



General Guidelines for the Deployment of In-Building Radio Coverage Solutions

**City of Coral Gables Communications Division
City of Coral Gables Fire Prevention Bureau**

The following document should be presented to the 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.

Important notice

1) **At no time shall work commence without an issued permit. Section 11 & 13 of this guideline shall be followed for issuance of permit and inspection procedures. Failure to follow Section 11 & 13's process will delay your project's inspections and building TCO/CO inspection.**

2) Many Municipalities in the region make use of the City of Coral Gables' 800 MHz radio system. Even if the Municipality has its own Building and Zoning Department, it may still be using the 800 MHz City radio system. The Designer/Installer of the new BDA should find out what Police/ Fire Agency responds to the specific location where the new BDA will be deployed. With that information, the Designer/Installer should contact City of Coral Gables Radio Shop, Attn: Jason Swift (305) 460-5404 or jswift@coralgables.com to confirm the frequency band to be used.

3) In order to establish if a new building requires a radio coverage solution, the Building Owner or General Contractor must produce (through a qualified Company) a preliminary assessment or baseline report of the in-door radio signal. The report should include floor plans showing the radio signal levels throughout the facility, as well as recommendations of the areas (if any) where radio signal improvement is required. The preliminary/baseline should be conducted when the building has all doors and windows installed as this can affect the RF signal penetration.

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 City of Coral Gables 800 MHz frequency band once it has been established that the new building requires an in-building radio coverage solution.

The in-building solution shall allow the Public Safety Agencies to properly communicate inside a given facility.

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.

Designer/Installer Qualifications

System installation personnel shall be qualified or shall be supervised by persons who are qualified in the installation, inspection and testing of the systems. The system installer shall provide evidence of their qualifications and/or certifications when requested by the authority having jurisdiction.

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 have a DBPR license and 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 Authority Having Jurisdiction. Government and local codes shall take precedence over the requirements of this document provided they offer added safety.

The Contractor must be knowledgeable of the following industry standards and codes that have been adopted by the City of Coral Gables Fire Department:

- NFPA 1, National Fire Protection Association Fire Code as adopted in the current Florida Fire Prevention Code.
- NFPA 70, National Fire Protection Code or “National Electrical Code” as adopted by the current Florida Fire Prevention Code.
- NFPA 72, National Fire Alarm and Signaling Code as adopted by the current Florida Fire Prevention Code.
- NFPA 780, “Standard for the Installation of Lightning Protection Systems”
- 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
- Current adoption of the 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-B, “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 meeting the requirements detailed in Section 8 (“Test procedures and measurement parameters”).

For the downlink signal, signal strength of -95 dBm throughout the structure with a DAQ of 3.4 or better, is required.

For General Structure Areas, the in-building RF solution shall provide the above specified coverage in 95% of the floor area as suggested in Section 8 of this document. General Structure Areas are defined as basements, parking garages, administrative offices and conference rooms.

For Critical Areas, the in-building RF solution shall provide the above specified coverage in 100% of the floor area.

Critical Areas are defined as:

- Elevator shafts (Currently NOT able to install in shaft ways).
- Generator rooms
- Fire pump rooms
- Mechanical rooms
- Elevator rooms
- Electrical rooms
- Stair enclosures
- Underground garages
- Underground rooms
- Fire command centers
- Corridors
- There may be other areas deemed by other AHJ's such as Police Dept., Building Official, as important dependent on the project.

The Designer/Installer shall contact the AHJ to confirm critical areas in the new construction.

Testing the uplink signal of a BDA 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 8 ("Test procedures and measurement parameters") for suggestions on this topic.

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

In the specific case of City of Coral Gables, The “base” frequencies are transmitted on by the City’s radio system. “Mobile” frequencies are transmitted on by user radios, such as mobile and, portable radios.

Base	Mobile	Call sign
851.0125	806.0125	WPCJ297
851.5125	806.5125	WPCJ297
852.0125	807.0125	WPCJ297
852.5125	807.5125	WPCJ297
852.6125	807.5125	WPCJ297
854.4875	809.4875	WYQ412
851.2	806.2	WPCJ404
851.225	806.225	WPCJ404
851.675	806.675	WPCJ404
851.7	806.7	WPCJ404
853.05	808.05	WPCJ404
853.075	808.075	WPCJ404
853.55	808.55	WPCJ404
853.775	808.775	WPCJ404
853.8	808.8	WPCJ404

To obtain information about a benchmarking/monitoring frequency in the City of Coral Gables 800 MHz bands and other questions about in-building solutions for 800 MHz, please contact at City of Coral Gables Radio Shop, (305) 460-5404, or Jswift@coralgables.com.

Be advised that no transmissions are allowed on the benchmarking/monitoring frequency. The in-building Public Safety radio coverage system and other radio systems operating within (or in the vicinity of) the facility shall not interfere with each other.

Signal boosters shall be FCC compliant.

For Class B signal boosters, it is the responsibility of the Contractor to 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. Please visit <http://wireless.fcc.gov/signal-boosters/part-90-boosters/index.html> for additional information about the registration procedure and labeling requirements for Class B signal boosters.

All NEMA 4 (or 4X) enclosure shall be installed in a fire engine-red color with locking mechanism. All power components must be inside of a NEMA 4 (or 4X) enclosure. Any penetration into the enclosure shall be done from underneath the enclosure **no exceptions.** *All enclosures must be listed and rated for its application and its location.*

3. Electrical power requirements.

All signal boosters shall be compatible with analog and digital communication simultaneously at the time of installation. All active components of the BDA shall be powered via dedicated (“home run”) and generator protected electrical circuits. In addition, twelve-hour battery backup for the in-building system operating at 100% capacity is required. If the BDA is not connected by a generator electrical circuit, the BDA must contain a 24hour operational time. **The location of the dedicated branch circuit disconnecting means shall be permanently identified at the control unit. For the communication system the circuit disconnecting means shall be identified in red and permanently labeled “BDA”.** It will be permissible to use fire alarm lockouts on the circuit breaker that are labeled as “Fire Alarm Circuit” but on the tin of the circuit breaker panel immediately adjacent to the circuit breaker it shall be labeled “BDA” in red.

NEMA twist-lock electrical plug and receptacle set shall be utilized to connect the active components of the BDA to the AC power.

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

4. Alarm and Monitoring System.

A 'Two-Way Radio Communications Enhancement System' as described in NFPA 72 & NFPA 1" is required with a dedicated annunciating panel in the Fire Command Room and shall be constantly monitored at the fire alarm panel. All alarm signals shall be connected in parallel from the BDA to the annunciator and the main fire alarm panel. The system shall monitor and produce an alarm in the event of a system malfunction or signal booster failure.

Additionally, in case that an in-building solution 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).

5. Propagation Delay

The maximum radio signal propagation delay introduced by the in-building coverage solution shall not exceed 12 μ s. If a delay greater than 12 μ s 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 BDA output signal.

6. Exterior Antenna System

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

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

The donor antenna shall be a low-gain, vertically polarized and specified for the operating frequencies. Yagi antennas are recommended for the donor.

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

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

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
 - Maximum VSWR measured in any RF branch of the DAS shall not exceed 1.5 (15 dB Return Loss).
- 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 (8/20 μ S waveform)
- Continuous handling RF power: 100 W or better at the respective frequency bands

A rooftop donor antenna installation shall meet the wind loading requirements of the Florida Building Code that is in affect ANSI/TIA-222-G.

7. In-Building Antennas

The in-building antenna system shall consist of a sufficient number of antennas distributed within the building and attached structures to meet the coverage criteria previously specified.

Splitters and any other active/passive components installed shall be mounted in a separate solid color coded **yellow** EMT/junction box, conspicuously located so it is easily accessible for maintenance while maintaining them secure from unauthorized tampering. The exception is in hospitals where the word "BDA" can be stenciled in yellow every 5ft on the visible side of the EMT and Junction boxes. J-Boxes and antennas should be marked to correspond with the plans.

8. Test procedures and measurement parameters

Before turning on the BDA you must get an approval from Jason Swift at City of Coral Gables Radio shop, (305) 460-5404, or jswift@coralgables.com.

- System isolation

Before conducting any further tests, the Contractor/Designer shall verify that the isolation between the donor and the indoor antenna systems is at least 15 dB greater than the gain of the BDA.

- Downlink Signal Strength Measurements

Downlink signal levels shall be measured to ensure the system meets the requirements mentioned in Section 2; that is, a minimum signal strength of negative (-) 95 dBm throughout the entire facility with a DAQ of 3.4 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 Radio Signal Strength 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.

- Uplink

Testing the uplink signal of a BDA 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 gain in the uplink to produce a signal strength of -95 dBm at the donor site. 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.

During the acceptance test of the system, the AHJ might request a re-adjustment of the uplink and/or the downlink gain(s) of the BDA.

9. Coax / Fiber

Coral Gables requires all coax and fiber shall be installed in EMT metal conduit and must meet 2-hour pathway survivability. The distribution branches can be in a 1 hour rated EMT (steel compression fittings, steel flex raceway to the antenna). All BDA cabling shall be independently run from any other service, **no exceptions.**

Installation criteria of coax cabling in stairwells shall be installed by the following guidelines:

A) Coax cabling may now be installed as vertical risers, penetrating through each stairwell landing, with no restrictions to the number of landings penetrated, as long as the coax is protected inside EMT conduit **and is done to serve coverage needs of the stairwell only!** **There is to be only one (1) penetration inside the stairwell.**

B) The penetration ports are sealed on both sides by fire retardant caulking sealant as per City of Coral Gables Fire Code.

C) EMT junction boxes may be utilized to split off signal to antennas mounted within each floor of the stairwell. Any junction box shall have the cover plate painted yellow.

D) All splits from junction boxes used to feed antennas shall be protected inside EMT conduit to meet the required 1 hour pathway survivability requirement to ensure that there are NO exposed coax cabling from the junction box to the antenna.

E) Location of penetration into stairwells shall be at the discretion of the designer/engineer with the sole intent of providing signal to antennas within a stairwell, the installation shall not be made to traverse through a stairwell and penetrate back out of the same stairwell for installation convenience.

F) All adopted Electrical Codes and Fire Codes by the State of Florida, shall be maintained throughout the installation process and will be verified upon inspection by City of Coral Gables departments to include: Radio Shop, Electrical Department & Fire Prevention Bureau. All other criteria listed in the City of Coral Gables General Guidelines for the Deployment of In-Building Radio Coverage Solutions, as distributed to all vendors, shall remain in full effect. Radio Shop reserves the right to modify and revise as needed, and will promulgate the revisions to all authorized BDA installation vendors. For further clarification, please contact Jason Swift at (305) 460-5404.

10. Acceptance Test by the AHJ

During the final acceptance test of the system, the AHJ shall perform random voice tests and RSSI measurements throughout the entire facility. The tests will be based on the Scope of Work and the “Before and after” floor plans depicting the readings submitted to the AHJ.

The purpose of the tests will be to verify if the in-building solution complies with the design criteria previously established in Section 2 detailed above (“General Scope of Work”). The AHJ will decide what areas of the building will be tested for RSSI and voice quality.

In addition, 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 BDA. If the aforementioned request is made, then a new system isolation test may be needed if so determined by the AHJ.

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

11. Designer/Contractor Responsibilities

- **AT NO TIME SHALL WORK COMMENCE WITHOUT AN APPROVED SET OF PLANS AND ISSUED PERMITS**
- **Conduit shall be run to tie buildings together for the same project to limit component installation. This policy is strictly enforced and is Contractor's/Ownership's obligation to clear any doubt before installation commences as to the projects need for compliance.**
- Survey the facility to demonstrate the necessity of an in-building solution in the new building and submit

benchmarking results and corresponding Scope of Work 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 entire facility and attached structures under the conditions described in this document or as per the conditions specified by the AHJ.
- Plans must be submitted to Jason Swift at jswift@coralgables.com and approved prior to the installation of any equipment. These plans should be reviewed in conjunction with Fire Prevention.
- Obtain the necessary building permits .
- Record all appropriate signal levels after the system implementation as previously detailed. Prepare and submit to the AHJ the “before and after” floor plans showing signal levels.
- Submit specification of all components such as splitter, ways, antennas, battery, etc. to Jason Swift at jswift@coralgables.com. In the event that a cut sheet has multiple part numbers, highlight the parts being used.
- Address any in-building coverage issue discovered during the Acceptance Test.
- Address any reported interference issue related to the new BDA installation.

- Provide the Building Owner/AHJ with project documentation including but not limited to “As-built” documentation, system documents, technical manuals, 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.

12. 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 VSWR readings of the RF lines, 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 of the Public Safety radio signal.
- Every 5 years a test is required and results provided to the AHJ.

13. City of Coral Gables Department procedure for BDA permitting process:

**** AT NO TIME SHALL WORK COMMENCE WITHOUT AN APPROVED SET OF PLANS AND ISSUED PERMITS ****

1. All new/existing structures changing occupancy classifications, are required by Code to conduct a reading of radio signal coverage and submit it for review to the AHJ. (FFPC 1:11:10 - 5th Ed.)
2. The AHJ will evaluate and test the building to confirm preliminary readings that were submitted by third party contractor.
3. If it is determined that a BDA system is required in the structure, it will be confirmed by the AHJ and their readings.
4. Plans will be submitted to the AHJ for review. Once the plans are AHJ approved, it will be stamped and signed on every page.
5. The AHJ will email Coral Gables Fire Prevention that your plans are ready for review by the Bureau.
6. Contractor will submit the original "AHJ stamped and signed" shop drawings for verification and review by Coral Gables Fire Prevention.
7. When Coral Gables Fire Prevention reviews and approves the plans, the Contractor will need to pull the proper permits.
8. When installation work is commenced, the appropriate inspections will be coordinated with the AHJ.

9. When the AHJ approves the final inspection, an email will be sent to Coral Gables Fire Prevention indicating the results.
10. When Coral Gables Fire Prevention receives the email, the contractor may call in the fire portion of the permit.