Appendix O: RFS System Test (Cable Sweeps)

Introduction

Before installing the Base Station at a site, the RFS and the associated cables must be tested, and the results of the tests documented. This procedure applies to the full RFS sub-assembly and associated cables: data/power cable, RF cables, and the RFS unit. All results are recorded in the RFS System Test Form P/N 40-00093-00.

Procedures – Combo & Split Chassis Base Stations

RFS Data/Power Cable (Combo and Split BTS Configurations Only)

This test will check the integrity of the data/power cable. The cable being tested consists of six twisted pairs of conductors. The conductors will be tested for continuity, opens, and shorts. Male connectors are on both ends of the cable. Each connector is wired the same. You will need to check all cables – the main cable from the RFS to the data/power cable surge protector, and the jumper cable from the data/power cable surge protector to the BTS. The pin layout is shown in Figure O1, looking at the connector face. Table O1 provides the pin layout details.

Figure O1: Pin Layout

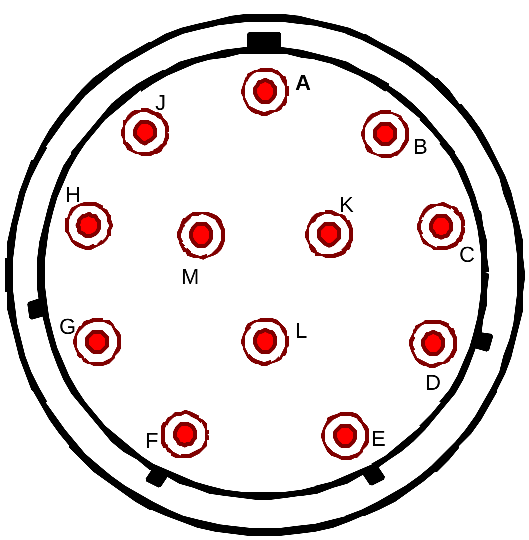


Table O1: Pin layout Details

POWER CABLE PIN OUT			
Circular Connector(s)	Wire Color	Wire Color	Signal Name
A	RED	PAIR	+12V A
B	BLACK		+12V A RTN
C	BROWN		Heater
D	DRAIN		GND (Shield Wire)
E	BLACK	PAIR	RX_EN_B-
F	WHITE		RX_EN_B+
G	BLUE	PAIR	RX_EN_A+
H	BLACK		RX_EN_A-
J	BLACK	PAIR	Diagbus-
K	GREEN		Diagbus+
L	BLACK	PAIR	+12V B Return
M	YELLOW		+12V B

Perform the continuity test with both the Volt Ohm Meter (VOM) and the power/data cable tester. If the power/data cable tester is not available, perform the continuity test with the VOM.

Required Equipment

?? VOM – Continuity tester

?? Jumper for shorting pins

?? RFS power/data cable tester

Continuity Test With VOM

Step 1. On one end of the cable, short a pair of conductors using a shorting device.

Step 2. Using a VOM/Digital Volt Meter (DVM) set to ohms, verify a short is present on the pair at the other end.

Step 3. Leaving one probe on one of the paired pins, contact all of the other pins with the other probe, ensuring an open connection.

Step 4. Check all 6 pairs of wires in the same manner.

Step 5. Verify continuity from the connector case to the drain wire (pin D) on each end of the cable and between each connector case.

Step 6. Verify an open circuit from the connector case to each individual wire, except to the drain wire.

Continuity Test With Power/Data Cable Tester

Step 1. Connect one end of the power/data cable to the connector on the power/data cable tester.

Step 2. Using a VOM/DVM set to ohms, check resistance to ground on the other end of the cable. Resistance is checked from the case of the connector to the individual pin. Resistance readings (+/– 10 percent) are shown in Table O2.

Table O2: Resistance to Ground

Pin	Resistance	Pin	Resistance
A	1K ohms	G	6.2K ohms
B	2K ohms	H	8.2K ohms
E	3.3K ohms	L	10K ohms
F	5.1K ohms	M	12K ohms

Step 3. Using a VOM/DVM set to ohms, check resistance between the pairs on the other end of the cable. Resistance should be the sum of the resistance of the two pairs, +/– 10 percent. Refer to Table O3.

Table O3: Resistance of Two Pairs

Pins	Resistance	Pins	Resistance
A & B	3K ohms	G & H	14.4K ohms
E & F	8.4K ohms	L & M	22K ohms

Step 4. Remove the power/data cable tester from the power/data cable.

Sweep Test of RF Cables & RFS

Sweep testing of the RF cables and the RFS is performed in three separate steps.

- ?? Sweep of the cables
- ?? Sweep of the RFS
- ?? Sweep of the cables and the RFS together

All results will be entered in the RFS System Test Form, P/N 40-00093-00. The total of the insertion loss for the cables and the RFS will be equal to the insertion loss of both parts swept together.

Equipment Required

?? Signal Generator - Agilent 8648C, or suitable alternative, tunable to the RFS center frequency
?? Spectrum Analyzer - Agilent E4402B, or equivalent
?? Signal Generator cable and Spectrum Analyzer cable – Gender can be changed using a barrel connector
?? Male and Female barrel connectors for Signal Generator cable and Spectrum Analyzer cable connections
?? Power/data test cable
?? Navini RFS Test Box

Equipment Settings

Spectrum Analyzer:
?? Span – 5 MHz
?? RBW – 100 KHz
?? VBW – 100 KHz
?? Sweep Time – Auto
?? Frequency (Provided in Table O4)

Signal Generator:
?? Amplitude – 0 dB
?? Frequency (Provided in Table O4)

Test Setup

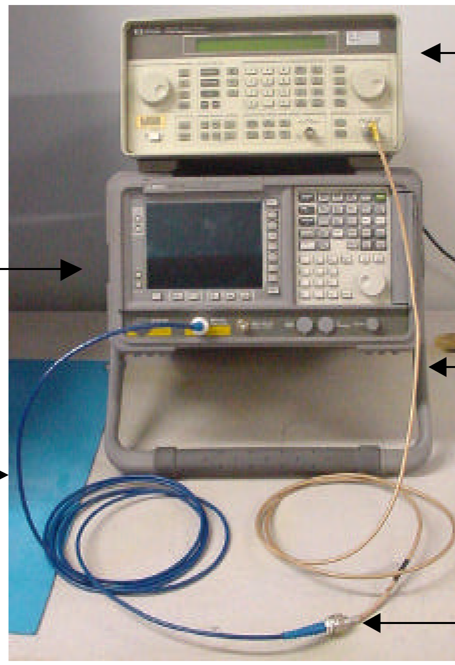
When performing each type of sweep, the sweep has to be performed at certain frequency intervals (Table C5). Perform the complete test at the first frequency. Go to the next frequency and recalibrate the test setup. Perform the complete test again. Do the same for the third frequency. Refer to Figure O2.

Table O4: Sweep Frequencies

System	Sweep 1	Sweep 2	Sweep 3
2.3 GHz High band	2348.25	2352.50	2357.50
2.3 GHz Low band	2307.50	2312.50	2316.75
2.4 GHz	2400.00	2440.00	2473.50
2.5 GHz	2500.00	2548.00	2596.00
2.6 GHz	2602.00	2620.00	2641.00
2.6 GHz EFGH	2602.00	2641.00	2683.00

1. Connect the Signal Generator cable to the Signal Generator.
2. Connect the Spectrum Analyzer cable to the Spectrum Analyzer.
3. Connect the other end of the cables together. Use a barrel connector if needed.

Figure O2: Test Setup



Test Procedure

The following procedures are for the Agilent E4402B Spectrum Analyzer. If alternative equipment is used, refer to the manufacturer's calibration procedures. The key point is to make accurate microwave frequency power measurements.

Step 1. Turn the Signal Generator and Spectrum Analyzer on. Allow the equipment to warm up for 15 minutes for the output to stabilize.

Step 2. Set the Signal Generator frequency to the desired test frequency (Table O4) of the RFS under test.

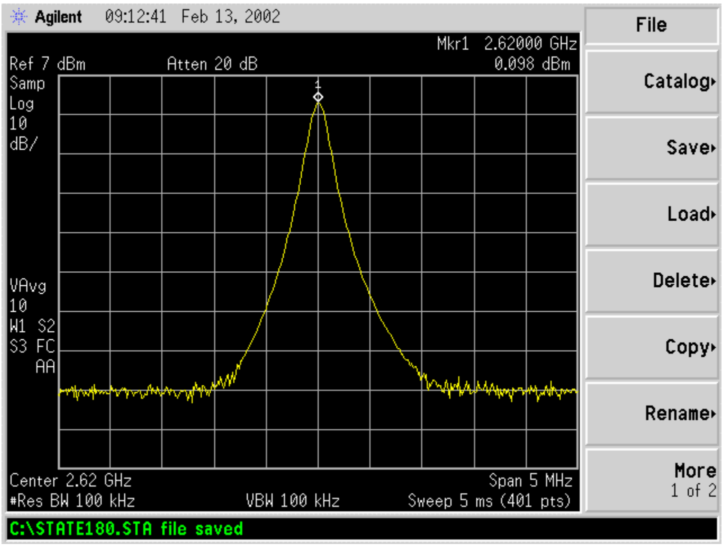
Step 3. Set the Signal Generator output amplitude to 0 dBm.

Step 4. Set the center frequency of the Spectrum Analyzer to the center frequency of the RFS under test.

Step 5. Set the Spectrum Analyzer to Span = 5 MHz and Resolution Bandwidth = 100 kHz.

Step 6. Take a marker measurement on the Spectrum Analyzer by using the 'marker to peak' or the 'peak search' function. The screen on the Spectrum Analyzer should look similar to that shown in Figure O3.

Figure O3: Sweep Test Marker Measurement Example



If the marker measurement doesn't read 0.0 dBm, adjust the amplitude on the Signal Generator until the Spectrum Analyzer marker reads 0.0 dBm, or as close to 0.0 dBm as possible. This will remove all losses associated with the test cables. All measurement data should be recorded one digit to the right of the decimal point, for example, 31.5dB.

Once the test setup is calibrated, these cables will remain in place and will be used throughout the whole test. If the test cables are removed or changed, incorrect readings will result.

RF Cable Insertion Loss

This test is performed on all RF cables that are installed in the system. This includes the eight antenna cables, the system calibration cable, and all jumper cables. Follow the procedures for either the cables on the ground or cables run up the tower.

Test Procedure For RF Cables on the Ground

Step 1. Ensure calibration of the test setup has been performed each time the test frequency is changed.

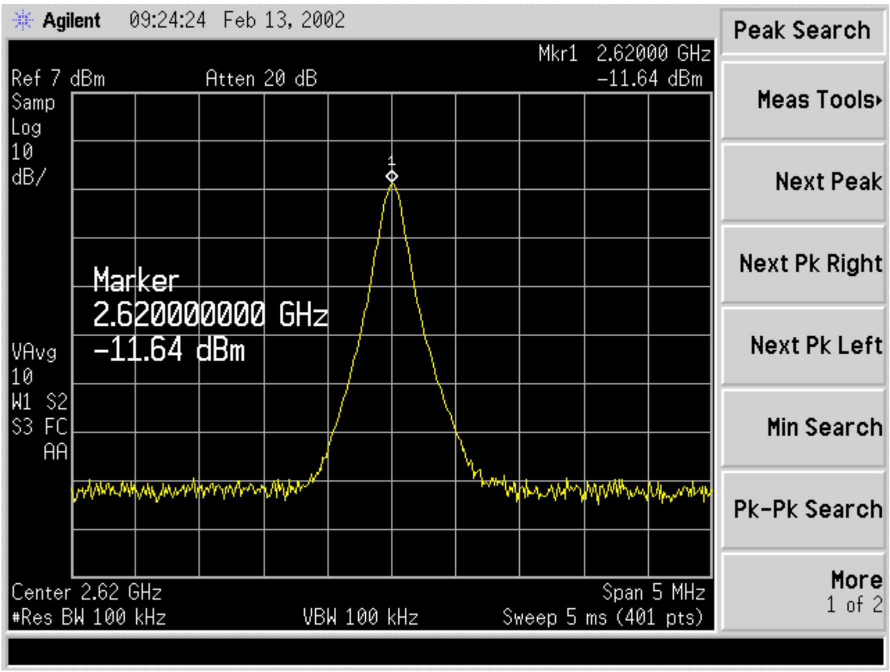
Step 2. If present, remove the barrel connector from between the Signal Generator and Spectrum Analyzer cables.

Step 3. Connect the cable from the Signal Generator to one end of the cable. Use a barrel connector to change the gender, if required.

Step 4. Connect the cable from the Spectrum Analyzer to the other end of the cable. Use a barrel connector to change the gender, if required.

Step 5. Take a marker measurement on the Spectrum Analyzer by using the 'marker to peak' or the 'peak search' function. The screen on the Spectrum Analyzer should look similar to the one shown in Figure O4.

Figure O4: Insertion Loss (Cables on Ground) Marker Measurement Example



Step 6. The result should be within +/– 0.5 dB of the calculated value. If the insertion loss results do not agree with the manufacturer's data, check the connectors for proper connection to the cable, and check for kinks in the cable. If the Spectrum Analyzer has a distance to fault (DTF) function, it can be used to help troubleshoot kinks in the cable.

CAUTION! Cables with results greater than the specified limits (i.e., 2 or 3 dB high) should not be installed, as a potential hardware fault exists.

Step 7. Record the data in the RFS System Test Form under "MAIN FEEDER LOSS" or "JUMPER LOSS". Ensure that the information is recorded under the channel number that is on the cable label.

Step 8. Repeat steps 3 through 7 for all remaining cables and jumpers.

Step 9. Change the frequency to the next test frequency (refer back to the Test Setup section of these procedures). Perform steps 1 through 8 until all cables have been successfully tested at the frequencies shown in Table O4.

Test Procedure For RF Cables Already Run Up the Tower

Step 1. Ensure calibration of the test setup has been performed each time the test frequency is changed.

Step 2. If present, remove the barrel connector from between the Signal Generator and Spectrum Analyzer cables.

Step 3. Have a member of the tower crew positioned on the tower, at the upper end of the cables, connect the calibration cable to antenna cable 1 with a barrel connector.

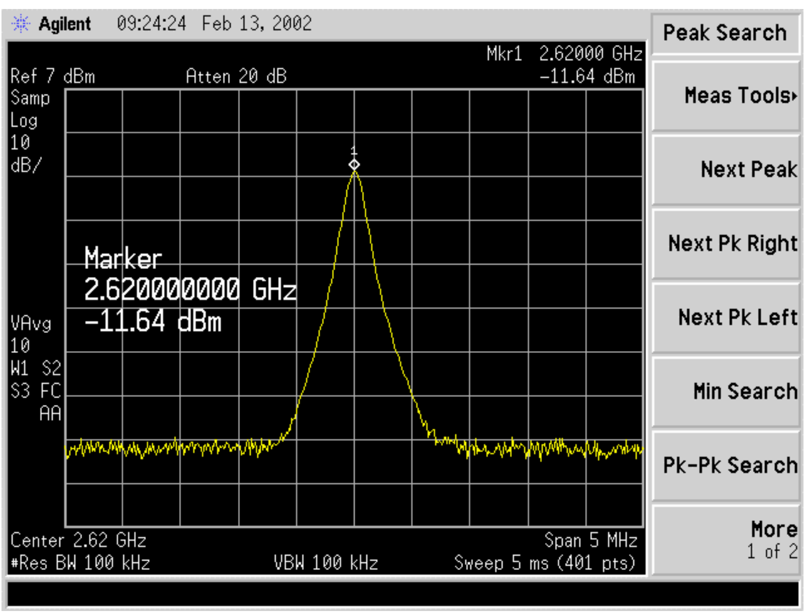
Step 4. At the lower end of the RF cables, connect the cable from the Signal Generator to the calibration cable. Use a barrel connector to change the gender, if required.

Step 5. Connect the cable from the Spectrum Analyzer to antenna cable 1. Use a barrel connector to change the gender, if required.

Step 6. Calculate the marker using the following formula: (the length of **BOTH** the calibration cable and the antenna cable) x (loss per foot at the RFS center frequency for the type of cable used).

Step 7. Take a marker measurement on the Spectrum Analyzer by using the 'marker to peak' or the 'peak search' function. The screen on the Spectrum Analyzer should look similar to the one shown in Figure O5.

Figure O5: Insertion Loss (Cables on Tower) Marker Measurement Example



Step 8. The result should be within +/– 0.5 dB of the calculated value. If the insertion loss results do not agree with the manufacturer's data, check the cable connectors for proper connection to the cable, and check for kinks in the cable. If the Spectrum Analyzer has a distance to fault (DTF) function, this can be used to help troubleshoot kinks in the cable.

Step 9. Divide this value in half and assign the result to the calibration cable and to the antenna cable.

Caution: Cables with results greater than the specified limits (i.e., 2 or 3 dB high) should not be installed, as a potential hardware fault exists.

Step 10. Record the data in the RFS System Test Form under “MAIN FEEDER LOSS”. Ensure that the information is recorded under the channel number that is on the cable label.

Step 11. Repeat steps 3 through 10 for antenna cables 2 through 8.

Step 12. When finished, take the average of the eight values obtained for the calibration cable. Use this value for the insertion loss of the calibration cable.

Step 13. Change the frequency to the next test frequency (refer back to Test Setup). Perform steps 1 through 12 until all cables have been successfully tested at the frequencies given in Table O4.

Step 14. Check the value of the nine jumpers at all three frequencies, per the procedure for cables on the ground. Record the data in the RFS System Test Form under “JUMPER LOSS”. Ensure that the information is recorded under the channel number that is on the cable label.

RFS Test Box Setup

Step 1. For **RFS only** testing, connect the power/data test cable to the data connector on the RFS and to the RFS Test Box.

- OR -

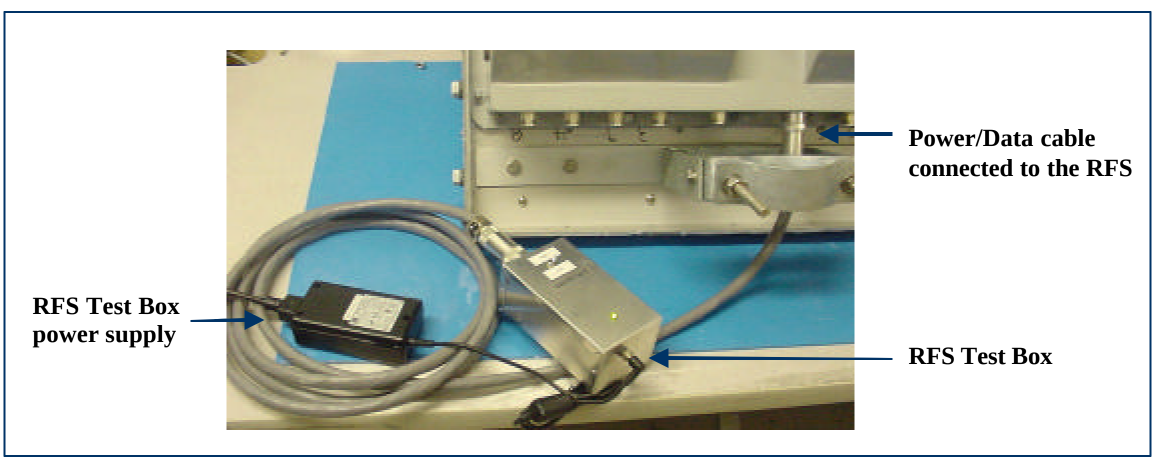
For RFS and cable testing, connect the installation power/data cable to the data connector on the RFS and to the RFS Test Box.

Refer to Figure O6.

Step 2. Connect the RFS Test Box power supply to the RFS Test Box.

Step 3. Plug the RFS Test Box power supply into a 110 VAC outlet.

Figure O6: RFS Only Testing Setup



RFS Only Transmit Verification

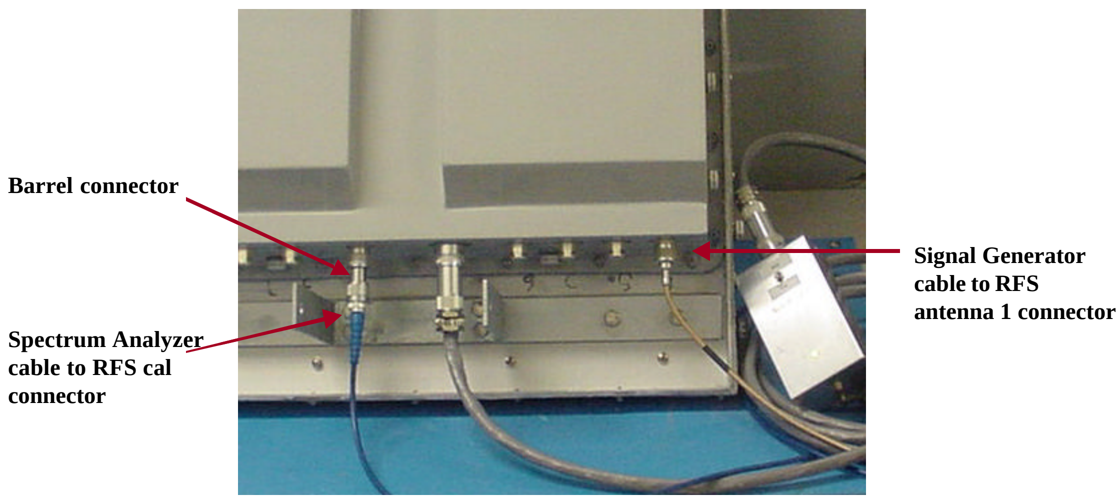
Ensure that the calibration of the test setup and RFS Test Box setup for RFS Only has been performed each time the test frequency is changed. Refer to Figure O7.

Step 1. Switch the RFS Test Box to the transmit (Tx) mode.

Step 2. Connect the cable from the Spectrum Analyzer to the RFS cal connector. Use a barrel connector to change the gender, if required.

Step 3. Connect the cable from the Signal Generator to the RFS antenna input number 1. Use a barrel connector to change the gender, if required.

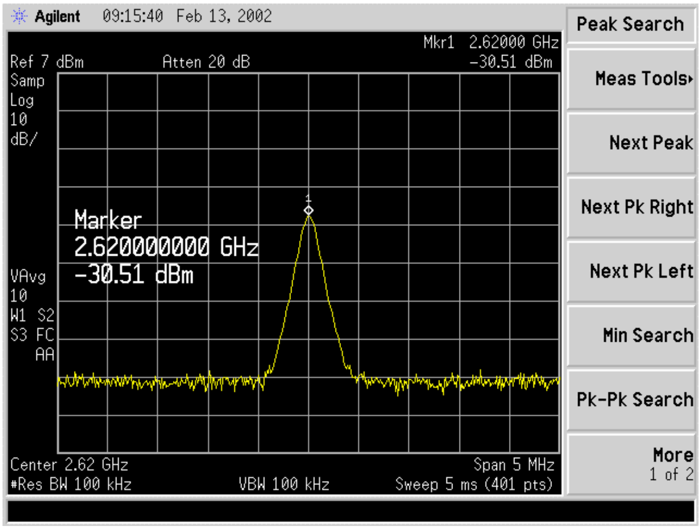
Figure O7: RFS Only Tx Verification



Note: The position of the RFS will vary the sweep results due to reflections from the test surface.

Step 4. Take a marker measurement on the Spectrum Analyzer by using the 'marker to peak' or the 'peak search' function. The screen on the Spectrum Analyzer should look similar to the one shown in Figure O8.

Figure O8: RFS Only Tx Marker Measurement Example



Step 5. The marker value should be equal to the RFS Only Tx insertion loss within +/– 2.0 dB, per the manufacturer's data. If the insertion loss results do not agree with the manufacturer's data, check the test setup.

Caution: An RFS with results greater than the +/– 2.0 dB limits should not be installed, as a potential hardware fault exists. Contact Navini Networks Technical Support.

Step 6. Record the data in the RFS System Test Form under "RFS TX PATH LOSS (RFS ONLY)". Ensure that the information is recorded under the channel number of the RFS antenna that is being tested.

Step 7. Repeat steps 5 and 6 for the remaining seven antenna inputs on the RFS.

Step 8. Change to the next test frequency (refer back to Test Setup). Perform steps 1 through 8 until the RFS has been successfully tested at the frequencies shown in Table O4.

RFS Only Receive Verification

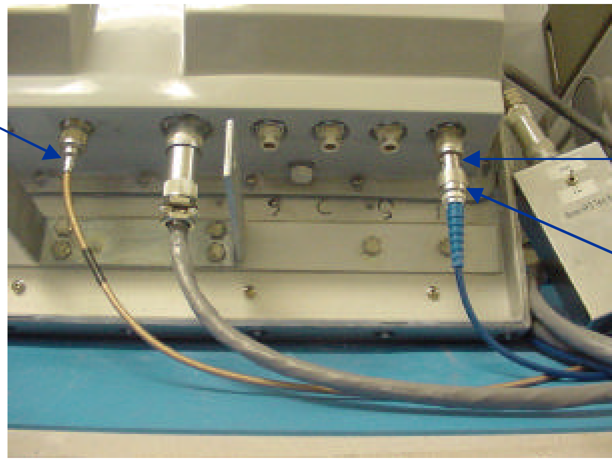
Step 1. Ensure calibration of the test setup and RFS Test Box setup for RFS Only has been performed each time the test frequency is changed.

Step 2. Switch the RFS Test Box to the Receive (Rx) mode.

Step 3. Connect the cable from the Signal Generator to the RFS cal connector. Use a barrel connector to change the gender, if required.

Step 4. Connect the cable from the Spectrum Analyzer to the RFS antenna input number 1. Use a barrel connector to change the gender, if required. See Figure O9.

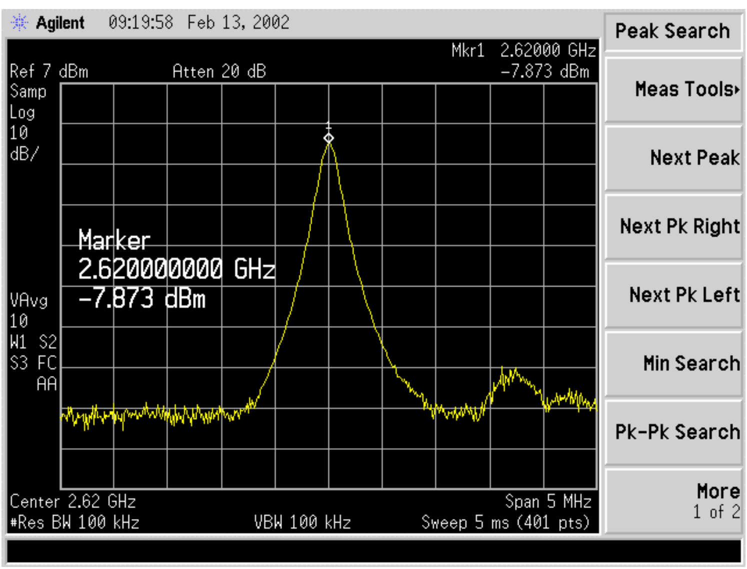
Figure O9: RFS Only Rx Verification



Note: The position of the RFS will vary the sweep results due to reflections from the test surface.

Step 5. Take a marker measurement on the Spectrum Analyzer by using the 'marker to peak' or the 'peak search' function. The screen on the Spectrum Analyzer should look similar to the one shown in Figure O10.

Figure O10: RFS Only Rx Marker Measurement Example



Step 6. The marker value should be equal to the RFS Only Rx insertion loss within +/– 2.0 dB, per the manufacturer's data. If the insertion loss results do not agree with the manufacturer's data, check the test setup.

Caution: An RFS with results greater than the +/– 2.0 dB limits should not be installed, as a potential hardware fault exists. Contact Navini Networks Technical Support.

Step 7. Record the data in the RFS System Test Form under "RFS RX PATH LOSS (RFS ONLY)". Ensure that the information is recorded under the channel number that is on the RFS antenna that is being tested.

Step 8. Repeat steps 5 through 7 for the remaining seven antenna inputs on the RFS.

Step 9. Change the frequency to the next test frequency (refer back to Test Setup). Perform steps 1 through 8 until the RFS has been successfully tested at the frequencies shown in Table O4.

RFS & Cables Transmit Verification

This test is performed after the RFS is installed and the antenna cables, calibration cable, and power/data cable are connected to the inputs on the RFS.

Step 1. Ensure calibration of the test setup and RFS Test Box setup for RFS and cables has been performed each time the test frequency is changed.

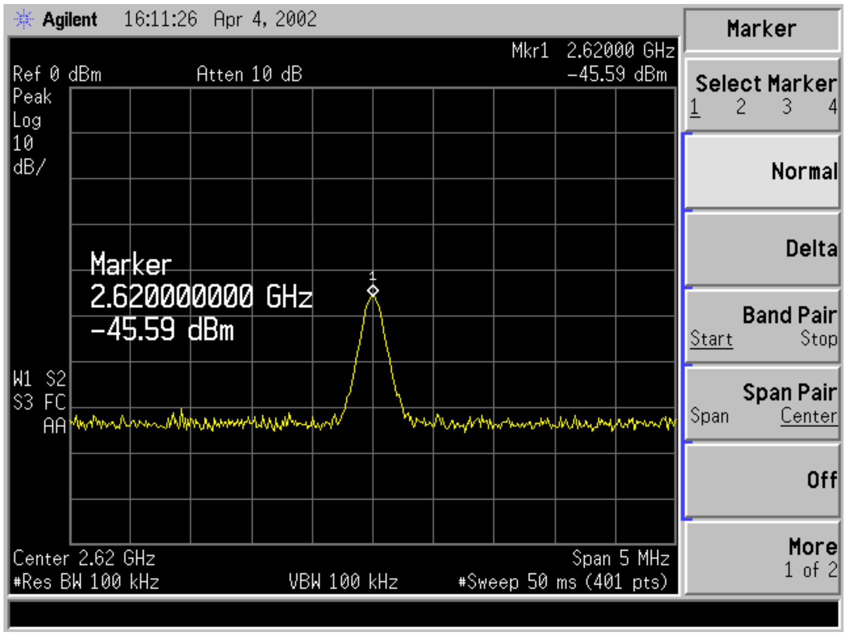
Step 2. Switch the RFS Test Box to the Transmit (Tx) mode.

Step 3. Connect the cable from the Spectrum Analyzer to the RFS calibration cable connector. Use a barrel connector to change the gender, if required.

Step 4. Connect the cable from the Signal Generator to the RFS antenna cable number 1 connector. Use a barrel connector to change the gender, if required.

Step 5. Take a marker measurement on the Spectrum Analyzer by using the 'marker to peak' or the 'peak search' function. The screen on the Spectrum Analyzer should look similar to the one shown in Figure O11.

Figure O11: RFS & Cables Tx Marker Measurement Example



Step 6. The marker value should be equal to the RFS Only Tx insertion loss + calibration cable loss + antenna cable loss + antenna cable jumper loss. Transmit insertion loss should be within +/– 2.0 dB of the sum of the parts. If the insertion loss results do not agree with the manufacturer's data, check the test setup and the cable connections.

Caution: If RFS & cables test results are greater than the +/– 2.0 dB limits, they should not be installed on a tower, as a potential hardware fault exists. Verify the connections and contact Navini Networks Technical Support.

Step 7. Record the data in the RFS System Test Form under "TOTAL TX PATH LOSS (CABLE-RFS)". Ensure that the information is recorded under the channel number that is on the cable label.

Step 8. Repeat steps 5 through 7 for the remaining seven antenna cable inputs on the RFS.

Step 9. Change the frequency to the next test frequency (refer to Test Setup). Perform steps 1 through 8 until the RFS has been successfully tested at the frequencies shown in Table O4.

RFS & Cables Receive Verification

This test is performed after the RFS is installed and the antenna cables, calibration cable, and power/data cable are connected to the inputs on the RFS.

Step 1. Ensure that the calibration of the test setup and RFS Test Box setup for RFS and cables has been performed each time the test frequency is changed.

Step 2. Switch the RFS Test Box to the Receive (Rx) mode.

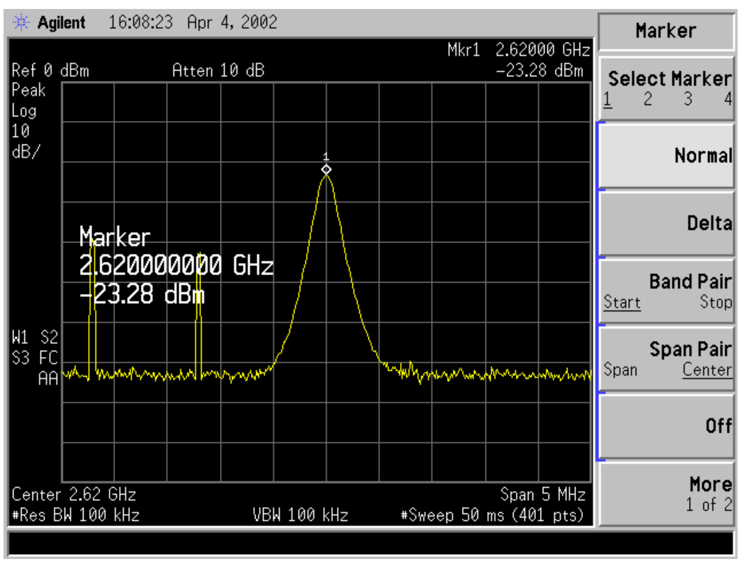
Step 3. If present, remove the barrel connector from between the Signal Generator and Spectrum Analyzer cables.

Step 4. Connect the cable from the Signal Generator to the RFS calibration cable connector. Use a barrel connector to change the gender, if required.

Step 5. Connect the cable from the Spectrum Analyzer to the RFS antenna cable number 1 connector. Use a barrel connector to change the gender, if required.

Take a marker measurement on the Spectrum Analyzer by using the 'marker to peak' or the 'peak search' function. The screen on the Spectrum Analyzer should look similar to the one shown in Figure O12.

Figure O12: RFS & Cables Rx Marker Measurement Example



The marker value should be equal to the RFS Only RX Insertion Loss + Calibration Cable Loss + Antenna Cable Loss + Antenna Cable Jumper Loss. RX Insertion Loss should be within +/– 2.0 dB of the sum of the parts. If the Insertion Loss results do not agree with the manufacturers data, check the test setup and the cable connections.

Caution: If RFS & cables test results are greater than the +/– 2.0 dB limits, they should not be installed on a tower, as a potential hardware fault exists. Verify connections and contact Navini Networks Technical Support.

Record the data in the RFS System Test Form under "TOTAL RX PATH LOSS (CABLE-RFS)". Ensure that the information is recorded under the channel number that is on the cable label.

Repeat steps 5 through 8 for the remaining seven antenna cable inputs on the RFS.

Change the frequency to the next test frequency (refer to Test Setup). Perform steps 1 through 9 until the RFS has been successfully tested at the frequencies given in Table O4.

Procedures – TTA Base Station

Equipment Required

- ?? Signal Generator - Agilent 8648D, or suitable alternative, tunable to the RFS center frequency
- ?? Spectrum Analyzer - Agilent E4404B, or equivalent
- ?? QMA female to SMA Female adapter
- ?? SMA male to N-type male test cable (Note: The cable can be changed but additional adapters will be required.)
- ?? RFS test box for RFS tests only (not required for cable tests) – see Figure O13

Figure O13: RFS & RFC Test Box

- ?? **JP1** - Cable port to be connected to the RFC or the RFS.
- ?? **M1/M2** - RFC DC output test points.
- ?? **Load Button** - Tests RFC full Current load. Used in conjunction with Power LED by JP1.
- ?? **RX/TX switch** - Supplies power to the RX or RX circuit in the RFS.
- ?? **RFC/RFS switch** - Moved to the RFS for testing of the RFS and to the RFC for testing of the RFC.
- ?? **10.7MHz** - Test point to measure the 10.7 MHz signal output of the RFC.
- ?? **J1** - External control of switches. **(Engineering use only)**
- ?? **P1** - DC power supply connection. **(Used for RFS testing only)**
- ?? **JP2** - Connection point for test equipment **(DC blocked port)**

Equipment Set-up

?? Spectrum Analyzer - connected to the test cable / QMA adapter on BTS end

Center Frequency:	Set to frequency to be tested
Span:	10 MHz
Resolution Bandwidth:	100 KHz
Video Bandwidth:	100 KHz
Sweep Time:	Auto

?? Signal Generator - connected to the RFS cable end

Frequency:	Set to frequency to be tested
Signal Level:	0 dB

Equipment Calibration

Refer to Figure O14 to calibrate the test equipment.

Step 1. Perform “Equipment Set-Up”.

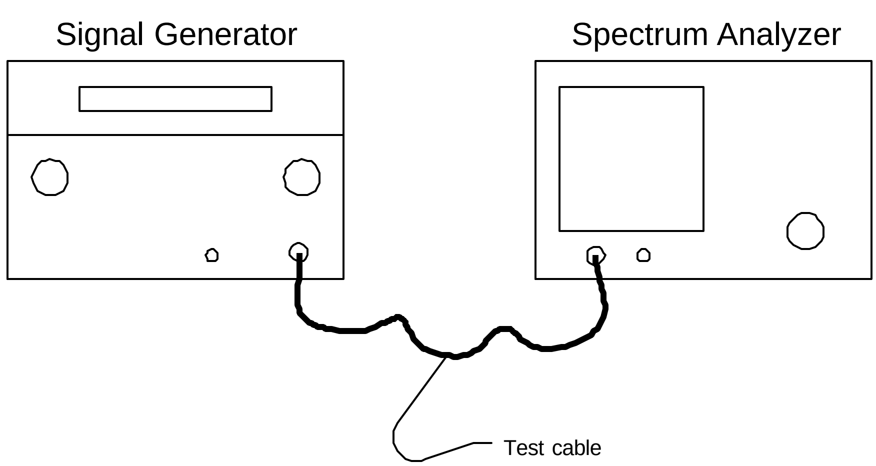
Step 2. Connect the test cable from the “RF Output” of the Signal Generator to the “RF input” of the Spectrum Analyzer.

Step 3. Turn on the RF output of the Signal Generator.

Step 4. Perform a “peak search” on the Spectrum Analyzer.

Step 5. Set a Delta point. The Delta sets a zero point on the Spectrum Analyzer so that when any additional cable or equipment is added to the link the new loss reading can be recorded. (Note: If the Spectrum Analyzer does not have a Delta function, increase the output of the Signal Generator until there is a 0 dB reading on the Spectrum Analyzer.)

Figure O14: Calibrate Test Equipment



RF Cable Sweeps Procedure

This section provides step-by-step procedures for calibrating the test equipment and performing insertion loss measurements of the RF cable. Refer to Figure O15.

Step 1. Calibrate the test equipment.

Step 2. Connect Signal Generator to cable 1 on the RFS side to the RF cable.

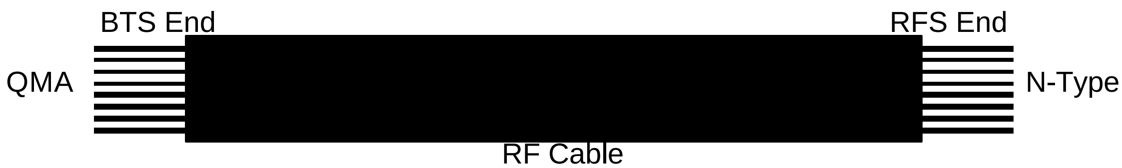
Step 3. Connect spectrum analyzer to cable 1 on BTS side of RF cable. This will be done with the test cable and the QMA/SMA adapter.

Step 4. Enable the RF on the signal generator.

Step 5. From the Delta marker found in Step 1 take the loss reading in db. Record the results.

Step 6. Perform steps 2 through 5 for all cables.

Figure O15: RF Cable Test



RFS Test Procedure

This procedure is performed twice for an installation. The first sweep is performed prior to mounting the RFS on the tower. This test verifies that all the equipment is in tact from shipment. These sweeps will need to be compared to the factory sweeps that are shipped with the RFS.

The second sweep is performed after the RFS has been mounted on the tower and the RF cables have been connected. This sweep verifies that no damage was done to the RFS when hoisting it, and that the RF cables are properly connected to the RFS.

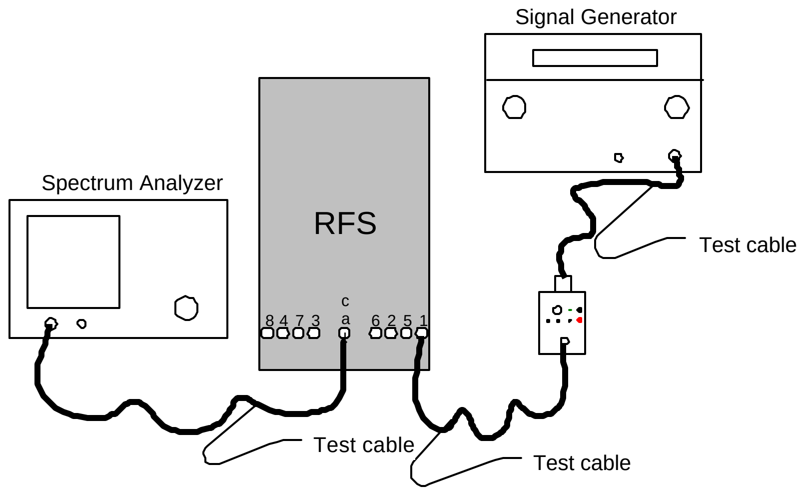
Step 1. Perform the “Equipment Set-up”.
Note: When performing the transmit (TX) side tests on the RFS, the signal level from the Signal Generator needs to be lowered to at least –20 dB. The RFS has protection circuits built in and will disable the PAs in the RFS if the incoming signal is too high.

Step 2. Perform the “Equipment Calibration”.

Step 3. Configure the test equipment as shown in Figure O16.

- ?? Spectrum Analyzer to the Cal Port
- ?? Signal Generator to the test equipment port of the test box.
- ?? Test box RFC/RFS port to the antenna

Figure O16: Transmit Side



Step 4. Set the test box to RFS and TX.

Step 5. From the Delta marker established during the calibration, record the insertion loss dB level.

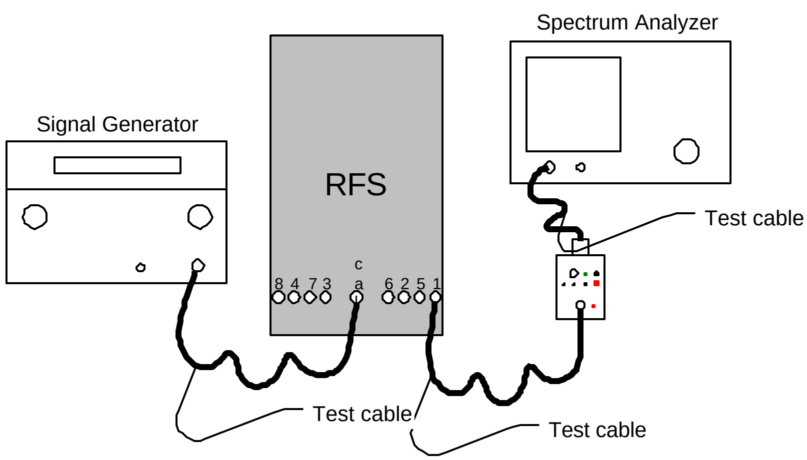
Step 6. Perform Step 5 for all eight antennas.

Step 7. Set the Signal Generator output level to 0 dB and recalibrate the test equipment.

Step 8. Configure the test equipment as shown in Figure O17.

?? Signal Generator to the Cal Port
?? Spectrum Analyzer to the test equipment port of the test box.
?? Test box RFC/RFS port to the antenna

Figure O17: Receive Side



Step 9. Set the test box to RX.

Step 10. From the Delta maker set on calibration, record the insertion loss value from the Spectrum Analyzer.

Step 11. Repeat Step 10 for all eight antennas.

Compare all recorded TX and RX values with the factory sweep results that are shipped with the RFS. If there is a mismatch, contact Navini Technical Support.

2.4 RFS System Test Form (Combo & Split Chassis)

Navini NETWORKS

Internet at the speed of thought™

2.4 GHz RFS INSTALL TEST RESULT FORM

RFS SN ____________
NAME ____________
DATE ____________

MEASUREMENT DESCRIPTION	CHANNEL	2400MHz	2440MHz	2473MHz	AVERAGE
RFS TX PATH LOSS (RFS ONLY)	1	-	-	-	- 0.00
RFS TX PATH LOSS (RFS ONLY)	2	-	-	-	- 0.00
RFS TX PATH LOSS (RFS ONLY)	3	-	-	-	- 0.00
RFS TX PATH LOSS (RFS ONLY)	4	-	-	-	- 0.00
RFS TX PATH LOSS (RFS ONLY)	5	-	-	-	- 0.00
RFS TX PATH LOSS (RFS ONLY)	6	-	-	-	- 0.00
RFS TX PATH LOSS (RFS ONLY)	7	-	-	-	- 0.00
RFS TX PATH LOSS (RFS ONLY)	8	-	-	-	- 0.00
RFS RX PATH LOSS (RFS ONLY)	1	-	-	-	- 0.00
RFS RX PATH LOSS (RFS ONLY)	2	-	-	-	- 0.00
RFS RX PATH LOSS (RFS ONLY)	3	-	-	-	- 0.00
RFS RX PATH LOSS (RFS ONLY)	4	-	-	-	- 0.00
RFS RX PATH LOSS (RFS ONLY)	5	-	-	-	- 0.00
RFS RX PATH LOSS (RFS ONLY)	6	-	-	-	- 0.00
RFS RX PATH LOSS (RFS ONLY)	7	-	-	-	- 0.00
RFS RX PATH LOSS (RFS ONLY)	8	-	-	-	- 0.00
JUMPER LOSS	1	-	-	-	- 0.00
JUMPER LOSS	2	-	-	-	- 0.00
JUMPER LOSS	3	-	-	-	- 0.00
JUMPER LOSS	4	-	-	-	- 0.00
JUMPER LOSS	5	-	-	-	- 0.00
JUMPER LOSS	6	-	-	-	- 0.00
JUMPER LOSS	7	-	-	-	- 0.00
JUMPER LOSS	8	-	-	-	- 0.00
JUMPER LOSS	CAL	-	-	-	- 0.00
MAIN FEEDER LOSS	1	-	-	-	- 0.00
MAIN FEEDER LOSS	2	-	-	-	- 0.00
MAIN FEEDER LOSS	3	-	-	-	- 0.00
MAIN FEEDER LOSS	4	-	-	-	- 0.00
MAIN FEEDER LOSS	5	-	-	-	- 0.00
MAIN FEEDER LOSS	6	-	-	-	- 0.00
MAIN FEEDER LOSS	7	-	-	-	- 0.00
MAIN FEEDER LOSS	8	-	-	-	- 0.00
MAIN FEEDER LOSS	CAL	-	-	-	- 0.00
TOTAL CABLE RUN LOSS	1	- 0.00	- 0.00	- 0.00	- 0.00
TOTAL CABLE RUN LOSS	2	- 0.00	- 0.00	- 0.00	- 0.00
TOTAL CABLE RUN LOSS	3	- 0.00	- 0.00	- 0.00	- 0.00
TOTAL CABLE RUN LOSS	4	- 0.00	- 0.00	- 0.00	- 0.00
TOTAL CABLE RUN LOSS	5	- 0.00	- 0.00	- 0.00	- 0.00
TOTAL CABLE RUN LOSS	6	- 0.00	- 0.00	- 0.00	- 0.00
TOTAL CABLE RUN LOSS	7	- 0.00	- 0.00	- 0.00	- 0.00
TOTAL CABLE RUN LOSS	8	- 0.00	- 0.00	- 0.00	- 0.00
TOTAL CABLE RUN LOSS	CAL	- 0.00	- 0.00	- 0.00	- 0.00
TOTAL TX PATH LOSS (CABLE-RFS)	1	-	-	-	- 0.00
TOTAL TX PATH LOSS (CABLE-RFS)	2	-	-	-	- 0.00
TOTAL TX PATH LOSS (CABLE-RFS)	3	-	-	-	- 0.00
TOTAL TX PATH LOSS (CABLE-RFS)	4	-	-	-	- 0.00
TOTAL TX PATH LOSS (CABLE-RFS)	5	-	-	-	- 0.00
TOTAL TX PATH LOSS (CABLE-RFS)	6	-	-	-	- 0.00
TOTAL TX PATH LOSS (CABLE-RFS)	7	-	-	-	- 0.00
TOTAL TX PATH LOSS (CABLE-RFS)	8	-	-	-	- 0.00
TOTAL RX PATH LOSS (CABLE-RFS)	1	-	-	-	- 0.00
TOTAL RX PATH LOSS (CABLE-RFS)	2	-	-	-	- 0.00
TOTAL RX PATH LOSS (CABLE-RFS)	3	-	-	-	- 0.00
TOTAL RX PATH LOSS (CABLE-RFS)	4	-	-	-	- 0.00
TOTAL RX PATH LOSS (CABLE-RFS)	5	-	-	-	- 0.00

2.6 RFS System Test Form

2.6 GHz RFS INSTALL TEST RESULT FORM

Internet at the speed of thought™

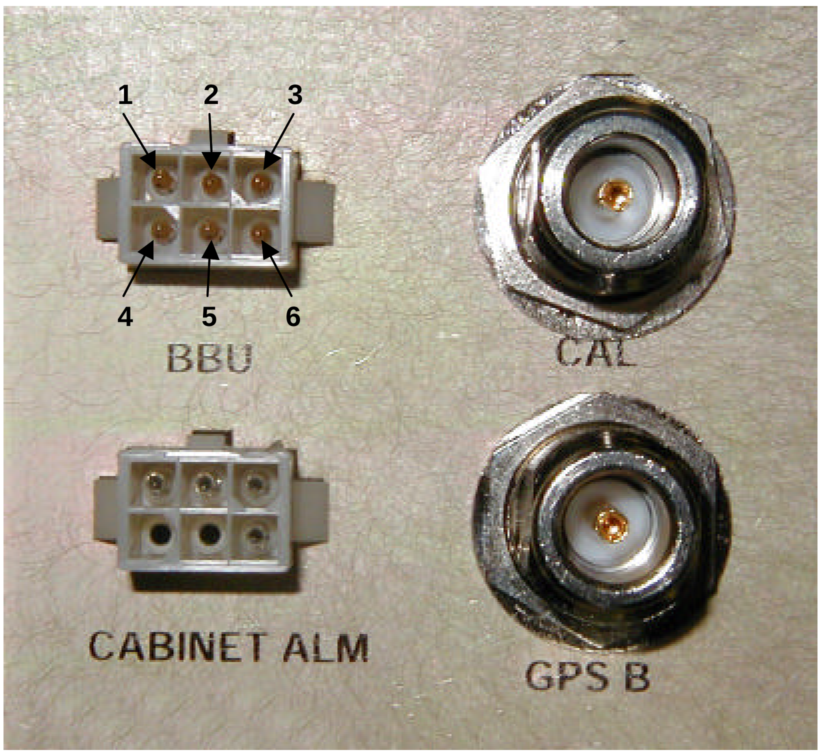
RFS SN ____________________
NAME ____________________
DATE ____________________

MEASUREMENT DESCRIPTION	CHANNEL				AVERAGE
RFS TX PATH LOSS (RFS ONLY)	1	-	-	-	- 0.00
RFS TX PATH LOSS (RFS ONLY)	2	-	-	-	- 0.00
RFS TX PATH LOSS (RFS ONLY)	3	-	-	-	- 0.00
RFS TX PATH LOSS (RFS ONLY)	4	-	-	-	- 0.00
RFS TX PATH LOSS (RFS ONLY)	5	-	-	-	- 0.00
RFS TX PATH LOSS (RFS ONLY)	6	-	-	-	- 0.00
RFS TX PATH LOSS (RFS ONLY)	7	-	-	-	- 0.00
RFS TX PATH LOSS (RFS ONLY)	8	-	-	-	- 0.00
RFS RX PATH LOSS (RFS ONLY)	1	-	-	-	- 0.00
RFS RX PATH LOSS (RFS ONLY)	2	-	-	-	- 0.00
RFS RX PATH LOSS (RFS ONLY)	3	-	-	-	- 0.00
RFS RX PATH LOSS (RFS ONLY)	4	-	-	-	- 0.00
RFS RX PATH LOSS (RFS ONLY)	5	-	-	-	- 0.00
RFS RX PATH LOSS (RFS ONLY)	6	-	-	-	- 0.00
RFS RX PATH LOSS (RFS ONLY)	7	-	-	-	- 0.00
RFS RX PATH LOSS (RFS ONLY)	8	-	-	-	- 0.00
JUMPER LOSS (Measured)	1	-	-	-	- 0.00
JUMPER LOSS (Measured)	2	-	-	-	- 0.00
JUMPER LOSS (Measured)	3	-	-	-	- 0.00
JUMPER LOSS (Measured)	4	-	-	-	- 0.00
JUMPER LOSS (Measured)	5	-	-	-	- 0.00
JUMPER LOSS (Measured)	6	-	-	-	- 0.00
JUMPER LOSS (Measured)	7	-	-	-	- 0.00
JUMPER LOSS (Measured)	8	-	-	-	- 0.00
JUMPER LOSS (Measured)	CAL	-	-	-	- 0.00
MAIN FEEDER LOSS (Measured)	1	-	-	-	- 0.00
MAIN FEEDER LOSS (Measured)	2	-	-	-	- 0.00
MAIN FEEDER LOSS (Measured)	3	-	-	-	- 0.00
MAIN FEEDER LOSS (Measured)	4	-	-	-	- 0.00
MAIN FEEDER LOSS (Measured)	5	-	-	-	- 0.00
MAIN FEEDER LOSS (Measured)	6	-	-	-	- 0.00
MAIN FEEDER LOSS (Measured)	7	-	-	-	- 0.00
MAIN FEEDER LOSS (Measured)	8	-	-	-	- 0.00
MAIN FEEDER LOSS (Measured)	CAL	-	-	-	- 0.00
TOTAL CABLE RUN LOSS (Measured)	1	- 0.00	- 0.00	- 0.00	- 0.00
TOTAL CABLE RUN LOSS (Measured)	2	- 0.00	- 0.00	- 0.00	- 0.00
TOTAL CABLE RUN LOSS (Measured)	3	- 0.00	- 0.00	- 0.00	- 0.00
TOTAL CABLE RUN LOSS (Measured)	4	- 0.00	- 0.00	- 0.00	- 0.00
TOTAL CABLE RUN LOSS (Measured)	5	- 0.00	- 0.00	- 0.00	- 0.00
TOTAL CABLE RUN LOSS (Measured)	6	- 0.00	- 0.00	- 0.00	- 0.00
TOTAL CABLE RUN LOSS (Measured)	7	- 0.00	- 0.00	- 0.00	- 0.00
TOTAL CABLE RUN LOSS (Measured)	8	- 0.00	- 0.00	- 0.00	- 0.00
TOTAL CABLE RUN LOSS (Measured)	CAL	- 0.00	- 0.00	- 0.00	- 0.00
TOTAL TX PATH LOSS (CABLE-RFS)	1	-	-	-	- 0.00
TOTAL TX PATH LOSS (CABLE-RFS)	2	-	-	-	- 0.00
TOTAL TX PATH LOSS (CABLE-RFS)	3	-	-	-	- 0.00
TOTAL TX PATH LOSS (CABLE-RFS)	4	-	-	-	- 0.00
TOTAL TX PATH LOSS (CABLE-RFS)	5	-	-	-	- 0.00
TOTAL TX PATH LOSS (CABLE-RFS)	6	-	-	-	- 0.00
TOTAL TX PATH LOSS (CABLE-RFS)	7	-	-	-	- 0.00
TOTAL TX PATH LOSS (CABLE-RFS)	8	-	-	-	- 0.00
TOTAL RX PATH LOSS (CABLE-RFS)	1	-	-	-	- 0.00
TOTAL RX PATH LOSS (CABLE-RFS)	2	-	-	-	- 0.00
TOTAL RX PATH LOSS (CABLE-RFS)	3	-	-	-	- 0.00
TOTAL RX PATH LOSS (CABLE-RFS)	4	-	-	-	- 0.00
TOTAL RX PATH LOSS (CABLE-RFS)	5	-	-	-	- 0.00

Appendix P: Chassis Alarms

The chassis contains two connectors that are used to send alarm indications to the BTS. One of the connectors, labeled CABINET ALARM, is used to trigger alarm conditions that occur within the external chassis. The second connector, labeled BBU, is used to process alarms from the battery backup unit. Both connectors contain six pins, which are numbered as shown in Figure P1. This figure also shows the CAL and GPS-B connectors for size reference.

Figure P1: Pin Orientation



The alarm connector uses only four of the six pins. The pin names can be found in Table P1.

Table P1: Pin Names

Pin	Name
1	General Fail Alarm
2	Ground reference for General Fail Alarm
3	Door Open Alarm
4	Ground reference for Door Open Alarm
5	Not Connected
6	Not Connected

The first pin of the alarm connector is the General Fail Alarm. This signal should be left open to indicate an alarm condition from the HMC module located in the outdoor chassis. If no alarm condition exists, this pin should be driven low. Pin 2 is used as the ground reference for this alarm. The second alarm sent to the chassis is located on pin 3, Door Open Alarm. This signal should be driven low when the door is closed. To indicate that the door of the outdoor chassis is open, this signal should be left open. The associated ground reference for this signal is taken from pin 4.

The BBU connector contains four alarm signals. These signal names are listed in Table P2.

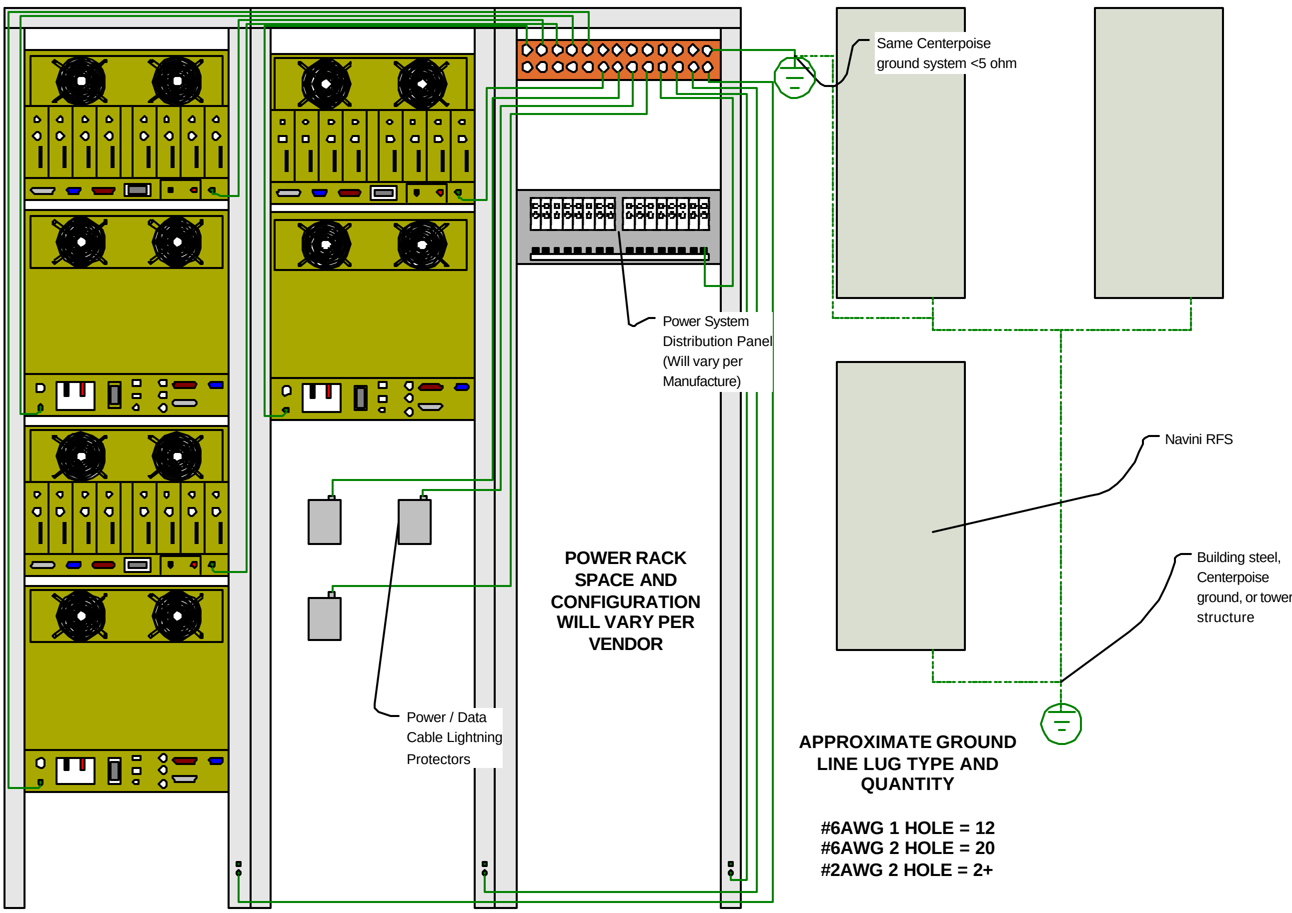
Table P2: BBU Signal Names

Pin	Name
1	Digital Ground Reference
2	BBU Battery Low
3	BBU Rectifier Fail
4	BBU AC Line Fail
5	BBU Charge Fail
6	Analog Ground Reference

The first alarm signal is located on pin 2, BBU Battery Low. If the BBUs battery is running low, the signal on pin 2 should be left open. BBU Rectifier Fail alarm is the next alarm and is located on pin 3. This signal should be left open to indicate a failure on the Battery Backup Unit's rectifier. The next alarm condition occurs if the AC Line to the BBU fails. In this condition, signal BBU AC Line Fail on pin 4 should be left open. If the BBU is unable to hold a charge, then the BBU Charge Fail signal on pin 5 should be left open. For non-alarm conditions (normal operation), these signals should be driven low. The digital ground reference for these signals is located on pin 3. The analog ground reference should be located on pin 4.

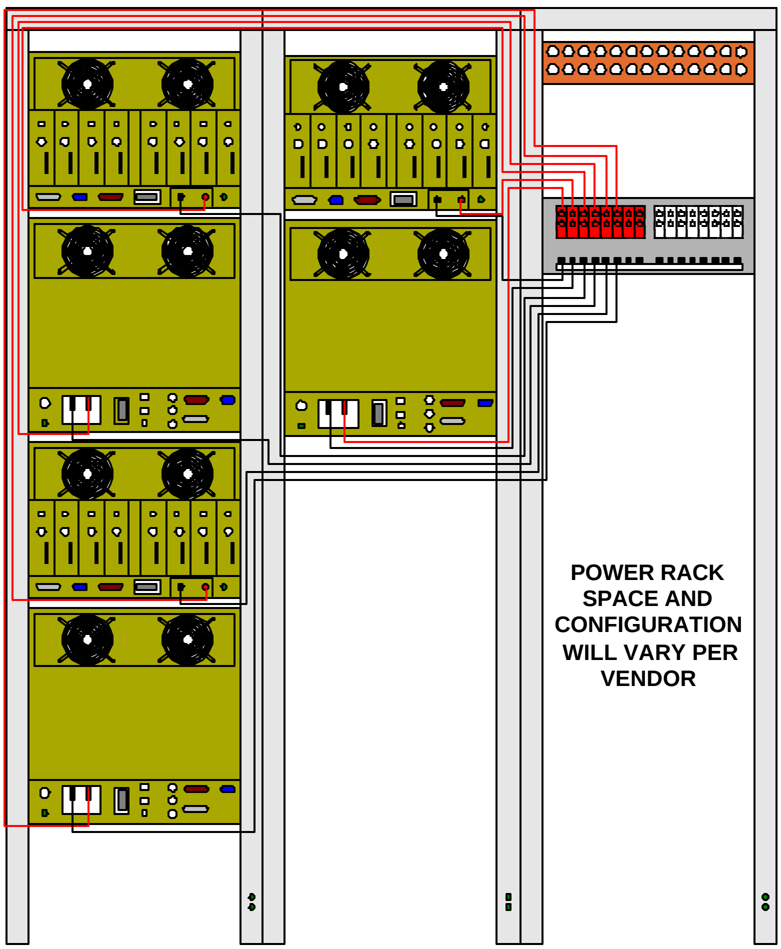
Appendix Q: Sample Tri-sector BTS Grounding

Refer to the Regulatory Information in Chapter 1, Page 8, regarding UL and NEC/CEC compliance.



Appendix R: Sample Tri-sector BTS Power

Refer to the Regulatory Information in Chapter 1, Page 8, regarding UL and NEC/CEC compliance.



REQUIRED DC BREAKER AMPERAGE AND QUANTITY

3 X 50A - FOR RF SHELF
3 X 20A FOR DIGITAL SHELF

APROXIMATE DC LINE LUG TYPE AND QUANTITY
#6AWG 1 HOLE = 12
#6AWG 2 HOLE = 12

Appendix S: Single Antenna Test Procedure

Objective

The object of the RFS Single Antenna Test Procedure is to verify the functionality of each antenna element in the Ripwave Radio Frequency Subsystem (RFS). The 8 antenna elements work together to create the beamforming that results from using a Smart Antenna - Phased Array technology. Using 8 combined single antenna elements creates the beamed radiation that is part of what constitutes the gain of up to 18 dB during transmission of data.

Each antenna element has an associated (and hard cabled) RF/Power Amplifier (PA) card in the Base Transceiver Station (BTS). In order to verify the correct beamforming and that each single antenna is working properly, we have to turn off the individual PA that controls each antenna element, one at a time.

The Single Antenna Test should be performed after completing an equipment check and after performing the Base Station Calibration Verification* procedure described in the *Ripwave Base Station Installation & Commissioning Guide*. This test is necessary since an equipment check does not check the functionality of the RFS, and the Calibration Verification only sweeps for losses in the RFS, not RFS functionality.

*Note: The Calibration Verification, where you check both transmit power and receive sensitivity, is also sometimes referred to as the RF Sanity test.

More specifically, the Single Antenna Test checks the following:

1. Low Noise Amplifier (LNA) at the RFS. LNAs are an integral part of the smart antenna technology.

2. Power Amplifiers. Each PA is a module in the BTS RF shelf that creates the RF transmission. With one per element, there are a total of 8 PAs in the shelf. The transmission is measured in dBm. This is what makes possible the transfer of data over-the-air.

3. Modulations. As each antenna element is checked, the variable modulations are tested. The higher the modulation, the higher the power and the better the data rate. The test ensures that all modulations possible, i.e., QPSK, 8PSK, and QAM16, are working properly.

Panel Procedure

Overview

Assuming the equipment has been installed and you have performed the calibration verification, if the results were erroneous this Single Antenna Test will not be valid. It is important to complete those two steps successfully before continuing.

For this test you will need two people. One person will verify the reception (Rx) of each antenna using the Constellation Debugger Tool and a Modem. The following summarizes what will happen during this test:

1. Person A will stay where the BTS or EMS is located. This person will control each PA in the BTS to be tested.

2. Person B will be in the field. This person will pick a complete Line of Sight (LOS) test point to the RFS (antenna). Person B will use the Constellation Debugger software supplied by Navini. This software allows the tester to verify functionality.

3. Once the two people are in place, start by turning all antennas off except for Antenna #1. NOTE: It does not matter which antenna you start with as long as the tester can keep track of which ones have been tested and each one's results.

4. With only one antenna powered on, Person B verifies the transmission, modulation, and signal strength of the single antenna. Person B verifies this information for at least 30 seconds.

5. When the first antenna is checked, Person A saves the file and waits for Person B to power on Antenna #2.

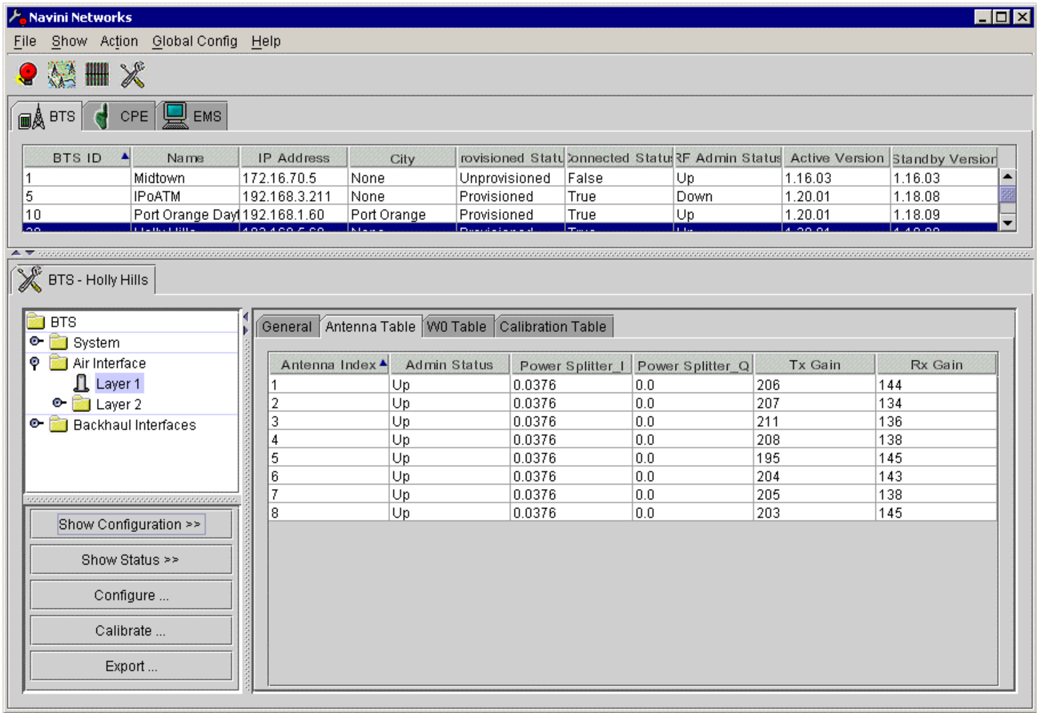
6. Steps 3 through 5 are repeated for each antenna element.

Details

The following provides more detail for each step, and includes snapshots of what to change and what to measure.

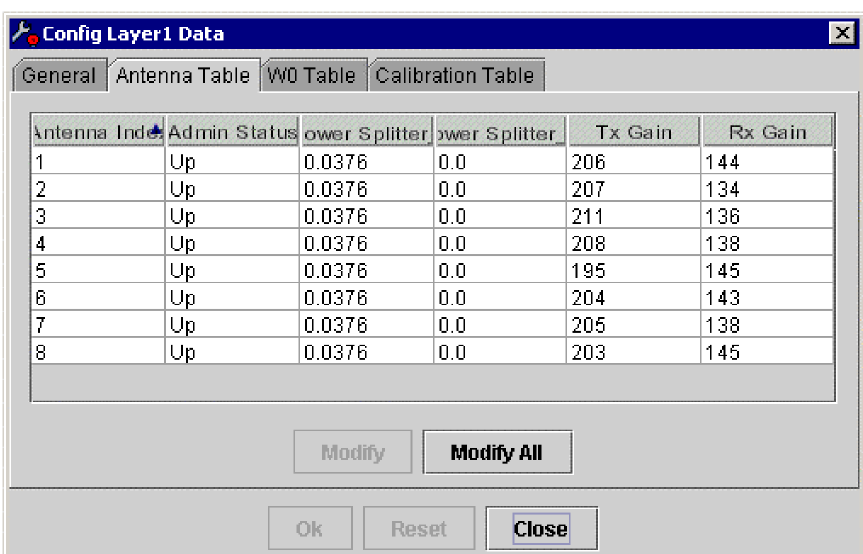
Step 1. After calibration verifications are successful, in EMS click on the BTS tab and highlight the specific BTS. Go to **Air Interface** > **Layer 1**, and click on the **Antenna Table** tab (Figure S1). This window will show all antennas and their PA status.

Figure S1: Antenna Tab



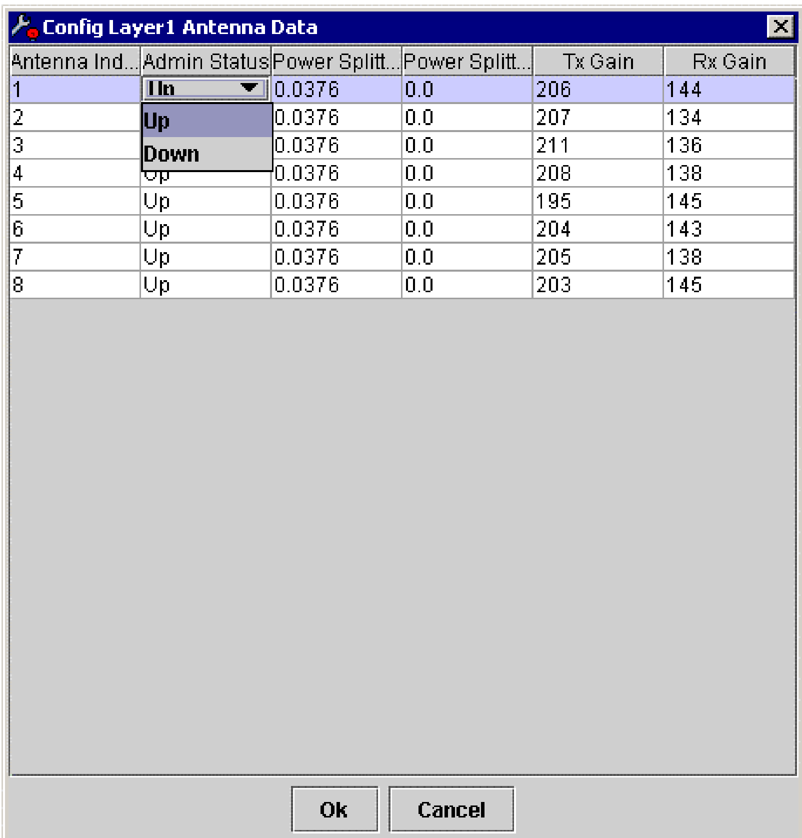
Step 2. After checking that all PAs are up and running, next click on **Configure** (Figure S2). This function will take you to the configuration mode of this particular window.

Figure S2: Configure Antenna Table



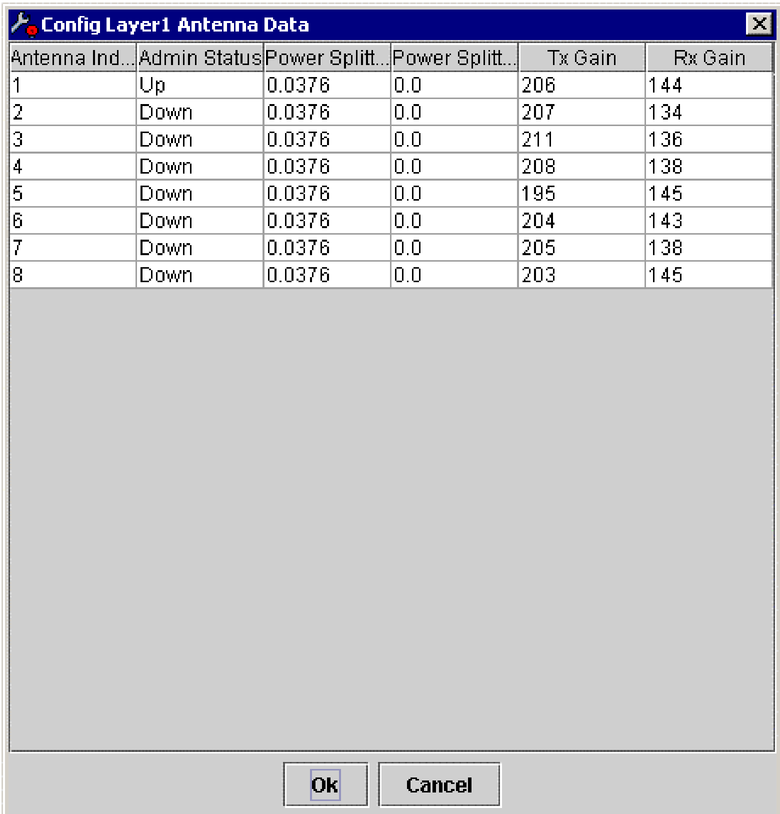
Step 3. Click on the button, Modify All. This function will allow you to modify all antennas and PAs at the same time. Notice that this window allows you to configure any column shown here. For our purpose we will only use the second column, Admin Status (Figure S3). This column shows the state of each PA that controls each antenna in the RFS. "Up" means the antenna and PA are on and functioning. "Down" means the antenna and PA are off and not transmitting.

Figure S3: Modify All



Step 4. Next, turn off (no transmission) all of the antennas and PAs except for Antenna #1. This begins the verification of this antenna. Refer to Figure S4. When only Antenna #1 is powered up and transmitting, the second person will verify at the other end that the antenna is actually transmitting information to the Modem. This can be completed by doing a Ping at the Modem side.

Figure S4: Antenna #1 On



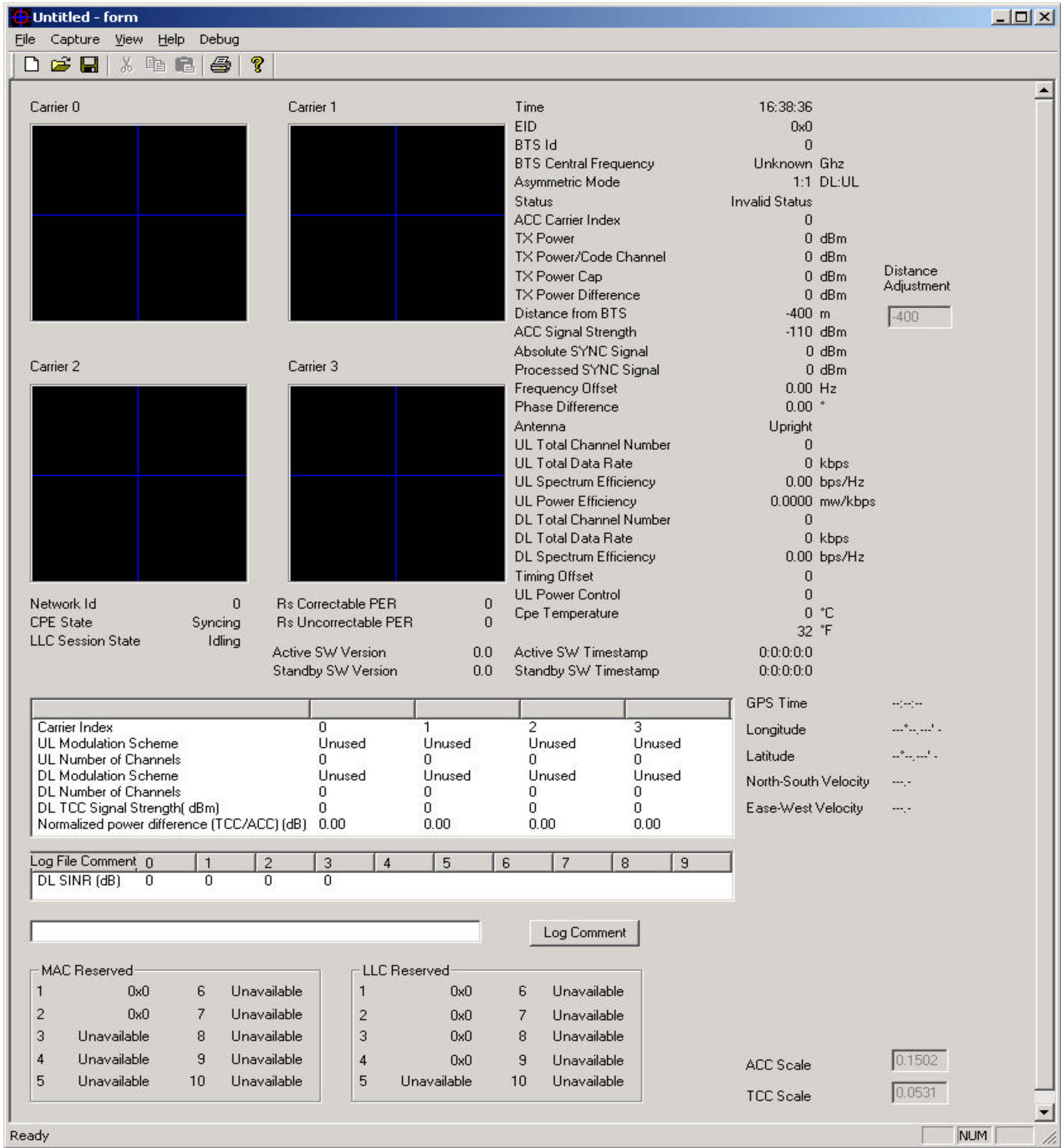
Antenna Ind...	Admin Status	Power Splitt...	Power Splitt...	Tx Gain	Rx Gain
1	Up	0.0376	0.0	206	144
2	Down	0.0376	0.0	207	134
3	Down	0.0376	0.0	211	136
4	Down	0.0376	0.0	208	138
5	Down	0.0376	0.0	195	145
6	Down	0.0376	0.0	204	143
7	Down	0.0376	0.0	205	138
8	Down	0.0376	0.0	203	145

Step 5. Start a Ping with the Modem and PC performing the test, observing the Constellation Debugger tool. Look for the following values:

- ACC Signal Strength
- Absolute Sync Signal
- Processed Sync Signal

These values, an example of which is shown in Figure S5, give you an indication if there is something wrong with the antenna. If the values are too low or you do not see a response from your Ping, it means that the antenna and/or the PA are not functioning properly.

Figure S5: Constellation Debugger Values



Step 6. Repeat Steps 4 and 5 to verify each one of the antennas and the PAs. The verification of each antenna concludes the testing procedure.

Comments & Suggestions

1. Navini Smart Antenna technology uses all the 8 antenna elements for the optimum performance of the system. It is recommended that all antennas are verified and working properly. If one of the antennas or PAs malfunctions or it breaks, the RFS will still work. It will not work at its optimum operation, but it will still be functioning equipment. It is recommended that you change or swap the bad board or equipment.

2. For the testing of each antenna it is recommended that you pick only one spot to measure the Rx side of the RFS. This spot must to be at a distance of 2-3 km with clear line-of-sight.

3. A difference of more than 2 dB between the Absolute and Processed SYNC Signal strength, typically indicates the presence of multipath in the environment.

Omni Procedure

<This info will be added at a later date>

Appendix T: Base Station Installation Certification

Navini NETWORKS™

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COMPANY ____________
SITE NAME ____________
SITE NO ____________
LOCATION ____________

BTS SITE COMPLETION CERTIFICATION

SITE TYPE	☐ MONOPOLE	☐ CO-LOCATE	☐ OTHER	________
ANTENNA TYPE	☐ OMNI	☐ SECTORIZED		
ANTENNA AZIMUTH				
FREQUENCY BAND	☐ 2.3GHz	☐ 2.4GHz	☐ 2.5GHz	☐ 2.6GHz
BTS CENTER FREQUENCY				
RFS ELECTRICAL DOWNTILT	☐ 0 Degree	☐ 2 Degree	☐ 4 Degree	☐ 6 Degree
RFS MECHANICAL TILT			☐ Uptilt	☐ Downtilt
RFS OVERALL DOWNTILT		________		
BTS ENCLOSURE	☐ INDOOR	☐ OUTDOOR	☐ OTHER	________

A	**Equipment Installed in Building**	☐ YES	☐ NO	
1	Equipment Installed and Secured Per Plan	☐ YES	☐ NO	☐ N/A
2	Roof/Ceiling/Wall Penetrations Patched, Sealed and Painted	☐ YES	☐ NO	☐ N/A
3	Penetration(s) Inspected by Landowner Representative	☐ YES	☐ NO	☐ N/A
B	**Equipment Installed on Roof**	☐ YES	☐ NO	
1	Equipment Installed and Secured Per Plan	☐ YES	☐ NO	☐ N/A
2	Structural Upgrades to Roof Installed Per Plan	☐ YES	☐ NO	☐ N/A
3	Equipment Support Frame Installed	☐ YES	☐ NO	☐ N/A
C	**Equipment Installed on Grade**	☐ YES	☐ NO	
1	Equipment Installed and Secured Per Plan	☐ YES	☐ NO	☐ N/A
2	Special Inspection for Foundation Steel Complete	☐ YES	☐ NO	☐ N/A
3	Concrete Placed and Vibrated	☐ YES	☐ NO	☐ N/A
4	Concrete Break Test Report Complete	☐ YES	☐ NO	☐ N/A
D	**Civil/Site Work**			
1	Fencing Complete (Tie-In to Ground System) Per Plan	☐ YES	☐ NO	☐ N/A
2	Gravel/Crushed Rock Placed over Weed Barrier	☐ YES	☐ NO	☐ N/A
3	Above Ground Conduits Installed Plumb	☐ YES	☐ NO	☐ N/A
4	Landscaping/ Erosion Control Complete Per Plan	☐ YES	☐ NO	☐ N/A
5	Access Road Complete Per Plan	☐ YES	☐ NO	☐ N/A
6	All Trash and Debris Hauled Off Site	☐ YES	☐ NO	☐ N/A
7	Site Area restored to Original Condition	☐ YES	☐ NO	☐ N/A
8	Unistruts, iron angles and Rods properly cold galvanized	☐ YES	☐ NO	☐ N/A
9	RF Safety Signage Installed where Required	☐ YES	☐ NO	☐ N/A

E	Monopole/Tower			
1	Monopole/Tower Plumb, Torqued and Free of Visible Defects	☐ YES	☐ NO	☐ N/A
2	Orientation of Monopole/Tower Per Plan	☐ YES	☐ NO	☐ N/A
3	Safety Climb Installed and Tensioned per Manufacturer Spec.	☐ YES	☐ NO	☐ N/A
4	Weep Hole Free of Obstructions	☐ YES	☐ NO	☐ N/A
5	Step Bolts Installed/ Removed Below 30 feet	☐ YES	☐ NO	☐ N/A
6	Monopole/Tower Tie-In to Ground Ring Complete	☐ YES	☐ NO	☐ N/A

F	Grounding			
1	Monopole/Tower Grounding Installed	☐ YES	☐ NO	☐ N/A
2	Ground Wire Types and Size meet construction Specs	☐ YES	☐ NO	☐ N/A
3	Lightning Rod Provided and Installed Per Plan	☐ YES	☐ NO	☐ N/A
4	5 Ohm Megger Ground Resistance Test Complete	☐ YES	☐ NO	☐ N/A
5	Buss Bars Installed Per Plan	☐ YES	☐ NO	☐ N/A
6	Surge Protector Installed Between RFS Antenna and Cable	☐ YES	☐ NO	☐ N/A
7	Coax Ground Kits Installed at RFS Antenna Per Plan	☐ YES	☐ NO	☐ N/A
8	Coax Ground Kits Installed at Tower Base Per Plan	☐ YES	☐ NO	☐ N/A
9	Coax Ground Kits Installed at Buss Bar Prior to BTS Per Plan	☐ YES	☐ NO	☐ N/A
10	Double Lug Connectors Used at All Buss Bar Attachments	☐ YES	☐ NO	☐ N/A
11	Cable Tray/Ice Bridge Bonded and Grounded to Buss Bar	☐ YES	☐ NO	☐ N/A
12	Surge Protectors Mounted and Secured on ground Buss Bar	☐ YES	☐ NO	☐ N/A
13	Master Ground Buss Bar Tied-In to Ground Ring	☐ YES	☐ NO	☐ N/A
14	Equipment Rack Ground Per Plan	☐ YES	☐ NO	☐ N/A
15	Power Supply/UPS, Rectifier Ground Per Plan	☐ YES	☐ NO	☐ N/A
16	Meter and Telco box Ground Per Plan	☐ YES	☐ NO	☐ N/A
17	Fence Work Grounded Per Plan	☐ YES	☐ NO	☐ N/A
18	Additional Equipment Tied-In to BTS properly Grounded	☐ YES	☐ NO	☐ N/A

G	Electrical, Telco and Network			
1	Power and Telco Conduits Installed Per Plan	☐ YES	☐ NO	☐ N/A
2	Conduits Are Labeled and Pull Strings are Provided	☐ YES	☐ NO	☐ N/A
3	Meter and Telco Box are Installed Per Plan	☐ YES	☐ NO	☐ N/A
4	Circuit Breakers Installed and Properly Labeled	☐ YES	☐ NO	☐ N/A
5	UPS Installed and All Internal Connections Made	☐ YES	☐ NO	☐ N/A
6	Rectifier Installed, Output and Wiring to BTS Checked	☐ YES	☐ NO	☐ N/A
7	Telco Tie-In to Source, Tested and Complete	☐ YES	☐ NO	☐ N/A
8	Network/Telco Tie-In to BTS, Tested and Complete	☐ YES	☐ NO	☐ N/A
9	EMS Installed and Connected to Network	☐ YES	☐ NO	☐ N/A

H	BTS System			
1	Cabinet is Positioned, Secured and Leveled Per Plan	☐ YES	☐ NO	☐ N/A
2	Cabinet Outer Surfaces Free from scratches, dents, corrosion	☐ YES	☐ NO	☐ N/A
3	All Hardware Connections within BTS are tightened/secured	☐ YES	☐ NO	☐ N/A
4	RF/GPS Coax Connectors Securely Connected to BTS	☐ YES	☐ NO	☐ N/A
5	Signal/Power Cable Securely Connected to BTS	☐ YES	☐ NO	☐ N/A
6	Ethernet/T1 cables Dressed and Secured to BTS	☐ YES	☐ NO	☐ N/A
7	Documents, License are Stored or Posted on BTS	☐ YES	☐ NO	☐ N/A

J	Antenna and Feeder System			
1	RFS Antenna Height and Orientation Per Plan	☐ YES	☐ NO	☐ N/A
2	RFS Antenna Mount Plumb Per Axis	☐ YES	☐ NO	☐ N/A
3	GPS Antenna Mounted Per Plan	☐ YES	☐ NO	☐ N/A
4	Zinc Cold Galvanizing compound used everywhere	☐ YES	☐ NO	☐ N/A
5	Coaxial Cables Run Straight (Not Exceeding Bend Radius)	☐ YES	☐ NO	☐ N/A
6	Coaxial Cables Tagged and Color Coded Per Plan	☐ YES	☐ NO	☐ N/A
7	Connectors and Jumpers Installed and Weatherproofed	☐ YES	☐ NO	☐ N/A
8	Cable Hangers, Bands or Ties Spaced up every 3 Feet	☐ YES	☐ NO	☐ N/A
9	Antenna Power and Data Cable Continuity Tested	☐ YES	☐ NO	☐ N/A
10	Antenna System Sweep Test Performed and Passed	☐ YES	☐ NO	☐ N/A
11	SW and Hard Copy of Antenna Sweep Test Results Provided	☐ YES	☐ NO	☐ N/A

NOTES

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Printed Name ______________________
Signature / Date ______________________
Company ______________________
Phone No. ______________________

Printed Name ______________________
Signature / Date ______________________
Company ______________________
Phone No. ______________________

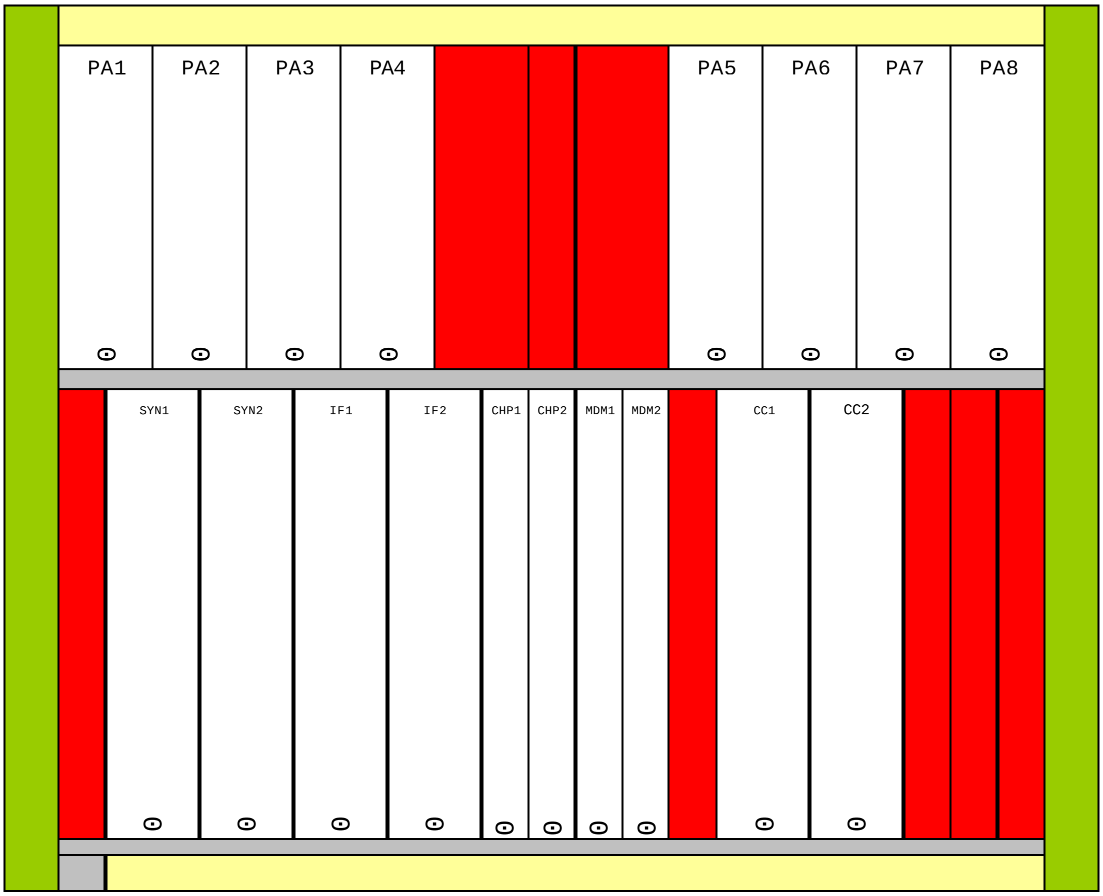
Printed Name ______________________
Signature / Date ______________________
Company ______________________
Phone No. ______________________

Navini NETWORKS™

Internet at the speed of thought™

COMPANY	0
SITE NAME	0
SITE NO	0
LOCATION	0

Note : Please write all Card Serial Numbers in the Spreadsheet Below



BTS SN		RFS SN	
RF SHELF		DIGITAL SHELF	
PA1		SYN1	
PA2		SYN2	
PA3		IF1	
PA4		IF2	
PA5		CHP1	

Appendix U: Excel Configuration Form

The configuration forms are used to plan and design the operating parameters for the system. The parameters for every system element are defined in the EMS Server.

****

EMS Configuration Data Form

(To configure EMS Servers & Clients in the Ripwave System)

Company:____

Your Name:__________________________________ Date:____________

NOTE 1: Field Values in gray rows indicate data that ordinarily should not be changed or that is populated automatically by the system.

NOTE 2: Default Field Values are underlined.

Field Name	Values	Description
EMS Id		Unique identifier for this EMS.
Alarm AutoAck	True	True or False. If True, the EMS will automatically acknowledge all alarms except alarms with a severity level of Warning (blue). An Alarm Engineer will only see current alarms on the system. However, all alarm activity is logged to an alarm file.
Server Ip Address		IP address of the EMS Server.
Database Schema Version	01 (example)	Version of the EMS server database schema.
Mib Version	1.19.01 (example)	Version of the BTS Management Information Base (MIB).
BTS/CPE SW Directory	loads (example)	Directory where BTS and CPE software loads are stored. Used by the EMS to obtain the location of the software loads during downloads. Copy BTS and CPE software loads to this directory during initial installations or upgrades. Otherwise, the EMS cannot download the software to the BTS. This field is used in conjunction with the FTP Server Root Path field by the EMS to obtain the software loads. The full path the EMS searches for software loads is <FTP Server Root Path>\<BTS/CPE SW Directory>. Example - C:\naviniems\ftp\loads.

continued…

Field Name	Values	Description
FTP Server Root Path		The Root directory where BTS and CPE software loads are stored. This field must match what is configured in the FTP Daemon. Otherwise, the EMS will not be able to download BTS and CPE software loads to the BTS. This path is used by the EMS to obtain the location of the software loads during downloads. Copy BTS and CPE software loads to this root directory during initial installations or upgrades. This field is used in conjunction with the BTS/CPE SW Directory field by the EMS to obtain the software loads. The full path the EMS searches for software loads is <FTP Server Root Path>\<BTS/CPE SW Directory>. Example - C:\naviniems\ftp\loads.
Network ID		Unique identifier for this Service Provider's wireless network. Intended to ensure other Service Providers' CPEs cannot operate in the identified network. A CPE with a different BTS network ID cannot be provided service by that BTS.
Server Name		Host name of the EMS Server machine.
EMS Version	1.19.01 (example)	Version of the EMS Server software.
Idl Build Number	1.18.09 (example)	CORBA networking software IDL version used by the EMS Server.
BTS/CPE SW Ftp User Name		User name for downloading BTS and CPE software from the EMS. This field must match what is configured in the FTP Daemon. Otherwise, the EMS cannot download BTS and CPE software loads to the BTS.
BTS/CPE SW Ftp Password		Password used when downloading BTS and CPE software. This field must match what is configured in the FTP Daemon. Otherwise, the EMS cannot download BTS and CPE software loads to the BTS.
Confirm Password		Password must be re-entered for security purposes.
CPE AutoProvisioning	Disabled	Enable or Disable. Determines if the EMS is in AutoProvision mode during CPE registration. If enabled, the EMS will allow unprovisioned CPEs to access the system with minimum bandwidth for a short period of time. The minimum bandwidth is defined by the first entry in the CPE Descriptor table. Once the CPE is allowed limited access to the system, it can connect to a default web site to enter billing information and the CPE can be provisioned automatically with the EMS. If disabled, the EMS will NOT allow an unprovisioned CPE to access the system.

BTS Configuration Form

Company:____
Your Name:________________________________ Date:_____________
BTS ID/NAME:____

NOTE 1: Field Values in gray rows indicate data that ordinarily should not be changed or that is populated automatically by the system.

NOTE 2: Default Field Values are underlined.

General Parameters

Status

Field Name	Values	Description
RF Admin Status	Up or Down	Determines if the BTS is transmitting Radio Frequency (RF). Up means transmitting. Down means not transmitting. To bring the RF Admin Status Up, execute the Enable action. To bring it Down, execute the Disable action.
Connected Status	True or False	Display only. The user cannot set this field. Indicates if the EMS can communicate with the BTS. The EMS Server sends a message to the BTS periodically. If the BTS responds, the EMS sets this field to True. If the BTS does not respond in a reasonable amount of time, the EMS changes the Connected Status to false. If the Connected Status is False, the EMS will not send any configuration messages to the BTS because it cannot communicate.
Provisioned Status	Provisioned or Unprovisioned	If Provisioned, the BTS has been configured and is ready for use.

IP

Field Name	Values	Description
BTS IP Address		Unique IP address for each BTS. Space bar used to remove or skip existing digits.
EMS Server IP Address		Unique IP address for an EMS. Defaults to the IP on which the EMS Server is running. Space bar used to remove or skip existing digits.
BTS Default Gateway		Default Gateway used to route IP packets for a BTS.
BTS Subnet Mask		Subnet Mask used to route IP packets for a BTS.
Street Address		Physical location of this BTS.
City		City in which BTS is located.
State		State in which BTS is located.
Zip		Zip code for location in which BTS is located

continued…

Field Name	Values	Description
BTS ID		Unique numeric identification number for this BTS. Cannot be changed once the BTS is created in the system.
BTS Name		Unique name given to this BTS. No two BTSs can have the same name.
Suppress Alarms	TRUE or FALSE	To suppress alarms from BTS to EMS, set to TRUE until problem is resolved. Useful if BTS is flooding EMS and affecting its performance. To allow alarms to be sent, set to FALSE.
Suppress CPE Registration	TRUE or FALSE	Determines if BTS can send CPE Registration messages to EMS. Useful if BTS is flooding EMS and affecting its performance. To allow messages to be sent, set to FALSE.
Calibration Interval (hours)	1 - 24	The interval of hours by which on-line calibration occurs.
Bridge Aging Timer (minutes)	1 - 60	BTS Bridge Table timer that controls how long a PVC is assigned to an EID (CPE). The PVC to EID association is removed when no user traffic is received for the timer interval. Applicable only when dynamic PVC assignment is used.
Enable PVC Loopback	TRUE or FALSE	Determines if any PVC on this BTS can perform loopback test.
BTS Contact Personnel		Textual identification of a contact person for this BTS and how to contact them.
BTS Configuration Source	EMS or BTS	Determines where the BTS obtains its configuration data when reset. If provisioning BTS for first time, set to EMS. After successful reset, defaults to BTS.
Interface Type	Ethernet or ATM	Indicates the backhaul to which the BTS is connected.
BTS Profile Type	Unlicensed 2.4 GHz MMDS 2.6 GHz	Select the correct system. 2.4 GHz is the only unlicensed frequency. Any other system, 2.3, 2.5, and 2.6, select MMDS.
Frequency	2.305 GHz - 2.359 GHz 2.40 GHz - 2.473 GHz 2.50 GHz - 2.595 GHz 2.602 - 2.686 GHz	Scroll bar that allows you to set the center frequency for the BTS operation. The range depends on the type of system, i.e., 2.3 GHz, 2.4 GHz, 2.5 GHz, 2.6 GHz. The field is operated by dragging the slider of the center frequency scroll bar left or right. The center frequency of an MMDS band BTS must match what is hard-wired on the RFS. During installation, the installers should check that the configured center frequency is identical to the center frequency labeled on the Channel Filter component of the RFS. **CAUTION**: Changing an MMDS BTS center frequency may result in destruction of the PAs.

Diagnostics

Field Name	Values	Description
Enable Const Display	True or False	Determines if the BTS Constellation Display application can be logged into and used on this BTS. If set to True, this BTS can be logged into and its Constellation Display viewed.
Max Beamform Displays	0-9	The maximum number of CPEs that can be viewed simultaneously using the BTS Beamforming diagnostic display.
User Name	ems	Authorized user of all diagnostic tools.
Password		The password used to authenticate the login to all diagnostic tools.
Enable Spec Analyzer Display	True or False	Determines if the BTS Spectrum Analyzer (frequency) application can be logged into and used on this BTS.
Confirm Password		Confirms that the correct password is entered.

Performance

Field Name	Values	Description
Perf Log Server IP Address		IP address of the performance log collection server.
Perf Log Storage Directory		The name of the directory at the Performance Log server where the performance logs are to be sent. Note: The location of the log directory is "<ftp root directory>\<pm data directory>". Example: If the FTP root directory is set to "d:\naviniems\ftp" and the pm data directory is set to "performance", the location of the log directory will be "d:\naviniems\ftp\performance". Therefore, when configuring the FTP Daemon, set the FTP root directory to "<ems install directory>\ftp".
Upload Interval (minutes or hours)	Disable, 15 minutes, 30 minutes, 1 hour, 2 hours, etc.	The interval that the BTS uploads performance data to the EMS.
Collection Interval (minutes or hours)	Disable, 15 minutes, 30 minutes, 1 hour	The interval that the BTS collects the performance logs.
Perf Log FTP User Name		The FTP user name set in the FTP Daemon running on the server where performance logs are captured.
Perf Log FTP Password		The FTP password set in the FTP Daemon running on the server capturing performance logs.
Confirm Password		Re-enter password to confirm authorized access.

GPS

Field Name	Values	Description
GPS Latitude	North or South 0 (deg) 0 (min) 0 (sec)	The latitude of the BTS in degrees, minutes, and seconds.
GPS Longitude	East or West 0 (deg) 0 (min) 0 (sec)	The longitude of the BTS in degrees, minutes, and seconds.
GPS Height (cm)	0	The height of the BTS in centimeters.
GPS Gmt Offset (min)	-360	The difference in time (minutes) between Greenwich Mean Time (GMT), which is zero, and the time zone where the BTS is located. For example, if the BTS is located in Dallas, Texas, the local time is 6 hours earlier than GMT. In this example, you would enter -360, which is 6 hrs x 60 min. If the local time is ahead of GMT, you would enter a + in front of the number.

Neighbor BTS Frequency List

Field Name	Values	Description
Center Frequency (Scroll Bar)	2.305 GHz - 2.359 GHz 2.40 GHz - 2.473 GHz 2.50 GHz - 2.595 GHz 2.602 - 2.686 GHz	The frequency at which the neighboring BTS is transmitting.
Co-located	Checkmark or blank	Click to place a checkmark indicating that the neighboring BTS is located on the same tower as the current BTS.

CPE Ping Table

Field Name	Values	Description
Ping Sequence	0, 1, 2, 3, etc.	Order in which the element with this IP address is pinged.
IP Address		IP address of the element being added to the Ping Table.
Display String	Alphanumeric (up to 30 characters)	User-assigned designation (name/string) for this element.

Air Interface Parameters

Layer 1 - General

Field Name	Values	Description
RFS	Active or Passive	Specifies whether the RFS has active or passive circuitry.
Gps Offset	0	This is the GPS timing offset to apply to the BTS in order of chips (2.5us). The GPS offset must be different for each BTS sharing the same frequency so they do not interfere with each other.
Sync Scale	0.1125	The scale setting applied to the transmitted synchronization signal.
Acc Scale	0.0557	The scale setting applied to the Access Channel.
Tcc Scale	0.0197	The scale setting applied to the Traffic Channel.
Max Scale	0.2516	The maximum allowable scale setting for each of the above scales: Sync, ACC, TCC.
Rx Sensitivity (–dBm)	100.0	The target Receiver sensitivity for each antenna. This target is used during full calibration. If it is changed, full calibration must be performed for it to take effect.
Antenna Power (dBm)	30.0	The target antenna power for each antenna. This target is used during full calibration.
Cal Cable Loss (dB)	0.0	Entered in the EMS during commissioning as one of several inputs for performing full calibration. This value is the measured calibration cable loss. If it is changed, full calibration must be performed for it to take effect.
Cal Backplane Loss (dB)	5.0	Calibration Backplane Loss (dB)
Cal Total Loss (dB)	0.0	Displays the total calibration loss, calculated from the values in Cal Cable Loss and Cal Backplane Loss fields.
Synthesizer Tx Gain		Displays the Transmitter gain setting for the Synthesizer used during calibration. This field is a result that is automatically returned from full calibration.
Synthesizer Rx Gain		Displays the Receiver gain setting for the Synthesizer used during calibration. This field is a result that is automatically returned from full calibration.
Synthesizer Sc Gain		Displays the Loopback gain setting for the Synthesizer used during calibration. This field is a result that is automatically returned from full calibration.
Synthesizer Level		Displays the power level of the Synthesizer.

Layer 1 - Antenna Table

Field Name	Values	Description
Antenna Index	1-8	The number of the antenna (1-8) that maps to a specific antenna element in the RFS.
Admin Status	Up or Down	Determines if the antenna is transmitting RF. Up means transmitting; Down means not transmitting.
Power Splitter_I		The real element of the calibrator board characteristics that is found in the RFS. This information captures the loss and phase information of the board. The Power Splitter data is unique to each RFS. An RFS Configuration CD ships with the equipment. It provides an RFS script and instructions for selecting the correct value to match the specific RFS that is physically installed with the BTS.
Power Splitter_Q		The imaginary element of the calibrator board that is found in the RFS. This information captures the loss & amplitude information of the board. The Power Splitter data is unique to each RFS. An RFS Configuration CD ships with the equipment. It provides an RFS script and instructions for selecting the correct value to match the specific RFS that is physically installed with the BTS.
RF Tx Gain	0-255	The Transmit gains for each antenna element, ranging from 0-255, with 0 being the lowest gain. This data is returned as a result of full calibration.
RF Rx Gain	0-255	The Receive gains for each antenna element, ranging from 0-255, with 0 being the lowest gain. This data is returned as a result of full calibration.

Layer 1 - w0 Table

Field Name	Values	Description
Sub Carrier Id	1-5	The number (ordinal) of the subcarrier pair.
Antenna Index	1-8	The number of the antenna element.
W0 Weight_I		Real elements of the vector used to control ACC spatial pattern.
W0 Weight_Q		Imaginary elements of the vector used to control ACC spatial pattern.

Layer 1 - Calibration Table

Field Name	Values	Description
Sub Carrier Id	1-10	The number (ordinal) of the subcarrier.
Antenna Index	1-8	The number of the antenna element.
Tx Weight_I		Real elements of the vector used while transmitting to control ACC spatial pattern. This data is returned as a result of any of the calibration modes.
Tx Weight_Q		Imaginary elements of the vector used while transmitting to control ACC spatial pattern. This data is returned as a result of any of the calibration modes.
Rx Weight_I		Real elements of the vector used during Receive to control ACC spatial pattern. This data is returned as a result of any of the calibration modes.
Rx Weight_Q		Imaginary elements of the vector used during Receive to control ACC spatial pattern. This data is returned as a result of any of the calibration modes.

Layer 2 - Carrier Data

Field Name	Values	Description
Sub Carrier Number / Sub Carrier	1-2, 3-4, 5-6, 7-8, 9-10	These two fields identify the 10 subcarriers. You can click on the pair of subcarriers to be enabled for this BTS. Subcarriers are assigned in pairs.
Access Channel	Checkmark or blank	Access Code Channels: The ACC Channel occupies the Code Channel with Walsh Index 0 configured on a specified subcarrier frequency. Each checkbox indicates which pair of subcarriers contains an Access Channel.
Broadcast Channel	Checkmark or blank	Broadcast Code Channel (BCC): If the box is checked, then a BCC will be transmitted in each pair of subcarriers that already contains an ACC. The BCCs are used to broadcast software upgrades to the Modems.
TDD Symmetry Ratio	Symmetric or Asymmetric	Symmetric Ratio is 1:1. Asymmetric Ratio is 1:3. This parameter determines the variable uplink and downlink ratio in a TDD frame. If set to Asymmetric, the downlink will have 3 times more bandwidth than the uplink. This is sometimes desired due to the types of users on the system, i.e., downloading files off the Internet.
Repeat Uplink Pkts	Checkmark or blank	If the box is checked, the Modems will repeat uplink packets.
Frequency (Scroll Bar)	2.305 GHz - 2.359 GHz 2.40 GHz - 2.473 GHz 2.50 GHz - 2.595 GHz 2.602 - 2.686 GHz	Indicates the center frequency of the BTS transmit signal.

Layer 2 - Bandwidth

Field Name	Values	Description
Underload Threshold (%)	80%	The threshold crossing in which a BTS changes its load congestion state from Overload (either Positive Access Overload or Negative Access Overload) to Underload.
Overload Threshold (%)	85%	The threshold crossing in which a BTS changes its load congestion state from Underload to Positive Access Overload.
Positive Access Overload Threshold (%)	90%	The threshold crossing in which a BTS changes its load congestion state from Negative Access Overload to Positive Access Overload.
Negative Access Overload Threshold (%)	95%	The threshold crossing in which a BTS changes its load congestion state from either Underload or Positive Access Overload.
Reserved Channels for Accesses	12	Number of channels reserved for access when in the Underload state.
CPE Inactive Time (min)	15	When a CPE has not communicated with a BTS for the set Inactive Time, the status of the CPE changes from active to inactive, as expressed in minutes.
Bandwidth Adjust Interval (10ms)	20	A user's bandwidth (uplink or downlink) is adjusted every Adjust Time if needed when on TCC. Expressed in units of 10 milliseconds.
Realtime Session Hold Time (10ms)	250	The length of time a user with realtime data holds RF resources after the incoming packet queue is empty. Expressed in units of 10 milliseconds.
Non-realtime Session Hold Time (10ms)	250	The length of time a user with non-realtime data holds RF resources after the incoming packet queue is empty. Expressed in units of 10 milliseconds.
Non RT PreRelease BW (Kbps)	0 - 2,048 Default is 32	The bandwidth a user is assigned while in Non-realtime Session Hold Time. The Non RT PreRelease BW is in units of MAC packets.
Denied Req Number	5	The number of consecutive times a user's access request fails due to lack of RF resources before access is denied.
Average LCC Q LEN Factor	2	Factor used to determine the average LLC queue length.
Exponential For Average	1	Average exponent for all statistical variables but power.
Average Burst Time (ms)	50	Average time for a data burst, expressed in units of 10 milliseconds.
Max Bts Power (TCC Power)	320	Maximum RF power a BTS has. It is in units of maximum TCC power per channel. This field is not configurable.
DL ACC Power Per Channel (TCC Power)	8	Downlink ACC RF power per channel. It is expressed in units of maximum TCC power per channel.
TCC Initial Setup Power (%)	25%	Initial setup power of a TCC channel. Expressed in units of the percentage of the max. TCC power per channel.
Average Exponential Factor	1	Average exponent for average power.
TCC Power per Channel Range (dB)	19	Number of decibels the downlink TCC power per channel can vary.
Min Realtime Data Bandwidth (Kbps)	0 - 2,048 Default is 32	The minimum bandwidth a user with realtime data holds that is not used for acknowledgement. Expressed in units of MAC packets (data rate).

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Field Name	Values	Description
Supported Modulations	QAM4 QAM4 QAM8 QAM4 QAM16 QAM4 QAM8 QAM16	The highest QAM Rank the BTS can process.
Total Priority Level Num.	8	The total number of QoS classes the BTS can maintain. Each class is associated with a priority.
Max Bandwidth for Priority 1-8 (%)	1 default 85% 2 default 10% 3 default 5% 4-8 default 0%	The percentage of the total bandwidth a QoS class associated with a certain priority is entitled to.

Layer 2 - WAN Congestion Control

Field Name	Values	Description
Average Queue Size Weight (%)	100.0	For downlink, this value - expressed as a percentage - indicates how much the current queue size contributes to the calculation of the average queue size. The average queue size is used by the BTS Resource Management software to determine how many Code Channels to give a CPE. The greater the weight, the greater influence the current queue size has on the average queue size. The lower the weight, the more the queue size is an actual average of the current queue size over time.
Max Queue Size (KB)	512	For downlink, the maximum queue size - in kilobytes - for each priority queue (high, low, voice). Once the queue is full (at Min Drop Threshold) all packets are dropped.
Min to Max Drop Probability (%)	10	For downlink, the probability of a packet being dropped when the Min Threshold has been reached. The higher this number, the more likely a packet will be dropped between the Min Threshold and the Max Threshold. NOTE: All packets are dropped at the Max Threshold.
Realtime Min Drop Threshold (%)	100	For downlink, the minimum queue size in which voice priority packets are considered for being dropped. For example, if set to 10%, once the queue size reaches 11% or more, voice priority packets **may** be dropped. The Max Drop Probability field determines if a packet is dropped once the Min Threshold is exceeded.
High Priority Min Drop Threshold (%)	100	For downlink, the minimum queue size in which high priority packets are considered for being dropped. For example, if set to 10%, once the queue size reaches 11% or more, high priority packets **may** be dropped. The Max Drop Probability field determines if a packet is dropped once the Min Threshold is exceeded.
Low Priority Min Drop Threshold (%)	100	For downlink, the minimum queue size in which low priority packets are considered for being dropped. For example, if set to 10%, once the queue size reaches 11% or more, high priority packets **may** be dropped. The Max Drop Probability field determines if a packet is dropped once the Min Threshold is exceeded.

Layer 2 - CPE Uplink Congestion Control

Field Name	Values	Description
Avg Queue Size Weight (%)	100.0	For the uplink, this value - expressed as a percentage - indicates how much the current queue size contributes to the calculation of average queue size. The average queue size is used by the BTS Resource Management software to determine how many Code Channels to give a CPE. The greater the weight, the greater influence the current queue size has on the average queue size. The lower the weight, the more the average queue size is an actual average of the current queue size over time.
Max Queue Size (KB)	512	For the uplink, the maximum queue size for each priority queue (high, low, voice). Once the queue is full (at Min Drop Threshold) all packets are dropped.
Min to Max Drop Probability (%)	10	For the uplink, the probability of a packet being dropped when the Min threshold has been reached. The higher this number, the more likely a packet will be dropped between the Min Threshold and Max Threshold. Note: All packets are dropped at the Max Threshold.
Realtime Min Drop Threshold (%)	100	For the uplink, the minimum queue size in which voice priority packets are considered for being dropped. For example, if set to 10% once the queue size reaches 11% or more, voice priority packets may be dropped. The Max Drop Probability field determines if a packet is dropped once the Min Threshold is exceeded.
High Priority Min Drop Threshold (%)	100	For the uplink, the minimum queue size in which high priority packets are considered for being dropped. For example, if set to 10% once the queue size reaches 11% or more, high priority packets may be dropped. The Max Drop Probability field determines if a packet is dropped once the Min Threshold is exceeded.
Low Priority Min Drop Threshold (%)	100	For the uplink, the minimum queue size in which low priority packets are considered for being dropped. For example, if set to 10% once the queue size reaches 11% or more, low priority packets may be dropped. The Max Drop Probability field determines if a packet is dropped once the Min Threshold is exceeded.

Backhaul Interface Parameters

T1

Field Name	Values	Description
Admin Status	Up	Up or Down. Display only. The administrative (operational) status of this T1. If Down, no traffic is able to go through this interface. This field is not configurable.
Line Type	ESF or D4	Framing format
Send Code	Send line code, Send No Code, Send Payload Code, Send Reset Code	Selection of codes used for far-end loopback tests
Signal Mode	*None*	Always None
Line Length (foot)	5000	Length of T1 cables from BTS to terminating equipment
Fdl	None, Att54016, AnsiT1403	Facility Data Link (FDL) signaling type
Line Status Change Trap	Enabled or Disabled	Enables generation of traps based on changes to the line status
Line Index	1	The ATM IF index that this T1 is associated with
Line Coding	B8ZS or AMI	Type of coding used to encode bits on the line
Circuit Identifier		Vendor's transmission circuit identifier
Transmit Clock Source	Loop timing or Local Timing	Source of the framer Transmit clock
Channelization	*Disabled*	Always Disabled (clear channel)

IMA Groups

Field Name	Values	Description
Admin Status	Up	Up or Down. This is the administration (operational) status of the IMA group. If Down, no traffic is able to go through this interface.
Symmetry	Symmetric operation, Symmetric & Asymmetric, or Asymmetric	Three options for the relationship of the Transmit and Receive link throughput: ✍ Symmetric operation - all links should be configured in both directions. Tx and Rx must both be active to use the disk. ✍ Symmetric and Asymmetric operation - all links should be configured in both directions. Transmitting is allowed when Tx is active and Rx is not active. ✍ Asymmetric operation - not required to configure the IMA links in both Tx and Rx directions.
Min Num Rx Links	3	Minimum number of active Receive links that is necessary for the IMA group to be active.
Tx Ima Id	0	Near-end (Transmit) IMA ID.

continued…

Field Name	Values	Description
Alpha Value	2	Used to specify the number of consecutive valid ICP cells to be detected before moving to the IMA hunt state from the IMA sync state.
Gamma Value	1	Used to specify the number of consecutive valid ICP cells to be detected before moving to the IMA sync state from the IMA pre-sync state.
Index	IMA group 2	IMA Group 1 or 2. Unique sequence number of the IMA group.
Min Num Tx Links	1	Minimum number of Transmission links that have to be active for the IMA group to be active.
Ne Tx Clk Mode	ITC	Near-end Transmit clock mode.
Tx Frame Length	M128	Length of IMA frame being transmitted. It is defined as M consecutive cells.
Beta Value	2	Used to specify the number of consecutive ICP cells with errors to be detected before moving to the IMA hunt state from the IMA sync state.

Add T1s to IMA Groups

IMA Group	T1s Associated With this IMA Group	Notes
IMA 1		
IMA 2		

ATM

Field Name	Values	Description
If Index	T1-1 (first T1 ID)	Interface (IF) Index associated with this ATM interface.
Max Vccs	1001	Maximum Virtual Channel Circuits for this interface.
Max Active Vci Bits	9	The number of bits for Virtual Channel Identifier (VCI). Determines the maximum VCI value allowed for this interface. The Max Value is calculated by 2^ (max active vci bits).
Max Vpcs	0	Maximum Virtual Private Circuits for this interface.
Max Active Vpi Bits	3	The number of bits for Virtual Private Identifier. Determines the maximum VPI value allowed for this interface. The max value is calculated by 2^ (max active vpi bits).

PVC

Field Name	Values	Description
if Index	T1-1	The ATM IF index that this PVC is associated with.
Vpi (start and end)	0	Virtual Path Identifier. The VPI + VCI are in the cell header and identify the next destination of a cell as it passes through a series of ATM switches.
Vci (start and end)	0	Virtual Channel Identifier. The VPI + VCI are in the cell header and identify the next destination of a cell as it passes through a series of ATM switches.
Tr/Re Traffic Descr Indexes	2	Index of the ATM Descriptor that applies to this PVC. The Transmit and Receive Descriptors are the same.
AAL5 CPCS Tx SDU Size (Byte)	1528	The maximum AAL5 CPCS SDU size, in bytes, that is supported in the Transmit direction.
AAL5 CPCS Rx SDU Size (Byte)	1528	The maximum AAL5 CPCS SDU size, in bytes, that is supported in the Receive direction.
Admin Status	Up	Up or Down. The administrative (operational) state of the PVC. If it is Down, this PVC may not be used for traffic.
AAL Type	AAL5 (1-5)	The type of ATM Adaptation Layer (AAL) used on this PVC: AAL1, AAL2, AAL3, AAL4, or AAL5.
AAL5 Encap Type	LLC encapsulation	The type of data encapsulation used over the AAL5 SSCS layer.
Cast Type	P2P	The connection topology type.
Conn Kind	PVC	The type of VCL. This is always PVC.

Assign CPE to PVC

Field Name	Values	Description
PVC	T1-1-1-100 (example)	Identifies the PVC to be assigned to the specified CPE.
CPE	0	CPE assigned to specified PVC.
Data		Denotes what type of PVC to assign.

Global Parameters Configuration Form

Company:____
Your Name:___________________________________Date:_____________

NOTE 1: Field Values in gray rows indicate data that ordinarily should not be changed or that is populated automatically by the system.

NOTE 2: Default Field Values are underlined.

ATM Descriptor

Field Name	Values	Description
Index	<u>0</u>	Identifier for this ATM Descriptor
Type	<u>NOCLPNOSCR</u>, NOCLPSCR, CLPNOTAGGINGSCR, CLPTAGGINGSCR, CLPNOTAGGINGMCR, CLPTRANSPARENTNOSCR, CLPTRANSPARENTSCR, NOCLPTAGGINGNOSCR	Type of ATM
Category	<u>CBR</u>, RTVBR, NRTVBR, ABR, UBR	Category of this ATM (see parameters, below)
Frame Discard	<u>True</u>	True or False. If set to True, enables the ability to discard ATM frames.
Param1 - Param5	<u>0</u>	Described below
CBR Parameters: **PCR**		 Peak Cell Rate
RTVBR Parameters: **PCR** **SCR** **MBS**		 Peak Cell Rate Sustainable Cell Rate Maximum Burst Size
NRTVBR Parameters: **PCR** **SCR** **MBS**		Peak Cell Rate Sustainable Cell Rate Maximum Burst Size
ABR Parameters: **PCR** **MCR** **ICR** **RDF** **RIF** **CDF**		 Peak Cell Rate Minimum Cell Rate Initial Cell Rate Rate Decrease Factor Rate Increase Factor Cutoff Decrease Factor
UBR Parameters: **PCR**		 Peak Cell Rate

CPE Descriptor

Field Name	Values	Description
Name		Name given to this CPE Descriptor.
Index	1 (1-8)	Unique index identifier for this CPE Descriptor.
Priority	0	The priority that a CPE with this assigned Descriptor will receive from the BTS Resource Manager software when requesting RF resources. This field maps to the Layer 2 > Bandwidth Data component in the BTS.
UL Max Bandwidth (Kbps)	0, 32, 64, 96, 128, 160, 192, 224, etc.	Maximum uplink bandwidth allowable for a CPE with this Descriptor. The maximum number of code channels allocated for a CPE is directly related to this field.
UL Min Bandwidth (Kbps)	0, 32, 64, 96, 128, 160, 192, 224, etc.	Minimum uplink bandwidth allowable for a CPE. This field determines the number of code channels allocated when a CPE begins a data session. The larger this value, the more code channels allocated at session startup.
DL Max Bandwidth (Kbps)	0, 32, 64, 96, 128, 160, 192, 224, etc.	Maximum downlink bandwidth allowable for a CPE. The maximum number of code channels allocated for a CPE is directly related to this field.
DL Min Bandwidth (Kbps)	0, 32, 64, 96, 128, 160, 192, 224, etc.	Minimum downlink bandwidth allowable for a CPE. This field determines the number of code channels allocated when a CPE begins a data session. The larger this value, the more code channels allocated at session startup.
Avg Queue Size Weight (%)	100.0	How much the current queue size contributes to the calculation of average queue size. The average queue size is used by the BTS Resource Manager to determine how many resources (code channels) to give a CPE. The greater the weight, the greater influence the current queue size has on the average queue size. The lower the weight, the more the average queue size is an actual average of the current queue size over time.
Max Queue Size (KB)	512	Maximum queue size for each priority queue (high, low, voice). Once full (Max Threshold) all packets are dropped.
Min to Max Drop Probability (%)	10	The probability of a packet being dropped when the Min Threshold has been reached. The higher this number, the more likely a packet will be dropped between the Min and Max Threshold. All packets are dropped at Max Threshold.
Realtime Min Drop Threshold (%)	100	The minimum queue size at which voice-priority packets are considered for being dropped. For example, if set to 10% once the queue size reaches 11% or more, voice priority packets **may** be dropped. The Max Threshold Probability field determines if a packet is dropped once the Min Threshold is exceeded.
High Priority Min Drop Threshold (%)	100	The minimum queue size at which high-priority packets are considered for being dropped. For example, if set to 10%, once the queue size reaches 11% or more, high priority packets **may** be dropped. The Max Threshold Probability field determines if a packet is dropped once the Min Threshold is exceeded.

continued…

Field Name	Values	Description
Low Priority Min Drop Threshold (%)	100	The minimum queue size at which low-priority packets are considered for being dropped. For example, if set to 10%, once the queue size reaches 11% or more, low priority packets may be dropped. The Max Threshold Probability field determines if a packet is dropped once the Min Threshold is exceeded.

DiffServ

Field Name	Values	Description

Code Point	0	Unique index (bit) to be mapped to a defined Differentiated Service. The code point is structured as follows:
		`    0   1   2   3   4   5   6   7`
		`  +---+---+---+---+---+---+---+---+`
		`  |         DSCP          |  CU   |`
		`  +---+---+---+---+---+---+---+---+`
		`DSCP: Differentiated Services Code Point`
		`CU:   Currently Unused`
		The Type of Service (ToS) bits are included in the DSCP.

Priority	Low, High, Voice	Low, High, or Voice. This is the priority given to data packets associated with this Code Point/Service. The BTS processes data packets with Voice, then High priority before Low priority packets.

DHCP Relay

Field Name	Values	Description
Relay Config Enabled	(Checkbox)	Enable or Disable. Clicking on the checkbox enables the DHCP Relay feature.
Free Address Low Agent Threshold	80	
Free Address High Agent Threshold	100	
Relay Config MaxDhcp Size	1488	
Option 82 Tagging	(Checkbox)	Enable or Disable. Clicking on the checkbox enables the inclusion of one or more of the following Relay Information sub-options.
Remote Id	(Checkbox)	If checked (enabled), include the Modem EID as the Remote ID Relay Information sub-option. It will be formatted as a 6 octet string “0000<EID>”. This format is often used in cable modem scenarios.

continued…

Field Name	Values	Description
Circuit Id	(Checkbox)	If checked (enabled), include the BTS ID as the Circuit ID Relay Information sub-option. It will be formatted as a 4-octet string "<BTS ID>". This format is often used in cable modem scenarios.
VPN Id	(Checkbox)	If checked (enabled), include the Modem EID as the VPN ID Relay Information sub-option. It will be formatted as a text string "navini<EID>". This format is often used in DSL scenarios.
Subnet Selection/Addr	(Checkbox)	If checked (enabled), include the specified Subnet Address as the Subnet Selection Relay Information sub-option.
DOCSIS Device/Class	(Checkbox)	If checked (enabled), include the specified DOCSIS Device Class as the DOCSIS Device Relay Information sub-option.

ARP Proxy

Field Name	Values	Description
ARP Ingress Proxy	(Checkbox)	If clicked, this enables the BTS to respond to ARP messages coming from the CPEs/Modems to the BTS.
ARP Egress Proxy	(Checkbox)	If clicked, this enables the BTS to respond to ARP messages coming from the network (backhaul) to the BTS on behalf of the CPEs/Modems.

Layer 3 Filter

Field Name	Values	Description
Dynamic Acl	(Checkbox)	If clicked, this enables the Dynamic Access Control List. It provides the filtering rules for DHCP Relay - where a BTS configured with these capabilities may add learned addresses to the Modem's Authenticated IP List (the Modem's Ingress Filter). When BTSs and Modems are configured for this feature, any packet whose MAC address cannot be found in the current Modem's Authenticated IP List will be discarded.
Egress Broadcast Filter	(Checkbox)	If clicked, this enables configured BTSs to drop all Ethernet Broadcast packets.

CPE Configuration Data Form

Company:____

Your Name:______________________________Date:___________

NOTE 1: Field Values in gray rows indicate data that ordinarily should not be changed or that is populated automatically by the system.
NOTE 2: Default Field Values are underlined.

Add CPE

Field Name	Values	Description
EID (hex)	0	Equipment Identifier unique to each CPE. This value is determined during the manufacturing process and is displayed on the case of the CPE hardware, as well as entered and displayed as a hexadecimal number in this field.
Descriptor Name	CPE Descriptor-1	The name of the CPE Descriptor to be used with this CPE. The CPE Descriptor level affects Quality-of-Service (QoS) for this CPE's data packets.
Collect Perf Data	True	True or False. Collect Performance Data. If True, this CPE sends performance metrics to the BTS at the set interval. The BTS then uploads the performance data to the EMS at set intervals. The interval setting for collection and upload from the BTS to the EMS is set in the Performance fields for the BTS.
Nomadic	Disabled	Enabled or Disabled. If Enabled, this CPE can access any BTS in the network that is defined in its Available Home BTS list at the bottom of the screen. When enabled, the Current Home BTS list is ignored. If disabled, this CPE can only access a BTS in its Available Home BTS list.
Admin Status	Active	Active or Suspended. If suspended, the CPE cannot access any BTS. A Service Provider may decide to make the CPE suspended due to late service payments, security concerns, etc., rather than deleting the CPE from the system database.

Home BTS

Field Name	Values	Description
Available Home BTS		Add or Remove BTS Names. A list of available BTSs to include in the Current Home BTS list for this CPE.
Current Home BTS		Add or Remove BTS Names. If Nomadic is disabled, these are the only BTSs this CPE can access. If Nomadic is enabled, this list is ignored.

Layer 3

Field Name	Values	Description
Ingress Acl	(Checkbox)	If checkbox is clicked "on" any incoming packet whose MAC address cannot be found in the current CPE Authenticated IP List will be discarded.
Ingress Broadcast	(Checkbox)	If checkbox is clicked "on" any incoming MAC broadcast message will be discarded.

DHCP Relay

Field Name	Values	Description
Free Address High Drop Policy	<u>Drop most recently leased</u> or Drop least recently leased	Drop the most recently leased or least recently leased IP addresses
Max Address Number	<u>Drop most recently leased</u> or Drop least recently leased	Drop the most recently leased or least recently leased IP addresses

IP Address

Field Name	Values	Description
Static Client IP Address	<u>0.0.0.0</u>	Use static, rather than dynamic, IP addressing for this device. If static IP assignment is being made, add this IP address to the Ingress Filter Authenticated IP List. Otherwise, leave zeroes.
Hardware Address	<u>0:0:0:0:0:0</u>	Enter the Ethernet address of the host computer to which the CPE is connected and that corresponds to the above Client IP Address.

Appendix V: Base Station Calibration Verification

Objective

The objective of this procedure is to verify the transmit power and noise figure of the Base Station using a Modem.

Test Equipment Required

- Installed Base Station, powered on and calibrated
- Navini Drive Test Box
- PC with Beamforming Display tool installed
- 4 Fixed Attenuators: two at 30 dB, two at 10 dB. Low power attenuator acceptable.
- RF cables and adaptors (3 ft or more)
- N type Terminator for GPS

Test Procedure

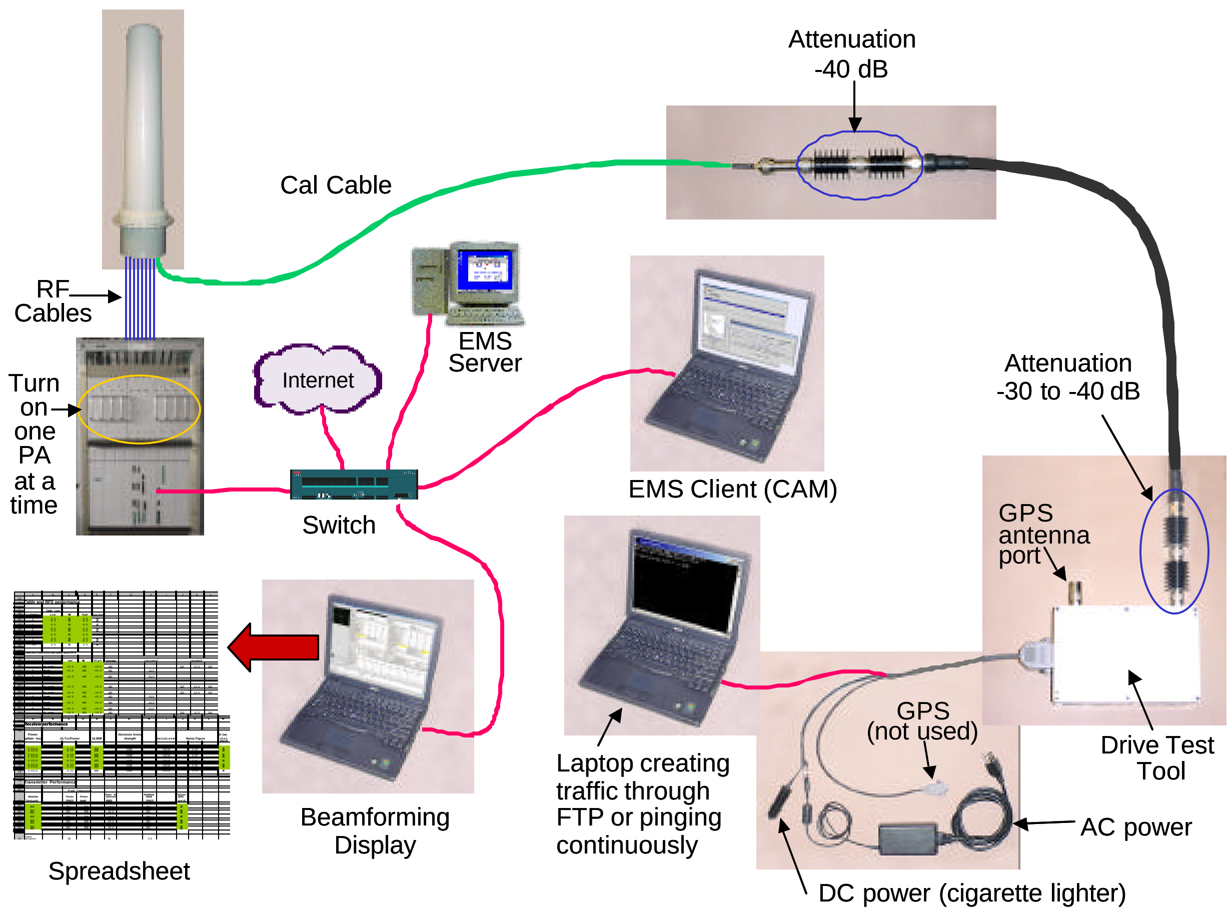
Step 1. If not already done, calibrate the Base Station. Verify a successful calibration by monitoring the console with "caldebugon". Verify that the cal error equals zero. If cal errors are not zero, troubleshoot the system before starting.

Step 2. Prepare the setup that is shown in Figure V1.

Step 3. Connect approximately 30-40 dB of attenuation to one end of the calibration cable. Connect a 3-6 ft RF cable to the other end of the attenuation. Connect 40 dB of attenuation to the end of that cable. Connect the attenuators to the Navini Drive Test box.

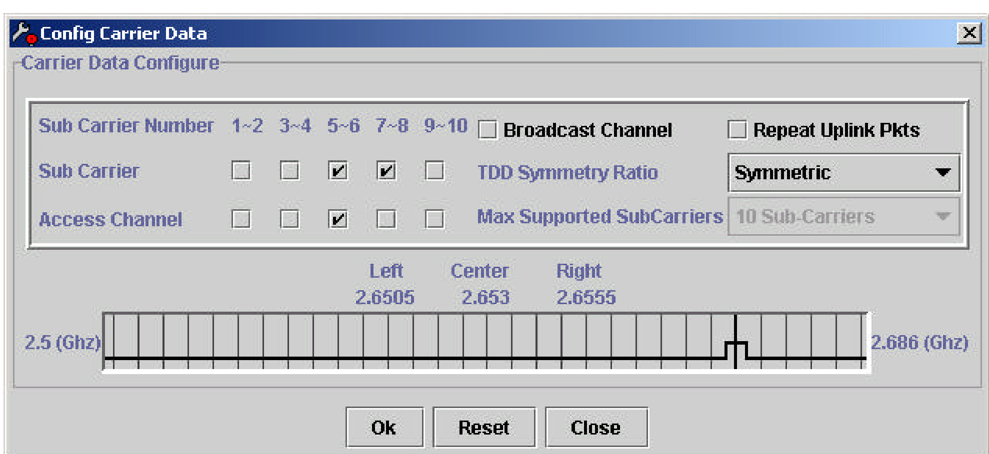
Step 4. Put the Drive Test box as far away from the Base Station as possible. Terminate the GPS connector. Calculate the path loss from the Drive Test box to the Cal cable. In the EMS disable carriers 1-2, 3-4, and 9-10, leaving 5-6 and 7-8 enabled. Also verify that the ACC for 5-6 is selected. This is found by clicking on the BTS tab, highlighting the specific BTS, then selecting **Air Interface** > **Layer 2** > **Carrier** data. Refer to Figure V2.

Figure V1: Test Setup



NOTE: The EMS Client (CAM) and the Beamforming Display may be run from the same laptop

Figure V2: Configure Carrier Data Window



Step 5. Connect approximately 20-40 dB of attenuation to the end of the calibration cable. Connect a 3-6 ft RF cable to the other end of the attenuation. Connect the remaining attenuation to the end of that cable. Connect the attenuators to the Navini Drive Test box.

Step 6. Put the Drive Test box as far away from the Base Station as possible. Terminate the GPS connector. Calculate the path loss from the Drive Test box to the Cal cable. In the EMS disable carriers 1-2, 3-4, and 9-10, leaving 5-6 and 7-8 enabled. Also verify that the ACC for 5-6 is selected. This is found by clicking on the BTS tab, highlighting the specific BTS, then selecting **Air Interface** > **Layer 2** > **Carrier** data. Refer to Figure V2.

Step 7. Disable all PAs except PA #1.

Step 8. From the Beamforming, verify that the Receive Sync from the Drive Test Tool is approximately –80 dBm. If not, adjust the value of the attenuators accordingly.

Step 9. Start an upload of a large file or ping continuously with packets 3,000 bytes or greater. You need to acquire at least 20 code channels in one sub-carrier. If the number of code channels is less than 20, start an additional ping sessions.

```
ping <ip_address> –l 3200 –t
```

Step 10. Capture the following parameters from the BTS Beam-forming display. Refer to Figure V3:

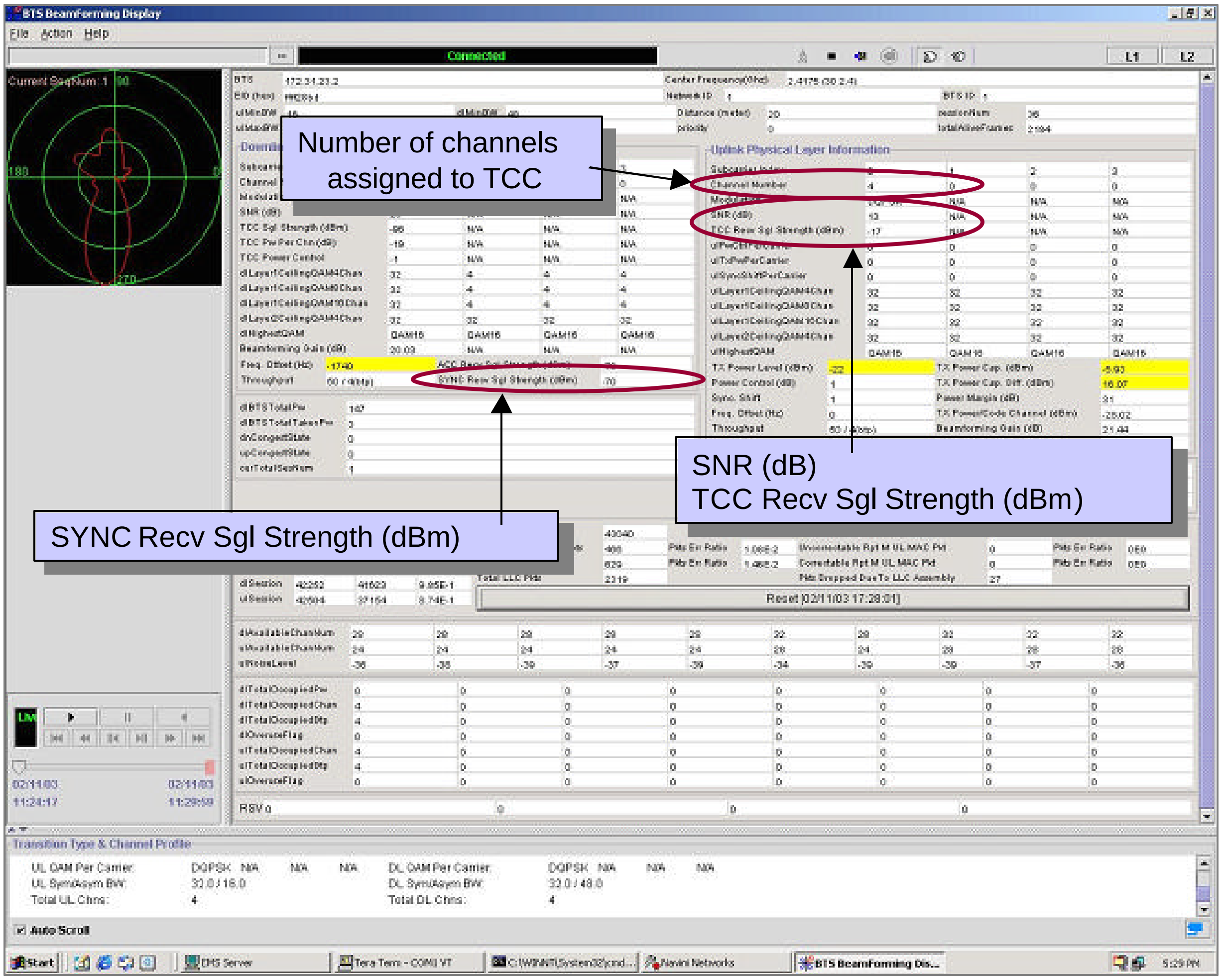
Downlink: SYNC Recv Sgl Strength (dBm)
Uplink: SNR (dB)
Uplink: TCC Recv Sgl Strength (dBm)

Step 11. Capture the same parameters as in Step 10 for each of the remaining PAs, one by one. That is, with PA #2 turned on and all other PAs turned off ; then with PA #3 turned on and all other PAs turned off; etc.

Step 12. Use the spreadsheet and input all the captured parameters to calculate the Tx power and Noise figure.

Step 13. Measure and record attenuation value.

Figure V3: BTS Beamforming Display Window



Other Parameters to Capture

The following parameters should also be captured:

- Calibration Sensitivity (set in EMS)
- Path Loss (to be measured)
- Cal Cable Loss (set in EMS)
- Power Splitter Loss (set in EMS)

Results

Using the Base Station Calibration Verification form (Figure V4), submit your results to Navini Networks for evaluation and sign-off.

Figure V4: Base Station Calibration Verification Form

	A	B	C	D	E	F	G	H	I
1									
2	**General information**						**Data input by user**		
3									
4	**Date**			9/28/2003					
5	**Site Name**								
6	**BTS ID**								
7	**Frequency (MHz)**								
8	**Software release**								
9	**Personnel**								
10									
11									
12	**Cal cable loss**			-6.0					
13	**Attenuation**			70.0					
14	**Total Path loss**			-76.0					
15	**RX sensitivity (set in EMS)**			-90.0					
16	**Antenna power (in EMS)**			30.0					
17	**Antenna gain**			18.0					
18									
19									
20									
21									
22									
23									

	A	B	C	D	E	F	G	H	I	J	K	L
25												
26	**Cable and RFS performance**											
27												
28		**Cable Loss**										
29	**Cable**	**Low**	**Mid**	**High**	**Avg. loss**							
30	1	-6.0	-6.0	-6.0	-6.0							
31	2	-6.0	-6.0	-6.0	-6.0							
32	3	-6.0	-6.0	-6.0	-6.0							
33	4	-6.0	-6.0	-6.0	-6.0							
34	5	-6.0	-6.0	-6.0	-6.0							
35	6	-6.0	-6.0	-6.0	-6.0							
36	7	-6.0	-6.0	-6.0	-6.0							
37	8	-6.0	-6.0	-6.0	-6.0							
38	cal	-6.0	-6.0	-6.0	-6.0							
39												
40												
41	**Insertion loss thru cal cable and RFS**											
42								**Cal path loss**			**LNA gain**	
43			**Low**	**Mid**	**High**	**Average**		(calculated)			(calculated)	
44	**1**	**TX path**	-40.0	-40.0	-40.0	-40.0		-31.0				
45		**RX path**	-18.0	-18.0	-18.0	-18.0				22.0	22.0	22.0
46	**2**	**TX path**	-40.0	-40.0	-40.0	-40.0		-31.0				
47		**RX path**	-18.0	-18.0	-18.0	-18.0				22.0	22.0	22.0
48	**3**	**TX path**	-40.0	-40.0	-40.0	-40.0		-31.0				
49		**RX path**	-18.0	-18.0	-18.0	-18.0				22.0	22.0	22.0
50	**4**	**TX path**	-40.0	-40.0	-40.0	-40.0		-31.0				
51		**RX path**	-18.0	-18.0	-18.0	-18.0				22.0	22.0	22.0
52	**5**	**TX path**	-40.0	-40.0	-40.0	-40.0		-31.0				
53		**RX path**	-18.0	-18.0	-18.0	-18.0				22.0	22.0	22.0
54	**6**	**TX path**	-40.0	-40.0	-40.0	-40.0		-31.0				
55		**RX path**	-18.0	-18.0	-18.0	-18.0				22.0	22.0	22.0
56	**7**	**TX path**	-40.0	-40.0	-40.0	-40.0		-31.0				
57		**RX path**	-18.0	-18.0	-18.0	-18.0				22.0	22.0	22.0
58	**8**	**TX path**	-40.0	-40.0	-40.0	-40.0		-31.0				
59		**RX path**	-18.0	-18.0	-18.0	-18.0				22.0	22.0	22.0
60												

	A	B	C	D	E	F	G	H	I	J	K	L	M
64													
65	**Receiver performance**												
66													
67	**Power splitter loss**		**UL Tcc Power**		**UL SNR**		**Absolute Signal strength**		**Noise Level**		**Noise Figure**		**RX Gain (DAC word)**
68													
69	0.0316		-8.00		12.00		-114.05		-126.05		5.95		145
70	0.0316		-8.00		12.00		-114.05		-126.05		5.95		145
71	0.0316		-8.00		12.00		-114.05		-126.05		5.95		145
72	0.0316		-8.00		12.00		-114.05		-126.05		5.95		145
73	0.0316		-8.00		12.00		-114.05		-126.05		5.95		145
74	0.0316		-8.00		12.00		-114.05		-126.05		5.95		145
75	0.0316		-8.00		12.00		-114.05		-126.05		5.95		145
76	0.0316		-8.00		12.00		-114.05		-126.05		5.95		145
77													
78													
79													
80	**Transmitter Performance**												
81													
82			**P out Transceiver**										
83	**Absolute Sync Level**		**Power (RMS)**	**Power (peak)**		**Power at antenna (RMS)**		**Radiated power (RMS)**		**TX Gain (DAC word)**			
84													
85	-80.0		36.0	45.49		30.0		48.0		200			
86	-80.0		36.0	45.49		30.0		48.0		200			
87	-80.0		36.0	45.49		30.0		48.0		200			
88	-80.0		36.0	45.49		30.0		48.0		200			
89	-80.0		36.0	45.49		30.0		48.0		200			
90	-80.0		36.0	45.49		30.0		48.0		200			
91	-80.0		36.0	45.49		30.0		48.0		200			
92	-80.0		36.0	45.49		30.0		48.0		200			
93													
94	Power deviation		0.0			0.0		0.0					

Test Form Instructions

These instructions explain how and what to enter into the Base Station Calibration Verification spreadsheet, as well as define each cell's function. The cells that need an entry are shown in green on the spreadsheet. This document and form are to be used in conjunction with the Base Station Installation & commissioning Guide P/N 40-00047-00.

I. Section 1: General Information

A. Date (D4)

Excel will enter the current date.

B. SITE NAME (D5)

Enter site name or customer designation.

C. BTS ID (D6)

Enter BTS identification number or customer description.

D. Frequency (D7)

Enter the system operating frequency that the customer has determined to use.

E. Software Release (D8)

Enter the release number of the software load being used.

F. Name (D9)

Enter your name.

G. Cal cable loss (D12)

Excel will enter averaged value of calibration cable loss from cell E38.

H. Attenuation (D13)
   Enter the attenuation value inserted into calibration path.

I. Total Path loss (D14)
   Excel will enter the calculated value of the total path loss.

J. Receiver sensitivity (in EMS) (D15)
   Enter the same number entered in the EMS under **Air Interface** > **Layer 1** > **General** tab > **RX sensitivity**.

K. Antenna power (in EMS) (D16)
   Enter the same number entered in the EMS under **Air Interface** > **Layer 1** > **General** tab > **Antenna power**.

L. Antenna gain (D17)
   Enter gain value of antenna elements.

II. Section 2: Cable and RFS performance

A. Cable loss (B30-D38)
   Enter the values measured during the cable sweeps. Include the minus sign on all entries. Include jumpers and surge protectors.

B. Insertion loss through cal cable and RFS (C44-E59)
   Enter values measured during the RF sweeps of the cables and the RFS. Include the minus sign for all entries.

C. Cal path loss (calculated) (H44-H58)
   Calculated value based on absolute loss measured during RF sweeps. The measured cable loss for antenna 1 plus 3dB for inherent loss in RFS (internal cables and LNA loss) is subtracted from the measured TX path loss to give absolute calibration path loss. **It is <u>important</u> to check this value to ensure that it does not exceed –45 dB**.

D. LNA gain (calculated) (J45-L59)
   Calculated value based on absolute loss measured during RF sweeps. The absolute value of the difference between TX path loss and RX path loss equals LNA gain for each antenna path.

III. Section 3: Receiver Performance

A. Power splitter loss (in EMS) (A69-A76)
   Before calibrating, the script must have been run to enter the decimal values of the calibration board loss for each path. Enter those same values here.

B. UL TCC power (C69-C76)
   From Beamforming Display, enter the value from the "Tcc receive signal strength" field. There should be only one carrier active. This is the relative power per code channel, referenced to RX sensitivity, of that carrier, being received by the Base Station.

C. UL SNR (E69-E76)
   Enter the value from the Beamforming Display. This value can be found just above the TCC value in the same carrier column.

D. Absolute Signal strength (G69-G76)
   Calculated signal strength of the receive signal converted to 5 MHz BW. TCC power per code channel is converted to absolute by adding RX sensitivity and then subtracting spreading gain. Multiple antenna gain is then added to show receive

signal strength at each antenna. (RX sensitivity + UL TCC power - 10*LOG10(320) + 9).

E. Noise level (I69-I76)
   Calculated digital noise floor of the system measured in a 5 MHz BW.

F. Noise Figure (K69-K76)
   Calculated by adding the spreading gain of the individual carriers back in and subtracting the thermal noise floor (KTB) in a 500 KHz BW.

G. RX gain (DAC word) (M69-M76)
   The data word generated during calibration for the receiver gain DAC that controls the IF attenuator. It is found in the EMS under **Air interface** > **Layer 1** > **Show configuration** > **Antenna** tab.

IV. Section 4: Transmitter Performance

A. Analyzer Readings (A90-B97)

1. Peak
   The peak amplitude of the sync signal measured on the spectrum analyzer. The measurement is taken with the spectrum analyzer in the time domain (0 Hz span) and RBW set for 5 MHz. Sweep time is typically between 10 and 20 ms. When taking the measurement, the sync signal will have peaks and valleys associated with it. Make sure to measure the absolute peak.

2. RMS
   This is a calculated value based on measurements taken on several occasions, comparing peak power to RMS power on a Rhode & Schwartz spectrum analyzer. It has been determined that the correction factor for peak to average on a standard spectrum analyzer is 9.5 dB. This correction factor is the default entry in this section. If it is possible to make the RMS measurement with the proper equipment then that is the preferred method. The calculation is very straightforward: peak power minus 9.5 dB = Power RMS.

B. P out transceiver (D90-E97)
   Power peak and Power RMS are calculated values using the value from the spectrum analyzer readings and the value entered for coupler/test cable loss (Cell H31).

C. Power at antenna (RMS) (G90-G97)
   Calculated value using the Output Power (P_{out}) of the transceivers and the Cable Loss plus the inherent loss of the RFS.

D. Radiated Power (RMS) (I90-I97)
   Calculated value using Power at the antenna and the value entered for antenna gain (Cell H32).

E. TX Gain (DAC word)
   The hex data generated during calibration for the transmit gain DAC that controls the IF attenuator. This is found in the EMS under **Air interface** > **Layer 1** > **Show configuration** > **Antenna** tab.

F. Max power deviation across all antennae (E99, G99, I99)
   Calculated value showing the deviation between the lowest power antenna and the highest power antenna for each column.

Appendix W: Local Modem Tests

Objective

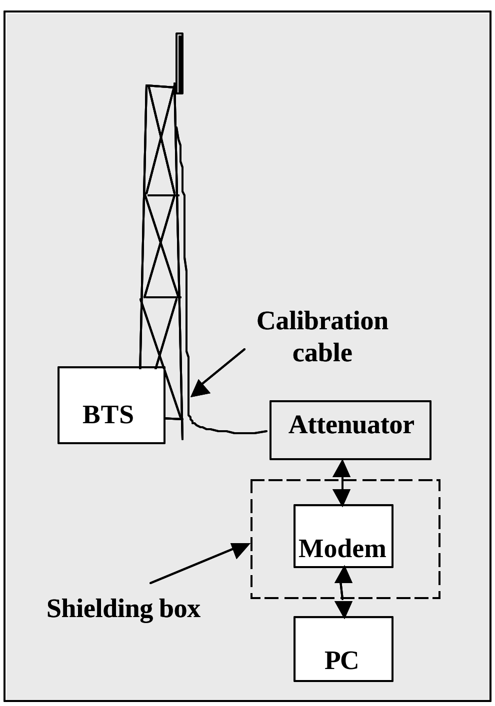
Local Wired Modem Testing (then Over-The-Air Modem Testing) will verify that the Base Station is working and able to transmit and receive data. Data rates are not being checked at this time. Refer to Figure W1 when setting up and performing the Wired Modem procedures.

Wired Modem Test

Equipment Required

?? Modem
?? PC - Laptop with CPE debug tool. Connect to CPE with an Ethernet cable
?? Attenuator - 70dB fixed attenuation, plus 40 adjustable range with 1dB resolution (cascade multiple attenuators)
?? Shielding box - Need to provide 80 dB isolation. Shielding box may not be needed if the Modem cannot sync to BTS over-the-air at the test location.

Figure W1: Wired Modem Setup



Equipment Settings

Part of the Test Procedures below.

Test Procedure Setup

Set up the test procedures, per the following.

Step 1. Calibrate the BTS and perform the Calibration Verification procedure.

Connect the Modem and the attenuators. The combined attenuation should be set roughly as follows:

Total attenuation = PTX - 30 + 18 – Cal cable loss + 80

Where PTX is the Tx output power at antenna input port that is set in EMS during calibration. Cal cable loss is the loss of the calibration cable.

The total attenuation should be partitioned between fixed and adjustable attenuators in such a way that the adjustable attenuator is set to about 10 dB.

Disconnect the calibration cable from the back of the BTS shelf and connect it to the attenuator as shown in the drawing

Ping the BTS continuously from the Modem.

Check the sync level at the CPE debug tool. The level should be about –80 dBm.

Test Procedure - Check Modem Sensitivity & Output Power

Follow the steps in the procedure below.

Step 1. Record the downlink TCC power level and SNR reading on the CPE debug tool.

Step 2. Calculate the effective noise floor: $NF = SNR_{TCC} – Level_{TCC}$.

Where SNR_{TCC} is the TCC SNR and $Level_{TCC}$ is the received downlink TCC level. NF should be close to –127 ±5.

Step 3. Check Modem output power cap difference. It should be greater than 0.

Step 4. Increase the attenuation by 10 dB (increase the attenuation of the adjustable attenuator).

Step 5. Measure the effective noise floor and the output power cap difference gain.

Step 6. Increase the attenuation by another 10 dB and take the measurements again (if the link is broken when the attenuation increases 10 dB, back off the attenuation by 10 dB and then increase the attenuation with 1 dB steps until the link is broken. Then reduce the attenuation by 4 dB).

Step 7. Calculate the maximum path allowed as follows:

Max loss = Attenuation total + Cal cable loss + 30

Where Attenuation total is the total attenuation of all attenuators (fixed + adjustable).

Test Procedure - Check BTS Sensitivity (Individual Antenna)

Step 1. Set the attenuation of the attenuator so the total attenuation is about P_{TX} – 30 – Cal cable loss + 80.

Step 2. Activate antenna #1 only.

Step 3. Record the uplink TCC power level and SNR reading on the BTS debug tool.

Step 4. Calculate the effective noise floor: NF = SNR_{TCC} – $Level_{TCC}$.
Where SNR_{TCC} is the TCC SNR and $Level_{TCC}$ is the received downlink TCC level.
NF should be close to: SNR – BTS Sensitivity + 25 ± 2.5.
Where BTS sensitivity is the BTS sensitivity setting during calibration.

Step 5. Record the Modem output power.

Step 6. Increase the attenuation by 10 dB (increase the attenuation of the adjustable attenuator).

Step 7. Measure BTS effective noise floor and Modem output power again.

Step 8. Increase the attenuation by another 10 dB and take the measurements again (if the link is broken when the attenuation increases 10 dB, back off the attenuation by 10 dB and then increase the attenuation with 1 dB steps until the link is broken. Then reduce the attenuation by 4 dB. The same attenuation will be used for all antenna tests).

Step 9. Calculate the maximum path allowed as follows:

Max loss = Attenuation total + Cal cable loss + 30

Where Attenuation total is the total attenuation of all attenuators (fixed + adjustable).

Step 10. Repeat the steps for antennas 2 through 8.

Step 11. Average the Modem output power over antennas 1 through 8 for each attenuation setting.

Test Procedure - Check BTS Sensitivity (Antenna Array)

Step 1. Set the initial attenuation the same as in the individual antenna testing procedure.

Step 2. Activate all antennas.

Step 3. Record the uplink TCC power level and SNR reading on BTS debug tool.

Step 4. Calculate the effective noise floor: $NF = SNR_{TCC} - Level_{TCC}$.
Where SNR_{TCC} is the TCC SNR and $Level_{TCC}$ is the received uplink TCC level.
NF should be close to SNR – BTS Sensitivity $+ 25 \pm 2.5$.
Where BTS sensitivity is the BTS sensitivity setting during calibration.

Step 5. Record the CPE output power.

Step 6. Increase the attenuation by 10 dB (increase the attenuation of the adjustable attenuator).

Step 7. Measure BTS effective noise floor and Modem output power again.

Step 8. Increase the attenuation by the same amount as in individual antenna tests and measure the BTS effective noise floor and Modem output power.

Step 9. For each attenuation setting, the Modem output power should be 9 dB less compared to those (average) in individual antenna tests.

Step 10. Increase the attenuation by another 18 dB. The link should be on.

Step 11. Calculate the maximum path allowed as follows:
Max loss = Attenuation total + Cal cable loss + 30
Where Attenuation total is the total attenuation of all attenuators (fixed + adjustable).

Test Procedure - Data Rate

Step 1. Set the attenuation of the attenuator so the total attenuation is about

PTX – 30 +18 – Cal cable loss + 80.

Step 2. Activate all antennas.

Step 3. FTP a file with size greater than 10 Mbps from Modem to BTS (uplink).

Step 4. Check the uplink data rate. It should be approximately 1 Mbps.

Step 5. FTP a file with size greater than 20 Mbps from BTS to Modem (downlink).

Step 6. Check the downlink data rate. It should be approximately 2 Mbps.

After the test is completed, reconnect the calibration cable back to the BTS and run the calibration. The new calibration table should be the same as before (the changes in Tx and Rx AGC should be within 2 bits).

Over-The-Air Modem Test

Equipment Required

Same as for Wired Modem Test.

Equipment Settings

Included in the Test Procedure.

Test Procedure

To set up a Modem for local over-the-air testing, follow the steps below.

Step 1. Connect a Modem to a test computer. Reference the *Ripwave Modem User Guide*, P/N 40-00026-00 for Modem setup procedures. The location of the test computer setup needs to be close to the Base Station, within its coverage range.

Step 2. Ensure that the Modem is registered in the EMS. Refer to *Ripwave Configuration Guide* for Modem registration procedures.

Step 3. Using FTP software, transfer a 2 Mb file over-the-air from the test computer to the BTS. This is a system uplink transfer.

Step 4. Using FTP software, transfer a 10 Mb file over-the-air from the BTS to the test computer. This is a system downlink transfer.

Step 5. Ensure that both files transferred during testing.

Appendix X: Drive Study

Overview

The Drive Study is performed to confirm Base Station coverage. It is used to validate that the Base Station can be “seen” by a Modem throughout its predicted coverage area.

The RF coverage analysis displays areas of coverage from “good” to “bad” by the use of color-coding. An RF coverage analysis and its legend may be seen in Figure X1. The legend on the left displays the decibel strength for a given area, with red designating ‘good coverage’ and white designating ‘bad coverage’. The RF coverage analysis is used to map out the Drive Study route (Figure X2), along with geographic areas of concern. You should pay particular attention to null (white) areas and the cell edges.

Figure X1: RF Coverage Analysis Example

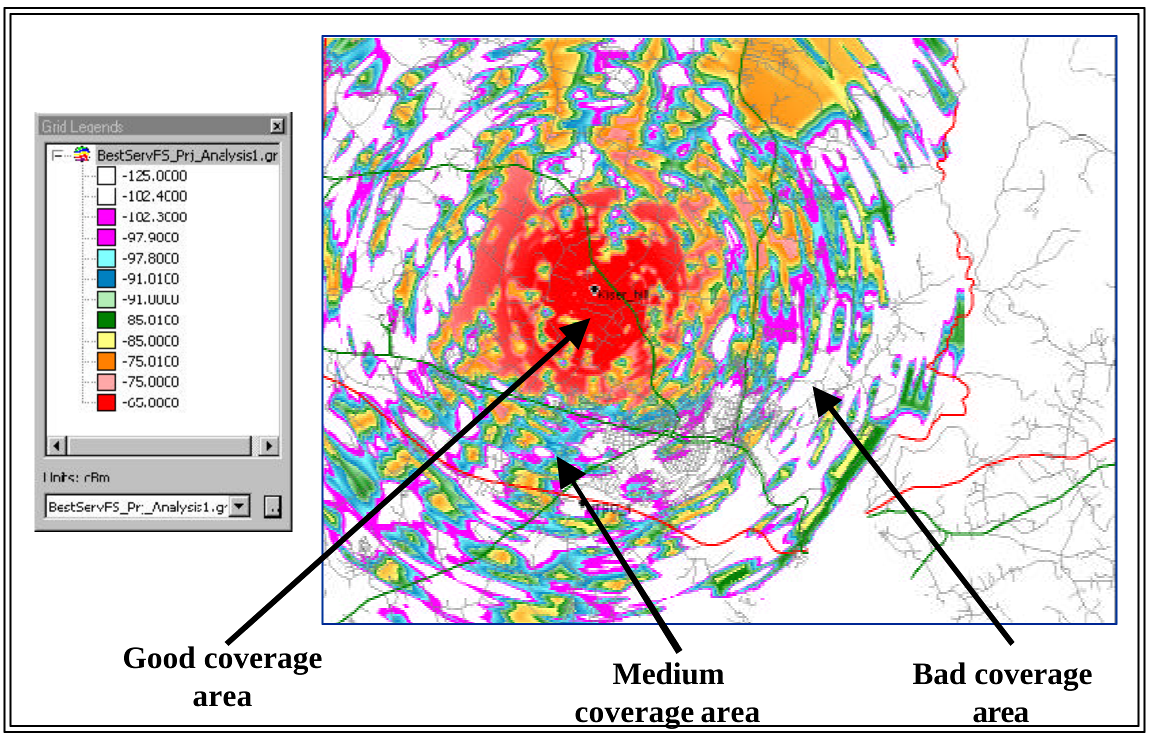
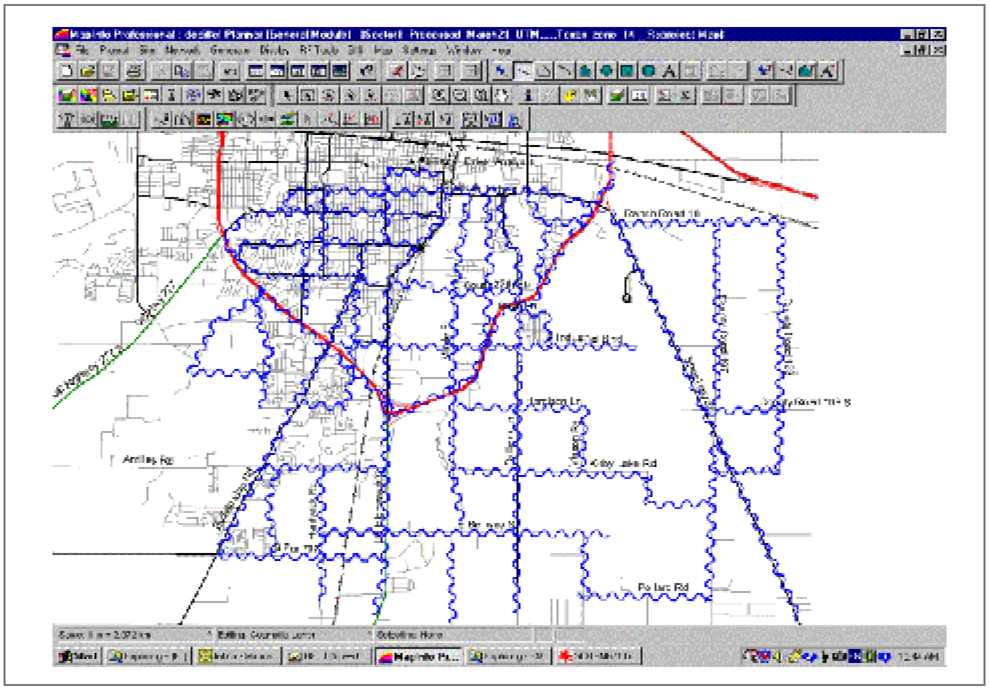


Figure X2: Drive Study Route Example



Equipment Required

?? Omni-directional antenna mounted outside vehicle
?? GPS with serial cable
?? Modem
?? Ethernet Cable
?? Modem power supply
?? DC to AC power converter
?? Laptop computer
?? Drive Study Form <shown later in this section>

Drive Test Procedure

While driving you will collect statistics to validate the coverage plot. The application takes a reading every second and records the data in comma delimited file format. It is important to ensure that the GPS is on and that you can see the GPS coordinates in the application.

Since the Ripwave system is not a mobile system, do not exceed 10 mph during the Drive Study. Going any faster will negate the adaptive beamforming, as the vehicle will not be in the exact position calculated by the Base Station.

Step 1. Ensure that the Base Station has successfully completed calibration and RF sanity measurements at the frequency and TX/RX signal levels that were determined during the site survey. Ensure that the Base Station is powered on and able to TX/RX data.

Step 2. Create a CPE Descriptor, and assign it to the Modems to be used for the Drive Study:
CPE Descriptor Parameters
Name: Drive Study
Index: Next available number
Priority: 1
UpLink Max Bandwidth: 64
UpLink Min Bandwidth: 32
DownLink Max Bandwidth: 96
DownLink Min Bandwidth: 64
Other parameters: Use defaults.

Step 3. Mount an omni-directional antenna on the roof of the vehicle. This will serve as the antenna for the Modem.

Step 4. Bring the RF cable from the omni-directional antenna into the vehicle through the window. Attach the antenna to the antenna input of the Modem. The rotating upright antenna on the Modem needs to be removed to perform this step. You will also need to disconnect the patch antennas inside (Figure X3).

Figure X3: Patch Antennas

<TO BE PROVIDED AT A LATER DATE>

Step 5. Connect the DC to AC power converter to the power port in the vehicle.

Step 6. If applicable, place the external antenna on the top of the vehicle.

Step 7. Connect the Modem power supply to the Modem and to the DC to AC power converter.

Step 8. Connect the Ethernet cable to the Ethernet port on the laptop computer and to the Ethernet port on the Modem.

Step 9. Connect the GPS to the serial port on the laptop computer.

Step 10. Optional: Connect the laptop power supply to the DC to AC power converter. (The laptop can be run off of its battery.)

Step 11. Power on the GPS and the laptop computer.

Step 12. On the laptop computer, start the Navini Networks Drive Study application.

Step 13. Verify that the GPS location (latitude and longitude) and the GPS time are seen in the application.

Step 14. Power on the Modem.

Step 15. Enter a memo into the log file comment field of the Constellation Debugger about the route of the Drive Study being performed. When finished, click the log comment button.

Step 16. Start driving along the Drive Study route determined during the RF coverage analysis. Do not exceed 10 - 15 mph.

Step 17. When testing is completed, prepare the file(s) to be sent back to Navini for post-processing and analysis.

Drive Study Form

Navini Networks Drive Test Check list		
Specify the following items before the drive test		
Drive test area name		
Date of Drive Test		
Drive Tester Name		
Standard Vehicle Name and Type		
CPE EID		
Frequency Band (ISM, MMDS)		
CPE test device RF cable loss (dB)		
CPE Test device Antenna gain (calibrated)		
Drive Route (Map attached)		
Drive test file name		
BTS Transmit Power		
Fill the site configuration		
BTS ID		
BTS antenna height		
BTS antenna Omni/Patch		
Mounted on the top or side		
Antenna Azimuth		
Antenna downtilt		
Drive Test Route Plan	**Yes / No**	**Typical Clutter Height**
High Density Urban Covered		
Commercial/Industrial		
Residential with Trees		
Residential with Few Trees		
Paved Areas		
Grass/Agriculture		
Open Area		
Forested Areas		
Water		
Airports		
Others		

Things to pay attention to:

1. Make sure that the GPS data on the constellation debugger is updating all the time during the drive tes

2. Make sure that the antenna only selects the omni port all the time.

3. Make sure that the CPE is locked to the correct BTS by checking the BTS ID and frequency.

4. Make sure that the RF connections are good all the time. Check this by observing the stability of the R

5. Please make proper log information in certain important locations.

Appendix Y: Location (FTP) Tests

Introduction

The Location, or FTP, Test is performed to check the Ripwave system operation through file transfers between the Base Station and the Modem. The test measures the data rate performance at various locations within the coverage area. Data throughput is measured by executing file transfers using the FTP protocol for both upstream and downstream links. A file server must be in place on the same subnet with the BTS to accurately perform the file transfer, and the CPE User computer must be loaded with an FTP Client. As the file transfer is running, a data file is captured by the Modem tool. Data rates are captured by the FTP program.

Data is recorded in a spreadsheet format. The spreadsheet lists the location, GPS, and other information. As data rates are captured, the results are entered manually. An average SNR and sync RSSI can be read from the debug tool, and recorded, for quick comparison to the acceptable criteria (see "Acceptable Criteria" section of this appendix). For NLOS indoor locations, tests are performed both outside the building and inside, so that the obstruction loss for the building can be determined. Unless the customer can provide indoor access, all results will be LOS or Near NLOS.

Planning the Locations

Before the actual testing is conducted, you will need to select the locations for the testing to occur. The sites should meet specific criteria and include a mixture of the following environments:

?? High Power (A), low clutter; close in, residential
?? High Power (A), high clutter; close in, commercial
?? Medium Power (B), low clutter; mid-range, residential
?? Medium Power (B), high clutter; mid-range, commercial
?? Low Power (C), low clutter; distant, residential
?? Lower Power (C), high clutter; distant, commercial

Where:

(A) High Power = Sync Value greater than –70 dBm
(B) Medium Power = Sync Value between –70 dBm and –85 dBm
(C) Low Power = Sync Value between –85 dBm, and –95 dBm

At least 5 test points for each type are attempted. This may be difficult, depending upon the actual deployment scenario. Results may yield a very large percentage in one of the categories. For selecting an even spread across a 120-degree sector for a panel antenna installation, divide the 120 degrees into 6 even slices of 20 degrees each. Then divide each slice into 2 Km segments. This spaces each location at an approximate even distance throughout the complete sector and yields 36 test sites.

To select an even spread across a 360-degree cell for an omni antenna installation, divide the 360-degree cell into 12 even slices of 30 degrees each. Next, divide each slice into segments based on distance (1 Km or 2 Km, depending upon propagation). This will approximately space each location an even distance from each other throughout the complete cell, yielding approximately 48 test sites (based on a 4 Km cell radius). To do this, split the cell into 4 quadrants. Using the RF coverage analysis, select up to 16 locations per quadrant (Figure H1). Pay particular attention to null areas and the cell edges. At these locations you will perform a file transfer to measure the data rates available. The FTP/Location Test Tool program and the BTS Beamforming Display tool will be used to record RF parameters during each test. Figures Y1 and Y2 provide examples of simple guidelines for selecting an even spread across a cell area.

Figure Y1: Example of a 3-sector Site

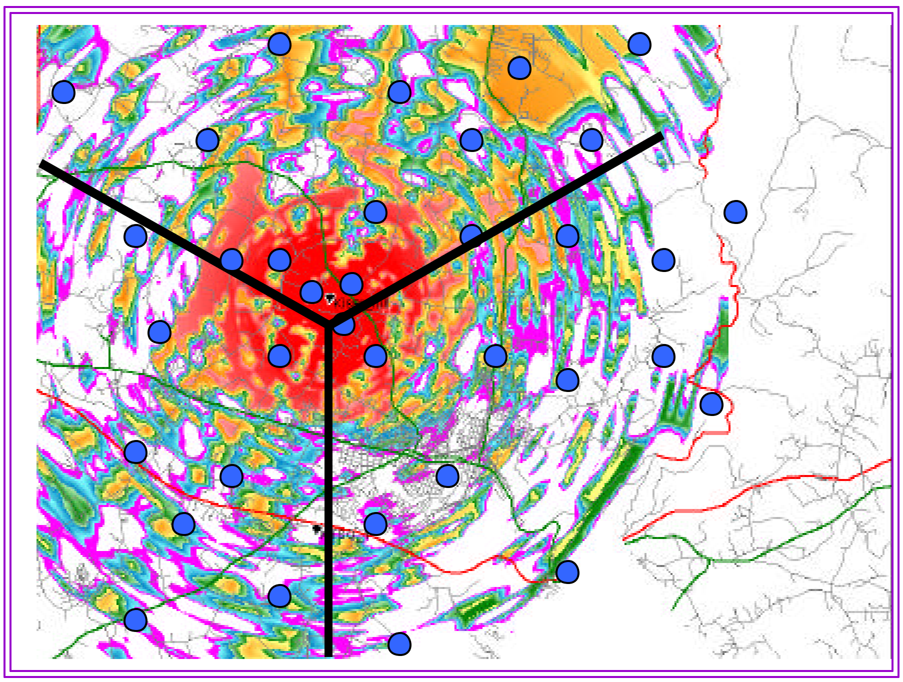
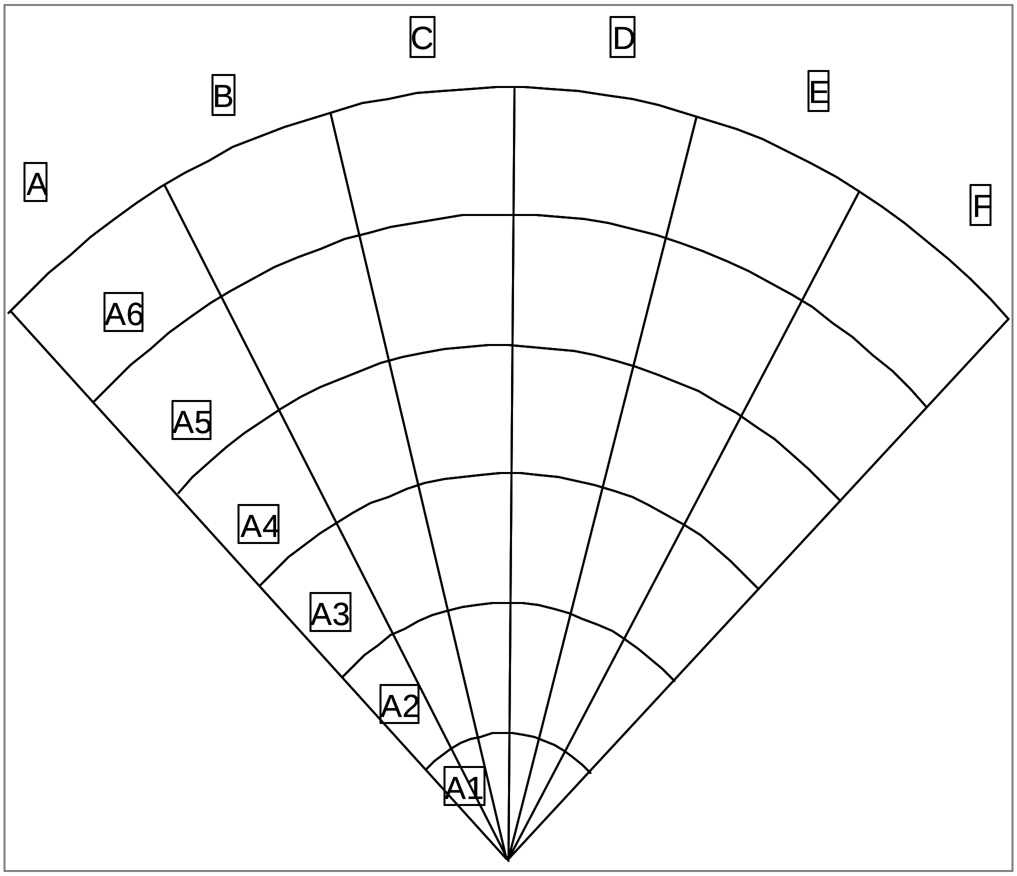


Figure Y2: Example of 120° of an Omni Site



Acceptable Criteria

In order to evaluate the test results, several criteria are reviewed. These criteria are valid for both LOS and NLOS measurements.

- Processed Sync Signal Strength: For a given test location, ± 2 dB variation during FTP
- Absolute Sync Signal Strength – Processed Sync Signal Strength: not greater than 2 dB variation during FTP
- SNR values consistent during the FTP for all carriers used:
  a. QPSK: at least 11 dB
  b. 8 PSK: at least 14 dB
  c. QAM16: at least 17 dB
- UL and DL Packet Error Rates (PER) not greater than 1%. This will vary according to interference levels, but may not render the system inoperable.
- Uplink Beamforming Gain: between 16 dB and 21 dB. Perform a comparison of UL and DL, Beamforming Gain differences should be not greater than 3 dB.

✍✍ Modem Transmit Power < 25 dBm; BTS Transmit Power < 0 dBm per code channel with power control

✍✍ Sync vs. Data Rate:

Absolute Sync (dBm)	UL Data Rate (Mbps)	DL Data Rate (Mbps)
(A) –55 to –70	0.6 to 1.0	1.5 to 2.0
(B) –70 to –85	0.5 to 1.0	1.2 to 2.0
(C) –85 to –95	0.10 to 0.5	0.3 to 1.0

Process

The recommended process for performing the Location (FTP) tests is described below.

First: Verify that a single Modem transmits and receives data at expected rates, as indicated previously.

Second: Verify that multiple Modems simultaneously transmit and receive data at acceptable rates, and the parameters listed above are being met. NOTE: The exact number of Modems is determined by field conditions. The minimum is two.

Third: Verify operation at the full range of the system*. Include LOS Location Tests at cell edges. The height of Modem and uplink and downlink data rates are recorded for each site. Data rates are to be compared with expected results, as seen in the last item (Sync vs. Data Rate) of Acceptance Criteria. For example:

*2.6 GHz : ~12 Km
*2.4 GHz: ~ 3 Km

Equipment Required

- Laptop computer
- GPS with serial cable
- FTP/Location Test Tool application
- BTS Beamforming diagnostic tool
- Modem
- Modem power supply
- DC to AC power converter
- Ethernet Cable

Location (FTP) Test Procedure

Two people are needed to perform this procedure. One will be in the car performing the location test, and the other will be at the Base Station checking the operation using the BTS Beamforming diagnostic tool.

1. Ensure that the Base Station has successfully completed calibration, RF sanity measurements, and the Drive Study at the frequency and TX/RX signal levels that were determined by the cell site survey. Also ensure that the Base Station is powered on and is able to transmit and receive data.
2. Connect the DC to AC power converter to the power port in the vehicle.
3. Connect the Modem power supply to the CPE and to the DC to AC power converter.
4. Connect the Ethernet cable to the Ethernet port on the laptop computer and to the Ethernet port on the Modem.
5. Connect the GPS to the serial port on the laptop computer.
6. Drive to one of the locations selected on the RF coverage analysis. Stop and turn off the vehicle.
7. Power on the GPS, the Modem, and the laptop computer. Place the Modem on the roof of the vehicle.
8. Start the Navini Networks FTP/Location Test Tool program.
9. Verify that the Base Station is transmitting and that the Modem establishes sync and can communicate with the Base Station. Ping a device address on the network side of the Base Station, and verify that a reply is received. While monitoring the Constellation Debugger, position the Modem to reduce the difference between absolute sync and processed sync levels to 2 or less.
10. Enter a memo into the comment field about which link of the test is being performed.
11. Verify that the GPS input is seen in the application.
12. Put the location number/site identifier into the comment field of the Navini Networks Constellation Debugger, and press the Enter key. This will identify the site location.
13. On the EMS connected to the Base Station, start the BTS Beamforming diagnostic tool.
14. From the laptop computer with the Modem connected to it, start a downlink FTP file transfer. Record the results on the site page or in the log.
15. On the EMS connected to the Base Station, using the BTS Beamforming diagnostic tool verify the strength and direction of the beam during the file transfer. Record the results on the site page or in the log.
16. Repeat the file transfer three times, stopping and starting the Debugger and Beamforming tool for each transfer
17. Repeat steps 14-15, this time performing an uplink FTP transfer.

18. When finished, remove the Modem from the roof and secure equipment for travel.
19. Drive to the next location selected on the RF coverage analysis. Stop, and turn off the vehicle.
20. Repeat steps 7 to 19 until all locations are tested. At this point send this data to the RF Engineers to analyze, or continue until each quadrant in the cell is complete. When you send the results depends upon the schedule or results from the file transfers.

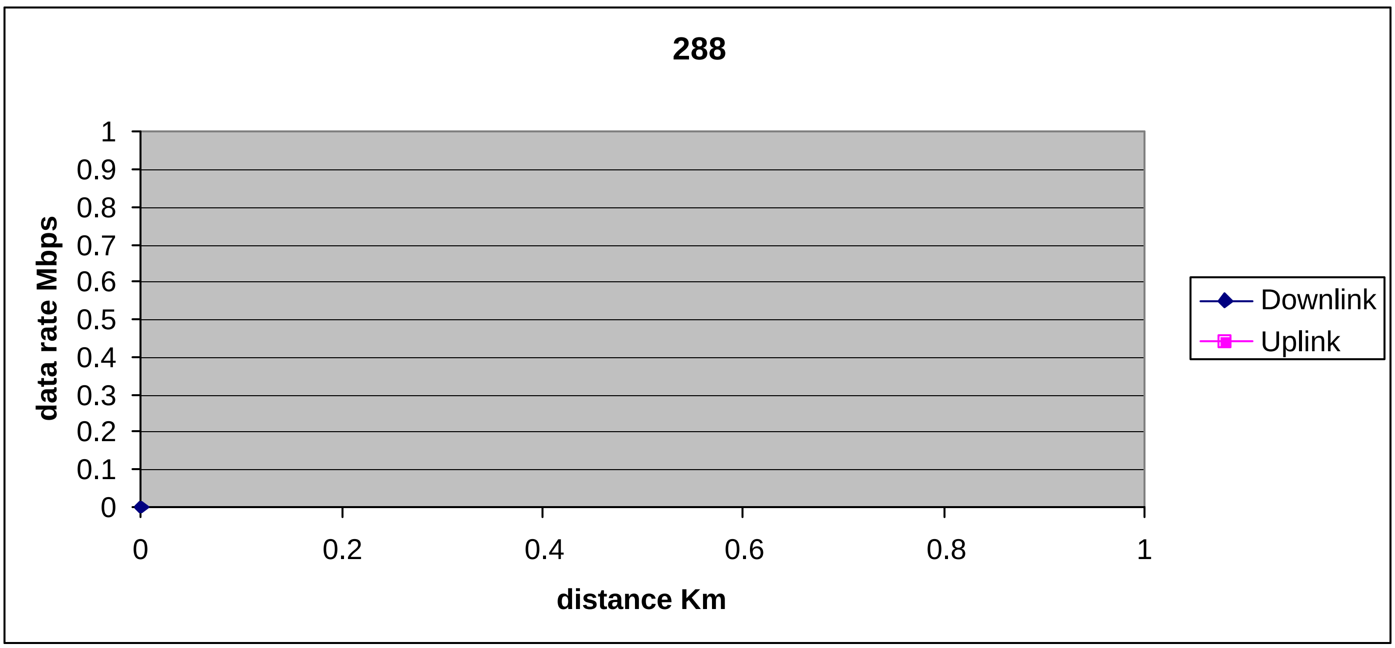
Location (FTP) Test Form

The form for recording the Location (FTP) test results is an Excel spreadsheet. Shown in Table Y1, the actual column headers go across the top of the form, but are broken into two sections here for readability.

Table Y1: Location (FTP) Test Form

BTS ID **Sector** **Software Release**

Site name	File name; CPE	File name; BTS	Distance (Km)	LOS	NLOS	CPE	CPE w/ ext	FTP Data Rate Downlink (Kbps)	FTP Data Rate Uplink (Kbps)	Absolute Sync (dB)	Remarks
			0					0			
								0			



Appendix Z: Site Installation Close-out Documentation

List of Documents

When performing a Ripwave Base Station installation, a number of tasks and forms are completed during the process. The following is a list and a brief description of each of the closing documents that are either required or optional for completing the Customer Acceptance of the system once it is commissioned. If the item is designated as REQUIRED it must be sent back to Navini Technical Services. If a required document cannot be obtained, you must retain approval in advance from the Manager, Navini Technical Services.

_____ 1. **Customer Contact List**. REQUIRED (Project Manager & Customer)
_____ 2. **Site Candidate Evaluation Form**. REQUIRED Drawings/pictures from site.
_____ 3. **Drive Instructions & Map to location**. REQUIRED
_____ 4. **Network Diagram.** Optional.
_____ 5. **Antenna Power and Cable Selection** REQUIRED
_____ 6. **Bill of Materials (BoM)**. REQUIRED This is a list of the physical materials and their associated quantities that are used to build the site. This list includes but is not limited to RF cable type and size, RF cable connectors, grounding, racks, power supplies, RF cable hangers, RFS mounts, and so forth.
_____ 7. **Excel Configuration Forms**. REQUIRED These forms are created in Excel spreadsheets and used to plan the system configuration parameters that must be in place as part of the installation and commissioning of the system. The forms are filled out according to how the EMS, BTS, Modems, and Global Parameters are to be configured for this customer site.
_____ 8. **RF Plot** REQUIRED
_____ 9. **Interference Data.** Optional.
_____ 10. **Interference Analysis Report.** REQUIRED if Interfere Data Collected (RF Planning)

Above information is required *before departing* to site

_____ 11. **RFS System Test Form**. REQUIRED This form contains the data that is captured during the RF sweeps on the Ripwave RFS antenna and RF cables.
_____ 12. **Base Station Installation Certification Form**. REQUIRED This form represents the close of a key milestone, the physical installation of the BTS and RFS. It includes RFS antenna height, azimuth, downtilt, grounding, weatherproofing, and other information about the site.
_____ 13. **Export BTS Data**. REQUIRED This is not a form that needs to be completed; rather, it is data that is captured from the EMS once the Base Station and Modems have been provisioned. This step should be completed prior to the Drive Study, and then again prior to the Location (FTP) tests.

_____ 14. **Export EMS Data.** REQUIRED
_____ 15. **Export CpeDescriptors** (all). Optional.
_____ 16. **Base Station Calibration Verification Form**. REQUIRED Calibration Verification is sometimes referred to as the Sanity Test. The form contains the operational results of the Base Station transmit and receive tests after the physical installation has been completed and the BTS has been turned on.
_____ 17. **Drive Study Form & Data**. REQUIRED Also referred to as Drive Test. The form contains results of driving the coverage area of the installed Base Station site and capturing sync data on a laptop. The information is provided to Navini Networks to help tune the RF coverage model. Need Data Constellation Display.
_____ 18. **RF Plot Tuned Model.** REQUIRED
_____ 19. **Location (FTP) Test Form**. REQUIRED This form contains data rate information that is captured during RF throughput testing. The data is captured at both the EMS and at the Modem location on a laptop. The number of points to capture is determined by Navini Networks and the customer. Need BTS Beamforming and Constellation Display.
_____ 20. **RMAs.** REQUIRED **if replaced cards from original shipment**
_____ 21. **Backup** of Customer Deployed EMS Server. REQUIRED

List of Pictures

The following is a list and description of the REQUIRED pictures that Navini Networks recommends capturing during the installation project. Additional pictures are acceptable.

_____ 1. RFS antenna mounted on the tower or rooftop

_____ 2. Weatherproofed connectors on the back of the RFS antenna

_____ 3. Cable Bend radius on the tower to the RFS

_____ 4. Jumper cable to RF main feeder connections weatherproofed

_____ 5. RF cable strap ground kit installation in all places as required for installation. RF main feeder runs.

_____ 6. Lower buss bar with lightning protectors (weatherproofed if outside the shelter)

_____ 7. Main feeder to BTS jumper connections

_____ 8. BTS jumper connections to BTS

_____ 9. RFS antenna grounding connections

_____ 10. BTS grounding connections at BTS and buss bar

_____ 11. Power connections to the BTS

_____ 12. BTS split chassis cabling

_____ 13. Ground connections to earth ground or building steel

_____ 14. Tower or mount connections to ground

Checklist

This checklist should be completed and sent to Navini Networks along with the forms and data.

	Closeout Documents	**Completed Date**	**File Name**
1.	Customer Contact List		
2.	Site Candidate Evaluation Form completed		
3.	Drive Instructions & Map		
4.	Network Diagram (optional)		
5.	Antenna Power & Cable Selection		
6.	Bill of Materials		
7.	Excel Configuration Forms		
8.	RF Plot		
9.	Interference Data (optional)		
10.	Interference Analysis Report		
11.	RFS System Test Form		
12.	Base Station Installation Certification Form		
13.	Exported BTS Data		
14.	Exported EMS Data		
15.	Exported CPE Descriptor Data (optional)		
16.	Base Station Calibration Verification Form		
17.	Drive Study Form & Data		
18.	RF Plot Tuned Model		
19.	Location (FTP) Test Form		
20.	RMAs		
21.	Backup from EMS		
	Closeout Pictures	**Completed Date**	**File Name**
1.	RFS mounted		
2.	Weatherproofed connectors on RFS		
3.	Cable Bend radius		
4.	Jumper cable to RF main feeder		
5.	Cable ground kits if needed		
6.	Shelter bus bar with lightning arrestors		
7.	Main feeder to BTS jumpers		
8.	BTS Jumpers to BTS		
9.	RFS grounded		
10.	BTS grounding at BTS/buss bar		

11.	Power connected to BTS		
12.	Split chassis cabling		
13.	Ground connections to earth ground		
14.	Tower or mount connections to ground		

Appendix AA: Customer Acceptance Form

Base Station Installation & Commissioning Services
Customer Acceptance Form

Customer Name:______________________________

Customer's Authorized Representative:______________________________

Job Title:______________________________

Office Address:______________________________

Email Address:______________________________

Office Phone:______________________________

Cell Phone or Pager:______________________________

Site Name:______________________________

Site Description:______________________________

Site Physical Address: ______________________________

____

INSTALLATION SECTION:
Date Installation Started:______________Completed:______________

Customer Acceptance By:______________Title:__________Date:
_____

COMMISSIONING SECTION:
Date Commissioning Started:______________Completed:______________

Customer Acceptance By:______________Title:__________Date:
____

TEST ACCEPTANCE SECTION:
Date Testing Started:______________Completed:______________

Customer Acceptance By:______________Title:__________Date:______________

This Customer Acceptance Form is subject to and governed by all of the terms and conditions set forth in the Master Supply Agreement between the parties. The Customer acknowledges, understands and agrees that when it's Authorized Representative signs-off the Test Acceptance Section of this Form, Customer has thoroughly inspected the installation and commissioning services, and Customer's sign-off means that completion of on-site verification that the Equipment installed by Seller performs in accordance with the Acceptance Criteria set forth in the Master Supply Agreement between the parties. The completed Navini Networks' Site Installation and Commissioning Documents referenced below and attached hereto are incorporated by reference into this Customer Acceptance Form for all purposes.

Navini Networks Site Installation and Commissioning Documents (double-click on the box to check or de-select a checkmark when completing the form):

- ☐ Site Candidate Evaluation Report
- ☐ Site Materials BoM
- ☐ Site Drawings
- ☐ Site Construction Specific Tests, as required – Grounding System Test Results, Concrete Break Test Results, Tower Guy Tensioning Test Results, etc.
- ☐ Site Specific Digital Photographs, as Required
- ☐ RFS System Tests
- ☐ Base Station Installation Certification
- ☐ Base Station Calibration Verification
- ☐ Location (FTP) Tests
- ☐ Drive Studies
- ☐ Coverage Predictions Maps
- ☐ Soft Copies of Test Results, if Requested