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## BI-DIRECTIONAL AMPLIFIER (BDA) SYSTEMS

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# BDA Agenda

- 1.) What is a BDA / ERCES?
- 2.) The problem / The solution
- 3.) Drivers – Codes and Standards
- 4.) System Components



# BDA | ERRCES: Many different terms are used *in Fire Codes*

- **Emergency Radio Communication Enhancement Systems - ERCES**
- **Bi-Directional Amplifier - BDA**
- In-building public safety radio signal booster - IBPSRSB
- In-building radio system -IBRS
- In building emergency communication radio enhancement systems – IBECRES
- **In-building emergency responder radio enhancement system – IBERRES**
- In-Building Public Safety Communication Systems - IBPSCS
- **Auxiliary Radio Communication | ARC System (in New York City & Long Island)**
- **Public safety signal booster – PSSB**
- Public safety in-building communications systems - PSIBCS
- Public safety bi directional amplifier –PSBDA
- Public safety radio enhancement system – PSRES
- **Emergency radio coverage system - ERCS**
- Emergency Communications Radio System – ECRS
- **Emergency responder radio coverage systems – ERRCS**
- Signal booster system – SBS
- Distributed antenna system –DAS
- 2-way radio communication enhancement systems – RCES

# What is a BDA System?

BDA – Bi-Directional Amplification system is used to enhance in-building radio frequency (RF) signal coverage.

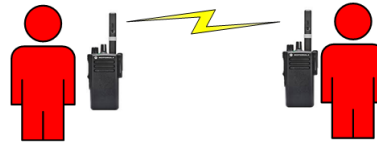


## Applications:

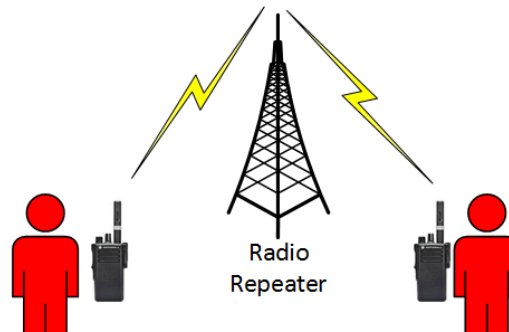
- Cellular
- Commercial Two-way Radio
- Paging and Telemetry
- Wireless Data
- **Public safety radio**

# The Two Modes of Two-Way Radio Communications:

- **Direct** Radio to Radio – aka “Simplex” Radio Communications where radios “talk” directly and there is no need for a central radio site.



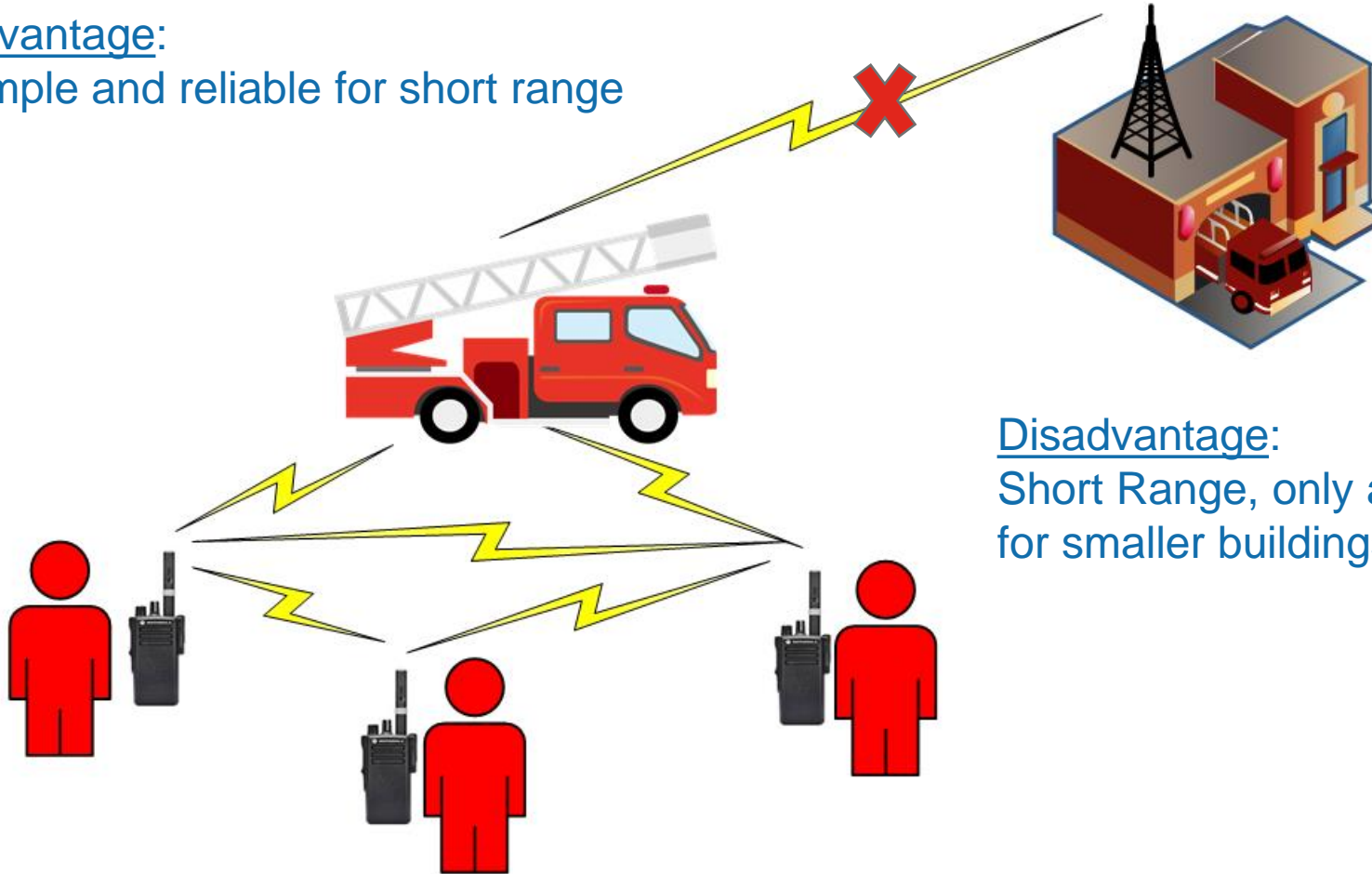
- **Repeated**, aka “duplex” frequency systems where all communications go through the repeater site. All transmissions are received and rebroadcasted with higher power by the repeater.





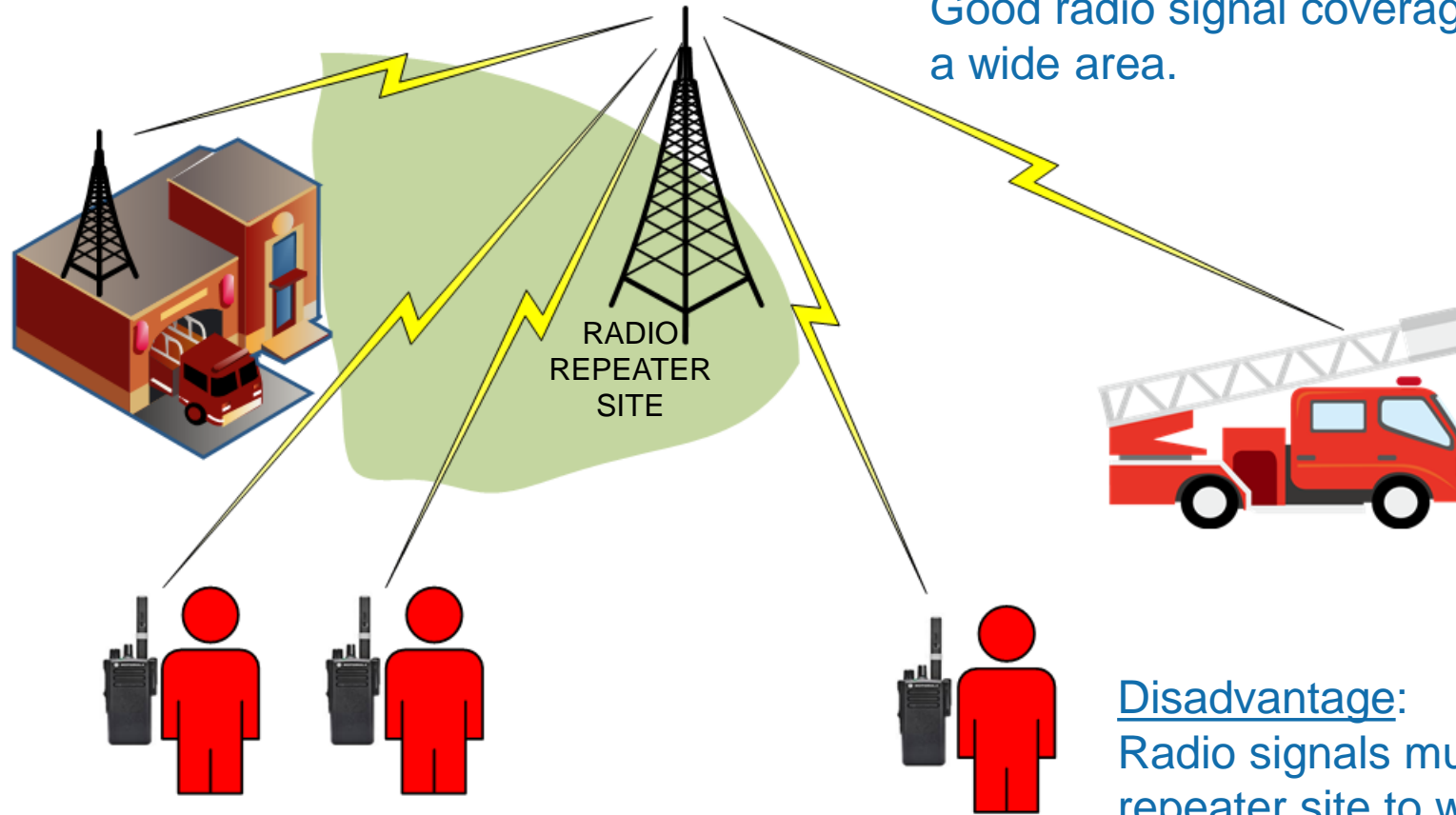
# Direct – “Simplex” Radio Communications

Advantage:  
Simple and reliable for short range



Disadvantage:  
Short Range, only acceptable  
for smaller buildings

# Repeated, “Duplex” Frequency Systems



Advantage:  
Good radio signal coverage over a wide area.

Disadvantage:  
Radio signals must reach repeater site to work.

# How important are BDAs to Public Safety? (IAFC Survey 2017)

## % Buildings with Poor Radio Frequency Coverage

Fire Departments Report that **98.5%**  
of the buildings have dead spots

## Level of Expertise with BDA / ERRCS systems:

- **5%** no knowledge
- **26%** Some awareness of the topic
- **32%** Basic Training / Some Experience

**63%**

Have you experienced a communications failure within a building *during an emergency incident*?

|               |           |
|---------------|-----------|
| Last 6 months | 31%       |
| Last Year     | 16%       |
| Last 2 Years  | <u>9%</u> |

**56%**

How important is reliable in-building communications coverage during emergencies?

**94% Agree**

**RELIABLE Communications  
are CRITICAL!**



# Public Safety Radio

**Reliable radio coverage is not a luxury.  
It is a necessity. Lives depend on it!**



# The Problem: In-building radio signal degradation

## Radio signals are attenuated by:

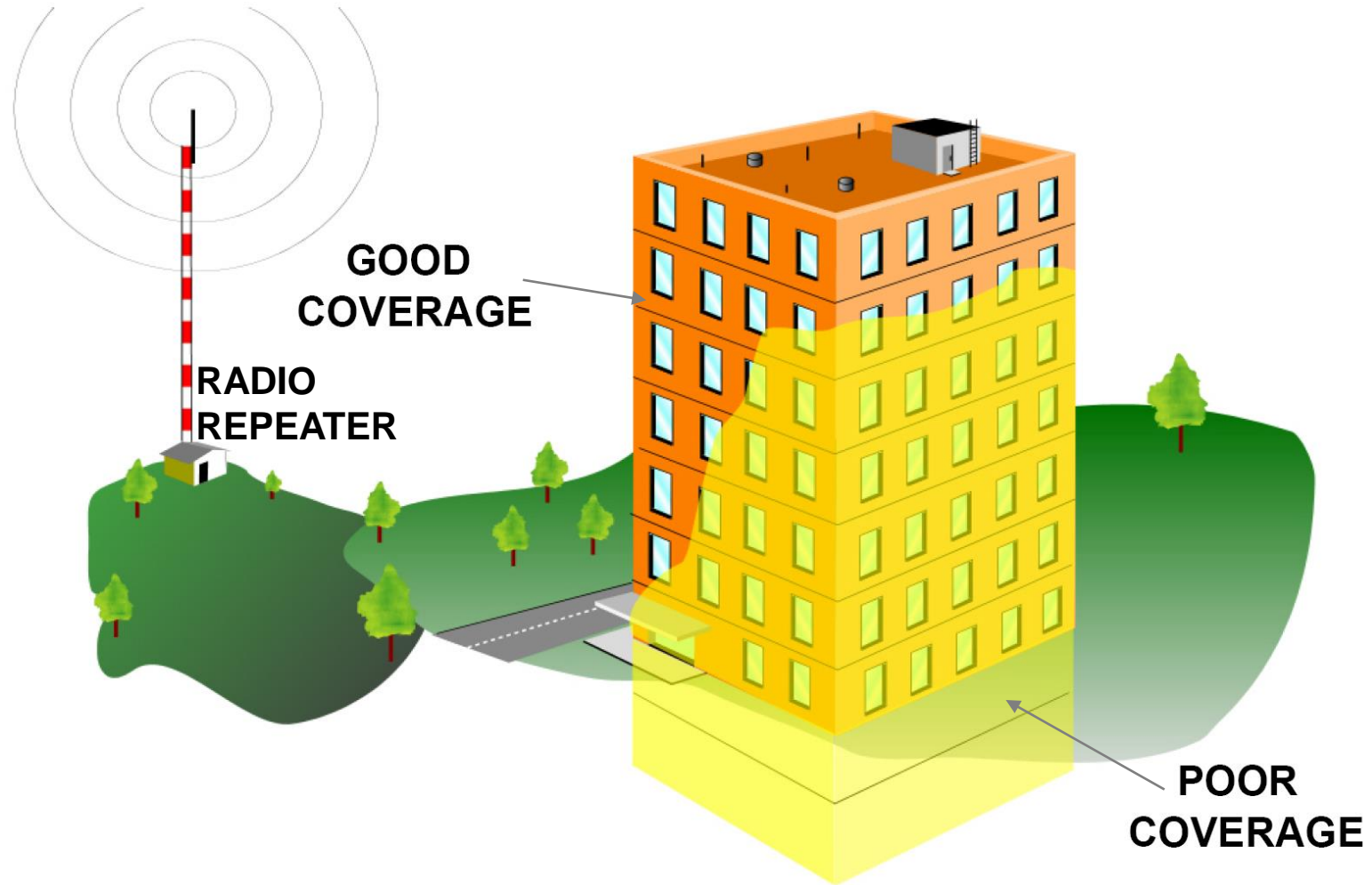
- Concrete, Metal and other building materials
- Low-E Glass
- Below-Ground Structures
- Other obstructions
- RF Interference

## The consequence:

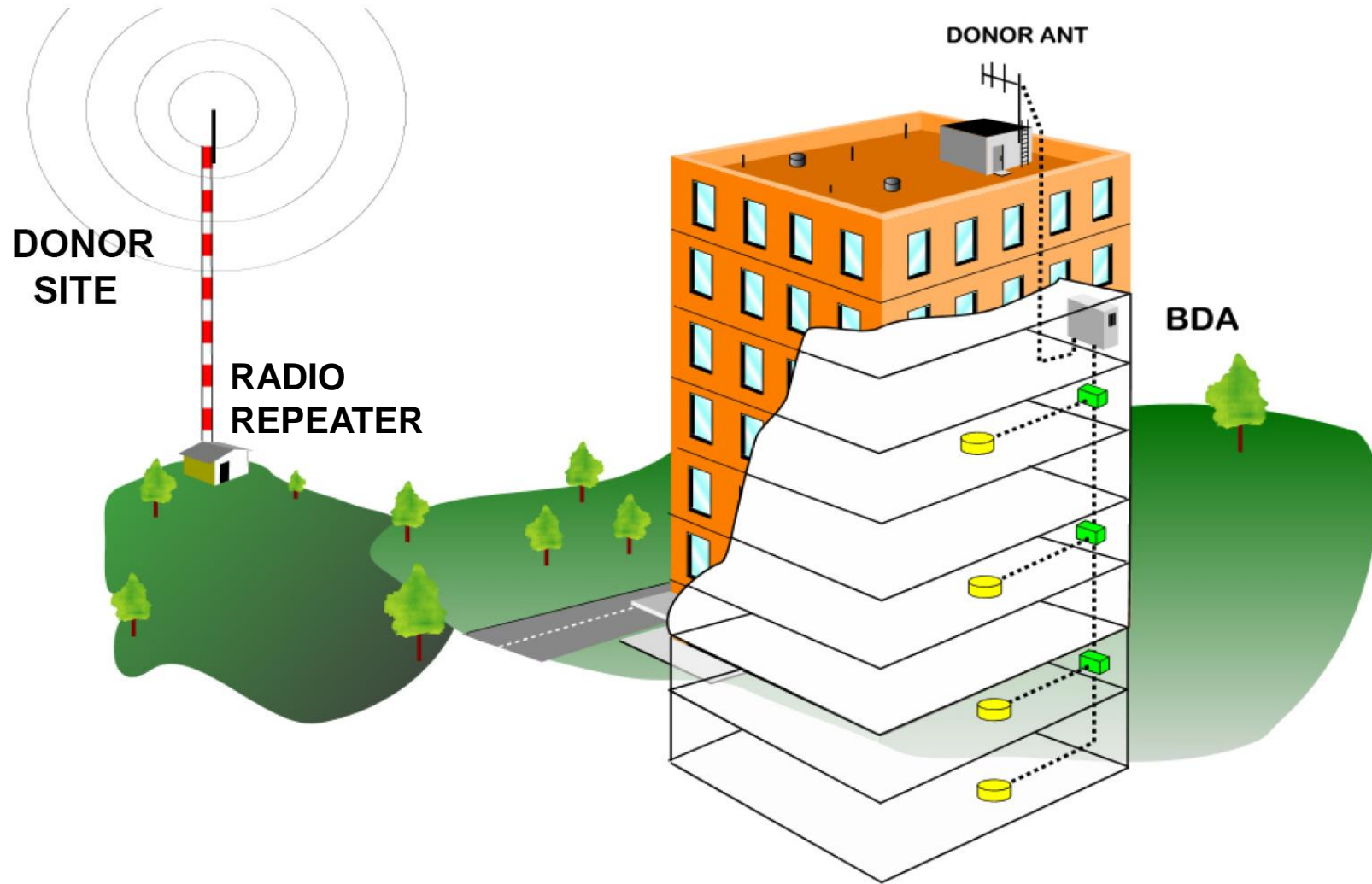
- Poor in-building radio signal coverage and “dead spots”
- Emergency responders lose communications



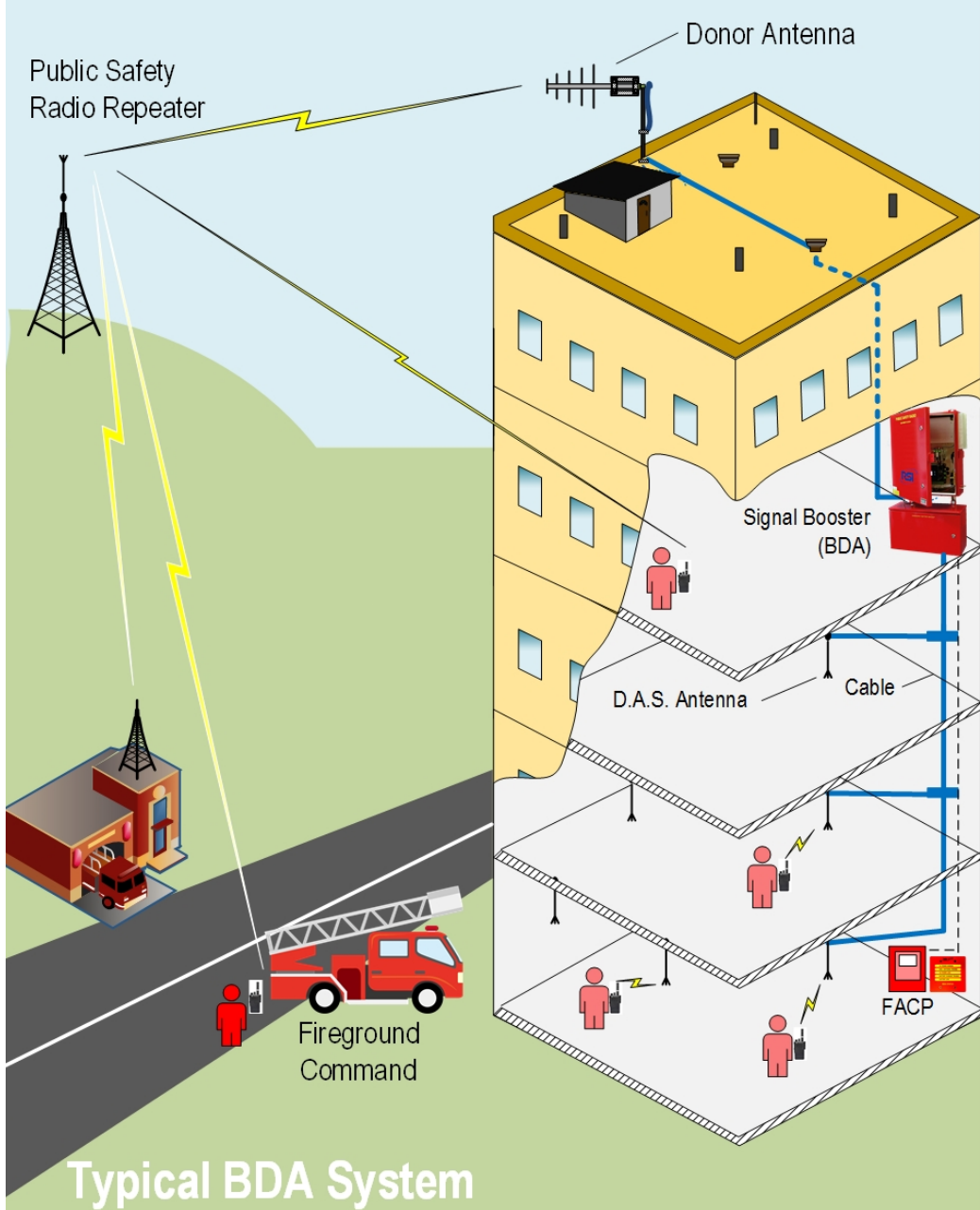
# The Coverage Problem



# BDA Systems Provide Reliable In-Building Coverage:



# Typical BDA System



Typical BDA System



# Because of these signal penetration issues the IFC made this a Code-Driven Requirement

## IBC 2015 - Section 916

Refers to IFC section 510 or the state recognized fire code

## IFC Section 510 Emergency Responder Radio Coverage

First appeared in the appendix of the 2009 IFC, the provision was moved to the body of the code in 2012

At present many states have adopted the 2012 edition of the IFC and the 2015 edition of the IBC

Section 1103.2 of the IFC specifies the requirements for emergency responder radio coverage in existing buildings

## NFPA 72 National Fire Alarm and Signaling Code

2010 / 2013 Edition, section 24.5.2

The 2016 edition of NFPA 72 relocated the requirements to NFPA 1221

2016 NFPA 1221, Section 9.6





# IFC 2015 Requirements New Buildings

## 510.1 Emergency responder radio coverage in new buildings.

***All new buildings shall have approved radio coverage for emergency responders within the building based upon the existing coverage levels of the public safety communication systems of the jurisdiction at the exterior of the building***

### Exceptions:

Where *approved* by the building official and the *fire code official*, a **wired communication system** in accordance with Section **907.2.13.2** shall be permitted to be installed or maintained instead of an ***approved* radio coverage system.**

Where it is determined by the *fire code official* that the radio coverage system is not needed.

**In facilities where emergency responder radio coverage is required and such systems, components or equipment required could have a negative impact** on the normal operations of that facility, the *fire code official* shall have the authority to accept an automatically activated emergency responder radio coverage system.

# IFC 2015 Requirements Existing Buildings

## 1103.2 Emergency responder radio coverage in existing buildings.

Existing buildings that do not have approved radio coverage for emergency responders within the building, based upon the existing coverage levels of the public safety communication systems of the jurisdiction at the exterior of the building, **shall be equipped with such coverage according to one of the following:**

1. Where an existing wired communication system cannot be repaired or is being replaced, or where not approved in accordance with Section 510.1, Exception 1.
2. Within a time frame established by the adopting authority.

Exception: Where it is determined by the fire code official that the radio coverage system is not needed.

# When is a BDA required?

**24.5.2.2.3 Amplification Components.** Buildings and structures that cannot support the required level of radio coverage shall be equipped with a radiating cable system or a distributed antenna system (DAS) with FCC-certified signal boosters, or both, or with a system that is otherwise approved, in order to achieve the required adequate radio coverage.

# Coverage Requirements

## 24.5.2\* Two-Way Radio Communications Enhancement Systems

**24.5.2.2.1 Critical Areas.** Critical areas, such as the fire command center(s), the fire pump room(s), exit stairs, exit passageways, elevator lobbies, standpipe cabinets, sprinkler sectional valve locations, and other areas deemed critical by the authority having jurisdiction, shall be provided with 99 percent floor area radio coverage.

**24.5.2.2.2 General Building Areas.** General building areas shall be provided with 90 percent floor area radio coverage.

# Signal Strength Requirements

## 24.5.2.3 Signal Strength

**24.5.2.3.1 Inbound.** A minimum inbound signal strength of  $-95$  dBm, or other signal strength as required by the authority having jurisdiction, shall be provided throughout the coverage

**24.5.2.3.2 Outbound.** A minimum outbound signal strength of  $-95$  dBm at the donor site, or other signal strength as required by the authority having jurisdiction, shall be provided from the coverage area.

# Enclosure

## 24.5.2.5.2 Component Enclosures

All repeater, transmitter, receiver, signal booster components, and battery system components shall be contained in a NEMA 4- or 4X-type enclosure(s).



# Power Supplies

## 24.5.2.5.5 Power Supplies

At least two independent and reliable power supplies shall be provided for all repeater, transmitter, receiver and signal booster components, one primary and one secondary.

# System Monitoring

## 24.5.2.5.6.1 Fire Alarm System

The public safety radio communications enhancement system shall include automatic supervisory and trouble signals for malfunctions of the signal booster(s) and power supply(ies) that are annunciated by the fire alarm system...

# System Monitoring

**24.5.2.6.2\* Dedicated Panel.** A dedicated monitoring panel shall be provided within the fire command center to annunciate the status of all signal booster locations. The monitoring panel shall provide visual and labeled indication of the following for each signal booster:

- (1) Normal ac power
- (2) Signal booster trouble
- (3) Loss of normal ac power
- (4) Failure of battery charger
- (5) Low-battery capacity

# F.C.C. GROL License Is Required to Design & Test BDA Systems\*

- From IFC 2009:

- J103.2.3 Minimum qualifications of personnel. The minimum qualifications of the system designer and lead installation personnel shall include:
  1. A valid FCC-issued General Radio Operators License, **and**
  2. Certification of in-building system training issued by a nationally recognized organization or school or a certificate issued by the manufacturer of the equipment being installed. The agency may waive these requirements upon successful demonstration of adequate skills and experience satisfactory to the fire code official.

- From IFC 2018:

- **510.5.2 Minimum qualifications of personnel.** The minimum qualifications of the system designer and lead installation personnel shall include **both of the following:**
  1. A valid FCC-issued General Radio Operators License, and
  2. Certification of in-building system training issued by an approved organization or approved school, or a certificate issued by the manufacturer of the equipment being installed.
- These qualifications shall not be required where demonstration of adequate skills and experience satisfactory to the *fire code official* is provided.

\* GROL *NOT* required to register for BDA program or attend training. It is required before we can ship BDAs to ESD. **Honeywell**

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# BDA – ERRC Requirements Summary

- Emergency responder radio coverage (ERRC) was first introduced in the appendix 2009 International Building Code to address the performance of emergency responders' portable radios inside buildings.
- Smaller buildings may already have sufficient radio signal coverage levels. In that case, property owner shall provide a signal survey report documenting the existing signal levels. **Survey is performed and signed by a qualified, FCC - GROL Licensed vendor.** Report is then submitted to AHJ for review and the coverage is verified by the AHJ.
- Buildings that **do not have** the required signal levels (-95 dBm) require amplification systems (i.e. signal boosters, BDA Bi-Directional Amplifiers or other system as specified by the AHJ)
- Upon system completion, a final survey shall be performed as specified.
- All buildings shall therefore have a *certification of the approved in-building signal coverage* on record with the AHJ, regardless if they have a BDA or not.
- Signal coverage and the BDA system need to be inspected, tested, and serviced annually.
- Property owners are responsible for maintenance, surveys and upgrades of the in-building systems as required by the building code and as requested and specified by the AHJ.



## **UL 2524 OUTLINE 1st Edition, December 21, 2017**

### **UL Outline for Investigation In-building 2-Way Emergency Radio Communication Enhancement Systems**

- **Includes UL 60950 Basic Safety, IFC-2018, NFPA1221 - 2016**
- **UL Listing Creates a Performance Standard for ALL BDA Manufacturers**
- **Ensures Life Safety Systems Perform the First Time & *Every Time***



# BDA System Components – 1 of 5

- **Donor Antenna**

- Installed on the Roof of the building
- Pointing to the public safety radio repeater site
- High gain, high directivity
- Does not need line of sight



- **Coaxial Cable**

- Typically Plenum Rated, 1/2" diameter
- Low insertion loss is required
- We now use red cable
- Some AHJs have special labeling requirements



# BDA System Components – 2 of 5

- **Signal Splitters and Couplers**

- Used for signal distribution
- Come in different coupling values



- **RF Connectors**

- Installed using specialized tool
- Easily done by a trained technician



- **DAS Antennas**

- Fiberglass “stick” antennas have the best performance
- Other antennas, such as low-profile are available
- Various mounting options are available



# BDA System Components – 3 of 5

- **Battery Backup**

- All Honeywell signal boosters come with a fully integrated battery charger and battery diagnostics functions
- OEM Battery backup enclosure is provided with the BDA
- Easy to install, designed to fit below the BDA

- **Annunciator Panel**

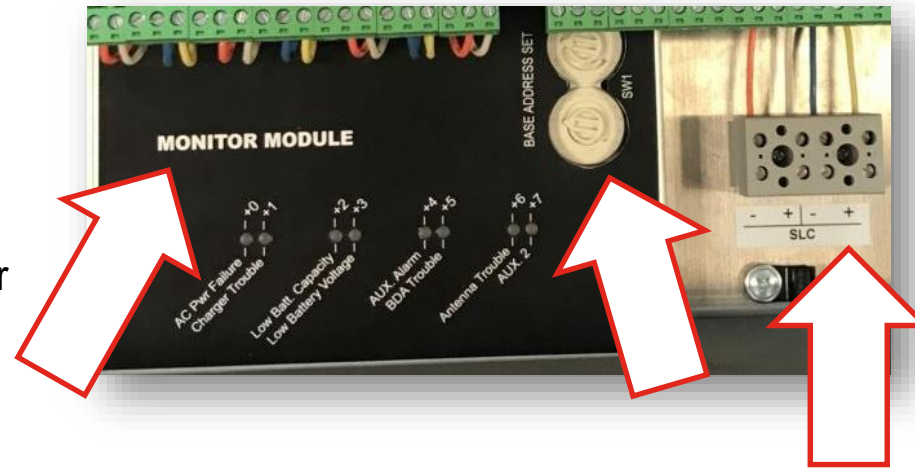
- Dedicated monitoring panel is required
- Specified in NFPA-72 and 1221
- Independent from fire alarm system
- Powered by the BDA power supply and battery
- OEM panel included with the BDA
- Easy installation on a standard 2-gang electrical box



# BDA System Components – 4 of 5

- **Fire Alarm Panel Connection**

- BDAs must be monitored by the building's Fire Alarm System
- Supervisory signals normally include:
  - Donor antenna malfunction
  - BDA Failure
  - Low Battery Capacity
  - Loss of normal AC Power
  - Failure of a Battery Charger



- **Built-in Addressable Monitoring Module is now available as an option for simple connection to Gamewell-FCI & Farenhyt Series Fire Alarm Panels**

# BDA System Components – 5 of 5

- **BDA (Signal Booster)**

- Must meet requirements of the local AHJ

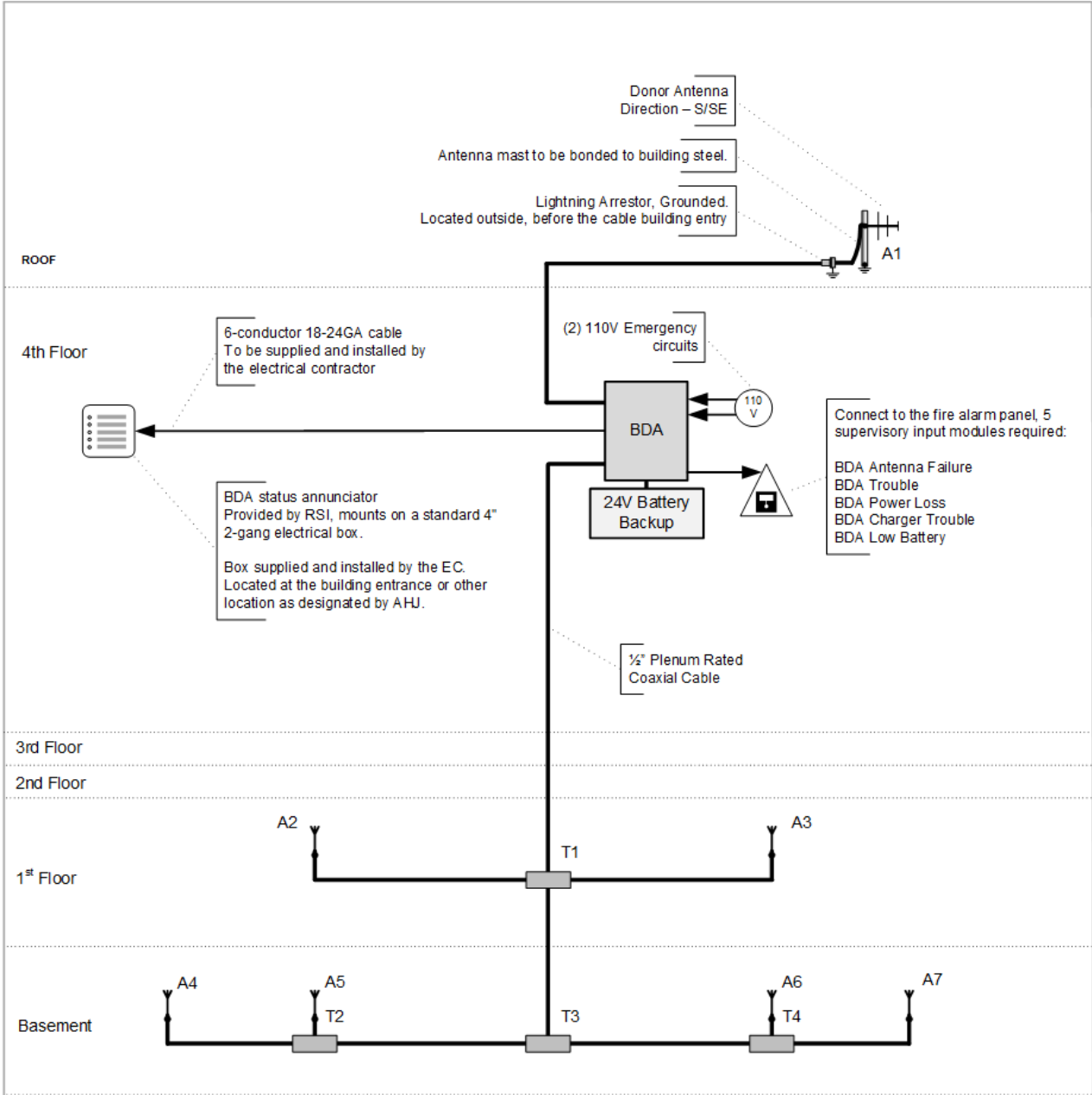
Each jurisdiction is different:

- Frequencies / channels required?
  - VHF, UHF, 700 or 800MHz, or multi-band?
- Fire only or Fire, Police, EMS, Regional?
- Bandwidth?
- Monitoring Requirements?
- Annunciator Location?
- Labeling Requirements?
- Any other requirements?

- AHJs in larger jurisdictions usually have well-written specs, but for many this is still a new requirement and there is no written spec
- Honeywell Pre-Sales Support and Industry Affairs can assist AHJs with technical specifications.



# Riser Diagram of a Typical BDA System

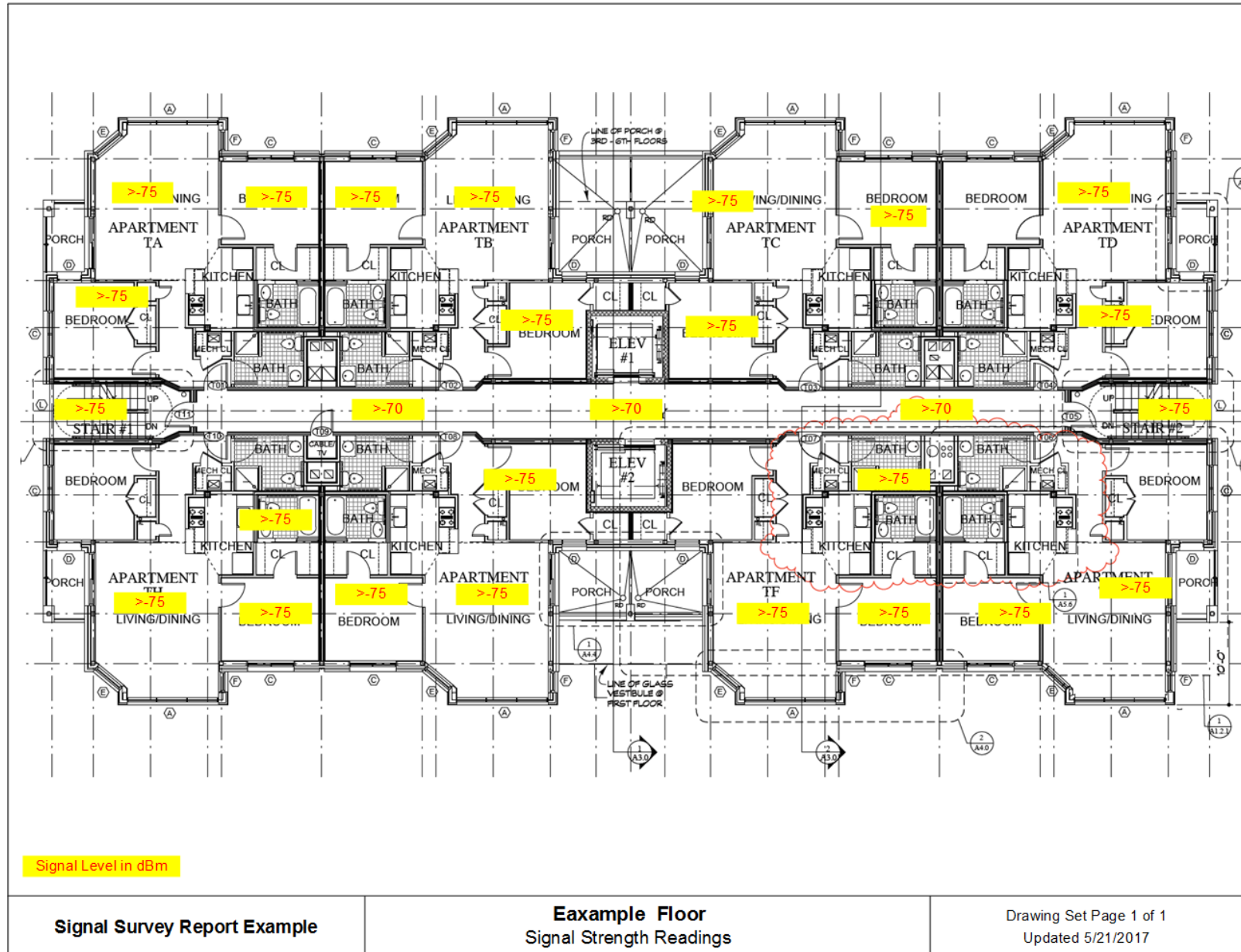


# FCC Certification and Registration Requirements

- Signal Boosters must be FCC certified (manufacturer product brochures and product labels must include FCC ID number)
- BDAs are FCC certified to operate on the licensee's frequencies
- FCC Requires frequency licensees (FD, PD, municipality, etc.) to register all signal boosters that operate on their frequencies
- Registration is free and FCC has a simple on-line registration tool:  
<https://signalboosters.fcc.gov/signal-boosters>
- Registration needs to be done by the AHJ (frequency licensee) because it requires the licensee FRN (federal registration) number and FCC password.
- BDA vendor can assist if needed



# Typical Signal Survey Report



Signal Level in dBm

|                              |  |   |
|------------------------------|--|---|
| Signal Survey Report Example | <p style="text-align: center;"><b>Example Floor</b><br/>Signal Strength Readings</p> | <p style="text-align: right;">Drawing Set Page 1 of 1<br/>Updated 5/21/2017</p> |
|------------------------------|--|---|

# Radioreference.com

**Omaha Regional Interoperability Network (ORION)**  
Project 25 Phase II

Most services are on this system

| Frequency | License | Type | Tone                 | Alpha Tag        | Description                        | Mode | Tag           |
|-----------|---------|------|----------------------|------------------|------------------------------------|------|---------------|
| 856.48750 | WPKN516 | RM   | 032 DPL              | DougYouthCnt     | County Youth Center                | FMN  | Corrections   |
| 453.32500 | WPRJ593 | B    | 123.0 PL             | DC FirePageE     | Fire Paging - East                 | FMN  | Fire Dispatch |
| 453.32500 | WPRJ593 | B    | 141.3 PL             | DC FirePageS     | Fire Paging - South                | FMN  | Fire Dispatch |
| 453.32500 | WPRJ593 | B    | 156.7 PL             | DC FirePageN     | Fire Paging - North                | FMN  | Fire Dispatch |
| 453.32500 | WPRJ593 | B    | 218.1 PL             | DC FirePageW     | Fire Paging - West                 | FMN  | Fire Dispatch |
| 453.40000 | WNNV513 | B    |                      | DC Fire BU 1     | Fire Paging Backup 1               | FMN  | Fire Dispatch |
| 453.60000 | WSY540  | B    |                      | DC Fire BU 2     | Fire Paging Backup 2               | FMN  | Fire Dispatch |
| 151.13000 | WPZX339 | RM   | 71.9 PL              | DouglasCoEMA     | Emergency Management               | FMN  | Emergency Ops |
| 158.76000 | WPZS456 | BM   | 411 DPL              | DouglasSiren     | Emergency Management Siren Control | FMN  | Emergency Ops |
| 453.72500 | KNEY538 | RM   | 127.3 PL             | DougCoCD         | Civil Preparedness                 | FMN  | Emergency Ops |
| 461.47500 | WQLI732 | RM   | CC 1<br>TG *<br>SL 1 | DC Health Center | Douglas County Health Center       | DMR  | Hospital      |
| 156.18000 | WPUA594 | RM   | 85.4 PL              | DougCoRoads      | Highway Department                 | FMN  | Public Works  |

## Omaha ▶

**Omaha Regional Interoperability Network (ORION)**  
Project 25 Phase II

Most services are on this system

| Frequency | License | Type | Tone     | Alpha Tag     | Description                                    | Mode | Tag            |
|-----------|---------|------|----------|---------------|--|------|----------------|
| 460.15000 | KAA312  | B    | 127.3 PL | Omaha FD Data | Fire Department Data                           | FMN  | Data           |
| 453.10000 | WQCG642 | RM   | 731 DPL  | Omaha Water   | Water Treatment Plant                          | FMN  | Public Works   |
| 463.27500 |         | RM   | 118.8 PL | Omaha Housing | Housing Authority                              | FMN  | Public Works   |
| 854.28750 | WPED559 | M    |          | OCCP TAC      | Omaha Coalition of Citizen Patrols Talk-Around | FMN  | Security       |
| 453.42500 | KVV927  | RM   | 167.9 PL | Omaha MAT     | Metro Area Transit                             | FMN  | Transportation |
| 453.52500 | KVV927  | RM   |          | Omaha MAT     | Metro Area Transit                             | FMN  | Transportation |
| 453.67500 | KVV927  | RM   | 100.0 PL | Omaha MAT     | Metro Area Transit                             | FMN  | Transportation |

# Questions



THANK YOU

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