PUBLIC SAFETY DAS OVERVIEW

NFOC 2017

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Microwave Photonic MPS Systems Inc.

AGENDA

- Public Safety DAS versus Carrier Services DAS
- Public Safety Radio Systems
- Requirements of Public Safety Networks
- Architecture of Public Safety DAS

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WHAT IS A DAS???

- Passive DAS
- Active DAS
- Hybrid DAS

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Where is PS DAS Required and who are the Customers?

- Public Safety Agencies, who primarily are in requirement of a DAS solution :
  a) Police
  b) Fire
  c) EMS
  d) Transit Police Operations

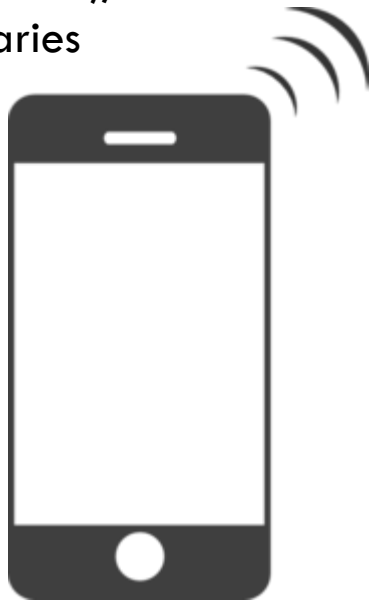
- Facilities/Customers who require the Public safety or non-commercial DAS solution:
  a) Hospitals
  b) College/ University Campuses
  c) Government Agencies
  d) Military Installations
  e) Transit (tunnels/stations etc.)
  f) Building Owners (facilities mgt.)

Portable Radio vs. Mobile Handset

+37 dBm, 25 kHz,
12.5 kHz, 6.25 kHz

- 150~174 MHz (VHF)
- 380~430 MHz (UHF, TETRA)
- 450~470 MHz (UHF, TETRA)
- 470~490 MHz (UHF)
- 490~512 MHz (UHF)
- 763~805 MHz (700 MHz)
- 806~869 MHz (800 MHz)
- 896~941 MHz (900 MHz)

+27 dBm (with power control), Bandwidth Varies



- 698~787 MHz
- 824~894 MHz
- 1850~1995 MHz
- 1710~2155 MHz
- WiFi Bands

Is Capacity a Concern for PS DAS?

- Commercial DAS is concerned about capacity
- Offload cellular users from Macro Network onto In-Building network
- For Public Safety Radio, Coverage is the primary concern
- Public Safety Radio needs ALL Frequencies Everywhere

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SUMMARY

Public Safety DAS

- Used by Emergency Services
- 150~941 MHz
- Portable Transmit Power Fixed
- **Coverage is primary goal**

Commercial DAS

- Used by Wireless Subscribers
- 698~2155 MHz or higher
- Portable Transmit Power Variable
- **Capacity is a Fundamental Requirement**

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DOWNLINK AND UPLINK

Downlink (DL)

- DL Signals are transmitted from the Base Station and Received by the User
- Also referred to as Base Station Transmit (TX) Signals

Uplink (UL)

- UL Signals are transmitted from the User's Radio and Received by the Base Station
- Also referred to as Base Station Receive (RX) Signals

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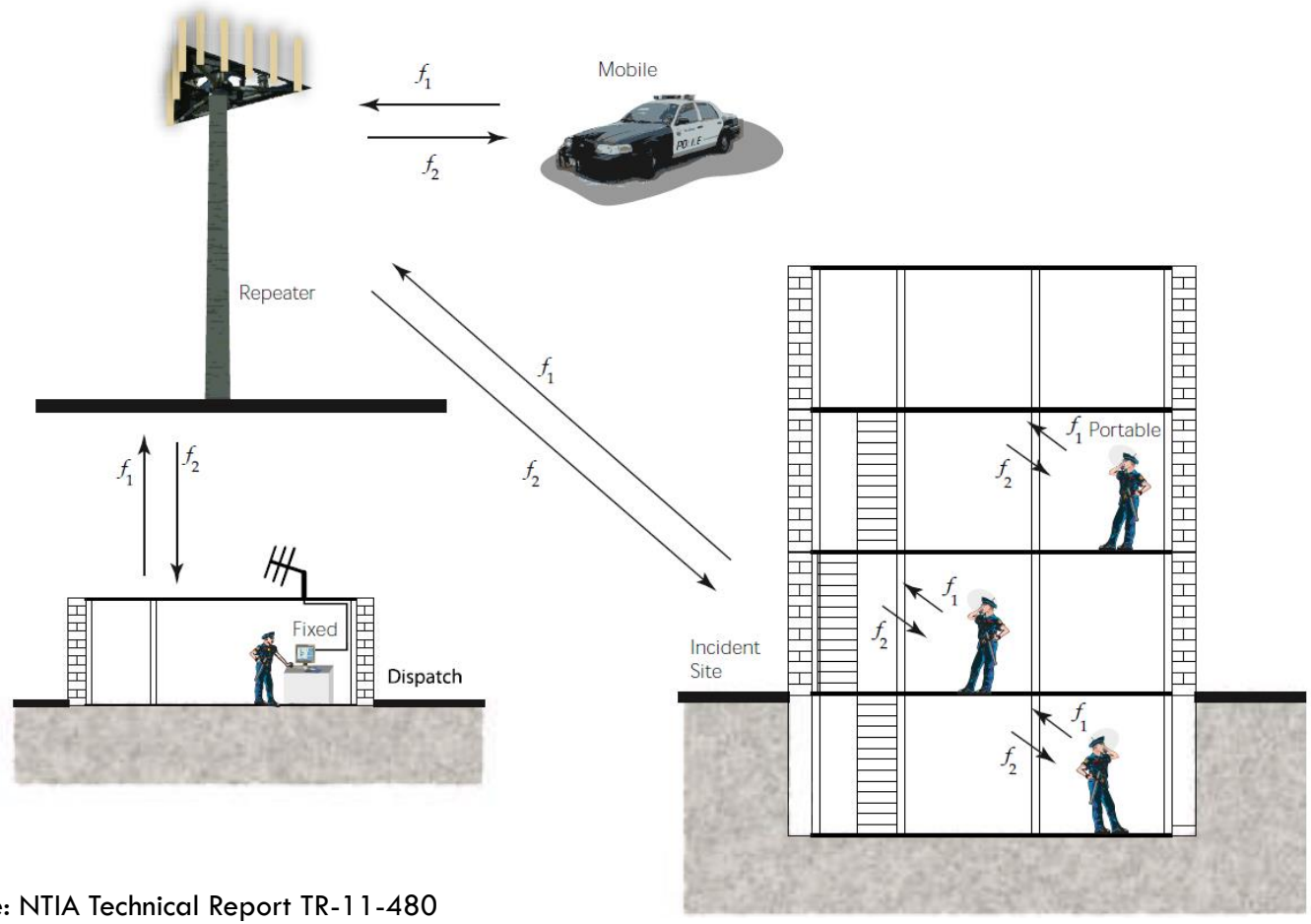
Where do Public Safety Signals Come From?

"Donor Site"

Direct Feed to/from Base Station Repeater

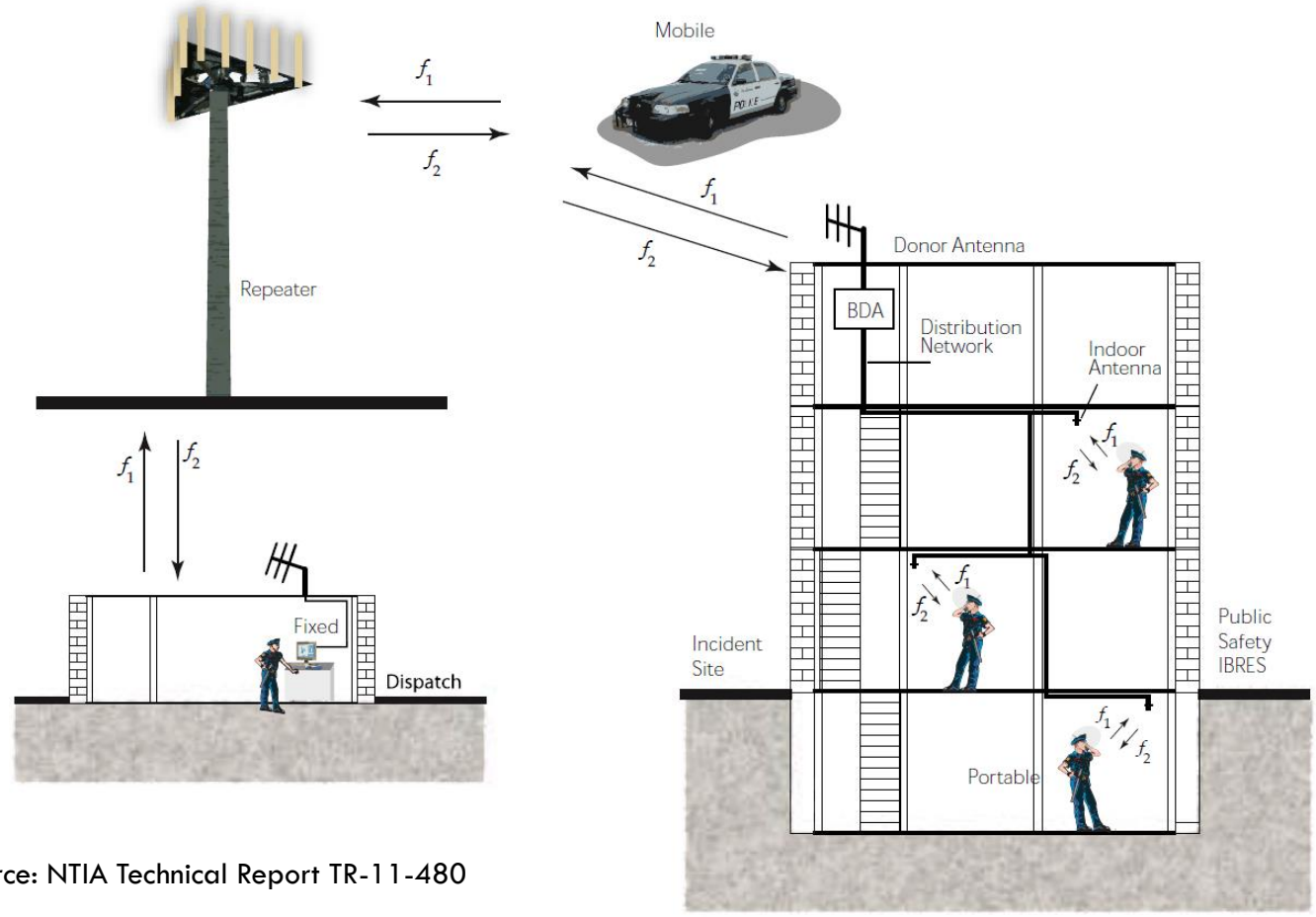
Off-Air Feed to/from Base Station Repeater Tower

PUBLIC SAFETY SYSTEM OVERVIEW (WITHOUT DAS)



Source: NTIA Technical Report TR-11-480

PUBLIC SAFETY WITH USE OF AN IN-BUILDING RADIO ENHANCEMENT SYSTEM



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REGULATORY REQUIREMENTS

- NFPA (National Fire Protection Association)
- IFC (International Fire Code)
- Coverage Specifications and Requirements (assume coverage signal strength to be -95 dBm if not provided)
- Delivered Audio Quality (DAQ)
- Back-up Power
- Redundancy
- Other Local Rules, Codes, and Project Specific Specifications

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DELIVERED AUDIO QUALITY (DAQ)

VOICE QUALITY PASS/FAIL CRITERIA: Standard DAQ Table

Ref. DAQ Level	Definition	Subjective Performance Description	Result
1	Bad	Unable to make contact, No Service	Fail
2	Poor	Speech understandable with considerable effort. Frequent repetition due to Noise/Distortion	Fail
3	Fair	Speech understandable with slight effort. Occasional repetition due to Noise/Distortion	Pass
4	Good	Speech easily understood with occasional (but not annoying) Noise/Distortion present.	Pass
5	Excellent	Speech Easily understood. No Noise/Distortion present.	Pass

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FREQUENCY ALLOCATION

- VHF (150~174 MHz) and UHF (380~512 MHz) generally lack standardized Uplink and Downlink sub-bands
- Interleaving of DL and UL channels frequently occurs when bringing all agencies together within a Public Safety System
- Standardizing VHF/UHF systems is impossible
- 700, 800, and 900 MHz Channels fall within pre-designated Downlink and Uplink sub-bands

Uplink (MHz)	Downlink (MHz)
465.5750	460.5750
465.6250	460.6250
473.8125	470.8125
473.8375	470.8375
473.8625	470.8625
473.9625	470.9625
474.0625	471.0625
474.0875	471.0875
474.1125	471.1125
479.3375	476.3375
479.4375	476.4375
479.5625	476.5625
479.5875	476.5875
479.7625	476.7625
481.0125	478.0125
485.6375	470.7125
485.6625	470.6875
485.6875	482.6875
485.8375	482.8375
151.3400	160.9050
158.7750	161.5050
158.8050	161.5650
158.8800	161.1900

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SUMMARY

- NFPA & IFC
- Frequency Allocation
  - VHF
  - UHF
  - 700 MHz
  - 800 MHz
  - 900 MHz
- Back-up Power and Alarming

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DONOR SITES

The donor sites is the interface to existing Public Safety Radio Systems, the donor sites provide the Downlink Signals to and receive the Uplink Signals from the PS DAS.

- All Downlink Signals intended for distribution through the PS DAS have to come from at least one donor site
- All Uplink Signals the PS DAS receives require a donor site to go to
- If a donor site for the desired channels does not exist, the PS DAS cannot operate those channels

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HEAD-END COMPONENTS

The headend in a PS DAS is where all signals meet. System alarm monitoring is available for all active PS DAS components in the system.

- Similarly banded Downlink Signals are combined from their respective Donor Sites before being split for remote distribution
- Uplink Signals are combined before being conditioned and distributed to their respective Donor Sites
- Starting point for troubleshooting

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REMOTE COMPONENTS

The remote components in a PS DAS comprise of one or many extensions of the PS DAS coverage. A single Remote Unit interfaces with the Head-End.

- Receives downlink signals from headend and sends them to the distribution network
- Receives uplink signals from the distribution network and sends them to the headend
- Remote units only report their own alarming

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DISTRIBUTION NETWORK

The distribution network is the infrastructure carrying the signals to antennas for distribution. These signals are what the end users see when they wonder how their radios work in the sub basement of the building.

- Receives Downlink Signals form the Remote Components and emits them from the antennas down to the end users
- Receives Uplink Signals from the portable radios of the end users and sends them to the Remote Components

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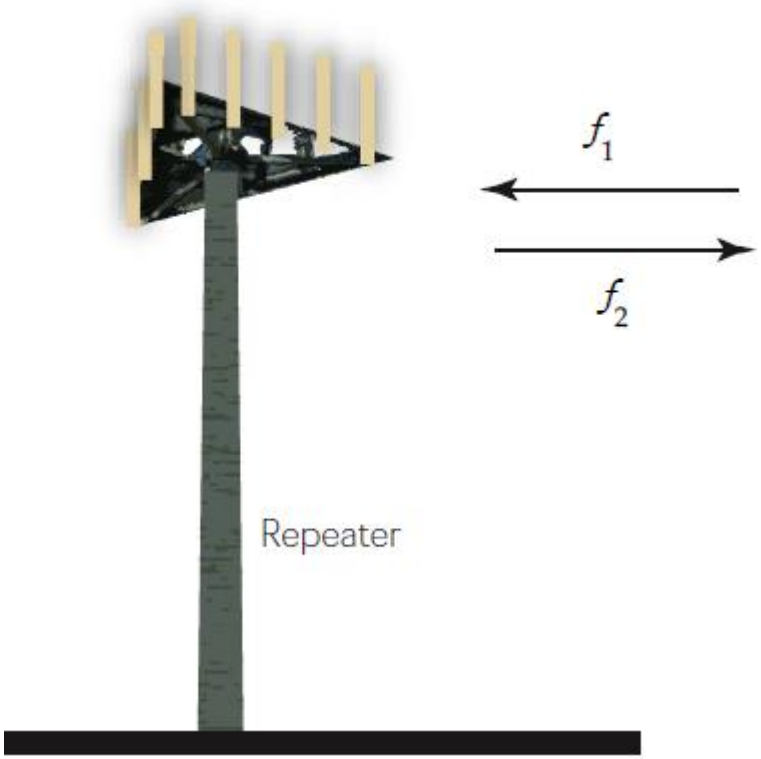
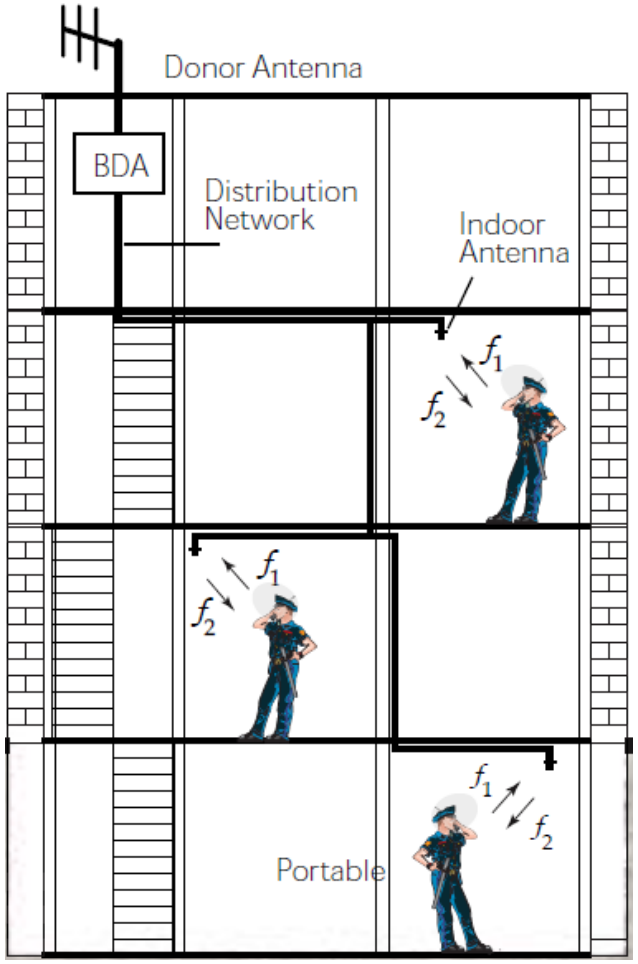
BASIC ARCHITECTURE OF A PUBLIC SAFETY DAS



Donor Side



DAS Side

Source: NTIA Technical Report TR-11-480

OFF-AIR FEED VS. DIRECT FEED TO BASE STATION

OFF AIR FEED

- Receive low level Downlink signals from Donor Site
- Transmit Uplink signals with high power to Donor Site
- Open to interfering signals picked up from Donor Antenna
- Susceptible to Feed-back Oscillation (gain > isolation)

DIRECT FEED TO BASE STATION

- Receive high level Downlink signals from Donor Site
- Transmit Uplink signals with low power to Donor Site
- Should not have interfering signals

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SUMMARY

- Basic Architecture
- Donor-Side Interface
  - Off-Air Feed
  - Direct Feed
- Interfering Carriers
- Channelized Requirements
- Location of Donor Sites
- Donor-to-Service Isolation
- Signal Conditioning
- Distributed Network

Q&A