Rocket science inside.
Unrivaled performance outside.

AbsoluteAir™ 2

Manual

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Revision X

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Tarana Wireless AbsoluteAir User Guide
This user guide incorporates features and functions provided with Tarana's AbsoluteAir 2 products.

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Table of Contents

About This Document

This document provides instructions for using the AbsoluteAir 2 products. Table 1 shows the specific products in this manual. This document is meant to provide both Quick Install instructions (section **Error! Reference source not found.**) and more in-depth guidance.

For additional information not contained in this User Guide, refer to the following Tarana documents:

- AbsoluteAir 2 CLI Reference
- Tarana Wireless White Papers

If you have questions about this documentation, email Tarana Wireless support (support@taranawireless.com).

Table 1. AbsoluteAir 2 Products

Product	Description	Frequency Range	Channel Width
CN	Concentrator Node High Performance or Standard Performance	2.5-2.7, 3.3-3.8, 5.x GHz	10, 20 MHz
EN	Edge Node High Performance or Standard Performance	2.5-2.7, 3.3-3.8, 5.x GHz	10, 20 MHz

1 Warnings, Regulatory Information, and Safety Information

1.1 General Warnings

Failure to observe these safety precautions may result in personal injury or damage to equipment.

- Follow all warnings and instructions marked on this product.
- Use standard safety guidelines when mounting. Installation and maintenance procedures must be followed and performed by trained personnel only.
- Before unmounting the product, disconnect power input to reduce the risk of hazards.
- Do not exceed 60V of input.
- Do not open the device. Opening the device voids the warranty.
- Do not stack anything on the radome.
- Dust covers must be installed on all connectors when not in use.
- Cable ends must be protected from weather if not connected to the device.
- This is a Class 1 laser product. Invisible laser radiation can be emitted from the aperture of the port when no fiber is connected; therefore, avoid exposure to laser radiation and do not stare into open apertures.

1.2 FCC Information

The FCC occupational controlled limit for maximum permissible exposure (MPE) is 5 mW/cm^2. It is estimated that the maximum power density at the radome is 1.25 mW/cm^2, which is below the FCC MPE limit. Since the power density for an occupational controlled environment is less than the FCC limit, no additional precautions are necesary. The occupational uncontrolled environment limit for maximum permissible exposure (MPE) is 1 mW/cm^2. To meet this MPE requirement, the operator must be at a distance of 5.41 in or 13.75 cm away from the radome cover of the system. However, an installer can reduce exposure further by turning off the power to the device or by issuing a CLI command to the device to mute its power.

1.3 Health and Safety Warning

All personnel must comply with the relevant health and safety practices when working on or around the AbsoluteAir radio equipment.

The AbsoluteAir system has been designed to meet relevant US and European health and safety standards as outlined in IEC Publication 60950-1.

AbsoluteAir is a Class A and Class B product. It is intended to be used exclusively in telecommunications centers.

Local safety regulations must be used if required. Safety instructions in this section should be used in addition to the local safety regulations. In the case of conflict between safety instructions stated herein and those indicated in local regulations, mandatory local norms will prevail. Should local regulations not be mandatory, then safety norms herein will prevail.

The following table describes general health and safety information about the AbsoluteAir radio.

Table 2. General Health and Safety Information

Topic	Explanation
Flammability	The equipment is designed and constructed to minimize the risk of smoke and fumes during a fire.
Hazardous Materials	No hazardous materials are used in the construction of this equipment.
Hazardous Voltage	The AbsoluteAir system meets global product safety requirements for safety extra-low voltage (SELV) rated equipment.
Safety Signs	External warning signs or other indicators on the equipment are not required.
Surface Temperatures	The external equipment surfaces become warm during operation, due to heat dissipation. However, the temperatures reached are not considered hazardous.

The following table describes the precautions that relate to installing or working on the AbsoluteAir radio.

Table 3. Operator Health and Safety Information

Topic	Explanation
Equipment Protrusions	The equipment has been designed to be free of unnecessary protrusions or sharp surfaces that may catch or otherwise cause injury during handling. However, always take care when working on or around the equipment.
Lifting Equipment	Be careful when hoisting or lifting the system during installation or maintenance. The AbsoluteAir product is approximately 5.4 kg (12 lbs) for the CN and EN-HP, 4.9kg (11 lbs) for the EN-SP.
Protection from RF Exposure	The AbsoluteAir radio does not generate RF fields intense enough to cause RF burns. However, when installing, servicing or inspecting an antenna, always comply with the Protection from RF Exposure guidelines under General Hazards (Table 4).
Safety Warnings	When a practice or procedure poses implied or potential harm to the user or to the radio equipment, a warning is included in this manual.

The following table describes general hazards that must be addressed when planning and installing an AbsoluteAir system.

Table 4. General Hazards

Topic	Explanation
Chassis Earthing	The AbsoluteAir chassis earth must be connected directly to the DC supply system earthing conductor, or to a bonding jumper from an earthing terminal bar, or bus to which the DC supply system earthing is connected.
Protection from RF Exposure	When installing, servicing or inspecting an antenna always comply with the following: • Locate the antenna such that it does not infringe the RF Exposure Limit Distance, relating to the Compliance Boundary General Public. • Stay aware of the potential risk of RF exposure and take appropriate precautions. • Do not stand in front of or look into an antenna without first ensuring the associated transmitter or transmitters are switched off. • At a multi-antenna site ask the site owner or operator for details of other radio services active at the site and for their requirements/recommendations for protection against potentially harmful exposure to RF radiation. • When it is not possible to switch transmitters off at a multi-antenna site and there is potential for exposure to harmful levels of RF radiation, wear a protective suit.
Fiber Optic Cables	• Handle optical fibers with care. Keep them in a safe and secure location during installation. • Do not attempt to bend them beyond their minimum bending radius. • Protect/cover unconnected optical fiber connectors with dust caps.
Grounding Connections	Reliable grounding of the AbsoluteAir chassis must be maintained.
Mains Power Supply Routing	AbsoluteAir DC power is not to be routed with any AC mains power lines. They are also to be kept away from any power lines which cross them.
Maximum Ambient Temperature	The maximum ambient temperature for the AbsoluteAir product is 60 degrees C. To ensure correct operation and to maximize long term component reliability, ambient temperatures must not be exceeded. Operational specification compliance is not guaranteed for higher ambients. AbsoluteAir should be mounted in such a way as to permit the vertical free flow of air through its cooling fins.
Mechanical Loading	When installing the AbsoluteAir on a tower, ensure that the tower is securely anchored. Ensure that the additional loading of devices will not cause any reduction in the mechanical stability of the tower.

Topic	Explanation
Power Supply Connection	AbsoluteAir operates from a nominal -48 VDC power supply.
Power Supply Disconnect	An appropriate power supply disconnect device should be provided as part of the installation.
Rack Mount Temperature Considerations	AbsoluteAir is designed to operate in an outdoor environment with no significant obstructions in front of the radome. Do not install AbsoluteAir in a closed or multi-unit rack assembly, because such a closed rack would impede the propagation of the RF signals. The maximum ambient temperature applies to the immediate operating environment of the AbsoluteAir product.

1.4 Warning Labels

WARRANTY VOID

DO NOT BREAK THE TAMPER SEALS ON HARDWARE. DOING SO WILL VOID THE WARRANTY.

WARNING

Making adjustments and/or modifications to this equipment that are not in accordance with the provisions of this User Guide, the Installation Guide or other supplementary documentation may result in personal injury or damage to the equipment, and may void the equipment warranty.

AVERTISSEMENT

Tout réglage ou modification faits à cet équipement hors du cadre édicté par ce guide d'utilisation ou par toute autre documentation supplémentaire pourraient causer des blessures ou endommager l'équipement et peut entraîner l'annulation de sa garantie.

WARNUNG

Die an diesen Geräten gemachte Einstellungen und/oder Änderungen, welche nicht gemäß dieser Bedienungsanleitung, oder gemäß anderen zusätzlichen Anleitungen, ausgeführt werden, können Verletzungen oder Materialschäden zur Folge haben und eventuell die Garantie ungültig machen.

ATENCIÓN

Llevar a cabo ajustamientos y/o modificaciones a este equipo, sin seguir las instrucciones provistas por este manual u otro documento adicional, podría resultar en lesiones a su persona o daños al equipo, y anular la garantía de este último.

警告

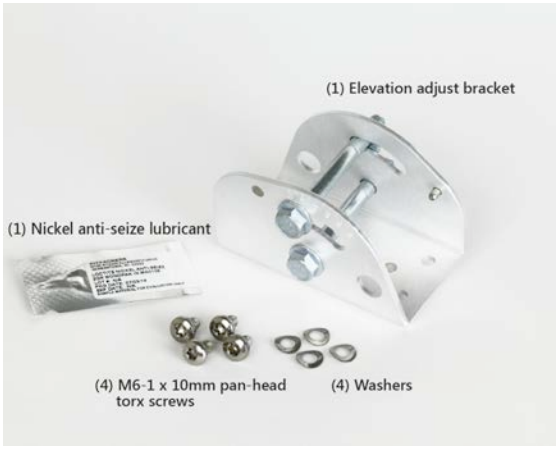
进行调整和/或修改本设备是不符合本用户指南的规定，安装手册或其他补充文件可能导致人身伤害或设备损坏，并可能会使设备保修。

2 Package Contents

The Tarana AbsoluteAir 2 solution ships with the following.

AbsoluteAir 2 Unit, either Standard Performance (SP) or High Performance (HP)

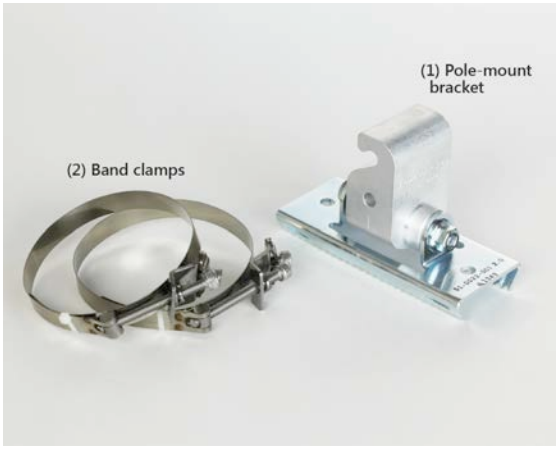
Mounting Bracket Kit



Mounting Kit

Options for pole-size ranges:

- 6.4 - 11.4 cm
- 11.4– 26.7 cm
- 26.7 - 35.5 cm



3 Product Overview

An AbsoluteAir 2 (AA2) link bridges layer 2 Ethernet traffic across a point-to-point RF communication link and consists of two devices, a Concentrator Node (CN) at the base and an Edge Node (EN) at or near the edge of the network. AA2 is based on adaptive array system (AAS) technology and multipath-tolerant OFDMA modulation.

The CN obtains network synchronization by leveraging an integrated, sensitive GPS module. Power requirements for both units are modest and can be powered over Ethernet (PoE).

As an all-in-one device, AA2 (CN or EN) becomes fully functional upon connection of a power cable and Ethernet. Enclosed in the IP67 housing are printed circuit board assemblies (PCBAs) that contain the IP packet processing and radio electronics coupled to an internal passive antenna for over-the-air transmission. To achieve the highest throughput for particular link conditions,the system dynamically adapts to the best modulation scheme. The system utilizes time division duplex (TDD) radio transmission.

The Tarana AA2 system is designed to enable the deployment of inexpensive, high capacity wireless links in difficult non-line-of-sight (NLoS) propagation environments. The system design enables efficient and rapid deployment of 3G and 4G base stations, helping operators to dramatically increase the capacity of their cellular networks while overcoming the backhaul bottleneck.

AbsoluteAir products are available for operation in the 2.5-2.7 GHz band and the 3.3-3.8 GHz band as separate SKUs.

Figure 1 shows a CN .

Figure 1. Concentrator Node (CN)

3.1 Deployment Configuration

Two AA2 devices (CN and EN) make up a complete link. In point-to-multipoint (PMP) scenarios, the system consists of up to four independent point-to-point (PTP) links operating on one frequency channel with the CN devices mounted together at the same location. The CN and EN carry bi-directional Ethernet traffic across the radio link.

3.2 Non-Line-of-Sight, Point-to-Multipoint Backhaul

AbsoluteAir products operate in all propagation morphologies and conditions. They operate at the same capacity and link rate regardless of the type of multipath, whether it is characterized as non-line of sight (NLoS), near line of sight (nLOS), or line of sight (LOS). The advanced signal processing and the state-of-the art antenna technology is able to re-assemble all wavefronts and eliminate destructive fading. The processing is very thorough; it comes within 1 dB of the channel equalization limit.

The NLoS property frees network operators from deploying point-to-point (PTP) LOS wireless links with large rooftop microwave dishes that must be carefully engineered, sited, and aligned.

In point-to-multipoint (PMP) scenarios, the system consists of up to four (4) independent PTP links operating on one frequency channel, with the CN devices mounted together at the same location. All these aggregated backhaul links share the same 10 MHz or 20 MHz radio channel, and operate simultaneously at full rate. This is achieved via advanced mutual interference cancellation between links. All the devices at the Concentrator site use multiple, simultaneous AAS beams to collect and concentrate traffic from the four Edge sites. Multiple CN devices can be co-located at a given location. CNs and ENs are never co-located because all CNs transmit at the same time that all ENs receive.

The system capacity of this PMP system in 20 MHz is 800 Mbps (first hop).

3.3 Frequency Bands and Frequency Reuse

AA2 systems operate using TDD in 10 or 20 MHz of unpaired spectrum, and are available in three licensed frequency bands: the 2496 - 2690 MHz band, the 3400 - 3800 MHz band and the 5300 – 5925 MHz band.

The universal frequency reuse pattern allows a single RF channel to be reused for all links in the service area. This is in keeping with the design philosophy to maximize the amount of spectrum available for access and to minimize the amount of spectrum needed for backhaul.

3.4 Key Applications

Cellular Backhaul

AbsoluteAir products enable cellular carriers to expand their networks in rural and urban areas quickly and cost-effectively, which leads to a lower total cost of ownership. AbsoluteAir systems are ideally suited for a broad range of cellular backhaul deployment scenarios. Using the system's key wireless enhancements, including NLoS, auto-alignment, and interference cancellation, allows carriers to extend network coverage, densify their existing network, and deploy small cells in otherwise challenging environments.

IP Backhaul

The AbsoluteAir radio series offers a unique, highly scalable and cost-effective backhaul solution. Designed to suit a wide range of topologies, AbsoluteAir is easy to install and maintain, enabling wireless operators to expand their networks and introduce new services to a growing subscriber base.

Private Networks

AbsoluteAir is the ideal solution for private networks such as enterprises and organizations that want to own and manage their own networks and eliminate recurring charges from local service providers. The cost-effective AbsoluteAir solution enables a variety of organizations to connect geographically dispersed sites at ranges of up to 10 km.

4 Deployment Overview

4.1 Electrical Power

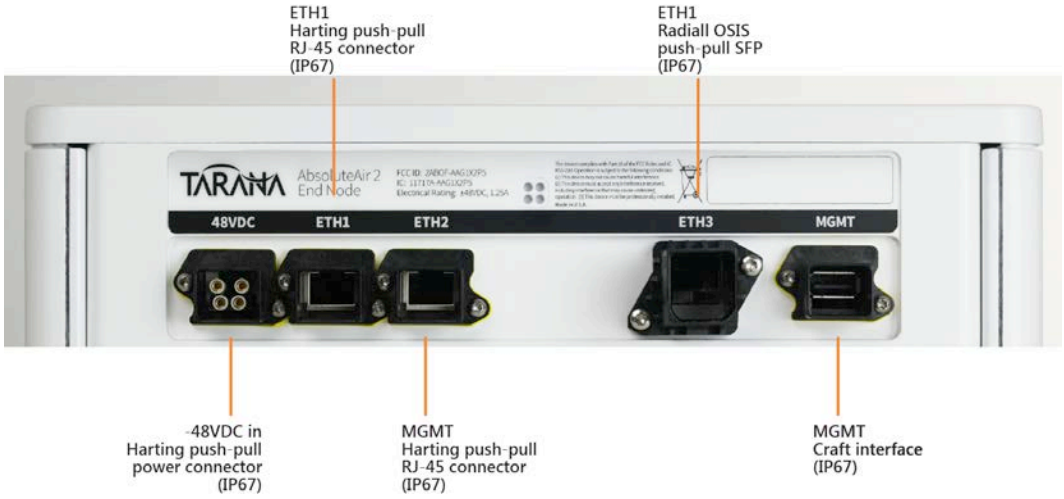
Electrical power is supplied to the devices through a 4-pin connector. Usually a red wire in the cable carries the most positive voltage to pin 1 and a black wire in the cable carries the most negative voltage.

Table 5 and Figure 2 show the CN and EN electrical interfaces.

Table 5. CN and EN Electrical Interfaces

Interface	Specification
Power	1X - Push-pull power connector, 48 VDC, 3 pole, 1.25 A, IP67
Ethernet (Electrical)	2X - Push-pull RJ-45 connector, 1000BaseT, IP67
Ethernet (Optical)	1X - Push-pull SFP connector, 1000BaseFX or 100/1000BaseT IP67
Console/Maintenance	1X – USB port
Electrical Ground	1X - Standard telecommunications equipment two hole lug (2 X M6) 1X - single hole lug (M6)

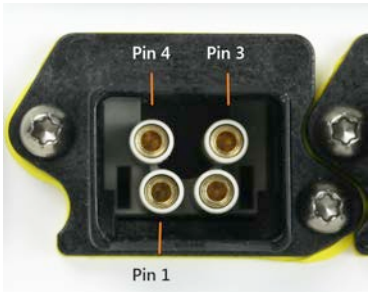
Figure 2. CN and EN Electrical Interfaces



Pin 1 is +48 V compared to pin 4, or pin 4 is –48 V compared to pin 1. Pin 1 and pin 4 are isolated from the chassis ground, while pin 3 is connected to chassis ground inside the device. Pin 3 of the cable must be connected to earth ground on the other side of the cable. The following figures show the numbering of the pins in the cable connector and the chassis connector.

Figure 3. Power Connector, Cable View

Figure 4. Power Connector, Chassis View



The power supply for the unit is rated at 90 W (1.8 A @ 48 V). The power consumption is a function of the percentage of the time that a unit transmits. For example, for a configuration with DL:UL ratio 1:1, the CN typically consumes 46 W and the EN consumes 38 W.

4.2 Power and Data Options

The device has three data connectors.

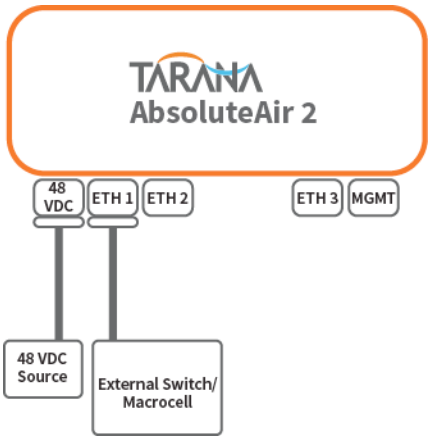
Table 6. Data Connectors

Connector	Power	Data Traffic	Management
Eth1 port	Yes (via Tarana PoE)	Yes	Yes (Management by VLAN)
Eth2 port	Yes (via Tarana PoE)	Yes	Yes (Management by VLAN)
Eth3 port (SFP)	No	Yes	Yes (Management by VLAN)

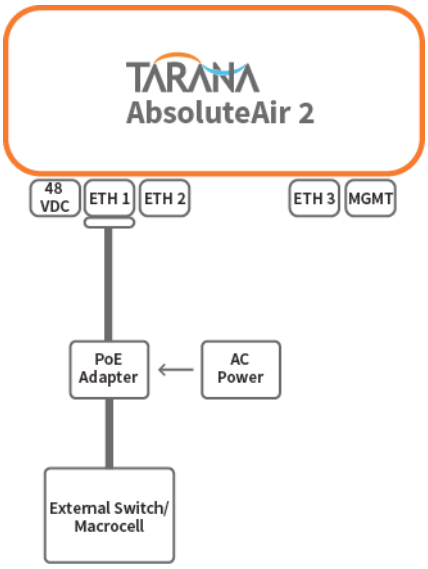
All the 3 Eth ports can be used to bring in Gigabit ethernet traffic for the link. So a variety of 3 different data sources can be multiplexed here. The two Ethernet ports, Eth1 and Eth2 are equipped to provide power over ethernet (PoE) for the device. By bringing in PoE to the device, the power connection through the dedicated power cable(as discussed in the previous section) can be avoided.

As a result, to connect the unit to a single data source, the following two ways can be used.

1. Dedicated power and dedicated Data connection



2. Single Data connection connected through PoE



By default, Tarana units use the native VLAN 1 for management purposes. So, no dedicated interface formanagement is necessary.

5 Pre-Provisioning

The provisioning tasks described in this section can be done before AA2 Units are installed to the field.

Map out unit locations and requirements (physical locations, power, and data availability). You can collocate 1 to 4 EN_M devices on a pole that has network connectivity, and locate the EN_S devices separately at locations that do not yet have network connectivity. You must locate the EN_S devices for a given cell closer to the EN_M devices for that cell than for any other EN_M nodes in any other cells.

To prepare for installation in the field:

1. Complete any network planning and site acquisition activities.
2. Complete the pre-planning sections of the commissioning sheet from Commissioning Plan / Checklist (Appendix C).
3. Perform the pre-provisioning tasks described in this section.

5.1 Required Information for Pre-Provisioning

- Center frequency of the channel.
- Link code. Each EN_M must have a unique link code, and all EN_S devices that connect to that EN_M must have the same link code. See Network Link Code Planning (Appendix B) for details.
- The bank is the cell field of the link code modulo 4. Do not assign the same bank to two adjacent cells.
- Network profile. Use the same network profile for all backhaul nodes in the network, including uplink/downlink ratio and cyclic prefix size.
- Management interface static IP address/DHCP and any dedicated VLAN for system management by IP.

5.2 Pre-Provision Using the Command Line Interface

Note Commands are shown in **Bold** command font and sample values are shown in ***Bold Italic***.

1. Connect one end of an Ethernet cable to any of the Ethernet ports. Connect the other end of the cable to a laptop. Configure the static IP address 192.168.10.10/24 for the laptop. The default EN_M or EN_S IP address is 192.168.10.2.

2. SSH into the device as user operator and password Operator$123.

   ```
   $ ssh operator@192.168.10.2
   ```

3. Enter configuration mode.

   ```
   tws# configure terminal
   tws(config)#
   ```

4. Change password (recommended).
   tws(config)# user *operator* password *newPassword12*

5. Set the mode (master/slave), frequency (MHz) , profile (0) , link code (group-id.set-id.cell-id.link-id). See Network Link Code Planning for more information on the link code.

   ```
   tws(config)# quick-setup node-mode slave frequency 2515.0
   profile 0 link-code 1.0.0.1
   ```

6. Unmute the transmitter.

   ```
   tws(config)# radio tx-opmode on
   tws(config)# end
   tws#
   ```

7. Verify the settings.

   ```
   tws# show radio config
   cory-mlk-slave# show radio config
   Carrier Freq, MHz:        2560.000
   Network Profile:          1 (5 ms frame at 1:1)
   Link Code:                0.0.1.3
   Max Tx Power, dBm:        37.0
   Tx Op Mode:               On
   ....
   ```

8. If the other end of the link is already configured and powered on, you can verify in a couple of minutes if the link has come up(*Track)*.

   ```
   tws# show rf-interface 0 status
   Link ID:                  0
   Link Code:                0.0.1.3
   Link State:               UP (track)
   Frame Number:             3819530
   Link Uptime,:             40s
   ```

```
...
```

9. Save the settings.

```
tws# configure terminal
tws(config)# configure save
Configuration saved
tws(config)# end
tws#
```

10. Configure a static or dynamic IP address.

    Enter the VLAN configure mode using the default VLAN ID 1

```
tws(config)# interface vlan 1
```

    For static assignment, modify the following command as needed. The first 4-tuple is the IP address and the second 4-tuple is the subnet-mask.

```
tws(config-if)# ip address 10.100.10.22 255.255.255.0
```

    For dynamic addressing, use the following command, and verify the MAC address to IP address mapping in the DHCP server.

```
tws(config-if)# ip address dhcp
```

11. Apply and save the configuration. Connectivity to the device is lost.

```
tws(config)# configure save
Configuration saved
```

12. Power the device down. It is now ready for installation in the field.

6 Quick Install

Following pre-provisioning, installation in the field requires only the following:

- Hardware mounting
- Power and data connection
- RF Link optimization

Additional configuration, such as quality of service (QoS), can be configured from the EMS or command line interface (CLI). See the *User Guide* for more information.

Follow these guidelines when mapping out device locations and requirements (physical locations, power, and data availability):

- Collocate up to 4 EN_M units on a pole that has network connectivity.
- Locate EN_S units separately at locations that don't yet have network connectivity.
- Locate the EN_S for a cell closer to the EN_M for that cell than to the EN_M for any other cell.

Field installation consists of the following tasks:

1. Verify that tools are available
2. Check package contents
3. Mount the unit
4. Connect data cables and power the unit
5. Perform link alignment

6.1 Verify That Tools are Available

Required installation tools

- Two 13mm combination wrenches (one side full round, other side open-ended) or one 13mm socket wrench and one 13mm combination wrench
- One 5mm Allen driver or wrench (for mini bolt clamps)
- One T9 Pin in Torx driver (console cover screws)
- One T30 Torx driver (elevation adjustment bracket)

Optional tools

To field terminate the push-pull cable connector:

- Harting 09468000000 Power Cable Contact Crimping Tool
- Harting 09468000098 Power Cable Contact Removal Tool
- Harting 09468000099 Power Cable Contact Insertion Tool

To field terminate the shielded RJ-45 connector:

- Sentinel 900005 RJ-45 Crimping Tool w/900216 die set

Add description for USB serial cable, USB WiFi device

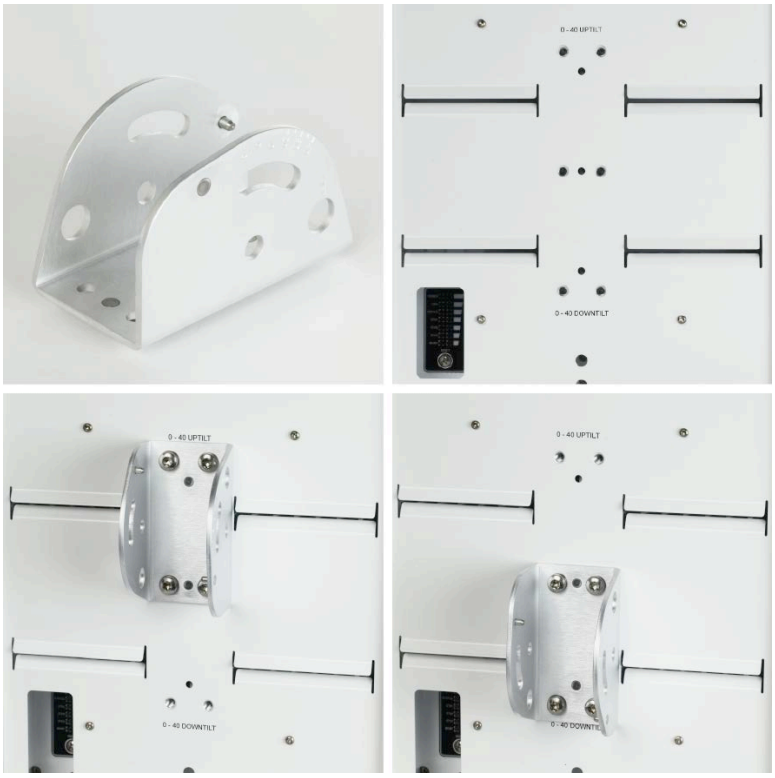
6.2 Check Package Contents

Verify that the contents of the shipping container match the items listed on the shipping list, including the model numbers and identification of EN_M and EN_S units.

6.3 Mount the Unit

To allow for proper link alignment, always install the EN_M prior to installing associated EN_S units. See Section 6.5 for details on the link alignment process.

1. Position the elevation adjustment bracket on the elevation adjustment plate on the back of the device. Markings on the plate indicate the proper location for up tilt or down tilt orientation. There is only one way to position the bracket for each orientation so that the four mounting holes are aligned.



2. Attach and tighten the elevation adjustment bracket using a Torx T30 screwdriver and four M6 machine screws. Torque these screws to 42-60 in-lb (5-7 Nm).
3. If the pole mount kit has not already been assembled, place one RIPP lock washer in the each of the counter bores of the pole-mount gimbal. Insert the pole-mount gimbal into the pole-mount bracket and hand tighten using the azimuth adjustment bolt and nut.

4. Slip two Band-It mini bolt clamps through the pole bracket to complete the pole mount kit.

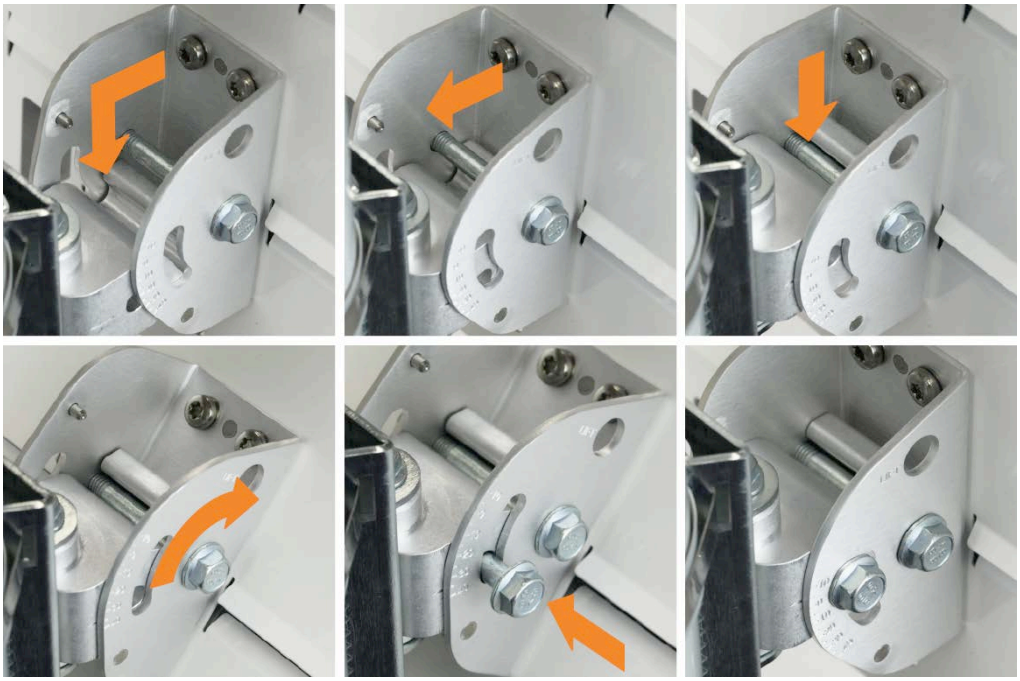
5. Attach the pole mount kit to the pole with the gimbal hook facing upward. To install the mini bolt clamps, insert the band through the slot under the Allen head locking bolt. Pull the band through the slot until nearly tight, then fold over the band at the edge of the locking bolt/slot. Torque the locking bolt with the 5mm Allen wrench to 42-44 in-lb (4.75-5 Nm). Clip off excess band if required. Partially tighten the tension bolt to secure the mini bolt clamp to the pole. Do not tighten completely, as you might want to adjust the location later as part of signal optimization.

6. The node has lifting holes on the elevation adjust plate. To keep the node from falling during installation, use a safety clip with a lanyard to tether the node to the pole structure.

7. Orient the node so that the product label is on the bottom. Position the node on the pole so that the hanger bolt on the elevation adjustment bracket slips onto the gimbal hook.

   The node should be in maximum downtilt position (regardless of uptilt or downtilt orientation) and hang freely (swivel freely up and down). There will also be some horizontal give because the azimuth adjustment bolt was only hand - tightened. When hanging the node, the gimbal must enter the two mechanical stops (a slight uptilt allows the node to be inserted between the two mechanical stops)

Verify that the hanger bolt is fully hanging on the gimbal hook.



8. Slide the elevation adjustment bolt through the gimbal and hand tighten. Do not torque the bolt at this time, as you might want to adjust the location later as part of link alignment. After the alignment has been completed, the torque applied to the nuts should be 25 ft-lb (33 Nm).
9. Rotate the node tilt to the desired elevation and hand tighten. Do not torque the bolt at this time, as you might want to adjust the location later as part of link alignment later on. After the alignment has been completed, the torque applied to the nuts should be 25 ft-lb (33 Nm).
10. Hand tighten the hanger bolt. Do not torque the bolt at this time, as you might want to adjust the location later as part of signal optimization.

6.4 Connect Data Cables and Power Up

1. Ground the unit by attaching the grounding wire assembly to the device and to earth ground in accordance with local electrical code requirements.

2. Remove the dust covers from the Power and required ETH ports. Push the data cables in until they click into place.

The unit supports 48 VDC or PoE power (see “Power and Data Options”). If you are using the 48V DC power option, remove the dust cover from the power connector and leave it hanging. Insert the 48 VDC power cable into the node and push until the cable connector clicks into place. (If you need to remove the cable press on the side and pull, no tools are required).

3. Attach the device to external power (48 VDC or PoE). As soon as the unit is connected to a power source, it powers up automatically.

   Notice the changes in the LEDs during power-up. The Power LED will be Red Solid for 2 seconds first. All LEDs will then quickly cycle through all colors. When the unit is successfully powered, the POWER LED is solid green.

   See “Interface Management

Section 2 in primer

Sections 6.1 & 6.2 (the basics)

7 Configuration and Software Management

Section 7 & 8 from primer

Configuration Management

Software Upgrade

8 Event and Alarm Management

Section 9 from primer & 11.1

9 Advanced Ethernet Management

Section 10

Troubleshooting" for information on troubleshooting during power-up.

Table 7. LED Status Values

LED	Status	Description
STATUS (shows errors and alarms)		
	Off	Powered off and during boot
	Red :Blinking	Reserved
	Red :Solid	Runtime errors of critical nature - HW failure has been detected - Link might be down and watchdog may be triggered
	Amber: Blinking	Reserved
	Amber: Solid	Runtime warnings and alarms that can be cleared - GPS is in holdover - Modulation change detected - Packet errors above threshold
	Green: Blinking	Configuration change or Software upgrade in progress
	Green: Solid	No Errors / No Alarms
POWER (shows power and boot status)		
	Off	Powered Off / No Power detected
	Red :Blinking	Reserved
	Red :Solid	Boot failure in POST, boot-loader or OS - Will trigger a watchdog reboot
	Amber: Blinking	Booting in progress

LED	Status	Description
	Amber: Solid	Reserved
	Green: Solid	Successfully boot and system is powered on
	Green : Blinking	Reserved
STATUS (shows link status)		
	Off	Powered off or during boot
	Red: Blinking	Reserved
	Red: Solid	Tx Muted
	Amber: Blinking	Radio is initializing
	Amber: Solid	Master - Radio is waiting for Slave Slave - Radio is searching for Master
	Green : Blinking	Master - Radio is ranging the Slave in Slave - Radio is trying to range in to Master
	Green: Solid	RF Link Up
ETH1 (shows status of the Copper Eth1 port)		
	Off	Not connected / Down
	Yellow : Solid	100 Mbps
	Yellow: Blinking	100 Mbps / Activity
	Green : Solid	1000 Mbps
	Green : Blinking	1000 Mbps / Activity
ETH2 (shows status of the Copper Eth2 port)		
	Off	Not connected / Down
	Yellow : Solid	100 Mbps
	Yellow: Blinking	100 Mbps / Activity
	Green : Solid	1000 Mbps
	Green : Blinking	1000 Mbps / Activity
ETH3 (shows status of the SFP Eth3 port)		
	Off	Not connected / Down
	Yellow : Solid	100 Mbps
	Yellow: Blinking	100 Mbps / Activity
	Green : Solid	1000 Mbps
	Green : Blinking	1000 Mbps / Activity

9.1 Link Alignment

The EN_M is always installed prior to the EN_S. The EN_M is pointed directly towards the eventual location of the EN_S as if the link were an LOS link. Using a compass, e.g. Smartphone, the installer then aligns the EN_M to point according to the azimuth and tilt rows in the completed Appendix C table. For severe NLoS links, the EN_M might need to be pointed slightly

away from the planned azimuth to avoid nearby buildings and pointing towards the potential reflector.

The following steps should be performed at the EN_S location. It is assumed that the other end of the link is installed, fully commissioned, and powered up.

EN_M location

Point the EN_M directly towards the intended EN_S location using a compass according to the azimuth and tilt rows in Appendix C.

EN_S location

Before following this procedure, verify that the EN_M end of the link is installed, fully commissioned, and powered up.

1. Remove the USB cover by removing the Push-pull console cap. This exposes the USB port.

2. Attach a USB WiFi dongle to the USB port.
3. Connect your laptop or other portable device to the WiFi SSID (tarana-<Device SERIAL_NO>). The EN_S can now be reached from the device at http://<IP address>. Verify that the link is in Tracking state.
4. Rotate the EN_S 360 degress around the mount. Observe the peak measured link quality. Then rotate the EN_S back to the position of maximum link quality.When the device is positioned for best alignment, tighten the bolts and nuts associated with azimuth and elevation adjustment to 25 ft-lb (33 Nm) of torque.
5. Reattach the console cover.

10 CLI and Management Basics

CLI – refer to section 1 primer and section 8.1 user guide

SNMP – Akash (protocols we support, MIB, root OID, etc – needs to be written up)

Web UI – Steven

Section 4 & 6.3 from primer

11 Radio Link Management

The Command Line Interface (CLI) can be used to configure and monitor your device from a remote terminal using ssh (Secure Shell).

This Section describes the usage of the Tarana CLI along with the most important commands for link configuration, monitoring and debugging.

Note See the AbsoluteAir CLI Guide for detailed instructions about all supported commands.

11.1 Logging in to the CLI

To log in to the device's CNS interface, ssh with one of the following usernames or the one allocated to the user.

Example to login to a device with its default IP address:

```
$ ssh admin@192.168.1.10
```

The following are the default user names and passwords.

User name	Password
Admin	Admin$123
Operator	Operator$123
User	User$123

Example login:

```
$ ssh admin@192.168.1.10
admin@192.168.1.10's password:********
tws#
```

The user exec mode is now available to the user. The command prompt always displays the current mode.

CLI commands need not be fully typed. The abbreviated forms of CLI commands are also accepted. For example, commands such as **`show radio config`** can be typed as **`sh rad con`**.

CLI commands are case insensitive. Appropriate error messages will be displayed, if the command fails.

After a link is up, 169.254.3.1 is the IP address of any EN-Master from its slave. Likewise, 169.254.3.2 is the IP address of the EN-Slave when accessed from its master. For example, to access the slave, at the EN-Master's `tws` prompt, enter:

```
tws# ssh admin@169.254.3.2
```

11.2 Commands for Configuration

Enter config mode:

```
tws# configure terminal
tws(config)#
```

Exit config mode:

```
tws(config)# end
tws#
```

Use the following commands to configure AbsoluteAir devices from config mode.

quick-setup

Set up the RF link with a single command.

Syntax

```
quick-setup node-mode {master | slave} {frequency <float>}
{profile <integer>} {link-code <group_id.set_id.cell_id.link_id>}
```

Parameter Description

Parameter	Description
`{master | slave}`	Specifies the device type (master = CN, slave = EN).
`frequency <float>`	Specifies the frequency in MHz. Range: 2500.7 MHz-2685.3 MHz.
`profile <integer>`	Specifies the profile ID(0/1), Profile 0- 1:1 (DL:UL ratio)-5ms(frame time)-64 (CyclicPrefix length) Profile 1- 3/2 (DL:UL ratio)-5ms (frame time)-64 (CyclicPrefix length)
`link-code <group_id.set_id. cell_id.link_id>`	Specifies the following: group_id range: (0-65535). set_id (0-3). cell_id (0-23). link_id (0-5). For details, see Appendix B, Network Link Code Planning.

ip address

Enter the VLAN configure mode from the config mode and use the below command to specify the static IP address or set the interface as a DHCP client.

Syntax

```
ip address {{<ucast_addr> <ip_mask>} | dhcp}
```

Parameter Description

Parameter	Description
{<ucast_addr> <ip_mask>}	Specifies the static IP address and the subnet mask.
dhcp	Specifies DHCP addressing.

Example

```
tws(config)# interface vlan 1

tws(config-if)# ip address 10.100.10.22 255.255.255.0
tws(config-if)# end
tws# show ip interface
      vlan1 is up, line protocol is up
      Internet Address is 10.100.10.22/24
      Broadcast Address  10.10.12.255
      Vlan counters disabled
tws#
```

Note

Use “no ip address” command before switching from DHCP to static command.

configure default

Reset the EN configuration to the factory default configuration. This command is usually followed by rebooting the system to boot up with the default settings.The following are set by this command:

- IP interface type: static
- IPv4 address: 192.168.10.2
- IPv4 subnet mask: 255.255.255.0
- IPv4 gateway: 192.168.10.1
- Node mode: Slave
- Node tx-opmode: off (muted)
- Link-code: 1.2.0.0
- Network profile: 0 (DL: UL ratio of 1:1 with cyclic prefix ratio of 1/16)
- Center tuned frequency: either 2595 or 3670 MHz (based on frequency band of the EN)
- Management VLAN ID: 1
- Data PVID: 2

Syntax

```
configure default
```

Example

```
tws(config)# configure default
tws(config)# end
tws# reboot
```

conf export-url

export the current configuration of the EN into a file and save it at the specified place.

Syntax

```
conf export-url <string>
```

Parameter Description

Parameter	Description
<string>	Specifies the URL in the form sftp://uid:pid@host/filename where • host: ip address of the machine • uid: username to login the machine • pid: password to login the machine • filename: name the config file.

Example

```
tws# rf conf export-url
sftp://lab1:lab1password@172.17.1.56/config_en
```

gps

Set GPS parameters for a slave device. Master device gets these values from its GPS.

Syntax

```
gps { latitude <string(10)> | longitude <string(11)> | elevation
<string(9)>}
```

Parameter Description

Parameter	Description
`latitude <string(10)>`	Specifies the latitude in format +/-XX.XXXXXX.
`longitude <string(10)>`	Specifies the latitude in format +/-XX.XXXXXX.
`elevation <string(9)>`	Specifies the elevation in meters.

Example

```
tws(config)# gps latitude 37.7833
tws(config)# gps longitude 122.4167
```

rf-interface

Configure RF node parameters.

Syntax

```
rf-interface {link-id <0-3>} { link-code <group_id.set_id.
cell_id.link_id> |
encryption-type <integer (0-1)> |
encryption-key <integer (1-65535)> | target-snr <float> | reset}
```

Parameter Description

Parameter	Description
`acm { enable | disable }`	Enables adaptive coding and modulation (ACM) on the RF link.
`mcs-dl <integer (5-12)>`	Specifies the maximum modulation for the downlink. If ACM is on, this is the maximum. If ACM is off, it is the configured value. Permissible values are: 5 16QAM-2/4 6 16QAM-3/4 8 64QAM-4/6 9 64QAM-4.5/6 10 64QAM-5/6 12 256QAM-6/8
`mcs-ul <integer (5-12)>`	Specifies the maximum modulation for the uplink.
`link-code <group_id.set_id. cell_id.link_id>`	Specifies the following: group_id range: (0-65535). set_id (0-3). cell_id (0-23). link_id (0-5). For details, see Appendix B, Network Link Code Planning
`encryption-type <integer (0-1)>` `target-snr <float>`	Specifies the encryption type for the link. 0=none, 1=AES Specifies the target signal - to - noise ratio (SNR) for the receiver.
`reset`	Resets the link.

Example

```
tws(config)# rf-interface 0 link-code 1.0.2.4
Code        = 0x824
tws(config)# rf-interface 0 target- 1.0.2.4
tws(config)# conf save
```

radio

Configure network parameters for the device.

Syntax

```
radio { frequency <float(2501-2685 | 3405-3795)> | profile
<integer(1-2)>}
```

Parameter Description

Parameter	Description:
`frequency <float>`	Specifies the frequency in MHz. Up to to 1 decimal digit (0.1 MHz resolution). If 20 MHz channel BW, the range is 2506.0 MHz-2680.0 or 3410 - 3790 MHz based on frequency band of the device.
`profile <integer>`	Specifies the profile ID (1/2)
`profile 1`	1/1 (DL/UL ratio) 5 ms (frame time) 64 (Cyclic Prefix length)
`profile 2`	3/2 (DL/UL ratio) 5 ms (frame time) 64 (Cyclic Prefix length)

Example

```
tws(config)# radio frequency 2525
% Frequency will be set to nearest permitted value 2525.0
tws(config)# radio profile 1
tws(config)# end
tws#
```

radio max-permitted-pa-power

Set the maximum total power output from all of the RF power amplifiers. This command is used to limit the total transmit power. For example, a 500 m LOS link should use less transmit power than a 2000 m NLoS link and this command can be used to limit the power of such a link.

Syntax

```
tws(config)# radio max-permitted-pa-power <float>
```

Parameter Description

Parameter	Description
`<float>`	Value of max permitted-pa-power between -50.0 and Max Regulatory Power in dBm

Example

```
tws(config)# radio max-permitted-pa-power 23
```

system node-mode

Set the mode for the device.

Syntax

```
system node-mode {master | slave}
```

Parameter Description

Parameter	Description
`{master | slave}`	Specifies the type of device. `master` uses GPS for synchronization. `slave` doesn't use GPS but rather receives its synchronization over the air from the master.

Example

```
tws(config)#mode master
```

radio tx-opmode

Set the actual transmission operating mode for the device.

Syntax

```
radio tx-opmode { on | off }
```

Parameter Description

Parameter	Description
off	Prevents the device from transmitting.
on	Enables the device to transmit.

Example

```
tws(config)# radio tx-opmode on
```

username

Add users or update passwords.

Syntax

```
username <username> password <newPassword>
```

Parameter Description

Parameter	Description
Username <username>	Use the existing user name to modify the password, or a new user name to add a new user.
Password <newPassword>	Specify the password.

Example

```
tws(config)# username user_123 password Pword123!
```

11.3 Commands for Monitoring

Execute these commands from user exec mode.

show gps

Display GPS information for the device.

Syntax

```
show gps
```

Example

```
tws# show gps
GPS Present:                yes
GPS Status:                 located
GPS Holdover Status:        1
GPS Antenna  Status:        1
GPS SNR,dB:                 47
GPS Latitude:               37.406306
GPS Longitude:              -121.980198
GPS Elevation,m:            0.00
```

show rf-interface <link-id (0-5)> joint-status

Display summary link status for master and slave.

Syntax

```
show rf-interfce <link-id (0-5)> joint-status
```

Example

```
tws# show rf-interface 0 joint-status
                            Local               Remote
State PHY/MAC:              TRACK/TXSFC         TRACK/ATHTCSN
Uptime PHY/MAC, s:          1571.8/1564.8       1572.3/1564.7
SINR, dB:                   26.9                26.9
TX Power, dBm:              14.9                15.1
RX Power, dBm:              -82.3               -76.9
Headroom Ind/Total, dB:     17.2/28.2           17.8/22.4
Pathloss UL/DL, dB:         119.8/119.8
Range, m:                   34
MCS DL/UL:                  12/12
CRC Errors :                0                   0
```

show radio config

Display RF link configuation for the device.

Syntax

```
show radio config
```

Example

```
tws# show radio config

      Profile:                        0 (18_18)
      Frequency, MHz:                 2526.0000
      Channel Width, khz:             10000
      Link code, GID.SID.CID.LID:     1.0.1.1 #(0x811)
      -------------------------------
      Frame Time, us:                 5000
      CP Length:                      64
      Tx Op mode:                     on
      Tx Max Regulatory Power, dBm:  99.0
      Tx Max Permitted PA Power, dBm:37.0
```

show radio status

Display the RF system information pertaining to the device.

Syntax

```
show radio status
```

Example

```
tws# show radio status

      Min Frequency, MHz:             2496.0000
      Max Frequency, MHz              2690.0000
      Downlink Symbols:               21
      Uplink Symbols:                 20
      Disabled Antennas:              0
      Antenna Status:                 Operational
```

show rf-interface <link-id (0-5)> config

Display RF link configuration for the device.

Syntax

```
show rf-interface <link-id (0-5)> config
```

Example

```
tws# show rf-interface 0 config

Link ID: 0
-------------------------------
ACM:                    ON
MCS DL:                 1024QAM-8/10
MCS UL:                 1024QAM-8/10
EncryptionType:         0
EncryptionKey:
Tx Power, dBm:          -82.4
Code,GID.SID.CID.LID: 1.0.1.1 #(0x811)
Remote IP:              10.100.12.19
Remote MAC:             04:F1:7D:80:06:19
Target-SNR, dB:         28.0
```

show rf-interface <link-id (0-5)> status

Display RF link configuration for the device.

Syntax

```
show rf-interface <link-id (0-5)> status
```

Example

```
tws# show rf-interface 0 status

Link ID: 0
-------------------------------
PhyState:               TRACK
BasebandState:          UP
Range, m:               139
Headroom, dB:           30.2
Up Time, s:             126
```

11.4 Upgrading the System Software

Use these commands to upgrade the system software. Replace the sample parameters in italics with values for your installation.

Start the download of the software image and wait for it to successfully finish.

```
tws(config)# sw-upgrade download start
sftp://USER:PASSWORD@SERVER-IP-ADDRESS/SYS_VERSION.tbn
      Downloading image from URL: sftp://USER:PASSWORD@SERVER-IP-
      ADDRESS/SYS_VERSION.tbn
      Download started. Check status through "show sw-upgrade"
tws(config)# end
tws# show sw-upgrade
      Download Status:              Inprogress
      Upgrade Status:               Idle
tws# show sw-upgrade
      Download Status:              Success
      Upgrade Status:               Idle
tws# configure terminal
```

Start the upgrade of the software image and wait for it to successfully finish.

```
tws(config)# sw-upgrade upgrade start
      Upgrading system
      Upgrade started. Check status through "show sw-upgrade"
tws(config)# end
tws# show sw-upgrade
      Download Status:              Success
      Upgrade Status:               Inprogress
tws# show sw-upgrade
      Download Status:              Success
      Upgrade Status:               Success
```

Reboot the device to switch to the newly installed software image.

```
tws# reboot
```

12 Interface Management

Section 2 in primer

Sections 6.1 & 6.2 (the basics)

13 Configuration and Software Management

Section 7 & 8 from primer

Configuration Management

Software Upgrade

14 Event and Alarm Management

Section 9 from primer & 11.1

15 Advanced Ethernet Management

Section 10

16 Troubleshooting

16.1 Accessing the USB Serial management console

Remove the push-pull plastic console cover by pulling it out. This exposes the USB port. Connect a USB serial cable and use the following IP address to connect to the device console.

- Baud Rate: 11500
- Data Bits: 8
- Parity: Odd
- Stop Bit: 1
- No Flow control

16.2 Debugging

Low link quality (SNR)

- Use the alignment app to adjust the ends of the link.
- Verify that cell size is set appropriately on nearby links.

Fluctuating modulation

- Increase the target SNR/SNR margin

Link does not come up

- Check cables
- Check power
- Check link code
- Check bandwidth
- Check frequency
- Check GPS lock
- Check that master is in ranging and slave is in acquire state, if not, wait then reboot

16.3 Reset

Configuration Reset

Open the screw for the Reset button. To actuate the reset button, use a straightened paper clip or similar object.

This externally accessible reset button is used to perform one of three different actions:

Soft reset: A soft reset is triggered by pressing the reset button for 1 second and letting go. Execute a soft reset while keeping all software and configuration intact.

a. The IP address will be reset to default to allow access in the event of a forgotten password or IP address.
b. The CLI management passwords will be reset to default
c. The Web interface passwords will be reset to default.
d. The SNMP read/write/trap community strings will be set to defaults.
e. The CLI prompt will be reset.

Config reset: A configuration reset is triggered by pressing and holding the reset button down for 6 seconds. Perform a configuration reset where the software release remains the same but all configuration files are reset to factory defaults. The unit will reboot automatically.

Factory reset: If pressed at power-on, perform a full factory reset where all software and configuration is reset to factory defaults.

Figure 5. Location of Reset Switch

Appendix A Ordering and Service

To maintain your AbsoluteAir radio with a minimum of down time, ensure that you have adequate spares on hand at all times. Faulty devices must be returned to Tarana for repair.

Customer Service

Please email `support@taranawireless.com` for support related queries.

Ordering Information

Spares should always be ordered with the initial equipment order. When ordering, refer to the *Ordering Guide*. If a part is not listed, please contact your Tarana sales representative (sales@taranawireless.com).

Model	Description
AAG1-M25X	AbsoluteAir Gen2 2.5 - 2.7 GHz Edge Node Master
AAG1-S25X	AbsoluteAir Gen2 2.5 – 2.7 GHz Edge Node Master
AAG1-M36X	AbsoluteAir Gen2 3.3 - 3.8 GHz Edge Node Master
AAG1-S36X	AbsoluteAir Gen2 3.3 - 3.8 GHz Edge Node Slave

Customer Training

Tarana Wireless provides training on installation, configuration, commissioning and troubleshooting as necessary. All training requirements must be quoted by Tarana's Customer Support.

Appendix B Network Link Code Planning

For an EN_M to communicate with an EN_S, they must have the same link_code. The link code must be unique to the EN_M/EN_S pair.

A link_code consists of the following numbers: group_id, set_id, cell_id, and link_id.

Plan the assignment of link codes in the network before installing any EN devices. Divide the network into groups, sets, cells, and links, with groups as the largest division and links as the smallest division.

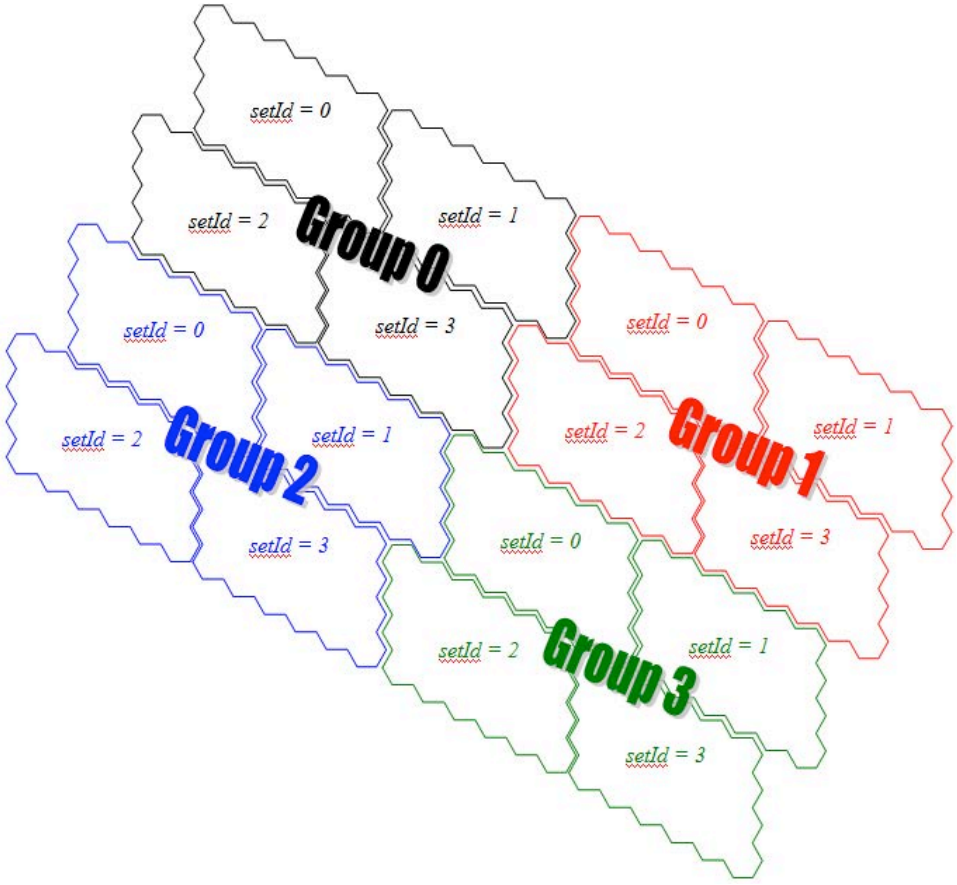
group_id

group_id ranges from 0 to 65535, and a typical metropolitan service area consists of several groups. From an IP perspective, place the nodes in a given metropolitan service area in the same same subnet.

set_id

set_id range values are 0-3. Figure 6 shows 4 adjacent groups and 4 sets within each group.

Figure 6. Sets and Groups



cell_id

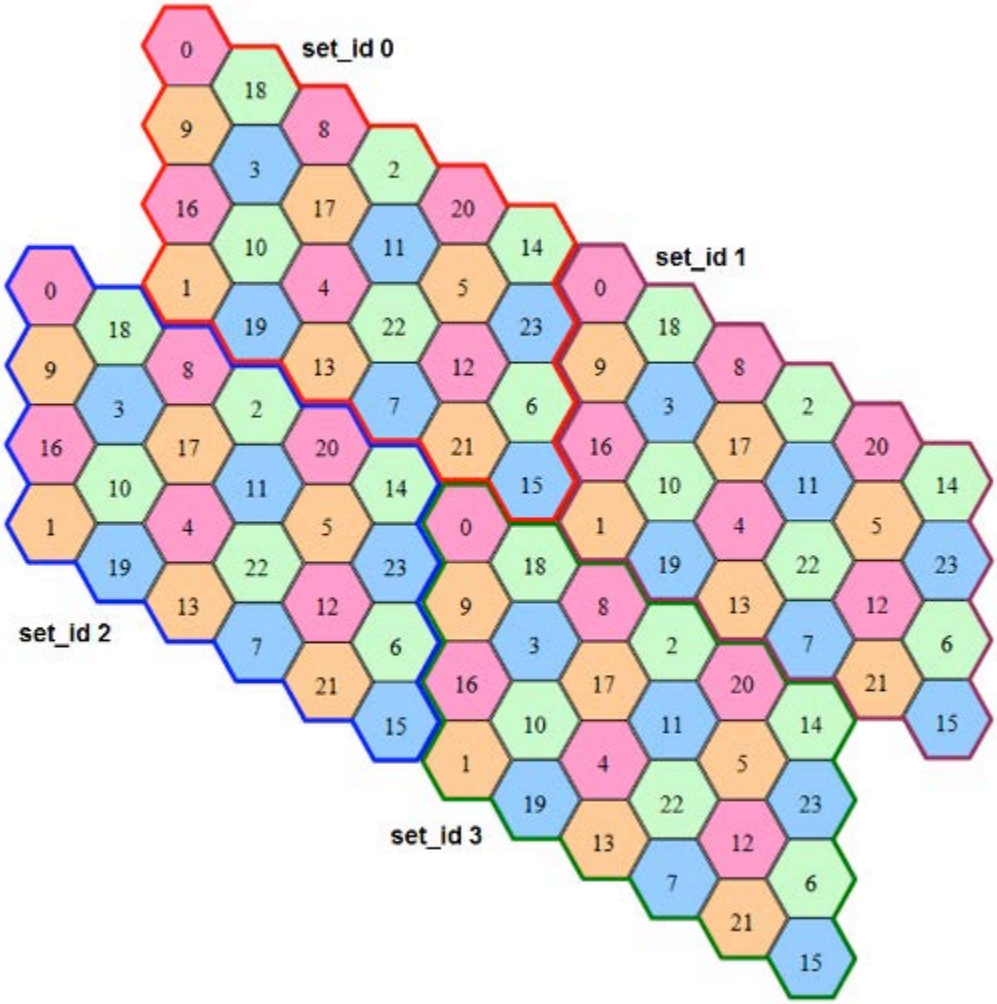
cell_id ranges from 0 to 23 in each set.

The center of a cell is usually a tall building or a tower with up to 6 EN_M devices installed. The communication protocol is designed for co-located EN_M devices, with EN_S devices dispersed throughout the rest of the cell. The communication protocol does not support two EN_S within a few feet of each other, each attempting to communicate to two EN_M both mounted on a single tower. From the tower's perspective, the various EN_S must be separated in azimuth and 0 degrees of separation is inadequate.

Figure 7 shows 4 adjacent sets and 24 cells within each set. Numbers represent cell IDs. Colors represent the bank, or the geographical reuse of communication codes. No two adjacent cells can have the same bank (color) When assigning cells to geographical coverage areas, maintain the relative geographical relationships between cells with respect to the cell_id.

For example, suppose that north is towards the top of Figure 7. Cell 17 is adjacent and to the north of cell 4, cell 11 is adjacent and to the north-east of cell 4, cell 22 is adjacent and to the south-east of cell 4, and so on.

Figure 7. Cell Geographical Reuse Pattern



You can assign cell numbers to geographical areas as follows.

1. Start with a cell somewhat in the center of the service area and assign it as 3.0, meaning (set_id = 3.cell_id = 0).
2. Assign 2.14 to the cell immediately north-west of 3.0.

3. Assign 0.15 to the cell immediately north-east of 3.0.
4. Assign 1.1 to the cell immediately south-west of 0.15.
5. Continue assigning set_id and cell_id using the figures in this section as a guide, trying to maintain the general relationships between the cell locations

The 4 colors of the cells in For example, suppose that north is towards the top of Figure 7. Cell 17 is adjacent and to the north of cell 4, cell 11 is adjacent and to the north-east of cell 4, cell 22 is adjacent and to the south-east of cell 4, and so on.

Figure 7represent different blocks of codes that the devices use to communicate with each other.

Any two adjacent cells must not have the same bank (color), whether or not they are in the same set. For example, a rose cell (such as cell 4) must not be reused until one travels two cells away (to cell 20, for example). All 6 cells that are adjacent to rose cell 4 are not rose in color, meaning that they each use a different block of communication codes compared to cell 4. Note that cells 8, 12, 16, and 20 are two cells away from cell 4 and reuse the rose block of communication codes.

The second goal in assigning the cell number to a geographical area is to maximize the minimum distance between any two cells with the same block of communication codes (or color).

The bank represents the color in Figure 6.
mod(cell,4) == 0 (cells 0, 4, 8, 12, 16, 20) have rose communication codes,
mod(cell,4) == 1 (cells 1, 5, 9, 13, 17, 21) have tan communication codes,
mod(cell,4) == 2 (cells 2, 6, 10, 14, 18, 22) have green communication codes, and
mod(cell,4) == 3 (cells 3, 7, 11, 15, 19, 23) have blue communication codes.

link_id

link_id specifies the individual links within a cell. A PTP link consists of one EN_M and one EN_S. link_id ranges from 0 to 5. Thus, there up to 6 EN_M at the center of a cell.

For example, if you are deploying a network with 4 links per cell, you could assign a pattern of the following type:
link_id = 0 to the link that has an EN_S to the north of the center of the cell,
link_id = 1 to the link that has an EN_S to the east of the center of the cell,
link_id = 2 to the link that has an EN_S to the south of the center of the cell, and
link_id = 3 to the link that has an EN_S to the west of the center of the cell.

.

Appendix C Commissioning Plan / Checklist

Work Order: [ ]

	AbsoluteAir2 EN-Master	AbsoluteAir2 EN-Slave
Install Plan		
Install date		
Location		
Installer		
Contact person/phone number		
Accessories		
Configuration		
System name		
Bandwidth (10 / 20) MHz		
Frequency (MHz)		
Link-code		
Network Profile		
Max Transmit Power (dBm)		
Model		
Channel bandwidth (MHz)		
Colocation with TD-LTE (y/n)		
# of Collocated EN-Masters		
Site		
Location (latitude, longitude)		
Height, above ground level (m)		
Anticipated tilt (degrees)*		
Anticipated azimuth (degrees)**		
Anticipated link distance (m)		
Mounting		
Wall/pole		
Pole diameter (mm)		

* Positive values mean uptilt, negative values mean downtilt

** Configure compass to use true north

Work Order: _____

	AbsoluteAir2 EN-Master	AbsoluteAir2 EN-Slave
Power		
Power source (indoor / outdoor)		
DC 48 V		
AC 110 / 220 , PoE Inj. connector type		
PoE		
Power cable length to power supply		
Ground wire		
Management		
Inband Management VLAN		
Management cable length		
IP address (Static / DHCP)		
IP address & subnet		
Data		
Data cable length		
Cable type (copper / fiber)		
Data source (eNB, Test Equipment, etc.)		
Commissioning Report		
Actual tilt (degrees)		
Actual azimuth from true North (deg.)		
Reported range (m)		
RF link status (up/down)		
Tx total power (dBm)		
Tx individual headroom (dB)		
Phy RSSI (dBm)		
Phy SINR (dB)		
Modulation		
Ethernet status		
Serial number		

Appendix D LED Status Values

The following table describes the status of the chassis LEDs.

Figure 8. System LEDs

Table 8. LED Status Values

LED	Status	Description
RF SYNC (shows errors and alarms)		
	Off	
	Red :Solid	Errors
	Red :Blinking	Reserved
	Green: Solid	No Errors / No Alarms
POWER/STATUS		
	Off	Powered Off / No Power detected
	Red :Solid	Error at startup, POST Failure
	Red :Blinking	Reserved
	Green: Solid	Successfully Powered on POST success
	Green : Blinking	Reserved
ALIGN (shows link status)		
	Off	Power off
	Red: Solid	Tx Muted
	Amber: Solid	No RF Link
	Green: Solid	RF Link Up
	Green : Blinking	Reserved

LED	Status	Description
ETH1 (shows status of the Eth1 port)		
	Off	Not connected / Down
	Yellow : Solid	10 Mbps
	Yellow: Blinking	10 Mbps / Activity
	Green : Solid	100 Mbps
	Green : Blinking	100 Mbps / Activity
MGMT (shows status of the management port)		
	Off	Not connected / Down
	Yellow : Solid	10 Mbps
	Yellow: Blinking	10 Mbps / Activity
	Green : Solid	100 Mbps
	Green : Blinking	100 Mbps / Activity
ETH2 (shows status of the Eth2 port)		
	Off	Not connected / Down
	Yellow : Solid	10 Mbps
	Yellow: Blinking	10 Mbps / Activity
	Green : Solid	100 Mbps
	Green : Blinking	100 Mbps / Activity

Appendix E Hardware Specifications

Table 9. Radio specifications

Radio	
Frequency (Range)	2.5-2.7, 3.3-3.8, 5.x GHz
Channel Width	10 MHz, 20 MHz
Spectral Efficiency	60 bps/Hz, Universal Frequency Reuse
Modulation	Adaptive modulation and coding schemes: 16QAM-3/4, 64QAM-4/6, 64QAM-4.5/6, 64QAM-5/6, 256QAM-6/8, 256QAM-7.25/8, 1024QAM-8/10
RF Interface	TDD / OFDM
Diversity Supported	Multi Element Space Time Adaptive Processing , XPIC
Downlink : Uplink ratio	3:1, 2:1, 1:1, configurable
Forward Error Correction	CRC, LDPC
Maximum Total Transmit Power	36 dBm
Receiver Threshold (@10^{-6} BER)	-75 dBm QAM256-6/8
Encryption	AES-256

Table 10. Physical specifications

Product	End-Node [EN] - HP	End-Node [EN] - SP
Size (WxHxD)	11''x11.8''x5.2"	9.6''x11.8''x4.4"
Weight	12 lb	11 lb
Power Source	-48 VDC	-48 VDC
Data Interfaces	2xRJ45 1000BaseT, 1x100/1000 Base-FX SFP	2xRJ45 1000BaseT, 1x100/1000 Base-FX SFP
Mgmt Interface	1x USB port	1x USB port
Reset	Push button reset(under a screw)	Push button reset(under a screw)
Status Indicators	7x2 Tri-Color LED for Ethernet(&USB) Speed/Activity, Power, Link, Status	7x2 Tri-Color LED for Ethernet(&USB) Speed/Activity, Power, Link, Status

Table 11. Environmental specifications

Environmental	
Operating Temperature	-40° to +55° C
Storage Temperature(packaged)	-25° to +55° C
MTBF	250,000 hours estimated
Transportation	ETSI EN 300 019-2-2, Class 2.3
Humidity	95% non-condensing
Safety	IEC/EN/UL 60950-1, IEC 60950-22
EMC	FCC Part 15 Class B
Environmental	ETS 300 019-2-4, Class 4.1E
Compliance	FCC C.F.R 47, Part 15, 27, & 90, EN 302-544, RoHS EN 302 544, EN 302 774, EN 301 489-4 RSS-Gen, RSS-192, & RSS-197
Transient Protection	IEC61000-4-2 (ESD) IEC61000-4-5 (Lightning) IEC61000-4-3 (EMI Immunity)
Ingress Protection	IP67
Altitude	3000m [with temperature profile]
Additional Protection	Reverse polarity, surge protection