Coverage Testing for RPMA Networks

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Contents

Revision History

Revision	Release Date	Change Description
A	April 21, 2015	Initial release.

1 Overview

This document provides information required to develop a test plan to perform RF coverage testing for an On-Ramp Wireless RPMA network. The following information is covered:

- Prerequisites for conducting coverage testing
- Drive testing outdoor coverage.
- Coverage testing at specific endpoint locations and “in-building” coverage testing
- Data to save and send to On-Ramp Wireless
- Configuring and downloading information for the GPS Logger Device
- Sample RF Coverage Test Worksheet
- Downloading and exporting PHY Stats from EMS

2 Coverage Testing Prerequisites

This chapter provides prerequisites for conducting coverage testing. Prior to starting coverage, testing the following items is required.

2.1 Access Point

One or more Access Points (AP) must be online and connected over the backhaul to the On-Ramp Wireless back office platform consisting of the RPMA network Gateway and EMS servers. The Network Operation Center (NOC) can confirm AP status.

Prior to coverage testing the “AP Site Survey” utility should be run. This offline utility looks at each RF channel and records peak and average channel noise/interference. This information should be downloaded from the AP and reviewed by the RF engineer responsible for making channel and reuse code assignments.

If the AP has been installed for less than twenty four hours the “Reset Broadcast Margin” procedure should be performed through the AP’s web interface. This process occurs daily at 00 hours GMT.

If a temporary AP is being installed for testing, it is very important to record the following information:

- Latitude and longitude coordinates for the AP’s location
- Antenna tip height
- Antenna model number and gain in dBi
- Antenna cable type
- Antenna cable length
- Target transmit power in dBm

This information is necessary to compare the actual coverage measured against predicted coverage.

The NOC should be notified at least 48 hours prior to any planned coverage testing if their support may be required.

2.2 Configuring the RF Deployment Tool for the Network

One or more RF Deployment Tools (RFDTs) are required for coverage testing. Each RFDT must be configured for the specific RPMA network being tested.

The RFDT consists of an On-Ramp Wireless microNode and a host processor. It selects the signal from the strongest AP when it is first turned on and then joins the RPMA network.

The RFDT has four yellow LEDs. Each LED provides a signal Margin indication of great than or equal to 0 dB, 10 dB, 20 dB, or 30 dB. These margin measurements are updated approximately

every 4.5 seconds. Refer to the *RF Deployment Tool Guide (010-0119-00)* for detailed information regarding the operation of the RFDT.

Several RF measurements, referred to as ”PHY Stats,” are measured and collected every “frame” (approximately every 4.5 seconds) for the RF link between the RFDT and the AP. This information is used to compute the “Margin” reported by the LEDs on the RFDT. This information is also sent to the Element Management System (EMS) server and temporarily stored. This information is typically available for five days and can be downloaded by On-Ramp Wireless for “hosted” systems or by the customer when using an On-Ramp Wireless “Appliance.”

The most valuable information in the PHY Stats for coverage testing is the Downlink RSSI value, expressed in dBm. The Uplink RSSI value is generally not useful due to power control of the Node’s transmitter on the uplink.

2.3 On-Ramp Provided Network Coverage Map

Prior to starting any coverage testing it is important to have an up-to-date version of the predicted coverage map for the area to be tested. It is also important that the AP site-related information used to create the map, coincide with the actual AP installation. This information includes:

- AP location
- Antenna height
- Antenna type and mounting configuration
- Antenna cable type and length
- The regulatory domain which determines the maximum allowed transmit power

2.4 GPS Logger

For large scale outdoor coverage testing, a GPS logger is required. For smaller scale or indoor testing, the GPS logger is not required but is still useful and strongly recommended. The GPS logger is configured to log its location with a precise time stamp every two seconds. When the coverage testing has been completed for the day, the log file can be downloaded to a PC. See Appendix A for more details.

By combining the time-based PHY Stats available from the EMS with the GPS log file, the downlink RSSI measured at each coverage test location can be accurately plotted on a map.

3 Drive Testing Outdoor Coverage

NOTE: RPMA networks are designed to communicate with devices at stationary locations. The term "Drive Testing" refers to collecting coverage measurements from a large number of outdoor locations. The vehicle performing the coverage testing must be stopped at each of the test locations to maximize the accuracy of the testing.

Drive Testing an AP's outdoor coverage is typically performed to validate the predicted coverage in a challenging terrain or clutter environment or to fine tune the prediction model. This is accomplished by collecting a large number of downlink RSSI measurements at a variety of locations predicted to have coverage from the AP.

When possible this type of testing should be performed before endpoints are installed on the network. This allows APs with significant overlapping coverage to be turned off, simplifying testing without impacting the network.

Drive Testing requires careful planning of the test route and close coordination with On-Ramp Wireless NOC and Network Planning teams.

3.1 Planning the Drive Test Route

1. Review a predicted coverage map for the AP providing the coverage to be tested.
2. Select areas within coverage to be tested. Test areas should generally have >75% probability of coverage but can be moved if coverage is significantly better or worse than predicted.
   - ❒ Include an area within 100 feet of the AP's antenna to confirm the AP is transmitting at the proper power level. If you cannot get within 100 feet of the antenna, include a location that is line-of-sight to the AP antenna and as close as possible.
   - ❒ Include a mix of environments. If there are open areas, suburban streets, and urban environments, do not collect data in just one area or environment.
   - ❒ Exclude areas that will not have coverage due to large terrain features.
   - ❒ Try to exclude areas that are clearly line-of-sight with the AP.
3. Establish a drive test route by identifying the streets and roads where the testing can be safely and easily performed.
4. Test locations should be at least 100 meters (300 feet) apart from each other to obtain a diverse set of measurements.
5. You should be able to stop your vehicle safely for at least 15 seconds to allow the RFDT to accurately measure the signal strength.
6. Determine the time of day when testing will be performed to minimize traffic delays and allow the testing to be completed as safely as possible.
7. Estimate the time required to complete the coverage testing with one or more vehicles. Large and comprehensive drive tests can take multiple days.

3.2 Performing the Drive Test

Performing the drive test consists of the following activities:

1. Replace the “C” size alkaline batteries in the RFDT, if necessary, as a new set of batteries will power the device for approximately 20 hours.
2. Attach the RFDT to the roof of the vehicle to minimize any signal obstructions caused by the vehicle. Accurate test results cannot be obtained with the RFDT inside of the vehicle.
3. Secure the GPS Logger to the dashboard of the vehicle and power it with the 12 VDC power adapter.
4. Turn on both the GPS Logger and the RFDT. Observe the LEDs on the RFDT to make certain that it “Joins” the network. This will typically take about 5 minutes.
5. Carry out the drive test. If it is safe to do so, stop the vehicle for a minimum of 15 seconds at each test location. Test locations should be at least 100 meters (300 feet) apart from each other. Check the surrounding traffic before moving to the next location.
6. Continue testing until the test route is completed. Periodically verify that one of the RFDT’s Margin LEDs is illuminated. If not, stop the test and determine why it is not.

3.3 Drive Testing Considerations

The following information should be considered when performing a drive test:

- Protect the RFDT from rain with a plastic tub or bag if rain is expected, the RFDT is not waterproof.
- When first turned on, the RFDT will always choose the strongest AP’s signal on the network on which it is configured to operate.
- During normal operation the RFDT **will not** rescan and choose a stronger AP’s signal.

4 Coverage Testing at Specific Locations

Coverage testing at specific locations is typically performed to confirm coverage at specific endpoint locations or to validate coverage shown on a network coverage prediction map. The test procedure assumes an AP has been installed and is fully operational as described in section 2.1. One or more RFDT's (configured for the network to be tested) must also be available for testing.

NOTE: If the signal of the AP becomes too weak, the RFDT will not be able stay "Joined" to the AP and will start scanning, looking for an AP's signal. It can take the RFDT up to 5 minutes from the time it loses the signal from an AP to scan and "Re-join" if an AP signal is present.

4.1 Planning the Coverage Test Locations

Identify the locations to be tested and list them on an "RF Coverage Test Worksheet." A sample work sheet is provided in Appendix B.

4.2 Performing the Test

The following steps outline the procedure for performing coverage testing at specific locations:

1. Verify that the RFDT is operating properly and is able to join the network near an AP location or at a location that is known to have good RF coverage. Turn the RFDT "OFF" and travel to the first test location.
2. Locate the RFDT as close as possible to the location where the endpoint will be installed. If time permits, it is desirable to turn the RFDT "ON" at each test location and wait approximately five minutes for it to join the network. This will allow the RFDT to take advantage of its antenna diversity and it will select the best antenna for that location.
3. Fill out the relevant information in the "RF Coverage Test Worksheet" provided in Appendix B.
    a. After the RFDT is joined and has been in position for at least 30 seconds, write down the highest and lowest margin values indicated by the LEDs during the test into the worksheet.
    b. Your location should be saved with a GPS logger, but write down enough information so that the test could be repeated at the same exact location. This is especially important when testing indoor locations.
    c. Include a note in the "Reference Measurement" column, if needed. If it is a reference measurement, mark it as "Reference" or, if it should be compared to the previous reference measurement, mark it as "Compare."
    d. Mark any comments in the "Comments" column.
4. Repeat steps 2 and 3 at each test location.

4.3 Location Testing Considerations

The following information should be considered when performing a location test:

- During the coverage testing it is very important that the RFDT be located at least 10 feet away from any people observing the test. Unless a specific endpoint location is being tested, the RFDT should also be located in a clear area, away from any metallic or concrete structures that may attenuate the signal.
- If accurate locations and start and stop test times are recorded for each test location, this information can be correlated with the Downlink RSSI information in the PHY Stats which can be downloaded from the EMS.
- Prior to testing a location inside a building or a metal cabinet, always verify that the RFDT will join the network outside of the building or cabinet.
- Taking a measurement outside or at an ideal location and marking it as a reference measurement will help with analysis. All measurements following the reference will be compared to the reference measurement to help characterize the difference between those locations. This is most useful for doing outside/inside building testing and outside/inside cabinet testing.

5 Saving Collected Data

Data can be downloaded by On-Ramp Wireless employees if the test was performed on an On-Ramp hosted network. If not, the customer must provide the log details for their network or download the data themselves.

5.1 On-Ramp Wireless Hosted Network

For an On-Ramp Wireless hosted network, you can save the data collected during the field test as follows:

1. Download the data from the GPS Data Logger as described in Appendix A.
2. Provide On-Ramp Wireless with a completed Coverage Test Worksheet in Appendix B.
3. Send the files to your On-Ramp Wireless contact for post processing.

5.2 Customer Hosted Network

For a customer hosted network, you can save the data collected during the field test as follows:

1. Download the data from the GPS Data Logger as described in Appendix A.
2. Provide On-Ramp Wireless with a completed Coverage Test Worksheet in Appendix B, if required.
3. Download the Node and Access Point PHY stats data described in Appendix C.
4. Send the files to your On-Ramp Wireless contact for post processing.

Appendix A GPS Data Logger Setup and Download Procedure

This guide provides the information required to set up, use, and transfer data off of the Qstarz BT-Q1000XT Data Logger GPS Receiver. An example of this model is available at: http://www.amazon.com/Q-1000XT-BT-Q1000XT-Bluetooth-Vibration-waypoints/dp/B000SNEBC2 . In this appendix, this device is referred to as the GPS Data Logger.

A.1 Battery Charging

Prior to using the GPS Data Logger, charge it using the mini-USB cable (provided with the device) by connecting it to the USB port on a computer or USB charger. Charging time is typically three hours.

Battery Status LED	Battery Status	Actions
Red	Low Battery	Recharge
Green	Battery Charging	None
Off	Fully Charged	None

A.2 Operation

1. Set the switch on the GPS Data Logger to the “LOG” position.
2. Provide the device with a clear view of the sky (no obstructions).
3. The device is tracking when you hear two consecutive beeps and an orange LED blinks once every second.

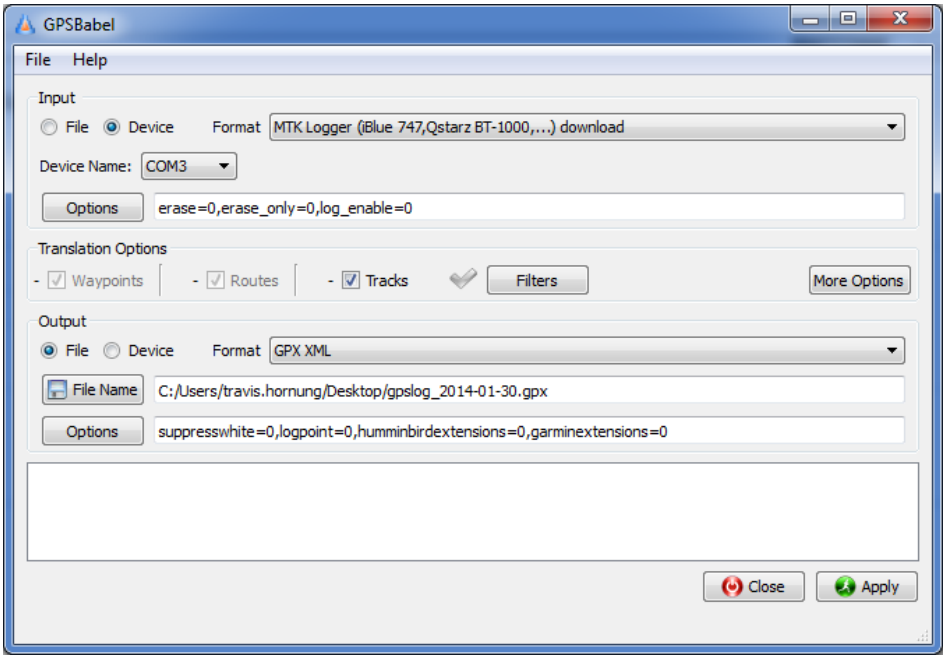
NOTE: The Logger should remain turned on with the switch in the “LOG” position for the duration of the testing period. It is capable of storing GPS location points every second for approximately 96 hours.

A.3 Data Transfer

1. Download and install the latest version of GPS Babel (a freeware application) from their website at http://www.gpsbabel.org/download.html.
2. Connect the GPS Data Logger to a USB port on your computer and set the switch on the Logger to the "NAV" position to turn it on without logging additional data.
3. Launch GPS Babel and enter the settings indicated in the following steps.
4. In the “Input” section of the dialog box:
   - ❒ Select the “Device” button
   - ❒ In the “Format” box select “MTK Logger (iBlue 747,Qstarz BT-1000, ...) download”

5. In the “Device Name” section of the dialog box:
   - Select the correct COM Port number. Note that it will not be COM1. If there are multiple choices, you may have to try each of them or go to the PC’s “Device Manger” and under “Ports” you should see an entry for “LOCOSYS Technology GPS Receiver (COMx).”
   - Select the “Options” button and uncheck all options.
6. In the “Translation Options” section of the dialog box:
   - Click on the “Tracks” checkbox.
   - Select the “Filters” button and uncheck all options.
   - Select the “More Options” button and uncheck all options.
7. In the “Output” section of the dialog box:
   - Select the “File” button.
   - From the “Format” dropdown list, select “GPX XML.”
   - Click on the “File Name” button to select the files location and enter a file name that includes the date. For example, “Drive Test 013114.” If a full path is not included, you will likely find your file in C:\Program Files (x86)\GPSBabel).
   - Click on the “Options” button and uncheck all options.
8. After making all of the selections indicated above, click on the "Apply" button. This should transfer and save the data within 2 – 30 seconds depending on the number of points that were collected.

Table 1. GPS Babel Settings



A.4 Removing Stored GPS Location Points

If the GPS Logger is reaching capacity, you can remove points from the device. Prior to downloading the data, select "Erase device data after download" from the “Input Options.” You can still select this option even if you have already downloaded the data.

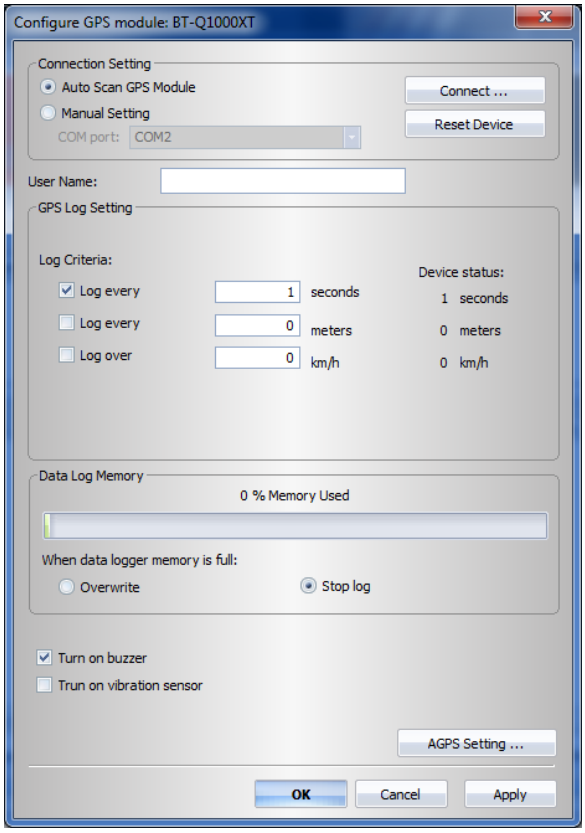
CAUTION: DO NOT SELECT "Only erase device data. Do not download anything." THIS WILL OVERWRITE ANY DATA YOU JUST DOWNLOADED.

A.5 Initial GPS Data Logger Setup

Setting up the GPS Data Logger is only required the first time the device is used. You must configure the device to record data every second, stop the log when the memory is full, and sound a buzzer.

1. To set up the GPS Data Logger, download Qstars Data Viewer from their website and install http://www.qstarz.com/download.php?t=4&m=BT-Q1000XT.
2. Confirm that both the Viewer and the Driver are selected when installing the software.
3. When the software installation is complete, you are prompted to restart your PC.
4. Make sure that the GPS device is plugged in and in the "NAV" position.
5. Launch Qstarz Data Viewer.
6. Select the “Configure GPS Module...”

Table 2. Configuration GPS Module Settings



7. In the “GPS Log Settings” area:
   - ❒ Check the “Log Criteria: Log every [ ] seconds” box
   - ❒ Enter 1 in the “seconds” box
8. In the “Data Log Memory” area, select the “Stop Log” option.
9. Check the “Turn on buzzer” box.
10. Click on the OK button to complete the setup process.

Appendix B On-Ramp Coverage Test Worksheet

On-Ramp Wireless RF Coverage Test Worksheet

Tester Name: _____ **Test Date:** _____

Node IDs: _____ **Test Start Time:** _____

APs: _____ **Test End Time:** _____

Test Area: _____ **Time Zone:** _____

Date	Start Time	Stop Time	High Margin	Low Margin	Location	Comments	Reference Measurement

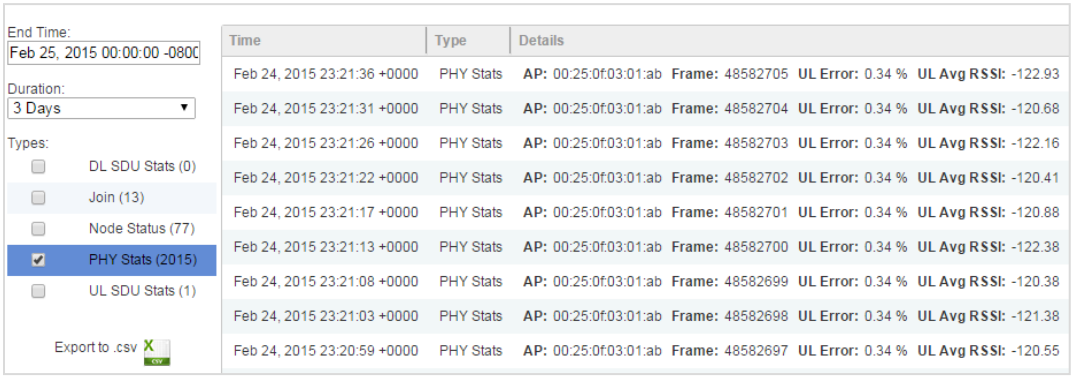
Appendix C Downloading PHY Stats from EMS

This appendix provides a guide to downloading and exporting PHY stats from EMS for the Node and the AP. **NOTE:** For best results, On-Ramp Wireless highly recommends that the test period be a full 24-hour period.

CAUTION: Older versions of EMS display time in UTC only.

C.1 Exporting Node PHY Stats

1. Using the EMS Devices tab, find each of your devices.
2. Open the Dashboard and go to "Device Events."
3. Enter the time period for which you'd like to download data.
4. Select the "PHY Stats" checkbox.
5. Click the "Export to .csv" button.
6. Do not rename the file. The node ID is part of the file name and is not saved inside of the file.



C.2 Exporting AP PHY Stats:

1. Using the EMS Access Points tab, find each of the APs used in the test.
2. Open the AP Dashboard and go to "AP Events."
3. Enter the time period for which you'd like to download data.
4. Select the "PHY Info" checkbox.
5. Click the "Export to .csv" button.
6. Do not rename the file. The AP ID is part of the file name and is not saved inside of the file.