Missouri Section ARES®
Communications Plan
And Handbook

Released October 2024

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Introduction

This document is both a plan and guide for emergency communications in the Missouri Section during a disaster or other situation requiring amateur radio assistance for communication of both tactical and non-tactical information among local, district and state governmental organizations and other non-governmental organizations such as Red Cross, Salvation Army, etc.

The first section is the **Emergency Operations Plan (EOP)** for the Section. This is the basic plan that describes the expected (required) operational characteristics for the conducting of emergency communications throughout the section. It starts with the local area group, expands to the district level and finally to the state level for communications. It also describes communications requirements for resource requests to the State Emergency Management Agency (SEMA).

The second section is the VHF/UHF communication plan for local and district use of the VHF & UHF FM frequencies. It describes the HVTAC and UVTAC frequencies and their distribution among the Districts in the Missouri Section.

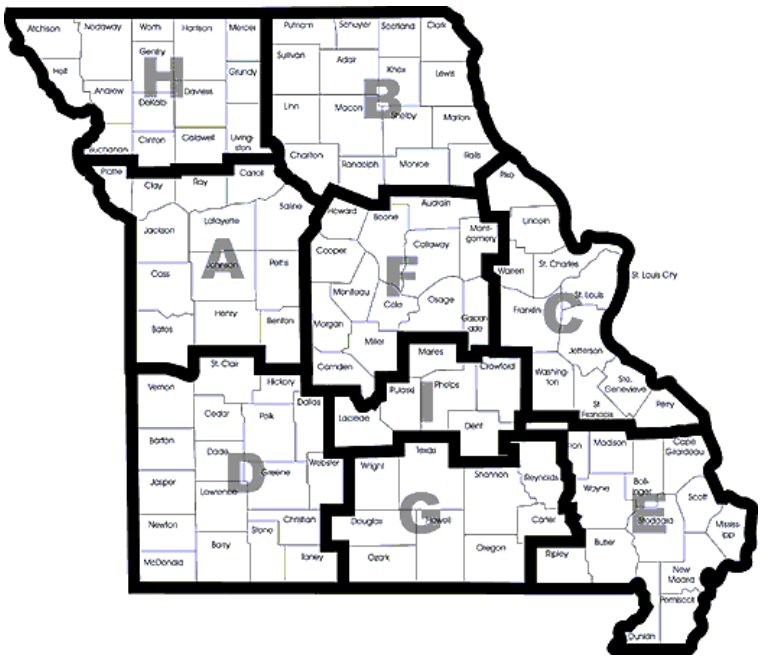
The third section is the Missouri Section Digital Data Communications Guide. This section describes the various mode/protocols of data communication that can be used in EmComm and principles and guidelines for use.

Finally, all ARES® members in the Missouri Section are encouraged to study this handbook and plans within in order to have their stations ready to communicate in case of emergency and/or disaster within the Missouri Section. All disasters start locally and escalate up the ladder to the State of Missouri. The handbook describes how to start with local emergency comms and expand up to the state level if needed. Let’s hope that this handbook is only used for exercises and communications practice and not for the real thing.

Missouri Section Emergency Operations Plan

Background

The Amateur Radio Service is authorized under Part 97 of the Federal Communications Commission's rules as a "voluntary non-commercial communication service, particularly with respect to providing emergency communications." The American Radio Relay League (ARRL) facilitates emergency communications through its Field Organization in general and the Amateur Radio Emergency Service (ARES) in particular.
The ARES is the emergency communications branch of the ARRL Field Organization. It operates under the direction of the Section Manager, an elected position within the Field Organization. There are 71 sections in the United States and its possessions. The State of Missouri is comprised of one section. Within the Missouri Section, there are 9 districts and 115 local jurisdictions including all 114 Missouri counties and the City of St. Louis. Each of the local jurisdictions should have an Emergency Coordinator (EC) assigned. These designated ECs report to their respective District Emergency Coordinator (DEC) in each of the 9 districts who in turn report to the Section Emergency Coordinator (SEC). An updated listing of Missouri Section ARES leadership is kept at http://ares-mo.org/district-info/ and all members are encouraged to keep contact information for their respective areas on hand.



The ARES operates to serve both governmental and non-governmental agencies through "Memoranda of Understanding" (MOUs). These MOUs are non-binding letters

explaining the participating parties' roles and responsibilities, and are initiated at both the national and section levels. Written MOUs need not be in place on a section or local level if they exist on a national level. District and local level MOUs must originate with the appropriate EC or DEC and must be approved and signed by the DEC, SEC and Section Manager prior to their execution. MOUs transfer in-kind as new ECs and DECs are appointed unless specifically cancelled by the incoming EC or DEC. Agencies signatory to MOUs are referred to as "Served Agencies."

It is the intention of this plan to provide guidelines for training and usage of Amateur Radio volunteer communicators. The Missouri Section ARES organizations recognize the role of the Radio Amateur Civil Emergency Service (RACES) to government agencies as auxiliary communications links during times of emergency. It is also the intention of this plan to provide for adequate training and preparation of ARES operators to assist with the needs of the state and local government communications as required. It is the recommendation of this plan that all ARES operators register with their local civil defense agencies. This fulfills the mandatory registration requirements of Part 97 for RACES operators. It will also provide a larger contingent of qualified operators that may be utilized during emergencies regardless of affiliation with ARES or RACES. ARES operators should be prepared to assist any agency whether government or private sector as dictated by the needs of any given situation.

The ARRL has established a new Strategic Plan for standardizing ARES training nationwide that will bring ARES into more compliance with National Incident Management System (NIMS). This plan provides guidance for uniform training of ARES volunteers. It is recommended that DECs follow this guidance to assure that all new ARES operators complete a basic curriculum for emergency communications training. This is a minimum requirement for training and served agencies may require additional training for supporting their operations. The DEC shall ensure that all jurisdictions within the district have adequate training available and regular exercises so that the district as a whole maintains a high degree of readiness.

Purpose

The purpose of this plan is to outline the ARES organization in the Missouri Section and present the basic information required for effective operation during an emergency. It will also contain addendums, which constitute the bulk of the "living document," as submitted by the various personnel. This plan is intended to be updated periodically, on an as-needed basis.

This plan is not intended to be the "last word" in emergency operations, but to be a resource in planning and operations. Recommendations for training are presented as a guideline to establish minimum standards for qualifying Amateur operators as ARES operators. ARES operator training will include items established by the Missouri State Emergency Management Agency for RACES operators. All training should be tailored to meet the needs of the agencies and communities served. Any additions, deletions or corrections affecting the section level should be brought to the attention of the DEC and District Training Coordinator. All submissions will be given due consideration for inclusion in updates as they are released.

Organization

The field services leadership of the Missouri Section is outlined as follows:

> Section Emergency Coordinator: Jeff Young, KB3HF
>
> Assistant Section Emergency Coordinator: Cecil Higgins, AC0HA
>
> See complete Section Organization and Contacts at http://ares-mo.org/district-info/

Plan Activation

If an ARES member determines that a true emergency situation exists, every effort should be made to notify the appropriate county EC so that information concerning an incident may be relayed through the ARES structure and formal net operations established. If the appropriate county EC is unavailable, the chain of command should be followed. This does not preclude operators from contacting an emergency dispatch center or requesting assistance for smaller incidents, such as initial fire, medical, or traffic accident calls. Then monitor the assigned Amateur Radio frequencies utilized in the affected area. This would include appropriate repeater output frequencies and predetermined high frequency net frequencies. If electrical service to a repeater is interrupted, stations should monitor the repeater output frequency or other predetermined simplex frequency, as directed by the local leadership.

It is important that operators not interrupt existing emergency communications, but instead listen and only transmit if specific assistance is requested from that station or if a clear relay can be given in times of difficult copy. Operators should conform to established net protocols at all times. Deviating from established net procedures slows and confuses operations.

Calls for assistance from Served Agencies should be routed to the appropriate EC. This will result in the most efficient and appropriate response. Only under prior arrangements should individual ARES members "self-dispatch" on their own. All ARES members shall have contact information for their leadership.

Alerting

When an emergency arises, the first knowledge of it is usually at the county level. The immediate response to an emergency is to call up local ARES members and begin establishing communications. This may be accomplished by whatever system each EC has in place in their county. As soon as this is accomplished, the EC should inform his/her DEC and/or the SEC of the situation.

The DEC and the SEC should be contacted by phone, if possible. In the event of any major disaster, all counties, DECs, and the SEC should monitor 3.963 or 7.263 MHz for updates and information if the local communications are inoperable. For everyone's

assistance, the Section ARES roster (issued separately by the SEC) contains phone numbers, pagers, and E-mail addresses to facilitate communicating with them when the need arises. These additions are intended to enhance the ability of the ARES to provide communications assistance.

In the event of any widespread communications emergency, every EC, DEC and the SEC should have an HF station monitoring 3.963 MHz or 7.263 MHz (If the EC or DEC or SEC does not have the capability to operate on these HF frequencies, they should make arrangements to use a local station, which has this capability within their county/district/section.)

EC Guidelines

When an emergency exists within a District, or when the DEC or Assistant District Emergency Coordinator (ADEC) begins wide area operations, the following operations guide will be followed by all ECs:

1. Each EC will stay in their county and be ready and available to provide assistance, as requested, by the DEC or ADEC, if the DEC is not available
2. NO EC will leave their county without the express consent of their DEC or the ADEC
3. ECs will be responsible for the following:
    a. When there is an emergency in their county each EC is responsible for:
        i. Determining the extent of the problem and evaluating their manpower needs
        ii. Establish operations based on the guidelines in the District Operating System
        iii. Notify your DEC and/or ADEC of the emergency
        iv. Establish operating schedules and request assistance from your DEC if required
        v. Keep your DEC and the ADEC up to date on the situation in your county
        vi. Keep logs and lists of involved Amateur operators
        vii. When operations are over, be sure all Amateur operators are notified and return home
    b. When notified of an emergency in another county or ARES District:
        i. Be ready to assemble assistance from your county, if requested
        ii. Notify your AECs of the possible need to provide assistance to another area
        iii. Maintain communications with your DEC and/or ADEC
        iv. Notify your DEC and/or the ADEC of any changes in your location or any additional means of communicating with you
        v. Notify the DEC and/or the ADEC of any changes that would affect contacting you including:
            1) Additional or different pager numbers
            2) Cell phone numbers

3) Fax numbers
4) Frequencies being used in your county.

c. When operations in your area are concluded be sure the following are accomplished prior to securing:
   i. Make sure all ARES personnel are accounted for
   ii. Pass along our appreciation to all participants
   iii. Be sure all Amateur operators are notified that operations have concluded
   iv. Collect reports and logs from your AECs and control stations
   v. Make recommendations for certificates
   vi. File a report with your DEC and the ADEC

Logging

ALL STATIONS WILL MAINTAIN COMPLETE LOGS.

All fixed stations operating during an emergency must maintain a complete log of their operations. This log will contain the TIME (local) of each message, the CALLSIGN of the contacted station and MESSAGE CONTENT of the message.

A copy of all FORMAL TRAFFIC will be kept and become part of the log.

Each log sheet will contain the OPERATING CALLSIGN, the location of the station, the call of the operator and be signed by the control operator.

Mobiles should log the STATION CALLED, TIME, and brief CONTENT of each message.
Each log should contain the operator's call sign and date and operator's signature.

ALL LOGS will be kept as a part of the ARES records. If an operator requires copies for his/her own log, copies should be made and the originals remain with the ARES EC

Training and Procedures

An annual test of the District/County ARES should be conducted in conjunction with the National Simulated Emergency Test (SET). This test can be conducted at various levels throughout the section. It is also recommended that local exercises be held as determined to be appropriate and coordinated with district or local agency participation whenever possible. It is recommended that one exercise annually in addition to SET be held to exercise interoperability and cross-jurisdictional response protocols.
As part of the Strategic Plan requirements, the ARRL provides courses for Emergency Communications training and certification. The courses are presented in three levels. The Basic EmComm Course is highly recommended as the basic training standard for new ARES members in Missouri. New ARES members are should complete the Basic EmComm Course training within one year of registration with their local ARES group. Information on Basic EmComm certification can be found at https://www.arrl.org/online-course-catalog. Continued training should include the Intermediate EmComm & Advanced Emcomm Courses Missouri Section leadership officials should complete all three EmComm Courses. Information on Intermediate and Advanced EmComm courses are available at the above link.

In addition, the following courses are part of the Strategic Plan requirements for all ARES members:

FEMA Course #	Description
IS-100c	Introduction to Incident Command System
IS-200c	ICS for Single Resources and Initial Action Incidents
IS-700b	National Incident Management System – An Introduction
IS-800c	National Response Framework, An Introduction

These courses can be found at FEMA Independent Study Program (ISP). They courses are self-study online and free of charge. See http://training.fema.gov/IS/crslist.aspx?all=true for more information,
Additional tests, drills, nets, and training will be carried out as directed by the individual ECs.
These sessions allow tailoring of training requirements to the specific needs of the areas and Served Agencies. Consideration should be given to the needs of adjacent areas for maintaining a high state of readiness for mutual aid support. It is recommended that neighboring districts be invited to participate in any exercises held on a district basis.

Directed Net Operations

Directed nets are the backbone of the ARES traffic handling operation. Directed nets operate with a Net Control Station (NCS) which maintains order on the net. Stations not directly involved with the operation of a directed net should stand by until the net is clear. At no time will a station transmit on a directed net except when called upon by the NCS, when checking in during a non-roll call period or when a station has bona fide emergency or priority traffic.

Most net operations relating to emergencies are “tactical” in nature. They are generally directed nets and messages sent can be qualified as any exchange that does not utilize an established message format or form. The National Traffic System (NTS) message format should be utilized whenever practical. Its use has a long history of reliable and accurate message exchange.

ARES members should become proficient in the ARRL NTS message format and its usage. Also, good operating technique and keeping a log of your operation is of primary importance. Remember, it is the Served Agency’s needs that will determine what will be used in any given situation.

Emergency Nets and Frequency Usage

The following frequencies are utilized within the Section for organized emergency nets. Contact may be attempted on these frequencies in the event that you are cut off from commercial telecommunications. Listen before transmitting! If an emergency net is in progress, do not interrupt! Monitor the frequency and follow the directions of the net control station.

HF

The Missouri Emergency Services Net (MESN) stands up when required for HF Statewide communications when there is an emergency or disaster in the Missouri Section. Monitor the MESN frequencies and check in to help pass traffic around the state.

MESN will also be the coordinating net for county to county or county to region digital data traffic. Normally MESN traffic is of tactical nature and stations needing to pass tactical voice traffic should check into the net and request an alternate frequency if net traffic is busy to pass traffic. When the traffic has been successfully passed, the stations should return to the net frequency and advise net control that the traffic is passed. Longer, detailed traffic such as list of specific requirements, meds, or personnel should be passed by digital data means. MESN net control will assess the current net roster of individuals on the net that are in the area that the traffic needs to be passed. These operators will move to an alternate agreed digital frequency and determine what digital method will be used to pass the peer-to-peer traffic. Upon completion of the digital data traffic, the stations will return to the main net and advise the traffic has been passed. Traffic required to be sent to SEMA must use Winlink messaging using the built in

WebEOC forms for requesting resources and sent to the SEMA email address for traffic.

Frequency	Net Name
3963.0 kHz.	MESN
7263.0 kHz.	MESN (daytime alternate)

Digital Voice Communications

As of this writing, there are numerous digital voice modes. For this reason, analog FM voice is the main method for communicating in an emergency. If a local jurisdiction decides to use digital voice communications, one operating station should still monitor FM voice on the appropriate frequencies described elsewhere is this plan.

The most popular mode is likely DMR. This mode can provide statewide voice communications via repeaters and hotspots that connect to the internet, if available. The statewide ARES talk group on Brandmeister is 31290. Statewide communications should be on this DMR talk group.

Uses for Mo-ARES talk group are:

1. Coordination of ARES response at EC, DEC and SEC levels.
2. Command and control of ARES resources such as personnel and equipment.
3. Liaison communications with other related nets.
4. Coordination during training and drill exercises.
5. Emergency means of overcoming deteriorated band conditions.

Digital Data Communications

Digital data communications are a technique for passing traffic with detailed lists that would be more time consuming and error prone by voice. Digital data is used by local choice and there are recommendations for using digital data for both local, district and statewide communications in the Missouri Section ARES Digital Data Communications Resource Guide and an operational procedure in the Missouri Section ARES Digital Data Net. Please refer to this document for detailed information.

VHF / UHF Repeater Systems

VHF or UHF repeaters serve most communities within the section. This may be a viable means of contacting a desired person or someone who can in turn contact that person for you. ARES members are strongly encouraged to obtain a listing of the available repeaters in their area BEFORE an emergency occurs. An up-to-date list of coordinated repeaters in the Section is available on a website maintained by the Missouri Repeater Council (www.missourirepeater.org).

Some portions of the section are served by linked systems, which allow more widespread coverage. This may allow getting into or out of a metropolitan area to rural communities. Some systems may be susceptible to commercial power interruption and may not function during times of widespread or localized power outage. When power outages occur and repeaters being utilized for emergency communications stop working, it is recommended that the output frequency of the repeater be use in 'simplex' mode along with relay stations to handle all traffic. Once the repeater system is on the air again, the transition back to repeater operation is simple. This method should be practiced whenever possible in order to understand the geographical challenges presented and for training operators in relay operations. It is highly recommended that all repeaters used for ARES operation should be equipped with emergency backup power systems.

VHF / UHF Simplex Frequencies

The Missouri section utilizes a set of predetermined simplex frequencies for "event or scene of action" operations. Use of the simplex mode minimizes exposure to power interruption, but also shortens effective communications range in most cases. A complete listing of frequencies and procedures for utilization can be found in the Missouri ARES Interoperability Document.

Some of the most commonly utilized frequencies section- wide are listed as follows:

Mnemonic	Frequency	TX CTCSS	Primary area of usage
HVCall	146.550	CSQ	Statewide - PRIMARY CALLS
HUCall	446.000	CSQ	Statewide – UHF CALL
HVCall	146.550	CSQ	Statewide – VHF CALL
HMCall	52.550	CSQ	Statewide – 6 M CALL

It is commonly known that ARES serves many agencies. These allocations minimize interference across jurisdictional boundaries in the event that an emergency may exist close to or across jurisdictions.

Missouri Section VHF/UHF Interoperability Plan

Reading this document

Please make note of your questions as you read the document. As you continue reading through some of the examples will make more sense as additional terms/contexts are defined. If terms/concepts are still not clear, please contact the SEC,

Why

Interoperability in this document refers to the ability of ARES groups and individuals involved in a coordinated response to communicate with each other.

In the event of an emergency or exercise, an interoperability plan can address connectivity issues and increase the effectiveness and speed of the response.

The idea is if you have these VHF frequencies in your rig, you will be able to start working as a communicator no matter where you are in the state. This plan is designed to augment your existing structure, not totally replace it. If you have an operational repeater or simplex net, by all means utilize it. However, please continue to monitor HVCall.

The APRS/Packet/DATA frequencies are meant to supplement your existing plan.

Example:

Instead of having one Moniteau ARES op contacting Cole ARES to pass traffic for MARS on one frequency, and another Moniteau op contacting Morgan ARES to pass MESN traffic on a different frequency, one op should go to "HVCall" and contact the Liaison stations for Cole and Morgan. Once they have made contact, they could QSY to "Foxtrot" to pass the traffic, leaving the call frequency clear. If another county had something to pass through either of us, they only have to know one frequency for contact.

Naming

Public Safety (PS) Interoperability frequencies are VTAC # and UTAC #. The ARES/Ham Radio frequencies are prefixed with an H to distinguish them from the PS frequencies. To alleviate confusion, standard mnemonics shall be used in all equipment to refer to individual channels. These are listed in the table below. Should the equipment not be capable of alphanumeric channel mnemonics, the radio should be placarded to indicate the channel mnemonic and its corresponding position on the radio's selector switch.

Naming Guide

- V refers to 2M VHF
- U refers to 70cm UHF
- L refers to 6M 'Low Band' VHF, scene ops
- M refers to 6M 'Mobile Low Band' VHF, wide area/mobile

Frequencies

These frequencies were determined by cross referencing the ARRL band plan with the Missouri Repeater Council band plan.

VHF 'Wide Area' Frequencies

Mnemonic	Frequency	TX CTCSS	Primary ARES District
HVCall	146.550	CSQ	Statewide
HVStage	147.555	100.0	Statewide
HVAPRS	144.990	CSQ	Statewide
HVData	144.910	CSQ	Statewide
HVPacket	144.950	CSQ	Statewide
HVTac0	147.495	100.0	Primary Digital Voice Frequency
HVTac1	145.600	100.0	Alpha
HVTac2	145.650	100.0	Bravo
HVTac3	145.700	100.0	Charlie
HVTac4	146.400	100.0	Delta
HVTac5	146.445	100.0	Echo
HVTac6	146.505	100.0	Foxtrot
HVTac7	146.595	100.0	Golf
HVTac8	147.405	100.0	Hotel
HVTac9	147.450	100.0	India

UHF 'Scene' Frequencies

Mnemonic	Freq	TX CTCSS
HUCall	446.000	CSQ
HUAPRS	446.150	CSQ
HUData	446.200	CSQ
HUTac1	445.900	100.0
HUTac2	445.925	100.0
HUTac3	445.950	100.0
HUTac4	445.975	100.0
HUTac5	446.025	100.0
HUTac6	446.050	100.0
HUTac7	446.075	100.0
HUTac8	446.100	100.0

6M 'Wide Area/Mobile' Frequencies

Mnemonic	Freq	TX CTCSS	Primary ARES District
HMCall	52.550	CSQ	Statewide
HMData	52.790	CSQ	Statewide
HMTac0	52.710	100.0	
HMTac1	52.310	100.0	Alpha
HMTac2	52.350	100.0	Bravo
HMTac3	52.390	100.0	Charlie
HMTac4	52.430	100.0	Delta
HMTac5	52.470	100.0	Echo
HMTac6	52.510	100.0	Foxtrot
HMTac7	52.590	100.0	Golf
HMTac8	52.630	100.0	Hotel
HMTac9	52.670	100.0	India

6M 'Scene' Frequencies

Mnemonic	Freq	TX CTCSS
HLCall	52.450	CSQ
HLTac1	52.530	100.0
HLTac2	52.730	100.0
HLTac3	52.690	100.0

HLTac4	52.650	100.0
HLTac5	52.610	100.0
HLTac6	52.570	100.0
HLTac7	52.750	100.0
HLTac8	52.330	100.0

Portable Repeater Frequencies to be determined. This will require coordination with the Missouri Repeater Council.

Mode for Voice Communications

The standard mode for voice communications is 20K0F3E, which is 5 KHz deviation FM.

Tone/CTCSS

- Calling frequencies - NO PL, NO CTCSS, NO DCS
- Tactical frequencies - PL/CTCSS 100.0
- This Tone was chosen to avoid interference from or interfering with Public Safety entities using 156.7.
- Do NOT use CTCSS unless needed to help manage QRM. ALWAYS transmit PL.

Power Output

- Users are strongly encouraged to increase antenna gain and directionality before increasing power.
- No more power than the minimum needed to establish a near full-quieting circuit.
- Adhere to the FCC regulations requiring the use of the minimum power needed to establish the circuit and RF Safety limits.

VHF - 2M and 6M

- Base Station: 200 watts max
- Mobile Station: 100 watts max
- Field Station: 500 watts max
- Tactical Frequencies used 'On Scene': 5 watts max

UHF

The UHF frequencies are intended for on scene operations and to minimize the possibility of inference with other stations:

- Base Station: 35 watts max
- Mobile Station: 35 watts max
- Field Station: 35 watts max
- Tactical Frequencies used 'On Scene': 5 watts max

Time Out Timers

All stations not operating in mobile relay mode, where permitted, shall employ a time out timer set to limit transmission duration to a period of no greater than 60 seconds (1 minute).

All stations operating in mobile relay mode, where permitted, shall be configured to immediately drop transmit carrier upon cessation of input signal. Reasonable hysteresis time in squelching action of weak received signals, Prolonged "hang time" in excess of 500ms is not permitted.

Priority Levels

1. Emergency or urgent operation involving imminent danger to life or property
2. Disaster or extreme emergency operation for mutual aid and inter-agency communications
3. Special event control, generally of a preplanned nature (including Task Force operations)
4. Joint training evolutions

To resolve contention within the same priority, assuming all radio equipment is exercising the lowest output and effective radiated power level practicable, the channel should go to the organization with the wider span of control/authority. This shall be determined by the SEC/DEC for the operation or by the levels of authority/government identified in the contention.

Use

How could these frequencies be used?

1. Calling

- Pt to Pt contacts, administrative level contacts, NOT tactical comms.
- After contact has been established, change frequency to the primary frequency of the calling party or the frequency directed. The calling party will then initiate the exchange.
- (See example above and Primary Intra-District Comms below)
  - Alert paging and SCADA operations are not permitted on Calling or TAC channels.
  - Temporary base station receivers shall not be muted by either selective calling alert mechanisms or DTMF signaling devices.

2. VHF

- HVCall may be used to INITIATE contacts for:
  - District to District
  - County to County
  - Mobile/Rover to County
  - Incoming Amateur Radio response to IC or Amateur Radio section chief

- HVCall IS THE PRIMARY CALLING CHANNEL OF THIS PLAN. Command/NCS should have someone assigned to monitor this frequency.

- HUCall, HMCall and HLCall are secondary calling channels. Command/NCS may not be monitoring these frequencies.

3. **UHF**

- HUCall similar to HVCall.
- Primarily Intra-County use and on-site tactical use.

4. 6M

- HMCall similar to HVCall HLCall similar to HUCall.
- The 'M' frequencies are for Point to Point and Mobile operations. The 'L' frequencies are intended for on scene tactical operations.

5. Staging

HVStage is used by hams responding in to an area to check in to staging. When Mutual Aid Teams have been requested, this is where they will check in.

6. Primary Intra-District Comms

a. APRS

HVAPRS is used for VHF APRS networks. HUAPRS is used for local UHF APRS networks.

b. Digital Data

- HMData is used for wide area inter-district networks.
- HVData is used for intra-district networks.
- HUData is used for 'scene' data links/networks.

Local area determines protocol.

Refer to the Missouri Section ARES Digital Data Communications Resource Guide for detailed information and recommendations for digital data communications.

c. VHF

HVTac1 - HVTac9 would be primarily for use within the District's Alpha-India for county-to-county traffic. Counties in District A would primarily change frequency to HVTac1 after making contact on the HVCall frequency.

d. UHF

Be aware that in your area HUTac1 - HUTac4 may be used as a repeater link frequency.

HUTac5 - HUTac8 may be in use for digital comms. Determine this ahead of time so you can adjust your response appropriately.

Since the tactical frequencies are intended for use by low power portable stations within a limited geographic area, you should be able to use the same frequency at multiple locations.

e. Suggested use of non-primary HVTac frequencies:

Note: You may also opt to use an existing repeater to support any of these tasks.

Also, keep in mind that spectrum is a shared resource. Do not interfere with any existing operation.

1. Command/Admin Net
    - Frequency for Administrative Net NCS and IC are here
    - Command or Liaison should also monitor HVCall

2. Logistics/Resources

    The person keeping track of Resources and coordinating procurement of material and personnel is here. This person will work closely with Staging. Ideal is to have them co-located. Staging monitors HVStage.

3. Digital Modes

    A non-primary Tac frequency may be used for digital mode communications. This use should supplement HVPacket and HVAPRS. HVTac0 would be the ideal frequency to use first.

    As of this writing, there are numerous digital voice modes. For this reason, analog FM voice is the main method for communicating in an emergency. If a local jurisdiction decides to use digital voice

communications, one operating station should still monitor FM voice on the appropriate frequencies described elsewhere is this plan.

For instance, you have a team that is equipped with DMR gear. They should be assigned to operate on HVTac0. The team leader is also monitoring/checked in to the Command/Admin net.

The most popular mode is likely DMR. This mode can provide statewide voice communications via repeaters and hotspots that connect to the internet, if available. The statewide Missouri Section ARES talk group on Brandmeister is 31290. Statewide communications should be on this DMR talk group.

Uses for Missouri Section ARES talk group are:

- Coordination of ARES response at EC, DEC and SEC levels.
- Command and control of ARES resources such as personnel and equipment.
- Liaison communications with other related nets.
- Coordination during training and drill exercises.
- Emergency means of overcoming deteriorated band conditions.

4. Tactical Frequencies

Intended for low power portables that have been assigned a specific task. For instance, comms may be needed within a shelter location. The shelter command should be monitoring and checked in to the Admin Net.

Shelter command should:

- Determine if a Tactical frequency is needed
- Determine a clear Tactical frequency.
- Advise NCS of the local use of the Tac frequency, by name.
- Continue monitoring their Tactical frequency.
- Continue monitoring their NCS assigned Net frequency.
- Advise NCS when the operation on the Tactical frequency has terminated.

Security

No security is implied. Systems may be readily monitored. Participants should recognize that the third man is always listening. Messages should be brief, to the point, and contain no more information than necessary.

Distribution

You are encouraged to distribute this document to all ARES/RACES stations so that they are familiar with the plan and have their radios pre-programmed in the event of activation.

Interoperability with Public Safety

An ARES/RACES Incident Commander or their designee may use the interoperability frequencies designated by the SIEC through the authority of their Served Agency. In addition to following the requirements of the SIEC MOU, the ARES/RACES station should also follow their Served Agency's guidelines. The guidelines should be established with an MOU between the ARES/RACES team and the Served Agency.

Equipment used on these frequencies should be Part 90 type accepted.

Missouri Section Digital Data Communications Resource Guide

Purpose

The intention of this document is to provide guidelines and suggestions for amateur radio operators, in the use of digital data communications when providing emergency communications for the State of Missouri Emergency Management Agency (SEMA), American Red Cross, Salvation Army, National Weather Service, and other public service and disaster relief organizations.

Objectives

To promote the use of advanced digital data technologies, techniques, strategies and best practices in support of agencies and organizations served by Missouri ARES

To document standard hardware and software commonly available to amateur radio operators

To create a list of digital modes and protocols deemed effective in emergency amateur radio communications consistent with the requirements of served agencies.

To encourage use of this document as a tool for development and establishment of Section-wide interoperability through ARES partnerships and links

To update this document to reflect future technological innovations in amateur radio.

Concept of Operations

Served agencies and event organizers typically require that a significant amount of data be compiled and transferred between agencies, reporting points along a route, or temporary facilities. The effective and rapid transfer by radio of detailed lists and forms is best handled by digital data communications.

The digital data modes and techniques described in this document are intended to assist ARES responders in selecting and implementing the most effective and reliable communications modes and networks to fit the situation. In addition, interoperability is required for a local operation to effectively communicate regionally or nationally. The informed choice of an interoperable network and digital data mode will, in large measure, determine the success or failure of the desired outcomes.

Digital Net coordination with the MESN voice net

The Missouri Emergency Services Net (MESN) stands up when required for HF statewide communications. It is anticipated that initial communications with the impacted area will be conducted by voice. Longer, detailed traffic such as a list of specific requirements, meds, or personnel should be passed by digital data means. Although the MESN directed voice net normally handles voice traffic it is well positioned and suitable for coordinating digital net messaging around the state. MESN will also be the coordinating net for county to county or county to region digital data traffic.

Procedure

Digital operators should check into the MESN net and continuously monitor the MESN net frequencies of 3963.0 kHz or 7263.0 kHz (daytime alternate) in the event MESN NCS requests digital messaging. Voice operators can simply request digital messaging support through MESN. MESN can then contact digital operators monitoring the MESN net. Digital nets operating independently of MESN should have at least one operator continuously monitoring MESN for digital messaging requests or have an alternate means of receiving MESN requests for digital assets.

Note: Traffic required to be sent to SEMA must use Winlink, using the built in ICS or WebEOC forms sent to the SEMA email address. See https://ares-mo.org/wp-content/uploads/2021/03/SEMA-Radio-Room-Contact-Information_2021.pdf SEMA email addresses.

Digital Data Modes, Hardware and Software

A general agreement throughout Missouri Section ARES regarding the standardization of digital EmComm modes is needed to prevent the potential collapse of intended interoperability. Because no single mode or combination of modes can satisfy all requirements in every situation, it becomes incumbent upon ARES leadership and responders to develop and utilize the best digital tools for the radio and administrative environments in which they operate.

The modes described below have been shown to be effective for ARES EmComm use and *are* currently in use by various EmComm practitioners and served agencies throughout Missouri. The list below reflects preference given to programs and modes offering keyboard to keyboard communications, file attachments, embedded ICS forms and special forms created specifically for governmental and non-governmental (NGO) use. An advantage of using digital modes is the ability to print messages or to cut and paste the text into a document that can be provided to the served agency for immediate action, archive or attachment to official documents.

The accuracy of message content is obviously important and some of the digital modes offer error correction (ARQ). The use of error correction increases accuracy

but may result in inordinate amounts of time consumed in retransmissions during adverse band conditions. Under these conditions the ARES operator may have to decide if enough message content can be received without invoking ARQ protocols.

The digital modes covered in this document are provided for guidance only. It is not the intention to endorse any given mode, hardware or software but rather to provide a list of those modes and operational procedures that have proven effective over time.

A. **Packet**

Packet radio can be used to establish direct simplex or digipeater-assisted data communications links between served agencies.

Packet offers peer-to-peer keyboard-to-keyboard chat and the use of 'mailboxes' embedded in the Terminal Node Controller (TNC) to leave messages for retrieval. Packet transmissions are seen as plain text by all Packet stations on the frequency which can be useful for 'broadcast' style bulletins or messages to multiple sites but might not be a desired feature for certain kinds of transmission.

Typical EmComm applications include simplex or digipeater links between state and local EOCs, NGOs such as American Red Cross and Salvation Army, community shelters, hospitals, ARES leadership for command and control, and other fixed post assignments. Packet is one of the modes that may also be used to access the Winlink system. However, terminal emulation programs such as *HyperTerminal* and *Tera Term* cannot be used to successfully 'complete' a Winlink transaction.

Software:

HyperTerminal and *Tera Term* are among rudimentary computer programs used with Packet. Past versions of *HyperTerminal* work fine and were free but current versions require a purchase. *Tera Term* is freeware. A number of advanced multi-mode software programs such as *HamScope and Outpost Package Message Manager* and PuTTY are available as freeware on the Internet. In addition, some manufacturers provide software for use with their hardware TNC.

Software TNC programs are also available for packet applications relieving the user from buying a hardware TNC. Two such programs are DireWolf, and UZ7HO. These programs use sound card applications to emulate hardware TNCs.

Hardware:

An external Terminal Node Controller (TNC) is required between the computer and the radio unless the radio has a built in TNC. Typical TNC manufacturers are Kantronics, Timewave and MFJ Enterprises. Individual configurations of Packet setups are beyond the scope of this document.

Operational tips:

Packet may be used on VHF, UHF or HF. VHF and UHF installations are much more common and generally provide more reliable links than HF. VHF/UHF packet RF transmissions typically occur at 1200 baud which is generally adequate for text messages. HF packet can be used successfully but is subject to all the normal issues associated with operation on the HF bands such as noise, fading, and interfering signals, even at a very slow 300 baud rate.[1]

New conventional TNCs are not extremely expensive and used TNC's can often be found at hamfests and swapmeets at very affordable prices.

[1]S. Ford, ARRL VHF Digital Handbook, First Edition, p 1-7

B. FSQCall

FSQCall, (FSQ), is a digital mode specifically designed for public service and disaster Near Vertical Incidence Skywave (NVIS) communications on HF. Unlike other ubiquitous digital modes, FSQ has features that are unique and especially useful for EmComm applications. A short list of features relevant and useful for EmComm include:

- Send an alert to a specific station
- Read a station's pre-defined message
- Find a station's location
- Send a message to just one station
- Send a message to all stations within range
- Read a station's recently heard list
- Poll a station to check reception
- Periodically sound (ID)
- Initiate automatic relays through other station(s) to reach stations which are otherwise unable to establish contact or to maintain contact.
- Adjustable transmit data rate to compensate for unfavorable band conditions

Applications to EmComm:

Good for emergency operations centers, hospitals and similar venues, or for temporary fixed sites such as shelters.

Software:

FSQCall V0.24.6 http://www.qsl.net/zl1bpu/MFSK/FSQweb.htm. A compatible version of FSQCall is available within the Fldigi software suite. The current version of Fldigi with FSQ embedded may be found at http://www.w1hkj.com/

Hardware:

Need a soundcard such as a SignaLink USB or RIGblaster with proper cabling to radio.

Operational tips:

Since FSQ messaging is open text the information passed on the air serves to inform all users on specific local, regional and statewide activity during disasters and exercises. Information transmitted between venues may be used to provide situational awareness to local emergency managers. FSQ may also be used to provide messaging between emergency management venues and other supported agencies.

FSQCall and fldigi/flmsg/flamp can run concurrently on the same frequency. FSQ station-to- station keyboard chat is assigned to 1500Hz on the waterfall. Flmsg NBEMS traffic and Flamp traffic is assigned to 700Hz on the waterfall.

Additional details regarding FSQCall and the Fldigi FSQ mode may be found at the following websites:
https://ares-mo.org/plans/
https://www.whitemesa.net/fsqcal/doc/FSQCAL_024_6_US/CALLhelp.htm

C. Winlink Express

Winlink Express is a radio e-mail client program with worldwide connectivity. Winlink provides amateurs with the means to send and receive error free emails, photos, ICS forms, customized forms via radio or the internet and SMS messages to smart phones(1). Senders and recipients need not be connected to Winlink servers simultaneously to move traffic.

Users may send messages and attachments to any amateur call sign registered with Winlink and to any regular email account. *TIP: Email accounts attempting to contact a Winlink account holder will be rejected unless a message has been sent to that email account via Winlink from the Winlink account holder first, or the first-time sender knows to put "//WL2K" in the subject line of the email.*

Applications to EmComm:
In the absence of local internet or cell service ARES operators can use Winlink to establish radio email and messaging services in support of served agencies. ARES

operators can use HF, VHF or UHF radios to connect to Winlink Radio Message Server (RMS) stations located domestically and around the world. For regional operations, amateurs using a regional RMS can conduct strategic and tactical communications through that hub without the need for internet. Likewise, Winlink's peer-to-peer feature provides direct communications between two stations within range of one another or, if using Packet, through a digipeater. A high-speed VARA mode session on Winlink is one of the fastest traffic throughput modes available using sound card modes.

Winlink maintains an internal library of HTML fillable templates (forms) such as ICS forms, ARRL Radiograms, and various public safety and non-governmental (NGO) forms. These ready-made templates (forms) increase efficiency in served agency messaging.

Software:

Winlink client software, which includes the various sound card and hardware modes, is free and is available from https://downloads.winlink.org/User%20Programs/. Download and install the current version of Winlink Express.

The Winlink client software is used in conjunction with the free VOACAP (ITSHFBC) propagation prediction software which can be downloaded separately from http://www.greg-hand.com/versions/.
Alternatively, the Winlink program will download and install the VOACAP program for you when you access the RMS channel list if it has not been previously installed on your hard drive or can't be found on your computer by Winlink. The VOACAP program runs seamlessly in the background to provide reasonably accurate estimates of probable connectivity to listed RMS stations in real time. The latest propagation predictions may be downloaded via internet or radio within the Winlink program.

Embedded Winlink modes include Packet, Pactor, ARDOP, VARA, VARA FM, Telnet and others. The modulation scheme of each mode largely determines whether a sound card interface or a hardware modem is required for operation.

VARA mode requires the VARA software program to work with Winlink, available for download from Winlink.org at downloads.winlink.org - /VARA Products/. VARA (freeware) and the fee-based higher speed version are available at https://rosmodem.wordpress.com/.

The RMS Express software suite can be run in Linux under the Wine MS Windows emulation software (details at https://www.winlink.org/sites/default/files/downloads/installing_rms_express_on_linux_with_wine.docx_.pdf). An additional software option for Linux operators is a program called "PAT Winlink" (available from http://getpat.io) along with the "ardopc"

modem software (available from
http://www.cantab.net/users/john.wiseman/Documents/ARDOPC.html).

Hardware:

Winlink sound card modes currently include ARDOP and VARA and VARA FM. WINMOR has been discontinued. Packet operation requires a hardware TNC, virtual TNC or TNC-equipped radio. Pactor will require a proprietary SCS brand modem such as the PTC III, DR-7400 and DR-7800 models;
https://www.p4dragon.com/en/Home.html

Operational tips:

Packet mode is a popular method of using Winlink on the VHF/UHF bands. The use of digipeaters extends the range from which connection to an RMS can be made. Fixed or portable digipeaters can be employed to overcome terrain impediments.

Winlink also offers peer-to-peer (P2P) and 'radio only' messaging modes for direct communications without the use of the Internet.

- Peer-to-Peer (P2P): direct connection between two stations without the use of internet
- Radio-Only - This mode relies solely on radio to connect to a radio Message Pickup Station (MPS) where messages to and from your station are stored and forwarded. Radio-only mode requires each participating station to have previously assigned two or three MPS stations where their messages are stored to be forwarded or retrieved. Reliable connectivity to the chosen MPS stations should be determined before assigning them. Messages sent to recipients not using the same MPS are routed over the Winlink system via radio to the intended recipient's MPS. This may take minutes or days depending on HF propagation.

Telnet mode allows the user to connect directly to Winlink over the internet. No radio is used. Telnet is obviously the fastest method of connecting to Winlink and, if internet is available, negates the need for
a radio link. Information transferred via Telnet could be then be forwarded to served agencies by radio or other means as necessary.

The Winlink client software is used by federal, state and local governmental agencies on non-amateur frequencies for virtually the same reasons used by ARES members on the amateur bands. Therefore, ARES members embedded with these agencies should become familiar with the many features offered by this program, including the use of SCS Pactor III and Pactor IV modems.

There are many possible Winlink setups, such as the use of tactical call sign addresses, and networking configurations that would add value to EmComm operations but are beyond the scope of this document.

Winlink Express can also send short text messages using the wireless carrier's domain format. Direct replies from a text back to a Winlink account may not be possible. The following link provides carrier format information: https://www.digitaltrends.com/mobile/how-to-send-a-text-from-your-email-account/

D. Fldigi

The Fldigi program is a component of the Narrow Band Emergency Messaging System (NBEMS). Fldigi offers a variety of sound card modes such as CW, RTTY, PSK, Olivia, MT63, FSQ and many more. Text files, CSV files, ICS forms and custom forms such as the Missouri WebEOC Resource Request Form for ham radio created by W0KAH can be sent and received when Fldigi is coupled with the Flmsg program. Fldigi can be used with SSB or FM radios on HF/VHF/UHF bands.

Applications to Emcomm**:**

Fldigi is ideally suited for Emcomm because of its low investment in hardware and software, its ease of use and its widespread use among amateur radio operators. The program suite is well suited to send detailed lists and critical information such as lists of evacuees, road conditions, sit-reps of impact areas, .csv spreadsheets of inventories and other administrative communications using its built-in forms, imported custom forms or plain text forms. Keyboard-to-keyboard chat provides for quick messaging.

Software:

Fldigi software and additional software programs such as Flrig, Flmsg, and Flamp are free and can be downloaded at www.w1hkj.com and at https://sourceforge.net/projects/fldigi/ Versions are available for Windows, LINUX and MacOS operating systems.

Flrig: Though not required, Flrig can be used to control the transceiver and is available as a free download at www.w1hkj.com and https://sourceforge.net/projects/fldigi/

Flamp (Amateur Multicast Protocol): Enables the Fldigi user to send multiple files from a queue to many recipients simultaneously. The files are sent in blocks and any missing blocks are reported by the receiving stations back to the sender. The sender can then resend only the missing blocks.

Flmsg (Fast Light Message): Flmsg is a messaging and forms manager with embedded, updateable NBEMS forms templates. Flmsg can be used in standard or ARQ modes. Flmsg in standard and ARQ modes can be used to leave messages with unattended stations that are on the air and running the program.

Flmsg in ARQ mode: Emphasis is placed on the ARQ in its name (automatic repeat request). Flmsg in ARQ mode is used with Fldigi to send error-free messages. As mentioned in the introductory paragraphs, the use of error correction increases accuracy but may result in inordinate amounts of time consumed in retransmissions during adverse band conditions. When used in ARQ mode, data integrity is 100% for all messages successfully sent, so is appropriate for sending critical data.

Develop a set of Fldigi macros to increase efficiency of standard transmissions such as log-ins

Hardware:

Fldigi uses the sound card in your PC or an external sound card such as a SignaLink, RIGblaster or other USB audio interfaces (including built-in audio interfaces in newer radios).

Operating Tips:

Some modes available in FLDIGI are more robust than others. Experience throughout the Emcomm community has shown that FSQ, MT-63, Olivia and MFSK16 are among the modes well suited for ARES operations.

Recommendations for various band conditions:

- Thor22 or MFSK32 in good conditions
- Thor16, Thor 11 or MFSK16 for average conditions
- Thor 8, MFSK 11 or MFSK 8 for poor conditions
- For extremely good conditions, with no QSB or static crashes, the PSKR and 8PSK modems work well, and are very fast.

Recommended procedure to implement Flarq with Flmsg:

1) Fldigi – TxID/RxID enabled, 700 Hz on the waterfall (if simultaneously using 1500 Hz for FSQ chat). *Note: Open Fldigi prior to opening Flms*

2) Open Flmsg. If the Simple User Interface appears with only File and Tools tabs, select Tools-Expert Dialog. The Expert User Interface now appears. Then select Config-User Interface-UI tab-and check 'expert' box. The Expert User Interface will now automatically appear when opening Flmsg.

3) Flmsg – Select desired form and compose message, save as file (Ex: NBEMS-ICS-MESSAGES)

4) Flmsg – Hit *'Autosend'* at top of form to transmit the message without engaging ARQ (only recommended for non-critical messaging – use Flmsg in ARQ mode for critical messaging).

5) Flmsg in ARQ mode - Select mode of choice at bottom of form, enter call sign of recipient station in box at bottom of form to right of ARQ, depress '*Send*' button – Disconnects from other station after transmission is complete or ARQ fails after the number of tries set up in Flmsg ARQ settings.

The following is recommended regarding the reduction of transmitter output: The radio itself should be set to 100% output power in its internal menus, then the audio drive from the PC/audio-interface should be set so that no more than 25% of maximum output power is obtained (e.g., drive the audio on a 100W radio to 25W or less). This ensures that the ALC won't become active, and avoids clipping the audio and the generation of spurious sidebands.

Recommended configurations for Fldigi, Flmsg and Flarq and setting up multiple instances of Fldigi can be found at http://rollanet.org/~counsil/modes/ then choose: MO_FSQcall_Traffic_Procedure_v10.pdf. Although this document is FSQ-centric there is a wealth of Fldigi general setup and operational details to assist users.

E. APRS - Automatic Packet Reporting System

APRS is a digital communications protocol for exchanging information among numerous stations covering a large (local) area. Data can include object Global Positioning System (GPS) coordinates, weather station telemetry, text messages, announcements, queries, and other telemetry. All this APRS data can be displayed on a map to provide emergency management staff with status updates at a glance.

Application to EmComm:

Whereas, WB4APR envisioned the APRS system as a "Packet Reporting" system, it has become the "Position Reporting" system for most hams. When equipped with a GPS receiver the APRS mobile station will report its position to the APRS listeners (including a network of digipeaters) where these positions can be displayed on a computer map in real time. The EOC, equipped with such a station can be aware of the locations of all the radio operators in the field as they move and take up new positions. Additionally, short text messages can be sent to specified stations via the APRS network.

Software:

Mapping software displays the locations of the received APRS stations on the computer monitor. Map databases have been issues in the past. Today the software PinPoint, receives data from the TNC and shows its location on a map with good variable displays. It will also provide digipeating, and I-Gating if desired, as well as produce APRS packets to broadcast the fixed location of the mapping station. This software could be deployed on a laptop computer with APRS radio equipment to give the mobile user a map display in the vehicle to aid in finding others in a

deployment. There are also some Smart-Phone apps which will send and receive location information to APRS.fi as if it were an APRS radio station.

PinPoint software is freeware and can be downloaded at
http://pinpointaprs.com/download.html

Hardware:

The APRS infrastructure comprises a variety of Terminal Node Controller (TNC) equipment put in place by individual amateur radio operators. This includes sound cards interfacing a radio to a computer (software TNC), simple TNCs, and "smart" TNCs. The "smart" TNCs can determine what has already happened with the packet and can prevent redundant packet repeating within the network. Some VHF radios come with internal TNCs and APRS software to decode the APRS packets as they are received and display the basic data in those streams on the radio display.

Some amateur radio clubs have built stand-alone APRS Trackers which consist of a 2M handheld radio, GPS receiver “puck,” Gel-Cell battery, mag-mount antenna and APRS controller from Byonics, http://www.byonics.com/aprs, all installed in a weather proof case for rapid deployment. These trackers can be placed on any vehicle to have its location shown on the APRS computer maps.

Operational Tips:

The standardized operating frequency for APRS in the US is 144.390 MHz FM. A mobile station should not expect to be in an APRS network when out-of-range from an APRS digipeater and APRS-IS gate. Parameters for setting up a good working APRS station are beyond the scope of this document. Good references can be found at www.aprs.org, and locally, in the St Louis Digital Operations manual at http://www.stlares.org/Docs/STLMETRO-Digital-Operations-Manual_v1_2.pdf.

A local Amateur Radio community should deploy an APRS digipeater to increase the coverage of the mobile APRS stations, much as a voice repeater increases the coverage for mobile radio usage. But too many local digipeaters will ruin the network as they may all try to digi the same signals and clog up the frequency so that no packets get through. For state wide coverage, digipeaters should be deployed every 40 miles, depending on the Height Above Average Terrain (HAAT). Portable digipeaters can be deployed into an area of poor APRS coverage to aid in temporary support of an event or disaster.

If internet is available at the digipeater site an APRS I-Gate station should be deployed. This will allow real time data from local APRS stations to be placed on the internet data base known as APRS.fi. Anyone can access the APRS.fi web server and discover the location of an APRS station.

F. AREDN - Mesh networks

AREDN (Amateur Radio Emergency Data Network) was an outgrowth of the ARRL working group on High-Speed Multimedia (HSMM). It has evolved over the past 10-12 years from its first implementation by Broadband Hamnet (BBHN).

Some refer to MESH application as Ham Wi-Fi. Ham radio operators have taken reasonably priced commercial grade Wi-Fi access points (AP) and, by replacing the manufacturer's firmware with AREDN, have created a ham radio asset. Now, hams can implement high-speed (up to 144 Mbps) data networks in support of Emergency Operations Centers (EOCs), non-governmental agencies (NGOs) and first responders. These networks are generally confined to an operating area of a few miles-depending on terrain, the height and style of antennas and the number of nodes. The MESH concept allows the growth of the network by adding more nodes which provide a greater coverage area or a more densely covered area.

EmComm Applications:

Areas that have no internet or phone service are prime candidates for installation of an AREDN network and its many applications. AREDN networks can bring email, document and file sharing, VoIP phone service and many other applications to the service-deprived area. Hospitals are examples of institutions that can benefit from such networks, providing a means for doctors and administrators to coordinate medical services.

Other valuable applications for EmComm mesh networks include APRS and, especially, the remote control of radios. Ostensibly any program capable of operating peer-to-peer over TCP/IP networks could be used with this network.

Software:

AREDN firmware will need to be installed on the individual access points that are to be used. Firmware images for specific brands of APs can be downloaded from https://www.arednmesh.org. AREDN supports more than 70 devices at this time.

The AREDN software replaces the firmware in the Wi-Fi access point turning it into an amateur radio operating on amateur radio allocations in the 2.4 GHz, 3 GHz and 5.8 GHz bands. Bringing up at least two access points will establish a network. Then the introduction of additional nodes, properly configured, will assimilate into the network seamlessly and will be identified by their MAC address.

Hardware:

Hardware platforms must be compatible with the AREDN firmware. As mentioned above, AREDN currently supports approximately 70 devices including those manufactured by TP-LINK, MIkrotik and Ubiquiti Networks. A list of supported

devices can be found at https://www.arednmesh.org/content/supported-platform-matrix/

Microwave frequencies are line-of-sight. Therefore, backbone configurations may require directional antennas to establish reliable links with an acceptable fade margin. It is recommended that network users not co-located with a node should use omni-directional antennas where practicable.

The omnidirectional pattern may increase the probability of connecting to an alternate node in case of trouble.

Connections to access points may be wired or wireless; wired is often believed to be more reliable and less susceptible to interference. Wireless connectivity to access points on the amateur radio frequencies is common but may require directional antennas to overcome path loss or to null out interfering signals in some cases.

Operational Tips:

Hardwired connections with CAT 5 or CAT 6 cable between computers and the AP are preferred. Wireless connections are possible but are vulnerable to in-band interference and may need to add a frequency conversion device to access the amateur radio portion of the band in use.

Large files, image captures and video recordings should be avoided because of possible major performance degradation on the network.

Channel planning will be required in order to establish reliable RF links. The AREDN website https://www.arednmesh.org provides the following frequency information (and more):

- 2.397-2.437 GHz, Channels (-) 2 thru (+) 6. All channels shared except 2.397 (Chan (-) 2) and 2.402 (Chan (-) 1). Channel 0 (zero) not available for use.
- 3.380-3.495 GHz, Channels 76-99, non-shared
- 5.665-5.895 GHz, Channels 133-179, Shared with unlicensed users, WIFI

Geographical coverage areas of 5 to 10 miles may be possible in urban terrain.

An excellent tutorial on AREDN including How-to guides is available at: https://arednmesh.readthedocs.io/en/stable/arednGettingStarted/aredn_overview.html

G. Pactor

Pactor is proprietary to SCS, the German company that created today's Pactor protocols and manufactures high-end Pactor modems. According to the SCS website, Pactor is one of the fastest and most accurate HF digital modes available due, in part, to its data compression techniques: https://www1.scs-ptc.com/pactor.html. Pactor also features *'memory'* ARQ to help in the reconstruction of an original packet. On January 8, 2024 the FCC authorized use of Pactor IV on the ham bands, significantly increasing the baud rate approximately two times faster than Pactor III.

Applications to EmComm:

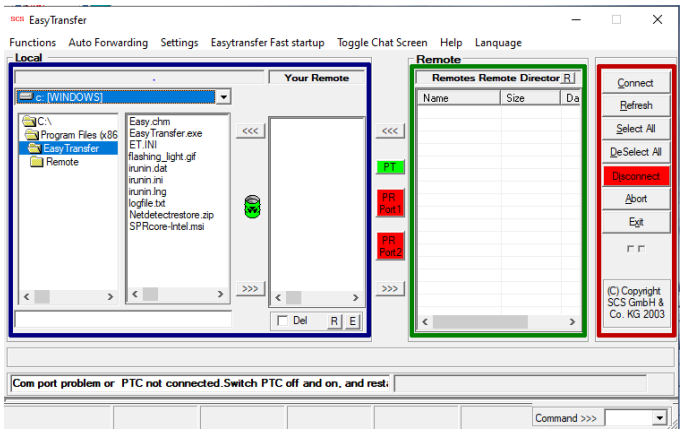
Pactor brings an advanced high-level protocol to the EmComm community which works very well in deteriorated band conditions. Thus, a higher expectation of successful data transfer is warranted when compared to other digital protocols on the HF bands. Moreover, the Pactor mode is fully compatible with Winlink Express.

A drop-down menu in Winlink Express provides for Pactor Winlink, Pactor peer-to-peer, and Pactor Radio-only modes. Conventional text messages, ICS forms and custom forms can be transported via Pactor on the Winlink system.

Software:

The SCS *Easy Transfer* user interface program provides for direct communications between two Pactor stations within range of one another; in a robust radio-only peer-to-peer configuration. The internet is not used. The manner in which *Easy Transfer* transfers files between the two connected modems and computers is unique and easy, as the name implies. Each operator can drag and drop files from their hard drive for immediate transfer to the other station. The SCS website https://www1.scs-ptc.com/software.html explains it this way:

"The left side of the user interface shows the content of the local hard drive, the right side shows the content of the remote directory of the distant station. Files can easily be moved between the two sides using standard drag-and-drop actions. In addition to the file transfer, EasyTransfer has a chat mode to exchange hand typed messages".



Another feature of the program, called Autoforward, provides for the unattended transfer of files. *Easy Transfer* cannot be used to connect to Winlink Express because the script will not execute correctly.

The *Easy Transfer* user interface program, manuals and firmware upgrades can be downloaded from the SCS website https://www1.scs-ptc.com/software.html

Simple32 Gold Special Edition is the program for amateur radio use with SCS Pactor modems. You must have an SCS modem to use this program. A free 'demo' version is available and is strongly recommended before purchase of the program and license at $49.95.

Hardware:

A computer with keyboard and mouse, an SCS Pactor modem, an HF radio and appropriate antenna are all that is needed for Pactor operation. Current SCS Pactor modems offer USB interface to computers. Cables from the Pactor modem to the radio can be ordered for a number of radio models or can be homebrewed from the schematics in the user manual. New Pactor modems cost approximately $1250-$2150 depending on the model.

The FCC authorizes the Pactor III protocol for use on the US amateur bands. Pactor level III upgrades are available for current PTC modems with a software upgrade. The Pactor IV protocol is not authorized for use on U.S. amateur bands as of this writing and is primarily used by federal, state and local agencies on governmental frequencies. The Pactor IV modems have built-in fallback when detecting the earlier Pactor I-II-III protocols and can thus be used on the amateur bands. Pactor I and II are not considered suitable for serious use today due primarily to comparatively slow speeds.

The SCS DR-7800 Pactor IV modem equipped with the optional Ethernet card can be configured for use on local or remote LANs. The LAN option can be a "plus" for

multi-operator stations and remote-control operations. The #2365 Ethernet/Linux Ethernet 'network' option for the DR-7800 is sold separately for approximately $225.

Operational tips:

An example of a remote-control configuration is that used by the Missouri State Emergency Management Agency (SEMA). SEMA operates their DR-7800 Pactor IV modem/ Winlink Express remotely via LAN at their tower site with a DSL link. A Virtual Serial Port is used to steer Winlink Express to the Pactor modem. This configuration demonstrates how amateur radio operators can set up their own remote-control networks.

As mentioned earlier, legacy Pactor I and II protocols are seldom used today due to the slower speeds involved. Pactor II provides a maximum of 1200 Bits/sec. Pactor III runs at 5200 Bits/sec. Pactor IV modems offer transfer rates of 1.5 to 3.5 times faster than Pactor III. Focusing on amateur radio, comparisons between Pactor III and the VARA sound card mode were conducted by Anthony Bombardiere, K2MO on the 40 and 80 meter bands. The tests indicated that VARA could produce greater transfer speeds than Pactor III under ideal band conditions. However, Pactor III eventually became faster under deteriorating band conditions. The tests were conducted using a Winlink session. This comparison was posted by K2MO on May 27, 2018 at:
https://digitalradio.groups.io/g/main/topic/vara_vs_pactor_iii_speed/20347199?p=,,,20,0,0,0::recentpostdate%2Fsticky,,,20,2,0,20347199

H. BPQ32

BPQ32 is a versatile suite of programs for radio networking. It runs under Microsoft Windows as BPQ32 or as LinBPQ under Linux. It allows a computer to act as a node in an AX.25 NET/ROM network, with serial interfaces to TNC's supporting KISS, JKISS, multi-drop BPQKISS and NET/ROM interfaces. It also supports internet connections via AX/IP/UDP as well as interfacing with AGWPE via a BPQtoAGW DLL. This latter capability allows BPQ32 to provide AX.25 NET/ROM services via devices connected to AGWPE, most significantly sound card modems. It also supports data-over-radio protocols other than AX.25 packet, including a driver for the WINMOR Virtual TNC, Pactor, V4, Telnet and others. The program can be configured many ways for many applications, including as an RMS gateway in the Winlink system, or as a client for communicating with RMS gateways, and more.
*https://www.winlink.org/BPQ32

Application To EmComm:

BPQ32 supports RMS, CMS, Packet and a variety of other digital protocols and can therefore operate on VHF, UHF and HF. The BBS/Node and multi-user, multi-mode features provide capability for rapid through-put of emergency message traffic.

Currently there are only four BPQ32 Nodes in Missouri located in ARES Districts H (one node) and C (three nodes).

Software:

BPQ32 software is available for either a Windows or Linux environment. The Linux version is finding popularity among Raspberry Pi computer users, for low-cost, low-power implementations. BPQ32 is a product of John Wiseman G8BPQ/GM8BPQ. BPQ32 or LinBPQ are not in the public domain. However,
they may be freely used by licensed radio amateurs in amateur radio applications. Software releases are available in the files section of the
www.cantab.net/users/john.wiseman/Documents/index.html

The main AX.25 interface to radios is via KISS mode TNCs connected to standard RS232 com ports. Other AX.25 interfaces provided are shown below:

AX25 Interfaces	Non-AX25 Radio Interfaces.
BPQtoAGW	AEAPactor
BPQAXIP	ARDOP
BPQETHER	FLDigi
BPQVKISS	HALDriver
SCS Tracker	KAM Pactor
UZ7HO Sound Modem	MultiPSK
	SCS Pactor
	Serial TNC
	Telnet
	V4
	VARA

The software includes an APRS compatible Digipeater and an interface to APRS/IS. A mapping and messaging application is available for use in conjunction with these interfaces.
* *www.cantab.net/users/john.wiseman/Documents/BPQ32.html*

Hardware:

BPQ32 requires only a computer running under Microsoft Windows® or Linux to act as a Node in a NET/ROM compatible AX25 network, and to support a multiuser Mailbox, or other similar applications. The switch section of the code allows up to 32 comm ports, supporting a number of radio protocols and the application interface supports up to 64 connections.
*www.cantab.net/users/john.wiseman/Documents/BPQ32.html

Operational Tips:

Configuration of the BPQ32 server software is generally not recommended for the casual radio email user. However, there are numerous websites and user groups dedicated to assisting new System Operators. Several offer free configuration files, which are easily modified, to help with setting up the BPQ32 software and its various components. Most radio email clients (Hams) connect to the BPQ32 servers with Winlink Express using the same software settings they use for the Winlink.org system.

It has been suggested that a statewide BPQ32 network could be established to become a pseudo-private platform for Missouri DECs and/or ECs to communicate (thereby establishing a statewide interoperability path). For example, if one BPQ32 station were installed in each district it would create the foundation of an inter-operative digital network that would serve the county, district and statewide ARES EmComm requirements.

Assistance in using BPQ32 can be found at these websites and others:
www.cantab.net/users/john.wiseman/Documents/BPQ32.html
https://nts-digital.net/mw/index.php/BPQ32_Hub_Operators
https://www.wh6fqe.com/bpq32-config
https://www.cantab.net/users/john.wiseman/Documents/Using%20WINMOR.htm

Note: URL's in italic preceded by an asterisk (*) indicate the material cited above them was copied, derived or adapted from that website.

I. JS8Call

JS8Call is a weak-signal mode with keyboard-to-keyboard messaging, store-and-forward messaging, and automatic station announcements. The JS8Call program uses a sound-card interface; making it an immediate hardware transition for stations already running sound-card based digital programs such as Fldigi, Digipan and others.
The features offered by JS8Call can be applied to a variety of scenarios facing ARES responders.

Specific applications to Emcomm:

JS8Call would be a good alternative for net control and coordination across a wide area, then moving formal traffic off frequency. This mode has the ability to forward messages to stations which are difficult to reach directly, to store messages at an unattended destination station, and to store third-party messages at intermediate stations. The "network" of JS8Call stations can be queried for the presence of stations, and for the presence of messages stored for a querying station.

Because JS8Call operates over the whole of the audio passband at a selected radio dial frequency it is possible for multiple simultaneous conversations to occur at the same dial frequency. This can be used to the advantage of a net control station to query the network (e.g., by sending a "Heartbeat" signal) and all stations in the audio passband who are enabled for automatic operation and in the passband will respond simultaneously on different frequencies, thus generating an instantaneous net station list. In addition, multiple traffic messages, if sent via JS8Call in the passband, can be monitored by Net Control. This multiple-frequency simultaneous operation is a significant advantage over other similar modes such as FSQCall, which is limited to a single frequency of 1500 Hz in the passband.

Software:

The software is called "JS8Call," is free and is available for all prominent operating-systems (Microsoft Windows, Linux, and MacOS). The source code is freely-available open-source. JS8Call is available at http://js8call.com .

Hardware:

Any computer-radio interfaced system for running any of the generally-accepted data modes, such as PSK31, in Upper Side Band can be used to run JS8Call. Hence the minimum requirements are for audio interfacing between the computer and the radio, and provision for Push-To-Talk (PTT) functionality between the computer and the radio (e.g., SignaLink, RIGblaster, RigExpert, home-brew interfacing, and on some modern radios the built-in data-mode interfacing). The software can take advantage of computer Assisted Tuning (CAT) if available, but CAT interfacing is not required.

Operational tips:
For best performance, be sure (as with all Audio Frequency-Shift-Keying [AFSK] data modes) that the audio drive to the radio does not "overdrive" the radio audio chain, thus preventing the generation of spurious sidebands. A good rule-of-thumb here is to set the radio internal menu to 100% output power, then gradually increase the audio drive from the computer to the radio until no more than 25% of maximum output power is achieved (e.g., increase the audio drive from JS8Call until a 100-Watt radio transmits less than 25 Watts).

J. VarAC

VarAC is an HF keyboard to keyboard chat application. VarAC uses Vara as the communications protocol, and takes full advantage of Vara's robust connection reliability and speed capabilities. **Regular VARA must be installed prior to the installation of VarAC. Regular Vara can be downloaded from **https://rosmodem.wordpress.com** or from Winlink.org.

VarAC includes a few notable features. Perhaps the biggest one is the ability to transfer files and images. VarAC's transport mode is also interesting. It's a very tight P2P connection, established and maintained by Vara. It's as though Vara sets up a VPN-like tunnel between the communicating stations, and makes sure all message traffic is heard on both ends 100% error free.

Application To EmComm:

A new version of VarAC was recently introduced that facilitates EmComm communications. The EmComm mode introduces several features tailored to emergency communication:

- Special EmComm Beacons: Beacons will stand out in red, clearly indicating an EmComm station for improved visibility among VarAC users.
- EmComm VMail Templates (Forms): VMail can be composed using predefined templates in ICS style, or templates can be customized by editing the "VarAC_templates.ini" file.
- VMail Reply with Original Message: the complete received VMail can be included in a reply for better context.
- Minimum 5-Minute Beacon Interval: Reduce their HF beacon time to a minimum of 5 minutes while in EmComm mode.
- Streamlined Main Screen Layout: Unnecessary buttons, such as the QSO Log, are removed to provide a cleaner interface, as all contacts are automatically logged in the background.
- Printing VMails: print VMails with the newly added PRINT button.

Software:

VarAC can be downloaded from www.varac-hamradio.com. VarAC is written in C# which means it runs on Windows as-is. But many are using it on Linux using the WINE platform. A ZIP package for Linux/Windows/Mac/Pi package can be downloaded here: www.varac-hamradio.com/downloadlinux.

VarAC needs to manage your PTT. In addition, it is recommended that it also manage your RIG frequency. Therefore, it requires CAT control of some kind (unless you chose to use VOX which is not recommended). You can use both direct CAT control, RTS/DTR for PTT, and your life is made easier by integration with Omnirig which covers every transceiver out there.

Hardware:

VarAC is a sound card mode that will need an external modem or a modem internal to your transceiver.

System Prerequisites

- Windows 8.1 and above (some hams reported that Win7 also works)
- .NET framework 4.X or above
- **VARA-HF 4.8.7 or higher / VARA-FM 4.3.7**
- Optional: FLRig / OmniRig (V1.2 only)
- 1280 X 800 screen resolution or higher & 10MB of disk space.

Operational Tips:

- VarAC has embedded dropdown Calling Frequencies for each band. QSOs are conducted on preset offset frequencies called ‘slots’. Slots can be manually selected or automatically changed by either station in the QSO if the radios are under CAT-type control. The VarAC program monitors which frequency is being used for a QSO and will ask to change to a ‘slot’ frequency.
- Stations listed in the Beacons (Heard list) or CQ panes can be simply ‘pinged’ with a right mouse click to determine the current SNR value for assessing reliable connectivity.
- Emcomm mode provides for file transfers in addition to the regular features. Emcomm mode should be conducted on a ‘slot’ or on a non-standard VarAC frequency.
- Check out Cherokee-ares.org for a useful VarAC tactical training guide. http://cherokee-ares.org/documents/VarAC for EmComm_tactical_guide.pdf

Communications Interoperability

The goal of interoperability is to establish common paths through which disparate local, regional and state agencies can quickly set up channels of communications with served agencies within and outside the impact zone. The Missouri Emergency Services Net (MESN) provides a viable common path for interagency connectivity by voice or via digital means. MESN will be the coordinating net for local county to county, regional and state digital traffic.

The Missouri Emergency Services Net (MESN) stands up when required for HF statewide communications. The MESN directed voice net primarily handles voice traffic but is well positioned geographically around the state and is a suitable platform for coordinating digital messaging locally and around the state. Although a wide variety of EmComm-suitable digital modes are available, Winlink Express, with its imbedded ICS and agency-specific forms has become the De Facto standard for interagency communications nationwide.

Digital Net coordination with the MESN voice net

Longer, detailed traffic such as requests for specific items or administrative matters can be more efficiently passed by digital data means. Amateur operators having digital capabilities should check into the MESN voice net and continuously monitor the MESN net for digital messaging requests. Similarly,
digital nets that may be operating independently of MESN should have at least one operator continuously monitoring MESN or have an alternate means of receiving MESN requests for digital assets. MESN standard frequencies, plus or minus QRM:

3963.0 kHz Primary
7263.0 kHz Alternate

MESN Digital Tips:

- Request assistance from the MESN NCS in locating a station that can relay the message either digitally or via voice
- Once a relay station has been identified, MESN NCS will direct the stations to an available voice or digital frequency as appropriate.
- When the traffic has been passed both stations must report back to MESN NCS to advise that the traffic has been passed.

Contacting SEMA:

Traffic sent to SEMA must use the Winlink email addresses provided to amateur operators using the built in plain text, served agency, FEMA ICS or WebEOC forms. See https://ares-mo.org/wp-content/uploads/2021/03/SEMA-Radio-Room-Contact-Information_2021.pdf for a current list of email addresses.

Recommendations for baseline interoperability:

- Identify mission partner agencies, NGOs and groups with whom to expect a need to communicate.
- Consummate written Memorandum of Understanding (MOU) agreements with these partner agencies, NGOs and other ARES response groups.
- Strive to maintain proficiency by training and practicing the provisions of those agreements using the prescribed nets and radios. Be sure to include home-based operators acting as multi-mode hubs or relay stations
- Develop so-called 'storm plans' and include such plans in MOUs or other agreements. Storm plans are essentially a hierarchal method of fallback from a preferred method or protocol of operation when that method is no longer viable. Consider using the acronym P.A.C.E; Primary-Alternate-Contingency-Emergency to develop a storm plan. The following example outlines a possible PACE configuration:

    P – Direct packet connection to recipient station
    A – Digipeater connection if/when direct connection fails

    C – Area packet operator enables his/her TNC for digipeater operation or as PBBS to help
        overcome communication failures
    E – Peer-to-peer packet station relays until destination reached

Note: This PACE model should be pre-arranged and practiced by participating stations and agencies.

Digital Data Networks

Digital Data Nets stood up in response to an incident or disaster should be managed much like the more familiar voice nets in order to be efficient and effective. Net control stations (NCS) should be assigned according to pre-established plans but, customarily, the first operator to arrive on frequency is the de facto NCS until the assigned operator arrives or other arrangements are made in the interim. If more than one net is activated it may be necessary to bring in net managers to ensure a smooth flow of traffic within and between nets.

The following list of nets and frequencies should be considered for inclusion in the development of local, regional and state level response plans. ICS Forms 205 and 309 should be filled out and posted at each station.

A. National Traffic System (NTS/NTSD) and Radio Relay International (RRI)
NTS - The ARRL NTS is a national system for conveying formal, written messages (Radiogram format) from origin to destination. NTS nets operate at four functional levels; local net(s), section net(s), region net(s) and area net(s). Messaging between area nets is a function of the Transcontinental Corps. Messages traverse up and down this hierarchy based upon their origin and destination.

NTSD – NTS Digital traffic nets support the legacy voice/CW NTS nets but can operate independently as well. Digital traffic is handled by a group of NTS-approved Digital Relay Stations using mailbox store and forward techniques. Traffic routing may include HF long haul and local VHF/UHF nodes using a variety of digital modes and best path choices. The standard ARRL Radiogram format is used for all messages; a potentially serious drawback for other than routine 'birthday' or health/welfare types of short messages.

NTSD and Radio Relay International (RRI)/Digital Traffic Network (DTN) – The RRI organization and its operators are closely aligned with NTSD at the 'region' and 'area' levels; a symbiotic relationship in many ways. RRI members use the NTSD infrastructure and the NTS hierarchy as its messaging platform. Sound card modes, Packet, and Pactor are used by RRI to connect to its hubs. RRI operators use Airmail, Winlink Express and BPQ32 to facilitate message handling. RRI operators have the option of conveying ICS forms, a definite advantage for EmComm purposes. A list of DTN stations can be found at http://nts-digital.net/mw/index.php/DTN_Stations The Missouri list needs updating as of this writing.

Note: The use of unattended mailboxes and unscheduled or infrequent nets may delay or halt delivery of messages.

B. Statewide VHF/UHF Digital Data Simplex Frequencies
Simplex frequencies are valuable resources and particularly useful for on-scene activities, for direct contact with and between command centers, and shelter-to-shelter types of operation. There are many other applications for simplex frequencies and it's helpful to have the following, and additional, frequencies pre-programmed into the radios of first responders.

HMData	**52.790**	**Wide area inter-district networks**
HVData	**144.910**	**Intra-district networks**
HVTac0	**147.495**	**Local links**
HUData	**446.200**	**On-scene**

C. Local VHF/UHF/Microwave digital data nets
VHF/UHF Packet would be a logical choice for local digital data nets. It should be a priority to install or pre-deploy multi-mode TNC's and radio equipment at the city and county EOC's and other key public safety and disaster relief organizations such as hospitals and Red Cross facilities.

During activation, packet users that are not involved in the incident should refrain from using the primary frequency, 145.070 MHz, or whatever the primary frequency is for the affected area. Similarly, stations are expected to halt all traffic that is not related to the ARES® operation.

As mentioned earlier, the preparation of ‘go’ kits should be a priority; Packet and digipeater kits that can be deployed most anywhere on short notice. The ‘go’ kits should also include off-grid power for initial, temporary operation.

Microwave nets: Point-to-point systems and mesh networking systems in the 2.4, 3, and 5 GHz ranges would likely be the most useful for EmComm purposes. Mesh networks would provide the most potential for multi-user access. An example of a viable microwave local network is the Kansas City mesh network that provides data and VOIP connectivity among hospitals in the metro area.

The following internet-listed microwave groups provide information regarding their activities and links to additional sites:
St. Louis Area Microwave Society (SLAMS) https://slams-stlouis.blogspot.com/
Kansas City Mesh (KCmesh): https://groups.io/g/KCmesh/topics
North Texas Microwave Society (NTMS) http://ntms.org/content.php

D. Amateur Radio Networking Tips:

The ARRL recommends specific types of networks based upon the EmComm mission. Some, or all, of these nets may be needed depending upon the situation.

Administrative net – NCS and Incident Command representative are here:

- Traffic net – written messages between agencies or other nets
- Resource net – operator check-ins for assignment, locate equipment
- Tactical net – on-site operations
- Information net – announcements, bulletins
- Health and Welfare net – self-explanatory, usually handled by NGOs such as the American Red Cross (ARC).

Record keeping:

- Log all contacts -- A minimum of two operators at each station; one to operate, one to take notes and fill out log
- Document and archive all messages, including pertinent notes.

Operational Tips:

- Set digital program audio drive level to have an output power no more than 20 watts for a 100 watt capable transceiver.
- Peer-to-Peer participants will determine the best digital mode and frequency that meets their needs, regardless of Net operations.

Missouri Section Ares Recommendations

In the event of a disaster or incident SEMA can be contacted with a wide variety of EmComm tools. In the event communications are disabled in the impact area amateur operators may be enlisted to provide EmComms through voice or Winlink Express. Winlink Express has become a De Facto standard for served agencies.

Amateurs should work with their local and county LEOC's to develop communication paths through Winlink Gateways to other LEOC's and SEMA. In the event that Winlink Gateway frequencies are congested these paths should also include Peer-to-Peer protocols for contact with LEOC's and served agencies in the immediate area. SEMA contacts must be Winlink Express email only.

In the event that a LEOC or served agency cannot be contacted through a Winlink Gateway the originating amateur station should monitor MESN voice frequencies of 3.963 MHz and 7.263 MHz and request assistance from the MESN NCS in locating a station that can relay the message either digitally or via voice. Once a relay station has been identified, MESN NCS will direct the stations to a voice or digital frequency as appropriate. When the traffic has been passed both stations must report back to MESN NCS to advise that the traffic has been passed.

A. Develop Local, District and Section response plans for use throughout the state, including ICS-217 forms to be posted on the Missouri Section ARES website. VHF/UHF plans for a number of Missouri counties are currently listed on ICS-217 forms at https://ares-mo.org/forms/ics-217-forms ARES members are encouraged to add their county assets to this list. HF frequencies should be included as well. See Appendix A for examples of Missouri Section ARES District ICS-217 forms. *A separate ICS-217 form listing the HF digital data net frequencies of all ARES districts should be compiled and posted on the Missouri Section ARES website.

   Please refer to the SEMA Contact Sheet for inclusion in frequency plans: https://ares-mo.org/forms/sema-resource-form/

B. Establish statewide drills or exercises to be held at a minimum of once a year, preferably more frequently, to practice and validate statewide response plans and procedures. It is therefore recommended that the SEC or the SEC's designee develop a standard protocol for exercising the emergency nets, including requirements that
   - a training syllabus be developed identifying skills to be addressed and practiced during each net session
   - standardized message formats and handling procedures be clearly defined
   - each participant in the drill sends and receives at least one message
   - injects be developed to cause concurrent interactive messaging between the digital and voice nets.

- the Missouri Section ARES DMR talk group 31290 is incorporated into drills and exercises to provide a communications path for coordination and control.

C. Documentation and Record Retention

There is a saying that goes, “If it’s not on paper; it didn’t happen.” Typical of forms required by governmental served agencies are the ICS-205 Incident Radio Communications Plan, ICS-213 General Message Form, ICS-214 Activity Log and an ICS-309 Communications Log. These documents become a part of the official record of a government agency or an NGO’s involvement in an incident or disaster. ARES members may be required to submit these and other forms for archiving.

Fortunately, Winlink Express, Fldigi/Flmsg and other digital programs have built-in NBEMS forms, automatic logging or both. These records can be printed out and submitted to the served agency. ARES members associated with an EOC should consider using the Missouri Section ARES WebEOC Ham Radio Resource Request Form. This form can be loaded into Fldigi NBEMS custom files. The form and instructions are available at https://ares-mo.org/forms/sema-resource-form/ Fillable ICS forms are available at https://ares-mo.org/forms/ics-forms/

D. Every district develops a digital go-kit for district use. The go kit should contain operator-supplied computer/printer with sound card, TNC, 13.8V power supply, batteries or solar, HF/VHF/UHF antennas, antenna tuner, suggest 80M-40M NVIS dipole on a 15' PVC pipe mast and a tool box, cables and connectors for installation and repair. Note: Other configurations of multiband HF antennas elevated 15-30 feet above ground also tend to exhibit NVIS characteristics that substantially cover the state.

E. Establish APRS monitoring at EOCs and command posts as a means of tracking the position of supporting mobile and portable amateur radio operators.

F. Establish Winlink RMS nodes in each district to improve access and interoperability.

G. Establish a series of BPQ32 Bulletin Board Systems (BBS) in Missouri as repositories for statewide ARES related tactical response information or general message traffic. The BPQ32 system utilizes the Winlink Express software and NBEMS forms on non-Winlink frequencies, bypassing the Winlink Express system entirely. One example of an application would be the one-to-many broadcast feature to notify, say all ARES DECs, that a disaster had occurred somewhere in the state, asking for additional ARES volunteers to respond to an official staging area. The one-to-many feature is conceptually similar to Winlink Express ‘group’ addresses.

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Appendices:

A. Sample ICS-217 for an ARES district
B. Sample Outline for Local and District Plans
C. Sample Outline for Go Kits

Appendix A – ICS-217

ICS-217 Appendix Models:

The Radio Frequency Assignment Worksheet (ICS-217) forms provided in this appendix are intended to be used as a starting point for preparation of detailed communications plans. They contain the basic established district and statewide frequencies and modes documented elsewhere. If plans are not otherwise established each EC should refer to the appropriate form for his district to begin building a communications plan. It should be kept in mind that some communications resources (i.e. repeaters, etc.) may be located outside a district but still be viable. When designating district digital calling and working frequencies 5 kHz spacing from other established frequencies should be observed to avoid interference.

District A Model:

COMMUNICATIONS RESOURCE AVAILABILITY WORKSHEET	Frequency Band	Description
		ARES District A

	Channel Configuration	Channel Name/Trunked Radio System Talkgroup	Eligible Users	RX Freq N or W	RX Tone/NAC	TX Freq N or W	Tx Tone/NAC	Mode A, D or M	Remarks
	Calling	HF Digital	NCS	3.590 USB	N/A	3.590 USB	N/A	D	Statewide HF Calling
	Calling	HF Digital Alt	NCS	7.083 USB	N/A	7.083 USB	N/A	D	Statewide HF Calling Alt
	Calling	HF Digital Alt	NCS	5.3465 USB	N/A	5.3465 USB	N/A	D	Statewide HF Calling Alt
	Working	HF Digital	Digital Net	NCS Direction	N/A	NCS Direction	N/A	D	Statewide HF Working
	Calling	HF Digital	NCS	3.5XX USB	N/A	3.5XX USB	N/A	D	District HF Calling
	Calling	HF Digital	Digital Net	3.5XX USB	N/A	3.5XX USB	N/A	D	District HF Working
	Calling	HVCall		146.550	CSQ	146.550	CSQ	A	Statewide VHF Calling
	Data	HVData		144.910	CSQ	144.910	CSQ	D	Statewide Data
	Packet	HVPacket		144.950	CSQ	144.950	CSQ	D	Statewide Packet
	Tactical	HVTac1	District A	145.600	PL 100.0	146.600	PL 100.0	A	District A VHF Tactical
	Calling	HUCall		446.000	CSQ	446.000	CSQ	A	Statewide UHF Calling
	Data	HUData		446.200	CSQ	446.200	CSQ	D	Statewide Data
	Calling	HUTac1	District A	445.900	PL 100.0	445.900	PL 100.0	A	District A UHF Tactical
	Msg Trfc	MESN Pri	HF :LSB Net	3.963	N/A	3.963	N/A	A	MESN
	Msg Trfc	MESN Sec	HF :LSB Net	7.263	N/A	7.263	N/A	A	MESN

The convention calls for frequency lists to show four digits after the decimal place, followed by either an "N" or a "W", depending on whether the frequency is narrow or wide band. Mode refers to either "A" or "D" indicating analog or digital (e.g. Project 25) or "M" indicating mixed mode. All channels are shown as if programmed in a control station, mobile or portable radio. Repeater and base stations must be programmed with the Rx and Tx reversed.

Appendix B- Sample Outline for Local and District Plans

Digital modes in everyday use by amateur radio operators do not require the structure of a network. They largely operate as any of the other modes available to amateurs seeking to make new contacts. However, EmComm applications require forethought in the development of plans to establish effective communication to and from a local area impacted by a disaster or emergency. This section will examine those things which should be considered in planning for such an event:

Local ARES

- On Scene Communications
  - NCS for voice and digital
  - Establish modes & frequencies
  - Portable digipeaters
- Served Agency Communications
  - Establish Relationships
    - EOC
    - Red Cross
    - Salvation Army
    - Religious Organizations
    - Other NGO's
  - Determine EmComm needs of above
    - Modes
    - Frequencies
      - FM voice
      - Packet
      - Other digital
    - Special Forms
      - ICS forms
      - Internal agency forms
      - Ham radio WebEOC resource request form https://ares-mo.org/forms/sema-resource-form/
  - EOC Communications
    - Equipment
    - Operators
    - WebEOC online information sharing and resource request tracing
  - Deployment of resources
    - Operators
      - Training and Skill level
      - Equipment
      - Operating modes
    - Available repeaters

- Local Net Control
  - NCS operators and alternates
  - Coordination with other nets

District ARES

- Inventory of District wireless assets
  - Create inventory of Wi-Fi Hot Spots for possible use --- Starbucks, McDonalds, other sites
  - Create Inventory of digipeaters in District
    - Location
    - Frequencies
    - Portable digipeaters
      - Availability
      - Where stored or pre-deployment site
  - Designated Net Control/Relay Station(s)
    - Established in coordination with District OES as applicable
- Existing Networks
  - Winlink Nodes
  - MESH
  - FSQCall
  - MESN (Voice)
  - Others
- District Digital Go Kit
  - Operator-supplied computer with digital programs installed, sound card modems, TNC, interconnecting cables, HF/VHF/UHF antennas
  - Tool kit for installation & repair including soldering iron
  - SO-239 connectors, PL-259, BNC connectors, others
  - Coax or another feedline
  - Power Supplies: 13.8vdc (shore power), solar, batteries/chargers

  See Also:
  - ARRL ARES Field Resources Manual for "Go" kits information
  - Appendix C below

- List of emergency contacts:
  - ARRL Field Organization managers/coordinators as applicable
  - Served agencies
  - Others

Appendix C – Sample Go-Kit Contents

1. Dual-band HT in padded belt case and/or mobile.
2. HF radio with internal/external sound card, tuner, HF antenna(s), power source(s)
3. Copy of current FCC Operating License.
4. Extra high-capacity (1000 ma) nicad, or backup AA battery case for HT.
5. DC adapter & cigarette plug cord for HT
6. Two sets of spare fuses (2A, 10A, 15A, 25A)
7. Roll up dual band HT antenna – N9TAX.com Slim Jim antenna
8. Earphone and/or speaker mike
9. Swiss Army knife
10. Multi-purpose tool
11. Mini-Mag-Lite, extra bulb and spare AAs
12. Pencil and pocket notepad
13. Emergency money - small bills and change.
14. SO-239 to BNC adapters (male/female)
15. SMA to BNC adapters (male/female)
16. 6 ft.to 10 ft. RG8-X jumper w/BNC male and female connectors
17. Small pocket compass
18. Folding chair/stool
19. Operating reference card for HT
20. ARES phone and frequency reference card
21. Small Tool Kit: Compact soldering iron, solder, needle nose pliers, screwdrivers, wire stripers, side cutters, Anderson Power Poles & Crimper.
22. 8 pack of AA alkaline batteries as running spares
23. Comfort, safety and basic first aid items: sunglasses, matches, tissues, toothbrush, sun block, sewing kit, insect repellent, tweezers, Band-Aids, adhesive tape, gauze pads, wound cleaning wipes, toilet paper, bottled water, spare eye glasses of current prescription etc.
24. Digital kit: Operator-supplied computer with digital programs installed, sound card modems, TNC, interconnecting cables, HF/VHF/UHF antennas, 13.8V power supply-batteries-solar.
25. Comprehensive lists of go-kit contents can be found on the internet