

BreezeNET DS.11 Series

WBS-DS.11

WBC-DS.11

User's Manual

May, 1999

Cat xxxxxxxx

Rev A

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1. This device may not cause harmful interference.
2. This device must accept any interference received, including interference that may cause undesired operation.

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This equipment has been tested and found to comply with the limits for a class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

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 the minimum distance between your body and the antenna as shown in the table below:

Low gain indoor antennas ($\leq 6\text{dBi}$)	4.5cm (1.8 inches)
High gain outdoor antennas ($> 6\text{dBi}$)	30cm (12 inches)

Information to User

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

Contacting BreezeCOM Technical Support

Should you need assistance beyond the scope of this guide, please contact your local BreezeCOM reseller or distributor. If they cannot solve your problem, feel free to contact the BreezeCOM Technical Support Department. The support representatives can assist you in solving any problems that cannot be solved by your reseller.

When requesting support, please have the following items available:

- Configuration of the system, including models of the BreezeCOM equipment used.
- Antenna type and cable lengths.
- Site information such as possible radio path problems (like trees, machines, and buildings).
- Distance between devices.
- Configuration, statistic counters, and error messages as seen on the monitor.
- Description of problems encountered.

To contact BreezeCOM Technical Support, refer to the Technical Support page of the BreezeCOM web site: www.breezecom.com

TABLE OF CONTENTS

1. Introduction	1-1
1.1 How to Use This Guide.....	1-1
1.2 BreezeNET DS.11 Features	1-2
1.3 BreezNET DS.11 Compatibility and Standards.....	1-3
1.4 BreezeNET DS.11 Functional Description.....	1-3
1.4.1..... Quick Review of Ethernet	1-3
1.4.2..... WBS-DS.11 Wireless Base Station	1-3
1.4.3..... WBC-DS.11 Wireless Bridge Client	1-4
1.5 Where to Use DSSS	1-4
2. Installation	2-6
2.1 Checking The LED Indicators	2-6
2.2 The Rear Panel.....	2-7
2.3 Outdoor Installation Considerations	2-8
2.3.1..... Site Selection Factors	2-8
2.3.2..... Rooftop Installation	2-9
2.3.3..... Antennas for Outdoor Applications	2-10
2.3.4..... Antenna Seal	2-12
2.3.5..... Cell Size	2-12
2.3.6..... Link Distance	2-12
2.3.7..... Using Outdoor Range Tables	2-13
2.4 Precautions.....	2-14
2.4.1..... Transmit Antenna	2-14
2.4.2..... Lightning Protection	2-14
2.4.3..... Rain Proofing	2-15

Table of Contents

3.	System Troubleshooting	3-1
3.1	Troubleshooting Guide	3-1
4.	BreezeNET Management Utility	4-3
4.1	BreezeNET Management Utility Main Window	4-3
4.1.1	..... Selecting IP Addresses of Units	4-4
4.1.2	..... The IP/SNMP Tab	4-5
4.1.3	..... The General Info Tab	4-7
4.1.4	..... The WLAN Parameters Tab	4-8
4.1.5	..... The RSSI tab	4-9
4.1.6	..... The Counters Tab	4-10
4.1.7	..... The Station Control Tab	4-11
4.1.8	..... The Log Tab	4-12
4.1.9	..... Debug Info	4-13
4.2	Quick Start to Wireless Networking	4-13
4.3	More about Cells	4-14
5.	Software DownLoad Procedure	5-15
6.	Technical specifications	6-16
6.1	Supported Standards	6-16
6.2	Environmental	6-16
6.3	Power specifications	6-16
6.4	Radio specifications	6-17
6.5	Specific features	6-17
6.6	Physical Dimensions	6-17
APPENDIX A. RADIO SIGNAL PROPAGATION		1
A.1	Radio Signal Propagation	1
A.1.1	Introduction	1
A.1.2	RF Terms and Definitions	2

TABLE OF FIGURES

Figure 1-1. A Typical DS.11 Wireless Bridging Combined with FHSS WLAN Segments	1-5
Figure 2-1. DS.11 LEDs	2-6
Figure 2-2. DS.11 Rear Panel	2-7
Figure 4-1. BreezeCOM Manager Main Window (IP/SNMP Tab).....	4-4
Figure 4-2. IP/SNMP Tab	4-5
Figure 4-3. The Set IP Dialog Box	4-6
Figure 4-4. General Info Tab	4-7
Figure 4-5. WLAN Parameters Tab.....	4-8
Figure 4-6. Counters Tab	4-10
Figure 4-7. The Station Control Tab.....	4-11
Figure 4-8. Log Tab	4-12
Figure A-1. A Typical Radio System.....	A-1
Figure A-2. Attenuation of an RF signal	A-2
Figure A-3. Side View	A-4
Figure A-4. Top View.....	A-4
Figure A-5. Radiation Pattern of Directional Antenna.....	A-5
Figure A-6. Multipath Reception.....	A-7
Figure A-7. Fresnel Zone.....	A-8
Figure A-8. Fresnel Zone Clear of Obstacles	A-9

1. INTRODUCTION

This chapter describes the main features of the BreezeNET DS.11 Wireless LAN, which includes the following products:

- WBS-DS.11 - Wireless Base Station
- WBC-DS.11 - Wireless Bridge Client

Also in this chapter: relevant standards, compatibility issues, product functionality and use of the DS (Direct Sequence) WLAN.

1.1 How to Use This Guide

This User's Manual contains instructions for overall planning and setting up your wireless LAN, and provides details of how to install each unit, and how to install antennas and accessories.

This manual contains the following chapters:

- ⇒ **Chapter 1 Introduction** – Explains how to use this manual and presents the BreezeNET DS.11 series.
- ⇒ **Chapter 2 Installation** – Describes how to install the BreezeNET DS.11 series units.
- ⇒ **Chapter 3 System Troubleshooting** - Contains a troubleshooting guide for some of the more common problems which may occur when installing and using the BreezeNET DS.11 products.
- ⇒ **Chapter 4 Using the BreezeNET Management Utility** – Describes how to use the BreezeNET Management utility to setup, configure, and manage BreezeNET DS.11 series units.
- ⇒ **Chapter 5 Downloading Software Upgrades** – Explains how to perform future upgrades for BreezeNET DS.11 series units using a TFTP application.

- ⇒ **Chapter 6 Technical Specifications** - Lists the technical specifications for the BreezeNET DS.11 series units.
- ⇒ **Appendix A. Radio Signal Propagation** - This section explains and simplifies many of the terms relating to antennas and RF (Radio Frequency) used when dealing with an RF installation system.

1.2 BreezeNET DS.11 Features

The following are the main features of the BreezeNET DS.11 series:

- **Rate** - 11 Mbps with 5.5, 2, and 1 Mbps auto fallback rates.
- **LED Display** – Power, Network Activity, and WLAN Load or Signal Quality LEDs indicate the current status of the unit.
- **Upgrading** – Simple, quick, and free software upgrades via TFTP.
- **Future-proof Investment** – All “infrastructure” items in the DS.11 series line offer Flash updates.
- **Management utility** – This user-friendly application helps you quickly setup and manage your WLAN. You can save the configuration to a file and import the file to other stations for fast installation.
- **Easy Installation** - The DS.11 series supports a true plug-and-play.
- **MIB support** - The DS.11 series supports all major SNMP management software: HP/OpenView, SUN NetManager, SNMPC.
- **Transmit Diversity** - The DS.11 series supports a single or dual antennas diversity.
- **Bridge Client Support** - Remote bridge clients support is up to 15 miles away. In addition, the DS.11 series supports up to 64 Bridge clients.

1.3 BreezeNET DS.11 Compatibility and Standards

- IEEE 802.11 TGb Compliant – All BreezeNET DS.11 series units are fully compliant with the final IEEE 802.11 specification for wireless LANs, and thus support interoperability with other 802.11 compliant vendors.
- Completely inter-operable with other 802.11 and 802.11 TGb products
- Supports the common SNMP standard MIB groups and the 802.11 MIB
- Uses the 2.4 Ghz ISM unlicensed band

1.4 BreezeNET DS.11 Functional Description

BreezeNET DS.11 units add wireless functionality to existing Ethernet LANs.

1.4.1 Quick Review of Ethernet

Standard Ethernet LAN stations are wired to a common bus. When one of the stations sends a message, it assigns a destination address to the message and sends the message on the bus. All stations on the bus “hear” the message, but only the station with the proper address processes the message.

1.4.2 WBS-DS.11 Wireless Base Station

The WBS-DS.11 enables 802.11 access to 802.3 (Ethernet) and guarantees inter-station communication.

1.4.3 WBC-DS.11 Wireless Bridge Client

The WBC-DS.11 wireless bridge client connects to a wired Ethernet LAN (hub). When a station on the WBC-DS.11's LAN sends a message that is not destined for a local station, the WBC-DS.11 wirelessly forwards the message to the WBS-DS.11. When the WBS-DS.11 receives a message destined for a station on the WBC-DS.11's LAN, the WBS-DS.11 wirelessly forwards it to the WBC-DS.11. In this manner, the WBC-DS.11 and the WBS-DS.11 work together like a standard network bridge.

The first time each station on the WBC-DS.11's LAN sends a message, the station's address is registered in the WBC-DS.11 and the WBS-DS.11. The WBC-DS.11 and WBS-DS.11 can hold all the addresses necessary to support an entire LAN connected to a WBC-DS.11.

1.5 Where to Use DSSS

DSSS technology (Direct Sequence Spread Spectrum) spreads a signal power over 22MHz bandwidth; the same frequency is used for each transmission. This provides the DS.11 with a fast bit rate and long range links, ideal for outdoor bridging.

By using a directional antennas, spatial separation, and cross polarized discrimination DS.11 can feed FH (Frequency Hopping) distribution points with no performance loss.

Backbone links - Our DS.11 Bridge has low latency, which makes it ideal for backbone links of the WLAN.

Data rates - The DS.11 is ideal for clients that need high sustained data rates or high burst rates.

Long links - The DS.11 remote bridging capabilities enables it to support clients up to 15 mile away.

Latency sensitivity - Use the DS.11 for applications that are sensitive to latency.

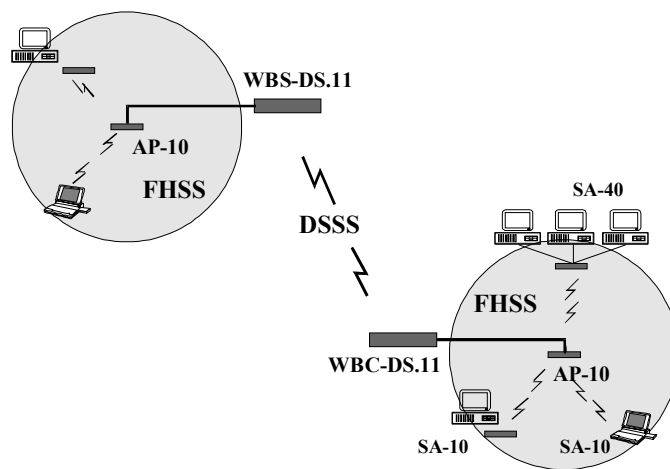


Figure 1-1. A Typical DS.11 Wireless Bridging Combined with FHSS WLAN Segments

2. INSTALLATION

1. Mount the antenna (see BreezeNET User's Manual) and locate the WBS/C accordingly.
2. Make sure the antennas are in a vertical position (if not, rotate over 90 degrees).
3. Insert the power connector.
4. Attach the Unshielded Twisted Pair (UTP) cable to the Wireless Base Station.
5. Switch on the unit.

2.1 Checking The LED Indicators

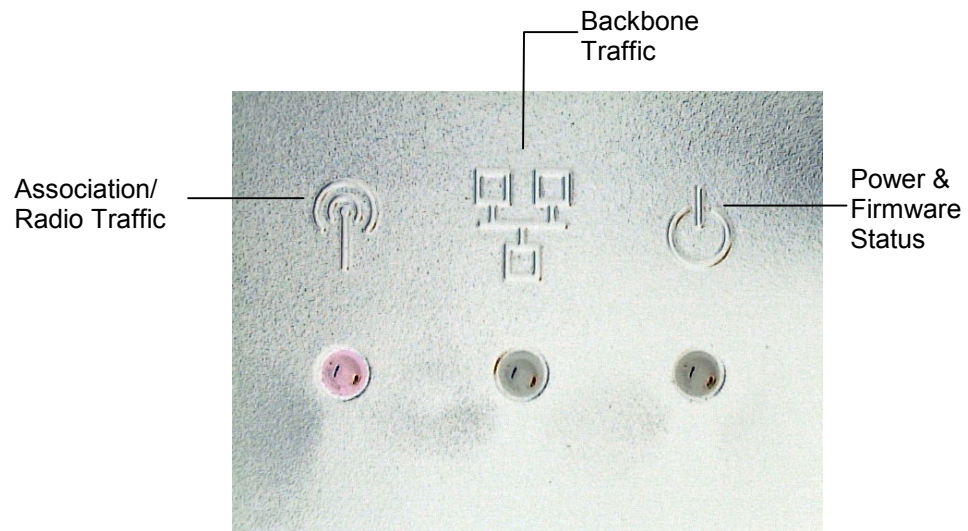


Figure 2-1. DS.11 LEDs

The following table lists the DS.11 LEDs and their diagnostics:

LED	Color	Explanation
Association/Radio Traffic Backbone Traffic Power & Firmware Status	Green	The server sends beacons immediately (10/s) while the station is scanning; the LED blinks irregularly until it is synchronized
Power & Firmware Status	Red	Firmware did not start. Power fault or wrong firmware.
Backbone Traffic	Red	No network connection detected. Check that the right cable is connected properly (crossed or not crossed).

2.2 The Rear Panel

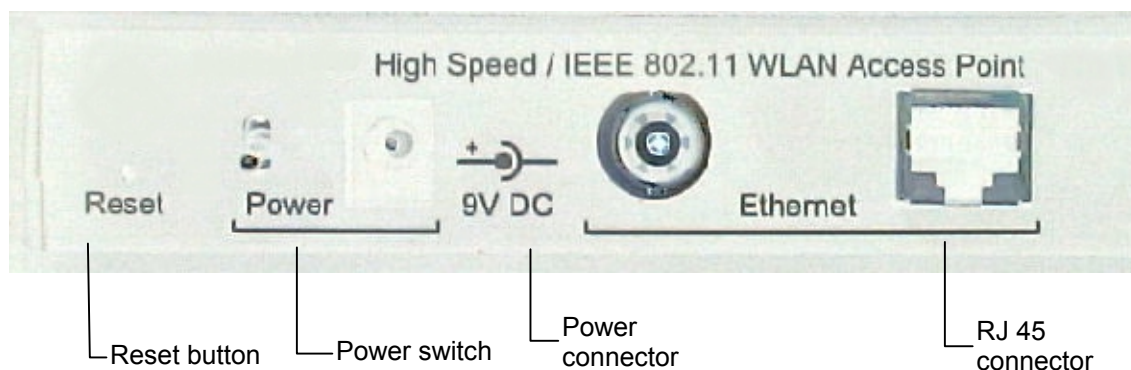


Figure 2-2. DS.11 Rear Panel

To reset the unit press the Reset button. Configured parameters will not be changed.

You can reset the unit's settings to factory defaults by pushing a paper clip in the little hole next to the Power switch while switching the unit on.

2.3 Outdoor Installation Considerations

This chapter describes various considerations to take into account when planning an outdoor installation. This includes site selection, antenna alignment, antenna diversity, antenna polarization, antenna seal, and cell size.

2.3.1 Site Selection Factors

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

- Minimum distance between sites
- Maximum height above the ground
- Maximum line of sight clearance
- Maximum separation between antennas (diversity option)

Path of Clearest Propagation

A propagation path is the path that signals traverse between the antennas of any two bridges. 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 physical object in the path between two bridges can cause signal attenuation. Common obstructions are buildings and trees. If a bridge's antenna is installed indoors, the walls and/or windows between the two sites are physical obstructions. If the antenna is positioned outdoors, any buildings or other physical structure such as trees, mountains or other natural geographic features higher than the antenna and situated in the path between the two sites can constitute obstructions.

Install indoor antennas as close as possible to a window (or wall if a window is not accessible) facing the required direction. Avoid metal obstacles such as metal window frames or metal film anti-glare windows in the transmission path. Install outdoor antennas high enough to avoid any obstacles which may block the signal.

Minimal Path Loss

Path loss is determined mainly by several factors:

- **Distance between sites** - Path loss is lower and system performance 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.

2.3.2 Rooftop Installation

***Note:** Rooftop antenna installations are extremely dangerous! Incorrect installation may result in death, serious injury and/or damage. Such installations should be performed by professional antenna installers only!*

Rooftop installations offer several advantages:

- Increased antenna range.
- Less obstacles in path.
- Improved performance due to greater height.
- Reduced multipath problems.

2.3.3 Antennas for Outdoor Applications

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

2.3.3.1 Point-to-Point

A point-to-point link is based on the use of one Access Point with external antennas (WBS-DS.11) and one adapter. The DS.11 and the WBC-DS.11 must be equipped with one or two directional antennas. The necessary antenna gain depends on the required range and performance.

2.3.3.2 Point-to-Multipoint

Setting up a point-to-multipoint link requires the use of an WBS-DS.11 equipped with omni-directional antennas and a remote WBC-DS.11 equipped with high-gain directional antennas.

2.3.3.3 Antenna Alignment

Low gain antennas do not require alignment due to their very wide radiation pattern. High gain antennas have a narrow beamwidth necessitating an alignment procedure in order to optimize the link.

Check antenna alignment by using the LED indicators on the front panel of whichever adapter is used in the link. These LED indicators provide indication of reception quality.

⇒ ***To perform antenna alignment:***

1. Assemble antennas according to the assembly instructions included with the antenna set.
2. Mount the antennas as high as possible.
3. Connect the coaxial cable to the WBS-DS.11 at the main site.
4. Connect the coaxial cable to the WBC-DS.11 at the remote site.

5. Power on both units.
6. Synchronize the units by aligning the antennas manually until the Association/Radio Traffic indicator LED on the front panel of the wireless Bridge and/or Station Adapter illuminates.
7. Align antennas at the main and remote sites until maximum signal quality is obtained.

If the received signal quality is lower than expected for this antenna/range combination, change antenna height and verify RF cables connections.

2.3.3.4 Antenna Diversity

In applications where no multipath propagation is expected, a single antenna is sufficient to ensure good performance levels. However, in cases where multipath propagation exists, BreezeCOM recommends that two antennas be used. This takes advantage of space diversity capabilities. By using two antennas per unit, the system can select the best antenna on a per-packet basis (every several milliseconds).

Multipath propagation is to be expected when there are potential reflectors between the main and remote sites. These reflectors may be buildings or moving objects such as airplanes and motor vehicles. If this is the case, the radio signal does not travel in a straight line, but is reflected or deflected off of the object, creating multiple propagation paths.

When installing a single antenna, modify the **transmit diversity** option to either antenna 1 or antenna 2, according to the antenna being used (refer to Section 4.1.4).

2.3.3.5 Antenna Polarization

Antenna polarization must be the same at either end of the link. In most applications, the preferred orientation is vertical polarization. Above-ground propagation of the signal is better when it is polarized vertically. To verify antenna polarization, refer to the assembly instructions supplied with the antenna set.

2.3.4 Antenna Seal

When using outdoor antennas, you must seal the antenna connectors against rain. Otherwise the antennas are not suitable for use in outdoor installations.

2.3.5 Cell Size

Cell size is determined by the maximum possible distance between the Access Point and the Bridge unit, usually related to point-to-multipoint installations using external antennas. For open outdoor areas with an unobstructed line of sight between the Access Point and the BreezeNET DS.11 Bridge, the suggested maximum distance between Access Point and Bridge is: Standard WBS-DS.11 700m (2000 ft.)

2.3.6 Link Distance

Link distance is the maximum distance between the WBS-DS.11 and the station adapter, usually related to point-to-point installations using external antennas. For open outdoor areas with an unobstructed line of sight between the WBS and the wireless bridge, the suggested maximum distance is 15 miles.

Note: *The maximum distance of 15 miles is achieved using 24 dBi antennas.*

For range tables, refer to Section 2.3.7.

2.3.7 Using Outdoor Range Tables

Outdoor installations must have a clear line-of-sight. Solid obstacles such as buildings or hills prevent the establishment of a link. Partial obstacles such as trees or traffic can reduce range. Extending coaxial cables can cause an increase in assembly signal loss and a reduction in range.

The ranges in the following tables are attained under good propagating conditions when using the standard cables supplied in the antenna set. Actual ranges may vary due to specific multipath and interference conditions.

For specific range guidelines and information about extending cables, consult your local dealer or BreezeCOM central offices.

	Omni-8	Uni-9	Uni-13	Uni-16	Uni-24
Omni-8	1.5	1.6	2	3	5
Uni-9	1.6	1.7	2.5	3	5
Uni-13	2	2.5	3.5	4.5	7
Uni-16	3	3	4.5	5	9
Uni-24	5	5	7	9	15

Distances shown are in Miles.

WARNING: It is the responsibility of the professional installer to ensure that when using the outdoor antenna kits in the United States (or where FCC rules apply), only these antenna configurations shown in the table above are used. The use of any antenna other than those listed is expressly forbidden in accordance to FCC rules CFR47 part 15.204.

2.4 Precautions

Note: *Detached antennas, whether installed indoors or out, 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.*

Failure to do so may void the BreezeNET Product Warranty and may expose the end user to legal and financial liabilities. BreezeCOM and its resellers or distributors are not liable for injury, damage or violation of government regulations associated with the installation of detached antennas.

2.4.1 Transmit Antenna

Regulations regarding maximum antenna gains vary from country to country. It is the responsibility of the end user to operate within the limits of these regulations and to ensure that the professional installer is aware of these regulations, as well. The FCC in the United States and ETSI in Europe limit effective transmit power to 36dBm (USA) and 20dBm (Europe). The maximum total assembly gain of antennas and cables in this case equals 19dBi (USA) and 3dBi (Europe).

2.4.2 Lightning Protection

Lightning protection is designed to protect people, property and equipment by providing a path to ground for the lightning's energy. The lightning arrestor diverts the strike energy to ground through a deliberate and controlled path instead of allowing it to choose a random path. Lightning protection for a building is more forgiving than protection of electronic devices. A building can withstand up to 100,000 volts, but electronic equipment may be damaged by just a few volts.

Lightning protection entails connecting an antenna discharge unit (also called an arrestor) to each cable as close as possible to the point where it enters the building. It also entails proper grounding of the arrestors and of the antenna mast (if the antenna is connected to one).

The lightning arrester should be installed and grounded at the point where the cable enters the building. The arrester is connected to the unit at one end and to the antenna at the other end.

The professional installer you choose must be knowledgeable about lightning protection. The installer must install the lightning protector in a way that maximizes lightning protection. BreezeCOM offers the following high-quality lightning arrester assembly:

BreezeNET AL 1 Lightning Arrester - Part No. 872905 5 ft (1.5m), *N* Male to *N* Female.

2.4.3 Rain Proofing

12, 18, and 24 dBi antennas must be sealed against rain at the point the cable enters the pole before they are suitable for external use.

3. SYSTEM TROUBLESHOOTING

The following troubleshooting guide provides answers to some of the more common problems which may occur when installing and using BreezeNET PRO.11 Series products. If problems not mentioned in this guide should arise, checking the Ethernet and WLAN counters may help (see Section **Error! Reference source not found.**). If the problem persists, please feel free to contact your local distributor or the BreezeCOM Technical Support Department.

3.1 Troubleshooting Guide

Problem and Indication	Possible Cause	Corrective Action
No Power to Unit. Power LED is off.	<ol style="list-style-type: none"> 1. Power cord is not properly connected. 2. Power supply is defective. 	<ol style="list-style-type: none"> 1. Verify power cord is properly connected to the BreezeNET unit and to the power outlet. 2. If this is not the cause, replace the power supply.
Failure to establish wireless link. Association LED is off and unit resets every few minutes.	<ol style="list-style-type: none"> 1. Power supply to units may be faulty 2. The units may not have the same ESSID as the AP-10. 	<ol style="list-style-type: none"> 1. Verify power to units. 2. Verify that all units in the network have the same ESSID as the AP (ESSID must be identical in all units in the network): Verify wireless link: Set WBS-DS.11 and Bridge unit side by side. Power on each unit and see if a wireless link is established (even "D" models without their external antennas should establish a link if placed side by side with the WBS-DS.11). If the units fail to associate, reset units to factory default values reset unit (see Section 2.2). The units should now establish a wireless link.

System Troubleshooting

Problem and Indication	Possible Cause	Corrective Action
Failure to establish wireless link ("D" models/external antennas)	<ol style="list-style-type: none">1. Power supply to units may be faulty.2. Cables may be improperly connected3. There may be some problem with antenna installation.	<ol style="list-style-type: none">1. Verify power to units.2. Verify that all cables are connected securely.3. Refer to previous Section and verify wireless link between the units.4. Verify that the antenna(s) are properly installed (see relevant Section in this manual): 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.
Wireless link established, but there is no Ethernet activity (WBS-DS.11 and WBC-DS.11 units).	<ol style="list-style-type: none">1. Ethernet hub port or UTP cable is faulty.2. Ethernet port in unit is faulty.	<ol style="list-style-type: none">1. Check that the Association LED is on and solid at the hub port. If this is not the case, the port is inactive. Try another port on the hub or another UTP cable.2. Verify that Ethernet port in unit is working. Ping unit to verify Ethernet connection.3. Verify that you are using a cross-over UTP cable (pins 1 & 3, 2 & 6) if connected directly to workstation, or a straight-through cable if connected to a hub.4. Check ETHR LED indicator in unit and Ethernet counters in Monitor to verify Ethernet activity (see Section 4.1.5).

4. BREEZENET MANAGEMENT UTILITY

The BreezeNET DS.11 is an SNMP-based (Simple Network Management Protocol) management utility that provides a consistent view of the wireless network. The systems administrator can use the management utility to control a large number of DS.11 Access Points from a single location.

Among the supported features:

- Assign radio channels for optimal cell management
- Program an Access Point with a specified IP address
- Set the SNMP Write Community strings
- Verify the status of all Access Points in the network
- Perform a site survey
- Antenna selection
- Configuration of parameters

4.1 BreezeNET Management Utility Main Window

The BreezeNET Management utility main window consists of two main areas:

- **The IP and Community Selection area** - In this area, you select the community string and address of the unit you wish to manage or edit.
- **The Tab area** - This area consists of five tabs containing parameter required for the management of the WLAN. When you switch between the tabs, the IP Selection area with the selected unit address, remains displayed.

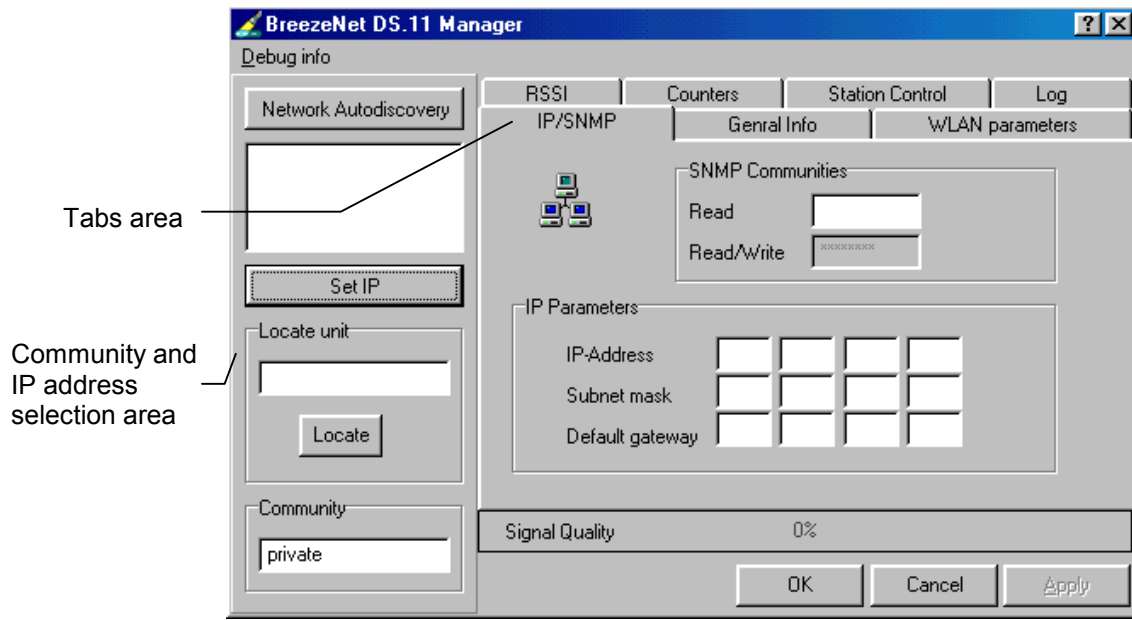


Figure 4-1. BreezeCOM Manager Main Window (IP/SNMP Tab)

4.1.1 Selecting IP Addresses of Units

You can select a unit's IP address in one of the following ways:

- Click the **Network Autodiscovery** button. All the current units IP addresses (under the selected community) are displayed in the list box below. Double-click on an address to select it.
- For stations which are located behind a router, type the unit's address in the Locate unit field and click **Locate** to display its parameters.
- **Signal Quality bar** - This bar appears only if the selected IP address is a WBC-DS.11 unit, and displays the signal quality between the selected Bridge unit and the WBS-DS.11 unit connected to it.

If the selected IP address is a WBC-DS.11 you can view its signal quality in the RSSI tab.

Note: If you select an IP address of a WBS-DS.11 unit, the signal quality is displayed in the Signal Quality tab. This tab displays a table that lists all the MAC addresses, connected to that AP, and their signal quality.

When the community is Read the parameters are grayed out (disabled).

4.1.2 The IP/SNMP Tab

All BreezeNET DS.11 units contain IP Host software. This software is used for testing the unit for SNMP management functions (and for downloading software upgrades using the TFTP protocol).

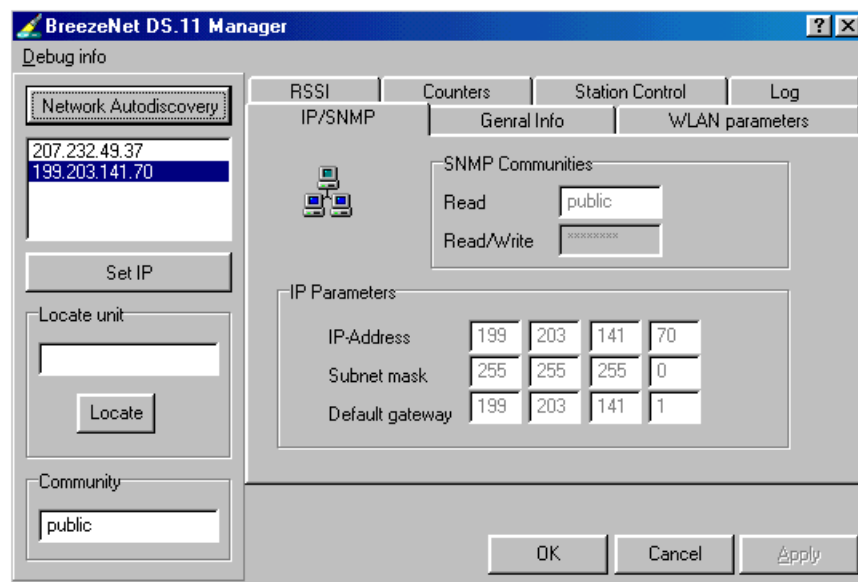



Figure 4-2. IP/SNMP Tab

The IP/SNMP tab allows you to define or edit IP parameters for the DS.11 units.

4.1.2.1 Assigning and Editing IP Parameters Using the Network Autodiscovery

1. Type the known Read/Write Community string in the Community field (the default string is Private).
2. Select a unit address as describe in Section 4.1.1. The unit's Read-Read/Write Community strings appear in the SNMP Communities area of the window, and the unit's parameters appear in the IP Parameters area of the window:
 - **Read** - The read only community string of the unit.
 - **Read/Write** - The read/write community string of the unit.
 - **IP Address** - The IP address of the selected unit.
 - **Subnet musk** -The Subnet mask of the selected unit.
 - **Default gateway** - The Default gateway of the selected unit.
3. Click  to apply configuration

4.1.2.2 Assigning and Editing IP Addresses Manually

1. Click the  button. The Set IP dialog box is displayed.

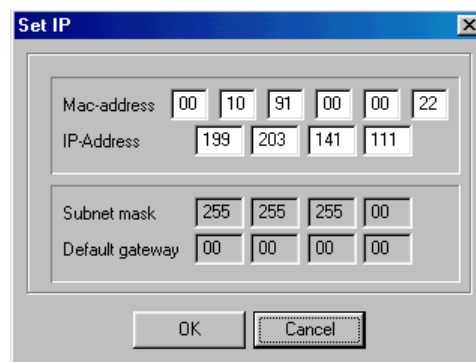


Figure 4-3. The Set IP Dialog Box

2. Type the parameters in the appropriate fields and click **OK**. A message box is displayed notifying you when the changes to take affect.

4.1.3 The General Info Tab

The General Info tab displays general information regarding the unit's firmware and hardware versions, and general unit address information.

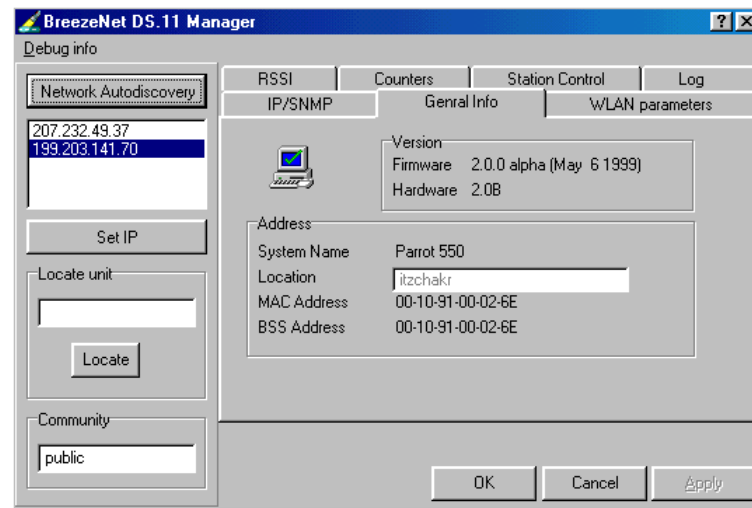


Figure 4-4. General Info Tab

- **Firmware** - the current firmware version.
- **Hardware** - the current hardware version.
- **System Name** - the name of the selected unit.
- **Location** - location of the selected unit.
- **MAC Address** - MAC address of the selected unit.
- **BSS Address** - BSS address of the selected unit.

Note: You can select unit's address in the same way you have selected addresses in the IP/SNMP tab (i.e., selecting the address from the list, or typing it directly).

4.1.4 The WLAN Parameters Tab

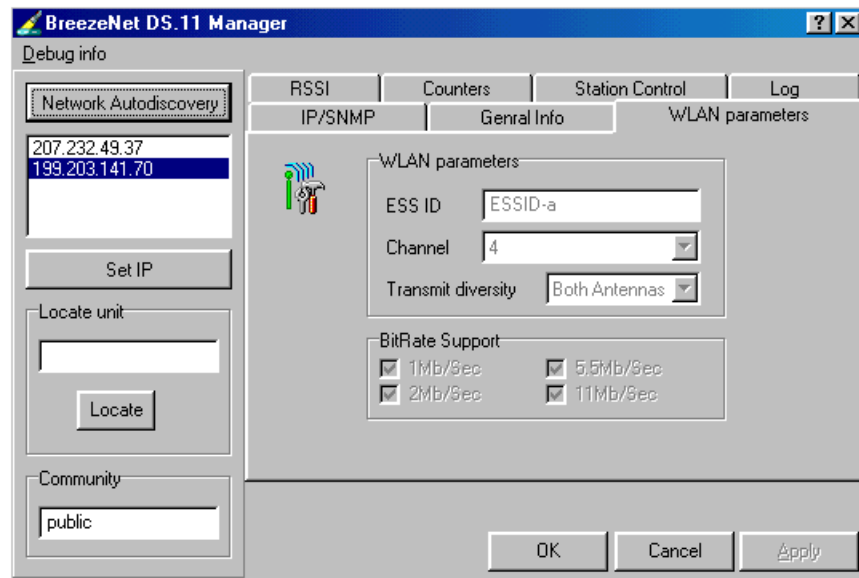


Figure 4-5. WLAN Parameters Tab

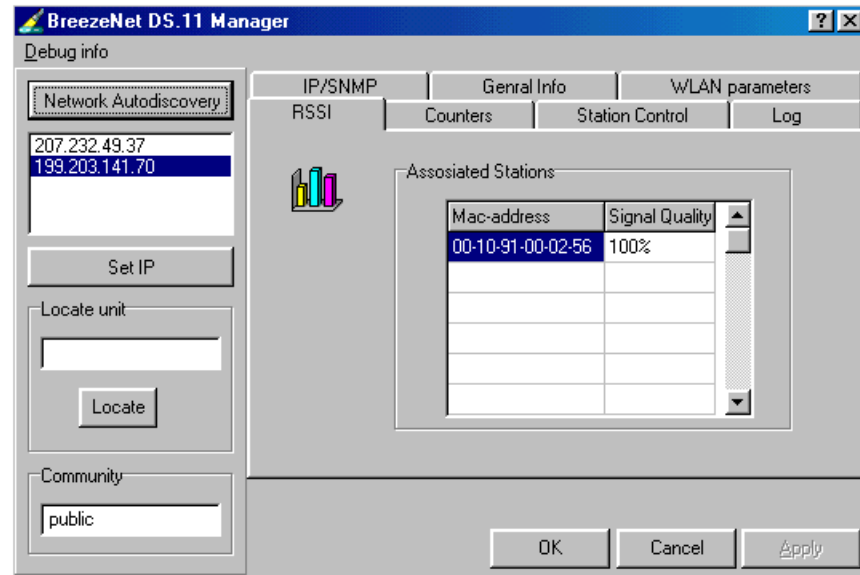
1. Set the ESS ID of the WLAN.
2. Select a channel.
3. Set Antenna diversity to Antenna No. 1, No. 2, or both.
4. Set the desired bit rate. For maximum bit rate support, check both 5.5 Mbps and 11 Mbps.

Note: The 1 Mbps and 2 Mbps bit rates are checked by default.

In case of interference, the BreezeNET Management utility automatically falls back to the lower bit rate.

4.1.5 The RSSI tab

This tab allows you to view signal quality of WBC units and the associated stations.



Select an IP address as explained previously in Section 4.1.1.

In the Associated Stations you can see all the stations associated with the selected unit and their signal quality.

4.1.6 The Counters Tab

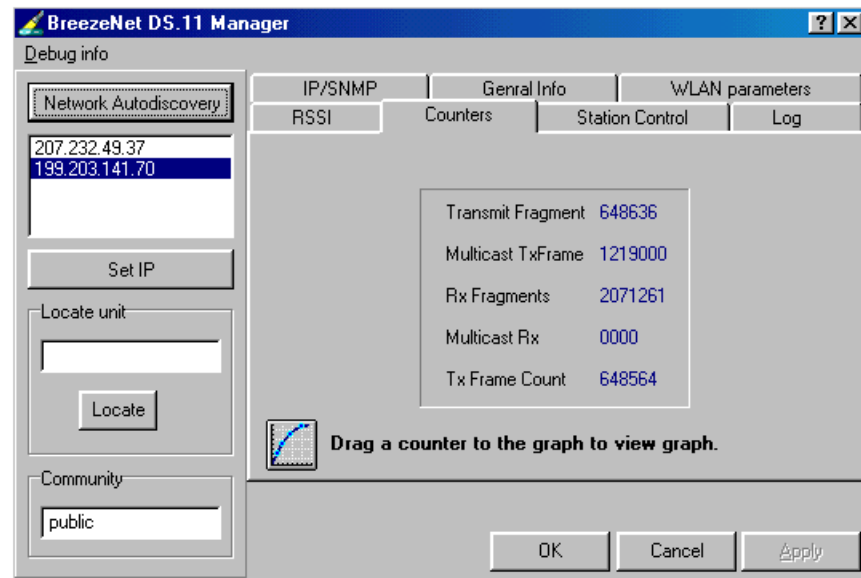



Figure 4-6. Counters Tab

Select a counter and drag it to the graph  icon to view the graph.

- **Transmit Fragment** - The total number of transmitted frames. The count includes data, control and management frames and also 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). In a point-to-point application, this counter should relatively correspond to the number of bad fragments received on the other side.
- **Tx Frame Count** - The number of frames transmitted to the wireless media. The count includes the first transmission of data frames (without retransmissions), and also the number of control and management frames.
- **Rx Fragments** - The total number of frames received, including data, control, and duplicate data frames.
- Multicast Rx -
- Multicast Tx -

4.1.7 The Station Control Tab

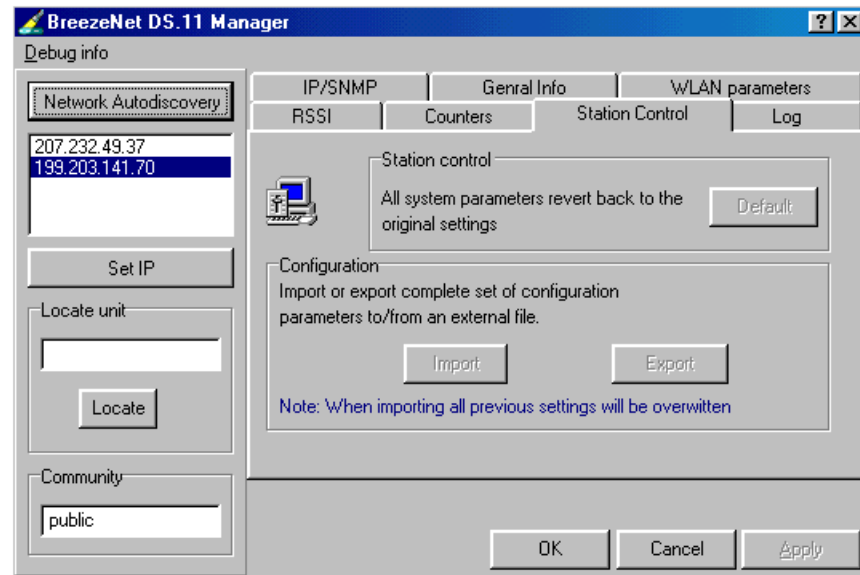
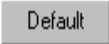


Figure 4-7. The Station Control Tab

Station Control - Click the  button to revert back to the factory default settings.

Configuration - Click Import/Export to import or export a complete set of configuration parameters to an external file.

4.1.8 The Log Tab

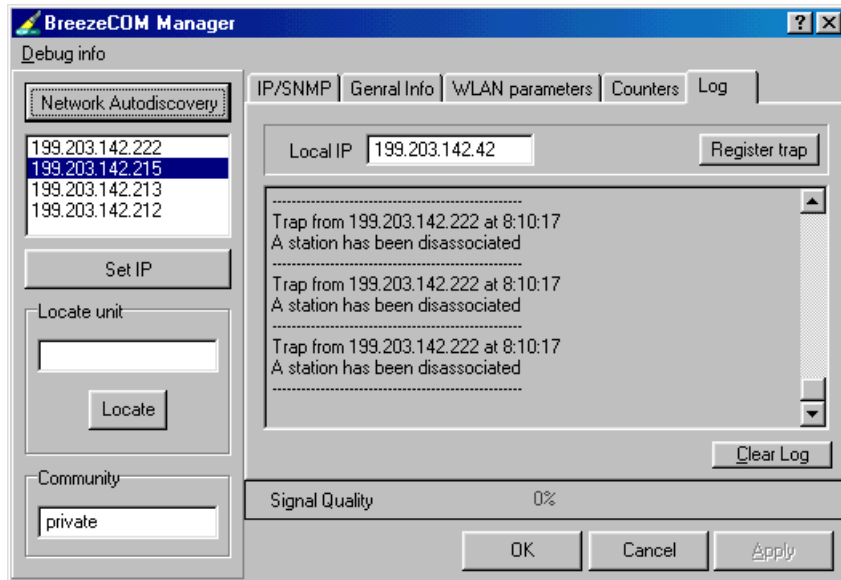


Figure 4-8. Log Tab

When an event occurs, a trap is sent to the defined host address. The Log tab allows you to configure the host address to which the traps are sent.

A list of the last traps is displayed in the event log area, below the Local IP field.

The default host address is the IP address of the PC running the BreezeNET Management utility.

1. Select the IP address as explained earlier. the selected address appears in the Local IP field.
2. Click the **Register trap** button to register this address as the host address.
3. Repeat Step 2 for all the IP addresses you wish to send traps to.

4.1.9 Debug Info

This option allows you to create a log file, named BreezeLog.log. Later you can send this log file to BreezeCOM Technical Support and receive help based on the information recorded in this file.

To start recording, open the Debug Info option and select Start Log.

When you finish recording (usually after 24 hours) select Stop Log and send the file to BreezeCOM Technical Support representatives.

4.2 Quick Start to Wireless Networking

Perform the following steps to configure a WLAN for the first time:

1. Physically connect the Access Points to the Ethernet LAN. Make sure they are switched on. The DS.11 wireless network will be up and running immediately. If you are content with the default settings of the Access Points, you can stop right here. It is more likely however, that you want to assign different radio frequencies to each Access Point, or impose some restrictions on the use of your wireless network.
2. To be able to manage the Access Points via SNMP, every Access Point needs a unique IP address. If you provide a DHCP or BOOTP service on your LAN (and have sufficient free IP addresses available) this will be taken care of automatically. If not, refer to Section 4.1.2.2 for further information on assigning IP addresses.
3. Use the BreezeNET Management utility to configure the Network Settings to reflect your situation.
4. Select the radio channels of the Access Points according to your cell plan. See Section 4.1.4 for further information. Add descriptive information about each Access Point for later reference.

4.3 More about Cells

Each Access Point in the network forms the center of a cell, or BSS. The Cells should overlap slightly to guarantee seamless wireless connectivity everywhere. Neighboring Access Points should preferably send and receive on different channels for maximum throughput.

Creating a cell plan for your site can be complicated, and is usually done by experts employing special measuring equipment.

Furthermore, the radio channels you may use depend on both the capabilities of the PC-Cards you are deploying, as well as the regulations in your area.

The following table provides specifications for the main regulatory domains:

Regulatory Domain	4.8.1.1 Area	Permissible Channels	Predefined channels
FCC	United States	1 – 11	1, 6, 11
DOC	Canada	1 – 11	1, 6, 11
ETSI	Europe except Spain and France	1 – 13	1, 7, 13
SPAIN	Spain	10	10
FRANCE	France	10	10
MKK	Japan	14	14

5. SOFTWARE DOWNLOAD PROCEDURE

1. Set the unit's IP address, using the BreezeCOM Manager utility, and verify that the PC's IP address belongs to the same Subnet Mask as the unit.
2. Ping the unit's IP address. Make sure that the Ping replies are being received.
3. Use the TFTP utility on the PC:
 - a) Syntax: TFTP [-i] destination host [PUT] source file [password]
 - b) Example: TFTP -i 199.203.141.30 put ap1100.arm private

Download will be completed within 1 minute, and a message of successful file transfer will show on the screen.
4. Click OK; the unit resets itself.
5. Check the diagnostics LEDs, and use the BreezeNET Management utility to make sure that the version number is correct.

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

6. TECHNICAL SPECIFICATIONS

6.1 Supported Standards

- Compliant with ETS 300 328 and ETS 300 826 (CE marked)
- IEEE 802.11 standard for Wireless LAN
- All major networking standards (including IP, IPX)

6.2 Environmental

Operating temperature (ambient)	0°C to 55°C (32°F to 131°F)
Storage temperature	-5°C to 70°C (23°F to 158°F)
Operating humidity	10% to 90% (non-condensing)
Storage humidity	5% to 95% (non-condensing)

6.3 Power specifications

DC power supply	In 230 VAC 50 Hz 150 mA Out 9 VDC 1.3 A
WBS-DS.11 Access Point	In 9 VDC 1 A

6.4 Radio specifications

Range	outdoors up to 15 miles
Transmit power	+18 dBm +2 dBm (Low power for use with high gain antenna)
Frequency range	2.4-2.4835 Ghz, direct sequence spread spectrum
Number of Channels	Europe: 13 (3 non-overlapping) US: 11 (3 non-overlapping) France: 4 (1 non-overlapping)

6.5 Specific features

Supported bit rates	<ul style="list-style-type: none"> • 11 Mbps • 5.5 Mbps • 2 Mbps • 1Mbps
Utility Software	DS11 BreezeNET Management utility

6.6 Physical Dimensions

Size	180 x 220 x 40 mm
Weight	

APPENDIX A. RADIO SIGNAL PROPAGATION

A.1 Radio Signal Propagation

A.1.1 Introduction

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

The following diagram depicts a typical radio system:

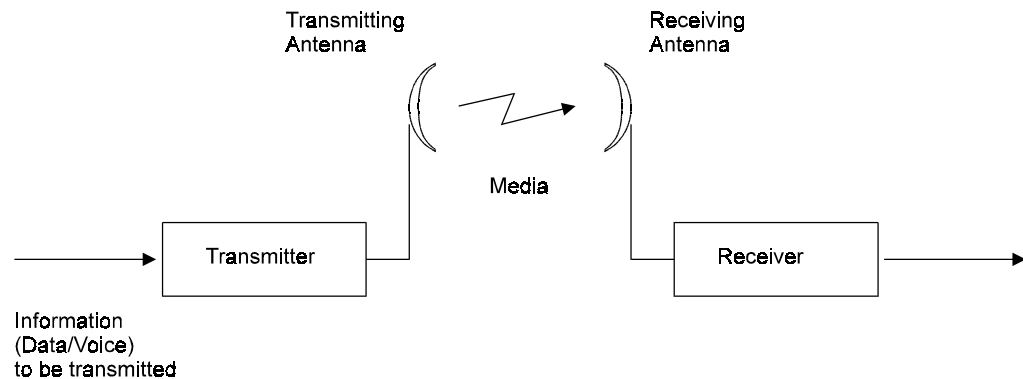


Figure A-1. A Typical Radio System

A radio system transmits information to the transmitter. The information is transmitted through an antenna which 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.

A.1.2 RF Terms and Definitions

dB

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

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.

Attenuation

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

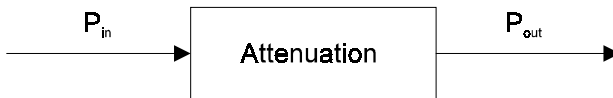


Figure A-2. Attenuation of an RF signal

P_{in} is the incident power level at the attenuated input

P_{out} is the output power level at the attenuated output

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 ($P_{out}/P_{in} = 1/2$), attenuation in dB is $-10 \times \text{Log}(1/2) = 3_{dB}$

Path Loss

Loss of power of an RF signal traveling (propagating) through space. It is 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

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.

At 2.4 Ghz, this formula is: $100 + 20 \times \text{Log}(R_{\text{Km}})$

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 defined as 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.

Omni-directional Antenna

Radiates and receives equally in all directions in azimuth. The following diagram shows the radiation pattern of an omni-directional antenna with its side lobes in polar form.

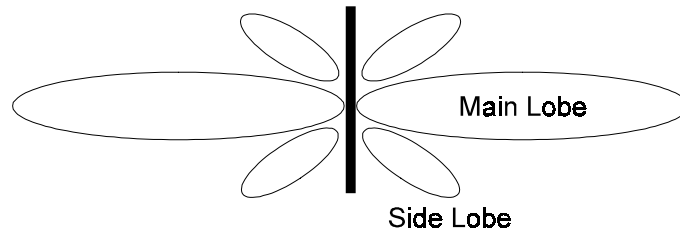


Figure A-3. Side View

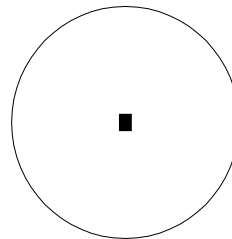


Figure A-4. Top View

Directional Antenna

Radiates and receives most of the signal power in one direction. The following diagram shows the radiation pattern of a directional antenna with its side lobes in polar form:

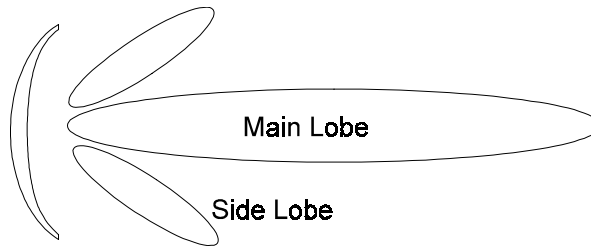


Figure A-5. Radiation Pattern of Directional Antenna

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.

System Characteristics

Receiver Sensitivity

The minimum RF signal power level required at the input of a receiver for certain performance (e.g. 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 of transmitted in dBm

C_t Transmitter cable attenuation in dB

G_t Transmitting antenna gain in dBi

GrReceiving antenna gain in dBi

PlPath loss in dB

CrReceiver cable attenuation is dB

SiReceived power level at receiver input in dBm

PsReceiver sensitivity is dBm

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

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

Example:

Link Parameters:

Frequency: 2.4 Ghz

$P_{out} = 4$ 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

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

$$P_l = 32.4 + 20 \times \text{Log}(\text{FMhz}) + 20 \times \text{Log}(\text{RKm}) \cong 110 \text{ dB}$$

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

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.

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.

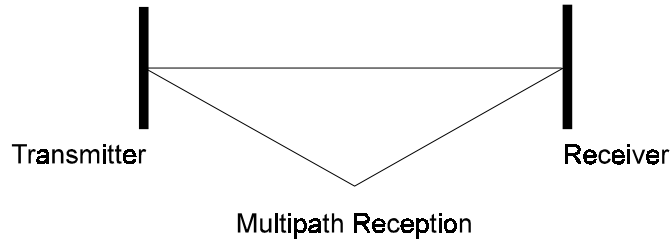


Figure A-6. Multipath Reception

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.

- Link Budget Calculations
- 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.

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:

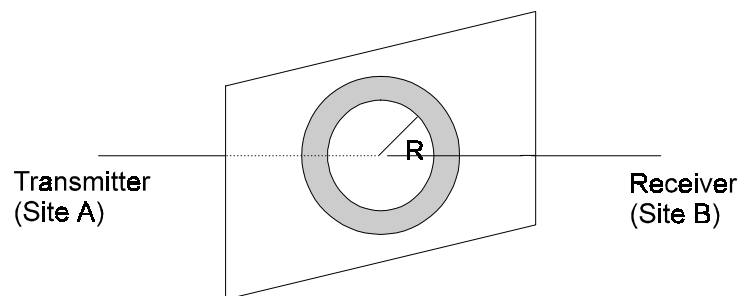


Figure A-7. Fresnel Zone

$$R = \frac{1}{2} \sqrt{\lambda x D}$$

R: radius of the first Fresnel zone

λ : wavelength

D: distance between sites

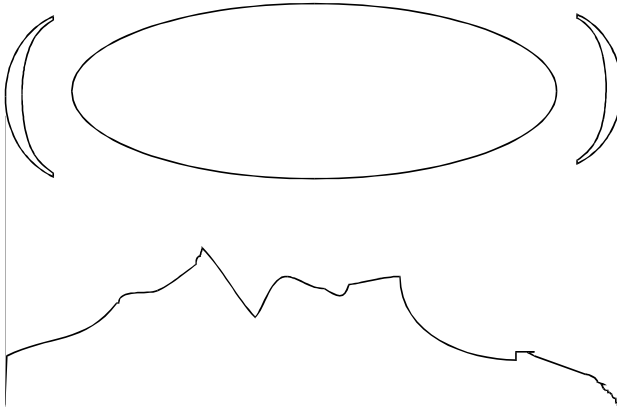


Figure A-8. Fresnel Zone Clear of Obstacles

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