COMMUNICATIONS for SAR Field Teams

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(April 16, 2023)

Items in this Presentation

- Why do I need a radio?
- Radio Equipment
- Frequencies
- Using your radio effectively for SAR
- Speaking - SAR Comms
- SAR Repeaters
- Ham Radio Capabilities – Ham Repeaters
- Linked Repeaters
- Incident Base & Comms

Communication

- a process by which information is exchanged between individuals through a common system of symbols, signs, or behavior (Merriam-Webster dictionary online)
  - Talking in person combines words, sounds, gestures, actions, facial expressions, tone of voice
  - Written messages may include explanatory notes, diagrams, pictures, etc.
  - Wireless
    - Voice over radio – words, sounds, tone of voice
    - Data over radio – being used more as tech advances, cell phone, GPS – APRS, GPS – digital, satellite for coordinates, lists, photos, etc.

Why Do I Need a Radio?

- Life Safety – in case of emergency to summon help
- Communicate with Incident Base
  - Receive assignments
  - Report local conditions
  - Health and Welfare Checks – everyone OK?
  - Team tracking – coordinates, are we where we are supposed to be?
  - Communicate clues and finds
  - Communicate & coordinate with other field teams

Using Cell Phones and Satellite Phones in the Field

- Cell phones –
  - Often no or limited service at search locations
  - Can serve as a GPS if maps are downloaded before getting into the field
  - Ensure ample battery life by packing a USB charging pack and cable
  - May be useful while *en route* to IB for directions or to rendezvous with other searchers
  - May be useful in an emergency – important to have contacts programmed before the search if data service is unavailable
- Satellite phones –
  - Limited to IB use due to cost and availability
  - May need an international calling plan to call in to them

Radios for SAR - Requirements

- **SAR frequencies LMRS** (Land Mobile Radio Service, Commercial, or Public Safety)
  - FCC Part 90 Certification of radios is legally required for operation
  - An FCC ID number e.g “FCC-ID:ZP5BF-82” appears on the device model number label in the battery compartment of HTs that are certified.
  - Operation of non-certified radios is subject to large fines by the FCC
  - Frequencies we use are licensed under FCC public safety provisions
  - 150-174 MHz, and 450-470 MHz (in VHF and UHF frequency range)
- **HAM (Amateur Radio) Frequencies**
  - An FCC radio amateur (Ham) license is required for operation on
  - Ham operators must pass a written test administered by authorized exam coordinators
  - 144-148 MHz, 420-450 MHz (in VHF and UHF frequency range)

For Search and Rescue LMRS and HAM are usually used/needed

- More transmitter power for more range
- Repeaters exist that provide coverage of greater areas
- Being able to talk to State Police and others – interoperability
  - E.g. Park Service, Forest Service, BLM, Fire, Law Enforcement…
- VHF and UHF frequencies are used in part because the equipment is compact, some properties of VHF/UHF:
  - Transmission is nearly line-of-sight
  - Mountains, ridges, hills, and even trees, buildings, and your body can block or reduce signals
  - Repeaters on mountain tops provide a way around

Radio Equipment

Examples of Some Handheld Radios for SAR

- Commercial Part 90 Radios (VHF only, single channel)
  - Icom F 3021S - 128 channels in 8 banks
- Other Part 90 Handheld Transceivers (HTs) (dual band VHF/UHF and dual channel)
  - Wouxun KG-UV6D - 199 channels
  - Baofeng UV-82C – 128 channels (lowest cost, works fairly well)
  - TYT MD-390 -1000 channels (VHF only)
  - **TYT MD-UV390 – 3000 channels, VHF/UHF, rugged, waterproof, optional GPS, (Analog & Digital DMR)**
  - **Anytone AT-D878UV – 4000 channels, VHF/UHF, GPS, APRS beacon position reporting (Analog & Digital DMR)**

Recommended Field Equipment

- Higher gain antennas (longer)
  - Provide greater range
  - Nagoya 771 or NA-24J are examples of preferred HT antennas, about 16” long. The 24J is ultra flexible
  - Make sure the connector ordered matches your radio’s connector (SMA-F for AT-D878UV)

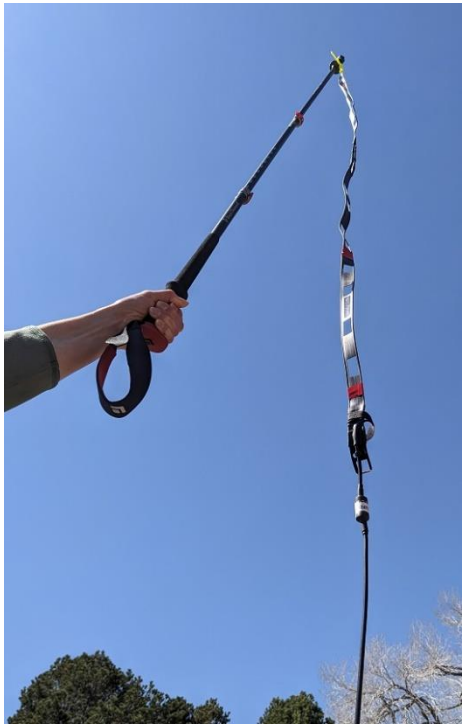
- Speaker microphone (speaker-mic)
  - More convenient operation
  - Allows raising radio higher while talking
- Chest harness that keeps the antenna vertical & above your shoulder as much as possible, like this!
- Extra Battery Pack – for extended operations

Advanced Field Equipment

- Roll-up antennas can be raised for greater range and signal strength compared to a radio-mounted antenna, an adapter may be needed to connect to your radio
  - N9TAX “Slim Jim” https://n9taxlabs.com/shop/ols/products GMRS/MURS is best for SAR frequencies, 2m/70cm is best for HAM frequencies, sturdier, heavier, lower cost.
  - Ed Fong DBJ2 J-Pole (commercial or HAM versions) VHF & UHF https://grapevineamateurradio.com/products/ed-fong-j-pole-antennas-dual-band-220-and-roll-up?variant=40854721200307 smaller, lighter, less robust, higher cost.

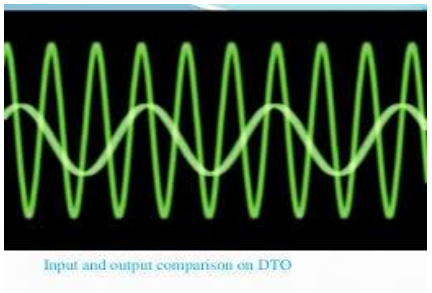
Roll-Up Antenna Deployment

- Supports for roll-ups may be ropes, trees, hiking poles, etc.
  - Must keep the length of the antenna away from your body and conductive poles or objects. These can drastically shift the frequency at which the antenna radiates efficiently, greatly reducing effectiveness.



Radio Frequencies

SAR Frequencies and Typical Reference Names



- NM Search and Rescue Council (NMSARC) website http://www.nmsarc.org/Communications.html primary frequencies (NMSARC holds these licenses, call sign KC7064)
  - SAR 1 (155.160 MHz) this is used nationwide
  - SAR 2 (151.370 MHz)
  - SAR 3 (159.285 MHz)
  - USAR 1 (460.250 MHz)
  - USAR 2 (465.250 MHz)
- FCC blanket license for interoperability use of VHF Tactical
  - VTAC11 (151.1375 MHz)
  - VTAC12 (154.4525 MHz)
  - VTAC13 (158.7375 MHz)
  - VTAC14 (159.4725 MHz)
  - VTAC33-38 Repeaters

SAR Frequencies (Cont.)

- Examples of some NM SAR Team frequencies
  - 154.445 MHz – Los Alamos Auxiliary Fire Brigade
  - 155.205 MHz – Mtn Canine Corps, Sandia Search Dogs
  - 155.220 MHz – Santa Fe SAR
  - 155.235 MHz –Atalaya SAR
  - 155.265 MHz – Cibola SAR
  - 155.28 MHz – Abq Mtn Rescue Council, Taos SAR
  - 155.295 MHz – Dona Anna County SAR, CAP
- No call sign or other ID requirements for field teams
  - Just use your tactical call e.g. “Team 5” or your first name if not in a group or formal position
- Licensed Hams may use Ham bands & repeaters
  - Anyone can use them in a life or death situation!

Ham versus SAR Frequencies

- Greater coverage area, versatility….more repeaters as well as simplex (direct) frequencies
- Must Use Your Assigned Ham Call Sign on Ham Frequencies
  - Use your tactical call, e.g. “Team 1”, and add your Ham call sign once every 10 minutes or at the end of each transmission
- Local linked repeaters can be heard over an extended area
- Mega-Link repeaters repeat your transmission all over the state! Increase chance of aid in urgent situations.
- Good idea: every so often announce that you are engaged in a search/SAR training/etc. when using Ham repeaters. Usually IB takes care of this.
- Getting your Technician HAM license is strongly encouraged!

Radio Use

Know your radio!

- Practice with your radio (use the 10 min. practice guide)
  - Turn on your radio and adjust the volume
  - Tune to the local NOAA weather broadcast channel (WX1 – 7) if available
  - Choose a channel (e.g. SAR3), find it on your radio and lock it (if possible)
  - Unlock and choose another channel (e.g. VTAC33) and find it
  - Return to SAR 1 and power off your radio
- Radio Reference Sheet (Recommend carrying) – operating controls on your radio
- Memory Channels Sheet (Must carry!) – locations of frequencies in your radio (small, laminated cards or file on cell phone)
- List of SAR team members w/ ham licenses – useful for finding call signs for Ham licensed team members (IB)
- The above may be available from your team's Comm guru

Common Radio Issues

- Volume control turned down – check volume setting frequently if no traffic is heard
- Battery low
  - Watch the display while pressing PTT, observe if TX is maintained
  - Carry spare charged battery
- Squelch level too high – adjust
- Radio locked or not – know how to switch
- Antenna blocked by body or not vertical
  - Hold radio high and vertical
- Radio switched to frequency rather than channel mode
  - Know your radio!
- Feedback noise – two radios near each other on the same channel, especially with volume turned up

Radio Squelch and Monitor Controls

- Know how to use your radio
- Analog squelch control – turn the squelch knob
- Digital squelch control – enter menu for squelch and select the level often using the up or down arrows
- Monitor button – turns off squelch, listen to the static to set the volume level, listen for weak signals

SAR1

One Frequency or Two?

SAR1
Elk Mtn

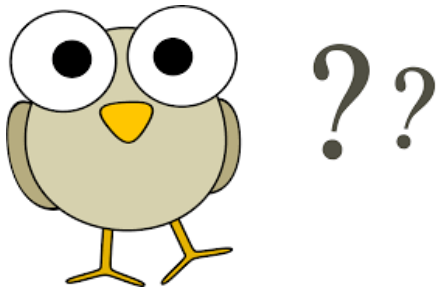
- Some radios (typically older ones) are single frequency radios – only one frequency and channel can be used at a time
- Many newer radios are now dual band (VHF & UHF) and dual frequency (dual channel) – two different frequencies may be monitored – this is useful but can lead to confusion
  - Know how to tell which frequency you are transmitting on
  - Know how to switch between channels for transmitting
  - The way to switch between channels varies depending on the brand and model of radio
- If you find it easier, you may want to switch your radio to single channel operation, or set both channels to the same frequency

Tips for Making Contact

- Check in with Incident Base (IB) Comms before leaving to test your radio
- Hold your radio (or antenna) high in the air
- Ensure you are holding your antenna vertical and not blocking it with your body
  - A mount that puts the antenna higher than your shoulder is best
- Make sure your radio is still on the correct frequency (channel) – learn to use the radio “lock” function
- Make sure your receive volume is turned up
- Hold the mic a few inches from your mouth and speak clearly and with a good strong voice
- When contacting Incident Base <u>be patient</u> – Comms may be busy with multiple tasks, if you transmit again too soon you may not hear when Comms is trying to reply to you

Speaking – SAR Comms

“What did he say?” - A Guide for talking on the Radio



- *Que dijo*?
  - Context is invaluable – be specific
- Some basic rules
  - Think of the message you want to send before pressing the push-to-talk key, keep your message simple and state it as clearly as possible
  - Listen for others on the channel before transmitting
  - Key the radio, pause 2 seconds before speaking
  - Identify in this order, **Station called** – **Station Calling** (Important!)
    - Hey **you**, this is **me**
    - “**Base**, this is **Team 3**”
  - Speak distinctly – slowly
  - Use plain language, no codes (with one exception) or jargon
  - Always repeat back important data, like positions, to verify correct copy

More on Communicating Over the Radio

- Use tactical call signs – “Incident Base”, “Team Two”, “Wilderness Gate” relay, “Mountain Trailhead” containment, “Strike Force One”,…
- Allow time for the receiving operator to log or write the message.
- Minimize transmission time. Others may have an urgent message to convey.
- The use of “pro” (procedure) words reduces transmission time and avoids confusion.
- Learn and use the International Phonetic Alphabet for spelling out names, call signs, etc.

Be Considerate - Think before speaking

- Often others are monitoring our radio communications, family members may overhear radios at IB
  - Try to choose your words carefully
  - “Subjects” of search, rather than names
  - “they” rather than “he” or “she” may help avoid identifying a person
  - Try to limit details when describing a death scene over radio
  - Usually use first names only or tactical calls
  - Try to avoid giving personal phone numbers over the air
  - Do not broadcast personal information
  - Remember to use the “delta code” if needed

Some Commonly Used “Pro” Words

- This Is – identifying your station by tactical call, name, etc.
- Over – I’m done talking, back to you
- Roger – acknowledging message understood
- Wait – I need to pause for a short time
- Stand By – Wait until I can get back to you
- Standing By – I will wait for you to call again
- Correct – what you said is correct
- Wrong – your information or message is incorrect
- Speak Slower – your are too fast to copy
- I Say Again – repeating what was just said
- I Verify – I will repeat your information as a check
- I Spell – I will spell the name, word, using phonetic alphabet
- Disregard – Ignore what was just said
- Priority – not a routine message, pay attention
- Affirmative/Negative – the answer is Yes/No

“Say it again” - Ways to Communicate Clearly

- Say UTM coordinates as individual digits:
  - “3” “7” “4” “0” “7” “7” by “3” “9” “7” “2” “2” “7” “3”
- Give bearings as individual numbers:
  - “Three four zero degrees true”
  - “Zero nine zero degrees magnetic”

- Give distances in combinations:
  - Three hundred twenty meters
    - In periods of poor comms, may have to say individual numbers: 3 2 0 meters
  - One quarter mile
- If communications are poor, it may help to repeat your message to get through or to have another team relay your message to Incident Base

Radio Signal Reports

- Signal Strength
  - LOUD - Your signal is very strong
  - GOOD - Your signal strength is good
  - WEAK - Your signal strength is weak
  - VERY WEAK - Continuous reception not reliable
- Audio Clarity
  - CLEAR - Quality of transmission is excellent
  - READABLE - Transmission is satisfactory
  - UNREADABLE - Cannot understand you
  - DISTORTED - Signal is distorted
  - INTERFERENCE - Signal experiencing interference

The International Phonetic Alphabet

A – ALPHA	J - JULIET	S – SIERRA
B - BRAVO	K – KILO	T – TANGO
C – CHARLIE	L – LIMA	U – UNIFORM
D – DELTA	M – MIKE	V – VICTOR
E – ECHO	N – NOVEMBER	W – WHISKEY
F – FOXTROT	O – OSCAR	X – X-RAY
G – GOLF	P – PAPA	Y – YANKEE
H – HOTEL	Q – QUEBEC	Z - ZULU
I - INDIA	R - ROMEO	

Steps to Try for Re-Contacting Incident Base

- Actions to re-establish comms
  - Hike up higher or hold your radio higher and try again, ensure antenna is vertical
  - Switch to a mission designated repeater or alternate frequency and try again
  - Request a relay to Incident Base (IB) via another team
  - Try a higher gain antenna on your radio, if available
  - Retrace your path to the last point where comms were satisfactory

Talking to Another Team

- To reduce or avoid interfering with traffic between other field teams and Incident Base –
  - Use your team frequency for communications between field teams, if possible
  - On the primary mission frequency, briefly request the other team to switch to the team frequency for your conversation
    - For example, “Team 4, contact team 3 on SF SAR, acknowledge.”
  - Consider keeping your second frequency or a second radio tuned to your team frequency for this purpose
    - Using a second radio may make it easier to communicate on two frequencies
  - When the conversation is completed remember to switch back to the main frequency if your are only using a single channel and radio

SAR Repeaters

Civil Air Patrol Cross Band Repeater

- Provided by the Civil Air Patrol (CAP) on airplanes typically referred to as “High Bird”
- Uses the National Interoperability VTAC33 (as of 4/3/2023) repeater frequency pair – should be programmed into SAR radios
- Provides excellent coverage but only available in good flying weather
- Slight repeater delays require short pause before speaking to avoid loss of first words
- Sometimes used in combination with ground-based VTAC33 repeaters to provide continuity of communications but likely with reduced coverage when High Bird is not in the air

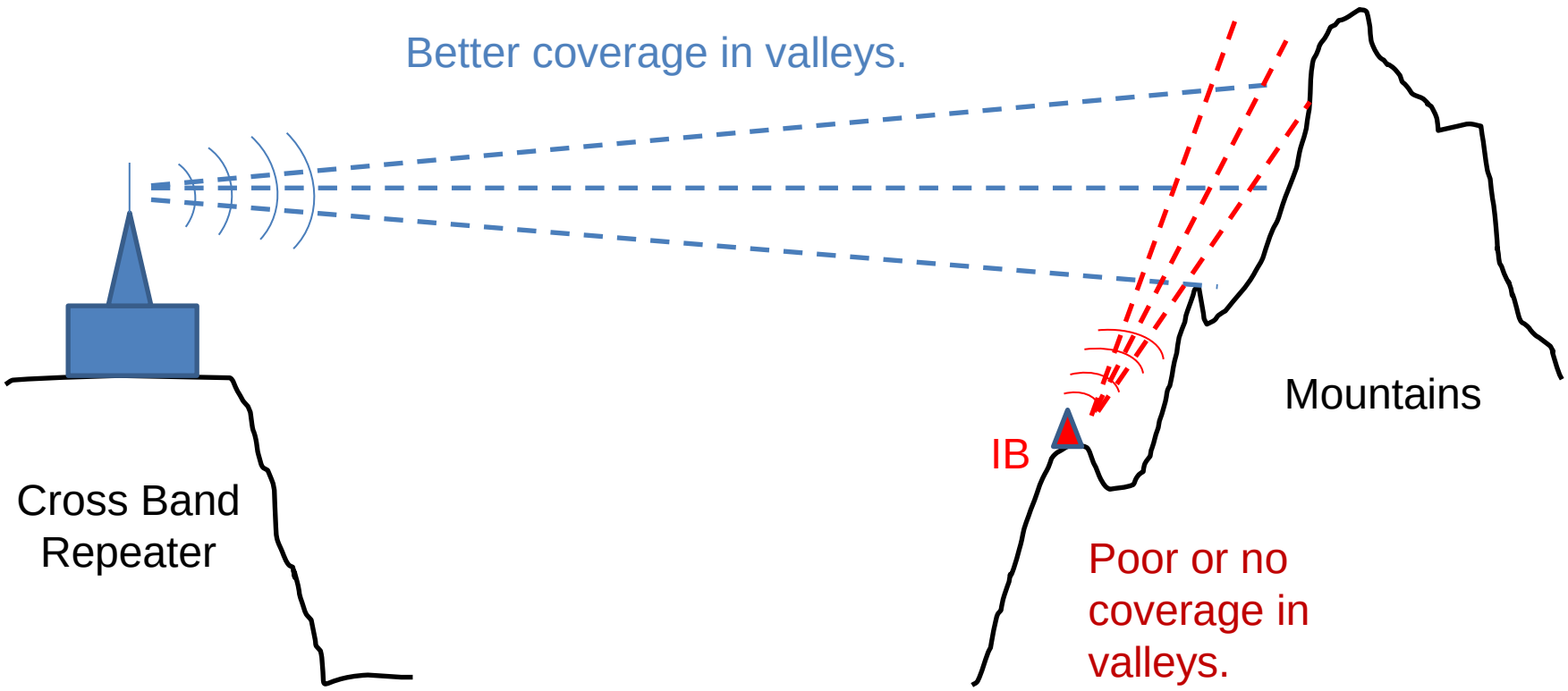
U.S. Forest Service Repeaters

- An agreement (11/2021) between NM State Police and the USFS allows SAR teams to use Forest Service repeaters for missions on FS lands as directed by the Incident Commander
- Provides valuable repeater coverage in rugged and remote areas of the state
- Valuable in warning of wildfire and other hazards
- Frequencies and access tones are being added to radios
- As with most repeaters, teams will be directed which channel to use, when, and how

Portable/Mobile Cross Band Repeaters

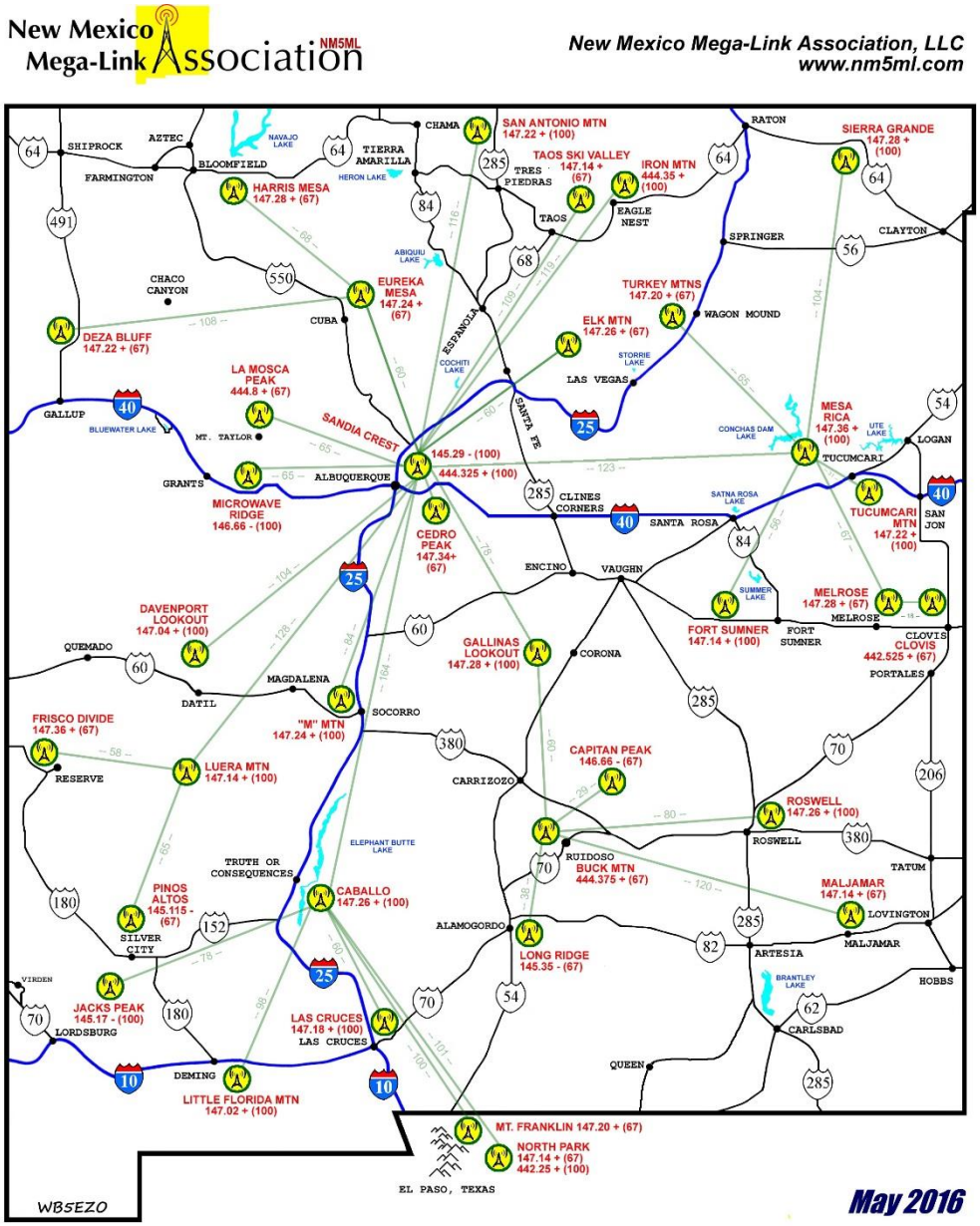
- Used for local searches sometimes – positioned as needed and possible
- Can provide better coverage than directly from incident base – better line of sight
- Typically, field teams use SAR1 (155.16 MHz VHF) as always, IB/Comms uses USAR1 (460.250 MHz UHF)
  - Slight repeater delays require short pause before speaking to avoid loss of first words
- Other frequency pairs in use in NM SAR
  - VTAC33 (CAP and/or ground-based repeaters, blanket FCC license)
  - VTAC17 (requires FCC license)

Cross Band Repeater Gives Improved Coverage on Mountain



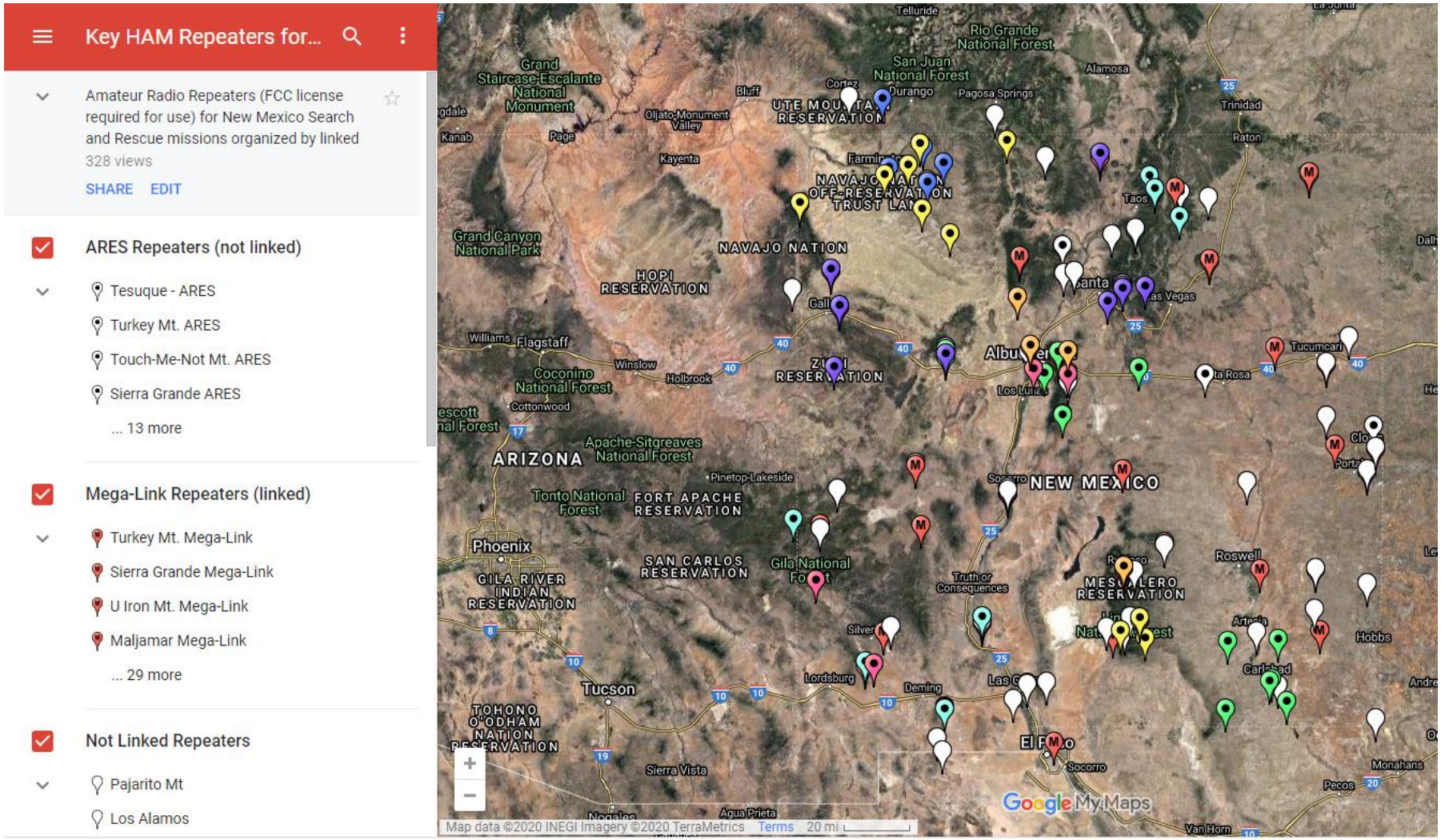
HAM Repeaters

NM MegaLink Linked Repeaters - Statewide



NMSARC Resources- Map

http://www.nmsarc.org/communications.html

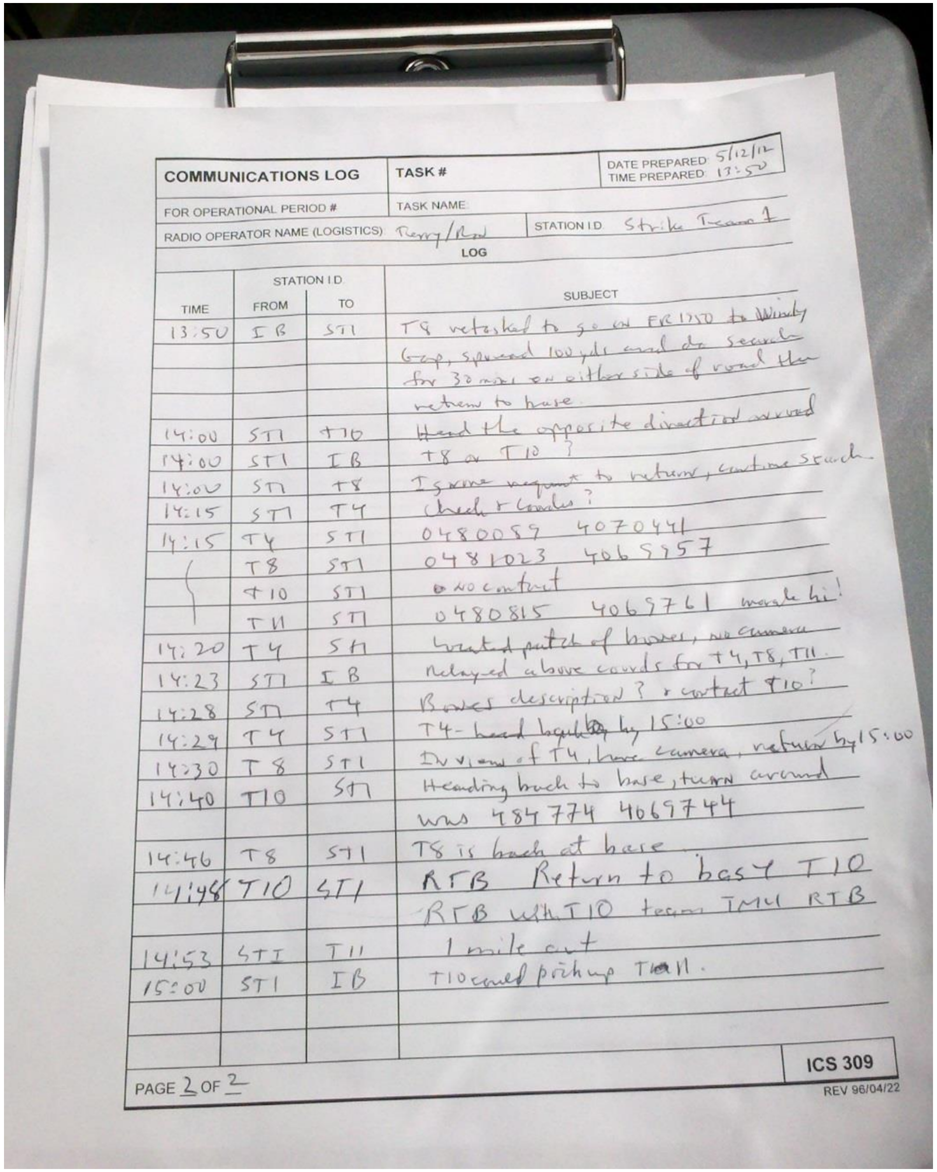


Incident Base & Communications

IB Communication Paperwork & Tasks

- Communications Plan (ICS 205)
  - Defines the frequencies and modes of communication to be used on a mission or training
  - A subset of these are assigned to each Field Team
- Comm Log (NMSAR Form 310)
  - Used to record every exchange, the time/date and Team
- Comms team –
  - Communicate and log messages
  - Interface with Incident Command (IC) Team to
    - Accurately pass messages & communicate assignments
    - Transfer coordinates for mapping

Sample Comms Log



COMMUNICATIONS LOG | TASK # | DATE PREPARED 5/12/12 | TIME PREPARED 13:50

FOR OPERATIONAL PERIOD # | TASK NAME

RADIO OPERATOR NAME (LOGISTICS) Terry/Rod | STATION I.D. Strike Team 1

LOG

TIME	STATION I.D. FROM	STATION I.D. TO	SUBJECT
13:50	IB	ST1	T8 retasked to go on FR1350 to Windy
			Gap, spread 100 yds and do search
			for 30 mins on either side of road then
			return to base.
14:00	ST1	T10	Head the opposite direction around
14:00	ST1	IB	T8 or T10 ?
14:00	ST1	T8	Ignore request to return, continue search.
14:15	ST1	T4	Check & coords?
14:15	T4	ST1	0480059 4070441
	T8	ST1	0481023 4065957
	T10	ST1	no contact
	T11	ST1	0480815 4069761 morale hi!
14:20	T4	ST1	located patch of boxes, no camera
14:23	ST1	IB	relayed above coords for T4, T8, T11.
14:28	ST1	T4	Boxes description? & contact T10?
14:29	T4	ST1	T4 - head back by 15:00
14:30	T8	ST1	In view of T4, have camera, return by 15:00
14:40	T10	ST1	Heading back to base, turn around
			was 484774 4069744
14:46	T8	ST1	T8 is back at base.
14:48	T10	ST1	RTB Return to base T10
			RTB with T10 team TMU RTB
14:53	ST1	T11	1 mile out
15:00	ST1	IB	T10 could pick up T11.

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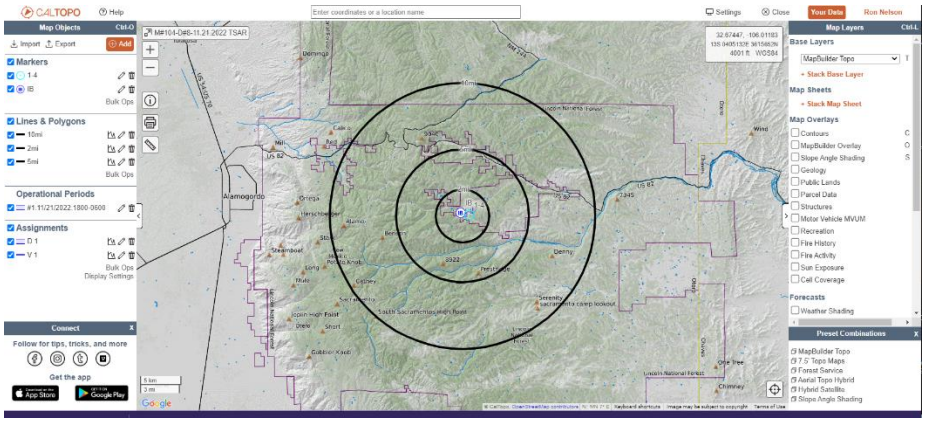
Columns are:

- Time
- From Station
- To Station
- Message

CALTOPO/SARTOPO Mapping

with automatic position reporting

- Faster, easier position and track reporting
- Use the CALTOPO app on your cell phone
- Sharing of maps if internet connection is available
- A statewide team is working to develop CALTOPO as a NM SAR standard
- Training will be available via Zoom and at ESCAPE https://www.nmsarc.org/escape-2023.html



Useful Information

- Frequencies for team trainings (NMSAR Council)
  - Authorization is given for all CURRENT NMSARC member teams to operate under our licenses while conducting Team Training Activities. However, Teams are encouraged to use their own Team Frequency or the Secondary SAR Frequencies, SAR2 151.370 MHz or SAR3 159.285 MHz for training purposes rather than the Primary SAR Frequency, 155.160 MHz. See https://www.nmsarc.org/communications.html
- Ham licensing
  - See https://hamstudy.org/
  - License exams are now available online, but require some video monitoring via laptop, smartphone, or other internet camera.
  - http://www.arrl.org/find-an-amateur-radio-license-exam-session

with thanks to Ray Wallace (NM5L) , Gene Murski (K5ZX) and Erik Nelson (KE5ZBG) for contributions to this presentation

Questions/Comments?

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