

RT System 2

Deployment Guide

December 12, 2013

Part Number: 90-0069

R01.b

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Overview

1.1 About this Guide

This document provides information on how to deploy the RT System 2 in the field. See the *RT System 2 Installation Guide* for instructions on setting up the recording truck equipment and software.

1.2 Who Should Use this Guide

The expected users of this document are as follows:

- ◆ Crew (Layout/Troubleshooters)
- ◆ Technician (LIU)
- ◆ Bosses (Line Crew)

1.3 Related Documents

RT System 2-related documents are as follows:

- ◆ **RT System 2 Documents Guide** (90-0026) – Lists all of the RT System 2 documents with a brief description of each.
- ◆ **RT System 2 Glossary** (90-0032) – Lists and defines RT System 2 terms and acronyms. Includes some general seismic and geologic terms and acronyms.
- ◆ **RT System 2 Installation Guide** (90-0028) – Provides instructions for setting up the recording truck hardware, and installing and updating software and firmware.
- ◆ **RT System 2 Troubleshooting Guide** (90-0039) – Provides instructions on how to solve common problems.

1.4 Getting Help

To get help on the RT System 2 Central Recording System, consult the online help. You can find the help documents by clicking the help icon in the user interface, or by navigating to the following directory:

```
C:\wsi\rt\vx.y.z\server\help\index.htm
```

Where vx.y.z is the version number (for example, v2.3.0).

To get help on the RT System 2 deployment, consult this document.

If you cannot find the answers you need, please contact Wireless Seismic, Inc. Customer Support at:

13100 Southwest Freeway, Suite 150
Sugar Land, TX 77478
(832) 532-5048

support@wirelessseismic.com

This chapter describes how to prepare (mobilization) and layout (install) the ground electronics. See the *RT System 2 Installation Guide* for instructions on setting up the recording truck equipment and software.



2.1 Prerequisites

In preparation for mobilization, define the following:

- ◆ Survey
- ◆ Backhaul plan

2.2 Getting Ready

Collect all of the following:



NOTE

Please refer to “Antenna Specifications” on page 143 for the list of supported antennas. Use of accessories other than those specified in this document is not supported or warranted.

RT System 2 ground equipment (05-0007):

- ◆ WRUs
- ◆ LIUs (see “Backhaul Components” on page 28)
- ◆ Antennas 5.5 dBi (65-0204)
- ◆ Geophones
- ◆ WRU Batteries (0400-001-01)
- ◆ WRU Dummy Batteries (55-0009)
- ◆ Antenna Extenders
 - 30 in (762 mm) antenna extender (65-00941) (standard)
 - 10 ft (3 m) M-to-F coax cable (65-0103)
 - 25 ft (7.6 m) M-to-F coax cable (65-0110)
- ◆ Backhaul Components (see “Backhaul Components” on page 28)
- ◆ Tools
- ◆ Manuals
- ◆ Consumables
- ◆ Spares (15-0003)
 - Mast Parts
 - Base Parts
 - Guy Lines

2. Layout

Preparing the Equipment

- Antennas
- Antenna Extenders
- Batteries
- Cables
- Connectors



NOTE

The batteries (when fully discharged) require 8 hours of continuous charging in the battery charger connected to an AC source; therefore, the battery charger should be located at the staging area or in town.

2.3 Preparing the Equipment

Ensure that the Central Recording System has the latest available software installed. Ensure that the ground equipment has the latest available firmware installed. See the following for more information:

- ◆ See the *RT System 2 Release Notes* for version numbers.
- ◆ See the *RT System 2 Installation Guide* for installation and update instructions.

Ensure that the industry standard best practices are followed for securing the equipment for transport.

2.4 Laying Out the Equipment

Lay out the ground equipment while the central recording system hardware and software is being prepared to save time.

The WRU is shown in the following figure:

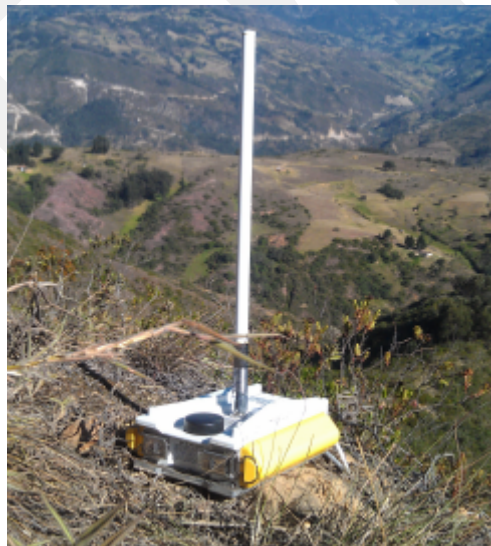


Figure 2–1 WRU

A WRU with a geophone attached is shown in the following figure



Figure 2–2 WRU with Geophone

2. Layout

Laying Out the Equipment

The LIU is shown in the following figure:



Figure 2-3 LIU

2.4.1 Prerequisites

Attach the batteries, antennas, and geophones to the ground equipment prior to going into the field, or as each unit is placed. If you are assembling as you place the units, ensure that you have sufficient quantities for each unit, plus a few spares.



NOTE

Do not deploy (tip to power on) the WRUs until they are at the actual location where they will be placed.



Figure 2–4 Assembling WRUs

The RT System 2 shall be used with only the supplied antennas (*Table A–1 Antenna Specifications, on page 143*) attached to the WRU with an integrated type N male connector.

- ◆ The RT System 2 antennas shall be installed and handled by professionals specifically designated for this purpose.
- ◆ Changes or modifications not expressly approved by Wireless Seismic, Inc. can void the user's authority to operate the equipment.

WARNING

In order to comply with radio frequency (RF) exposure requirements, the RT System 2 units must be installed so that a minimum separation distance of 20 cm is maintained between the antenna(s) and the body of all persons at all times during normal operation.

2. Layout

Laying Out the Equipment

AVERTISSEMENT

Afin de se conformer aux normes de la en matière d'exposition aux radiofréquences (RF), les unités RT System 2 doivent être installées de manière à garder en permanence une distance minimale de 20 cm entre la ou les antennes et le corps de toute personne en mode de fonctionnement normal.

2.4.2 Assembling the Ground Equipment

This section describes the process to assemble the ground equipment prior to deployment.

To assemble the ground equipment:

- 1 Gather the equipment:
 - WRU
 - Antenna
 - Antenna Extender
 - Geophone
 - Batteries
- 2 Gather any special tools and equipment:
 - Optional: Nylon grip pliers
 - Optional: Loctite® 222
 - Safety gear such as vests, hard hat, and gloves.

CAUTION

The metal ground equipment can become hot while exposed to the sun. Wear gloves to handle hot equipment.

PRUDENCE

L'équipement au sol en métal peut devenir très chaud lors de l'exposition au soleil. Portez des gants pour manipuler l'équipement chaud.

UWAGA

L'équipement au sol en métal peut devenir très chaud lors de l'exposition au soleil. Portez des gants pour manipuler l'équipement chaud.

- 3 Attach one or more batteries to the WRU.
 - Press the battery into the connector.
 - Flip the bail over the molded area on the end of the battery.
 - Press the lever until the catch snaps to lock it in place.

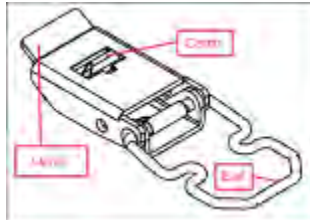


Figure 2–5 Battery Latch



Figure 2–6 Installing the Battery

- 4 Attach the geophone to the WRU.



To record three components of seismic data with the multiple-channel WRU, connect three separate arrays of one-component geophones to the same WRU, or connect a multiple-component geophone to the WRU

2. Layout

Laying Out the Equipment



Figure 2–7 Installing the Geophone

- 5 Attach the antenna with extender to the WRU. Ensure that the antenna connection is clean, and the antenna is snug and does not wobble.



TIP

The antenna screws on to the WRU in a clockwise direction. It should twist on easily; do not use force. To ensure that the threads are properly aligned, turn the connector counter-clockwise until you hear a click indicating that the threads are aligned, then turn clockwise to tighten.



Figure 2–8 Antenna Extender (65-0091)



Figure 2-9 Antenna with Spring Relief

2.4.3 Placing the WRU in the Field

This section describes the process to ready the ground equipment for interaction with the central recording system (deployment).



NOTE

Do not deploy (tip to power on) the WRUs until they are at the actual location where they will be placed.

To deploy the WRU:

- 1 Prerequisites:
 - The WRU is assembled with battery, geophone, and antenna



NOTE

When using a WRU as a Repeater, the deployment instructions are the same, except a geophone is not required. Repeaters are added to the line segment in the Spread Manager. See the RT System 2 Operator Guide for more information.

If a geophone is not connected, you can skip the geophone test. See "D. LED Indicators" on page 161 for more information on skipping the test and the relevant LED status indicators.

- 2 Pick up the WRU and point the geophone connector end towards the ground as shown in the following figure. After a few seconds, all of the LEDs illuminate:

2. Layout

Laying Out the Equipment

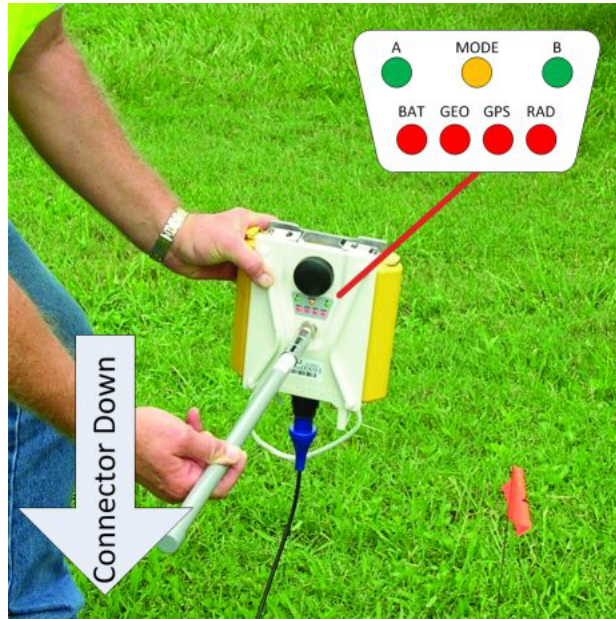


Figure 2–10 Power on the Unit

- 3 Place the unit flat on the ground as shown in the following figure:

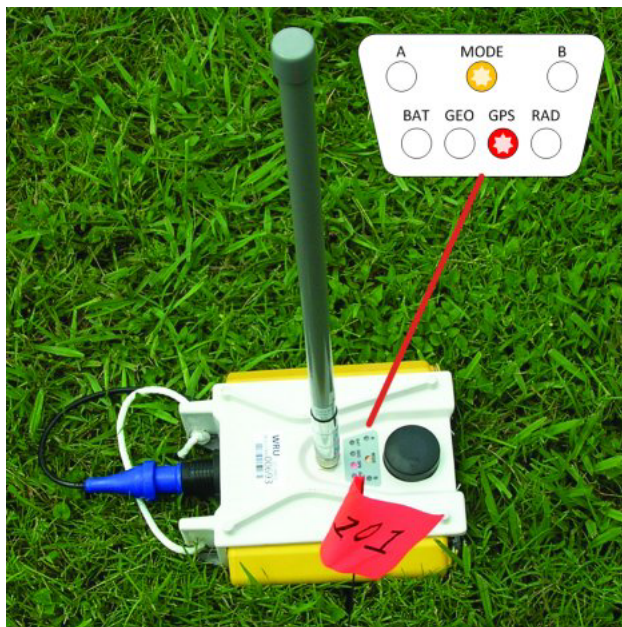


Figure 2-11 Place the Unit

- 4 The unit first turns on its GPS and acquires a new position. Then it will begin a series of internal and external tests. The LEDs on the top of the unit indicate the current test and whether the unit passes or fails each test.



NOTE

The WRU will attempt to get a 3-meter GPS lock for up to 15 minutes. During this time, the GPS LED flashes. The WRU will not form until the GPS lock is achieved. If the GPS lock cannot be achieved, form by serial number.

- 5 Press or stomp the geophone into the ground. If you stomp the geophone while the geophone test is running, the test will fail and the WRU will not deploy.

Verify that the WRU does not show a GEO self-test failure (see the following figure) after placing the geophone. If the WRU does show a self-test failure, pick up the WRU, point the geophone connector end towards the ground until all of the LEDs illuminate, and then place the unit flat on the ground to re-run the self-test.

2. Layout

Laying Out the Equipment

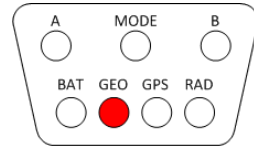


Figure 2–12 Geophone Self-Test Failure



NOTE

See “D. LED Indicators” on page 161 for an explanation of the LED status and error conditions.

If a WRU self test fails, the WRU will continue to the next test.

Skip a self-test by tipping the WRU geophone down and then returning it to the upright position (flat on the ground).

2.4.4 Placing the LIU in the Field

The LIU is part of the backhaul configuration. See “3. Backhaul” on page 23 for more information.

Backhaul

3.1 Overview

In network communications, the *backhaul* is the part of the network that contains the links and equipment between the core network and the sub networks. The following table defines concepts associated with backhaul communications:

Table 3–1 Backhaul Communication Concepts

Term	Definition	Reference
Point-to-Point	<p>A method where each radio node in the network captures and disseminates its own data as well as serves as a relay for other radio nodes in the network sending data along a path, <i>hopping</i> from one node to the next.</p> <p>This is how the RT System 2 WRUs send information to the LIU and how LIUs communicate with each other in a point-to-point configuration.</p> <p>Also called Bucket Brigade or String-of-Pearls.</p>	<ul style="list-style-type: none"> • <i>"Point-to-Point Single Backhaul Data Direction" on page 25</i> • <i>"Point-to-Point Dual Backhaul Data Direction" on page 26</i> • <i>"4. Point-to-Point Backhaul" on page 62</i>
Point-to-Multipoint	<p>A method where each line station LIU communicates directly with the recorder LIU. The backhaul is composed of a number of line station mast/radio/LIUs pointing to a recording truck mast/radio/LIU. The following list describes the most common configurations:</p> <ul style="list-style-type: none"> • Point-to-Multipoint – A single recording truck radio and multiple line station radios • Point-to-Multipoint (redundant) – A single active recording truck radio, a backup (redundant) recording truck radio, and multiple line station radios • Point-to-Multipoint (custom) – A combination of recording truck radios and line station radios <p>Also called Star Configuration.</p>	<ul style="list-style-type: none"> • <i>"Point-to-Multipoint Backhaul Data Direction" on page 27</i> • <i>"5. Point-to-Multipoint Backhaul" on page 96</i>

3. Backhaul

Overview

Table 3–1 Backhaul Communication Concepts

Term	Definition	Reference
Power over Ethernet (PoE)	<p>A technology that passes electrical power along an Ethernet cable. PoE is used where DC power is not available and USB unsuitable. Power can be supplied at the end of a network span or somewhere in the middle.</p> <p>PoE <i>switches</i> supply power at the end of a span. The RT System 2 Line Interface Unit (LIU) acts as a switch with PoE.</p> <p>PoE <i>injectors</i> supply power somewhere between the PoE switch and the powered device. They inject power and do not affect the data. A discrete PoE injector is used when configuring the backhaul radios.</p>	<ul style="list-style-type: none">• “Ubiquiti Rocket/Bullet Private Network Connection” on page 105• “Ubiquiti NanoStation Private Network Connection” on page 70

In the RT System 2 system, the LIU communicates with the Central Software System (CSS) computer in the central recording truck along a backhaul on the 5.8 GHz Industrial, Scientific, and Medical (ISM) radio band. Some smaller systems may not require a backhaul.

The following figure illustrates the components and data flow for a four-line, single-backhaul, point-to-point line:

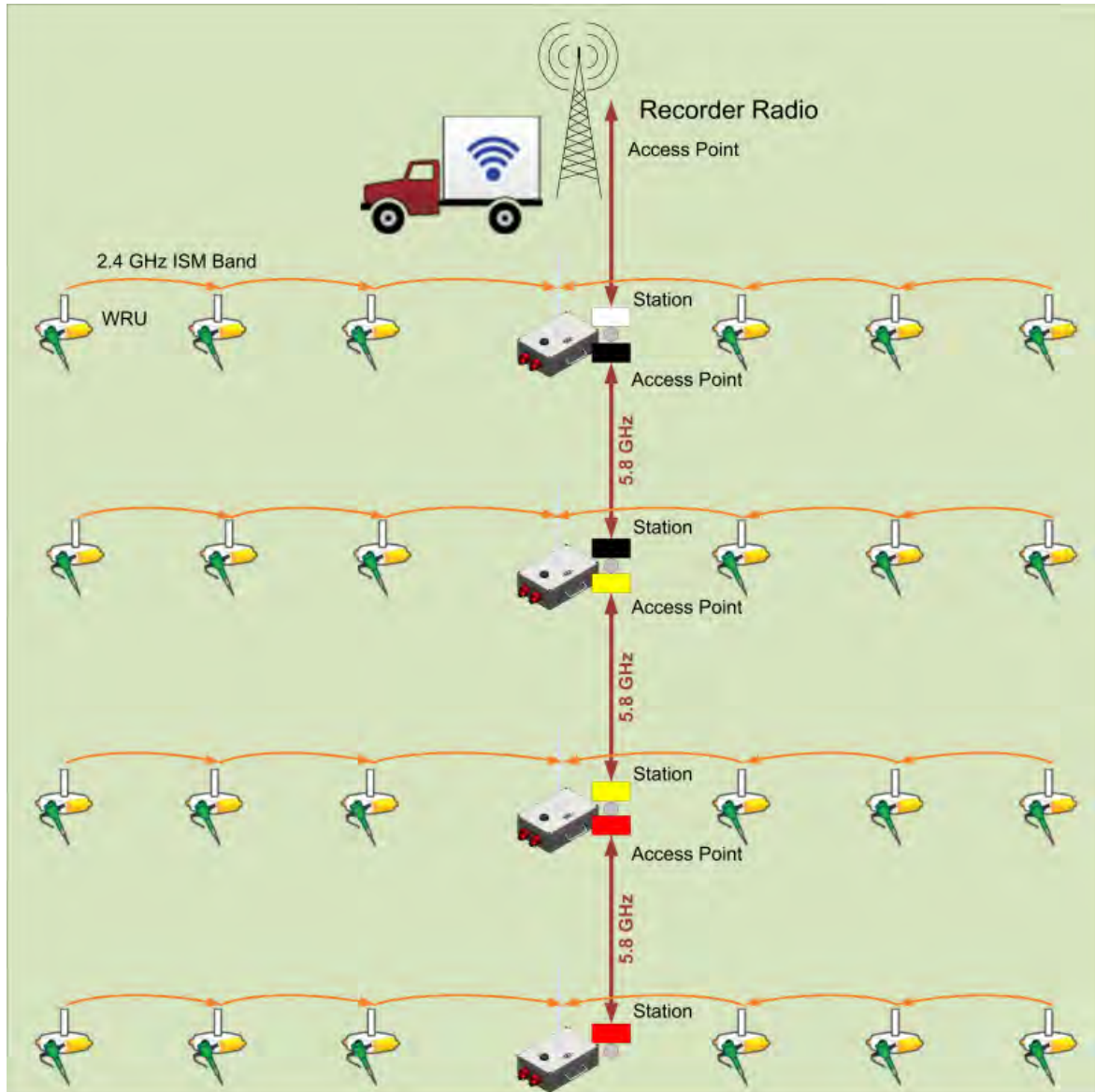


Figure 3–1 Point-to-Point Single Backhaul Data Direction

3. Backhaul

Overview

The following figure illustrates the components and data flow for a four-line, dual-backhaul, point-to-point line:

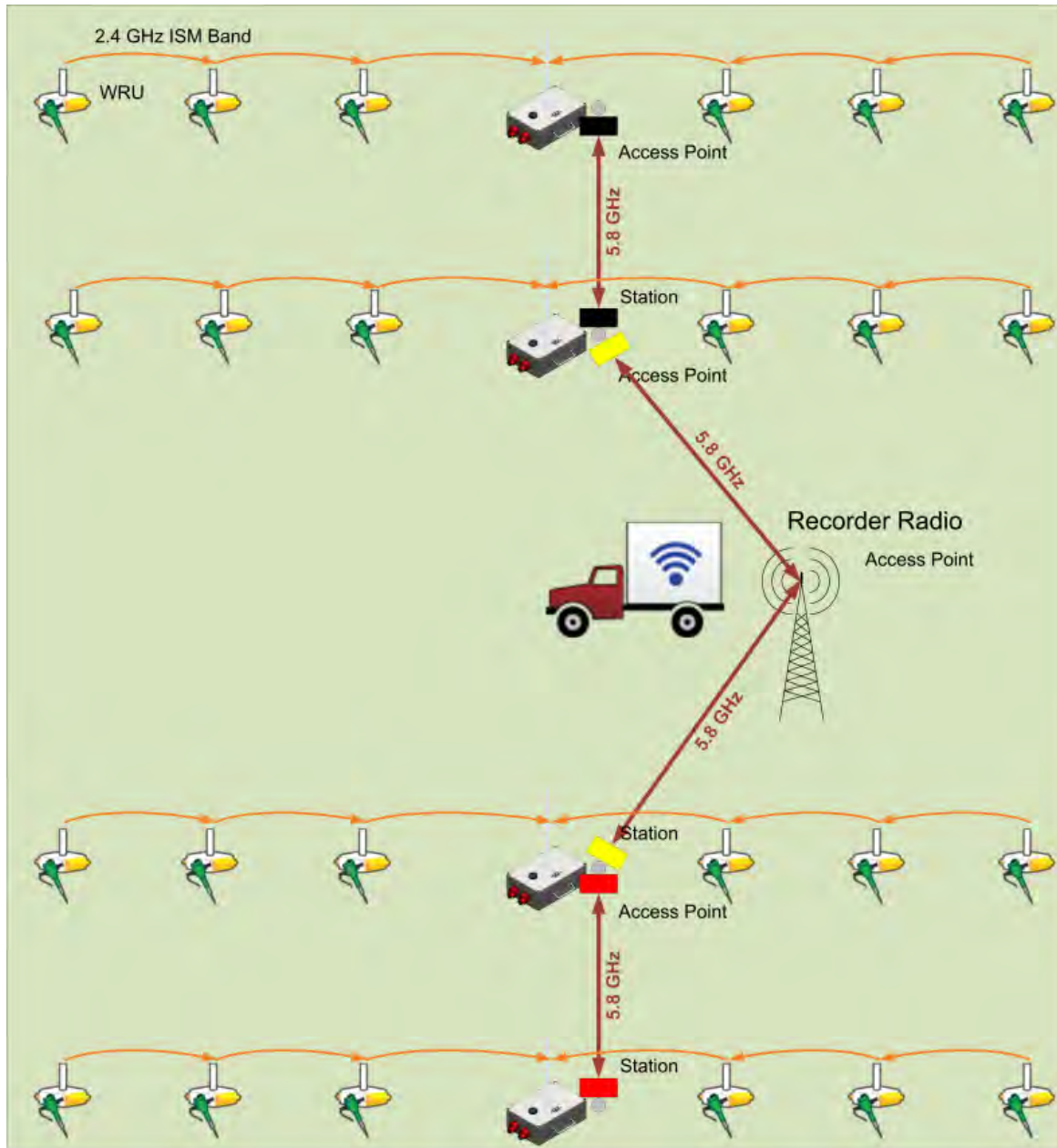


Figure 3–2 Point-to-Point Dual Backhaul Data Direction

The following figure illustrates the components and data flow for a point-to-multipoint, star configuration:

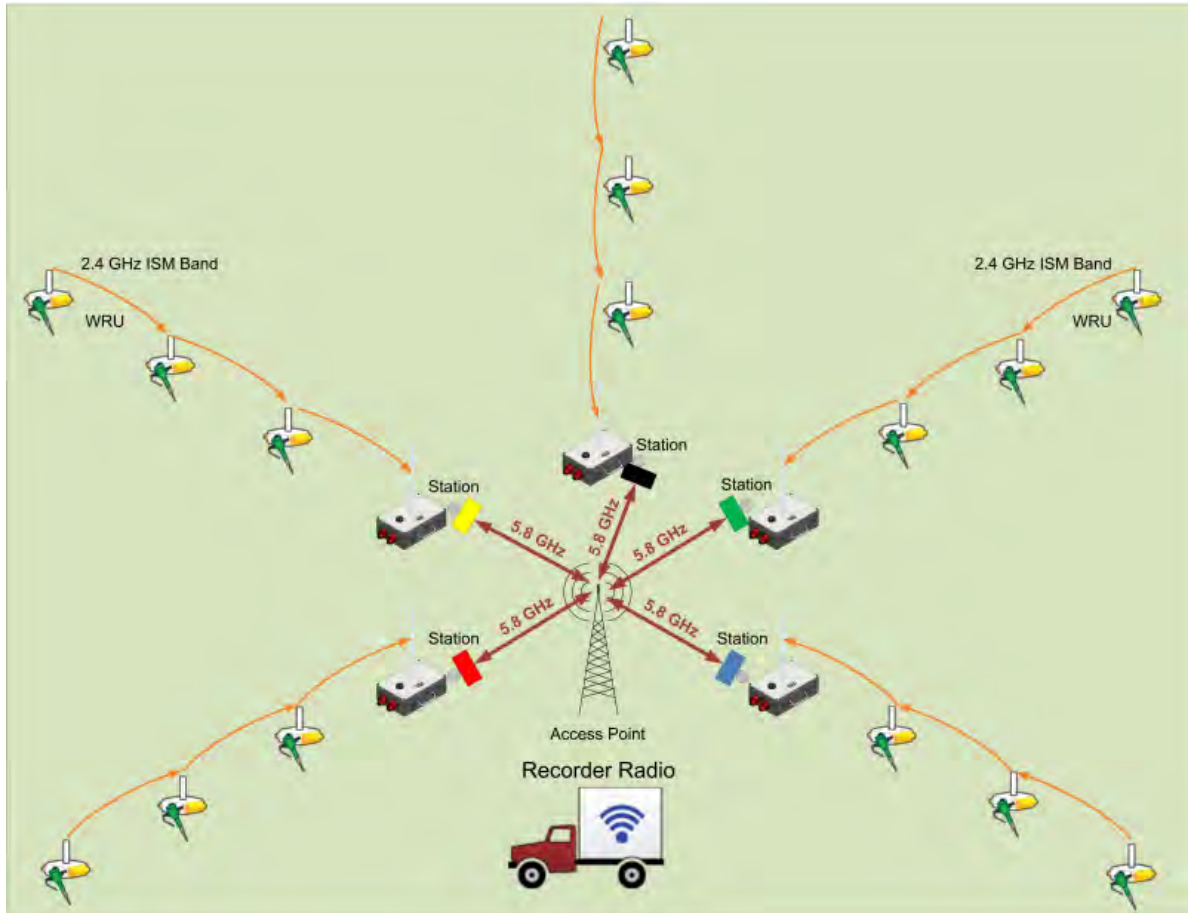


Figure 3–3 Point-to-Multipoint Backhaul Data Direction

3. Backhaul

Backhaul Components

3.2 Backhaul Components

The backhaul components are either *line station* (remote) backhaul components or *recorder* (central) backhaul components. Line station components are the components that are not physically located next to the recording truck. Recorder components are physically located at the recording truck.

The following tables and figures illustrate the backhaul components.

Table 3–2 Backhaul Components, LIU, Mast, and Fiber

#	EA	Item	Line	Recorder	Reference
L-1	1	LIU Kit (15-0041)	Y	Y	—
L-2	1	• LIU (10-0016)	Y	Y	<i>"LIU" on page 35</i>
L-3	1	• Cable, LIU to Battery, yellow (60-0034)	Y	Y	<i>"Cable Assemblies" on page 42</i>
L-4	—	• An antenna is required to communicate with the WRUs.	Y	Y	<i>"LIU and WRU Antennas" on page 36</i>
L-5	—	• A 12 V DC Battery or power supply is required, but not included.	Y	Y	<i>"LIU and WRU Antennas" on page 36</i>
M-1	1	Mast Kit (15-0046)	Y	Y	—
M-2	1	• Mast (15-0051)	Y	Y	<i>"Mast and Base" on page 46</i>
M-3	1	– 20 ft Telescoping Mast (70-0130)	Y	Y	—
M-4	1	– Mast Guy Ring (70-0133)	Y	Y	—
M-5	1	– Bracket, Omni Antenna (70-0136)	Y	Y	—
B-1	1	• Base (55-0050)	Y	Y	<i>"Mast and Base" on page 46</i>
B-2	2	– Knob, 10-32 x 1/2 inch Threaded Stud (70-0137)	Y	Y	—
BK-1	1	• Backpack Kit (15-0014)	Y	Y	<i>"Setting up the Backhaul" on page 47</i>
BK-2	1	– Backpack, Red/Grey (70-0059)	Y	Y	—
BK-3	4	– Antenna Mast Guy Line, 4 mm, 15.25 m, Orange (70-0057)	Y	Y	—
BK-4	4	– Tent Stake, Steel, 12 in (70-0061) (hard ground stakes)	Y	Y	—
BK-5	4	– Tent Stake, Plastic, 16 in, Orange (70-0060) (soft ground stakes)	Y	Y	—
BK-6	5	– Nail, 12 in (70-0062)	Y	Y	—
BK-7	4	– Guy Line Holder (70-0063)	Y	Y	—

Table 3–2 Backhaul Components, LIU, Mast, and Fiber (cont.)

#	EA	Item	Line	Recorder	Reference
BK-8	1	– Hammer, 2.5 lb (70-0064)	Y	Y	—
BK-9	1	– Pry Bar, 15 in (70-0065)	Y	Y	—
BK-10	2	– Flagging Roll, Orange (70-0066)	Y	Y	—
BK-11	1	– Compass Sighting (70-0067)	Y	Y	<i>"F. Using a Compass" on page 182</i>
BK-12	5	– Hose Clamp, 2 in (70-0142)	Y	Y	—
BK-13	2	– Hose Clamp, 0.5 in (70-0084)	Y	Y	—
BK-14	15 ft	– Wire, 18AWG Green (65-0077)	Y	Y	—
F-1	1	<ul style="list-style-type: none"> • Fiber Backhaul Kit, 250 m (15-0037) – OR – • Fiber Backhaul Kit, 500 m (15-0038) 	Y	Y	—
F-2	1	– Media Converter (60-0017)	Y	Y	<i>"Cable Assemblies" on page 42</i>
F-3	1	– Cable, Backhaul Jumper (60-0033)	Y	Y	<i>"Cable Assemblies" on page 42</i>
F-4	1	<ul style="list-style-type: none"> – Cable, Fiber Optic, Armored, 250 m (60-0026) – OR – – Cable, Fiber Optic, Armored, 500 m (60-0023) 	Y	Y	<i>"Cable Assemblies" on page 42</i>

Table 3–3 Backhaul Components, Radios

#	EA	Item	Line	Recorder	Reference
LB-1	1	Ubiquiti Bullet Radio Line Radio Kit (US) (15-0044)	Y	—	—
	1	– OR – Line Radio Kit (Intl) (15-0053)			
LB-2	2	<ul style="list-style-type: none"> • 5 GHz Radio (US) (56-0019 US) – OR – • 5 GHz Radio (Intl) (56-0024) 	Y	—	<i>"Bullet Line Station Radios" on page 155</i>
LB-3	1	• 5.8 GHz 6 dBi Omni Antenna (65-0179)	Y	—	<i>"Bullet Line Station Antenna" on page 147</i>

3. Backhaul

Backhaul Components

Table 3–3 Backhaul Components, Radios (cont.)

#	EA	Item	Line	Recorder	Reference
LB-4	1	• 5.8 GHz 19 dBi Panel Antenna, W Polarization (56-0020)	Y	—	<i>"Bullet Line Station Antenna" on page 147</i>
LB-5	1	• 5.8 GHz 19 dBi Panel Antenna, G Polarization (56-0021)	Y	—	<i>"Bullet Line Station Antenna" on page 147</i>
LB-6	1	• Bracket, Line Radio (55-0047)	Y	—	—
LB-7	2	• Cable, Armored Ethernet, 10 ft, White (60-0053)	Y	—	<i>"Cable Assemblies" on page 42</i>
LB-8	1	• Cable, Armored Ethernet, 15 ft, Green (60-0055)	Y	—	<i>"Cable Assemblies" on page 42</i>
LB-9	2	• Cable, Shielded Ethernet, 15 ft, Black (60-0054)	Y	—	<i>"Cable Assemblies" on page 42</i>
LB-10	1	• Carrying Case (70-0138)	Y	—	—
LB-11	1	• Hose Clamp, 4 in (70-0140)	Y	—	—
LB-12	1	• Hose Clamp, 2 in (70-0142)	Y	—	—
LB-13	1	• Nut Driver, 5/16 in (70-0147)	Y	—	—
LB-14	2	• Elbow connector (comes with 15-0044 and 15-0053)	Y	—	—
RR-1	1	Ubiquiti Rocket Radio Recorder Radio Kit (US) (15-0045)	—	Y	—
		– OR –			
	1	Recorder Radio Kit (Intl) (15-0055)			
RR-2	1	• Recorder Radio and Antenna (US) (15-0052)	—	Y	—
		– OR –			
	1	• Recorder Radio and Antenna (Intl) (15-0054)			
RR-3	1	– 5 GHz Radio (US) (75-0031 US)	—	Y	<i>"Rocket Recorder Radios" on page 157</i>
		– OR –			
	1	– 5 GHz Radio (Intl) (75-0038)			
RR-4	1	– 5 GHz 13 dBi Dual Polarity Omni Antenna (65-0178)	—	Y	<i>"Rocket Recorder Antenna" on page 150</i>
RR-5	1	– Shield, Recorder Radio Omni (70-0129)	—	Y	<i>"Cable Assemblies" on page 42</i>
RR-6	1	– Bracket GPS Antenna Holder (70-0148)	—	Y	—
RR-7		– GPS Antenna (comes with 15-0045 and 15-0055)	—	Y	—

Table 3–3 Backhaul Components, Radios (cont.)

#	EA	Item	Line	Recorder	Reference
RR-8	1	– Cable, Shielded Ethernet, 3 ft, Black (65-0104)	—	Y	"Cable Assemblies" on page 42
—	1	– PoE Injector (75-0023)	—	—	<ul style="list-style-type: none"> • "Ubiquiti Rocket/Bullet Private Network Connection" on page 105 • "Ubiquiti NanoStation Private Network Connection" on page 70
RR-9	1	• Surge Protector (75-0021)	—	Y	"Surge Protector Box" on page 41
RR-10	1	• Cable, Shielded Ethernet, 120 ft, Black (60-0038)	—	Y	"Cable Assemblies" on page 42
RR-11	60 ft	• Wire, 18AWG Green (65-0077)	—	Y	—
RR-12	1	• Case, Recorder Radio Kit (70-0139)	—	Y	—
RR-13	1	• Nut Driver, 5/16 in (70-0147)	—	Y	—
RN-1	2	Ubiquiti NanoStation Radio Kit	—	Y	—
	2	• Recorder Radio Kit (US) (15-0068)			
		– OR –			
	2	• Recorder Radio Kit (Intl) (15-0067)			
RN-2	2	– 5 GHz Radio Assembly (US) (56-0035 US)	—	Y	—
		– OR –			
		– 5 GHz Radio Assembly (Intl) (56-0032)			
RN-3	2	– Cable, Shielded Ethernet, 120 ft, Black with Red shrink tube (60-0036)	—	Y	—
RN-4	3	– Strain Relief, Wedge Clamp .160/.330 DIA. (70-0171)	—	Y	—
RN-5	1	– Case, NanoStation Line Radio (70-0176)	—	Y	—
RN-6	1	– Nut driver, 7/16 in, Brown (70-0178)	—	Y	—
RN-7	1	– Wrench, Double Open-end, 7/16 in - 1/2 in (70-0179)	—	Y	—

3. Backhaul

Backhaul Components

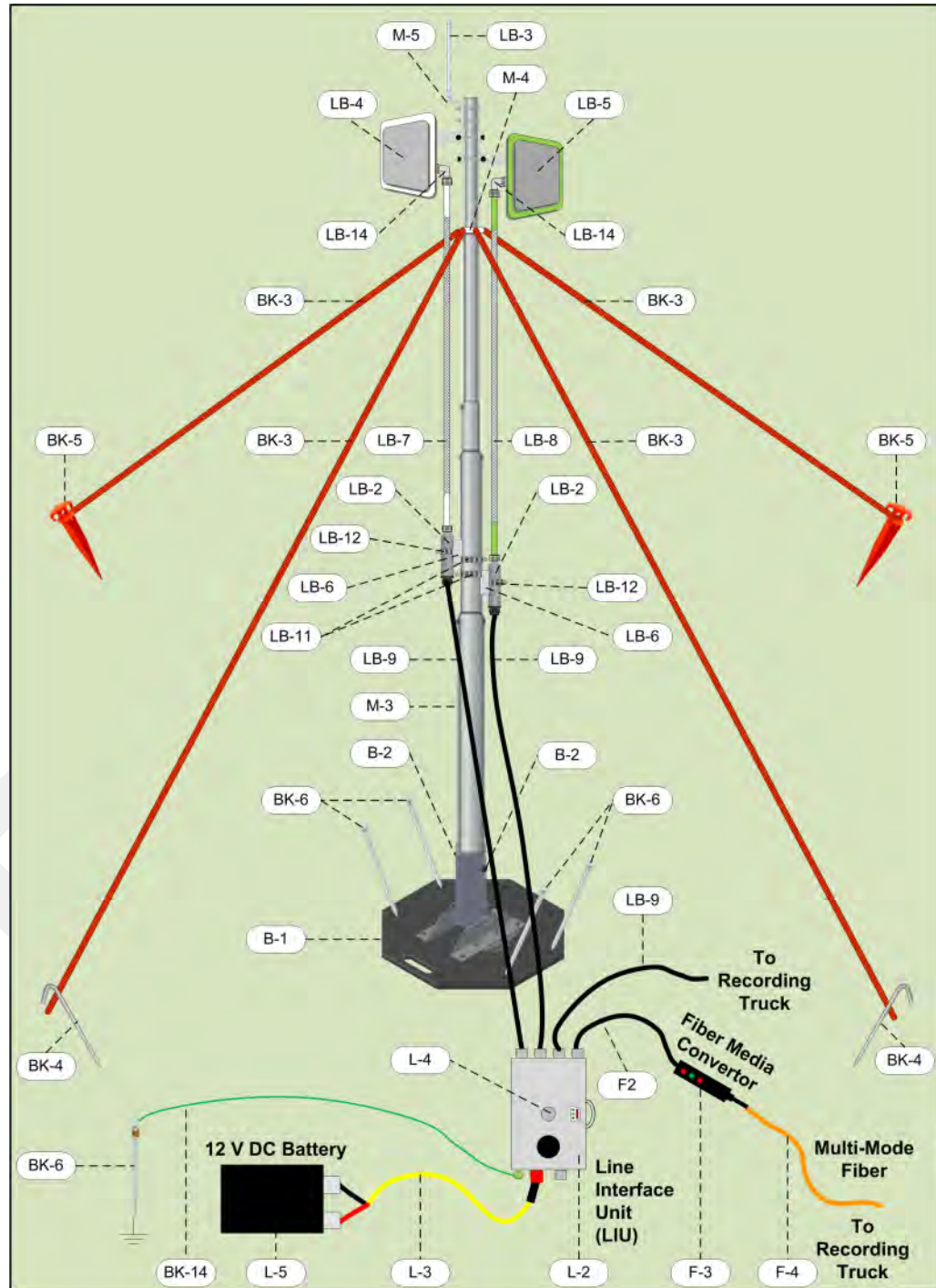


Figure 3-4 Line Station Backhaul Components

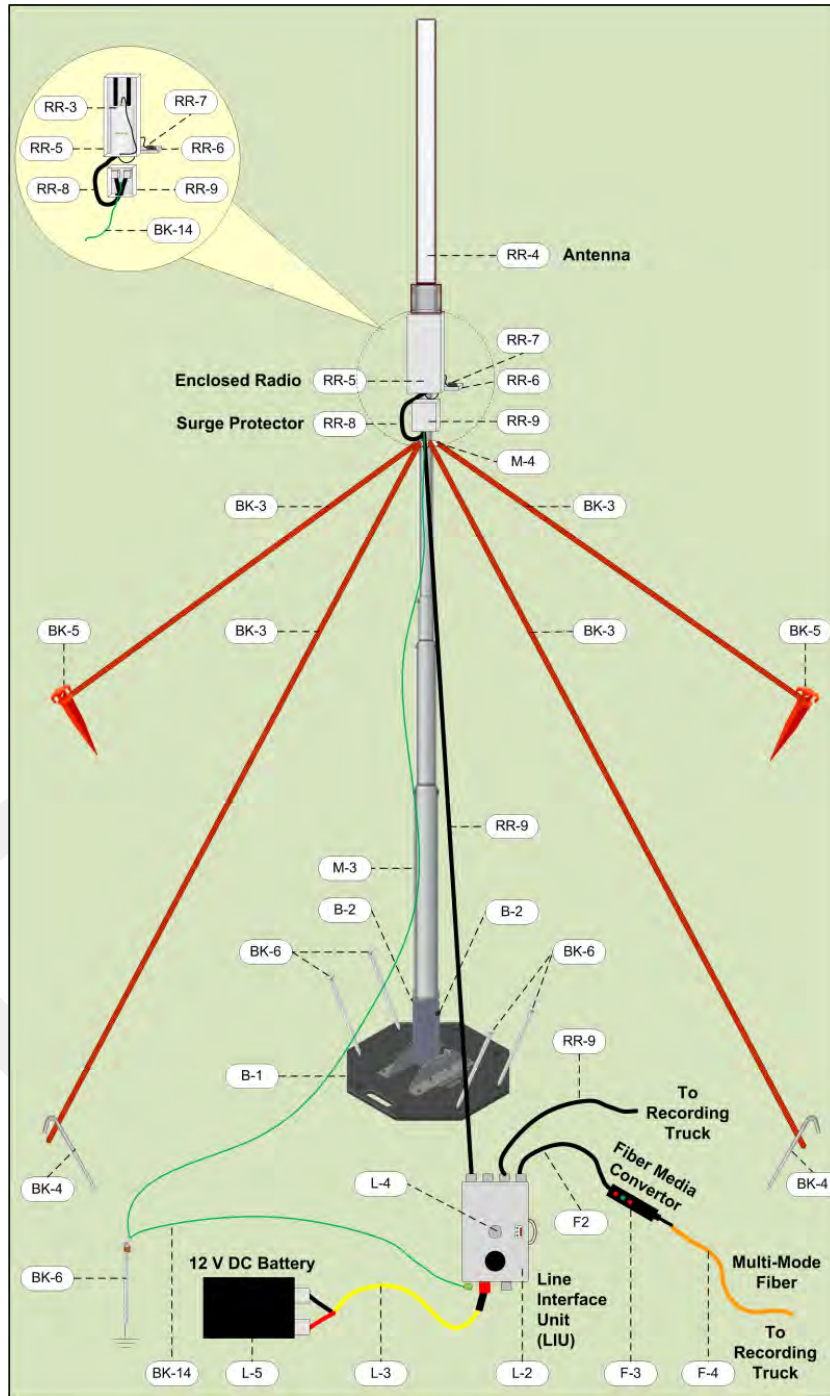


Figure 3–5 Recorder Backhaul Components

3. Backhaul

Backhaul Components

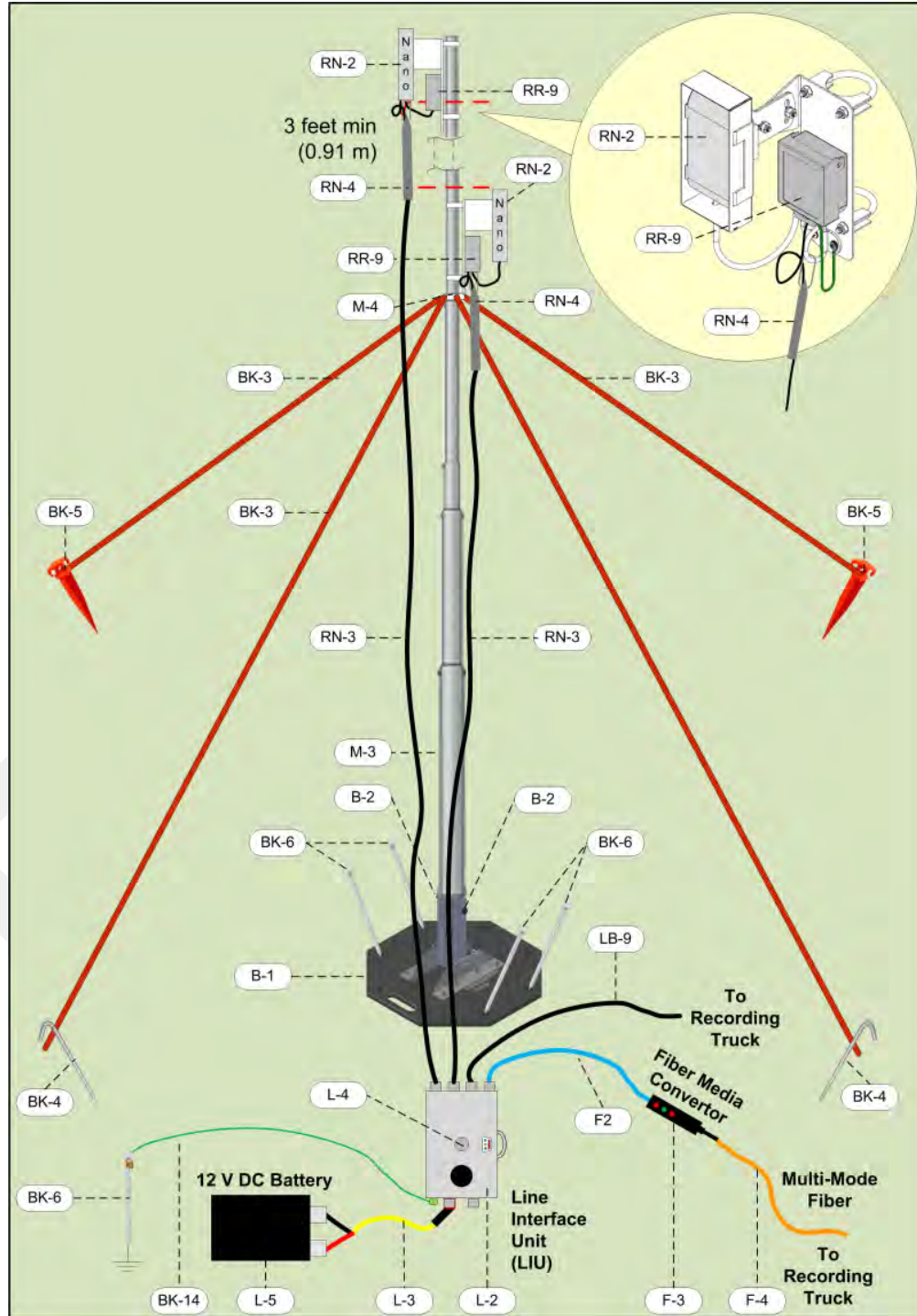


Figure 3-6 Recorder/Line NanoStation Backhaul Components

3.2.1 LIU

The data transmitted by the WRUs is collected by the Line Interface Unit (LIU). The LIU acts as the interface between the network of WRUs and the backhaul equipment. The LIU has an Ethernet port that can be connected directly to a computer, or more commonly, to an armored fiber optic cable or a backhaul radio. Backhaul radios operate in the 5.8 GHz band. A second array of WRUs can be deployed on the other side of the LIU, symmetrically or asymmetrically around the LIU. The LIU is shown in the following figure:



Figure 3-7 Line Interface Unit (LIU)

Before the Central Software System can communicate with the LIU, you must set up the backhaul.

 **NOTE**

See “D. LED Indicators” on page 161 for an explanation of the LED status and error conditions.

3. Backhaul

Backhaul Components

3.2.2 LIU Battery or Power Supply

Power is supplied to the LIU components by way of a 12 V DC battery or power supply. The external battery is not supplied as part of the backhaul system.



The backhaul power requirements vary depending on the hardware in use and period of use. For example, you may be using one or two radios. Supply enough power to ensure there is enough power for the entire duration of the time you are using the backhaul.

See the *Troubleshooting Guide, Best Practices chapter, LIU Batteries* section for instructions on how to hot-swap the LIU battery.

3.2.3 LIU and WRU Antennas

The following table lists the supported antennas for the LIUs and the WRUs. The remote and central backhauls use the same antennas:

Table 3–4 Antenna Specifications, WRU/LIU

Model	Frequency (MHz)	Gain	Vertical Beam Width	Weight	Dimension (Length x Diameter)
WSI 65-0204 (antenna-standard)	2400	5.5 dBi	25°	0.4 lbs 0.2 kg	32 x 0.6 in 810.5 x 15 mm
WSI 65-0091 (extender-standard)	2400	0 dBi	N/A	0.6 lbs 0.3 kg	30 x 0.7 in 762 x 18.5 mm

There is an *auto-power-leveling* feature built into the firmware. It works in conjunction with the RSSI parameters to keep the power at a defined level. If the **Unit Thresholds** → **Command** (or **Data**) **RSSI** parameter is set to any number greater than zero, power-leveling is enabled.

3.2.4 Line Radios

There are two line radio options provided as follows:

- ◆ **Ubiquiti Bullet** – Currently supported for point-to-point (string-of-pearls) backhauls:
 - 5 GHz Radio (US) (56-0019 US)
 - 5 GHz Radio (Intl) (56-0024)
- ◆ **Ubiquiti NanoStation M5** – Currently supported for point-to-multi-point (star) backhauls:
 - 5 GHz Radio Assembly (US) (56-0035 US)
 - 5 GHz Radio Assembly (Intl) (56-0032)

The Ubiquiti Bullet line radio is normally used with a directional antenna; however an omnidirectional antenna is also included. The antennas are attached at the top of the mast and the radio is attached to the mast at eye level as shown in the following figure.



Figure 3–8 Line Radio and Antennas, Bullet

3. Backhaul

Backhaul Components

The Ubiquiti NanoStation M5 radio has an integrated (internal) antenna. The radio is attached at the top of the mast with a surge protector as shown in the following figure:

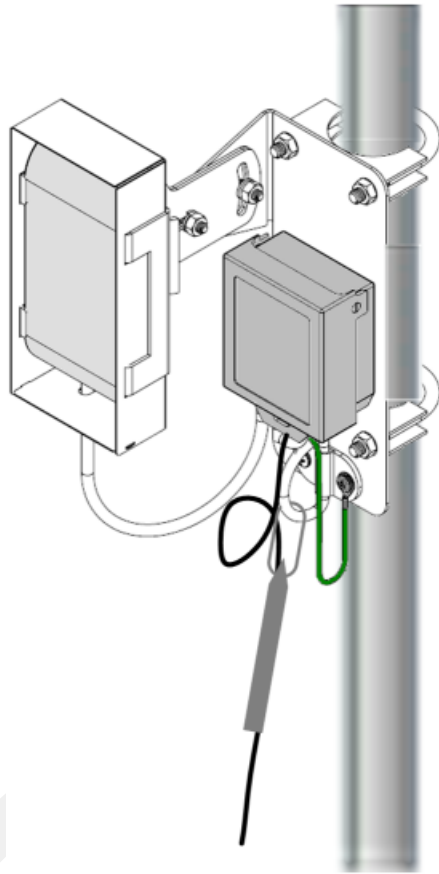


Figure 3–9 Line Radio, NanoStation

The line radios and antennas can be stored in their protective case when not in use:



Figure 3–10 Bullet Radio Case (70-0138)



Figure 3–11 NanoStation Radio Case (70-0176)

See “C. Radio Specifications” on page 147 for FCC information and other technical specifications.

3.2.5 Recorder Radio

There are two recorder radio options provided as follows:

- ◆ **Ubiquiti Rocket** – Currently supported for point-to-point (string-of-pearls) backhails:
 - Recorder Radio and Antenna (US) (15-0052)
 - Recorder Radio and Antenna (Intl) (15-0054)
- ◆ **Ubiquiti NanoStation M5** – Currently supported for point-to-multi-point (star) backhails
 - 5 GHz Radio Assembly (US) (56-0035 US)
 - 5 GHz Radio Assembly (Intl) (56-0032)

3. Backhaul

Backhaul Components

The Ubiquiti Rocket recorder radio is used with an omnidirectional antenna. It is attached to the top of the mast and is shown in the following figure. The Rocket radio is completely enclosed in a protective metal case when installed.



Figure 3-12 Recorder Radio

The Ubiquiti NanoStation M5 radio has an integrated (internal) antenna. The radio is attached at the top of the mast with a surge protector as shown in *“Line Radio, NanoStation”* on page 38.

See *“C. Radio Specifications”* on page 147 for FCC information and other technical specifications.

3.2.6 Radio Antennas

The following table lists the supported antennas for the radios:

Table 3–5 Antenna Specifications, Radios

Model	Frequency (MHz)	Gain	Dimension (Length x Diameter)	See
WSI 65-0178 2x2 Dual Polarity MIMO Omni	5450 - 5850	13 dBi	6.2x3.8x32.8 in 158x98x834 mm	"Rocket Recorder Antenna" on page 150
WSI 65-0179 Omni	5275 - 5850	6 dBi	10.6 in 269 mm	"Bullet Line Station Antenna" on page 147
WSI 65-0177 Antenna Panel	5150 - 5825	19 dBi	7.5 x 7.5 x 0.8 in 190 x 190 x 20 mm	"Bullet Line Station Antenna" on page 147

3.2.7 Surge Protector Box

The following figure illustrates the inside of the Surge Protector. Use a surge protector on each mast between the Rocket radio or the NanoStation radio and the LIU.

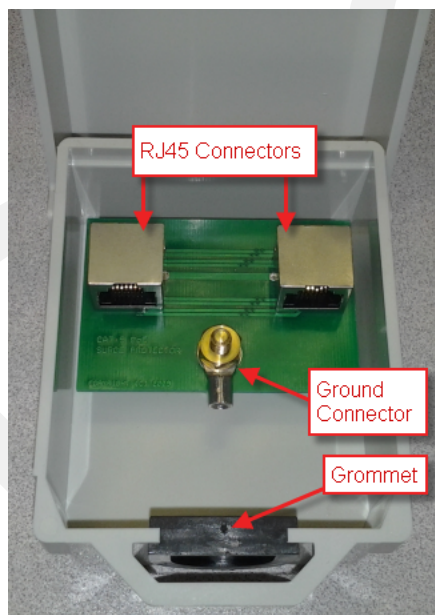


Figure 3–13 Surge Protector Connections

3.2.8 Cable Assemblies

The following cables are used in the backhaul:

- ◆ Cable, LIU to Battery (60-0034)
- ◆ Cable, LIU to NanoStation Radio (60-0036)
- ◆ Cable, Ethernet, 120 ft Shielded, Black with Red shrink tube (60-0036)
- ◆ Cable, LIU-to-PC (60-0039)
- ◆ Cable, Ethernet, 3 ft Shielded (65-0104)
- ◆ Cable, Armored Ethernet, 10 ft (60-0053)
- ◆ Cable, Shielded Ethernet, 15 ft (60-0054)
- ◆ Cable, Armored Ethernet, 15 ft (60-0055)
- ◆ Cable, Shielded Ethernet, 120 ft (60-0038)
- ◆ Cable, RF Extender, 10 ft (65-0103)
- ◆ Cable, RF Extender, 25 ft (65-0110)
- ◆ Fiber Backhaul Kit, 250 m (15-0037)
 - Media Converter (60-0017)
 - Cable, Backhaul Jumper (60-0033)
 - Cable, Fiber Optic, Armored, 250 m (60-0026)
- ◆ Fiber Backhaul Kit, 500 m (15-0038)
 - Media Converter (60-0017)
 - Cable, Backhaul Jumper (60-0033)
 - Cable, Fiber Optic, Armored, 500 m (60-0023)



Figure 3–14 Cable, LIU to Battery (60-0034)

Table 3–6 Cable Pinout, LIU to Battery (60-0034)

5-Pin Connector	2-Terminal End	Signal Name
A	NC	—
B	WHT	+V
C	BLK5	-V
D	NC	—
E	NC	—



Figure 3-15 Cable, LIU to NanoStation Radio (60-0036)

CAUTION

The LIU to Radio cable is a powered Ethernet Cable. Do not plug it into the Ethernet port on a Laptop computer when troubleshooting the radios. Use a non-powered Ethernet cable.

Table 3-7 Cable Pinout, to NanoStation Radio(60-0036)

14-Pin Connector	RJ-45 Connector	Signal Name
B	1	TX+
A	2	TX-
C	3	RX+
H	4	POSITIVE
F	5	POSITIVE
D	6	RX-
E	7	RETURN
L	8	RETURN
P	—	SHIELD DRAIN
R*	NC	—
M*	NC	—
* Jumper R and M together.		

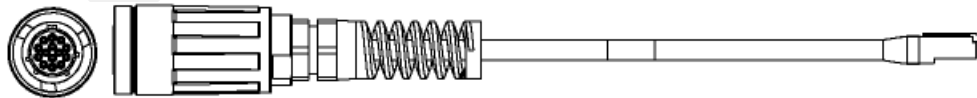


Figure 3-16 Cable, LIU-to-PC (60-0039)

3. Backhaul

Backhaul Components

Table 3–8 Cable Pinout, LIU-to-PC (60-0039)

14-Pin Connector	RJ-45 Connector	Signal Name
B	1	TX +
A	2	TX -
C	3	RX +
NC	4	POSITIVE
NC	5	POSITIVE
D	6	RX -
NC	7	RETURN
NC	8	RETURN
P	—	SHIELD DRAIN



Figure 3–17 Cable, Ethernet, 3 ft Shielded (65-0104)



Figure 3–18 Cable, Armored Ethernet, 10 ft (60-0053)



Figure 3–19 Cable, RF Extender, 10 ft (65-0103)



Figure 3–20 Media Converter (60-0017)



Figure 3–21 Cable, Backhaul Jumper (60-0033)

Table 3–9 Cable Pinout, Backhaul Jumper (60-0033)

14-Pin Connector	Wire Color	8-Pin Connector	Signal Name
B	WHT/ORG	A	TX +
A	ORG	B	TX -
C	WHT/GRN	C	RX +
H	BLU	D	PWR +
F	WHT/BLU	E	PWR +
D	GRN	F	RX -
E	WHT/BRN	G	GND
L	BRN	H	GND

3. Backhaul

Backhaul Components

Table 3–9 Cable Pinout, Backhaul Jumper (60-0033)

14-Pin Connector	Wire Color	8-Pin Connector	Signal Name
R*	RED	NC	—
M*		NC	—

* Install a 1.5 inch long jumper wire between pins R and M
WHT = White, ORG = Orange, GRN = Green, BLU = Blue, BRN = Brown, BLK= Black, YEL = Yellow

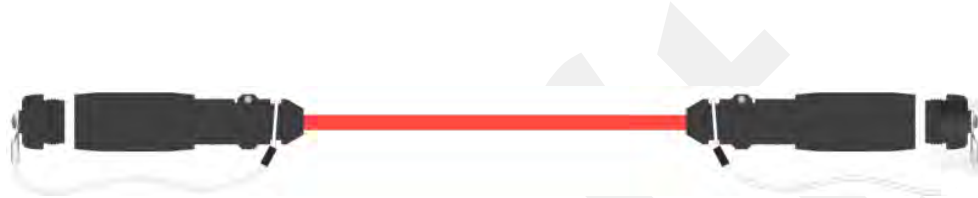


Figure 3–22 Cable, Fiber Optic, Armored, 250 m (60-0026)

3.2.9 Mast and Base

The line and recorder backhauls use the same mast kit components.

3.2.9.1 Telescoping Mast

Telescoping backhaul masts are used to elevate the backhaul components above obstructions and to enable radio communications to accommodate typical cross-line distances. The mast is stabilized with guy ropes. The following figure shows the mast:



Figure 3–23 Mast (55-0050)

3.2.9.2 Base

The base (shown in the following figure) stabilizes the mast that is attached to the hinged mast sleeve. The base is staked into the ground for added stability.



Figure 3–24 Base (55-0050)

The Weighted Base (70-0070) is another option for use when staking is impractical (see “E. Weighted Base” on page 180).

3.3 Setting up the Backhaul

This section provides instructions on how to assemble the backhaul components.

Table 3–10 How to Set Up the Backhaul

Step	Image
<ol style="list-style-type: none"> 1 Gather all of the backhaul components. 2 Refer to the deployment instructions to determine the location and compass heading to the next back haul site closer to central. 3 Use the compass to determine and mark that direction. 4 Use the following considerations while positioning the base: <ul style="list-style-type: none"> • Locate the base such that the guy lines and the mast clear obstructions during erection and while in operation. • If the ground is sloped, position the base such that when the base is flush to the ground, the bracket orientation allows the mast to remain perpendicular to the ground. 	

3. Backhaul

Setting up the Backhaul

Table 3–10 How to Set Up the Backhaul

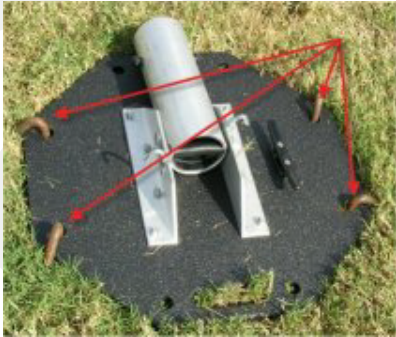
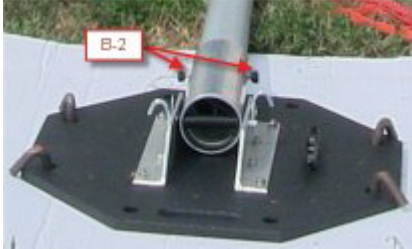
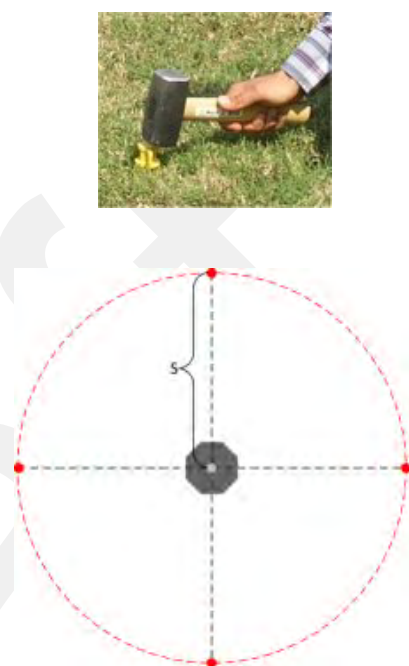
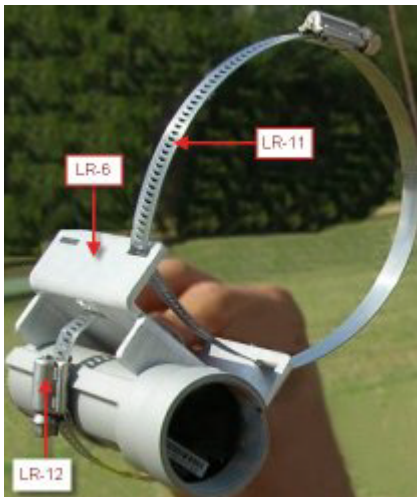
Step	Image
<ul style="list-style-type: none">• If the wind is blowing, the mast is more stable when the brackets are perpendicular to the wind.	
<p>5 Secure the base [B-1] to the ground with stakes [BK-4] or nails [BK-6].</p>	
<p>6 Attach the mast [M-3] to the base [B-1]. Tighten both knobs [B-2].</p>	

Table 3–10 How to Set Up the Backhaul

Step	Image
<p>7 Position four stakes equal distances apart at approximately 20 ft (6 m) from the base. Pound them into the ground.</p>	
<p>8 Assemble the radios and brackets:</p> <ul style="list-style-type: none"> • Bullet line radio installation – Assemble the Bullet radios and brackets. <ul style="list-style-type: none"> ▶ Insert the 4 in hose clamp [LR-11] in the side slots of the bracket [LR-6]. ▶ Insert the 2 in hose clamp [LR-12] in the center slots of the bracket [LR-6]. ▶ Insert the line radio between the bracket [LR-6] and the 2 in hose clamp [LR-12]. ▶ Tighten the 2 in hose clamp [LR-12] around the radio. 	<p>Line radio in bracket:</p> 

3. Backhaul

Setting up the Backhaul

Table 3–10 How to Set Up the Backhaul

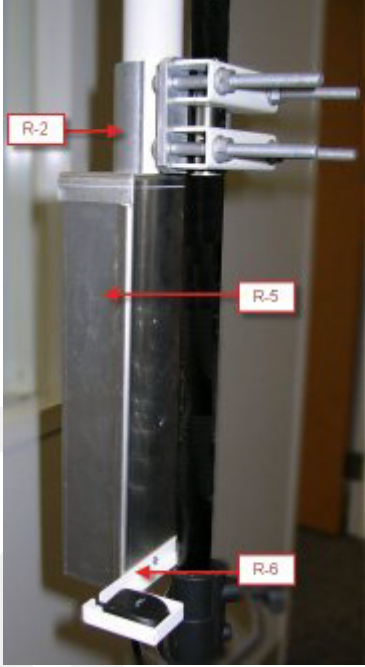
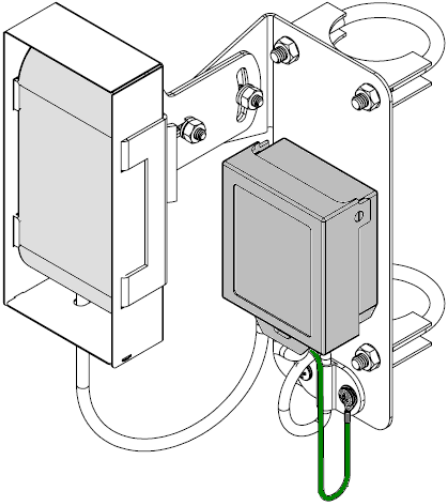
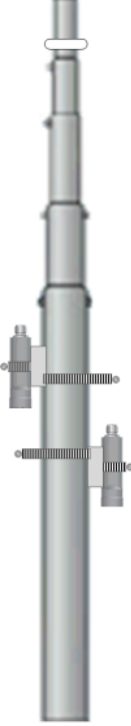
Step	Image
<ul style="list-style-type: none">• Rocket radio installation – The Rocket radio, antennas, and bracket are already assembled.	<p>Recorder radio in bracket:</p>  <p>A photograph showing a Rocket radio assembly mounted on a vertical pole. The assembly consists of a black cylindrical radio unit with a silver bracket on top. Three callout boxes with red arrows point to specific parts: 'R-2' points to the top bracket, 'R-5' points to the side of the radio unit, and 'R-6' points to a small white component at the bottom of the radio unit.</p>
<ul style="list-style-type: none">• NanoStation radio installation – The NanoStation radio, surge protector, and bracket are already assembled.	 <p>A technical line drawing of a NanoStation radio assembly. It shows a rectangular radio unit mounted on a metal bracket. A surge protector is connected to the bottom of the radio unit. A green U-shaped component is attached to the bottom of the surge protector. The drawing includes various mounting holes and screws on the bracket.</p>

Table 3–10 How to Set Up the Backhaul

Step	Image
<p>9 Assemble the mast:</p> <ul style="list-style-type: none">• Bullet radio installation – While the mast is resting on the ground, slide the following on the mast:<ul style="list-style-type: none">▶ Bullet radios and clamps (<i>do not tighten</i>)▶ Mast guy ring [M-4]	 A vertical metal mast assembly is shown. At the top, there is a small white cap. Below it, the mast has several sections. A guy ring is attached to the side of the mast, consisting of a horizontal bar with a central nut and a vertical post. Below the guy ring, there are two clamps or brackets attached to the mast, each with a horizontal bar and a central nut. The mast is shown in a vertical orientation, resting on the ground.

3. Backhaul

Setting up the Backhaul

Table 3–10 How to Set Up the Backhaul



Step	Image
<ul style="list-style-type: none">• Rocket radio installation – While the mast is resting on the ground, slide the following on the mast:<ul style="list-style-type: none">▶ Mast guy ring [M-4]▶ Surge Protector cable clamp (<i>do not tighten</i>)	 <p>The image shows a vertical metal mast assembly. At the top, there is a guy ring (labeled M-4) and a surge protector cable clamp. The mast is shown in a vertical orientation, resting on the ground.</p>

Table 3–10 How to Set Up the Backhaul

Step	Image
<ul style="list-style-type: none">• NanoStation radio installation – While the mast is resting on the ground, slide the following on the mast:<ul style="list-style-type: none">▶ Mast guy ring [M-4]	 A vertical metal mast with a small ring at the top. The mast is shown against a white background with a large, faint watermark.
<p>10 Attach and tighten the following:</p> <ul style="list-style-type: none">• Bullet radio installation:<ul style="list-style-type: none">▶ Bullet radio antenna brackets and antennas [LR-4, LR-5]▶ Omni antenna bracket [M-5] and antenna [LR-3]	 A close-up photograph of a radio antenna assembly mounted on a mast. The assembly includes a white antenna and a silver bracket. The background is a grassy field.

3. Backhaul

Setting up the Backhaul

Table 3–10 How to Set Up the Backhaul


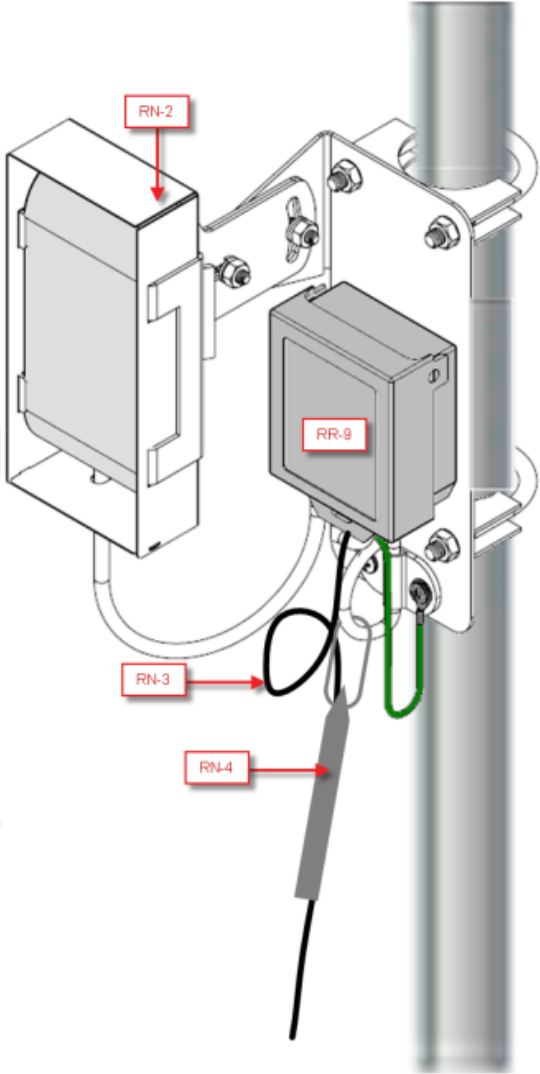
Step	Image
<ul style="list-style-type: none">• Rocket radio installation – Attach the Rocket radio antenna and bracket [R-2] to the mast.	

Table 3–10 How to Set Up the Backhaul

Step	Image
<ul style="list-style-type: none"><li data-bbox="293 394 805 468">• NanoStation radio installation – Attach the NanoStation radio bracket assembly [RN-2] to the mast.	 <p>The diagram illustrates the installation of a NanoStation radio on a mast. A white bracket assembly, labeled RN-2, is mounted to the mast. A NanoStation radio, labeled RR-9, is attached to the bracket. A black cable, labeled RN-3, is connected to the radio. A green cable, labeled RN-4, is connected to the mast. The mast is a vertical metal rod.</p>

3. Backhaul

Setting up the Backhaul

Table 3–10 How to Set Up the Backhaul



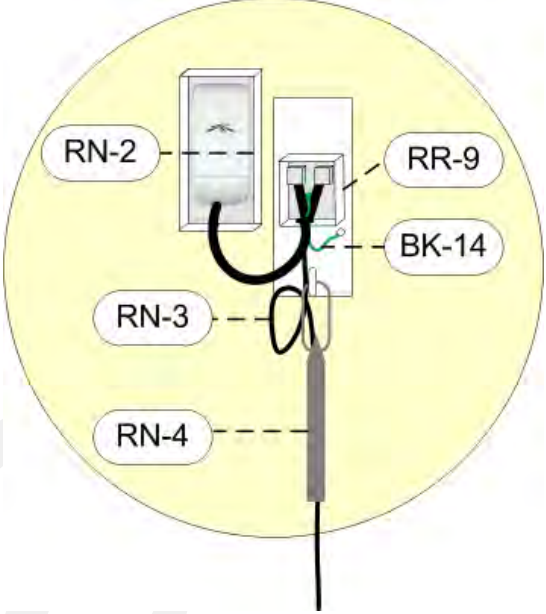

Step	Image
<p>11 Attach the cables:</p> <ul style="list-style-type: none">• Bullet radio installation – Attach an elbow connector [LR-14] to the antenna and then an armored cable [LR-7, LR-8] to the elbow connector. <p>Match white-to-white and green-to-green if your panels are color-coded.</p>	
<ul style="list-style-type: none">• Rocket radio installation:<ul style="list-style-type: none">▶ Open the protective metal case if the Ethernet cable is not already attached.▶ Connect the GPS antenna if it is not already connected.▶ Connect a short Ethernet cable [R-8] to the radio [R-3].▶ Close the protective metal case.▶ Open the surge protector case [R-9].▶ Remove the rubber grommet from the surge protector case and cut some slots in it.▶ Thread two Ethernet cables [R-8, R-10] and a ground wire [BK-14] through the grommet and place the grommet back in the case.▶ Plug the Ethernet cables into the shielded RJ45 jacks. It does not matter which cable goes to which jack; the unit provides bidirectional protection.▶ Attach the ground wire to the ground lug.▶ Close the surge protector case and secure it to the mast with the hose clamp.	

Table 3–10 How to Set Up the Backhaul

Step	Image
<ul style="list-style-type: none"> • NanoStation radio installation: <ul style="list-style-type: none"> ▶ Open the surge protector case [R-9]. ▶ Remove the grommet from the case. ▶ Thread the Ethernet cable [RN-3], through the grommet with the short Ethernet cable (that is attached to the redound the ground wire [BK-14]. Place the grommet back in the case. ▶ Plug the Ethernet cable into the shielded RJ45 jacks. It does not matter which cable goes to which jack; the unit provides bidirectional protection. ▶ Close the surge protector case. ▶ Attache the strain relief [RN-4] to the D-ring on the bracket. ▶ Loop the Ethernet Cable [RN-3] through the strain relief [RN-4]. 	 <p>The diagram illustrates the connection of an Ethernet cable (RN-3) through a surge protector case (R-9) and a strain relief (RN-4) to a shielded RJ45 jack (BK-14). Labels include RN-2, RN-3, RN-4, RR-9, and BK-14.</p>
<p>12 Attach the guy lines to the mast collar.</p> <p>NOTE: Use a taut-line-hitch knot for best results (see “G. Rope Knot” on page 186).</p>	 <p>The photograph shows a white plastic mast collar attached to a metal mast with an orange rope tied around it using a taut-line-hitch knot.</p>




3. Backhaul

Setting up the Backhaul

Table 3–10 How to Set Up the Backhaul

Step	Image
<p>13 Lay out the four guy lines close to the stakes.</p>	
<p>14 Extend the mast, clicking the segments into place.</p>	
<p>15 Attach the guy lines to the stakes.</p> <p>NOTE: Use a taut-line-hitch knot for best results (see "G. Rope Knot" on page 186).</p>	

Table 3–10 How to Set Up the Backhaul

Step	Image
<p>16 Walk the mast to an upright position.</p>	
<p>17 While one person holds the mast, a second person tightens the guy lines evenly. Keep the mast level/vertical (use the level included with the kit).</p>	
<p>18 If assembling the Bullet radio backhaul: a Attach the cables from the antennas to the top of the Bullet radios.</p>	

3. Backhaul

Setting up the Backhaul

Table 3–10 How to Set Up the Backhaul


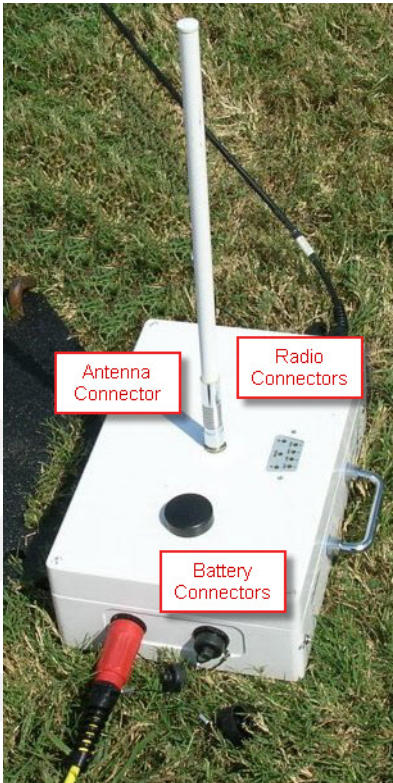
Step	Image
<p>b Attach the cables to the bottom end of the Bullet radios.</p> <ul style="list-style-type: none">▶ Assemble the connector for the radio as shown in the image to the right:▶ Plug the Ethernet connector into the radio.▶ Screw the large coupler into the base of the radio. Hand-tighten only.▶ Push the rubber grommet into the base of the large coupler.▶ Screw the end cap on the large coupler. Hand-tighten only.	
<p>c Tighten the clamps on the Bullet radios.</p> <ul style="list-style-type: none">▶ Verify that the armored cables attached to the antennas are straight and not twisted.▶ Position the line radio so the armored cable is not pulling on the antenna.▶ Tighten the cable clamp.	
<p>19 Set up the LIU:</p> <ul style="list-style-type: none">• Ground the LIU – Verify that the LIU is grounded. Attach a ground wire to the case, and to a nail that is driven into the ground. Attach the LIU ground wire and the Surge Protector ground wire to the same nail.	

Table 3–10 How to Set Up the Backhaul

Step	Image
<ul style="list-style-type: none">• Attach the radio cables to the LIU.• Attach the antenna to LIU.• Attach the battery to the LIU.	

Point-to-Point Backhaul

4.1 Overview

The backhaul is composed of a number of line station mast/radio/LIUs. The number of poles (masts/towers) in your point-to-point spread must be a multiple of the number of channels used.

A channel is an 80 MHz wide frequency band with 40 MHz on either side of the center frequency. For example, if the center frequency is 2.412 GHz, the frequency range for that channel is 2.372 to 2.452 GHz.

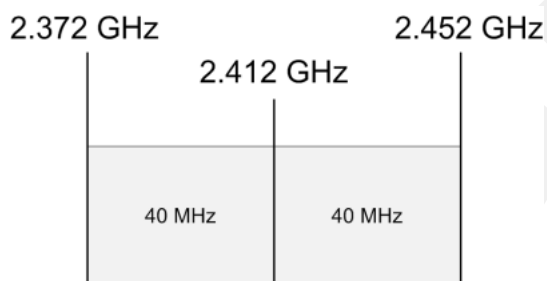


Figure 4–1 Channel – 80 MHz Wide Frequency Band

When using a system with six possible channels, the backhaul could have just 6 poles, or a multiple of 6 poles: 6, 12, 18, 24, and so on.

This section uses an example of six possible channels, and 18 line station mast/radio/LIUs. Each pole (mast/tower) has two radios and one LIU as shown in the following figure.

NOTE

If using the mast at the recording truck, connect the LIU with an Ethernet or Fiber cable to the recording truck. If the mast is not used at the recording truck, the connections shown in the figure to the recording truck are not used.

See “Connecting to the Recording Truck” on page 90 for a radio link (pendant) option).

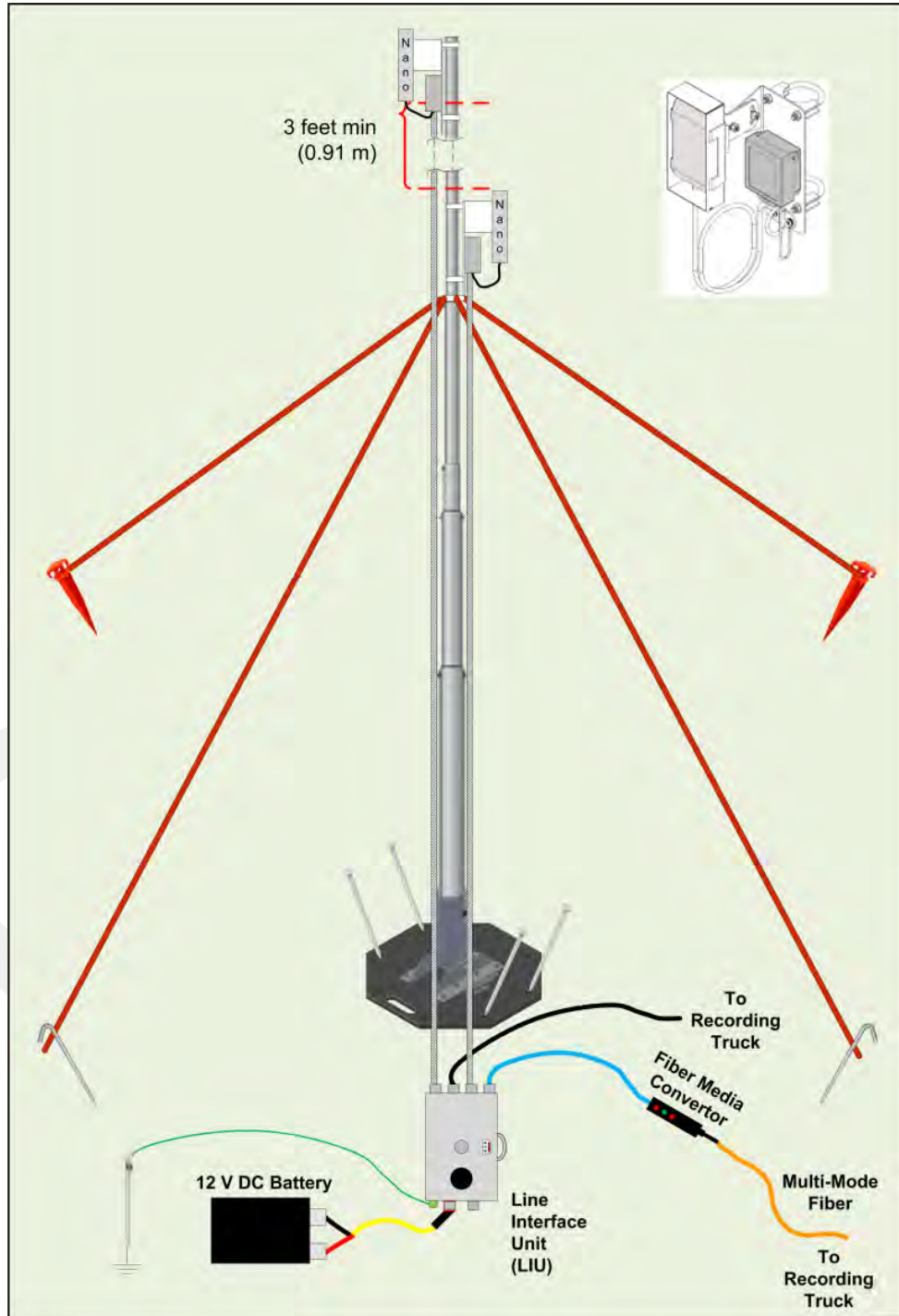


Figure 4-2 Line Station Backhaul

4. Point-to-Point Backhaul

Overview

The radios are configured as pairs and are either an Access Point (A) or a Station (S).

An Access Point communicates only with a Station. An Access Point cannot communicate with an Access Point, and a Station cannot communicate with a Station.

The poles (masts) and radios for a six-channel system are labeled and color-coded as follows. The number of colors used should match the number of channels used.

Pole	Radio	Color
Pole 1	18:S-P1	White
	1:A-P1	Black
Pole 2	1:S-P2	Black
	2:A-P2	Yellow
Pole 3	2:S-P3	Yellow
	3:A-P3	Red
Pole 4	3:S-P4	Red
	4:A-P4	Green
Pole 5	4:S-P5	Green
	5:A-P5	Blue
Pole 6	5:S-P6	Blue
	6:A-P6	White
Pole 7	6:S-P7	White
	7:A-P7	Black
Pole 8	7:S-P8	Black
	8:A-P8	Yellow
Pole 9	8:S-P9	Yellow
	9:A-P9	Red
Pole 10	9:S-P10	Red
	10:A-P10	Green
Pole 11	10:S-P11	Green
	11:A-P11	Blue
Pole 12	11:S-P12	Blue
	12:A-P12	White
Pole 13	12:S-P13	White
	13:A-P13	Black
Pole 14	13:S-P14	Black
	14:A-P14	Yellow
Pole 15	14:S-P15	Yellow
	15:A-P15	Red
Pole 16	15:S-P16	Red
	16:A-P16	Green
Pole 17	16:S-P17	Green
	17:A-P17	Blue
Pole 18	17:S-P18	Blue
	18:A-P18	White

Where:

- ◆ Label Nomenclature:

Table 4–1 Label Nomenclature

Pair #	:	A or S	-	Pole #
2	:	A	-	P2
2	:	S	-	P3

- ◆ S = Station
- ◆ A = Access Point
- ◆ The pole pairs must remain in sequential order:
 - Radio 1:A-P1 communicates only with Radio 1:S-P2
 - Radio 2:A-P2 communicates only with Radio 2:S-P3
 - And so on until pole 18, where Radio 18:A-P18 communicates only with Radio 18:S-P1

 **NOTE**

The primary indicator for radio-to-radio communication is the alpha-numeric label. The colored label is provided as a visual indicator to ensure that the pole is pointed correctly to the next radio. For example, a yellow radio cannot communicate with all yellow radios.

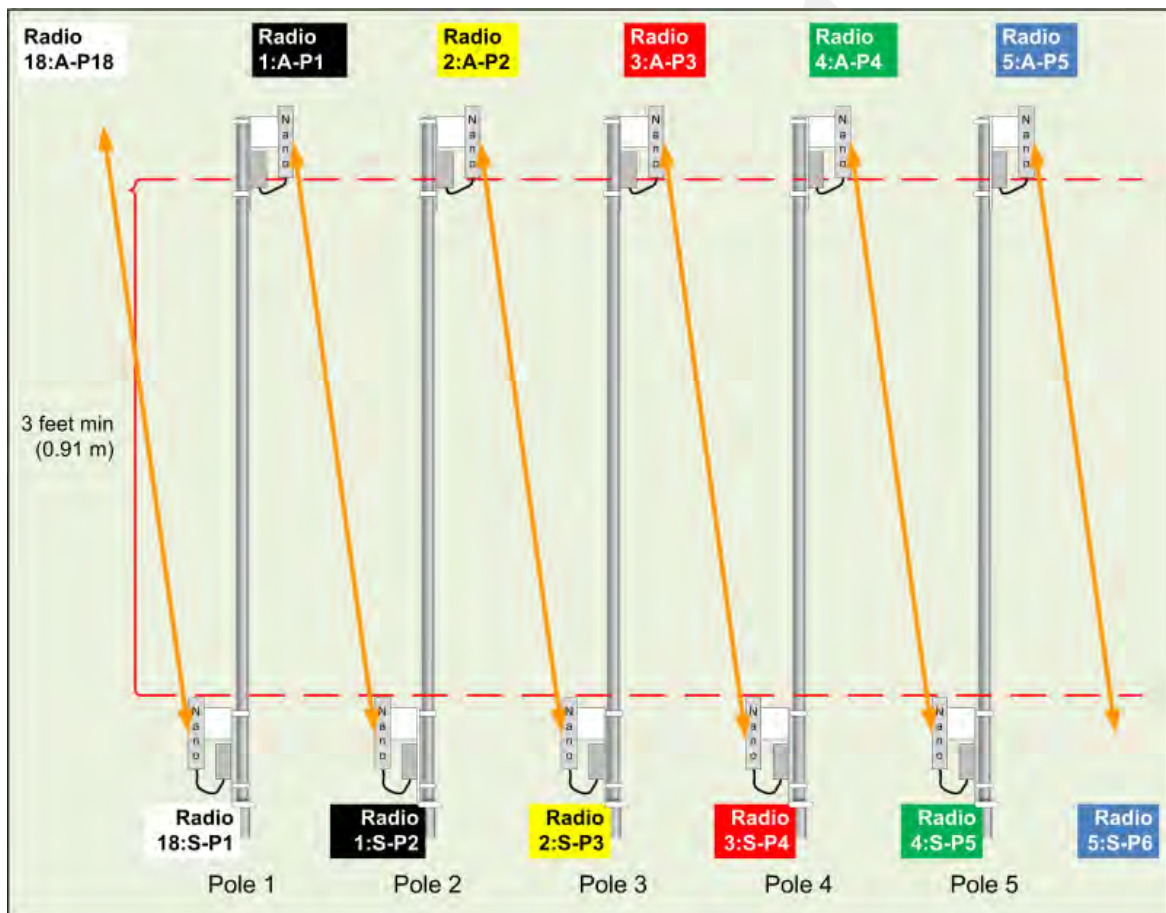


Figure 4–3 Radio-to-Radio Communication

In some cases—such as when line-of-sight cannot be established—using fiber cables can improve communication. Install the radios and poles using the same labels and positioning; however, only the odd *or* even pairings are used for radio communication. The other pairings are linked together with fiber cable as shown in the following figure.

4. Point-to-Point Backhaul

Overview

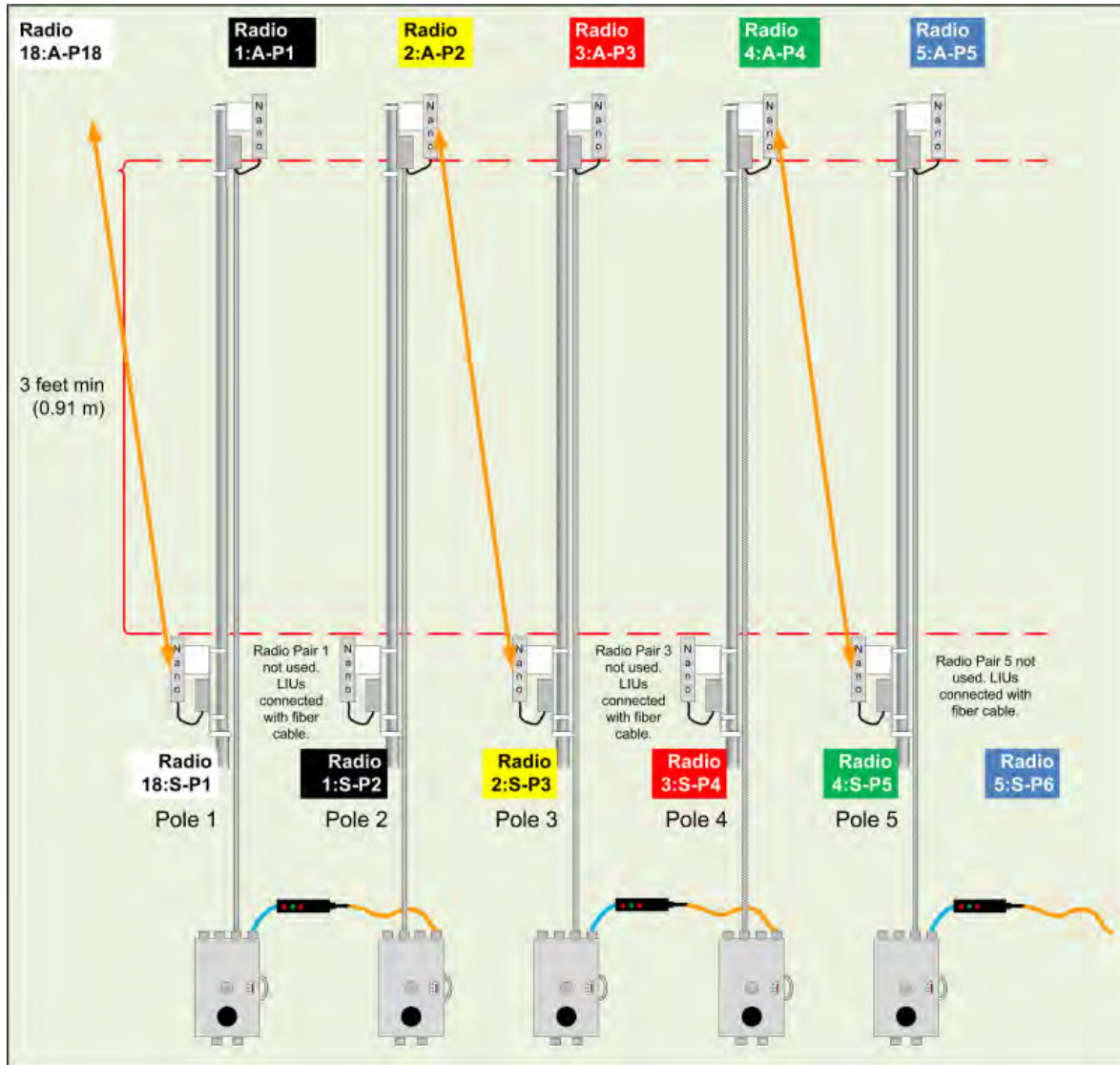


Figure 4-4 Radio-to-Fiber Communication

4.2 Preparation

This section provides the steps required to prepare the radios for placement in the field.

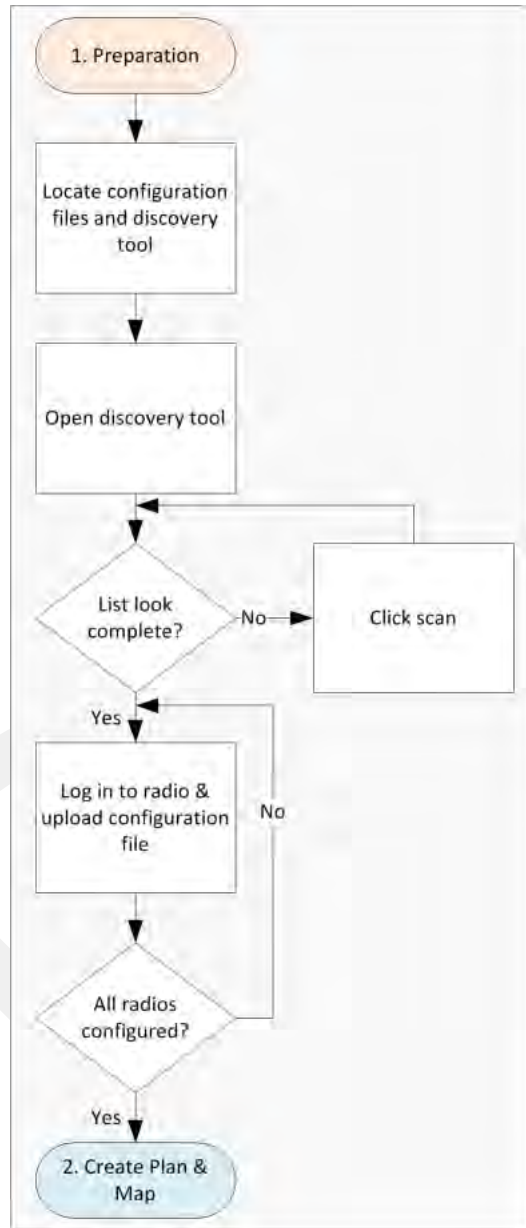


Figure 4–5 Preparation Troubleshooting Flow

There are two versions of the NanoStation M5 radio. Verify that you are using the correct radio and configuration files for your location. Wireless Seismic, Inc. recommends using only the following radios in a point-to-point network.

4. Point-to-Point Backhaul

Preparation

- ◆ **United States frequencies** (56-0035 US) – Operating frequency 5745 – 5825 MHz
- ◆ **International frequencies** (56-0032 INTL) – Operating frequency 5470 – 5825 MHz

WARNING

Operating outside of the allowed frequency range could result in sanctions by governmental regulatory agencies. Verify that all radios are correct for the market in which they will be used.

AVERTISSEMENT

Le fait de faire marcher à l'extérieur de la bande de fréquences permise pourrait s'ensuivre dans les sanctions par les agences gouvernementales de contrôle. Vérifiez que toutes les radios sont correctes pour le marché dans lequel ils seront utilisés.

OSTRZEŻENIE

Działających poza zakres częstotliwości dozwolonych może skutkować sankcjami przez rządowe agencje regulacyjne. Sprawdź, czy wszystkie radia są poprawne dla rynku, w którym będą one wykorzystywane.

If you use an international configuration file with a United States radio, or a United States configuration file with an international radio, an error message is displayed:

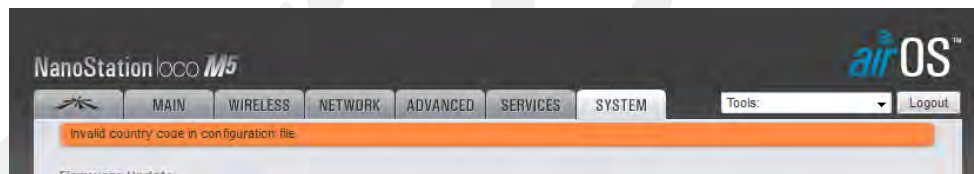


Figure 4–6 Invalid Country Code Error Message

The ability to modify the Country Code is disabled for radios that are configured for use in the United States and Canada.

NOTE

Country codes are three-digit codes defined in ISO 3166-1. See the following for more information:

- http://www.iso.org/iso/home/standards/country_codes.htm
- “H. Country Codes” on page 187

To discover and configure the radios:

→ **RT System 2 Windows computer**

- 1 Verify that the configuration files for the radios and the discovery tool are on the RT System 2 Windows computer. The configuration files and the **Ubiquiti Discovery**

Tool files are provided as a ZIP file. Extract the files if necessary.

The file names are as follows:

- ubnt-discovery-v2.3.bat
- 1-AP.cfg
- 1-S.cfg
- 2-AP.cfg
- 2-S.cfg
- 3-AP.cfg
- 3-S.cfg
- 4-AP.cfg
- 4-S.cfg
- 5-AP.cfg
- 5-S.cfg
- 6-AP.cfg
- 6-S.cfg
- ubnt-discovery-v2.3.jar
- 7-AP.cfg
- 7-S.cfg
- 8-AP.cfg
- 8-S.cfg
- 9-AP.cfg
- 9-S.cfg
- 10-AP.cfg
- 10-S.cfg
- 11-A P.cfg
- 11-S.cfg
- 12-AP.cfg
- 12-S.cfg
- 13-AP.cfg
- 13-S.cfg
- 14-AP.cfg
- 14-S.cfg
- 15-AP.cfg
- 15-S.cfg
- 16-AP.cfg
- 16-S.cfg
- 17-AP.cfg
- 17-S.cfg
- 18-AP.cfg
- 18-S.cfg

 **NOTE**

When using a radio link (pendant) to the recording truck, the following configuration files are also required:

- Recorder-AP.cfg
- Recorder-S.cfg

See "Connecting to the Recording Truck" on page 90 for more information on using a pendant radio link.

- 2 Configure the computer to be a private network with a static IP address of 192.168.1.100. See the *Troubleshooting Guide, Additional Information chapter, Setting a Static IP Address* section if you need instructions on setting the IP address.
- 3 Connect a single radio to the computer.

4. Point-to-Point Backhaul

Preparation

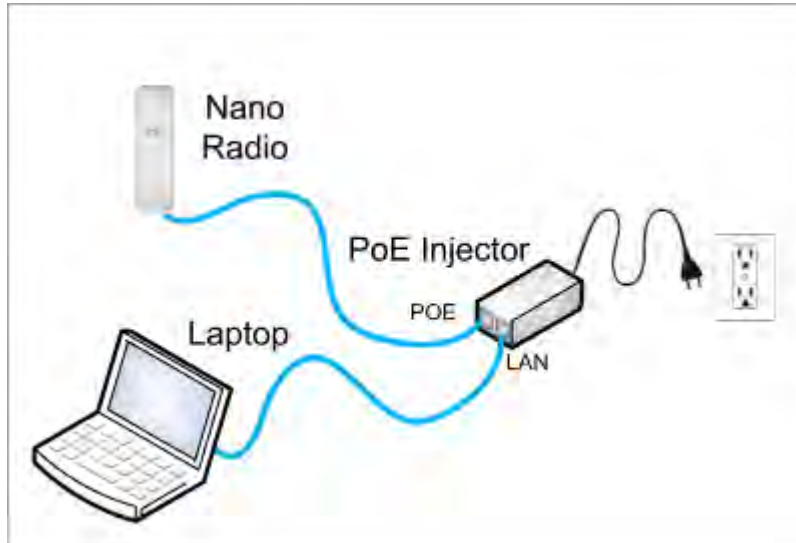


Figure 4–7 Ubiquiti NanoStation Private Network Connection

- 4 Open the **Ubiquiti Discovery Tool** by double-clicking the shortcut on the desktop.



Figure 4–8 Ubiquiti Discovery Tool Icon



TIP

Ensure that the `.bat` file and the `.jar` file are in the same directory.



NOTE

The discovery tool can also be downloaded from the following location:

<http://www.ubnt.com/download#app>

Extract the files from the downloaded ZIP file to the desktop.

- 5 The **Discovery** window opens and displays a list of all **Discovered Devices**:

**NOTE**

The factory default IP address for the radios is 192.168.1.20. Configure the radios one at a time.

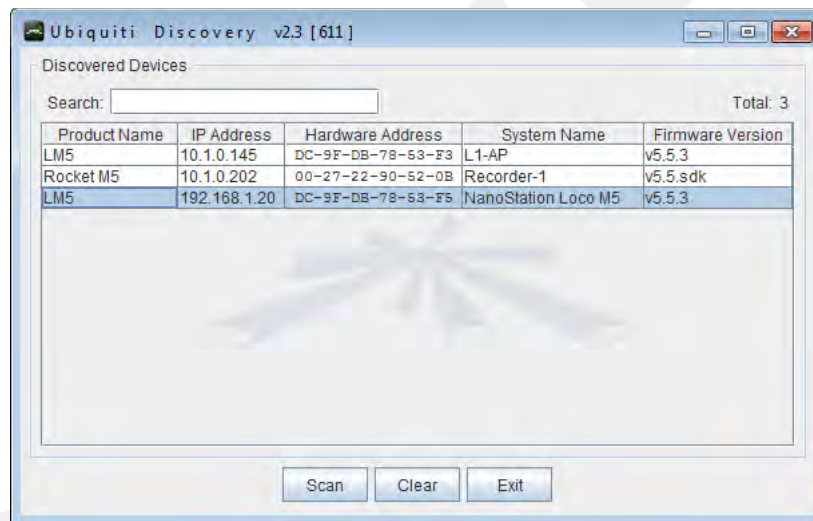


Figure 4–9 Ubiquiti Discovery Window

- 6 If the list does not look correct, click **Scan**.
- 7 Right-click one of the radios and then click **Web UI**. For example, right-click the following row:

L M5 | 192.168.1.20 | DC-9F-DB-78-53-F3 | NanoStation Loco M5

and then click **Web UI**. The **airOS** login window opens:

4. Point-to-Point Backhaul

Preparation

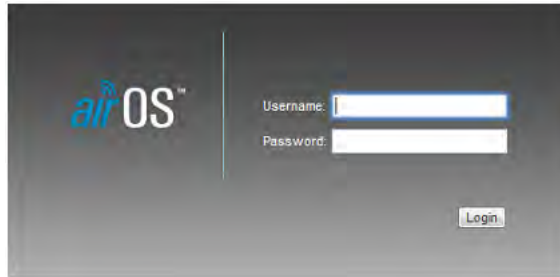


Figure 4–10 Ubiquiti airOS Login Window

- 8** Type the following credentials and click **Login**:
 - Username: ubnt
 - Password: ubnt
- 9** The radio configuration window opens. Click the **System** tab.



Figure 4–11 Ubiquiti airOS Window, System Tab

- 10 In the **Configuration Management** → **Upload Configuration** area, click **Browse**. Browse to the configuration file (for example 1-AP.cfg), and then click **Upload**.

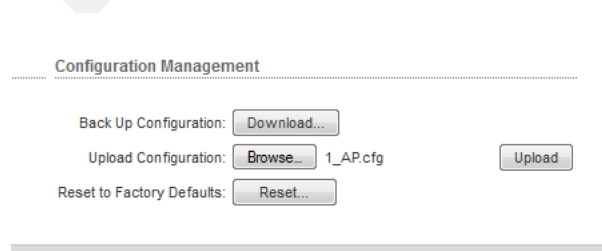


Figure 4–12 Ubiquiti, Upload Configuration File

4. Point-to-Point Backhaul

Create Plan and Map

- 11 Click **Apply**.

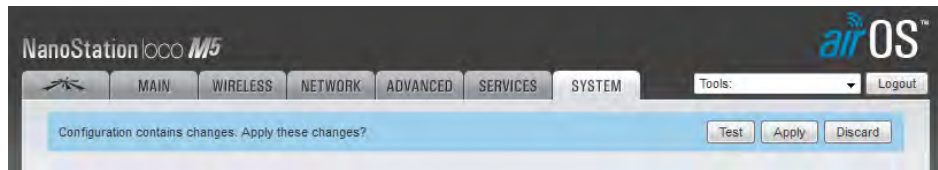


Figure 4–13 Ubiquiti, Apply Configuration Changes

- 12 The radio reboots and obtains a new IP address if a DHCP server is active. The current session of airOS is no longer valid since the IP address of the radio has changed.
- 13 Close the browser window.
- 14 Disconnect the radio. It is now ready for deployment.
- 15 Continue connecting radios and uploading configuration files until they are all configured.

NOTE

Radios were labeled prior to shipment and there should be a 1:1 correlation between radios and configuration files. Make sure the correct configuration file is loaded onto the corresponding radio.

4.3 Create Plan and Map

Using the documents provided for the job (survey, planned LIU locations, and so on), create a plan to plot radio locations and map the layout of AP and S radios.



Figure 4–14 Create Plan and Map Troubleshooting Flow

Keep the following in mind as you create the layout plan:

- ◆ Point the radio pairs directly at each other whenever possible maintaining line-of-sight around obstructions (see “Maintain Line-of-Sight” on page 75).

- ◆ Use a tool such as Google Earth or Global Mapper to create an Elevation Profile to assist with determining the best locations for radio towers. See *“Creating a Google Earth Elevation Profile”* on page 111 for an example.
- ◆ An Access Point communicates only with a Station. An Access Point cannot communicate with an Access Point, and a Station cannot communicate with a Station.

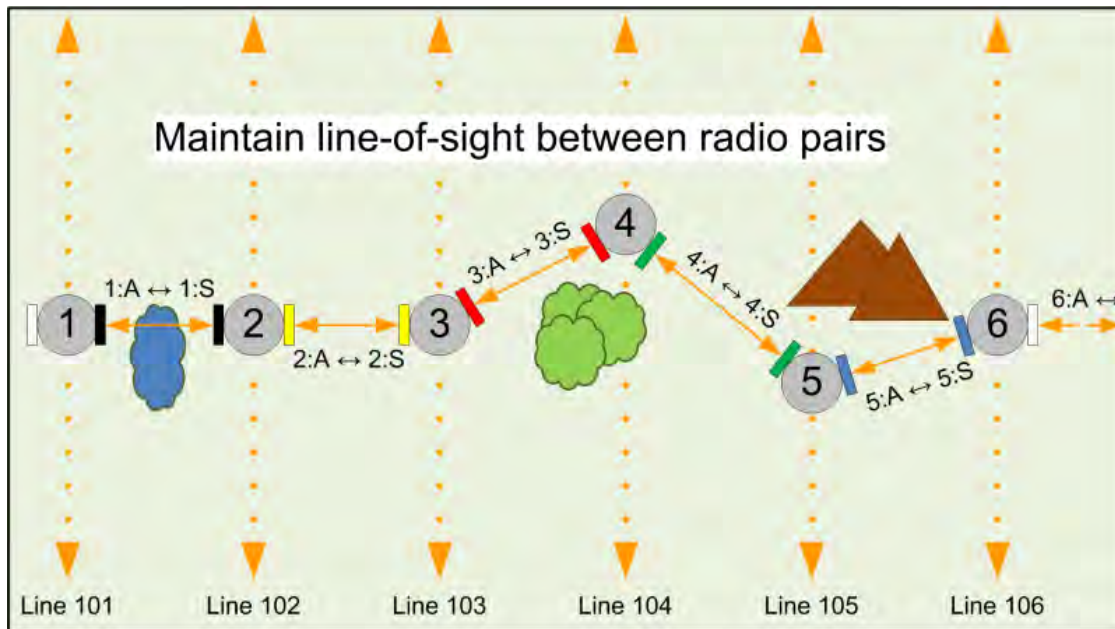


Figure 4–15 Maintain Line-of-Sight

4.4 Install and Troubleshoot

This section describes how to install the radios and troubleshoot the radio communications.

4. Point-to-Point Backhaul

Install and Troubleshoot

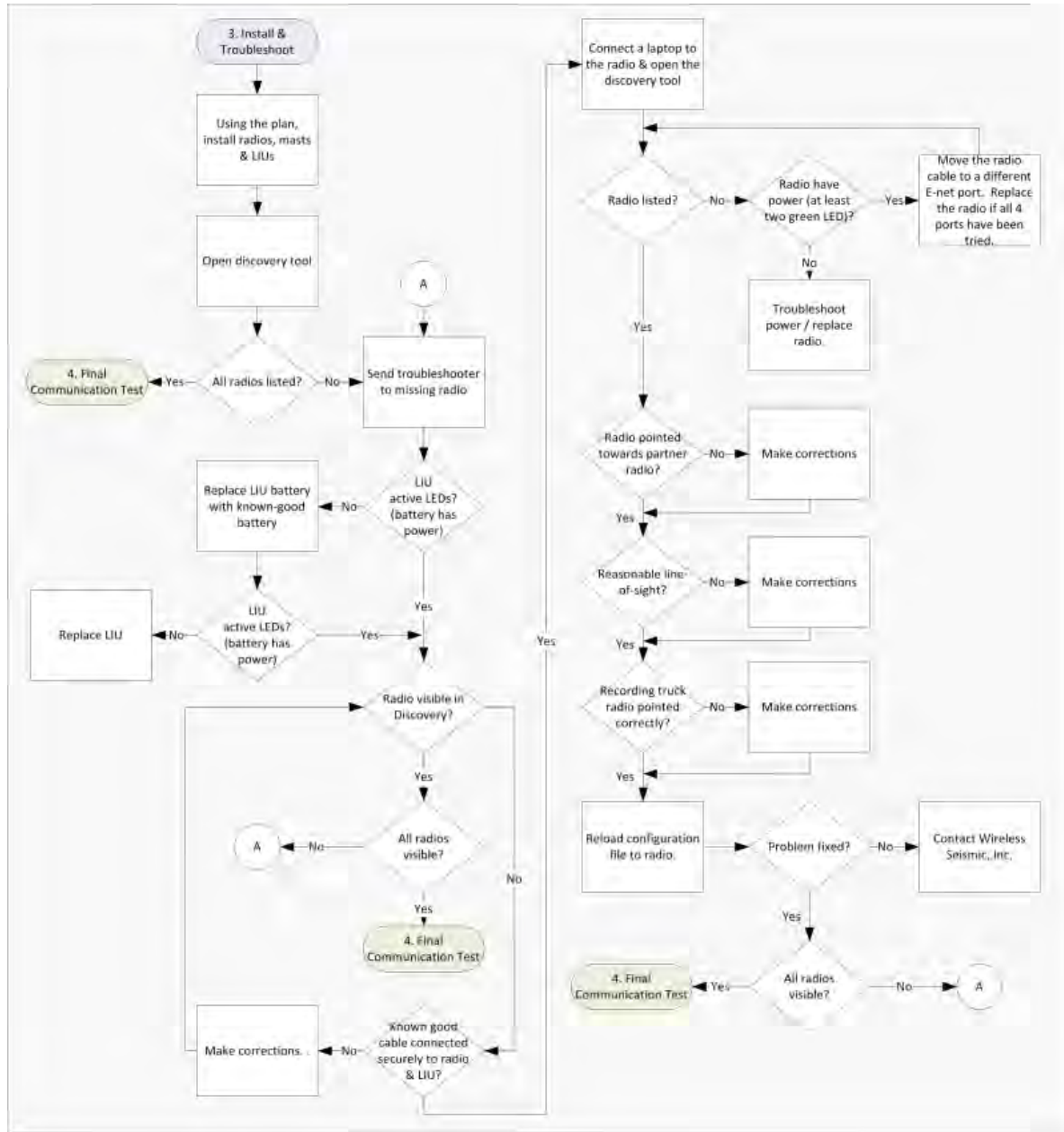


Figure 4–16 Install and Troubleshoot the Radios Flow

To install and troubleshoot the radios:

- 1 Using the plan created in section “Create Plan and Map” on page 74, install all of the radios, masts, and LIUs. Keep the following in mind as you proceed through the installation:

- Use labels to ensure that the correct radios are in the correct positions.
 - Install the Access Point (A) radios at the top of the pole, and the Station (S) radios on the same pole are at least three feet below the Access Point radios as shown in *"Radio-to-Radio Communication"* on page 65.
 - Point radio pairs directly at each other where possible (see *"Maintain Line-of-Sight"* on page 75). Some inaccuracy is tolerable; however, align the radios as close as possible using binoculars or compass bearing.
- 2 From the recording truck, open the **Ubiquiti Discovery Tool**. Verify that all of the radios are listed, and verify that each of the radios has a valid IP Address. Note the following:
- If a radio is listed, that means there is an Ethernet path to the radio.
 - If a radio has a valid IP address that means the DHCP is active, DHCP is being accepted by the radios, and DHCP is being passed from radio link to radio link.
 - ▶ DHCP server-assigned IP addresses are 10.xxx.xxx.xxx
 - ▶ Non-DHCP server-assigned IP addresses are 192.168.1.xxx
- 3 If a radio is not listed, send a troubleshooter to the first radio that is not listed (the radio closest to the recording truck) and perform the following steps:
- a Verify that the LIU has active LED lights (the battery has power).
 - b Verify that the radio is visible in Discovery.
 - c Verify that the radio is securely connected to the LIU with a known-good cable.
 - d Connect a laptop to the LIU.
- IMPORTANT:** The Ethernet ports on the LIU are PoE enabled. When connecting a laptop computer to the LIU, use a non-powered cable (60-0039) to protect the computer's Ethernet port. Do not use a powered Ethernet cable (60-0054). See *"Ethernet Cable Connections Comparison"* on page 78 for more information.
- e Open the discovery tool and verify that the radio is listed. If the radio is not listed, perform the following steps:
 - 1) Verify that the radio has power by visually inspecting the LEDs.
 - 2) If the radio has power but is not visible to the laptop, try a different Ethernet port.
 - 3) If the radio does not have power, troubleshoot the power and/or replace the radio.
 - f Verify that the radio is pointed in the direction of its partner (pair) radio and has reasonable line-of-sight to its partner (pair) (see *"Maintain Line-of-Sight"* on page 75).
 - g Verify that the last radio visible from the doghouse is pointed in the correct direction.
 - h Reload the configuration file to the radio.
 - i If the above steps fail, contact Wireless Seismic, Inc. for assistance.

4. Point-to-Point Backhaul

Final Communication Test

The following table compares the powered Ethernet cable and the non-powered Ethernet cable:

Table 4–2 Ethernet Cable Connections Comparison

60-0039 LIU to Computer		Signal Name	60-0054 LIU to Radio PoE	
14-Pin Connector	RJ-45 Connector		RJ-45 Connector	11-Pin Connector
B	1	TX+	1	B
A	2	TX-	2	A
C	3	RX+	3	C
NC	4	POSITIVE	4	H
NC	5	POSITIVE	5	F
D	6	RX-	6	D
NC	7	RETURN	7	E
NC	8	RETURN	8	L
P	—	SHIELD DRAIN	—	P
—	—	—	NC	R*
—	—	—	NC	M*
—			*Jumper pins R and M together.	

4.5 Final Communication Test

This section describes how to run the final speed test to verify good communication throughout the backhaul.

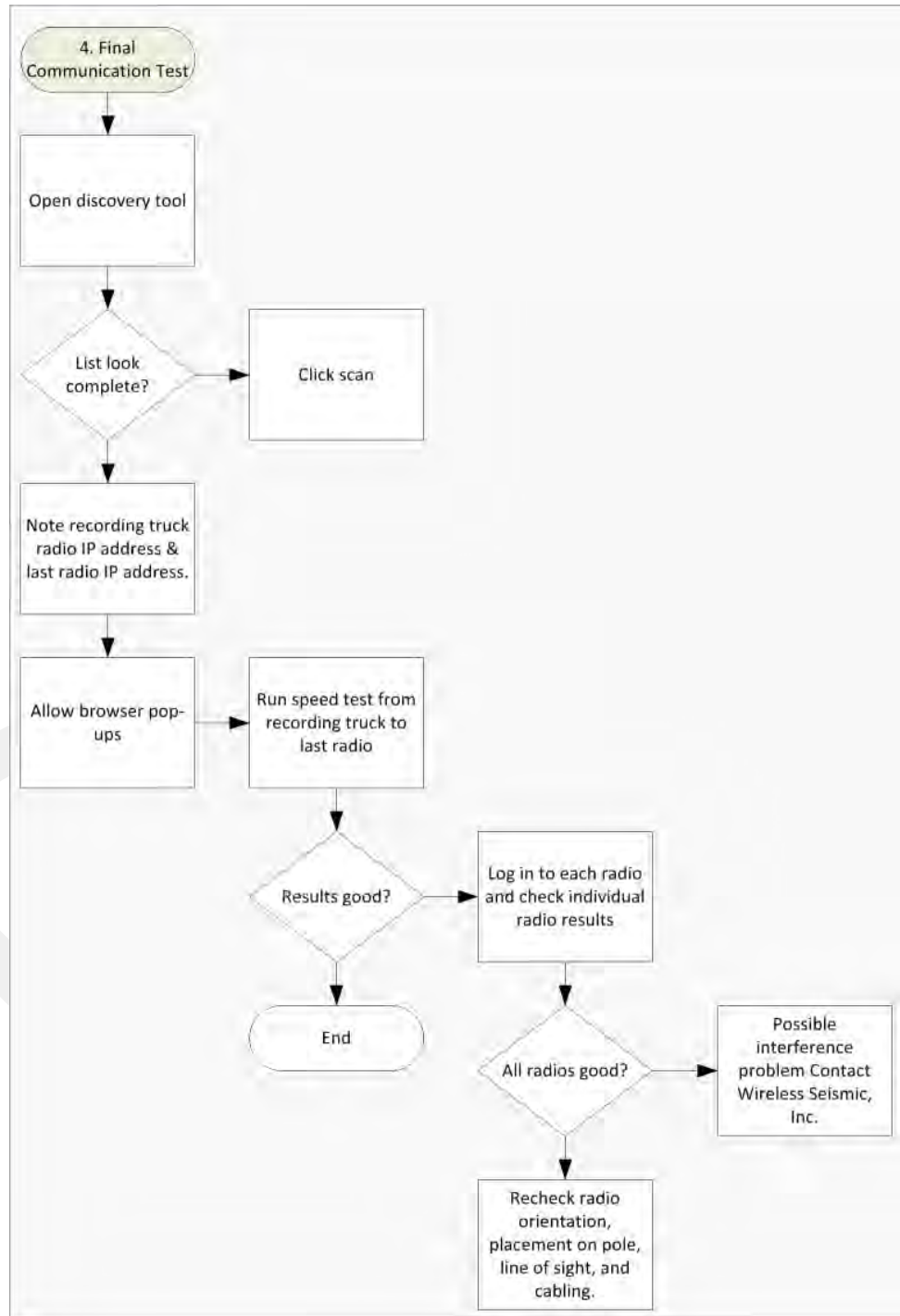


Figure 4–17 Final Communication Test Flow

4. Point-to-Point Backhaul

Final Communication Test

To run the speed test:

- 1 Verify that all radios are listed in the **Ubiquiti Discovery Tool** as described in *step 4 on page 70 through step 6 on page 71*.
- 2 Make a note of the following IP addresses:
 - The last radio in the line segment, that is, the radio farthest away from the recording truck:

 - The radio at the recording truck:

- 3 The speed test should be run from the recording truck radio to the radio farthest from the recording truck. Log in to the recording truck radio as described in *step 4 on page 70 through step 8 on page 72*.
- 4 Verify that browser pop-ups are allowed:
 - ▶ **Firefox** – **Tools** → **Options** → **Content** → clear the **Block pop-up windows** check box → click **OK**
 - ▶ **Internet Explorer** – **Tools** → **Internet Options** → **Privacy** → clear the **Turn on Pop-up Blocker** check box → click **OK**
- 5 Click **Tools** → **Speed Test**.

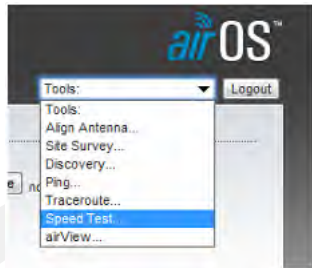


Figure 4–18 Ubiquiti airOS Tools

- 6 In the **Speed Test** window, perform the following steps:
 - a Click the IP address for the radio farthest from the recording truck in the **Select Destination IP** list:

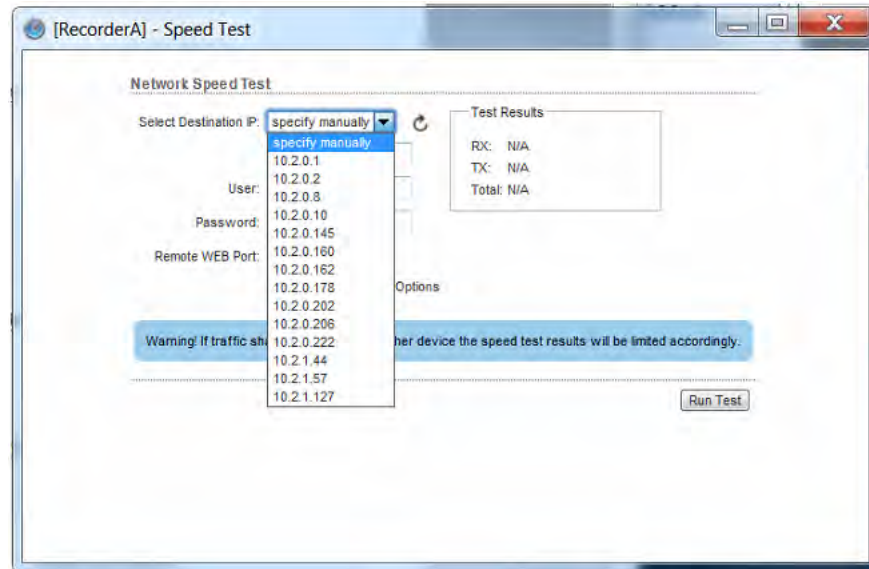


Figure 4–19 Speed Test Window

- b Type `ubnt` in the **User** text box.
- c Type `ubnt` in the **Password** text box.
- d Type `443` in the **Remote WEB Port** text box.
- e The default test **Direction** is **duplex**; the test is performed for both transmit and receive. If you want to run the test in only one direction, perform the following steps:
 - 1) Select the **Show Advanced Options** check box.
 - 2) Select **transmit** or **receive**.
- f Click **Run Test**.
- g Good **Test Results** are as follows:
 - ▶ RX (receive) only = 70+ Mbps
 - ▶ TX (transmit) only = 70+ Mbps
 - ▶ Total (duplex) = 90+ Mbps
 - RX = 40+ Mbps
 - TX = 40+ Mbps
- 7 If **Speed Test** results are low, use a systematic approach of testing links to identify the offending radio pairs:
 - a Log in to a Station (S) radio.
 - b Click the **Main** tab and verify the following values:
 - ▶ Signal Strength < -75 dBm
 - ▶ Either the Vertical or Horizontal (Main Tab, Stations only) < -80 (between -65 and -75 is ideal)
 - ▶ Transmit CCQ < 90% (100% is ideal)
 - ▶ Click **AP Information** in the **Monitor** area. Verify that the Access Point **Signal Strength** < -75 dBm

4. Point-to-Point Backhaul

Final Communication Test

The screenshot displays the NanoStation loco M5 web interface. The top navigation bar includes tabs for MAIN, WIRELESS, NETWORK, ADVANCED, SERVICES, and SYSTEM. The 'Status' tab is active, showing device information such as Device Name (L1-S), Network Mode (Bridge), and Wireless Mode (Station WDS). A red box highlights the 'Signal Strength' section, which includes a color-coded bar, Vertical/Horizontal signal levels (-44 / -51 dBm), Noise Floor (-90 dBm), and Transmit CCR (98.3%).

The 'Monitor' tab is also visible, with a sub-tab for 'AP Information' highlighted by a red box. This sub-tab shows details for the Access Point DC:9F:DB:78:53:F3, including Device Name (L1-AP), Connection Time (01:40:18), Signal Strength (-45 dBm), Noise Floor (-90 dBm), Distance (0.1 miles), and CCQ (99%). A table lists MCS rates from MCS0 to MCS15, with signal strength values for MCS13 (-49) and MCS15 (-49). Buttons for 'Reconnect' and 'Refresh' are located at the bottom right of the monitor section.

Figure 4–20 NanoStation Main Tab

- c Repeat *step a* on page 81 and *step b* on page 81 for all of the radios.
- 8 If the individual links are all good but the backhaul as a whole does not deliver the appropriate throughput, it indicates that there is an interference problem.

Contact Andy Prokop, Jerry Stair, or Mike Shilts for project-specific recommendations.
- 9 If there are individual links with low numbers, perform the following steps to fix them:
 - a Verify that the radios are pointing in the correct directions.
 - b Verify that shielding is properly installed. The following figure shows the NanoStation radio shielding and surge suppressor assembly (56-0032):

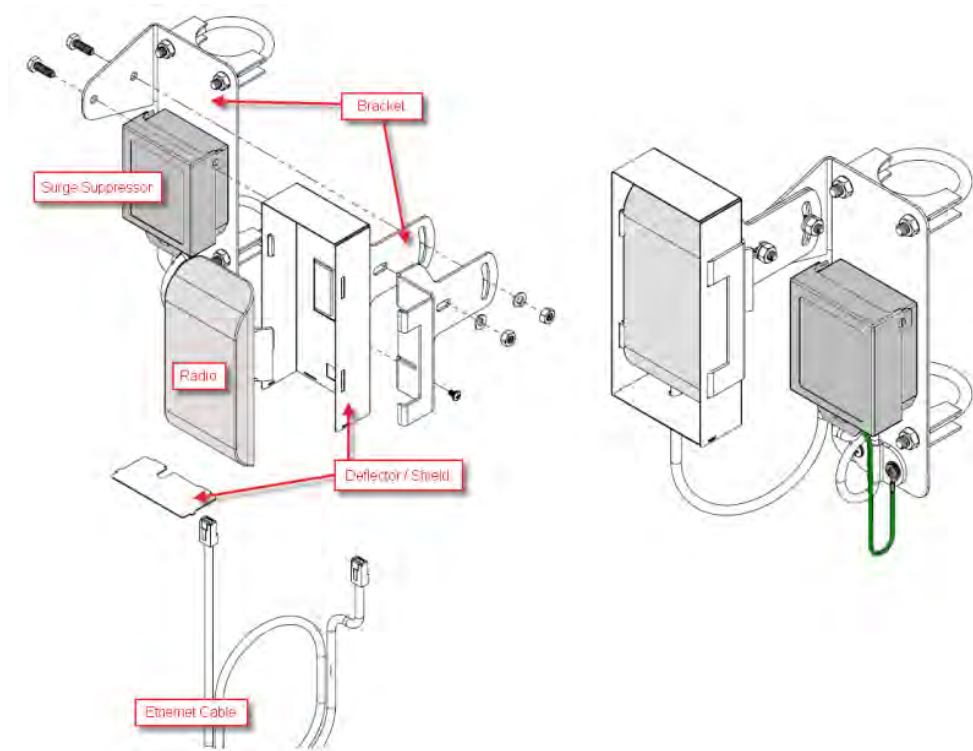


Figure 4–21 NanoStation Radio Shielding and Surge Suppressor

- c** Check for misaligned or improperly installed shielding.
- d** Verify that the radios on the same pole are at least three feet apart.
- e** Verify that the Access Point (A) radio is three feet higher on the pole than the Station (S) radio.
- f** If possible, raise the poles (masts) to provide the least-obstructed view to the partner radio as is reasonable.
- g** Verify that there are no frayed cables or cables with water intrusion.

4.6 Rolling the Backhaul

As production rolls away from the lines, radios, and towers farthest from the recording truck, these lines, radios, and towers become available to be used on the other side of the recording truck.

As you move the equipment, note the following:

- ◆ Maintain the A-to-S configuration throughout the survey.
- ◆ The poles must stay in sequential order as you roll the spread.



NOTE

The recording truck radio can be any one of the poles; in an ideal case the recording truck starts at pole farthest from the recording truck, for example Pole 18. When you roll Pole 18, you will also need to move the recording truck.

The following figure shows the movement of the poles and recording truck:

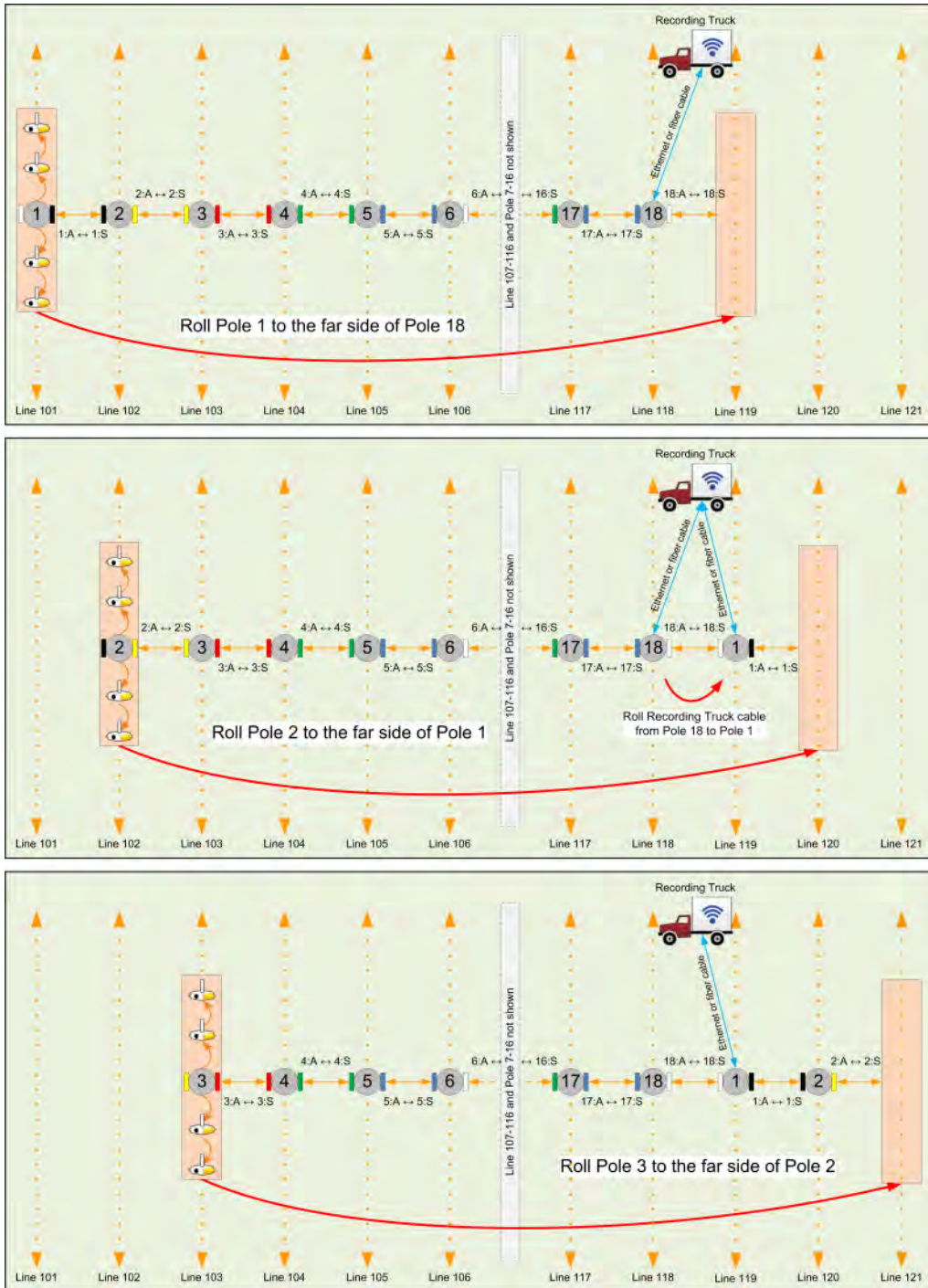


Figure 4–22 Rolling the Poles Example for 18 Total Poles

4. Point-to-Point Backhaul

Rolling the Backhaul

The following figure shows the movement of the poles when using 18 total poles:

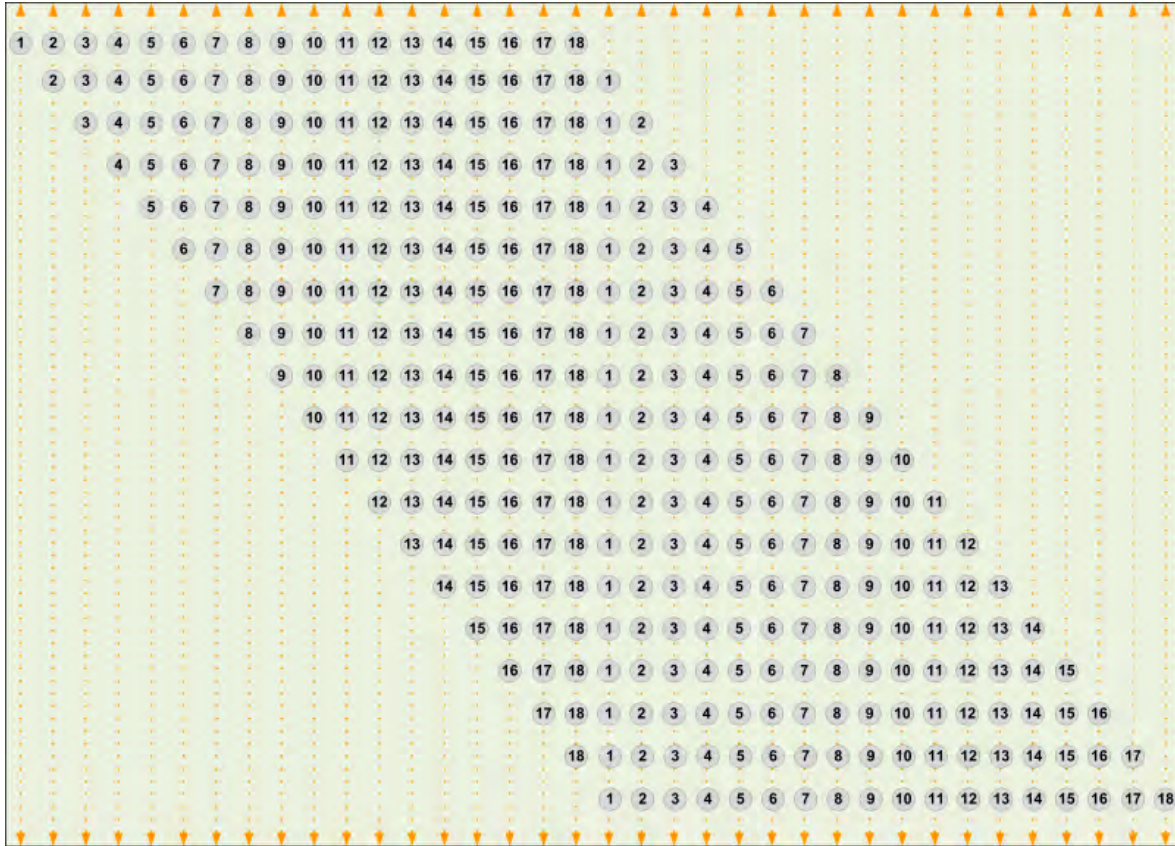


Figure 4–23 Rolling Scheme, 18 Total Poles Example

For a backhaul using 18 poles, even if you do not have all 18 lines set up at the same time, the rolling scheme must be followed using all 18 poles as shown in the following figure:

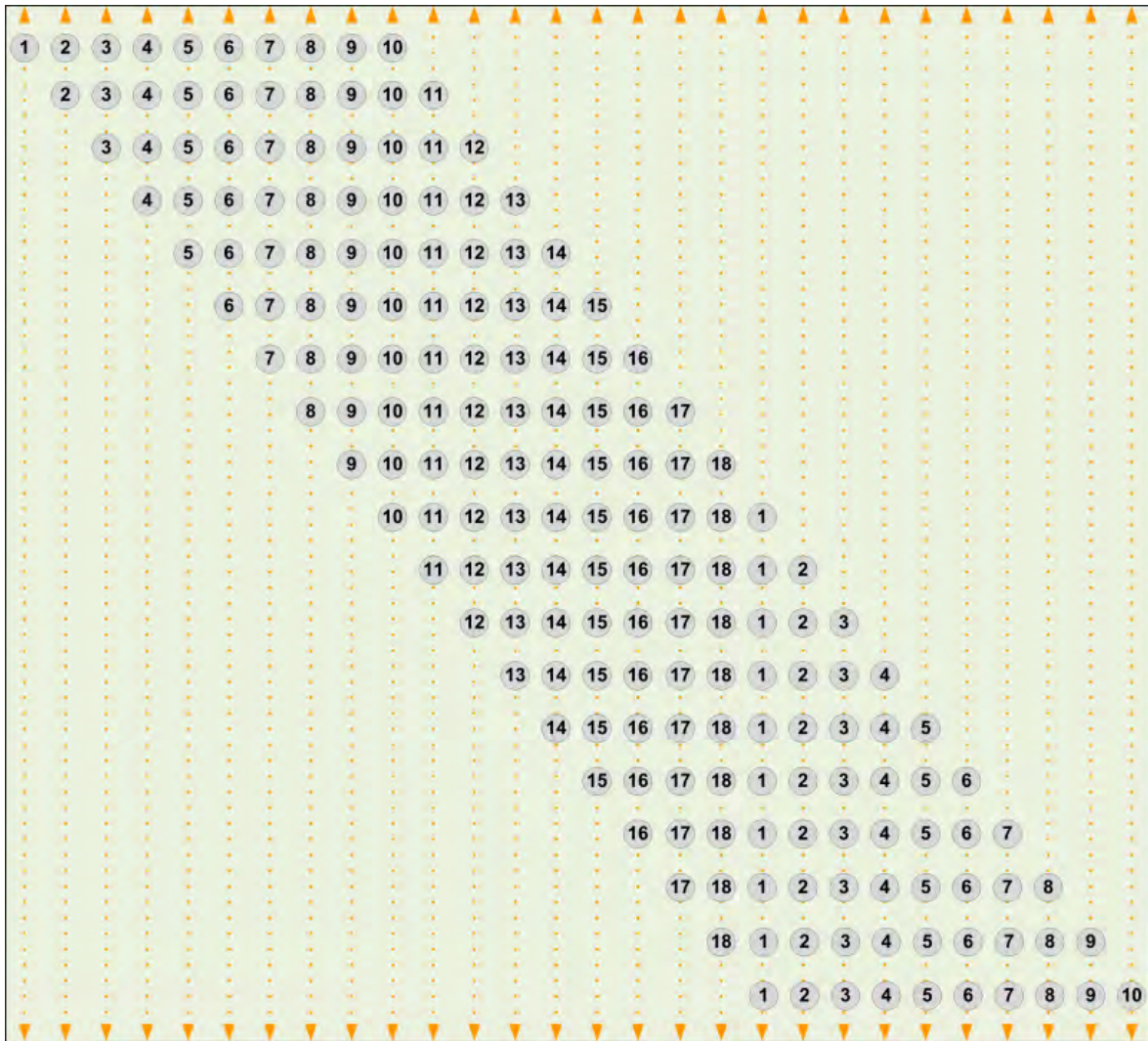


Figure 4–24 Rolling Scheme, 18 Pole Backhaul, 10 Poles in Use

4.7 Replacing a Radio

Any number of environmental hazards could destroy an existing radio. When this happens, replace it using the following instructions:

- 1 Identify the radio that needs to be replaced.
- 2 When the radio was initially configured for the point-to-point backhaul, a label was attached to the radio indicating which configuration file was used. Make a note of the configuration label (for example, 12:A-P12).
- 3 Duplicate the configuration label and attach it to the replacement radio using the same information and color.

The following example label indicates a radio configured for the following:

- Radio pair 12
- Access Point
- Pole 12

12:A-P12	White
----------	-------

- 4 Locate the corresponding configuration file (for example, 12-AP.cfg) and upload it to the replacement radio according to *step 4 on page 70* through *step 13 on page 74*.
- 5 Mark the faulty radio is so that it does not work its way back into the spread.
- 6 Replace the radio on the pole.

4.8 Upload New Firmware

This section describes how to upload new firmware into the radio.

To upload new firmware:

→ Windows computer → Radio Configuration, System tab

- 1 Click **Browse** next to **Upload Firmware** and navigate to the supplied BIN file.
- 2 Select the file and click **Open**.
- 3 Click **Upload**.
- 4 Click **Update**.
- 5 Do not power off the radio until the firmware is updated.

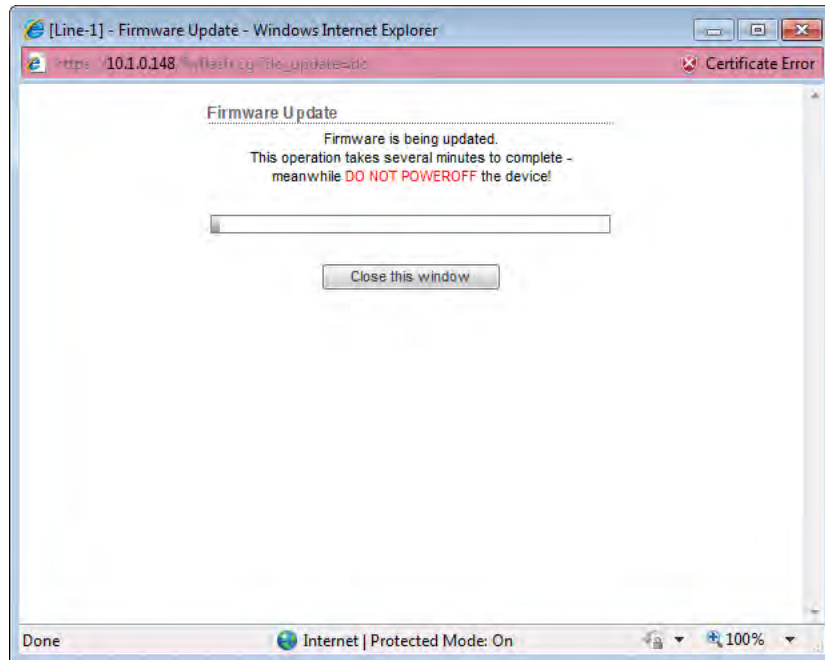


Figure 4–25 Radio Configuration, Updating Firmware

4.9 Unzipping the Configuration Files

The configuration files are delivered combined into one compressed file (config.zip).

To extract the files, use the built-in Windows 7 extraction process, or you can use a third-party tool such as 7-Zip.

To use the Windows 7 process:

- 1 Locate the ZIP file in Windows Explorer.
- 2 Right-click the ZIP file name and then click **Extract All**.
- 3 Browse to and select a folder.
- 4 Click **Extract**.

To use 7-Zip:

- 1 Download and install 7-Zip if it is not already installed:
<http://www.7-zip.org/download.html>
- 2 Locate the ZIP file in Windows Explorer.
- 3 Right-click the ZIP file name and then click **7-zip** → **Extract Files**.
- 4 Browse to and select a folder.

4. Point-to-Point Backhaul

Connecting to the Recording Truck

- 5 Click **OK**.

4.10 Connecting to the Recording Truck

The line communicates to the recording truck through an LIU using one of the following methods:

- ◆ Fiber cable
- ◆ Radio link (pendant)

The following figure shows a fiber cable connection example:

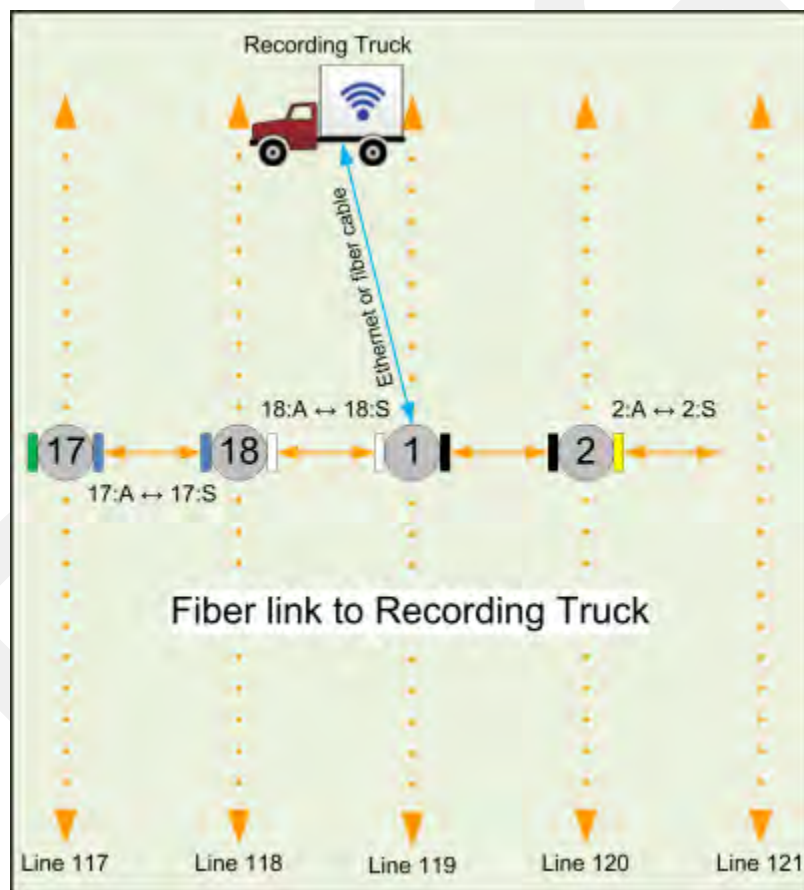


Figure 4–26 Connecting the Recording Truck with Fiber

The following figure shows a radio link (pendant) connection example.



Figure 4–27 Connecting the Recording Truck with a Pendant Radio Link

4. Point-to-Point Backhaul

Connecting to the Recording Truck

The following figure shows the optimal angle between the pendant and the line.

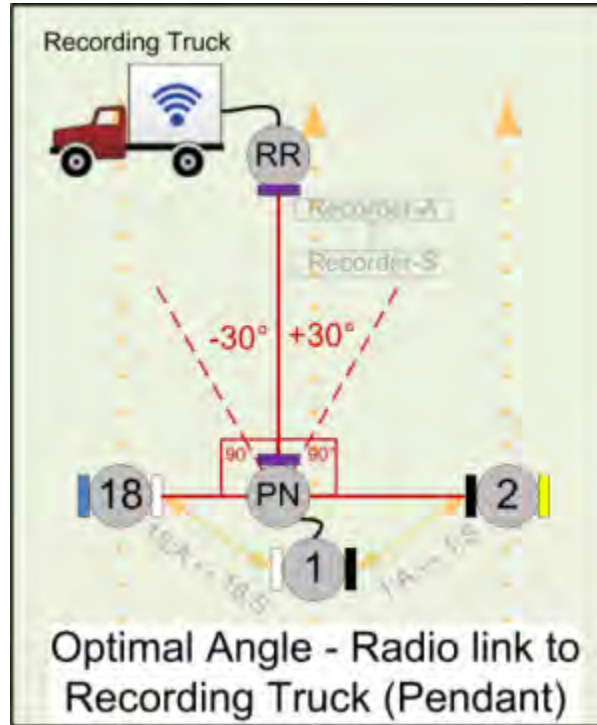


Figure 4–28 Optimal Angle, Radio Link to Recording Truck

The following figure shows the connections for the pendant radio link example.

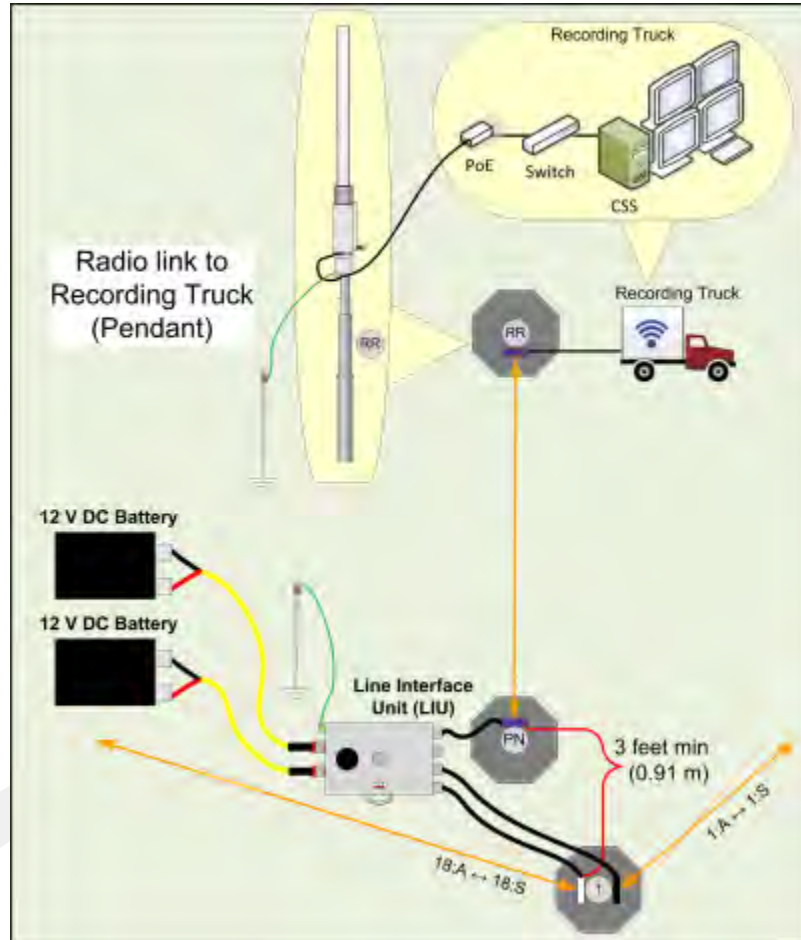


Figure 4–29 Connecting the Pendant Radio Link

4. Point-to-Point Backhaul

Connecting to the Recording Truck

The following table lists information about the pendant radio connection.

Table 4–3 Pendant Radio Link Elements

Item	Description
Configuration	<p>The following additional configuration files are provided:</p> <ul style="list-style-type: none"> • Recorder-AP.cfg • Recorder-S.cfg
RR	<ul style="list-style-type: none"> • The radio at the recording truck is a Rocket radio with an Omni antenna and is indicated in the drawings as RR (Recorder/Rocket). • Use the Recorder-AP.cfg file with this radio. • The RR radio should be installed at the top of the pole, pointing directly at the pendant radio (PN).
PN	<ul style="list-style-type: none"> • The radio at the line is a NanoStation radio with a built-in antenna and is indicated in the drawings as PN (Pendant/Nano). • Use the Recorder-S.cfg file with this radio. • The PN radio should be installed at the top of the pole, pointing directly at the recording truck radio antenna (RR). • The optimal angle between the pendant radio link (RR to PN) and the next LIU in the line segment (pearl) is 90° as shown in <i>“Optimal Angle, Radio Link to Recording Truck” on page 92</i>. If necessary, ±30° off of perpendicular should also work. • The PN radio should be at least 3 ft (0.91 m) from the line pole (Pole 1 in the example shown in <i>“Connecting the Recording Truck with a Pendant Radio Link” on page 91</i>). Use as much distance as you can as allowed by your cable lengths. • The PN radio and pole should be between the line and the recording truck as shown in <i>“Connecting the Recording Truck with a Pendant Radio Link” on page 91</i>.
Batteries	<ul style="list-style-type: none"> • Adding a third radio to the LIU increases the battery usage at this position. To ensure that the LIU does not reset due to a low or depleted battery, keep two batteries connected to the LIU at all times. • The battery with the lowest voltage is used until the voltage falls below the Unit Thresholds ? LIU Voltage Warning number (usually about 11V). At this point, the LIU auto-swaps to the battery with the higher voltage. Monitor the battery status in the Ground Equipment Table. Replace the low-voltage battery with a fully-charged battery as soon as possible after the battery auto-swap occurs.

After the pendant radio link radios are configured and installed, log in to the PN radio and set the power level to the minimum amount required to achieve communication with the RR.

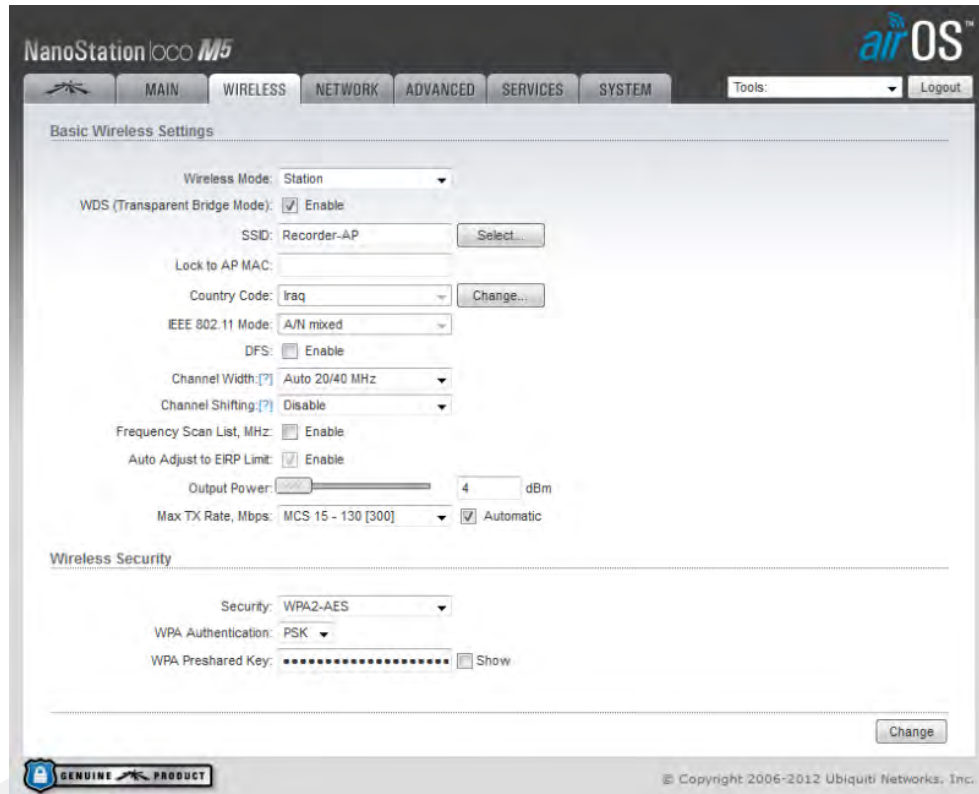


Figure 4–30 Wireless Tab

To set the PN radio power level:

- 1 Click the **Wireless** tab.
- 2 Move the **Output Power** slider bar to the desired power level.
- 3 Click **Change** at the bottom of the window.
- 4 Click **Apply Command** at the top of the window.
- 5 Wait 30 – 60 seconds.

Point-to-Multipoint Backhaul

5.1 Overview

A channel is a frequency band of a specified width. For example, if the center frequency is 2.412 GHz, and the frequency band is 80 MHz wide, there are 40 MHz on either side of the center frequency, and the frequency range for that channel is 2.372 to 2.452 GHz.

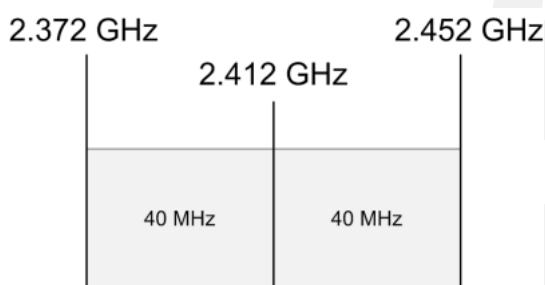


Figure 5–1 Channel, 80 MHz Wide Frequency Band

Some custom configurations will require multiple channels operating at the same time. Verify that channel ranges do not overlap to avoid interference.

The recording truck radios are configured Access Points (A) and the line station radios are configured as Stations (S).

An Access Point communicates only with a Station. An Access Point cannot communicate with an Access Point, and a Station cannot communicate with a Station.



A line station must require an LIU to communicate with the recording truck. A mast located at the recording truck can communicate using an LIU or a PoE connected directly to the recording truck computer. See the following figures for examples.

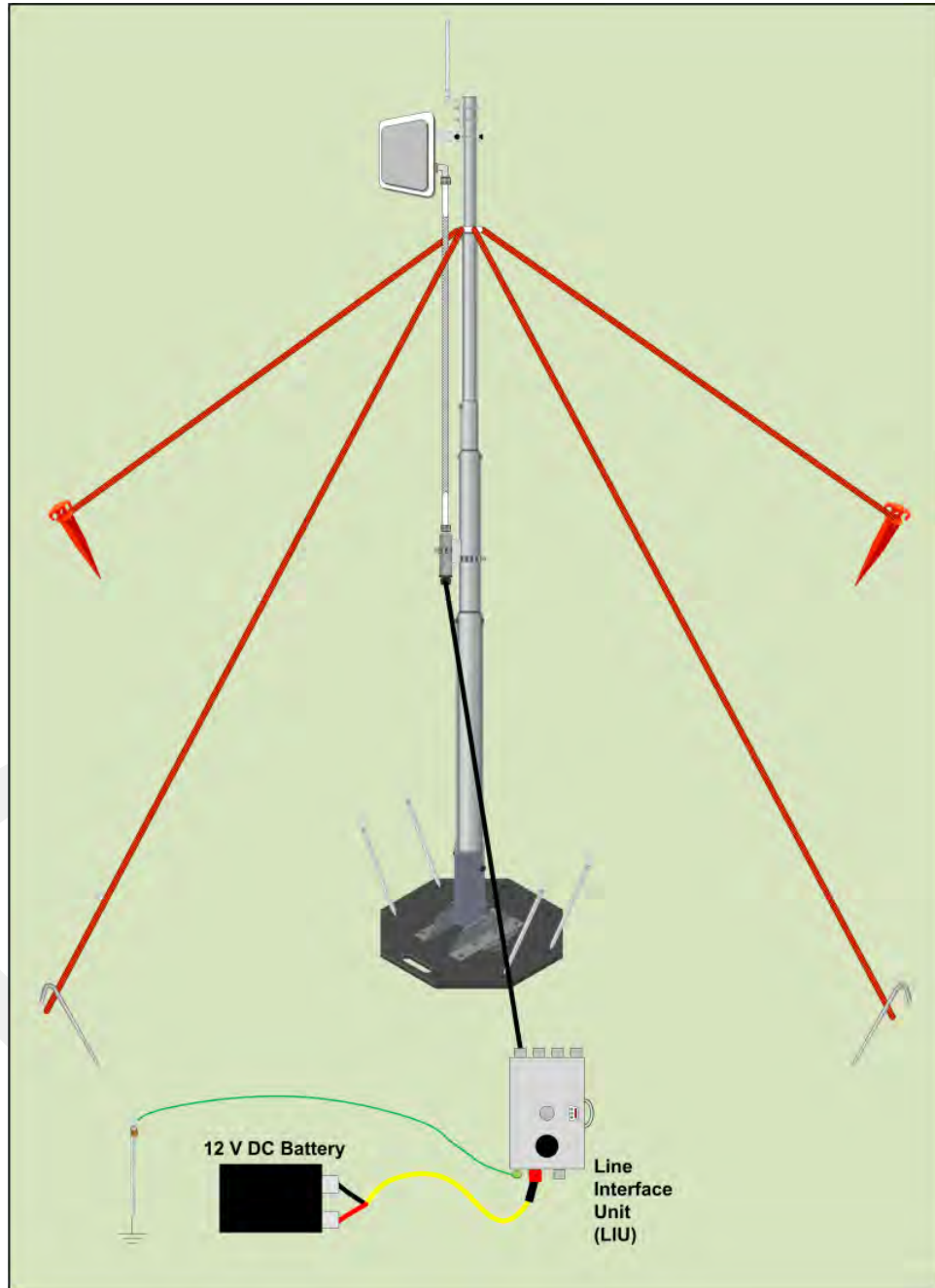


Figure 5–2 Line Station Mast (Bullet Radio)

5. Point-to-Multipoint Backhaul

Overview

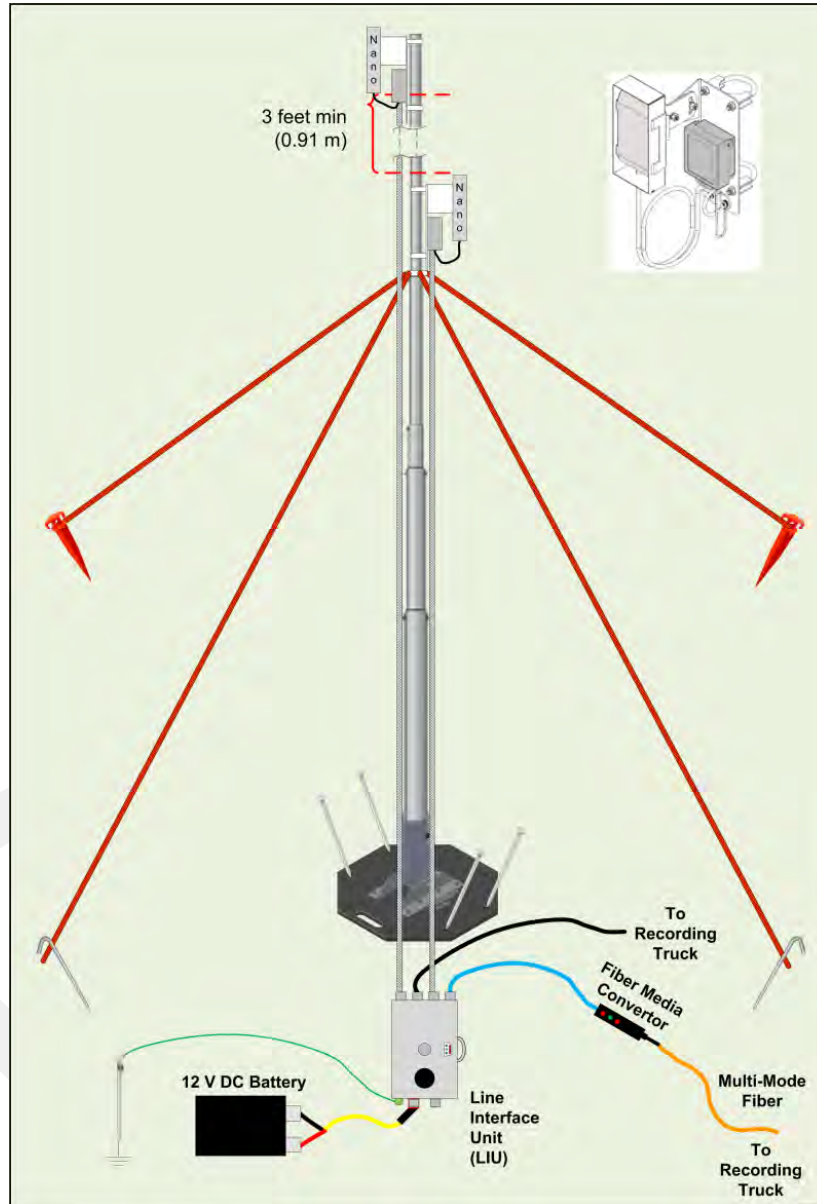


Figure 5–3 Recording Truck or Line Station Mast (NanoStation Radio)



NOTE

If using the mast at the recording truck, connect the LIU with an Ethernet or Fiber cable to the recording truck. If the mast is not used at the recording truck, the connections shown in the figure to the recording truck are not used.

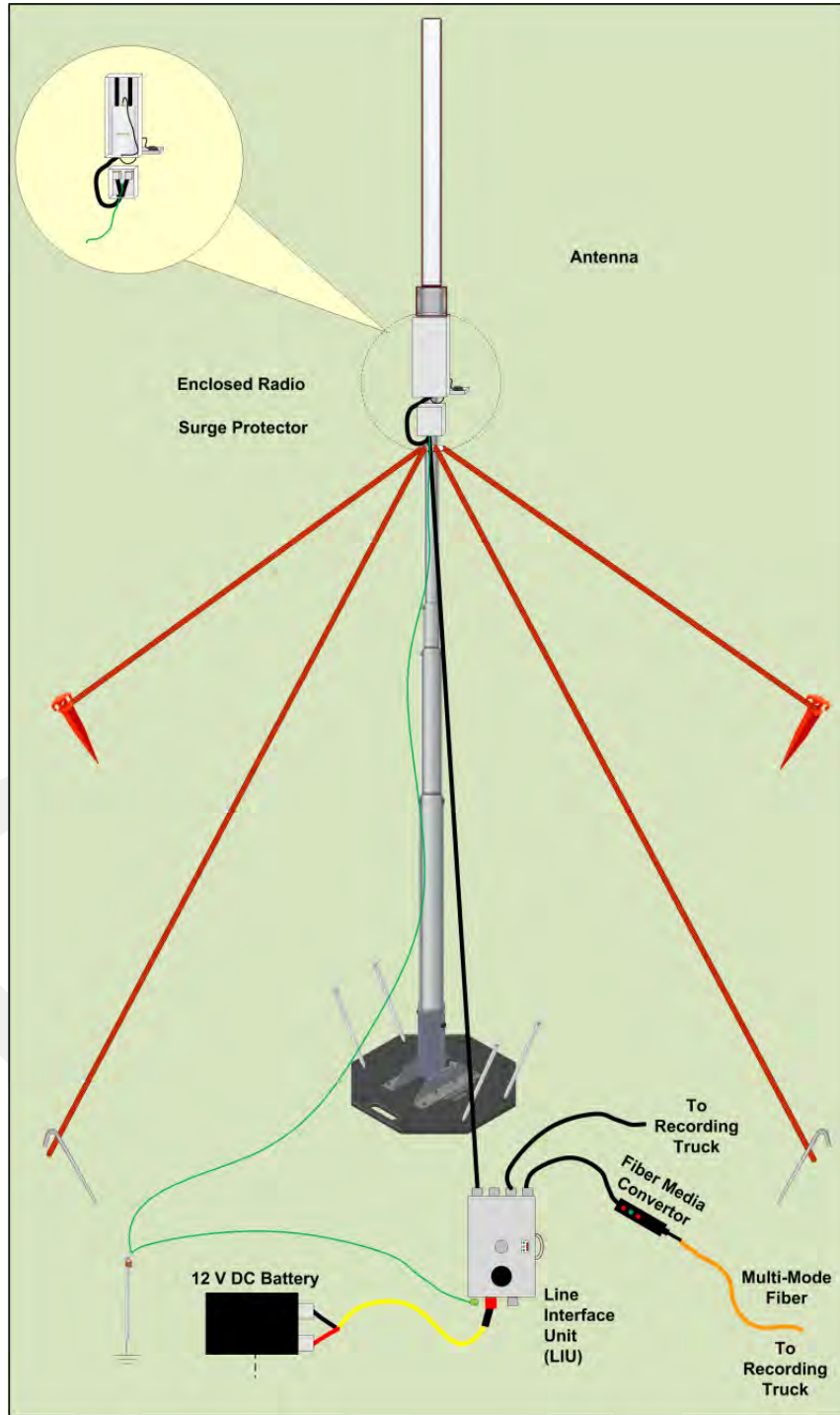


Figure 5-4 Recording Truck Mast with LIU (Rocket Radio)

5. Point-to-Multipoint Backhaul

Overview

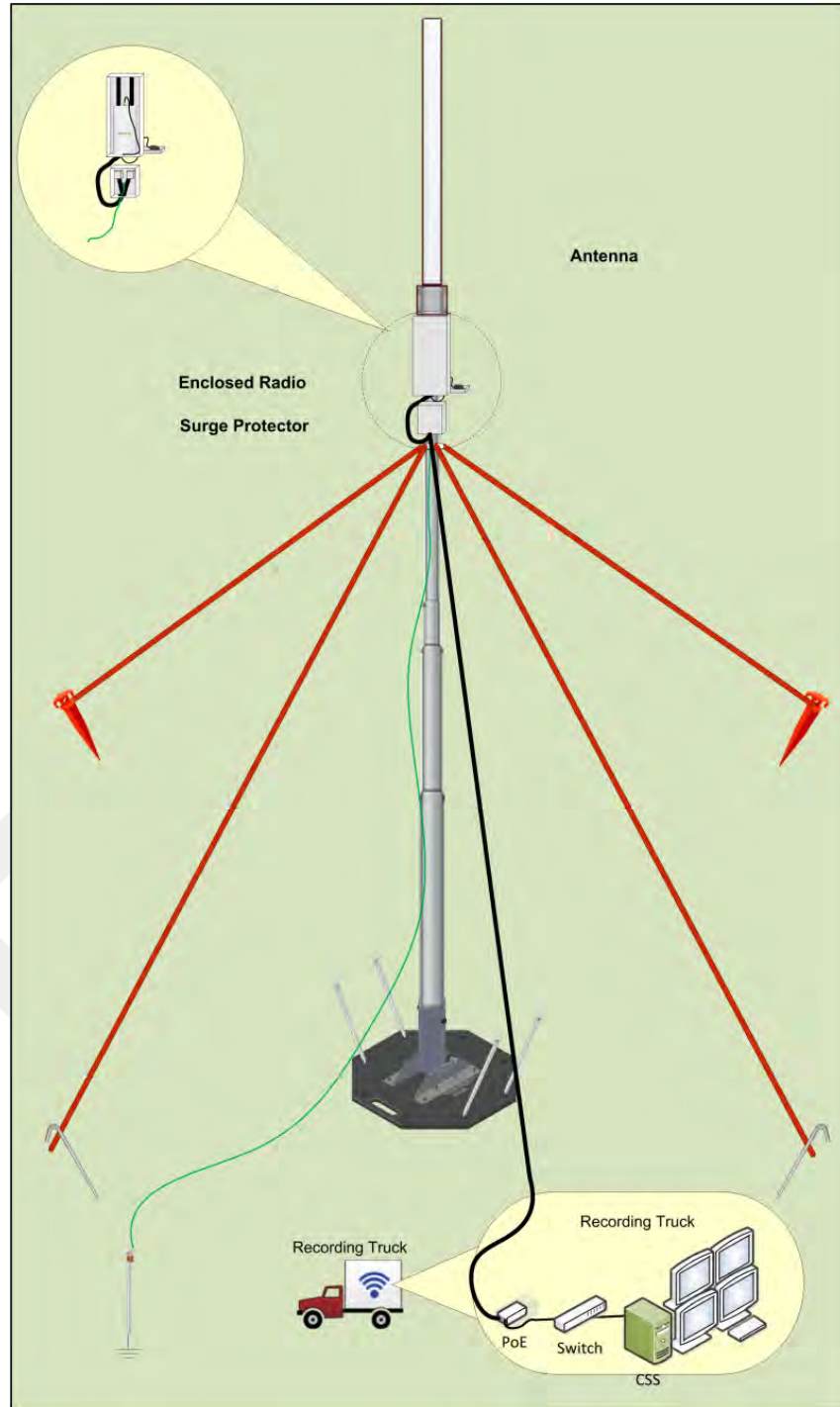


Figure 5–5 Recording Truck Mast without LIU (Rocket Radio)

 **NOTE**

You can use a NanoStation radio instead of the Rocket Radio on the mast at the Recording Truck without an LIU.

 **TIP**

If you have multiple radios at the recording truck, and enough PoE devices, Ethernet cables, Ethernet ports, and AC power receptacles, all of the recording truck radios can be used without an LIU unit.

Draft