District of Columbia's Public Safety In-Building Radio Systems

Operational Testing Requirements

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Version 3.1

GOVERNMENT OF THE DISTRICT OF COLUMBIA

Office of Unified Communications, Washington, DC

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1 Introduction

Increasingly, public safety entities, commercial wireless service providers, and wireless users require reliable communications inside buildings and inside tunnels. For public safety, reliable two-way communications are essential throughout the whole geographical area of a jurisdiction including on-street, in tunnels and within buildings.

Effective January 2015, the District of Columbia has adopted a legislation mandating radio coverage for newly constructed buildings as required by the International Fire Code (see http://dcregs.dc.gov/Gateway/RuleHome.aspx?RuleNumber=12-H510). This legislation therefore results into the deployment of numerous in-building radio systems repeating signals from the District public safety radio network (host network) into the depth of the city's buildings. While the Bi-Directional Amplifiers (BDA) and Distributed Antennas Systems (DAS) that make up in-building radio systems do effectively enhance coverage, they also have the potential to negatively affect both in-building and overall radio network coverage if not properly designed, installed, and maintained. Furthermore, without proper BDA/DAS records management, locating in-building systems that interfere with the network can be very challenging.

The code specifies that "emergency responder radio coverage systems and related equipment shall comply with all additional requirements, specifications and criteria established by the District of Columbia Office of Unified Communications to satisfy the operational needs of emergency responders and to prevent adverse impact on the District of Columbia's public safety communications". The set of documents that constitutes the additional requirements, specifications and criteria established by the District of Columbia Office of Unified Communications is available at https://ouc.dc.gov/page/oucs-public-safety-building-radio-systems-requirements. It includes:

- A presentation giving an overview of the process
- A document describing in detail the process for the District validation of public safety in-building repeater systems.
- A document describing the OUC technical requirements for those systems
- A document describing the OUC systems acceptance testing process
- A document describing the annual testing requirements
- Various forms supporting the process

The purpose of this set of documents is to serve as a reference guide to outline how in-building BDA and DAS Systems shall be designed and deployed to provide emergency responders radio coverage in buildings throughout the District of Columbia. Those documents are provided to relevant organizations to facilitate the process of implementing and operating BDAs and DAS that will provide the required radio services and not adversely affect the mission critical radio network that the Office of Unified Communications (OUC) of the District of Columbia.

This specific document herein contains a description of the annual testing procedures for the District of Columbia's public safety in-building radio systems.

2 In-Building Radio System Periodic Testing Overview

2.1 Background

The purpose of periodic in-building radio systems test is to verify that the in-building public safety radio system still meet the OUC requirements.

These tests are designed to be performed on a yearly basis and detect any issues related to coverage, interference or equipment malfunction. Any failed test shall likely require additional investigation and more testing than described here.

This test includes a coverage test plus some interference testing. It also includes a checking of the configuration and basic performance of the equipment. The outcome of this test is the authorization to continue transmission of OUC licensed frequencies.

2.2 Building Owner/Manager Responsibilities

The owner of the building is responsible for:

- Fund the testing and any troubleshooting and repairs costs if necessary
- Contract one of the OUC approved vendors to perform the testing
- Schedule with the approved vendor and the OUC the testing itself
- Provide the OUC a testing report including the required information delineated in section 4 and Appendix
- In case of deficiencies, investigating the cause of the issue(s)
- Fixing deficient equipment or configurations.

3 Annual Testing Process

3.1 Prerequisites

1. Retrieve the results of the latest acceptance testing (baseline testing) including:
   a) Maps showing:
      i) All Antenna locations
      ii) All remote units locations and identification of each remote unit coverage
      iii) 2 Fringe coverage locations (areas where the measured field strength were the lowest)
      iv) Critical coverage areas (stairs, elevators lobbies, equipment rooms)
   b) Latest acceptance testing charts showing:
      i) The selected donor site and associated path loss
      ii) The measurements made during the latest acceptance functional test
      iii) The baseline measurements made under DAS antennas
   c) The testing equipment shall include 2 radios with the OUC testing code-plug, a spectrum analyzer and a RSSI measurement tool,
2. Notify users IN ADVANCE that the service will be interrupted. For public safety sites, that notice needs to be sent out 10 days in advance and be approved by the OUC **before** proceeding.

3. Coordinate testing with OUC network system manager such he can read the host base station receiver levels.
4. Notify the NOC and the users that the system test will occur.
5. Check alarms
6. Bring the test equipment and documentation listed above (section **Error! Reference source not found.**~~1~~)
7. Additionally retrieve:
   a) The acceptance testing report including the OUC uplink link budget worksheet.

3.2 Monitoring system check:

1. Notify monitoring agencies of system test
2. Remotely login into the monitoring system (via wireless modem for instance)
3. Check that you can shut down the system
4. Check that local system shutdown functions.
5. Check that during the following tests you see the relevant alarms

3.3 Site inspection

1. Check Head end room for any alarms or loose connection
   a. Check the signage is still legible
   b. Cables labeling (needs to match the existing documentation)
   c. Check the alarm display and make sure there are no existing alarms
   d. Unplug the AC cable and make sure the BDA power switches to battery backup
   e. Check the alarm on the BDA/DAS are also visible (these may be at the fire annunciator panel)
   f. Check that you can remotely login into the monitoring system and that the alarms were sent.
2. Roof Top Measurement and inspection:
   a. Make sure physically the donor antenna is ok, there is no apparent rust or damage due to weather condition
   b. Check Grounding: make sure the connection to the ground is not corroded or disconnected. Make sure the grounding meets industry standard grounding guidelines (R56 or equivalent)
   c. Make sure all cables and antennas are still clearly labeled to facilitate potential future troubleshooting.

3.4 Contribution to host receiver noise floor evaluation

1) Check downlink signal
   a) Measure the downlink signal on the control channel
   b) Compare with previous test and note if significant difference
2) Noise Floor measurement
   a) Check with the system manager that the testing frequency is clear for testing
   b) Make sure that the BDA is turned off and not transmitting.

c) Make sure no radio is transmitting on the selected testing frequency.
d) Ask the system manager to read the noise floor at the receiver for all the frequencies
e) Have him check that all receivers noise levels are about the same.
f) We obtained the receivers' noise reference (~ -115 dBm).
g) Note the corresponding values: NoiseReference

3) Evaluate Propagation loss
   a) Setup a portable to transmit on channel locked talk-group at a known power level P.
   b) Connect the portable to the donor antenna jumper
   c) Ask the system manager to read the received signal strength at all potentially affected OUC sites
   d) Note the corresponding "RxLev" values.
   e) Subtract those values from the transmitted power P.
   f) We obtained the propagation loss to each potentially affected site: Path Loss = P – RxLev
   g) Check the highest signal is still on the selected donor site and note if the path loss is significantly different from the previous tests.
   h) Record the three highest signals coming to the 3 best sites
4) Uplink Noise Contribution Evaluation
   a) Connect the spectrum analyzer to the BDA output (the output that is transmitting the uplink towards the donor antenna).
   b) Ensure that no radio is transmitting on the testing frequency and make the measurement on the testing frequency.
   c) Note the corresponding value that is the Noise generated by the BDA: N_BDA.
   d) Calculate the contribution to noise received at each OUC site:
   e) Noise contribution = N_BDA – PathLoss
   f) Compare those values to the Noise References. They should be significantly lower (at least 15 dB).

3.5 Coverage and Remote Units Testing

This test has 3 parts:

3.5.1 Remote Units/Active zones

1) During this test, the technicians walks/drives when possible to all active component zones. An active component zone is the area covered by one remote unit. Copper DAS systems with one BDA count as one active zone.
   a) Test that each frequency goes through using the radio with the in-building testing code-plug
   b) Check that all RSSI received for all channels are approximately equal

3.5.1.1 At each DAS antenna location

a) Measure RSSI level and log on recording chart.
b) Test is performed from directly below antenna at operator hip Level.
c) Compare the measured value to the baseline value collected during the previous system acceptance.
d) Check that the RSSI at the host receiving site is below -45 dBm

e) Check that at the host receiver(s), the signal to noise ratio is greater than 18 dB
f) Note any deviations on the chart from the values collected in the baseline test, or values not meeting the thresholds described in b) and c) above.

3.5.2 Fringe coverage test

Those tests include:

- The locations where during the acceptance test or previous annual test the measured levels were the lowest

- The critical areas on the floors above the last floor where a DAS antenna was installed. For instance, if the building is 10 floors high and all the DAS antennas are on level 5 and below, test will be made on floors 6 to 10. Those tests do not need to be done on a grid basis, but critical areas such as elevator lobbies will be tested and reported.

a) Measure RSSI level and log on recording chart
b) At the host receiver(s), the signal to noise ratio is equal to 18 dB
c) Check the audio
a) Note any deviations

4 Deliverables

Acceptance Test Checklist & results (see example in Appendix A)

1. Information requested in the header tab
2. Checks and values included in the checklist tab. Comment as necessary.
3. Remote units/active zone checks
4. Coverage baseline values
5. Audio test results.