ITD Radio Division

General Guidelines for the Deployment of In-Building 800 MHz Radio Coverage Solutions for First Responders

Version 4.6, June 12, 2023

The following document should be presented to the Authority Having Jurisdiction (AHJ) to confirm that there are no discrepancies with any local ordinance or code. In case of discrepancies, the local ordinance or code will prevail unless the AHJ decides differently.

Specifically in Miami-Dade County, the AHJ is the Miami-Dade Fire Rescue Department. Please contact this agency at MDFRBDAS@miamidade.gov for details and requirements about planning and deployment of a BDA system for First Responders.

Important Notice

1) *Many municipalities in the region make use of the Miami-Dade County's 800 MHz radio system. Even if the municipality has its own Building and Zoning Department, it may still be using the 800 MHz County radio system. In order to confirm the appropriate 800/700 MHz Public Safety band to be used in a given location, the Designer/Installer of the new in-building solution should contact Miami-Dade County Radio Division, Attn: Ramiro Diaz, at Ramiro.Diaz@miamidade.gov and MDC ITD Radio Engineering to confirm the appropriate 800/700 MHz frequency band to amplify in the new building.*

2) *In order to establish if a new building requires a radio coverage solution, the Building Owner or General Contractor must request (as the very first step of the project) an initial inspection (Pre-Acceptance test) via MDFRBDAS@miamidade.gov. Once the AHJ has determined that an in-building solution is indeed needed in a facility, then the building owner or general contractor should hire a specialized company to plan and deploy the new BDA system. This specialized company must produce a preliminary assessment or baseline report of the indoor radio signal in the facility. The report should include floor plans showing the radio signal levels throughout the facility, as well as recommendations of the areas where radio signal improvement is required.*

   For the baseline readings, as per the MDFR In-Building Public Safety Radio Enhancement System Notice dated July 3rd, 2018, prior to any testing, the occupancy shall be structurally completed with all interior partitions, windows, and doors installed.

For 800 MHz, Miami-Dade County ITD Radio Division shall review the baseline report produced by the Building Owner or General Contractor. Please send the report to Ramiro.Diaz@miamidade.gov and MDC ITD Radio Engineering.

1. Objective

The purpose of this document is to provide general guidance for the deployment of an in-building solution to enable Public Safety Radio Communications in the Miami-Dade County 800 MHz frequency band.

The in-building solution shall allow the Public Safety agencies to properly communicate inside the facility in question.

This document does not constitute a Design or Construction Plan and does not substitute or supersede partially or entirely any guidelines, codes or specifications coming from the AHJ where the in-building solution is being deployed.

Contractor Qualifications

Once the AHJ has determined that a BDA system is needed in a facility, the Building Owner or General Contractor must hire a specialized company to design and deploy the BDA system solution. The specialized company shall be able to demonstrate previous experience in deployments of in-building radio coverage solutions for First Responders, specifically in 450 MHz and 800 MHz.

To ensure personnel safety, all construction tasks shall be conducted in accordance with OSHA safety and/or local safety regulations (whichever is more stringent). Contractors must comply with applicable Federal, State and Local Codes and requirements, including the Florida Building Code. All site development and equipment installation work shall comply with all applicable codes in use by the AHJ. Government and local codes shall take precedence over the requirements of this document provided they offer added safety.

The Contractor shall be knowledgeable and adhere to the industry standards and codes (including respective amendments and latest versions) listed below. It is strongly advisable to verify with the AHJ what specific version of the codes and standards listed below are being enforced in the jurisdiction in question.

- NFPA 1, National Fire Protection Association Fire Code
- NFPA 101, Life Safety Code
- NFPA 1221, Standard for the Installation, Maintenance and use of Emergency Services Communication Systems
- NFPA 70, National Fire Protection Code or “National Electrical Code”
- NFPA 72, National Fire Alarm and Signaling Code
- NFPA 780, “Standard for the Installation of Lightning Protection Systems”
- Harris, “Site Grounding and Lightning Protection Guidelines”
- Motorola R-56, “Standards and Guidelines for Communication Sites”
- TIA Bulletin TSB-88.1-C, Wireless Communications Systems Performance in Noise- Limited Situations, Part 1: Recommended Methods for Technology-Independent Performance Modeling
- Florida Building Code
- ANSI/TIA-222-G, Structural Standard for Antenna Supporting Structures and Antennas
- IEEE STD 142 “Green Book”, “Recommended Practice for Grounding of Industrial and Commercial Power Systems”
- ANSI/TIA/EIA-568-C, “Commercial Building Telecommunications Cabling Standard

- ANSI/TIA/EIA-569-B, "Commercial Building Standards for Telecommunications Pathways and Spaces"
- ANSI/TIA/EIA-606, "The Administration Standard for the Telecommunications Infrastructure of Commercial Building"
- ANSI/TIA/EIA-607, "Commercial Building Grounding and Bonding Requirements for Telecommunications"
- All other applicable Federal, State and Local Building Codes and Requirements

2. General Scope of Work

The Designer/Installer shall provide a "turn-key" solution for the design, installation and testing of an in-building RF coverage system capable of satisfying the following coverage requirements:

- For the downlink signal, a minimum signal strength of negative (-) 95 dBm throughout the entire facility with a DAQ of 3.4 or better, is required 100% of the time.
- For General Building Areas, the in-building RF solution shall provide the above-specified coverage in 90% of the floor space. General Building Areas are defined as living areas, basements, parking garages, administrative offices, and conference rooms.
- For Critical Areas, the in-building RF solution shall provide the above-specified coverage in 99% of the floor space. Critical Areas are defined as mechanical and utility rooms, public bathrooms, "Employee Only" rooms, stairwells, exit stairs, exit passageways, police holding areas, elevator lobbies, fire pump rooms, sprinkler valve locations, and other sections of the building considered by the AHJ. The Designer/Installer shall contact the AHJ to confirm Critical Areas in the construction(s) or existing building(s).
- Coverage inside elevators: As per regulations enforced in Miami-Dade County, for buildings that are six (6) stories or greater, the elevators are considered critical areas when determining the requirements for a system. For buildings that are less than six (6) stories, elevators are considered general areas when determining the requirements for a system. In buildings that are LESS than six (6) stories, if a building lacks adequate signal strength in other areas besides the elevator, and it is determined to need radio coverage (fails to meet the percentages as stated above), the elevator shafts are then considered critical areas and are required to have radio coverage.
- Testing the uplink signal of a DAS is a difficult task for the Contractor since it would imply conducting measurements directly in the infrastructure of the Public Safety radio system. Refer to Section 9, on page 6 of this document ("Test Procedures and Measurement Parameters") for suggestions on this topic.
- The system shall provide the required coverage in the frequency bands, channels, and bandwidths specified by the AHJ.
- In the specific case of Miami-Dade County, the downlink and uplink frequency bands for the 800 MHz Public Safety signal booster are 851-854 MHz and 806-809 MHz respectively.
- In Miami-Dade County, due to the significant amount of Public Safety channels in 800 MHz, a Class B BDA should be used for this application. For 450 MHz, a Class A BDA is needed. (For specifics about the 450 MHz channels, please contact MDFR at MDFRBDAS@miamidade.gov)
- To obtain information about a benchmarking/monitoring frequency in the Miami-Dade 800 MHz band, and for questions about 800 MHz in-building solutions, please contact Ramiro Diaz, ITD Miami-Dade County Radio Division at Ramiro.Diaz@miamidade.gov.

- Other radio systems operating within or near the facility shall not interfere with the in-building Public Safety radio coverage system.
- Signal boosters shall be FCC Part 90 Industrial devices and must operate in accordance with the FCC rules and regulations.
- As per FCC regulations, for a Class B signal booster, it is the responsibility of the Contractor to register the booster directly with the FCC before activating the unit. In addition, the Contractor must obtain the consent of the licensee(s) whose signals are intended to amplify. Please refer to the following links for more information:
  - https://apps.fcc.gov/cores/userLogin.do
  - https://www.fcc.gov/wireless/bureau-divisions/mobility-division/signal-boosters/part-90-signal-boosters
- Upon completion of the project, a copy of the FCC registration of the Class B signal booster, along with a Retransmission Agreement must be submitted to Miami-Dade County ITD-Radio Division, Attn: Ramiro Diaz at Ramiro.Diaz@miamidade.gov. Please find a sample of a Retransmission Agreement on page 10.
- The signal booster shall be installed in a NEMA 4 (or 4X) enclosure with locking mechanism.
- Maximum VSWR measured in any RF branch of the DAS shall be 1.5:1 or better (14 dB RL or better).

3. System Survivability

Before designing and deploying a DAS, it is strongly advisable to consult with the AHJ the requirements for system survivability that are enforced in the specific jurisdiction.

4. Electrical Power and Other Requirements

All active components of the BDA system must be powered via dedicated ("home-run") and generator protected electrical circuits.

It is strongly advisable to verify with the AHJ other specific requirements concerning this topic.

5. Alarm and Monitoring System

An automatic monitoring system and panel are required for the operation of the new First Responders BDA system. This alarm and monitoring system must monitor and produce an alarm in the event of antennae, signal booster, or power source malfunction. It is advisable to consult with the AHJ regarding specifics of the alarms to be monitored and location of the alarm panel.

The selected signal booster shall be capable of "AGC Overdrive" and "Oscillation Control" features. This includes, but is not limited to, an alarm and automatic shutdown for oscillating amplifiers. These features are intended to minimize interference due to oscillation of the signal booster(s).

Power supplies must, at a minimum, alarm at loss of normal AC power, failure of the battery charger, and low battery charge (defined as 70% of capacity). Please consult with the AHJ for specifics.

5.1 About Room Temperature and Humidity

Temperature and humidity conditions at the BDA locations and other areas with active components (remote units, etc.) must be kept at normal room temperature and humidity (Temperature no higher than 75° F; Humidity no greater than 60%). A room temperature and/or humidity above 85° F and/or 70% must trigger an alarm in the Central Fire Alarm Panel.

6. Propagation Delay

For the Miami-Dade County 800 MHz system, the maximum allowed radio signal propagation delay introduced by a Class B in-building coverage solution must not exceed 15 µs.
If a delay greater than 15 µs is expected by design, then further analysis should be conducted in conjunction with the AHJ to evaluate potential signal degradation in areas where the direct signal coming from a radio site coincides with the output (downlink) signal of the BDA system.

7. Exterior (Donor) Antenna System

The orientation of the exterior (donor) antenna shall be determined in coordination with the AHJ.

In Miami-Dade County, orientation of the 450 MHz donor antenna and specific operating channels are provided by MDFR. Specifics about 800 MHz are provided by ITD Radio Engineering.

If required by FAA regulations, obstruction lighting and/or marking shall be installed.

All exterior antennas are to be narrowband, directional, vertically polarized and designed for the specified frequency band. Yagi or corner reflector-type antennas are recommended.
Wideband/multiband donor antennas are not acceptable.

As per Motorola R56 and L3 Harris guidelines, the installation of the donor antenna, including the shield of the coaxial cable shall be suitably connected to the building's electrical ground system at the base of the antenna mast and at a coaxial lightning protector.

Appropriate vertical or horizontal separation between donor antennas must be considered. Please note this requirement is valid even if the donor antennas are intended for different frequency bands. For vertical deployment, a minimum 6-foot separation between antennas is advisable. For horizontal separation, 10-12 feet will suffice.

A weatherized coaxial lightning protector designed for the proper frequency band shall be installed in the coaxial feed of the donor antenna outside the facility.

For more details about the deployment of the donor antenna, please see attached drawing showing a typical rooftop antenna installation.

Typical requirements for coaxial lightning protectors are the following:

- Impedance: 50 Ω
- Frequency range: as needed for the specific frequency bands
- VSWR: 1.5:1 or better
- Insertion Loss: 0.1 dB or better
- Impulse Discharge Current: 10KA or better
- Turn-on voltage: 600 V
- Turn-on Time: 2.5 nS for 2kV/nS
- Energy Throughput Rating: 5 nJoule for 3 kA (8/20µS waveform)
- Continuous handling RF power: 100 W or better at the respective frequency bands

A rooftop antenna installation shall meet the wind loading requirements of the South Florida Building Code and ANSI/TIA-222-G or other code adopted by the AHJ.

8. In-Building Antennas

The in-building antenna system shall consist of a sufficient but not excessive number of indoor antennas. They shall be distributed in a wise manner within the building to meet the coverage criteria previously specified for Critical and General Building areas.

Extra-broadband antennas specified for segment of frequencies not required for a First Responder BDA system should be avoided.

Directional couplers, power dividers, and any other passive components installed in locations other than communication closets shall be mounted in a separate color code junction box conspicuously located to be easily accessible for maintenance while keeping them secure from unauthorized tampering. In addition, please check with the AHJ requirements for system survivability in reference to all components of the BDA system.

The bandwidth of the indoor antennas must cover just the intended frequency band(s). The use of extra-wideband indoor antennas should be avoided. The market normally supplies indoor antennas with bandwidths in the order of GHz(s). The main purpose of these wideband antennas is to optimize the design of DAS by covering all the most common First Responders and Cellular frequency bands. However, since in Miami-Dade County a DAS design to share First Responders and Cellular services is not allowed, it is recommended to use ~~i~~ndoor antennas covering just 450-470 MHz and 769-861 MHz (if available in the market).

9. Test Procedures and Measurement of Parameters

- **System Isolation**

  Once the donor and the indoor antennas of the BDA system are in place, and before enabling the active components of the system, the very first test the Contractor shall perform is to verify that the isolation between the donor and the indoor antennas is at least 20 dB greater than the maximum nominal gain of the BDA as specified by the manufacturer.

- **Downlink Signal Strength Measurements**

  The readings of the downlink signal levels shall be measured following the methodology required by the AHJ. Typically, a "Before & After" grid test report is required.

  For information about benchmarking downlink frequency for 800MHz in Miami-Dade County, please contact ITD-Radio Division, Ramiro Diaz at Ramiro.Diaz@miamidade.gov and MDC ITD Radio Engineering.

  The Miami-Dade County 800 MHz radio system is a trunking-simulcast system. It is very important for the vendor to find out what to measure before taking baseline or final readings of the RSSI in 800 MHz.

- **Uplink**

  Testing the uplink signal of a Public Safety BDA System is a difficult task for the Contractor since it would imply conducting measurements directly in the infrastructure of the Public Safety radio system.

Calculations of the link budget may be used to estimate the necessary BDA gain in the uplink to produce a signal strength of -95 dBm at the donor site. However, as a rule of thumb it is advisable to set the uplink gain of the BDA system at values ranging between 10-20 dB less than the downlink gain.

During the final RF inspection, the uplink and downlink gains will probably need to be modified. Therefore, the Installer or Project Manager must be ready to perform changes in the settings of the BDA.

10. Acceptance Test by the AHJ

The Contractor should coordinate the Acceptance Test of the BDA system, as part of the regular permitting process through the AHJ.

During the final Acceptance Test of the system, the AHJ will probably perform random voice tests and RSSI measurements throughout the entire facility. The AHJ representative might also take readings of some critical parameters of the system at the head-end and other segments of the system. The representative will also verify the approved plans to verify the deployment is congruent with the approved documentation.

The purpose of the tests is to verify if the in-building solution complies with the design criteria previously stated and with the different parameters established in the sections above.

The AHJ will decide what areas of the building will be tested for RSSI and voice quality.

During the Acceptance Test of the system, the AHJ may request a re-adjustment of the uplink and/or the downlink gain(s) of the DAS, as well as the removal of indoor antennas impacting the system isolation, or considered to be impacting the radio infrastructure.

The AHJ might also request a test of the UPS and the alarm and monitoring systems.

11. Designer/Contractor Responsibilities

- Once the AHJ has determined that a BDA system is indeed needed in a new or existing building, the vendor must survey the facility to establish RSSI baseline readings and capture data to properly design the BDA system. These baseline results will be part of the permit and planning documentation to submit to the AHJ.
- Design, commissioning and testing of an in-building RF coverage solution that guarantees a minimum RF signal level of -95 dBm and 3.4 DAQ throughout the facility and attached structures under the conditions described in this document or as per the conditions specified by the AHJ.
- Obtain the necessary permits.
- Record all appropriate signal levels before and after the system implementation as previously detailed. Prepare and submit to the AHJ “Before and After” floor plans showing downlink signal levels.
- Address any in-building coverage issue discovered during the Acceptance Test.
- Address any report of RF interference that might impact the operation of the new signal booster.

- Provide the Building Owner with project documentation including but not limited to “As-built” documentation, system documents, technical manuals, RF system isolation readings, return loss or VSWR readings of the RF lines, diagrams showing equipment placement and routing for antennas, coaxial cables, fiber optics interconnections and AC power.
- Work with the Building Owner or General Contractor to provide suitable temperature and humidity conditions for any active component of the system (see paragraph 4 5.1).

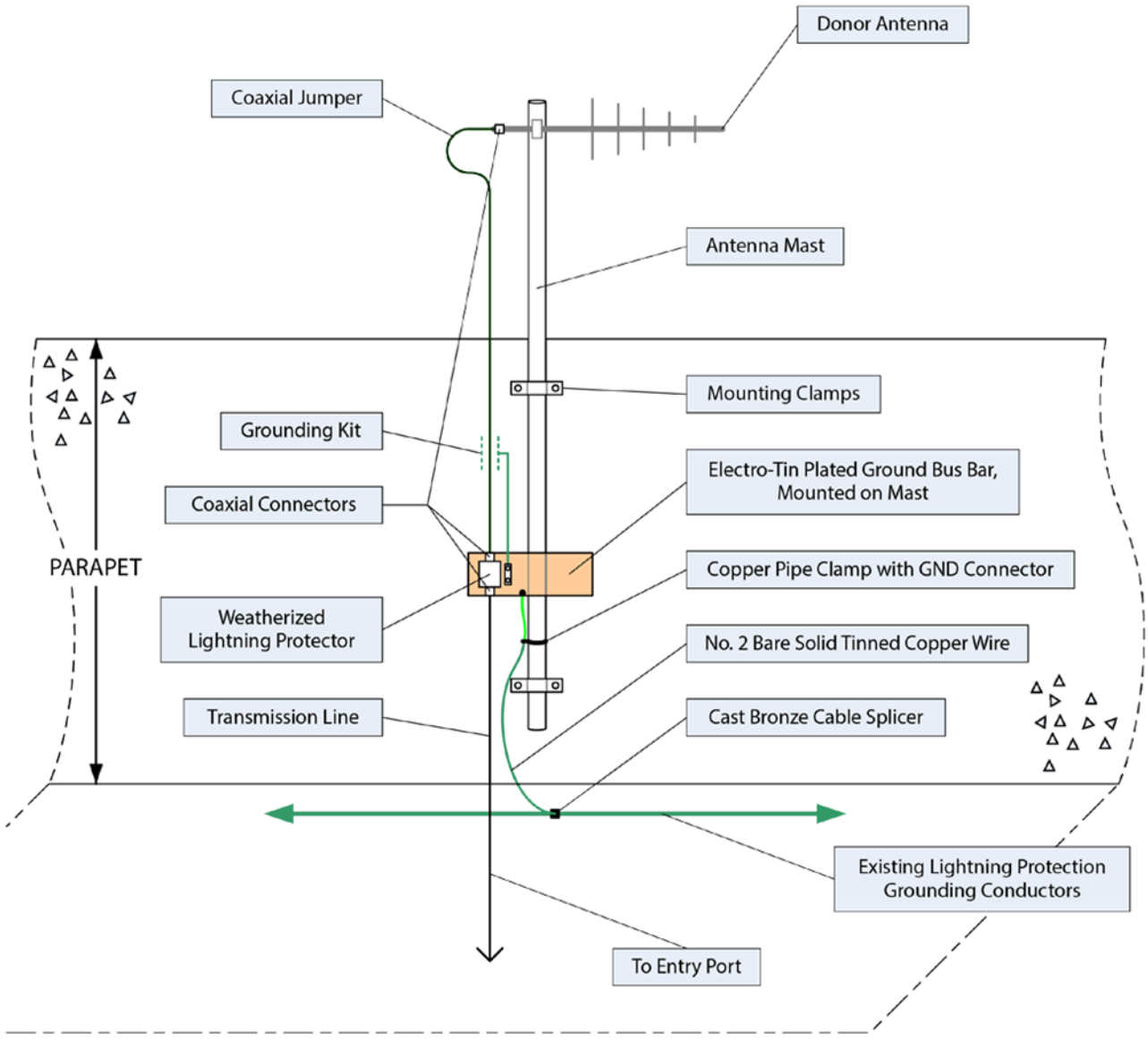
12. Building Owner Responsibilities

- Keep record of the project documentation, including but not limited to “As-built” documentation, system documents, technical manuals, return loss or VSWR readings of the RF lines, system isolation, diagrams showing equipment placement and routing for antennas, coaxial cables, fiber optics interconnections and AC power.
- Have in place a service contract with a qualified Vendor for technical maintenance, repair (including all components of the system), operation and troubleshooting in the event of radio interference involving the in-building radio coverage solution.
- The Building Owner shall provide the contact information of the System Maintenance Vendor to the AHJ, so this entity can work directly with the Vendor in case of troubleshooting due to an interference event.
- Provide the AHJ with continuous access to the facility for purposes of testing the Public Safety radio signal.
- Provide suitable temperature and humidity conditions for any active component of the system (see paragraph 5.1).

13. Important Note

The drawing on the following page refers to the deployment of a single antenna in a rooftop mast. If two antennas are co-located on the same mast (and even if the frequency bands of those antennas are different), then appropriate vertical separation between antennas must be considered to achieve some degree of isolation between them (see paragraph 7).

TYPICAL ANTENNA INSTALLATION



MIAMI-DADE COUNTY	ITD RADIO ENGINEERING GROUP			
	TITLE: TYPICAL 800 MHz ANTENNA INSTALLATION			
DESIGN BY: ALBERTO DELGADO	FILE NAME: TYP 800 ANT INST	REV. DATE:	REV: 2.0	
PROJECT:	SCALE:	DATE:	SHEET: 1 OF 1	

COMPANY LOGO

SAMPLE – RETRANSMISSION AGREEMENT

Date: _____

Retransmission Agreement For
WPGD547

Miami-Dade Public Safety/Emergency Response 806-809/851-854 MHz

To:

Miguel Luna
Frequency Coordinator
Miami-Dade County
Information Technology Dept.
5680 SW 87 Avenue
Miami, Florida 33101

From:

John Smith
DAS Outstanding Services Co.
100 NW 55 Avenue
Miami, Florida 33123
Phone: _____
E-mail: _____

Location of the Signal Booster:

4444 SW 90th Avenue
Miami, Florida 33145

Building Owner:

ABC Signature Co.
99 NE 3rd Court
Miami, Florida 33167
Contact person: _____
Phone: _____

Equipment Installed

Manufacturer: _____
Model: _____
FCC ID: _____

FCC Booster Registration

FRN: _____
Booster ID: _____

In compliance with FCC Part 90, we request permission to retransmit the frequencies for call-sign WPGD547. We understand that if radio interference is caused from the location described above, our company, "DAS Outstanding Services Co.," will fully comply with all FCC regulations and will address and resolve the interference issue.

Sincerely,

John Smith, Director
DAS Outstanding Services Co.

Approved by:
Miguel Luna
MDC, ITD Radio Division