Spectrum24
Access Point AP-302X

Product Reference Guide

INF-UAP-01
Revision A
September 2000

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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; 5,229,591; 5,230,088; 5,235,167; 5,243,655; 5,247,162; 5,250,791; 5,250,792; 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; 5,578,810; 5,581,070; 5,589,679; 5,589,680; 5,608,202; 5,612,531; 5,619,028; 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; 5,745,794; 5,754,587; 5,658,383; D305,885; D341,584; D344,501; D359,483; D362,453; D362,435; D363,700; D363,918; D370,478; D383,124; D391,250.

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
70-20135-02	Single High Performance Antenna (ML-2499-HPA-00)/Twin High Performance Diversity Antenna (ML-2499-DVA1-00)
70-20136-01	Mountable F-Plane Antenna (ML-2499-DSA1-00)

Users can find RFCs (Request For Comments) on the Web at: (http://www.kashpureff.org/nic/) or (http://www.rfc-editor.org/).

Croft, Bill and Gilmore, John, RFC 951 Bootstrap Protocol (BOOTP), September 1985.

Case, J., Fedor, M., Schoffstall, M. and Davin, J., RFC 1157 A Simple Network Management Protocol (SNMP), May 1990.

Rivest, R. and RSA Data Security, Inc., RFC 1321 The MD5 Message-Digest Algorithm, April 1992.

Droms, R., RFC 2131 Dynamic Host Configuration Protocol (DHCP), March 1997.

Tanenbaum, Andrew S., Computer Networks 3rd Edition, 1996 Prentice Hall PTR.

Solomon, James D., Mobile IP, The Internet Unplugged, 1998 Prentice Hall PTR.

Beyda, William J., Data Communications, From Basics to Broadband 2nd Edition, 1996 Prentice Hall PTR.

Shrader, Robert L., Electronic Communication 4th Edition, 1980 Mc Graw Hill.

802.11-1997, IEEE Standard for Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications, 1997 IEEE.

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 a given 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 time a term is used, a book title, variables, and menu titles.
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 types of 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 frequency-hopping, 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 large or small environments.

Spectrum24 features include:

- bridging architecture to provide communication between radio and wired multiple network segments
- a design based on the IEEE 802.11 standard
- a 2 Mbps data rate for fast operation
- seamless roaming for mobile users with devices such as laptop computers, wireless computers, scanning terminals and computer devices 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, scanners and third-party devices.

The AP provides 1 and 2 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
- a four-way bridging architecture (wireless, Ethernet, PPP, internal stack)
- wireless MAC interface
- 10base-T Ethernet port interface with full-speed filtering
- 100 mW and 500 mW radio versions
- power supply IEC connector and a country-specific AC power cable
- PC/AT Serial Port Interface
- built-in antenna diversity
- multiple antenna options
- support for 255 mobile units
- SNMP support
- Access Control List
- wireless AP support
- IEEE 802.1d Spanning Tree support
- Auto-Fallback to Wireless Mode
- enhanced SNMP MIB support
- DHCP support
- HTTP, Web server support
- Mobile IP support
- programmable SNMP Trap support using SNMP Agents
- data encryption
- wireless Options in Radio Parameters
- AP Auto Upgrade of other APs through messaging
- multiple gateways
- repeater functions.

An MU communicating with an AP appears on the network as a peer to other network devices. The wireless interface is transparent. The AP receives data from its wired or wireless interfaces and forwards the data to the proper interface.

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

The AP requires a single antenna for radio transmission and reception. The dual-antenna system allows the AP to select the best radio signal.

1.1.1 New Features

- Intelligent Queuing
- International Roaming.

1.2 Radio Basics

Spectrum24 uses *electromagnetic waves*, or radio signals, to transmit and receive information 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 devices use the *environment* (the air and certain objects) as the transmission medium. Spectrum24 radio devices use 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. The 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

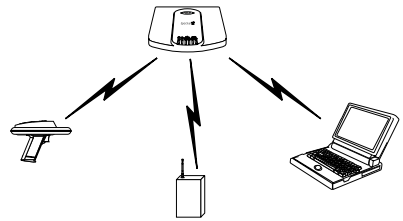
The variations possible in Spectrum24 network topologies depend on the following factors:

- the AP function in the network
- the data transfer rate
- the *wireless AP (WLAP)* interface.

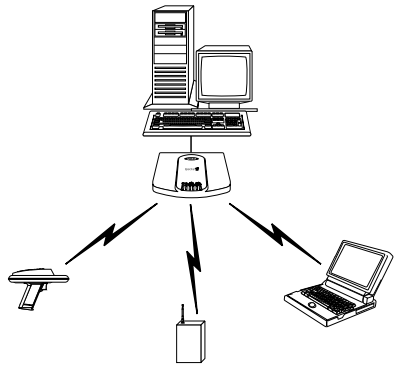
A WLAP communicates only with its root AP through the wireless interface as discussed in *The Root AP and Association Process* on page 18.

If the AP is not in wireless mode, select from the following topologies:

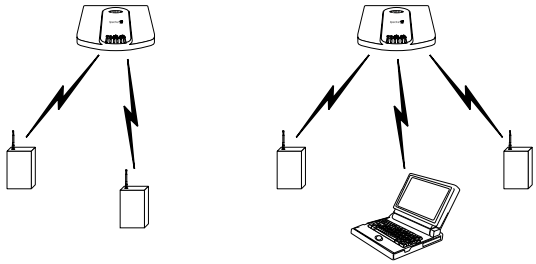
- A single AP used without the wired network provides a single-cell wireless network for peer-to-peer MUs.



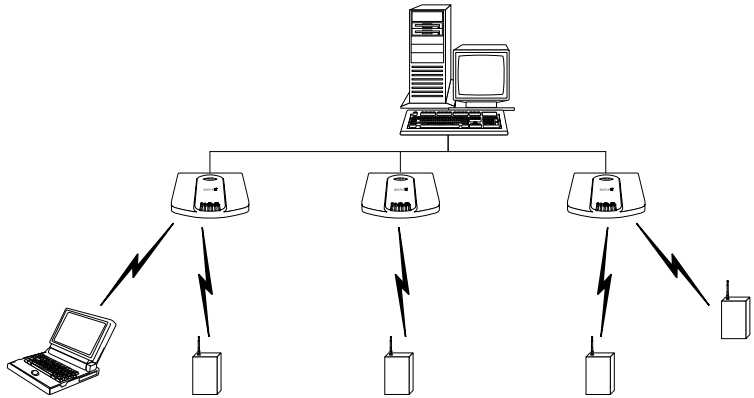
- A single AP can bridge the Ethernet and radio networks.



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



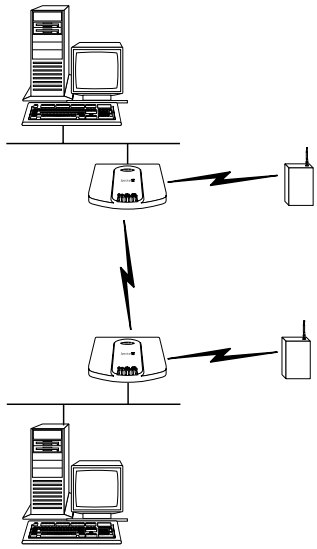
- Multiple APs wired together provide a network with better coverage area and performance.



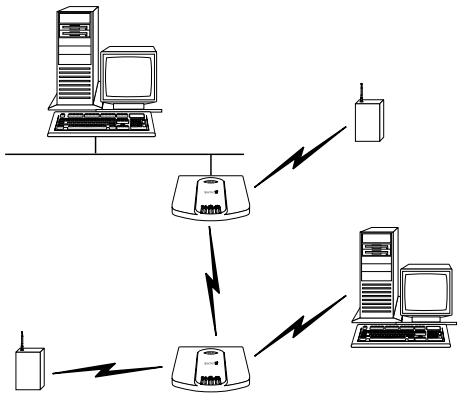
- Multiple 1 Mbps and 2 Mbps APs wired together.

In WLAP mode, a wireless AP-to-AP connection functions:

- as a bridge to connect two Ethernet networks



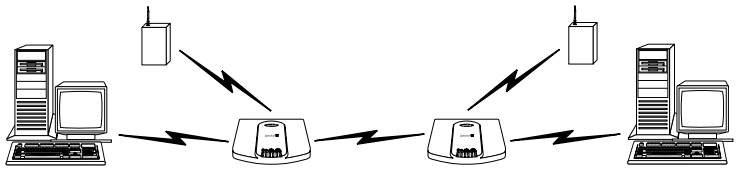
- as a repeater to extend coverage area without additional network cabling



Note

When using a wireless AP-to-AP connection, use the optimal antenna configuration for the site. For example, use a directional antenna when establishing a dedicated wireless bridge or repeater.

- A wireless AP network is possible, depending on the network bandwidth and configuration. Each wireless AP can have connections with up to four other wireless APs.



Using more than two WLAPs to establish a connection slows network performance for all topologies. If not using the AP *Auto Configure* feature, disable *WNMP Functions* and *AP-AP State Xchg* parameters under the *Set System Configuration* screen to increase WLAP performance.

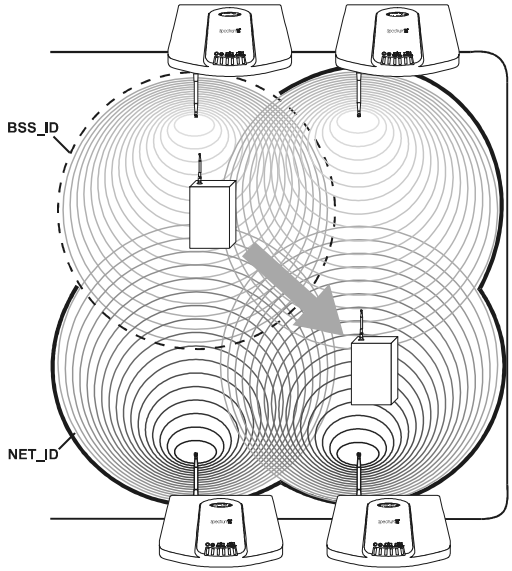
To set up an AP for wireless operation automatically, select the `Enabled` option for the *WLAP Mode* parameter. To set these values, see *2.5 Configuring Radio Parameters* on page 74.

Note

The WLAP initialization process length depends on the time specified in the *WLAP Forward Delay* field. See *2.5 Configuring Radio Parameters* on page 74.

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 creating that cell. Each cell has a *Basic Service Set Identifier (BSS_ID)*. In 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 the 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*. Roaming is transparent in high-level applications.

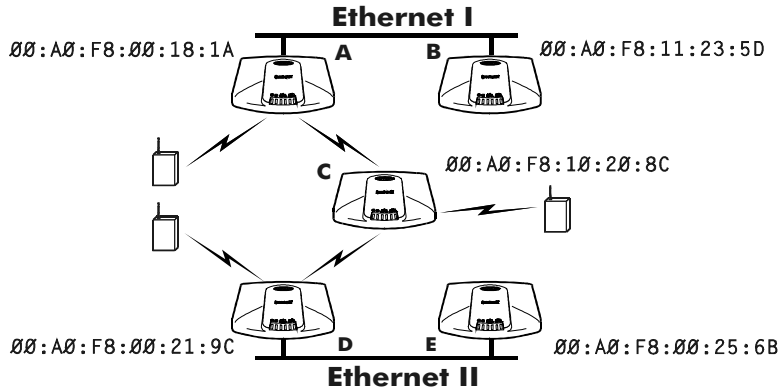
The user can configure the Net_ID (ESS). A valid Net_ID (ESS) is an alphanumeric, case-sensitive identifier up to 32 characters. Ensure all nodes within one LAN use the same Net_ID (ESS) to communicate on the same LAN. Multiple wireless LANs can coexist in a single environment by assigning different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

The Root AP and Association Process

By default, APs with *WLAP Mode* enabled and within range of each other automatically associate and configure wireless operation parameters at power up. This association process determines the wireless connection viability and establishes the *Root AP* and subsequently designated WLAPs.

APs communicating wirelessly together require the same: Net_ID (ESS), Encryption mode settings.

The root AP maintains the wireless connection among WLAPs by sending out beacons, sending and receiving configuration *BPDU (Bridge Protocol Data Unit)* packets between each designated WLAP. The WLAP with the lowest *WLAP ID* becomes the Root AP. A concatenation of the *WLAP Priority* value and the MAC address becomes the WLAP ID. Ensure the WLAPs associated with the Root AP use the Root AP hop sequence, *DTIM (Delivery Traffic Indication Message)* and *TIM (Traffic Indication Map)* interval.



In this configuration, the WLAP Priority value is the default 8000 Hex. On concatenating this value to the MAC addresses of the APs, AP A on Ethernet I has the lowest WLAP ID with 800000A0F800181A, making it the Root AP. AP C uses the AP A hop sequence, DTIM and TIM interval.

If AP D on Ethernet II has data for a device on Ethernet I, it requires a bridge or a repeater. In this configuration, AP C functions as a repeater. To ensure transmission to devices on Ethernet I, AP D has to use the AP A hop sequence, DTIM and TIM interval.

To manually designate AP B as the Root AP, assign it a lower WLAP Priority value. See *2.5 Configuring Radio Parameters* on page 74. Assigning a WLAP Priority value of 7000 Hex to the AP B MAC address 00:A0:F8:11:23:5D causes AP B to become the Root AP by having the lowest WLAP ID 700000A0F811235D.

IEEE 802.1d Spanning Tree Support

This protocol creates a *loop-free* topography with exactly ONE path between every device and LAN. This is the shortest path from the Root AP to each WLAP and LAN. If the connection between a WLAP and LAN fails, a new route is calculated and added to the tree. All packet forwarding follows the spanning tree. APs in a network have to choose one AP as the Root AP.

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 antennas in open areas or add APs as needed to improve coverage.

In an open-air environment the radio range reaches up to 2000 ft. (606 m). In a typical office or retail environment the radio range is between 180 and 250 ft. (54.5 to 75.7 m).

Site Surveys

A site survey analyzes the installation environment and provides users with recommendations for equipment and its placement.
Variables considered when performing a site survey include:

- RF systems already in use
- host system location
- available AC power
- interfering structures like metal girders and walls
- doorways and passages causing RF propagation.

A site survey provides the information below:

- components required to provide the necessary radio coverage area
- network considerations for installation
- analysis of site conditions
- power considerations for installation
- equipment location and mounting recommendations
- floor plan drawing with recommended components and locations
- system layout drawings
- overall network design drawings
- and equipment lists with manufacturer and part numbers.

For more information on site surveys contact the Symbol Support Center at 1-800-653-5350.

1.3 Access Point Functional 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.

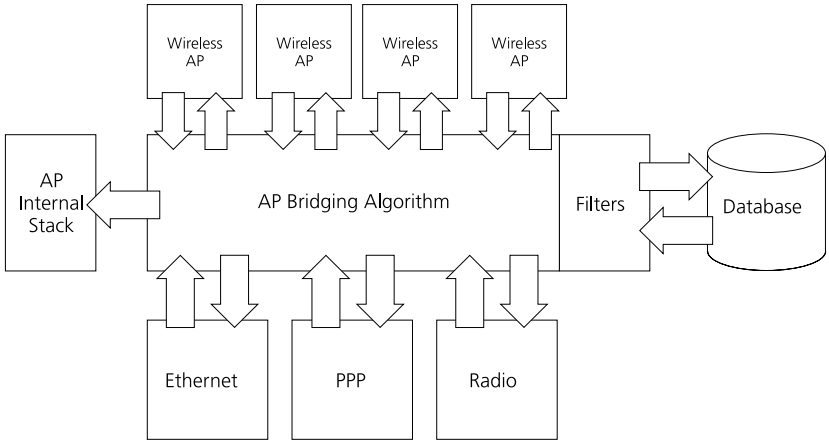
The AP provides *MAC layer bridging* between its interfaces. The AP monitors traffic from its interfaces and, based on frame address, forwards the frames to the proper destination. The AP tracks the sources and destinations of the frames to provide intelligent bridging as MUs roam or network topologies 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 associate with the AP. The AP uses the database to forward packets from one interface to another as they arrive. The bridge forwards packets addressed to unknown systems to the Default Interface (either Ethernet or PPP). Users can use the Ethernet interface as a wireless AP interface.

Note

Users have up to four wireless AP interfaces available for the bridging algorithm (v3.10 and above only).



Note

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, radio and WLAP) 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.

Only ARP request packets received over radio are echoed-back over radio for other APs to hear.

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 can provide network security or improve performance by eliminating broadcast/multicast packets from the radio network.

The *ACL (Access Control List)* contains the 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 Auto Fallback to Wireless Mode

The AP supports an Auto Fallback to Wireless when the hardware Ethernet connection fails or becomes broken. The Auto Fallback function operates only with an AP in WLAP Mode and connected to the Ethernet network. The AP resets itself and during initialization attempts to associate with any other WLAP in the network.

See *2.4 Configuring System Parameters* on page 66 and *2.5.1 Wireless Operation Parameters* on page 79.

To make this feature available: set the WLAP Mode to `Link Required`.

1.3.3 DHCP Support

The AP uses *Dynamic Host Configuration Protocol (DHCP)* to obtain a leased IP address, network configuration information and additional configuration options 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 file names. Because BOOTP and DHCP interoperate, whichever response the AP selects first becomes the server allocating the information. The AP determines the response to accept depending on the option selected in the *Access Point Installation* setup menu. The DHCP client automatically sends a DHCP request every XX hours/days to renew the IP address lease while 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 four files when a boot takes place, the configuration file, the ACL file and the firmware file. An HTML file is also downloaded, because firmware versions 4.00-31 and above have an embedded web server to provide support for web clients. Users can program the DHCP or BOOTP server to transfer these four files when a DHCP request is made. In the server set DHCP option 67 for the firmware and HTML file. Set DHCP Option 129 for the configuration file and 130 for the ACL file. Set DHCP Option 128 for the ESSID.

When the AP receives a network configuration change or the APs IP address lease has expired, 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.

1.3.4 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 1 or 2 Mbps. This rate requires adjustment of AP application time-out values for data transfer between the Ethernet and radio interfaces. The Ethernet interface is optional for single-cell or PPP-connected networks.

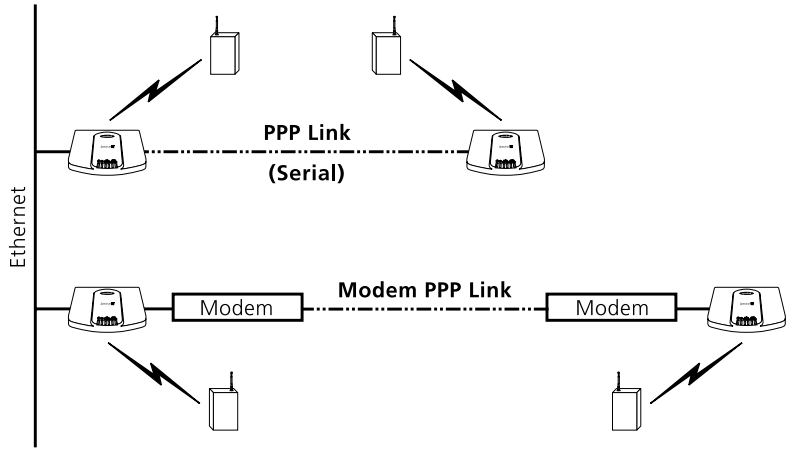
The *radio interface* conforms to IEEE 802.11 specifications. The interface operates at 1 and 2 Mbps using frequency hopping, spread spectrum radio technology. The AP supports multiple-cell operations with fast roaming between cells. With the frequency-hopping system, each cell operates independently. Each cell provides a 1 or 2 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 computer requires a null modem cable and connecting the AP to a modem requires a straight-through cable.

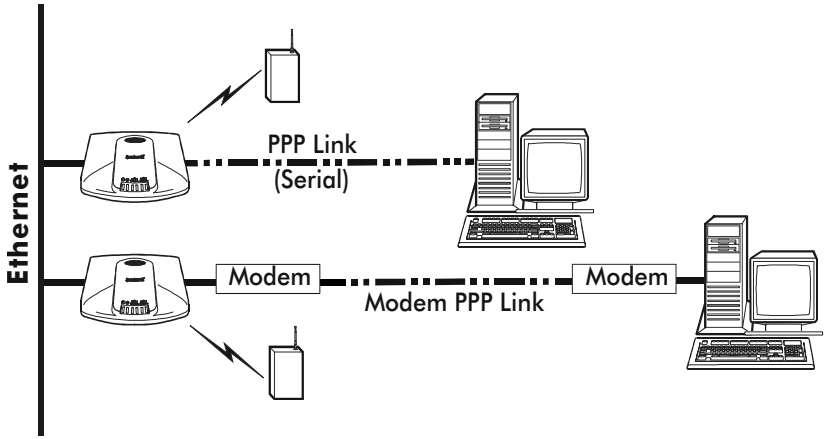
1.3.5 Bridging Support

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 through 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 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.

Note

Users cannot plug a non-AP node directly into the AP serial port, only AP-to-AP PPP links.

The PPP implementation in the AP uses the *Link Control Protocol (LCP)* and *Network Control Protocol (NCP)* to encapsulate packets at the Ethernet level, provide IP bridging control, MAC-level bridging and support for PPP negotiations as described in:

- RFC 1171: The Point-to-Point Protocol, July 1990
- RFC 1172: 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.

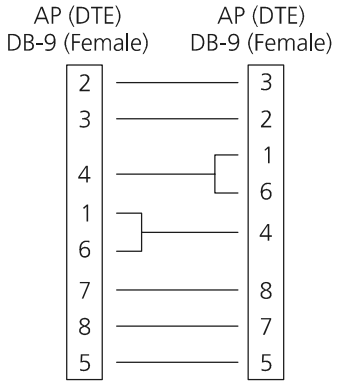
The AP database dynamically tracks MUs and APs on the PPP interface. Packets are forwarded to the PPP link after the AP determines their destination.

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

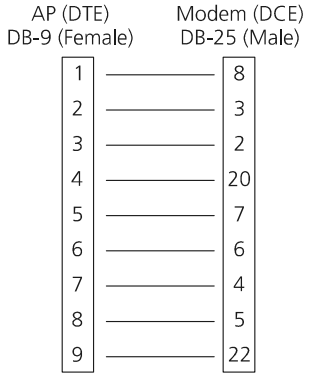
Refer to the listed RFCs for more information.

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 using a telephone line for as long as the link remains active.



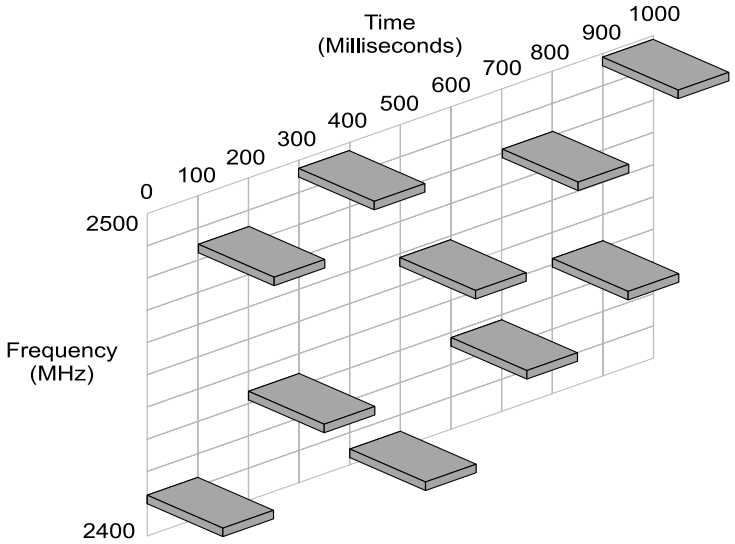
If using a modem connection, one AP represents the originating AP and the other represents the answering AP. When using a PPP link, do not use the serial port to access the UI. Access to the UI requires establishing a Telnet session with the AP.

1.3.6 Frequency-Hopping Spread Spectrum

The *Spread spectrum* technique (also known as *broadband*) takes a narrowband signal and spreads the data signal over a broad segment of the radio frequency band or spectrum. Spectrum24 uses the Frequency Hopping Spread Spectrum (FHSS) technology for radio communication. FHSS spreads the signal by transmitting a short burst on one frequency, jumping to another frequency for another short burst and so on. Spectrum24 uses the 2.4 - 2.5 GHz range depending on the country. This range does not require licensing from the FCC. FHSS offers a higher transmission rate than a conventional radio narrowband method.

In FHSS systems, the carrier frequency of the transmitter changes (or hops) in accordance with the pseudo-random code sequence. The code sequence dictates the frequency order selected by the transmitter. The transmitter takes the input data and spreads it in a predefined method. Each receiver has to

understand this predefined method and reconstruct the signal before interpreting data. Stations in a cell using FHSS techniques hop or change the carrier frequency at synchronized intervals. Government regulatory agencies and standards, such as ETSI, MKK, the FCC and IEEE 802.11, determine the number of frequency *hops* (79 for the U.S.), the *hopping pattern* (sequence each frequency is used) and *dwell time* (time at each frequency). The FCC requires 75 or more hopping frequencies used and a maximum 400ms for dwell time per frequency. The transmitter and receiver synchronize to the hop sequence to ensure communication. The time synchronization field included in message packets coordinates the hop timing of all units. The user can program the length of each hop. Each hop is a frequency at least 6 MHz away from the previous frequency and has a 1 MHz bandwidth.



FHSS can survive in an adverse environment and coexist with other devices/ services in the same band. The average signal strength being relatively low on any given frequency results from FHSS. When the signal intelligence is spread out over several MHz in the frequency spectrum, the resulting power spectrum also spreads out (less than 1 watt). This results in the transmitted power spread out over a wide frequency bandwidth and makes detection very difficult without the code sequence or pattern.

Hopping provides enhanced data reception in the presence of interfering signals, like fixed frequency radio networks or microwave ovens. The system also resists interference because it spends a short time on each given frequency. If an interfering source is present or interference at a specific frequency, only a small number of frequency hops are blocked rather than the entire range. With interference occurring on one frequency, the data is retransmitted on a subsequent hop at another frequency. Even if constant interference exists on a given frequency, it affects the radio network for only a short time on that specific frequency. Although APs can share the same hopping sequence, they usually do not synchronize in time. Rarely do they simultaneously arrive at the same frequency, referred to as contention. Interfering signals can reduce overall throughput at some frequencies. This reduces the probability and impact of overlapping frequencies or collisions. Although devices can hop to the same frequency, they eventually hop to different frequencies after the hop time.

With Spectrum24, each AP on the local network negotiates a different hopping sequence at start-up. This allows APs to provide frequency separation and evenly divide the frequency spectrum among the units.

1.3.7 MU Association Process

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

- the signal strength between the AP and MU
- the MUs currently associated with the AP
- the MUs encryption and authentication capabilities and the type enabled
- the MU Supported Rate.

Mobile Unit	Access Point (Rate Set)			
transmit rate (supported rates)	1 only	1 reqd, 2 optl default	1 & 2 reqd	2 only
1	1	1	NA	NA
1 & 2 default	1	Dynamic Rate Control	Dynamic Rate Control	2
2	NA	NA	NA	2

Where:

reqd = required

optl = optional

NA = No Association

Dynamic Rate Control = rate chosen for best transmission.

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 frequency-hopping statistics like:

- hopping sequences
- the current hopping frequencies
- the time until the hop ends (*hop interval*).

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 associate or 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 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 probe response within the time limits, it repeats the probe process on the next channel in the sequence. This process continues through all channels in the range.

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 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 the 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
- the MU detects an imbalance in the number of MUs associated with available APs and roams to a less loaded AP.

The MU selects the best available AP and adjusts itself to the correct hopping sequence to begin association. Once associated, the AP begins forwarding any frames it receives addressed to the MU. Each beacon from the AP contains fields for the current hop frequency and how much time remains in the current hop sequence. The MU uses these fields to resynchronize its hopping pattern to the AP.

1.3.8 Mobile IP

The Internet Protocol identifies the MU point of attachment to a network through its IP address. The AP routes packets for the MU 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 and this causes forthcoming packets to become undeliverable.
- The MU changes its IP address when it moves to a new network and this causes it to lose the 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 a forwarding address to a local post office when an individual leaves home for an extended period. When mail arrives for the home address it is forwarded by the local post office to the temporary care-of-address. Using this method, only the local post office requires notification of the 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 that provides a routing service on the MUs home network. The home agent intercepts packets sent to the MUs 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 that provides a routing service at the MUs location on a foreign link. The foreign agent receives tunneled packets for the MU sent by the MUs home agent. 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 roams to another foreign link. Users can view it as an exit point of a tunnel between the MUs home agent and the MU itself.

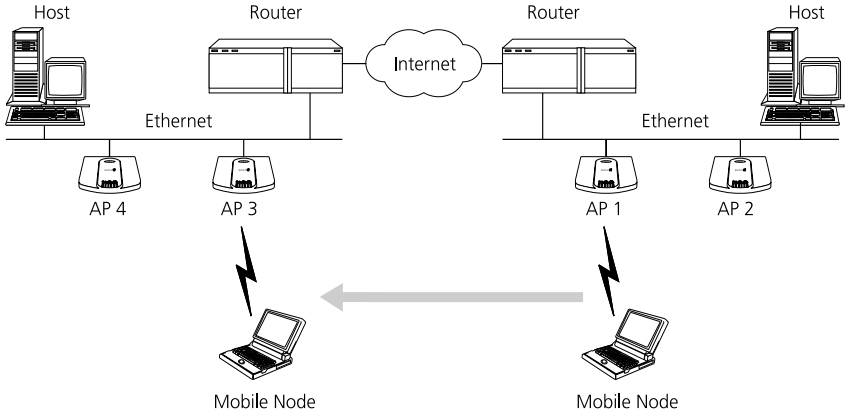
The *S24 Mobile IP (roaming across routers)* feature enables an MU on the Internet to move from one subnet to another while keeping its IP address unchanged.


Note

To configure this feature, see *2.4 Configuring System Parameters* on page 66.

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 MUs 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.

1.3.9 Supporting CAM and PSP Stations

CAM (Continuously Aware Mode) stations leave their radios on continuously and 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 Indication Message)* and the *TIM (Traffic Indication Map)*.

PSP (Power Save Polling) stations power off their radios for long periods. When an MU in PSP mode associates with an AP, it notifies the AP of its activity status. The AP responds by buffering packets received for the MU. The PSP-mode MU wakes up to listen to the AP beacon every n^{th} *Beacon Interval* where `n` is a PSP-mode value from the 1 to 10-range; the *Beacon Interval* is set on the MU.

When the MU wakes up and sees its bit set in the TIM, it issues a poll request to the AP for packets stored. The AP sends them to the MU and the MU goes back to sleep. A DTIM field, also called a countdown field, informs MUs of the next window for listening to broadcast and multicast messages. The AP sends the messages following the n^{th} `beacon` where `n` is the DTIM interval defined in the AP. When the AP has buffered broadcast or multicast messages for associated MUs, it sends the next DTIM with a *DTIM Interval* value. This value decreases by '`1`' with each successive beacon. The AP sends broadcast and multicast messages immediately following the beacon where the DTIM value is '`0`.' To prevent a PSP-mode 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*.

1.3.10 Data Encryption

Mobile nodes and other hosts on any network can be a target of information theft. This occurs when unauthorized users eavesdrop on a network to glean proprietary information. The absence of a physical connection makes wireless links particularly vulnerable to eavesdropping.

Encryption becomes the most efficient method in preventing information theft and improving data security. *Encryption* requires scrambling and coding of information, typically with mathematical formulas called algorithms, before the information is transmitted over a communications link or network. An *algorithm* is a set of instructions or formula describing how to scramble and encode the data. A *key* is the unique code used by the algorithm to encrypt or decrypt the data. *Decryption* is decoding and unscrambling the received encrypted data.

The same device, host computer or front-end processor, usually performs both encryption and decryption. The data direction determines which function, encryption or decryption, the device performs. The device takes plain text, encrypts and scrambles the text typically by mathematically combining the key with the plain text as instructed by the algorithm, then transmits the data over the network. At the receiving end another device unscrambles and decodes the encrypted text revealing the original message. A user can know the algorithm, but cannot interpret the data without the key. Only the sender and receiver of the transmitted data know the *secret key*.

Symbol uses the *Wired Equivalent Privacy (WEP)* algorithm, specified in IEEE 802.11 section 8, for encryption and decryption. WEP uses the same secret key for both encrypting and decrypting plain text. Typically, an external key management service distributes the secret key. Symbol recommends that users regularly change keys 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*, an error-checking operation, 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*, also called packets, are unicast, meaning authentication messages transmit between only one AP and one MU, not broadcast or multicast.

1.3.11 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 capabilities.

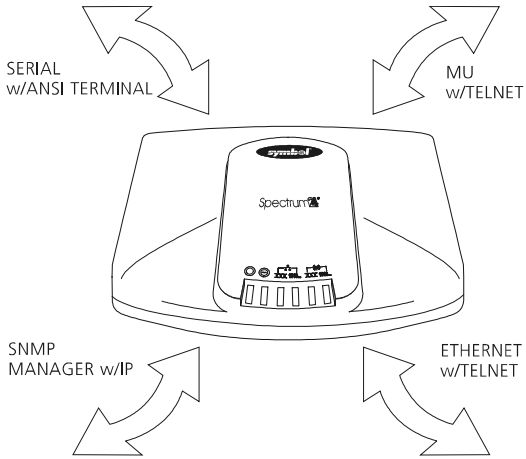
Web pages are written in *Hypertext Markup Language* (HTML). HTML allows the user to create web pages containing text, graphics and pointers or links to other web pages or elsewhere on the page or document. Pointers are generally known as *Uniform Resource Locators* (URLs). A URL is essentially the name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

- 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.

1.3.12 Management Options

Managing Spectrum24 includes viewing network statistics and setting configuration options. Statistics track network activity of associated MUs and data transfers on the AP interfaces. Configuration involves setting system operating parameters and filters used in bridging.



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

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

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

Programmable SNMP Trap Support

SNMP is the primary network management model for the Transport and Network layers suite of protocols, such as TCP/IP. This model defines the method for obtaining explicit network operation information, allows the user to change router (AP) and gateway parameters and consists of four elements:

- *Management Station* contains an application suite used for network management, data analysis, fault management and so on.
- *Management Agent* performs management operations on a configured device for the management station.
- *Management Information Base* (MIB) defines the structure and contents of a database for the information exchanged between a management station and a management agent.
- *Network Management Protocol* (SNMP) is the protocol linking the management agent to the management station and specifying the rules for communication between the two devices.

Nodes can perform as hosts, routers, bridges or other network 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 manages the network by running the special management application suite that analyzes network operation.

An *SNMP trap* is an unsolicited alert sent by the management agent to a configured management station indicating some significant event has occurred on the network. The management station reads the SNMP trap notification for details of each specific event, including what, when, 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 the event is and its contents when issued. SNMP traps are asynchronous to other network transmissions.

Using SNMP

The AP includes *SNMP agent* versions accessible through an SNMP manager application such as, HP Open View or Cabletron Spectrum MIB browser. The SNMP agent supports SNMP version 1, a limited feature set of SNMP version 2, MIB II, the 802.11 MIB and one Symbol proprietary *Symbol MIB*. The SNMP agent supports read-write, read-only or disabled modes. The AP supports traps that return to the SNMP manager when certain events occur. The *Wireless LAN Installation* disk packaged with MUs contains the MIB.

Expanded MIB Support

The *MIB (Management Information Base)* has ten categories defining what the management station needs to understand and which objects the station manages. The Symbol proprietary MIB is enterprise specific and has 22 groups defined with approximately 250 variables. MIB-II is an Internet standard MIB, as defined in RFC 1213, supports network monitoring and management from the transport layer down. MIB-II has ten categories defined with approximately 175 variables. The new IEEE 802.11 MIB is for 802.11 entities.

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	Access to the AP built-in Telnet server from any AP interface including remote Ethernet connections. See *2.1.1 Using Telnet* on page 45.
Direct Serial Connection	The AP acts as a DTE device to connect directly to another 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 47.
Dial Up Access	The dial-up access method requires a communication program with ANSI emulation on the remote terminal or computer. The terminal or computer 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 48.
SNMP through a MIB Browser	Access to the AP SNMP function using a MIB Browser. Typically a Network Manager uses this feature, however, Symbol does not recommend accessing the AP using this interface method. Refer to the MIB Browser documentation for usage.
Web Browser	Access to the AP built-in Web server from any AP interface including remote Ethernet connections. See *2.1.4 Using a Web Browser* on page 49.

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 are updated to all APs with the same Net_ID (ESS) when users choose 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. If using a PPP or serial connection, access the UI through a Telnet session.

2.1.1 Using Telnet

Using a Telnet session to gain access to the UI requires a remote station to 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 enter the password:

   ```
   Symbol
   ```

The password is case-sensitive.

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

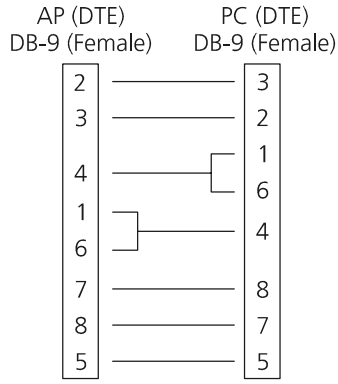
```
Symbol Access Point          MAIN MENU
Show System Summary                 AP Installation
Show Interface Statistics           Special Functions
Show Forwarding Counts              Set System Configuration
Show Mobile Units                   Set RF Configuration
Show Known APs                      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.
   – Press CTRL+D to manually terminate the session.

Set the *System Passwords* 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 computer. Connecting the AP directly to a computer 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*.

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 62.

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 computer 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 62.

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. There are two methods to setup the Web Help file:

- placing the Help file on the network Web server
- placing the Help file on the local workstation hard disk.

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 in order to access the Help file from the *Spectrum24 Access Point Configuration Management System* web pages. This procedure is intended for Microsoft Internet Information Server. The network Web server can be different, if so, some procedures will be different.

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. From the Symbol Web site, (http://www.symbol.com/services/downloads/download_spec24.html), select Spectrum24® - 1 and 2 Mbps FH Firmware, Software, Drivers, Tools and ….
3. Select Firmware and Software.
4. Select Firmware -- Access Point.
5. Select Access Point Web Site Help Files (File based installation).
6. The Save As... window appears. Select the directory created in step one for the location to save the file by entering the full path (C:\) to the AP Web Site Help Files. The File name is APHTMLHelp_Install32_102.exe.
7. Select the Save button. A window appears indicating the file is being saved.
8. From the directory created in step one, select the self-extracting file APHTMLHelp_Install32_102.exe.
9. The WinZip Self-Extractor window appears. For the Unzip to folder field, type in the directory created in step one for the location to copy the files.
10. Select Unzip.
11. A window appears indicating the files were unzipped successfully. Select the OK button.


Note

This installation process is for Windows NT 4.0.

12. From the windows Task Bar select Start.
13. From the drop down menu select Programs.
14. From this menu select Microsoft Internet Server(common).
15. From this menu select Internet Service Manager to launch the Internet Information Server Service Manager.
16. Select the server providing the WWW service listed under Computer in the window.

Ensure the server WWW service is running. If WWW service is not running, install WWW services from the Microsoft Internet Server software.

17. Select Properties.
18. Select Service Properties to display the WWW service properties for the server.
19. The Service Properties window opens.
20. Select the Directories Tab.
21. Select the Add button to open the Directories window.
22. Type the *Directory/Folder* path of the files copied in step one.
23. Select the Virtual Directory button.
24. Type the folder *alias* such as *FHapHelp* and select the OK button.
25. Select the Default document check box.
26. Type *FHapHelp.htm* as the default document and select the Apply button.
27. Select the OK button to exit the window.
28. Test the accessibility to the Help file using a Web browser with a URL similar to: (http://webserver.com/FHapHelp) or (http://xxx.xxx.xxx.xxx/FHapHelp)
    Where xxx.xxx.xxx.xxx is the IP address of the server.

Setup Local Workstation Help File Access

To access the Help file from a local workstation, the Help file needs to reside on the local workstations hard disk. If the Help file does not reside on the local workstations hard disk, load the Help file on to the hard disk.

To install the Help file run the InstallShield program.

1. Create a directory on the local workstation hard disk for the AP Web Site Help Files to reside. Often this is a subdirectory to C:\InetPub\wwwRoot.

2. From the Symbol Web site, (http://www.symbol.com) and search for Spectrum24 Firmware & Software Download Page.
3. Select Access Point Web Site Help Files.
4. The Save As... window appears. Select the directory created in step one to save the file by entering the full path (C:\) to the AP Web Site Help Files. The File name is APHTMLHelp_Install32_102.exe.
5. Select the Save button. A window appears indicating the file is saving.
6. From the directory created in step one, select the file: APHTMLHelp_Install32_102.exe.
7. The Unpacking UAP HTML Help window appears indicating the file is unpacking and the installation wizard is preparing to start.
8. The UAP HTML Help Installation Setup screen displays.
9. Follow the on-screen instructions to install the Help file on the local workstation hard disk.

To access the Help file located on the local workstation:

1. From the Windows Task bar select the Start button.
2. From the Start drop down menu select Programs.
3. From the Programs drop down menu select Symbol Technologies or the directory name chosen during the installation process.
4. Select UAP HTML Help to launch the help file program.

To exit the Help file:

1. From the window menu bar select File.
2. From the drop down menu select Close/Exit.

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. If not, use the TAB key to select the `Web Server` option. Use the LEFT/RIGHT ARROW key to toggle the option to `Enable`.
4. Select `Save-[F1]` to save the configuration.

Reset the AP for changes to take effect.

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

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 of the Web server and the folder alias of the Web server for the Help file location. (http://xxx.xxx.xxx.xxx/FHapHelp) 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. Select the `Save Configuration` option to save the new setting.
9. Select `Yes` at the confirmation prompt.
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. Select `Yes` at the confirmation prompt.

To access the AP UI through 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.


Note

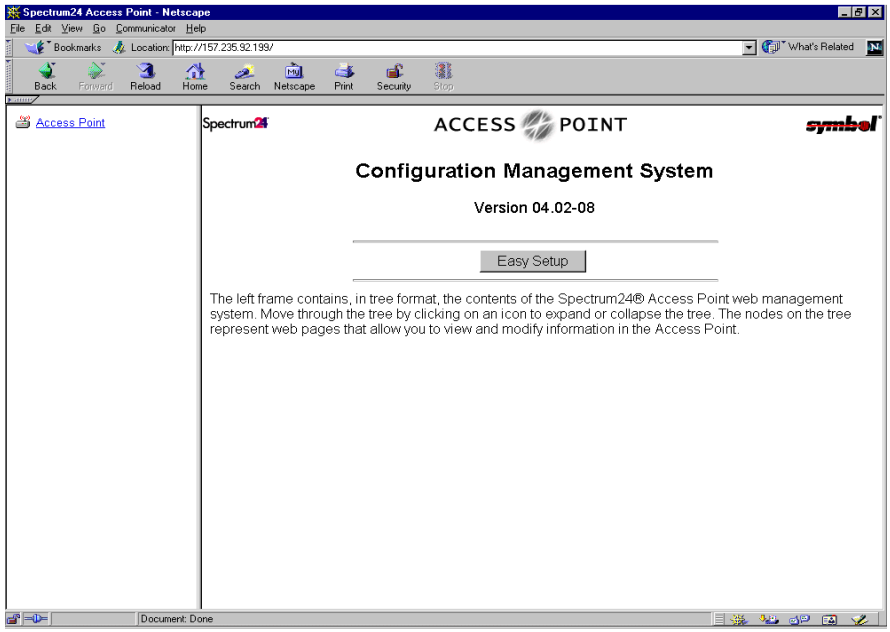
Reset the workstation or laptop using the Web browser to access the UI.

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

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

   – Where xxx.xxx.xxx.xxx is the AP IP address.
   – 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.
   – For wired network access, enter the IP Address in the Address or Location field for any AP on the network to access the AP through the Web browser: http://xxx.xxx.xxx.xxx
   – For wireless network access, enter the IP Address in the Address or Location field for any AP with the same Net_ID (ESS) to access the AP through 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. 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.

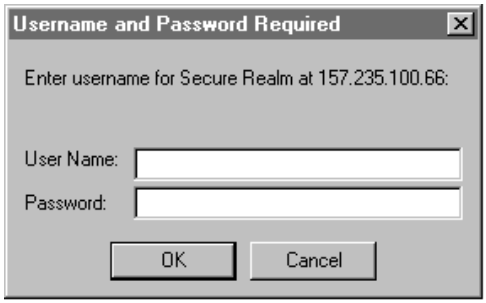
- To view configuration, function or option changes on the Web page(s) turn off the caching function for the browser used.
  - For Netscape, from the menu bar select Edit, Preferences, Advanced, Cache.
    - Select Document in cache is compared to document on network: Every time.
  - For Internet Explorer,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

- From the Temporary Internet files element, select Check for newer versions of stored pages: Every visit to the page.
- Select the OK button.

Caution

Turn this property/option off for the browser to view pages with current information, otherwise the browser views the stored page version. Set this option in the browser to ensure the latest version of a web page displays.

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



1. Enter the AP name.

   `Symbol Access Point`

2. Enter the password:

   `Symbol`

The AP name and password are case-sensitive.

- Exit the browser to manually terminate the session.

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 using ARROW keys 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 through 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:
  - 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.
- Press ESC to exit from submenus.

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 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. Example: AP-3020 running FW 4.01-xx.
Cancel	Does not register settings changed in a screen and returns to the previous screen.

2.2.1 Entering Admin Mode

The UI defaults to *User* mode that allows 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. Enter 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 passwords* 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 Admin-[F4]*.

3. The *Change System Passwords* screen displays:

```
Symbol Access Point
                                Change System Passwords


                          User Password       *******

                          Admin Password      *******









                          Save-[F1]              Cancel-[ESC]

   Password for user access(Monitor only)
```

4. Change the passwords using the following parameters:

User Password	Allows the user to only monitor or view the screens. Select any alphanumeric, case-sensitive entry up to 13 characters, the characters selected are displayed as asterisks. The default password is Symbol.
Admin Password	Allows the user to view and change the parameters on each screen. Select any alphanumeric, case-sensitive entry up to 13 characters, the characters selected are displayed as asterisks. The default password is Symbol.

5. Select `Save-[F1]` to register settings by writing changes to NVM. Selecting `Save` displays a confirmation prompt.
6. Select `Cancel-[ESC]` to disregard any changes made to this screen and return to the previous menu.

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 computer requires a modem and a communication program (e.g. Microsoft Windows Terminal program or HyperTerminal).


Note

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 the 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 through a Web Browser

Refer to the online help file for the Web Browser navigation methods and basic functionality. For file download instructions and the associated file(s) refer to the Web page: (http://www.symbol.com/services/downloads/download_spec24.htm) and select Spectrum24® 1 and 2 Mbps FH Firmware, Software, Drivers, Tools and ….

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 the administration mode by selecting *Enter Admin Mode* on the *Main Menu* and typing the correct password.
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          157.235.96.52                      157.235.101.2
                                                         0.0.0.0
  .Gateway IP Address 157.235.96.2                       0.0.0.0
                                                         0.0.0.0
  .Subnet Mask        255.255.255.0                      0.0.0.0
                                                         0.0.0.0
  .DNS IP ADDRESS     157.235.101.1                      0.0.0.0
                                                         0.0.0.0
  .Net_ID (ESS)       101                              .Additional DNS
                                                         157.235.101.2
  .Antenna Selection  Primary Only                       0.0.0.0

  .DHCP/BOOTP         Enabled


    OK-[CR]       Save-[F1]      Save All APs-[F2]         Cancel-[ESC]
      (Most parameters take effect only after being saved and AP is reset)
```

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 wired Ethernet for the 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.
DNS IP Address	Primary Domain Name Server IP address.
Additional DNS	The IP address of the additional DNS servers available. A maximum of two additional DNS servers are available.
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 eight gateways.
DHCP/BOOTP	DHCP and BOOTP interoperate, whichever response the AP selects first becomes the server allocating the information. As a DHCP client, the AP automatically sends a DHCP request every XX hours/days to renew the IP address lease as long as the AP is running. As a BOOTP client, the AP assumes a permanent lease of the IP address and is not required to renew the IP address with the server.
DHCP Only	Only DHCP responses will be accepted by the AP.

BOOTP Only	Only BOOTP responses will be accepted by the AP.
Disabled	Disables BOOTP and DHCP network configuration is manually entered.

3. Verify the values set reflect the network environment. Change them as needed.
4. In the *Antenna Selection* field, use SPACE BAR or LEFT/RIGHT-ARROW keys to toggle between `Primary Only` and `Primary and Secondary`.
5. Select `OK` or `Save` to register settings to write changes to NVM. Selecting `Save` displays a confirmation prompt.
6. Select `Save ALL APs-[F2]` 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.
7. Select `Cancel-[ESC]` to disregard any changes made to this screen and return to the previous menu.

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

 Hopping Set             1              .Access Control     Enabled
 Hopping Sequence        4              .Type Filtering     Disabled

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

 .AP Auto Configure   Enabled           .MU-MU Disallowed   Off

 .Web Server          Enabled

 System Password Admin-[F4]

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

2. Configure the AP system settings as required:

   Hopping Set — The IEEE 802.11 standard requires three hop sets identified by the numerals `1-3`. The U.S. for example, has 3 hop sets with 26 hopping patterns available for each hop set. The default is `1`. Reset the AP for the change to take effect.

Hopping Sequence

AP hopping sequence or pattern depends on the country. The U.S. for example, has 78 hopping patterns. Reset the AP for the change to take effect.

3 sets of	1 through 26	Standard
3 sets of	1 through 11	Israel and France
3 sets of	1 through 9	Spain
3 sets of	1 through 4	Japan and Korea
3 sets of	1 through 6	Belgium (outdoor)
3 sets of	1 through 9	Mexico

Ethernet Timeout Disables the 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.

For values 2, 3, and 4 association with the Root AP is not necessary.

If the value is set to `2` and the WLAP mode is enabled, the WLAP sends a *WLAP Alive BPDU* on the Ethernet line every *WLAP Hello Time* seconds to allow WLAPs on the Ethernet line to detect its existence.

If the value is set to `3`, the WLAP tracks the *WLAP Alive BPDU*. If the BPDU is missing for *WLAP Hello Time* seconds, the Ethernet Attached and Activity LEDs will blink slowly. The RF interface is disabled and the WLAP state changes to *WLAP Lost on Ethernet*. Once the *WLAP Alive BPDU* is detected, the WLAP resets and starts over.

If the value is set to `4`, the WLAP tracks the *WLAP Alive BPDU*. If the BPDU is missing for *WLAP Hello Time* seconds, the WLAP resets.

When the Ethernet connection is broken the AP clears the MU table and disables the RF interface until the Ethernet connection comes up.

Telnet Logins Specifies if the AP accepts or rejects Telnet Logins. The default value is `Enabled`.

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.
AP Auto Configure	If enabled, this feature allows APs to automatically resolve hop sequence conflicts.
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 the HyperTerminal or Telnet applications. An AP Reset is required for this feature to take effect.
System Password Admin	Allows the user to change the passwords for the AP. This screen can be accessed only when the AP is in *Telnet* mode. *Serial* mode provides read-only privileges and does not allow the user to view this screen.
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 this AP can perform WNMP functions. The default value is `Enabled`.
AP-AP State Xchg	Specifies AP-to-AP communication exchanged. If Disabled prevents AP Auto Configure and AP load leveling functions.

3. 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 the radio. The default value is `On`.
Default Interface	Specifies the default interface (Ethernet, PPP or WLAP) that the AP forwards a frame to if the AP cannot find the address in its forwarding database. The default interface is `Ethernet`.

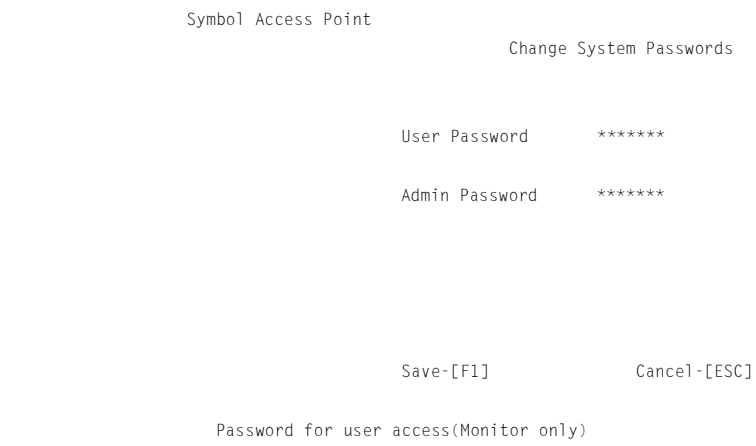
4. Verify the values set reflect the network environment. Change them as needed.
5. Select `OK` or `Save` to register settings by writing changes to NVM. Selecting `Save` displays a confirmation prompt.
6. Select `Save ALL APs-[F2]` to save the *System Configuration* information to all APs with the same Net_ID (ESS). 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.
7. Select `Cancel-[ESC]` to disregard any changes made to this screen and return to the previous menu.

2.4.1 System Password Administration

This screen allows the network administrator to configure the passwords for the AP. The user password allows the user to Telnet into the AP or use the serial port and have read-only privileges. Accessing the UI in an Admin mode session through the Serial port the session does not time-out.

On entering the Admin mode with both the Telnet and Serial Port interfaces active enables Admin mode on both interfaces. This can cause a security breach if a user, without admin privileges, Telnets into the AP while the admin security level is enabled entitling the user to admin level access.

1. To access and change the System Passwords, select `System Password Admin- [F4]` from the *System Configuration* Menu. The *Change System Passwords* screen displays:



2. Change the passwords using the following parameters:

User Password	Allows the user to only monitor or view the screens. Select any alphanumeric, case-sensitive entry up to 13 characters, the characters selected are displayed as asterisks. The default password is Symbol.
Admin Password	Allows the user to view and change the parameters on each screen. Select any alphanumeric, case-sensitive entry up to 13 characters, the characters selected are displayed as asterisks.

In Firmware version 04.02-08 and above changing the *Admin* password does not change the *Read/Write Community* name set in the *SNMP Configuration* screen. The *Admin* and *Read/Write Community* name default password is Symbol.

3. Select `Save` to register settings by writing changes to NVM. Selecting `Save` displays a confirmation prompt.
4. Select `Cancel-[ESC]` to disregard any changes made to this screen and return to the previous menu.

2.5 Configuring Radio Parameters

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

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

```
Symbol Access Point
                              RF Configuration

 .DTIM Interval            1Ø            WLAP Mode            Disabled
 .BC/MC Q Max              1Ø
 .Reassembly timeout     9ØØØ            WLAP Priority        8ØØØ hex
 .Max Retries (d)          15            WLAP Manual BSS ID  ØØ:ØØ:ØØ:ØØ:ØØ:ØØ
 .Max Retries (v)           5
 .Multicast Mask (d) Ø9ØØØE ØØ  hex      WLAP Hello Time        2Ø
 .Multicast Mask (v) Ø1ØØ5E ØØ  hex      WLAP Max Age          1ØØ
 .Hop Dwell Time          1ØØ  K-us      WLAP Forward Delay      5
 .Beacon Interval         1ØØ  K-us
 .Accept Broadcast ESSID  Disabled       .WEP (Privacy)     Open System Only
 .MU Inactivity Timeout    6Ø  min.      .Encrypt Key ID         1
 .Rate Control  (Mb/s)  1 reqd,2 optl    .Encrypt Key1           1Ø111213 14
 .Fragmentation Threshold 572  bytes     .Encrypt Key2           2Ø212222 24
 .RTS Threshold          1514  bytes     .Encrypt Key3           3Ø313233 34
                                         .Encrypt Key4           4Ø414243 44

                                          Intelligent Queuing Enabled

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

  The frequency of DTIM packets as a multiple of TIM packets. Range(1. .255)
```

RTS Threshold is not a user configurable parameter.

2. Configure the settings as required:

DTIM Interval	DTIM packet frequency as a multiple of beacon packets (*1-255*). 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 (*0-100) and corresponds to maximum-sized Ethernet packets. The default is* 1Ø.
Reassembly timeout	Sets the time in Ø.5 ms units (*0-9999) before a time-out occurs during a packet reassembly. Packet reassembly occurs when a large Ethernet packet is fragmented into smaller wireless network packets. The default is* 9ØØØ.
Max Retries (d)	The maximum allowed retries (*0-32*) before aborting a single data packet transmission. The default is 15. Users should not modify.
Max Retries (v)	The maximum allowed retries (*0-32*) 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.
Hop Dwell Time	The time *(20-390)* spent on a single channel between hops in kilo-microseconds (`1024` microseconds). The default is `100`. Avoid changing this parameter because it can adversely affect the performance of PSP-mode terminals.
Beacon Interval	The time between beacons in kilo-microseconds (*20-1000*). 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 devices interoperability by specifying the time *(3-600) 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*.

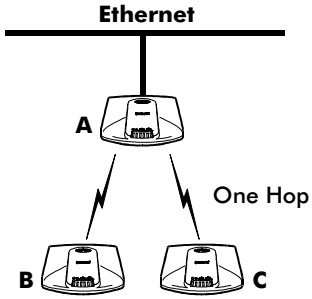
Rate Control (Mb/s)	Defines the data transmission rate: *1 reqd, 2 optl* - allows the AP to automatically select the best transmit rate allowed by the conditions. All management and broadcast traffic is transmitted at 1 Mbps. This mode allows a mixture of 1 Mbps and 2 Mbps radios in the same network. *2 only* - forces the AP to always transmit at 2 Mbps and does not allow 1 Mbps stations to associate with it. *1 only* - forces the AP to always transmit at 1 Mbps even if a station can transmit at a higher rate. *1 & 2 reqd* - allows the AP to automatically select the best transmit rate allowed by the conditions and allows the AP to ACK received 2Mb packets at 2 Mbps. Also allows sending Broadcast traffic matching the Broadcast Mask at 2 Mbps.
Fragmentation Threshold	Defines the maximum size *(256-2346)* for directed data packets transmitted over the radio. Larger frames are fragmented into several packets this size or smaller before transmission over the radio. The receiving station reassembles the transmitted fragments. This parameter has no impact on the APs ability to receive packets. The AP can receive any packet size up to the maximum Ethernet packet size specified in IEEE 802.11.
RTS Threshold	Request to send threshold. Allows the AP to use RTS (Request To Send) on frames longer than the specified length. The default is `2347` (0-2347) Bytes.
WEP Algorithm	Defines the number of bits and type of WEP algorithm used. Admin privileges are required to make changes to this parameter. The default is `Open System Only`.

Encryption Key ID	Allows the user to change the `Active Key` number. Admin privileges are required to make changes to this parameter. The default key ID is `1`.
Encryption Keys (1 - 4)	Allows the user to create or change the values for each encryption key. Admin privileges are required to make changes to these parameters.
Intelligent Queuing	Prioritizes traffic the AP determines might contain multimedia (streaming audio or video). The default is `ON`.

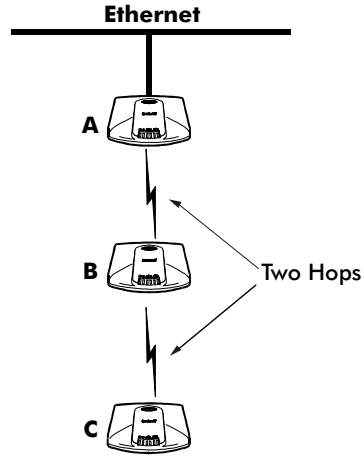
3. Verify the values set reflect the network environment. Change them as needed.
4. Select `OK` or `Save` to register settings by writing changes to NVM. Selecting `Save` displays a confirmation prompt.
5. Select `Save ALL APs-[F2]` to save the *RF Configuration* information to all APs with the same Net_ID (ESS). 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. Select `Cancel-[ESC]` to disregard any changes made to this screen and return to the previous menu.

2.5.1 Wireless Operation Parameters

The AP supports up to four WLAP interfaces. Symbol recommends using one WLAP as an interface on high traffic networks, for low traffic networks no more than two WLAPs, because excessive channel contention causes the WLAP to miss beacons from the Root AP shown in the example.



High Traffic Network

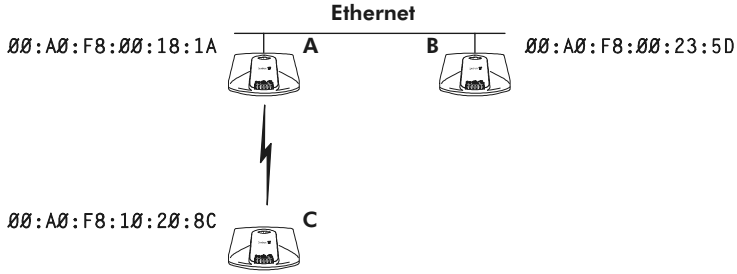


Low Traffic Network

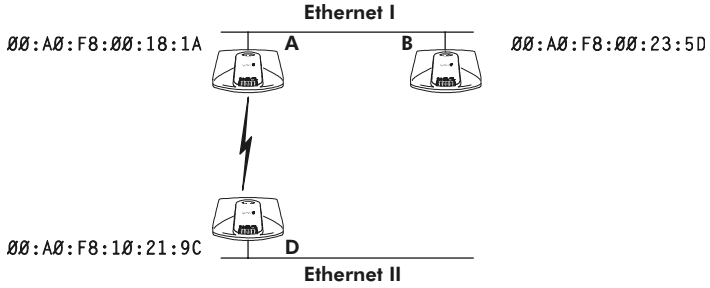
See *4.8 LED Indicators* on page 164 for indication of AP status. If more than two WLAPs operate in a repeater configuration, Symbol recommends the WLAPs with the lowest WLAP IDs be placed on the wired network.

To avoid forming a loop, per the IEEE 802.1d Spanning Tree Protocol, the Wireless WLAP associates with only one wired WLAP.

1. Set the default interface for AP A to `Ethernet`.
2. Set the default interface for AP B to `Ethernet`.
3. Set the default interface for AP C to `WLAP`.
   This allows the MUs to roam and transmit data between AP B and C.



If an AP functions as a bridge between wired LANs, Symbol recommends one LAN contain all the lower WLAP IDs.



To configure the AP for wireless operation:

1. Select *Set RF Configuration* from the *Main Menu*.

2. Configure the settings as required:

WLAP Mode	Specifies the APs wireless-AP operation status. *Enabled*, the AP sets up automatically for wireless operation. The AP can operate in any of these configurations: Wireless, Repeater or Ethernet Bridge. *Disabled*, no wireless operation possible. Default setting. *Link Required*. At power up: • If the WLAP is the Root AP, an Ethernet connection is required. • If the WLAP is a designated WLAP, association to the Root AP is required. During normal operation: • If the Ethernet connection is lost, the Root AP resets. • If the WLAP association is lost, the designated WLAP resets.
WLAP Priority	Allows a user to determine the Root and the designated WLAP in wireless operation. Concatenate the priority value as the most significant portion of the MAC address. An AP with a lower numerical value for priority is more likely to become the root AP. The default is 8ØØØ hex from the Ø - ØxFFFF range.

WLAP Manual BSS_ID	Specifies the BSS_ID of a particular WLAP and forces the current AP to associate only with that WLAP. If setting the *WLAP Manual BSS_ID* to the current BSS_ID, the current AP jumps into *Functional State* immediately and waits for an Association Request from the other WLAP. See *3.8 Radio Statistics* on page 142. This feature speeds up the association process and minimizes confusion when more than two WLAPs try to associate with each other.
WLAP Hello Time	Sets the time lapse, in seconds, between *Config BPDU* packets sent to the Root AP by a designated WLAP. The default is 2Ø seconds. If the Root AP fails to hear from the designated WLAP within the *WLAP Max Age* time, it removes the designated WLAP from its interface table. The *WLAP Hello Time* of the Root AP overwrites the *WLAP Hello Time* of designated WLAPs. The *WLAP Hello Time* does not refer to the time lapse between beacons sent by the Root AP. If a designated WLAP fails to receive a beacon, it knows that its Root AP has lost the Root status.
WLAP Max Age	Defines time, in seconds, before discarding aged configuration messages. This causes a disconnection between the two WLAPs. The recommended value is a multiple of the *WLAP Hello Time*. The default is 1ØØ seconds. The *WLAP Max Age* of the Root AP overwrites the *WLAP Max Age* of designated WLAPs.

WLAP Forward Delay	Specifies the time, in seconds, to prevent an AP from forwarding data packets to and from an interface during initialization. The WLAPs involved and the wireless operation state, see *3.8 Radio Statistics* on page 142, affect the *WLAP Forward Delay* time. This delay ensures that all WLAP nodes are heard. The default is 5 seconds per wireless operation state. The *WLAP Forward Delay* of the Root AP overwrites the *WLAP Forward Delay* of designated WLAPs.

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        UI                  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 in to 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 enter 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 `6Ø` 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:

1. Select the *Serial Port Configurations* screen from the *Main Menu*.
2. Set the *Dialout Mode* to `Auto`.

3. Select `Save-[F1]` to save the changes in NVM.
4. Select the *Special Functions* screen from the *Main Menu*.
5. Select Reset AP.

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

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. An AP can be accessed through the SNMP Trap Manager to configure settings and parameters, Symbol does not recommend this process.

Configuring the encryption Keys using the SNMP Trap Manager overrides the Key values for the AP or APs accessed by the SNMP Trap Manager.

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 disk for specific entries.

The AP supports SNMP Version1, a limited feature set of SNMP Version 2, MIB-II, IEEE 802.11 MIB and the SYMBOL.MIB.

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

```
Symbol Access Point
                            SNMP Configuration

.SNMP Agent Mode          Read/Write
.Trap Host1               TrapHost1.sj.symbol.com
.Trap Host2               TrapHost2.sj.symbol.com
.Read-Only Community      *******
.Read-Write Community     *******
.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
WLAP Connection 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:

In Firmware version 04.02-08 and above changing the *Read/Write Community* name, does not change the *Admin* password. The *Admin and Read/Write Community name* default password is Symbol.

SNMP Agent Mode	Defines the SNMP agent mode: *Disabled* disables SNMP functions. *Readonly* allows get and trap operations. *Read/Write* (default) allows get, set and trap operations.
Trap Host1	The Trap Host1 manager IP address or name up to 49 characters.
Trap Host2	The Trap Host2 manager IP address or name up to 49 characters.
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 31 characters for users with read/write privileges.
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 value is `Disabled`.
Access Cntrl Violation	Send a trap to manager when an ACL violation occurs. The default value is `Disabled`.

MU State Change	Send a trap to the manager when the AP state with an MU changes: • MU associated • MU unassociated • MU state changes from PSP to CAM mode • MU state changed from CAM to PSP mode.
WLAP Connection Change	If enabled, this trap generates the following enterprise-specific traps: • Root WLAP Up Indicates that the Root AP connection is setup and ready to forward data. • Root WLAP Lost If the current WLAP fails to receive a Beacon packet from its Root AP within one second, it considers the Root AP lost. The WLAP eventually resets itself to reestablish the network topology. • Designated WLAP Up Indicates that the Designated WLAP connection is setup and ready to forward data. • Designated WLAP Lost If the current WLAP fails to receive a *Config BPDU* packet from its Designated WLAP for *MAX AGE* time, it considers the Designated WLAP lost.

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.

1. Verify the values set reflect the network environment.
   Change them as needed.
2. Select `OK` or `Save` to register settings by writing changes to NVM.
   Selecting `Save` displays a confirmation prompt.
3. Select `Save ALL APs-[F2]` to save the *SNMP Configuration* information to all APs with the same Net_ID (ESS).
   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.
4. Select `Cancel-[ESC]` to disregard any changes made to this screen and return to the previous menu.

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 the values set reflect the network environment. Change them as needed.
7. Select `Delete-[F1]`to delete a range of Mobile Units.

8. Select `Add-[F2]`to add a range of Mobile Units.
9. Select `Save ALL APs-[F2]` to save the *Ranges of Allowed Mobile Units* information to all APs with the same Net_ID (ESS).
   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. Select `Exit-[ESC]`to return to the previous menu.

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. Select `Save ALL APs-[F2]` to save the *Adding Allowed MUs* information to all APs with the same Net_ID (ESS).
   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.

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 Allow/Disable the ACL

To switch between `Allowed, Disallowed` or `Disabled` 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 select `Allowed, Disallowed` or `Disabled`.
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 enter 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 for associated MUs to the ACL.
3. Press ENTER.

2.8.7 Load ACL File Via TFTP

The Ethernet TFTP update method requires a connection between the AP and a computer on the same Ethernet segment. Verify the computer 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 update method requires a connection between the AP and a TFTP server. The TFTP server can be running on a Symbol Spectrum24 device.

Loading the ACL file requires a TFTP server running in the background.

To load the ACL file:

1. Copy the ACL file *ap_acl.txt* to the terminal or computer hard disk.
2. Telnet to the AP using its IP address.
3. At the prompt enter the password:

   ```
   Symbol
   ```

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

   The AP displays the *Main Menu*.
4. Select *Special Functions* from the *Main Menu* and press ENTER.

Verify the paths accuracy for the File name. See step one.

5. Enter the TFTP Server IP address or name in the *TFTP Server* field.

6. Press F1 to save settings.
7. The Special Functions Menu displays `Are You Sure? yes no` Type Y.
8. *Select* `Load ACL from file via TFTP`.
9. Press ENTER.

   The *Special Functions Menu* displays

   ```
   Loading ...
   ```

10. The download is complete when the UI displays:

    ```
    Set Succesfully
    ```

11. Repeat process for other APs in the network.

2.8.8 Load ACL from File Via Xmodem

This option from the *Special Functions* menu creates an ACL from a user defined ACL file (*ap_acl.txt*).

1. Enter the *Special Functions* screen from the *Main Menu*.
2. Select `Load ACL from File via XMODEM` to load site specific ACL.
3. Press ENTER. The *Special Functions Menu* screen displays:

   ```
   Please send ACL file...
   ```

4. From the emulation program menu bar, select Transfer.
5. Select the Send File command.
6. Select the Browse button and locate the file *ap_acl.txt*.
7. Select the XModem protocol from the drop down list.
8. Select the Send button.
9. The terminal or computer displays the transfer process through a progress bar.
10. The download is complete when the UI displays:

    ```
    Set Successfully
    ```

The following is an example of the *ap_acl.txt* file.

[ACLIndividual]
Add 00:A0:F8:FF:01:FB
Add 00:A0:F8:FF:01:FC
Add 00:A0:F8:FF:01:FD
Add 00:A0:F8:FF:01:FE
Add 00:A0:F8:FF:01:FF
;Delete00:A0:F8:FF:00:0A
;Delete00:A0:F8:FF:00:1A
;Delete00:A0:F8:FF:00:2A

[ACLRange]

Add 00:A0:F8:FD:01:00 00:A0:F8:FF:01:20
Add 00:A0:F8:FD:02:00 00:A0:F8:FD:02:20
Add 00:A0:F8:FD:03:00 00:A0:F8:FD:03:20
Add 00:A0:F8:FD:04:00 00:A0:F8:FD:04:20
Add 00:A0:F8:FD:08:00 00:A0:F8:FD:08:20
;Delete 00:A0:F8:FD:05:00 00:A0:F8:FD:05:20

[AddressFilter]
Add 00:A0:F8:FF:00:03
Add 00:A0:F8:FF:00:04
Add 00:A0:F8:FF:00:05

[TypeFilter]
Add 807e
Add 6006
Add 8001

2.9 Configuring Address Filtering

The AP can keep a list of MAC addresses for 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

00:A0:F8:F0:00:0A              00:A0:F8:F0:48:01
00:A0:F8:F0:00:01              00:A0:F8:F0:00:02
00:A0:F8:FE:10:01
00:A0:F8:F0:03:0A
00:A0:F8:F0:03:A1
00:A0:F8:B0:A0:09
00:A0:F8:F1:A2:08
00:A0:F8:F0:08:08
00:A0:F8:F2:06:01
00:A0:F8:F2:0B:02
00:A0:F8:F2:0C:04
00:A0:F8:F0:04:01
00:A0:F8:F4:03:02
00:A0:F8:F0:07:0C
00:A0:F8:F0:0C:07
00:A0:F8:F1:21:30
00:A0:F8:F0:20:A1
00:A0:F8:F0:A0:03
00:A0:F8:F0:09:0B

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

1. Select `Save ALL APs-[F2]` to save the *Disallowed Addresses* information to all APs with the same Net_ID (ESS).
   Users can perform this option only among the same hardware platforms and firmware versions.

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 individually 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.

2.9.3 Removing All Disallowed MUs

The AP provides a facility to remove all MUs from the *Disallowed Addresses* list.

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

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-[F1]`.

2.10.3 Removing All Filter Types

The AP provides a facility to remove all MUs from the *Type Filtering* list.

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

2.10.4 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. Select `Save ALL APs-[F2]` to save the *Type Filtering Setup* information to all APs with the same Net_ID (ESS) .
   Users can perform this option only among the same hardware platforms and firmware versions.

2.11 Updating AP Configuration from File

Options for updating the AP configuration:

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

Users can simplify the AP configuration process by entering only the necessary site specific parameters into the ap_cfg.txt file. Use any text editor, to specify only the items that need to be changed in the ap_cfg.txt file to customize for the site specific network environment.

Edit the following *ap_cfg.txt* file required for manual configuration of the AP, to match the site specific network settings.;Sample AP Configuration File

```
[APInstallation]
;UnitName              testhost.symbol.com ; up to 31 chars
;IPAddress             157.235.101.33      ; comment out if DHCP enabled
Gateway1               157.235.101.1
Gateway2               157.235.101.2
SubNetMask             255.255.255.0
NetID                  Engineering         ;up to 32 chars
;AntennaSelect         PrimaryOnly         ;"PrimaryOnly","Primary&Secondary"
DHCP                   Enabled             ;"Disabled", "Enabled","DHCP Only", "Bootp Only"
DNSServer1             157.235.101.1
DNSServer2             157.235.101.2
DNSServer3             157.235.101.3

[SpecialFunction]
;FWFileName            uap_fw.bin          ; up to 49 chars
;HTMLFileName          uap_html.bin        ; up to 49 chars
ConfigFileName         ap_cfg.txt          ; up to 49 chars
ACLFileName            ap_acl.txt          ; up to 49 chars
;HelpURL               www.symbol.com      ; up to 49 chars
TFTPServer             tftp.apfw.symbol.com; ip address or name up to 49 characters


[SystemConfig]
;HoppingSet            2                   ; 1 - 3
;HoppingSequence       18                  ; 1 - 26
EthernetTimeOut        0                   ; 0: disabled,
                                           ; 1: hw detection,
                                           ; 2,3,4: WLAP detection,
                                           ; 30 - 255 seconds: sw detection
TelnetLogins           Enabled             ; "Disabled", "Enabled"
AgentAdInterval        0                   ; 0 - 1200 seconds
S24MobileIP            Disabled            ; "Disabled", "Enabled"
MobileHomeMD5Key       Symbol              ; up to 13 chars
APAutoConfigure        Enabled             ; "Disabled", "Enabled"
InternationalMode      Disabled            ; "Disabled", "Enabled"
WebServer              Enabled             ; "Disabled", "Enabled"
AccessControl          Disabled            ; "Disabled", "Allowed","Disallowed"
```

```
TypeFiltering          Disabled           ; "Disabled", "Forward","Discard"
WNMPFunctions          Enabled            ; "Disabled", "Enabled"
APAPStateExchange      Enabled            ; "Disabled", "Enabled","1", "4"
EthernetInterface      On                 ; "Off", "On"
PPPInterface           Off                ; "Off", "On"
RFInterface            On                 ; "Off", "On"
DefaultInterface       Ethernet           ; "Ethernet", "PPP"
MUMUDisallowed         Off                ; "Off", "On"
;AdminPassword         admin              ; up to 13 chars
;UserPassword          user               ; up to 13 chars


[RFConfig]
DTIMInterval           1Ø                 ; 1- 255
BCMCQMax               1Ø                 ; Ø - 1ØØ
ReassemblyTimeout      9ØØØ               ; Ø - 9999
MaxRetriesData         15                 ; Ø - 32
MaxRetriesVoice        5                  ; Ø - 32
MulticastMaskData      Ø9ØØØE ØØ
MulticastMaskVoice     Ø1ØØ5E ØØ
HopDwellTime           1ØØ                ; 2Ø - 39Ø
BeaconInterval         1ØØ                ; 2Ø - 1ØØØ
AcceptBroadcastESSID   Disabled           ; "Disabled", "Enabled"
MUInactivityTimeout    6Ø                 ; 3 - 6ØØ
RateControl            1reqd2opt          ; "1only", "1reqd2opt", 2only", "1&2reqd"
FragmentationThreshold 572                ; 256 - 2346
RTSThreshold           1514               ; Ø - 2347
WLAPMode               Disabled           ; "Disabled", "Enabled", "LinkRequired"
WLAPPriority           8ØØØ               ; Ø - FFFF
WLAPManualBSSID        ØØ:A Ø:F8:ØØ:B8:B9
WLAPHelloTime          2Ø                 ; Ø - 9999
WLAPMaxAge             1ØØ                ; Ø - 9999
WLAPForwardDelay       5                  ; Ø - 9999
WEPAlgorithm           OpenSystemOnly     ;"OpenSystemOnly","SharedKeyOnly","Open&Shared"
EncryptionKeyID        1                  ; 1 - 4
EncryptionKey1         1Ø11121314
EncryptionKey2         2Ø21222324
EncryptionKey3         3Ø31323334
EncryptionKey4         4Ø41424344
```

```
IntelligentQueuing    Enabled            ; "Disabled", "Enabled"


[SerialPortConfig]
PortUse               UI                 ; "UI", "PPP"
ConnectMode           Answer             ; "Answer", "Originate"
ModemConnected        No                 ; "No", "Yes"
DialoutMode           Auto               ; "Manual", "Auto"
ModemSpeaker          On                 ; "Off", "On"
DialoutNumber         1234567            ; up to 31 chars
AnswerWaitTime        6Ø                 ; Ø - 9999
InactivityTimeout     5                  ; Ø - 9999
PPPTimeout            3                  ; Ø - 9999
PPPTerminates         1Ø                 ; Ø - 9999


[SNMPConfig]
AgentMode             ReadOnly           ; "Disable",; "ReadOnly"; "ReadWrite"
TrapHost1             157.235.1Ø1.1Ø1    ; ip address or name up to 49 characters
TrapHost2             157.235.1Ø1.1Ø2    ; ip address or name up to 49 characters
ReadOnlyCommunity     public             ; up to 31 chars
ReadWriteCommunity    admin              ; up to 31 chars
AllTraps              Enabled            ; "Disabled", "Enabled"
ColdBoot              TrapHost2Only      ; "Disabled", "TrapHost1Only","TrapHost2Only"
                                         ; "AllTrapHosts"
AuthenticationFailure TrapHost1Only      ; "Disabled",; "TrapHost1Only";"TrapHost2Only"
                                         ; "AllTrapHosts"
RadioRestart          TrapHost2Only      ; "Disabled", "TrapHost1Only", "TrapHost2Only"
                                         ; "AllTrapHosts"
AccessViolation       AllTrapHosts       ; "Disabled",; "TrapHost1Only","TrapHost2Only"
                                         ; "AllTrapHosts"
MUStateChange         TrapHost1Only      ; "Disabled", "TrapHost1Only", "TrapHost2Only"
                                         ; "AllTrapHosts"
WLAPConnectionChange  TrapHost2Only      ;"Disabled", "TrapHost1Only", "TrapHost2Only"
                                         ; "AllTrapHosts"
DHCPChange            AllTrapHosts       ; "Disabled", "TrapHost1Only", "TrapHost2Only"
                                         ; "AllTrapHosts"
```

```
[EventLogConfig]
AnyEventLogging       Enabled           ; "Disabled", "Enabled"
SecurityViolation     Disabled          ; "Disabled", "Enabled"
MUStateChanges        Enabled           ; "Disabled", "Enabled"
WNMPEvents            Enabled           ; "Disabled", "Enabled"
SerialPortEvents      Enabled           ; "Disabled", "Enabled"
APAPMessages          Disabled          ; "Disabled", "Enabled"
TelnetLogins          Enabled           ; "Disabled", "Enabled"
SystemEvents          Enabled           ; "Disabled", "Enabled"
EthernetEvents        Disabled          ; "Disabled", "Enabled"
```

The Ethernet TFTP update method requires a connection between the AP and a computer on the same Ethernet segment. Verify the computer 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 update method requires a connection between the AP and a TFTP server. The TFTP server can be running on a Symbol Spectrum24 device.

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

To update the AP configuration:

1. Copy the configuration file AP_CFG.TXT to the terminal or computer hard disk.
2. Telnet to the AP using its IP address.
3. At the prompt enter the password:

   ```
   Symbol
   ```

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

   The AP displays the *Main Menu*.

4. Select *Special Functions* from the *Main Menu* and press ENTER.

5. *Press F3 to view the Special Functions update page.*

```
Access Point
                              Special Functions Menu

 Use TFTP to update Access Point's:
    Firmware   HTML file   Firmware and HTML File   Config
  Use XMODEM to update Access Point's:
    Firmware   HTML file   Firmware and HTML File   Config

  Use TFTP to update ALL Access Points':
    Firmware   HTML file

  Alter Filename(s)/HELP URL/TFTP Server
    .Firmware Filename uap_fw.bin
    .HTML Filename     uap_html.bin
    .Config. Filename  ap_cfg.txt
    .ACL Filename      ap_acl.txt
    .HELP URL
    .TFTP Server       111.111.12.137




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

6. Select *Alter Filename(s)/HELP URL/TFTP Server* and press ENTER.
7. Enter the configuration file name (AP_CFG.TXT) in the `Config. Filename` field:

Change this only if the user or system/network administrator requires a new File name. The default is AP_CFG.TXT.

Ensure the File name is AP_CFG.TXT unless the user changed the File name.


Note

Verify the paths accuracy for the File name. See step one.

8. Enter the TFTP Server IP address or name in the *TFTP Server* field.
9. Press F1 to save settings.
10. The Special Functions Menu displays `Are You Sure? yes no` Type Y.


Caution

If using telnet to connect to the AP through 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 configuration file over the serial interface.

11. *Under the function heading* `Use TFTP to Update Access Point's:` *select* `Config`.
12. Press ENTER.
13. The *Special Functions Menu* displays `Are You Sure? yes no` Type Y.


Note

The Telnet session ends when the user answers Y at the prompt.

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


Note

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

The AP resets when the file transfer completes.

14. Telnet to the AP using its IP address.
15. At the prompt enter the password:

```
Symbol
```

The password is case-sensitive.

The AP displays the *Main Menu*.

16. Verify that the network settings are correct on the *System Summary* screen.
17. Press CTRL+D to end Telnet session.
18. Repeat process for other APs in the network.

2.11.1 Updating using Xmodem

The Xmodem upgrade method requires a direct connection between the AP and a computer 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 configuration:

1. Copy the configuration file AP_CFG.TXT to the computer hard disk that runs a terminal emulation program.
2. Attach a null modem serial cable from the AP to the computer serial port.
3. On the computer, 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 enter the password:

```
Symbol
```

The password is case-sensitive.

9. Enter the *Special Functions* screen.
10. *Press F3 to view the Special Functions update page.*
11. Under the function heading `Use XMODEM to Update Access Point's:`, select `Config`.
12. Press ENTER.

Selecting `Config` downloads the file AP_CFG.TXT.

13. The *Special Functions Menu* displays `Are You Sure? yes no` Type Y.

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

When using Xmodem, verify the file is correct 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 AP_CFG.TXT.
16. Select the XModem protocol from the drop down list.
17. Select the Send button.
18. The terminal or computer displays the transfer process through a progress bar.
19. The download is complete when the UI displays:

    ```
    Download Successful
    ```

    If the Config update fails, the UI displays an error message indicating the cause.

The AP automatically resets after the file transfer completes.

- Repeat this process for other APs in the network.

2.12 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 MUs associated with it. MUs cleared from one AP try to reassociate with the AP or another nearby AP.

2.13 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	Ethernet events such as packet transmissions and errors.

3. Verify the values set reflect the network environment. Change them as needed.
4. Select `OK` or `Save` to register settings by writing changes to NVM. Selecting `Save` displays a confirmation prompt.
5. Select `Save ALL APs-[F2]` to save the *Event Logging Configuration* information to all APs with the same Net_ID (ESS). 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. Select `Cancel-[ESC]` to disregard any changes made to this screen and return to the previous menu.

2.14 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 UAP_FW.BIN and UAP_HTML.BIN.

2.14.1 Updating using TFTP

The Ethernet TFTP upgrade method requires a connection between the AP and a computer on the same Ethernet segment. Verify the computer 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 UAP_FW.BIN and UAP_HTML.BIN on the terminal or computer hard disk.
2. Telnet to the AP using its IP address.
3. At the prompt enter the password:

   ```
   Symbol
   ```

The password is case-sensitive. Set the *System Passwords* 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 UAP_FW.BIN and UAP_HTML.BIN.

`uap_fw.bin` or `uap_html.bin`

Ensure the File name is UAP_FW.BIN or UAP_HTML.BIN unless the user changed the File name.

Verify the paths accuracy for the File name. See step one.

1. Enter the TFTP Server IP address in the *TFTP Server* field.
2. Press ENTER.
3. Press F1 to save settings.

If using telnet to connect to the AP through 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.

4. Select *Special Functions* from the *Main Menu*.
5. Under the function heading `Use TFTP to Update Access Point's:`, select `Firmware` or `Firmware and HTML File`.
6. Press ENTER.
7. The Special Functions Menu displays `Are You Sure? yes no` 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.

8. Telnet to the AP using its IP address.
9. At the prompt enter the password:

   ```
   Symbol
   ```

The password is case-sensitive.

The AP displays the *Main Menu*.

10. Verify that the version number is correct on the *System Summary* screen.
11. Press CTRL+D to end Telnet session.
12. Repeat process for other APs in the network.

2.14.2 Updating using Xmodem

The Xmodem upgrade method requires a direct connection between the AP and a computer 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 UAP_FW.BIN and UAP_HTML.BIN to the computer hard disk that runs a terminal emulation program.

2. Attach a null modem serial cable from the AP to the computer serial port.
3. On the computer, 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 enter 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 file or Firmware and HTML File`.
11. Press ENTER.

Selecting `Firmware, HTML file` or `Firmware and HTML File` downloads the files UAP_FW.bin and HTML.bin files separately. Ensure that 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 UAP_FW.BIN or UAP_HTML.BIN are the firmware files.

When using Xmodem, verify the file is correct 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), UAP_FW.BIN or UAP_HTML.BIN.
16. Select the XModem protocol from the drop down list.
17. Select the Send button.
18. The terminal or computer 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.

2.15 Auto Upgrade all APs through Messaging

The `Update ALL Access Points` option up/downgrades the firmware for all associated APs with the same Net_ID on the same subnet and includes all recognized hardware platforms regardless of firmware version. The initiating AP is responsible for sending 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 up/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 at a time from accessing the TFTP server and causing network congestion.

The Ethernet TFTP upgrade method requires a connection between the AP and a computer on the same Ethernet segment. Verify the computer 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 UAP_FW.BIN and UAP_HTML.BIN on the terminal or computer hard disk.
2. Telnet to the AP using its IP address.
3. At the prompt enter the password:

   `Symbol`

The password is case-sensitive. Set the *System Passwords* 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. Enter the firmware file name in the *Download Filename* field:

   `uap_fw.bin` or `uap_html.bin`

   Change this only if the user or system/network administrator requires a new File name. The defaults are UAP_FW.BIN and UAP_HTML.BIN.

Ensure the File name is UAP_FW.BIN or UAP_HTML.BIN unless the user changed the File name.

Verify the paths accuracy for the file name. (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.
10. Select *Special Functions* from the *Main Menu*.

11. Select `Use TFTP to Update Access Point's:` and press ENTER.
12. The Special Functions Menu displays `Are you sure yes no` 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.


Note

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

    The AP resets when the file transfer and flash programming completes.
10. Telnet to the AP using its IP address.
11. At the prompt enter the password:

    `Symbol`


Note

The password is case-sensitive.

    The AP displays the *Main Menu*.
13. Verify that the version number is correct on the *Known APs* screen for all APs with the same Net_ID and hardware platform.
14. Press CTRL+D to end Telnet session.

2.16 Performing Pings

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

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

No pings received 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:R2:E
 ØØ:AØ:F8:1Ø:4B:AB: P:R2:V
 ØØ:aØ:F8:1Ø:4A:13: P:R1:
 ØØ:AØ:F8:1Ø:3C:85: C:R2:









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

3. Press the TAB key to highlight the MAC address of the station to ping
4. Select `Ping-[F1]` to display the *Packet Ping Setup* screen:

```
                      Packet Ping Setup

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









                     [Start-CR]          [Cancel-ESC]

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

3. Enter the number of Pings (`1` to `539`), length of packets in bytes (`1` to `539`) and data content in hex (`ØxØØ` to `ØxFF`).

4. Select *Start-[CR]* to begin ping. The AP dynamically displays ping packets transmitted and received:

```
                    Pinging Station...


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




                    Press any key to stop
```

5. To abort the process, press any key.

2.17 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.

2.18 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 that display 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                Restore Factory Config.
   Clear MU Table                      Save Configuration
   Clear ACL                           Save Config. to All APs
   Clear Address Filters
   Clear Type Filters

   Load ACL from File via TFTP
   Load ACL from File via XMODEM
   Load ACL from MU List

   Modem Dialout
   Modem Hangup

   Reset AP

   Run MKK Tests



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

2. Select *Save Configuration* and press ENTER.
   The `Save Config. to 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 version.
   The NVRAM stores saved configuration information. To clear the NVRAM-stored configuration, see *2.20 Restoring the Factory Configuration* on page 125.

2.19 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.

2.20 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 depending on the DHCP setting.

DHCP Disabled	all AP configuration and statistics are reset, except the *AP Installation* screen
DHCP Enabled	all AP configuration and statistics are reset

To restore factory configuration:

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

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) ØØ:AØ:F8:73:51:F2     Access Control    Disabled
 IP Address         157.235.95.225        WLAP Mode         Enabled
 Net_ID (ESS)       1Ø1
                                          Model Number      AP-3Ø21
 Hopping Set          1                   Serial Number     ALPH3Ø69
 Hopping Sequence    23                   Hardware Revision Rev 1
 Country            International Mode
 Antenna Selection  Primary Only          AP Firmware Ver.  Ø4.Ø2-Ø6
 Rate Control          2 only             HTML  File  Ver.  Ø3.ØØ-Ø1
 WEP Algorithm      Open System Only

 Current MUs           Ø                  Start Flashing All LEDs
 Total Assoc           Ø                  Reset AP


 System Up Time       27:54:21


                                Exit-[ESC]
```

Information includes:

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.		
Hopping Set	An industry standard requires three hop sets identified by the numerals `1-3`. To establish these hop sets, divide the number of hop sequences for each country by three.		
Hopping Sequence	3 sets of	1 through 26	Standard
	3 sets of	1 through 11	Israel and France
	3 sets of	1 through 9	Spain
	3 sets of	1 through 4	Japan and Korea
	3 sets of	1 through 6	Belgium (outdoor)
	3 sets of	1 through 9	Mexico
Country	Identifies AP country code that in turn determines the AP hopping sequence and channel range.		
Antenna Selection	Indicates if the AP is configured for single or dual antenna mode.		

Rate control	defines the data transmission rate: *1 reqd, 2 optl* - allows the AP to automatically select the best transmit rate allowed by the conditions. All management and broadcast traffic transmits at 1 Mbps. This mode allows a mixture of 1 Mbps and 2 Mbps radios in the same network. *2 only* - forces the AP to transmit at 2 Mbps and does not allow 1 Mbps stations to associate with it. *1 only* - forces the AP to always transmit at the lower rate regardless of whether a station is capable of the higher rate. *1 & 2 reqd* - allows the AP to automatically select the best transmit rate allowed by the conditions and allows the AP to ACK received 2Mb packets at 2 Mbps. Also allows *Broadcast traffic* matching the *Broadcast Mask* sending at 2 Mbps.
WEP Algorithm	Defines the number of bits and type of WEP algorithm used. Admin privileges are required to make changes to this parameter. The default is `Open`.
Current MUs	Specifies the current number of MUs associated with this AP.
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 reaching a maximum `12Ø` hours.
Access Control	Specifies if the access control feature is *Disabled* (default setting), *Allowed* or *Disallowed*. If *Allowed*, the ACL specifies the MAC addresses of the MUs that can associate with this AP. If *Disallowed* only the MUs with their MAC address on the disallowed list will be prevented from associating with this AP.

WLAP Mode	Specifies if enabling the wireless AP operation status. If enabled, the AP sets up automatically for wireless operation. This feature is `Disabled` by default.
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.
HTML File Ver	Specifies the HTML file version.
Start Flashing All LEDs	Begins a test routine to check the LED functionality and allows the user to determine the AP location.
Reset AP	Clears the APs statistics and restores the last saved configuration.

- 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     125775Ø           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]
```

  - Select `Refresh` at the status display to update the values manually.
  - Select `Timed` to automatically update this display every two seconds.
  - Press ESC to return to the previous menu.

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]
```

  - Select `Refresh` at the status display to update the values manually.
  - Select `Timed` to automatically update this display every two seconds.
  - Press ESC to return to the previous menu.

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 only 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


ØØ:AØ:F8:29:C9:E2: C:R2:E
ØØ:AØ:F8:1Ø:4B:AB: P:R2:V
ØØ:AØ:F8:1Ø:4A:13: P:R1:
ØØ:AØ:F8:1Ø:3C:85: C:R2:




      Information-[CR]    Ping-[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: 1 for 1 Mbps, 2 for 2 Mbps.
e	Encryption is enabled for this MU.
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 *2.16 Performing Pings* on page 121.

  - Select `Next` to display the next screen.
  - Select `Timed` to automatically update this display every two seconds.
  - Press ESC to return to the previous menu.

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

```
Symbol Access Point

                    Information for MU:  ØØ:AØ:F8:26:FC:45


 Interface              WLAP          Packets Sent               21
 State                  Associated    Packets Rcvd              334
 Power Mode             PSP           Bytes Sent               2243
 Station id               3           Bytes Rcvd              29573
 Begin Current Assoc      Ø:ØØ:47     Discard Pkts/CRC            Ø
 Supported Rates        1 Mb/s
 Current Xmt Rate       1 Mb/s        Last Activity         Ø:ØØ:16
 Priority               Normal        Last Data Activity    Ø:ØØ:47
 Encryption             Off



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

Information displayed includes:

Interface — the AP interface shows the MU connection as: 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 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.
Priority	Indicates whether the MU is a voice or data type device. *Voice* indicates packet delivery is time critical and a high priority. *Normal* indicates packet delivery is not time critical.
Encryption	MU encryption type supported: *On* or *Off*.
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.

- Select `Refresh` at the status display to update the values manually.
- Press ESC to return to the previous menu.

3.5 Mobile IP

The following tables display the mapping of MUs to mobility agents. See *1.3.8 Mobile IP* on page 34.

- 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     157.235.95.180
 157.235.95.125     157.235.95.180
 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, Unit Names (select the *Switch* option to display Unit Names) 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 multicast message to APs every 12 seconds determines this list.

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 version.

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

```
Symbol Access Point              Known Access Points

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

 ØØ:AØ:F8:78:43:5D  157.235.96.52      1    8    Ø    Ø     Ø4.Ø1-13
 ØØ:AØ:F8:FF:FF:FF  157.235.99.34      1   16    Ø    Ø
 ØØ:AØ:F8:1Ø:A7:Ø4  157.235.99.65      1   14    2    5
 ØØ:AØ:F8:1Ø:31:66  157.235.99.47      2    6    Ø    Ø                *

                                        X = non-8Ø2.11 AP
  Ping-[F1]    Delete-[F2]    Next-[F3]   Previous-[F4]   Switch   Exit-[ESC]
```

- Select `Switch` to display:

```
Symbol Access Point              Known Access Points

                              Net_ID:        1Ø1
 IP Address        Unit Name

157.235.96.52  ap123.apeng.symbol.com
157.235.99.34  ap124.aptes.symbol.com
157.235.99.65  ap125.apsup.symbol.com
157.235.99.65  ap126.apsup.symbol.com




                                    X = non-8Ø2.11 AP
Ping-[F1]    Delete-[F2]    Next-[F3]   Previous-[F4]   Switch   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.
	An x after the IP address indicates the AP on this line is not using the 802.11 protocol. Upgrade its firmware.
HST	Hop set
HSQ	AP hopping sequence or pattern.
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 is a functional part of the network or *away*. Away indicates the last known transmission took place 12 or more seconds.
Unit Name	The user assinged AP name. Displayed when the *Switch* option is selected in the *Known Access Points Screen*

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

- Select `Refresh` at the status display to update the values manually.
- Select `Timed` to automatically update this display every two seconds.
- Press ESC to return to the previous menu.

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                  Ø
 Encrypted Pkts Sent             Ø     Encrypted Pkts Rcvd             Ø
 Data Bytes Sent                 Ø     Data Bytes Rcvd                 Ø

 BC/MC Packets Sent            121     BC/MC Packets Rcvd              Ø
 BC/MC Bytes Sent             29Ø4     BC/MC Bytes Rcvd                Ø

 Sys Packets Sent                Ø     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]    WLAP-[F3]    Exit-[ESC]
```

Radio performance statistics include:

Data Packets Sent	total data packets transmitted
Encrypted Pkts Sent	total encrypted 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
Encrypted Pkts Rcvd	total encrypted 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.

- Select `Refresh` at the status display to update the values manually.
- Select `Timed` to automatically update this display every two seconds.
- Press ESC to return to the previous menu.

- To display the *WLAP RF Statistics* screen select `WLAP-[F3]`.

```
Symbol Access Point            WLAP RF Statistics

 Current # WLAP  Itf   Ø               Root Interface       Ø
 Current # INTLR Itf   Ø               Root Priority     8ØØØ hex
 Current State    Functional           Root MAC Addr     ØØ:AØ:F8:73:51:F2
 Priority         8ØØØ hex             Root Path Cost       Ø


         -------------  Wireless AP Interface Table  ---------------

 Itf      WLAP Itf      Itf   Path         Designated             Designated
 ID       MAC Addr     State  Cost    Root ID      Cost      WLAP ID      Itf ID

8ØØ1 ØØ:ØØ:ØØ:ØØ:ØØ:ØØ  DIS    1  8ØØØØØaØf87351F2  Ø   8ØØØØØaØf87351F2   8ØØ1
8ØØ2 ØØ:ØØ:ØØ:ØØ:ØØ:ØØ  DIS    1  8ØØØØØaØf87351F2  Ø   8ØØØØØaØf87351F2   8ØØ2
8ØØ3 ØØ:ØØ:ØØ:ØØ:ØØ:ØØ  DIS    1  8ØØØØØaØf87351F2  Ø   8ØØØØØaØf87351F2   8ØØ3
8ØØ4 ØØ:ØØ:ØØ:ØØ:ØØ:ØØ  DIS    1  8ØØØØØaØf87351F2  Ø   8ØØØØØaØf87351F2   8ØØ4


     Refresh-[F1]   Timed-[F2]   INTLR-[F3]   Previous-[F4]   Exit-[ESC]
```

Where:

Current # WLAP Itf Refers to the current Wireless AP interfaces in use in a `1-4` range.

Current # INTLR Itf Refers to the current International Roaming Access Bridge interfaces in use in a `1-1Ø` range.

Current State	On initialization, the AP can be in any of the following states of wireless operation: • starting the initializing process: – Initializing – Sending Probe – *Send Assoc Req* (association request) – *Send Cfg BPDU (configuration Bridge Protocol Data Unit)* – Wait for Probe – *Send Probe Rsp* (probe response) – *Send Assoc Rsp* (association response) – *Send Cfg Rsp* (configuration response) – *Received Root Rsp* (Root response) • operating in wireless mode: – Root WLAP lost – Disabled – Functional The *1.2.2 Cellular Coverage* on page 17 provides an explanation of a Root AP.
Priority	States the WLAP priority value assigned to the AP under *2.5 Configuring Radio Parameters* on page 74.
Root Interface	States the interface leading to the Root AP.
Root Priority	States the priority value of the Root AP.
Root MAC Address	States the MAC address of the Root AP.
Root Path Cost	Indicates the hops between the current WLAP and the Root AP.
Itf ID	Identifies the wireless interface the AP uses to communicate with another device.
WLAP Itf MAC Addr	States the MAC address of the associated WLAP.

Itf State	Identifies the state of the interface from: • *DIS* - the interface is disabled • *LIS* - the AP listens for information • *LRN* - the AP learns the information • *FWD* - the AP forwards data • *BLK* - the AP blocks transmission.
Path Cost	An abstract unit added to the *Root Path Cost* field in the *Config BPDU* received on this interface. The unit represents a hop on the path to the Root AP.
Designated Root ID	An ID designated by the Root AP. APs in WLAP mode negotiate the position of Root AP at power up. The AP with the lowest Root ID, path and WLAP ID becomes the Root AP. The Root ID and the WLAP ID are 16-digit numbers. The first 4 digits represent the Priority value and the remaining 12 digits represent the MAC address of the AP.
Designated Cost	A path cost designated by the Root AP.
Designated WLAP ID	A WLAP ID assigned by the Root AP.
Designated Itf ID	An Itf ID assigned by the Root AP.

  – Select `Refresh` at the status display to update the values manually.
  – Select `Timed` to automatically update this display every two seconds.
  – Press ESC to return to the previous menu.

- To display the *International Roaming Access Bridge Interface Table* select `INTLR`.

This screen is for future applications in development. For more information, contact a Symbol Representative.

```
Symbol Access Point

     -------  International Roaming Access Bridge Interface Table  -------

 Itf      INTLR Itf     Itf   Path         Designated             Designated
 ID       MAC Addr     State  Cost    Root ID      Cost    INTLR ID       Itf ID

800F 00:00:00:00:00:00  DIS    1  800000a0f87351F2  0   800000a0f87351F2   800F
8010 00:00:00:00:00:00  DIS    1  800000a0f87351F2  0   800000a0f87351F2   8010
8011 00:00:00:00:00:00  DIS    1  800000a0f87351F2  0   800000a0f87351F2   8011
8012 00:00:00:00:00:00  DIS    1  800000a0f87351F2  0   800000a0f87351F2   8012
8013 00:00:00:00:00:00  DIS    1  800000a0f87351F2  0   800000a0f87351F2   8013
8014 00:00:00:00:00:00  DIS    1  800000a0f87351F2  0   800000a0f87351F2   8014
8015 00:00:00:00:00:00  DIS    1  800000a0f87351F2  0   800000a0f87351F2   8015
8016 00:00:00:00:00:00  DIS    1  800000a0f87351F2  0   800000a0f87351F2   8016
8017 00:00:00:00:00:00  DIS    1  800000a0f87351F2  0   800000a0f87351F2   8017
8018 00:00:00:00:00:00  DIS    1  800000a0f87351F2  0   800000a0f87351F2   8018

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

Itf ID	Identifies the wireless interface the AP uses to communicate with another device.
INTLR Itf MAC Addr	States the MAC address of the associated International Roaming Access Bridge.

Itf State	Identifies the state of the interface from: • *DIS* - the interface is disabled • *LIS* - the AP listens for information • *LRN* - the AP learns the information • *FWD* - the AP forwards data • *BLK* - the AP blocks transmission.
Path Cost	An abstract unit added to the *Root Path Cost* field in the *Config BPDU* received on this interface. The unit represents a hop on the path to the Root AP.
Designated Root ID	An ID designated by the Root AP. APs in International mode negotiate the position of Root AP at power up. The AP with the lowest Root ID, path and WLAP ID becomes the Root AP. The Root ID and the WLAP ID are `16`-digit numbers. The first `4` digits represent the Priority value and the remaining `12` digits represent the MAC address of the AP.
Designated Cost	A path cost designated by the Root AP.
Designated INTLR ID	An International Roaming Access Bridge ID assigned by the Root AP.
Designated Itf ID	An Itf ID assigned by the Root AP.

The AP can have up to ten Access Bridges associated in addition to four associated WLAPs.

- Select `Refresh` at the status display to update the values manually.
- Select `Timed` to automatically update this display every two seconds.
- Press ESC to return to the previous menu.

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 Statistics
                                      Retry Histogram



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

WNMP statistics are:

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 are:

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

Filter statistics are:

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 are:

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.

- Select `Refresh` at the status display to update the values manually.
- Select `Timed` to automatically update this display every two seconds.
- Press ESC to return to the previous menu.

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:

Freq.	Sent	Rcvd	Retry	Freq.	Sent	Rcvd	Retry
2402:	0	0	68	2403:	0	0	45
2404:	0	0	28	2405:	0	0	146
2406:	0	0	198	2407:	0	0	68
2408:	0	0	133	2409:	0	0	40
2410:	0	0	75	2411:	0	0	98
2412:	0	0	18	2413:	0	1	6
2414:	0	1	30	2415:	0	1	148
2416:	0	0	50	2417:	0	0	21
2418:	0	0	74	2419:	0	1	110
2420:	0	0	48	2421:	0	0	100
2422:	0	1	43	2423:	0	0	35
2424:	0	0	50	2425:	0	1	40
2426:	0	0	24	2427:	0	0	44
2428:	0	0	179	2429:	0	0	61
2430:	0	0	40	2431:	0	0	64
2432:	0	0	89	2433:	0	0	96
2434:	0	0	131	2435:	0	0	62
2436:	0	0	68	2437:	0	0	117
2438:	0	0	28	2439:	0	1	79
2440:	0	0	67	2441:	0	0	20
2442:	0	0	58	2443:	0	0	112

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 for the next set of channels.


Note

The AP displays a maximum of 79 channels.

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 backoff and retry later at random times. 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).

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

3.10 Event History

The AP tracks the occurrence of 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.

- Select *Show Event History* from the *Main Menu* to display:

```
Symbol Access Point              Event History                          pg 1
       Warning: Event logging is frozen while this screen is displayed.

              Ø:ØØ:51  MU Rm - Roam (adr) ØØ:AØ:F8:74:B7:Ø8
              Ø:Ø2:5Ø  MU Rm - Roam (adr) ØØ:AØ:F8:7D:ØD:EA
              Ø:Ø1:48  MU Rm - Roam (adr) ØØ:AØ:F8:26:F9:44
              Ø:ØØ:13  MU Assoc ØØ:AØ:F8:74:B7:Ø8
              Ø:ØØ:12  MU Assoc ØØ:AØ:F8:7D:ØD:EA
              Ø:ØØ:1Ø  MU Assoc ØØ:AØ:F8:26:F9:44
              Ø:ØØ:1Ø  MU Assoc ØØ:AØ:F8:26:F9:44
              Ø:ØØ:Ø2  RF Initialized
              Ø:ØØ:ØØ  Ethernet Initialized
              Ø:ØØ:ØØ  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, attaching antennas, 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
- antenna

Report missing or malfunctioning items to the Symbol Support Center.

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 are:

- a power outlet
- an antenna.

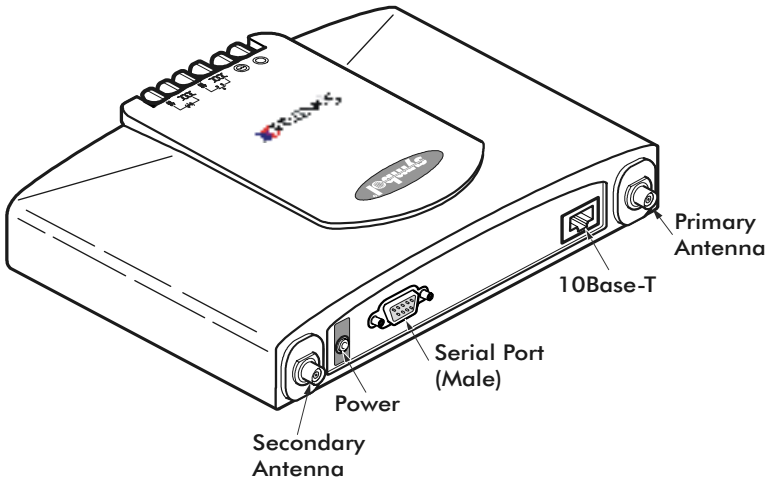
The AP supports a 10Base-T *unshielded twisted pair (UTP)* standard. Users can order a null-modem cable, part number 61383-00-0, for direct serial connections by contacting a Symbol sales representative.

Note

Test and use the radio network with an MU.

4.3.1 Network Connection

Locate connectors for Ethernet, antennas 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 Wireless mode single cell.


Note

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

4.3.2 10Base-T UTP

Use a 10Base-T connection for multiple APs or 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).
3. Add additional APs as needed.

4.3.3 Wireless Mode Single Cell

The Wireless mode 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 Antenna(s) and AP Placement

Antenna coverage is analogous to tossing a pebble into a pool of water. As the pebble enters the waters surface, waves begin to move out from the entry point. As the waves get further from the entry point the waves become smaller (or *weaker)* and eventually *dissipate* or *fade* into the waters mass.

Obstructions or objects on the waters surface change the wave movements. Obstructions can cause the waves to *bounce* or *reflect back* toward the center or beginning. Obstructions can also cause the wave to appear to *bend* around the obstruction, depending on the obstructions shape. An obstruction with a flat or square surface causes the wave to *bounce back* from the

surface it contacts and continues on either side of the object, such as a wooden beam or post. An obstruction with a round or curved surface causes the waves to bend into or around the surface. This bending causes the wave to reflect in all directions from the surface the wave contacts.

Waves can also *bounce off* each other as they are reflected. If more pebbles are tossed into the water, the waves begin to *interfere* with other waves bouncing off each other causing multiple reflections or disturbances in the waves *propagation*.


Note

Propagation is the way an object spreads or travels, including speed and direction.

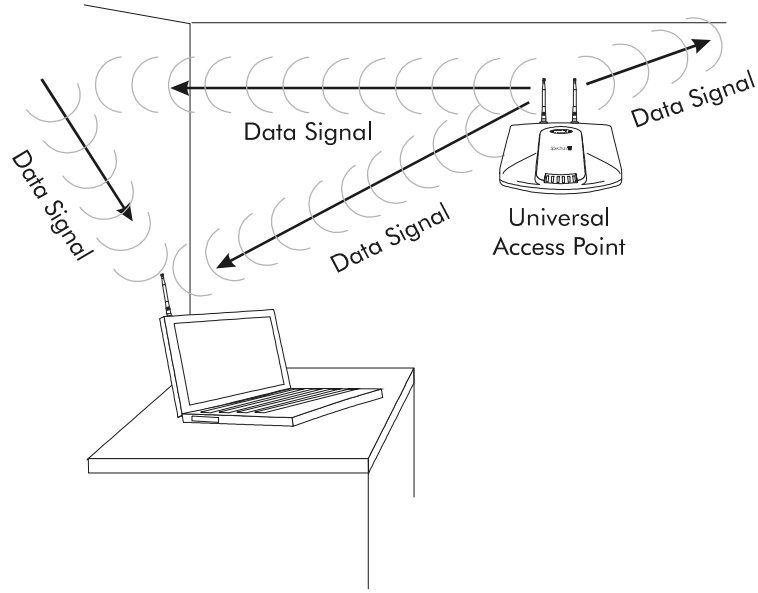
Antenna coverage also resembles lighting, in that an area lit from far away might not be bright enough. An area lit sharply minimizes coverage by creating *shaded* or *dark areas* where little or no light exists. An even antenna placement in an area (like an even placement of light bulbs) provides even, efficient coverage.

The purpose, to create a coverage area with many overlapping cells to provide a range large enough the user can roam throughout the environment without loosing network connection.

Radio waves can move through most indoor walls and minor obstacles. Interactions with building objects can affect radio wave propagation (including reinforced concrete, walls, metal, other transmitting equipment and people) which effects the networks range coverage. At high frequencies, radio waves tend to travel in straight lines and bounce-off solid obstacles. At low frequencies, radio waves can pass through most obstacles.

Typically a site survey, an environment analysis, determines the placement and antenna type used. Four basic environment types:

- *Open*: no obstructions.
- *Semi-open*: a room with wood/synthetic materials and partitions.
- *Closed*: floor to ceiling brick walls or other thick, solid materials.
- *Obstructed*: metal structures, reinforced concrete (walls, floors or ceilings), unusually dense obstructions or require complex coverage areas.



Line-of-site (it can be seen from here) connections are the best, otherwise place the antenna using the following guidelines:

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

The AP requires one antenna and can use two. Two antennas provide *diversity* that can improve performance and signal reception by using the signal with the strongest reception overcoming interference or fading. The *primary antenna* is used for both transmitting and receiving. The *secondary antenna* is used only for receiving radio signals.

1. Attach antennas to ANTENNA connectors on the back of the AP. For a single antenna, use the PRIMARY ANTENNA connector.
2. Refer to antenna documentation for mounting requirements.

The standard rubber antenna works for most office environments. Obtain additional or higher performance antennas from Symbol. Contact a Symbol sales representative to order the following models:

standard rubber antenna	ML 2499-APA1-00
single high performance antenna	ML 2499-HPA1-00
twin high performance diversity antennas	ML 2499-DVA1-00
mountable F-plane antenna	ML 2499-PSA1-00

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

If installing two antennas, enable the Antenna Selection in the UI, see *2.3 Access Point Installation* on page 64, for `Primary and Secondary`.

4.4.1 Antenna Extension Cables

Symbol offers extension cables for AP antennas. Some range loss occurs when increasing the distance between the antenna and the AP.

Model	Length	Loss	Range Loss
25-19371-01	6 ft	2.0 db	5%
25-19371-02	12 ft	4.0 db	10%

To order extension cables contact a Symbol representative.

4.5 Power Options

- Standard power supply, 115/230VAC, 50/60Hz. Part Number: 50-24000-006
  - US line cord, Part Number: 23844-00-00
- Remote power distribution system, Part Number: AP-PS-11
  - Refer to application note AP-PS-01 located on the Symbol Technologies web page.

4.6 Mounting the AP

The AP rests on a flat surface or attaches to a wall, or any hard, flat, stable surface. Position the AP at any angle. Use the standard-mounting kit provided.

Users can obtain a *universal wall-mounting bracket* (ML-2499-APB1-00) and an *AP-3020 adapter bracket* (12-20436-01) from Symbol for attaching the AP and antennas to the wall or ceiling. Contact a Symbol sales representative to order.

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.

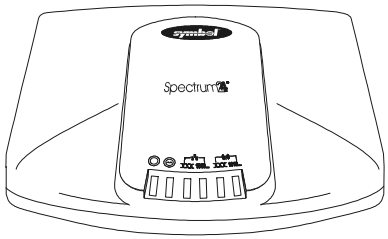
1. Verify the power adapter is correct according to the country.
2. Plug the power adapter cable into the socket at the back of the AP.
3. Plug the adapter into an outlet. The AP is functional when the Status indicator on the front of the AP reaches a consistent flashing and the

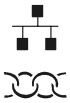
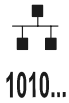
Wireless LAN Activity indicator begins flickering. This indicates that the AP is ready for MUs to associate with it.

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, error condition, and other activity. The indicators are:



	*Status*	One flash per second indicates normal operation. A steady on or off, or irregular flashing indicates a fault condition.
	*Serial*	Flashing indicates serial port activity.
	*Wired LAN Attached*	On indicates a valid Ethernet connection for a 10Base-T connection.
	*Wired LAN In Use*	Flashing indicates data transfers on wired connection.

	*Wireless LAN Attached*	On indicates an MU is associated with the AP.
	*Wireless LAN In Use*	Flickering indicates beacons and data transfers with MUs.

4.8.1 WLAP mode LED display.

When in the WLAP mode this chart signifies the APs LED indicator status. For the IEEE 802.11 protocol and APs using firmware version 4.ØØ-2Ø or above only.

1. After power up, system initialization begins:

LED	State
Status	Blinks
Serial	Blinks if activity occurs
Wired LAN Attached	On if Ethernet cable attached
Wired LAN Activity	Blinks if activity occurs
Wireless LAN Attached	Off
Wireless LAN Activity	Off

2. When a WLAP begins a full scan:

LED	State
Status	On
Serial	Off
Wired LAN Attached	Off
Wired LAN Activity	Off
Wireless LAN Attached	Blinks slowly
Wireless LAN Activity	Blinks slowly

3. When one or more WLAPs are found, but still in full scan state:

LED	State
Status	On
Serial	Off
Wired LAN Attached	Off
Wired LAN Activity	Off
Wireless LAN Attached	Off
Wireless LAN Activity	Blinks slowly

4. When the WLAP is in functional state, but one or more WLAP connections are not in Forward state:

LED	State
Status	Blinks regularly
Serial	Blinks if activity occurs
Wired LAN Attached	On if Ethernet cable attached
Wired LAN Activity	Blinks if activity occurs
Wireless LAN Attached	Blinks if activity occurs
Wireless LAN Activity	Blinks slowly

5. When all WLAP connections are in Forward state:

LED	State
Status	Blinks regularly
Serial	Blinks if activity occurs
Wired LAN Attached	On if Ethernet cable attached
Wired LAN Activity	Blinks if activity occurs
Wireless LAN Attached	On
Wireless LAN Activity	Blinks if activity occurs

Special cases:

- If the WLAP manual BSS_ID is NOT set and no other WLAP is found, the WLAP goes to the functional state.
- If the WLAP manual BSS_ID is set and the specified WLAP not found, the WLAP remains in FULL Scan state permanently. The LEDs have the following indicator status permanently:

LED	State
Status	On
Serial	Off
Wired LAN Attached	Off
Wired LAN Activity	Off
Wireless LAN Attached	Blinks slowly
Wireless LAN Activity	Blinks slowly

- If the WLAP manual BSS_ID is set with the broadcast bit ON (i.e.: the first Byte is Ø1) and the specified WLAP not found, the WLAP tries to associate with another WLAP. If it still cannot find another WLAP, it goes to Functional State.
- IF the Ethernet Timeout in the System Configuration menu is set to 3, the WLAP will keep track of the WLAP Alive BPDU. If the BPDU is missing for *WLAP Hello Time* seconds, the WLAP state changes to *WLAP Lost on Ethernet* and the LEDs have the following states:

LED	State
Status	On
Serial	Off
Wired LAN Attached	Blinks slowly
Wired LAN Activity	Blinks slowly
Wireless LAN Attached	Off
Wireless LAN Activity	Off

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, all six LEDs turn on. If the test fails, the LEDs all turn off and the AP resets. The LEDs turn off sequentially, in the order shown, as each of the following tests pass.

LED	State	Test Passed
Wireless LAN Activity	Off	Serial port initialized, flush FIFO buffer, serial port to AP connection checked.
Wireless LAN Attached	Off	Exit the AP manufacturing environment.
Wired LAN Activity	Off	LAN adapter present.
Wired LAN Attached	Off	Valid manufacturing configuration exists.
Serial	Off	Valid run time code exists.
Status	Blinks continuously	Bootup and run time codes downloaded to AP flash memory successful. Run time code controls the AP.

Identify wired network problems:

1. No operation:
   - Verify AP configuration through 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 bandwidth use does not exceed `37%`.
   - 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 the AP is using the primary antenna connection for single antenna use.
   - Verify that antenna diversity setting for AP is appropriate. If using one antenna, the setting is `Primary Only`, if using two 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 1Ø 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.

MUs attach to the network and interact with the AP transparently.

Appendix A

Specifications

A.1 Physical Characteristics

Dimensions	1.25" H x 5.5" L x 7.75" W (3.18 cm H x 14.97 cm L x 19.69 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 Hopping	Hops	79 Standard
		35 in France
		27 in Spain
		23 in Japan
		20 in Belgium (outdoor)
		29 in Mexico
	Hop Rate	configurable
	Hop Sequences	78 (per IEEE 802.11 standard)
Radio Data Rate	1 and 2 Mbps per channel	
Radio Power Output	100mW and 500mW versions	
1Mbps Range	open environment - over 1000 ft. (303 m) typical office or retail environment - between 180 and within 250 ft. (54.5 to 75.7 m)	
2 Mbps Range	open environment - 500 ft. (152 m) typical office or retail environment - between 125 and within 175 ft. (38 to 53 m)	
TX Maximum Effective Radiated Power	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 Charateristics

Driver Support	ODI v1.6, NDIS v2.01
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 Female, RS-232 using a DTE termination, 19200 bps
SNMP	Version 1, limited feature set of Version 2, MIB-II, IEEE 802.11 MIB, and Symbol MIB.

Appendix B
Supported Modems

The AP supports modems that use the generic Hayes Smartmodem command set.

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:

- 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
- Practical Peripherals PM288MT II V.34
- Supra Fax Modem 288
- USRobotics Sportster Modem 28.8

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

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 Compliance

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:

- Re-orient 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

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