Edge-corE

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OAP6626A
Dual-Band Outdoor Access Point / Bridge

User Guide

www.edge-core.com

User Guide

Dual-Band Outdoor Access Point/Bridge

IEEE 802.11a/b/g Access Point / Bridge
With External Antenna Options and Integrated High-Gain Antenna

Compliances

Federal Communication Commission Interference Statement

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

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and receiver
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected
- Consult the dealer or an experienced radio/TV technician for help

Warnings: **1.** Wear an anti-static wrist strap or take other suitable measures to prevent electrostatic discharge when handling this equipment.

2. When connecting this device to a power outlet, connect the field ground lead on the tri-pole power plug to a valid earth ground line to prevent electrical hazards.

IMPORTANT NOTE: FCC Radiation Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20 centimeters (8 inches) between the radiator and your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Wireless 5 GHz Band Statement:

As the access point can operate in the 5150-5250 MHz frequency band it is limited by the FCC, Industry Canada and some other countries to indoor use only so as to reduce the potential for harmful interference to co-channel Mobile Satellite systems.

High power radars are allocated as primary users (meaning they have priority) of the 5250-5350 MHz and 5650-5850 MHz bands. These radars could cause interference and/or damage to the access point.

EC Conformance Declaration CE0560!

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

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

Countries of Operation & Conditions of Use in the European Community

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

Note: The user must use the configuration utility provided with this product to ensure the channels of operation are in conformance with the spectrum usage rules for European Community countries as described below.

- This device requires that the user or installer properly enter the current country of operation in the command line interface as described in the user guide, before operating this device.
- This device will automatically limit the allowable channels determined by the current country of operation. Incorrectly entering the country of operation may result in illegal operation and may cause harmful interference to other system. The user is obligated to ensure the device is operating according to the channel limitations, indoor/outdoor restrictions and license requirements for each European Community country as described in this document.
- This device employs a radar detection feature required for European Community operation in the 5 GHz band. This feature is automatically enabled when the country of operation is correctly configured for any European Community country. The presence of nearby radar operation may result in temporary interruption of operation of this device. The radar detection feature will automatically restart operation on a channel free of radar.
- The 5 GHz Turbo Mode feature is not allowed for operation in any European Community country. The current setting for this feature is found in the 5 GHz 802.11a Radio Settings Window as described in the user guide.
- The 5 GHz radio's Auto Channel Select setting described in the user guide must always remain enabled to ensure that automatic 5 GHz channel selection complies with European requirements. The current setting for this feature is found in the 5 GHz 802.11a Radio Settings Window as described in the user guide.

- This device may be operated *indoors or outdoors* in all countries of the European Community using the 2.4 GHz band: Channels 1 - 13, except where noted below.
  - In Italy the end-user must apply for a license from the national spectrum authority to operate this device outdoors.
  - In Belgium outdoor operation is only permitted using the 2.46 - 2.4835 GHz band: Channel 13.
  - In France outdoor operation is only permitted using the 2.4 - 2.454 GHz band: Channels 1 - 7

Operation Using 5 GHz Channels in the European Community

The user/installer must use the provided configuration utility to check the current channel of operation and make necessary configuration changes to ensure operation occurs in conformance with European National spectrum usage laws as described below and elsewhere in this document.

Allowed 5GHz Channels in Each European Community Country		
Allowed Frequency Bands	**Allowed Channel Numbers**	**Countries**
5.15 - 5.25 GHz*	36, 40, 44, 48	Austria, Belgium
5.15 - 5.35 GHz*	36, 40, 44, 48, 52, 56, 60, 64	France, Switzerland, Liechtenstein
5.15 - 5.35* & 5.470 - 5.725 GHz	36, 40, 44, 48, 52, 56, 60, 64, 100, 104, 108, 112, 116, 120, 124, 128, 132, 136, 140	Denmark, Finland, Germany, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, U.K.
5 GHz Operation Not Allowed	None	Greece

* Outdoor operation is not allowed using 5.15-5.35 GHz bands (Channels 36 - 64).

Channels 36 - 64 are currently not available for use.

Declaration of Conformity in Languages of the European Community

English	Hereby, Edgecore, declares that this Radio LAN device is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC.
Finnish	Valmistaja Edgecore vakuuttaa täten että Radio LAN device tyyppinen laite on direktiivin 1999/5/EY oleellisten vaatimusten ja sitä koskevien direktiivin muiden ehtojen mukainen.
Dutch	Hierbij verklaart Edgecore dat het toestel Radio LAN device in overeenstemming is met de essentiële eisen en de andere relevante bepalingen van richtlijn 1999/5/EG Bij deze Edgecore dat deze Radio LAN device voldoet aan de essentiële eisen en aan de overige relevante bepalingen van Richtlijn 1999/5/EC.
French	Par la présente Edgecore déclare que l'appareil Radio LAN device est conforme aux exigences essentielles et aux autres dispositions pertinentes de la directive 1999/5/CE
Swedish	Härmed intygar Edgecore att denna Radio LAN device står I överensstämmelse med de väsentliga egenskapskrav och övriga relevanta bestämmelser som framgår av direktiv 1999/5/EG.
Danish	Undertegnede Edgecore erklærer herved, at følgende udstyr Radio LAN device overholder de væsentlige krav og øvrige relevante krav i direktiv 1999/5/EF
German	Hiermit erklärt Edgecore, dass sich dieser/diese/dieses Radio LAN device in Übereinstimmung mit den grundlegenden Anforderungen und den anderen relevanten Vorschriften der Richtlinie 1999/5/EG befindet". (BMWi) Hiermit erklärt Edgecore die Übereinstimmung des Gerätes Radio LAN device mit den grundlegenden Anforderungen und den anderen relevanten Festlegungen der Richtlinie 1999/5/EG. (Wien)
Greek	με την παρουσα EDGECORE δηλωνει οτι radio LAN device συμμορφωνεται προσ τισ ουσιωδεισ απαιτησεισ και τισ λοιπεσ σΧετικεσ διαταξεισ τησ οδηγιασ 1999/5/εκ
Italian	Con la presente Edgecore dichiara che questo Radio LAN device è conforme ai requisiti essenziali ed alle altre disposizioni pertinenti stabilite dalla direttiva 1999/5/CE.
Spanish	Por medio de la presente Edgecore declara que el Radio LAN device cumple con los requisitos esenciales y cualesquiera otras disposiciones aplicables o exigibles de la Directiva 1999/5/CE
Portuguese	Edgecore declara que este Radio LAN device está conforme com os requisitos essenciais e outras disposições da Directiva 1999/5/CE.

Safety Compliance

Power Cord Safety

Please read the following safety information carefully before installing the device:

Warning: Installation and removal of the unit must be carried out by qualified personnel only.

- The unit must be connected to an earthed (grounded) outlet to comply with international safety standards.
- Do not connect the unit to an A.C. outlet (power supply) without an earth (ground) connection.
- The appliance coupler (the connector to the unit and not the wall plug) must have a configuration for mating with an EN 60320/IEC 320 appliance inlet.
- The socket outlet must be near to the unit and easily accessible. You can only remove power from the unit by disconnecting the power cord from the outlet.
- This unit operates under SELV (Safety Extra Low Voltage) conditions according to IEC 60950. The conditions are only maintained if the equipment to which it is connected also operates under SELV conditions.

France and Peru only
This unit cannot be powered from IT† supplies. If your supplies are of IT type, this unit must be powered by 230 V (2P+T) via an isolation transformer ratio 1:1, with the secondary connection point labelled Neutral, connected directly to earth (ground).

† Impédance à la terre

Important! Before making connections, make sure you have the correct cord set. Check it (read the label on the cable) against the following:

Power Cord Set	
U.S.A. and Canada	The cord set must be UL-approved and CSA certified.
	The minimum specifications for the flexible cord are: - No. 18 AWG - not longer than 2 meters, or 16 AWG. - Type SV or SJ - 3-conductor
	The cord set must have a rated current capacity of at least 10 A
	The attachment plug must be an earth-grounding type with NEMA 5-15P (15 A, 125 V) or NEMA 6-15P (15 A, 250 V) configuration.
Denmark	The supply plug must comply with Section 107-2-D1, Standard DK2-1a or DK2-5a.
Switzerland	The supply plug must comply with SEV/ASE 1011.
U.K.	The supply plug must comply with BS1363 (3-pin 13 A) and be fitted with a 5 A fuse which complies with BS1362.
	The mains cord must be <HAR> or <BASEC> marked and be of type HO3VVF3GO.75 (minimum).

Power Cord Set	
Europe	The supply plug must comply with CEE7/7 (“SCHUKO”).
	The mains cord must be <HAR> or <BASEC> marked and be of type HO3VVF3GO.75 (minimum).
	IEC-320 receptacle.

Veuillez lire à fond l'information de la sécurité suivante avant d'installer l’appareil:

AVERTISSEMENT: L’installation et la dépose de ce groupe doivent être confiés à un personnel qualifié.

- Ne branchez pas votre appareil sur une prise secteur (alimentation électrique) lorsqu'il n'y a pas de connexion de mise à la terre (mise à la masse).
- Vous devez raccorder ce groupe à une sortie mise à la terre (mise à la masse) afin de respecter les normes internationales de sécurité.
- Le coupleur d’appareil (le connecteur du groupe et non pas la prise murale) doit respecter une configuration qui permet un branchement sur une entrée d’appareil EN 60320/IEC 320.
- La prise secteur doit se trouver à proximité de l’appareil et son accès doit être facile. Vous ne pouvez mettre l’appareil hors circuit qu’en débranchant son cordon électrique au niveau de cette prise.
- L’appareil fonctionne à une tension extrêmement basse de sécurité qui est conforme à la norme IEC 60950. Ces conditions ne sont maintenues que si l’équipement auquel il est raccordé fonctionne dans les mêmes conditions.

France et Pérou uniquement:
Ce groupe ne peut pas être alimenté par un dispositif à impédance à la terre. Si vos alimentations sont du type impédance à la terre, ce groupe doit être alimenté par une tension de 230 V (2 P+T) par le biais d’un transformateur d’isolement à rapport 1:1, avec un point secondaire de connexion portant l’appellation Neutre et avec raccordement direct à la terre (masse).

Cordon électrique - Il doit être agréé dans le pays d’utilisation	
Etats-Unis et Canada:	Le cordon doit avoir reçu l’homologation des UL et un certificat de la CSA.
	Les spe'cifications minimales pour un cable flexible sont AWG No. 18, ouAWG No. 16 pour un cable de longueur infe'rieure a` 2 me'tres. - type SV ou SJ - 3 conducteurs
	Le cordon doit être en mesure d’acheminer un courant nominal d’au moins 10 A.
	La prise femelle de branchement doit être du type à mise à la terre (mise à la masse) et respecter la configuration NEMA 5-15P (15 A, 125 V) ou NEMA 6-15P (15 A, 250 V).
Danemark:	La prise mâle d’alimentation doit respecter la section 107-2 D1 de la norme DK2 1a ou DK2 5a.

Cordon électrique - Il doit être agréé dans le pays d'utilisation	
Suisse:	La prise mâle d'alimentation doit respecter la norme SEV/ASE 1011.
Europe	La prise secteur doit être conforme aux normes CEE 7/7 ("SCHUKO") LE cordon secteur doit porter la mention <HAR> ou <BASEC> et doit être de type HO3VVF3GO.75 (minimum).

Bitte unbedingt vor dem Einbauen des Geräts die folgenden Sicherheitsanweisungen durchlesen (Germany)**:**

WARNUNG: Die Installation und der Ausbau des Geräts darf nur durch Fachpersonal erfolgen.

- Das Gerät sollte nicht an eine ungeerdete Wechselstromsteckdose angeschlossen werden.
- Das Gerät muß an eine geerdete Steckdose angeschlossen werden, welche die internationalen Sicherheitsnormen erfüllt.
- Der Gerätestecker (der Anschluß an das Gerät, nicht der Wandsteckdosenstecker) muß einen gemäß EN 60320/IEC 320 konfigurierten Geräteeingang haben.
- Die Netzsteckdose muß in der Nähe des Geräts und leicht zugänglich sein. Die Stromversorgung des Geräts kann nur durch Herausziehen des Gerätenetzkabels aus der Netzsteckdose unterbrochen werden.
- Der Betrieb dieses Geräts erfolgt unter den SELV-Bedingungen (Sicherheitskleinstspannung) gemäß IEC 60950. Diese Bedingungen sind nur gegeben, wenn auch die an das Gerät angeschlossenen Geräte unter SELV-Bedingungen betrieben werden.

Stromkabel**. Dies muss von dem Land, in dem es benutzt wird geprüft werden:**	
U.S.A und Canada	Der Cord muß das UL gepruft und war das CSA beglaubigt.
	Das Minimum spezifikation fur der Cord sind: - Nu. 18 AWG - nicht mehr als 2 meter, oder 16 AWG. - Der typ SV oder SJ - 3-Leiter
	Der Cord muß haben eine strombelastbarkeit aus wenigstens 10 A
	Dieser Stromstecker muß hat einer erdschluss mit der typ NEMA 5-15P (15A, 125V) oder NEMA 6-15P (15A, 250V) konfiguration.
Danemark	Dieser Stromstecker muß die ebene 107-2-D1, der standard DK2-1a oder DK2-5a Bestimmungen einhalten.
Schweiz	Dieser Stromstecker muß die SEV/ASE 1011Bestimmungen einhalten.
Europe	Das Netzkabel muß vom Typ HO3VVF3GO.75 (Mindestanforderung) sein und die Aufschrift <HAR> oder <BASEC> tragen. Der Netzstecker muß die Norm CEE 7/7 erfüllen (”SCHUKO”).

Contents

Chapter 1: Introduction

The Dual-band Outdoor Access Point / Bridge system provides point-to-point or point-to-multipoint bridge links between remote Ethernet LANs, and wireless access point services for clients in the local LAN area.

- **OAP6626A** – Includes an integrated high-gain antenna for the 802.11a radio and can be configured to operate as a “Master” or “Slave” bridge in point-to-multipoint configurations, or provide a high-speed point-to-point wireless link between two sites that can be up to 15.4 km (9.6 miles) apart. Up to two 5 GHz and two 2.4 GHz antennas con be connected to the uinit. The 802.11b/g radio requires an external antenna option. It supports wireless bridge connections to as many as 16 OAP6626A units configured as slaves.

The unit is housed in a weatherproof enclosure for mounting outdoors and includes its own brackets for attaching to a wall, pole, radio mast, or tower structure. It is powered through its Ethernet cable connection from a power injector module that is installed indoors.

The wireless bridge system offers a fast, reliable, and cost-effective solution for connectivity between remote Ethernet wired LANs or to provide Internet access to an isolated site. The system is also easy to install and operate, ideal for situations where a wired link may be difficult or expensive to deploy. The wireless bridge connection provides data rates of up to 108 Mbps.

In addition, both wireless bridge models offer full network management capabilities through an easy-to-use web interface, a command-line interface, and support for Simple Network Management Protocol (SNMP) tools.

Radio Characteristics – The IEEE 802.11a and 802.11g standards use a radio modulation technique known as Orthogonal Frequency Division Multiplexing (OFDM), and a shared collision domain (CSMA/CA). The 802.11a standard operates in the 5 GHz Unlicensed National Information Infrastructure (UNII) band, and the 802.11g standard in the 2.4 GHz band.

IEEE 802.11g includes backward compatibility with the IEEE 802.11b standard. IEEE 802.11b also operates at 2.4 GHz, but uses Direct Sequence Spread Spectrum (DSSS) and Complementary Code Keying (CCK) modulation technology to achieve a communication rate of up to 11 Mbps.

The wireless bridge provides a 54 Mbps half-duplex connection for each active channel (up to 108 Mbps in turbo mode on the 802.11a interface).

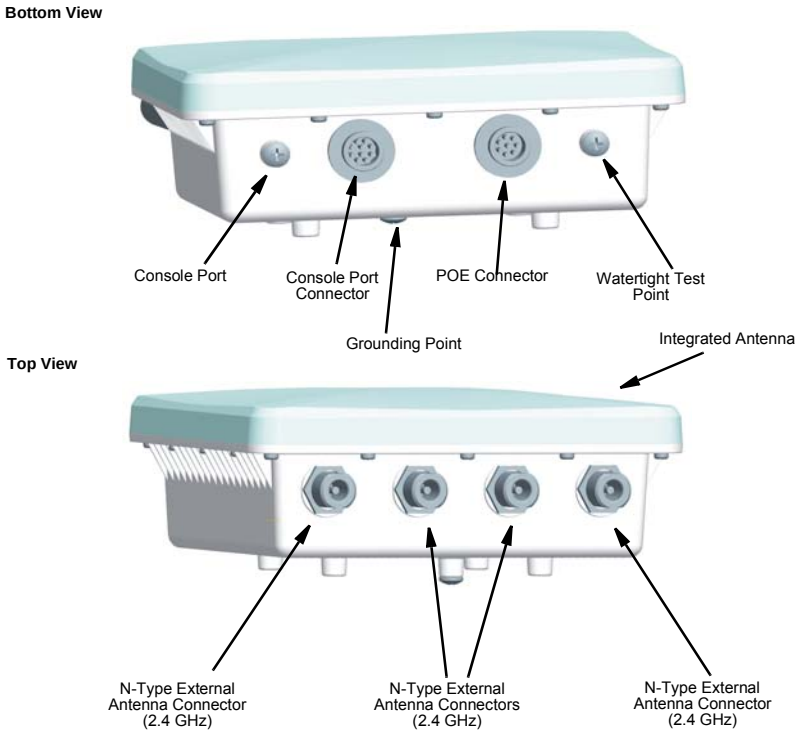
Package Checklist

The Dual-band Outdoor Access Point / Bridge package includes:

- One Dual-band Outdoor Access Point / Bridge (OAP6626A)
- One Category 5 network cable, length 164 ft (50 m)
- One power injector module and power cord (2.15 m)
- One POE powercore cable (? m)
- One RS-232 console cable (? m)
- Outdoor mounting bracket kit
- This User Guide
- Owners registration card

Inform your dealer if there are any incorrect, missing or damaged parts. If possible, retain the carton, including the original packing materials. Use them again to repack the product in case there is a need to return it.

Hardware Description



Integrated High-Gain Antenna

The OAP6626A wireless bridge includes an integrated high-gain (17 dBi) flat-panel antenna for 5 GHz operation. The antenna can provide a direct line-of-sight link up to 15.4 km (9.6 miles) with a 6 Mbps data rate.

External Antenna Options

The unit provides various external antenna options for both 5 GHz and 2.4 GHz operation. In a point-to-multipoint configuration, an external high-gain omnidirectional, sector, or high-gain panel antenna can be attached to communicate with bridges spread over a wide area. The following table summarizes the external antenna options:

Antenna Type	Gain (dBi)	HPBW* Horizontal	HPBW* Vertical	Polarization	Max Range/Speed
5 GHz Omnidirectional	8	360	12	Linear, vertical	3.3 km at 6 Mbps
5 GHz 120-Degree Sector	13.5	120	6	Linear, vertical	10.3 km at 6 Mbps
5 GHz 60-Degree Sector	16.5	60	6	Linear, vertical	14 km at 6 Mbps
5 GHz High-Gain Panel	23	9	9	Linear, vertical/ horizontal	24.4 km at 6 Mbps
2.4 GHz Omnidirectional	8	360	15	Linear, vertical	7.6 km at 6 Mbps

* Half-power beam width in degrees

External antennas connect to the N-type RF connectors on the wireless bridge using the provided coaxial cables.

Ethernet Port

The wireless bridge has one 10BASE-T/100BASE-TX 8-pin DIN port that connects to the power injector module using the included Ethernet cable. The Ethernet port connection provides power to the wireless bridge as well as a data link to the local network.

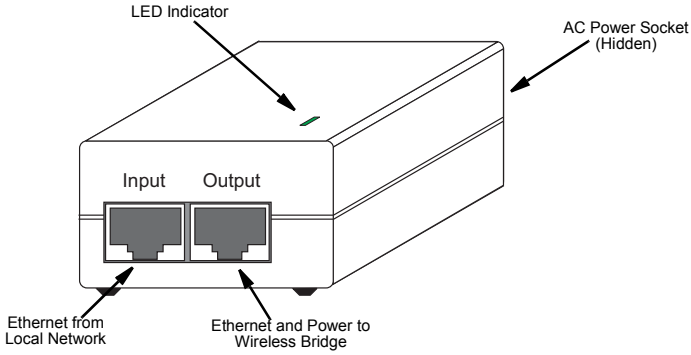
The wireless bridge appears as an Ethernet node and performs a bridging function by moving packets from the wired LAN to the remote end of the wireless bridge link.

Note: The power injector module does not support Power over Ethernet (PoE) based on the IEEE 802.3af standard. The wireless bridge unit must always be powered on by being connected to the power injector module.

Power Injector Module

The wireless bridge receives power through its network cable connection using power-over-Ethernet technology. A power injector module is included in the wireless bridge package and provides two RJ-45 Ethernet ports, one for connecting to the wireless bridge (Output), and the other for connecting to a local LAN switch (Input).

The Input port uses an MDI (i.e., internal straight-through) pin configuration. You can therefore use straight-through twisted-pair cable to connect this port to most network interconnection devices such as a switch or router that provide MDI-X ports. However, when connecting the access point to a workstation or other device that does not have MDI-X ports, you must use crossover twisted-pair cable.



The wireless bridge does not have a power switch. It is powered on when its Ethernet port is connected to the power injector module, and the power injector module is connected to an AC power source. The power injector includes one LED indicator that turns on when AC power is applied.

The power injector module automatically adjusts to any AC voltage between 100-240 volts at 50 or 60 Hz. No voltage range settings are required.

Warning: The power injector module is designed for indoor use only. Never mount the power injector outside with the wireless bridge unit.

Receive Signal Strength Indicator (RSSI) BNC Connector

The RSSI connector provides an output voltage that is proportional to the received radio signal strength. A DC voltmeter can be connected the this port to assist in aligning the antennas at both ends of a wireless bridge link.

Grounding Point

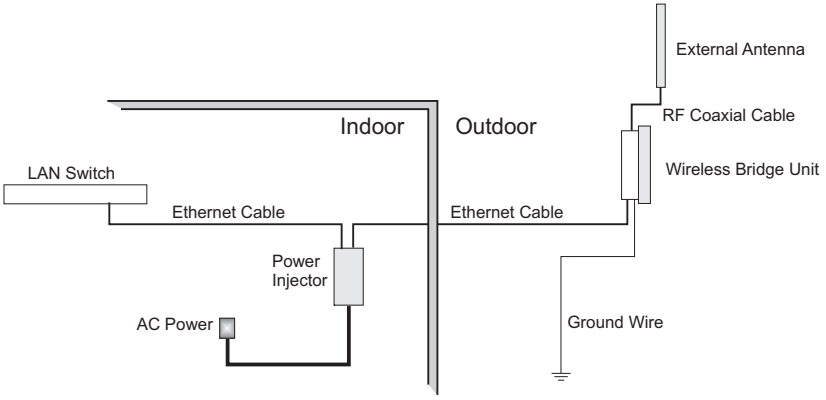
Even though the wireless bridge includes its own built-in lightning protection, it is important that the unit is properly connected to ground. Two grounding screws are provided for attaching a ground wire to the unit.

Wall- and Pole-Mounting Bracket Kits

The wireless bridge includes bracket kits that can be used to mount the bridge to a wall, pole, radio mast, or part of a tower structure.

System Configuration

At each location where a unit is installed, it must be connected to the local network using the power injector module. The following figure illustrates the system component connections.



Features and Benefits

- Functioning as a slave the unit supports a 5 GHz point-to-point wireless link up 15.4 km (at 6 Mbps data rate) using integrated high-gain 16.5 dBi antennas
- Functioning as a master the unit support 5 GHz point-to-multipoint links using various external antenna options
- The unit also supports access point services for the 5 GHz and 2.4 GHz radios using various external antenna options
- Maximum data rate up to 108 Mbps on the 802.11a (5 GHz) radio
- Outdoor weatherproof design
- IEEE 802.11a and 802.11b/g compliant
- Local network connection via 10/100 Mbps Ethernet port
- Powered through its Ethernet cable connection to the power injector module
- Includes wall- and pole-mount brackets
- Security through 64/128/152-bit Wired Equivalent Protection (WEP) or 128-bit Advanced Encryption Standard (AES) encryption
- Scans all available channels and selects the best channel and data rate based on the signal-to-noise ratio
- Manageable through an easy-to-use web-browser interface, command line (via Telnet), or SNMP network management tools

System Defaults

The following table lists some of the wireless bridge's basic system defaults. To reset the bridge defaults, use the CLI command "reset configuration" from the Exec level prompt.

Feature	Parameter	Default
Identification	System Name	Dual Band Outdoor AP
Administration	User Name	admin
	Password	*null*
General	HTTP Server	Enabled
	HTTP Server Port	80
TCP/IP	IP Address	192.168.1.1
	Subnet Mask	255.255.255.0
	Default Gateway	0.0.0.0
	Primary DNS IP	0.0.0.0
	Secondary DNS IP	0.0.0.0
VLANs	Status	Disabled
	Native VLAN ID	1
Filter Control	Ethernet Type	Disabled
SNMP	Status	Enabled
	Location	null
	Contact	Contact
	Community (Read Only)	Public
	Community (Read/Write)	Private
	Traps	Enabled
	Trap Destination IP Address	null
	Trap Destination Community Name	Public
System Logging	Syslog	Disabled
	Logging Host	Disabled
	Logging Console	Disabled
	IP Address / Host Name	0.0.0.0
	Logging Level	Informational
	Logging Facility Type	16

Feature	Parameter	Default
Spanning Tree	Status	Enabled
Ethernet Interface	Speed and Duplex	Auto
WDS Bridging	Outdoor Bridge Band	A (802.11a)
Wireless Interface 802.11a	Status	Enabled
	SSID	DualBandOutdoor
	Turbo Mode	Disabled
	Radio Channel	Default to first channel
	Auto Channel Select	Enabled
	Transmit Power	Full
	Maximum Data Rate	54 Mbps
	Beacon Interval	100 TUs
	Data Beacon Rate (DTIM Interval)	2 beacons
	RTS Threshold	2347 bytes
Wireless Security 802.11a	Authentication Type	Open System
	AES Encryption	Disabled
	WEP Encryption	Disabled
	WEP Key Length	128 bits
	WEP Key Type	Hexadecimal
	WEP Transmit Key Number	1
Wireless Interface 802.11b/g	Status	Enabled
	SSID	DualBandOutdoor
	Radio Channel	Default to first channel
	Auto Channel Select	Enabled
	Transmit Power	Full
	Maximum Data Rate	54 Mbps
	Beacon Interval	100 TUs
	Data Beacon Rate (DTIM Interval)	2 beacons
	RTS Threshold	2347 bytes

Feature	Parameter	Default
Wireless Security 802.11b/g	Authentication Type	Open System
	AES Encryption	Disabled
	WEP Encryption	Disabled
	WEP Key Length	128 bits
	WEP Key Type	Hexadecimal
	WEP Transmit Key Number	1
	WEP Keys	null
	WEP Keys	null

Chapter 2: Network Configuration

The Dual-band Outdoor Access Point / Bridge system provides access point or bridging services through either the 5 GHz or 2.4 GHz radio interfaces.

The wireless bridge units can be used just as normal 802.11a/b/g access points connected to a local wired LAN, providing connectivity and roaming services for wireless clients in an outdoor area. Units can also be used purely as bridges connecting remote LANs. Alternatively, you can employ both access point and bridging functions together, offering a flexible and convenient wireless solution for many applications.

This chapter describes the role of wireless bridge in various wireless network configurations.

Access Point Topologies

Wireless networks support a stand-alone wireless configuration as well as an integrated configuration with 10/100 Mbps Ethernet LANs.

Wireless network cards, adapters, and access points can be configured as:

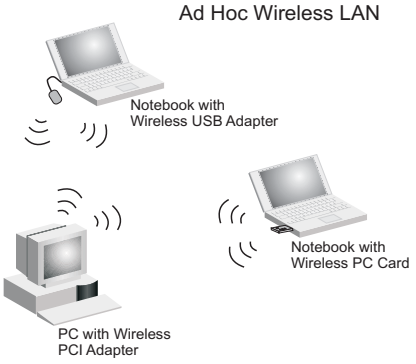
- Ad hoc for departmental, SOHO, or enterprise LANs
- Infrastructure for wireless LANs
- Infrastructure wireless LAN for roaming wireless PCs

The 802.11b and 802.11g frequency band, which operates at 2.4 GHz, can easily encounter interference from other 2.4 GHz devices, such as other 802.11b or g wireless devices, cordless phones and microwave ovens. If you experience poor wireless LAN performance, try the following measures:

- Limit any possible sources of radio interference within the service area
- Increase the distance between neighboring access points
- Increase the channel separation of neighboring access points (e.g., up to 3 channels of separation for 802.11b or up to 5 channels for 802.11g)

Ad Hoc Wireless LAN (no Access Point or Bridge)

An ad hoc wireless LAN consists of a group of computers, each equipped with a wireless adapter, connected through radio signals as an independent wireless LAN. Computers in a specific ad hoc wireless LAN must therefore be configured to the same radio channel.

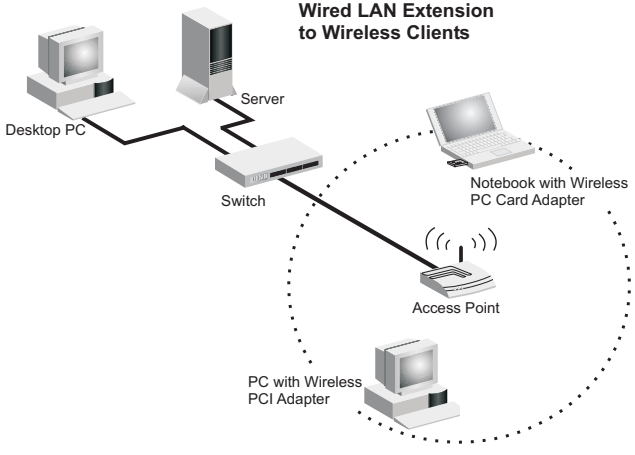


Infrastructure Wireless LAN

The access point function of the wireless bridge provides access to a wired LAN for 802.11a/b/g wireless workstations. An integrated wired/wireless LAN is called an Infrastructure configuration. A Basic Service Set (BSS) consists of a group of wireless PC users and an access point that is directly connected to the wired LAN. Each wireless PC in a BSS can connect to any computer in its wireless group or access other computers or network resources in the wired LAN infrastructure through the access point.

The infrastructure configuration not only extends the accessibility of wireless PCs to the wired LAN, but also increases the effective wireless transmission range for wireless PCs by passing their signals through one or more access points.

A wireless infrastructure can be used for access to a central database, or for connection between mobile workers, as shown in the following figure.

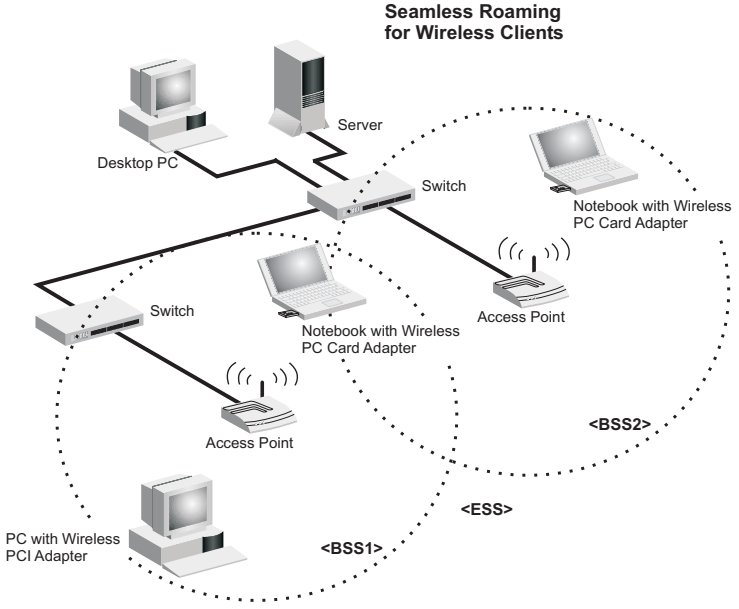


Infrastructure Wireless LAN for Roaming Wireless PCs

The Basic Service Set (BSS) defines the communications domain for each access point and its associated wireless clients. The BSS ID is a 48-bit binary number based on the access point's wireless MAC address, and is set automatically and transparently as clients associate with the access point. The BSS ID is used in frames sent between the access point and its clients to identify traffic in the service area.

The BSS ID is only set by the access point, never by its clients. The clients only need to set the Service Set Identifier (SSID) that identifies the service set provided by one or more access points. The SSID can be manually configured by the clients, can be detected in an access point's beacon, or can be obtained by querying for the identity of the nearest access point. For clients that do not need to roam, set the SSID for the wireless card to that used by the access point to which you want to connect.

A wireless infrastructure can also support roaming for mobile workers. More than one access point can be configured to create an Extended Service Set (ESS). By placing the access points so that a continuous coverage area is created, wireless users within this ESS can roam freely. All wireless network card adapters and wireless access points within a specific ESS must be configured with the same SSID.



Bridge Link Topologies

The IEEE 802.11 standard defines a WIreless Distribution System (WDS) for bridge connections between BSS areas (access points). The outdoor wireless bridge uses WDS to forward traffic on links between units. Up to 16 WDS links can be specified for a OAP6626A unit configured as a “Master” in the wireless bridge network. OAP6626A slave units support only one WDS link, which must be to the network’s master unit.

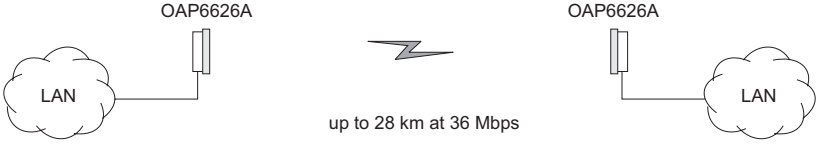
The OAP6626A support WDS bridge links on either the 5 GHz (802.11a) or 2.4 GHz (802.11b/g) bands and can be used with various external antennas to offer flexible deployment options.

Note: The external antennas offer longer range options using the 5 GHz radio, which makes this interface more suitable for bridge links. The 2.4 GHz radio has only the 8 dBi omnidirectional antenna option, which is better suited for local access point services.

When using WDS on a radio band, only wireless bridge units can associate to each other. Wireless clients can only associate with the wireless bridge using a radio band set to access point mode.

Point-to-Point Configuration

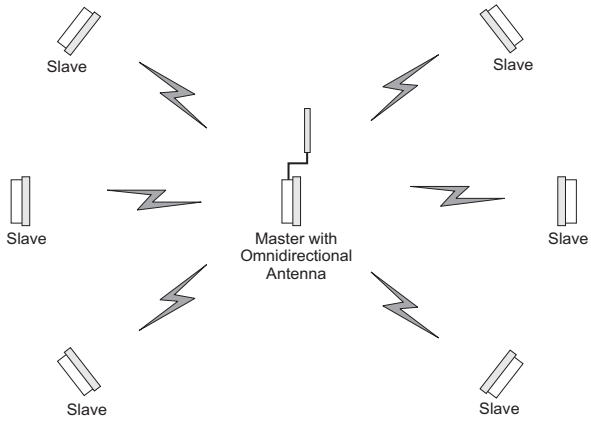
Two OAP6626A bridges can form a wireless point-to-point link using their 5 GHz (802.11a) integrated antennas. A point-to-point configuration can provide a limited data rate (6 Mbps) link over a long range (up to 15.4 km), or a high data rate (108 Mbps) over a short range (1.3 km).

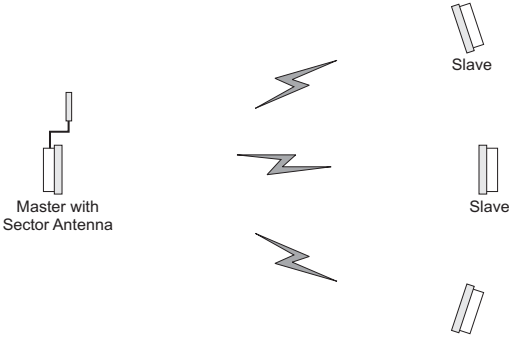


Point-to-Multipoint Configuration

A OAP6626A configured as a “Master” wireless bridge can use an omnidirectional or sector antenna to connect to as many as 16 bridges in a point-to-multipoint configuration. There can only be one OAP6626A “Master” unit in the wireless bridge network, all other bridges must be OAP6626A “Slave” units.

Using the 5 GHz 8 dBi omnidirectional external antenna, the Master unit can connect to Slave units up to 3.3 km (2 miles) away. Using the 13.5 dBi 120-degree sector antenna, the Master can connect to Slave units up to 10.3 km (6.4 miles) away.


Slave
Slave
Slave
Master with
Omnidirectional
Antenna
Slave
Slave
Slave


Slave
Master with
Sector Antenna
Slave

Chapter 3: Bridge Link Planning

The Dual-band Outdoor Access Point / Bridge supports fixed point-to-point or point-to-multipoint wireless links. A single link between two points can be used to connect a remote site to larger core network. Multiple bridge links can provide a way to connect widespread Ethernet LANs.

For each link in a wireless bridge network to be reliable and provide optimum performance, some careful site planning is required. This chapter provides guidance and information for planning your wireless bridge links.

Note: The planning and installation of the wireless bridge requires professional personnel that are trained in the installation of radio transmitting equipment. The user is responsible for compliance with local regulations concerning items such as antenna power, use of lightning arrestors, grounding, and radio mast or tower construction. Therefore, it is recommended to consult a professional contractor knowledgeable in local radio regulations prior to equipment installation.

Data Rates

Using its 5 GHz integrated antenna, the OAP6626A bridge can operate over a range of up to 15.4 km (9.6 miles) or provide a high-speed connection of 54 Mbps (108 Mbps in turbo mode). However, the maximum data rate for a link decreases as the operating range increases. A 15.4 km link can only operate up to 6 Mbps, whereas a 108 Mbps connection is limited to a range of 1.3 km.

When you are planning each wireless bridge link, take into account the maximum distance and data rates for the various antenna options. A summary for 5 GHz (802.11a) antennas is provided in the following table. For full specifications for each antenna, see “Antenna Specifications” on page B-3.

Distances Achieved Using Normal Mode					
Data Rate	17 dBi Integrated	8 dBi Omni	13.5 dBi 120-Degree Sector	16.5 dBi 60-Degree Sector	23 dBi Panel
6 Mbps	15.4 km	3.3 km	10.3 km	14 km	24.4 km
9 Mbps	14.7 km	2.9 km	9.2 km	13.4 km	23.3 km
12 Mbps	14 km	2.6 km	8.2 km	12.8 km	22.2 km
18 Mbps	12.8 km	2.1 km	6.5 km	11.7 km	20.3 km
24 Mbps	11.1 km	1.5 km	4.6 km	9.2 km	17.7 km
36 Mbps	6.5 km	0.8 km	2.6 km	5.2 km	14 km

Distances Achieved Using Normal Mode					
Data Rate	17 dBi Integrated	8 dBi Omni	13.5 dBi 120-Degree Sector	16.5 dBi 60-Degree Sector	23 dBi Panel
48 Mbps	2.9 km	0.4 km	1.2 km	2.3 km	9.2 km
54 Mbps	1.8 km	0.2 km	0.7 km	1.5 km	5.8 km

Distances provided in this table are an estimate for a typical deployment and may be reduced by local regulatory limits. For accurate distances, you need to calculate the power link budget for your specific environment.

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Distances Achieved Using Turbo Mode					
Data Rate	17 dBi Integrated	8 dBi Omni	13.5 dBi 120-Degree Sector	16.5 dBi 60-Degree Sector	23 dBi Panel
12 Mbps	13.4 km	2.3 km	7.3 km	12.2 km	21.2 km
18 Mbps	12.8 km	2.1 km	6.5 km	11.7 km	20.3 km
24 Mbps	12.2 km	1.8 km	5.8 km	11.1 km	19.4 km
36 Mbps	11.1 km	1.5 km	4.6 km	9.2 km	17.7 km
48 Mbps	8.2 km	1 km	3.3 km	6.5 km	15.4 km
72 Mbps	4.6 km	0.6 km	1.8 km	3.7 km	12.2 km
96 Mbps	2.1 km	0.3 km	0.8 km	1.6 km	6.5 km
108 Mbps	1.3 km	0.2 km	0.5 km	1 km	4.1 km

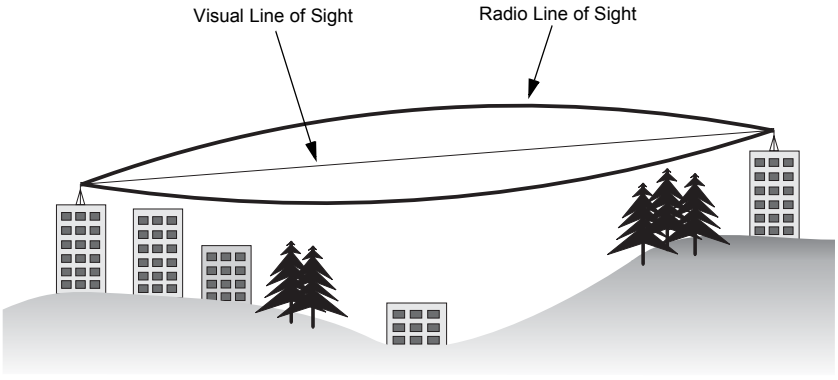
Distances provided in this table are an estimate for a typical deployment and may be reduced by local regulatory limits. For accurate distances, you need to calculate the power link budget for your specific environment.

Radio Path Planning

Although the wireless bridge uses IEEE 802.11a radio technology, which is capable of reducing the effect of multipath signals due to obstructions, the wireless bridge link requires a “radio line-of-sight” between the two antennas for optimum performance.

The concept of radio line-of-sight involves the area along a radio link path through which the bulk of the radio signal power travels. This area is known as the first Fresnel Zone of the radio link. For a radio link not to be affected by obstacles along its path, no object, including the ground, must intrude within 60% of the first Fresnel Zone.

The following figure illustrates the concept of a good radio line-of-sight.



If there are obstacles in the radio path, there may still be a radio link but the quality and strength of the signal will be affected. Calculating the maximum clearance from objects on a path is important as it directly affects the decision on antenna placement and height. It is especially critical for long-distance links, where the radio signal could easily be lost.

Note: For wireless links less than 500 m, the IEEE 802.11a radio signal will tolerate some obstacles in the path and may not even require a visual line of sight between the antennas.

When planning the radio path for a wireless bridge link, consider these factors:

- Avoid any partial line-of-sight between the antennas.
- Be cautious of trees or other foliage that may be near the path, or may grow and obstruct the path.
- Be sure there is enough clearance from buildings and that no building construction may eventually block the path.
- Check the topology of the land between the antennas using topographical maps, aerial photos, or even satellite image data (software packages are available that may include this information for your area)
- Avoid a path that may incur temporary blockage due to the movement of cars, trains, or aircraft.

Antenna Height

A reliable wireless link is usually best achieved by mounting the antennas at each end high enough for a clear radio line of sight between them. The minimum height required depends on the distance of the link, obstacles that may be in the path, topology of the terrain, and the curvature of the earth (for links over 3 miles).

For long-distance links, a mast or pole may need to be contsructed to attain the minimum required height. Use the following table to estimate the required minimum clearance above the ground or path obstruction (for 5 GHz bridge links).

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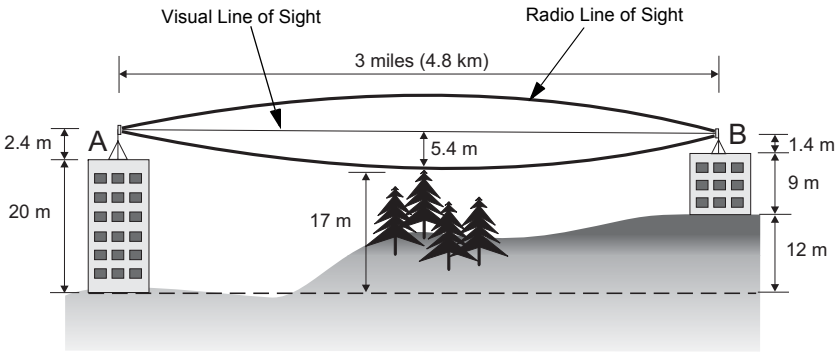
Total Link Distance	Max Clearance for 60% of First Fresnel Zone at 5.8 GHz	Approximate Clearance for Earth Curvature	Total Clearance Required at Mid-point of Link
0.25 mile (402 m)	4.5 ft (1.4 m)	0	4.5 ft (1.4 m)
0.5 mile (805 m)	6.4 ft (1.95 m)	0	6.4 ft (1.95 m)
1 mile (1.6 km)	9 ft (2.7 m)	0	9 ft (2.7 m)
2 miles (3.2 km)	12.7 ft (3.9 m)	0	12.7 ft (3.9 m)
3 miles (4.8 km)	15.6 ft (4.8 m)	1.8 ft (0.5 m)	17.4 ft (5.3 m)
4 miles (6.4 km)	18 ft (5.5 m)	3.2 ft (1.0 m)	21.2 ft (6.5 m)
5 miles (8 km)	20 ft (6.1 m)	5 ft (1.5 m)	25 ft (7.6 m)
7 miles (11.3 km)	24 ft (7.3 m)	9.8 ft (3.0 m)	33.8 ft (10.3 m)
9 miles (14.5 km)	27 ft (8.2 m)	16 ft (4.9 m)	43 ft (13.1 m)
12 miles (19.3 km)	31 ft (9.5 m)	29 ft (8.8 m)	60 ft (18.3 m)
15 miles (24.1 km)	35 ft (10.7 m)	45 ft (13.7 m)	80 ft (24.4 m)
17 miles (27.4 km)	37 ft (11.3 m)	58 ft (17.7 m)	95 ft (29 m)

Note that to avoid any obstruction along the path, the height of the object must be added to the minimum clearance required for a clear radio line-of-sight. Consider the following simple example, illustrated in the figure below.



A wireless bridge link is deployed to connect building A to a building B, which is located three miles (4.8 km) away. Mid-way between the two buildings is a small tree-covered hill. From the above table it can be seen that for a three-mile link, the object clearance required at the mid-point is 5.3 m (17.4 ft). The tree-tops on the hill are at an elevation of 17 m (56 ft), so the antennas at each end of the link need to be at least 22.3 m (73 ft) high. Building A is six stories high, or 20 m (66 ft), so a 2.3 m (7.5 ft) mast or pole must be contructed on its roof to achieve the required antenna height. Building B is only three stories high, or 9 m (30 ft), but is located at an elevation that is 12 m (39 ft) higher than bulding A. To mount an anntena at the required height on building B, a mast or pole of only 1.3 m (4.3 ft) is needed.

Warning: Never construct a radio mast, pole, or tower near overhead power lines.

Note: Local regulations may limit or prevent construction of a high radio mast or tower. If your wireless bridge link requires a high radio mast or tower, consult a professional contractor for advice.

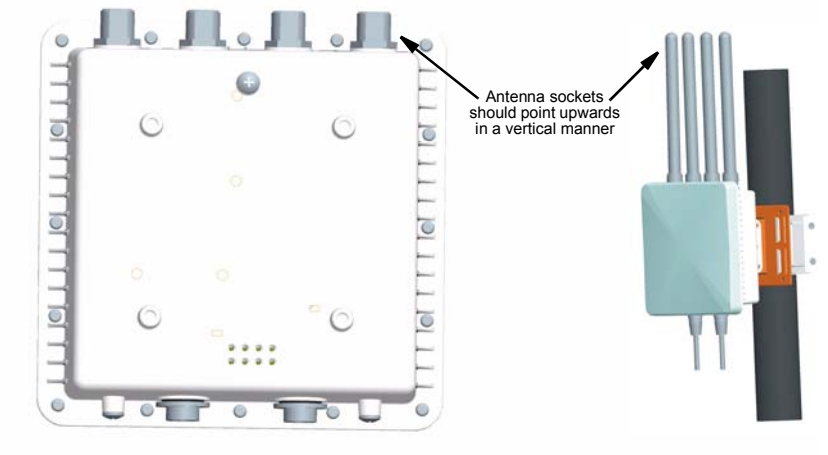
Antenna Position and Orientation

Once the required antenna height has been determined, other factors affecting the precise position of the wireless bridge must be considered:

- Be sure there are no other radio antennas within 2 m (6 ft) of the wireless bridge
- Place the wireless bridge away from power and telephone lines
- Avoid placing the wireless bridge too close to any metallic reflective surfaces, such as roof-installed air-conditioning equipment, tinted windows, wire fences, or water pipes
- The wireless bridge antennas at both ends of the link must be positioned with the same polarization direction, either horizontal or vertical

Antenna Polarization — The wireless bridge's integrated antenna sends a radio signal that is polarized in a particular direction. The antenna's receive sensitivity is also higher for radio signals that have the same polarization. To maximize the performance of the wireless link, both antennas must be set to the same polarization

direction. The unit should be mounted with the antenna sockets facing upwards and both console and POE ports pointing downwards.



Radio Interference

The avoidance of radio interference is an important part of wireless link planning. Interference is caused by other radio transmissions using the same or an adjacent channel frequency. You should first scan your proposed site using a spectrum analyzer to determine if there are any strong radio signals using the 802.11a channel frequencies. Always use a channel frequency that is furthest away from another signal.

If radio interference is still a problem with your wireless bridge link, changing the antenna polarization direction may improve the situation.

Weather Conditions

When planning wireless bridge links, you must take into account any extreme weather conditions that are known to affect your location. Consider these factors:

- **Temperature** — The wireless bridge is tested for normal operation in temperatures from -33°C to 55°C. Operating in temperatures outside of this range may cause the unit to fail.
- **Wind Velocity** — The wireless bridge can operate in winds up to 90 MPH and survive higher wind speeds up to 125 MPH. You must consider the known maximum wind velocity and direction at the site and be sure that any supporting structure, such as a pole, mast, or tower, is built to withstand this force.
- **Lightning** — The wireless bridge includes its own built-in lightning protection. However, you should make sure that the unit, any supporting structure, and cables

are all properly grounded. Additional protection using lightning rods, lightning arrestors, or surge suppressors may also be employed.

- **Rain** — The wireless bridge is weatherproofed against rain. Also, prolonged heavy rain has no significant effect on the radio signal. However, it is recommended to apply weatherproof sealing tape around the Ethernet port and antenna connectors for extra protection. If moisture enters a connector, it may cause a degradation in performance or even a complete failure of the link.
- **Snow and Ice** — Falling snow, like rain, has no significant effect on the radio signal. However, a build up of snow or ice on antennas may cause the link to fail. In this case, the snow or ice has to be cleared from the antennas to restore operation of the link.

Ethernet Cabling

When a suitable antenna location has been determined, you must plan a cable route from the wireless bridge outdoors to the power injector module indoors. Consider these points:

- The Ethernet cable length should never be longer than 100 m (328 ft)
- Determine a building entry point for the cable
- Determine if conduits, bracing, or other structures are required for safety or protection of the cable
- For lightning protection at the power injector end of the cable, consider using a lightning arrestor immediately before the cable enters the building

Grounding

It is important that the wireless bridge, cables, and any supporting structures are properly grounded. The wireless bridge unit includes a grounding screw for attaching a ground wire. Be sure that grounding is available and that it meets local and national electrical codes.

Chapter 4: Hardware Installation

Before mounting antennas to set up your wireless bridge links, be sure you have selected appropriate locations for each antenna. Follow the guidance and information in Chapter 2, “Wireless Link Planning.”

Also, before mounting units in their intended locations, you should first perform initial configuration and test the basic operation of the wireless bridge links in a controlled environment over a very short range. (See the section “Testing Basic Link Operation” in this chapter.)

The wireless bridge includes its own bracket kit for mounting the unit to a 1.5 to 2 inch diameter steel pole or tube. The pole-mounting bracket allows the unit to be mounted to part of a radio mast or tower structure. The unit also has a wall-mounting bracket kit that enables it to be fixed to a building wall or roof when using external antennas.

Hardware installation of the wireless bridge involves these steps:

1. Mount the unit on a wall, pole, mast, or tower using the mounting bracket.
2. Mount external antennas on the same supporting structure as the bridge and connect them to the bridge unit.
3. Connect the Ethernet cable and a grounding wire to the unit.
4. Connect the power injector to the Ethernet cable, a local LAN switch, and an AC power source.
5. Align antennas at both ends of the link.

Testing Basic Link Operation

Set up the units over a very short range (15 to 25 feet), either outdoors or indoors. Connect the units as indicated in this chapter and be sure to perform all the basic configuration tasks outlined in Chapter 4, “Initial Configuration.” When you are satisfied that the links are operating correctly, proceed to mount the units in their intended locations.

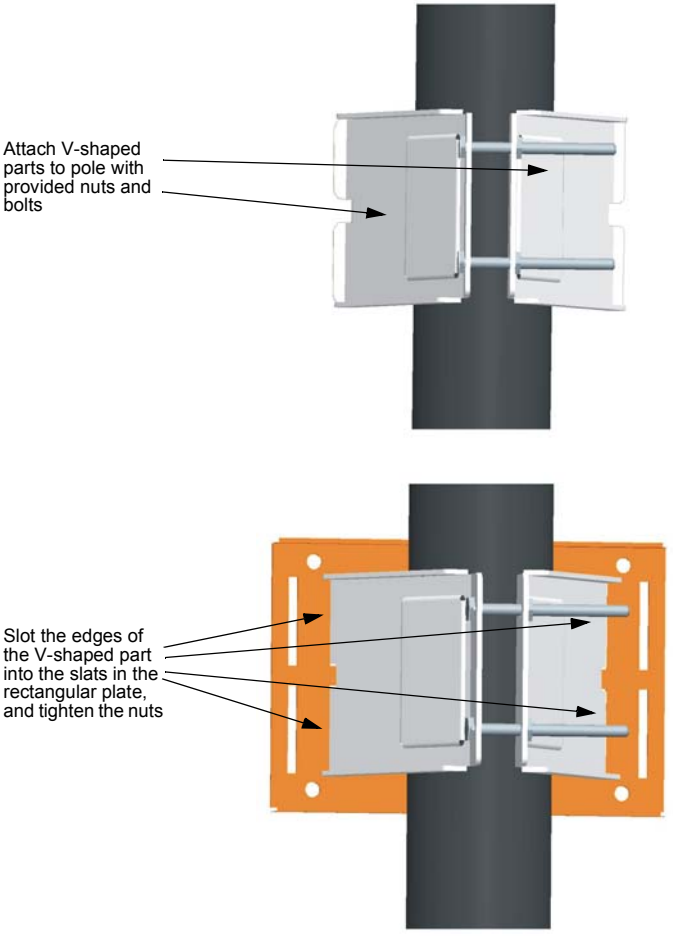
Mount the Unit

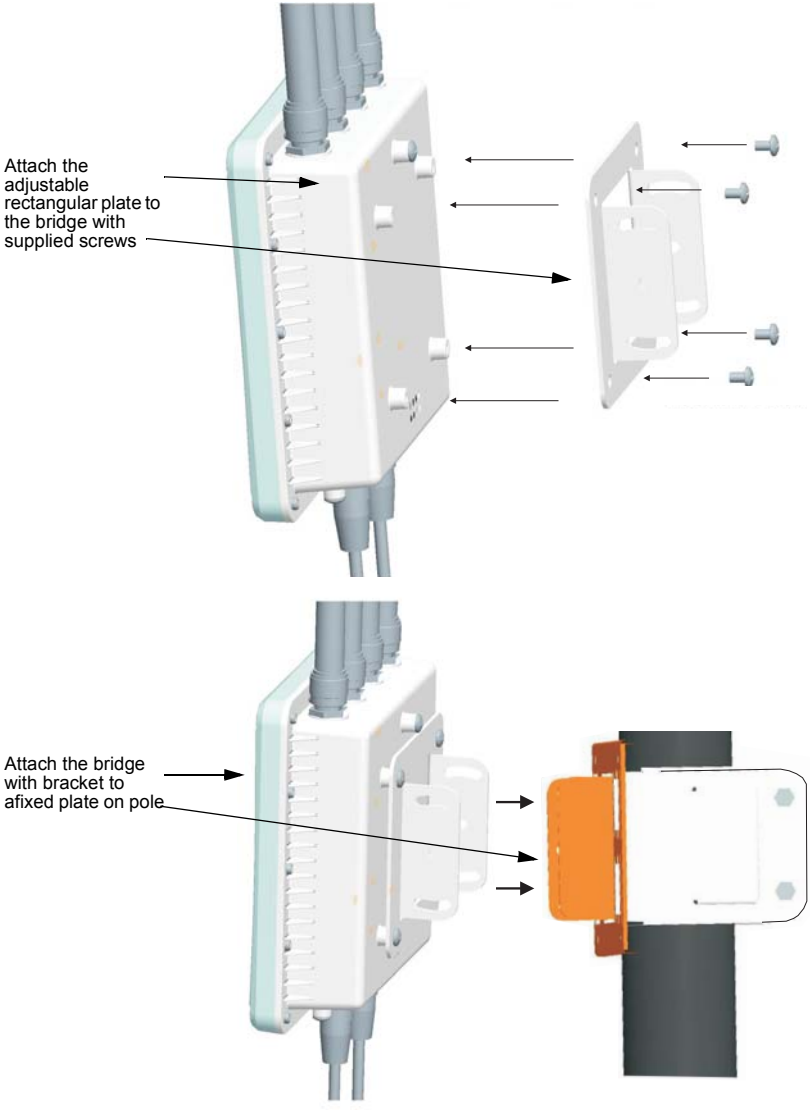
Using the Pole-Mounting Bracket

Perform the following steps to mount the unit to a 1.5 to 2 inch diameter steel pole or tube using the mounting bracket:

1. Always attach the bracket to a pole with the open end of the mounting grooves facing up.

2. Place the V-shaped part of the bracket around the pole and tighten the securing nuts just enough to hold the bracket to the pole. (The bracket may need to be rotated around the pole during the alignment process.)





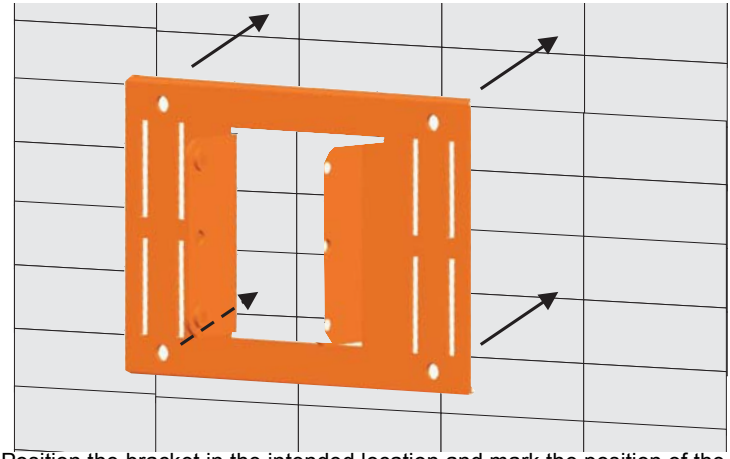
3. Use the included nuts to tightly secure the wireless bridge to the bracket. Be sure to take account of the antenna polarization direction; all antennas in a link must be mounted with the same polarization.

Using the Wall-Mounting Bracket

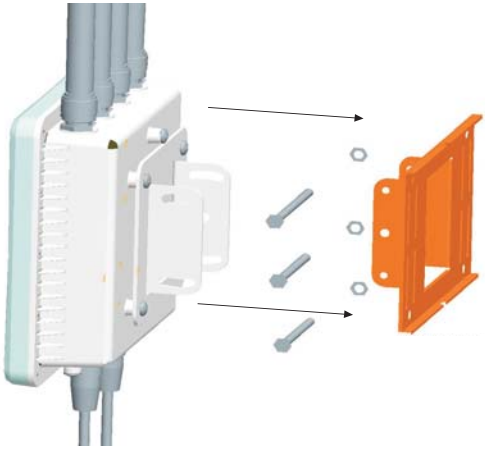
Perform the following steps to mount the unit to a wall using the wall-mounting bracket:

Note: The wall-mounting bracket does not allow the wireless bridge's intrgrated antenna to be aligned. It is intended for use with the unit using an external antenna.

1. Always attach the bracket to a wall with flat side flush against the wall (see following figure).



2. Position the bracket in the intended location and mark the position of the three mounting screw holes.
3. Drill three holes in the wall that match the screws and wall plugs included in the bracket kit, then secure the bracket to the wall.
4. Use the included nuts to tightly secure the wireless bridge to the bracket.

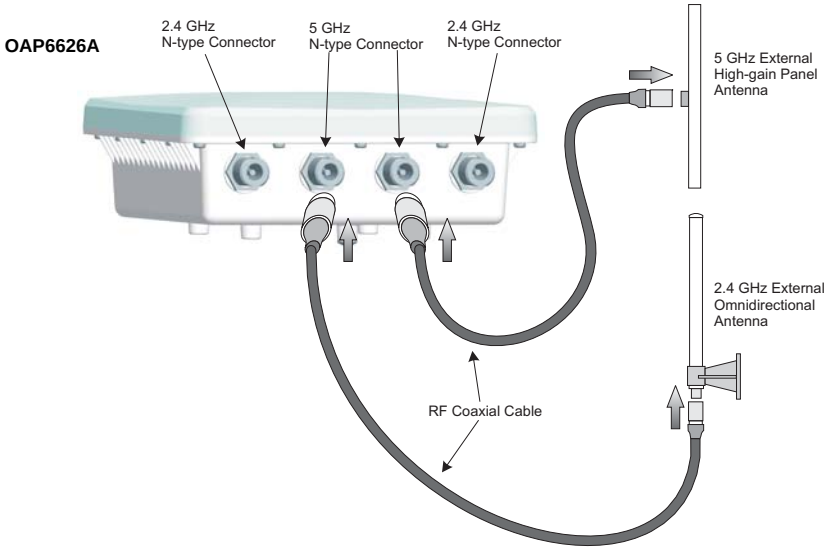


Connect External Antennas

When deploying a OAP6626AM Master bridge unit for a bridge link or access point operation, you need to mount external antennas and connect them to the bridge. Typically, a bridge link requires a 5 GHz antenna, and access point operation a 2.4 GHz antenna. OAP6626A Slave units also require an external antenna for 2.4 GHz operation.

Perform these steps:

1. Mount the external antenna to the same supporting structure as the bridge, within 3 m (10 ft) distance, using the bracket supplied in the antenna package.
2. Connect the antenna to the bridge's N-type connector using the RF coaxial cable provided in the antenna package.
3. Apply weatherproofing tape to the antenna connectors to help prevent water entering the connectors.



Connect Cables to the Unit

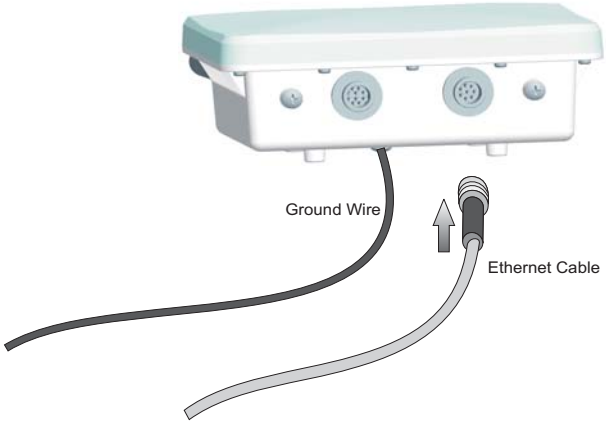
1. Attach the Ethernet cable to the Ethernet port on the wireless bridge.

Note: The Ethernet cable included with the package is 30 m (100 ft) long. To wire a longer cable (maximum 100 m, 325 ft), use the connector pinout information in Appendix B.

2. For extra protection against rain or moisture, apply weatherproofing tape (not included) around the Ethernet connector.

3. Be sure to ground the unit with an appropriate grounding wire (not included) by attaching it to the grounding screw on the unit.

Caution: Be sure that grounding is available and that it meets local and national electrical codes. For additional lightning protection, use lightning rods, lightning arrestors, or surge suppressors.



Connect the Power Injector

To connect the wireless bridge to a power source:

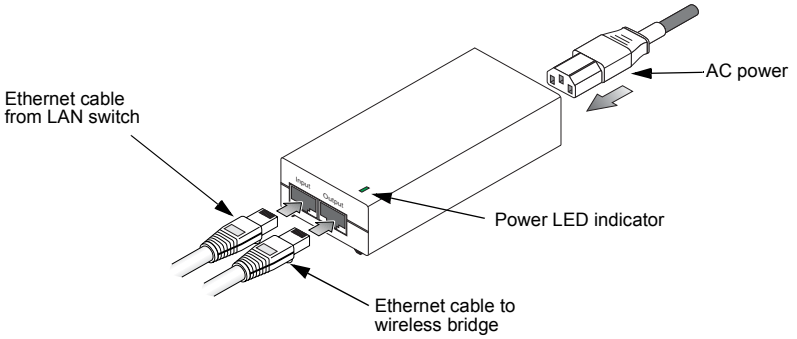
Caution: Do not install the power injector outdoors. The unit is for indoor installation only.

Note: The wireless bridge's Ethernet port does not support Power over Ethernet (PoE) based on the IEEE 802.3af standard. Do not try to power the unit by connecting it directly to a network switch that provides IEEE 802.3af PoE. Always connect the unit to the included power injector module.

1. Connect the Ethernet cable from the wireless bridge to the RJ-45 port labeled "Output" on the power injector.

2. Connect a straight-through unshielded twisted-pair (UTP) cable from a local LAN switch to the RJ-45 port labeled "Input" on the power injector. Use Category 5 or better UTP cable for 10/100BASE-TX connections.

Note: The RJ-45 port on the power injector is an MDI port. If connecting directly to a computer for testing the link, use a crossover cable.



3. Insert the power cable plug directly into the standard AC receptacle on the power injector.

4. Plug the other end of the power cable into a grounded, 3-pin socket, AC power source.

Note: For International use, you may need to change the AC line cord. You must use a line cord set that has been approved for the receptacle type in your country.

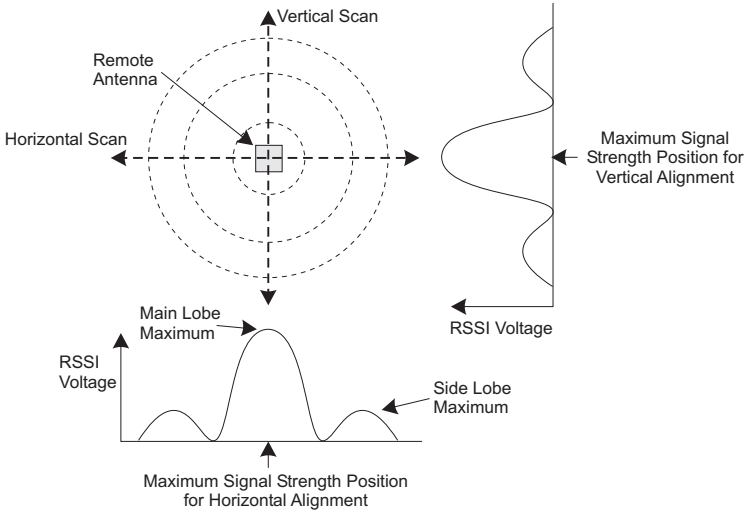
5. Check the LED on top of the power injector to be sure that power is being supplied to the wireless bridge through the Ethernet connection.

Align Antennas

After wireless bridge units have been mounted, connected, and their radios are operating, the antennas must be accurately aligned to ensure optimum performance on the bridge links. This alignment process is particularly important for long-range point-to-point links. In a point-to-multipoint configuration the Master bridge uses an omnidirectional or sector antenna, which does not require alignment, but Slave bridges still need to be correctly aligned with the Master bridge antennna.

- **Point-to-Point Configurations** – In a point-to-point configuration, the alignment process requires two people at each end of the link. The use of cell phones or two-way radio communication may help with coordination. To start, you can just point the antennas at each other, using binoculars or a compass to set the general direction. For accurate alignment, you must connect a DC voltmeter to the RSSI connector on the wireless bridge and monitor the voltage as the antenna moves horizontally and vertically.
- **Point-to-Multipoint Configurations** – In a point-to-multipoint configuration all Slave bridges must be aligned with the Master bridge antenna. The alignment process is the same as in point-to-point links, but only the Slave end of the link requires the alignment.

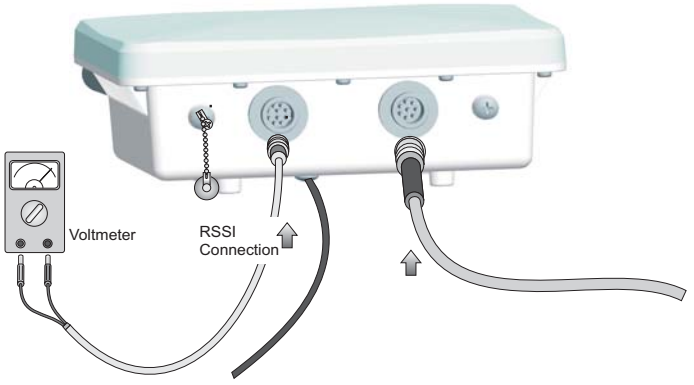
The RSSI connector provides an output voltage between 0 and 3.28 VDC that is proportional to the received radio signal strength. The higher the voltage reading, the stronger the signal. The radio signal from the remote antenna can be seen to have a strong central main lobe and smaller side lobes. The object of the alignment process is to set the antenna so that it is receiving the strongest signal from the central main lobe.



To align the antennas in the link using the RSSI output voltage, start with one antenna fixed and then perform the following procedure on the other antenna:

Note: The RSSI output can be configured through management interfaces to output a value for specific WDS ports.

1. Remove the RSSI connector cover and connect a voltmeter using a cable with a male BNC connector (not included).



2. Pan the antenna horizontally back and forth while checking the RSSI voltage. If using the pole-mounting bracket with the unit, you must rotate the mounting bracket around the pole. Other external antenna brackets may require a different horizontal adjustment.

3. Find the point where the signal is strongest (highest voltage) and secure the horizontal adjustment in that position.

Note: Sometimes there may not be a central lobe peak in the voltage because vertical alignment is too far off; only two similar peaks for the side lobes are detected. In this case, fix the antenna so that it is halfway between the two peaks.

4. Loosen the vertical adjustment on the mounting bracket and tilt the antenna slowly up and down while checking the RSSI voltage.

5. Find the point where the signal is strongest and secure the vertical adjustment in that position.

6. Remove the voltmeter cable and replace the RSSI connector cover.

Appendix A: Troubleshooting

Check the following items before you contact local Technical Support.

1. If wireless bridge units do not associate with each other, check the following:
   - Check the power injector LED for each bridge unit to be sure that power is being supplied
   - Be sure that antennas in the link are properly aligned.
   - Be sure that channel settings match on all bridges
   - If encryption is enabled, ensure that all bridge links are configured with the same encryption keys.
2. If you experience poor performance (high packet loss rate) over the wireless bridge link:
   - Check that the range of the link is within the limits for the antennas used.
   - Be sure that antennas in the link are properly aligned.
   - Check that there is an unobstructed radio line-of-sight between the antennas.
   - Be sure there is no interference from other radio sources. Try setting the bridge link to another radio channel.
   - Be sure there is no other radio transmitter too close to either antenna. If necessary, move the antennas to another location.
3. If the wireless bridge cannot be configured using Telnet, a web browser, or SNMP software:
   - Be sure to have configured the wireless bridge with a valid IP address, subnet mask and default gateway.
   - Check that you have a valid network connection to the wireless bridge and that the Ethernet port or the wireless interface has not been disabled.
   - If you are connecting to the wireless bridge through the wired Ethernet interface, check the network cabling between the management station and the wireless bridge.
   - If you cannot connect using Telnet, you may have exceeded the maximum number of concurrent Telnet sessions permitted (i.e, four sessions). Try connecting again at a later time.
4. If all other recovery measures fail, and the wireless bridge is still not functioning properly, take any of these steps:
   - Reset the wireless bridge's hardware using the CLI, web interface, or through a power reset.
   - Reset the wireless bridge to its default configuration.

5. If you forgot or lost the password:
   - Contact Technical Support.

Appendix B: Specifications

General Specifications

Maximum Channels (Outdoor)

802.11a:
- US & Canada: 9 (normal mode), 3 (turbo mode)
- Japan: 4 (normal mode), 1 (turbo mode)
- ETSI: 11 channels (normal mode), 4 (turbo mode)
- Taiwan: 4 (normal mode), 1 (turbo mode)

802.11g:
- FCC/IC: 1-11
- ETSI: 1-13
- France: 1-7
- MKK: 1-14
- Taiwan: 1-11

Data Rates

802.11a:
- Normal Mode: 6, 9, 12, 18, 24, 36, 48, 54 Mbps per channel
- Turbo Mode: 12, 18, 24, 36, 48, 72, 96, 108 Mbps per channel

802.11g:
- 6, 9, 11, 12, 18, 24, 36, 48, 54 Mbps per channel

802.11b:
- 1, 2, 5.5, 11 Mbps per channel

Maximum Clients

64 for the radio interface set to access point mode

Modulation Types

802.11a: BPSK, QPSK, 16-QAM, 64-QAM
802.11g: CCK, BPSK, QPSK, OFDM
802.11b: CCK, BPSK, QPSK

Network Configuration

Bridge Mode:
- Point-to-point and point-to-multipoint

Access Point Mode:
- Infrastructure

Operating Frequency
802.11a:
5.15 ~ 5.25 GHz (lower band) US/Canada
5.25 ~ 5.35 GHz (middle band) US/Canada
5.725 ~ 5.825 GHz (upper band) US/Canada
5.25 ~ 5.35 GHz (middle band) Taiwan
5.725 ~ 5.825 GHz (high band) Taiwan
802.11b/g:
2.4 ~ 2.4835 GHz (US, Canada, ETSI)
2.4 ~ 2.497 GHz (Japan)
2.400 ~ 2.4835 GHz (Taiwan)

Power Injector
Input: 100-240 VAC, 47-63 Hz, 1.5 A
Output: 48 VDC, 1.2 A

Bridge Power (DC)
Input voltage: 48 volts, 1.2 A, 30 watts maximum

Physical Size
19.8 x 19.8 x 6.33 cm (7.8 x 7.8 x 2.49 in)

Weight
4.8 kg (10.58 lbs)

Network Management
Web-browser, Telnet, SNMP

Temperature
Operating: -33 to 55 °C (-27.4 to 131 °F)
Storage: -40 to 80 °C (-40 to 176 °F)

Humidity
5% to 95% (non-condensing)

EMC Compliance (Class B)
FCC Class B (US)
RTTED 1999/5/EC
DGT (Taiwan)

Radio Signal Certification
FCC Part 15 15.407(b) (5 GHz)
FCC Part 15.247 (2.4 GHz)
EN 300.328, EN 302.893
EN 300 826, EN 301.489-1, EN 301.489-17
ETSI 300.328; ETS 300 826 (802.11b)

Safety
CSA/NTRL (CSA 22.2 No. 950 & UL 1950)

Standards
IEEE 802.3 10BASE-T, IEEE 802.3u 100BASE-TX,
IEEE 802.11a, b, g

Antenna Specifications

17 dBi Integrated Panel

Frequency Range
5.150 - 5.850 GHz

Gain
17 dBi

VSWR
1.8 : 1 max

Polarization
Linear, vertical/horizontal

HPBW
Horizontal: 20°
Vertical: 22°

Front-to-Back Ratio
>25 dB

Power Handling
10 W (cw)

Impedance
50 Ohms

Connector
SMA female

17 dBi Integrated Panel Antenna Link Budget (5.825 GHz, Cable Loss 1 dB, Fade Margin 5 dB)			
Modulation/Rates	Transmit Power (dBm)	Receive Sensitivity (dBm)	Maximum Range (km) with 17 dBi Panel*
Normal Mode			
BPSK (6 Mbps)	20	-88	15.4
BPSK (9 Mbps)	20	-87	14.7
QPSK (12 Mbps)	20	-86	14.0
QPSK (18 Mbps)	20	-84	12.8
16 QAM (24 Mbps)	20	-81	11.1
16 QAM (36 Mbps)	20	-76	6.5
64 QAM (48 Mbps)	18	-71	2.9
64 QAM (54 Mbps)	17	-68	1.8
Turbo Mode			
BPSK (12 Mbps)	20	-85	13.4
BPSK (18 Mbps)	20	-84	12.8
QPSK (24 Mbps)	20	-83	12.2
QPSK (36 Mbps)	20	-81	11.1
16 QAM (48 Mbps)	20	-78	8.2
16 QAM (72 Mbps)	20	-73	4.6
64 QAM (96 Mbps)	18	-68	2.1
64 QAM (108 Mbps)	17	-65	1.3

* The maximum range calculated with a 17 dBi panel antenna at the far end of the link. The maximum transmit power (hence range) may be lowered by regulatory (FCC etc) EIRP (effective isotropic radiated power) limits.

8 dBi Omnidirectional (2.4 GHz)

Model Number
R0205-135

Frequency Range
2.400 - 2.500 GHz

Gain
8 dBi

VSWR
2.0 : 1 max

Polarization
Linear, vertical

HPBW
Horizontal: 360°
Vertical: 15°

Downtilt
0°

Power Handling
50 W (cw)

Impedance
50 Ohms

Connector
N type, male

Radome
Material: Fiber glass
Color: Gray-white

Environmental
Survival Wind Speed: 216 km/hr
Temperature: -40 °C to 80 °C
Humidity: 95% @ 25 °C

Mechanical
Dimensions: 46 x 1.9 cm (diameter) (18.11 x 0.75 in)
Weight: 200 g (0.44 lbs)

8 dBi Omnidirectional Antenna Link Budget (2.483 GHz, Cable Loss 0 dB, Fade Margin 3 dB)			
Modulation/Rates	Transmit Power (dBm)	Receive Sensitivity (dBm)	Maximum Range (km) with 2 dBi NIC
BPSK (6 Mbps)	20	-88	7.641
BPSK (9 Mbps)	20	-87	6.810
QPSK (12 Mbps)	20	-86	6.070
QPSK (18 Mbps)	20	-84	4.821
16 QAM (24 Mbps)	20	-81	3.413
16 QAM (36 Mbps)	20	-76	2.154
64 QAM (48 Mbps)	19	-71	1.079
64 QAM (54 Mbps)	18	-68	0.541

* The maximum range calculated with a 2 dBi NIC antenna at the far end of the link.
The maximum transmit power (hence range) may be lowered by regulatory (FCC etc) EIRP (effective isotropic radiated power) limits.

8 dBi Omnidirectional (5 GHz)

Model Number
MTI 09038

Frequency range
5.725 - 5.875 GHz

Gain
8 dBi

VSWR
2.0 : 1 max

Polarization
Linear, vertical

HPBW
Horizontal: 360°
Vertical: 12°

Downtilt
0°

Power Handling
5 W (cw)

Impedance
50 Ohms

Connector
N type, female

Radome
Material: Fiber glass
Color: Gray-white

Environmental
Survival Wind Speed: 216 km/hr
Temperature: -40 °C to 80 °C
Humidity: 95% @ 25 °C

Mechanical
Dimensions: 7 x 8 x 37.3 cm (2.76 x 3.15 x 14.69 in)
Weight: 245 g (0.54 lbs)

8 dBi Omnidirectional Antenna Link Budget (5.825 GHz, Cable Loss 0 dB, Fade Margin 3 dB)			
Modulation/Rates	Transmit Power (dBm)	Receive Sensitivity (dBm)	Maximum Range (km) with 2 dBi NIC
Normal Mode			
BPSK (6 Mbps)	20	-88	3.3
BPSK (9 Mbps)	20	-87	2.9
QPSK (12 Mbps)	20	-86	2.6
QPSK (18 Mbps)	20	-84	2.1
16 QAM (24 Mbps)	20	-81	1.5
16 QAM (36 Mbps)	20	-76	0.8
64 QAM (48 Mbps)	18	-71	0.4
64 QAM (54 Mbps)	17	-68	0.2
Turbo Mode			
BPSK (12 Mbps)	20	-85	2.3
BPSK (18 Mbps)	20	-84	2.1
QPSK (24 Mbps)	20	-83	1.8
QPSK (36 Mbps)	20	-81	1.5
16 QAM (48 Mbps)	20	-78	1.0
16 QAM (72 Mbps)	20	-73	0.6
64 QAM (96 Mbps)	18	-68	0.3
64 QAM (108 Mbps)	17	-65	0.2

* The maximum range calculated with a 2 dBi NIC antenna at the far end of the link.
The maximum transmit power (hence range) may be lowered by regulatory (FCC etc) EIRP (effective isotropic radiated power) limits.

13.5 dBi 120-Degree Sector

Model Number
R0320-099

Frequency range
5.150 - 5.875 GHz

Gain
13.5 dBi

VSWR
2.0 : 1 max

Polarization
Linear, vertical

HPBW
Horizontal: 120°
Vertical: 6°

Downtilt
0°

Power Handling
5 W (cw)

Impedance
50 Ohms

Connector
N type, female

Radome
Material: ABS
Color: Gray, white

Environmental
Survival Wind Speed: 216 km/hr
Temperature: -40 °C to 80 °C
Humidity: 95% @ 25 °C

Mechanical
Dimensions: 62 x 8.8 x 7 cm (24.4 x 3.46 x 2.76 in)
Weight: 590 g (1.3 lbs)

13.5 dBi 120-Degree Sector Antenna Link Budget (5.825 GHz, Cable Loss 1 dB, Fade Margin 5 dB)			
Modulation/Rates	Transmit Power (dBm)	Receive Sensitivity (dBm)	Maximum Range (km) with 13.5 dBi Sector
Normal Mode			
BPSK (6 Mbps)	20	-88	10.3
BPSK (9 Mbps)	20	-87	9.2
QPSK (12 Mbps)	20	-86	8.2
QPSK (18 Mbps)	20	-84	6.5
16 QAM (24 Mbps)	20	-81	4.6
16 QAM (36 Mbps)	20	-76	2.6
64 QAM (48 Mbps)	18	-71	1.2
64 QAM (54 Mbps)	17	-68	0.7
Turbo Mode			
BPSK (12 Mbps)	20	-85	7.3
BPSK (18 Mbps)	20	-84	6.5

13.5 dBi 120-Degree Sector Antenna Link Budget (5.825 GHz, Cable Loss 1 dB, Fade Margin 5 dB)			
Modulation/Rates	Transmit Power (dBm)	Receive Sensitivity (dBm)	Maximum Range (km) with 13.5 dBi Sector
QPSK (24 Mbps)	20	-83	5.8
QPSK (36 Mbps)	20	-81	4.6
16 QAM (48 Mbps)	20	-78	3.3
16 QAM (72 Mbps)	20	-73	1.8
64 QAM (96 Mbps)	18	-68	0.8
64 QAM (108 Mbps)	17	-65	0.5

* The maximum range calculated with a 13.5 dBi sector antenna at the far end of the link. The maximum transmit power (hence range) may be lowered by regulatory (FCC etc) EIRP (effective isotropic radiated power) limits.

16.5 dBi 60-Degree Sector

Model Number
R0320-100

Frequency range
5.150 - 5.875 GHz

Gain
16.5 dBi

VSWR
2.0 : 1 max

Polarization
Linear, vertical

HPBW
Horizontal: 60°
Vertical: 6°

Downtilt
0°

Power Handling
5 W (cw)

Impedance
50 Ohms

Connector
N type, female

Radome
Material: ABS
Color: Gray, white

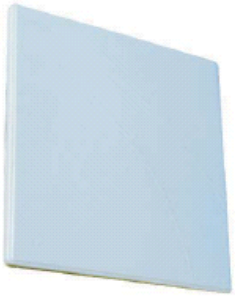
Environmental
Survival Wind Speed: 216 km/hr
Temperature: -40 °C to 80 °C
Humidity: 95% @ 25 °C

Mechanical
Dimensions: 62 x 8.8 x 7 cm (24.41 x 3.46 x 2.76 in)
Weight: 565 g (1.25 lbs)

16.5 dBi 60-Degree Sector Antenna Link Budget (5.825 GHz, Cable Loss 1 dB, Fade Margin 5 dB)			
Modulation/Rates	Transmit Power (dBm)	Receive Sensitivity (dBm)	Maximum Range (km) with 16.5 dBi Sector
Normal Mode			
BPSK (6 Mbps)	20	-88	14.0
BPSK (9 Mbps)	20	-87	13.4
QPSK (12 Mbps)	20	-86	12.8
QPSK (18 Mbps)	20	-84	11.7
16 QAM (24 Mbps)	20	-81	9.2
16 QAM (36 Mbps)	20	-76	5.2
64 QAM (48 Mbps)	18	-71	2.3
64 QAM (54 Mbps)	17	-68	1.5
Turbo Mode			
BPSK (12 Mbps)	20	-85	12.2
BPSK (18 Mbps)	20	-84	11.7
QPSK (24 Mbps)	20	-83	11.1
QPSK (36 Mbps)	20	-81	9.2
16 QAM (48 Mbps)	20	-81	6.5
16 QAM (72 Mbps)	20	-78	3.7
64 QAM (96 Mbps)	18	-73	1.6
64 QAM (108 Mbps)	17	-68	1.0

* The maximum range calculated with a 16.5 dBi sector antenna at the far end of the link.
The maximum transmit power (hence range) may be lowered by regulatory (FCC etc) EIRP (effective isotropic radiated power) limits.

23 dBi High-Gain Panel



Model Number
MTI 09009

Frequency range
5.725 - 5.875 GHz

Gain
23 dBi

VSWR
1.5 : 1 max

Polarization
Linear, vertical/horizontal

HPBW
Horizontal: 9°
Vertical: 9°

Front-to-Back Ratio
40 dB

Cross Polarization
25 dB

Power Handling
20 W (cw)

Impedance
50 Ohms

Connector
N type, female

Radome
Material: ABS, UV resistant
Color: White

Environmental
Survival Wind Speed: 216 km/hr
Temperature: -40 °C to 80 °C
Humidity: 95% @ 25 °C

Mechanical
Dimensions: 36 x 36 x 1.6 cm (14.17 x 14.17 x 0.63 in)
Weight: 1600 g (3.53 lbs)

23 dBi Panel Antenna Link Budget (5.825 GHz, Cable Loss 1 dB, Fade Margin 5 dB)			
Modulation/Rates	Transmit Power (dBm)	Receive Sensitivity (dBm)	Maximum Range (km) with 23 dBi Panel
Normal Mode			
BPSK (6 Mbps)	20	-88	24.4
BPSK (9 Mbps)	20	-87	23.3
QPSK (12 Mbps)	20	-86	22.2
QPSK (18 Mbps)	20	-84	20.3
16 QAM (24 Mbps)	20	-81	17.7
16 QAM (36 Mbps)	20	-76	14.0
64 QAM (48 Mbps)	18	-71	9.2
64 QAM (54 Mbps)	17	-68	5.8
Turbo Mode			
BPSK (12 Mbps)	20	-85	21.2
BPSK (18 Mbps)	20	-84	20.3
QPSK (24 Mbps)	20	-83	19.4
QPSK (36 Mbps)	20	-81	17.7
16 QAM (48 Mbps)	20	-78	15.4
16 QAM (72 Mbps)	20	-73	12.2
64 QAM (96 Mbps)	18	-68	6.5
64 QAM (108 Mbps)	17	-65	4.1

* The maximum range calculated with a 23 dBi panel antenna at the far end of the link.
The maximum transmit power (hence range) may be lowered by regulatory (FCC etc) EIRP (effective isotropic radiated power) limits.

Appendix C: Cables and Pinouts

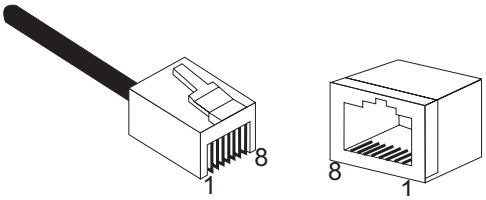
Twisted-Pair Cable Assignments

For 10/100BASE-TX connections, a twisted-pair cable must have two pairs of wires. Each wire pair is identified by two different colors. For example, one wire might be green and the other, green with white stripes. Also, an RJ-45 connector must be attached to both ends of the cable.

Caution: Each wire pair must be attached to the RJ-45 connectors in a specific orientation.

Caution: DO NOT plug a phone jack connector into a power injector RJ-45 port. Use only twisted-pair cables with RJ-45 connectors that conform with FCC standards.

The following figure illustrates how the pins on the RJ-45 connector are numbered. Be sure to hold the connectors in the same orientation when attaching the wires to the pins.



10/100BASE-TX Pin Assignments

Use unshielded twisted-pair (UTP) or shielded twisted-pair (STP) cable for RJ-45 connections: 100-ohm Category 3 or better cable for 10 Mbps connections, or 100-ohm Category 5 or better cable for 100 Mbps connections. Also be sure that the length of any twisted-pair connection does not exceed 100 meters (328 feet).

The RJ-45 Input port on the power injector is wired with MDI pinouts. This means that you must use crossover cables for connections to PCs or servers, and straight-through cable for connections to switches or hubs. However, when connecting to devices that support automatic MDI/MDI-X pinout configuration, you can use either straight-through or crossover cable.

10/100BASE-TX MDI and MDI-X Port Pinouts		
Pin	MDI-X Signal Name	MDI Signal Name
1	Receive Data plus (RD+)	Transmit Data plus (TD+)
2	Receive Data minus (RD-)	Transmit Data minus (TD-)
3	Transmit Data plus (TD+)	Receive Data plus (RD+)
6	Transmit Data minus (TD-)	Receive Data minus (RD-)
4,5,7,8	Not used	Not used

Note: The “+” and “-” signs represent the polarity of the wires that make up each wire pair.

Straight-Through Wiring

Because the 10/100 Mbps Input port on the power injector uses an MDI pin configuration, you must use “straight-through” cable for network connections to hubs or switches that only have MDI-X ports. However, if the device to which you are connecting supports automatic MDI/MDI-X operation, you can use either “straight-through” or “crossover” cable.

EIA/TIA 568B RJ-45 Wiring Standard
10/100BASE-TX Straight-through Cable

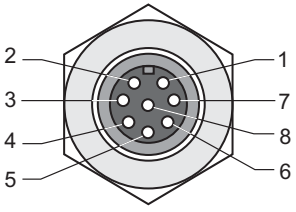
Crossover Wiring

Because the 10/100 Mbps port on the power injector uses an MDI pin configuration, you must use “crossover” cable for network connections to PCs, servers or other end nodes that only have MDI ports. However, if the device to which you are connecting supports automatic MDI/MDI-X operation, you can use either “straight-through” or “crossover” cable.

EIA/TIA 568B RJ-45 Wiring Standard
10/100BASE-TX Crossover Cable

8-Pin DIN Connector Pinout

The Ethernet cable from the power injector connects to an 8-pin DIN connector on the wireless bridge. This connector is described in the following figure and table.



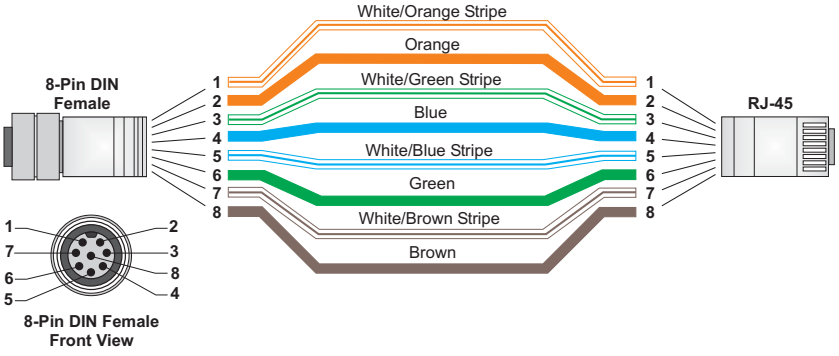
8-Pin DIN Ethernet Port Pinout	
Pin	Signal Name
1	Transmit Data plus (TD+)
2	Transmit Data minus (TD-)
3	Receive Data plus (RD+)
4	+48 VDC power
5	+48 VDC power
6	Receive Data minus (RD-)
7	Return power
8	Return power

Note: The “+” and “-” signs represent the polarity of the wires that make up each wire pair.

8-Pin DIN to RJ-45 Cable Wiring

To construct an extended Ethernet cable to connect from the power injector's RJ-45 Output port to the wireless bridge's 8-pin DIN connector, follow the wiring diagram below. Use Category 5 or better UTP or STP cable, maximum length 100 m (328 ft), and be sure to connect all four wire pairs.

Note: To construct a reliable Ethernet cable, always use the proper tools or ask a professional cable supplier to construct the cable.



Glossary

10BASE-T

IEEE 802.3 specification for 10 Mbps Ethernet over two pairs of Category 3 or better UTP cable.

100BASE-TX

IEEE 802.3u specification for 100 Mbps Fast Ethernet over two pairs of Category 5 or better UTP cable.

Access Point

An internetworking device that seamlessly connects wired and wireless networks. Access points attached to a wired network, support the creation of multiple radio cells that enable roaming throughout a facility.

Advanced Encryption Standard (AES)

An encryption algorithm that implements symmetric key cryptography. AES provides very strong encryption using a completely different ciphering algorithm to TKIP and WEP.

Authentication

The process to verify the identity of a client requesting network access. IEEE 802.11 specifies two forms of authentication: open system and shared key.

Backbone

The core infrastructure of a network. The portion of the network that transports information from one central location to another central location where it is unloaded onto a local system.

Basic Service Set (BSS)

A set of 802.11-compliant stations and an access point that operate as a fully-connected wireless network.

Beacon

A signal periodically transmitted from the access point that is used to identify the service set, and to maintain contact with wireless clients.

CSMA/CA

Carrier Sense Multiple Access with Collision Avoidance.

dBm

The unit dBm refers to a precise measure of power based upon the decibel scale, but referenced to the milliwatt: i.e. 1 dBm = .001 Watt. The dBm is often used to describe absolute power level where the point of reference is 1 milliwatt.

Dynamic Host Configuration Protocol (DHCP)

Provides a framework for passing configuration information to hosts on a TCP/IP network. DHCP is based on the Bootstrap Protocol (BOOTP), adding the capability of automatic allocation of reusable network addresses and additional configuration options.

Encryption

Data passing between the access point and clients can use encryption to protect from interception and evesdropping.

Ethernet

A popular local area data communications network, which accepts transmission from computers and terminals.

File Transfer Protocol (FTP)

A TCP/IP protocol used for file transfer.

Hypertext Transfer Protocol (HTTP)

HTTP is a standard used to transmit and receive all data over the World Wide Web.

IEEE 802.11a

A wireless standard that supports high-speed communications in the 5 GHz band using Orthogonal Frequency Division Multiplexing (OFDM). The standard supports data rates of 6, 12, 24, and 54 Mbps.

Local Area Network (LAN)

A group of interconnected computer and support devices.

MAC Address

The physical layer address used to uniquely identify network nodes.

Network Time Protocol (NTP)

NTP provides the mechanisms to synchronize time across the network. The time servers operate in a hierarchical-master-slave configuration in order to synchronize local clocks within the subnet and to national time standards via wire or radio.

Open System

A security option which broadcasts a beacon signal including the access point's configured SSID. Wireless clients can read the SSID from the beacon, and

automatically reset their SSID to allow immediate connection to the nearest access point.

Orthogonal Frequency Division Multiplexing (ODFM)

OFDM/ allows multiple users to transmit in an allocated band by dividing the bandwidth into many narrow bandwidth carriers.

RTS Threshold

Transmitters contending for the medium may not be aware of each other. RTS/CTS mechanism can solve this “Hidden Node Problem.” If the packet size is smaller than the preset RTS Threshold size, the RTS/CTS mechanism will NOT be enabled.

Service Set Identifier (SSID)

An identifier that is attached to packets sent over the wireless LAN and functions as a password for joining a particular radio cell; i.e., Basic Service Set (BSS).

Session Key

Session keys are unique to each client, and are used to authenticate a client connection, and correlate traffic passing between a specific client and the access point.

Shared Key

A shared key can be used to authenticate each client attached to a wireless network. Shared Key authentication must be used along with the 802.11 Wireless Equivalent Privacy algorithm.

Simple Network Management Protocol (SNMP)

The application protocol in the Internet suite of protocols which offers network management services.

Simple Network Time Protocol (SNTP)

SNTP allows a device to set its internal clock based on periodic updates from a Network Time Protocol (NTP) server. Updates can be requested from a specific NTP server, or can be received via broadcasts sent by NTP servers.

Trivial File Transfer Protocol (TFTP)

A TCP/IP protocol commonly used for software downloads.

Wired Equivalent Privacy (WEP)

WEP is based on the use of security keys and the popular RC4 encryption algorithm. Wireless devices without a valid WEP key will be excluded from network traffic.

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