



2017 NFPA Conference



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When is a Two Way Radio Communications Enhancement System needed?

When public safety radios do not transmit or receive at a location (building)!





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- Weather Related
- Building Materials : Hurricane ratings, Window Films (LEED)
- Lack of current Radio System Coverage





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What does a system include?

- Donor Antenna – Rooftop antenna aimed at nearest public safety base station radio site
- Bi-Directional Amplifier (BDA) – Amplifier that provides two way (transmit and Receive) communications
- Distributed Antenna System (DAS)

*For Inspectors: Similar to Fire Sprinkler System:
Donor Ant. = water source; AMP = Pump; DAS = Sprinklers.*





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What does a system include?

- In some systems in very large or tall buildings, fiber optic cables are required to connect between the BDA and the distant floors or areas
- There is a radio frequency (RF) to optical conversion to allow the light signals to travel down low loss fiber optic cables
- Then at periodic points (usually every other floor, or major building sections) the light signals are converted back to RF and distributed with antennas or 'leaky coax' (think lawn sprinkler hose)



- Donor Antenna on rooftop

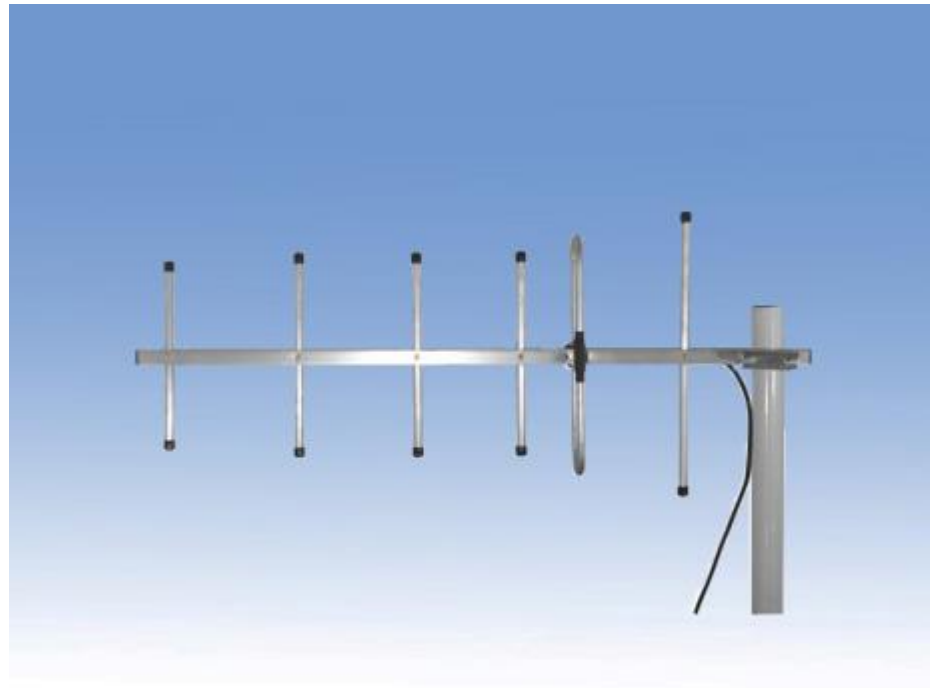


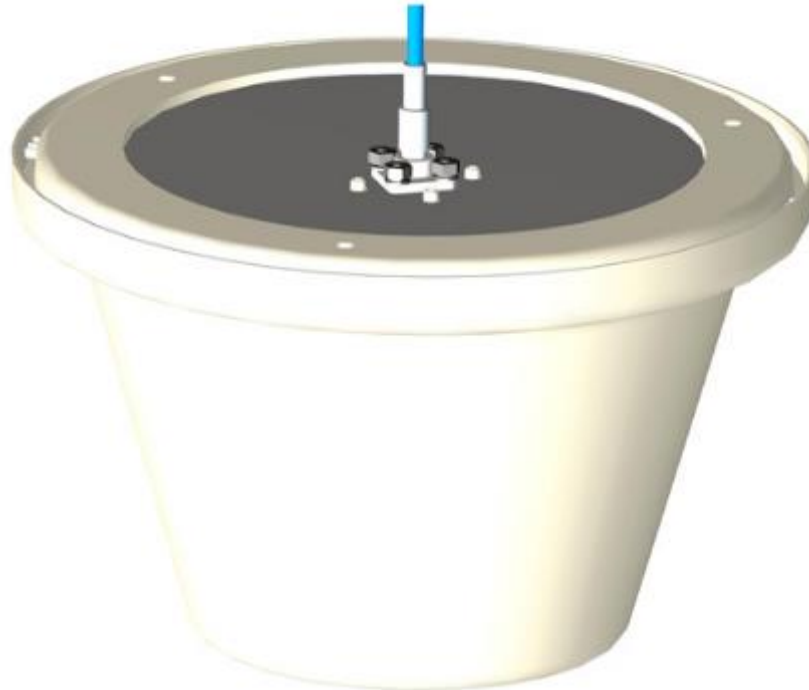
Image: www.shengdacom.com

- Bi-Directional Amplifier (BDA)

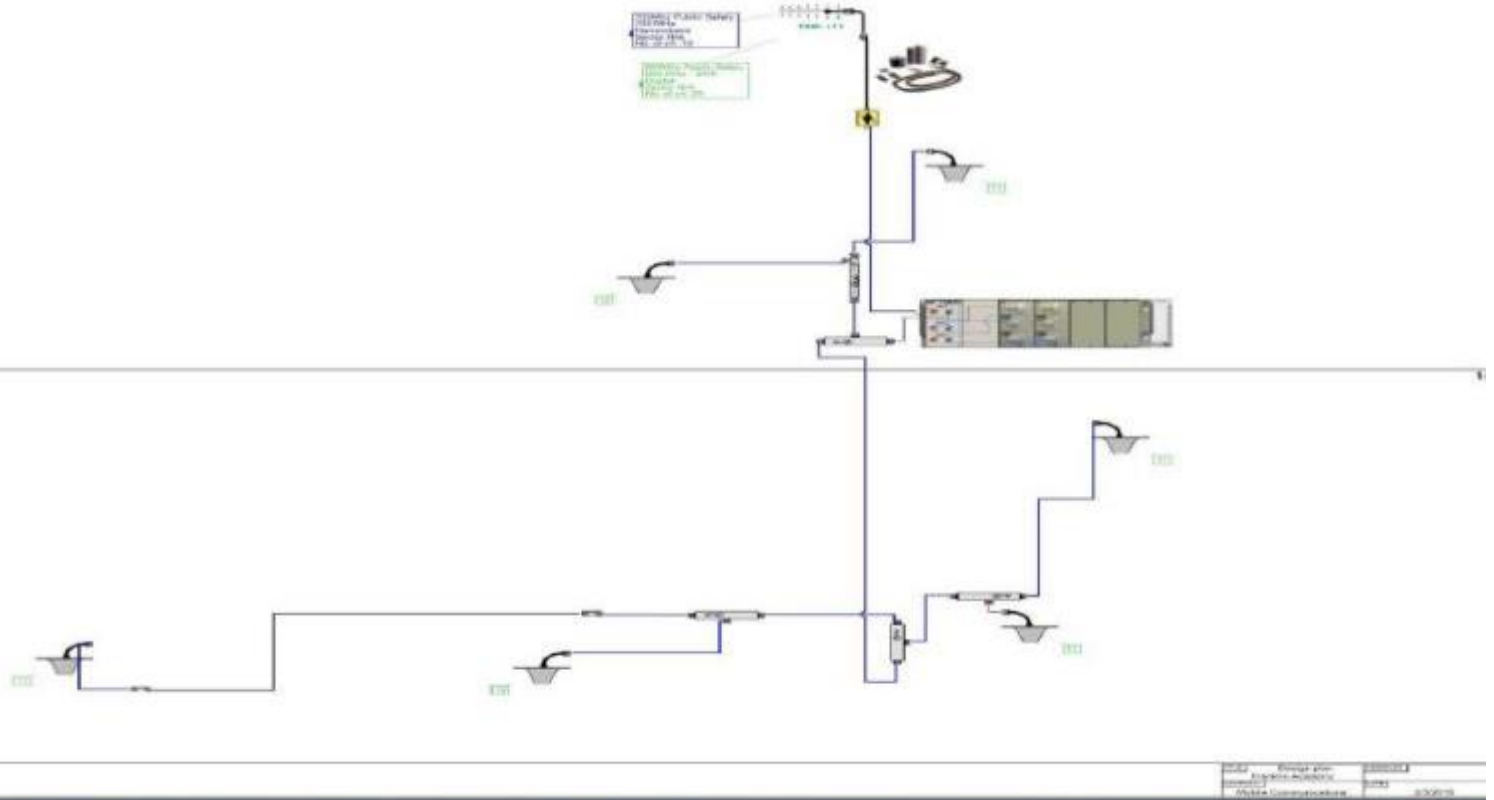




DAS Ceiling Antenna

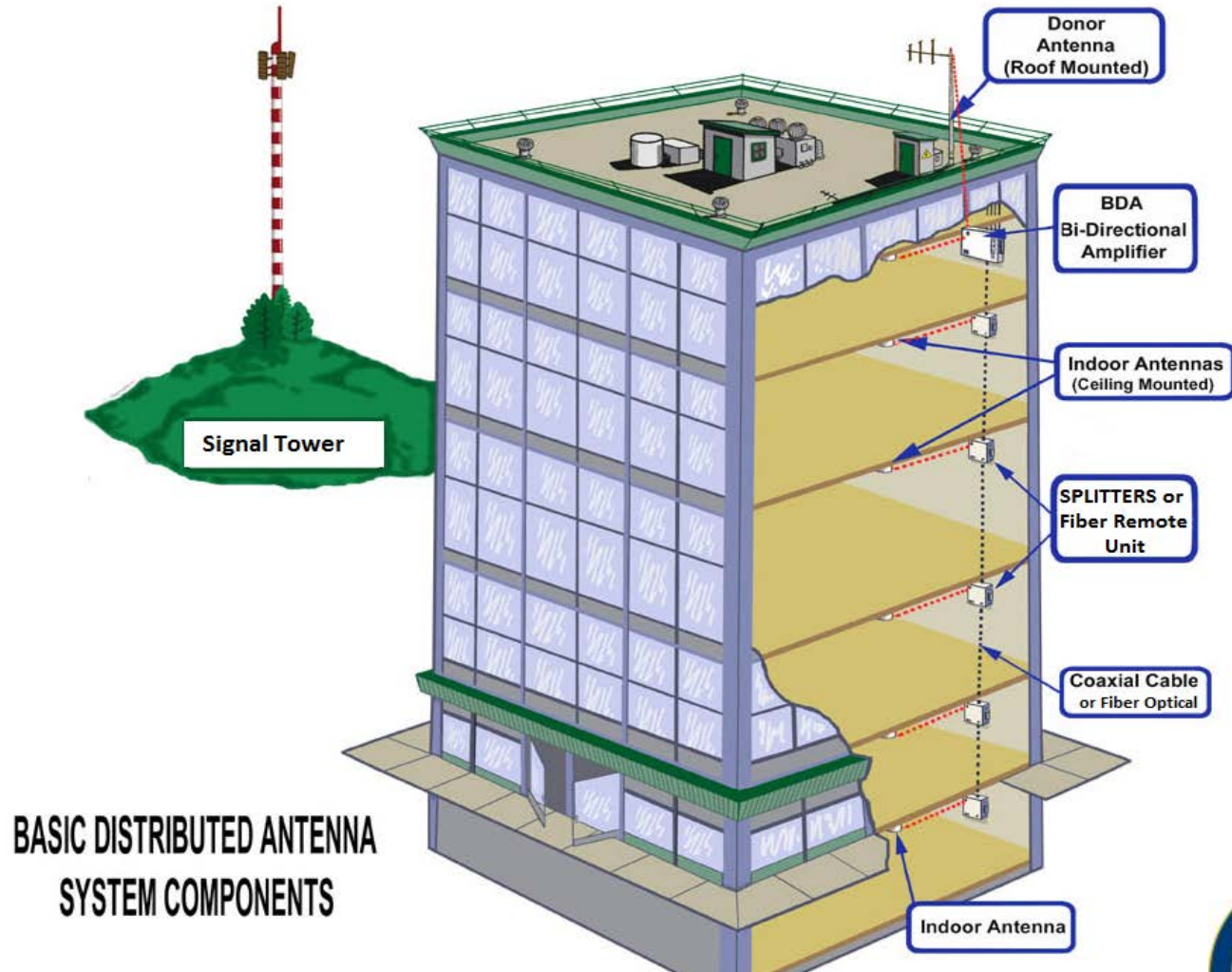


- A Simple Non-Optical Fiber BDA and DAS System



- DAS





**BASIC DISTRIBUTED ANTENNA
SYSTEM COMPONENTS**



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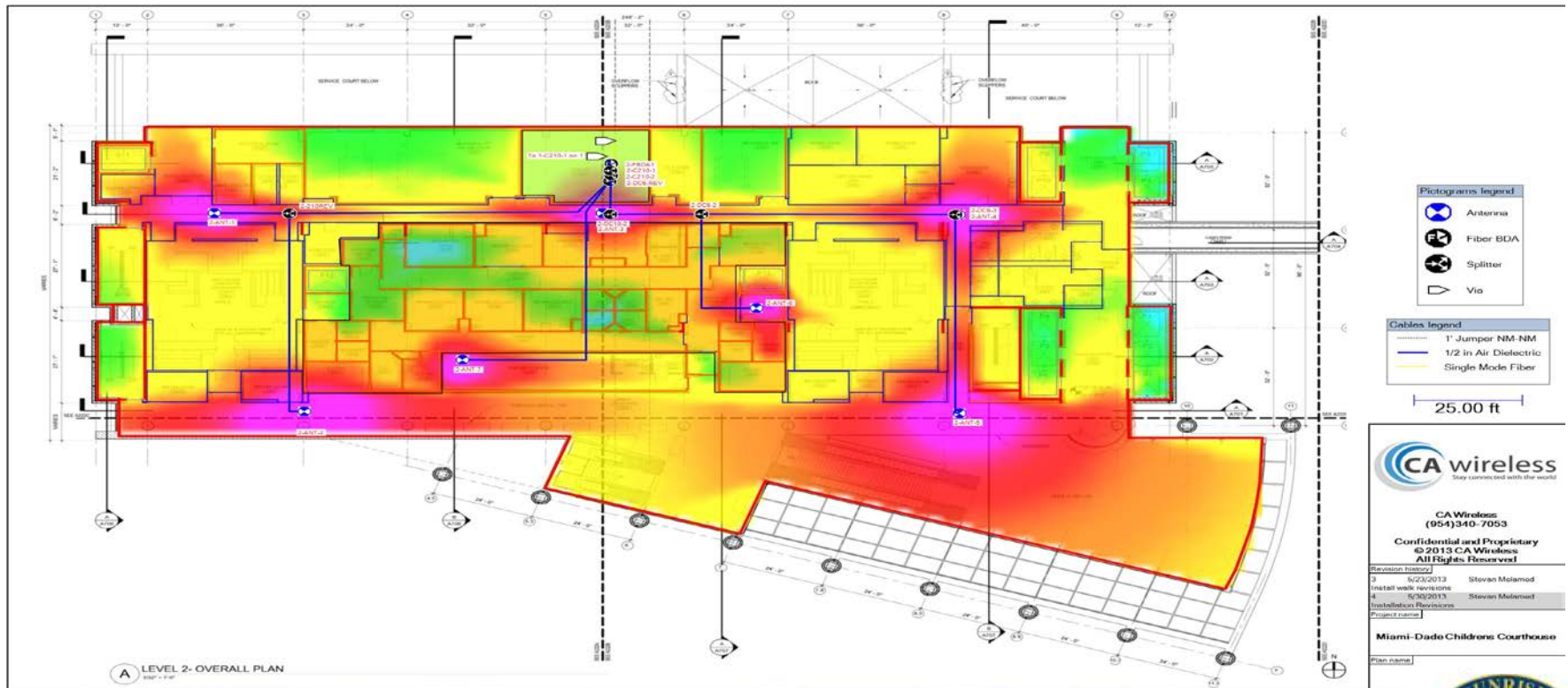
Developers, Planning, and Engineering

Be upfront

- What are AHJ's DAQ signal requirements for public safety at the property, and the floor area coverage ?
- Theoretic signal in building propagation analysis using software tools*
- AHJ should include a note that says “ A Certificate of Occupancy will not be given without minimum public safety DAQ signal requirements”



Typical Signal Propagation Map





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- Requires Permits and Design submittals
- Must amplify AHJ public safety radio – (i.e. 700 MHz/800MHz, Band 14 LTE) Police/Fire/EMS system
- Minimum Signal Strength of -95dBm NO LONGER REQUIRED IN NFPA 1221 2016 edition; instead DAQ level
 - (engineer to RF, Test to DAQ)
- Critical areas 99% coverage. (Fire control, pump rooms, exit stairs, elevator lobbies, and as determined by AHJ)
- General areas 90% coverage





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- Auxiliary Power Back up (Generator, UPS, Battery, 12 hours minimum)
- Alarm output to a dedicated Fire Panel (supervised circuit)
- AHJ may have a list of approved equipment
- *Annual testing and Certification* – upon acceptance and every 12 months. Procedures as defined by the AHJ (NFPA 1221, 2016)





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- Must prove that the system will be monitored by alarm system vendor*
- Building Owner Must have Service Level Agreement (SLA) In Place minimum 48 hour turnaround – Notification to FD if system out. ***(Local Ordinance)***
- Annex material suggests desired certification of installation and testing personnel.





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Testing

- “Can you hear me now” - DAQ of 3.0 is what is now required by 1221. Subjective but simpler testing.
- Traditionally public safety radio systems were designed to a higher level, DAQ 3.4. NFPA 1221 is a minimum standard; AHJ can still require 3.4 instead of 3.0.
- Test Passes if you can talk in both directions with a good quality of audio.





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Testing

- RF signal level doesn't always predict the actual audio quality that the user hears (can depend on the kind of radios used, noise reduction circuits, etc.)
- DAQ applies to analog or digital radio systems
- Some AHJs may still require spectrum analyzer to prove signal levels predicted by propagation maps, in all areas, however this is above the standard





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- DAQ Delivered Audio Quality Subjective Performance Description

DAQ & MOS Definitions

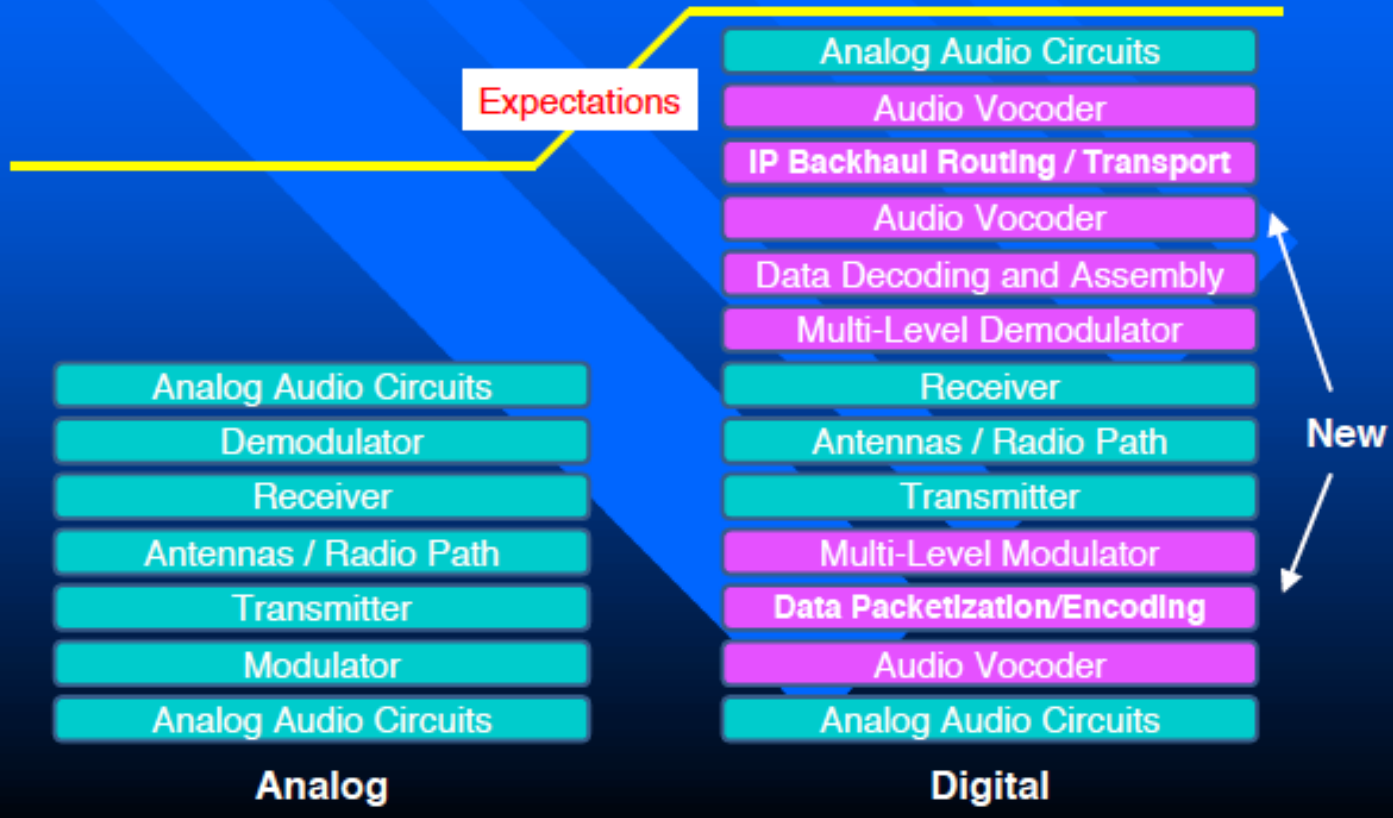
DAQ	Definition	MOS	Definition
DAQ 1.0	Unusable. Speech present but not understandable.	MOS 1	Bad. Very annoying.
DAQ 2.0	Understandable with considerable effort. Frequent repetitions and noise/distortion.	MOS 2	Poor. Annoying.
DAQ 3.0	Speech understandable with slight effort. Occasional repetition required due to noise/distortion.	MOS 3	Fair. Slightly annoying.
DAQ 3.4	Speech understandable with repetition only rarely required. Some noise/distortion.	MOS 4	Good. Impairments perceptible but not annoying.
DAQ 4.0	Speech easily understood. Occasional noise/distortion.	MOS 5	Excellent. Impairments imperceptible.

MOS = Mean Opinion Score. Note that repetitions are not part of definition. No correlation between DAQ and MOS is implied by this table.



So What's New with Digital?

*Many more systems, software, and technology between the user and their expectations
Users who expect the "same performance but better"*



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**This is why DAQ testing takes all of this into account –
what does the end user hear –
good or bad audio??**



New



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Signal Distribution Options

NFPA 1221

The AHJ may approve, a signal distribution network can support additional services such as Cellular carriers, and PCS as long as there is no harmful interference to either service.

Same Antenna System can be used for:

- Public Safety

- Wi-Fi

- Cellular Communication (ATT / Verizon / Sprint etc.)

However, not always recommended





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NFPA 1221 TESTING PER ANNEX

- Divide each floor into 20 equal sized grids (< 128,000sf), test for minimum DAQ 3.0 audio - Document results (per Standard Specification)
- 2 non- adjacent grids can fail either test and still pass in the 20 grid squares tested.
- 2 adjacent, or more than 3 failing grids or Critical Area failure of a on a floor is considered a “fail” and requires halving the grid sizes
- Testing of battery back-up and Alarming function
- Provide Permit, Plan submittals and Test results
- Fill out compliance document (AHJ generated)





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Annual Inspection

- Best test is “CAN YOU HEAR ME NOW”, sampling is essential, and random testing in general areas.
- Specific testing in critical areas: (Fire control, pump rooms, exit stairs, elevators)
- Use the original acceptance results and maps.
- Test passes based on DAQ





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Common Problems encountered

- BDA amplifier not powerful enough to handle the building cable distances
- Donor antenna on the roof too close to other roof top antennas of other systems
- Bad cabling or connections (Crimped, cut, tight)
- Not enough distance (isolation) between Donor antenna and indoor antennas causing in-building system to go into self oscillation-very bad
- Amateurish installation





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SUMMARY of NFPA 1221 (2016) re 2-Way Radio Enhancement Systems

- Material moved from NFPA 72
- Backup power is 12 hours
- DAQ of 3.0 instead of RF signal levels (engineer to RF, Test to DAQ)
- Distributed Antenna Systems, including fiber optic cabling, now included





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