Equipment	Quantity	Description
Ethernet Cable (Radio-Network)	1	
Attenuators	2	
Whip Antennas	2	
OA&M computer (with Power Adapter)	1	Optional for use with QDBS-Cellular overlay.
Ethernet cables for the OA&M computer	2	Optional for use with QDBS-Cellular overlay.
Software Disks (CD-ROM and DVD)		
Documentation		

Section 4

QDBS–Broadband Hardware

This section provides specific descriptions of the QDBS–Broadband hardware components.

4.1. Radio Case components

Figure 5 identifies the major components of the Radio Case. Each component is described in the following subsections.

Note: Some Radio components are mounted in the rear of the transit case.

Figure 5: Radio Case components (front view)

4.2. Operations, Administration, and Maintenance Computer

CAUTION: Do not install additional software onto the OA&M computer. Additional software may cause OA&M operations to malfunction.

The Operations, Administration, and Maintenance (OA&M) computer is installed with a CentOS Linux operating system (OS), and is used to perform system configuration, operation, and maintenance through the user interface (UI) and/or command line interface (CLI). The OA&M computer also controls the power (on/off) to the individual AC line receptacles of the RN and RNC Power Distribution Units (PDUs). QDBS–Broadband applications running on the OA&M Computer can operate with the laptop in the open or closed position. When the computer is closed, the Element Management System continues to function by receiving updates of component status, log events, etc.

Figure 6: OA&M Computer

The OA&M Computer is stored in a cover of the Network Case.

4.2.1. Radio Node (RN)

The RN provides radio resources and maintains radio links with the Access Terminal (AT). The RN implements the Physical and Media Access Control (MAC) layers of the EV-DO protocol stack. The RN is analogous to the BTS in the QDBS-Cellular.

4.2.2. Power Distribution Unit (PDU)

The PDU is a power controller that provides AC power, EMI/RFI filtering, and spike/surge protection to the components in the transit case. While the PDU has a master power switch and eight momentary touch-switches that control the eight individual AC line receptacles, these switches should not be turned on or off manually, as they are controlled by the OA&M computer.

CAUTION: Turning off the components manually using the PDU's individual (numbered) switches, may cause irreparable damage to the components.

4.2.3. Radio Frequency Front End (RFFE)

WARNING: Do not begin radiating an RF signal unless the appropriately loaded antennas are connected to the RF terminals (TxRx0 and Rx1 of the RAN Connector Interface Panel). Exposure to high levels of RF energy could result, causing bodily injury.

The RFFE is a single sector, 20 W power amplifier that boosts the signal from the RN sector to the Tx/Rx0 and Rx1 antennas, resulting in greater coverage area. When the RN is used with the RFFE, the radio is referred to as macro-cell. Each RN can support up to three sectors (each sector requiring its own RFFE). The basic QDBS–Broadband, however, includes only one RFFE and can therefore accommodate only one macro-sector. Additional RFFEs may be added to the QDBS–Broadband (up to three per RN) to increase the number of macro-sectors.

The RFFE contains an internal Ethernet controller with Digital and Analog signals. The OAM laptop controls the RFFE output power level, calibration, output protection and status monitoring via the Ethernet controller. The RN RF output is connected to the RFFE input through Sub-Miniature version A (SMA) connectors on the back of the RFFE and on the front the RN. The RFFE output is connected to the Tx/Rx0 and Rx1 antennas using two N-type connectors (one for transmitting and one for receiving) on the Radio Case CIP.

The front of the RFFE is shown in Figure 5. The rear of the RFFE is denoted with 3 in Figure 7.

Figure 7: Radio Case (rear panel view)

4.2.4. Connector Interface Panel

The Connector Interface Panel (CIP) is a cable pass-through panel designed to make connecting and disconnecting the various serial and Ethernet connections in the transit cases easier. The CIP is located in the rear of the transit case and is denoted with 2 in Figure 7, while CIP detail is shown in Figure 8.

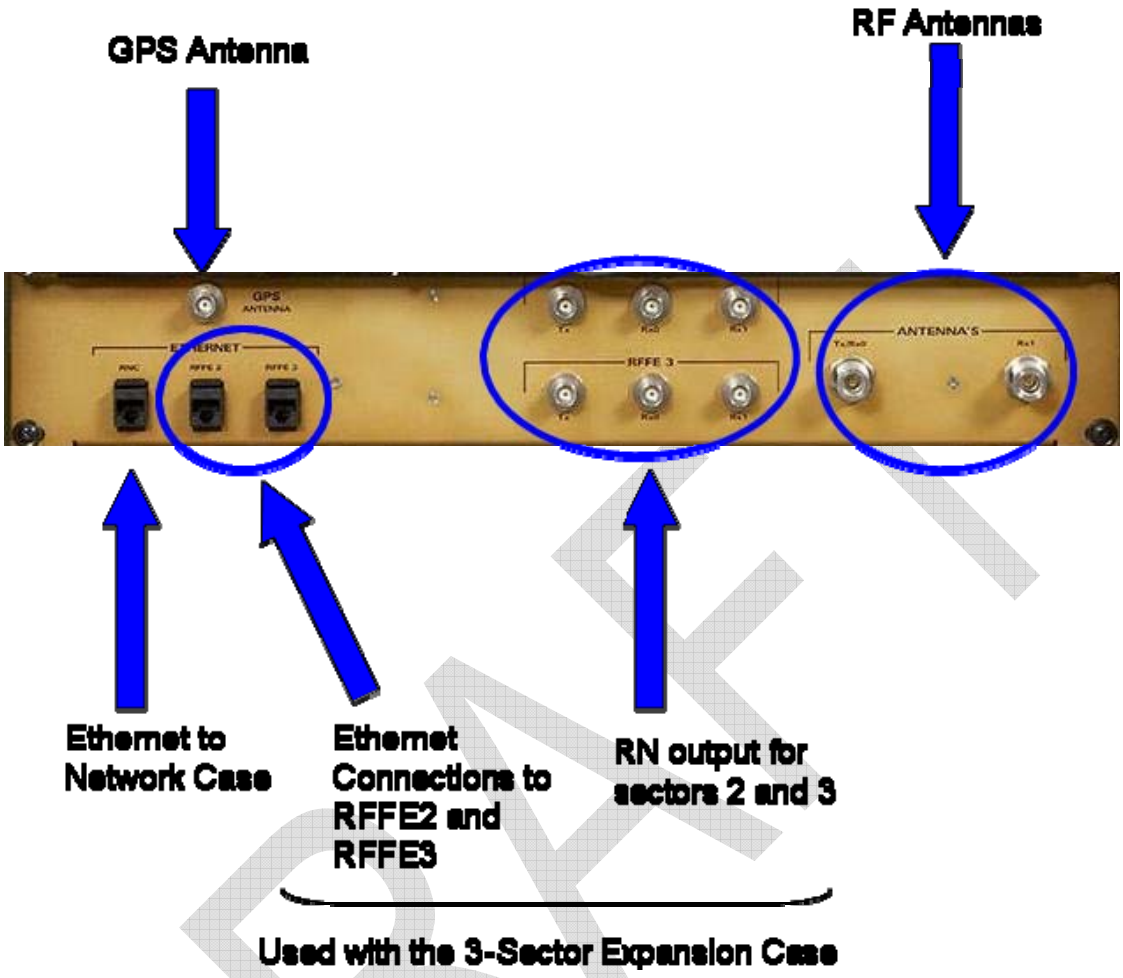

Figure 8: Detail of the Radio Case CIP

4.2.5. Ethernet switch

The Ethernet switch denoted with (1) in Figure 7 is used for Ethernet connectivity and Local Area Network Internet Protocol (LAN IP) communications. The Ethernet switch has 16 10/100 Mb/s auto-speed Ethernet ports and built-in link and activity lights. Access to the switch is from the rear of the Radio Case.

All major components of the Radio Case (RN, RNC, and RFFE) connect to the Ethernet switch and communicate with each other using IP.

4.2.6. RF antennas

WARNING: When operating the QDBS–Broadband in pico-cell mode, install a 30 dB attenuator between the transmit port of the RAN CIP and the transmit antenna. Failure to install the attenuator may result in dangerous RF exposure and bodily harm.

For pico-cell operation, two small magnetic-mounted wire-whip RF antennas (one for transmitting and one for receiving), are provided with the QDBS–Broadband. Macro antennas are an optional QDBS–Broadband accessory.

4.3. Network Case components

Figure 9 identifies the components of the Network Case. Each component is described in the following subsections.

Figure 9: Major components of the Network Case (front view)

4.3.1. Authentication, Authorization, and Accounting (AAA) Server

The AAA sever is an optional component of the QDBS-Broadband. The AAA is used for access control whereby the authentication function identifies the user, the authorization function

implements policies that determine which resources and services a valid user may access, and the accounting function keeps track of time and data resources used for billing and analysis.

4.3.2. Power Distribution Unit (PDU)

CAUTION: Turning off the components manually, using the PDU's individual (numbered) switches may cause irreparable damage to the components.

The PDU is a power controller that provides AC power, EMI/RFI filtering, and spike/surge protection to the components in the Network Case. While the PDU has a master power switch and eight momentary touch switches that control the eight individual AC line receptacles, these switches should not be manually turned on or off as they are controlled by the OA&M computer.

4.3.3. Radio Node Controller (RNC)

The RNC controls one or more Radio Cases, manages the AT's radio connection and session, and controls mobility within its service area. The RNC implements the connection, session, stream, and application layers of the EV-DO protocol stack. The RNC is analogous to the BSC in the QDBS–Cellular.

Also implemented within the RNC is the Packet Control Function (PCF) that provides connectivity between the RAN and the PDSN. The PCF manages the packet data state (active, dormant) and relays end user data packets between the AT and the PDSN. If a AAA server is deployed, the PCF can also pass the AT's usage information to the AAA via the PDSN for usage accounting purposes.

4.3.4. Packet Data Serving Node (PDSN)

The Packet Data Serving Node (PDSN) provides wireless packet data services and IP connectivity for the phones or aircards, to the Internet or private intranet (such as NIPRNET). The PDSN connects a radio network to an IP network via a serving router. Primarily, the PDSN establishes, maintains, and terminates PPP packet data sessions from a mobile device to a data network by routing IP packets to mobile nodes. The PDSN assigns a dynamic or fixed IP address to a mobile device during a data call. The PDSN is also the entry point to the public Internet or a private network. Connection to an external IP network is made through an RJ-45 connection.

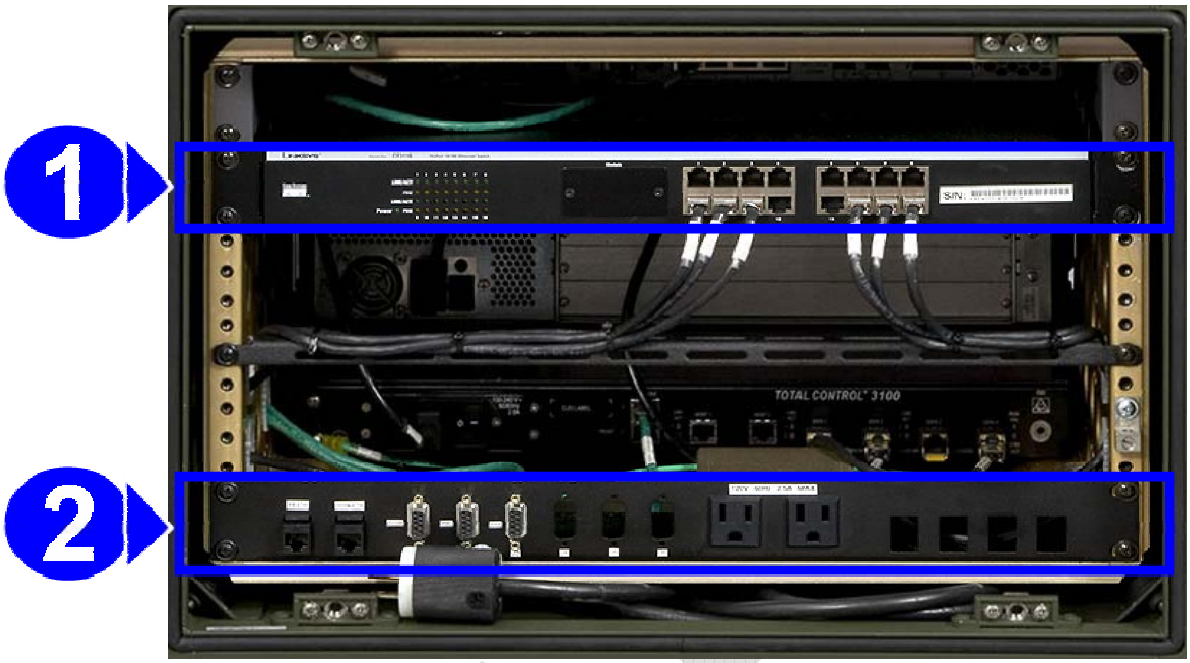

Figure 10: RNC case (rear view)

4.3.5. Ethernet switch

The Ethernet switch denoted with 1 in Figure 10 is used for Ethernet connectivity and LAN IP communications. The Ethernet has sixteen 10/100 Mbps auto-speed Ethernet ports and built-in link and activity lights. The switch is accessed from the rear of the RAN.

4.3.6. Connector Interface Panel

The Connector Interface Panel (CIP) denoted with 2 in Figure 10 is a cable pass-through panel designed to make connecting and disconnecting the various serial and Ethernet connections in the transit cases easier. The CIP is located in the rear of the transit case. The Network CIP also has connections for the IP network Ethernet, the backhaul to the Radio, and convenience outlets.

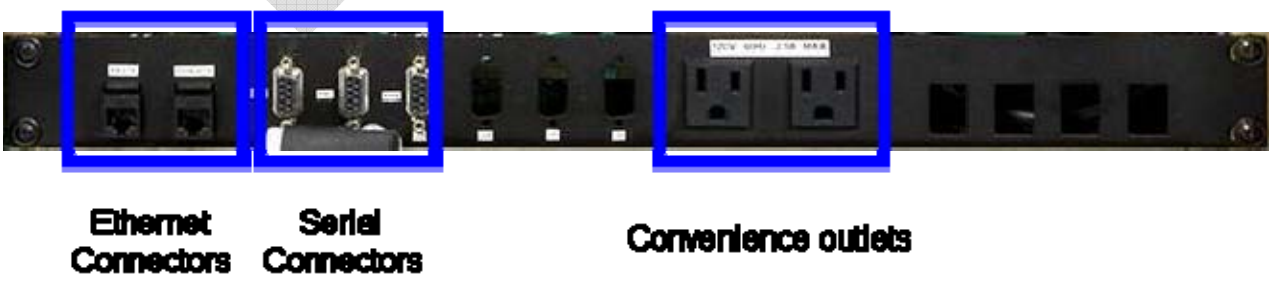

Figure 11: Network CIP

4.3.7. Serial console

A serial console panel denoted with 2 in Figure 10 allows easy access to the serial ports of the components of the Network Case.

4.3.8. 120V Convenience outlets

The 120 VAC outlets denoted with 2 in Figure 10 provide power for additional equipment needed during the operation of the system. Typically, these outlets support a phone charger or a laptop power adapter. These outlets are not intended to supply power to any high wattage device.

CAUTION: Overloading this receptacle may cause the main breaker to trip, and may cause irreparable damage to components.

4.4. Cabling

Figure 12 shows the cable interconnections for RF, Ethernet, and serial connectivity within the Radio and Network Cases.

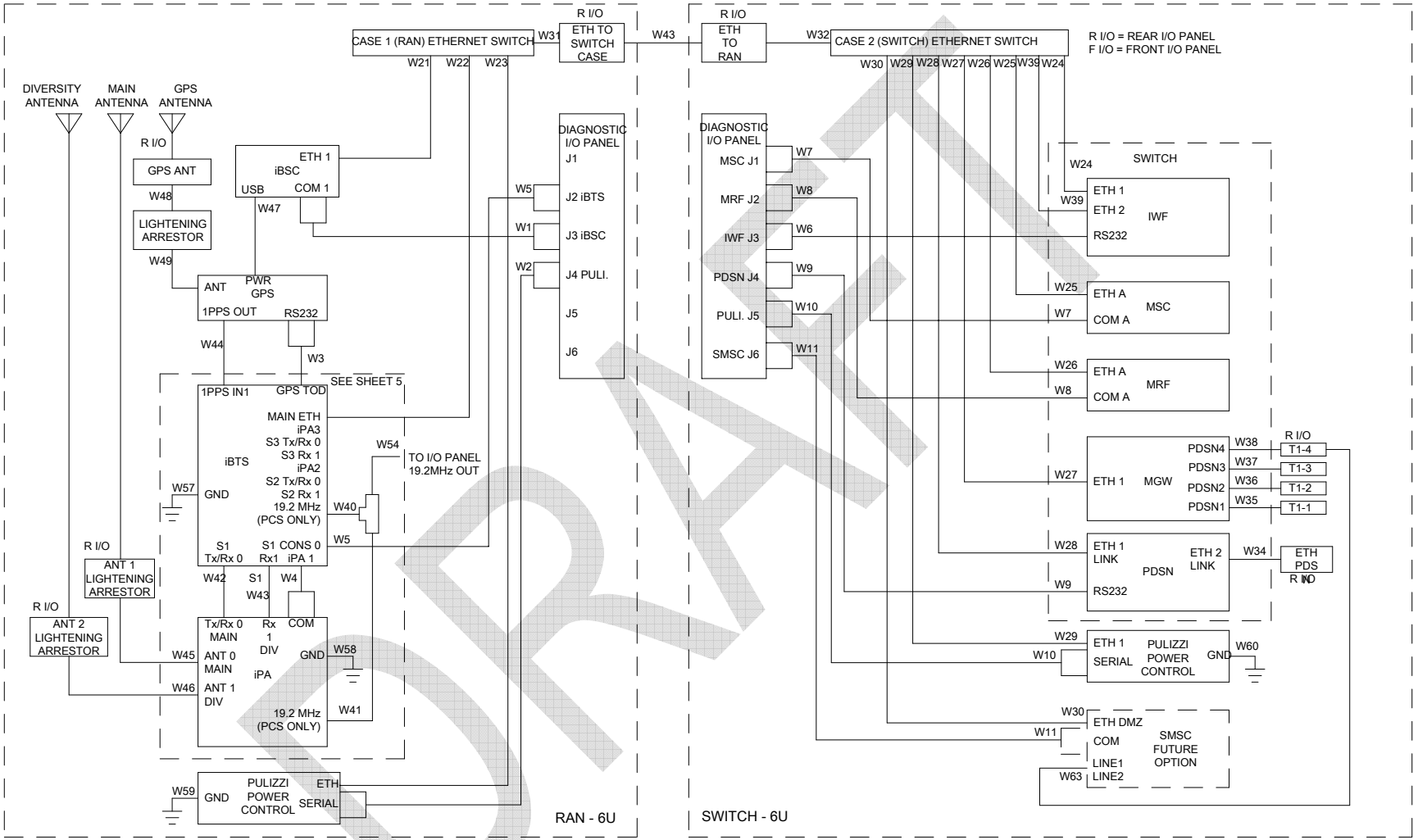

Figure 12: QDBS–Broadband cabling

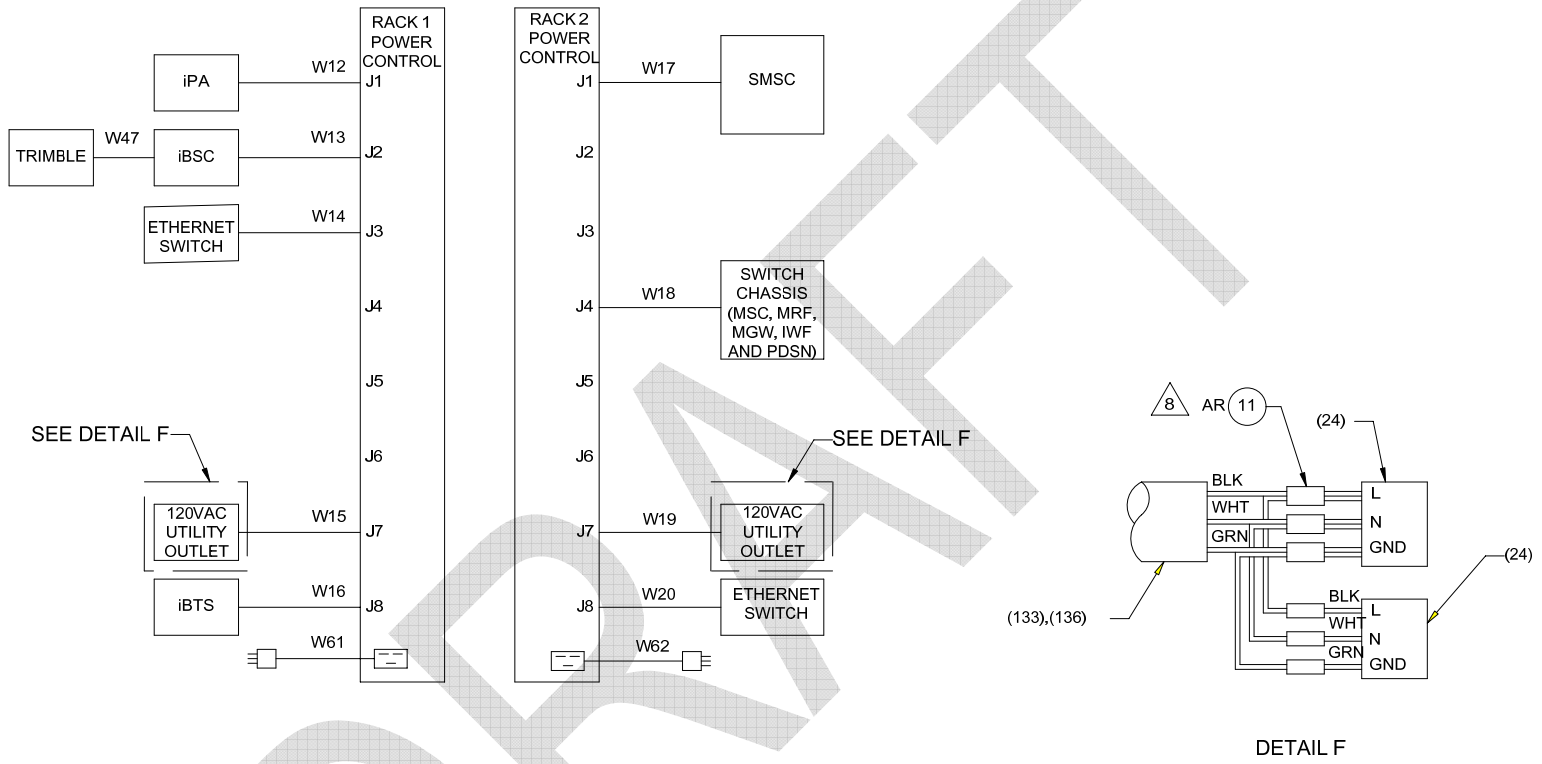

Figure 13: AC power wiring

Section 5

Setting Up the QDBS–Broadband

5.1. Site preparation

WARNING: Grounding the QDBS–Broadband to an appropriate ground is required to prevent injury or death in the event of a lightning strike. Depending on your deployment scenario, you can ground each QDBS–Broadband case grounding lug to facility ground by using grounding rods and cables, or ground to a vehicle-frame. Grounding equipment is not included with the QDBS–Broadband.

NOTE: Do not operate without applicable FCC licenses and FCC authorization. Also, do not operate in such a way as to interfere with commercial wireless network operations.

The QDBS–Broadband should be operated on a hard, dry, flat surface, free from dust and debris with approximately two-feet of space around the transit cases for air-flow cooling. The QDBS–Broadband is designed to operate in a sheltered environment such as a command tent, vehicle, or building. It should not be exposed to rain, sleet, snow or other adverse weather conditions.

One 15-amp, 120 VAC power circuit with two outlets is required to operate the QDBS–Broadband.

5.2. Setting up the transit cases

The QDBS–Broadband comes from the factory with all inter-component cabling in place. Setup is limited to connecting the system to an external AC power source, setting up the GPS and RF antennas, and verifying the connections of the inter-component cables.

The QDBS–Broadband is delivered with all required software installed, eliminating the need to install software on the system. The transit cases may be set up in a stacked or side-by-side configuration. A common configuration is to stack the Radio Case on top of the Network Case prior to initial setup.

5.2.1. Setup sequence

See Figure 14 and **Error! Reference source not found.** for help on identifying the locations of items called out in the setup sequence.

To set up the QDBS–Broadband transit cases:

1. Press the red pressure relief valve on each case to relieve any pressure differences.
2. Remove the covers from the ends of the transit cases by unscrewing the captive threaded thumbscrews.
3. Remove the OA&M computer from the cover of the Network Case.
4. Connect the OA&M computer LAN connection to any open port of the Network Case Ethernet switch using the CAT5 cable provided.
5. Store the transit case covers in a secure place.
6. Connect the ground on both the Radio Case and the Network Case, (see Figure 14 for details).

WARNING - Connect the Radio Case and Network Case grounding lugs to an appropriate ground (facility ground, grounding rods and cables, or vehicle-frame ground). An ungrounded system can be a serious electrical-shock hazard and can result in bodily harm or even death.

7. Connect the GPS cable between the GPS antenna and the Radio Case CIP, (see Figure 14 for details).
8. Place the GPS antenna outdoors with a clear view of the sky to ensure that the antenna acquires the GPS satellite signals.
9. Connect the Ethernet cable between the Radio Case CIP and the Network Case CIP, (see Figure 14 for additional details).

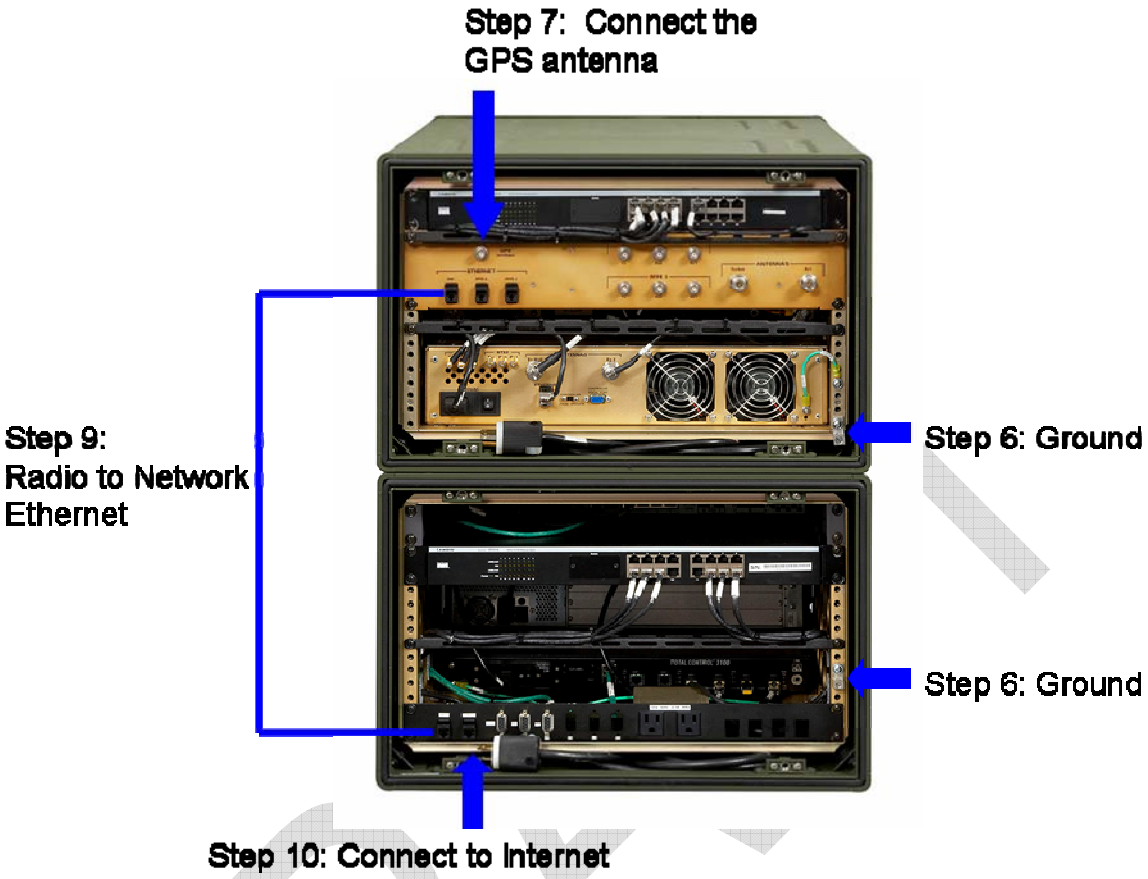

Figure 14: Connections on the QDBS–Broadband

10. If the QDBS–Broadband is to be connected to a data network, connect the external network's Ethernet cable to the PDSN port on the Radio Case CIP.

11. Connect both the Radio Case and Network Case AC power cables to a minimum of a 15A, 120V AC power supply.

5.3. Connecting the RF antennas

The QDBS–Broadband can operate in two modes: pico-cell mode for a limited coverage area and macro-cell mode (20 W output) for a large, multi-mile coverage area. Each mode uses a specific antenna configuration. Pico-cell mode uses the small magnetic-mounted wire whip antennas. Macro-cell mode uses large outdoor antennas, which are mounted to a customer provided mast, tower, or vehicular-mast system.

WARNING: Personnel in proximity to the transmitting antenna need to ensure that the ANSI/IEEE C95.1-1992 "Safety Levels with Respect to Human Exposure to Radio

Frequency Electromagnetic Fields, 3 kHz to 300 GHz"" are being meet, when measured in accordance with the ANSI/IEEE C95.3-1992 "Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave" procedure. Exposure to excessive levels of RF radiation may cause serious bodily harm.

5.3.1. Pico-cell mode

To connect a pico-cell antenna:

1. Connect the 30 dB RF loads to the ports labeled **TxRx 0** (transmit port) and **Rx 1** (Receive Diversity) of the Radio Case CIP, (see Figure 15 for more details).

NOTE: This 30 dB load is required to attenuate the transmit signal coming out of the 20 W RFFE.

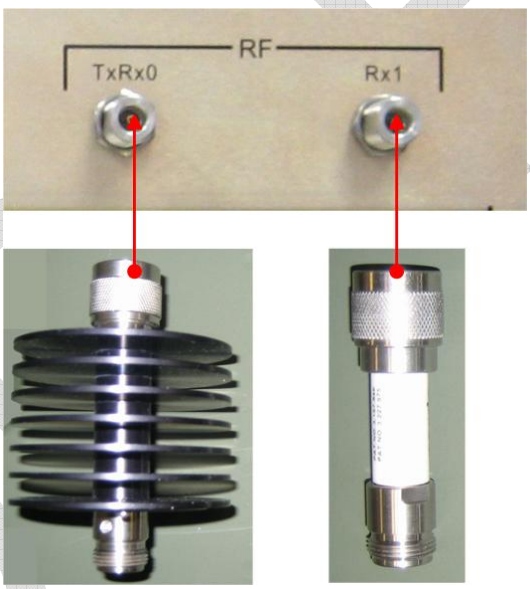

Figure 15: RF attenuators for pico-cell operation

2. Connect a wire whip antenna to each of the 30 dB RF loads.

5.3.2. Macro-cell mode

See [10] for additional information on cellular antenna selection and installation guidelines.

WARNING: Follow all manufactures procedures and precautions when mounting the antennas on a mast, tower, or vehicle to ensure they are securely mounted. Failure to

do so may result in the antenna detaching from the mounting surface and seriously injuring personnel.

To connect a macro-cell antenna:

1. Connect the two macro-cell antennas (Transmit and Receive) to the desired mounting structure.

NOTE: The two antennas should be at least five (5) feet apart for receive signal diversity.

2. Connect one end of the ½ inch diameter RF coax cable to bottom of the Transmit antenna.
3. Repeat Step 2 for the Receive Antenna.
4. Connect the Transmit Antenna cable to the port labeled **TxRx 0** of the Radio Case CIP.

NOTE - Do not attach the RF load to the transmit port when a macro-cell antenna is attached, as the system range will be greatly reduced.

5. Connect the Receive Antenna cable to the port labeled **Rx 1** of the Radio Case CIP.

Section 6

Setting Up QDBS–Broadband Remote Radio Case(s)

The basic QDBS–Broadband system has a single Radio Case. This single Radio Case is capable of providing broadband coverage over a large geographic area. If more coverage is required, additional Radios may be connected to the QDBS–Broadband.

The initial Radio Case provided as a part of the basic QDBS–Broadband is referred to as a "local" Radio, since this Radio is physically in the same location as the Network Case. Additional Radios will normally be located several miles from the Network Case in order to cover a different geographic area, and are referred to as "remote" Radio Cases. The remote Radio has the same hardware and software configuration as the local Radio, with a single exception; the remote Radio does not have an OA&M Computer. A remote Radio is setup in the same manner as the local Radio.

NOTE: Requires the "Radio Node Controller Capacity Upgrade" option to support connection of up to four Radio Cases or up to twelve Radio Cases per Network Case.

An illustration of a remote Radio deployment is shown in Figure 16.

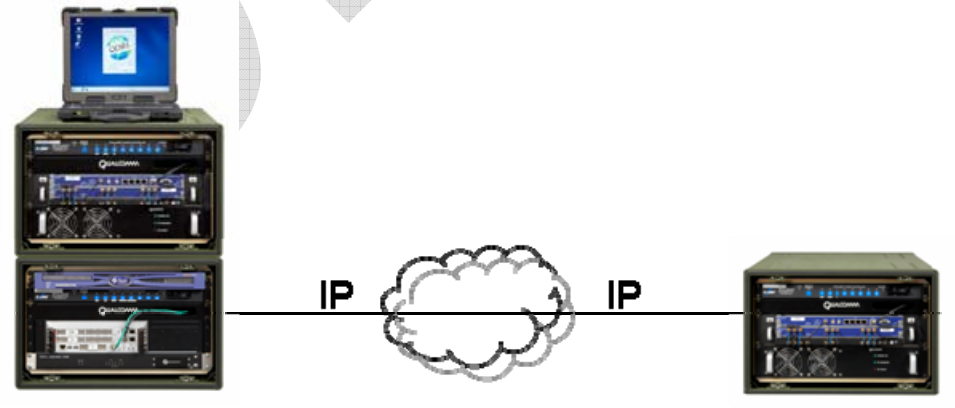

Figure 16: Example remote Radio deployment

6.1. Remote Radio Case connectivity

The remote RN is connected to the QDBS–Broadband using IP. A connection must be established between the Ethernet switch of the remote Radio Case and the Ethernet switch of the Network Case. This connection must be of adequate bandwidth to support the signaling and traffic requirements between the remote Radio and the components of the Network Case.

Section 7

Setting Up the QDBS–Broadband & QDBS–Cellular in Overlay

7.1. Hardware setup

The QDBS–Broadband can be configured with a QDBS–Cellular to provide overlay coverage of Cellular 1x-RTT and Broadband EV-DO Rev. A coverage. The setup consists of two Radio Cases, QDBS-Cellular and QDBS-Broadband. The two QDBS systems are interconnected to provide overlay coverage.

7.2. Overlay system setup

1. Set up the QDBS–Cellular as described in the *QDBS-Cellular Hardware Setup Guide*.
2. Set up the QDBS–Broadband as described in Section 5. It is not necessary that the systems be right next to each other; however, they must be close enough that the Cat 5e Ethernet cable can reach between the two.
3. Connect one end of the Cat 5e Ethernet cable to the Ethernet switch in the QDBS–Cellular and connect the other end of the cable to the switch in the QDBS–Broadband, as shown in (figure x).
4. Connect the RF Antennas as described in section 7.2, ensuring that the antennas are separated by at least five (5) feet.

NOTE: The QDBS–Cellular CDMA channel must be different than the QDBS–Broadband channel by at least 50 channels to prevent interference.