



ADRF & Public Safety ERCES

Emergency Responder Communication Enhancement System

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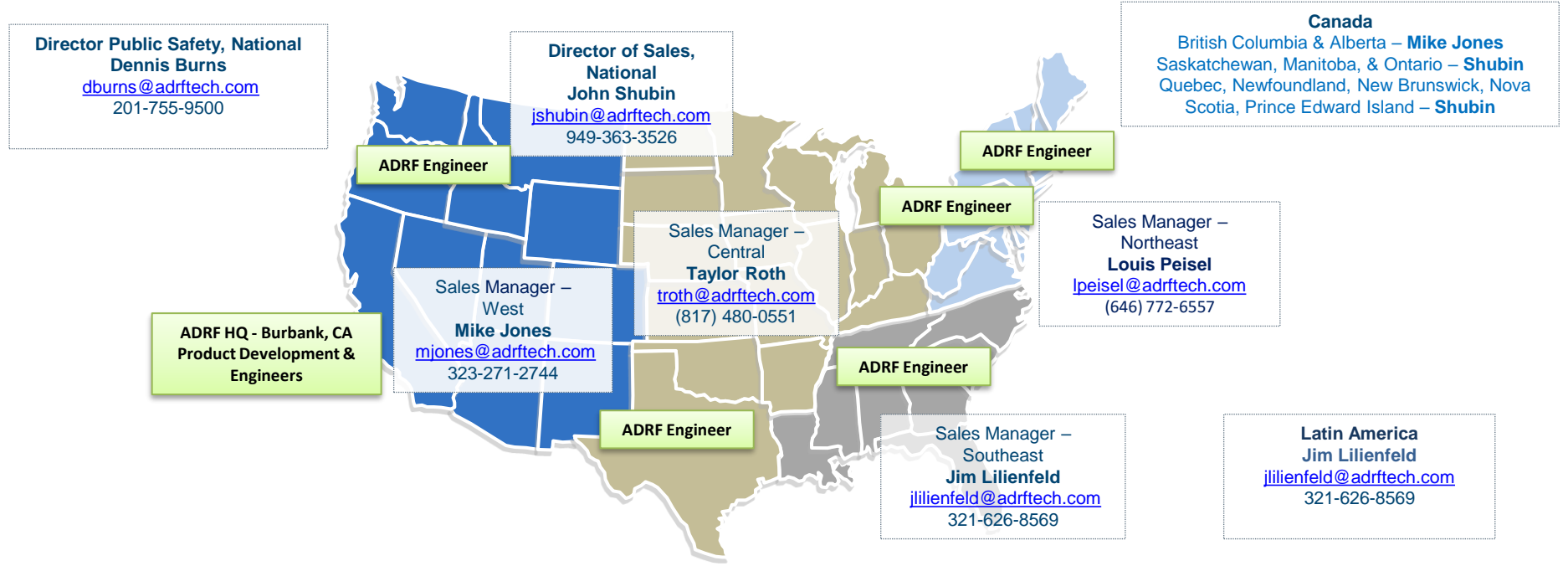


Agenda Topics

1. Who is ADRF
2. Public Safety Landscape
 - Glossary
3. Codes/Standards/Regulations driving the market
 1. IFC-2021 / NFPA-1225 Code Updates
4. ADRF Public Safety Solutions
5. UL 2524, Second Edition - “-U” Series Solutions
6. New Public Safety Products from ADRF
7. Stakeholders and Steps for Successful System Deployment
8. ADRF Advantages for Public Safety
9. ADRF Projects and Customer Deployments



ADRF National Footprint



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(800) 313-9345

DAS Engineering Team
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ADRF's Value Prop

Best-in-class Pre-sales Support

- Quick turnarounds on designs
- Easy to order
- Short shipping timeframes
- Fast product development schedule
- In-house manufacturing resources
- Training and certification, free of charge
- iBwave / RAN Plan - design / review / support

Best-in-class Post-sales Support

- Among lowest RMAs
- Flexible warranty terms- Extended Warranty available
- On-site commissioning assistance (complimentary)
- 24/7/365 remote troubleshooting and optimization
- Under warranty RMA or out of warranty repair

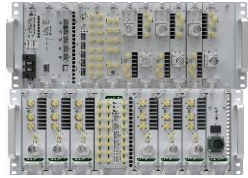
Best-in-class Industry Support

- Safer Buildings Coalition – Board President
- Engaged with National and Local Codes and Standards



ADRF Product Portfolio

Fiber DAS



ADXD Series



ADX V Series

Commercial Repeaters



MWR



SDR



SDR-ICS

Public Safety Repeaters



FiRe



PSR-U



PSR-X



PSR

Components



Antennas



Public Safety Landscape



History of Public Safety Communication

- 1852: First fire box was installed using telegraph technology
- 1896: National Fire Protection Association (NFPA)
- 1923: First two-way radio developed in Australia
- 1940s: Motorola two-way radio widely used in WWII
- 1950s: Two-way radio market shifted to Fire, Police and EMS
- 1973: First cellular phone call
- 1997: International Building Code published
- 1999: Wireless Communications and Public Safety Act was passed
- 2009: First Model Code Language for In-Building Public Safety Radio: Appendix of the IFC and NFPA



Glossary

- ERRCS/ERCES/ERRS/ESCS: Emergency Responder Radio Coverage Systems / Emergency Responder Communication Enhancement Systems / Emergency Responder Radio System / Emergency Services Communication System
- DAS: Distributed Antenna System
- PS-DAS: Public Safety DAS
- PS LTE: Public Safety LTE
- BDA: Bi-Directional Amplifier / Repeater
- AHJ: Authority Having Jurisdiction
- FirstNet: First Responder Network Authority is an independent government authority with a mandate to provide specialized communication services for public safety on LTE Band 14
- FACP – Fire Alarm Control Panel
- NFPA: National Fire Protection Association
- IFC: International Fire Code
- GROL: General Radio Operators License



ERCES (Public Safety DAS)

What is it?

- An In-Building Emergency Responder Communication Enhancement System ensures that radio signals are able to penetrate into all areas of buildings, including areas that are especially difficult for RF to penetrate such as stairwells, elevators, basements, and thick-walled or shielded. A typical passive ERCES consists of a BDA, donor antenna, coaxial cable, splitters, couplers, and server distribution antennas throughout the facility

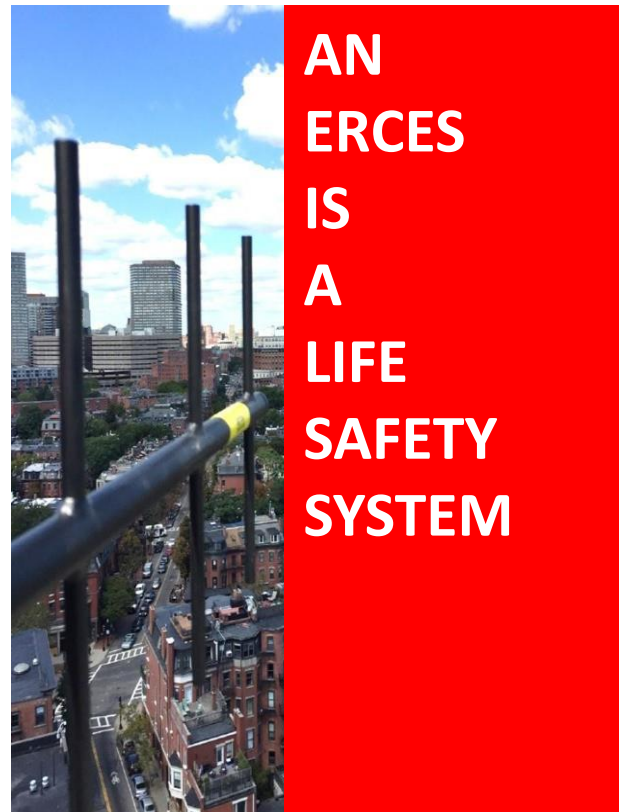
What is needed?

- Radio signals have limited propagation through various materials. Factors include how deep inside a building the receiver may be, wall composition, whether a building has energy saving “low-e glass” or other energy saving cladding, the specific frequencies in use (low frequencies penetrate better).
- In order to meet local codes enforced by local AHJ/FM (Authority Having Jurisdiction/Fire Marshal) buildings need to comply with either IFC, NFPA code year or requirements enforced by local AHJ
- IFC (Section 510) , NFPA 72(Chapter 24), 1221(Section 9.6) and NFPA 1225 Model codes being enforced by AHJ




ERCES – Emergency Responder Communication Enhancement System

- **Code Driven Requirements for all buildings new and existing.**
- **Local AHJ-Fire Marshal Specifications**
 - AHJ/Jurisdictions have different interpretations and requirements
- **Typically purchased with Fire Alarm**
 - Installed and tested by qualified, factory certified technicians
 - Inspected by AHJ
- **Supervised by the building's fire alarm system**



Public Safety Opportunity

- The FCC estimates that an improvement of one minute for 9-1-1 response time would save 10,000 lives in the US each year
 - 80% of 911 calls are generated from a cell phone  65% from cell in-building!
- Evolution of NFPA & IFC fire codes will continue to drive demand
 - New codes will also create confusion & opportunities
- There are more than 6.2 million commercial buildings in the US today!
 - Growth of 6% to 8% per year
- In-building public safety DAS will double by 2021 and revenue will increase to \$1.7 billion with largest spend in North America
- BDA's will outpace traditional Life Safety Security market within 3 years
- The DAS/BDA market is growing at 17%-20% per year
- Public Safety will help drive new commercial cellular opportunities
- Public Safety is a 'MUST HAVE & REQUIRED' by most AHJ's today



Total Construction Forecast by 2024 Across Verticals

(In Billions)



Codes, Standards and Regulations



**IFC
510**



**72
1221
1225**



**Federal
Part 20
Part 90**



**State
and
Local**



**60950
2524
62368**

Public Safety Codes and Standards for ERRCS/ERCES



National Fire Protection Association (NFPA):

National Fire Alarm and Signal Codes for installation, performance, operation of public emergency services, communication systems and facilities.



International Fire Codes (IFC):

A model code that regulates minimum fire safety requirements for new and existing buildings, facilities, storage, and processes.



Underwriters Lab (UL):

Standards designed to make two-way emergency radio communication systems safer and more reliable for first responders.

Public Safety Codes and Standards for ERCES

- **IFC Code Section 510 – Contains key ERCES Requirements**
- **NFPA 1 – Fire Code, Life Safety for Public and First Responders**
- NFPA 72 – Fire Alarm and Signaling Code
- NFPA 1221 – Survivability & Standard for the Installation Maintenance and Use of Emergency Responder Systems
- NFPA 1061, Standard for Public Safety Telecommunications Personnel Professional Qualifications
- **NFPA 1225 - Standard for Emergency Services Communications (1221 & 1061)**
- NFPA 101 – Life Safety Code
- FCC Part 90 Rules (FCC.gov)
- UL 2524 – In-building 2-Way Emergency Radio Communications Enhancement Systems
- Local Code Amendment Publications



NFPA 72 & 1221 – Section 9.6

Emergency Services Communications Systems

NFPA 72 CODES	NFPA 72 - 2013	NFPA 1221 - 2016	NFPA 1221 - 2019
In-Building Solution Required	NFPA 1 Section 11.10	NFPA 1 Section 11.10	NFPA 1 Section 11.10
Pathway Survivability for Coaxial Cable Required	2 Hour for Riser Coaxial Cable – Sec. 24.3.6.8	2-Hour for Riser Coaxial Cable - Sec. 9.6.2.1.3	Backbone Cable Routed Through Enclosure Matching Bldgs. Fire Rating Sec. 9.6.2.3
Plenum Rated Coaxial Cable Required	Yes, Riser & Feeder Coaxial Cable Sec. 24.3.6.8	Yes, Riser & Feeder Coaxial Cable – Sec. 9.6.2.1.1.1	Yes, Backbone & Antenna Distribution Cables Sec. 9.6.2.1
Lightning Protection Required	Not addressed in Section 24.5.2	Yes, In accordance with NFPA 780 – Sec. 9.6.3	Yes, Section 9.6.3 Installed per NFPA 780
Isolation of Donor Antenna Required	Yes, 15 db – Sec. 24.5.2.3.3	Yes, 20 db – Sec. 9.6.9	Yes, 20 dB Above System Gain Sec. 9.6.9
Battery Backup Required	12 Hours – Sec. 24.5.2.5.2	12 Hours – Sec. 9.6.12.2	12 Hours Battery or Generator Section 9.6.12.2
Signal Strength & Area Coverage Required	-95 dBm – Sec. 24.5.2.3 90% General – Sec. 24.5.2.2.2 99% Critical – Sec. 24.5.2.2.1	DAQ 3.0 - Sec. 9.6.8 90% General - Sec. 9.6.7.5 99% Critical - Sec. 9.6.7.4	DAQ 3.0 - Sec. 9.6.8 90% General - Sec. 9.6.7.4 99% Critical - Sec. 9.6.7.3
Monitoring By Fire Alarm Required	Yes – Sec. 24.5.2.6	Yes – Sec. 9.6.13	Yes – Sec. 9.6.13 & Chapter 10 of NFPA 72
Cabinets for Equipment & Battery Backup Required	Yes, NEMA 4/NEMA 4X – Sec. 24.5.2.5.2	Yes, NEMA 4/NEMA 4X – Sec. 9.6.11.2	Yes, NEMA 4/4X & NEMA 3R for Batteries Sec. 9.6.11.2
Monitor Antenna Malfunction Required	Yes, Donor Antenna – Sec. 24.5.2.6(2)(a)	Yes, Donor Antenna – Sec. 9.6.13.1(2)(a)	Yes, Donor Antenna – Sec. 9.6.13.2.1(5)
System Acceptance/Testing	Section 24.5.2.1.2 & 14.4.10	Section 9.6.4, 11.3.9 & 11.3.9.1	Section 9.6.4, 11.3.9 & 11.3.9.1
Listing of Equipment	Not Specifically Addressed	Not Specifically Addressed	Specific Listing Requirement TBD by the AHJ






IFC – Section 5.10-ERRCS

Emergency Responder Radio Coverage Systems

IFC CODESU	IFC - 2015	IFC - 2018	IFC - 2021
In-Building Solution Required	Sec. 510.1	Sec. 510.1	Sec. 510.1
Pathway Survivability for Coaxial Cable Required	Not Specifically Addressed in Section 510. Referenced in 2013 NFPA 72 Sec. 24.3.6.8	Yes, Section 510.4.2. Reference to NFPA 1221. ** Also See NFPA 1221 TIA 16-2	Yes, Section 510.4.2. Reference to NFPA 1221.
Plenum Rated Coaxial Cable Required	Not Specifically Addressed in Section 510. Referenced in 2013 NFPA 72 Sec. 24.3.6.8	Yes, Sec. 510.4.2. Reference to NFPA 1221	Yes, Section 510.4.2 Reference to NFPA 1221
Lightning Protection Required	Not Specifically Addressed in Section 510	Yes, Sec. 510.4.2 Per NFPA 780 as Referenced in NFPA 1221	Yes, Sec. 510.4.2 Per NFPA 1221 Sec. 9.6.3 Installed per NFPA 780
Isolation of Donor Antenna Required	Not Specifically Addressed in Section 510	Yes, 20 db – Sec. 510.4.2.4 (4)	Yes, 20 db – Sec. 510.4.2.4 (4)
Battery Backup Required	24 Hours – Sec. 510.4.2.3	12 Hours – Sec. 510.4.2.3 or 2- Hours Battery w/ Emergency Generator	12 Hours – Sec. 510.4.2.3 or 2- Hours Battery w/ Emergency Generator
Signal Strength & Area Coverage Required	-95 dBm – Sec. 510.4.1 95% General – Sec. 510.4.1 99% Critical – Not Specifically Addressed in Sec. 510	DAQ 3.0 - Sec. 510.4.1.1 95% General - Sec. 510.4.1 99% Critical - Sec. 510.4.2 Reference to NFPA 1221	DAQ 3.0 - Sec. 510.4.1.1 95% General - Sec. 510.4.1 99% Critical - Sec. 510.4.1
Monitoring By Fire Alarm Required	Not Specifically Addressed in Sec. 510 – See 2013 NFPA 72	Yes – Sec. 510.4.2.5	Yes – Sec. 510.4.2.5
Cabinets for Equipment & Battery Backup Required	Yes, NEMA 4 – Sec. 510.4.2.4 (1) & (2)	Yes, NEMA 4/NEMA 3R – Sec. 510.4.2.4 (1) & (2)	Yes, NEMA 4/NEMA 3R – Sec. 510.4.2.4 (1) & (2)
Monitor Antenna Malfunction Required	Not Specifically Addressed in Section 510	Yes, Donor Antenna – Sec. 510.4.2.4(4)	Yes, Donor Antenna – Sec. 510.4.2.4(4)
System Acceptance/Testing	Section 510.5.3	Section 510.5.3	New – Section 510.5.4 Annual – Section 510.6.1
Listing of Equipment	Not Required by Section 510	Not Required by Section 510	Yes, Section 510.4 (UL 2524, 2 nd edition)
Mounting of Donor Antenna	Not Specifically Addressed	Not Specifically Addressed	Section 510.5.1

UL 2524 Overview

- Covers products used for in-building 2-way Emergency Responder Communication Enhancement Systems (e.g. repeater, transmitter, receiver, signal booster components, remote annunciators and operational consoles, power supply, and battery charging system components) installed in a location to improve wireless communication at that location.
- Does not cover passive RF components which are defined in the standard as “any device that RF passes through that does not have an active electronic component that requires external power. This includes, antennas, splitters, couplers, coaxial cable and connectors. Passive components cannot amplify RF signals.”

Model: PSR-78-9533-U	
	UL 2524 Listed Second Edition: In-building Two-way Emergency Radio Enhancement System Equipment
	Indoor Environment / Dry Location Type 4 Enclosure / Watertight
	AC Input: 100-240Vac, 50/60Hz, 1.93 – 0.84A DC Input: 27Vdc, 4.85A (Battery Port Only)
S/N: P789537U200001	 Advanced RF Technologies 3116 WEST VANOWEN ST. BURBANK, CA 91505
	

Code Updates



510.1 Emergency responder communication coverage in new buildings.

Approved in-building, two-way emergency responder communication coverage for emergency responders shall be provided in all new buildings. In-building, two-way emergency responder communication coverage within the building shall be based on the existing coverage levels of the public safety communication systems utilized by the jurisdiction, measured at the exterior of the building. This section shall not require improvement of the existing public safety communication systems.

510.2 Emergency responder communication coverage in existing buildings.

Existing buildings shall be provided with *approved* in-building, two-way emergency responder communication coverage for emergency responders as required in [Chapter 11](#).

510.4 Technical requirements.

Equipment required to provide in-building, two-way emergency responder communication coverage shall be *listed* in accordance with [UL 2524](#). Systems, components and equipment required to provide the in-building, two-way emergency responder communication coverage system shall comply with [Sections 510.4.1](#) through [510.4.2.8](#).



510.5.3 Minimum qualifications of personnel.

The minimum qualifications of the system designer and lead installation personnel shall include both of the following:

- 1.1. A valid FCC-issued general radio operators license.
- 2.2. 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.



11.10* Two-Way Radio Communication Enhancement Systems.

11.10.1 - In all new and existing buildings, minimum radio signal strength for fire department communications shall be maintained at a level determined by the AHJ.

11.10.2 - Where required by the AHJ, two-way radio communication enhancement systems shall comply with NFPA 1221.

11.10.3 - Where a two-way radio communication enhancement system is required and such system, components, or equipment has a negative impact on the normal operations of the facility at which it is installed, the AHJ shall have the authority to accept an automatically activated responder system.



18.2.1*

Where an in-building emergency responder communications enhancement system is used, the design of the system shall be approved by the AHJ and the frequency license holder(s).

18.3.2* **Oscillation Detection and Control.**

Signal boosters used in emergency responder communications enhancement systems shall have built-in oscillation detection and control circuitry to reduce gain and maintain operation.

18.3.4 **Communication Antenna Density.**

18.3.4.1*

In-building emergency responder communication enhancement systems shall be designed to minimize the near-far effect.

18.3.4.2

In-building emergency responder communication enhancement system designs shall include a sufficient number of distribution antennas(density) to address reduced gain conditions.

18.3.4.3

Where an in-building emergency responder communication enhancement system is required and such system, components, or equipment has a negative impact on the normal operations of the facility at which it is installed, the AHJ shall have the authority to accept an automatically activated responder system.



18.6 Non-Interference and Non-Public Safety System Degradation.

18.6.1*

No in-building emergency responder communications enhancement system capable of operating on frequencies or causing interference to frequencies assigned to the jurisdiction by the licensing authority of the country of jurisdiction shall be installed without prior coordination and approval of the AHJ and the frequency license holder(s).

18.6.2

The building owner or authorized agent shall suspend and correct equipment installations that degrade the performance of the public safety communications system or emergency responder communications enhancement system.

18.6.3*

Systems that share infrastructure with non-public safety services shall ensure that the coverage and performance of the public safety communications channels are not degraded below the level of performance identified in Sections [18.8](#) and [18.9](#), regardless of the amount of traffic carried by the non-public safety services



18.12 System Components.

18.12.1* Component Approval, Certification, and Listing.

18.12.1.1

RF-emitting devices and cabling used in the installation of in-building emergency responder communications enhancement systems shall be approved by the AHJ and the frequency license holder.

18.12.1.2

All RF-emitting devices shall have the certification of the radio licensing authority of that country and be suitable for public safety use prior to installation.

18.12.1.3

All repeaters, transmitters, receivers, signal-booster components, remote annunciators and operational consoles, power supplies, and battery charging system components shall be listed and labeled in accordance with **UL 2524, *Standard for In-Building 2-Way Emergency Radio Communication Enhancement Systems.***



18.12.3 Component Requirements.

18.12.3.3

Backbone cables and backbone cable components installed in buildings that are fully protected by an automatic sprinkler system in accordance with NFPA 13 shall not be required to have a fire resistance rating.

18.12.3.4*

Backbone cables and backbone cable components installed in nonsprinklered buildings, in buildings that are partially protected by a sprinkler system, or in high-rise buildings shall be protected from attack by fire in accordance with one of the following:

- (1) Use a cable with a listed fire-resistance rating in accordance with the following:
 - (1) Where the primary structural frame of a building is required to have a fire-resistance rating of 2 hours or more or is classified as heavy timber construction, the minimum fire-resistance rating shall be 2 hours.
 - (2) Where the primary structural frame of a building is required to have a fire-resistance rating of less than 2 hours, the minimum fire resistance rating shall be 1 hour.
 - (3) Where the primary structural frame of a building does not require a fire-resistance rating, a fire resistance rating shall not be required.



18.13 Power Sources.

At least two independent and reliable power sources shall be provided for all RF-emitting devices and any other active electronic components of the system: one primary and one secondary.

18.13.1 Primary Power Source.

The primary power source shall be all of the following.

- (1) Supplied from a dedicated branch circuit
- (2) Permanently connected
- (3) Compliant with *NFPA 72*
- (4) Protected from overvoltage

18.13.2 Secondary Power Source.

The secondary power source shall consist of one of the following:

- (1) A storage battery dedicated to the system with 12 hours of 100 percent system operation capacity
- (2) An alternative power source of 12 hours at 100 percent system operation capacity as approved by the AHJ
- (3) A 2-hour standby battery and connection to the facility generator power system, providing the facility generator power system can support the complete system load for 12 hours



20.3 Operational Testing

- Operational tests to verify system performance each year – Entire section detailing what needs to be done annually and every 5 years

20.3.10.2.3 Periodic Testing of Systems.

20.3.10.2.3.1

All systems shall be operationally tested at least annually to confirm system operation during normal operations.

20.3.10.2.3.2

Annual operational tests shall include the following:

- (1) At least one quantitative DAQ test shall be in accordance with [18.9.1](#) and [18.9.2](#) on each floor. Where the floor area exceeds 128,000 ft² (11,900 m²), additional quantitative tests shall be performed.
- [\(2\)*](#) Signal boosters shall be tested to verify that the gain is the same as it was during the initial installation and acceptance or set to optimize the performance of the system.

- (3) Backup batteries and power supplies shall be tested under load for a period of 1 hour.
- (4) Other active components shall be checked to verify operation within the manufacturer's published specifications.
- (5) All required supervisory monitoring signals shall be tested.
- (6) A spectrum analyzer or other suitable test equipment shall be utilized to ensure spurious oscillations are not being generated by the subject signal booster.
- (7) Where a donor antenna is used, isolation in accordance with Section [18.10](#) shall be verified.
- (8) An inspection shall be made to evaluate if the building structural changes or alternations that have been made impact the communications coverage of the system as required in Section [18.8](#).

20.3.10.2.3.3

At least every five years systems shall be quantitatively tested to ensure that the system still provides the required DAQ values in accordance with Section [18.9](#).





NFPA 1225 – 2022 Edition

Q: Is there anything in the code that specifically prohibits shared infrastructure between LMR and LTE systems?

A: No.

18.6.3*

Systems that share infrastructure with non-public safety services shall ensure that the coverage and performance of the public safety communications channels are not degraded below the level of performance identified in Sections 18.8 and 18.9, regardless of the amount of traffic carried by the non-public safety services.

- New Jersey - vote planned in 2023 on IFC 510.2 which could become first state to mandate ERCES coverage in ALL existing buildings
- Jurisdictions authorizing NFPA 1225 for ERCES even though the state might be on an older version of model fire code
 - Jacksonville, FL, Orlando, FL, Miami Dade, FL
- Orange County, CA now mandating channelized Class B (<200KHz) in new ERCES requirements
- New Bill working its way through the House in Michigan – HB 5561
 - All K-12 schools MUST have an ERCES!
- 2024 IFC Draft contains minimum square footage requirement of 12,000 square feet for ERCES
- NC approved statewide code change: all new buildings >7.5k sq' must have ERCES coverage
- AHJ's mandating NICET certification and UL ERCES program as part of ERCES permitting
 - San Francisco – UL ERCES Certification starting Jan 1, 2023
 - NC mandating NICET Certification starting July 2023
- New TIA's introduced to make changes/updates to NFPA 1225
- CA now enforcing IFC 2021 Statewide as of 1/1/2023



- Denver is currently IFC 2018 with several amendments
 - All new buildings 50,000 square feet or more must test for first responder coverage
 - System must cover the public safety 800MHz band
 - System can be Class A or Class B
 - Permitting requires an FCC GROL plus a Denver Fire Department License
 - Integrator/Installer must be certified by the OEM for all equipment being installed
 - Battery backup is 12 hours standalone or 4 hours plus a generator
 - ERCES Backbone must be in 1-hour fire rated conduit
 - ERCES Distribution does not require conduit
 - Annunciator is not mandatory, but all NFPA alarms must be supervised at the FACP per NFPA
 - UL 2524 is not mandatory currently, but Denver Fire evaluating potential change later in 2023
- Note:
 - Denver has postponed moving to IFC 2021 and will re-look at potential move later in 2023
 - UL Muting is not mandatory today, but Denver Fire is looking to add this requirement later in 2023

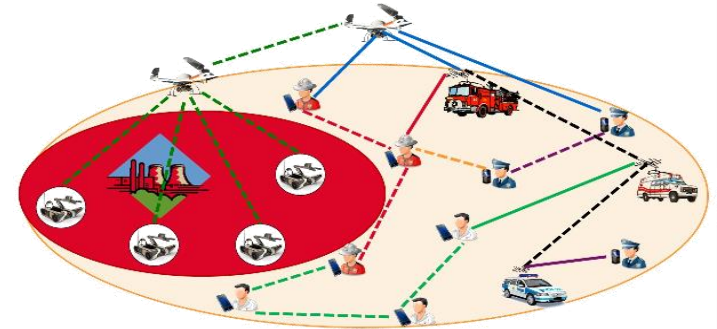


Public Safety Frequency Bands

Public Safety Frequencies

- Similar to commercial spectrum ownership and operation, the frequencies used by public safety groups and first responders will vary depending on the state, market, and/or county. Each system will be operating one or more of the following frequencies:

Freq.	Downlink	Uplink
VHF	136-174 MHz	
UHF	380-512 MHz	
700 MHz PS	758-775 MHz	788-805 MHz
800 MHz PS	851-861 MHz	806-816 MHz
900 MHz PS	929 – 942 MHz	896 – 903 MHz



Public Safety Frequencies

- **VHF/UHF**
 - Set up for many narrowband channels as small as 6.25KHz
 - Unlike 700MHz and 800MHz, the Tx (Downlink) and Rx (Uplink) channels don't have a designated frequency range. They can be spread out and interleaved across the frequency band
- **700 MHz(SMR)/PS LTE & FirstNet**
 - 20 MHz (10 DL/10 UL) of 700 PS Band has been allocated for FirstNet, providing uniform LTE coverage for many critical organizations. The roll out of this service is in full swing and being used today!
- **800 MHz**
 - Currently the most commonly used Public Safety frequency band
- **900 MHz**
 - Primarily used for private "in-house" radio and campus/casino operations

Public Safety Repeater Classes

FCC Part 90 Repeater Classes

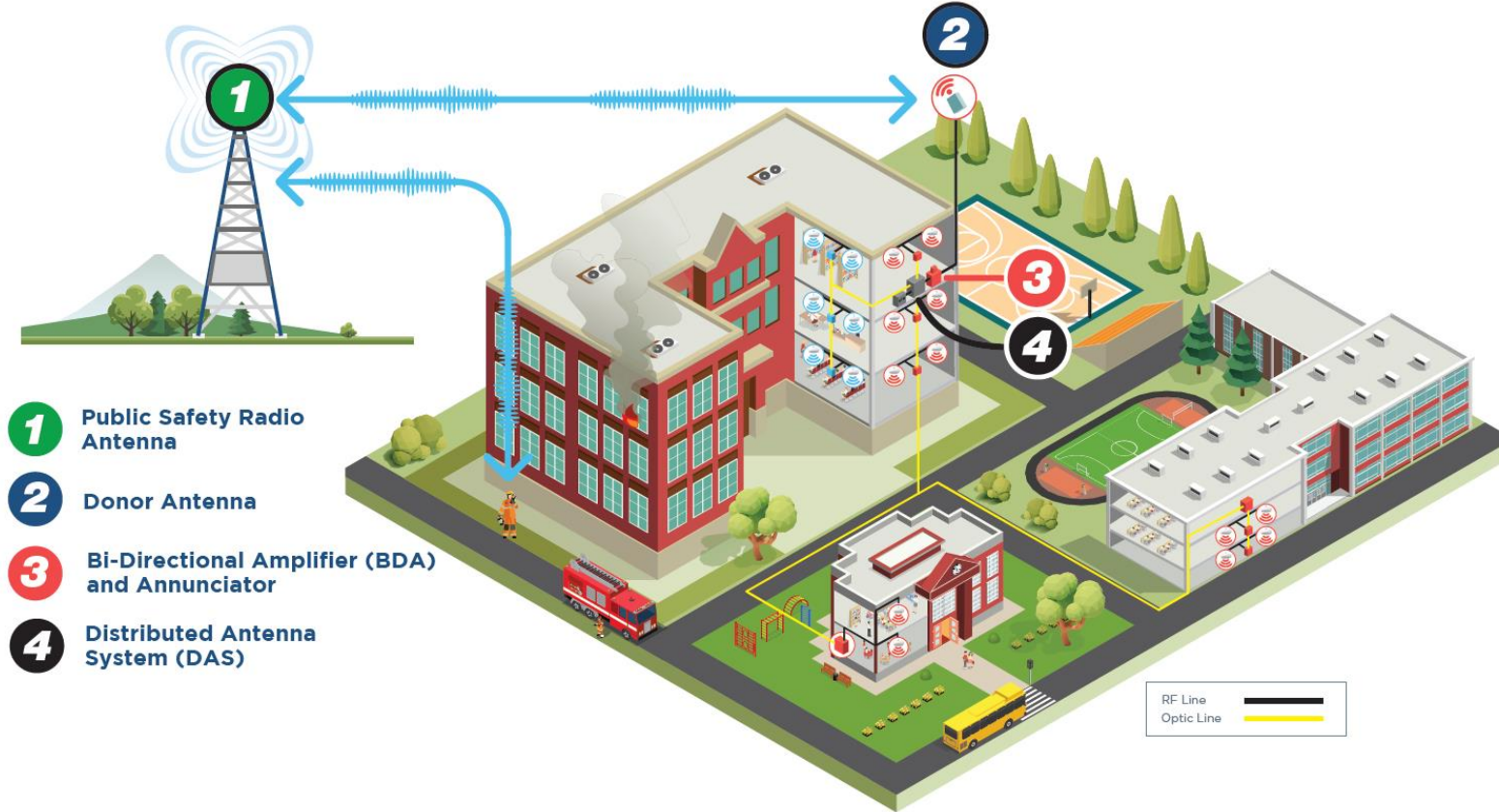
- Public Safety repeaters are classified in two categories based primarily on the **filtering bandwidth** for the supported channels.
- The AHJ may specifically require the use of a Class A or Class B repeater.

Class A	Class B
Capable of finer filtering to select channels as narrow as 6.25KHz	Allows for the selection of channels as narrow as 250KHz
Typically, capable of supporting 8 or more narrowband channels, no passbands exceeding 75KHz	Typically supports one or two wideband filters with passbands that exceed 75KHz (up to 20MHz) to support multiple channels
Ideal for system that has channels dispersed throughout the band or interleaved with channels that need to be excluded from the system	Ideal for system where all the supported channels are contiguous
Recommended for applications that are sensitive to noise	Can introduce more noise to the system if the supported traffic channels are non-contiguous



Public Safety System Architecture

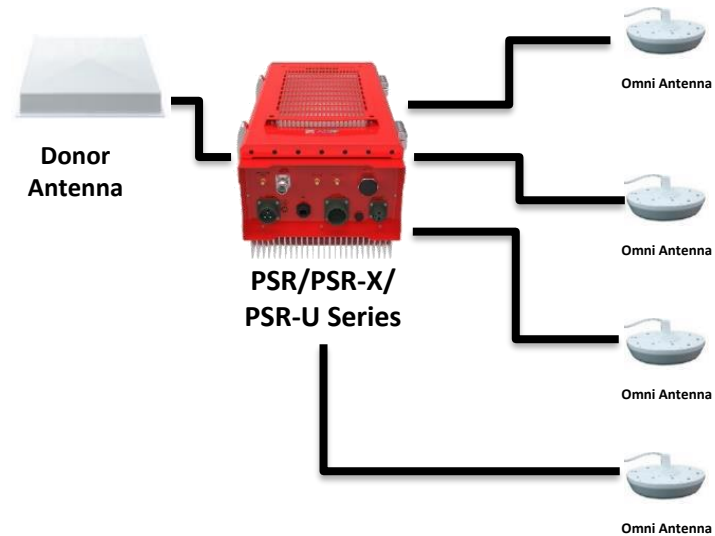
Public Safety Solutions System Diagram



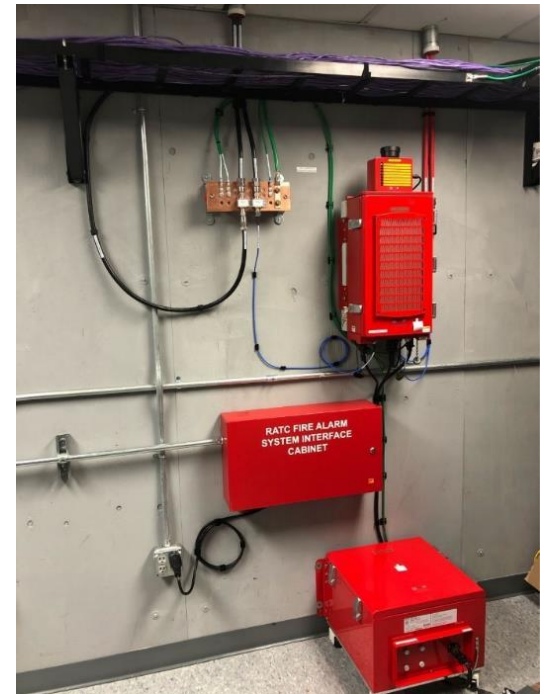
- 1** Public Safety Radio Antenna
- 2** Donor Antenna
- 3** Bi-Directional Amplifier (BDA) and Annunciator
- 4** Distributed Antenna System (DAS)

RF Line
 Optic Line

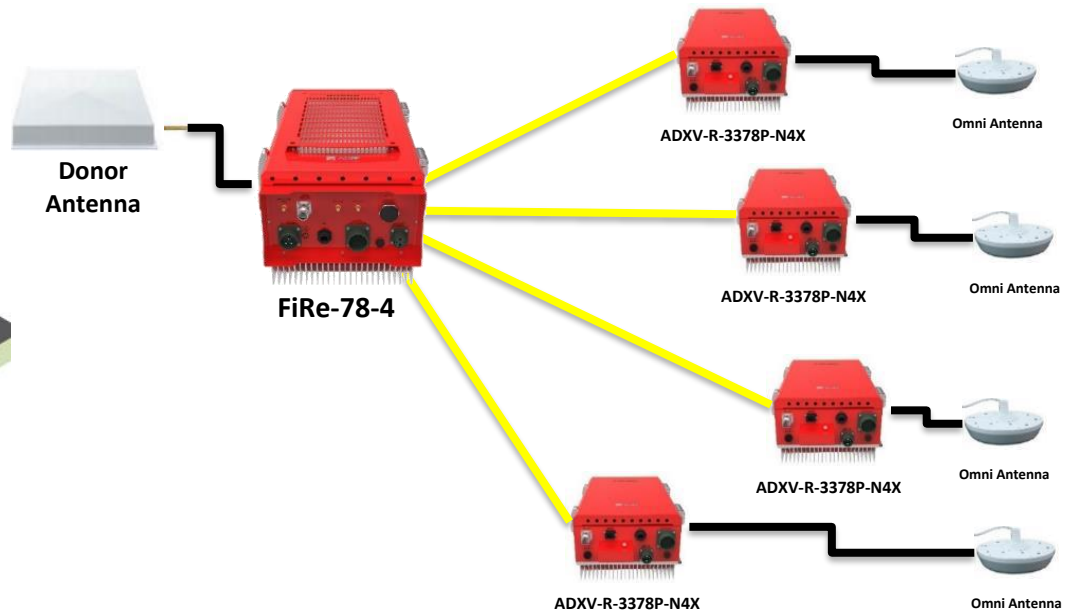
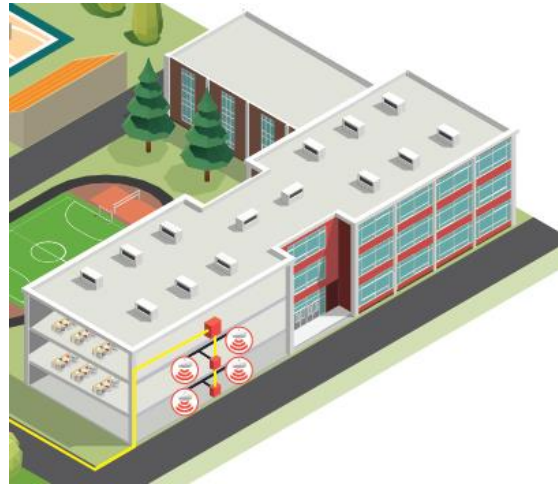
Public Safety Solutions – Small Venue



Typical Deployment Passive System (Small Venue)



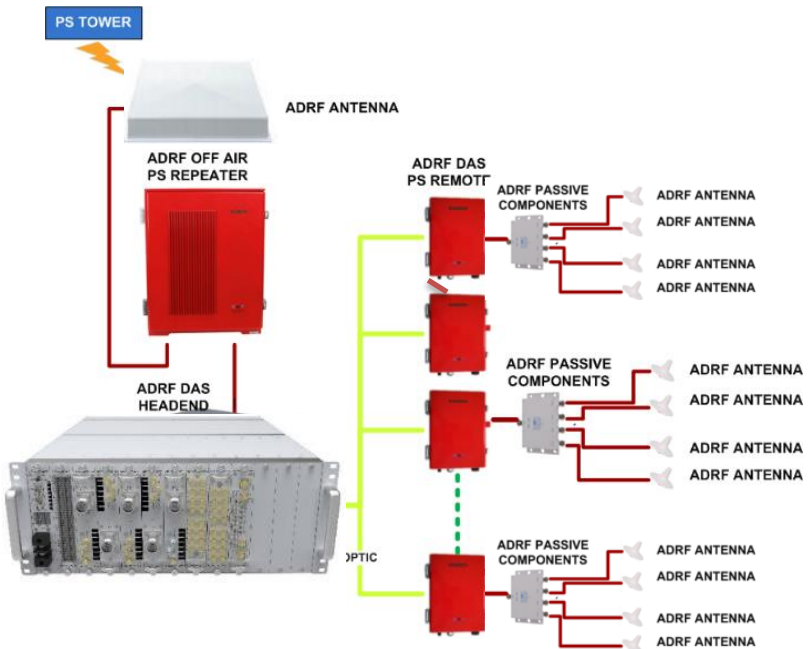
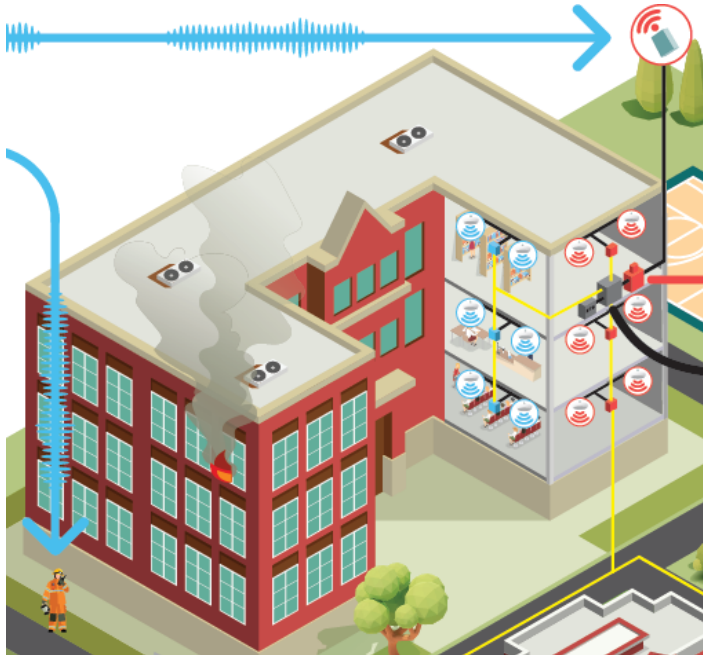
Public Safety Solutions – Medium Sized Venue (Hybrid)



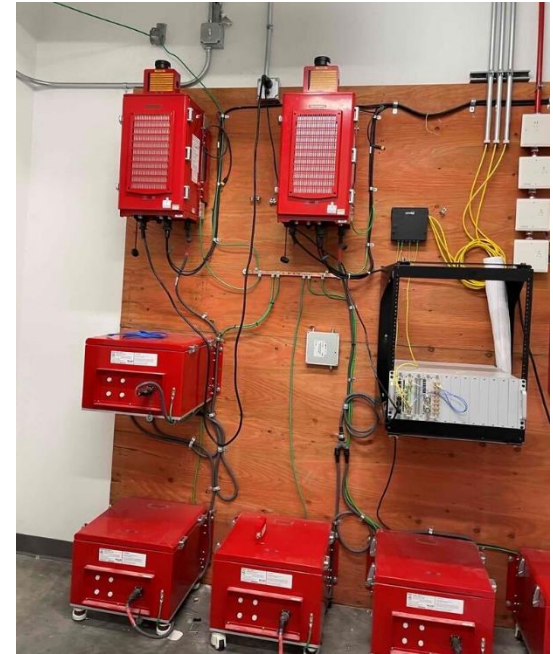
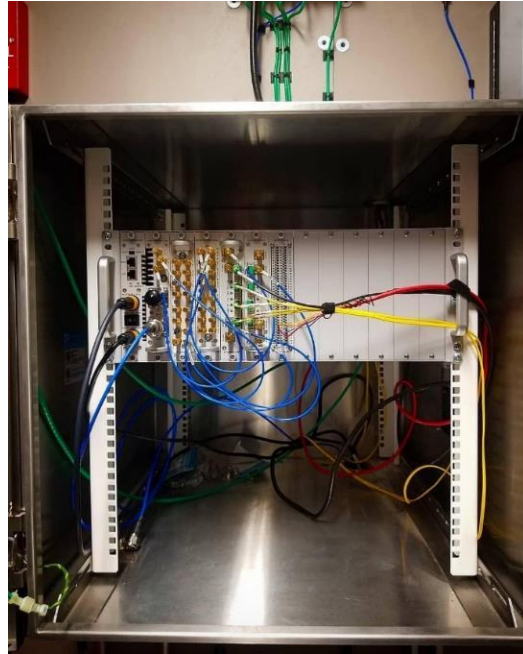
Typical Deployment for Hybrid Active Fiber DAS (Med to Large Venue)



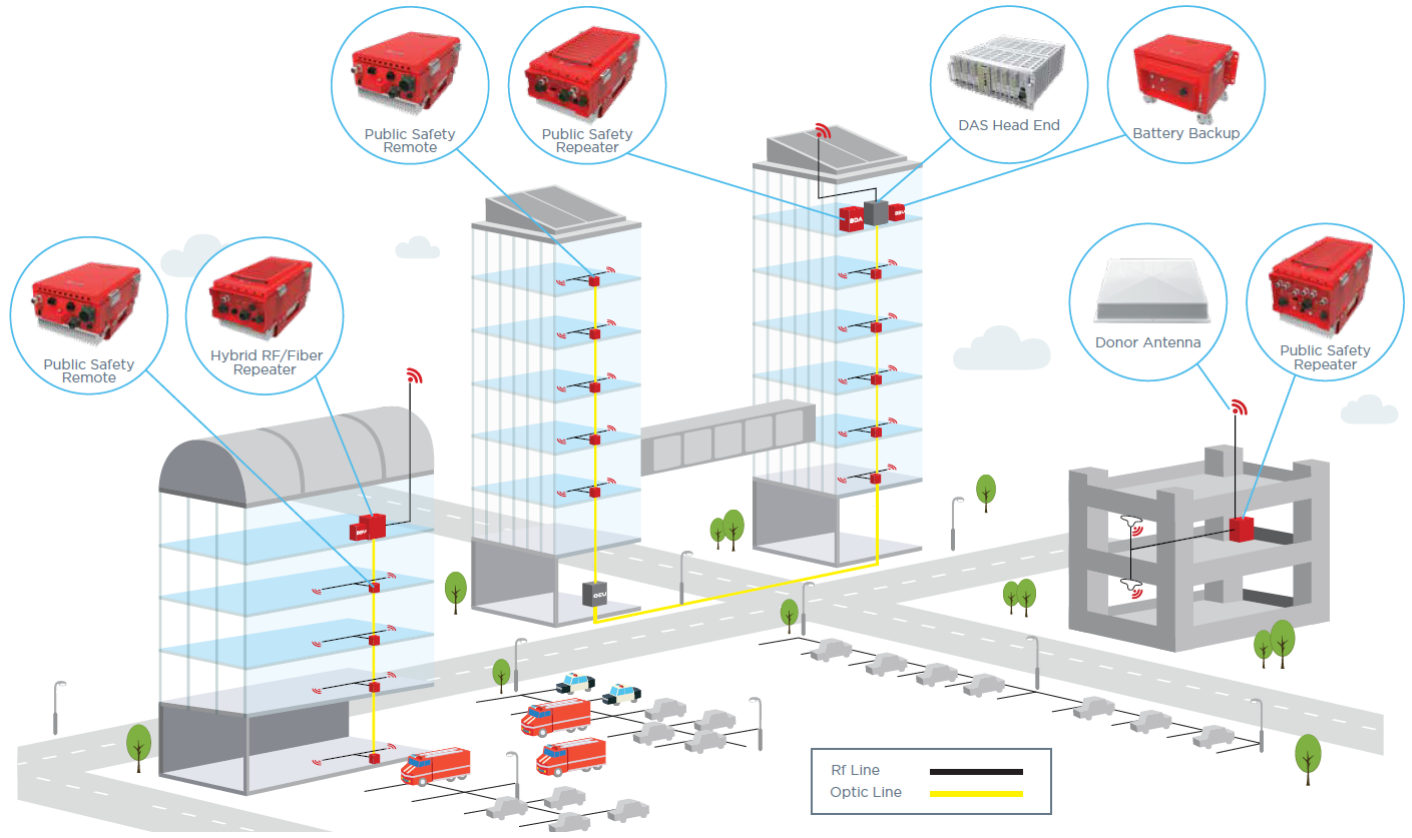
Public Safety Solutions – Large Venue



Typical Deployment for Active Fiber DAS (Med to Large Venue)



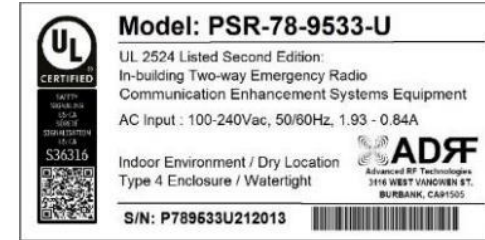
Public Safety Solutions in a Business Campus



ADRF **Public Safety** Products

ADRF Public Safety Products

- PSR-78-8527-PKG: Digital Class B, PS Repeater, 700/800 MHz, 0.5 watt
 - PSR-78-9533-X: Channelized Digital PS Repeater, 700/800 MHz, 2 watts
 - PSR-78-9537-X: Channelized Digital PS Repeater, 700/800 MHz, 5 watts
 - PSR-VU-9537-X: Channelized, Digital PS Repeater, VHF/UHF MHz, 5 watts
 - **PSR-78-9533-U: UL 2524 Channelized Digital PS Repeater, 700/800 MHz, 2 watts**
 - **PSR-78-9537-U: UL 2524 Channelized Digital PS Repeater, 700/800 MHz, 5 watts**
 - **PSR-VU-9537-U: UL 2524 Channelized Digital PS Repeater, VHF/UHF, simplex/duplex**
 - **PSR-U-9537-U: UL 2524 Channelized Digital PS Repeater, VHF/UHF, internal duplex**
-
- ADRF-BBS-X: Small battery back up unit
 - ADRF-BBL-X: Large battery back up unit
 - **ADRF-BBS-U: UL 2524 Small battery back up unit**
 - **ADRF-BBL-U: UL 2524 Large battery back up unit**
 - **ADRF-BBU-W: UL 2524 Wall mount battery back up unit (Q1 2023)**
-
- FiRe-78-4: Channelized Digital PS Hybrid Fiber Optic Repeater, 700/800 MHz (also supports VHF/UHF)
 - **FiRe-78-8-8-U: UL 2524 Digital PS Hybrid Fiber Optic Repeater, 700/800, 8 remotes (Q1 2023)**
 - ADRF-ADXV: Fiber DAS (VHF, UHF, 700, 800, & 900MHz)
 - ADXV-R-3378P-N4X, ADXV-R-25VU-N4X, 700, 800, VHF, UHF Fiber Remotes
 - **ADXV-R-3378P-U: UL 2524 700/800MHz Fiber Remote (Q1 2023)**



(UL 2524 Listed/Certified products highlighted in red)
 (All PSR “-X” and “-U” Series include the annunciator)

PSR-U SERIES

NFPA / IFC Compliant and UL 2524, second edition, Listed/Certified

ADRF is the first to achieve UL 2524, second edition certification with UL for North America and currently the only OEM to use the new UL enhanced smart certification mark



Smart Mark with QR Code – Landing page on UL Product IQ Certification Site



[Print this page](#)



ADRF UL 2524 Certified/Listed, 2nd Edition Products for North America

THIS PRODUCT IS
CERTIFIED BY UL



This page confirms the products listed are Certified by UL. Scroll down to see more details about Product and Manufacturer Information, and Certification.

Manufacturer Information



ADVANCED RF TECHNOLOGIES INC
3116 W VANOWEN ST
BURBANK, CA 91505-1237, United States

Product Information

Related Products under this Certification

- ADRF-BBL-U - In-building two-way emergency radio enhancement system equipment enclosure - battery box
- ADRF-BBS-U - In-building two-way emergency radio enhancement system equipment enclosure - battery box
- PSR-78-9533-U - In-building two-way emergency radio enhancement system equipment - bi-directional amplifier
- PSR-78-9537-U - In-building two-way emergency radio enhancement system equipment - bi-directional amplifier
- PSR-ANN - In-building two-way emergency radio enhancement system equipment - dedicated annunciator
- PSR-U-9537-U - In-building two-way emergency radio enhancement system equipment - bi-directional amplifier
- PSR-VU-9537-U - In-building two-way emergency radio enhancement system equipment - bi-directional amplifier

Certification

Scope
Safety, Signaling

Certification Status
Certified

CCN(s)
UTMH

Unique Identifier (File Number)
S36316



700/800 MHz Repeaters: PSR-78-9533-U or 9537-U

UL 2524 Listed/Certified



Dual Band – Supports 700/800 MHz & 700 FirstNet

Support for both Class A or Class B

Maximum Gain 700/800 MHz: 95dB

DL Output Power 700/800 MHz: 2W & 5 W Version

Narrowband Digital Filtering (32 Channels, 4 Modes)

12.5, 25, 75, 100, 150, 200 KHz options

Wideband Digital Filtering (3, 5, 6, and 10MHz options)

NFPA 72, NFPA 1221 & IFC Code Compliant

Web GUI via DHCP

Dry Alarm Contacts

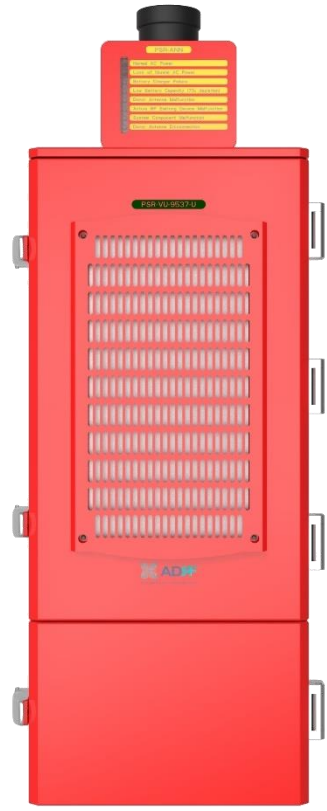
Wiring Compartment with Terminal Blocks for Easy Install

UL 2524 Listed/Certified Second Edition (UL ID: S36316)

Optional 12 and 24-Hour Battery Backup Unit

VHF/UHF Repeater: PSR-VU-9537-U / PSR-U-9537-U

(simplex or external duplexer) / (simplex or internal duplexer)



- Dual Band – Supports either VHF or UHF**
- Maximum Gain VHF : 85dB**
- Maximum Gain UHF : 85dB (APC025) / 95dB (LMR450)**
- Composite Output Power VHF [DL/UL]: 28dBm / 24dBm, w/o Duplexer**
- Composite Output Power UHF [DL/UL] : 37dBm / 27dBm, w/o Duplexer**
- Narrowband and Wideband Digital Filtering – Class A or Class B support**
- NFPA 72, NFPA 1221 & IFC Code Compliant**
- Adjustable ALC**
- Web GUI via DHCP**
- Dry Alarm Contacts**
- Wiring Compartment with Terminal Blocks for Easy Install**
- UL 2524 Listed/Certified Second Edition (UL ID: S36316)**
- Optional 12 and 24-Hour Battery Backup Unit**

Wiring Compartment



New Wiring Compartment

- Pre-drilled holes requiring liquid tight conduit hub connectors and connector fittings
 - 7/8" for AC, DC, ANN
 - 1 3/8" for Server, Donor, AAI
- New wiring terminals for *AC and **Battery Backup connections
- New PSR-ANN-U connector

*AC cable will be hard wired from circuit, through conduit, into new terminal blocks

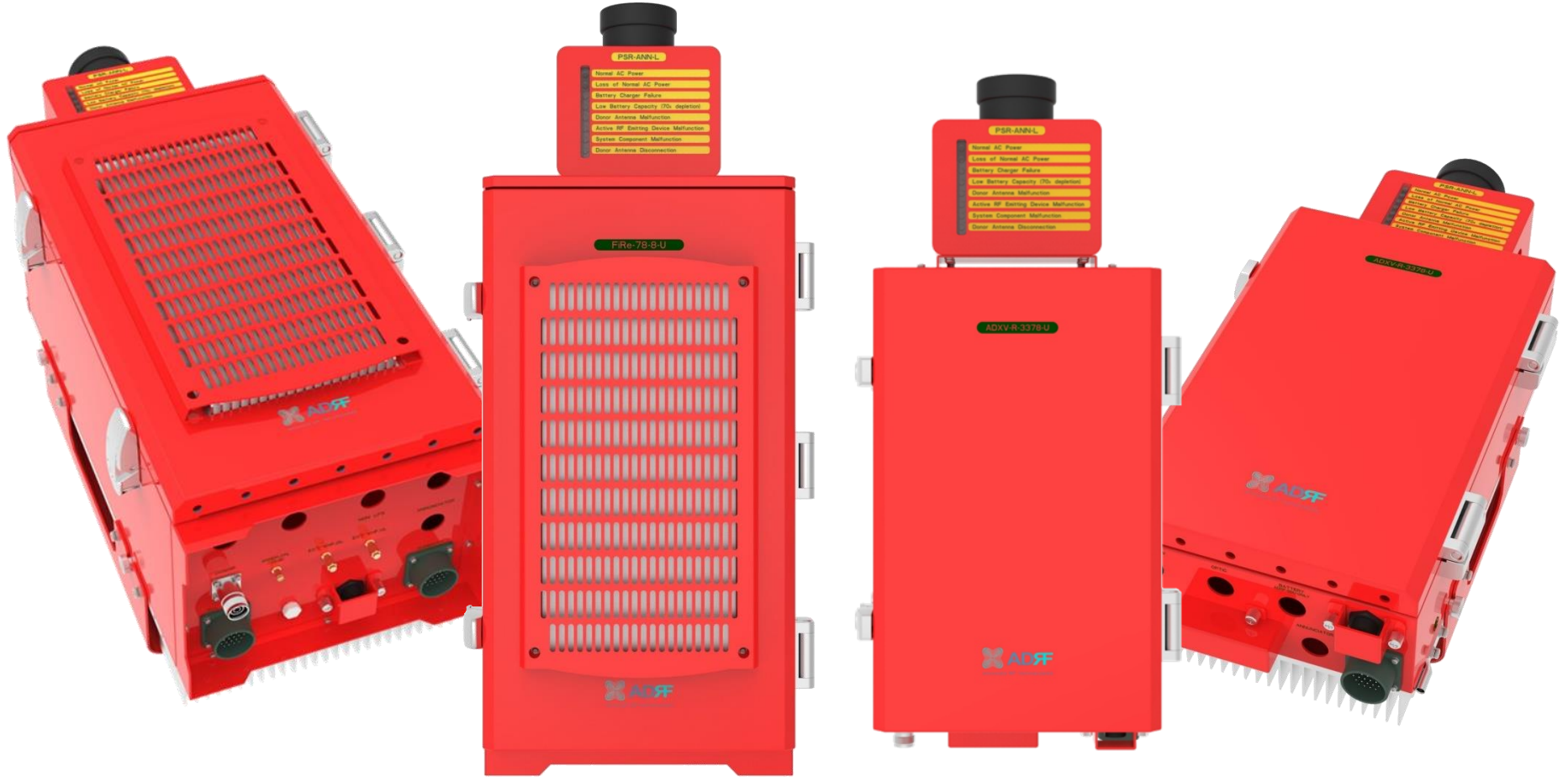
**Battery Backup cable will run through conduit and has leads that screw onto terminals

Battery Back-up – BBL-U & BBS-U – UL 2524 Listed

- DC battery backups are an option for **secondary** power source as required by the **NFPA/IFC** code in case the primary AC source is lost at the headend and at the remotes (for fiber DAS)
- Similar to the DAS equipment, the BBU needs to be enclosed in an **environmental approved enclosure**. BBU is in a **Type-4 with venting** chassis per code.
- The required runtime of the battery will **vary** depending on the jurisdiction(AHJ) between 2 hours and 24-hours
- The new BBL-U and BBS-U includes a new wiring compartment with terminal blocks for easy install



ADRF NEW **Public Safety** Products - Q1 2023



FiRe-78-8-U: Hybrid DAS PS Fiber Repeater



Combined repeater and fiber DAS headend in one NEMA 4 enclosure – feeds up to 8 PS remote units

Multi-Band – Supports 700 & 800 MHZ PS and FirstNet(PS LTE)

Maximum System Gain : 95 dB

Composite Output Power for each remote [DL]: 33 dBm

Wideband Filtering: 2 (non-contiguous) – Class B (3, 5, 6, 10MHz)

Narrowband: Up to 32 (noncontiguous) @ PS 700/PS 800 (4 modes) – Class A

Alarm monitoring/remote management of repeater & HE via web-based monitoring system

NFPA 72, NFPA 1221/1225 & IFC Code Compliant

Provides single point of interface for all subordinate modules

Supports ADRF-BBx for an external battery backup solution

Supports dry contact alarming at the headend and remote

Includes PSR-ANN-L (long range annunciator up to 1,000 feet) – ability to add 2nd PSR-ANN-L

ADXV-R-3378P-U - DAS PS Fiber Remote

ADXV-R-3378P-U

- UL 2524 Certified Second Edition
- 33dBm of downlink composite output power
- 4.3-10 Duplex output connector
- NEMA 4 enclosure
- Supports dry contact alarming
- Supports ADRF-BBx-U battery backup solutions
- Spectrum Analyzer Capability
- Supports optional ANN-L long range annunciator
- NFPA 72, NFPA 1221/1225 & IFC Code Compliant



Wall Mount Battery Back-up – ADRF-BBU-W

- UL 2524 Certified Second Edition
- Lithium-Ion battery option now available
- DC battery backups are an option for **secondary** power source as required by the **NFPA/IFC** code in case the primary AC source is lost at the headend and/or at the remotes (for fiber DAS)
- Similar to the DAS equipment, the BBU needs to be enclosed in an **environmental enclosure**. BBU is in a **Type-4 with venting** chassis per code
- The required runtime of the battery will **vary** depending on the jurisdiction(AHJ) between 2 hours and 24-hours





New Wall Mount Battery Backup Solution

ADRF-BBU-W Series

12V / 24V / 48V Battery Backup
Solution for ADRF Repeater / DAS



Product Features

- Wall mountable battery enclosure with support for 12V, 24V, and 48V configurations
- Tested, approved, and listed to UL 2524, Second Edition by Underwriters Laboratories (expected January 2023)
- Includes single cable between battery and DAS / repeater
- NFPA 72-2013, NFPA 1221-2016/2019, NFPA 1225, IFC 2015/2018/2021 code compliant and FirstNet compliant
- Support for up to 24-hour runtime and all NFPA / IFC compliant alarms
- Increase runtime by adding unit using parallel cable (ADRF-BBX-U-CBL-21P)

Electrical Specifications	ADRF-BBU-W-045-4S	ADRF-BBU-W-045-2P	ADRF-BBU-W-045-2S	ADRF-BBU-W-120-2P	ADRF-BBU-W-120-2S
Operating Voltage	48 V	12 V	24 V	12 V	24 V
Battery Capacity	45 Ah	90 Ah	45 Ah	240 Ah	120 Ah
Configuration	4EA In Series	2EA In Parallel	2EA In Series	2EA In Parallel	2EA In Series
Battery Type	Seal Lead Acid AGM	Seal Lead Acid AGM	Seal Lead Acid AGM	Seal Lead Acid AGM	Seal Lead Acid AGM

Mechanical Specifications	ADRF-BBU-W-045-4S	ADRF-BBU-W-045-2P	ADRF-BBU-W-045-2S	ADRF-BBU-W-120-2P	ADRF-BBU-W-120-2S
Dimension	7.5 x 22.1 x 11.0 in. (190 x 561 x 279 mm.)	7.5 x 22.1 x 11.0 in. (190 x 561 x 279 mm.)	7.5 x 22.1 x 11.0 in. (190 x 561 x 279 mm.)	7.5 x 22.1 x 11.0 in. (190 x 561 x 279 mm.)	7.5 x 22.1 x 11.0 in. (190 x 561 x 279 mm.)
Weight (Enclosure)	50.7 lbs. (22.9 kg)	50.7 lbs. (22.9 kg)	50.7 lbs. (22.9 kg)	50.7 lbs. (22.9 kg)	50.7 lbs. (22.9 kg)
Weight (Batteries)	29.8 lbs. x 4 (13.5 kg x 4)	29.8 lbs. x 2 (13.5 kg x 2)	29.8 lbs. x 2 (13.5 kg x 2)	70.0 lbs. x 2 (31.7 kg x 2)	70.0 lbs. x 2 (31.7 kg x 2)
Weather Resistance	UL50E	UL50E	UL50E	UL50E	UL50E
Cooling	Air Convection	Air Convection	Air Convection	Air Convection	Air Convection
Mounting Type	Wall Mount	Wall Mount	Wall Mount	Wall Mount	Wall Mount

Battery Runtime	ADRF-BBU-W-045-4S	ADRF-BBU-W-045-2P	ADRF-BBU-W-045-2S	ADRF-BBU-W-120-2P	ADRF-BBU-W-120-2S
PSR-VU-U-9537-U	12.72 hours	-	-	-	-
PSR-7B-9533-U (single/dual)	-	-	10.7 / 8.5 hours	-	28.6 / 22.6 hours
PSR-7B-9537-U (single/dual)	-	-	7.93 / 5.44 hours	-	21.1 / 14.5 hours
FiRe-7B-8-U	-	-	12.00 hours	-	32 hours
AD XV-R-3378P-U	-	-	22.95 hours	-	61.2 hours
PSR-7B-8527-PKG	-	-	11.78 hours	-	31.4 hours
AD XV-HE (4RU) - 700/800	-	15.43 hours	-	41.15 hours	-
AD XV-HE (4RU) - VHF/UHF	-	16.36 hours	-	43.62 hours	-
AD XV-HE (8RU) - 700/800	-	10.00 hours	-	26.67 hours	-
AD XV-HE (8RU) - VHF/UHF	-	10.38 hours	-	27.69 hours	-

ADRF-BBU-W Series

12V / 24V / 48V Battery Backup
Solution for ADRF Repeater / DAS



Product Specifications (Continued)

Electrical Specifications	ADRF-BBU-W-125-2S	ADRF-BBU-W-125-2P
Operating Voltage	24 V	12 V
Battery Capacity	125 Ah	250 Ah
Configuration	2EA In Series	2EA In Parallel
Battery Type	Lithium	Lithium

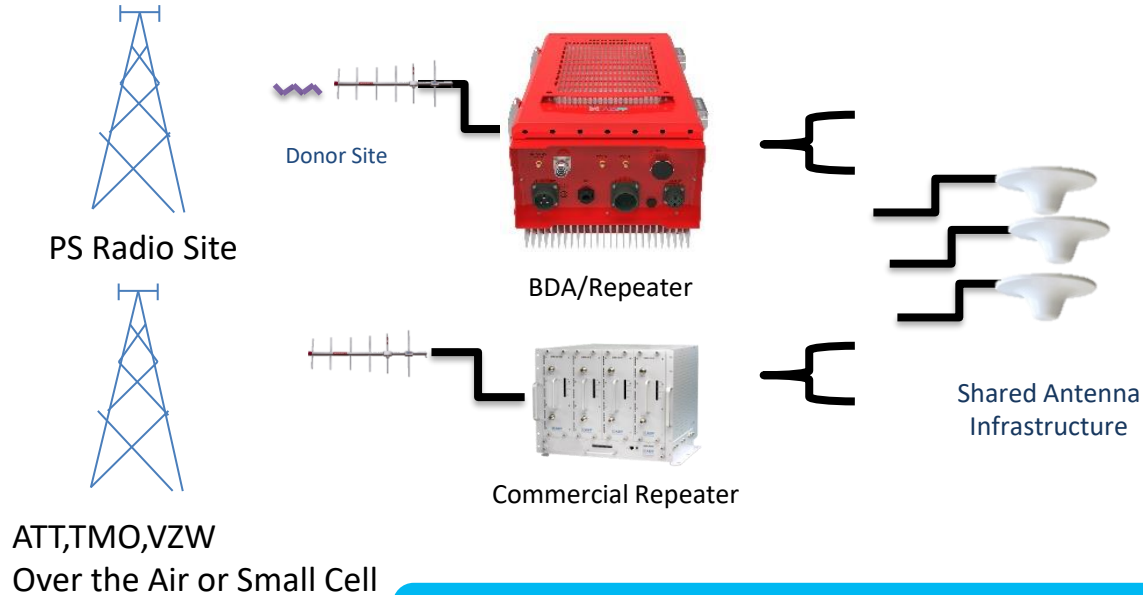
Mechanical Specifications	ADRF-BBU-W-125-2S	ADRF-BBU-W-125-2P
Dimension	7.5 x 22.1 x 11.0 in. (190 x 561 x 279 mm.)	7.5 x 22.1 x 11.0 in. (190 x 561 x 279 mm.)
Weight (Enclosure)	50.7 lbs. (22.9 kg)	50.7 lbs. (22.9 kg)
Weight (Batteries)	34.2 lbs. x 2 (15.5 kg x 2)	34.2 lbs. x 2 (15.5 kg x 2)
Weather Resistance	UL50E	UL50E
Cooling	Air Convection	Air Convection
Mounting Type	Wall Mount	Wall Mount

Battery Runtime	ADRF-BBU-W-125-2S	ADRF-BBU-W-125-2P
PSR-VU-U-9537-U	-	-
PSR-7B-9533-U (single/dual)	28.6 / 22.6 hours	-
PSR-7B-9537-U (single/dual)	21.1 / 14.5 hours	-
FiRe-7B-8-U	33.33 hours	-
AD XV-R-3378P-U	61.2 hours	-
PSR-7B-8527-PKG	31.4 hours	-
AD XV-HE (4RU) - 700/800	-	42.86 hours
AD XV-HE (4RU) - VHF/UHF	-	45.44 hours
AD XV-HE (8RU) - 700/800	-	27.79 hours
AD XV-HE (8RU) - VHF/UHF	-	28.85 hours

ADRF NEW **Public Safety** Products – Q2 2023

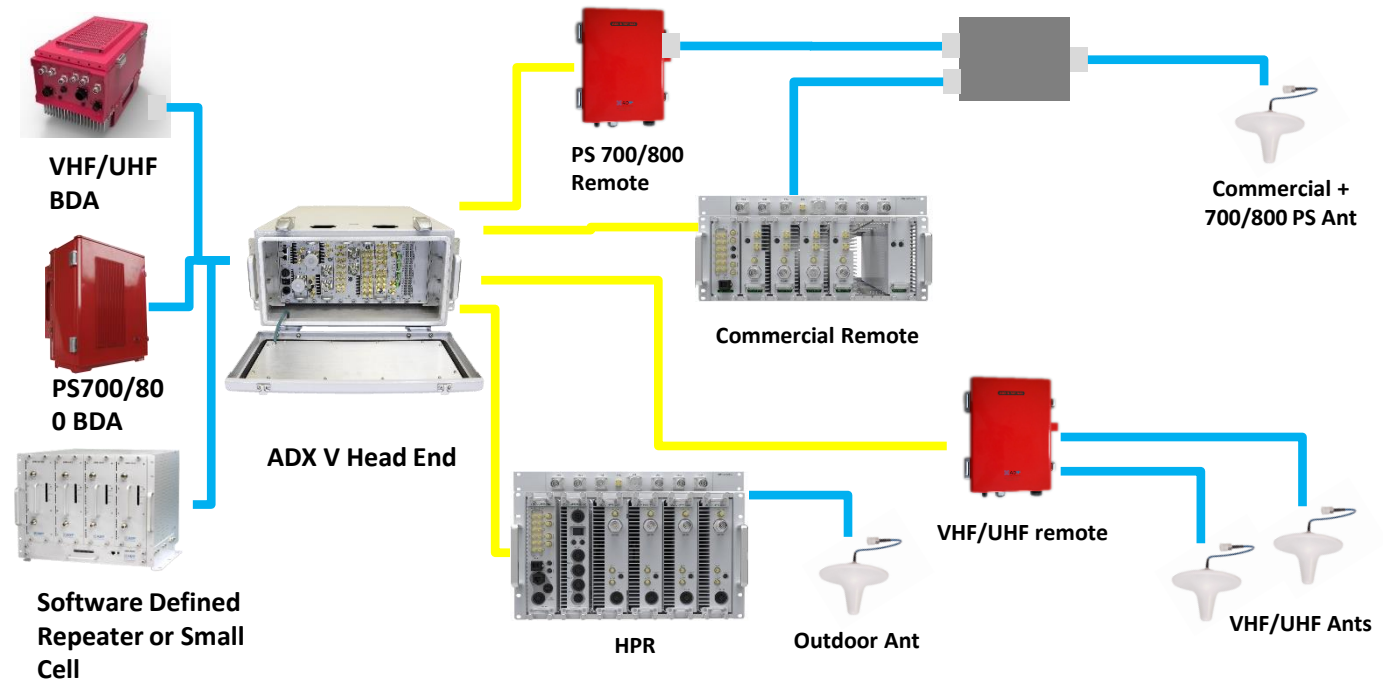
Converged – Shared Infrastructure – small system

Passive DAS



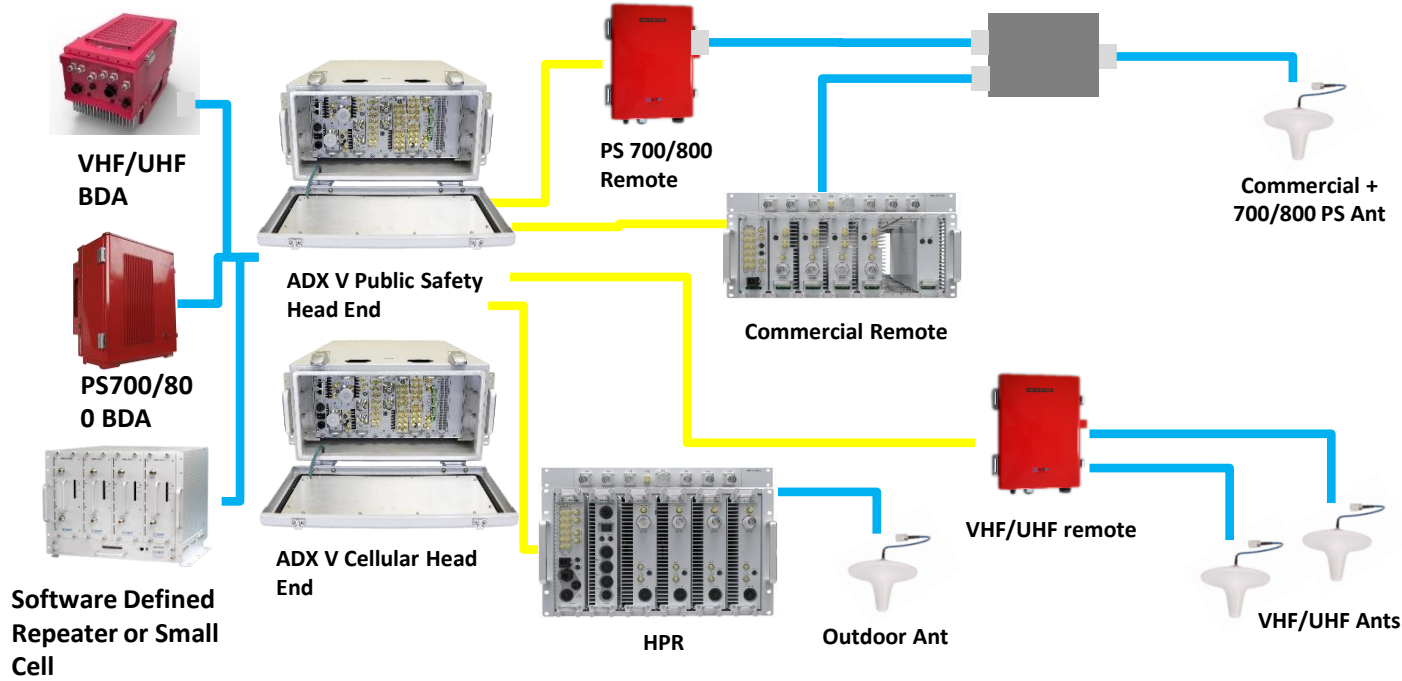
Separate Public Safety BDA and Cellular BDA with shared passives (distribution)

Converged – Shared Infrastructure with single headend for Cell and Public Safety – Med/Large system



**Manage both Public Safety and Commercial bands
thru one headend and software system**

Converged – Shared Infrastructure with separate headends for Cellular and Public Safety – Med/Large system



Manage both Public Safety and Cellular bands with two separate headends and one software system

Public Safety System - Breaking ground to system acceptance....



Stakeholders

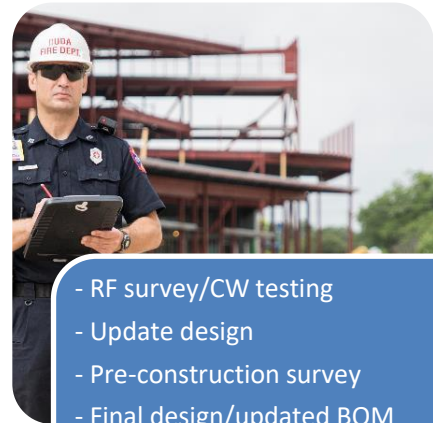
- First Responders / Public Safety Agencies
- FCC & FCC frequency license holder(s)
- OEMs: repeaters, active fiber DAS, passives, antennas, & coaxial cable
- System Integrators: RF testing, design & installation
- Material Distributors: Logistics, coordination, supply
- Building owners (REITs)
- Local AHJ (Authority Having Jurisdiction)
- Specifiers (Architects, Consultants, etc.)
- General Contractors
- Electrical Contractors
- Fire Marshal
- Inspectors
- Wireless Carriers



ROLE OF THE STAKEHOLDERS

- **Influencers**
 - Public Safety Code Agencies: NFPA, IFC, CFC
 - Standards Writers: UL
 - FCC & Local Radio License Holder
 - Wireless Carriers
 - Wireless Consortium: Safer Buildings Coalition
- **Adopters & Enforcers**
 - Local Code Enforcement: AHJ (Authority Having Jurisdiction), Code Officials, Inspectors
 - FCC
- **Users**
 - First Responders: Police, Fire, EMS (Homeland Security, FBI & Others)
 - Building tenants/owners, Campus Public Safety, Private Security & Others
- **Installers (Responsible Parties)**
 - Building owners (REITs), facility managers, general/electrical contractors, architects, engineering firms
 - OEMs: repeaters, passives, antennas, & coaxial cable
 - System Integrators: RF testing, design, installation & annual certification
 - Material Distributors: Logistics, coordination, supply

Steps for Success – ERCES PS System Deployment



- Identify AHJ & local requirements
- FCC license holder
- Engage System Integrator(SI)
- Site survey
- Baseline testing
- System definition
- Performance requirements
- Preliminary design-ROM BOM
- Statement of work (SOW)

- RF survey/CW testing
- Update design
- Pre-construction survey
- Final design/updated BOM
- Submittal documents
- Sign-off by customer
- Order equipment based on final design
- Equipment tested at ADRF and shipped

CERTIFICATE OF OCCUPANCY

City of (Insert)

Building and Safety Division

I, the referenced building or portion thereof, as noted below, has been inspected at the requirements of the code noted below and with the city laws and ordinances in use, and is hereby issued a Certificate of Occupancy.

Number: _____

Classification & Location: _____

Address: _____

- Installation
- Commissioning
- Grid/Approval testing
- System acceptance
- Sign-off by Fire Marshal
- Certificate of occupancy
- Annual maintenance and health check

Step for success when deploying a public safety system

- Engage the AHJ early to understand their set of requirements for in-building public safety system & this will help prevent delays during the system approval process
 - Each local Authority Having Jurisdiction (AHJ) interprets the NFPA code differently
 - DAS must meet their specific interpretation in order to get approved
- Engage a System Integrator that understands the local codes and understands Rf. The right SI will make your project go smoothly from start to finish.
 - Rf study, design, system selection based on needs/requirements, installation, turn-up, commissioning, testing, approval, C of O
 - LEED certification is great for energy conservation, but impacts coverage within a building
- Delays are most commonly a result of:
 - ERRCS does not meet local code requirements or wrong code year
 - DAS Alarming
 - Battery Backup Alarming
 - Insufficient RF Coverage at critical areas such as exit passageways and stairwells
- **Proper planning upfront & engaging the right partners will save time, money, and headaches!**

ADRF Advantages for Public Safety

Manufacturing, Fulfillment & Engineering Support

- In house manufacturing capabilities: Ability to adjust & react to market trends/needs quickly
- US based Inventory & Quick delivery
- Reliability: Very low out of box failure
- 3 year warranty on active and passive
- Minority/Woman owned business (MBE/WBE certified)
- “Buy American Act” compliant
- Quick turnaround on BOM’s
- Best of Breed 24/7/365 Nationwide engineering & internal sales support
- NO COST Technical Training and Certification Programs
- NO COST iBwave design support

Product Features

- Class A & Class B filtering options in same box
- Price/Value leader: Competitive cost effective solutions
- Smaller form factor to reduce space requirements
- Low noise figure – FCC 90.219 compliant
- Future proof
- Broad operating temperature range
- Full support of public safety frequencies including: VHF, UHF, 700, 800, 900, Band 14
- Public Safety solutions for both passive & active fiber DAS
- Easy connectivity to any Life Safety FACP

Code Compliance

- NFPA 72/NFPA 1221 / IFC Code Compliant
- FirstNet Compliant
- MET Classified for UL2524 Fire & Shock
- **UL2524 Listed Second Edition(S36316)**
- UL60950 Listed
- FCC Part 90 Compliant
- Dry Contact Alarming
- Battery backup solutions for all products & runtimes as required by AHJs & Code Officials
- SNMP for remote monitoring and control
- Code compliant enclosures & weather resistance rating (NEMA 4/Type 4)

ADRF **Public Safety** Training / Test & Measurement

ADRF Training

- MyADRF Portal: <http://adrftech.com/adrf-login/>
 - On-line Product Training
 - Certification Exams
 - Technical Documents >> Manuals, QSG, Spec Sheets, Whitepaper, Application Notes, Firmware/Software, Visio Stencils, Vex files, MIB files, and more.
- In-person Training: available as needed
- List of Training Courses
- ROM Tool

DAS Solutions

- ADX Certification
- ADXV Certification

Basic Training

- DAS 101
- Public Safety 101

Advanced Training

- Public Safety 102

Commercial Repeaters

- SDR Components & Architecture Certification
- SDR GUI & Commissioning Certification
- AXM-ICS-X Certification

ERCES

- PSR-78-9533/9537 Certification
- PSR-VU-9537 Certification
- FiRe-78-4 Certification
- PSR-78-8527 Certification

AUTOMATED TESTING SAVES TIME & MONEY

Prepare. Measure. Report. It's That Easy.

Replace manual processes and ensure critical communications radio coverage with the PCTEL® Public Safety Network Testing Solution. Our streamlined grid-based testing tool makes it easy to meet or enforce local building codes for Emergency Radio Responder Coverage (ERRC). The simple pass/fail grading system is also a great way to ensure coverage for cellular, WiFi, life safety, and business critical radio networks.



1 PREPARE

Create grids and set up tests

- Import a floorplan
- Add grids per floor
- Identify test locations and critical test points
- Select frequencies
- Configure pass/fail criteria



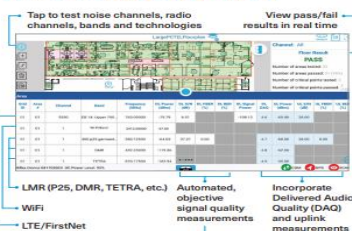
▲ Automatically identify test locations with easy-to-use grid creation tools that rotate to fit your floorplans.



▲ Planning tool integration enables you to easily import floor plans and export test data.

2 MEASURE

Execute tests and grade by threshold



Radio Type	Min (dB)	Max (dB)
Analog FM LMR	N/A	26
V-T-D (V2, D, V4)	N/A	22
Analog PMR LMR	N/A	22
V-T-D (V2, V4)	2	16.2
PSE CPTM (SMBE)	2	17.7
WIFI (2.4 GHz)	1.4	19
PSE CPTM (VSELP)	2	17
WIFI (5 GHz)	2	19.8
PSE CPTM (SMBE)	2	19.8
WICORP 0.6 kHz/1.2 MHz	2.4	16.4
PSE H-CPTM (1.2 MHz)	2.8	19.7
WICORP 0.6 kHz/1.2 MHz	2	16.6
DMR 2-slot (SMBE+2)	2	16.6
TETRA	Contact radio manufacturer as sensitivity varies by deployment configuration.	

“We did the coverage testing in about 25% of the time planned.”

— Jason Chambers, Day Wireless Area Service Manager

3 REPORT

Auto generate real-time results and submittable reports with one tap

- Generate reports in real-time or on demand, by building, by floor, or by channel
- Automatically incorporate equipment room test results
- Save printable reports within minutes
- Customize pass/fail criteria to meet local government or business requirements
- Create multiple reports from one test



▲ Instant pass/fail reports

Save as Excel or Word document

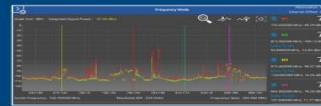


GET EVEN MORE DONE, FASTER

PCTEL's Public Safety Network Testing Solution includes additional tools that streamline testing throughout your project lifecycle.



▲ Indoor walk testing: detailed data for DAS and small cell network design, baseline testing and optimization



▲ Spectrum Analysis mode for troubleshooting and equipment room work, right on your tablet



▲ Antenna Verification Tool (optional): fast troubleshooting during the DAS and small cell commissioning process

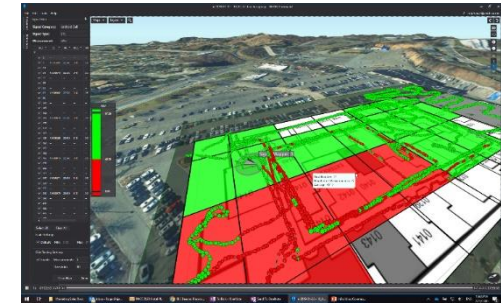


▲ Outdoor mode (optional): drive and walk testing for cellular and LMR networks with automatic GPS mapping

Product Type	Part Name	Description	Partner Price
Test Equipment	ADRF-09500-05	PCTEL 09500-05 P25, EG, 08902-E IBFLEX BASE, OP465 SAMSUNG GALAXY TAB, OP412 WALK TEST KIT	\$ CALL

ADRF Public Safety Guide

- In-Building Coverage mapping for all major LTE, Public Safety, radio and WiFi air standards
- Does not require the use of GPS signal
 - Ideal for in-building, stairwells, basements, hard to reach areas
- Scan multiple frequencies simultaneously
- Record and document coverage mapping exercises compliant to government regulations (NFPA 72 IFC 510)
- Portable, lightweight, well-protected



Product Type	Part Name	Description	Partner Price
Test Equipment	ADRF-MS27101A-1	ANRITSU MS27101A-IBCM PKG, EG, MS27101A REMOTE SPECTRUM MONITOR, 67135 BACKPACK	\$ CALL
Test Equipment	ADRF-S412E-1	ANRITSU S412E PKG, EG, S412E LMR MASTER, 760-243-R TRANSIT CASE	\$ CALL

What do we cover in PS 102 Training:

- I. Site Survey – Benchmark Testing
- II. Design
- III. Construction
- IV. Commissioning (GUI)
- V. Closeout & Grid Testing
- VI. Test Equipment Packages with 3rd party training
- VII. Common Issues

ADRF Projects and Deployments

Select Deployments in California



A map of California in light blue, with the letters 'CA' in the center. Several yellow location pins are clustered in the southern part of the state, indicating deployment locations.

Logos surrounding the map include:

- UCIRVINE
- UNITED STATES POSTAL SERVICE
- amazon
- American Airlines
- BOEING
- DIRECTV
- DOLBY THEATRE
- SAN DIEGO INTERNATIONAL AIRPORT
- SAN DIEGO convention center
- EMPIRE POLO CLUB
- THE RITZ-CARLTON®
- Qualcomm
- NORTHROP GRUMMAN
- COUNTY OF LOS ANGELES CALIFORNIA
- HYUNDAI
- NFL
- NAVY FEDERAL Credit Union
- METROPOLIS LOS ANGELES
- CITY OF LOS ANGELES FOUNDED 1781

Select Deployments in Florida



Select Deployments in Midwest

The image features a central map of the Midwestern United States, divided into four quadrants representing Wisconsin (WI), Michigan (MI), Illinois (IL), and Indiana (IN). The map is color-coded: WI and MI are orange, IL and IN are blue. Several yellow location pins are placed across the map, indicating deployment sites. Surrounding the map are logos for various organizations and institutions:

- Top Left:** University of Michigan (M logo), Wisconsin (W logo), Alliant Energy (star logo), Amazon (amazon logo).
- Top Right:** Art Institute Chicago (red square logo).
- Middle Left:** Ulta Beauty (ULTA BEAUTY logo), Robinson (ROBINSON logo), NEMA CHICAGO (NEMA. CHICAGO logo), Mercyhealth (Mercyhealth logo).
- Middle Right:** Coca-Cola (Coca-Cola logo), Harman (HARMAN SAMSUNG COMPANY logo), Henry Ford Health System (Henry Ford HEALTH SYSTEM logo).
- Bottom Left:** McCormick Place Chicago (McCormick PLACE CHICAGO logo), JPMorgan Chase & Co. (JPMORGAN CHASE & Co. logo), Johnson Controls (Johnson Controls logo).
- Bottom Right:** Indianapolis International Airport (INDIANAPOLIS INTERNATIONAL AIRPORT logo).

Select Deployments in Texas

A central blue silhouette of the state of Texas is shown with several yellow location pins indicating deployment sites. Surrounding the map are logos for various organizations and institutions:

- WESTIN HOTELS & RESORTS**
- amazon**
- charles SCHWAB**
- THOMSON REUTERS**
- DFW DALLAS FORT WORTH INTERNATIONAL AIRPORT**
- ATM TEXAS A&M UNIVERSITY**
- SPACE CENTER HOUSTON**
- Dr Pepper Est. 1885**
- ExxonMobil**
- SAN ANTONIO INTERNATIONAL AIRPORT**
- Fannie Mae**
- MFA H The Museum of Fine Arts, Houston**
- FURUM ENERGY TECHNOLOGIES**
- MCKESSON**
- Marriott HOTELS · RESORTS · SUITES**
- GE GE Oil & Gas**

Select Deployments in New York

UNION COLLEGE
FOUNDED 1795

John F. Kennedy International Airport

HUDSON YARDS
NEW YORK

UR STRONG MEDICINE MEMORIAL HOSPITAL

Memorial Sloan Kettering Cancer Center

HUDSON RIVER PK



550 MADISON

SolarCity

CROSSGATES MALL

Long Island Jewish Medical Center
Northwell Health

NYC HEALTH+ HOSPITALS | Jacobi

NYC HEALTH+ HOSPITALS | Lincoln

LaGuardia Airport

Recent Deployment & Current Expansion



National Renewable Energy Lab - Colorado

- System: ADXV
- Remotes: 2W, 5W, 20W, 40W
- Total Nodes: 19
- Carriers on Air: Sprint, AT&T, T-Mobile, Verizon, 800 MHz Public Safety

Recent Deployments



Memorial Sloan Kettering

System: ADXV - Carriers on Air: Verizon, AT&T, T-Mobile, Sprint



Hudson Yards – Multiple Buildings



535 Mission

System: ADXV

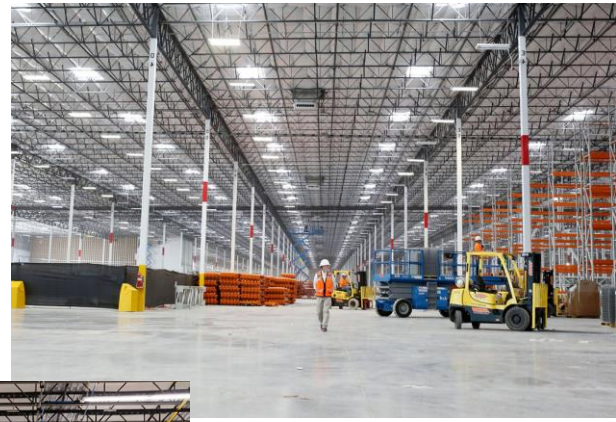
Carriers on Air: Verizon, AT&T (T-Mobile interested)



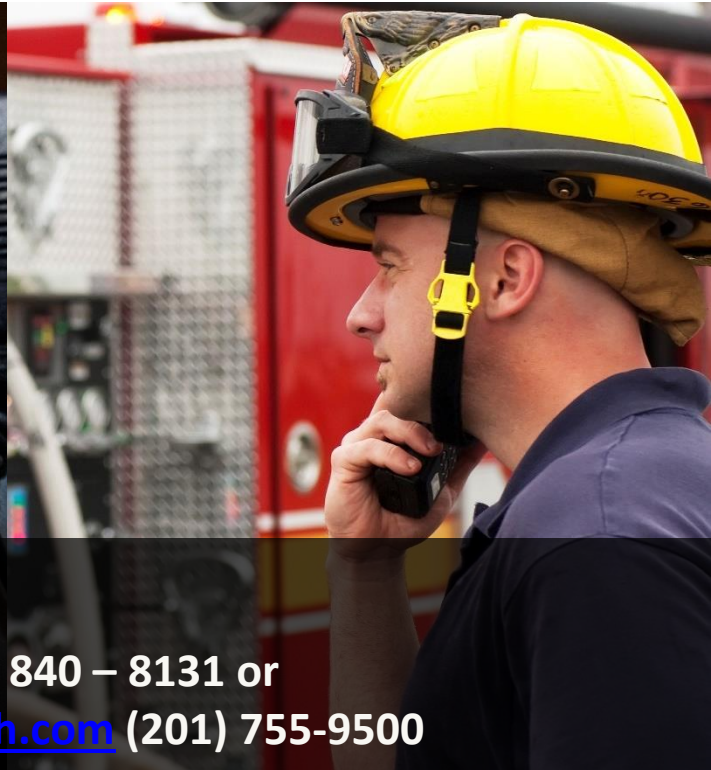
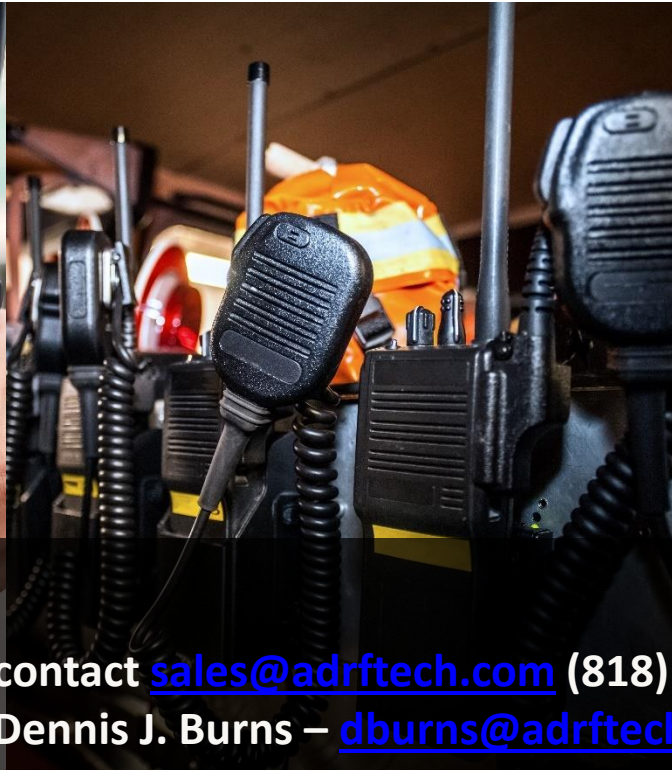
15 Hudson Yards

4/28/20

Multiple Locations



Amazon Fulfillment Centers (multiple)



Thank You

For more information, contact sales@adrfttech.com (818) 840 – 8131 or
Dennis J. Burns – dburns@adrfttech.com (201) 755-9500