

# Radio Exercise 100-3: Identifying Radio Propagation



## OBJECTIVES:

At the completion of this training exercise, participants should:

- Be comfortable using an FRS/GMRS radio
- Establish and utilize a Radio Net while utilizing Tactical Call Signs
- Identify locations within their neighborhood for effective communication with FRS/GMRS radios
- Understand Readability Reporting

**SKILL LEVEL:** Basic

**ESTIMATED DURATION:** 30 to 60 minutes

**RECOMMENDED PARTICIPANTS:**

Minimum: 2

Maximum: No limit, though 4-8 is ideal

## EQUIPMENT NEEDED:

- Participants will need a Family Radio Service (FRS) or General Mobile Radio Service (GMRS) radio during this exercise
- A clipboard or writing surface, notepad and a pen or pencil is needed for documentation
- It is recommended that at least one participant has access to either a printed map of the immediate area or

## PREREQUISITE:

Participants should have experience operating an FRS/GMRS radio and be familiar with operating within a Radio Net.

## REFERENCE MATERIAL:

- ITU Phonetic Alphabet
- Generic Radio Net script for the purposes of this exercise

## BACKGROUND:

There are a wide variety of radios available in the consumer marketplace and the effective useful distance between radios is impacted by a variety of factors. The output power of a radio, the antenna, obstructions caused by buildings, trees, geography/terrain, etc. can all impact the distance users can be away from each other for clear communication. The actual range of two-way radios is very often, much less than that found printed on packaging. The best radio signals occur if radios have a direct 'line of sight' between each other.

FRS radios do not require a license to use and are marketed to the general public for a variety of uses. As a result, these radios operate at the lowest power settings (1/2 to 2 watts), don't allow for an external antenna and would have the shortest useful range while compared to other radio types while being impacted the most by obstructions.

GMRS radios operate on the same 22 frequencies as FRS radios, require a license (but no test), operate on higher power levels (1/2 to 5 to 50 watts), allow for the usage of external antennas to improve radio reception/transmissions and have the option to use an additional 8 repeater channels. A repeater is another radio that receives radio transmissions on one frequency and rebroadcasts it out on a second frequency. Placing a repeater at the top of mountain ridge would allow users on both sides of the mountain to communicate via the radio at the top.

The City of Lake Oswego has varying geography and elevations across the city. Within a particular neighborhood, differences in terrain/elevation can significantly impact the useful range of radios even in short distances. This may result in two radio users not being able to communicate with each other directly. However, adding a third radio user, or “relay person” in the middle, can be useful. This relay person can pass messages from one person to another allowing two radio users who are geographically out of radio range to share information. Neighborhood Emergency Response Teams, Community Emergency Response Team trained individuals and other citizens should identify strategic neighborhood gathering sites such as a park, school or other buildings that could be used as a neighborhood meeting spot during a disaster.

It is important for citizens and radio users to understand the usage limitations not only of the radios that they use but also how they function within their own neighborhood. Radio distance range or radio propagation testing is a way to identify those limitations or how far their radio signal can travel. This type of analysis can be done a number of ways but this exercise includes several possible methods best accomplished with a small group.

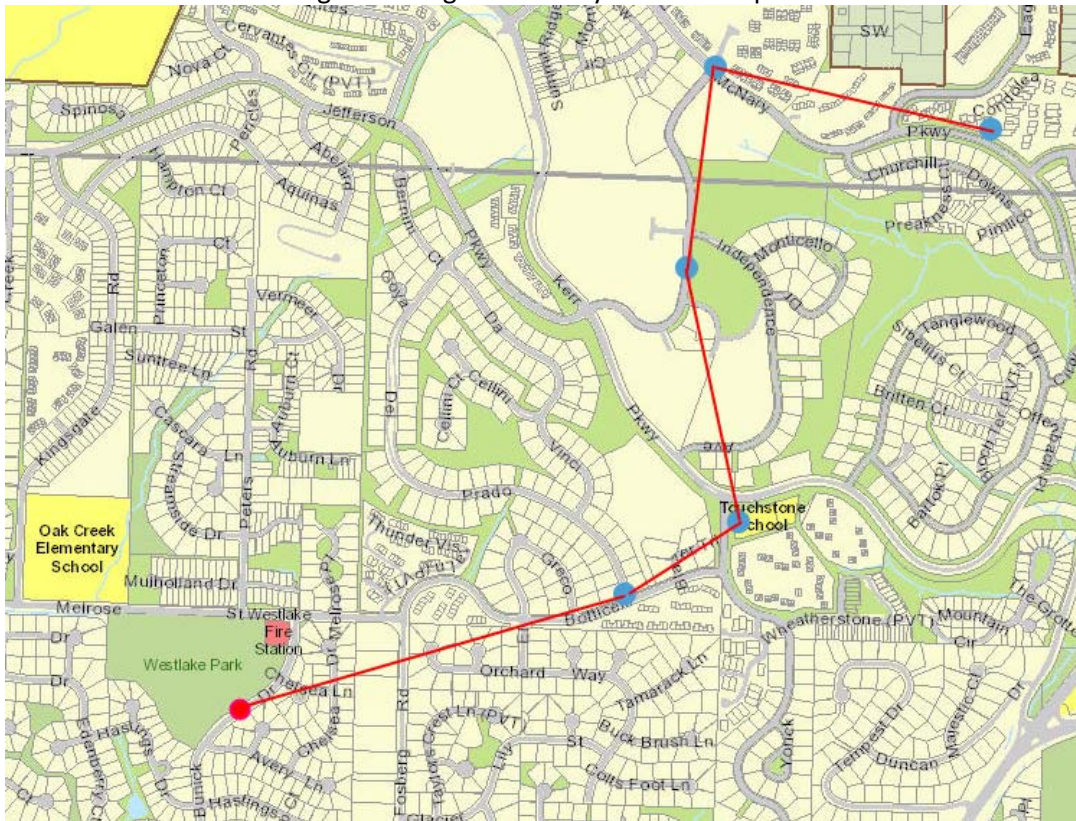
Method 1: Radio users start together in a central location and begin spreading outward. Participants will travel away from the central spot some distance, then radio back to the central location for a radio readability report. Participants continue traveling away until they no longer have any reception and are unable to communicate. This will help establish the limits of a signal readability boundary from the central location. Participants can then return to the radio contact zone and move to another location, continuing to ask for a readability report until they are again out of range. A log should be kept of locations where users were successful communicating from. A map can be generated showing strategic radio communication paths.

Figure 1: Central Point Example – Originates from One Spot



Method 2: In the event a neighborhood has geographic features such as sharp ridges or valleys that prevent a wide communication path, users may find value in determining strategic relay locations that can be used to pass information up and over the terrain. In this scenario, participants would identify a starting point and an end point. Users would gather at the starting point and all start traveling along the planned path until they reach a point where they can maintain communication with the prior location. One person would remain here while the other participants continued farther until they again reach the limits of communication with the prior location. The second person would stay here while the others continue on the planned route. In this situation, each middle participant can only communicate with the users directly adjoining them. They would need to relay information to the individuals adjacent them to continue passing along a radio message to the next person.

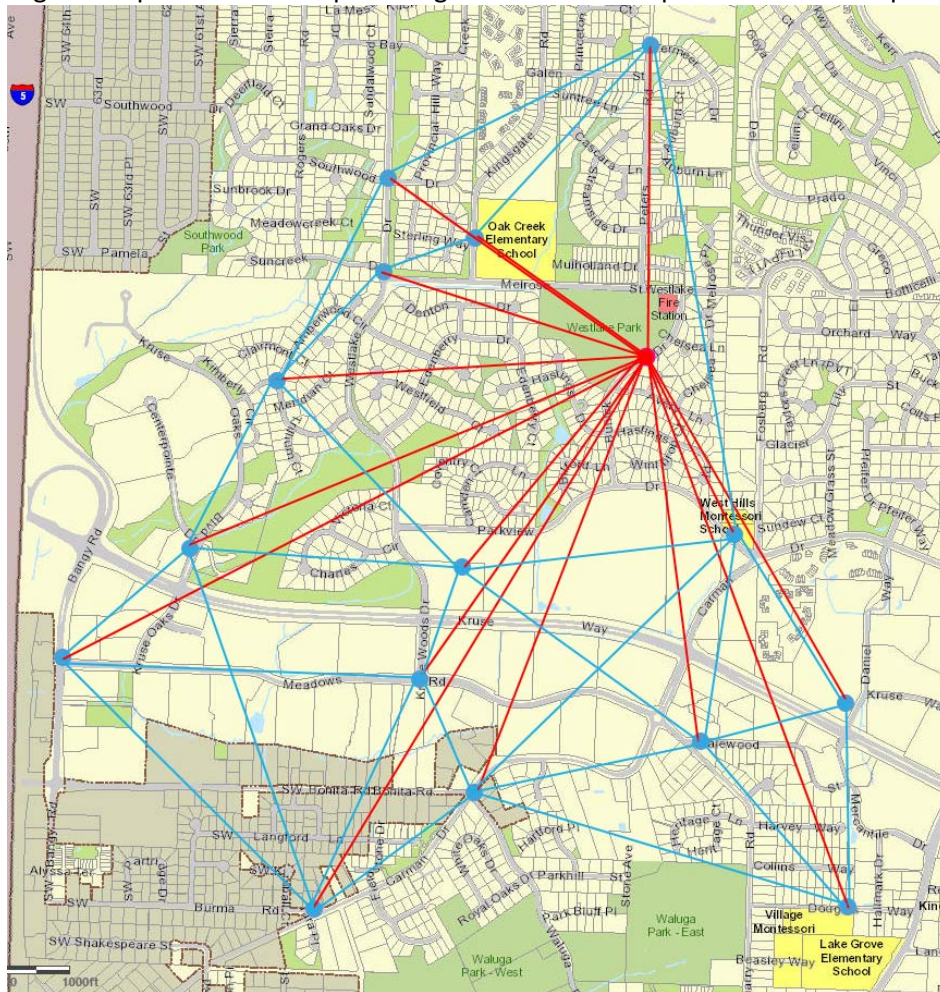
Figure 2: Single Line Relay Series Example



Method 3: It is also possible to combine the first two types of radio propagation testing; though it does take more coordination and patience among the participants. Using the central spot example, participants branch out to various locations and not only attempt contact with the central location but also other radio users (see Figure 3). When using this method, it is recommended that all users be assigned a known physical starting location that Net Control has a list of. Participants report to their assigned starting locations and report when they are in position to Net Control. Net Control then makes radio contact with all participants first to verify all are within radio range. Then, Net Control begins contacting the first participant and allowing that participant to attempt calling a neighboring participant using the appropriate tactical call sign. It's important that only the first participant attempt the radio contact with all of the other participants to reduce the likelihood of 'doubles,' or two or more users talking on the radio at the same time. It is also very important that participants don't start changing

locations on their own but rather allow Net Control to assign any new staging location. That way Net Control can update records accordingly and be able to advise any other participant of the change.

Figure 3: Spider Web Example – Originates from One Spot and Connects Spots



#### INSTRUCTIONS:

- 1) Gather all participants at a common location and identify an individual to serve as Net Control and an individual to serve as a Scribe. One person could serve both roles but it is better to have a separate person fill each role.
  - Net Control should have a copy of the “Radio Propagation Radio Net Script” in order to initiate a Radio Net for the purpose of the exercise.
  - Scribe should have access to a local map with pertinent identifiers such as street names and other landmarks (parks, schools, etc.).
- 2) Participants will decide the manner in which the radio test will be conducted. Either participants will A) fan out and remain in contact with Net Control to determine approximate distance radios function, B) participants will go out as a group to develop appropriate relay locations in a predetermined route or C) participants will go to predesignated locations and identify multiple communication paths from each location.

- 3) Net Control should establish the name of the Radio NET to be used for the exercise along with a primary radio channel/tone and a secondary channel/tone. This information will be shared with all participants. A Radio NET name could include the name of the neighborhood such as the *Waluga Radio NET* or *Mountain Park Radio NET* or it could be a more specific such as the *Carman Oaks Radio NET*.
- 4) Participants should identify tactical call signs to use for the exercise. Tactical call signs can be developed by the physical location a participant may be located such as "Daniel Way," "Meadows" or "Aspen Park." In a scenario where participants may be continually changing locations, consider using a generic call sign such as "Waluga 1," "Waluga 2," etc..
- 5) Net Control and the Scribe should document the tactical call signs for all of the participants.
- 6) With participants spread out enough so that each operator can hear, Net Control begins the exercise by initiating the Radio Net. This will allow all participants to verify that their radios are all on the proper channel/tone and functioning properly before leaving the area.

#### **Method 1 – Central Point of Contact**

7) Participants then proceed either to their predesignated locations to test or begin moving away from Net Control. When they arrive at their designated location or a location they wish to evaluate, they will contact Net Control for a Readability Report. The Scribe should document the participant (via tactical call sign) and their physical location. Upon confirming the radio communication, Net Control could ask each participant to remain at that location or move on to a new location.

8) Having a participant remain at a location until told to relocate may be necessary in the event a second participant's designated location is at the edge of the radio range. If Participant 1's location is located roughly between Participant 2 and Net Control, Participant 1 could become a relay person if Participant 2 and Net Control are out of range. Participant 1 may hear Participant 2 trying to contact Net Control and advise both of the situation. Participant 2 could then move in a direction closer to Net Control until he/she is able to contact Net Control.

9) Participants will continue to attempt contact and report radio signals until they cover the immediate geographic area to their satisfaction or Net Control advises all identified locations were reached and all can return to the starting location.

#### **Method 2 – Single Line Extended Relay**

7) Participants leave the starting location together in the predetermined route. The participants stop at the first predetermined location and the participant who will be the first relay location will attempt radio contact with Net Control. If there is no radio communications, the first participant will back track until they have clear communications with Net Control. The scribe will document this location.

8) The remaining participants will continue along the route until the second participant is at the edge of readable radio signals with the first participant. The second participant will radio the first participant and advise of their location. The first participant will relay that location to Net

Control so that the scribe can document it. Net Control should confirm to the first participant that they received and documented the location of the second participant.

9) Remaining participants will continue this process of extending the radio relay route until the locations of all participants has been documented. When the last participant receives confirmation that Net Control and the scribe have documented their location, Net Control can have participants return to the starting location.

### **Method 3 – Spider Web Communication**

7) Participants proceed to their predesignated locations. When they arrive at their spot, they contact Net Control for a Readability Report. The Scribe should document the participant (via tactical call sign), their physical location and readability report. Upon confirming the radio communication with Net Control, each participant remains at that location awaiting further instruction.

9) Net Control will contact one participant (i.e. “Kruse Way”) and temporarily pass control of that radio net to that individual. This participant (i.e. “Kruse Way”) will then attempt to contact the other participants in a systematic manner. Net Control can monitor and the Scribe can document when “Kruse Way” is able to communicate with the other participants. When the first participant has completed their attempts at contacting all other participants, radio control is passed back to Net Control. Based upon the available list and records kept by the Scribe, Net Control can then contact any participants who may have not been in contact with Participant 1 due to radio range or someone who is between Participant 1 and a non-contacted user. The person in the middle is then given control of the radio net to attempt contacts and

10) When all participants have contacted Net Control and the Scribe documents all pertinent information, the exercise can be terminated. Net Control should announce over the radio and close down the radio net.

# ITU Phonetic Alphabet

<b>A</b> ALFA AL-FAH	<b>B</b> BRAVO BRAH-VOH	<b>C</b> CHARLIE CHAR-LEE	<b>D</b> DELTA DELL-TAH	<b>E</b> ECHO ECK-OH	<b>F</b> FOXTROT FOKS-TROT
<b>G</b> GOLF GOLF	<b>H</b> HOTEL HOH-TEL	<b>I</b> INDIA INI-DEE-AH	<b>J</b> JULIET JEW-LEE-ETT	<b>K</b> KILO KEY-LOH	<b>L</b> LIMA LEE-MAH
<b>M</b> MIKE MIKE	<b>N</b> NOVEMBER NO-VEH-BER	<b>O</b> OSCAR OSS-CAH	<b>P</b> PAPA PAH-PAH	<b>Q</b> QUEBEC KEH-BECK	<b>R</b> ROMEO ROW-ME-OH
<b>S</b> SIERRA SEE-AIR-RAH	<b>T</b> TANGO TANG-GO	<b>U</b> UNIFORM YOU-NEE-FORM	<b>V</b> VICTOR VIK-TAH	<b>W</b> WHISKEY WISS-KEY	<b>X</b> X-RAY ECKS-RAY
<b>Y</b> YANKEE YANG-KEY	<b>Z</b> ZULU ZOO-LOO	<b>1</b> ONE WUN	<b>2</b> TWO TOO	<b>3</b> THREE TREE	<b>4</b> FOUR FOW-ER
<b>5</b> FIVE FIFE	<b>6</b> SIX SIX	<b>7</b> SEVEN SEV-EN	<b>8</b> EIGHT AIT	<b>9</b> NINE NIN-ER	<b>0</b> ZERO ZEE-RO

The following is a prepared script that can be used to assist neighborhood associations with conducting their own radio propagation training.

- Black text refers to the script that a Net Control Station would be reading.
- Text in [**BOLD UPPERCASE**] are placeholders that should be substituted with appropriate information
- Red text enclosed in [Brackets] is instructional and is not intended to be read 'over the air'.
  - Whenever you see the prompt [Pause], this is a reminder that the net control operator shall release the PTT button on the radio and wait a 3-5 seconds before resuming. This will allow a short period for other radio stations to interrupt if necessary.
- Blue text indicates alternate script text that may not be necessary to read.

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[A few minutes before the start of the net, check to see if the desired channel for the training is in use. After announcing your name each time, spell it phonetically.]

This is [NAME] in the [NEIGHBORHOOD NAME] neighborhood. Is this channel in use?

[Net Control Station (NCS) should then listen and if nothing is heard broadcast "nothing heard" and pause for several seconds, allowing any other station on the net who DOES hear stations already using the frequency to interrupt and notify the NCS. If the frequency is in use, request the use of the channel for the training exercise or announce the alternate frequency, and switch to that frequency. It is suggested that the alternate frequency not be announced to prevent malicious interference.]

This is [NAME] and due to other radio traffic on this channel, we will move the [NEIGHBORHOOD CALL SIGN] radio net to our secondary channel and tone. [It is worth repeating this message on the original channel just before starting the net]

[One minute before starting the net]

All stations on channel [CHAN #] with tone [TONE #] please standby for the start of the [NEIGHBORHOOD CALL SIGN] radio net. If anyone has any emergency traffic or if you need to make a quick call, please go ahead and do so now. I'll be starting the [NEIGHBORHOOD CALL SIGN] radio net in one minute.

[At the determined net start time]

Attention all stations, attention all stations, this is [NAME] in the [NEIGHBORHOOD NAME] neighborhood. I will be the Net Control Station and at this time I am establishing the [NEIGHBORHOOD CALL SIGN] radio net. The purpose of today's net is for radio propagation testing to identify critical relay locations in the \_\_\_\_\_ neighborhood]. [Pause: release PTT button and wait 3-5 seconds]

This will be a directed net meaning all traffic will go through net control. [Pause]

This net will interrupt at any time for emergency traffic. If you have such traffic, please say the word 'emergency' followed by your name or tactical call sign and wait to be acknowledged. Does anyone have any emergency traffic? [Pause. No emergency traffic heard.]



Again, this is [NAME] and I am the net control for today's [NEIGHBORHOOD CALL SIGN] Radio Net. This Radio Net has been established for testing and training purposes. Please be sure to include the phrase "this is a test" if you pass along any messages that could be construed as an emergency if they aren't.

[Pause]

Continue using plain language for the duration of this exercise and practicing usage of the ITU Phonetic Alphabet when possible. Participants will be able to share their locations, provide readability reports, relay radio traffic and share information to fulfill the requirements of identifying radio signals as necessary.

Once the goals of the participants or the time period set for the exercise have been met, you may terminate the net.

This is [NAME] and I am the net control for today's [NEIGHBORHOOD CALL SIGN] Radio Net. If any stations have any other additional announcements or comments prior to closing the net, please call out now. [Pause. Wait and see if anyone else requests to make an announcement or comment.]

This will conclude our training exercise and I would like to thank everyone who participated today along with those that held their traffic so we could utilize this channel. I am now closing this session of the [NEIGHBORHOOD CALL SIGN] Radio Net and returning the channel to normal use.