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# BI-DIRECTIONAL AMPLIFIER SYSTEMS OVERVIEW FOR NSRS

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# Bi-directional amplifier (BDA) systems overview

- This presentation will cover…
  - What is a BDA and what do they do?
  - What types are there?
  - When are they desired/applicable?
  - What requirements/standards must be met?
    - ex: FCC Registration
    - ex: NFPA Standards
  - What minimum technical specifications are applicable to P25 BDAs
  - Q&A

# What is a BDA and what does it do?

- A BDA is a bi-directional amplifier aka: *Distributed Antenna System (DAS)*
  - It amplifies RF signals going in two different directions on different frequency bands at the same time.

- The application goal is…. to  extend or enhance RF coverage inside buildings or tunnels or any other “indoor” location where radio systems may be lacking radio coverage

- In effect it collects downlink signals ***from*** a radio tower site and...

- At the same time, it collects uplink signals from users inside a structure and sends them ***to*** a radio tower site

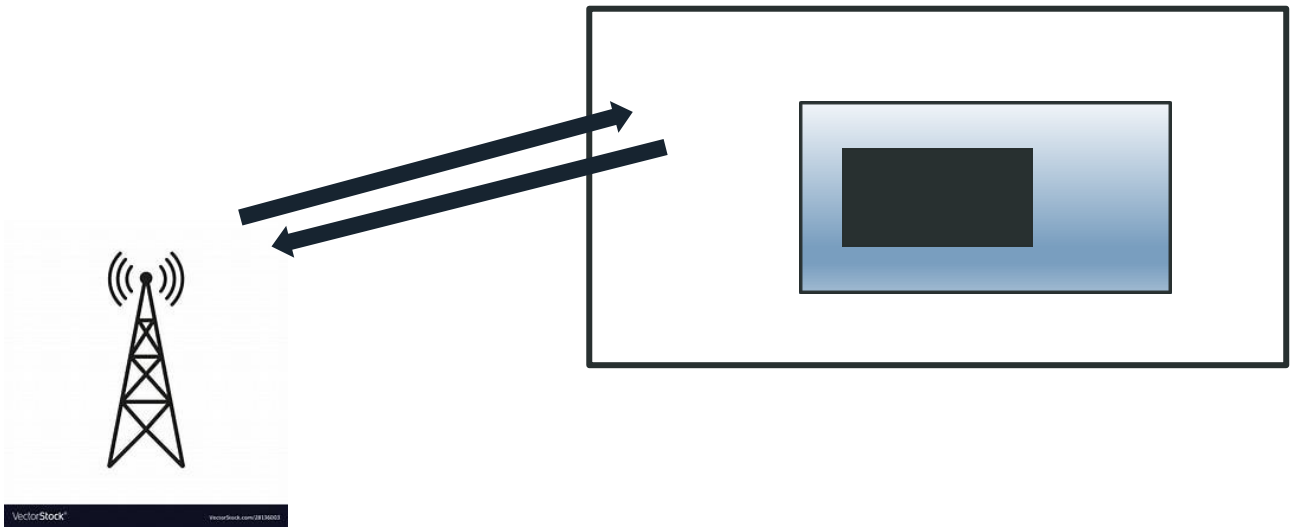
- Careful amplification of signals in both directions is critical (do not make interference along the way)

# What types are there?

- Broadband  (aka: wideband) --- *full xxxMHz LMR band*
- Channelized --- only specific LMR-band channels
- LMR vs. Cellular/wireless
- Multi-band and/or shared BDAs
  - Might appear to have cost-savings attractiveness
  - However,…..”*sharing*” a common BDA for a given building can result in conflicting goals by the mutual parties
  - Technical goals are not the same
- Beware…….*”mutually-assured-interreference”*

# When are they desired and or applicable?

- Anytime/place where RF signal levels “on the street” are not strong enough
- ….or….cannot otherwise be strong enough to compete with interference levels from ubiquitous wireless & electronics ….my own office desk, the *“vending machine”*



# Requirements… (1 of 3)

- Need for FCC Registration
  - 47 CFR Part 90  See: https://signalbooster.fcc.gov
    - FCC FRN, Booster ID #, Company, Location
    - See next slide

  - Historical and legacy BDA interference reasons
      - An L3H-customer example….

# Requirements… (2 of 3)

- Example of an FCC search…

RESET FILTER

| Booster ID | Name | City | County | State | Zip Code | Latitude | Longitude | Frequency | Call Sign | Date Filed |
|---|---|---|---|---|---|---|---|---|---|---|
| Booster II | Compa | City | County | State | Zip Co | -90 to 90 | -180 to 180 | Frequency | Call sign | mm/dd/y |
| SB0005223 | Hunt Electric | Reno | Washoe County | NV | 89511 | 39.393583 | -119.789543 | • 851-862 MHz | • WPKJ526<br>• WPUF364 | 03/20/2018 |
| SB0005658 | Hunt Electric | Reno | Washoe County | NV | 89511 | 39.393583 | -119.789543 | • 851-862 MHz | • WPUF364 | 07/30/2018 |

# Requirements… (3 of 3)

- NFPA
  - Not intended to conflict with FCC…
  - But a higher standard…
    - Minimum run-times, painting requirements, AC-power cuts, -95dBm, 95%
  - NFPA standards evolve
  - IFC Code too…
  - IFC Section 510… *accommodates/stipulates auto-activated BDA systems*
    - *Also see NFPA 11.10.3*
    - *Remodeling can trigger a building re-test*
    - *Document technical specs <u>including the tower sites</u> serving a BDA*
    - *Goal is to try and PREVENT things degrading overtime until it's too late and the BDA needs to save lives…but has fallen-apart, or a tower site was "relocated" and nobody told the owner of now-renamed "Hotel Smoke-Trap"*

    - *YET…..IFC has **NO** certifications for "BDA testers"….*
      - *as far as I can tell today*

# What technical specifications?

- Pick an experienced and well-educated BDA vendor
  - Ask for references
  - Don't be afraid…if vendor can't/won't be well versed, you don't want him anyway
- P25 Phase-I  vs. Phase-II…
  - FDMA vs. TDMA
- LMR needs to deal with TDMA and dynamic-range limitations
  - 3w portable vs. a 100mW cell-phone  ("*We've done 10,000 cellular BDAs!*")
- Think the future… rather than "good enough for today", "can I upgrade?"
- Remember the -95dBm/95% for NFPA/IFC factors and constant evolutions
- Costs…..$25k to >$250k  …all depends on sq footage, fiber, coax, doner inputs/outputs….over the air or directly wired…

# Q&A time…

***Any questions I can try and answer?***