

ND Department of Emergency Services



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"Ensuring a safe and secure homeland for all North Dakotans"

TESTIMONY
 INFORMATION TECHNOLOGY INTERIM COMMITTEE
 AUGUST 20, 2013
 BY MIKE LYNK
 DIRECTOR, DIVISION OF STATE RADIO
 NORTH DAKOTA DEPARTMENT OF EMERGENCY SERVICES

Mr. Chairman and members of the committee, my name is Mike Lynk. I am the director of the Division of State Radio, North Dakota Department of Emergency Services (NDDDES). My purpose is to provide testimony relating to the State Radio Communication Plan and related issues.

Since 2009, public safety communications has undergone several important procedural changes to enhance emergency response through development of the "Statewide Communication Interoperability Frequency Management Plan, Signal Operating Instructions (SOI) and Public Safety Communication General Usage Guide (ND PSC Guide). Final drafts of the Frequency Plan and the SOI were facilitated during eight regional meetings, approved by the Statewide Interoperability Executive Committee (SIEC), and published on May 4, 2010. Since publication, these documents have been revised to meet evolving procedures. In 2011, the plans were tested in several exercises designed to meet Interoperable Communication "Goal 2", a federal initiative to test the ability to establish interoperable public safety communications within one hour of an emergency.

The SEIC was established through Executive Order 2007-17 by Governor Hoeven, reaffirmed by Governor Dalrymple, and placed into law through SB 2353. Its purpose is to coordinate and manage use of all State Radio designated infrastructure and state licensed radio frequencies and working with all wireless communication user groups and associations to ensure interoperability among all public and emergency response wireless communication systems.

The Frequency Plan provides a common set of federal public safety channels available nationally and a common radio standard APCO Program 25 (P-25). In April 2012, the Department produced the ND PSC Guide to assist users with radio operations.

North Dakota met the Federal Communication Commission (FCC) mandate that by January 1, 2013, radios operating in the public safety frequencies must be narrow banded; this reduced the operational power (MHz) of the radios from 25 MHz to 12.5 MHz. In the near future, the FCC plans to reduce the operational power to 6.25 MHz, which requires digital transmission. State Radio switched two of its primary channels to digital in anticipation of the 6.25 MHz digital requirement and left the primary emergency channel in analog. Transition from analog to digital requires a new operational method; consequently, the Department developed a Radio Usage Guide to assist users.

Since 2009, the Department has allocated \$5,096,865 for radio equipment and \$1,254,701 for radio programming. Thirty six (36) training exercises were held statewide to test communication operations; four (4) were conducted by the Department and thirty two (32) conducted by local entities.

The following challenges presented by narrow banding have prolong a smooth transition.

- Reduced range caused by reduces operation power (MHz)
- Digital radio operational changes creating a learning curve
- Improper programming by radio vendors/agency personnel
- Radio manufacturing defects

Using a secure broadband connection (commercial cellular service) some responders relay data to and from responders to dispatch through a computer aided dispatch (CAD) system easing radio traffic and digital radio issues.

A federally funded initiative, FirstNET, will in the future provide a national broadband system for public safety. It will provide an information relay between response units and support services. The future model will include a hand held device intended to replace the current public safety radio system. In preparation for FirstNET, the entire public safety communication system in North Dakota will be examined.

The Department has two major recommendations for the Interim Committee to consider:

1. Examine all current land mobile radio infrastructures (State, Local and Tribal).
2. Analyze and determine future infrastructure needs and required actions or steps necessary to implement newly emerging technologies (FirstNET).

At this time I will respond to member questions.

Division of State Radio

Radio Use Guide



ND Department of Emergency Services

*Ensuring a safe and secure homeland
for all North Dakotans.*

INTRODUCTION

- It is the responsibility of each user to understand the radio system and how to use it effectively and efficiently.

- **YOUR HEALTH AND SAFETY AND THAT OF OTHERS MAY DEPEND ON IT.**

WHY DO WE USE RADIOS?

- They allow point-to-point communications.
- They allow broadcasting to many users at the same time.
- There may be no other option for communication.

RADIO INFRASTRUCTURE

•**REPEATER:** An antenna located on a tower used to increase the range and coverage of mobile and handheld units. Repeaters receive on one frequency and simultaneously re-broadcast (repeat) the signal on a different frequency.

•**BASE RADIOS:** Fixed base stations transmit to a tower and are connected to an office or dispatch center via telephone lines or other “uplink” format. A base station may also be located directly at the office or dispatch center. They are used to access repeaters or talk using direct communication, much like the individual user’s mobile or handheld.

•**BASE RADIOS DO NOT REPEAT**

RADIO INFRASTRUCTURE

- HANDHELD/PORTABLE:** A radio easily carried by field personnel while on foot or using other modes of transportation. They typically use a self contained battery pack. Other names may include “handie talkie” or “walkie talkie”.
- MOBILE:** A radio securely mounted in a vehicle. ALL vehicles that are used in the field should have a mobile radio installed. These radios work using the vehicle’s electrical system and have exterior antennas. They work much more effectively than a handheld radio, at a much higher power.



RADIO INFRASTRUCTURE

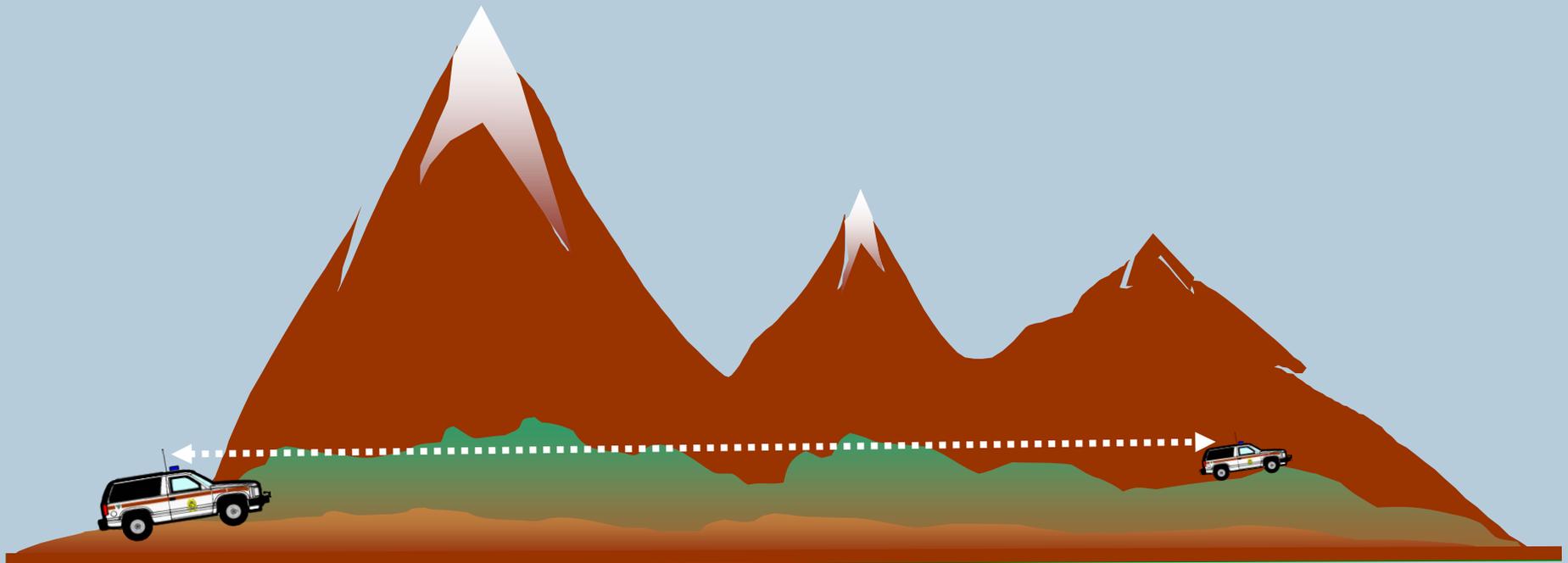
Radio waves are a type of electromagnetic radiation, like light waves, so they can be thought of in a similar way. If you want light to reach a certain object, a lamp needs to be in that object's "line of sight" with nothing blocking its path. Radio waves are the same. In order to communicate with a certain radio, you need to be in that radio's "line of sight".

NO LINE OF SITE



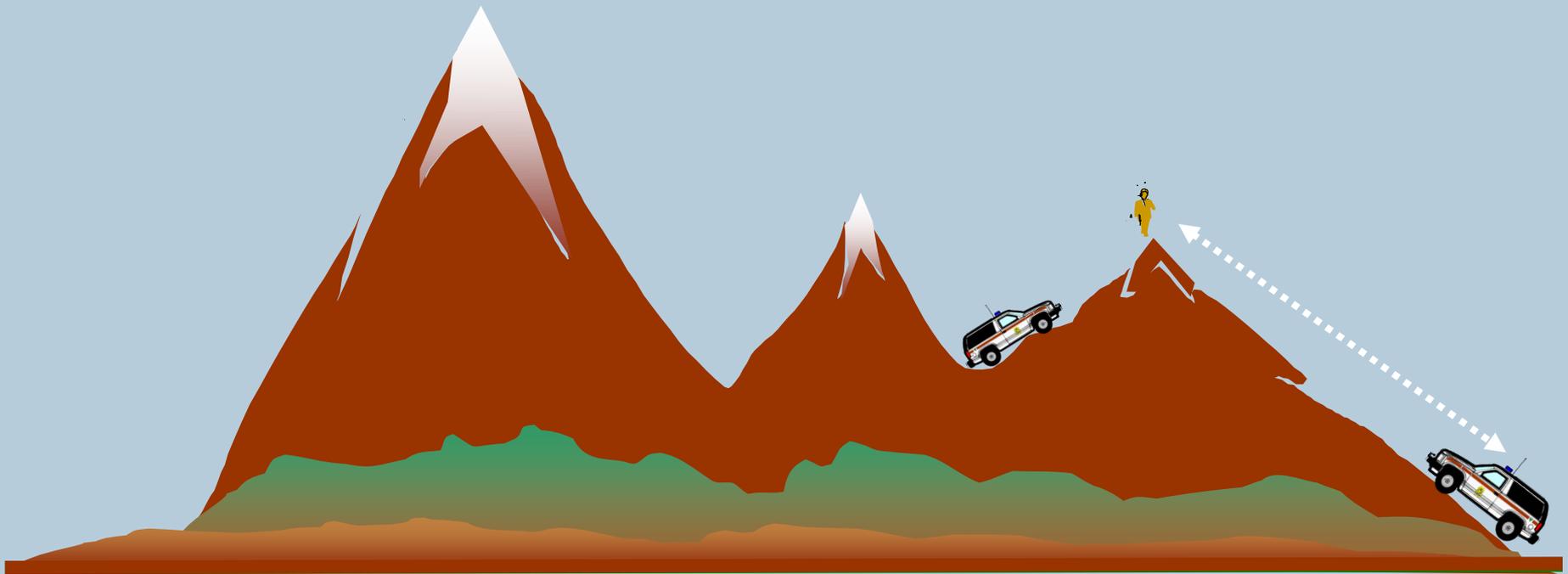
RADIO INFRASTRUCTURE

DIRECT LINE OF SITE



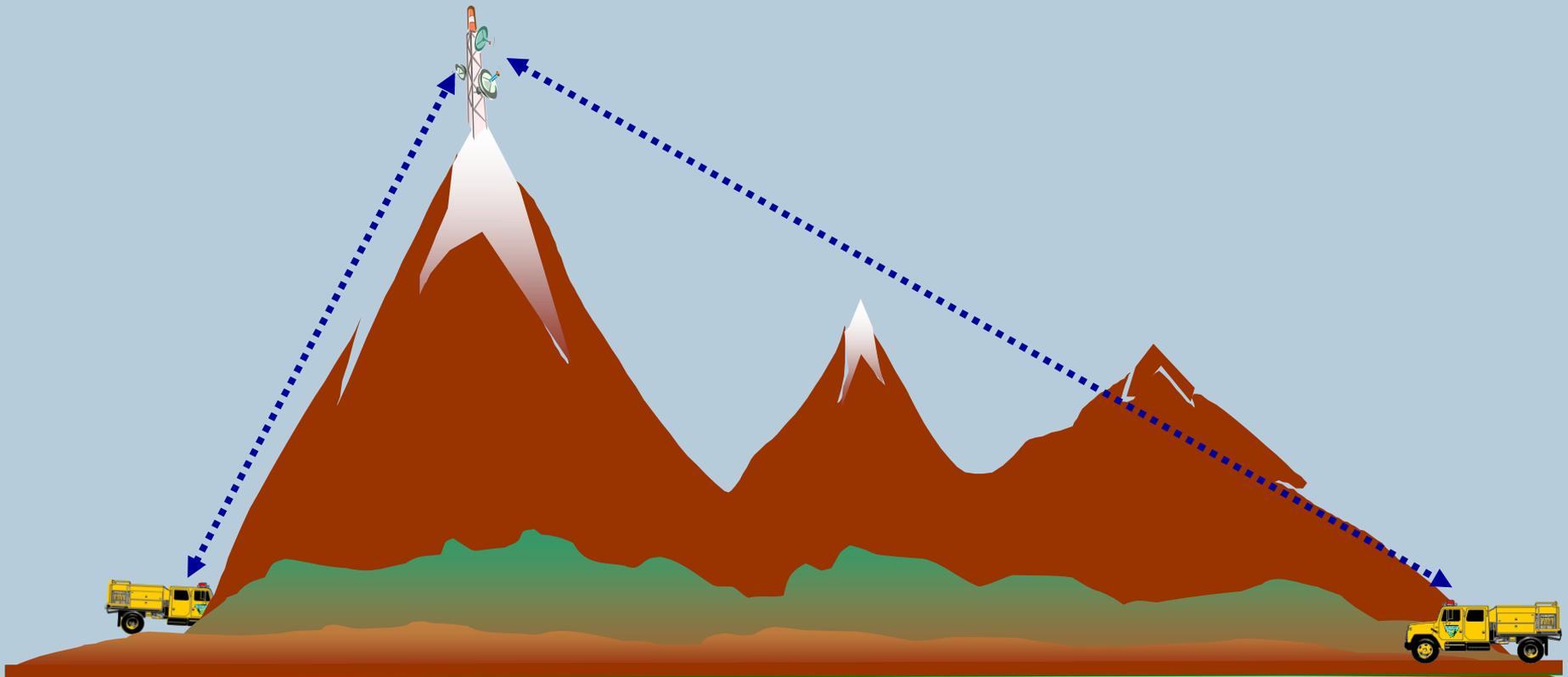
RADIO INFRASTRUCTURE

USER-CORRECTED LINE OF SITE



RADIO INFRASTRUCTURE

REPEATER CORRECTED LINE OF SITE

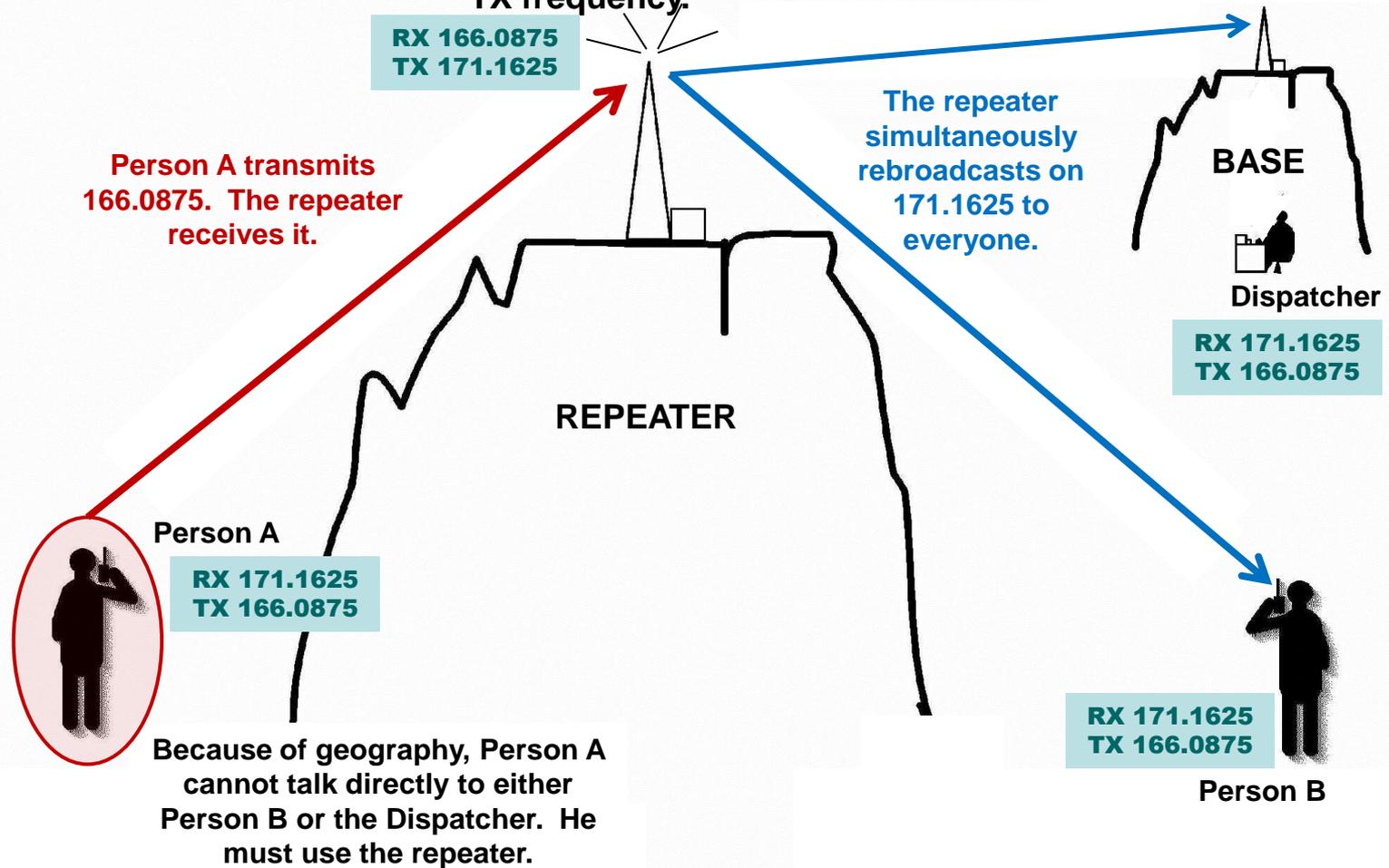


RADIO INFRASTRUCTURE

- **For field communications not requiring contact with the office or dispatch, use direct “line of sight” simplex channels when possible. These are channels that operate on a single frequency and do not go through a repeater.**
 - **Keeps limited resources (repeaters) free for use by others.**
 - **Office and dispatch personnel don’t need to monitor your traffic.**
- **If you are unable to establish contact using simplex channel, then try a repeater. Repeaters extend the range and “line of sight” of any radio. Again, the repeater receives on one frequency and then simultaneously re-broadcasts (repeats) on another frequency.**

REPEATER & BASE OPERATION

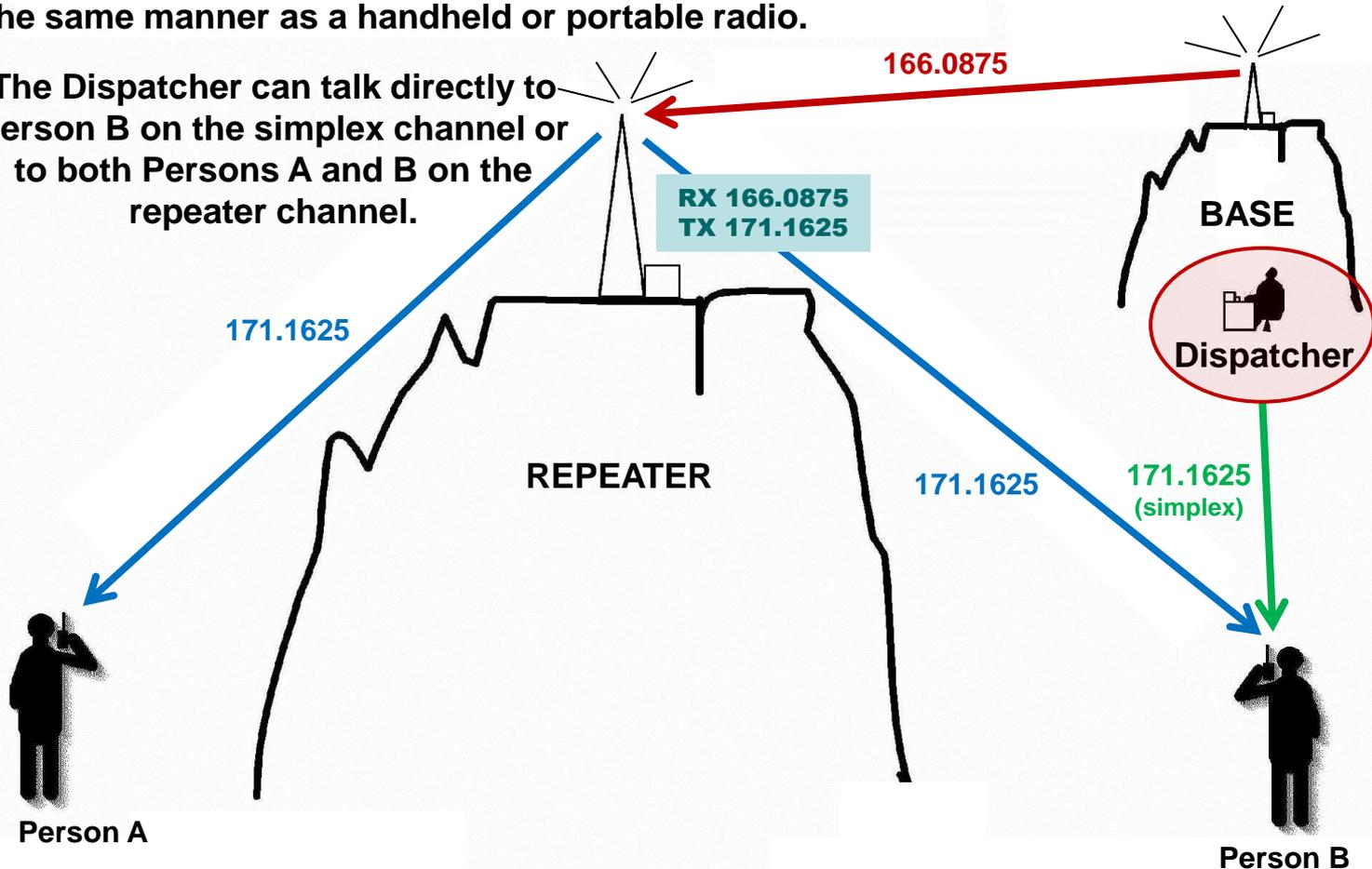
A repeater uses two frequencies so what it “hears” on the channel’s RX frequency, it then simultaneously rebroadcasts on the channel’s TX frequency.



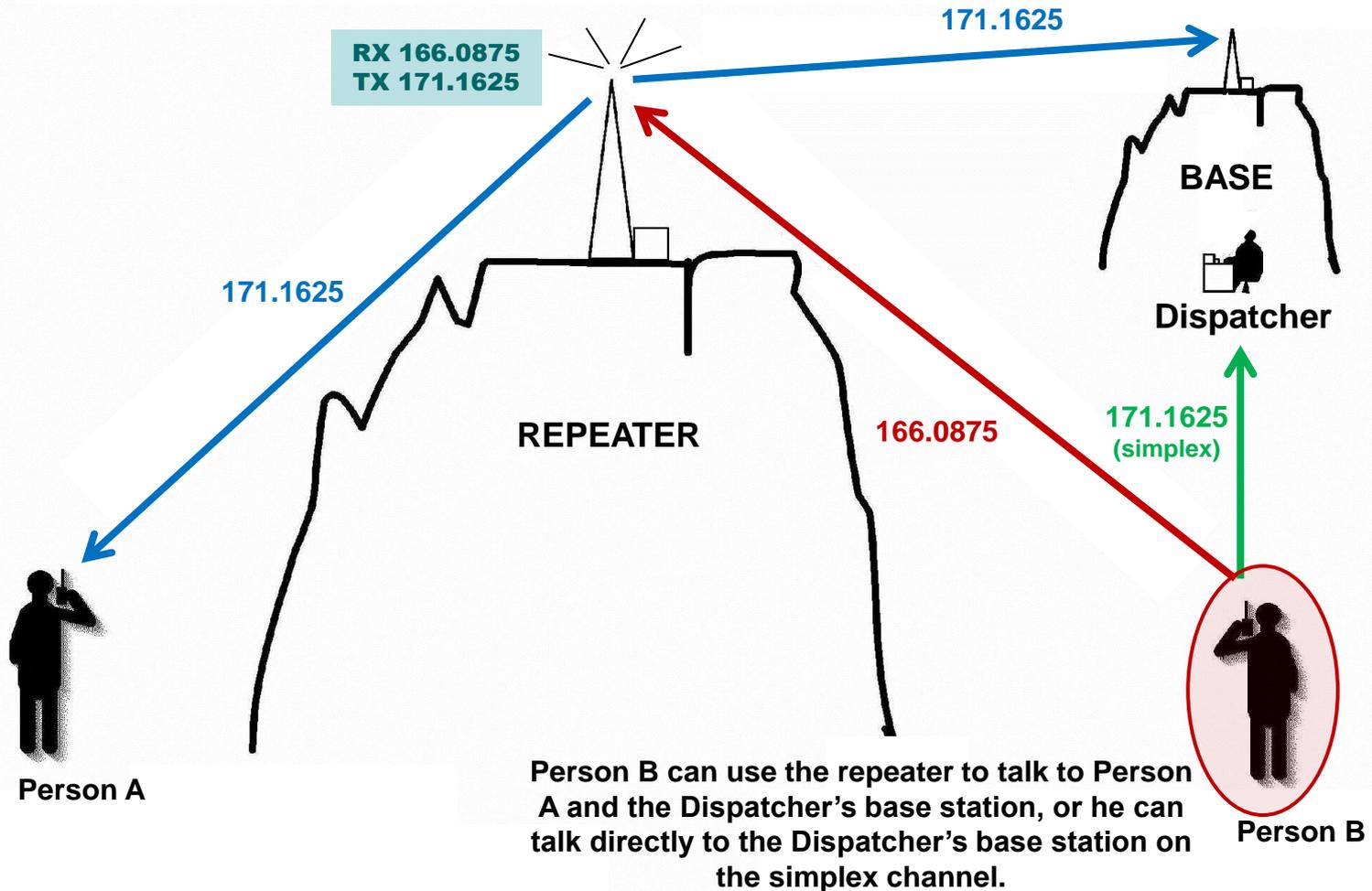
REPEATER & BASE OPERATION

A base station is basically a fixed radio operating in the same manner as a handheld or portable radio.

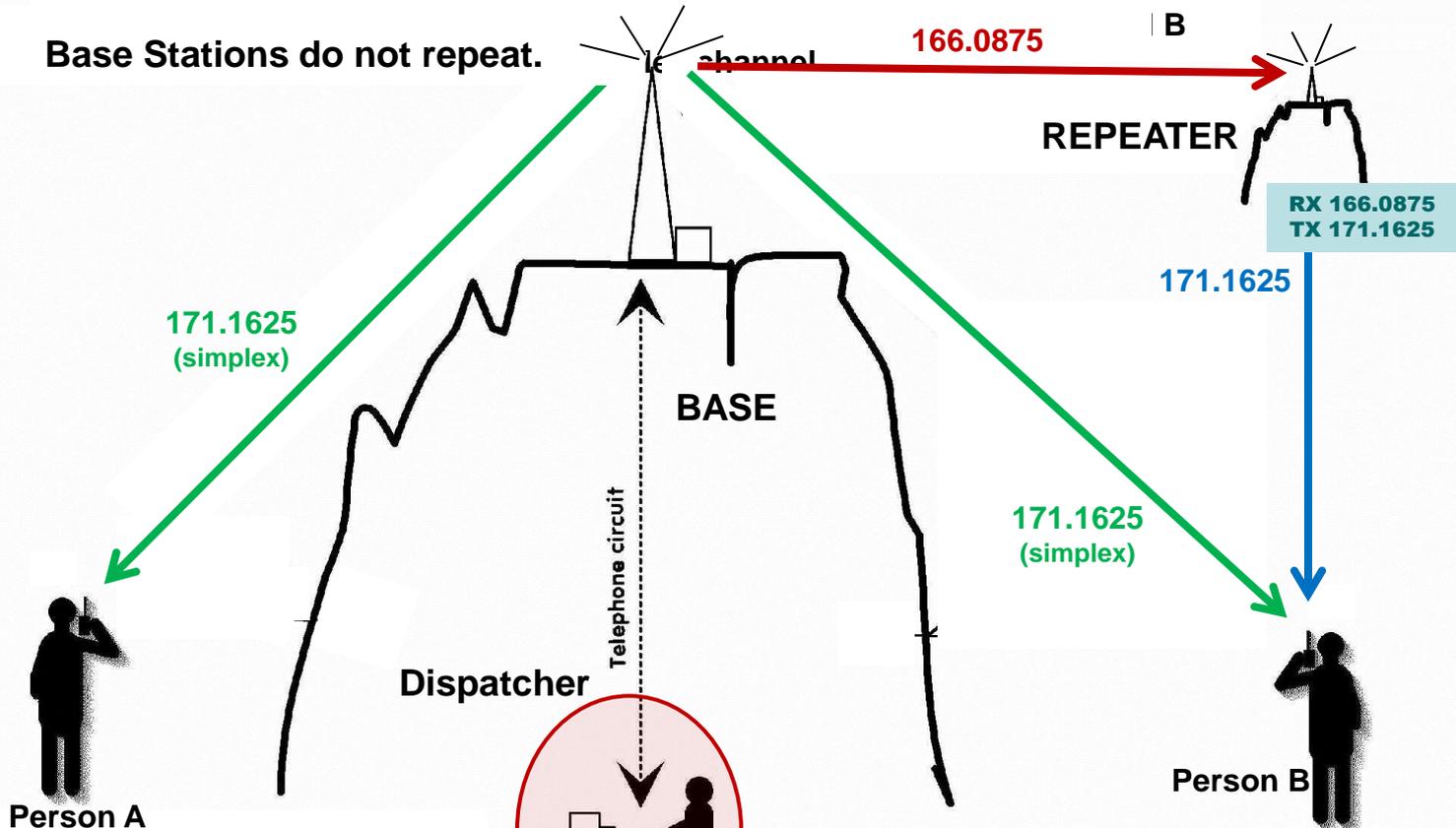
The Dispatcher can talk directly to Person B on the simplex channel or to both Persons A and B on the repeater channel.



REPEATER & BASE OPERATION



REPEATER & BASE OPERATION



The Dispatcher can talk to both Persons A and B directly on the simplex channel via the base radio, or to Person B through the repeater.

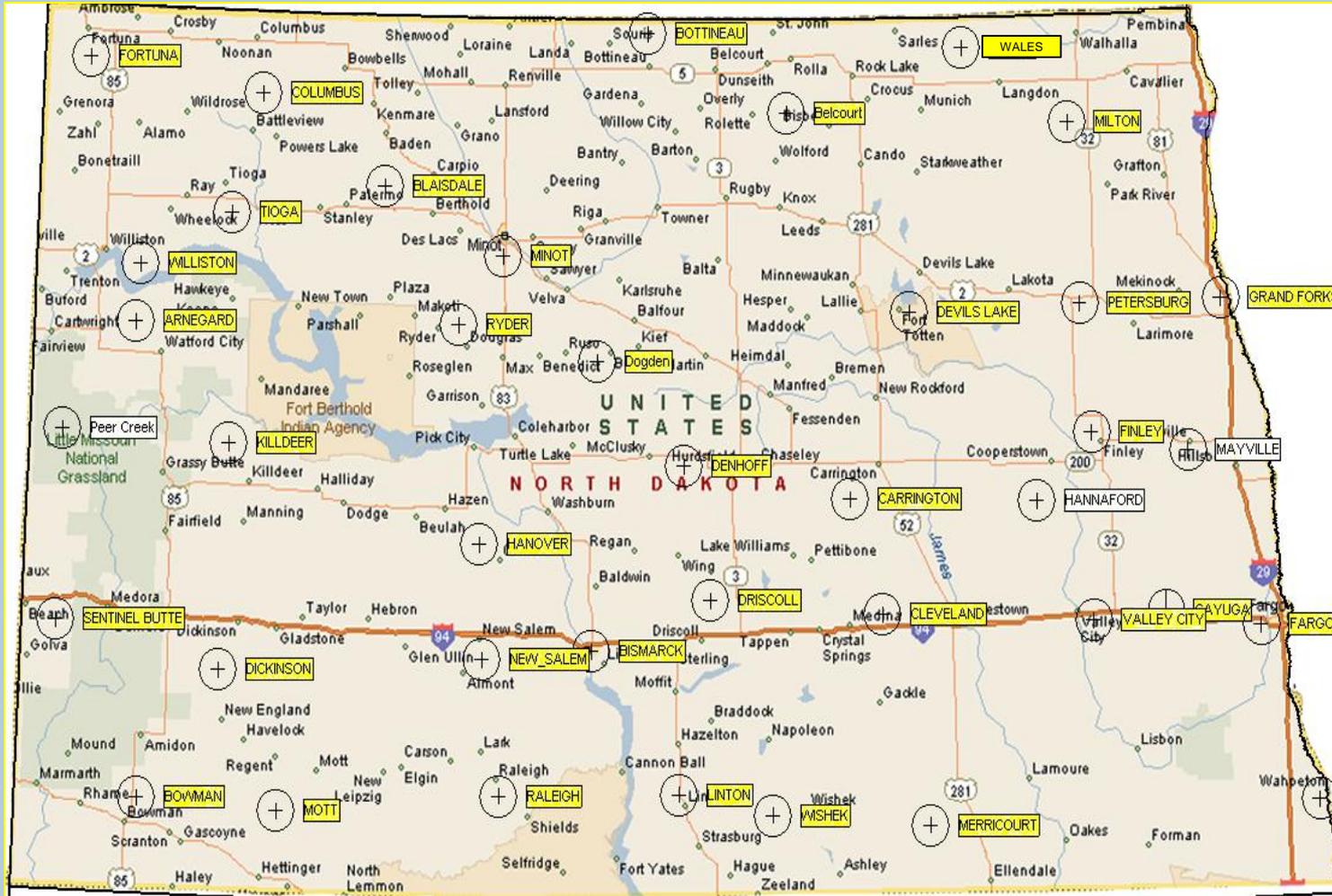
Also, since Person A and Person B do not have a means for either direct or repeater communications, the Dispatcher can relay messages between them.

RADIO INFRASTRUCTURE

•TO USE A REPEATER:

- Decide which tower/repeater is closest or provides the best “line of sight” for your needs.**
- Select the proper channel for the repeater. (State Radio ch 1 or 2)**
- Contact State Radio to open the repeater.**
- If your signal is hitting the repeater you should hear a repeater kick-back or “squelch tail”.**

RADIO SYSTEM MAPS

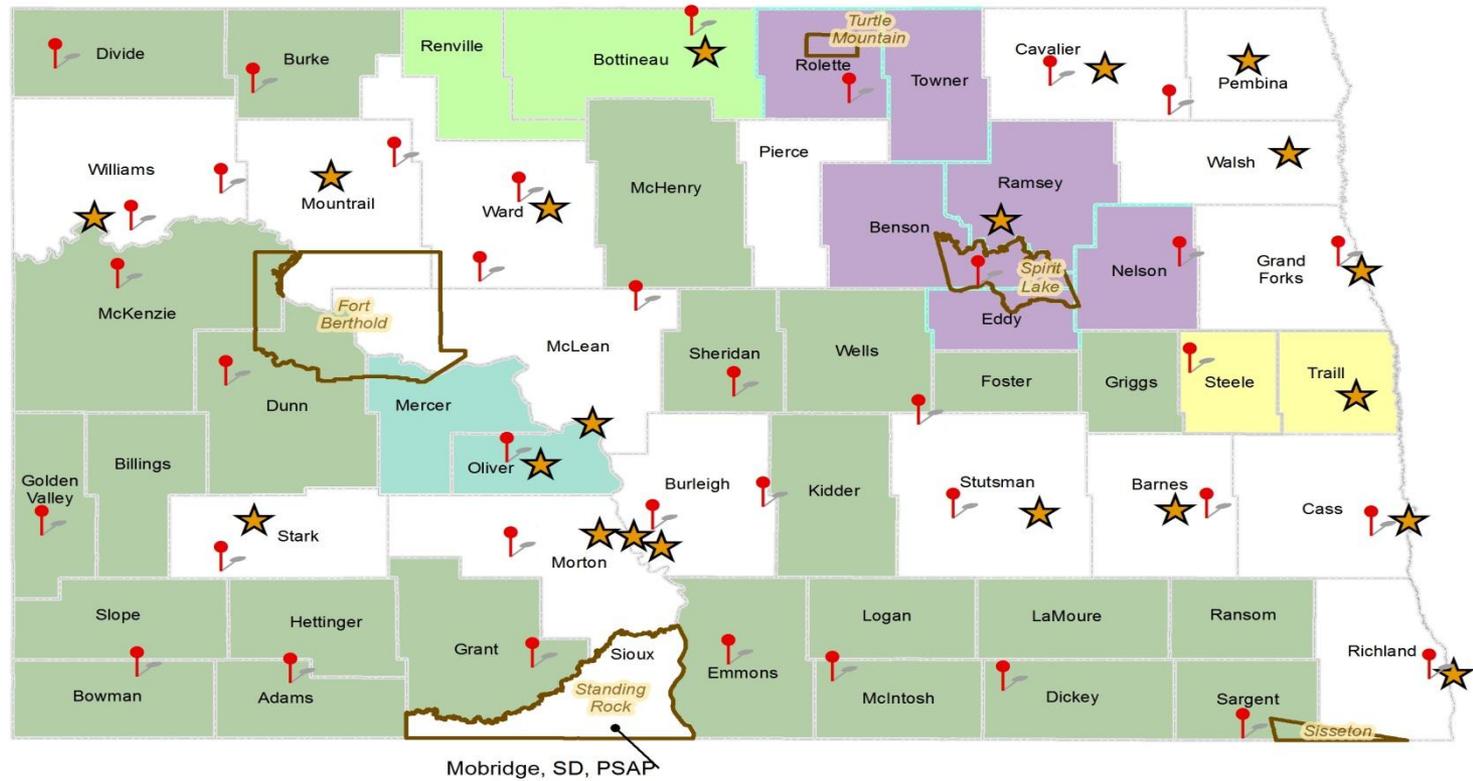


You need to know where tower/repeater sites are in relation to your location to decide which tower/repeater to use. Be sure to obtain a system map of your local area.

-  Statewide System & DOT sites
-  DOT only sites

PSAP Map

North Dakota Emergency Communications Coverage



Legend

-  State Radio Tower Sites
-  Public Service Answering Points (PSAPs)
-  Tribal Lands

PSAP Boundaries

-  County PSAP
-  Devils Lake PSAP
-  Mercer/Oliver PSAP

-  Renville/Bottineau PSAP
-  Steele/Traill PSAP
-  State Radio 911 Dispatch



FIELD OPERATIONS - SOP

- Understand and follow your office or dispatch Standard Operating Procedures for field-going personnel.
- Checkout with your local office and/or dispatch. This is a great time to be sure your radio is operating correctly.
- Include where you are going and your estimated time of return. Check in again if you change location or your return time changes.
- Check in upon return at the end of the duty day. ***IF YOU FORGET A SEARCH MAY ENSUE !***



FIELD OPERATIONS – Knowledge is Power

- Know which radio sites cover your work area.
- Know which radio channels are required to access them.
- Know the appropriate tones to access them if necessary.
- Know the simplex channels and what they're used for.
- If limited or no radio coverage, do you have an alternative form of communications?
 - Cell phone
 - Satellite phone
 - An extremely loud voice – unfortunately, this goes back to the age-old question: “If a tree falls in the woods...”
- For extended work in areas with no coverage contact your radio tech for possible solutions.

FIELD OPERATIONS – Check Your Equipment

- **Is your mobile or handheld radio working?**
 - Call someone...be sure you get a response
 - Is your portable battery charged?
 - If you are using a clamshell, do you have enough “good” “AA” batteries? You should have at least 2 sets, one in and one spare.
- **Is the Radio System operational?**
 - Perform a quick check with the office or dispatch when you arrive in your work area.
 - Call the radio tech if there is any question of site operations.
- Report any problems noted with radio systems, mobiles
 - or portables to your local radio tech!

FIELD OPERATIONS – Proper Radio Protocol

- Listen first – you don't want to “walk” on someone else's traffic.
- When initiating a call, use a To/From format and identify the channel you are using. EXAMPLE: “Dispatch, this is Miller on Grizzly.”
- Key the mic, pause about 2 seconds, then speak. A pause allows the radio system components to link properly.
- Hold the mic within a few inches of your mouth.
- Use a normal voice; don't whisper or shout.
- Speak slowly and distinctly; enunciate, don't mumble!

FIELD OPERATIONS – Proper Radio Protocol

- **IN AN EMERGENCY, BE SURE TO AVOID USING THE SUBJECTS' NAMES.**
- **Restrict radio communications to official business.**
- **Keep conversations brief and to the point.**
- **Never use profanity or obscene language.**
- **Use plain English, no 10-codes, etc.**
- **Acknowledge transmissions.**



•REMEMBER...

- **Anyone out there with a radio scanner is able to hear your radio conversations!!!**

- **TROUBLESHOOTING**

- **YOUR RADIO**



FIELD OPERATIONS/TROUBLESHOOTING

MOBILE RADIO NOT POWERING UP:

- Check wire and cable connections at the radio, the radio control head and at the battery.
- Check for blown fuses. Vehicle radios have two or three fuses.
- If neither of these solutions work or you are unsure, call a radio tech and we will gladly assist you.

MOBILE RADIO HAS POWER, BUT YOU HAVE NO COMMS:

- Check the mic jack for a secure connection.
- Check antenna connections at the radio and on the roof.
- Check external speaker connections.

FIELD OPERATIONS/TROUBLESHOOTING

HANDHELD RADIO NOT POWERING UP:

- Check the battery and battery connections.

HANDHELD RADIO HAS POWER, BUT YOU HAVE NO COMMS:

- Check the antenna connection.
- Re-locate to higher ground.
- Don't block the intended signal path with your body (e.g. when using a chest pack) or other objects if possible.

FIELD OPERATIONS/TROUBLESHOOTING

PROBLEM: I can barely hear the traffic coming in, or they can barely hear me.

SOLUTION: You may be out of range for the tower you are using. Try switching to another tower.

PROBLEM: My radio keeps making a loud scratchy noise (static).

SOLUTION: Your squelch may need to be adjusted.

PROBLEM: I can't hit a certain tower.

SOLUTION: Double check your tower map against the area you are in. Make sure you are using the tower closest to you

PROBLEM: My portable/mobile will not switch channels.

SOLUTION: If you are in scan/priority scan mode, turn scan off and try again.

FIELD OPERATIONS/TROUBLESHOOTING

PROBLEM: I don't hear the repeater kick-back, or squelch tail.

SOLUTION: Make sure you are on a repeater channel and are using the correct code guard. If you are on a repeater channel, and you can hit other repeaters but not the one closest to you, please notify dispatch or the radio shop as that repeater may not be working.

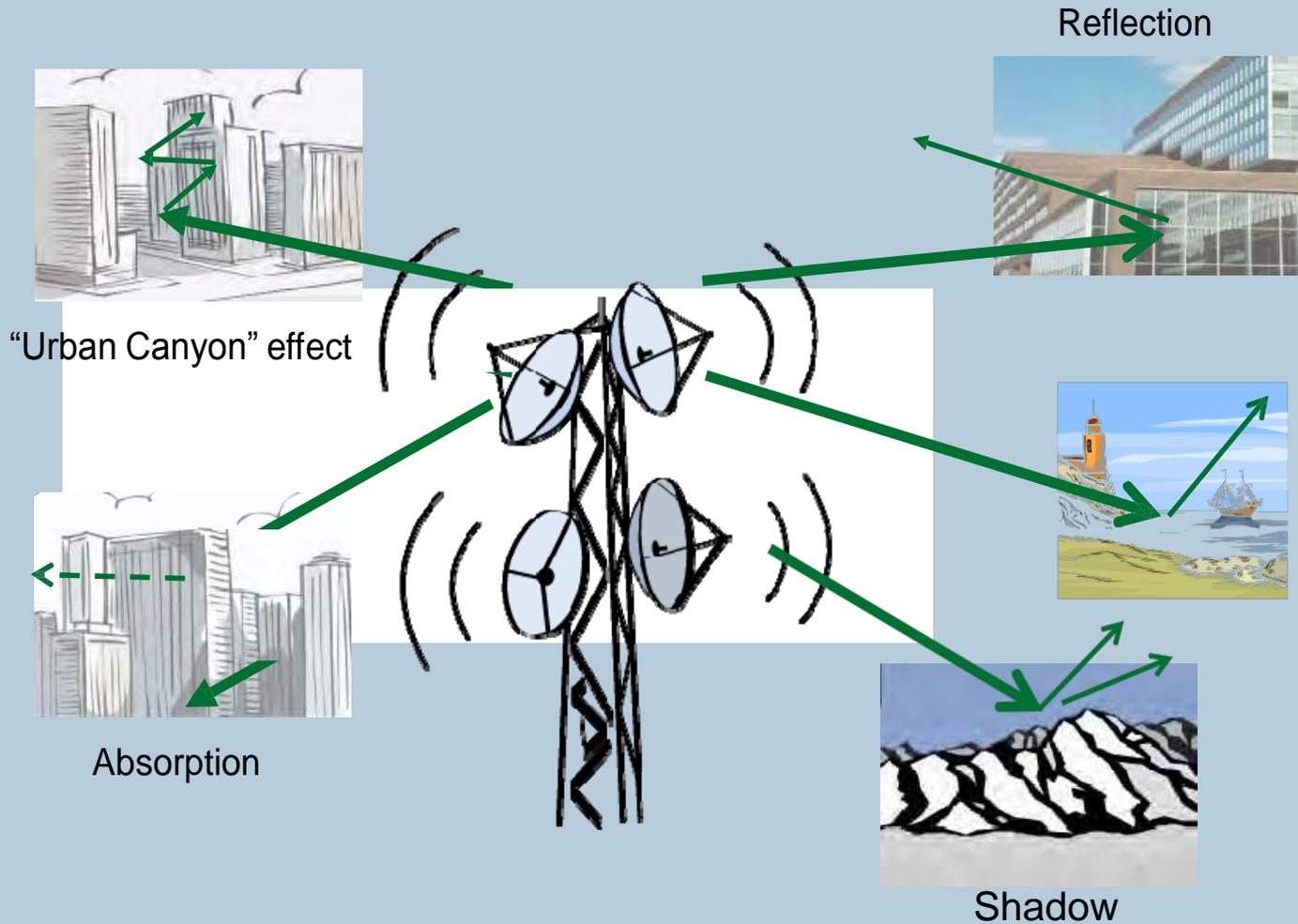
PROBLEM: I was talking on the radio and got cut off.

SOLUTION: Your radio or the repeater may be programmed to cut off after a given amount of transmit time, (time out timer – usually set for 90 seconds). When you are getting close to 90 seconds, say “break” to break your traffic. Release the push-to-talk button (PTT). Wait a couple seconds then say “continuing” and finish your traffic.

Do Radio Waves Bounce?

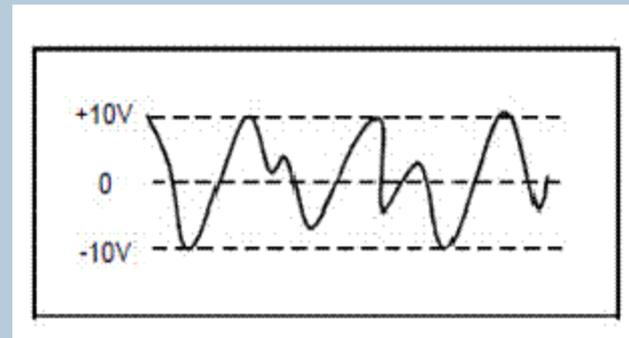
- Under normal conditions, radio signals flow from the field user to the tower and back (this is called propagation). However, some conditions can cause radio signals to scatter and result in distorted or no communication.
- Glass buildings can reflect and scatter radio waves. Buildings can also create an "urban canyon" effect, where radio waves bounce between structures and cannot reach the street level.
- Large, dense buildings such as hospitals can absorb radio waves; lakes, other bodies of water, and hills can reflect radio waves.
- There are also "shadows," which are dead spots where radio waves cannot reach around a hill. However, the height of a hill can also be used to help boost the distance radio waves will travel.

These illustrations depict the various ways in which propagation affects radio waves.



Analog Voice Transmission

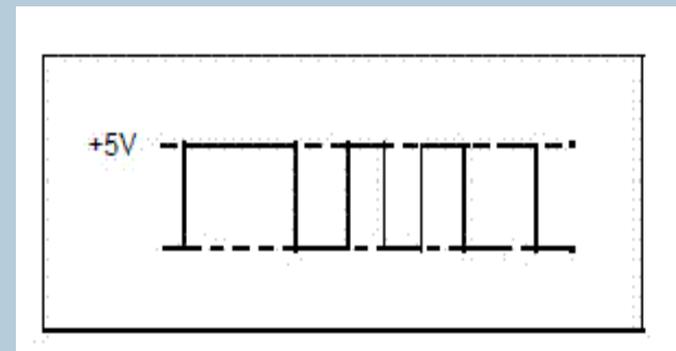
Analog systems use Frequency Modulation (FM), similar to regular FM broadcast radio. A voice radio transmission is carried as a range of values over the designated frequency. As you speak into the microphone, the wave form jumps to correspond to the spoken voice.



Digital Voice Transmission

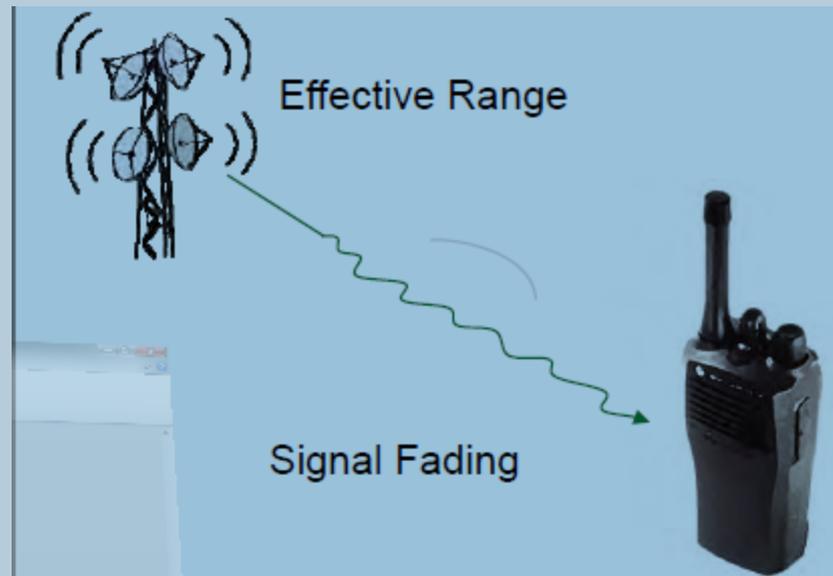
Digital Modulation uses a voice encoder/decoder (called a "vocoder") to convert human voice into 1's and 0's and then back from 1's and 0's to human voice.

The radio transmission is actually a "data" transmission, NOT a voice transmission.



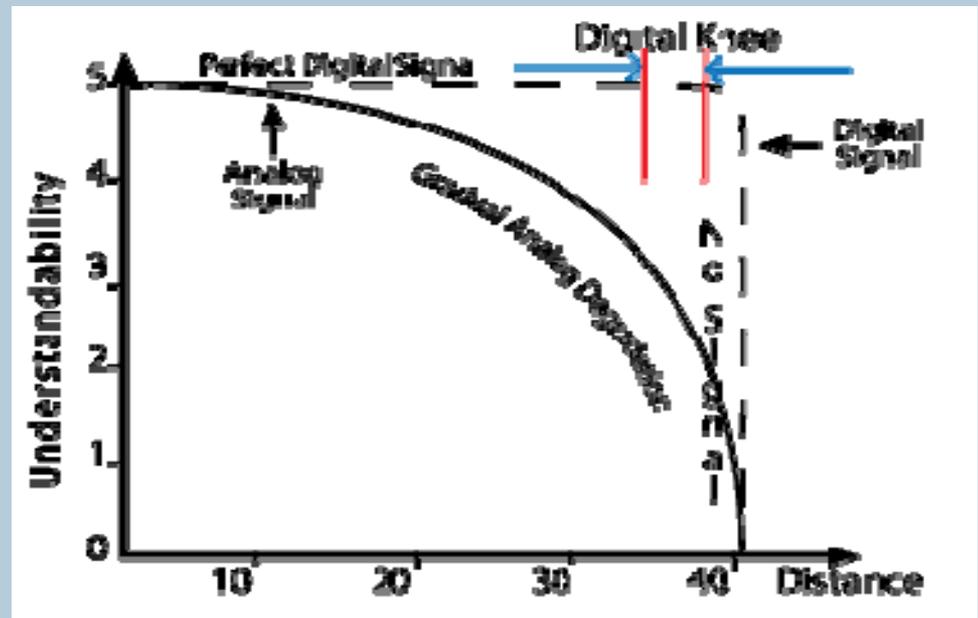
Analog Transmission Fade

- As an analog radio moves into a poor signal coverage area, the voice transmissions will become weak with increasing static until the signal is lost.
- Click the speaker below to hear a sample of a fading signal.



Analog and Digital Issues

Digital radio users need to understand that the "digital knee" where communication goes from "acceptable" to "nothing" can be a very short distance. . .even just a few feet inside of a building!



Digital Voice Encoder

- The digital voice encoder ("vocoder") was designed to encode and decode human voice. Certain types of loud background noise can confuse the radio.
- If the background noise is loud enough and/or in the right frequency range, it can confuse the radio which will then transmit silence or a distorted transmission instead of the user's voice.

Radio Tips

Tip #1: If possible and safe to do so, hold the portable radio in your hand with the antenna pointed "up." Leaving the portable radio on your belt greatly reduces the radio range.

- If you are using a speaker mic on your shoulder, a speaker mic that has a built-in antenna may work better than using a shoulder mic without an antenna.



Radio Tips

- This officer is using a lapel microphone with no antenna. The radio is on her belt, so the radio antenna must transmit through or around her body, reducing the transmission range. The antenna is also closer to the ground, at waist level, further reducing its range.



Radio Tips

- This officer removed his radio from his belt to transmit. The antenna is now at his shoulder height, increasing the range of the radio.



Radio Tips

- This firefighter is using a speaker microphone with an attached antenna. The antenna is at shoulder height, increasing the range of the radio.



Radio Tips

Tip #2: Monitor the radio for 1 second before transmitting (unless you have an emergency). Listen to be sure you are not interrupting a conversation already in progress **AND** to be sure that the radio channel is not restricted due to an emergency.



Radio Tips

Tip #3: Press the transmit button and pause before speaking.

- If you are using a conventional system that transmits Unit ID information, be sure to wait for the audible data signal to finish before you start transmitting.
- In conventional repeated radio systems, pause after pressing the transmit button to give the repeater time to key up to rebroadcast your message.
- If talking through a gateway or radio patch, pause after pressing the transmit button to give the system time to "set up."
- In the absence of a radio tone telling you it is OK to transmit, pause two seconds before starting your conversation.

Radio Tips

Tip #4: Hold microphone about two inches from your mouth; speak directly into it. Talking across the microphone may cause your voice to fade; holding the microphone too close may cause distortion from your breath hitting the unit. Note the position of the mic in these two photos. A slight adjustment makes a big difference!

• **Not this. . .**



But this. . .



- Be sure the microphone is facing your mouth to reduce the chance that it will pick up other noise in the area.
- In windy conditions, try to shield the microphone to reduce "wind noise." If tactically possible, always transmit from an area with the lowest background noise.
- Speak in a normal tone of voice; loud voices can cause over-modulation. (distortion).

Radio Tips

Tip #5: Know all the features and capabilities of your radio, including how to

- Turn the radio ON and OFF
- Access all agencies programmed in your radio
- Change channels, talk groups, and zones
- Activate and clear an Emergency Call Button
- Operate the SCAN function, including Scan, Priority Scan, Scan Resume, and understand how scan can disrupt normal radio reception
- Switch your radio to Talk Around/Direct Mode (Simplex)
- Determine which channels/talk groups are digital and which are analog
- Leave encryption and transmit "in the clear."

Radio Tips

Tip #6: Always use consistent channel and unit names. Refer to a channel by its official name; using slang can be confusing.

- Always use your full radio identifier when communicating. Abbreviating your radio ID can cause confusion and could cause assistance to be sent to the wrong unit.
- When communicating on Mutual Aid and inter-agency channels, follow local, regional, and statewide policies. Always use your unit ID.

Radio Tips

Tip #7: Use only approved accessories for your radio, and use only provided batteries, lapel microphones, and antennas. Accessories are rarely compatible between different vendors and even between different models from the same vendor.

- Attaching an incompatible antenna, battery, or lapel microphone can cause the radio to malfunction and may lock the microphone open! In some cases, your radio may appear to function normally but will fail when you try to transmit.

Radio Tips

Tip #8: Treat your radio with respect.

- Do not hang your keys on the antenna. This can reduce the range of your radio.
- Do not carry the radio by the antenna. It can damage the internal coil and reduce the radio range.
- To the extent possible, based on your assignment, do not get the radio wet or dirty. Water can cause the radio to short and lock the microphone open.
- Never open the cover to the radio to look inside or to try to repair the unit.

Radio Tips

Tip #9: Know your agency's radio policy and procedures. Understand the use of each channel.

- Understand how to request emergency and non-emergency assistance.
- Know all the agencies programmed in your radio and how access them.
- Know how interoperability is handled on a daily basis and during a major incident.
- Know who to call if your radio is in need of repair.
- Know what to do if your agency radio system fails.
- Know how to operate your emergency button (if programmed).

If the radio transmissions are noisy,
check the following:

- Make sure the *portable* antenna connection is tight OR the *mobile* antenna is securely attached to the vehicle and is not loose.
- Is background noise drowning out your transmission? Could background noise be confusing your digital radio? Move to a different location if possible.
- Could you be in a poor coverage area?

Questions

Contact:

State Radio (701) 328-9921