PHAZR^{TM} 5GAC FWA

RABACK Base Station

RBK6028
RBK6032

Installation and Maintenance Manual

Phazr Document Reference: RBK60xx-xxxxx

Status: Draft

Revision: 0.043

Date: August 3, 2018

Table of Contents

List of Figures

List of Tables

Revision History

Revision Number	Date	Updated By	Revision Notes
0.01	June 26, 2018	Bala Balasekar	Initial Draft
0.02	July 24, 2018	G. Etheridge	Draft
0.03	July 27, 2018	G. Etheridge	Draft
0.04	July 30, 2018	G. Etheridge	Draft
0.041	July 31, 2018	G. Etheridge	Update for FCC
0.042	August 2, 2018	G. Etheridge	Added frequency and channel usage. Updated TOC.
0.043	August 3, 2018	G. Etheridge	Review update

Legal Notice

Information contained herein is the property of Phazr, Inc. and is supplied without liability for errors or omissions. No part of this document may be reproduced, in any form, except as authorized by contract or other written permission from the owner.

Any brand names and product names included in this manual are trademarks, registered trademarks, or trade names of their respective holders.

The contents of this document are current as of the date of publication. Phazr reserves the right to change the contents without prior notice.

1.1 Open Source License Compliance

The product described in this document include Open-Source Licenses and as required per open source license agreements, the open source components are listed here:

Table 1. Open source license compliance

Open Source Software Components	License Type
TBD	

2 Introduction

This document describes the RBK60XX Product for customers and detail the installation, operation and maintenance of the RBK60XX Series Base Station. Intended audience for this document are engineers and technicians installing and operators maintaining and managing after the initial installation.

Latest version of this document may be available by contacting Phazr customer support or visiting Phazr customer support portal.

> **NOTE:** RBK60xx products require professional installation and maintenance. Installation and maintenance requires special skills related to RF and wireless systems, and knowledge of regional and national regulatory as well as safety requirements and standards. Phazr has not approved any changes or modifications to this device by the user. Any changes or modifications could void the user's authority to operate the equipment

2.1 Glossary/Acronyms

The acronyms and terms are used in this document are listed in Table 2.

Table 2. Acronyms and terms

Term	Description
B	
BDS	BeiDou Navigation Satellite System
BPSK	Binary Phase Shift Keying
BTS	Base Tranceiver Station
BW	Bandwidth
C	
C	Celsius
CB	IECEE scheme
CFR	Code of Federal Regulations (USA)
CPE	Customer Premise Equipment
CSMA CD	Carrier Sense Multiple Access Collision Detection
CSV	Comma Separated Value(s)
D	
DFS	Dynamic Frequency Selection
DL	Downlink
E	
ECCAN	Phazr, Inc. proprietary EMS GUI (not an acronym)
EIRP	Effective Isometric Radiated Power
EMS	Element Management System
ETSI	European Telecommunications Standards Institute (France)
F	
F	Fahrenheit

Term	Description
FCC	Federal Communication Commisssion (USA)
FPGA	Field Programmable Gate Array
FWA	Fixed Wireless Access
Ft	Foot (feet)
G	
Galileo	European GPS
Gb	Gigabit
GB	Gigabyte
Gb/s	Gigabits per Second
GE	Gigabit Ethernet
GHz	Gigahertz
GLONASS	Global Navigation Satellite System (Russia)
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GUI	Graphical User Interface
H	
HPW	High Performance Waveguide
Hz	Hertz
I	
I&M	Installation and Maintenance
In	Inch, inches
L	
L2	Layer 2 (data link layer)
lb	Pound, pounds (weight)
M	
Mb	Megabit
MB	Megabyte
Mb/s	Megabits per Second
MHz	Megahertz
MIMO	Multiple Input, Multiple Output
mm	Millimeter
mmW	Millimeter Wave (mmWave)
mS	Milliseconds
MTU	Maximum Transmission Unit
P	
PLL	Phase-Locked Loop
PTP (P2P, PtP)	Point-to Point
Q	
QAM	Quadrature Amplitude Modulation
R	
RF	Radio Frequency
RH	Relative Humidity

Copyright © by PHAZR Inc. 2018   03 August 2018

Term	Description
RSS	Radio Standards Specification (Canada)
Rx	Receive
S	
SFP	Small Form Factor Pluggable (optical transceiver module)
T	
TBD	To Be Determined
TDD	Time Division Duplex
Tx	Transmit
TxRx	Transmit Receive
U	
UL	Uplink
UL	Underwriters Laboratories Incorporated
UV	UltraViolet (radiation)
V	
Vac	Voltage Alternating Current
Vdc	Voltage Direct Current
W	
W	Watts
WiFi	IEEE 802.11B wireless networking (not an acronym)

2.2 **Documentation Icons and Notes**

DANGER: Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING: Indicates a hazardous situation which, if not avoided, could result in death, serious injury or property damage.

CAUTION: Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury or property damage, including data loss.

NOTE: A note contains information or tips that are important and helpful to the user.

3 Contact Information

While this document provides sufficient information for installation, operation and maintenance of this product, there will be additional information our customers may need to address special circumstances. Here are ways you can contact Phazr:

Customer Support Portal to sign up for online account with Phazr for all support needs:

  http://www.phazr.net/support

To Reach Customer Support Personnel:

  Phone: 972-816-3302
  Email: *support@phazr.net*

For User manual, Installation and Maintenance (I&M) Guide, open source information, warranties, and licenses:

  http://support.phazr.net/documents

Software downloads, Release Notes:

  http://support.phazr.net/downloads

For all other general enquiries:

  Phone: 972-816-3302
  Email: *info@phazr.net*
  Web: http://phazr.net/contact-us/

4   RBK60xx Product Description

4.1 **Product Brief**

RABACK® is industry's most advanced 5G base station integrating antennas, multiple radio frequencies, baseband processing and a full featured Ethernet switch, all in a small form-factor passively-cooled and in a weatherproof outdoor enclosure ready to mount.

RBK60xx is a product family of millimeter wave (mmWave) outdoor base stations providing fixed wireless access via client (CPE) devices that connect to these RABACK devices. See Figure 1.
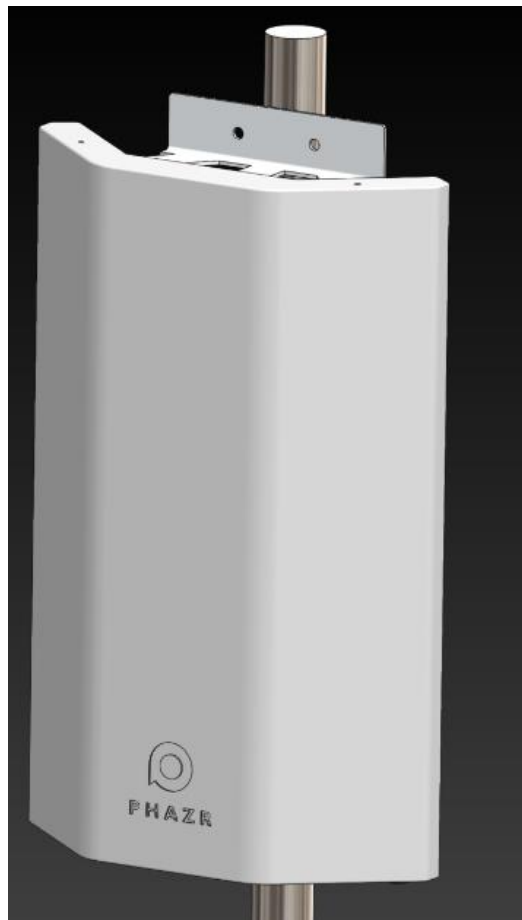
Figure 1. Phazr RABACK Model RBK60xx (front view)

RBK60xx product family employs a Quadplex system to maximize efficiency, not just in spectrum utilization but also in optimizing power consumption and form-factor in base stations as well as in CPEs that connect to these RABACK base stations.

Quadplex allows base stations and CPEs to communicate with each other using both mmWave and 5 GHz frequency bands, in downlink and uplink, respectively. See Figure 2.
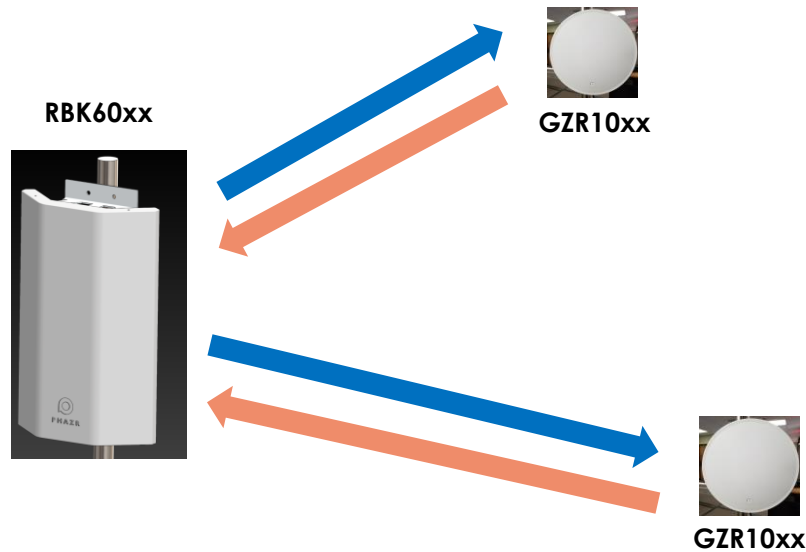
Figure 2. Phazr Quadplex System – Fixed Wireless Access System

Each RBK60xx unit consists of three sub-sectors. Each sub-sector is designed to encompass a 40-degree sector, resulting in 120 degrees of continuous coverage with a single RBK60xx unit.

Further, there are two transmitters and receivers (TxRx) pairs in each sub-sector, for total of six (6) transmitters/receivers per RBK60xx unit, each capable of operating independently.

Frequency (or channel reuse) across these six TxRx pairs further increases the overall system capacity per given frequency spectrum utilized. Combinations of frequency (channels) and bandwidth reuse limitations are documented in the channel plan configuration section.

RBK60xx Base Station consists of four (4) downlink 28 GHz mmWave transmitter chains with two (2) integrated vertically-polarized antennas and two integrated horizontally-polarized antennas. Uplink 5 GHz receiver chains with two (2) integrated vertically-polarized antennas and two integrated horizontally -polarized antennas. Each antenna consists of multiple antenna elements. RBK60xx systems uses 2x2 MIMO in each polarization to increase throughput to/from a specific CPE.

Each TxRx pair, within the frequency duplex channel (DL at mmWave, UL at 5 GHz), operates in TDD (CSMA CD as in WiFi protocol), hence yielding a Quadplex operation.

4.2 Product Models

Products within the RBK60xx product family are listed in Table 3. The difference between them is the mmWave frequency supported, otherwise the specifications are common as described in Section 4.3, Product Specifications.

Table 3. RABACK product models

Product	Model Number	DL MmWave Frequency (GHz)	UL Frequency (GHz)
RABACK 5GAC 28 GHz Base Station	RBK6028	27.500 to 28.350	5
RABACK 5GAC 32 GHz Base Station	RBK6032	31.800 to 33.400	5

NOTE: The RABACK operating frequency bands are licensed with the FCC, however, the operator must obtain a license from the regional licensing authority where the RBK60xx unit will be installed. Note that all products support uplink frequency in the 5 GHz band. Although the 5 GHz band is a license exempt band, regulatory compliance applies. The Operator must determine where and to what extent the regulations apply to its RABACK installations in advance of RABACK deployment. It must then comply with applicable local laws and regulations regarding those bands.

4.3 Product Specifications

Specification that are common to all products in RBK60xx series is provided in **Error! Reference source not found.**.

Table 4. RABACK RBK60xx specifications

Product Attribute	Specification
Peak Aggregate Capacity Ethernet User Data (L2)[1]	6 Gb/s
Total Power Consumption	<240 W
Power Supply[2]	−48 Vdc or 120/240 Vac input; 12 Vdc output
Antenna Connections/Installation	Fully Integrated mmWave; 5 GHz antenna
HPW Beamwidth (Azimuth and Elevation in degrees) (Refer to the following NOTES)[3]	±24˚ and ±10˚
Dimensions	27.2 x 14.5 x 2.7 in (690.88 x 368.3 x 56.58 mm)
Weight	44 lb (19.96 kg)
Operating Temperature	−40˚ to +55˚ C (−40˚ to +131˚ F)
Humidity	99% RH
Altitude	15,000 ft (4572 m)
Cooling	Passive cooling, solar shield not required

Product Attribute	Specification
Mount Options	Pole 0.5 to 6.0 in (12.7 to 152.4 mm); wall mount kits
Enclosure Materials	Anodized aluminum and UV resistant plastic radome
Wind Survivability	120 mph (193.12 kph)
Wind Load	84 lb at 100 mph (38.1 kg at 160.93 kph)
EIRP (Max)	52 dBm
Channel Bandwidths	Configurable 20-/40-/80-/160-MHz carriers across 6 Independent transmitters/receivers. (Maximum Channel BW of 6 x160 = 960 MHz)
Modulation (Both DL and UL)	BPSK, 16-QAM, 64-QAM, 256-QAM
Network Interface	10GE SFP+[5]
Weatherproofing/Ingress Protection	IP65
Lightning Protection	6 kV

NOTES:

1. Peak Aggregate capacity assumes clear line-of-sight with the distance between RABACK and the CPE at about 328 ft (100 m) and six (6) or more CPEs utilizing six (6) TxRx base station pairs, and channel allocation to maximize throughput.

2. RBK60xx products offer either ac or dc powered options for any unit, just not both in a single unit.

3. Beamwidth specification is approximate..

4. EIRP varies per model (see **Error! Reference source not found.**).

5. 10GE SFP+ is equipped with either single mode or multimode fiber. They are not user interchangeable.

4.4 Power Supply

There are two (2) different power supplies used by the RABACK base stations. One model RABACK comes equipped with an ac power supply. Another model RABACK has a dc power supply. The ac power supply accepts 110–220 Vac power. The dc power supply accepts –48 Vdc power. Connect the included power cable to the power port of your local power supply or battery array.

Both ac or dc versions generate an internal 12 Vdc output to power the entire RABACK unit internal electronics (switch and circuit boards).

WARNING: For RABACKs powered by a dc circuit, a surge supressor on the power feed to the base station is required to protect the equipment in the event of a power surge. Dc units should be protected

by an external 10A circuit breaker and Ac units should have a 15A breaker at the service panel.

4.5 Network Interface

The network port accepts a 10 Gb/s Ethernet SFP+ connection. The SFP+ module used is dependent upon the frequency model of RABACK as provided in Table 5.

Table 5. RABACK SFP/SFP+ and fiber cable usage

RABACK Model	Frequency	Fiber Cable Type	SFP+ module (x1)	SFP module (x4)
RBK6028	28 GHz	Duplex single mode	10GBase 1310 nm, 10 km, single mode	1G copper
RBK6032	32 GHz	Duplex single mode	10GBase 1310 nm, 10 km, single mode	1G copper

4.6 RF Transmission and Antenna

The RBK60xx is comprised of four mmWave transmitters in the 28-/29-/32-/39-GHz bands, and four sub7-GHz receivers in the 5 GHz band. The mmWave transmitters comprise both horizontal and vertical polarizations that are used to beamform and enable MIMO operations. The mmWave antennas are comprised of an array of patch elements. Each RBK6028/RBK6029/RBK6039 comprises a total of 192 elements that enable high-efficiency transmission. The RBK6032 comprises a total of 384 elements in the transmit antennas. Further, on-board PLLs are employed to position the baseband 5 GHz channels from the radio to the desired channel in the mmWave band. While the mmWave up-converters are common across all RBK60xx, they differ in the use of a band-specific mmWave power amplifiers used in the RF front-end. Necessary filtering is employed using printed filters to aid in interference leakage and emissions suppression.

The sub-7 GHz receivers also comprise both horizontal and vertical polarizations that are used to enable beamforming and MIMO gains in the reception. Air-gap 5 GHz antennas, followed by amplification and filtering, is used prior to feeding the signals to the baseband device.

4.7 Timing and Synchronization, GPS

Each hypercore of the RBK6028 consists of a full GNSS module with an antenna that receives the GPS/GLONASS/Galileo/BeiDou signals to generate a 1 PPS signal. This 1 PPS signal is used to synchronize the system clocks (40 MHz) to aid in timing synchronization across radios from multiple RBK6028 units.

4.8 Console Interface

The RJ45 serial port connects internally to the fiber LAN switch. It is for factory use only.

4.9 RF and EMC Regulatory Compliance Standards

WARNING: RBK6xxx products transmit in radio frequency and are compliant to CFR 47 Section 2.1091 and Canada RSS-102. These devices must not be within a certain distance from humans according to the frequency of the RABACK Model RBK60xx: RBK6032—9.8 in (25 cm), RBK6028—9.1 in (23 cm) of the human body during normal operation.

4.9.1 Receive Sensitivity

Receiver sensitivity and channel rejection for RABACK Model RBK60xx as provided in Table 6.

Table 6. RABACK receiver sensitivity and channel rejection

Mod	Rate	Minimum Receive Sensitivity (dBm)				Adjacent Channel Rejection (dB)	Non-Adjacent Channel Rejection (dB)
		20 MHz	40 MHz	80 MHz	160 / 80+80	20/../160	20/../160
BPSK	1/2	-82	-79	-76	-73	16	32
QPSK	1/2	-79	-76	-73	-70	13	29
QPSK	3/4	-77	-74	-71	-68	11	27
16-QAM	1/2	-74	-71	-68	-65	8	24
16-QAM	3/4	-70	-67	-64	-61	4	20
64-QAM	2/3	-66	-63	-60	-57	0	16
64-QAM	3/4	-65	-62	-59	-56	-1	15
64-QAM	5/6	-64	-61	-58	-55	-2	14
256-QAM	3/4	-59	-56	-53	-50	-7	9
256-QAM	5/6	-57	-54	-51	-48	-9	7

4.9.2 RF Compliance

RF Regulatory Compliance by model number is provided in Table 7.

Table 7. RABACK RBK60xx compliance

Model Number	FCC Compliance	ETSI/CE Compliance	Frequency Range of Operation Permitted (GHz)
RBK6028	Part 30 Subpart E FCC Part 15B	EN 302 326-2 V1.2.2 EN 301 489-1/-17 EN 301 893 V2.1.1 EN 302 502 V2.1.1 EN62311	DL: 27.5–28.35 UL: 5.15–5.35 5.47–5.725 5.735–5.835

             03 August 2018

Model Number	FCC Compliance	ETSI/CE Compliance	Frequency Range of Operation Permitted (GHz)
RBK6032	Not FCC approved band yet	EN 302 326-2 V1.2.2 EN 301 489-1/-17 EN 301 893 V2.1.1 EN 302 502 V2.1.1 EN62311	DL: 31.8–33.4 UL: 5.15–5.35 5.47–5.85
NOTE: Operation outside the indicated frequency range for the regulatory regimes, above, is not permitted through the user interface (ECCAN).			

Use of 5 GHz licensed spectrum entails DFS compliance. However, RABACK is not required to comply with DFS as it does not transmit in the 5 GHz spectrum. However, it participates in implementing DFS compliance by CPE devices that are connected to the RABACK. Also, frequency channel configuration is done at the RABACK, and the CPE listens and joins the RABACK in the channel RABACK is operating, so it is important for the user to be aware of the DFS channels and plan the channel configurations for the network accordingly.

4.9.3 FCC Part 15 statement

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

4.9.4 IC RSS-247 statement

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's (ISED) licence-exempt RSS(s). Operation is subject to the following two conditions:

1. This device may not cause interference.

2. This device must accept any interference, including interference that may cause undesired operation of the device.

4.10 Safety Compliance Standards

All RBK60xx product comply to the following safety standards.

EN 62368-1:2014

EN 62368-22

IECEE CB Scheme

UL62368-1

UL62368-22

> ⚠️ **WARNING:** Class 1 laser product. RABACK uses a Class 1 laser to send/receive data. Do not look into the end of of the bulkhead fiber connector or any optical fiber connected to the RABACK while it is operating.

4.11 **Non-modification Warning**

Any changes or modifications to this device not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.Features and Functions

Raback 60xx series base station offers several features and functions to facilitate an effective Fixed Wireless Access (FWA) solutioon.

List of these features are provided below. Refer to additional details in later Sections, including how they are configured.

- Quadplex system

- Use of standard 802.11ac Protocol over both mmWave (downlink) and 5 GHz (uplinnk) with modifications to support mmWave upconversion

- Full features of 802.11ac is taken advantage of in this system, including modulation, channelization, MIMO, Digital Beamforming, MAC layer protocol, and other features of a 802.11ac-based WiFi system

- Desired frequency-band support can be configured in software via EMS/ECCAN

- Full use of spectrum up to 960 MHz in a 120-degree RBK60xx base station (operated as 6 x 160 MHz band)

- Full or partial frequency reuse across every 40-degree sub-sector within a 120 degree sector

- With each 40-degree sub-sector, there are two transmitters, each operating on two different frequency channels.

- Each of the 6 transmitter/receiver (tranceivers) in a RBK60xx radio can be tuned to a different desired BW. 20-, 40-, 80- and 160-MHz configurations are supported

- BW configuration on downlink and uplink can be different as long as both the DL and the UL have the same primary 20 MHz channel.

- Multiple antenna elements (both mmWave and 5 GHz)

- Large number of CPE devices per RABACK radio

- Low latency, typical value <3 ms

- GPS support

Copyright © by PHAZR Inc. 2018

- Full-featured Ethernet switch built into the RABACK system

- QoS support

- VLAN and Q-in-Q support

- Large MTU Size

- Traffic limiting and rating functions

- 10 Gb/s SFP+ interface (single-mode and multimode fiber options)

- Security, including over the air encryption

- Management, Operations, Monitoring and Diagnostics features supported with ECCAN

- IPv4 and IPv6 Support

- Multiple Link Aggregation (across sub-sectors) over single 10GE backhaul link

- Access network optimization with HyperSON

- Supports fast handover of CPE devices

5   Preparation for Installation

5.1   Link Planning

Base station locations and frequencies must be pre-determined to minimize overall interference in the network.

5.2   Software and Configuration Data Upgrade

Phazr, Inc. will schedule periodic software and configuration updates as they become available and will be provided through ECCAN.

5.3   Pre-Installation and Configuration

Power drops must have properly sized surge protection device(s) in series. The correct fuse or breaker must be installed. A means for proper grounding must be in place prior to mounting the RABACK onto a tower, pole, or wall.

6   Installation Procedure

6.1   Attaching Mounting hardware to Radio Unit

The RABACK unit comes assembled with mounting bracket and radome. Various cutouts and threaded taps are located on the mounting bracket to make it easy to position the unit onto the mounting bracket using supplied mounting hardware.

6.2   Attaching/Mounting the RABACK Unit

There are two mounting procedures for installing a RABACK base station: single-sector and multi-sector. The single-sector procedure refers to installing a single RABACK, while the multi-sector procedure can support two or three RABACKs. Each mounting procedure uses a unique mounting bracket (see Figure 3). The mounts can be attached to either a wall or a pole.

The mount allows for variable tilt of the RABACK base station. Tilt can be adjusted in five increments of 2.5°.

Procedure:

1. Remove the tilt pin from both sides of the mounting bracket.

2. Tilt the RABACK in place, and replace the tilt pin at the new tilt setting.

   NOTE: If you choose to mount a RABACK to a wall, the mounting bracket does not allow for tilting.
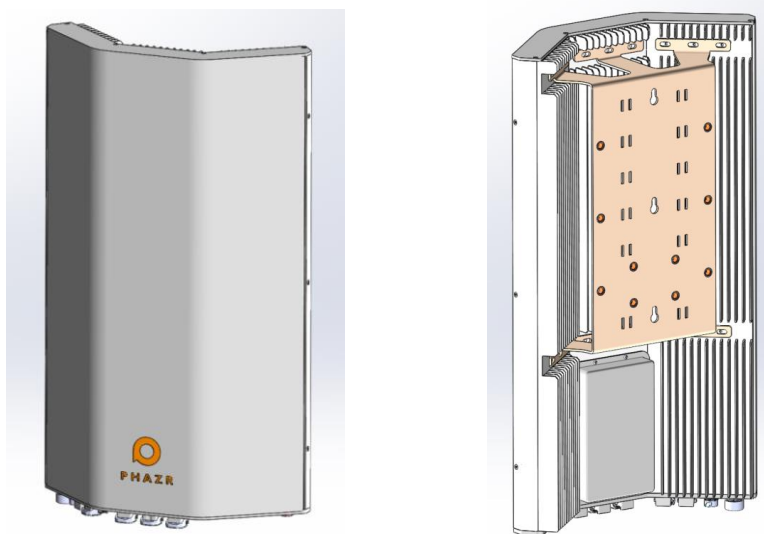

Figure 3.   Common RABACK unit and rear mounting plate

6.3   Single-Sector Mounting

A single-sector mount can support a single RABACK base station and can be attached to either a wall or a pole.
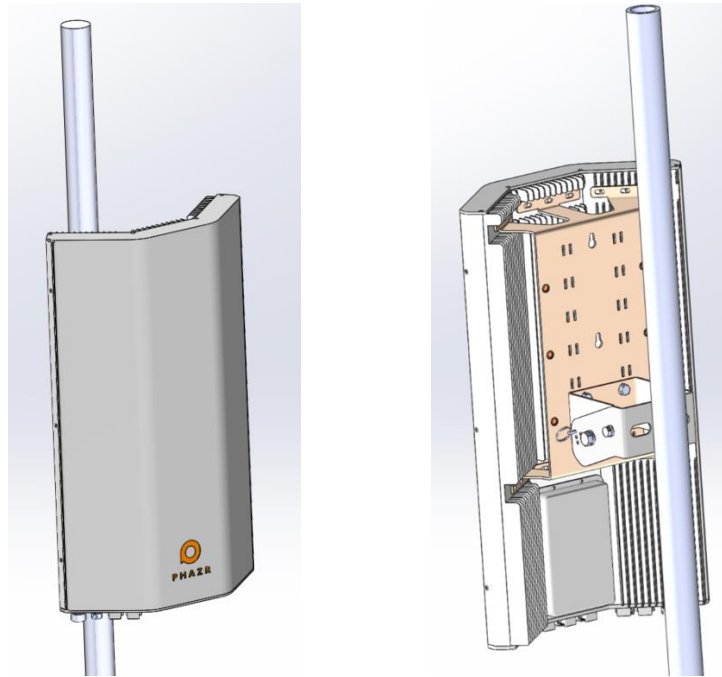
Figure 4.   Front and rear view of a single RABACK mounted to a pole

6.3.1 Pole Mounting

The single-sector mounting bracket can be attached to a pole of diameter 1.625 to 3.250 in (41.275 to 82.550 mm). Pole mounting is a two-person procedure. Once the desired position for the base station is determined, the rear mounting bracket must be attached to the desired point on the pole using a standard pipe clamp and assemble as described in the following steps and as shown in Figure 5 through Figure 7.

1. Holding the rear mounting bracket to the pole, slide the U-bolt around the pole and slot it through the two openings on the back of the rear mounting plate.

2. Secure the U-bolt to the rear mounting plate using two washers (increasing size) and a hex-nut on each side of the U-bolt.

3. Attach the forward mounting bracket to the RABACK backplate.

4. Have two people lift the RABACK so the forward mounting bracket of the RABACK slides over the rear mounting bracket. Screw the brackets together using bolts on both sides of the brackets.

5. Set the RABACK to the desired tilt and lock it in place by inserting the tilt pins on either side of the mounting bracket.
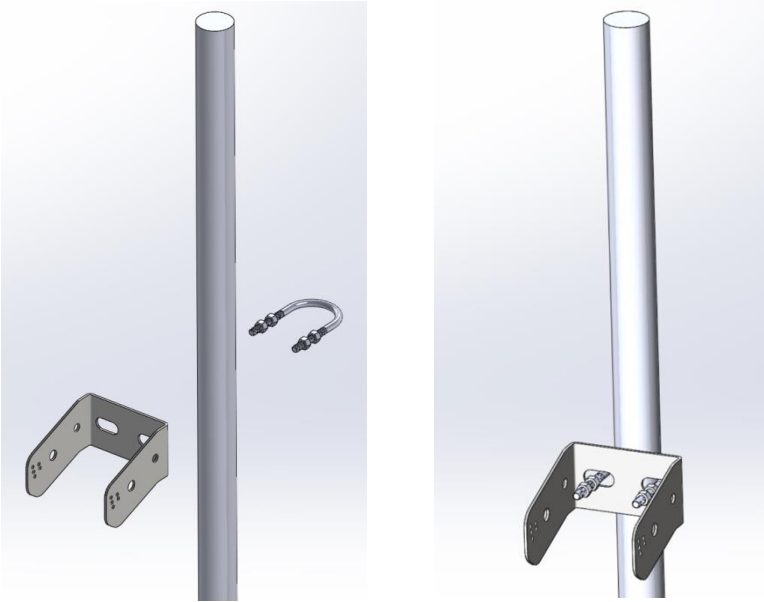
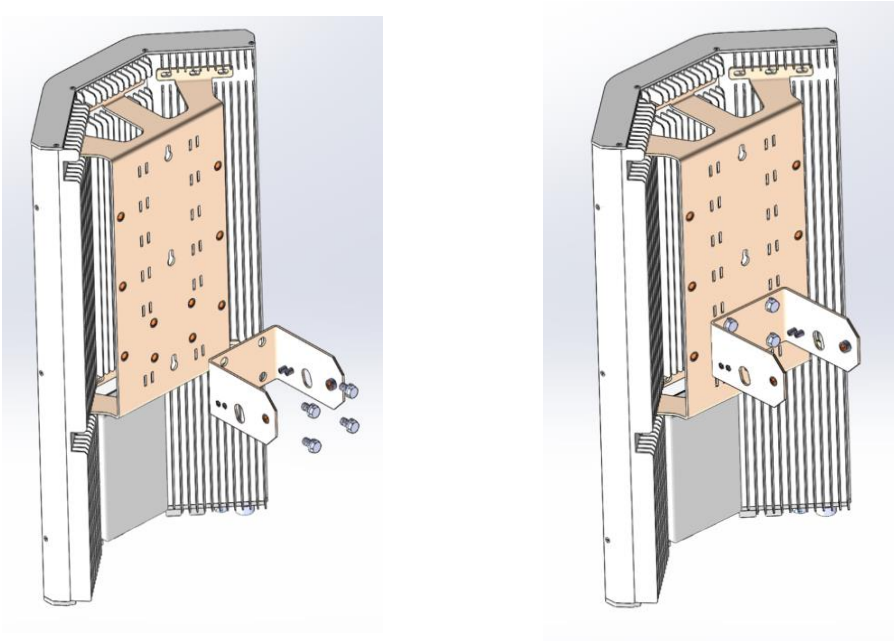**Figure 5.   Attaching the rear mounting bracket to the pole, Step 2**

Figure 6.   Attaching the forward mounting bracket to the RABACK backplate, Step 3
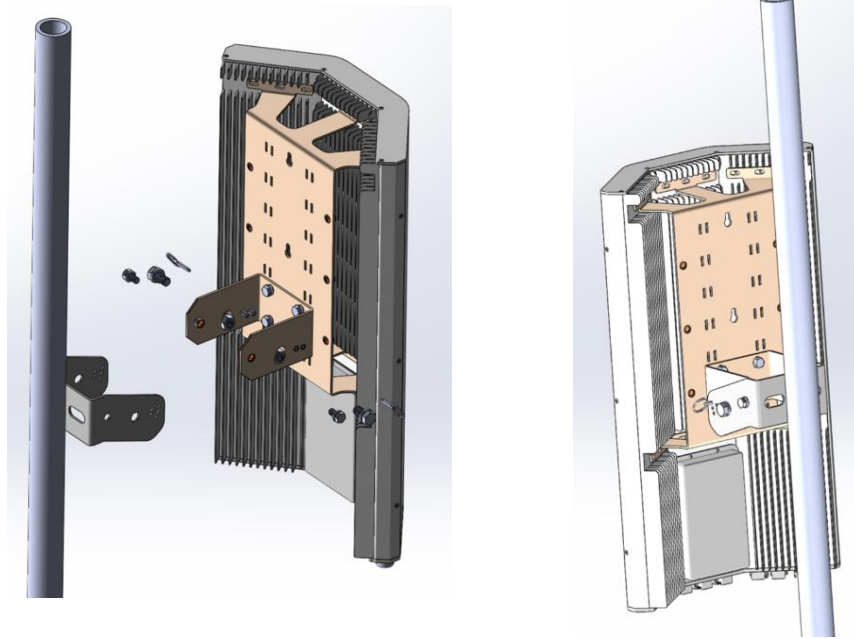
Figure 7.   Attaching the forward mounting bracket to the rear mounting bracket, Step 4

6.3.2 Wall Mounting

Wall mounting can be accomplished by drilling two holes in the wall and bolting the mount to the wall using bolts. The backplate extensions must be attached to the RABACK backplate as direct in the following steps and shown in Figure 8 and Figure 9 .

1) Attach the backplate extensions to the backplate of the RABACK.

2) Determine the desired mounting position of the RABACK on the wall.

3) Drill holes in the wall spaced appropriately for the backplate extensions.
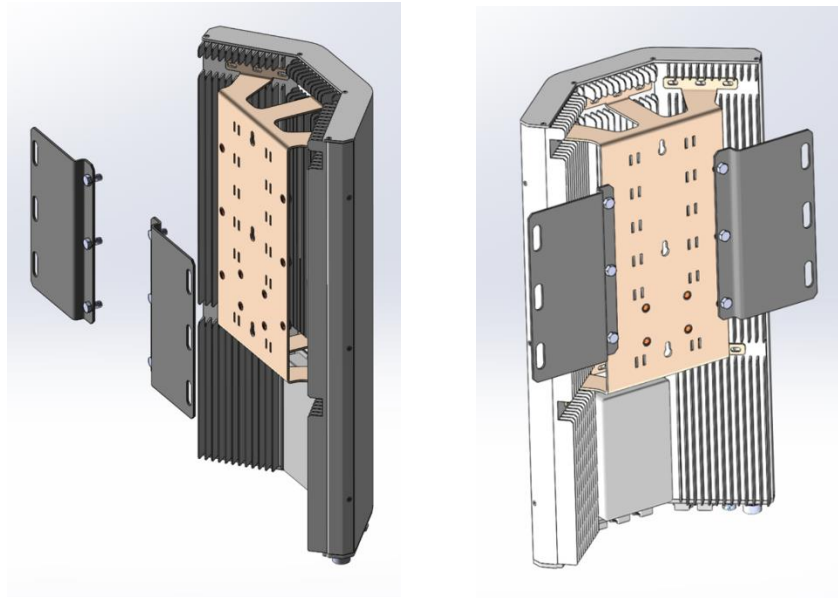
4) Bolt the backplate to the wall.

Figure 8.   Attaching the RABACK backplate extensions, Step 1

Figure 9.   Mounting the RABACK to the wall, Step 4

6.4 **Multi-Sector Mounting**

A multi-sector mount can support two or three RABACK base stations and can be attached to a pole with a diameter of 2.500–3.375 in (63.500–75.725 mm). See Figure 10.
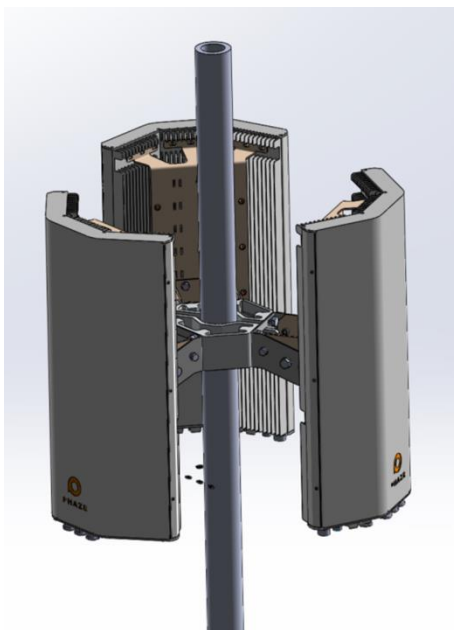
Figure 10. Three RABACKs mounted to a pole

6.4.1 Pole Mounting

Pole mounting is a two-person procedure. Once the desired position for the base stations is determined, the two mounting collars must be attached to the pole as directed in the following steps and in Figure 11 through Figure 14.

1) Attach the collars to pole by placing the two halves around the pole and bolting them together.

2) Attach the multi-mount rear mounting bracket to the collars by bolting it to the collars.

3) Attach the forward mounting brackets to the RABACK backplate (same as Single Sector pole mounting Step 3).

4) Have two people lift the RABACK so the forward mounting bracket of the RABACK slides into the rear mounting bracket. Screw the plates together using the brass thumb screws on either side of the plates.

5) Set the RABACK to the desired tilt and lock it in place by inserting the tilt pins on either side of the brackets.

6) Repeat steps 2–4 for the total number of RABACK you would like to attach to this mount.
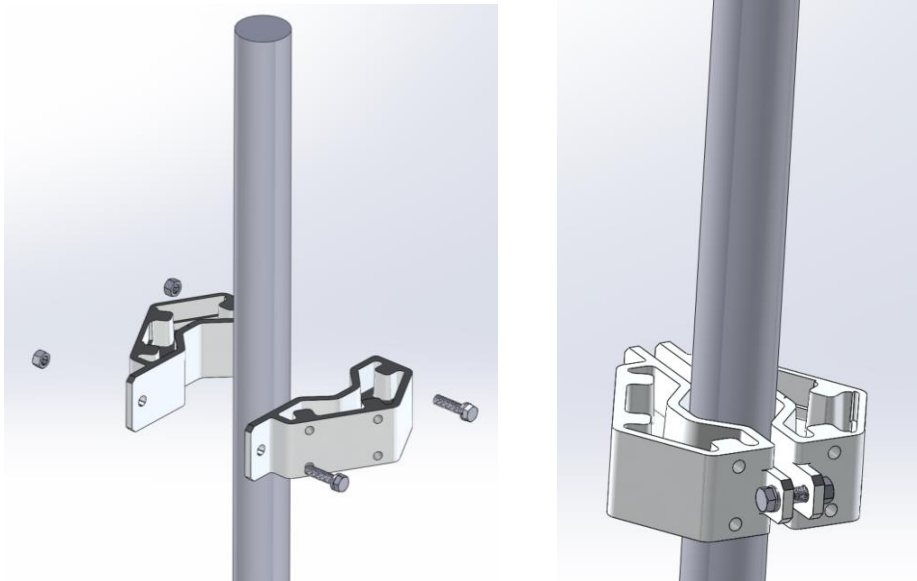
Figure 11. Attaching a multi-sector mountin collars to a pole, Step 1
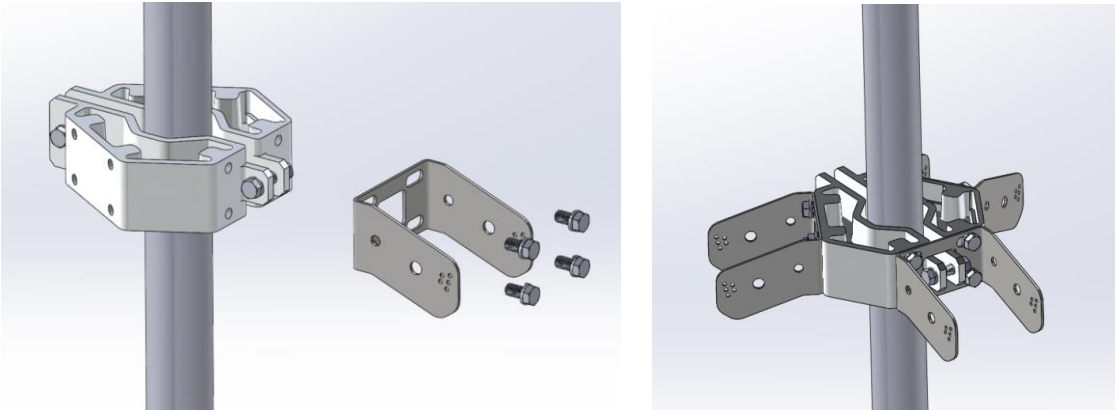
Figure 12. Attaching multi-sector brackets to the collars, Step 2
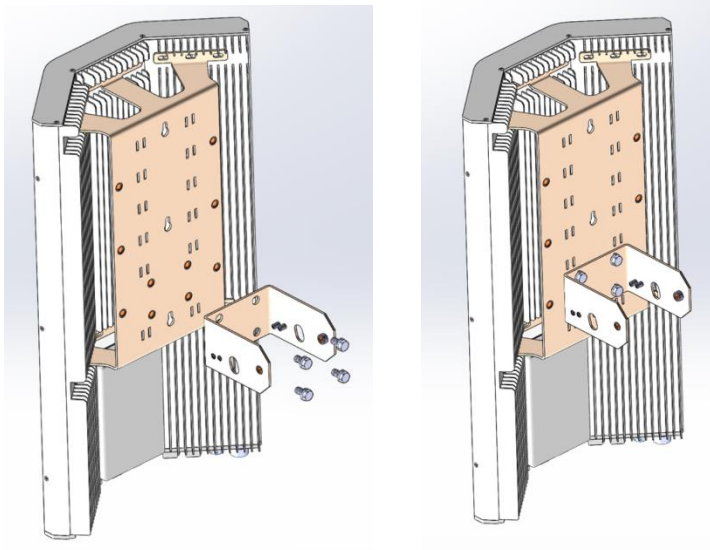
Figure 13. Attaching the forward mounting bracket to the backplate, Step 3
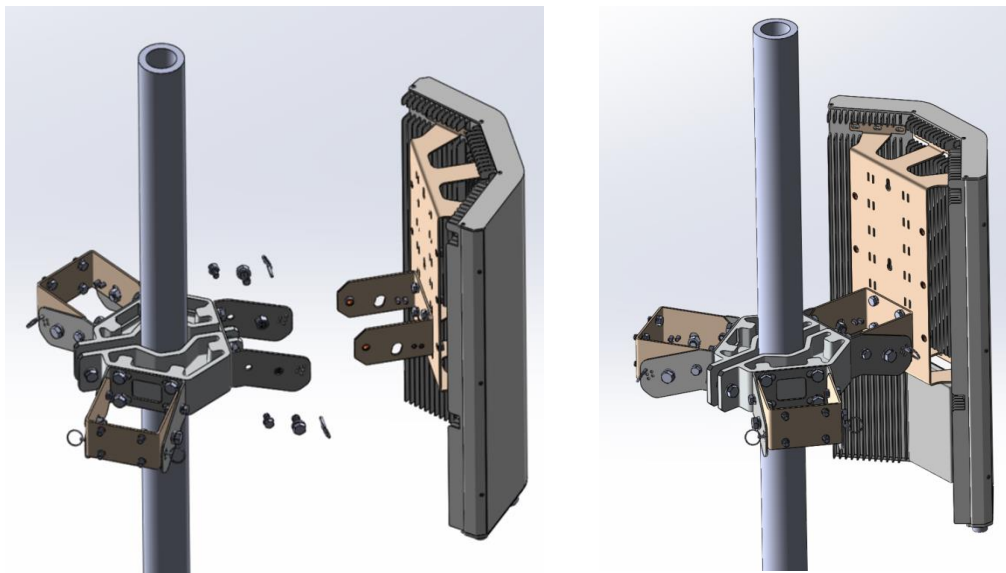
Figure 14. Attaching a RABACK to the multi-sector rear bracket, Steps 4 and 5

6.5 **Tilt and Rotation and other Alignments**

The RABACK can be tilted on the Y-axis to optimize antenna vertical alignment.

6.6 **Power Supply and Cabling**

The RABACK Model 60xxx units can be ordered to operate using 120 Vac or -48 Vdc. RABACK units must use the proper power cord to bring power to the unit. To eliminate plugging in the wrong cable,

ac-powered RABACKs use a power cable with a 3-pin DIN connector (Phazr PN 840-00016) and dc-powered RABACKs use a power cable with a 4-pin DIN connector (Phazr PN 840-00015). The RABACK RBK60xx bulkhead connector has exposed pins and is male. Pinouts for the power cables are shown in Figure 15.

Power cables supplied are 3 ft (4 m) in length and are connectorized on both ends with female connectors. An additional mated connector is supplied in the power cable kit for connection to the Operator's power source. Optional kits can be ordered for installations requiring longer cabling. They can be ordered by the Operator in lengths of 32.8 ft (10 m), 164.1 ft (50 m) and 328.1 ft (100 m).

To connect the power cord to the RABACK RBK60xx, simply align the connector pins, plug into unit, engage the threads of the locknut, and turn the locknut clockwise until it is finger tight.

NOTE: View from bottom of RABACK unit

Ac Power Cable	
Pin 1	NEUTRAL
Pin 2	GND
Pin 3	LINE

Dc Power Cable	
Pin 1	NEG (-)
Pin 2	GND
Pin 3	POS (+)
Pin 4	nc

Ac Power Connector Pinouts

Dc Power Connector Pinouts
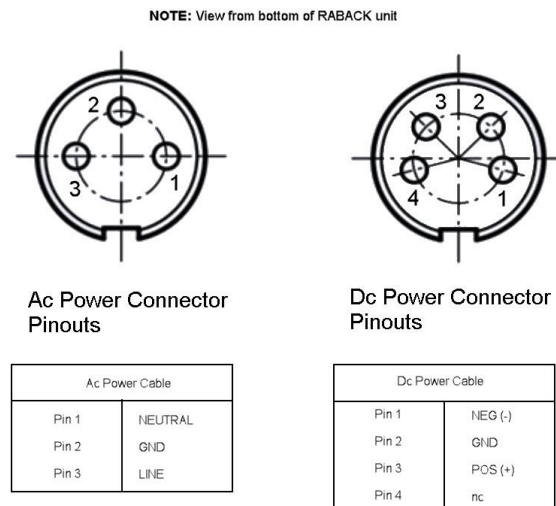
Figure 15. Ac/Dc power connector termination

6.7 Lightning and Surge Protection

An approved lightning protection/surge suppression device must be provided/installed by the Operator on the power connector cable at the output of the RABACK. Another surge suppressor must be placed on the power cable just before entering any facility. The surge suppressors must be properly grounded to the ground bonding point in an approved manner.

6.8 LED Indicators

There are no LED indicators located on the outside of the RABACK RBK60xx. LEDs located inside the RABACK, which can be observed at night glowing behind the radome, are for factory use only.

6.9 Powering Up the RABACK

After mounting the RABACK RBK60xx, the following conditions must be met before powering on the unit:

1. Grounding cable has been connected to earth ground.

    NOTE: Connect the grounding cable first before connecting any other cables to the RABACK unit.

2. Power cable has been connected to the Operator's equipment to include connection of a surge suppression device.

3. Fiber optic cable has been connected to the Operator's equipment.

4. All cables have been secured with cable ties.

Power on the RABACK unit by simply switching the associated breaker to the ON position. There are not external lamps to indicate that the unit has powered on, however, an operator can verify the unit has switched on using the ECCAN user interface.

Copyright © by PHAZR Inc. 2018

7 Basic Configuration by Installer

7.1 Pre-Configuration at Factory

After mounting and cabling has been completed, apply power to the RABACK. The transmitters will be turned on and verified remotely using ECCAN.

7.2 Basic Configuration by Installer

ECCAN provides the basic set up including the frequency channels, channel bandwidths, transmit power settings, IP address configurations as well as the configurations necessary to form links with the CPE devices.

8   User Configuration

8.1   Basic End User Configurations

The Operator installs and configures ECCAN on the network management servers. The RABACK can be added to the network by editing the ECCAN configuration files and adding the UUID of the RABACK to the known base station list. This will connect the new RABACK base station to the core network.

8.2   Configuring RABACK with ECCAN

The Operator's PHAZR 5G network can be configured entirely using the ECCAN webapp. Network elements are provisioned using the following hierarchy:

> Cell Sites > RABACK > Hypercore

Each Cell Site can be configured with multiple RABACKs. Each RABACK has three Hypercores and each Hypercore has two Radio Cores. This section explains how to provision these elements using the configuration entry screens, as well as the various management options available for each of these network elements.
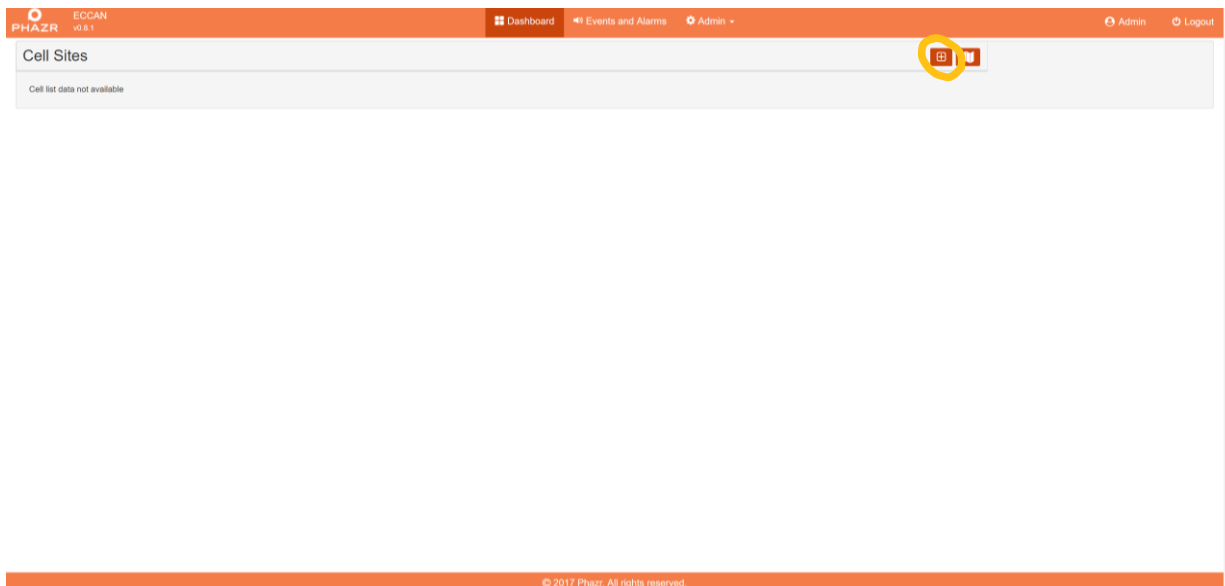

Figure 16. The ECCAN Dashboard with no provisioned Cell Sites and the Provision Cell Site button

8.2.1.1   Cell Sites

Cell Sites represent a group of RABACK base stations in a certain location.

Figure 17. The Cell Site Provisioning window

8.2.1.2   Provisioning

The Cell Site provisioning process can be started with the **Provision Cell Site** button (see Figure 16). When provisioning a Cell Site, you will be asked to provide information about the site you want to configure. Those options are:

- **UUID** – A unique identifier for the Cell Site. We recommend using UUID version 4. An example UUID4 is given below. These numbers can be generated using the Linux tool `uuidgen`.

    - c819bf65-a8a1-40d4-a772-139b2d33c48d

- **Name** – The name of the cell site. This is the name that will show up in the Dashboard. We recommend following a naming convention for all of cell sites, so they are easy to find. An example of a Cell Site name is:

    - CELLSITE_LONDON_NORTH_EAST_001

- **Address** – The physical location of the Cell Site.

- **Description** – A description field for any additional information you would like to save about the Cell Site.

- **Statistics** – You can choose to log up to four types of statistics about the Cell Site. You can also specify the individual sample rate (in seconds) for these statistics. The interval for statistic gathering must be a multiple of 5. These statistics will be shown in the Dashboard when the Cell Site is selected. Once the Cell Site information has been entered, select **Add** to add the Cell Site to the network. If you would like to cancel the provisioning process at any time, simply return to the Dashboard.

Figure 18. The ECCAN Dashboard with a provisioned Cell Site showing the CELL SITE Actions dropdown menu and the Provision RABACK button

8.2.1.3   Management

There are several actions you can perform for each Cell Site. From the **CELL SITE Actions** drop down (see Figure 18), you have the following options.

- **View** – View information about the Cell Site. This includes the address, the description, and the intervals for the statistics being gathered.
- **Update** – Update the sampling interval for the statistics gathered by the Cell Site.
- **Delete** – Deletes the Cell Site.

8.2.1.4   RABACKs

RABACKs can be provisioned and managed when their parent Cell Site is selected in the Dashboard. See Figure 19.

                   03 August 2018

Figure 19. The RABACK Provisioning window

8.2.1.5   Provisioning

Provisioning a RABACK follows the same process as provisioning a Cell Site. When a Cell Site is selected in the Dashboard, the provision button will say "Provision RABACK" (see Figure 3.b). You will be asked to provided information about the RABACK in the Device Provision window. Specifically, you will be asked for:

- **Parent CELL SITE** – The Cell Site the RABACK will be added to. You can select from any of the Cell Sites that have already been provisioned in ECCAN. The current Cell Site selected in the Dashboard will automatically be selected.

- **UUID** – A unique identifier for the RABACK. Again, we recommend generating UUID version 4 identifiers for this field.

- **Name** – The name of the RABACK. This is the name that will show up in the Dashboard.

- **Serial Number** – The device serial number of the RABACK. This can be found on the device packaging.

- **Hardware Version** – The hardware version number of the RABACK base station. This can be found on the device packaging.

- **Latitude** – The latitude of the RABACK base station. This will be used to show its location.

- **Longitude** – The longitude of the RABACK base station. This will be used to show its location.

- **Description** – A description field for any additional information you would like to save about the RABACK.

Once the device information has been entered, press Add to add the RABACK to the Cell Site. If you would like to cancel the provisioning process at any time, simply return to the Dashboard.
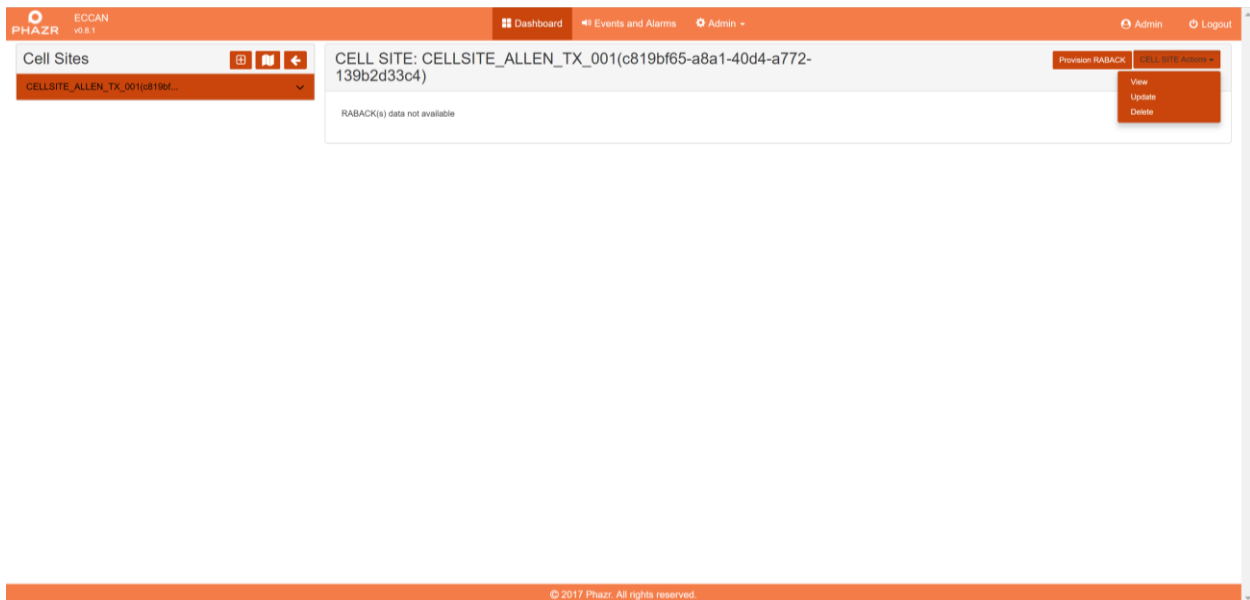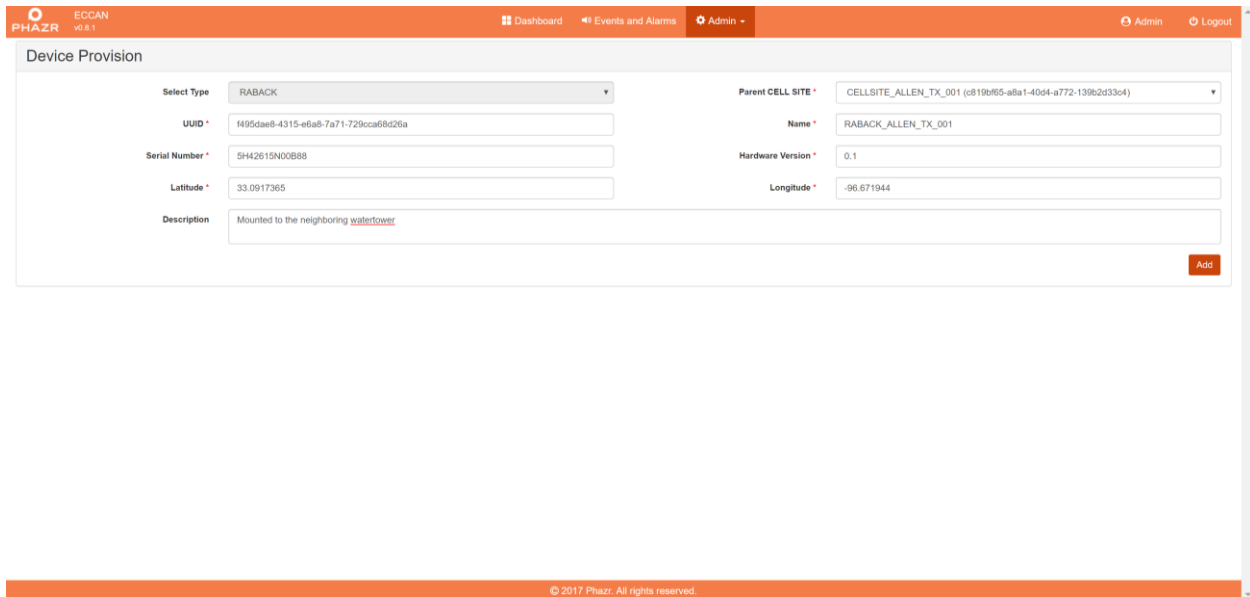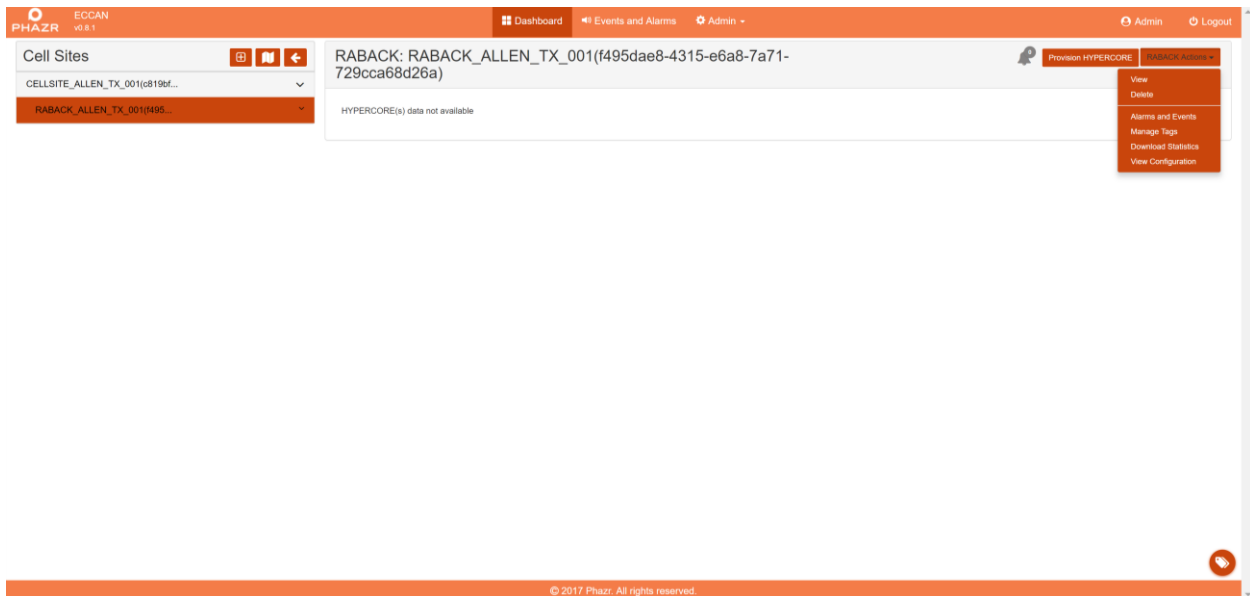
Figure 20. The ECCAN Dashboard with a provisioned RABACK
a) the RABACK Actions dropdown menu, b) the Provision Hypercore button

8.2.1.6   Management

When a RABACK is selected in the Dashboard, the actions dropdown will change to say RABACK Actions (see Figure 20). From here, you can:

- **View** – View information about the RABACK. This includes the UUID of the parent Cell Site, the hardware version, the manufacturer, the latitude and longitude of the base station, the device serial number, and the description.

- **Delete** – Delete the RABACK from the Cell Site.

- **Alarms and Events** – Opens the Events and Alarms tab and filters the results to only show Events and Alarms for the selected RABACK.

- **Manage Tags** – Add a new tag to the RABACK.

- **Download Statistics** – Download gathered statistics about the RABACK. Downloads can be done by specific Hypercores or in bulk, and you can select what type of statistics to download. You can also choose to download statistics in a certain time window or by the tags applied to the RABACK. You can download this data in CSV format.

- **View Configuration** – Lets you view wireless configuration details about Hypercores in the RABACK. You can also create a template wireless configuration for future Hypercores.

8.2.1.7   Hypercores

Hypercores can be provisioned and managed when their parent RABACK is selected in the Dashboard.

Figure 21. The Hypercore Provisioning window
a)Save Statistics settings, b) save Radio Core settings

8.2.1.8   Provisioning

Hypercore provisioning follows the same process as that of both Cell Sites and RABACKs. When a RABACK is selected in the Dashboard, the provision button will change to say "Provision HYPERCORE" (see Figure 21). You will be asked to provide information about the Hypercore and its associated Radio Cores. You will be asked for:

- **Parent RABACK** – The RABACK this Hypercore will be configured for. You can select from any RABACKs that have already been provisioned. The current RABACK selected in the Dashboard will automatically be selected.

- **UUID** – A unique identifier for the Hypercore. We recommend using UUID version 4.

- **Name** – The name of the Hypercore. Enter the name you would like to appear in the Dashboard.

- **Serial Number** – The device serial number of the Hypercore. This can be found on the device packaging. Hardware Version – The hardware version number of the Hypercore. This can be found on the device packaging.

- **Heartbeat Interval** – The interval of time (in seconds) between heartbeat transmissions from the client back to the Hypercore. After this interval has expired, the connection will be deemed closed and all open TCP connections to that client will be terminated.

- **Device Make** – The model version of the Hypercore.

- **Description** – A description field for any additional information you would like to save about the Hypercore. For example, you could save what 40° sector of the RABACK this Hypercore is sitting in.

Along with the general information above about the Hypercore, you will need to provide the following information about one or two Radio Cores:

- **MAC Address** – The MAC address of the device. This can be found on the device packaging.

- **Interface Name** – The interface of the Hypercore the Radio Core is connected to. This will either be core0 or core1 and can be found on the device packaging.

- **Frequency Band** – The frequency of the mmWave broadcast band. This will be set for the device and can be found on the device packaging.

- **Statistics** – Statistic information for the Radio Core to sample. Each type of statistic can have a unique sample rate. The sample rate is in seconds and must be a multiple of 5. Once you have set the statistics you would like to gather, press the Check button to save the settings (see Figure 6.a). The Check button will then change to a plus that will let you edit the statistics settings. Selecting the Check button wills save the settings for that Radio Core (see Figure 6.b). Once the first Radio Core is configured, you can add a second Radio Core using the Plus button, or you can edit the existing Radio Core with the Edit button. If two Radio Cores are being configured, the Plus button will switch to a Delete button that will let you remove the Radio Core.

  You can then press Add to add the Hypercore to its parent RABACK.
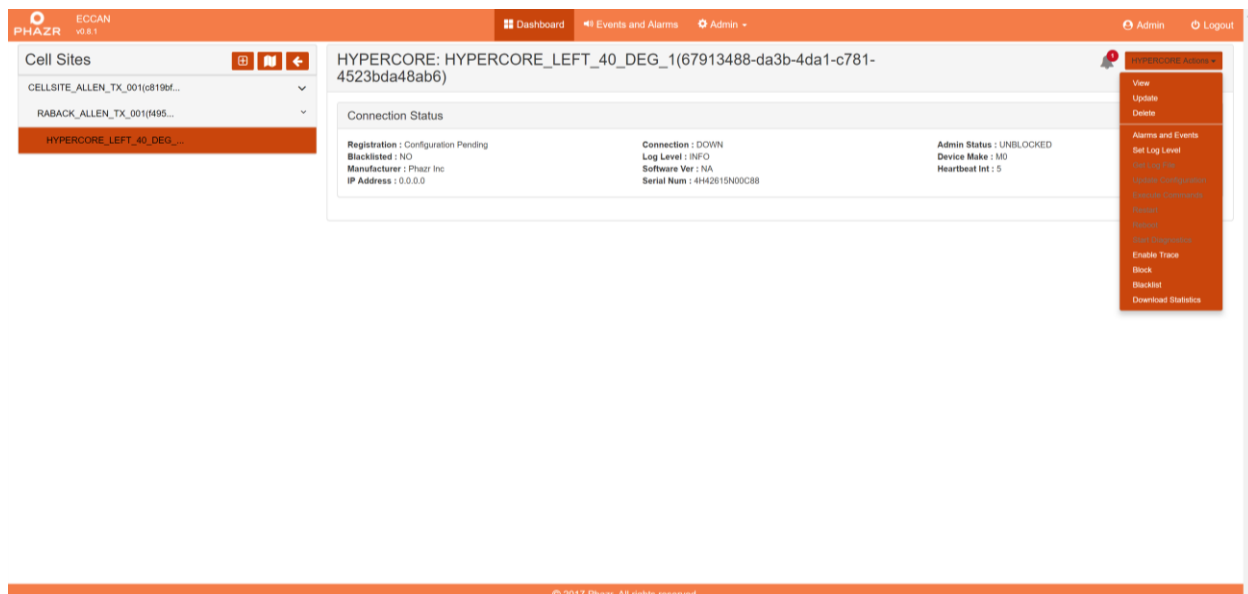
Figure 22. The ECCAN Dashboard with a provisioned Hypercore
a) the Hypercore Actions dropdown menu

8.2.1.9 Management

When a Hypercore is selected in the Dashboard, the Action dropdown will change to say "HYPERCORE Actions". See Figure 22. From here, you can:

- **View** – View all configuration information about the Hypercore, including the parent UUID, the hardware version, the manufacturer, the software version, the heartbeat interval, the device make, the template the Hypercore is based on (if any), the device serial number, and the description. You can also view configuration information on the one or two Radio Cores in the Hypercore and their statistic gathering information.

- **Update** – Allows you to edit or remove statistics gathering information for each configured Radio Core.

- **Delete** – Delete the Hypercore.

- **Alarms and Events** – Opens the Events and Alarms tab and filters the results to only show Events and Alarms for the selected Hypercore.

- **Set Log Level** – Lets you change the level of logging for the selected Hypercore. You can set the log level to debug, info, notice, warning, error, critical, alert, and emergency.

- ***Get Log File** – Disabled

- ***Update Configuration** – Disabled

- ***Execute Commands** – Disabled

- **Restart** – Restart the device.

- **Reboot** – Reboot the device.

- **Disable SSH** – Prevent SSH access to the device.

- **Start Diagnostics** – Runs ping, traceroute, and various other diagnostic tools. Results are downloaded as a CSV.

- **Enable Trace** – A very specific level of logging. This is meant to provide as much information as possible about the Hypercore.

- **Block** – Prevent the Hypercore from connecting to the core network.

- **Download Statistics** – Allows statistics information for the Hypercore can be downloaded. Like the RABACK, statistics can be downloaded for a certain time window or by the tags applied to the Hypercore. Downloaded data is in the CSV format.

8.3 Advanced Configurations

8.3.1 The Admin Panel

The Admin dropdown menu allows access to various network administration operations.

8.3.2 Device Management

The Device Management window provides a list view of all of the devices on the network. From this window, you can also provision a new Cell Site, RABACK, Hypercore, or Gazer. You can also bulk provision devices by selecting the type of device to provision. You can download a template CSV for the device and edit the information for all of the devices you would like to provision. When you upload this file, all of the devices in the CSV will be provisioned.

8.3.3 Device Configuration

You can edit specific configuration information for each individual type of Hypercore through the Device Configuration window. These changes can then be applied in bulk to deployed Hypercores or loaded when future Hypercores are provisioned. You can set the options in Table 8.

Table 8. RABACK configuration options

Provisioning Option	Description
TCP Connection Timeout	Time before a TCP connection is disconnected
TCP Connection Retry Timer	Time before attempting to re-establish a TCP connection
TCP Connection Block Retry Timer	Time before a TCP block is retransmitted
CPU Threshold Timer	Time span between CPU threshold checks
CPU Threshold Critical	Threshold where CPU usage is considered critical (% utilization)
CPU Threshold Major	Threshold where CPU usage is considered major (% utilization)
CPU Threshold Minor	Threshold where CPU usage is considered minor (% utilization)
Disk Threshold Timer	Time span between disk threshold checks
Disk Threshold Critical	Threshold where disk usage is considered critical (% utilization)
Disk Threshold Major	Threshold where disk usage is considered major (% utilization)
Disk Threshold Minor	Threshold where disk usage is considered minor (% utilization)
Memory Threshold Timer	Time span between memory threshold checks
Memory Threshold Critical	Threshold where memory usage is considered critical (% utilization)
Memory Threshold Major	Threshold where memory usage is considered major (% utilization)
Memory Threshold Minor	Threshold where memory usage is considered minor (% utilization)
Temperature Threshold Timer	Time between system temperature threshold checks
Temperature Threshold Critical	Threshold where system temperature is considered critical
Temperature Threshold Major	Threshold where system temperature is considered major
Temperature Threshold Minor	Threshold where system temperature is considered minor
Response Timer	Time to wait for a response
PStatus Alarm Timer Interval	Time span between PStatus Alarms
PStatus LF MCU Temp Threshold	Temperature threshold for low frequency PStatus
PStatus HF MCU Temp Threshold	Temperature threshold for high frequency PStatus
TLS Connection Root CA Path	Path to the root TLS certificate

Copyright © by PHAZR Inc. 2018   03 August 2018

Provisioning Option	Description
TLS Connection Client Cert Path	Path to the client TLS certificate
TLS Connection Client Key Path	Path to the client TLS key

8.3.3.1   Download Device Statistics

From here you can download previously generated statistics files or request a new file.

8.3.3.2   Diagnostics Report

Runs ping, traceroute, and various other diagnostic tools. Results are downloaded as a CSV.

8.3.3.3   Auto Download Statistics

From here, you can schedule timeframes to automatically download device statistics for. Downloads are performed every night at midnight. You can set this based on individual RABACKs or GAZERs.

8.3.3.4   Wireless Configuration Template

From here, you can view existing wireless configuration templates, or define a new. If you would like to define a new template, you will need to provide the following:

- **Name** - Name of the template
- **SSID** - ID of the template
- **Number of Radio Cores** - Number of radio cores to configure with the template
- **DL Spectrum Blocks** - Number of blocks to support through downlink
- **UL Frequency Band** - Set the frequency for the uplink band
- **UL Spectrum Blocks** - Number of blocks to support through uplink
- **Description** - Description of the template

You can also specify the lower and upper bound for each of the downlink and uplink blocks.

8.3.3.5   RABACK Wireless Configuration

From here, you can view or apply an existing template to provisioned RABACKs. This is required to complete the setup process for RABACKs.

8.4   User Adminstration

Lets you add users and define security groups.

8.4.1.1   Manage Users

View all users and their Privilege level. You can also create new users from this window. When you go to create a new user, you will be asked for:

- **Username** - the name of the user
- **Password** - the user's password

- **User Privilege** - the privilege level of the user

- **Email Address** - the user's email address

8.4.1.2   Manage Privileges

View all security groups and create new security groups. When making the group, you can select the actions the group can perform. When you go to create a privilege level, you will be asked for:

- **Name** - the name of the group

- **Privilege key** - the level of the group

- **Event Commands** - Issue event commands

- **User Management** - Ability to create new users and security groups

- **Config Management** - Ability to create device configuration templates

- **Device Management** - Ability to provision, update, and delete devices

- **Download Statistics** - Ability to request new statistic reports for download

8.5   Monitoring and Statistics

8.5.1   Events and Alarms

The Events and Alarms panel offers a high level view of how the network is behaving. Alarms and events are both generated by the system. Events and Alarms can each be filtered by device type and can be searched.

8.5.2   Events

Device Events provides a record of everything that has happened to the devices on the network. This includes:

- Device additions

- Device removals

- Device credential errors

- Establishment of TCP/UDP connections

- Dropping of TCP/UDP connections

8.5.2.1   Alarms

Device Alarms are reported by the system according to Alarm ID, Type, Name, UUID, Criticality, Clear Flag and Timestamp, and View Status.

Device Events are reported by the system according to Event ID, Type, Name, UUID, Event Info, Event Category, Timestamp, and View Status.

Alarms and Events can be filtered to provide pertinent information about a specific device through a drop down menu.

9   System Upgrade

9.1   Hardware Field Upgrade and Serviceability

Hardware upgrades will be at the discretion of Phazr, Inc. and according to the terms of the RABACK Purchase Agreement with the Operator. Should an upgrade be required, arrangement will be made in advance to minimize the affect the upgrade will have on the Operator.

9.2   System Firmware Upgrade

Firmware upgrades will be at the discretion of Phazr, Inc. and according to the terms of the RABACK Purchase Agreement with the Operator. Should a firmware upgrade be required, arrangement will be made in advance to minimize the affect the upgrade will have on the Operator.

10 Troubleshooting and Maintenance

10.1 Caring and Maintaining the RABACK Hardware

Once the RABACK has been installed, it should be inspected yearly to make sure all connectors are secure, it is still securely mounted, and heatsink fins are clear of obstructions such as spider webs, bird nests, insects, or other debris. No other periodic maintenance or special care is required.

10.2 Hardware Failures and Steps to Take

Should the RABACK fail for any reason, contact Phazr, Inc. The service contract the Operator has in place at time of RABACK failure will determine Phazr, Inc.'s recourse.

10.3 System Performance Issues and Steps to Take

Should the RABACK exhibit inadequate performance issues, contact Phazr, Inc. If the unit is still under Phazr Warranty, Phazr, Inc. will act in accordance with the warranty terms in the RABACK Purchase Agreement. If the RABACK performance issues cannot be remedied, Phazr, Inc. will replace the unit with another functioning unit according to terms of the RABACK Purchase Agreement.

10.4 Functional and Software Failures and Steps to Take

Should the RABACK exhibit inadequate performance issues, contact Phazr, Inc. If the unit is still under Phazr Warranty, Phazr, Inc. will act in accordance with the warranty terms in the RABACK Purchase Agreement. If the RABACK performance issues cannot be remedied, Phazr, Inc. will replace the unit with another functioning unit according to terms of the RABACK Purchase Agreement.

                     03 August 2018