For Professional Installers

Product Manual And Installation Guide

WirelessGRID Indoor Wireless Bridge
(For use with outdoor antennas and RF cables)

Indoor Bridge with N-type Connector
AI108-4958-N

Indoor Bridge w/RF Cable and Outdoor Antenna
AI108-4958-1/AI108-4958-SU

Indoor Bridge Kit w/RF Cables & Outdoor Antennas
AI108-4958-Kit

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International Headquarters
637 Adair Court
Morgan Hill, CA 95037
Tel: 866-224-7292
Tel: 408-776-9583 International
Fax 408-776-9583
E-mail: support@airaya.com
Skype: airaya_support
Web site: www.airaya.com

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AIRAYA Corp.

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Note: *AIRAYA will provide fee-based service for up to three years following discontinuance of any product from the active AIRAYA price list. Under the one-year warranty, internal and external power supplies, and fans are covered by a standard one-year warranty from date of purchase.*

Regulatory Information

FCC and Industry Canada Guidelines

The radiated output power of the AIRAYA WirelessGRID Wireless Bridge is far below the FCC radio frequency exposure limits. Nevertheless, the device shall be used in such a manner that the potential for human contact during normal operation is minimized. It is the responsibility of the installer and users of the WirelessGRID to guarantee that the antenna operates at least 20 centimeters (8 inches) from any person. This is necessary to insure that the product operates in accordance with the Federal Communications Commission's RF Guidelines for Human Exposure.

The WirelessGRID's built-in antennas may NOT be replaced at any time. They are designed to comply with the maximum EIRP limits specified by the FCC and Industry Canada. Modifications to the WirelessGRID, unless expressly approved by AIRAYA, could void the user's authority to operate the equipment.

The WirelessGRID wireless bridge operates in the 5.25 to 5.35 GHz frequency range. High power radar systems in both Canada and the United States are allocated as primary users of this spectrum. These radars can cause interference and or damage to devices such as the WirelessGRID wireless bridge when used outdoors.

The term "IC:" before the radio certification number only signifies that Industry Canada technical specifications were met.

FCC ID: QDE-GRIDC3
IC: 4433A-GRIDC3

THIS DEVICE COMPLIES WITH PART 15 OF THE FCC RULES. OPERATION IS SUBJECT TO THE FOLLOWING TWO CONDITIONS: (1) THIS DEVICE MAY NOT CAUSE HARMFUL INTERFERENCE, AND (2) THIS DEVICE MUST ACCEPT ANY INTERFERENCE RECEIVED, INCLUDING INTERFERENCE THAT MAY CAUSE UNDESIRED OPERATION.

Class A Digital Compliance

NOTE: 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 or her own expense.

Frequency Stability Statement

The 40 MHz crystal provides the core clock for the AR2313 and AR5112. This crystal is attached to the AR5112, witch then internally forms an oscillator. The AR5112 then provides the output of the oscillator to its internal frequency synthesizer, and to the AR2313.

The maximum frequency tolerance allowed by the IEEE 802.11 standard is ±20 ppm. Therefore, the crystal device needs to meet this requirement over all operating conditions. Atheros recommends a crystal device with an overall tolerance of 18 ppm that includes initial tolerance, tolerance over operating temperature range, and aging tolerance.

The crystal device used in the Reference Design is calibrated at 15 pF load. When designing the crystal circuit, care should be taken to include the board stray and other capacitances, such as those inherent with the oscillator circuits, in the overall calculation of the load capacitance.

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Introduction

AIRAYA WirelessGRID series wireless bridges have been designed to provide transparent, high-speed data communications between two to 32 locations. Point-to-point, multipoint, and repeater functionality are built into all AIRAYA WirelessGRID broadband wireless access products.

This solution offers fast, reliable wireless connectivity with considerable cost savings compared to wired alternatives. Utilizing proprietary 5 GHz technology, WirelessGRID bridges easily replace Ethernet or T1 connections or seamlessly integrate into a newer 100 Mbps Ethernet Local Area Network (LAN).

Package Checklist

Each **AI108-4958-N** comes in one carton and contains the following components:

- ✓ One indoor bridge unit with N-type female connector
- ✓ One 6 foot straight-through Ethernet cable
- ✓ One 120V AC Power Supply (Full range option available)
- ✓ This installation manual

NOTE

Two AI108-4958-N bridges must be used to create a link between two locations. In addition, an RF cable and antenna must be purchased separately for each AI108-4958-N

Each **AI108-4958-1** or **AI108-4958-SU** comes in one carton and contains the following components:

- ✓ One AI108-4958-N units with N-type female connectors
- ✓ One 23 dBi antenna with N-type female connector & mounting bracket
- ✓ One 25 foot LMR-400 cable with N-type male connector
- ✓ This installation manual

Each **AI108-4958-Kit** comes in one carton and contains the following components:

- ✓ Two AI108-4958-N units with N-type female connectors
- ✓ Two 23 dBi antennas with N-type female connectors & mounting brackets
- ✓ Two 25 foot LMR-400 cables with N-type male connectors
- ✓ This installation manual

Please register your product online at: **www.airaya.com** in the support/ product registration section of our web site. **Note:** Free technical support is only available to registered users of AIRAYA equipment.

Please inform your dealer if there are any incorrect, missing, or damaged parts. If possible, retain the carton and original packing materials for repacking purposes in case you need to return the bridge for repair.

Hardware Description

Ethernet Compatibility

Each AIRAYA WirelessGRID wireless bridge can be attached directly to a 10BASE-T/100BASE-TX (twisted-pair) Ethernet LAN segment. These segments must conform to the IEEE 802.3 specification.

Radio Characteristics

The WirelessGRID bridge utilizes a radio modulation technique known as Orthogonal Frequency Division Multiplexing (OFDM) and is capable of operating in the 4.9 GHz to 5.850 GHz frequency range with 5, 10, 20, or 40 MHz wide channels. Data is transmitted over a half-duplex radio channel at speeds of up to 108 Mbps.

Antenna Type

The AI108-4958-kit comes with 23 dBi patch antenna and 28 dBi dish antennas that operate in the 5.15-5.850 GHz frequency range.

For international and military markets, the AI108-4958-N can be used with external antennas options and radio output power between 6 and 21 dBm. Please contact AIRAYA for additional antenna options. Local regulations apply.

Backhaul / Point-to-point Architecture

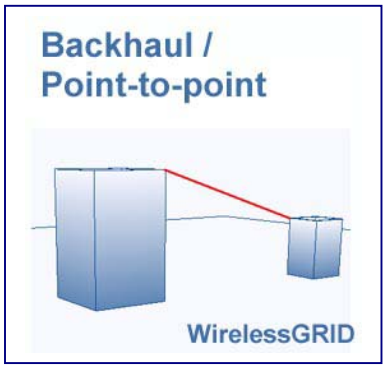


Figure 1. This diagram illustrates a typical use scenario of a WirelessGRID bridge interconnecting two networks in separate buildings.

TIP

Utilizing two properly configured links on the same path will provide redundancy and double throughput between locations.

Multipoint Architecture

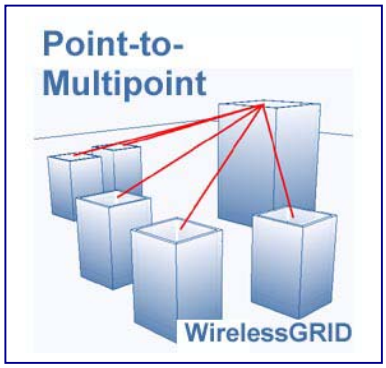


Figure 2. This diagram illustrates a typical use scenario of a WirelessGRID outdoor base station connecting to multiple subscriber units at different locations in a city. Up to 32 subscriber units can be connected to one base station. WirelessGRID point-to-point and multipoint functionality can be combined to form a broadband wireless infrastructure.

Repeater Architecture

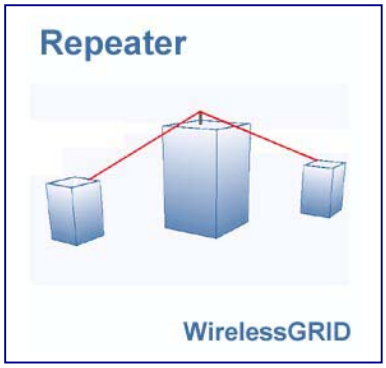


Figure 3. This diagram illustrates the use of an AI108-4958-ON2 repeater/base station. The single radio repeater configuration requires two antenna/cable assemblies to one pointing toward the building to the left and one pointing toward the building to the right. Alternatively, this product can be used as a base station with two sector antennas to increase the coverage area wider horizontal plane. For example, two 120° sector antennas attached to the AI108-4958-ON2 would provide a 240° degree coverage area.

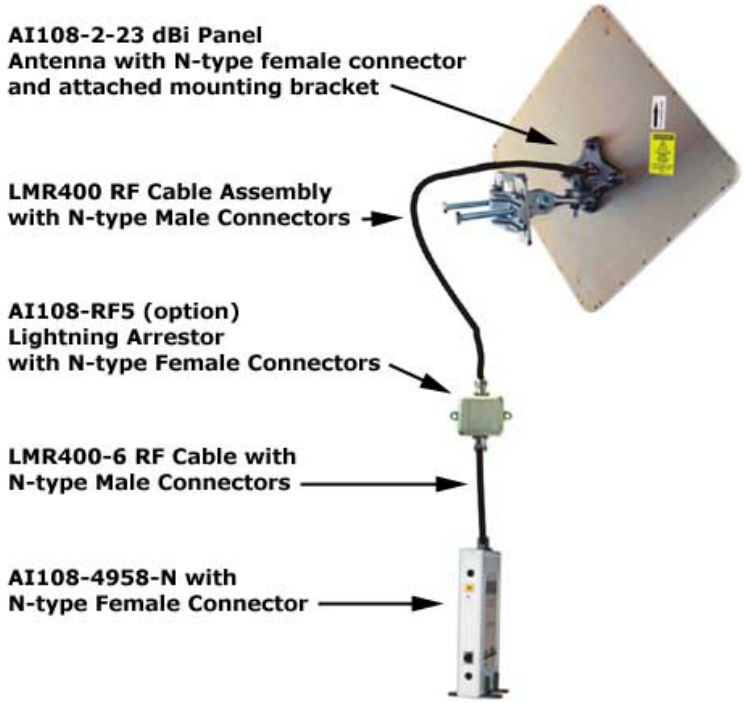
Mesh Architecture

Figure 4. This diagram illustrates the combined use of WirelessGRID backhaul, repeater and multi-point equipment to cover a large geographic area, creating a mesh network.

For complete information on model numbers, please refer to the ordering guide on page 57.

AI108-4958-Kit, -1, -SU, and -N Connection Diagram

Figure 5. This diagram illustrates a typical bridge configuration.



NOTE

All outdoor RF connections should be weather-sealed. Please refer to Appendix C for instructions on weatherproofing RF connections

System Requirements

Before installing the AI108-4958-N, AI108-4958-SU, AI108-4958-1, or AI108-4958-Kit, be sure you have the following items on-hand:

- ✓ An AC power outlet (100 to 120 V, 50 to 60 Hz) or (optional 100-220 V, 50 to 60 Hz) to supply power to each indoor bridge unit
- ✓ An outdoor antenna mast with a 1 to 6 inch (25.4 to 152.4 mm) diameter, or a suitable wall mount location and screw-in anchors, molly bolts, or pan-head screws to attach antenna mounting bracket
- ✓ An available RJ-45 (UTP) port on a 10/100 Mbps Ethernet switch or router
- ✓ Web browser for software configuration

The WirelessGRID bridge has been designed to withstand normal handling procedures, but reasonable precautions should be taken during installation, particularly with regard to static discharge.

- Make sure that you are adequately grounded by touching the bare metal surface on the back of a computer or networking device before installing bridge.
- Avoid moving around the work area in order to eliminate static charge buildup.
- If possible, do not work on a carpeted area.

Hardware Installation

Indoor Bridge Connections

Figure 5. Front and rear panel views

The AI108-4958-N, AI108-4958-1, or AI108-SU connect to your network with a standard 100/10 Mbps Ethernet cable; and connects to the outdoor antenna using an RF cable. The AI108-4958-N, -1, -SU units features the following LED status indicators:

LED	Indication
Power LED	Blinks while bridge is powering up and performing power-on self-test. While bridge is ready, LED remains on without blinking.
5 GHz LED	Indicates the bridge is operating in 4.9-5.85 GHz range. LED blinks at a different rate in correspondence to the transfer rate.
2.4 GHz LED	Indicates the bridge is operating in 2.4-2.5 GHz. This functionality is not available in standard configuration.
10M LED	Indicates the bridge has a physical Ethernet connection and is linked to your network at 10 Mbps.
100M LED	Indicates the bridge has a physical Ethernet connection and is linked to your network at 100 Mbps.
Rear Panel	
Reset button	Pressing the reset button and holding it in for more than 4 seconds will set the bridge network settings to factory defaults. Cycle the power to enable new settings.

Before you mount the AI108-4958-N, AI108-4958-1, or AI108-SU to a fixed location, consider the following requirements to determine the optimal placement:

The RF cable between the AI108-4958-N, AI108-4958-1, or AI108-SU and the antenna should be as short as possible without putting too much stress on the connectors at the bridge and antenna. The RF cable attenuates (reduces) the radio signal and will reduce the effective range of your wireless link.

The cable length from the Ethernet network port to the AI108-4958-N, AI108-4958-1, or AI108-SU must not exceed 328 ft (100 meters).

Placement must allow for easy access to disconnect the bridge unit from the AC power outlet if necessary.

Follow these steps to install the AI108-4958-N, AI108-4958-1, or AI108-SU indoor bridge:

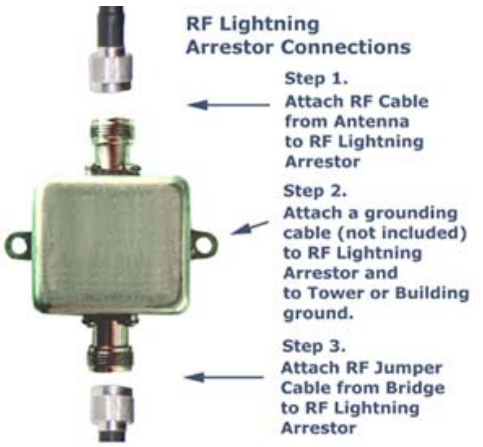
1. Connect the Ethernet cable – The AI108-4 and AI108-N should be connected to a 10/100Mbps Ethernet network through a switch or router. Alternatively, a computer can be directly connected to the bridge using an Ethernet cross-over cable. Connect to the RJ-45 connector socket on the back panel of the bridge with 5 UTP Ethernet cable and an RJ-45 connector.

2. Connect the power adapter cable to the 5V, 2A DC power socket on the rear panel, and plug the power adapter into the wall outlet.

   Warning: Use only the power adapter supplied with the bridge in order to prevent damage and void warranty.

3. Refer to the section above on LED status indicators to verify the unit is powered on and functioning properly.

4. Connect the optional lightning arrestor and jumper cable assembly



Step 4. Weatherproof RF connections using rubber tape, then wrap with electrical tape

Installing and Visually Aligning Outdoor Antenna

To ensure maximum performance and stability of your wireless link, it is crucial that you determine the right locations for the outdoor antennas based on the following criteria:

- A good signal path, ideally with visual line of sight and adequate Fresnel clearance between bridges
- Minimal distance between bridges
- Minimal reflections from other objects.

Figure 6. If using 23 dBi directional antennas supplied by AIRAYA, mast mounting of the external antennas can be accomplished using the included mounting brackets with full vertical and horizontal adjustment.

NOTE

When wall mounting the antenna to the side of a structure, you will not need the back portion of the mounting bracket. Use screw-in anchors, molly bolts, or pan-head screws to attach antenna mounting bracket to side of structure.

Follow these steps to install and visually align outdoor antennas:

1. Attach the antenna to a mast or side of a building using the included bracket.

2. Align the outdoor antenna horizontally: Loosen the horizontal adjustment bolt and nut to visually aim the antenna at the remote bridge. Set the appropriate horizontal angle and tighten the horizontal adjustment bolt and nut so that the angle is locked in place.

3. Align the outdoor antenna vertically: Loosen the vertical adjustment bolt and nut on the mounting bracket and point the antenna towards the remote end point. Set the appropriate elevation angle and tighten the alignment bolts so that the angle is locked in place.

4. Secure the cable along the mast between the outdoor antenna and the indoor bridge inside your building. **Note:** We recommend that you secure the entire cable to the mast at 10-foot intervals.

5. Repeat steps one through four for each remote location outdoor antenna.

6. Use the real-time Signal Strength Monitor to fine-tune received signal strength (RSSi) between bridges. This tool is designed to maximize the throughput of your new WirelessGRID link by providing the highest possible signal strength across a wireless path. See the section on *"Antenna Alignment and Link Monitoring Tool"* for instructions.

TIP

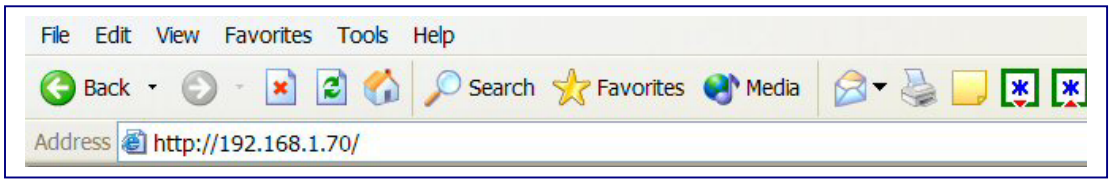
If this is your first installation of an AIRAYA link, AIRAYA recommends that you perform the bench test procedure in Appendix A before deploying the product. This will ensure that bridges are functioning properly and fully configured, and will allow you to become familiar with the tools for aligning antennas and optimizing throughput before you get into the field.

Software Configuration

You can configure the network, radio, and security parameters of the WirelessGRID bridge using the built-in WirelessGRID Network Management System (NMS). This web-based configuration utility greatly simplifies the setup process by allowing you to access all parameters and settings through a single, consistent user interface.

Getting Started

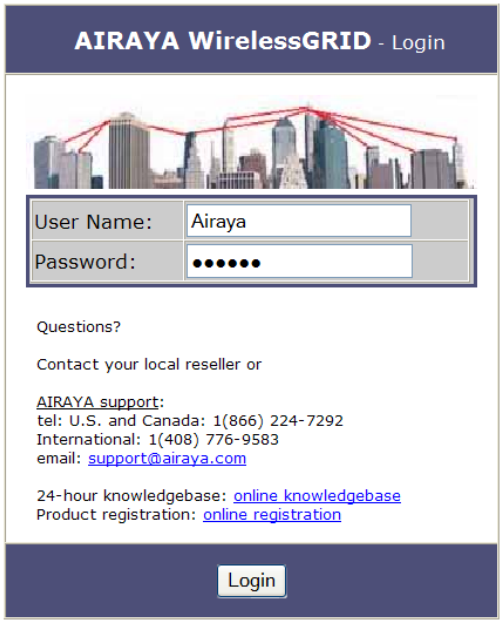
The factory default IP address of the WirelessGRID bridge is *192.168.1.70*. Type that string into the address field of your browser and press the *Return* key to load the WirelessGRID NMS.



You will be prompted for a User Name and Password. Refer to the next section for information about default settings.

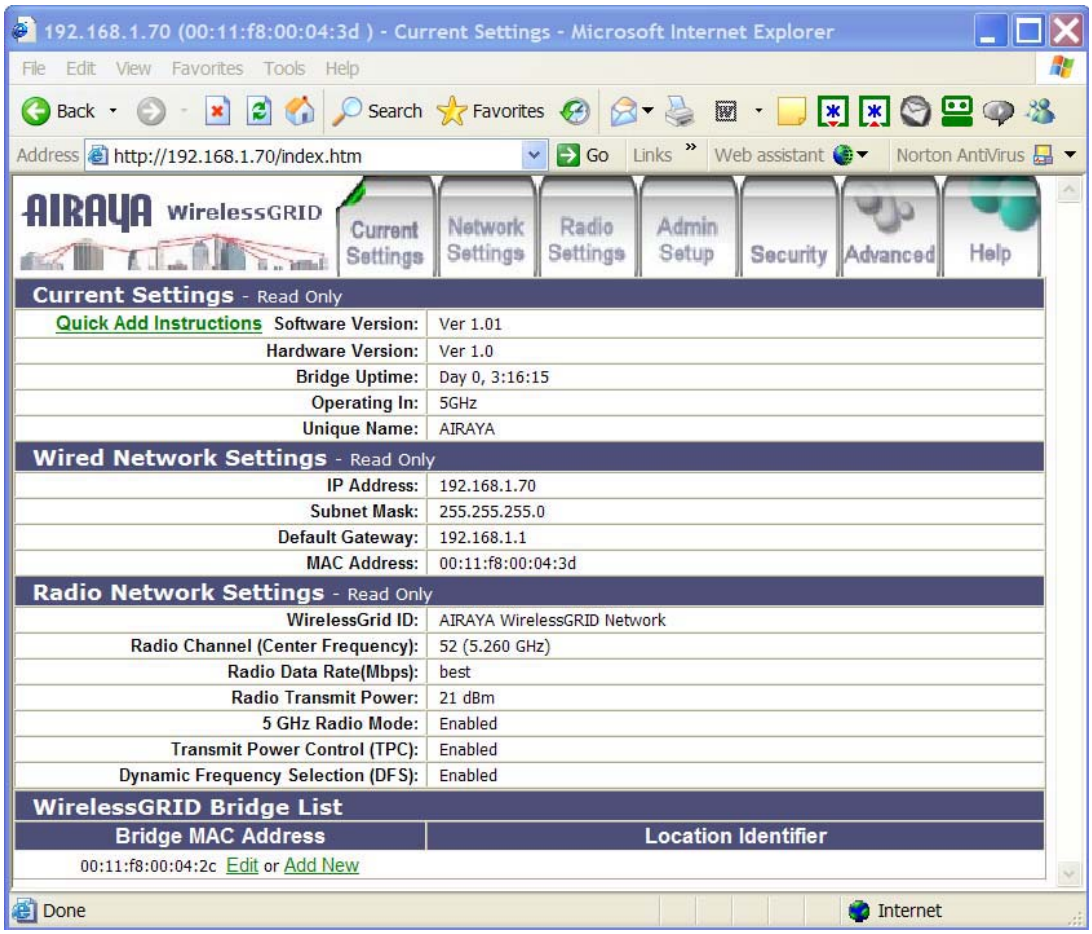
Logging into the WirelessGRID NMS

The WirelessGRID bridge requires you to enter a user name and password to gain access to the configuration utility. The default **User Name** and **Password** is "Airaya."



Once logged in, you can access all available WirelessGRID configuration options. The web interface is organized into tabs that allow you to access screens that let you view and change bridge parameters.

Tabs include *Current Settings, Network Settings, Radio Settings, Admin Setup, Advanced, WirelessGRID Authentication, Data Encryption, Security Server, Active Bridges, Station Stats, Download Updates* and screen-specific *Help*.



The following sections describe the entries in each area of the Current Settings screen:

Current Settings

Quick Add Instructions – Step-by-step instructions to set up and add a new bridge to a WirelessGRID network.

Software Revision – Current software (firmware) version installed on the bridge.

Hardware Revision – Current hardware revision of the bridge you're connected to.

Bridge Uptime – Amount of time the bridge has been active since the last reboot.

Operating In – Specifies the general frequency range of bridge operation.

Unique Name – A unique identifier with up to 32 characters, which is commonly used as a location identifier. Control characters are not allowed in this field.

Wired Network Settings

IP Address – IP address of the bridge. The IP address for each bridge must be unique, so please check with your network administrator for the correct IP address assigned to your device.

Subnet Mask – Current subnet mask of the bridge you are working with. The subnet mask allows networking software to determine which parts of the IP address specify the network address and which parts specify the host address.

Gateway Address – Current gateway address of the bridge you are working with. IP packets destined for other subnets are automatically sent to the default gateway, which routes traffic to the correct network.

MAC Address – Unique Ethernet address of bridge you are working with.

Radio Network Settings

WirelessGrid ID – Displays a unique network ID. All bridges in a WirelessGRID network are required to use the same WirelessGRID ID.

Radio Channel (center frequency) – Current channel and center frequency of the bridge.

Radio Data Rate – Current radio data rate setting. Available options for data rates are based on channel size.

Radio Transmit Power – Current radio transmit power setting.

5 GHz Radio Mode – Current mode (e.g. enabled, disabled).

Transmit Power Control (TPC) – Current status of TPC (e.g. enable or

disable).

Dynamic Frequency Selection (DFS) – Current status of DFS (e.g. enable or disable).

WirelessGRID Bridge List

Authorization List of all bridges allowed to associate and communicate with the bridge you are working with.

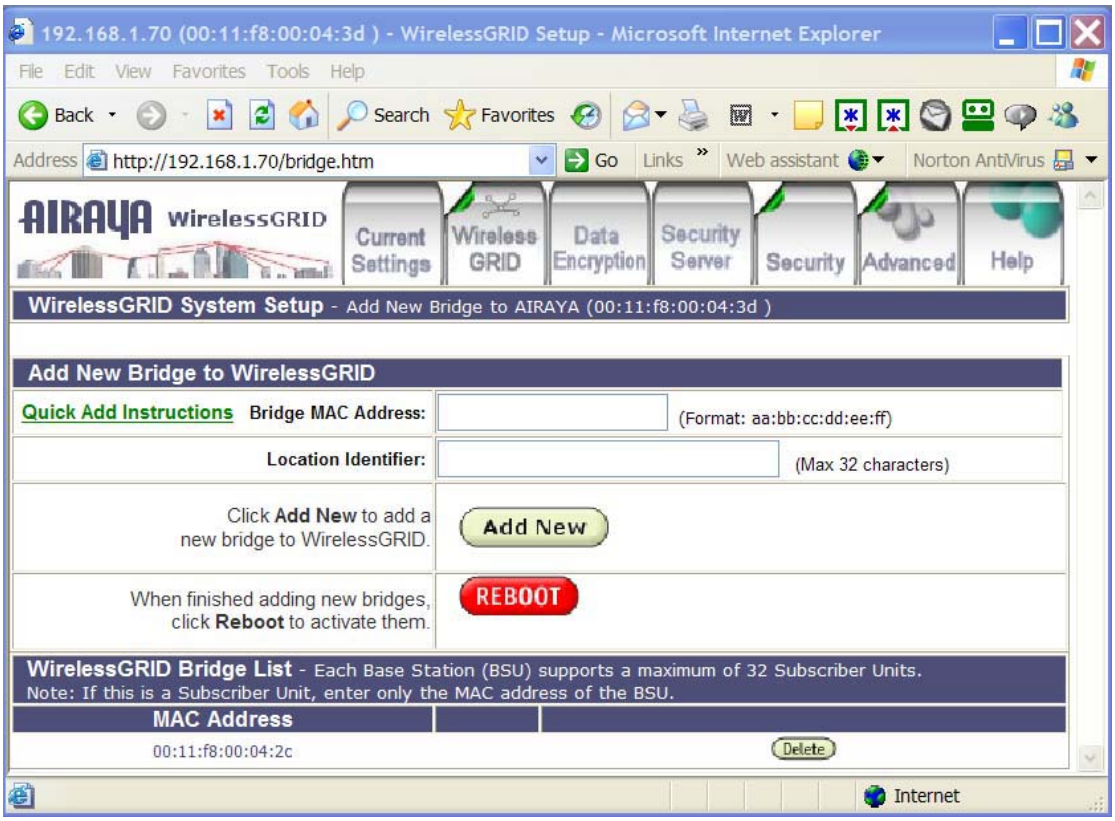
Bridge MAC Address – MAC address of bridge configured to access a WirelessGRID network. This entry is required for each bridge allowed in the WirelessGRID network.

Edit or **Add New –** Keys that you can click to update or add a new bridge to a WirelessGRID network.

Location Identifier – IP Address and Unique Name of remote bridge in WirelessGRID network.

WirelessGRID System Setup Tab

The *WirelessGRID System Setup* screen is used to add or delete remote **Bridge MAC addresses** from a bridge authorization list. Each bridge contains a WirelessGRID authentication list, and all bridges require reciprocal entries to communicate.



The *Add New Bridge to WirelessGRID* section of the screen contains the following entries:

Quick Add Instructions – Step-by-step instructions to set up and add a new bridge to a WirelessGRID network

Bridge MAC Address – The MAC address of a remote bridge you want authorized to connect to the bridge you are working with. You must enter this information in the proper format. Base stations can accept up to 32 entries. Backhaul/Point-point bridges and subscriber units can accept 2 entries.

Location Identifier – A text description of the bridge you are adding (e.g. Building 12). ***Note:*** *This feature is not enabled at this time.*

TIP

Each bridge contains a WirelessGRID authorization list, and all bridges require reciprocal entries to communicate. Base stations support up to 32 list entries. Subscriber units and point-to-point bridges support two WirelessGRID list entries.

Follow these steps to add a bridge to the WirelessGRID authorization list:

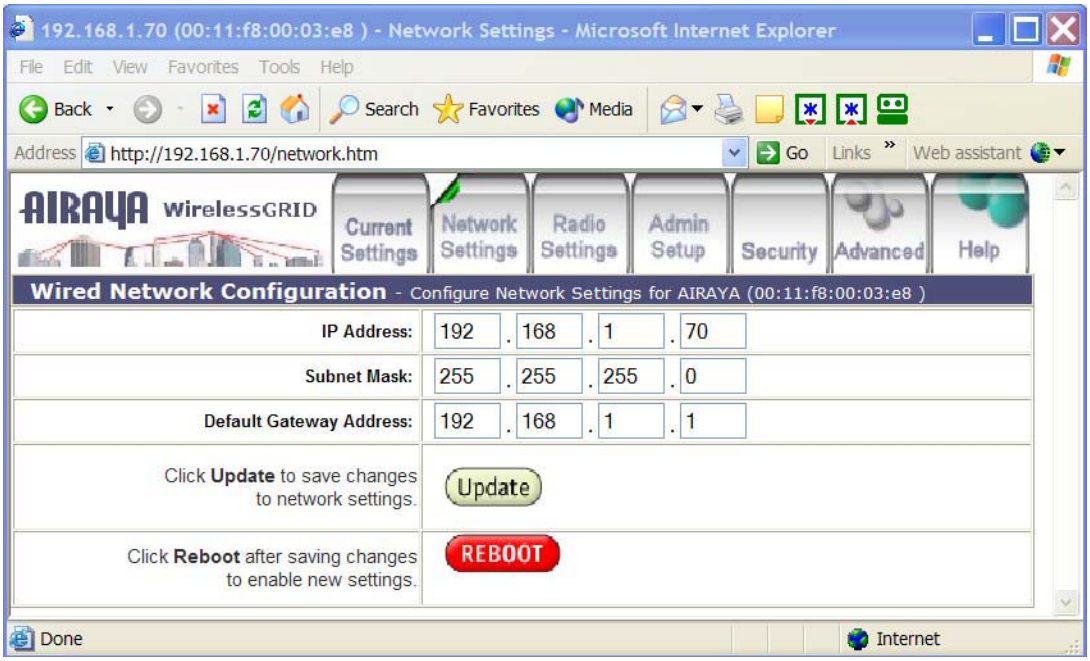
1. Enter the **MAC Address** of a new bridge.
2. Enter a **Location Identifier** to identify the bridge.
3. Press **Add New** to include the new bridge in the WirelessGRID list.
4. Confirm that the new entry was entered correctly by reviewing the list at the bottom of the page.
5. If the device is a base station, continue adding bridges until you are finished.
6. Press **Reboot** to cycle power and enable new settings.

Follow these steps to remove a bridge from the WirelessGRID list:

1. Press **Delete**.
2. On the next screen, press **Delete** to confirm or **Cancel** to return to the WirelessGRID list screen without removing the entry.

Network Settings Tab

The *Network Settings* screen is used to modify your network **IP Address**, **Subnet Mask**, and **Default Gateway Address**.



The screen includes the following entries:

IP Address – The IP address of the bridge you are working with. The IP address for each bridge must be unique; check with your network administrator for the correct IP address assigned to this device. *Default IP address: 192.168.1.70.*

Subnet Mask – The subnet mask allows networking software to determine which parts of the IP address specify the network address and which parts specify the host address. *Default Subnet Mask: 255.255.255.0*.

Default Gateway Address – IP packets destined for other subnets are automatically sent to the default gateway, which routes the traffic to the correct network. The gateway address must be specified following the same convention as the IP address. *Default Gateway Address: 192.168.1.1.*

TIP

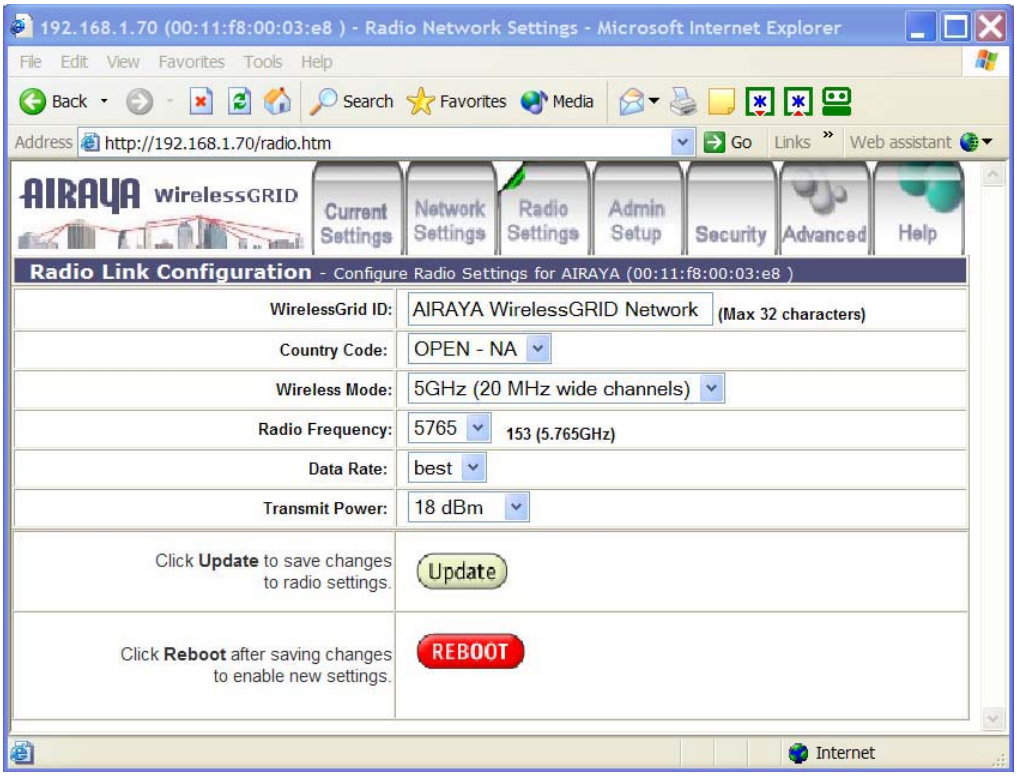
If you want to return to the WirelessGRID NMS after updating network settings, enter the new IP address in your web browser and follow the log in procedure.

Follow these steps to update network settings:

1. Update the IP Address.
2. Update the Subnet Mask.
3. Update the Gateway Address.
4. Press **Update** to save changes.
5. Press **Reboot** to cycle power and enable new network settings.

Radio Settings Tab

The *Radio Settings* screen is used to define the **WirelessGRID ID**, **Country Code**, **Wireless Mode**, **Radio Frequency**, **Data Rate**, and **Transmit Power** settings of a bridge.



The following parameters can be modified on the *Radio Settings* screen:

WirelessGRID ID – The WirelessGRID ID provides a unique network ID for each WirelessGRID network. Enter a number or address with up to 32 characters. All bridges in a WirelessGRID network require the same WirelessGRID ID to associate with each other.

Default WirelessGRID ID: "AIRAYA WirelessGRID Network"

NOTE

Broadcast of the WirelessGRID ID is disabled by default.

Country Code – Select the Country Code for the location in which the WirelessGRID will be operating. If you are not sure select N/A; all channel options available in the WirelessGRID network will be provided. Changing the Country Code will change available Wireless Mode, Radio Frequency (center channels), and Data Rate options for your WirelessGRID.

NOTE

When you have finished updating the **Country Code**, make sure to press **Update** to view revised Wireless Mode, Radio Frequency, and Data Rate settings.

Wireless Mode – Select the desired channel size for your AIRAYA WirelessGRID bridge. The unit is capable of operating on 5, 10, 20 or 40 MHz wide channels.

NOTE

When you have finished updating the **Wireless Mode**, make sure to press **Update** to view revised Radio Frequency, and Data Rate settings.

Radio Frequency – Select the desired frequency of operation from the drop-down menu. The radio frequencies that appear are dependent on the Wireless Mode specified.

Data Rate – Select the desired data rate from the drop-down menu. The data rates that appear are dependent on the Wireless Mode specified.

Transmit Power – Select the desired Transmit Power option from the drop-down menu. The options are dependent on the Country Code specified.

Follow these steps to update the radio network settings.

NOTE

You must press **Update** after each radio parameter change. Radio parameters are interdependent, so each will change with every selection you make.

1. Update the WirelessGRID ID.
2. Select Country Code (if drop down list is available)
3. Select Wireless Mode
4. Select Radio Frequency
5. Select Data Rate
6. Select Transmit Output Power

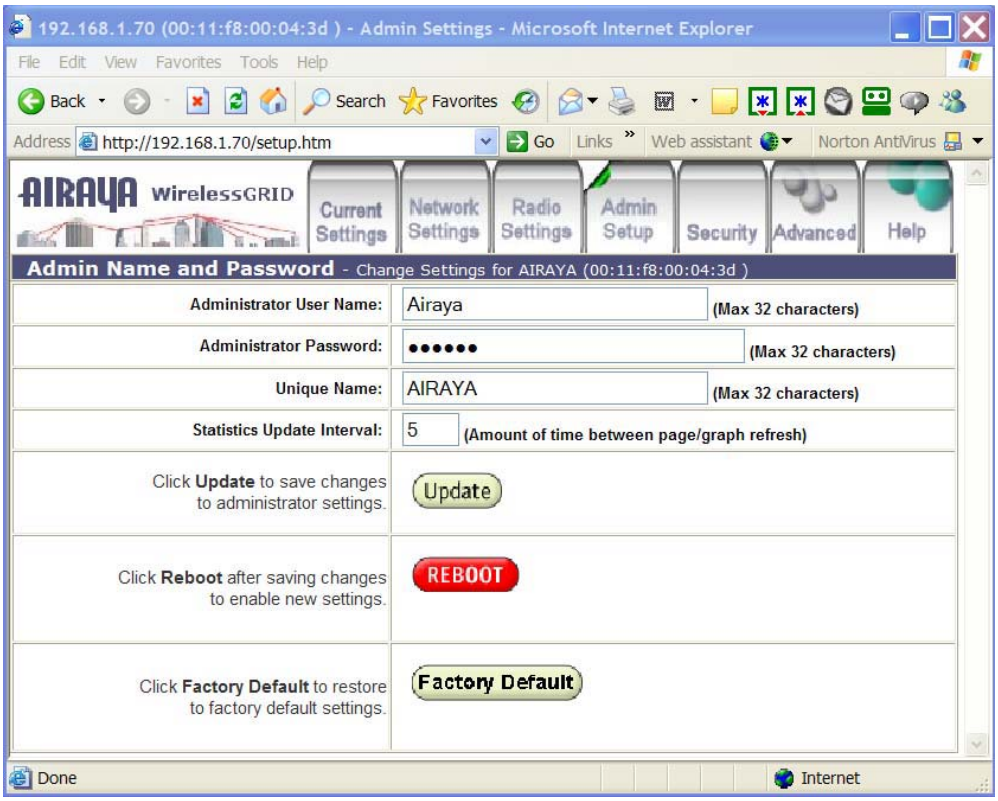
7. Press **Reboot** to cycle power and enable new radio settings.

NOTE

All bridges in the WirelessGRID network require the same **Country Code**, **WirelessGRID ID**, **Wireless Mode**, and **Radio Frequency** settings to send and receive information.

Admin Setup Tab

The *Admin Setup* screen is used to modify the Administrator **User Name** and **Password** for the WirelessGRID NMS, as well as the **Unique Name** and **Statistics Update Interval** settings, described below:



Administrator User Name – Create a new user name by typing over the contents of this field. *Default Administrator User Name: Airaya.*

Administrator Password – Create a new password by typing over the contents of this field. *Default Password: Airaya*

Unique Name – A 32 character string used to identify the bridge. *Default Unique Name: AIRAYA (All capital letters.)*

Statistics Update Interval – This value sets the page refresh rate for the remote bridge statistics screen and graph. Default interval: *5*

Factory Defaults – This button clears all parameters and resets the bridge to factory default settings.

SECURITY TIPS

- ✓ To ensure that only authorized users gain access to the WirelessGRID NMS, AIRAYA recommends that you change the Administrator User Name and Password from their factory default settings.
- ✓ When selecting a new password, do not use a term that can be easily guessed, such as your name. Random combinations of numbers and characters are much safer to use, though harder to remember.

Follow these steps to update administrator login settings:

1. Update the **Administrator User Name**.
2. Update the **Administrator Password**.
3. Write down your new login settings and keep them in a safe place for future reference.
4. Press **Update** to save settings.
5. Press **Reboot** to cycle power and enable new settings.

Follow these steps to update **Unique Name** and **Statistics Update Interval** settings:

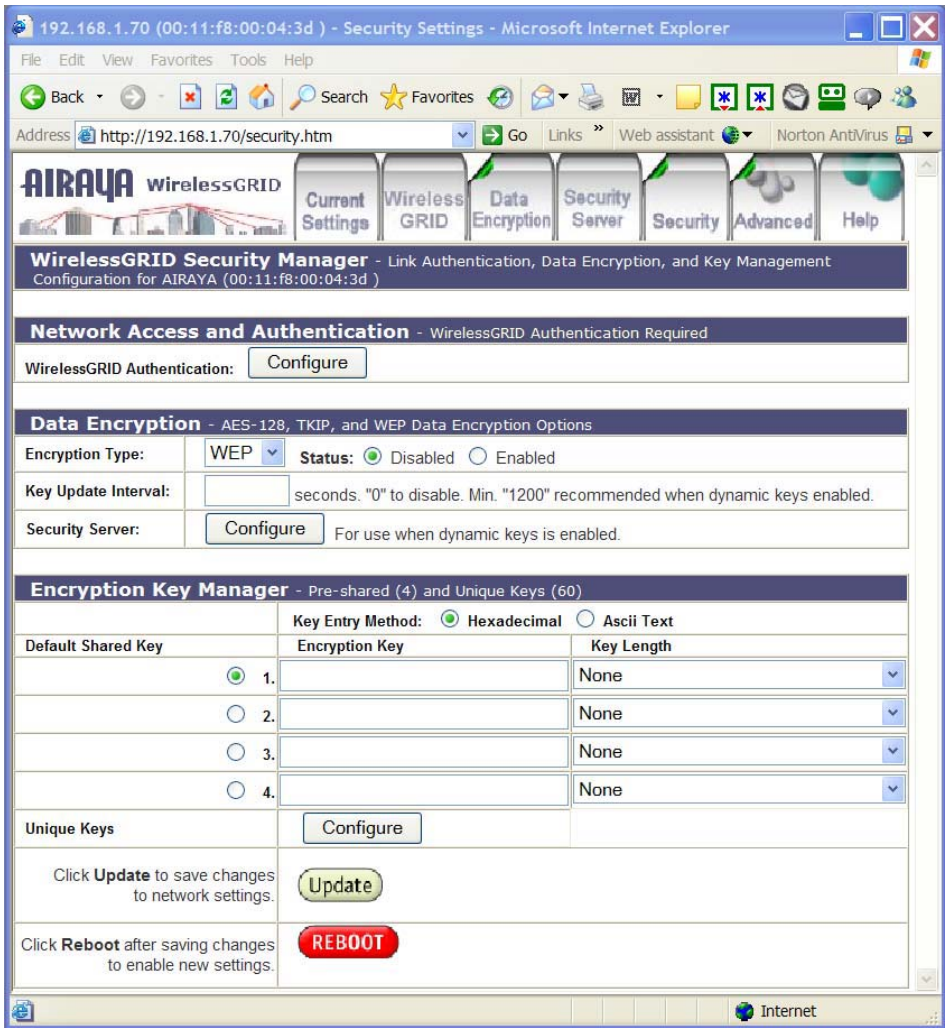
1. Update the **Unique Name**.
2. Update the **Statistics Update Interval** value.
3. Press **Update** to save your new settings.
4. Press **Reboot** to cycle power and enable new settings.

Follow these steps to reset the bridge to factory defaults:

1. Press **Factory Defaults** to reset bridge to AIRAYA default settings.
2. When prompted, press **Reset** to restore default settings or **Cancel** to keep current settings.
3. Press **Reboot** to cycle power and restore factory defaults.

Security Tab –Authentication and Data Encryption

The *Security* screen provides links to the WirelessGRID List and Unique Key Manager screens. It is also used to enter or update shared keys and data encryption settings for the bridge. The following sections describe the entries of each area on this screen.



WirelessGRID Authentication

Click **Configure** to add, edit, or delete bridge MAC addresses from the WirelessGRID authorization list.

NOTE

Refer to the section on the *WirelessGRID System Setup* tab for detailed instructions on how to add, edit, or delete bridge MAC addresses.

Data Encryption

Encryption Type – WirelessGRID bridges support three types of encryption. *Default: Auto.*

WEP **–** Wired Equivalent Privacy (WEP) data encryption (64, 128, or 152 bit key lengths can be registered). The 64 bit keys must be entered as 10 hexadecimal digits in the range of 0-9, A-F, or a-f. If 128 bit is chosen, enter 26 hexadecimal digits. If 152 bit is chosen, enter 32 digits.

AES/WPA2 **–** Advanced Encryption Standard (AES) data encryption is the most robust data encryption in the market today. It was designed to comply with U.S. requirements [Federal Information Processing Standard (FIPS)] for use by U.S. government organizations to protect sensitive, unclassified information. The WirelessGRID supports 128 bit AES keys. Enter 26 hexadecimal digits.

TKIP **–** Temporal Key Integrity Protocol (TKIP) is a WPA security standard that uses the original encryption key as a starting point to derive encryption keys mathematically. TKIP automatically changes and rotates encryption keys so that the same encryption key is never used twice. This is an automated encryption key switching process that does not require user intervention.

Status – The status button indicates the current encryption state of your bridge. *Default: Disabled.*

Disabled **–** No data encryption is enforced on your bridge.

Enabled **–** Data encryption is enforced on your bridge.

Key Update Interval – Specifies the group key update interval in seconds. The value is only used with dynamic keys and can be either 0 (disabled) or any value above 15. *Default: 0.*

Security Server – For use with dynamic keys utilizing 802.1x security. Click on **Configure** to set up the **Security Server** if dynamic (802.1x) encryption is selected for the bridge on the security screen.

NOTE

This function in not supported in the current release. Refer to the section on the *Security Server tab* for detailed instructions on how to configure the Security Server.

Follow these steps to enable **Data Encryption** on the bridge:

1. Select an **Encryption Type** (AES or WEP).
2. Change the **Status** to reflect the proper status.
3. Press **Update** to save settings.
4. Press **Reboot** to enable new security settings.

Encryption Key Manager

Pre-Shared Key Configuration – When you select Pre-Shared Key for encryption, you should enter four default shared-keys in the Encryption Key Manager. Make sure that each bridge in the network has an identical Key Entry Method, Encryption Key, and Encryption Key Length.

Key Entry Method – You can use hexadecimal digits or ASCII text to enter each key. Click on the "key length" drop-down menu to view lengths for each type of key.

Default Shared Key **–** Select the default pre-shared key you want to enable.

Encryption Key **–** Enter up to four pre-shared encryption keys.

Key Length **–** Specify the length of the pre-shared encryption keys.

Unique Key Configuration – When you select Unique Keys for encryption, refer to the instructions below to enter keys. The bridge supports up to 60 unique keys in the Unique Key Manager.

Use the following steps to add a **Pre-Shared Key** to the Key Manager on the main security screen:

1. Select a **Key Entry Method** (hexadecimal or ASCII text).
2. Select a **Default Shared Key**.
3. Enter up to four shared **Encryption Keys.**
4. Specify the **Encryption Key Length** based on the Encryption Key just entered.
5. Press **Update** to save settings.
6. Press **Reboot** to enable new security settings.

Follow these steps to add a **Unique Key** to the Key Manager:

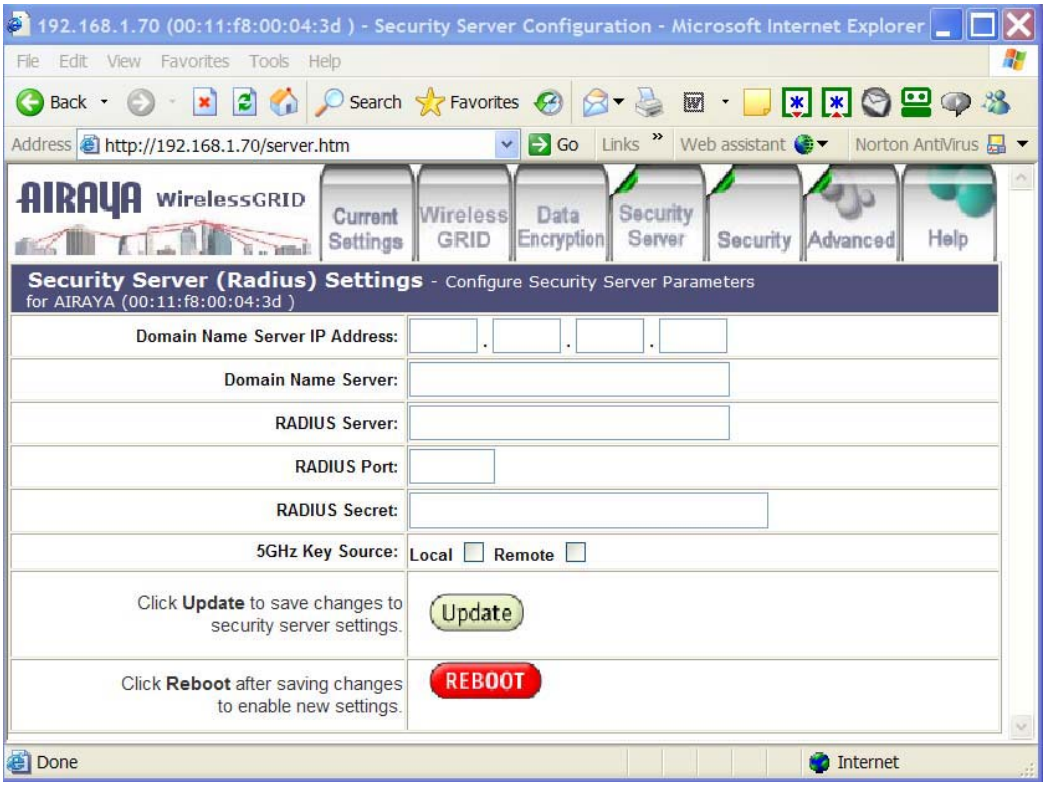
1. Press **Configure** to open the Unique Key Manager screen.
2. Enter unique encryption keys.
3. Select the **Key Size** from the drop-down menu.
4. Enter the **Key Value** based on the Key Size selected.
5. Press **Add New** to add the key to the Key Manager.
6. Check the Key List to ensure the key value and size were entered correctly.
7. Press **Reboot** to enable new key settings.

Follow these steps to remove a **Unique Key** from the Key Manager:

1. Press **Configure** to enter unique encryption keys.
2. Enter the **Key Number** to delete.
3. Press **Delete** to remove the key from the Key Manager.
4. Press **Reboot** to enable new key settings.

Security Server (RADIUS) Settings

This screen is used to view, add, and update a bridge's security server settings. *Note: This feature is currently NOT implemented.*



This screen includes the following settings:

Domain Name Server IP Address – Specifies the IP address of the domain name server.

Domain Name Server – Specifies the domain name server.

RADIUS Server – Specifies the IP address of the RADIUS server.

RADIUS Port – Specifies the port of the RADIUS server.

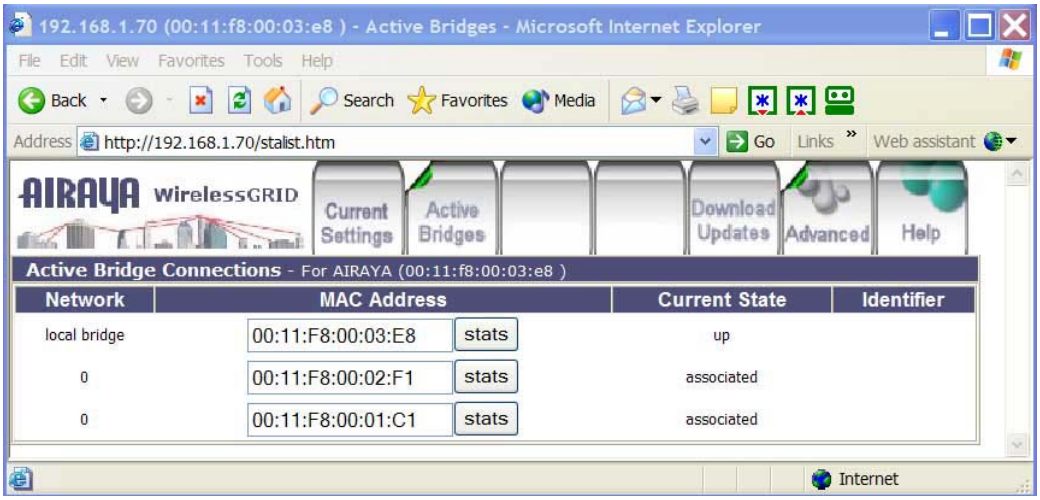
RADIUS Secret – Specifies the password for the RADIUS server.

RADIUS Key Source – Specifies the location of RADIUS keys.

5GHz Key Source – Check "Local" to specify that the keys are located in the bridge; check "Remote" to indicate that the RADIUS keys are located on a external RADIUS server.

Active Bridge Status Tab

This screen is used to view the current status of all authorized remote bridges for the (local) bridge that you are logged into.



This screen provides the following data:

Network – "Local bridge" denotes the bridge you are logged into and all authorized remote bridges have a value of "0".

MAC Address – MAC Address of each remote bridge in network.

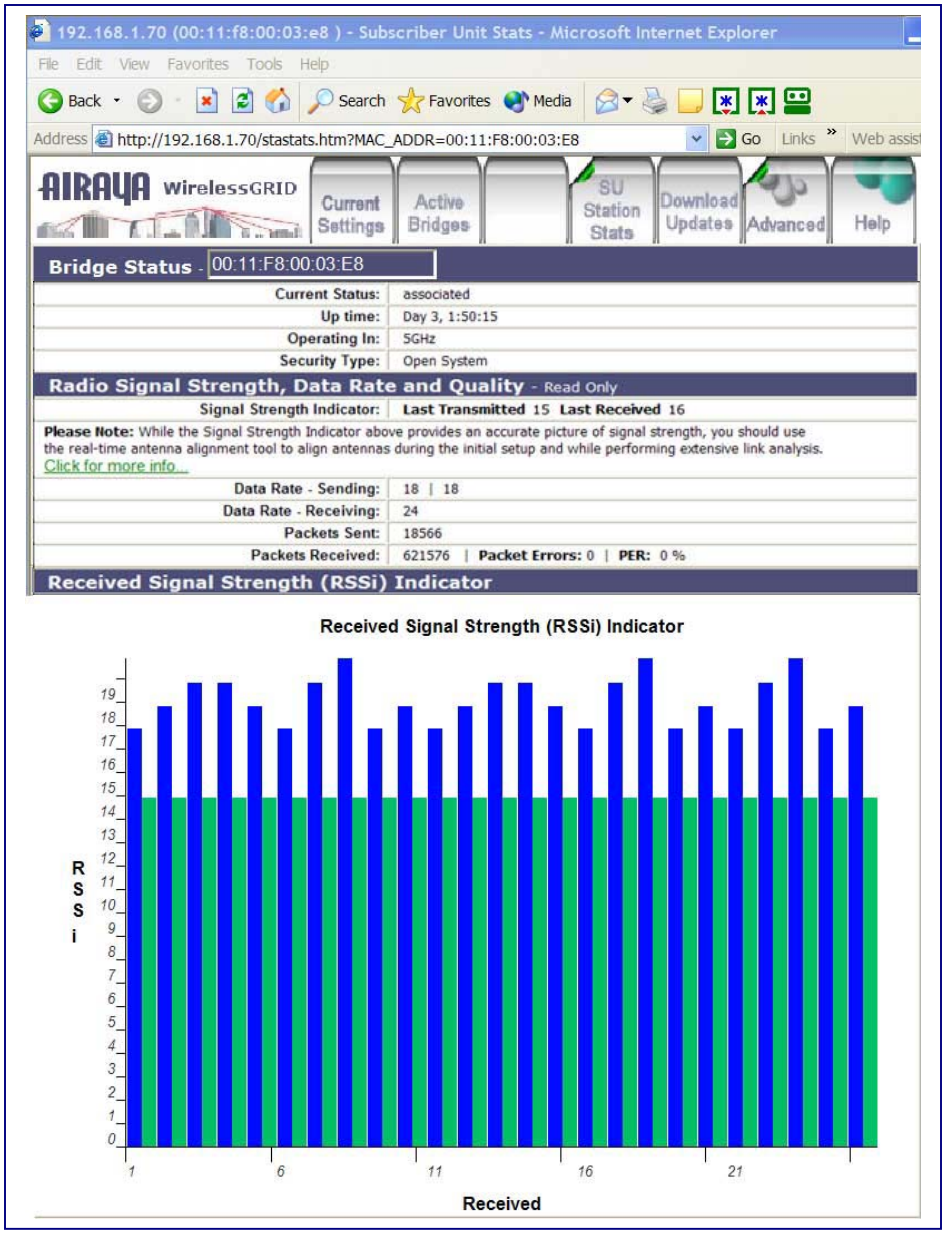
Current State – Displays "up" if local bridge and "associated" if remote bridge is enabled and in "up" state.

Identifier – Encryption type; blank if disabled.

Stats button – Displays the remote bridge statistics screen for the MAC address you select. Press **stats** to open the remote bridge statistics screen.

Remote Bridge (SU Station) Statistics Tab

This screen is used to view the current statistics of a remote bridge associated with the (local) bridge you are logged into.



This screen provides the following data:

Bridge Status

Current Status. Current state of remote bridge. While authenticated, the remote bridge status should indicate "Associated".

Uptime. Elapsed time the bridge has been up and since the last power cycle.

Operating In. Specifies the general frequency range remote bridge is operating in.

Security Type. Displays the current Security Type settings for this bridge.

Signal Strength, Radio rates, and Quality:

Signal Strength Indicator. Signal Strength is a good indicator of overall network quality. Lower values (below 15) indicate a bridge will only be able to communicate at low data rates. Higher signal strength values (above 15) indicate the bridges have the ability to run at faster data rates.

NOTE

Tip: To allow WirelessGRID bridges to monitor their own signal strength and dynamically adjust data rates, you can set *Data Rate* on the **Radio Settings** tab to "Best". This will allow the bridge to monitor signal strength on a packet-by-packet basis, adjusting data rate accordingly. If signal strength is not optimum, the radio will adapt and change to a lower modulation, which in turn lowers the radio data rate, but provides a higher effective TCP/IP data rate by increasing radio receiver sensitivity and reducing the packet error rate. This adaptive data rate ability provides for better overall quality and reliability of the link.

Last Transmitted. Signal Strength values (measured in dBm) for the last packets transmitted. Signal Strength is a good indicator of how your link will run. When “best” data rate is selected low values indicate the local and remote bridge are operating in a slower mode.

Last Received. Signal Strength values (measured in dBm) for the last packets received.

Data Rate - Sending. Displays the current radio data rate being used to send data between the local and remote bridge.

Data Rate - Receiving. Displays the current radio data rate being used to receive data.

Packets Sent. Indicates the total number of packets transmitted since the bridge has been up.

Packets Received. Indicates the total number of packets received since the bridge has been up.

Receive Packet Errors. Indicates the total number of receive packets errors generated since the bridge has been up.

Receive Packet Error rate (PER). Percentage of receive packet errors to packets received since the bridge has been up.

Received Signal Strength (RSSi) Indicator As indicated above, RSSi is the signal strength received at the bridge you are running this utility from, and is being provide by the bridge at the remote end of the link. RSSi, combined with the calculated packet error rate, are key variables used to adapt the radio's modulation and data rate.

RSSi. Received Signal Strength (dBm). The blue value represents the net amount of signal strength received at the local bridge, from the remote bridge. The green value is the average of all values presented on the graph.

Received. Display of the last 25 RSSi values received by the bridge. This page will refresh with up to 25 reading each refresh interval.

Firmware Update Tab

Periodically, AIRAYA releases firmware updates that fix known issues and enhance the functionality of WirelessGRID bridges. The latest WirelessGRID firmware release can be located in the support section of the AIRAYA website at the following URL:

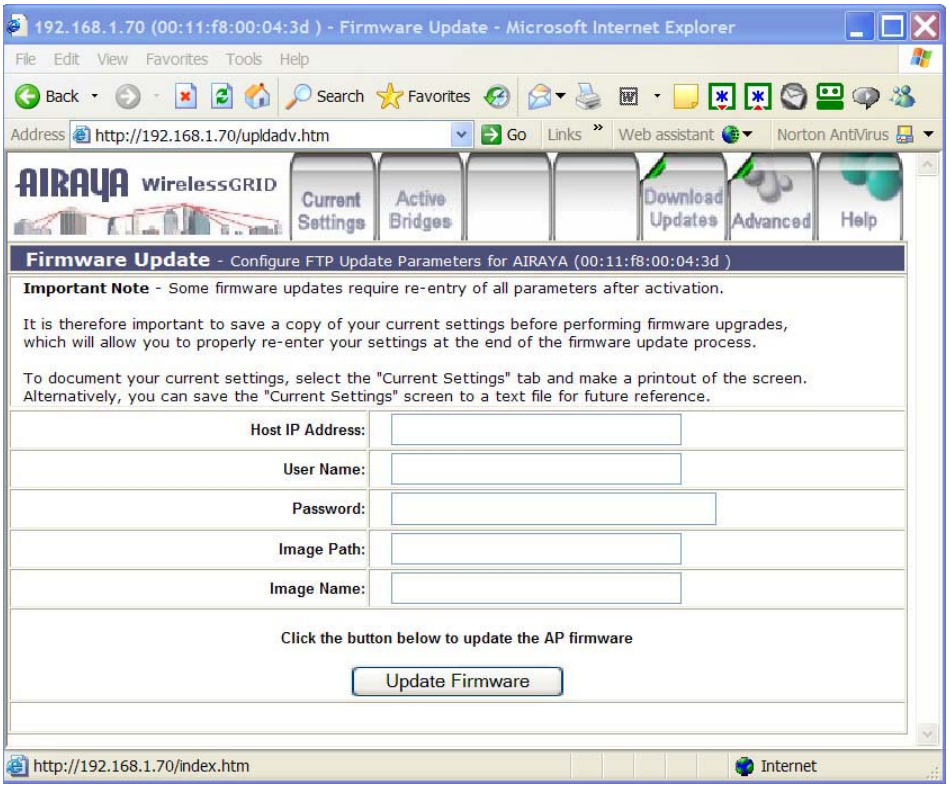
http://www.airaya.com/products/productdb/_product_support.asp

If you are unsure whether you need an upgrade, please contact AIRAYA customer support (support@airaya.com) and a representative will help you.

WARNING!

Some configuration parameters can be overwritten during the bridge firmware upgrade process. As a safeguard, save a copy of your current settings before performing the upgrade. This will allow you to re-enter your settings if necessary. To document your settings, you can either select the *Current Settings* tab and copy the screen to a text file or print the screen. You should follow this procedure for each bridge that you plan to upgrade.

The following screen shows the settings used for upgrading bridge firmware:



Settings include:

Host Name – The IP address of FTP server where new firmware is located.

User Name – Authorized User Name for accessing the FTP server.

Password – Valid Password for accessing the FTP server.

Image Path –Path to firmware image on the FTP server. If firmware image is located in the root directory of your FTP server, leave this field empty.

Image Name – Filename of firmware image.

Update Firmware –Button to start upload procedure for new firmware.

Follow these steps to update a bridge with new firmware image:

1. Enter the IP Address of your FTP server in the **Host Name** field.
2. Enter your authorized *User Name* for accessing the FTP Server in the **User Name** field.
3. Enter your *Password* for accessing the FTP Server in the **Password** field.
4. Enter a valid *path* to the firmware image on the FTP server in the **Image Path** field. If firmware image is located in the root directory of your FTP server, leave this field empty.
5. Enter the *filename* of the firmware image you are using to update the bridge in the **Image Name** field.
6. Click on **Update Firmware** button to load new firmware image into bridge.
7. Press **Reboot** to enable new key settings.

Help Tab

The AIRAYA online help system provides useful information about all parameters and menus available in the WirelessGRID NMS and configuration utility. Select the *Help* tab on any screen and the appropriate topics will appear in a pop-up style browser window.

Antenna alignment and link monitoring tool

Each WirelessGRID bridge includes an integrated signal strength monitoring tool for use during setup and bridge operation. Use this tool to optimize antenna alignment during initial link setup. You can also use this tool to remotely check or continuously monitor the signal strength between any two bridges in a WirelessGRID network.

This Telnet-based utility provides Received Signal Strength Indication (RSSi) values in real-time, measuring the amount of power being received at the bridge where the utility is being run. *The longer the distance between locations, the more essential the tool becomes for creating a fast, reliable link.*

IMPORTANT NOTE

Before setting up a link between two or more locations, you should take GPS readings at both ends of your link to confirm distance and elevation estimates. Garmin International (www.garmin.com) manufactures excellent low-cost GPS navigation units that can be used to calculate distance. Most GPS devices contain a built-in compass that will help also help you to visually aim bridges in the right direction.

AIRAYA recommends that you use a two-person installation team when using the Antenna Alignment and Link Monitoring Tool. To complete alignment successfully, you'll need team members at both ends of the link to relay information and make physical adjustments to each bridge.

Check List for Antenna Alignment

Items you'll need at both ends of a link.

- ✓ Two 1/2 inch wrenches per end (four total) for adjusting and mounting antenna on mast
- ✓ One 7/16 inch socket or wrench for removing antenna mount from antenna (commonly used to change between vertical and horizontal polarization). *Note:* Torque less than 30 pounds.
- ✓ Cell phones or two-way radios for communicating with each team member.

When you've assembled the necessary tools and personnel to physically adjust your bridges, refer to the next section, "*Running the Antenna Alignment and Signal Quality Tool.*"

Using the real-time signal strength monitor for antenna alignment

It is a good idea for you to become familiar with the product before installing it for the first time. AIRAYA recommends you perform a bench test before deploying any units to the field.

The bench test and verification process can also be performed in the field, but it is generally much easier to configure the units on the bench before setting them up in the field.

Changes in field-deployed bridges include but are not limited to the following:

1. IP Addresses to match your network
2. Change the administrative user name and password to prevent un-authorized access the administrative interfaces
3. Location-specific unique names entries to help in identifying units in the field

Encryption enabled if you want your data encrypted as it travels across your new WirelessGRID system.

Follow these steps to run the real-time signal quality tool and physically align antennas:

1. Power on the bridge and wait ~20 seconds.
2. Open a Telnet session to the bridge IP address, port 3000 (see figure below).

3. At the Telnet prompt, enter the login (Administrative User Name) and press Enter.
4. Enter the Administrative Password and press Enter.
5. Enter Remote MAC Address of the bridge you would like to test and press Enter.

When you've entered the remote MAC address of the remote bridge and pressed Enter, you should see receive signal strength values (displayed in dBm) streaming across the Telnet screen (see figure below). These values

indicate the RSSi (signal strength) of the RF packets sent from the remote bridge.

```
Telnet 192.168.1.70 3000
login: Airaya

password: Airaya

Remote MAC address: 00:11:F8:2a:3b:b2

18 19 20 17 18 20 19 20 19 17 19 19 19 19 20 19 19 19 20 18    avg: 19
20 19 20 20 20 18 18 17 20 18 19 20 19 19 17 21 19 19 20 18    avg: 19
19 21 19 19 20 20 20 20 21 20 21 20 19 19 18 19 19 19 19 19    avg: 20
17 19 20 19 19 20 20 19 18 20 20 20 20 19 17 17 20 20 19 19    avg: 19
18 18 18 20 20 17 20 20 20 19 20 18 19 21 19 19 20 20 18 18    avg: 19
20 19 18 17 19 20 20 19 20 18 18 18 20 21 17 18 19 20 19 20    avg: 19
19 19 19 20 20 19 20 21 19 20 19 20 19 19 19 20 21 20 17 18    avg: 19
19 21 19 19 19 20 20 20 19 20 21 20 18 19 20 20 17 17 18 20    avg: 19
20 20 19 18 19 19 19 19 18 18 19 20 19 19 18 20 20 20 20 19    avg: 19
18 19 18 20 20 20 17
```

TIP

If you do not see values streaming across the screen, confirm that both bridges are powered on and then manually aim the bridges at each other until the values appear. If you see very few or no values streaming across the screen, there is probably no traffic going across the radio link. You can generate traffic by opening additional ping windows or FTP file transfers on your test stations if you do not have a traffic-generating program.

The first 20 values displayed on each line represent individual RSSi values; the 21st represents the average of the first 20 values (e.g.: avg: 19). Focus on obtaining the highest average values.

The key to achieving optimal throughput and reliable radio communication is to obtain the highest possible average RSSi values for bridges at BOTH ends of a link. This means you need to run this utility from both ends of a link to ensure signal strength is good in both directions.

FAST FACT

Optimal RSSi values for field deployments range between 18 and 40. Values for bench tests can be as high as 75. The disparity between such figures is normal, due to factors such as loss of signal strength along the wireless path, alignment differences, environmental issues, and other variables.

Antenna Adjustment Using the real-time Signal Strength Monitor

In the initial hardware installation, you visually aimed the antennas at each other. Though a good first step, this does not provide optimum antenna alignment, signal quality, or maximum throughput. To fine-tune your antennas, we recommend that you perform the following procedures at both ends of a link:

1. Start the Signal Strength Monitor on one end of a link. (We'll call this *Side A*.) The RSSi values from *Side B* should be displayed in the Telnet screen at *Side A*.
2. Using your communications device (i.e., cell phone, two-way radio), direct the *Side B* installer to adjust both horizontal and vertical antenna alignment using the appropriate tools. The installer should physically adjust *Side B* to the highest possible average value using the data relayed from *Side A*. A 20-second sweep of the antenna at side B, from left to right, and then a 20 second sweep up and down, should be enough to find the strongest received signal from side B.
3. When the installer at Side A is confident that the highest possible average RSSi values are being consistently displayed on the screen at *Side A*, the installer at *Side A* should instruct the *Side B* installer to secure the unit.
4. Repeat this process for Side A using the steps just described.

TIP

Leave the antenna real-time signal strength monitor running until the *Side B* antenna or outdoor unit is securely fastened to ensure that the RSSi values don't change, and remain optimized.

Specifications

Radio	
Multiple Frequency Bands Supported. 40, 20, 10, 5 MHz wide channel selections (Local regulations apply)	4.940-4.990 GHz Public Safety Band (FCC Part 70, licensed Intl.)☐Non-overlapping Channels: 8 x 5 MHz, 4 x 10 MHz, 2 x 20 MHz, 1 x 40 MHz
	5.25-5.35 GHz license-exempt (FCC, Industry Canada, Mexico)☐Non-overlapping Channels: 19 x 5 MHz, 9 x 10 MHz, 4 x 20 MHz, 2 x 40 MHz
	5.47-5.72 GHz license-exempt (ETSI, FCC, ITU) with TPC and DFS☐Non-overlapping Channels: 44 x 5 MHz, 22 x 10 MHz, 11 x 20 MHz, 5 x 40 MHz
	5.725-5.850 GHz license exempt UNII & ISM Bands (ETSI, FCC, MII) ☐Non-overlapping Channels: ISM, UNII: 25 x 5 MHz, 12 x 10 MHz, 5 x 20 MHz, 2 x 40 MHz
Radio Type	Orthogonal Frequency Division Multiplexing (OFDM)
Standards Compliance	802.3, 802.11i draft, 802.11a hardware with proprietary bridging extensions
Total System EIRP and Radio Output Power	Radio output power: Max: 21dBm (Set to local regulatory requirements to comply with transmit, conducted and EIRP power limits)
Radio Receiver Sensitivity	Data Rate: 1 to 108 Mbps Sensitivity: -73 to –91dBm Modulation: 64QAM, 16QAM, QPSK, BPSK
Operating Modes	Point to Multipoint, Point to Point, Repeater (See Ordering Guide)
Antenna Type(s)	AI108-4958-N: No Antenna. Order a Sector, Omni, GRID, or Panel AI108-4958-SU and -1: Flat Panel 23 dBi Directional External antennas may be used with local regulatory approval.
Range	
FCC/Industry Canada Version	Up to 7.5 miles (12 km) with built-in 23 dBi panel antennas☐Up to 30 miles (48.27 km) with max radio output power and optional external 34.5 dBi antennas
International Version	Up to 30 miles (48.27 km) - N-type version (AI108-4958-ON-xxx) with max radio output power and optional external 34.5 dBi antennas
Security	
Authentication and Encryption	SecureRF Architecture - WirelessGRID link authentication. Proprietary Channels, AES/WEP 152bit data encryption options
Configuration and Management	
Configuration Utility	Built-in web-based utility, Telnet. Available at all time through secure login interface.
Software Upgrades	FTP download
Antenna Alignment	Real-time RSSi (signal strength) monitor, link optimization, and throughput maximization utility

LED Status Indicators	Power, Radio Link/Activity, Network Link/Activity
Real-time Monitoring	Secure Management Interface – Centralized real-time statistics and signal strength monitor.
Indoor Bridge to Outdoor Antenna Cable	
Cable Type	LMR-400
Cable Length	25 ft (7.62 meters). For other lengths, please contact AIRAYA
Cable Connectors	N-type Male to N-type Male
Interfaces	
Antenna Connector	N-Type Female Input
Bridge Connector	N-Type Female Input
Ethernet	100/10 Mbps Ethernet (RJ-45), 100 Mbps full-duplex recommended
Electrical	
Power Input	100-120V Auto-ranging (~50Hz-60Hz). 220V option available
Power Output	5VDC, 2Amps (2.1mm Coax, Center-pin positive)
Mechanical Dimensions	
Outdoor Antenna	12 x 12 x 1 in (30 x 30 x 2.5 cm)
Wireless Bridge	7.6 x 5.5 x 1.2 in (19.4 x 14.0 x 3.05 cm)
Outdoor Antenna Mount	Includes mast mount(s) and clamp kit(s) for 1 to 4.5 in (26 to 115 mm) diameter mast, also wall-mount capable
Environmental	
Radio Operating Temperature	32°F to 149°F, 0 to 55°C
Radio Operating Humidity	Max 95% non-condensing
Outdoor Antenna	Outdoor antenna: Fully weather protected
Compliance and Certification	
EMC	FCC Part 15, Industry Canada RSS-210, Mexico, ETSI
Safety	UL - Canada, USA, CE
Radio	Public Safety (Part 70 fixed wireless) FCC 15.407 (UNII, ISM), Industry Canada RSS-210, ETSI (w/TPC and DFS)

Ordering Information

Multipoint Bridges - Ordered Individually. Includes outdoor mounting brackets	
AI108-4958-BSU	Outdoor Base Station (BSU) w/150ft. PoE Cable, 1 x N-type female connector (1)
AI108-4958-ON2-150	Outdoor Base Station (BSU)/Repeater w/150ft. PoE Cable, 2 x N-type female connectors (1)
AI108-4958-OSU	Outdoor subscriber unit w/150ft. PoE Cable, 23 dBi integrated antenna
AI108-4958-SU	Indoor subscriber unit w/25ft. RF Cable, 23 dBi outdoor antenna
Outdoor Backhaul/Point to Point Bridge Kits. Includes outdoor mounting brackets	
AI108-4958-O-050	Complete kit includes 2 radio bridges with 50ft. PoE Cables, 23 dBi antennas
AI108-4958-O-150	Complete kit includes 2 radio bridges with 150ft. PoE Cables, 23 dBi antennas
AI108-4958-O-300	Complete kit includes 2 radio bridges with 300ft. PoE Cables, 23 dBi antennas
AI108-4958-ON-150	Complete kit includes 2 radio bridges with 150ft. PoE Cables, **N-type female Connectors**, and outdoor mounting brackets. No antennas
Indoor Radios/Kits - For use with RF cables and outdoor antennas	
AI108-4958-Kit	2 x radios, 2 x 25 ft RF cables, 2 x 23 dBi Antennas w/mounting brackets
AI108-4958-1	Indoor radio, 1 x 25 ft RF cable, and 1 x 23 dBi antenna w/mounting bracket (2)
AI108-4958-N	Radio only. No antenna, no cable (1)
Antennas	
AI108-MP-60	60° Sector Antenna - 5° V, 17 dBi Gain, Vertical Polar. (5.15-5.875 GHz) (3)
AI108-MP-90	90° Sector Antenna - 5° V, 16 dBi Gain, Vertical Polar. (5.15-5.875 GHz) (3)
AI108-MP-120	120° Sector Antenna - 5° V, 15 dBi Gain, Vertical Polar. (5.15-5.875 GHz) (3)
AI108-MP-OMNI	360° Omni Antenna - 9° V, 10 dBi Gain, Vertical Polar. (5.47-5.87 GHz) (3)
AI108-2-28	28 dBi Directional Grid Antenna - 5° H, 5° V, 28 dBi Gain, (5.15-5.875 GHz)
AI108-2-23	23 dBi Directional Panel Antenna - 10.5° H, 10.5° V, 23 dBi Gain, (5.15-5.875 GHz)
Lightning Protection	
AI108-LA-PoE	PoE lightning arrestor. 48VDC, 0.3A Power, 100/10 Mbps Ethernet
AI108-LA-Ethernet	Surge Suppressor for 100/10 Mbps Ethernet
AI108-LA5	5GHz RF Cable Lightning Arrestor (4)

Ordering Notes:
(1) For Base Stations (BSU, BSU2), outdoor bridge N-type kits (ON), and N-type indoor bridges (N), antennas are ordered separately
(2) Two AI108-4958-1 units (unless ordered as AI108-4958-kit) are required to setup a complete building to building bridge.
(3) Sector and Omni antennas come with 6ft LMR-400 NM-NM cable when ordered with base station/repeater
(4) 5 GHz RF Cable Lightning Arrestor comes with 6ft LMR-400 cable when ordered with bridge
"O" designates the unit is designed for outdoor use and comes in a NEMA-rated outdoor enclosure
"N" designates the unit has N-type connector(s) and does not come with cables or antennas
Each point-to-multipoint unit is either a base station, repeater, or subscriber unit.
Two AI108-4958-1 units (unless ordered as the kit) are required to set up a building-to-building bridge.

WirelessGRID Worldwide Frequency Channel Plan

WirelessGRID Worldwide Frequency Channel Plan. Please note: Not all channels are available in every regulatory domain.

Channel Width	4.990-4.995 GHz Public Safety Band	5.25-5.35 GHz Band	5.47-5.72 GHz Band	5.725-5.85 GHz Band
5 MHz Wide Channel Selections	4950, 4955, 4960, 4965, 4970, 4975, 4980, 4985	5255, 5260, 5265, 5270, 5275, 5280, 5285, 5290, 5295, 5300, 5305, 5310, 5315, 5320, 5325, 5330, 5335, 5340, 5345 (Note 1)	5480, 5485, 5490, 5495, 5500, 5505, 5510, 5515, 5520, 5525, 5530, 5535, 5540, 5545, 5550, 5555, 5560, 5565, 5570, 5575, 5580, 5585, 5590, 5595, 5600, 5605, 5610, 5615, 5620, 5625, 5630, 5635, 5640, 5645, 5650, 5655, 5660, 5665, 5670, 5675, 5680, 5685, 5690, 5695, 5700, 5705, 5710, 5715	5725, 5730, 5735, 5740, 5745, 5750, 5755, 5760, 5765, 5770, 5775, 5780, 5785, 5790, 5795, 5800, 5805, 5810, 5815, 5820, 5825, 5830, 5835, 5840, 5845
10 MHz Wide Channel Selections	4950, 4960, 4970, 4980	5260, 5270, 5280, 5290, 5300, 5310, 5320, 5330, 5340	5490, 5500, 5510, 5520, 5530, 5540, 5550, 5560, 5570, 5580, 5590, 5600, 5610, 5620, 5630, 5640, 5650, 5660, 5670, 5680, 5690, 5700, 5710, 5720	5730, 5740, 5750, 5760, 5770, 5780, 5790, 5800, 5810, 5820, 5830, 5840
20 MHz Wide Channel Selections	4950, 4970	5270, 5290, 5310, 5330	5480, 5500, 5520, 5540, 5560, 5580, 5600, 5620, 5640, 5660, 5680, 5700	5745, 5765, 5785, 5805, 5825
40 MHz Wide Channel Selections	4965	5270, 5310	5520, 5560, 5600, 5640, 5680	5760, 5800

Local regulations apply

The matrix above shows all channel selections currently available for WirelessGRID radios. This configuration is commonly used by government, military and defense agencies that require maximum flexibility in system design AND control their regulatory environment.

If you are in this position and would like to request custom channelization for a proprietary application, please contact AIRAYA for further information.

Most countries do not allow all available WirelessGRID® channel selections, and products shipped will only have channel selections available in compliance with local regulations.

Note 1 – Not available in the US and Canada

Appendix A – Bench Test Procedure

This WirelessGRID bench test guide is designed to provide a new AIRAYA installer with insight and understanding of how to setup, test and verify the functionality of a WirelessGRID link before performing a field installation. Utilities for testing network communication, configuring bridges, aligning antennas, and measuring throughput are discussed. Answers to common questions and troubleshooting tips are noted throughout the document for your convenience.

While performing a bench test, antenna alignment is not critical as antennas are close together and the signal strength (RSSi) utilities will always show a strong signal. As in all field installations, bench tests should be performed with antennas correctly polarized, either vertically or horizontally, and pointing at each other, at a distance of no less than 15 feet apart. Each integrated radio or outdoor antenna has a polarity arrow sticker on it. An Up or Down arrow = vertical polarization. A Left and Right pointing arrow = horizontal polarization. Both arrows should be pointing in the same direction.

To obtain optimal throughput and link reliability, signal strength readings should be above 18 for all bench tests. Very high signal strength values (RSSi above 50) are common in bench tests and will not damage radios; however, measured TCP/IP throughput results may be lower.

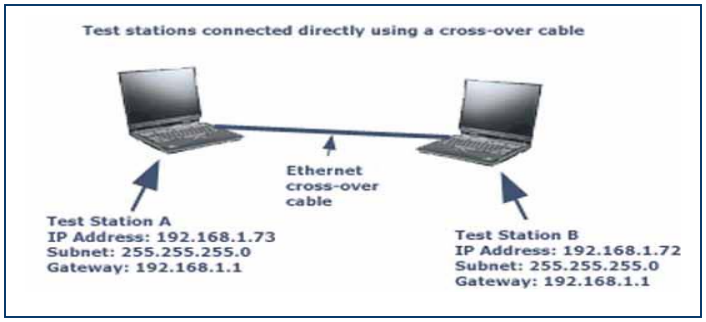
Bench test Procedure

Step 1. Setup a wired Ethernet network between test stations

1. Configure 2 test stations so that their network IP addresses are in the same range and can communicate with each other via Ethernet. If you are not familiar with IP addresses, please contact AIRAYA for the name of a qualified network installer in your area.

2. Verify your test network setup by using an Ethernet crossover cable directly connected between the two test stations, or by connecting the 2 stations using a switch, hub or router using straight-through Ethernet cables.

To verify your wired network setup is working properly, run a continuous ping between test stations A and B. To do this, open a DOS or CMD window on test station A, then type the following at the command prompt: **ping 192.168.1.72 –t** and on station B, type **ping 192.168.1.73 -t** Note: **-t** runs a continuous ping.



If you receive ping responses from both test stations, the network IP configuration and physical wiring is working properly between the 2 test stations using Ethernet. If you cannot ping both test stations, check your Ethernet cable connections and test station network settings to verify they are configured properly.

NOTE

If ping does not work between 2 wired test stations, it will not work between 2 test stations connected by a WirelessGRID link.

When ping works properly with wired test stations, go to Step 2.

Step 2. Setup wired Ethernet network connections to bridges

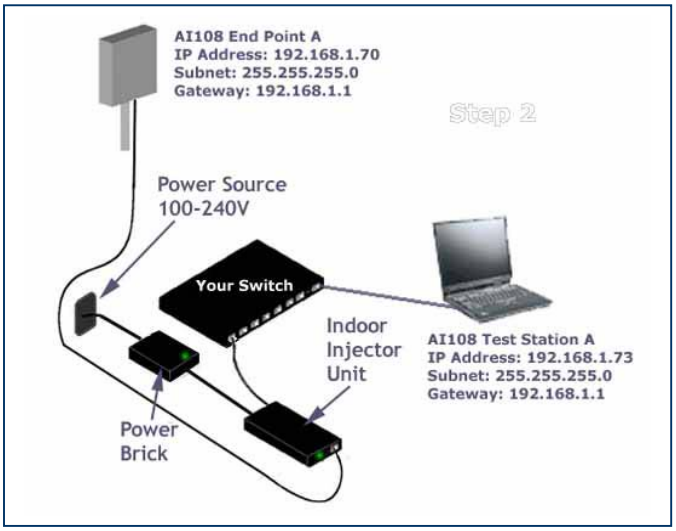
Connect directly using crossover cables, or through network switches or routers using straight-thru Ethernet cables.

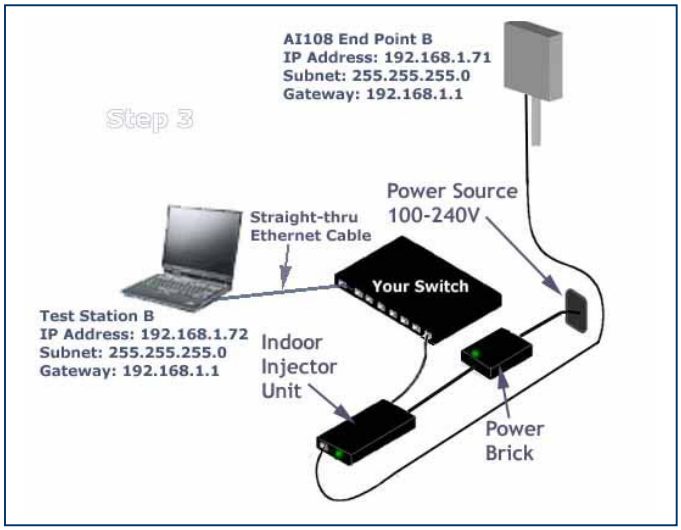
NOTE

WirelessGRID products shipped as complete kits have one bridge factory-configured with IP address 192.168.1.70, and one bridge factory-configured with IP address 192.168.1.71. Both bridges have a default subnet mask of 255.255.255.0

100 Mbps full duplex ports are best from connecting bridges to wired Ethernet networks.

Example IP Configuration of test stations and outdoor bridges with default configuration parameters:





1. Start a continuous ping from test Station A to bridge end point A. To start a continuous ping using the factory default IP settings of the bridge, type the following into a DOS or CMD window on test station A:

   Ping 192.168.1.70 –t (leave this ping window running so you can see ping results easily)

2. If there is no response, try IP address 192.168.1.71, or cycle the power on bridge end point A.

Note
Check that the Ethernet link light is on at test station A if connected directly to bridge A with cross-over cable, or on the switch/router port that bridge A is plugged into if connected with a straight-though Ethernet cable. If the Ethernet link light is on and you cannot ping bridge A, then re-check IP address and

After ~30 seconds, you should see ping responses from 192.168.1.70 (bridge A). If you see ping responses on test station A, you have an IP network connection between test station A and bridge A.

If you can ping bridge A, you can open the HTTP configuration utility and network management system (NMS) using a web browser. You will not be able to ping across the link to bridge B until WirelessGRID bridge list authorization entries are made in both bridges. (See step 3)

3. Setup the Ethernet network connection between bridge B and test station B using the same procedure described above, then verify that the test station B to bridge B setup is correct.

NOTE
When doing a multipoint bench test, it is easiest to setup the base station as bridge A, and the first subscriber unit as bridge B using the procedure above. To test additional subscriber units, repeat step 3, substituting a new subscriber unit (with a different IP address) one at a time. This will help to simplify diagnostics and reduce confusion.

After verifying that <u>both</u> bridges and their respective test stations can communicate via Ethernet, go to step 3.

Step 3. Setup bridge software configuration for bridge

After verifying that both bridges and their respective test stations can communicate via Ethernet, you will need to setup and verify bridge configuration so they will be able to communicate over the radio link. The configuration given here will be a minimal configuration for test purposes; for more detailed configuration information, please refer to the product manual.

NOTE

Factory default administrative User Name and Password are **Airaya** with an uppercase **A**

As a security measure, the WirelessGRID http configuration utility and network management systems (NMS) will timeout if left open with no activity for 3 or more minutes. You will need to re-login to again access the utility.

1. On each test station, open an **http** session by entering the bridge IP address into the address field of your web browser. The correct format is: http://192.168.1.70, or whatever the bridge's IP address has been set to.
2. Login using the default Administrator name and password. Each test station should now be displaying the "Current Settings" screen.
3. Record the IP address and MAC address of each bridge. You can also enter a Unique Name under the Admin *Setup* tab to help in identifying bridges. It is common to use this field to enter 32-character location identifiers.

Bridge	IP Address	MAC Address	Unique Name
A			
B			

4. Under **WirelessGRID Bridge List**, on bridge A, click "Add New," and enter bridge B's MAC address in the "Bridge MAC Address" box, using the xx:xx:xx:xx:xx:xx format. Click "Add New."
5. On bridge B, use the same procedure above to add bridge A's MAC address.
6. On the "Security" tab, make sure both ACL Authentication and encryption are disabled.
7. On each bridge, click on the "Reboot" button on either the Network Settings or Radio Settings tab to enable new WirelessGRID Bridge List settings.
8. On each bridge, reopen the http interface and verify that entries were correctly saved by reviewing the "Current Settings" screen.

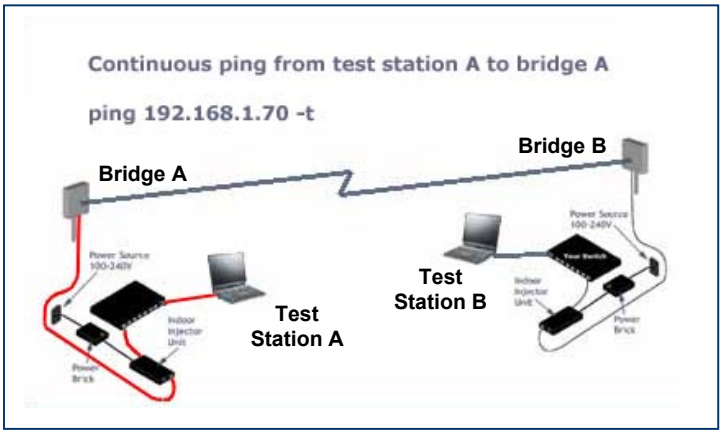
After verifying that both bridges have the proper WirelessGRID Bridge List settings, go to step 4.

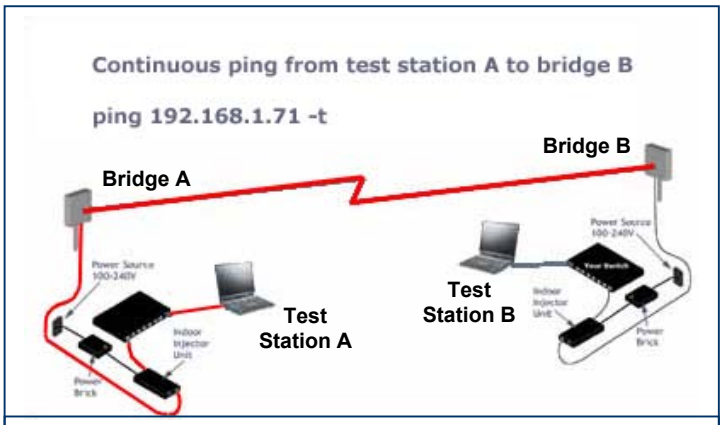
Step 4. Test network connectivity across a WirelessGRID link

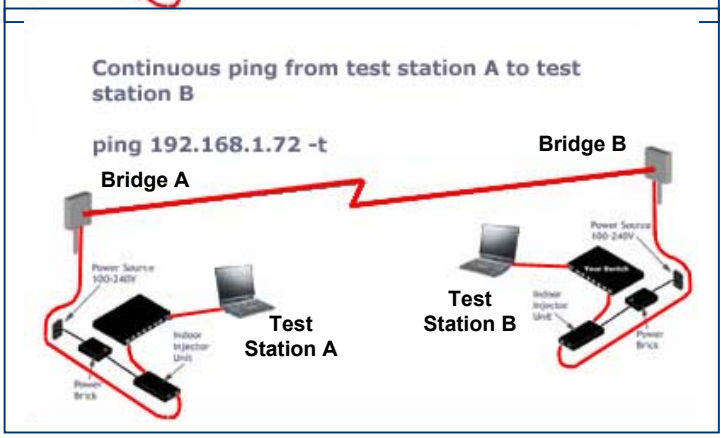
After verifying that both bridges and their respective test stations can communicate via Ethernet, and confirming new WirelessGRID bridge list entries were saved, the following ping tests should be done.

NOTE

After rebooting bridges, the radio link should be established within one minute. If TPC and DFS are enabled, this process may take up to two minutes.







To verify network connectivity across a WirelessGRID link, you should use test station A to do the following:

Ping 192.168.1.70 -t to ping bridge A

Ping 192.168.1.71 -t to ping bridge B across the wireless radio link

Ping 192.168.1.72 -t to ping test station B across the wireless link

If all ping tests are successful, then you have a properly configured WirelessGRID link. Go to Step 5.

Troubleshooting tips for pinging across a link:

If you do not get a ping across the two end points from test station A to test station B;

You may have a power problem

- Verify that each bridge is connected to a power source with the proper input voltage.

You may have an Ethernet network cable problem at one end

- Verify all physical connections. You should have an Ethernet link light on the switch, router, or computer connected to each bridge.

You may have an http configuration error

- Verify the configurations of both bridges using the http NMS. Bridge A should have an entry in its WirelessGRID Bridge List for the MAC address of the bridge B, and bridge B should have an entry in its WirelessGRID Bridge List for the MAC address of the bridge A - without correct MAC addresses (bridge authorization) in each side of the link, the bridges will not communicate or let traffic pass.

NOTE

When doing a **Multipoint bench test**, it is best to setup the base station as bridge A, and the first subscriber unit as bridge B using the procedure in Step 3. To test additional subscriber units, use this procedure for each new subscriber unit, repeating the ping test for bridge B one at a time. Use different IP addresses for each new subscriber units. (E.g. Ping 192.168.1.74 -t for subscriber two, and so on) This will simplify diagnostics. Once all subscriber units (SU) respond to this test and you have verified that each subscriber has a different IP address, you can power up all SU's and each one should be ping-able.

Step 4a. Check throughput of WirelessGRID link (optional)

To check the throughput of a WirelessGRID link, use an FTP program or some other type of throughput measuring utility to check the speed of your link. If you don't know what program to use to test link throughput, AIRAYA can provide you with a traffic generating program and shareware throughput monitoring utility at no charge. A link to these utilities can be found on the main page of the AIRAYA support section of website. http://www.airaya.com/products/productdb/_product_support.asp

If you are planning to do meaningful throughput tests, you will need a minimum of 2 test stations with at least 1.6GHz processors and Windows XP, 2000, or the Linux operating system. Windows 95, 98, ME TCP/IP stacks limit TCP throughput and cannot be used to accurately test throughput on an AIRAYA WirelessGRID link.

AIRAYA's internal bench test results can be found at the following web address: http://www.airaya.com/products/wirelessgrid_testdata.html

NOTE

If you use 10 Mbps Ethernet to communicate with a WirelessGRID bridge, you **will not** get maximum throughput, and packet errors may occur between the bridge and your 10 Mbps Ethernet device. AIRAYA recommends 100 Mbps Ethernet switches or routers to maximize throughput. Throughput tests will not work if Step 4 above has not been finished successfully.

Step 5. Running the real-time Signal Strength Monitor

In this document, we discuss only the use of the WirelessGRID's exclusive real-time signal strength monitor. At anytime and from any location in your network, this monitoring tool can be used to check signal quality between any two WirelessGRID bridges in the network.

Additional information on our web-based Signal Strength Indicator and RSSi Graph, and detailed physical antenna adjustment instructions can also be found in the product manual.

NOTE

When field deploying a new WirelessGRID link or multipoint system, it is important to use the antenna alignment utility, combined with the physical antenna alignment process, to optimize the received signal strength between bridges. This applies to both point-to-point links and entire multipoint or mesh networks. The longer the path between two locations, the more important these tools are in optimizing signal strength and data throughput, and maximizing link reliability. This tool should always be run at BOTH ends of a point-to-point link to ensure both antennas are properly aligned.

Optimal RSSi values for field deployments range between 18 and 40. Values seen in bench tests can be as high as 75. The difference between such figures is normal, due to factors such as expected loss of signal strength along the wireless path, antenna alignment differences, environmental issues, and other variables.

With steps 1 through 4 completed, and a ping session running to verify you're connected to bridge A, open a Telnet session from test station A to bridge A using the following steps.

1. Open a Telnet session to the bridge A, IP address, port 3000 (see example below).

2. At the Telnet prompt, enter the User Name and press Enter.
3. Enter the Password and press Enter.
4. Enter the Remote MAC Address of bridge B and press Enter.

When you've entered the remote MAC address of bridge B and pressed Enter, you should see receive signal strength values (displayed in dBm) streaming across the Telnet screen (see figure below). These values indicate the RSSi (signal strength) of the RF packets sent from bridge B.

```
Telnet 192.168.1.70 3000
login: Airaya

password: Airaya

Remote MAC address: 00:11:F8:2a:3b:b2

18 19 20 17 18 20 19 20 19 17 19 19 19 19 20 19 19 19 20 18     avg: 19
20 19 20 20 20 18 18 17 20 18 19 20 19 19 17 21 19 19 20 18     avg: 19
19 21 19 19 20 20 20 20 21 20 21 20 19 19 18 19 19 19 19 19     avg: 20
17 19 20 19 19 20 20 19 18 20 20 20 20 19 17 17 20 20 19 19     avg: 19
18 18 18 20 20 17 20 20 20 19 20 18 19 21 19 19 20 20 18 18     avg: 19
20 19 18 17 19 20 20 19 20 18 18 18 20 21 17 18 19 20 19 20     avg: 19
19 19 19 20 20 19 20 21 19 20 19 20 19 19 19 20 21 20 17 18     avg: 19
19 21 19 19 19 20 20 20 19 20 21 20 18 19 20 20 17 17 18 20     avg: 19
20 20 19 18 19 19 19 19 18 18 19 20 19 19 18 20 20 20 20 19     avg: 19
18 19 18 20 20 20 17
```

NOTE

If you see very few or no values streaming across the screen, there is probably no traffic going across the radio link. You can generate traffic by opening additional ping windows or FTP file transfers on your test stations if you do not have a traffic-generating program.

The first 20 values displayed on each line represent individual RSSi values; the 21st represents the average of the first 20 values (e.g.: avg: 19). Focus on obtaining the highest average values.

The key to achieving optimal throughput and reliable radio communication is to obtain the highest possible average RSSi values for bridges at BOTH ends of a link. This means you need to run this utility from both ends of a link to ensure signal strength is good in both directions.

Now that you are familiar with operation of two stations, and if you are testing a multipoint installation, you can add subscriber units to your test, one at a time. Be sure to add ONLY the BSU MAC address to each subscriber units' WirelessGRID bridge list, and add all subscriber MAC address to the base station's WirelessGRID bridge list.

Step 6. Field deployment of WirelessGRID bridges

It is a good idea for you to become familiar with the product before installing it for the first time. AIRAYA recommends you perform a bench test before deploying any units to the field.

The bench test and verification process can also be performed in the field, but it is generally much easier to configure the units on the bench before setting them up in the field.

Changes in field-deployed bridges include but are not limited to the following:

4. IP Addresses to match your network
5. Change the administrative user name and password to prevent un-authorized access the administrative interfaces
6. Location-specific unique names entries to help in identifying units in the field
7. Encryption enabled if you want your data encrypted as it travels across your new WirelessGRID system.

Appendix B. Multi-point Bridge Configuration Log

Bridge	IP Address	MAC Address	Unique Name
1 (BSU)			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
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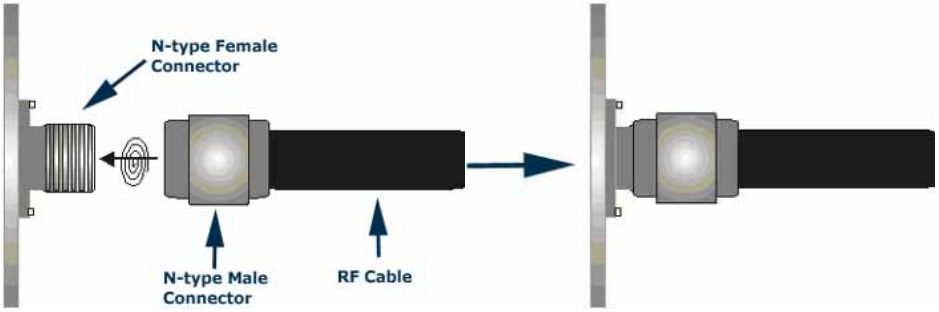
25			
26			
27			
28			
29			
30			
31			
32			
33			

Appendix C: Weatherproofing RF Cable Connections

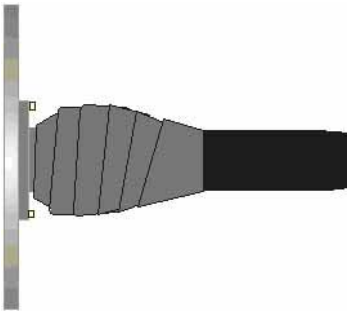
Step 1. Connecting Cable Assembly to Antenna or Enclosure

Attach RF cable assembly to antenna/enclosure by fastening the N-type male connector to the N-type female connector. Notes: Ensure both connectors are clean and dry. Hand-tighten firmly.



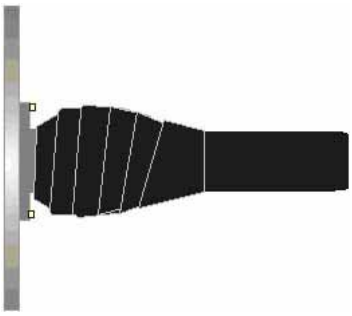
Step 2. Sealing the Connector Assembly

Tightly wrap the connectors with 2 layers of rubber tape (butyl). Notes: Rubber tape should seal entire connection and extend 1 inch beyond antenna connector/cable assembly. 3M 3339 tape works very well in this application.



Step 3. Covering Rubber Tape with Electrical Tape

Tightly wrap the rubber tape with 2 layers of electrical tape. Note: Electrical tape should extend 1 inch beyond rubber tape to ensure full coverage.



How to Get Help

AIRAYA offers several customer support options to assist you with difficulties you might experience with your WirelessGRID wireless bridge:

Worldwide Web Support

The AIRAYA web site (www.airaya.com) provides quick and easy answers to common technical questions. You'll find a complete *Knowledgebase*, a variety of technical documents, product manuals and literature, and other helpful information. Most materials can be found in the support area.

Contacting AIRAYA

Contact your AIRAYA distributor or dealer before you call AIRAYA. They are familiar with your needs and will generally be able to provide you with the fastest and most comprehensive support. If they are unavailable or unable to answer your questions, then contact AIRAYA directly by one of the methods listed below.

Before contacting our technical support team, please create a copy of the "Current Settings" tab using your web browser and the instructions in this manual. If you are not able to run the web-based configuration utility, then write down any error messages you see on-screen and the appropriate support number list above.

AIRAYA Contacts

Phone	(866) 224-7292 (U.S.) (408) 776-9583 (international)
Skype	AIRAYA_Support
Fax	(408) 776-9583
E-mail	support@airaya.com
Web site	www.airaya.com

IMPORTANT NOTE

Free support is only available to registered users. Register via the AIRAYA web site (www.airaya.com) in the support section. Support is available 24 hours a day.