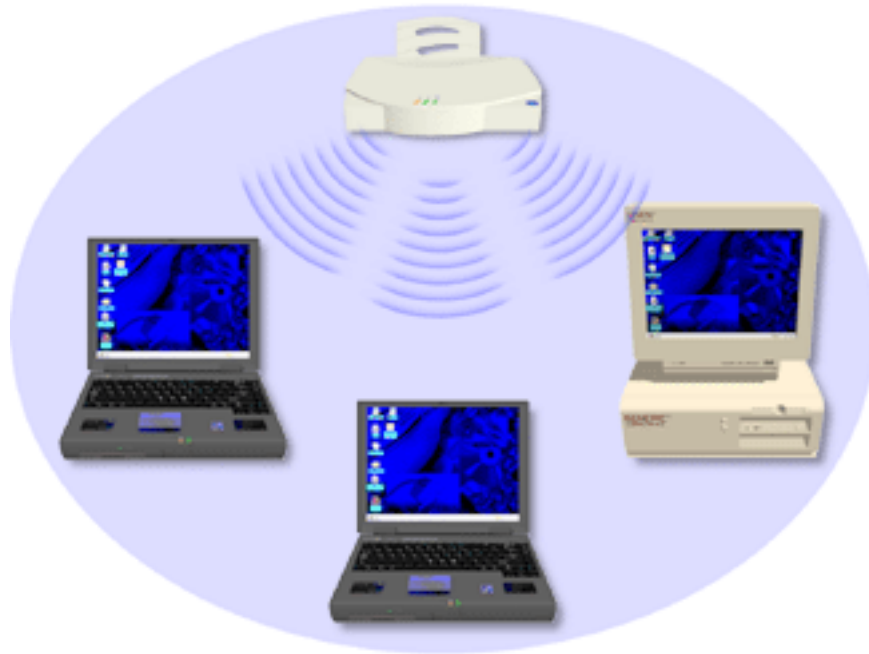
Same-Site Separate Networks   In this scenario, as shown in the figure below, Multiple APs can coexist as separate networks at the same site without interference using different network identifiers (wireless LAN service areas). The wireless clients can move within the coverage area of one AP and remain connected, or can roam (if configured to do so) to the coverage area of a different AP, and communicate with the wireless clients associated with that AP.
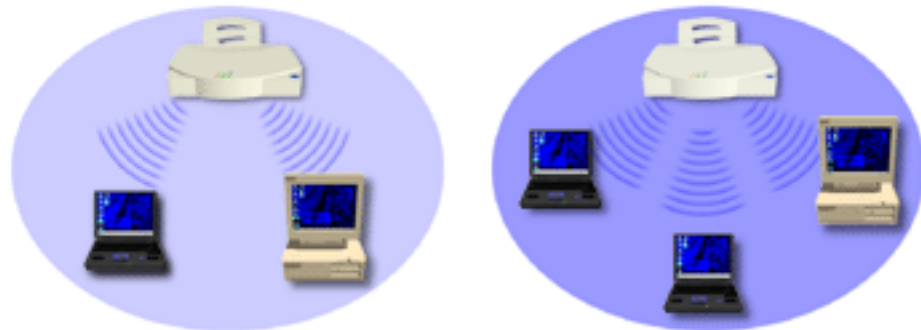
Single AP Bridge   Another possible AirConnect topology is a single AP bridging an Ethernet and wireless network. As shown in the next figure, the AP, wired to a network server or LAN through an Ethernet cable, serves as a network node and provides the link between the server and the wireless clients. The wireless clients can move freely throughout the coverage area of the AP while remaining connected to the server.
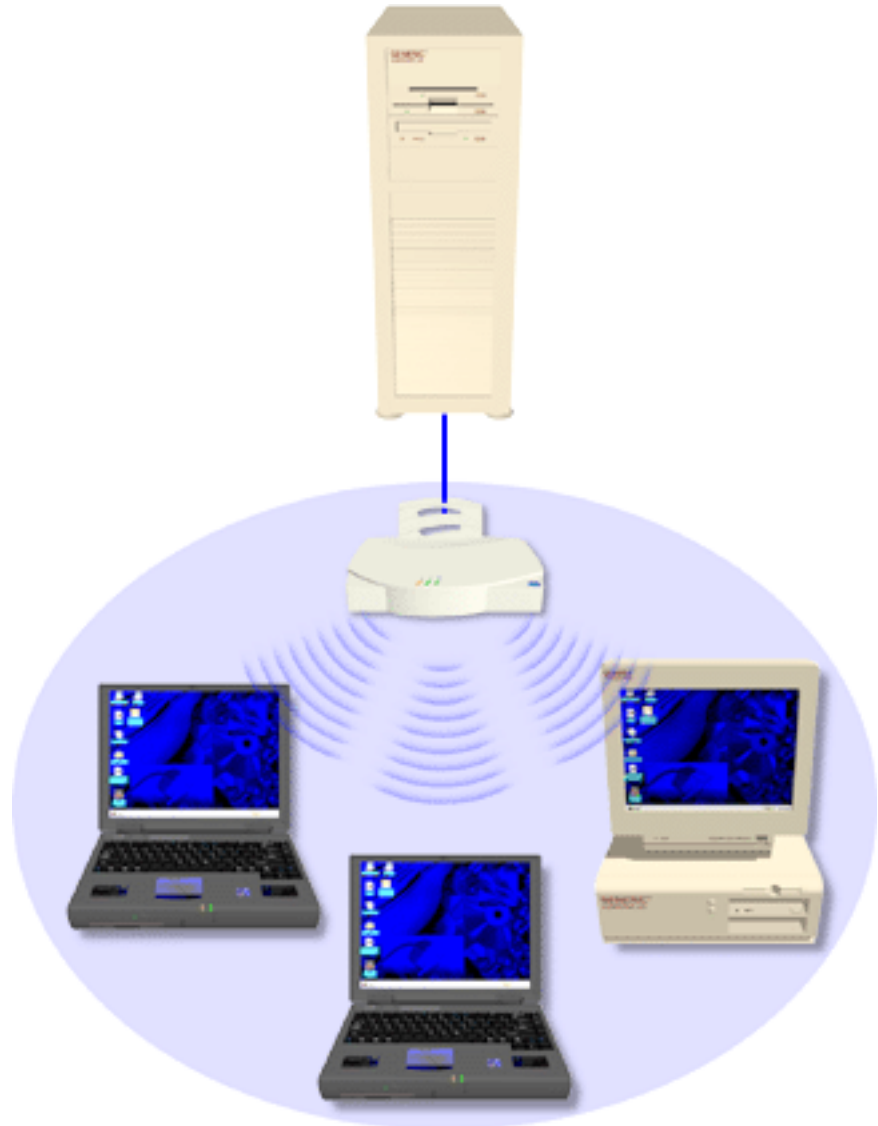
Multiple-AP Full Coverage Network

This network topology will be used in most enterprise environments: multiple APs wired to an existing LAN to provide complete wireless network coverage. In this scenario, as shown in the next figure, wireless clients can roam seamlessly between different coverage areas and remain connected to the network.
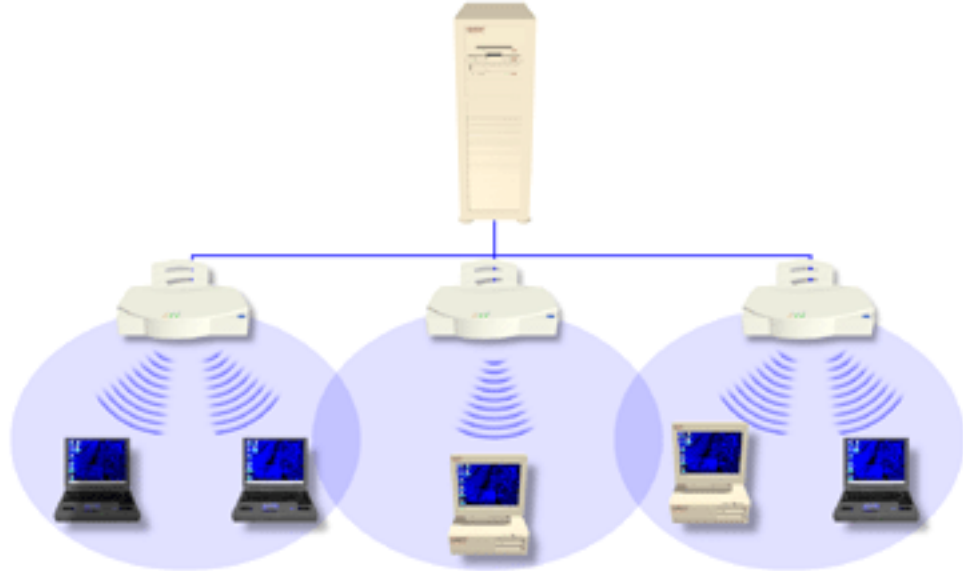
Theory of Operation

To improve AP management and performance, you should understand basic AP functionality and configuration options. The AP includes features for different interface connections and network management.

The AP provides *MAC layer bridging* between its interfaces. The AP monitors traffic from its interfaces and, based on frame address, forwards the frames to the proper destination. The AP tracks the frames sources and destinations to provide intelligent bridging as wireless clients roam or network topologies change. The AP also handles broadcast and multicast message initiations and responds to wireless client association requests.

MAC Layer Bridging

The AP listens to all packets on all interfaces and builds an address database using the unique IEEE 48-bit address (MAC address). An address in the database includes the interface media that the device uses to associates with the AP. (The AP internal stack interface handles all messages directed to the AP.) The AP uses the database to forward packets from one interface to another. The bridge forwards packets addressed to unknown systems to the default interface (either Ethernet or PPP).

Each AP stores information on destinations and their interfaces to facilitate *forwarding*. When you send an *Address Resolution Protocol* (ARP) request packet, the AP forwards the request over all enabled interfaces (Ethernet, PPP, or radio), except over the interface on which the ARP request packet was received. (Radio-received ARP request packets echo back to other APs over radio.)

Upon receiving the ARP response packet, the AP database keeps a record of the destination address along with the receiving interface. With this information, the AP forwards any directed packet to the correct destination. The AP forwards packets for unknown destinations to the Ethernet interface.

The AP removes from its database destinations or interfaces not used for a specified time. The AP refreshes its database when it transmits or receives data from these destinations and interfaces.

Filtering and Access Control

The AP provides facilities to limit the wireless clients that associate with it and the data packets that can forward through it. Filters provide network security or improve performance by eliminating broadcast/multicast packets from the radio network.

The *Access Control List* (ACL) contains MAC addresses for wireless clients allowed to associate with the AP. This provides security by preventing unauthorized access.

The AP also uses a *disallowed address* list of destinations. This feature prevents the AP from communicating with specified destinations. This can include network devices that do not require communication with the AP or its wireless clients.

Depending on the setting, the AP can keep a list of frame types that it forwards or discards. The *Type Filtering* option prevents specific frames (indicated by the 16-bit DIX Ethernet Type field) from being processed by the AP. These include certain broadcast frames from devices unimportant to the wireless LAN but which utilize bandwidth. Filtering out unnecessary frames also improve throughput.

DHCP Support   The AP uses *Dynamic Host Configuration Protocol* (DHCP) to obtain a leased IP address and network configuration information from a remote server. DHCP is based on BOOTP protocol. DHCP can coexist or interoperate with BOOTP. An AP sends out a *DHCP request* searching for a *DHCP server* to acquire the network configuration and firmware filenames. Because BOOTP and DHCP interoperate, the one that responds first becomes the server that allocates information. The DHCP client automatically sends a DHCP request to renew the IP address lease as long as the AP is running. (This parameter is programmed at the DHCP server. For example, Windows NT servers typically are set for 3 days.)

The AP can optionally download two files when a boot takes place, the firmware file and an HTML file, because firmware versions 4.00-31 and above support Web servers. Users can program the DHCP or BOOTP server to transfer these two files when a DHCP request is made.

When the AP receives a network configuration change or is not able to renew the IP address lease the AP sends out an SNMP trap.

Media Types   The AP supports bridging between Ethernet, radio, and serial media.

The *Ethernet interface* fully complies with Ethernet Rev. 2 and IEEE 802.3 specifications. The AP supports 10BASE-T wired connections and full-speed filtering. The data transfer rate over radio waves is 11 Mbps. The Ethernet interface is optional for single-cell or PPP-connected networks.

The *radio interface* conforms to IEEE 802.11 HR specifications. The interface operates at 11 Mbps using direct-sequence radio technology. The AP supports multiple-cell operations with fast, transparent roaming between cells. With the direct-sequence system, each cell operates independently. Each cell provides a 11 Mbps bandwidth. Adding cells to the network provides increased coverage area and total system capacity. The AP supports wireless clients operating in *Power Save Polling* (PSP) mode or *Continuously Aware Mode* (CAM) without user intervention.

The *DB-9*, 9-pin, *RS-232 serial port* provides a *User Interface* (UI) or a *Point to Point Protocol* (PPP*)* connection. The UI provides basic management tools for the AP. The PPP provides a link between APs using a serial connection. The serial link supports *short haul* (direct serial) or *long haul* (telephone line) connections. The AP is a *Data Terminal Equipment* (DTE) device with male pin connectors for the RS-232 port. Connecting the AP to a PC requires a null-modem cable; connecting the AP to a modem requires a straight-through cable.

Bridging Support   The AP PPP interface, accessible from the serial port at the rear of the AP, provides two types of bridging operations: *Internet Protocol* (IP) bridging between an AP and a computer, and between two APs (with one AP connected to a LAN). To establish an Internet Protocol bridge with an AP, ensure that the computer includes the appropriate Telnet software with PPP and TCP/IP protocols. Using Telnet, a remote computer can connect to any AP on an Ethernet network, as long as data transfers through IP packets.

A PPP link provides the option of using a direct serial link or modem to extend wired Ethernet topologies. Once in PPP mode, the AP automatically attempts to communicate with the other device using the *Data-Link Bridging* (DLB) protocol. An AP using DLB communicates on the MAC level, and receives and transmits Ethernet frames.

If the other device does not support DLB, the AP attempts to communicate using *Internet Protocol Control Protocol* (IPCP). An AP using IPCP communicates on the IP level, and receives and transmits IP packets.

The PPP implementation in the AP uses the *Link Control Protocol* (LCP) and *Network Control Protocol* (NCP) as described in:

- RFC 1171: the Point-to-Point Protocol, July 1990
- RFC 1220: PPP Extensions for Bridging, April 1991
- RFC 1332: The PPP Internet Protocol Control Protocol, May 1992
- RFC 1661: The Point-to-Point Protocol, July 1994

(RFCs are *Requests For Comments* used in Internet Communities.)

The AP database dynamically tracks wireless clients and APs on the PPP interface. Packets forward to the PPP link after the AP determines their destination.

The PPP implementation in the AP uses the NCP as described in RFC 1220: PPP Extensions for Bridging to encapsulate packets at the Ethernet level. The PPP provides IP bridging control as defined by RFC 1172 and MAC-level bridging. The protocol provides support for PPP negotiations conforming to RFC 1661. Users cannot plug a non-AP node directly into the AP serial port, only AP-to-AP PPP links.

For detailed information, refer to *RFC 1171: The Point to Point Protocol and RFC 1220: PPP Extensions for Bridging.*

PPP Connection

Connecting an AP and a computer with a direct serial link requires the use of a null-modem serial cable.

Null-modem serial cable pinout:

```
AP (DIL)              AP (DIL)
DB-9 (Female)     DB-9 (Female)

  2 ───────────────── 3
  3 ───────────────── 2
  4 ──────────┐       1
  1 ──────┐   └────── 6
  6 ──────┴────────── 4
  7 ───────────────── 8
  8 ───────────────── 7
  5 ───────────────── 5
```
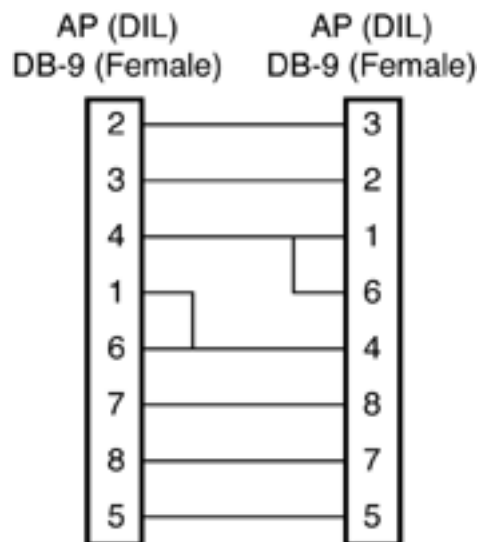
Connecting an AP and computer with modem devices requires the use of straight-through cables between the APs and modems. Using modems requires a telephone line for as long as the link remains active.

Straight-through cable pinout:

```
      AP (DIL)            AP (DIL)
   DB-9 (Female)        DB-9 (Male)

       ┌───┐             ┌───┐
       │ 1 ├─────────────┤ 8 │
       │ 2 ├─────────────┤ 3 │
       │ 3 ├─────────────┤ 2 │
       │ 4 ├─────────────┤ 20│
       │ 5 ├─────────────┤ 7 │
       │ 6 ├─────────────┤ 6 │
       │ 7 ├─────────────┤ 4 │
       │ 8 ├─────────────┤ 5 │
       │ 9 ├─────────────┤ 22│
       └───┘             └───┘
```
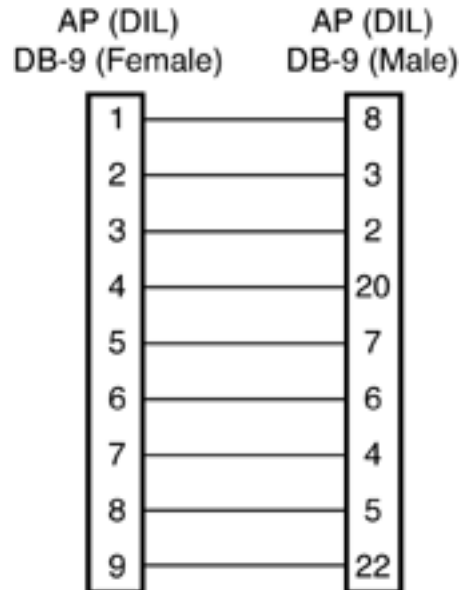
When using a modem connection, one AP represents the originating AP and the other represents the answering AP. When using a PPP link, do not use the serial port to access the UI. Access to the UI requires establishing a Telnet session with the AP.

Direct-Sequence Spread Spectrum

Direct Sequence Spread Spectrum (DSSS) uses a high-speed, non-information bearing signal to spread the transmitted information over a segment of the radio frequency band or spectrum. The AirConnect access point uses DSSS for radio communication.

Direct-sequence systems communicate by continuously transmitting a redundant pattern of bits called a *chipping sequence*. Each bit of transmitted data is mapped into *chips* by the access point to find the chipping sequence corresponding to the output signal.

Wireless clients receiving a direct-sequence transmission use the same chipping sequence to recreate the original data transmitted by the access point. Intercepting and decoding a direct-sequence transmission requires a predefined algorithm to associate the chipping sequence used by the transmitting access point to the receiving wireless client. This algorithm is established when the access point and wireless client are configured. The bit redundancy within the chipping sequence enables the receiving wireless client to recreate the original data pattern, even if bits in the chipping sequence are corrupted by interference.

Wireless Client Association Process

APs recognize wireless clients as they associate with the AP. The AP keeps a list of the wireless clients it services. Wireless clients associate with an AP based on the following conditions:

- Signal strength between the AP and wireless client

- Wireless clients currently associated with the AP

- Wireless client Supported Rate (see the table below)

- Positive match between the wireless client and encryption keys (optional)

- Positive wireless client authorization by the Access Control List (optional)

The following table gives the wireless client support rates:

Data Rate	Requirement
11 Mbps	Optional
5.5 Mbps	Optional
2 Mbps	Optional
1 Mbps	Required

Wireless clients perform preemptive roaming by intermittently scanning for APs and associating with the best available AP. Before roaming and associating with APs, wireless clients perform scans to collect AP statistics and determine the direct-sequence channel used by the AP.

Scanning is a periodic process where the wireless client sends out messages on all frequencies defined by the country code. The statistics enable a wireless client to reassociate by synchronizing its frequency to the AP. The wireless client continues communicating with that AP until it needs to switch cells or roam.

Wireless clients perform scans at start-up. In a scan, a wireless client uses a sequential set of channels as the scan range. For each channel in range, the wireless client tests for *Clear Channel Assessment* (CCA). When a transmission-free channel becomes available, the wireless client broadcasts a probe with the wireless LAN service area and the broadcast HSA_ID. An AP-directed probe response generates a wireless client *Acknowledgment* (ACK) and the addition of the AP to the AP table with a proximity classification. An unsuccessful AP packet transmission generates another wireless client probe on the same channel. If the wireless client fails to receive a probe response within the time limits, it repeats the probe process on the next channel in the sequence. This process continues through all channels in the range.

A wireless client can roam within the coverage area by switching APs. Roaming is transparent and virtually instantaneous in high-level applications. Roaming occurs when:

- An unassociated wireless client attempts to associate or reassociate with an available AP.

- The supported rate changes or the wireless client finds a better transmit rate with another AP.

- The signal quality of a potential AP exceeds that of the current AP.

- The ratio of good-transmitted packets to attempted-transmitted packets falls below a threshold.
- The wireless client detects an imbalance in the number of wireless clients associated with available APs and roams to a less loaded AP.

A wireless client selects the best available AP and adjusts itself to the AP direct-sequence channel to begin association. Once associated, the AP begins forwarding any frames it receives addressed to the wireless client. Each frame contains fields for the current direct-sequence channel. The wireless client uses these fields to resynchronize to the AP.

Mobile IP   The Internet Protocol identifies the wireless client point of attachment to a network through its IP address. The AP routes packets according to the location information contained in the IP header. If the wireless client roams across routers to another subnet, the following situations occur:

- The wireless client changes its point of attachment without changing its IP address, causing forthcoming packets to become undeliverable.
- The wireless client changes its IP address when it moves to a new network, causing it to lose connection.

Mobile IP enables a wireless client to communicate with other hosts using only its home IP address after changing its point-of-attachment to the internet/intranet.

Mobile IP is like giving an individual a local post office forwarding address when leaving home for an extended period. When mail arrives for the individual home address, it is forwarded by the local post office to the current care-of-address. Using this method, only the local post office requires notification of the individual current address. While this example represents the general concept of Mobile IP operation and functionality, it does not represent the implementation of Mobile IP used.

A tunnel is the path taken by the original packet encapsulated within the payload portion of a second packet to some destination on the network.

A *Home Agent* is an AP acting as a router on the wireless client home network. The home agent intercepts packets sent to the wireless client home address and tunnels the message to the wireless client at its current location. This happens as long as the wireless client keeps its home agent informed of its current location on some foreign link.

A *Foreign Agent* is an AP acting as a router at the wireless client location on a foreign link. The foreign agent serves as the default router for packets sent out by the wireless client connected on the same foreign link.

A care-of-address is the IP address used by the wireless client visiting a foreign link. This address changes each time the wireless client moves to another foreign link. It can also be viewed as an exit point of a tunnel between the wireless client home agent and the wireless client itself.

The *AirConnect Mobile IP (roaming across routers)* feature enables a wireless client on the Internet to move from one subnet to another while keeping its IP address unchanged. The scanning and associating process continues for active wireless clients. This allows the wireless clients to find new APs and discard out-of-range or deactivated APs. By testing the airwaves, the wireless clients can choose the best network connection available.

Set the wireless client for Mobile IP as specified in the *AirConnect Network Interface User Guide*.

Security

Security involves two distinct areas: authentication and privacy. Authentication ensures that only authorized users access the wireless network. Privacy ensures that communication between authenticated users and the network cannot be intercepted or overheard. The Access Control List provides authentication using the wireless LAN service area and a system administrator-supplied list of all the wireless client MAC addresses authorized to access the Home Service Area. Privacy is ensured by enabling the 40-bit WEP encryption option.

Supporting CAM and PSP Stations

Continuously Aware Mode (CAM) stations leave their radios on continuously to hear every beacon and message transmitted. These systems operate without any adjustments by the AP.

A *beacon* is a uniframe system packet broadcast by the AP to keep the network synchronized. A beacon includes the wireless LAN service area, the AP address, the Broadcast destination addresses, a time stamp, *Delivery Traffic Indicator Maps,* and the *Traffic Indicator Message* (TIM).

Power Save Polling (PSP) stations power off their radios for long periods. When a wireless client in PSP mode associates with an AP, it notifies the AP of its activity status. The AP responds by buffering packets received for the wireless client. The PSP-mode wireless client wakes up to listen to the AP beacon every n^{th} *Beacon Interval* where n is a PSP-mode value from the 1 to 5-range; the *Beacon Interval* is set on the wireless client. When the wireless client wakes up and sees its bit set in the TIM, it issues a poll request to the AP for packets stored for it. The AP sends them to the wireless client and the wireless client goes back to sleep. A DTIM field, also called a countdown field, informs wireless clients of the next window for listening to broadcast and multicast messages. The AP sends the messages following the nth beacon where n is the DTIM interval defined in the AP. When the AP has buffered broadcast or multicast messages for associated wireless clients, it sends the next DTIM with a *DTIM Interval* value. This value decreases by '1' with each successive beacon. The AP sends broadcast and multicast messages immediately following the beacon where the DTIM value is '0.' To prevent a PSP-mode wireless client from sleeping through a DTIM notification, select a PSP mode value less than or equal to the DTIM value. PSP-mode wireless clients hear the beacons and awaken to receive the broadcast and multicast messages.

A TIM is a compressed virtual bitmap identifying the AP associated wireless clients in PSP mode that have buffered directed messages. wireless clients issue a poll request when APs issue a TIM. A beacon with the broadcast-indicator bit set causes the wireless client to note *DTIM Count* field value. The value informs the wireless client of the beacons remaining before next DTIM. This ensures the wireless client turns on the receiver for the DTIM and the following *BC/MC packet transmissions*.

HTTP, HTML Web Server Support

Hypertext Transfer Protocol (HTTP) is the native language of the World Wide Web. The HTTP protocol makes requests from browsers to servers and responses from servers to browsers. This function provides the user with a Web-based format for configuration and firmware download.

Web pages are written in *Hypertext Markup Language* (HTML). HTML allows the user to create Web pages containing text, graphics, and pointers or links to other Web pages or elsewhere on the page or document. Pointers are known as *Uniform Resource Locators* (URLs). A URL is essentially the name of the Web page. The URL consists of three parts:

1 Protocol (or Scheme)

2 Fully Qualified Domain Name (FQDN), the machine where the page is located

3 Local name that identifies the page (usually the HTML file name)

The HTML language describes how to format the document, indication which fonts to use, much like a copy editor describes which fonts to use, such as the location, color, header size and text.

Management Options

Managing AirConnect includes viewing network statistics and setting configuration options. Statistics track the network activity of associated wireless clients and data transfers on the AP interfaces. Configuration involves, among other things, setting system operating parameters and filters used in bridging.

The AP requires one of the following to perform a custom installation or maintain the AirConnect network:

■ *Simple Network Management Protocol* (SNMP)

■ Wired or wireless LAN workstation with a telnet client

■ Terminal or PC with RS-232 connection and access to ANSI emulation

Changing one AP does not affect the configuration of other APs on the network. Make configuration changes to APs individually. Each AP requires an individual IP address.

Programmable SNMP Trap Support

The SNMP protocol defines the method for obtaining information about networks operating characteristics and changing router and gateway parameters. The SNMP protocol consists of three elements:

- Management stations

- Management information

- *Management protocol* (MIB)

Nodes can perform as hosts, routers, bridges or other devices that can communicate status information. An *SNMP Agent* is a node that runs the SNMP management process to systematically monitor and manage the network. The management station performs network management by running application management software.

An *SNMP trap* is an alert to all configured management stations of some significant event that occurred on the network. The management station queries all stations for details of each specific event, including what, when and where the event took place and the current status of the node or network. The format or structure is defined in the SNMP protocol. The MIB defines what and who monitors the variables.

Using SNMP

The AP includes *SNMP agent* versions accessible through an SNMP manager application (HP Open View or Cabletron Spectrum MIB browser). The SNMP agent supports SNMP versions 1 and 2, MIB II, 802.11 MIB and one proprietary *3Com Management Information Base* (MIB). The SNMP agent supports read-write, read-only or disabled modes. The AP supports traps that return to the SNMP manager when certain events occur. The *Wireless LAN Installation and Utilities* disk packaged with wireless clients contains the MIB.

Increased MIB Support

The MIB defines what the management station needs to understand and which objects the station manages. The MIB has ten categories defined with approximately 175 variables.

Using the User Interface

The *User Interface* (UI) is a text-based maintenance tool integrated into the AP. It provides statistical displays, AP configuration options, and firmware upgrades. Access to the UI requires one of the following:

Method	Description
Telnet Client	Gain access to the AP built-in Telnet server from any AP interface including remote Ethernet connections.
Direct Serial Connection	Acts as a DTE device to connect directly to a DTE device with a null-modem serial cable. The direct serial access method requires a communication program with ANSI emulation.
Dial Up Access	The dial-up access method requires a communication program with ANSI emulation on the remote terminal or PC. The terminal or PC dials to an AP with a modem connection. The AP supports connection to a Hayes-compatible 28,800-baud or faster modem.
SNMP Via a MIB Browser	Gain access to the AP SNMP function via a MIB Browser.
Web Browser	Gain access to the AP built-in Web server from any AP interface including remote Ethernet connections.

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