



Motorola symbol ap 5131 manual

Motorola dp4400 programming.

AP-5131 Access PointProduct Reference Guide AP-5131 Access Point Product Reference Guide AP-5131 Access Point Product Reference Guide 72E-70930-01 Revision A October 2005 © 2005 by Symbol Technologies, Inc. All rights reserved. No part of this publication may be reproduced or used in any form, or by any electrical or mechanical means, without permission in writing from Symbol. This includes electronic or mechanical means, such as photocopying, recording, or information storage and retrieval systems. The material in this manual is subject to change without notice. The software is provided strictly on an "as is" basis. All software, including firmware, furnished to the user is on a licensed basis.



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Customer Support x AP-5131 Access Point Product Reference Guide About This Guide Introduction This guide provides configuration and setup information for the AP-5131 model access point. 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. ! viii AP-5131 Access Point Product Reference Guide 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 alternati encountered with the AP-5131, 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 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 AP-5131 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) and other devices. The AP-5131 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. The AP-5131-4002X-WW), that can be configured as either an 802.11a access point or an 802.11b/g access point. • A dual-radio version (Part No. AP-5131-4002X-WW), that can be configured as either an 802.11a access point or an 802.11b/g access point. No. AP-5131-1304X-WW), allowing both the 802.11a radio and the 802.11b/g radio to function simultaneously.

If you are new to using an access point for managing your network, refer to Theory of Operations on page 1-14 for an overview on wireless networking fundamentals. 1-2 AP-5131 has the following features: • 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 • 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 One or two possible configurations are available on the AP-5131 depending on which model is purchased. If the AP-5131 is manufactured as a single radio access point, the AP-5131 is manufactured as a dual-radio access point, the AP-5131 is manufactured as a single radio access point. configure one radio for 802.11a, and the other 802.11b/g. For more information on configuring your AP-5131, see Setting the WLAN's Radio Configuration on page 5-36. The AP-5131 has one LAN port, each with their own MAC address. The AP-5131 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 AP-5131 can only use a Power-over-Ethernet device when connected to the LAN port, see Configuring the AP-5131 LAN po 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 AP-5131's intended mode of operation. For information on configuring the AP-5131's WAN port, see Configuring WAN Settings on page 5-13. The LAN and WAN port MAC addresses can be located within the LAN and WAN Statistics on page 7-2 and Viewing WAN Statistics on page 7-2 and Viewing WAN Statistics on page 7-2. 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 AP-5131 in a location that has not been approved in an AP-5131 on page 2-11. The AP-5131 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 2 (5.2 GHz) antennas supported on the AP-5131's Reverse SMA (RSMA) connectors, see Technical Specifications on page A-1. 1-4 AP-5131 Access Point Product Reference Guide 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 AP-5131 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 on an AP-5131 radio, see Enabling Wireless LANs (WLANs) on page 5-22. The AP-5131 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. If 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 #2 00:A0:F8:72:20:DF Radio MAC address +2 BSSID #2 00:A0:F8:72:20:DF Radio MAC address +3 For information on strategically mapping BSSIDs to WLANs, see Configuring the 802.11a or 802.11b/ g Radio on page 5-38. The AP-5131 QoS implementation provides applications running on different wireless devices a variety of priority levels to transmit data to and from the AP-5131. Equal data transmission priority is fine for data transmission priority levels to transmit data to and from the AP-5131. 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 AP-5131 QoS implementation. The WiFi Multimedia QOS Extensions (WMM) implementation used by the AP-5131 shortens the time between transmitting higher priority data traffic and is thus desirable for multimedia applications.

AP-5131 Introduction WMM defines four access categories (voice, video, best effort and background) to prioritize traffic to provide enhanced multimedia support. For information on configuring QoS support for the AP-5131, see Setting the WLAN Quality of Service (QoS) Policy on page 5-31.

The AP-5131 supports numerous encryption and authentication techniques to protect the data transmitting on the WLAN. The following authentication * EAP Authentication The following encryption techniques are supported on the AP-5131: • WEP Encryption • KeyGuard Encryption • Wi-Fi Protected Access (WPA) Using TKIP Encryption 1-5 In addition, the AP-5131 supports the following additional security • VPN Tunnels • Content Filtering For an overview on the encryption and authentication schemes available on the AP-5131, refer to Configuring Access Point Security on page 6-1. Authentication is a means of verifying information that is transmitted from a secure source. If information is authentic, 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 1-6 AP-5131 Access Point Product Reference Guide 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) is 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 on page 6-9 The Extensible Authentication Protocol (EAP) feature provides access points and their associated MU's an additional measure of security with Kerberos and WEP. 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 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 AP-5131 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 802.1x EAP Authentication on page 6-11. 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 to various extents. Encryption to various extents of which will be a set of the security rely on encryption to various extents. instructions AP-5131 Introduction or formula for scrambling the data. A key is the specific code used by the algorithm to encrypt or decrypt the 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, 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 AP-5131 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 key is a string of case sensitive characters used to encrypt and decrypt data packets transmitted between a mobile unit (MU) and the AP-5131. An AP-5131 and associated wireless clients must use the same encryption key (typically 1 through 4) to interoperate. For additional information on configuring WEP, see Configuring WEP 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 Encryption on configuring KeyGuard is only supported on Symbol MUs. KeyGuard Encryption on page 6-17. 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 1-8 AP-5131 Access Point Product Reference Guide • 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 additional information con configuring WPA, see Configuring WPA, see Configuring WPA Using TKIP on page 6-19. 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 secret key WPA2-CCMP (802.11i) on page 6-22. A firewall keeps personal data in and hackers out. The AP-5131 firewall prevents suspicious Internet traffic from proliferating the AP-5131 managed network. The AP-5131 managed 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 instructions on setting the AP-5131 firewall, see Configuring Firewall Settings on page 6-25. 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 AP-5131 can function as a robust VPN gateway. For additional information on configuring VPN security on the AP-5131, see Configuring VPN security on the AP-5131 can function as a robust VPN gateway. system administrators to block specific commands and URL extensions from going out through the AP-5131 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 affords system administrators selective control on the content proliferating the network and is a powerful screening tool. allows blocking of specific outbound HTTP, SMTP, and FTP requests. For instructions on configuring content filtering on the AP-5131, see Configuring Content Filtering on the AP-5131, see Configuring Content filtering on the AP-5131, see Configuring Content Filtering Settings on page 6-48. A Virtual Local Area Network (VLAN) is a means to electronically separate data on the same AP-5131 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 AP-5131. An administrator can map up to 16 WLANs to 16 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 more information, see Configuring VLAN Support on page 5-5. 1-9 The AP-5131 can be accessed and configured using one of the following methods: • Java-Based Web UI • Human readable config file (imported via FTP) • MIB (Management Information Base) • Command Line Interface (CLI) accessed via RS-232 or Telnet. Use the AP-5131 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. 1-10 AP-5131 Access Point Product Reference Guide Symbol periodically releases updated versions of the AP-5131 device firmware to the Symbol Web site. If the AP-5131 firmware version displayed on the System Settings page (see Configuring System Settings on page 4-2) is older than the version for full feature functionality. For instructions on updating the AP-5131 firmware using FTP or TFTP, see Updating Device Firmware on page 4-34. Simple Network Management Information Bases (MIBs) to manage the 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 problems, and plan for network growth. The AP-5131 supports SNMP management functions for gathering information from its network components. The AP-5131 CDROM and the (AP5131 downloads site) contains the following 2 MIB files: • Symbol-AP-5131-MIB (AP-5131 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 information on configuring SNMP traps, see Configuring SNMP traps, see Configuration maintains SNMPv1/2c support of the community names, hence providing backward compatibility. solution, they often need to place access points in obscure locations. In the past, a dedicated power and Ethernet infrastructure. This often required for each access point in addition to the Ethernet infrastructure. one cable, reducing the burden of installation and allows optimal AP-5131 placement in respect to the intended radio coverage area. The AP-5131 Introduction 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 AP-5131. The Power Injector's single DC and Ethernet data cable creates a modified Ethernet data in a single cable connecting to the AP-5131's LAN port eliminating the need for separate Ethernet data in a single cable creates a modified Ethernet data in a single cable connecting to the AP-5131's LAN port eliminating the need for separate Ethernet data in a single cable connecting to the AP-5131's LAN port eliminating the need for separate Ethernet data in a single cable connecting to the AP-5131's LAN port eliminating the need for separate Ethernet data in a single cable connecting to the AP-5131's LAN port eliminating the need for separate Ethernet data in a single cable connecting to the AP-5131's LAN port eliminating the need for separate Ethernet data in a single cable connecting to the AP-5131's LAN port eliminating the need for separate Ethernet data in a single cable connecting to the AP-5131's LAN port eliminating the need for separate Ethernet data in a single cable connecting to the AP-5131's LAN port eliminating the need for separate Ethernet data in a single cable connecting to the AP-5131's LAN port eliminating the need for separate Ethernet data in a single cable connecting to the AP-5131's LAN port eliminating the need for separate Ethernet data in a single cable connecting to the AP-5131's LAN port eliminating the need for separate Ethernet data in a single cable connecting to the AP-5131's LAN port eliminating the need for separate Ethernet data in a single cable connecting to the AP-5131's LAN port eliminating the need for separate Ethernet data in a single cable connecting to the AP-5131's LAN port eliminating the need for separate Ethernet data in a single cable connecting to the AP-5131's LAN port eliminating the need for separate Ethernet data in a single cable connecting to the AP-5131's LAN port eliminating to the AP-5131's LAN port eliminating to the AP-5131's LAN port eliminating to the AP-5131 see Symbol Power Injector System on page 2-7. The AP-5131'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, it will not be able to communicate with any other MUs connected to this AP-5131. For information on configuring an AP-5131 WLAN to disallow MU to MU communications, see Creating/Editing Individual WLANs on page 5-24.

Each AP-5131 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 AP-5131 802.11a or 802.11b/g radio. 1-11 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 AP-5131 to assign priority to voice traffic over data traffic, and (if necessary) assign legacy voice supported devices, see Setting the WLAN Quality of Service (QoS) Policy on page 5-31. 1-12 AP-5131 Access Point Product Reference Guide The AP-5131 supports both CAM and PSP powered MUs. CAM (Continuously to hear every beacon and message transmitted. These systems operate without any adjustments by the AP-5131. A beacon is a uniframe system packet broadcast by the AP to keep the network synchronized. A beacon includes the ESSID, AP-5131 MAC address, Broadcast destination addresses, a time stamp, a DTIM (Delivery 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 AP-5131, it notifies the AP-5131 of its activity status. The AP-5131 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. The AP-5131 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 AP-5131's 802.11a and 802.11b/g radios. An advanced radio statistics page is also available to display retry histograms for specific MUs. An echo (ping) test is also available to ping specific MUs to assess association strength. Finally, the AP-5131 can detect and displayed as well as the properties of individual APs. For information on available AP-5131 statistical displays and the values they represent, see Monitoring Statistics on page 7-1. The AP-5131 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 AP-5131's placement or network requirements as defined in the AP-5131 has a configurable power level in respect to the AP-5131's placement or network requirements as defined in the AP-5131 has a configurable power level for each radio. setting the radio transmit power level, see Configuring the 802.11a or 802.11b/g Radio on page 5-38. The AP-5131 provides the capability for periodically logging system events. Logging events is useful in assessing the throughput and performance of the AP-5131 or troubleshooting problems on the AP-5131 Introduction AP-5131 managed Local Area Network (LAN). For more information, see Logging Configuration on page 4-28. Configuration settings for an AP-5131 can be downloaded from the current configuration before making significant changes or restoring the default configuration. For information on importing 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 AP-5131 supports have been moved to different radio coverage areas. For information on restoring a default or partial default configuration, see 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 AP-5131 to send out a DHCP request searching for a DHCP/ BOOTP and DHCP interoperate, whichever responds first becomes the server that allocates information. The AP-5131 can be set to only accept replies from DHCP and BOOTP servers or both (this is the default setting). Disabling DHCP and BOOTP and DHCP and BOOTP and DHCP and requires network settings to be set manually. If running both DHCP and BOOTP and DHCP and BOOTP and DHCP and BOOTP and DHCP and BOOTP and DHCP and requires network settings. 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 AP-5131 is running (this parameter is programmed at the DHCP server). For example: Windows 2000 servers typically are set for 3 days. 1-14 AP-5131 Access Point Product Reference Guide The AP-5131 houses seven LED indicators. 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 AP-5131 and are viewable using a single (customer installed) extended light pipe, adjusted as required to suit above the ceiling installations. For detailed descriptions of the AP-5131 LEDs and their functionality, see LED Indicators on page 2-20. To understand AP-5131 includes features for different interface connections and network management. The AP-5131 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. 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 AP-5131 radio signal propagates into the air as electromagnetic waves.

A receiving antenna (on the MU) in the path of 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 AP-5131 uses its environment (the air and certain objects) as the transmission medium. The AP-5131 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, 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 • Network Topology AP-5131 Introduction • MAC Layer Bridging • Content Filtering • DHCP Support • Media Types • Direct-Sequence Spread Spectrum • MU Association Process • Operating Modes • Management Access Options An AP-5131 establishes an average communication range with MUs called a Basic Service Set (BSS) or cell.

When in a particular cell, the MU associates and communicates with the AP-5131 supporting the radio coverage area of that cell. Adding AP-5131'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 AP-5131's makes them part of the same Wireless LAN. AP-5131's with the same ESSID defines a coverage area. A valid ESSID is an alphanumeric, casesensitive identifier up to 32 characters. An MU searches for an AP-5131 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 AP-5131. The roam occurs when the MU analyzes the reception quality at a location and determines a different AP-5131 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 802.11b/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 AP-5131 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. 1-16 AP-5131 Access Point Product Reference Guide The following are sample topologies: • A single AP-5131 without a wired network establishing a single-cell wireless network for peer-to-peer MUs. • A single AP-5131 Introduction 1-17 1-18 AP-5131 Introduction 1using different ESSIDs. These separate WLANs can be configured to use different channel assignments to avoid RF interference. AP-5131 Introduction • Multiple AP-5131's wired together provide a network with better coverage area and performance when using the same ESSID. 1-19 The AP-5131 provides MAC layer bridging between its interfaces. The AP-5131 monitors traffic from its interfaces and, based on frame address, forwards the proper destination. The AP-5131 tracks source and destination. The AP-5131 also handles broadcast and multicast messages and responds to MU association requests. The AP-5131 listens to all packets on its LAN and WAN interfaces and builds an address database using MAC addresses. An address in the database to forward packets from one interface 1-20 AP-5131 Access Point Product Reference Guide to another. The bridge forwards packets addressed to unknown systems to the Default Interface (Ethernet). The AP-5131 internal stack interface to facilitate forwarding. When a user sends an ARP (Address Resolution Protocol) request packet, the AP-5131 forwards it over all enabled interfaces except over the interface the ARP request packet was received. On receiving interface. With this information, the AP-5131 forwards any directed packet to the correct destination. Transmitted ARP request packets echo back to other MUs. The AP-5131 removes from its database when it transmits or receives data from these destinations and interfaces. The AP-5131 radio interface conforms to IEEE 802.11a/b/g specifications. The interface operates at a maximum 54Mbps (802.11a radio) using 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 connectors for the RS-232 port. Connecting the AP-5131 to a PC requires a null modem serial cable. Spread spectrum (broadband) uses a narrowband signal to spread spectrum technique where the transmitted signal is spread over a particular frequency band or spectrum. Direct-sequence is a spread spectrum (DSSS) for radio communication. Directsequence systems communicate by continuously transmitting a redundant pattern of bits called a chipping sequence. Each bit of 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 AP-5131. AP-5131 Introduction Intercepting and decoding a direct-sequence transmission requires a predefined algorithm to associate the spreading code used by the transmitting AP-5131 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 enables the receiving MU. 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 AP-5131 uses different modulation schemes to encode more bits per chip at higher data rates. The AP-5131 is capable of a maximum 54Mbps data transmission rate (802.11a radio), but the coverage area is less than AP-5131's operating at lower data rates since coverage area decreases as bandwidth increases.

An AP-5131 recognizes MUs as they begin the association process with the AP-5131.

An AP-5131 keeps a list of the MUs it services. MUs associate with an AP-5131 based on the following conditions: • signal strength between the AP-5131 • MUs encryption and authentication capabilities • MUs supported data rate 1-21 MUs perform pre-emptive roaming by intermittently scanning for AP-5131's and associating with the best available AP-5131. Before roaming and associating, MUs perform full or partial scans to collect AP-5131. 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 AP-5131. The MU continues communicating with that AP-5131 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 AP-5131's classified as proximate on the AP-5131 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 AP-5131 and updates the table. An MU can roam within a coverage area by switching AP-5131 1-22 AP-5131 Access Point Product Reference Guide • Supported rate changes or the MU finds a better transmit rate with another AP-5131 • RSSI (received signal strength indicator) of a potential AP-5131 exceeds the current AP-5131 • Ratio of good-transmitted packets falls below a threshold. An MU selects the best available AP-5131 and adjusts itself to the AP-5131 direct-sequence channel to begin association. Once associated, the AP-5131 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 AP-5131. The scanning and association process continues for active MUs. This process allows the MUs to find new AP-5131's and discard out-of-range or deactivated AP-5131's. By testing AP-4131 access point, the AP-5131 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 AP-5131 WLANs. Each WLAN can be configured to be broadcast by one or both AP-5131 radios (unlike the AP-4131). The AP-5131 radios (unlike the AP-5131 radios (u configuration define how the Access Point and Wireless Gateway/Router - If operating as a Wireless Gateway/Router, the AP-5131 functions as a router between two layer 2 networks: the WAN uplink (the ethernet port) and the Wireless Gateway/Router - If operating as a Vireless Gateway/Router - If operating as a Wireless Gateway/Router - If operating as a Vireless Gateway/Rou single-cell deployment: • PPPoE - The WAN interface can terminate a PPPoE connectivity. • NAT - (Network Address Translation) on the Wireless interface. Using NAT, the AP-5131 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 AP-5131 can assign private IP addresses. • Firewall - In between the WAN and Wireless interfaces, a Firewall protects against a number of known attacks. configuration options.

Statistics track the network activity of associated MUs and data transfers on the AP interfaces.

The AP-5131 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 AP-5131 CDROM contains the following 2 MIB files: • Symbol-CC-WS2000-MIB-2.0 (standard Symbol MIB file) • Symbol-AP-5131-MIB (AP-5131 SNMP function using a MIB files) • Symbol-CC-WS2000-MIB-2.0 (standard Symbol MIB file) • Symbol-AP-5131 SNMP function using a MIB files: • Symbol-CC-WS2000-MIB-2.0 (standard Symbol MIB file) • Symbol-AP-5131 SNMP function using a MIB files: • Symbol-AP-5131 SNMP function using a MIB files: • Symbol-CC-WS2000-MIB-2.0 (standard Symbol MIB file) • Symbol-AP-5131 SNMP function using a MIB files: • Symbol-AP-5131 SNMP function using a MIB configuration changes to AP-5131's individually. Optionally, use the AP-5131 import/export configuration function to download AP-5131's settings to other AP-5131's not export and the AP-5131's settings to other AP-5131's not export and the AP-5131' 5131 on a table-top, wall, ceiling T-bar or above the ceiling (attic or plenum), connecting the AP-5131 to the network (LAN or WAN port connection), connecting a radio site survey prior to installing ! Before installing the AP-5131 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. the AP-5131. A site survey is an excellent method of documenting areas of radio interference and providing a tool for AP-5131 placement. 2-2 AP-5131 Access Point Product Reference Guide Check package contents for the correct model AP-5131 accessories. Each available) • Single 802.11a/g radio, external antenna (Part No. AP-5131-4002X-WW) • Dual 802.11a+g radios, external antenna (Part No. AP-5131-1304X-WW) • Software and Documentation CD-ROM • AP-5131 Install Guide (Part No. 72-70931-01) • Accessories Bag (4 rubber feet for desk mounting and a LED light pipe, badge and label for above the ceiling installations). 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 Access Point AP-5131 Install Guide Power Injector (Part No. AP-PSBIAS-T-1P-AF) 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 AP-5131-13043-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 AP-5131-13043-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 AP-5131-13043-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 AP-5131-13043-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 AP-5131-13043-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 AP-5131-13043-WW AP-5131 802.11a+g Dual Radio Access Point AP-5131 802.11a+g Dual R Documentation CD-ROM Power Injector (Part No. AP-PSBIAS-T-1P-AF) (4) Dual-Band Antennae (Part No. ML-2452-APA2-01) Accessories Bag Symbol Part # Description 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-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) 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-WW AP-5131 802.11a/g Single Radio Access Point AP-5131 Install Guide Software and Documentation CD-ROM Power Injector (Part No. ML-2452-APA2-01) Accessories Bag Hardware Installation 2-3 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-T-1P-AF) 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 2-7. 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 2-5. For detailed specifications on the 2.4 GHz and 5.2 GHz antenna suite, see 2.4 GHz Antenna Matrix on page A-4 and 5.2 GHz Antenna Matrix on page A-4. 2-4 AP-5131 Access Point Product Reference Guide 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. The minimum installation requirements for a single-cell, peer-to-peer network: • AP-5131 (either the dual or single radio model) • AP-5131 (either antennae for the single-radio model and 4 antennae for the dual-radio model. . For optimal performance, install the AP-5131 away from transformers, heavy-duty motors, fluorescent lights, microwave ovens, refrigerators and other industrial equipment. 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 AP-5131 using the following guidelines: • Install the AP-5131 at an ideal height of 10 feet from the ground. • Orient the AP-5131 antennae vertically for best reception.

• Point the AP-5131 antenna(s) downward if attaching to the ceiling. Hardware Installation Symbol recommends conducting a site survey to define and document radio interference obstacles before installing the AP-5131 to maximize its radio coverage area.

A site survey analyzes the installation environment and provides users with recommendations for equipment and placement. The optimum placement of 802.11a access points, because the locations and number of access points required are different to support the radio coverage area. Symbol recommendations conducting a new site survey and developing a new coverage area floor plan when switching from 2 or 11Mbps access points (AP-5131 models), as the device placement requirements are significantly different. 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 suite supporting the 5.2 GHz band. Select an antenna model best suited to the intended operational environment of your AP-5131. 2-5 NOTE On a single-radio AP-5131, Radio 1 can be configured to be either a 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 antennae 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 RSMA to R-BNC adapter (Part No. 25-72178-01) can be purchased separately from Symbol. The 2.4 GHz antenna suite includes the following models: Symbol Part Number Antenna Type Nominal Net Gain (dBi) ML-2499-11PNA2-01 Wide Angle Directional 8.5 ML-2499-HPA3-01 Omni-Directional Antenna 3.3 2-6 AP-5131 Access Point Product Reference Guide Symbol Part Number Antenna 13.9 ML-2452-APA2-01 Dual-Band 3.0 NOTE An additional adapter is required to use ML-2499-BYGA2-01 Yagi Antenna 13.9 ML-2452-APA2-01 Dual-Band 3.0 NOTE An additional adapter is required to use ML-2499-BYGA2-01 Yagi Antenna 13.9 ML-2452-APA2-01 Dual-Band 3.0 NOTE An additional adapter is required to use ML-2499-BYGA2-01 Yagi Antenna 13.9 ML-2452-APA2-01 Dual-Band 3.0 NOTE An additional adapter is required to use ML-2499-BYGA2-01 Yagi Antenna 13.9 ML-2452-APA2-01 Dual-Band 3.0 NOTE An additional adapter is required to use ML-2499-BYGA2-01 Yagi Antenna 13.9 ML-2452-APA2-01 Dual-Band 3.0 NOTE An additional adapter is required to use ML-2499-BYGA2-01 Yagi Antenna 13.9 ML-2452-APA2-01 Dual-Band 3.0 NOTE An additional Adapter is required to use ML-2499-BYGA2-01 Yagi Antenna 13.9 ML-2452-APA2-01 Dual-Band 3.0 NOTE An additional Adapter is required to use ML-2499-BYGA2-01 Yagi Antenna 13.9 ML-2452-APA2-01 Dual-Band 3.0 NOTE An additional Adapter is required to use ML-2499-BYGA2-01 Yagi Antenna 13.9 ML-2452-APA2-01 Dual-Band 3.0 NOTE An additional Adapter is required to use ML-2499-BYGA2-01 Yagi Antenna 13.9 ML-2452-APA2-01 Dual-Band 3.0 NOTE An additional Adapter is required to use ML-2499-BYGA2-01 Yagi Antenna 13.9 ML-2452-APA2-01 Dual-Band 3.0 NOTE An additional Adapter is required to use ML-2499-BYGA2-01 Yagi Antenna 13.9 ML-2452-APA2-01 Dual-Band 3.0 NOTE An additional Adapter is required to use ML-2499-BYGA2-01 Yagi Antenna 13.9 ML-2452-APA2-01 Dual-Band 3.0 NOTE An additional Adapter is required to use ML-2499-BYGA2-01 Yagi Antenna 13.9 ML-2452-APA2-01 Dual-Band 3.0 NOTE An additional Adapter is required to use ML-2499-BYGA2-01 Yagi Antenna 13.9 ML-2452-APA2-01 Dual-Band 3.0 NOTE AN Adapter is required to use ML-2499-BYGA2-01 Yagi Antenna 13.9 ML-2452-APA2-01 Dual-Band 3.0 NOTE AN Adapter is required to use ML-2499-BYGA2-01 Yagi Adapter is requir 11PNA2-01 and ML-2499-BYGA2-01 model antennae. Please contact Symbol for more information. The 5.2 GHz antenna suite includes the following models: Symbol Part Number Antenna 13.0 ML-5299-WPNA1-01 Panel Antenna 13.0 ML-5299-WPNA1-01 Panel Antenna ML-2452-APA2-0 Dual-Band 4.0 5.0 Hardware Installation 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-4. The power options for the AP-5131 include: • Symbol Power Supply (Part No. 50-24000-050) • Any standard 802.3af compliant device. 2-7 The AP-5131 can receive power either directly form a Symbol 48V AC-DC power supply (Part No. 50-24000-050) 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 installation and allows optimal AP-5131 placement in respect to the intended radio coverage area. The Symbol Power Injector (Part No. AP-PSBIAS-T-1P-AF) 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 2-8 AP-5131 Access Point Product Reference Guide connecting to the AP-5131. The AP-5131 can only use a Power Injector when connected to the LAN port. The Symbol AP-5131 can only use a Power Injector when connected to the LAN port. CAUTION The AP-5131 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 AP-5131 and void the product warranty. A separate power injector is required for each AP-5131 comprising the network.

Data Power Power Injector AP-5131 Wireless LAN to AP-5131 LAN Port Hardware Installation • Cabling the power injector • Power 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 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 to an Ethernet data source and AP-5131: CAUTION Ensure AC power is supplied to the power injector.

using an AC cable ! 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 out connector and the Symbol AP-5131 LAN port. CAUTION Cabling the power injector to the AP-5131's WAN port renders the ! with an appropriate ground connection approved for the country of operation. AP-5131 non-operational. Only use a AP-PSBIAS-T-1P-AF model power injector with the AP-5131's LAN port. 2-10 AP-5131 Access Point Product Reference Guide 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 and is ready for AP-5131 device connection as soon as AC power is applied. 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. Green (Blinking) Output voltage source is out of range. The power injector is overloaded or has a Indicates a device is connected to the power injector's outgoing Data & Power cable. short circuit.