70/80 GHz

AireLink™

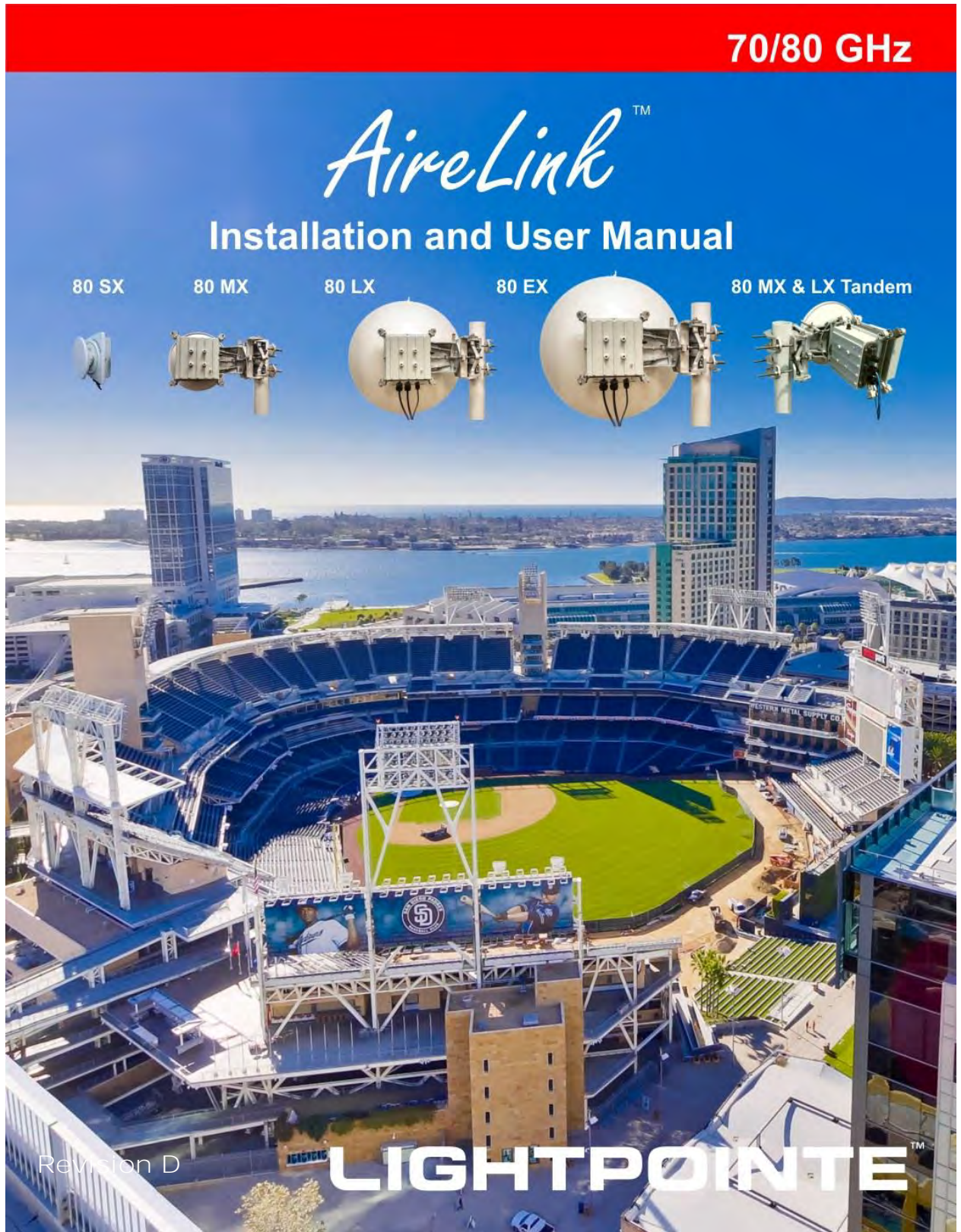## Installation and User Manual

80 SX 80 MX 80 LX 80 EX 80 MX & LX Tandem

Revision D

LIGHTPOINTE™

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INFORMATION TO USER

> *NOTE: CHANGES OR MODIFICATIONS OF THE SYSTEM NOT EXPRESSLY APPROVED BY LIGHTPOINTE COULD VOID THE USER'S AUTHORITY TO OPERATE THE EQUIPMENT.*

Cautions and Warnings

The following symbols are used in this manual to indicate that the installer should take particular caution to prevent injury or damage to the equipment.

Exercise caution when you see this symbol. It indicates actions that could be harmful to the installer or to the equipment.

Prenez garde lorsque vous voyez ce symbole, il s'agit d'un avertissement indiquant qu'il y a danger pour l'installateur ou l'equipement.

Exercise extreme caution when you see this symbol. It indicates potentially lethal voltages!

Soyez extremement prudent lorsque vous voyez ce symbole, il s'agit d'un avertissement denotant la presence de haut voltage pouvant causer la mort ou des blessures graves.

Note: There are no serviceable parts within the units and the system should not be opened in the field.

Observe Standard Precautions

All persons having access to this equipment must observe all standard precautions as defined in applicable national statutory health and safety legislation.

The outdoor equipment must be properly protected against voltage surges and prevent the built-up of static electric charges. We recommend following the IEC 61024/ IEC 62305 standards for proper lightning protection.

For installations in the U.S.A., for information with respect to proper grounding and applicable lightning protection for DC cables please refer to Articles 810830 of the National Electrical Code, ANSI/NFPA No. 70.

In case the system is installed in a country outside of the U.S.A., implement protection in accordance with local safety standards and regulatory requirements.

Do not install or operate this equipment in the presence of or close to flammable gases or fumes. Operation of any electrical equipment in such an environment constitutes a potential safety hazard.

Qualified Personnel

Qualified personnel who understand and are trained to work with the equipment must perform all repair, modification, reconfiguration, and upgrading operations.

Note: Always power the system down before moving or removing the system.

Service

There are no serviceable parts within the radio units. Only factory trained personnel can provide service on any internal components of the radio units.

Export Control

All LightPointe AireLink™ radio products are commodities that fall under ECCN 5A002 of the Department of Commerce. These products are "ENC restricted" under section 740.17(b)(1) of the Export Administration Regulations (EAR). This License Exception ENC does not authorize export or re-export to, or provision of any service in any country listed in Country Group E:1 in Supplement No. 1 to part 740 of the EAR. Diversion contrary to U.S. law is expressly prohibited.

Regulatory Information

North America:

47 CFR §15.19

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

47 CFR §15.105

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

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

47 CFR Part 101

These devices have been type approved by FCC in accordance with 47 CFR PART 101 of the Federal Communication Commission rules.

In the U.S. millimeter wave radio transmission equipment operating in the 70/80 GHz frequency bands are regulated using a Lite Licensing registration procedure. Customers in other countries are responsible for obtaining proper operator licenses in case they are required by law.

This device complies with Part 101 of the FCC Rules. Operation is subject to the following conditions:

This device may not cause harmful interference, and

This device must accept any interference received, including interference that may cause undesired operation.

European Union:

These devices are in compliance with the European Directive R&TTE 1999/5/EC on Radio Equipment and Telecommunications Terminal Equipment and have been assessed against the following Applicable Standards:

EN 302 217-3 V2.2.1 (2014-04)

R&TTE: EN 302 217-4-2 V1.5.1 (2010-01)

EN 301 489-1 V1.9.2 (2011-09)

EN 301-489-4 V2.2.0 (2015-01)

IEC/EN 60950-1:2005 (2nd Ed.), +A1: 2009, +A11:2009, +A12:2011

CE ①

Environmental: This product is ROHS compliant

Other Recommendations and Selected National Standards

ECC/CEPT: CEPT ERC/REC/(05)07

Germany: Mitteilung Nr. *233/2010*

Austria: FSB-RR071

France: Décision n° 2010-1044

To ensure public safety requirements for installation of an RF system in an uncontrolled location, an RF exposure calculation was performed by an independent and accredited test lab (BACL USA). The results are presented below.

Safe distance according to FCC CFR 47 § 1.1307, §1.1310; and Industry Canada's (IC)
RSS-102, Issue 5, Safety Code 6

For the safety distance calculation, the power density limits and average exposure time according to the US FCC and Industry Canada IC regulation was taken into consideration. According to FCC § 1.1310 the limits for general population and uncontrolled exposure are as follows:

Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm²)	Averaging Time (minutes)
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f²)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

Industry Canada's RSS-102 requirement are listed below and are slightly different from the FCC regulation.

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m²)	Time Averaging (min)
0.003 - 1	280	2.19	-	6
1 - 10	280 / f	2.19 / f	-	6
10 - 30	28	2.19 / f	-	6
30 – 300	28	0.073	2*	6
300 – 1 500	1.585 f^{0.5}	0.0042 f^{0.5}	f / 150	6
1 500 – 15 000	61.4	0.163	10	6
15 000 – 150 000	61.4	0.163	10	$616000 / f^{1.2}$
150 000- 300 000	0.158 f^{0.5}	4.21 x 10 -4 f^{0.5}	$6.67 \times 10^{-5} f$	$616000 / f^{1.2}$

*Note: f is frequency in MHz. * Power density limit is applicable at frequencies greater than 100 MHz.*

A calculation was performed to confirm the required safe distance for fixed service devices.

Limit for power density for general population/uncontrolled exposure was calculated for a power density of max. 1 mW/cm^2 and for the frequency range 1500 -100000 MHz.

MPE Prediction

Predication of MPE limit at a given distance, Equation from OET Bulletin 65, Edition 97-01
S = PG/4_R²
Where: S = power density
P = power input to antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

MPE Results

41dBi antenna

Maximum tune up power at antenna input terminal (dBm):	13
Maximum tune up power at antenna input terminal (mW):	19.95
Prediction distance (cm):	142
Prediction frequency (MHz):	71500
Maximum Antenna Gain, typical (dBi):	41
Maximum Antenna Gain (numeric):	12589.25
Power density of prediction frequency at 142 cm (mW/cm^2):	0.9913
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

45dBi antenna

Maximum tune up power at antenna input terminal (dBm):	13
Maximum tune up power at antenna input terminal (mW):	19.95
Prediction distance (cm):	225
Prediction frequency (MHz):	71500
Maximum Antenna Gain, typical (dBi):	45
Maximum Antenna Gain (numeric):	31622.78
Power density of prediction frequency at 225 cm (mW/cm^2):	0.9918
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

51dBi antenna

Maximum tune up power at antenna input terminal (dBm):	13
Maximum tune up power at antenna input terminal (mW):	19.95
Prediction distance (cm):	448
Prediction frequency (MHz):	71500
Maximum Antenna Gain, typical (dBi):	51
Maximum Antenna Gain (numeric):	125892.5
Power density of prediction frequency at 448 cm (mW/cm^2):	0.9959
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

54dBi antenna

Maximum tune up power at antenna input terminal (dBm):	13
Maximum tune up power at antenna input terminal (mW):	19.95
Prediction distance (cm):	632
Prediction frequency (MHz):	71500
Maximum Antenna Gain, typical (dBi):	54
Maximum Antenna Gain (numeric):	251188.6
Power density of prediction frequency at 632 cm (mW/cm^2):	0.9985
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

RF Exposure Summary

To comply with the FCC/IC RF exposure limits the device must be installed so as to maintain the following minimum separation distance between the main lobe of the transmit antenna (front of the antenna) and nearby persons. At these distances the average exposure time should be limited to 30 minutes (FCC) and 10 minutes (IC)

Pour se conformer aux limites d'exposition aux RF de RS-102, Issue 5, la distance minimale de **séparation entre la principale source d'émission (avant de l'antenne) et des personnes à proximité** droit être limité à:

41dBi antenna

The worst power density level at 142 cm is 0.9913 mW/cm^2 antenna, which is below the uncontrolled exposure limit of 1.0 mW/cm^2.

45dBi antenna

The worst power density level at 225 cm is 0.9918 mW/cm^2 antenna, which is below the uncontrolled exposure limit of 1.0 mW/cm^2.

51dBi antenna

The worst power density level at 448 cm is 0.9959 mW/cm^2 antenna, which is below the uncontrolled exposure limit of 1.0 mW/cm^2.

54dBi antenna

The worst power density level at 632 cm is 0.9985 mW/cm^2 antenna, which is below the uncontrolled exposure limit of 1.0 mW/cm^2.

Configuration	Antenna size	Antenna gain	Minimum separation
AireLink™80 SX	20 cm	41 dBi	142 cm (4.7 feet)*
AireLink™80 MX	30 cm	45 dBi	225 cm (7.4 feet)*
AireLink™80 LX	60 cm	51 dBi	448 cm (14.7 feet)*
AireLink™80 EX	90 cm	54 dBi	632 cm (20.7 feet)*

*Average exposure time 30 minutes (FCC) or 10 minutes (IC).

FCC ID : PHVAK80 *Warning: This device is a high-powered transceiver that operates at frequencies that could be potentially harmful to human tissue if the following precautions are not taken,* *(1) Minimum safe operating distance of 1.42 meters must be observed at all times between unit and users** *(2) Unit shall be mounted so that minimum operating distance is no inadvertently impinged by the public, or non- user personnel.* **Please see exposure limits listed in FCC §1.1310* **FC**	**FCC ID : PHVAK80** *Warning: This device is a high-powered transceiver that operates at frequencies that could be potentially harmful to human tissue if the following precautions are not taken,* *(1) Minimum safe operating distance of 2.25 meters must be observed at all times between unit and users** *(2) Unit shall be mounted so that minimum operating distance is no inadvertently impinged by the public, or non- user personnel.* **Please see exposure limits listed in FCC §1.1310* **FC**

AireLink™80 SX   AireLink™80 MX

FCC ID : PHVAK80 *Warning: This device is a high-powered transceiver that operates at frequencies that could be potentially harmful to human tissue if the following precautions are not taken,* *(1) Minimum safe operating distance of 4.48 meters must be observed at all times between unit and users** *(2) Unit shall be mounted so that minimum operating distance is no inadvertently impinged by the public, or non- user personnel.* **Please see exposure limits listed in FCC §1.1310* **FC**	**FCC ID : PHVAK80** *Warning: This device is a high-powered transceiver that operates at frequencies that could be potentially harmful to human tissue if the following precautions are not taken,* *(1) Minimum safe operating distance of 6.32 meters must be observed at all times between unit and users** *(2) Unit shall be mounted so that minimum operating distance is no inadvertently impinged by the public, or non- user personnel.* **Please see exposure limits listed in FCC §1.1310* **FC**

AireLink™80 LX   AireLink™80 EX

CE Declaration of Conformity

Date of Issue: 2017-03-17

We, LightPointe Communications, Inc., with address 11696 Sorrento Valley Road, Suite 101, San Diego, CA 92121 declares under our sole responsibility that:

Product Description: Point-to-Point Millimeter Wave Transmission System

Model Number(s):   **AireLink™ 80**-xx

To which this declaration relates is in conformity with the following standard(s) or other normative document(s) that this product has been assessed against the following Applicable Standards:

EN 302 217-3 v2.2.1 (2014-4)

EN 302 217-4-2 v1.5.1 (2010-01)

R&TTE: EN 301 489-1 V1.9.2 (2011-09)

EN 301 489-04 v2.2.0 (2015-01)

IEC/EN 60950-1:2005 (2nd Ed.), +A1: 2009, +A11:2009, +A12:2011

To which this declaration relates is in conformity with the provisions of the following Directives:

Directive R&TTE 1999/5/EC on Radio Equipment and Telecommunications Terminal Equipment

The CE Mark shall be affixed on the product as evidence of compliance to this declaration.

Declaration by:

Brian Schick	Director of Operations
Name	Title

	2017-03-17
Signature	Date

Warranty Information

LightPointe warrants this product against faulty materials or workmanship under the terms of a Standard Warranty and Support Agreement provided that the product was purchased directly from LightPointe or from one of our authorized resellers. Please contact LightPointe Customer Service for additional information or to obtain a copy of the Warranty Agreement.

Contacting LightPointe

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Website: www.LightPointe.com

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1   INTRODUCTION

Before starting to cover details on how to install the system we will briefly review the system components included with the shipment and explain the basic principle of operation.

1.1   SHIPPING CONTENT

The **AireLink™80** system is shipped with an integrated or an external antenna. Depending on the system ordered packaging / box contents will be different.

1.1.1   AireLink™80 with integrated antenna

The **AireLink™80** SX ships in a single box. Please verify that the shipment contains the following items:

- Two 80 GHz radios with integrated 200 mm lens antenna
- Two mounting brackets
- Two RSSI Alignment cables for use with voltmeter
- Two ferrite beads
- One Micro USB cable
- Two Power over Ethernet (PoE) injectors (optionally: Two 48 Vdc outdoor rated power supplies)
- Two **Bluetooth™** rubber antennas with SMA connector
- CD with Installation Manual

Figure 1-1: **AireLink™80** SX with integrated antenna (left) and accessories (right)

The **AireLink™80** SX system ships with all accessories necessary to install the system as well as a heavy-duty alignment bracket.

1.1.2 AireLink™80 with external antenna:

The **AireLink™80** MX/LX/EX with external antenna ships in three separate boxes. Please verify that the shipment contains the following items:

- Two detachable **AireLink™80** outdoor radio transmission units (ODU)
- Two Power over Ethernet (PoE) injectors (optionally: Two 48 Vdc outdoor rated power supplies)
- Two RSSI Alignment cables for use with voltmeter
- One Micro USB cable
- Two **Bluetooth™** rubber antennas with SMA connector
- Two antennas (either 12", 24" or 36") w/attached side pole mounting bracket
- CD with Installation Manual
- Optional: Site Alignment Tool

  The pictures below show the content of each individual shipping box.

Figure 1-2: Shipping Box 1 (**AireLink™80** detachable ODU and accessories)

Figure 1-3: Shipping Boxes 2 and 3 (1 foot antennas)
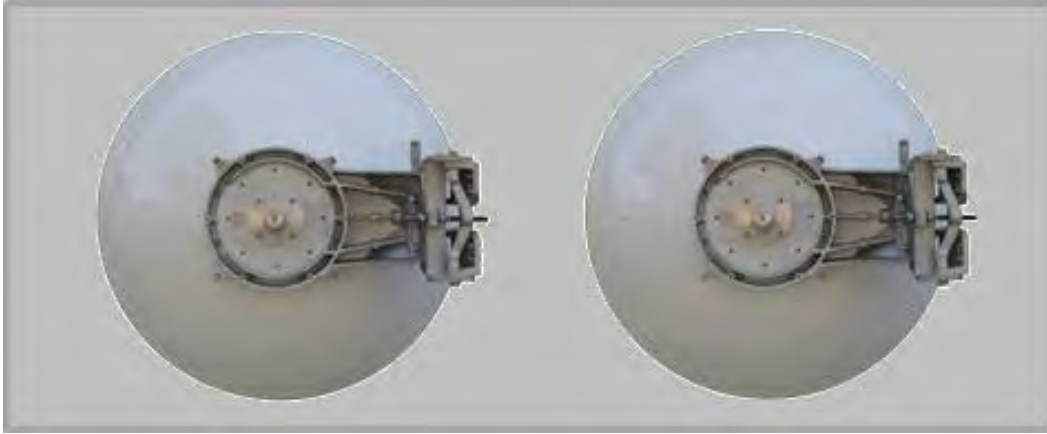
Figure 1-4: Shipping Boxes 2 and 3 (2 and 3 foot antennas)

1.2   MAIN RADIO COMPONENTS

The **AireLink™80** ships either with an integrated 200 mm parabolic antenna or with external **12", 24" or 36"** high gain parabolic Cassegrain antennas.

1.2.1   AireLink™80 ODU with integrated antennas

The **AireLink™80** with integrated lens antenna shown in Fig. 1-5 is designed around an aluminum-based IP 66 rated outdoor housing to protect the electronics from rain, dust and other environmental conditions. The system can be used to easily create a shorter distance point to point wireless Network connection between remote locations. This highly integrated and outdoor rated system can be easily installed at walls, towers or other structure by using the pole mount alignment bracket that comes with the system. The stainless steel mounting bracket is designed to accommodate pole diameters **ranging from 2.5….4.5 inches** (65…115 mm). All network/management and power connectors located on the system user panel can be easily accessed via a clear and detachable access panel cover. Power and port status LEDs on the back panel are visible from the outside through the transparent cover. IP67 rated cable gland compression fittings for power/networking cables are integrated into the access panel cover.

The transmission equipment operates in full-duplex mode and in slightly different frequency bands. The lower band radio transmits in the 71…76 GHz GHz frequency band and the upper band radio transmits in the 81…86 GHz frequency band. On the back panel is a HIGH BAND and LOW BAND sticker to distinguish between the radios. The **AireLink™80** radios are equipped with a **Bluetooth™** Low Energy (BLE) transceiver that allows for remotely monitoring the radio via smart phone of tablet via an encrypted and password protected **Bluetooth™** connection. Figure 1-5 shows the **Bluetooth™** antenna attached to the radio enclosure.

Figure 1-5: **AireLink™80** SX with integrated antenna and view of access panel cover

1.2.2 AireLink™80 ODU with external antennas

The longer distance version of the **AireLink™80** comes with separate antennas and a detachable radio outdoor unit (ODU). The ODU electronics is contained within an aluminum-based outdoor housing to protect the electronics from rain, dust and other environmental conditions. Same as the integrated antenna solution, the radios operate in full-duplex mode. A sticker on the back panel shows the HIGH BAND and LOW BAND radio unit. The ODU is shown in Fig. 1-6. It can be easily detached from the antenna by releasing the 4 spring loads latches and simply pulling the ODU of the antenna waveguide flange. Same as the **AireLink™80** radios with integrated antenna, the ODU is equipped with a **Bluetooth™** Low Energy (BLE) transceiver that allows for remotely monitoring the radio via smart phone of tablet via an encrypted and password protected **Bluetooth™** connection. The **Bluetooth™** antenna has ships with the system is attached to a SMA connector located at the side of the enclosure.

Figure 1-6: **AireLink™80** ODU

The ODU is fully IP 67 outdoor rated and all network/management and power connectors can be easily accessed via a clear and detachable access panel cover. The transparent cover also allows to see all network port status indicators. The ODU can be easily removed from the antenna waveguide by releasing 4 spring loaded latches. The ODU is the same for all external antennas. By rotating the ODU 90 degrees the polarization can be changed easily. Chapter 4 describes the ODU Networking, Service and Power Connections in more detail.

1.2.3   External Antennas and Mounting Brackets

Depending on the system ordered, the **AireLink™80** is shipped either with a high performance and high **gain 12", 24" or 36"** parabolic Cassegrain antenna. The mounting and alignment bracket is the same for both antennas. Fig. 1-7 shows the **12"** (top) and **24"** (bottom) system. For illustrative purposes the systems are shown with and without the ODU attached.
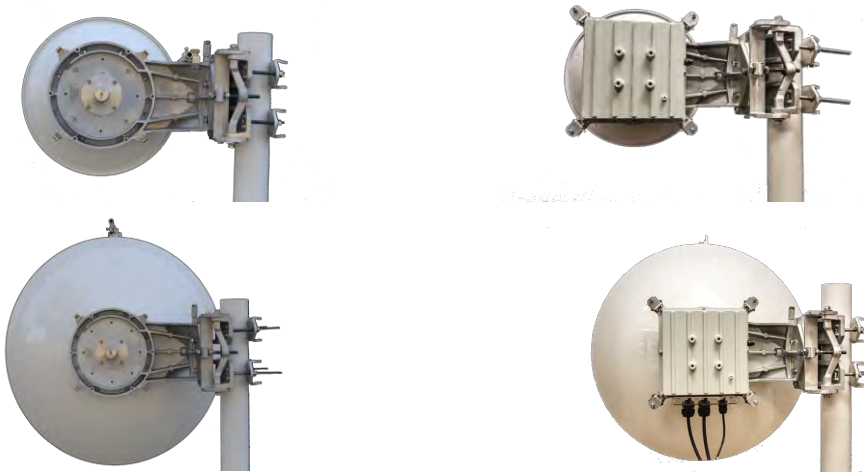
Figure 1-7: **AireLink™80** with one foot (top) and two foot (bottom) antennas attached.

The antenna is equipped with a robust side pole mounting and alignment bracket. The bracket easily attaches to a vertical structure with pole diameters **from 2.5…4.0 inches (65…110 mm)**. The pole mounted alignment bracket is shown in Fig. 1-8. Also shown are the locations of the horizontal and vertical alignment screws.
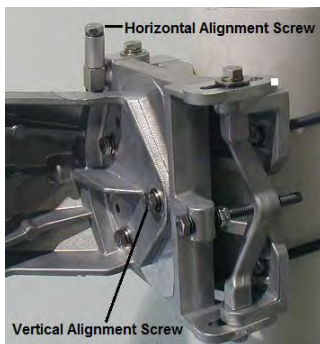
Figure 1-8: Alignment bracket and locations of alignment screws

1.2.4   Power over Ethernet (PoE) Modules

The **AireLink™80** system ships standard with two Power over Ethernet (PoE) injectors for powering the transmission units. The power provided to the **AireLink™80** unit travels over a separate CAT5E/CAT6 cable as the network data but shares a cable with the out-of-band management connection. The PoE modules accept universal 90-240 Vac input and provide 48Vdc to the **AireLink™80** units. The port labeled Output on the PoE should be connected to the RJ-45 port labeled Management/PoE on the **AireLink™80** unit. The port labeled Input on the PoE injector can be connected to your management network to enable out-of-band system management. The PoE injector is shown in Fig. 1.9 below.

Figure 1-9: Power over Ethernet modules

In case the customer orders the system with the dc power option rather than the standard PoE supplies, the PoE injectors will be replaced with a dc power supply (Figure 1-10 below).

Figure 1-10: Optional dc power supply

1.2.5 Miscellaneous

1.2.5.1   RSSI Alignment Cables

A digital voltmeter is used to measure the RSSI voltage changes of the receive signal level during alignment. Two cables, one for each **AireLink™80** radio unit, are provided with the shipment. The cables are terminated on one side with a 2-pin female connector for attachment to the **AireLink™80** waterproofed IP67 RSSI voltage connector located at the side of the radio enclosure. At the opposite side the cable has banana plug connectors for attachment to a digital voltmeter (see Fig. 1-11).

Figure 1-11: RSSI alignment cables

1.2.5.2   Lightning/ Surge Protection

When using the PoE powering/management option and/or the copper data port rather than the fiber data port option, we strongly recommend using a surge protector to protect networking equipment attached to the radio to suffer from potential lightning strikes. In case of the PoE/management port, a 10/100 Mbps solution with built in PoE power protection will be sufficient. To protect the 1000 Mbps copper data port connection, a GbE capable surge protector solution must be used. Figure 1-14 (left) below shows examples of Ethernet surge protector in an outdoor rated and weather resistant enclosure made by Enable-IT http://www.ethernetextender.com/ethernet-extension-products/lightning-protection/265LP.php.

The device in the left of Figure 1-12 is an outdoor rated GbE and PoE+ capable Ethernet lightning/surge protector (LightPointe part number LM-SURGE-1). LightPointe recommend to install a lightning/surge protector close to the AireLink radio head to prevent damage to the indoor networking equipment that is connected to the radio head via CAT5/6 copper cable.

In case the direct two wire 48 Vdc powering option is used, we also strongly recommend using a surge protector to prevent potential lightning strike surges to enter the in-building power plant. The device on the right in Figure 1-12 is a 48 Vdc surge protector made by Transtector (**Transtector DCOD 48-2.5**) http://www.smithspower.com/brands/transtector/products/dc-surge-protection/1101-1025

CAT5/6 Ethernet Cable Surge Protectors   48 Vdc Powerline Surge Protector
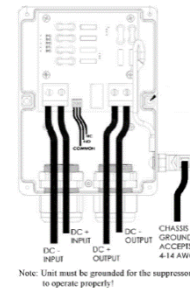
Figure 1-12: Surge Protectors

1.2.5.3   Optional: Antenna Alignment Tool

To ease the alignment of the narrow beam external antennas, LightPointe can provide a simple alignment tool (see Figure 1-14) to correctly aim the antenna beam towards the remote antenna site. The tool works very similar but it is different for the integrated and the externals antennas. In particular, when aligning the longer range 2 and 3 foot antennas and or when installing the antennas on a tower, this tool will reduce the time it takes to get the antennas aligned correctly. The alignment tool is attached to the ODU /antenna mount and can be easily removed after the alignment process is completed. It can therefore be easily re-used when multiple antennas need to be aligned. The function, installation and use of the alignment tool will be explained in detail in Chapter 4.

Figure 1-14: Alignment Tool for integrated (left) and external Antenna (right)

2   SURVEYING THE INSTALLATION SITE

Chapter 2 educates the user on millimeter wave transmission technology and the site survey/review process used in successful deployment of LightPointe **AireLink™80** systems. Please read this chapter before installing the system.

2.1   TOOLS

Please ensure that the following measures have been taken and that tools are available for surveying the installation site.

> ➢ Have permission of building owner to install the system
> ➢ Ensure that the installation meets any local requirements
> ➢ Use an accurately scaled map for locating sites and doing rough distance calculations
> ➢ Laser range finder or GPS for accurate distance measurement (optional)
> ➢ Binoculars to assist in locating opposite-end installation site
> ➢ Sketch or notepad to make rough drawings and notes
> ➢ Tape measure to determine approximate distance of fiber, power runs, etc.
> ➢ Camera to take pictures of the installation sites (optional)

2.2   INSTALLATION SITE REVIEW

When performing a site review certain measures must be taken to ensure the successful deployment of a millimeter wave transmission system.

> *Determine the appropriate system to meet the needs of each specific location:*

> ➢ Measure point-to-point distance using a map, a laser range finder or GPS coordinates
> ➢ Refer to the ITU rain zone chart and locate the ITU rain zone where the system will be installed
> ➢ Determine what physical connections will be required (e.g. SM/MM fiber or CAT5E/6 copper cable, PoE or direct 48 Vdc)

> *Determine line-of-sight*

Ensure that the antenna has sufficient path clearance. The Fresnel Zone is the area around the visual line-of-sight that radio waves spread out into after they leave the antenna (see Figure 2-1). To maintain good signal strength is important to maintain sufficient path clearance. Typically, a 20% Fresnel Zone blockage introduces little signal. However, nearing 40% blockage the signal loss will become significant.

➢ The Fresnel Zone formula shown below is based on a flat earth. In other words, it does not take the curvature of the earth into consideration. The effect of this is to budge the earth in the middle of the link. However, for relatively short distances, the effect of the earth's curvature and the specific topography of the terrain are negligible.

➢ Table 2-1 shows the calculated minimum path clearance required for operation of a pt-to-pt millimeter wave operating in the 80 GHz band based on the Fresnel Zone formula shown below.

$$r_{(in\ mts)} = 17.32 \times \sqrt{\frac{d\ (in\ Km)}{4f\ (in\ GHz)}} \qquad r_{(in\ ft)} = 72.05 \times \sqrt{\frac{d\ (in\ miles)}{4f\ (in\ GHz)}}$$
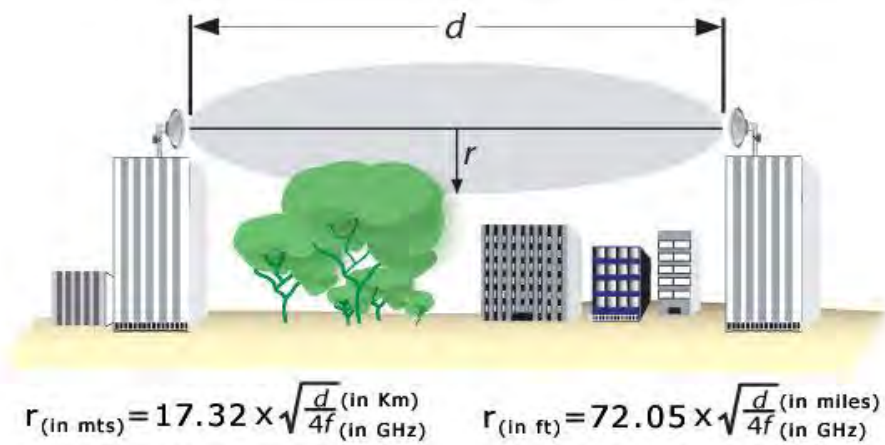
Figure 2-1: Fresnel Zone illustration.

Path length in meters	Path clearance radius r in meters
100	0.25
500	0.55
1000	0.80
2000	1.10
4000	1.50
10000	2.50

Table 2-1 Fresnel zone path clearance @80 GHz

➢ Can emissions, blowing or swaying trees, or other obstacles in the line of sight interrupt the connection?

➢ Is there a possibility of work activity or people passing in front of the transmission that could interfere with the clear line-of-sight

Evaluate environmental mounting conditions

➢ Only mount the radio transmission equipment to a stable and vibration-free mounting platform – this is a critical factor to successful performance.

➢ Evaluate that the foundation at the mounting location is not susceptible to change due to humidity or temperature (avoid wooden mounting platforms)

Evaluate mounting locations for human access

➢ Safe access to the radio transmission unit
➢ Stable location/platform to stand upon
➢ Safety considerations for installers and maintainers of the system in all weather conditions

Evaluate mounting locations to avoid interruptions of transmission

➢ Near roof edge to avoid people walking in front of the transmission unit
➢ Non-penetrating roof mount and at least 7 feet high to avoid people walking in front of the transmission unit
➢ Mounting the antenna in the middle of the roof and close to the roof surface can cause the antenna to experience undesirable multi-path reflections
➢ At the side or corner of a building wall without people being able to walk in front of the transmission unit
➢ Weather-protected location if possible
➢ Safe location that will not be subject to damage from vandals

Evaluate mount stability

➢ Solid concrete or steel structural building member
➢ Directly on a flat roof surface if using a non-penetrating mount
➢ Securely fastened to the side or top of parapet wall

2.3   LINK DISTANCE

Measurement of the link distance is important in estimating the link availability and calculating the expected Receive Signal Level (RSL). When using a Global Positioning System (GPS) device this measurement can be performed using the Latitude and Longitude coordinate readings from the proposed locations of the antennas. When a GPS device is not available, online tools like Google Earth are also very helpful to determine the link distance. However, GPS reading will be required in order to comply with any required regulatory registration process.

To estimate maximum distances and availabilities for a given product and region please refer to the **AireLink™** Fade Margin/Availability charts shown in Chapter 2.5.

2.4   ANTENNA LOCATION

For proper operation and easy maintenance, the optimum location for the antennas must be determined. The ideal location should provide for ease of erecting and mounting the antenna, as well as providing unimpeded LOS to the remote location. The following factors should be taken into account:

➢ Type of mounting—fixed installation or non-penetrating roof pole mounting
➢ Access location of fiber/RJ-45 cables and power wiring of the building
➢ Length of cable runs
➢ Earth Grounding connection points
➢ Potential obstructions (also temporary), including allowances for tree growth
➢ Accessibility of the radio mounting location
➢ Accessibility of the site during and after working hours

2.5   ATMOSPHERIC AND RAIN ATTENUATION OF MILLIMETER WAVE BEAMS

Millimeter wave systems operating in the 70/80 GHz frequency ranges are able to transmit and receive high data rates such as 1250 Mbps (Gigabit Ethernet) or higher due to wider spectrum bands available at higher frequencies. The actual distance/availability performance of a specific system depends on parameters such as transmission power, antenna size, and receiver sensitivity. In general terms millimeter wave frequencies are attenuated by rain and additionally by oxygen absorption in the case of systems operating in the 60 GHz frequency range. Oxygen absorption plays a minor role in the higher 70/80/90 GHz millimeter wave frequency ranges and therefore these systems are typically better suited in establishing a connection over longer distances. Millimeter wave transmission does not suffer from attenuation in fog or during sand storms. Figure 2-2 shows the typical atmospheric attenuation of signals in different frequency bands.
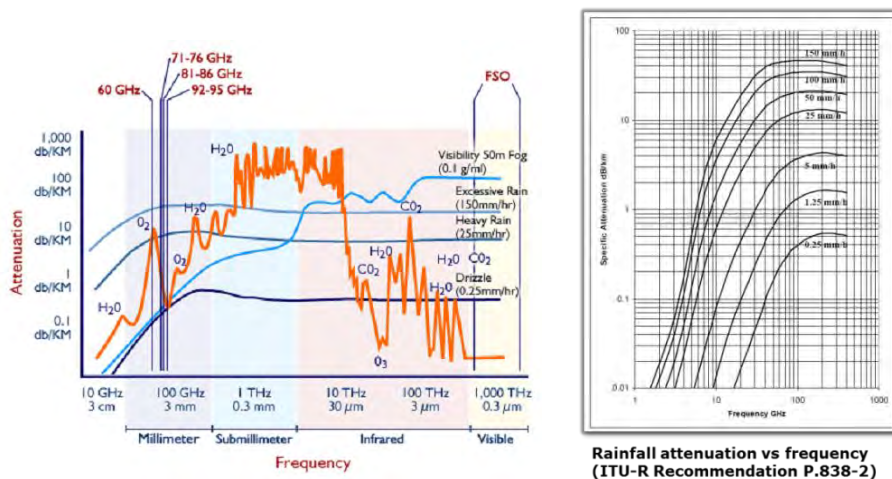
Figure 2-2: Atmospheric attenuation of signals at different frequencies.

Rain attenuation of millimeter wave signals has been studied extensively over several decades and models are available to reliably predict the availability of a millimeter wave transmission system in various rain zones around the world. Based on the actual rain rates collected in specific regions, the International Telecommunications Union (ITU) has published charts dividing the globe into separate rainfall regions. Similar charts with slightly different geographical breakdowns exist, based on the work of the researcher Crane. Both charts can be used to predict availability performance of millimeter wave transmission systems. Figure 2-3 shows the ITU chart of different rain rate regions of the world. The regions are divided by using an alphanumerical notation with region A having the least and region Q having the highest rain fall rates. Naturally the highest rain rates occur around the equator (rain zones N, P, Q) and in these regions rain rates up to 250 mm/h can be observed for very short periods of time. Very low rain rates (rain zone A) can be observed in the African, Middle Eastern and Asian dessert regions as well as in the Northern Polar regions.

Figure 2-3: ITU rain zone chart of the earth

Using the ITU or Crane rain zone charts one can calculate the availability of a millimeter wave transmission system in a specific rain zone. When it comes to rain attenuation it is important to keep in mind that the rain fall rate and not the total amount of yearly rainfall determines the availability of a millimeter wave radio system. For example, it is well known that the number of rainy days in the North Western region of the United States and in cities like Seattle greatly exceeds the number of rainy days in the South Eastern areas like Florida. However, when looking at Table 2-2, representing the actual duration of peak rain fall rates in mm/hour in different rain zones, one finds that the rain fall rate (or rain intensity) in the North Western region of the United States is far less when compared to

the rain fall rate in the south. Consequently, and using the same system availability figure, a millimeter wave system installed in the North West (rain zone D) can operate over a longer distance compared to a system installed in Florida (rain zone N), for example.

Avalability	Downtime/year	A mm/hr	A dB/km	B mm/hr	B dB/km	C mm/hr	C dB/km	D mm/hr	D dB/km	E mm/hr	E dB/km	F mm/hr	F dB/km	G mm/hr	G dB/km	H mm/hr	H dB/km
99.999%	5 min	22	10.54	32	14.04	42	17.29	42	17.29	70	25.56	78	27.77	65	24.15	83	29.12
99.99%	1 hr	8	4.86	12	6.62	15	7.86	19	9.42	22	10.54	28	12.67	30	13.36	32	14.04
99.9%	9 hr	2	1.68	3	2.29	5	3.39	8	4.86	6	3.9	8	4.86	12	6.62	10	5.76
99%	88 hr	0.1	0.17	0.5	0.58	0.7	0.75	2.1	1.74	0.6	0.67	1.7	1.48	3	2.29	2	1.68

Avalability	Downtime/year	J mm/hr	J dB/km	K mm/hr	K dB/km	L mm/hr	L dB/km	M mm/hr	M dB/km	N mm/hr	N dB/km	P mm/hr	P dB/km	Q mm/hr	Q dB/km
99.999%	5 min	55	21.25	100	33.59	150	45.82	120	38.62	180	52.68	250	67.75	170	50.43
99.99%	1 hr	35	15.04	42	17.29	60	22.72	63	23.58	95	32.3	145	44.65	115	37.39
99.9%	9 hr	20	9.8	12	6.62	15	7.86	22	10.54	35	15.04	65	24.15	75	26.95
99%	88 hr	8	4.86	1.5	1.35	2	1.68	4	2.86	5	3.39	12	6.62	24	11.26

Table 2-2: Rain rates, duration and 80 GHz signal attenuation

LightPointe calculates the **AireLink™80** availability vs. distance charts based on internal system parameters and ITU-R Recommendation P.838-3. These charts are shown below for North American (Figure 2-4), European (Figure 2-5) and Australian (Figure 2-6) rain zones and for the integrated 20 cm, as well as the external 30 cm, 60 cm and 90 cm antenna options. Other rain zone charts as well as a system fade margin calculator for the **AireLink™80** products are available upon request. Please contact LightPointe Customer Support for more information.

GbE Throughput Distance versus Availability (Integrated 20 cm parabolic antenna)
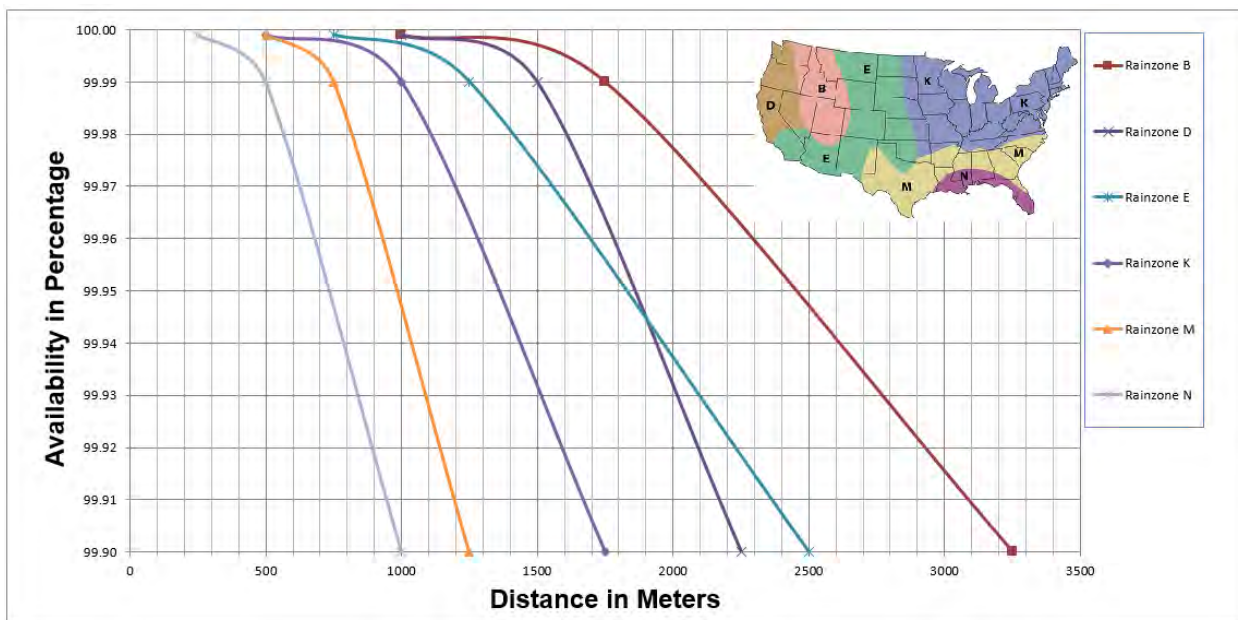
GbE Throughput Distance versus Availability (External 30 cm antenna)
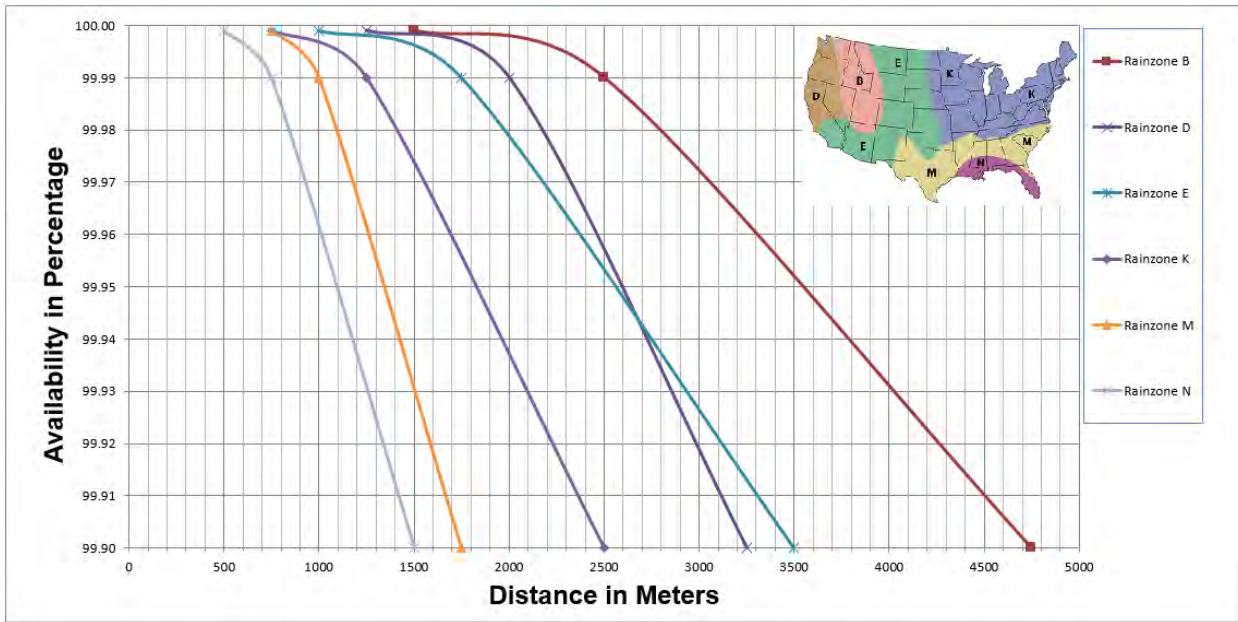
GbE Throughput Distance versus Availability (External 60 cm antenna)
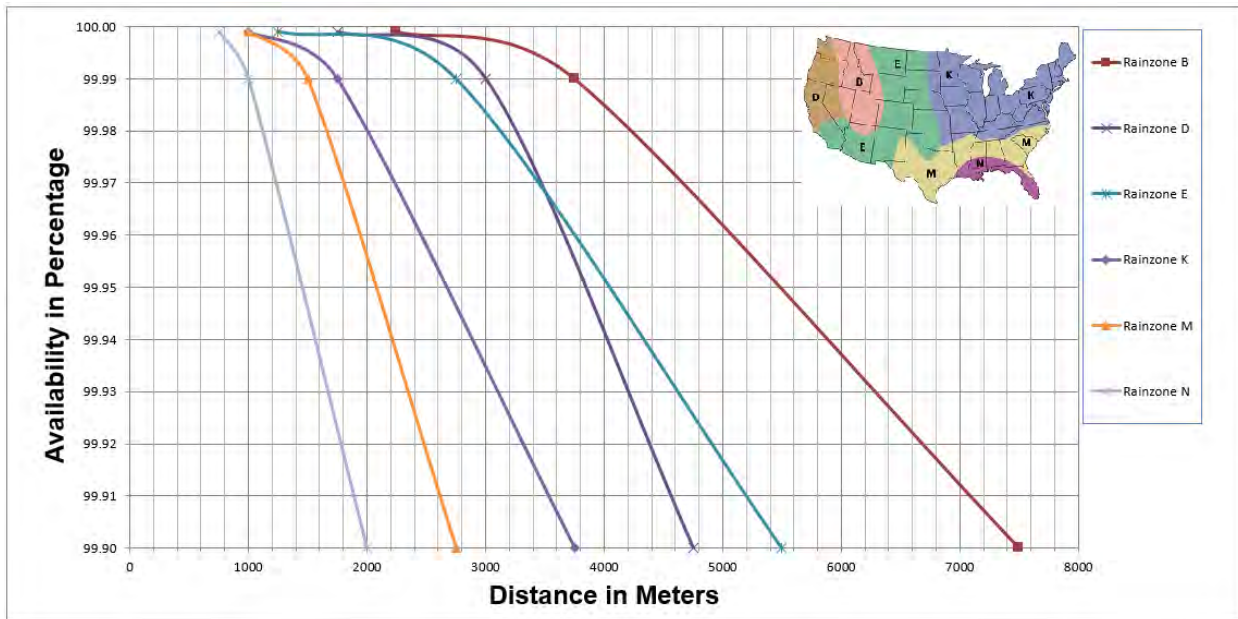
GbE Throughput Distance versus Availability (External 90 cm antenna)
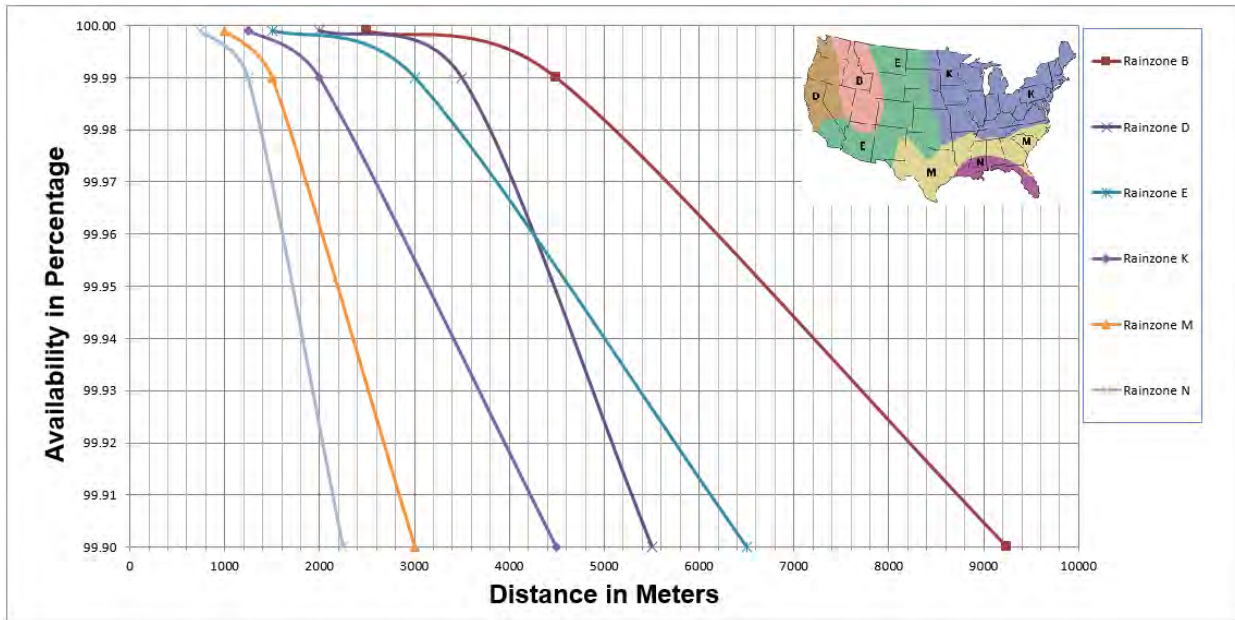
Figure 2-4: **AireLink™80** Distance vs. Availability North America

GbE Throughput Distance versus Availability (Integrated 20 cm parabolic antenna)
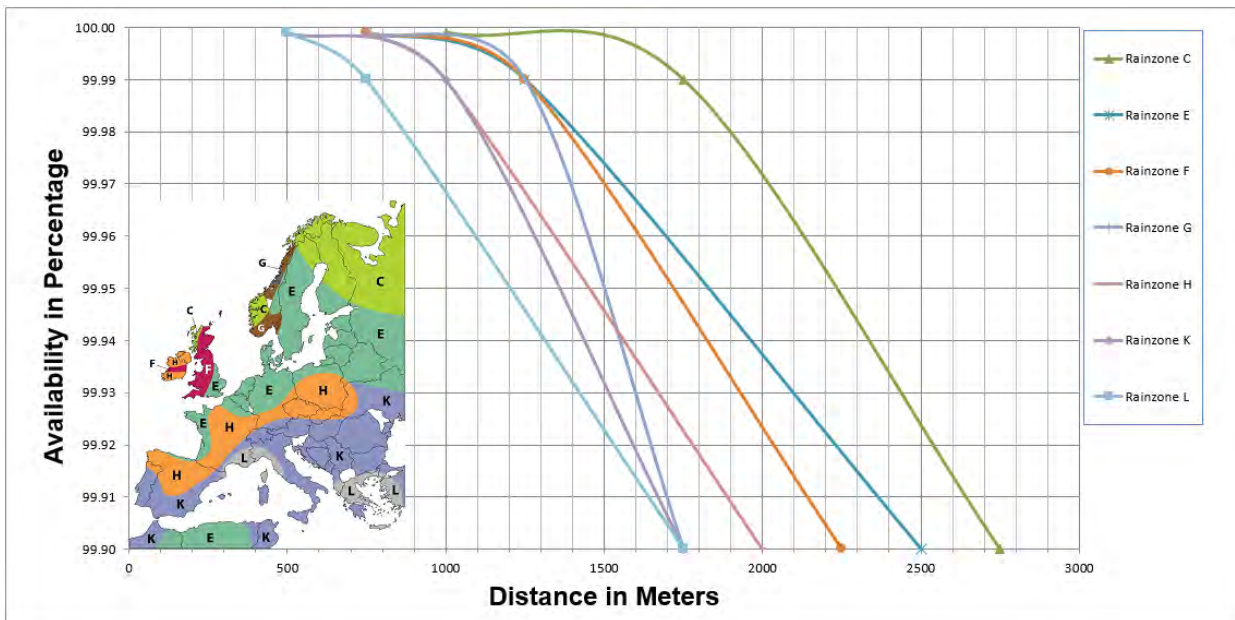
GbE Throughput Distance versus Availability (External 30 cm antenna)
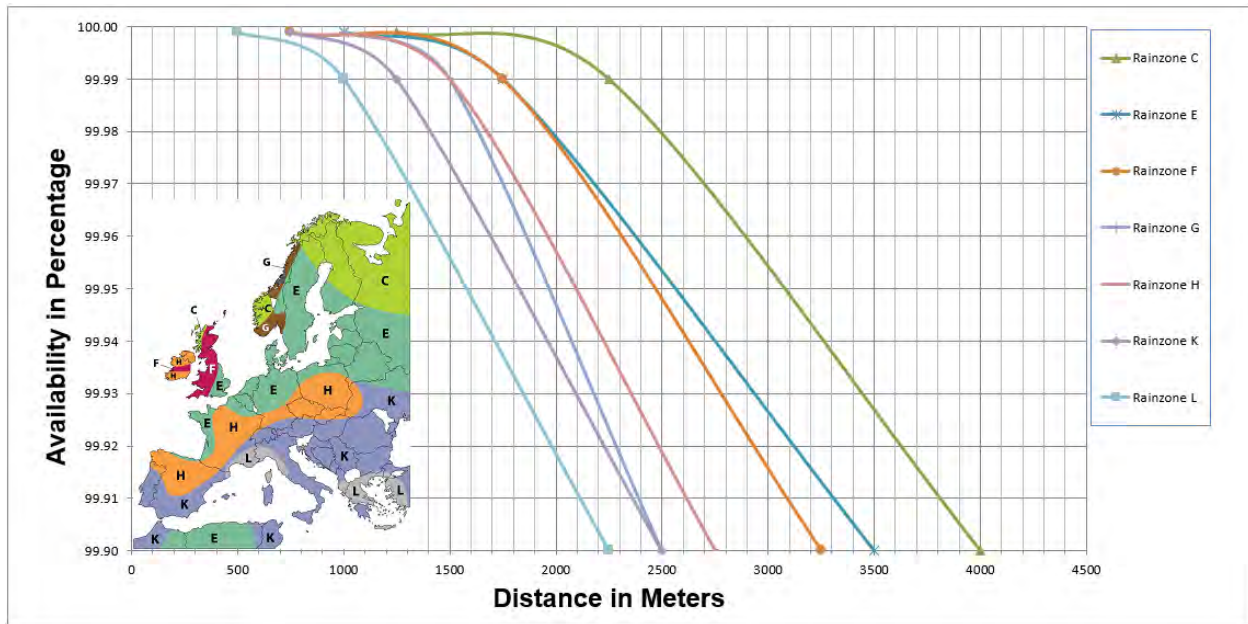
GbE Throughput Distance versus Availability (External 60 cm antenna)
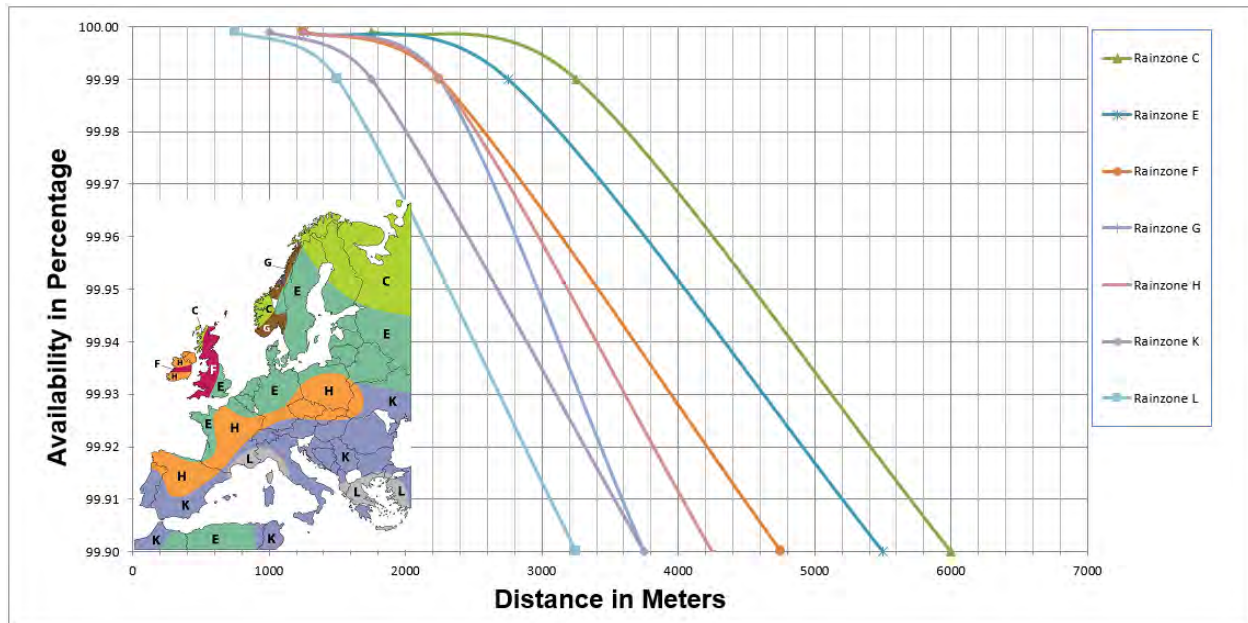
GbE Throughput Distance versus Availability (External 90 cm antenna)
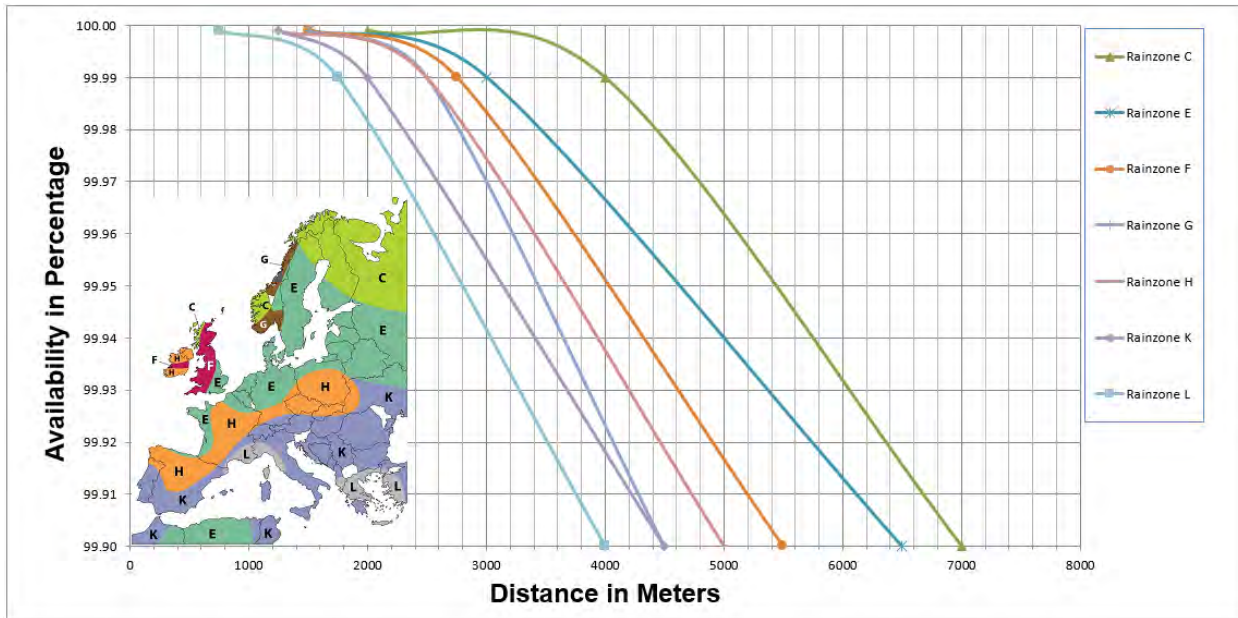
Figure 2-5: **AireLink™80** Distance vs. Availability Europe

GbE Throughput Distance versus Availability (Integrated 20 m parabolic antenna)
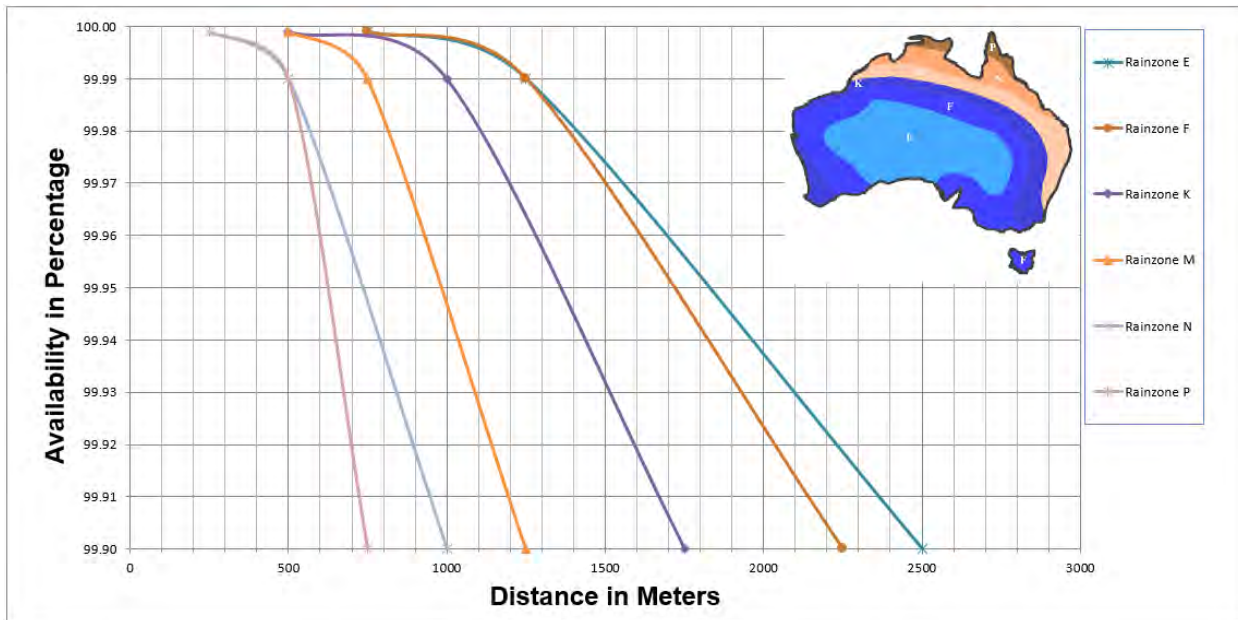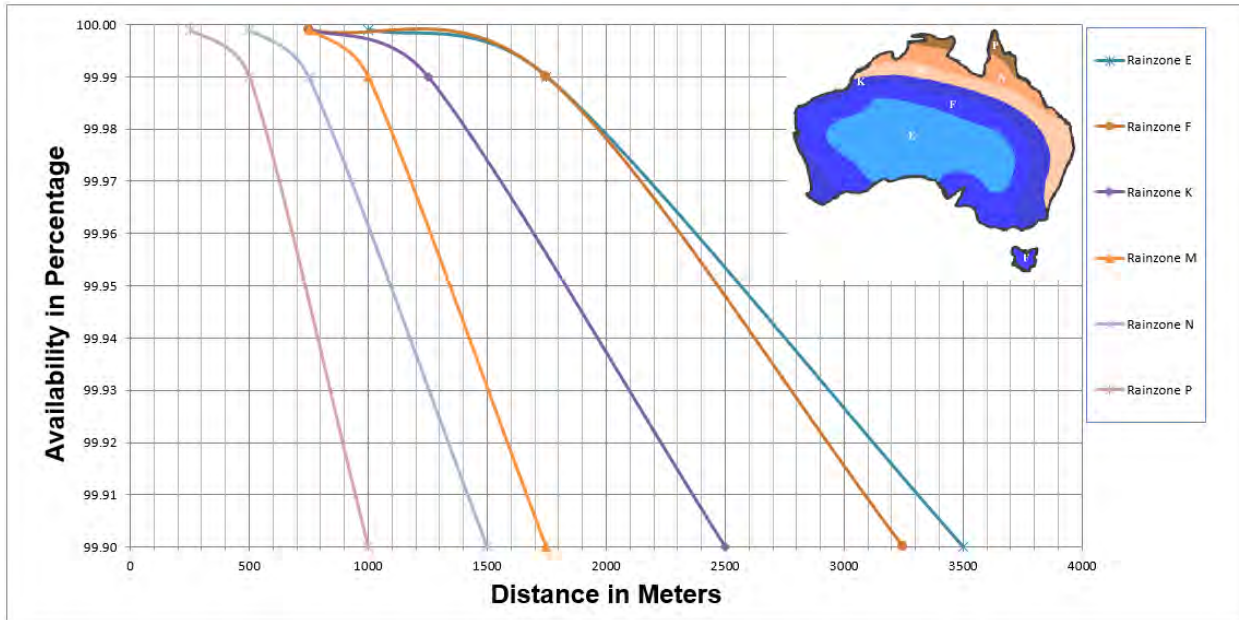
GbE Throughput Distance versus Availability (External 30 cm antenna)

GbE Throughput Distance versus Availability (External 60 cm antenna)
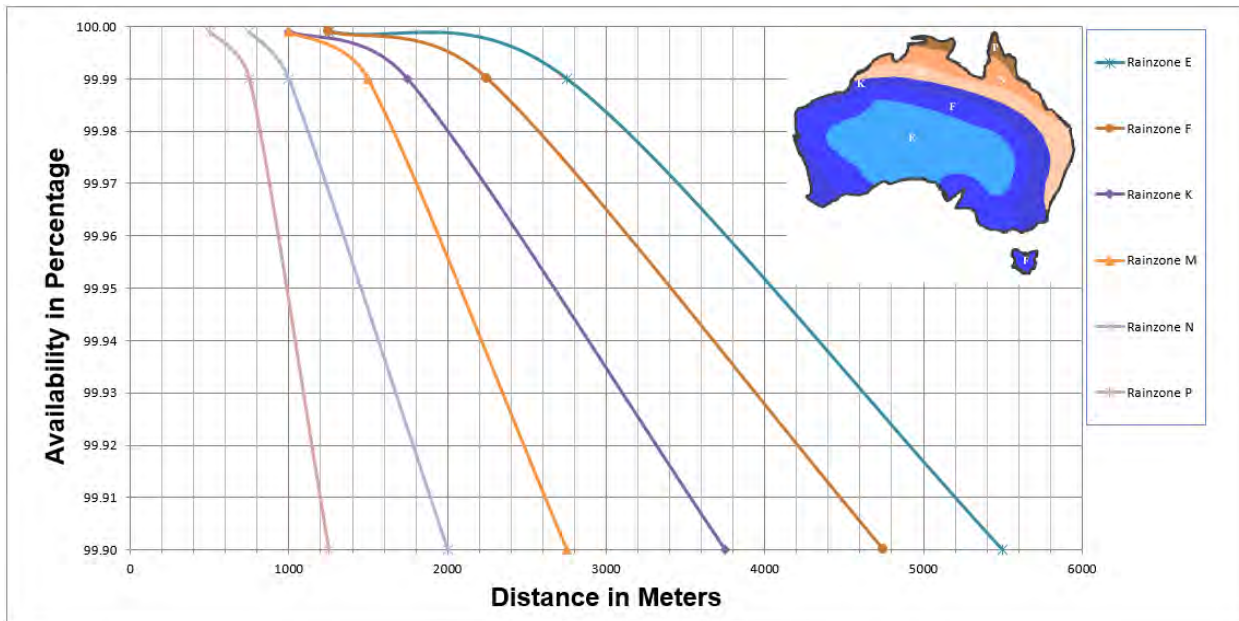
GbE Throughput Distance versus Availability (External 90 cm antenna)
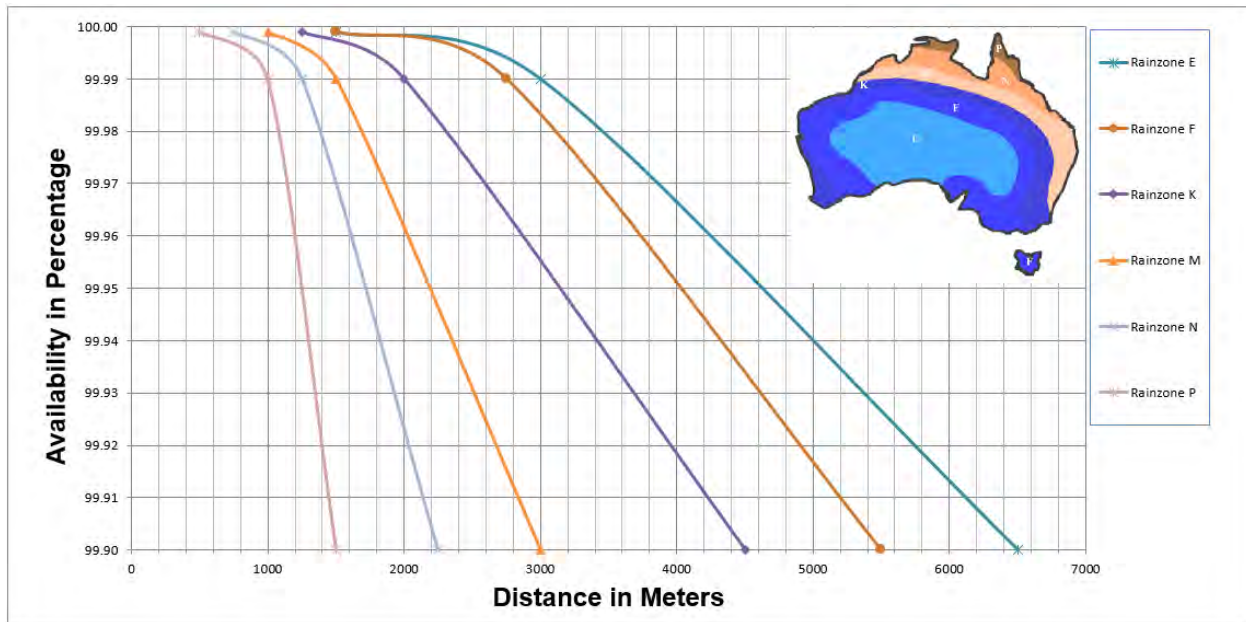
Figure 2-6: **AireLink™80** Distance vs. Availability Australia

Typical RSSI vs. Distance charts for the **AireLink™**80 is shown in Figure 2-4 below. These RSSI vs. Distance readings can slightly vary from system to system. The actual values can be slightly different due to the installation locations of the antennas and of course weather conditions at the time of reading. However, the RSSI readings provide a very good guideline of the expected receive signal level for the specific installation distance. Please, contact LightPointe or your Reseller to obtain the chart for your specific system.
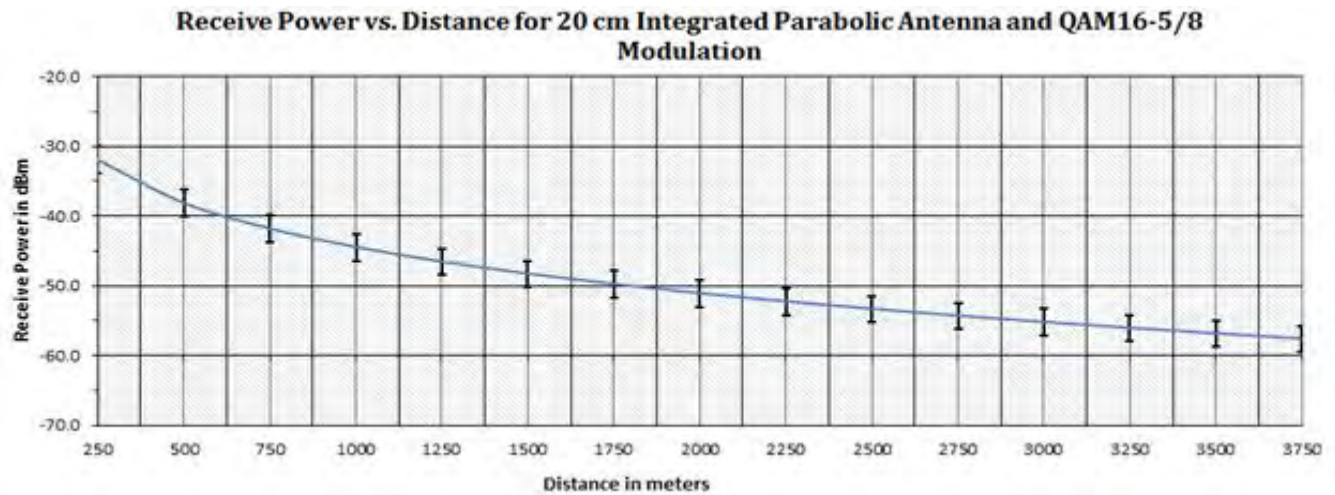
Receive Power vs. Distance for 1 Foot Antenna and QAM16-5/8 Modulation
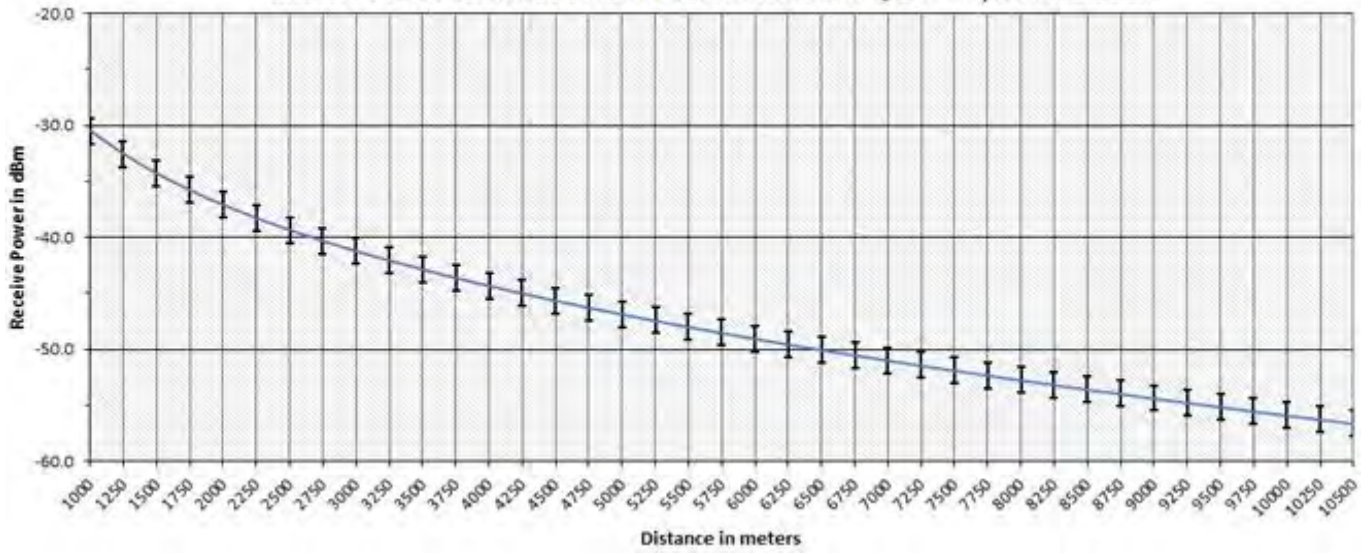
Receive Power vs. Distance for 2 Foot Antenna and QAM16-5/8 Modulation
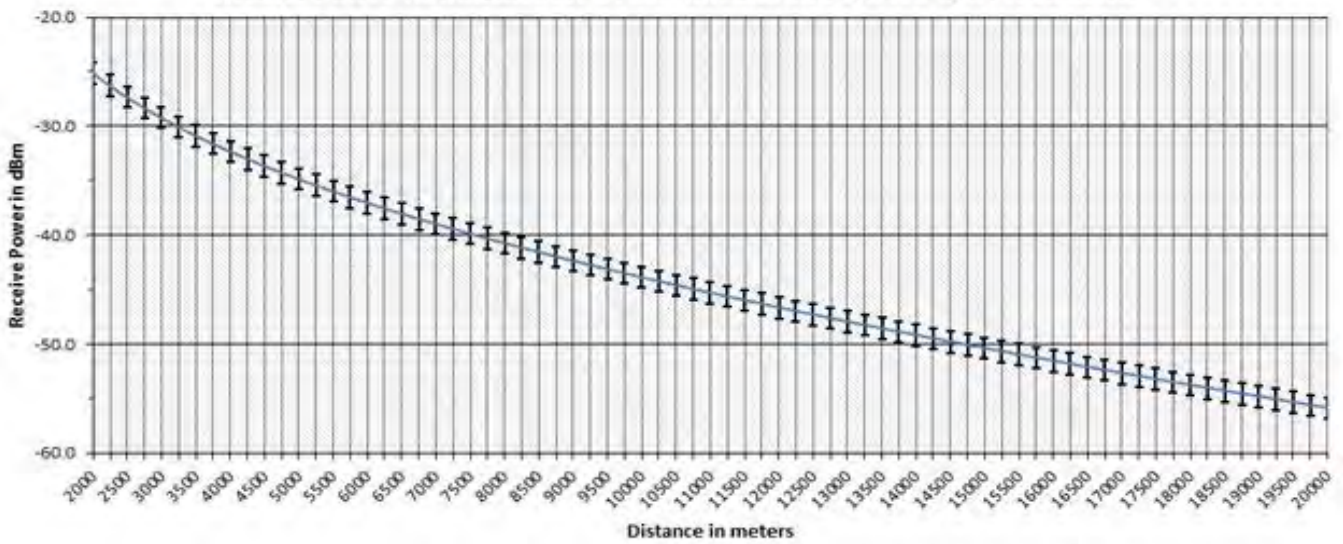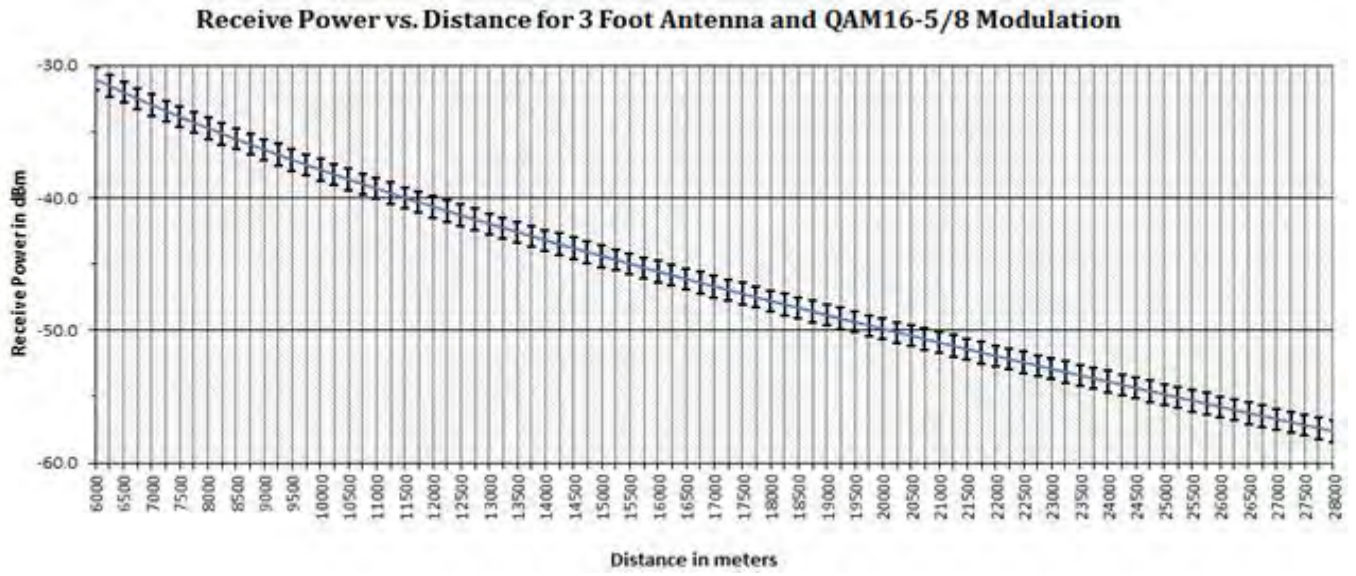
Figure 2-4: Typical AireLink™ 80 RSSI vs. Distance charts

3   NETWORKING, POWER AND SERVICE CONNECTIONS

The **AireLink™80** with integrated 20 cm parabolic antenna and the systems with external 1, 2 or 3 foot parabolic antennas have the same networking, power and service connections. In case of the external antenna solution the radio itself comes as a fully outdoor rated ODU that is attached to the antenna base using 4 spring loaded latches (see Figure 1-7). Please, review Chapter 1 in case there are questions regarding the general system/ODU design.

At this point, we recommend that the user/installer gets familiar with the user panel and connectors before installing the system on the roof/tower. The user panel can be easily accessed by using a Philips screwdriver and remove the 4 screws that attach the clear access panel cover the radio housing (see Figure 1-5). In case the system ordered is the external antenna version, we recommend removing the ODU from the antenna Base by releasing the 4 spring loaded ODU latches and pulling the ODU of the antenna waveguide flange. This allows the user taking a closer look at the ODU and start the process of preconfiguring the system before installing on the roof.

Note	We recommend pre-configuring the system before installing it on the roof. This relatively simple process requires powering up the system and being familiar with the use of a serial interface program such as Windows based HyperTerminal or PuTTY http://www.chiark.greenend.org.uk/~sgtatham/putty/download.html The connection to the serial port is done via the USB port and the customer needs to download and install the appropriate USB to UART Bridge Virtual COM Port (VCP) drivers from Silicon labs. http://www.silabs.com/products/development-tools/software/usb-to-uart-bridge-vcp-drivers

3.1   AIRELINK™80 USER PANEL

The **AireLink™80** user panel is identical for the integrated and external radio solution where it is part of the ODU. The user panel is located at the side of the housing and a transparent hard plastic cover protects the user panel from being exposed to the environment. The plastic cover is fitted with a rubber seal to ensure a watertight connection with the radio enclosure, and also has 3 integrated and IP67 rated compression fitted cable glands for:

➢   +/- 48 Vdc Power Cable

➢   PoE & Management Cable

➢   Copper or Fiber Data Network Cable

The diameters of the glands are large enough to accept a wide variety of cable diameters and even pre-connectorized cable.

To get access to the user panel one needs to untighten the 4 screws that attaches the cover to the radio enclosure. Once removed, the user panel connections and status LEDs are clearly visible and easily accessible. Figure 3-1 shows the user panel with plastic cover removed.
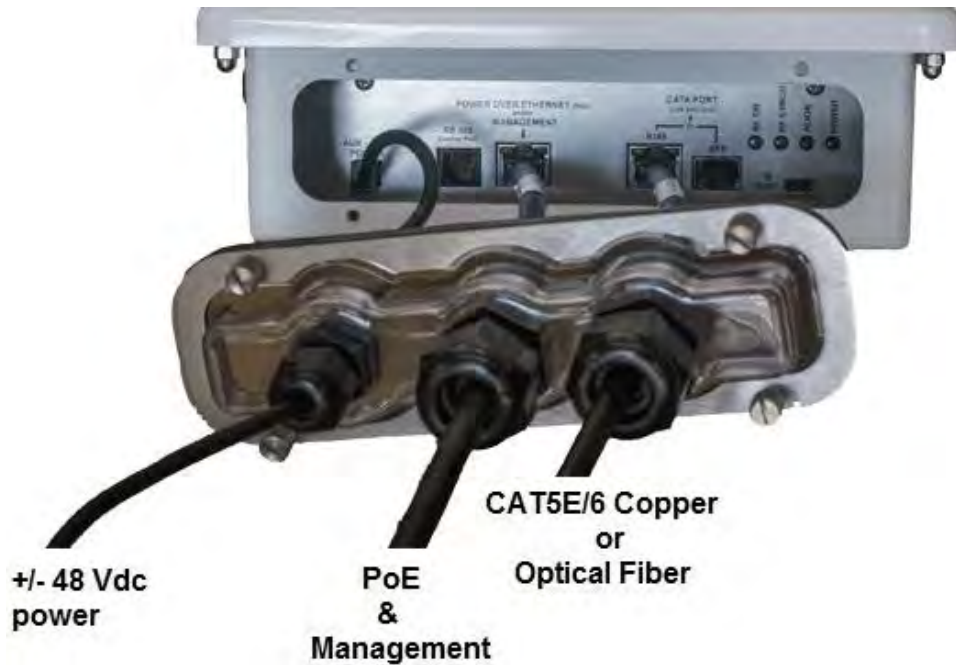
Figure 3-1: **AireLink™80** User Panel with plastic cover removed

A detailed drawing of the user panel is shown in Figure 3-2. Besides the RSSI connector that is located at the outside of the enclosure, the user panel has all required networking, power and service connections to install the system. It incorporates also several status LEDs to visually monitor the system operational status. Table 3-1 has a listing of power/networking connectors and status LEDs.
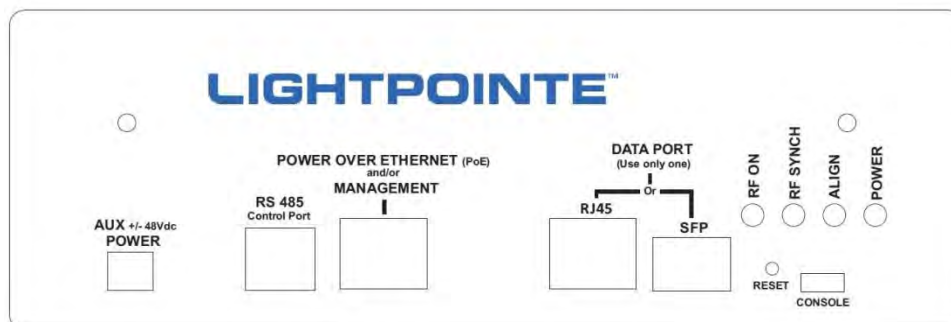
Figure 3-2: **AireLink™80** User panel

User Panel Connections	
AUX Power	Direct +/-48Vdc power connection (Polarity independent)
RS485 Control Port	NA
PoE and Management Port	100/1000 Base-TX RJ-45 Ethernet Management connection for Out-of-Band radio management and high power PoE connection via LightPointe PoE injector
Data Port	100/1000 Base-TX RJ-45 copper/ SFP transceiver Combo port. SFP port support all industry standard GbE fiber and copper SFPs.
Console	USB based serial port connection (Customer Support / Technicians only)
Reset	When pressed for more than 5 seconds the system will revert to factory default settings.
User Panel Status Indicators	
RF ON	Indicates if the RF modules is operational
RF SYNCH	Indicates if local and remote radio units are synchronized
ALIGN	Indicates if system is in alignment mode. ⚠ Alignment mode is activated automatically when the system is shipped and aligned initially. In alignment mode no network connection is required to align the system.
POWER	Indicates if system is powered on.

Table 3-1: User Panel Connections and Status LEDs

3.2   POWER CONNECTION

There are two options to power the radio:

1. Power over Ethernet (PoE) ➔ Use Lightpointe high power passive PoE injector (see Fig. 1-9) and connect to PoE and Management Port.

2. Direct +/-48 Vdc ➔ Use Lightpointe 48 Vdc power supply shown in Figure 1-10 and connect to the AUX power port. Always connect the 48 Vdc connection first before switching on the power supply to avoid potential damage to the radio head electronics!

Note	Power redundancy operation can be achieved by connecting a PoE and a 48 Vdc power supply in parallel. To ensure uninterrupted power in case of a power failure on either power line without system restart, please connect the PoE power first and wait until the system boot is completed before connecting the 48Vdc power line.

3.2.1 Powering via PoE

The PoE powering option is the LightPointe suggested standard way to power the system. The system ships with two indoor table top 48 Vdc PoE injector as shown in Fig. 1-9. Both the integrated antenna as well as the ODU solution requires 23 Watts of electrical power for operation and the PoE injector supplied with the system is rated at 48 Watts, leaving plenty of ample power. Input to the PoE injector **is 90....24**0 Vac.
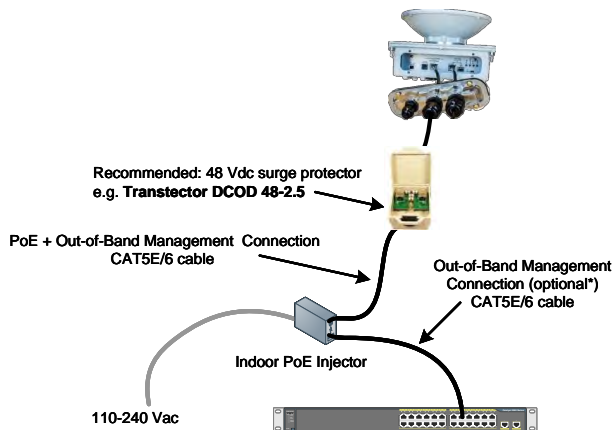
Figure 3-3: Powering via PoE

The PoE Injector is equipped with a powered and a non-powered 10/100 RJ-45 Port. Use the powered port (Output) to connect to the system *PoE and Management* port.

NOTE: For EMC compatibility reasons the system is shipped by two *ferrite beads*, one for each side of the link. Loop the Ethernet cable to be connected to the *PoE and Management* port and place the ferrite beat around the cable as shown in Fig. 3-3. The fully outdoor rated ferrite beat housing has a snap on lock mechanism to hold it in place. Distance between the entrance of the Ethernet cable into the radio housing and ferrite bead location should be around 3 inches (8 cm).

We also recommend placing a surge protector into the PoE line and preferably close to the radio head (see Fig. 3-3). The surge protector needs to be grounded and tied into the roof/tower grounding infrastructure. The PoE port also serves as Out-of-Band management port. To access the out-of-band management interface connect the non-powered port (Input) to an Ethernet switch or hub and the out-of-band management system. For more information on setting up the management system see the chapter **"AireLink™** Manager - NMS Platform for **AireLink™** Products**"**.

	The passive PoE Injector shipped with the system provides up to 60 Watts of electrical power @48 Vdc. Same as with the lower power 802.3at standard the injector provides power to pins 4,5 (+) and 7,8 (-). To comply with the Ethernet standard on maximum CAT5E/6 cable length, distance between the PoE output and the ODU input be not exceed 100 meters. For longer runs, please use a suitable repeater as shown in Chapter 1.2.4.3. Caution: The PoE Injector shipped with the AireLink system has a built-in short circuit and overvoltage protection. However, to prevent damage to the indoor networking equipment from potential lightning strikes we recommend using an external PoE surge protector as shown in Chapter 1.2.4.2

3.2.2 Powering via Direct 48 Vdc

Alternatively, the **AireLink™80** system can be powered by a direct 48 Vdc power connection connected to the AUX Power port on the radio user panel. When using the direct powering method, it is possible to extend a 16-gauge power cable length to more than 1000 feet (330 meters) using the LightPointe 48 Vdc power supply shown in Fig. 1-5. Same as for the PoE powering option, we recommend placing

an external lightning/surge protector as shown in Chapter 1.2.4.2 into the power line and close to the radio head (see Fig. 3-4).

Recommended: 48 Vdc surge protector
e.g. **Transtector DCOD 48-2.5**

Indoor/Outdoor 48 Vdc Power Supply

110-240 Vac
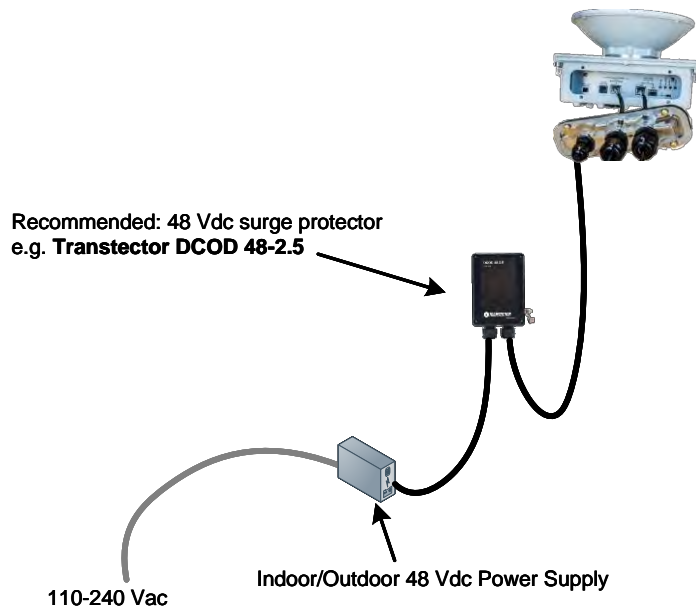
Figure 3-4: Direct 48 Vdc Power Connection

> To prevent damage to the building power infrastructure from potential lightning strikes we recommend using an external 48Vdc Surge Protector as shown in Chapter 1.2.4.2.
>
> Always connect the 48 Vdc connection first before switching on the power supply. Otherwise, and due to a potential in rush current peak, there is a risk to destroy the power board inside the radio!

3.3   GROUNDING/ LIGHTNING PROTECTION

Ground radio housing by attaching an AWG 14 solid copper wire to the ground pillar on the back of the housing (see Fig. 3-5) and using the self-tapping screw and the wire lug provided with the system. Attach the opposite end of the wire to the mounting pole and make sure that there is a good and solid electrical contact. Most important, verify that the mounting pole is connected to the building/tower grounding infrastructure.

Figure 3-5: Enclosure Ground Connection

In addition, and where applicable, we recommend following the IEC 61024/ IEC 62305 standards for proper lightning protection and install the antennas within the lightning protection zone LPZ O_B where the equipment is not subject to direct lightning strikes (See Fig. 3-7).

| 1 | IEC 61024 | When the linkhead is located near another grounded/earthed object, such as a tower, lightning (Franklin) rod or any type of mast or pole, it may fall under the zone of protection provided by the tower or mast. |
| | | Even if it is not under the Zone, if it is not a good path to ground/earth it is less likely to be destroyed by lightning. |

2	High Lightning zones	It is possible to deliberately place a protective mast near the linkhead to provide this type of zone. In this case the linkhead is protected by the mast and is further protected by not being a good path to ground/earth for the lightning.
		The mast should have a sharp point at the top. This encourages the formation of the lightning strike where the electrons are concentrated at the tip of the rod and further protects the equipment
3	Towers	A linkhead mounted on a tower is almost always within the LPZ O_B zone and has some protection simply because of its location.

Figure 3-7: Lightning Protection Zones

3.4   NETWORK DATA CONNECTION

The **AireLink™80** has a Combo networking data port located on the user panel (see Fig. 3-1). The system is shipped standard with a copper 100/1000 Base-TX RJ-45 connector. Auto-MDIX configuration automatically detects the required cable connection type and configures the connection appropriately, removing the potential need for crossover cables. If required by the specific setup, the port speed and simplex/duplex operation can also be fixed via the web browser/ management software.

Alternatively, the combo port can be equipped with a Gigabit Ethernet SFP fiber transceiver slot. Please, ask LightPointe sales/customer support for details and recommendations on suitable SFP fiber transceivers.

Fig. 3-8 below shows how the **AireLink™80** is connected to the network.

| ⚠ | The Combo data port acts as a single network connection. This means that EITHER the RJ-45 copper port OR the SFP port should be connected to the network at the same time. Connecting both ports in parallel can/will cause networking problems. |
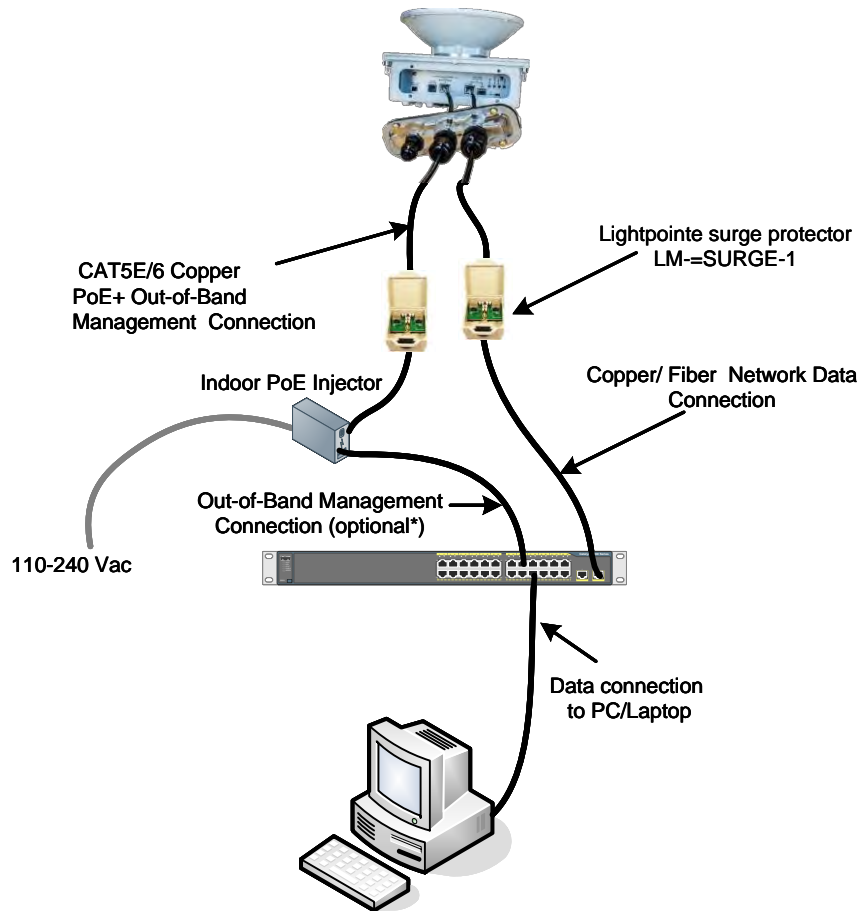
Figure 3-8: Data Network Connection

3.5   OUT-OF-BAND MANAGEMENT CONNECTION

The **AireLink™**80 Out-of-Band management connection shares the RJ45 100/1000Base-TX PoE powering port provided via a CAT5/6 twisted pair Ethernet cable. To get access to the AireLink™ management system the input port of the PoE module must be connected to your management network.

The Ethernet cable length of the management cable from the **AireLink™80** radio to the switch or router should not exceed 100 meters due to Ethernet compliance issues. Otherwise a suitable Ethernet repeating device as shown in Chapter 1.2.4.3 must be used.

In Chapter 4 the **AireLink™** Manager will be described in more detail.

3.6   CONSOLE PORT

The user panel micro USB based Console port is used to establish a serial port connection to a PC/laptop and the shipment contains a micro USB2.0 cable to establish the connection. The serial port is used by customer support personal / technicians for advanced troubleshooting purposes. It is therefore not necessary to pull cable for the serial port during installation. All setup and management functions can be performed over the **AireLink™** Manager web-console, Telnet or SNMP. Before accessing the serial connection the user/installer needs to download and install the appropriate USB to UART Bridge Virtual COM Port (VCP) drivers from the Silicon Labs webpage http://www.silabs.com/products/development-tools/software/usb-to-uart-bridge-vcp-drivers. After installation of the driver the serial port is accessible via a serial communications program such as HyperTerminal or PuTTY. Settings: Baud rate: 115200, Data bits 8, Parity none, Stop bits 1, Control flow none

3.7   RSSI VOLTAGE CONNECTOR

The RSSI voltage level can be measured by connecting a digital voltmeter to the two pin and IP67 outdoor rated RSSI signal connector located on the outside of the radio enclosure (see Fig. 3-9). Two adapter cables to connect the RSSI signals to a standard voltmeter equipped with banana plug receptacles are included with the shipment (see Fig. 1-10).   During the alignment process the RSSI voltage readings are taken to achieve optimum alignment of the **AireLink™** system.

Figure 3-9: RSSI Voltage Port Connector Location

3.8   BLUETOOTH™ ANTENNA CONNECTOR

The **Bluetooth™** antenna is attached to the radio enclosure via a SMA connector located at the side of the enclosure. Fig. 3-10 shows the antenna location on the AireLink™ **SX** system with integrated 20 cm antenna. The antenna location is the same on the ODU enclosure with the external antennas. The **Bluetooth™** antenna is included with the shipment and must be connected to the SMA connector to enable proper **Bluetooth™** communication with an Android based smart phone or tablet. The 2 dBi **Bluetooth™** antenna allows for remote communication up to a distance of 100 meters under clear line-of-sight conditions between the radio link and the smart phone/tablet. In case there is no direct line-of-sight, the distance it shortened. If required, alternative higher gain antennas with SMA connectors can be used to extend the communication distance in particular in non-line-of-sight scenarios.
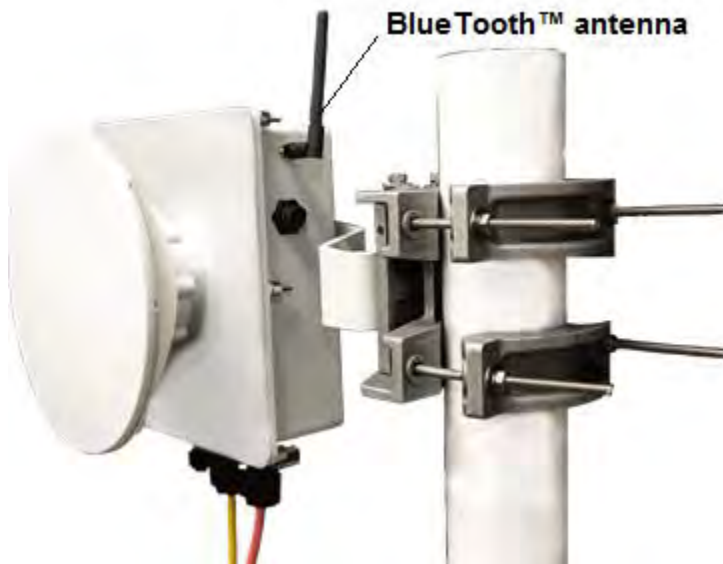
Figure 3-10: External **Bluetooth™** antenna location

4   RECOMMENDED SOFTWARE PRE-CONFIGURATIONS

Before installing the radio on the roof, we recommend to perform a few simple software pre-configurations. These basic settings are important to access the management interface/web browser.

4.1   REQUIRED NETWORK SETTINGS INFO

Please, ask the Network Administrator to provide the following information:

1. IP Address for both 80 GHz radios (Pre-configured IP address is 192.168.1.10)
2. Subnet Mask (Pre-configured subnet mask is 255.255.255.0)
3. Default Gateway Address (Pre-configured gateway address is 192.168.1.1)
4. Password for CLI access (default password is admin)
5. Password for WEB BROWSER access (default password is admin)

Besides these basic settings, additional settings (e.g. SNMP community settings, VLAN settings, etc.) can be configured via the TELNET CLI interface (see Chapter 7.). Alternatively, configuration changes can be performed via the web browser interface (see Chapter 6.).

4.2   AIRELINK CONFIGURATION VIA TELNET CLI INTERFACE

Please perform the following steps to connect the ODU to the serial port:
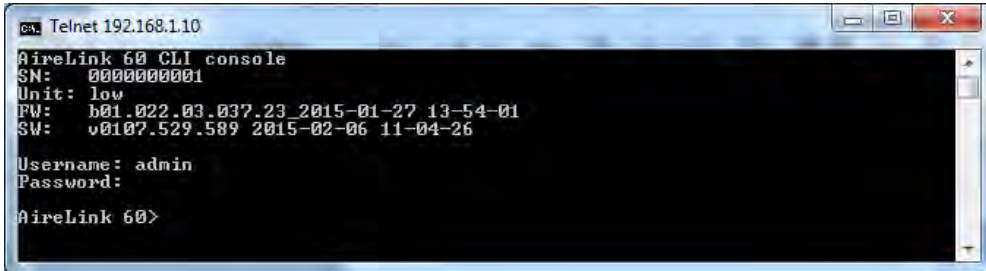
Step 1	Connect the AireLink *Management and PoE Port* to the Output of the PoE Injector using a straight-through Cat5E cable. Plug the PoE Injector into a 110 or 240VAC outlet. The AireLink system will now power up and initialize. Depending on the software load this process can take up to 2 minutes. The boot process is completed when the Power LED on the back panel (see Figure 3-2) stops blinking and is solid green.

Step 2	Connect a laptop/PC to the input port of the PoE injector. Ensure that the Laptop/PC is on a 192.168.1.xx subnet (default) with subnet mask 255.255.255.0 (default). Open a Windows command prompt and type >telnet 192.168.1.10. When asked for Username type admin and password is admin After successful login, the AireLink 80> command prompt will show.
Step 3	Type >*configure* and a new command prompt AireLink 80(configure)# Will appear.
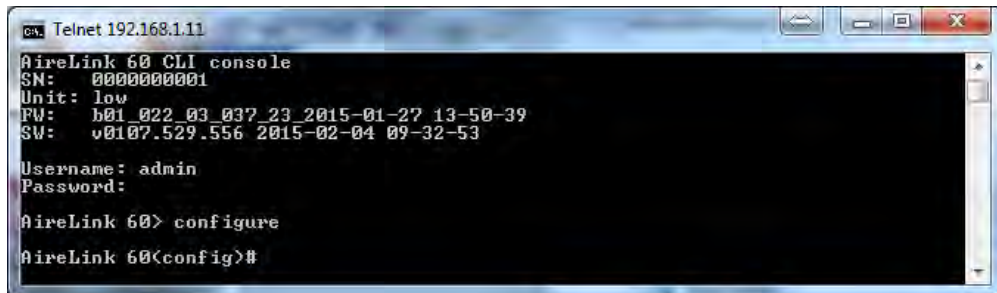
Step 4	To change/modify basic IP settings from the original default settings (IP: 192.168.1.10, Subnet mask: 255.255.255.0, Gateway: 192.168.1.1), please use/type the following command following the AireLink 80(configure)# command prompt: *Change/set new IP address:* Command: **airelink80(config)# interface management ip *mynewIP*** *Note: When management port IP address is changed, the new setting will occur immediately. At that point one will need to re-connect to the CLI via Telnet and using the new IP address setting.* *Change/set new Network Mask:* Command: **airelink80(config)# interface management netmask *mynewmask*** *Change/set new Default Gateway:* Command: **airelink80(config)# interface management gateway *mynewgateway***
Step 5	At this point the user can/might want to also change the login password for the CLI interface and the web browser. These passwords can be different. It is important to write them down and store in a secure place to avoid problems in the future. *Change/set new CLI password:* Command: **airelink80(config)# password cli *mynewclipassword*** *Change/set new WEB BROWSER password:* Command: **airelink80(config)# password web *mynewwebpassword***

Step 6	IMPORTANT: To save the changes in the system configuration, first exit the configuration mode by typing: *Exit configuration mode:* Command: **airelink80(config)# exit** To save the changes in the system configuration the following CLI command must be executed: *Save changes to system configuration:* Example: **airelink80> copy** running-config startup-config This will copy all changes to the startup configuration file located in the system flash memory. The flash preserves the new settings after system reboot.

5　SYSTEM INSTALLATION

This Chapter describes the installation processes involved with successfully deploying the LightPointe **AireLink™80** system. Please read carefully and be certain to understand the necessary steps in deploying a high availability point-to-point wireless link. Contact LightPointe customer support if any clarification is needed.

5.1　TOOLS

Although the installation of the **AireLink™80** system requires only a 13 mm wrench (open-end or combination wrench), a #5 Allen wrench and a simple digital voltmeter, please consider having the following tools and supplies handy when installing the LightPointe **AireLink™80** system.

Standard electro-mechanical tool kit with pliers, screwdrivers, wire cutters, wire strippers, etc.

  ➢ Two-way radio or cell phones to communicate when aligning transmission units

  ➢ Optical fiber connector cleaning kit - if using fiber to the network

  ➢ Plastic tie wraps to secure flexible conduits, etc.

  ➢ 13 mm open-end or combination wrench (one for each mounting location)

  ➢ 13 mm socket/ratchet wrench (one for each mounting location)

  ➢ 6 mm Allen wrench **–** when using the optional LightPointe Universal Mount

  ➢ Whatever tools may be needed for securing the mount to surfaces/platforms

  ➢ Electrical tape for securing and fastening

  ➢ Optical light source and fiber power meter to ensure fiber performance from/to transmission unit

  ➢ Digital voltmeter to check electrical system connection and measure the receive signal level (RSSI)

  ➢ Step or extension ladder, in needed, for access to elevated locations

  ➢ High quality rope to use for hoisting materials and/or to be used in conjunction with a safety harness to ensure installer safety

  ➢ Exterior rated extension cord

  ➢ Fish tape for pulling cable

5.2   UNIVERSAL MOUNT ASSEMBLY

The antenna mounting bracket attaches to any solid vertical pole structure with a pole diameter **between 2.5…4.0 inches (60…120 mm). If desired, and optionally, it is possible to use the LightPointe** Universal Mount that was developed for FSO/radio solutions requiring a very stable operating platform. The fully assembled mount (without the radio link head attached) and the base plate hole mounting pattern are shown in Fig. 5-1. The 200 mm square Base Mounting Plate has four 15 mm screw holes with 160 mm center separation. During installation the Base Plate must be attached to a solid support **structure (concrete parapet wall, concrete or brick wall, etc.) by using suitable heavy duty 3/8" or ½"** masonry wall anchors (e.g. sleeve anchors).
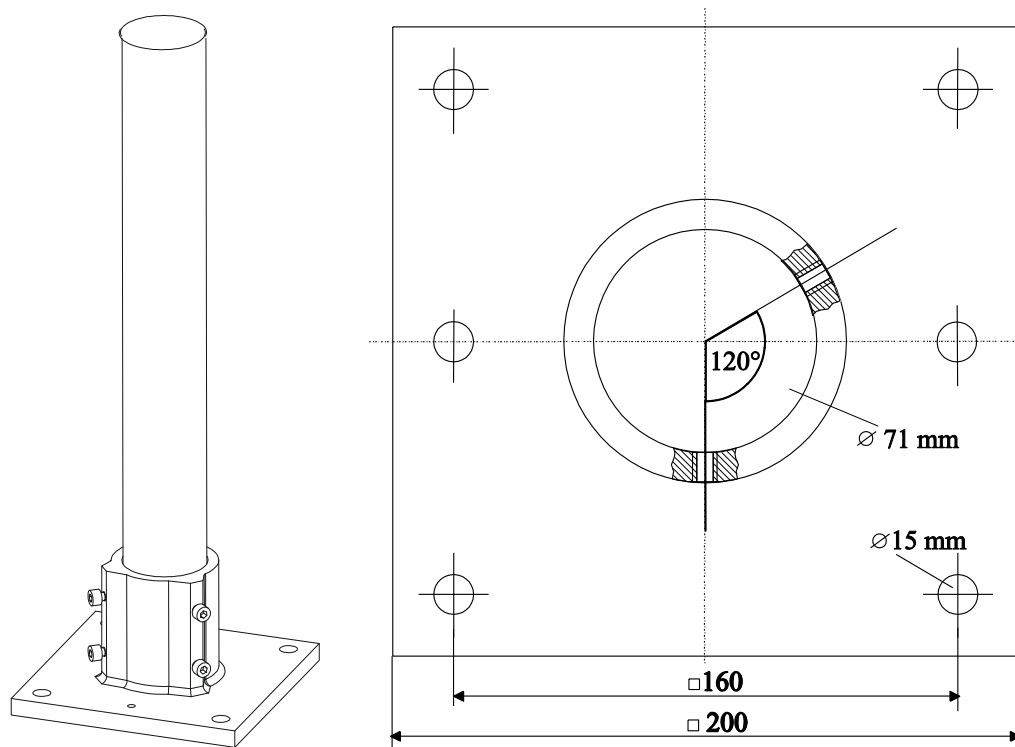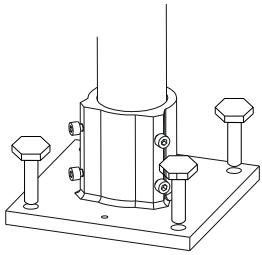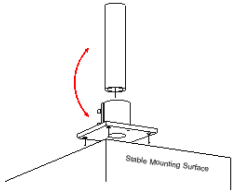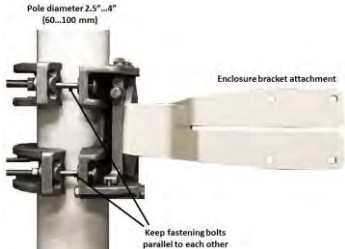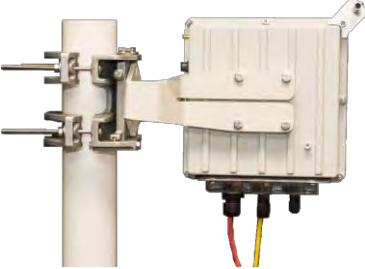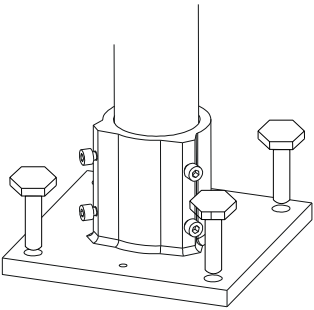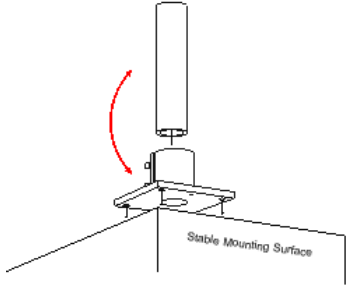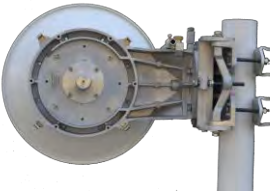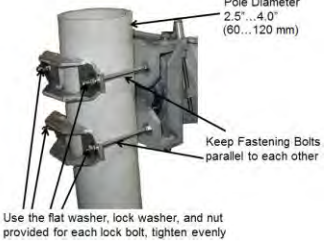
Figure 5-1: Assembled Universal Mount and Base Plate Hole Pattern

The pole can serve as the mounting pole for the **AireLink™80** system with integrated 20 cm and external 1 or two foot antennas. If it is required for the specific installation, it is also possible to replace **the standard 24" long pole of the Un**iversal Mounting kit with a longer pole. However, it is NOT recommended that poles longer than 4 feet be used **with the 12" and 24" antenna** without stabilizing the mounting pole with guard wires.

5.3   POLE MOUNT INSTALLATION OF AIRELINK 80 WITH INTEGRATED ANTENNA

	Step 1	Install the mounting base plate to a solid platform **using 12 mm (1/2") bolts.** ➢ Anchor the mount in wall or concrete (recommend M12-screws) ➢ Use bolts of hardness class not less than 6.6 To ensure stability, keep the mounting post as short as possible. The maximum allowable mounting pole length is 7 feet (~200 cm).
	Step 2	Attach and fasten the mounting post assembly to the base plate using the supplied fastening 8mm screws with 6mm Allen heads. Do not over tighten the mounting screws.
	Step 3-a basic bracket	Basic bracket- Attach the radio mounting /alignment bracket to the mounting pole. Roughly align the antenna towards the opposite radio location and tighten the bracket bolts using a 13 mm open-end or combination wrench. Ensure the bolts are EVENLY tightened. Note: Bracket must be assembled as shown in picture. Rotating ball joint by 90 degrees from position shown may result in unstable operation.
	Step 3-b	Heavy duty bracket - Attach the radio mounting/alignment bracket to the mounting pole **with a diameter between 2.5…4".** Tighten the bracket bolts using a 13 mm open-end or combination wrench. Ensure the bolts are EVENLY tightened.
	Step 4	Attached the radio enclosure to the enclosure bracket holder and ensure that: ➢ The antenna roughly points towards the opposite antenna location ➢ The bolts are parallel to each other ➢ Use flat washers, lock washers, and nuts provided with the lock bolts ➢ The bolts are evenly tightened
Antenna pre-installation completed!		

5.4   POLE MOUNT INSTALLATION OF AIRELINK 80 WITH EXTERNAL ANTENNA

	Step 1	Install the mounting base plate to a solid platform **using 12 mm (1/2") bolts.** ➢ Anchor the mount in wall or concrete (recommend M12-screws) ➢ Use bolts of hardness class not less than 6.6 To ensure stability, keep the mounting post as short as possible. Without using guard wires the maximum allowable mounting pole length is 4 feet (120 cm).
	Step 2	Attach and fasten the mounting post assembly to the base plate using the supplied fastening 8mm screws with 6mm Allen heads. Do not over tighten the mounting screws.
	Step 3	Attach the radio mounting/alignment bracket to the mounting pole. Roughly align the antenna towards the opposite radio location and tighten the bracket bolts using a 13 mm open-end or combination wrench. Ensure the bolts are EVENLY tightened.
	Step 4	When tightening the bolts ensure that: ➢ The antenna roughly points towards the opposite antenna location ➢ The bolts are parallel to each other ➢ Use flat washers, lock washers, and nuts provided with the lock bolts ➢ Tighten the lock nuts evenly
		Antenna pre-installation completed!

5.5   ODU INSTALLATION (EXTERNAL ANTENNA SYSTEM ONLY)

After installing the antenna, please ensure that the radios on each side operate in the same polarization. In other words, the physical orientation of the radio enclosure (ODU) must be the same on both sides. There is an arrow symbol imprinted on the back of the ODU that must point in the same direction, either upwards (vertical polarization) or sideways (horizontal polarization), when looking at the back of ODU (see Figure 5-2). This ensures that both radio antennas operate in the same horizontal or vertical polarization plane. To attach the ODU to the antenna, simply guide the ODU onto the round metal flange on the back of the antenna. Use a drop of silicone grease to lubricate the O-ring. This will ease the process of pushing the ODU onto the antenna waveguide flange. Slightly rotate the ODU while pushing it towards the antenna base plate, and ensure to not destroy the rubber O-ring that serves as a seal/gasket between the antenna flange and the ODU housing.
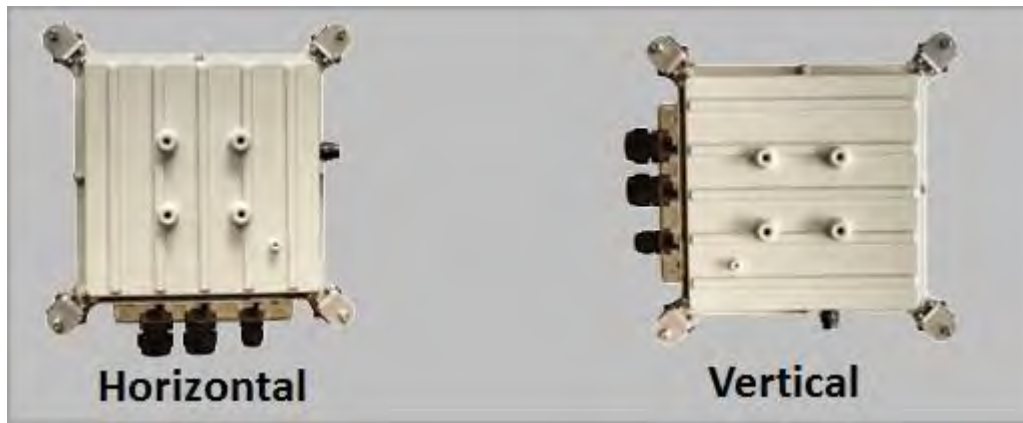
Figure 5-2: ODU Polarization Directions

Once the ODU it pushed all the way down onto the antenna baseplate and aligned correctly in either horizontal or vertical position, fasten the 4 spring loaded latches to finalize the attachment of the ODU to the antenna base. Fig. 5.3 shows the **AireLink™80** system with the ODU installed.

⚠	A transmission link that uses a different polarization on each side will not function properly.

It is also critically important that a high-band radio on one side is paired with a low band radio on the opposite side to ensure proper operation, because the individual radio operate in different transmit and receive frequency ranges. Before installing the radio units check each radio to verify one is a high-band and the other is a low-band version. A sticker on the ODU user panel indicates the HIGH BAND and LOW BAND unit. When installing a 80 GHz radio link under a network license, ensure that the low-band and the high-band radios are installed at each side according to the assigned and approved frequency allocation plan.
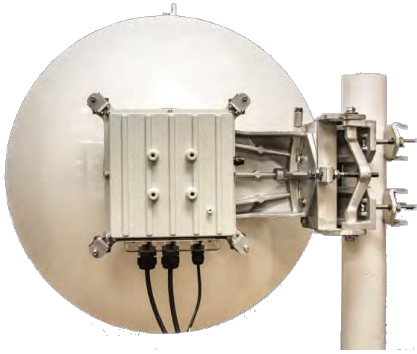
Figure 5-3: **AireLink™80** installed on LightPointe Universal Mount

5.6   SYSTEM ALIGNMENT BASICS

After finishing the mounting of the antennas, and connecting the cabling as described in Chapter 3, the system is ready for alignment. During the alignment procedure it is only required to power on the radio, and active network traffic is not needed to align the system. The radio will automatically switch to the *alignment mode* when it is installed for the first time. To verify that the system is in *Alignment Mode*, observe the ALIGN LED the user panel. A lit LED indicates that the system is in active *alignment mode*. Regardless of the system being connected to the network via one of the data port, no traffic will pass across the radio link until the system is switch from *Alignment Mode* into D*ata Mode.* See Chapter 6.3 on how to switch the system from the *Alignment Mode* into D*ata Mode* using the web browser interface. After the alignment is completed it is important to save the system setting in using the Administrative sub menu in the web browser (see Chapter 6.9). Without saving the settings the system will come up in *Alignment Mode* rather than in *Data Mode* each time the power is recycled.

⚠️	The radio will be in *Alignment Mode* when installed for the first time and the alignment LED on the back panel will be lit. To enable data transmission the system must be switched into *Data Mode.* The new setting must be saved to avoid the system rebooting in *Alignment Mode* after power is recycled.

The alignment process itself will be eased if two people (one on each side) are involved in the alignment procedure. This is particularly true for the larger **AireLink™80** with the 2 foot antenna option due to its narrower beam pattern when compared to the smaller **AireLink™80** with the integrated 12 cm antenna or the external 1 foot antenna. Two-way radios or cell phones are extremely helpful in exchanging information between the two parties performing the alignment. While it is possible for a single individual to align the units, walking or driving back and forth between the two mounting locations can be a cumbersome and time consuming process. The correct alignment of the system is crucial for ensuring proper performance of the system and no rush should be in play when aligning the system. Depending on the experience of the installer(s) in aligning narrow beam radio transmission equipment and the actual antenna used, this process can take anywhere from 15 to 90 minutes.

5.7 ANTENNA RADIATION PATTERN AND SIDE LOBES

When aligning a 80 GHz radio with a narrow beam directional antenna pattern, it is important to **understand that besides the "antenna main lobe" that contains most of the energy, there are also "antenna side lobes". A "perfect" antenna would contain all energy in the main lobe** but this is physically impossible. Although these side lobes contain far less energy - in the case of a good directional 80 GHz antenna the power of the 1st side lobe is typically more than 20 dB lower when **compared to the main lobe's peak power** - one can **"see"** the 1st side lobe during the alignment process. This is mainly because in an 80 GHz antenna the main lobe and the 1st antenna side lobe are separated by an angle of just 2-3 degrees. This small value for the angular separation is actually close to the radiation angle of the main lobe itself. When installing a millimeter wave radio transmission system it is important to keep in mind that the antenna main lobe and the 1st antenna side lobe point in virtually the same direction. Aligning the system on a side lobe instead of aligning it on the main lobe will negatively impact performance of the system. For illustrative purposes Fig. 5-9 shows a typical antenna Radiation Pattern Envelope (RPE) diagram of a Cassegrain antenna.

Note:	During the alignment process it is important to find the main lobe and not to align the system on a side. To ensure that the main lobe is found, move the system about 10 degrees in horizontal and vertical direction and away from the **perceived highest readout voltage. While "scanning" through the beam pattern** from the left to the right (or from the top to the bottom) one can find the higher **RSSI voltage readings before the signal drops significantly. These two "local"** voltage maxima to the left and the right of the main lobe are the 1st side lobe.
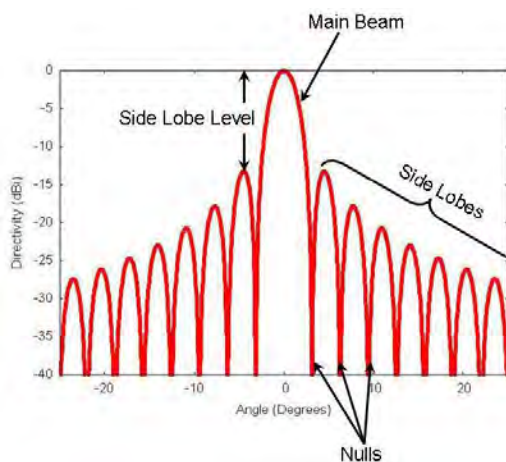
Figure 5-4: Typical antenna Radiation Pattern Envelope (RPE) diagram

5.8   INSTALLING AIRELINK™80 WITH INTEGRATED 20 CM ANTENNA

In preparation for the actual alignment process, carry out the following steps:

1. Power-on both radios on both sides using either the PoE or the direct 48 Vdc power connection. There is no ON/OFF switch and once connected to the power source, the radio will start the boot process. During the boot process the green Power LED on the back panel is blinking and solid green after the boot process is completed. This process will take about 90 seconds. Verify that the green *POWER LED* on the user panel inside the radio housings are lit at both radios.

2. After the boot process is completed, verify that the *RF ON LED* and the ALIGNMENT LED are lit. In case the alignment LED is off, please switch the system into alignment mode using the web browser interface (see Chapter 6.3) or execute the appropriate command via the COMMAND LINE INTERFACE (see Chapter 7.)

3. There are two options to connect to the radio and read the RSSI values:

    a. Via digital voltmeter - Connect the digital voltmeter to the 2-pin connector located at the side of the radio housing using the RSSI Alignment Cables included with the system. Make sure that the digital voltmeter readout can be clearly seen during the installation process (e.g. Tape it to the installation pole).

    b. Via **Bluetooth™** connection - Use an ANDROID (Version 4.4.2 or higher) and Bluetooth™ capable based smart phone or tablet and download the free *LightPointe BLE Tool* from the Goggle apps store https://play.google.com/store (see Chapter 8 for more details).

⚠️	After installation of the software is completed, please reboot/restart your phone/tablet to ensure proper operation of the application.

c. After starting the application, the software will automatically scan for AireLink systems. To find the system the line-of-sight distance between the phone/tablet and the AireLink system should not be more than 300 feet (100 meters). Distances will be shorter in case of an obstructed view. After successful discovery, click the AireLink system you would like to connect to. When asked, please enter the default passcode 0000 to finalize the connection. (Note: This code can be changed later using the web browser interface to preclude non-authorized system access.) Open the application RADIO tab and observe the RSSI value.

4. Verify that the RF ON LED is lit (green) on both radio heads.

5. Most likely at this point there is no connectivity established between the radios and *RF SYNCH LED* will be off. Depending on the status and wiring of additional networking connections there might be other data port LEDs lit, too. However, these are not essential for the alignment process and the system can be aligned without an active network connection being present.

6. In case you bought the optional Alignment Sight Tool, please attach it to either side of the radio enclosure as shown in Fig. 5-5. The Alignment Sight Tool does not eliminate the need for precise adjustment of the antennas, but it shortens the time it takes to correctly point the antenna towards the remote antenna locations.
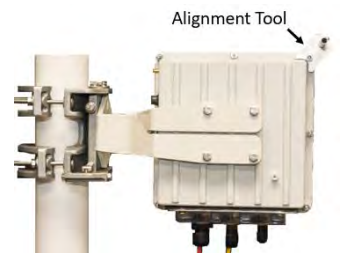
Figure 5-5: Alignment Sight Tool (Integrated Antenna System)

7. Look through the Alignment Sight Tool and turn the Elevation and Azimuth Adjustment Screws until the opposite antenna location shows in the middle of the Alignment Sight Tool. The inside of the tool is reflective and this helps to center the remote antenna site location. In case the opposite side is too far away to be clearly seen, please use binoculars to find an easy

recognizable landmark close to the opposite antenna side. Perform the same procedure at both sides.

8. The alignment tool is meant to provide a rough alignment towards to opposite antenna location. It is however not an exact tool for finding the best alignment of the antennas. More precise alignment is done via the digital voltmeter or the *LightPointe BLE Tool* that measures the receive signal strength/RSSI voltage. Within several dB of accuracy the RSSI voltage reading in Volt corresponds to the RF RSSI signal reading in dBm. In other words, and with the correct polarity chosen, a system that is not aligned at all will show a negative voltage reading close to −0.80 Volt and this translates into -80 dBm. This signal level is far too low to establish a data connection. During the alignment process the **voltage reading will increase, meaning "less negative" voltages or higher RF RSSI reading in dBm will be recorded. The goal is to align the** system at its best possible and highest RSSI reading (e.g. increase the voltage reading from -0.8 V to -0.5V). LightPointe provides a distance vs. voltage reading chart for the AireLink 80 system using either the integrated or the external antenna options (see Figure 5-8). When using the *Lightpointe BLE Tool*, the RSSI reading is given in dBm directly.

9. To align the system turn the Azimuth and Elevation Adjustment Screws at each antenna left/right for best azimuth alignment and up/down for best elevation alignment and observe the voltmeter or Android software reading. The goal is to find the maximum RSSI voltage reading (lowest negative voltage) on both sides of the link. Using a meander-like scan pattern has proven to be the most efficient way to align the antennas. This is illustrated in Fig. 5-6.
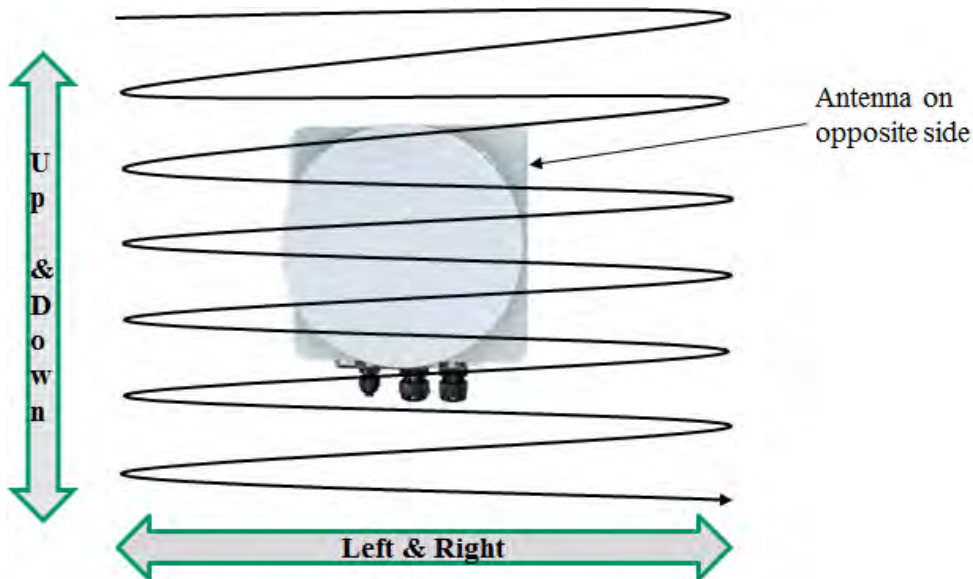
Figure 5-6: Antenna alignment scan

> ⚠️ Do NOT move both radios at the same time. Try to optimize the RSSI signal level first at one side and then repeat this process at the opposite side. Communicate changes in signal levels during the adjustment process to the person at the opposite side via a two-way radio or cell phone.

10. Ensure that the antennas are not aligned on a side-lobe. In particular when the system is installed over short distances the side-lobes can be easily seen. Rotate the antenna a few degrees to each side of the perceived alignment center and both side-lobes can be detected as **"local RSSI voltage minima". The main lobe which is located right in the middle between the** two side lobes will have a much higher voltage reading. Fig. 5-7 shows a simple illustration of the alignment process and the location of the antenna side lobes in relation to the main lobe.

> Note: For longer distances between the antennas the side lobes might not be visible due to the much lower signal power contained in a side lobe when compared to the main lobe.

Figure 5-7: Simple illustration of the alignment process

11. When aligning the system it is important to take a look at the Receive Signal Strength chart shown in Fig. 5-8. The RSSI chart shows the RSSI signal voltage as a function of the deployment distance in clear weather conditions. Therefore, and when the system is installed under non-clear weather conditions, the values can be lower during the actual installation process. 80 GHz systems are also impacted by oxygen absorption (see Fig. 2-2) and these values can also vary several dB between sea level installations and installations at higher altitudes. The RSSI values are different for the low band and the high band radio and the values vary slightly and within a few percent from one radio system to another due to manufacturing tolerances. However, the chart provides a very good indication of expected RSSI values as a function of deployment distance. The overall goal of the alignment process is to align the system as close as possible to the RSSI value provided in the RSSI chart.
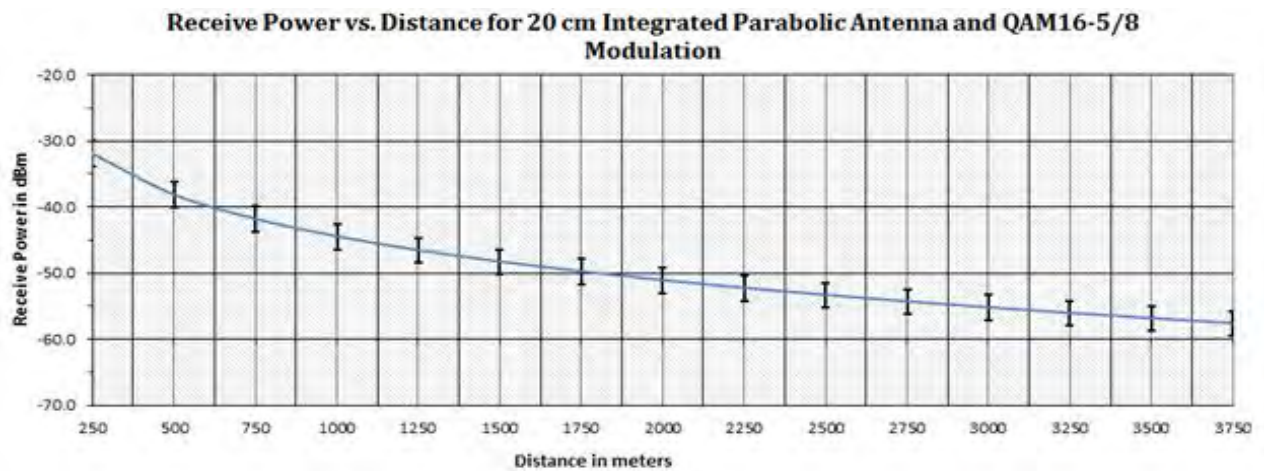
Figure 5-8:   Typical AireLink 80-SX RSSI vs. Distance Charts for standard distance setting.

12. After maximizing the RSSI signal levels on both sides of the link, do not forget tightening the Elevation and Azimuth Locking Bolts (see Fig. 5-7 and Fig. 5-8).

13. Disconnect the voltmeter from the RSSI signal connector. Use web browser to switch the system from ALIGNMENT MODE to DATA MODE operation. Failing to perform this step will result in the system rebooting in ALIGNMENT MODE when the system is power cycled. After performing this step, the   *ALIGN LED* on the user panel should be off.

14. When looking at the user panel (see Fig. 5-9) the following LEDs should be on:

   ✓ *POWER LED*
   ✓ *RF ON*
   ✓ *RF SYNCH*

Depending on the status of the networking connections additional port status LEDs might be lit, too.
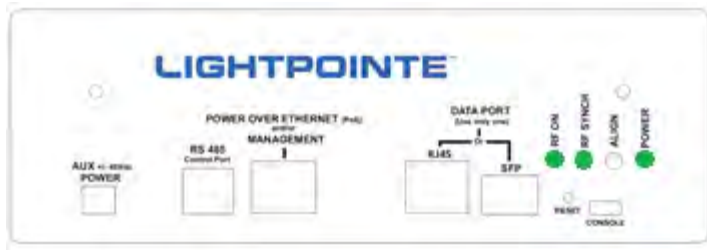
Figure 5-9: Default User Panel status after successful alignment

15. When using the integrated lens antenna the minimum distance between the antennas in Standard distance mode (see RF Link menu on page 74) is 100 meter. If the system is installed over a shorter distance, please change the distance setting to Short or Very Short distance to avoid receiver saturation which occurs around -32 dBm. The table below shows the distance ranges for Standard, Short and Very Short distance settings.

Antenna Type	Standard Distance	Short Distance	Very Short Distance
Int. parabolic antenna (SX)	>400 meters	>200 meters	>100 meters

16. Alternatively, the AireLink 80 system is equipped with Automatic Transmission Power Control (ATPC) functionality. This allows to install the system over even shorter distances without saturating the receiver. To enable ATPC, please see the *Distance* settings under *RF Link View Screen - Settings* in the web browser interface (page 98)

The Installation is now completed and the radio link operational!

5.9   INSTALLING AIRELINK™80 WITH EXTERNAL ANTENNAS

In general terms, the alignment of the **AireLink™80** with an external 1 or 2 foot antenna is very similar to the alignment of the system with the integrated 12 cm antenna. However, the larger antenna systems, and in particular the 2 foot antenna system, have a narrower antenna transmission/receive angle. Consequently, the installation can take a little bit longer.

5.10   INSTALLING THE OPTIONAL ALIGNMENT SIGHT TOOL FOR EXTERNAL ANTENNAS

To ease the alignment process using narrow angle 1 and 2 foot external antennas LightPointe provides an optional *Alignment Sight Tool* (see Fig. 5-10) that attaches to either the 1 foot, 2 foot or three foot antenna system. The Alignment Sight Tool does not eliminate the need for precise adjustment of the antennas but it shortens the time it takes to correctly point the antenna towards the remote antenna locations.

Figure 5-10: Alignment Sight Tool (External Antenna System)

5.11   AIRELINK™80 WITH 1 FOOT ANTENNA

In case of the **AireLink™80** with the external 1 foot antenna the Alignment Sight Tool attaches to the mounting/alignment bracket. The following procedure to install the Alignment Sight Tool should be followed:

1. Determine the location to install the Alignment Sight Tool. The Alignment Sight Tool can be positioned on the top or bottom of the antenna mount (see Fig. 5-11, upper left). It is best to attach sight beside the azimuth adjustment screw to ensure adequate room for use of wrenches during alignment procedure. Note that antenna mount can be used in different orientations; therefore the azimuth adjustment screw may be on the top or bottom.

2. Slide sight onto the mount. It is very important to make sure that the ridge on the mount is engaged with the groove on the underside of the sight clamp. If the clamp does not fit as shown Fig. 5-11 (upper right), see Sight Setup instructions further.

3. Once the sight is in position on the mount tighten the knob to hold it in place.
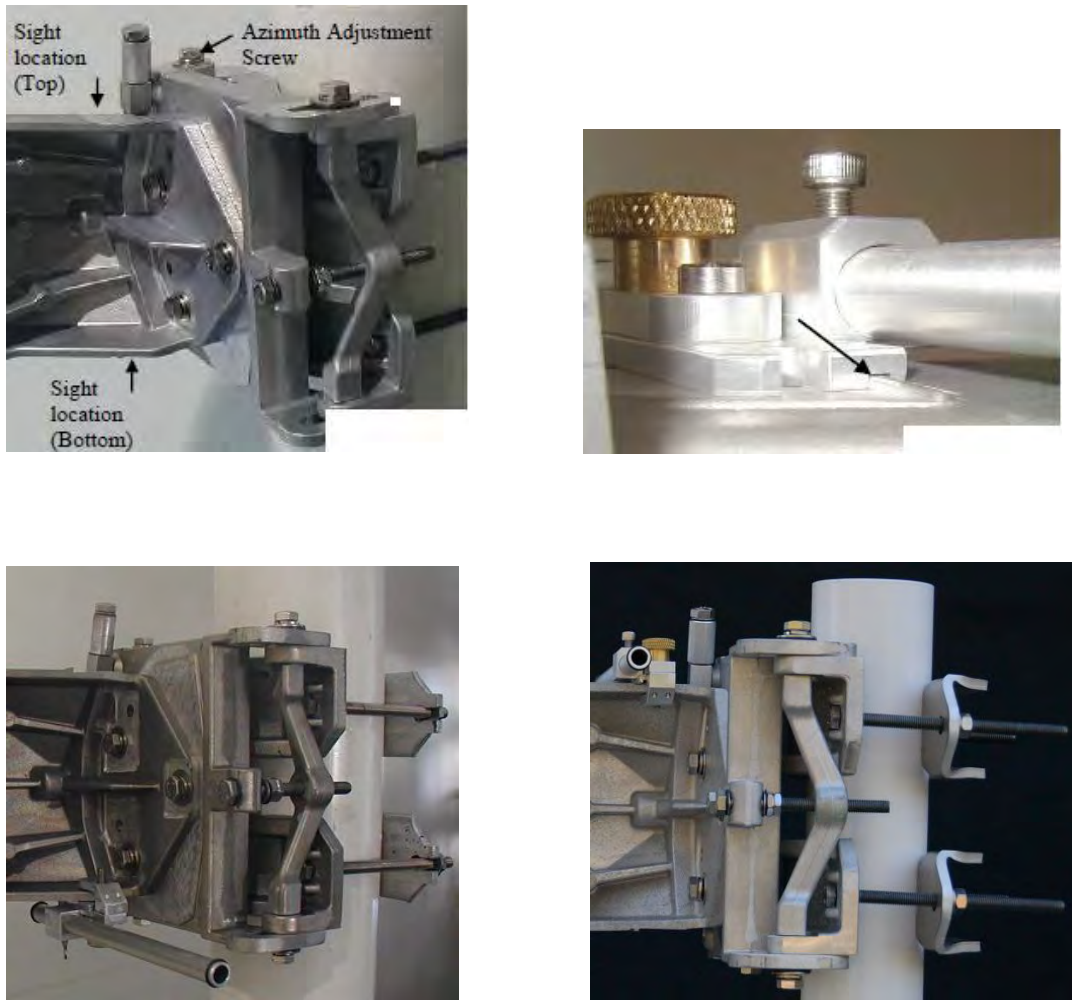
Figure 5-11: Attach Alignment Sight Tool to external 1 foot antenna

5.12 AIRELINK™80 WITH 2 FOOT ANTENNA

1. The sight clamp for the Alignment Sight Tool is on the top (bottom) of the 2 and 3 foot antenna.

2. Slide the Sight onto the mounting bracket as shown in Fig. 5-12 (right). It is very important to make sure that the ridge on the bracket is engaged with the groove on the sight clamp.
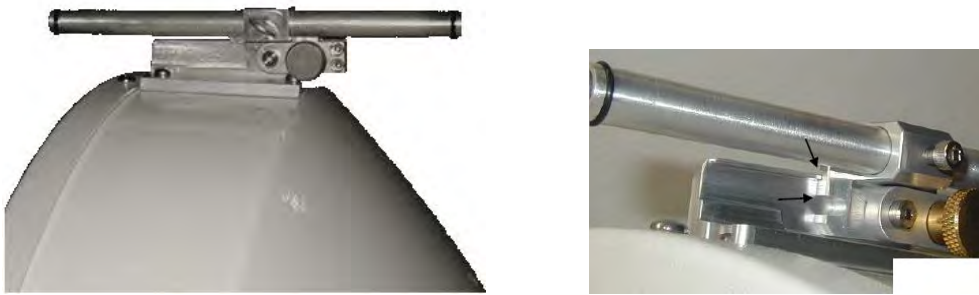
Figure 5-12: Attach Alignment Sight Tool to external 2 foot antenna

5.13 CONFIGURATION OF THE ALIGNMENT SIGHT TOOL

The alignment sight clamp may need to be reconfigured for proper fit. Fig. 5-13 shows how to change the configurations. To re-configure, remove the brass knob, move to clamp the desired position and replace the knob.

Figure 5-13: Re-configuring Alignment Sight Tool

5.14 MOUNTING BRACKET ADJUSTMENT

At this point during the installation process the antennas should be attached to the mounting pole in such a way that they roughly point towards each other. The alignment brackets fine adjust mechanisms are used to precisely tune the antenna elevation and azimuth. The procedure described below is the same for all external antennas.

Elevation Adjustment

To adjust the elevation settings of the antenna, see Fig. 5-7 and perform the following steps:

1. Slightly loosen the 3 Elevation locking bolts.

2. Determine if elevation adjustment must be performed in upwards or downward direction.

3. In case the elevation must be adjusted upwards, ensure that the two Elevation Locking Bolts marked I/II in Fig. 5-14 are both in position I. If not, keep the Pivot Bolt in place and unscrew these two locking bolts. Support the antenna when removing the last/second bolt to avoid the antenna sliding down. On the back of the alignment bracket is the lock bolt holder (see Fig. 5-7) and it needs to be put in place again before re-inserting the bolts in position I. Do not completely tighten the bolts to allow the antenna to move when turning the Elevation Adjustment Screw.
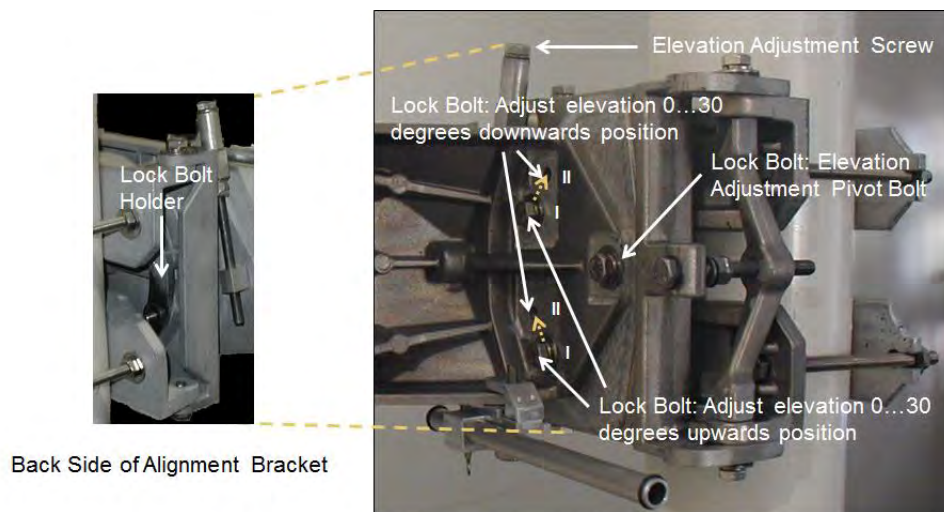
Figure 5-14: Elevation Adjustment

4. In case the antenna elevation needs to be adjusted downwards, take sure that the two Elevation Locking Bolts are both in position II. If not, perform steps as described under 3.

Note	When re-arranging the antenna bracket for upwards/downwards elevation adjustment, it is helpful to have a second person assisting the process.

5. To adjust the antenna elevation use a 13 mm combination or racket wrench and turn the Elevation Adjustment Screw either clock- or counter clock wise.

Azimuth Adjustment

1. To adjust the azimuth settings of the antenna see Fig. 5-15 and perform the following steps:

2. Slightly loosen the 4 Azimuth Adjustment Locking Bolts.

3. To adjust the antenna azimuth direction use a 13 mm combination or racket wrench and turn the Azimuth Adjustment Screw either clock- or counter clock wise.
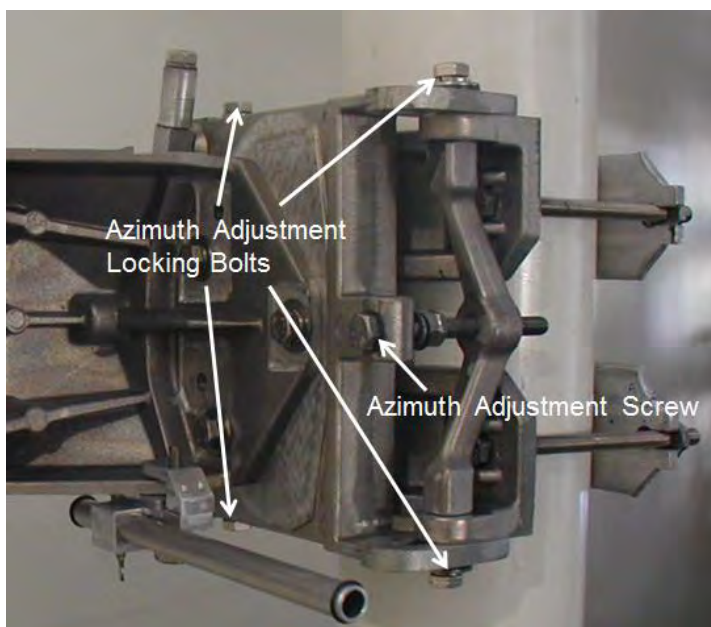
Figure 5-15: Azimuth Adjustment

5.15 ALIGNING THE 80 GHZ ANTENNAS

In preparation for the actual alignment process, carry out the following steps:

1. Power-on both radios on both sides using either the PoE or the direct 48 Vdc power connection. There is no ON/OFF switch and once connected to the power source, the radio will start the boot process. During the boot process the green Power LED on the back panel is blinking and solid green after the boot process is completed. This process will take about 90 seconds. Verify that the green *POWER LED* on the user panel inside the radio housings are lit at both radios.

2. After the boot process is completed, verify that the *RF ON LED* and the ALIGNMENT LED are lit. In case the alignment LED is off, please switch the system into alignment mode using the web browser interface (see Chapter 6.3) or execute the appropriate command via the COMMAND LINE INTERFACE (see Chapter 7.)

3. There are two options to connect to the radio and read the RSSI values:

   a. Via digital voltmeter - Connect the digital voltmeter to the 2-pin connector located at the side of the radio housing using the RSSI Alignment Cables included with the system. Make sure that the digital voltmeter readout can be clearly seen during the installation process (e.g. Tape it to the installation pole).

   b. Via **Bluetooth™** connection - Use an ANDROID (Version 4.4.2 or higher) and Bluetooth™ capable based smart phone or tablet and download the free *LightPointe BLE Tool* from the Goggle apps store https://play.google.com/store. Installing the software will require to grant access to the phone's Bluetooth™ connection (see Chapter 8 for more details).

> ⚠️ After installation of the software is completed, please reboot/restart your phone/tablet to ensure proper operation of the application.

c. After starting the application, the software will automatically scan for AireLink systems. To find the system the line-of-sight distance between the phone/tablet and the AireLink system should not be more than 300 feet (100 meters). Distances will be shorter in case of an obstructed view. After successful discovery, click the AireLink system you would like to connect to. When asked, please enter the default passcode 0000 to finalize the connection. (Note: This code can be changed later using the web browser interface to preclude non authorized system access.) Open the application RADIO tab and observe the RSSI value.

4. Verify that the RF ON LED is lit (green) on both radio heads.

5. Most likely at this point there is no connectivity established between the radios and *RF SYNCH LED* will be off. Depending on the status and wiring of additional networking connections there might be other data port LEDs lit, too. However, these are not essential for the alignment process and the system can be aligned without an active network connection being present.

6. Look through the Alignment Sight Tool and turn the Elevation and Azimuth Adjustment Screws until the opposite antenna location shows in the middle of the Alignment Sight Tool. The inside of the tool is reflective and this helps to center the remote antenna site location. In case the opposite side is too far away to be clearly seen, please use binoculars to find an easy recognizable landmark close to the opposite antenna side. Perform the same procedure at both sides.

7. The alignment tool is meant to provide a rough alignment towards to opposite antenna location. It is however not an exact tool for finding the best alignment of the antennas. This is done via the digital voltmeter.

8. Turn the Azimuth and Elevation Adjustment Screws at each antenna left/right for best azimuth alignment and up/down for best elevation alignment and observe the voltmeter reading. The goal is to find the maximum RSSI voltage reading on both sides of the link. Using a meander-like scan pattern has proven to be the most efficient way to align the antennas. This is illustrated in Fig. 5-16.
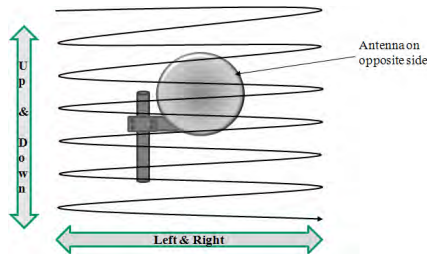
Figure 5-16: Antenna alignment scan

⚠	Do NOT move both radios at the same time. Try to optimize the RSSI signal level first at one side and then repeat this process at the opposite side. Communicate changes in signal levels during the adjustment process to the person at the opposite side via a two-way radio or cell phone.

Ensure that the antennas are not aligned on a side-lobe. In particular when the system is installed over short distances the side-lobes can be easily seen. Rotate the antenna a few degrees to each side of the perceived alignment center and both side-**lobes can be detected as "local RSSI voltage minima".** The main lobe which is located right in the middle between the two side lobes will have a much higher voltage reading. Fig. 5-17 shows a simple illustration of the alignment process and the location of the antenna side lobes in relation to the main lobe.
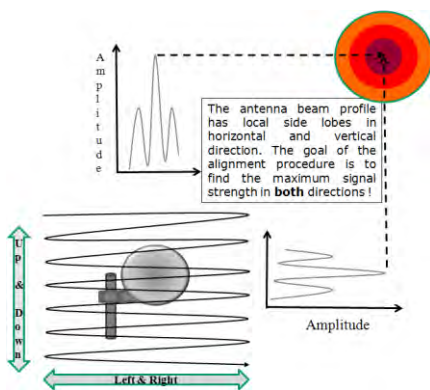
Figure 5-17: Simple illustration of the alignment process

Note:	For longer distances between the antennas the side lobes might not be visible due to the much lower signal power contained in a side lobe when compared to the main lobe.

17. When aligning the system, it is important to take a look at the Receive Signal Strength using either a voltmeter attached to the alignment voltage connector located at the side of the radio housing, or using the LightPointe BLE Tool and Observe the RSSI value shown in the radio submenu. The RSSI chart in Fig. 5-18 shows the RSSI signal voltage as a function of the deployment distance under ideal and clear weather conditions and with 1 foot antenna attached to the radio. Therefore, and when the system is installed under non-clear weather conditions, the values can be lower during the actual installation process. The RSSI values are slightly different for the low band and the high band radio and, in addition, the values vary slightly and within a few percent from one radio system to another due to manufacturing tolerances. However, the chart provides a very good indication of expected RSSI values as a function of deployment distance. RSSI chart for the 2 foot and 3 foot antenna can be found on pages 40/41.The overall goal of the alignment process is to align the system as close as possible to the RSSI value provided in the RSSI chart. The RSSI voltage reading in Volt corresponds to the RF RSSI signal reading in dBm. In other words, and with the correct polarity chosen, a system that is not aligned at all will show a negative voltage reading close to −0.80 Volt and this translates into a -80 dBm power reading. This signal level is far too low to establish a data connection. During the alignment process the voltage reading will increase, **meaning "less negative" voltages or higher RF RSSI reading in dBm will be recorded. The goal is to align the** system at its best possible and highest RSSI reading (e.g. increase the voltage reading. When using the *Lightpointe BLE Tool*, the RSSI reading is given in dBm directly.
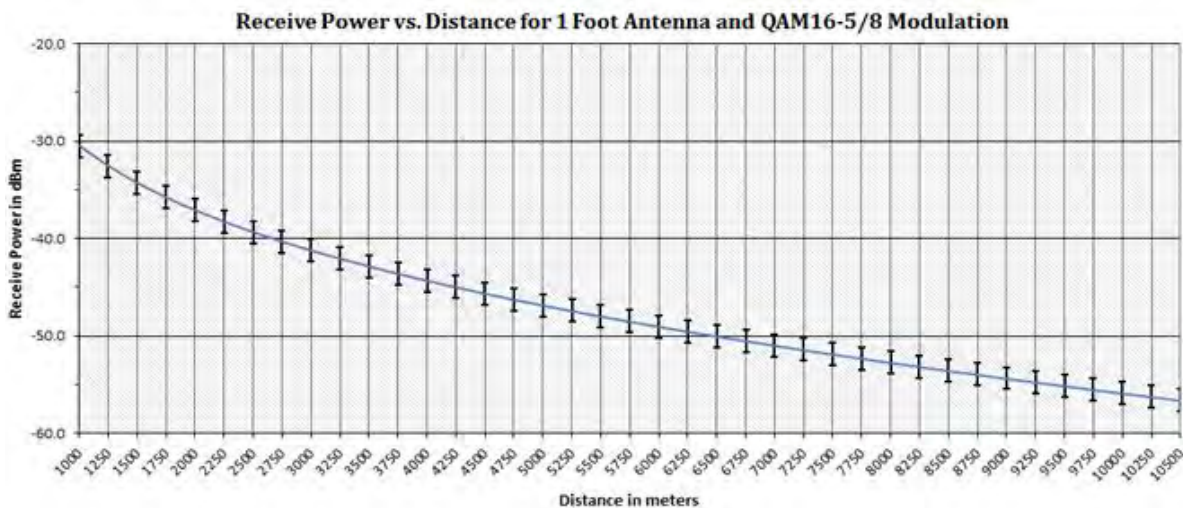
Figure 5-18: Typical AireLink 80 RSSI vs. Distance Charts for 1 foot antenna

9. After maximizing the RSSI signal levels on both sides of the link, do not forget tightening the Elevation and Azimuth Locking Bolts (see Fig. 5-14 and Fig. 5-15).

10. Disconnect the voltmeter from the RSSI signal connector. Use web browser to switch the system from ALIGNMENT MODE to DATA MODE operation. Failing to perform this step

will result in the system rebooting in ALIGNMENT MODE when the system is power cycled. After performing this step, the *ALIGN LED* on the user panel should be off.

11. When looking at the user panel (see Fig. 5-19 the following LEDs should be on:

   ✓ *POWER LED*
   ✓ *RF ON*
   ✓ *RF SYNCH*

Depending on the status of the networking connections additional port status LEDs might be lit, too.

Figure 5-19: Default User Panel status after successful alignment

12. When using the external 1 foot or 2 foot dish antennas, the minimum distance between the antennas in Standard distance mode (see RF Link menu on page 74) is 1000 and 3250 meters, respectively. If the system is installed over a shorter distance, please change the distance setting to Short or Very Short to avoid receiver saturation which occurs around -30 dBm. The table below shows the distance ranges for Standard, Short and Very Short distance settings.

Antenna Type	Standard Distance	Short Distance	Very Short Distance
1 Foot Dish (MX)	>1000 meters	>500 meters	>250 meters
2 Foot Dish (LX)	>3250 meters	>1750 meters	>1000 meters

13. Alternatively, the AireLink 80 system is equipped with Automatic Transmission Power Control (ATPC) functionality. This allows to install the system over even shorter distances without saturating the receiver. To enable ATPC, please see the *Distance* settings under *RF Link View Screen - Settings* in the web browser interface (page 98)

The Installation is now completed and the radio link operational!

6   AIRELINK 80 DUAL POLARIZATION TANDEM SYSTEM

Using the Tandem system allows for either doubling the transmission capacity by establishing two independent GbE connections (2+0 configuration), or to establish a redundant network connection (1+1 configuration). To enable the 2+0 operation the customer needs to configure the network switch and enable a common networking trunking or traffic aggregation protocol such as EtherChannel or similar. 1+1 redundancy operation can be enabled by using Layer 2 RSPT (Rapid Spanning Tree) networking protocols or a Layer 3 routing protocol like OSPF (Open Shortest Path First).
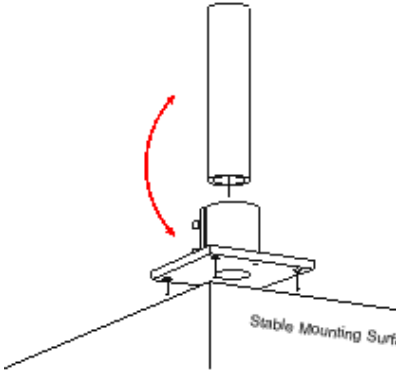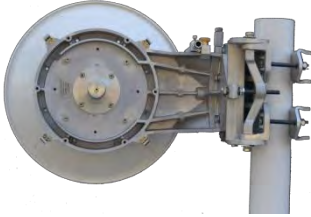
⚠	Please configure your networking equipment before connecting the AireLink 80 Tandem system to the networking switch to avoid potential networking problems.

6.1   HARDWARE INSTALLATION

The basic AireLink 80 Tandem system installation using 2 ODUs and a single antenna with a Dual Pol Adapter (DPA) is very similar to the installation of the standard AireLink 80 system. Please follow the steps outlined below to install the system using the LightPointe mounting pole a standard mounting pole with a pole diam**eter between 2.5…4.0 inches (60…10**0 mm):

	Step 1	Install the mounting base plate to a solid platform **using 12 mm (1/2") bolts.**
		❑ Anchor the mount in wall or concrete (recommend M12-screws)
		❑ Use bolts of hardness class not less than 6.6
		To ensure stability, keep the mounting post as short as possible. The maximum allowable mounting pole lengths are 4 feet (120 cm).

	Step 2	Attach and fasten the mounting post assembly to the base plate using the supplied fastening 8mm screws with 6mm Allen heads. Do not over tighten the mounting screws.
	Step 3	Use a level to verify that the mounting pole is installed vertically. This will ensure that the polarization planes are aligned and that the system operates according to specification.
	Step 4	Attach the radio mounting/alignment bracket to the mounting pole. Roughly align the antenna towards the opposite radio location and tighten the bracket bolts using a 13 mm open-end or combination wrench. Ensure the bolts are EVENLY tightened.
	Step 5	Remove the protective tape from in waveguide tube of Dual Pole Adapter.
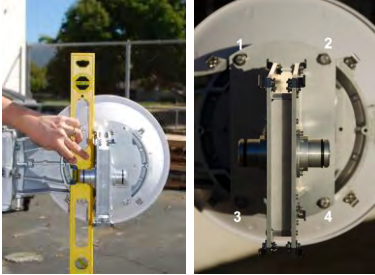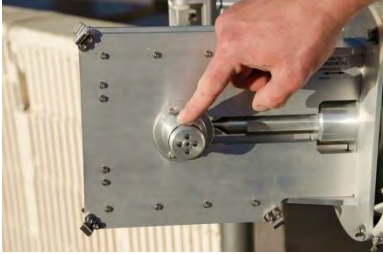
	Step 6	Use a drop of silicone grease to lubricate the rubber O-ring of antenna waveguide flange. Attach the Dual Pole Adapter to the antenna waveguide flange.
	Step 7	Use level to ensure that the Dual Pole Adapter is installed in vertical position and evenly tighten the 4 fastening bolts provided with the Dual Pole Adapter.
	Step 8	Use a drop of silicone grease and spread with finger to lubricate the rubber O-ring on both sides of the Dual Pole Adapter waveguide flange.
Antenna pre-installation completed!		

Figure 6-1: Tandem Dual Polarization Adapter Installation

6.2   TANDEM ODU INSTALLATION

After installing the antenna, the ODUs can be installed. Two ODUs will be installed at each side of the link. One ODU will operate in the vertical polarization and one in the horizontal mode of polarization. It is important to attach the ODUs correctly to the Dual Pole Adapter because the Adapter is sensitive towards the polarization of the ODU and will not work correctly if the ODU are installed with reverse polarity.

The radio operates in horizontal polarization when the cable glands on the plastic cover point downwards and in vertical polarization when the cable glands point sideways (see Figure 6-2).
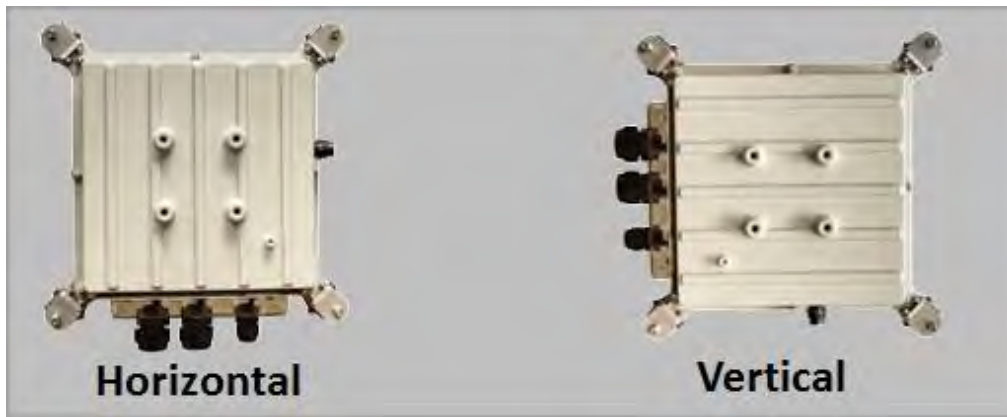
Figure 6-2: ODU Polarization Orientation

Note: Ensure that the LOW BAND and HIGH BAND ODUs are installed on the same DPA. The LOW/HIGH ODU indication is labeled on the radio network user panel.   Installing a LOW BAND and HIGH BAND ODU on the same DPA will not work.

The Dual Pole Adapter also has a writing indicating which side operates in horizontal or vertical polarization (see Figure 6-3).

Figure 6-3: Dual Pole Adapter Polarization Label

Before installing the ODUs to the Dual Pole Adapter, please ensure that the polarizations of the ODU and the Adapter are matched correctly. To attach the ODU to the antenna, simply guide the ODU onto the round metal flange on the back of the antenna. Adding a drop of silicone grease to the O-ring will help to slide the ODU onto the waveguide flange (see Figure 6-1, Step 8). Slightly rotate the ODU while pushing it towards the antenna base plate, and ensure to not destroy the rubber O-ring that serves as a seal/gasket between the antenna flange and the ODU housing. Once the ODU it pushed all the way down onto the antenna baseplate and aligned correctly in either horizontal or vertical position, fasten the 4 spring loaded latches to finalize the attachment of the ODU to the antenna base. Fig. 6-4 shows the AireLink 80-MX TANDEM system with both ODUs installed.

It is also critically important that a high-band radio on one side is paired with a low-band radio on the opposite side to ensure proper operation. Before installing the radio units check each radio to verify one is a high-band and the other is a low-band version. The information can be found on the back panel and when looking through the back panel window. A sticker will say **either "HIGH" or "LOW"** behind the system serial number listing. When installing the system in a country that requires a license for operation, ensure that the low-band and the high-band radios are installed at each side according to the assigned and approved frequency allocation plan.
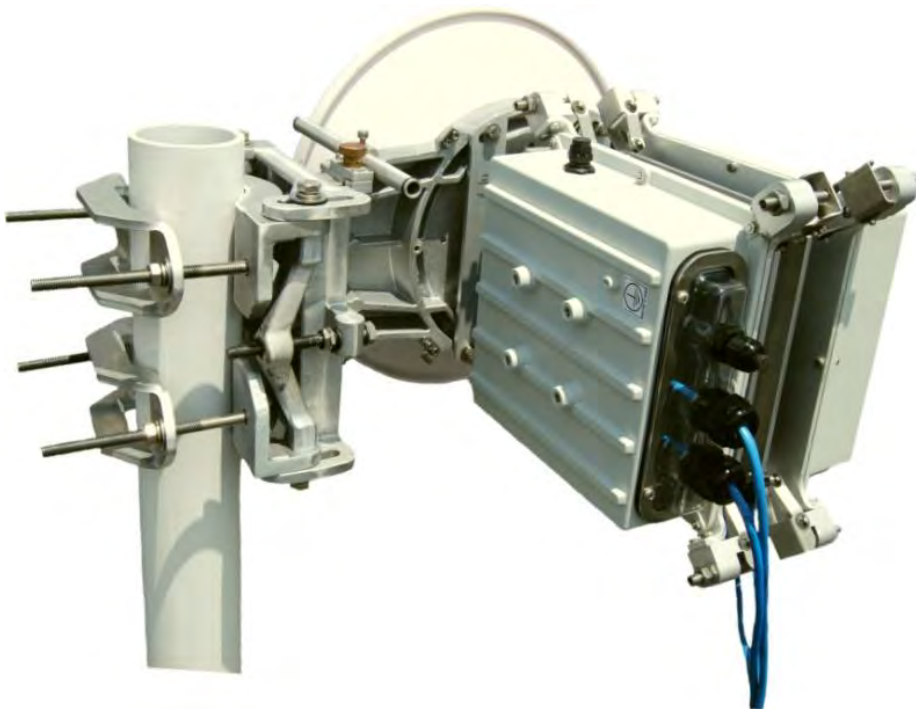
Figure 6-4: AireLink 80-MX TANDEM with ODUs attached

6.3 SYSTEM ALIGNMENT PROCEDURE

After finishing the mounting of the antennas, and connecting the cabling to the ODU as described in Chapter 3., the system is ready for alignment. At this point it is only required to power on one ODU pair, either the horizontal or the vertical pair, and actual active network traffic is not needed to **align the system because the system is shipped in "Alignment" mode of operation.** The actual antenna alignment process is not different from aligning the single ODU system.

The alignment process of the Dual Pol AireLink system will be eased quite dramatically if two people (one on each side) are involved in the alignment procedure. This is particularly true for the larger 2 foot LX antenna due to its narrower beam pattern when compared to the smaller 1 foot MX antenna. Two-way radios or cell phones are extremely helpful in exchanging information between the two parties performing the alignment. While it is possible for a single individual to align the units, walking or driving back and forth between the two mounting locations can be a cumbersome and time consuming process. The correct alignment of the system and in particular the correct adjustment of the polarization planes is crucial for ensuring proper performance of the system. Reserve enough time to complete this process and no rush should be in play when aligning the system. Depending on the experience of the installer(s) in aligning narrow beam radio transmission equipment, this process can take anywhere from 15 to 90 minutes.

Note: For future reference we will name the installation location A and B and the polarizations V (vertical) and H (horizontal). The individual radios will therefore be referred to as A-H, A-V and B-H, B-V.

Now follow the steps below to align the dual pol adapter:

Note: When aligning the dual pole system, initially power on only one of the radio pairs. The second pair will be turn on at a later stage of the alignment process.

In preparation for the actual alignment process, carry out the following steps:

1. Connect the digital voltmeter to the 2-pin connecter on the side of the radio housing (see Figure 6-2) using the RSSI Alignment Cables included with the system. Make sure that the digital voltmeter readout can be clearly seen during the installation process (e.g. Tape it to the installation pole). Alternatively, use an Android smartphone/tablet and download the LightPointe **Bluetooth™** (BLE) application from the GOOGLE PLAY STORE

    https://play.google.com/store/search?q=lightpointe%20ble&hl=en

2. Power-on the A-V and B-V pair of radios and verify that the green power-LEDs on the PC board inside the radio housings are lit and wait until the boot process is completed. The second radio pair will stay powered off. Depending on the status and wiring of additional networking connections there might be other LEDs lit, too.

3. Look through the Alignment Sight Tool and turn the Elevation and Azimuth Adjustment Screws (see Figures 5-14 and 5-15) until the opposite antenna location shows in the middle of the Alignment Sight Tool. The inside of the tool is reflective and this helps to center the remote antenna site location. In case the opposite side is too far away to be clearly seen, please use binoculars to find an easy recognizable landmark close to the opposite antenna side. Perform the same procedure at both sides.

4. The alignment tool is meant to provide a rough alignment towards to opposite antenna location. It is however not an exact tool for finding the best alignment of the antennas. This is done via the digital voltmeter or by reading the RSSI voltage from the LightPointe BLE Android application.

5. Turn the Azimuth and Elevation Adjustment Screws at each antenna left/right for best azimuth alignment and up/down for best elevation alignment and observe the voltmeter reading. The goal is to find the maximum RSSI voltage reading on both sides of the link. Using a meander-like scan pattern has proven to be the most efficient way to align the antennas. This is illustrated in Fig. 6-5.
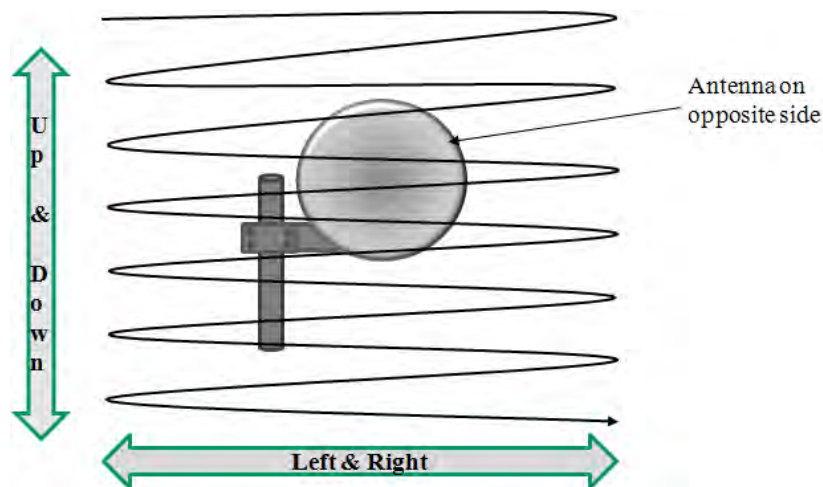
Figure 6-5: Antenna alignment scan

Note:	Do NOT move both radios at the same time. Try to optimize the RSSI signal level first at one side and then repeat this process at the opposite side. Communicate changes in signal levels during the adjustment process to the person at the opposite side via a two-way radio or cell phone.

6. Ensure that the antennas are not aligned on a side-lobe. When rotating the antenna a few degrees to each side of the perceived alignment center, both side-lobes can be detected as "local RSSI voltage minima". The main lobe which is located right in the middle between the two side lobes will have a much higher voltage reading. Figure 6-6 shows a simple illustration of the alignment process and the location of the antenna side lobes in relation to the main lobe.

Note:	For longer distances between the antennas the side lobes might not be visible due to the much lower signal power contained in a side lobe when compared to the main lobe.
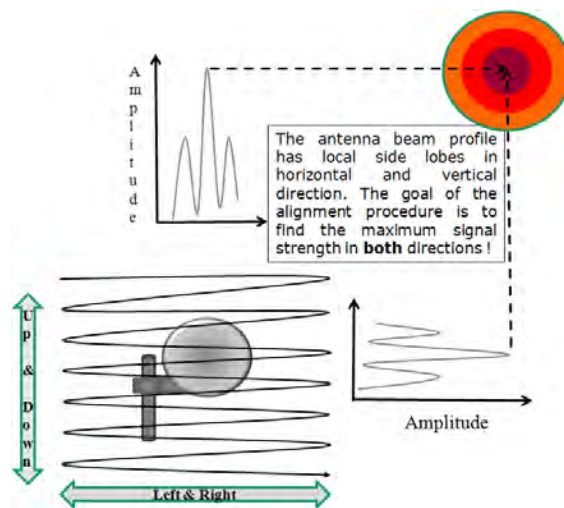
Figure 6-6: Simple illustration of the alignment process

7. When aligning the system it is important to take a look at the Receive Signal Strength Indicator (RSSI) voltage shown in Fig. 6-7. The voltage reading is the actual receive power in dBm. The RSSI chart shows the RSSI signal voltage as a function of the deployment distance in clear weather conditions. Therefore, and when the system is installed under non-clear weather conditions, the values can be lower during the actual installation process. The RSSI values are different for the low band and the high band radio and the values vary slightly and within a few percent from one radio system to another due to manufacturing tolerances. However, the chart provides a very good indication of expected RSSI values as a function of deployment distance. The overall goal of the alignment process is to align the system as close as possible to the RSSI value provided in the RSSI chart.

Figure 6-7: Typical AireLink 80 DPA RSSI vs. Distance Charts

8. After maximizing the RSSI signal levels on both sides of the link, do not forget tightening the Elevation and Azimuth Locking Bolts (see Fig. 5-14 and Fig. 5-15). Please, write down the RSSI voltage values for the A-V and B-V antennas.

9. For proper operation of the dual pole system it is very important to check the correct alignment of the polarization plane. If the polarizations are not aligned correctly, the system will not work according to specifications. Assuming that the mounting pole and the Dual Pole Adapter are already leveled in vertical position quite well, only a slight adjustment might be needed.

10. Turn on the A-H & B-H radios, turn off the A-V & B-V radios and record the RSSI for both radios on the horizontal link. The insertion loss of each dual pol adapter is 1.3 dB average and 2.5 dB max. Based on path loss calculations, if any of the RSSI values are unexpected, one of the

antennas is likely aligned on a side lobe. You must pan further in azimuth and elevation to find the main lobe of each antenna so that expected RSSI levels are obtained.

11. This step is to be performed using cross polarized radios. Turn off either A-H & B-V or A-V & B-H. Using the remaining cross polarized radios, slightly loose the 4 fastening bolts that attach the Dual Pol Adapter to the antenna at either radio (see 1 to 4 in Figure 6-8). Rotate the dual pol adapter assembly to minimize the RSSI. Record the RSSI at both ends of the link.
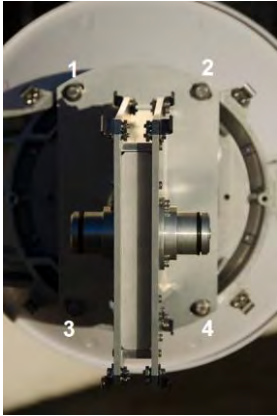
Figure 6-8: Dual Pole Adapter Fastening Bolts

12. Using the same cross polarized radio pair used in step 11 (with the other two radios still turned off), carefully tweak the azimuth and elevation fine pointing adjustments (see Figures. 5-14 & 5-15) at one end of the link to see if the RSSI can be further reduced. You are looking for a very steep cross pol null that may be slightly misaligned from the co-pol beam of the antenna found in step 8. A very slight fine re-pointing should enable you to minimize the RSSI. Repeat this step on the antenna at the other end of the link.

13. Repeat step 11.

14. Turn on all radios and record the co-polarized RSSI at each radio. It should be close to the values recorded in step 10 above. If not, the fine re-pointing went too far in step 12 and this procedure must be repeated starting again at step 5.

15. The final step is to change the operating status of the radios via the Web interface from **"ALIGNMENT" mode of operation to "DATA" mode of operation, save the setting and restart the** radios (see Chapter 7.3)

The installation and alignment procedures are now completed and the system is ready for use with two independent GbE channels!

``

7   LINKMANAGER™– NETWORK MANAGEMENT PLATFORM

The AireLink™ system can be monitored/managed via a web browser based interface, a TELNET based CLI Interface, via or SNMP. The web browser interface can be easily accessed via the http protocol using a standard INTERNET EXPLORER, CHROME or FIREFOX web browser. SNMP operation requires the installation of a SNMP Management System at the customer side.

7.1   MANAGEMENT APPLICATION VIEWS

To connect to the LinkManager™ browser-based management application, connect an Ethernet cable to the *Power-over-Ethernet and Management Port* located on the radio back panel (see Fig. 5-19) and open a web-browser on the same subnet as the Aire unit and enter the IP address of the AireLink unit in the address/URL field.

Note	The default IP address of the AireLink radio is 192.168.1.10. The default user name is admin and the default password is admin

Figure 7-1: LinkManager**™** Login Window
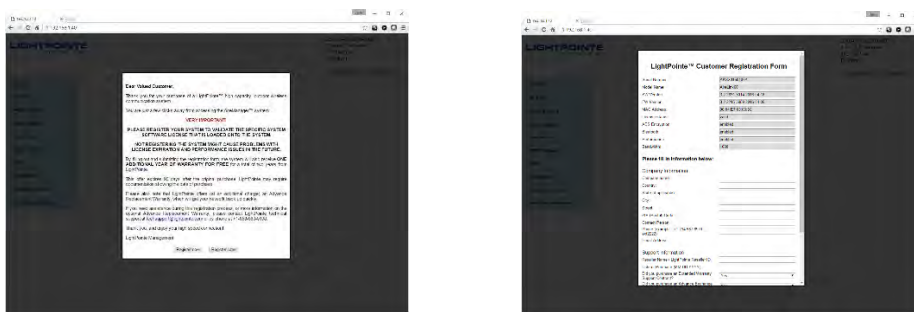
Figure 7-2: LinkManager Registration Screen

When first time logging into the LinkManager™ management application you are presented with the registration screen (see Fig. 7-2). This screen will appear every time you log into the application, until the registration process has been completed. Please complete the registration process because it will help customer support troubleshoot the system in case of an installation problem.

Next the LinkManager™ main screen will appear. On the upper right of the window the local time, system uptime and the IP address are displayed. Below the time and IP **settings, there are "**Save Settings**" and a "**Log out**" buttons.**

On the left side of the main window several sub menus are displayed. Specific changes to some of the system settings can be made within each of the sub menus. Settings that can be changed will be listed in red in the tables below. To change a system setting, first press the Edit button. Next the background color of the specific entries that can be changed will turn white. After performing the desired changes **please press the "**Apply**"** button, or the "Cancel" button to keep the original settings. To make the **changes permanent do not forget to safe them to the system flash memory by clicking the "**Save settings**" button on the upper right of the main page.**

Clicking on a specific submenu will open a window displaying its content. In the following the functionality provided by each submenu will be explained in detail.

Figure 7-3: LinkManager**™** Main Screen
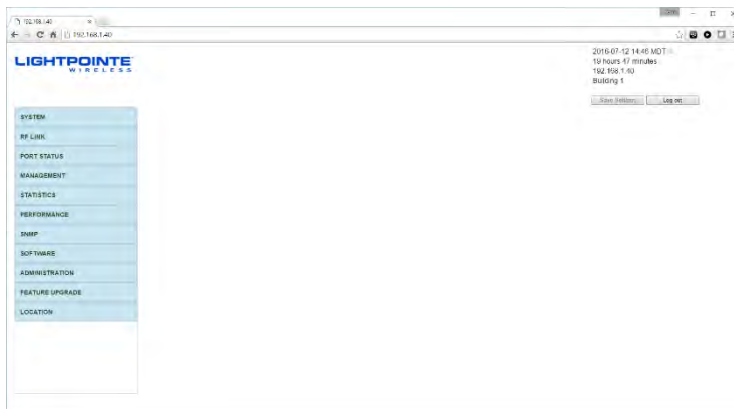
Upper right:
- System Time
- System Uptime
- System IP address
- System Installation Location
- Save Settings   Log out

SYSTEM	Shows general system information
RF LINK	Allows monitoring and changing RF radio parameters
PORT STATUS	Allows monitoring and changing physical network port specific settings
MANAGEMENT	Allows monitoring and changing management port specific settings
STATISTICS	Allows monitoring RMON counters
PERFORMANCE	Allows for recording and storing RSSI and MCS values
SNMP	Allows settings SNMP specific parameters
SOFTWARE	Allows download/upload of software/firmware
ADMINISTRATION	Allows settings/execution of administrative parameters
FEATURE UPGRADE	Allows upgrading software feature
LOCATION	Shows installation location in Google maps

7.2   SYSTEM VIEW
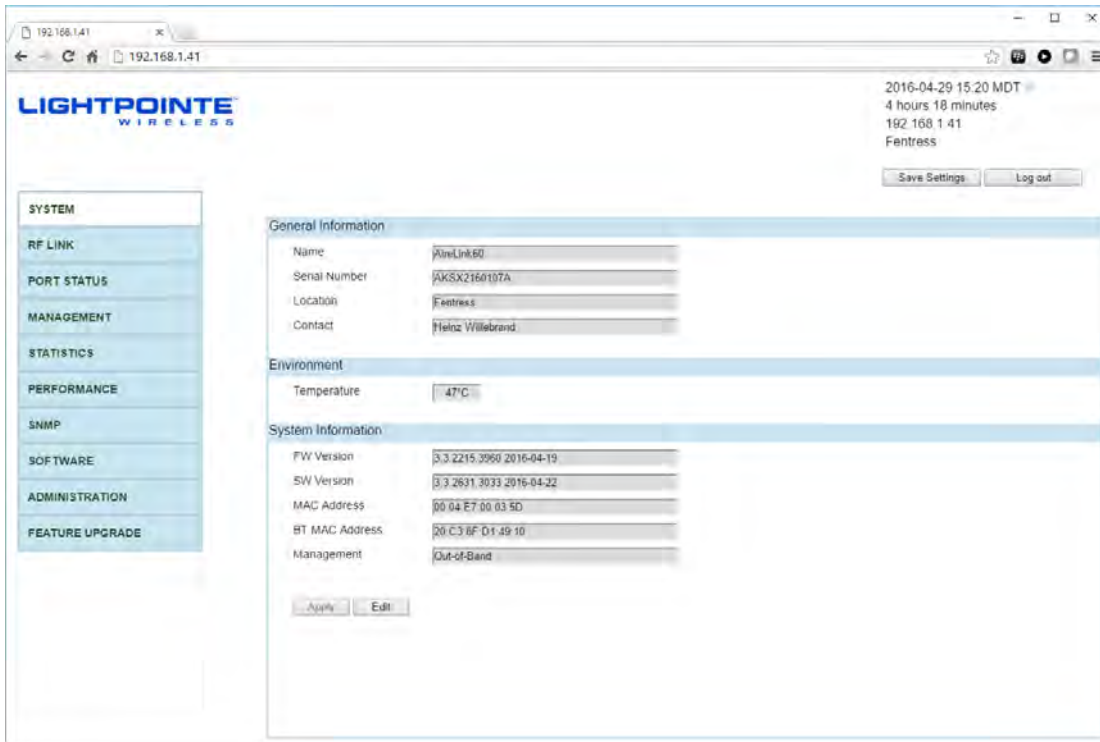
Figure 7-4: System View Screen

GENERAL INFORMATION

Name	Name of System Model
Serial Number	System Serial Number
Location	Installation Location
Contact	Contact Info

ENVIRONMENT

Temperature	Internal Temperature

SYSTEM INFORMATION

FW Version	Installed Firmware Version
SW Version	Installed Software Version
MAC Address	System MAC Address
BT MAC Address	MAC Address of Bluetooth Transceiver
Management	Out-of-Band (default)

7.3   RF LINK VIEW
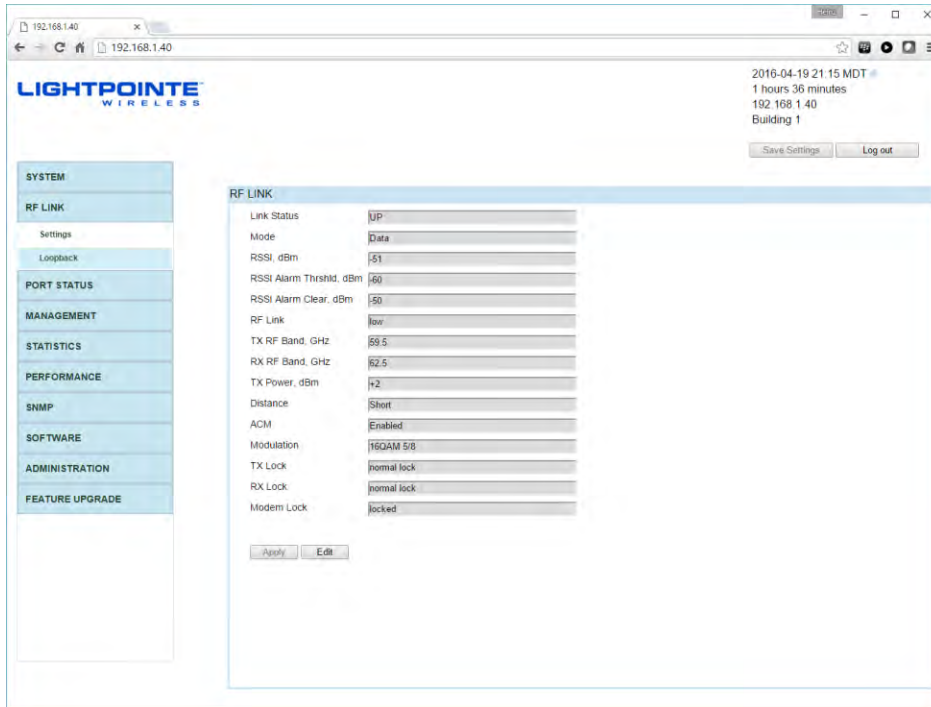
Figure 7-5: RF Link View Screen - Settings

RF LINK - Settings

Link Status	Displays Link Status → UP/DOWN
Mode	Operational Mode → Alignment Mode / Data Transmission Mode
RSSI	Displays System RSSI Reading
RSSI Alarm Threshold	RSSI Alarm Threshold Value
RSSI Alarm Clear	RSSI Alarm Clear Value
RF Band	Shows and allows changing radio TX transmission and RX receive frequencies Options: 71.5…75.5 GHz, 17 channels, 250 MHz increments (low band) 81.5…85.5 GHz, 17 channels, 250 MHz increments (high band)
TX Power	Shows System Transmit Power Level
Distance	Set to Automatic Transmission Power Control (ATPC) or to fixed TX power when systems are deployed over short or very short distances. Default is STANDARD distance setting (no ATPC enabled)
ACM	Automatic Coding and Modulation Setting → ENABLED/DISABLED
Modulation Status	Displays System Modulation Level
Set Modulation	System Modulation (Only when ACM is DISABLED)
TX Lock	Displays Transmitter Lock Status
RX Lock	Displays Receiver Lock Status
Modem Lock	Displays Modem Lock Status
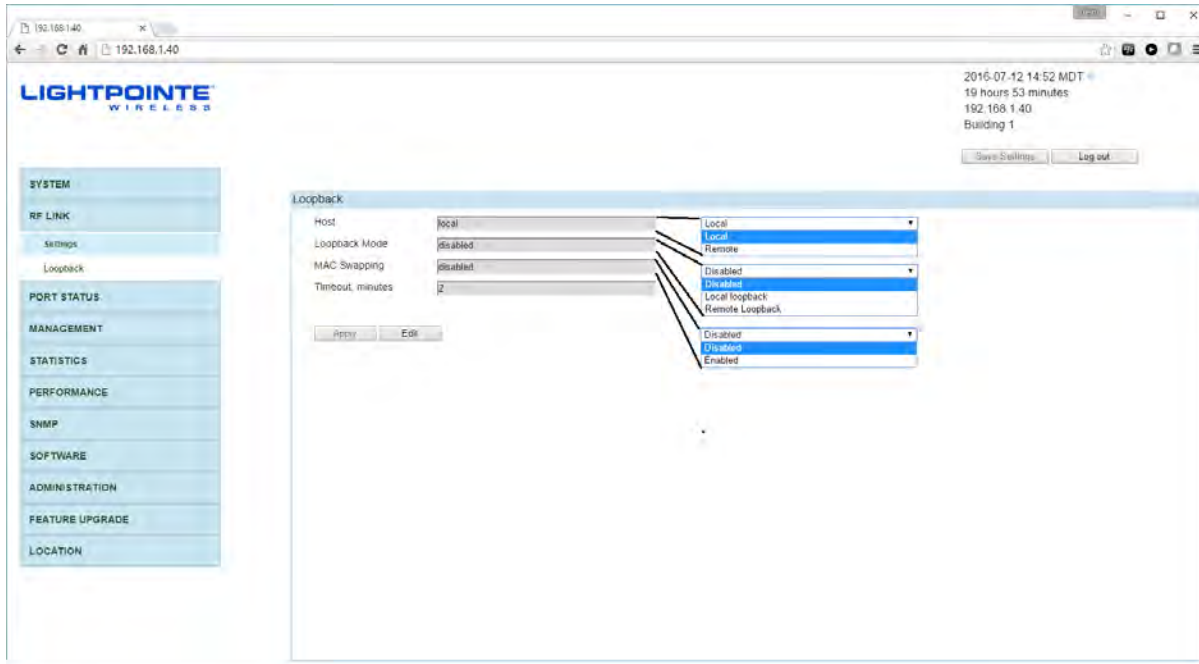
Figure 7-6: RF Link View Screen - Loopback

RF LINK - Loopback

Host	
Loopback Mode	Set Loopback Mode status ➔ Disabled, Local Loopback, Remote Loopback
MAC Swapping	Set MAC Swapping operation ➔ Enabled / Disabled
Timeout, minutes	Set time until Loopback Mode is automatically disabled

The loopback operation can be used to troubleshoot specific network segment using either network testers or software tools like Wireshark https://www.wireshark.org/

In remote loopback mode Ethernet packets are looped back at the networking port of the local radio. In remote loopback mode the packets are received by the remote radio and looped back to the local radio via the RF air interface.

If required, MAC swapping will automatically swap the source and destination MAC address

The Timeout function sets the time until loopback mode will revert back to normal network operation.

7.4   PORT STATUS VIEW

The AireLink 80 system has three networking ports:

1. 100/1000 RJ45 copper port
2. GbE Fiber SFP port for SM/MM fiber transceiver
3. 100/1000 RJ45 copper management port (802.3at PoE compatible)

Each port can be configured separately via the LinkManager™ application.

RJ45 Data Port:
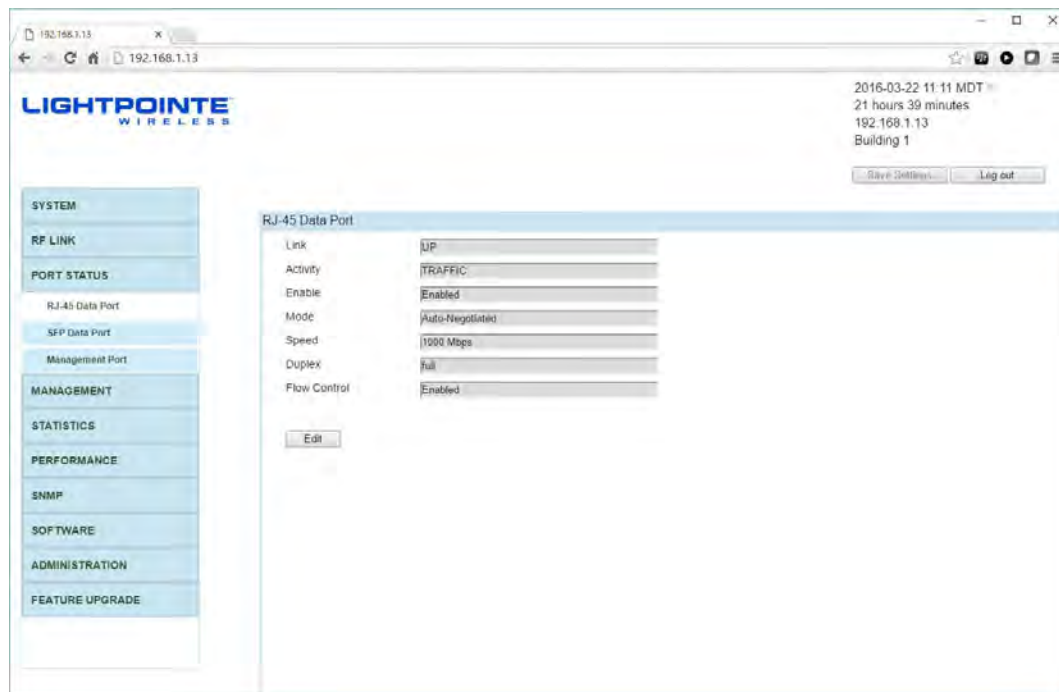
Figure 7-7: Port Status View (RJ45 Data Port)

RJ45 DATA PORT

Link	Displays Link Status → UP/DOWN
Activity	Displays Link Activity → Traffic / No Traffic
Enable	Port Status → ENABLED / DISABLED
Mode	Negotiation → MANUAL / AUTO-NEGOTIATED
Speed	Throughput Configuration → 100 Mbps / 1000 Mbps
Duplex	Duple Mode → HALF / FULL
Flow Control	Control Flow → ENABLED / DISABLED

SFP Data Port:
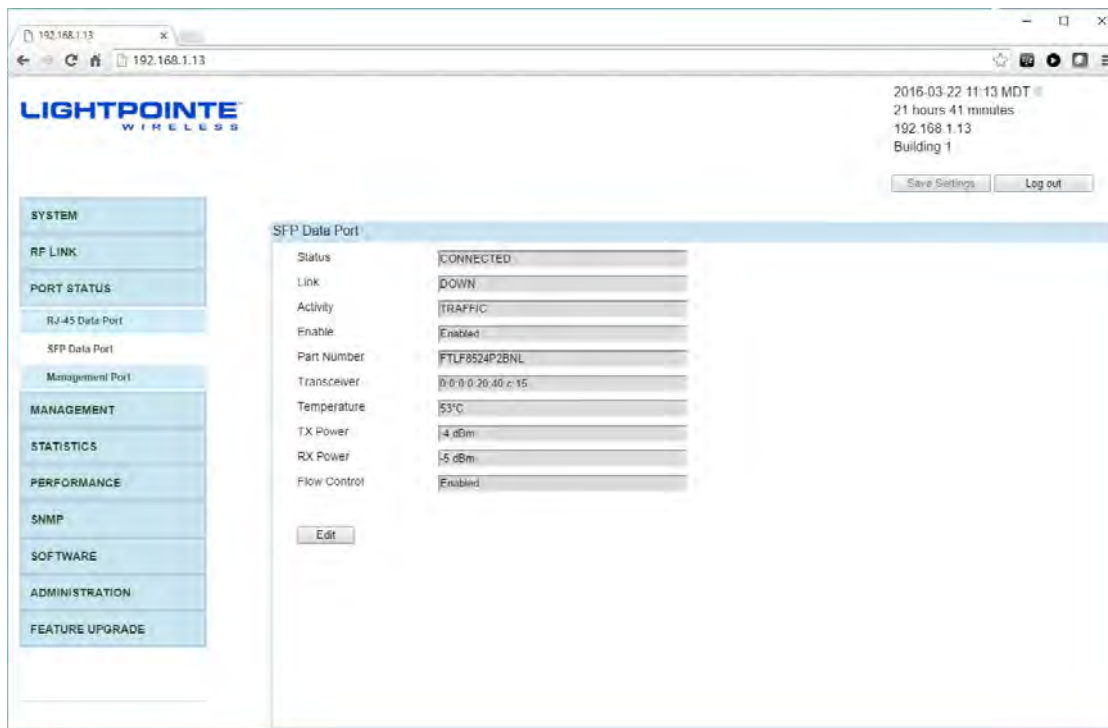
Figure 7-8: Port Status View (SFP Data Port)

SFP DATA PORT

Status	Displays Link Status → Connected / Disconnected
Link	Displays Link Status → UP/DOWN
Activity	Displays Link Activity → Traffic / No Traffic
Enable	Port Status → ENABLED / DISABLED
Part Number	Displays SFP Part Number
Transceiver	Displays SFP Transceiver Information
Temperature	Shows SFP Temperature
TX Power	Displays SFP TX Transmission Power
RX Power	Displays SFP RX Receive Power Level
Flow Control	Control Flow → ENABLED/DISABLED

Management Port:
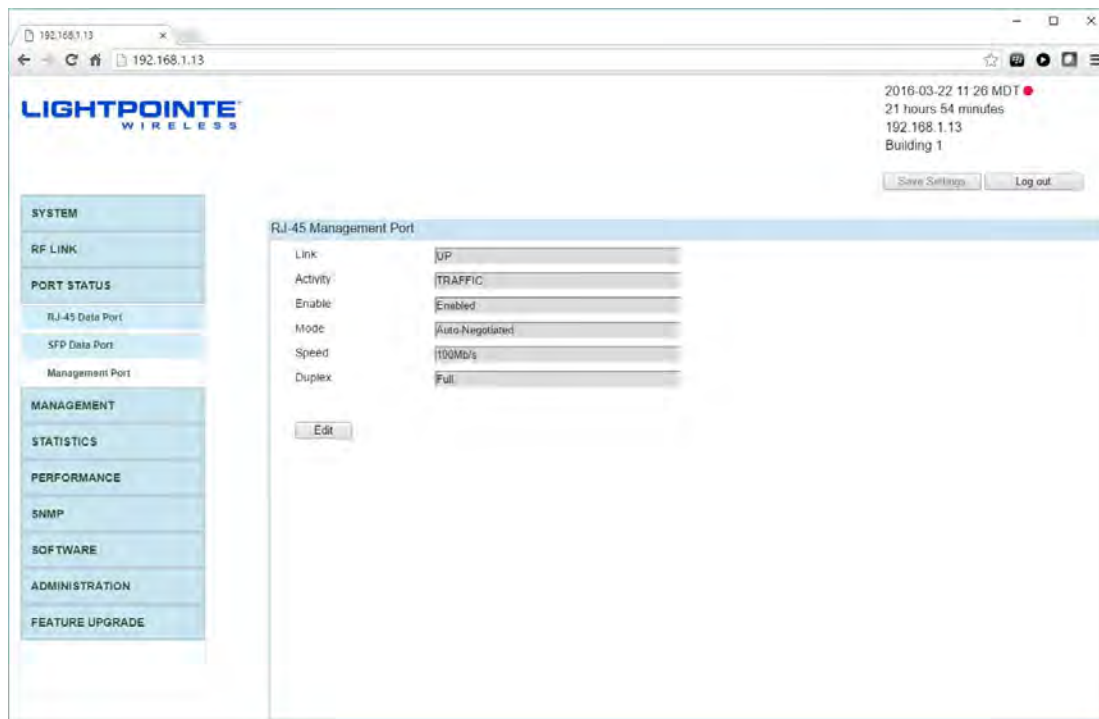
Figure 7-9: Port Status View (RJ45 Management Port)

RJ45 MANAGEMENT PORT

Link	Displays Link Status → UP/DOWN
Activity	Displays Link Activity → Traffic / No Traffic
Enable	Port Status → ENABLED / DISABLED
Mode	Negotiation → MANUAL / AUTO-NEGOTIATED
Speed	Throughput Configuration → 100 Mbps / 1000 Mbps
Duplex	Duple Mode → HALF / FULL

7.5 MANAGEMENT VIEW
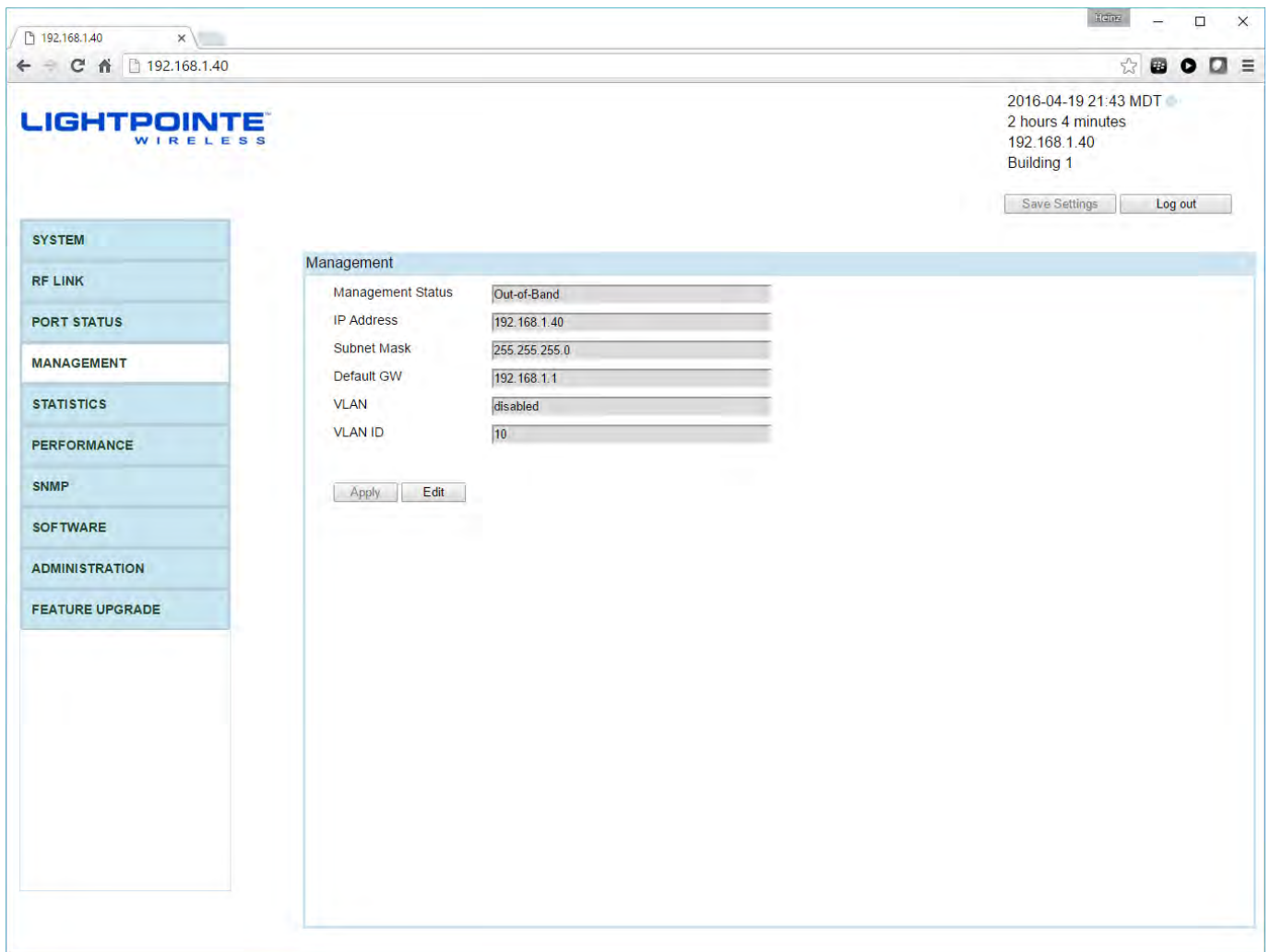
Figure 7-10: Management View Screen

MANAGEMENT

Management Status	Displays Management Status
IP Address	System IP Address
Subnet Mask	System SUBNET Mask
Default GW	Default GW Address
VLAN	VLAN Setting ➔ ENABLED / DISABLED
VLAN ID	VLAN ID Setting

7.6   PERFORMANCE VIEW
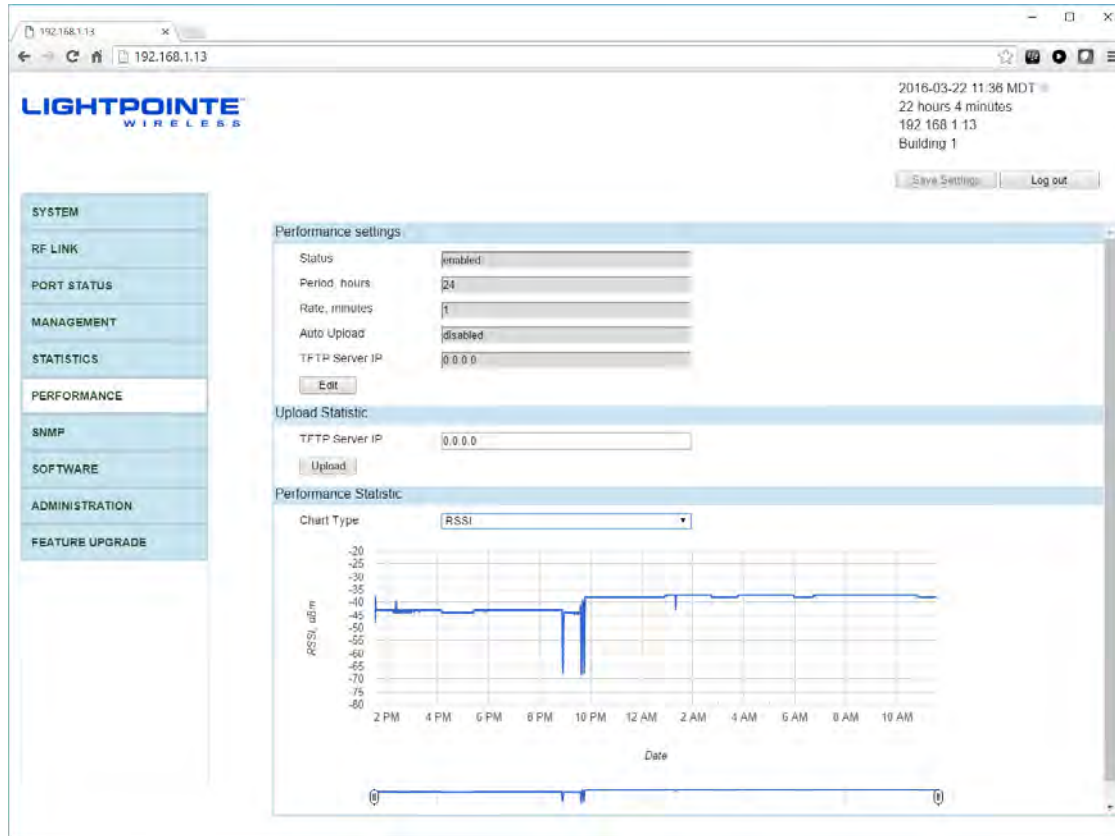
Figure 7-11: Performance View Screen

PERFORMANCE	Displays Performance settings parameters
Performance Settings	ONLY available if Performance Recording module is licensed
Status	Enable/disable performance parameter recording
Period, hours	Recording Interval length in hours (max. 72 hours when set to 1 minute rate, or max. 4320 recordings/file)
Rate, minutes	Recording rate in minutes (minimum 1 minute)
Auto Upload	Enable/disable automatic upload of recorded values to network storage via TFTP server
TFTP Server IP	IP address of TFTP server assigned to receive uploaded performance records
Upload	
TFTP server IP	IP address of TFTP server assigned to receive uploaded performance records
Upload	Manually upload recorded parameters (automatic overwrite after 4320 records have been taken)
Performance Statistic	
Chart Type	Display options None, RSSI, MCS (Scaling via slider, left/right mouse button, and mouse track wheel (if available)

7.7   STATISTICS VIEW
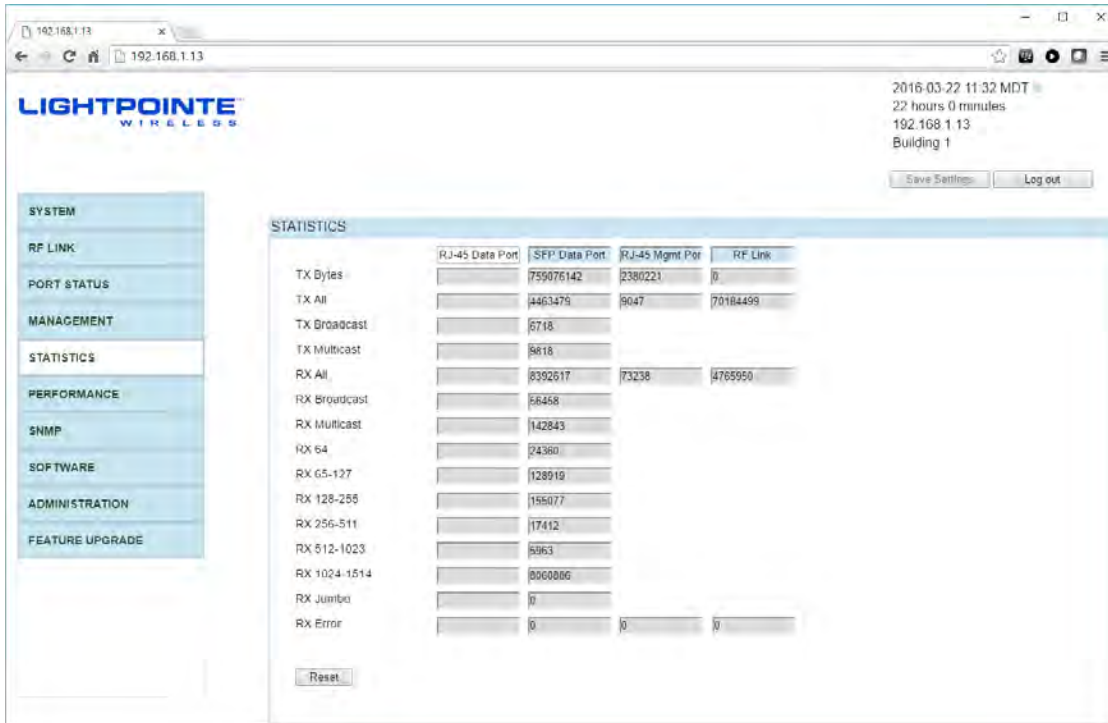
Figure 7-12: Statistics View Screen

STATISTICS
RMON COUNTER   RJ-45 Data Port   / SFP Data Port /   RJ-45 Mgmt Port   /   RF Link

Use "RESET" button to clear RMON counters

7.8   SNMP VIEW
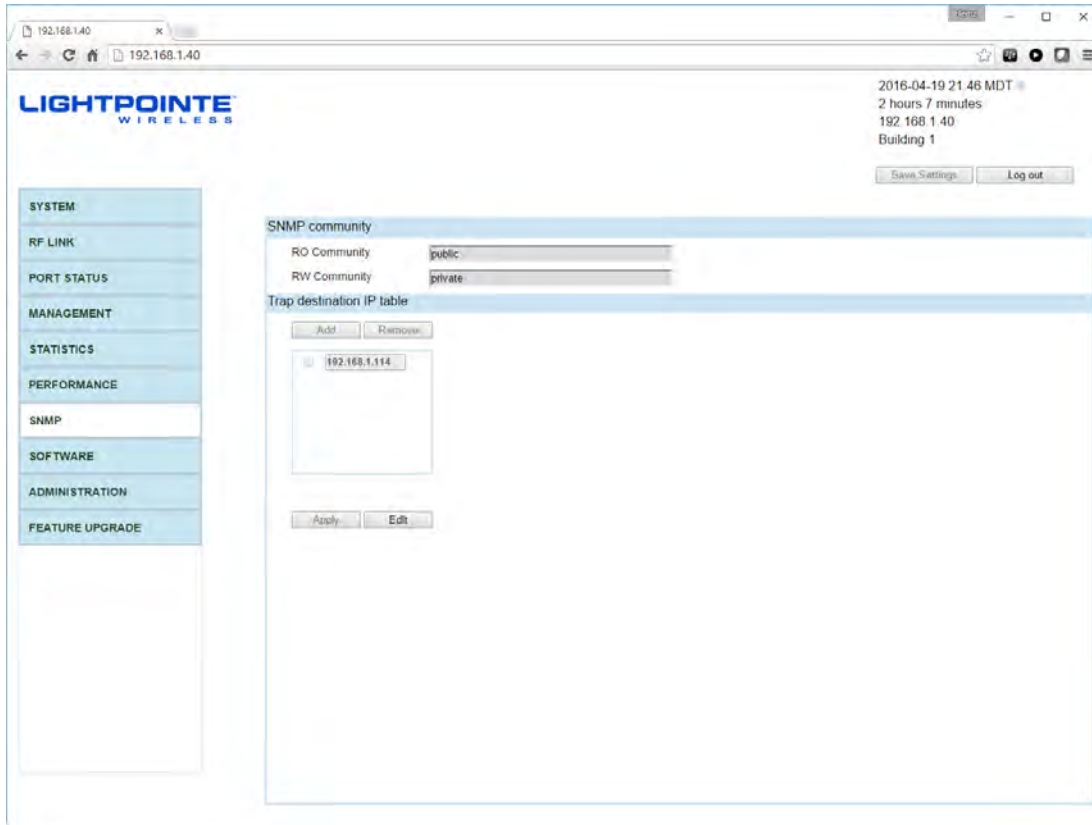
Figure 7-13: SNMP View Screen

SNMP COMMUNITY

RO Community   Displays and allows setting the GET COMMUNITY String
RW Community   Displays and allows setting the SET COMMUNITY String
TRAP DISTINATION IP TABLE   Displays and allows setting/deleting IP TRAP Addresses

7.9   SOFTWARE VIEW
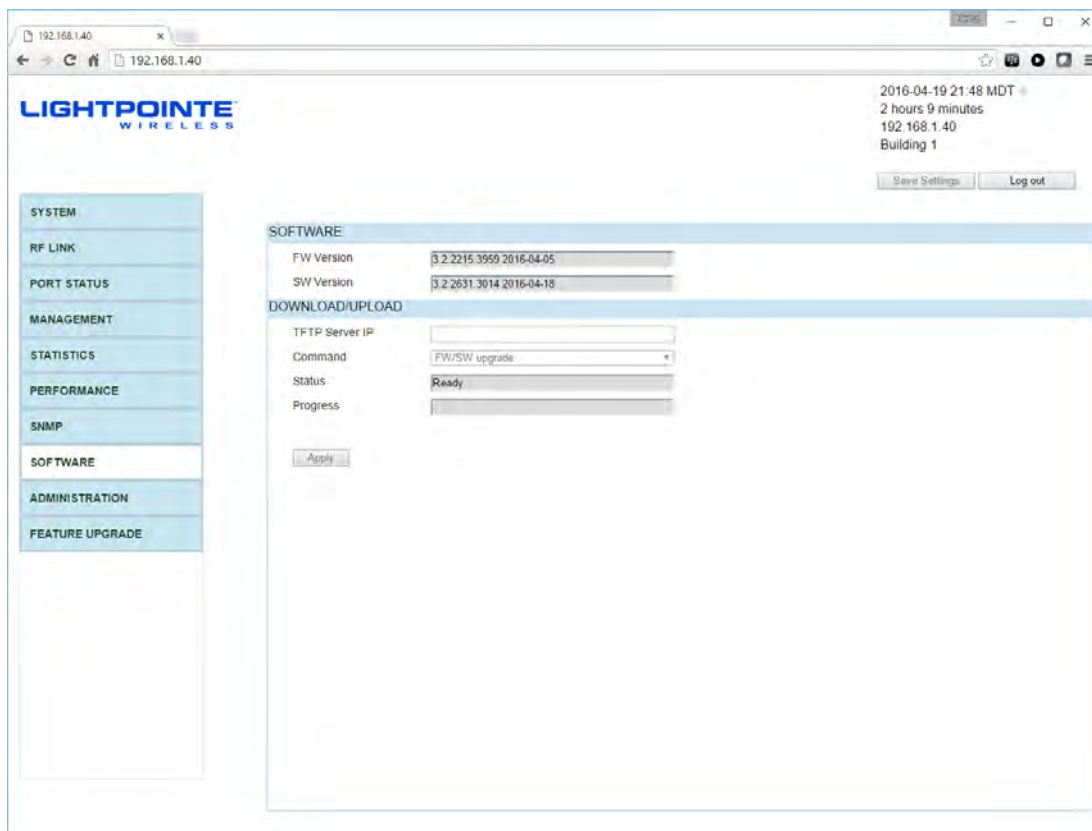
Figure 7-14: Software View Screen

SOFTWARE

FW Version	Displays Installed Firmware Version
SW Version	Displays Installed Software Version

DOWNLOAD/UPLOAD

TFTP server IP	Displays and Allows to Set the TFTP Server Address
Command	Allows to upgrade either FW or SW (currently combined upgrade only)
Status	Reports status of upgrade process
Progress	Reports progress on upgrade process
Apply	Click to start download process

7.10 ADMINISTRATION
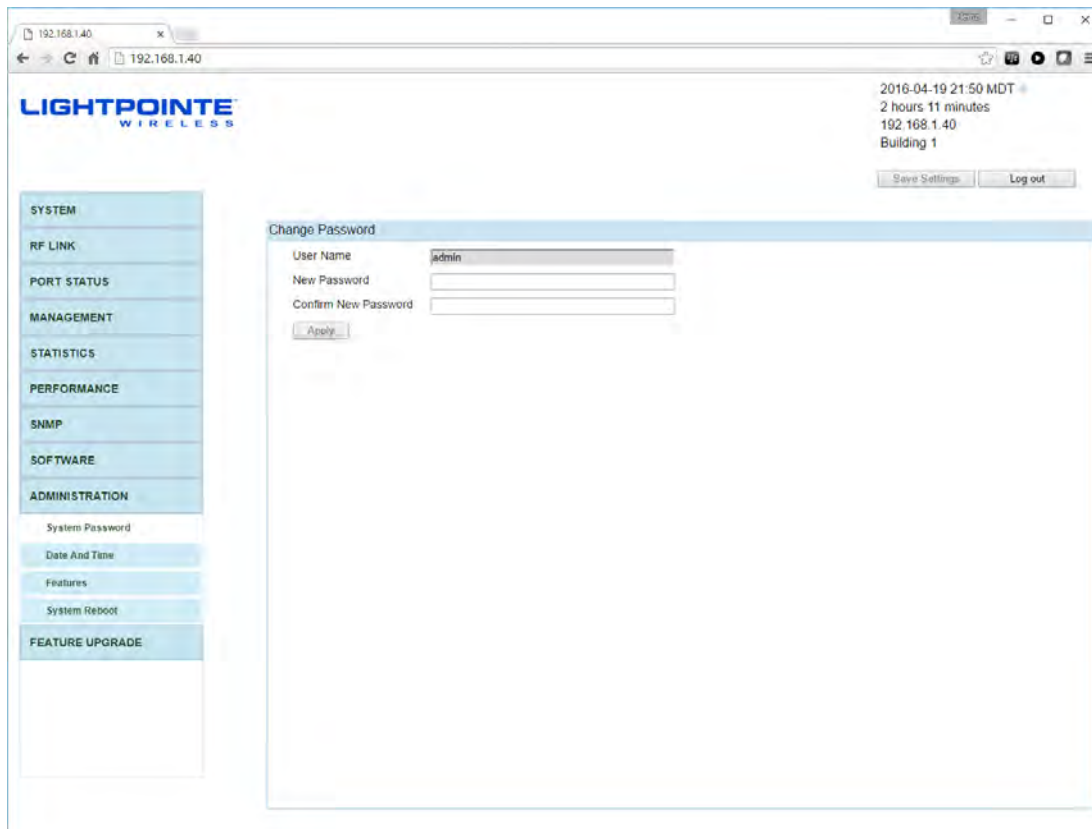
Figure 7-15: Administration View Screen **–**System password

CHANGE PASSWORD

New Password	Change/enter **new Bluetooth™ password (default: 0000)**
Confirm New Password	Confirm new password
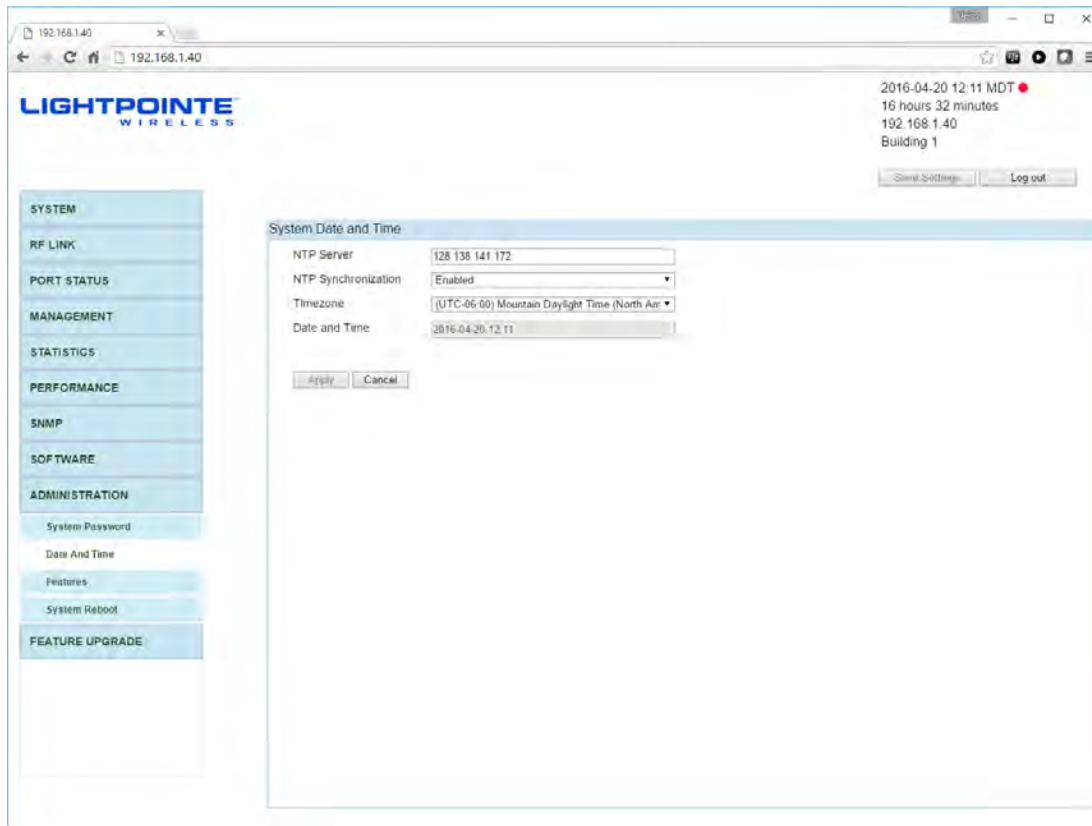
Figure 7-16: Administration View Screen **–** Date and Time

SYSTEM DATE AND TIME

NTP Server	Enter NTP server IP address (e.g. 128.138.141.172)
NTP synchronization	Enable/disable NTP synchronization
Time zone	Select your local time zone
Date and Time	Set time manually when NTP server is disabled
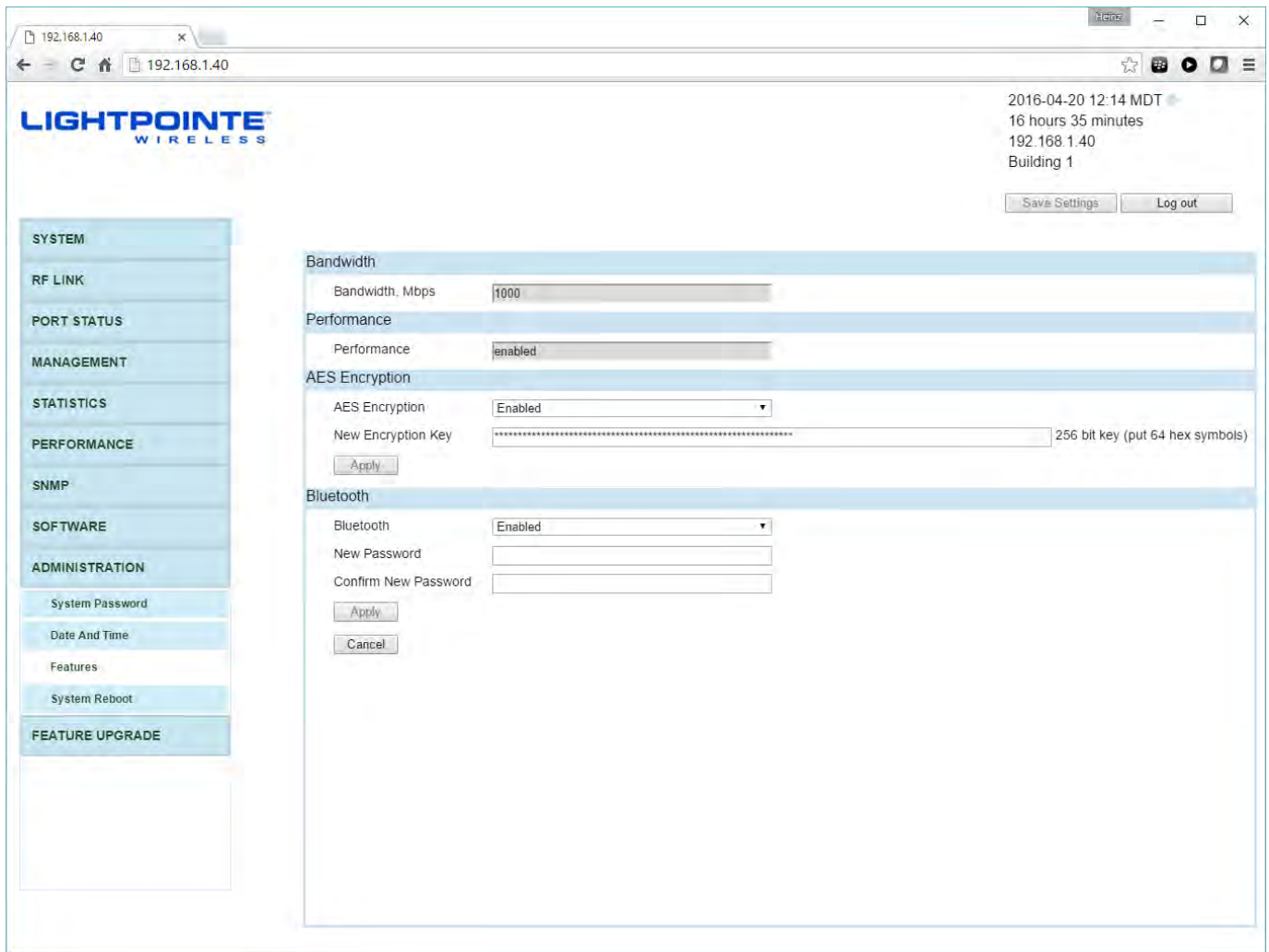
Figure 7-17: Administration View Screen **–** Features

BANDWIDTH

Bandwidth, Mbps   Shows the maximum bandwidth enabled by installed license key

PERFORMANCE

Performance   Shows the status of the performance recoding feature

AES ENCRYPTION   ONLY available if encryption module is licensed

AES Encryption   Enable/disable encryption

New Encryption Key   Enter encryption key (256 bit key, enter 64 hex characters 0…9, a…f))

Bluetooth™   **ONLY available if Bluetooth™ module is licensed**

Bluetooth™   Enable/disable **Bluetooth™ operation**

New Password   Change/enter **new Bluetooth™ password (default: 0000)**

Confirm New Password   Confirm new password
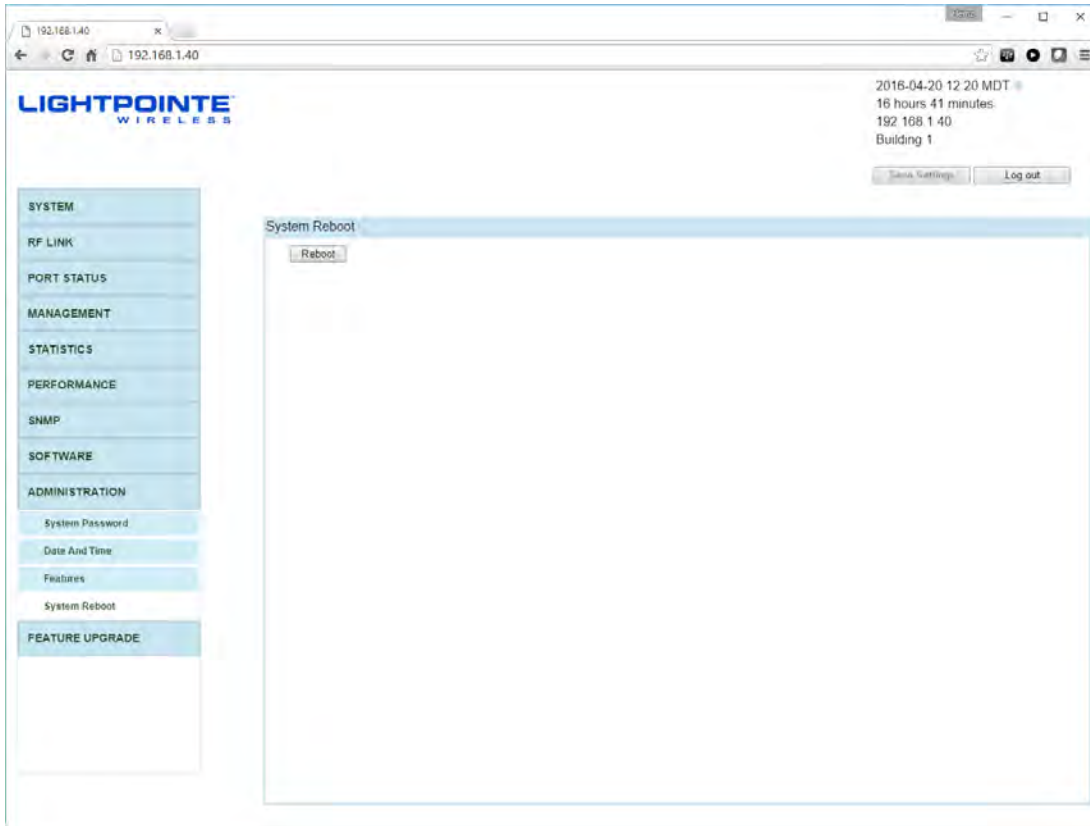
Figure 7-18: Administration View Screen **–** System Reboot

SYSTEM REBOOT

Reboot   Executes software system reboot

7.11   FEATURE UPGRADE
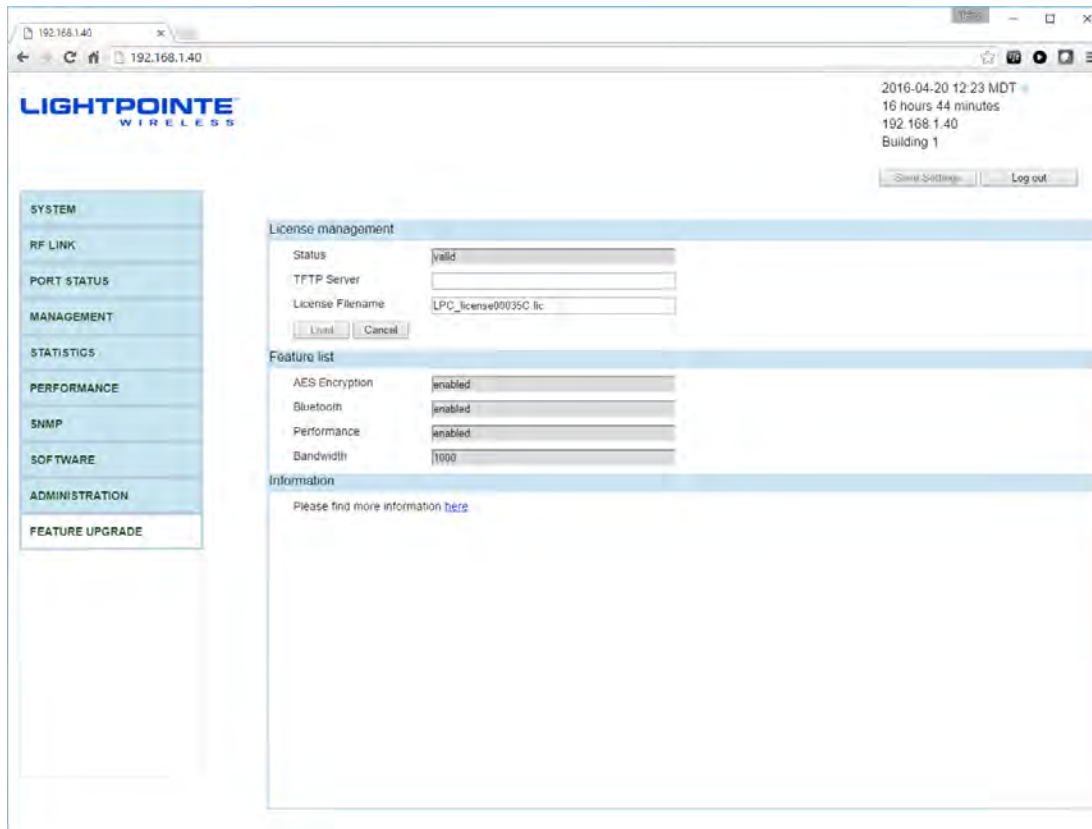
Figure 7-19: Feature Upgrade View Screen

LICENSE MANAGEMENT

Status	Shows if software license is installed and/or valid
TFTP Server	IP address of TFTP Server to upload a license file
License file name	Default name of license file installed or license file to be uploaded. The numbers shown refer to the last three bytes of the system MAC address.

FEATURE LIST

AES Encryption	Shows license status of the encryption module
Bluetooth™	Shows license status of the **Bluetooth™** module
Performance	Shows license status of the Performance Recording module
Bandwidth	Shows the maximum bandwidth in Mbps allowed by the installed license (Three licensing options available 250, 500 or 1000 Mbps)

INFORMATION

Click link below to find out more about licensing features at
http://www.lightpointe.com/license.html
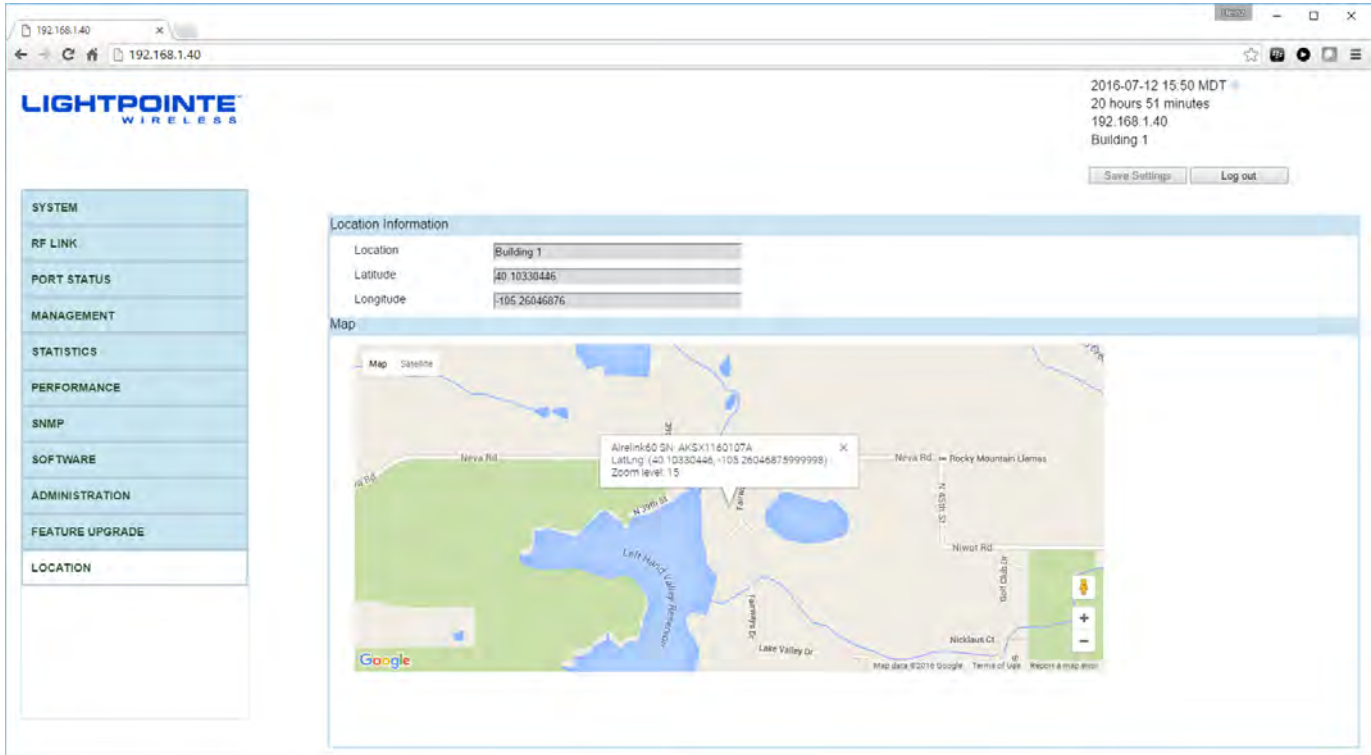
7.12 LOCATION

LOCATION INFORMATION	
Location	Shows the location name as entered by user under the SYSTEM tab
Latitude	Shows the latitude coordinate of the installation location.
Longitude	Shows the longitude coordinate of the installation location.
MAP	Displays system installation location in Google maps

NOTE: Retrieval the of GPS coordinates of the installation location requires the optional Bluetooth license, and an Android based phone/tablet running the LightPointe BLE application that is available for free in Google Play https://play.google.com/store/search?q=LightPointe%20BLE&c=apps

To push the GPS coordinates from the phone to the web browser application, go to the installation location and open the LightPointe BLE application. Click on the location tab and wait until the application displays the GPS coordinates. Now click the RW button to write/store the GPS coordinates to the radio non-volatile flash memory. When opening the LinkManager™ Web browser application you will be asked to confirm if you want to open Google maps and display the installation location.

8   LICENSE FILE UPGRADE PROCEDURE

Please follow these steps to upload/upgrade a license file:

1. Launch a standard TFTP server program such as TFTP32
    http://tftpd32.jounin.net/tftpd32_download.html
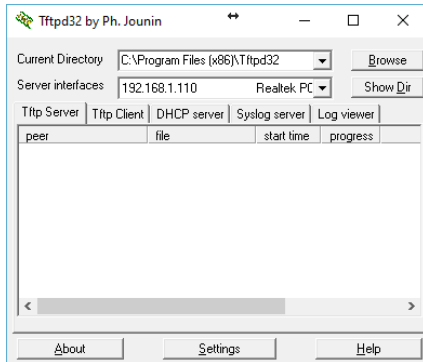
2. Point server interface to the correct Ethernet interface to be used for download the license file.

3. Browse the server directory and locate the folder containing the license file.

4. Using a standard text editor please open the license file.

```
DO NOT EDIT THIS FILE!

Board info:
MAC address: 00:04:E7:00:03:5C
Serial Number: AKSX1160107A
Date and time: 2016.12.31 23:59:59

Features list:
AES encryption: enabled
Bluetooth: enabled
Performance: enabled
Bandwidth: 1000

License:
DE42E36BC796E2C9E7AFBBE4AAB9E381422814F7D1FC72F6BA49F9C97CE90D0DB
4ACF2E64B0EF253C55A639D04CC48738C4BD5F1B7AA1F75468EC273055D063003
E302E9156C38280B41F8BD369260C320F81370B9ED0121997A60D95F900703D54
130DF5AD28E16328697C72D888639CF62BC8105647A73410AFEF09D685583
```

Figure 8-1: License File Structure

5. Verify that the MAC address and the radio serial number are correct. One can find the system MAC address and serial number in the SYSTEM tab of the LinkManager™ **(see chapter 7.2)**. The feature list shows the modules licensed with the particular license file.

6. Open the LinkManager™ web interface and open the FEATURE UPGRADE tab (see chapter 7.11).
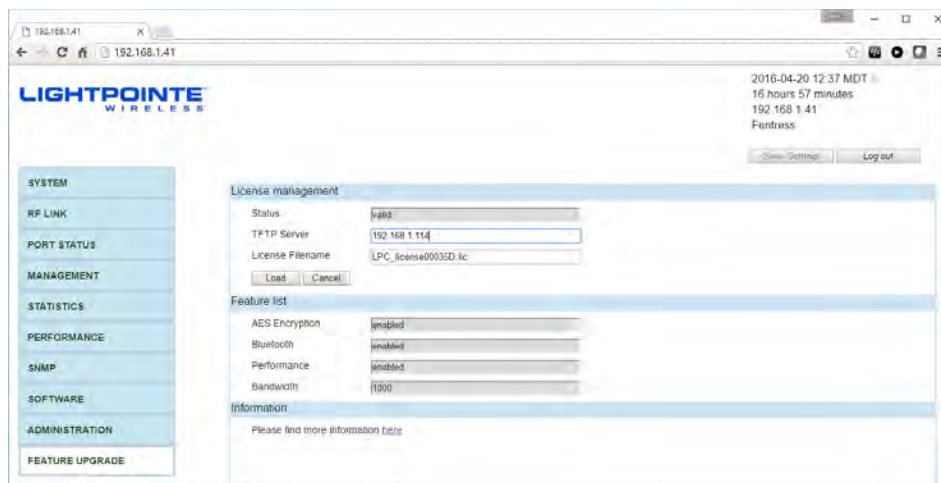
7. Click the EDIT button.

8. Enter the TFTP server address.

9. Verify that the license file name is correct or change name accordingly.

10. Click the LOAD button.

The system verifies that the license file is valid and after successful installation of the license file a text box will appear confirming that a new license file was installed. Please, verify to reboot the radio after successful installation to complete the licensing process.

9   CLI -- COMMAND LINE INTERFACE

The CLI interface has a Cisco-like command line interface with two modes of access levels:

➢ User configuration ➔ *show* command
➢ Global configuration ➔ *configure* command

In addition there are there are misc. command line instructions like *ping*, *copy*, and *upgrade tftp*.

To access the AireLink™ CLI interface please open the Windows command prompt and type >telnet IP_address, e.g. telnet 192.168.1.10 (default setting)

The AireLink™ CLI access is protected from unauthorized access by login/password protection.

Default login/password is "admin".
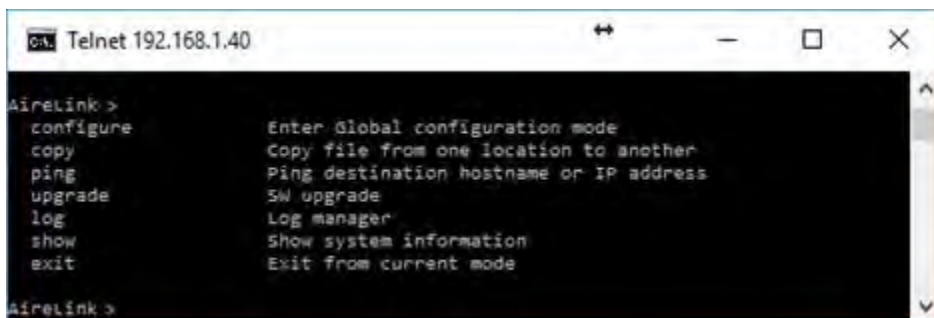
After successful login the *AireLink>* command prompt is displayed (see below).

The user mode contains a limited number of basic commands to display the device status. To view the available commands, please type ? (See below).

While the user mode displays system parameters, the configure mode is used to change system settings. After typing *configure* the command prompt will change to *AireLink(config)#* (see below). To return to the previous mode, please type *exit*. Typing the *exit* command from the user mode command prompt will terminate the CLI session.

9.1   USER MODE COMMANDS

Command: ?

Description: Show all commands available in the user mode in alphabetical order

Example: **AireLink>?**

User mode commands:

show   Show system information

configure   Enter global configuration mode

Notes: See each command for the description message

9.2   CLI – SHOW COMMAND

Command: **AireLink>show {*?|flash|interface|performance|radio|snmp|system|versions|vlan*}**

```
?                       Show available command options
flash
interface
performance
radio
snmp
system
versions
vlan
license
```

Description: Show system relevant parameters

9.2.1   Command Show Flash

Command: **AireLink(config)#show flash**

Description: Show hardware and software versions of system flash partitions

Example:

FlasFlash Partition: Golden
FW version: 2.1.2214.3939 2015-10-20
SW version: 2.1.2615.2627 2015-12-07

Flash Partition: Update
FW version: 3.4.2216.3965 2016-07-06
SW version: 3.4.2631.3159 2016-07-07

Running system partition: Update

Command Show Interface

Command: **AireLink(config)#show interface**

Description: Show status of networking interfaces

Example: **AireLink(config)#show interface**

data interface
   flow control: enabled
   type of connection: SerDes (Fiber) media
   Data interface eth0:
   power: up
   link status: up
   SFP module part number: FTLF8524P2BNL-MD
   SFP module part number (hex): 46 54 4c 46 38 35 32 34 50 32 42 4e 4c 2d 4d 44 0
   module status: connected
   SFP module transceiver ID: 0:0:0:0:20:40:c:15
   SFP module temperature: 60 C
   SFP module TX power: -5 dBm
   SFP module RX power: -5 dBm

management interface
   Speed: 100Mb/s
   Duplex: Full
   Auto-negotiation: on
   Link detected: yes
   MAC address: 00:0A:35:00:00:02
   IP address: 192.168.1.11
   Mask: 255.255.255.0
   Gateway: 192.168.1.1

9.2.2 Command Show Performance

Command: **AireLink>show performance {?|log|settings}**

Description: Copy file from one location to another. First field in the command is the "copy from" option. Second field in the command is the "copy to" option.

```
?                      Show available command options
log                    Show performance data log
settings               Show performance data settings
```

Example: **AireLink> show performance settings**

9.2.3 Command Show Radio

Command: **AireLink(config)#show radio {?}**

Description: Show detailed radio settings

Example: **AireLink(config)#show radio**

Running system partition: Update
FW version: 3.4.2216.3965 2016-07-06
SW version: 3.4.2631.3159 2016-07-07
Modem Board Serial Number: MB1015-7
Radio Board Serial Number: None

Unit: low
TX band: 59.5 GHz
RX band: 62.5 GHz
Radio TX power: -4 dBm
Rfic pll status:
  TX: locked
  RX: locked
Alignment mode status: off
Modulation: 16QAM 5/8 (9)
Radio acm status: on
Rssi: -37 dBm
Distance: very short
RF is synced
Radio loopback mode: off
Bandwidth: 1000 Mbps

9.2.4   Command Show SNMP

Command: **AireLink(config)#show snmp {?}**

Description: Show SNMP settings

Example: **AireLink(config)#show snmp**

Read-only community string: public
Read-write community string: private
trap table:
  1: 192.168.1.5

9.2.5   Command Show System

Command: **AireLink(config)#show system {?}**

Description: Show SNMP settings

Example: **AireLink(config)#show system**

Name: Airelink80
Unit: low
Contact: default_contact
Location: default_location_11

Unit Serial Number: 0000000001
Modem Board Serial Number: mayak_b_01-03-modem
Radio Board Serial Number: mayak_b_01_03-radio

Running system partition: Update
FW version: 2.0.aes.2214.3939 2015-10-20
SW version: 2.0.aes.1710.2472 2015-11-17

Temperature: 52 C

NTP server IP: 132.163.4.101
NTP synchronization: enabled

AES encryption:
  system status: enabled and ready

9.2.6   Command Show Versions

Command: **AireLink(config)#show versions {?}**

Description: Show hardware and software version settings

Example: **AireLink(config)#show version**

Unit Serial Number: 0000000001
Modem Board Serial Number: mayak_b_01-03-modem
Radio Board Serial Number: mayak_b_01_03-radio

Running system partition: Update
FW version: 2.0.aes.2214.3939 2015-10-20
SW version: 2.0.aes.1710.2472 2015-11-17

9.2.7   Command Show VLAN

Command: **AireLink(config)#show vlan {?}**

Description: Show management VLAN settings

Example: **AireLink(config)#show vlan**

VLAN Settings eth0:
VLAN TX/RX: disabled
VLAN ID: 10

9.2.8   Command Show License

Command: **AireLink(config)#show vlan {?}**

Description: Show License settings settings

Example: **AireLink(config)#show license**

License is valid
AES: enabled Settings eth0:
Bluetooth: enabled
performance: disabled
bandwidth: 1000

9.3   CLI --CONFIGURATION COMMANDS

Command: **AireLink>configure {N/A}**
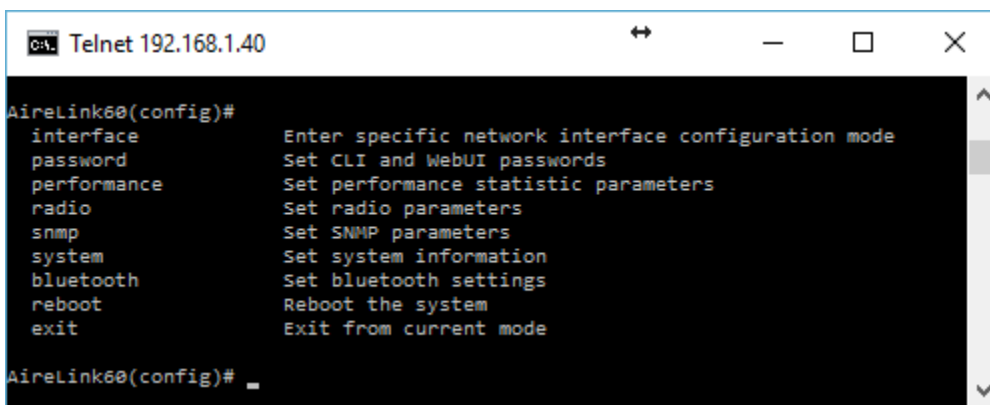
Description: Enters Global configuration mode

Notes: After entering to the Global configuration mode the command prompt will change from **AireLink>** to **AireLink(config)#**

Command:**?**
Description: Show all commands available in the global mode
Example: **airelink80(config)#?**

```
Telnet 192.168.1.40

AireLink60(config)#
  interface          Enter specific network interface configuration mode
  password           Set CLI and WebUI passwords
  performance        Set performance statistic parameters
  radio              Set radio parameters
  snmp               Set SNMP parameters
  system             Set system information
  bluetooth          Set bluetooth settings
  reboot             Reboot the system
  exit               Exit from current mode

AireLink60(config)# _
```

Note: See each command for the description message

9.3.1   Interface Commands

Command: **AireLink(config)# interface {data|management}**

Description: Configure data and management ports

```
        ?                   Show available command options
        management          Enter Management port configuration mode
        data                Enter Data port configuration mode
```

Example: **AireLink(config)# interface data ?**

9.3.1.1   Interface data commands

Command: **AireLink(config)# interface data shutdown {?|enable|disable}**

Description: Set network data interface operational status

```
?                   Show available command options
  enable            Enable interface shutdown
  disable           Disable interface shutdown
```

Example: **AireLink(config)# interface data shutdown enable**

Command: **AireLink(config)# interface data autonegotiation {?|enable|disable}**

Description: Set network data interface auto-negotiation status

```
?                   Show available command options
  enable            Enable autonegotiation
  disable           Disable autonegotiation
```

Example: **AireLink(config)# interface data autonegotiation enable**

Command: **AireLink(config)# interface data speed {?|10|100|1000}**

Description: Set network data interface Ethernet speed

```
?                   Show available command options
  10                Set speed to 10 Mbit/s
  100               Set speed to 100 Mbit/s
  1000              Set speed to 1000 Mbit/s
```

Example: **AireLink(config)# interface data speed 1000**

Command: **AireLink(config)# interface data duplex {?|full|half}**

Description: Set data network interface duplex status

```
?                   Show available command options
  full              Set full duplex
  half              Set half duplex
```

Example: **AireLink(config)# interface data duplex full**

Command: **AireLink(config)# interface data flowcontrol {?|enable|disable}**

Description: Set network data interface control flow status

```
?                Show available command options
enable           Enable flow control
disable          Disable flow control
```

Example: **AireLink(config)# interface data flowcontrol enable**

9.3.1.2   Interface management commands

Command: **AireLink(config)# interface management duplex {?|full|half}**

Description: Set network management interface duplex mode

```
?                Show available command options
full             Set full duplex
half             Set half duplex
```

Example: **AireLink(config)# interface management duplex full**

Command: **AireLink(config)# interface management speed {?|10|100|1000}**

Description: Set network management interface Ethernet speed

```
?                Show available command options
100              Set speed to 100 Mbit/s
1000             Set speed to 1000 Mbit/s
```

Example: **AireLink(config)# interface management speed 1000**

Command: **AireLink(config)# interface management shutdown {?|enable|disable}**

Description: Set network management interface port status

```
?                Show available command options
enable           Enable interface shutdown
disable          Disable interface shutdown
```

Example: **airelink80(config)# interface management shutdown enable**

Command: **AireLink(config)# interface management vlan {?|enable|disable|id** *vlan_id***}**

Description: Set network management interface VLAN

```
?                   Show available command options
enable              Enable VLAN
disable             Disable VLAN
id vlan_id          Set port VLAN ID
```

Example: **AireLink(config)# interface management vlan enable**

Command: **AireLink(config)# interface management ip {?|IP** *ip_address***}**

Description: Set management interface IP address

```
?                   Show available command options
ip                  Set management IP address
```

Example: **AireLink(config)# interface management ip 192.168.1.11**

Command: **AireLink(config)# interface management netmask {?|netmask** *netmask***}**

Description: Set management interface netmask

```
?                   Show available command options
netmask             Set management port IP netmask
```

Example: **AireLink(config)# interface management netmask 255.255.255.0**

Command: **AireLink(config)# interface management gateway {?|gateway** *ip_address***}**

Description: Set management interface gateway IP address

```
?                   Show available command options
gateway             Set gateway IP address
```

Example: **AireLink(config)# interface management gateway 192.1168.1.1**

9.3.2 Password Command

Command: **AireLink(config)# password {?|cli/web}**

Description: Set cli/web password

```
         ?                  Show available command options
     cli/web            Set CLI/web password
```

Example: **AireLink(config)# password cli → enter password at command prompt)**

9.3.3 Performance Commands

Command: **AireLink(config)# performance {?|enable|disable|frequency|period|server_ip|tftp|upload}**

Description: Set performance data recording parameters.

```
enable      Enable performance data collection
disable     Disable performance data collection
frequency   Set frequency of performance data collection (minutes)
period      Set period of performance data collection (hours)
server_ip   Set TFTP server IP address for uploading performance data
tftp        Automatic upload performance data to specified TFTP server
upload      Manually upload performance data to specified TFTP server
```

Examples: **AireLink(config)# performance enable**
          AireLink(config)# performance frequency 1

9.3.4 Radio Commands

Command:

AireLink(config)#radio {?|acm [enable|disable]|modulation *modulation_idx*]|statistics reset|align [enable|disable]| tx_band *tx_band_freq*rx_band *rx_band_freq*tx_power *tx_power_value*}

Description: Set radio parameters

```
    N/A                 Show radio status information
    ?                   Show available command options
    acm                 Configure ACM radio settings
    align               Configure radio alignment mode
    distance            Set power settings for different distances
    loopback            Configure modem loopback settings
    modulation          Set modulation scheme
```

```
            rssi_alarm_thr        Set RSSI alarm threshold
            rssi_alarm_clear      Set RSSI alarm clear threshold
            rx_band               Show available command options
            statistics reset      Reset radio packet counters
            tx_band               Show available command options
```

Command: **AireLink(config)# radio acm {?|enable|disable}**

Description: Set Automatic Coding and Modulation (MCS) Mode

```
            ?           Show available command options
            enable      Enable Automatic Coding and Modulation (MCS)Mode
            disable     Disable Automatic Coding and Modulation (MCS)Mode
```

Example: **AireLink(config)# radio acm enable**

Command: **AireLink(config)# radio align {?|enable|disable}**

Description: Set radio alignment mode status

```
            ?           Show available command options
            enable      Enable radio alignment mode
            disable     Disable radio alignment mode
```

Example: **AireLink(config)# radio align enable**

Command: **AireLink(config)# radio distance {?|standard|short|veryshort}**

Description: Set radio deployment distance

```
            ?           Show available command options
            standard    Set power setting for standard distance (default)
            short       Set power setting for short distance
            veryshort   Set power setting for very short distance
```

Example: **AireLink(config)# radio distance short**

Command: **AireLink(config)# radio loopback {?|mode|mac-swap|timeout}**

Description: Sets radio loopback mode

```
?               Show available command options
mode            Set modem loopback mode
mac-swap        Set modem loopback mode and swap the MAC address
timeout         Set modem loopback timeout/reset in x seconds
```

Example: **airelink80(config)# radio loopback mac-swap**

Command: **AireLink(config)# radio modulation {?|0|1|…|9}**

Description: Sets radio modulation scheme according to MCS values

```
?               Show available command options
#               0 – BPSK 1/2 ; 1 – BPSK 5/8 ; 2 – BPSK 3/4
                3 – BPSK 13/16 ; 4 – QPSK 1/2 ; 5 – QPSK 5/8
                6 – QPSK 3/4 ; 7 – QPSK 13/16 ; 8 – 16QAM 1/2
                9 – 16QAM 5/8
```

Example: **AireLink(config)# radio modulation 9**

Command: **AireLink(config)# radio rssi_alarm_thr {?|*value in dBm*}**

Description: Sets radio RSSI alarm threshold in dBm

Example: **AireLink(config)# radio rssi_alarm_thr -60**

Command: **AireLink(config)# radio rssi_alarm_clear {?|*value in dBm*}**

Description: Sets radio RSSI alarm clear threshold in dBm

Example: **AireLink(config)# radio rssi_alarm_thr -50**

Command: **AireLink(config)# radio rx_band {?| 71.50 | 71.75 | 72.00 | 72.25 | 72.50 | 72.75 | 73.00 | 73.25 | 73.50 | |73.75 | 74.00 | 74.25 | 74.50 | 74.75 | 75.00 | 75.25 | 75.50} or {?| 81.50 | 81.75 | 82.00 | 82.25 | 82.50 | 82.75 | 83.00 | 83.25 | 83.50 | 83.75 | 84.00 | 84.25 | 84.50 | 84.75 | 85.00 | 85.25 | 85.50}**

Description: Sets radio receive band for low band unit **{ 71.50 | 71.75 | 72.00 | 72.25 | 72.50 | 72.75 | 73.00 | 73.25 | 73.50 | |73.75 | 74.00 | 74.25 | 74.50 | 74.75 | 75.00 | 75.25 | 75.50}** and high band unit **{81.50 | 81.75 | 82.00 | 82.25 | 82.50 | 82.75 | 83.00 | 83.25 | 83.50 | 83.75 | 84.00 | 84.25 | 84.50 | 84.75 | 85.00 | 85.25 | 85.50}**

Example: **AireLink(config)# radio rx_band 72.50**

Command: **AireLink(config)# radio tx_band {?| 71.50 | 71.75 | 72.00 | 72.25 | 72.50 | 72.75 | 73.00 | 73.25 | 73.50 | |73.75 | 74.00 | 74.25 | 74.50 | 74.75 | 75.00 | 75.25 | 75.50} or {?| 81.50 | 81.75 | 82.00 | 82.25 | 82.50 | 82.75 | 83.00 | 83.25 | 83.50 | 83.75 | 84.00 | 84.25 | 84.50 | 84.75 | 85.00 | 85.25 | 85.50}**

Description: Sets radio transmission band for low band unit **{71.50 | 71.75 | 72.00 | 72.25 | 72.50 | 72.75 | 73.00 | 73.25 | 73.50 | |73.75 | 74.00 | 74.25 | 74.50 | 74.75 | 75.00 | 75.25 | 75.50}** and high band unit **{81.50 | 81.75 | 82.00 | 82.25 | 82.50 | 82.75 | 83.00 | 83.25 | 83.50 | 83.75 | 84.00 | 84.25 | 84.50 | 84.75 | 85.00 | 85.25 | 85.50}**

Example: **airelink80(config)# radio tx_band 82.50**

Command: **AireLink(config)# radio statistics reset {?}**

Description: Resets the RMON counters

Example: **AireLink(config)# radio statistics reset**

9.3.5 SNMP Commands

Command:

AireLink(config)#snmp {?|community ro *get_community_string* **|community rw** *set_community_string***|trap-table [add** *ip_address***|delete** *ip_address***]}**

Description: Show system status information

```
?                  Show available command options
Community ro       Set SNMP get community
Community rw       Set SNMP set community
trap-table add     Add SNMP trap destination IP address
trap-table delete  Delete SNMP trap destination IP address
```

Example: **airelink80(config)# snmp get-community public**

9.3.6   System Commands

Command: **AireLink(config)#system{?|aes|location|contact|ntp}**

Description: Enable/disable encryption and set encryption key

?	Show available command options
enable	Enable AES encryption settings Set AES 256 encryption key (64 hex characters 0…9,a…f)
disable	Disable AES encryption settings

Example: **AireLink(config)# system aes enable**

Command: **AireLink(config)#system{?|location** *system_location***}**

Description: Set system installation location

Example: **AireLink(config)# system location** *MyStreet*

Command: **AireLink(config)#system{?|contact** *system_contact***}**

Description: Set system administrator contact information

Example: **AireLink(config)# system contact** *MyName*

Command: **AireLink(config)#system{?|ntp}**

Description: Enable/disable Internet Time Protocol and set Internet Time Server IP address

?	Show available command options
enable	Enable Internet Time protocol
disable	Disable Internet Time protocol
server	Set Internet Time Server IP address

Example: **AireLink(config)# system ntp server 132.163.4.102**

9.3.7 Bluetooth Commands

Command: **AireLink(config)#bluetooth{?}**

Description: Enable/disable encryption and set bluetooth password

```
?               Show available command options
enable          Enable  AES encryption settings Set AES
                256 encryption key (64 hex characters
                0…9,a…f)
disable         Disable  AES encryption settings
password        Set Bluetooth password
```

Example: **AireLink(config)# bluetooth enable**

9.3.8 Reboot Command

Command: **AireLink(config)# reboot**

Description: Executing this command will reboot the system

Example: **AireLink(config)# reboot**

9.3.9 Exit Command

Command: **AireLink(config)# exit**

Description: Exit Configuration mode

9.4 CLI -- SAVE SESSION SETTINGS ON FLASH AND SOFTWARE UPGRADE

Command: **AireLink>copy {?|running-config|startup-config|flash|tftp}**

Description: Copy file from one location to another. First field in the command is the "copy from" option. Second field in the command is the "copy to" option.

?	Show available command options
	? before the first field shows "Copy from" options
	? after the first field shows "Copy to" options
	"Copy to/from" options are the same as shown below
running-config	Current system configuration
startup-config	Startup system configuration

To save the changes in the system configuration that was done during the CLI session the following CLI command should be executed:

Example: **AireLink> copy** running-config startup-config

This will copy all the changes to the flash to preserve new settings after the reboot.

9.5   CLI -- PING COMMAND

Command: **AireLink>ping {*hostname|ip_address*}**

Description: Ping destination hostname or IP address

?	Show available command options
`hostname`	Ping destination hostname
`ip_address`	Ping destination IP address

Example: **AireLink> ping 192.168.1.115**

9.6   CLI – Upgrade TFTP Command

Command: **AireLink>upgrade {?|tftp *IPserver address*|status}**

Description: **Copy file from one location to another. First field in the command is the "copy from" option. Second field in the command is the "copy to" option.**

?	Show available command options
tftp IP address	Upgrade TFTP server IP address
status	Upgrade status

Example: **AireLink> upgrade tftp 192.168.1.1**

9.7   CLI – LOG COMMAND

<u>Command:</u> **AireLink>log {?|tftp** *IPserver address***}**

Description:

```
?                   Show available command options
tftp IP address     Get  LOG  files  from  specified  TFTP
                    server
```

Example: **AireLink> log tftp 192.168.1.246**

Alternative command:

tftp -p -l <full path to local file on ODU> -r <filename on remote host> <tftp server IP>

Example:

tftp -p -l /var/log/airelink_init.log -r airelink_init.log 192.168.1.1

10 BLUETOOTH™ AIRELINK VIEWER

The AireLink™ 80 system is equipped with a **Bluetooth™** transceiver fully compatible with latest low power **BLUETOOTH™** SMART specification. When the system ships the **Bluetooth™** connection is enabled by default and the over the air **Bluetooth™** connection is encrypted and password protected to ensure the highest level of security. Initially use default passcode 0000 to access the radio

Bluetooth™ connection. Please, change the password after the initial installation is completed using the **Bluetooth™** setting in the web browser *Administration* tab (see Chapter 7.14) The user can also enable/disable access to **Bluetooth™** in the web browser *Administration* tab (see Chapter 7.14)

LightPointe provides an ANDROID app called *LightPointe BLE* to access the radio **Bluetooth™** connection. The app can be downloaded for free from the Goggle Play store https://play.google.com/store. Running the application requires a **Bluetooth™** capable based smart phone or tablet with Android KitKat (version 4.4) or higher installed. Installing the software will require to grant access to the smart phone/tablet **Bluetooth™** connection.

⚠️	After installation of the software is completed, please reboot/restart your Android phone/tablet to ensure proper operation of the application.

After installing and launching the application, a scan for an AireLink™ systems will start automatically. To establish a connection, the line-of-sight distance between the phone and the AireLink™ system should not be more than 300 feet (100 meters). The distance will be less in case there is an obstruction (roof, tree, etc.) between the smart phone/tablet and the radio link head. After successful discovery, click the AireLink™ system you would like to connect to. When asked, please enter the default passcode 0000 to establish the connection.

The following pages show step-by-step instructions on how to install, launch and interact with the software.
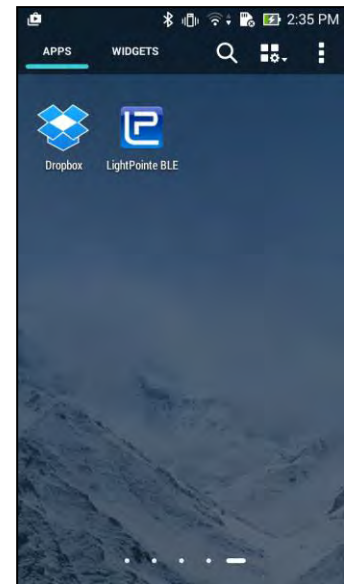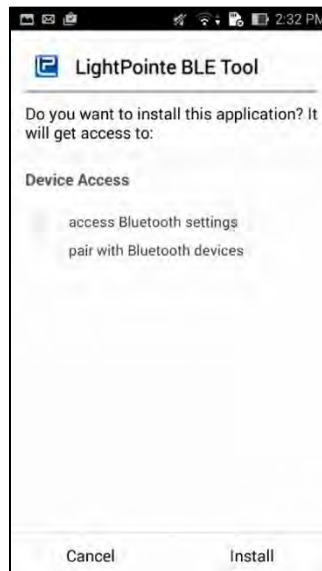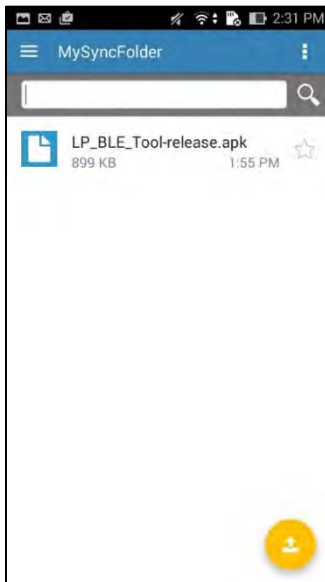
1. Download the application   2. Click on *Install* button.   3. Open the BLE application
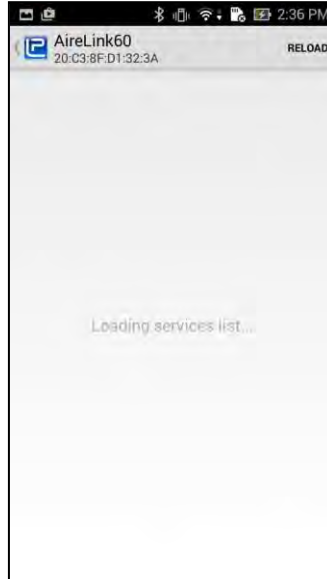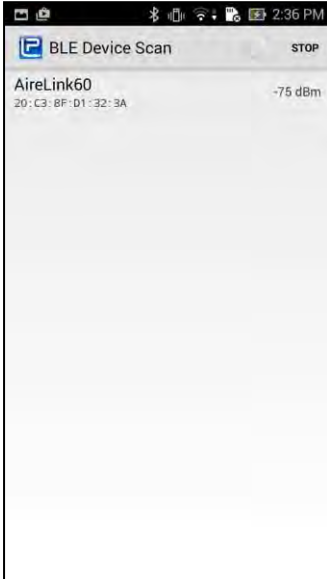
4. The application will scan for AireLink radios. Wait until the scanning finishes.

5. Click on the AireLink radio you would like to monitor. The Application will load services from the radio link.
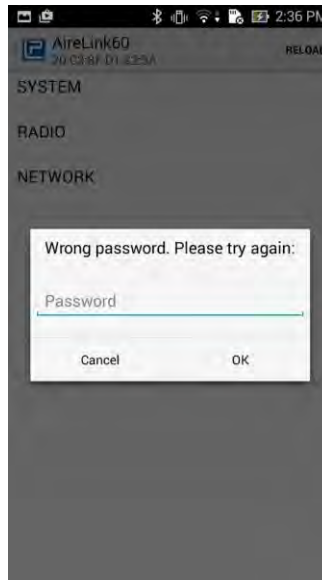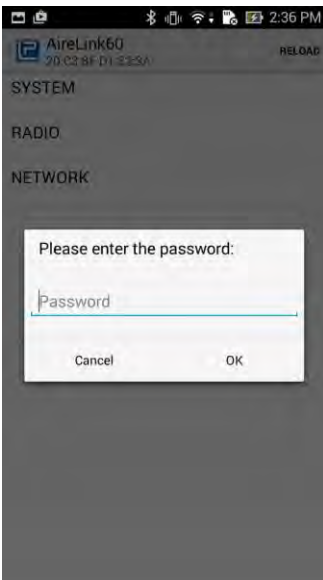
6. After loading of services is completed, please enter default password 0000. Re-enter the password in case of a typo. The password can be changed using the web browser Administrative tab

7. After successful loading of the services the AireLink™ monitoring menu is displayed. There are four tabs:

> ➢ SYSTEM

> ➢ RADIO

> ➢ NETWORK

> ➢ LOCATION
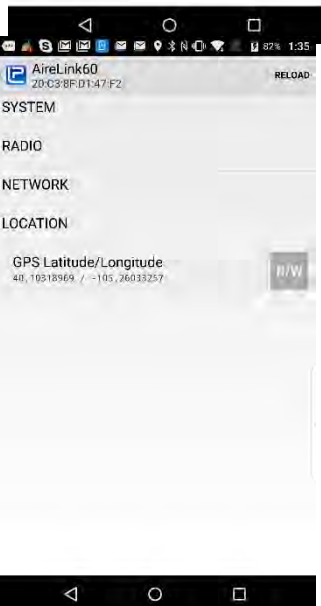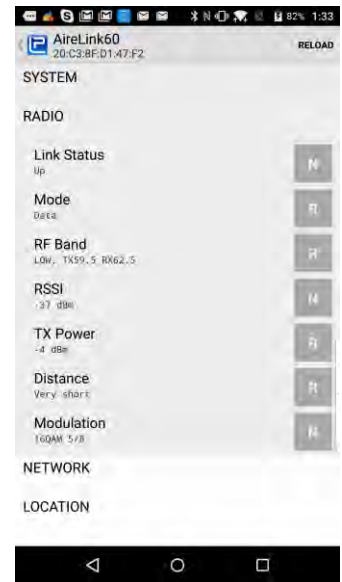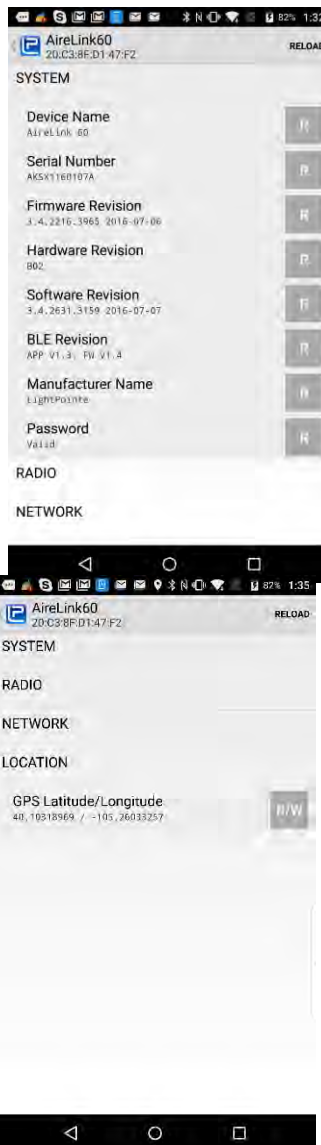
Click/tapping on one of the tabs will open the display of the radio parameters. Parameters listed with the designation R are read only once during application launch.

Parameters listed with the designation N (Link Status, RSSI and Modulation) are continuously updated.

The GPS coordinates in the Location tab are retrieved from the phone/tablet GPS receiver. When the phone/tablet is used during installation and placed close to the radio, the GPS coordinates corresponds to the radio installation location. Clicking/tapping the R/W button will send the phone GPS coordinates to the radio management board. When launching the LinkManager™ web browser and opening the location submenu, the user can confirm to store the GPS coordinates in the on board non-volatile flash memory, and a Google map windows will open and show the installation location of the radio.

11 SNMP

11.1 BASICS

The AireLink™ system supports the Simple Network Management Protocol (SNMP), an Internet-standard protocol for managing devices on IP networks. The system supports SNMP v.1 & SNMP v.2c versions. In typical SNMP implementations, one or more administrative computers, called managers, have the task of monitoring or managing a group of hosts or devices such as the AireLink™ system on a computer network. Each managed system executes, at all times, a software component called an agent which reports information via SNMP to the manager. An agent is a network-management software module that resides on a managed device such as the AireLink™ system. The agent has local knowledge of management information and translates that information to or from an SNMP specific form. SNMP itself does not define which information/variables a managed system should offer. Rather, SNMP uses an extensible design, where the available information is defined by management information bases (MIBs). MIBs describe the structure of the management data of a device subsystem; they use a hierarchical namespace containing object identifiers (OID). Each OID identifies a variable that can be read or set via SNMP. For the SNMP system to function properly, the MIBs of monitored components must be compiled into an SNMP Management System such as NET-SNMP, HP OPENVIEW, SNMPC or similar commercially available programs. For illustrative purposes we are using the MG-SOFT Software

11.2 LightPointe MIB Files

LightPointe provides a MIB named LPCOMM-MIB to monitor the AireLink™ wireless point to point communication systems. The MIB must be compiled into the management system using the appropriate compiler function. After the MIB is compiled correctly, it must both show as part of the loaded MIB modules. See the example in Figure 10-1 below.
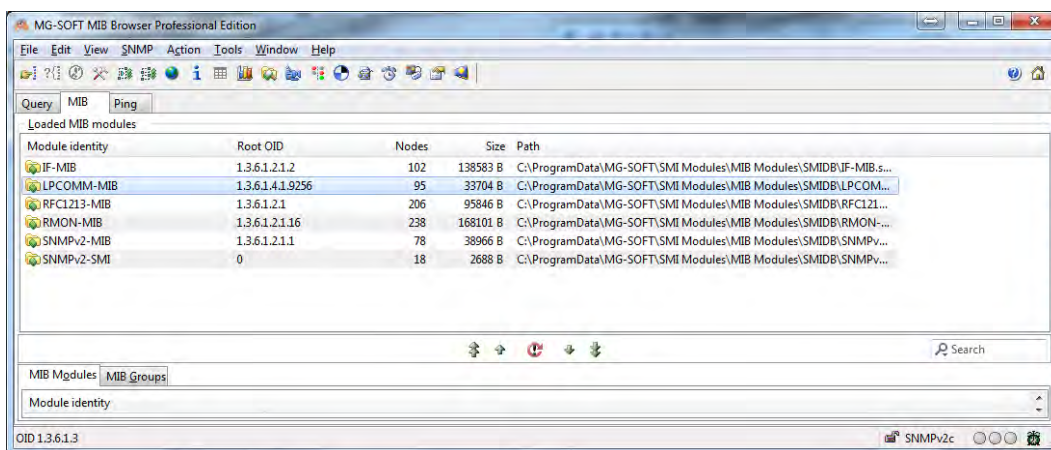
Figure 10-1: LightPointe MIB modules

11.3   LIGHTPOINTE MIB TREE

After successful compilation of the LightPointe Airelink™ MIB file the corresponding variables are shown under the following MIB tree structure:

iso/org/dod/internet/private/enterprises/lpcomm (see Figure 10-2)

The variables with a in front of the variable name can be polled via SNMP command. Some variables are READ ONLY and others have a READ/WRITE status. Most SNMP programs allow highlighting a specific variable and open a property description window similar to the one shown in Figure 10-2 below. The MIB file is actually a readable ASCII Text file and the meaning of a specific variable is documented in the MIB file.
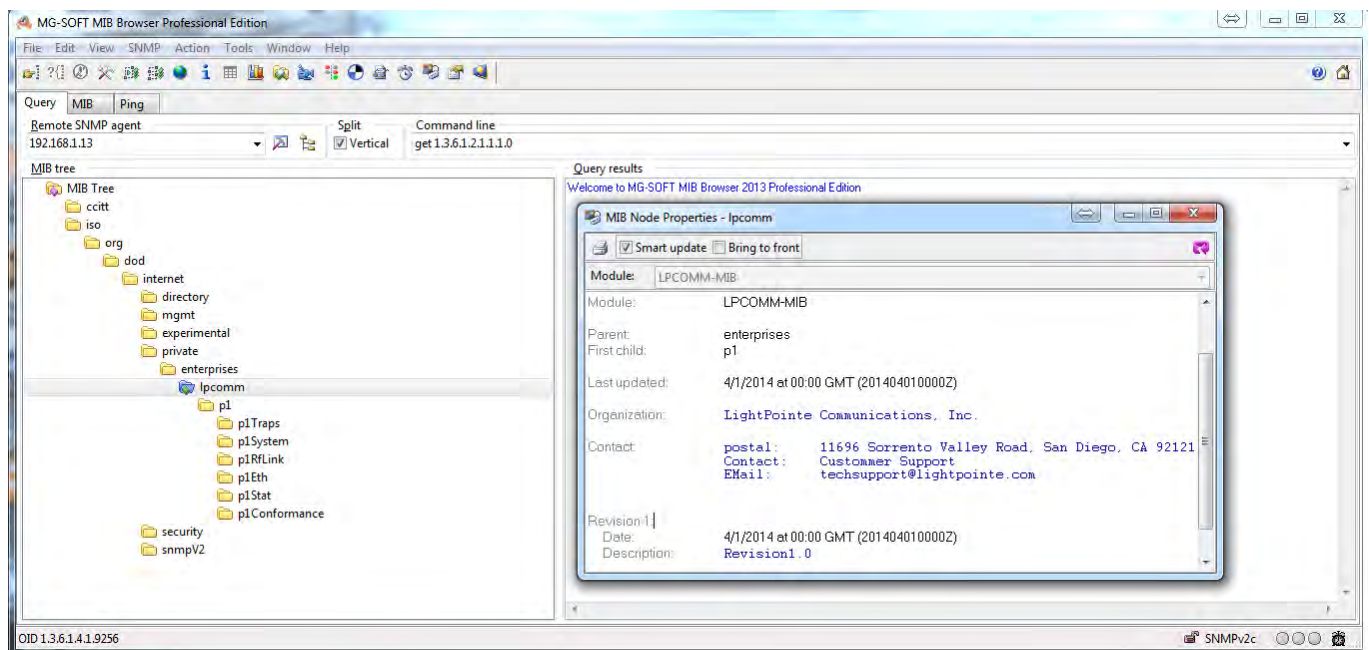
Figure 10-2: MIB tree iso/org/dod/internet/private/enterprises/lpcomm

A more detailed view of the MIB tree itself is shown in Figure 10-3. The variables are grouped according to functonality such as traps, RfLink, Ethernet interfaces, and statistics.
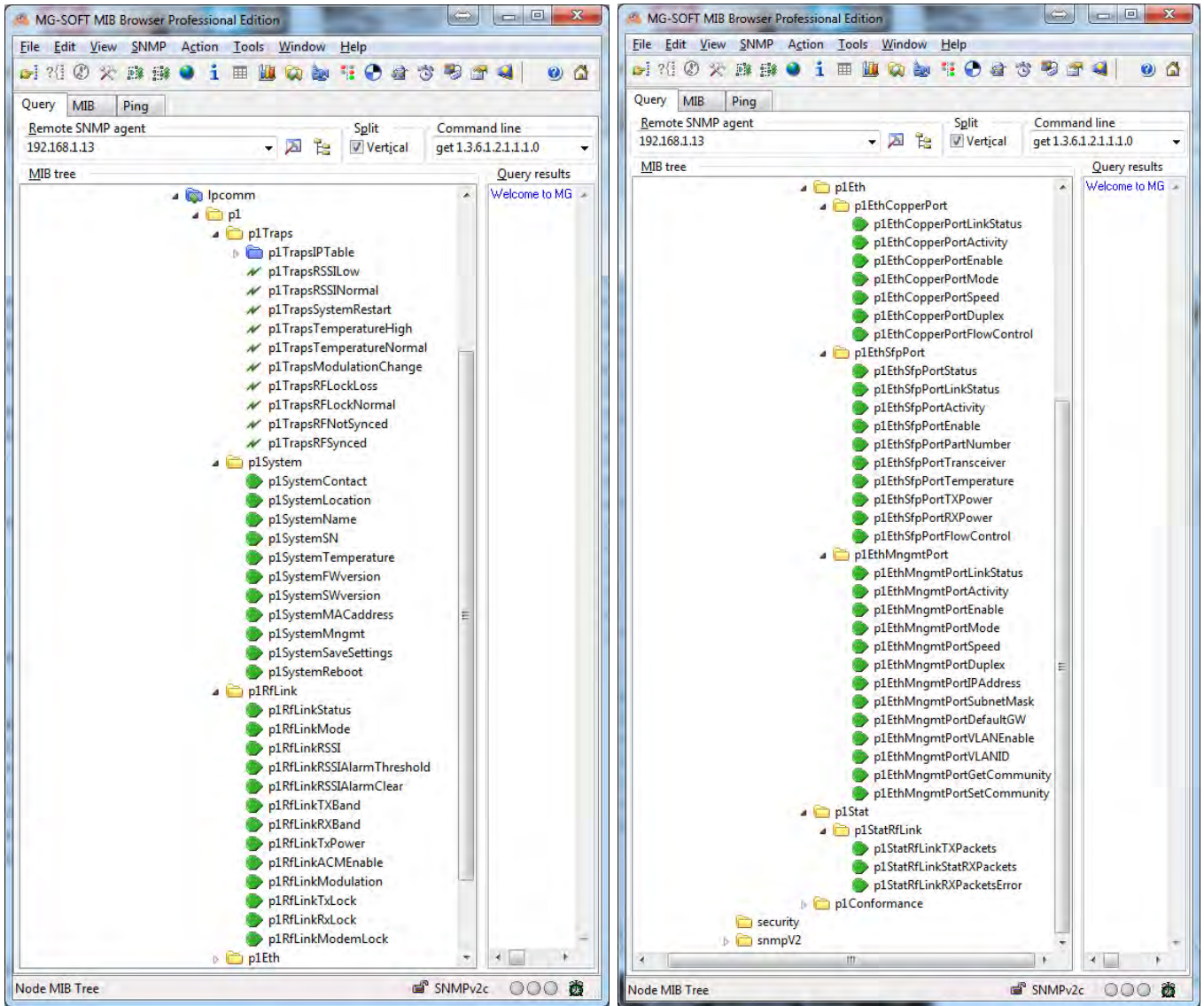
Figure 10-3: Detailed view of LPCOMM MIB tree

Most SNMP programs allow monitoring/polling specific variables over time and display the values graphically or write the values to a file. Such a performance graph can be very useful during troubleshooting. Figure 10-4 shows an illustration of RSSI values polled as a function of time.
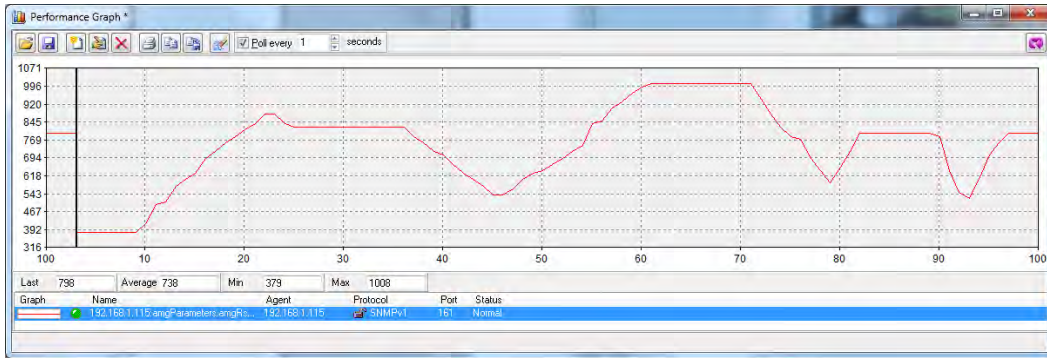
Figure 10-4: Performance Graph

11.4 SNMP TRAP MONITORING

An SNMP trap allows an element, such as the AireLink™ system, to contact network management when there is a significant event. This is done via unsolicited SNMP messages. For example, if the AireLink unit reaches a critical RSSILow threshold value, an SNMP trap will be sent to the computer with the message that the unit has reached the RSSILow value. When the RSSILow conditions resolves the montoring computer will receive an RSSINormal message via a different trap message.

The system can send out 10 different traps and they are listed in the p1Traps folder under the lpcomm MIB tree. Figure 10-5 below shows the location in the MIB tree. The meaning of then traps can easily be derived from the trap name like RSSILow or TemperatureHigh tap. The MIB file list more details regarding the traps.
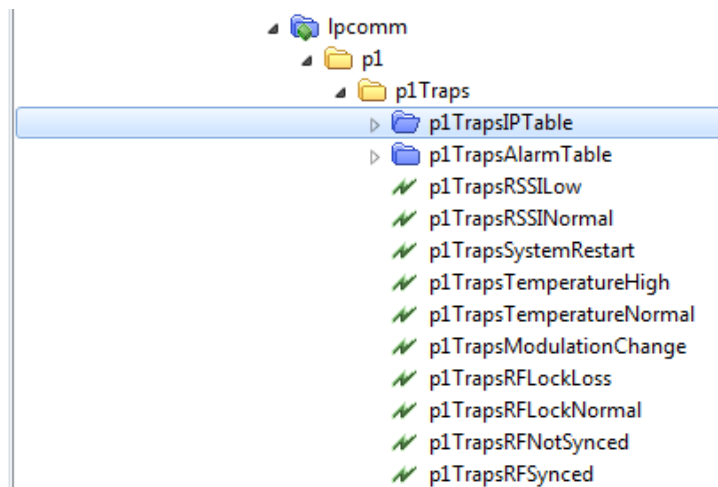
Figure 10-5: SNMP Traps

12   Troubleshooting and Diagnostics

This chapter provides helpful tips on troubleshooting the equipment and covers the following topics:

- ➢ Types of Failure

- ➢ Fault isolation troubleshooting charts

- ➢ Additional troubleshooting methods

The radio units provide a Layer 2 Ethernet connection between remote locations. If the radio units are correctly aligned and data is transmitted, the problem is usually outside the system.

12.1 FAILURE TYPES

Three different kinds of failures can affect system performance:

- ➢ Failures caused by attached network components

- ➢ Failures caused by the environment

- ➢ System failure of one of the radio units

The use of the Aire**Link™** Manager program is highly recommended during the troubleshooting process. Although the Aire**Link™ Manager** is not needed to transmit information through the system, the program is an essential component in monitoring and managing the **AireLink™80** system. For details please refer to Chapter 6 of this manual **"**LinkManager**™** - Network Management Platform**"**

Troubleshooting Charts

The following troubleshooting charts are meant to guide the user through some simple failure analysis procedures. Following these procedures will greatly help to ease the troubleshooting process and many problems can be solved on short notice by the user of the equipment and consequently minimize the downtime of the system in case of a malfunction. Please use the following charts to locate the problem before contacting LightPointe or your Reseller.

Observation: Network connection cannot be established with the opposite radio or throughput is low. Received RSSI signal reading **is "low" or** RF sign**al status is "off"**

Problem	Cause	Action
Power Source	The equipment power supply at the opposite side is switched off.	Turn power supply on. Check that the green Power LED on radio user panel is lit.
	Broken power supply	Replace power supply. Call LightPointe or reseller in case the power supply was part of the shipment.
System Setup	RF ON LED is off	Restart the system and call LightPointe or reseller in case the Led does not turn ON.
	RF SYNCH LED is off	In case the RF ON LED is ON/GREEN at both radios, realign system. See chapter 5 in this manual.
	System is misaligned.	Realign system. Use chart in Fig. 5-8 or Fig. 5-18 to find correct RSSI voltage reading. See chapter 5 in this manual.
	Distance between locations exceeds specific system distance specification.	System can still be used but throughput will be lower.
	Antenna is mounted incorrectly and the polarization is crossed.	Re-install the antenna and ensure that both antennas transmit at the same polarization. See chapter 5.3 in this manual.
Environment	High signal attenuation due to heavy rain	Wait until the rain stops and observe if this resolves the problem.
	Antenna covered with snow.	Remove snow from antenna.

Table 11-1: Troubleshooting Chart I

Observation: 'SFP Port **Status'** reports **"Link DOWN"**

Problem	Cause	Action
Optic Cables or Transceiver	TX and RX terminal connection error	Check fiber cables and ensure that transceivers are connected correctly. Check SFP Port status in LinkManager™.
	Optical transceiver standards do not match	Use the LinkManager™ and verify that the correct transceiver is installed.
	Dirt or dust or breakage of optical fiber	Clean fiber output or replace the cable with a new one. Use LinkManager™ software to verify correct optical receive power at ODU fiber port.
	Broken transceiver at the network premise equipment side	Replace transceiver
	Broken transceiver at the radio side	Call LightPointe or Reseller.
Premise Equipment Connection	The network premise equipment at the opposite side is turned off	Under SFP Port status in LinkManager™, check RX power entry. Check Power on premise equipment
	Network port of premise equipment is de-activated	Under SFP Port status in LinkManager™, check RX power entry. Activate network port

Table 11-2: Troubleshooting Chart II

13 Advanced Troubleshooting Methods

13.1 Performing a PING Test

A ping test is not a particularly sophisticated networking test but it does provide the user with an easy method to check the connectivity of IP based network equipment. When performing a ping test between two laptops and without other network equipment in the circuit, the ping test provides valuable information about the performance of the radio transmission link itself. Other tests may involve additional network equipment and therefore complicate the issue, making it difficult to find the root cause of a potential problem. The following equipment and software are needed to perform a ping test:

➢ Two laptops or PCs with Ethernet cards

➢ Two Ethernet cables with RJ45 connectors

Additionally, if performing the test over radio fiber connection:

➢ Two media converters

▪ Depending on SFP transceiver installed in radio units use either multimode 1000Base-SX (850 nm) or 1000Base-LX (1300 nm) media converter. In case of using an older laptop that does not have a 1250 Mbps RJ45 (Gigabit Ethernet) connection, a 100/1000 switched media converter will be required.

▪ Four simplex (or two duplex) optical fiber patch cords with correct termination. The radio transceiver has a LC type connector and the other termination will depend on the termination of the media converter.
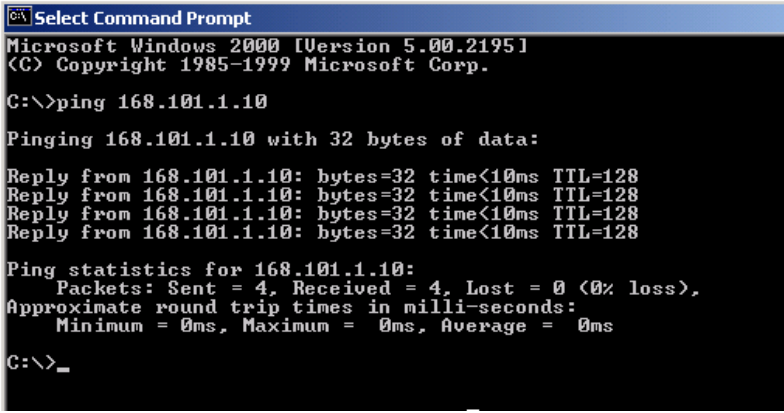
13.2 EQUIPMENT CONNECTION AND NETWORK SETTINGS

To perform a ping test directly connect the two laptops/PCs to the radio link heads using either Cat5E/6 cables or additionally with a media converter on each side, if connecting via fiber. It is important to know which port of the radio unit is active. For details please refer to the **"LinkManager™** - Network Management **Platform" in Chapter 6.** Ensure that the radio units are aligned and that all status indicators show that the system is physically connected.

Note	This ping test is based on using two computers. It is possible to do a ping test with just one laptop if the remote radio side is connected to network equipment (switch/router) with a known IP. However, by doing so it might be difficult to isolate a potential networking problem and draw a definitive conclusion.

13.3 STEP-BY-STEP INSTRUCTIONS TO PERFORM A PING TEST

Step 1	Locate the required equipment listed above.
Step 2	On each side, attach an RJ-45 cable or optical fiber cables via SFP transceiver to the radio port labeled DATA PORT. Connect the opposite ends of the RJ-45 cable to a laptop or fiber cables to the TX/RX ports of the media converters.
Step 3	Connect an Ethernet cable between the PC RJ45 network port and the media converter RJ45 port on each laptop/PC and complete the following setup instructions on each laptop. The exact procedure will depend on the actual Windows operating system installed but the procedure is basically the same for any Windows operating system.
Step 4	From Windows click the Start button.
Step 5	Click on Settings.
Step 6	Click on Control Panel.
Step 7	Click on the Network And Dial-Up Connector icon.
Step 8	Click on Incoming Connection.
Step 9	Click on the Network tab.
Step 10	Double click on Internet Protocol TCP/IP.
Step 11	Select the Specify TCP/IP Address radio button.
Step 12	The local side should type 192.168.1.1 in the IP Address Box. The remote side should type 192.168.1.10 in the IP address box. The Subnet address will automatically generate.
Step 13	Click the Okay button.
Step 14	Exit all dialog boxes.
Step 15	Click on the Start button.
Step 16	Select Programs.

Step 17	Select the MS-DOS Prompt.
Step 18	Type the word ping and the different ping command options will be displayed.
Step 19	To perform the ping test, the local laptop has to ping the IP address of the laptop and the other way around. From C:\> Type: ping -t 192.168.1.1 on the local laptop. The remote side laptop can ping by typing: ping -t 192.168.1.10. To stop the ping tests, type <Ctrl> C.

Step 20	A successful ping will display the following information on the PC screen.
	
	![Command Prompt]
	``
	Select Command Prompt
	Microsoft Windows 2000 [Version 5.00.2195]
	(C) Copyright 1985-1999 Microsoft Corp.
	
	C:\>ping 168.101.1.10
	
	Pinging 168.101.1.10 with 32 bytes of data:
	
	Reply from 168.101.1.10: bytes=32 time<10ms TTL=128
	Reply from 168.101.1.10: bytes=32 time<10ms TTL=128
	Reply from 168.101.1.10: bytes=32 time<10ms TTL=128
	Reply from 168.101.1.10: bytes=32 time<10ms TTL=128
	
	Ping statistics for 168.101.1.10:
	    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
	Approximate round trip times in milli-seconds:
	    Minimum = 0ms, Maximum = 0ms, Average = 0ms
	
	C:\>_
	``

Step 21	Let the ping program run for several minutes and then type <Ctrl> C to stop the program. Take a look at the lost ping counter to verify that the system operates correctly. We using two laptops, no packet should be lost during the transmission.

13.4 BER TESTING

Bit Error Rate (BER) testing is the most advanced way to check on the performance of a communication link. The radio transmission link operates as a transparent layer 2 Ethernet connection. The radio operates in full-duplex mode at real network throughput speed and extremely low latency of typically < 50 microseconds. Higher protocol layer performance is not determined by the radio but by the attached networking equipment. There are several vendors in the market that provide BER testing equipment. In case you are interested in performing a BER test and do not have a BER tester, please contact LightPointe for information on test equipment companies that lease a BER Tester

14 SPECIFICATIONS

Parameter	AireLink™ 80 SX/MX/LX/EX
Frequency of Operation	**Paired 71...76/81....86 GHz, ETSI compliant frequency grid, 17 paired channels,** 250 MHz channel spacing
High/Low Channel Separation	> 60 dB
Transmission Power	+13 dBm (max.)
Throughput	1000 Mbps, Full duplex
Modulation	BPSK/QPSK/16QAM, 9 Level Hitless Automatic Coding and Modulation (ACM)
Max. Link budget	194 dB (BPSK-1/2), 193 dB (BPSK-5/8), 193 dB (BPSK-3/4), 192 dB (QPSK-1/2), 191 dB (QPSK-5/8), 189 dB (QPSK-3/4), 181 dB (16QAM-1/2), 177 dB (16QAM-5/8)
Power Control	Adaptive Transmission Power Control (ATPC) or manually adjustable power settings for short distance deployments
Supply Voltage	Power over Ethernet (802.3at) or Direct 48Vdc, Reverse Polarization Protection, Back-to-Back Power Redundancy
Power Consumption	25 Watts max.
Network Interface	RJ-45 (100/1000 Base Tx) or MM/SM Fiber SFP (1000Base-SX/LX)
QoS/Protocol support	802.3z (Gigabit Ethernet), Flow Control, Transparent Bridging(802.1d) VLAN support (802.1q), VLAN Stacking (802.1ad)
Frame size	Jumbo frames (up to 10K)
Encryption	Optional: Full duplex, line speed and real time AES 256 encryption
Terminal Latency	< 40 µs + (distance in meters/300) µs
Management & OS	AireLink web based Management Platform, Telnet Command Line Interface (CLI), SNMP v1/2c, RS232 Console port (micro USB connection), Loopback operation, On board Performance Data Collection with user selectable TFTP upload, NTP
Bluetooth™	**Bluetooth™ SMART support for remote management via smart phone (Android)**
Status Indicators	Networking port Status/Activity, RF ON, RF SYNC., ALIGN MODE, POWER
Signal Level Meter	External RSSI Voltage Connector
Operating Temperature	-30°C ... +60°C
Environmental / IP Rating	IP66
Standard Compliance	USA: FCC Part 101; ETSI/CEPT: EN302-217-3 V1.3.1; EN302-217-4-2 V1.5.1; EN301-489, EN60950-1; EN61000-3; EN61000-4; ECC/REC(05)07
Size (LxWxD)	(220x220x70) mm (enclosure w/o antenna and mounting bracket)

Model		SX	MX	LX	EX
Weight (incl. mount bracket)		4 kg	6.35 kg	9.07 kg	12kg
Antenna	Type	Parabolic Antenna	Cassegrain (external)		
	Size	20 cm	30 cm	60 cm	90 cm
	Gain	41dBi	45 dBi	51 dBi	54 dBi
	Polarization	Horizontal/Vertical	Horizontal/vertical	Horizontal/vertical	Horizontal/vertical
	Pol. Crosstalk	>35 dB	>35 dB	>35 dB	>35dB
	HPBW	2.5°	1.1°	0.6°	0.3°

15   TECHNICAL SUPPORT

Be sure to fill out the following checklist before calling your reseller on contacting LightPointe Technical Support.

General Information	Your Installation
❑ Application (Fast Ethernet or GbE)?	
❑ Distance?	
❑ How long has system been in operation?	
How does the error show up?	
❑ Temporary/permanent error?	
❑ Is error observed for the first time?	
How was the weather when error showed up?	
❑ Weather conditions (rain, fog, snowfall)	
❑ Outside temperature	
Status of LEDs (on radio unit user panel)	
❑ Is the power LED on (green)?	Yes/No
❑ Is the RF ON LED on (green)?	Yes/No
❑ Is the RF SYNCH. LED on (green)?	Yes/no
❑ Do you see the network link/activity LED ON?	Yes/No
Status in AireLink™ Manager	
❑ AireLink™ Manager connection ok?	Yes/No
❑ What is the Link Status of the RF link?	Up/down
❑ Is RSSI power value displayed?	Yes/No If yes, what is the reading in dBm?
❑ What is the TX, RX and modem lock status?	
❑ Is temperature value displayed?	Yes/No If yes, what is the reading in ^{O}C?
❑ Can you see the RMON counter status?	Yes/No If yes, do you see any CRC errors?
What type of system is installed?	
❑ Integrated antenna or 1 or 2 foot ext. antenna?	
❑ Model number	
❑ Serial number	

15.1   RETURN MATERIAL AUTHORIZATION (RMA) PROCEDURE

Please contact LightPointe before returning any system components for repair or replacement.

RMA products include:

- Link head

- Standard power supply

15.2   CONTACTING LIGHTPOINTE

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