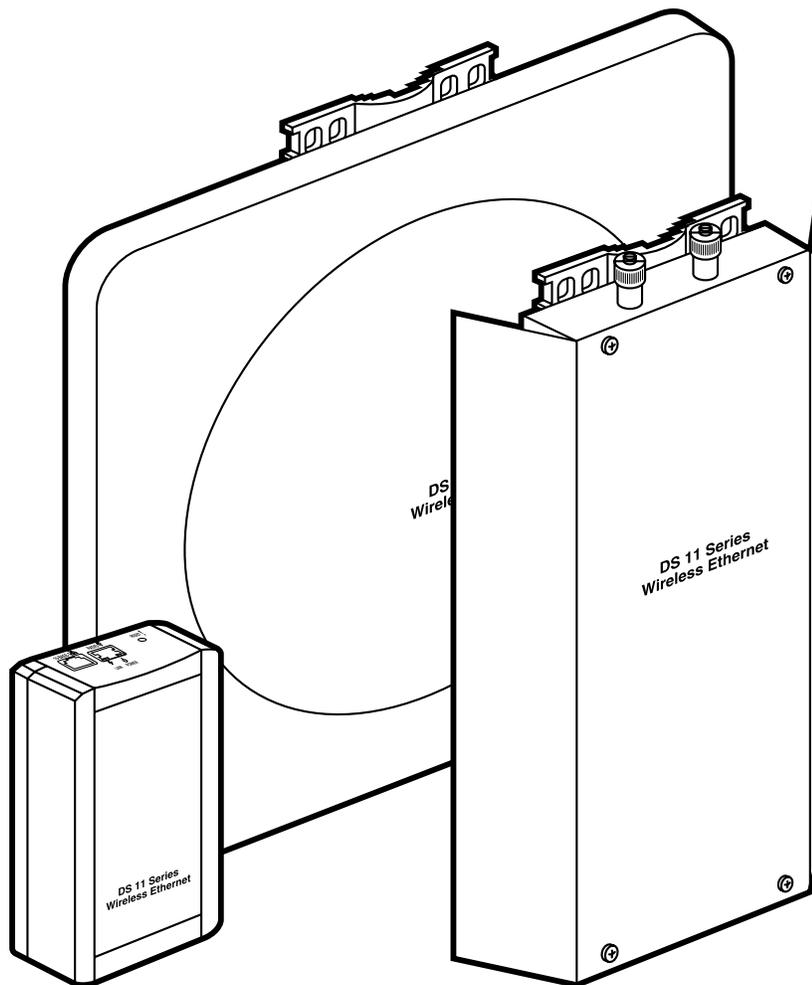




NOVEMBER 2001

LW2001A-CA	LW2003A-US	LW2007A-UK
LW2001A-EU	LW2005A-CA	LW2007A-US
LW2001A-UK	LW2005A-EU	LW2022A
LW2001A-US	LW2005A-UK	LW2050A
LW2003A-CA	LW2005A-US	LW2090A
LW2003A-EU	LW2007A-CA	
LW2003A-UK	LW2007A-EU	

DS.11 Series Wireless Ethernet Users' Manual



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**FEDERAL COMMUNICATIONS COMMISSION
and INDUSTRY CANADA
RADIO FREQUENCY INTERFERENCE STATEMENTS**

Class B Digital Device. This equipment has been tested and found to comply with the limits for a Class B computing device pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. However, there is no guarantee that interference will not occur in a particular 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. If this equipment does cause harmful interference to radio or telephone 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 an experienced radio/TV technician for help.

Caution

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

To meet FCC requirements, shielded cables and power cords are required to connect this device to a personal computer or other Class B certified device.

This digital apparatus does not exceed the Class B limits for radio noise emission from digital apparatus set out in the Radio Interference Regulation of Industry Canada.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de classe B prescrites dans le Règlement sur le brouillage radioélectrique publié par Industrie Canada.

EUROPEAN UNION DECLARATION OF CONFORMITY

This equipment complies with the requirements of the European EMC Directive 89/336/EEC.



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 bloquea 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 deber 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: Objetos 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.

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WARNING

FCC RADIATION EXPOSURE STATEMENT

To comply with FCC RF exposure requirements in section 1.1307, a minimum separation distance of 2 m (79 inches) is required between the antenna and all persons.

Antenna Installation

WARNING

It is the responsibility of the installer to make sure that when using the outdoor antenna kits in the United States (or where FCC rules apply), only those antennas certified with the product are used. The use of any antenna other than those certified with the product is expressly forbidden in accordance to FCC rules CFR47 part 15.204.

The installer should configure the output power level of antennas, according to country regulations and per antenna type.

CAUTION

Any changes or modifications of equipment not expressly approved by the manufacturer could void the user's authority to operate the equipment.

UL

This product is UL® listed.

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1. Specifications

1.1 Supported Standards

- Compliant with ETS 300 328 and ETS 300 826 (CE marked).
- IEEE 802.11b HR standard for Wireless LAN at 11 and 5.5 Mbps.
- IEEE 802.11b standard for 1 and 2 Mbps.

1.2 Configuration and Management

Management and Setup: SNMP-based configuration utility

Site Survey Tool: Integrated into the configuration utility

SNMP Agents: MIB II, Bridge MIB, DS.11 Private MIBs

Software Upgrade: Simultaneous multiple units using the configuration utility; TFTP download

LED Indicators: Indoor Interface Unit: Power status, End-to-end Ethernet status; Outdoor Unit: Power status, RSSI in the RB/Load gauge in base unit, Ethernet status/traffic, Wireless link status/traffic

1.3 Radio

Frequency Range: 2.4 to 2.4835 GHz ISM band (ETSI, FCC); 2.4 to 2.4835 GHz (Japan)

Radio Type: Direct Sequence Spread Spectrum (DSSS)

Wireless LAN Standards: Compliant with IEEE 802.11b HR

Selectable Sub-Channels: FCC: 1–11; ETSI: 1–13; Japan: TELEC 1–13; France: 10–13

Output Power (at the antenna port): FCC: -4, -2, 4, 6, 12, 14, 20, 24; ETSI (dBm): -4, -2, 4, 6, 12, 14; Japan: TELEC -4, -2, 4, 6, 12, 14

Table 1-1. Sensitivity (BER 10E-6).

Data Rate	Sensitivity	Modulation
11 Mbps	-85 dBm	256 CCK
5.5 Mbps	-88 dBm	16 CCK
2 Mbps	-90 dBm	DQPSK
1 Mbps	-93 dBm	DBPSK

Processing Gain: 10.4 dB nominal

Integrated Antenna Type: Flat panel 16 dBi, 20° vertical/horizontal

1.4 Range

Europe/ETSI (20 dBm EIRP): Up to 10 km (6.2 miles)

US FCC: Up to 25 km (15.5 miles)

1.5 Security

Authentication and Data: 40-bit RC4 WEP

1.6 Outdoor Unit-to-Indoor Unit Communication

Cable Type: Cat 5 FTP 4x2x24 double jacket

Maximum Cable Length Between Units: 90 m (295 feet)

1.7 Interfaces

RF (antenna) Connector in the Outdoor Unit: N-Type jack, lightning protected

Baseband (Indoor-to-Outdoor Units): Outdoor units: Shielded RJ-45 with special waterproof sealed cap;
Indoor units: Shielded RJ-45

Ethernet: Indoor units: 10BASE-T, (RJ-45) with two embedded LEDs

1.8 Electrical

Power: 110/220 VAC, 500/250 mA

1.9 Mechanical Dimensions

Size: Outdoor unit: 12"H x 4.7"W x 2"D (30.5 x 11.9 x 5.1 cm); Indoor unit: 6.1"H x 3.3"W x 2.2"D (15.5 x 8.4 x 5.6 cm)

1.10 Environmental

Operating Temperature: Indoor unit: 32 to 104°F (0 to 40°C); Outdoor unit: -40 to +131°F (-40 to +55°C)

Operating Humidity: 5 to 95% non-condensing (Outdoor units are weather protected)

1.11 Standards and Compliance

EMC: EN 300-385, FCC Part 15

Safety: EN 60950, UL® 1950

Environmental: ETS 300 019

Radio: ETSI ETS 300 328, FCC Part 15

2. Introduction

2.1 Using This Manual

This users' manual provides instructions for planning and setting up a Wireless link based on the DS.11 wireless base unit and remote bridge.

- **Chapter 1:** Specifications—Lists the technical specifications for the DS.11 series units.
- **Chapter 2 (this chapter):** Introduction—Explains how to use this manual and presents the DS.11 series.
- **Chapter 3:** Installation—Describes how to install the units.
- **Chapter 4:** The DS.11 Configuration Utility—Describes how to use the DS.11 Configuration Utility to set up, configure, and manage DS.11 series units.
- **Chapter 5:** System Troubleshooting—Solves some of the more common problems that may occur when installing and using the DS.11 products.
- **Appendix A:** DS.11 Frequently Asked Questions—Answers questions frequently asked by customers.
- **Appendix B:** Preparing the Indoor to Outdoor Cable—Explains how to prepare and install the cable connecting the indoor and outdoor units.
- **Appendix C:** Radio Signal Propagation—Explains many of the terms and concepts related to antennas and RF (Radio Frequency) systems.

2.2 System Description

The DS.11 Wireless Base Unit and Wireless Remote Bridge provide long-range point-to-multipoint links for outdoor applications (see Figure 2-1). The products use direct-sequence spread-spectrum radio technology operating at the frequency range of 2.4 to 2.4835 GHz, a part of the FCC's unlicensed Industrial, Scientific, Medical (ISM) band. Data is transmitted at rates of up to 11 Mbps, providing network users with full 10BASE-T Ethernet speeds.

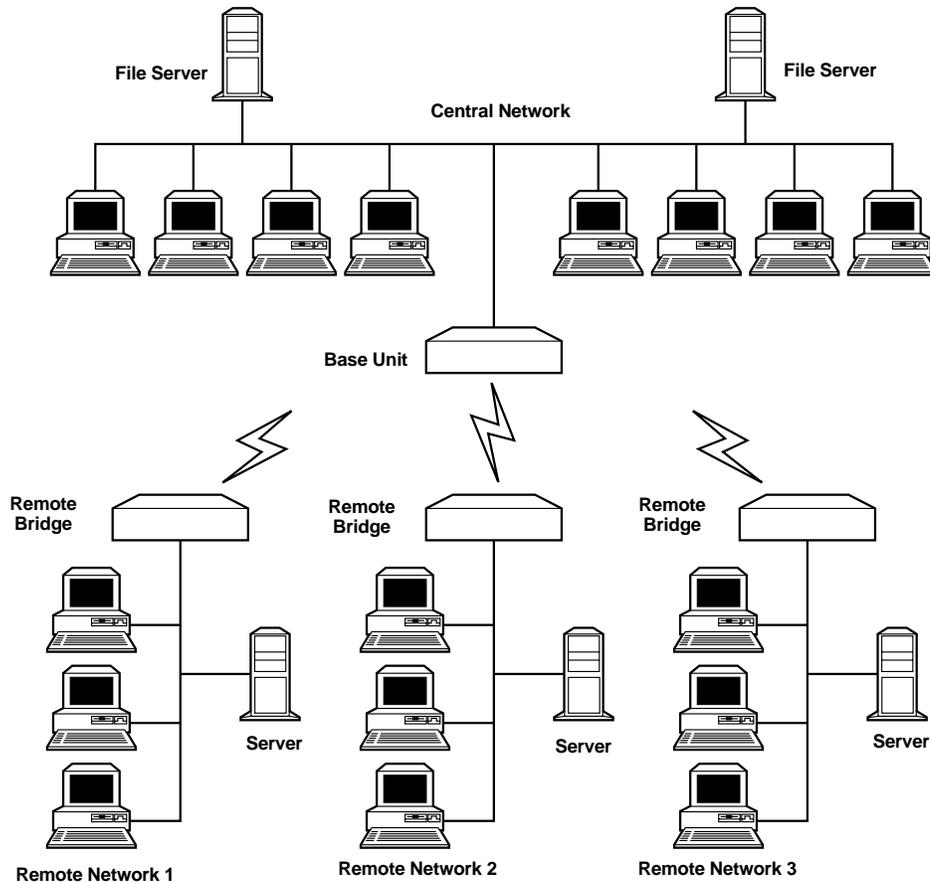


Figure 2-1. DS.11 point-to-multipoint application.

The base unit and remote bridge can be used as high-speed connections between two or more remote networks.

Wireless Base Unit

The base unit is an IEEE 802.11b-compliant base station that connects one or more remote sites to a central server or Internet connection. In a point-to-multipoint configuration, the base unit is the central unit. In point-to-point configurations, the base unit should be installed at one end of the link.

The base unit is available in two options: with or without an integrated antenna.

The LW2005A is the base unit, equipped with an antenna integrated into the front cover of the outdoor unit.

The LW2007A doesn't have an integrated antenna and has a connector on the outdoor unit for an external antenna (not included with the unit). A protective sun cover is supplied and should be mounted on the front of the outdoor unit. Refer to **Sections 3.4.4** and **3.4.9** for information on how to select the appropriate external antenna.

Wireless Remote Bridge

The Wireless Remote Bridge (LW2001A with integrated antenna or LW2003A with detached antenna) connects a remote Ethernet network to a central network server or Internet site via a Multipoint Base Unit.

The maximum number of MAC addresses that the unit can handle at any specific time is 1024, and the Aging algorithm is applied at all times.

When a station on the Ethernet LAN sends a message that is not destined for a local station, the remote bridge forwards the message to the base unit. When the base unit receives a message destined for a station on the remote bridge's LAN, the base unit forwards it to the remote bridge. In this manner, the remote bridge and the base unit work together like a standard network bridge.

The first time each station on the remote bridge's LAN sends a message, the station's address is registered by both the remote unit and the base unit. It is possible for the remote bridge and the base unit to store all the addresses necessary to support an entire LAN connected to a remote bridge.

There are two remote bridge options available: LW2001A and LW2003A.

The LW2001A is the base unit, equipped with an antenna integrated into the front cover of the outdoor unit.

The LW2003A has no integrated antenna and has an antenna connector on the outdoor unit for connecting an external antenna (not included). When this unit is ordered, a protective sun cover is supplied and should be mounted on the front of the outdoor unit.

Refer to **Sections 3.4.4** and **3.4.9** for information on how to select an external antenna.

2.3 DS.11 Compatibility and Standards

DS.11 products are compatible with the following standards and are interoperable with other IEEE 802.11b-compatible, 2.4-GHz direct-sequence products.

- IEEE 802.11b Wireless LAN.
- IEEE 802.3 10BASE-T Ethernet.
- DHCP for automatic IP address assignment.
- SNMP for system management.

3. Installation

3.1 What the Package Includes

Verify that all of the following items are included with the unit:

- Indoor unit.
- Outdoor unit (includes integrated antenna or antenna connector for optional connection to external antenna).
- Sun cover with screws (with LW2003A and LW2007A units only).
- Pole mounting kit for the outdoor unit (includes two brackets and four sets of screws, nuts, and washers).
- 110/220-VAC power cord.
- 20-meter (65.6-ft.) Indoor-to-Outdoor cable.
- (3) shielded RJ-45 connectors.
- Configuration Utility diskette.

3.2 What You Need to Supply

- Indoor-to-Outdoor cable (available in different lengths if the 20-m cable included with the unit is insufficient).
- Antenna and RF cable (if using an external antenna).
- Ground cable with an appropriate termination.
- Ethernet cable (straight for connecting to a hub).
- Installation tools and materials, including appropriate means (for example, a pole) for installing the outdoor unit.
- Crimping tool for shielded RJ-45 connectors.

3.3 Installation Overview

1. Select appropriate locations for the outdoor unit, the antenna (if using an external antenna), and the indoor unit.
2. Mount the outdoor unit. If using an external antenna, mount the antenna and connect it to the outdoor unit.
3. Connect a ground cable from the outdoor unit to an appropriate grounding point.
4. Connect the Indoor-to-Outdoor cable to the outdoor unit and route it to the location selected for the indoor unit. Refer to **Appendix B** for instructions on preparing the Indoor-to-Outdoor cable.
5. Mount the indoor unit. Connect the Indoor-to-Outdoor cable to the indoor unit's Radio port.

6. Connect the indoor unit's Ethernet port to the user's network using an Ethernet cable.
7. Configure the unit's parameters.
8. Align the antenna and verify connectivity with any other units.

NOTE

The indoor unit should be connected to the power source only after it has been connected to the outdoor unit.

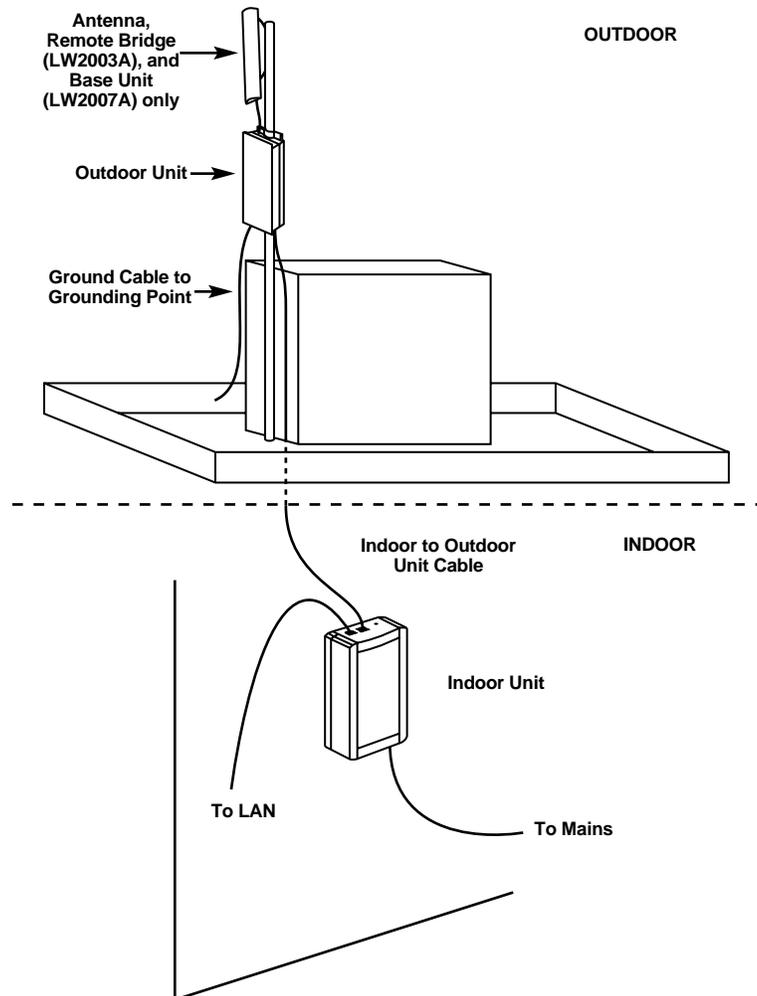


Figure 3-1. General installation scheme—pole mounting.

NOTE

Use a straight Ethernet cable to connect the indoor unit to a hub, or use a crossed cable to connect it directly to a PC's Network Interface Card (NIC).

3.4 Outdoor Installation Considerations

This section describes various considerations to take into account when planning an outdoor installation.

3.4.1 CO-LOCATING DS.11 OUTDOOR UNITS

Up to three base units with omnidirectional antennas (the exact number depends on the number of non-overlapping channels available in the relevant regulatory domain) can be co-located on the same building top or tower. Co-locating more than three units may decrease performance depending upon the type of antenna and its direction. Each unit should be assigned to one of the non-overlapping channels: 1, 7, or 13 in ETSI, or 1, 6, or 11 in FCC.

3.4.2 SITE-SELECTION FACTORS

When selecting a location for outdoor units and external antennas, remember to take into consideration the following guidelines:

- Minimum distance between sites.
- Maximum height above the ground.
- Maximum line-of-sight clearance.

Path of Clearest Propagation

A propagation path is the path that signals traverse between the antennas of any two units. The “line” between two antenna sites is an imaginary straight line, which may be drawn between the two antennas. Any obstacles in the path of the “line” degrade the propagation path. The best propagation path is, therefore, a clear line-of-sight with good clearance between the “line” and any physical obstacle.

Physical Obstacles

Any buildings or other physical structures such as trees, mountains, or other geographic features higher than the antenna and situated in the path between the two sites can constitute obstructions and cause signal attenuation. Install outdoor antennas high enough to avoid any obstacles, which may block the signal.

Path Loss

Path loss is determined by several factors:

- Distance between sites—Path loss is lower and system performance is better when distances between sites are shorter.
- Clearance—Path loss is minimized when there exists a clear line of sight. The number, location, size, and makeup of obstacles determine their contribution to path loss.
- Antenna height—Path loss is lower when antennas are positioned higher. Antenna height is the distance from the imaginary line connecting the antennas at the two sites to ground level. Ground level in an open area is the actual ground. In dense urban areas, ground level is the average height of the buildings between the antenna sites.

3.4.3 ROOFTOP INSTALLATION

Rooftop installations offer several advantages:

- Fewer obstacles in the path.
- Improved performance due to greater height.

3.4.4 ANTENNAS FOR OUTDOOR APPLICATIONS

The DS.11 series can be used in point-to-point or point-to-multipoint configurations.

Point-to-Point

The LW2001A/LW2005A can be equipped with a directional antenna. The required antenna gain depends on the required range and performance.

Point-to-Multipoint

Setting up a point-to-multipoint link requires the use of a base unit equipped with an omnidirectional antenna (or an antenna with sufficient beamwidth to illuminate all units) and at least two remote units equipped with high-gain directional antennas.

3.4.5 ANTENNA POLARIZATION

Antenna polarization must be the same at both ends of the link. In most applications, the preferred orientation is vertical polarization, which is best for above-ground propagation. To verify antenna polarization, refer to the assembly instructions supplied with the antenna set.

3.4.6 ANTENNA SEAL

When using outdoor antennas, you must seal all cable connections to prevent water or dirt from entering the connector.

3.4.7 CELL SIZE/LINK DISTANCE

Cell size is determined by the maximum possible distance between the LW2005A and a LW2001A unit. For open outdoor areas with an unobstructed line of sight between the LW2005A and the LW2001A units, the suggested maximum distance is up to 6 miles (9.7 km) where ETSI is the regulatory domain and 15 miles (25 km) where FCC is the regulatory domain.

NOTE

The maximum distance of 25 km/15 miles is achieved using 24-dBi antennas and 24-dBm output power. The maximum distance of 9.7 km/6 miles is achieved using 24-dBi antennas and -4dBm-output power.

3.4.8 USING OUTDOOR RANGE TABLES

For specific range tables, guidelines, and information about extended cables, call Black Box Technical Support at 724-746-5500.

Outdoor installations must have a clear line of sight between antennas. Solid obstacles (such as buildings or hills) can prevent the establishment of a link while partial obstacles (such as trees or traffic) can reduce range. Extended coaxial cables can cause an increase in signal loss and a reduction in range.

3.4.9 AVAILABLE ANTENNAS

Table 3-1 lists several antennas suitable for DS.11 units.

TIP

Cable length should be minimized in order to gain maximum link budget.

Table 3-1. Antennas.

Part Number	Ant. Gain	Ideal for:	Dispersion	Dimensions (H x W x D)
LW0029A-R2	8 dBi	Establishing 360° coverage for outdoor multipoint links.	360° H/13° V	20" x 5/8" tubular
LW019A	16 dBi	Medium- to long-range outdoor links requiring compact form factors.	28° H/28° V	11" x 11" x 3.5"
LW013	24 dBi	Long-range outdoor point-to-point links.	6° H/10° V	24" x 36" x 15"

3.4.10 PRECAUTIONS**WARNING**

Outdoor units and antennas should be installed ONLY by experienced antenna installation professionals who are familiar with local building and safety codes and, wherever applicable, are licensed by the appropriate government regulatory authorities.

The system complies with the ETS 300 385 standard and is protected against secondary lightning strikes when its outdoor unit is properly grounded according to the applicable country-specific industry standards for protection against lightning. The system complies with EN 61000-4-5, test level 3 (2kV).

Failure to do so may expose the user to personal injury and/or legal and financial liabilities.

3.4.11 COMPLIANCE WITH RADIO REGULATIONS

Regulations regarding maximum antenna gains vary from country to country. It is the responsibility of the user to operate within the limits of these regulations as well as to make sure that the professional installer is aware of these regulations.

Violation of government regulations exposes the user to legal and financial liabilities.

3.5 Installing the Outdoor Unit

The outdoor unit can be secured to the pole using one of the following options:

- Special brackets sets (supplied with each unit). There are two pairs of screw holes on the units, which allow you to use these brackets with various pole widths.

- U-bolts—size A (inner installation holes, up to 2" pole).
- U-bolt—size B (outside installation holes, up to 3" pole).
- Metal bands ($\frac{3}{16}$ " wide, minimum 12" long).

Figure 3-2 shows the locations of the holes, grooves, and screw holes on the back of the unit.

Figure 3-3 illustrates the method of installing a unit on a pole using the supplied brackets.

NOTE

Make sure to install the unit with the bottom panel (the panel with the signal strength bar and LEDs) facing downward.

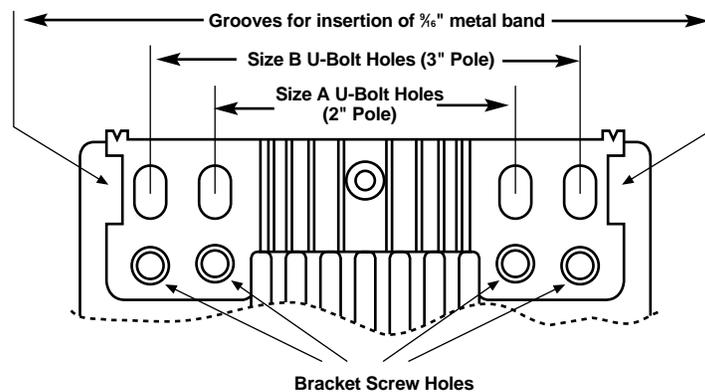


Figure 3-2. Holes/grooves and screw holes.

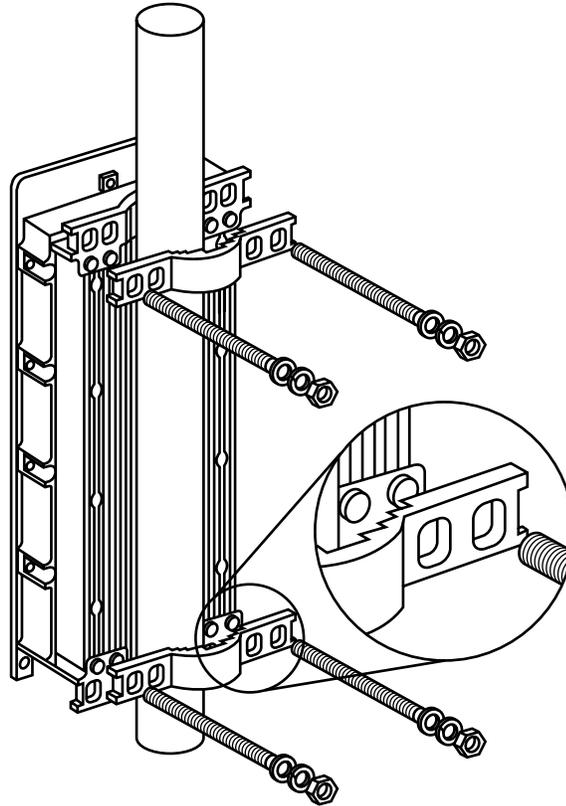


Figure 3-3. 3" pole mounting installation using the supplied brackets.

NOTE

When inserting the open-ended screws, make sure to insert them with the grooves pointing outwards; these grooves are intended to allow fastening of the screws with a screwdriver.

3.5.1 CONNECTING THE GROUND AND ANTENNA CABLES

The Ground terminal (marked \oplus) is located on the bottom panel of the outdoor unit. The Antenna RF connector (marked Υ) is located on the top panel of the LW2007A outdoor base unit.

NOTE

In DS.11 units with two antenna connectors, always use the connector marked $\Upsilon-1$.

1. Connect one end of the grounding cable to the Ground terminal and connect the other end to a good ground connection.
2. For LW2007A units, connect an RF cable between the antenna connector and the antenna.

3.5.2 CONNECTING THE INDOOR-TO-OUTDOOR CABLE

1. Remove the two screws that hold the waterproof seal to the outdoor unit. Remove the waterproof seal.
2. Unscrew the top nut from the waterproof seal.

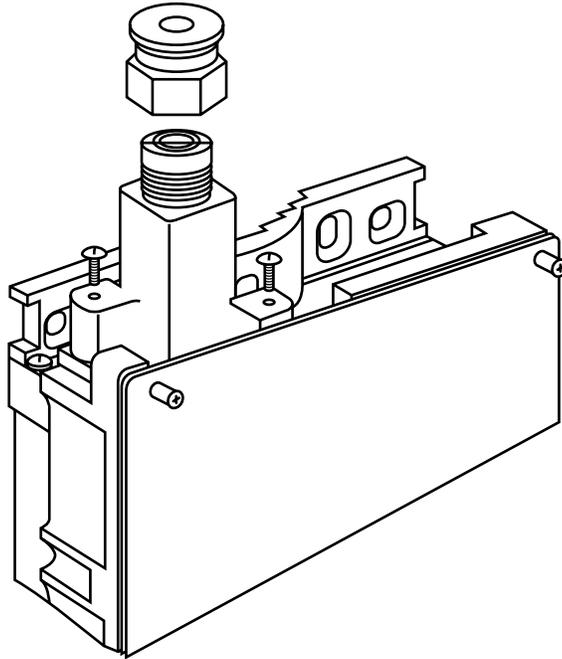


Figure 3-4. The waterproof seal.

3. Route a straight, uncrimped Ethernet cable (8-wire, 24-AWG pin-to-pin) through both the top nut and the waterproof seal.

NOTE

The 8-wire cable should be shielded.

4. Insert and crimp the RJ-45 connector. Refer to **Appendix B** for instructions on preparing the RJ-45 cable connector.
5. Connect the Ethernet cable to the outdoor unit's RJ-45 connector.
6. Replace the outdoor unit's waterproof seal assembly, then replace the top nut. To guarantee a good sealing, make sure that the cable's external jacket is well inside the waterproof seal.
7. Route the cable to the location selected for the indoor unit.

3.5.3 INSTALLING THE SUN COVER (LW2003A AND LW2007A UNITS ONLY)

For units without an integral antenna, a plastic sun cover is provided to protect the unit from direct sunlight. It is mounted to the front of the unit using four standard screws (included).

3.6 Installing the Indoor Unit

Route the Indoor-to-Outdoor cable into the building so that it reaches the indoor unit while avoiding interference sources. We recommend that you use a cable that's a little longer than necessary. The cable is supplied open-ended so it can be threaded into the building.

1. Remove the wall-mounting bracket clipped to the back of the indoor unit and mount it on a wall as shown in Figure 3-5. Mount the indoor unit on the mounting bracket.
2. Assemble an RJ-45 connector with a protective cover on the indoor side of the Indoor-to-Outdoor cable. Refer to **Appendix B** for instructions on preparing the RJ-45 cable connector.
3. Connect the Indoor-to-Outdoor cable to the Radio connector, which is located on the top panel of the indoor unit. (See Figure 3-7.) The Indoor-to-Outdoor cable should be connected to the unit before the unit is connected to the mains power.

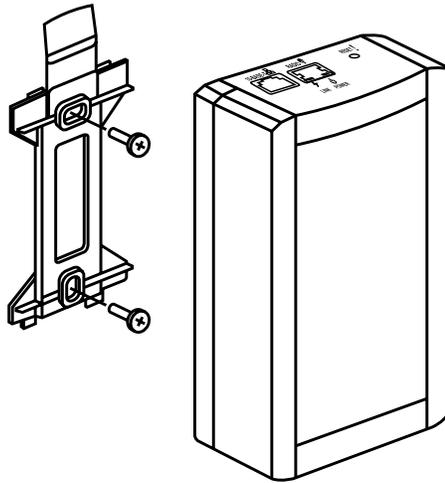


Figure 3-5. Wallmounting the indoor unit.

NOTE

The color codes of the power cable are:

brown	phase~
blue	neutral 0
yellow/green	grounding

- After connecting the outdoor unit to the indoor unit using the Indoor-to-Outdoor cable, connect the power cord to the unit's AC socket, located on the bottom panel (see Figure 3-6). Connect the other end of the power cord to the AC mains after verifying that the unit is rated for the voltage in the country of use; the AC rating is indicated on the bottom panel of the indoor unit.

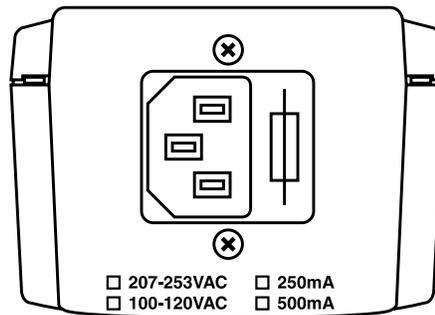


Figure 3-6. Indoor unit bottom panel.

- Verify that the yellow Power LED located on the top panel is lit. This indicates that the unit is supplying power to the Radio port.

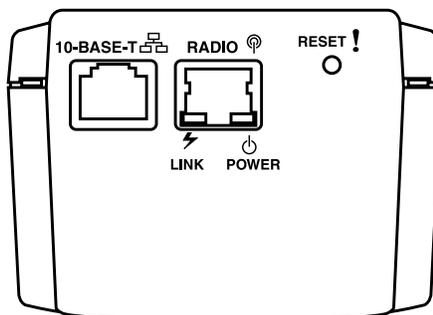


Figure 3-7. Indoor unit top panel.

6. Connect the 10BASE-T connector to the network. The cable connection should be straight Ethernet if connecting the indoor unit to a hub and a crossed cable if connecting it directly to a PC Network Interface Card (NIC).

NOTE

The length of the Ethernet cable connecting the indoor unit to the user's equipment, along with the length of the Indoor-to-Outdoor cable, should not exceed 90 meters (295 ft.).

3.6.1 CONFIGURING PARAMETERS

Before aligning the antenna, certain key parameters must be configured to enable connectivity with linked units. See **Section 4.2.1** for more information.

3.6.2 ANTENNA ALIGNMENT

Usually, low-gain antennas do not require alignment due to their very wide radiation pattern. High-gain antennas, including the integral antenna of DS.11 units, have a narrow beamwidth necessitating an alignment procedure in order to optimize the link.

Check the antenna alignment by using the RSSI bar on the bottom panel of the remote bridge unit (LW2001A).

To align the antenna:

1. Confirm that the units at both ends of the link are receiving power.
2. Synchronize the units by aligning the antennas at the central and remote sites until maximum signal quality is obtained. Check the signal-quality RSSI bar on the remote bridge's bottom panel. The first LED lights red to indicate that the unit is working. The remaining nine LEDs light green to indicate the signal strength. The stronger the signal, the more LEDs are lit. Rotate the antenna to the left or right until you reach the point of maximum RSSI reading. Make sure that at all times the front of the antenna faces the general direction of the base unit.

3.7 Verifying Correct Operation

3.7.1 VERIFYING CORRECT OPERATION OF THE INDOOR UNIT

To verify proper operation, check the LED indicators located on the top panel of the indoor unit as shown in Figure 3-7 and as described in Table 3-2.

Table 3-2. Indoor unit LEDs.

Name	Description	Function
Power	Power indication	Green: 48 VDC is present on the Radio RJ-45 port. Off: No power is supplied to the Radio RJ-45 port.
Link	Self-test and Ethernet Link indication	The Link LED indicates end-to-end connection between the outdoor unit and the Ethernet connection to the indoor unit. Off: No Ethernet connectivity has been detected between the outdoor unit and the device connected to the indoor unit. Orange: Self-test passed and Ethernet connection is confirmed by the outdoor unit (Ethernet integrity check passed).

3.7.2 VERIFYING CORRECT OPERATION OF THE OUTDOOR UNIT

To verify proper operation, check the LED indicators located on the bottom panel of the outdoor unit.

Table 3-3. Outdoor unit LEDs.

Name	Description	Function
WLAN	Wireless link indicator	Blinking Green: Data is received or transmitted on the wireless link. Blinking rate is slower when there is less wireless traffic.
DC Power	Self-test and power indication	Green: Power is available and self-test passed. Red: Self-test failed. Firmware did not load successfully.
RSSI Bar	Remote Bridge (LW2001A, LW2003A): Received signal strength indication. Base Unit (LW2005A, LW2007A): Number of associated Remote Bridge (LW2001A, LW2003A) units.	

(continued on the next page)

Table 3-3 (continued). Outdoor unit LEDs.

Name	Description	Function
ETH	Ethernet activity/ connectivity indication	<p>Off: Ethernet connectivity is OK. No traffic activity is detected on the port.</p> <p>Blinking Green: Ethernet connectivity is OK, with traffic on the port.</p> <p>Red: No Ethernet connectivity. When this state occurs, check the Ethernet cable and Indoor-to-Outdoor cable connections.</p>

What to do if the self-test fails

If the self-test failed (DC Power LED light remains red), try the following:

- Reset the unit (disconnect/reconnect the power).
- Check the Indoor-to-Outdoor cable.
- Reset to factory defaults (see **Section 4.5**).
- Contact Black Box Technical Support at 724-746-5500.

4. The DS.11 Configuration Utility

The DS.11 Configuration Utility is an SNMP-based utility that provides a consistent view of the wireless network. The system administrator can use the DS.11 Configuration Utility to control a large number of DS.11 units from a single location. The Configuration Utility can be used to manage base units and remote bridge units.

Using the Configuration Utility you can:

- Assign radio channels for optimal cell operation.
- Configure units with a specified IP address.
- Set the SNMP read/write community strings.
- Verify the status of all units in the network.
- Configure a wide range of operational parameters, including WLAN, IP, and security parameters.
- View Tx and Rx counters.
- Obtain general information such as the firmware version and system name.

4.1 Installing and Running the Configuration Utility

The Configuration Utility can be installed from a 3.5" diskette.

1. Insert the provided diskette into the computer where you want to install the Configuration Utility.
2. Run **DS11mgr.exe**.
3. Follow all instructions until you are informed that the utility was installed successfully.
4. Run the Configuration Utility from the Start menu by selecting it in the DS.11 Configuration Utility folder under **Programs**.

4.2 Configuration Utility Modes

There are several DS.11 Configuration Utility modes of operation. These options are selected via the Mode menu in the Configuration Utility main window (shown in Figure 4-1). The selected mode is indicated by a check mark in the menu.

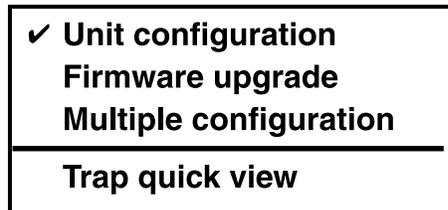


Figure 4-1. Configuration Utility modes of operation.

- Unit configuration: This is the default mode and is used for setting parameters as detailed in this manual.
- Firmware upgrade: Used for upgrading the embedded software in managed units; refer to **Section 4.2.2** for instructions on using this feature.
- Multiple configuration: Used for setting configuration parameters for more than one unit simultaneously; refer to **Section 4.2.3** for instructions on using this feature.
- Trap quick view: When set to this mode, the PC (if set as described later in this section) switches automatically to the Trap Monitor tab when Unit Configuration mode is selected.

4.2.1 UNIT CONFIGURATION MODE

The Control Window Section

In this section, you can:

- Discover the units that are connected to the network.
- View the DS.11 units that have been discovered by their IP address.
- Select the units you wish to manage.
- Locate units behind a router that cannot be detected by the autodiscovery feature
- Assign unit IP addresses based on unit MAC addresses.
- Set the SNMP Community string.

If there are many units in the managed network, you can enlarge the list box by clicking on the horizontal line above the list; click again to toggle back the default display state. The list box also displays the Location of each unit, as set in the Station Status dialog box (described later in this section).

The Tabs Section

This section consists of several tabs, each containing parameters required for the management of the selected unit. The number of tabs displayed varies between the type of managed unit. The different tabs are described in the following sections. When you switch between the tabs, the selected unit's address remains displayed.

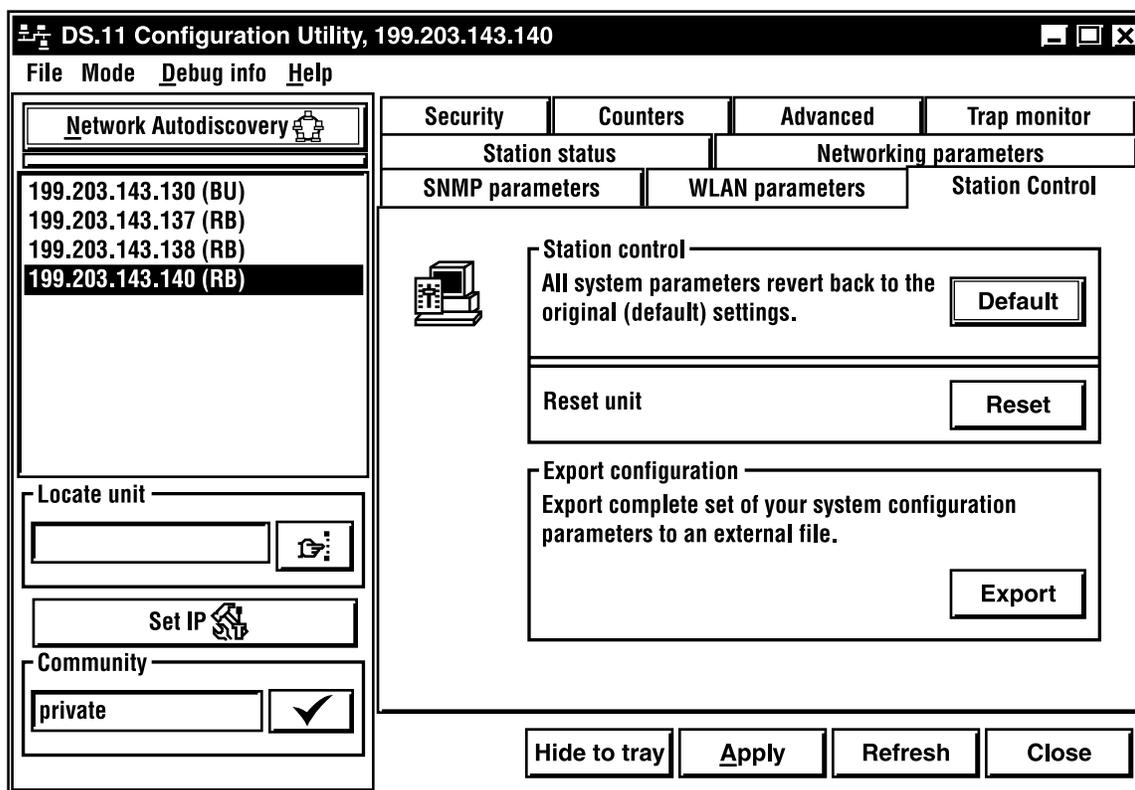


Figure 4-2. DS.11 Configuration Utility main window (Station Control tab).

The Control Window

Selecting Units

You can select a unit to manage in one of the following ways:

- Click the Network Autodiscovery button. All the IP addresses of units that are in the same domain but not hidden behind a router (under the selected community) are displayed in the list box underneath the button. Click on an address to select the corresponding unit for viewing and configuration (see Figure 4-2.)
- Type the unit's IP address in the Locate Unit field (for stations that are located behind a router) and click . This will add the unit information to the selection list.

Setting the SNMP Community String

Type the known Read/Write Community string in the Community field (the default string is public for read and private for read/write). Click the button to confirm.

Assigning and Editing IP Addresses Manually (Based on MAC Addresses)

1. Click the Set IP button. The Set IP dialog box appears.

Field	Value 1	Value 2	Value 3	Value 4	Value 5	Value 6
Mac-Address	00	20	d6	e1	a6	d2
IP-Address	198	121	200	132		
Subnet Mask	255	255	255	00		
Default Gateway	00	00	00	00		

Figure 4-3. The Set IP dialog box.

2. Type the parameters in the appropriate fields and click OK. The MAC address is shown on the bottom label of the Indoor and Outdoor units. A message box notifies you when the changes are to take effect. This feature can be used only if the DS.11 Configuration Utility is on the same Ethernet segment as the unit and not behind the router.

NOTE

In order to see the unit after assigning the IP address, the PC with the Configuration utility should be on the same IP subnet as the assigned IP address.

Units receive an auto IP address if there is no DHCP server and the unit is configured to work in the Smart mode as described later in this section. The IP address will be chosen randomly in the 169.254.x.x range with a subnet mask of 255.255.0.0.

Application Control Buttons

The following buttons always appear at the bottom of the Configuration Utility window. Additional buttons, specific to certain tabs, are explained when relevant.

- Hide to tray: Minimizes the application into the  icon, placed in the Windows task bar (at the bottom of the Windows desktop). To restore the application, click the  icon.
- Apply: Implements any changes you made.
- Refresh: Refreshes the window with the most recent data from the unit.
- Close: Closes the window without implementing any changes you made.

Configuration Utility Tabs

Station Status Tab

The Station Status tab displays general information regarding the unit's firmware and hardware versions, as well as general unit address information.

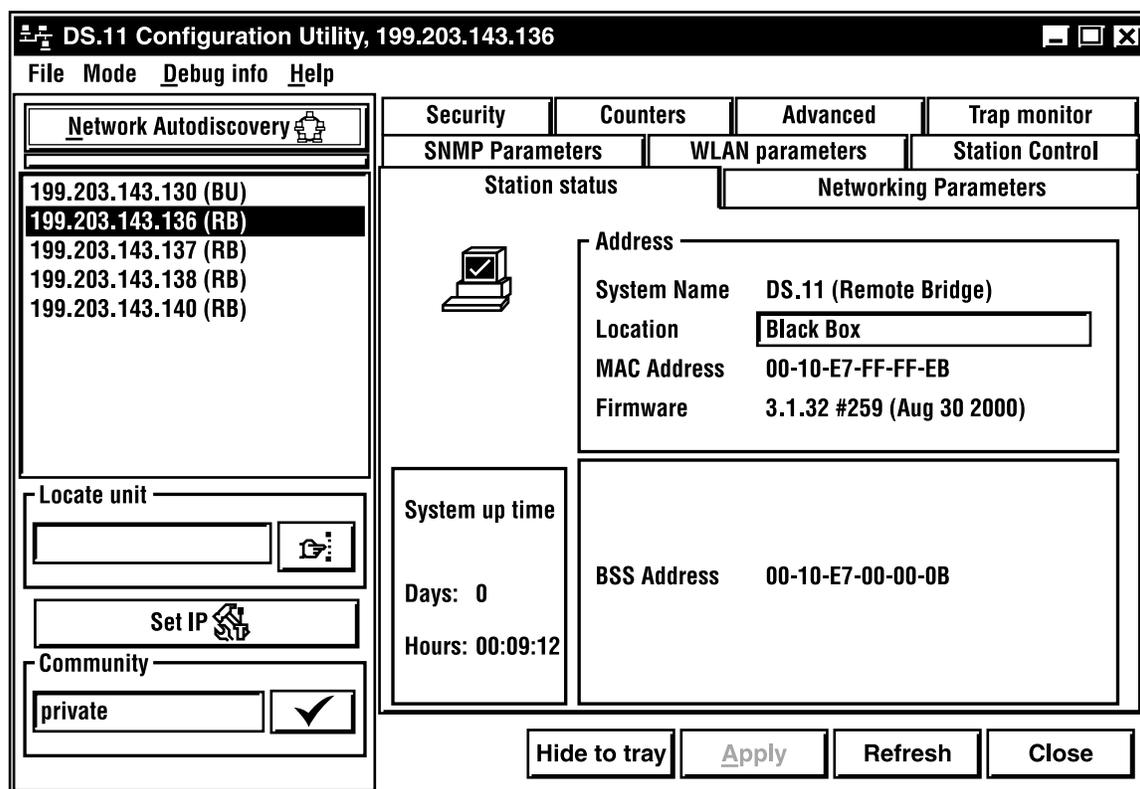


Figure 4-4. Station Status tab.

- System Name: The name of the selected unit.
- Location: A user-defined description of the location of the selected unit, up to 28 ASCII characters long (optional).
- MAC Address: MAC address of the selected unit.
- Firmware: The current firmware version.
- BSS Address (remote bridge [LW2001A, LW2003A] units only): Defines the MAC address of the BSS, which is the base unit (LW2005A, LW2007A) the remote bridge unit is associated with.

Networking Parameters Tab

The Networking Parameters tab allows you to define or edit the IP parameters of units.

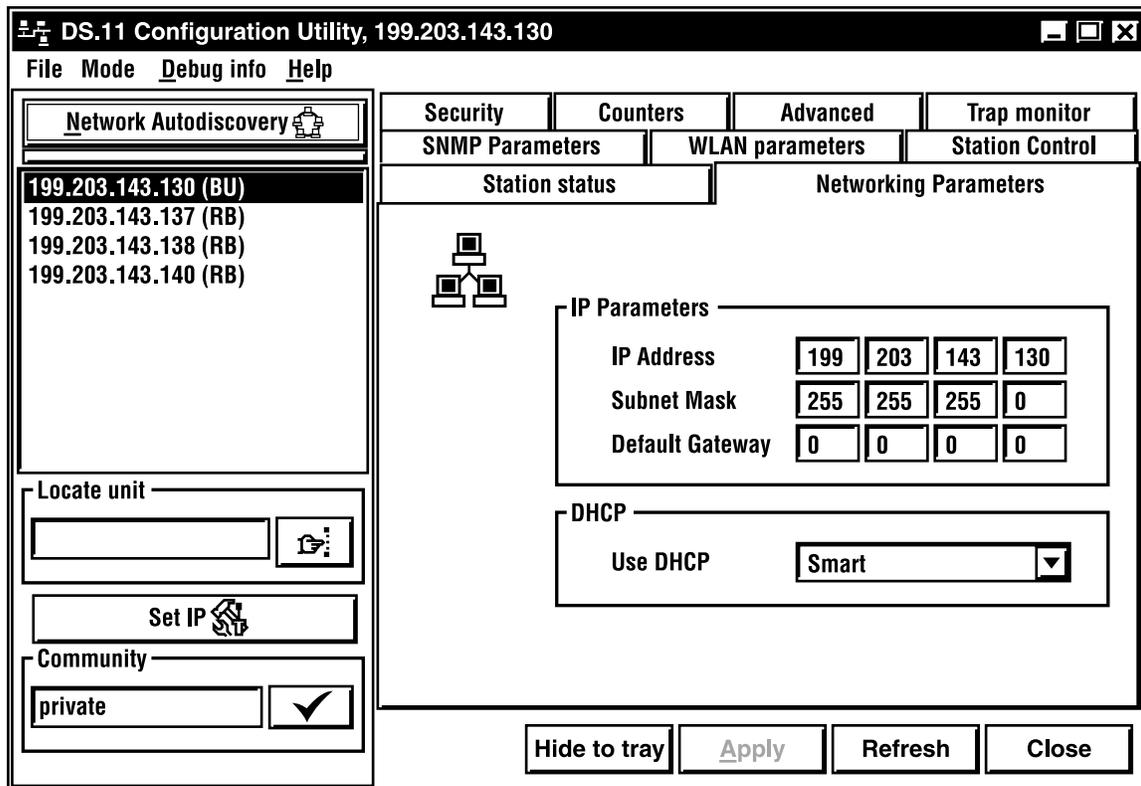


Figure 4-5. Networking Parameters tab.

- IP Address: The IP address of the selected unit.
- Subnet Mask: The Subnet mask of the selected unit.
- Default Gateway: The default gateway of the selected unit.
- DHCP: Sets the way your system utilizes the Dynamic Host Configuration Protocol (DHCP, used for automatic IP assignment).

Always: The system searches for a DHCP server each time the unit is turned on.

Smart: The system searches for a DHCP server only if no IP address was assigned. If an IP address was assigned manually, the system will not search for a DHCP server.

Never: The system never searches for a DHCP server.

The default value is Smart.

NOTE

When the unit is configured to use a DHCP server and none exists, the unit will assign itself an automatic class B address in the range 169.254.X.X; this can be used with Auto discovery when the MAC address is not available.

SNMP Parameters Tab

The SNMP parameters tab allows you to define or edit the SNMP community strings and the SNMP-related parameters.

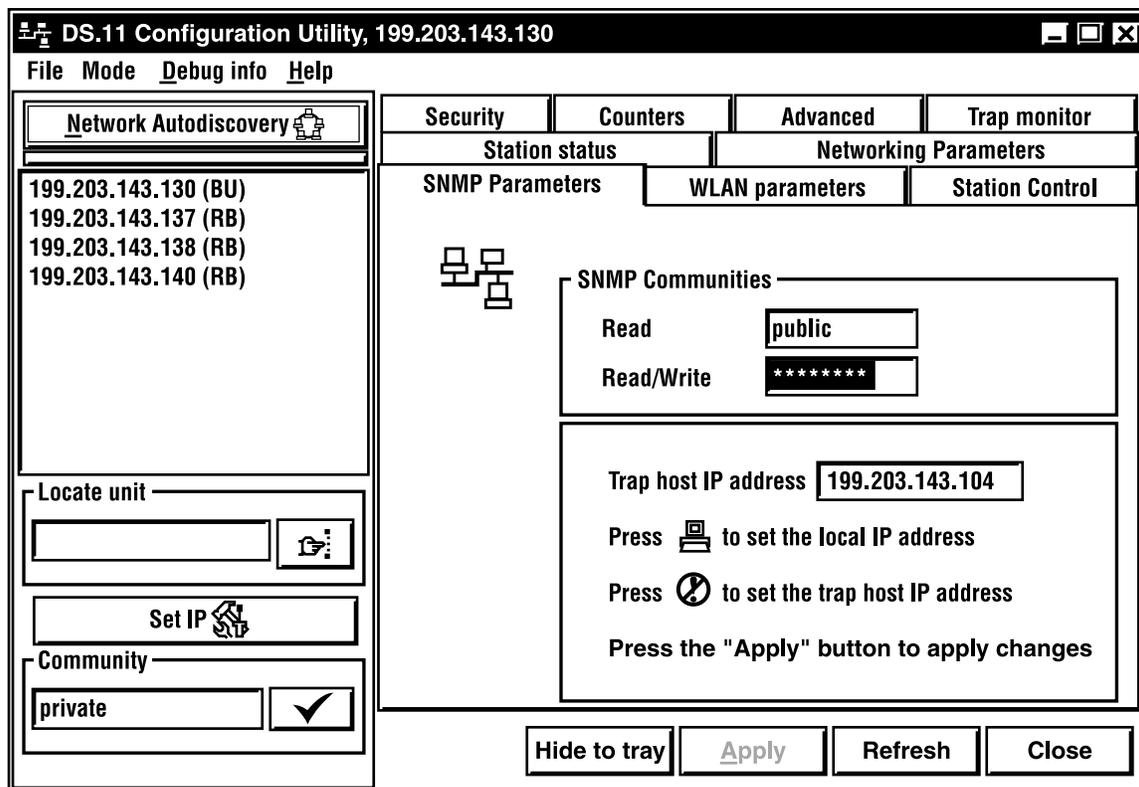


Figure 4-6. SNMP Parameters Tab.

- Read: The read-only community string of the unit. Default is public.
- Read/Write: The read/write community string of the unit. Default is private. This value is displayed as asterisks for security purposes.
- Trap Host IP Address: The IP address of the host to which SNMP traps are sent.

Click the  icon directly beneath this field to apply the defined Trap Host IP address.

Click the  icon directly beneath this field to disable the sending of traps (inserts a value of 255.255.255.255).

Counters Tab

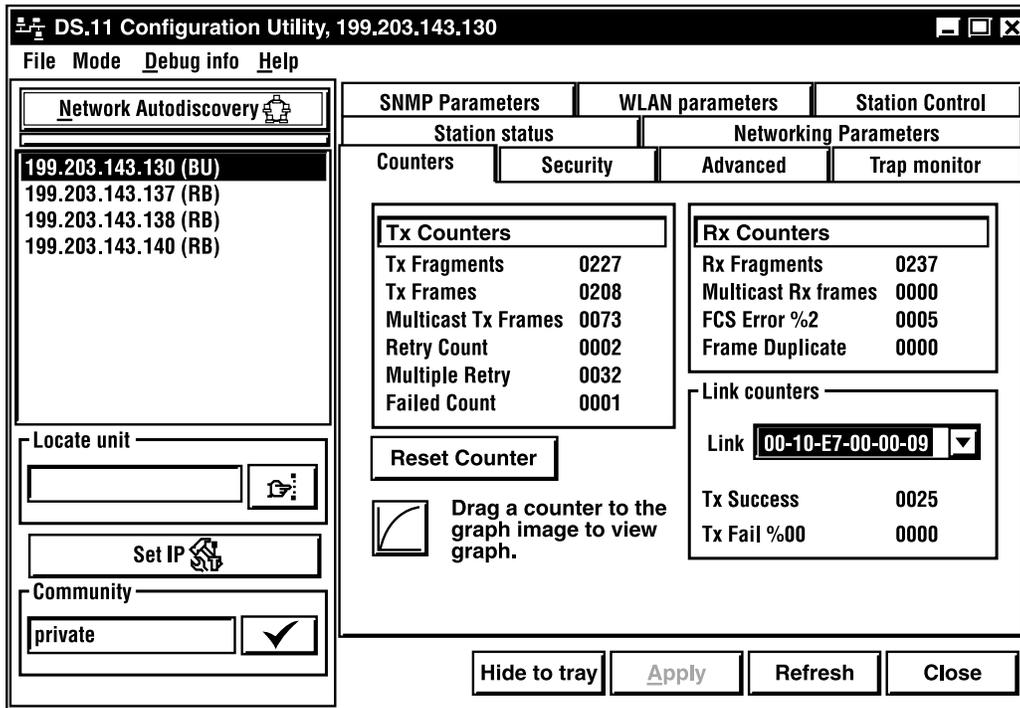


Figure 4-7. Counters Tab (base units).

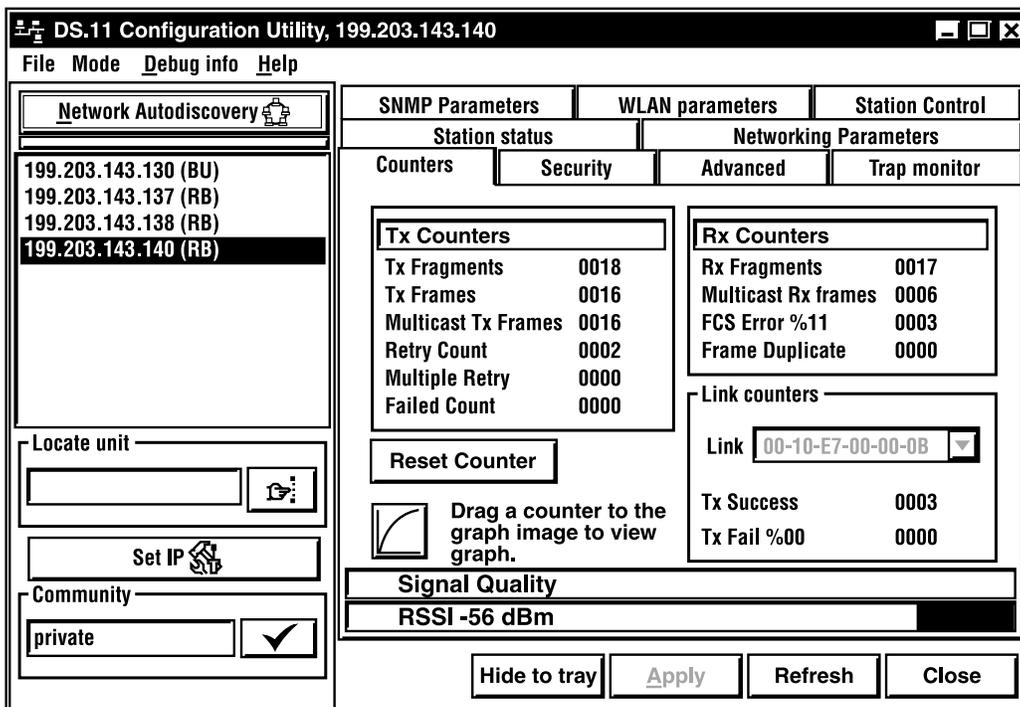


Figure 4-8. Counters Tab (remote bridge units).

Using the Counters windows, you can view a wide range of performance data at both sides of the link. For remote bridge units, you can monitor the received signal strength through the RSSI (Received Signal Strength Indication) bar indicator at the bottom of the window. This RSSI bar can be used to optimize antenna alignment and improve link quality.

Additional performance counters displayed in this window include the following. To obtain a graph that displays the counter values, select a counter and drag it to the  icon.

Tx Counters

- **Tx Fragments:** The number of transmitted frames. The count includes data, control, management frames, and the number of retransmissions of data frames (for example, if the same data frame is retransmitted ten times then the count will increase ten times).
- **Tx Frames:** The number of frames transmitted to the wireless media. The count includes the first transmission of data frames (without retransmissions) and the number of control and management frames.
- **Multicast Tx Frames:** The number of transmitted multicast frames.
- **Retry Count:** The number of retransmissions.
- **Multiple Retry:** This counter is incremented when a packet is successfully transmitted after more than one retransmission.
- **Failed Count:** This counter is incremented when a packet is not transmitted successfully due to the number of transmit attempts exceeding either the Short Retry Limit or Long Retry Limit.

Rx Counters

- **Rx Fragments:** The number of frames received, including data, control, and duplicate data frames.
- **Multicast Rx Frames:** The number of received multicast frames.
- **FCS Error:** The number of CRC errors, in addition to the percentage of CRC errors out of the total frames.
- **Frame Duplicate:** The number of duplicate frames that were sent or received.

Link Counters

The Tx Success and Tx Fail counters displayed at the end of the counters list are link-specific. To activate these counters for a specific link, select the MAC address of the unit at the other end of the link and click Apply.

When you click the Reset Counters button, these counters are actually reset (unlike the other counters which are only reset on-screen).

- **Tx Success:** The number of successfully sent Request To Send frames.
- **Tx Fail:** The number of frames which the station failed to send.

Resetting Counters

You can reset the counters displayed in the Counters tab by clicking the Reset Counters button. All displayed values are reset to display zero.

NOTE

This action does not reset the counters stored in the actual unit, but just resets the values displayed in the screen (an exception to this are the Link Counters). Therefore, if you exit the Counters tab, after performing a reset and reopening it at a later time, the counter values are displayed to reflect the values stored in the unit. To reset the counters in the unit, turn off the unit and then turn it back on.

WLAN Parameters Tab

The WLAN parameters tab allows you to define or edit parameters related to the Wireless LAN environment in which the selected unit is operating. The window displayed varies depending on the type of unit selected.

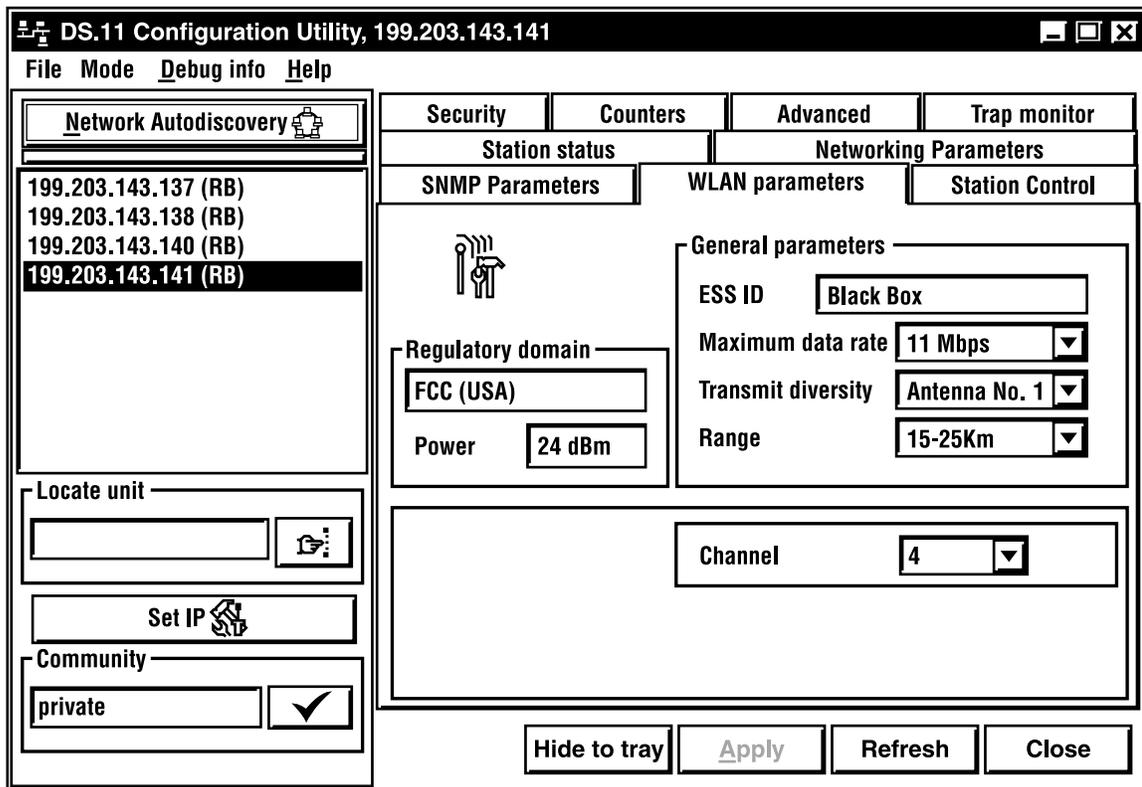


Figure 4-9. WLAN parameters tab (base units).

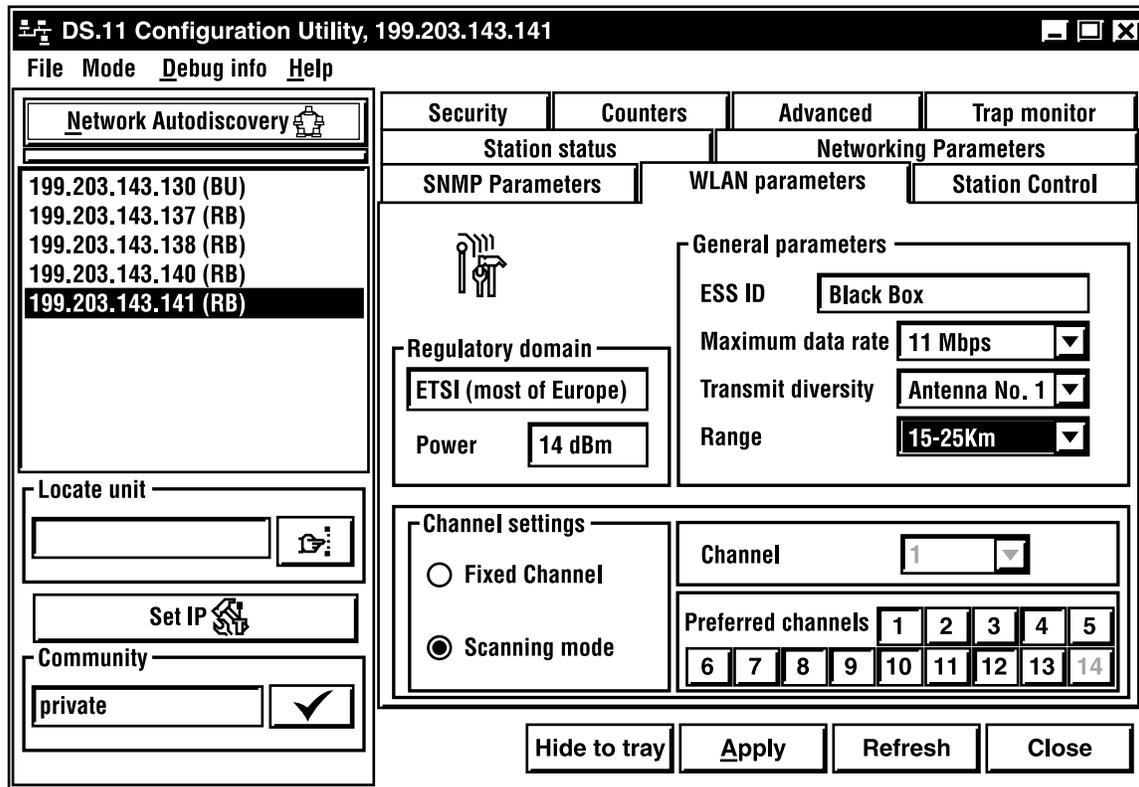


Figure 4-10. WLAN parameters tab (remote bridge units).

- Regulatory Domain: Displays the regulatory authorities in the relevant country of use (for example, Canada, ETSI, FCC, Japan).
- Power: Displays the current output power level at the antenna port.
- ESS ID: An ASCII string of up to 32 characters used to identify a WLAN that prevents the unintentional merging of two co-located WLANs. It is essential that the ESS ID is set to the same value in all remote bridges and base units that should communicate with each other. The ESS ID field is **case-sensitive**.
- Maximum data rate: By default, the unit adaptively selects the highest possible rate for transmission. Under certain conditions (for range/speed trade-off) you may decide not to use the higher rates. Possible values are 2, 5.5, or 11 Mbps. The default value is 11 Mbps.
- Transmit diversity: The antenna diversity option, which must be set to Antenna No. 1.

NOTE

In the present product release, antenna diversity is not supported; therefore, always select Antenna No. 1.

- Range: The operative range of your WLAN or wireless link in the drop-down list. This parameter affects the acknowledge delay time, which needs to be increased in long links. The default value is up to 5 km.

- Channel: Channel selection varies, depending on the type of unit.

For base units (LW2005A, LW2007A), select the channel that the unit will use by selecting a value (range: 1–13, depending on your regulatory domain) from the channel drop-down menu. Refer to Table 4-2 for the list of corresponding frequencies.

For remote bridge units (LW2001A, LW2003A), there are two channel setting options: Fixed Channel and Scanning Mode. The channel you select must match the channel selected in the base unit at the other end of the link.

- 1) If you select the Fixed Channel option by clicking the appropriate radio button, then the remote bridge will search for the base unit on the selected channel (from the channel pull down field) and synchronize with it.
- 2) If you select the Scanning Mode option (by selecting the appropriate radio button), you can specify preferred channels by clicking one or more of the buttons displayed at the bottom of the window. In this mode, the remote bridge will first search for the base unit on the channel you select in the Channel pull-down field and synchronize with it if the link is established. If the remote bridge does not find the base unit, it will scan and search for one of the preferred channel frequencies you selected. If it does not find the base unit on any of the preferred channels, it will continue to scan until it finds the base unit on one of the channels permitted according to the regulatory domain.

Table 4-1 describes the channels used in each regulatory domain, the default channel, the maximum output power, and the default output power.

Table 4-1. Regulatory domains specifications.

Regulatory Domain	Lowest Channel	Highest Channel	Default Channel	Max. Output Power	Default Output Power
ETSI	1	13	7	14	4
FCC	1	11	6	24	24
TELEC	1	13	7	14	6
France	10	13	11	14	4
Canada	1	11	6	24	24

Table 4-2. Frequency list.

Channel	Frequency
1	2412 MHz
2	2417 MHz
3	2422 MHz
4	2427 MHz
5	2432 MHz
6	2437 MHz
7	2442 MHz
8	2447 MHz
9	2452 MHz
10	2457 MHz
11	2462 MHz
12	2467 MHz
13	2472 MHz

NOTE

The frequencies listed in Table 4-2 are at the center of the channel. Each channel occupies 22 MHz; therefore, each channel occupies -11 MHz to +11 MHz from the frequency specified.

Station Control Tab

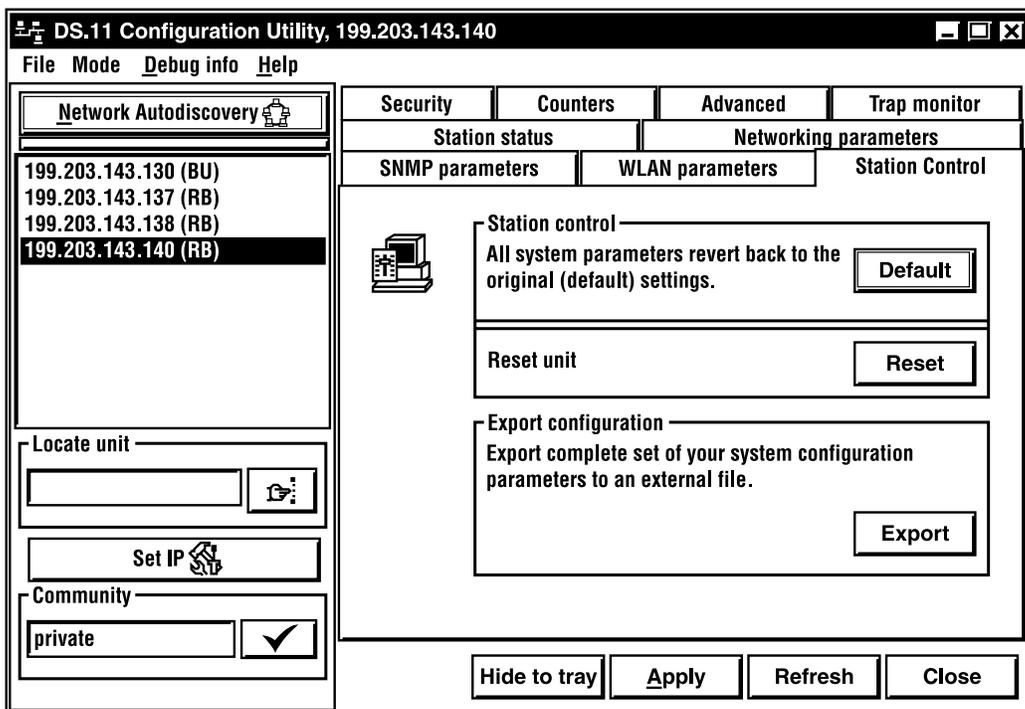


Figure 4-11. The Station Control tab.

- **Station Control:** Click the Default button for all parameters to revert to the factory defaults.
- **Reset Unit:** Click the Reset button to reset the unit and apply any changes made to the system parameters.
- **Export Configuration:** Click the Export button to export the current basic configuration of this unit to a file. A popup window prompts you to specify the name of the file. The created file can be used to save the configuration information or to send it to Tech Support as a reference for troubleshooting.

Security Tab

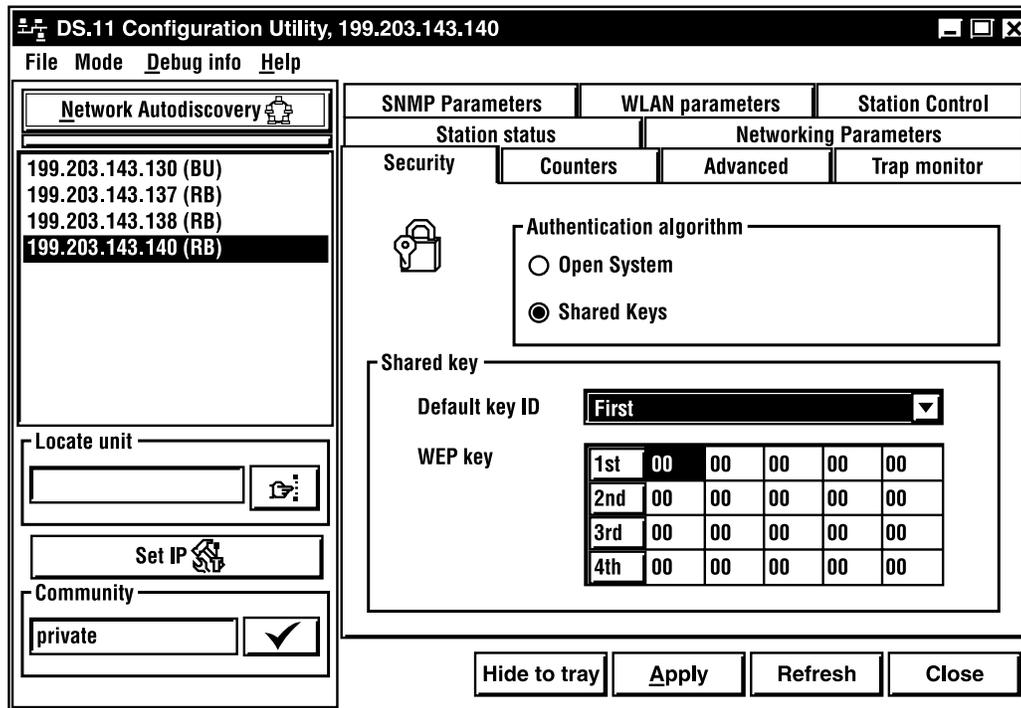


Figure 4-12. Security tab.

This tab displays information regarding the unit's security configuration. Wired Equivalent Privacy (WEP) is an authentication algorithm that protects authorized Wireless LAN users against eavesdropping and is implemented in DS.11 units. WEP is defined in the IEEE 802.11b standard. This encryption is applicable for both authentication and data, and the key length is 40 bits.

DS.11 units can use one of the following authentication algorithms (as defined in the IEEE 802.11b standard).

- **Open System:** Any station in the WLAN can associate with any other unit and receive and transmit data freely (null authentication).
- **Shared Key:** Only stations using a shared key encryption are allowed to associate.

The default authentication algorithm is Open System.

If you select the Shared Key algorithm, set the following parameters:

- **Default Key ID:** Sets the key for encryption.

- WEP Key: Defines the encryption keys used. Define each key by clicking the appropriate WEP Key row and entering ten hexadecimal characters (five sets of two characters each) for each of the four keys. After clicking Apply, the WEP Key values are displayed as zeros for security reasons.

The default WEP key is the first key.

NOTE

All units in the same cell should use the same key.

Advanced Tab

The Advanced tab provides additional performance parameters.

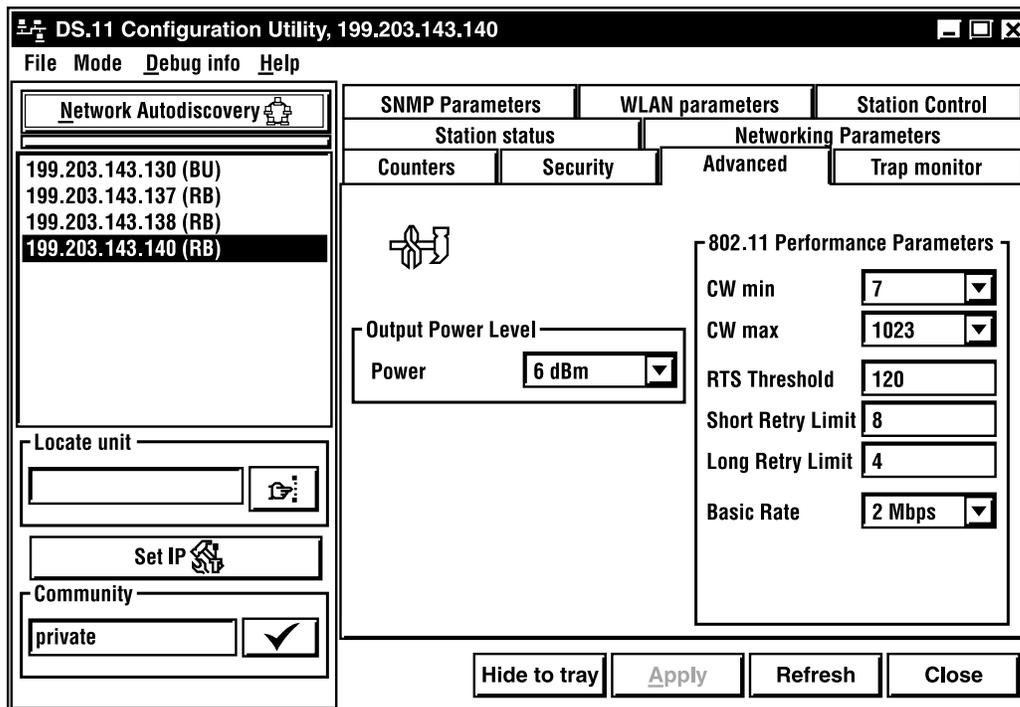


Figure 4-13. Advanced tab.

- CW Min/Max: The size of the contention window. The contention window backoff algorithm is a method used to resolve contention between different stations trying to access the medium. The valid range is from 7 to 1023.

Defaults are 31 for CW Min and 1023 for CW Max.

- RTS Threshold: The minimum packet size required for an RTS (Request to Send) to be sent. For packets with a size below the RTS Threshold value, an RTS is not sent and the data packet is transmitted directly to the WLAN.
- Short Retry Limit: The maximum number of transmission attempts for a frame that is shorter than or equal to the RTS Threshold. The default value is 8.

- Long Retry Limit: The maximum number of transmission attempts for a frame that is longer than the RTS Threshold. The default value is 4.
- Basic Rate: The maximum rate of multicast, broadcast, and control frames transmissions. Multicast and broadcast transmissions are not acknowledged; therefore there is a chance that such transmissions will not be properly received without the possibility of using the acknowledgement mechanism for retransmission. Therefore, we recommend that you use a lower rate for transmission of broadcast, multicast and control frames, to increase the probability that they will be received without errors. Enter the data rate at which broadcast, multicast, and control frames are transmitted. The default value is 2 Mbps.

NOTE

The Basic Rate parameter should be changed only if you are sure that all units in the cell can handle the defined rate. Use this parameter with caution, as it may bring the link down.

- Power: The transmit power level. The possible range is from -4 dBm to +24 dBm.

NOTE

The Power setting should not exceed the maximum output allowed in the applicable regulatory domain according to Table 4-1.

Trap Monitor Tab

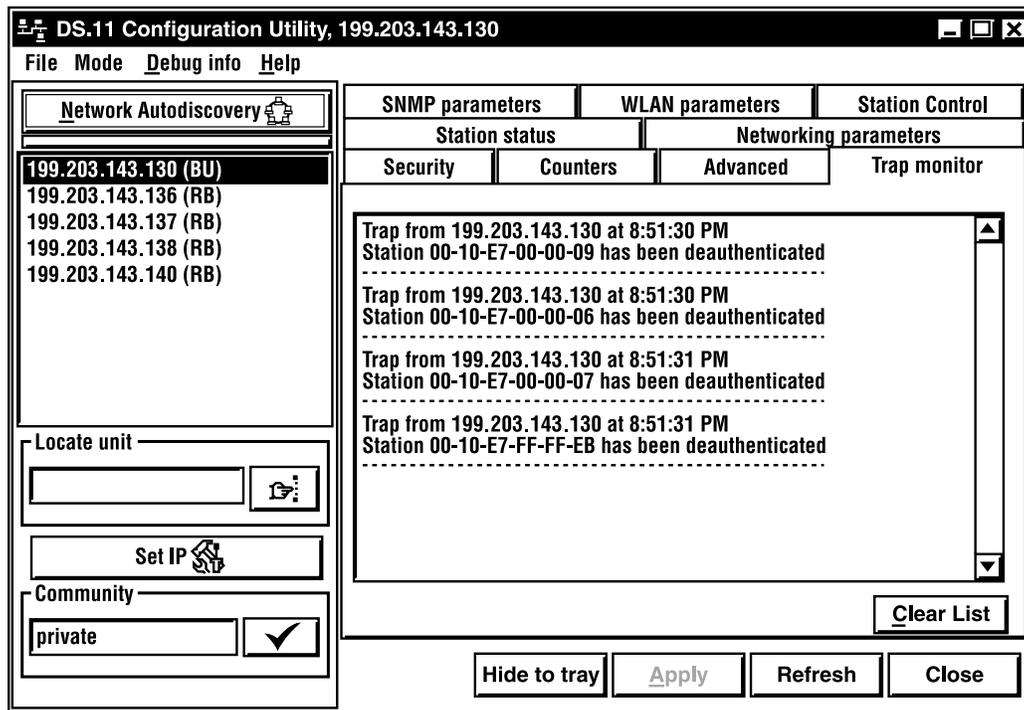


Figure 4-14. Trap Monitor tab.

When an event occurs, a trap is sent to the defined host address (the setting is made in the SNMP Parameters tab described earlier in this section). This window displays the recorded traps.

Click the Clear List button to clear the display area.

4.2.2 FIRMWARE UPGRADE MODE

This mode allows the embedded software in managed units to be upgraded. When you select this mode from the Options menu, the following dialog box is displayed.

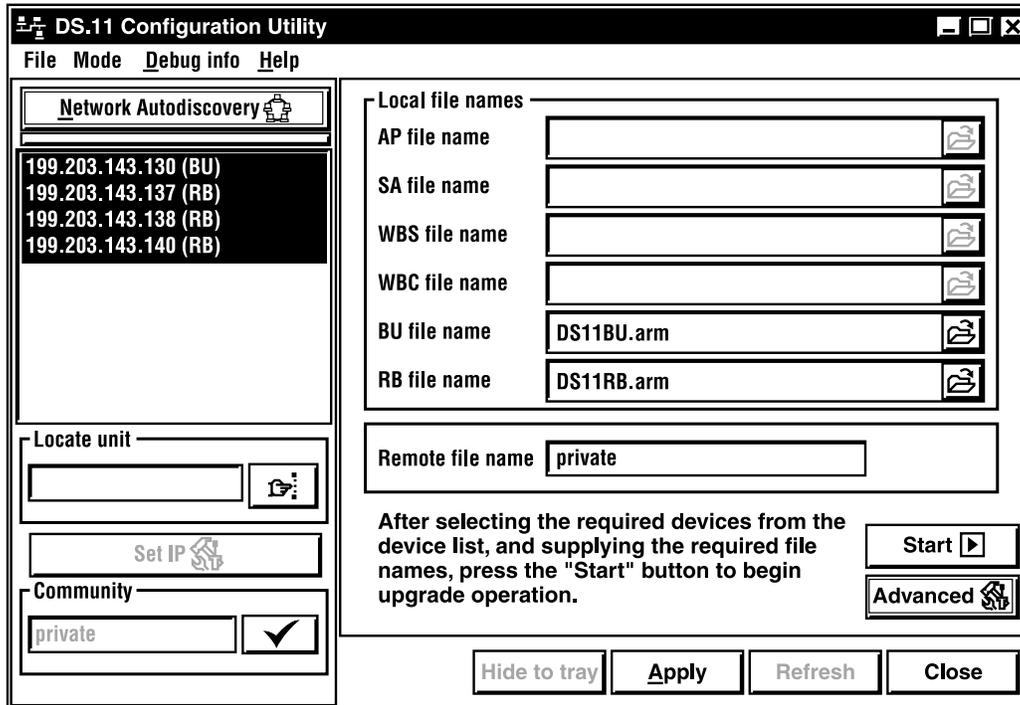


Figure 4-15. Firmware upgrade mode dialog box.

NOTE

The Configuration Utility does not resolve the topology of the cell. Therefore, firmware upgrades should be made from the central point where the base units are located.

The list box on the left-hand side of the dialog box displays the managed units; it is sorted sequentially by base unit followed by remote bridge units.

To upgrade firmware:

1. Select the units that you want to upgrade from the list box. Use Shift-click and/or Ctrl-click to select multiple units, or select multiple units by dragging with the mouse.
2. Specify the firmware file you want to use in the Local file name fields; there are separate fields for files of different device type. The field text is displayed in blue when corresponding unit types are selected in the list box.

3. In the Remote File Name field, enter the Read/Write community string of the unit(s).
4. Click **Advanced** if you want to change the settings of the TFTP session used in the upgrade download (see **Section 4.2.1**).
5. Click **Start** to initiate the firmware upgrade; progress bars are displayed indicating the progress of the operation. If both base unit and remote bridge devices are selected, the program will upgrade remote bridge units first.

At the end of the upgrade session, the window below is displayed, indicating that the operation was successful.

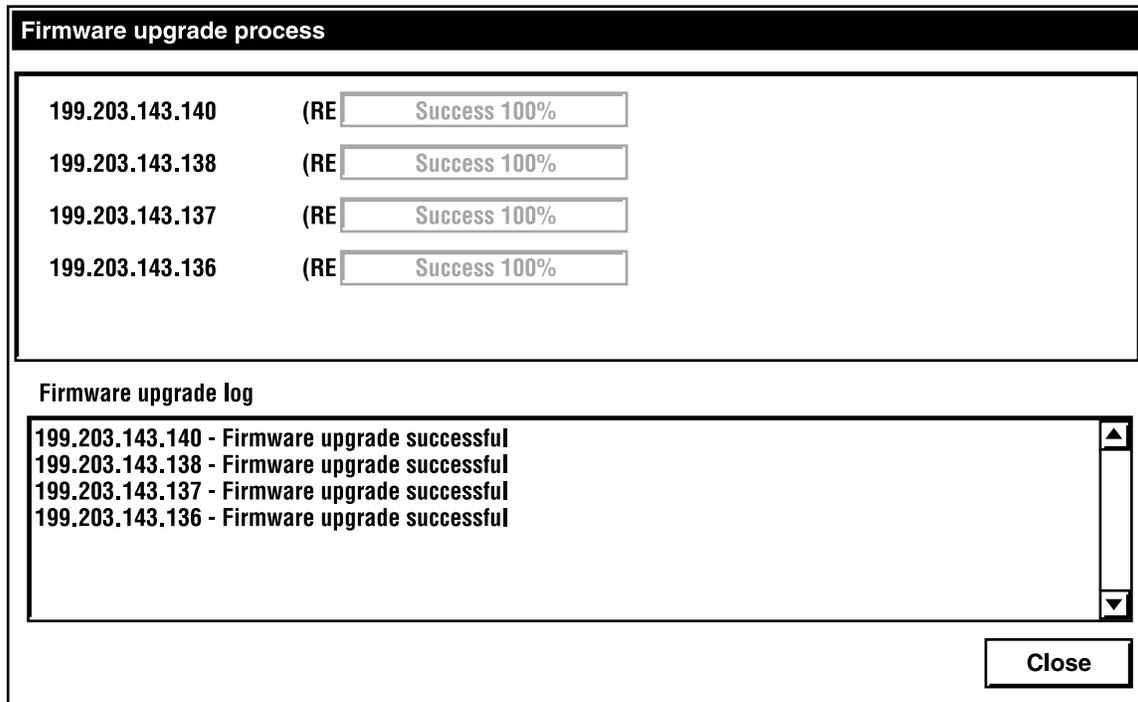
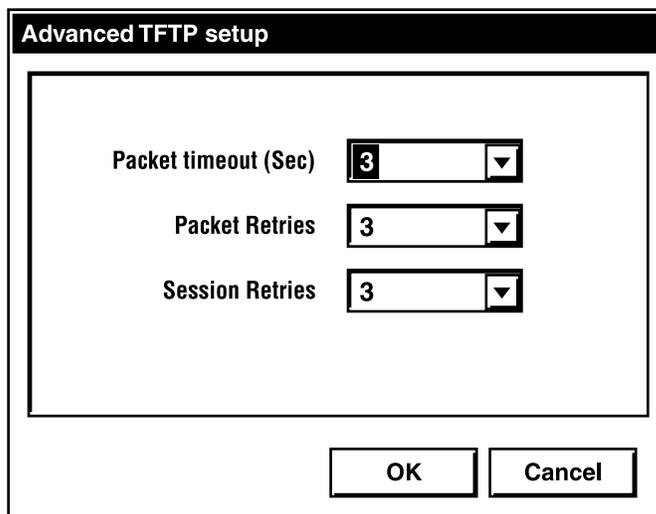


Figure 4-16. Firmware upgrade process.

NOTE

Do not disconnect any cables or try to stop the process before downloading is completed.

All configured parameters are saved during the upgrade/download procedure.

Advanced TFTP Settings

The image shows a dialog box titled "Advanced TFTP setup". It contains three settings, each with a text label and a spin box with a dropdown arrow:

- Packet timeout (Sec) with a value of 3.
- Packet Retries with a value of 3.
- Session Retries with a value of 3.

At the bottom of the dialog box are two buttons: "OK" and "Cancel".

Figure 4-17. Advanced TFTP setup dialog box.

The Advanced TFTP Setup window enables you to tune the TFTP session parameters for a more efficient firmware upgrade, depending on your actual deployment.

- **Packet timeout:** Defines the time (in seconds) it takes for a packet to timeout. The range is from 1 to 30 seconds with a default of 3 seconds.
- **Packet Retries:** Defines the number of times that a packet will be sent after it timeouts in a TFTP session. The range is from 1 to 5 retries with a default of 3 retries.
- **Session Retries:** Defines the number of times a TFTP session will be repeated before the firmware upgrade operation is designated a failure. The range is 1–5 retries with a default of 3 retries.

4.2.3 MULTIPLE UNIT CONFIGURATION MODE

This feature allows configuration parameters to be downloaded to multiple units simultaneously. When you select this option in the Options menu, all configuration windows become write-only. Irrelevant parameters are disabled.

NOTE

The Configuration Utility does not resolve the topology of the cell. Therefore, multiple-unit configuration operations should be done at the location where the base unit is located.

Select the units that you want to upgrade from the list box on the left-hand side of any dialog box tabs. Use Shift-click and/or Ctrl-click to select multiple units.

Enter the configuration parameter values and click **Apply**. The following dialog box is displayed.

Multiple configuration

Please review the changes summary and press "Apply" to begin operation. Press "Cancel" to discard all changes.

Selected devices	Changes summary
199.203.143.140 (RB)	Range= 15-25Km.
199.203.143.138 (RB)	ESSID= Black Box
199.203.143.137 (RB)	
199.203.143.136 (RB)	
199.203.143.130 (BU)	

Result log

199.203.143.140 (RB) - Success
199.203.143.138 (RB) - Success
199.203.143.137 (RB) - Success
199.203.143.136 (RB) - Success
199.203.143.130 (BU) - Success
Resetting: 199.203.143.140 (RB)
Resetting: 199.203.143.138 (RB)
Resetting: 199.203.143.137 (RB)

Reset units after setting parameters.

Apply Close

Figure 4-18. Multiple Configuration Mode dialog box.

This dialog box lists the selected units and displays the configuration changes to be made during the multiple configuration session. Select the reset units after setting parameters check box to reset all selected units.

A log of the multiple configuration session is displayed during and after the operation.

4.3 Debug Info

This option allows you to create a .log file. You can send this log file to Black Box Technical Support and receive help based on the information recorded in this file.

To start recording, open the Debug Info menu item in the main menu and select **Start Log**.

When you finish recording (usually after 24 hours) select **Stop Log** from the Debug Info menu item and send the file to Black Box Technical Support.

4.4 Resetting the SNMP Community Strings

The SNMP Read/Write Community strings are an SNMP security feature to restrict management access to authorized persons only. Refer to **Section 4.2.1**.

To reset the SNMP community strings, insert a paper clip or another suitable tool into the Reset button on the top panel of the unit while the unit is operating. The community strings are reset to the default values, private (Write) and public (Read).

4.5 Reloading Factory-Default Settings

To reset the unit to the factory defaults:

1. Disconnect the power cable from the indoor unit.
2. Insert a paper clip or another suitable tool into the Reset button on the top panel of the unit (see Figure 3-7). Keep the Reset button pressed while inserting the power cable back into its socket.

5. System Troubleshooting

The following troubleshooting guide provides answers to some of the more common problems that may occur when installing and using the DS.11. If problems not mentioned in this guide should arise, checking the Ethernet and WLAN counters may help (see **Section 4.2.1**). If the problem persists, please feel free to contact Black Box Technical Support.

5.1 Troubleshooting Guide

Problem and Indication: No power to unit. Power LED is off.

Possible Cause: Power cord is not properly connected.

Corrective Action: Verify that power cord is properly connected to the Black Box unit and to the power outlet.

Problem and Indication: Failure to establish wireless link. Wireless Link LED is off and unit resets every few minutes.

Possible Cause #1: Power supply to units may be faulty

Corrective Action #1: Verify power to units.

Possible Cause #2: The remote bridge units may not have the same ESS ID as the base unit.

Corrective Action #2: Verify that all units in the network have the same ESS ID (ESS ID must be identical in all units in the WLAN; the ESS ID is case sensitive). Check that the units are on the same channel.

Corrective Action #3: Verify wireless link.

- Set the base unit and the remote bridge units side by side.
- Power on each unit and see if a wireless link is established (even models without their external antennas [LW2003A and LW2007A] should establish a link if placed side by side).
- If the units fail to associate, reset units to factory-default values (see **Section 4.5**). The units should now establish a wireless link.

Problem and Indication: Failure to establish wireless link (in models with external antennas [LW2003A and LW2007A]).

Possible Cause #1: Power supply to units may be faulty.

Possible Solution #1: Verify power to units.

Possible Cause #2: Cables may be improperly connected.

Possible Solution #2: Verify that all cables are connected securely.

Possible Cause #3: There may be some problem with antenna installation.

Possible Solution #3: Refer to **Chapter 3** and verify the wireless link between the units.

Possible Solution #4: Verify that the antenna(s) are properly installed (see **Chapter 3**):

- Check antenna alignment.
- Verify that antenna polarization is the same at both ends.
- Verify that the range matches specifications.
- Verify line-of-sight/antenna alignment/antenna height.

Problem and Indication: Wireless link is established, but there is no Ethernet activity (base unit and remote bridge units).

Possible Cause #1: Ethernet hub port or UTP cable is faulty.

Possible Solution #1: Make sure the Link LED is lit green. If this is not the case, the port is inactive. Try another port on the hub or another UTP cable.

Possible Cause #2: Ethernet port in unit is faulty.

Possible Solution #2: Verify that the Ethernet port in the unit is working. Ping the unit to verify Ethernet connection.

NOTE

All bridges respond to a ping on their Ethernet ports only. You cannot ping a bridge across the wireless link.

Possible Cause #3: The remote bridge is associated with a base unit that is not connected correctly to the LAN.

Possible Solution #3:

- Verify that you are using a cross-over UTP cable (pins 1 and 3, 2 and 6) if connected directly to a workstation, or a straight-through cable if connected to a hub.
- Check the unit's Link LED indicator and check the Ethernet counters in the monitor to verify Ethernet activity (see **Section 4.2.1**).
- Make sure the base unit is correctly connected to the LAN.

5.2 Calling Black Box

If you determine that your DS.11 Wireless Ethernet is malfunctioning, do not attempt to alter or repair the unit. It contains no user-serviceable parts. Contact Black Box at 724-746-5500.

Before you do, make a record of the history of the problem. We will be able to provide more efficient and accurate assistance if you have a complete description, including:

- the nature and duration of the problem.

- when the problem occurs.
- the components involved in the problem.
- any particular application that, when used, appears to create the problem or make it worse.

5.3 Shipping and Packaging

If you need to transport or ship your DS.11 Wireless Ethernet:

- Package it carefully. We recommend that you use the original container.
- If you are shipping the DS.11 Wireless Ethernet for repair, make sure you include everything that came in the original package. Before you ship, contact Black Box to get a Return Authorization (RA) number.

Appendix A. DS.11 Frequently Asked Questions

A.1 General

Can the base unit/remote bridge indoor unit be placed outdoors?

It's not recommended. The base unit/remote bridge indoor units are specified to operate between 32 and 104°F (0 and 40°C) and is not weather proof, so it is best to mount the DS.11 indoors or in a protective cabinet.

Do DS.11 units support 802.1Q VLAN?

Yes, but the support is limited to transparent operation. This means that the DS.11 does not take any action on 802.1Q frames, but will transparently pass them within a VLAN network.

What is the maximum number of networked PCs the base unit/remote bridge can learn?

1024 network MAC addresses can be learned by the base unit/remote bridge from the LAN side.

Can the base unit/remote bridge be used for multipoint as well as point-to-point links?

Yes. The base unit can support multiple remote bridge units, creating a point-to-multipoint network.

How many remote bridge units can one base unit support?

The maximum number of associations is 128.

What is the practical limit to the number of remote bridge units per base unit? And, what performance can I expect for a multipoint link?

This depends upon average throughput expectations. All clients would have the maximum throughput available for burst traffic; however the overall average would depend on the utilization of the network. For example, in a heavily used network needing about 350 kbps to 500 kbps average net throughput per site, 9 to 12 remote bridges would be the limit. For a moderately used network needing about 175 kbps to 258 kbps average, 18 to 24 remote bridges should be used, and a lightly used network needing 32 kbps to 48 kbps average net throughput per site could use up to 128 remote bridges.

What is the range of the base unit/remote bridges?

15 miles/25 km (FCC) or 6.2 miles/10 km (ETSI) can be achieved using the antenna kit for a point-to-point link. Consult the antenna and accessory guide range tables for distances using other antennas.

Does the base unit/remote bridge support 802.1d spanning tree protocol?

No, the base unit/remote bridge does not support spanning tree.

What is the normal PER (Packet Error Rate) for the base unit/remote bridge?

The error rate will be about 4% to 6% (transmitted fragments vs. retry count). This is typical when operating in a non-interference environment at maximum range for bi-directional traffic loads. If the traffic load is more uni-directional, then the PER will be less.

What is the best value for the CW min parameter on the DS.11?

Setting the CW min parameter to 31 for heavy bi-directional traffic loads will minimize the PER. Setting the CW min to 15 will improve performance for more uni-directional traffic loads. CW min 7 should only be used for short-range point-to-point links, and 63 should be used for large, long-range multipoint links.

Is the DS.11 compatible with DS equipment from other vendors?

Yes. However, for the outdoor bridges, interoperability can vary from vendor to vendor and in some cases it may not operate if the manufacturer's implementation is not pure 802.11b. The base unit/remote bridge can operate at 1 and 2 Mbps with legacy 802.11b DS equipment, and at 5.5 Mbps and 11 Mbps with 802.11b High Rate DS equipment. Black Box DS.11 units are fully WI-FI compliant.

A.2 Co-Location

How many base unit or remote bridge units can be co-located on the same building or tower?

You can co-locate up to 3 base units or remote bridge units on the same structure.

Each unit is assigned to one of the non-overlapping channels (see Table 4-1).

What is the antenna separation requirement for co-locating the base unit or remote bridge units on the same building or tower?

The antennas should be mounted at least 2 feet (0.6 m) apart when using LW019A antennas, 15 feet apart when using LW013 antennas, and 75 feet apart when using LW0029A-R2 antennas. Greater separation will improve the link distance.

Can a Frequency Hopping network operate in the same area as the Black Box DS.11?

Yes, but in a co-located network both products will suffer some a decrease in performance. The degree of performance loss depends on network use. For example, the higher the utilization of the Frequency Hopping network, the higher the level of impact on the Direct Sequence (DS.11) network, and vice versa. Typically, in light to moderately used networks, the performance loss is not significant.

Can I use DS.11 Bridges to feed a Frequency Hopping distribution point?

Yes, bandwidth sharing between the Direct Sequence and Frequency Hopping products can be minimized if the network is designed using cross-polarized directional antennas with as much spatial separation as possible. Contact Technical Support for more information.

A.3 Performance

What is the data throughput of the DS.11?

The base unit/remote bridge link typical performance is 4.2 Mbps using TCP and 6.2 Mbps using UDP. For long-range links, the performance drops by about 5%.

What if the DS.11 link experiences interference?

If interference is affecting the DS.11 link, one of the other channels may be selected to operate away from the frequency of the interference. Also, physically relocating the antennas may help.

What is the typical latency of a base unit/remote bridge?

A point-to-point link would realize about 3 ms latency.

A.4 Firmware

Can the base unit/remote bridge firmware be upgraded?

Yes, the firmware in the base unit/remote bridge is stored in flash and is upgraded using the built-in Configuration Utility or the TFTP server.

Can the base unit/remote bridge flash be erased or the firmware changed by an unauthorized person?

No, as long as you have changed the password from the default. The TFTP server in the base unit/remote bridge requires the SNMP write community name (password) to perform an upgrade.

Can the firmware flash be corrupted when upgrading to a new version?

Yes, if the TFTP file transfer is interrupted during a flash update, the firmware may be corrupted. The DS.11 has a backup flash, which contains the previous version for firmware. If the primary flash is corrupt, then the backup is automatically used to return the unit to an operating state.

When does the backup flash image get upgraded?

After completing a firmware upgrade, the backup flash containing the old firmware version is overwritten with the new version on the new power-on cycle.

Can DS.11 firmware be downgraded?

Yes, an earlier version of firmware can overwrite a newer version.

Can the previous version of firmware be kept?

The previous version of firmware cannot be kept on the DS.11 itself, but can be stored on your PC and loaded if needed.

A.5 Configuration

Can the regulatory domain (country) of a DS.11 unit be changed?

No. The regulatory domain is factory set.

How can the DS.11 be configured or managed if the SNMP Community name has been forgotten?

Use a paper clip to press the reset button on the top panel. This will set the read and write Community names to public and private, respectively.

How can the DS.11 unit be returned to factory-default settings?

There are two ways. One way is to use the Default button on the Station Control Tab in the DS.11 Configuration Utility. The other is to press and hold the reset button on the back of the unit while powering on the unit. Remember that all settings—including IP addresses—will be lost when resetting defaults.

A.6 Management

What management options are available for the DS.11?

The base unit/remote bridge comes with a graphical Configuration Utility that operates on any Windows® based network-ready PC. With this utility, you can configure and monitor every DS.11 on your network. You can also use the DS.11 SNMP MIB on standard management platforms like SNMPc and HP® OpenView®.

Does the DS.11 offer out-of-band management?

No, the DS.11 does not offer out-of-band management, such as a serial port. The DS.11 is managed in-band only via the DS.11 Configuration Utility or SNMP.

What installation and site survey tools are available for base unit/remote bridge?

The DS.11 comes with a Windows based manager utility. With this utility, you can configure link parameters and monitor signal quality and RSSI (received signal strength indication). Optimizing antenna alignment is done using the signal quality and RSSI display. Any computer on the network can use this utility to manage the base unit/remote bridge.

Appendix B. Preparing the Indoor-to-Outdoor Cable

The Indoor-to-Outdoor cable provides pin-to-pin connection on both sides. It's open-ended at both sides so you can conveniently route the cable into the outdoor unit's waterproof seal and through holes in walls.

Figure B-1 shows the wire pair connections required for the Indoor-to-Outdoor cable.

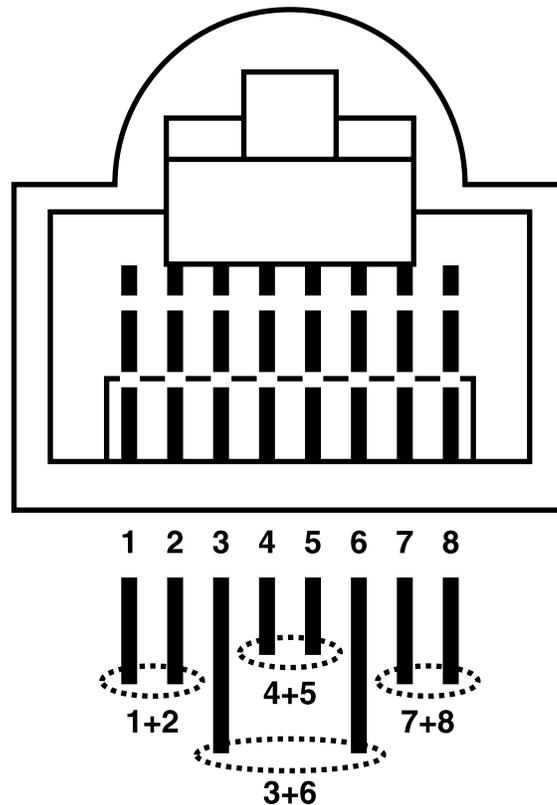


Figure B-1. Wire pair connections.

Use a standard crimp tool for shielded RJ-45 connectors to prepare the wires. Insert the wires into the appropriate pins, and use the crimp tool to crimp the connector. Make sure to do the following:

- a) When crimping the wires, remove as small a length as possible of the external jacket. To ensure good sealing, make sure the external jacket is well inside the service box when connected to the outdoor unit.
- b) Pull back the shield drain wire before inserting the cable into the RJ-45 connector. This will ensure a good connection with the connector's shield after crimping.

Appendix C. Radio Signal Propagation

C.1 Introduction

This chapter explains and simplifies many of the terms relating to antennas and RF (Radio Frequency) used when dealing with an RF installation system.

Figure C-1 shows a typical radio system.

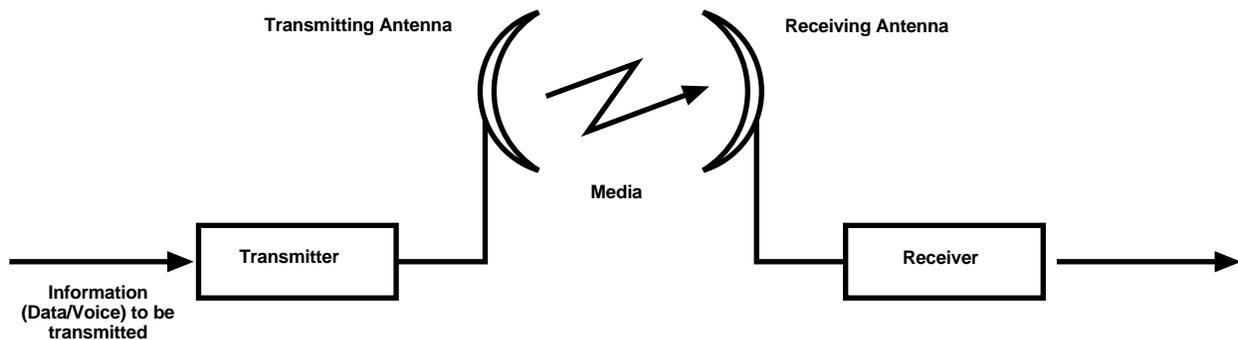


Figure C-1. A typical radio system.

A radio system transmits information to the transmitter. The information is transmitted through an antenna that converts the RF signal into an electromagnetic wave. The transmission medium for electromagnetic wave propagation is free space.

The electromagnetic wave is intercepted by the receiving antenna, which converts it back to an RF signal. Ideally, this RF signal is the same as that originally generated by the transmitter. The original information is then demodulated back to its original form.

C.2 RF Terms and Definitions

C.2.1 dB

dB is an abbreviation for decibels. It shows the relationship between two values.

C.2.2 RF POWER LEVEL

RF power level at either the transmitter output or the receiver input is expressed in watts. It can also be expressed in dBm. The relation between dBm and watts can be expressed as follows:

$$P_{\text{dBm}} = 10 \times \text{Log } P_{\text{mw}}$$

For example: 1 watt = 1000 mW; $P_{\text{dBm}} = 10 \times \text{Log } 1000 = 30 \text{ dBm}$
 100 mW; $P_{\text{dBm}} = 10 \times \text{Log } 100 = 20 \text{ dBm}$

For link budget calculations, the dBm convention is more convenient than the watts convention.

C.2.3 ATTENUATION

Attenuation (fading) of an RF signal is defined as follows:



Figure C-2. Attenuation of an RF signal.

P_{in} is the incident power level before attenuation

P_{out} is the output power level after attenuation

Attenuation is expressed in dB as follows: $P_{\text{dB}} = -10 \times \text{Log } (P_{\text{out}}/P_{\text{in}})$

For example: If, due to attenuation, half the power is lost ($P_{\text{out}}/P_{\text{in}} = \frac{1}{2}$),
 attenuation in dB is $-10 \times \text{Log } (\frac{1}{2}) = 3 \text{ dB}$

C.2.4 PATH LOSS

Loss of power of an RF signal traveling (propagating) through space, expressed in dB. Path loss depends on:

- The distance between transmitting and receiving antennas
- Line of sight clearance between the receiving and transmitting antennas
- Antenna height

C.2.5 FREE SPACE LOSS

Attenuation of the electromagnetic wave while propagating through space. This attenuation is calculated using the following formula:

$$\text{Free space loss} = 32.4 + 20 \times \text{Log}(F_{\text{MHz}}) + 20 \times \text{Log}(R_{\text{km}})$$

F is the RF frequency expressed in MHz.

R is the distance between the transmitting and receiving antennas (expressed in km).

At 2.4 GHz, this formula is $100 + 20 \times \text{Log}(R_{\text{km}})$

C.2.6 ANTENNA CHARACTERISTICS

Isotropic Antenna

A hypothetical antenna having equal radiation intensity in all directions. Used as a zero dB gain reference in directivity calculation (gain).

Antenna Gain

A measure of directivity. It is the ratio of the radiation intensity in a given direction to the radiation intensity that would be obtained if the power accepted by the antenna was radiated equally in all directions (isotropically). Antenna gain is expressed in dBi.

Radiation Pattern

A graphical representation in either polar or rectangular coordinates of the spatial energy distribution of an antenna.

Side Lobes

The radiation lobes in any direction other than that of the main lobe.

Omnidirectional Antenna

Radiates and receives equally in all directions in azimuth. Figures C-3 and C-4 show the radiation pattern of an omnidirectional antenna with its side lobes in polar form.

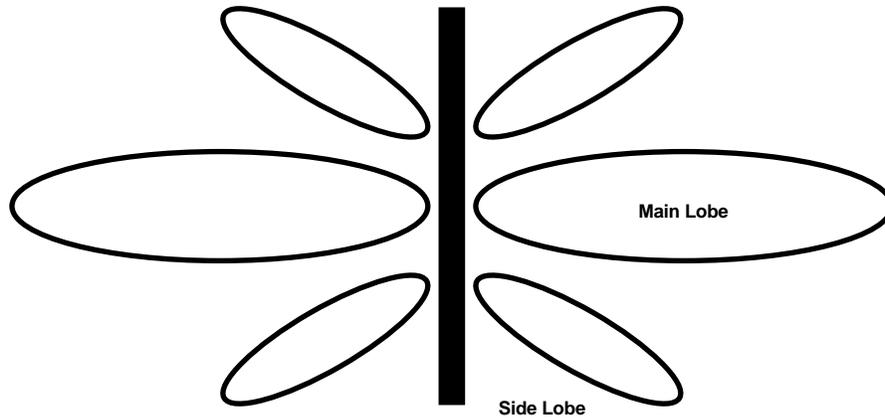


Figure C-3. Radiation pattern of an omnidirectional antenna—side view.

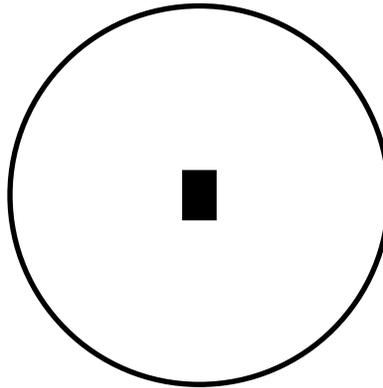


Figure C-4. Radiation pattern of an omnidirectional antenna—top view.

Directional Antenna

Radiates and receives most of the signal power in one direction. Figure C-5 shows the radiation pattern of a directional antenna with its side lobes in polar form.

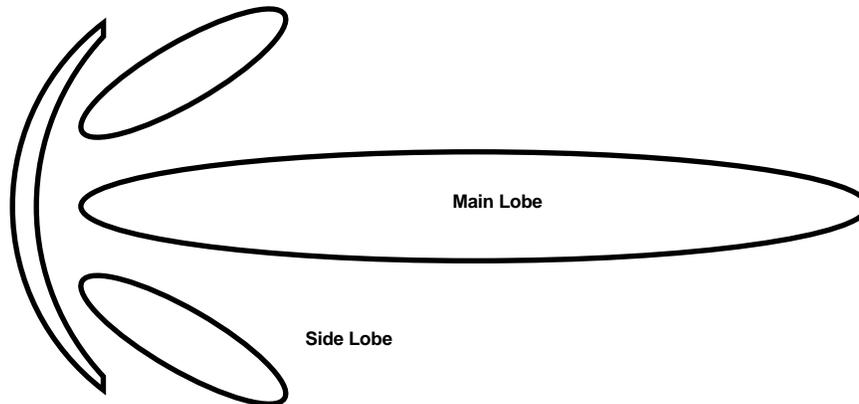


Figure C-5. Radiation pattern of directional antenna.

Antenna Beamwidth

The directiveness of a directional antenna. Defined as the angle between two half-power (-3 dB) points on either side of the main lobe of radiation.

C.2.7 SYSTEM CHARACTERISTICS*Receiver Sensitivity*

The minimum RF signal power level required at the input of a receiver for certain performance (for example, BER).

EIRP (Effective Isotropic Radiated Power)

The antenna-transmitted power. Equal to the transmitted output power minus cable loss plus the transmitting antenna gain.

P_{out} = Output power transmitted in dBm

C_t = Transmitter cable attenuation in dB

G_t = Transmitting antenna gain in dBi

G_r = Receiving antenna gain in dBi

P_l = Path loss in dB

C_r = Receiver cable attenuation in dB

S_i = Received power level at receiver input in dBm

P_s = Receiver sensitivity in dBm

$$S_i = P_{\text{out}} - C_t + G_t - P_l + G_r - C_r$$

$$\text{EIRP} = P_{\text{out}} - C_t + G_t$$

Example:

Link Parameters:

Frequency: 2.4 GHz

$P_{\text{out}} = 4 \text{ dBm}$ (2.5 mW)

Tx and Rx cable length (C_t and C_r) = 10 m. cable type RG214 (0.6 dB/meter)

Tx and Rx antenna gain (G_t and G_r) = 18 dBi

Distance between sites = 3 km

Receiver sensitivity (P_s) = -84 dBm

Link Budget Calculation

$$\text{EIRP} = P_{\text{out}} - C_t + G_t = 16 \text{ dBm}$$

$$P_l = 32.4 + 20 \times \text{Log}(\text{FMHz}) + 20 \times \text{Log}(\text{Rkm}) = 110 \text{ dB}$$

$$S_i = \text{EIRP} - P_l + G_r - C_r = -82 \text{ dBm}$$

In conclusion, the received signal power is above the sensitivity threshold, so the link should work. The problem is that there is only a 2-dB difference between received signal power and sensitivity. Normally, a higher margin is desirable due to fluctuation in received power as a result of signal fading.

C.2.8 SIGNAL FADING

Fading of the RF signal is caused by several factors:

- **Multipath:** The transmitted signal arrives at the receiver from different directions, with different path lengths, attenuation, and delays. The summed signal at the receiver may result in an attenuated signal.

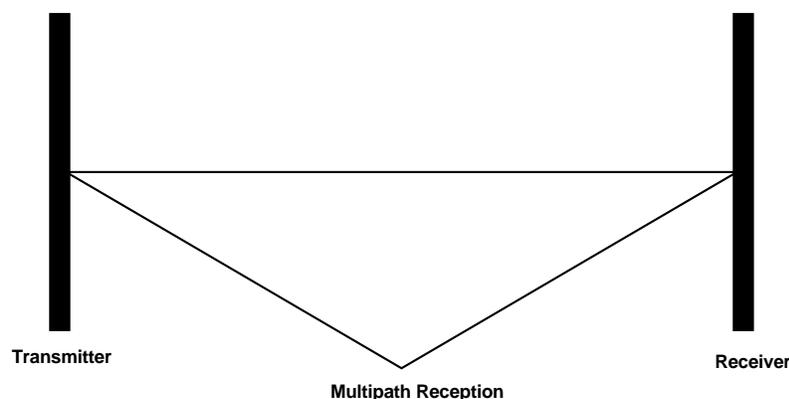


Figure C-6. Multipath reception.

- **Bad Line of Sight:** An optical line of sight exists if an imaginary straight line can connect the antennas on either side of the link. Radio wave clear line of sight exists if a certain area around the optical line of sight (Fresnel zone) is clear of obstacles. A bad line of sight exists if the first Fresnel Zone is obscured.
- **Distance**
- **Weather conditions (rain, wind, etc.)** At high rain intensity (150 mm/hr.), the fading of an RF signal at 2.4 GHz may reach a maximum of 0.02 dB/km. Wind may cause fading due to antenna motion.
- **Interference:** Interference may be caused by another system on the same frequency range, external noise, or some other co-located system.

C.2.9 THE LINE-OF-SIGHT CONCEPT

An optical line of sight exists if an imaginary straight line can be drawn connecting the antennas on either side of the link.

Clear Line of Sight

A clear line of sight exists when no physical objects obstruct viewing one antenna from the location of the other antenna.

A radio wave clear line of sight exists if a defined area around the optical line of sight (Fresnel Zone) is clear of obstacles.

Fresnel Zone

The Fresnel Zone is the area of a circle around the line of sight. The Fresnel Zone is defined as follows:

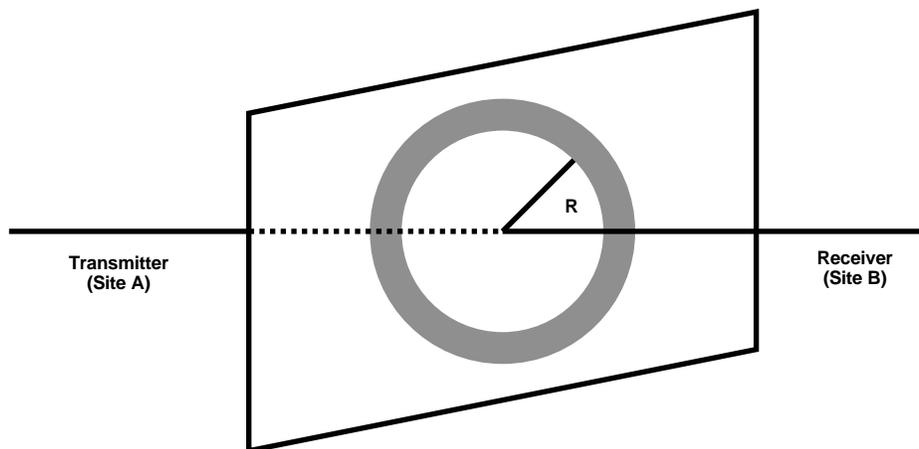


Figure C-7. Fresnel Aone.

$$R = 1/2 \sqrt{(\lambda \times D)}$$

R: radius of the first Fresnel Zone.

Lambda: wavelength (expressed in feet).

D: distance between sites (expressed in km).

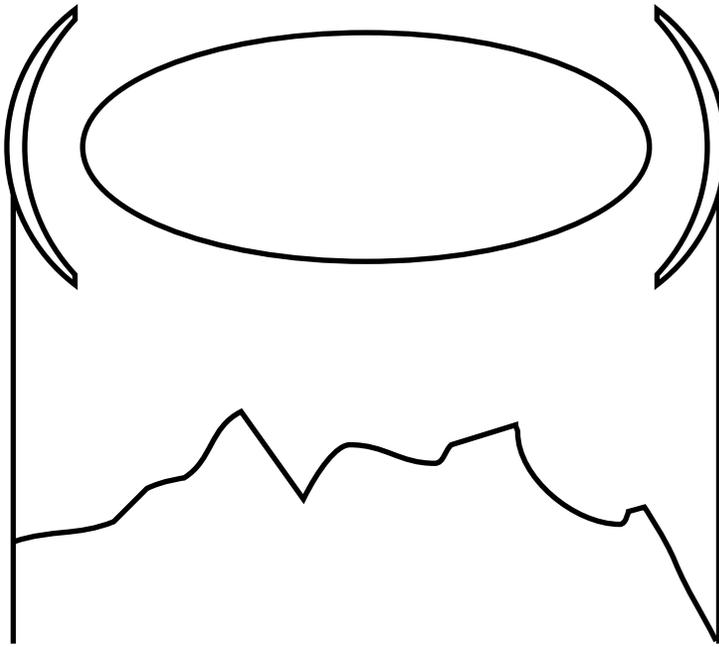


Figure C-8. Fresnel Zone clear of obstacles.

When at least 80% of the first Fresnel Zone is clear of obstacles, propagation loss is equivalent to that of free space.



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