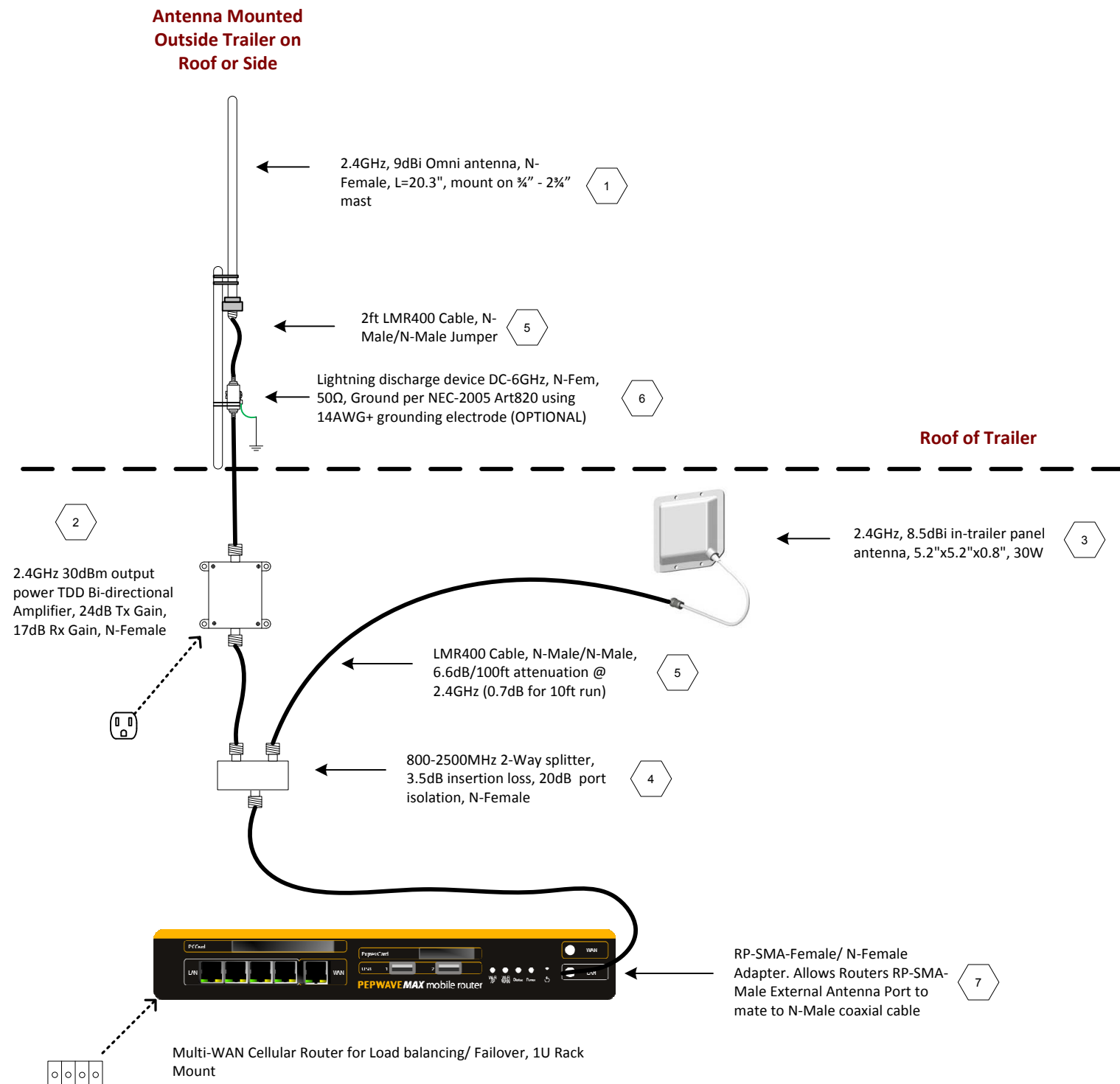


**Section 5: Improving Range of 802.11b/g WLAN within & Outside Emergency Mgmt Trailer**



|  |                   |                           |                              |
|--|-------------------|---------------------------|------------------------------|
| <b>Wireless Communication System for Emergency Management Trailer</b>  |                   |                           |                              |
| Solution for WWAN, WLAN & PtMp Wireless Systems<br>JOB # BWA-40350-0410<br>Section 5.0: WLAN 2.4GHz BDA, Antenna, Splitter & Cabling |                   |                           |                              |
| DRAWN BY: RT (Engr)<br>APPROVED BY:  | SIZE              | LIC NO<br>AZ ROC # 253407 | DWG NO<br>BW-403500410-001   |
| FREQ(s): 2.4GHz ISM, 5GHz ISM/UNII, 800MHz Cell, 1900MHz PCS   | SCALE<br>NO SCALE | FRN: 0018086041           | REV<br>1A<br>SHEET<br>1 OF 3 |

D  
C  
B  
A



**Bill of Materials**

| ITEM | QTY. | RFWEL SKU     | DESCRIPTION   |
|------|------|---------------|---|
| 1    | 1    | TSAN371231    | 2.4GHz 9dBi Rugged Outdoor Omni Antenna, N-Female         |
| 2    | 1    | 12-213        | 2.4GHz 1 Watt (30dBm) Bi-Directional TDD Amp, N-Female    |
| 3    | 1    | ARC-PA2409S01 | 2.4GHz 8.5dBi Indoor Panel Antenna, N-Female              |
| 4    | 1    | SPLIT2500_2   | 800-2500MHz 2-Way Splitter, 3.5dB IL, N-Female            |
| 5    | 4    | 952310        | 10ft LMR-400 low loss coaxial cable (N-Male/N-Male)       |
| 6    | 1    | LPNFN276V     | Coax Lightning protector DC-6GHz, IL<0.7dB, 276VDC, N-Fem |
| 7    | 1    | ADPRPSMAFNF   | RP-SMA-Female/ N-Female Adapter                           |

**NOTES:**

**5 WLAN 2.4GHz Antenna & Cabling**

5.0 Selection Guide:

5.0.1 If the Wireless 802.11g signal created by the MultiWAN router in 1.1 requires to be routed outside the communication trailer we will require outdoor omnidirectional 2.4GHz antennas and cabling. A 9dBi outdoor omni antenna would suffice. Will also require a low-loss cable with correct port interface to connect antenna to WiFi radio.

5.0.2 If the Wireless 802.11g signal created by the MultiWAN router in 1.1 requires to be utilized inside the communication trailer and if the standard 5dBi magnetic base indoor antenna is not sufficient (due to radiation pattern or form factor) may require an indoor panel/dome 2.4GHz antennas or other omni antenna. May also need low-loss coaxial cable to move this antenna to where it is likely to be needed and away from rack & other obstructions. Recommend 8.5dBi patch antenna for mount to side of trailer wall.

5.0.3 For 5.0.1 and 5.0.2 concurrently include a 50/50 power splitter/combiner. Recommend 800MHz-2500MHz power splitter. One port attaches to 9dBi omni outside trailer and one port attaches to 8.5dBi patch inside trailer.

5.0.4 To overcome the 3.5dB insertion loss of 5.0.3 and to improve outdoor coverage where needed require a 2.4GHz amplifier. Recommend Teletronics 2.4GHz 1 Watt (30dBm) indoor amplifier with AGC (Automatic Gain Control). This is a bi-directional amplifier and will boost both the transmitted and received WiFi signals.

**⚠ Note should not arbitrarily add outdoor omni antenna gain lest system EIRP exceeds regulatory limits for 802.11g**

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### Section 6: Long Distance Point-to-Point/ Point-to-MultiPoint Wireless Link

MIMO Primary Antenna

MIMO Diversity Antenna

5GHz, 12dBi Omni antenna, N-Female, mount on 3/4" - 2 3/4" mast

Radios allow for Non-Line-of-Sight paths. A careful link budget analysis required to optimize EIRP for target links. Sample results provided for a 2mile LOS link w/ 12dBi 2x2 MIMO at BS and 21dBi Integrated 2x2 MIMO SU at 5.8GHz.

REMOTE SITE

Tsunami MP8150 Ruggedized Subscriber Unit w/ 2x2 MIMO 21dBi integrated Antennas. Mount Subscriber Station to provide best link to BS radio in Emergency Mgmt Trailer (See attached link budget analysis for 2 mile LOS link)

Roof of Trailer

Tsunami MP8100 Ruggedized Base-Station, MIMO 3x3 300Mbps, 5.8GHz, N-Female

LMR400 Cable, N-Male/N-Male, 10.8dB/100ft attenuation @ 5.8GHz (1.1dB for 10ft run)

POE Injector

CAT5/6

Multi-WAN Cellular Router for Load balancing/ Failover, 1U Rack Mount

terminal block



For maximum MIMO diversity gain separate as much as practical. Maintain at least 2.5ft separation between antennas.



1616 S. Stapley Dr. Ste 103, Mesa, AZ, 85204, U.S.A  
www.rfwel.com | 480.218.1877

Wireless Communication System for Emergency Management Trailer

Solution for WWAN, WLAN & PtMp Wireless Systems  
JOB # BWA-40350-0410  
Section 6.0: Long Range Wireless Link

DRAWN BY: RT (Engr)  
APPROVED BY:

SIZE

LIC NO

DWG NO

REV

AZ ROC # 253407

BW-403500410-001

1A

FREQ(s): 2.4GHz ISM, 5GHz ISM/UNII, 800MHz Cell, 1900MHz PCS

SCALE

NO SCALE

FRN: 0018086041

SHEET

2 OF 3

### Bill of Materials

| ITEM | QTY. | RFWEL SKU      | DESCRIPTION  |
|------|------|----------------|--|
| 1    | 1    | CT-82-5315B    | 5GHz 12dBi Rugged Outdoor Omni Antenna, N-Female             |
| 2    | 2    | 952310         | 10ft LMR-400 low loss coaxial cable (N-Male/N-Male)          |
| 3    | 1    | MP-8100-BSU-US | Tsunami MP8100 Ruggedized Base-Station, 300Mbps, 5.8GHz, N-F |
| 4    | 1    | ADPRPSMAFNF    | Tsunami MP8150 Ruggedized SU, MIMO 2x2 w/ 21dbi intg'd       |

NOTES:

#### 6 Point-to-Point/ Point-to-Multipoint Wireless Links

6.0 May be required as a redundant link for backhaul or to increase link performance. For example if within command center there's an additional data connection this may be linked to the trailer using a point-to-point (PtP) or point-to-Multipoint (PtMp) or even mesh topology and this may be connected as an input the MultiWAN router and used either as a primary or redundant link. Another example may be where the communication trailer needs to provide data backhaul to LAN/WLAN systems outside the trailer outside the range of the available 802.11g WLAN provided by the MultiWAN router.

6.1 We design for a 2 mile line-of-sight link with 50mbps+ datarate. Recommend Proxim Wireless Tsunami QB-8100 MIMO radio. The radio selected is capable of non-line-of-sight range and much longer range and datarate with different antenna selection. System is modular to allow antenna replacement as desired for increased radiated power. We start with 12dBi omnidirectional antenna mounted on trailer to provide a 360-degree coverage zone. The subscriber radio is specified with an integrated dual-polarity 21dBi antenna for ease of deployment. The radio selected operates in 5GHz ISM/UNII band to avoid interference with 2.4GHz WiFi radios in trailer. MIMO provides additional redundancy (spatial diversity).

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**Wireless Communication System for Emergency Management Trailer**

Solution for WWAN, WLAN & PtMp Wireless Systems  
 JOB # BWA-40350-0410  
 Section 6.0: Long Range Wireless Link (RF Link Budget Analysis)

|   |       |                           |                            |           |
|---|-------|---------------------------|----------------------------|-----------|
| DRAWN BY: RT (Engr)<br>APPROVED BY:                             | SIZE  | LIC NO<br>AZ ROC # 253407 | DWG NO<br>BW-403500410-001 | REV<br>1A |
| FREQ(s): 2.4GHz ISM, 5GHz ISM/UNII,<br>800MHz Cell, 1900MHz PCS | SCALE | <b>NO SCALE</b>           | FRN: 0018086041<br>SHEET   | 3 OF 3    |

**proxim wireless** Project Name: CBRAC - Emergency Management Trailer Proxim Wireless, Inc  
 8100 Calculator v1.1b 1-Aug-09

**Regulatory** Calculator Mode:  
 Unlimited EIRP (100dBm) Miles  Kilometers

**Link / Environment**  
 Distance:  Miles Terrain: 1.00 (Average) Climate: 0.5 (Humid)  
 Free Space Loss: 117.89 Free Space Latency: 10.8uSec

**Endpoint-A / BSU** Trailer Mounted Max EIRP = 100 dBm  
 Antenna:  dBi Losses: MIMO 2 Tx / 2 Rx TPC: 1.1 dB

**Endpoint-B / SU** Remote Site Max EIRP = 100 dBm  
 Antenna: QB81x0 Integrated Dual-pol Panel 23dBi Losses: Other TPC: None

**Equipment / Operation**  
 Radio Mode: Dual Channel Size: 20MHz Frequency Band: 5.725 - 5.850 GHz (Upper)  
 Frequencies available in US & World Units

| Modulation | DataRate   | Availability |           | Fade Margin (dB) |        | RSL (dBm) |        | Rx Sens (dBm) |        | EIRP (dBm) |        |
|------------|------------|--------------|-----------|------------------|--------|-----------|--------|---------------|--------|------------|--------|
|            |            | Site-A       | Site-B    | Site-A           | Site-B | Site-A    | Site-B | Site-A        | Site-B | Site-A     | Site-B |
| BPSK 1/2   | 14.4 Mbps  | 100.0000%    | 100.0000% | 29.0             | 29.0   | -64.0     | -64.0  | -93           | -93    | 30.9       | 43     |
| QPSK 1/2   | 28.9 Mbps  | 100.0000%    | 100.0000% | 26.0             | 26.0   | -64.0     | -64.0  | -90           | -90    | 30.9       | 43     |
| QPSK 3/4   | 43.3 Mbps  | 100.0000%    | 100.0000% | 24.0             | 24.0   | -64.0     | -64.0  | -88           | -88    | 30.9       | 43     |
| 16QAM 1/2  | 57.8 Mbps  | 100.0000%    | 100.0000% | 21.0             | 21.0   | -64.0     | -64.0  | -85           | -85    | 30.9       | 43     |
| 16QAM 3/4  | 86.7 Mbps  | 99.9999%     | 99.9999%  | 16.0             | 16.0   | -64.0     | -64.0  | -80           | -80    | 30.9       | 43     |
| 64QAM 2/3  | 115.6 Mbps | 99.9993%     | 99.9993%  | 9.0              | 9.0    | -66.0     | -66.0  | -75           | -75    | 28.9       | 41     |
| 64QAM 3/4  | 130 Mbps   | 99.9982%     | 99.9982%  | 5.0              | 5.0    | -67.0     | -67.0  | -72           | -72    | 27.9       | 40     |
| 64QAM 5/6  | 144.4 Mbps |              |           | 3.0              | 3.0    | -68.0     | -68.0  | -71           | -71    | 26.9       | 39     |

**Important Note:** The provided calculations are not a guarantee of link performance. The data is provided in order to assist with the design of a wireless link using a Tsunami 8100 product. The calculated performance may be useful for comparison with the actual system when installed. These calculations assume an unobstructed line-of-site radio path with adequate clearance for antenna height above terrain and obstructions. The availability and outage results are based on the industry-standard formulae and use the manufacturer's specified performance for transmitter output power, receiver threshold, and antenna gain. Standard factors apply for the terrain type and current climate conditions, assuming no unusual or multipath propagation.