Spectrum24
AP-4111DS Access Point

Product Reference Guide

70-20688-01
Revision A
November 1999

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Patents

This product is covered by one or more of the following U.S. and foreign Patents:

U.S. Patent No.

4,360,798; 4,369,361; 4,387,297; 4,460,120; 4,496,831; 4,593,186; 4,603,262; 4,607,156; 4,652,750; 4,673,805;
4,736,095; 4,758,717; 4,816,660; 4,845,350; 4,896,026; 4,897,532; 4,923,281; 4,933,538; 4,992,717; 5,015,833;
5,017,765; 5,021,641; 5,029,183; 5,047,617; 5,103,461; 5,113,445; 5,130,520; 5,140,144; 5,142,550; 5,149,950;
5,157,687; 5,168,148; 5,168,149; 5,180,904; 5,216,232; 5,229,591; 5,230,088; 5,235,167; 5,243,655; 5,247,162;
5,250,791; 5,250,792; 5,260,553; 5,262,627; 5,262,628; 5,266,787; 5,278,398; 5,280,162; 5,280,163; 5,280,164;
5,280,498; 5,304,786; 5,304,788; 5,306,900; 5,321,246; 5,324,924; 5,337,361; 5,367,151; 5,373,148; 5,378,882;
5,396,053; 5,396,055; 5,399,846; 5,408,081; 5,410,139; 5,410,140; 5,412,198; 5,418,812; 5,420,411; 5,436,440;
5,444,231; 5,449,891; 5,449,893; 5,468,949; 5,471,042; 5,478,998; 5,479,000; 5,479,002; 5,479,441; 5,504,322;
5,519,577; 5,528,621; 5,532,469; 5,543,610; 5,545,889; 5,552,592; 5,557,093; 5,578,810; 5,581,070; 5,589,679;
5,589,680; 5,608,202; 5,612,531; 5,619,028; 5,627,359; 5,637,852; 5,664,229; 5,668,803; 5,675,139; 5,693,929;
5,698,835; 5,705,800; 5,714,746; 5,723,851; 5,734,152; 5,734,153; 5,742,043; 5,745,794; 5,754,587; 5,762,516;
5,763,863; 5,767,500; 5,789,728; 5,789,731; 5,808,287; 5,811,785; 5,811,787; 5,815,811; 5,821,519; 5,821,520;
5,823,812; 5,828,050; 5,850,078; 5,861,615; 5,874,720; 5,875,415; 5,900,617; 5,902,989; 5,907,146; 5,912,450;
5,914,478; 5,917,173; 5,920,059; 5,923,025; 5,929,420; 5,945,658; 5,945,659; 5,946,194; 5,959,285; D305,885;
D341,584; D344,501; D359,483; D362,453; D363,700; D363,918; D370,478; D383,124; D391,250; D405,077;
D406,581; D414,171; D414,172

Invention No. 55,358; 62,539; 69,060; 69,187 (Taiwan); No. 1,601,796; 1,907,875; 1,955,269 (Japan); European Patent 367,299; 414,281; 367,300; 367,298; UK 2,072,832; France 81/03938; Italy 1,138,713

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About This Document

Reference Documents

This reference guide refers to the following documents:

Part Number	Document Title
70-20706-01	Wireless LAN Adapter Models LA-4111 PC Card & LA-4113 PCI Adapter Product Reference Guide
70-20709-01	Spectrum24 Plus Pack Users Guide
70-20708-01	Spectrum24 Site Survey System Administrators Guide

Conventions

Keystrokes are indicated as follows:

ENTER	identifies a key.
FUNC, CTRL, C	identifies a key sequence. Press and release each key in turn.
Press A+B	press the indicated keys simultaneously.
Hold A+B	press and hold the indicated keys while performing or waiting for another function. Used in combination with another keystroke.

Typeface conventions used include.

<angles>	indicates mandatory parameters in syntax.
[brackets]	for command line, indicates available parameters; in configuration files, brackets act as separators for options.
GUI Screen text	indicates the name of a control in a GUI-based application.
Italics	indicates the first use of a term, book title, variable or menu title.
`Screen`	indicates monitor screen dialog. Also indicates user input. A screen is the hardware device on which data appears. A display is data arranged on a screen.
`Terminal`	indicates text shown on a radio terminal screen.
URL	indicates Uniform Resource Locator.

This document uses the following for certain conditions or information:

Indicates tips or special requirements.

Indicates conditions that can cause equipment damage or data loss.

Indicates a potentially dangerous condition or procedure that only Symbol-trained personnel should attempt to correct or perform.

Contents

Chapter 1 Introduction

Spectrum24 is a spread spectrum cellular network that operates between 2.4 and 2.5 *GHz (gigahertz)*. This technology provides a high-capacity network using multiple access points within any environment.

The Symbol AP-4111 access point (AP) is a Spectrum24 direct-sequence (DS) product. Spectrum24 DS products use direct-sequence technology to provide a high-capacity, high-data-rate wireless network.

Spectrum24 DS infrastructure products include:

- bridging architecture to provide communication between radio and wired multiple network segments
- a design based on the IEEE 802.11 standard
- an 11 Mbps data rate for fast operation
- seamless roaming for mobile users with devices such as laptops, wireless PCs, scanning terminals and other computers with PCMCIA slots.

1.1 Access Point (AP)

The *Access Point (AP)* provides a bridge between Ethernet wired LANs and Spectrum24 wireless networks. It provides connectivity between Ethernet wired networks and radio-equipped *mobile units (MUs)*. MUs include the full line of Symbol Spectrum24 terminals, PC Cards and PCI adapters, bar-code scanners, third-party devices and other devices.

The AP provides an 11 Mbps data transfer rate on the radio network. It monitors Ethernet traffic and forwards appropriate Ethernet messages to MUs over the Spectrum24 network. It also monitors MU radio traffic and forwards MU packets to the Ethernet LAN.

The AP meets the following:

- the regulatory requirements for Europe and many other areas of the world
- FCC part 15, class A with no external shielding
- FCC part 15 class B, ETS 300-339 compliance, including CE mark.

The AP has the following features:

- built-in diagnostics including a power-up self-check
- built-in dual antenna assembly with optional diversity
- wireless MAC interface
- field upgradable Firmware
- 10baseT Ethernet port interface with full-speed filtering
- power supply IEC connector and a country-specific AC power cable
- PC/AT Serial Port Interface
- support for up to 127 MUs
- data encryption
- increased MIB support
- SNMP support
- Mobile IP support
- DHCP support
- HTTP Web server support.

When properly configured, an MU communicating with an AP appears on the network as a peer to other network devices. The AP receives data from its wired interfaces and forwards the data to the proper interface.

The AP has connections for the wired network and power supply. The AP attaches to a wall or ceiling depending on installation-site requirements.

1.2 Radio Basics

Spectrum24 devices use both *electromagnetic waves* to transmit and receive electric signals without wires. Users communicate with the network by establishing radio links between terminals and APs.

Spectrum24 uses *FM (frequency modulation)* to transmit digital data from one device to another. Using FM, a radio signal begins with a carrier signal that provides the base or center frequency. The digital data signal is superimposed on the *carrier signal (modulation)*. The radio signal propagates into the air as electromagnetic waves. A receiving antenna in the path of the waves absorbs the waves as electrical signals. The receiving device demodulates the signal by removing the carrier signal. This demodulation results in the original digital data.

Spectrum24 uses the *environment* (the air and certain objects) as the transmission medium. Spectrum24 radio devices transmit in the 2.4 to 2.5-GHz frequency range, a license-free range throughout most of the world. The actual range is country-dependent.

Spectrum24 devices, like other Ethernet devices, have unique, hardware-encoded *Media Access Control (MAC)* or *IEEE addresses*. MAC addresses determine the device sending or receiving data. A MAC address is a 48-bit number written as six hexadecimal bytes separated by colons. For example:

```
ØØ:AØ:F8:24:9A:C8
```

To locate the AP MAC address see the bottom of the unit.

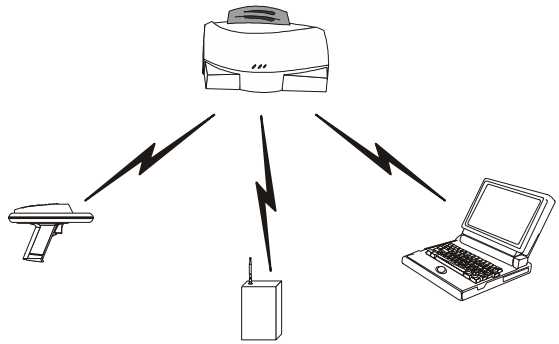
1.2.1 S24 Network Topology

The variations possible in Spectrum24 network topologies depend on the following factors:

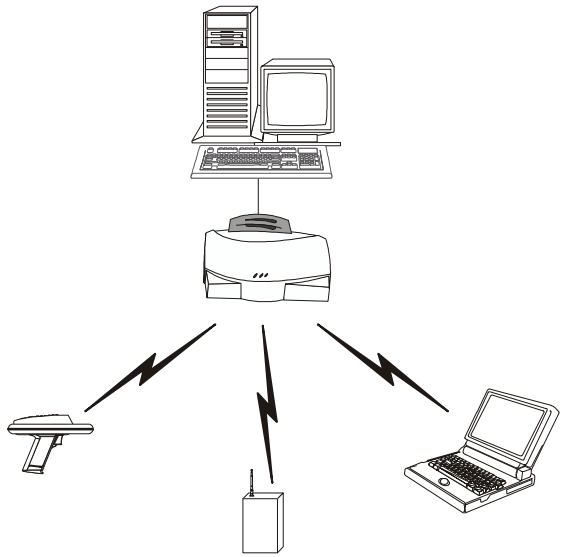
- the AP function in the network
- the data transfer rate

Select from the following topologies:

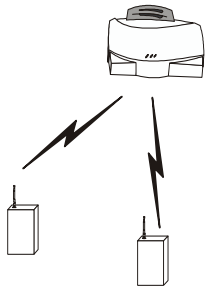
- A single AP used without the wired network provides a single-cell wireless network for peer-to-peer MUs.

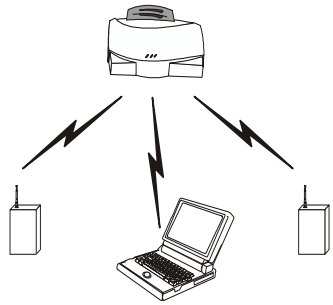


- A single AP can bridge the Ethernet and radio networks.

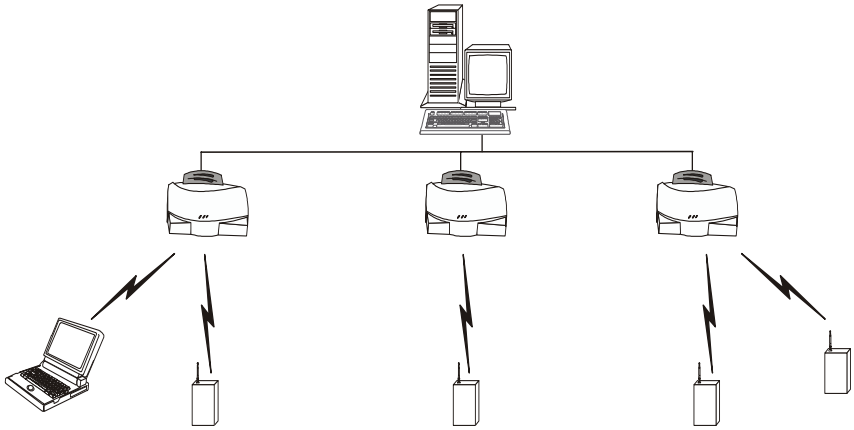


- Multiple APs can coexist as separate, individual networks at the same site without interference using different Net_IDs.



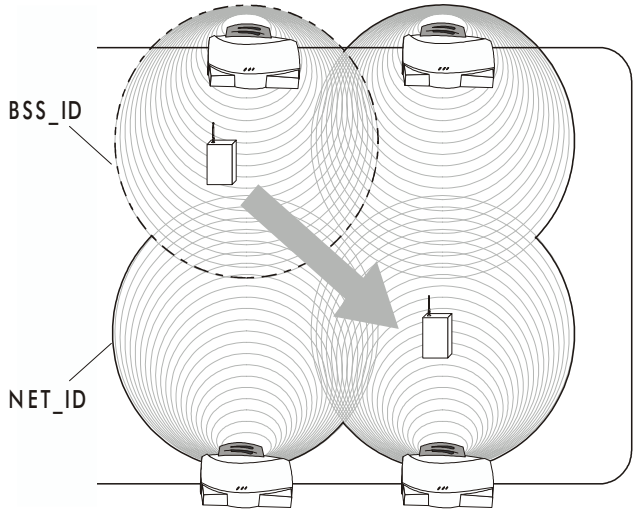


- Multiple APs wired together provide a network with better coverage area and performance when using the same Net_IDs.



1.2.2 Cellular Coverage

The AP establishes an average communication range with MUs called *a Basic Service Set (BSS*) or *cell*. When in a particular cell the MU associates and communicates with the AP of that cell. Each cell has a *Basic Service Set Identifier (BSS_ID)*. In IEEE 802.11, the AP MAC address represents the BSS_ID. The MU recognizes the AP it associates with using the BSS_ID. Adding APs to a LAN establishes more cells in an environment, making it an RF Network using the same *Net_ID or Extended Service Set (ESS)*.



APs with the same Net_ID (ESS) define a coverage area. The MU searches for APs with a matching Net_ID (ESS) and synchronizes with an AP to establish communications. This allows MUs within the coverage area to move about or *roam*. As the MU roams from cell to cell, it switches APs. The switch occurs when the MU analyzes the reception quality at a location and decides the AP to communicate with based on the best signal strength and lowest MU load distribution.

If the MU does not find an AP with a workable signal, it performs a scan to find any AP. As MUs switch APs, the AP updates the *association table*.

The user can configure the Net_ID (ESS). A valid Net_ID (ESS) is an alphanumeric, case-sensitive identifier up to 32 characters. Ensure all nodes within one LAN use the same Net_ID (ESS) to communicate on the same LAN. Multiple wireless LANs can coexist in a single environment by assigning different Net_IDs (ESS) for APs.

1.2.3 Site Topography

For optimal performance, locate MUs and APs away from transformers, heavy-duty motors, fluorescent lights, microwave ovens, refrigerators and other industrial equipment.

Signal loss can occur when metal, concrete, walls or floors block transmission. Locate APs in open areas or add APs as needed to improve coverage.

Site Surveys

A site survey analyzes the installation environment and provides users with recommendations for equipment and its placement. The optimum placement of 11 Mbps access points differs for 1 or 2 Mbps access points, because the locations and number of access points required are different.

Symbol recommends conducting a new site survey and developing a new coverage area floor plan when switching from 1 or 2 Mbps frequency-hopping access points to 11 Mbps direct-sequence access points.

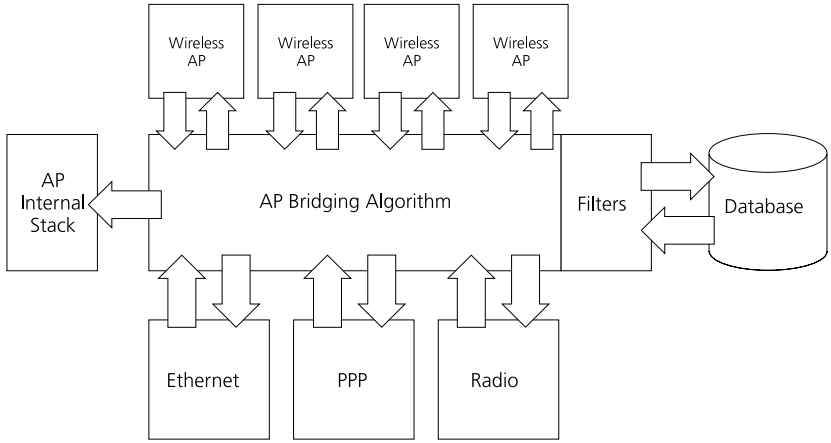
1.3 Advanced Radio Theory

To improve AP management and performance, users need to 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 MUs roam or network topologies change. The AP also handles broadcast and multicast message initiations and responds to MU association requests.

1.3.1 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 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).



The AP internal stack interface handles all messages directed to the AP.

Each AP stores information on destinations and their interfaces to facilitate *forwarding*. When a user sends an *ARP (Address Resolution Protocol)* request packet, the AP forwards it over all enabled interfaces (Ethernet, PPP and radio) except over the interface the ARP request packet was received. On 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.

Transmitted ARP request packets echo back to other MUs.

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

The AP 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 MUs.

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 take up bandwidth. Filtering out unnecessary frames can also improve performance.

1.3.2 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 every XX hours/days to renew the IP address lease as long as the AP is running. (This parameter is programmed at the DHCP server. 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. 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.

Mobile IP is not available when DHCP is used. Disable DHCP support when configuring an AP and mobile device for Mobile IP.

1.3.3 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.

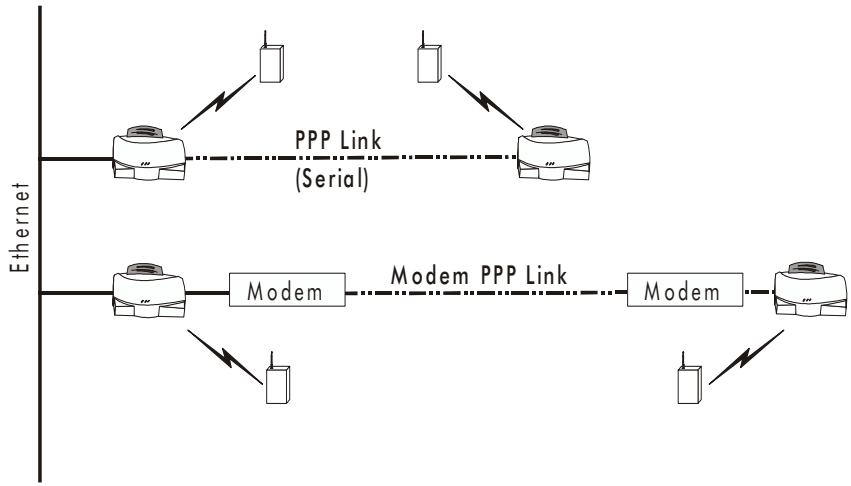
The *radio interface* conforms to IEEE 802.11 specifications. The interface operates at 11 Mbps using direct-sequence radio technology. The AP supports multiple-cell operations with fast roaming between cells. With the direct-sequence system, each cell operates independently. Each cell provides an 11 Mbps bandwidth. Adding cells to the network provides increased coverage area and total system capacity. The AP supports MUs 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 *UI (User Interface)* or a *PPP (Point to Point Protocol)* 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 *DTE (Data Terminal Equipment)* device with male pin connectors for the RS-232 port. Connecting the AP to a PC requires a null modem cable and connecting the AP to a modem requires a straight-through cable.

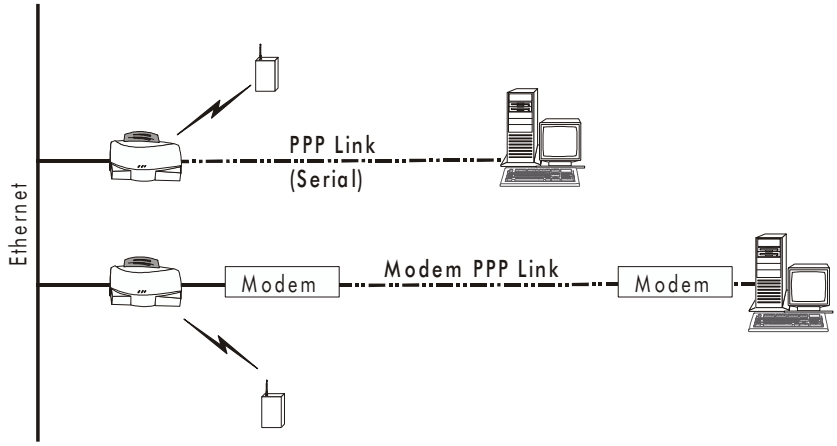
1.3.4 Bridging Support

The AP *PPP (Point to Point Protocol)* interface, accessible from the serial port at the rear of the AP, provides two types of bridging operations:

- Data-link bridging between two APs. A network using a data-link bridge provides radio coverage by using a remote AP in a location geographically distant from the AP connected to the Ethernet network. The remote AP cannot provide an Ethernet connection to other APs. MUs associating with the remote AP transmit and receive from the Ethernet network via the PPP link.



- Internet Protocol bridging between an AP and a computer. To establish an Internet Protocol bridge with an AP, ensure 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 (Internet Protocol)* 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.

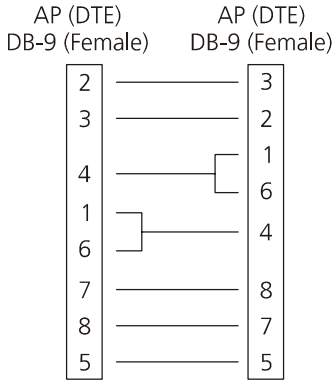
The AP database dynamically tracks MUs and APs on the PPP interface. Packets forward to the PPP link after the AP determines their destination.

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*. It 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.

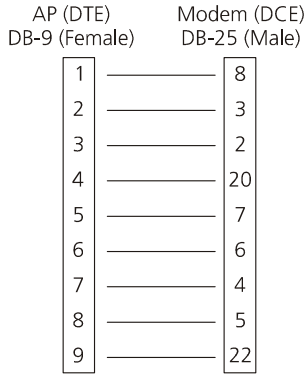
Refer to *RFC 1171: The Point to Point Protocol* and *RFC 1220: PPP Extensions for Bridging* for information.

PPP Connection

Connecting two APs with a direct serial link requires a null-modem serial cable.



Connecting two APs with modem devices requires straight-through cables between the APs and modems. Using modems requires a telephone line for as long as the link remains active.

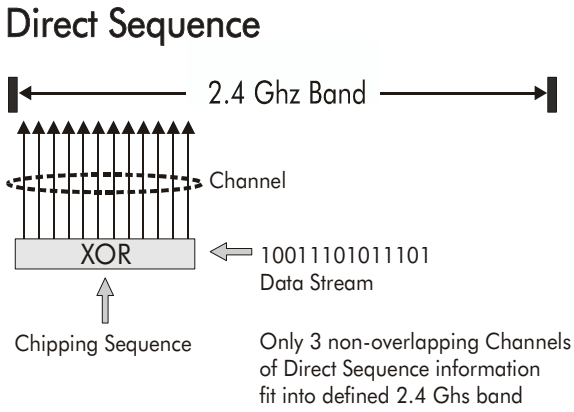


When using a modem connection, one AP represents the originating AP and the other represents the answering AP. When using a PPP link, do not use the serial port to access the UI. Access to the UI requires establishing a Telnet session with the AP.

1.3.5 Direct-Sequence Spread Spectrum

Spread spectrum (*broadband*) uses a narrowband signal to spread the transmission over a segment of the radio frequency band or spectrum. Direct-sequence is a spread spectrum technique where the transmitted signal is spread over a particular frequency range. The Spectrum24 AP-4111DS Access Point uses direct-sequence spread spectrum (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 and rearranged into a pseudorandom *spreading code* to form the chipping sequence. The chipping sequence is combined with a transmitted data stream to produce the AP output signal.



Note

In the United States, the three non-overlapping direct-sequence channels are channels 1, 6 and 11.

Mobile Units receiving a direct-sequence transmission use the spreading code to map the chips within the chipping sequence back into bits to recreate the original data transmitted by the access point. Intercepting and decoding a direct-sequence transmission requires a predefined algorithm to associate

the spreading code used by the transmitting access point to the receiving MU. This algorithm is established when the access point and MU are configured. The bit redundancy within the chipping sequence enables the receiving MU to recreate the original data pattern, even if bits in the chipping sequence are corrupted by interference.

The ratio of chips per bit is called the *spreading ratio.* A high spreading ratio increases the resistance of the signal to interference. A low spreading ratio increases the bandwidth available to the user. The access point uses two chips per bit among three channels within the 2.4 GHz band in a pattern avoiding any 1 or 2 Mbps systems operating in the same area. The access point is capable of an 11 Mbps data transmission rate, but the coverage area is less than a 1 or 2 Mbps access point since coverage area decreases as bandwidth increases.

1.3.6 MU Association Process

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

- the signal strength between the AP and MU
- the MU data rate (1 Mbps, 2 Mbps, 5.5 Mbps or 11 Mbps).

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

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

MUs perform full scans at start-up. In a full scan, an MU uses a sequential set of channels as the scan range. For each channel in range, the MU tests for *CCA (Clear Channel Assessment)*. When a transmission-free channel becomes available, the MU broadcasts a probe with the Net_ID (ESS) and the broadcast BSS_ID. An AP-directed probe response generates an MU ACK (Mobile Unit Acknowledgment) and the addition of the AP to the AP table with a proximity classification. An unsuccessful AP packet transmission generates another MU probe on the same channel. If the MU fails to receive a response within the time limit, it repeats the probe on the next channel in the sequence. This process continues through all channels in the range.

MUs perform partial scans at programmed intervals, when missing expected beacons or after excessive transmission retries. In a partial scan, the MU scans APs classified as proximate on the AP table. For each channel, the MU tests for CCA. The MU broadcasts a probe with the Net_ID (ESS) and broadcast BSS_ID when the channel is transmission-free. It sends an ACK to a directed probe response from the AP, and updates the AP table. An

unsuccessful AP packet transmission causes the MU to broadcast another probe on the same channel. The MU classifies an AP as out-of-range in the AP table if it fails to receive a probe response within the time limits. This process continues through all APs classified as proximate on the AP table.

An MU can roam within a coverage area by switching APs. Roaming occurs when:

- an unassociated MU attempts to associate or reassociate with an available AP
- the supported rate changes or the MU finds a better transmit rate with another AP
- the *RSSI (received signal strength indicator)* of a potential AP exceeds the current AP
- the ratio of good-transmitted packets to attempted-transmitted packets falls below a threshold.

An MU 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 MU. Each frame contains fields for the current direct-sequence channel. The MU uses these fields to resynchronize to the AP.

1.3.7 Mobile IP

The Internet Protocol identifies the MU 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 MU roams across routers to another subnet, the following situations occur:

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

Mobile IP enables an MU 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 MU home network. The home agent intercepts packets sent to the MU home address and tunnels the message to the MU at its current location. This happens as long as the MU 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 MU location on a foreign link. The foreign agent serves as the default router for packets sent out by the MU connected on the same foreign link.

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

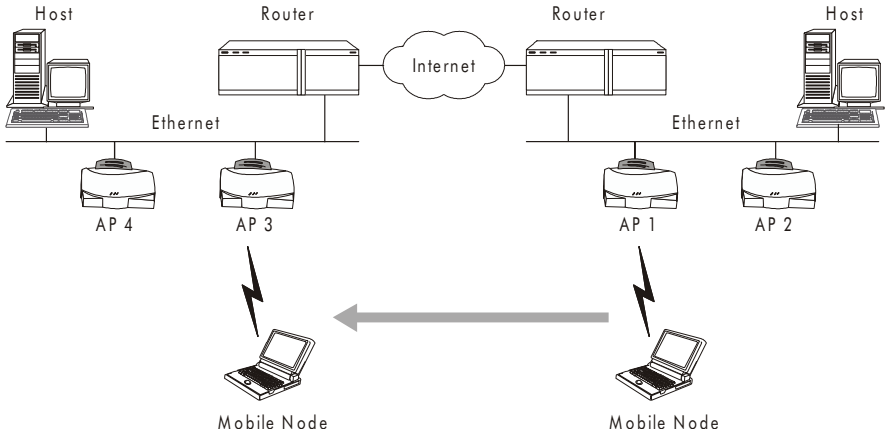
The *S24 Mobile IP (roaming across routers)* feature enables an MU on the Internet to move from one subnet to another while keeping its IP address unchanged.


Note

To configure this feature, see *2.4 Configuring System Parameters* on page 47.

The scanning and association process continues for active MUs. This allows the MUs to find new APs and discard out-of-range or deactivated APs. By testing the airwaves, the MUs can choose the best network connection available.

The following diagram illustrates Mobile IP (roaming across routers):



Note

Set the MU for Mobile IP as specified in the MU user documentation.

Security has become a concern to mobile users. Enabling the *Mobile-Home MD5 key* option in the *System Configuration* menu generates a 16-byte *checksum authenticator* using an *MD5 algorithm*. The MU and AP share the *checksum,* called a *key,* to authenticate transmitted messages between them. The AP and MU share the key while the MU is visiting a foreign subnet. The MU and AP have to use the same key. If not, the AP refuses to become the *Home Agent* for the MU. The maximum key length is 13 characters. The AP allows all printable characters.

1.3.8 Supporting CAM and PSP Stations

CAM (Continuously Aware Mode) 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 Net_ID (ESS), the AP address, the Broadcast destination addresses, a time stamp, a *DTIM (Delivery Traffic Indicator Maps)* and the *TIM (Traffic Indicator Message)*.

PSP (Power Save Polling) stations power off their radios for long periods. When a Spectrum24 MU in PSP mode associates with an AP, it notifies the AP of its activity status. The Spectrum24 AP-4111 DS access point responds by buffering packets received for the MU. The Spectrum24 adapters use a PSP performance index from 1 to 5, where 1 provides the quickest response time and 5 provides the most efficient power consumption.

The performance index determines how long the adapter stays in CAM after transmit or receive activity. Regardless of the performance index used, adapters switch to CAM for data reception/transmission. The awake interval in PSP performance index 1 is long enough to allow for round-trip packet response times. The packet response time in PSP performance index 5 is only 25 msec, the adapter goes back to sleep and requires another wake up period to receive data.

When the MU wakes up and sees its bit set in the TIM, it issues a short frame to the AP for the packets stored. The AP sends them to the MU and the MU issues another short frame when the data has been received and is ready to go back to PSP. A DTIM field, also called a countdown field, informs MUs of the next window for listening to broadcast and multicast messages. When the AP has buffered broadcast or multicast messages for associated MUs, it sends the next DTIM with a *DTIM Interval* value. To prevent a PSP-mode MU from sleeping through a DTIM notification, select a PSP mode value less than or equal to the DTIM value. PSP-mode MUs hear the beacons and awaken to receive the broadcast and multicast messages.

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

1.3.9 Data Encryption

Spectrum24 devices operating on a wired or wireless network face possible information theft. This occurs when an unauthorized user eavesdrops on someone else to obtain information illegally. The absence of a physical connection makes wireless links particularly vulnerable to this form of theft. *Encryption* becomes the most efficient method in preventing information theft and improving data security. Encryption entails scrambling and coding information, typically with mathematical formulas called *algorithms*, before the information is transmitted over a network. An algorithm is a set of instructions or formula for scrambling the data. A *key* is the specific code used by the algorithm to encrypt or decrypt the data. *Decryption* is the decoding and unscrambling of received encrypted data. The same device, host computer or front-end processor, usually performs both encryption and decryption. The data transmit or receive direction determines whether the encryption or decryption function is performed. This device takes the plain text and scrambles or encrypts it and transmitting the data over the network, typically by mathematically combining the key with the plain text as prescribed by the algorithm. At the receiving end another device takes the encrypted text and decrypts, unscrambles, the text resulting in the original plain text. An authorized user can know the algorithm, but cannot interpret the encrypted data without the appropriate key. Only the sender and receiver of the transmitted data know the key.

Symbol uses the *Wired Equivalent Privacy (WEP)* algorithm, specified in IEEE 802.11 section 8, for encryption and decryption. WEP uses the same key for both encrypting and decrypting plain text. Typically an external key management service distributes the key. Users should change the key often for added security. IEEE 802.11 defines two types of *authentication*, *Open System* and *Shared Key*. *Open system authentication* is a null authentication

algorithm. *Shared key authentication* is an algorithm where both the AP and the MU share an *authentication key* to perform a *checksum* on the original message. By default, IEEE 802.11 devices operate in *an open system network* where any wireless device can associate with an AP without authorization. A wireless device with a valid shared key is allowed to associate with the AP. *Authentication management messages* (packets) are unicast, meaning authentication messages transmit from one AP to one MU only, not broadcast or multicast.

1.3.10 HTTP, HTML Web Server Support

Hypertext Transfer Protocol (HTTP) is the native language of the Web. The HTTP protocol makes requests from browsers (the user) 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 HTML (Hypertext Markup Language.) 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:

- the protocol (a scheme)
- the DNS (Domain Name Server) the machine where the page is located
- the local name that identifies the page (usually the file name).

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

1.3.11 Management Options

Managing Spectrum24 includes viewing network statistics and setting configuration options. Statistics track the network activity of associated MUs and data transfers on the AP interfaces.

The AP requires one of the following to perform a custom installation or maintain the Spectrum24 network:

- SNMP (Simple Network Management Protocol)
- wired LAN workstation with a Telnet client
- terminal or PC with RS-232 connection and ANSI emulation

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 (MIB)
- a management protocol (SNMP).

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 via an SNMP manager application such as, HP Open View or Cabletron Spectrum MIB browser. The SNMP agent supports SNMP versions 1 and 2, MIB II, the 802.11 MIB and one Symbol proprietary *Symbol MIB (Management Information Base)*. 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 MUs contains the MIB.

Increased MIB Support

The *MIB (Management Information Base)* has ten categories defining what the management station needs to understand and which objects the station manages.

Using the UI

The *UI (User Interface)* is a 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:

Telnet Client	Gain access to the AP built-in Telnet server from any interface including remote Ethernet connections. See *2.1.1 Using Telnet* on page 29.
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. See *2.1.2 Using a Direct Serial Connection* on page 31.
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. See *2.1.3 Using a Dial-Up Connection* on page 32.
SNMP Via a MIB Browser	Gain access to the AP SNMP function via a MIB Browser. Typically a Network Manager uses this feature, however, Symbol does not recommend AP access using this interface method. Refer to the MIB Browser documentation for usage.
Web Browser	Gain access to the AP built-in Web server from any AP interface including Ethernet connections. See *2.1.4 Using a Web Browser* on page 33.

Chapter 2 Configuring the AP

Software configuration requires setting up a connection to the AP and gaining access to the UI (User Interface).

The dot in front of certain parameters, functions or options (`.Antenna Selection Primary Only`) indicates these items update to all APs with the same Net_ID (ESS) when choosing the `Save ALL APs-[F2]` option. Users can perform this option only among the same hardware platforms and same firmware versions.

2.1 Gaining Access to the UI

The method for establishing access to the UI depends on the connection used. Select the setup that best fits the network environment.

2.1.1 Using Telnet

Using a Telnet session to gain access to the UI requires that a remote station have a TCP/IP stack. The remote station can be on the wired or wireless LAN.

To access the AP from the workstation:

1. From the DOS prompt Telnet to the AP using its IP address:

   ```
   Telnet xxx.xxx.xxx.xxx
   ```

2. At the prompt type the password:

   ```
   Symbol
   ```

The password is case-sensitive.

3. Press the ESC key. The AP displays the *Main Menu*:

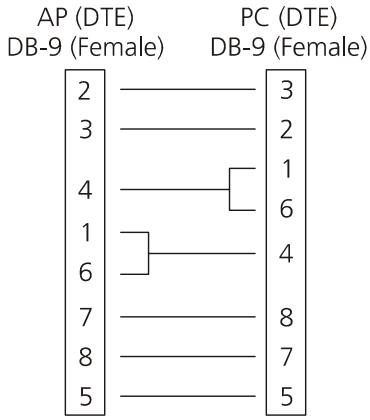
```
Symbol Access Point          MAIN MENU
Show System Summary                 AP Installation
Show Interface Statistics           Special Functions
Show Forwarding Counts              Set System Configuration
Show Mobile Units                   Set RF Configuration
Show Known APs                      Set Serial Port Configuration
Show Ethernet Statistics            Set Access Control List
Show RF Statistics                  Set Address Filtering
Show Misc. Statistics               Set Type Filtering
Show Event History                  Set SNMP Configuration
Enter Admin Mode                    Set Event Logging Configuration
```

   – If the session is idle (e.g. no input) for the configured time, the session terminates.
   – To manually terminate the session, press CTRL+D.

   Set the *System Password* in the *Set System Configuration* screen.

2.1.2 Using a Direct Serial Connection

The AP serial port is a DB-9, 9-pin male connector. The serial port allows PPP connections to another AP, or a UI connection to a configuration PC. Connecting the AP directly to a PC with a 9-pin serial port requires a null modem cable with the following configuration:



The factory-configured AP accepts a direct serial connection to the UI. Configure the AP for the following:

- `Enable` *serial port*.
- Set *Port Use* to `UI`.
- `Disable` *modem connection*.

Note

Configure these settings in the *Set Serial Port Configuration* screen within the UI. See *2.2.3 Configuring for Dial-Up to the UI* on page 43.

Assuming the UI and serial port are enabled on the AP:

1. Attach a null modem serial cable from the AP to the terminal or PC serial port.
2. From the terminal, start the communication program, such as HyperTerminal for windows.
3. Select the correct COM port along with the following parameters.

emulation	ANSI
baud rate	19200 bps
data bits	8
stop bits	1
parity	none
flow control	none

   There is no password requirement.
4. Press ESC to refresh the display. The AP displays the *Main Menu*.
5. Exit the communication program to terminate the session.

2.1.3 Using a Dial-Up Connection

The AP supports a dial-up connection to the UI. This requires accessing the UI from Telnet or a direct serial connection and changing the serial port configuration. Configure the AP for the following:

- `Enable` *serial port*.
- *Set serial port* for `UI`.
- `Disable` any modem connection.
- Set AP to `answer` mode.

Configure these settings in the *Set Serial Port Configuration* screen within the UI. See *2.2.3 Configuring for Dial-Up to the UI* on page 43.

2.1.4 Using a Web Browser

A Web Browser is a program used to view Web documents or *pages*. The browser retrieves the requested page, interprets its text and displays the page properly formatted on a computer screen.

Using a Web Browser to gain access to the UI requires the workstation to have a TCP/IP stack and access to a Web browser. The remote station can be on the wired or wireless LAN.

The Web Browser (Internet Explorer 4.0 or greater or Netscape) requires JavaScript to gain access to the UI.

Setup Network Web Server Help File Access

A network Web server is required to access the Help file from the *Spectrum24 Access Point Configuration Management System* web pages. This procedure applies to the Microsoft Internet Information Server. The network Web server can be different, if so, some of the procedures differ.

This procedure is for Network or System Administration personnel only.

To create the Help file on a network Web server:

1. Create a directory on the network Web server for the AP Web Site Help Files to reside.

   Often this is a subdirectory to C:\InetPub\wwwRoot.

2. Copy the *.gif and *.htm files to this directory/folder.

   The files are maintained in the *x*:\firmware\AP\AP Web Site\Help File directory.

   Where *x* is the letter assigned to the computer CDROM drive.


Note

This installation example is for Windows NT 4.0.

3. From the windows Task Bar select Start.
4. From the drop down menu select Programs.
5. From this menu select Microsoft Internet Server(common).
6. From this menu select Internet Service Manager to launch the Internet Information Server Service Manager.

   Click on the Web service.


Note

Ensure the server WWW service is running.

7. Select Properties.
8. Select Service Properties to display the WWW service properties for the server.
9. The WWW Service Properties window opens.
10. Select the Directories Tab.
11. Select the Add button to open the Directories window.
12. Type the *Directory/Folder* path of the directory created in step one.
13. Select the Virtual Directory button.
14. Type a folder *alias* such as *WebHelp* and select OK.
15. Select the Enable Default Document checkbox.
16. Type *S24apHelp.htm* as the default document and select Apply.
17. Select OK to exit the window.
18. Test the accessibility to the Help file using a Web browser with a URL similar to: http://*xxx.xxx.xxx.xxx*/WebHelp

    Where *xxx.xxx.xxx.xxx* is IP address of the server.

Accessing Web Browser UI

Using a Web Browser to gain access to the UI requires the workstation to have a TCP/IP stack and access to a Web browser. The remote station can be on the wired or wireless LAN.

Ensure the `Web Server` option is enabled for the AP:

1. Access the UI using a Serial or Telnet connection.
2. Select the *System Configuration* screen.
3. Verify the `Web Server` option on the *System Configuration* screen is enabled.
4. Save the configuration by selecting `Save-[F1].`

Reset the AP for changes to take effect.

1. Select the *Special Functions* screen.
2. Select `Reset AP.`
3. At the confirmation prompt, select `Yes`.

To enable Help file access, change the Help URL parameter:

1. Select the *Special Functions* screen.
2. Use the TAB or UP/DOWN ARROW key to select the `Alter Filename(s)/ HELP URL/TFTP Server/DHCP.`
3. Press ENTER.
4. Use the TAB or DOWN ARROW key to select the `.HELP URL` field.
5. Type the IP address/URL (Universal Request Locator) of the Web server and the directory/folder of the Web server for the Help file location. http://*xxx.xxx.xxx.xxx*/WebHelp

   Where *xxx.xxx.xxx.xxx* is the IP address of the server.
6. Press ENTER.
7. Use the TAB or DOWN ARROW key to select `OK-[CR]` and press ENTER.
8. Save the new setting by selecting the `Save Configuration` option.

9. At the confirmation prompt, select `Yes`.
10. The *Main Menu* screen displays.

Reset the AP for changes to take effect.

1. Select the *Special Functions* screen.
2. Select `Reset AP`.
3. At the confirmation prompt, select `Yes`.

To access the AP UI via a Web Browser from a workstation:

1. From the NCPA properties window set the IP address of the workstation and the subnet mask. The system tells the user to reboot for property changes to take effect.

The workstation, in this case, is the workstation or laptop computer running the Web browser.

2. To verify the connection, ping the AP. At the default DOS prompt, type:

   `Ping -t xxx.xxx.xxx.xxx`

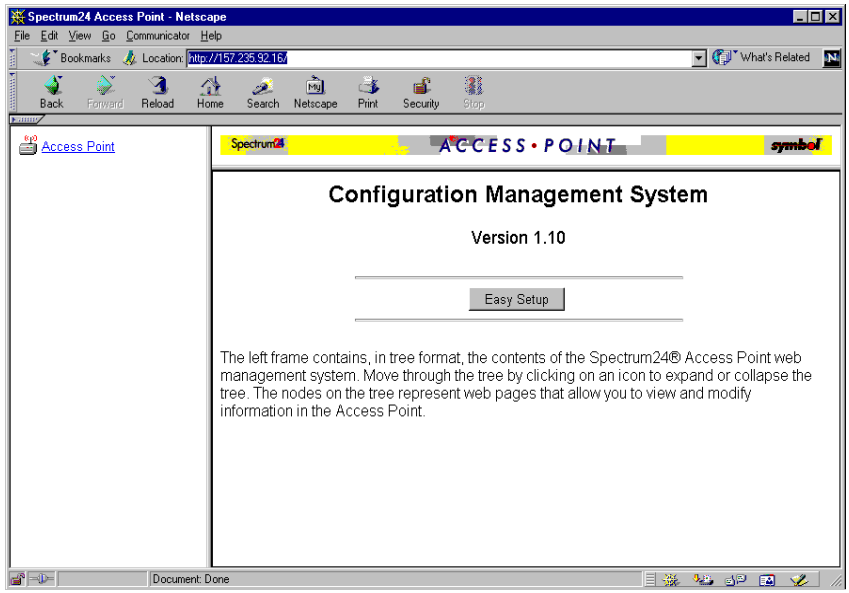
   – If the ping receives no response, verify that the hardware connections, IP address, gateway address and subnet mask are correct. If correct, contact the site System Administrator for network assistance.

3. Start a Web browser such as Internet Explorer 4.0 or greater, or Netscape 3.0 or greater.

   Type the IP Address for the associated AP to access the AP via the Web browser:

   http://xxx.xxx.xxx.xxx

4. The *Spectrum24 Access Point Configuration Management System* main page displays:



Note

The Web pages look different than the Telnet, Direct Serial or Dial-Up Connections, but the contents are the same. Access the different pages using the nodes located in the left frame. Refer to the online help file for Web page navigation, page contents and parameter use.

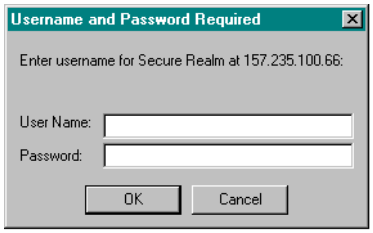
- To view configuration, function or option changes on the Web page(s) turn off the caching function for the browser being used.
  - For Netscape, from the menu bar select Edit, Properties and Advanced, Cache.
  - Select Document in cache is compared to document on network: Every time.

– For Internet Explorer, from the menu bar select View, Internet Options, Temporary Internet files and Settings.
– Select Check for newer versions of stored pages: Every visit to the page.

Note

If this property/option is not turned off, the browser returns the previous view of the page without the changes. To ensure the latest version of a web page is viewed, set this option in the browser.

- To access help from any *Spectrum24 Access Point Configuration Management System* web page, select the Help button located in the top right-hand corner of each page.
- For access to the *Easy Setup* and *Configuration* pages this popup dialogue box appears:



1. Type the AP name.

   `Symbol Access Point`

2. Type the password:

   `Symbol`

Note

The AP name and password are case-sensitive.

- To manually terminate the session, exit the browser.

2.2 Navigating the UI

The AP displays a *Main Menu* when gaining access to the UI:

```
Symbol Access Point          MAIN MENU
Show System Summary                 AP Installation
Show Interface Statistics           Special Functions
Show Forwarding Counts              Set System Configuration
Show Mobile Units                   Set RF Configuration
Show Known APs                      Set Serial Port Configuration
Show Ethernet Statistics            Set Access Control List
Show RF Statistics                  Set Address Filtering
Show Misc. Statistics               Set Type Filtering
Show Event History                  Set SNMP Configuration
Enter Admin Mode                    Set Event Logging Configuration
```

The top line displays the *System Name* for the AP (default is *Symbol Access Point*) and the name of the configuration screen.

The UI uses the following keystrokes to navigate through the menus and screens depending on the terminal emulation. For terminal emulation programs that do not support arrow or function keys, use the control-character equivalents:

UP ARROW	CTRL + O
DOWN ARROW	CTRL + I
LEFT ARROW	CTRL + U
RIGHT ARROW	CTRL + P
F1	CTRL + Q
F2	CTRL + W
F3	CTRL + E
F4	CTRL + R

The following conventions also apply when navigating screens and menus:

- To select menu items, press the key corresponding to the bold letter for the item (case-sensitive hot key). Press ENTER to select the item.
- Press TAB to scroll through menu items.
- To change menu items, note the bottom line on the screen for configuration options. For multiple choice options, press the bold letter to select. To change values, type in the value and press ENTER. If the value is invalid, the AP beeps and restores the original value. Press TAB to scroll to next menu item.
- The bottom line on the menu enables menu/screen changes to take effect. Press TAB to scroll to the item and press ENTER to select.
- When changing values such as *System Name* or *System Password*, accept values by scrolling to the next field or pressing ENTER.
- Some screens use function keys to initiate commands. For example, statistic screens include `refresh-[F1]` and `Timed-[F2]` commands to update the display.
- Some options listed at the bottom of screens indicate possible commands for a selected item. For example, in the *Known APs* screen, highlighting an AP on the list and pressing the [F1] key brings up the Ping function to Ping that AP.
- To exit from submenus, press ESC.

Administration screens include options for saving or clearing data that appear on the bottom line of the screen. Confirmation prompts include the following:

OK	Registers settings but does not save them in *NVM (nonvolatile memory*). A reset command returns to previously saved settings.
Save	Saves all settings (including ones not on that screen) to NVM. This is the same as *Save Configuration* in the *Special Functions* screen.
Save ALL APs	To save the *AP installation* configuration information to all APs with the same Net_ID (ESS). This option saves the configuration changes for the current AP on the *Known APs* table to update their configuration and reset after the configuration has been modified. Users can perform this option only among the same hardware platforms and same firmware versions.
Cancel	Does not register settings changed in a screen.

2.2.1 Entering Admin Mode

The UI defaults to *User* mode allowing read-only access to the APs functions (e.g., view statistics). Switching to *Admin* mode provides access to configuration menus and allows the user to configure the AP.

Entering *Admin* mode requires the administration password.

1. Select *Enter Admin Mode* from the *Main Menu*. The AP prompts for the administration password:

   ```
   Enter System Password:
   ```

2. Type the default password:

   ```
   Symbol
   ```

The password is case-sensitive.

- If the password is correct, the AP displays the Main Menu with the Enter Admin Mode menu item changed to Exit Admin Mode.
- If the password is incorrect, the AP continues to display the Main Menu with the Enter Admin Mode menu item.

Set the *System password* in the *Set System Configuration* screen.

2.2.2 Changing the Access to the UI

To prevent unauthorized Telnet access, change the configuration access to the UI. This includes enabling or disabling the *Telnet Logins* or changing the *System Password*.

To change Telnet access to the AP:

1. Select *Set System Configuration* from the Main Menu.
2. Select *Telnet Logins*.
3. Press the SPACE BAR or LEFT/RIGHT-ARROW keys to toggle between Enabled and Disabled.
4. Use the TAB key to highlight the SAVE-[F1] function at the bottom of the screen, press ENTER to confirm save.

To change the *System Password*:

1. Select *Set System Configuration* from the *Main Menu*.
2. Press TAB to select *System Password*.
3. Type in the new password and press ENTER.
4. Use the TAB key to highlight the SAVE-[F1] function at the bottom of the screen, press ENTER to confirm save.

2.2.3 Configuring for Dial-Up to the UI

A dial-up connection requires a straight-through cable between the modem and the AP. The remote PC requires a modem and a communication program (e.g. Microsoft Windows Terminal program).

See *Appendix B, Supported Modems* for modems supported by the AP.

Configuring Serial Port

To enable and configure the serial port connection on the AP:

1. Select *Set Serial Port Configuration* from the *Main Menu*.
2. Set the *Port Use* parameter to `PPP`.
3. Set the *Modem Connected* parameter to `Yes`.

Configure the other settings as required on the AP.

Answer Wait Time	The time waiting for a remote connection before dropping the attempt. The default is `60` seconds from a `5` to `255`-second range.
Modem Speaker	AP sends a command to the modem to turn on/off the modem speaker. The default is `On`.
Inactivity Timeout	The inactivity time on the UI that causes the AP to terminate the connection while using a modem. The default is `5` minutes from a 0 to 255-minute range. The 0 value indicates no time-out.

Configuring the Dial-Up System

Assuming the PPP, serial port and answer mode are enabled on the AP:

1. Attach a straight-through serial cable from the AP to the modem.
2. Verify the modem connects to the telephone line and has power.

   Refer to the modem documentation for information on verifying device power.
3. From the remote terminal, start the communication program.
4. Select the correct serial port along with the following parameters.

emulation	ANSI
baud rate	19200 bps
data bits	8
stop bits	1
parity	none
flow control	none

5. Dial out to the AP with the correct telephone number.
   No password required.
6. Press ESC to refresh the display. The AP displays the *Main Menu*.

Hanging Up

To hang up from the UI while connected:

1. Select the *Special Functions* Menu from the *Main Menu*.
2. Select *Modem Hangup*.

2.2.4 Navigating the UI Via a Web Browser

Refer to the online help file for information on Web Browser navigation and basic functionality. For file download instructions and the associated file(s) refer to the Web page: (http://www.symbol.com) and search for **Spectrum24 Firmware & Software Downloads**.

2.3 Access Point Installation

The AP UI includes an *AP Installation* screen supporting additional configuration to set basic parameters for a Spectrum24 network. These parameters include designating a gateway address that provides the ability to forward messages across routers on the wired Ethernet.

To install an AP:

1. Enter *Admin* Mode.
2. Select *AP Installation* from the *Main Menu* to display:

```
Symbol Access Point
                        Access Point Installation


   Unit Name          Symbol Access Point              .Additional Gateways
   IP Address         157.235.1Ø1.152                   157.235.1Ø1.2
                                                         Ø.Ø.Ø.Ø
  .Gateway IP Address 157.235.1Ø1.1                     Ø.Ø.Ø.Ø
                                                        Ø.Ø.Ø.Ø
  .Subnet Mask        255.255.255.Ø                     Ø.Ø.Ø.Ø
                                                        Ø.Ø.Ø.Ø
  .Net_ID (ESS)       1Ø1                               Ø.Ø.Ø.Ø

  .Antenna Selection  Diversity On

  .DHCP               Enabled


   OK-[CR]       Save-[F1]      Save ALL APs-[F2]        Cancel-[ESC]
```

Where:

Unit Name	the AP name.
IP Address	the network-assigned Internet Protocol address of the AP.
Gateway IP Address	IP address of a router the AP uses on the Ethernet default gateway.

Subnet Mask	The first two sets of numbers specify the network domain, the next set specifies the subset of hosts within a larger network and the final set specifies an individual computer. These values help divide a network into subnetworks and simplify routing and data transmission. The subnet mask defines the size of the subnet.
Net_ID (ESS)	the unique 32-character, alphanumeric, case-sensitive network identifier of the AP.
Antenna Selection	enables selection of antenna diversity.
Additional Gateways	The IP address of the additional gateways used. Access up to seven gateways.
DHCP	enables the DHCP client to automatically send a DHCP request every XX hours/days to renew the IP address lease as long as the AP is running.

3. Verify the AP parameters reflect the network environment. Change them as needed.
4. In the *Antenna Selection* field, use the SPACE BAR or LEFT/RIGHT-ARROW keys to toggle between `Primary Only` and `Primary and Secondary`.
5. To register settings select `OK` or `Save` to write changes to NVM. Selecting `Save` displays a confirmation prompt.
6. To save the *AP installation* configuration information to all APs with the same Net_ID (ESS) select `Save ALL APs-[F2]`.

   This option saves the configuration changes for the current AP on the *Known APs* table to update their configuration and reset after the configuration has been modified. Users can perform this option only among the same hardware platforms and same firmware versions.
7. To disregard any changes made to this screen and return to the previous menu, select `Cancel-[ESC]`.

2.4 Configuring System Parameters

The AP provides configuration options for how the unit operates, including security access and interface control. Some parameters do not require modification.

1. Select *Set System Configuration* from the *Main Menu* to display:

```
Symbol Access Point
                          System Configuration

 Channel               3              .Access Control     Disabled
                                      .Type Filtering     Disabled

.Ethernet Timeout      Ø              WNMP Functions      Enabled
                                      .AP-AP State Xchg   Enabled
.Telnet Logins       Enabled
.System Password     Symbol           Ethernet Interface  On
                                      PPP Interface       Off
.Agent Ad Interval     Ø              RF Interface        On
.S24 Mobile IP       Enabled
.Mobile-Home MD5 key Symbol           Default Interface   Ethernet

.AP Auto Configure   Enabled          .MU-MU Disallowed   Off

.Web Server          Enabled

   OK-[CR]       Save-[F1]      Save ALL APs-[F2]        Cancel-[ESC]

                 Save, then reset AP to take effect.
```

2. Configure the direct-sequence channel settings.

Frequency	Allowed Channel Range	Country
2412-2470	1-11	United States
2430-2447	5-8	Israel
2557-2463	10-11	Spain
2458-2472	10-13	France
2483-2485	14	Japan

3. Configure the AP system settings as required:

Ethernet Timeout	Disables radio interface if no activity is detected on the Ethernet line after the seconds indicated (30-255). The AP disassociates MUs and prevents further associations until it detects Ethernet activity. The default value `0` disables this feature. The `1` value detects if the 10Base-T line goes down.
Telnet Logins	Specifies if the AP accepts or rejects Telnet Logins. The default value is Enabled.
System Password	For administrative access, select any alphanumeric, case-sensitive entry up to 13 characters. The default System Password is Symbol.
Agent Ad Interval	Specifies the interval in seconds between the mobility agent advertisement transmission.
S24 Mobile IP	If enabled, this feature allows MUs to roam across routers.
Mobile-Home MD5 key	Secret key used for Mobile-Home registration and authentication.
MU-MU Disallowed	If enabled, mobile units associated with the same AP are not allowed to communicate with each other.
Web Server	Enables the use of a Web based browser to access the UI instead of HyperTerminal or Telnet applications. An AP Reset is required for this feature to take effect.
Access Control	Specifies enabling or disabling the access control feature. If enabled, the ACL (Access Control List) specifies the MAC addresses of MUs that can associate with this AP. The default is Disabled.
Type Filtering	Specifies filter type for packets received either Forward/ Discard or Disabled. The default value is Disabled.
WNMP Functions	Specifies if the AP can perform WNMP functions. The default value is Enabled.
AP-AP State Xchg	Specifies AP-to-AP communication exchanged.

4. To enable or disable interfaces on the AP, modify the following parameters:

Ethernet Interface	Enables or disables wired Ethernet. The default value is On.
PPP Interface	Enables or disables serial PPP. The default value is Off.
RF Interface	Enables or disables radio. The default value is On.
Default Interface	Specifies the default interface (Ethernet or PPP) that the AP forwards a frame to if the AP cannot find the address in its forwarding database. The default interface is Ethernet.

5. Verify the values set reflect the network environment. Change them as needed.
6. To register settings, select `OK` or `Save` to write changes to NVM. Selecting `Save` displays a confirmation prompt.
7. To save the *System Configuration* information to all APs with the same Net_ID (ESS), select `Save ALL APs-[F2]`.

   This option saves the configuration changes for the current AP, and sends two WNMP messages to all other APs on the *Known APs* table to update their configuration and reset after the configuration has been modified. Users can perform this option only among the same hardware platforms and same firmware versions.
8. To disregard any changes made to this screen and return to the previous menu, select `Cancel-[ESC]`.

2.5 Configuring Radio Parameters

The AP automatically configures most radio parameters. Only advanced users, Symbol trained users or Symbol representatives should adjust the radio parameters for the AP. Options in the *RF Configuration* screen fine-tune the radio functions.

1. Select *Set RF Configuration* from the *Main Menu* to display:

```
Symbol Access Point
                                RF Configuration

 .DTIM Interval             1Ø
 .BC/MC Q Max               1Ø
 .Reassembly timeout      9ØØØ
 .Max Retries (d)           15
 .Max Retries (v)            3
 .Multicast Mask (d) Ø9ØØØE ØØ  hex
 .Multicast Mask (v) Ø1ØØ5E ØØ  hex
 .Beacon Interval          1ØØ  K-us
 .Accept Broadcast ESSID  Disabled
 .MU Inactivity Timeout     6Ø  min.
 .Rate Control
     5.5 & 11 Mb/s         Optional
     1 & 2 Mb/s            Required


 .RTS Threshold           2347  bytes
 .CCA Mode              Carrier Sense
 .CCA Energy Threshold      6Ø

   OK-[CR]       Save-[F1]      Save ALL APs-[F2]         Cancel-[ESC]

The frequency of DTIM packets as a multiple of TIM packets
```

Fragmentation Threshold, RTS Threshold, CCA Mode and CCA Energy Threshold are not user configurable parameters.

2. Configure the settings as required:

DTIM Interval	Configure DTIM packet frequency as a multiple of beacon packets. The DTIM Interval indicates how many beacons equal one cycle. Do not modify.
BC/MC Q Max	Determines the memory allocated for the queue used in the AP to temporarily hold broadcast/ multicast messages. Unit measure is in packets and corresponds to maximum-sized Ethernet packets. The default is 1Ø.
Max Retries (d)	The maximum allowed retries before aborting a single data packet transmission. The default is 15. Users should not modify.
Max Retries (v)	The maximum allowed retries before aborting a single voice packet transmission. The default is 5. Do not modify.
Multicast Mask (d)	Supports broadcast download protocols for any MU, typically Point-of-Sale terminals, requiring the expedited download of a new operating image over the network instead of using a local nonvolatile drive. All multicast downstream data packets that match the top 32 bits of the multicast mask are forwarded immediately instead of being queued for transmission at the next DTIM interval.
Multicast Mask (v)	Supports broadcast, or *party-line*, voice communications. All multicast downstream data packets that match the top 32 bits of the multicast mask are forwarded immediately instead of being queued for transmission at the next DTIM interval.
Beacon Interval	The time between beacons in Kilo-microseconds. The default is 100. Avoid changing this parameter because it can adversely affect PSP-mode terminal performance.

Accept Broadcast ESSID	Allows the AP to respond to any station sending probe packets with the industry-standard broadcast ESS. If Enabled, this feature allows industry-standard devices interoperability. The AP probe response includes the ESS and information about the network. By default, this feature is Disabled and the AP responds only to stations that know the ESSID. This helps preserve network security. MUs require using Broadcast ESS to use this function.
MU inactivity Timeout	Allows industry-standard device interoperability by specifying the time the AP allows for MU inactivity. A Spectrum24 AP recognizes MU activity through data packet transmission and reception, and through scanning. Spectrum24 MUs conduct active scanning. Other industry-standard MUs might conduct passive scans and a Spectrum24 AP can classify them as inactive.
Rate Control	Defines the data transmission rate: • 5.5 & 11 Mbps - Optional • 1 & 2 Mbps - Required
RTS Threshold	Request to send threshold (256 – 2347). Allows the AP to use RTS (Request To Send) on frames longer than the specified length. The default is 2347 Bytes.

3. Verify the values set reflect the network environment. Change them as needed.
4. To register the settings select `OK` or `Save` to write changes to NVM. Selecting `Save` displays a confirmation prompt.
5. To save the *RF Configuration* information to all APs with the same Net_ID (ESS), select `Save ALL APs-[F2]`.

   This option saves the configuration changes for the current AP, and sends two WNMP messages to all other APs on the *Known APs* table to update their configuration and reset after the configuration has been modified. Users can perform this option only among the same hardware platforms and same firmware versions.
6. To disregard any changes made to this screen and return to the previous menu select `Cancel-[ESC]`.

2.6 Configuring PPP

To use a PPP connection, choose the hardware connection (direct or modem) and verify the enable status of serial port (default) in the System Configuration menu.

2.6.1 PPP Direct

A direct null modem serial cable connection between two APs.

From the UI:

1. Select *Set Serial Port Configuration* from the *Main Menu* to display:

```
Symbol Access Point

                    Serial Port Configuration


Port Use         PPP                 Answer Wait Time      6Ø
Connect Mode     Answer              Inactivity Timeout     5
Modem Connected  No                  PPP Timeout            3
Dialout Mode     Auto                PPP Terminates        1Ø
Modem Speaker    On
Dialout Number   1234567


          OK-[CR]          Save-[F1]          Cancel-[ESC]

(Use the space bar or left/right cursor keys to change)
```

2. Set the *Port Use* parameter to `PPP`.
3. Verify that the *Modem Connected* parameter setting is `No`.
4. Set the *Connect Mode* parameter to `Answer`.
5. Repeat for the other AP. Set the other APs *Connect Mode* to `Originate`.

2.6.2 Establishing Connection

To establish the PPP port connection on both APs:

1. Select *Set System Configuration* from the *Main Menu*.
2. Set the *PPP Interface* to `ON`.
3. Use the SPACE BAR or LEFT/RIGHT-arrow keys to change and press ENTER to confirm.

2.6.3 PPP with Modems

The PPP interface provides a connection using modems over a telephone line. Connect modems to the APs with straight-through serial cables. Designate one AP as the *Originating* AP and the other as the *Answering* AP. Configure the Originating AP with dial-out information to the answering AP. The answering AP waits for the originating AP to dial into it. See *Appendix B: Supported Modems* for modems supported by the AP.

Dial out manually through the *Special Functions* menu or dial out automatically on boot.

2.6.4 Originating AP

From the originating APs UI:

1. Select Set Serial Port Configuration from the *Main Menu*.
2. Set the *Port Use* parameter to `PPP`.
3. Set the *Modem Connected* parameter to `Yes`.
4. Set the *Connect Mode* to `Originate`.
5. Select *Dialout Number* and type the dial-out telephone number of the answering AP (maximum 31 characters). This string matches what follows a typical Hayes Smartmodem ATDT command. Possible characters include pauses, numbers and letters. Refer to the modem documentation.
6. Set the *Dialout Mode* to `Auto`.

7. Configure the other settings as required:

Answer Wait Time	Time in seconds waiting for a remote connection before dropping attempt. The default is `60` from a `5` to `255`-second range.
Modem Speaker	Sends a command to the modem to turn on or off the modem speaker. The default is `On`.
PPP Timeout	Controls the time-out between issuing a PPP packet and expecting a reply. This is necessary if the serial connection has long delay periods. The `0` value indicates no time-out. The default is `3` from a `0` to `255`-second range.
PPP Terminates	Controls the PPP terminate requests the AP issues when a PPP-linked AP does not respond to a terminate request. The AP closes the PPP connection after making the maximum requests. The default is `10` from a `0` to `255`-terminate request range.

2.6.5 Answering AP

From the answering APs UI:

1. Select *Set Serial Port Configuration* from the *Main Menu*.
2. Set the *Port Use* parameter to `PPP`.
3. Set the *Modem Connected* parameter to `Yes`.
4. Set the *Connect Mode* to `Answer`.
5. Configure the other required settings as on the originating AP.

2.6.6 Initiating Modem Connection

To manually initiate dial-out from the originating AP to the answering AP:

1. Select the *Special Functions* Menu from the *Main Menu*.
2. Select *Modem Dialout*.

The AP dials out and attempts to make connection according to parameters set in *Serial Port Configuration*. If dial-out fails, the AP switches to manual dial-out.

For automatic dial-out, reset the AP.

To hang up:

1. Select the *Special Functions* Menu from the *Main Menu*.
2. Select *Modem Hangup*.

2.7 Configuring the SNMP Agent

An SNMP manager application gains access to the AP SNMP agent if it has the AP IP address. The agent configures as *read-only, read-write* or *disabled* to provide security when using SNMP. The AP sends specific traps for some conditions. Ensure the SNMP trap manager recognizes how to manage these traps.

Refer to the Symbol MIB on the Wireless LAN Installation and Utilities disk for specific entries.

The AP supports SNMP V1, MIB-II and the SYMBOL.MIB.

1. Select *Set SNMP Configuration* from the *Main Menu* to AP display:

```
Symbol Access Point
                              SNMP Configuration

                        .SNMP Agent Mode          Read/Write

                        .Read-Only Community      public
                        .Read-Write Community     Symbol
                        .Trap IP Address          Ø.Ø.Ø.Ø
                        .All Traps                Disabled

                         Generic Traps:
                        .Cold Boot                Disabled
                        .Authentication failure   Disabled

                         Enterprise-Specific Traps:
                        .Radio Restart            Disabled
                        .Access Cntrl Violation   Disabled
                        .MU State Change          Disabled
                        .DHCP Change              Disabled

   OK-[CR]       Save-[F1]      Save ALL APs-[F2]         Cancel-[ESC]

  (Use the space bar or left/right cursor keys to change)
```

2. Configure the settings as required:

SNMP Agent Mode	defines the SNMP agent mode: *Disabled* disables SNMP functions. *Read-only* allows get and trap operations. *Read/Write* (default) allows get, set and trap operations.
Read-Only Community	User-defined password string up to 31 characters identifying users with read-only privileges.
Read/Write Community	User-defined password up to 13 characters for users with read/write privileges. Ensure the password used matches the System Password used to gain access to the System Configuration screen.
Trap IP Address	Trap manager IP address.
All Traps	Enables or disables all trap operations. The default value is Disabled.
Cold Boot	Send a trap to manager when the AP cold boots. The default value is Disabled.
Authentication failure	Indicates that community strings other than those specified for the Read-Only and Read/Write Community were submitted. The default value is Disabled.
Radio Restart	Send a trap to manager for radio restart. The default is value Disabled.
Access Cntrl Violation	Send a trap to manager when an ACL violation occurs. The default value is Disabled.
MU State Change	if enabled, this trap generates the following enterprise-specific traps: • MU Associated • MU Unassociated • MU state changed from PSP mode to CAM mode • MU state changed from CAM mode to PSP mode.

DHCP Change — If enabled, this trap generates the following enterprise-specific traps:

- Gateway Address change
  Indicates the gateway address for the router has changed.
- IP Address Change
  Indicates the IP address for the AP has changed.
- IP Address Lease is up
  Informs the user the IP address leased from the DHCP server is about to expire.

3. Verify the values reflect the network environment. Change them as needed.
4. To register settings select `OK` or `Save` to write changes to NVM. Selecting `Save` displays a confirmation prompt.
5. To save the *SNMP Configuration* information to all APs with the same Net_ID (ESS), select `Save ALL APs-[F2]`.

   This option saves the configuration changes for the current AP, and sends two WNMP messages to all other APs on the *Known APs* table to update their configuration and reset after the configuration has been modified. Users can perform this option only among the same hardware platforms and same firmware versions.
6. To disregard any changes made to this screen and return to the previous menu, select `Cancel-[ESC]`.

2.8 Configuring the ACL

The ACL supports adding MU entries by individual MAC address or by a range of MAC addresses. The maximum number of entries is 512 if no entries have been made for Disallowed Address Filtering. Only 512 entries are available to both ACL and Disallowed Address Filtering.

1. Select the *Set Access Control List* option from the *Main Menu* to display:

```
Address Type?   range individual
```

2. Use the UP/DOWN-ARROW keys to toggle between `range` and `individual`.

2.8.1 Range of MUs

To select a range of MAC addresses:

1. Type in the minimum MAC address as the top value:
   `ØØ:ØA:F8:FØ:Ø1:Ø1`
2. Press ENTER to accept the value; use the DOWN-ARROW key to select the maximum value.
3. Type in the maximum MAC address in the bottom value:
   `ØØ:ØA:F8:FØ:Ø2:FF`
4. Press ENTER to accept the value; use the DOWN-ARROW key to select OK.
5. Press ENTER. The UI displays:

```
 Symbol Access Point
                        Ranges of Allowed Mobile Units

                        Min Address          Max Address

                    ØØ:AØ:F8:FØ:Ø1:Ø1   ØØ:AØ:F8:FØ:Ø2:FF
                    ØØ:AØ:F8:29:1Ø:Ø2   ØØ:AØ:F8:29:11:ØØ


    Delete-[F1]     Add-[F2]       Save All APs-[F3]      Exit-[ESC]
```

6. Verify values reflect the network environment. Change them as needed.
7. To delete a range of Mobile Units select `Delete-[F1]`.
8. To add a range of Mobile Units select `Add-[F2]`.
9. To save the *Ranges of Allowed Mobile Units* information to all APs with the same Net_ID (ESS), select `Save ALL APs-[F3]`.

   This option saves the configuration changes for the current AP, and sends two WNMP messages to all other APs on the *Known APs* table to update their configuration and reset after the configuration has been modified. Users can perform this option only among the same hardware platforms and firmware versions.
10. To return to the previous menu select `Exit-[ESC]`.

When users enable the *Access Control* option, all MUs within the specified range can associate with the AP. Specify additional ranges as needed or add to the ACL using individual address entries.

2.8.2 Adding Allowed MUs

The *Access Control List* screen provides a facility to add MUs to the ACL.

1. Select the *Set Access Control List* option from the *Main Menu* to display:
   `Address Type?  range individual`
2. Use the UP/DOWN-ARROW keys to toggle between `range` and `individual`. Select `individual`.
3. Press `Add-[F2]`. The AP prompts for a MAC address.
   `ØØ:ØØ:ØØ:ØØ:ØØ:ØØ`
4. Enter the MAC address.

Users can enter MAC addresses without colons.

5. To save the *AP installation* configuration information to all APs with the same Net_ID (ESS), select `Save ALL APs-[F3]`.
   This option saves the configuration changes for the current AP, and sends two WNMP messages to all other APs on the *Known APs* table to update their configuration and reset after the configuration has been modified. Users can perform this option only among the same hardware platforms and firmware version.

2.8.3 Removing Allowed MUs

The *Allowed Mobile Units* screen provides a facility to remove MUs from the ACL.

1. Highlight the entry using the UP/DOWN-ARROW keys.
2. Press `Delete - [F1]`.

2.8.4 Enable/Disable the ACL

To switch between enable or disable locate the ACL in the *System Configuration* screen.

1. Select *Set System Configuration* from the *Main Menu*.
2. Press TAB to select `Access Control`.
3. Press SPACE BAR to `Enable`.
4. Select Save to save changes.

2.8.5 Removing All Allowed MUs

The AP provides a facility to remove all MUs from the ACL.

1. Select *Special Functions* from the *Main Menu*.
2. Select *Clear ACL*.

2.8.6 Load ACL from MU List

This option from the *Special Functions* menu takes all associated MUs and creates an ACL from them. This builds an ACL without having to manually type addresses. Edit the ACL using the add and delete functions.

1. Select *Special Functions* from the *Main Menu*.
2. Select *Load ACL* from MU List to add addresses of associated MUs to the ACL.

2.9 Configuring Address Filtering

The AP can keep a list of MAC addresses of the MUs not allowed to associate with it. The *Disallowed Addresses* option provides security by preventing unauthorized access by known devices. Use it for preferred association of MUs to APs. The maximum number of entries is 512 if no entries have been made for the ACL. 512 is the number of entries available to both ACL and Disallowed Address Filtering entries.

- Select *Set Address Filtering* from the *Main Menu* to display:

```
Symbol Access Point
                              Disallowed Addresses

ØØ:AØ:F8:FØ:ØØ:ØA              ØØ:AØ:F8:FF:FF:C7
ØØ:AØ:F8:FØ:ØØ:Ø1              ØØ:AØ:F8:FF:FF:89
ØØ:AØ:F8:FE:1Ø:Ø1
ØØ:AØ:F8:FØ:Ø3:ØA
ØØ:AØ:F8:FØ:Ø3:A1
ØØ:AØ:F8:BØ:AØ:Ø9
ØØ:AØ:F8:F1:A2:Ø8
ØØ:AØ:F8:FØ:Ø8:Ø8
ØØ:AØ:F8:F2:Ø6:Ø1
ØØ:AØ:F8:F2:ØB:Ø2
ØØ:AØ:F8:F2:ØC:Ø4
ØØ:AØ:F8:FØ:Ø4:Ø1
ØØ:AØ:F8:F4:Ø3:Ø2
ØØ:AØ:F8:FØ:Ø7:ØC
ØØ:AØ:F8:FØ:ØC:Ø7
ØØ:AØ:F8:F1:21:3Ø
ØØ:AØ:F8:FØ:2Ø:A1
ØØ:AØ:F8:FØ:AØ:Ø3
ØØ:AØ:F8:FØ:Ø9:ØB

Delete-[F1]   Add-[F2]   Next-[F3]   Save All APs-[F3]   Exit-[ESC]
```

2.9.1 Adding Disallowed MUs

The *Disallowed Addresses* screen provides a facility to add MUs to the list:

1. Select Add -[F2]. The AP prompts for a MAC address.
   `ØØ:ØØ:ØØ:ØØ:ØØ:ØØ`
2. Enter the MAC address.

Users can enter MAC addresses without colons.

2.9.2 Removing Disallowed MUs

The *Disallowed Addresses* screen provides a facility to remove MUs from the list:

1. Highlight the MAC address using the UP/DOWN-ARROW keys.
2. Select `Delete-[F1]` to delete the MAC address.

2.10 Configuring Type Filtering

Packet types supported for the type filtering function include the 16-bit DIX Ethernet types. The list can include up to 16 types.

2.10.1 Adding Filter Types

The Type Filtering screen provides a facility to add types to the list.

1. Select `Add-[F2]`.
2. Enter the packet type.

2.10.2 Removing Filter Types

The *Type Filtering* screen provides a facility to remove types from the list.

1. Highlight the packet type using the UP/DOWN-ARROW keys.
2. Select `Delete`.

2.10.3 Controlling Type Filters

Set the type filters to forward or discard the types listed. To control the type filtering mode:

1. Select *Set System Configuration* from the *Main Menu*.
2. Select *Type Filtering*.
3. Press the SPACE BAR to toggle between the `Forward`, `Discard` or `Disable` type filtering and press `ENTER` to confirm the choice.
4. To save the *Type Filtering Setup* information to all APs with the same Net_ID (ESS), select `Save ALL APs-[F2]`. Users can perform this option only among the same hardware platforms and firmware versions.

Users can only enable one type filtering option at a time.

2.11 Clearing MUs from the AP

Clear the MU association table for diagnostic purposes. Clear MUs from the AP if the AP has many MU associations no longer in use. Use this option to ensure that MUs associating with the AP are active.

To clear MUs associated with the AP:

1. Select *Special Functions* from the *Main Menu*.
2. Select *Clear MU Table*. The AP removes the MUs associated with it. MUs cleared from the AP try to reassociate with the AP or another nearby AP.

2.12 Setting Logging Options

The event log kept by the AP depends on settings for logging options. This allows the administrator to log important events. This option keeps the log concise through the 128-entry circular buffer.

1. Select *Set Event Logging Configuration* from the *Main Menu* to display:

```
Symbol Access Point

                        Event Logging Configuration


                      .Any Event Logging        Enabled

                      .Security Violations      Enabled
                      .MU State Changes         Enabled
                      .WNMP Events              Disabled
                      .Serial Port Events       Enabled
                      .AP-AP Msgs               Enabled
                      .Telnet Logins            Enabled
                      .System Events            Enabled
                      .Ethernet Events          Disabled


   OK-[CR]       Save-[F1]      Save ALL APs-[F2]         Cancel-[ESC]
```

2. Set *Any Event Logging* to `Enabled` to log all events. Specify the events that do not require logging when disabling *Any Event Logging*. Use SPACE BAR or LEFT/RIGHT-ARROW keys to toggle between *Enabled* and *Disabled*:

Any Event Logging	Logs all events listed in the screen.
Security Violations	ACL filter or administrative password access violations.
MU State Changes	Allows logging all MU state changes.
WNMP Events	WNMP events such as MUs using WNMP.
Serial Port Events	Serial port activity.
AP-AP Msgs	AP to AP communication.
Telnet Logins	Telnet sessions for monitoring and administration.
System Events	Internal use only.
Ethernet Events	Events such as packet transmissions and errors.

3. Verify the values reflect the network environment. Change them as needed.
4. To register settings select `OK` or `Save` to write changes to NVM. Selecting `Save` displays a confirmation prompt.
5. To save the *Event Logging Configuration* information to all APs with the same Net_ID (ESS), select `Save ALL APs-[F2]`.

   This option saves the configuration changes for the current AP, and sends two WNMP messages to all other APs on the *Known APs* table to update their configuration and reset after the configuration has been modified. Users can perform this option only among the same hardware platforms and firmware versions.
6. To disregard any changes made to this screen and return to the previous menu select `Cancel-[ESC]`.

2.13 Manually Updating AP Firmware

Options for manually updating the firmware:

- A TFTP host
- Any computer using the Xmodem file transfer protocol.

The files required for firmware updates are DSAP_FW.BIN and DSAP_HTM.BIN.

2.13.1 Update using TFTP

The Ethernet TFTP upgrade method requires a connection between the AP and PC on the same Ethernet segment. Verify the PC has a TFTP server running on it. Running the server requires third party software like FTP PC/TCP for DOS or OnNet™ for Windows. The wireless TFTP upgrade method requires a connection between the AP and a TFTP server. The TFTP server can be running on a Symbol Spectrum24 device.

Updating the firmware requires a TFTP server running in the background.

To update the AP firmware:

1. Copy the Firmware files DSAP_FW.BIN and DSAP_HTM.BIN on the terminal or PC hard disk.
2. Telnet to the AP using its IP address.
3. At the prompt type the password:

   ```
   Symbol
   ```

The password is case-sensitive. Set the *System Password* in the *Set System Configuration* screen.

   The AP displays the *Main Menu*.
4. Select *Special Functions* from the *Main Menu*.
5. Select *Alter Filename(s)/HELP URL/TFTP* and press ENTER.
6. Enter the firmware file-name in the *Download Filename* field:

Change this only if the user or system/network administrator requires a new file-name. The defaults are DSAP_FW.BIN and DSAP_HTM.BIN.

```
dsap_fw.bin or dsap_htm.bin
```

Ensure the file name is DSAP_FW.BIN and DSAP_HTM.BIN unless the user changed the file-name.

Verify the path for the file name is accurate. (See step one)

7. Enter the TFTP Server IP address in the *TFTP Server* field.
8. Press ENTER.
9. Select *Save Configuration* to save settings.

If using telnet to connect to the AP via an Ethernet interface, do not use the *Use XMODEM to Update Access Point's Firmware* option. This option causes the AP to reset and look for the firmware file over the serial interface.

10. Select *Special Functions* from the *Main Menu*.
11. Select *Use TFTP to Update Access Point's* and press ENTER.
12. "`Are you sure (Y/N)?`" Type "`y`".

The Telnet session ends when the user answers "`y`" at the prompt.

– The WIRED LAN ACTIVITY indicator on the AP does NOT flash.

To view the file transfer log, switch to the TFTP application.

The AP resets when the file transfer and FLASH programming completes.

13. Telnet to the AP using its IP address.
14. At the prompt type the password:

    `Symbol`

The password is case-sensitive.

The AP displays the *Main Menu*.

15. Verify the accuracy of the version number on the *System Summary* screen.
16. Press CTRL+D to end Telnet session.
17. Repeat process for other APs in the network.

2.13.2 Updating using Xmodem

The Xmodem upgrade method requires a direct connection between the AP and PC using a Null modem serial cable and using software like HyperTerminal for Windows 95. Xmodem supports file transfers between terminal emulation programs and the AP UI.

Xmodem transfers require more time than TFTP transfers.

To update the AP firmware:

1. Copy the firmware files DSAP_FW.BIN and DSAP_HTM.BIN to the PC hard disk that runs a terminal emulation program.
2. Attach a null modem serial cable from the AP to the PC serial port.

3. On the PC, start the communication program.
4. Name the session *Spectrum24 AP* and select **OK**.

The procedure described below is for Windows 98.

5. Select the correct communication port, typically **Direct to Com1**, along with the following parameters:

emulation	ANSI
baud rate	19200 bps
data bits	8
stop bits	1
parity	none
flow control	none

6. Select **OK**.
7. Press ENTER to display the *Main Menu*.
8. Select *Enter Admin Mode* and type the password:

   `Symbol`

The password is case-sensitive.

9. Enter the *Special Functions* screen.
10. Under the function heading *Use XMODEM to Update Access Point's*, select `Firmware`, `HTML` or `Both`.
11. Press ENTER.


Note

Selecting `Both` downloads the files DSAP_FW.BIN and DSAP_HTM.BIN files separately. Ensure both files are located in the same directory before the download begins.

12. At the confirmation prompt, press `Y` to display:

```
Downloading firmware using XMODEM.
Send firmware with XMODEM now ...
```

    Where DSAP_FW.BIN and DSAP_HTM.BIN are the firmware files.


Caution

When using Xmodem, verify the accuracy of the file before a send. An incorrect file can render the AP inoperable.

13. From the emulation program menu bar, select **Transfer**.
14. Select the **Send File** command.
15. Select the **Browse** button and locate the file(s), DSAP_FW.BIN and DSAP_HTM.BIN.
16. Select the **XModem** protocol from the drop down list.
17. Click **Send**.
18. The terminal or PC displays the transfer process through a progress bar.
19. If downloading both the firmware and HTML files, the screen flashes:

```
Downloading HTML file using XMODEM.
Send HTML file with XMODEM now ...
```

    If downloading both files, repeat the steps beginning at step 13 to download the next file and avoid a transfer time-out error. If not, continue to step 20.

20. The download is complete when the UI displays:

```
Download Successful
Updating AP
Update Successful
```

If the firmware update fails, the UI displays an error code indicating the cause.

The AP automatically resets after all file transfers are completed.

- Exit the communication program to terminate the session.
- Repeat this process for other APs in the network.

2.14 Auto Upgrade all APs Via Messaging

The Update ALL Access Points option upgrades or downgrades the firmware of all associated APs with the same Net_ID (ESS) on the same subnet and includes all recognized hardware platforms regardless of firmware version. The initiating AP sends the correct file name for each Symbol platform. The initiating AP does not send update commands to non-Symbol platforms.

Users can find the specific APs that have firmware upgraded or downgraded on the *Known APs* screen. The time interval between the WNMP update firmware commands for updating each AP is 2 seconds. This interval prevents more than one AP from accessing the TFTP server and causing network congestion.

The Ethernet TFTP upgrade method requires a connection between the AP and PC on the same Ethernet segment. Verify the PC has a TFTP server running on it. Running the server requires third party software like FTP PC/TCP for DOS or OnNet™ for Windows.

The wireless TFTP upgrade method requires a connection between the AP and a TFTP server. The TFTP server can be running on a Symbol Spectrum24 device.

Updating the firmware requires a TFTP server running in the background.

To update the AP firmware:

1. Copy the Firmware files DSAP_FW.BIN and DSAP_HTM.BIN on the terminal or PC hard disk.
2. Telnet to the AP using its IP address.
3. At the prompt type the password:

   `Symbol`

The password is case-sensitive. Set the *System Password* in the *Set System Configuration* screen.

   The AP displays the *Main Menu*.
4. Select *Special Functions* from the *Main Menu*.
5. Select *Alter Filename(s)/HELP URL/TFTP Server* and press ENTER.
6. Type the firmware file-name in the *Download Filename* field:

   `dsap_fw.bin` or `dsap_htm.bin`

   Change this only if the user or system/network administrator requires a new file-name. The defaults are DSAP_FW.BIN and DSAP_HTM.BIN.

Ensure the file name is DSAP_FW.BIN and DSAP_HTM.BIN unless the user changed the file-name.

Verify the accuracy of the path for the file name. (See step one)

7. Type the TFTP Server IP address in the *TFTP Server* field.
8. Press ENTER.
9. Select *Save Configuration* to save settings.
10. Select *Special Functions* from the *Main Menu*.

11. Select *Use TFTP to update ALL Access Point's* and press ENTER.

    "`Are you sure (Y/N)?`" is displayed. Type "`y`".

    The Telnet session ends when the user answers "`y`" at the prompt.


Note

To view the file transfer log, switch to the TFTP application.

    The AP resets when the file transfer and FLASH programming completes.

12. Telnet to the AP using its IP address.
13. At the prompt type the password:

    `Symbol`


Note

The password is case-sensitive.

    The AP displays the *Main Menu*.

14. Verify the accuracy of the version number on the *System Summary* screen.
15. Press CTRL+D to end the Telnet session.

2.15 Performing Pings

An access point sends a ping packet to an MU and waits for a response. Use pings to evaluate signal strength between two stations. The other station can exist on any AP interface.


Note

This ping operates at the MAC level and not at the *ICMP (Internet Control Message Protocol)* level.

No pings returned or fewer pings returned than sent can indicate a communication problem between the AP and the other station.

To ping another station:

1. Select the *Show Mobile Units* screen from the *Main Menu* to display:

```
Symbol Access Point
                          MAIN MENU
   Show System Summary                AP Installation
   Show Interface Statistics          Special Functions
   Show Forwarding Counts             Set System Configuration
   Show Mobile Units                  Set RF Configuration
   Show Known APs                     Set Serial Port Configuration
   Show Ethernet Statistics           Set Access Control List
   Show RF Statistics                 Set Address Filtering
   Show Misc. Statistics              Set Type Filtering
   Show Event History                 Set SNMP Configuration
   Enter Admin Mode                   Set Event Logging Configuration
   Regular   Home Agent   Foreign Agent
```

2. Select *Regular* from the *Show Mobile Units* screen to display:

```
Symbol Access Point
                          Mobile Units

 ØØ:AØ:F8:29:C9:E2: C:R11:E
 ØØ:AØ:F8:1Ø:4B:AB: P:R11:
 ØØ:aØ:F8:1Ø:4A:13: P:R11:
 ØØ:AØ:F8:1Ø:3C:85: C:R11:



    Information-[CR]    Echo-[F1]    Timed-[F2]    Next-[F3]    Exit-[ESC]
```

Select TAB to highlight the MAC address of the station, and press the [F1] key to display the *Echo Test* screen:

```
                          Echo Test

Station Address      ØØ:AØ:F8:1Ø:4A:13
Number of Requests     1Ø
Packet Length          1Ø
Packet Data            55


                [Start-CR]          [Cancel-ESC]

Enter the MAC address of the station to echo
```

1. Enter the number of echo requests (1 to 539), length of packets in bytes (1 to 539) and data content in hex (0x00 to 0xFF).
2. Select *Start-[CR]* to begin. The AP dynamically displays packets transmitted and received:

```
                  Echo Test in Progress...


          Station Address         ØØ:AØ:F8:1Ø:4A:13
          Requests Transmitted    1
          Responses Received      1


                  Press any key to stop
```

2.16 Mobile IP Using MD5 Authentication

Users can achieve authentication by using the *MD5 algorithm* with a shared key configured into the AP and its MU. MD5 is *a message-digest algorithm* that takes an arbitrarily long message and computes a fixed-length digest version, consisting of 16 bytes (128 bits), of the original message. Users can think of the message-digest as a *fingerprint* of the original message. Since the message-digest is computed using a mathematical formula or algorithm, the probability of an entity reproducing the message-digest is equivalent to two people having the same fingerprints. The message-digest is the authentication checksum of a message from a mobile MU to an AP during the Home Agent registration process. The MD5 algorithm purpose, therefore, prevents an MU from impersonating an authenticated MU.

2.17 Saving the Configuration

The AP keeps only saved configuration changes after a reset. To make configuration changes permanent, save changes as needed.

To save all changes:

- Press F1 in the configuration screens displaying the `Save` option.

OR complete the following procedure:

1. Select *Special Functions* from the *Main Menu* to display:

```
Symbol Access Point
                            Special Functions Menu

   Clear All Statistics     Use TFTP to update Access Point's:
   Clear MU Table             Firmware   HTML file   BOTH
   Clear ACL
   Clear Address Filters    Use XMODEM to update Access Point's:
                              Firmware   HTML file   BOTH
   Load ACL from MU List
                            Use TFTP to update ALL Access Points':
   Modem Dialout              Firmware   HTML file
   Modem Hangup
                            Alter Filename(s)/HELP URL/TFTP Server/DHCP
   Reset AP                   .Firmware Filename dsap_fw.bin
                              .HTML Filename     dsap_htm.bin
   Run MKK Tests              .HELP URL http://157.233.68.00/Spectrum24WebHelp
                              .TFTP Server       157.235.99.236
   Restore Factory Config.
   Save Configuration         Save All APs
   Save Config. to All APs


                                 Exit-[ESC]
```

2. Select *Save Configuration* and press `ENTER`.

   The `Save All APs` function saves only the five preceding items. The function does not save other configuration parameters when selected. Users can perform this option only among the same hardware platforms and firmware versions.

   The NVRAM stores saved configuration information. To clear the NVRAM-stored configuration, see *2.19 Restoring the Factory Configuration* on page 82.

2.18 Resetting the AP

Resetting an AP clears statistics and restores the last saved configuration. If users make unsaved changes, the AP clears those changes and restores the last saved configuration on reset.

- Select *Special Functions* from the *Main Menu*.
- Select *Reset AP*.

The AP flashes its LEDs as if powering up and returns to a STATUS-flashing state.

2.19 Restoring the Factory Configuration

If the AP fails to communicate due to improper settings, restore the factory configuration defaults. Restoring configuration settings clears all configuration and statistics for the AP.

To restore factory configuration:

1. Select *Special Functions* from the *Main Menu*.
2. Select *Restore Factory Configuration*. The AP erases all configuration information and replaces it with the factory configuration.


Note

When the factory configuration is restored, the ACL list is not erased.

Chapter 3 Monitoring Statistics

The AP keeps statistics of its transactions during operation. These statistics indicate traffic, transmission success and the existence of other radio network devices. Clear statistics as needed.

3.1 System Summary

The *Show System Summary* screen displays information about the APs configuration.

To view information about the AP configuration:

1. Select *Show System Summary* from the *Main Menu* to display:

```
Symbol Access Point
                            System Summary

 Unit Name          Symbol Access Point
 MAC Address (BSS)  00:A0:F8:73:51:F2     Access Control    Disabled
 IP Address         157.235.95.225
 Net_ID (ESS)       CA2
                                          Model Number      DSAP
                                          Serial Number     (S)F559123
 Channel               3                  Hardware Revision Rev 2
 Country            United States
 Antenna Selection  Diversity On           AP Firmware Ver.  d1.00-00
                                          RF Firmware Ver.  Vo. 96.00
                                           HTML File Ver.    00.03

 Current MUs           0
 Total Assoc           4

 System Up Time      47:47:23


                                  Exit-[ESC]
```

2. Configure the AP system settings as required:

Unit Name	Identifies the AP name.
MAC Address (BSS)	Identifies the unique 48-bit, hard-coded Media Access Control address.
IP Address	Identifies the network-assigned Internet Protocol address.
Net_ID (ESS)	Identifies the unique 32-character, alphanumeric, case-sensitive network identifier.
Channel	Identifies the direct-sequence channel used by the access point. The channel used is within the range required for the operating country.
Country	Identifies AP country code that in turn determines the AP direct-sequence channel range.
Antenna Selection	Indicates if the AP is configured for single or dual antenna mode.
Rate control	Defines the rate used by the AP to transmit data: • 5.5 & 11 Mbps - Optional • 1 & 2 Mbps - Required
Current MUs	Specifies the current number of associated MUs.
Total Assoc	Specifies the total MU associations handled by this AP.
System Up Time	Specifies how long the system has been operational. System Up Time resets to zero after a 119, 304 hours.
Access Control	Specifies if the access control feature is enabled or disabled. If enabled, the ACL specifies the MAC addresses of the MUs that can associate with this AP.
Model Number	Identifies the model number.
Serial Number	States the APs unique identifier.
Hardware Revision	Specifies the hardware version.
AP Firmware Ver	Specifies the firmware version.

3. Press ESC to return to the previous menu.

3.2 Interface Statistics

The *Interface Statistics* screen provides:

- packet forwarding statistics for each interface (Ethernet, PPP, RF)
- performance information for each interface in packets per second (PPS) and bytes per second (BPS).

The AP interface indicates packets sent to the AP protocol stack (e.g. configuration requests, SNMP, Telnet).

- Select *Interface Statistics* from the *Main Menu* to display:

```
 Symbol Access Point              Interface Statistics

-------------------- Interface Counts -----------------------

               Packets     Packets       Bytes       Bytes
                Sent        Rcvd         Sent        Rcvd

 Ethernet         14Ø66          Ø     126Ø844          Ø
 PPP                 Ø          Ø           Ø          Ø
 RF                  Ø          Ø           Ø          Ø
 AP              13975          Ø     1257750          Ø

------------------- Interface Rates -----------------------

                 PPS         PPS         BPS         BPS
                 Sent        Rcvd        Sent        Rcvd

 Ethernet            Ø          Ø           Ø          Ø
 PPP                 Ø          Ø           Ø          Ø
 RF                  Ø          Ø           Ø          Ø
 AP                  Ø          Ø           Ø          Ø

        Refresh-[F1]        Timed-[F2]          Exit-[ESC]
```

  - To update the values manually, select `Refresh` at the status display.
  - To have the AP automatically update the display every two seconds select `Timed`.
  - To return to the previous menu press ESC.

3.3 Forwarding Counts

Forwarding Counts provides information on packets transmitted from one interface to another (Ethernet, PPP, radio, AP). Forwarding Counts also displays the broadcast packets (Bcast) transmitted from the AP.

- Select *Forwarding Counts* from the *Main Menu* to display:

```
Symbol Access Point
                      Forwarding Counts

- From -            ------------ To -----------------
             Ethernet         PPP          RF          AP

Ethernet              Ø          Ø          Ø          Ø
PPP                   Ø          Ø          Ø          Ø
RF                    Ø          Ø          Ø          Ø
AP                    Ø          Ø          Ø          Ø
Bcast             14Ø85      14Ø85          Ø          Ø



        Refresh-[F1]       Timed-[F2]         Exit-[ESC]
```

  - To update the values manually, select `Refresh` at the status display.
  - To have the AP automatically update the display every two seconds select `Timed`.
  - To return to the previous menu press ESC.

3.4 Mobile Units

Mobile Units statistics provide information on MUs associated with the AP. The statistics include information on data sent and received, activity and association. An MU shows only in the *Home/Foreign Agent Table* screens when an MU has roamed to another AP on a different subnet. Once an MU has roamed, the MU *IP Address* displays on the *Home Agent Table* screen of the MU "home" AP with the IP Address of the *Foreign Agent* to tell the "home" AP where to forward packets.

The MU IP Address is also shown in the *Foreign Agent Table* and *Regular* screens of the new "foreign" AP to tell the new AP where to expect packets from for newly associated MUs. The AP Regular screen shows the MUs associated locally on the same subnet.

- Select *Show Mobile Units* from the *Main Menu* to display:

```
Symbol Access Point
                              MAIN MENU
   Show System Summary                AP Installation
   Show Interface Statistics          Special Functions
   Show Forwarding Counts             Set System Configuration
   Show Mobile Units                  Set RF Configuration
   Show Known APs                     Set Serial Port Configuration
   Show Ethernet Statistics           Set Access Control List
   Show RF Statistics                 Set Address Filtering
   Show Misc. Statistics              Set Type Filtering
   Show Event History                 Set SNMP Configuration
   Enter Admin Mode                   Set Event Logging Configuration
   Regular   Home Agent   Foreign Agent
```

Use the TAB or arrow keys to highlight the desired screen. Press ENTER to display the selected screen.

- Select *Regular* from the *Mobile Units* prompt to display:

```
Symbol Access Point          Mobile Units


00:A0:F8:29:C9:E2: C:R11:
00:A0:F8:10:4A:13  P:R11:


Information-[CR]    Echo-[F1]    Timed-[F2]    Next-[F3]    Exit-[ESC]
```

The display shows the currently associated MUs listed by MAC address. The list appears as follows:

```
addr [p:i:#:e:V]
```

Where:

addr	MU MAC address in xx:xx:xx:xx:xx:xx format
p	MUs power mode: P for PSP, C for CAM. An unassociated MU does not display any character.
i	MU location on AP interfaces. R for radio, P for PPP. MUs with an A were associated with the AP in the past, but no longer associate with it at time of verifying status.
#	AP current Radio transmit rate for the messages sent to this MU: 11 for 11 Mbps.
e	Encryption is enabled for this device.
V	Indicates a Symbol Voice enabled device.

- To bring up the *WNMP Packet Ping Function* screen, press TAB to highlight the MU and select `Ping`. This allows the AP to ping an MU. See *2.15 Performing Pings* on page 77.
  - to have the AP automatically update the display every two seconds select `Timed`
  - to display the next screen select `Next`
  - to return to the previous menu press ESC

- To bring up detailed information on an MU, press TAB to highlight the MU and select `Information` to display:

```
Symbol Access Point

                    Information for MU:  ØØ:AØ:F8:29:C9:E2


 Interface             RF             Packets Sent              62Ø
 State                 Associated     Packets Rcvd              237
 Power Mode            CAM            Bytes Sent             899879
 Station id            1              Bytes Rcvd              143ØØ
 Begin Current Assoc   16:37:51       Discard Pkts/CRC          Ø
 Supported Rates       1, 2, 5.5 & 11 Mb/s
 Current Xmt Rate      5.5 Mb/s       Last Activity          Ø:ØØ:11
 Priority              Normal         Last Data Activity     16:37:14
 Encryption            Off

                 Refresh-[F1]                  Exit-[ESC]
```

Displayed information includes:

Interface	the AP interface shows the MU connection (RF, Ethernet, PPP or AP)
State	the connection state between the AP and the MU: • *Host* indicates the unit is on the AP or PPP interface • *Associated* indicates the current association on the radio interface • *Away* indicates the unit is no longer associated with the AP.
Power Mode	the MU power mode (CAM, PSP or N/A)
Station ID	the IEEE 802.11 specification requires that each AP assign a station ID to all associated MUs, regardless of the MU power mode (PSP or CAM)
Begin Current Assoc	the time the current association begins in hours, minutes and seconds

Supported Rates	data transmission rates the station supports
Current Xmt Rate	the current rate the AP transmits data to the station
Encryption	MU encryption type supported: *Open* or *Shared*.
Packets Sent	the packets sent by the AP to the MU
Packets Rcvd	the packets received by the AP from the MU
Bytes Sent	the bytes sent by the AP to the MU
Bytes Rcvd	the bytes received by the AP from the MU
Discard Pkts/CRC	the packets discarded because of data error
Last Activity	the time in hours, minutes and seconds since the last communication with the MU
Last Data Activity	the time in hours, minutes and seconds since the last data transfer

- To update the values manually, select the `Refresh` command at the status display.
- To return to the previous menu, press ESC.

3.5 Mobile IP

The following tables display the mapping of MUs to mobility agents. See *1.3.7 Mobile IP* on page 20.

- Select *Home Agent* from the *Mobile Units* prompt to display:

```
Symbol Access Point
                              Home Agent Table
   Mobile Unit       Foreign Agent       Mobile Unit       Foreign Agent
 157.235.95.184     157.235.96.141
 157.235.95.111     157.235.97.157
 157.235.95.125     157.235.96.141
 157.235.95.34      157.235.93.245



    Refresh-[F1]        Timed-[F2]        Next-[F3]        Exit-[ESC]
```

- Select *Foreign Agent* from the *Mobile Units* prompt to display:

```
Symbol Access Point
                                 Foreign Agent Table
  Mobile Unit        Home Agent         Mobile Unit        Home Agent
157.235.95.184     157.235.95.18Ø
157.235.95.125     157.235.95.18Ø
157.235.97.114     157.235.97.27



   Refresh-[F1]        Timed-[F2]        Next-[F3]        Exit-[ESC]
```

3.6 Known APs

The AP displays a list of the known APs derived from AP-to-AP communication. The list includes the MAC and IP addresses and configuration information for each AP. The first AP on the list provides the information. The AP recognizes other APs listed in subsequent lines. A broadcast message to APs every 12 seconds determines this list.


Note

The `Save All APs` function from the *Special Functions Menu* updates configures all APs firmware, HTML code shown in the *Known APs* menu. Users can perform this option only among the same hardware platforms and firmware versions.

- Select *Known APs* from the *Main Menu* to display:

```
Symbol Access Point              Known Access Points

                                Net_ID:        1Ø1
MAC Address        IP Address        CH  HST  HSQ  MUS  KBIOS     FW_Ver     Away

ØØ:AØ:F8:ØØ:B8:B9  157.235.1Ø1.45     3   -    -    Ø   d1.ØØ-ØØ  Ø4.Ø1-13
ØØ:AØ:F8:78:9D:E3  157.235.1Ø1.46     -   1   19    Ø   Ø4.Ø1-17


  Echo-[F1]      Delete-[F2]      Next-[F3]      Previous-[F4]     Exit-[ESC]
```

The AP displays for each known AP:

MAC Address	the unique 48-bit, hard-coded Media Access Control address, known as the devices station identifier
IP Address	the network-assigned Internet Protocol address
DS Channel	The direct-sequence channel used by the AP.
MUS	The MUs associated with the AP.
KBIOS	The data traffic handled by the AP in kilobytes in and out per second
FW_Ver	the firmware version used by the specified AP
Away	Determines if the AP functions as a part of the network or *away*. Away indicates the last known transmission took place 12 or more seconds.

3.7 Ethernet Statistics

The AP keeps Ethernet performance statistics including packet transmission and data retries until reset.

- Select *Ethernet Statistics* from the *Main Menu* to display:

```
Symbol Access Point     Ethernet Statistics

 Packets Seen                    Ø     Packets Sent             138
 Packets Forwarded               Ø     Any Collisions             Ø
   Discarded/NoMatch             Ø     1 + Collisions             Ø
   Discarded/Forced              Ø     Maximum Collisions         Ø
   Discarded/Buffer              Ø     Late Collisions            Ø
   Discarded/CRC                 Ø     Defers                     Ø

 Broadcast/Multicast             Ø
 Individual Address              Ø



          Refresh-[F1]        Timed-[F2]          Exit-[ESC]
```

Packet display for Ethernet statistical units:

Packets Seen	packets received on Ethernet interface
Packets Forwarded	packets forwarded from Ethernet interface to other interfaces
Discarded/NoMatch	packets discarded because of unknown destinations (destinations not in the known list of database entries)
Discarded/Forced	packets discarded because of the applied address filters
Discarded/Buffer	packets discarded because insufficient buffers in AP
Discarded/CRC	packets discarded because of data errors
Broadcast/Multicast	total broadcast or multicast packets received
Individual Address	packets received with designated individual addresses
Packets Sent	total packets sent out
Any Collision	packets affected by at least one collision
1 + Collisions	packets affected by more than one collision
Maximum Collisions	packets affected by the maximum number of collision
Late Collisions	collisions occurring after the first 64 bytes
Defers	the times the AP had to defer transmit requests on the Ethernet because of a busy medium

- To update the values manually at the status display select `Refresh`.
- To have the AP automatically update the display every two seconds select `Timed`.
- To return to the previous menu press ESC.

3.8 Radio Statistics

The AP keeps radio performance statistics including packet and communication information.

To view RF statistics:

- Select *Show RF Statistics* from the *Main Menu* to display:

```
Symbol Access Point
                              RF Statistics

 Data Pkts Sent                  Ø     Data Pkts Rcvd               494
 Data Bytes Sent                 Ø     Data Bytes Rcvd            36524

 BC/MC Packets Sent             28     BC/MC Packets Rcvd            23
 BC/MC Bytes Sent             29Ø4     BC/MC Bytes Rcvd               Ø

 Sys Packets Sent                5     Sys Packets Rcvd               Ø
 SBC/MC Packets Sent          1412Ø     SBC/MC Packets Rcvd          52Ø

 Succ Frag Packets               Ø     Succ Reass Packets             Ø
 UnSucc Frag Packets             Ø     UnSucc Reass Packets           Ø
 Fragments Sent                  Ø     Fragments Rcvd                 Ø

 Packets w/o Retries             Ø     Rcv Duplicate Pkts             Ø
 Packets w/ Retries              Ø     Undecryptable Pkts             Ø
 Packets w/ Max Retries          Ø
 Total Retries                   Ø     Rcv CRC Errors                54
                                       Rcv ICV Errors                 Ø

          Refresh-[F1]    Timed-[F2]    Exit-[ESC]
```

Radio performance statistics include:

Data Packets Sent	total data packets transmitted
Data Bytes Sent	total data packets transmitted in bytes
BC/MC Packets Sent	broadcast/multicast user data packets successfully transmitted
BC/MC Bytes Sent	broadcast/multicast user data bytes successfully transmitted
Sys Packets Sent	system packets successfully transmitted
SBC/MC Packets Sent	broadcast/multicast system packets successfully transmitted
Succ Frag Packets	fragmented packets successfully transmitted
Unsucc Frag Packets	fragmented packets unsuccessfully transmitted
Fragments Sent	packet fragments transmitted
Packets w/o Retries	transmitted packets not affected by retries
Packets w/ Retries	transmitted packets affected by retries
Packets w/ Max Retries	transmitted packets affected by the maximum limit of retries
Total Retries	Retries occurring on the interface. A retry occurs if the device fails to receive an *acknowledgment (ACK)* from a destination.
Data Packets Rcvd	total data packets received
Data Bytes Rcvd	total data packets received in bytes
BC/MC Packets Rcvd	broadcast/multicast user data packets successfully received
BC/MC Bytes Rcvd	broadcast/multicast user data bytes successfully received
Sys Packets Rcvd	system packets successfully received
SBC/MC Packets Rcvd	broadcast/multicast system packets successfully received
Succ Reass Packets	packets successfully reassembled
Unsucc Reass Packets	packets unsuccessfully reassembled

Fragments Rcvd	packet fragments received
Rcv Duplicate Pkts	Duplicate packets received by the AP. This indicates the AP sent an ACK, but the MU did not receive it and transmitted the packet again.
Undecryptable Pkts	total data packets that could not be decrypted
Rcv CRC Errors	Packets received that contained *CRC (Cyclic Redundancy Check)* errors. An MU transmitted a corrupt data packet and failed to pass the CRC verification. Ensure that any acknowledgment of the data packet contains the correct CRC word. An incorrect CRC causes the AP to discard the data packet.
Rcv ICV Errors	Packets received containing *ICV (Identity Check Value)* errors. An MU transmitted a corrupt data packet and failed to pass the ICV verification. The calculated ICV value does not match with the ICV value in the received packet.

- To update the values manually at the status display select `Refresh`.
- To have the AP automatically update the display every two seconds select `Timed`.
- To return to the previous menu press ESC.

3.9 Miscellaneous Statistics

The AP keeps statistics on WNMP and SNMP packets, filtering violations and serial port use. The *Miscellaneous Statistics* screen shows grouped statistics.

- Select *Show Misc Statistics* from the *Main Menu* to display:

```
Symbol Access Point
                    Misc System Statistics

  WNMP                                Serial Port
    Echos                    Ø        Number of Dialouts        Ø
    Pings                    Ø        Dialout Failures          Ø
    Passthrough Echos        Ø        Number of Answers         Ø
                                      Current Call Time         Ø
  SNMP                                Last Call Time            Ø
    Requests                 Ø
    Traps                          Ø Mobile IP
                                       Agent Ad Sent            Ø
  Filters                              Reg. Request Rcvd         Ø
    ACL Violations           Ø         Reg. Reply Sent           Ø
    Address                  Ø
    type                     Ø      Per Frequency
                                    Retry Histogram



       Refresh-[F1]       Timed-[F2]         Exit-[ESC]
```

WNMP statistics include:

Echoes	echo requests received by the AP
Pings	ping requests received by the AP
Passthrough Echoes	echoes for MUs associated with the AP

SNMP statistics include:

Requests	configuration requests received from the SNMP manager
Traps	AP messages sent to the SNMP manager

Filter statistics include:

ACL Violations	attempts by MU, not in ACL list to associate with this AP
Address	packets discarded by address filter
Type	packets discarded by type filter

Modem statistics for the serial port include:

Number of Dialouts	dial-out attempts by the AP
Dialout Failures	dial-out failures by the AP
Number of Answers	answer attempts by the AP
Current Call Time	current connection session length in seconds
Last Call Time	last connection session length in seconds

Mobile IP statistics include:

Agent Ad Sent	number of agent advertisements sent from the AP
Reg Request Received	number of Mobile IP registration requests received
Reg Reply Sent	number of Mobile IP registration replies sent

- To update the values manually at the status display select `Refresh`.
- To have the AP automatically update the display every two seconds select `Timed`.
- To return to the previous menu press ESC.

3.9.1 Analyzing Frequency Use

The AP keeps statistics for individual frequencies (channels). These identify channels that have difficulty transmitting or receiving due to retries.

To view statistics for individual frequencies:

1. Select *Show Misc Statistics* from the *Main Menu*.
2. Select Per *Frequency Statistics* to display:

```
Chnl.      Sent      Rcvd     Retry
=====      ====      ====     =====
   1:         Ø         Ø         Ø
   2:         Ø         Ø         Ø
   3:        88        89         3
   4:         Ø         Ø         Ø
   5:         Ø         Ø         Ø
   6:         Ø         Ø         Ø
   7:         Ø         Ø         Ø
   8:         Ø         Ø         Ø
   9:         Ø         Ø         Ø
  1Ø:         Ø         Ø         Ø
  11:         Ø         Ø         Ø


                Press any key to continue
```

   The display shows counters for the packets sent, received and retries for each channel.

3. Press any key to continue.

3.9.2 Analyzing Retries

The AP keeps statistics of packets with multiple retries. Use these statistics to identify severe occurrences of retries. Retries occur when the transmitting station fails to receive an acknowledgment for a transmitted packet. This lack of acknowledgment can result from:

- two or more stations transmitting simultaneously and causing collisions
- the receiving station moving out of range
- the receiving station being powered off.

Any one of these results causes both devices to suspend transmitting and retry later. Too many retries can indicate a system problem.

To view retry severity:

1. Select *Show Misc Statistics* from the *Main Menu*.
2. Select *Retry Histogram* to display:

Retries	Packets
Ø	65795
1	32Ø
2	112
3	86
4	21
5	12
6	8
7	3
8	Ø
9	Ø
1Ø	1
11	Ø
12	Ø
13	Ø
14	Ø
15	Ø

   The display indicates the packets that experience retries (up to 15 retries).

3. Press any key to return to the *Main Menu*.

3.10 Event History

The AP tracks specific events. The types of events logged are configurable. The log is a 128-entry circular buffer. After the 128th entry, the earliest event entry deletes.

The *Event History* displays the most recent event at the top of the list. Each event lists a time stamp recorded in hh:mm:ss from the time the AP powered up or reset. The type of event logged follows the time stamp. If the event involves an MU or AP, the unit MAC address displays.

```
Symbol Access Point              Event History                          pg 2
       Warning: Event logging is frozen while this screen is displayed.


              Ø:Ø4:45  MU Assoc ØØ:AØ:F8:FF:FD:8Ø
              Ø:Ø2:45  MU Rm - Roam (adr) ØØ:AØ:F8:FF:FD:5D
              Ø:Ø1:5Ø  MU Assoc ØØ:AØ:F8:FF:FD:5D
              Ø:ØØ:19  Received AP Info from ØØ:AØ:F8:ØØ:C2:9C
              Ø:ØØ:14  Received AP Info from ØØ:AØ:F8:ØØ:C2:C2
              Ø:ØØ:ØØ  RF Initialized
              Ø:ØØ:ØØ  Ethernet Initialized
              Ø:ØØ:Ø2  Multitasker Initialized
              Ø:ØØ:ØØ  AP Driver Initialized
              Ø:ØØ:ØØ  Event Log Initialized


          Previous-[F3]          Next-[F4]          Exit-[ESC]
```

3.11 Clearing Statistics

To clear statistics:

1. Select *Special Functions* from the *Main Menu*.
2. Select *Clear All Statistics*. The AP zeroes all statistics.

Resetting the AP also clears statistics.

Chapter 4 Hardware Installation

AP installation includes connecting the AP to the wired network, AP placement and power up. Installation procedures vary for different environments.

4.1 Precautions

Before installing the AP verify the following:

- Do not install in wet or dusty areas without additional protection. Contact a Symbol representative for more information.
- Verify the environment has a temperature range between -20° C to 55° C.
- If attaching to a wired Ethernet, keep AP on the same subnet.

4.2 Package Contents

Check package contents for:

- AP
- power adapter

Contact the Symbol Support Center to report missing or improperly functioning items.

Verify the AP model indicated on the bottom of the unit and packaging.

4.3 Requirements

The minimum installation requirements for a single-cell, peer-to-peer network:

- a power outlet
- an AP antenna.

The AP supports a 10Base-T *unshielded twisted pair (UTP)* standard. Users can order a null-modem cable, part number 61383-00-0, for direct serial connections by contacting a Symbol sales representative.

Test and use the radio network with an MU.

4.3.1 Network Connection

Locate connectors for Ethernet and power on the back of the AP.

Ethernet configurations vary according to the environment. Determine the Ethernet wiring to connect the AP, 10Base-T UTP or single cell.

The site survey determines the number of APs to install and their location.

4.3.2 10Base-T UTP

Use a 10Base-T connection for an AP attached to a wired UTP Ethernet hub. Normal 10Base-T limitations apply.

1. Plug the data cable RJ-45 connector into the AP RJ-45 connector.
2. Plug the other end of the data cable into the LAN access port (possibly a hub or wall connection).

4.3.3 Single Cell

The single-cell connection option allows a single AP to bridge MUs without a wired network. MUs appear as peers as in any Ethernet environment.

4.4 Placing the AP

AP antenna coverage resembles lighting in that an area lit from far away might not be bright enough. An area lit sharply minimizes coverage and creates *dark areas* where no light exists. Even AP placement (like even placement of a light bulb) provides even, efficient coverage.

Place an AP using the following guidelines:

- Install the AP as high as practical
- Orient the AP vertically for best reception
- Point the AP antenna downward if attaching the AP to the ceiling.

The AP-4111 DS dual antenna assembly provides diversity that can improve performance and signal reception.

Symbol continues to add antenna options for Spectrum24 devices. Contact a Symbol sales representative for available antenna options.

4.5 Power Options

Standard 24 volt, 1 amp power supply Part Number: 50-24000-024
115/230VAC, 50/60Hz.

- US line cord Part Number: 23844-00-00

A Symbol BIAS-T system can also be used to combine low-voltage DC with Ethernet data in a single cable connecting to an access point. For information on the BIAS-T system, go to (www.symbol.com) and search for the BIAS-T low power distribution system.

4.6 Mounting the AP

The AP rests on a flat surface or attaches to a wall, or any hard, flat, stable surface. Use the standard-mounting kit provided with the Spectrum24 AP-4111 DS access point.

Choose one of the options based on environment

Resting flat	Rests on the four rubber pads on the underside of the AP. Place on a surface clear of debris and away from traffic.
Attaching on the wall	Rests on screws. Orient the AP in a downward position on the wall so the LEDs face the floor.

4.7 Connecting the Power Adapter

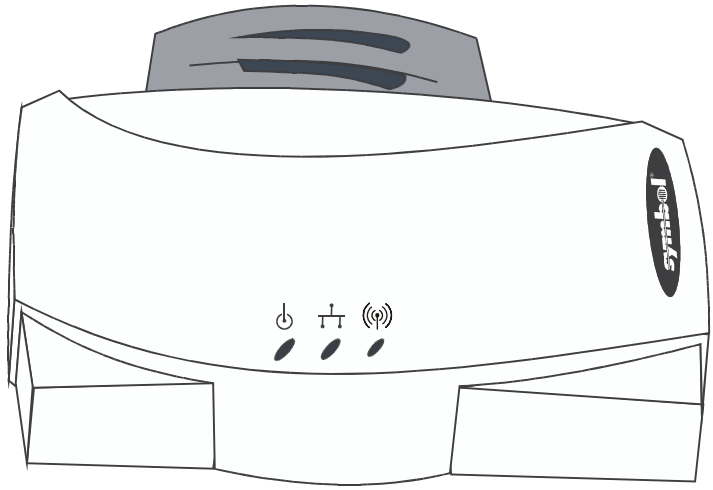
The power adapter connects to the rear of the AP and to a power outlet.

1. Verify the power adapter is correct according to the country.
2. Plug the power adapter cable into the socket at the back of the AP.
3. Plug the adapter into an outlet. The AP is functional when the Status indicator on the front of the AP reaches a consistent flashing and *the Wireless LAN Activity* indicator begins flickering. This indicates that the AP is ready for MUs to associate with it.

The AP works without user intervention after setup. See the AP LED indicators to verify that the unit operates properly.

4.8 LED Indicators

The top panel LED indicators provide a status display indicating transmission, and other activity. The indicators are:



	Power	Flashing indicates AP initialization. Steady Green during operation.
	Wired LAN Activity	Flashing indicates data transfers on wired connection.
	Wireless LAN Activity	Flickering indicates beacons and data transfers with MUs.

4.9 Troubleshooting

Check the following symptoms and their possible causes before contacting the Symbol Support Center.

4.9.1 Ensure wired network is operating

Verify AP operation:

1. AP does not power up:
   - faulty AP power supply
   - failed AC supply
   - *Electrical Management System (EMS)* operating outlet.
2. After the AP resets and hardware is initialized, it performs an SRAM test. If the test passes, the LEDs turn on. If the test fails, the LEDs all turn off and the AP resets. The LEDs turn off sequentially as each test passes.

Identify wired network problems:

1. No operation:
   - Verify AP configuration via Telnet, PPP or UI. Review procedures for Ethernet and serial connection of the AP. Review AP firmware revisions and update procedures.
   - Verify network configuration by ensuring that there are no duplicate IP addresses. Power down the device in question and ping the assigned address of the device. Ensure no other device responds to that address.
2. AP powered on but has no connection to the wired network:
   - Check connections for proper wiring.
3. Verify network wiring and topology for proper configuration:
   - Check that the cables used have proper pinouts and connectors.
   - Verify router configuration and filtration setting.
   - Check that network band use does not exceed 37% of bandwidth.
   - Verify MU operations.
   - Confirm AP operation.

- Confirm AP and MU Net_ID (ESS).
- Check that the radio driver loaded properly.
- Check that the MU PROTOCOL.INI or NET.CFG file is compatible with the network operating system.

4. Slow or erratic performance:
   - Check MU and RF communications range.
   - Check antenna, connectors and cabling.
   - Verify that antenna diversity setting for AP is appropriate. If using one antenna, the setting is `Primary Only`, if using both antennas, the setting is `Primary and Secondary`.
   - Verify network traffic does not exceed 37% of bandwidth.
   - Check to see that the wired network does not exceed 10 broadcast messages per second.
   - Verify wired network topology and configuration.

4.10 Setting Up MUs

Refer to MU documentation for installing drivers, client software and testing. Use the default values for the Net_ID (ESS) and other configuration parameters until network connection verification.

Appendix A

Specifications

A.1 Physical Characteristics

Dimensions	1.75″ H x 6″ L x 8.5″ W (4.45″ cm H x 15.24″ cm L x 21.59″ cm W)
Weight (w/power supply)	1 lbs. (0.454 kg)
Operating Temperature	-4° F to 131° F (-20° C to 55° C)
Storage Temperature	-40° F to 149° F (-40° C to 65° C)
Humidity	10% to 95% noncondensing
Shock	40 G, 11 ms, half-sine
ESD	meets CE-Mark
Drop	withstands up to a 30 in. (76 cm) drop to concrete with possible surface marring

A.2 Radio Characteristics

Frequency Range country dependent; within 2400 MHz to 2500 MHz

Frequency	*Allowed Channel Range*	*Country*
2412-2470	1-11	United States
2430-2447	5-8	Israel
2457-2463	10-11	Spain
2458-2472	10-13	France
2483-2485	14	Japan

Radio Data Rate	• 5.5 & 11 Mbps - Optional • 1 & 2 Mbps - Required
11 Mbps Range	open environment - over 100 ft. typical office or retail environment - 30 to 50 ft.
TX Max. Radiated EIRP	US: FCC part 15.247 Europe: ETS 300 320 Japan: RCR STD-33
Modulation	Binary GFSK
TX Out-of-Band Emissions	US: FCC part 15.247, 15.205, 15.209 Europe: ETS 300 320 Japan: RCR STD-33

A.3 Network Characteristics

Driver Support	NDIS v4.0 and v5.0
Ethernet Frame	DIX, Ethernet_II and IEEE 802.3
Filtering Packet Rate	14,400 frames per second filtering and forwarding
Ethernet Connection	10Base-T (RJ-45)
Serial	PC/AT serial port - DB9 Male, RS-232 using a DTE termination, 19200 bps
SNMP	Version 1, Symbol MIB, 802.11 MIB and MIB-II

Appendix B
Supported Modems

The AP uses Hayes commands and is capable of working with various modems of 19200 baud or faster.

Symbol does not support modems the company has not qualified.

The following modems qualify to work with the AP-4111 DS access point:

- US Robotics Faxmodem v.90.56K
- US Robotics Faxmodem v.33.6K
- US Robotics Faxmodem v.34 and v.32 bis Sportster 28.8K
- Diamond Supra Express 56K

Appendix C

Customer Support

Symbol Technologies provides its customers with prompt and accurate customer support. Use the Symbol Support Center as the primary contact for any technical problem, question or support issue involving Symbol products.

If the Symbol Customer Support specialists cannot solve a problem, access to all technical disciplines within Symbol becomes available for further assistance and support. Symbol Customer Support responds to calls by email, telephone or fax within the time limits set forth in individual contractual agreements.

When contacting Symbol Customer Support, please provide the following information:

- serial number of unit
- model number or product name
- software type and version number.

North American Contacts

Inside North America, contact Symbol by:

- Symbol Technologies, Inc.
  One Symbol Plaza
  Holtsville, New York 11742-1300
  Telephone: 1-516-738-2400/1-800-SCAN 234
  Fax: 1-516-738-5990
- Symbol Support Center:
  - telephone: 1-800-653-5350
  - fax: (516) 563-5410
  - Email: support@symbol.com

International Contacts

Outside North America, contact Symbol by:

- Symbol Technologies Technical Support
  12 Oaklands Park
  Berkshire, RG41 2FD, United Kingdom
  Tel: 011-44-118-945-7000 or 1-516-738-2400
  ext. 6213

Symbol Developer Program Web Site

http://sdp.symbol.com

Additional Information

Obtain additional information by contacting Symbol at:

- 1-800-722-6234, inside North America
- +1-516-738-5200, in/outside North America
- http://www.symbol.com/

Appendix D

Regulatory Addendum

To comply with U.S. and international regulatory requirements, the following information has been included. The document applies to the complete line of Symbol products. Some of the labels shown, and statements applicable to other devices might not apply to all products.

Radio Frequency Interference Requirements

This device has been tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of the Federal Communications Commissions Rules and Regulation. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

However, there is no guarantee that interference will not occur in a particular installation. If the equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Radio Frequency Interference Requirements - Canada

This Class A digital apparatus meets the requirements of the Canadian Interference-Causing Equipment Regulations.

CE Marking & European Union Compliance

CE

Products intended for sale within the European Union are marked with the CEMark which indicates compliance to applicable Directives and European Normes (EN), as follows. Amendments to these Directives or ENs are included: Normes (EN), as follows.

Applicable Directives:

- Electromagnetic Compatibility Directive 89/336/EEC
- Low Voltage Directive 73/23/EEC

Applicable Standards:

- EN 55 022 - Limits and Methods of Measurement of Radio Interference Characteristics of Information technology Equipment
- EN 50 082-1 - Electromagnetic Compatibility - Generic Immunity Standard, Part 1: Residential, commercial, Light Industry
- IEC 801.2 - Electromagnetic Compatibility for Industrial Process Measurement and Control Equipment Part 2: Electrostatic Discharge Requirements
- IEC 801.3 - Electromagnetic Compatibility for Industrial Process Measurement and Control Equipment Part 3: Radiated Electromagnetic Field Requirements
- IEC 801.4 - Electromagnetic Compatibility for Industrial Process Measurement and Control Equipment Part 4: Electrical Fast Transients Requirements
- EN 60 950 + Amd 1 + Amd 2 - Safety of Information Technology Equipment Including Electrical Business Equipment
- EN 60 825-1 (EN 60 825) - Safety of Devices Containing Lasers

RF Devices

Symbol's RF products are designed to be compliant with the rules and regulations in the locations into which they are sold and will be labeled as required. The majority of Symbol's RF devices are type approved and do not require the user to obtain license or authorization before using the equipment. Any changes or modifications to Symbol Technologies equipment not expressly approved by Symbol Technologies could void the user's authority to operate the equipment.

Telephone Devices (Modems)

United States

If this product contains an internal modem it is compliant with Part 68 of the Federal Communications Commission Rules and Regulations and there will be a label on the product showing the FCC ID Number and the REN, Ringer Equivalence Number. The REN is used to determine the quantity of devices which maybe connected to the telephone line. Excessive RENs on the telephone line may result in the device not ringing in response to an incoming call. In most but not all areas, the sum of the RENs should not exceed 5.0. To be certain of the number of devices that may be connected to the line, as determined by the total number of RENs, contact the telephone company to determine the maximum REN for the calling area.

If the modem causes harm to the telephone network, the telephone company will notify you in advance; however, if advance notice is not practical, you will be notified as soon as possible. Also, you will be advised of your right to file a complaint with the FCC if you believe it is necessary.

The telephone company may make changes in its facilities, equipment, operations or procedures that could affect the operation of the modem. If this happens the telephone company will provide advance notice so you may make any necessary modifications to maintain uninterrupted service.

Canada

If this product contains an internal modem it is compliant with CS-03 of Industry Canada and there will be a Canadian certification number (CANADA: _____) on a label on the outside of the product. This certification means that the equipment meets certain telecommunications network protective, operational and safety requirements. The Department does not guarantee the equipment will operate to the user's satisfaction.

Before installing this equipment, users should ensure that it is permissible to be connected to the facilities of the local telecommunications company. The equipment must also be installed using an acceptable method of connection. In some cases, the company's inside wiring associated with a single-line, individual service maybe extended by means of a certified convector assembly (telephone extension cord). The customer should be aware that compliance with the above conditions may not prevent degradation of service in some situations.

Repairs to certified equipment should be made by an authorized Canadian maintenance facility designated by the supplier. Any repairs or alterations made by the user to this equipment, or equipment malfunctions, may give the telecommunications company cause to request the user to disconnect the equipment.

User should ensure for their own protection that the electrical ground connections of the power utility, telephone lines and internal metallic water pipe system, if present, are connected together. This precaution may be particularly important in rural areas.


Caution

User should not attempt to make such connections themselves, but should contact the appropriate electric inspection authority, or electrician, as appropriate.

The Load Number (LN) assigned to each terminal device denotes the percentage of the total load to be connected to the telephone loop which is used by the device, to prevent overloading. The termination of a loop may consist of any combination of devices, subject only to the requirement that the total of the Load Numbers of all devices not exceed 100.

The Load Number is located on a label on the product.

Contact your local Symbol Technologies, Inc., representative for service and support;

Symbol Technologies, Inc.,
Canadian Sales and Service
2540 Matheson Boulevard East
Mississauga, Ontario
Canada L4W 4Z2
Phone - 905 629 7226

Laser Devices

Symbol products using lasers comply with US 21CFR1040.10, Subchapter J and IEC825/EN 60 825 (or IEC825-1/EN 60 825-1, depending on the date of manufacture). The laser classification is marked one of the labels on the product.

Class 1 Laser devices are not considered to be hazardous when used for their intended purpose. The following statement is required to comply with US and international regulations:

Use of controls, adjustments or performance of procedures other than those specified herein may result in hazardous visible or invisible laser light exposure.

Class 2 laser scanners use a low power, visible light diode. As with any very bright light source, such as the sun, the user should avoid staring directly into the light beam. Momentary exposure to a Class 2 laser is not known to be harmful.

Laser information labels are found in the product Quick Reference Guide.

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