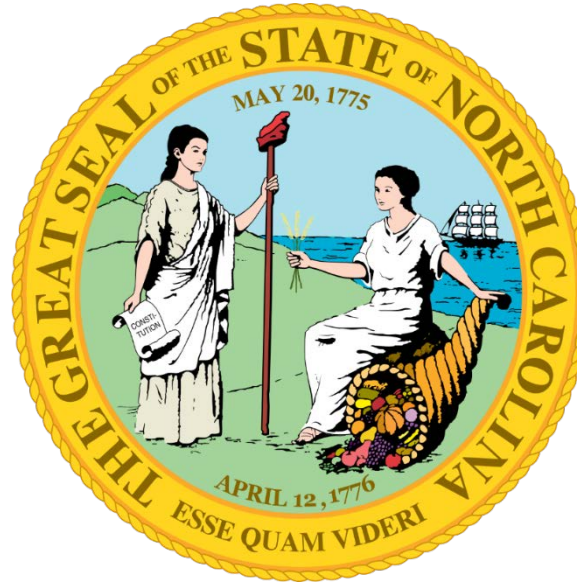


# NORTH CAROLINA VIPER RADIO TRAINING



2022 UPDATE

# SUMMARY

- Reason for VIPER training update
- Review of how system works
- Review of most common equipment (portables and mobiles)
- Statewide template
- Best practices
- Troubleshooting
- Future discipline specific modules





# SUPPLEMENTAL TRAINING

- Healthcare (Hospitals)
- Aviation
- SAR
- AUXCOMM
- Communication resource lists
- ESF2 flow
- Documentation

RELEASE DATES TBA



# DISCLAIMER

VIPER is a Motorola P25 Phase I Frequency Division Multiple Access (FDMA) Trunked radio system.

- Any mention of a particular vendor or picture does not necessarily endorse a specific product.
- Please refer to the VIPER Approved Radio List for reference on system compatibility.
- Pictures of radios in training slides are of the most common platform(s). Please refer to your specific hardware manual for further information.





# WHY DO WE USE RADIOS?

When used properly, radios are a life saving tool that provides the following:

- Effective interoperable communications among agencies when managing unplanned events, planned events or day to day operations.
- Ease of use, especially during times of high stress. (Select the proper channel and use the PTT button)
- Durability and ruggedness that exceeds other non public safety grade communication devices
- Reliable means of communication without public competition
- Resiliency





# VIPER SYSTEM

## SECTION 1

**VIPER** stands for **V**oice **I**nteroperability **P**lan for **E**mergency **R**esponders

North Carolina's interoperable radio communication system - a statewide system that allows all public safety, medical and emergency response agencies in North Carolina to talk to seamlessly talk to each other.



# VIPER SYSTEM

## History:

1994 – Assessment of interoperability capabilities conducted.

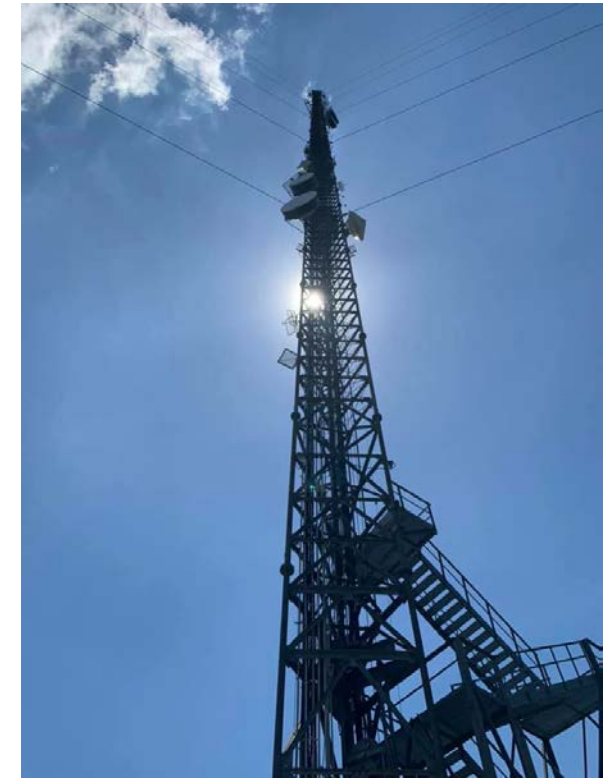
1995 – Deficiencies in interoperability identified.

1999 – State Highway Patrol directed to plan and develop an 800 MHz system.

2001 – Terrorist attacks on September 11, 2001.

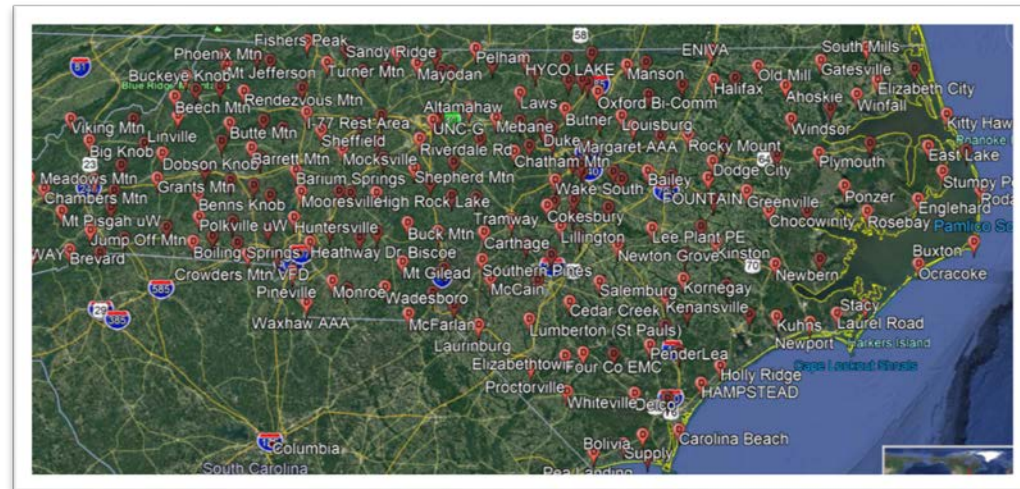
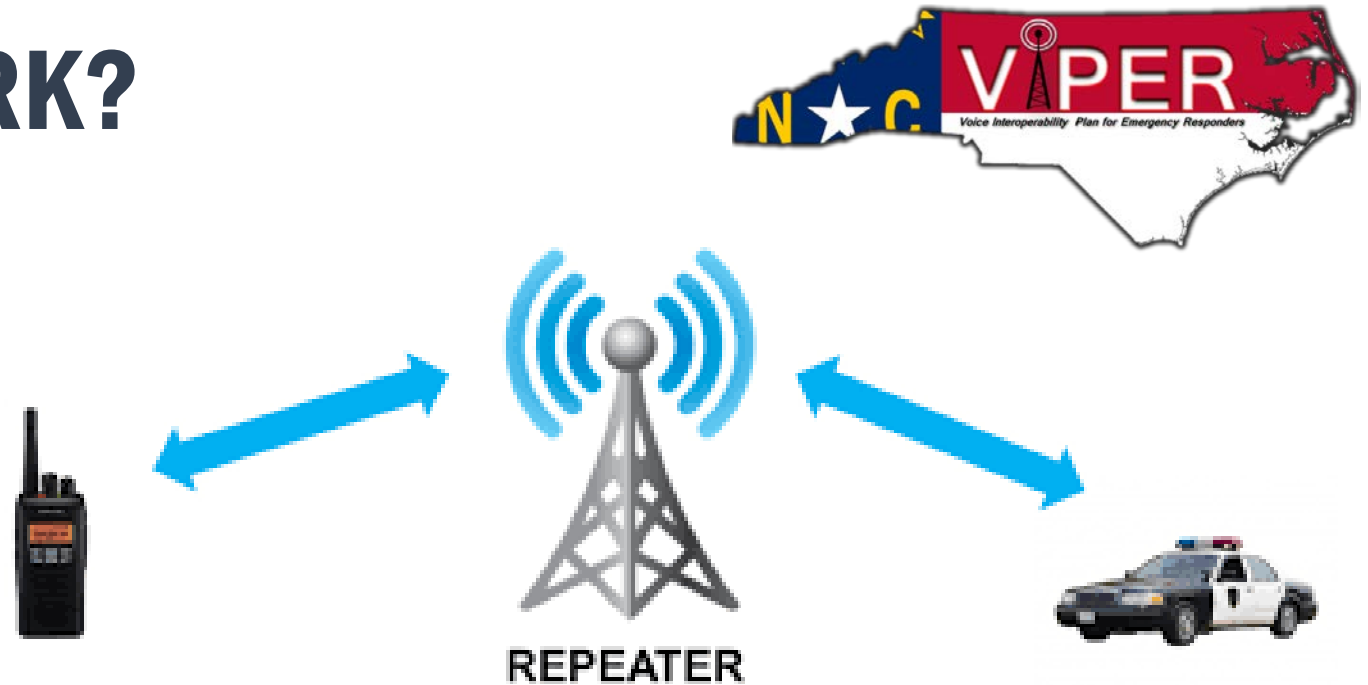
2003 – Official construction of VIPER begins.

FY 2021-22 – 100% of infrastructure expected to be completed.



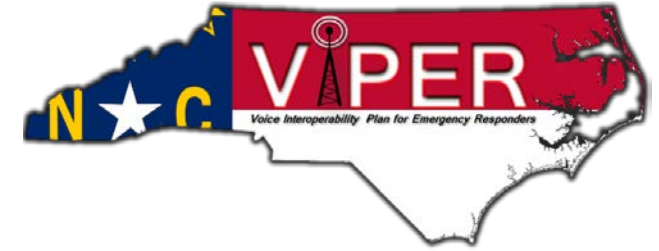
# HOW DOES VIPER WORK?

- Sites function just like traditional repeater sites by listening and rebroadcasting from an elevated position.
- Series of separate repeater voice channels and a control channel that make up the site.
- Coverage varies by site based on height and terrain.



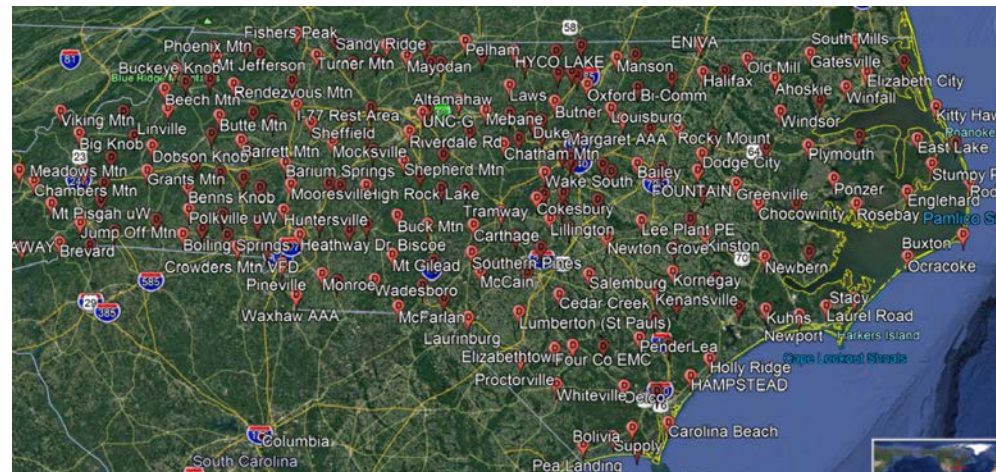


# SYSTEM NUMBERS



## Overview:

- 223 sites (241)
- 1784 trunking channels
- 731 conventional channels
- 4307 Talk Groups (Channels)
- 447 communication center connections (tied in)
- PTT average daily 288,000 Monthly average 8,500,000



(As of January 2021)

These figures are dynamic and increase daily

# VIPER POC (STRUCTURE)

- Each agency or discipline has a VIPER POC (Point of Contact)
- This person is the main contact between the TSU and Agency/Discipline
- Keeps accurate record of database and certifies yearly
- New IDs are coordinated through the POC and activated by the TSU
- Outages/Maintenance notifications are sent to POCs.

AGENCY



VIPER POC



TSU





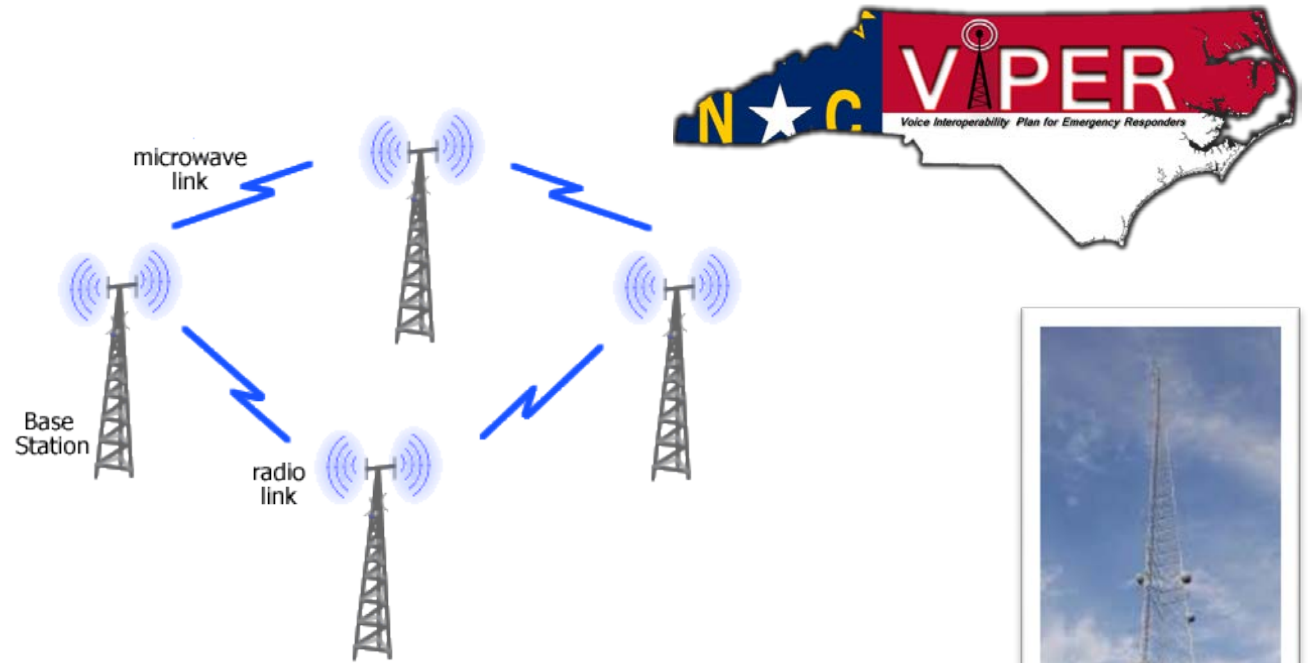
# HOW DOES TRUNKING WORK?

- Computer aided radio network that uses resources wisely
- Radio has a unique ID that communicates with trunking system controller. Appropriate resources are assigned as needed
- Handshakes are completed regularly to ensure the right information is passed to the correct station
- “Talk permit tones” are GOOD and “denials Bonks” are BAD



# WHY IS VIPER UNIQUE?

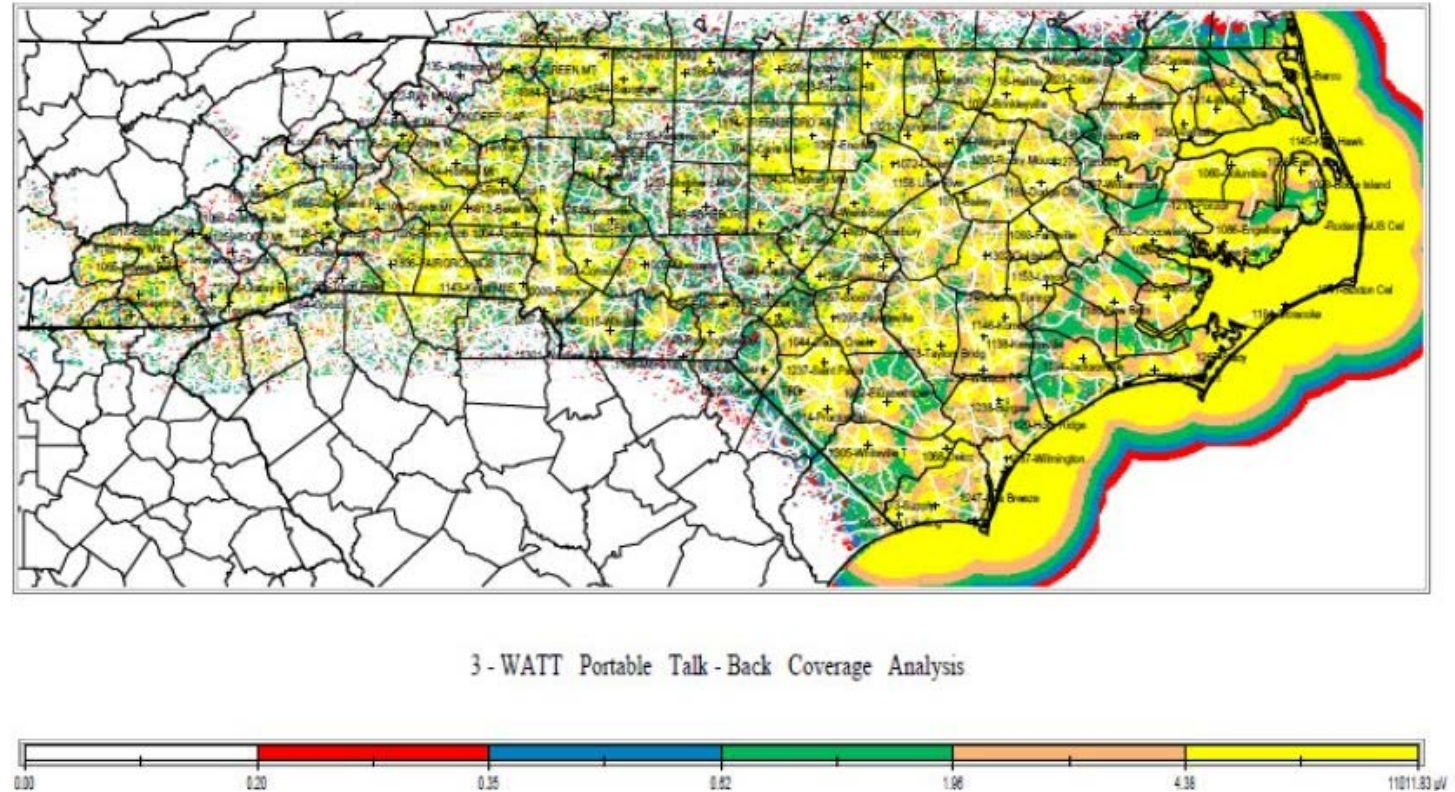
- Almost the entire system is interconnected with microwave links. Think of the system as a gigantic spider web of connectivity.
- Independent from third party transport reliance
- Protected from flooding environments as links are high above the ground



# COVERAGE

- Most trunking systems are designed for 95% coverage at the street level based on 3 watt portable
- All of NC is covered by the system (Higher difficulty in mountain area)
- Not designed to penetrate deep into buildings without BDAs (Bi-Directional Amplifiers). New fire code mandates study of commercial buildings under construction
- Some coverage across state lines

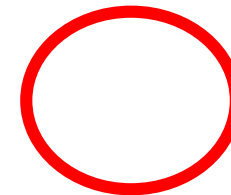
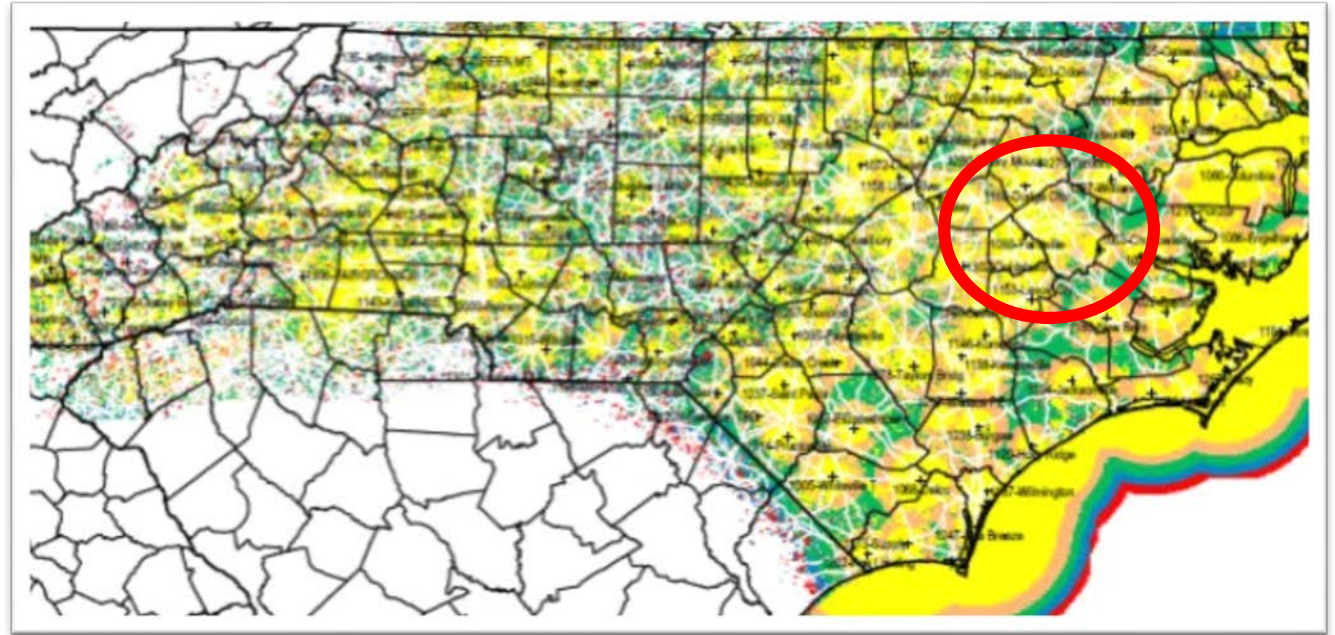
OLDER PICTURE (2004)





# TALKGROUP RESTRICTIONS

- Some talkgroups are open for statewide coverage (all sites)
- Some talkgroups are considered “local” talkgroups. Most local talkgroups will work a few sites away, but then are restricted
- In the example, a local talkgroup for Pitt County will work in the surrounding area, but will not be heard outside the area. This is the design of local talkgroups.
- Anything in the mandatory VIPER template Standard Operating Guideline (SOG) is considered statewide coverage

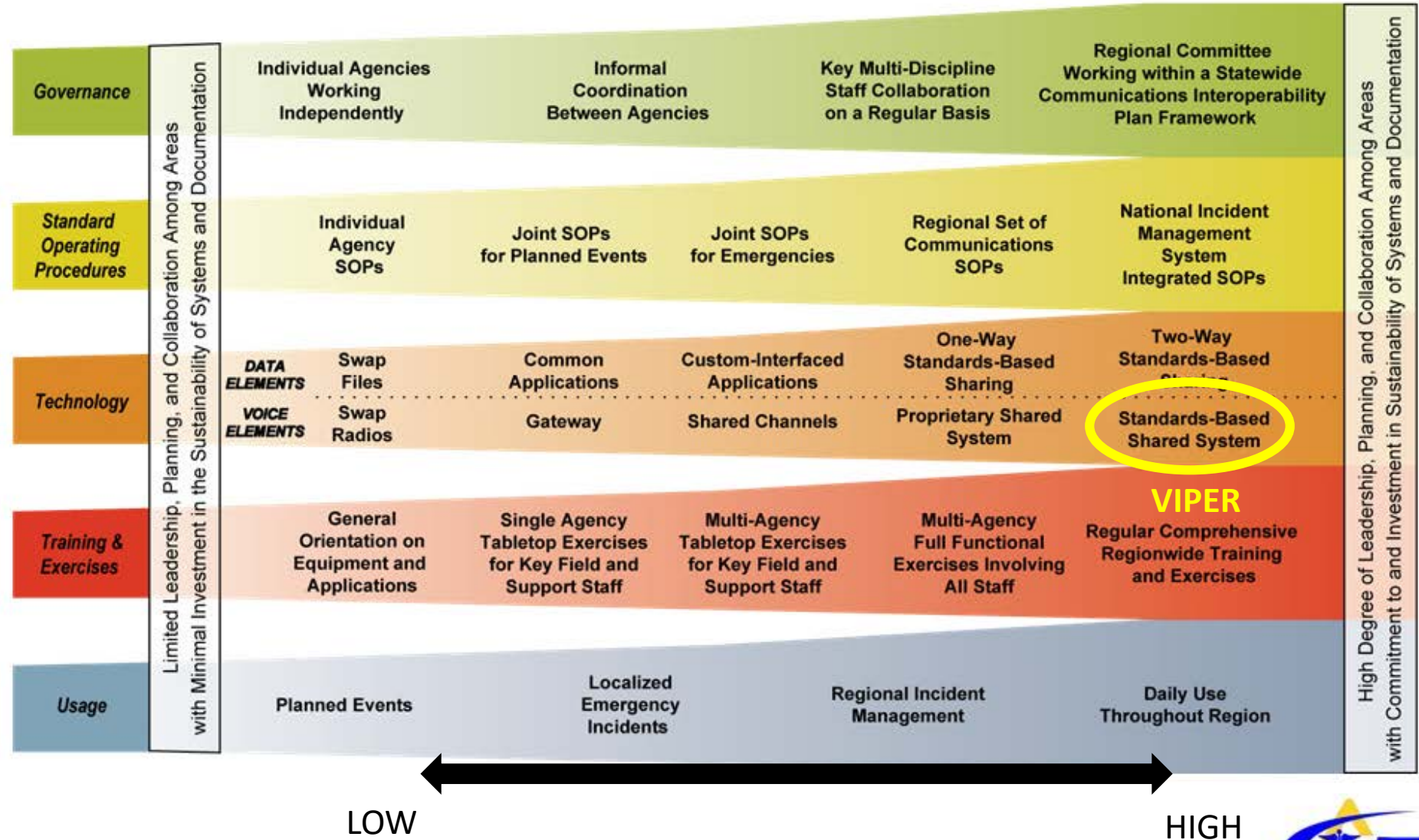


Local Talkgroup



# INTEROPERABILITY CONTINUUM

- The highest level of interoperability comes with a standards-based shared system.
- The Interoperability Continuum is a benchmarking guide for agencies to see where they rank from low to high.



# CONVENTIONAL SYSTEM THEORY

## Conventional Radio System:

- A radio uses one dedicated frequency for each channel.  
A frequency = a channel (ex. 154.2350 MHz is County Fire)
- Only one user can talk on the frequency at a time.
- If a new user group is developed, a new frequency must be obtained to create a new channel.



# TRUNKING SYSTEM THEORY

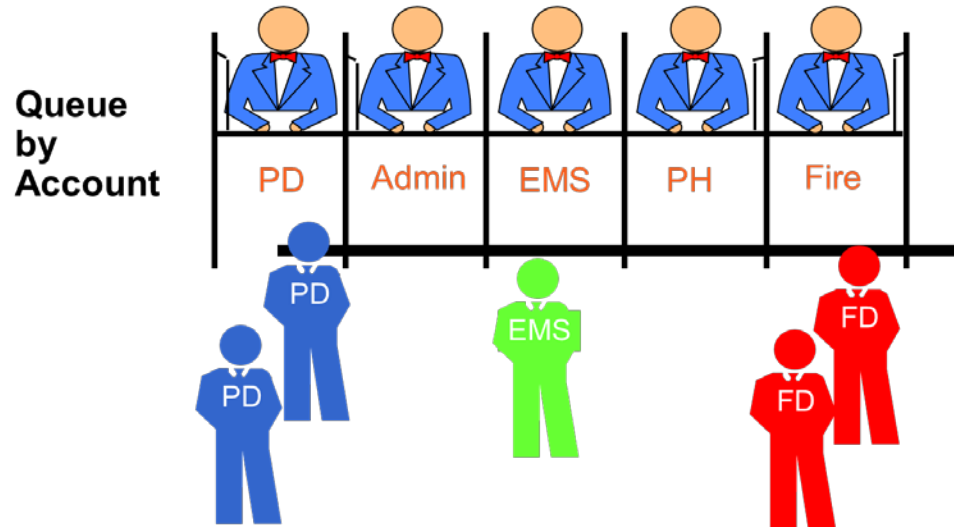
## Trunked Radio System:

- “The sharing of a limited number of communications paths (Trunks) among many users.”
- A talkgroup is a virtual channel
- Responsible use of resources. Each agency is not required to run and maintain their own communication system



# TRUNKING THEORY

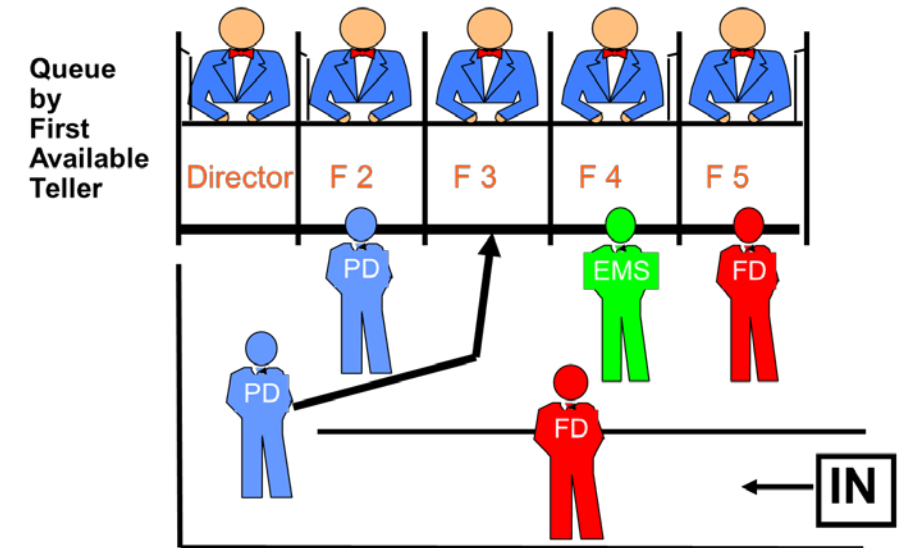
Your Bank Tellers – as “Conventional”



CONVENTIONAL

Each agency has their own resource. Actual on air usage is small. Example, a repeater may only be used 20 minutes out of a 24 hour day. Not an efficient use of resources and spectrum.

Your Bank Tellers – as “Trunked”

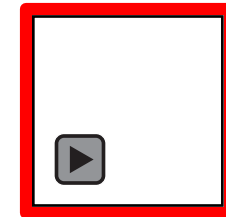
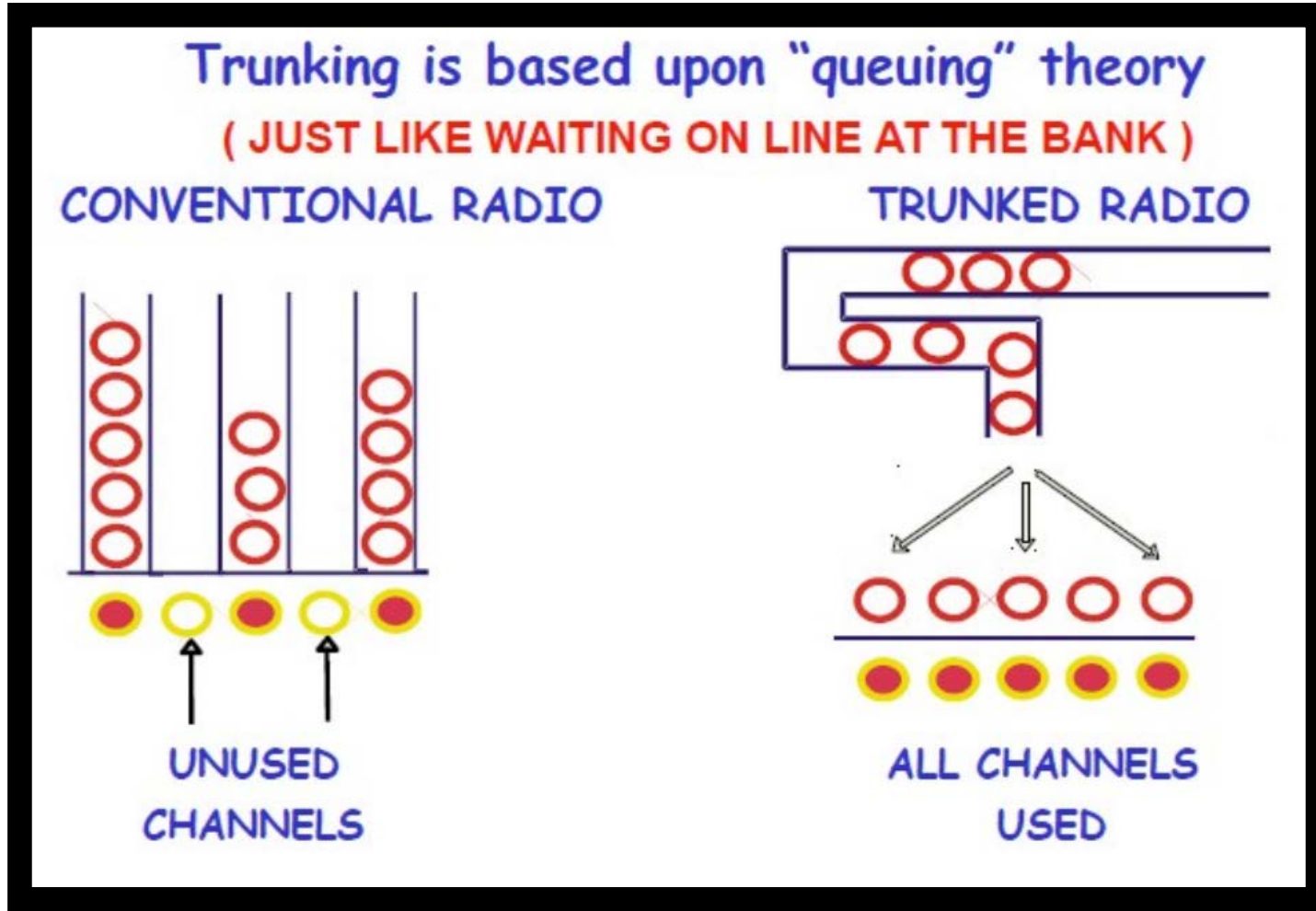


TRUNKING

Resources are shared among many agencies. The Director (Control Channel) assigns users open resources to use as needed. Efficient use of resources and spectrum.



# TRUNKING THEORY (Another view)

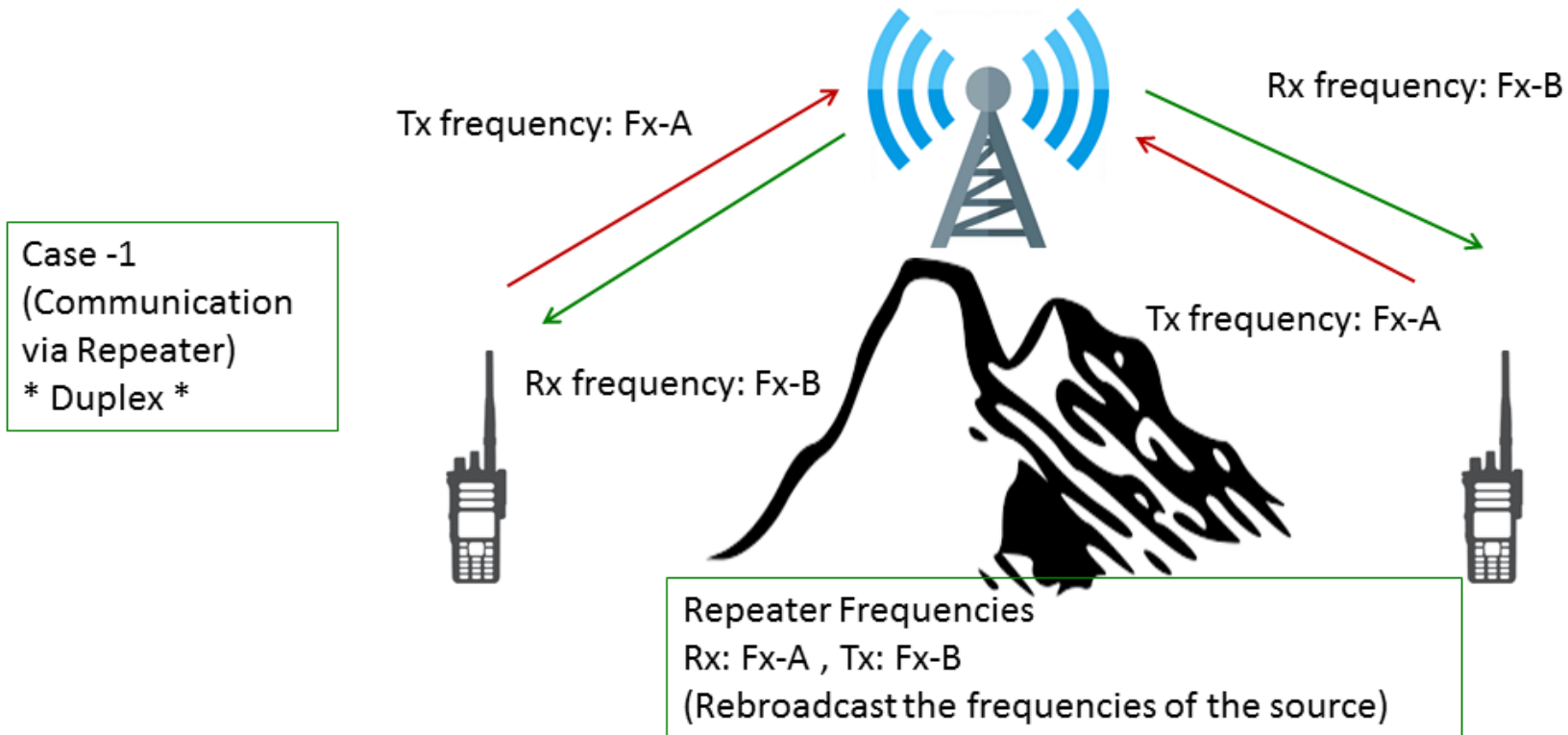


Click to listen  
to what a  
Control  
Channel  
sounds like

# TRUNKING THEORY (Another view)



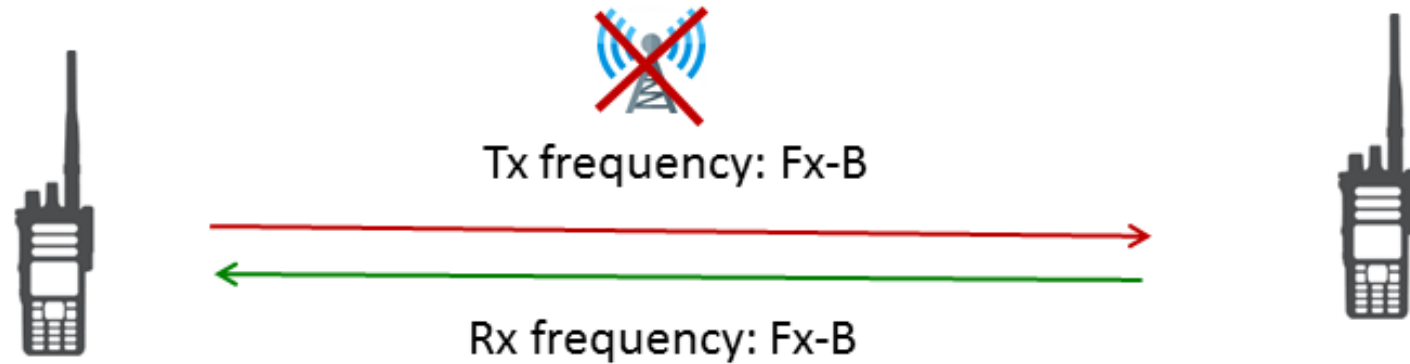
# REPEATER (DUPLEX COMMUNICATIONS)



A tower at high elevation receives and re-transmits signals in much larger area. Radio is receiving on one frequency and transmitting on another. Almost all duplex radios systems are using some form of a repeater

# DIRECT / TALK AROUND (SIMPLEX COMMUNICATIONS)

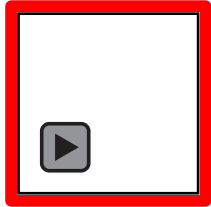
Case -2  
(Communication  
via Talk around)  
\* Simplex \*



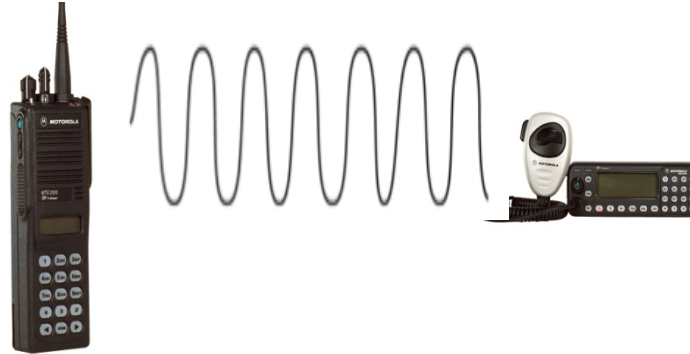
Direct radio to radio communication. This is referred as “Direct” or “Talk around” or “Simplex” type communication. Range is often limited to LOS (Line of sight) depending on frequency band. In the 700/800MHz spectrum, line of sight is a good judge on range. No infrastructure is helping in-between the radios



# MODULATION TECHNIQUES

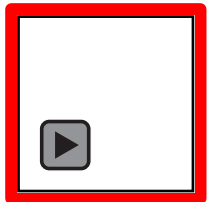


Click for sample

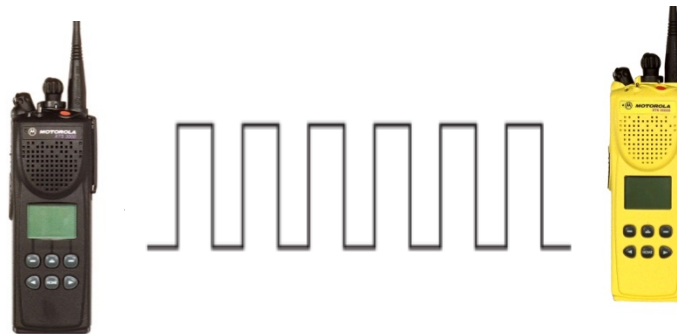


Analog transmission

Information is sent by changing the frequency, amplitude or phase of the radio signal



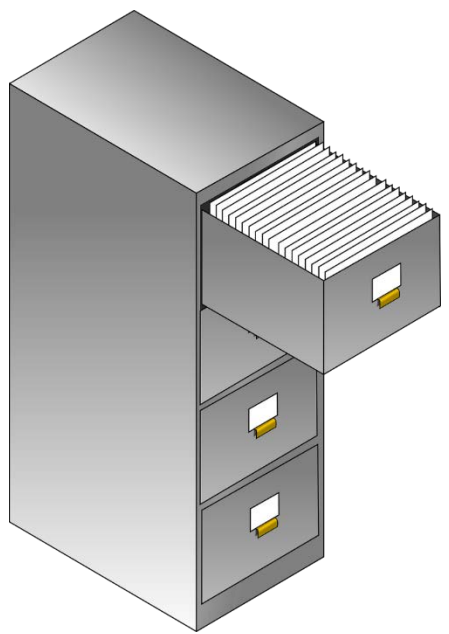
Click for sample



Digital transmission

Information is converted to true data bits, and applied directly to the radio transmitter using FDMA, (or TDMA or CDMA)

# ORGANIZATION OF TALKGROUPS INTO ZONES



- Talkgroups are “virtual” channels.
- Talkgroups are placed in a list to form a “zone”
- On average, most radios will hold over 1,000 channels (or talkgroups)
- On average, most radios are capable of over 50 zones
- On average, most radios are designed in zones of (16) channels or talkgroups

NAME	
ZONE	AIR OPS
Position	NAME
1	AIROPS1
2	AIROPS2
3	AIROPS3
4	AIROPS4
5	AIROPS5
6	AIROPS6
7	AIROPS7
8	AIROPS8
9	AIROPS9
10	AIROPS10
11	7AG58D
12	7AG60D
13	7AG67D
14	7AG68D
15	7AG88D
16	8TAC94D

# MINIMUM REQUIRED TEMPLATE

- Created by the Statewide Interoperability Executive Committee (SIEC) to ensure all radios are equipped with standard programming.
- Viper template was updated to include new channels, modification of existing and deletion of some talkgroups
- Added guidance on Encryption
- Programming authority
- State Event Talkgroup strategy

North Carolina State Interoperability  
Executive Committee



**VIPER Statewide Required  
Template**

Standard Operating Guideline

March 2021

Click to open the Viper Template SOG

# STATE EVENT TALKGROUPS

- State Event Talkgroups are assigned by the NC 24hr watch (NCEOC) or Regional Coordination Centers (RCCs)
- DO NOT just pick a talkgroup and use without clearance!
- (80) Talkgroups are available
- Statewide coverage
- Review the Viper Template SOG for specific information



## State Event Talkgroups

The state event talkgroups are established as follows:

ZONE	<i>NAME</i> EVT A-D	<i>NAME</i> EVT E-H	<i>NAME</i> EVT I-L	<i>NAME</i> EVT M-P	<i>NAME</i> EVT Q-T
<i>Position</i>	<i>NAME</i>	<i>NAME</i>	<i>NAME</i>	<i>NAME</i>	<i>NAME</i>
1	ALPHA1	ECHO1	INDIA1	MIKE1	QUEBEC1
2	ALPHA2	ECHO2	INDIA2	MIKE2	QUEBEC2
3	ALPHA3	ECHO3	INDIA3	MIKE3	QUEBEC3
4	ALPHA4	ECHO4	INDIA4	MIKE4	QUEBEC4
5	BRAVO1	FXTRT1	JULIET1	NOVEMBR1	ROMEO1
6	BRAVO2	FXTRT2	JULIET2	NOVEMBR2	ROMEO2
7	BRAVO3	FXTRT3	JULIET3	NOVEMBR3	ROMEO3
8	BRAVO4	FXTRT4	JULIET4	NOVEMBR4	ROMEO4
9	CHRLY1	GOLF1	KILO1	OSCAR1	SIERRA1
10	CHRLY2	GOLF2	KILO2	OSCAR2	SIERRA2
11	CHRLY3	GOLF3	KILO3	OSCAR3	SIERRA3
12	CHRLY4	GOLF4	KILO4	OSCAR4	SIERRA4
13	DELTA1	HOTEL1	LIMA1	PAPA1	TANGO1
14	DELTA2	HOTEL2	LIMA2	PAPA2	TANGO2
15	DELTA3	HOTEL3	LIMA3	PAPA3	TANGO3
16	DELTA4	HOTEL4	LIMA4	PAPA4	TANGO4



# DOMESTIC PREPAREDNESS REGION (DPR) TALKGROUPS


- Designed for regional events



## State of North Carolina Division of Emergency Management



### Domestic Preparedness Region Talkgroup Boundaries

	Coordination PSAP
 DPR West Talkgroups	Mitchell County 911 (828)688-9110
 DPR Central Talkgroups	Surry County 911 (336)374-3000
 DPR East Talkgroups	Pitt County 911 (252)902-2602

ZONE	NAME	NAME	NAME
	DPR EAST	DPR CENTRAL	DPR WEST
Position	NAME	NAME	NAME
1	DPREAST1	DPRCENT1	DPRWEST1
2	DPREAST2	DPRCENT2	DPRWEST2
3	DPREAST3	DPRCENT3	DPRWEST3
4	DPREAST4	DPRCENT4	DPRWEST4
5	DPREAST5	DPRCENT5	DPRWEST5
6	DPREAST6	DPRCENT6	DPRWEST6
7	DPREAST7	DPRCENT7	DPRWEST7
8	DPREAST8	DPRCENT8	DPRWEST8
9	DPREAST9	DPRCENT9	DPRWEST9
10	DPREAST10	DPRCENT10	DPRWEST10
11	DPREAST11	DPRCENT11	DPRWEST11
12	DPREAST12	DPRCENT12	DPRWEST12
13	DPREAST13	DPRCENT13	DPRWEST13
14	DPREAST14	DPRCENT14	DPRWEST14
15	DPREAST15	DPRCENT15	DPRWEST15
16	FREESPACE	FREESPACE	FREESPACE

Valid as of 9/20/20

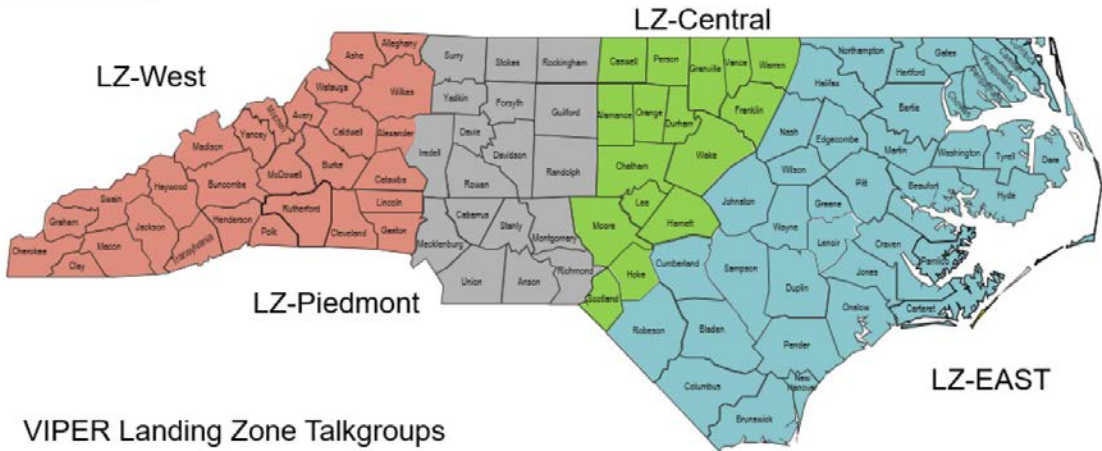


# NCEM STATEWIDE TALKGROUPS

- Addition of the PIEDMONT zone
- Addition of LZ (Landing Zone) 2 to each zone
- Addition of SW CONF



## State of North Carolina Division of Emergency Management



VIPER Landing Zone Talkgroups

- LZ-EAST 1 and LZ-EAST 2
- LZ-CENTRAL1 and LZ-CENTRAL2
- LZ-PDMONT1 and LZ-PDMONT2
- LZ-WEST1 and LZ-WEST2

Valid as of 9/29/20

	<i><u>NAME</u></i>
ZONE	STATEWD
<i><u>Position</u></i>	<i><u>NAME</u></i>
1	SW CALL
2	SW CONF
3	EM EOC
4	EM EBO
5	EM CBO
6	EM WBO
7	EM RRT
8	EM SAR
9	LZWEST1
10	LZWEST2
11	LZEAST1
12	LZEAST2
13	LZCENTRAL1
14	LZCENTRAL2
15	LZPDMONT1
16	LZPDMONT2

\*\*\*LZ Talkgroups are for Air to Ground LZ coordination. LZ Talkgroups are not for flight following unless all other options have failed.

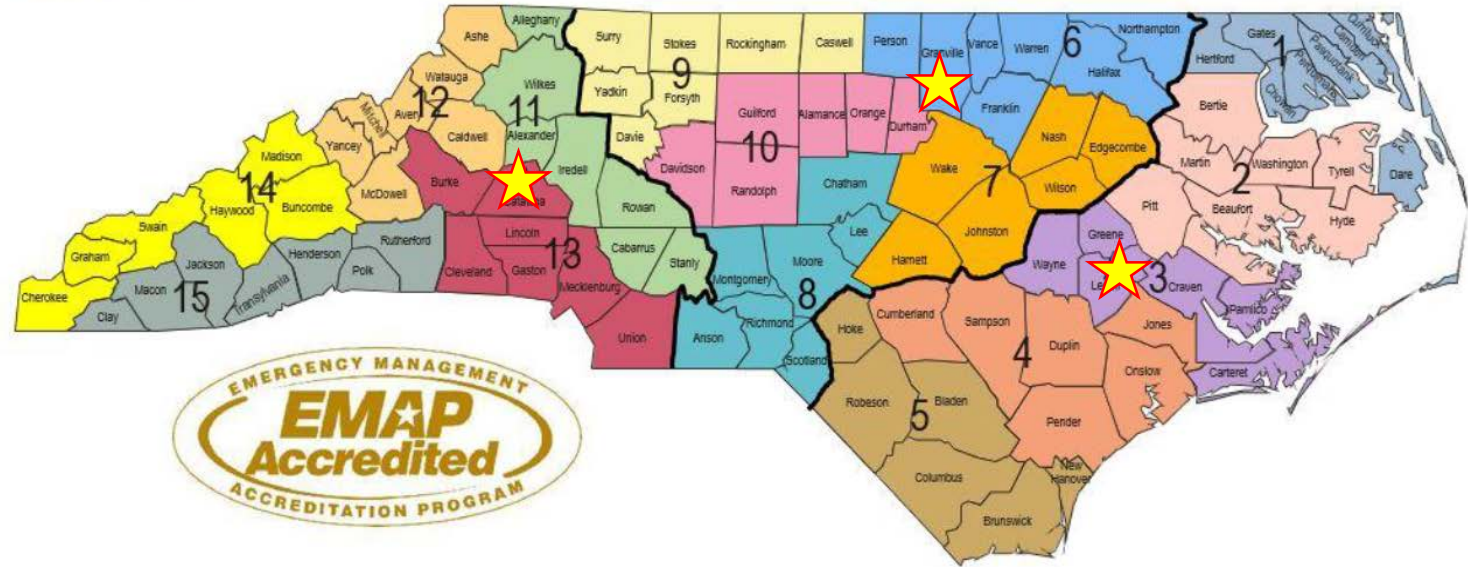
# NCEM RCC's

- NCEM Regional Coordination Centers (East, Central West)
- Otherwise know as NCEM Branch Offices
- During disasters, regions work with their County and RCC for Communication

Communication flow is  
LOCAL>COUNTY>RCC>EOC



## State of North Carolina Division of Emergency Management



**Western Branch**  
WBO Talkgroup  
3305-15 16th Avenue SE  
Conover, NC 28613  
Office: 828-466-5555

Area 11 Coordinator  
Area 12 Coordinator  
Area 13 Coordinator  
Area 14 Coordinator  
Area 15 Coordinator

**Central Branch**  
CBO Talkgroup  
401 Central Avenue  
Butner, NC 27509  
Office: 919-575-4122

Area 6 Coordinator  
Area 7 Coordinator  
Area 8 Coordinator  
Area 9 Coordinator  
Area 10 Coordinator

**Eastern Branch**  
EBO Talkgroup  
3802 Highway 58 N. Suite B  
Kinston, NC 28502  
Office: 252-520-4923

Area 1 Coordinator  
Area 2 Coordinator  
Area 3 Coordinator  
Area 4 Coordinator  
Area 5 Coordinator



# AIR OPERATIONS TALKGROUPS

- Designed for Air Operations
- These can be for any need, examples:  
air to air or air to ground
- Must be coordinated the NCEOC /24Hr Watch
- 700 channels are digital conventional NPS (National Public Safety). All are radio to radio (Direct/Simplex)

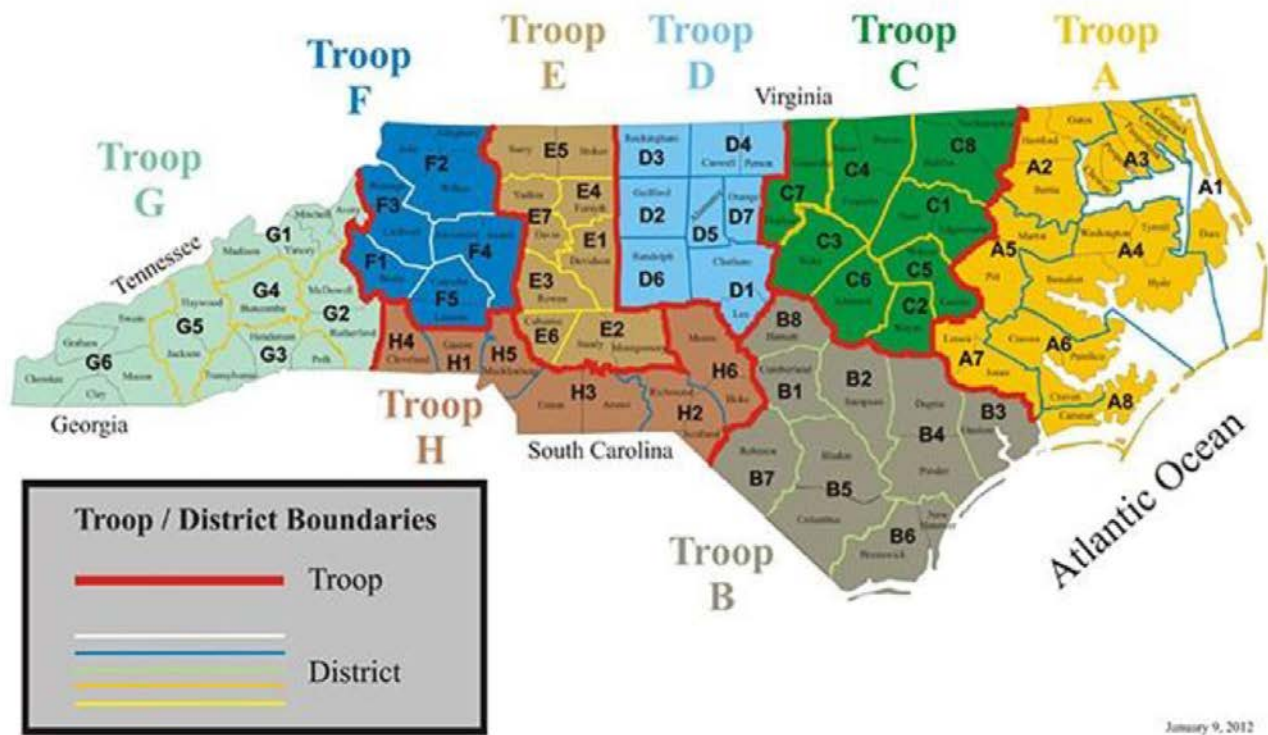


	<i><b>NAME</b></i>
<i><b>ZONE</b></i>	<i><b>AIR OPS</b></i>
<i><b>Position</b></i>	<i><b>NAME</b></i>
1	AIOPS1
2	AIOPS2
3	AIOPS3
4	AIOPS4
5	AIOPS5
6	AIOPS6
7	AIOPS7
8	AIOPS8
9	AIOPS9
10	AIOPS10
11	7AG58D
12	7AG60D
13	7AG67D
14	7AG68D
15	7AG88D
16	8TAC94D



# HIGHWAY PATROL TALKGROUPS

## North Carolina State Highway Patrol Troop and District Boundaries



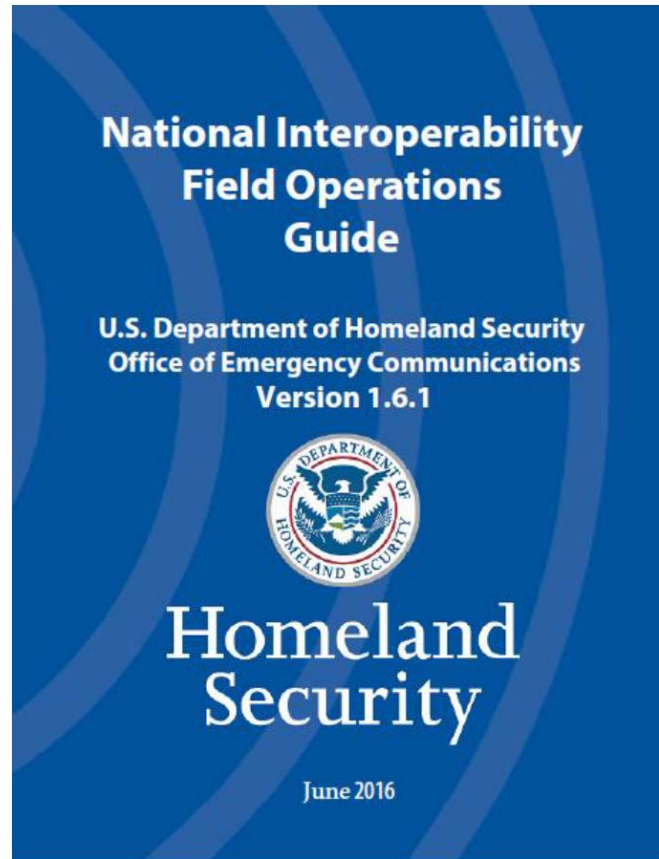
January 9, 2012



	<i>NAME</i>
ZONE	NC SHP MA
<i>Position</i>	<i>NAME</i>
1	TRPA MA
2	TRPA CMN2
3	TRPB MA
4	TRPB CMN2
5	TRPC MA
6	TRPC CMN2
7	TRPD MA
8	TRPD CMN2
9	TRPE MA
10	TRPE CMN2
11	TRPF MA
12	TRPF CMN2
13	TRPG MA
14	TRPG CMN2
15	TRPH MA
16	TRPH CMN2

# NPS (NATIONAL PUBLIC SAFETY)

- Mix of analog and simplex interoperable channels.
- Most common channels selected
- All channels can be referenced in the NIFOG



	<i><b>NAME</b></i>	<i><b>NAME</b></i>
<i><b>ZONE</b></i>	<i><b>NIFOG RPT</b></i>	<i><b>NIFOG DIR</b></i>
<i><b>Position</b></i>	<i><b>NAME</b></i>	<i><b>NAME</b></i>
1	8CALL90	8CALL90D
2	8TAC91	8TAC91D
3	8TAC92	8TAC92D
4	8TAC93	8TAC93D
5	8TAC94	8TAC94D
6	7TAC51	7TAC51D
7	7TAC52	7TAC52D
8	7TAC53	7TAC53D
9	7TAC54	7TAC54D
10	7TAC71	7TAC71D
11	7TAC72	7TAC72D
12	7TAC73	7TAC73D
13	7TAC74	7TAC74D
14	7LAW61	7LAW61D
15	7FIRE63	7FIRE63D
16	7MED65	7MED65D

# LAW ENFORCEMENT TALKGROUPS

- Zone specifically for LE operations
- North Carolina has a variety of Interoperable Encryption Keys available for approved agencies
- Variety of Encryption algorithms available (AES256, DES and RC4)
- Agencies must request permission to load and access interop keys.

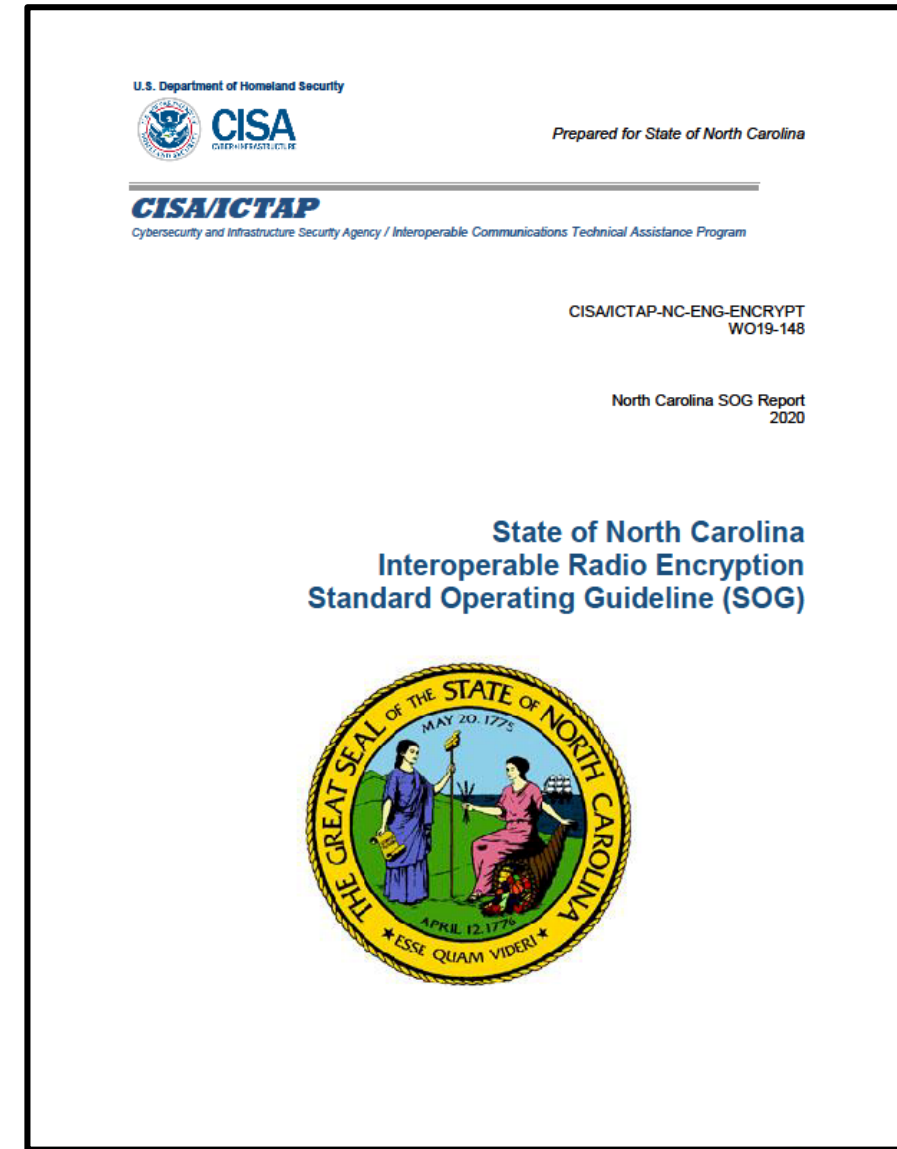


	<i><b>NAME</b></i>
<i><b>ZONE</b></i>	<i><b>LE INTEROP</b></i>
<i><b>Position</b></i>	<i><b>NAME</b></i>
1	AGENCY DISP
2	LAW1 CLEAR
3	LAW2 CLEAR
4	LAW3 CLEAR
5	LAW4 DES
6	LAW5 DES
7	LAW6 DES
8	LAW7 AES
9	LAW8 AES
10	LAW9 AES
11	LAW10 ENC
12	LAW11 ENC
13	LAW12 ENC
14	LAW13 ENC
15	LAW14 ENC
16	FREE SPACE

# NC INTEROPERABLE ENCRYPTION PLAN

- Outlines a plan for Interoperable Encryption in NC and with other national agencies.
- Covers county Common Key Reference / Storage Location Number (CKR/SLN) assignments
- Covers NC Interoperable Encryption keys
- Provides guidance on how to obtain National Interoperability Keys

**Most important item to know- Seek assistance with Encryption items before implementing! This document outlines how to do that.**







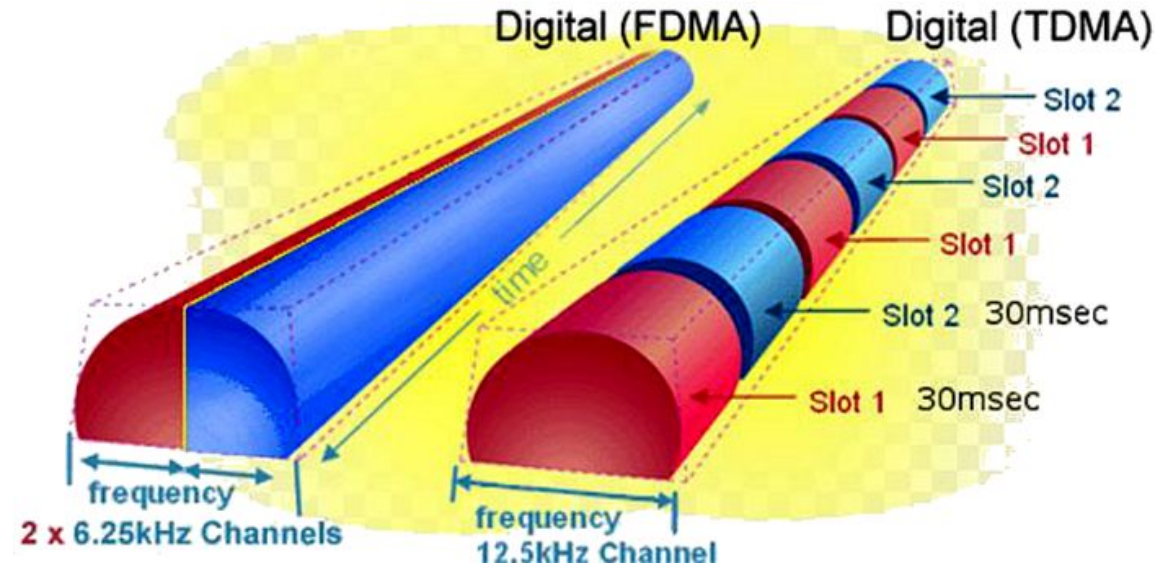
# RADIO FUNCTIONS

## SECTION 2

The following radios are the most common subscribers on the VIPER system. If you have a different vendor/model, please refer to specific platform training. In this presentation, the Motorola XTS and APX platform will be covered.

# VIPER P25 PHASE II (TDMA)

- VIPER will be upgrading the system to P25 phase II Time Division Multiple Access (TDMA)
- This upgrade increases capacity and provides additional capability
- The Astro25 (XTS/XTL) platform will be covered in this training, but it must be known the equipment will no longer be VIPER capable in 2025
- Additional information on P25 Phase II can be found at:  
<http://www.p25phase2.com/p25-phase-2>



**THIS CHANGE IS PLANNED FOR 2025**

# SIGNAL STRENGTH

- Omni directional (360deg) antennas are designed to operate in a vertical format
- Most antennas on towers, vehicles and portable radios are meant to be in the vertical position (or perpendicular to ground)
- Strongest signal radiates perpendicular to antenna direction (to sides)
- Weakest or null area is directly overhead





# MOTOROLA ASTRO25 (XTS PLATFORM)



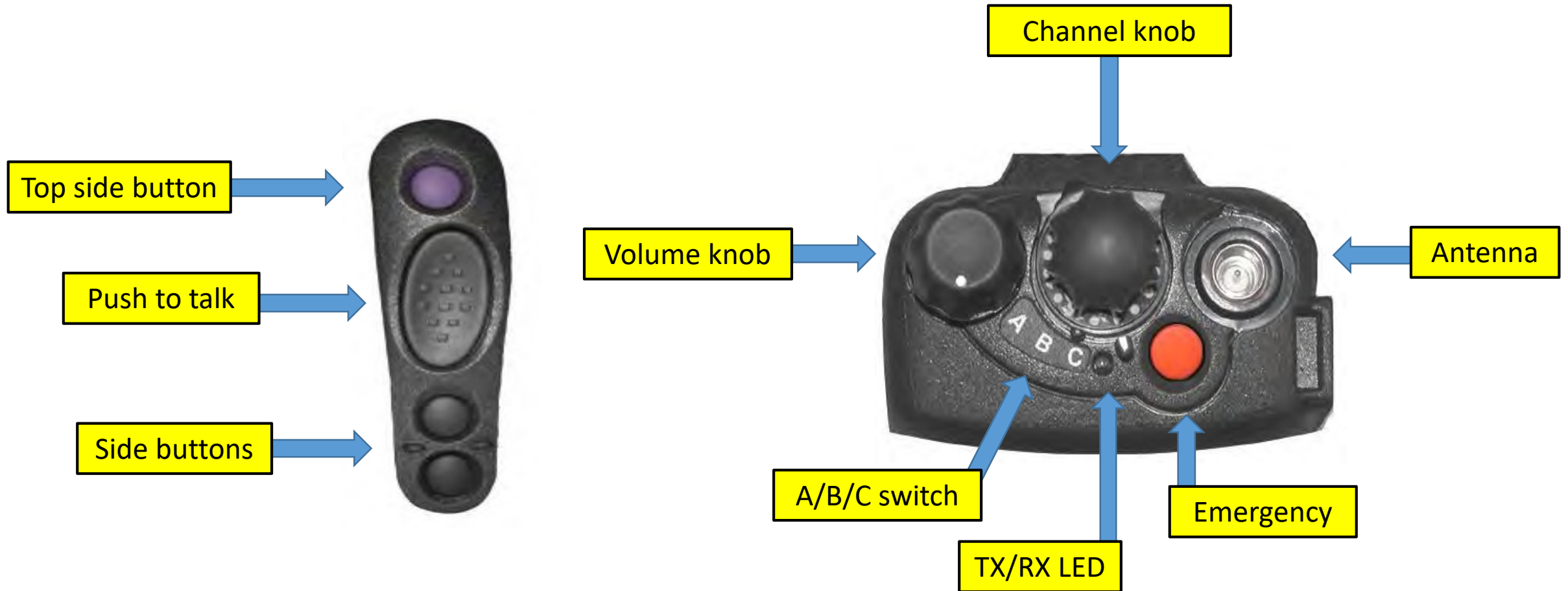


# XTS – FRONT ANATOMY:

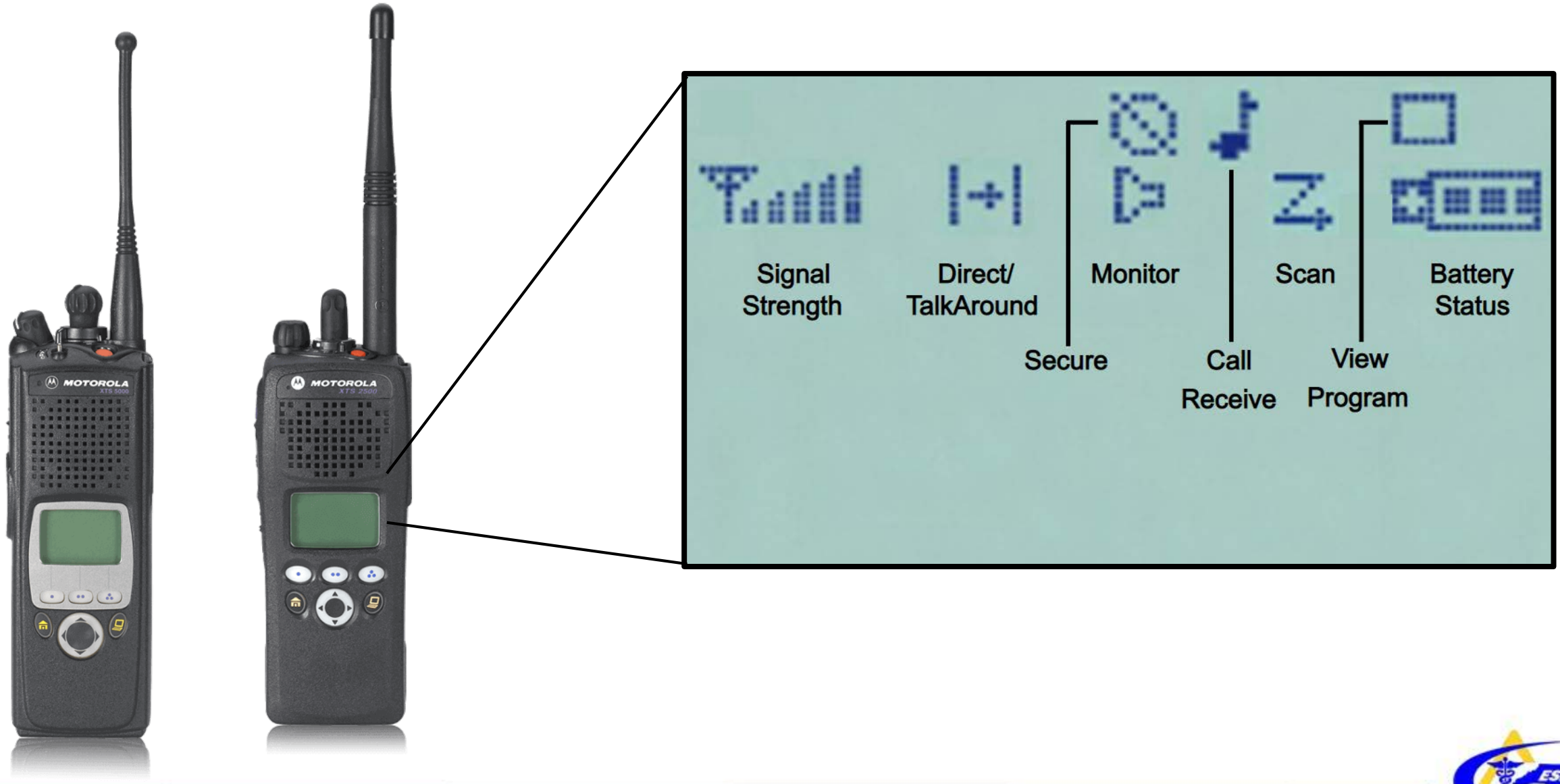
- The Astro25 (XTS) platform remains a popular radio on the VIPER system.
- While discontinued, these radios will continue to work until the 2025 TDMA switch.
- The following slides are examples of how radios CAN be programmed and general use instructions.



# XTS – TOP & SIDE ANATOMY:



# XTS – DISPLAY:



# XTS – DISPLAY (ZONE):



## To select a zone:

1. Press the right side of the 4-way Navigation button until ZONE appears on the display.
2. Press the button directly below ZONE.  
*The zone name flashes on the display.*
3. Press the right side of the 4-way Navigation button to find the zone you want.  
*If the zone you selected is unprogrammed, repeat step 3.*
4. Press the Home button to confirm the displayed zone and channel.  
OR  
Press the PTT button to transmit on the displayed zone/channel.



# XTS – DISPLAY (TALKGROUP/CHANNEL):



## To select a channel/mode:

1. Press the right side of the 4-way Navigation button until CHAN appears on the display.

2. Press the button directly below CHAN.

*The channel/talkgroup name flashes on the display.*

3. Press the right side of the 4-way Navigation button to find the channel you want.

*If the channel you selected is unprogrammed, repeat step 3.*

4. Press the Home button to confirm the displayed channel/talkgroup.

OR

Press the PTT button to transmit on the displayed zone/channel.

# XTS – CHANNEL CHANGE:

To select a channel/mode:

ZONE	NAME
	AIR OPS
Position	NAME
1	AIROPS1
2	AIROPS2
3	AIROPS3
4	AIROPS4
5	AIROPS5
6	AIROPS6
7	AIROPS7
8	AIROPS8
9	AIROPS9
10	AIROPS10
11	7AG58D
12	7AG60D
13	7AG67D
14	7AG68D
15	7AG88D
16	8TAC94D

- Turn top rotary channel knob until desired channel is reached
- It is common for the first and last position to be dispatch channels in many zones
- Generally, portable radios are designed in zones containing (16) channels

There are 16 Channels per bank and can be reached by turning the channel knob.

Push-to-Talk (PTT)



Channel knob



Talkgroup / Channel name



# XTS – LED LIGHT:

## RED

- **Solid**
  - PTT is pressed; radio is transmitting
- **Flashing**
  - Channel Busy
  - Low Battery (lights while transmitting)



RED LED

## GREEN

- **Solid**
  - Self-test being performed
- **Flashing**
  - Incoming Private Call



GREEN LED

# XTS - ANTENNA:

## To install the antenna:

1. Turn the radio off
2. Screw the antenna (clockwise) into the antenna receptacle on top of the radio
3. Tighten the antenna firmly with your fingers. Do not over tighten!

## To remove the antenna:

1. Turn the radio off
2. Unscrew the antenna (counter clockwise) and remove it from the antenna receptacle on top of the radio





# XTS - BATTERY:

## To install the battery:

1. Turn the radio off.
2. Align the three tabs at the bottom of the battery with the three slots at the bottom of the back of the radio.
3. Angle the battery forward toward the radio until the battery clicks into place.

## To remove the battery:

1. Turn the radio off.
2. Holding the radio in one hand, push down on the battery release slides on both sides of the battery with the other hand.
3. Angle the battery away from the radio and remove.



# XTS – ACCESSORY CONNECTOR:

*The universal connector cover protects the side connector near the antenna.*

## To remove the cover:

1. Turn the radio off.
2. Carefully insert a flat-bladed screwdriver between the bottom of the cover and the connector. **Some debate on correct side (Top or bottom). Both work**
3. Holding the top of the cover with your thumb, push the screwdriver gently downward and lever the cover away from the radio.

## To install the cover:

1. Turn the radio off.
2. Insert the hooked end of the cover into the slot above the connector.
3. Rub the ball of your thumb from the top to the bottom of the cover, applying pressure towards the radio. This will flex the cover and snap it into place.



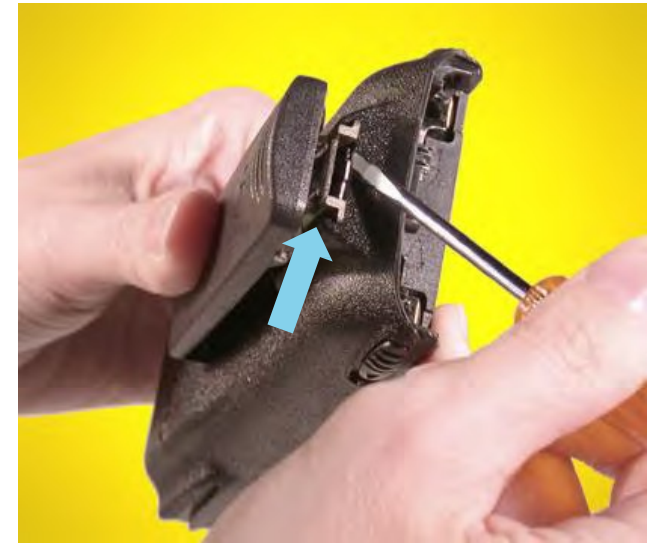
# XTS – BELT CLIP:

## To install the belt clip:

- 1.Remove battery before installing or removing the belt clip.
- 2.Hold the battery with the back of the battery facing you.
- 3.Hold the belt clip with the top facing upward, and align the clip with the slots on the battery back.
- 4.Slide the belt clip downward into the slots until it clicks into place.

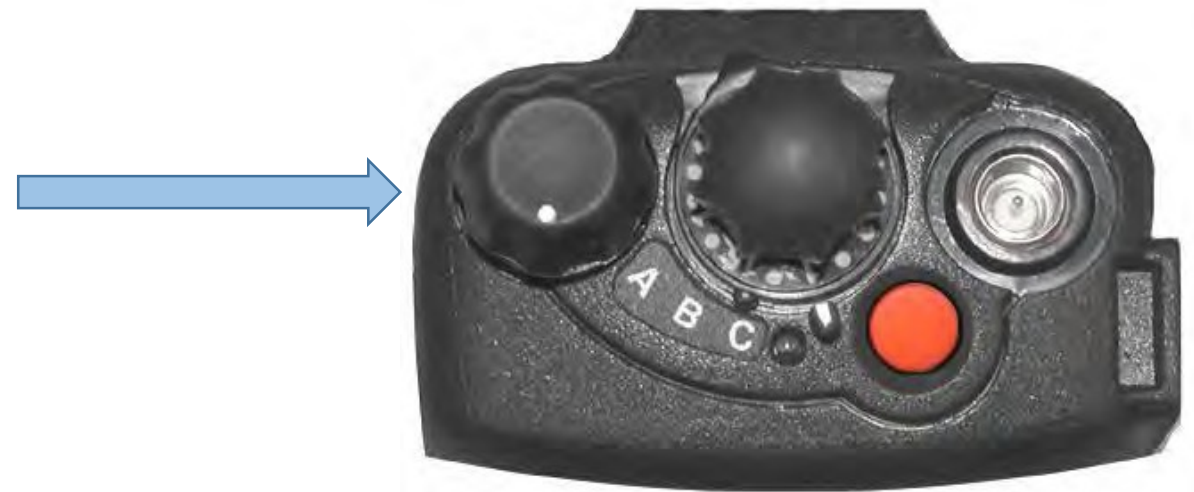
## To remove the belt clip:

- 1.Pull away the metal tab at the top of the battery clip from the battery.
- 2.Slide the clip upward until it comes away from the radio.





# XTS-ANATOMY OF A RADIO

- On/Off/Volume Knob
- Turn clockwise to turn on and continue doing so to adjust the volume up.
- Turn counterclockwise to adjust the volume down and to turn the radio off.





# XTS-ANATOMY OF A RADIO

- 2-Position Concentric Switch (5000)
- 3-Position Concentric Switch (2500)
- These rocker switches can be programmed for a variety of functions.
- Common for encryption selection
- SEC TX Only = Secure Transmit Only 
- CLR TX Only = Clear Transmit Only 



XTS2500



XTS5000

# XTS-ANATOMY OF A RADIO

- Orange button
- Most commonly used as a “panic button” or Emergency Alarm
- Can be set up in a variety of ways
- It is important to understand what occurs when an Emergency Alarm is transmitted. Do not ignore it if transmitted.
- Every activation must be acknowledged and or cleared. The system performance is impacted due to priority. Emergency Alarms will be covered in greater detail later in the training.



# XTS-ANATOMY OF A RADIO

- 3-Position Switch
- Switch can serve many functions such as scan, lock, zone etc:
  - A – User programmable
  - B – User programmable
  - C – User programmable
- Please consult your local programming parameters for its use.



# XTS-ANATOMY OF A RADIO

- Microphone and Speaker
- Hold radio a few inches from your face when speaking in a normal clear voice
- Do not poke the holes in the speaker grille with sharp or pointed objects.
- Avoid getting your radio wet. If it does, shake the radio well to remove any water trapped in the speaker grille or microphone port.





# XTS-ANATOMY OF A RADIO

- 4-Way Navigation Button
- a.k.a. the arrow button
- Move through the screen icons by pressing the button right and left.
- Use in conjunction with the soft keys and home button.



# MOTOROLA ASTRO25 (XTL PLATFORM)



# MOTOROLA ASTRO25 (XTL PLATFORM)

- There is no current standard on how buttons or menus are programmed. Consult your AHJ on how these are programmed.
- Generally, the channel knob and home buttons remain constant



# MOTOROLA ASTRO25 (XTL PLATFORM)





# MOTOROLA (APX PLATFORM)



# APX SERIES HANDHELD

- This is an example of how buttons and functions can be programmed.
- Some features are standard such as PTT, Volume, Channel knob.
- All other buttons are configurable by your agency. Please reference your agency programming plan



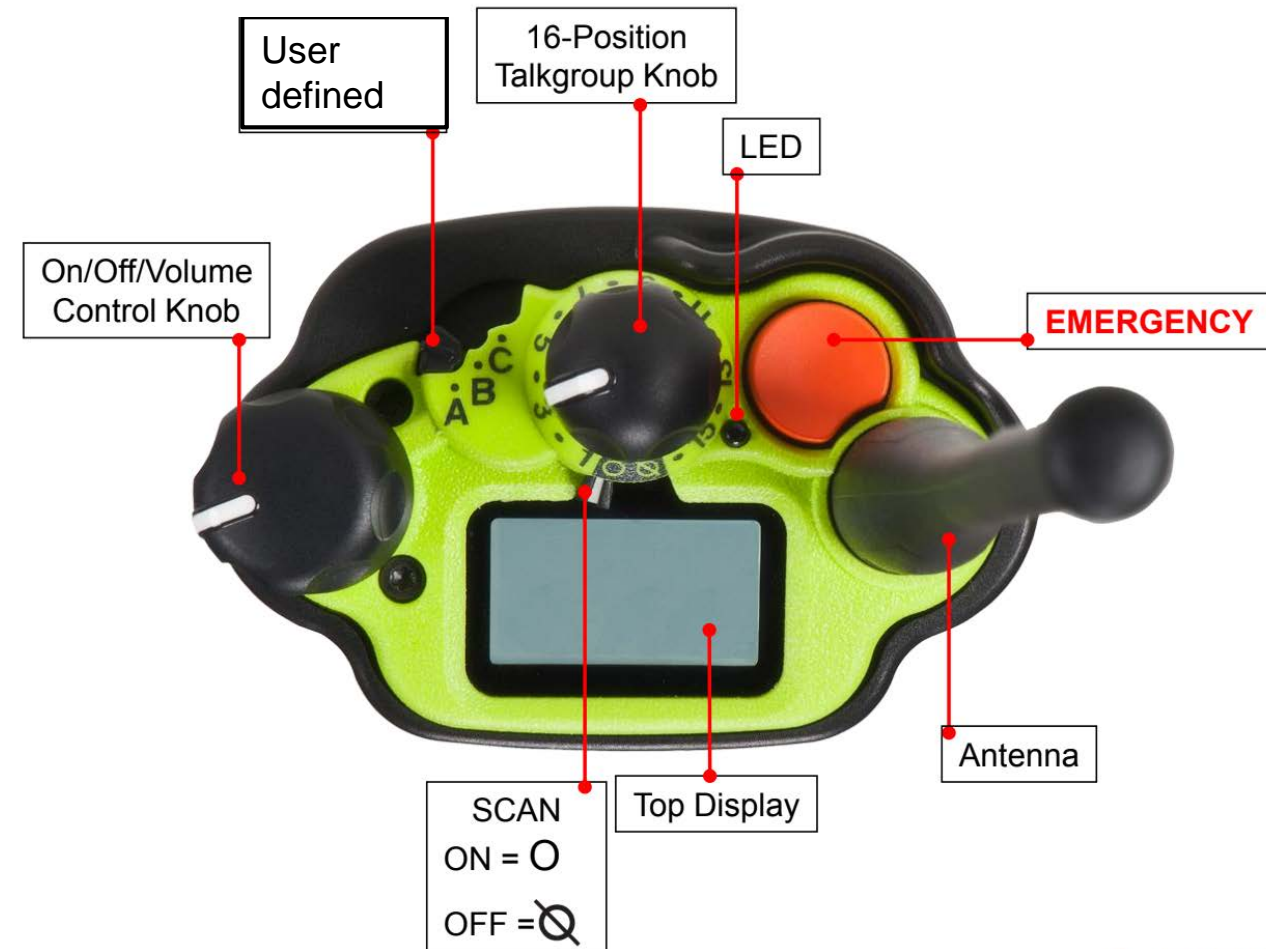
# APX SERIES

- This is an example of how buttons and functions can be programmed.
- Some features are standard such as PTT, Volume, Channel knob.
- All other buttons are configurable by your agency. Please reference your agency programming plan.



# APX SERIES (TOP)

- This is an APX 6000 XE version. Notice the larger screen, channel knob, emergency and volume.
- Top display can show zone/channel information normal or inverted.





# APX SERIES (BATTERY)

- With the radio turned off, slide the battery into the radio until the side latches click into place.
- To remove the battery, turn the radio off. Squeeze the release latches and slide the battery out.



# APX SERIES (ANTENNA)

- Frequently check the antenna to ensure it is tight.
- Do not overtighten
- Only use antenna supplied with radio. All antennas are not alike.



# APX SERIES (ACCESSORY CONNECTOR)

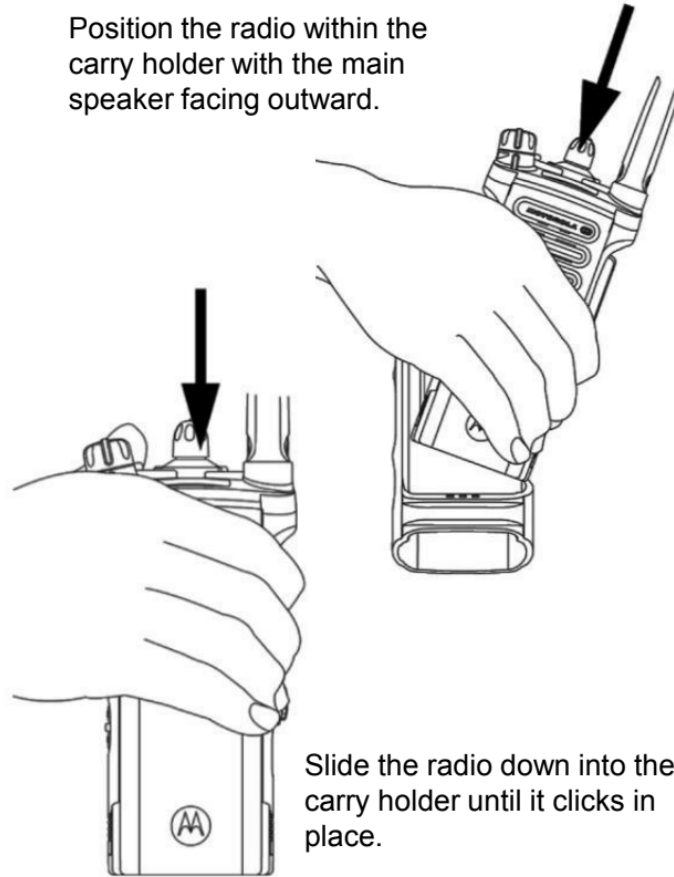
- Keep dust cover on when no accessories are connected
- Do not over tighten thumb screw
- Regularly inspect and clean contacts if needed



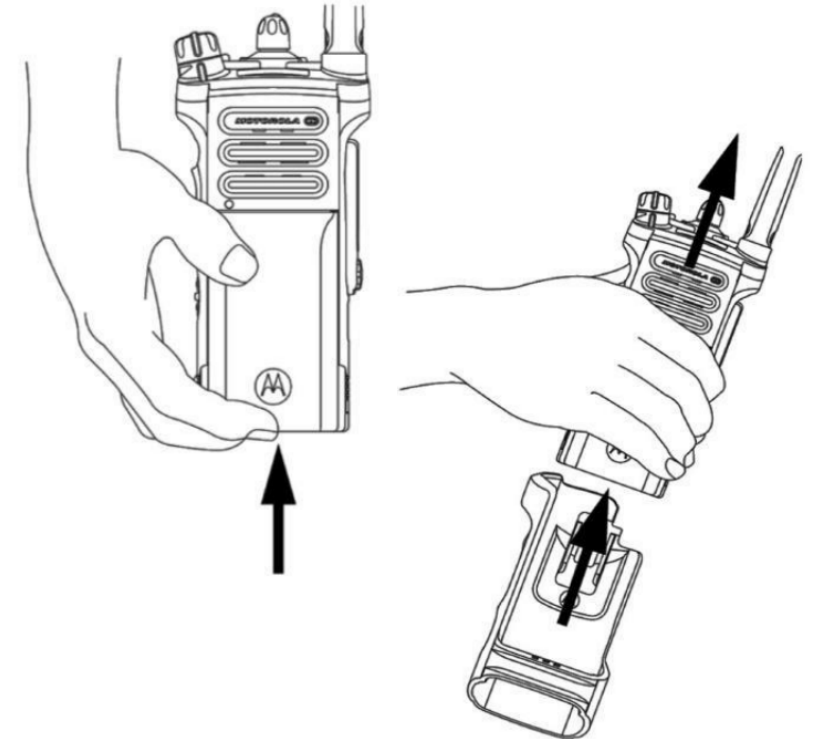
# APX SERIES (CARRY HOLSTER)

- Multiple carry options exist.
- The most common holster is the standard slide in

Position the radio within the carry holder with the main speaker facing outward.



To remove the radio from the carry holder, place the tip of your fingers on the ledge of the carry holder and push at the bottom of the radio until the radio is released from it.





# APX-ANATOMY OF A RADIO (VOLUME)

- On/Off/Volume Knob
- Turn clockwise to turn on and continue doing so to adjust the volume up.
- Turn counterclockwise to adjust the volume down and to turn the radio off.



# APX-ANATOMY OF A RADIO (PTT)

- Push to talk (PTT) button
- Standard position across platforms
- Take notice of Bluetooth pairing location (blue dot)



# APX-ANATOMY OF A RADIO (MIC)

- Microphone is on either side of radio
- Radio will sense which side is receiving the audio
- Remote speaker microphone (mic) location shown



☐ Red Lines indicate microphones

# APX-ANATOMY OF A RADIO (BUTTONS)

- Most vendors have different level models.
- Some have limited buttons and keypad while others have full DTMF keypads



MODEL 1

MODEL 2

MODEL 3

MODEL 1

MODEL 2

MODEL 3



Menu Select  
Buttons

Home  
Button

\*Future  
Usage

4-Way  
Navigation  
Button



# APX- ANATOMY OF A RADIO (ICONS)

The 240 x 320 pixel front liquid crystal display (LCD) of your radio shows radio status, text entries, and menu entries. The top two display rows contain color icons that indicate radio operating conditions.

The following are the icons that appear on the radio's display.



## Receiving

Radio is receiving a call or data.



## Transmitting

Radio is transmitting a call or data.



Top Display



## Battery

For IMPRES battery operation only – the icon shown indicates the charge remaining in the battery.  
For all battery operation – the icon blinks when the battery is low.



Top Display



## Received Signal Strength Indicator (RSSI)

The number of bars displayed represents the received signal strength for the current site, for trunking only. The more stripes in the icon, the stronger the signal.



Top Display



## Direct

- **On** = Radio is currently configured for direct radio-to-radio communication (during conventional operation only).
- **Off** = Radio is connected with other radios through a repeater.



Top Display



## Power Level

- **L** = Radio is set at Low power.
- **H** = Radio is set at High power.



Top Display



## Scan

Radio is scanning a scan list.












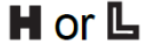


Top Display



## Priority Channel Scan

- **Blinking dot** = Radio detects activity on channel designated as Priority-One.
- **Steady dot** = Radio detects activity on channel designated as Priority-Two.

# APX- ANATOMY OF A RADIO (ICONS)

	<b>Secure Operation</b> <ul style="list-style-type: none"><li>• On = Secure operation.</li><li>• Off = Clear operation.</li><li>• Blinking = Receiving an encrypted voice call.</li></ul>		<b>Bluetooth On</b> <p>Bluetooth is on and ready for Bluetooth connection.</p>
	<b>Location Signal</b> <ul style="list-style-type: none"><li>• On = Location feature is enabled, and location signal is available.</li><li>• Off = Location feature is disabled.</li><li>• Blinking = Location feature is enabled, but no location signal is available.</li></ul>	 Top Display	<b>Bluetooth Connected</b> <p>Bluetooth is currently connected to the external Bluetooth device.</p>
	<b>User Login Indicator (IP Packet Data)</b> <ul style="list-style-type: none"><li>• On = User is currently associated with the radio.</li><li>• Off = User is currently not associated with the radio.</li><li>• Blinking = Device registration or user registration with the server failed due to an invalid username or pin.</li></ul>		<b>Wi-Fi</b> <p>The radio Wi-Fi network is connected. The number of bars displayed represents the signal strength of the Wi-Fi signal.</p>
	<b>Data Activity</b> <p>Data activity is present.</p>		<b>Monitor (Carrier Squelch)</b> <p>Selected channel is being monitored (during conventional operation only).</p>
Top Display 	<b>View/Program Mode</b> <p>Radio is in the view or program mode.</p> <ul style="list-style-type: none"><li>• On steady = View mode</li><li>• Blinking = Program mode</li></ul>		<b>Power Level</b> <ul style="list-style-type: none"><li>• L = Radio is set at Low power.</li><li>• H = Radio is set at High power.</li></ul>
			<b>Scan</b> <p>Radio is scanning a scan list.</p>
			<b>Priority Channel Scan</b> <ul style="list-style-type: none"><li>• Blinking dot = Radio detects activity on channel designated as Priority-One.</li><li>• Steady dot = Radio detects activity on channel designated as Priority-Two.</li></ul>

# APX- ANATOMY OF A RADIO (LED)

- LED can tell you a lot about what the radio is doing
- Most common is solid red for transmitting in trunk mode
- Solid yellow is common for receiving in conventional mode

## IDENTIFYING STATUS INDICATORS

**Solid red** – Radio is transmitting in trunked mode.

**Blinking red** – Radio is transmitting at low battery condition.

**Double blinking red** – Radio is in Emergency Mode.

**Rapidly blinking red** – Radio has failed the self test upon powering up or encountered a fatal error.

**Solid yellow (Conventional Only)** – Channel is busy.

**Blinking yellow** – Radio is receiving a secured transmission.

**Solid green** – Radio is powering up, or is on a non-priority channel while in the Scan List Programming mode.

**Blinking green** – Radio is on a Priority-Two channel while in the Scan List Programming mode.

**Note:** No LED indication when the radio receives a clear (non-secured) transmission in trunking Mode.



# APX- ANATOMY OF A RADIO (SCREEN)

- APX radios will display a red “Out of range” when the desired trunk system is not heard
- Radio can display an orange “Emergency” icon if programmed





# APX- ANATOMY OF A RADIO (BATTERY CHARGER)

## IMPRES Adaptive Charger

- Monitors the usage pattern of the IMPRES battery
- Stores that information in the IMPRES battery
- Performs a recondition cycle only when needed.
- Will not overheat the battery regardless of how long it is left in the charger.
- Charger monitors the battery and automatically “tops off” the battery, as required.

### NOTE:

- The battery must be charged before use.
- Memory effect is a phenomenon that causes a loss in battery capacity or voltage due to repetitive shallow discharging or long-term overcharging.
- This memory effect has been greatly reduced in your batteries through the use of new cell technology.
- It is still recommended that you discharge your battery as much as possible before recharging it.
- Recharging after each shift is good standard practice.
- When charging a battery that is attached to your radio, turn the radio off to ensure a full charge.



# APX- ANATOMY OF A RADIO (BATTERY LIGHTS)

## Charge Indicator

Single Flash Green



Charger has successfully powered up.

Steady Red



Battery is in rapid charge mode.

Flashing Green



Battery has completed rapid charge (>90% available capacity).  
Battery is in Top-Off charge (Trickle Charge) and requires approximately 1 hour.

Steady Green



**Battery has completed charging and is fully charged.**

Flashing Yellow



Battery is recognized by charger but is waiting to charge.  
(Either the battery voltage is too low or the battery temperature is too low or too high to allow charging. When this condition is corrected, the battery will begin charging).

Flashing Red



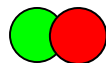
**Battery is un-chargeable or not making proper contact.**

Steady Yellow



Battery is in recondition mode. The length of time the charger remains in this mode is dependent upon the state of charge remaining in the battery when inserted. (Fully charged batteries require more time to recondition—8 hours or more—than fully discharged batteries.)

Flashing Red & Green



Battery may be approaching the end of its rated service life. This is not a fault indication, merely a notification to the user that the battery may soon no longer be able to yield expected service and may need to be replaced.



# RADIO CHARGING TIPS

- Batteries can be charged connected to the radio or disconnected from the radio.
- Only use the charger provided with your radio or a Motorola-approved charger.
- How to charge:
  - Turn off radio
  - Plug the charger into the wall outlet and confirm that power is going to the charger base.
  - Make sure the battery is all the way to the back of the charger. LED lights on charger will activate.
  - As a note” generally the lights on a bank charger are the same on an individual charger (color meaning for same vendor)

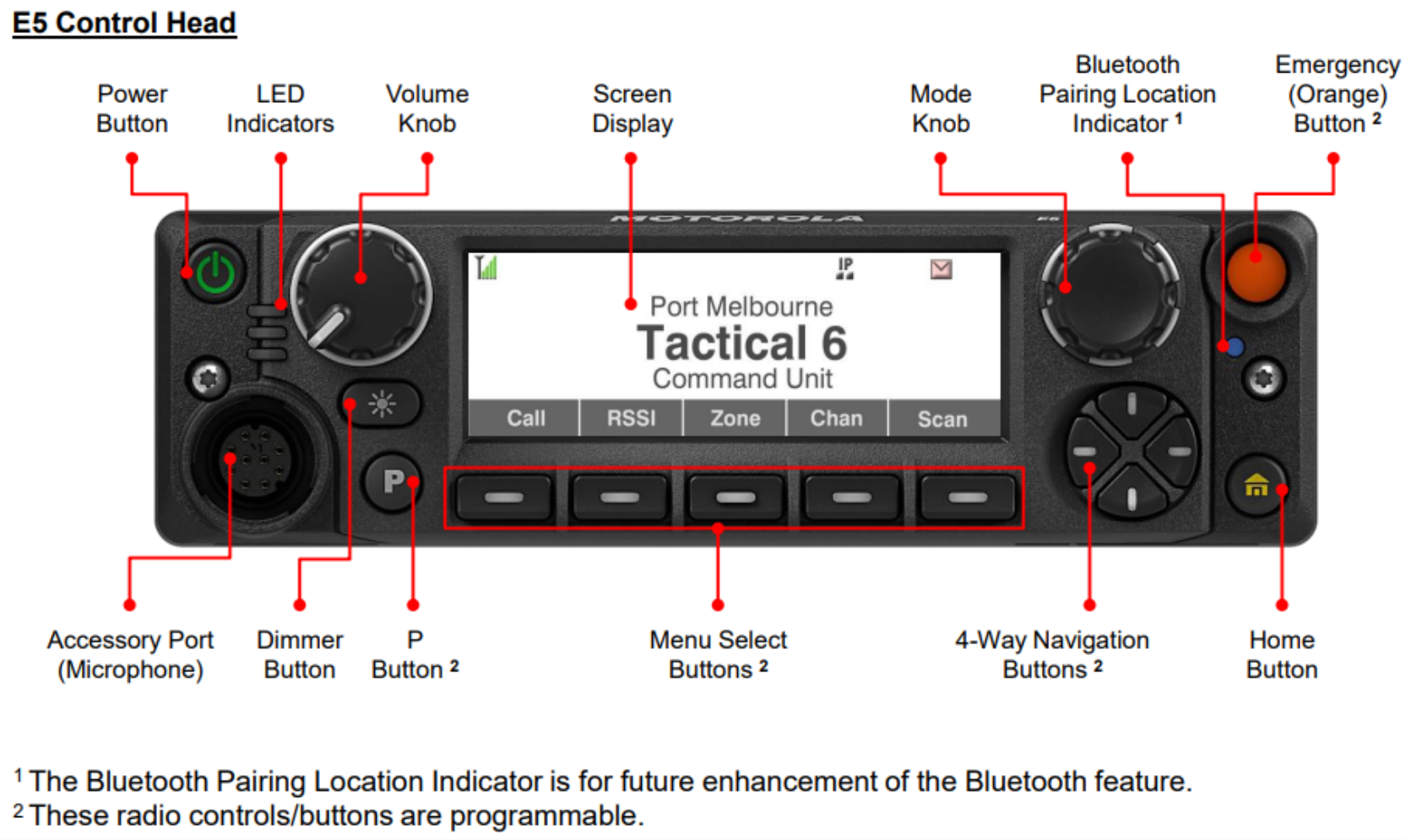


# MOTOROLA APX (MOBILE)

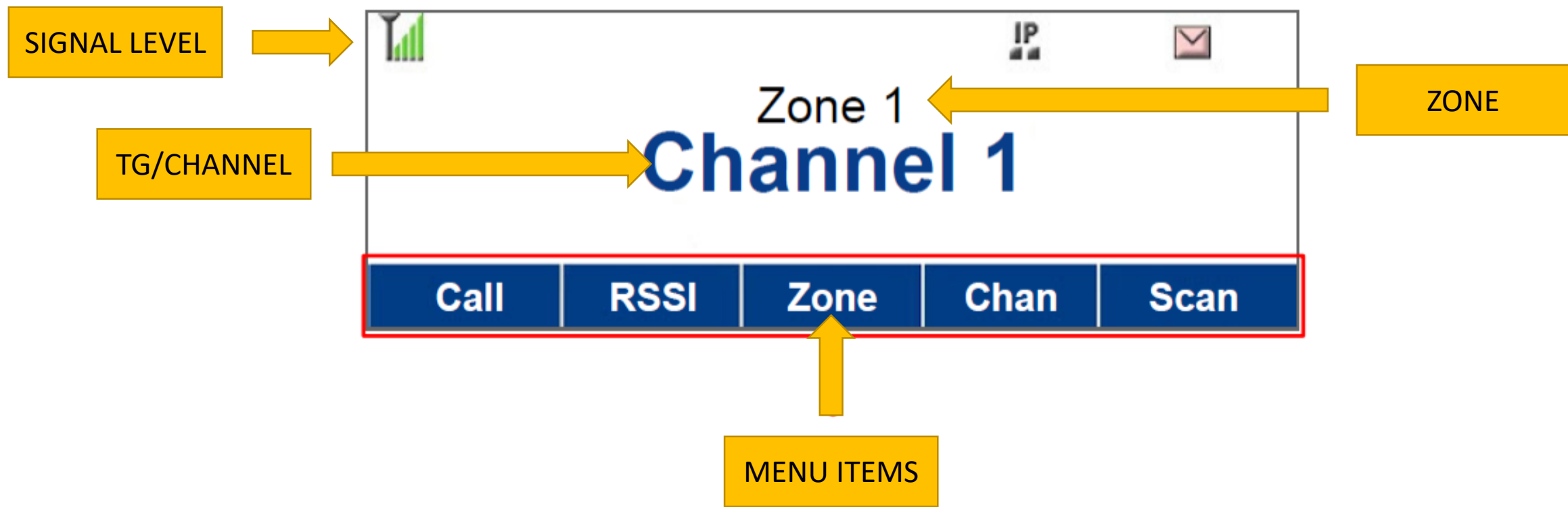




# ANATOMY OF A RADIO APX7500 E5 SUMMARY



# ANATOMY OF A RADIO APX7500 E5 SCREEN



# KEYPAD MICROPHONE

## Keypad Microphone












<sup>1</sup> These radio controls/buttons are programmable.

# ANATOMY OF A RADIO APX7500 E5 LED SUMMARY

## LED Indications

The LED Indication shows the operational status of your radio.  
A qualified technician can permanently disable the LED indication by preprogramming it.

Indication	Status
 Solid red	Radio is transmitting.
 Blinking red	Radio is transmitting at low battery condition or detects an incompatible battery.
 Double blinking red	Radio is transmitting an emergency alarm or call.
 Rapidly blinking red	Radio has failed the self-test upon powering up or encountered a fatal error.

Indication	Status
 Solid yellow	Channel is busy in conventional mode.
 Blinking yellow	Radio is receiving a secured transmission.
 Solid green	Radio is powering up or is on a non-priority channel while in the Scan List Programming mode.
 Blinking green	Radio is receiving an individual or telephone call or is on a Priority-Two channel while in the Scan List Programming mode.
 Rapid blinking green	Radio is on a Priority-One channel while in the Scan List Programming mode.

# ANATOMY OF A RADIO APX7500 E5 OUT OF RANGE

- Out of range conditions will turn the radio and button backdrop red
- Radio is not able to receive the desired trunk system. Consider alternatives (PACE) and or relocation (Will be discussed further in presentation)





# MCD5000 (DESKSET)

- Desk set is common where radio must be located a distance away from the user
- Very common in hospital ER settings
- Desk set is an extension of the radio



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# TRUNK SYSTEM – RADIO SOUNDS

Talk Permit Tone


















Denial/Prohibit or no service “Bonk”






System busy






Tone Name		Tone Information	
Acknowledge		Receipt of a call sent to the central controller	
Button Press		A valid key was pressed on the keypad	
Call Alert		- Receipt of a Call Alert page sent to your radio - Confirmation receipt of a page received sent from your radio	
Emergency		Emergency alarm was sent from your radio	
Failsoft		Radio has lost communication with the central controller	
Low Battery		Weak battery indication	
No Acknowledge		A call to the central controller was not acknowledged	
Out of Range		Radio is out of range of the system	
Power-up		Radio has successfully powered on	
Private Call I		Receipt of a Private Conversation call sent to your radio	
Private Call Enhanced		Receipt of a Private Conversation call sent to your radio	
Prohibit		Talkgroup or channel is not accessible	
System Busy		Channel, system or target radio is busy	
Talk Permit		Channel is ready to use	
Time-out Timer		Time-out timer limit has been reached	

# ADDITIONAL RADIO SOUNDS

IDENTIFYING STATUS INDICATORS		
You Hear	Tone Name	Heard
<b>Short, Medium-Pitched Tone</b>   <b>Play</b>	Valid Key-Press	When correct key is pressed.
	Radio Self Test Pass	When radio passes its power-up self test.
	Clear Voice	At beginning of a non-coded communication.
	Priority Channel Received	When activity on a priority channel is received.
	Emergency Alarm Entry	When entering the emergency state.
	Central Echo	When central controller has received a request from a radio.
<b>Long, Medium-Pitched Tone</b>   <b>Play</b>	Volume Set	When volume is changed on a quiet channel.
	Emergency Exit	When exiting the emergency state.
<b>A Group of Medium-Pitched Tones</b>   <b>Play</b>	Failsoft	When the trunking system fails.
	Automatic Call Back	When voice channel is available from previous request.
	Keyfail	When encryption key has been lost.
	Console Acknowledge	When status, emergency alarm, or reprogram request ACK is received.
	Received Individual Call	When Call Alert or Private Call is received.
	Call Alert Sent	When Call Alert is received by the target radio.
<b>Two Short, Medium- Pitched Tones</b>	Site Trunking	When a SmartZone trunking system fails.
	Over-the-Air Programming request	When the radio receives an over-the-air programming request.
<b>Short, High-Pitched Tone (Chirp)</b>	Low-Battery Chirp	When battery is below preset threshold value.

# ADDITIONAL RADIO SOUNDS

IDENTIFYING STATUS INDICATORS		
You Hear	Tone Name	Heard
Two High-Pitched Tones	GPS Fails	When the GPS signal is lost or when GPS fails.
<b>Ringing</b>  	Fast Ringing	When system is searching for target of Private Call.
	Enhanced Call Sent	When waiting for target of Private Call to answer the call.
	Phone Call Received	When a land-to-mobile phone call is received.
<b>Gurgle</b>  	Dynamic Regrouping	(When the <b>PTT</b> button is pressed) a dynamic ID has been received.
	Talk Permit	(When PTT button is pressed) is verifying with the system for accepting its transmissions.
 <b>Play</b>		
Unique, Low-Pitched Chirp	New Message	When a new message is received.
Unique, High-Pitched Chirp	Priority Status	When a priority message is received.
Incremental-Pitched Tone	Bluetooth Paired	When Bluetooth accessory is paired with the radio.
	Bluetooth Connected	When Bluetooth accessory is connected to the radio.
Decremental-Pitched Tone	Bluetooth Unpaired	When Bluetooth accessory is unpaired from the radio.
	Bluetooth Disconnected	When Bluetooth accessory is disconnected from the radio.
A Group of Very High-Pitched Tones	Man Down Continuous Tone	When radio is in Man Down mode and prepares to transmit Emergency Alarm when the timer of this alarm ends.
	Critical Man Down Continuous Tone	When radio is in Man Down Enhanced mode and prepares to transmit Emergency Alarm when the timer of this alarm ends.
Unique Low-High Tone	Enhanced Zone Bank Up	When <b>EZB Up</b> button is pressed to scroll the Enhance Zone Bank up.
Unique High-Low Tone	Enhanced Zone Bank Down	When <b>EZB Down</b> button is pressed to scroll the Enhance Zone Bank down.

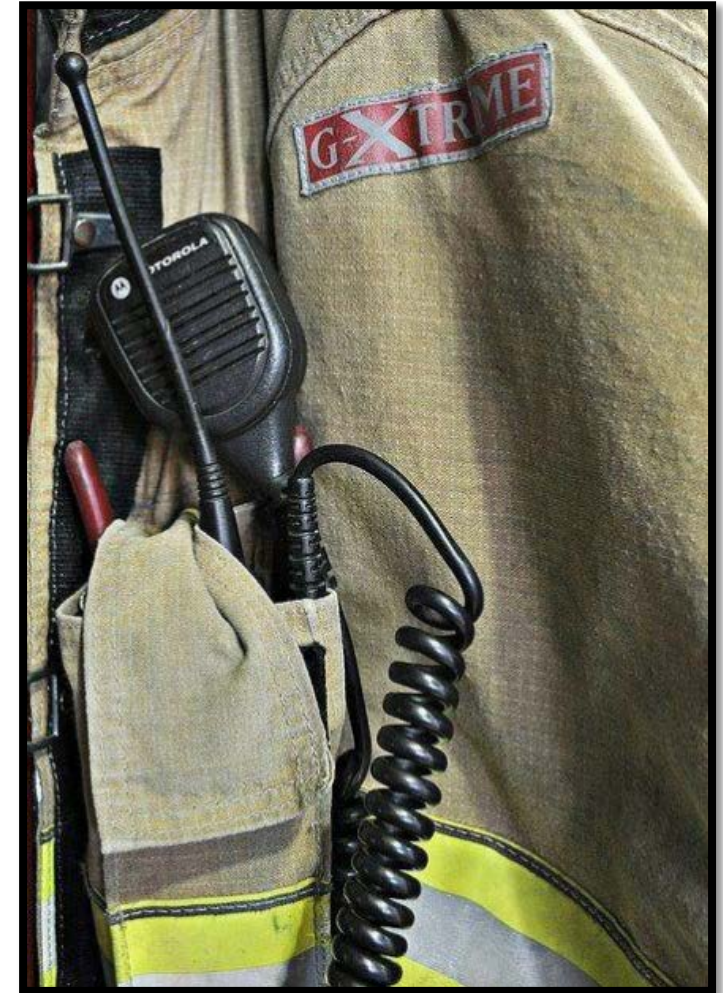
# USAGE AND BEST PRACTICES





# HOW TO USE A RADIO

- Turn radio on and select desired channel/talkgroup
- Wait for talk permit tone before speaking
- Garbage into the radio produces garbage out the other end. Speak in a calm, clear voice
- Speak a few inches away from mic with a normal voice level
- Remove radio from hip/pockets if you are having difficulty communicating
- Hold radio upright. Do not put radio at angle
- Do not carry the radio by the antenna



# RADIO PLACEMENT RECOMMENDATIONS

- Radio position is critical to transmitting and receiving the best signal
- Consideration is needed to protect electronics from high heat and flooding water
- Body acts like a shield for radio signals



Example of a better way to carry a radio

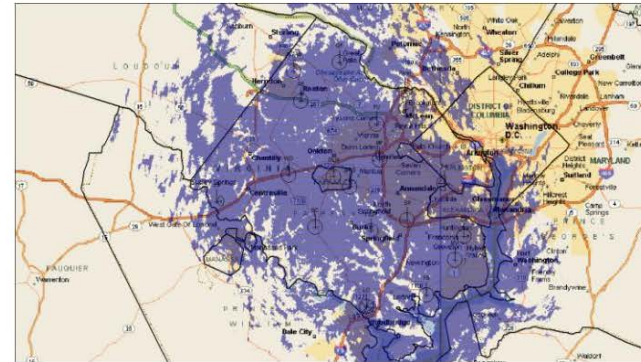


# EXAMPLES OF SIGNAL LOSS BASED ON RADIO POSITION

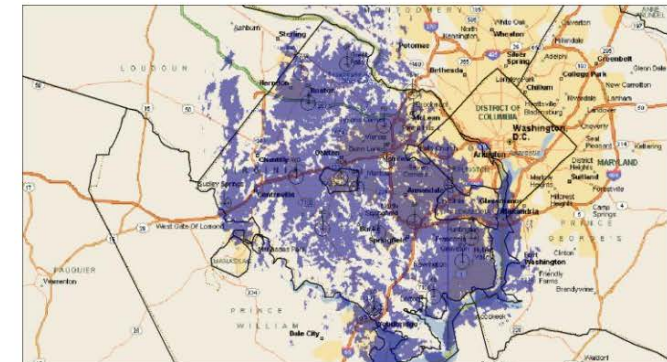
The following examples show:

- Normal radio position in open
- Radio on strap exposed outside PPE
- Radio on strap exposed crawling
- Radio in pocket while crawling
- Radio pocket while crawling is a 30dB loss! That means your 3 watt handheld is now effectively transmitting 0.003 watts!

## Radio Signal Loss Overlay Comparison

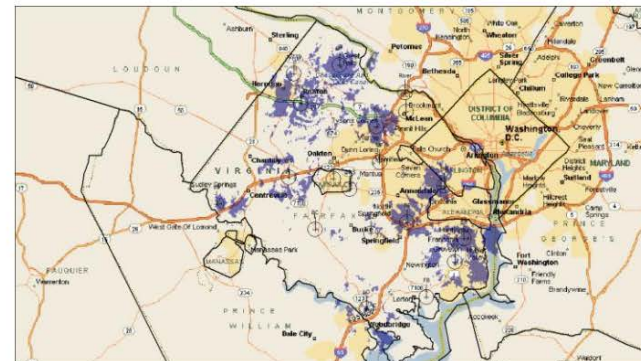


0.0dB LOSS



7.0dB LOSS

### Optimal 95% Estimated Coverage in SFD



15.0dB LOSS

### Strap Under Coat Antenna Exposed—Standing



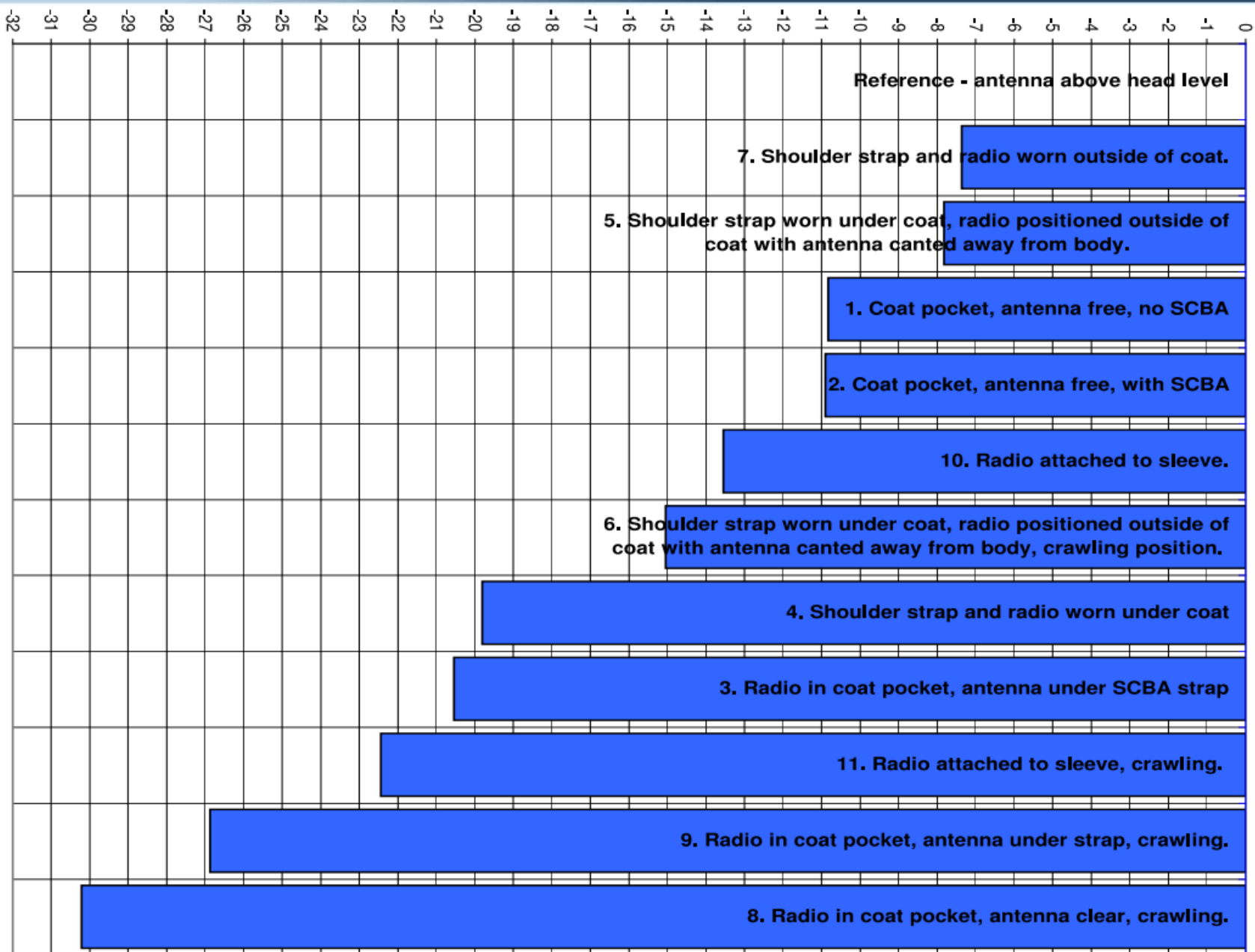
30.0dB LOSS

### Strap Under Coat Antenna Exposed—Crawling

### Radio Pocket—Standing

### Radio Pocket While Crawling

# Loss in dB for Various Portable Radio Configurations - Fire and Rescue



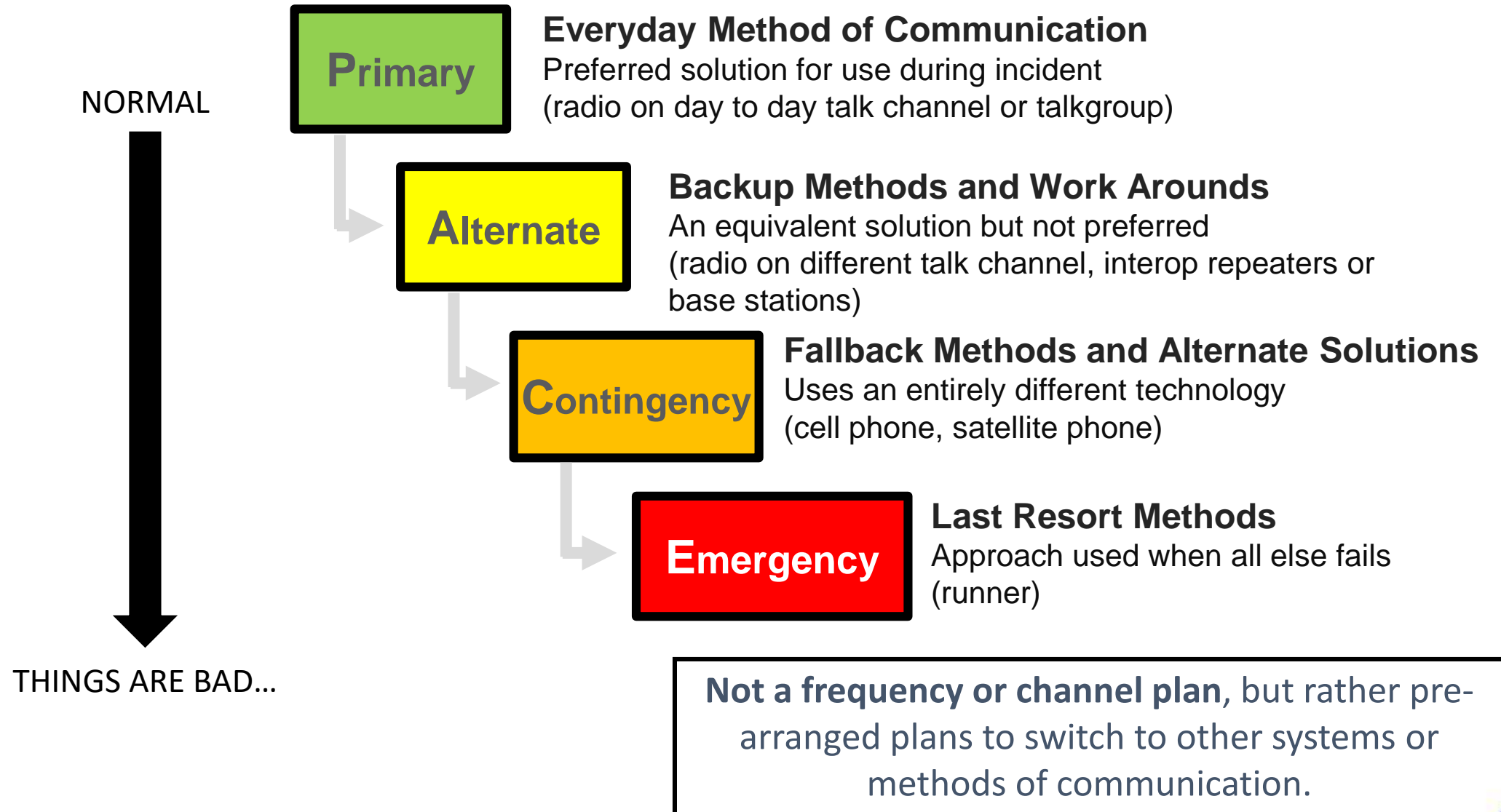
# COMMUNICATION DIFFICULTY

- Alert the communications team, incident commander, and dispatch if possible
- Ensure your radio antenna is pointing directly up to ensure maximum horizontal signal
- Switch to direct / simplex channels if not resolved
- Switch to a different means of communication, preferably on a different band (e.g., switching from cellular to UHF or VHF bands or Satellite Communications [SATCOM] could be a potential course of action)
- Shield the mobile radio behind a wall or large vehicle (If interference is occurring)
- Find higher ground
- Elevate your radio like the Statue of Liberty



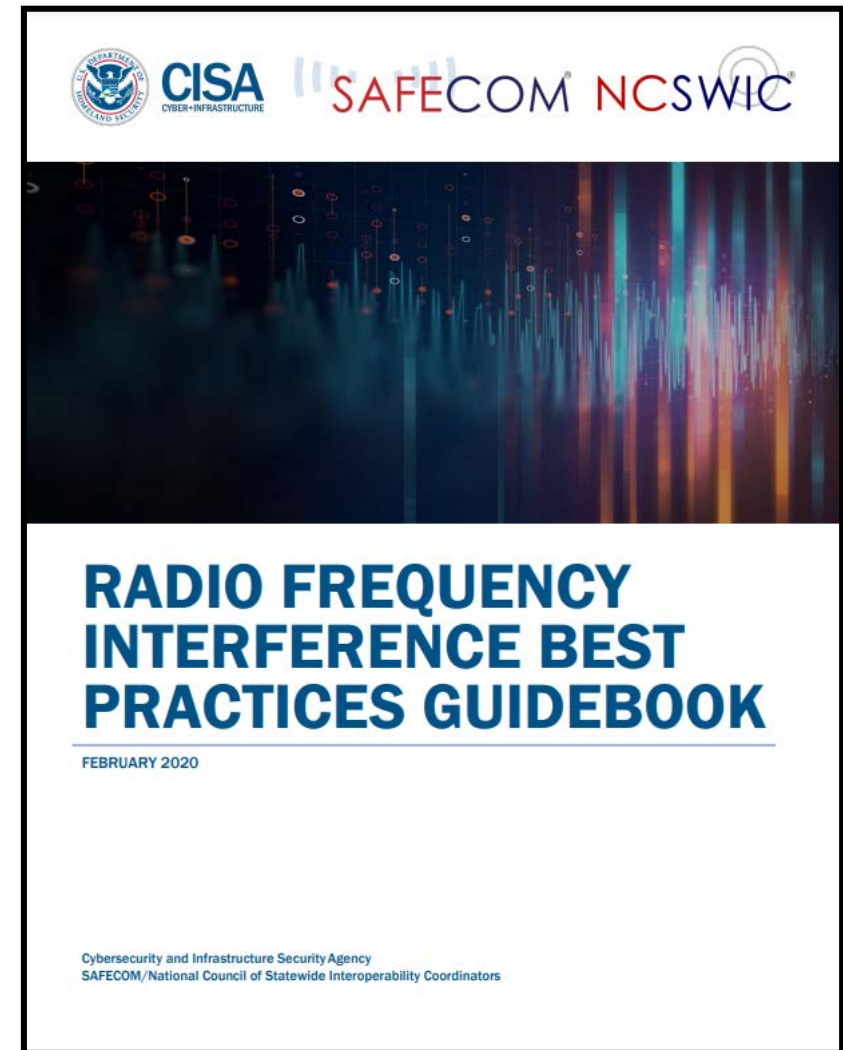


# Communication **PACE** Planning



# INFORMATION ON INTERFERENCE MITIGATION

[SAFECOM Interference guidebook link](#)



# VIPER NEED TO KNOW ITEMS

System busy condition:

It should be a rare occurrence that a busy is encountered on the VIPER system. If a busy tone is encountered- do not turn the radio off and reattempt your traffic. The system places you in a que in the order received. When a voice channel is open, it will alert your radio with a talk permit tone. Traffic can then be passed.

Click for System Busy sound

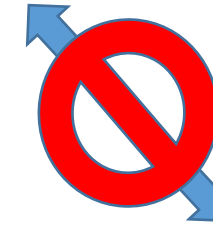


# VIPER NEED TO KNOW ITEMS

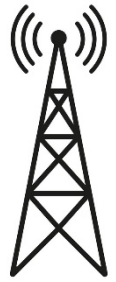
## Site Trunking

- Site Trunking is a condition in which the individual radio site is no longer connected to the wide area system.
- The site continues to work normally, but traffic does not leave that site coverage. Dispatch centers with core connections only will not be able to communicate on sites in site trunking conditions.
- Attempt to force radio to move to adjacent site if possible (Site scan feature). If not resolved after a few minutes, work with your VIPER POC and if needed, contact the TSU NOC

Site Trunking



Normal



Normal



Click for Site Trunking sound (if programmed)



# VIPER NEED TO KNOW ITEMS

Responsible monitoring:

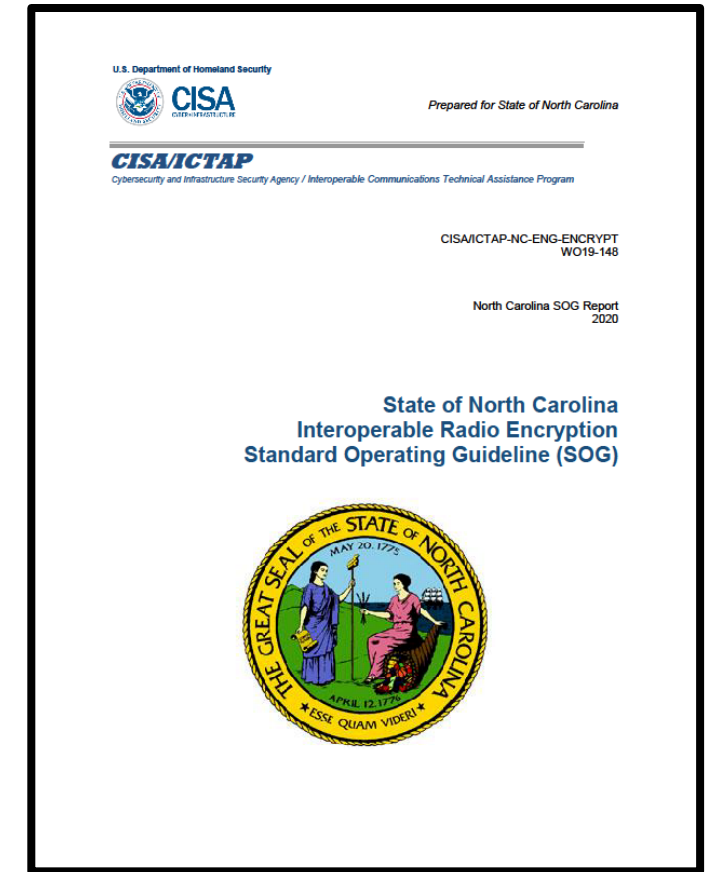
- Listening to an operation impacts the radio system
- The system must find resources to send the audio to you. “All Start” is a system feature that ensures audio can reach all recipients. If a site is busy and cannot process the traffic- nobody will receive it anywhere!
- Do not listen to operations you are not directly involved with. It impacts the system, especially in disaster settings. This means if you are not assigned to the incident, you shouldn't be listening!



# VIPER NEED TO KNOW ITEMS

## Encryption

- Radio encryption is becoming an important hot topic in today's world
- If your agency wishes to use encryption, please ensure you reach out to the point of contact listed in document for key assignment coordination.
- It is much easier to coordinate this on the front end before all equipment is programmed.
- North Carolina has Interoperability Keys along with access to National Interoperability Keys



# EMERGENCIES AND HOW TO GET HELP ON THE RADIO

- If outside your jurisdiction, VIPER Talkgroup SWCALL (Statewide Call) is monitored by most PSAPs (Public Safety Answering Point) aka 911 center.
- If you have no other means to contact 911, you can hail for assistance:

“Wayne County 911, this is XXXXXX (Your agency or call sign), I am on scene of a large tractor trailer on fire at exit 93 on Highway 95 South. Please dispatch appropriate units.”

	<i>NAME</i>
ZONE	STATEWD
<i>Position</i>	<i>NAME</i>
1	SW CALL
2	SW CONF
3	EM EOC
4	EM EBO
5	EM CBO
6	EM WBO
7	EM RRT
8	EM SAR
9	LZWEST1
10	LZWEST2
11	LZEAST1
12	LZEAST2
13	LZCENTRAL1
14	LZCENTRAL2
15	LZPDMONT1
16	LZPDMONT2

# RADIO PROGRAMMING

- Do not try to reprogram your VIPER radio unless you are authorized to do so
- The radios require special programs and keys that ensures the system security
- Work with an authorized vendor to ensure you have the most up to date information
- General recommendation: budget for updating radio templates (programming) every few years
- Consider having radios aligned periodically to ensure peak performance. Consult your vendor for recommended timeframe.





# DON'T FORGET THESE IMPORTANT ITEMS

- Upgraded VIPER Network – 2025
- Astro25 (XTS/XTL) radios are no longer able to be added to VIPER. They will not work post the 2025 migration
- VIPER radios MUST have the VIPER Required Statewide Template. The implementation was February 2022. Please ensure your equipment is updated



US Coast Guard utilizing VIPER while performing rescue operations during Hurricane Florence



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# Glossary

Acronym	Definition
AES256	Advanced Encryption Standard (256)
AUXCOMM	Auxiliary Communications
BDA	Bi-Directional Amplifier
CKR	Common Key Reference
DES	Data Encryption Standard
EHPC	Eastern Healthcare Preparedness Coalition
EM	Emergency Management
EOC	Emergency Operations Center
ESF	Emergency Support Function (2= Communications)
FDMA	Frequency-division multiple access
LOS	Line of sight
LZ	Landing zone
MHz	Megahertz
POC	Point of contact

# Glossary

Acronym	Definition
PTT	Push to talk
RC4	Rivest-Cipher 4 encryption
RCC	Regional Coordination Center
SAR	Search and Rescue
SIEC	Statewide Interoperability Executive Committee
TDMA	Time-division multiple access
TSU	Technical Services Unit of NC State Highway Patrol
VIPER	Voice Interoperability Plan for Emergency Responders



# QUESTIONS



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