



LWN602A	LWN600VMA
LWN602AE	LWN600CM-1
LWN602HA	LWN600CM-3
LWN602HAE	LWN602WA

SmartPath™ Enterprise Wireless System User Guide

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Federal Communication Commission Interference Statement

Each Black Box product described in this manual complies with part 15 of the FCC Rules when operating under the following restrictions: (1) This device may not cause harmful interference, and (2) they must accept any RF interference received, including interference that might cause an unwanted impact on their operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

Reorient or relocate the receiving antenna.

Increase the separation between the equipment and receiver.

Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

Consult the dealer or an experienced radio/TV technician for help.

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

Important: FCC Regulatory Warning Notices

LWN602A devices are restricted to indoor use due to their operation in 5 GHz frequencies, which are shared by mobile satellite systems and government radar systems. The FCC requires that these products only be used indoors to reduce the potential for harmful interference with co-channel radar that might be operating in the 5.25–5.35 or 5.47–5.725 GHz frequency ranges in the same area. The conflicting activity of radar stations and these devices can cause interference or damage to each other. In addition, these devices have a radar detection function that might interrupt normal operations when they detect a radar signal. To reduce the risk of interference even further, installing these devices away from windows is recommended.

LWN602A devices operating within the 5.15–5.25 GHz frequency range are restricted to indoor environments.

The FCC region code is set in the device during the manufacturing process, the option to set it to any region other than FCC is disabled, and the country code selection function has been completely removed from all U.S. models. It is impossible for the end user to change the region to anything other than FCC.

FCC Radiation Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 23 centimeters (9 inches) between the radiator and your body.

The availability of some specific channel and/or operational frequency bands are country dependent and are firmware programmed at the factory to match the intended destination. The firmware setting is not accessible by end user.

Only attach antennas that are certified for use with this device. Replacing antennas with unauthorized, high-gain antennas greatly increases the risk of interference and invalidates the FCC certification.

NOM Statement/Radiation Exposure Statement

Instrucciones de Seguridad

(Normas Oficiales Mexicanas Electrical Safety Statement)

1. Todas las instrucciones de seguridad y operación deberán ser leídas antes de que el aparato eléctrico sea operado.
2. Las instrucciones de seguridad y operación deberán ser guardadas para referencia futura.
3. Todas las advertencias en el aparato eléctrico y en sus instrucciones de operación deben ser respetadas.
4. Todas las instrucciones de operación y uso deben ser seguidas.
5. El aparato eléctrico no deberá ser usado cerca del agua—por ejemplo, cerca de la tina de baño, lavabo, sótano mojado o cerca de una alberca, etc.
6. El aparato eléctrico debe ser usado únicamente con carritos o pedestales que sean recomendados por el fabricante.
7. El aparato eléctrico debe ser montado a la pared o al techo sólo como sea recomendado por el fabricante.
8. Servicio—El usuario no debe intentar dar servicio al equipo eléctrico más allá a lo descrito en las instrucciones de operación. Todo otro servicio deberá ser referido a personal de servicio calificado.
9. El aparato eléctrico debe ser situado de tal manera que su posición no interfiera su uso. La colocación del aparato eléctrico sobre una cama, sofá, alfombra o superficie similar puede bloquear la ventilación, no se debe colocar en libreros o gabinetes que impidan el flujo de aire por los orificios de ventilación.
10. El equipo eléctrico deberá ser situado fuera del alcance de fuentes de calor como radiadores, registros de calor, estufas u otros aparatos (incluyendo amplificadores) que producen calor.
11. El aparato eléctrico deberá ser conectado a una fuente de poder sólo del tipo descrito en el instructivo de operación, o como se indique en el aparato.
12. Precaución debe ser tomada de tal manera que la tierra física y la polarización del equipo no sea eliminada.
13. Los cables de la fuente de poder deben ser guiados de tal manera que no sean pisados ni pellizcados por objetos colocados sobre o contra ellos, poniendo particular atención a los contactos y receptáculos donde salen del aparato.
14. El equipo eléctrico debe ser limpiado únicamente de acuerdo a las recomendaciones del fabricante.
15. En caso de existir, una antena externa deberá ser localizada lejos de las líneas de energía.
16. El cable de corriente deberá ser desconectado del cuando el equipo no sea usado por un largo periodo de tiempo.
17. Cuidado debe ser tomado de tal manera que objetos líquidos no sean derramados sobre la cubierta u orificios de ventilación.
18. Servicio por personal calificado deberá ser provisto cuando:
 - A: El cable de poder o el contacto ha sido dañado; u
 - B: Objectos han caído o líquido ha sido derramado dentro del aparato; o
 - C: El aparato ha sido expuesto a la lluvia; o
 - D: El aparato parece no operar normalmente o muestra un cambio en su desempeño; o
 - E: El aparato ha sido tirado o su cubierta ha sido dañada.

Important: Radiation Exposure Statement

This equipment complies with radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 8 inches (20 cm) between the radiator and your body. This transmitter must not be colocated or operating with any other antenna or transmitter. For more information about RF exposure limits, visit www.fcc.gov (U.S.) or www.ic.gc.ca (Canada).

Wi-Fi Certification

The Wi-Fi CERTIFIED™ Logo is a certification mark of the Wi-Fi Alliance®. The SmartPath APs have been certified for WPA™, WPA2™, WMM® (Wi-Fi Multimedia™), WMM Power Save, IEEE 802.11d, IEEE 802.11h, and the following types of EAP (Extensible Authentication Protocol):

- EAP-TLS
- EAP-SIM
- EAP-TTLS/MSCHAPv2
- EAP-AKA
- PEAPv0/EAP-MSCHAPv2
- EAP-FAST
- PEAPv1/EAP-GTC

The SmarPath APs (LWN602A and LWN602HA) have also been certified for short guard interval and 40-MHz operation in the 5-GHz band.

EC Conformance Declaration



Marking by the above symbol indicates compliance with the Essential Requirements of the R&TTE Directive of the European Union (1999/5/EC). This equipment meets the following conformance standards:

- EN 60950-1 (IEC 60950-1) - Product Safety
- EN 301 893 - Technical requirements for 5-GHz radio equipment
- EN 300 328 - Technical requirements for 2.4-GHz radio equipment
- EN 301 489-1 / EN 301 489-17 - EMC requirements for radio equipment

WEEE and RoHS Compliance

SmartPath products have been reviewed, analyzed, and found to be in compliance with the European Union (EU) directive for Waste Electrical and Electronic Equipment (WEEE) and with the EU directive for the Restriction of Hazardous Substances (RoHS).

Countries of Operation and Conditions of Use in the European Community

SmartPath APs are intended to be operated in all countries of the European Community. Requirements for indoor vs. outdoor operation, license requirements and allowed channels of operation apply in some countries as described below.

- Before operating a SmartPath AP, the admin or installer must properly enter the current country code as described in Black Box product documentation.

NOTE: For U.S. model owners: To comply with U.S. FCC regulations, the country selection function has been completely removed from all U.S. models. The above function is for non-U.S. models only.

Countries of Operation and Conditions of Use in the European Community

- SmartPath APs automatically limit the allowable channels determined by the current country of operation. Incorrectly entering the country of operation might result in illegal operation and cause harmful interference to other systems. The admin is obligated to ensure SmartPath APs are operating according to the channel limitations, indoor/outdoor restrictions and license requirements for each European Community country as described in this section.
- SmartPath APs can be operated indoors or outdoors in all countries of the European Community using the 2.4 GHz band: Channels 1–13, except where noted below:
 - In Italy and Luxembourg, you must apply for a license from the national spectrum authority to operate a SmartPath AP outside your own premises and for public use or service.
 - In Belgium outdoor operation is only permitted using the 2.46- to 2.4835-GHz band: Channel 13.
 - In France outdoor operation is limited to the 2.454- to 2.4835-GHz band (Channels 8 to 13) at a maximum of 10 mW EIRP (effective isotropic radiated power).
 - In Norway, the 2.4-GHz band cannot be used outdoors within a 20-km radius of the center of Ny-Ålesund.
 - In Russia, the 2.4-GHz band is for indoor use only.
- Because radar systems use some bands in the 5-GHz spectrum, WLAN devices operating in these bands must use Dynamic Frequency Selection (DFS) to detect radar activity and switch channels automatically to avoid interfering with radar operations. For the ETSI region, the SmartPath AP (LWN602HA) is certified for the latest ETSI EN 301 893 v1.5.1 DFS requirements and can use DFS channels 52 to 140 (5.26 GHz to 5.32 GHz, and 5.5 GHz to 5.7 GHz). To comply with ETSI regulations when deploying a SmartPath AP (LWN602HA) device outdoors, set the 5-GHz radio to operate on the DFS channels and enable DFS. When deploying a SmartPath AP (LWN602HA) indoors, then the 5-GHz radio can also use Channels 36 to 48 as well as the DFS channels. The maximum transmit power for channels from 36 to 48 is 17 dBm in the ETSI region. Because this maximum is enforced by SmartPath OS, the SmartPath AP automatically limits the power to 17 dBm even if the setting is greater than that.
- The availability of some specific channels and/or operational frequency bands are country dependent and are firmware programmed at installation to match the intended destination. The firmware setting is accessible by the end user. Some national restrictions are noted below:
 - In Italy and Luxembourg, you must apply for a license from the national spectrum authority to operate a SmartPath AP outside your own premises and for public use or service in the 5.15- to 5.35-GHz band (Channels 36 to 64) and 5.47- to 5.725-GHz band (Channels 100 to 140).
 - In Russia, you can only use the 5.15- to 5.35-GHz band at 100 mW (20 dBm) indoors, in closed industrial and warehouse areas, and on-board aircraft for local network and crew communications during all stages of a flight and for public WLAN access only at an altitude of 3000 meters or higher. You can only use the 5.65- to 5.825-GHz band with 100 mW EIRP on board aircraft at an altitude of 3000 meters or higher.

Declaration of Conformity in Languages of the European Community

English: Hereby, we declare that this Radio LAN device is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC.

Finnish: Valmistaja Black Box vakuuttaa täten että Radio LAN device tyyppinen laite on direktiivin 1999/5/EY oleellisten vaatimusten ja sitä koskevien direktiivin muiden ehtojen mukainen.

Dutch: Hierbij verklaart Black Box dat het toestel Radio LAN device in overeenstemming is met de essentiële eisen en de andere relevante bepalingen van richtlijn 1999/5/EG. Bij deze Black Box dat deze Radio LAN device voldoet aan de essentiële eisen en aan de overige relevante bepalingen van Richtlijn 1999/5/EC.

French: Par la présente Black Box déclare que cet appareil Radio LAN est conforme aux exigences essentielles et aux autres dispositions relatives à la directive 1999/5/CE.

Swedish: Härmed intygar Black Box att denna Radio LAN device står i överensstämmelse med de väsentliga egenskapskrav och övriga relevanta bestämmelser som framgår av direktiv 1999/5/EG.

Danish: Undertegnede Black Box erklærer herved, at følgende udstyr Radio LAN device overholder de væsentlige krav og øvrige relevante krav i direktiv 1999/5/EF.

German: Hiermit erklärt Black Box, dass sich dieser/diese/ dieses Radio LAN device in Übereinstimmung mit den grundlegenden Anforderungen und den anderen relevanten Vorschriften der Richtlinie 1999/5/EG befindet". (BMWi) Hiermit erklärt Black Box die Übereinstimmung des Gerätes Radio LAN device mit den grundlegenden Anforderungen und den anderen relevanten Festlegungen der Richtlinie 1999/5/EG. (Wien)

Italian: Con la presente Black Box dichiara che questo Radio LAN device è conforme ai requisiti essenziali ed alle altre disposizioni pertinenti stabilite dalla direttiva 1999/5/CE.

Spanish: Por medio de la presente Black Box declara que el Radio LAN device cumple con los requisitos esenciales y cualesquiera otras disposiciones aplicables o exigibles de la Directiva 1999/5/CE.

Portuguese: Black Box declara que este Radio LAN device está conforme com os requisitos essenciais e outras disposições da Directiva 1999/5/CE.

SmartPath AP Safety Compliance

Power Cord Safety

Please read the following safety information carefully before installing a SmartPath AP:

WARNING: *Installation and removal of SmartPath APs must be carried out by qualified personnel only.*

- SmartPath APs must be connected to a grounded (earthed) outlet to comply with international safety standards.
- Do not connect SmartPath APs to an AC outlet (power supply) without a ground (earth) connection.
- The appliance coupler (the connector to the unit and not the wall plug) must have a configuration for mating with an EN 60320/IEC320 appliance inlet.
- The socket outlet must be near the SmartPath AP and easily accessible. You can only remove power from a SmartPath AP by disconnecting the power cord from the outlet.
- SmartPath APs operate under Safety Extra-Low Voltage (SELV) conditions according to IEC 60950. The conditions are only maintained if the equipment to which they are connected also operates under SELV conditions.
- A SmartPath AP receiving power through its Power over Ethernet (PoE) interface must be in the same building as the equipment from which it receives power.

France and Peru only:

SmartPath APs cannot be powered from IT* supplies. If your supplies are of IT type, then a SmartPath AP must be powered by 230 V (2P+T) via an isolation transformer ratio 1:1, with the secondary connection point labelled Neutral, connected directly to ground (earth). *Impédance à la terre

IMPORTANT: *Before making connections, make sure you have the correct cord set. Check it (read the label on the cable) against the description in this section.*

U.S.A. and Canada only:

- The cord set must be UL® and CSA certified.
- Minimum specifications for the flexible cord:
 - No. 18 AWG, not longer than 2 m, or 16 AWG
 - Type SV or SJ
- The cord set must have a rated current capacity of at least 10 A.

- The attachment plug must be an earth-grounding type with NEMA 5-15P (15 A, 125 V) or NEMA 6-15 (15 A, 250 V) configuration.

Denmark only:

- The supply plug must comply with Section 107-2-D1, Standard DK2-1a or DK2-5a.
- Switzerland:
- The supply plug must comply with SEV/ASE 1011.

U.K. only:

- The supply plug must comply with BS1363 (3-pin 13 A) and be fitted with a 5-A fuse that complies with BS1362.
- The power (mains) cord must be <HAR> or <BASEC> marked and be of type HO3VVF3GO.75 (minimum).
- IEC-320 receptacle.

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Chapter 1: Specifications

1. Specifications

1.1 Smart Path AP (LWN602HA)

Antennas: (3) omnidirectional 802.11b/g/n antennas, and (3) omnidirectional 802.11a/n antennas

NOTE: *Antennas are not included.*

Interface: Serial Port: 9600 bps, 8 data bits, no parity, 1 stop bit, no flow control;

Ethernet: Autosensing 10/100/1000 BASE-T/TX Mbps; both ports comply with the IEEE 802.3af and the 802.3at standard for Power over Ethernet (PoE)

Connectors: (3) RJ-45: (2) 10/100/1000BASE-T/TX Ethernet ports, (1) RJ-45 serial console port; (3) 802.11a/b/g/n RP-SMA, (3) 802.11a/n RP-SMA, (1) barrel connector for power

Indicators: (5) Status LEDs: (1) Power, (1) ETH0, (1) ETH1, (1) WIFI0, (1) WIFI1

Temperature Tolerance: Operating: -4 to +131° F (-20 to +55° C);

Storage: -40 to +176° F (-40 to +80° C)

Relative Humidity: 95% maximum

Power: Optional AC power adapter: Input: 100–240 VAC; Output: 48 VDC, 0.625 amps;

*PoE nominal input voltages: 802.3af: 48 VDC, 0.35 amps;

802.3at: 48 V, 0.625 amps;

RJ-45 power input pins: Wires 4, 5, 7, 8 or 1, 2, 3, 6

***NOTE:** *When using 802.3af, power should be applied to both Ethernet ports to maintain all features (see Section 3.2.1, Smart PoE).*

Size: 1.25" H x 8.5" W x 8"D (3.2 x 21.5 x 20.3 cm)

Weight: 3 lb. (1.4 kg)

1.2 Smart Path AP (LWN602A)

Antennas: (2) omnidirectional 802.11b/g/n antennas, and (2) omnidirectional 802.11a/n antennas

Interface: RJ-45 power input pins: Wires 4, 5, 7, 8 or 1, 2, 3, 6

Connectors: (1) RJ-45 autosensing 10/100/1000BASE-T/TX Mbps port; complies with the IEEE 802.3af and the 802.3at standard for Power over Ethernet (PoE), (1) barrel connector for power

Indicators: (1) Status LED that conveys operational states for system power, firmware updates, Ethernet and wireless interface activity and major alarms

Temperature Tolerance: Operating: +32 to +104° F (0 to +40° C);

Storage: -40 to +185° F (-40 to +85° C)

Relative Humidity: 95% maximum. noncondensing

Power: Optional AC power adapter: Input: 100–240 VAC; Output: 48 VDC, 0.625 amps;

PoE nominal input voltages: 802.3af: 48 VDC, 0.35 amps;

802.3at: 48 V, 0.625 amps;

RJ-45 power input pins: Wires 4, 5, 7, 8 or 1, 2, 3, 6

Size: 2" H x 6.5" W x 6.5"D (5.1 x 16.5 x 16.5 cm)

Weight: 1.75 lb. (0.8 kg)

1.3 Smart Path EMS Virtual Management Appliance (VMA) Software (LWN600VMA)

Maximum Supported APs — 5000

Minimum System Requirements — Processor: Dual-core 2 GHz;
Memory: 2 GB VM, 1 GB host;
Storage: 10 GB available disk space

Tested Virtualization Platforms — ESXi 4.0 or better;

Player on CentOS;
Player on Windows Vista®

1.4 SmartPath Outdoor Access Point (LWN602WA)

Antennas — (4) N-type female connectors for external antennas

Environmental Compliance — IP68

Mounting Options — Horizontal or vertical pole mount; pole must be 1" to 3.5" (2.5 cm to 8.9 cm) in diameter; wall or flat surface mount

PoE Nominal Input Voltage — 48 V, 30 watts

Wind Speed Tolerance — > 165 mph (266 kph)

Connectors — (1) RJ-45 Ethernet connector: autosensing 10/100/1000 Mbps; compliant with the IEEE 802.3at standard for PoE

Temperature Tolerance — Operating: -40 to +131° F (-40 to +55° C);
Storage: -40 to +176° F (-40 to +80° C)

Relative Humidity — Up to 100%

Size — Without antennas: 3" H x 7 $\frac{7}{8}$ " W x 9 $\frac{5}{8}$ " L (7.6 x 20 x 22.4 cm)

Weight — With antennas: 4.85 lb. (2.199 kg);
With antennas and brackets: 6.05 lb. (2.744 kg)

NOTE: For information on how to install the SmartPath Outdoor Wireless Access Point (LWN602WA), see the LWN602WA Installation Guide at [ftp://ftp.blackbox.com/anonymous/manuals/L/LWN602WA_install.pdf](http://ftp.blackbox.com/anonymous/manuals/L/LWN602WA_install.pdf)

2. Preparing for a WAN Deployment

To ensure a smooth WLAN deployment, you need to begin with a bit of planning. A straightforward review of your deployment plan before you begin will provide the best results in the least amount of time. The goals of this chapter are to assist you in assessing your readiness for WLAN implementation and to provide tips and tricks to resolve any issues that might arise in your environment.

NOTE: This guide assumes an understanding of corporate data networking and past experience with LAN configuration and deployment. It also assumes some basic Wi-Fi understanding.

2.1 Assessing Your Requirements

To get started with your Black Box WLAN installation, examine the basic requirements of your implementation. First, consider who your stakeholders are and take the time to fully understand their access requirements. Talk to department managers within your organization and make sure everyone has documented the full complement of potential network users. Check if the applications are standard employee applications or if there are other requirements, such as access for guests or consultants.

Next, make a complete list of the application types that your network will need to support. Begin your list with mission-critical applications, paying special attention to those that generate high levels of traffic and those requiring deterministic behavior. Identify applications with heavy data requirements and expected service levels.

Demanding applications such as voice and video will require a higher density of access points. Many enterprises are investigating the potential of VoWLAN (Voice over WLAN) in the hopes of integrating mobile phones and IP-PBX systems. Doing so requires an evaluation of other data transmission types that can disrupt the quality of voice conversations. Because voice traffic is sensitive to network jitter and latency, an inadequate number of access points can degrade quality. To the user, excessive jitter and delay can cause clipped conversations or dropped calls. Additional quality and reliability issues might arise when transmitting video, such as for training video or surveillance operations, because of the sheer size of the data stream.

Other applications such as network backup and file transfers can also have an impact on the network. Therefore, take into account any bandwidth-intensive applications if you expect your mobile workforce to be accessing the WLAN while these applications or services are occurring.

Considering the above issues will result in a more informed—and therefore more successful—deployment plan.

2.2 Planning

This section reviews the fundamental elements for planning your WLAN deployment. This includes conducting a site survey, both for an upgrade from an existing WLAN and for a completely fresh—or greenfield—deployment.

2.2.1 Upgrading from Existing Wi-Fi

If you are upgrading to SmartPath from an existing WLAN, you already have plenty of data about how your current network is performing. This information can lead to more informed decisions about your new implementation.

To begin, perform a quick site survey with the existing access points in place. If they are less than three years old and support 802.11g, their coverage and capacity will be lower than the SmartPath 802.11n radio. If the coverage is good and has the appropriate density for your deployment, the simplest approach is to replace one set of access points with a new set of SmartPath APs. However, this scenario is rare because network upgrades are usually done to improve capacity and to augment the existing layout with a denser deployment of access points.

Be sure to take note whether your existing network uses “fat” or “thin” APs (access points). A “fat” AP is an autonomous or standalone access point, which contains the capability to connect to any Ethernet switch. With a “thin” AP, most of the intelligence has been removed and replaced in a centralized WAN controller. An upgrade from fat APs to SmartPath APs is very natural. Generally, with fat APs you simply need to unplug the existing ones and plug in the new SmartPath APs and provision them. With this approach, you can maintain or enhance all existing VLANs and security policies. This is a huge advantage over migrating from fat AP to controller-based solutions because you typically need to re-architect the network.

Upgrading from a thin AP solution is also easy. However, because a thin AP makes use of an overlay tunneled network, you sometimes have to add a local VLAN for access or use tunnels to replicate the overlay network. However, because using VLANs rather than tunnels provides significant performance and scalability advantages, this is clearly the recommended path.

2.2.2 New WLAN Deployment

In a new—or greenfield—WLAN deployment, you do not have the benefit of an existing network for testing and analysis, which makes your job a bit more difficult. In this case, the following key questions are critical to the proper design of your WLAN:

- How many users will need wireless service and what applications will they use?

Determining the scope of your WLAN deployment will have a major impact on capacity and coverage. Will only certain groups within the organization have WLAN access, or will it be rolled out across the enterprise? Will you provide guest access to visitors, consultants, and contractors? Most WLANs support just data applications, but many organizations are considering adding voice services. Voice support raises other design considerations that drive the need for denser deployments of access points and different Quality of Service (QoS) settings.

- Are there any known major sources of interference?

For example, is there a nearby cafeteria with microwave ovens? Commercial-grade microwaves are a particularly bad source of interference. Is there a wireless telephone or video surveillance system not using Wi-Fi? Is there a radar installation nearby? If you cannot find the answer to these questions easily, consider employing a spectrum analysis product, such as the AirMagnet® Spectrum Analyzer.

- Are building blueprints available?

With blueprints, you can see the location of elevators, load-bearing walls, and other building characteristics that can impact signal quality. Different materials, such as concrete walls, brick walls, cubicle walls, glass, and elevator shafts impact signal quality differently. You can often load these blueprints into a planning or site survey tool to make the process easier.

- What devices need to access the WLAN?

Determine and document the full complement of devices that people will use to access the WLAN. The performance requirements of the WLAN will depend on both the applications and the capabilities of the client devices. For example, design engineers, architects, and doctors tend to work with bandwidth-hungry applications, so you might need to provide greater capacity. Conversely, if it is a warehouse with a low client density of mostly barcode scanners, a lower access point density might be suitable. Finally it is important to consider voice, or the future use of voice. If some or all people will use VoWLAN (Voice over WLAN) devices, that can affect how many users each access point can accommodate.

NOTE: For some access point User Guidelines, see Section 2.2.5, Bandwidth Assumptions for Wi-Fi.

2.2.3 Site Surveys

One of the first questions IT managers ask when they are preparing for a WLAN deployment is whether or not a site survey should be performed. In a site survey, the administrator walks around the facility with a site survey tool to measure the radio frequency (RF) coverage of a test access point or the existing WLAN infrastructure.

Whether or not you decide to do a site survey for your enterprise depends on the cost of the survey and the complexity of the environment. Here are the three ways to deploy a wireless network—with and without a site survey:

- Predeployment Survey

The safest approach is to perform a site survey before deployment to determine the best locations for the access points. Typically, site survey professionals temporarily place access points in different locations, take measurements, and adjust their settings and locations as necessary. After they complete the survey, they install the access points and then perform another site survey to confirm that the goals have been achieved. This method is clearly the most reliable way to deploy a wireless network; however, it can be expensive, time consuming, and impractical if an enterprise has many sites.

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- Deploy and Check

In this scenario, an initial site survey is not performed. Instead, wireless administrators make educated guesses on the best locations for the access points, or they use a planning tool to determine the locations more reliably. After deploying the access points, the administrators do a quick site survey. If they need to provide greater coverage, they deploy additional access points. If there are areas where access points are interfering with each other, they then relocate one or more of them. With cooperative RF control, SmartPath APs automatically adjust their channel and power to compensate for coverage gaps and areas of interference.

The deploy-and-check approach is often much cheaper and faster than doing a predeployment site survey. The risk is that you might have to move some access points and CAT5 (Category 5) Ethernet cables if you do not plan properly. SmartPath provides a huge competitive advantage in the deploy-and-check approach, thanks to its flexible mesh networking capability. An administrator can deploy with mesh (before running wires) and check the performance in several layouts, determine the best layout, and then run the wires to their final location.

- Deploy without Survey

Although it is usually advisable to do a site survey, there are many situations in which it is not feasible or even necessary. If the location is sufficiently small—for example, a deployment of only three or fewer access points—site surveys have limited value because there is virtually no opportunity for interference. If there are numerous remote locations, a site survey might be impractical because of the cost of traveling to each site. In these locations, you can use a slightly denser deployment to ensure appropriate coverage and capacity. SmartPath APs automatically adjust their radio power levels to ensure that there is minimal overlap from interfering channels. Usually the cost of extra access points is offset by the cost saved by not doing a site survey in a remote location.

2.2.4 Budgeting Wi-Fi: The Chicken and Egg Problem

The hardware cost of a Wi-Fi solution is generally driven by the number of access points needed, and a SmartPath network is no exception. Unfortunately, a traditional challenge of budgeting for Wi-Fi is that it is difficult to know how many access points to plan for until you have deployed and measured them. There are methods of doing site surveys before a deployment to answer these questions. While doing so is often worthwhile, you might just need a general idea of what you should budget. Fortunately there are some simple guidelines that you can use to figure out how many access points you need, including the number of access points per square foot, the number of clients per access point, and the distance between access points.

- Access Points per Square Foot

The simplest and most common way of budgeting access points is per square foot. You simply take the square footage of a building and divide it by some number. The most common metric used today is one access point for every 4000 to 5000 square feet for standard offices with cubicles. However, if you need to support voice applications, you need a higher concentration of access points. In this case, the recommended formula is one access point for every 3000 square feet, or even as low as one access point for every 2000 square feet. In the lightest weight convenience networks, it is possible to use fewer access points, and densities as low as one access point for every 10,000 to 15,000 square feet can be successful. Keep in mind that such a deployment often has dead spots and can only support very low client densities.

- Number of Clients for Each Access Point

Another way to determine the number of access points needed is to consider the number of clients you want each access point to support. In a standard office environment, most enterprises plan to support an average of 5 to 15 clients per access point. Although the specifications of most access points state that they can support up to about 120 clients, a significantly lower density is recommended to get an acceptable throughput for standard office applications. If you expect to support voice over Wi-Fi in the enterprise, account for those phones as well. With the addition of voice, the client density substantially increases, requiring you to plan for an average of 5 to 10 data clients and 5 to 10 voice clients for each access point. Remember that voice clients consume virtually zero bandwidth when they are not on a call. However, when they are on a call, it is imperative that the traffic goes through.

- Distance Between Access Points

In a standard office environment, it is a good idea to ensure that access points are between 30 and 100 feet from one another. A distance of 30 feet is needed in high-density environments and those with many walls separating access points. A distance of 100 feet is sufficient in low-density areas with plenty of open space.

These three tips can help determine how many access points to deploy in a given area. In general, the square footage estimate provides the best budgeting estimate, with client estimations and the distance between access points confirming the square footage calculations.

As with all rules, there are exceptions. If certain locations in the network have a higher density of clients, such as conference rooms or lecture halls, a higher density of access points is required. Conversely if there are large open areas with few active clients, fewer access points are sufficient.

Planning Tools

If following general guidelines does not provide enough confidence or if the deployment environment is particularly challenging, you might consider using software planning tools like AirMagnet Planner or Ekahau® Site Survey (ESS). Black Box also includes a free planning tool with the SmartPath AP on-line software. Such tools are useful in determining the placement of access points without performing a site survey.

Associated Access Point Costs

After you determine how many access points you need, it becomes simpler to determine the other costs involved with deploying Wi-Fi because most are driven by the quantity of access points. These costs include the following:

- Installation and Wiring

- CAT5: CAT5 wiring is required for all SmartPath APs acting as portals.* One advantage of SmartPath networks is that you can deploy SmartPath APs in a mesh to avoid some of the wiring costs.

- Power: Power lines are required for all SmartPath APs acting as mesh points.† Portals receive power through power lines or through Ethernet cables by using the Power-over-Ethernet (PoE) option.

- Installation: SmartPath APs can simply snap into standard dropped-ceiling environments. However, if the installation is in a warehouse or any environment without dropped ceilings, consider the installation costs.

- Infrastructure: PoE Switches

You must cable every SmartPath AP acting as a portal to a switch port. For PoE, there are several considerations:

- 802.3af: The current PoE specification provides enough power for all 802.11a/b/g access points.

- 802.3at: The current PoE specification supports higher power devices like 802.11n access points.

- PoE injectors and midspans: These save money on switch upgrades by injecting power into standard Ethernet connections.

- Site Survey and Debugging Software

- For a sizable deployment, you probably will use site survey and debugging software. Deployment and troubleshooting tools from Ekahau and AirMagnet pay for themselves very quickly. These products enable the validation of a deployment and allow you to troubleshoot client and access point issues. (For more information, see Section 2.3, Operational Considerations.)

- Professional Services

- When deploying wireless LANs, professional services are often required to perform site surveys.

*A portal is a cluster member that links one or more mesh points to the wired LAN.

†Mesh points are cluster members that use a wireless backhaul connection to link through a portal to the wired LAN.

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- Client Software

- Depending on the deployment, users can use built-in Microsoft® Windows®, Linux® and/or Macintosh® client software (supplicants).

- For better services and troubleshooting, consider a third-party supplicant such as Juniper Networks® Odyssey Client.

2.2.5 Bandwidth Assumptions for Wi-Fi

People frequently talk about how much coverage an access point provides; however, it is capacity—not coverage—that typically constrains an access point in an enterprise environment. The challenge is not how far the RF signal can travel (coverage), but how to deliver enough bandwidth to meet the demands of business applications (capacity). In other words, you might be able to cover an office of 50 people with one access point, but if all 50 people choose to access it at the same time, it might become overloaded. Indeed, if you use the formulas provided in this paper, you should find the saturation of access points on your campus to be more than sufficient. Enterprise users are accustomed to speedy switched networks and expect similar performance from their wireless LAN connections. This is why documenting the size and type of applications that will rely on your WLAN is so critical to your planning. In short, if you plan for optimal capacity, complete coverage will follow automatically.

In general, the way to increase capacity is to add more access points (within reason) and tune down the radio power to avoid interference. One reason for deploying a high-capacity network is to create a WLAN for voice and data applications. In such a WLAN, everyone has a VoIP handset running wirelessly all the time.

In general, the following table shows the standard densities for office deployments:

Table 2-1. Standard densities for office deployments.

Office Requirements	Expected Data Rate with 802.11g Clients	Expected Data Rate with 802.11n Clients		Access Point Density)
		20 MHz	40 MHz	
Coverage (low capacity)	12 to 24 Mbps	-39 Mbps	-81 Mbps	1 access point per 8000 square feet
Standard office deployment	36 Mbps	-104 Mbps	-216 Mbps	1 access point per 5000 square feet
Standard office deployment with voice	54 Mbps	-130 to -144 Mbps	-270 to -300 Mbps	1 access point per 2000 to 3000 square feet

NOTE: Data rate is not the same as TCP throughput. Because of various headers, inter-frame gaps, and session creation, real TCP throughput usually does not exceed 22 Mbps at data rates of 54 Mbps.

2.2.6 Overcoming Physical Impediments

Not every potential deployment is a standard business campus. The following scenarios are a few that merit special consideration.

- Open Space

Open spaces, such as a large foyer or an outdoor area, are very easy to cover with Wi-Fi because there are few impediments to propagation and fewer opportunities for multipath interference. In such spaces, Wi-Fi signals can propagate many hundreds of feet. This is good if you want to provide coverage for just a few users.

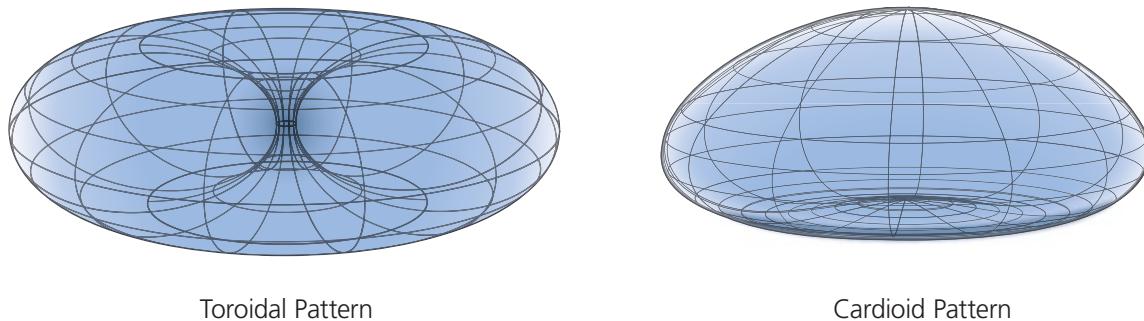
You will run into challenges if there are many users and high-capacity service goals. In these situations, it is important to tune down the RF to a minimal level. The SmartPath APs do this on their own automatically. Another trick is to take advantage of obstacles that block Wi-Fi. Look for trees or walls and put neighboring access points on either side of them. Doing so limits the interference of the two access points and allows for the installation of more access points with less interference.

- Warehouse and Retail

Warehouse and retail environments present many challenges. One of the largest challenges is that RF characteristics often change because of varying inventory levels and, in the case of retail, seasonal displays (such as tinsel or a stack of soda cans on an end cap). Additionally, metal shelves and high ceilings can be challenges to propagation. To resolve with these issues, it is wise to put at least one access point per aisle to ensure coverage for that aisle. This usually requires a higher density of access points than would otherwise be required.

- Configuring Antennas

As anyone who has administered a WLAN system in the past knows, proper configuration of the access point antennas at the outset can save you lots of trouble. The SmartPath AP (LWN602A) has internal antennas that cannot be adjusted. However, the antennas for the SmartPath (LWN602HA) are adjustable. The SmartPath AP (LWN602A) has a pair of fixed, dual-band omnidirectional antennas; and the SmartPath AP (LWN602HA) can support up to six single-band omnidirectional antennas (three for the 2.4-GHz radio and three for the 5-GHz radio). You typically orient these antennas vertically, positioning the antennas on all SmartPath APs in the same direction. Omnidirectional antennas create a coverage areas that can be toroidal (doughnut-shaped) or cardioid (heart- or plum-shaped), broadcasting to the sides much more effectively than up or down (see Figure 2-1). In general, this is good for most office environments because you have large flat floors. However, it can be a problem in environments with high ceilings.



Toroidal Pattern

Cardioid Pattern

Figure 2-1. Omnidirectional antenna radiation patterns.

The SmartPath AP can accommodate external antennas via coaxial jacks on its chassis. The jack is a standard male RP-SMA connector. Various patch, directional, and omnidirectional antennas can be used to change the coverage pattern. The most common external antennas are patch antennas. These are directional antennas that provide coverage in a single direction. Most commonly they have a transmission pattern as shown in Figure 2-2. Based on the gain, the signal will be wide (like the low gain antenna shown on top) or narrow and long (like the high gain antenna shown on the bottom). Note that the coverage patterns are not perfect for these antennas and that they often broadcast slightly in other directions than the primary one. These extra "lobes" can be seen in both of the patterns shown below.

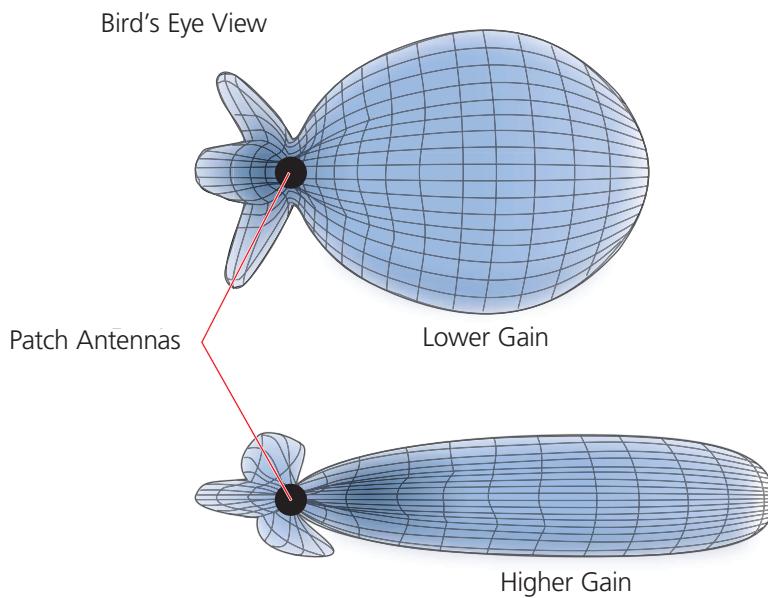


Figure 2-2. Directional antenna patterns.

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The following are some quick hints for deploying access points:

- Standard sheetrock walls and dropped ceilings are the best locations for mounting access points.
- When deploying WLANs in retail stores, doing a site survey at each store is likely to be impractical. It is more common to run detailed site surveys at a few locations and use the results to set up User Guidelines for the remaining sites.
- Be aware of metal-lined firewalls, steel pillars, and other metallic surfaces. RF signals can reflect off metal surfaces, which can cause unexpected coverage patterns. Also watch out for objects that can block or reflect signals, such as mirrors, plants, walls, steel doors, elevator shafts, and bathroom stalls.
- The quality and performance of a Wi-Fi network is a function of the signal-to-noise ratio. To avoid noise issues, check the area for common noise generators such as industrial microwave ovens, wireless video cameras, cordless phones and headsets, and Bluetooth devices. Such devices especially cause interference in the 2.4-GHz spectrum.
- Plan appropriately for high ceilings. With an omnidirectional antenna, the downward coverage is not great. In normal office space, the ceilings rarely exceed 15 feet, so this issue does not come up very often. In environments such as warehouses, where ceilings can be up to 50 feet high, ceiling-mounted access points are not optimal. It is best to deploy them on non-metallic walls about 10 feet to 15 feet above the floor. If this is not feasible, using patch antennas can help direct the RF energy downward.
- In high-density or high-capacity environments, placing access points on exterior walls allows for a greater number of cells inside the building and more capacity. In other deployments, it is recommended that the outer access points be no farther than 30 feet from the exterior walls to ensure coverage.

2.2.7 Preparing the Wired Network for Wireless

One of the advantages of moving to a Black Box WLAN is that you do not have to make changes to the underlying network, such as putting controllers into wiring closets. This can save you considerable time and effort during installation. However, some network changes might make sense for some deployments. For example, you might want to add additional VLANs or security settings. This section covers a few of the more common considerations that IT departments are handling.

- 802.1Q VLANs

SmartPath APs can segment users into VLANs if an administrator wants. This decision can be made by a returned RADIUS attribute or it can be configured as part of a user profile or SSID. Enterprises often set up separate VLANs for wireless and guest access, so that this traffic is segmented from the rest of the network; however, it is possible to set up any number of other VLANs for further segmentation.

- Firewalls

Depending on the environment, enterprises might use firewalls to segment wired and wireless data. This can be implemented as a discrete firewall enforcing traffic between VLANs or between ports, or you might use the stateful firewall that is integrated in SmartPath OS (the SmartPath AP operating system).

- RADIUS Authentication

If RADIUS authentication is required, then a RADIUS server must be in place and be able to support the necessary protocols for wireless—often called 802.1X EAP types: PEAP, EAP-TLS, EAP-TTLS, WEP 8021.x (dynamic WEP), LEAP, EAP-FAST, and captive web portal authentication using CHAP.

- DNS and DHCP Configuration

If you use the SmartPath EMS VMA (see Section 2.3, Operational Considerations), it is possible to install SmartPath APs without any extra configuration and they will be able to contact SmartPath EMS VMA for management. If the SmartPath APs are linked to a different subnet than the one to which SmartPath EMS VMA is connected, then you can set either a DHCP option or DNS entry to give the location of SmartPath EMS VMA (see “How SmartPath APs Connect to SmartPath EMS VMA” in Section 8.4, Example 4: Connecting SmartPath Units).

2.2.8 Online Planner Enhancements

Several enhancements were made to improve the usability and accuracy of the on-line planner.

Perimeter Wall Type: You can now specify a wall type for building perimeter walls. The perimeter is the blue line that defines the area of a building in which SmartPath EMS VMA can automatically place SmartPath AP icons. To apply a wall type to a perimeter that you have already drawn, right-click the perimeter line, click "Change Wall Type," and then choose Dry Wall (3 dB), Brick Wall (10 dB), or Concrete (12 dB). (See Figure 2-3.) To apply a wall type in previous releases, you had to draw a blue perimeter, and then trace over it with another wall type, such as a brick wall. The new approach is much more efficient.



Figure 2-3. Choosing wall type.

Wall Opacity: The main purpose of adding walls to a map is to show their effect on signal attenuation. After adding walls—including perimeter walls—you can diminish their opacity so that they blend into the background map instead of standing out prominently in the foreground. To adjust their opacity, click Operation > Global Settings, or right-click the top-level map name, and click "Global Settings." Then choose the percent of opacity that you want for the walls from the Opacity of walls drop-down list (see Figure 2-4).

Opacity of background **100** % coverage **90** % walls **100** %

Figure 2-4. Wall opacity.

Meaningful SmartPath AP Host Names: When using the Auto Placement feature, SmartPath EMS VMA automatically names the SmartPath AP icons. However, names like "LWN602A-0021400" are not particularly meaningful. You can give them names like "Lobby" or "Conf Room 1," which makes it easier for installers to use an exported PDF report to know where each one goes. To change the host name of a SmartPath AP icon, right-click it, and then edit the Host Name field in the AP Details dialog box that appears (see Figure 2-5). To see the host names in the GUI and in PDF reports, choose "Host Name" from the AP Labels drop-down list on the View tab.

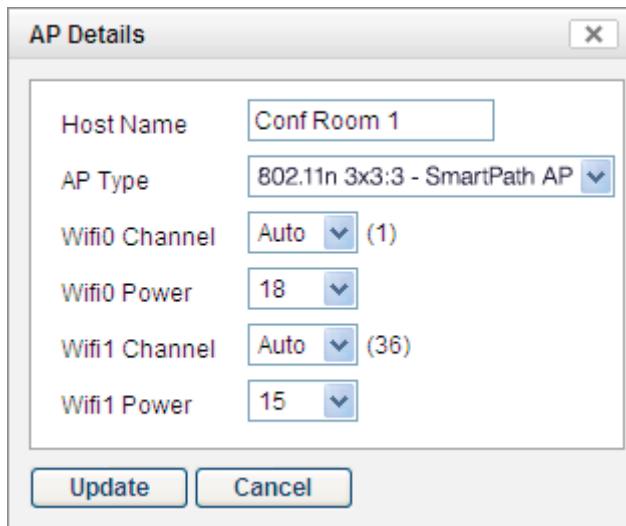


Figure 2-5. AP details.

Setting the Navigation Tree Width: By default, the width of the navigation tree is 180 pixels. If you want to make the tree wider or narrower, based on the length of map names and the depth of the nested structure, you can reset the width by clicking Operation > Update Tree Width (see Figure 2-6). Then enter a different value in pixels and click "Update." Different administrators can define different settings, which SmartPath EMS VMA retains for each one when they return to the topology section. Note that making the tree width too narrow can cause some of the information in the notifications section at the bottom of the tree panel to be cut off.



Figure 2-6. Navigation tree width.

Auto Placement Improvements: The calculation for the automatic placement of SmartPath AP icons on a map has been revised to leave smaller coverage holes on maps (see Figure 2-7). The automatic placement of icons, especially on smaller floor plans, sometimes left considerable coverage holes. With the new improvements, coverage is now greater than 90% and often greater than 95%.

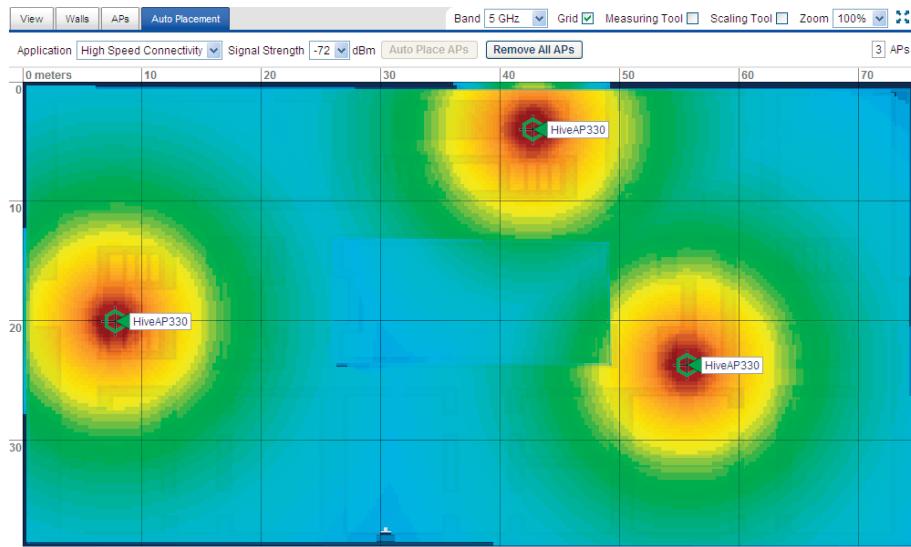


Figure 2-7. Auto placement.

2.3 Operational Considerations

To make your WLAN deployment process as smooth as possible, you should consider more than just the distribution and installation of access points. You should also consider how you will manage, optimize, and troubleshoot your WLAN after deployment.

2.3.1 Tuning

Approach building an enterprise WLAN with the same life-cycle approach you would apply to a wired network. After you deploy the WLAN, revisit key network engineering processes to account for changes in the environment. Watch for access points that are overloaded or are underused, and check for potential dead spots. Furthermore, be aware that the likely points of failure can change as the environment changes. For example, a neighboring business might install access points that cause RF interference on your network. You should schedule and perform periodic walkthroughs to ensure that the design goals of the wireless network continue to be met. The SmartPath EMS VMA provides quick views into how the network is behaving, which SmartPath APs are the most heavily loaded, and which have the most clients.

2.3.2 Spectrum Analysis

Black Box SmartPath APs have the ability to perform spectrum analysis in both the 2.4-GHz and 5-GHz band. Spectrum analysis provides a live view of the RF environment so that you can plan for further WLAN deployment or troubleshoot WLAN issues such as high retransmission rates caused by device interference or slow connections from overuse.

There are two main spectrum analysis functions: the graphical rendering of the RF environment in an FFT trace and swept spectrogram, and the identification of interference devices such as cordless phones, microwave ovens, video bridges, and Bluetooth devices. The SmartPath APs that support each of the spectrum analysis functions are listed in the following table:

Table 2-2. Supported spectrum analysis functions.

Access Point	FFT Graphs and Swept Spectrographs	Interference Device Identification
SmartPath AP (LWN602A)	Yes	Yes
SmartPath AP (LWN602HA)	No	No

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The number of SmartPath APs that can perform a spectral scan concurrently varies depending on the SmartPath EMS VMA platform you use. SmartPath EMS VMA Virtual Appliance limits the number of concurrent scans to two (that is, only two SmartPath APs can perform spectrum analysis functions at the same time); the physical SmartPath EMS VMA permits up to 20 concurrent scans.

To start the spectrum analyzer feature:

1. Click Monitor > Access Points > SmartPath APs, select the SmartPath AP on which you want to start the spectrum analyzer feature, and then click Tools > Spectrum Analysis.

A message appears with a warning that performing spectrum analysis on the selected SmartPath AP will affect performance and prompts you to confirm your decision. As a general rule, try to use this tool on SmartPath AP portals that are not actively serving clients rather than on mesh points with which clients are currently associated.

2. If you want to continue, click "Yes."

SmartPath EMS VMA immediately initiates the analysis tool on the selected SmartPath AP and displays the analysis pane, which contains three main areas: a status bar at the top of the pane, an area containing the graphical analysis feedback, and an interference reporting area at the bottom of the pane.

NOTE: To use the spectrum analysis feature on a radio in access mode, you must have at least one SSID configured on your WLAN on at least one SmartPath AP running SmartPath OS 4.0r1.

Status Bar

The status bar contains a brief overview of the current analysis parameters, including which SmartPath AP is employed, the frequency band and channels, and the time remaining in the analysis. In addition to the parametric information, four navigation buttons are also displayed.



Figure 2-8. Status bar.

Settings: Click to open a dialog box in which you can change the parameters of the spectrum analysis. Modify the following settings, and then click "Update:"

Interface: Choose which interface you want to use to collect data by the band with which it is associated. If you choose 2.4 GHz (11n/b/g), then the SmartPath AP uses its wifi0 interface to monitor the 2.4-GHz band. If you choose 5 GHz (11n/a), then it uses its wifi1 interface to monitor the 5-GHz band.

2.4-GHz Channels: This field only appears if you choose 2.4 GHz (11n/b/g) from the Interface drop-down list. In this field, you can enter any combination of channels that occurs in the 2.4-GHz band. If you are entering noncontiguous channels, then separate the channel numbers by commas. If you are entering a range of channels, use the hyphen (-) to indicate the range. For example, to monitor Channel 1, 5, and the range 7 through 11, then enter 1, 5, 7-11 into this field. To monitor the entire band, enter 1-11, or 1-13, or 1-14, depending on the channels allowed for your region.

5.0-GHz Channels: This field only appears if you choose 5 GHz (11n/a) from the Interface drop-down list. In this field you can enter any combination of channels that occurs in the 5-GHz band. If you are entering noncontiguous channels, then separate the channel numbers by commas. If you are entering a range of channels, use a hyphen (-) to indicate the range. For example, to monitor Channel 36, 48, and the range 149 through 165, then enter 36, 48, 149-165 into this field. To monitor the entire band, enter 36-165.

Data Collect Interval: The data collection interval refers to the time interval between scans of the spectrum. Each time the SmartPath AP scans the spectrum, it updates the display. If the data collection interval is five seconds, then the SmartPath AP scans every five seconds and updates the display. You can change the interval from 1 to 30 seconds. The default is a one-second interval.

Run Time: The run time determines how long the scanning process lasts. The default run time is five minutes, which is generally long enough to get a rough idea of the RF (radio frequency) environment. For more intense scrutiny of the RF environment, longer run times are called for. The maximum run time is eight hours.

Return: The Return button returns you to the Monitor > Access Points > SmartPath APs page without stopping the analysis. When you return to the Monitor > Access Points > SmartPath APs page, an icon appears to the right of the SmartPath AP name indicating that the spectrum analysis feature is enabled, which means that an analysis is running. To return again to the spectrum analysis page, simply click this icon or perform the same steps to start an analysis. Attempting to start an analysis while one is already running does not start a new instance; rather, it returns to the view of the current analysis in progress.

Stop: When you click "Stop," the current analysis ends. SmartPath EMS VMA appliance allows for 10 concurrent scans, and SmartPath EMS Online displays the Monitor > Access Points > SmartPath APs page again.

Maximize: Clicking the maximize button (four outward-pointing arrows) on the status bar causes the entire pane to be maximized to fill the browser frame. To return to the normal view, simply click the Restore Down button (four inward-pointing arrows) in the upper right corner of the browser.

Graphical Analysis Feedback Area

The graphical analysis feedback area displays four representations of the received signals, arranged by default in a two-by-two array.

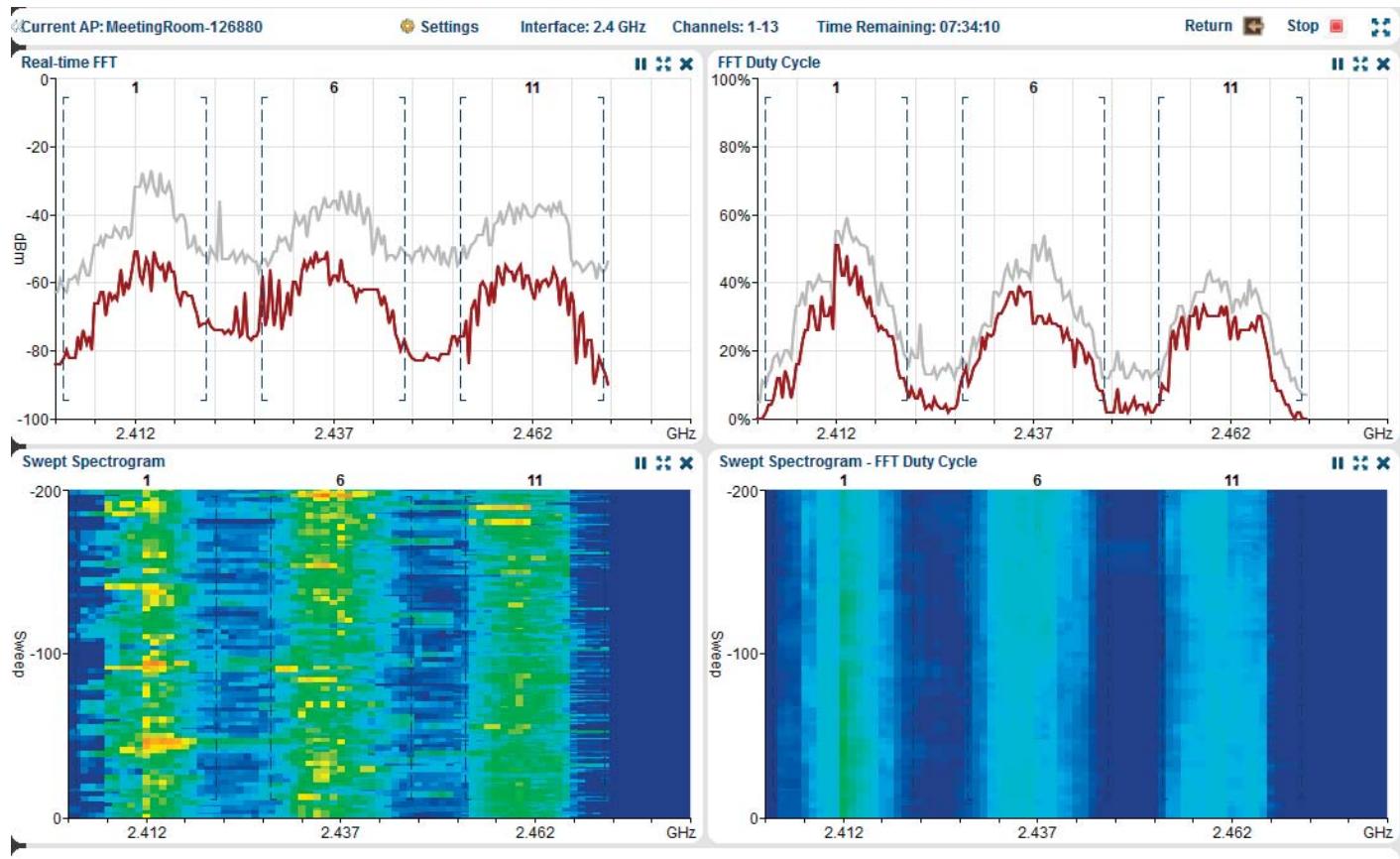


Figure 2-9. Graphical analysis.

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Each of the representations can be enlarged to fill the entire analysis pane to provide more detail or to increase its visibility, or be deleted from the array to simplify the display. To change the display in this manner, use the buttons in the upper right corner of each of the representations.

Pause/Resume: You can suspend a trace by clicking the Pause button. When you click "Pause," the button becomes a Resume button (right-pointing triangle). To resume the trace, click "Resume."

NOTE: Pausing one of the displays does not affect any of the other displays and does not stop the collection of data. When you resume a display, it returns to displaying data as if there were no interruption.

Maximize: Click the Maximize button (four outward-pointing arrows). This causes the small display to enlarge to fill the entire content pane of the page. This is distinct from the Maximize button on the status bar, which maximizes the content pane to fill the browser. To return to the smaller view, click the Restore Down button. This causes the display to return to the previous arrangement.

Close: When you click the Close [x] button, the affected display disappears and the neighboring display expands to fill the vacated area. To recover a closed display, navigate away from the spectrum analysis page and then return to it. When you return, SmartPath EMS VMA again organizes the display in its default arrangement.

A description of each of the four graphical representations of the RF environment follows:

Real-time FFT: The real-time FFT is a trace that indicates the power of a signal (vertical axis) along a domain of frequencies (horizontal axis). The term FFT (fast Fourier transform) refers to the mathematical algorithm used to decompose received signals into their component's frequencies. Within this display, there are two traces: the red trace indicates the real-time power levels, whereas the gray trace indicates the maximum power level reached during the current data collection session.

On maximizing this display, you gain access to the following additional display parameters:

Band: You can choose which band you want to monitor in this display: 2.400-2.500 GHz, 5.150-5.350 GHz, 5.470-5.725 GHz, or 5.725-5.850 GHz.

Channels: Choose one of the channel combinations in the drop-down list to display channel boundaries within the graph.

Center: Use this control to scroll the graph right or left. You can use the Center control in combination with the Span control to zoom in on a specific area of the frequency domain.

Span: This control establishes the width of the viewable area, effectively zooming in on the center frequency. Use this control with the Center control to zoom in on a specific area of the frequency domain.

Reference Level: By default, the reference level of the graph (the top line) is 0 dBm. When used with the Vertical Scale control, you can zoom in on a specific portion of the actual trace.

By changing the reference level using this control, you can also view very low power levels near the noise floor. In a very quiet environment, the noise floor is generally between -130 dBm and -90 dBm; in very noisy or busy environments, it is much higher.

Vertical Scale: The vertical scale of a graph indicates how much vertical distance on the graph corresponds to power. By default, the vertical scale is set to 10 dB, which means that a power change of 10 dB corresponds to a specific, physical vertical distance on the graphic display. Changing that setting to 5 dB doubles the vertical resolution of the graph. Because there are many different sizes of monitors, the actual scale that you see in your browser is relative.

Max Hold: By default, this check box is selected and SmartPath EMS VMA displays the gray trace that indicates the maximum power level reached during the current data collection session. To turn off the gray trace, clear the check box.

FFT Duty Cycle: The FFT duty cycle is the amount of time as a percent of total time that the SmartPath AP receives a signal above 20 dB above the noise floor. FFT duty cycle is often referred to as channel utilization because it indicates to what extent a channel is actually in use in terms of the relative amount of time the signal is present (vertical axis). Within this display, there are two traces: the red trace indicates the real-time duty cycle, whereas the gray trace indicates the maximum duty cycle reached during this data collection session.

On maximizing this display, you gain access to the following additional display parameters:

Band: You can choose which band you want to monitor in this display: 2.400-2.500 GHz, 5.150-5.350 GHz, 5.470-5.725 GHz, or 5.725-5.850 GHz.

Channels: Choose one of the channel combinations in the drop-down list to display channel boundaries within the graph.

Center: Use this control to scroll the graph right or left. You can use this control in combination with the Span control to zoom in on a specific area of the frequency domain.

Span: This control establishes the width of the viewable area, effectively zooming in on the center frequency. Use this control with the Center control to zoom in on a specific area of the frequency domain.

Maximum: By default, the maximum is set to 100%. This means that when the trace reaches the top of the graph, it has a duty cycle of 100%. You can use this control to set a lower maximum to gain resolution. When used with the Minimum control, you can zoom in on a specific portion of the trace.

Minimum: By default, the minimum is set to 0%. This means that when the trace reaches the bottom of the graph, it has a duty cycle of 0%. You can use this control to set a higher minimum to gain resolution. When used with the Maximum control, you can zoom in on a specific portion of the trace.

Max Hold: By default, this check box is selected and SmartPath EMS VMA allows for 10 concurrent scans, and SmartPath EMS Online displays the gray trace that indicates the maximum duty cycle reached during this data collection session. To turn off the gray trace, clear the checkbox.

Swept Spectrogram: A swept spectrogram tracks the signal power over time. That is, it produces a color-coded sweep of spectral information such that the admin can view the real-time FFT in terms of its historical values. The swept spectrogram—also called a heat map—reports the frequency on the horizontal axis, the history (in sweeps) on the vertical axis, and the power encoded as a set of colors. Blue indicates low power levels, whereas red indicates high power levels; the gradient of colors from light blue, through green, yellow, and orange, indicates intermediate power levels.

On maximizing this display, you gain access to the following additional display parameters:

Band: You can choose which band you want to monitor in this display: 2.400-2.500 GHz, 5.150-5.350 GHz, 5.470-5.725 GHz, or 5.725-5.850 GHz.

Channels: Choose one of the channel combinations in the drop-down list to display channel boundaries within the graph.

Swept Spectrogram-FFT Duty Cycle: A swept spectrogram of the FFT duty cycle tracks the duty cycle over time. This spectrogram produces a color-coded sweep of duty cycle information with frequency on the horizontal axis, history (in sweeps) on the vertical axis, and the duty cycle encoded as a set of colors. Blue colors indicate low duty cycle (the darkest blue is 0%), whereas red colors indicate high duty cycles (the darkest red is 100%); the gradient of colors from light blue, through green, yellow, and orange, indicates intermediate duty cycle values.

On maximizing this display, you gain access to the following additional display parameters:

Band: You can choose which band you want to monitor in this display: 2.400-2.500 GHz, 5.150-5.350 GHz, 5.470-5.725 GHz, or 5.725-5.850 GHz.

Channels: Choose one of the channel combinations in the drop-down list to display channel boundaries within the graph.

Both swept spectrograms together provide a useful view of how the RF environment behaves over time, which in turn provides clues to uncovering problems, such as identifying intermittent interference sources.

Interference Reporting Area

The interference reporting area at the bottom of the pane displays any sources of RF interference that the spectrum analyzer can identify. This area provides a summary of all interference sources for quick review. This area contains six columns to help identify the affected channels and the approximate position of the interference.

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AP Name: The name of the SmartPath AP that is reporting the interference. If an interference source is reported by a few SmartPath APs, but not others, you can use this to approximate the physical location of the interference.

Device Type: SmartPath EMS VMA maps the signature of the interference to a specific device type such as a cordless phone, microwave oven, or Bluetooth, which it then reports in the Device Type column. The device type listing can help determine whether the interference source might be a security concern.

Discovered: This column shows the date and time that the SmartPath AP discovered the source of the interference. You can track regular, periodic, and intermittent interference sources using this information.

Channel Affected: When SmartPath EMS VMA identifies an interference source, the channel in which it occurs appears here.

Center Frequency: The center frequency of the affected channel appears in this column.

Occupied Bandwidth: This column displays the bandwidth of the affected range of frequencies.

NOTE: The last three columns contain redundant information and provide the same information from different perspectives so that you can gain a more a complete understanding of the affected frequencies and channels.

Table 2-3. Interference reporting.

AP Name	Device Type	Discovered	Channel Affected	Center Frequency	Occupied Bandwidth
SmartPathAP-0e5580	Microwave oven	2011-05-17 12:09:17	9	2542	20
SmartPathAP-0e5580	Microwave oven	2011-05-17 12:04:22	10	2457	20

During the brief intervals of time that the spectrum analyzer is sampling, no data transfer occurs. However, if the SmartPath AP is very busy processing wireless traffic (that is, it has a high duty cycle), then the sampling and analysis can subtly impact the performance. In addition, any analysis that monitors multiple channels must accommodate the added time needed for the scanning interface to switch channels.

2.3.3 Troubleshooting

Some of the most common issues that arise after deploying a new wireless network are RF interference, RADIUS issues, and desktop client issues. The first step in troubleshooting is to look at logs and use debug commands. Black Box offers an extensive set of event monitoring and debug tools that you can use through SmartPath EMS VMA, the SmartPath AP network management system. For additional troubleshooting, particularly of clients or neighboring networks, Black Box recommends two tools, which are available on the Internet: Ethereal Warehouser (<http://www.wireshark.org/>) and AirMagnet Laptop Analyzer (<http://www.airmagnet.com/products/laptop.htm>).

2.3.4 Management

Current Wi-Fi networks typically span an entire company and have complex security policies. Fortunately, the SmartPath EMS VMA Network Management System makes it simple to manage large networks from a central location. It provides a single centralized management instance for the entire wireless network. Although managed SmartPath APs can operate without SmartPath EMS VMA, it simplifies the provisioning of global policy management and centralized configuration and monitoring. SmartPath EMS VMA lowers operating costs by speeding deployment, configuration, and monitoring of the wireless network.

Managing faults and alarms is critical to maintaining uptime. You can view and manage events through SmartPath EMS VMA logging. Optionally, you can use a third-party tool such as HP® OpenView®.

SmartPath EMS VMA makes it easy to monitor and troubleshoot SmartPath APs within a WLAN infrastructure. SmartPath EMS VMA can import hierarchical map views that represent the physical location of the network, from the perspective of the entire world down to the floor level.

2.3.5 Manual, Automatic, and Semi-Automatic Rogue Mitigation

You can manually mitigate rogue APs and their clients, or you can configure SmartPath APs to mitigate them automatically upon detection. You can also use a semi-automatic approach in which you determine when to start and stop the mitigation and allow the SmartPath APs to determine which SmartPath APs carry out the deauth attacks that comprise the mitigation effort.

After creating a WIPS policy on the Configuration > Advanced Configuration > Security Policies > WIPS Policies > New page, define how you want to perform rogue AP and client mitigation: manually, automatically, or semi-automatically. Each approach is described below.

Manual Mitigation

To mitigate rogue APs and their clients manually, expand the Optional Settings section and select Manual. The following mitigation parameters apply when operating in manual mode:

Period for client detection and mitigation: After you enable rogue detection on a SmartPath AP, it scans detected rogue APs for clients during the period of time that you specify. If you manually start mitigation against a rogue, the SmartPath AP not only continues scanning for clients during this period, it also sends deauth frames to the rogue AP and any detected clients during the same period. For example, if you leave this at its default setting of 1 second, the SmartPath AP checks for rogues and attacks them every second.

Consecutive number of mitigation periods: This specifies how many consecutive periods of time to spend attacking a rogue AP and its clients before allowing client inactivity to cause a ceasefire and commence a countdown to end the mitigation. The default setting is 60 consecutive periods.

Max time limit for mitigation efforts per rogue AP: This is the maximum amount of time that an attack against a rogue AP can last. If the length of client inactivity does not cause the attack to be suspended or if you do not manually stop the attack, the SmartPath AP will stop it when this time limit elapses. The default duration is 14,400 seconds (4 hours), which means that a SmartPath AP continues checking for clients of a detected rogue for up to four hours and mitigating them if it finds them.

Length of client inactivity needed to stop mitigation: The SmartPath AP stops an attack when there are no more clients associated with the mitigated rogue AP for this length of time. The default setting is 3600 seconds (1 hour). If the SmartPath AP detects any associated clients before this length of time elapses, it sends a deauth flood attack and resets the counter to begin the countdown again. If there are no more clients associated with the AP after this length of time elapses, the SmartPath AP stops the mitigation process—even if there is still time remaining in the maximum time limit.

NOTE: The remaining parameter—max number of mitigator APs per rogue AP—only applies when using automatic and semi-automatic modes.

In Manual mode, you must periodically check for rogue APs and their clients on the Monitor > Access Points > Rogue APs page. If you find a rogue that you want to mitigate, select the checkbox in each row of a reporting SmartPath AP that you want to use to perform the mitigation, and then click “Mitigation > Start.” When you think that the mitigation process has continued long enough and you want to stop it, select the check box of each attacking SmartPath AP and then click Mitigation > Stop. With manual mitigation, you manually control the entire mitigation process: which rogues to attack, which SmartPath APs to use in the attack, when to start the attack, and when to stop it.

Automatic Mitigation

To configure SmartPath APs to mitigate rogue APs and their clients automatically, expand the Optional Settings section and select Automatic. In this mode, SmartPath APs automatically start and stop the mitigation process without any administrator involvement.

When you select Automatic, the following option appears: Automatically mitigate rogue APs only if they are connected to your network. By default, this check box is selected. This ensures that SmartPath APs only attack rogue APs that are in their backhaul network, not APs in external networks that happen to be within radio range.

NOTE: Be careful not to attack legitimate external APs. If there are neighboring wireless LANs within radio detection range, only enable automatic mitigation of rogue APs detected in your own network.

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All the parameters in the Mitigation Parameters for Rogue APs and Their Clients section apply to SmartPath APs that perform automatic mitigation. In addition to the parameters explained above, there is one other:

Max number of mitigator APs per rogue AP: For automatic and semi-automatic mitigation, cluster members choose one SmartPath AP to be the arbitrator AP, which is the one to which all the detector APs send reports. The arbitrator AP also determines which detector APs perform mitigation. When they start, they become mitigator APs. Set the number of mitigator APs that the arbitrator AP can automatically assign to attack a rogue AP and its clients.

Semi-Automatic Mitigation

To configure SmartPath APs to mitigate rogue APs and their clients semi-automatically, expand the Optional Settings section and select Semi-Automatic. This approach combines elements of both the manual and automatic approaches. Like manual mitigation, you must periodically check for rogue APs and their clients on the Monitor > Access Points > Rogue APs page, choose a rogue AP to mitigate, and start the mitigation process. Like automatic mitigation, the arbitrator AP automatically chooses which SmartPath APs perform the attack. Because the arbitrator AP determines which SmartPath APs perform the mitigation, it does not matter which entries on the Rogue APs page you select or how many you select. The arbitrator AP decides which SmartPath AP to assign to do mitigation based on two factors: radio channels and RSSI values. If a SmartPath AP is already using the same channel as a rogue AP, the arbitrator is likely to assign it as a mitigator AP so that it does not have to change channels to launch its attack. If one SmartPath AP reports a stronger RSSI value for a rogue AP than another SmartPath AP, that also increases the likelihood of it being selected as a mitigator because it is within closer attack range of the rogue and its clients.

2.3.6 Deploying with Confidence

Moving a large enterprise—or even a small one—to a WLAN for the very first time need not be daunting. If you have moderate experience with LAN deployments of other types and you have taken time to get answers to the important questions that will affect the network data load, you have every prerequisite for success. The bottom line is to remember to take stock of your project before you begin to ward against unforeseen costs and performance bottlenecks. If you have considered the issues and guidelines presented here, you are not far away from a successful WLAN deployment.

2.4 Basic Wi-Fi Concepts

The goal of this section is to provide some background on Wi-Fi propagation and how to lay out a wireless network. Although radio frequency (RF) engineering is a rather complicated science, this section provides a simple overview on the basics of Wi-Fi propagation and channel layout that you need to be able to install an enterprise WLAN.

The first thing to know is that Wi-Fi is forgiving. Wi-Fi tends to transmit a bit farther than you expect, and even in cases of interference, it tends to just work. This can be both a blessing and a curse. It is a blessing because people will likely have access to the network, and it is a curse because your overall performance might be suboptimal without obvious symptoms, like lack of connectivity. Understanding the basics presented in this section will help ensure a high-performance layout.

The first concept to understand is signal strength and how it relates to throughput. Radio power is measured in decibels relative to one milliwatt (dBm) where 0 dBm = 1 milliwatt, but decibels increase using a log10 math function. Rather than dusting off your old math books and pulling out your calculator, look at the dBm-to-milliwatt converter that appears below. Often in Wi-Fi, dBm and milliwatts (mW)—and microwatts (μW)—are used interchangeably. The following table converts between the two units of measurement:

Table 2-4. dBm-to-milliwatt conversions.

dBm-to-milliwatt	dBm-to-milliwatt
20 dBm = 100 mW	2 dBm = 1.6 mW
15 dBm = 32 mW	1 dBm = 1.3 mW
10 dBm = 10 mW	0 dBm = 1.0 mW
5 dBm = 3.2 mW	-1 dBm = 794 μW
4 dBm = 2.5 mW	-5 dBm = 316 μW
3 dBm = 2.0 mW	-10 dBm = 100 μW

In RF, there is also a relative measurement that you can use to compare two numbers. This measurement is simply dB (without the "m"). To see how this concept is applied, consider how radio signal propagation changes over a distance and how it can be affected. Figure 2-3 shows signal strength over distance as a curve that has the best signal strength closer to the access point. It also shows noise. In general, noise is considered to be low-level background RF signals that can interfere with a WLAN. This noise tends to be the garbled background RF that comes from everything from the sun and stars to man-made interfering devices like Bluetooth® headsets. It is impossible to block out noise, and it should not be attempted. This low level of background noise is called the "noise floor."

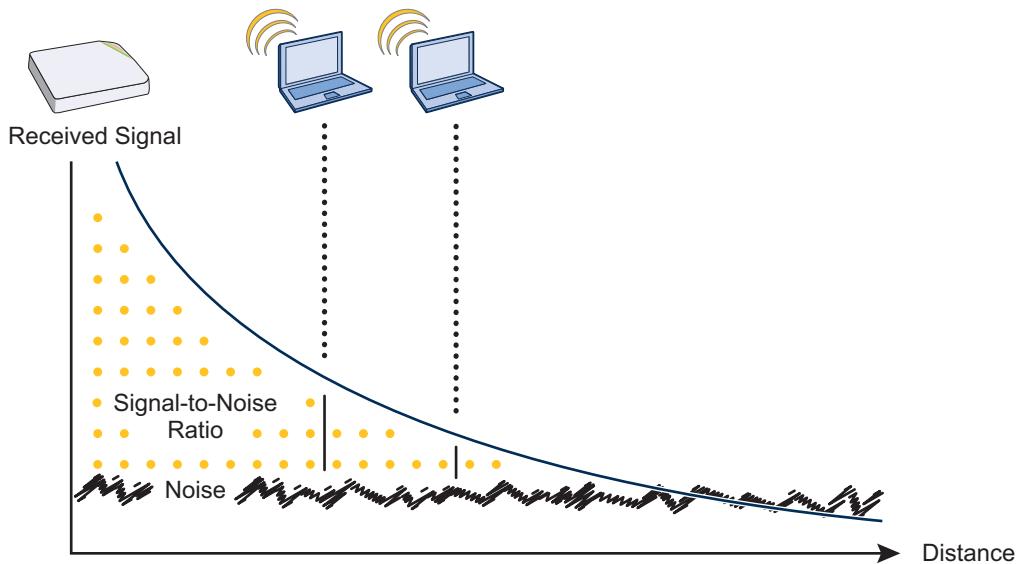


Figure 2-10. Path loss in an open space.

When clients send a packet, the ratio of the signal-to-noise (SNR) level defines the quality of the link, which is directly related to the performance of the network. Based on the SNR, the client and AP negotiate a data rate in which to send the packet, so the higher the SNR the better. For good performance, the SNR should be greater than 20 dB, and for optimal performance it should be at least 25 dB.

Signal strength not only diminishes over distance, but it can also be affected by objects in the way (see Figure 2-4). This can be a wall, a tree, or even a person. There is a fairly predictable dB drop through most objects that also decreases the SNR, thus decreasing the data rate. Although this appears to be a bad thing, clever Wi-Fi installers use it to their advantage. It enables them to place more access points in a tighter spot by using pre-existing walls and other impediments to Wi-Fi propagation to keep them from interfering with each other.

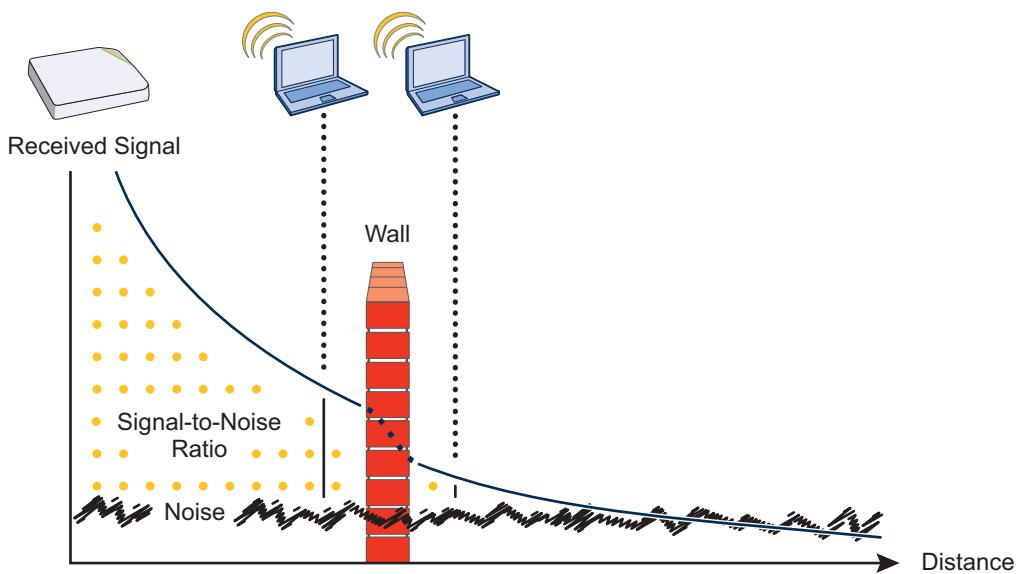


Figure 2-11. Path loss through a wall.

Microwave ovens, wireless video cameras, Bluetooth headsets, and cordless phones can all interfere with Wi-Fi signals (see Figure 2-5). Excess noise in an environment is often difficult to diagnose and can have a major negative impact on network performance. To discover noise sources, a spectrum analysis system is needed. AirMagnet provides an affordable spectrum analysis tool that operates in the 2.4-GHz and 5-GHz spectra.

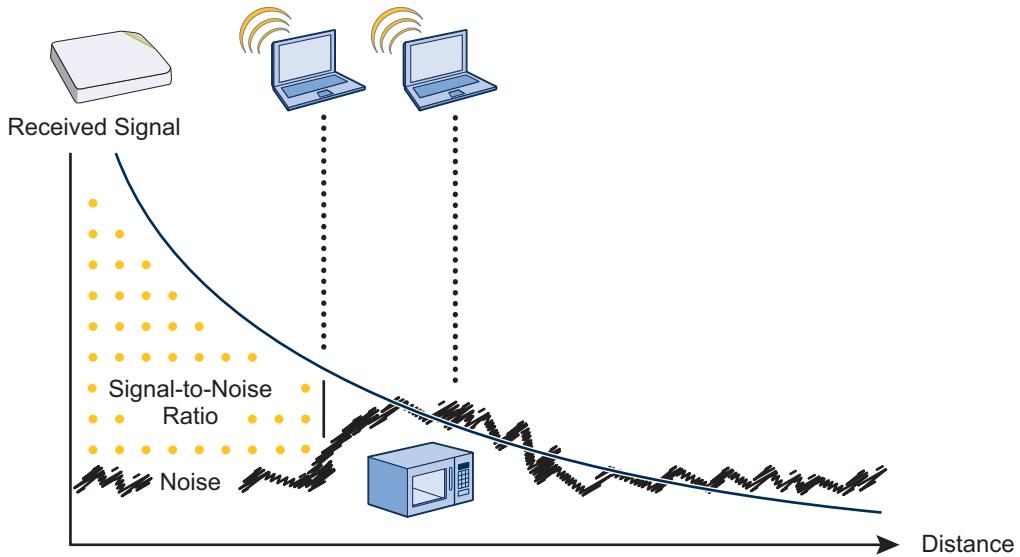


Figure 2-12. Path loss with noise (from a microwave).

Now that you have a sense of how Wi-Fi performance changes over distance and with noise, look at some ways to perform channel assignment. If two access points are on the same channel right next to each other, they are forced to share the same spectrum. This means that they share the 54-Mbps speeds available in 802.11a/g or the 300-Mbps speeds in 802.11n rather than each being capable of 54- or 300-Mbps speeds independently. This essentially halves the bandwidth for each access point. To manage this situation, make sure that neighboring APs are on different channels and that their power is adjusted so that it does not overlap that of other APs with the same channel.

In the 2.4 GHz spectrum, there are 11 channels in the United States. However, a Wi-Fi signal consumes more than one channel. Consequently, there are only 3 non-overlapping channels: 1, 6, and 11. To achieve optimal performance, you need to design a channel layout pattern such as the one on the left in Figure 2-6.

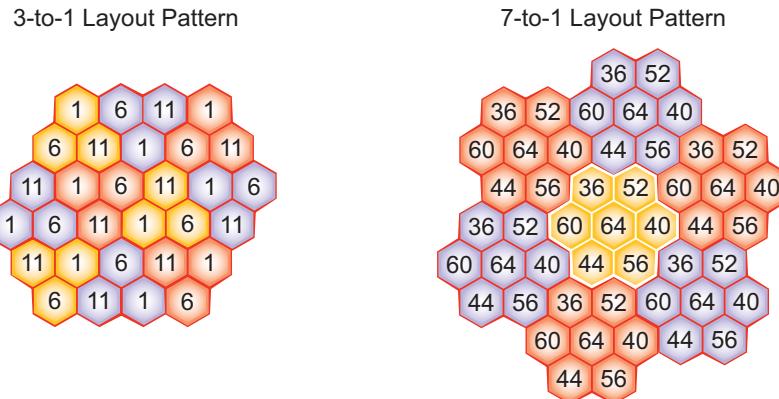


Figure 2-13. Channel layout patterns.

NOTE: There are alternative 2.4-GHz channel layouts, such as one for four channels using 1, 4, 8 and 11 and another using channels 1, 5, 9 to counter interference from microwaves, which tend to cause interference in the high end of the spectrum. Black Box recommends alternative channel layouts only for the most challenging radio environments.

Designing a channel pattern is easier for the 5-GHz spectrum. Depending on the country and the device being used, there are between 4 and 24 channels available for Wi-Fi use. However, in most countries there are at least eight 40-MHz-wide channels with which to work. To simplify the layout of more than 3 channels, most use a 7-to-1 pattern, as is shown on the right in Figure 2-6. This channel layout is much more flexible than the 3-channel system and allows for much better capacity over all channels.

The last topic to cover is the concept of multipath. When a client receives a transmission from an access point (or vice versa), the RF signal reaches the client first through a “direct path,” but then shortly thereafter by the “indirect paths” reflected off other objects. The direct path combined with the indirect paths make up multipaths (see Figure 2-7). RF signals can bounce off almost anything—walls, people, plants, and so on—but they bounce off metal most. As the RF signals bounce about while propagating, one or more of the secondary paths can interfere with the primary path, causing the signal strength of the direct path to diminish. In doing so, multipath can greatly decrease signal-to-noise ratio with legacy 802.11a/g radios. With 802.11n, a certain amount of multipath is desirable and increases performance.

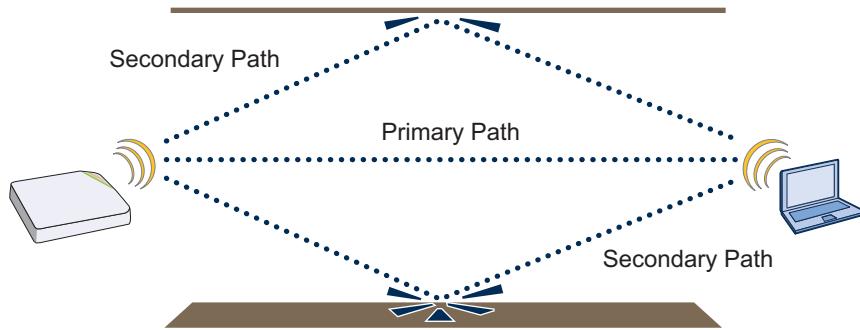


Figure 2-14. Multipath radio waves.

NOTE: If you would like to learn more about how radio-frequency propagation works or the details of 802.11, Wikipedia provides excellent background information under the entries “IEEE 802.11,” “radio propagation,” and “multipath.” Additionally, spending a few hours with a site survey tool such as AirMagnet Surveyor or the Ekahau Site Survey (ESS) and a few test APs can increase both your familiarity with Wi-Fi propagation and your confidence about how it behaves.

2.5 New and Enhanced SmartPath OS Features for Release 4.0r1

Spectrum Analysis: You can use up to ten SmartPath APs to function as spectrum analyzers for fixed lengths of time. You can use the spectrum analyzer feature to monitor both the 2.4-GHz and 5-GHz bands. Each SmartPath AP performing spectrum analysis provides a real-time FFT (fast Fourier transform) trace that displays the frequency-power relationship, along with a swept spectrogram to monitor power and frequency changes over time. It also provides an FFT duty cycle trace that indicates how busy the medium is, along with another swept spectrogram to monitor changes in the duty cycle over time. Additionally, SmartPath APs can identify many sources of interference by their RF (radio frequency) signatures.

Access and Backhaul on the Same Radio: When operating SmartPath APs as mesh points, you can configure SmartPath AP radios to operate simultaneously as an access interface and a backhaul interface. This not only provides a failover mechanism if one of the wireless interfaces fails or loses connectivity, it also allows single radio implementations to service clients and act as mesh points at the same time.

Automatic and Semi-Automatic Rogue Mitigation: In addition to manually mitigating rogue APs and their clients, you can configure SmartPath APs to mitigate them automatically upon detection. You can also use a semi-automatic approach in which you determine when to start the mitigation and allow the SmartPath APs to determine which SmartPath APs carry out the deauth attacks that comprise the mitigation effort.

Private PSK Enhancements: You can set up a captive Web portal that allows users to self-register and receive their own individual private PSKs. You can also configure SmartPath APs to generate private PSKs in bulk on a recurring basis with varying expiration times. Finally, you can configure an SSID so that it automatically binds a private PSK to the MAC address of the first client that uses it, reserving the key for exclusive use by that client until the private PSK lifetime expires or until an admin manually unbinds it.

User Profile Reassignment: SmartPath APs can reassign users to different user profiles based on their MAC addresses or OUIs, operating systems, and device domain names. This allows a user to go on the network with the same credentials, but be assigned one user profile when using one type of device and a different profile when using another.

NetConfig UI: By default, SmartPath APs act as DHCP clients, so that when you put them on a network, they automatically obtain appropriate network settings from a DHCP server. However, when a network uses static IP addressing, you must configure network settings manually on all devices attached to that network. To ease deployment in such circumstances, SmartPath APs support a NetConfig UI that allows you to ready a SmartPath AP for use on your network quickly and easily. The NetConfig UI is a Web user interface through which you can manually configure the IP address, netmask, and gateway for a SmartPath AP and configure SmartPath EMS VMA connectivity settings so that after the SmartPath AP is connected to the network, you can continue configuring and managing it through SmartPath EMS VMA.

IP Firewall Policy Support of Domain Names: IP firewall policies now support domain names as the source and destination in their rules.

VMware PCoIP and Citrix ICA: With both PCoIP (PC-over-IP) and Citrix ICA (Independent Computing Architecture) desktop virtualization protocols now predefined as services, you can quickly create firewall rules to allow or block these two services.

2.6 New and Enhanced SmartPath EMS VMA Features for Release 4.0r1

Active Directory Configuration Improvement: The internal processes used to connect to or query an Active Directory domain are now more streamlined to simplify the initial setup required to integrate a SmartPath AP RADIUS server with an Active Directory server. Also, you can now use SmartPath EMS VMA in Express mode to configure a SmartPath AP RADIUS server to work with an Active Directory server—a feature formerly available only when using Enterprise mode.

RADIUS Authentication for VHM Administrators: In previous SmartPath EMS VMA versions, it was only possible to use RADIUS authentication for home system administrators when no VHMs were present. Now both home system and VHM administrators can be authenticated through an external RADIUS server.

CAPWAP Latency Reports: SmartPath EMS VMA tracks the average latency in its CAPWAP connections to each managed SmartPath AP and displays an icon indicating the average amount of current latency in the Connection column on the Monitor > Access Points > SmartPath APs page when viewed in Monitor mode. A green hexagon indicates normal latency, based on an average that SmartPath EMS VMA has calculated from periodic SmartPath AP reports. The icon changes to yellow when the latency increases to the point that responsiveness has slowed noticeably; however, configuration and image uploads can still succeed. It changes to orange when connectivity issues reach the point that configuration and image upload attempts might no longer be successful.

Online Planner: Several enhancements were made to improve the usability and accuracy of the on-line planner.

2.7 New and Enhanced SmartPath OS and SmartPath EMS VMA Features for Release 4.1r1

Selective Multicast Forwarding through GRE Tunnels: SmartPath APs can selectively block or allow broadcast and multicast traffic through GRE tunnels to reduce traffic congestion. You can filter traffic either by using a blacklist to block all broadcast and multicast traffic (or to block all except to a few select destinations) or by using a whitelist to allow all broadcast and multicast traffic (or to allow all except to a few destinations).

Multiple Default Routing: It is now possible to configure multiple Layer 2 routes based on the VLAN ID of a user so that the SmartPath AP can route Layer 2 traffic through different Ethernet interfaces as appropriate. This allows, for example, a guest user on a corporate network segment to access a more appropriate segment for routing to the Internet while the SmartPath AP forwards traffic from an employee on a different VLAN through a different Ethernet interface.

Captive Web Portal Enhancements: The default captive Web portal pages have been redesigned to resize automatically for optimal viewing per device type: smartphone, tablet, and computer monitor. In addition, captive Web portals can now support a registration page with buttons linking to various URLs.

IP Multicast Enhancements: To minimize airtime consumption caused by multicast frame transmissions, SmartPath APs can convert multicast to unicast frames when channel use is high or multicast group membership is low. Furthermore, when a SmartPath AP cannot detect any multicast group members among its active clients, it can automatically suppress multicast frame transmissions completely.

LLDP Maximum Power: To avoid SmartPath APs sending LLDP (Link Layer Discovery Protocol) transmissions requesting more power through PoE from the connecting switch than the switch can provide, you can set a maximum power level that SmartPath APs can request in their LLDP advertisements on the Configuration > Advanced Configuration > Network Objects > LLDP/CDP Profiles > New page. By default, the maximum is 15.4 watts.

3. The SmartPath AP (LWN602HA) Overview

The SmartPath AP is a high-performance and highly reliable 802.11n wireless access point. The SmartPath AP provides dual concurrent 802.11b/g/n and 802.11a/n radios for 3x3 MIMO (Multiple In, Multiple Out) and dual 10/100/1000 Ethernet ports for link aggregation or link redundancy. Its power management system uses a concept called smart Power over Ethernet (PoE) to adjust its power consumption automatically in response to the available power in different environments. Smart PoE supports the IEEE 802.3af and 802.3at standards.

3.1 Hardware Description

The SmartPath AP is a multichannel wireless access point. It is compatible with IEEE 802.11b/g/n (2.4 GHz) and IEEE 802.11a/n (5 GHz) standards and supports a variety of wireless fidelity (Wi-Fi) security protocols, including Wi-Fi Protected Access (WPA) and WPA2.

You can see the hardware components on the SmartPath AP in Figures 3-1 and 3-2. Each component is described in Table 3-1.

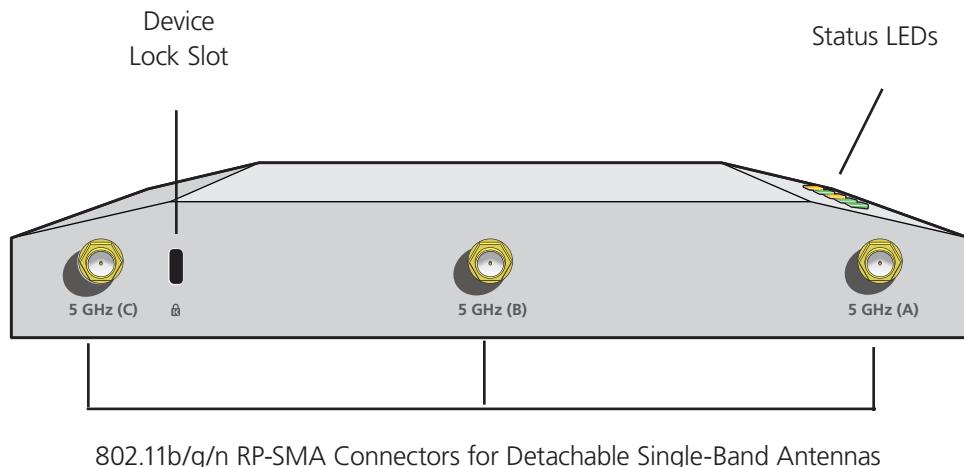


Figure 3-1. SmartPath AP front panel.

802.11a/n RP-SMA Connectors for Detachable Single-Band Antennas

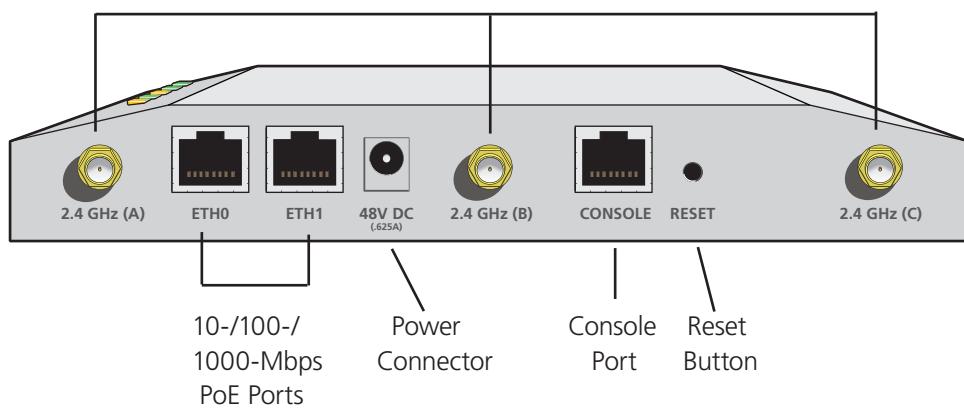


Figure 3-2. SmartPath AP back panel.

Chapter 3: The SmartPath AP (LWN602HA) Overview

Table 3-1. SmartPath (LWN602HA) component descriptions.

Component	Description
Status LEDs	The status LEDs convey operational states for system power, firmware, Ethernet interfaces, and radios. For details, see Section 3.3, Status LEDs.
Device lock slot	You can physically secure the SmartPath AP by attaching a lock and cable (such as a Kensington® notebook lock) to the device lock slot or by using the lock adapter that is included in the mounting kit and a padlock. For more information, see “Locking the SmartPath AP” in Section 3.5.1, Ceiling Mount.
802.11a/b/g/n RP-SMA connectors	You can connect up to six detachable single-band antennas to the male 802.11a/b/g/n reverse polarity-subminiature version A (RP-SMA) connectors. Connect the longer antennas, which support 2.4-GHz frequencies (for IEEE 802.11b/g/n), to the connectors on the side panel with the Ethernet ports. Connect the shorter antennas, which support 5-GHz frequencies (for IEEE 802.11a/n), to the connectors on the side panel with the device lock slot. For details, see Section 3.4, Antennas.
10-/100-/1000-Mbps ports	The two 10-/100-/1000-Mbps Ethernet ports—ETH0 and ETH1—support IEEE 802.3af and 802.3at PoE and have RJ-45 connectors. The SmartPath AP can receive power through one or both Ethernet connections from power sourcing equipment (PSE) that is compatible with the 802.3af standard and the 802.3at standard, such as one of the PoE injectors available as an optional accessory from Black Box. (If you connect the SmartPath AP to a power source through the power connector and PoE ports simultaneously, the device draws power through the power connector and automatically disables PoE.) You can configure ETH0 and ETH1 as two individual Ethernet interfaces, combine them into an aggregate interface to increase throughput, or combine them into a redundant interface to increase reliability. You can connect the SmartPath AP to a wired network or to a wired device (such as a security camera) through these ports using bridging. They are compatible with 10/100/1000BASE-T/TX and automatically negotiate half- and full-duplex connections with the connecting device. They are autosensing and adjust to straight-through and cross-over Ethernet cables automatically. For details, see Section 3.2, Ethernet and Console Ports.
Power connector	The 48-volt DC power connector (0.625 amps) is one of two methods through which you can power the SmartPath AP. To connect it to a 100–240-volt AC power source, use the AC/DC power adapter that is available as an extra option (LWN600PS-US, LWN600PS-UK, or LWN600PS-EU). Because the SmartPath AP does not have an on/off switch, connecting it to a power source automatically powers on the device.
Console port	You can access the CLI by making a serial connection to the RJ-45 console port. The management station from which you make a serial connection to the SmartPath AP must have a VT100 emulation program, such as Tera Term Pro (a free terminal emulator) or Hilgraeve® Hyperterminal® (provided with Windows® operating systems). The following are the serial connection settings: bits per second: 9600, data bits: 8, parity: none, stop bits: 1, flow control: none. For details, see Section 3.2, Ethernet and Console Ports.
Reset button	The reset button allows you to reboot the device or reset the SmartPath AP to its factory default settings. Insert a paper clip, or something similar, into the Reset pinhole and press the reset button. To reboot the device, hold the button down between 1 and 5 seconds. To return the configuration to the factory default settings, hold it down for at least 5 seconds. After releasing the button, the Power LED goes dark as the system reboots. Then it pulses green while the firmware loads and the system performs a self-test. After the software finishes loading, the Power LED glows steady green. To disable the reset button from resetting the configuration, enter this command: no reset-button reset-config-enable Pressing the button between 1 and 5 seconds will still reboot the SmartPath AP, but pressing it for more than 5 seconds will not reset its configuration.

Chapter 3: The SmartPath AP (LWN602HA) Overview

NOTE: The rear surface of the SmartPath AP is used for heat dissipation to reduce the internal temperature. Consequently, it can become hot, so use caution when handling it.

3.2 Ethernet and Console Ports

There are three ports on the SmartPath AP: two RJ-45 10/100/1000BASE-T/TX Ethernet ports and an RJ-45 console port. The pin assignments in the PoE (Power over Ethernet) Ethernet ports follow the TIA/EIA-568-B standard (see Figure 3-3 and Table 3-2). The ports accept standard types of Ethernet cable—CAT3, CAT5, CAT5e, or CAT6—and can receive power over this cable from power sourcing equipment (PSE) that is 802.3af-compatible. If you use CAT5, CAT5e, or CAT6 cables, the SmartPath AP can also support 802.3at-compliant PSE. Such equipment can be embedded in a switch or router, or it can come from purpose-built devices that inject power into the Ethernet line en route to the SmartPath AP. Because the PoE ports have autosensing capabilities, the wiring termination in the Ethernet cable can be either straight-through or cross-over.

8 1

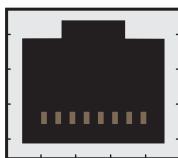


Table 3-2. PoE wire usage and pin assignments.

Figure 3-3. View of the ETH0 PoE port on the SmartPath AP (LWN602HA).

Pin	Data Signal	802.3af Alternative A (Data and Power on the Same Wires)		802.3af Alternative B (Data and Power on Separate Wires)		802.3at Wiring Options			
		MDI	MDI-X	MDI or MDI-X	—	1	2	3	4
1	Transmit +	DC+	DC-	—	—	DC1+	DC1-	DC1+	DC1-
2	Transmit -	DC+	DC-	—	—	DC1+	DC1-	DC1+	DC1-
3	Receive +	DC-	DC+	—	—	DC1-	DC1+	DC1-	DC1+
4	Not used	—	—	DC+	—	DC2+	DC2+	DC2-	DC2-
5	Not used	—	—	DC+	—	DC2+	DC2+	DC2-	DC2-
6	Receive -	DC-	DC+	—	—	DC1-	DC1+	DC1-	DC1+
7	Not used	—	—	DC-	—	DC2-	DC2-	DC2+	DC2+
8	Not used	—	—	DC-	—	DC2-	DC2-	DC2+	DC2+

MDI = Medium-dependent interface for straight-through connections.

MDI-X = Medium-dependent interface for crossover connections

The PoE ports are autosensing and can automatically adjust to transmit and receive data over straight-through or crossover Ethernet connections. Likewise, they can automatically adjust to 802.3af Alternative A and B power delivery methods. Furthermore, when the Alternative A method is used, the ports automatically allow for polarity reversals depending on their role as either MDI or MDI-X. In 802.3at, the 1/2 and 3/6 wire pairs connect to DC source 1 and 4/5 and 7/8 pairs to DC source 2 in PSE. Although the exact polarity depends on the PSE design, the SmartPath AP Ethernet ports can support all possible options.

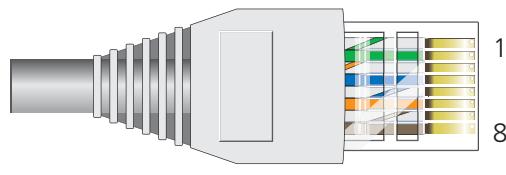


Table 3-3. T568A Wire Color.

Pin	T568A Wire Color
1	White/Green
2	Green
3	White/Orange
4	Blue
5	White/Blue
6	Orange
7	White/Brown
8	Brown

Figure 3-4. T568A Terminated Ethernet Cable with an RJ-45 connector.

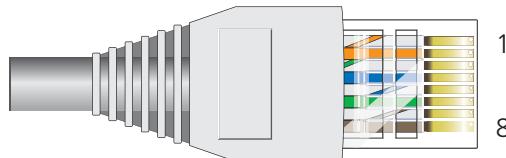


Table 3-4. T568B Wire Color.

Pin	T568A Wire Color
1	White/Orange
2	Orange
3	White/Green
4	Blue
5	White/Blue
6	Green
7	White/Brown
8	Brown

Figure 3-5. T568B Terminated Ethernet Cable with an RJ-45 connector.

T568A and T568B are two standard wiring termination schemes. Note that the only difference between them is that the white/green + solid green pair of wires and the white/orange + solid orange pair are reversed.

For straight-through Ethernet cables—using either the T568A or T568B standard—the eight wires terminate at the same pins on each end.

For cross-over Ethernet cables, the wires terminate at one end according to the T568A standard and at the other according to T568B.

3.2.1 Smart PoE

The SmartPath AP (LWN602HA) applies the concept of smart PoE to adjust power consumption as necessitated by varying levels of available power. The SmartPath AP supports PoE on both its ETH0 or ETH1 interfaces and can draw power through either one or through both simultaneously. Based on the available power that the SmartPath AP detects, it manages its internal power use by making the following adjustments:

- No adjustments are needed when the power level is 20 W (watts) or higher. If the available power drops to a range between 18 and 20 W, the SmartPath AP disables its ETH1 interface, assuming that it is drawing power through its ETH0 interface. If it is drawing power solely through its ETH1 interface, then it disables its ETH0 interface instead.
- If the power level drops to the 15–18 W range, the SmartPath AP then switches from 3x3 MIMO (Multiple In, Multiple Out) to 2x3 (see Section 3.4.1, MIMO).
- In rare cases when the power drops between 13.6 and 15 W and further power conservation is necessary, the SmartPath AP reduces the speed on its active Ethernet interface—ETH0 or ETH1—from 10/100/1000 Mbps to 10/100 Mbps.
- Finally, if there is a problem with the PoE switch or Ethernet cable, and the power falls between 0 and 13.6 W, the SmartPath AP disables its wireless interfaces and returns its ETH0 and ETH1 interfaces to 10-/100-/1000-Mbps speeds.

Through the application of smart PoE, the SmartPath AP can make power usage adjustments so that it can continue functioning even when the available power level drops.

3.2.2 Aggregate and Redundant Interfaces

By default ETH0 and ETH1 act as two individual Ethernet interfaces. When both interfaces are connected to the network and are in backhaul mode, the SmartPath AP transmits broadcast traffic only through ETH0. The SmartPath AP transmits broadcast traffic through ETH1 only when ETH0 does not have network connectivity. When both Ethernet interfaces are connected to the network and are in access mode, then the SmartPath AP transmits broadcast traffic through all the access interfaces: ETH0, ETH1, and all wireless subinterfaces in access mode.

In addition to using ETH0 and ETH1 as individual interfaces, you can combine them into an aggregate interface (agg0) to increase throughput, or combine them into a redundant interface (red0) to increase reliability. The logical red0 and agg0 interfaces support all the settings that you can configure for Ethernet interfaces except those pertaining to physical link characteristics such as link speed. For configuration information, see the next sections.

Aggregate Interface

You can increase throughput onto the wired network by combining ETH0 and ETH1 into a single logically aggregated interface called "agg0". The aggregate interface effectively doubles the bandwidth that each physical interface has when used individually. In this configuration, both Ethernet ports actively forward traffic, the SmartPath AP applying an internal scheduling mechanism based on the source MAC address of each packet to send traffic through the aggregate member interfaces. To configure an aggregate interface, enter the following commands:

```
interface eth0 bind agg0
interface eth1 bind agg0
```

In addition to configuring the SmartPath AP, you must also configure the connecting switch to support EtherChannel. For example, the following commands bind two physical Ethernet ports—0/1 and 0/2—to the logical interface port-channel group 1 on a Cisco® Catalyst® 2900 switch running Cisco IOS 12.2:

```
Switch#conf t
Switch(config)#interface port-channel 1
Switch(config-if)#switchport mode access
Switch(config-if)#spanning-tree portfast
Switch(config-if)#exit
Switch(config)#interface fastEthernet 0/1
Switch(config-if)#switchport mode access
Switch(config-if)#channel-group 1 mode on
Switch(config-if)#spanning-tree portfast
```

```
Switch(config-if)#exit
Switch(config)#int fastEthernet 0/2
Switch(config-if)#switchport mode access
Switch(config-if)#channel-group 1 mode on
Switch(config-if)#spanning-tree portfast
Switch(config-if)#exit
Switch(config)#exit
Switch#wr mem
```

Finally, you must cable the Cisco switch and the SmartPath AP together: Cisco 0/1 to SmartPath AP eth0, and Cisco 0/2 to SmartPath AP eth1.

Redundant Interface

If a single Ethernet link provides sufficient bandwidth and speed, such as a 1000-Mbps link, but you want to ensure link redundancy, you can connect the two Ethernet ports to the same switch—or to two different switches—and configure them to act as a redundant interface called "red0". In this mode, only one Ethernet interface is actively forwarding traffic at any one time. If eth0 is active and eth1 is passive and eth0 loses its connection, the SmartPath AP switches over to eth1. To configure a redundant interface, enter the following commands:

```
interface eth0 bind red0 primary
interface eth1 bind red0
```

The interface that you specify as primary is the one that the SmartPath AP uses when both interfaces have network connectivity. Because the SmartPath AP uses eth0 as the primary interface by default, it is unnecessary to specify "primary" in the first command above. However, it is included to make the role of eth0 as the primary interface obvious.

NOTE: No extra configuration is necessary on the connecting switch or switches to support a redundant interface.

Interface Selection for the Default Route

In cases where there are multiple active interfaces in backhaul mode, the SmartPath AP uses the following logic to choose which interface to use in its default route:

- If there is an Ethernet interface and a wireless interface in backhaul mode, the SmartPath AP uses the Ethernet interface in its default route.
- If there are multiple Ethernet interfaces in backhaul mode, the SmartPath AP chooses which one to use in its default route in the following order:
 - It uses red0 or agg0 if one of them has at least one member interface bound to it and its link state is UP.
 - It uses ETH0 if neither red0 nor agg0 has any member interfaces and the link state for ETH0 is UP.
 - It uses ETH1 if neither red0 nor agg0 has any member interfaces, the link state for ETH0 is DOWN, and the link state for ETH1 is UP.

3.2.3 Console Port

The pin-to-signal mapping in the RJ-45 console port is shown shown in Figure 3-6.

Chapter 3: The SmartPath AP (LWN602HA) Overview

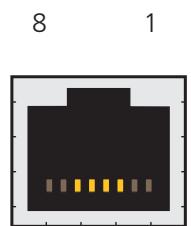


Figure 3-6. View of the console port on the SmartPath AP (LWN602HA).

Table 3-5. Console port pin assignments.

Pin	Signal	Direction
1	RTS (Request to Send)	Output, unused
2	DTR (Data Terminal Ready)	Output, unused
3	TXD (Transmitted Data)	Output
4	Ground	Ground
5	Ground	Ground
6	RXD (Received Data)	Input
7	DSR (Data Set Ready)	Input, unused
8	CTS (Clear to Send)	Input, unused

To make a serial connection between your management system and the SmartPath AP, you can use the console cable that is available as an extra accessory. Insert the RJ-45 connector into the SmartPath AP console port and attach the DB9 connector to the serial (or COM) port on your management system. The management system must have a VT100 terminal emulation program, such as Tera Term Pro (a free terminal emulator) or Hilgraeve Hyperterminal (provided with Windows operating systems). If you want to make your own serial cable and adapter, refer to Figure 3-7 and Table 3-6.

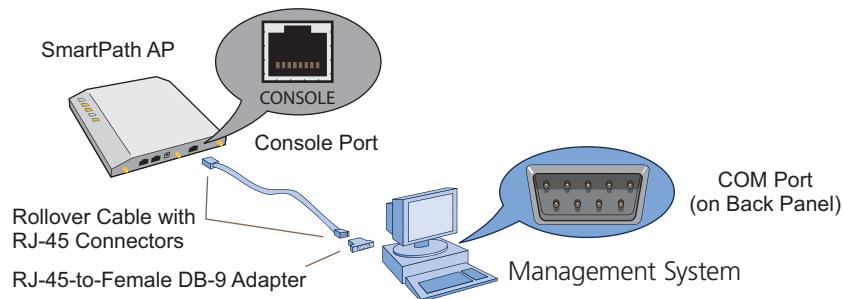


Figure 3-7. Wiring details for making a serial cable with an RJ-45-to-female DB9 adapter.

Table 3-6. Wiring details for making a serial cable with an RJ-45-to-female DB9 adapter.

Console Port (LWN602HA)	RJ-45-to-RJ-45 Rollover Cable		RJ-45-to-Female DB9 Adapter		Management System
Signal	RJ-45 Pin	RJ-45 Pin	RJ-45 Pin	DB9 Pin	Signal
RTS (Request to Send)	1	8	1	8	CTS (unused)
DTR (Data Terminal Ready)	2	7	2	6	DSR (unused)
TXD (Transmitted Data)	3	6	3	2	RXD
Ground	4	5	4	5	Ground
Ground	5	4	5	1	Ground
RXD (Received Data)	6	3	6	3	TXD
DSR (Data Set Ready)	7	2	7	4	DTR (unused)
CTS (Clear to Send)	8	1	8	7	RTS (unused)
—	—	—	—	9	RI (Ring Indicator, unused)

3.3 Status LEDs

The five status LEDs on the top of the SmartPath AP indicate various states of activity through their color (dark, green, amber, and red) and illumination patterns (steady glow or pulsing).

Power

- Dark: No power
- Steady green: Powered on and the firmware is running normally
- Pulsing green: Firmware is booting up
- Steady amber: Firmware is being updated
- Pulsing amber: Alarm indicating a firmware issue has occurred
- Steady red: Alarm indicating a hardware issue has occurred

ETH0 and ETH1

- Dark: Ethernet link is down or disabled
- Steady green: 1000-Mbps Ethernet link is up but inactive
- Pulsing green: 1000-Mbps Ethernet link is up and active
- Steady amber: 10-/100-Mbps Ethernet link is up but inactive
- Pulsing amber: 10-/100-Mbps Ethernet link is up and active

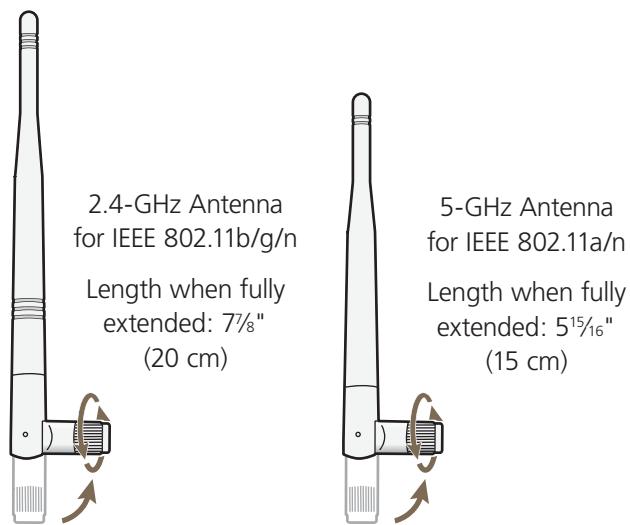
WIFI0 and WIFI1

- Dark: Wireless interface is disabled
- Steady green: Wireless interface is in access mode but inactive
- Pulsing green: Wireless interface is in access mode and active
- Steady amber: Wireless interface is in backhaul mode but inactive
- Pulsing amber: Wireless interface is in backhaul mode and is connected with other cluster members
- Alternating green and amber: Wireless interface is in backhaul mode and is searching for other cluster members

3.4 Antennas

Antennas are an integral part of the SmartPath AP. The SmartPath AP can accept up to six detachable dipole antennas. The three shorter antennas are designed for the 5-GHz band and have a 2-dBi gain. The three longer antennas are designed for the 2.4-GHz band and have a 4.9-dBi gain. These antennas are omnidirectional, providing fairly equal coverage in all directions in a toroidal (donut-shaped) pattern around each antenna (see Figure 2-1). For greater coverage on a horizontal plane, it is best to orient the antennas vertically. So that you can easily do that whether the SmartPath AP chassis is mounted horizontally or vertically, the antennas hinge and swivel (see Figure 3-8).

Although cluster members automatically adjust their signal strength according to their environments, you can resize the area of coverage by increasing or decreasing the signal strength manually by entering the interface { wifi0 | wifi1 } radio power <number> command, where <number> can be from 1 to 20 and represents a value in dBm.



The base of the antennas hinge up to 90 degrees so that you can orient the antennas independently of the orientation of the SmartPath AP chassis. The antennas also rotate in a full circle.

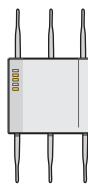
Figure 3-8. SmartPath AP (LWN602HA) antennas.

Generally, orient the antennas vertically for improved radio coverage, as shown here:

When mounting the SmartPath AP (LWN602HA) on a ceiling, orient its antennas downward.



When mounting the SmartPath AP on a wall or post, fully extend its antennas upward and downward.



When mounting the SmartPath AP above a ceiling or on a horizontal beam, orient its antennas upward.



Figure 3-9. SmartPath AP antennas, installed.

3.4.1 Multiple In, Multiple Out (MIMO)

Multiple In, Multiple Out (MIMO) is a major WLAN advancement introduced in the IEEE 802.11n standard in which multiple RF links are formed on the same channel between the transmitter and receiver simultaneously. To accomplish this, the transmitter separates a single data stream into multiple spatial streams, one for each RF chain (an antenna + various digital signal processing modules linked to the antenna). The transmit antennas at the end of each RF chain then transmit their spatial streams. The recipient's receive antennas obtain streams from all the transmit antennas. In fact, because of multipath, they receive multiple streams from each transmit antenna. The receive antennas pass the spatial streams to the digital signal processors in their RF chains, which take the best data from all the spatial streams and reassemble them into a single data stream once again (see Figure 3-10).

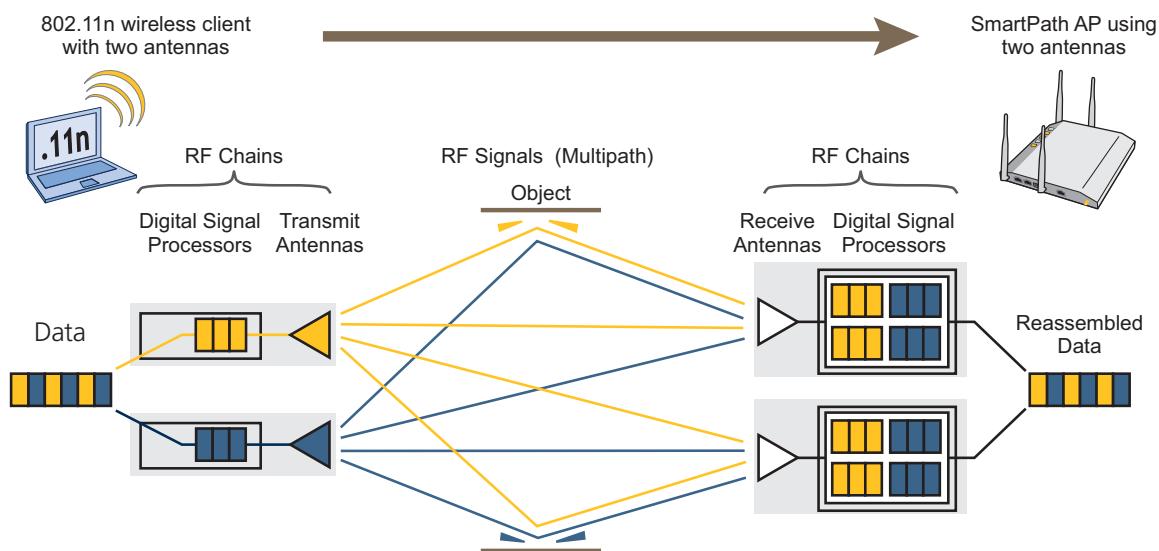


Figure 3-10. 2x2 MIMO (2 transmit antennas x 2 receive antennas).

Chapter 3: The SmartPath AP (LWN602HA) Overview

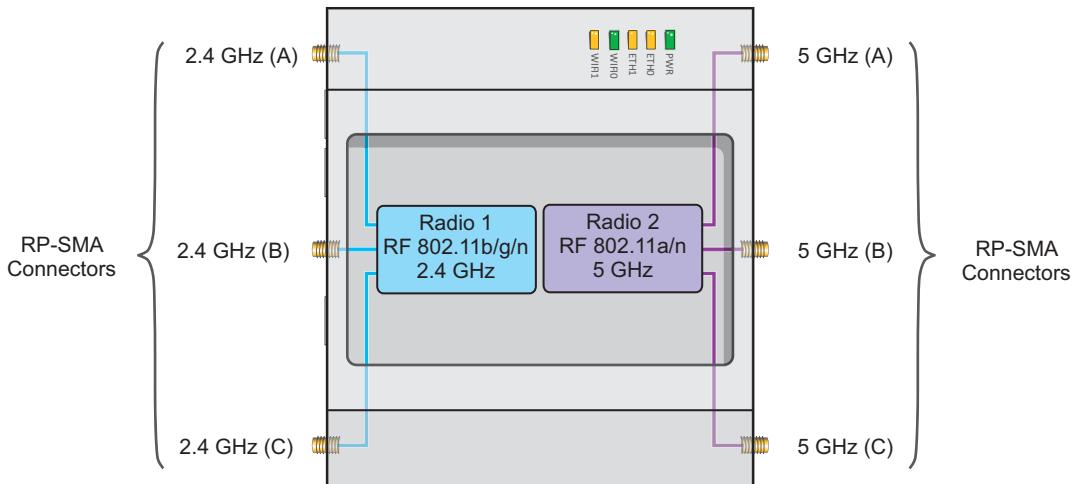
In previous 802.11 standards, access points and clients each used a single set of components, or RF chain, for transmitting or receiving. Although two antennas are often used for diversity, only the one with the best signal-to-noise ratio is used at any given moment, and that antenna makes use of the single RF chain while the other antenna remains inactive. A significant improvement that MIMO introduces is to permit each antenna to have its own RF chain and for all antennas to function simultaneously. For the SmartPath AP, you can connect up to three antennas per radio and configure the radio to use two or three transmit chains and two or three receive chains.* Using two or three transmit and receive chains simultaneously increases the amount of data that can flow across the WLAN and accelerates the processing of that data at each end of the wireless link.

*The convention for presenting the configuration of transmitting and receiving MIMO RF chains is TxR. For example, a SmartPath AP radio functioning in access mode might be configured to use two RF chains for transmitting and three for receiving. In that case, its configuration can be presented as "2x3." In general, the number of receive antennas is equal to or greater than the number of transmit antennas.

Another major aspect of MIMO is how it turns multipath signals from a curse to a boon. As a radio signal moves through space, some objects reflect it, others interfere with it, and still others absorb it. The receiver can end up receiving multiple copies of the original signal, all kind of muddled together. However, the digital signal processors in the multiple receive chains are able to combine their processing efforts to sort through all the received data and reconstruct the original message. Furthermore, because the transmitter makes use of multiple RF chains, there is an even richer supply of signals for the receive chains to use in their processing. To set the transmit and receive RF chains for a radio profile, enter the following commands:

```
radio profile <name> transmit-chain { 2 | 3 }  
radio profile <name> receive-chain { 2 | 3 }
```

There are two sets of antennas—three antennas per set—that operate concurrently in two different frequency ranges: 2.4 GHz (IEEE 802.11b/g/n) and 5 GHz (IEEE 802.11a/n). Using two different frequency ranges reduces the probability of interference that can occur when numerous channels operate within the same range. Conceptually, the relationship of antennas and radios is shown in Figure 3-11.



Cut-away view of the SmartPath AP to show the relationship of the antennas and the two internal radios

Figure 3-11. Antennas and radios.

The wifi0 interface links to radio 1 (frequency range = 2.4 GHz for IEEE 802.11b/g), and the wifi1 interface links to radio 2 (frequency range = 5 GHz for IEEE 802.11a). These interface-to-radio relationships are permanent.

When deciding how many antennas to use, consider the types of wireless clients—802.11n only, 802.11g/n, 802.11b/g/n, or 802.11a/n—the area needing coverage, and the RF environment.

3.4.2 Using MIMO with Legacy Clients

In addition to supporting up to 300-Mbps throughput per radio for 802.11n clients, MIMO can improve the reliability and speed of legacy 802.11a/b/g client traffic. When an 802.11a/b/g access point does not receive acknowledgement that a frame it sent was received, it resends that frame, possibly at a somewhat lower transmission rate. If the access point must continue resending frames, it will continue lowering its transmission rate. As a result, clients that could get 54-Mbps throughput in an interference-free environment might have to drop to 48- or 36-Mbps speeds because of multipath interface. However, because MIMO technology makes better use of multipath, an access point using MIMO can continue transmitting at 54 Mbps, or at least at a better rate than it would in a pure 802.11a/b/g environment, thus improving the reliability and speed of 802.11a/b/g client traffic.

Although 802.11a/b/g client traffic can benefit somewhat from an 802.11n access point using MIMO, supporting such legacy clients along with 802.11n clients can have a negative impact on 802.11n client traffic. Legacy clients take longer to send the same amount of data as 802.11n clients. Consequently, legacy clients consume more airtime than 802.11n clients do, causing greater congestion in the WLAN and reducing 802.11n performance.

By default, the SmartPath AP supports 802.11a/b/g clients. You can restrict access only to clients using the IEEE 802.11n standard. By only allowing traffic from clients using 802.11n, you can increase the overall bandwidth capacity of the access point so that there will not be an impact on 802.11n clients during times of network congestion. To do that, enter the following command:

```
radio profile <string> 11n-clients-only
```

You can also deny access just to clients using the IEEE 802.11b standard, which has the slowest data rates of the three legacy standards, while continuing to support 802.11a and 802.11g clients. To do that, enter the following command:

```
no radio profile <string> allow-11b-clients
```

By blocking access to 802.11b clients, their slower data rates cannot clog the WLAN when the amount of wireless traffic increases.

3.5 Mounting the SmartPath AP (LWN602HA)

Using the mounting plate and track clips, you can mount the SmartPath AP to the tracks of a dropped ceiling grid. Using just the mounting plate, you can mount the SmartPath AP to any surface that can support its weight (3.3 lb., 1.5 kg).

This document covers the following methods for mounting the SmartPath AP (LWN602HA):

- Section 3.5.1, Ceiling Mount—Using the mounting plate and track clips, you can mount the SmartPath AP to the tracks of a dropped ceiling grid so that it is suspended upside down against the ceiling.
- Section 3.5.2, Plenum Mount—Using the mounting plate, hanger clip, and hanger frame, you can mount it in the plenum above a dropped ceiling.
- Section 3.5.3, Suspended Mount—Using the mounting plate, cable, quad-toggle, and locking device, you can suspend the device from a beam, bracket, or any object that can support its weight (3.3 lb. [1.5 kg]).
- Section 3.5.4, Surface Mount—Using just the mounting plate and some screws or nails, you can mount the SmartPath AP directly to any surface that can support its weight.

NOTE: In addition to these methods, you can also mount the SmartPath AP on a table using the set of four rubber feet that ship with the product. Simply peel the rubber feet off the adhesive sheet and press them against the underside of the SmartPath AP in its four corners.

3.5.1 Ceiling Mount

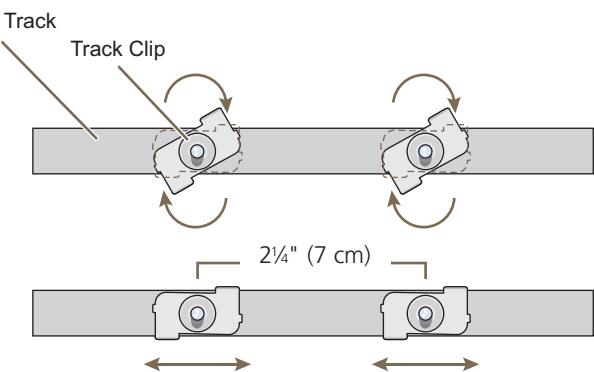
To mount the SmartPath AP to a standard 1"-wide track in a dropped ceiling, you need the mounting plate, two track clips, and two Keps nuts that ship with the SmartPath AP. You also need a drill, a wrench, and—most likely—a ladder. Nudge the ceiling tiles slightly away from the track to clear some space. Attach the track clips to the ceiling track, and then fasten the mounting plate to the clips, as shown in Figure 3-12. When you have the mounting plate in the correct location, cut or drill a hole in the ceiling. Use it to pass through the Ethernet and power cables.

Chapter 3: The SmartPath AP (LWN602HA) Overview

Worm's eye view with ceiling tiles removed for clarity.

- 1 Press the track clips against the ceiling track and swivel them until they snap into place, gripping the edges of the track.

If necessary, slide one or both of the clips along the track to position them at the proper distance $2\frac{1}{4}$ " or 7 cm to fit through the holes in the mounting plate.



- 2 Insert the mounting plate over the screws attached to the track clips, and use the Keps nuts to fasten the plate firmly to the screws on the clips.

Use a wrench to tighten the nuts firmly to the bolts and secure the plate to the track.

- 3 Through the oblong opening in the plate, drill a hole in the ceiling tile (not shown). Then pass one or both Ethernet cables through the hole, and if you plan to supply power from an AC power source rather than through PoE, pass the power cable through as well.

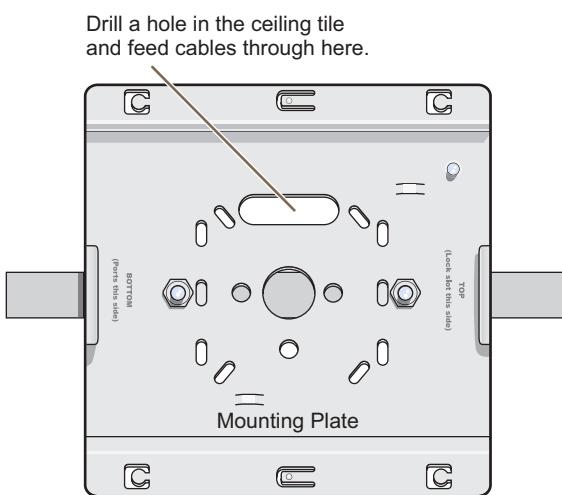


Figure 3-12. Attaching the track clips and mounting plate to the ceiling track.

Attach the SmartPath AP to the mounting plate and connect the cables, as shown in Figure 3-13.

NOTE: You can tie the cables to the tie points (small arched strips) on the mounting plate to prevent them from being pulled out of their connections accidentally.

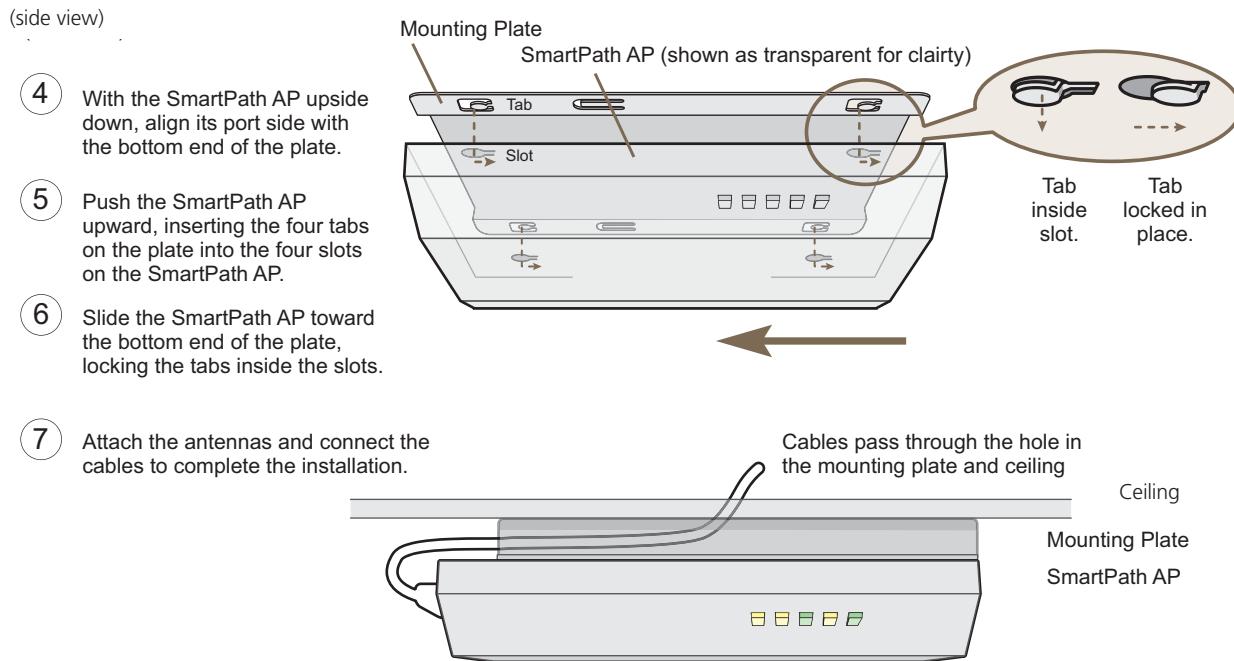


Figure 3-13. Attaching the SmartPath AP to the mounting plate and connecting cables.

When done, adjust the ceiling tiles back into their former position.

Locking the SmartPath AP (LWN602HA)

To lock the SmartPath AP to the mounting plate, use either a Kensington lock or the lock adapter that is included with the mounting kit and a small padlock (not included).

To use a Kensington lock, loop the cable attached to the lock around a secure object, insert the T-bar component of the lock into the device lock slot on the SmartPath AP, and then turn the key to engage the lock mechanism.

To use the lock adapter:

1. Insert the T-shaped extension on the adapter into the device lock slot, and rotate it clockwise so that the curved section extends through the slot in the mounting plate (see Figure 3-14).

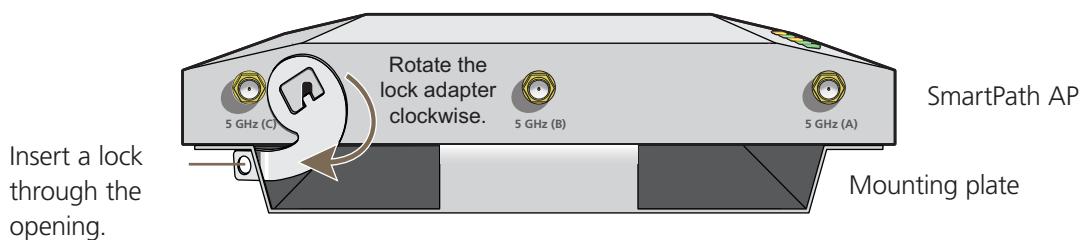


Figure 3-14. Locking the SmartPath AP to the mounting plate.

2. Link a padlock through the opening in the adapter and engage the lock to secure the SmartPath AP to the mounting plate. The opening is $\frac{1}{8}$ " (0.3 cm) in diameter at its narrowest.

3.5.2 Plenum Mount

To mount the SmartPath AP in the plenum space above a dropped ceiling grid, you need the mounting plate, hanger clip, and a standard 24"-wide hanger frame, which can be ordered separately (call Black Box Technical Support at 724-746-5500 for details).

1. With the recessed side of the mounting plate facing downward, insert the hanger clip through the large hole in the center of the plate.
2. Squeeze the clip until the projecting tabs at the ends of its two feet snap into the smaller holes on both sides of the larger hole (see Figure 3-15).

Insert the hanger clip through the large hole in the mounting plate.

Squeeze the hanger clip to pull the tabs on its feet inward until they snap upward into the two holes on either side of the larger hole.

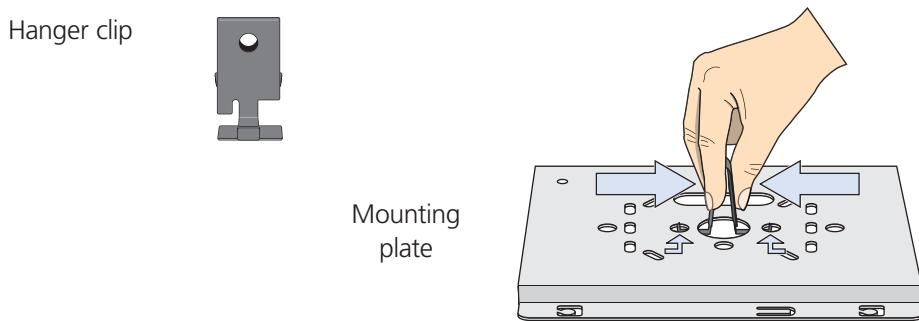


Figure 3-15. Fitting the hanger clip to the mounting plate.

3. Attach the SmartPath AP to the mounting plate, and then attach the antennas to the connectors (see Figure 3-16).

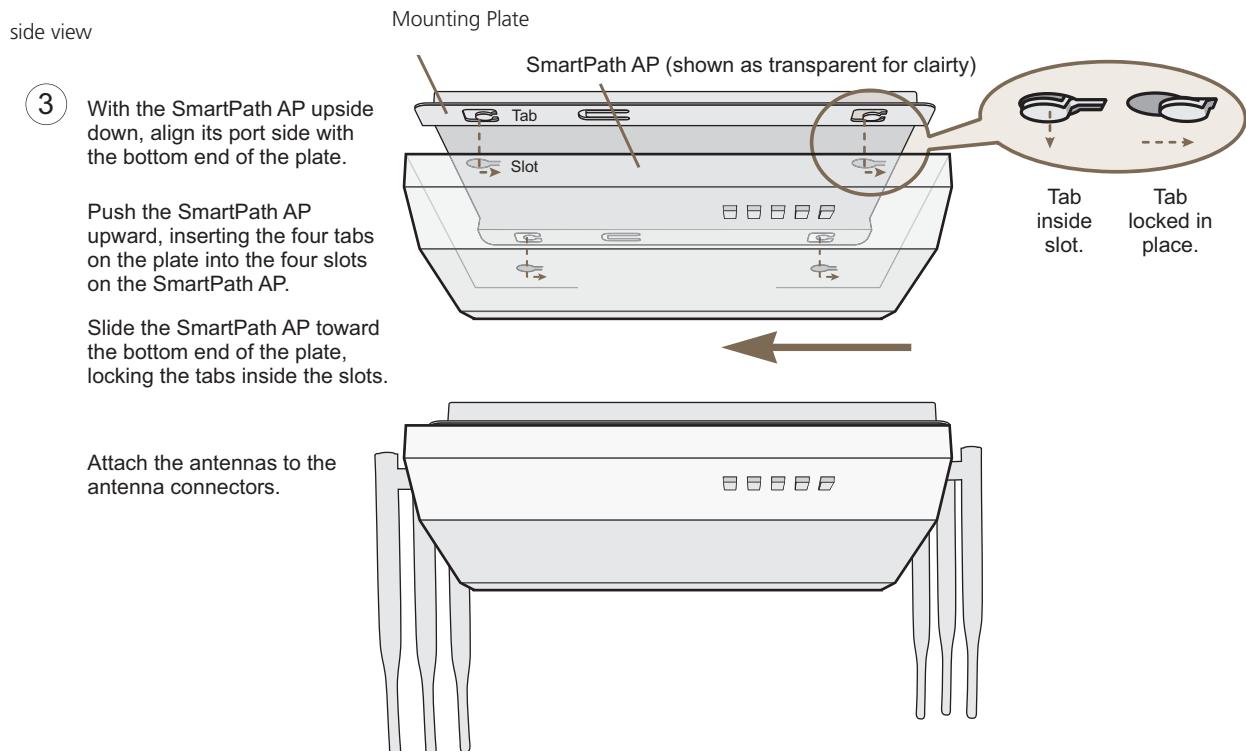


Figure 3-16. Attaching the SmartPath AP to the mounting plate.

4. Remove the ceiling tile next to the area where you want to mount the device.
5. Press the hanger frame downward into place on the ceiling track until the claws on each leg grips the track below the top ridge (see Figure 3-17).

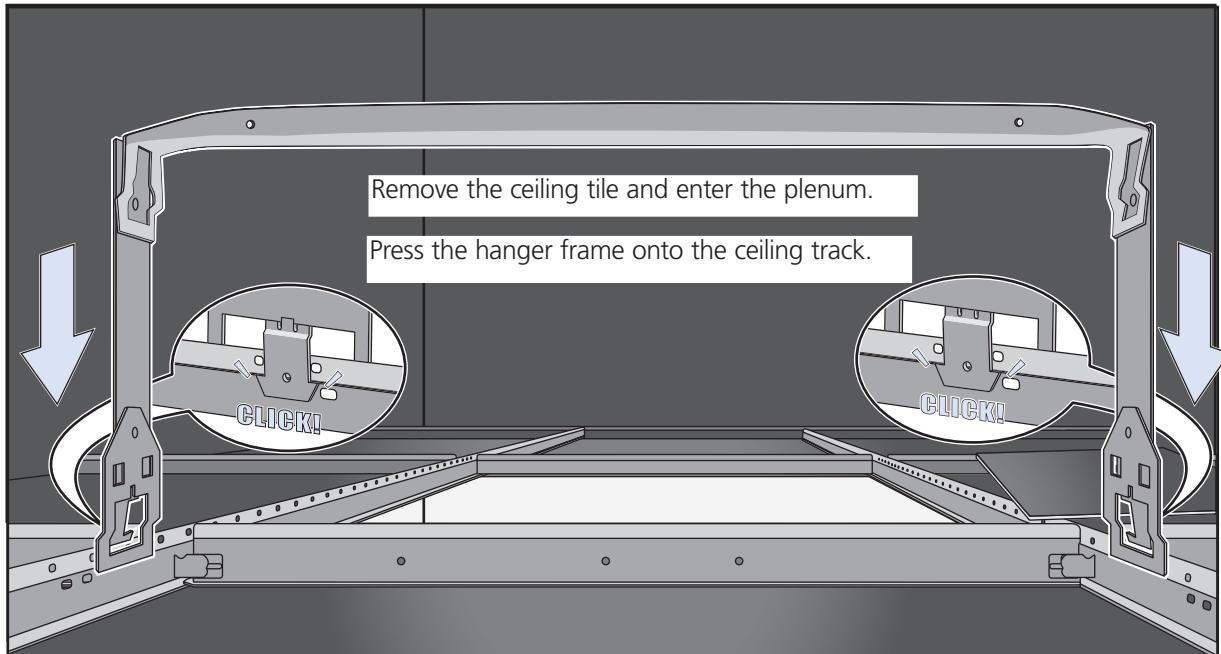


Figure 3-17. Clipping the hanger frame onto the track.

6. Insert the hanger clip upward through the center slot in the hanger frame, and then twist it counterclockwise until the clip snaps into a locked position against the sides of the crossbar (see Figure 3-18).

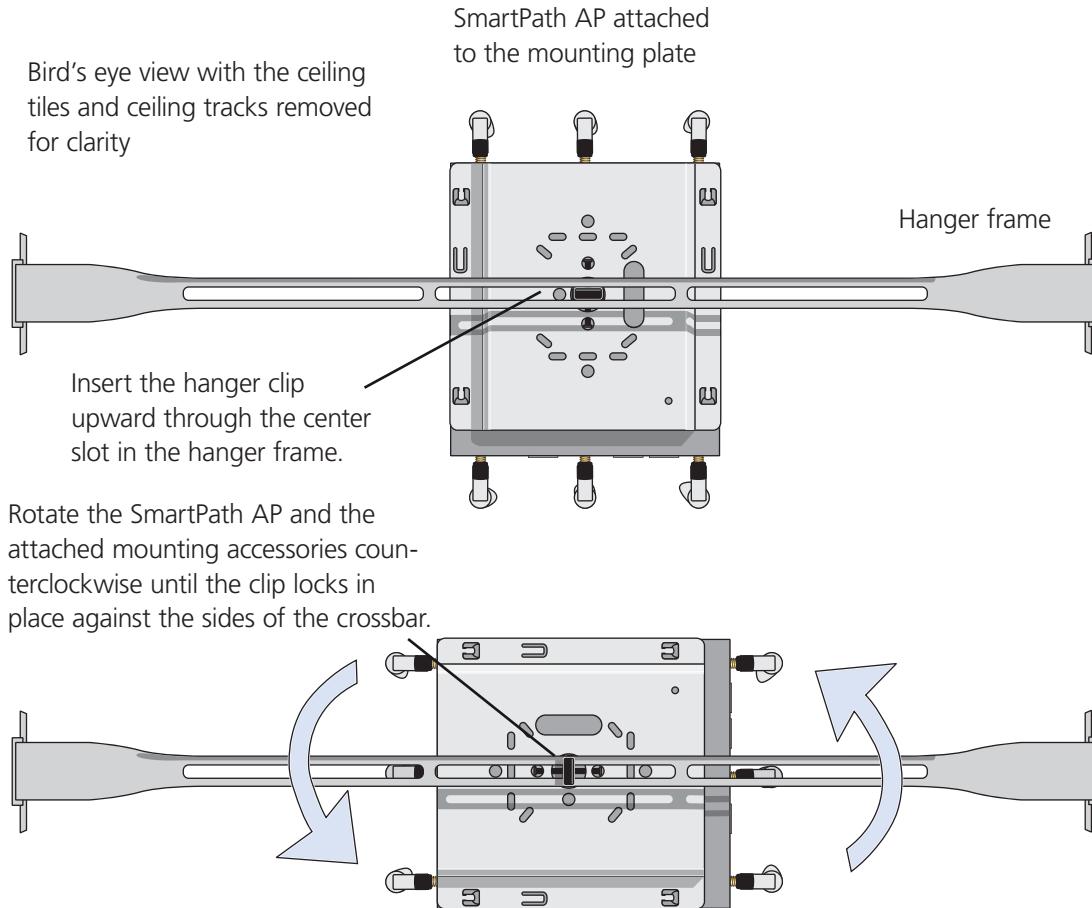


Figure 3-18. Securing the SmartPath AP to the hanger frame.

7. Connect one or two Ethernet cables to the network, and—if not using PoE—connect the power cord to a power source.
8. Replace the ceiling tile to complete the installation.

3.5.3 Suspended Mount

You can suspend the SmartPath AP from a horizontal beam, post, strut, or girder. As well as the mounting plate, you need a quad-toggle, a 1.5 mm (0.059 inch) wire rope with hook, and a locking device. ERICO® supplies these items in its CADDY® SPEED LINK product line. The part number for the quad-toggle is SLD15QT250 and that for the set that includes the wire rope, hook, and locking device is SLD15L2T. These items are available through various suppliers.

1. With the recessed side of the mounting plate facing downward, insert the four ends of the quad-toggle through holes in the mounting plate.
2. Turn the SmartPath AP face down and attach it to the mounting plate (see Figure 3-19).

To secure each of the four strands to the mounting plate:

1. Insert the metal cleat at the end of a strand through a hole in the plate.
2. Sliding the oblong washer along the strand; pass it through the hole.
3. Pull the strand upward to lock the cleat and washer against the underside of the plate.

To attach the SmartPath AP to the mounting plate:

1. Align the tabs on the plate with the wider, circular section of the keyhole shaped slots on the underside of the device, which is face down as shown.

- Push the tabs into the slots and slide the SmartPath AP toward its port panel. This repositions the tabs in the narrower, rectangular section of the slots and holds the device firmly in place below the mounting plate.

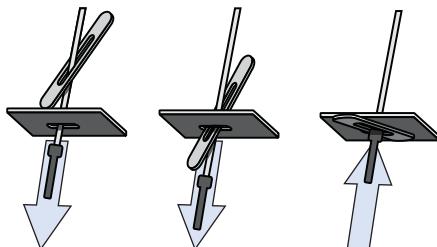
Mounting Plate

The recommended holes for the four strands are shaded in.

1

To secure each of the four strands to the mounting plate:

- Insert the metal cleat at the end of a strand through a hole in the plate.
- Sliding the oblong washer along the strand, pass it through the hole.
- Pull the strand upward to lock the cleat and washer against the underside of the plate.



2

To attach the SmartPath AP to the mounting plate:

- Align the tabs on the plate with the wider, circular section of the keyhole-shaped slots on the underside of the device, which is face down as shown.
- Push the tabs into the slots and slide the SmartPath AP toward its port panel. This repositions the tabs in the narrower, rectangular section of the slots and holds the device firmly in place below the mounting plate.

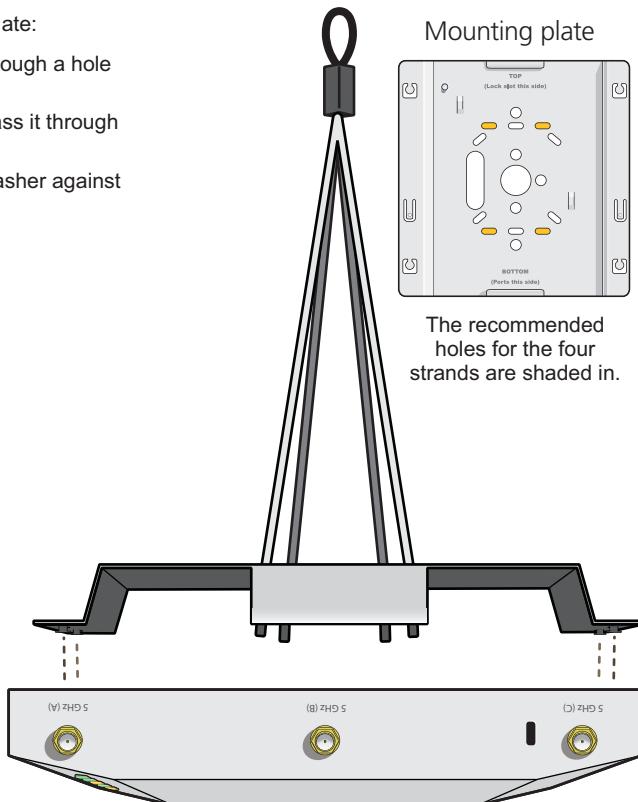


Figure 3-19. Connecting the quad-toggle and SmartPath AP to the mounting plate.

- Draw the wire rope over a support beam, fasten the hook around the wire, and pull the wire until the hook is snug against the underside of the beam.
- Push the plain end of the wire rope—the end without the hook—through the side hole in the locking device in the direction indicated by the arrow on its side, and then pass it through the loop at the end of the quad-toggle.
- Insert the wire rope back through the center hole in the locking device, and then continue pulling it through the locking device until the SmartPath AP is suspended at the height you want (see Figure 3-20).

The center tube that runs through the locking device is designed to allow you to pull the rope wire up through it while preventing the rope from slipping back down. If you ever pull too much rope through and need to pull it back down, use a tool such as a screwdriver to press against the inner tube in the locking device to release the rope. Then you can pull it back out (see “Height Correction,” next page).

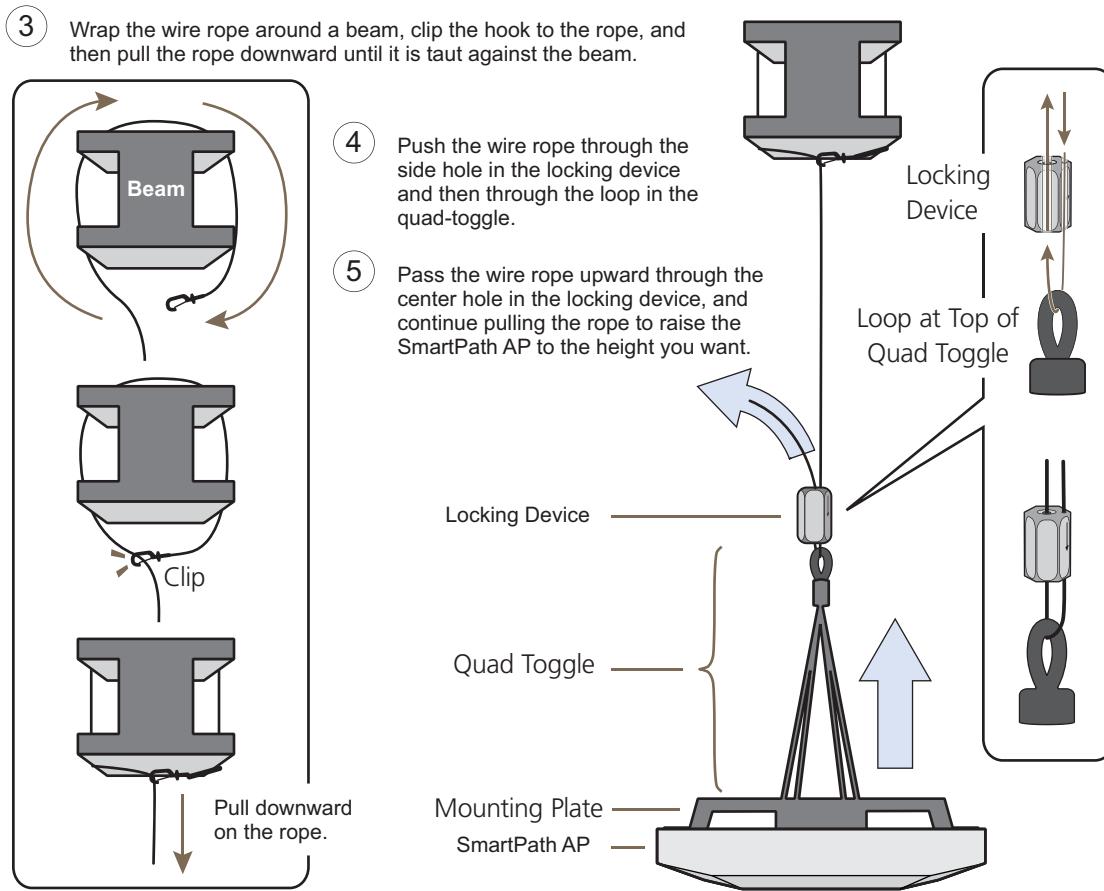


Figure 3-20. Suspending the SmartPath AP.

6. Attach antennas to the antenna connectors on the SmartPath AP, connect one or two Ethernet cables to the network, and—if not using PoE—connect the power cord to a power source.

Height Correction

If you accidentally pull too much wire rope through the locking device, raising the SmartPath AP too high, and you then need to lower it, do the following: Take a tool, such as a screwdriver with a $\frac{1}{8}$ " flat tip, and press it against the lip of the inner tube in the opposite direction from the arrow on the outside of the locking device (see Figure 3-21). This releases its grip on the rope, enabling you to pull out the rope the same way it was inserted. While maintaining pressure on the tube, adjust the rope until the SmartPath AP is at the height you want. When you are satisfied, stop pressing against the tube so that it can regain its grip on the rope.

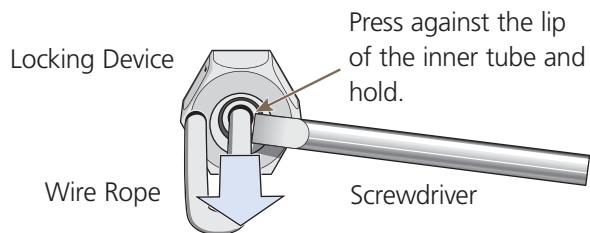


Figure 3-21. Releasing the wire rope from the locking device.

3.5.4 Surface Mount

You can use the mounting plate to attach the SmartPath AP to any surface that supports its weight, and to which you can screw or nail the plate. First, mount the plate to the surface. Then, through one of the two large openings in the plate, make a hole in the wall so that you can pass the cables through to the SmartPath AP.

NOTE: You can tie the cables to the tie points on the mounting plate to prevent them from being pulled out of their connections accidentally.

Finally, attach the device to the plate, and connect the cables, as shown in Figure 3-22.

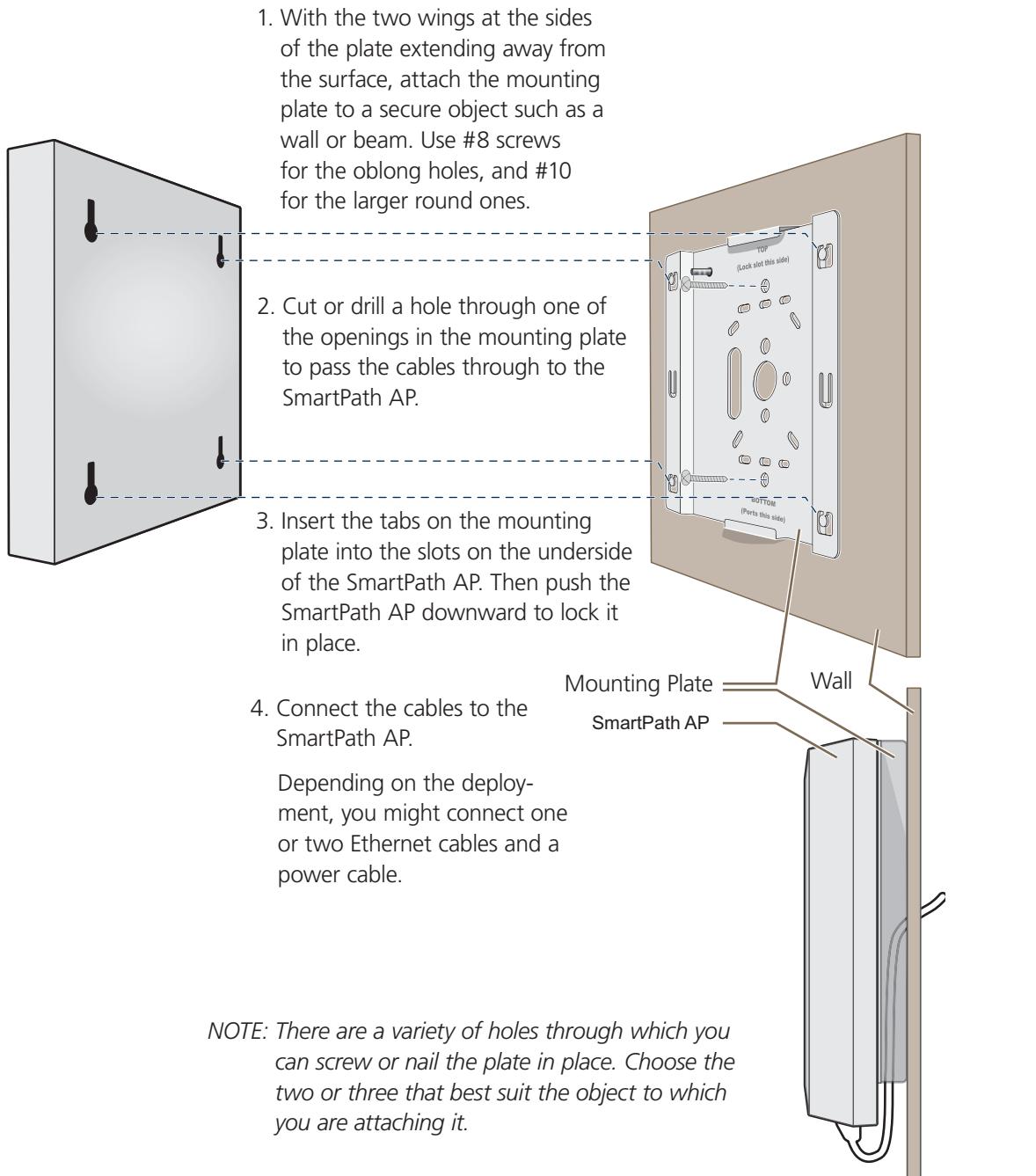


Figure 3-22. Mounting the SmartPath AP on a wall.

3.6 Device, Power, and Environmental Specifications

Understanding the range of specifications for the SmartPath AP is necessary for optimal deployment and device operation. The following specifications describe the physical features and hardware components, the power adapter and PoE electrical requirements, and the temperature and humidity ranges in which the device can operate.

Device Specifications

- Chassis dimensions: 8.5" W x 1.25" H x 8" D (21.5 x 3.2 x 20.3 cm)
- Weight: 3 lb. (1.36 kg)
- Antennas: Three omnidirectional 802.11b/g/n antennas, and three omnidirectional 802.11a/n antennas
- Serial port: RJ-45 (bits per second: 9600, data bits: 8, parity: none, stop bits: 1, flow control: none)
- Ethernet ports: autosensing 10/100/1000 Mbps; both ports are compliant with the IEEE 802.3af standard and the forthcoming 802.3at standard for PoE (Power over Ethernet)

Power Specifications

- AC/DC power adapter:
- Input: 100–240 VAC
- Output: 48 V/0.625 A
- PoE nominal input voltages:
 - 802.3af: 48 V/0.35 A
 - Pre-802.3at: 48 V/0.625 A
- RJ-45 power input pins: Wires 4, 5, 7, 8 or 1, 2, 3, 6

Environmental Specifications

- Operating temperature: -4 to +131° F (-20 to +55° C)
- Storage temperature: -40 to +176° F (-40 to +80° C)
- Relative Humidity: Maximum 95%

4. SmartPath AP (LWN602A) Overview

The SmartPath AP LWN602A is a high-performance wireless access point suitable for small offices, mobile employees, and tele-commuters. The SmartPath AP has two radios—one for 802.11a/n and one for 802.11b/g/n, both of which can operate concurrently. Both platforms provide 2x2 MIMO and a single 10/100/1000 Ethernet port through which they can be powered using PoE that follows the IEEE 802.3af standard or the 802.3at pre-standard. Optionally, they can be powered by an AC/DC desktop power adapter.

NOTE: SmartPath AP (LWN602A) devices support 802.11n features. Of particular interest is their support of 2x2 MIMO. For more information, see Section 3.4.1, MIMO and Section 3.4.2, Using MIMO with Legacy Clients.

4.1 Hardware Description

The SmartPath AP (LWN602A) is a multichannel wireless access point. It contains a dual-band radio that can operate at either 2.4 GHz or 5 GHz—but not in both bands simultaneously. The SmartPath AP contains a 2.4-GHz radio and a 5-GHz radio that can operate concurrently through four internal antennas. The SmartPath AP supports a variety of Wi-Fi security protocols, including WPA, and WPA2.

You can see the hardware components on the SmartPath AP in Figure 4-1. Each component is described in Table 4-1.

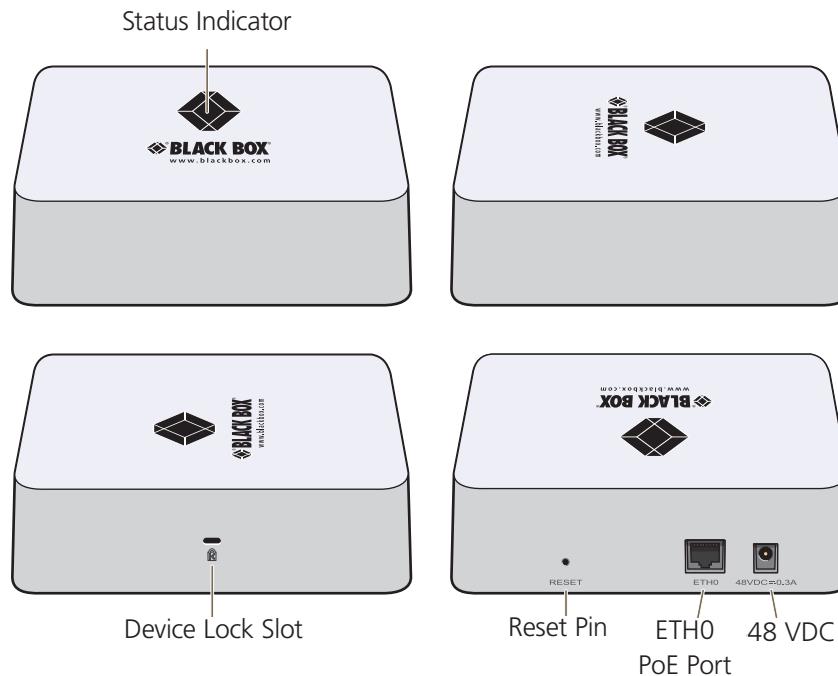


Figure 4-1. SmartPath LWN602A hardware components.

Chapter 4: The SmartPath AP (LWN602A) Overview

Table 4-1. SmartPath AP component descriptions.

Component	Description
Status Indicator	The status indicator conveys operational states for system power, firmware updates, Ethernet and wireless interface activity, and major alarms. For details, see Section 4.3, Status Indicator.
Device Lock Slot	You can physically secure the SmartPath AP by attaching a Kensington lock and cable to the device lock slot. For more information, see Locking the SmartPath AP in Section 4.5.1, Ceiling Mount.
Reset Button	<p>The reset button allows you to reboot the device or reset the SmartPath AP to its factory default settings. Insert a paper clip, or something similar, into the Reset pinhole and press the reset button. To reboot the device, hold the button down between 1 and 5 seconds. To return the configuration to the factory default settings, hold it down for at least 5 seconds. After releasing the button, the status indicator goes dark as the system reboots. Then it glows blue while the device boots and the system performs a self-test. After the firmware finishes loading and the SmartPath AP is ready to serve clients, the status indicator glows white.</p> <p>To disable the reset button from resetting the configuration, enter this command: no reset-button reset-configurable. Pressing the button between 1 and 5 seconds will still reboot the SmartPath AP, but pressing it for more than 5 seconds will not reset its configuration.</p>
ETH0 PoE Port	<p>The 10-/100-/1000-Mbps Ethernet port—ETH0—receives an RJ-45 connector. The SmartPath AP can receive power through an Ethernet connection to the ETH0 port from power sourcing equipment (PSE) that is compatible with the 802.3af standard and the forthcoming 802.3at standard. Black Box provides suitable PoE injectors as an optional accessory. (If you connect the SmartPath AP to a power source through the power connector and the ETH0 PoE port simultaneously, the device draws power through the power connector and automatically disables PoE.)</p> <p>The ETH0 port is compatible with 10/100/1000BASE-T/TX and automatically negotiates half- and full-duplex connections with the connecting device. It is autosensing and adjusts to straight-through and cross-over Ethernet cables automatically. For details, see Section 4.2, Ethernet Port.</p>
48-VDC Power Connector	The 48-volt DC power connector (0.3 amps), with a voltage range of 36 to 57 volts DC, is one of two methods through which you can power the SmartPath AP (the other is PoE). To connect it to a 100 – 240-volt AC power source, use the AC/DC power adapter that is available as an extra accessory. Because the SmartPath AP does not have an on/off switch, connecting it to a power source automatically powers on the device.

4.2 Ethernet Port

The pin assignments in the PoE 10/100/1000BASE-T/TX Ethernet port follow the TIA/EIA-568-B standard (see Figure 3-3 and Table 3-2). The port accepts standard types of Ethernet cable—CAT3, CAT5, CAT5e, or CAT6—and can receive power over the Ethernet cable from PSE that is 802.3af compatible. If you use CAT5, CAT5e, or CAT6 cables, the ETH0 port can also support 802.3at-compliant PSE. Such equipment can be embedded in a switch or router, or it can come from purpose-built devices that inject power into the Ethernet line en route to the SmartPath AP. Because the PoE port has autosensing capabilities, the wiring termination in the Ethernet cable can be either straight-through or cross-over.

4.3 Status Indicator

The status indicator has been incorporated into the Black Box logo on the top of the SmartPath AP LWN602A. It is illuminated by various colors to indicate different states of activity. The meanings of the colors are as follows:

- Dark: There is no power or the status indicator is disabled.
- Blue: solid: The device is booting up or there is no backhaul link; flashing: the device is shutting down.
- Green: The default route is through the backhaul Ethernet interface, but not all conditions for normal operations (white) have been met.

- Yellow: The default route is through a backhaul Wi-Fi interface, but not all conditions for normal operations (white) have been met.
- White: The device is powered on and the firmware is operating normally; that is, a wireless interface in access mode is up, a wired or wireless backhaul link is up, and the SmartPath AP has a CAPWAP connection to either SmartPath EMS VMA or a management AP.
- Purple: A new image is being loaded from SmartPath EMS VMA or a management AP.
- Orange: An alarm indicating a firmware or hardware issue has occurred.

For locations where the status indicator might be a distraction or attract unwanted attention, you can adjust its brightness level from bright (the default) to soft to dim. You can even turn it off completely. In SmartPath EMS VMA, choose the brightness level that you want from the LED Brightness drop-down list on the Configuration > Management Services > Management Options page. Through the CLI, enter [no] system led brightness { soft | dim | off }. The four settings are represented graphically in Figure 4-2.

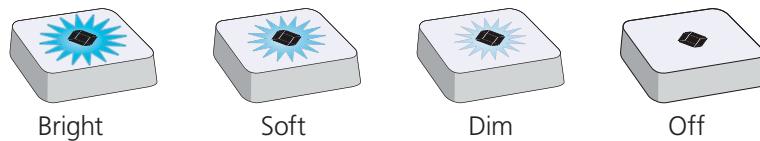


Figure 4-2. Adjustable status indicator brightness levels.

4.4 Antennas

Antennas are an integral part of the SmartPath AP (LWN602A). The SmartPath AP LWN602A has four internal single-band antennas. Two of the antennas operate in the 2.4-GHz band (IEEE 802.11b/g/n) and have a 0-dBi gain. The other two antennas operate in the 5-GHz band (IEEE 802.11a/n) and have a 3-dBi gain. All antennas are omnidirectional, providing fairly equal coverage in all directions in a cardioid (heart-shaped) pattern around each antenna (see Figure 2-1).

On the SmartPath AP LWN602A, the two 2.4-GHz antennas link to one radio, and the two 5-GHz antennas link to the other radio, both of which can operate concurrently. The relationship of antennas and radios is shown in Figure 4-3.

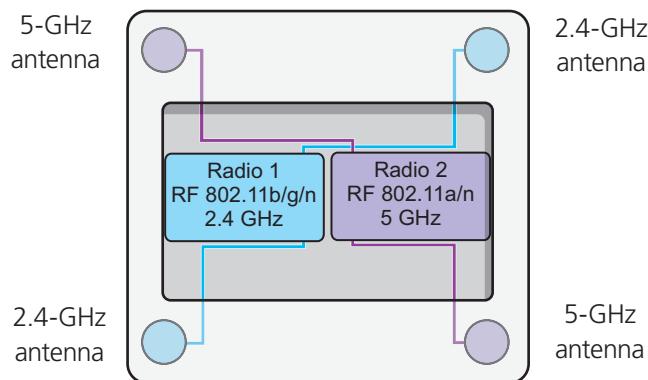


Figure 4-3. Cut-away view of the SmartPath AP (LWN602A) showing the relationship of the internal antennas and radios.

4.5 Mounting a SmartPath AP (LWN602A)

Using one of the track clips included in the box with the SmartPath AP, you can mount it to a track in a dropped ceiling grid. To mount the SmartPath AP to any flat surface that can support its weight (1.75 lb., 0.8 kg), use two #6 or #8 screws to mount it on a wall and three screws to mount it on a ceiling.

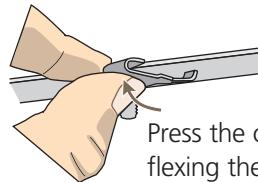
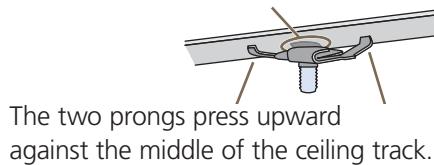
NOTE: In addition to these methods, you can also mount the SmartPath AP on a table using the set of four rubber feet that ship with the product. Simply peel the rubber feet off the adhesive sheet and press them against the underside of the SmartPath AP in its four corners.

4.5.1 Ceiling Mount

To mount a SmartPath AP series device to a track in a dropped ceiling, use the appropriate track clip for the width of the ceiling track. Two clips come with the SmartPath AP: one for 1" (2.54 cm) tracks and one for 1/2" (1.27 cm) tracks.

1. Nudge the ceiling tiles slightly away from the track to clear some space and slide one tab of the track clip over the edge of the track.
2. With the tips of the track clip prongs positioned against the middle of the track, press upward on the other tab until it clears the track edge, as shown in Figure 4-4. Keeping the prongs away from the track edges until both tabs grip the track ensures that the clip does not snap into place prematurely with only one tab in position.

Position the clip so one tab is over the edge of the ceiling track. (The ceiling track is shown as transparent to expose the tab above the track.)



Press the other tab upward, flexing the prongs against the track until the tab clears the edge of the track.

Figure 4-4. Attaching the track clip to the ceiling track.

3. Twist the track clip until it snaps onto the ceiling track, as shown in Figure 4-5. You can then slide the clip along the track to reposition it if necessary.

Worm's eye view with ceiling tiles removed for clarity

Twist the clip until the prongs snap into place and grip the edges of the track.

If necessary, slide the clip along the track to position it exactly where you want it to be.

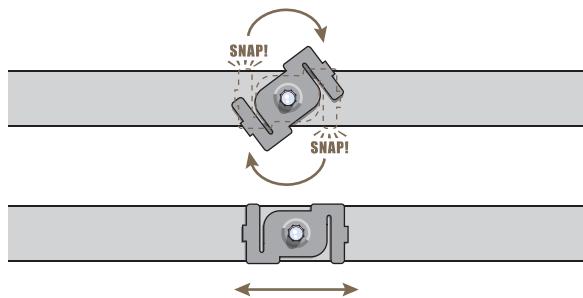


Figure 4-5. Securing the clip to the track and repositioning it if necessary.

4. Holding the SmartPath AP upside down, raise it until the threaded stud on the track clip enters the hole on the SmartPath AP. Then rotate the SmartPath AP until it is firmly attached to the clip (see Figure 4-6).

With the SmartPath AP upside down, lift it until the threaded stud on the track clip enters the hole in the SmartPath AP. Rotate the SmartPath AP until it is securely attached to the clip.

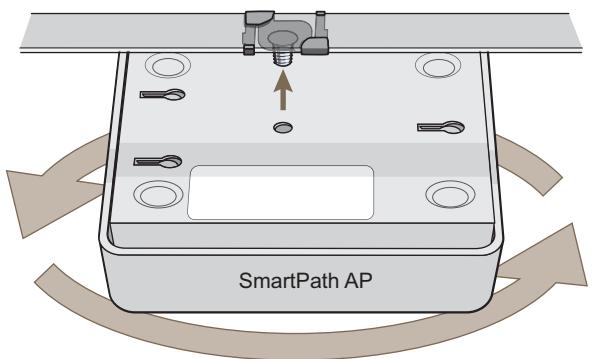


Figure 4-6. Attaching the SmartPath AP to the track clip.

- When you have the SmartPath AP in the correct location, cut or drill a hole in the ceiling through which you can then pass the Ethernet and power cables. Pass the cables through the hole and attach them to the SmartPath AP.
- When done, adjust the ceiling tiles back into their former position.

NOTE: You can also mount the SmartPath AP to a solid ceiling—or the underside of any horizontal object such as a cross beam—using three #6 or #8 screws. Position the three screws in a T-shaped layout: two screws 2" (5 cm) apart from each other and the third screw center-aligned between them and 4.75" (12 cm) away. Then attach the SmartPath AP to the screws as explained in Section 4.5.2, Surface Mount.

Locking the SmartPath AP

To lock the SmartPath AP to a secure object, use a Kensington lock and cable. Loop the cable around a securely anchored object, insert the Kensington lock in the device lock slot in the SmartPath AP, and engage the locking mechanism (Figure 4-7).

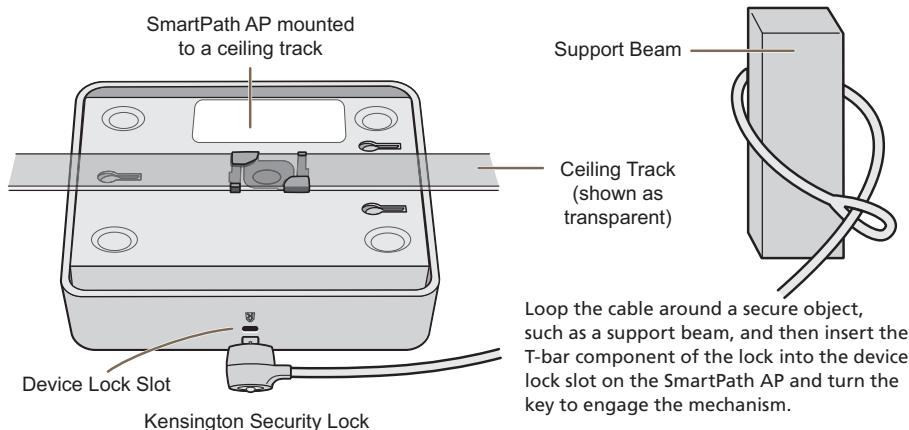


Figure 4-7. Locking the SmartPath AP with a Kensington security lock.

4.5.2 Surface Mount

You can attach the SmartPath AP LWN602A to any flat surface that supports its weight. First, attach two screws to the surface. Then, make a hole in the wall a few inches or centimeters above the screws so that you can pass the cables through the wall to the SmartPath AP. Finally, attach the device to the screws, and connect the cables (see Figure 4-8).

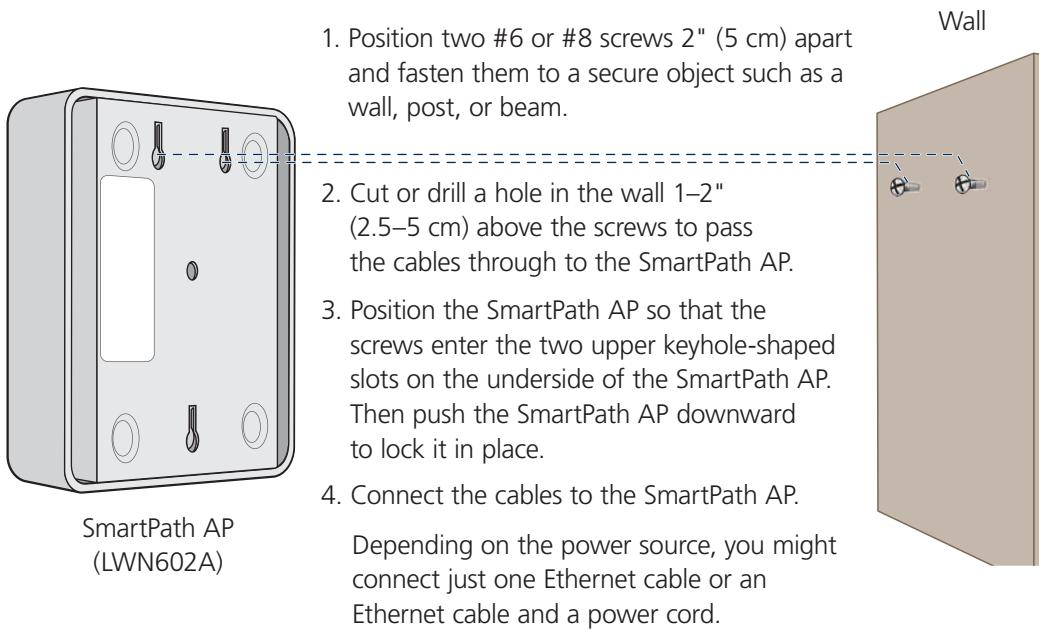


Figure 4-8. Mounting the SmartPath AP on a wall.

Instead of passing the cables through a hole in the wall, you can also simply run them along the wall from the port side of the SmartPath AP, which is located at the top of the device when it is mounted on a wall.

NOTE: You can use a Kensington lock to secure the SmartPath AP to a stationary object. For information, see "Locking the SmartPath AP" in Section 4.5.1.

4.6 Device, Power, and Environmental Specifications

Understanding the specifications for the SmartPath AP LWN602A is necessary for optimal deployment and device operation. The following specifications describe the physical features and hardware components, the power adapter and PoE (Power over Ethernet) electrical requirements, and the temperature and humidity ranges in which the device can operate.

Device Specifications

- Chassis dimensions: 6.5" W x 2" H x 6.5" D (16.3 cm W x 4.6 cm H x 16.3 cm D)
- Weight: 1.75 lb. (0.8 kg)
- Antennas: SmartPath AP (LWN602A): two omnidirectional 802.11b/g/n antennas, and two omnidirectional 802.11a/n antennas
- Ethernet port: one autosensing 10/100/1000 Base-T/TX Mbps port; compliant with the IEEE 802.3af standard and the 802.3at standard for PoE (Power over Ethernet)

Power Specifications

- DC Input: 36 - 57VDC (48 V/0.3A)
- PoE input:
 - 802.3af
 - Pre-802.3at
- RJ-45 power input pins: Wires 4, 5, 7, 8 or 1, 2, 3, 6

Environmental Specifications

- Operating temperature: +32 to +104 degrees F (0 to +40 degrees C)
- Storage temperature: -40 to +185 degrees F (-40 to +85 degrees C)
- Relative Humidity: Maximum 95% noncondensing

5. The SmartPath EMS

The SmartPath Enterprise Management System (EMS), available as a cloud-based service (LWN600CM-1 or LWN600CM-3) or as a virtual management appliance (VMA) (LWN600VMA), is a GUI for centrally configuring and monitoring the APs as well as setting security and guest log-in parameters.

- Simplified installations and management of up to 2000 SmartPath APs
- Profile-based configurations that simplify the deployment of large numbers of SmartPath APs
- Scheduled firmware upgrades on SmartPath APs by location
- Exportation of detailed information on SmartPath APs for reporting

Server Requirements

Minimum Hardware:

Processor: Dual-core 2 GHz or better

Memory: 2 GB dedicated to SmartPath EMS Virtual Appliance, at least 1 GB for the computer hosting it

Disk: 60 GB dedicated to SmartPath EMS Virtual Appliance

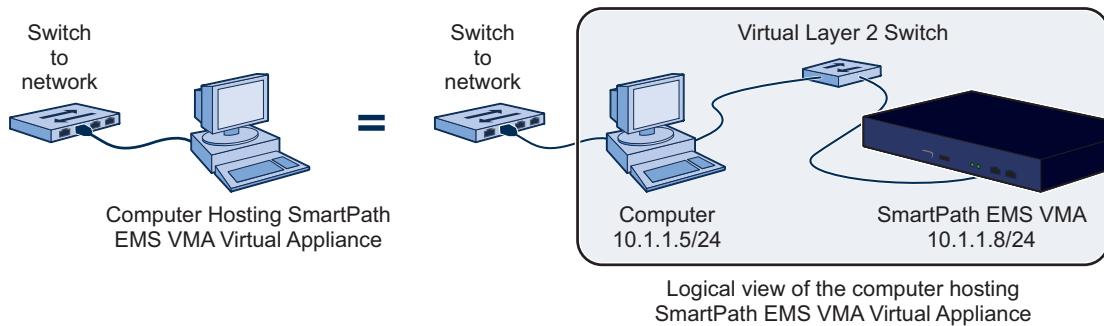


Figure 5-1. Typical application.

6. SmartPath EMS VMA On-line (Cloud-Based Service)

In addition to a SmartPath EMS VMA, the SmartPath EMS VMA network management system is available in one other form. SmartPath EMS Online is a cloud-based service running on hardware hosted and maintained by Black Box (see Figure 6-1). This management system provides cost-effective alternatives for managing WLAN networks that might not require the investment of a physical appliance.

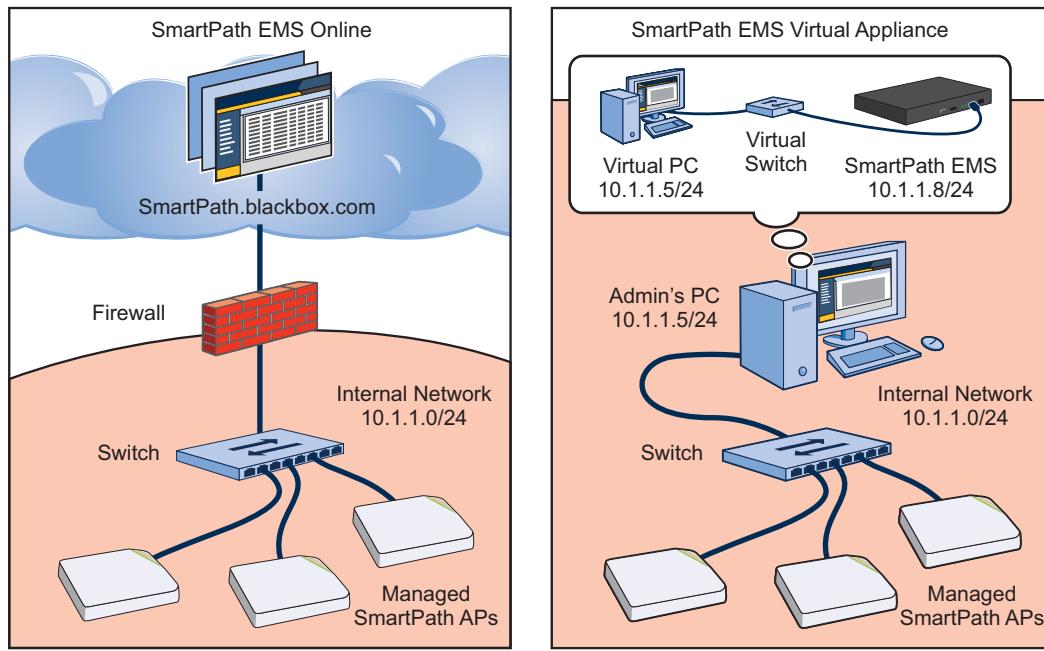


Figure 6-1. SmartPath EMS Online.

Figure 6-2. SmartPath EMS VMA.

Black Box hosts SmartPath EMS Online at smartpath.blackbox.com, maintaining the SmartPath EMS VMA hardware and updating the SmartPath EMS VMA software as new releases become available. You receive access to a VEMS (virtual SmartPath EMS VMA) running on the SmartPath EMS VMA hardware. Each VEMS is an independent management system with its own administrators managing their own set of SmartPath APs. Without the expense of buying a physical appliance or SmartPath EMS VMA Virtual Appliance, SmartPath EMS Online can be the most cost-efficient choice for managing a small number of SmartPath APs.

After purchasing SmartPath EMS Online, you receive your login URL and credentials in an e-mail message. After logging in, you enter the SmartPath landing space. From there, you can access your VEMS.

Through your VEMS, you can manage SmartPath APs deployed remotely. By default, SmartPath APs first try to connect to a local SmartPath EMS VMA. If the MAC address or serial number of the SmartPath AP is already assigned to a VEMS, SmartPath.blackbox.com redirects the SmartPath AP to it (see Figure 6-2).

NOTE: Once ordered for use with the VEMS, the SmartPath APs will be preconfigured to try and reach the online VEMS (SmartPath.blackbox.com).

NOTE: If you factory-reset an AP that has been provisioned to look for the online manager at SmartPath.Blackbox.com, it will default to looking for a local EMS. You have to create an SSH connection to the AP and send two config lines using the VEMS CLI (see below).

Enter:

Capwap client server primary name: Smartpath.blackbox.com and press the <Enter> key.

Save config run boot and press the <Enter> key

Once this is done, when the AP is connected to an Internet connection, the AP will look to the VEMS at SmartPath.blackbox.com and show there.

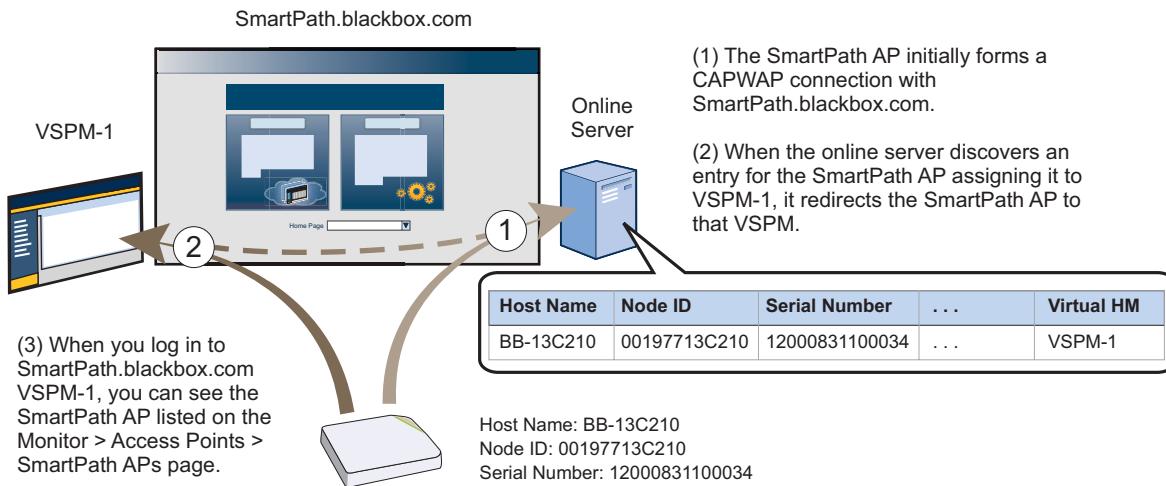


Figure 6-3. Online server.

If the SmartPath AP MAC address or serial number is in Smartpath.blackbox.com, but not yet assigned to the VHM, the SmartPath AP that forms a CAPWAP connection with Smartpath.blackbox.com remains connected to it. If the SmartPath AP MAC address or serialnumber is not in Smartpath.blackbox.com, then Smartpath.blackbox.com does not respond to the CAPWAP connection attempts from that SmartPath AP. For details about the initial CAPWAP connection process, see "How SmartPath APs Connect to SmartPath EMS VMA" in Section 8.4.

6.1 Captive Web Portal Enhancements

The default captive Web portal pages have been redesigned to resize automatically for optimal viewing per device type: smartphone, tablet, and computer monitor. In addition, captive Web portals can now support a registration page with buttons linking to various URLs.

Two significant enhancements have been made to the captive Web portal feature: the default pages have been revised, and support for a new type of user registration has been added.

New Default Captive Web Portal Pages

With the proliferation of mobile devices, the default captive Web portal registration, success, and failure pages have been redesigned to resize automatically to fit the screen of the device accessing them. For example, here is the registration page for user authentication on a computer monitor, a tablet, and a smartphone. You can see how the page adjusts to fit the screen for optimal display no matter what type of device is in use.



Figure 6-4. Captive Web portal page shown on a computer monitor, tablet, and smartphone.

In addition, the page layout and design have been updated with the latest Black Box logo and colors.

Registration Page with Links to Multiple URLs

You can create a custom registration page that has hyperlinks to various URLs. To register successfully, a user only has to click one of the links. The act of clicking a link signals the SmartPath AP that the user has registered. After visiting the selected URL, the user then has access to the rest of the network and can browse freely.

Here is a sample of the HTML code required for a SmartPath AP to register a user that has clicked a link:

```
<form name="form1" action="reg.php" method="post">  
<input type="hidden" name="redir_url" value="http://www.Black Box.com"/>  
<input type="hidden" name="checkbox" value="checkbox"/>  
  
</form>
```

In the preceding example, the redir_url parameter performs the same function as the Submit button on other registration pages. When the SmartPath AP receives a request containing this parameter, which in this case occurs when a user clicks an image of the Black Box logo (img src="Black Box.gif") on a form with the action set as reg.php, the method set as post, and an attribute set with the value of checkbox, it then considers the user as having passed the registration process. You can add as many links to the page as you like as long as each one has a different form name, such as "form1", "form2", "form3", and so on.

6.2 SmartPath Virtual Appliance

SmartPath Virtual Appliance (SmartPath EMS VMA) is similar to a physical appliance except that it is available as VMware that you load onto a computer of your choice. SmartPath EMS VMA ships as VMware on a CD.

You must first install a VMware product such as VMware Workstation or VMware Player on your computer. Then install SmartPath EMS VMA on the VMware workstation or player, where it runs like a virtual server inside your computer. SmartPath EMS VMA forms a virtual Layer 2 connection to your computer—much as if the two were connected by a layer 2 switch internally—and shares the Ethernet connection with your computer.

NOTE: You can find full installation instructions on the SmartPath EMS VMA Virtual Appliance QuickStart, which is also included on the CD.

7. Using SmartPath EMS VMA

Think of the cooperative control architecture as consisting of three broad planes of communication. On the data plane, wireless clients gain network access by forming associations with SmartPath APs. On the control plane, SmartPath APs communicate with each other to coordinate functions such as best-path forwarding, fast roaming, and automatic RF management. On the management plane, SmartPath EMS VMA provides centralized configuration, monitoring, and reporting of multiple SmartPath APs. These three planes are shown in Figure 7-1.

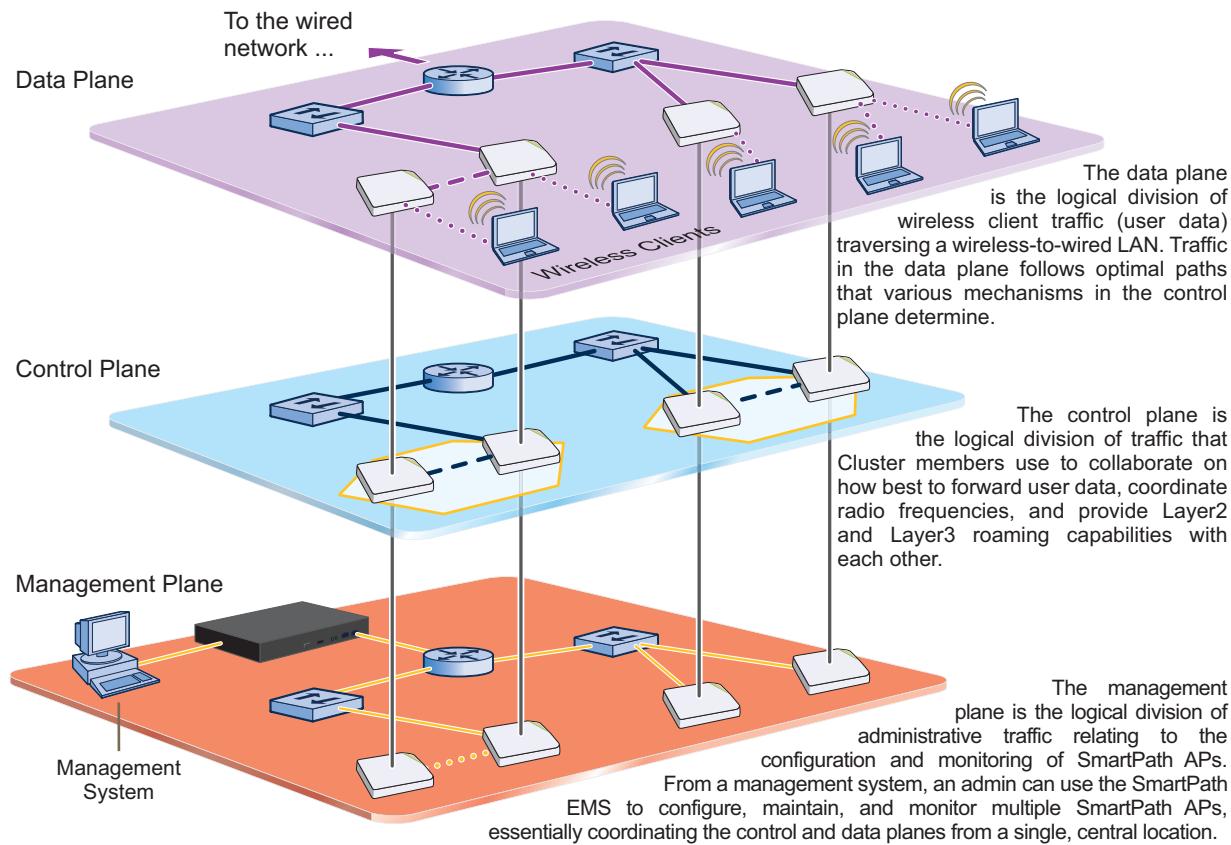


Figure 7-1. Three communication planes in the cooperative control architecture.

As you can see in Figure 7-1, SmartPath EMS VMA operates solely on the management plane. Any loss of connectivity between SmartPath EMS VMA and the SmartPath APs it manages only affects SmartPath AP manageability; such a loss has no impact on communications occurring on the control and data planes.

7.1 Installing and Connecting to the SmartPath EMS VMA GUI

To begin using the SmartPath EMS VMA GUI, you must first configure the MGT interface to be accessible on the network, cable SmartPath EMS VMA and your management system (that is, your computer) to the network, and then make an HTTP connection from your system to the MGT interface.

NOTE: SmartPath EMS VMA has two Ethernet interfaces—MGT and LAN. You can put just the MGT interface on the network and use it for all types of traffic, or you can use both interfaces—which must be in different subnets—and separate SmartPath EMS VMA management traffic (MGT) from SmartPath AP management traffic (LAN).

Chapter 7: Using SmartPath EMS VMA

Besides SmartPath EMS VMA and your management system, you need two or three Ethernet cables and a serial cable (or “null modem”). The Ethernet cables can be standard CAT3, CAT5, CAT5e, or CAT6 cables with T568A or T568B terminations and RJ-45 connectors. The serial cable must comply with the RS-232 standard and terminate on the SmartPath EMS VMA end with a female DB9 connector. (For more details, see Section 5.2, Ethernet and Console Ports.)

The GUI requirements for the management system are as follows:

- Minimum screen resolution of 1280 x 1024 pixels
- Standard browser—Black Box recommends Internet Explorer® v7.0 or Mozilla® Firefox® v2.0.0 or later—with Flash v9.0 or later, which is required for viewing charts with dynamically updated SmartPath AP alarms and wireless client data

Your management system also needs a VT100 terminal emulation program, such as Tera Term Pro (a free terminal emulator) or Hilgraeve Hyperterminal (provided with Windows 95 to Windows XP operating systems).

Finally, you need a license key or, for a physical SmartPath EMS VMA appliance that does not have Internet access to the entitlement server, a license key. You should have received this when you purchased your SmartPath EMS VMA software license.

Changing Network Settings

To connect SmartPath EMS VMA to the network, you must first set the IP address/netmask of its MGT interface so that it is in the subnet to which you plan to cable it. To do this, you can use the SmartPath EMS VMA console port.

1. Connect the power cable to a 100–240-volt power source, and turn on SmartPath EMS VMA. The power switch is on the back panel of the device.
2. Connect one end of an RS-232 serial cable to the serial port (or COM port) on your management system.
3. Connect the other end of the cable to the male DB9 console port on SmartPath EMS VMA.
4. On your management system, run a VT100 emulation program using the following settings:
 - Bits per second (baud rate): 9600
 - Data bits: 8
 - Parity: none
 - Stop bits: 1
 - Flow control: none
5. Log in by entering the default user name (admin) and password (blackbox).
6. The SmartPath EMS VMA CLI shell launches. To change network settings, enter **1** (1 Network Settings and Tools), and then enter **1** again (1 View/Set IP/Netmask /Gateway/DNS Settings).
7. Follow the instructions to configure the IP address and netmask for the MGT interface, its default gateway, the SmartPath EMS VMA host name and domain name, and its primary DNS server.

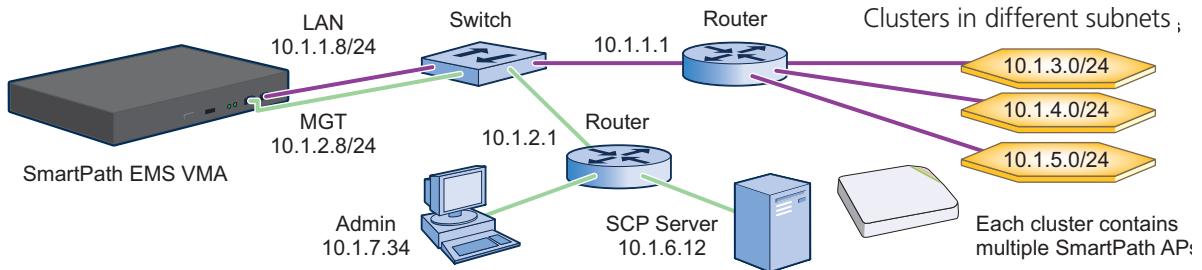
NOTE: The default IP address/netmask for the MGT interface is 192.168.2.10/24. The default gateway IP address is 192.168.2.1.

The LAN interface is disabled by default and does not have a default IP address. You can define network settings for the LAN interface through the SmartPath EMS VMA GUI after you log in.

When deciding to use one interface (MGT) or both (MGT and LAN), keep in mind that there are two main types of traffic to and from SmartPath EMS VMA:

- SmartPath EMS VMA management traffic for admin access and file uploads
- SmartPath AP management traffic and configuration, file, and SmartPathOS image downloads to managed SmartPath APs

When you enable both interfaces, SmartPath EMS VMA management traffic uses the MGT interface while SmartPath AP management traffic uses the LAN interface, as shown in Figure 7-2.



Static Routes: SmartPath EMS VMA sends traffic destined for 10.1.6.0/24 to 10.1.2.1.

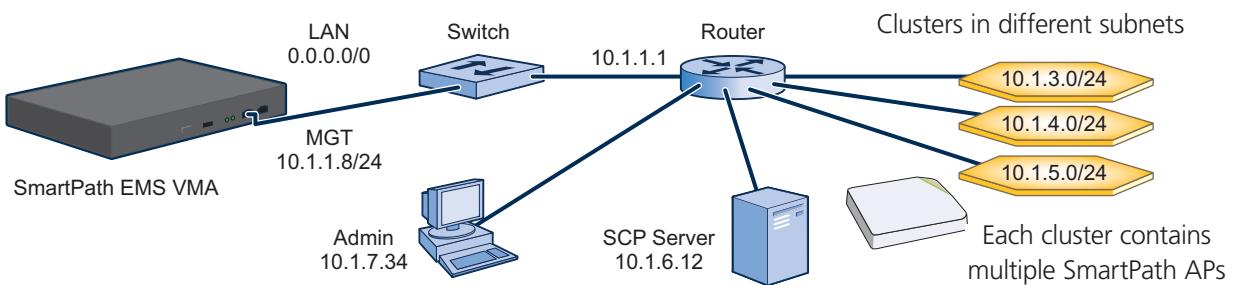
SmartPath EMS VMA sends traffic destined for 10.1.7.0/24 to 10.1.2.1.

Default Gateway: 10.1.1.1 (SmartPath EMS VMA sends traffic here when there are no specific routes to a destination.)

Figure 7-2. Using both MGT and LAN interfaces.

NOTE: To set static routes after you log in to the GUI, click Home > Administration > SmartPath EMS VMA Settings > Routing > Add, set the destination IP address, netmask, and gateway, and then click "Apply."

When only the MGT interface is enabled, both types of management traffic use it. A possible drawback to this approach is that you cannot separate the two types of management traffic into two different networks. For example, if you have an existing management network, you would not be able to use it for SmartPath EMS VMA management traffic. Both SmartPath EMS VMA and SmartPath AP management traffic would need to flow on the operational network because SmartPath EMS VMA would need to communicate with the SmartPath APs from its MGT interface (see Figure 7-3). However, if the separation of both types of traffic is not an issue, then using just the MGT interface is a simple approach to consider.



Default Gateway: 10.1.1.1 (SmartPath EMS VMA sends all traffic to the default gateway.)

Figure 7-3. Using just the MGT interface.

8. After you finish configuring the network settings, restart network services by entering 6 (6 Restart Network Services) and then enter yes to confirm the action. You can now disconnect the serial cable.

Connecting to the GUI through the MGT Interface

1. Connect Ethernet cables from the MGT interface and LAN interface—if you are using it—to the network.
2. Connect an Ethernet cable from your management system to the network so that you can make an HTTPS connection to the IP address that you set for the MGT interface.

Chapter 7: Using SmartPath EMS VMA

3. Open a Web browser and enter the IP address of the MGT interface in the address field. For example, if you changed the IP address to 10.1.1.8, enter this in the address field: <https://10.1.1.8>.

NOTE: If you ever forget the IP address of the MGT interface and cannot make an HTTPS connection to SmartPath EMS VMA, make a serial connection to its console port and enter 1 for "Network Settings and Tools" and then 1 again for "View/Set IP/Netmask/Gateway/DNS Settings." The serial connection settings are explained in "Changing Network Settings" in Section 7.1, Installing and Connecting to the SmartPath EMS VMA GUI.

A login prompt appears.

4. Type the default name (admin) and password (blackbox) in the login fields, and then click Log in.

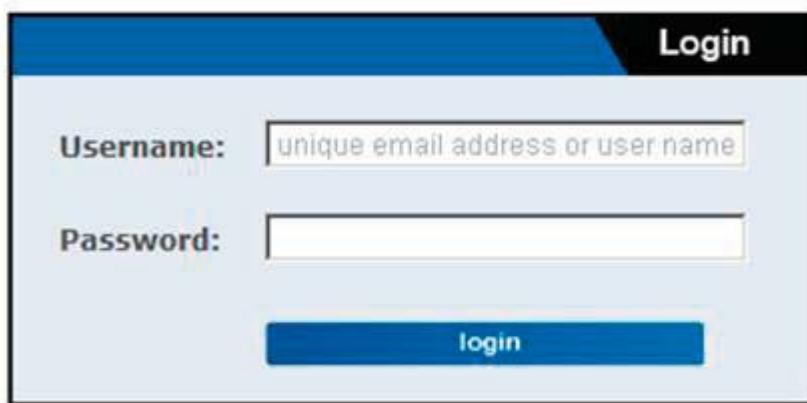


Figure 7-4. Login screen.

5. After logging in to SmartPath EMS VMA Virtual Appliance, the Black Box End User License Agreement appears. Read it over, and if you agree with its content, click Agree.
6. An initial "Welcome to SmartPath EMS VMA" dialog box appears as shown below.

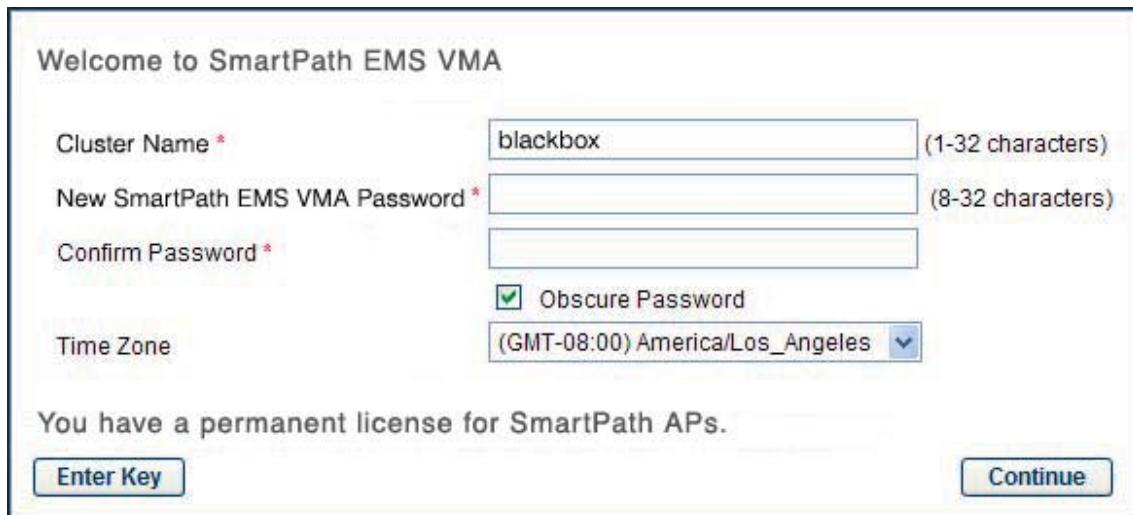


Figure 7-5. Welcome screen.

Change the cluster name for your SmartPath APs (default: blackbox), change your SmartPath EMS VMA login password, and set the time zone where you are located, which might be the same time zone as that for SmartPath EMS VMA or a different one. If you have an entitlement key, click Enter Key. The following dialog box appears.



Figure 7-6. Entitlement key screen.

For a physical appliance with Internet access, select "Enter Entitlement Key." Copy the entitlement key text string that Black Box sent you in an e-mail message, paste it in the Entitlement Key field, and then click "Enter." You also have the option of installing a SmartPath EMS VMA license key, which is useful if you are working with an appliance in a location that does not have Internet access, such as a test lab. If you already have a license, select "Install License Key," copy the license key text string previously supplied by Black Box in an email message, paste it in the License Key field, and then click "Enter."

For SmartPath EMS Online and SmartPath EMS VMA Virtual Appliance, copy the entitlement key text string, paste it in the Entitlement Key field, and then click "Enter." SmartPath EMS Online transmits the entitlement key to the on-line Black Box entitlement server, which replies with all licenses associated with that key.

If you do not have an entitlement key or license key yet, click "Continue." You can access the GUI for a 30-day period without a key. To request an entitlement key or license key, you can send an e-mail to orders@blackbox.com. Make sure to include your customer name and sales order number in the request. When you receive the key, click "Enter Now" in the prompt displayed at the top of the GUI (shown below) or click Home > Administration > License Management. Copy the key from the e-mail and paste it in the appropriate field.



Figure 7-7. GUI.

You are now logged in to the SmartPath EMS VMA GUI. Later, after completing the Global Settings page in the next steps, you can check details about the installed entitlement key and licenses on the Home > Administration > License Management page. You can also enter more licenses there if necessary.

7. SmartPath EMS VMA can operate in one of two administrative modes: Express and Enterprise. Express mode (the default) provides a simple set of configuration components designed for managing a single network. Enterprise mode provides configuration components for managing multiple networks that require more advanced settings. Because the examples throughout this guide are based on Enterprise mode, switch to that mode by clicking Home > Global Settings and selecting Enterprise (recommended for more advanced networks).*

*If you choose Express, you can later switch to Enterprise mode, and SmartPath EMS VMA will automatically convert your settings from the structure used in Express mode to that used in Enterprise mode. However, after choosing Enterprise, you cannot later switch to Express mode and preserve your settings. To change from Enterprise to Express mode, you must erase the database, and then choose Express after you log back in.

8. After selecting Enterprise mode, you have the option of changing the root admin password for logging in to SmartPathAPs. SmartPath EMS VMA uses this password when making SSH connections and uploading a full configuration to SmartPathAPs. The default root admin name and password is admin and blackbox. To set a different password, enter it in the New SmartPath AP Password and Confirm Password fields. The SmartPath AP password can be any alphanumeric string from 5 to 32 characters long. To see the password string that you enter, clear Obscure Password.

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Start Here

Select the SmartPath EMS administrative mode

Express (recommended for a simple network)
 Enterprise (recommended for more advanced networks)

For your network security, change the login password

New SmartPath AP Password (5-32 characters)

Confirm Password

Obscure Password

New SmartPath EMS Password (1-32 characters)

Confirm Password

Obscure Password

Save

Figure 7-8. Start here screen.

9. To save your settings and enter the SmartPath EMS VMA GUI in Enterprise mode, click "Update."
10. A message appears prompting you to confirm your selection of Enterprise mode. After reading the confirmation message, click "Yes."

NOTE: You can change the SmartPath AP root admin name in the Credentials section of the SmartPath AP configuration dialog box (Monitor > Access Points >SmartPath AP > smartpathap_name > Modify).

SmartPath EMS VMA displays the Guided Configuration page to assist you with the main configuration steps:

- Device-level settings for SmartPath APs
- The three major WLAN policy-level configuration objects, which reference all other configuration objects: user profiles, SSIDs, and WLAN policies
- The transfer of the device- and policy-level settings from SmartPath EMS VMA to SmartPath APs

7.2 Introduction to the SmartPath EMS VMA GUI

Using the SmartPath EMS VMA GUI, you can set up the configurations needed to deploy, manage, and monitor large numbers of SmartPath APs. The configuration workflow is described in Section 7.3. The GUI consists of several important sections, which are shown in Figure 7-9.

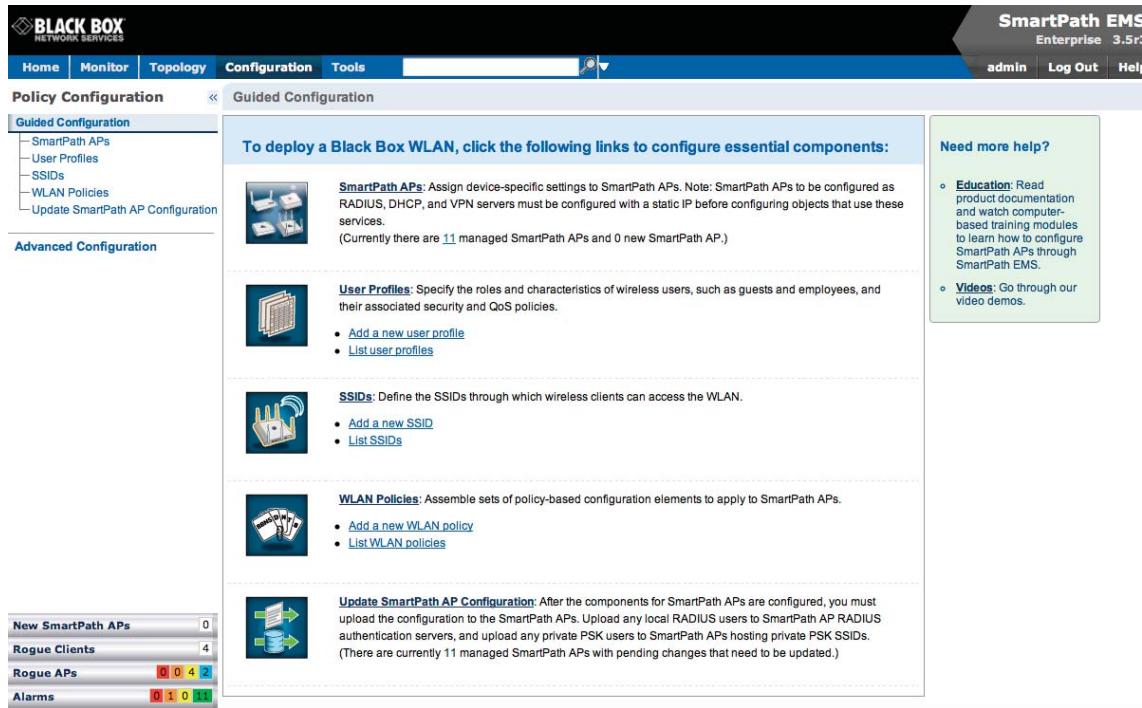


Figure 7-9. Important sections of the SmartPath EMS VMA GUI.

Menu Bar: The items in the menu bar open the major sections of the GUI. You can then use the navigation tree to navigate to specific topics within the selected section.

Search: This is a tool for finding a text string anywhere in the GUI (except in Reports). You can do a global search or confine a search to a specific part of the GUI.

Log Out: Click to log out of your administrative session. If you are logged in as an admin with super user privileges and there are virtual systems, you can exit the home system and enter a different virtual system from here.

Navigation Tree: The navigation tree contains all the topics within the GUI section that you chose in the menu bar. Items you select in the navigation tree appear in the main panel.

Main Panel: The main panel contains the windows in which you set and view various parameters.

Notifications: SmartPath EMS VMA displays a summary of new SmartPath APs, rogue clients, rogue APs, and alarms detected on managed SmartPath APs here. Clicking a displayed number opens the relevant page with more details.

Some convenient aspects that the SmartPath EMS VMA GUI offers are the ability to clone configurations, apply configurations to multiple SmartPath APs at once, and sort displayed information. Brief overviews of these functions are presented in the following sections.

7.2.1 Viewing Reports

When viewing reports that contain graphs (Monitor > Reports ...), you can use your mouse to control what information SmartPath EMS VMA displays. Moving your mouse over a measurement point on any line in a graph displays the type of data being reported and the date, time, and value of the measurement. In the graph for active client details (Monitor > Clients > Active Clients > client_mac_addr) or a report defined as a "New Report Version", moving your mouse over a color box in the legend hides all other lines except the one matching that color (see Figures 7-10 and 7-11).

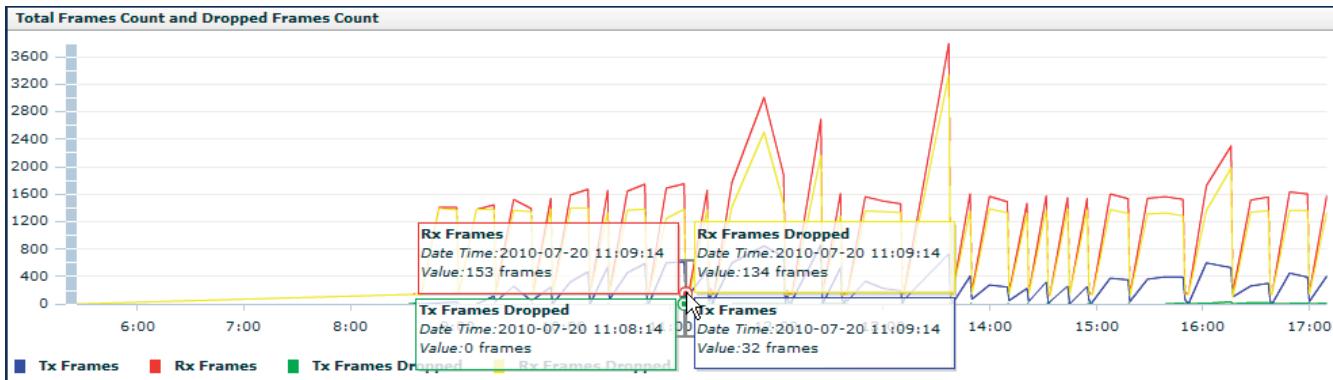


Figure 7-10. Working with graphs in reports.

Moving the mouse over a measurement point in a graph displays data about that measurement. If measurement points on multiple lines happen to converge at the same point, SmartPath EMS VMA displays data for all of them. Here you can see information about the total number of transmitted (Tx) and received (Rx) frames and dropped frames.

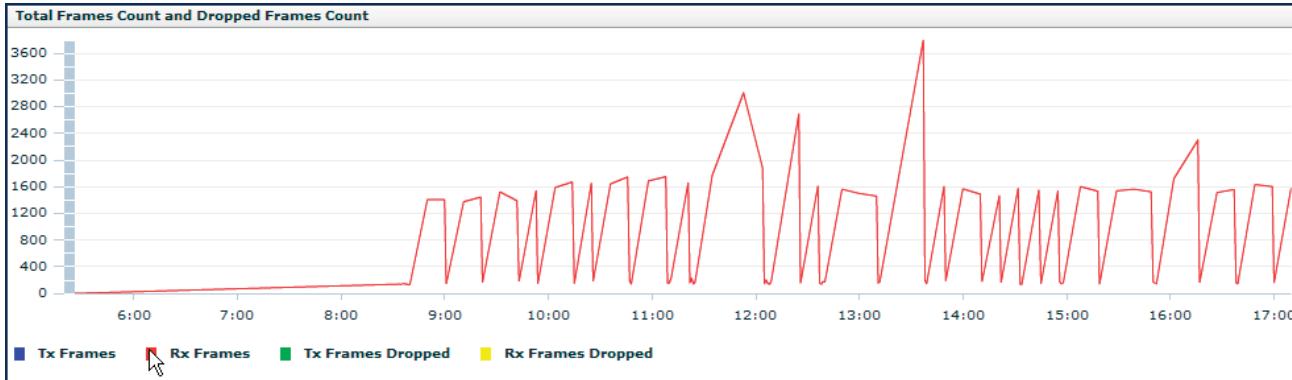


Figure 7-11. Working with graphs in reports.

In the graph showing details for a selected active client, moving the mouse over a colored box in the legend hides all other lines except the one that is the same color as the box under the mouse. Here SmartPath EMS VMA only shows the red line for transmitted frames because the mouse is over the red box next to Rx Frames in the legend.

7.2.2 CAPWAP Latency Reports

CAPWAP Latency Reports: SmartPath EMS VMA tracks the average latency in its CAPWAP connections to each managed SmartPath AP and displays an icon indicating the average amount of current latency in the Connection column on the Monitor > Access Points > SmartPath APs page when viewed in Monitor mode. A green hexagon indicates normal latency, based on an average that SmartPath EMS VMA has calculated from periodic SmartPath AP reports. The icon changes to yellow when the latency increases to the point that responsiveness has slowed noticeably; however, configuration and image uploads can still succeed. It changes to orange when connectivity issues reach the point that configuration and image upload attempts might no longer be successful.

7.2.3 Searching

The SmartPath EMS VMA GUI provides a search feature that you can use to find text strings throughout the SmartPath EMS VMA database and the entire GUI (except in Reports and Topology) or within one or more specified sections of the GUI. By default, SmartPath EMS VMA searches through the following sections of the GUI: Configuration, Access Points, Clients, Administration, and Tools. You can also include Events and Alarms in your search, but not Topology. To restrict the scope of your search, click the down arrow to the right of the search icon and select the areas of the GUI that you want to include and clear those that you want to exclude (see Figure 7-12).

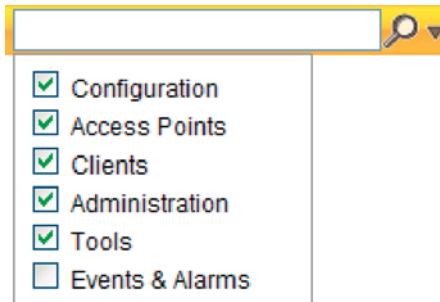


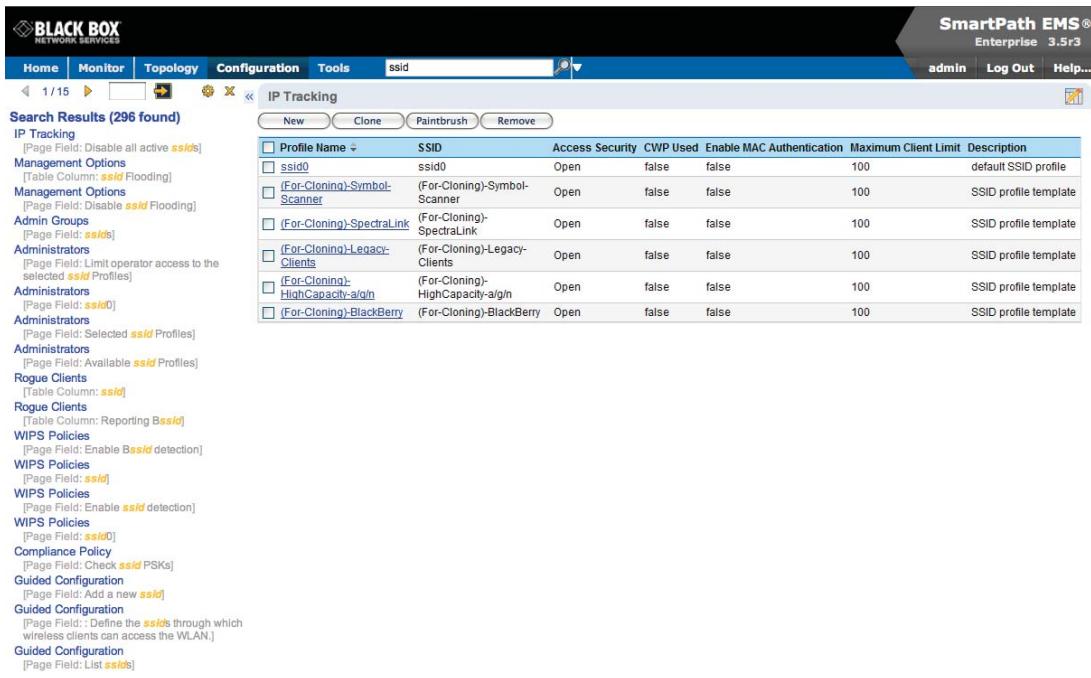
Figure 7-12. Search tool.

The following items are ignored when using the search tool:

- The names of fields in dialog boxes
- The settings on the following Home > Administration pages: SmartPath EMS VMA Settings, SmartPath EMS VMA Services, and SPM Notification Mail List
- Certificates, captive web portal web page files, and image files
- Reports

When you enter a word or phrase in the search field and then click the Search icon—or press the Enter key on your keyboard—SmartPath EMS VMA displays the search results in the left panel that usually contains the navigation tree. The first item in the list is displayed in the main window. To view a different page, click the page name (see Figure 7-13).

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The screenshot shows the SmartPath EMS VMA interface. The top navigation bar includes Home, Monitor, Topology, Configuration, Tools, and a search bar with the term 'ssid'. The Configuration tab is selected. The main content area is titled 'IP Tracking' and shows a table of 'Search Results (296 found)'. The table has columns: Profile Name, SSID, Access Security, CWP Used, Enable MAC Authentication, Maximum Client Limit, and Description. The table lists several entries, including 'ssid0', '(For-Cloning)-Symbol-Scanner', '(For-Cloning)-SpectralLink', '(For-Cloning)-Legacy-Clients', '(For-Cloning)-HighCapacity-a/g/n', and '(For-Cloning)-BlackBerry'. Each entry includes a checkbox for selection. Below the table, there is a list of search results for 'ssid' across various configuration sections like Management Options, Admin Groups, Administrators, and WIPS Policies.

Profile Name	SSID	Access Security	CWP Used	Enable MAC Authentication	Maximum Client Limit	Description
ssid0	ssid0	Open	false	false	100	default SSID profile
(For-Cloning)-Symbol-Scanner	(For-Cloning)-Symbol-Scanner	Open	false	false	100	SSID profile template
(For-Cloning)-SpectralLink	(For-Cloning)-SpectralLink	Open	false	false	100	SSID profile template
(For-Cloning)-Legacy-Clients	(For-Cloning)-Legacy-Clients	Open	false	false	100	SSID profile template
(For-Cloning)-HighCapacity-a/g/n	(For-Cloning)-HighCapacity-a/g/n	Open	false	false	100	SSID profile template
(For-Cloning)-BlackBerry	(For-Cloning)-BlackBerry	Open	false	false	100	SSID profile template

Figure 7-13. Search results.

NOTE: Do not use quotation marks to enclose a phrase of two or more words. Simply enter the phrase that you want to find with spaces. See the SmartPath EMS VMA on-line Help for more information on the Search tool.

7.2.4 Multiselecting

You can select multiple objects to make the same modifications or perform the same operation to all of them at once.

Select the check boxes to select multiple noncontiguous objects, or shift-click to select check boxes for multiple contiguous objects.

Then click the Modify button to configure them with the same settings.

Audit	Host Name	Alarm	IP Address	External IP Address	Node ID	Connection	AP Type	Clients	Uptime	SmartPath OS
<input checked="" type="checkbox"/>	SIMU-000070	green	192.168.1.8	192.168.1.8	008C10000070	key padlock	Portal	20	16 Days, 21 Hrs 38 Mins 28 Secs	SmartPath OS 3.5r3 release
<input checked="" type="checkbox"/>	SIMU-000010	green	192.168.1.2	192.168.1.2	008C10000010	key padlock	Portal	20	16 Days, 21 Hrs 38 Mins 28 Secs	SmartPath OS 3.5r3 release
<input checked="" type="checkbox"/>	SIMU-000090	green	192.168.1.10	192.168.1.10	008C10000090	key padlock	Mesh Point	20	16 Days, 21 Hrs 38 Mins 28 Secs	SmartPath OS 3.5r3 release
<input checked="" type="checkbox"/>	SIMU-000050	green	192.168.1.6	192.168.1.6	008C10000050	key padlock	Mesh Point	20	16 Days, 21 Hrs 38 Mins 28 Secs	SmartPath OS 3.5r3 release
<input checked="" type="checkbox"/>	SIMU-000080	green	192.168.1.9	192.168.1.9	008C10000080	key padlock	Mesh Point	20	16 Days, 21 Hrs 38 Mins 28 Secs	SmartPath OS 3.5r3 release
<input checked="" type="checkbox"/>	SIMU-000060	green	192.168.1.7	192.168.1.7	008C10000060	key padlock	Portal	20	16 Days, 21 Hrs 38 Mins 28 Secs	SmartPath OS 3.5r3 release
<input checked="" type="checkbox"/>	BB-05db80	orange	10.50.106	209.128.117.93	008C1005DB80	key padlock	Portal	0	27 Days, 19 Hrs 20 Mins 5 Secs	SmartPath OS 3.5r3 release build0125
<input checked="" type="checkbox"/>	SIMU-000000	green	192.168.1.1	192.168.1.1	008C10000000	key padlock	Mesh Point	20	16 Days, 21 Hrs 38 Mins 29 Secs	SmartPath OS 3.5r3 release
<input checked="" type="checkbox"/>	SIMU-000020	green	192.168.1.3	192.168.1.3	008C10000020	key padlock	Mesh Point	20	16 Days, 21 Hrs 38 Mins 29 Secs	SmartPath OS 3.5r3 release
<input checked="" type="checkbox"/>	SIMU-000040	green	192.168.1.5	192.168.1.5	008C10000040	key padlock	Mesh Point	20	16 Days, 21 Hrs 38 Mins 29 Secs	SmartPath OS 3.5r3 release
<input checked="" type="checkbox"/>	SIMU-000030	green	192.168.1.4	192.168.1.4	008C10000030	key padlock	Mesh Point	20	16 Days, 21 Hrs 38 Mins 29 Secs	SmartPath OS 3.5r3 release

New SmartPath APs: 0
Rogue Clients: 4
Rogue APs: 0 0 4 2
Alarms: 0 1 0 11

Figure 7-14. Selecting multiple new SmartPath APs.

Here, you use the shift-click multiselection method to select a set of the topmost eight SmartPath APs in the list; that is, you select the checkbox for the top SmartPath AP and hold down the SHIFT key while selecting the checkbox for the eighth SmartPath AP from the top.

7.2.5 Cloning Configurations

When you need to configure multiple similar objects, you can save time by configuring just the first object, cloning it, and then making slight modifications to the subsequent objects. With this approach, you can avoid re-entering repeated data.

To clone an object, select it in an open window, and then click the Clone button. Retain the settings you want to keep, and modify those you want to change.

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Audit	Host Name	Alarm	IP Address	External IP Address	Node ID	Connection	AP Type	Clients	Uptime	SmartPath OS
	SIMU-00007Q		192.168.1.8	192.168.1.8	008C10000070		Portal	20	16 Days, 21 Hrs 38 Mins 28 Secs	SmartPath OS 3.5r3 release
	SIMU-000010		192.168.1.2	192.168.1.2	008C10000010		Portal	20	16 Days, 21 Hrs 38 Mins 28 Secs	SmartPath OS 3.5r3 release
	SIMU-00009Q		192.168.1.10	192.168.1.10	008C10000090		Mesh Point	20	16 Days, 21 Hrs 38 Mins 28 Secs	SmartPath OS 3.5r3 release
	SIMU-00005Q		192.168.1.6	192.168.1.6	008C10000050		Mesh Point	20	16 Days, 21 Hrs 38 Mins 28 Secs	SmartPath OS 3.5r3 release
	SIMU-00008Q		192.168.1.9	192.168.1.9	008C10000080		Mesh Point	20	16 Days, 21 Hrs 38 Mins 28 Secs	SmartPath OS 3.5r3 release
	SIMU-00006Q		192.168.1.7	192.168.1.7	008C10000060		Portal	20	16 Days, 21 Hrs 38 Mins 28 Secs	SmartPath OS 3.5r3 release
	BB-05db80		10.5.50.106	209.128.117.93	008C1005DB80		Portal	0	27 Days, 19 Hrs 20 Mins 5 Secs	SmartPath OS 3.5r3 release build0125
	SIMU-00000Q		192.168.1.1	192.168.1.1	008C10000000		Mesh Point	20	16 Days, 21 Hrs 38 Mins 29 Secs	SmartPath OS 3.5r3 release
	SIMU-00002Q		192.168.1.3	192.168.1.3	008C10000020		Mesh Point	20	16 Days, 21 Hrs 38 Mins 29 Secs	SmartPath OS 3.5r3 release
	SIMU-00004Q		192.168.1.5	192.168.1.5	008C10000040		Mesh Point	20	16 Days, 21 Hrs 38 Mins 29 Secs	SmartPath OS 3.5r3 release
	SIMU-00003Q		192.168.1.4	192.168.1.4	008C10000030		Mesh Point	20	16 Days, 21 Hrs 38 Mins 29 Secs	SmartPath OS 3.5r3 release

Figure 7-15. Cloning a cluster.

7.2.6 Sorting Displayed Data

You can control how the GUI displays data in the main panel by clicking a column header. This causes the displayed content to reorder itself alphanumerically or chronologically in either ascending or descending order. Clicking the header a second time reverses the order in which the data is displayed.

By default, displayed objects are sorted alphanumerically from the top by name. If you click the name again, the order is reversed; that is, the objects are ordered alphanumerically from the bottom.

Host Name	Node ID	Occurred	Description	Component
SIMU-00007Q	008C10000070	12-30-2010 12:21:02	[wifi]: SLA: send bad trap for 0016:cb00:0801 SLA bw 100 Kbps, actual usage 63 Kbps action_taken 0X03	Client_Management
SIMU-000010	008C10000010	12-30-2010 12:21:02	[wifi]: SLA: send bad trap for 0016:cb00:0200 SLA bw 100 Kbps, actual usage 73 Kbps action_taken 0X03	Client_Management
SIMU-00007Q	008C10000070	12-30-2010 12:10:57	[wifi]: SLA: send clear trap for 0016:cb00:0801 SLA bw 100 Kbps, actual usage 142 Kbps action_taken 0X00	Client_Management
SIMU-000010	008C10000010	12-30-2010 11:40:42	[wifi]: SLA: send clear trap for 0016:cb00:0203 SLA bw 100 Kbps, actual usage 103 Kbps action_taken 0X00	Client_Management
SIMU-00007Q	008C10000070	12-30-2010 11:30:37	[wifi]: SLA: send not meet trap for 0016:cb00:0803 SLA bw 100 Kbps, actual usage 82 Kbps action_taken 0X03	Client_Management
SIMU-00007Q	008C10000070	12-30-2010 11:10:27	[wifi]: SLA: send alert trap for 0016:cb00:0803 SLA bw 100 Kbps, actual usage 81 Kbps action_taken 0X01	Client_Management
SIMU-00007Q	008C10000070	12-30-2010 11:10:27	[wifi]: SLA: send clear trap for 0016:cb00:0802 SLA bw 100 Kbps, actual usage 141 Kbps action_taken 0X00	Client_Management
SIMU-000010	008C10000010	12-30-2010 11:10:27	[wifi]: SLA: send alert trap for 0016:cb00:0203 SLA bw 100 Kbps, actual usage 64 Kbps action_taken 0X01	Client_Management
SIMU-000010	008C10000010	12-30-2010 11:00:22	[wifi]: SLA: send clear trap for 0016:cb00:0202 SLA bw 100 Kbps, actual usage 135 Kbps action_taken 0X00	Client_Management
SIMU-00007Q	008C10000070	12-30-2010 10:40:12	[wifi]: SLA: send alert trap for 0016:cb00:0802 SLA bw 100 Kbps, actual usage 66 Kbps action_taken 0X01	Client_Management
SIMU-00007Q	008C10000070	12-30-2010 10:40:12	[wifi]: SLA: send bad trap for 0016:cb00:0801 SLA bw 100 Kbps, actual usage 64 Kbps action_taken 0X03	Client_Management

Figure 7-16. Sorting event log entries by SmartPath AP host name and then chronologically.

By clicking the heading of a column, you can reorder the display of objects either alphanumerically or chronologically, depending on the content of the selected column. Here you reorder the data chronologically.

Host Name	Node ID	Occurred	Description	Component
SIMU-000070	008C10000070	12-30-2010 12:21:02	[wifi]: SLA: send bad trap for 0016:cb00:0801 SLA bw 100 Kbps, actual usage 63 Kbps action_taken 0X03	Client_Management
SIMU-000010	008C10000010	12-30-2010 12:21:02	[wifi]: SLA: send bad trap for 0016:cb00:0200 SLA bw 100 Kbps, actual usage 73 Kbps action_taken 0X03	Client_Management
SIMU-000070	008C10000070	12-30-2010 12:10:57	[wifi]: SLA: send clear trap for 0016:cb00:0801 SLA bw 100 Kbps, actual usage 142 Kbps action_taken 0X00	Client_Management
SIMU-000010	008C10000010	12-30-2010 11:40:42	[wifi]: SLA: send clear trap for 0016:cb00:0203 SLA bw 100 Kbps, actual usage 103 Kbps action_taken 0X00	Client_Management
SIMU-000070	008C10000070	12-30-2010 11:30:37	[wifi]: SLA: send not meet trap for 0016:cb00:0803 SLA bw 100 Kbps, actual usage 82 Kbps action_taken 0X03	Client_Management
SIMU-000070	008C10000070	12-30-2010 11:10:27	[wifi]: SLA: send alert trap for 0016:cb00:0803 SLA bw 100 Kbps, actual usage 81 Kbps action_taken 0X01	Client_Management
SIMU-000070	008C10000070	12-30-2010 11:10:27	[wifi]: SLA: send clear trap for 0016:cb00:0802 SLA bw 100 Kbps, actual usage 141 Kbps action_taken 0X00	Client_Management
SIMU-000010	008C10000010	12-30-2010 11:10:27	[wifi]: SLA: send alert trap for 0016:cb00:0203 SLA bw 100 Kbps, actual usage 64 Kbps action_taken 0X01	Client_Management
SIMU-000010	008C10000010	12-30-2010 11:00:22	[wifi]: SLA: send clear trap for 0016:cb00:0202 SLA bw 100 Kbps, actual usage 135 Kbps action_taken 0X00	Client_Management
SIMU-000070	008C10000070	12-30-2010 10:40:12	[wifi]: SLA: send alert trap for 0016:cb00:0802 SLA bw 100 Kbps, actual usage 66 Kbps action_taken 0X01	Client_Management
SIMU-000070	008C10000070	12-30-2010 10:40:12	[wifi]: SLA: send bad trap for 0016:cb00:0801 SLA bw 100 Kbps, actual usage 64 Kbps action_taken 0X03	Client_Management

Figure 7-17. Click to reorder the display of objects.

Indicates that the list appears in descending order from the top

Indicates that the list appears in ascending order from the bottom

7.3 SmartPath Configuration Workflow (Enterprise Mode)

Assuming that you have already set SmartPath EMS VMA in Enterprise mode and configured its basic settings, and that you have deployed SmartPath APs, which are now connected to SmartPath EMS VMA, you can start configuring the SmartPath APs through SmartPath EMS VMA.* You can configure numerous objects, some of which might need to reference other objects. An efficient configuration strategy is first to define any objects that you will later need to use when configuring other objects. If one object must reference another that has not yet been defined, there is usually a “New” button that you can click, define the object you need, and then return to the first dialog box to continue with its configuration.

*When SmartPath APs are in the same subnet as SmartPath EMS VMA, they can use CAPWAP (Control and Provisioning of Wireless Access Points) to discover SmartPath EMS VMA on the network. CAPWAP works within a Layer 2 broadcast domain and is enabled by default on all SmartPath APs. If the SmartPath APs and SmartPath EMS VMA are in different subnets, then you can use one of several approaches to enable SmartPath APs to connect to SmartPath EMS VMA. For information about these options, see “How SmartPath APs Connect to SmartPath EMS VMA” in Section 8.4, Example 4: Connecting SmartPath APs to SmartPath EMS VMA.

NOTE: An important initial configuration task to perform is to synchronize the internal clocks of all the managed SmartPath APs either with the clock on SmartPath EMS VMA or with the time on an NTP server. If you plan on having the SmartPath APs validate RADIUS, VPN, and HTTPS (captive web portal) certificates, synchronizing all the devices with the same NTP server helps ensure synchronization.

The typical workflow proceeds like this:

1. Use default settings or configure new settings for various features that, when combined, constitute a user profile, an SSID, and a WLAN policy. These are the three main objects that reference most of the other ones. Together these features define policies that you can apply to multiple SmartPath APs.

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Table 7-1. Typical Workflow.

User Profile —>	SSID —>	WLAN P
QoS rate control and queuing	User profiles	SSIDs
IP firewall rules	Captive Web portal (possibly including a RADIUS server profile and certificates)	Cluster (possibly including MAC filters and MAC DoS)
MAC firewall rules	MAC filters	Management options
GRE and VPN tunnel policies	Schedules	QoS classifier and marker maps, dynamic airtime scheduling
VLAN	IP DoS	Traffic filters
SLA (service-level agreement) settings	MAC DoS	VPN service
Attribute number	—	DNS, NTP, SNMP, syslog, location services
User manager control	CTS (Clear to Send)	Service settings for WIPS, virtual access console, ALG services, Mgt IP filter, LLDP/CDP link discovery protocols, and IP tracking

2. Define various device-level configuration objects to apply to individual SmartPath APs. These include map, CAPWAP servers, radio profiles, scheduled configuration audits, RADIUS authentication server settings, and DHCP server or DHCP relay agent settings.
3. Apply the policy-level settings (contained within a WLAN policy) and device-level settings to one or more SmartPath APs, and then push the configurations to physical SmartPath AP devices across the network.

LLDP Maximum Power:

To avoid SmartPath APs sending LLDP (Link Layer Discovery Protocol) transmissions requesting more power through PoE from the connecting switch than the switch can provide, you can set a maximum power level that SmartPath APs can request in their LLDP advertisements on the Configuration > Advanced Configuration > Network Objects > LLDP/CDP Profiles > New page. By default, the maximum is 15.4 watts.

7.4 Updating Software on SmartPath EMS VMA

You can update the software running on SmartPath EMS VMA from either a local directory on your management system or an SCP (Secure Copy) server. If you download an image and save it to a local directory, you can load it from there. If you save the image to an SCP server, you can direct SmartPath EMS VMA to log in and load it from a directory there.

1. If you do not yet have an account on the Black Box Support portal, send an e-mail request to info@blackbox.com to set one up.
2. When you have login credentials, visit www.blackbox.com/support/login and log in.
3. Navigate to the software image that you want to load onto SmartPath EMS VMA (Customer Support > Software Downloads > SmartPath EMS VMA software images) and download the file.
4. Save the SmartPath EMS VMA image file to a local directory or an SCP server.
5. Log in to SmartPath EMS VMA and navigate to Home > Administration > SmartPath EMS VMA Operations > Update Software.
6. To load files from a directory on your local management system, choose either Update and clear alarm and event logs or Full update (to keep existing log entries after the upgrade), and then enter the following: File from local host: (select); type the directory path and a file name; or click Browse, navigate to the software file, and select it.

or

To load a file from an SCP server:

File from remote server: (select)

IP Address: Enter the IP address of the SCP server.

SCP Port: Enter the port number of the SCP server (the default port number for SCP is 22).

File Path: Enter the directory path and SmartPath EMS VMA software file name. If the file is in the root directory of the SCP server, you can simply enter the file name.

User Name: Type a user name with which SmartPath EMS VMA can access the SCP server.

Password: Type a password with which SmartPath EMS VMA can use to log in securely to the SCP server.

or

To load a file from the Black Box update server:

File from Black Box update server: (select)

A pop-up window appears with a list of newer SmartPath EMS VMA image files. If you have the latest available version, the list will be empty. If there are newer images, select the one you want, and upgrade SmartPath EMS VMA to that image by transferring the file over an HTTPS connection from the server to SmartPath EMS VMA.

7. To save the new software and reboot SmartPath EMS VMA, click "OK."

7.5 Updating SmartPathOS Firmware

SmartPath EMS VMA makes it easy to update SmartPathOS firmware running on managed SmartPath APs. First, you obtain new SmartPath AP firmware from Black Box Technical Support and upload it onto SmartPath EMS VMA. Then you push the firmware to the SmartPath APs and activate it by rebooting them.

NOTE: When upgrading both SmartPath EMS VMA software and SmartPathOS firmware, do so in this order:

- Upgrade SmartPath EMS VMA (SmartPath EMS VMA can manage SmartPath APs running the current version of SmartPathOS and also previous versions going back two major releases).
- Upload the new SmartPathOS firmware to the managed SmartPath APs, and reboot them to activate it.
- Reload the SmartPathOS configurations to the managed SmartPath APs—even if nothing in the configurations has changed—and reboot them to activate the configuration that is compatible with the new SmartPathOS image.

1. Log in to the Black Box SmartPath Portal to obtain a new SmartPathOS image.

2. Save the SmartPathOS image file to a directory on your local management system or network.

3. Log in to SmartPath EMS VMA and navigate to Monitor > Access Points > SmartPath APs.

4. In the SmartPath APs window, select one or more SmartPath APs, and then click "Update > Upload and Activate SmartPathOS Software."

The Upload and Activate SmartPathOS Software dialog box appears.

5. To the right of the SmartPathOS Image field, click "Add/Remove."

6. In the Add/Remove SmartPathOS Image dialog box that appears, enter one of the following—depending on how you intend to upload the SmartPathOS image file to SmartPath EMS VMA—and then click "Upload:"

To load a SmartPathOS image file from the Black Box update server:

SmartPathOS <version> images from Black Box update server: (select)

To load a SmartPathOS image file from a directory on your local management system:

Local File: (select); type the directory path and image file name, or click Browse, navigate to the image file, and select it.

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To load a SmartPathOS image file from an SCP server:

SCP Server: (select) IP Address : Enter the IP address of the SCP server.

SCP Port: Enter the port number of the SCP server (the default port number for SCP is 22).

File Path: Enter the path to the SmartPathOS image file and the file name. If the file is in the root directory of the SCP server, you can simply enter the file name.

User Name: Type a user name with which SmartPath EMS VMA can access the SCP server.

Password: Type a password that SmartPath EMS VMA can use to log in securely to the SCP server.

NOTE: To delete an old SmartPathOS file, select the file in the "Available Images" list, and then click Remove.

7. Click Upload.

8. Close the dialog box by clicking the Close icon (X) in the upper right corner.

9. By default, the SmartPath EMS VMA uses SCP to transfer the file to the selected SmartPath APs and requires a manual reboot of the SmartPath APs to activate it. If you want to change these settings, click Settings in the upper right corner of the Upload and Activate SmartPathOS Software page.

A section expands allowing you to change how SmartPathOS images are displayed (by software version or by file name), how the software is activated (these options are explained below), which transfer protocol to use (SCP or TFTP), the type of connection between SmartPath EMS VMA and the SmartPath APs, and how long to wait before timing out an incomplete update attempt.

In the Activation Time section, select one of the following options, depending on when you want to activate the firmware—by rebooting the SmartPath APs—after SmartPath EMS VMA finishes loading it:

- Activate at: Select and set the time at which you want the SmartPath APs to activate the firmware. To use this option accurately, make sure that both SmartPath EMS VMA and managed SmartPath AP clocks are synchronized.
- Activate after: Select to load the firmware on the selected SmartPath APs and activate it after a specified interval. The range is 0–3600 seconds; that is, immediately to one hour. The default is 5 seconds.
- Activate at next reboot: Select to load the firmware and not activate it. The loaded firmware gets activated the next time the SmartPath AP reboots.

NOTE: When choosing which option to use, consider how SmartPath EMS VMA connects to the SmartPath APs it is updating. See Section 7.6.

10. To save your settings, click the Save icon in the upper right corner. Otherwise, click the Close icon to use these settings just this time. If you do not save your modified settings, the next time you upload a SmartPathOS image to SmartPath APs, SmartPath EMS VMA will again apply the default settings.

11. Select the file you just loaded from the SmartPath OS Image drop-down list, select one or more SmartPath APs at the bottom of the dialog box, and then click Upload.

SmartPath EMS VMA displays the progress of the SmartPathOS image upload—and its eventual success or failure—on the Monitor > Access Points > SmartPath AP Update Results page.

7.6 Updating SmartPath APs in a Mesh Environment

When updating cluster members in a mesh environment, be careful of the order in which the SmartPath APs reboot. If a portal completes the upload and reboots before a mesh point beyond it completes its upload—which most likely would happen because portals receive the uploaded content first and then forward it to mesh points—the reboot will interrupt the data transfer to the mesh point. This can also happen if a mesh point linking SmartPath EMS VMA to another mesh point reboots before the more distant mesh point completes its upload. As a result of such an interruption, the affected mesh point receives an incomplete firmware or configuration file and aborts the update.

NOTE: A mesh point is a cluster member that uses a wireless backhaul connection to communicate with the rest of the cluster.

SmartPath EMS VMA manages mesh points through another cluster member that acts as a portal, which links mesh points to the wired LAN.

When updating SmartPath APs in a mesh environment, the SmartPath EMS VMA communicates with mesh points through their portal and, if there are any intervening mesh points, through them as well. While updating SmartPath APs in such an environment, it is important to keep the path from the SmartPath EMS VMA to all SmartPath APs clear so that the data transfer along that path is not disrupted. Therefore, when updating a firmware image or configuration on SmartPath APs in a mesh environment, make sure that the portal or a mesh point closer to the portal does not reboot before the upload to a mesh point farther away completes.

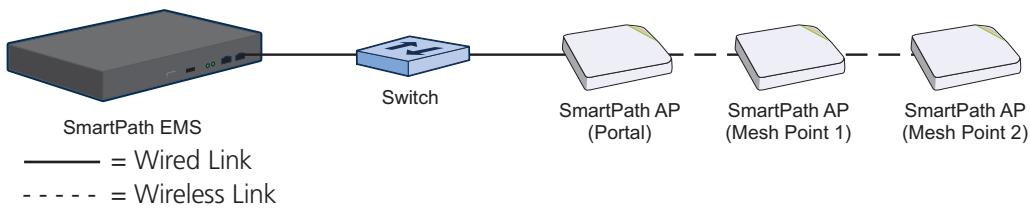


Figure 7-18. SmartPath APs in a mesh environment.

To avoid the reboot of an intervening SmartPath AP from interfering with an ongoing upload to a mesh point beyond it, allow enough time for the firmware to reach the farthest mesh points before activating the firmware. After all the SmartPath APs have the firmware, rebooting any SmartPath APs between them and SmartPath EMS VMA becomes inconsequential.

Chapter 8: Basic Configuration Examples

8. Basic Configuration Examples

This chapter introduces the SmartPath EMS VMA GUI in Enterprise mode through a series of examples showing how to create a basic configuration of an SSID, cluster, and WLAN policy. It then explains how to connect several SmartPath APs to SmartPath EMS VMA, accept them for management, and push the configuration to them over the network.

NOTE: Although maps provide a convenient method for organizing and managing your SmartPath AP deployment, they are not strictly required and are not covered in this chapter. For information about using maps, see Section 9.1.

You can look at any of the following examples individually to study how to configure a specific feature or view all of them sequentially to understand the basic workflow for configuring and managing SmartPath APs through SmartPath EMS VMA.

The examples are as follows:

- Section 8.1, Example 1: Defining an SSID: Define the security and network settings that wireless clients and SmartPath APs use to communicate.
- Section 8.2, Example 2: Creating a Cluster: Create a cluster so that the SmartPath APs can exchange information with each other to coordinate client access, provide best-path forwarding, and enforce QoS policy.
- Section 8.3, Example 3: Creating a WLAN Policy: Define a WLAN policy, which contains the SSID and cluster defined in the first two examples.
- Section 8.4, Example 4: Access and Backhaul on the Same Radio.
- Section 8.5, Example 5: Connecting SmartPath APs to SmartPath EMS VMA: Cable two SmartPath APs to the network to act as portals and set up a third one as a mesh point. Put the SmartPath APs on the same subnet as SmartPath EMS VMA and allow them to make a CAPWAP connection to SmartPath EMS VMA.
- Section 8.6, Example 6: Assigning the Configuration to SmartPath APs: Assign the WLAN policy to the SmartPath APs. Also, change SmartPath AP login settings and—if necessary—country codes.
- Section 8.7, Example 7: Selective Multicast Forwarding through GRE Tunnels.
- Section 8.8, Example 8: IP Multicast Enhancements.

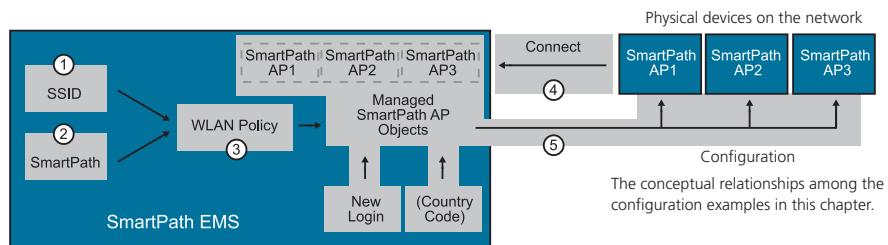


Figure 8-1. The conceptual relationships among the configuration examples in this chapter.

In the first three examples, you define configuration objects in the Configuration section of the GUI. In the last two examples, you connect some SmartPath APs to the network, enable them to make a CAPWAP connection to SmartPath EMS VMA, and then manage them in the Monitor section of the GUI.

8.1 Example 1: Defining an SSID

A service set identifier (SSID) is an alphanumeric string that identifies a group of security and network settings that wireless clients and access points use when establishing wireless communications with each other. In this example, you define the following SSID, which uses a preshared key (PSK) for client authentication and data encryption:

SSID name: test1-psk

SSID access security: WPA/WPA2 PSK (Personal)

Preshared key: CmFwbo1121

A PSK is the simplest way to provide client authentication and data encryption: simply configure an SSID with the same PSK on the SmartPath AP and its clients. A PSK authenticates clients by the simple fact that the clients and SmartPath AP have the same key. For data encryption, both the SmartPath AP and clients use the PSK as a pairwise master key (PMK) from which they generate a pairwise transient key (PTK), which they use to encrypt unicast traffic. Although the PSK/PMK is the same on all clients, the generated PTKs are different not only for each client but for each session.

Because of its simplicity, a PSK is suitable for testing and small deployments; however, there is a drawback with using PSKs on a larger scale. All clients connecting through the same SSID use the same PSK, so if the key is compromised or a user leaves the company, you must change the PSK on the SmartPath AP and all its clients. With a large number of clients, this can be very time-consuming. For examples of key management solutions that are more suitable for large-scale deployments, see the 802.1X and private PSK examples in Chapter 9. For the present goal of showing how to use SmartPath EMS VMA to configure an SSID, the PSK method works well.

To configure the SSID, log in to the SmartPath EMS VMA GUI (see Section 7.1), click Configuration > SSIDs > New, enter the following, and then click Save:

Profile Name: test1-psk (A profile name does not support spaces, although an SSID name does.)

The profile name is the name for the entire group of settings for an SSID. It can reference a captive Web portal; include default or modified data rate settings; apply denial of service (DoS) policies, MAC filters, and schedules; and specify the SSID name that the SmartPath AP advertises in beacons and probe responses. The profile name—not the SSID name (although they can both be the same)—is the one that appears in the Available SSIDs list in the WLAN Policy dialog box. You will later choose this SSID when defining a WLAN policy in Section 8.3.

When you type in a profile name, SmartPath EMS VMA automatically fills in the SSID field with the same text string. By default, the profile and SSID names are the same, yet they can also be different. You can create many different SSID profiles, each with a different group of settings, but each with the same SSID name. For users, their clients connect to the same SSID at different locations. From the SmartPath AP perspective, each SSID profile applies a different group of settings.

SSID: test1-psk

This is the SSID name that clients discover from beacons and probe responses.

Description: Test SSID for learning how to use the GUI; remove later

This note and the very name "test1-psk" are deliberately being used as reminders to replace this configuration later with an SSID profile and SSID name that you really intend to use in your WLAN.

SSID Access Security: WPA/WPA2 PSK (Personal)

Use Default WPA/WPA2 PSK Settings: (select)

By default, when a SmartPath AP hosts a WPA/WPA2 PSK (Personal) SSID, it negotiates with clients over the use of WPA or WPA2 for key management and TKIP or CCMP (AES) for encryption, and uses whichever methods each client supports. Also, the PSK text string is in ASCII format by default.

Key Value and Confirm Value: CmFwbo1121 (To see the text strings that you enter, clear the Obscure Password checkbox.)

With these settings, the SmartPath AP and its clients can use either WPA or WPA2 for key management, CCMP (AES) or TKIP for data encryption, and the preshared key "CmFwbo1121" as the pairwise master key from which they each generate pairwise transient keys.

Enable Captive Web Portal: (clear)

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Enable MAC Authentication: (clear)

User profile assigned to users that associate with this SSID: default-profile

The predefined user profile "default-profile" applies the standard SmartPath Quality of Service level through the predefined QoS policy "def-user-qos" and assigns user traffic to VLAN 1.

SSID Broadcast Band: 2.4 GHz (11n/b/g)

SmartPath APs have two radios: a 2.4-GHz radio, which supports 802.11n/b/g, and a 5-GHz radio, which supports 802.11n/a. On all SmartPath AP models, both radios can function concurrently. This setting broadcasts the SSID on the wifi0 interface, which is bound to the 2.4-GHz radio. (There is an assumption that your clients support at least one of the following IEEE standards: 802.11n, 802.11g, or 802.11b.)

As will be seen later in this chapter, one SmartPath AP will be deployed as a mesh point; that is, it will not have an Ethernet connection but will connect to the wired network over a wireless backhaul link through another SmartPath AP that does have an Ethernet connection (see Section 8.5). Because of this, the SmartPath APs must use one radio for wireless backhaul communications and the other radio for client access. By default, both the 2.4-GHz and 5-GHz radios are in access mode.

In the series of examples in this chapter, you set the 5-GHz radio in backhaul mode, and the 2.4-GHz radio in access mode. Therefore, you assign the SSID to the 2.4-GHz band.

To see how the different SSID settings determine the way that the SmartPath AP advertises the SSID and how clients form associations with it, see Figure 8-2.

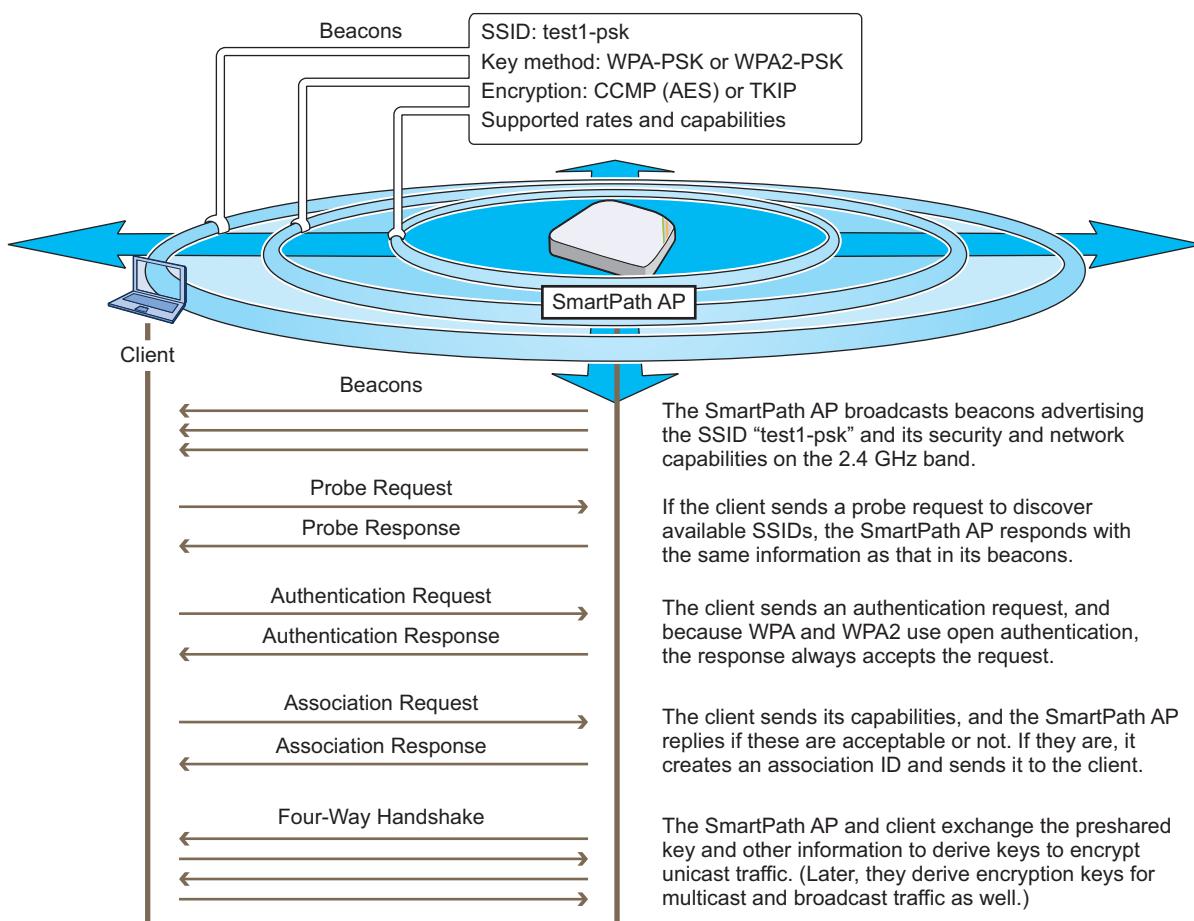


Figure 8-2. How a client discovers the SSID and forms a secure association.

8.2 Example 2: Creating a Cluster

A cluster is a group of SmartPath APs that exchanges information with each other to form a collaborative whole. Through coordinated actions based on shared information, cluster members can provide the following services:

- Consistent Quality of Service (QoS) policy enforcement across all cluster members
- Coordinated and predictive wireless access control that provides seamless Layer 2 and Layer 3 roaming to clients moving from one cluster member to another (The members of a cluster can be in the same subnet or different subnets, allowing clients to roam across subnet boundaries.)
- Dynamic best-path routing for optimized data forwarding and network path redundancy
- Automatic radio frequency and power selection for wireless mesh and access radios
- Tunneling of client traffic from one cluster member to another, such as the tunneling of guest traffic from a SmartPath AP in the internal network to another SmartPath AP in the corporate DMZ

Cluster members use Wi-Fi Protected Access with a preshared key (WPA-PSK) to exchange keys and secure wireless cluster communications. To authenticate and encrypt wireless cluster communications, cluster members use open authentication and CCMP (AES) encryption. CCMP is a rough acronym for "Counter Mode with Cipher Block Chaining Message Authentication Code Protocol" that makes use of Advanced Encryption Standard (AES). This is very similar to the security provided by the SSID in the preceding example.

In this example, you define a cluster and name it "cluster-test1". Later, in Section 8.3, you assign the cluster to a WLAN policy, which in turn, you assign to SmartPath AP devices in Section 8.5.

NOTE: A WLAN policy is different from a cluster. Unlike the members of a WLAN policy who share a set of policy-based configurations, the members of a cluster communicate with each other and coordinate their activities as access points. WLAN policy members share configurations. Cluster members work together collaboratively.

Click Configuration > Advanced Configuration > Clusters > New, enter the following, leave the other options at their default settings, and then click Save:

Cluster: cluster1-test (You cannot include spaces in the name of a cluster.)

Description: Test cluster for learning how to use the GUI; remove later

As was done in the previous example, this note and the name "cluster1-test" are intended to act as reminders to replace this configuration later with a cluster name that you really intend to use.

Modify Encryption Protection: (select)

Automatically generate password: (select)

The password is what cluster members use when authenticating themselves to each other over the wireless backhaul link using WPA-PSK CCMP (AES). As an admin, you never need to see or know what this string is; therefore, using the automatic password generation method saves you the trouble of inventing a long—up to 63 characters—and random alphanumeric string.

Optional Settings: Leave the optional settings as they are by default. For information about these settings, and about any setting in the GUI for that matter, see the SmartPath EMS VMA on-line Help system.

8.3 Example 3: Creating a WLAN Policy

Through SmartPath EMS VMA, you can configure two broad types of features:

- Policy-level features—In combination, these features form policies that control how users access the network: SSIDs, user profiles, QoS forwarding mechanisms and rates, clusters, AAA (authentication, authorization, accounting) services, management services (DNS, NTP, SNMP, and syslog), tunnel policies, IP and MAC firewall policies, and VLAN assignments.

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- Device-level features—These features control how cluster members communicate with the network and how radios operate in different modes, frequencies, and signal strengths.

A WLAN policy is an assembly of policy-level feature configurations that SmartPath EMS VMA pushes to all SmartPath APs that you assign to the policy. Because these configurations are policy-based, they can apply across multiple physical devices. In contrast, device-level configurations are more appropriately applied to smaller sets of devices or to individual devices themselves.

In this example, you create a WLAN policy that includes the SSID and cluster configured in the previous two examples. Although the New WLAN Policy dialog box consists of several pages, for this basic configuration, you only need to configure items on the first page (see Figure 8-3).

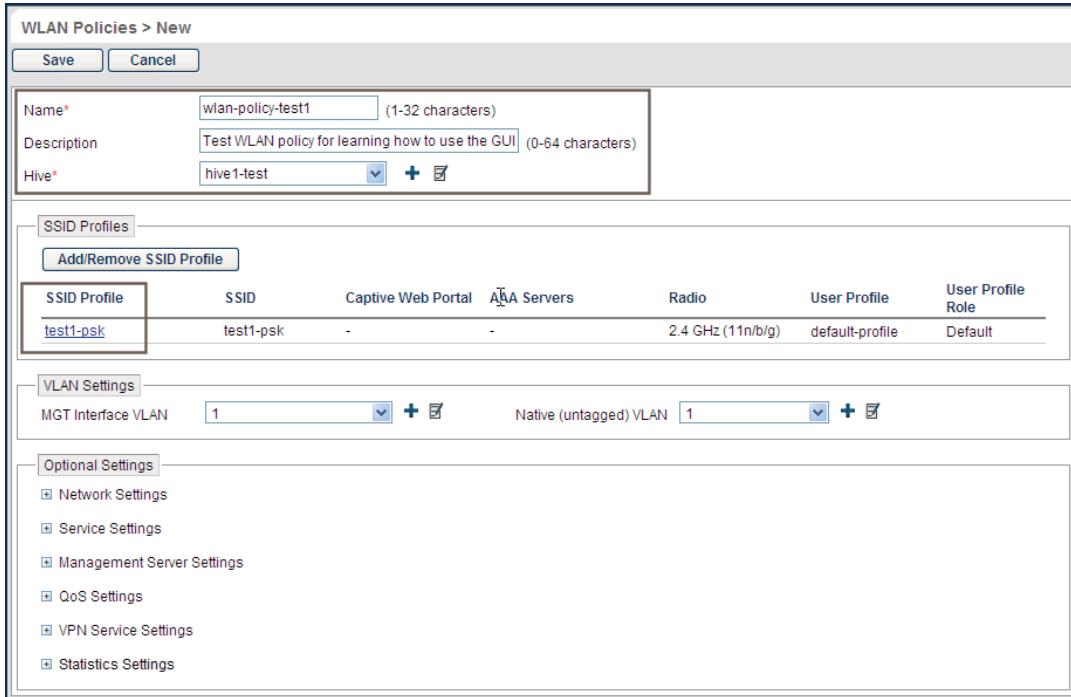


Figure 8-3. WLAN policy general settings.

Click Configuration > WLAN Policies > New, enter the following on the first page of the new WLAN policy dialog box, leave all the other settings as they are, and then click Save:

Name: wlan-policy-test1 (You cannot use spaces in the WLAN policy name.)

Description: Test WLAN policy for learning how to use the GUI; remove later

Cluster: cluster1-test (The cluster was previously configured in “Example 2: Creating a Cluster” in Section 8.2.)

SSID Profiles: Click Add/Remove SSID Profile, choose test1-psk in the Available SSID Profiles list, click the right arrow (>) to move it to the Selected SSID Profiles list, and then click Apply. (The SSID was previously configured in Section 8.1.)

The creation of a WLAN policy that puts the SmartPath APs to which you apply it in a cluster and provides them with an SSID is complete. In the following examples, you deploy several SmartPath APs on a network, accept them for SmartPath EMS VMA management, and then apply the WLAN policy to them.

8.4 Example 4: Access and Backhaul on the Same Radio

Black Box SmartPath APs have the ability to provide both wireless client access and backhaul services on the same interface. When you configure a SmartPath AP mesh point to operate in this way, you create a redundant pathway if one of the interfaces fails. This capability allows single radio SmartPath APs to operate as a mesh point with client access abilities, which was not possible previously.

Mesh Failover Overview

Mesh failover is the process by which a SmartPath AP maintains a network connection if the physical Ethernet connection is lost. SmartPath APs constantly check the health of the Ethernet connection and begin scanning for a SmartPath AP with which to form a mesh link using ACSP (Advanced Channel Selection Protocol). For mesh failover to occur, both client access and mesh communications must be possible simultaneously. If wifi0 is in access mode and wifi1 is in either backhaul or dual mode (access and backhaul, see below), then the SmartPath AP selects the wifi1 interface to form the mesh link.

NOTE: There are two places in the GUI that affect mesh failover: the backhaul failover settings in the specified radio profile and the radio mode settings for the SmartPath AP. To enable backhaul failover, it must be enabled in the radio profile and the radio must be in either backhaul or dual mode. (Backhaul mode provides a mesh link to another SmartPath AP. Dual mode provides both client access and backhaul mesh link on the same radio.)

See the following table for how these settings affect failover ability and client support.

Table 8-1. Failover ability and client support.

SmartPath AP Radio Service Settings	Services Clients on Both Bands	Provides Mesh Link Failover
Use both radios for client access	Yes	No
Use radio (2.4 GHz) for client access, radio (5 GHz) for a mesh link	No	No
Use radio (2.4 GHz) for client access, radio (5 GHz) for client access, radio (5 GHz) for client access and a mesh link (default setting)	Yes	Yes

The following illustration provides an overview of how the failover occurs. Three SmartPath APs are connected to an Ethernet backhaul, and each has clients on both the wifi0 and wifi1 interfaces on the channels and in the modes shown:

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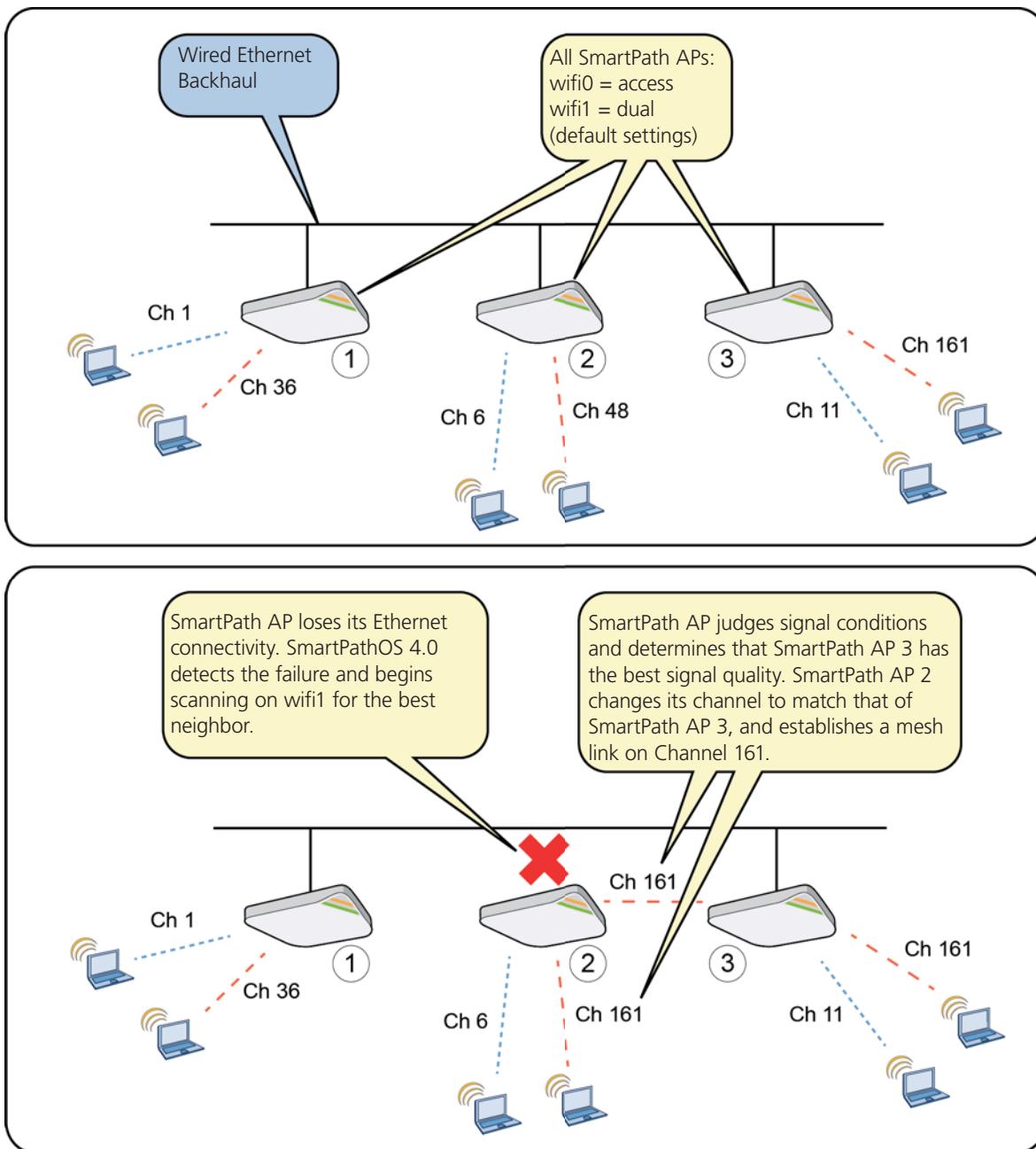


Figure 8-4. Overview of failover.

To configure a SmartPath AP to use access and backhaul simultaneously:

Click Monitor > Access Points > SmartPath APs, select the check box next to the SmartPath AP you want to configure, click "Modify," select the "Use radio (2.4 GHz) for client access, radio (5 GHz) for client access as well as a mesh link radio," and then click "Save."

- Use radio (2.4GHz) for client access, radio (5GHz) for client access as well as a mesh link
- Use both radios for client access
- Use one radio (2.4 GHz) for client access and one radio (5 GHz) for a mesh link
- Use a bridge configuration
- Use a custom configuration

Figure 8-5. Select radio.

By selecting the Enable the bridging of Ethernet connection devices over the wireless mesh network network checkbox, you enable advanced bridging features, such as bridge-access and bridge-802.1Q modes. To configure these modes, click Optional Settings > Interface and Network Settings.

8.5 Example 5: Connecting SmartPath APs to SmartPath EMS VMA

In this example, you set up three SmartPath APs for management through SmartPath EMS VMA. Cable two of the SmartPath APs—SmartPath AP1 and SmartPath AP2—to the network. Run an Ethernet cable from the eth0 port on each SmartPath AP to a switch so that they are in the same subnet as the IP address of the MGT interface on SmartPath EMS VMA. (Neither the SmartPath AP 300 eth1 port nor the SmartPath EMS VMA LAN port are used in this example.) You can use AC/DC power adapters to connect them to a 100–240 VAC power source or allow them to obtain power through PoE from PSE on the network. (Both power adapters and PoE injectors are available from Black Box as options.) Place the third SmartPath AP—SmartPath AP3—within range of the other two, and use a power adapter to connect it to an AC power source. See Figure 8-6, in which the switch uses PoE to provide power to SmartPath APs 1 and 2.

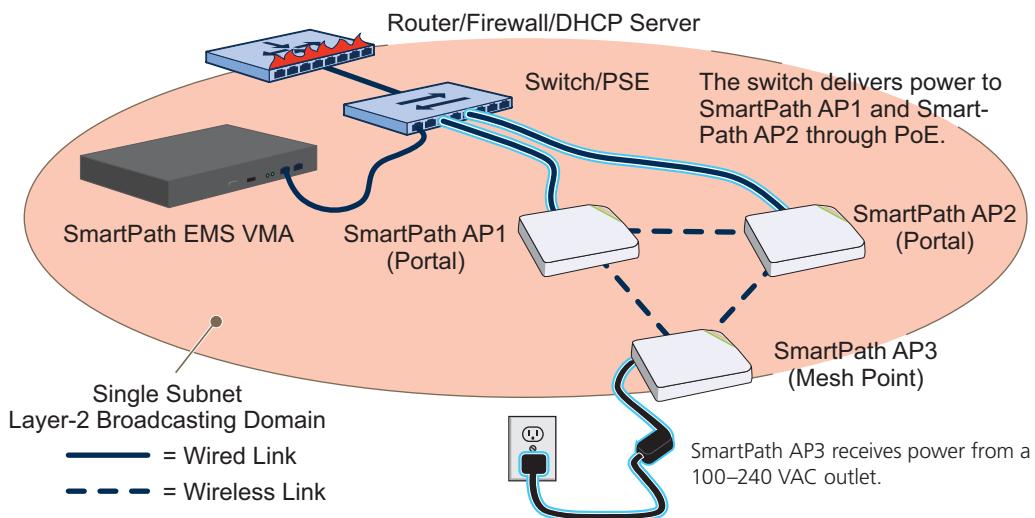


Figure 8-6. Connecting SmartPath APs to the network.

By default, the SmartPath APs obtain their network settings dynamically from a DHCP server. SmartPath AP3 reaches the DHCP server after first forming a wireless link with the other two SmartPath APs. (A SmartPath AP in the position of SmartPath AP3 is referred to as a mesh point, and SmartPath APs such as SmartPath AP1 and 2 are called portals.)

Within the framework of the CAPWAP protocol, SmartPath APs act as CAPWAP clients and SmartPath EMS VMA as a CAPWAP server. Because all devices are in the same subnet in this example, the clients can broadcast CAPWAP Discovery Request messages to discover and establish a secure connection with the server automatically. During the connection process, each client proceeds through a series of CAPWAP states, resulting in the establishment of a secure Datagram Transport Layer Security (DTLS) connection. These states and the basic events that trigger the client to transition from one state to another are shown in Figure 8-7.

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NOTE: To illustrate all possible CAPWAP states, Figure 8-5 begins by showing a SmartPath AP and SmartPath EMS VMA already in the Run state. When a SmartPath AP first attempts to discover a SmartPath EMS VMA—after the SmartPath AP has an IP address for its mgt0 interface and has discovered or has been configured with the SmartPath EMS VMA IP address—it begins in the Discovery state.

For information about various ways that SmartPath APs can form a secure CAPWAP connection with a physical SmartPath EMS VMA appliance or a SmartPath EMS VMA Virtual Appliance in the same or different subnets, and with SmartPath EMS Online, see “How SmartPath APs Connect to SmartPath EMS VMA” in this section.

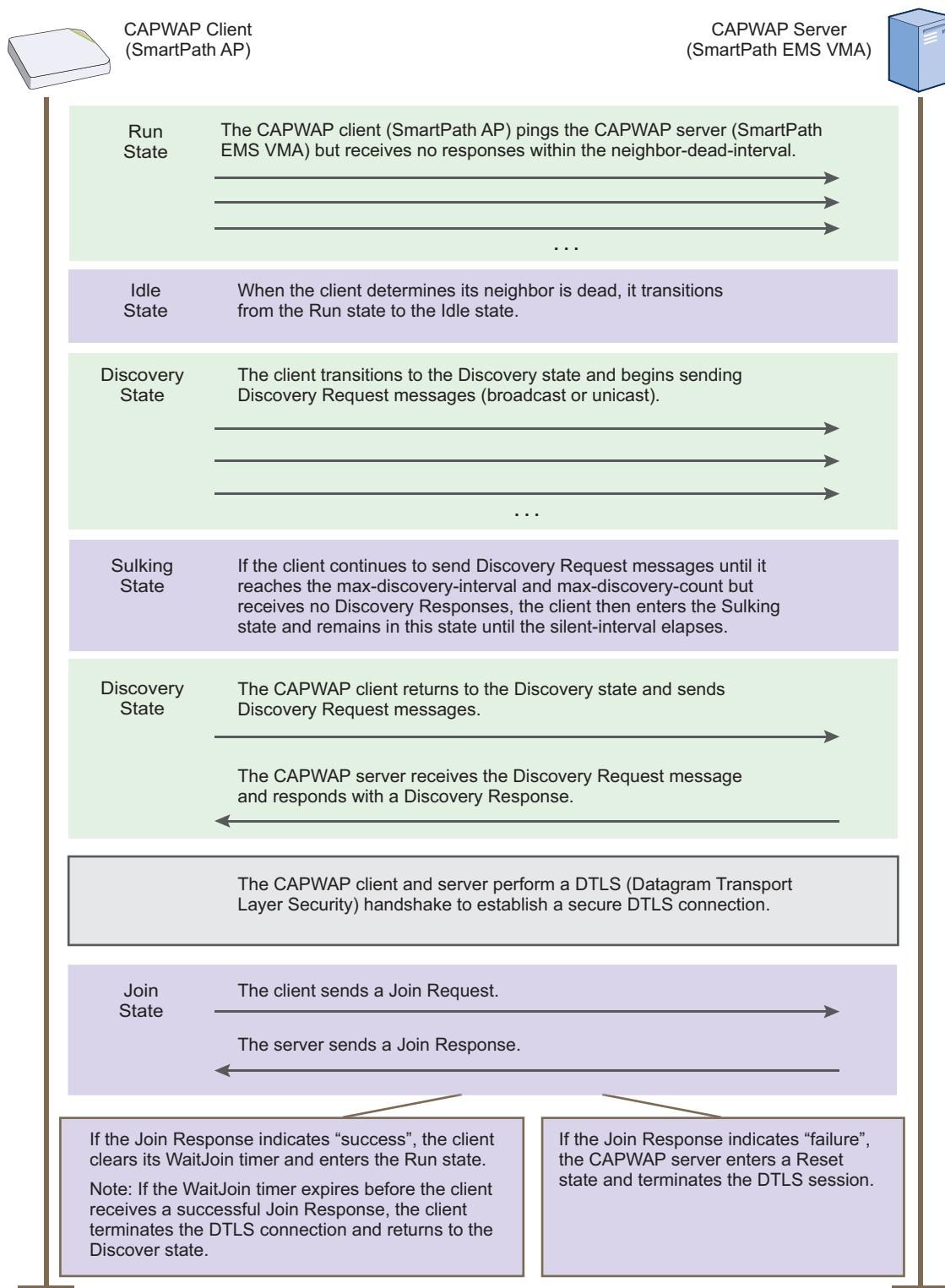


Figure 8-7. CAPWAP Connection process—beginning from the run state.

Check that the SmartPath APs have made a CAPWAP connection with SmartPath EMS VMA:

Click "Monitor > Access Points > SmartPath APs."

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The page displays the three SmartPath APs that you put on the network. If you see the three SmartPath APs, refer to Figure 8-6. If you do not see them, check the following:

- Do the SmartPath APs have power?

Check the PWR (Power) status LED on the top of the devices. If it is glowing steady green, it has power and has finished booting up. If the PWR status LED on a SmartPath AP (LWN602HA) is pulsing green, it is still loading the SmartPathOS firmware. If the PWR status LED is dark, the device does not have power. If a SmartPath AP is getting power through PoE from the switch or from a power injector, make sure that the PSE is configured and cabled correctly. If a SmartPath AP is powered from an AC outlet, make sure that the power cable is firmly attached to the power connector, the AC/DC power adapter, and the outlet.

- Are the two portals—SmartPath AP1 and SmartPath AP2—connected to the Ethernet network?

When the devices are properly connected, the ETH0 status LED on the SmartPath AP (LWN602HA) pulses green to indicate a 1000-Mbps link or amber for a 10-/100-Mbps link. If the ETH0 is dark, make sure that both ends of the Ethernet cable are fully seated in the SmartPath AP and switch ports. If the ETH0 status LED is still dark, try a different cable.

- Did the SmartPath APs receive network settings from a DHCP server? At a minimum, each SmartPath AP needs to receive an IP address, netmask, and default gateway in the same subnet as SmartPath EMS VMA. To check their settings, make a physical or virtual console connection to the SmartPath APs,* and do the following:

To check the IP address, netmask, and default gateway of the mgt0 interface on a SmartPath AP, enter `show interface mgt0`, and look at the settings displayed in the output.

* To make a physical console connection, connect a console cable to the SmartPath AP as explained in Chapter 5 (the SmartPath AP platform chapter). A virtual access console is an SSID that the SmartPath AP automatically makes available for administrative access when it does not yet have a configuration and cannot reach its default gateway. By default, the SSID name is "<host-name>_ac". Form a wireless association with the SmartPath AP through this SSID, check the IP address of the default gateway that the SmartPath AP assigns to your wireless client, and then make an SSH or Telnet connection to the SmartPath AP at that IP address. When you first connect, the Initial CLI Configuration Wizard appears. Because you do need to configure all the settings presented in the wizard, enter N to cancel it. When prompted to log in, enter the default admin name: BB-(last six digits of MAC address) (for example, BB-123456) and password: blackbox. For SmartPath APs set with "world" as the region code, enter the boot-param country-code number command. For number, enter the country code for the location where you intend to deploy the SmartPath AP. For a list of country codes, see Appendix: Country Codes.

A mesh point must first establish a wireless link to a portal over their backhaul interfaces before it can contact a DHCP server. To see that the mesh point (SmartPath AP3) has successfully formed a link with a portal using the default cluster "cluster0", enter `show cluster cluster0 neighbor` and check the Cstate column. If at least one other SmartPath AP is listed as a neighbor and its cluster state is Auth, the mesh point has successfully formed a link and can access the network. If the cluster state is anything else, it might still be in the process of forming a link. The following are the various cluster states:

Disv (Discover)—Another SmartPath AP has been discovered, but there is a mismatch with its cluster ID.

Neibor (Neighbor)—Another SmartPath AP has been discovered whose cluster ID matches, but it has not yet been authenticated.

CandPr (Candidate Peer)—The cluster ID on a discovered SmartPath AP matches, and it can accept more neighbors.

AssocPd (Association Pending)—A SmartPath AP is on the same backhaul channel, and an association process is in progress.

Assocd (Associated)—A SmartPath AP has associated with the local SmartPath AP and can now start the authentication process.

Auth (Authenticated)—The SmartPath AP has been authenticated and can now exchange data traffic. You can also check the presence of cluster neighbors by viewing the entries listed in the Supplicant column for the wifi1.1 interface in the output of the `show auth` command.

If the SmartPath AP does not have any network settings, check that it can reach the DHCP server. To check if a DHCP server is accessible, enter interface mgt0 dhcp-probe vlan-range <number1> <number2>, in which <number1> and <number2> indicate the range of VLAN IDs on which you want the SmartPath AP to probe for DHCP servers. The results of this probe indicate if a DHCP server is present and has responded. If the probe succeeds, check the DHCP server for MAC address filters or any other settings that might interfere with delivery of network settings to the SmartPath AP.

- Are the SmartPath APs in the same subnet as SmartPath EMS VMA?

SmartPath APs must be in the same subnet and the same VLAN as SmartPath EMS VMA for their broadcast CAPWAP Discovery messages to reach it. If you can move the SmartPath APs or SmartPath EMS VMA so that they are all in the same subnet, do so. If they must be in different subnets from each other, it is still possible for the SmartPath APs to contact SmartPath EMS VMA, but not by broadcasting CAPWAP messages. For a list of other connection options, see "How SmartPath APs Connect to SmartPath EMS VMA" on the next page.

- Can the SmartPath APs ping the IP address of the SmartPath EMS VMA MGT interface?

Enter the ping <ip_addr> command on the SmartPath AP, where the variable <ip_addr> is the IP address of the SmartPath EMS VMA MGT interface. If it does not elicit any ICMP echo replies from SmartPath EMS VMA, make sure that SmartPath EMS VMA is connected to the network through its MGT interface, not its LAN interface, and that the IP address settings for the MGT interface are accurate (see SP Admin > SmartPath EMS VMA Settings > Interface Settings in the SmartPath EMS VMA GUI).

- What is the status of the CAPWAP client running on the SmartPath AP?

To check the CAPWAP status of a SmartPath AP, enter the show capwap client command. Compare the "RUN state" with the CAPWAP states explained in Figure 8-5. Check that the SmartPath AP has an IP address for itself and the correct address for SmartPath EMS VMA. If for some reason, the SmartPath AP does not have the correct address for SmartPath EMS VMA, you can set it manually by entering the capwap client server name <ip_addr> command, in which <ip_addr> is the SmartPath EMS VMA MGT interface IP address.

When SmartPath APs have contacted SmartPath EMS VMA, they appear in the Monitor > Access Points > SmartPath APs page, as shown in Figure 8-8.

Audit icons:

Green square + red triangle: The configuration on a SmartPath AP does not match that on the SmartPath EMS VMA.

Two green squares: they match.

CAPWAP connection and security icons:

Green linked chain/red unlinked chain: The SmartPath AP is connected or disconnected.

Green locked padlock/red unlocked padlock: Connection is secured through DTLS or not.

You can customize the table contents by clicking the Edit Table icon. You can add more columns (radio channels and power, for example), remove columns, and reorder them.

SmartPath APs (Monitor Config)								
New	Modify	Clone	Remove	Import	Update...	Tools...	SmartPath AP OS	
Audit	Host Name	Alarm	IP Address	Node ID	Connection	AP Type	Clients	Uptime
New HiveAPs [-]								
<input type="checkbox"/>	SmartPath AP-1	<input checked="" type="checkbox"/>	10.45.1.38	0019770E5580		Portal	0	1 Days, 10 Hrs 3 Mins 48 Secs
<input type="checkbox"/>	SmartPath AP-2	<input checked="" type="checkbox"/>	10.45.1.33	001977000190		Portal	0	8 Days, 6 Hrs 16 Mins 58 Secs
<input type="checkbox"/>	SmartPath AP-3	<input checked="" type="checkbox"/>	10.45.1.38	00197725BC20		Mesh Point	0	1 Days, 10 Hrs 3 Mins 48 Secs

The host names have been changed to match those in the example.

By default, the host name is BB- + the last six bytes of its MAC address. (Example: BB-0E5580)

The AP type for SmartPath AP1 and SmartPath AP2 is "Portal." They have Ethernet connections to the network. SmartPath AP3 is the "Mesh Point." It connects to the network through a portal.

Figure 8-8. Monitor > Access Points > SmartPath APs (view mode: Monitor).

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NOTE: If you see a different group of SmartPath AP settings, make sure that Monitor is selected as the view mode at the top of the SmartPath APs page. The GUI provides two view modes for SmartPath APs, one that focuses on monitoring SmartPath APs (Monitor) and another that focuses on configuring them (Config).

How SmartPath APs Connect to SmartPath EMS VMA

SmartPath APs and SmartPath EMS communicate with one another through CAPWAP (Control and Provisioning of Wireless Access Points). SmartPath APs act as CAPWAP clients and SmartPath EMS acts as a CAPWAP server. SmartPath APs can form a CAPWAP connection with SmartPath EMS in any of the following ways:

- When SmartPath APs are in the same layer 2 broadcast domain as a SmartPath EMS appliance or SmartPath EMS VMA Virtual Appliance, the SmartPath APs broadcast CAPWAP Discovery Request messages to discover SmartPath EMS and establish a secure connection with it automatically.
- If there is no SmartPath EMS VMA in the same broadcast domain but the SmartPath APs can reach the SmartPath EMS Online redirector—and serial number entries for the SmartPath APs have already been added to the SmartPath EMS Online ACL (access control list)—then they can form secure CAPWAP connections with the redirector (redirection server). From there, an administrator can assign the connected SmartPath APs to a SmartPath EMS VMA (virtual management appliance) at the cluster site or to a SmartPath EMS VMA appliance—virtual or otherwise—at another site.
- Finally, SmartPath APs and a local SmartPath EMS VMA might be in different subnets and the SmartPath APs either cannot reach SmartPath EMS Online or they can but they are not listed in the ACL (perhaps because they are not included in any SmartPath EMS Online account). In this case, the SmartPath APs cannot discover SmartPath EMS by broadcasting CAPWAP Discovery Request messages, nor can they reach the redirector. So that the SmartPath APs can form a CAPWAP connection to SmartPath EMS, you can use one of the following methods to configure them with the SmartPath EMS VMA domain name or IP address or configure them so that they can learn it through DHCP or DNS settings. When SmartPath APs have the IP address of the CAPWAP server, they then send unicast CAPWAP Discovery Request messages to that address.
- Log in to the CLI on the SmartPath AP and enter the IP address or domain name of the CAPWAP server:

```
capwap client server name <string>
```

- Configure the DHCP server to supply the SmartPath EMS VMA domain name as DHCP option 225 or its IP address as option 226 in its DHCPOFFER. (If you use a domain name, the authoritative DNS server for that domain must also be configured with an A record that maps the domain name to the SmartPath EMS VMA IP address.) A SmartPath AP requests options 225 and 226 by default when it broadcasts DHCPDISCOVER and DHCPREQUEST messages.

NOTE: If you need to change the DHCP option number (perhaps because another custom option with that number is already in use on the DHCP server), enter this command with a different option number:

```
interface mgt0 dhcp client option custom clustermanager <number> { ip | string }
```

- If SmartPath EMS VMA continues to use its default domain name ("smartpathemsvma") plus the name of the local domain to which it and the SmartPath APs belong, configure an authoritative DNS server with an A record that resolves "clustermanager.<local_domain>" to an IP address. If a SmartPath AP does not have an IP address or domain name configured for the CAPWAP server and does not receive an address or a domain name returned in a DHCP option, then it tries to resolve the domain name to an IP address.

If you are using SmartPath EMS Online instead of a physical SmartPath EMS VMA appliance or SmartPath EMS VMA Virtual Appliance and the SmartPath APs go on-line for the first time without any specific CAPWAP server configuration entered manually or received as a DHCP option, they progress through the following cycle of CAPWAP connection attempts. First, they try to connect with a CAPWAP server at clustermanager.<local_domain>. If that is unsuccessful, they next try to elicit a response from the broadcast of CAPWAP Discovery messages on their local subnet. If neither of these efforts produces a response, they try to connect to SmartPath EMS Online, first using the CAPWAP UDP port 12222 and then using CAPWAP over the HTTP TCP port of 80. This cycle is shown in Figure 8-9.

1. If the DNS server cannot resolve the domain name to an IP address, the SmartPath AP broadcasts CAPWAP Discovery messages on its local subnet for a CAPWAP server (SmartPath EMS VMA). If SmartPath EMS VMA is on the local network and responds, they form a secure CAPWAP connection.

The SmartPath AP tries to connect to SmartPath EMS VMA using the following default domain name: smartpathEMS.<local_domain>, where "<local_domain>" is the domain name that a DHCP server supplied to the SmartPath AP.

If a DNS server has been configured with an A record to resolve that domain name to an IP address, the SmartPath AP and SmartPath EMS VMA then form a secure CAPWAP connection.

If the first two searches for a local SmartPath EMS VMA produce no results, the SmartPath AP broadens its search even wider and tries to contact SmartPath EMS Online at SmartPath.blackbox.com:12222. If the online server has a serial number or MAC address for that SmartPath AP, it responds and they form a secure CAPWAP connection.

If the SmartPath AP cannot make a CAPWAP connection to SmartPath EMS Online using UDP Port 12222, it tries to reach it by using TCP Port 80:smartpath.blackbox.com:80. If that proves unsuccessful, the SmartPath AP returns to its initial search through a DNS lookup and repeats the cycle.

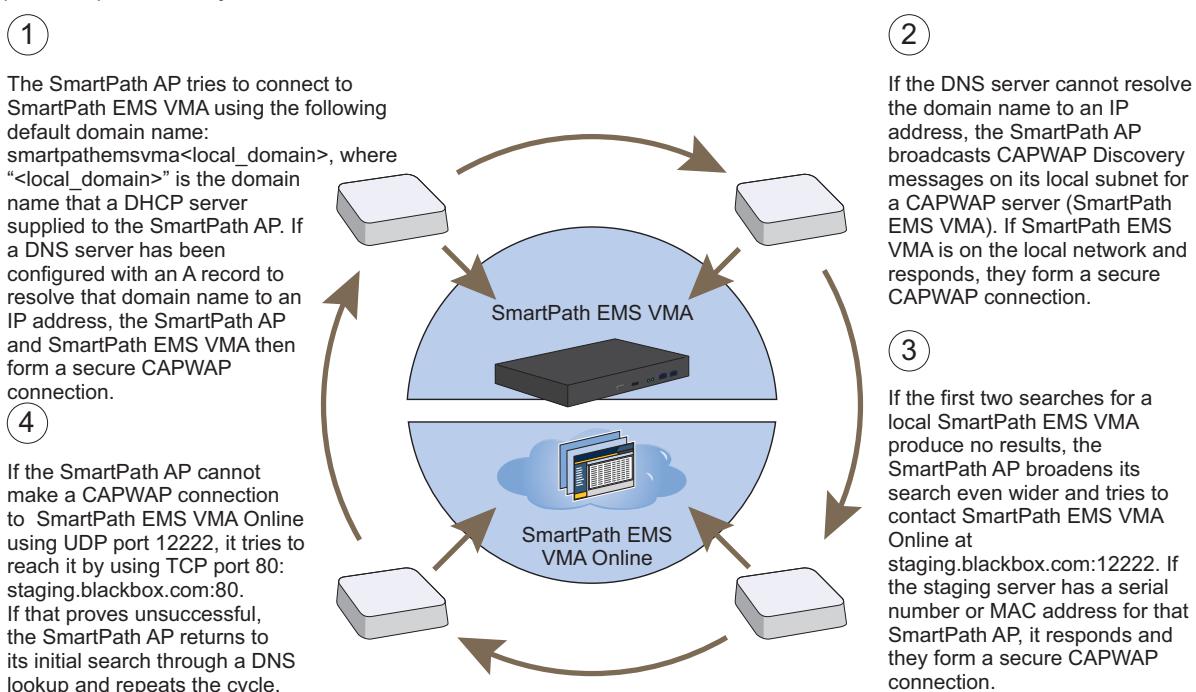


Figure 8-9. Discovering the CAPWAP server.

8.6 Example 6: Assigning the Configuration to SmartPath APs

After completing the steps in the previous examples, you now assign the WLAN policy to the SmartPath APs. In addition, you set one radio in access mode and one in backhaul mode, and you change their login settings (and country code if necessary). Finally, you push the configuration to the SmartPath APs. The transfer of SmartPath AP configuration assignments is presented conceptually in Figure 8-10.

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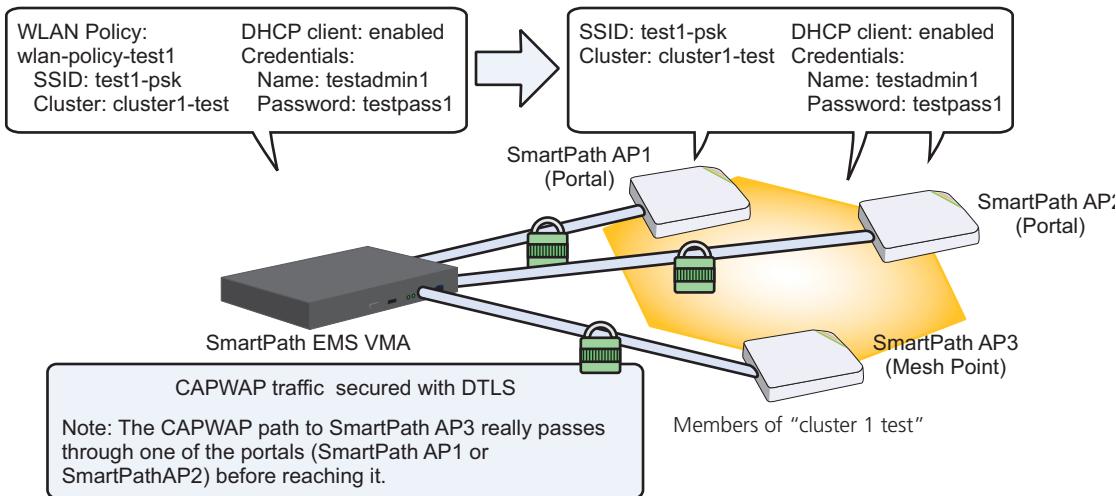


Figure 8-10. SmartPath AP configuration assignments.

Assigning Configurations

1. Click "Monitor > Access Points > SmartPath APs (View mode: Config)."
2. Because you can only set radio modes on individual SmartPath APs, click one of their names, select Use one radio (2.4 GHz) for client access and one radio (5 GHz) for a mesh link, and then click Save. Repeat this step for all the other SmartPath APs as well.
3. To modify all the SmartPath APs at the same time, select the checkbox in the header to the left of Host Name, which selects the checkboxes of all the SmartPath APs, and then click "Modify."

The SmartPath APs > Modify (Multiple) dialog box appears.

4. From the WLAN Policy drop-down list, choose wlan-policy-test1. This is the WLAN policy that you created in Section 8.3. Do not modify any of the other basic settings.
5. In the Optional Settings section, expand Credentials, and then enter the following in the Root Admin Configuration section:

New Admin Name: testadmin1

This is the root admin name that SmartPath EMS VMA uses to make SSH connections and upload a full configuration to managed SmartPath APs. The default root admin name and password is admin and blackbox.

New Password: testpass1

Confirm New Password: testpass1

Although changing the login credentials is not necessary, it is good practice, which is why it is included here. When you are ready to deploy the SmartPath APs on your network, change the admin name and password again.

NOTE: To see the text strings that you enter, clear the Obscure Password check box.

6. Leave the other settings as they are, and then click Save to save your configuration and close the dialog box.
7. Check your settings in the SmartPath APs window (see Figure 8-11).

Audit	Host Name	Alarm	IP Address	External IP Address	Node ID	Connection	AP Type	Clients	Uptime	SmartPath OS
<input type="checkbox"/>	SIMU-000070	✓	192.168.1.8	192.168.1.8	008C10000070		Portal	20	16 Days, 23 Hrs 36 Mins 35 Secs	SmartPath OS 3.5r3 release
<input type="checkbox"/>	SIMU-000010	✓	192.168.1.2	192.168.1.2	008C10000010		Portal	20	16 Days, 23 Hrs 36 Mins 35 Secs	SmartPath OS 3.5r3 release
<input type="checkbox"/>	SIMU-000090	✓	192.168.1.10	192.168.1.10	008C10000090		Mesh Point	20	16 Days, 23 Hrs 36 Mins 35 Secs	SmartPath OS 3.5r3 release
<input type="checkbox"/>	SIMU-000050	✓	192.168.1.6	192.168.1.6	008C10000050		Mesh Point	20	16 Days, 23 Hrs 36 Mins 35 Secs	SmartPath OS 3.5r3 release

Figure 8-11. Monitor > Access Points > SmartPath APs (view mode: Config).

Updating the Country Code

For SmartPath APs intended for use in the United States, the region code is preset as "FCC"—for "Federal Communications Commission"—and the country code is preset as "United States". If this is the case, you can skip this section.

If the preset region code for the managed SmartPath APs is "World", you must set the appropriate country code to control the radio channel and power selections that SmartPath APs can use. If this is the case, set the country code as follows:

1. On the Monitor > Access Points > SmartPath APs page, select the checkbox for SmartPath AP3, and then click Update > Update Country Code.*

*When updating the country code on SmartPath APs in a mesh environment, you do not want the rebooting of portals to interrupt the data path between the SmartPath EMS VMA and mesh points before they can complete their update process. Therefore, try to update and reboot mesh points first. Then, update and reboot the portals. See Section 7.6.

2. In the Update Country Code dialog box, enter the following, and then click Upload:

- Choose the country where they are deployed from the New Country Code drop-down list.

NOTE: Be sure to choose the correct country. An incorrect choice might result in illegal radio operation and cause harmful interference to other systems.

- In the Activate after field, set an interval in seconds after which the SmartPath AP reboots to activate the updated country code settings.
- Make sure that the checkbox for SmartPath AP3 is selected.

SmartPath EMS VMA updates the country code on SmartPath AP3 and then reboots it after the activation interval that you set elapses. After SmartPath AP3 reboots, it puts the appropriate radio settings for the updated country code into effect.

3. Select the checkboxes for the two portals SmartPath AP1 and SmartPath AP2, and then repeat the previous steps to update their country codes.

After they reboot, all the SmartPath APs will have the correct country code, will reform into a cluster, and reconnect to SmartPath EMS VMA.

Uploading SmartPath AP Configurations

At this point, you have finished assigning configurations to the managed SmartPath AP objects on SmartPath EMS VMA, and it is time to push these configurations from SmartPath EMS VMA to the physical SmartPath AP devices. Because this is the first time to use SmartPath EMS VMA to update the configuration on these SmartPath APs, you must perform a full upload, which requires rebooting the SmartPath APs to activate their new configurations.

Chapter 8: Basic Configuration Examples

Because SmartPath AP3 is a mesh point and the update involves changing its cluster—from cluster0 to cluster1-test—you must make sure to update its configuration before updating the configurations on SmartPath AP1 and SmartPath AP2. If you upload the configuration on all of them at the same time and schedule them to reboot too quickly (say, 1 second after the upload process completes), there is a chance that the portal through which the configuration for the mesh point is passing will reboot before the mesh point finishes receiving its configuration. If that happens, only the configuration on the portals will be updated. As a result, the portals will become members of a different cluster (cluster1-test) from the mesh point (cluster0). The mesh point will no longer be able to connect to the network through a portal using cluster0 and will become disconnected from the network and from SmartPath EMS VMA.

To avoid the preceding scenario, you must first change the cluster on mesh points while they can still connect to the network. After you change the cluster to which the mesh points belong, they will lose network and SmartPath EMS VMA connectivity temporarily until you update the configuration on the portals. After they also join the new cluster, the mesh points will once again be able to connect through their portals to the network and to SmartPath EMS VMA. For more information on this topic, see Section 7.6.

1. On the Monitor > Access Points > SmartPath APs page, select the checkbox for SmartPath AP3, and then click Update > Upload and Activate Configuration.

The Upload and Activate Configuration dialog box appears.

2. When initially sending the configuration to SmartPath APs, SmartPath EMS VMA must perform a complete upload, which it does automatically. After that, it automatically performs a delta upload by comparing the current configuration for the SmartPath AP stored on SmartPath EMS VMA with that running on the SmartPath AP and then uploading only the parts that are different. The three options (found in the Settings section) for uploading configurations are as follows:

Complete Upload: This option uploads the complete configuration to the selected SmartPath APs and reboots them to activate their new configuration.

Delta Upload (Compare with last SmartPath EMS VMA config): This option uploads only the parts of the configuration that were not previously pushed to the SmartPath APs from SmartPath EMS VMA.

Delta Upload (Compare with running SmartPath AP config): This option uploads only the changes to the configuration based on a comparison of the current configuration for the selected SmartPath APs on SmartPath EMS VMA with the current configuration running on the SmartPath APs.

Uploading a delta configuration does not require activation by rebooting the SmartPath AP and is, therefore, less disruptive. However, before SmartPath EMS VMA can upload a delta configuration to a managed SmartPath AP, it must first upload the full configuration and activate it by rebooting the SmartPath AP. After that, you can use the delta options.

NOTE: If there is any failure when performing a delta upload, use a complete upload the next time.

3. Click Settings, select Activate after, leave the default interval of 5 seconds, and then click Save. The three options for controlling the activation of an uploaded configuration are as follows:

Activate at: Select this option and set the time when you want the updated SmartPath APs to activate their new configuration. This is a good choice if you want to stagger the activation, or if you want to load a configuration now but activate it when the network is less busy. To use this option accurately, both SmartPath EMS VMA and the managed SmartPath APs need to have NTP enabled.

Activate after: Select this option to load a configuration on the selected SmartPath APs and activate it after a specified interval. The range is 0–3600 seconds; that is, immediately to one hour. The default is 5 seconds.

Activate at next reboot: Select this option to load the configuration and not activate it. The loaded configuration is activated the next time the SmartPath AP reboots.

4. Select Upload and activate configuration (the other items that can be uploaded are inapplicable at this point), make sure that SmartPath AP3 is selected, and then click Upload.