# General Guidelines for the Deployment of Two-Way Radio Communication Enhancement System (BDAs)

**Miami-Dade County Fire Prevention Division**

**ATTENTION:** This document is a guideline for contractors to use and understand the process for radio inspections, plan reviews, and radio systems deployment. When starting any project in Miami-Dade County (MDC), it is recommended to email MDFRBDAS@miamidade.gov to find out if any changes have been made.

The installation and operation of two-way radio communication enhancement system shall comply with this document.

## ***Purpose***

The purpose of this document is to provide general guidance for the deployment of an in-building solution to enhance minimum radio signal strength for fire department communications once it has been established that a building requires a two-way radio communication enhancement system.

**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 Authority Having Jurisdiction (AHJ) where the in-building solution is being deployed.**

## ***References***

### 2023 Florida Fire Prevention Code – 633.202

(18)(a) The authority having jurisdiction shall determine the minimum radio signal strength for fire department communications in all new and existing buildings. Two-way radio communication enhancement systems or equivalent systems may be used to comply with the minimum radio signal strength requirements. However, two-way radio communication enhancement systems or equivalent systems are not required in apartment buildings 75 feet or less in height that are constructed using wood framing, provided that the building has less than 150 dwelling units and that all dwelling units discharge to the exterior or to a corridor that leads directly to an exit as defined by the Florida Building Code. Evidence of wood frame construction shall be shown by the owner providing building permit documentation which identifies the construction type as wood frame. Existing high-rise buildings as defined by the Florida Building Code are not required to comply with minimum radio strength for fire department communications and two-way radio communication enhancement systems as required by the Florida Fire Prevention Code until January 1, 2025. However, by January 1, 2024, an existing high-rise building that is not in compliance with the requirements for minimum radio strength for fire department communications must apply for an appropriate permit for the required installation with the local government agency having jurisdiction and must demonstrate that the building will become compliant by January 1, 2025. Existing high-rise apartment buildings are not required to comply until January 1, 2025. However, existing high-rise apartment buildings are required to apply for the appropriate permit for the required communications installation by January 1, 2024.

### Miami-Dade County Ordinance Sec. 14-69 - In-Building Public Safety Two-Way Radio Communication Enhancement Systems.

(A) Where required by the Florida Fire Prevention Code, the rules and regulations of the State Fire Marshal or any fire safety standard of a municipality more stringent than any of the foregoing, or when an in-building public safety two-way radio communication enhancement system is voluntarily installed, it will be installed, inspected, tested and maintained in accordance with the policies, procedures and specifications of the Chief Fire Official.

(B) *Monitoring*. In-building public safety two-way radio enhancement systems shall transmit all required supervisory and trouble signals to a central station or to the radio service provider contracted to provide the runner service. If signals are transmitted to a central

station, the central station must contact the radio service provider contracted to provide the runner service immediately.

(C) *Runner Service and Service Contracts.* All in-building public safety two-way radio communication enhancement systems shall be required to have in effect at all times a service contract with a licensed radio service provider.

(1) The service contract shall include a provision for runner service available to respond to the protected premises at any and all times within four (4) hours of notification of the runner service of any trouble or supervisory signal.

(2) The runner shall restore the system to complete working order.

(3) In the event that the runner cannot restore the system to complete working order, the building, structure, or occupancy may be subject to certain limitations, conditions, and restrictions, including fire watch requirements, as determined by the authority having jurisdiction until such time as the system is returned to complete working order.

(D) *Critical Areas.* Elevator shafts shall be considered a critical area as defined in the Florida Fire Prevention Code in all buildings with six stories or greater and shall be required to have a 99 percent total critical area radio coverage. Elevator shafts shall be considered a critical area as defined in the Florida Fire Prevention Code in buildings less than six stories that are lacking signal strength in areas other than the elevator shaft, and shall have an in-building public safety two-way radio communication enhancement system.

**The AHJ will determine the minimum radio signal strength required for in-building communications and will make the final determination if a building will need an in-building solution. Under no circumstances should plans be submitted to the Miami-Dade County Fire Department prior to a pre-test inspection as outlined in this document.*

****No amplification system capable of operating on frequencies or causing interference on frequencies assigned to Miami-Dade County Fire Department communication by the Federal Communications Commission (FCC) shall be installed without prior coordination and approval of the AHJ.***

All contractors and installers must be knowledgeable of the following industry standards and codes enforced by Miami-Dade County. It is strongly advised to verify with MDC what specific version of the codes and standards listed below are currently being enforced:

- Florida Fire Prevention Code (current edition)
- Applicable Standards
- Florida Chapter 69A-60.005

## ***Miami-Dade County Radio System***

The following are used for fire department communications in Miami-Dade County:

- 450 MHz analog radio system (UHF), analog conventional
- 800 MHz trunked digital radio system

Channels/talk groups required for the radio system are specific to the geographic location of a building. As noted, each building is unique and technical radio information required for any building must be designated by MDFR.

*NOTE: To request radio information and pre-tests regarding a specific building, an email must be sent to MDFRBDAS@miamidade.gov and itdMDCITDRadioEngineering@miamidadecounty.onmicrosoft.com. In order to establish if a building requires a radio coverage solution, the Building Owner or General Contractor must first have a pre-test inspection by MDFR.*

## ***Designer/Contractor Responsibilities***

- **Submit an email to mdfrbdas@miamidade.gov and itdMDCITDRadioEngineering@miamidadecounty.onmicrosoft.com to request a pre-test inspection prior to plans submittal.**
- **Obtain the two-way radio communication enhancement system permit only AFTER a pre-test inspection by MDFR determines it is required. Any plans submitted prior to the MDFR pre-test inspection will automatically be disapproved.**
    - **Design professionals may request, at their discretion, a pre-submittal meeting to ensure the design of a system is best suited for the project size, design, and location to allow for the least amount of interference possible.**
- **A study showing the initial received signal strength indicator (RSSI) readings prior to installation must be included with plans submittal.**
- **The BDA Checklist must be completed and included with plans submittal.**
- At no time shall any radio equipment be installed prior to an approved set of plans.
- Design, commissioning, and testing of an in-building radio frequency (RF) coverage solution that guarantees a minimum RF signal level of -95 dBm and 3.0 delivered audio quality (DAQ) throughout the entire facility and attached structures under the conditions described in this document or as per the conditions specified by the AHJ.
- For Class B signal boosters, the Contractor must register the signal booster(s) with the FCC as per “Part 90 Class B Signal Booster Registration & Discovery Report and Order” released on February 20th, 2013. For additional information about the registration procedure and labeling requirements for Class B signal boosters, please see Public Notice appearing on https://www.fcc.gov/document/part-90-class-b-signal-booster-registration-tool-now-available.
- 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: Retransmission Agreement to itdMDCITDRadioEngineering@miamidadecounty.onmicrosoft.com.

- The Acceptance Test request must be accompanied by the following documents:
    - The before and after readings on the floor plans showing the signal level improvements.
    - Commissioning documents for the bi-directional amplifier (BDA) systems installed. These must be filled out electronically and will be submitted for review.
    - Screenshots of the systems programming as detailed per the commissioning documents.
    - Retransmission Agreement.
    - FCC Registration document.
    - Any other information as required by Miami-Dade County.
- During the Acceptance Test:
    - Address any in-building coverage issue(s) discovered during the Acceptance Test.
    - Address any reported interference issue(s) related to the new BDA installation.

## ***Building Owner Responsibilities***

- **AT NO TIME SHALL THE OWNER ALLOW WORK TO COMMENCE WITHOUT AN APPROVED SET OF PLANS AND ISSUED PERMITS.**

- Keep record of the project documentation, including but not limited to: "As-built" documentation, system documents, technical manuals, Return Loss, or Voltage Standing Wave Ratio (VSWR) readings of the RF lines, diagrams showing equipment placement, routing for antennas, coaxial cables, fiber optics interconnections, and AC power.

- Have in place and maintain a service contract as per Section 14-69, Code of Miami-Dade County.

- 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. (Section 14-18, Code of Miami-Dade County)

- Provide the AHJ with access to the facility for testing purposes of the two-way radio communication enhancement system.

## ***System Requirements***

The Designer/Installer shall provide a "turn-key" solution for the design, installation, and testing of **the two-way radio communication enhancement system**. For the downlink signal, a signal strength of -95 dBm throughout the structure with a DAQ of 3.0 or better, is required.

For General Structure Areas, the in-building RF solution shall provide the above specified coverage in 90% of the floor area.

For Critical Areas, the in-building RF solution shall provide the above specified coverage in 99% of the floor area. Critical Areas are defined as:

- Elevator shafts in all buildings six stories or greater
- Elevator lobbies
- Generator rooms
- Fire pump rooms
- Mechanical rooms
- Roof access
- Stair enclosures
- Fire command centers
- Any other area deemed critical by the AHJ.

The need for ~~the~~ installation of a two-way radio communication enhancement system will be determined by the AHJ.

At no time is the uplink permitted to be connected or powered on without written approval by the AHJ.

The system shall provide the required coverage in the frequency bands or channels specified by the AHJ.

Signal boosters shall be FCC-type accepted and must operate in accordance with FCC rules.

All NEMA 4 (or 4X) enclosures shall be installed in a yellow color with locking mechanism. All power components must be inside of a NEMA 4 (or 4X) enclosure.

## ***Electrical Power Requirements***

All two-way radio communication enhancement systems shall be compatible with analog and digital communication systems simultaneously at the time of installation. All active components of the two-way radio communication enhancement system shall be powered via hard-wired, dedicated 20 Amp and a secondary power source.

**All circuits are to be properly labeled.**

**It will be permissible to use fire alarm lockouts on the circuit breaker that are labeled as "Fire Alarm Circuit"; the tin of the circuit breaker panel immediately adjacent to the circuit breaker shall be labeled "BDA."**

Surge protection device(s) shall be used to protect active components of the BDA from electrical transients.

## ***Alarm and Monitoring System***

A Two-Way Radio Communication Enhancement System as described in NFPA 72 and NFPA 1 is required with a dedicated annunciating panel in the Fire Command Room (when required) and shall be constantly monitored at the fire alarm panel. The dedicated panel will be similar to what is used for generators with a dedicated light and next to it a description of the alarm.

The system shall include automatic supervisory signals for malfunctions of the two-way radio communication~~s~~ enhancement system~~s~~ that ~~are~~ is annunciated by the fire alarm system in accordance with *NFPA 72* and shall comply with the following:

- Monitoring for integrity of the system shall comply with Chapter 10 of *NFPA 72*.

- System supervisory signals shall include the following:
    - Donor antenna malfunction.
    - Active RF-emitting device failure.
    - Low-battery capacity indication when 70 percent of the 12-hour operating capacity has been depleted.
    - Active system component failure.

- Power supply supervisory signals shall include the following for each RF-emitting device and active system components:
    - Loss of normal AC power.
    - Failure of battery charger.

- ~~(4)~~ The communications link between the fire alarm system and the two-way radio communication~~s~~ enhancement system shall be monitored for integrity.

All alarm signals shall be connected in parallel from the BDA to the annunciator and the main fire alarm panel. The dedicated panel shall not hinder any signal from reaching the main fire alarm control panel. All alarms shall be independent of each other; for example, a “Low Battery” alarm shall show only a “Low Battery” alarm at the panel and not in combination with another alarm, such as a “Battery Charger Failure” alarm. The only exemption to this requirement is alarms for “A~~/~~C Power Failure” showing with “Battery Charger Failure” in a 48 VDC system setup. The dedicated panel shall be labeled exactly as described below:

- Normal A~~/~~C Power
- Signal booster trouble
- Loss of normal AC power
- Failure of battery charger
- Low battery capacity
- Donor antenna failure

**Additionally, in a case that a two-way radio communication enhancement system based on RF/Fiber Optics converters is selected, the system shall also be capable of alarming in the event of malfunctions of the main and the expansion hubs.**

A separate alarm for oscillating amplifiers is also required. 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 AC power, failure of the battery charger, and low battery charge (defined as 70% minimum of capacity).

## ***Propagation Delay***

For the Class A channel filter:

- Channel filter bandwidth @ -3 dB points: Not greater that 15 KHz."
- Out-of-band suppression: minimum 60 dB rejection at filter center + 35 KHz (Stop band: 70 KHz bandwidth @ 60 dB rejection).
- Group delay: Better than 90 µs.

If a delay greater than 90 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 DAS output signal.

## ***Exterior Antenna System***

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

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

All exterior antennas are to be narrowband, high-gain, vertically polarized and designed for the specified frequency band. Yagi or corner reflector-type antennas are recommended. Per the AHJ, wideband/multi-band donor antennas are not approved for the UHF radio spectrum.

The installation of the donor antenna, including the shield of the coaxial cable, shall be suitably connected to the building electrical ground system at the base of the antenna mast and at a coaxial lightning protector as current standards.

If more than one donor antenna is to be installed in a single rooftop mast, then appropriate vertical and horizontal separation between antennas shall be considered.

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 (Attachment – Typical Antenna Installation).

To reduce the possibility of severe interference in a multi-building complex, consideration should be made of a system that interconnects and has one head end or donor antenna.

Typical requirements for coaxial lightning protectors are the following:

- ✓ Impedance: 50 Ω
- ✓ Frequency range: as needed to the respective bands.
- ✓ VSWR: 1.1:1 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 Florida Building Code and ANSI/TIA-222-G or other code adopted by the AHJ.

## ***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.

Splitters and any other active or passive components installed for backbone wiring (riser) shall be mounted in a 2-hour fire-rated yellow colored lid. This must be conspicuously located to be easily accessible for maintenance, while keeping them secure from unauthorized tampering.

## ***Measurement Parameters***

- System isolation

Once the DAS is deployed, and before turning up the active components of the DAS, the very first test the Contractor shall perform is to verify that the isolation between the donor and the indoor antenna systems is at least 20 dB greater than the maximum gain of the DAS.

NOTE: The system shall provide the required coverage in the frequency bands or channels specified by the AHJ.

- Testing the uplink signal of a BDA is not allowed for the contractor and/or installer since it would imply conducting measurements directly in the infrastructure of the emergency radio system. The uplink should never be connected or turned on prior to written permission from the AHJ.

- Calculations of the link budget may be used to estimate the necessary 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 up the uplink gain of the BDA at values ranging between 10-20 dB less than the downlink gain, depending on the distance to the donor site.

- Downlink signal levels shall be measured to ensure the system meets the requirements of the AHJ; that is, a minimum signal strength of -95 dBm throughout the entire facility with a DAQ of 3.0 or better.

To measure the signal strength in the downlink, it is advisable that two (2) traces be defined in the spectrum analyzer to be used for testing. The first trace would be holding maximum values of the RSSI of the RF frequency(ies) under test, and the second trace would be holding minimum

values of the RSSI. The “true” signal strength in a given test point would be the average of the two readings, taken during a minimum 30-second interval.

For the benchmarking of the facility, as well as a part of the “As-built” documentation of the project, the contractor/vendor shall reflect in appropriate floor plan(s) the maximum and minimum RSSI readings obtained at each test point to show “before” and “after” measurements.

## ***MDFR Inspection Procedures***

MDFR’s BDA inspection test request form is found online at www.miamidade.gov/fire. This form must be filled out to request an inspection of any new construction or existing building. Any additional documents should be attached and submitted together. Once the inspection request form and documentation is reviewed and approved, the next available inspection date will be offered. Any incorrect or invalid information will delay the process.

*PLEASE NOTE – A PDF of the plans/all floors must be attached and submitted with all pre-test inspection requests. Other additional information may be requested by AHJ prior to inspection. If a third party (through a qualified company) has conducted a preliminary assessment or grid test of the indoor radio signal study, a copy of the grid test report should also accompany the pre-test inspection request. The report should include floor plans showing the radio signal levels throughout the facility in a grid system layout. The grid size dimension for measurement purposes shall be based on the size of the structure. The study(ies) conducted should be identified and submitted, each on separate PDF floor plans (450mhz and 800mhz).*

### New Construction Projects:

**The General Contractor’s information must be included on the inspection request form. This information will be verified by MDFR. Any requests without this information will not be processed.**

The following phases of construction must be completed prior to requesting a pre-test inspection:

- Flooring, ceilings, walls, windows, and doors installed per approved set of plans.
- Elevators (fully operational).
- All interior walls.
- All interior doors/stairwell doors (need to be fully closed).
- Construction debris/items removed or minimized.

### Existing Construction Projects:

Building owner, property manager or association manager information must be on the form. This information will be verified by MDFR. Any requests without this information will not be processed.

Any building without a Miami-Dade County permit will be provided a process number by MDFR. After receipt of the request form, an email will be sent to the requestor with the process number

and information to complete this step. Once completed, the next available inspection date will be offered.

## ***On-Site – Day of PRE-TEST INSPECTION*** *(Phase I)*

The on-site contact should be present upon arrival by MDFR and/or MDC personnel. On-site personnel will need to have access to all areas/doors/elevators. These individuals must be familiar with the building's interior floor plan. Please supply site personnel with the appropriate and necessary "Key Access/Card(s)." The walkthrough by MDFR/MDC is to verify the radio signal strength inside the building. MDC will take readings throughout the building using a calibrated spectrum analyzer, as well as conduct random voice tests using handheld radios to verify DAQ levels. If at any time the inspection fails to meet code (coverage in 99% critical areas and/or 90% general areas) the inspection will terminate. The results of the inspection will be sent via email to the GC/property manager and/or approved representative within two (2) business days. A copy of the emailed results must be included when submitting the plans for the BDA system (category 0040). If the building fails, information will be provided for proper compliance to include MDFR Plans Submittal Guide sheet and MDFR Inspections Guide sheet.

## ***MDC Acceptance Test Inspection***

The Inspection Test request form is available online at www.miamidade.gov/fire. The BDA (0040) permit number must be provided on the form. The form must be submitted and accompanied by several items to be processed:

- The commissioning documents must be filled out accurately and submitted to mdfrbdas@miamidade.gov.
- Clear pictures/screenshots of the system programming that corresponds with the commissioning documents must be submitted.
- Grid test of downlink readings of each respective system must be submitted (separate grid maps of 450mhz and 800mhz). DO NOT TEST OR CONNECT UPLINK OF SYSTEM. UNDER NO CIRCUMSTANCES ARE UPLINK SIGNAL TRANSMISSIONS ALLOWED WITHOUT WRITTEN AUTHORIZATION FROM MDFR.

Once all the above is received, reviewed, and approved, the next available inspection date will be offered.

## ***On-Site – Day of Acceptance Test Inspection*** *(Phase II)*

The BDA installation contractor with the approved set of plans must be present for the entire test. The on-site contact should also be present and will need to have access to all areas/doors/elevators. These individuals must be familiar with the building's interior floor plan. Please supply site personnel with the appropriate and necessary "Key Access/Card(s)." The walkthrough by MDC is to verify the radio signal strength inside the building. MDC will take readings throughout the building using a calibrated spectrum analyzer, as well as conduct random voice tests using handheld radios to verify DAQ levels. If at any time the inspection fails to meet code (coverage in 99% critical areas and/or 90% general areas), the inspection will terminate. The results of the inspection will be sent via email to the GC/property manager and/or approved

representative within two (2) business days. If a failure occurs, re-inspection will need to be scheduled and fees applied.

Once all ERRCS testing is complete and accepted, the fire alarm testing can be scheduled. The fire alarm test must be completed for the BDA permit to be closed.