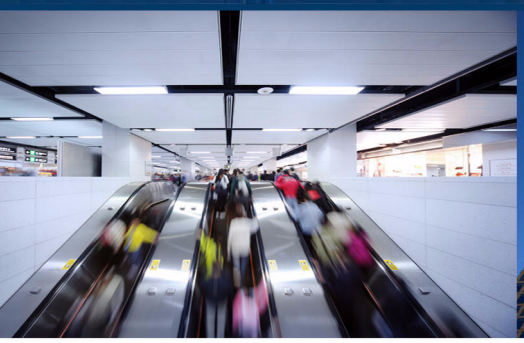
Tsunami® 800 and 8000 Series (Point-to-point and Point-to-multipoint Products)

Antenna Installation Guide

Products Covered

--> Tsunami® Multipoint
- MP-820-BSU-100
  - MP-820-SUA-50+
- MP-8100-BSU and MP-8200-BSU
  - MP-8100-SUA
  - MP-8200-SUA
- MP-8160-BSU
  - MP-8160-SUA

--> Tsunami Quickbridge®
- QB-8100-EPA
- QB-8100-LNK
- QB-8200-EPA
- QB-8200-LNK



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Tsunami® 800 and 8000 Series - Antenna Installation Guide

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Preface

This chapter contains information on the following:

About this Guide

The guide gives an insight on how to set up and install the outdoor antenna(s) for the Tsunami® 800 and 8000 series products that are tabulated below:

Product(s)	Description
MP-820-BSU-100	The MP-820 Base Station unit, is a flexible wireless outdoor product that operates in 5.150 – 5.925 GHz frequency band. This connectorized device comes with 2x2 MIMO radio and two N-Type connectors to connect external antennas. It provides an aggregate throughput of 100 Mbps.
MP-820-SUA-50+	The MP-820 Subscriber unit, is a flexible wireless outdoor product that operates in 5.150 to 5.925 GHz frequency band. This connectorized device comes with a 2x2 MIMO radio and two N-Type connectors to connect external antennas. It provides an aggregate throughput of 50 Mbps, license upgradable to 100 Mbps.
MP-8100-BSU	The Tsunami MP-8100 Base Station unit, is a flexible wireless outdoor product that operates in 2.3 – 2.5 and 4.9 – 6.0 GHz frequency band. This connectorized device comes with a 3x3 MIMO radio and three N-Type connectors to connect external antennas.
MP-8100-SUA	The Tsunami MP-8100 Subscriber unit, is a flexible wireless outdoor product that operates in 2.3 – 2.5 and 4.9 – 6.0 GHz frequency band. This connectorized device comes with a 3x3 MIMO radio and three N-Type connectors to connect external antennas.
MP-8200-BSU	The Tsunami MP-8200 Base Station unit, is a flexible wireless outdoor product that operates in 4.900 to 5.925 GHz frequency band. This connectorized device comes with a 3x3 MIMO high power radio and three N-Type connectors to connect external antennas.
MP-8200-SUA	The Tsunami MP-8200 Subscriber unit, is a flexible wireless outdoor product that operates in 4.900 to 5.925 GHz frequency band. This connectorized device comes with a 3x3 MIMO high power radio and three N-Type connectors to connect external antennas.
MP-8160-BSU	The Tsunami MP-8160 Base Station unit, is a flexible outdoor product that operates in 5.9 – 6.4 GHz frequency band. This connectorized device comes with a high power 2x2 MIMO radio and two N-Type connectors to connect external antennas.

MP-8160-SUA	The Tsunami MP-8160 Subscriber unit, is a flexible outdoor product that operates in 5.9 – 6.4 GHz frequency band. This connectorized device comes with a high power 2x2 MIMO radio and two N-Type connectors to connect external antennas.
QB-8100-EPA	The Tsunami QB-8100-EPA QuickBridge operates in 2.3 – 2.5 and 4.9 – 6.0 GHz frequency band. This connectorized device comes with a 3x3 MIMO radio and three N-Type connectors to connect external antennas.
QB-8100-LNK	A pair of Tsunami QB-8100-EPA devices form a link.
QB-8200-EPA	The Tsunami QB-8200-EPA QuickBridge operates in 4.900 – 5.925 GHz frequency band. This connectorized device comes with a 3x3 MIMO high power radio and three N-Type connectors to connect external antennas.
QB-8200-LNK	A pair of Tsunami QB-8200-EPA devices form a link.

Who Should Use This Guide

At a basic level, the person referring to this guide should meet the following pre-requisites:

- A professional experienced in mounting outdoor antennas, installing surge arrestors, installing and configuring network components.
- Have a working knowledge on installation procedures for network operating systems like Microsoft Windows.

However, Proxim recommends only a qualified antenna installation professional to install the antennas and follow the following guidelines:

- The outdoor antennas should be mounted only on an antenna tower, on a roof, or on the external surface of the building.
- The site pre-requisites must be verified by the professional, familiar with the applicable national electrical code and with other regulations governing this type of installation, within the country of use.
- If you are not aware about the regulations that apply in your country, contact Proxim's Technical Services and Support.
- While installing the outdoor antennas, ensure to comply with the local radio regulations and use the correct cable type and surge arrestor.
- Local radio regulations or legislation may impose restrictions on the use of specific combinations of:
    - Low - loss antenna cables and outdoor antennas.
    - Selected radio channels that are connected to specific outdoor antennas.

Documentation Conventions

Icon Representation

Name	Image	Meaning
Note		A special instruction that draws attention of a user.
Important		A note of significant importance that a user should be aware of.
Caution		A warning that cautions a user of the possible danger.

Related Documents

In addition to this guide, you can refer to the following documents for Tsunami® 800 and 8000 series products, that are available at Proxim's support site http://my.proxim.com.

- **Quick Installation Guide (QIG)** - A quick reference guide that provides essential information to install and configure the device.
- **Hardware Installation Guide** - A guide that provides an overview about the installation methods and hardware specifications of the device.
- **Software Management Guide** - A guide that gives jump-start working knowledge on the step-by-step procedure to configure, manage and monitor the device, by using Web Interface.
- **Reference Guide** - A guide that provides instructions on how to configure, manage and monitor the device by using Command Line Interface.
- **Safety and Regulatory Compliance Guide** - A guide that provides country specific safety and regulatory norms to be followed while installing the devices.
- **Recommended Antennas Guide** - A guide that gives insight on the recommended antennas for the device, along with the antenna specifications.

1 Antenna Installation

This chapter contains information on the following:

1.1 Safety Precautions

Listed below are the safety precautions to be satisfied, prior to the outdoor antennas installation:

- Outdoor antennas and antenna cables (good conductors of electricity) should be installed properly to avoid the transients or electrostatic discharges (that occur due to lightning during thunderstorm) from damaging your equipment and causing personal injury or death to the persons touching the exposed metal connectors of the equipment.
- When installing, disconnecting, or replacing one of the cable components, ensure that each of the exposed metal connectors of the antenna cabling system are grounded locally.
- Do not install the antenna, where there is a possibility of contact with the high-voltage arc-over from the power cables or service drops to the buildings. Ensure that the antenna-mast or antenna-tower are not close by any power line, during the installation or removal of antennas.
- Apply a *Danger* label on a plainly visible area of the antenna support structure.
- Do not climb the rooftops during a thunderstorm, in wet or windy conditions, or on the equipment installation area which is covered with ice or snow.
- Do not touch the antennas, surge arrestors, or antenna cables during a thunderstorm.
- Install the antennas at a safe distance (at least twice the height of the antenna-mast plus the antenna) from power lines or telephone lines.
- Mount the antennas at a safe distance, avoiding any human contact during the normal equipment operation.
- Ensure that the human proximity to the antenna is atleast 50 cm (8 inches) high, avoid the possibility of exceeding the FCC radio frequency exposure limits, during the normal operation of the equipment.

- Verify that the low-loss antenna cable used to connect the antenna with the surge arrestor, or the ethernet cable used to connect the surge arrestor, are at least 1 m (3 ft.) away from any high voltage current cable.
- Check whether the antenna mast and its guy wires or wall bracket are positioned correctly and secured properly to the roof or walls. Also, ensure that the base area, where the antenna-mast is mounted is weatherproofed.
- Ensure, that the grounding system for the antenna mast and the surge arrestor have been installed. The grounding system must comply with the local electrical code and other requirements. See Grounding the Antennas
- Always consult an experienced electrician to assure that the antenna mast, surge arrestor, and the equipment hardware are grounded properly.
- The antenna cable between the antenna and the surge arrestor should be grounded. Ensure that the exposed metal connector of the cable is grounded locally, if the cable is disconnected at one end (disconnected to replace the surge arrestor).

1.2 Installation Process

Follow the following step-by-step procedure to install outdoor antennas:

1. Ensure that all the materials, essential to install the outdoor antennas are acquired. See Required Materials.
2. Once you have acquired all the required materials, refer *Quick Installation Guide* (that comes along with your product) to mount the outdoor equipment and begin the outdoor antenna installation.
3. Verify the optimal antenna placement, maintaining a clear line-of-sight. See Determining the Optimal Antenna Placement.
4. Mount the antenna to the support structure, following the guidelines as described in Mounting the Antenna.
5. Verify that the device, support structure for antenna (antenna-mast) and entire cable set-up for the antenna are connected properly. See Connecting the Cables.
6. Connect the antenna cable to the antenna. See Connecting the Antenna Cable.
7. Ensure that the cabling of ethernet / power cables and the surge arrestor is proper. See Connecting the Surge Arrestor and Ethernet / Power cables
8. Ensure that the antennas are grounded properly to the grounding system, satisfying the local electrical code requirements. See Grounding the Antennas
9. Once the antenna is properly positioned, grounded and the outdoor cable setup is verified, secure all the cables and use weatherproofing tape to seal all the outdoor connectors. See Sealing the Cable Connectors.
10. Make sure that the outdoor antennas at both the ends maintain the same antenna polarizations. See Step 4: Next, wrap a layer of the butyl mastic tape on the adhesive side.
11. Align the antennas to establish a wireless link with a better throughput, by using device antenna alignment utilities like Audible Antenna Alignment and Antenna Alignment using CLI commands. See Aligning the Antenna.

: *For easy outdoor antenna installation, note the following:*

- *Go through the* Safety Precautions*.*
- *Read all the requirements outlined in this chapter. See* Required Materials*.*
- *Familiarize yourself with the antenna and the radio-specific mounting instructions, prior to climbing any roof or ladder.*
- *Verify that you have arranged all safety measures for outdoor installation or rooftop installation. See* Safety Precautions*.*
- *Test all the equipment before beginning the actual rooftop installation, to determine if all the required equipment is functioning properly.*

- *Install the grounding system for the antenna mast, device, and surge arrestor before connecting the cables. This protects your system against lightning strikes during installation.*
- *When you remove or relocate the antenna, verify the* Required Materials *and* Safety Precautions*, before you restart the installation process, and follow the above steps in exactly the reverse order.*

1.2.1 Required Materials

The outdoor installation of the equipment and the antennas, require the following:

- An outdoor radio unit.
- An outdoor antenna, supporting the local electrical code.
- A low-loss antenna cable.

: *We recommend you to use a coaxial antenna cable (P/N CBL-5054-600-6), that is available with your distributor.*

- Antenna mast or wall bracket for the antenna/device**.**
- A grounding system that meets the local electrical code. See Grounding the System
- Weatherproofing kit for sealing all the cable connections. See Sealing the Cable Connectors
- Tools and material to mount the antenna. See Mounting the Antenna
- Tape or wraps to attach the antenna cable to the mast.
- Ethernet cable (RJ 45 cable / CAT5e or CAT6 cable) with waterproof cap.
- Proper tools for system installation.
- Ethernet Surge Arrestor and Surge Protector (RF-cable). See Connecting the Surge Arrestor and Ethernet / Power cables

Ensure that you have acquired all the materials listed above, to begin with the outdoor antenna installation. Refer to the *Quick Installation Guide,* that comes along with your product, for details on mounting the outdoor equipment.

1.2.2 Determining the Optimal Antenna Placement

To achieve the maximum throughput, the outdoor antenna must have clear line-of-sight with the antenna at the other end. The outdoor antennas are said to have a clear line-of-sight, when there are:

- No obstacles in the direct path between the antennas (antenna beam)
- No obstacles within a defined zone around the antenna beam

Although, the radio signal can work well without the clear line-of-sight in urban environments, where the signal is transported by reflection rather than transporting it directly along the obstacles. The following figure shows some typical examples of obstacles you must avoid in urban environments, for the directional antenna to operate effectively.

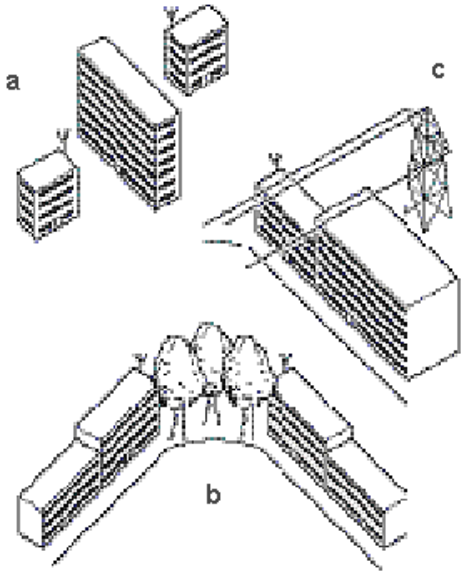


Figure 1-1 Obstacles to be avoided : (a) Neighbouring Buildings (b) Tall Trees (c) Power Lines

To minimize the signal interference or reflections due to obstacles, note the following guidelines:

- Mount the antenna as high as possible above the ground to allow maximum clearance.
  - In open areas, 'ground' is the actual surface of the earth.
  - In dense urban areas, 'ground' is to be interpreted as the height of the highest obstacle in the signal path between the two antenna sites.
- Avoid trees in the signal path to avoid signal absorption due to seasonal changes (leaves or ice).
- Install the antenna at least 2 m (6 ft.) away from all other antennas.

Other situations in which reflections of the radio signal may cause interference are environments with large reflecting surfaces, parallel or partly perpendicular to the antenna beam, such as:

- Mirror-glass buildings.
- Crowded parking lots.
- Water surface, moist earth and moist vegetation.
- Electric power lines and telephone lines above the ground level.

: *Reflective surfaces can be used to improve the performance of a link, if the direct line-of-sight is impaired or absent.*

In the absence of a direct path or clear line-of-sight, transporting a signal through reflection depends on two factors:

- **Fresnel Zone**: It is required to calculate the distance of the obstacle from the antenna. See Fresnel Zone
- **Clearance Factor**: It is required for optimal performance (See Clearance Factor). Ensure that the type and placement of the antennas leave sufficient clearance of the Fresnel Zone at the maximum width of the bulge, which is typically at the mid-point between the antennas.

1.2.3 Mounting the Antenna

Mounting an antenna directly to the wall does not let you align the antenna properly with the corresponding antenna at the opposite end of your wireless link. Poor antenna alignment typically results in poor performance and therefore, we recommend mounting the antennas to a mast.

The two methods followed frequently to erect an antenna mast are:

- **Tripod Mount**: The tripod mount is used primarily on peak and flat roofs. The antenna mast must be secured to the roof using three or four guy wires equally spaced around the mast. When the height of the antenna mast is more than 3 meters (10 ft.), you should use at least three guy wires for every 3-meter (10-foot) section of the mast.
- **Wall (Side) Mount:** A wall (side) mount allows you to mount the antenna (mast) on the side of a building or on the side of an elevator penthouse. This provides you with a convenient mounting location, when the roof overhang is not excessive or when the location is high enough to provide a clear line-of-sight.

When mounting multiple antennas on a single mast, use the following methods to minimize the influence of cross-talk interference between the antennas:

  – Place your antennas as far as possible.
  – Mount the directional antennas, such that the identical side of both the antennas face the same direction.
  – For 8xxx connectorized unit, use the antenna port A1, if you are using a single polarized antenna. Use the antenna port A1 and A3, if If you are using a dual polarized antenna.
  – For 82x connectorized unit, use antenna ports A1 and A2 for dual polarized antenna.

: *As the mounting procedures for the various antennas differ from one another, refer to the guide that comes along with the antenna.*

: The antennas installed at both the ends of a wireless link should maintain same antenna polarizations. See Step 4: Next, wrap a layer of the butyl mastic tape on the adhesive side.

1.2.3.1 Antenna Mast Requirements

To accommodate the antennas, the antenna mast must satisfy the following requirements:

- The construction of the antenna mast must contain sturdy, weatherproof, and non-corrosive material (for example, galvanized or stainless steel construction pipe).
- Diameter of the mast should be between 35 mm (1.4 inches) and 41 mm (1.6 inches). The diameter of the antenna mast vary depending on the type of antenna you intend to install.
- The height of the antenna mast must be high enough to allow the antenna to be installed at least 1.5 m (5 ft.) above the roof. The height of the antenna should be at least 3 m (10 ft.) above, if it is a metal roof.
- The antenna mast or wall bracket must be free from any material (like paint) that prevents a good electrical conduction with the antenna.

1.2.4 Connecting the Cables

Once the outdoor antennas are properly mounted, the cable setup essential to complete the outdoor antenna installation is depicted in the following figure:

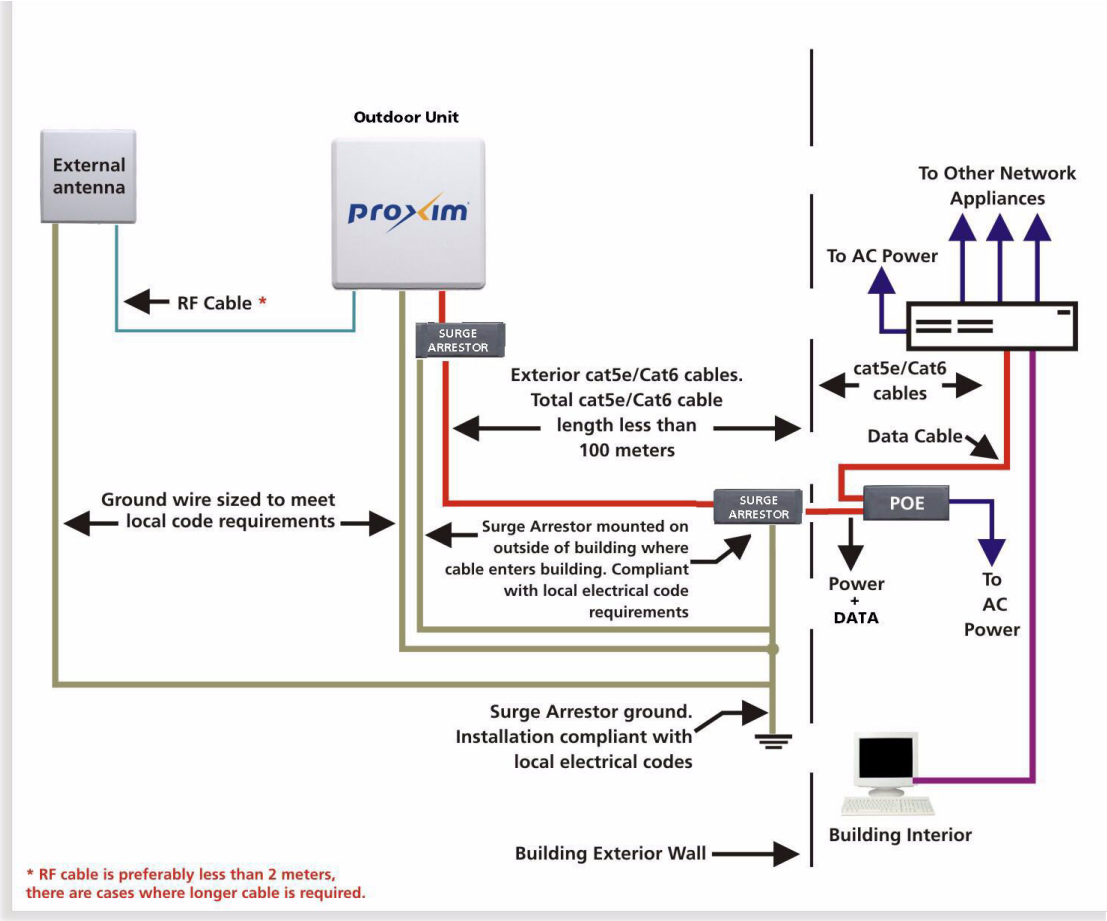


Figure 1-2 Cable Setup

The entire outdoor cabling setup requires the following cabling to be done:

1. Connecting the Antenna Cable
2. Connecting the Surge Arrestor and Ethernet / Power cables
3. Grounding the System

1.2.4.1 Connecting the Antenna Cable

Follow the following steps to connect an antenna to the device, by using an antenna cable.

1. Use an RF cable (antenna cable) to connect the outdoor device to an external antenna.
2. Connect the right-angled N-male connector of RF cable on the antenna. The antenna cables run from the external antenna to the N-Type connectors on the device. The N-Type connectors have built-in surge protection for Tsunami® 800 and 8000 product series.
3. Secure the antenna cable to the antenna mast, as the cable connectors do not support the full weight of the cable.
4. Connect the other end of the antenna cable to the device.

: Do not use tools to tighten the cable connectors, as they damage the antenna cable and connectors.

5. If required, adjust the direction of the antenna.
6. Tighten the nuts of the antenna to lock the antenna into its position.

> ***: Avoid over-tightening of the connector, nuts and screws that are used to mount the antenna, to protect the antenna and device from getting damaged.***

7. Secure the cable along its complete length with a cable or electrical tape to relieve strain on the antenna connector. No part of the cable should be allowed to hang free, especially the parts that are routed outside the building.
8. Weatherproof all the outdoor connectors. See Sealing the Cable Connectors

Ensure you follow the below guidelines while using the antenna cable:

- The entire cable used must be secured and no part of the antenna cable should be allowed to hang free, precisely the outdoor cable parts.
- The antenna cable and cable connectors are not designed to withstand excessive force.
- Do not use the connectors like 'cable grips', to pull the cable through raceways or conduits.
  - Do not use the cable connector to support the weight of the cable during or after installation.
  - Do not use any tool to tighten the connectors.
- Always seal the connectors using the weatherproofing tape.
- Avoid any water or moisture entering the cable, as it impacts the performance of the wireless link.
- Prior to sealing the outdoor connectors and permanently securing the cable to the wall with cable ties and wall hooks, assure that the components that are installed are functioning properly.

Antenna Cable Routing

The antenna cable must be routed and fixed in such a way, that the installation technicians have a clear passage area. All the connectors that are located outdoor must have a weatherproof seal. We recommend you to seal the connectors only after completing the final radio test. See Sealing the Cable Connectors

1.2.4.2 Connecting the Surge Arrestor and Ethernet / Power cables

Perform the following steps to ensure proper surge protection, and ethernet or power cabling:

- Connect the surge arrestor near the outdoor device with a CAT5e/CAT6 ethernet cable (properly ground it near to the cable ingress point of the building, complying with the local electrical code requirements).
- Connect the RJ 45 'LAN-IN' port on the POE (power injector) and the network interface card of the personal computer with a CAT5e/CAT6 ethernet cable.
- Plug one end of the Cat5e/Cat6 cable into the ethernet port of the surge arrestor (near building ingress point) and connect the other end of the cable to the 'PWR-LAN-OUT' port on the POE. Ensure that the cable connector is latched securely.
- Connect the remaining ports on both the surge arrestors (one near the outdoor device and other at the building ingress point) with an RJ 45 terminated cable.

> ***:*** *Proxim recommends two approved lightning surge protectors to be installed, one near to the device and the other at the building ingress point. To buy an additional Surge Protector (with Part Number: 235-00001), place an order separately with your distributor.*

: The surge arrestor and the antenna mast must be connected to the same grounding system, by using the shortest cable possible, as prescribed by local electrical codes.

1.2.4.3 Grounding the System

Direct grounding of the antenna mast, device, and surge arrestor is extremely important. Refer to the *Quick Installation Guide*, that comes along with your product, for detailed illustration on grounding the outdoor device and surge arrestors.

: *A safety grounding system is necessary to protect your radio from lightning strikes and the static electricity generated from it.*

Grounding the Antennas

Following precautions should be satisfied, while grounding the antenna:

- The antenna mast and the grounding system should be installed only by qualified installation professionals and electrician, who are familiar with local building, safety, and electrical codes in the country of use.
- The antenna mast, the device, and the surge arrestor must be connected to the same ground, by using an equi-potential bonding conductor.
- A good electrical connection should be made to one or more ground rods, by using at least a 10AWG ground wire and non-corrosive hardware.

1.2.5 Sealing the Cable Connectors

Corrosion of the antenna cable, cable connectors and other wireless outdoor installations degrade the performance of the wireless link. To avoid, you must always seal the outdoor cable connectors using weatherproofing tape. To weatherproof the antenna connectors at both the ends of a wireless link, follow the following step-by-step procedure:

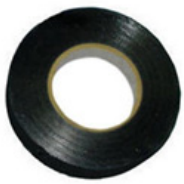
1. **Collect the required material:**

   The material required for weatherproofing connectors are,

   - Any standard Butyl Mastic Tape
   - Any standard Vinyl Tape

   We have used the following Butyl Mastic Tape and Vinyl Tape as an example to demonstrate the weatherproofing steps:

Butyl Mastic Tape



Vinyl Tape

2. **Follow the following weatherproofing steps:**

: We have taken MP-8100-BSU and 16 dBi dual polarized sector antenna as an example to explain the weatherproofing steps. Follow the same method to weatherproof the antenna connectors of the Tsunami® 800 and 8000 series products.

Step 1: Wrap a vinyl tape in a half-lapped fashion, from the weatherproofed connector end and continue wrapping till 3 inches onto the cable.

a. Weatherproofing at the device end:

(a)

(b)

b. Weatherproofing at the antenna end:

(a)

(b)

(c)

Step 2: Wrap a second layer of the vinyl tape over the first layer but in other direction.

a. Weatherproofing at the device end:

(a)

(b)

b. Weatherproofing at the antenna end:

(a)

(b)

Step 3: Now, wrap a layer of vinyl tape with the adhesive side out as it provides sticky surface for the next layer.

a. Weatherproofing antenna connectors on the device:

(a)

(b)

b. Weatherproofing antenna cable:

(a)

(b)

Step 4: Next, wrap a layer of the butyl mastic tape on the adhesive side.

a. Weatherproofing antenna connectors on the device:

(a)

(b)

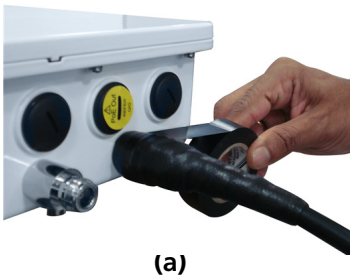
b. Weatherproofing antenna cable:

(a)

(b)

Step 5: Finally, wrap vinyl tap over the butyl layer.

a. Weatherproofing antenna connectors on the device:



(a)

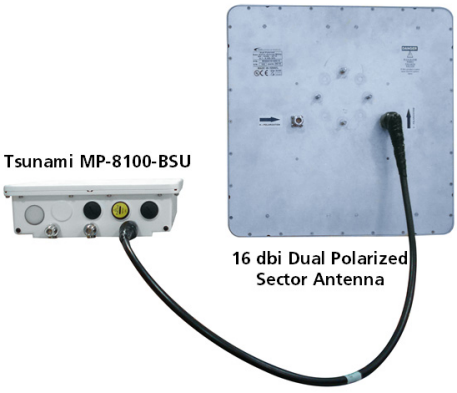
(b)

b. Weatherproofing antenna cable:

(a)

(b)

The figure below depicts the complete weatherproofing of the RF connection.



1.2.6 Antenna Polarization

For optimal wireless link performance, you must always verify that the same antenna polarizations are maintained on both the ends of a wireless link. Tabulated below are the antenna polarizations for the Tsunami® 800 and 8000 product series.

Product	3x3 MIMO	2x2 MIMO
MP-820-BSU-100	Not Applicable	Antenna (A1) = Horizontal polarization Antenna (A2) = Vertical polarization
MP-820-SUA-50+	Not Applicable	Antenna (A1) = Horizontal polarization Antenna (A2) = Vertical polarization
MP-8100-BSU/SUA	Antenna (A1) = +45 degree Polarization Antenna (A2) = Vertical Polarization Antenna (A3) = -45 degree polarization	Antenna (A1) = Vertical polarization Antenna (A2) = Not connected Antenna (A3) = Horizontal polarization
MP-8200-BSU/SUA	Antenna (A1) = +45 degree Polarization Antenna (A2) = Vertical Polarization Antenna (A3) = -45 degree polarization	Antenna (A1) = Vertical polarization Antenna (A2) = 50 ohm load Antenna (A3) = Horizontal polarization
MP-8160-BSU/SUA	Not Applicable	Antenna (A1) = Horizontal polarization Antenna (A2) = Vertical polarization
QB-8100-EPA	Antenna (A1) = +45 degree Polarization Antenna (A2) = Vertical Polarization Antenna (A3) = -45 degree polarization	Antenna (A1) = Vertical polarization Antenna (A2) = Not connected Antenna (A3) = Horizontal polarization
QB-8200-EPA	Antenna (A1) = +45 degree Polarization Antenna (A2) = Vertical Polarization Antenna (A3) = -45 degree polarization	Antenna (A1) = Vertical polarization Antenna (A2) = 50 ohm load Antenna (A3) = Horizontal polarization

:

- *If you are using all the antenna ports of a MIMO device, we recommend you to maintain different antenna polarizations on both the ends to avoid coupling.*
- *If you are using a single polarized or dual polarized antenna, it is recommended to terminate the unused antenna ports with an N-male 50 ohm terminator (supplied with the product package). Refer Tsunami® 800 and 8000 Series - Hardware Installation Guide, for details.*

Consider mounting the antenna for horizontal polarization and minimize the influence of cross-talk between antennas, only under the following circumstances:

- When you are using single polarized antennas at both the ends of a wireless link.
- When multi-directional antennas are mounted to the same mast.
- When the wireless link receives interference from a vertically polarized antenna in the vicinity.

1.2.7 Aligning the Antenna

Antenna alignment is the process of physically aligning the antenna of the radio receiver and transmitter to establish a link with a better throughput. The antenna alignment process is usually performed during the installation of the antennas. You can align the antennas by using the following two methods:

- Audible Antenna Alignment
- Antenna Alignment using CLI Commands

Alternatively, consult an antenna installation service professional to optimize the antenna alignment.

1.2.7.1 Audible Antenna Alignment

The device has a built-in audible antenna alignment tool that can be activated by plugging in the supplied RJ11 serial dongle. It is audible up to a distance of 30 meters. The CLI command enables both audible and numerical feedback as the CLI shows the running Signal-to-Noise Ratio (SNR) values twice a second.

The output from the beeper consists of short beeps with a variable interval. The interval changes with the SNR level to assist in correctly aligning the antenna. An increase in signal level is indicated by a shorter interval between beeps and a reduction in signal level results in longer beeps.

The alignment process averages the SNR, which is represented by an average length beep. When a higher SNR is received, the beep period becomes shorter, dependent upon the difference to the average. A lower SNR results in a longer period between beeps.

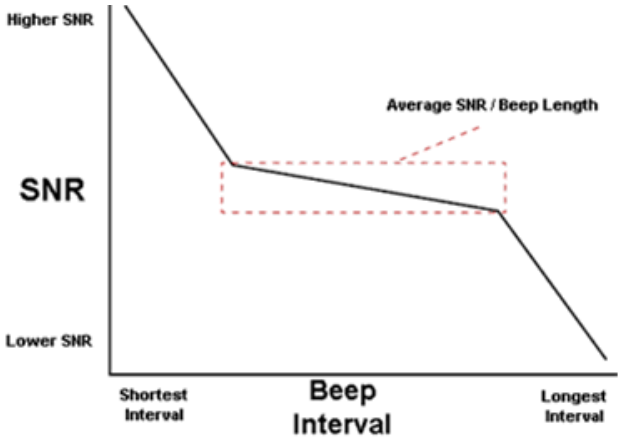


Figure 1-3 Beep Interval

When the antenna is aimed, the beep intuitively represents whether the SNR is rising or falling. The higher the SNR rises, the higher is the frequency of the beep and shorter beep is heard. When you change the position of the antenna, SNR averaging settles at the new value and the beeping returns to the average length so the antenna can again be aimed for rising SNR. Aiming is complete if moving the antenna in any direction results in a falling SNR value (which can be heard as longer periods between beeps).

:

- *The range of the average SNR is limited to values from 5 to 43. Anything over 43 always results in a short period between beeps and values below 5 always have a long period.*
- *The Antenna Alignment Display (AAD) CLI command is automatically disabled 30 minutes after it is enabled to remove the load of extra messages on the wireless interface. The default telnet time-out is 300 seconds (5 minutes).*
- *It is applicable only to 8xxx devices.*

1.2.7.2 Antenna Alignment using CLI Commands

To enable the antenna alignment display from the CLI prompt, enter the following commands:

- **`aad enable local`**: Enables display of the local signal, noise and SNR.
- **`aad enable remote`**: Enables display of the remote signal, noise and SNR.
- **`aad enable`**: Enables display of local and remote signal, noise and SNR.

: *Use a flat blade screw driver to disconnect and pull out the serial cable from the enclosure after the antenna alignment is done. After withdrawing the cables, seal the serial port carefully to avoid water seepage.*

Measuring Signal Performance 2

This chapter contains information on the following:

2.1 Introduction

The performance of a microwave link (wireless link established between two outdoor antennas) is closely related to the following factors:

- Range
- Fresnel Zone
- Clearance Factor

Calculating the above factors help you align the antennas properly and achieve a better throughput.

2.2 Determining the Range

Range is the maximum distance a microwave link travels and is based on the:

- Type of the outdoor antenna equipment (Outdoor antennas differ in technical specifications).
- Data speed of the wireless link.
- Clearance of the signal path (see Clearance Factor).

Use the following formula to determine the range of the microwave link:

Range = Maximum Range x Clearance Factor

1. **Maximum Range**: It is the theoretically calculated value achieved under optimal circumstances, by using the available products and their technical specifications that comply with the local radio regulations. The calculations made assuming the optimal radio conditions do not guarantee of achieving the same maximum distance at your location.
2. **Clearance Factor**: See Clearance Factor.

Variations in calculations of the above two factors occur due to any of the following reasons:

- Incorrect alignment of antennas (Refer to Aligning the Antenna).
- Polarization mismatch of the antennas.
- Sources of interference or unexpected reflections in the signal path that affect the quality of communication (Refer Determining the Optimal Antenna Placement).
- Severe weather conditions such as heavy rainfall, snow or strong winds.
- Unexpected obstacles in the link path.
- Seasonal influences such as leaves on trees or icing of the antennas.

2.3 Fresnel Zone

The narrow antenna beam emerged from the antennas contain a bulged area called as Fresnel Zone. The first Fresnel Zone is known to be an imaginary boundary line offset along the direct path of the signal, where a signal reflected will travel an additional one-half distance of wavelength. Each succeeding Fresnel Zone boundary adds an additional half-wavelength to the reflected path distance than the direct signal path between the antennas.

When any significant part of the Fresnel Zone is obstructed, a portion of the radio energy is lost that results in reduced performance. Reduced performance can also occur when obstacles close to the antenna beam cause signal reflections or noise that interfere with the radio signal.

Weather conditions (rain or snow) usually do not have much impact on the performance of your device, provided you have sealed all the cable connectors with weatherproofing tape. Seasonal influence on signal propagation can occur in the following situations:

- Marginal communications quality in late fall (with no leaves on the trees along the signal path) might fail in the summer (with leaves on the trees along the signal path).
- In winter, a wireless link can fail when the antenna is exposed to ice buildup or when the antenna elements are covered with snow.

Radio paths over water or extremely flat ground require optimization of antenna height at one end. This is due to in-phase or out-of-phase reflections. Adjustment of antenna height by 1 to 3 meters may move the signal from null to peak.

Long distance links may be obstructed by earth curvature, so the antenna height requirements must not only take the height of obstructions and Fresnel Zone into account but also the earth bulge. The earth bulge is approximately 5 meters (16.4 ft.) at a link distance of 16 Kilometers (10 millimeters). Consult your supplier to take appropriate steps to maintain or optimize wireless link performance.

2.3.1 Fresnel Zone Calculation

The exact shape and width of the Fresnel Zone is determined by calculating the Fresnel Radius. The distance between the Fresnel Zone boundary and a straight line running along the signal path (shortest path) between the antennas is called the Fresnel Radius. Fresnel Radius can be determined by using the path difference (difference between the shortest path and alternative path) and frequency of the radio signal. If there are no obstacles in the space forming 60% of the path difference, then the propagation characteristics are said to be the same as that in free space.

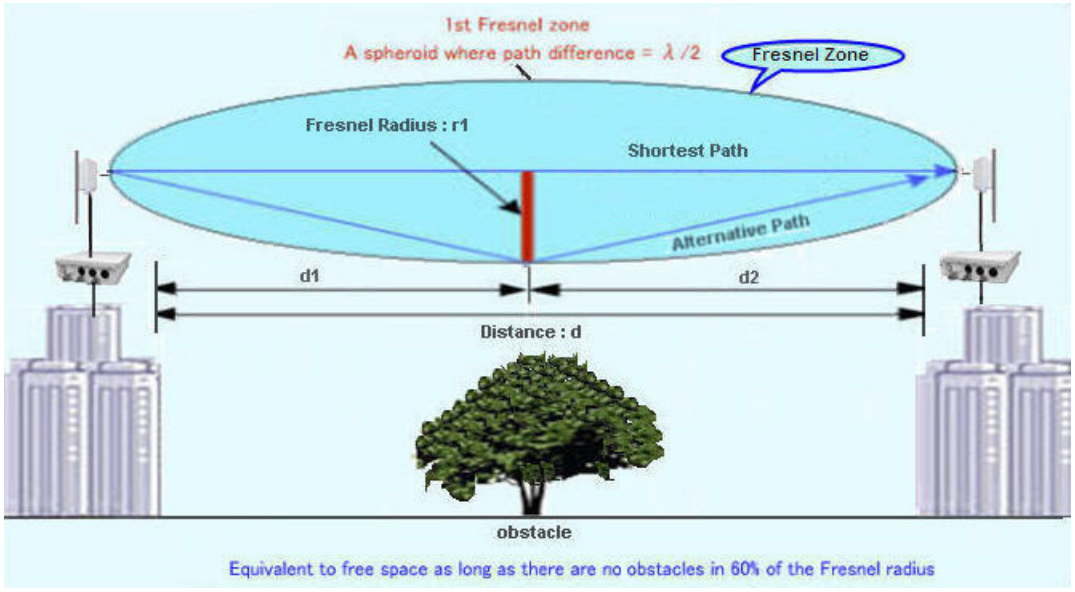


Figure 2-1 Fresnel Zone Calculation

Let's say, in the above figure:

- **d1** is the distance between the obstacle and the antenna at one end.
- **d2** is the distance between the obstacle and the antenna at the other end.
- λ is the wavelength of the operating frequency.

Then, Path Difference (**d3**) and Fresnel Radius ($\mathbf{r_n}$, radius of the $\mathbf{n^{th}}$ Fresnel Zone) can be calculated from the formula below:

$$\text{Path difference: } d3 = \sqrt{d1^2 + r_n^2} + \sqrt{d2^2 + r_n^2} - d = \frac{\lambda}{2}$$

$$\text{Fresnel radius: } r_n = \sqrt{n\lambda \frac{d1 \times d2}{d1 + d2}}$$

(where **n** = 1, for the first Fresnel Zone and $\mathbf{r_n} = \mathbf{r_1}$)

The path difference is the required clearance of the antenna beam from obstacles in its path to avoid loss of radio signal. Signals reflected from any even-numbered Fresnel Zone result in signal cancellation while the odd-numbered Fresnel Zones add to the direct path signal.

2.4 Clearance Factor

Clearance Factor is a correction value (in percentage) that should be used in case, where the signal path of your wireless link does not provide the minimum clearance as listed in the Maximum Range Table. In general, clearance factor is taken as 60% of the Fresnel Zone and is calculated as:

Clearance Factor = Fresnel Zone x 60%

For optimal performance of your outdoor wireless link, the signal path between the BSU and SU must provide sufficient clearance. Clearance is interpreted as:

- The total height above the surface of the earth, in the open areas without obstacles in the signal path. Let's say antenna is mounted on the roof, then clearance is the total height including the height of the building and the height of the mast above the rooftop.
- The height above the highest possible obstacle, in the areas with obstacles along the signal path (path between two antennas).
- The height above the rooftop or highest obstacle in the signal path, in dense urban areas.

: *An outdoor wireless link that lacks sufficient clearance will exhibit poor performance, which is typically perceived as slow network response time. However, your radio equipment automatically retransmits every lost data frame due to an out-of-range situation or frame collision. The larger the number of retransmissions, the lower is the throughput efficiency of your wireless link.*

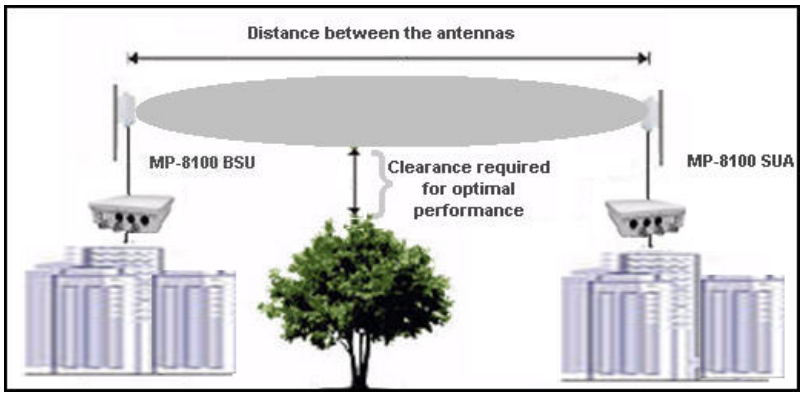


Figure 2-2 Clearance required for the Optimal Performance

As shown in the above figure, the clearance required for optimal performance is interpreted as:

- Vertical clearance above the ground and the highest buildings or objects along the signal path
- Horizontal clearance from neighboring buildings and objects along the signal path

For optimal range and throughput performance, you must ensure that your antenna installation provides maximum clearance in both horizontal and vertical directions.

If the local authorities, proprietor of the premises or other miscellaneous factors do not allow you to set up an antenna mast for the clearance requirements, then you may not achieve a full line-of-sight clearance. However, if the distance that your wireless outdoor installation covers is less than the listed maximum range, you don't need full clearance.

To determine the effect of insufficient signal path clearance, you must determine the Clearance Factor and also calculate its effect on the range for your antenna installation, by using the formula described in Determining the Range.

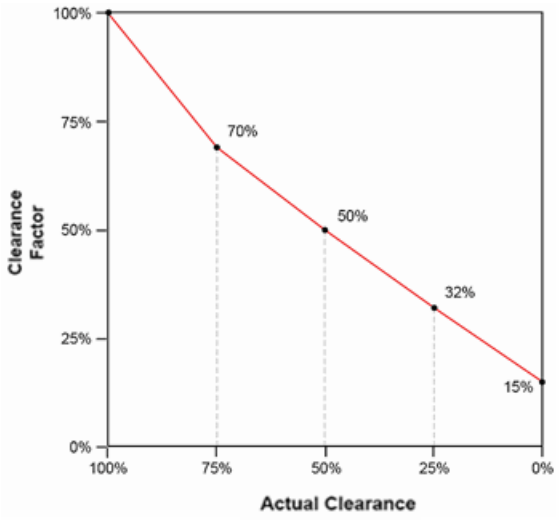


Figure 2-3 Clearance Factor

If the clearance for your antenna installation is equal to or better than the minimum clearance required, then the Clearance Factor for your installation is 100%. If your actual clearance is less than the minimum clearance, then refer Figure 2-3 to determine the actual range that applies to the current requirement.

: *Practically, it is impossible to achieve the maximum range due to the interference from the other radio products.*

Proxim recommends you to maintain at least 60-70% of the first Fresnel Zone free. If the clearance is lower than this percentage, then the *link budget* and acquired *fade margin* are affected. Clearances more than 100% of the Fresnel Zone can cause reflections that are 180 degrees out of phase and can cancel the signal. The Fresnel Zone works in both the horizontal and vertical paths.

2.5 Calculations

A microwave link is established along the path between antennas. Availability of the microwave path is therefore a prediction of the percent of time that the wireless link operates. In the absence of direct interference, availability of microwave path is affected by the following factors:

- Path length
- Fade margin
- Frequency
- Terrain (smooth, average, mountainous)
- Climate (dry, temperate, humid)

Availability of the microwave path can be improved by increasing the fade margin, either by making the path shorter or by using the higher gain antennas in conjunction with lower loss antenna cable (using a higher quality antenna cable, shortening the length, or both).

Establish a wireless link for a specific availability rate of microwave path, depending upon the type of information carried over the link and the overall network design redundancy. Let's say, the data or voice traffic carried by the radio is critical, then the link can be established at a very high availability rate of microwave path (say, 99.999% or 5.3 minutes of predicted outage per year).

2.5.1 Calculating Link Budget

Use the following formula to estimate the received signal level (RSL):

RSL (dBm) = P_{out} - L_1+ G_1 + G_2 - L_2 - L_p

where:

- **P_{out}** is the output power (in dBm) of the transmitter.
- **L_1** is the total loss of all transmission elements between the antenna and the RF device on one side of the link (in dB).
- **G_1** is the gain of the antenna on one side of the link (in dB).
- **G_2** is the gain of the antenna on the opposite side of the link (in dB).
- **L_2** is the total loss of all transmission elements between the antenna and the RF device on the opposite side of the link (in dB).
- **L_p** is the Path loss, defined by:
  $Lp\ (dB) = 96.6 + 20\ log_{10}F + 20\ log_{10}D$; where:
  - **F** is the frequency of the radio system in GHz.
  - **D** is the distance of the path in miles.

:

- *This formula is available on a calculation sheet provided by Proxim to generate an estimate of link distance and reliability.*
- *The path loss must be smaller than the link budget minus the minimum required fade margin. The maximum ranges cause the path loss plus the fade margin to be the same as the link budget.*

The following figure is a pictorial representation of the elements in the Link Budget equation.

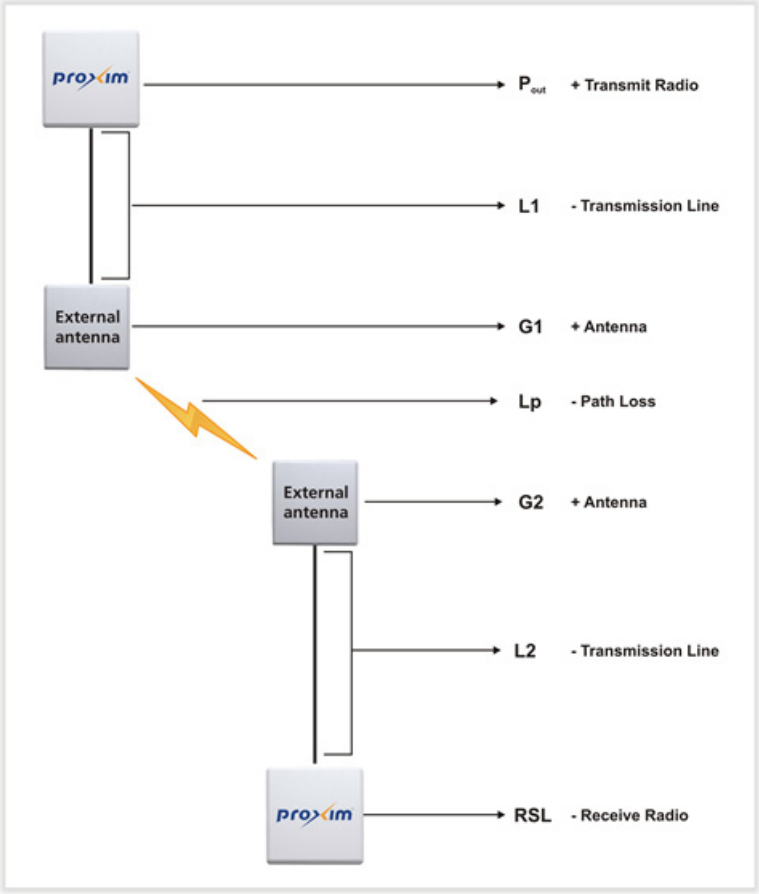


Figure 2-4 Link Budget Equation-Pictorial Representation

Procedure

1. Start with the transmit power and the number of the channel to be used in dBm. Subtract the total loss of all transmission elements between the antenna and the radio on one side of the link (dB).
2. Add the dBi of the antenna you will be using. The total is the **EIRP** (Equivalent Isotropically Radiated Power).
3. Determine the path loss of the microwave link by using the mathematical formula of $\mathbf{L_p}$, illustrated in Calculating Link Budget.
4. Add the gain of the antenna on the second side of the link.
5. Subtract the total loss of all transmission elements between the antenna and the radio on the second side of the link. The result is the **Received Signal Level** (RSL).
6. For details on the receive sensitivity and data rate values used for the wireless link, please refer to the *Tsunami® 800 and 8000 series - Hardware Installation Guide*.
7. Subtract this value from the Received Signal Level; this is the **Fade Margin**.

:

- *The RSL must be higher than the Receiver Sensitivity plus the Fade Margin for a good link. The amount of Fade Margin indicates the reliability of the link. The more the Fade Margin, the more reliable is the link.*

The results of this link budget calculation are very important for determining any potential problems during installation. If you have calculated the expected RSL, you can verify that it has been achieved during installation and troubleshooting.

Tabulated below is the relation between the *Distance* and *Link Budget,* for a selected frequency:

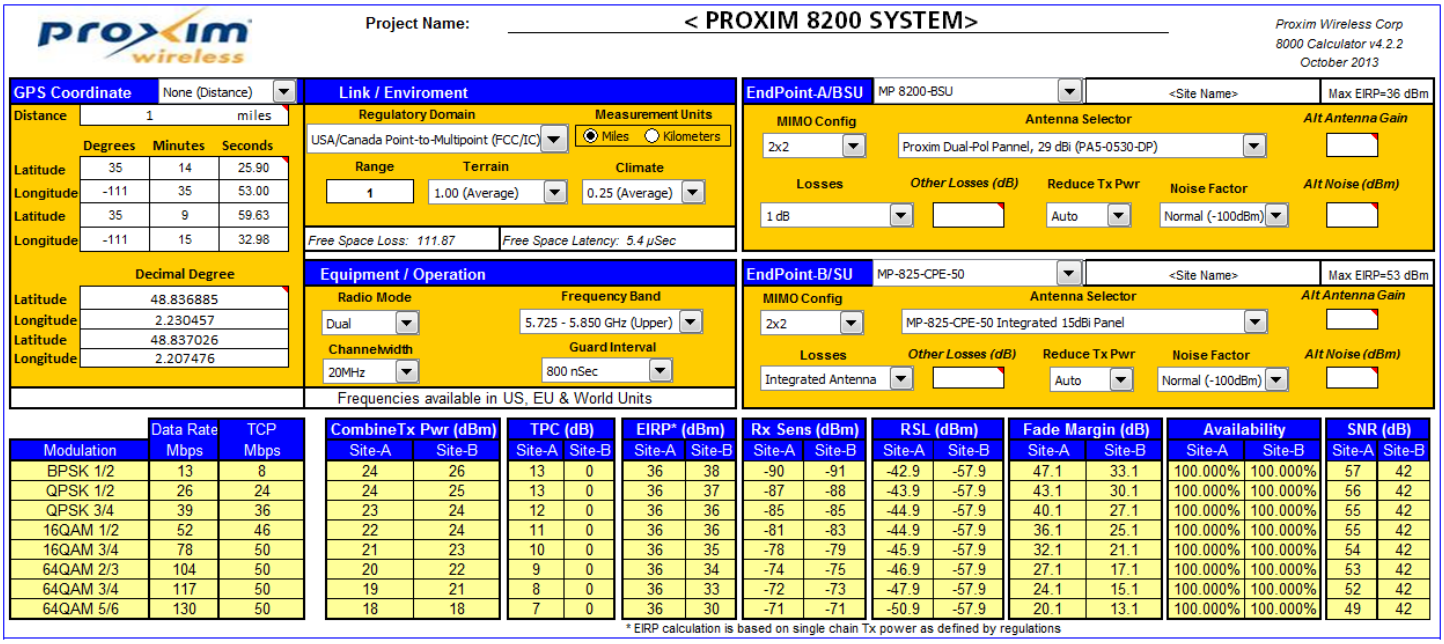
Reference Frequency: 5600 MHz Center Frequency for Europe								
Link Budget (dB)	**Distance (m)**	**Fresnel Zone (m)**	**Link Budget (dB)**	**Distance (m)**	**Fresnel Zone (m)**	**Link Budget (dB)**	**Distance (m)**	**Fresnel Zone (m)**
61	4.8	0.3	91	151	1.4	121	4.8	8.0
62	5.4	0.3	92	170	1.5	122	5.4	8.5
63	6.0	0.3	93	190	1.6	123	6.0	9.0
64	6.8	0.3	94	214	1.7	124	6.8	9.5
65	7.6	0.3	95	240	1.8	125	7.6	10.1
66	8.5	0.3	96	269	1.9	126	8.5	10.7
67	9.5	0.4	97	302	2.0	127	9.5	11.3
68	11	0.4	98	339	2.1	128	10.7	12.0
69	12	0.4	99	380	2.3	129	12.0	12.7
Link Budget (dB)	**Distance (m)**	**Fresnel Zone (m)**	**Link Budget (dB)**	**Distance (m)**	**Fresnel Zone (m)**	**Link Budget (dB)**	**Distance (m)**	**Fresnel Zone (m)**
70	13	0.4	100	426	2.4	130	13.5	13.4
71	15	0.5	101	478	2.5	131	15.1	14.2
72	17	0.5	102	537	2.7	132	17.0	15.1
73	19	0.5	103	602	2.8	133	19.0	16.0
74	21	0.5	104	676	3.0	134	21.4	16.9
75	24	0.6	105	758	3.2	135	24.0	17.9
76	27	0.6	106	850	3.4	136	26.9	19.0
77	30	0.6	107	954	3.6	137	30.2	20.1
78	34	0.7	108	1071	3.8	138	33.9	21.3
79	38	0.7	109	1201	4.0	139	38.0	22.6
80	43	0.8	110	1348	4.2	140	42.6	23.9
81	48	0.8	111	1512	4.5	141	47.8	25.3
82	54	0.8	112	1697	4.8	142	53.7	26.8
83	60	0.9	113	1904	5.0	143	60.2	28.4
84	68	1.0	114	2136	5.3	144	67.6	30.1
85	76	1.0	115	2397	5.7	145	75.8	31.9
86	85	1.1	116	2689	6.0	146	85.0	33.7
87	95	1.1	117	3018	6.4	147	95.4	35.7
88	107	1.2	118	3386	6.7	148	107.1	37.9
89	120	1.3	119	3799	7.1	149	120.1	40.1
90	135	1.3	120	4263	7.6	150	134.8	42.5

: *The* ***Distance (m)*** *is calculated by assuming the 60% of the 1st Fresnal to be clear.*

Effective Isotropic Radiated Power (EIRP)

In countries like USA and Canada, radio can be installed with any directional antennas gain, as there is no Effective Isotropic Radiated Power (EIRP) limit for the application of these systems for fixed point-to-point applications in the 5.8 GHz frequency band. In other bands and in other countries, EIRP limits may apply. In the case of EIRP limits, use the lower values of either (P_{out} - L_1+ G_1) or the EIRP limit, within the Link Budget equation. You should check this calculation in both the directions to assure legal application. An EIRP limit is the maximum RF energy that can be transmitted as measured at the transmitting antenna and is usually determined by government regulations. For details, we recommend you to refer the **Max EIRP** values listed under the **Wireless Interface properties**, in the *Tsunami® 800 and 8000 Series - Software Management Guide*.

The figure below illustrates the calculation of range through Proxim Link (MP/QB 81XX) Calculator, available at http://my.proxim.com, that dynamically adapts the transmit power and receive sensitivity values for a selected product to follow the local EIRP rule.



proxim wireless

Project Name: < PROXIM 8200 SYSTEM>

Proxim Wireless Corp
8000 Calculator v4.2.2
October 2013

GPS Coordinate None (Distance)

Distance 1 miles

	Degrees	Minutes	Seconds
Latitude	35	14	25.90
Longitude	-111	35	53.00
Latitude	35	9	59.63
Longitude	-111	15	32.98

Decimal Degree	
Latitude	48.836885
Longitude	2.230457
Latitude	48.837026
Longitude	2.207476

Link / Enviroment

Regulatory Domain: USA/Canada Point-to-Multipoint (FCC/IC)
Measurement Units: (•) Miles ( ) Kilometers
Range: 1
Terrain: 1.00 (Average)
Climate: 0.25 (Average)
Free Space Loss: 111.87
Free Space Latency: 5.4 µSec

Equipment / Operation

Radio Mode: Dual
Frequency Band: 5.725 - 5.850 GHz (Upper)
Channelwidth: 20MHz
Guard Interval: 800 nSec
Frequencies available in US, EU & World Units

EndPoint-A/BSU MP 8200-BSU <Site Name> Max EIRP=36 dBm
MIMO Config: 2x2
Antenna Selector: Proxim Dual-Pol Pannel, 29 dBi (PA5-0530-DP)
Alt Antenna Gain:
Losses: 1 dB
Other Losses (dB):
Reduce Tx Pwr: Auto
Noise Factor: Normal (-100dBm)
Alt Noise (dBm):

EndPoint-B/SU MP-825-CPE-50 <Site Name> Max EIRP=53 dBm
MIMO Config: 2x2
Antenna Selector: MP-825-CPE-50 Integrated 15dBi Panel
Alt Antenna Gain:
Losses: Integrated Antenna
Other Losses (dB):
Reduce Tx Pwr: Auto
Noise Factor: Normal (-100dBm)
Alt Noise (dBm):

Modulation	Data Rate Mbps	TCP Mbps	CombineTx Pwr (dBm) Site-A	CombineTx Pwr (dBm) Site-B	TPC (dB) Site-A	TPC (dB) Site-B	EIRP* (dBm) Site-A	EIRP* (dBm) Site-B	Rx Sens (dBm) Site-A	Rx Sens (dBm) Site-B	RSL (dBm) Site-A	RSL (dBm) Site-B	Fade Margin (dB) Site-A	Fade Margin (dB) Site-B	Availability Site-A	Availability Site-B	SNR (dB) Site-A	SNR (dB) Site-B
BPSK 1/2	13	8	24	26	13	0	36	38	-90	-91	-42.9	-57.9	47.1	33.1	100.000%	100.000%	57	42
QPSK 1/2	26	24	24	25	13	0	36	37	-87	-88	-43.9	-57.9	43.1	30.1	100.000%	100.000%	56	42
QPSK 3/4	39	36	23	24	12	0	36	36	-85	-85	-44.9	-57.9	40.1	27.1	100.000%	100.000%	55	42
16QAM 1/2	52	46	22	24	11	0	36	36	-81	-83	-44.9	-57.9	36.1	25.1	100.000%	100.000%	55	42
16QAM 3/4	78	50	21	23	10	0	36	35	-78	-79	-45.9	-57.9	32.1	21.1	100.000%	100.000%	54	42
64QAM 2/3	104	50	20	22	9	0	36	34	-74	-75	-46.9	-57.9	27.1	17.1	100.000%	100.000%	53	42
64QAM 3/4	117	50	19	21	8	0	36	33	-72	-73	-47.9	-57.9	24.1	15.1	100.000%	100.000%	52	42
64QAM 5/6	130	50	18	18	7	0	36	30	-71	-71	-50.9	-57.9	20.1	13.1	100.000%	100.000%	49	42

* EIRP calculation is based on single chain Tx power as defined by regulations

Important Note: The provided calculations are not a guarantee of link performance. The data is provided in order to assist with the design of a wireless link using Tsunami 8000/800 product. The calculated performance may be useful for comparison with the actual system when installed. These calculations assume an unobstructed line-of-site radio path with adequate clearance for antenna height above terrain and obstructions. The availability and outage results are based on the industry-standard formulae and use the manufacturer's specified performance for transmitter output power, receiver threshold, and antenna gain. Standard factors apply for the terrain type and current climate conditions, assuming no unusual or multipath propagation.

Figure 2-5 Proxim Link Calculator

3 Statement of Warranty

Warranty Coverage

Proxim Wireless Corporation warrants that its products are manufactured solely from new parts, conform substantially to specifications, and will be free of defects in material and workmanship for a Warranty Period of 1 year from the date of purchase.

Repair or Replacement

When Proxim determines that a returned product does not meet the warranted criteria during the warranty period, Proxim at its option, will either: (a) repair the defective product; (b) replace the defective product with a new or refurbished product that is at least equivalent to the original; or (c) refund the price paid for the defective product. Generally, products are repaired or replaced within thirty (30) business days of receipt of the product at a Proxim Logistical/Repair Center. The warranty period for repaired or replacement products is ninety (90) days or the remainder of the original warranty period, whichever is longer. These three alternatives constitute the customer's sole and exclusive remedy and Proxim's sole and exclusive liability under warranty provisions.

Limitations of Warranty

Proxim's warranties do not apply to any product (hardware or software) which has (a) been subjected to abuse, misuse, neglect, accident, or mishandling, (b) been opened, repaired, modified, or altered by anyone other than Proxim, (c) been used for or subjected to applications, environments, or physical or electrical stress or conditions other than as intended and recommended by Proxim, (d) been improperly stored, transported, installed, or used, or (e) had its serial number or other identification markings altered or removed.

Buyers can contact Proxim Wireless Customer Service Center either by telephone or via web. Support and repair of products that are out of warranty will be subject to a fee. Contact information is shown below. Additional support information can be found at Proxim Wireless's web site at http://my.proxim.com.

Contact technical support via telephone as follows:

USA and Canada Customers

- **Phone**: +1-408-383-7700; +1-866-674-6626
- **Business Hours**: 24x7 live response. Tier 3 support: 8 a.m. to 5 p.m. M-F PDT (UTC/GMT -7 hrs)

International Customers

- **Phone**: +1-408-383-7700; 0800-916475 (France); 8-800-100-9485 (Russia)
- **Business Hours**: 24x7 live response. Tier 3 support: 8 a.m. to 5 p.m. M-F PDT (UTC/GMT -7 hrs)

General Procedures

When contacting the Customer Service for support, Buyer should be prepared to provide the product description and serial number and a description of the problem. The serial number should be on the product.

In the event the Customer Service Center determines that the problem can be corrected with a software update, Buyer might be instructed to download the update from Proxim Wireless's web site or, if that's not possible, the update will be sent to Buyer. In the event the Customer Service Center instructs Buyer to return the product to Proxim Wireless for repair or replacement, the Customer Service Center will provide Buyer a Return Material Authorization ("RMA") number and shipping instructions. Buyer must return the defective product to Proxim Wireless, properly packaged to prevent damage, shipping prepaid, with the RMA number prominently displayed on the outside of the container.

Calls to the Customer Service Center for reasons other than product failure will not be accepted unless Buyer has purchased a Proxim Wireless Service Contract or the call is made within the warranty period. After the warranty period, Technical Support is fee based (detailed in Technical Services and Support).

If Proxim Wireless reasonably determines that a returned product is not defective or is not covered by the terms of this Warranty, Buyer shall be charged a service charge and return shipping charges.

Other Information

Search Knowledgebase

Proxim Wireless stores all resolved problems in a solution database at the following URL: http://my.proxim.com.

Create a Support Request

Submit a question or open an issue to Proxim Wireless technical support staff at the following URL: https://my.proxim.com/new_case.

4 Technical Services and Support

Obtaining Technical Service and Support

If you are having trouble using the Proxim product, please read this guide and the additional documentation provided with your product. If you require additional support to resolve your issue, please be ready to provide the following information before you contact Proxim's Technical Services team:

- Product information
  - Part number and serial number of the suspected faulty device
- Trouble/error information
  - Trouble/symptom being experienced
  - Activities completed to confirm fault
  - Network information (What kind of network are you using?)
  - Circumstances that preceded or led up to the error
  - Message or alarms viewed
  - Steps taken to reproduce the problem
- ServPak information (if a Servpak customer):
  - ServPak account number
- Registration information
  - If the product is not registered, date and location where you purchased the product

: Technical Support is free for the warranty period from the date of purchase.

Support Options

Proxim eService Web Site Support

The Proxim eService Web site is available 7x24x365 at http://my.proxim.com.

On the Proxim eService Web Site, you can access the following services:

- **Product Download Page**: Provides quick links to product firmware, software, and documentation downloads.
- **Proxim TV Links**: A link to helpful video tutorials.
- **Knowledgebase**: A solution database of all the resolved problems. You can search by product, category, keywords, or phrases.
- **Live Chat**: Chat with a support technician on-line or request to call back at a later time.
- **Create a Support Request**: Create a support request with our technical support staff who will reply to you by email.
- **Case Management**: Login to check the status of your support cases, update your personal profile, or access restricted information and features.
- **Provide Feedback**: Submit a suggestion, complaint, or other feedback about the support site and our products.

Telephone Support

Contact technical support via telephone as follows:

- **USA and Canada Customers**
  - **Phone**: +1-408-383-7700; +1-866-674-6626
  - **Business Hours**: 24x7 live response. Tier 3 support: 8 a.m. to 5 p.m. M-F PDT (UTC/GMT -7 hrs)
- **International Customers**
  - **Phone**: +1-408-383-7700; 0800-916475 (France); 8-800-100-9485 (Russia)
  - **Business Hours**: 24x7 live response. Tier 3 support: 8 a.m. to 5 p.m. M-F PDT (UTC/GMT -7 hrs)

ServPak Support

To provide even greater investment protection, Proxim Wireless offers a cost-effective support program called ServPak. ServPak is a program of enhanced service support options that can be purchased as a bundle or individually, tailored to meet your specific needs. Whether your requirement is round the clock technical support or advance replacement service, we are confident that the level of support provided in every service in our portfolio will exceed your expectations.

All ServPak service bundles are sold as service contracts that provide coverage for specific products from 1 to 3 years. Servpak bundles are considered an upgrade to the standard product warranty and not an extension.

All Plans Include	ServPak Plus	ServPak Prime	ServPak Elite
24x7 Basic Technical Support	**Basic Advanced Replacement (Two business days/ International economy shipment service)**	**Priority Advanced Replacement (Next business day/ International priority shipment service)**	**Priority Comprehensive Advance Replacement (Next business day/ International priority shipment service)**
8x7 Advanced Technical Support		**24x7 Advanced Technical Support**	**24x7 Advanced Technical Support**
Software Maintenance		**PVES & PV NMS Support**	**PVES & PV NMS Support**
Access to Knowledge Base			**Post-Installation Optimization**
			50% discount on Onsite Technical Support and Services

Additional Information on ServPak Options

Advanced Replacement of Hardware

In the event of a hardware failure, our guaranteed turnaround time for return to factory repair is 30 days or less. Customers who purchase this service are guaranteed replacement of refurbished or new hardware to be shipped out within one or two business days, as applicable. Options are available for shipment services depending on the customer's support needs. Hardware is shipped on business days, Monday – Friday excluding Holidays, 8:00 AM – 3:30 PM Eastern Time.

Comprehensive Advanced Replacement of Hardware

In addition to ServPak Prime options, in the event of a hardware failure, Proxim will repair or replace the failed product for any reason, other than vandalism.

7x24x365 Availability

Unlimited, direct access to technical support engineers 24 hours a day, 7 days a week, 365 days a year including Holidays.

8x5 Availability

Unlimited, direct access to world-class technical support engineers 8 hours a day, 5 days a week, Monday through Friday from 8:00AM - 5:00PM Pacific Standard Time.

Basic Technical Support

Customers who purchase this service can be rest assured that their call will be answered by Proxim's Tier 1 technical support and a case opened immediately to document the problem and provide initial troubleshooting to identify the solution and resolve the incident in a timely manner.

Advanced Technical Support

In addition to Proxim's world-class Tier 1 technical support, customers will be able to have their more complex issues escalated to our world-class Tier 3 technical support engineers. Our Tier 3 engineers will review specific configurations to troubleshoot intricate issues and will also provide helpful insights regarding Proxim's products and various tips from decades of collective experience in the wireless industry.

Software Maintenance

It's important to maintain and enhance security and performance of wireless equipment and Proxim makes this easy by providing a Software Maintenance program that enables customers to access new feature and functionality rich software upgrades and updates. Customers will also have full access to Proxim's vast Knowledgebase of technical bulletins, white papers and troubleshooting documents.

Post-Installation Optimization

You can consult with our technical support engineers to enhance performance and efficiency of your network. Post-installation optimization services include:

- Review frequencies to select best possible channel
- Review Modulation, Channel Bandwidth, MIMO, and WORP settings to optimize throughput and link quality
- Review Satellite Density & TPC/ATPC settings
- Assistance with Bandwidth controls

- Assistance with QoS, RADIUS, and VLAN settings on Proxim equipment

To purchase ServPak support services, please contact your authorized Proxim distributor. To receive more information or for questions on any of the available ServPak support options, please visit our website at http://www.proxim.com/support/servpak, call Proxim Support (For telephone numbers, see Telephone Support) or send an email to servpak@proxim.com.

Technical Support Policy

Technical Support for Current Products during Warranty Period

All Customers are entitled to free technical support for the Proxim products they purchase from Proxim's authorized resellers or distributors. Technical Support is defined as communication via the Proxim Support website (http://my.proxim.com) and/or via telephone. This technical support will be provided for free for the entire time the product is covered by a Proxim warranty. The term of Proxim's warranty is determined according to the agreement under which the product was sold and generally varies from 3 months to 2 years depending on the product. If a Customer disagrees with Proxim's determination of warranty duration, a request for review supported by a copy of all product purchase documentation may be submitted.

Technical Support for Current Products after Warranty Period

After the warranty period, technical support on products then being sold by Proxim will be based upon one of the following three options Customers can choose:

- Customers can choose to purchase one of Proxim's ServPak extended warranty and enhanced support packages for the product
- Customers can choose to purchase one-time per-incident technical support for the product for a fee
- Customers can choose to call the reseller or distributor who sold them the product for technical support

Tech Support on Discontinued Products

Technical Support on some products that Proxim has declared as EOL (End of Life) or otherwise is no longer selling is available based upon one of the following three options Customers can choose:

- For some discontinued products, Customers can choose to purchase one of Proxim's EOL ServPak support packages for the product
  - No EOL ServPak support package will be available for any product discontinued more than 5 years ago
  - No EOL ServPak support package is available for certain discontinued products
- Customers can choose to purchase one-time per-incident technical support for the product on a per hour basis at a rate of $125 an hour (4 hours minimum payable in advance by major credit card). This fee is payable in addition to any RMA fee that may be charged to subsequently repair the product.
- Customers can choose to call the reseller or distributor who sold them the product for technical support

All Proxim technical support for discontinued products, whether through an EOL ServPak package or otherwise, is provided on a "best effort" basis and is subject to the continued availability of necessary components, equipment, and other technical resources.

Note that Proxim is unable to support or warrant any equipment that has been modified, whether this modification is physical, or if third-party software codes have been loaded onto the product.