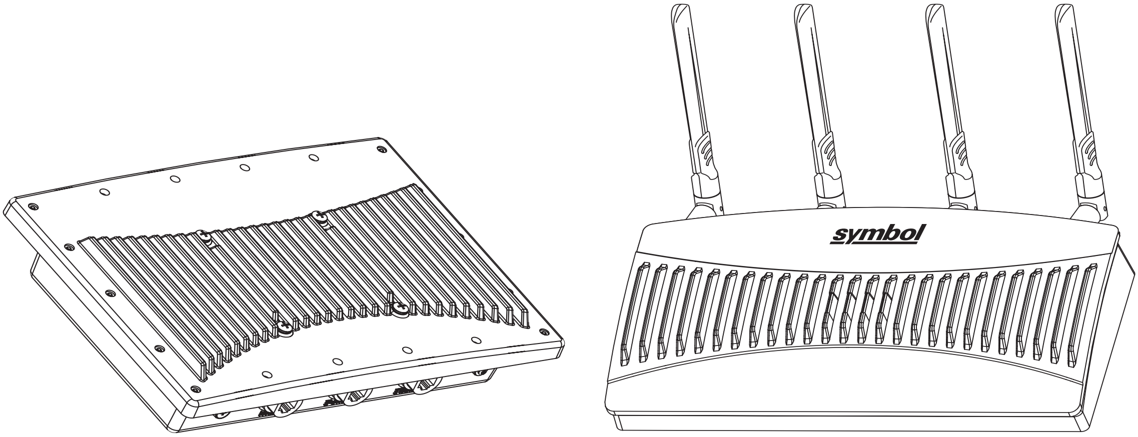
AP-51xx Access Point

Product Reference Guide



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The Enterprise Mobility Company™

AP-51xx Access Point

Product Reference Guide

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About This Guide

Introduction

This guide provides configuration and setup information for the AP-5131 and AP-5181 model access points. For the purposes of this guide, the devices will be called AP-51xx or the generic term “access point” when an identical conifiguration activities applied to both models.

Document Conventions

The following document conventions are used in this document:

✓ **NOTE** Indicate tips or special requirements.

CAUTION Indicates conditions that can cause equipment damage or data loss.

WARNING! Indicates a condition or procedure that could result in personal injury or equipment damage.

Notational Conventions

The following notational conventions are used in this document:

- Italics are used to highlight specific items in the general text, and to identify chapters and sections in this and related documents.
- Bullets (•) indicate:
  - action items
  - lists of alternatives
  - lists of required steps that are not necessarily sequential
- Sequential lists (those describing step-by-step procedures) appear as numbered lists.

Service Information

If a problem is encountered with the access point, contact the *Symbol Customer Support*. Refer to *Appendix C* for contact information. Before calling, have the model number and serial number at hand.

If the problem cannot be solved over the phone, you may need to return your equipment for servicing. If that is necessary, you will be given specific instructions.

Symbol Technologies is not responsible for any damages incurred during shipment if the approved shipping container is not used. Shipping the units improperly can possibly void the warranty. If the original shipping container was not kept, contact Symbol to have another sent to you.

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Introduction

This *AP-51xx Product Reference Guide* contains setup and advanced configuration instructions for both the AP-5131 and AP-5181 model Symbol access points. Both the AP-5131 and AP-5181 model access points share the same Web UI interface, thus there is no difference in how the devices are configured using the instructions within this guide. However, there are marked differences in how the devices are physically installed, as the AP-5181 is constructed to support outdoor installations, while the AP-5131 model is constructed primarily for indoor deployments.

The *access point* (AP) provides a bridge between Ethernet wired LANs or WANs and wireless networks. It provides connectivity between Ethernet wired networks and radio-equipped mobile units (MUs). MUs include the full line of Symbol terminals, bar-code scanners, adapters (PC cards, Compact Flash cards and PCI adapters) and other devices.

The access point provides a maximum 54Mbps data transfer rate via each radio. It monitors Ethernet traffic and forwards appropriate Ethernet messages to MUs over the network. It also monitors MU radio traffic and forwards MU packets to the Ethernet LAN.

If you are new to using an access point for managing your network, refer to *Theory of Operations on page 1-19* for an overview on wireless networking fundamentals.

1.1 New Features

With this most recent 1.1 release of the access point firmware, the following new features have been introduced to the existing feature set:

- *Mesh Networking*
- *Additional LAN Subnet*
- *On-board Radius Server Authentication*
- *Hotspot Support*
- *Routing Information Protocol (RIP)*
- *Manual Date and Time Settings*

1.1.1 Mesh Networking

Utilize the new mesh networking functionality to allow the access point to function as a bridge to connect two Ethernet networks or as a repeater to extend your network's coverage area without additional cabling. Mesh networking is configurable in two modes. It can be set in a wireless client bridge mode and/or a wireless base bridge mode (which accepts connections from client bridges). These two modes are not mutually exclusive.

In client bridge mode, the access point scans to find other access points using the selected WLAN's ESSID. The access point must go through the association and authentication process to establish a wireless connection. The mesh networking association process is identical to the access point's MU association process. Once the association/authentication process is complete, the wireless client adds the connection as a port on its bridge module. This causes the access point (in client bridge mode) to begin forwarding configuration packets to the base bridge. An access point in base bridge mode allows the access point radio to accept client bridge connections.

The two bridges communicate using the *Spanning Tree Protocol* (STP). The spanning tree determines the path to the root and detects if the current connection is part of a network loop with another connection. Once the spanning tree converges, both access points begin learning which destinations reside on which side of the network. This allows them to forward traffic intelligently.

After the access point (in client bridge mode) establishes at least one wireless connection, it will begin beaconing and accepting wireless connections (if configured to support mobile users). If the access point is configured as both a client bridge and a base bridge, it begins accepting client bridge connections. In this way, the mesh network builds itself over time and distance.

Once the access point (in client bridge mode) establishes at least one wireless connection, it establishes other wireless connections in the background as they become available. In this way, the access point is able to establish simultaneous redundant links. An access point (in client bridge mode) can establish up to 3 simultaneous wireless connections with other AP-5131s or AP-5181s. A client bridge always initiates the connections and the base bridge is always the acceptor of the mesh network data proliferating the network.

Since each access point can establish up to 3 simultaneous wireless connections, some of these connections may be redundant. In that case, the STP algorithm establishes which links are the redundant links and disables the links from forwarding.

For an overview on mesh networking as well as details on configuring the access point's mesh networking functionality, see *Configuring Mesh Networking on page 9-1*.

1.1.2 Additional LAN Subnet

In a typical retail or small office environment (wherein a wireless network is available along with a production WLAN) it is frequently necessary to segment a LAN into two subnets. Consequently, a second LAN is necessary to "segregate" wireless traffic.

The access point now has a second LAN subnet enabling administrators to segment the access point's LAN connection into two separate networks. The main access point LAN screen now allows the user to select either LAN1 or LAN2 as the active LAN over the access point's Ethernet port. Both LANs can still be active at any given time, but only one can transmit over the access point physical LAN connection. Each LAN has a separate configuration screen (called LAN 1 and LAN 2 by default) accessible under the main LAN screen. The user can rename each LAN as necessary. Additionally, each LAN can have its own Ethernet Type Filter configuration, and subnet access (HTTP, SSH, SNMP and telnet) configuration.

For detailed information on configuring the access point for additional LAN subnet support, see *Configuring the LAN Interface on page 5-1*.

1.1.3 On-board Radius Server Authentication

The access point now has the ability to work as a Radius Server to provide user database information and user authentication. Several new screens have been added to the access point's menu tree to configure Radius server authentication and configure the local user database and access policies. A new Radius Server screen allows an administrator to define the data source, authentication type and associate digital certificates with the authentication scheme. The LDAP screen allows the administrator to configure an external LDAP Server for use with the access point. A new Access Policy screen enables the administrator to set WLAN access based on user groups defined within the User Database screen. Each user is authorized based on the access policies applicable to that user. Access policies allow an administrator to control access to a user groups based on the WLAN configurations.

For detailed information on configuring the access point for AAA Radius Server support, see *Configuring User Authentication on page 6-61*.

1.1.4 Hotspot Support

The access point now allows hotspot operators to provide user authentication and accounting without a special client application. The access point uses a traditional Internet browser as a secure authentication device. Rather than rely on built-in 802.11security features to control access point association privileges, you can configure a WLAN with no WEP (an open network). The access point issues an IP address to the user using a DHCP server, authenticates the user and grants the user to access the Internet.

If a tourist visits a public hotspot and wants to browse a Web page, they boot their laptop and associate with a local Wi-Fi network by entering a valid SSID. They start a browser, and the hotspot's access controller forces the un-authenticated user to a Welcome page (from the hotspot operator) that allows the user to login with a username and password. In order to send a redirected page (a login page), a TCP termination exists locally on the access point. Once the login page displays, the user enters their credentials. The access point connects to the Radius server and determines the identity of the connected wireless user. Thus, allowing the user to access the Internet once successfully authenticated.

For detailed information on configuring the access point for Hotspot support, see *Configuring WLAN Hotspot Support on page 5-39*.

1.1.5 Routing Information Protocol (RIP)

With the release of the 1.1 version access point, *Routing Information Protocol* (RIP) functionality has been added to the existing Router screen. RIP is an interior gateway protocol that specifies how routers exchange routing-table information. The parent Router screen also allows the administrator to select the type of RIP and the type of RIP authentication used.

For detailed information on configuring RIP functionality as part of the access point's Router functionality, see *Setting the RIP Configuration on page 5-58*.

1.1.6 Manual Date and Time Settings

As an alternative to defining a NTP server to provide access point system time, the access point can now have its date and time set manually. A new Manual Date/Time Setting screen can be used to set the access point time using a Year-Month-Day HH:MM:SS format.

For detailed information on manually setting the access point's system time, see *Configuring Network Time Protocol (NTP) on page 4-31*.

1.2 Feature Overview

The Symbol access point has the following existing features carried forward from its initial 1.0 release:

- *Single or Dual Mode Radio Options*
- *Separate LAN and WAN Ports*
- *Multiple Mounting Options*
- *Antenna Support for 2.4 GHz and 5.2 GHz Radios*
- *Sixteen Configurable WLANs*
- *Support for 4 BSSIDs per Radio*
- *Quality of Service (QoS) Support*
- *Industry Leading Data Security*
- *VLAN Support*
- *Multiple Management Accessibility Options*
- *Updatable Firmware*
- *Programmable SNMP v1/v2/v3 Trap Support*
- *Power-over-Ethernet Support*
- *MU-MU Transmission Disallow*
- *Voice Prioritization*
- *Support for CAM and PSP MUs*
- *Statistical Displays*
- *Transmit Power Control*
- *Advanced Event Logging Capability*
- *Configuration File Import/Export Functionality*
- *Default Configuration Restoration*
- *DHCP Support*
- *Multi-Function LEDs*

1.2.1 Single or Dual Mode Radio Options

One or two possible configurations are available on the access point depending on which model is purchased. If the access point is manufactured as a single radio access point, the access point enables you to configure the single radio for either 802.11a or 802.11b/g.

If the access point is manufactured as a dual-radio access point, the access point enables you to configure one radio for 802.11a, and the other 802.11b/g.

For detailed information on configuring your access point, see *Setting the WLAN's Radio Configuration on page 5-44*.

1.2.2 Separate LAN and WAN Ports

The access point has one LAN port and one WAN port, each with their own MAC address. The access point must manage all data traffic over the LAN connection carefully as either a DHCP client, BOOTP client, DHCP server or using a static IP address. The access point can only use a Power-over-Ethernet device when connected to the LAN port.

For detailed information on configuring the access point LAN port, see *Configuring the LAN Interface on page 5-1*.

A *Wide Area Network (WAN)* is a widely dispersed telecommunications network. In a corporate environment, the WAN port might connect to a larger corporate network. For a small business, the WAN port might connect to a DSL or cable modem to access the Internet. Regardless, network address information must be configured for the access point's intended mode of operation.

For detailed information on configuring the access point's WAN port, see *Configuring WAN Settings on page 5-14*.

The LAN and WAN port MAC addresses can be located within the LAN and WAN Stats screens.

For detailed information on locating the access point MAC addresses, see *Viewing WAN Statistics on page 7-2* and *Viewing LAN Statistics on page 7-6*.

1.2.3 Multiple Mounting Options

The access point rests on a flat surface, attaches to a wall, mounts under a ceiling or above a ceiling (attic). Choose a mounting option based on the physical environment of the coverage area. Do not mount the access point in a location that has not been approved in an access point radio coverage site survey.

For detailed information on the mounting options available for the access point, see *Mounting the AP-5131 on page 2-12*.

1.2.4 Antenna Support for 2.4 GHz and 5.2 GHz Radios

The access point supports several 802.11a and 802.11b/g radio antennas. Select the antenna best suited to the radio transmission requirements of your coverage area.

For an overview of the Radio 1 (2.4 GHz) and Radio 2 (5.2 GHz) antennas supported on the access point's *Reverse SMA (RSMA)* connectors, see *Antenna Specifications on page A-5*.

1.2.5 Sixteen Configurable WLANs

A *Wireless Local Area Network (WLAN)* is a data-communications system that flexibly extends the functionalities of a wired LAN. A WLAN does not require lining up devices for line-of-sight transmission, and are thus, desirable for wireless networking. Roaming users can be handed off from one access point to another like a cellular phone system. WLANs can therefore be configured around the needs of specific groups of users, even when they are not in physical proximity. Sixteen WLANs are configurable on each access point.

To enable and configure WLANs on an access point radio, see *Enabling Wireless LANs (WLANs) on page 5-22*.

1.2.6 Support for 4 BSSIDs per Radio

The access point supports four BSSIDs per radio. Each BSSID has a corresponding MAC address. The first MAC address corresponds to BSSID #1. The MAC addresses for the other three BSSIDs (BSSIDs #2, #3, #4) are derived by adding 1, 2, 3, respectively, to the radio MAC address.

If the radio MAC address displayed on the Radio Settings screen is 00:A0:F8:72:20:DC, then the BSSIDs for that radio will have the following MAC addresses:

BSSID	MAC Address	Hexadecimal Addition
BSSID #1	00:A0:F8:72:20:DC	Same as Radio MAC address
BSSID #2	00:A0:F8:72:20:DD	Radio MAC address +1
BSSID #3	00:A0:F8:72:20:DE	Radio MAC address +2
BSSID #4	00:A0:F8:72:20:DF	Radio MAC address +3

For detailed information on strategically mapping BSSIDs to WLANs, see *Configuring the 802.11a or 802.11b/g Radio on page 5-47*.

1.2.7 Quality of Service (QoS) Support

The access point QoS implementation provides applications running on different wireless devices a variety of priority levels to transmit data to and from the access point. Equal data transmission priority is fine for data traffic from applications such as Web browsers, file transfers or email, but is inadequate for multimedia applications.

Voice over Internet Protocol (VoIP), video streaming and interactive gaming are highly sensitive to latency increases and throughput reductions. These forms of higher priority data traffic can significantly benefit from the access point QoS implementation.The *WiFi Multimedia QOS Extensions (WMM)* implementation used by the access point shortens the time between transmitting higher priority data traffic and is thus desirable for multimedia applications. In addition, U-APSD (WMM Power Save) is also supported.

WMM defines four access categories—*voice, video*, *best effort* and *background*—to prioritize traffic for providing enhanced multimedia support.

For detailed information on configuring QoS support for the access point, see *Setting the WLAN Quality of Service (QoS) Policy on page 5-33*.

1.2.8 Industry Leading Data Security

The access point supports numerous encryption and authentication techniques to protect the data transmitting on the WLAN.

The following authentication techniques are supported on the access point:

- *Kerberos Authentication*
- *EAP Authentication*

The following encryption techniques are supported on the access point:

- *WEP Encryption*
- *KeyGuard Encryption*
- *Wi-Fi Protected Access (WPA) Using TKIP Encryption*
- *WPA2-CCMP (802.11i) Encryption*

In addition, the access point supports the following additional security features:

- *Firewall Security*
- *VPN Tunnels*

- *Content Filtering*

For an overview on the encryption and authentication schemes available on the access point, refer to *Configuring Access Point Security on page 6-1.*

1.2.8.1 Kerberos Authentication

Authentication is a means of verifying information that is transmitted from a secure source. If information is *authentic*, you know who created it and you know that it has not been altered in any way since it was originated. Authentication entails a network administrator employing a software "supplicant" on their computer or wireless device.

Authentication is critical for the security of any wireless LAN device. Traditional authentication methods are not suitable for use in wireless networks where an unauthorized user can monitor network traffic and intercept passwords. The use of strong authentication methods that do not disclose passwords is necessary. Symbol uses the *Kerberos* authentication service protocol (specified in RFC 1510), to authenticate users/clients in a wireless network environment and to securely distribute the encryption keys used for both encrypting and decrypting.

A basic understanding of *RFC 1510 Kerberos Network Authentication Service (V5) i*s helpful in understanding how Kerberos functions. By default, WLAN devices operate in *an open system network* where any wireless device can associate with an AP without authorization. Kerberos requires device authentication before access to the wired network is permitted.

For detailed information on Kerbeors configurations, see *Configuring Kerberos Authentication on page 6-9*.

1.2.8.2 EAP Authentication

The *Extensible Authentication Protocol (EAP)* feature provides access points and their associated MU's an additional measure of security for data transmitted over the wireless network. Using EAP, authentication between devices is achieved through the exchange and verification of certificates.

EAP is a mutual authentication method whereby both the MU and AP are required to prove their identities. Like Kerberos, the user loses device authentication if the server cannot provide proof of device identification

Using EAP, a user requests connection to a WLAN through the access point. The access point then requests the identity of the user and transmits that identity to an authentication server. The server prompts the AP for proof of identity (supplied to the access point by the user) and then transmits the user data back to the server to complete the authentication.

An MU is not able to access the network if not authenticated. When configured for EAP support, the access point displays the MU as an EAP station.

EAP is only supported on mobile devices running Windows XP, Windows 2000 (using Service Pack #4) and Windows Mobile 2003. Refer to the system administrator for information on configuring a Radius Server for EAP (802.1x) support.

For detailed information on EAP configurations, see *Configuring 802.1x EAP Authentication on page 6-11*.

1.2.8.3 WEP Encryption

All WLAN devices face possible information theft. Theft occurs when an unauthorized user eavesdrops to obtain information illegally. The absence of a physical connection makes wireless links particularly vulnerable to this form of theft. Most forms of WLAN security rely on encryption to various extents. Encryption entails scrambling and coding information, typically with mathematical formulas called *algorithms*, before the information is transmitted. An algorithm is a set of instructions or formula for scrambling the data. A *key* is the specific code used by the algorithm to encrypt or decrypt the data. *Decryption* is the decoding and unscrambling of received encrypted data.

The same device, host computer or front-end processor, usually performs both encryption and decryption. The data transmit or receive direction determines whether the encryption or decryption function is performed. The device takes plain text, encrypts or 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 takes the encrypted text and decrypts, or unscrambles, the text revealing the original message. An unauthorized user can know the algorithm, but cannot interpret the encrypted data without the appropriate key. Only the sender and receiver of the transmitted data know the key.

Wired Equivalent Privacy (WEP) is an encryption security protocol specified in the IEEE Wireless Fidelity (Wi-Fi) standard, 802.11b and supported by the access point AP. WEP encryption is designed to provide a WLAN with a level of security and privacy comparable to that of a wired LAN. The level of protection provided by WEP encryption is determined by the encryption key length and algorithm. An encryption key is a string of case sensitive characters used to encrypt and decrypt data packets transmitted between a mobile unit (MU) and the access point. An access point and associated wireless clients must use the same encryption key (typically 1 through 4) to interoperate.

For detailed information on WEP configurations, see *Configuring WEP Encryption on page 6-16*.

1.2.8.4 KeyGuard Encryption

Use KeyGuard to shield the master encryption keys from being discovered through hacking. KeyGuard negotiation takes place between the access point and MU upon association. The access point can use KeyGuard with Symbol MUs. KeyGuard is only supported on Symbol MUs making it a Symbol proprietary security mechanism.

For detailed information on KeyGuard configurations, see *Configuring KeyGuard Encryption on page 6-18*.

1.2.8.5 Wi-Fi Protected Access (WPA) Using TKIP Encryption

Wi-Fi Protected Access (WPA) is a security standard for systems operating with a Wi-Fi wireless connection. WEP's lack of user authentication mechanisms is addressed by WPA. Compared to WEP, WPA provides superior data encryption and user authentication.

WPA addresses the weaknesses of WEP by including:

- a per-packet key mixing function
- a message integrity check
- an extended initialization vector with sequencing rules
- a re-keying mechanism

WPA uses an encryption method called *Temporal Key Integrity Protocol* (TKIP). WPA employs 802.1X and *Extensible Authentication Protocol* (EAP).

For detailed information on WPA using TKIP configurations, see *Configuring WPA Using TKIP on page 6-20*.

1.2.8.6 WPA2-CCMP (802.11i) Encryption

WPA2 is a newer 802.11i standard that provides even stronger wireless security than Wi-Fi Protected Access (WPA) and WEP. *Counter-mode/CBC-MAC Protocol (CCMP)* is the security standard used by the *Advanced Encryption Standard (AES).* AES serves the same function TKIP does for WPA-TKIP. CCMP computes a *Message Integrity Check (MIC)* using the proven *Cipher Block Message Authentication Code (CBC-MAC)* technique. Changing just one bit in a message produces a totally different result.

WPA2-CCMP is based on the concept of a *Robust Security Network (RSN),* which defines a hierarchy of keys with a limited lifetime (similar to TKIP). Like TKIP, the keys the administrator provides are used to derive other keys. Messages are encrypted using a 128-bit secret key and a 128-bit block of data. the end result is an encryption scheme as secure as any the access point provides.

For detailed information on WPA2-CCMP configurations, see *Configuring WPA2-CCMP (802.11i) on page 6-22*.

1.2.8.7 Firewall Security

A firewall keeps personal data in and hackers out. The access point firewall prevents suspicious Internet traffic from proliferating the access point managed network. The access point performs network address translation (NAT) on packets passing to and from the WAN port. This combination provides enhanced security by monitoring communication with the wired network.

For detailed information on configuring the access point firewall, see *Configuring Firewall Settings on page 6-25*.

1.2.8.8 VPN Tunnels

Virtual Private Networks (VPNs) are IP-based networks using encryption and tunneling providing users remote access to a secure LAN. In essence, the trust relationship is extended from one LAN across the public network to another LAN, without sacrificing security. A VPN behaves like a private network; however, because the data travels through the public network, it needs several layers of security. The access point can function as a robust VPN gateway.

For detailed information on configuring VPN security support, see *Configuring VPN Tunnels on page 6-33*.

1.2.8.9 Content Filtering

Content filtering allows system administrators to block specific commands and URL extensions from going out through the access point WAN port only. Therefore, content filtering affords system administrators selective control on the content proliferating the network and is a powerful screening tool. Content filtering allows the blocking of up to 10 files or URL extensions and allows blocking of specific outbound HTTP, SMTP, and FTP requests.

For detailed information on configuring content filtering support, see *Configuring Content Filtering Settings on page 6-49*.

1.2.9 VLAN Support

A *Virtual Local Area Network (VLAN)* is a means to electronically separate data on the same access point from a single broadcast domain into separate broadcast domains. By using a VLAN, you can group by logical function instead of physical location. There are 16 VLANs supported on the access point. An administrator can map up to 16 WLANs to 16 VLANs and enable or disable dynamic VLAN assignment. In addition to these 16 VLANs, the access point supports dynamic, user-based, VLANs when using EAP authentication.

VLANs enable organizations to share network resources in various network segments within large areas (airports, shopping malls, etc.). A VLAN is a group of clients with a common set of requirements independent of their physical location. VLANs have the same attributes as physical LANs, but they enable administrators to group clients even when they are not members of the same network segment.

For detailed information on configuring VLAN support, see *Configuring VLAN Support on page 5-4*.

1.2.10 Multiple Management Accessibility Options

The access point can be accessed and configured using one of the following methods:

- Java-Based Web UI
- Human readable config file (imported via FTP or TFTP)
- MIB (Management Information Base)
- *Command Line Interface (CLI)* accessed via RS-232 or Telnet. Use the access point DB-9 serial port for direct access to the command-line interface from a PC. Use Symbol's Null-Modem cable (Part No. 25-632878-0) for the best fitting connection.

1.2.11 Updatable Firmware

Symbol periodically releases updated versions of the access point device firmware to the Symbol Web site. If the access point firmware version displayed on the System Settings page (see *Configuring System Settings on page 4-2*) is older than the version on the Web site, Symbol recommends updating the access point to the latest firmware version for full feature functionality.

For detailed information on updating the access point firmware using FTP or TFTP, see *Updating Device Firmware on page 4-40*.

1.2.12 Programmable SNMP v1/v2/v3 Trap Support

Simple Network Management Protocol (SNMP) facilitates the exchange of management information between network devices. SNMP uses *Management Information Bases (MIBs)* to manage the device configuration and monitor Internet devices in remote locations. MIB information accessed via SNMP is defined by a set of managed objects called *object identifiers (OIDs)*. An object identifier (OID) is used to uniquely identify each object variable of a MIB.

SNMP allows a network administrator to configure the access point, manage network performance, find and solve network problems, and plan for network growth. The access point supports SNMP management functions for gathering information from its network components. The access point downloads site contains the following 2 MIB files:

- Symbol-CC-WS2000-MIB-2.0 (standard Symbol MIB file)
- Symbol-AP-5131-MIB (AP-5131 and AP-5181 specific MIB file)

The access point SNMP agent functions as a command responder and is a multilingual agent responding to SNMPv1, v2c and v3 managers (command generators). The factory default configuration maintains SNMPv1/2c support of the community names, hence providing backward compatibility.

For detailed information on configuring SNMP traps, see *Configuring SNMP Settings on page 4-17*.

1.2.13 Power-over-Ethernet Support

When users purchase a Symbol WLAN solution, they often need to place access points in obscure locations. In the past, a dedicated power source was required for each access point in addition to the Ethernet infrastructure. This often required an electrical contractor to install power drops at each access point location.

An approved power injector solution merges power and Ethernet into one cable, reducing the burden of installation and allows optimal access point placement in respect to the intended radio coverage area. An AP-5131 or AP-5181 can only use a Power-over-Ethernet device when connected to the LAN port.

The Symbol Power Injector (Part No. AP-PSBIAS-T-1P-AF) is a single-port, 802.3af compliant Power over Ethernet hub combining low-voltage DC with Ethernet data in a single cable connecting to the access point. The Power Injector's single DC and Ethernet data cable creates a modified Ethernet cabling environment on the access point's LAN port eliminating the need for separate Ethernet and power cables.

For detailed information on using the Symbol Power Injector, see *Symbol Power Injector System on page 2-9*.

1.2.14 MU-MU Transmission Disallow

The access point's MU-MU Disallow feature prohibits MUs from communicating with each other even if they are on different WLANs, assuming one of the WLAN's is configured to disallow MU-MU communication. Therefore, if an MU's WLAN is configured for MU-MU disallow, it will not be able to communicate with any other MUs connected to this access point.

For detailed information on configuring an access point WLAN to disallow MU to MU communications, see *Creating/Editing Individual WLANs on page 5-24*.

1.2.15 Voice Prioritization

Each access point WLAN has the capability of having its QoS policy configured to prioritize the network traffic requirements for associated MUs. A WLAN QoS page is available for each enabled WLAN on either the access point 802.11a or 802.11b/g radio.

Use the QoS page to enable voice prioritization for devices to receive the transmission priority they may not normally receive over other data traffic. Voice prioritization allows the access point to assign priority to voice traffic over data traffic, and (if necessary) assign legacy voice supported devices (non WMM supported voice devices) additional priority.

For detailed information on configuring voice prioritization over other voice enabled devices, see *Setting the WLAN Quality of Service (QoS) Policy on page 5-33*.

1.2.16 Support for CAM and PSP MUs

The access point supports both CAM and PSP powered MUs. *CAM (Continuously Aware Mode)* MUs leave their radios on continuously to hear every beacon and message transmitted. These systems operate without any adjustments by the access point.

A beacon is a uniframe system packet broadcast by the AP to keep the network synchronized. A beacon includes the ESSID, access point MAC address, Broadcast destination addresses, a time stamp, a *DTIM (Delivery Traffic Indication Message)* and the *TIM (Traffic Indication Map)*.

PSP (Power Save Polling) MUs power off their radios for short periods. When a Symbol MU in PSP mode associates with an access point, it notifies the access point of its activity status. The access point responds by buffering packets received for the MU. PSP mode is used to extend an MU's battery life by enabling the MU to "sleep" during periods of inactivity.

1.2.17 Statistical Displays

The access point can display robust transmit and receive statistics for the WAN and LAN ports. WLAN stats can be displayed collectively and individually for enabled WLANs. Transmit and receive statistics are available for the access point's 802.11a and 802.11b/g radios. An advanced radio statistics page is also available to display retry histograms for specific data packet retry information.

Associated MU stats can be displayed collectively and individually for specific MUs. An echo (ping) test is also available to ping specific MUs to assess association strength. Finally, the access point can detect and display the properties of other APs detected within the access point's radio coverage area. The type of AP detected can be displayed as well as the properties of individual APs.

For detailed information on available access point statistical displays and the values they represent, see *Monitoring Statistics on page 7-1*.

1.2.18 Transmit Power Control

The access point has a configurable power level for each radio. This enables the network administrator to define the antenna's transmission power level in respect to the access point's placement or network requirements as defined in the access point site survey.

For detailed information on setting the radio transmit power level, see *Configuring the 802.11a or 802.11b/g Radio on page 5-47*.

1.2.19 Advanced Event Logging Capability

The access point provides the capability for periodically logging system events. Logging events is useful in assessing the throughput and performance of the access point or troubleshooting problems on the access point managed Local Area Network (LAN).

For detailed information on access point events, see *Logging Configuration on page 4-34*.

1.2.20 Configuration File Import/Export Functionality

Configuration settings for an access point can be downloaded from the current configuration of another access point. This affords the administrator the opportunity to save the current configuration before making significant changes or restoring the default configuration.

For detailed information on importing or exporting configuration files, see *Importing/Exporting Configurations on page 4-36*.

1.2.21 Default Configuration Restoration

The access point has the ability to restore its default configuration or a partial default configuration with the exception of current WAN and SNMP settings. Restoring the default configuration is a good way to create new WLANs if the MUs the access point supports have been moved to different radio coverage areas.

For detailed information on restoring a default or partial default configuration, see *Configuring System Settings on page 4-2*.

1.2.22 DHCP Support

The access point can use *Dynamic Host Configuration Protocol (DHCP)* to obtain a leased IP address and configuration information from a remote server. DHCP is based on the BOOTP protocol and can coexist or interoperate with BOOTP. Configure the access point to send out a *DHCP request* searching for a *DHCP/BOOTP* server to acquire HTML, firmware or network configuration files when the access point boots. Because BOOTP and DHCP interoperate, whichever responds first becomes the server that allocates information.

The access point can be set to only accept replies from DHCP or BOOTP servers or both (this is the default setting). Disabling DHCP disables BOOTP and DHCP and requires network settings to be set manually. If running both DHCP and BOOTP, do not select BOOTP Only. BOOTP should only be used when the server is running BOOTP exclusively.

The DHCP client automatically sends a DHCP request at an interval specified by the DHCP server to renew the IP address lease as long as the access point is running (this parameter is programmed at the DHCP server). For example: Windows 2000 servers typically are set for 3 days.

1.2.23 Multi-Function LEDs

The access point houses seven LED indicators. Four LEDs exist on the top of the access point and are visible from wall, ceiling and table-top orientations. Three of these four LEDs are single color activity LEDs, and one is a multi-function red and white status LED. Two LEDs exist on the rear of the access point and are viewable using a single (customer installed) extended light pipe, adjusted as required to suit above the ceiling installations.

For detailed information of the access point LEDs and their functionality, see *AP-5131 LED Indicators on page 2-21*.

1.3 Theory of Operations

To understand access point management and performance alternatives, users need familiarity with access point functionality and configuration options. The access point includes features for different interface connections and network management.

The access point uses electromagnetic waves to transmit and receive electric signals without wires. Users communicate with the network by establishing radio links between *mobile units (MUs)* and access points.

The access point uses *DSSS (direct sequence spread spectrum)* to transmit digital data from one device to another. A radio signal begins with a carrier signal that provides the base or center frequency. The digital data signal is encoded onto the carriers using a DSSS *chipping algorithm*. The access point radio signal propagates into the air as electromagnetic waves. A receiving antenna (on the MU) in the path of the waves absorbs the waves as electrical signals. The receiving MU interprets (demodulates) the signal by reapplying the direct sequence chipping code. This demodulation results in the original digital data.

The access point uses its environment (the air and certain objects) as the transmission medium.The access point can either transmit in the 2.4 to 2.5-GHz frequency range (802.11b/g radio) or the 5.2 GHz frequency range (802.11a radio), the actual range is country-dependent. Symbol devices, like other Ethernet devices, have unique, hardware encoded *Media Access Control (MAC)* or IEEE addresses. MAC addresses determine the device sending or receiving data. A MAC address is a 48-bit number written as six hexadecimal bytes separated by colons. For example: 00:A0:F8:24:9A:C8

Also see the following sections:

- *Cellular Coverage*
- *MAC Layer Bridging*
- *Content Filtering*
- *DHCP Support*
- *Media Types*
- *Direct-Sequence Spread Spectrum*
- *MU Association Process*
- *Operating Modes*
- *Management Access Options*

1.3.1 Cellular Coverage

An access point 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 access point supporting the radio coverage area of that cell. Adding access point’s to a single LAN establishes more cells to extend the range of the network. Configuring the same *ESSID (Extended Service Set Identifier)* on all access points makes them part of the same Wireless LAN.

access points with the same ESSID defines a coverage area. A valid ESSID is an alphanumeric, case-sensitive identifier up to 32 characters. An MU searches for an access point with a matching ESSID and synchronizes (associates) to establish communications. This device association allows MUs within the coverage area to move about or *roam.* As the MU roams from cell to cell, it associates with a different access point. The roam occurs when the MU analyzes the reception quality at a location and determines a different access point provides better signal strength and lower MU load distribution.

If the MU does not find an access point with a workable signal, it can perform a scan to find any AP. As MUs switch APs, the AP updates its association statistics.

The user can configure the ESSID to correspond to up to 16 WLANs on each 802.11a or 802.11b/g radio. A *Wireless Local Area Network (WLAN)* is a data-communications system that flexibly extends the functionalities of a wired LAN. A WLAN does not require lining up devices for line-of-sight transmission, and are thus, desirable. Within the WLAN, roaming users can be handed off from one access point to another like a cellular phone system. WLANs can therefore be configured around the needs of specific groups of users, even when they are not in physical proximity.

1.3.2 MAC Layer Bridging

The access point provides *MAC layer bridging* between its interfaces. The access point monitors traffic from its interfaces and, based on frame address, forwards the frames to the proper destination. The

access point tracks source and destination addresses to provide intelligent bridging as MUs roam or network topologies change. The access point also handles broadcast and multicast messages and responds to MU association requests.

The access point listens to all packets on its LAN and WAN interfaces and builds an address database using MAC addresses. An address in the database includes the interface media that the device uses to associate with the access point. The access point uses the database to forward packets from one interface to another. The bridge forwards packets addressed to unknown systems to the *Default Interface* (Ethernet).

The access point internal stack interface handles all messages directed to the access point. Each access point stores information on destinations and their interfaces to facilitate *forwarding*. When a user sends an *ARP (Address Resolution Protocol)* request packet, the access point forwards it over all enabled interfaces except over the interface the ARP request packet was received.

On receiving the ARP response packet, the access point database keeps a record of the destination address along with the receiving interface. With this information, the access point forwards any

directed packet to the correct destination. Transmitted ARP request packets echo back to other MUs. The
access point removes from its database the destination or interface information that is not used for a specified time. The AP refreshes its database when it transmits or receives data from these destinations and interfaces.

1.3.3 Media Types

The access point radio interface conforms to IEEE 802.11a/b/g specifications. The interface operates at a maximum 54Mbps (802.11a radio) using direct-sequence radio technology. The access point supports multiple-cell operations with fast roaming between cells. Within a direct-sequence system, each cell can operates independently. Adding cells to the network provides increased coverage area and total system capacity.

The RS-232 serial port provides a *Command Line Interface (CLI)* connection. The serial link supports a direct serial connection. The access point is a *Data Terminal Equipment (DTE)* device with male pin connectors for the RS-232 port. Connecting the access point to a PC requires a null modem serial cable.

1.3.4 Direct-Sequence Spread Spectrum

Spread spectrum (broadband) uses a narrowband signal to spread the transmission over a segment of the radio frequency band or spectrum. Direct-sequence is a spread spectrum technique where the transmitted signal is spread over a particular frequency range. The Symbol access point uses *Direct-Sequence Spread Spectrum (DSSS)* for radio communication.

Direct-sequence systems communicate by continuously transmitting a redundant pattern of bits called a *chipping sequence*. Each bit of transmitted data is mapped into chips by the access point and rearranged into a pseudorandom spreading code to form the chipping sequence. The chipping sequence is combined with a transmitted data stream to produce the AP -5131's output signal.

MUs receiving a direct-sequence transmission use the spreading code to map the chips within the chipping sequence back into bits to recreate the original data transmitted by the access point. Intercepting and decoding a direct-sequence transmission requires a predefined algorithm to associate the spreading code used by the transmitting access point to the receiving MU. This algorithm is established by IEEE 802.11b specifications. The bit redundancy within the chipping sequence enables the receiving MU to recreate the original data pattern, even if bits in the chipping sequence are corrupted by interference.

The ratio of chips per bit is called the *spreading ratio*. A high spreading ratio increases the resistance of the signal to interference. A low spreading ratio increases the bandwidth available to the user. The access point uses different modulation schemes to encode more bits per chip at higher data rates. The access point is capable of a maximum 54Mbps data transmission rate (802.11a radio), but the coverage area is less than that of access point operating at lower data rates since coverage area decreases as bandwidth increases.

1.3.5 MU Association Process

An access point recognizes MUs as they begin the association process with the access point. An access point keeps a list of the MUs it services. MUs associate with an access point based on the following conditions:

- Signal strength between the access pointand MU
- Number of MUs currently associated with the access point
- MUs encryption and authentication capabilities
- MUs supported data rate

MUs perform pre-emptive roaming by intermittently scanning for access point's and associating with the best available access point. Before roaming and associating, MUs perform full or partial scans to collect access point statistics and determine the direct-sequence channel used by the access point.

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

MUs perform partial scans at programmed intervals, when missing expected beacons or after excessive transmission retries. In a partial scan, the MU scans access point's classified as proximate on the access point table. For each channel, the MU tests for *Clear Channel Assessment* (CCA). The MU broadcasts a probe with the ESSID and broadcast BSS_ID when the channel is transmission-free. It sends an ACK to a directed probe response from the access point and updates the table.

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

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

An MU selects the best available access point and adjusts itself to the access point direct-sequence channel to begin association. Once associated, the access point begins forwarding frames addressed to the target MU. Each frame contains fields for the current direct-sequence channel. The MU uses these fields to resynchronize to the access point.

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

1.3.6 Operating Modes

The access point can operate in a couple of configurations.

- **Access Point** - As an *Access Point*, the access point functions as a layer 2 bridge (similar to Symbol's existing AP-4131 access point). The wired uplink can operate as a trunk and support multiple VLANs. Up to 16 WLANs can be defined and mapped to access point WLANs. Each WLAN can be configured to be broadcast by one or both access point radios (unlike the AP-4131 model access point). An AP-5131 or AP-5181 can operate in both an Access Point mode and Wireless Gateway/Router mode simultaneously. The network architecture and access point configuration define how the Access Point and Wireless Gateway/Router mode are negotiated.
- **Wireless Gateway/Router** - If operating as a *Wireless Gateway/Router*, the access point functions as a router between two layer 2 networks: the WAN uplink (the ethernet port) and the Wireless side. The following options are available providing a solution for single-cell deployment:
  - **PPPoE** - The WAN interface can terminate a PPPoE connection, thus enabling the access point to operate in conjunction with a DSL or Cable modem to provide WAN connectivity.
  - **NAT** - *(Network Address Translation)* on the Wireless interface. Using NAT, the access point router is able to manage a private IP scheme. NAT allows translation of private addresses to the WAN IP address.
  - **DHCP** - On the Wireless side, the access point can assign private IP addresses.
  - **Firewall** - In between the WAN and Wireless interfaces, a Firewall protects against a number of known attacks.

1.3.7 Management Access Options

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

The access point requires one of the following connection methods to perform a custom installation and manage the network:

- *Secure Java-Based WEB UI* - (use *Sun Microsystems' JRE 1.5* or higher available from Sun's Web site and be sure to disable Microsoft's Java Virtual Machine if installed)
- *Command Line Interface (CLI)* via Serial, Telnet and SSH
- *Config file* - Human-readable; Importable/Exportable via FTP and TFTP
- *MIB (Management Information Base)* accessing the access point SNMP function using a MIB Browser. The AP-5131 or AP-5181 downloads site contains the following 2 MIB files:
    - Symbol-CC-WS2000-MIB-2.0 (standard Symbol MIB file)
    - Symbol-AP-5131-MIB (AP-5131 and AP-5181 specific MIB file)

Make configuration changes to access point's individually. Optionally, use the access point import/ export configuration function to download access point's settings to other access points.

For detailed information, see *Importing/Exporting Configurations on page 4-36*.

2

Hardware Installation

An access point installation includes mounting the access point, connecting the access point to the network (LAN or WAN port connection), connecting antennae and applying power. Installation procedures vary for different environments. See the following sections for more details:

- *Precautions*
- *Requirements*
- *Access Point Placement*
- *Power Options*
- *Symbol Power Injector System*
- *Mounting the AP-5131*
- *AP-5131 LED Indicators*
- *Mounting the AP-5181*
- *AP-5181 LED Indicators*
- *Mounting the AP-5181*

CAUTION Symbol recommends conducting a radio site survey prior to installing the access point. A site survey is an excellent method of documenting areas of radio interference and providing a tool for device placement.

2.1 Precautions

Before installing an AP-5131 or AP-5181 model access point 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 continuous temperature range between -20° C to 50° C.

2.2 Available Product Configurations

2.2.1 AP-5131 Configurations

An AP-5131 can be ordered in the following access point and accessory combinations:

Symbol Part #	Description
AP-5131-13040-WW	AP-5131 802.11a+g Dual Radio Access Point AP-5131 Install Guide Software and Documentation CD-ROM Accessories Bag
AP-5131-13041-WWR	AP-5131 802.11a+g Dual Radio Access Point AP-5131 Install Guide Power Injector (Part No. AP-PSBIAS-1P2-AFR) Software and Documentation CD-ROM Accessories Bag
AP-5131-13042-WW	AP-5131 802.11a+g Dual Radio Access Point AP-5131 Install Guide Software and Documentation CD-ROM (4) Dual-Band Antennae (Part No. ML-2452-APA2-01) Accessories Bag

Symbol Part #	**Description**
AP-5131-13043-WWR	AP-5131 802.11a+g Dual Radio Access Point AP-5131 Install Guide Software and Documentation CD-ROM Power Injector (Part No. AP-PSBIAS-1P2-AFR) (4) Dual-Band Antennae (Part No. ML-2452-APA2-01) Accessories Bag
AP-5131-40020-WW	AP-5131 802.11a/g Single Radio Access Point AP-5131 Install Guide Software and Documentation CD-ROM Accessories Bag
AP-5131-40021-WWR	AP-5131 802.11a/g Single Radio Access Point AP-5131 Install Guide Software and Documentation CD-ROM Power Injector (Part No. AP-PSBIAS-1P2-AFR) Accessories Bag
AP-5131-40022-WW	AP-5131 802.11a/g Single Radio Access Point AP-5131 Install Guide Software and Documentation CD-ROM (2) Dual-Band Antennae (Part No. ML-2452-APA2-01) Accessories Bag
AP-5131-40023-WWR	AP-5131 802.11a/g Single Radio Access Point AP-5131 Install Guide Software and Documentation CD-ROM Power Injector (Part No. AP-PSBIAS-1P2-AFR) (2) Dual-Band Antennae (Part No. ML-2452-APA2-01) Accessories Bag

Verify the model indicated on the bottom of the AP-5131 is correct. Contact the Symbol Support Center to report missing or improperly functioning items.

The Symbol power injector (Part No. AP-PSBIAS-1P2-AFR) is included in certain orderable configurations, but can be added to any configuration. For more information on the Symbol power injector, see *Symbol Power Injector System on page 2-9*.

NOTE A standard Symbol 48 Volt Power Adapter (Part No. 50-24000-050) is recommended with AP-5131 product SKUs that do not include the Symbol power injector.

For an overview on the optional antennae available for the AP-5131, see *Antenna Options on page 2-6*. For detailed specifications on the 2.4 GHz and 5.2 GHz antenna suite, see *2.4 GHz Antenna Matrix on page A-5* and *5.2 GHz Antenna Matrix on page A-5*.

⚠ **CAUTION** Using an antenna other than the Dual-Band Antenna (Part No. ML-2452-APA2-01) could render the AP-5131's Rogue AP Detector Mode feature inoperable. Contact your Symbol sales associate for specific information.

2.2.2 AP-5181 Configurations

TBD

2.3 Requirements

The minimum installation requirements for a single-cell, peer-to-peer network (regardless of access point model)

- An AP-5131 or AP-5181 model access point (either a dual or single radio model)
- 48 Volt Power Supply (Part No. 50-24000-050) or Symbol power injector (Part No. AP-PSBIAS-1P2-AFR)
- a power outlet
- Dual-Band Antennae.

✓ **NOTE** An AP-5131 or AP-5181 model access point optimally uses 2 antennae for the single-radio model and 4 antennae for the dual-radio model.

2.4 Access Point Placement

For optimal performance, install the access point (regardless of model) 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. Install the access point in open areas or add access points as needed to improve coverage.

Antenna coverage is analogous to lighting. Users might find an area lit from far away to be not bright enough. An area lit sharply might minimize coverage and create *dark areas.* Uniform antenna placement in an area (like even placement of a light bulb) provides even, efficient coverage.

Place the access point using the following guidelines:

- Install the access point at an ideal height of 10 feet from the ground.
- Orient the access point antennae vertically for best reception.
- Point the access point antenna(s) downward if attaching to the ceiling.

Symbol recommends conducting a site survey to define and document radio interference obstacles before installing the access point to maximize its radio coverage area.

2.4.1 Site Surveys

A site survey analyzes the installation environment and provides users with recommendations for equipment and placement. The optimum placement of 802.11a access points differs from 802.11b/g access points, because the locations and number of access points required are different to support the radio coverage area.

Symbol recommends conducting a new site survey and developing a new coverage area floor plan when switching from 2 or 11Mbps access points (AP-3021 or AP-4131 models) to 54Mbps access points (AP-5131 and AP-5181 models), as the device placement requirements are significantly different.

2.4.2 Antenna Options

2.4.2.1 AP-5131 Antenna Options

Both Radio 1 and Radio 2 require one antenna and can optimally use two antennae per radio (4 antennae total for dual-radio models). Two antennae per radio provides diversity that can improve performance and signal reception. Symbol supports two antenna suites for the AP-5131. One antenna suite supporting the 2.4 GHz band and another antenna suite supporting the 5.2 GHz band. Select an antenna model best suited to the intended operational environment of your AP-5131.

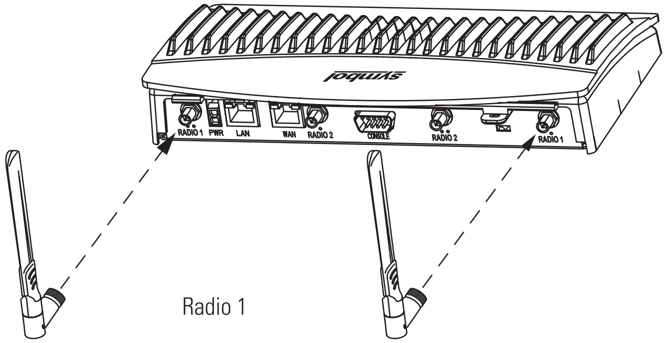
NOTE On a single-radio AP-5131, Radio 1 can be configured to be either a 2.4 GHz or 5.2 GHz radio. On a dual-radio model, Radio 1 refers to the AP-5131's 2.4 GHz radio and Radio 2 refers to the AP-5131 5.2 GHz radio. However, there could be some cases where a dual-radio AP-5131 is performing a Rogue AP detector function. In this scenario, the AP-5131 is receiving in either 2.4 GHz or 5.2 GHz over the Radio 1 or Radio 2 antennae depending on which radio is selected for the scan.

Antenna connectors for Radio 1 are located in a different location from the Radio 2 antenna connectors. On single radio versions, the R-SMA connectors can support both bands and should be connected to a R-SMA dual-band antenna or an appropriate single band antenna. If necessary a R-SMA to R-BNC adapter (Part No. 25-72178-01) can be purchased separately from Symbol.

The AP-5131 2.4 GHz antenna suite includes the following models:

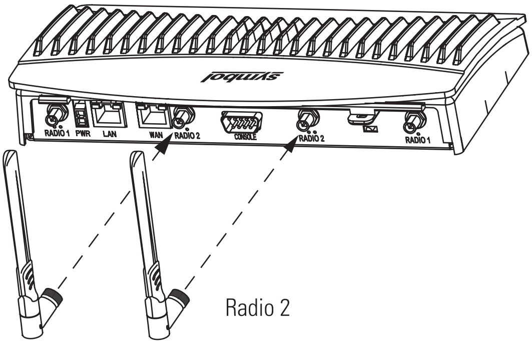
Symbol Part Number	Antenna Type	Nominal Net Gain (dBi)
ML-2499-11PNA2-01R	Wide Angle Directional	8.5
ML-2499-HPA3-01R	Omni-Directional Antenna	3.3
ML-2499-BYGA2-01R	Yagi Antenna	13.9
ML-2452-APA2-01	Dual-Band	3.0

NOTE An additional adapter is required to use ML-2499-11PNA2-01 and ML-2499-BYGA2-01 model antennae. Please contact Symbol for more information.



The AP-5131 5.2 GHz antenna suite includes the following models:

Symbol Part Number	Antenna Type	Nominal Net Gain (dBi)
ML-5299-WPNA1-01R	Panel Antenna	13.0
ML-5299-HPA1-01R	Wide-Band Omni-Directional Antenna	5.0
ML-2452-APA2-0	Dual-Band	4.0



For detailed specifications on the 2.4 GHz and 5.2 GHz antennae mentioned in this section, see section *2.4 GHz Antenna Matrix on page A-5* and section *5.2 GHz Antenna Matrix on page A-5*.

2.4.2.2 AP-5181 Antenna Options -TBD

2.5 Power Options

2.5.1 AP-5131 Power Options

The power options for the AP-5131 include:

- Symbol Power Injector (Part No. AP-PSBIAS-1P2-AFR)
- Symbol 48-Volt Power Supply (Part No. 50-24000-050)
- Any standard 802.3af compliant device.

2.5.2 AP-5181 Power Options

The power options for the AP-5181 include:

CAUTION An AP-5181 model access point cannot use the AP-5131 recommended Symbol 48-Volt Power Supply (Part No. 50-24000-050). However, Symbol does recommend the AP-PSBIAS-5181-01R model power supply for use the AP-5181.

- Symbol Power Injector (Part No. AP-PSBIAS-1P2-AFR)
- Symbol (AP-5181 specific) 48-Volt Power Supply (Part No. AP-PSBIAS-5181-01R)
- Any standard 802.3af compliant device.

2.6 Symbol Power Injector System

The access point can receive power either directly form a Symbol 48V AC-DC power supply or via an Ethernet cable connected to the LAN port (using the 802.3af standard).

When users purchase a Symbol WLAN solution, they often need to place access points in obscure locations. In the past, a dedicated power source was required for each access point in addition to the Ethernet infrastructure. This often required an electrical contractor to install power drops at each access point location. An approved power injector solution merges power and Ethernet into one cable, reducing the burden of installation and allows optimal access point placement in respect to the intended radio coverage area.

The Symbol Power Injector is included in certain AP-5131 and AP-5181 kits. The Symbol Power Injector (Part No. AP-PSBIAS-1P2-AFR) is an integrated AC-DC converter and 802.3af power injector which requires 110-220V AC power to combine low-voltage DC with Ethernet data in a single cable connecting to the access point. The access point can only use a Power Injector when connected to the LAN port.

The Symbol AP-5131 and AP-5181 Power Supply (Part Numbers 50-24000-050 and AP-PSBIAS-5181-01R respectively) are not included in the kit and must be orderable separately as an accessory.

CAUTION The access point supports any standards-based 802.3af compliant power source (including non-Symbol power sources). However, using the wrong solution (including a POE system used on a legacy Symbol access point) could severely damage the access point and void the product warranty.

A separate power injector is required for each access point comprising the network.

2.6.1 Installing the Power Injector

Refer to the following sections for information on planning, installing, and validating the power injector installation:

- *Preparing for Site Installation*
- *Cabling the Power Injector*
- *Power Injector LED Indicators*

2.6.1.1 Preparing for Site Installation

The power injector can be installed free standing, on an even horizontal surface or wall mounted using the power injector's wall mounting key holes. The following guidelines should be adhered to before cabling the power injector to an Ethernet source and an access point:

- Do not block or cover airflow to the power injector.
- Keep the power injector away from excessive heat, humidity, vibration and dust.
- The power injector is not a repeater, and does not amplify the Ethernet data signal. For optimal performance, ensure the power injector is placed as close as possible to the network data port.

2.6.1.2 Cabling the Power Injector

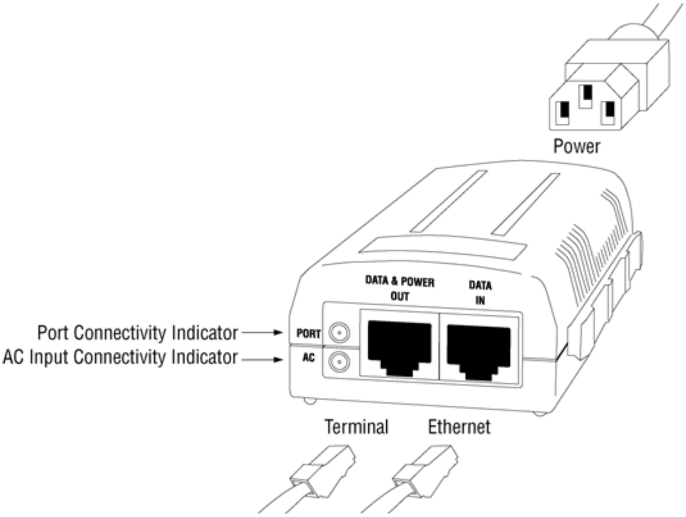
To install the power injector to an Ethernet data source and access point:

CAUTION Ensure AC power is supplied to the power injector using an AC cable with an appropriate ground connection approved for the country of operation.

1. Connect the power injector to an AC outlet (110VAC to 220VAC).
2. Connect an RJ-45 Ethernet cable between the network data supply (host) and the power injector **Data In** connector.
3. Connect an RJ-45 Ethernet cable between the power injector **Data & Power Out** connector and the Symbol access point LAN port.

CAUTION Cabling the power injector to the access point's WAN port renders the AP-5131 non-operational. Only use a AP-PSBIAS-1P2-AFR model power injector with the access point's LAN port.

Ensure the cable length from the Ethernet source (host) to the power injector and access point does not exceed 100 meters (333 ft.)



The power injector has no On/Off power switch. The power injector receives power and is ready for access point device connection and operation as soon as AC power is applied.

2.6.1.3 Power Injector LED Indicators

The power injector demonstrates the following LED behavior under normal and/or problematic operating conditions:

LED	***AC (Main)***	***Port***
Green *(Steady)*	Power injector is receiving power from AC outlet.	Indicates a device is connected to the power injector’s outgoing Data & Power cable.
Green *(Blinking)*	Output voltage source is out of range.	The power injector is overloaded or has a short circuit.

For more information and device specifications for the Symbol power injector, refer to the *Power Injector Quick Install Guide* (Part No. 72-70762-01) available from the Symbol Web site.

2.7 Mounting the AP-5131

The AP-5131 can rest on a flat surface, attach to a wall, mount under a suspended T-Bar or above a ceiling (plenum or attic). Choose one of the following mounting options based on the physical environment of the coverage area. Do not mount the AP-5131 in a location that has not been approved in a site survey.

Refer to the following, depending on how you intend to mount the AP-5131:

- *Desk Mounted Installations*
- *Wall Mounted Installations*
- *Suspended Ceiling T-Bar Installations*
- *Above the Ceiling (Plenum) Installations*

2.7.1 Desk Mounted Installations

The desk mount option uses rubber feet allowing the unit to sit on most flat surfaces. The four (4) round rubber feet can be found in the AP-5131 (main) box in a separate plastic bag.

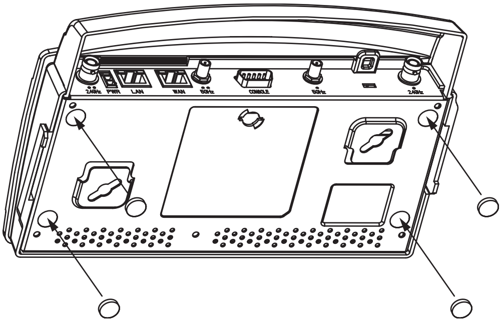
To install the AP-5131 in a desk mount orientation:

1. Turn the AP-5131 upside down.
2. Attach the radio antennae to their correct connectors.

   The antenna protection plate cannot be used in a desk mount configuration, as the plate only allows antennas to be positioned in a downward orientation.

CAUTION Both the Dual and Single Radio model AP-5131's use RSMA type antenna connectors. On the Dual Radio AP-5131, a single dot on the antenna connector indicates the primary antenna for both Radio 1 (2.4 GHz) and Radio 2 (5.2 GHz). Two dots designate the secondary antenna for both Radio 1 and Radio 2. On Single Radio models, a single dot on the antenna connector indicates the primary antenna for Radio 1, and two dots designate the secondary antenna for Radio 1.

3. Remove the backings from the four (4) rubber feet and attach them to the four rubber feet recess areas on the AP-5131.



4. Cable the AP-5131 using either the Symbol power injector solution or an approved line cord and power supply.

CAUTION Do not supply power to the AP-5131 until the cabling of the unit is complete**.**

For Symbol power injector installations:

a. Connect a RJ-45 Ethernet cable between the network data supply (host) and the power injector **Data In** connector.

b. Connect a RJ-45 Ethernet cable between the power injector **Data & Power Out** connector and the Symbol AP-5131 LAN port.

c. Ensure the cable length from the Ethernet source (host) to the power injector and AP-5131 does not exceed 100 meters (333 ft). The power injector has no On/Off power switch. The power injector receives power as soon as AC power is applied. For more information on using the power injector, see *Symbol Power Injector System on page 2-9*.

For standard Symbol 48-Volt power adapter (Part No. 50-24000-050) and line cord installations:

a. Connect RJ-45 Ethernet cable between the network data supply (host) and the AP-5131 LAN port.

b. Verify the power adapter is correctly rated according the country of operation.

c. Connect the power supply line cord to the power adapter.

d. Attach the power adapter cable into the power connector on the AP-5131.

e. Plug the power adapter into an outlet.

5. Verify the behavior of the AP-5131 LEDs. For more information, see *AP-5131 LED Indicators on page 2-21*.

6. Return the AP-5131 to an upright position and place it in the location you wish it to operate. Ensure the AP-5131 is sitting evenly on all four rubber feet.

   The AP-5131 is ready to configure. For information on an AP-5131 default configuration, see *Getting Started on page 3-1*. For specific details on AP-5131 system configurations, see *System Configuration on page 4-1*.

2.7.2 Wall Mounted Installations

Wall mounting requires hanging the AP-5131 along its width (or length) using the pair of slots on the bottom of the unit and using the AP-5131 itself as a mounting template for the screws. The AP-5131 can be mounted onto any plaster or wood wall surface.

The mounting hardware and tools (customer provided) required to install the AP-5131 on a wall consists of:

- Two Phillips pan head self-tapping screws (ANSI Standard) #6-18 X 0.875in. Type A or AB Self-Tapping screw, or (ANSI Standard Metric) M3.5 X 0.6 X 20mm Type D Self-Tapping screw
- Two wall anchors
- Security cable (optional)

To mount the AP-5131 on a wall:

1. Orient the AP-5131 on the wall by its width or length.
2. Using the arrows on one edge of the case as guides, move the edge to the midline of the mounting area and mark points on the midline for the screws.
3. At each point, drill a hole in the wall, insert an anchor, screw into the anchor the wall mounting screw and stop when there is 1mm between the screw head and the wall.

   If pre-drilling a hole, the recommended hole size is 2.8mm (0.11in.) if the screws are going directly into the wall and 6mm (0.23in.) if wall anchors are being used.
4. If required, install and attach a security cable to the AP-5131 lock port.
5. Place the large corner of each of the mount slots over the screw heads.
6. Slide the AP-5131 down along the mounting surface to hang the mount slots on the screw heads.
7. Attach the radio antennae to their correct connectors.

⚠ **CAUTION** Both the Dual and Single Radio model AP-5131s use RSMA type antenna connectors. On the Dual Radio AP-5131, a single dot on the antenna connector indicates the primary antenna for both Radio 1 (2.4 GHz) and Radio 2 (5.2 GHz). Two dots designate the secondary antenna for both Radio 1 and Radio 2. On Single Radio models, a single dot on the antenna connector indicates the primary antenna for Radio 1, and two dots designate the secondary antenna for Radio 1.

8. Cable the AP-5131 using either the Symbol power injector solution or an approved line cord and power supply.

✓ **NOTE** The access point must be mounted with the RJ45 cable connector oriented upwards to ensure proper operation.

⚠ **CAUTION** Do not supply power to the AP-5131 until the cabling of the unit is complete.

For Symbol power injector installations:

a. Connect a RJ-45 Ethernet cable between the network data supply (host) and the Power Injector **Data In** connector.

b. Connect a RJ-45 Ethernet cable between the power injector **Data & Power Out** connector and the AP-5131 LAN port.

c. Ensure the cable length from the Ethernet source (host) to the power injector and AP-5131 does not exceed 100 meters (333 ft). The power injector has no On/Off power switch. The power injector receives power as soon as AC power is applied. For more information on using the power injector, see *Symbol Power Injector System on page 2-9*.

For standard Symbol 48-Volt Power Adapter (Part No. 50-24000-050) and line cord installations:

a. Connect RJ-45 Ethernet cable between the network data supply (host) and the AP-5131 LAN port.

b. Verify the power adapter is correctly rated according the country of operation.

c. Connect the power supply line cord to the power adapter.

d. Attach the power adapter cable into the power connector on the AP-5131.

e. Plug the power adapter into an outlet.

✓ **NOTE** If the AP-5131 is utilizing remote management antennae, a wire cover can be used to provide a clean finished look to the installation. Contact Symbol for more information.

9. Verify the behavior of the AP-5131 LEDs. For more information, see *AP-5131 LED Indicators on page 2-21*.

   The AP-5131 is ready to configure. For information on an AP-5131 default configuration, see *Getting Started on page 3-1*. For specific details on AP-5131 system configurations, see *System Configuration on page 4-1*.

2.7.3 Suspended Ceiling T-Bar Installations

A suspended ceiling mount requires holding the AP-5131 up against the T-bar of a suspended ceiling grid and twisting the AP-5131 chassis onto the T-bar.

The mounting hardware and tools (customer provided) required to install the AP-5131 on a ceiling T-bar consists of:

- Safety wire (recommended)
- Security cable (optional)

To install the AP-5131 on a ceiling T-bar:

1. If required, loop a safety wire —with a diameter of at least 1.01 mm (.04 in.), but no more than 0.158 mm (.0625 in.) —through the tie post (above the AP-5131's console connector) and secure the loop.
2. If required, install and attach a security cable to the AP-5131 lock port.
3. Attach the radio antennae to their correct connectors.

⚠ **CAUTION** Both the Dual and Single Radio model AP-5131s use RSMA type antenna connectors. On the Dual Radio AP-5131, a single dot on the antenna connector indicates the primary antenna for both Radio 1 (2.4 GHz) and Radio 2 (5.2 GHz). Two dots designate the secondary antenna for both Radio 1 and Radio 2. On Single Radio models, a single dot on the antenna connector indicates the primary antenna for Radio 1, and two dots designate the secondary antenna for Radio 1

4. Cable the AP-5131 using either the Symbol power injector solution or an approved line cord and power supply.

⚠ **CAUTION** Do not supply power to the AP-5131 until the cabling of the unit is complete.

For Symbol power injector installations:

a. Connect a RJ-45 Ethernet cable between the network data supply (host) and the Power Injector **Data In** connector.

b. Connect a RJ-45 Ethernet cable between the power injector **Data & Power Out** connector and the AP-5131 LAN port.

c. Ensure the cable length from the Ethernet source (host) to the power injector and AP-5131 does not exceed 100 meters (333 ft). The power injector has no On/Off power switch. The power injector receives power as soon as AC power is applied. For more information on using the power injector, see *Symbol Power Injector System on page 2-9*.

For standard Symbol 48-Volt Power Adapter (Part No. 50-24000-050) and line cord installations:

a. Connect RJ-45 Ethernet cable between the network data supply (host) and the AP-5131 LAN port.

b. Verify the power adapter is correctly rated according the country of operation.

c. Connect the power supply line cord to the power adapter.

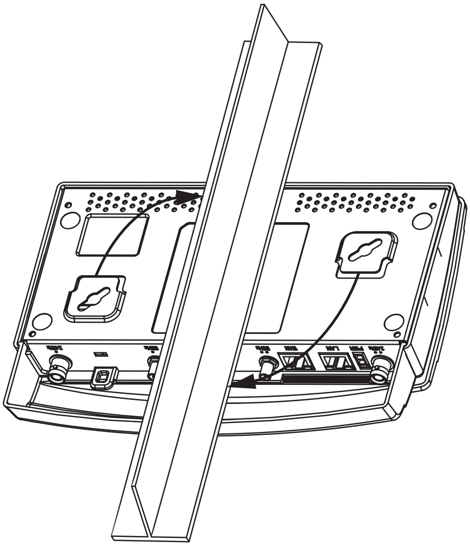
d. Attach the power adapter cable into the power connector on the AP-5131.

e. Plug the power adapter into an outlet.

5. Verify the behavior of the AP-5131 LEDs. For more information, see *AP-5131 LED Indicators on page 2-21*.
6. Align the bottom of the ceiling T-bar with the back of the AP-5131.
7. Orient the AP-5131 chassis by its length and the length of the ceiling T-bar.
8. Rotate the AP-5131 chassis 45 degrees clockwise, or about 10 o’clock.
9. Push the back of the AP-5131 chassis on to the bottom of the ceiling T-bar.

⚠ **CAUTION** Ensure the safety wire and cabling used in the T-Bar AP-5131 installation is securely fastened to the building structure in order to provide a safe operating environment.

10. Rotate the AP-5131 chassis 45 degrees counter-clockwise. The clips click as they fasten to the T-bar.



11. The AP-5131 is ready to configure. For information on an AP-5131 default configuration, see *Getting Started on page 3-1*. For specific details on AP-5131 system configurations, see *System Configuration on page 4-1*.

✓ **NOTE** If the AP-5131 is utilizing remote management antennae, a wire cover can be used to provide a clean finished look to the installation. Contact Symbol for more information.

2.7.4 Above the Ceiling (Plenum) Installations

An AP-5131 above the ceiling installation requires placing the AP-5131 above a suspended ceiling and installing the provided light pipe under the ceiling tile for viewing the rear panel status LEDs of the unit. An above the ceiling AP-5131 installation enables installations compliant with drop ceilings, suspended ceilings and industry standard tiles from .625 to .75 inches thick.

✓ **NOTE** The AP-5131 is Plenum rated to UL2043 and NEC1999 to support above the ceiling installations.

CAUTION Symbol does not recommend mounting the AP-5131 directly to any suspended ceiling tile with a thickness less than 12.7mm (0.5in.) or a suspended ceiling tile with an unsupported span greater than 660mm (26in.). Symbol strongly recommends fitting the AP-5131 with a safety wire suitable for supporting the weight of the device. The safety wire should be a standard ceiling suspension cable or equivalent steel wire between 1.59mm (.062in.) and 2.5mm (.10in.) in diameter.

The mounting hardware required to install the AP-5131 above a ceiling consists of:

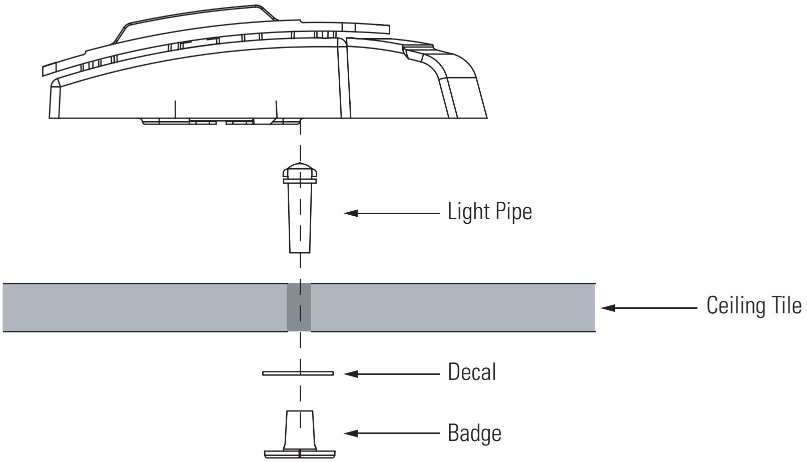
- Light pipe
- Badge for light pipe
- Decal for badge
- Safety wire (strongly recommended)
- Security cable (optional)

To install the AP-5131 above a ceiling:

1. If possible, remove the adjacent ceiling tile from its frame and place it aside.
2. Install a safety wire, between 1.5mm (.06in.) and 2.5mm (.10in.) in diameter, in the ceiling space.
3. If required, install and attach a security cable to the AP-5131's lock port.
4. Mark a point on the finished side of the tile where the light pipe is to be located.
5. Create a light pipe path hole in the target position on the ceiling tile.
6. Use a drill to make a hole in the tile the approximate size of the AP-5131 LED light pipe.

CAUTION Symbol recommends care be taken not to damage the finished surface of the ceiling tile when creating the light pipe hole and installing the light pipe.

7. Remove the light pipe's rubber stopper before installing the light pipe.
8. Connect the light pipe to the bottom of the AP-5131. Align the tabs and rotate approximately 90 degrees. Do not over tighten



9. Snap the clips of the light pipe into the bottom of the AP-5131.
10. Fit the light pipe into hole in the tile from its unfinished side.
11. Place the decal on the back of the badge and slide the badge onto the light pipe from the finished side of the tile.
12. Attach the radio antennae to their correct connectors.

⚠ **CAUTION** Both the Dual and Single Radio model AP-5131s use RSMA type antenna connectors. On the Dual Radio AP-5131, a single dot on the antenna connector indicates the primary antenna for both Radio 1 (2.4 GHz) and Radio 2 (5.2 GHz). Two dots designate the secondary antenna for both Radio 1 and Radio 2. On Single Radio models, a single dot on the antenna connector indicates the primary antenna for Radio 1, and two dots designate the secondary antenna for Radio 1.

13. Attach safety wire (if used) to the AP-5131 safety wire tie point or security cable (if used) to the AP-5131’s lock port.
14. Align the ceiling tile into its former ceiling space.
15. Cable the AP-5131 using either the Symbol power injector solution or an approved line cord and power supply.

⚠ **CAUTION** Do not supply power to the AP-5131 until the cabling of the unit is complete.

For Symbol power injector installations:

a. Connect a RJ-45 Ethernet cable between the network data supply (host) and the Power Injector **Data In** connector.

b. Connect a RJ-45 Ethernet cable between the power injector **Data & Power Out** connector and the AP-5131 LAN port.

c. Ensure the cable length from the Ethernet source (host) to the power injector and AP-5131 does not exceed 100 meters (333 ft). The power injector has no On/Off power switch. The power injector receives power as soon as AC power is applied. For more information on using the power injector, see *Symbol Power Injector System on page 2-9*.

For standard Symbol 48-Volt Power Adapter (Part No. 50-24000-050) and line cord installations:

a. Connect RJ-45 Ethernet cable between the network data supply (host) and the AP-5131 LAN port.

b. Verify the power adapter is correctly rated according the country of operation.

c. Connect the power supply line cord to the power adapter.

d. Attach the power adapter cable into the power connector on the AP-5131.

e. Plug the power adapter into an outlet.

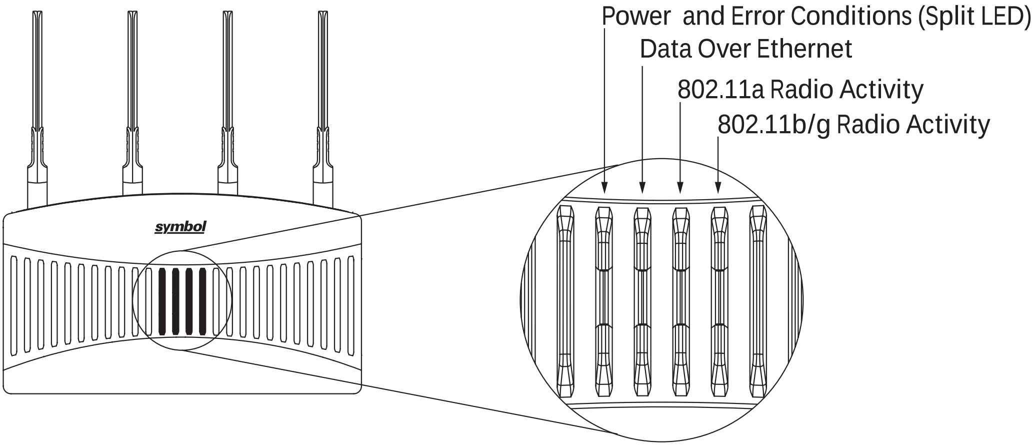
16. Verify the behavior of the AP-5131 LED lightpipe. For more information, see *AP-5131 LED Indicators on page 2-21*.

17. Place the ceiling tile back in its frame and verify it is secure.

    The AP-5131 is ready to configure. For information on an AP-5131 default configuration, see *Getting Started on page 3-1*. For specific details on AP-5131 system configurations, see *System Configuration on page 4-1*.

2.8 AP-5131 LED Indicators

The AP-5131 utilizes seven LED indicators. Five LEDs display within four LED slots on the front of the AP-5131 (on top of the AP-5131 housing) and two LEDs (for above the ceiling installations) are located on the back of the device (the side containing the LAN, WAN and antenna connectors).



The five LEDs on the top housing of the AP-5131 are clearly visible in table-top, wall and below ceiling installations. The five AP-5131 top housing LEDs have the following display and functionality:

Power Status	Solid **white** indicates the AP-5131 is adequately powered.
Error Conditions	Solid **red** indicates the AP-5131 is experiencing a problem condition requiring immediate attention.
Ethernet Activity	Flashing **white** indicates data transfers and Ethernet activity.
802.11a Radio Activity	Flickering **amber** indicates beacons and data transfers over the AP-5131 802.11a radio.
802.11b/g Radio Activity	Flickering **green** indicates beacons and data transfers over the AP-5131 802.11b/g radio.

The LEDs on the rear of the AP-5131 are viewed using a single (customer installed) extended lightpipe, adjusted as required to suit above the ceiling installations. The LEDs displayed using the lightpipe have the following color display and functionality:

Boot and Power Status Solid **white** indicates the AP-5131 is adequately powered.

Error Conditions Solid **red** indicates the AP-5131 is experiencing a problem condition requiring immediate attention.

Power and Error Conditions Blinking **red** indicates the AP-5131 Rogue AP Detection feature has located a rogue device

2.9 Mounting the AP-5181

The AP-5181 can be connected to a pole or attach to a wall. Choose one of the following mounting options based on the physical environment of the coverage area. Do not mount the AP-5181 in a location that has not been approved in a site survey.

Refer to the following, depending on how you intend to mount the AP-5181:

- *AP-5181 Pole Mounted Installations*
- *AP-5181 Wall Monuted Installations*

2.9.1 AP-5181 Pole Mounted Installations

Complete the following steps to mount the AP-5181 to a 1.5 to 2 inch diameter steel pole or tube (using the mounting bracket):

1. Fit the edges of the V-shaped clamp parts into the slots on the flat side of the rectangular plate. The inner slots are for the 1.5-inch diameter pole and the outer slots for a 2-inch diameter pole.
2. Place the V-shaped bracket clamp parts around the pole and tighten the nuts just enough to hold the bracket to the pole. (The bracket may need to be rotated around the pole during the antenna alignment process).
3. Attach the square mounting plate to the bridge with the supplied screws.
4. Attach the AP-5181 and mounting plate to the bracket already fixed to the pole.
5. Secure the AP-5181 to the pole bracket using the provided nuts.

✓ **NOTE** The AP-5181 tilt angle may need to be adjusted during the antenna alignment process. Verify the antenna polarization angle when installing, enusre the antennas are oriented corretly in respect to the AP-5181's coverage area.

2.9.2 AP-5181 Wall Monuted Installations

Complete the following steps to mount the AP-5181 to a wall using the supplied wall-mounting bracket:

1. Attach the bracket to a wall with flat side flush against the wall (see the illustration below). Position the bracket in the intended location and mark the positions of the four mounting screw holes.
2. Drill four holes in the wall that match the screws and wall plugs.
3. Secure the bracket to the wall.
4. Attach the square mounting plate to the bridge with the supplied screws. Attach the bridge to the plate on the pole.
5. Use the included nuts to tightly secure the wireless bridge to the bracket.

2.10 AP-5181 LED Indicators

The AP-5181 utilizes four LED indicators. Five LEDs display within four LED slots on the back of the access point. The five LEDs have the following display and functionality:

Illustration forthcoming

Power Status	Solid **white** indicates the AP-5131 is adequately powered.
Error Conditions	Solid **red** indicates the AP-5131 is experiencing a problem condition requiring immediate attention.
Ethernet Activity	Flashing **white** indicates data transfers and Ethernet activity.
802.11a Radio Activity	Flickering **amber** indicates beacons and data transfers over the AP-5131 802.11a radio.
802.11b/g Radio Activity	Flickering **green** indicates beacons and data transfers over the AP-5131 802.11b/g radio.

The LEDs on the rear of the access point are viewed using a single (customer installed) extended lightpipe, adjusted as required to suit above the ceiling installations.

2.11 Setting Up MUs

For a discussion of how to initially test the access point to ensure it can interoperate with the MUs intended for its operational environment, see *Basic Device Configuration on page 3-3* and specifically *Testing Connectivity on page 3-11*.

Refer to the *LA-5030 & LA-5033 Wireless Networker PC Card and PCI Adapter Users Guide,* available from the Symbol Web site, for installing drivers and client software if operating in an 802.11a/g network environment.

Refer to the *Spectrum24 LA-4121 PC Card, LA-4123 PCI Adapter & LA-4137 Wireless Networker User Guide,* available from the Symbol Web site, for installing drivers and client software if operating in an 802.11b network environment.

Use the default values for the ESSID and other configuration parameters until the network connection is verified. MUs attach to the network and interact with the AP transparently.

3

Getting Started

The access point should be installed in an area tested for radio coverage using one of the site survey tools available to the Symbol field service technician. Once an installation site has been identified, the installer should carefully follow the hardware precautions, requirements, mounting guidelines and power options outlined in *Appendix 2, Hardware Installation on page 2-1.*

See the following sections for more details:

- *Installing the Access Point*
- *Configuration Options*
- *Basic Device Configuration*

3.1 Installing the Access Point

Make the required cable and power connections before mounting the access point in its final operating position. Test the access point with an associated MU before mounting and securing the access point. Carefully follow the mounting instructions in one of the following sections to ensure the access point is installed correctly:

For installing an AP-5131 model access point

- For instructions on installing the AP-5131 on a table top, see *Desk Mounted Installations on page 2-12*.
- For instructions on mounting an AP-5131 to a wall, see *Wall Mounted Installations on page 2-14*.
- For instructions on mounting an AP-5131 to a ceiling T-bar, see *Suspended Ceiling T-Bar Installations on page 2-16*.
- For instructions on installing the AP-5131 in an above the ceiling attic space, see *Above the Ceiling (Plenum) Installations on page 2-18*.

For installing an AP-5181 model access point:

- For instructions on installing the AP-5181 to a pole, see *AP-5181 Pole Mounted Installations on page 2-23*.
- For instructions on installing the AP-5181 to a wall, see *AP-5181 Wall Monuted Installations on page 2-24*.

For information on the 802.11a and 802.11b/g radio antenna suite available to the access point, see *Antenna Options on page 2-6*. For more information on using a Symbol Power Injector to combine Ethernet and power in one cable to the access point, see *Symbol Power Injector System on page 2-9*. To verify AP-5131 LED behavior once installed, see *AP-5131 LED Indicators on page 2-21*. To verify the behavior of the AP-5181 LEDs once installed, see *AP-5181 LED Indicators on page 2-25*.

3.2 Configuration Options

Once installed and powered, the access point can be configured using one of several connection techniques. Managing the access point includes viewing network statistics and setting configuration options. The access point requires one of the following connection methods to manage the network:

- *Secure Java-Based WEB UI* - (use *Sun Microsystems' JRE 1.5* or higher available from Sun's Web site. Disable Microsoft's Java Virtual Machine if installed). For information on using the Web UI to set access point default configuration values, see *Basic Device Configuration on page 3-3* or chapters 4 through 7 of this guide.
- *Command Line Interface (CLI)* via Serial, Telnet and SSH. The access point CLI is accessed through the RS232 port, via Telnet or SSH. The CLI follows the same configuration conventions as the device user interface with a few documented exceptions. For details on using the CLI to manage the access point, see *Appendix 8, Command Line Interface Reference on page 8-1*.

- *Config file* - Readable text file; Importable/Exportable via FTP, TFTP and HTTP. Configuration settings for an access point can be downloaded from the current configuration of another access point meeting the import/export requirements. For information on importing or exporting configuration files, see *Importing/Exporting Configurations on page 4-36*.
- *MIB (Management Information Base)* accessing the access point SNMP functions using a MIB Browser. The access point download package contains the following 2 MIB files:
  - Symbol-CC-WS2000-MIB-2.0 (standard Symbol MIB file)
  - Symbol-AP-5131-MIB (AP-5131 specific MIB file)

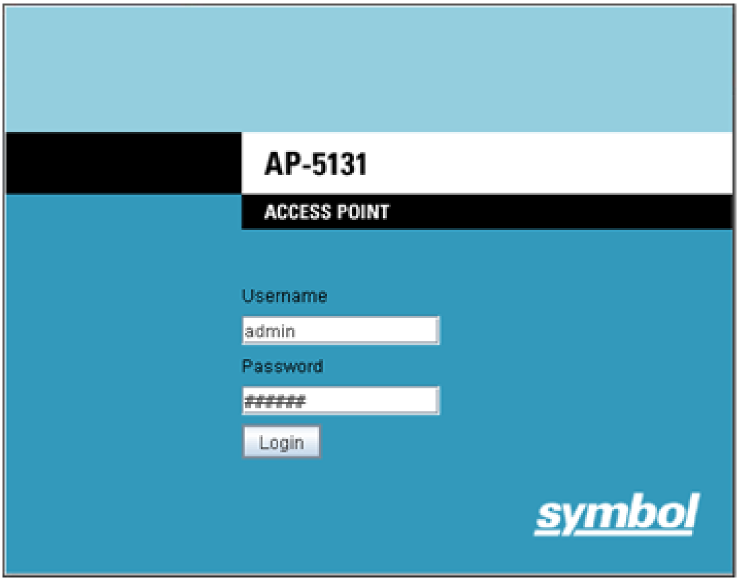
3.3 Basic Device Configuration

For the basic setup described in this section, the Java-based Web UI will be used to configure the access point. Use the access point's LAN interface for establishing a link with the access point. Configure the access point as a DHCP client. For optimal screen resolution, set your screen resolution to 1024 x 768 pixels or greater.

1. Start Internet Explorer and enter the following IP address in the address field: 192.168.0.1. The access point login screen displays.

✓ **NOTE** DNS names are not supported as a valid IP address for the access point. The user is required to enter a numerical IP address.

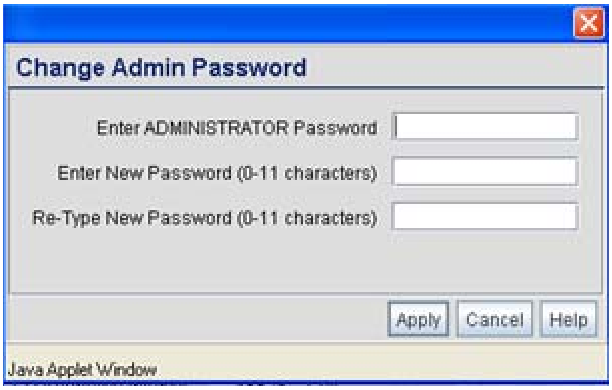
✓ **NOTE** For optimum compatibility, use Sun Microsystems' JRE 1.5 or higher (available from Sun's Website), and be sure to disable Microsoft's Java Virtual Machine if installed.



Username
admin

Password
######

2. Log in using **admin** as the default User ID and **symbol** as the default Password. Though the example above is for an AP-5131, there is no difference for an AP-5181.
3. If the default login is successful, the **Change Admin Password** window displays. Change the password.



Change Admin Password

Enter ADMINISTRATOR Password

Enter New Password (0-11 characters)

Re-Type New Password (0-11 characters)

Enter the current password and a new admin password in fields provided, and click **Apply**. Once the admin password has been updated, a warning message displays stating the access point must be set to a country.

The export function will always export the encrypted Admin User password. The import function will import the Admin Password only if the access point is set to factory default. If the access point is not configured to factory default settings, the Admin User password WILL NOT get imported.

✓ **NOTE** Though the access point can have its basic settings defined using a number of different screens, Symbol recommends using the access point **Quick Setup** screen to set the correct country of operation and define its minimum required configuration from one convenient location.

3.3.1 Configuring Device Settings

Configure a set of minimum required device settings within the **Quick Setup** screen. The values defined within the Quick Setup screen are also configurable in numerous other locations within the menu tree. When you change the settings in the Quick Setup screen, the values also change within the screen where these parameters also exist. Additionally, if the values are updated in these other screens, the values initially set within the Quick Setup screen will be updated.

To define a basic access point configuration:

1. Select **System Configuration** -> **Quick Setup** from the menu tree, if the Quick Setup screen is not already displayed.

2. Enter a **System Name** for the access point.

   The System Name is useful if multiple Symbol devices are being administered.

3. Select the **Country** for the access point's country of operation from the drop-down menu

   The access point prompts the user for the correct country code on the first login. A warning message also displays stating that an incorrect country settings may result in illegal radio operation. Selecting the correct country is central to legally operating the access point. Each country has its own regulatory restrictions concerning electromagnetic emissions and the maximum RF signal strength that can be transmitted. To ensure compliance with national and local laws, be sure to set the Country accurately. CLI and MIB users cannot configure their access point until a two character country code (for example, United States - us) is set. Refer to *Appendix A, Country Codes on page A-7* for the two character country codes.

✓ **NOTE** The System Name and Country are also configurable within the **System Settings** screen. Refer to *Configuring System Settings on page 4-2* (if necessary) to set a system location and admin email address for the access point or to view other default settings.

4. Optionally enter the IP address of the server used to provide system time to the access point within the Time Server field.

✓ **NOTE** DNS names are not supported as a valid IP address. The user is required to enter a numerical IP address.

Once the IP address is entered, the access point's *Network Time Protocol (NTP)* functionality is engaged automatically. Refer to the access point *Product Reference Guide* for information on defining alternate time servers and setting a synchronization interval for the access point to adjust its displayed time. Refer to *Configuring Network Time Protocol (NTP) on page 4-31* (if necessary) for information on setting alternate time servers and setting a synchronization interval for the access point to adjust its displayed time.

5. Click the **WAN** tab to set a minimum set of parameters for using the WAN interface.
   a. Select the **Enable WAN Interface** checkbox to enable a connection between the access point and a larger network or outside world through the WAN port. Disable this option to effectively isolate the access point's WAN connection. No connections to a larger network or the Internet will be possible. MUs cannot communicate beyond the configured subnets.
   b. Select the **This Interface is a DHCP Client** checkbox to enable DHCP for the access point WAN connection. This is useful, if the larger corporate network or *Internet Service Provider (ISP)* uses DHCP. DHCP is a protocol that includes mechanisms for IP address allocation and delivery of host-specific configuration parameters from a DHCP server to a host. Some of these parameters are IP address, network mask, and gateway.

✓ **NOTE** Symbol recommends that the WAN and LAN ports should not both be configured as DHCP clients.

   c. Specify an **IP address** for the access point's WAN connection. An IP address uses a series of four numbers expressed in dot notation, for example, 190.188.12.1 (no DNS names supported).
   d. Specify a **Subnet Mask** for the access point's WAN connection. This number is available from the ISP for a DSL or cable-modem connection, or from an administrator if the access point connects to a larger network. A subnet mask uses a series of four numbers expressed in dot notation. For example, 255.255.255.0 is a valid subnet mask.

   e. Define a **Default Gateway** address for the access point's WAN connection. The ISP or a network administrator provides this address.

   f. Specify the address of a **Primary DNS Server**. The ISP or a network administrator provides this address.

6. Optionally, use the **Enable PPP over Ethernet** checkbox to enable *Point-to-Point over Ethernet (PPPoE)* for a high-speed connection that supports this protocol. Most DSL providers are currently using or deploying this protocol. PPPoE is a data-link protocol for dialup connections. PPPoE will allow the access point to use a broadband modem (DSL, cable modem, etc.) for access to high-speed data networks.

   a. Select the **Keep Alive** checkbox to enable occasional communications over the WAN port even when client communications to the WAN are idle. Some ISPs terminate inactive connections, while others do not. In either case, enabling Keep-Alive maintains the WAN connection, even when there is no traffic. If the ISP drops the connection after the idle time, the access point automatically reestablishes the connection to the ISP.

   b. Specify a **Username** entered when connecting to the ISP. When the Internet session begins, the ISP authenticates the username.

   c. Specify a **Password** entered when connecting to the ISP. When the Internet session starts, the ISP authenticates the password.

   For additional access point WAN port configuration options, see *Configuring WAN Settings on page 5-14*.

7. Click the **LAN** tab to set a minimum set of parameters to use the access point LAN interface.

   a. Select the **Enable LAN Interface** checkbox to forward data traffic over the access point LAN connection. The LAN connection is enabled by default.

   b. Use the **This Interface** drop-down menu to specify how network address information is defined over the access point's LAN connection. Select **DHCP Client** if the larger corporate network uses DHCP. DHCP is a protocol that includes mechanisms for IP address allocation and delivery of host-specific configuration parameters from a DHCP server to a host. Some of these parameters are IP address, network mask, and gateway. Select **DHCP Server** to use the access point as a DHCP server over the LAN connection. Select the **Bootp client** option to enable a diskless system to discover its own IP address.

NOTE Symbol recommends that the WAN and LAN ports should not both be configured as DHCP clients.

c. If using the static or DHCP Server option, enter the network-assigned **IP Address** of the access point.

✓ **NOTE** DNS names are not supported as a valid IP address for the access point. The user is required to enter a numerical IP address.

d. The **Subnet Mask** defines the size of the subnet. The first two sets of numbers specify the network domain, the next set specifies the subset of hosts within a larger network. These values help divide a network into subnetworks and simplify routing and data transmission.

e. If using the static or DHCP Server option, enter a **Default Gateway** to define the numerical IP address of a router the access point uses on the Ethernet as its default gateway.

f. If using the static or DHCP Server option, enter the **Primary DNS Server** numerical IP address.

g. If using the DHCP Server option, use the **Address Assignment Range** parameter to specify a range of IP address reserved for mapping clients to IP addresses. If a manually (static) mapped IP address is within the IP address range specified, that IP address could still be assigned to another client. To avoid this, ensure all statically mapped IP addresses are outside of the IP address range assigned to the DHCP server.

For additional access point LAN port configuration options, see *Configuring the LAN Interface on page 5-1*.

8. Enable the radio(s) using the **Enable** checkbox(es) within the Radio Configuration field. If using a single radio access point, enable the radio, then select either 2.4 GHz or 5.2 GHz from the **RF Band of Operation** field. Only one RF band option at a time is permissible in a single-radio model. If using a dual-radio model, the user can enable both RF bands. For additional radio configuration options, see *Configuring the 802.11a or 802.11b/g Radio on page 5-47*.

9. Select the **WLAN #1** tab (WLANs 1 - 4 are available within the Quick Setup screen) to define its ESSID and security scheme for basic operation.

✓ **NOTE** A maximum of 16 WLANs are configurable within the Wireless Configuration screen. The limitation of 16 WLANs exists regardless of whether the access point is a single or dual-radio model.

   a. Enter the *Extended Services Set Identification (ESSID)* and name associated with the WLAN. For additional information on creating and editing up to 16 WLANs per access point, see *Creating/Editing Individual WLANs on page 5-24*.

   b. Use the **Available On** checkboxes to define whether the target WLAN is operating over the 802.11a or 802.11b/g radio. Ensure the radio selected has been enabled (see step 8).

   c. Even an access point configured with minimal values must protect its data against theft and corruption. A security policy should be configured for WLAN1 as part of the basic configuration outlined in this guide. A security policy can be configured for the WLAN from within the **Quick Setup** screen. Policies can be defined over time and saved to be used as needed as security requirements change. Symbol recommends you familiarize yourself with the security options available on the access point before defining a security policy. Refer to *Configuring WLAN Security Settings on page 3-9*.

10. Click **Apply** to save any changes to the access point Quick Setup screen. Navigating away from the screen without clicking Apply results in all changes to the screens being lost.
11. Click **Undo Changes** (if necessary) to undo any changes made. Undo Changes reverts the settings displayed on the access point Quick Setup screen to the last saved configuration.

3.3.1.1 Configuring WLAN Security Settings

To configure a basic security policy for a WLAN:

1. From the access point Quick Setup screen, click the **Create** button to the right of the Security Policy item.

   The **New Security Policy** screen displays with the **Manually Pre-shared key/No authentication** and **No Encryption** options selected. Naming and saving such a policy (as is) would provide no security and might only make sense in a guest network wherein no sensitive data is either transmitted or received. Consequently, at a minimum, a basic security scheme (in this case WEP 128) is recommended in a network environment wherein sensitive data is transmitted.

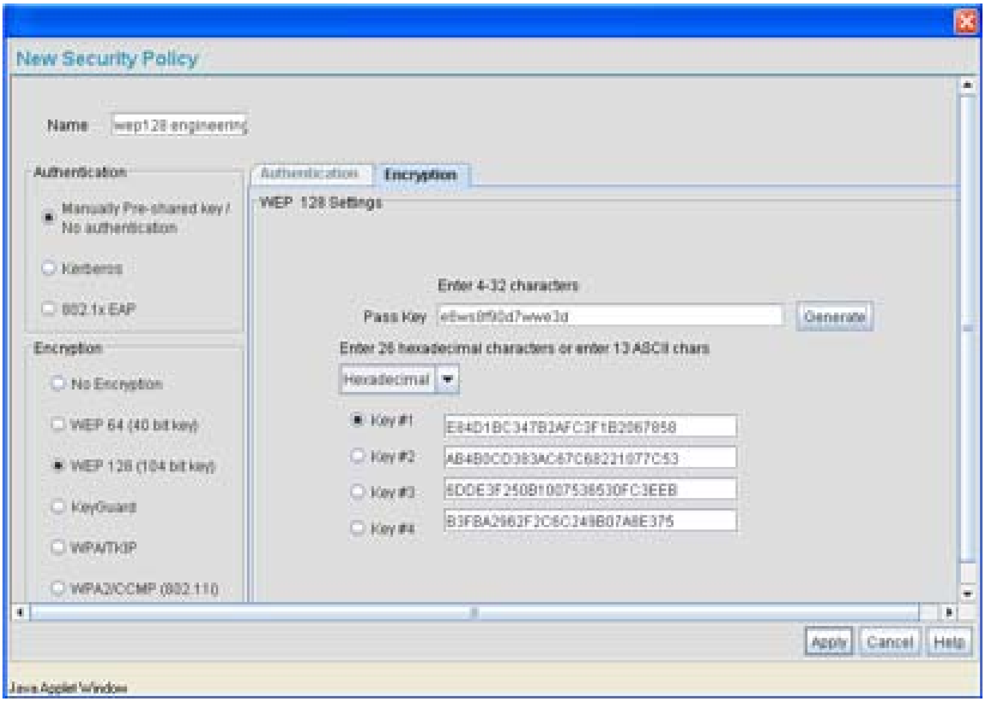
NOTE For information on configuring the other encryption and authentication options available to the access point, see *Configuring Security Options on page 6-2*.

2. Ensure the **Name** of the security policy entered suits the intended configuration or function of the policy.

Multiple WLANs can share the same security policy, so be careful not to name security policies after specific WLANs or risk defining a WLAN to single policy. Symbol recommends naming the policy after the attributes of the authentication or encryption type selected.

3. Select the **WEP 128 (104 bit key)** checkbox.

   The **WEP 128 Settings** field displays within the New Security Policy screen.



New Security Policy

Name: wep128 engineering

Authentication
- ● Manually Pre-shared key / No authentication
- ○ Kerberos
- ○ 802.1x EAP

Encryption
- ○ No Encryption
- ○ WEP 64 (40 bit key)
- ● WEP 128 (104 bit key)
- ○ KeyGuard
- ○ WPA/TKIP
- ○ WPA2/CCMP (802.11i)

WEP 128 Settings

Enter 4-32 characters

Pass Key: e8ws8f90d7wwe3d

Enter 26 hexadecimal characters or enter 13 ASCII chars

Hexadecimal

- ● Key #1: E84D1BC347B3AFC3F1B2067858
- ○ Key #2: AB4B0CD383AC67C68221077C53
- ○ Key #3: 6DDE3F250B1007538530FC3EEB
- ○ Key #4: B3FBA2962F2C6C349B07A8E375

4. Configure the **WEP 128 Settings** field as required to define the Pass Key used to generate the WEP keys.

Pass Key — Specify a 4 to 32 character pass key and click the **Generate** button. The access point, other proprietary routers and Symbol MUs use the same algorithm to convert an ASCII string to the same hexadecimal number. Non-Symbol clients and devices need to enter WEP keys manually as hexadecimal numbers. The access point and its target client(s) must use the same pass key to interoperate.

Keys #1-4 Use the **Key #1-4** fields to specify key numbers. The key can be either a hexidecimal or ASCII depending on which option is selected from the drop-down menu. For WEP 64 (40-bit key), the keys are 10 hexadecimal characters in length or 5 ASCII characters. For WEP 128 (104-bit key), the keys are 26 hexadecimal characters in length or 13 ASCII characters. Select one of these keys for activation by clicking its radio button. The access point and its target client(s) must use the same key to interoperate.

5. Click the **Apply** button to save the security policy and return to the access point **Quick Setup** screen.

   At this point, you can test the access point for MU interoperability.

3.3.2 Testing Connectivity

Verify the access point's link with an MU by sending *Wireless Network Management Protocol* (WNMP) ping packets to the associated MU. Use the Echo Test screen to specify a target MU and configure the parameters of the test. The WNMP ping test only works with Symbol MUs. Only use a Symbol MU to test access point connectivity using WNMP.

NOTE Before testing for connectivity, the target MU needs to be set to the same ESSID as the access point. Since WEP 128 has been configured for the access point, the MU also needs to be configured for WEP 128 and use the same WEP keys. Ensure the MU is associated with the access point before testing for connectivity.

To ping a specific MU to assess its connection with an access point:

1. Select **Status and Statistics** -> **MU Stats** from the menu tree.
2. Select the **Echo Test** button from within the **MU Stats Summary** screen.
3. Define the following parameters for the test.

Station Address The station address is the IP address of the target MU. Refer to the MU Stats Summary screen for associated MU IP address information.

Number of pings Defines the number of packets to be transmitted to the MU. The default is 100.

Packet Length	Specifies the length of each packet transmitted to the MU during the test. The default length is 100 bytes.

4. Click the **Ping** button to begin transmitting packets to the specified MU address.

   Refer to the Number of Responses value to assess the number of responses from the MU versus the number of ping packets transmitted by the access point. Use the ratio of packets sent versus the number of packets received the link quality between the MU and the access point.

   Click the **OK** button to exit the Echo Test screen and return to the MU Stats Summary screen.

3.3.3 Where to Go from Here?

Once basic connectivity has been verified, the access point can be fully configured to meet the needs of the network and the users it supports. Refer to the following:

- For detailed information on access point device access, SNMP settings, network time, importing/exporting device configurations and device firmware updates, see *Chapter 4, System Configuration on page 4-1*.
- For detailed information on configuring access point LAN interface (subnet) and WAN interface see, *Chapter 5, Network Management on page 5-1*.
- For detailed information on configuring specific encryption and authentication security schemes for individual access point WLANs, see *Chapter 6, Configuring Access Point Security on page 6-1*.
- To view detailed statistics on the access point and its associated MUs, see *Chapter 7, Monitoring Statistics on page 7-1*.

4

System Configuration

The Symbol access point contains a built-in browser interface for system configuration and remote management using a standard Web browser such as Microsoft Internet Explorer, Netscape Navigator or Mozilla Firefox. The browser interface also allows for system monitoring of the access point.

Web management of the access point requires either Microsoft Internet Explorer 5.0 or later or Netscape Navigator 6.0 or later.

✓ **NOTE** For optimum compatibility, use *Sun Microsystems' JRE 1.5* or higher (available from Sun's Web site), and be sure to disable Microsoft's Java Virtual Machine if installed.

To connect to the AP, the access point IP is required. Enter 192.168.0.1 for the default IP address. The password is "symbol."

✓ **NOTE** DNS names are not supported as a valid IP address for the access point. The user is required to enter a numerical IP address.

System configuration topics include:

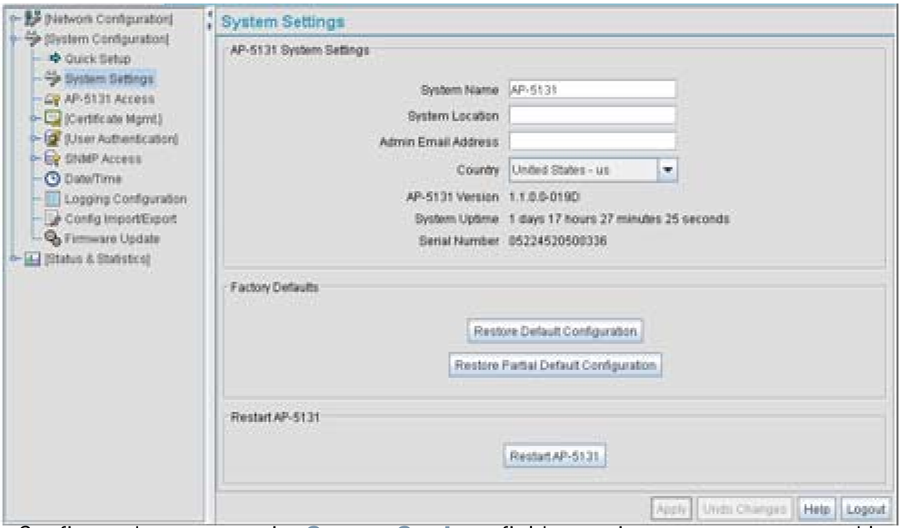
- *Configuring System Settings*
- *Configuring Data Access*
- *Managing Certificate Authority (CA) Certificates*
- *Configuring SNMP Settings*
- *Configuring Network Time Protocol (NTP)*
- *Logging Configuration*
- *Importing/Exporting Configurations*
- *Updating Device Firmware*

4.1 Configuring System Settings

Use the **System Settings** screen to specify the name and location of the access point, assign an email address for the network administrator, restore the AP's default configuration or restart the AP.

To configure System Settings for the access point:

1. Select **System Configuration** -> **System Settings** from the access point menu tree.



System Name: AP-5131
System Location:
Admin Email Address:
Country: United States - us
AP-5131 Version: 1.1.0.0-019D
System Uptime: 1 days 17 hours 27 minutes 25 seconds
Serial Number: 05224520500336

2. Configure the access point **System Settings** field to assign a system name and location, set the country of operation and view device version information.

System Name — Specify a device name for the access point. Symbol recommends selecting a name serving as a reminder of the user base the access point supports (engineering, retail, etc.).

System Location — Enter the location of the access point. The **System Location** parameter acts as a reminder of where the AP can be found. Use the System Name field as a specific identifier of device location. Use the System Name and System Location fields together to optionally define the AP name by the radio coverage it supports and specific physical location. For example, "second floor engineering"

Admin Email Address — Specify the AP administrator's email address.

Country — The access point prompts the user for the correct country code after the first login. A warning message also displays stating that an incorrect country setting will lead to an illegal use of the access point. Use the pull-down menu to select the country of operation. Selecting the correct country is extremely important. Each country has its own regulatory restrictions concerning electromagnetic emissions (channel range) and the maximum RF signal strength transmitted. To ensure compliance with national and local laws, be sure to set the **Country** field correctly.

If using the access point configuration file, CLI or MIB to configure the access point's country code, see *Country Codes on page A-7*.

access point *Version* — The displayed number is the current version of the access point device firmware. Use this information to determine if the AP is running the most recent firmware available from Symbol. Use the **Firmware Update** screen to keep the AP's firmware up to date. For more information, see *Updating Device Firmware on page 4-40*.

System Uptime — Displays the current uptime of the access point defined in the System Name field. *System Uptime* is the cumulative time since the access point was last rebooted or lost power.

Serial Number — Displays the access point *Media Access Control (MAC)* address. The access point MAC address is hard coded at the factory and cannot be modified. The LAN and WAN port MAC addresses can be located within the LAN and WAN Stats screens. For information on locating the access point MAC addresses, see *Viewing WAN Statistics on page 7-2* and *Viewing LAN Statistics on page 7-6*.

3. Refer to the **Factory Defaults** field to restore either a full or partial default configuration.

CAUTION Restoring the access point’s configuration back to default settings changes the administrative password back to “symbol.” If restoring the configuration back to default settings, be sure you change the administrative password accordingly.

Restore Default Configuration

Select the **Restore Default Configuration** button to reset the AP’s configuration to factory default settings. If selected, a message displays warning the user the current configuration will be lost if the default configuration is restored. Before using this feature, Symbol recommends using the **Config Import/Export** screen to export the current configuration for safekeeping, see *Importing/Exporting Configurations on page 4-36*.

Restore Partial Default Configuration

Select the **Restore Partial Default Configuration** button to restore a default configuration with the exception of the current LAN, WAN, SNMP settings and IP address used to launch the browser. If selected, a message displays warning the user all current configuration settings will be lost with the exception of WAN and SNMP settings. Before using this feature, Symbol recommends using the **Config Import/Export** screen to export the current configuration for safekeeping, see *Importing/Exporting Configurations on page 4-36*.

4. Use the **Restart** access point field to restart the AP (if necessary).

Restart access point

Click the **Restart** access point button to reboot the AP. Restarting the access point resets all data collection values to zero. Symbol does not recommend restarting the AP during significant system uptime or data collection activities.

CAUTION After a reboot, static route entries disappear from the AP Route Table if a LAN Interface is set to DHCP Client. The entries can be retrieved (once the reboot is done) by performing an Apply operation from the WEB UI or a save operation from the CLI.

5. Click **Apply** to save any changes to the System Settings screen. Navigating away from the screen without clicking the Apply button results in all changes to the screen being lost.

☑ **NOTE** The **Apply** button is not needed for restoring the access point default configuration or restarting the access point.

6. Click **Undo Changes** (if necessary) to undo any changes made. Undo Changes reverts the settings displayed on the System Settings screen to the last saved configuration.
7. Click **Logout** to securely exit the access point Symbol Access Point applet. A prompt displays confirming the logout before the applet is closed.

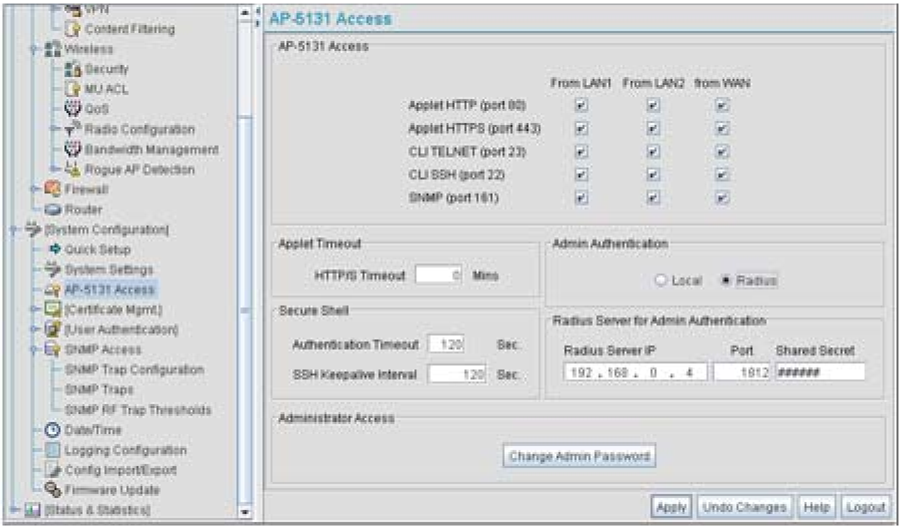
4.2 Configuring Data Access

Use the access point **Access** screen to enable/disable data throughput to the access point's LAN1, LAN2 and/or WAN interfaces and display screens for changing administrator passwords.

Use the access point Access screen checkboxes to enable or disable LAN1, LAN2 and/or WAN access using the protocols and ports listed. If access is disabled, this effectively locks out the administrator from configuring the access point using that interface. To avoid jeopardizing the network data managed by the access point, Symbol recommends enabling only those interfaces used in the routine (daily) management of the network, and disabling all other interfaces until they are required.

To configure access for the access point:

1. Select **System Configuration** -> **access point Access** from the access point menu tree.



AP-5131 Access

AP-5131 Access

	From LAN1	From LAN2	from WAN
Applet HTTP (port 80)	☑	☑	☑
Applet HTTPS (port 443)	☑	☑	☑
CLI TELNET (port 23)	☑	☑	☑
CLI SSH (port 22)	☑	☑	☑
SNMP (port 161)	☑	☑	☑

Applet Timeout

HTTP/S Timeout 0 Mins

Admin Authentication

○ Local ● Radius

Secure Shell

Authentication Timeout 120 Sec.

SSH Keepalive Interval 120 Sec.

Radius Server for Admin Authentication

Radius Server IP	Port	Shared Secret
192 . 168 . 0 . 4	1812	######

Administrator Access

Change Admin Password

2. Use the access point **Access** field checkboxes to enable/disable the following on the access point’s LAN1, LAN2 or WAN interfaces:

Applet HTTP (port 80) Select the LAN1, LAN2 and/or WAN checkboxes to enable access to the access point configuration applet using a Web browser.

Applet HTTPS (port 443) Select the LAN1, LAN2 and/or WAN checkboxes to enable access to the access point configuration applet using a *Secure Sockets Layer (SSL)* for encrypted HTTP sessions.

CLI TELNET (port 23) Select the LAN1, LAN2 and/or WAN checkboxes to enable access to the access point CLI via the TELNET terminal emulation TCP/IP protocol.

CLI SSH (port 22) Select the LAN1, LAN2 and/or WAN checkboxes to enable access to the access point CLI using the SSH (Secure Shell) protocol.

SNMP (port 161) Select the LAN1, LAN2 and/or WAN checkboxes to enable access to the access point configuration settings from an SNMP-capable client.

3. Refer to the **Applet Timeout** field to set an HTTPS timeout interval.

HTTP/S Timeout Disables access to the access point if no data activity is detected over Applet HTTPS (port 443) after the user defined interval. Default is 0 Mins.

4. Configure the **Secure Shell** field to set timeout values to reduce network inactivity.

   Authentication Timeout

   Defines the maximum time (between 30 - 120 seconds) allowed for SSH authentication to occur before executing a timeout. The minimum permissible value is 30 seconds.

   SSH Keepalive Interval

   The SSH Keepalive Interval defines a period (in seconds) after which if no data has been received from a client, SSH sends a message through the encrypted channel to request a response from the client. The default is 0, and no messages will be sent to the client until a non-zero value is set. Defining a Keepalive interval is important, otherwise programs running on a server may never notice if the other end of a connection is rebooted.

5. Use the **Admin Authentication** buttons to specify the authentication server connection method.

   Local

   The access point verifies the authentication connection.

   Radius

   Designates that a Radius server is used in the authentication credential verification. If using this option, the connected PC is required to have its Radius credentials verified with an external Radius server. Additionally, the Radius Server's Active Directory should have a valid user configured and have a PAP based Remote Access Policy configured for Radius Admin Authentication to work.

6. Use the Radius Server if a Radius server has been selected as the authentication server, enter the required network address information.

   Radius Server IP

   Specify the numerical (non DNS name) IP address of the *Remote Authentication Dial-In User Service* (Radius) server. Radius is a client/server protocol and software enabling remote-access servers to communicate with a server used to authenticate users and authorize access to the requested system or service.

   Port

   Specify the port on which the server is listening. The Radius server typically listens on ports 1812 (default port).

Shared Secret

Define a shared secret for authentication on the server. The shared secret is required to be the same as the shared secret defined on the Radius server. Use shared secrets to verify Radius messages (with the exception of the Access-Request message) sent by a Radius-enabled device configured with the same shared secret.

Apply the qualifications of a well-chosen password to the generation of a shared secret. Generate a random, case-sensitive string using letters, numbers and symbols. The default is symbol.

7. Update the **Administrator Access** field to change the administrative password used to access the access point configuration settings.

Change Admin Password

Click the **Change Admin Password** button to display a screen for updating the AP administrator password. Enter and confirm a new administrator password as required.

8. Click **Apply** to save any changes to the access point Access screen. Navigating away from the screen without clicking the Apply button results in all changes to the screen being lost.
9. Click **Undo Changes** (if necessary) to undo any changes made. Undo Changes reverts the settings displayed on the access point Access screen to the last saved configuration.
10. Click **Logout** to securely exit the access point Symbol Access Point applet. A prompt displays confirming the logout before the applet is closed.

4.3 Managing Certificate Authority (CA) Certificates

Certificate management includes the following sections:

- *Importing a CA Certificate*
- *Creating Self Certificates for Accessing the VPN*

4.3.1 Importing a CA Certificate

A *certificate authority (CA)* is a network authority that issues and manages security credentials and public keys for message encryption. The CA signs all digital certificates that it issues with its own private key. The corresponding public key is contained within the certificate and is called a CA certificate. A browser must contain this CA certificate in its *Trusted Root Library* so that it can trust certificates “signed” by the CA's private key.

Depending on the public key infrastructure, the digital certificate includes the owner's public key, the certificate expiration date, the owner's name and other public key owner information.

The access point can import and maintain a set of CA certificates to use as an authentication option for *Virtual Private Network* (VPN) access. To use the certificate for a VPN tunnel, define a tunnel and select the IKE settings to use either RSA or DES certificates. For additional information on configuring VPN tunnels, see *Configuring VPN Tunnels on page 6-33*.

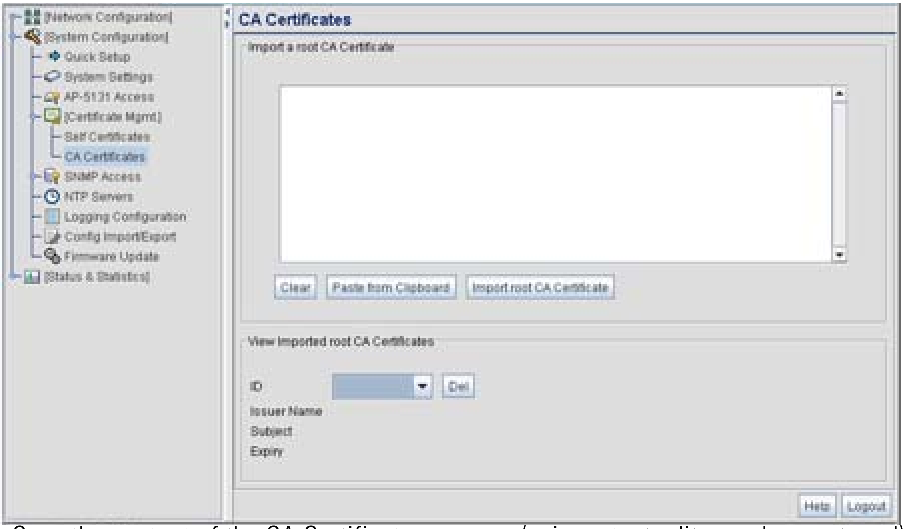
⚠ **CAUTION** Loaded and signed CA certificates will be lost when changing the access point’s firmware version using either the GUI or CLI. After a certificate has been successfully loaded, export it to a secure location to ensure its availability after a firmware update.

Refer to your access point network administrator to obtain a CA certificate to import into the access point.

☑ **NOTE** Verify the access point device time is synchronized with an NTP server before importing a certificate to avoid issues with conflicting date/time stamps. For more information, see *Configuring Network Time Protocol (NTP) on page 4-31*.

To import a CA certificate:

1. Select **System Configuration** -> **Certificate Mgmt** -> **CA Certificates** from the access point menu tree.



2. Copy the content of the CA Certificate message (using a text editor such as notepad) and then click on **Paste from Clipboard**.

   The content of the certificate displays in the **Import a root CA Certificate** field.

3. Click the **Import root CA Certificate** button to import it into the CA Certificate list.
4. Once in the list, select the certificate ID within the **View Imported root CA Certificates** field to view the certificate issuer name, subject, and certificate expiration data.
5. To delete a certificate, select the Id from the drop-down menu and click the **Del** button.

4.3.2 Creating Self Certificates for Accessing the VPN

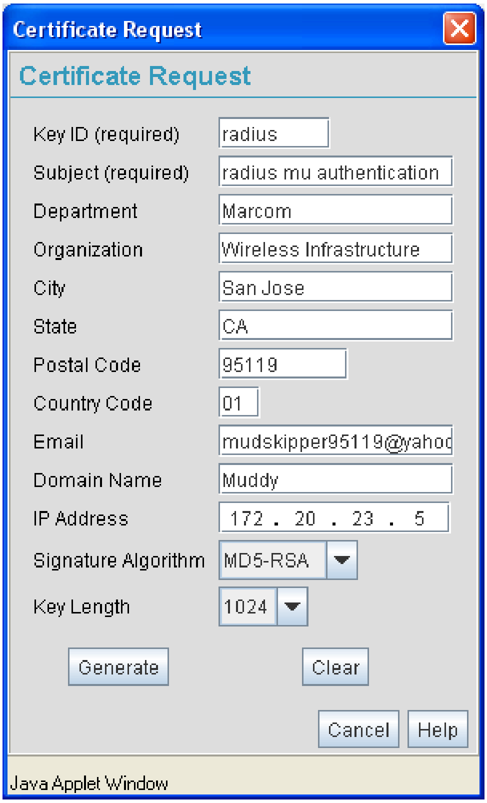
The access point requires two kinds of certificates for accessing the VPN, CA certificates and self certificates. Self certificates are certificate requests you create, send to a Certificate Authority (CA) to be signed, then import the signed certificate into the management system.

CAUTION Self certificates can only be generated using the access point GUI and CLI interfaces. No functionality exists for creating a self-certificate using the access point's SNMP configuration option.

To create a self certificate:

1. Select **System Configuration** -> **Certificate Mgmt** -> **Self Certificates** from the access point menu tree.

2. Click on the **Add** button to create the certificate request.



Key ID (required)	radius
Subject (required)	radius mu authentication
Department	Marcom
Organization	Wireless Infrastructure
City	San Jose
State	CA
Postal Code	95119
Country Code	01
Email	mudskipper95119@yahoo
Domain Name	Muddy
IP Address	172 . 20 . 23 . 5
Signature Algorithm	MD5-RSA
Key Length	1024

The **Certificate Request** screen displays.

3. Complete the request form with the pertinent information. Only 4 values are required, the others optional:

Key ID Enter a logical name for the certificate to help distinguish between certificates. The name can be up to 7 characters in length.

Subject The required **Subject** value contains important information about the certificate. Contact the CA signing the certificate to determine the content of the Subject parameter.

Signature Algorithm Use the drop-down menu to select the signature algorithm used for the certificate. Options include:

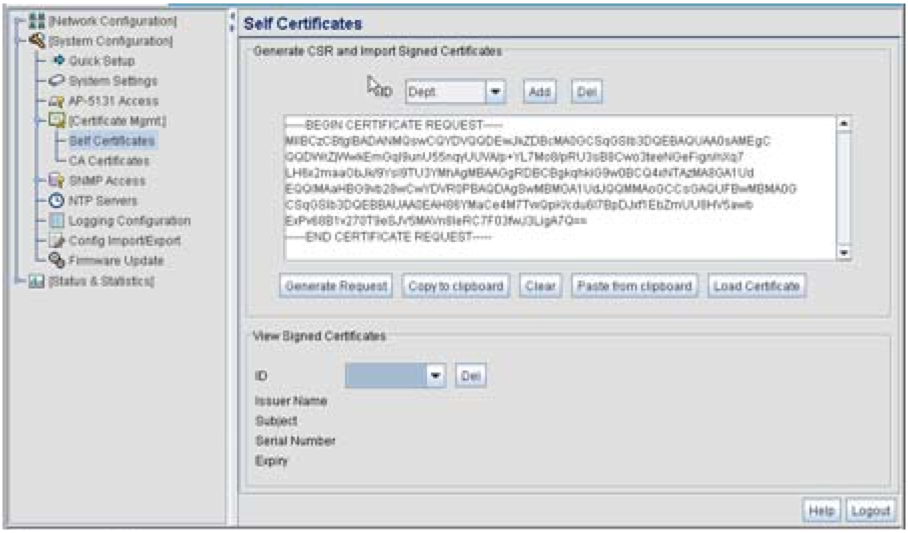
- MD5-RSA - Message Digest 5 algorithm in combination with RSA encryption.
- SHA1-RSA - Secure Hash Algorithm 1 in combination with RSA encryption.

Key Length Defines the length of the key. Possible values are 512, 1024, and 2048.

4. When the form is completed, click the **Generate** button.

   The Certificate Request screen disappears and the ID of the generated certificate request displays in the drop-down list of certificates within the Self Certificates screen.

5. Click the **Generate Request** button.



ID Dept

```
-----BEGIN CERTIFICATE REQUEST-----
MIIBCzCBtgIBADANMQswCQYDVQQDEwJkZDBcMA0GCSqGSIb3DQEBAQUAA0sAMEgC
GQDWkZjWwkEmOqI9unU55nqyUUVAp+YL7Mc8/pRU3sB8Cwo3teeNGeFignlnXq7
LH8x2maa0bJk/9Yp9TU3YMhAgMBAAGgRDBCBgkqhkiG9w0BCQ4xNTAzMA8GA1Ud
EQQIMAaHBG9vb28wCwYDVR0PBAQDAgSwMBMGA1UdJQQMMAoGCCsGAQUFBwMBMA0G
CSqGSIb3DQEBBAUAA0EAH98YMaCe4M7TwQpKcdu6l7BpDJxf1EbZmUU8HV5aw6
ExPv68B1x270T9eSJV5MAVn8leRC7F03fwJ3LigA7Q==
-----END CERTIFICATE REQUEST-----
```

ID

   The generated certificate request displays in Self Certificates screen text box.

6. Click the **Copy to Clipboard** button.

   The content of certificate request is copied to the clipboard.

   Create an email to your CA, paste the content of the request into the body of the message and send it to the CA.

The CA signs the certificate and will send it back. Once received, copy the content from the email into the clipboard.

7. Click the **Paste from clipboard** button.

   The content of the email displays in the window.

   Click the **Load Certificate** button to import the certificate and make it available for use as a VPN authentication option. The certificate ID displays in the Signed list.

✓ **NOTE** If the access point is restarted after a certificate request has been generated but before the signed certificate is imported, the import will not execute properly. Do not restart the access point during this process.

8. To use the certificate for a VPN tunnel, first define a tunnel and select the IKE settings to use either RSA or DES certificates. For additional information on configuring VPN tunnels, see *Configuring VPN Tunnels on page 6-33*.

4.3.3 Creating a Certificate for Onboard Radius Authentication

The access point can use its on-board Radius Server to generate certificates to authenticate MUs for use with the access point. In addition, a Windows 2000 or 2003 Server is used to sign the certificate before downloading it back to the access point's on-board Radius server and loading the certificate for use with the access point.

Both a CA and Self certificate are required for Onboard Radius Authentication. For information on CA Certificates, see *Importing a CA Certificate on page 4-8*. Ensure the certificate is in a Base 64 Encoded format or risk loading an invalid certificate.

⚠ **CAUTION** Self certificates can only be generated using the access point GUI and CLI interfaces. No functionality exists for creating a self-certificate using the access point's SNMP configuration option.

To create a self certificate for on-board Radius authentication:

1. Select **System Configuration** -> **Certificate Mgmt** -> **Self Certificates** from the access point menu tree.

2. Click on the **Add** button to create the certificate request.

   The **Certificate Request** screen displays.

3. Complete the request form with the pertinent information.

Key ID (required) Enter a logical name for the certificate to help distinguish between certificates. The name can be up to 7 characters in length.

Subject (required) The required **Subject** value contains important information about the certificate. Contact the CA signing the certificate to determine the content of the Subject parameter.

Department Optionally enter a value for your organizations's department name if needing to differentiate the certificate from similar certificates used in other departments within your organization.

Organization Optionally enter the name of your organization for supporting information for the certificate request.

City Optionally enter the name of the City where the access point (using the certificate) resides.

State Optionally enter the name of the State where the access point (using the certificate) resides.

Postal Code Optionally enter the name of the Postal (Zip) Code where the access point (using the certificate) resides.

Country Code Optionally enter the access point's Country Code.

Email Enter a organizational email address (avoid using a personal address if possible) to associate the request with the proper requesting organization.

Domain Name Ensure the Domain name is the name of the CA Server. This value must be set correctly to ensure the certificate is properly generated.

IP Address Enter the IP address of this access point (as you are using the access point's onbard Radius server).

Signature Algorithm Use the drop-down menu to select the signature algorithm used for the certificate. Options include:

- MD5-RSA - Message Digest 5 algorithm in combination with RSA encryption.
- SHA1-RSA - Secure Hash Algorithm 1 in combination with RSA encryption.

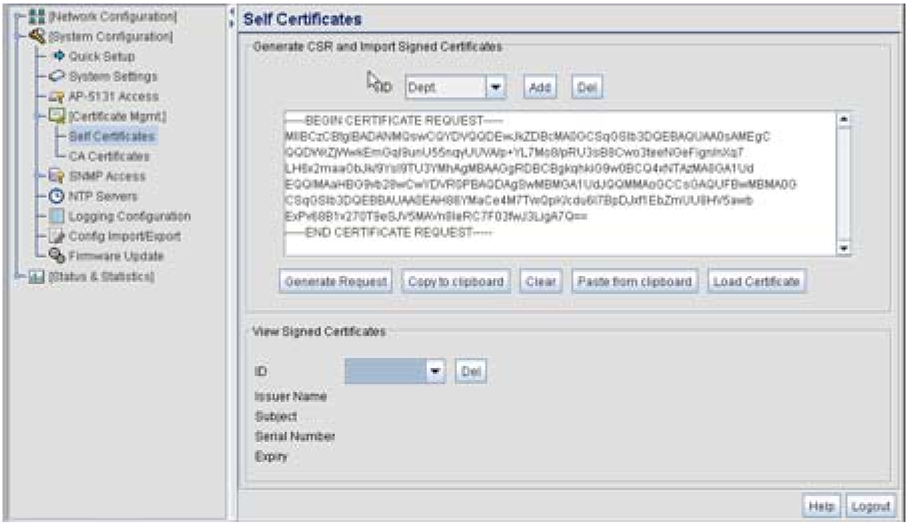
Key Length Defines the length of the key. Possible values are 512, 1024, and 2048. Symbol recommends setting this value to 1024 to ensure optimum functionality.

4. Complete as many of the optional values within the **Certificate Request** screen as possible.
5. When the form is completed, click the **Generate** button from within the Certificate Request screen.

   The Certificate Request screen disappears and the ID of the generated certificate request displays in the drop-down list of certificates within the Self Certificates screen.

NOTE A Warning screen may display at this phase stating key information could be lost if you proceed with the certificate request. Click the **OK** button to continue, as the certificate has not been signed yet.

6. Click the **Generate Request** button from within the Self Certificates screen. The certificate content displays within the Self Certificate screen.



```
-----BEGIN CERTIFICATE REQUEST-----
MIIBCzCBtgIBADANMQswCQYDVQQDEwJkZDBcMA0GCSqGSIb3DQEBAQUAA0sAMEgC
QQDWkZjWwkEmGqI9unU55nqyUUVAlp+YL7Ms8/pRU3sB8Cwo3teeNOeFlgnlnXqT
LH6x2maa0bJk/9Yrsl9TU3YMhAgMBAAGgRDBCBgkqhkiG9w0BCQ4xNTAzMA8GA1Ud
EQQIMAaHBO9wb28wCwYDVR0PBAQDAgSwMBMGA1UdJQQMMAoGCCsGAQUFBwMBMA0G
CSqGSIb3DQEBBAUAA0EAH8tYMaCe4M7TwQpKcdu6lTBpDJxf1EbZmUU8HV5awb
ExPv68B1x270T9eSJV5MAVn8leRC7F03fwJ3LigA7Q==
-----END CERTIFICATE REQUEST-----
```

7. Click the **Copy to clipboard** button. Save the certificate content to a secure location.
8. Connect to the Windows 2000 or 2003 server used to sign the certificate.
9. Select the **Request a certificate** option. Click **Next** to continue.

10. Select the **Advanced request** checkbox from within the Choose Request Type screen and click Next to continue.
11. From within the Advanced Certificate Requests screen, select the **Submit a certificate request using a base 64 encoded PKCS #10 file or a renewal request using a base64 encoded PKCS file** option. Click Next to continue.
12. Paste the content of certificate in the **Saved Request** field (within the Submit a Saved Request screen).

✓ **NOTE** An administrator must make sure the **Web Server** option is available as a selectable option for those without administrative privileges.

If you do not have administrative privileges, ensure the **Web Server** option has been selected from the Certificate Template drop-down menu. Click Submit.

13. Select the **Base 64 encoded** checkbox option from within the Certificate Issued screen and select the **Download CA Certificate** link.

    A **File Download** screen displays prompting the user to select the download location for the certificate.

14. Click the **Save** button and save the certificate to a secure location.
15. Load the certificates on the access point.

⚠ **CAUTION** Ensure the CA Certificate is loaded before the Self Certificate, or risk an invalid certificate load.

16. Open the certificate file and copy its contents into the CA Certificates screen by clicking the **Paste from Clipboard** button.

    The certificate is now ready to be loaded into the access point’s flash memory.

17. Click the **Import root CA Certificate** button from within the CA Certificates screen.
18. Verify the contents of the certificate file display correctly within the CA Certificates screen.
19. Open the certificate file and copy its contents into the Self Certificates screen by clicking the **Paste from Clipboard** button.
20. Click the **Load Certificate** button.
21. Verify the contents of the certificate file display correctly within the Self Certificates screen.

    The certificate for the onboard Radius authentication of MUs has now been generated and loaded into the access point’s flash memory.

4.4 Configuring SNMP Settings

Simple Network Management Protocol (SNMP) facilitates the exchange of management information between network devices. SNMP uses *Management Information Bases (MIBs)* to manage the device configuration and monitor Internet devices in potentially remote locations. MIB information accessed via SNMP is defined by a set of managed objects called *object identifiers (OIDs)*. An object identifier (OID) is used to uniquely identify each object variable of a MIB. The access point Web download package contains the following 2 MIB files:

- Symbol-CC-WS2000-MIB-2.0 (common Symbol MIB file)
- Symbol-AP-5131-MIB (AP-5131 specific MIB file)

NOTE The Symbol-AP-5131-MIB contains the majority of the information contained within the Symbol-CC-WS2000-MIB-2.0 file. This feature rich information has been validated with the Symbol WS2000 and proven reliable. The remaining portion of the Symbol-AP-5131-MIB contains supplemental information unique to the access point feature set.

If using the Symbol-CC-WS2000-MIB-2.0 and/or Symbol-AP-5131-MIB to configure the AP-5131, use the table below to locate the MIB where the feature can be configured.

Feature	MIB	Feature	MIB
LAN Configuration	Symbol-AP-5131-MIB	*Subnet Configuration*	Symbol-CC-WS2000-MIB-2.0
VLAN Configuration	Symbol-AP-5131-MIB	*DHCP Server Configuration*	Symbol-CC-WS2000-MIB-2.0
802.1x Port Authentication	Symbol-AP-5131-MIB	*Advanced DHCP Server configuration*	Symbol-CC-WS2000-MIB-2.0
Ethernet Type Filter Configuration	Symbol-AP-5131-MIB	*WAN IP Configuration*	Symbol-CC-WS2000-MIB-2.0
Wireless Configuration	Symbol-AP-5131-MIB	*PPP Over Ethernet*	Symbol-CC-WS2000-MIB-2.0
Security Configuration	Symbol-AP-5131-MIB	*NAT Address Mapping*	Symbol-CC-WS2000-MIB-2.0
MU ACL Configuration	Symbol-AP-5131-MIB	*VPN Tunnel Configuration*	Symbol-CC-WS2000-MIB-2.0
QOS Configuration	Symbol-AP-5131-MIB	*VPN Tunnel status*	Symbol-CC-WS2000-MIB-2.0

Radio Configuration	Symbol-AP-5131-MIB	*Content Filtering*	Symbol-CC-WS2000-MIB-2.0
Bandwidth Management	Symbol-AP-5131-MIB	*Rogue AP Detection*	Symbol-CC-WS2000-MIB-2.0
SNMP Trap Selection	Symbol-AP-5131-MIB	*Firewall Configuration*	Symbol-CC-WS2000-MIB-2.0
SNMP RF Trap Thresholds	Symbol-AP-5131-MIB	*LAN to WAN Access*	Symbol-CC-WS2000-MIB-2.0
Config Import/Export	Symbol-AP-5131-MIB	*Advanced LAN Access*	Symbol-CC-WS2000-MIB-2.0
MU Authentication Stats	Symbol-AP-5131-MIB	*Router Configuration*	Symbol-CC-WS2000-MIB-2.0

Feature	**MIB**	**Feature**	**MIB**
WNMP Ping Configuration	Symbol-AP-5131-MIB	*System Settings*	Symbol-CC-WS2000-MIB-2.0
Known AP Stats	Symbol-AP-5131-MIB	*AP 5131 Access*	Symbol-CC-WS2000-MIB-2.0
Flash LEDs	Symbol-AP-5131-MIB	*Certificate Mgt*	Symbol-CC-WS2000-MIB-2.0
Automatic Update	Symbol-AP-5131-MIB	*SNMP Access Configuration*	Symbol-CC-WS2000-MIB-2.0
		SNMP Trap Configuration	Symbol-CC-WS2000-MIB-2.0
		NTP Server Configuration	Symbol-CC-WS2000-MIB-2.0
		Logging Configuration	Symbol-CC-WS2000-MIB-2.0
		Firmware Update	Symbol-CC-WS2000-MIB-2.0
		Wireless Stats	Symbol-CC-WS2000-MIB-2.0
		Radio Stats	Symbol-CC-WS2000-MIB-2.0
		MU Stats	Symbol-CC-WS2000-MIB-2.0
		Automatic Update	Symbol-CC-WS2000-MIB-2.0

SNMP allows a network administrator to manage network performance, find and solve network problems, and plan for network growth. The access point supports SNMP management functions for gathering information from its network components, communicating that information to specified users and configuring the access point. All the fields available within the access point are also configurable within the MIB.