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

Technical Requirements

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Version 7.1

GOVERNMENT OF THE DISTRICT OF COLUMBIA
Office of Unified Communications, Washington, DC

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1 Introduction

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 public safety 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 are 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. The contents of these documents are made available 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 describes the technical requirements that BDA and DA need to meet to be approved by the OUC.

2 Radio System Technical Requirements

All Emergency Responder Radio Communication in-building radio systems shall be designed and installed in accordance to the current District of Columbia Fire Code. The District Fire Code is consistent with the International Fire Code. The in-building radio system must provide seamless public safety radio communications in all elevators, elevator lobbies, emergency and standby power rooms, and fire pump rooms, areas of refuge and inside enclosed exit stairways within all newly constructed buildings in the District of Columbia.

A list of deliverables and items that the OUC will use to evaluate the system is described in the 6.4 Design checklist document located here: OUC webpage https://ouc.dc.gov/page/oucs-public-safety-building-radio-systems-requirements. Those deliverables shall be emailed to das.ouc@dc.gov.

2.1 System Requirements

2.1.1 Frequencies

All in-building radio systems shall be designed to operate on the frequencies operated by the OUC. Those frequencies are listed in the 6.2 OUC public safety frequencies document located here: https://ouc.dc.gov/page/oucs-public-safety-building-radio-systems-requirements. . Both uplink and downlink frequencies shall be repeated.

The in-building radio system shall be capable of modification or expansion in the event frequency changes are required by the District of Columbia, the FCC, another federal agency, or in the case that additional frequencies are allocated to the District. In particular, the in-building radio system shall be expandable to operate on the Firstnet 700 MHz National Public Safety Broadband Network frequencies 758-768/ 788-798 MHz upon notification by the OUC.

2.1.2 Donor sites

A list of existing the OUC public safety radio network donor site locations is referenced in in the 6.3 Uplink link budget document that can be found here: https://ouc.dc.gov/page/oucs-public-safety-building-radio-systems-requirements. In that table, frequencies 1 to 26 are simultaneously transmitted on all 10 sites (simulcast system). The settings of the in-building radio system shall ensure the coverage performances are met for those 26 frequencies.

The last 3 frequencies (27, 28 and 29) are nationwide Mutual Aid channels. All mutual aid channels are transmitted from the 4D site, 6001 Georgia Avenue NW, **and only from that site**.

2.1.3 Equipment Requirements

The in-building radio system shall use a channelized BDA (one 12.5 kHz filter per frequency. The BDA shall be certified Class A by the FCC. The system must also be compatible and fully operational with both P25 Phase 1 and P25 phase 2 for all OUC channels. The BDA shall also provide a squelch capability for uplink.

Some of those BDAs meet the requirements only when the relevant features are configured appropriately, so the vendor will ensure that it is the case. More than one BDA maybe coupled to support ALL OUC frequencies.

2.2 Performance Requirements

2.2.1 Coverage

Link budgets shall assume the use of a 3W portable for buildings and for the areas a vehicle can access (tunnels, garage) shall support both portables and 35 W mobile devices. Talk-out link budgets shall assume the radio at hip level and talk-in at hip level. Talk-out link budget and Talk-in link budgets shall be balanced.

The minimum downlink coverage requirement is -95 dBm. Additionally, the building shall be considered to have acceptable emergency responder radio coverage when signal strength measurements in 95 percent of all areas on each floor of the building, and 99% of critical areas such as emergency and standby power rooms, elevator lobbies, exit stairs and exit passage ways and elevator machine rooms, achieve the Delivered Audio Quality (DAQ) score of 3.4 for voice quality for Talk-Out. For Talk-In, the required level is a minimum of -95 dBm or 18 dB above the noise floor, whichever is more stringent.

BDA systems should target a signal received at the host site receiver equal to the noise floor plus 18 dB when transmitted from the edge of the cell (lowest received signal in the targeted area).

A significant risk is presented by BDA sites transmitting signals received at OUC host sites at overly high levels. All BDA transmissions must be limited to be received at OUC sites below -45 dBm. Appropriate adjustments to the design to accommodate the adjusted gain values are the responsibility of the vendor.

The signal level received at the input of the BDA and transmitted by the user device (portable or mobile) shall be at least 5dB below the max operating power of the BDA and at least 10 dB lower than the max damaging threshold of the BDA in particular when transmitted in close proximity of a DAS antenna (“hot signal” or “Near Test”).

The same applies to Fiber DAS Head-end if used.

The sites spreadsheet in the 6.3 Uplink link budget spreadsheet indicates the ERP transmitted from the sites, and an estimate of the gain of the sites receiving antenna systems. The vendor shall use those values to make a first estimate of the required BDA gains.

Link budgets shall be detailed and show losses for each DAS antenna, donor antenna, coupler, splitter, cable, as well as the gains of active components, both in the uplink (talk-in) and the downlink (talk-out). The link budgets shall be detailed enough the OUC can check that the signals at the inputs of the BDA and if applicable the DAS fiber Head-end and remote units are within the equipment vendor(s) specifications both on the uplink and the downlink.

The system must be able to successfully operate to the voice quality standards in the presence of multiple simultaneous public safety portable radio transmissions (operating in "worst-case" locations). In particular, the system shall be balanced such that any negative "near-far" effect is avoided.

Downlink coverage maps shall show coverage for 1 frequency assuming 10 frequencies transmitting simultaneously in each band. Uplink shall assume simultaneous channels.

All provided maps shall have a scale (ruler).

2.2.2 Interference Management

The in-building radio repeater system must be able to withstand and maintain compliance with voice quality requirements with any other licensed system (other than the OUC system) with signal transmitting into the DAS antenna that would produce the highest signal level.

A significant risk of in-building radio repeater system is to raise the level of noise at donor site(s) receiver(s), damaging therefore the coverage of the public safety system beyond the targeted building. In order to minimize that risk, the system shall be designed such that the contribution of the BDA to the noise at the receiver of the host site(s) will be 15 dB below the noise floor of the receiver of the host site prior to the installation of the BDA. During acceptance test the OUC and the vendor will optimize the gain of the BDA to ensure that it is the case.

The uplink squelch threshold shall be set 5 dB above the noise measured at the uplink input of the BDA and coming from the DAS. The measurement of the noise shall be done as per the "Acceptance Procedure" document describes.

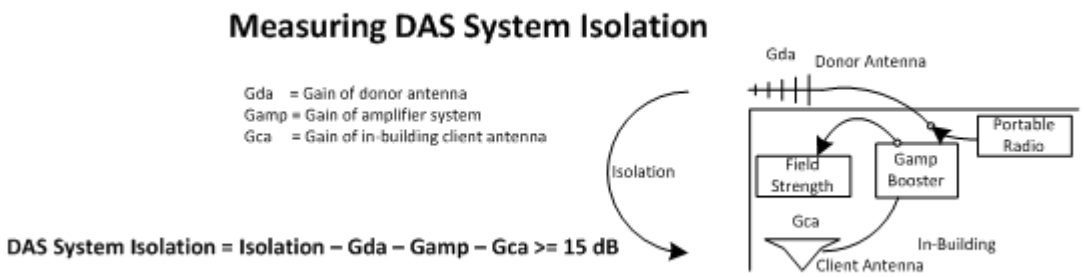
OUC utilizes 3 W (5 dBm max power) portables and 35 W mobiles. The vendor is responsible for ensuring proper BDA protection (manufacturer operating specifications plus 5 dB) in all regularly accessible areas for mobile (where it makes sense) and portable users.

2.2.3 Other Radio Systems

The building shall notify the OUC if any other radio system is located in the building. A non-exhaustive list of other radio systems includes internal radio communications systems used by the building engineering team, building security or others, as well as cellular Distributed Antennas Systems. If such systems are deployed, the designer shall provide intermodulation studies with the design. Depending on the results of those intermodulation studies, the OUC might require the vendor to perform PIM testing while installing the system.

2.2.4 Isolation

The DAS system isolation shall be greater than 15 dB (see drawing below)



2.3 Backup Power Requirements

The emergency responder radio coverage system shall be equipped with a secondary source of power. The secondary power supply shall supply power automatically when the primary power source is lost. The secondary source of power shall be capable of operating the emergency responder radio coverage system for the period of time specified in the Fire Code (IFC 2012).

The active components of the installed system or systems shall be capable of operating on an independent battery system for a period of at least 12 hours without external power input. The battery system shall automatically charge in the presence of external power input.

Where the building is provided with a standby or emergency generator, the emergency responder radio system shall be connected to the building emergency power circuit. In that case the battery backup system shall be capable of supporting operations for a period of at least 4 hours. Also, the vendor shall provide an affidavit attesting the emergency power solution is designed to support necessary operations and has been tested.

2.4 System Monitoring & Control

The DAS shall have a network management system (NMS) capable of alarm, monitor, configuration, and control of all active components. The NMS shall be accessible via local and remote access.

Local indication of the in-building radio system status to the Fire Alarm system shall include the BDA (and fiber DAS if applicable) system component malfunction summary alarms visible at the fire alarm annunciator panel.

In accordance with NFPA requirements, the alarms visible in the Fire Control Center shall include the following:

a. Normal AC Power
b. Loss of Normal AC Power
c. Battery Charger Failure

d. Low Battery capacity (to 70 percent depletion)
f. Active RF emitting device malfunction
g. System component malfunction
h. Donor antenna malfunction (VSWR)

When alarms are detected, the Building Managers shall be notified of the alarm condition as well and must be responsive within 4 hours. The Building Managers must immediately notify the OUC of any system outage. The OUC will then notify radio system users of the outage.

Alarms shall be capable of being automatically transmitted to the OUC Network Operations Center (NOC). The DAS NMS shall be capable of integration with third-party SNMP-based NMS products for alarm purposes and to provide alarming information. The system shall support SNMP versions 2c and 3 for capturing alarms or setting configurations respectively which is enabled when configured for SNMPv3.

The System shall allow a firefighter or an OUC technician to shut down the BDA from the fire control center via a simple key switch, button or equivalent. That switch shall turn the amplifiers off.

Additionally, the OUC requires remote access to the In-Building Radio System over the internet via an encrypted VPN Tunnel. The VPN technology shall be OpenVPN.

The remote access shall allow the OUC to remotely shut down the BDA (turn the amplifiers off).

An acceptable non-exhaustive list of OpenVPN solutions can include a small hardware VPN router behind a Cell/cable modem isolated from the building LAN's or a router/virtual machine/gateway computer/ on a building Lan/vlan. OUC does not endorse one solution over another.

Their Vendor shall provide credentials that shall give the OUC the ability to shut down and cease transmission of the in-building radio system at OUC discretion. The VPN shall be configured so OUC operates as a client. The BDA shall be behind the "VPN server". Vendor shall provide OUC with the following in a secure manner (**usernames and passwords not sent via the same communication media**)

- ".ovpn" file
- Necessary username and password credentials for VPN login
- BDA IP/PORT, user name and password.
- Directions to shut-down the BDA.
- Directions to turn the BDA back on.

The Building Manager is responsible for ensuring that the VPN server remains patched and secure. The cost of connectivity supporting those requirements will be supported by the Building Manager.

2.5 Installation Requirements

The installation of the public safety radio coverage system shall be in accordance with the building code and the Fire Code. Those codes are consistent with the IFC and NFPA 72.

2.5.1 Enclosure

All signal booster/BDA components shall be contained in a NEMA4-type waterproof cabinet and installed in a climate controlled room as specified in NFPA 72 Chapter 24. Those components will include the BDA, the DAS Head-end and the active components of the battery charging/maintenance system.

2.5.2 Signage

Proper signage for all DAS BDA NEMA4-type cabinets shall be of fire engine red color, and bear the following in bright yellow lettering:

District of Columbia Fire Department Radio

Contact OUC Radio Engineering

(202) 373-3700

All cables (Fiber/COAX) shall be clearly marked and identified for troubleshooting and upgrade purposes.

The minimum qualifications of the lead installation personnel shall include certificate(s) issued by the manufacturer(s) of the equipment being installed.

All equipment, material and devices will be installed in accordance with all manufacturers' requirements and standards in this document, whether expressly written or by reference.

2.5.3 Sharing Components with Commercial Systems

For buildings where in addition to the public safety in-building system, commercial or cellular systems will be installed:

- No active components shall be shared between the public safety system and the commercial or cellular systems
- The BDA enclosure hosting public safety system shall solely host public safety components
- Passive components may be shared

2.5.4 Fiber Optic Cable Installation (if Applicable)

Cable management will provide strain relief for each optical fiber strand and its connectors.

Connectors will be equipped with protective dust covers on each end. The dust covers will be left in place after testing is complete.

2.5.5 Coaxial Cable Installation

The coaxial cables will be Plenum rated and have a low PIM rating. Verticals cables shall be in conduits or riser with survivability in accordance with the building and fire codes.

All coaxial cables will be installed in accordance with the manufacturer's specifications.

All connectors will be shielded type and installed in accordance with manufacturer's specifications.

2.5.6 Equipment and Antennas

Installation will be in accordance with the final design document, Cable FAQs and all other requirements contained in this document.

2.5.7 Head-End Equipment

The equipment will be installed in a temperature controlled space.

The installer will ground all equipment in accordance with all manufacturer specifications.

All equipment will be connected in accordance with all manufacturer specifications and applicable standards.

2.5.8 Remote Equipment

All equipment will be connected in accordance with all manufacturer specifications and applicable standards.

2.5.9 Antennas

Antennas will be installed in accordance with manufacturer's specification in locations noted on the final approved plans.

Any antenna that requires painting will be painted with a non-metallic paint that is approved by the antenna manufacturer

2.5.10 Grounding and Bonding

Equipment grounding (at HE and RHUs) will be with #6 AWG/green- jacketed/grounding wires to the nearest ground bus bar.

All equipment will be grounded in accordance with manufacturer specifications to existing ground bus bars located in the telecom rooms or at the head-end.

Donor Antenna, Mount, and Coax shall be grounded and bonded on the roof, to suitable building ground. Surge arrestor shall be installed at building entrance and grounded & bonded to suitable building ground.

2.5.11 Labeling

All cables will be at every end in accordance with the approved labeling plan.

Installation contractor will tag and label all coax, CAT5e, Fiber or braided coaxial cables at both ends indicating the active device, antenna number and any other required information.

Installation contractor will label all antennae with the assigned antenna number provided in the approved construction drawings. Label will be applied to outer diameter edge of the base plate on an omni-directional antenna or on the side edge of a panel and be visible from the ground.

All cable ID labels will be machine-generated, non-metallic, fade-resistant and designed for communication cable application. P-Touch labeling device will be used to generate the labels unless otherwise stated in the approved plans.

All items labeled will be recorded and provided to the Customer or its agent in the form of a Microsoft Excel spreadsheet and documented in the required as-built plans.

3 Documentation

Design vendors and installation vendors shall provide all necessary design and installation documentation to the OUC.

3.1 Documentation required with design submittal

In order to facilitate an easy review of the designs, the vendor shall provide all the documentation included in the checklist spreadsheet described in the "DesignCheckList.xlsx" document available on the OUC webpage. Each item shall be provided in a separate document and in the format specified in the document 6.4 Design checklist that can be found here: https://ouc.dc.gov/page/oucs-public-safety-building-radio-systems-requirements.

That checklist is also provided as a separate document on the OUC web page.

No design review will be initiated until all the requested documentation listed in that checklist is provided.

3.2 Documentation required to schedule acceptance testing

In order to ensure an efficient acceptance test, prior to scheduling the test, the vendor shall provide all the documentation included in the checklist spreadsheet described in the "OUC Pre-testing CheckList.xlsx" document available on the OUC webpage. Each item shall be provided in a separate document and in the format specified in Appendix E.

3.3 Acceptance testing Documentation

OUC approved vendor shall provide the OUC:

- an acceptance testing report (see 6.5 Acceptance Testing Pre-requisites and 6.6 Acceptance testing checklist that can be found here: https://ouc.dc.gov/page/oucs-public-safety-building-radio-systems-requirements.
- An updated uplink link budget spreadsheet (see 6.3 Uplink Link Budget.